



Mueller Laboratory Renovation

By

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Construction Management

Dr. David Riley, Advisor



Mueller Laboratory Renovation

Presentation Outline:

Introduction

Breadth topic 1 – Roof Reinforcement

Depth topic 1 – Recycling Opportunities

Depth topic 2 – Site Logistics

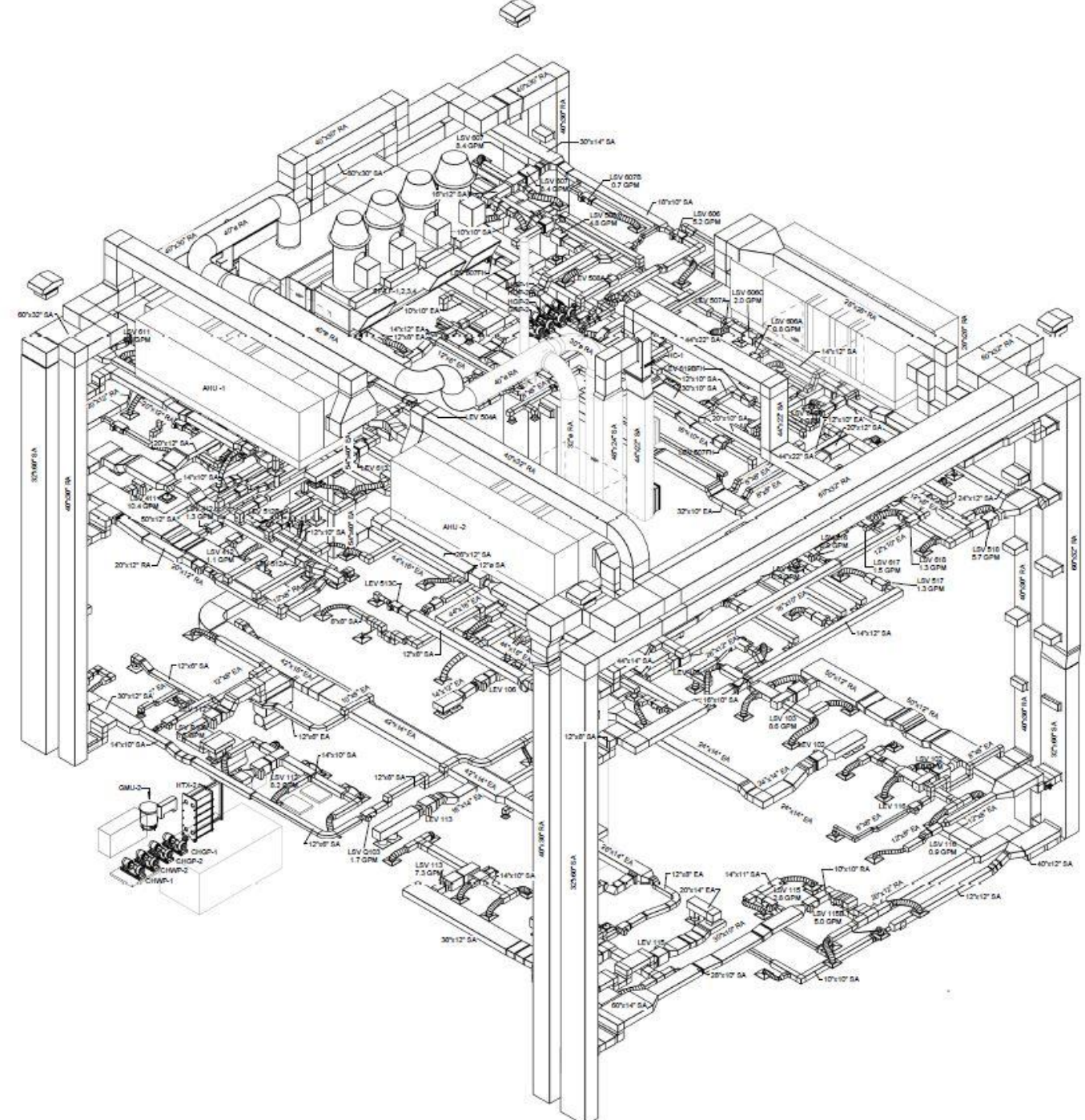
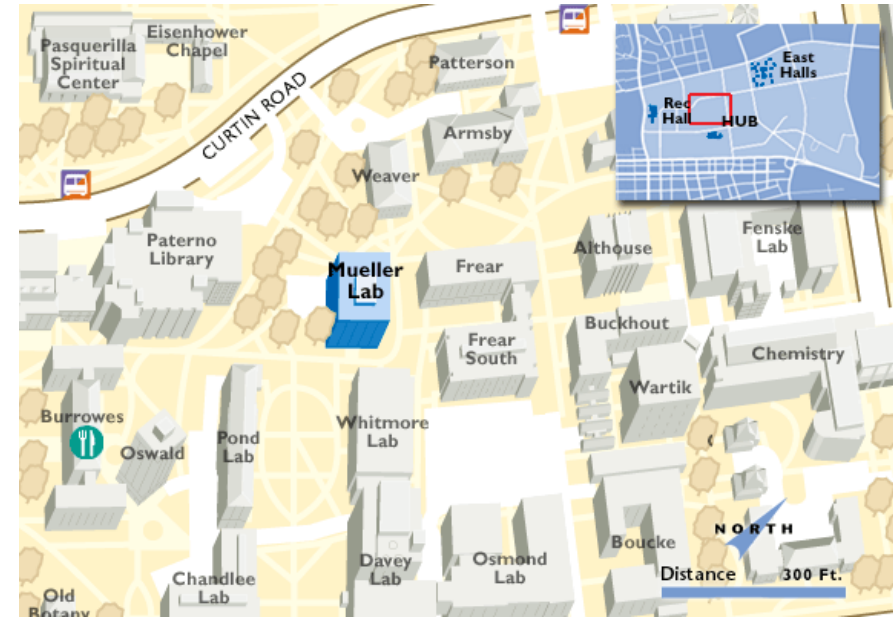
Breadth topic 2 – LED Downlights

Conclusion

Introduction

- Mueller Laboratory Renovation
- On PSU University Park campus
- \$18 million project
- Gutting, renovation of 4 of 7 floors
- Replacement of outdated HVAC, electrical systems
- Scheduled to be completed before 2015 school year

PENNSYLVANIA STATE UNIVERSITY



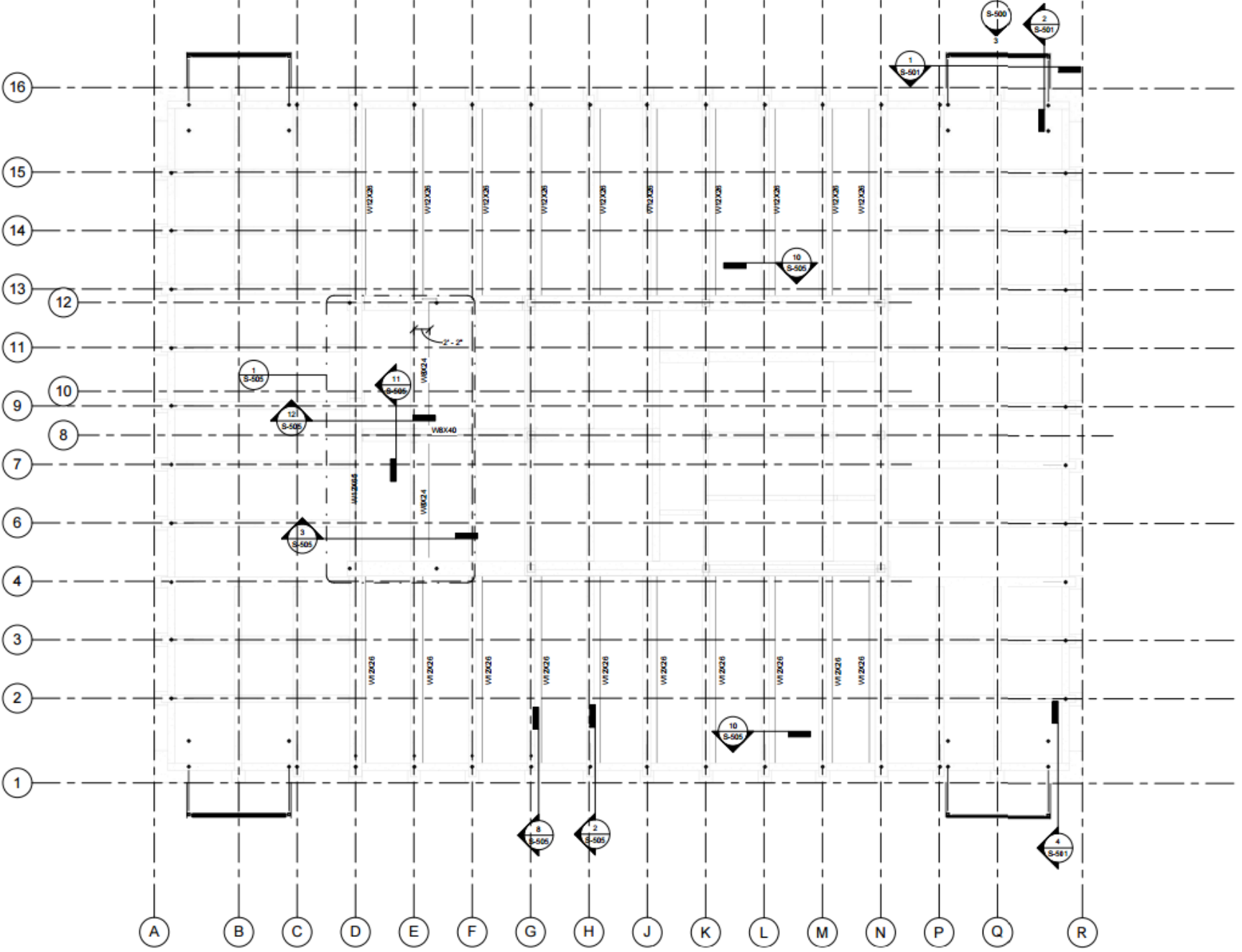
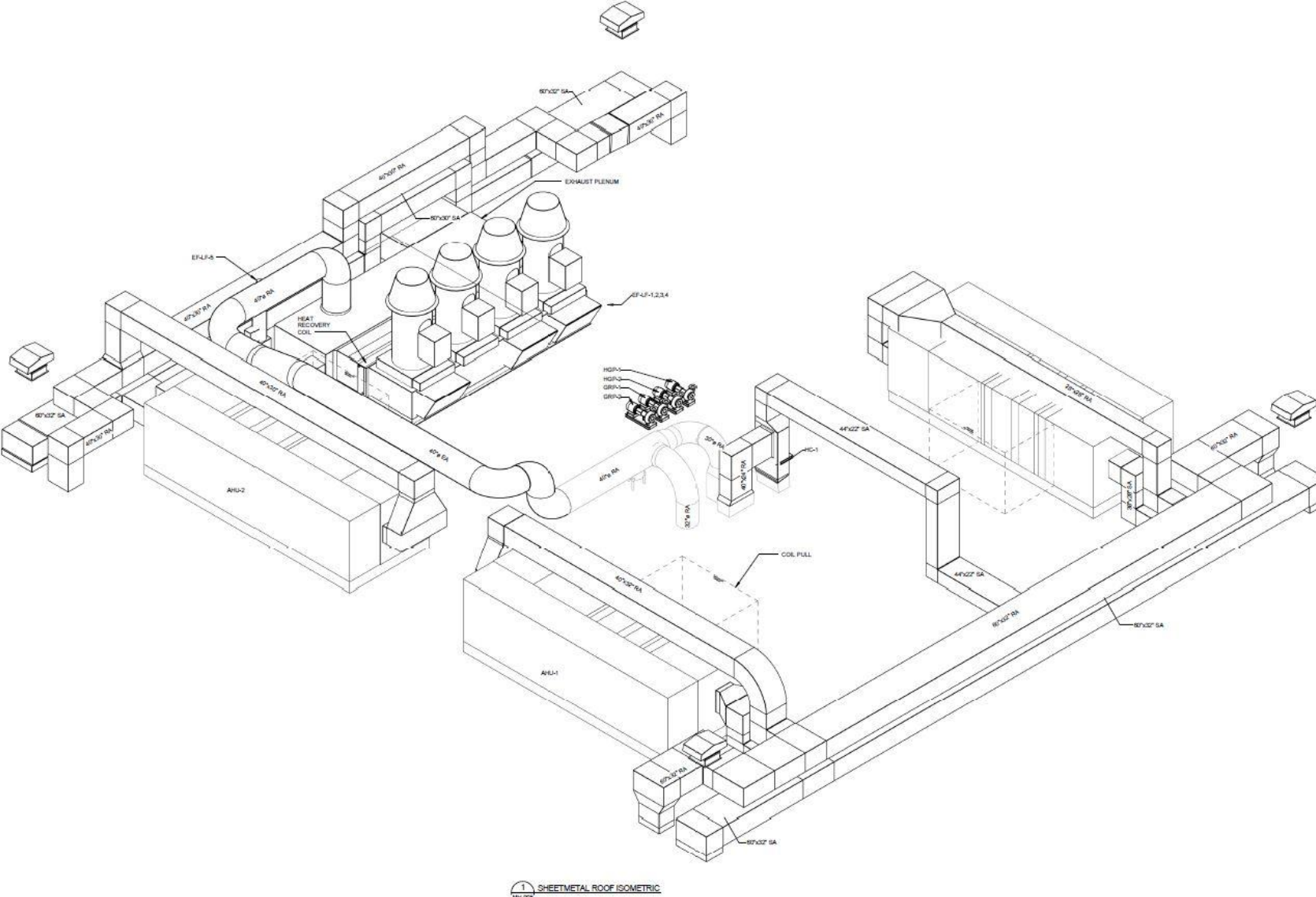
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- Breadth topic 2 – LED Downlights
- Conclusion

