NEBRASKA INNOVATION CAMPUS

Centralized Renewable Energy System (C.R.E.S)

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CampusEnergy2020
THE POWER TO CHANGE
FEBRUARY 10-14 ▲ SHERATON DENVER DOWNTOWN ▲ DENVER, CO

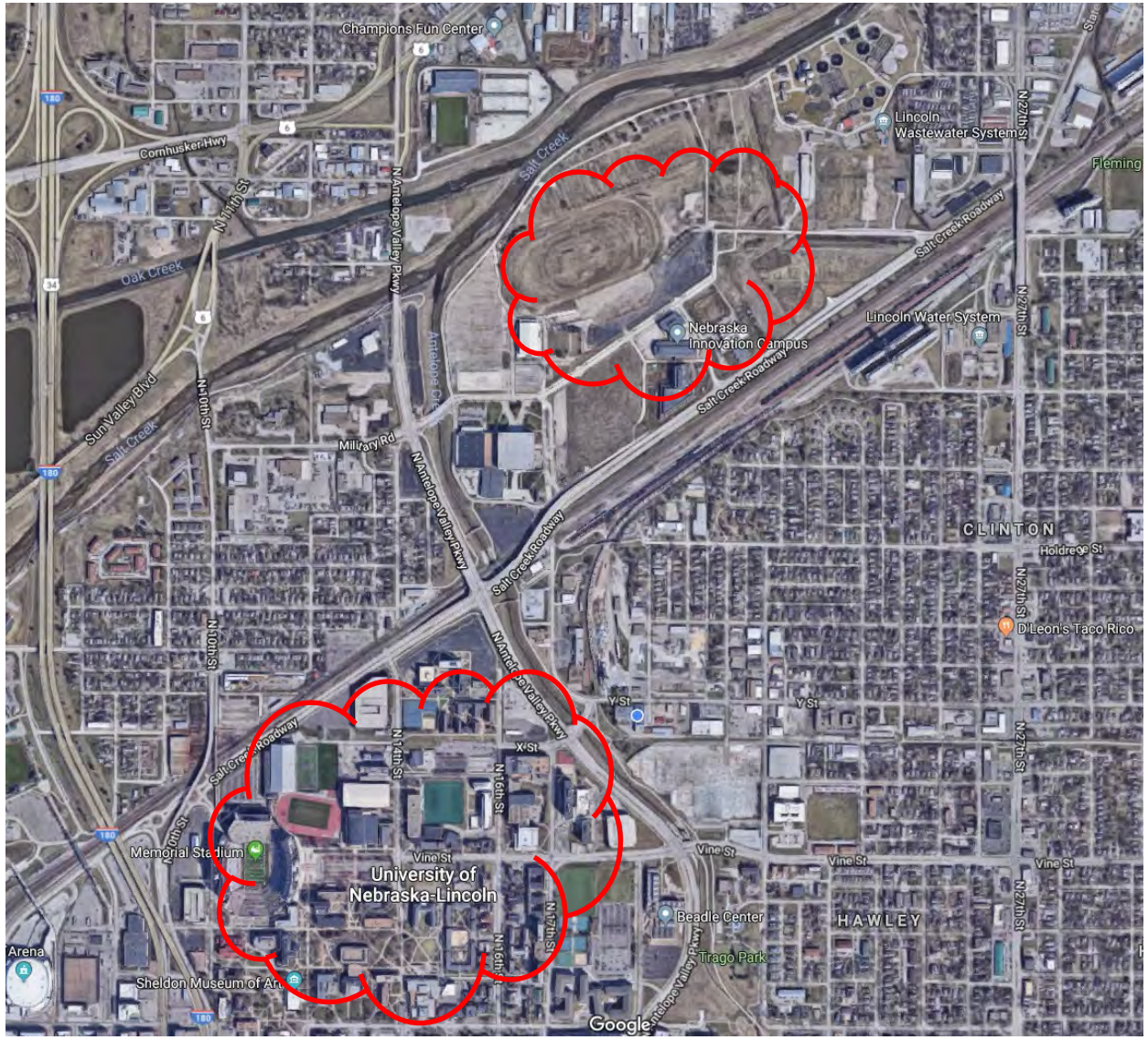
Presentation Outline

- General Overview of Nebraska Innovation Campus (NIC)
- System Concepts
- Design
- Construction
- Operations
- Q/A

Nebraska Innovation Campus (NIC)

- Research campus built and operated under a Public / Private Partnership (P3) arrangement.
- 2.2 million square foot campus at full build out.
- Meant to foster In-depth partnerships between the UNL and private sector businesses.
  - ❑ Stimulate Ideas
  - ❑ Collaboration
  - ❑ Interaction / Innovation

Nebraska Innovation Campus (NIC) – Old State Fair Grounds



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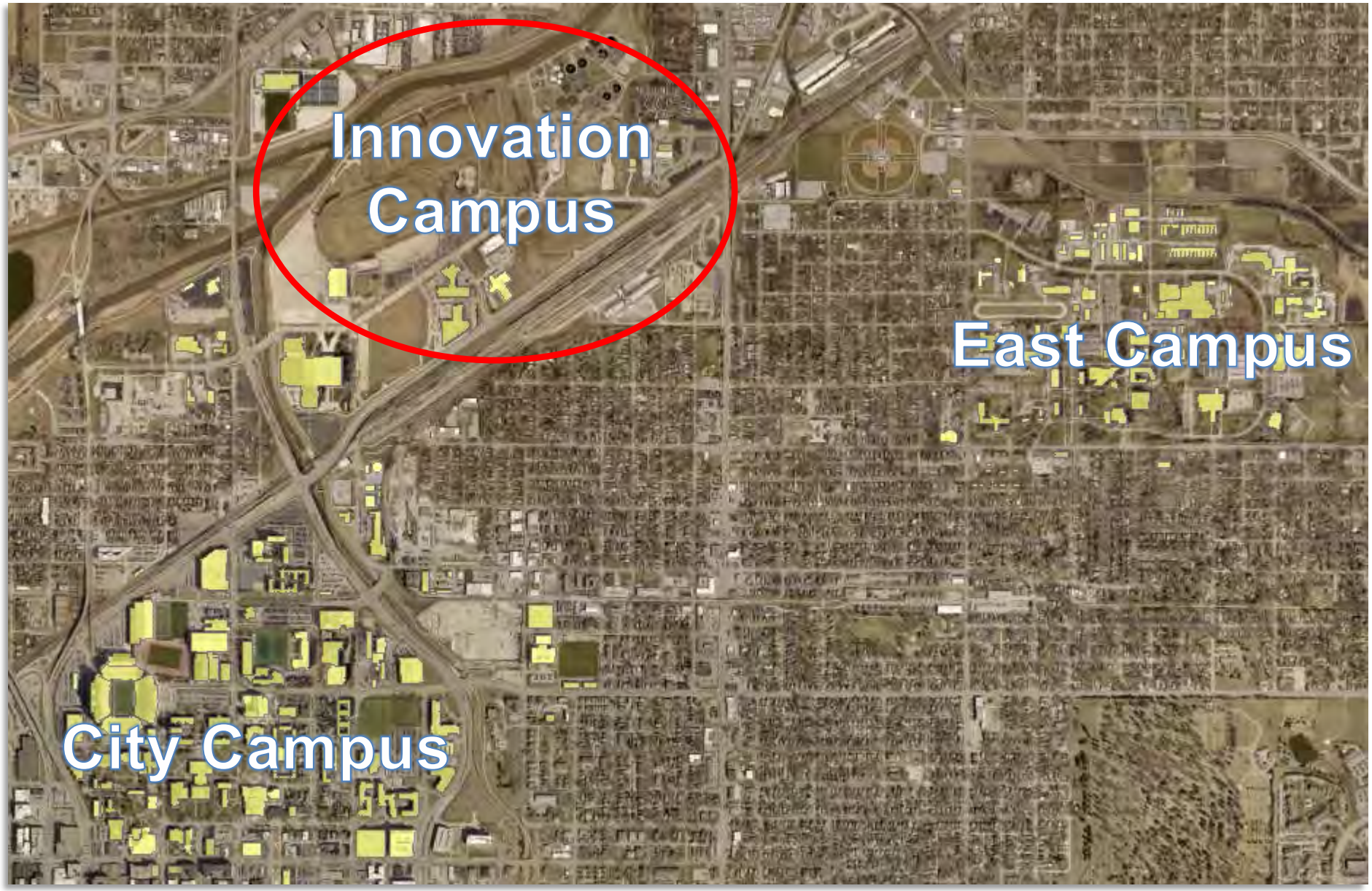


System Concepts – Theresa Street Wastewater Treatment Facility

Theresa Street Wastewater Treatment Plant (TSWWTP)

