



# Chilled Water Distribution Upgrade at Oklahoma State University

*Lessons Learned – The Good, The Bad,  
and The Ugly*



**CampusEnergy2020**

THE POWER TO CHANGE

FEBRUARY 10-14 • SHERATON DENVER DOWNTOWN • DENVER, CO

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# Introductions



- **James Rosner, PE, CEM**
  - Associate Vice Chancellor – University of Denver
- **Phil Curley**
  - Utilities Distribution Engineer – Oklahoma State University
- **Justin Grissom , PE, CEM**
  - Project Manager – Burns & McDonnell



# Overview

- Master Planning
- Distribution Design Constraints
- From paper to reality
- Construction Challenges
  - 4 Speed Bumps
- Lessons Learned

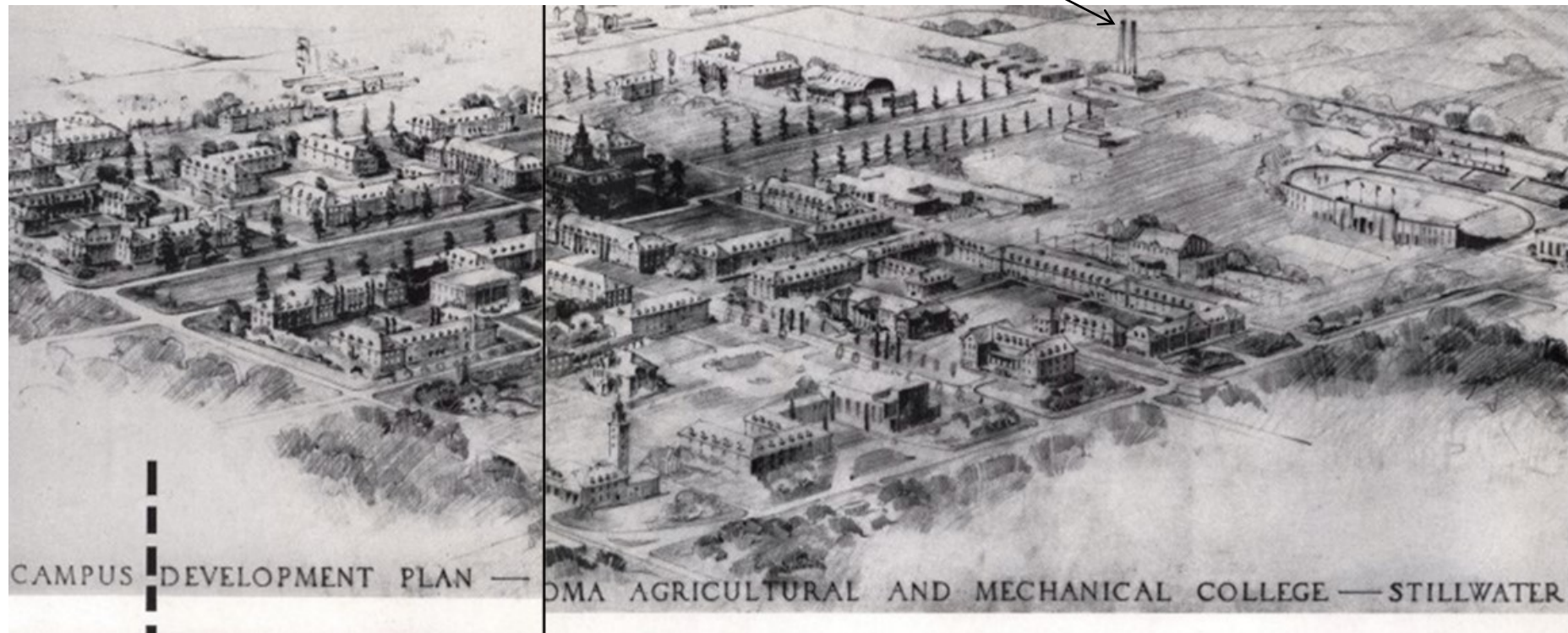




# Basis of Existing Utilities



Existing Power Plant



Oklahoma Agricultural and Mechanical College Campus Development Plan From 1945 Redskin Yearbook



# Program Summary

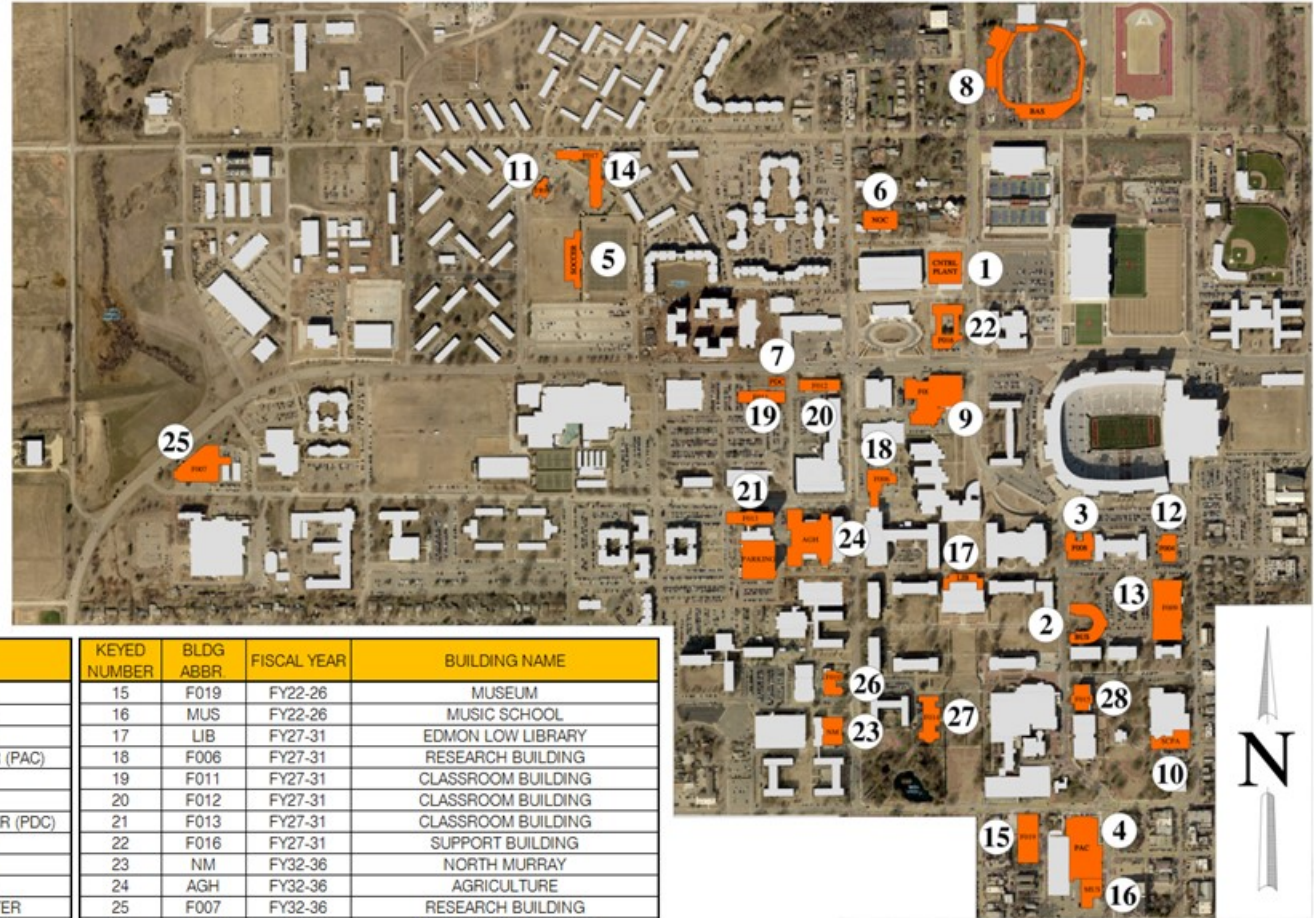
## ■ Utility Master Plan

- Plan for correcting existing deficiencies
- 5-year plans for steam, chilled water, and electrical
- 20-year plans for steam, chilled water, and electrical

