

The Medical Office Building



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Mechanical Option
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The Medical Office Building

Overview

Overview

Existing Conditions

Ground Coupled Depth

System Design Options

Cost Analysis

Structural Breadth

Joist Redesign

Girder Redesign

Cost

Conclusion

- Located in North-East United State
- Exam, Physical Therapy, Radiology, Small Lab
- ~73,000 SF
- \$21.9 Million
- Currently Under Construction

Exam

Physical
Therapy

Radiology



The Medical Office Building

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- **Packaged Rooftop Units**

- 70 Ton

- VAV Reheat

- **Ductless Split System Units**

- **Propane and Electric**

	Summer Design Cooling (0.4%)	Winter Design Heating (99.6%)
Outdoor Air Dry Bulb (°F)	92.4	9.4
Outdoor Air Wet Bulb (°F)	74.1	-
Indoor Air Design Temp (°F)	75	72

The Medical Office Building

Trane Modeling

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- Trane TRACE 700
- Blocks Defined As:
 - Conference
 - Corridor
 - Lobby
 - Office
 - Physical Therapy
 - Procedure
 - Reception
 - Storage
- 115 Tons
- \$46,060 Yearly Utility

	Electric (kWh)	Gas (kBtu)	Total Building Energy (kBtu/yr)
Heating	-	709,240	709,240
Cooling	204,744	-	698,791
Lighting	529,746	-	1,808,024
Receptacles	115,781	-	395,161
			3,611,216

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Trane Modeling

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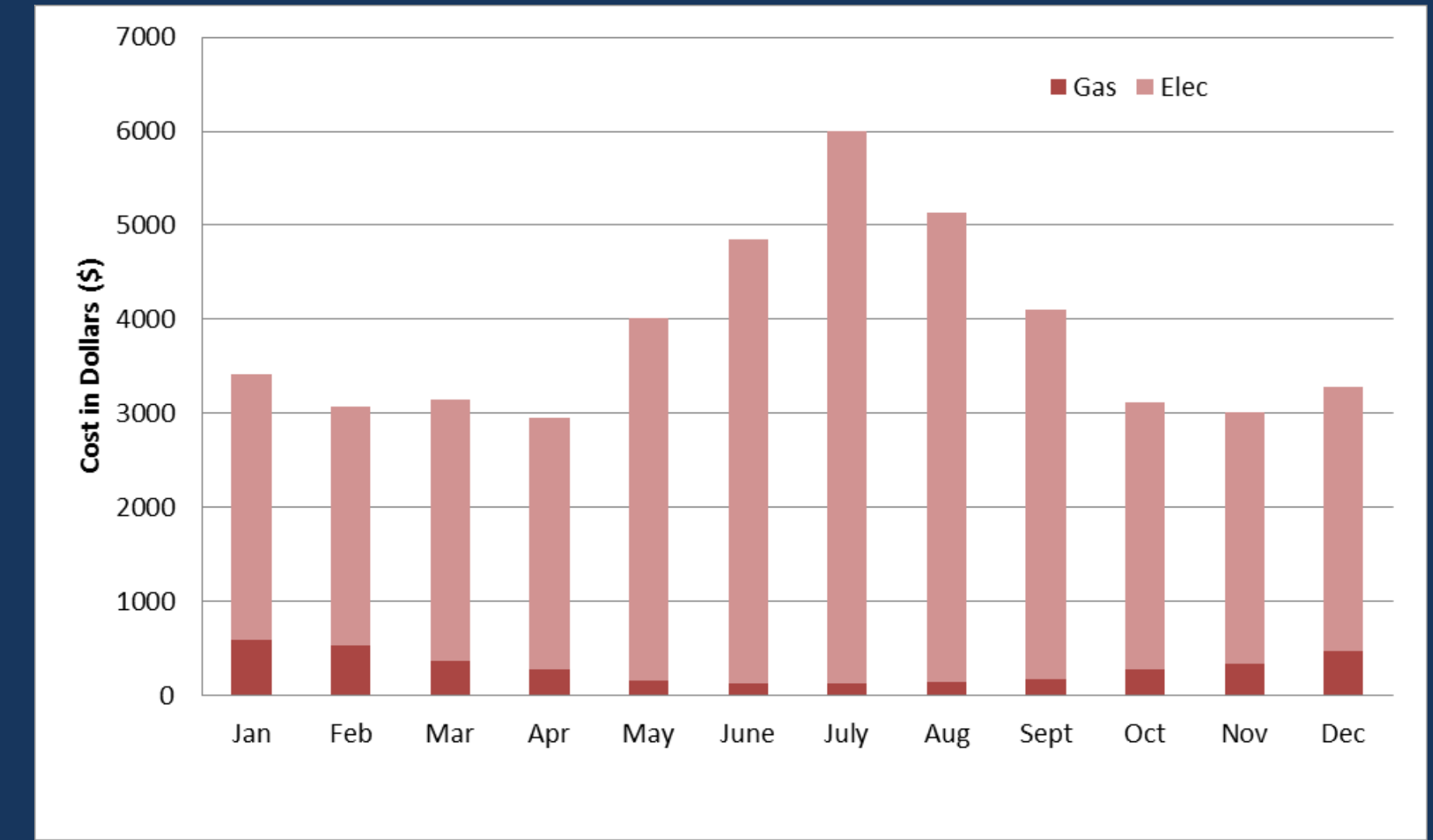
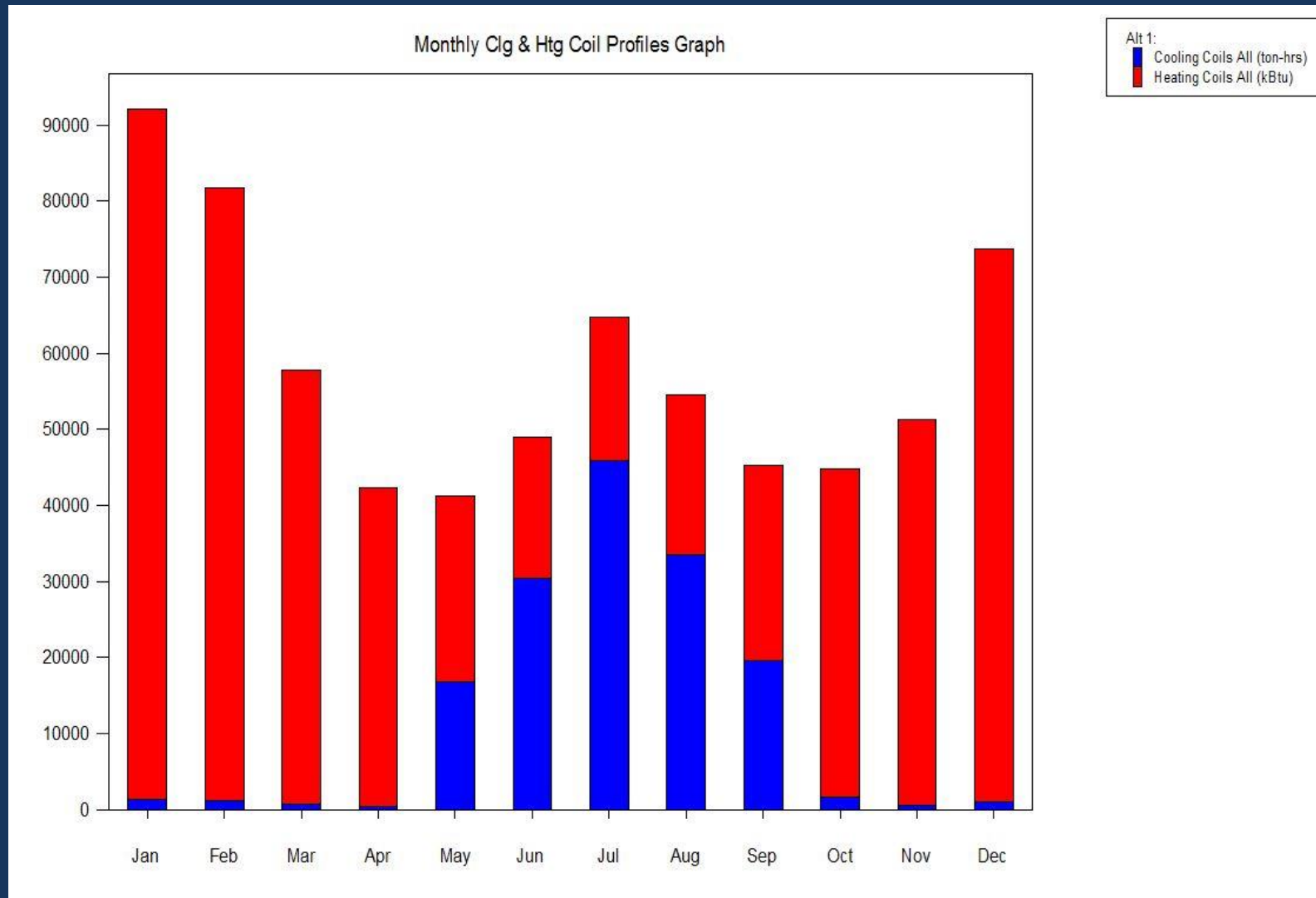
Structural Breadth