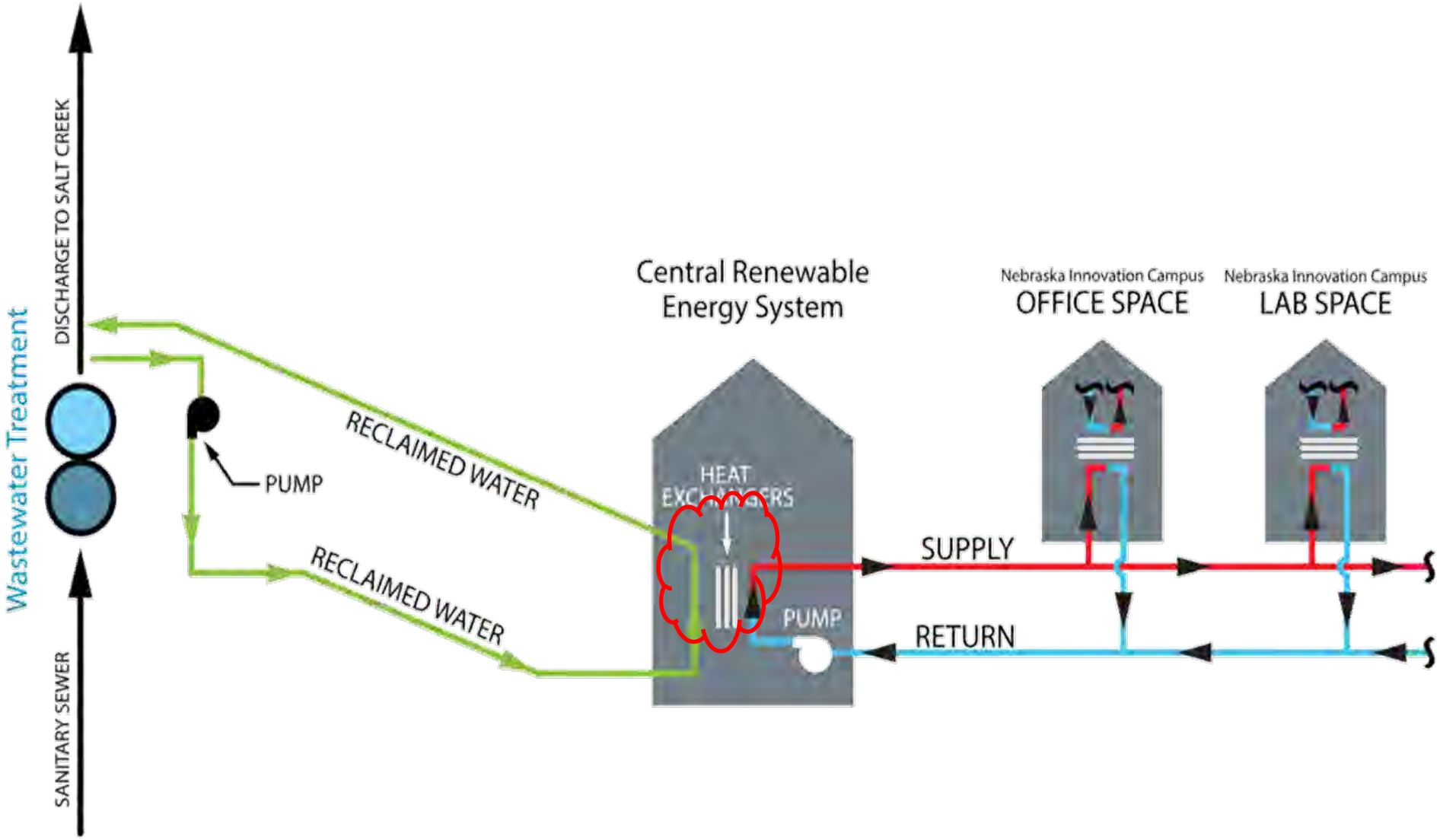
System Concepts – Theresa Street Wastewater Treatment Facility

N

Discharge to Salt Creek

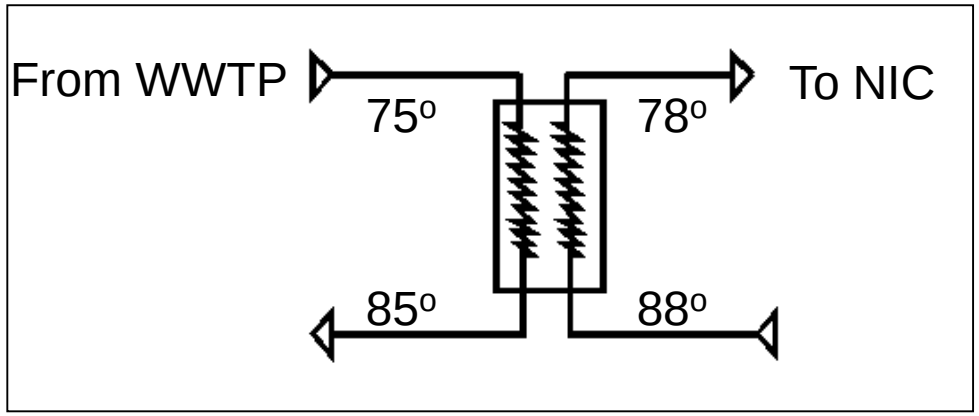
System Concepts – Theresa Street Wastewater Treatment Facility Discharge