Roof Reinforcement

Reason for Reinforcement



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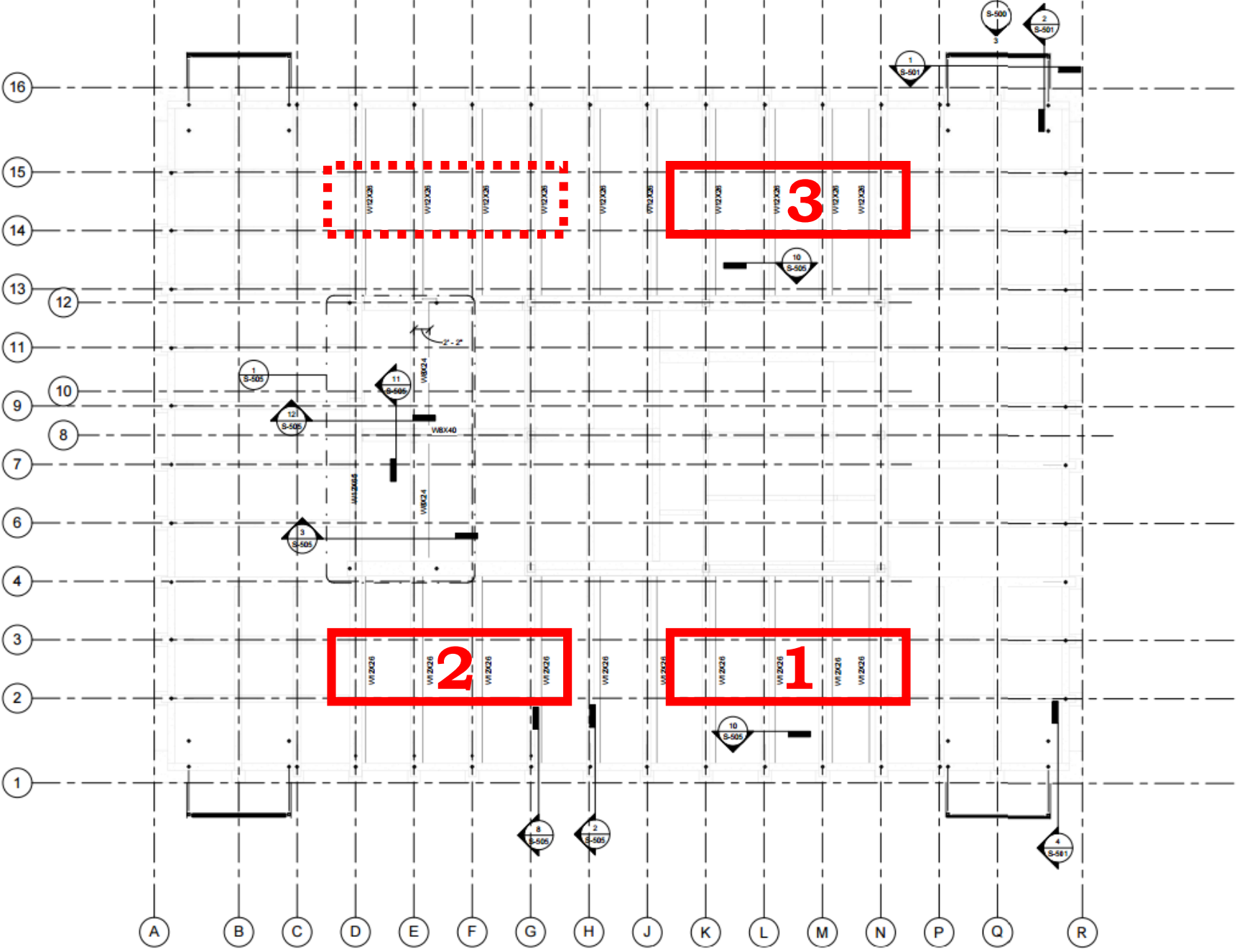
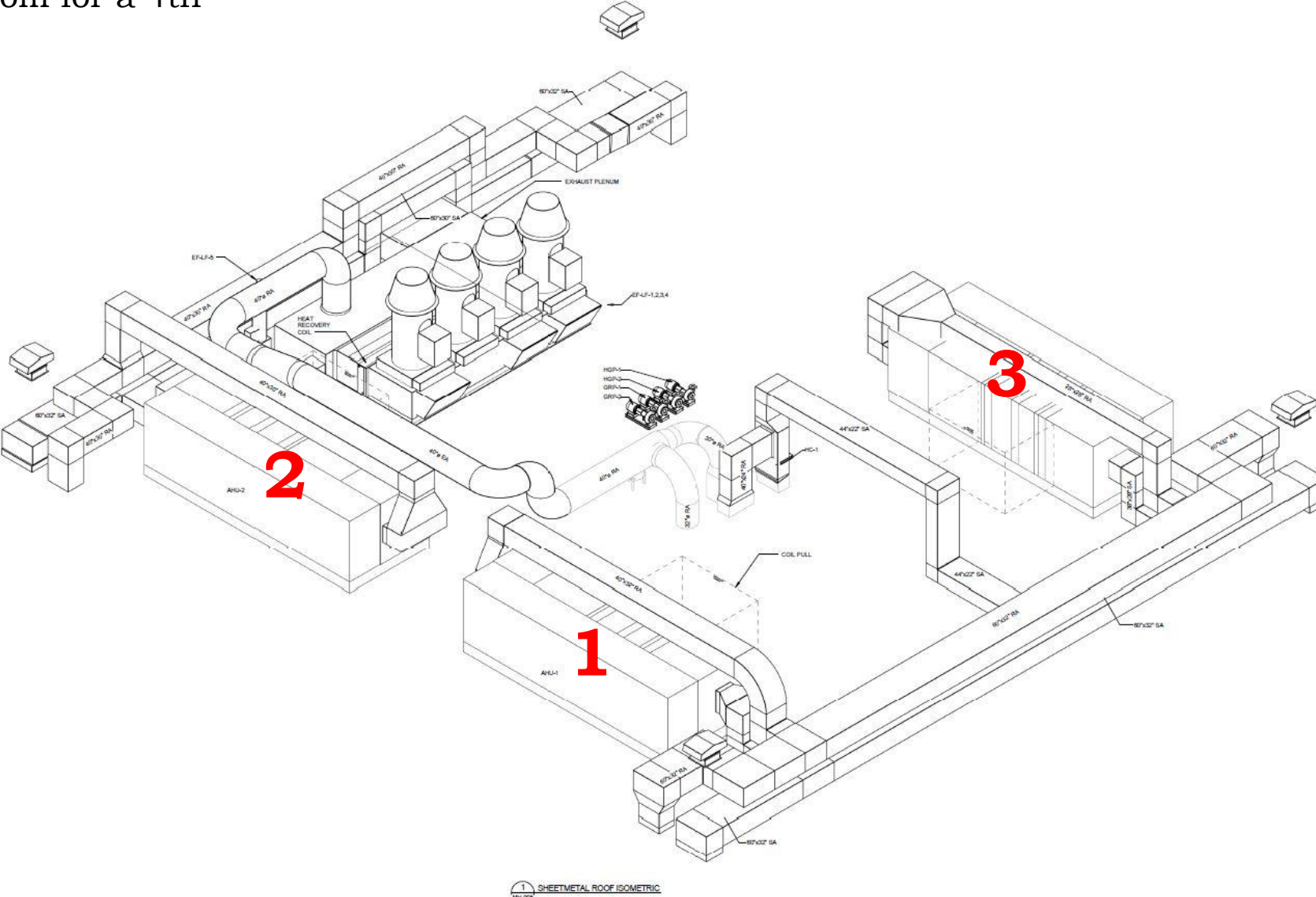
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Roof Reinforcement

Reason for Reinforcement

- 3 new air handling units (with room for a 4th)



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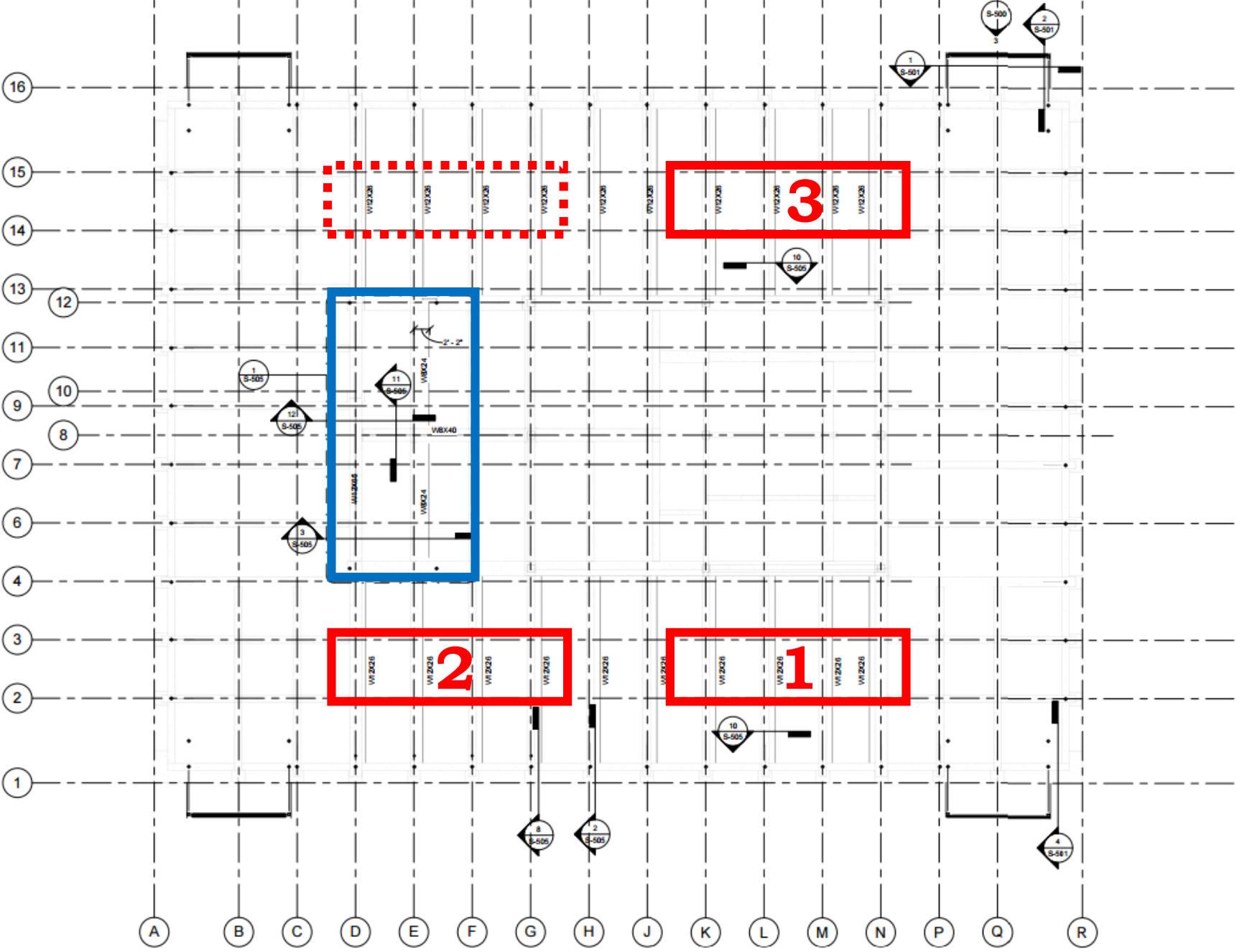
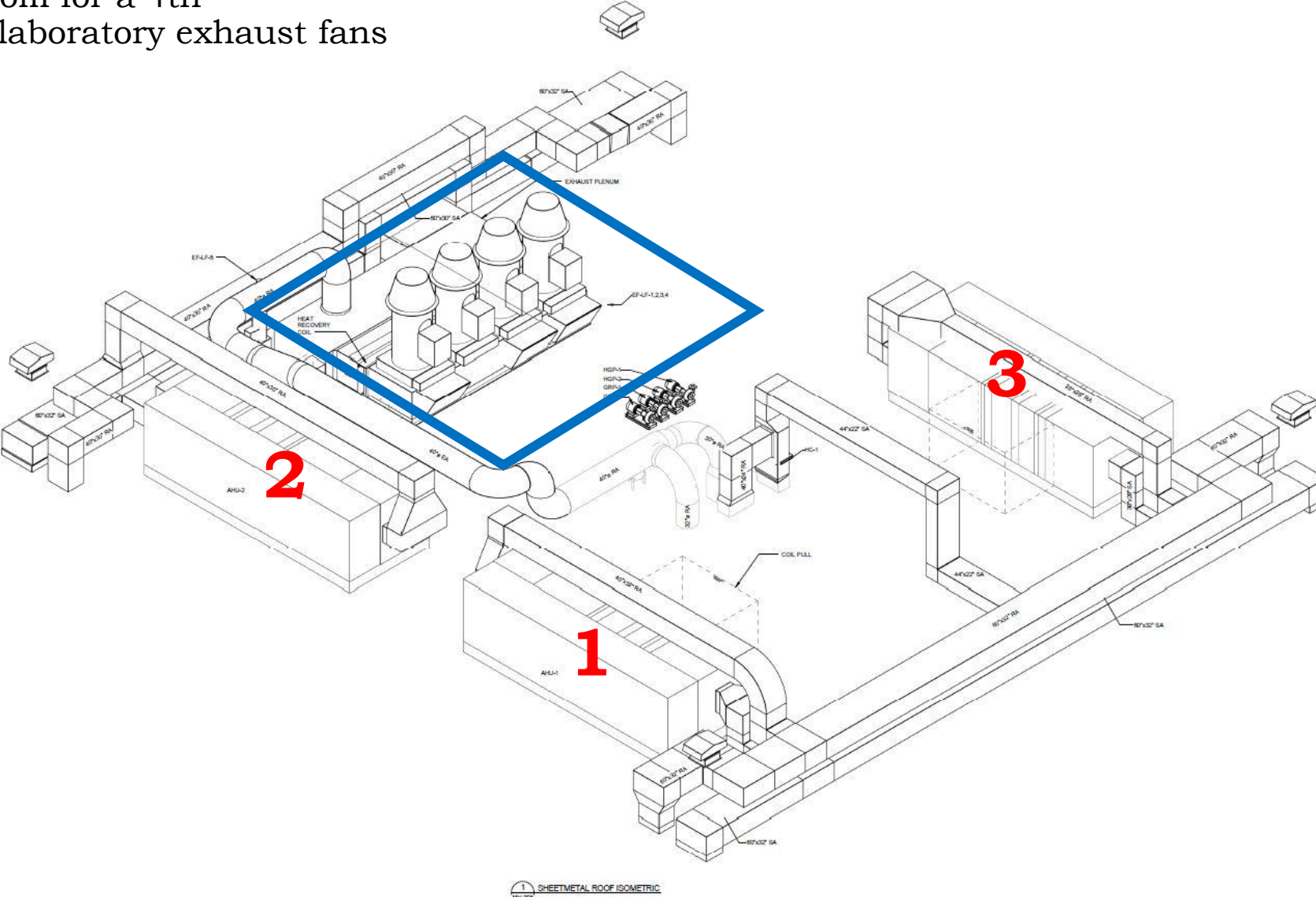
Breadth topic 2 – LED Downlights

