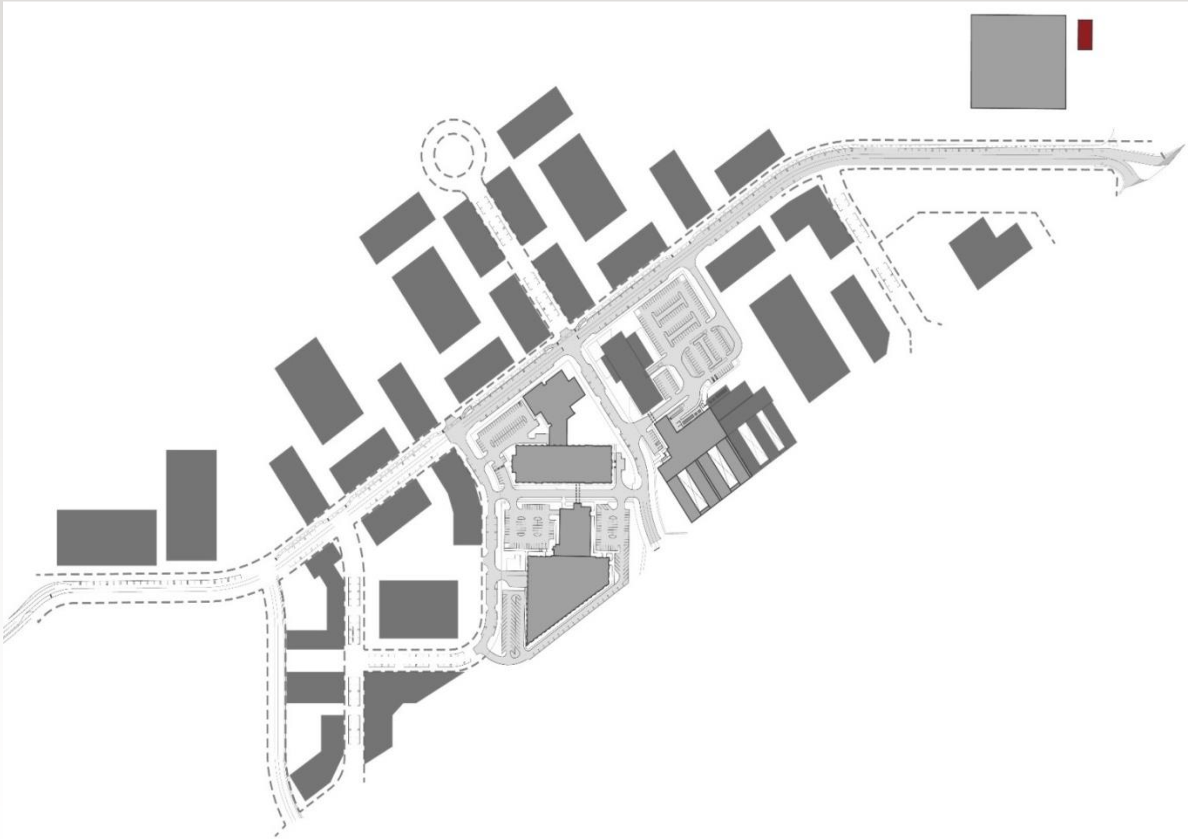
# NEBRASKA INNOVATION CAMPUS

# C.R.E.S.



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PROPERTY GROUP

OLSSON®
ASSOCIATES

CITY OF
LINCOLN™
NEBRASKA

PKS Kiewit

GILMORE BELL

NEBRASKA
INNOVATION
CAMPUS

SINCLAIR hille
architects

Seacrest & Kalkowski, PC, LLO

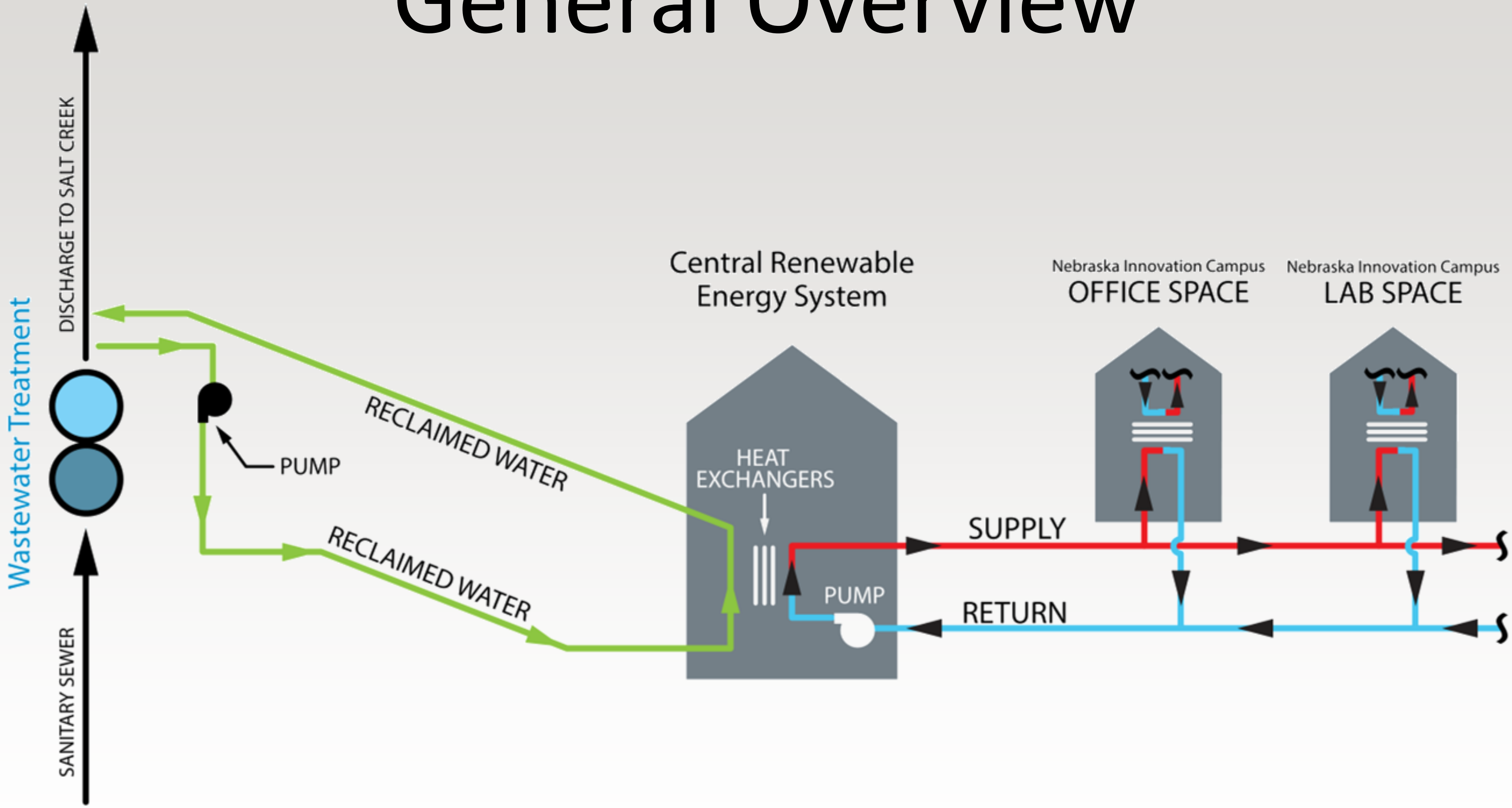
# Presentation Outline

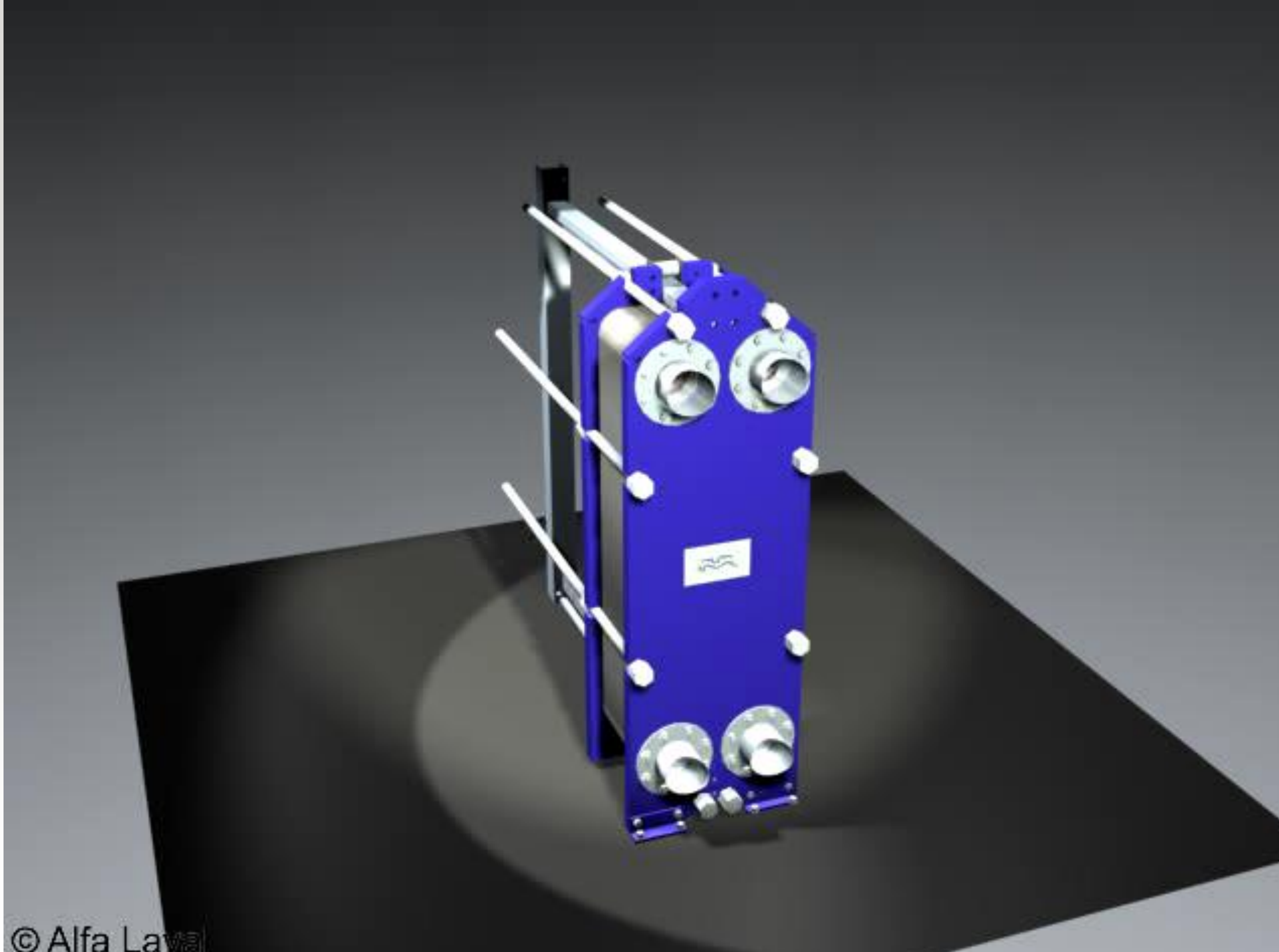
I. General Overview
II. CRES Financial Operations
III. Methods of Collecting Revenue
IV. Preliminary Design
V. Final Design
VI. Project Delivery and Construction

# Theresa Street Wastewater Treatment Facility

- Nitrification Capacity 27.4 MGD
- Hydraulic Capacity 91MGD
- Nitrification, De-Nitrification Fine Bubble Aeration
- Vortec Grit Removal
- Anaerobic Sludge Digestion
- Methane Fueled Electrical Generation (900 kW)
- UV Disinfection
- Enhanced SCADA/Process Automation
- Chemical Wet Scrubber Odor Control