System Concepts

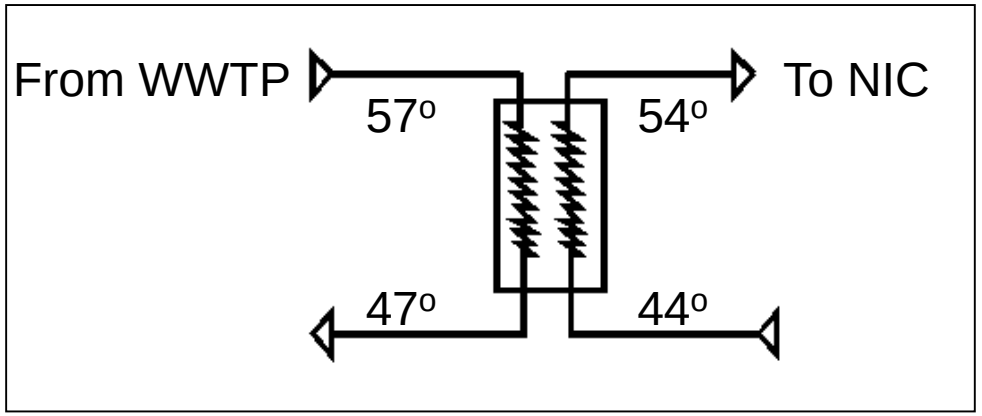


System Concepts

Summer



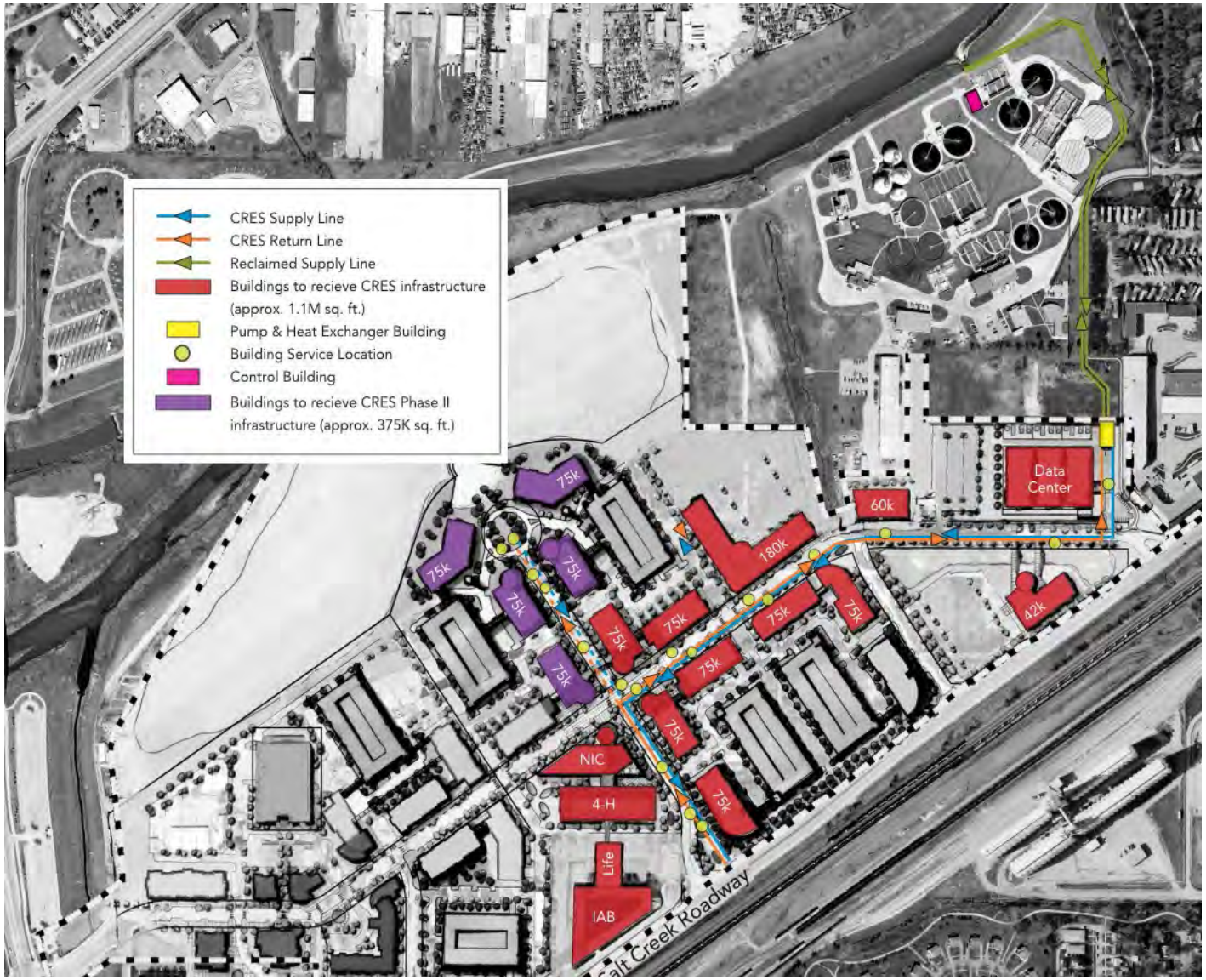
Winter



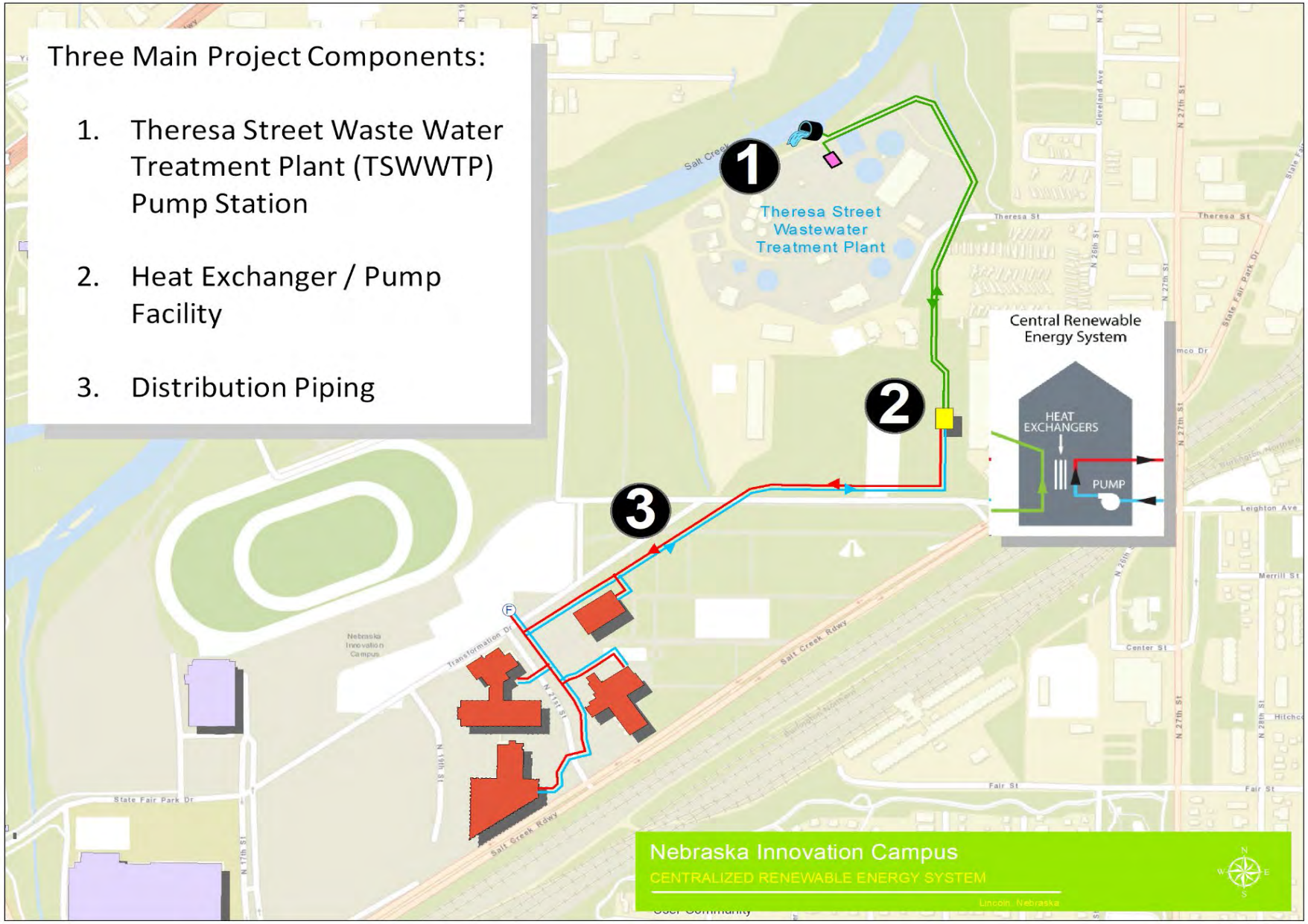
* WWTP = Waste Water Treatment Plant
NIC = Nebraska Innovation Campus

- The system acts exactly like a geothermal heat source or heat sink.
- Either centralized or distributed heat pump / chiller equipment is required at each building