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The Medical Office Building

Ground Coupled Motivation

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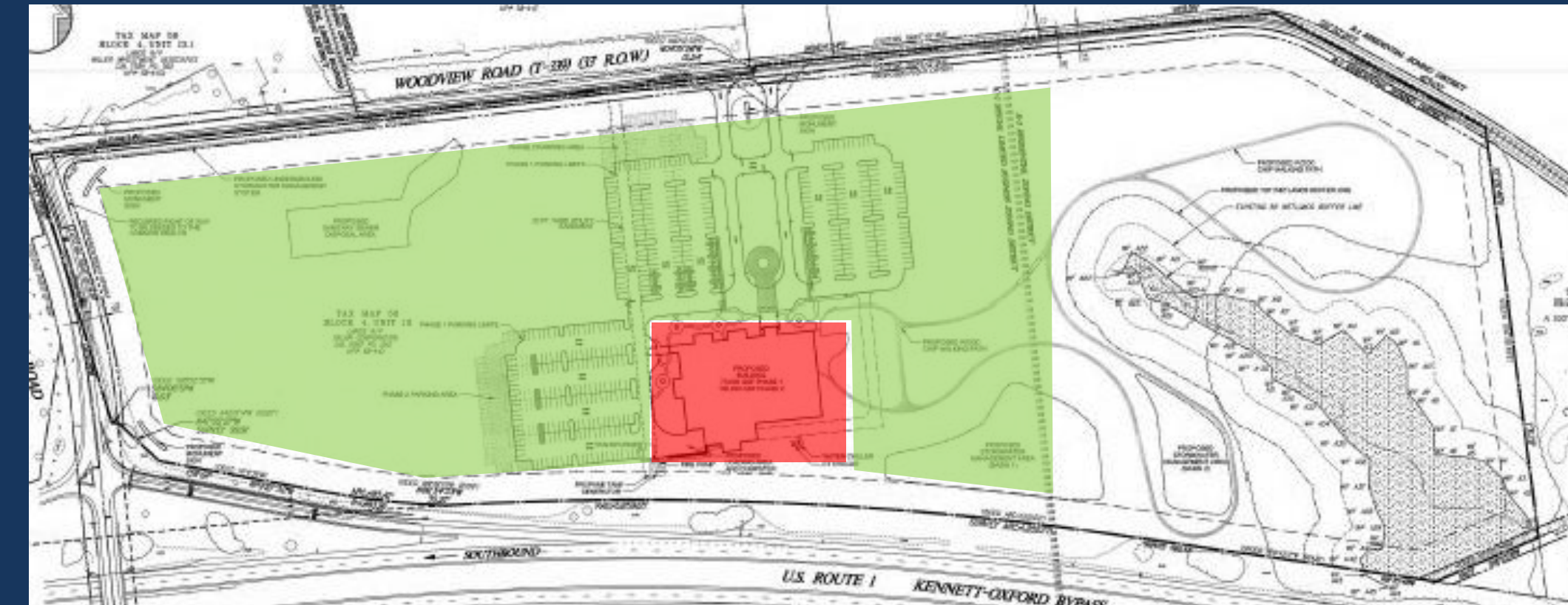
Joist Redesign

Girder Redesign

Cost

Conclusion

- Large area for ground coupled placement
- Eliminate need for propane gas
- Potential for large energy savings
- Reduce Emissions