# General Overview

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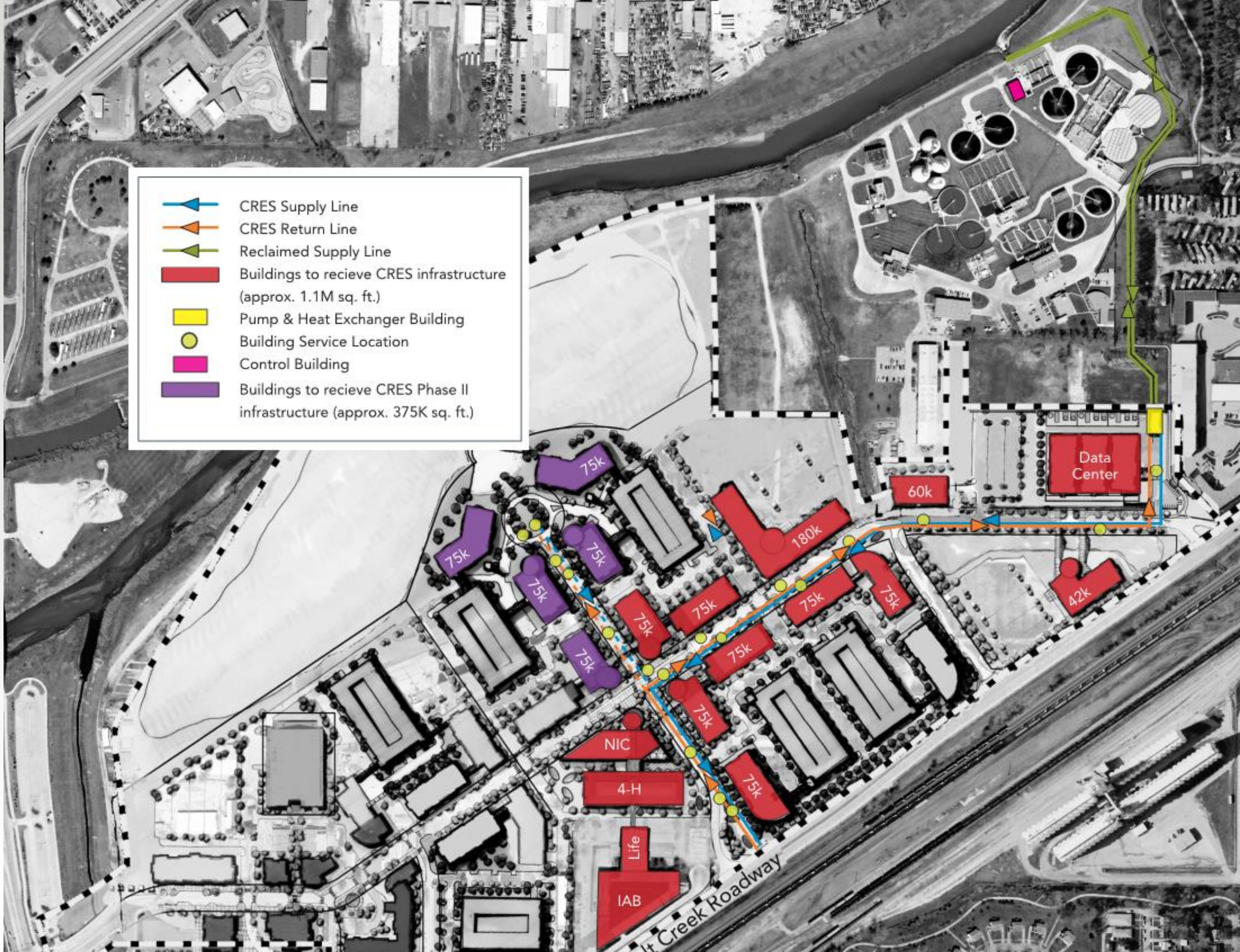
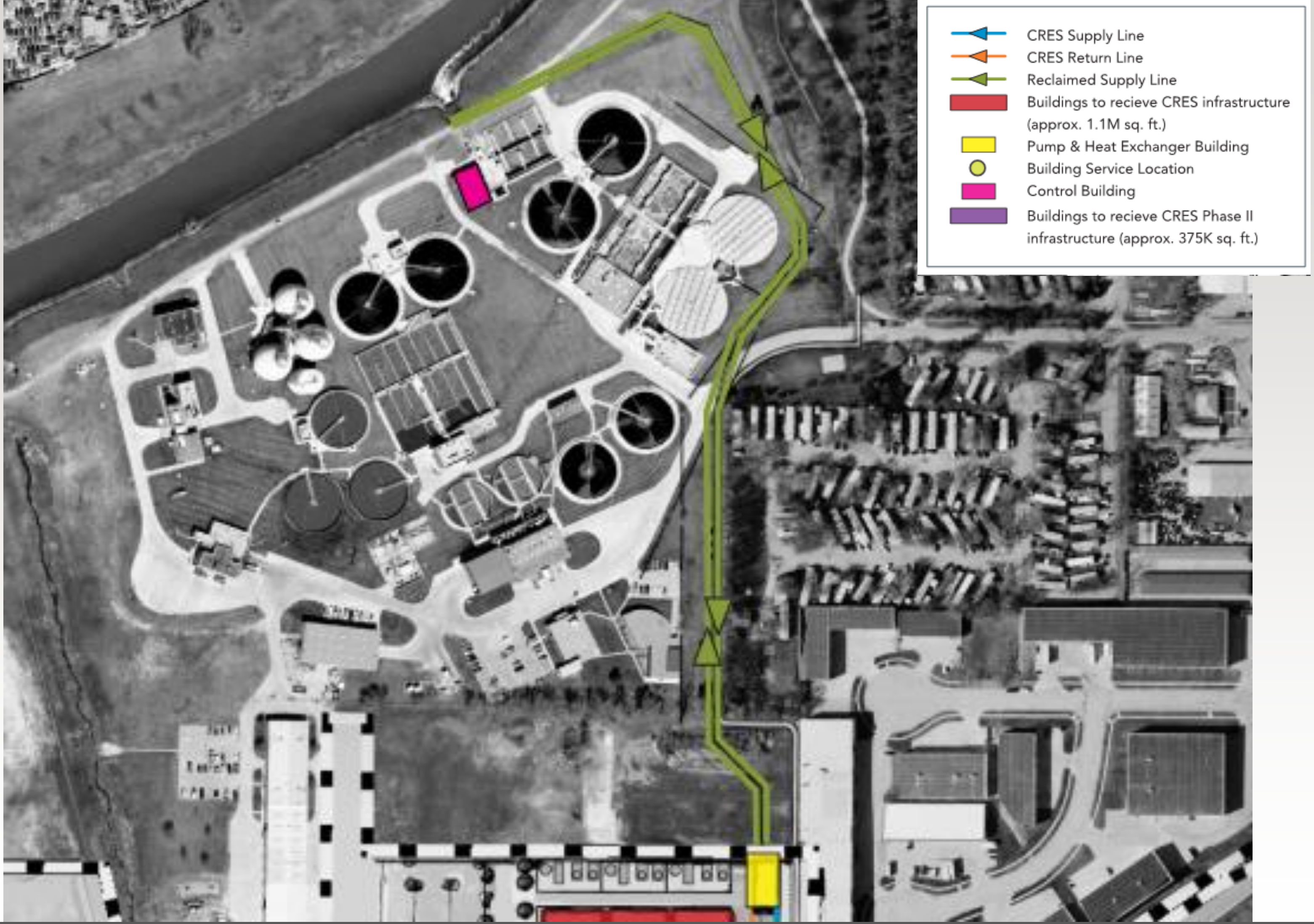


CRES Supply Line
CRES Return Line
Reclaimed Supply Line
Buildings to recieve CRES infrastructure (approx. 1.1M sq. ft.)
Pump & Heat Exchanger Building
Building Service Location
Control Building
Buildings to recieve CRES Phase II infrastructure (approx. 375K sq. ft.)
Data Center
60k
180k
42k
75k
NIC
4-H
Life
IAB
Salt Creek Roadway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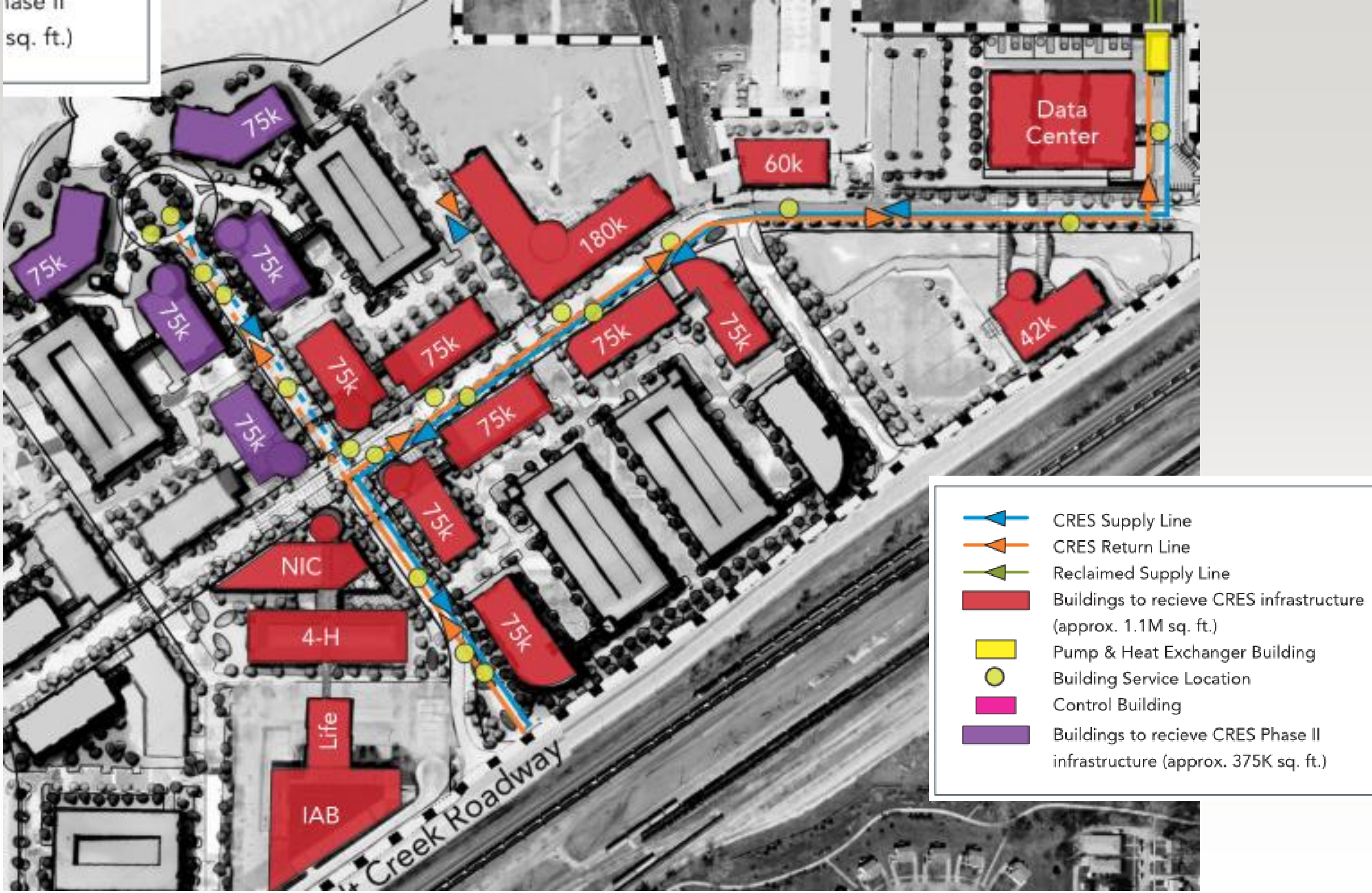
hase II
sq. ft.)
75k
75k
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75k
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75k
180k
60k
Data Center
42k
75k
75k
75k
75k
75k
75k
NIC
4-H
Life
IAB
Creek Roadway
CRES Supply Line
CRES Return Line
Reclaimed Supply Line
Buildings to recieve CRES infrastructure (approx. 1.1M sq. ft.)
Pump & Heat Exchanger Building
Building Service Location
Control Building
Buildings to recieve CRES Phase II infrastructure (approx. 375K sq. ft.)

# General Overview

1. This system will have the capacity to heat and cool:
    - 1,875,000 SF of lab/office space
    - 1,500 houses at 2,000 SF each

2. 18,000 GPM is equivalent to 7,500 Tons of cooling at a 10 degree delta T.

3. The C.R.E.S. essentially works like a geothermal system but rather than pumping from water from the ground, the water is pumped from the City of Lincoln wastewater plant.

4. Water temperatures range from 57 to 75°F. At these temperatures, buildings will be able to utilize geothermal heat pumps that can operate up to **30%** more efficient than standard equipment.

# General Overview

## Comparison vs. Traditional Systems

| System | End User Cost [1] | Efficiency [2] | Cooling savings [3] | Heating Savings [4] | Lifespan [5] |
|---|---|---|---|---|---|
| Chillers & Boilers (base system) | 100 | 92% | 0% | 0% | 30 years |
| Steam & Storage (East Campus) | 100 | 90% | 10% | 20% | 30 years |
| CRES | 100 | 95% | 25% | 30% | 50 years |

(1) Capital cost to install mechanical systems to use source of energy
(2) Annual Fuel Utilization Efficiency (AFUE)
(3) Cooling months energy savings
(4) Heating months energy savings over traditional systems
(5) Project lifespan of mechanical systems

**Calculations/Assumptions:**

1. Base system uses an air-cooled chiller that meets ASHRAE minimum standards of 2.8 COP.
2. CRES system utilizes a water to water heat pump system that meets ASHRAE minimum standards of 4.2 COP. In this system, the electrical pumping energy is included from the CRES.
3. This savings is only based on summer cooling, as the system will use more electrical energy over the entire year. The reason for this is due to the base system utilizing gas for heating and the CRES using water to water heat pumps. It is important to understand the peak that sets demand will be less in summer and therefore will save demand charges throughout the year.
4. This evaluation considers making the same amount of chilled water throughout the year in both the base and the CRES.
5. **Savings could even be larger as this evaluation does not consider additional free cooling available from the CRES.**

# General Overview

## C.R.E.S. Bottom Line

1. **More efficient** than geothermal system due to consistent water temperatures and no issues from raising ground temperatures over time
2. System **can easily and economically add on new users** up to the 28 million gallons per day capacity
3. **Renewable and sustainable source of energy** with no risk of commodity rate increase
4. Fewer systems exposed to elements = **longer lifespans**
5. System is controlled through **sophisticated monitoring devices** that are networked and provide real-time information
6. Building mechanical systems **costs the same** as a traditional systems
7. Up to **30% more efficient** than traditional boiler and chiller system
8. Up to **25% energy savings** in the summer cooling months