## ■ Campus Planning Tools

- KY Pipe steam and chilled water models
- SKM Power Tools electrical model
- Utility Geographic Information System (GIS)

## ■ New Central Plant



KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME	KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME
1	CP	FY16	CENTRAL PLANT	15	F019	FY22-26	MUSEUM
2	BUS	FY17	BUSINESS BUILDING	16	MUS	FY22-26	MUSIC SCHOOL
3	F008	FY17	CEAT LAB BUILDING	17	LIB	FY27-31	EDMON LOW LIBRARY
4	PAC	FY18	PERFORMING ARTS CENTER (PAC)	18	F006	FY27-31	RESEARCH BUILDING
5	SOC	FY18	SOCCER STADIUM	19	F011	FY27-31	CLASSROOM BUILDING
6	NOC	FY18	NOC BUILDING	20	F012	FY27-31	CLASSROOM BUILDING
7	PDC	FY18	POWER DISTRIBUTION CENTER (PDC)	21	F013	FY27-31	CLASSROOM BUILDING
8	BAS	FY19	BASEBALL STADIUM	22	F016	FY27-31	SUPPORT BUILDING
9	F005	FY21	FUTURE BUILDING	23	NM	FY32-36	NORTH MURRAY
10	SCPA	FY22-26	SERETEAN CENTER	24	AGH	FY32-36	AGRICULTURE
11	FRC	FY22-26	FAMILY RESOURCE CENTER	25	F007	FY32-36	RESEARCH BUILDING
12	F004	FY22-26	CLASSROOM BUILDING	26	F010	FY32-36	CLASSROOM BUILDING
13	F009	FY22-26	CLASSROOM BUILDING	27	F014	FY32-36	CLASSROOM BUILDING
14	F017	FY22-26	RESIDENCE HALL	28	F015	FY32-36	CLASSROOM BUILDING



## Chilled Water

- |  |             |
|--|-------------|
| ■ Current campus peak demand as of 2016: | 15,300 tons |
| ■ Estimated 5-year campus peak demand:   | 15,469 tons |
| ■ Estimated 20-year campus peak demand:  | 18,992 tons |

## Heating

- |  |               |
|--|---------------|
| ■ Current campus peak demand as of 2016: | 136,000 LB/HR |
| ■ Estimated 5-year campus peak demand:   | 150,000 LB/HR |
| ■ Estimated 20-year campus peak demand:  | 190,000 LB/HR |

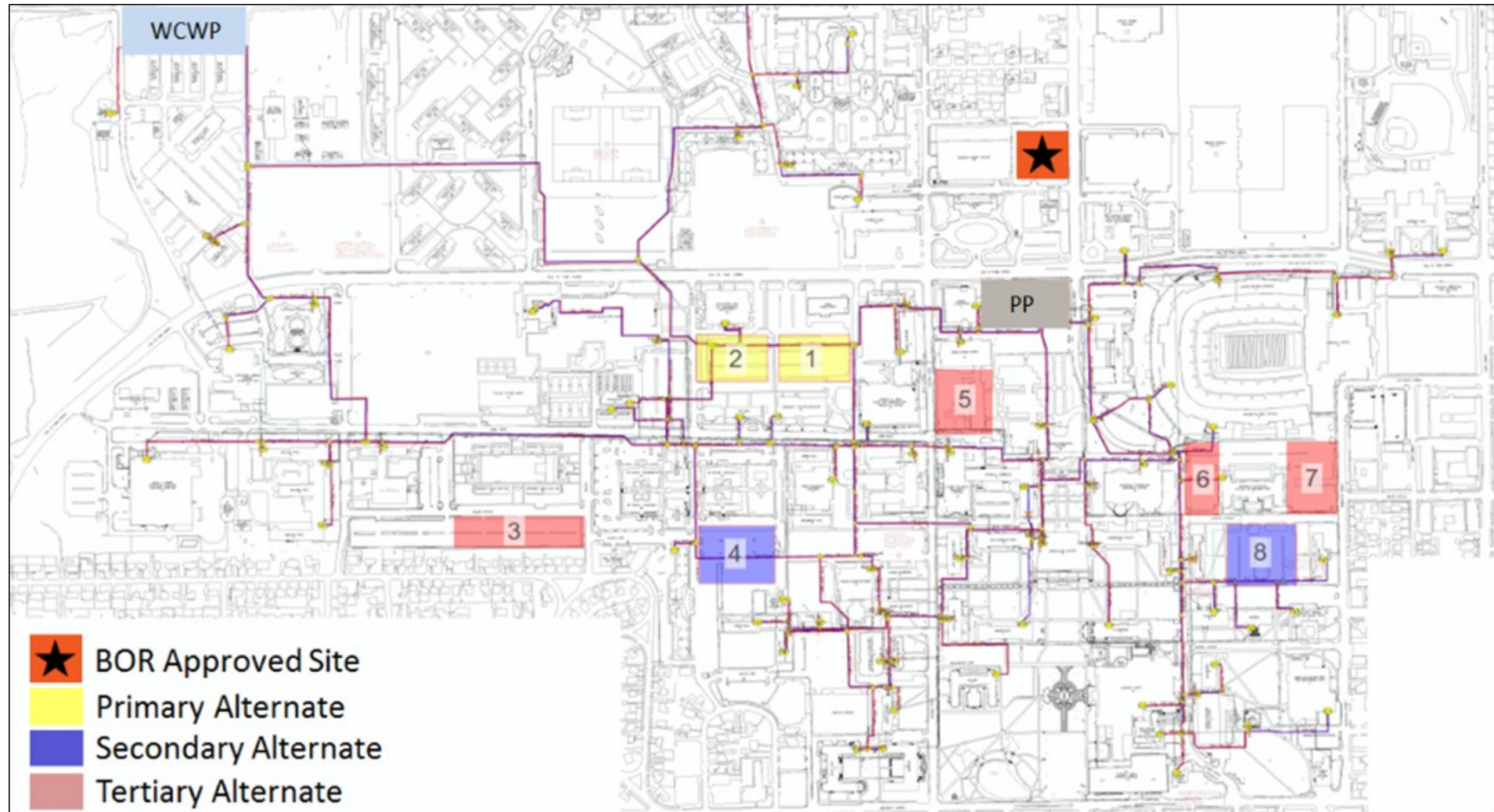
## Electrical

- |  |           |
|--|-----------|
| ■ Current campus peak demand as of 2016: | 31,995 kW |
| ■ Estimated 5-year campus peak demand:   | 32,647 kW |
| ■ Estimated 20-year campus peak demand:  | 38,291 kW |