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Roof Reinforcement

Reason for Reinforcement

- 3 new air handling units (with room for a 4th)
- 4 laboratory exhaust fans



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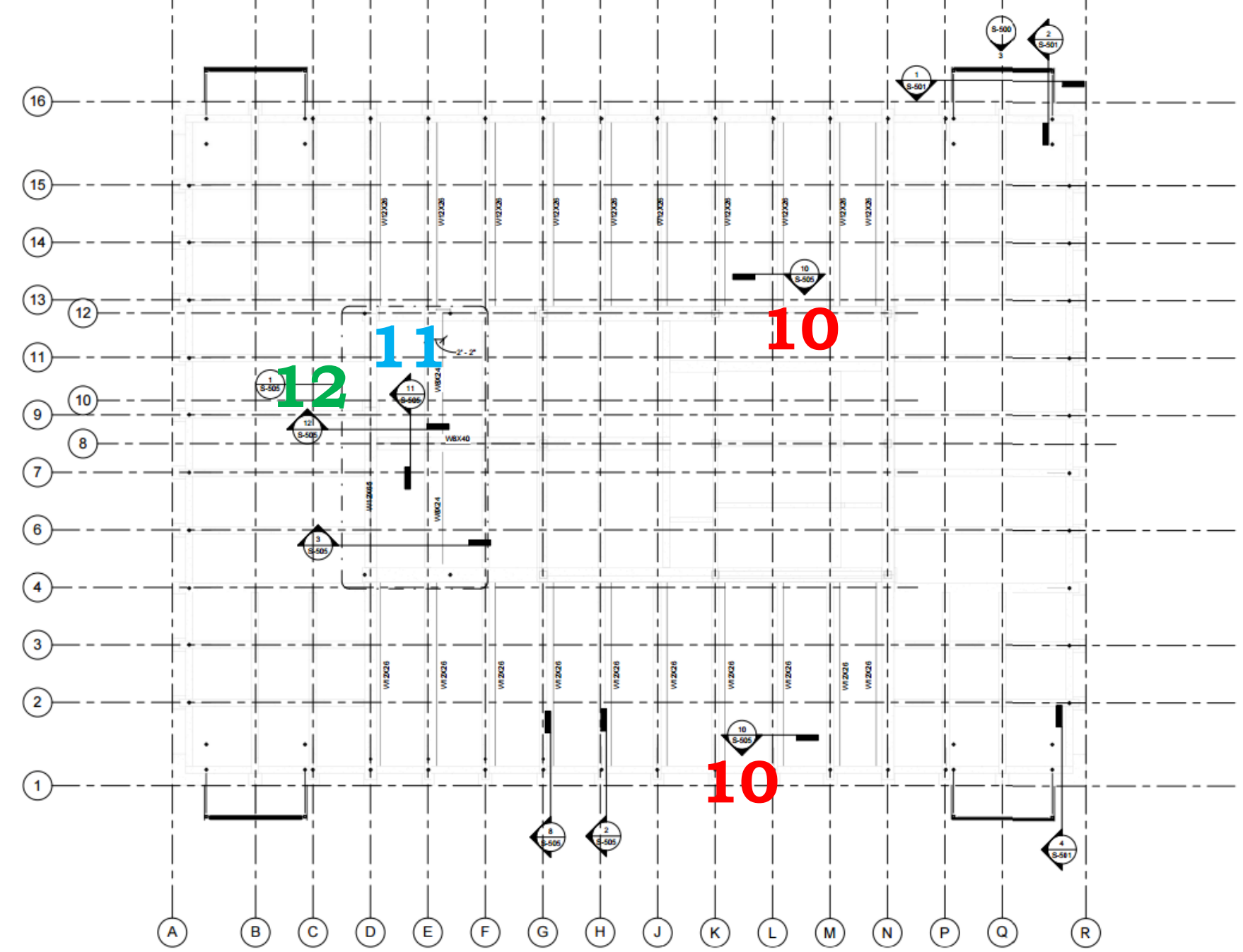
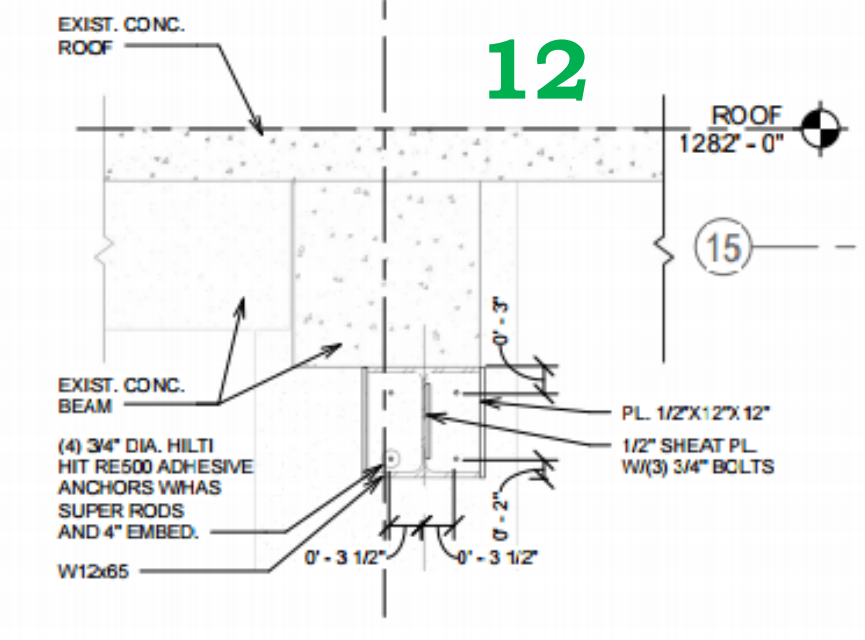
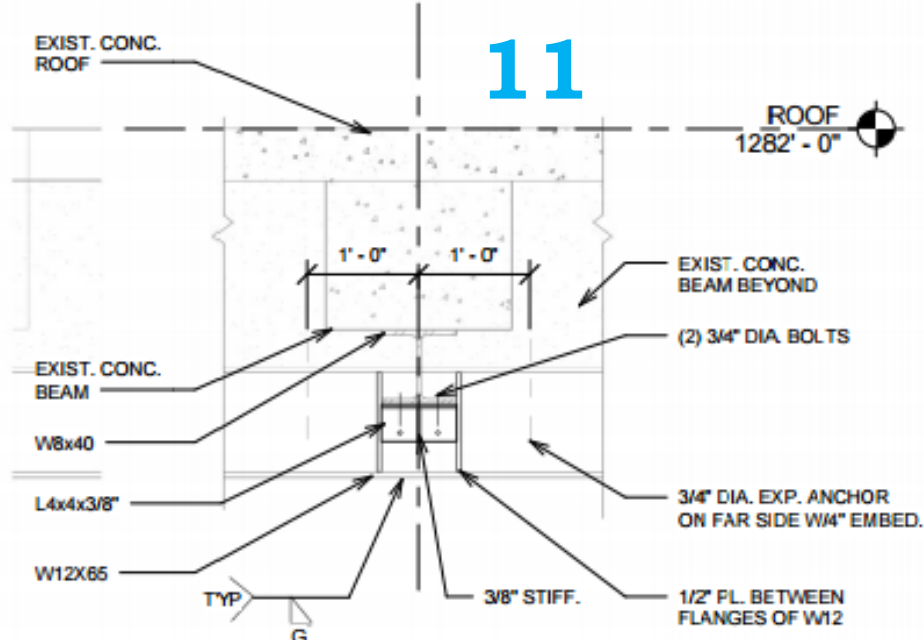
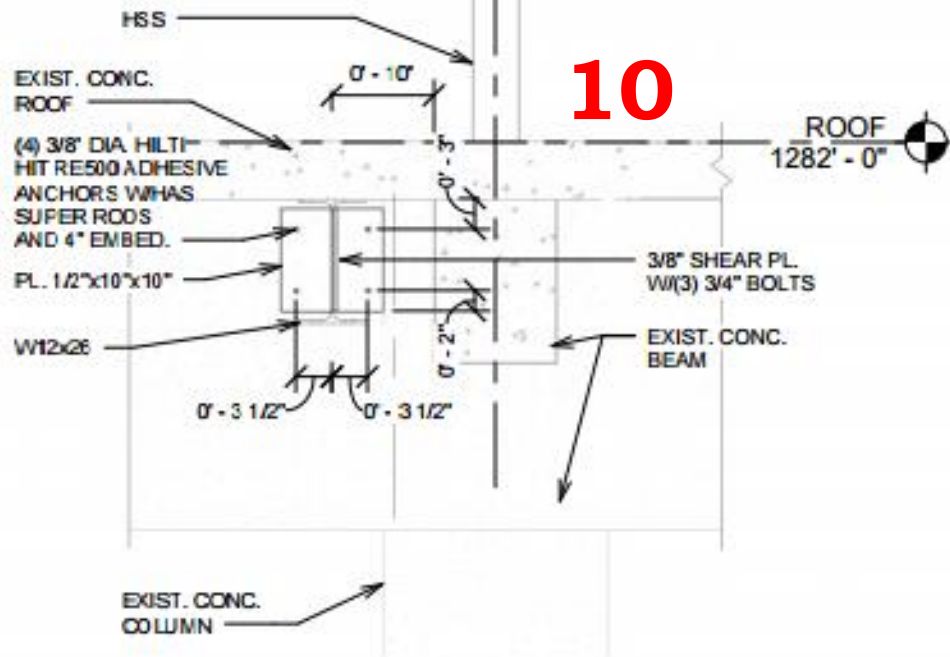
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Roof Reinforcement

Under-deck Reinforcing Beams

- 25 steel beams
- Next to existing concrete joists
- Underneath existing concrete joists
- Hung with bolts off of concrete beams



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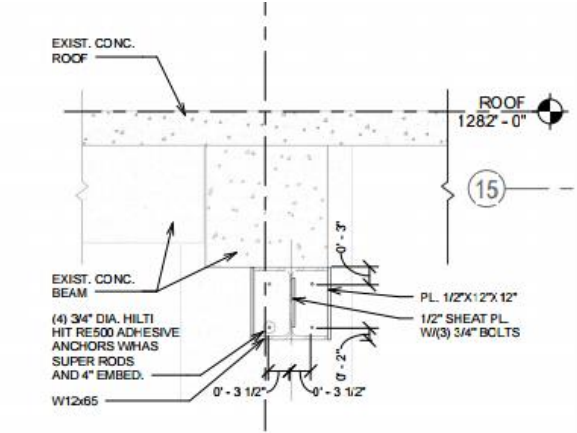
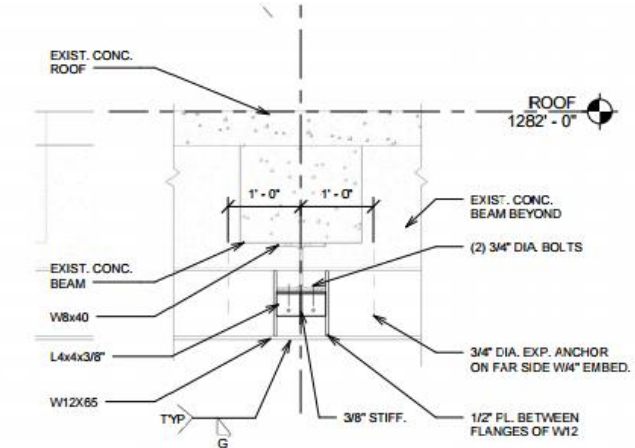
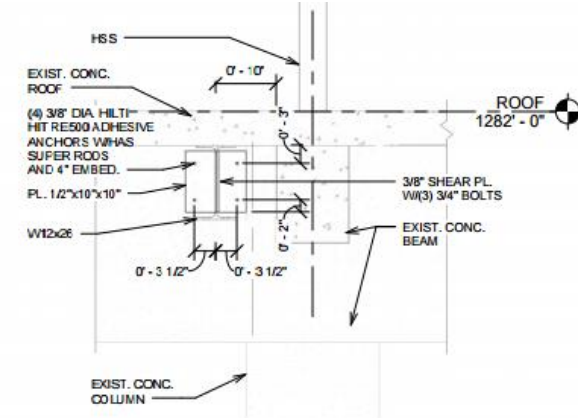
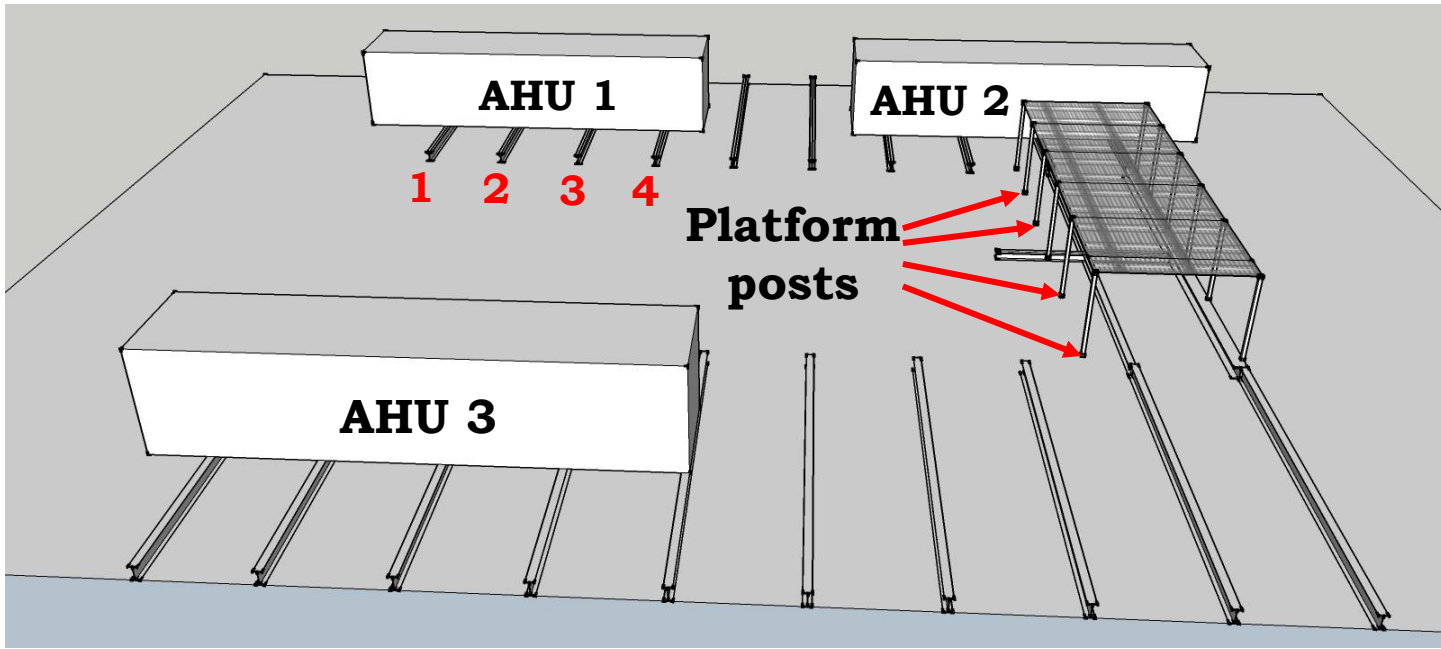
Conclusion