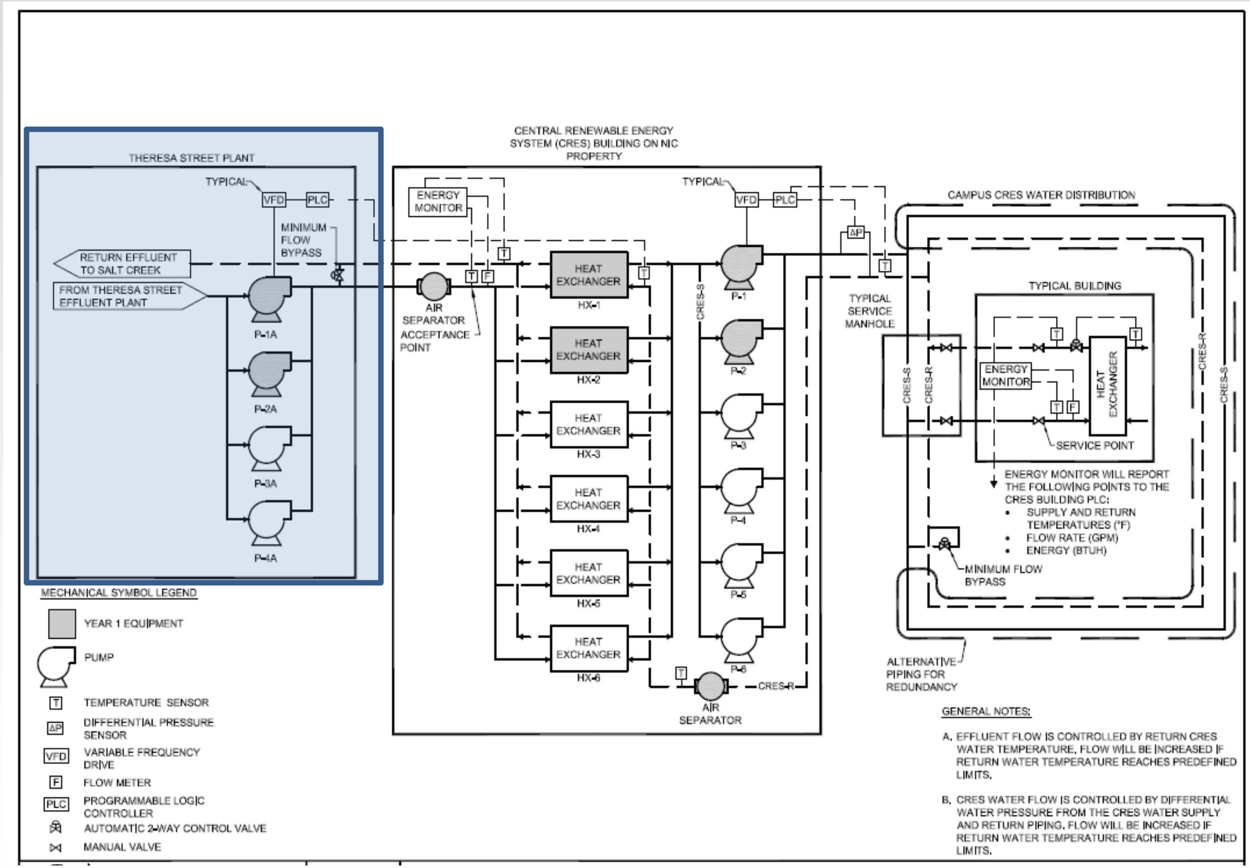
# Business Pro Forma

- Pro Forma Developed to Show Project Payback
  - Pro Forma Included:
    - Assumptions
    - Financing
    - Energy Rates and Rate Increases for Gas and Electric
    - Wastewater Effluent Energy Value (MMBtu)
    - Cash Flow Analysis

# CRES Financial Operations

- $12 Million CRES Infrastructure financed with Qualified Energy Conservation Bonds (QECBs)
- CRES Utility Rates Equivalent to Local Market Utility Rates
- CRES Revenue Pays QECB Bonds and CRES Operational Expenses
- CRES Partners Share in Future Operational Savings

# Preliminary Design



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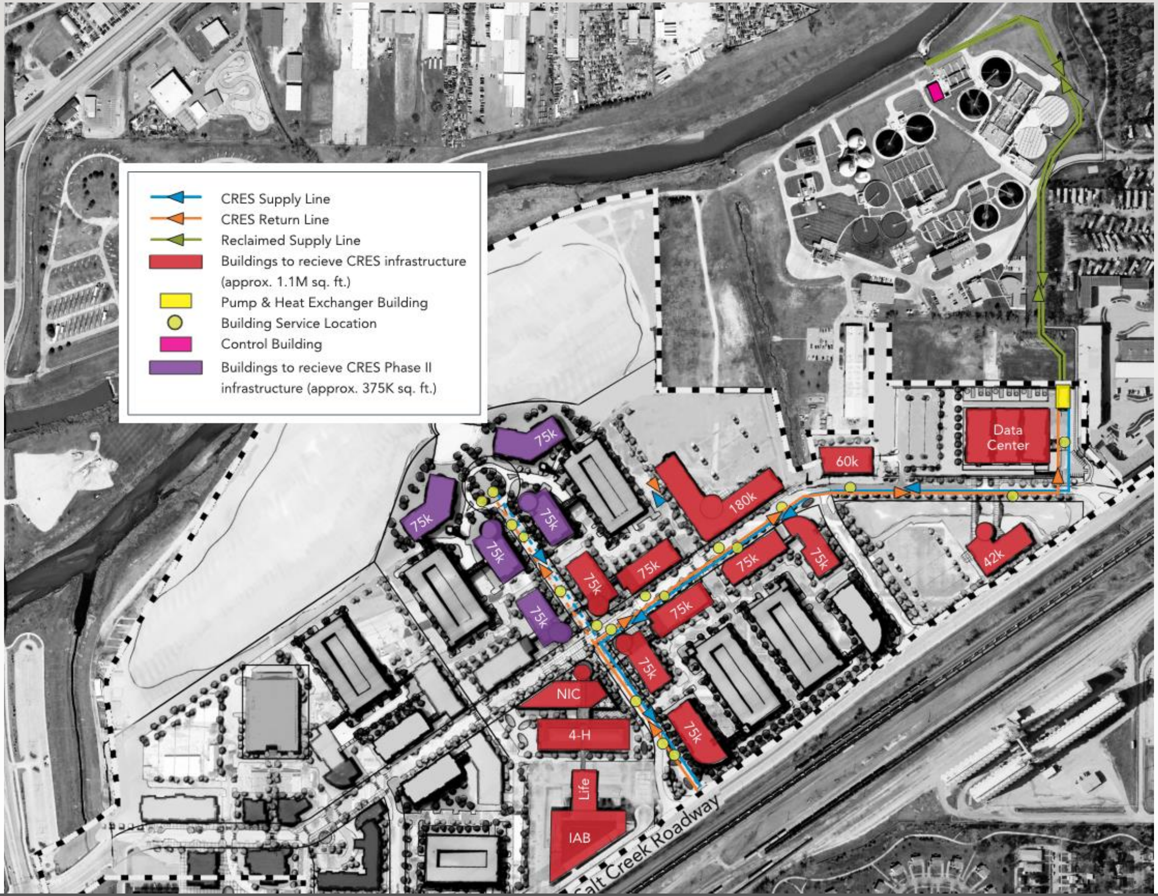


# Preliminary Design

## THERESA ST WWTP

- Use of Theresa St. WWTP Effluent
  - Current NPDES Permit Must be Met – Temperature Limits
  - Project Avoided Second Permit by Discharging Return Water to Same Location
  - WWTP Effluent Available Flow Rate (Up to 28 MGD)

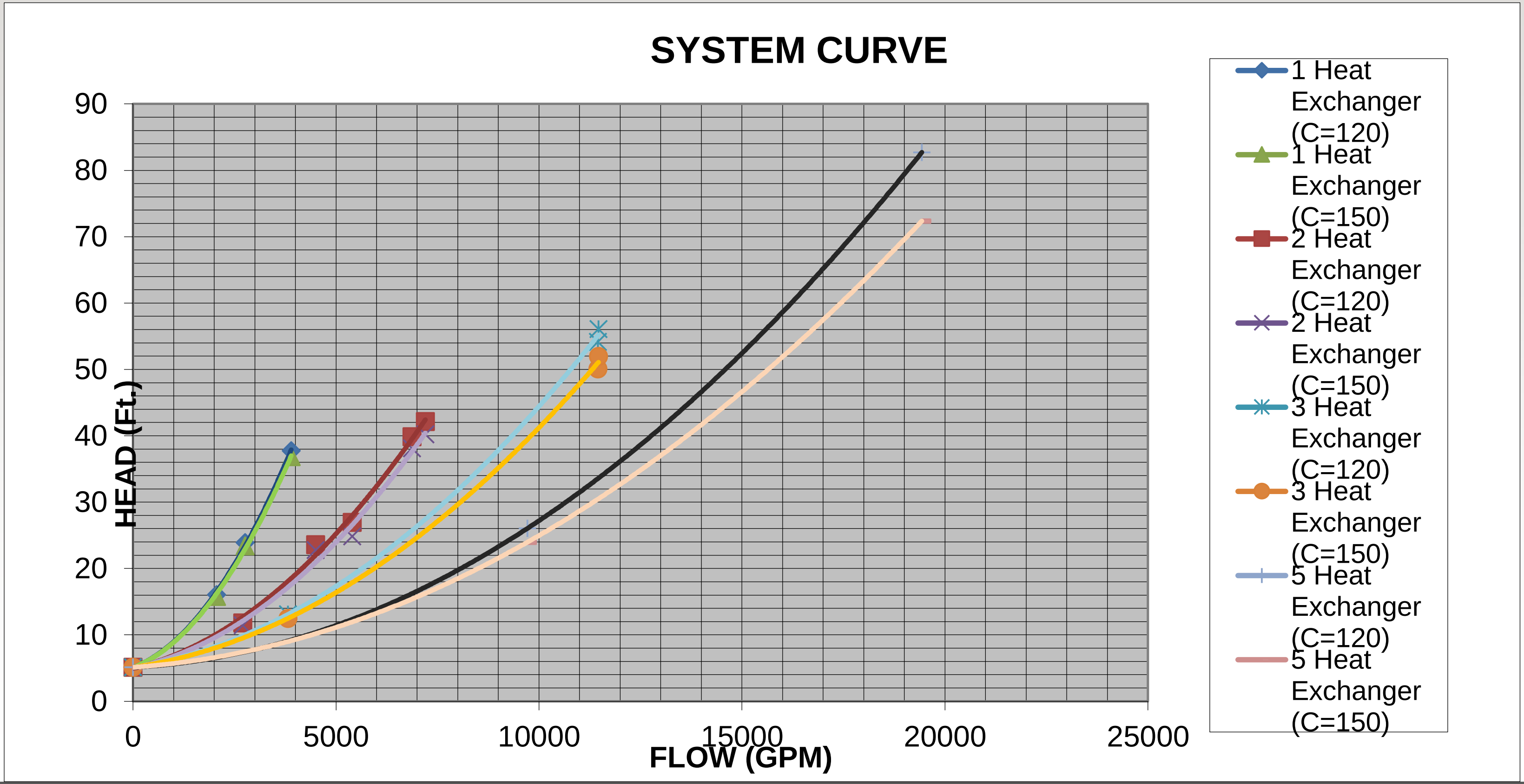
# Preliminary Design

## THERESA ST WWTP

- Lift Station at Theresa St. WWTP
  - WWTP Effluent Available Flow Rate
    Up to 28 MGD to Supply the Heat Exchangers
  - Pump Design
    - Match Heat Exchangers Capacity
    - Phased Installation of Pumps (Modular by Design)
    - Pumps are Operated by VFD’s
    - Spare Pump

# Preliminary Design

## THERESA ST WWTP



# Preliminary Design

## THERESA ST WWTP

- Pumps Were Sized Based Upon System Curves
  - **Initial Build**: Three Pumps Total (2 Pumps with 1 Spare)
  - **Peak Flow:** 16.5 MGD
  - **Average Flow:** Winter 9.9 MGD
  - **Average Flow:** Summer 6.5 MGD

# Preliminary Design

## THERESA ST WWTP

- Pumps Were Sized Based Upon System Curves
  - **Final Build:** Six Pumps Total (5 Pumps with 1 Spare)
  - **Peak Flow:** 28 MGD
  - **Average Flow:** Winter 16.5 MGD
  - **Average Flow:** Summer 10.4 MGD

# Preliminary Design

## THERESA ST WWTP

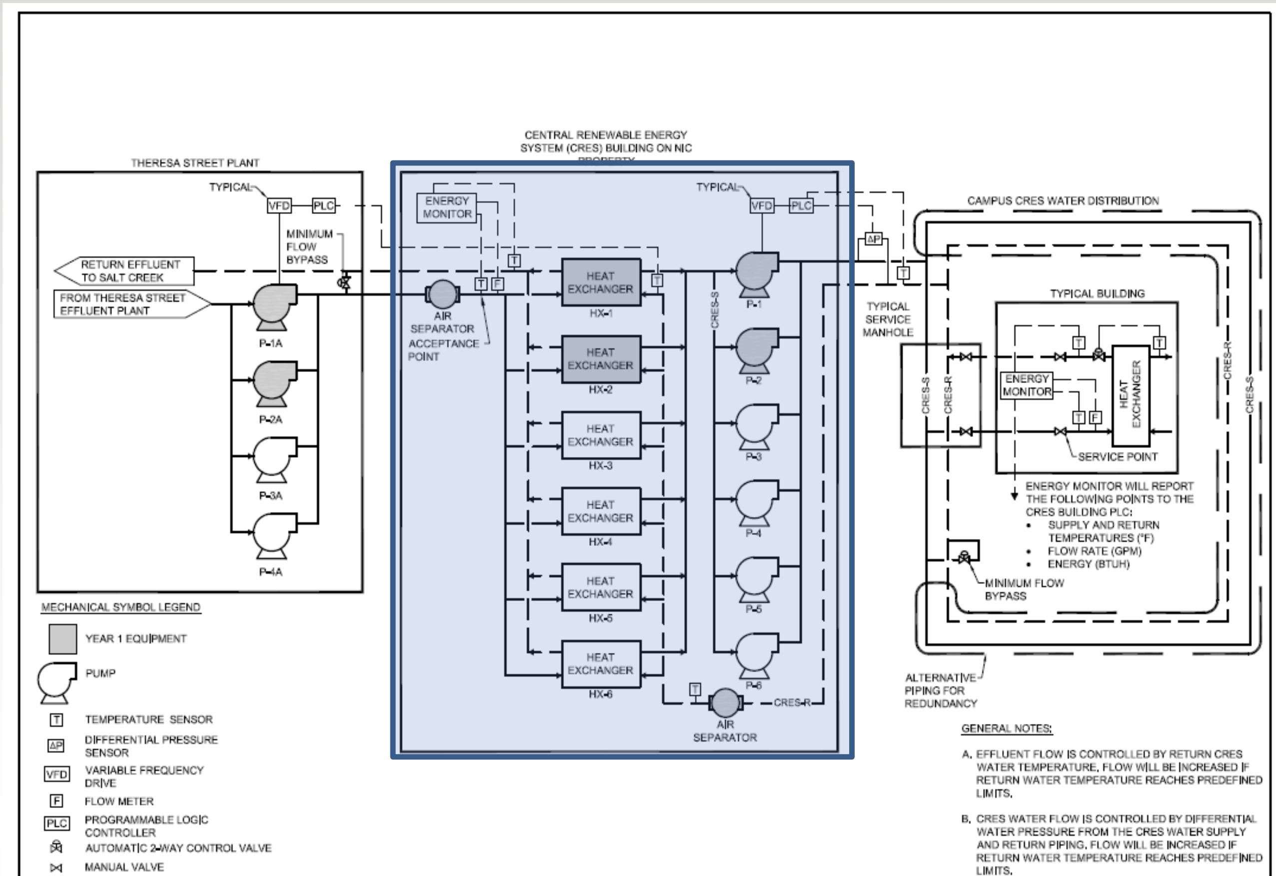
- Pump Selection
  - Non Clog Submersible Pumps
  - All pumps are the same size
  - 110 Hp, 5,000 GPM @ 62.4 Ft Head
  - Flow and Head Vary with speed and number of pumps in use
  - VFD's to Control Flow Rate