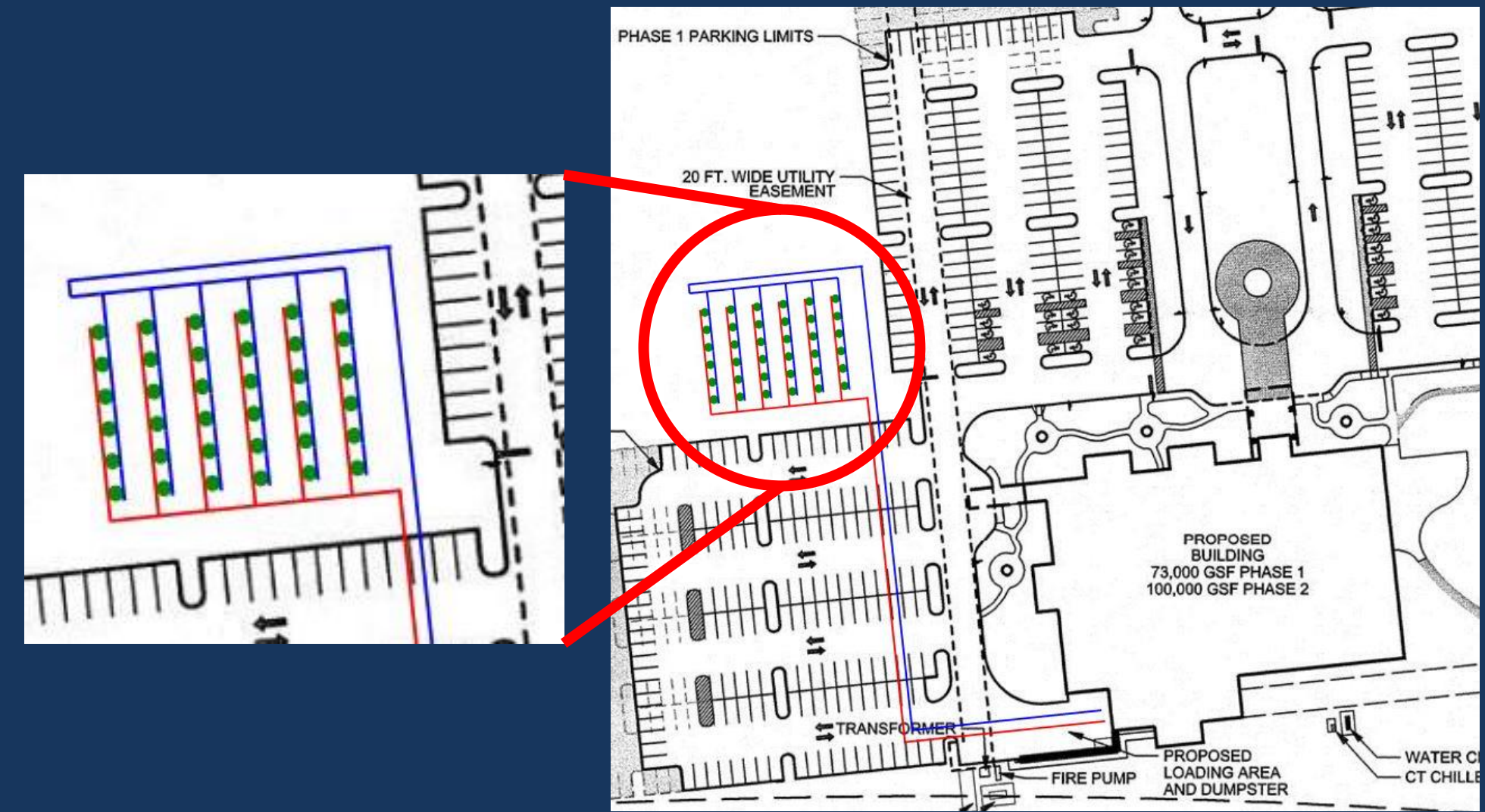
The Medical Office Building

Vertical Well

- Overview
- Existing Conditions
- Ground Coupled Depth
- System Design Options
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- Joist Redesign
- Girder Redesign
- Cost
- Conclusion

- Required well length of 10,702 ft
 - 15% factor of safety
- 36 wells needed
 - 300' well depth

Well Depth (ft)	Required Length	Number of Wells
100	10702	108
200	10702	54
300	10702	36



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Horizontal Well

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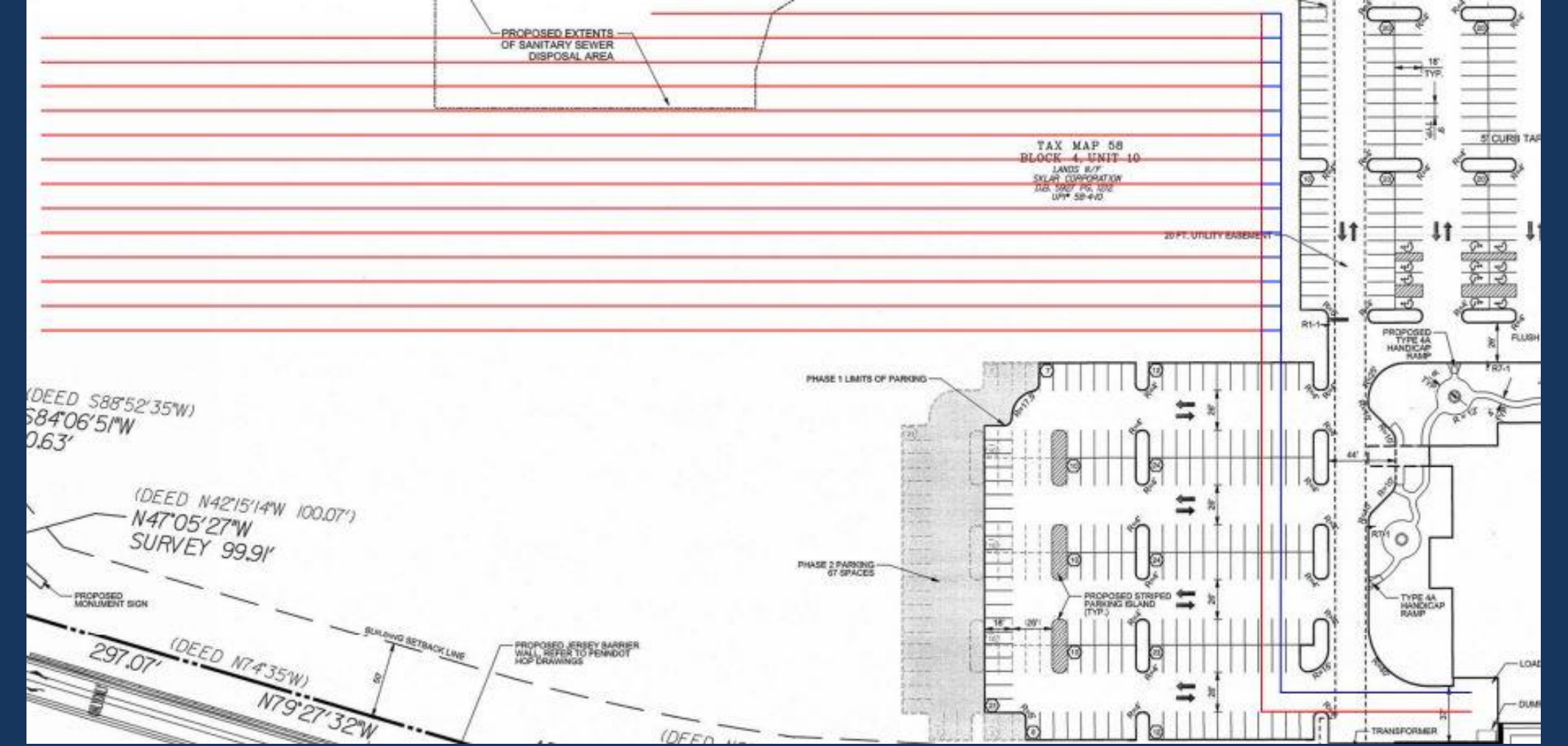
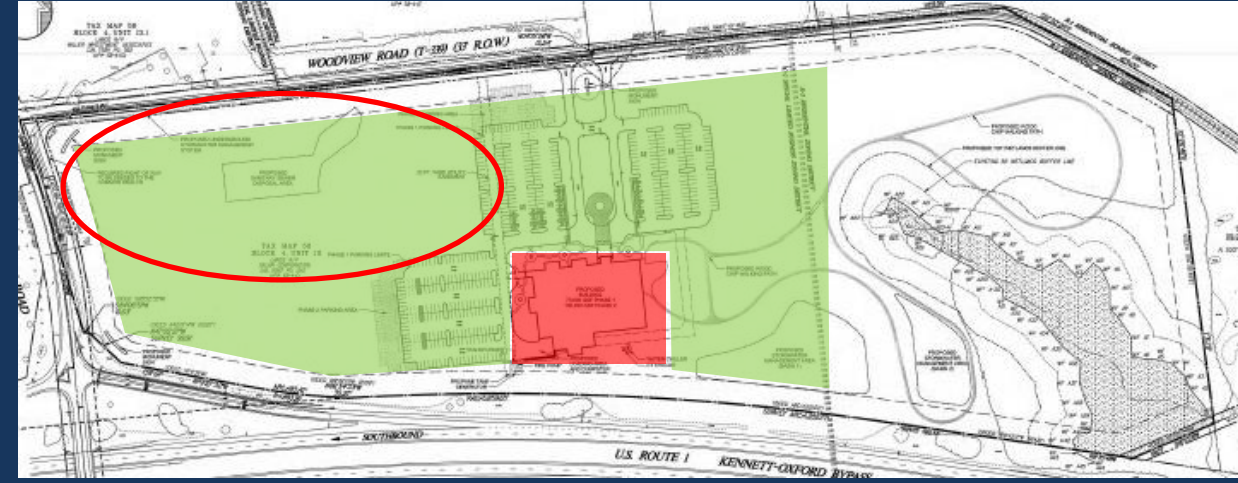
Joist Redesign