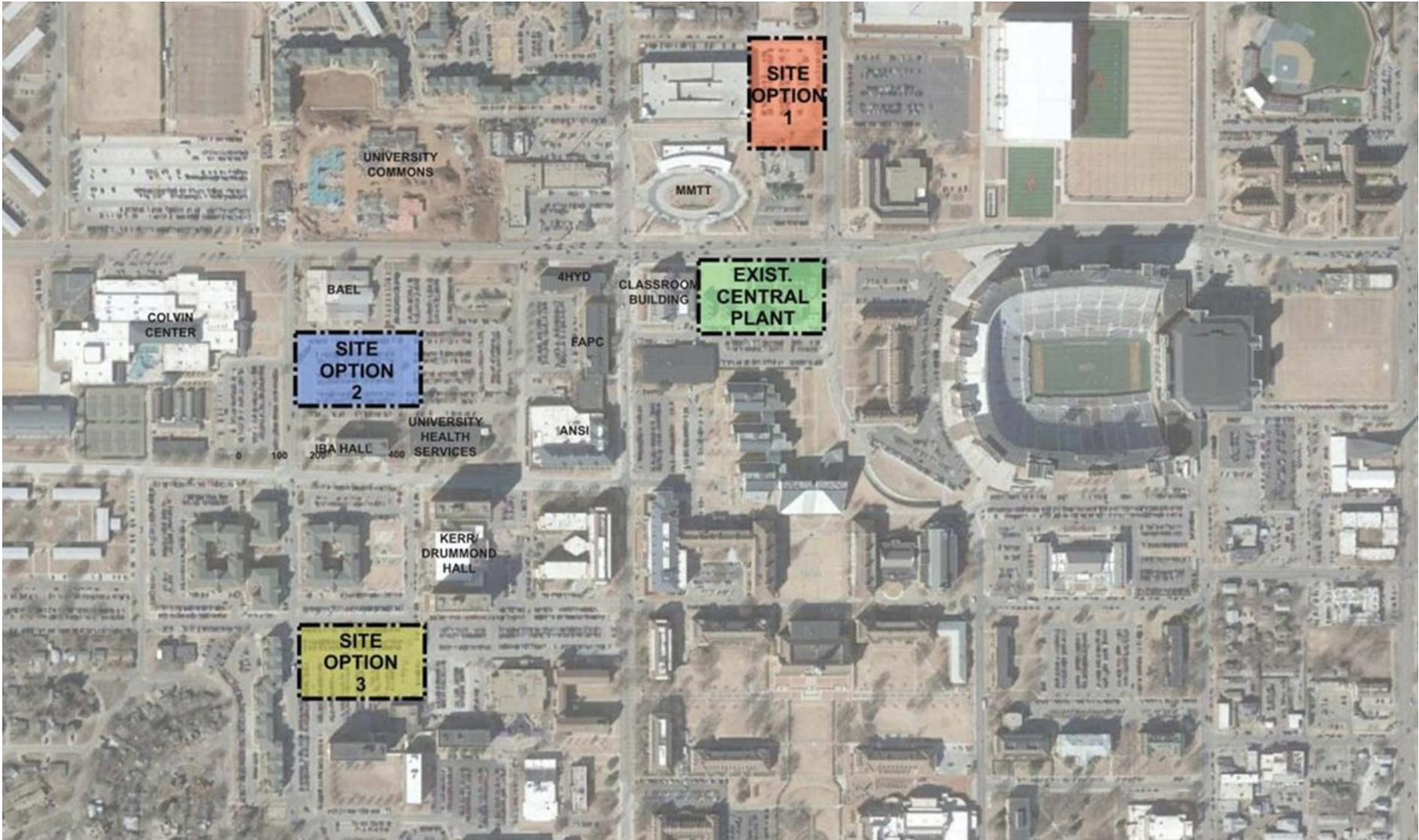
# New Central Plant Locations

- Nine sites analyzed resulting in Washington & Scott location





# Central Plant Site Options







- Steam, chilled water, electrical models revealed impacts of Central Plant location when compared to Campus Master Plan growth
- Determines amount of campus disruption for distribution connection


**Distribution Costs for New Central Plant**

	<u>Today</u>	<u>Future</u>	
■ Option 1:	\$14.5M	\$0	Future upgrades needed to main lines based on plant location for campus growth
■ Option 2:	\$19.1M	\$800K	
■ Option 3:	\$26.1M	\$3.6M	Extension of lines will still be required to support specific projects



# Master Planning Into Design: Constraints



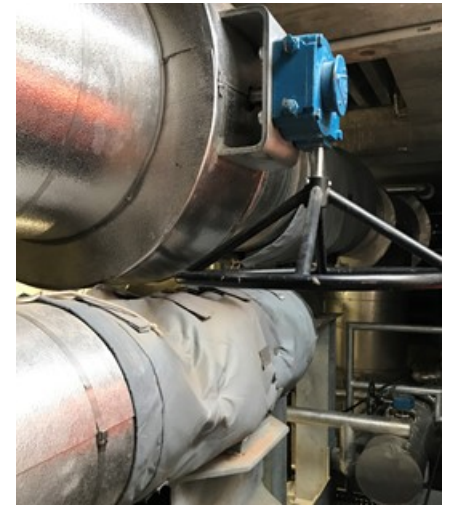
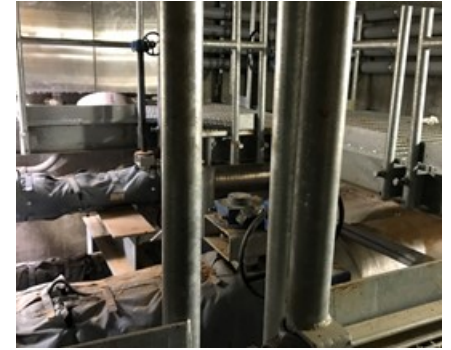
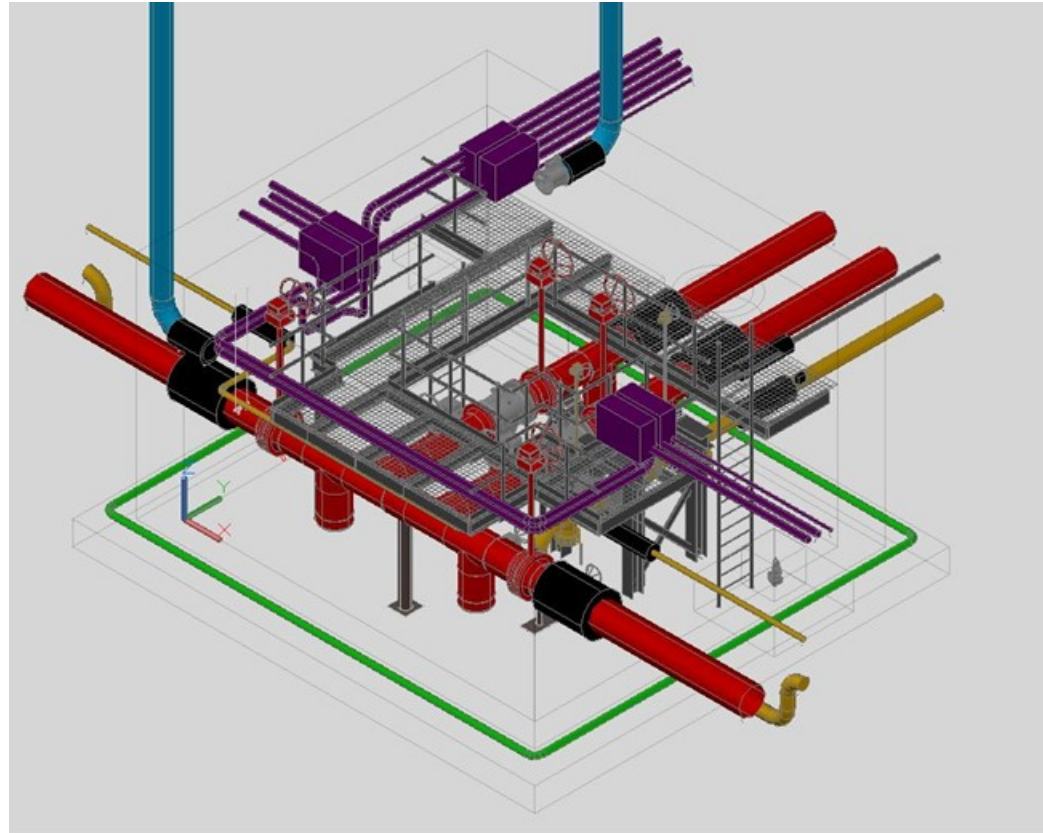
- Route 12,000+ total LF of:
    - 36" chilled water supply and return
    - 2x20" steam supply
    - 8" pumped condensate return
    - 3" flash steam
    - Two (2) 8" domestic water feeds
    - 3x3 6" electrical ductbank
    - 10" natural gas (from the north)
- 
- From New Plant to "Hub" at Power Plant
  - Campus Schedule Critical Completion Dates
  - Must be Open for 1<sup>st</sup> Home Football Game
    - Washington Street Stadium Access
  - Zero Outages to Campus
  - Oh, and for Hall of Fame Avenue....