# Preliminary Design

## THERESA ST WWTP

- Theresa St. WWTP
  - Lift Station and Piping Layout
  - 30-Inch Diameter Ductile Iron Pipe – 4,000 LF
  - Connection to UV Channel for Supply and Return

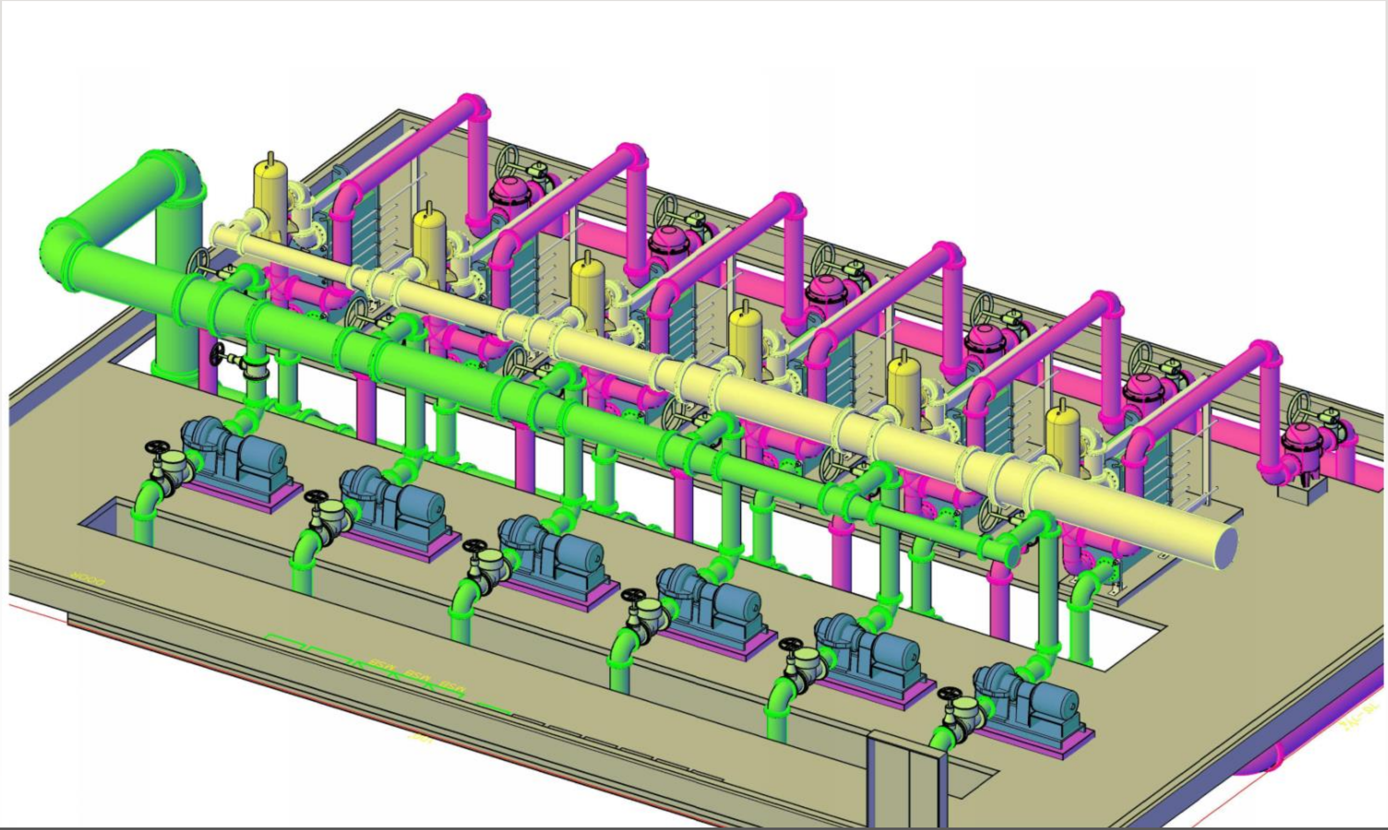
# Preliminary Design



# Preliminary Design

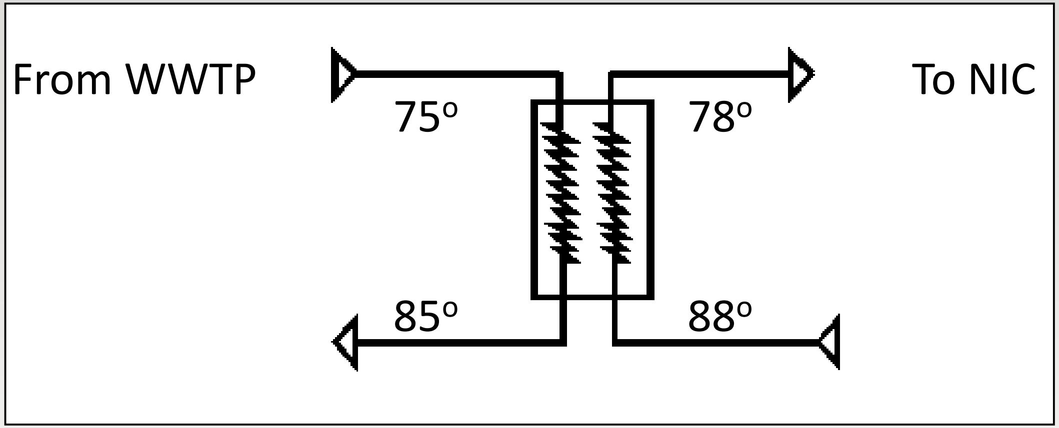
## HEAT EXCHANGE FACILITY

Preliminary Layout

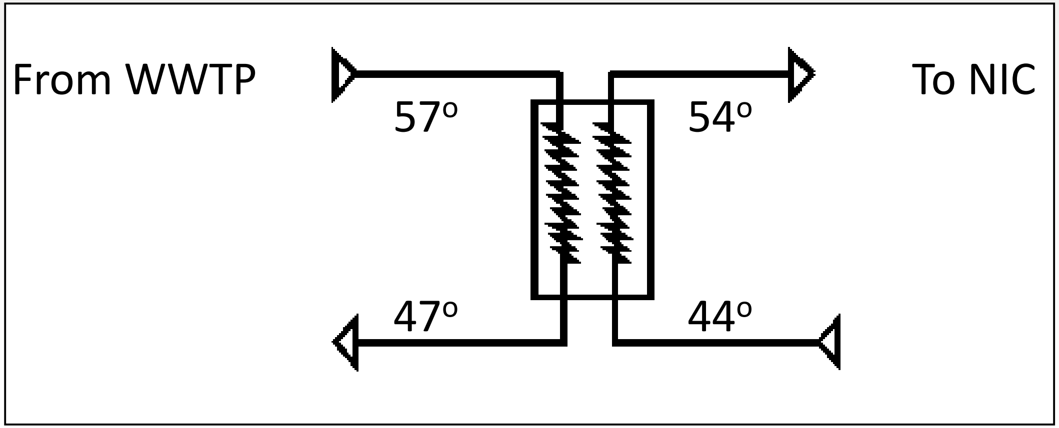


# Preliminary Design

Summer



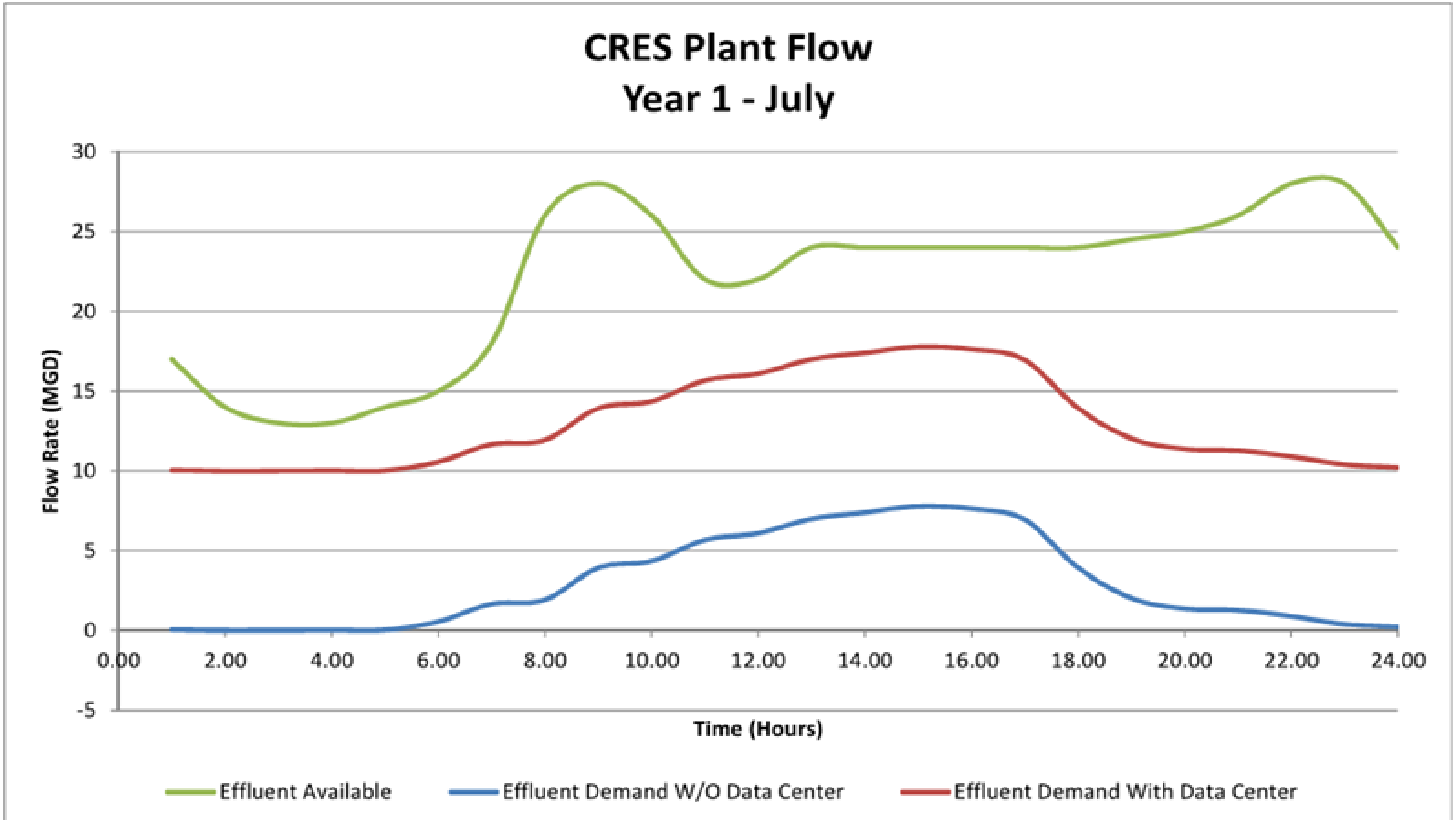

Winter

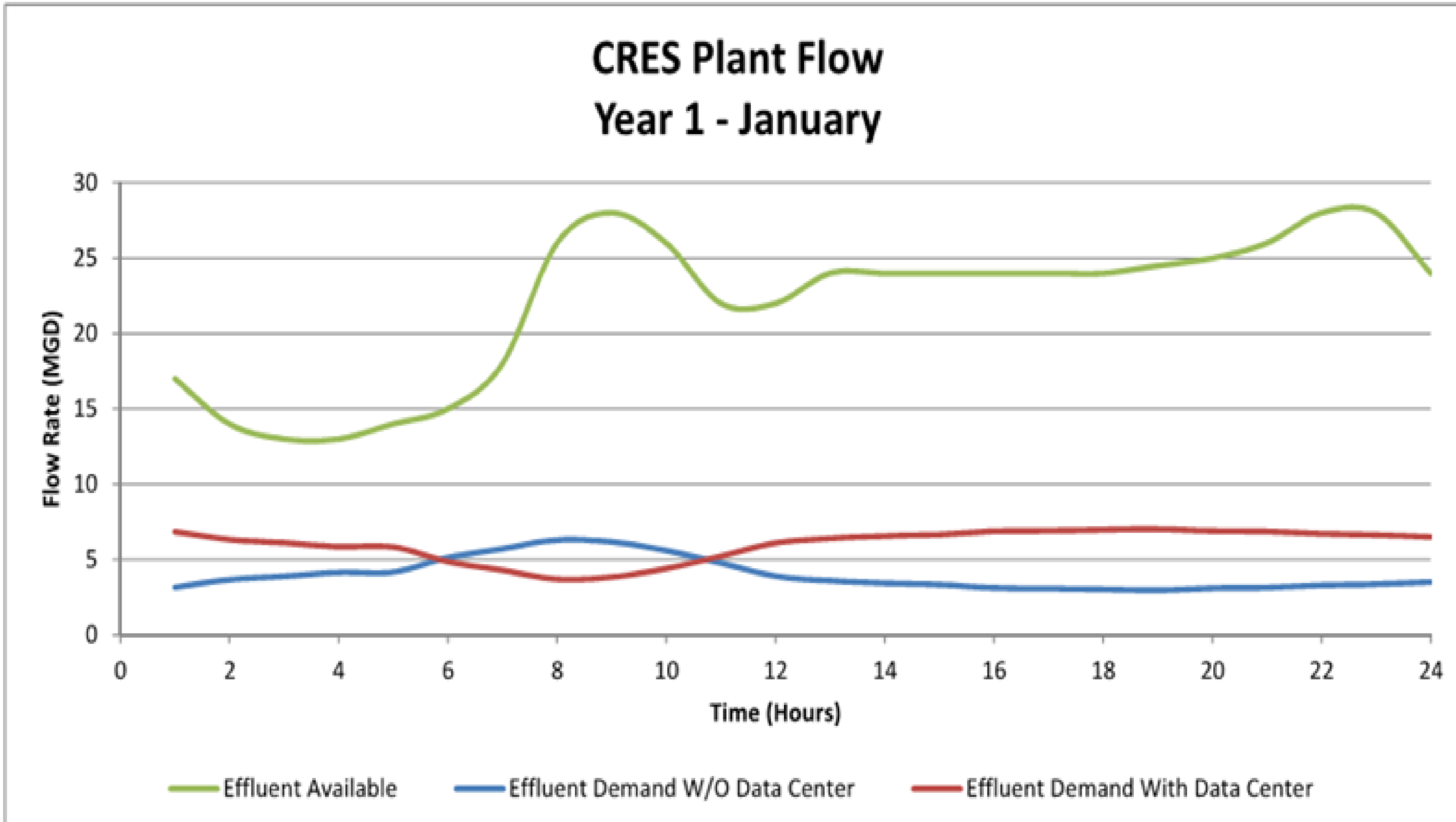


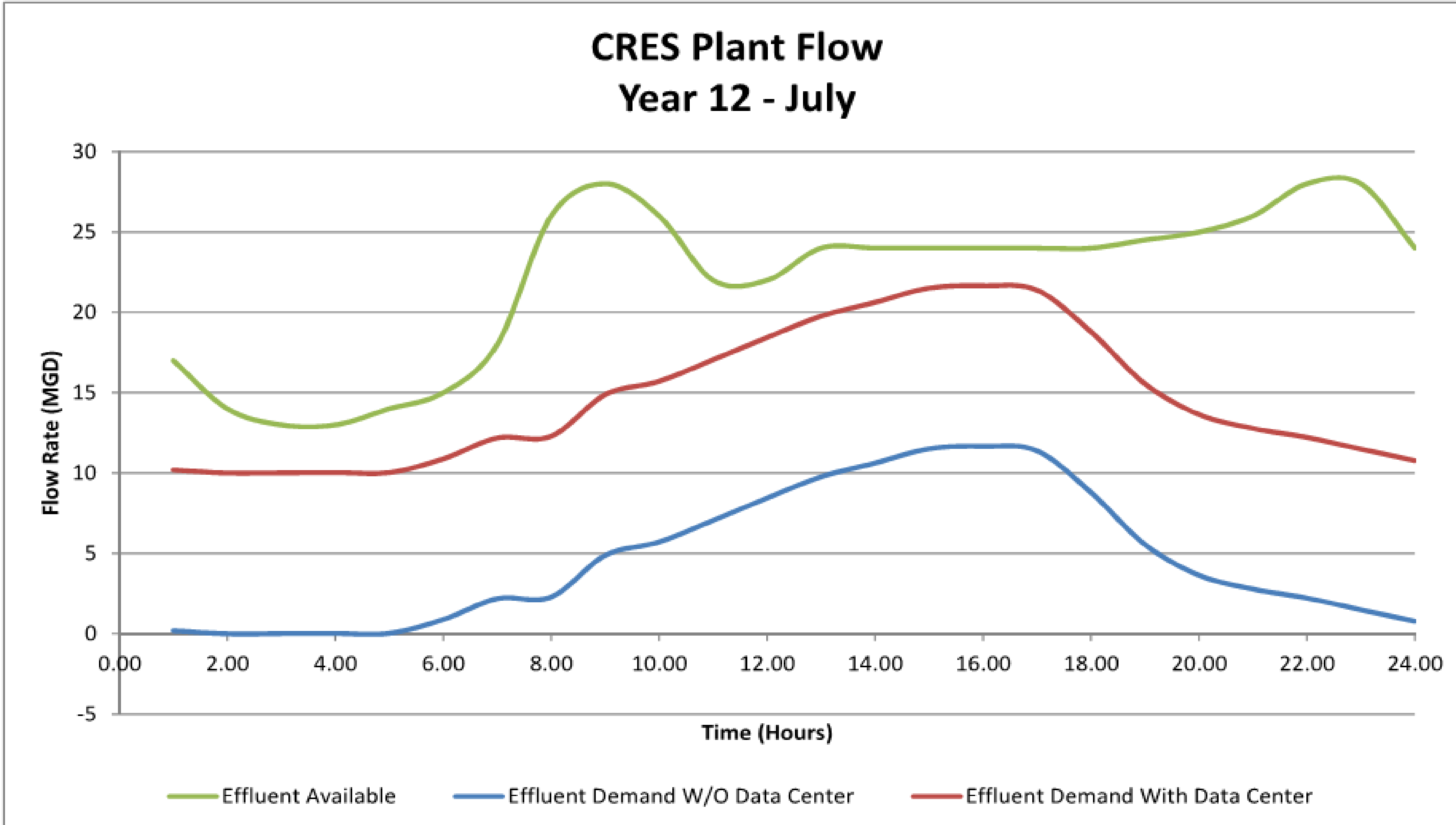
# Preliminary Design

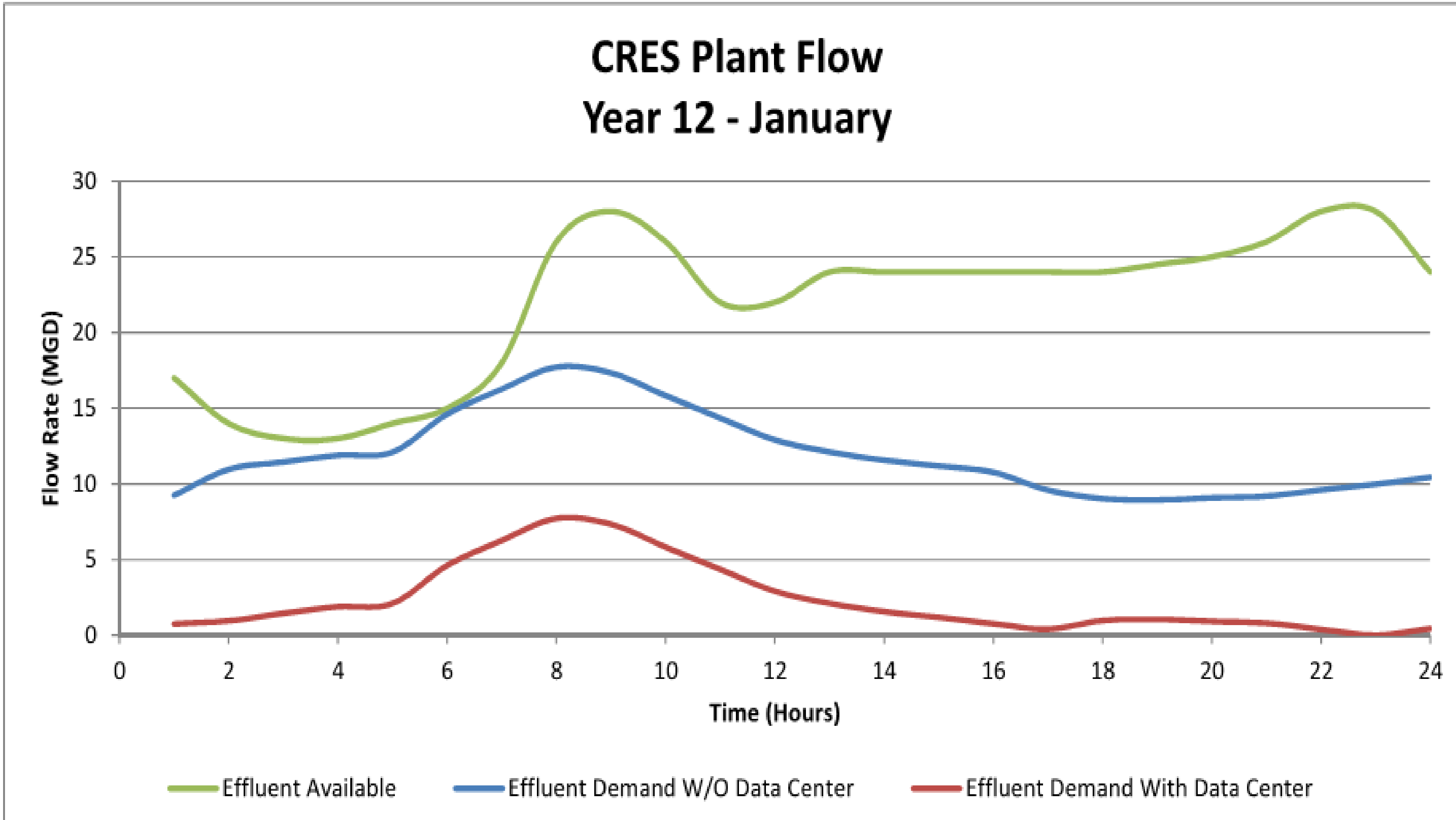
## HEAT EXCHANGE FACILITY

- Sized Based Upon Effluent Flow and Temperature
- Sized and Phased Based Upon Projected Innovation Campus Building Loads
- All Phases Include a Redundant Heat Exchange Unit


CRES Plant Flow
Year 1 - July
Flow Rate (MGD)
30
25
20
15
10
5
0
-5
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (Hours)
Effluent Available
Effluent Demand W/O Data Center
Effluent Demand With Data Center


CRES Plant Flow
Year 1 - January
Flow Rate (MGD)
0
5
10
15
20
25
30
Time (Hours)
0
2
4
6
8
10
12
14
16