Girder Redesign

Cost

Conclusion

- Required Length of 10,702ft
 - 15% factor of safety
- 13 - 800ft runs
- 1 - 400ft run
- 10,800ft total



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Cost Analysis - Rooftop Units

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- **Trane Axiom GER 300**
– 25 Ton Capacity

	Original Units	New Units
Cost per Unit	\$62,650	\$24,975
Number of Units	2	5
Total Cost	\$125,300	\$124,875



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Cost Analysis - Wells

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Joist Redesign

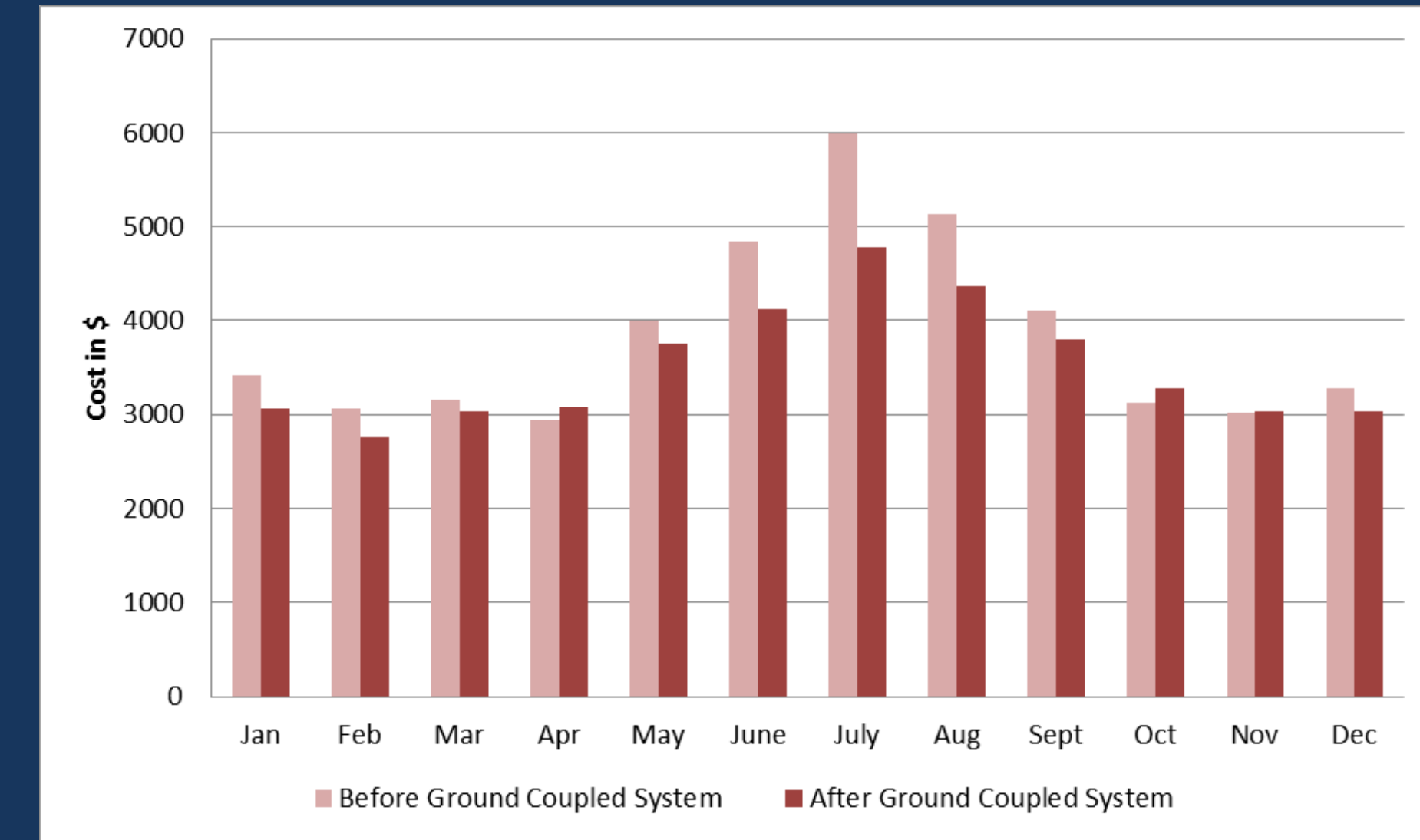
Girder Redesign

Cost

Conclusion

- Utility cost after - \$42,115
- Savings - \$3,945

	Vertical Well	Horizontal Well
Cost per Unit Length	\$10.57	\$1.12
Total Length	10,702	10,800
Pipe & Fitting Cost	-	\$6,048
Total Cost	\$114,156	\$18,144
Simple Payback	28.9 years	4.6 years
Discounted Payback	-	4.9 years



The Medical Office Building

Loads & Original Design

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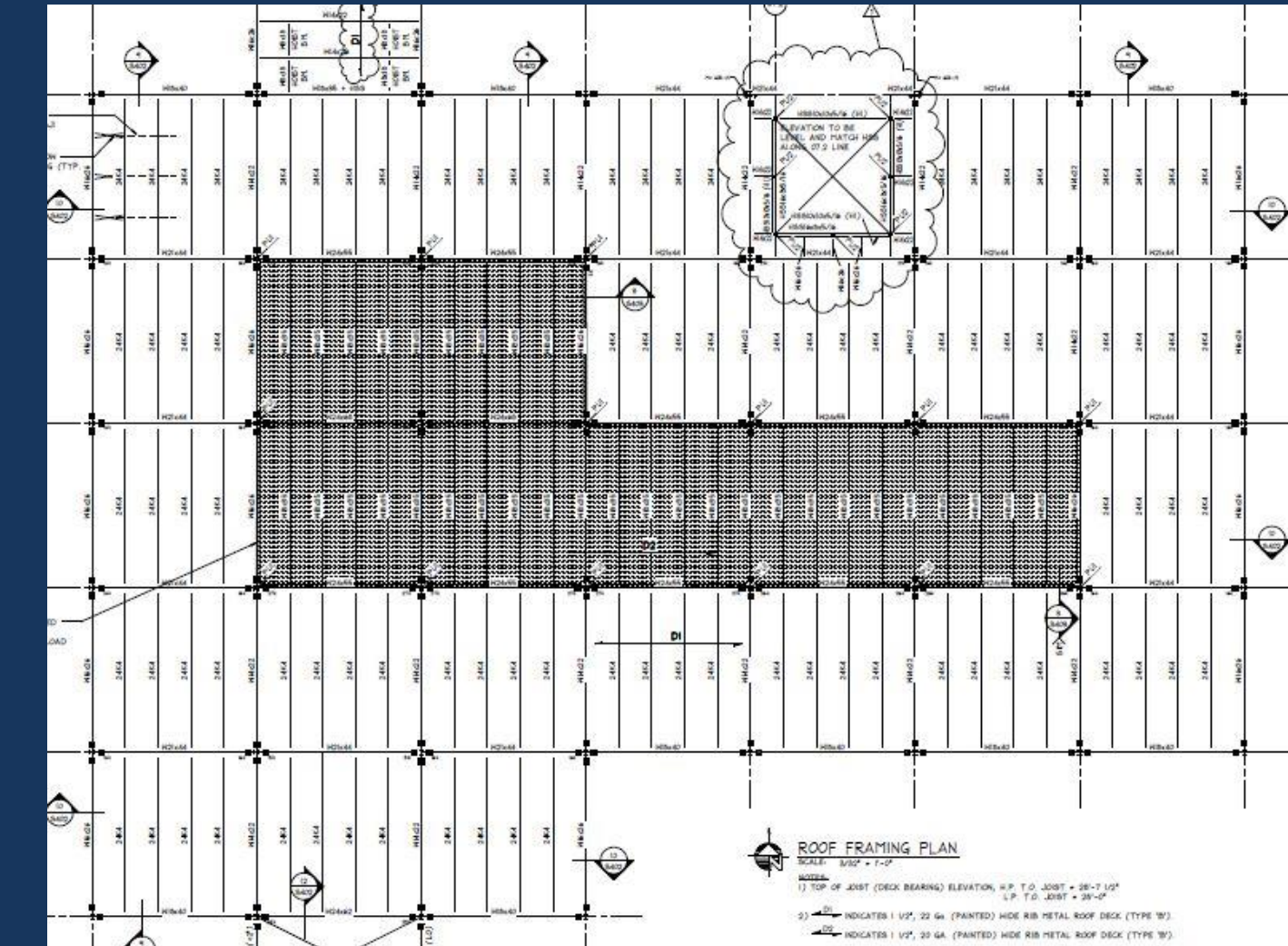
Joist Redesign