Initial Direction to Design Team:



# Steam and Chilled Water Distribution Design

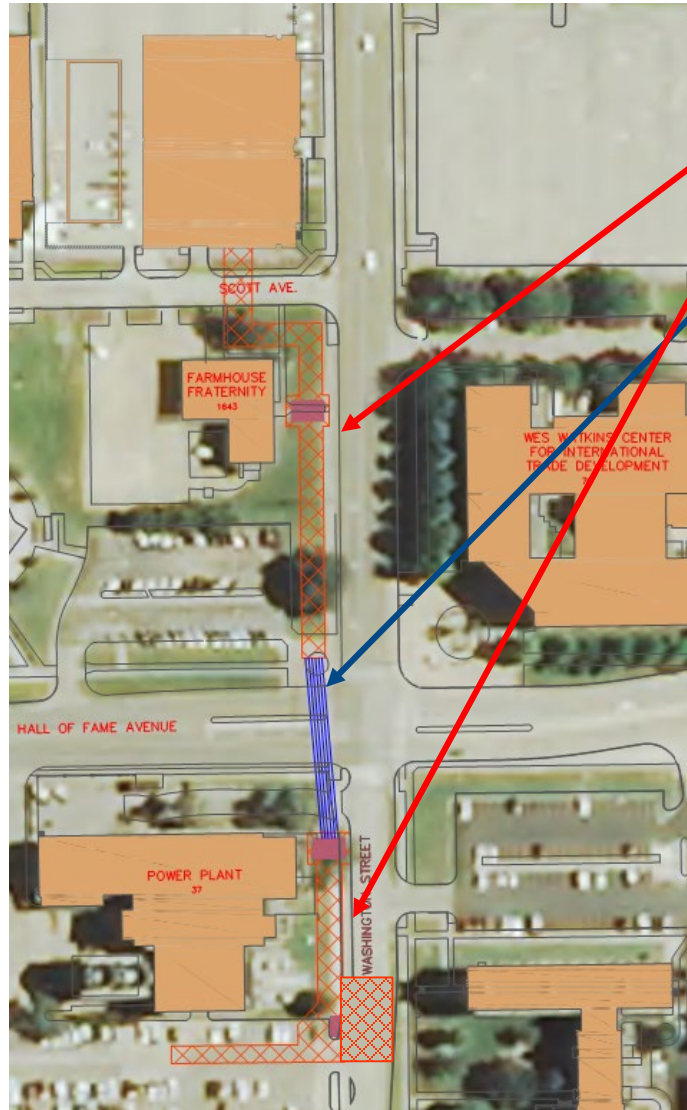


Five vaults for steam traps, valves, and expansion joints

- Replace/interface with existing tunnel
- Robust design
- Access, safety, and maintainability is critical