Roof Reinforcement

Problems with Under-Deck Reinforcement

- Schedule depends on demolition
- Difficulty of overhead work
- Constraints on steel placement
- Lowered ceiling height

6TH FLOOR		210	30-Jun-14	20-Apr-15
6F-01010	Owner Vacates Floor	0		30-Jun-14*
6F-01020	Erect Temporary Barriers and Lab Bench Protection	5	01-Jul-14	07-Jul-14
6F-02240	MEP Cut, Cap, Make Safe for Abatement/Demo	5	08-Jul-14	14-Jul-14
6F-02250	Demo Lab Casework; Set Up Abatement	5	08-Jul-14	14-Jul-14
6F-02290	Abatement	10	15-Jul-14	28-Jul-14
6F-02320	MEP Cut, Cap, Safe, Drop for Bulk Demo	10	29-Jul-14	11-Aug-14
6F-02340	Rough Demolition	10	12-Aug-14	25-Aug-14
6F-22020	Remove MEP Stub Ups Thru Floor	5	26-Aug-14	01-Sep-14
6F-22030	U/S Drain Connections/Core Drilling	5	26-Aug-14	01-Sep-14
6F-22040	OH Storm Piping R/I	30	26-Aug-14	06-Oct-14
6F-05100	Install Steel Reinforcing Below Roof Slab	10	26-Aug-14	08-Sep-14



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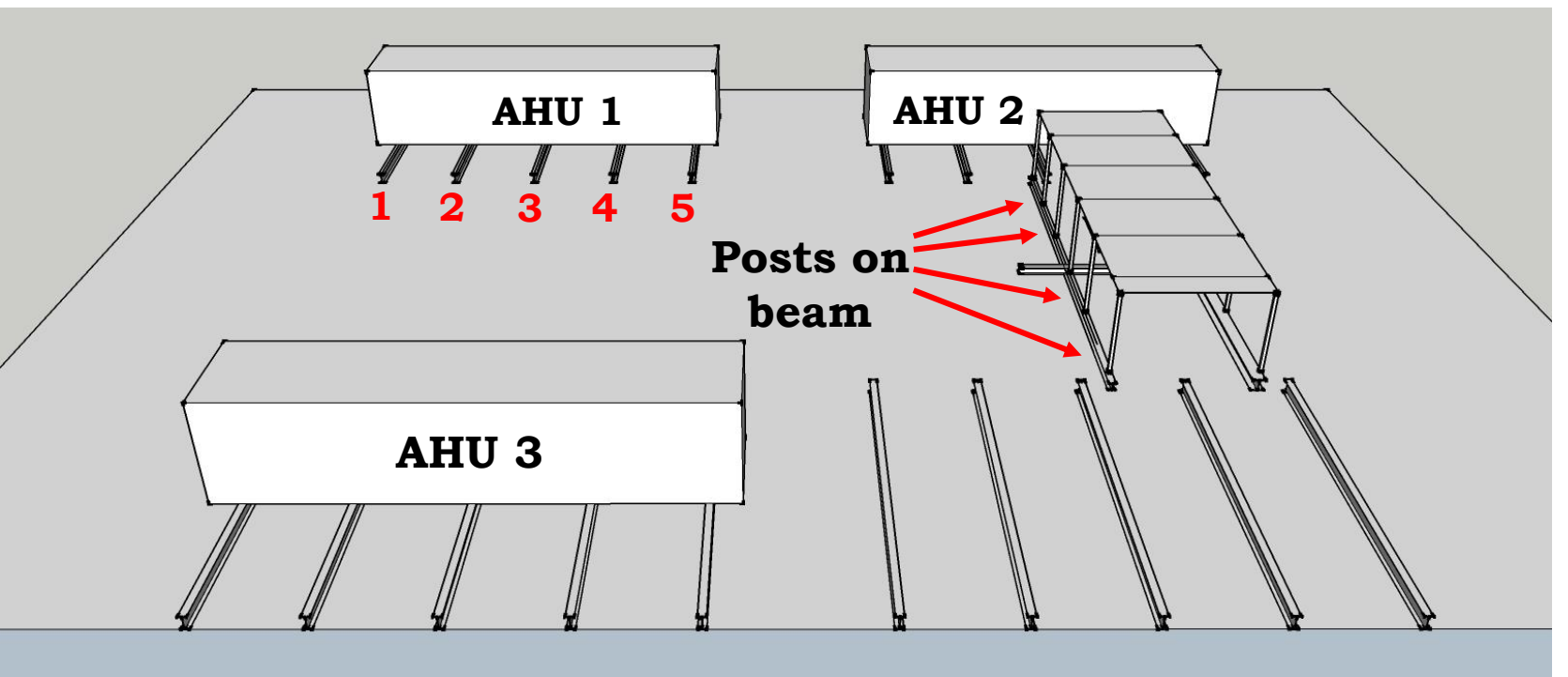
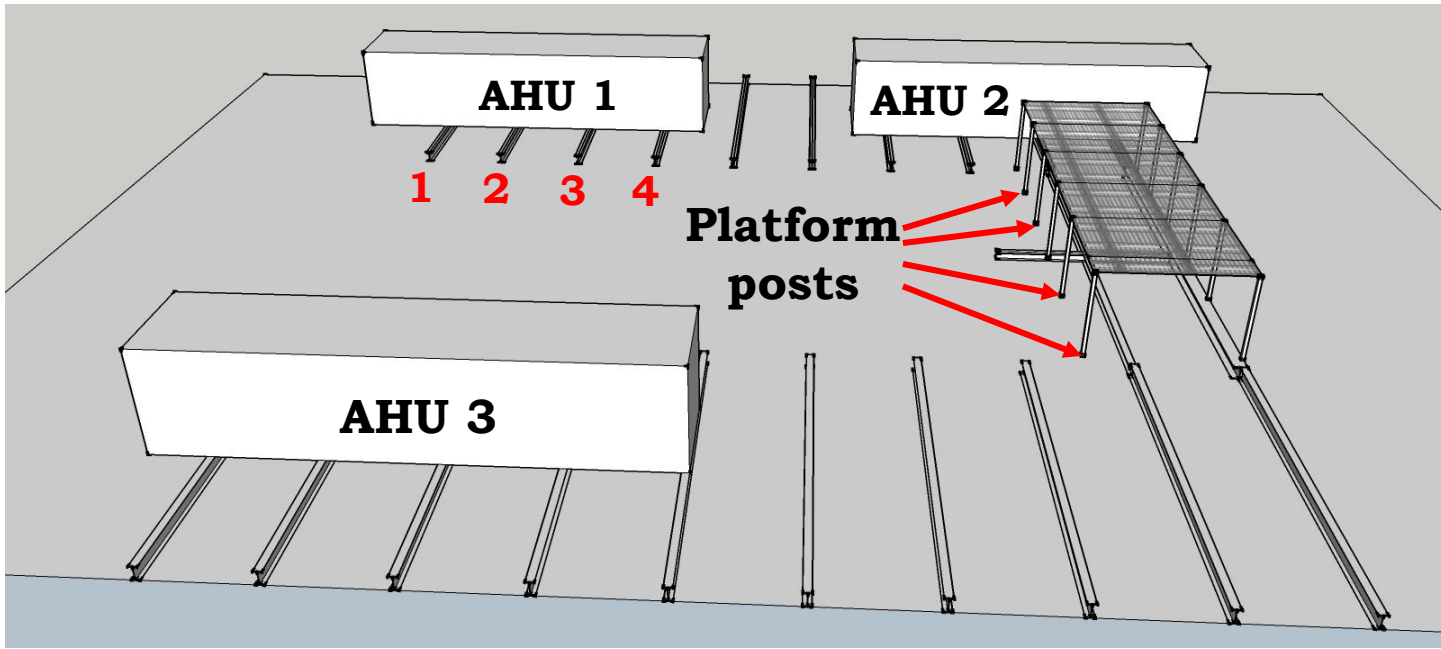
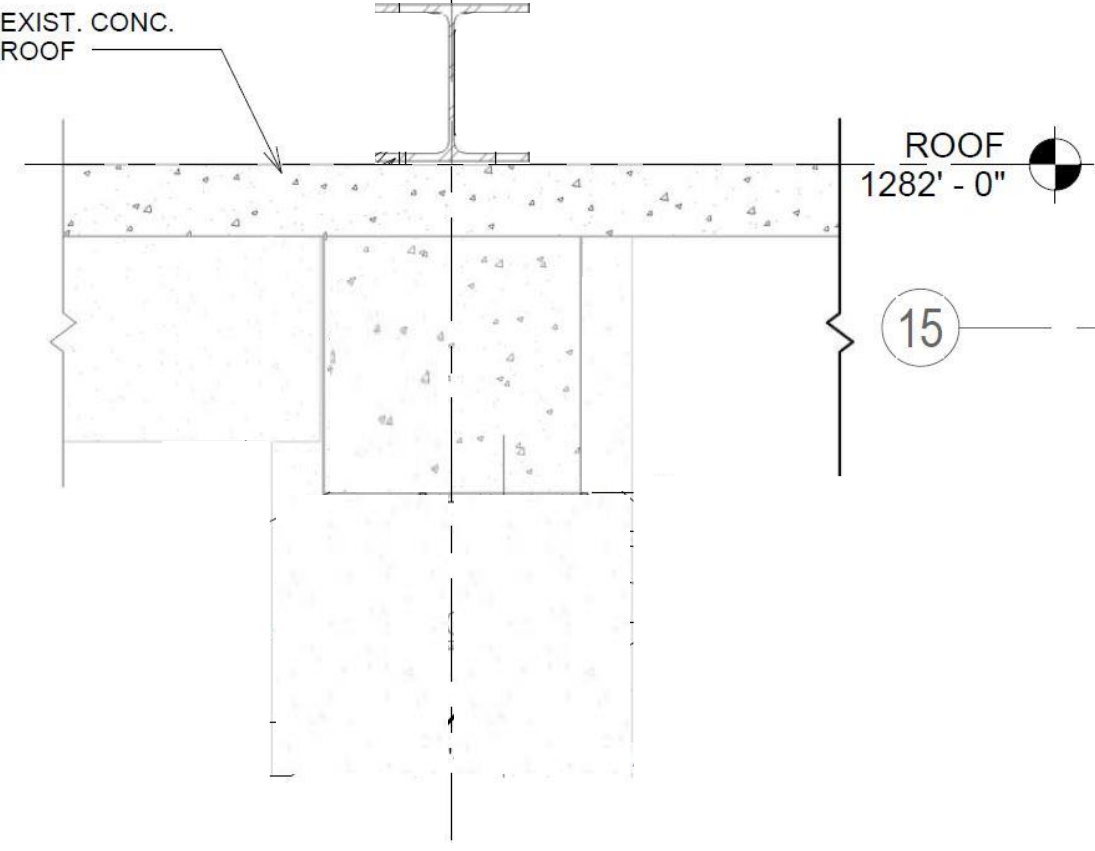
Breadth topic 2 – LED Downlights

Conclusion

Roof Reinforcement

Advantages to Roof-Top Reinforcement

- Does not depend on demolition
- No overhead work means safer work, higher quality product
- No constraints on steel placement
- No lowered ceiling height