Girder Redesign

Cost

Conclusion

- 24K4 Roof Joist
- W18X35 Mechanical Joist
- Loads
 - Snow Load - 20psf
 - Live Load - 30psf
 - Dead Load - 8psf
 - Collateral - 7psf
 - Mechanical Dead Load - 75psf



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Joist Redesign

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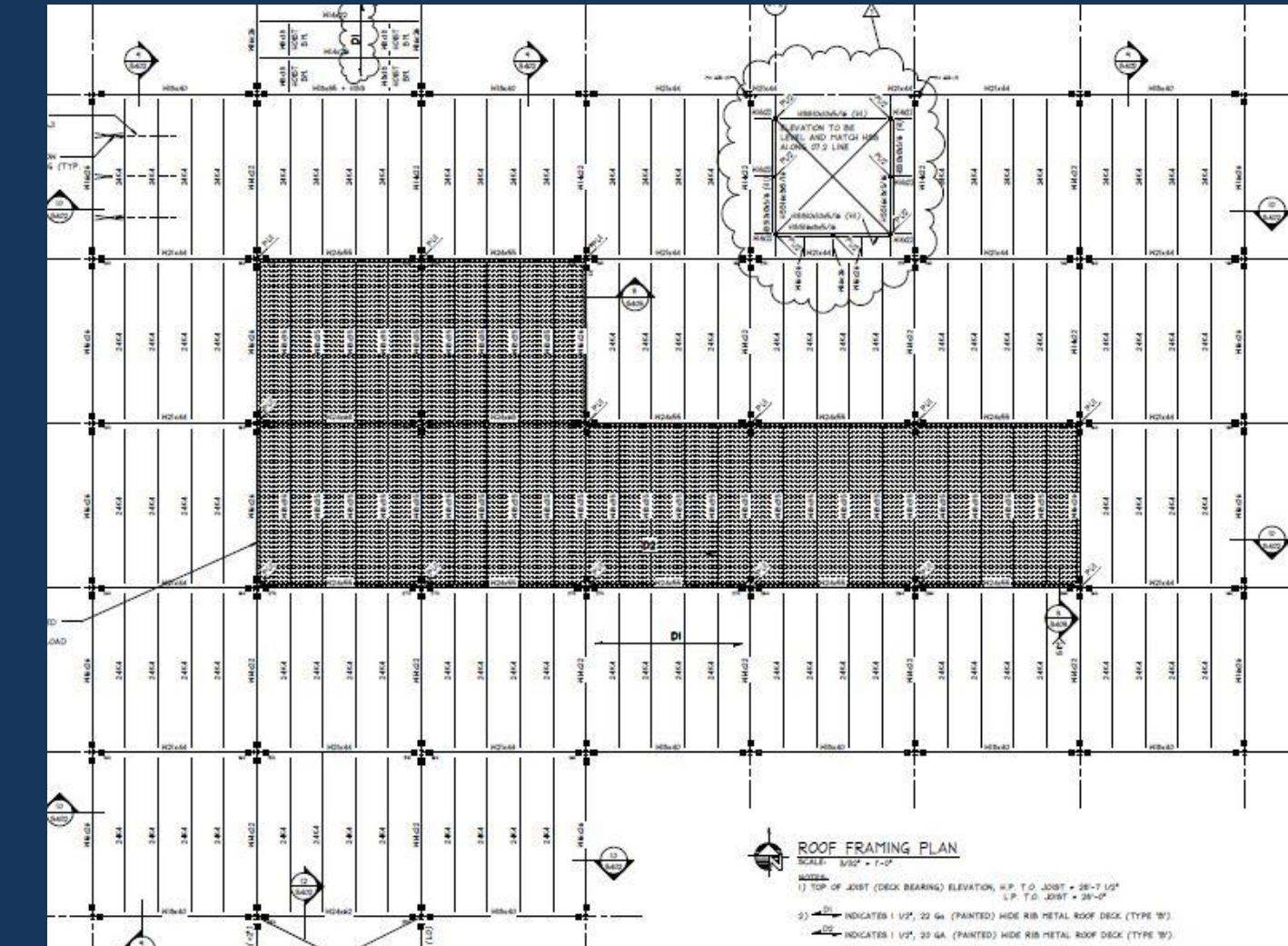
Joist Redesign

Girder Redesign

Cost

Conclusion

- 42nd Edition Catalog of Standard Specifications and Load and Weight Tables for Steel Joists and Joist Girders
- New Joists: 20LH08