# Initial Distribution Design



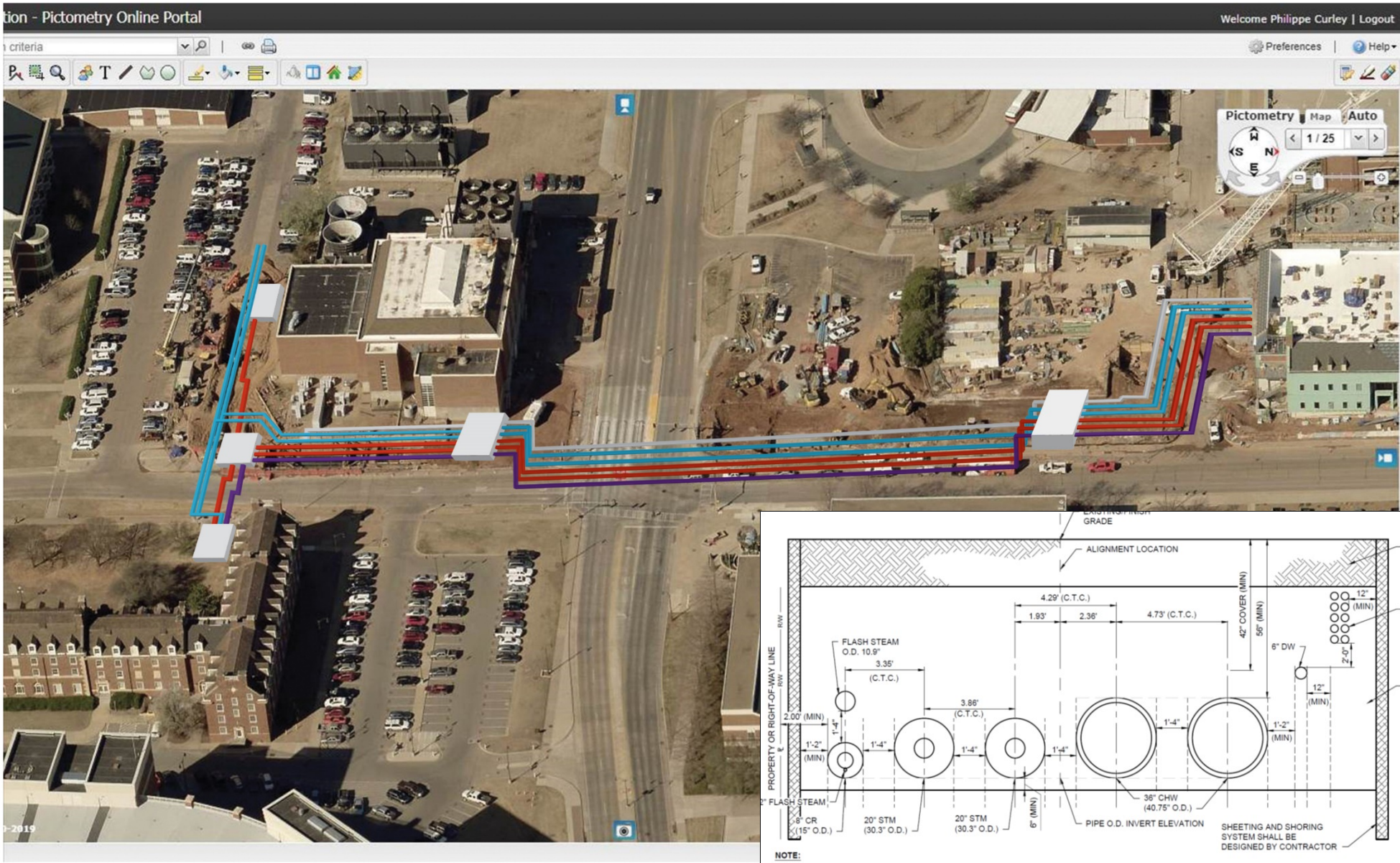
**UTILITY TRANSMISSION LINE TRENCHING**

**UTILITY TRANSMISSION LINE BORING BENEATH  
HALL OF FAME AVENUE**

- Design considerations
  - Direct buried vs. walkable tunnel
  - Open cut vs. trenchless installation
  - Pre-insulated Class A piping system
  - Separate steam mains leaving plant
  - Variety of complex construction methods required



# Initial Distribution Design



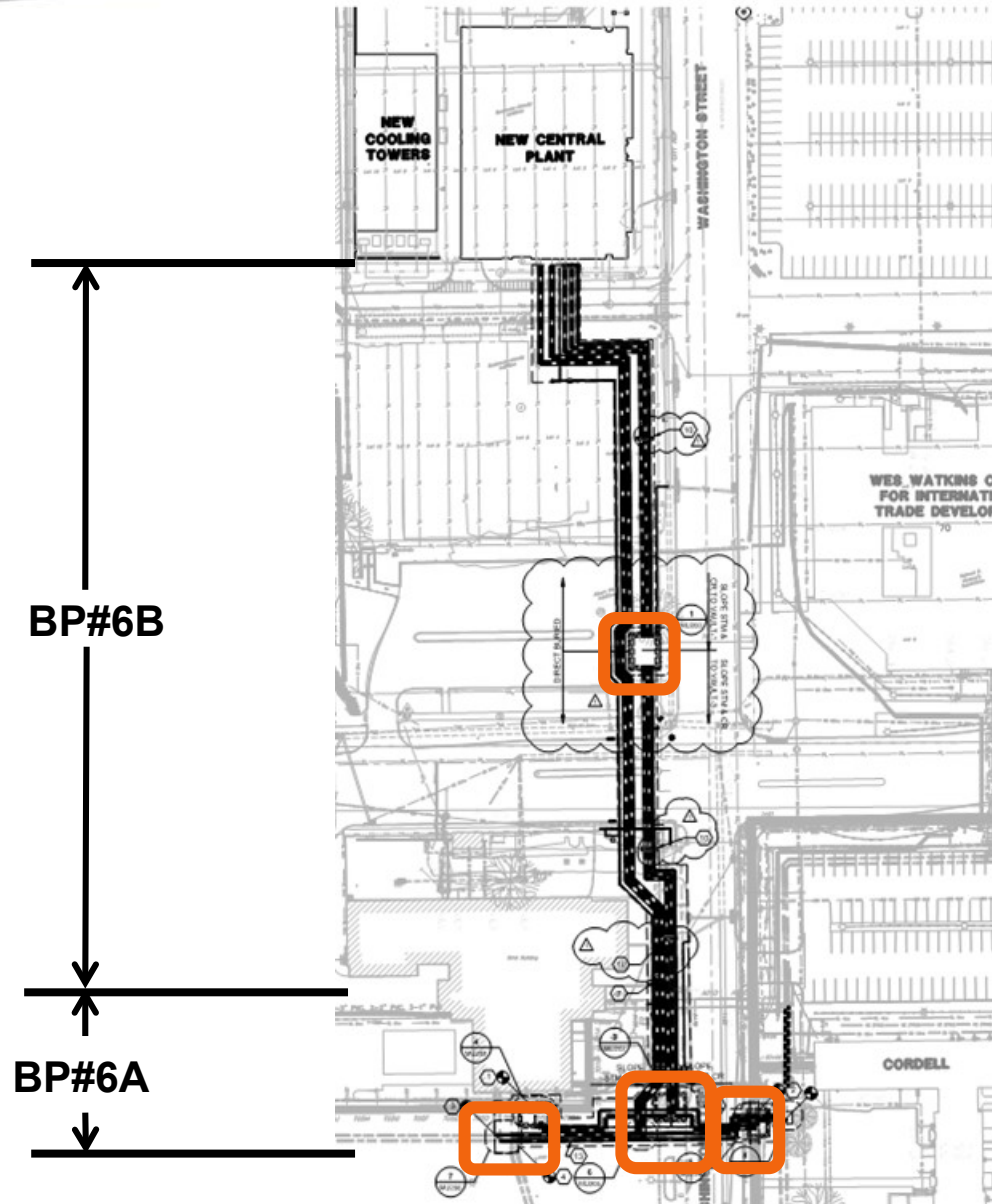


# Speed Bump #1: 9 million reasons



- Why get permission to close Hall of Fame?
  - \$9 million bust for Distribution Bid Package (#6)
- Keep Design south of Hall of Fame
  - Vaults 3, 4, and 5
- Redesign from Plant to Vault 3
- Request Permission and Plan for a Closure of Hall of Fame Avenue

# Updated Distribution Design



- Begin Construction on Bid Package #6A
- Re-design Bid Package #6B
- Drivers for Re-design
  - Reduced Costs (within budget)
  - Maintainability and Accessibility
  - Reduced Number of Vaults