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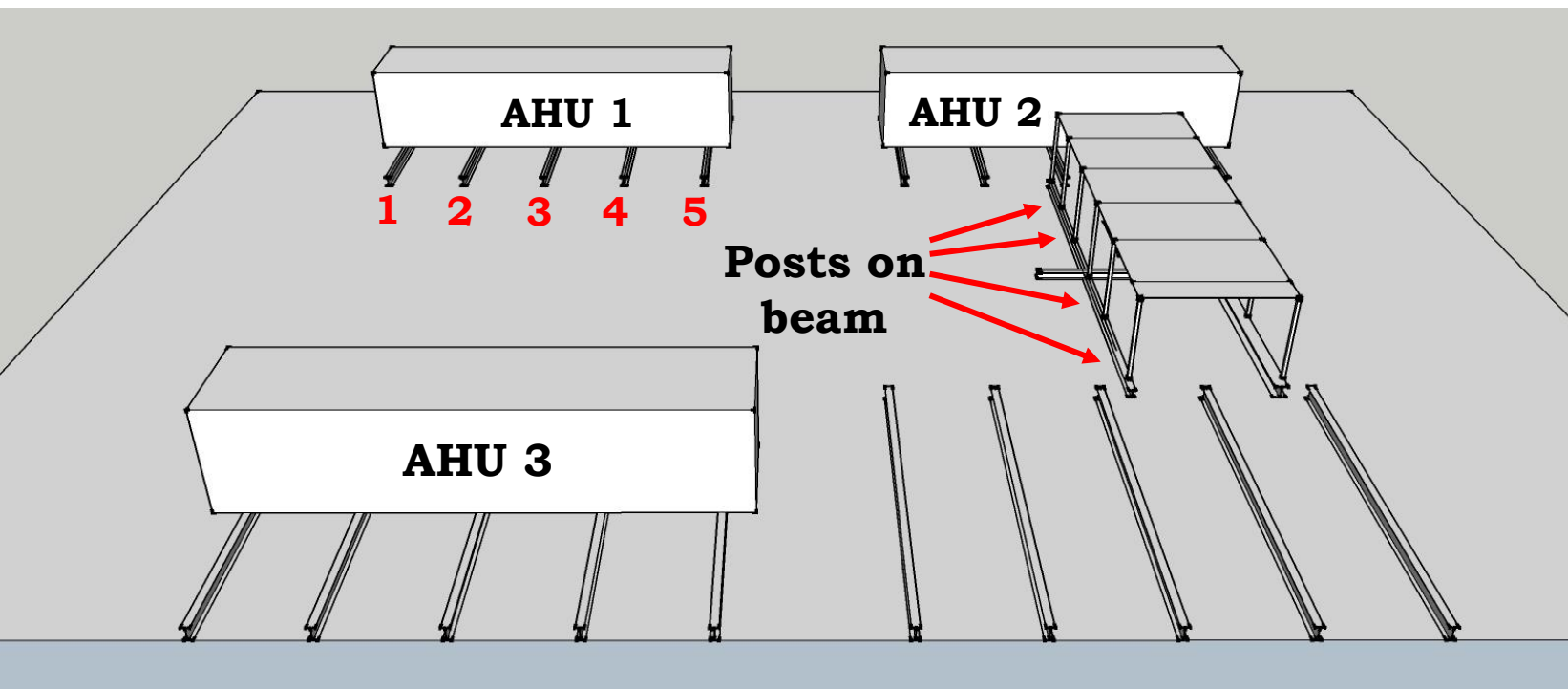
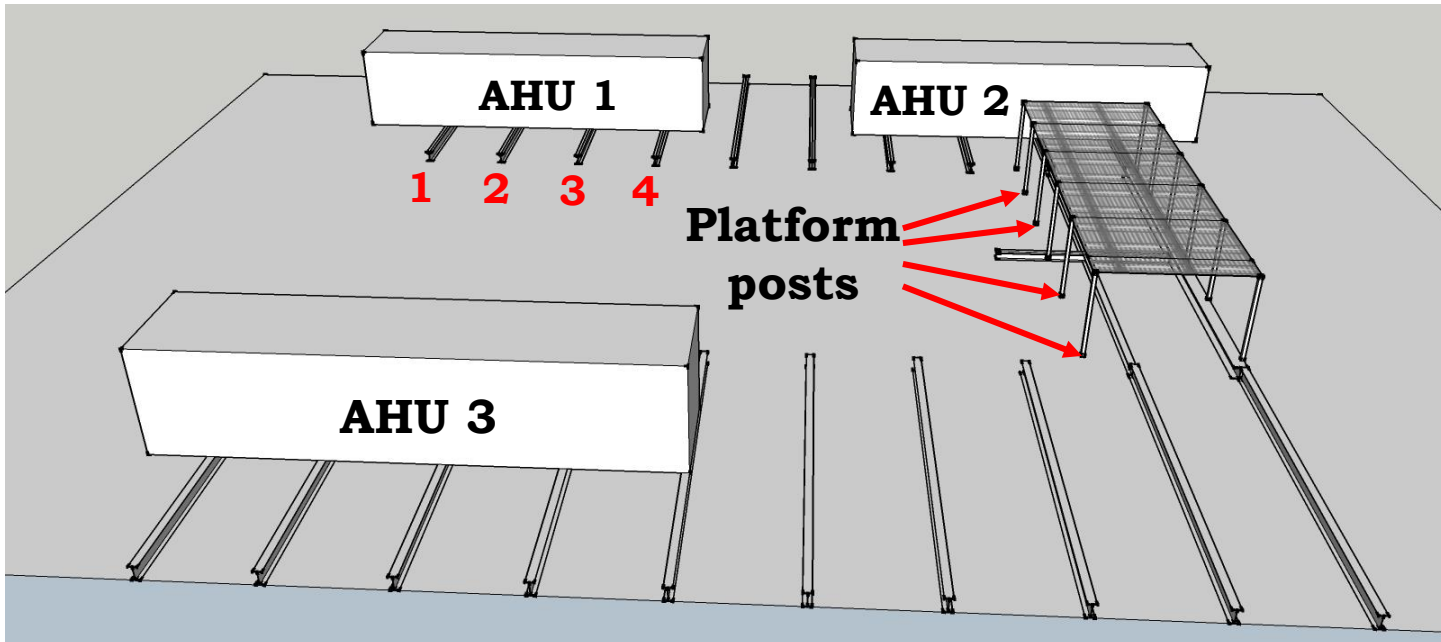
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Roof Reinforcement

Roof Waterproofing

- Project scope includes membrane roof replacement
- Install new roof membrane after steel is in place

ROOF		140	01-Jul-14	12-Jan-15
RF-23020	Temp Tie-in of Existing AHU 1/4 to 5/6 Floor Make-up Air Duct	10	01-Jul-14	14-Jul-14
6F-05020	Erect Screen Wal Structure - Quad 1	10	07-Jul-14	18-Jul-14
6F-02300	Remove AHU 5/6	10	15-Jul-14	28-Jul-14
6F-05050	Erect Screen Wal Structure - Quad 2	5	21-Jul-14	25-Jul-14
6F-05060	Erect Screen Wal Structure - Quad 3	5	28-Jul-14	01-Aug-14
RF-23050	Install HRC/EF Roof Curb	5	29-Jul-14	04-Aug-14
6F-05080	Erect Screen Wal Structure - Quad 4	5	04-Aug-14	08-Aug-14
6F-07010	Replace Roofing Membrane - Quad 1	15	05-Aug-14	25-Aug-14
RF-23060	Set HRC/EF (1st half)	5	05-Aug-14	11-Aug-14
RF-23070	Re-tie Existing Exhaust Riser & Vector Fans	10	12-Aug-14	25-Aug-14
RF-23080	Final Connections & Start-up - EF/HRC (1st half)	20	12-Aug-14	08-Sep-14
6F-08000	Install Metal Wal Panels - Quad 1	5	26-Aug-14	01-Sep-14
RF-23100	Install Distrib Duct - Quad 1	10	26-Aug-14	08-Sep-14
6F-08010	Install FRP Panels - Quad 1	5	02-Sep-14	08-Sep-14
6F-02390	Remove Existing HRC/EF	10	09-Sep-14	22-Sep-14
RF-23130	Install Curb for AHU 2	5	23-Sep-14	29-Sep-14
6F-07050	Replace Roofing Membrane - Quad 3	15	30-Sep-14	20-Oct-14
RF-23140	Set AHU-2	5	30-Sep-14	06-Oct-14
RF-23150	Final Connections & Start-up - AHU 2	20	07-Oct-14	03-Nov-14
6F-02510	Remove Chiller	10	17-Oct-14	30-Oct-14
RF-23160	Install Distrib Duct - Quad 3	10	21-Oct-14	03-Nov-14
6F-08030	Install Metal Wal Panels - Quad 3	5	21-Oct-14	27-Oct-14
6F-08040	Install FRP Panels - Quad 3	5	28-Oct-14	03-Nov-14
RF-23180	Install Curb for AHU-3	5	31-Oct-14	06-Nov-14
RF-23190	Connect Existing Supply Air Piping to AHU's	10	04-Nov-14	17-Nov-14
6F-07060	Replace Roofing Membrane - Quad 2	15	07-Nov-14	27-Nov-14
RF-23210	Set AHU-3	5	07-Nov-14	13-Nov-14



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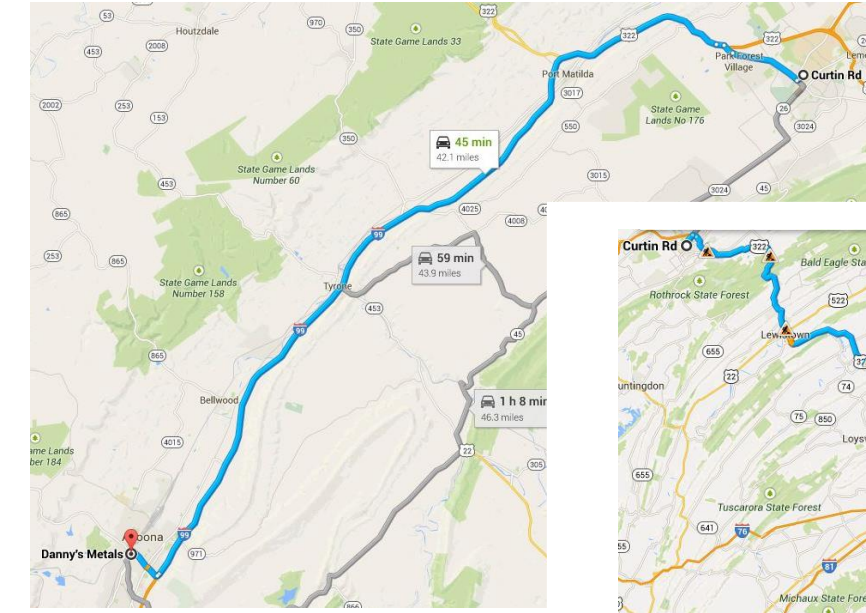
Conclusion

Recycling Opportunities



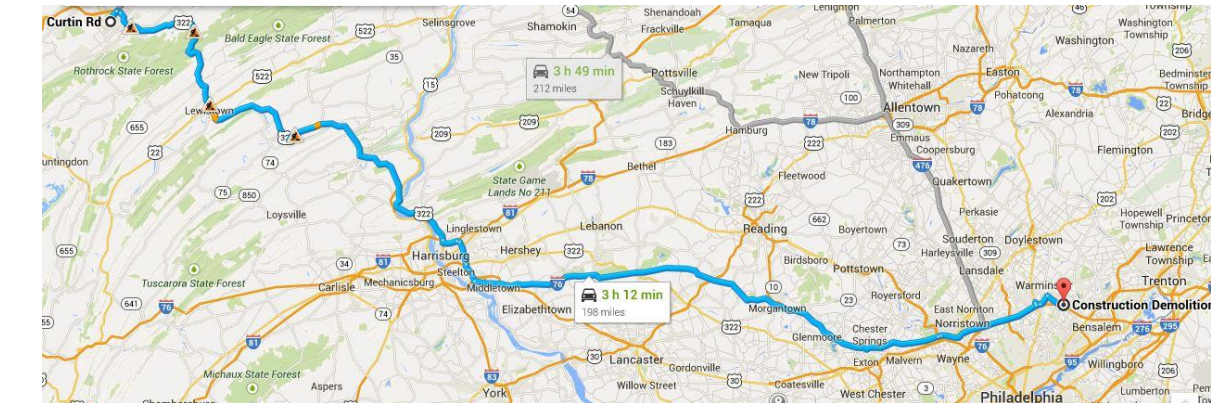
- Altoona, PA
- Recycles scrap metals
- Offers free pick-up
- Pays cash for scrap
- **42 miles away**

$$42 \text{ miles} \times \frac{1 \text{ gallon}}{6 \text{ miles}} = 7 \text{ gallons diesel fuel}$$



- Southampton, PA
- Offers offsite sorting/recycling
- Accepts general construction debris
- **198 miles away**

$$198 \text{ miles} \times \frac{1 \text{ gallon}}{6 \text{ miles}} = 33 \text{ gallons diesel fuel}$$



- Lancaster, PA
- Recycles new and used ceiling tiles
- **126 miles away**

$$126 \text{ miles} \times \frac{1 \text{ gallon}}{6 \text{ miles}} = 21 \text{ gallons diesel fuel}$$



- Reinholds, PA
- Recycles new, unpainted gypsum only
- No demolition drywall
- **135 miles away**

$$135 \text{ miles} \times \frac{1 \text{ gallon}}{6 \text{ miles}} = 22.5 \text{ gallons diesel fuel}$$



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Recycling Opportunities


Trash Chute Rental

	Size	Day	Week	4 Weeks
Trash Chute	50'	115.00	305.00	700.00

NOTE: Prices displayed do not include sales tax or damage waiver.


$$10 \text{ months} \times \frac{4.3 \text{ weeks}}{1 \text{ month}} \times \frac{\$700}{4 \text{ weeks}} = \$7525 \text{ total rental cost}$$

Trash Chute Purchase




DuraChute
More durable than flat chutes. Stronger chutes minimize downtime, damage to property and...

\$200.00



Trash Chute Hopper
Top section for trash chute system stands up to punishment.