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Girder Redesign

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- **Original Girders**

- W24X55 Edge

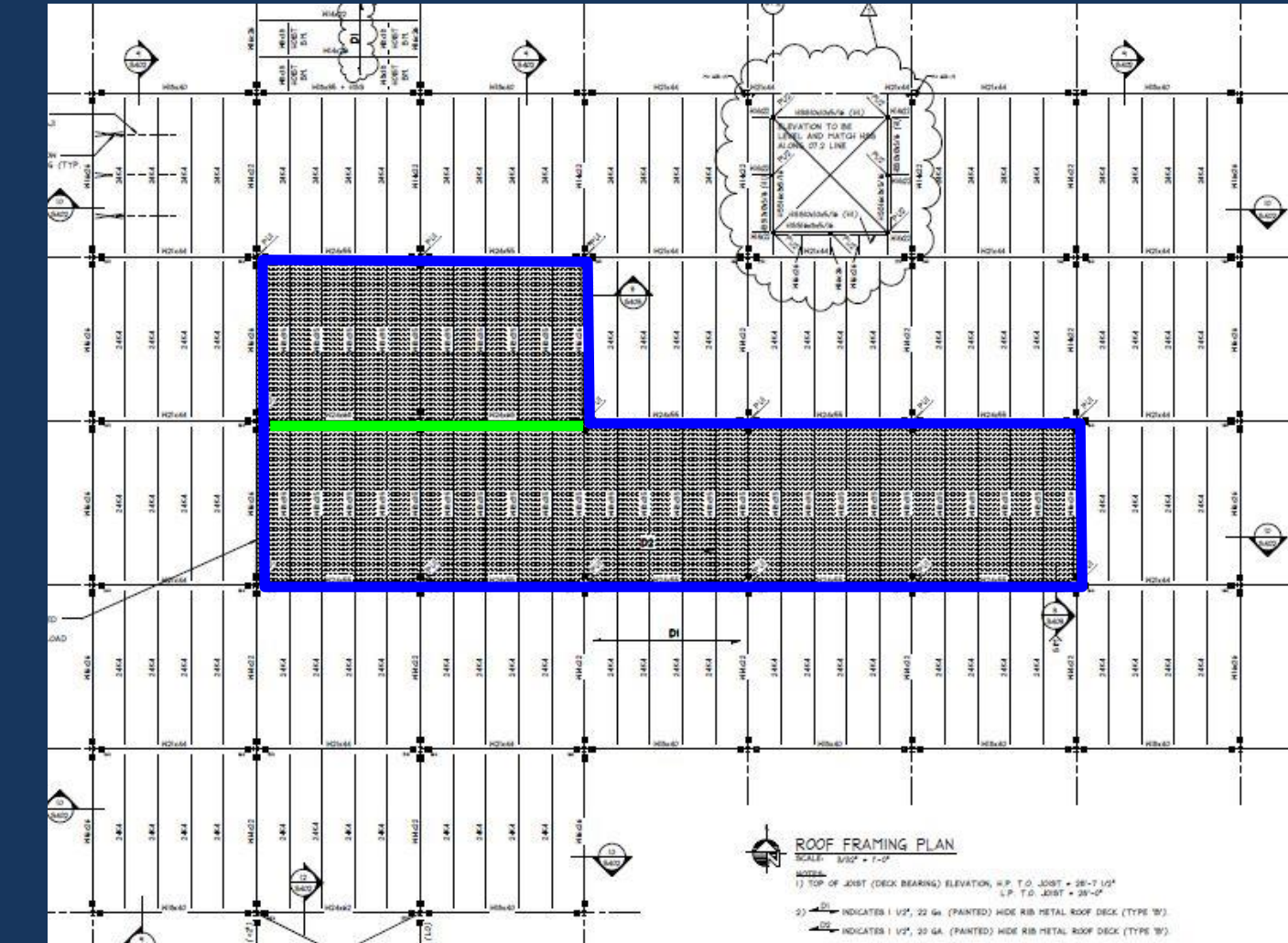
- W24X68 Center

- $M_u = \frac{wl^2}{8}$

- **Redesign Girders**

- W21X55 Edge

- W21X73 Center



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Cost Comparison

Overview

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- Savings of \$32,724

Original Design			
Member	Cost per Member	# of Members	Total Cost
W18X35	\$1,530.00	28	\$42,840.00
W24X55	\$2,640.00	10	\$26,400.00
W24X68	\$2,970.00	2	\$5,940.00
			\$75,180.00

Redesign			
Member	Cost per Member	# of Members	Total Cost
20LH08	\$522.00	28	\$14,616.00
W21X55	\$2,190.00	10	\$21,900.00
W21X73	\$2,970.00	2	\$5,940.00
			\$42,456.00

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Conclusion/Recommendations

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- **Ground coupled system**
 - Saves \$3,945/year
 - Vertical Well - Payback of 28.9 years
 - Horizontal Well - Payback of 4.9 years
- **Roof framing redesign**
 - 20LH08 Joists
 - W21X55 and W21X73 Girders
 - Save \$32,724



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Acknowledgements

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Joist Redesign

Girder Redesign

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- Dr. Donghyun Rim - Advisor
- Kurt Hutter - Anchor Health Properties
- Randy Cook - The Procz Group Inc.
- Family and Friends



The Medical Office Building

Appendices - Charts

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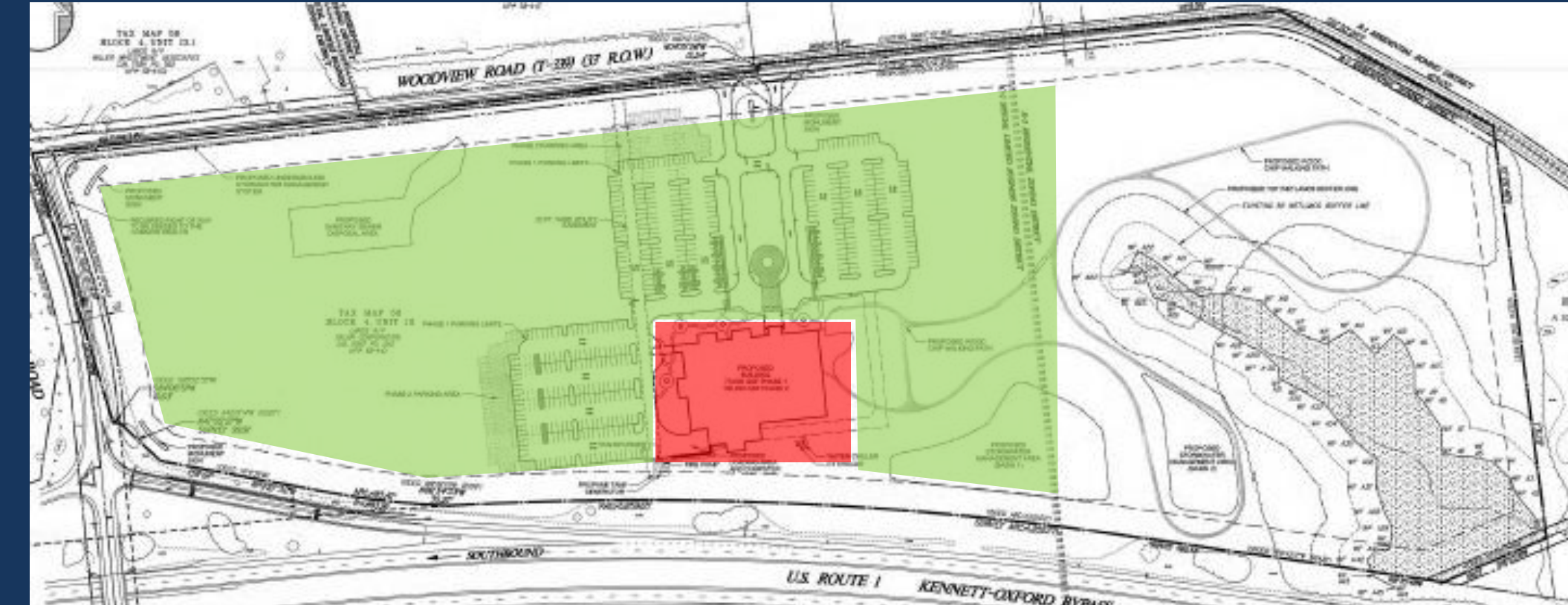
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Girder Redesign