# Utility Transmission

CONSTRUCTION SCHEDULE – JUNE 2016 to JUNE 2017



**1c. TUNNEL TO VAULT #3,  
& VAULT #3:**

**6-1-2016 to 9-1-2016**

**2a. VAULT #3 TO VAULT #4:**

**9-1-2016 to 11-21-2016**

**2b. VAULT #4:**

**9-1-2016 to 11-21-2016**

**3. FROM PLANT TO HoF:**

**1-15-2017 to 5-15-2017 (est)**

**4. OPEN TRENCH HoF & VAULT 2:**

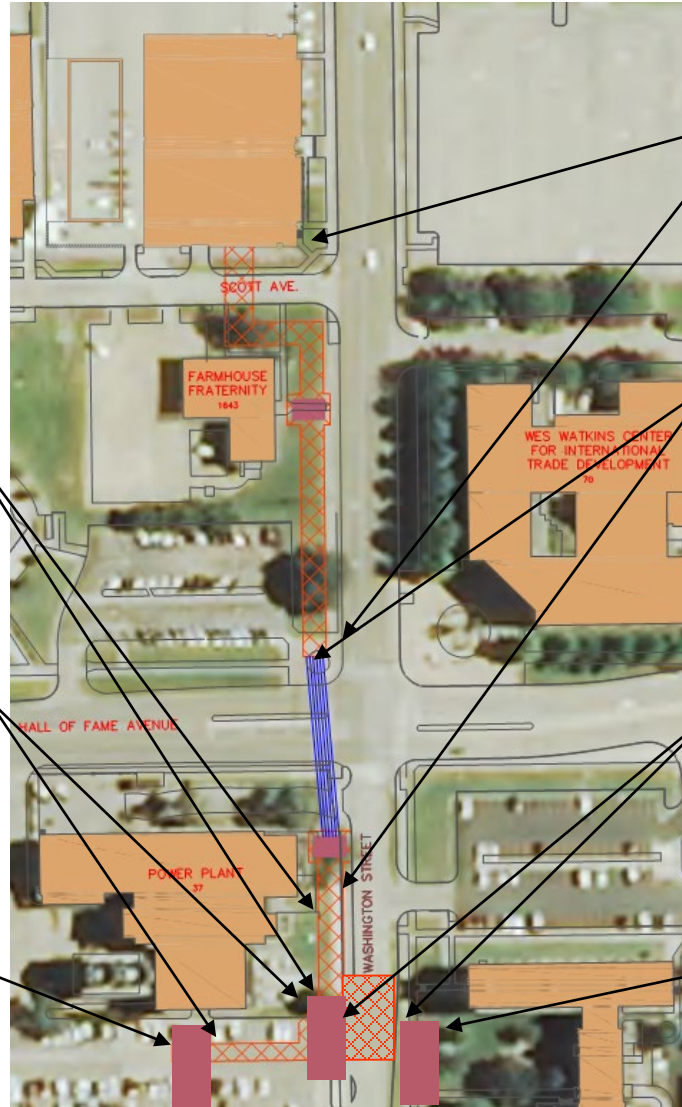
**5-15-2017 to 8-30-2017 (est)**

**1a. VAULT #3 TO VAULT #5:**

**6-1-2016 to 9-1-2016**

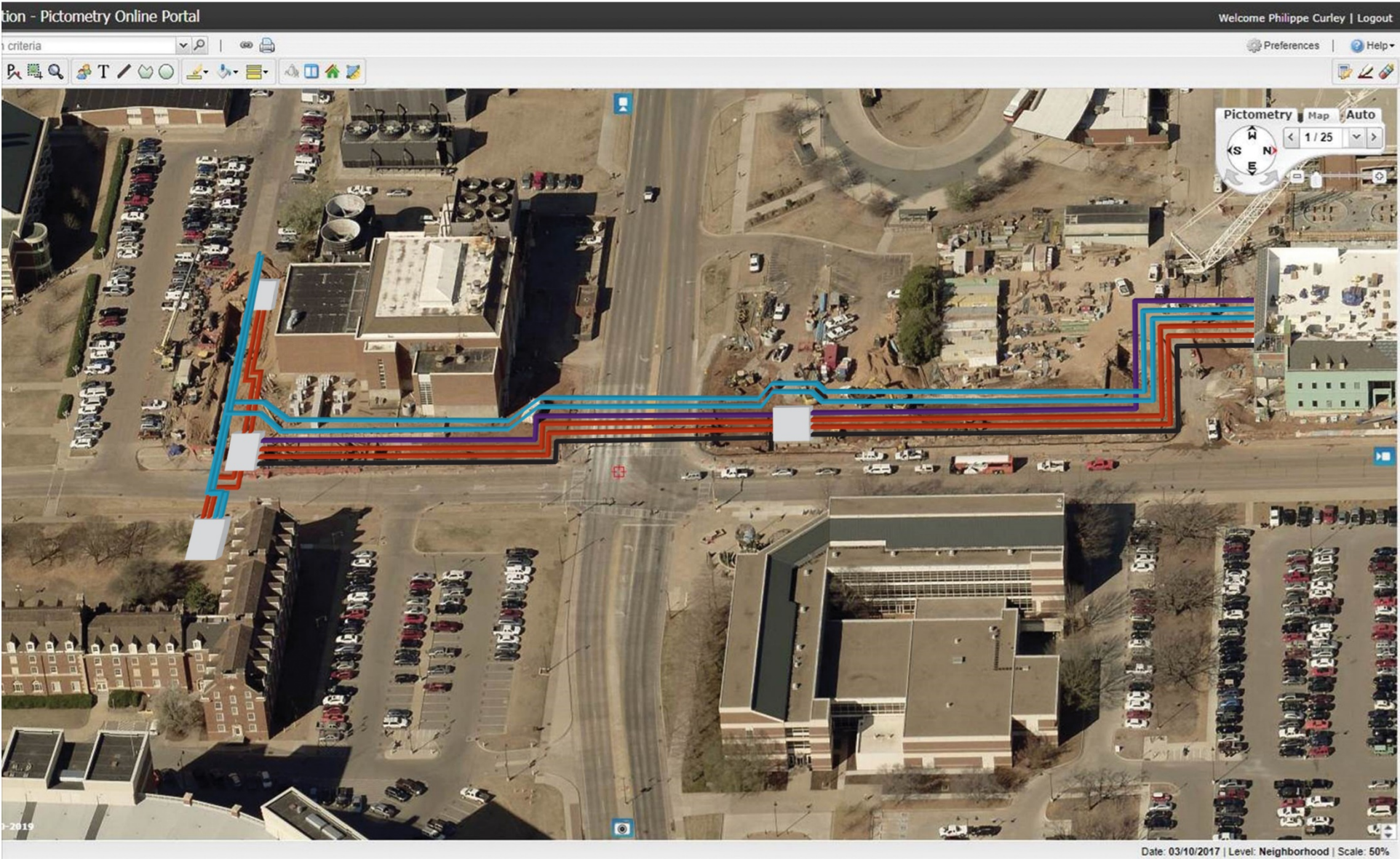
**1b. VAULT #5:**

**6-1-2016 to 8-30-2016**





# Updated Distribution Design





## Speed Bump #2: What AT&T Ductbank?



- AT&T Ductbank
- Never Located or marked after 811 calls
- Running parallel to existing steam tunnel
- Not discovered until excavation for installation of Vault #4
- Primary infrastructure serving North East Oklahoma!