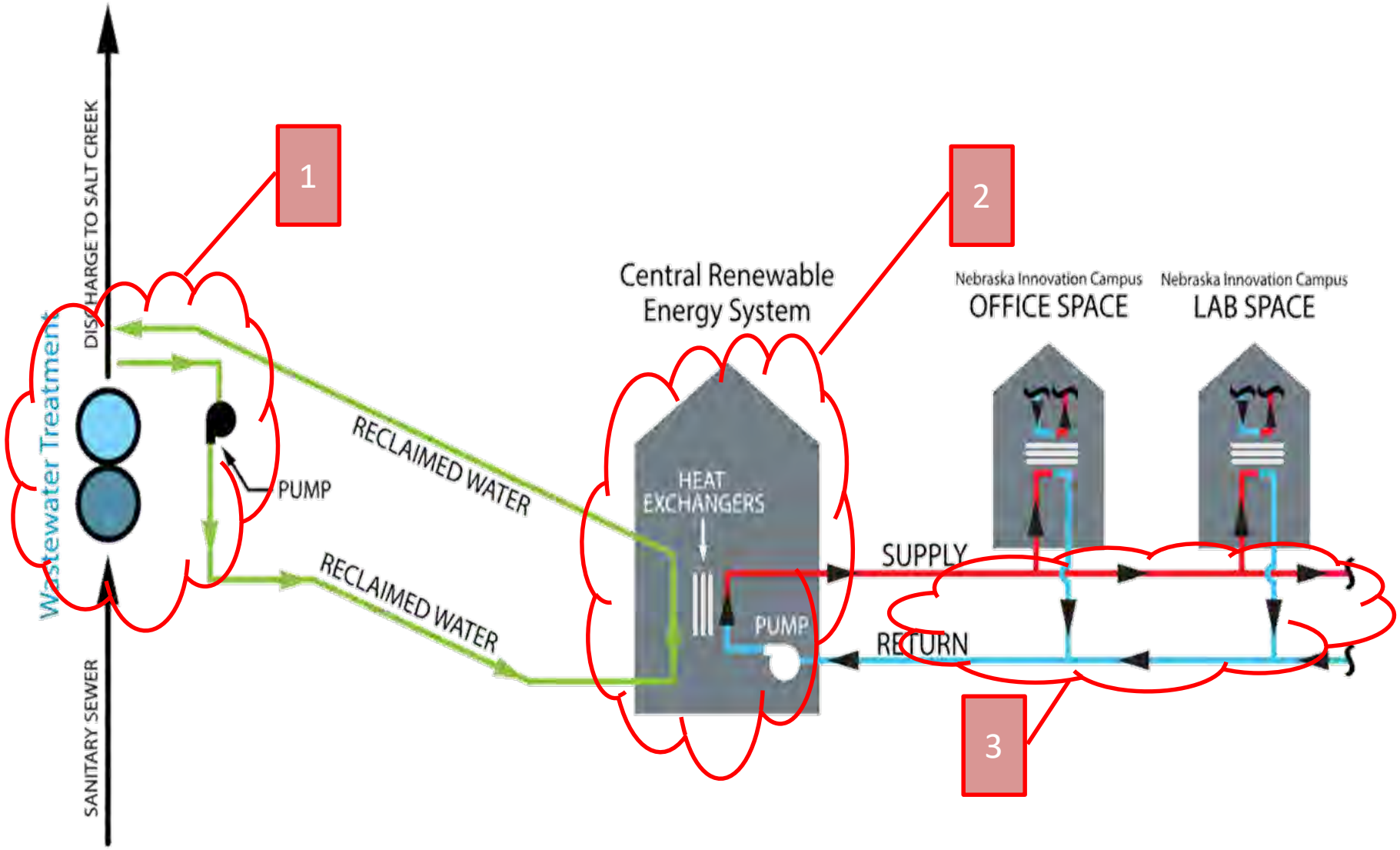
System Concepts



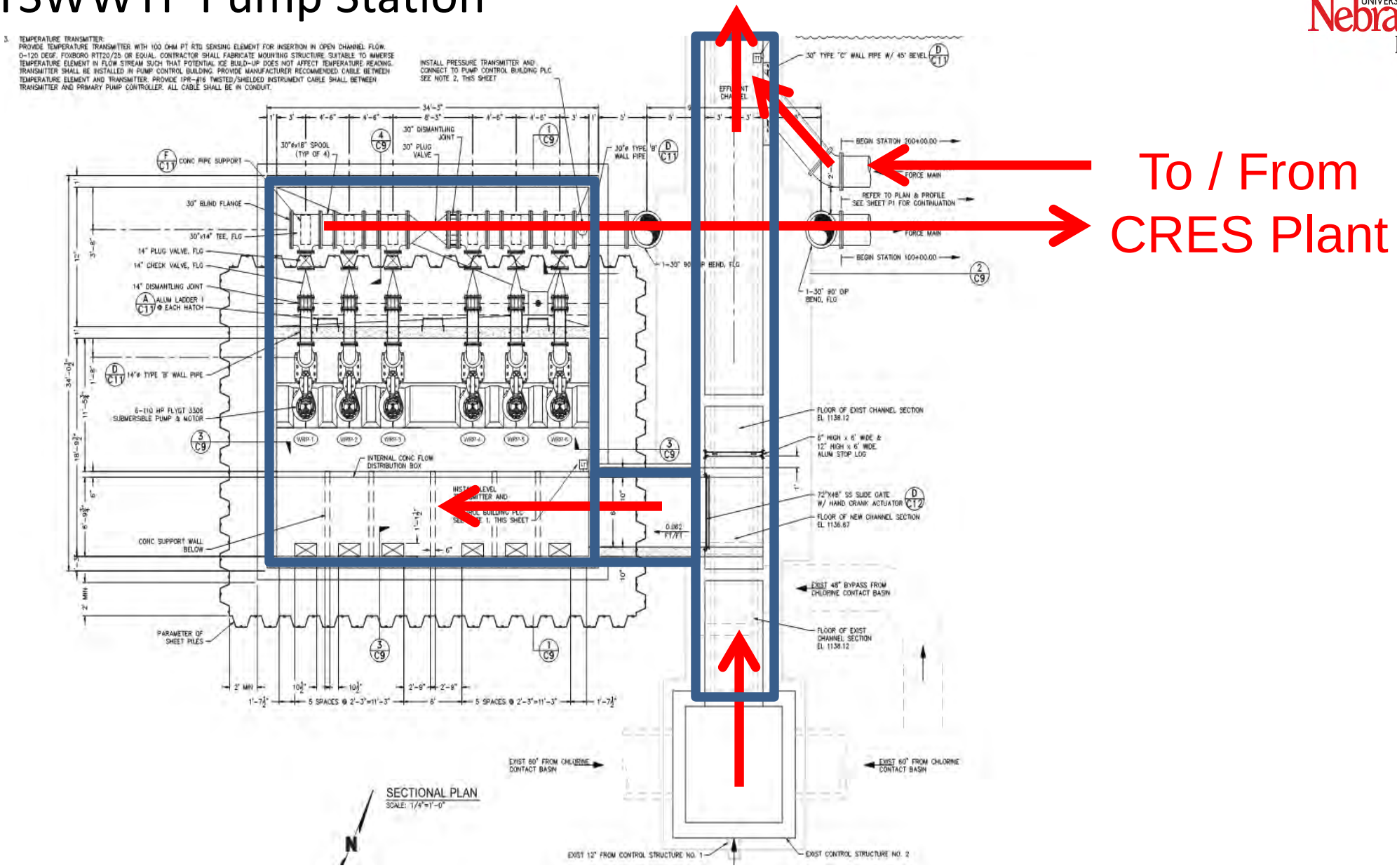
Design


Three Main Project Components:
1. Theresa Street Waste Water Treatment Plant (TSWWTP) Pump Station
2. Heat Exchanger / Pump Facility
3. Distribution Piping
1
Theresa Street Wastewater Treatment Plant
2
Central Renewable Energy System
HEAT EXCHANGERS
PUMP
3
Nebraska Innovation Campus
CENTRALIZED RENEWABLE ENERGY SYSTEM
Lincoln, Nebraska

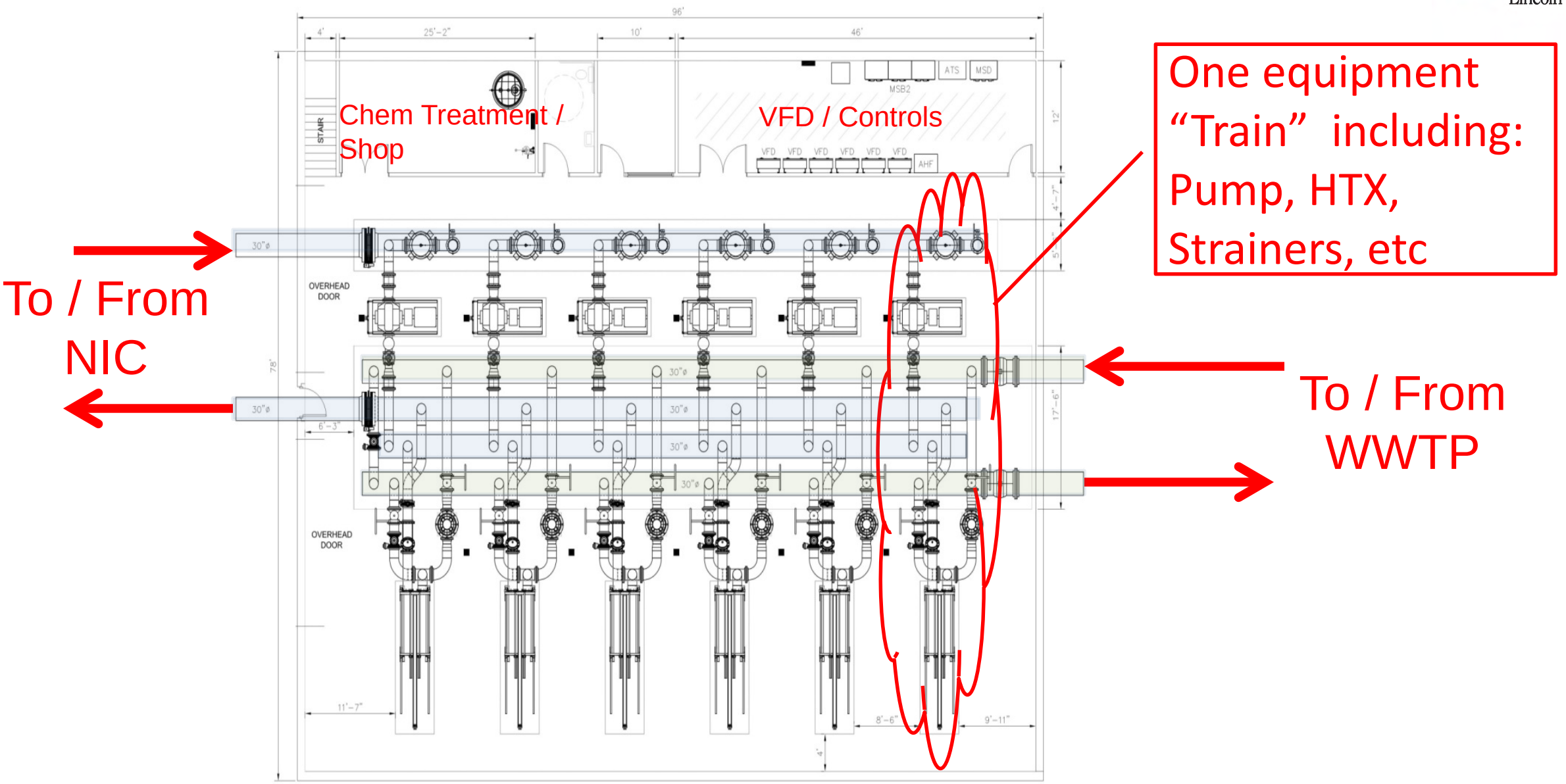
Design


1
2
3
DISCHARGE TO SALT CREEK
Wastewater Treatment
PUMP
SANITARY SEWER
RECLAIMED WATER
RECLAIMED WATER
Central Renewable
Energy System
HEAT
EXCHANGERS
PUMP
SUPPLY
RETURN
Nebraska Innovation Campus
OFFICE SPACE
Nebraska Innovation Campus
LAB SPACE