18
20
22
24
Effluent Available
Effluent Demand W/O Data Center
Effluent Demand With Data Center


CRES Plant Flow
Year 12 - July
30
25
20
15
10
5
0
-5
Flow Rate (MGD)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (Hours)
Effluent Available
Effluent Demand W/O Data Center
Effluent Demand With Data Center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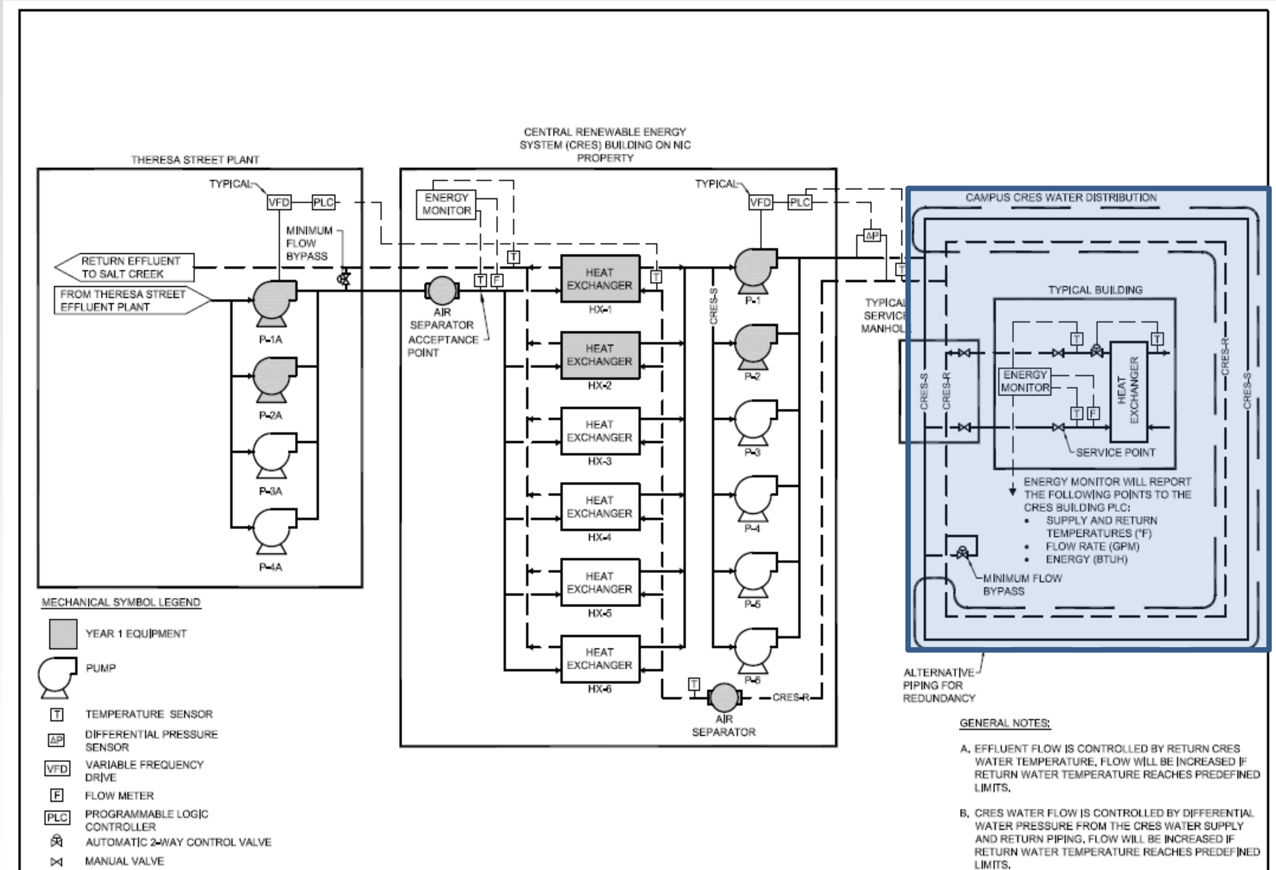
# Preliminary Design

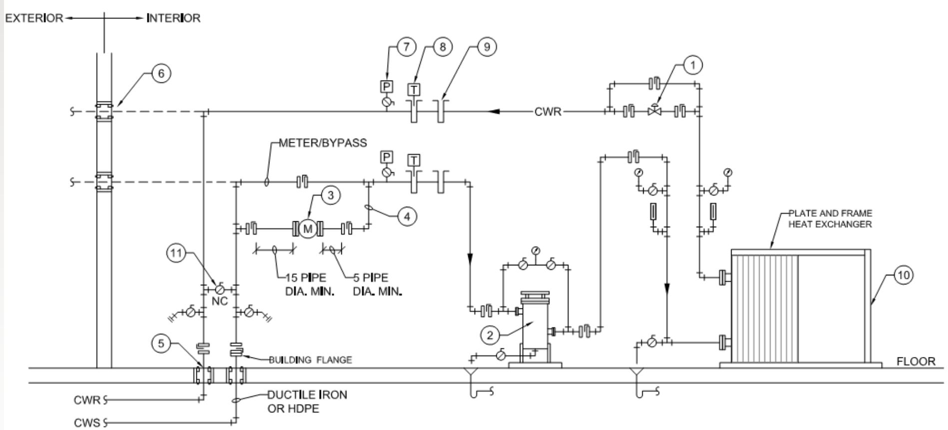


# Preliminary Design

- Distribution System
  - 36-inch Diameter HDPE Pipe
  - Twin Piping (Supply and Return)
  - Total of 6,100 LF

# Preliminary Design

## BUILDING SERVICE ENTRANCE




CRES BUILDING SERVICE ENTRANCE PIPING SCHEMATIC

1 A1.01 SCALE: NO SCALE

CWS - CRES WATER SUPPLY
CWR - CRES WATER RETURN

### GENERAL NOTES

1. UNLESS OTHERWISE NOTED, ALL EQUIPMENT, PIPING, VALVES, ETC. SHALL BE PROVIDED, INSTALLED AND MAINTAINED BY THE BUILDING TENANT.
2. ONLY THE CRES SUPPLY / RETURN WATER SYSTEM IS SHOWN. PIPING LAYOUT AND DEVICES ON THE BUILDING SIDE OF THE HEAT EXCHANGER ARE NOT SHOWN. A MANUAL PRESSURE GAGE AND THERMOMETER ARE REQUIRED ON THE BUILDING SUPPLY AND RETURN LINES.