\$635.00



DuraChute Window/Parapet Outrigger (Set)
Window/Parapet Outrigger (Set) for DuraChute System

\$800.00

$$75' \text{ chute} \times \frac{12 \text{ inches}}{1 \text{ foot}} \times \frac{1 \text{ section}}{31 \text{ inches}} = 29 \text{ sections}$$

$$29 \text{ sections} \times \frac{\$200}{1 \text{ section}} = \$5800$$

$$\begin{aligned}
 & \$5800 \text{ chute} \\
 & +\$635 \text{ hopper} \\
 & +\$800 \text{ mount} \\
 & = \mathbf{\$7235 \text{ total purchase cost}}
 \end{aligned}$$

Dumpster Rental



$$10 \text{ months} \times \frac{4.3 \text{ weeks}}{1 \text{ month}} \times \frac{\$13.5}{1 \text{ week}} = \$580.50$$

$$\begin{aligned}
 & \$580.50 \text{ extra fee} \\
 & +\$810.72 \text{ base price} \\
 & = \mathbf{\$1391.22 \text{ total dumpster rental cost}}
 \end{aligned}$$

$$\begin{aligned}
 & \$1391 \text{ dumpster rental} \\
 & +\$7235 \text{ trash chute purchase} \\
 & = \mathbf{\$8626 \text{ Total Cost}}
 \end{aligned}$$

Break Even Calculations

$$\begin{aligned}
 & \$8626 \text{ Chute and Dumpster cost} \\
 & \div \$0.11 \text{ per lb scrap steel} \\
 & = \mathbf{78,418 \text{ lbs scraps steel}}
 \end{aligned}$$

$$\begin{aligned}
 & 9751 \text{ lbs duct being installed on 1st floor} \\
 & \times 3 \text{ for 1st, 5th, 6th floor} \\
 & = \mathbf{29,253 \text{ lbs scrapped duct weight}}
 \end{aligned}$$

$$\begin{aligned}
 & 18700 \text{ lbs per AHU} \\
 & \times 3 \text{ being installed} \\
 & = \mathbf{56,100 \text{ lbs scrapped AHU weight}}
 \end{aligned}$$

$$\begin{aligned}
 & 29,253 \text{ lbs duct weight} \\
 & + 56,100 \text{ lbs AHUs} \\
 & = \mathbf{85,353 \text{ lbs Mech scrap weight}}
 \end{aligned}$$

Results

- Mech scrap will pay for dumpster, trash chute
- Electrical scrap extra
- Plumbing scrap extra

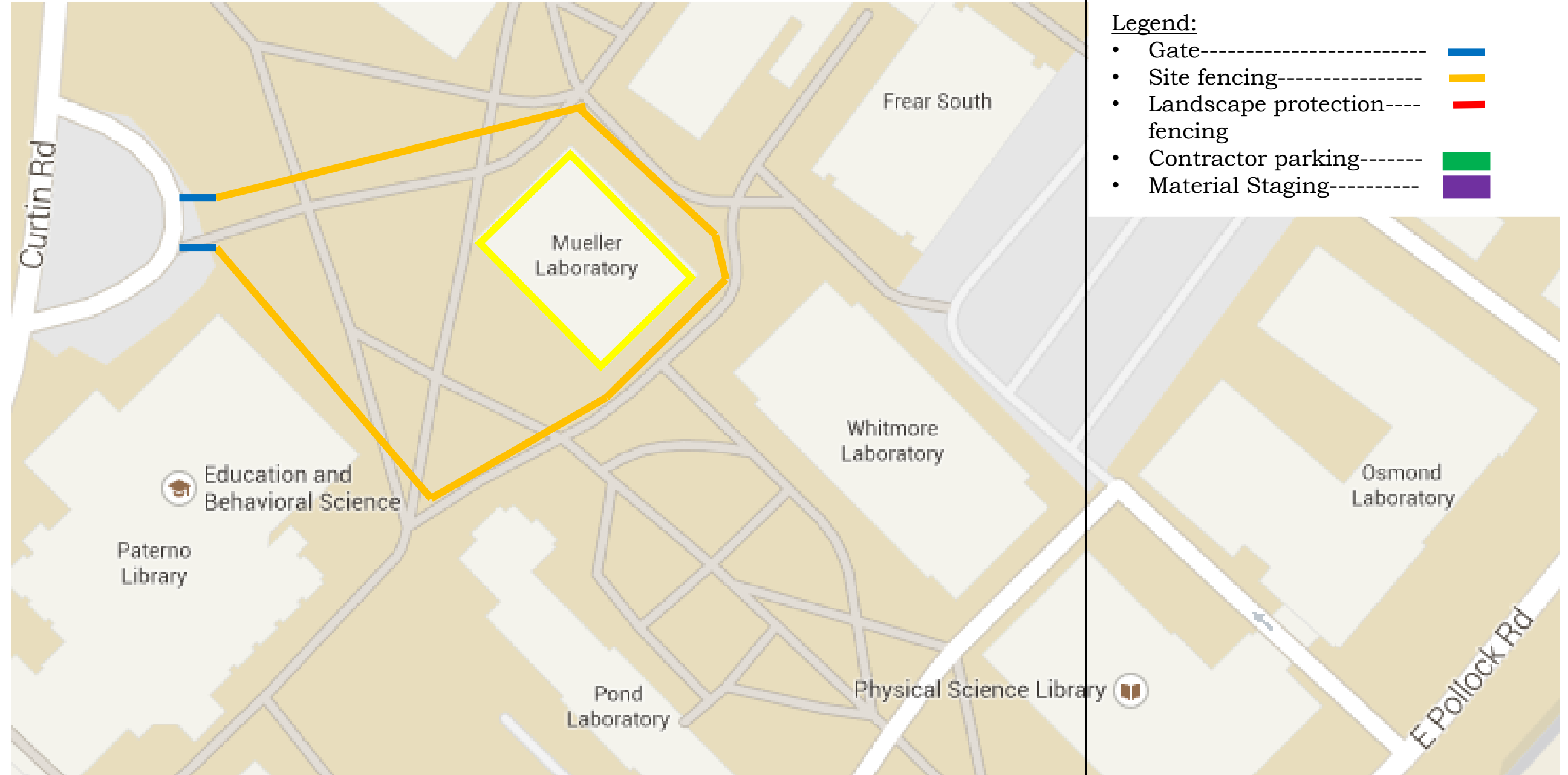


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Site Logistics

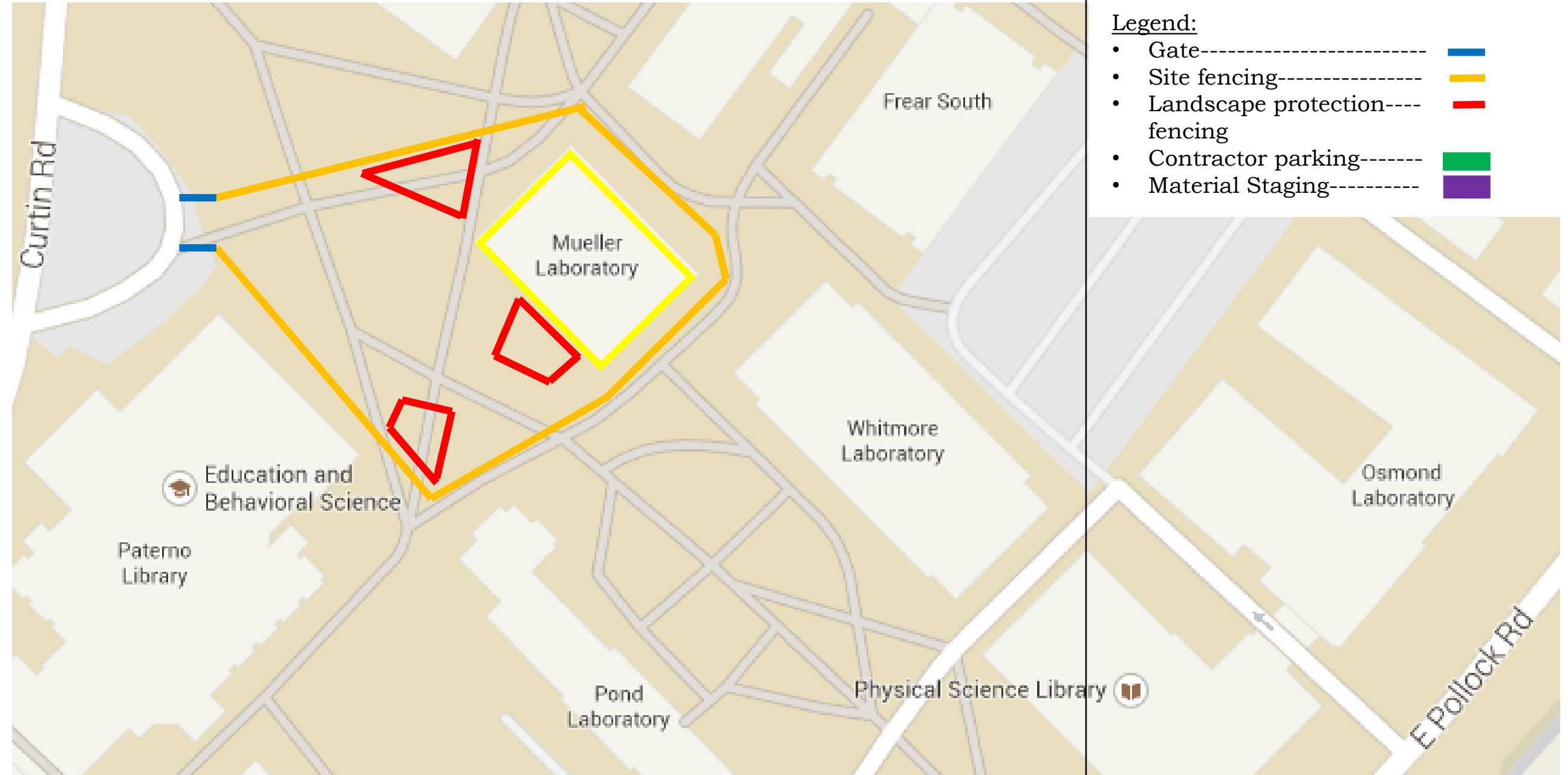


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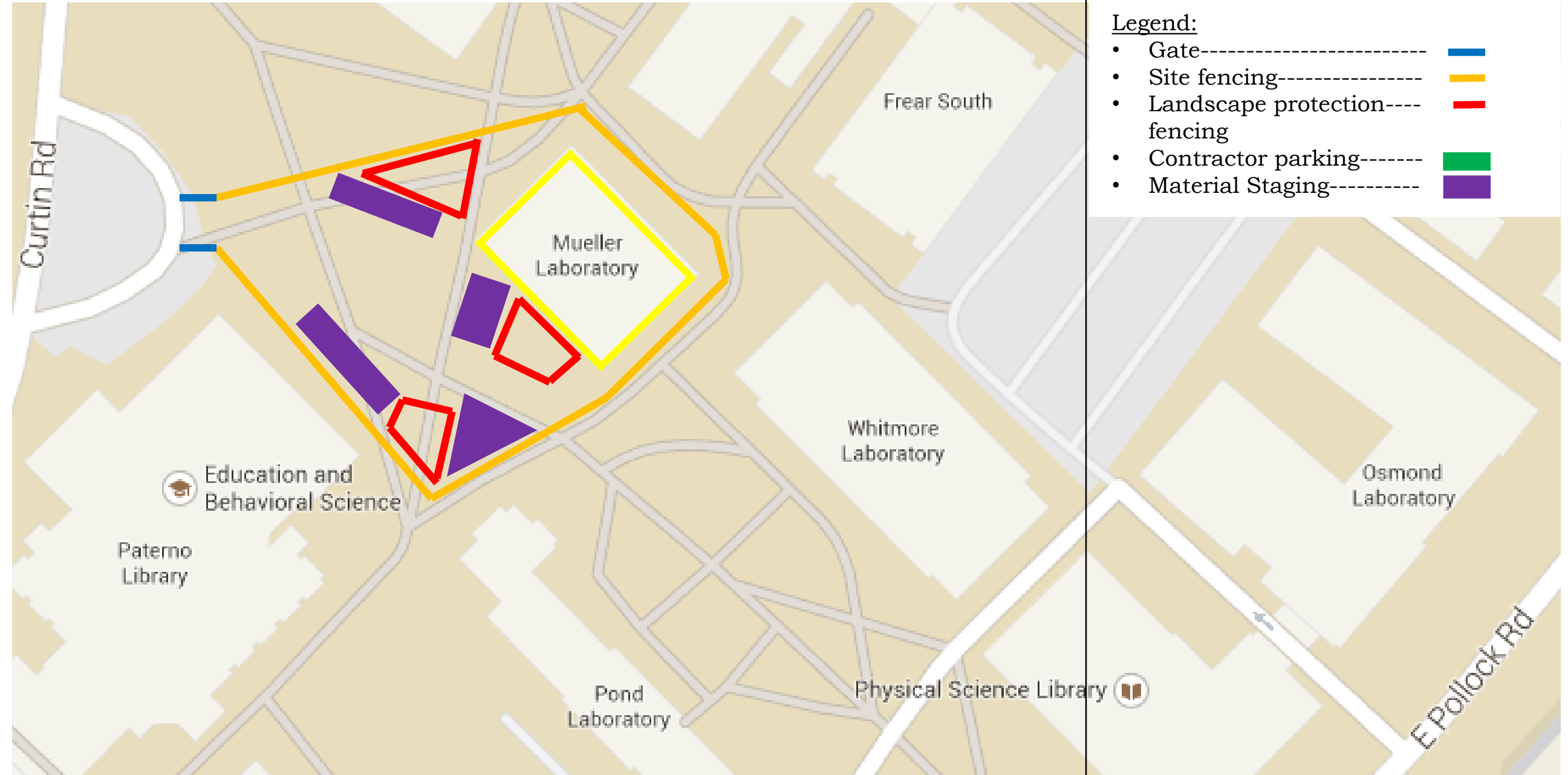


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Site Logistics



Legend:

- Gate----- [Blue line]
- Site fencing----- [Yellow line]
- Landscape protection----- [Red line]
- Contractor parking----- [Green shaded area]
- Material Staging----- [Purple shaded area]