Design – TSWWTP Pump Station



Design – Heat Exchanger Pump Facility



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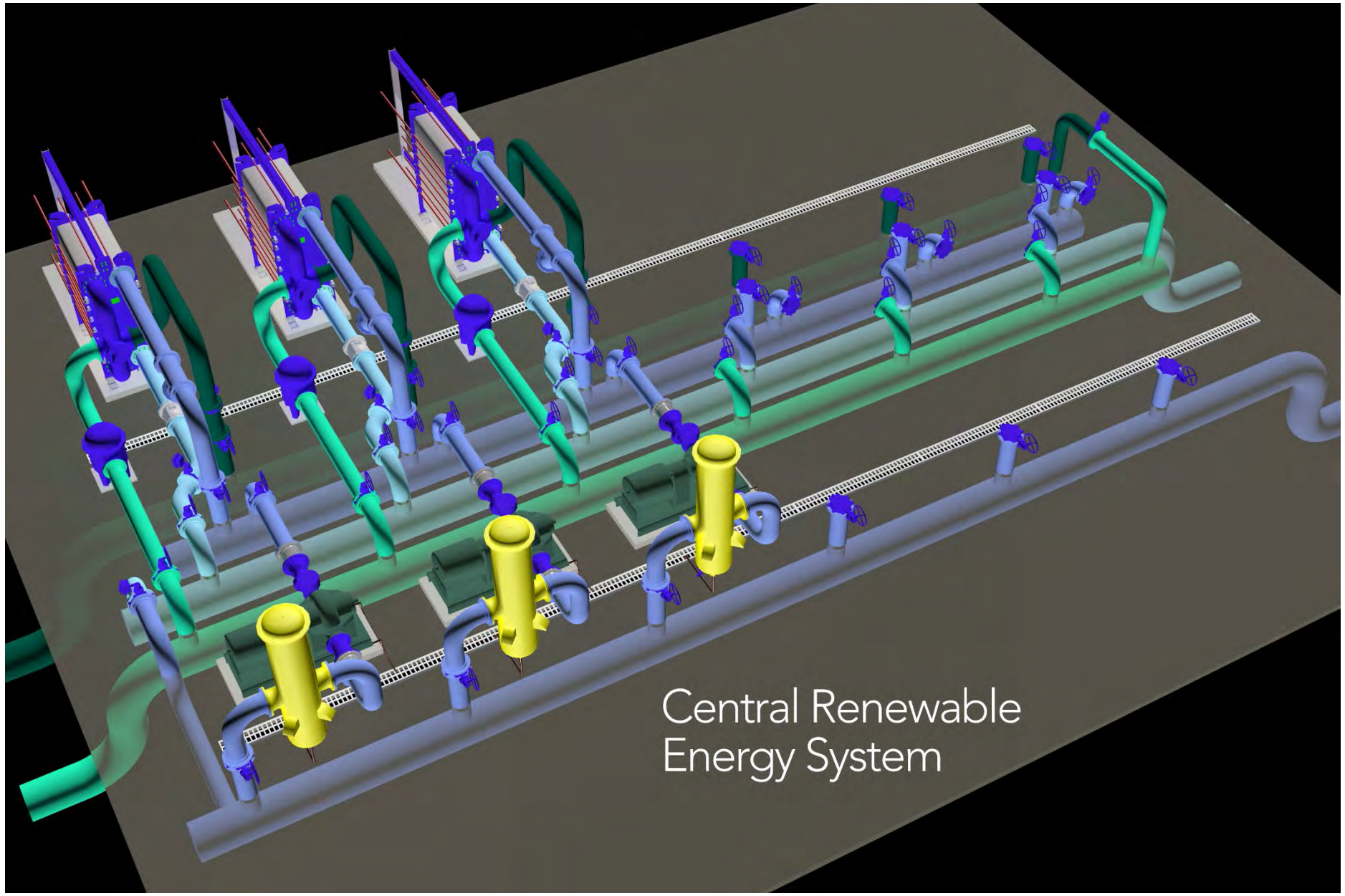

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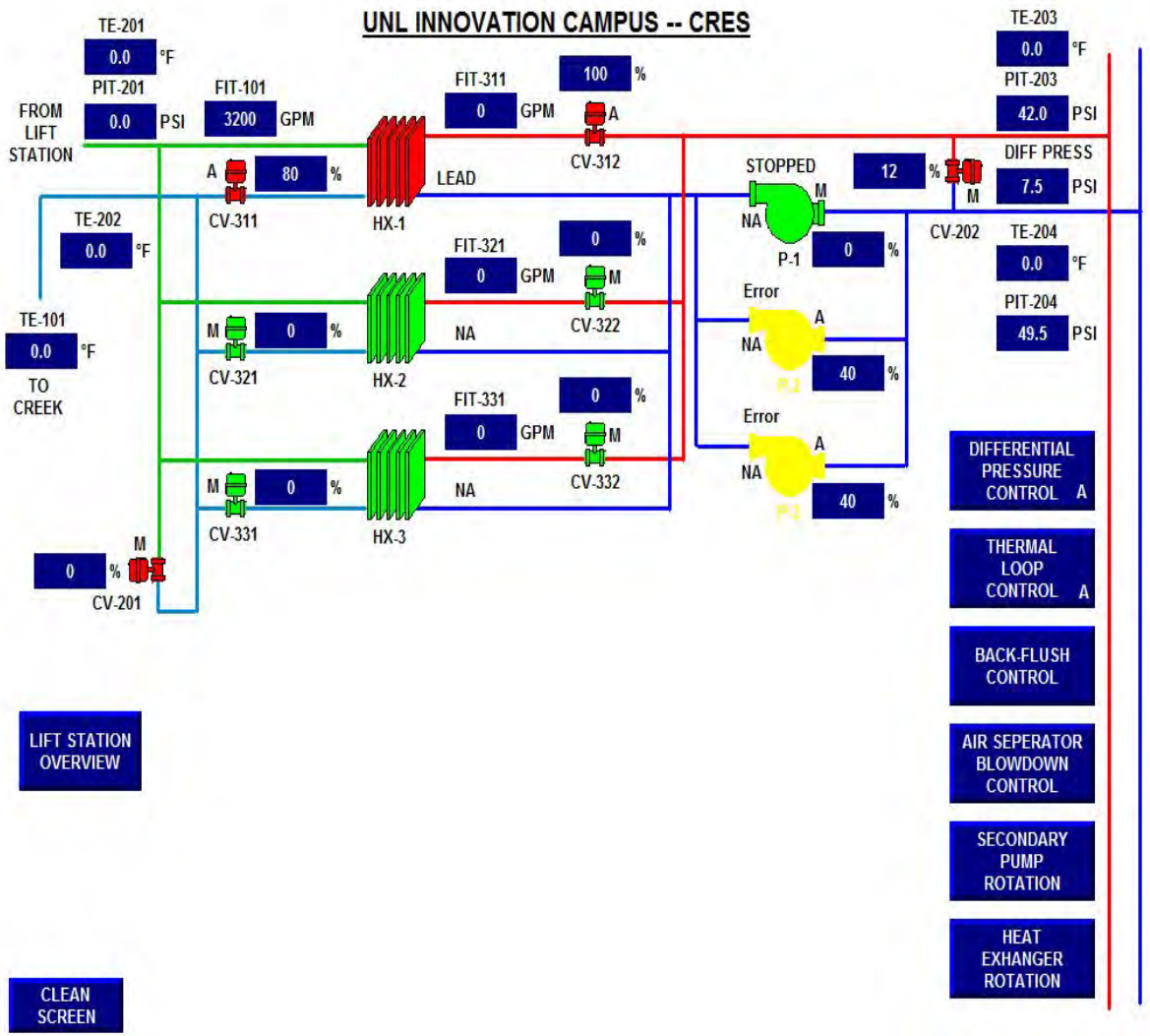
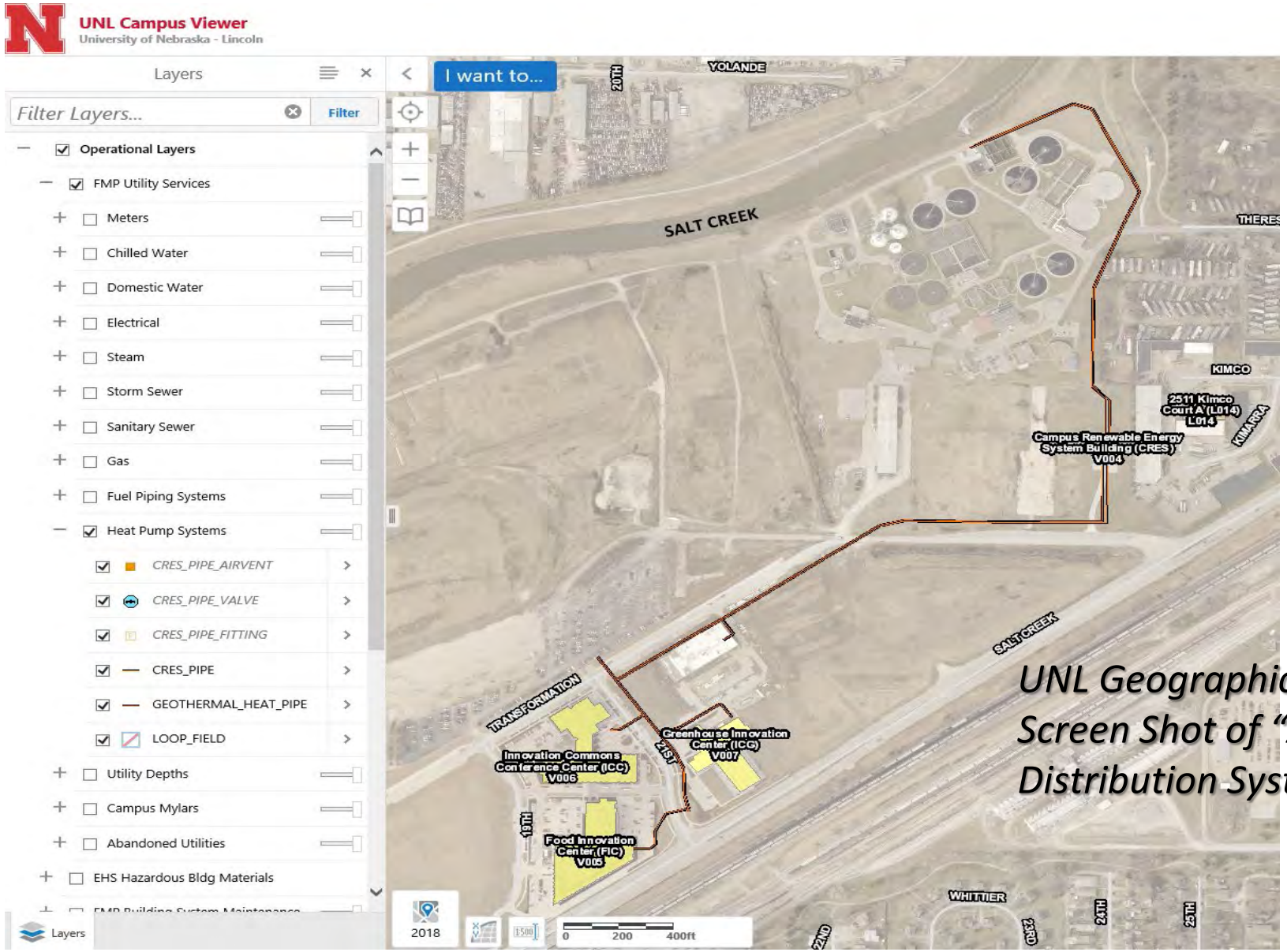