### # KEY NOTES

1. HEAT EXCHANGER FLOW CONTROL VALVE PROVIDED AND CONTROLLED BY BUILDING CONTROL VENDOR.
2. DUPLEX BASKET STRAINER WITH 1/16" SCREEN. TWO SINGLE STRAINERS MAY BE PROVIDED IN LIEU OF DUPLEX UNIT. PIPE BLOWDOWN PIPE TO NEAREST FLOOR DRAIN.
3. FLOW METER PROVIDED BY UNL, INSTALLED BY CONTRACTOR. CONDUIT AND WIRE BACK TO METERING PANEL CABLE GUTTER BY CONTRACTOR. SEE CRES BUILDING METER WIRING DETAIL. PROVIDE MINIMUM UPSTREAM AND DOWNSTREAM PIPE DIAMETERS AS SHOWN BETWEEN METER AND ANY VALVE / FITTINGS.
4. PROVIDE A MINIMUM OF 15" SPACE BETWEEN METER LEG AND BYPASS LEG.
5. PROVIDE PIPE SLEEVE AND LINK-SEAL WITH SS HARDWARE AT FLOOR PENETRATION. INSTALL SO THAT THREADED NUTS ARE EXPOSED.
6. ALTERNATE WALL PENETRATION LOCATION IF SERVICE ENTRANCE IS LOCATED IN BASEMENT. PROVIDE SLEEVE AND SEAL PER NOTE 7.
7. PRESSURE SENSOR PROVIDED BY UNL, INSTALLED BY CONTRACTOR. CONDUIT AND WIRE BACK TO METERING PANEL CABLE GUTTER BY CONTRACTOR. SEE CRES BUILDING METER WIRING DETAIL.
8. TEMPERATURE SENSOR PROVIDED BY UNL, INSTALLED BY CONTRACTOR. CONDUIT AND WIRE BACK TO METERING PANEL CABLE GUTTER BY CONTRACTOR. SEE CRES BUILDING METER WIRING DETAIL.
9. EXTRA THERMO-WELL FOR SENSOR CALIBRATION PROVIDED BY UNL, INSTALLED BY CONTRACTOR.
10. PLATE AND FRAME HEAT EXCHANGER TO BE INSTALLED IN FIRST FLOOR OR BASEMENT OF TENANT BUILDING.
11. 1" NORMALLY CLOSED BYPASS TO PREVENT ZERO FLOW CONDITIONS FOR EXTENDED OUTAGES.

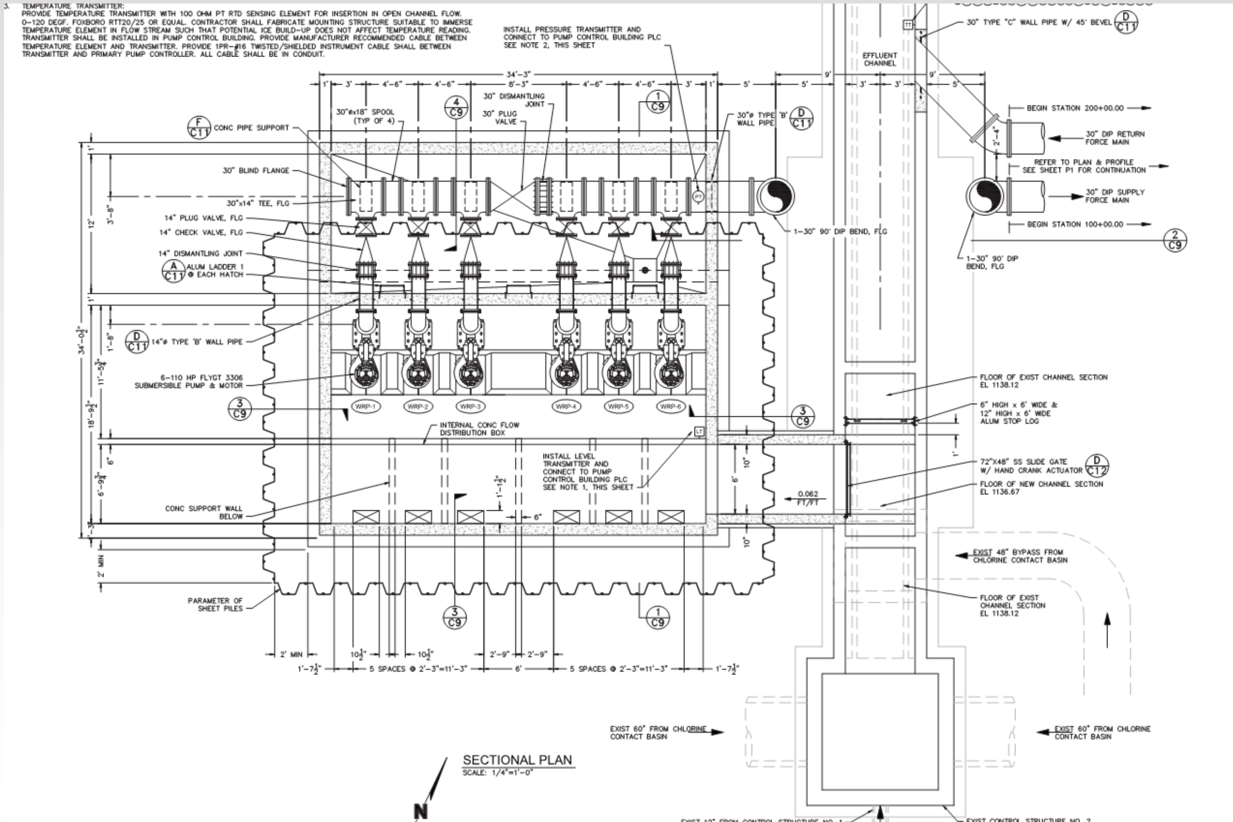
# Final Design

## THERESA ST WWTP

- Lift Station Full Build-out = 5 pumps with a spare
- Prepackaged Pump Control Building
- Generator
- Pipe and Lift Station Within Levee Critical Zone

# Final Design

## THERESA ST WWTP



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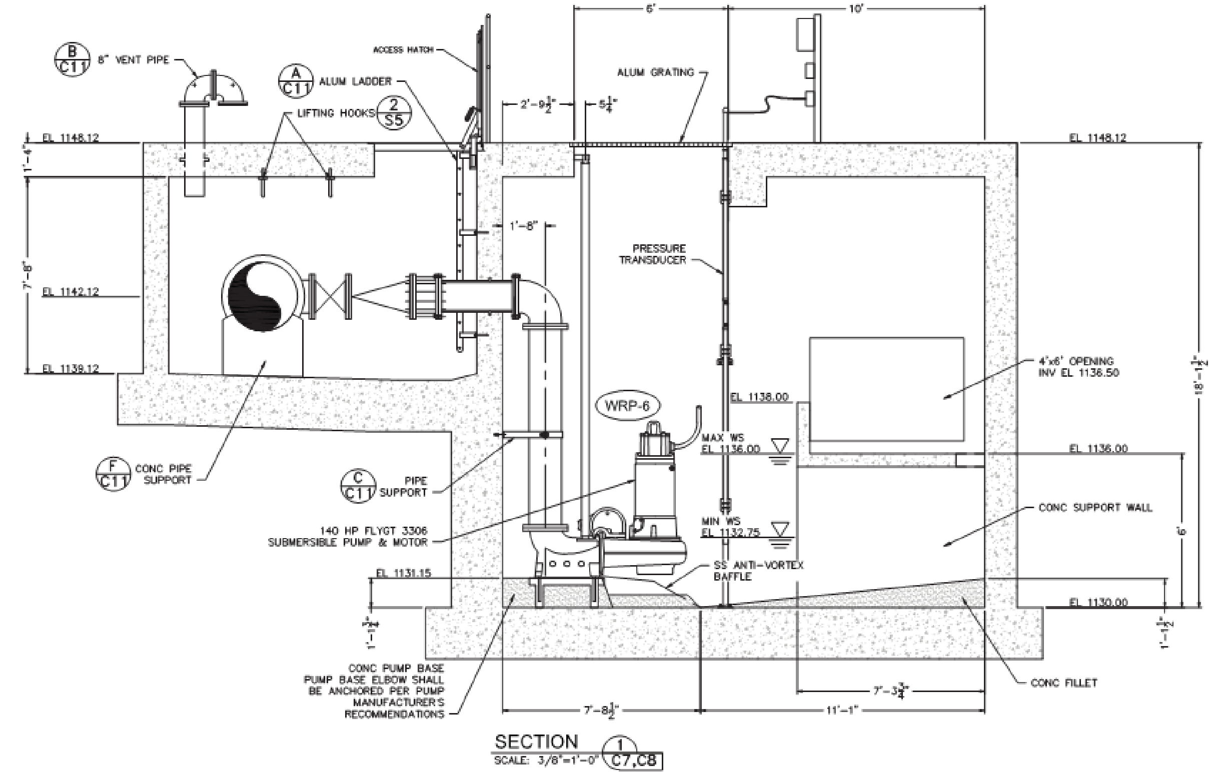

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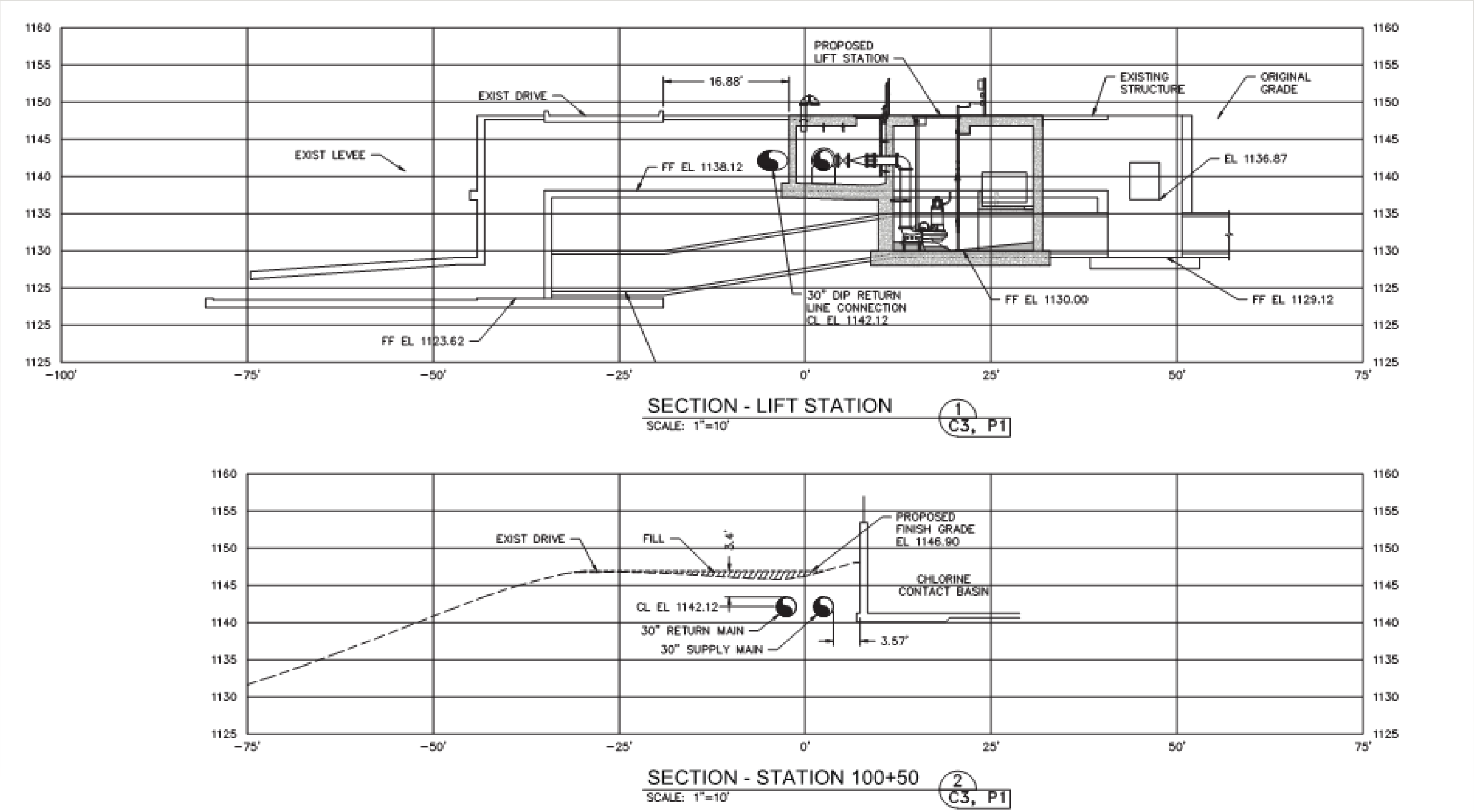