## Speed Bump #2: What AT&T Ductbank?





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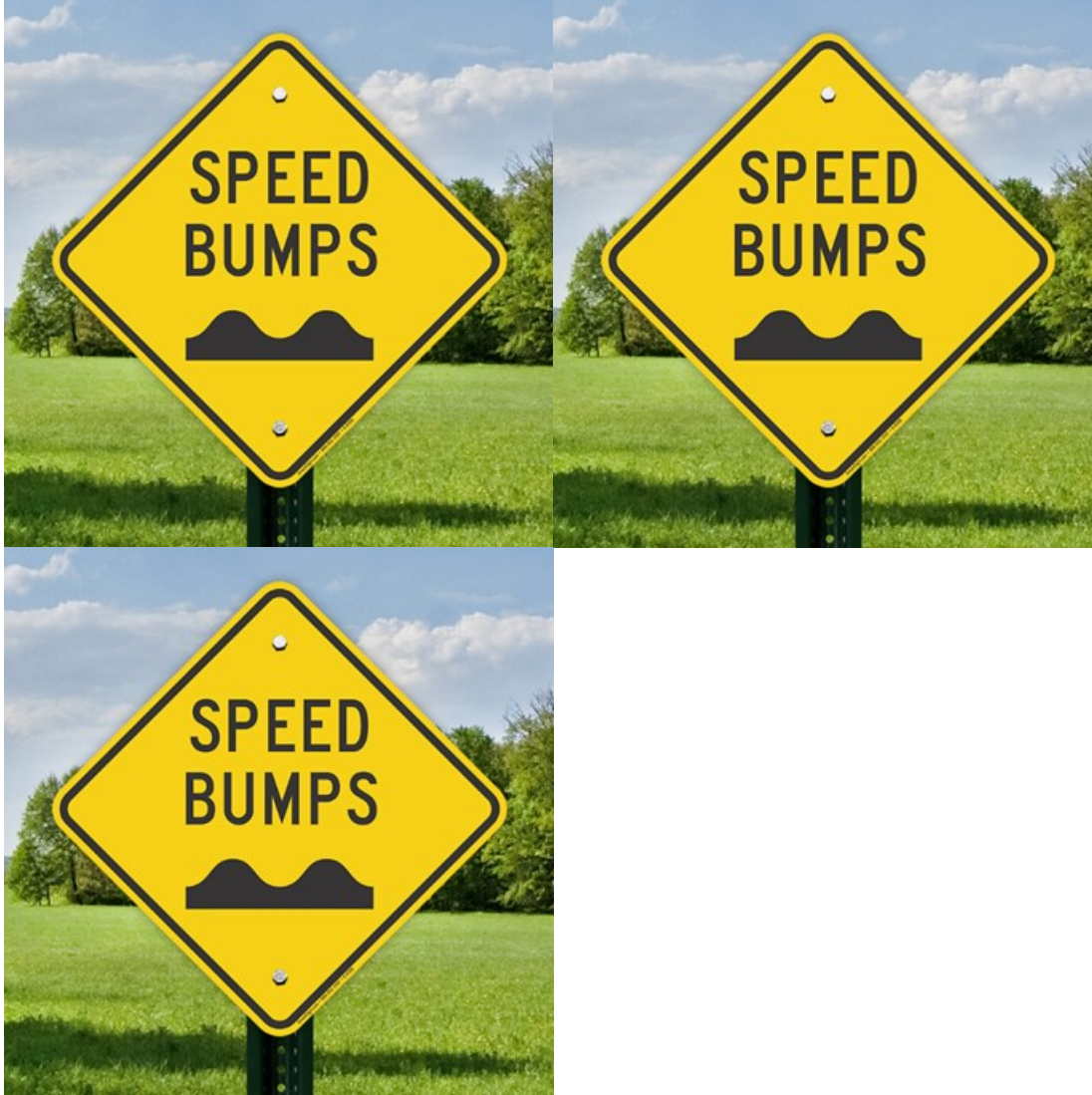


## Speed Bump #2: What AT&T Ductbank?



Is there anything that looks odd in this picture?

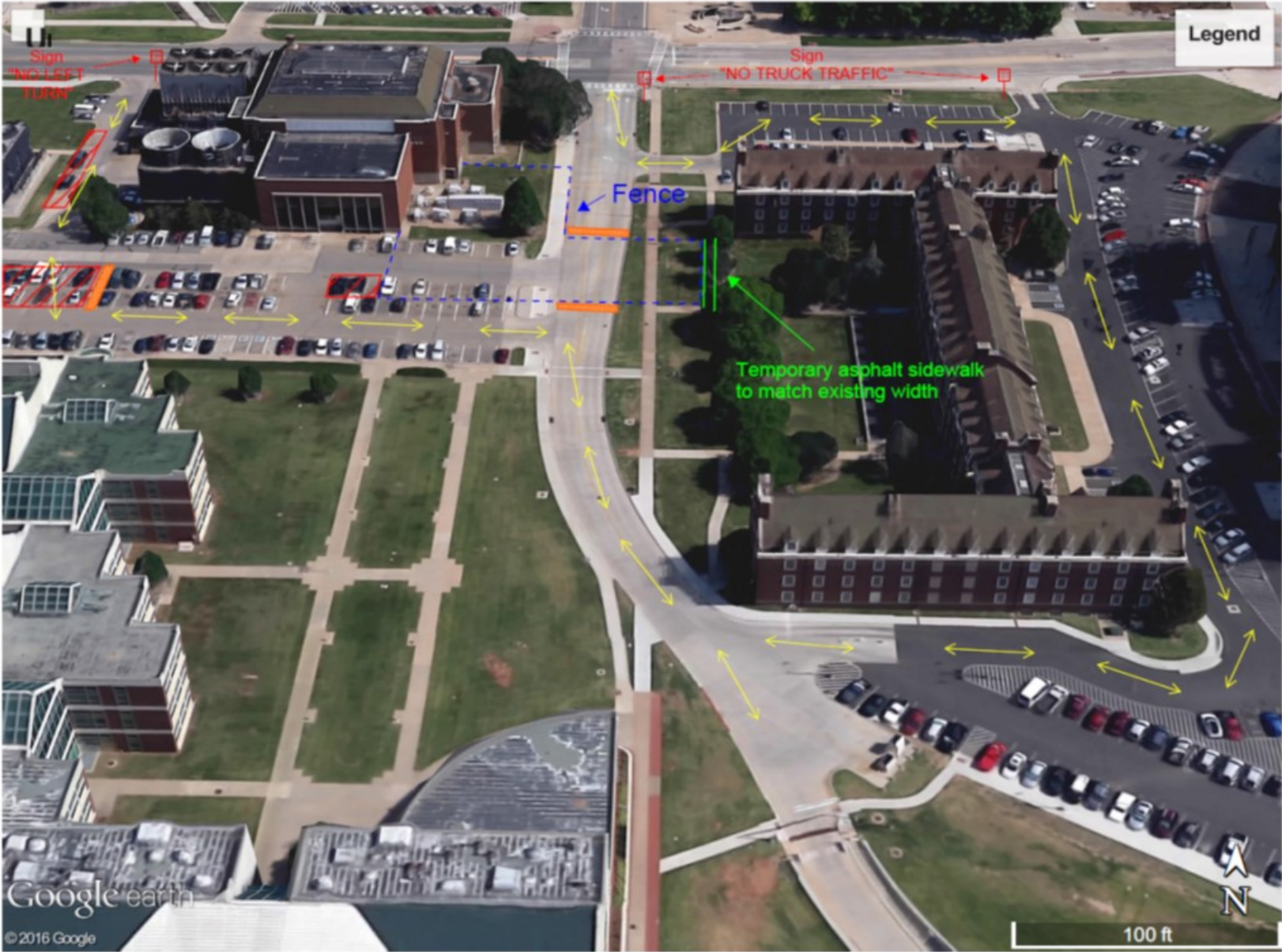
## Speed Bump #3: Vault 3 Swimming Pool



- Pulled Shoring
- 18" Transite Pipe
- Lost all chilled water to campus for multiple hours (over **95** buildings affected)
- 5 buildings had no chilled water for **three days**
- Over **131,000 Gallons** of chilled water were released into excavation area



# Speed Bump #3: Vault 3 Swimming Pool





# Washington St. Vault 3 and 5







Placeholder for video



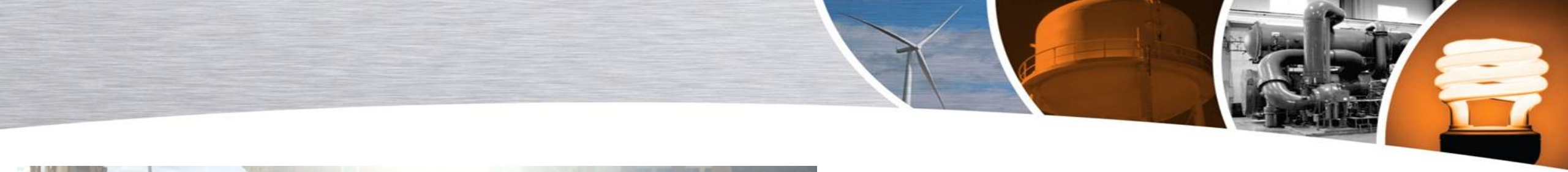






August 2, 2016 @ 9:09am.