- Plant is fully automated and remotely monitored
- Pump Cycling
- Pump Speed Control
- Strainer Blowdown
- CCTV
- Flow / Pressure / Temperature

Design – Distribution Piping



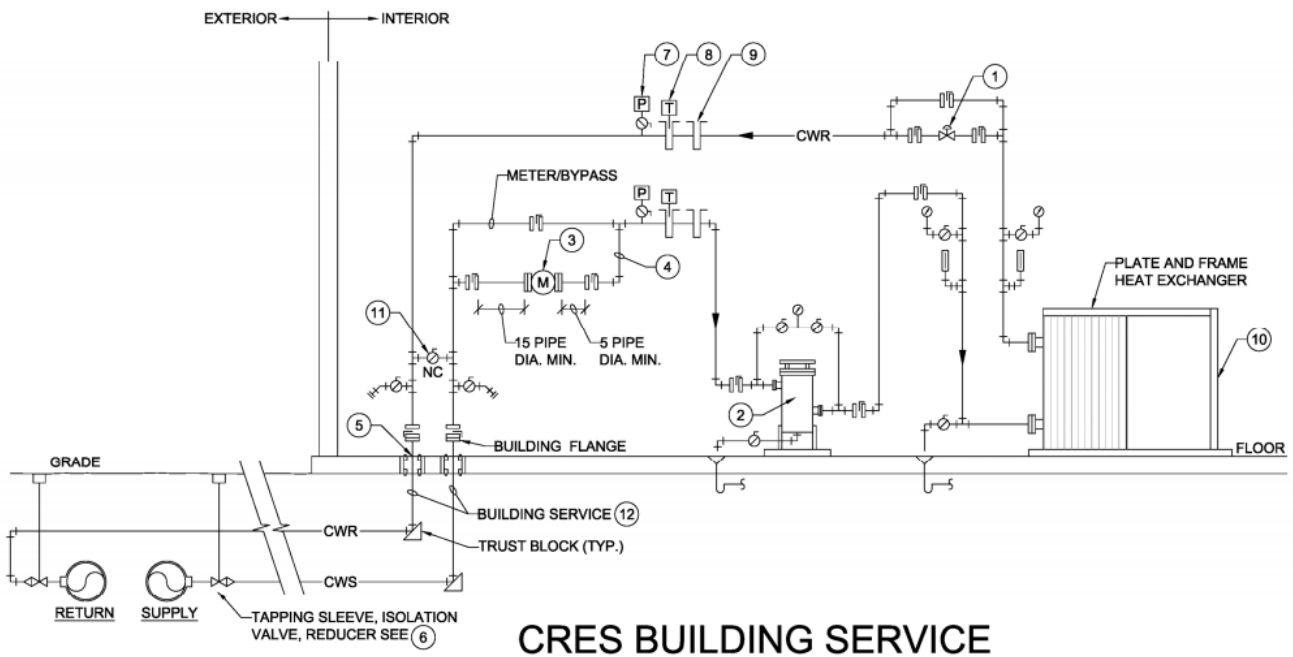
UNL Geographic Information System Screen Shot of "As-Built" Distribution System

Design – Distribution Piping

Central Renewable Energy System Customer Installation and Operational Guidelines

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.



CRES BUILDING SERVICE PIPING SCHEMATIC

1 / A1.01 SCALE: NO SCALE

CWS - CRES WATER SUPPLY
CWR - CRES WATER RETURN

KEY NOTES

1. HEAT EXCHANGER FLOW CONTROL VALVE PROVIDED AND CONTROLLED BY BUILDING CONTROL VENDOR. FLOW CONTROL SHALL BE PRESSURE INDEPENDENT TYPE WITH MAXIMUM FLOW SET FOR HEAT EXCHANGER DESIGN FLOW. ACCEPTABLE MANUFACTURERS ARE: BELIMO, DANFOSS, AND TOUR ANDERSON.
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 CALIBRATED AND MAINTAINED 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. TAPPING SLEEVES, ISOLATION VALVES AND REDUCERS TO BE PROVIDED AND INSTALLED BY UNL AS PART OF CONNECTION FEE.
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.
12. CEMENT LINED, DUCTILE IRON PIPE WITH POLYETHYLENE SLEEVE. ANSI/AWWA C150/A21.5 CLASS 250.

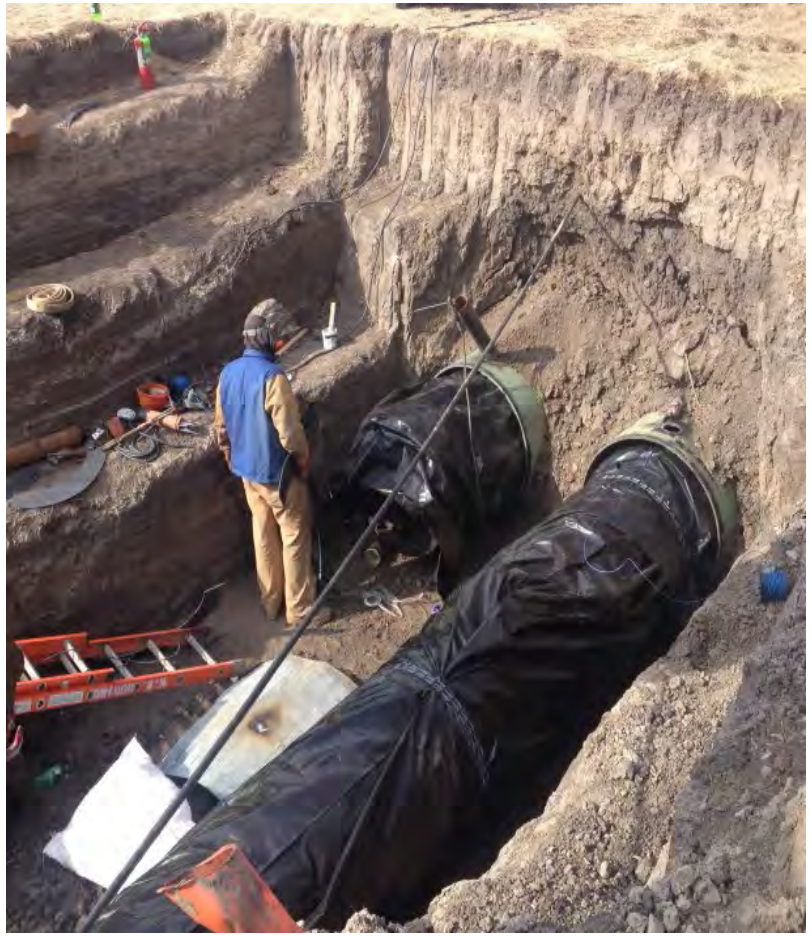
University of Nebraska Lincoln

Facilities Planning & Construction Standard Detail

Detail No.: 03
Scale: N.T.S.
Date: NOVEMBER 2013

Detail Title: CRES BUILDING SERVICE ENTRANCE PIPING SCHEMATIC

Construction – WWTP Lift Station and Piping



Construction – WWTP Lift Station and Piping

Construction – WWTP Lift Station and Piping

Construction – Heat Exchanger and Pump Facility

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Construction – Heat Exchanger and Pump Facility