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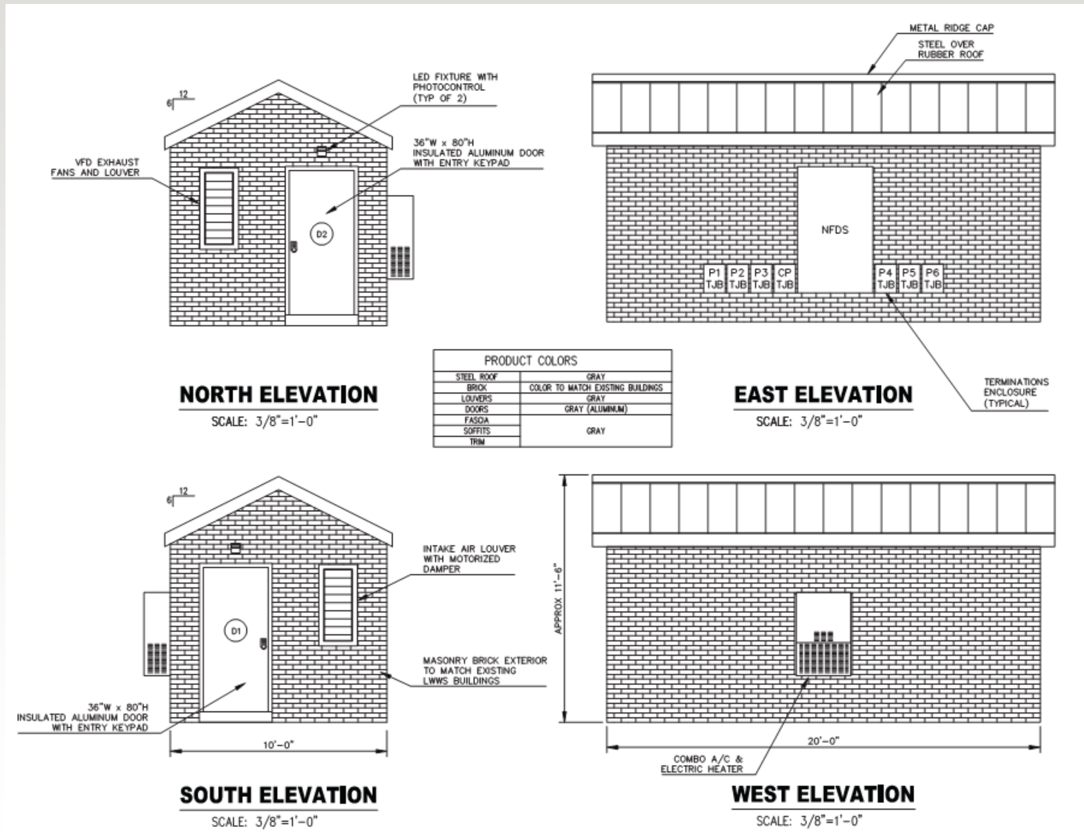


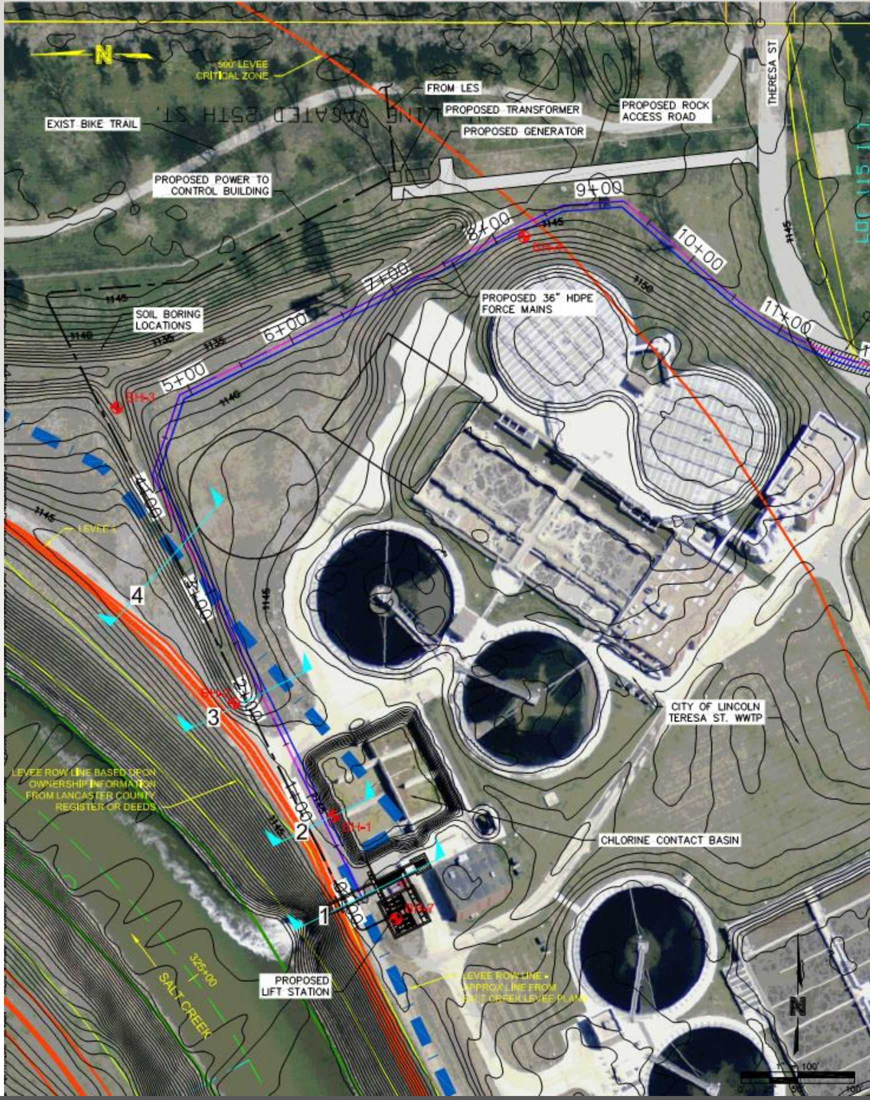

| PRODUCT COLORS | |
|---|---|
| STEEL ROOF | GRAY |
| BRICK | COLOR TO MATCH EXISTING BUILDINGS |
| LOUVERS | GRAY |
| DOORS | GRAY (ALUMINUM) |
| FASCIA | GRAY |
| SOFFITS | |
| TRIM | |

# Final Design

## THERESA ST WWTP

100% Design Required For Regulatory Review by:

- NDEQ
- USACE and NRD

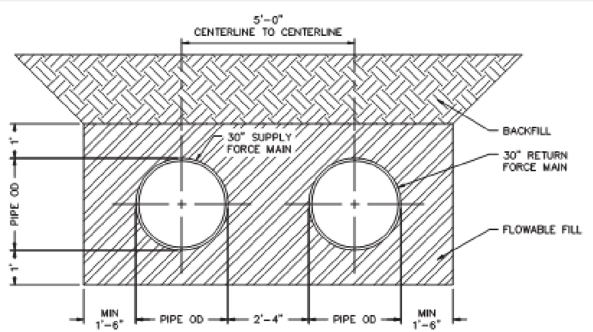


# Final Design

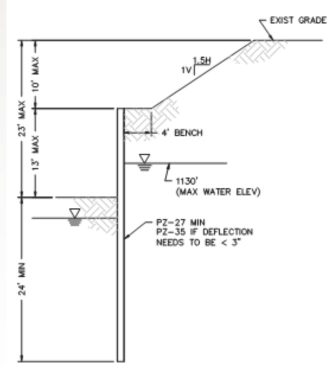
## THERESA ST WWTP

### Corps Requirements

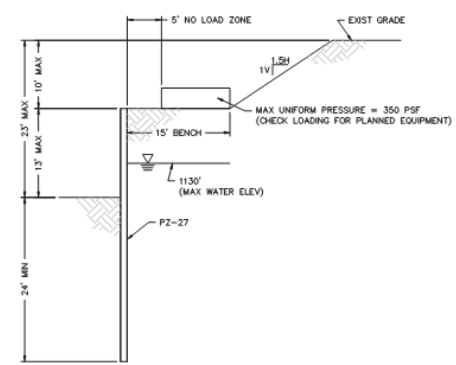
- Shoring
- Dewatering
- Emergency Plan for High Flows in Salt Creek
- Flowable Fill




DETAIL OF BEDDING MATERIAL FOR DIP W/ FLOWABLE FILL
STA 100+00 TO 108+89 & STA 200+00 TO 208+89 A/P1
SCALE: 1/2"=1'-0"



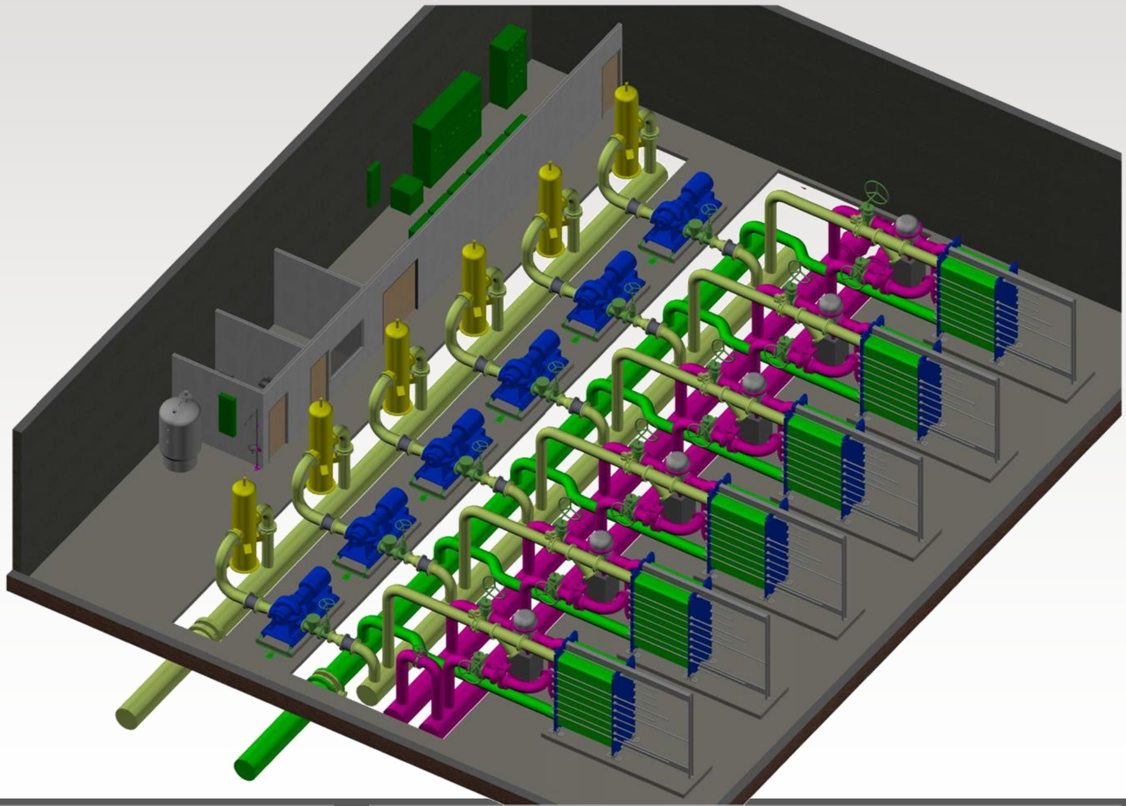

SECTION 3/C8
SCALE: 1"=100'




SECTION 4/C8
SCALE: 1"=100'