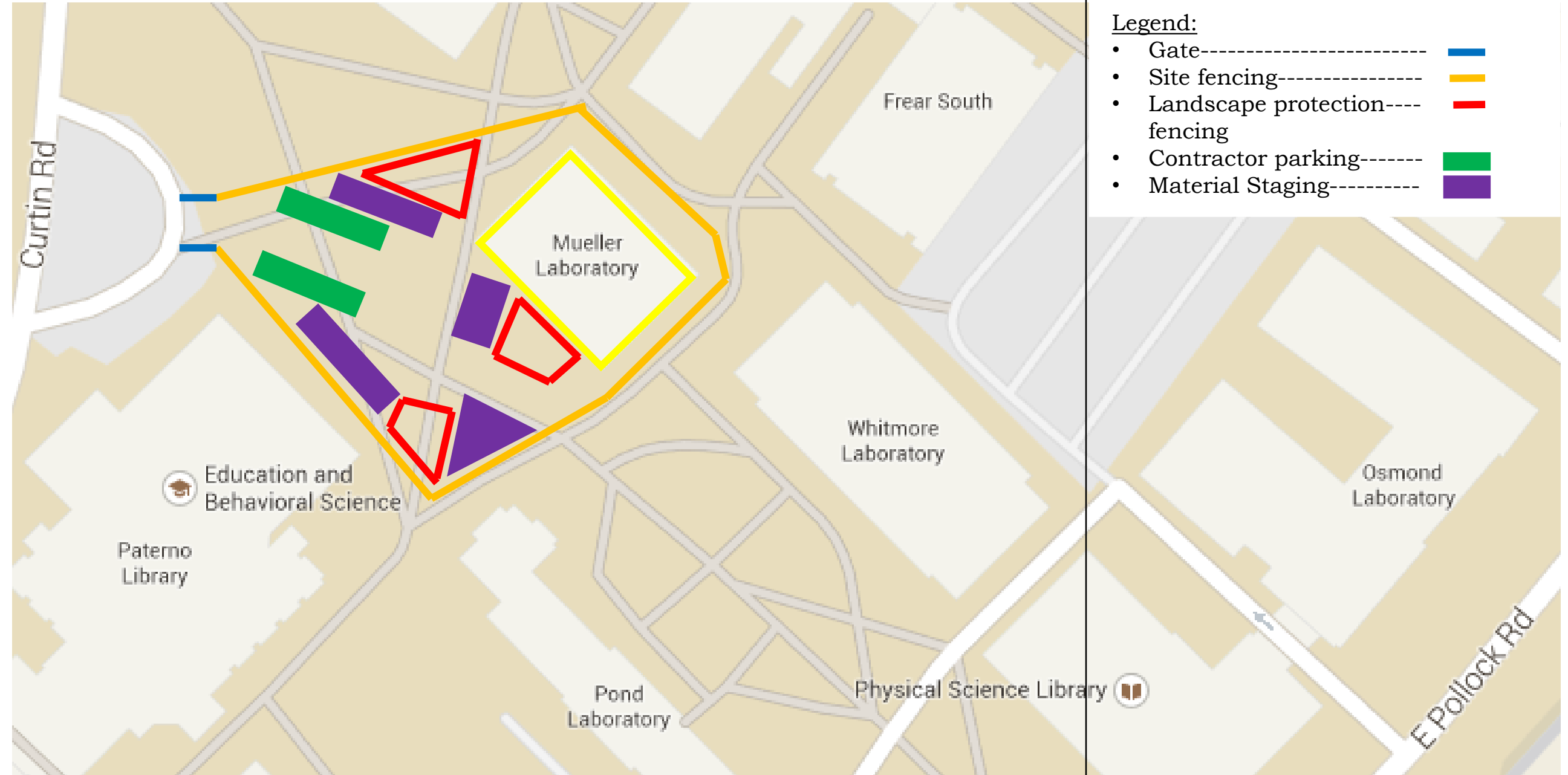


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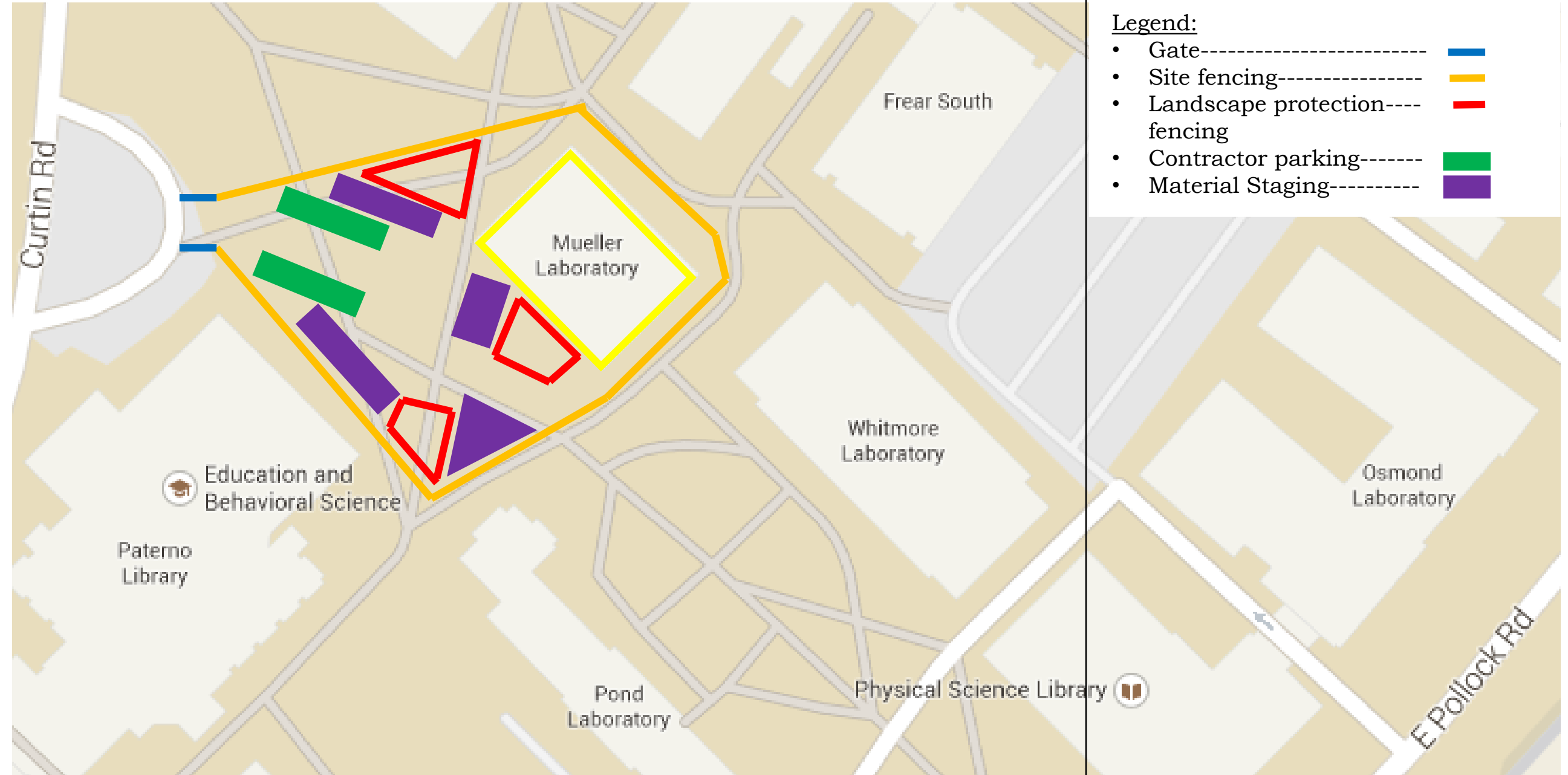


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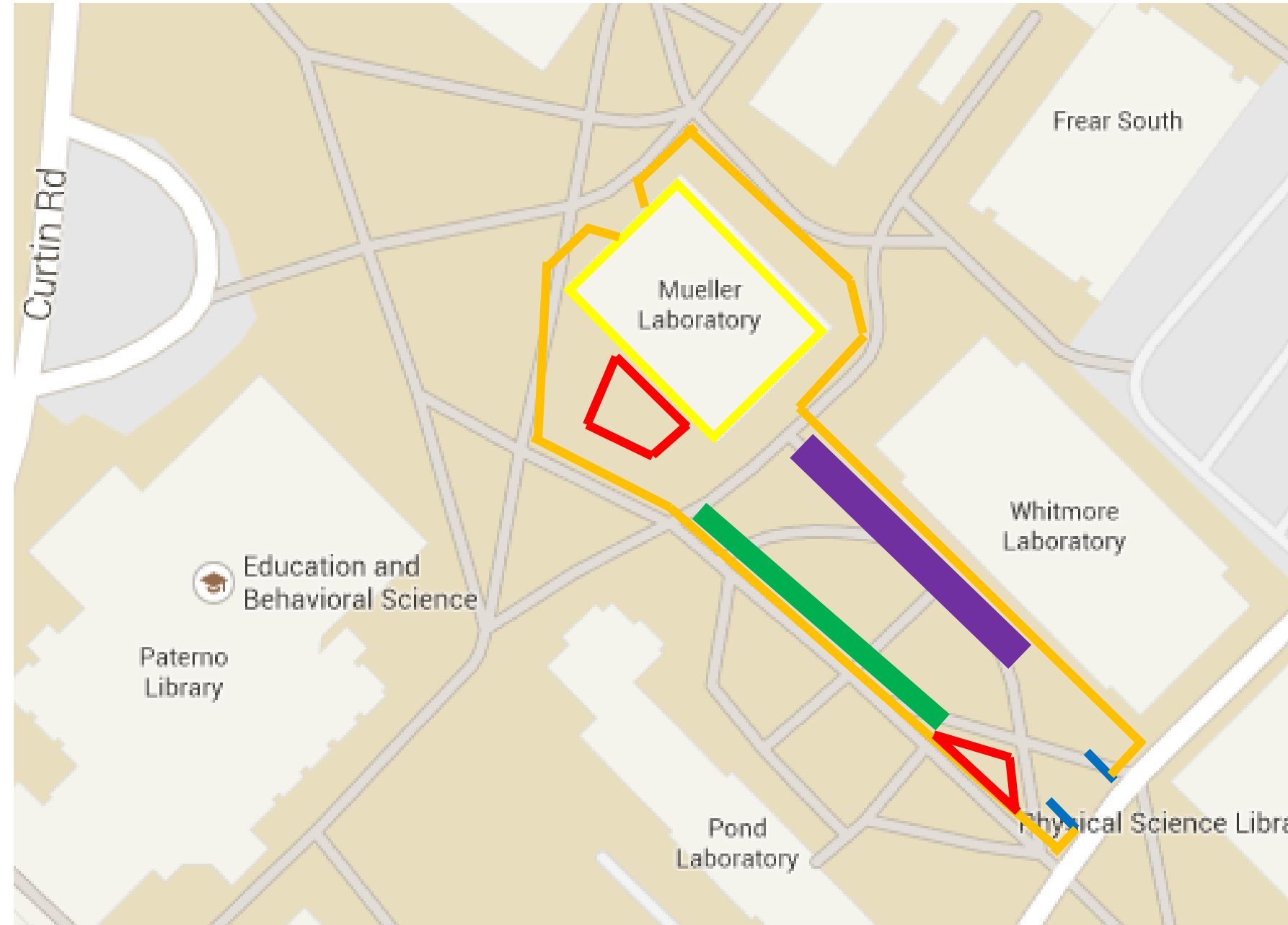


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Proposed Plan

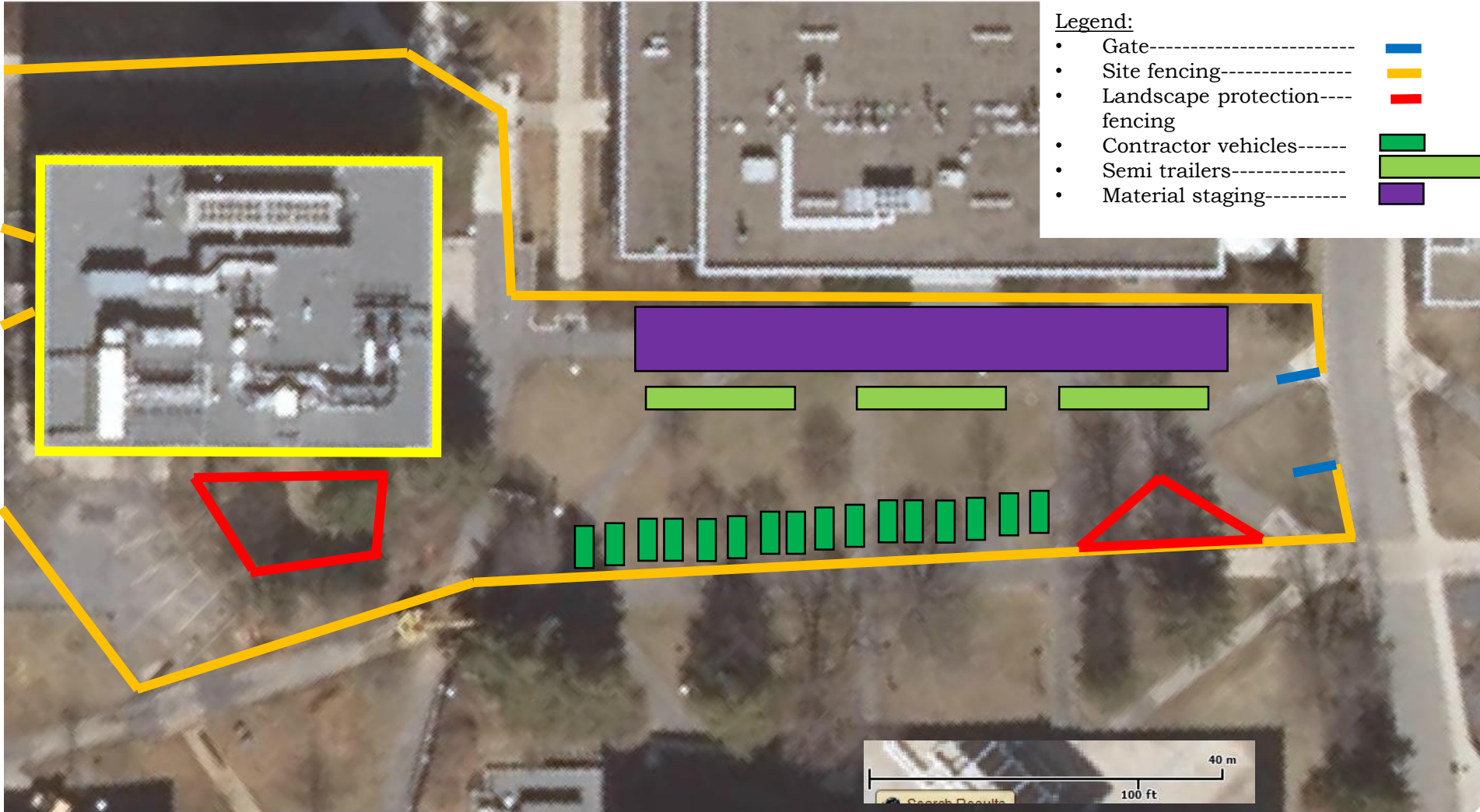
- New work site between Whitmore, Pond Labs
- Whitmore accessible from south, east, west
- Work site access from south, Pollock Road
- Hydrant for truck-wash station