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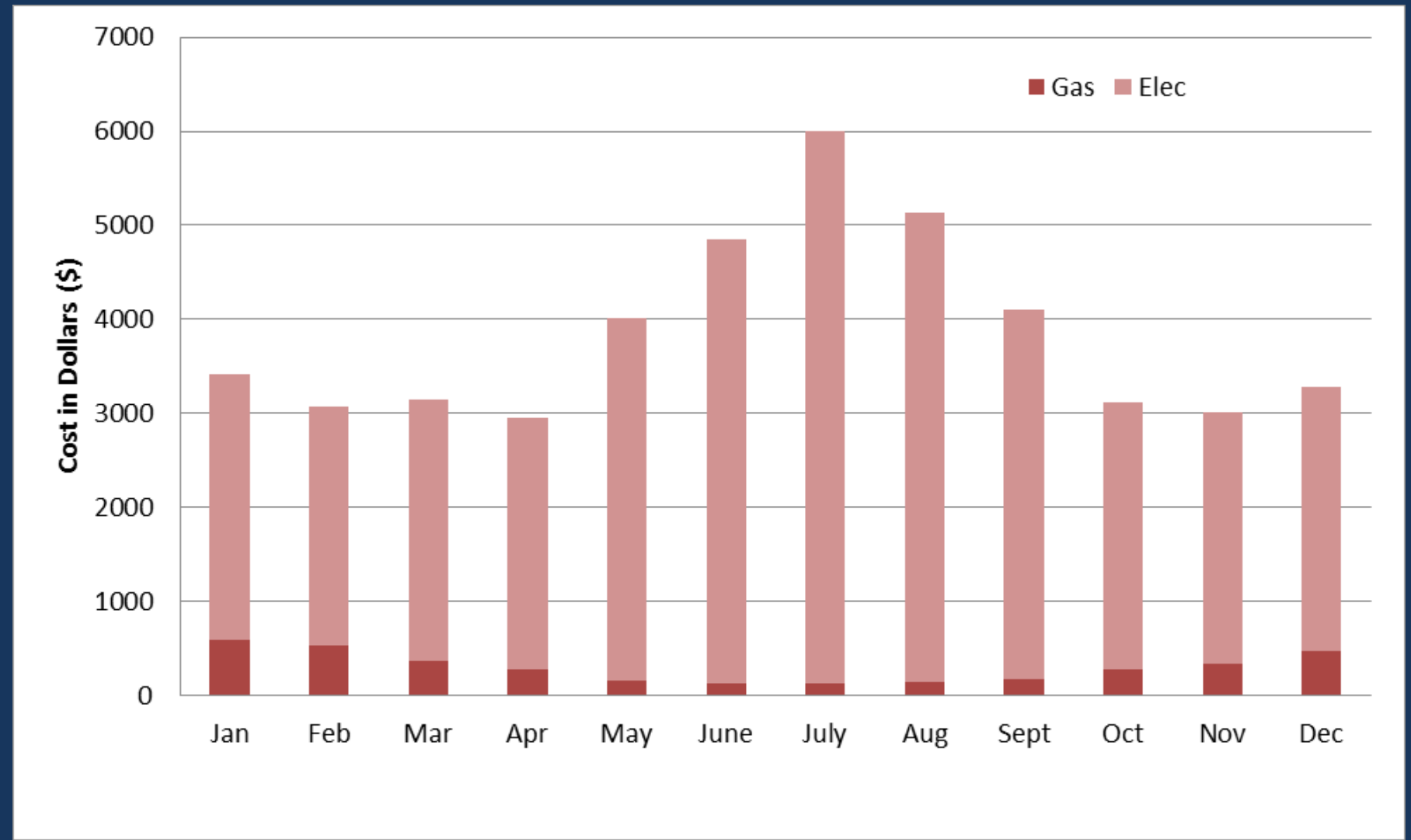
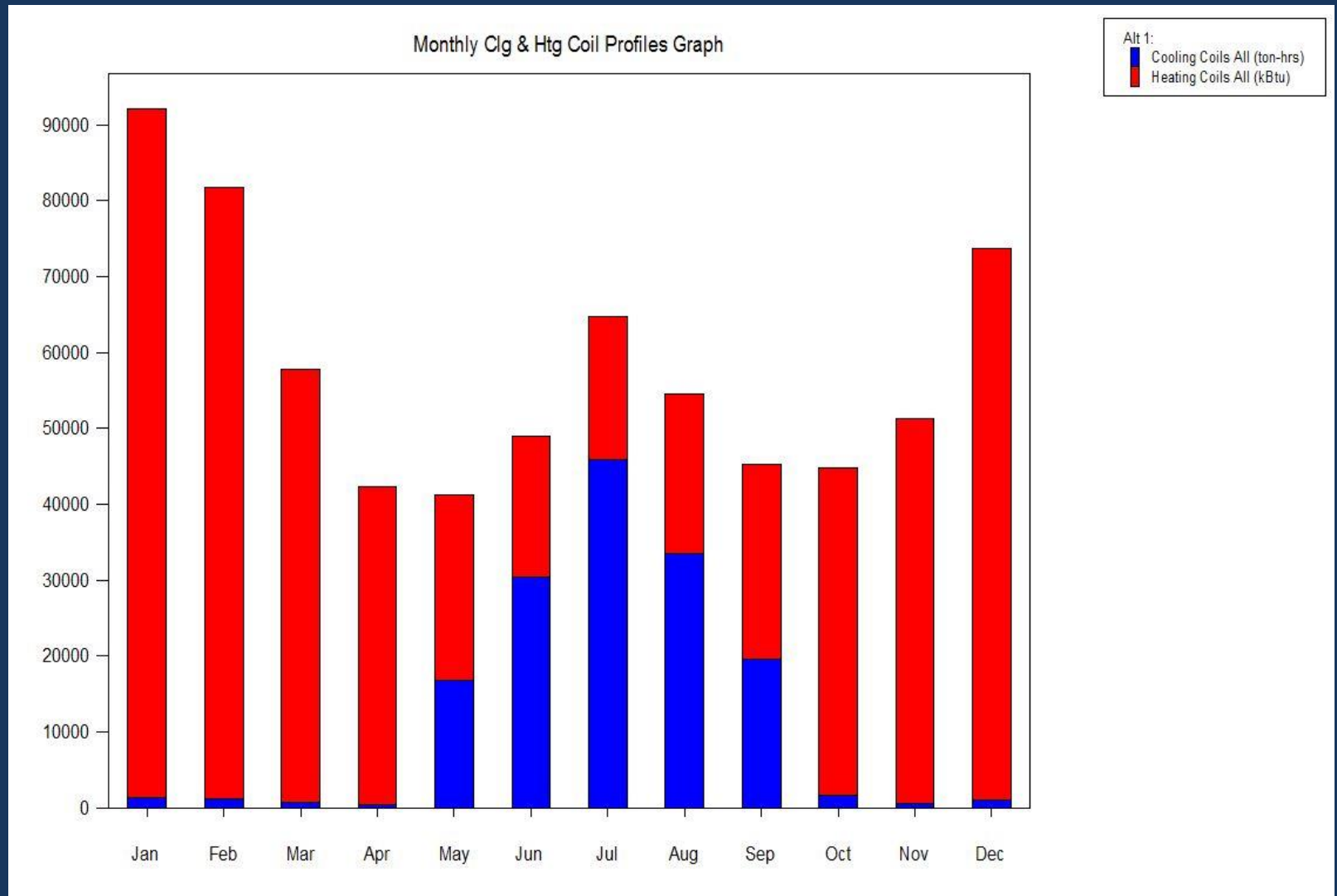
Conclusion