# Final Design

## HEAT EXCHANGE FACILITY



# Final Design

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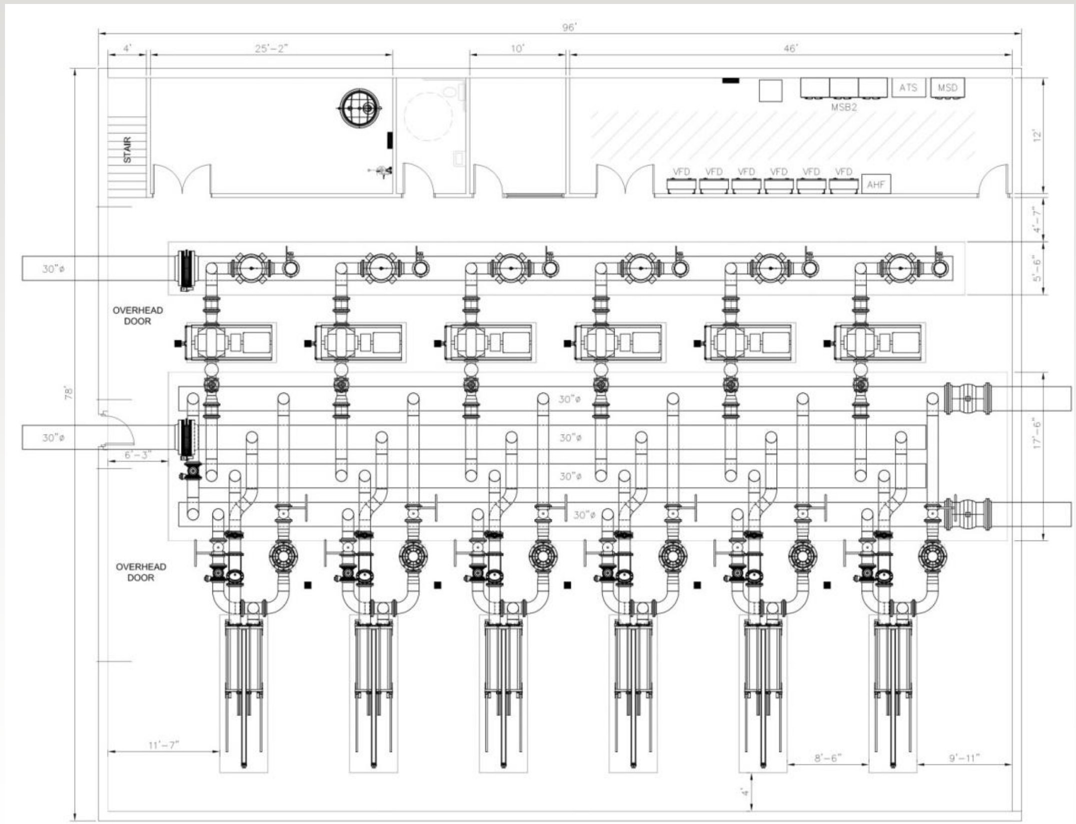
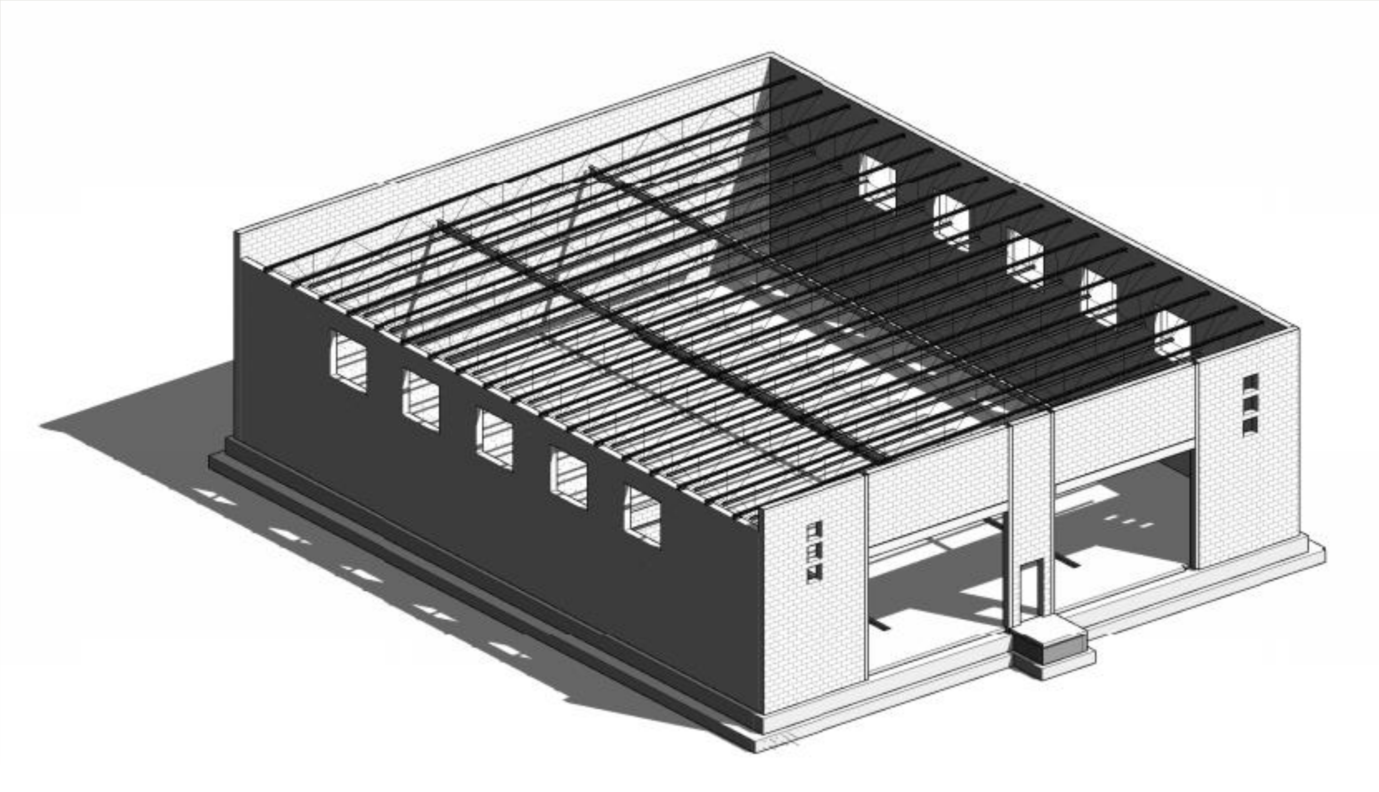


# Final Design

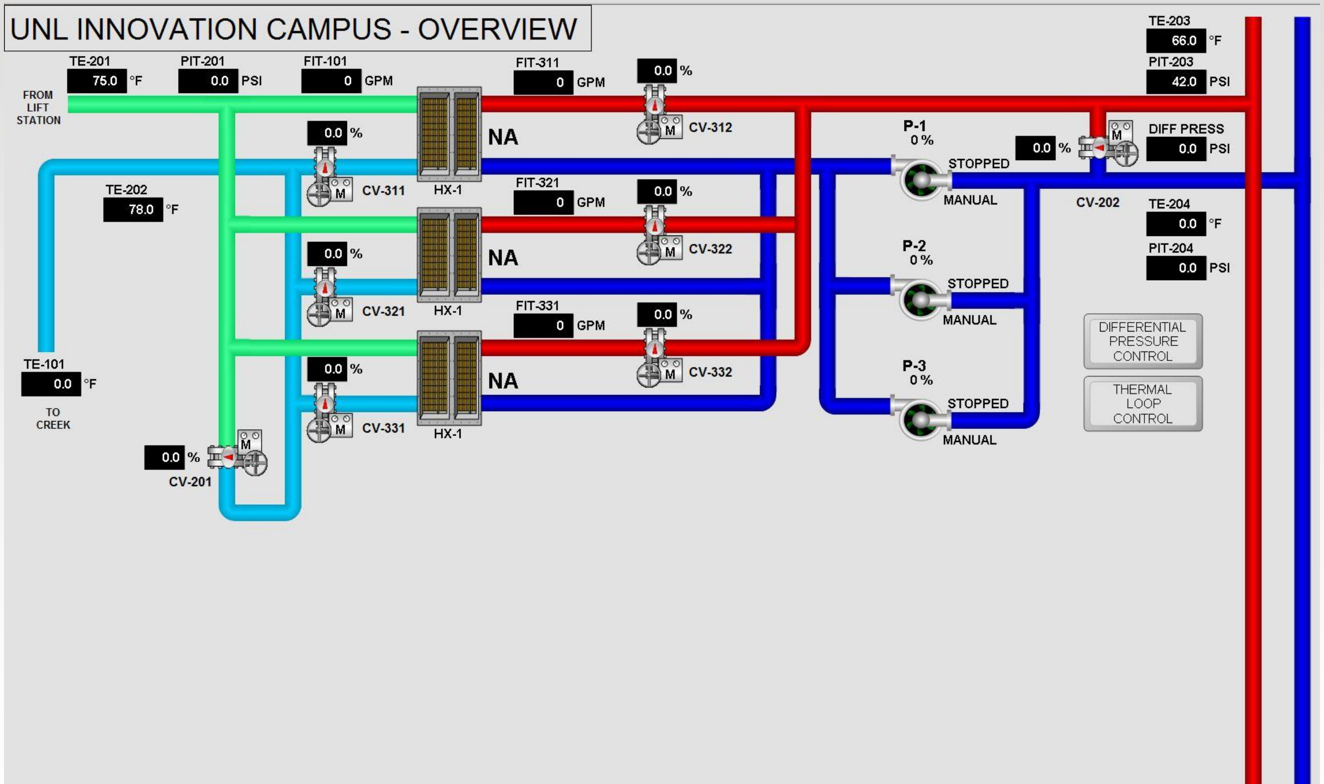
## HEAT EXCHANGE FACILITY

# Final Design

## HEAT EXCHANGE FACILITY

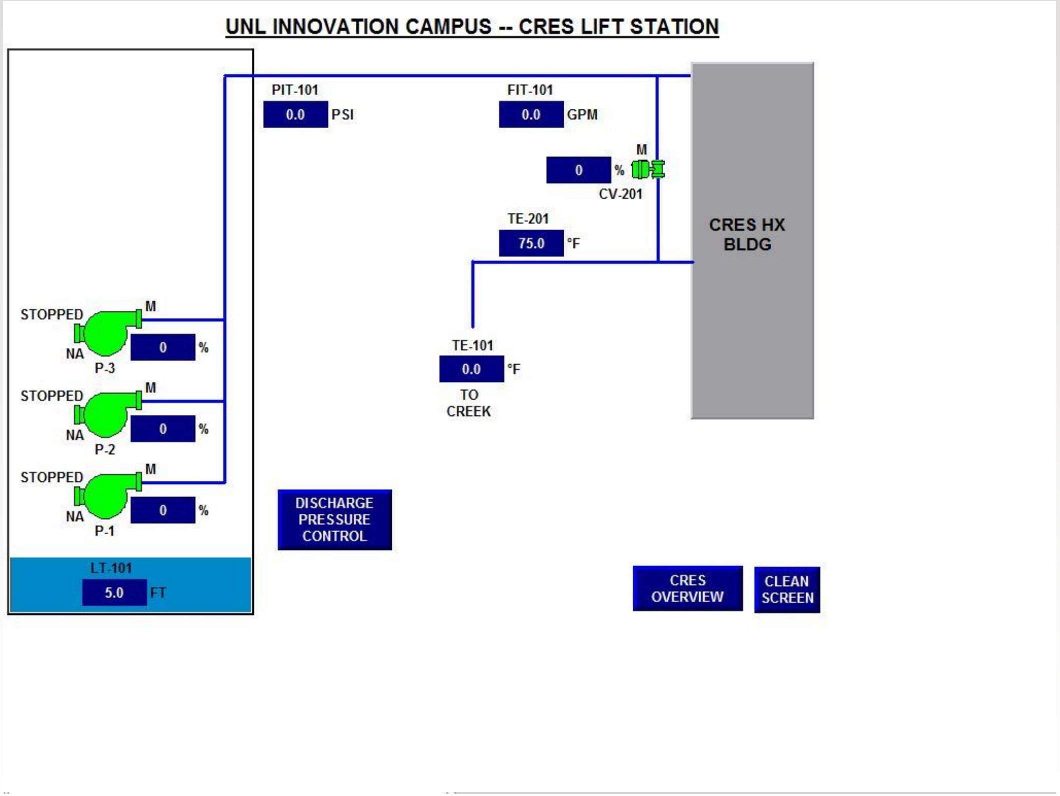


# Final Design
## CONTROLS



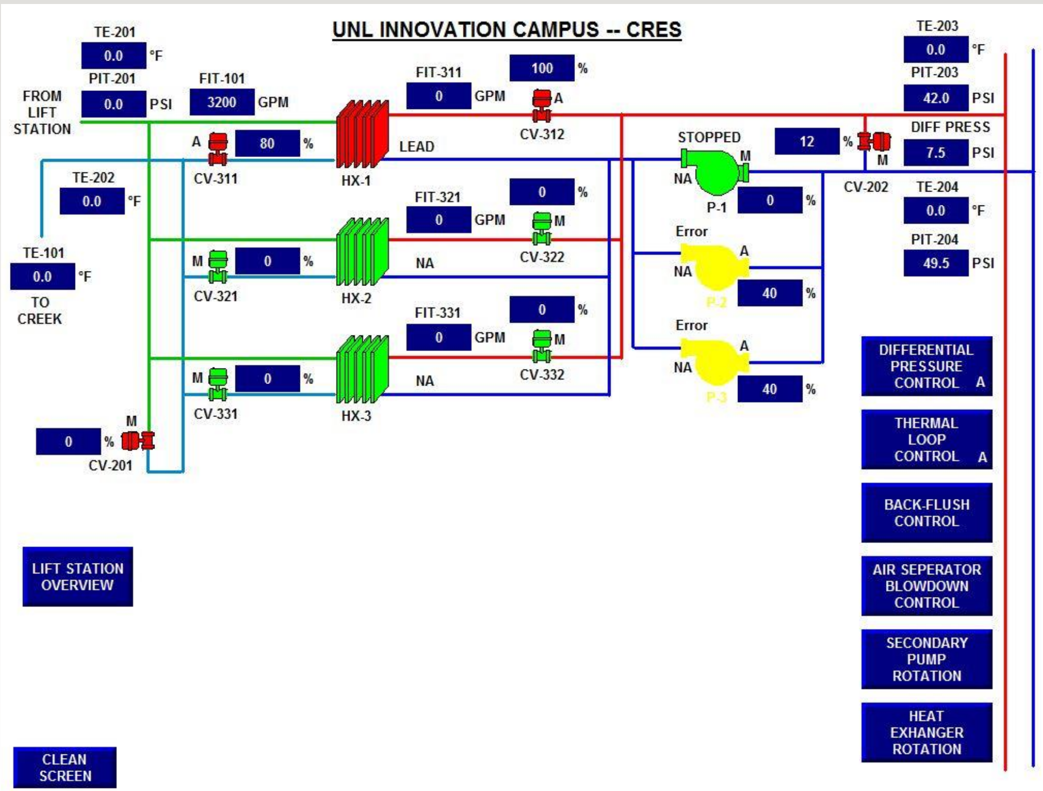

- LWWS LIFT STATION EFFLUENT
- CRES HEAT EXCHANGER PLAN
- NIC CAMPUS LOOP

# Final Design
## CONTROLS




- **LWWS LIFT STATION EFFLUENT**
  3 Variable speed pumps. Pump speed is automatically modulated to maintain a discharge pressure on HX primary side.

# Final Design
## CONTROLS




- **NIC CAMPUS LOOP**
  - 3 Thermal Loop VFD Pumps
  - Automatically maintain differential pressure to campus.
- **CRES HEAT EXCHANGER PLANT**
  - 3 Heat Exchangers
  - Automatically vary flow through heat exchangers to maintain thermal loop temperature to campus

# Project Delivery and Construction

## Project Schedule

- Phased
- Initial Coordination With Developer and City
- All agreements in place
- Complete design near Levee

# Project Delivery and Construction

## Project Schedule

- Selection of Construction Manager at Risk (CMAR)
- 30% CD's and GMP
- Funding by UNL
- NDEQ, USACE and NRD Review and Approval
- Beginning of Construction October 2013
- Final Completion August 2014

# Project Delivery and Construction

## THERESA ST. LIFT STATION AND PIPING

# Project Delivery and Construction

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# Project Delivery and Construction
## HEAT EXCHANGE FACILITY

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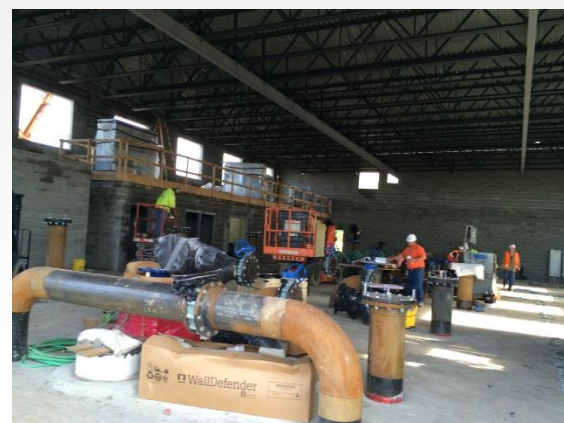

# Project Delivery and Construction

HEAT EXCHANGE FACILITY

# Project Delivery and Construction

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