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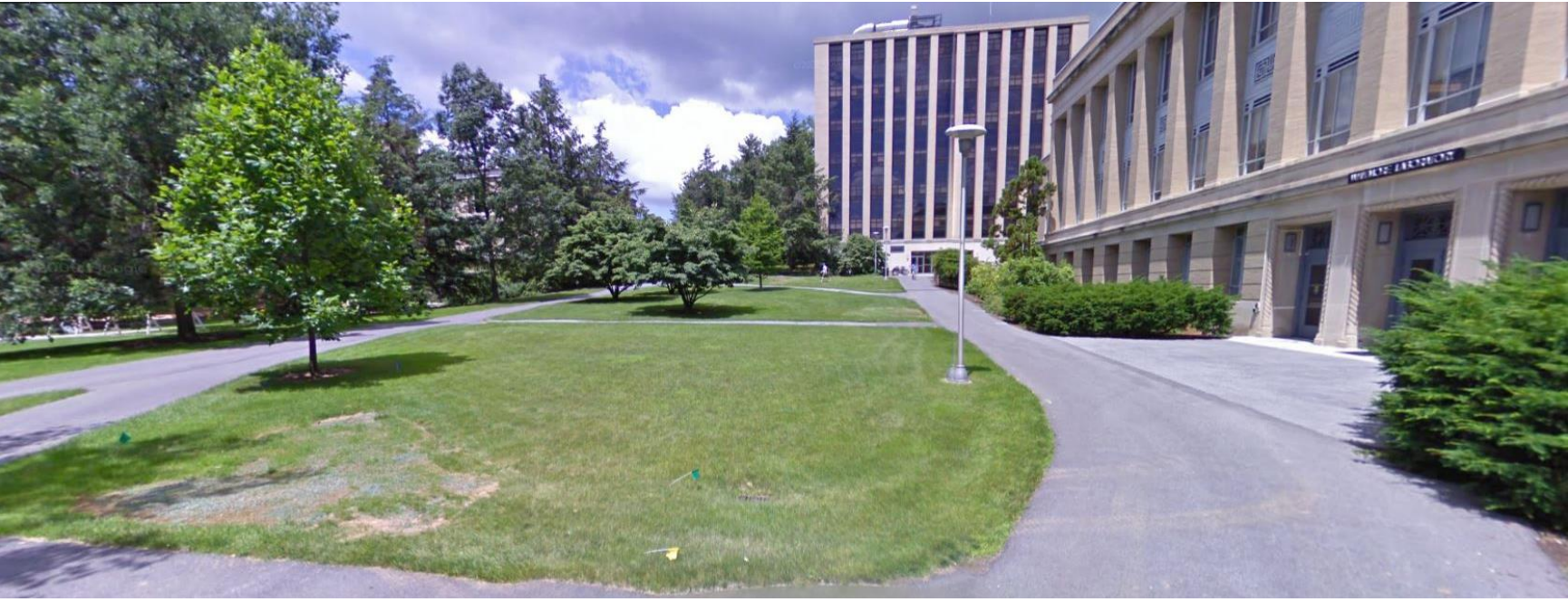
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Site Logistics



Proposed Plan

- Fewer trees to work around
- More contractor parking
- More staging area
- Flatter staging area
- More delivery space
- North entrance open for duration of construction



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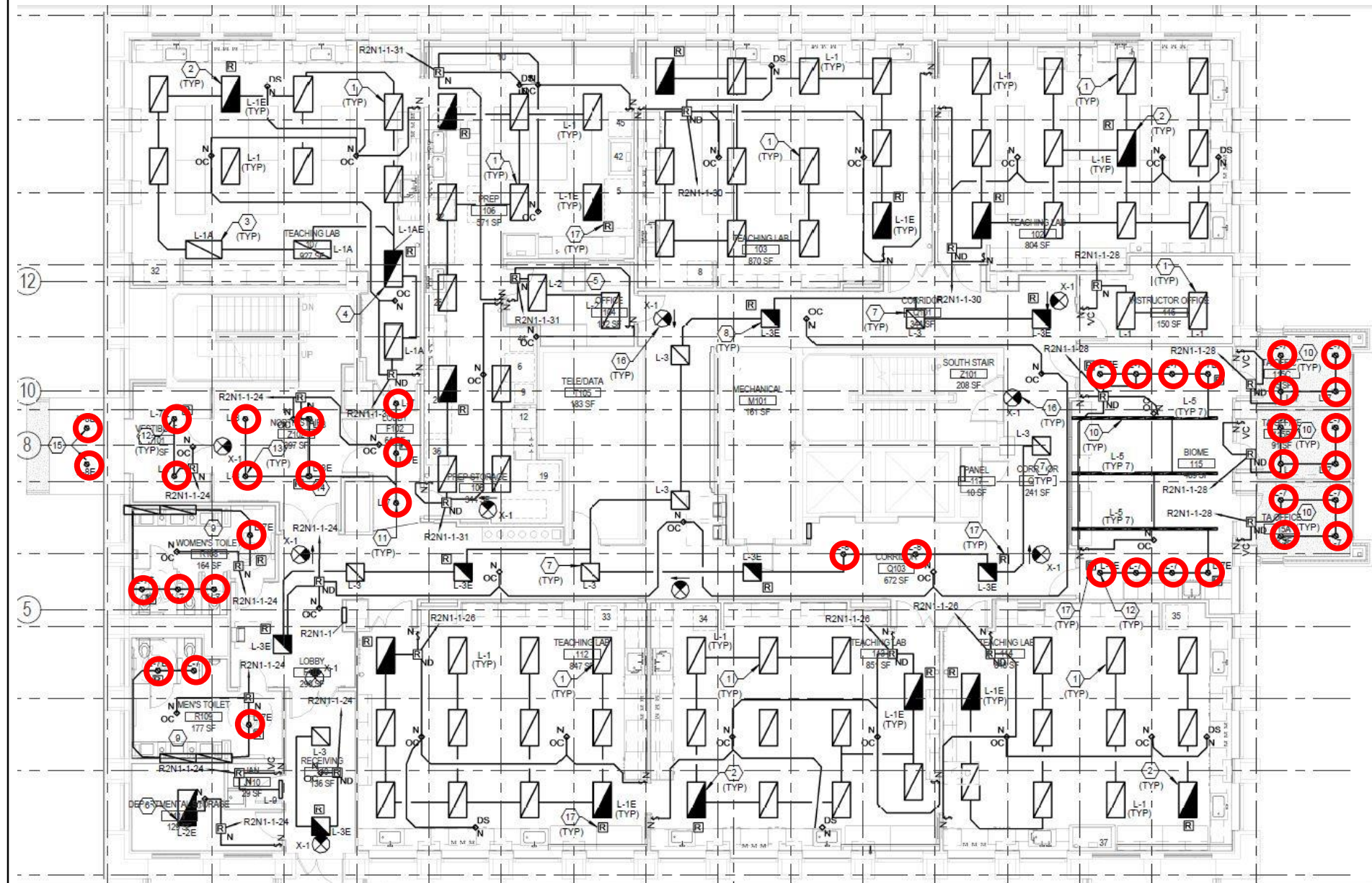
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LED Downlights

Current LED Downlight Fixtures

- In entryways, lobbies, bathrooms
- Not in lab space
- 60 fixtures total

	Wattage	Lumens	CRI	CRT
CREE 4" LED fixture	13	665	90	4000
CREE 6" LED fixture 1	18	1250	90	4000
CREE 6" LED fixture 2	30	1664	90	4000



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LED Downlights

Proposed LED Downlight Fixtures

- Use standard can fixtures
- Use screw-in LED bulbs
- Match bulb performance to spec'd fixture

	Wattage	Lumens	CRI	CRT
CREE 4" LED fixture	13	665	90	4000
CREE 6" LED fixture 1	18	1250	90	4000
CREE 6" LED fixture 2	30	1664	90	4000
LED bulb 1	13	700	92	2700
LED bulb 2	20.8	1250	94	2700
LED bulb 3	26	1650	82	4000

	Fixtures	Cost per fixture	CREE fixture total costs	Cost per screw-in bulb	Screw in bulb total costs	Difference in total costs
CREE 4"	2	\$157	\$314	\$33	\$66	\$248
CREE 6" #1	48	\$157	\$7536	\$36	\$1728	\$5808
CREE 6" #2	10	\$204	\$2040	\$69	\$690	\$1350
				Total amount saved:		\$7406



Advantages of screw-in LED bulbs

- Less expensive than hard-wired fixtures
- Better performance from screw-in bulbs
- Inexpensive maintenance
- Can take advantage of technological advances

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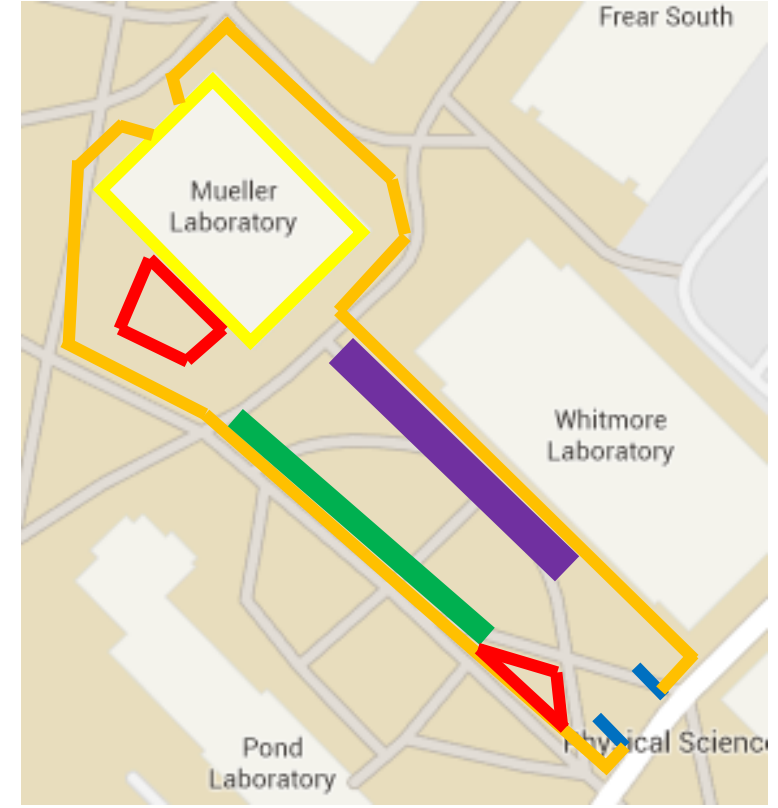
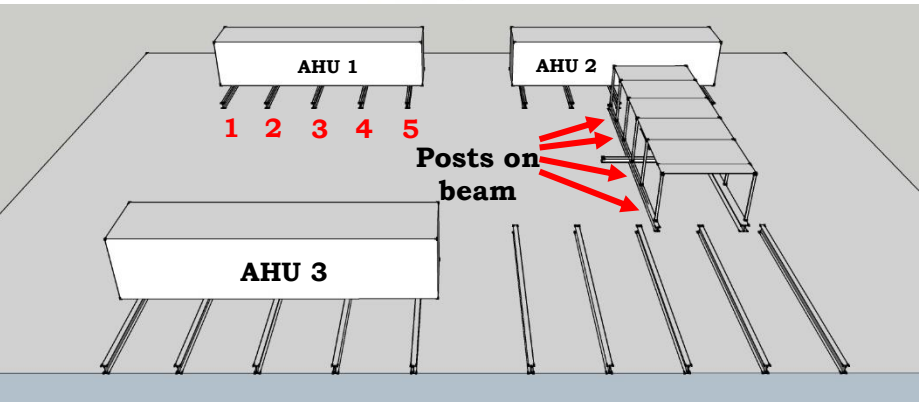
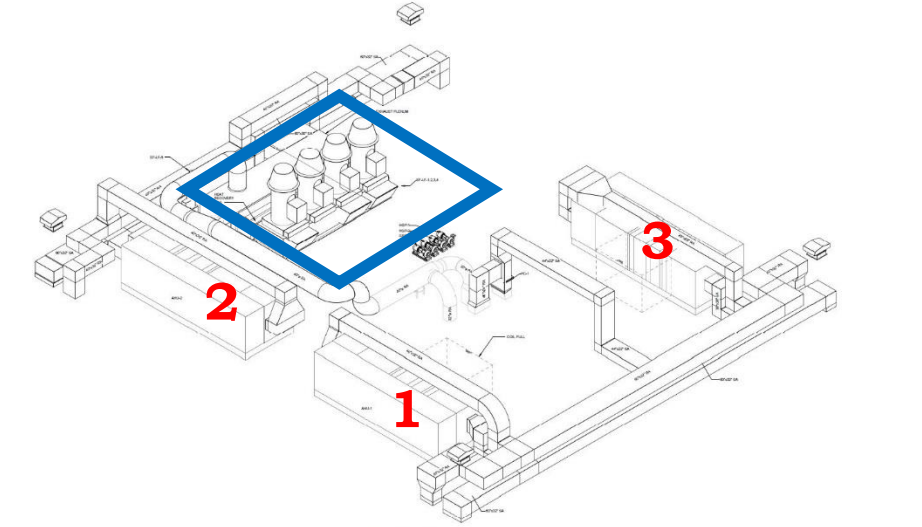
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Conclusion

Recommendations

- Move the roof reinforcement to the top of the roof deck.
- Scrap metal recycling is economical and easy.
- The project's worksite would benefit greatly from going south, not west.
- Screw-in LED bulbs should be used instead of hard-wired LED downlights.



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Barton Malow
Dr. Riley
PSU AE Department

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Questions?