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Appendices - Figures

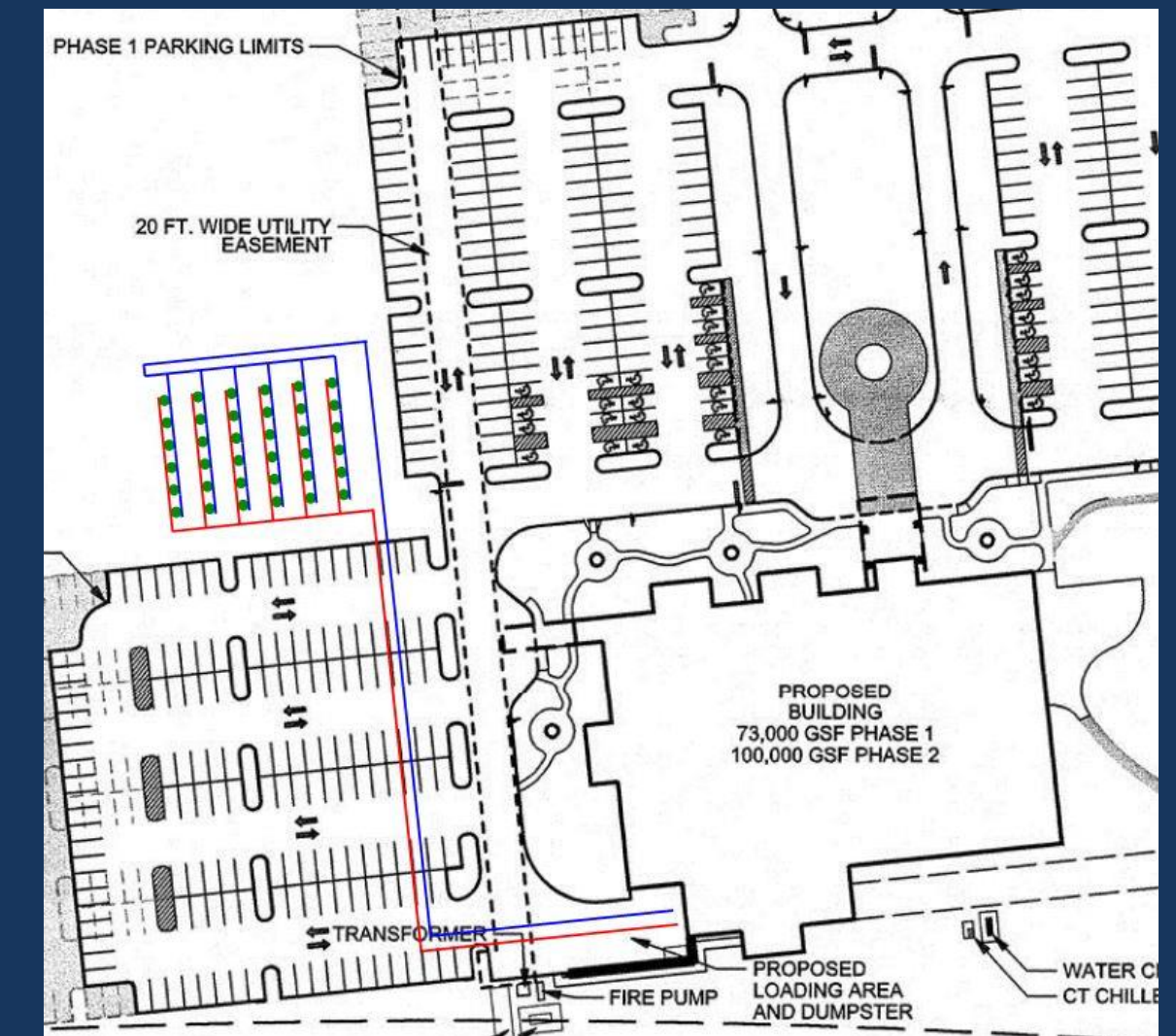
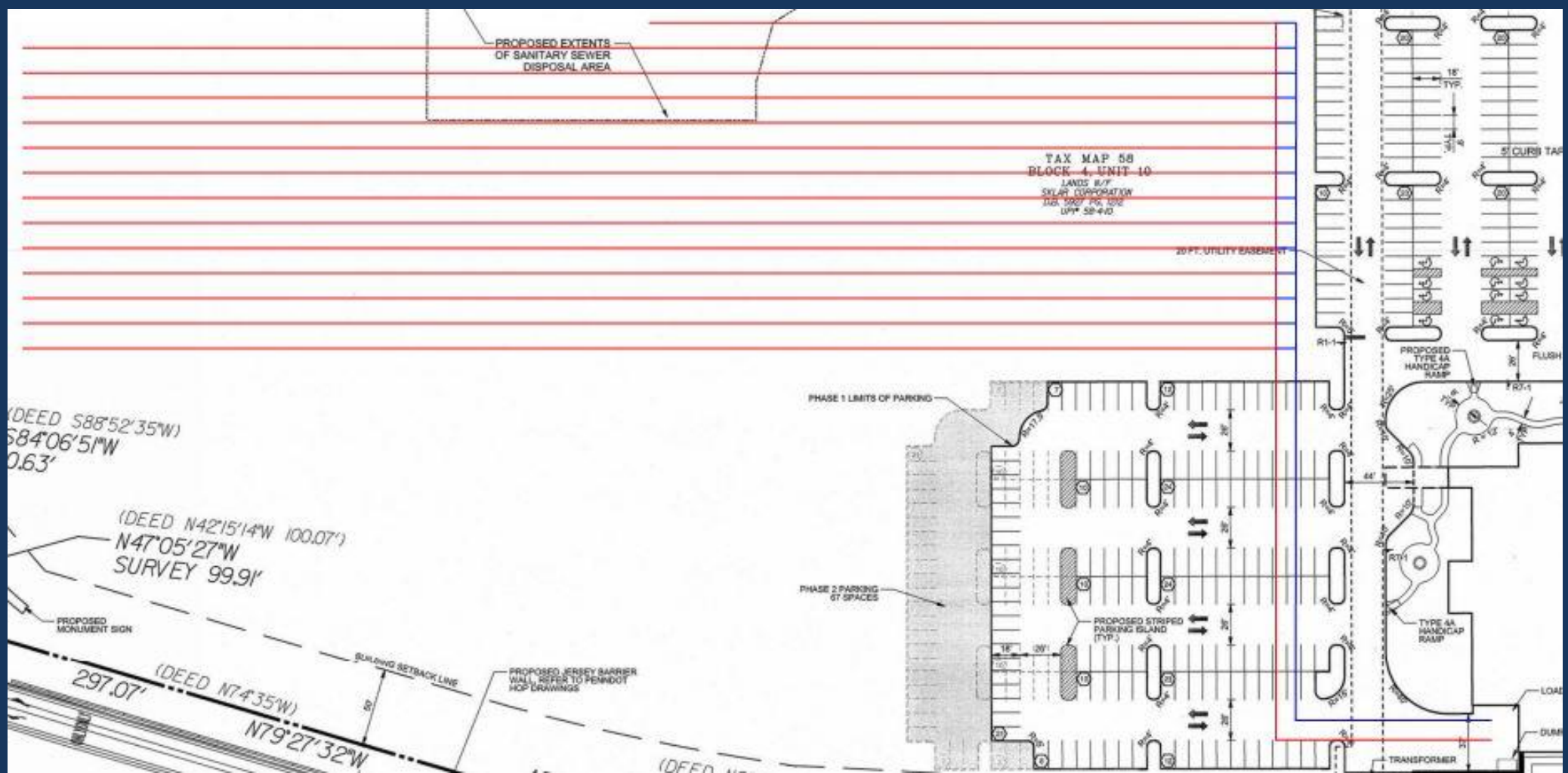
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