Construction – Heat Exchanger and Pump Facility

Construction – Distribution

Operations

Current Buildings and Actual Cooling Peak Loads

	Building Area [GSF]	Peak Cooling Load [Tons](1)	Cooling Density [GSF/Ton]
Commons Area (includes old 4H building)	151,990	385	395
RISE Building	75,000	250	300
Food Innovation Center (FIC)	161,900	680	238
Greenhouse Innovation Center (ICG)	45,950	630	73
Totals	**434,840**	**1945**	

Notes

(1) Actual peak from summer 2019

Operations

Operations

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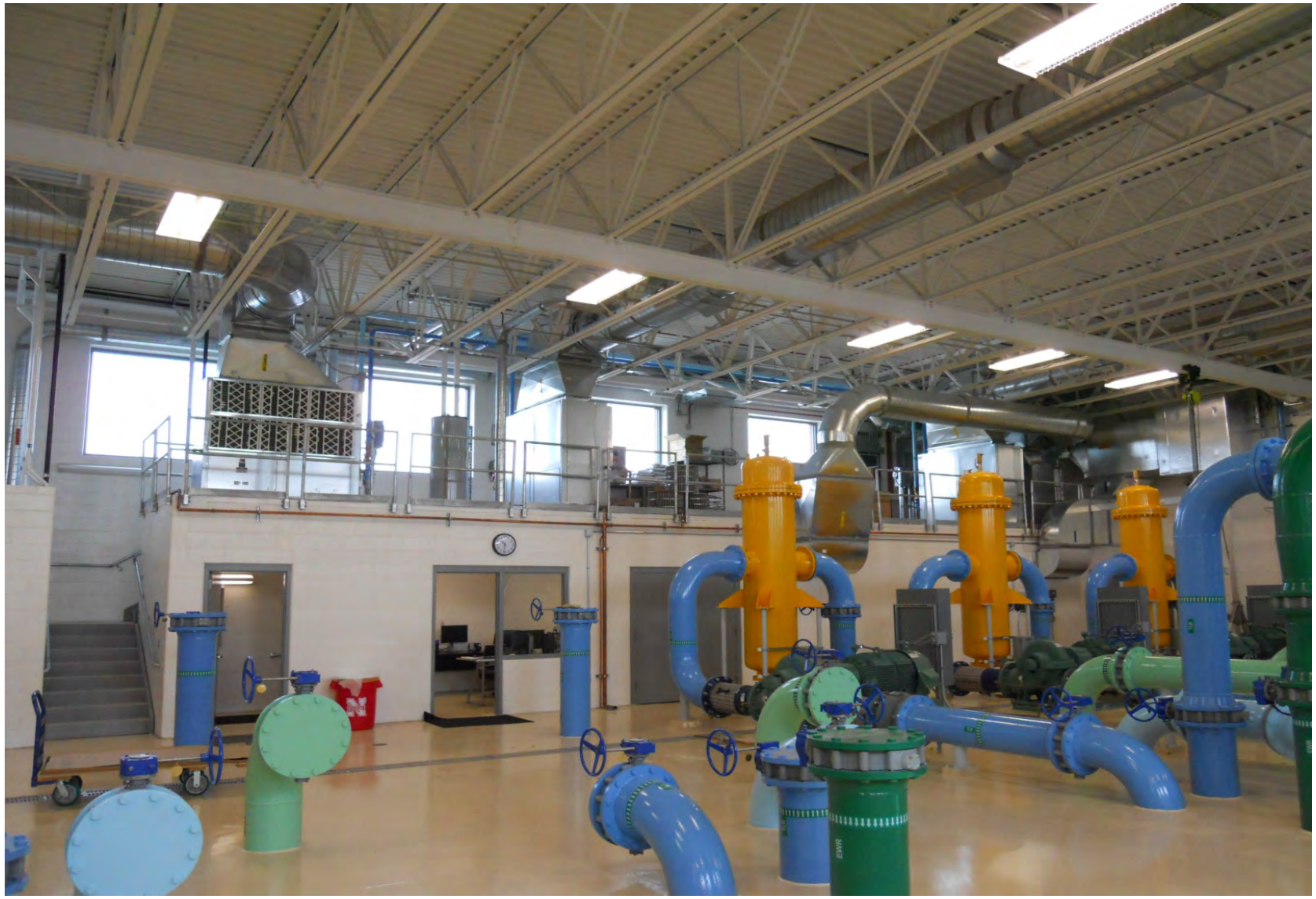
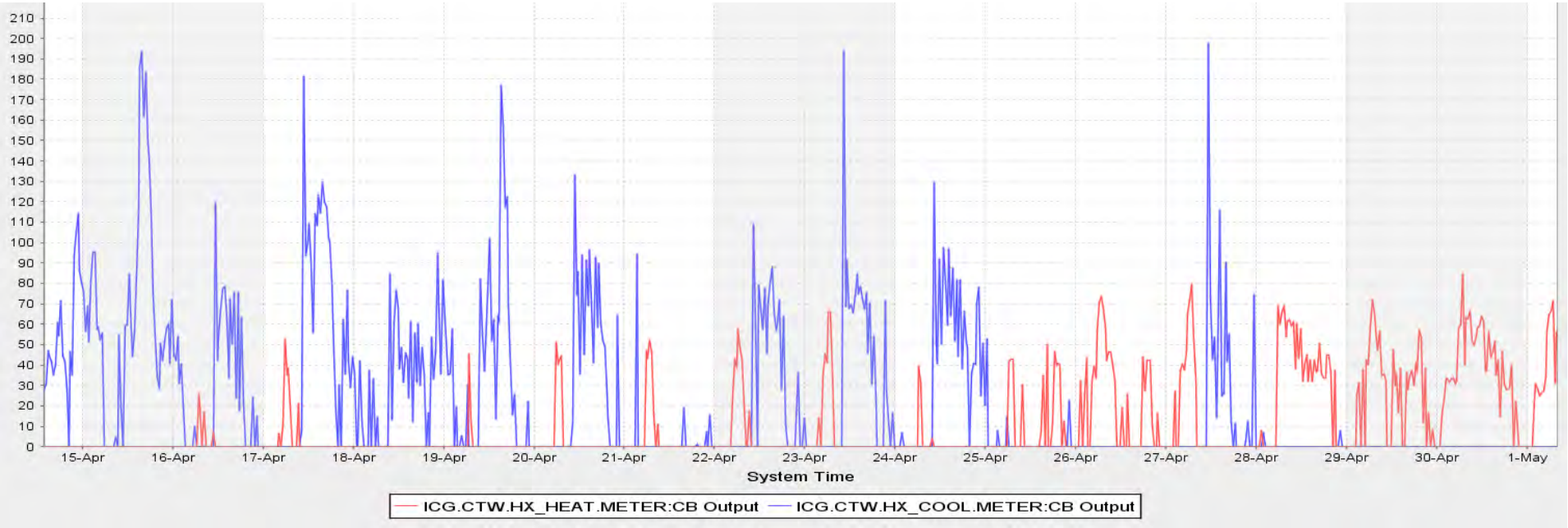