CW line break gets a “thumbs down” from James









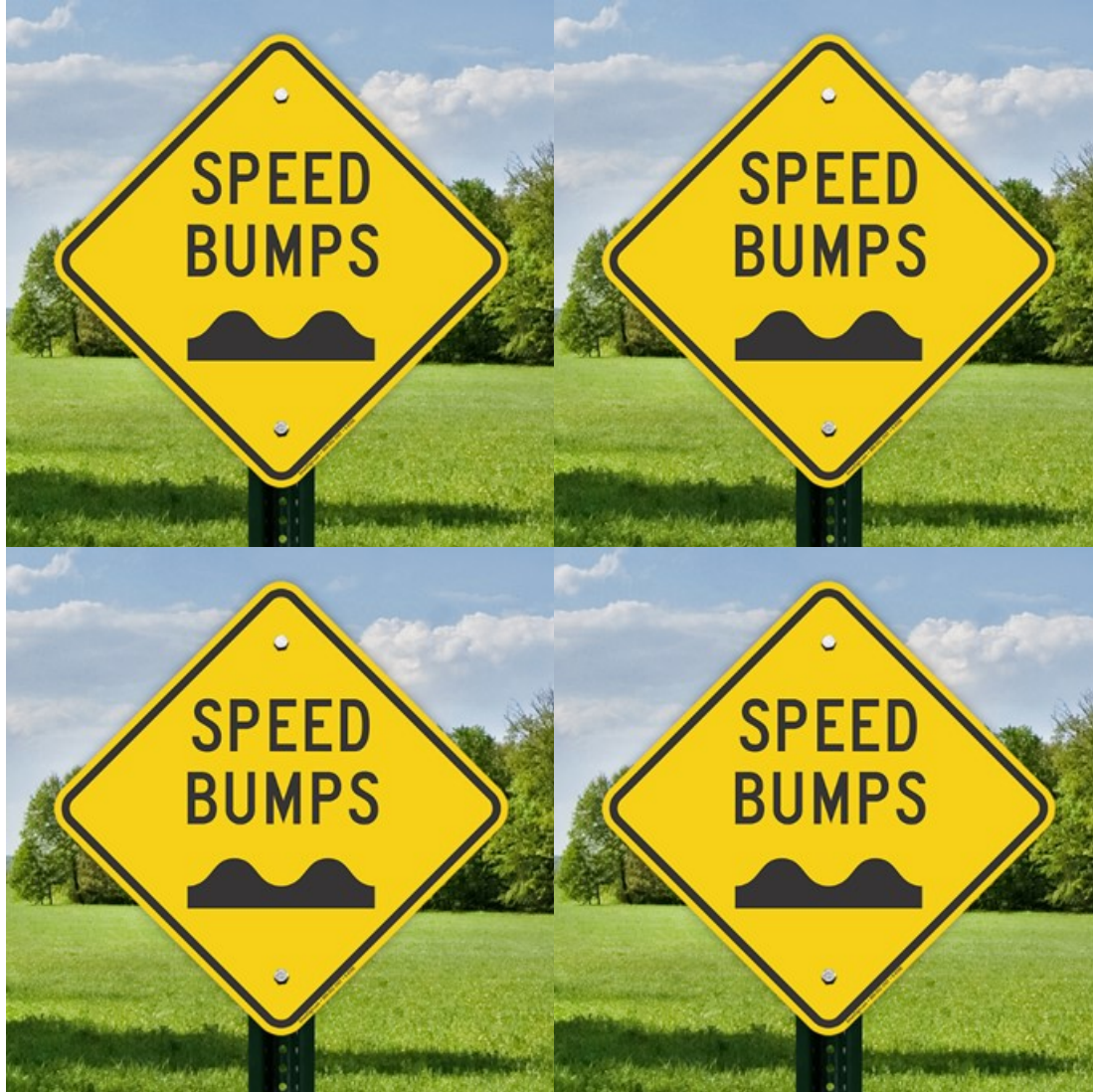




Pouring concrete on August 30, 2016, just 4 days before first home football game. Like it never happened...



## Speed Bump #4: Crossing over Christmas



- Request Permission and Plan for a Closure of Hall of Fame Avenue
- Granted for Start and Finish over OSU Winter Break
- HoF to be open on January 9, 2017 with start date of December 11, 2016
- Crossing over winter break had a roughly \$200k price adder, but reduced Hall of Fame construction crossing timeline from 3 months to 3 weeks.











# Utility Distribution BP#6b









# Utility Distribution BP#6a







### Distribution at Central Plant.





# Excavation south leaving New Plant







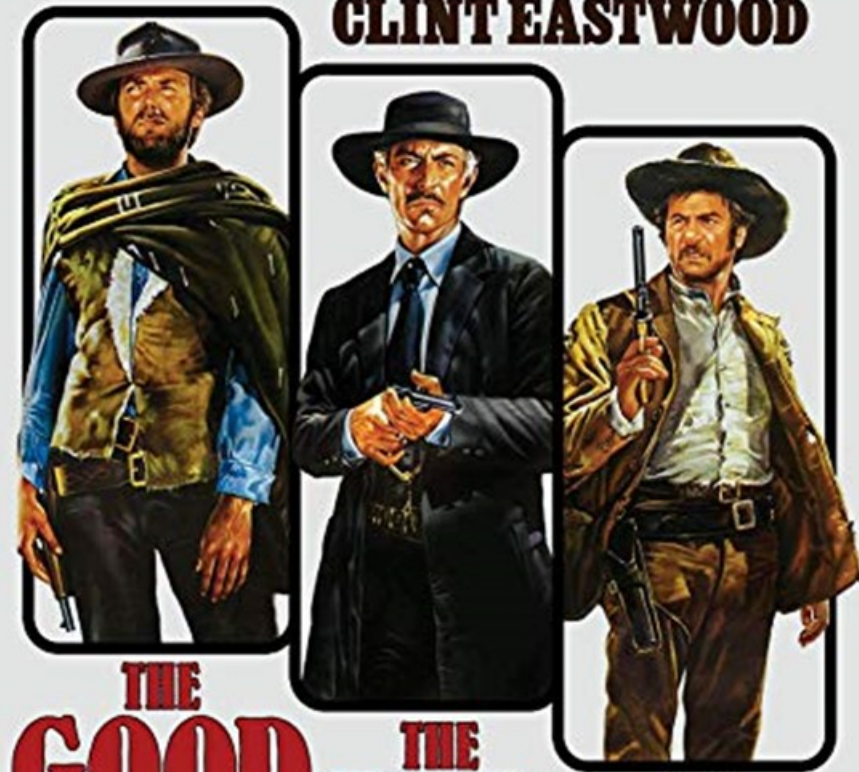






50<sup>th</sup> ANNIVERSARY EDITION

CLINT EASTWOOD



THE  
**GOOD**

THE  
**BAD**

and THE  
**UGLY**

JAMES ROSNER

PHIL CURLEY

JUSTIN GRISSOM