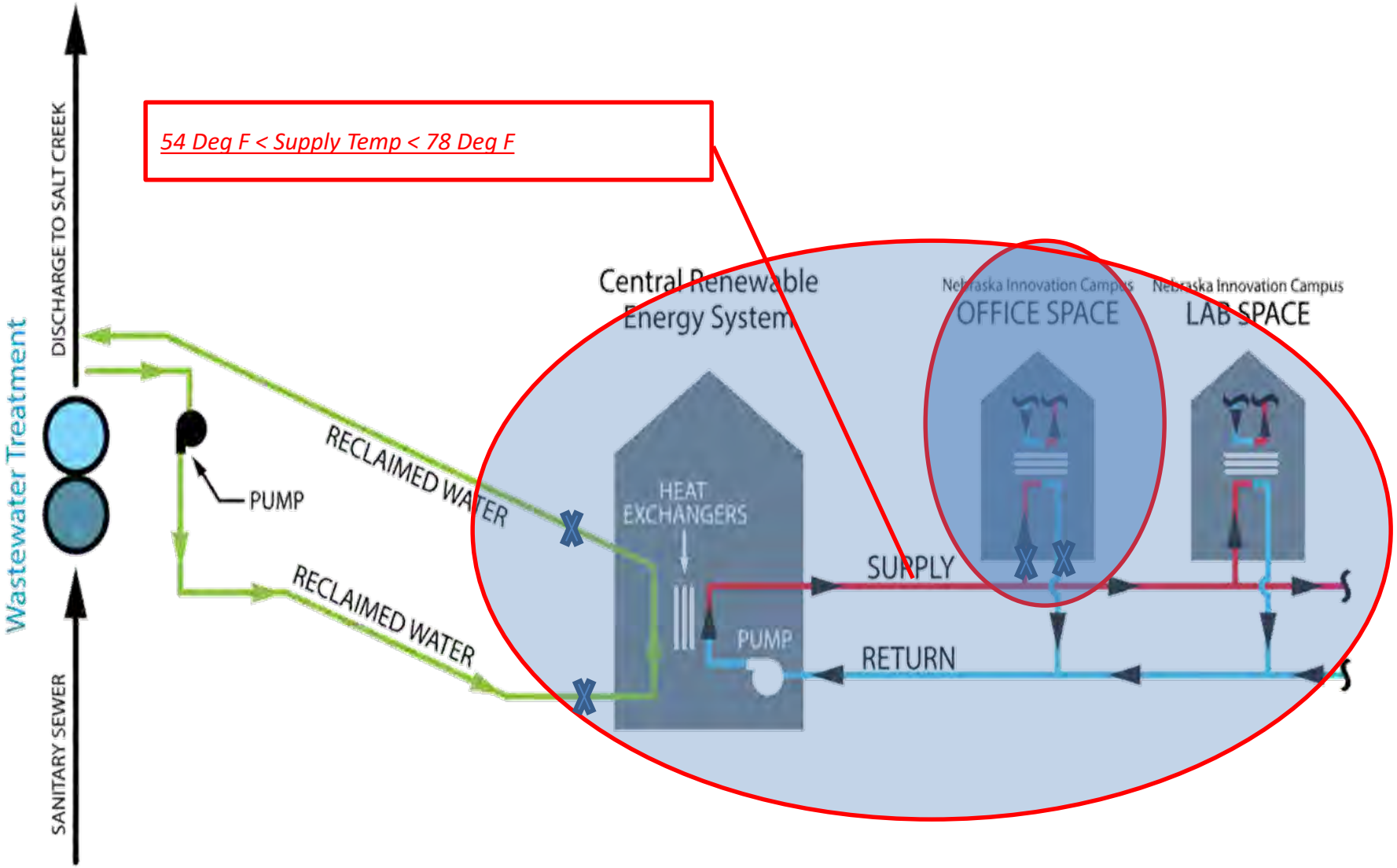
Operations

Operations

Building Heat Absorption / Rejection



Operations – Heat Balance



Maintenance

Maintenance

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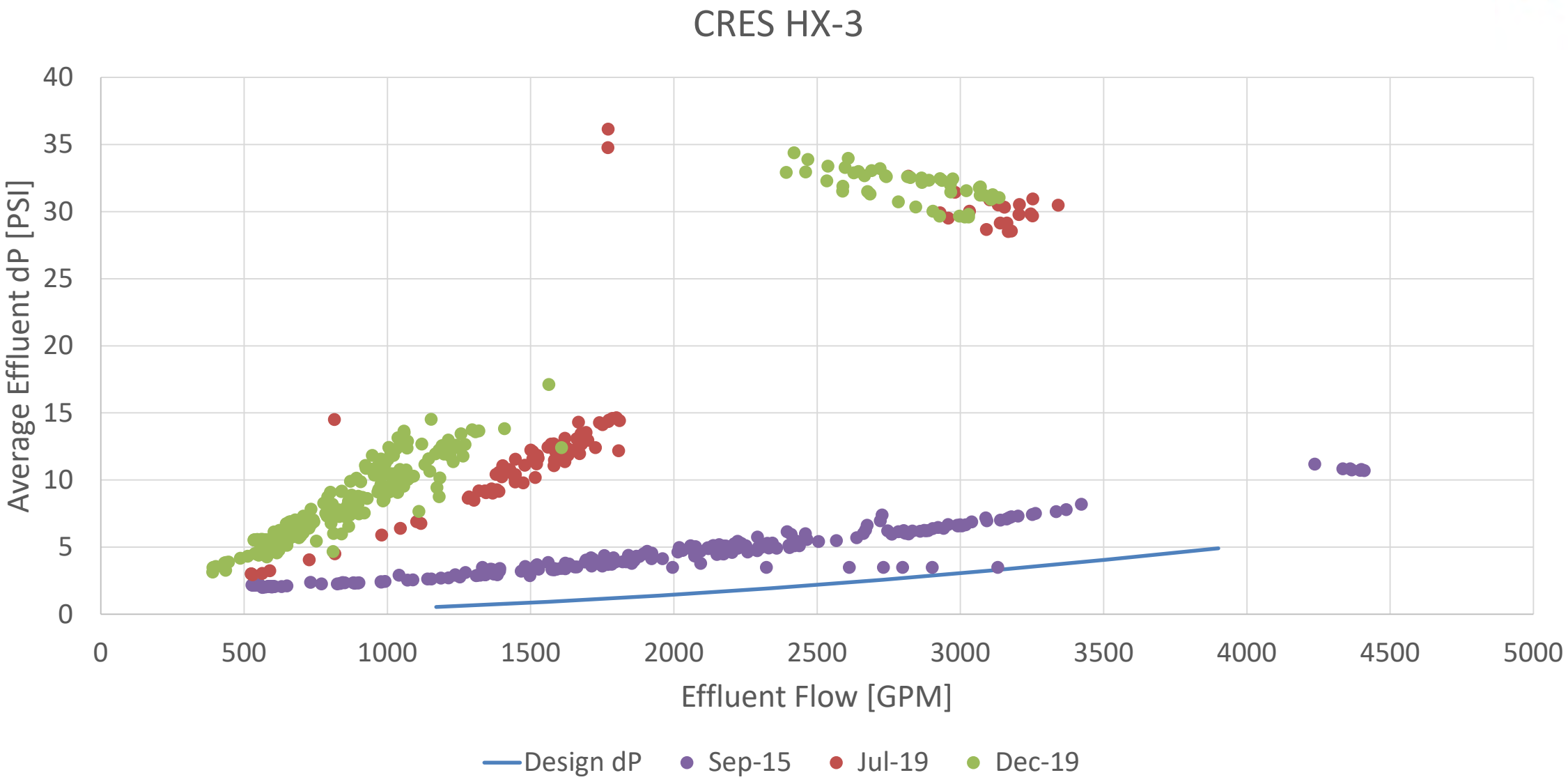

Maintenance

Thank You!

Questions?

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More Questions?

See the following slides for supplemental design and operational data

System Concepts

System Capacity Constraints

- Waste water treatment plant outfall rates average 24 Million Gallons per Day (MGD)
- 24MGD * 1 / 24Hr *Day * 1 / 60 Min/Hr = 19,000 Gallons Per Minute (GPM)
- 19,000 GPM is equivalent to 7,900 Tons of cooling at a 10 degree “delta T”
- This system will have the capacity to heat and cool roughly 1,875,000 SF of lab/office space (250 Sq Ft / Ton)
- There is a time-of-day fluctuation but it happens to align with the load profile of a building.
- Water leaving CRES back to Salt Creek MUST stay below 90 Deg F

Design – TSWWTP Pump Station

Non Clog Submersible Pumps

110 Hp, 5,000 GPM @ 62.4 Ft Head

Variable Speed Drives to Control Flow Rate

Initial Buildout: Three Pumps Total
(2 Pumps with 1 Spare) – 10,000 GPM

Final Buildout: Six Pumps Total
(5 Pumps with 1 Spare) – 25,000 GPM

Design – Heat Exchanger Pump Facility

Pumps:
Horiz. Split Case
3900 GPM, 140 Ft Head, 200 HP Motor

Heat Exchangers:
Plate and Frame
3900 GPM, 10 Deg F DeltaT, 1630 Tons

Initial Buildout: Three Equipment "Trains" (2 with 1 Spare) – 3260 Tons

Final Build out: Six Equipment "Trains" (5 with 1 Spare) – 8150 Tons

Distribution System

30-inch Diameter Ductile Iron Pipe

Twin Piping (Supply and Return)

Total of 6,100 LF Ductile Iron

Customer Installation Operational Guidelines:

https://facilities.unl.edu/DesignNarratives/Utilities/UNL%20Innovation%20Campus%20CRES%20Customer%20Installation%20and%20Operational%20Guidelines.pdf

Operations

- The CRES plant is funded and operated the same as any other University of Nebraska – Lincoln Utility plant
- The City of Lincoln bills the University for lift station pump energy and maintenance.
- Nebraska Innovation Campus (NIC) buildings are individually metered and billed for the amount of heat extracted or rejected.
  - Heat extraction rates (winter) are tied to market price of natural gas.
  - Heat rejection rates (summer) are tied to market price of electricity.
  - Rates do include a low “delta-T” penalty and incentive