



FEBRUARY 5<sup>TH</sup>, 2020

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# Healthy, Resilient, Affordable: Zero Energy Modular

Peter Schneider



# ZEM impact 2013-December 2019



97

ZEM homes delivered



1,209,766

energy (heat + electric)  
costs avoided by owners



2,313

metric tons CO<sub>2</sub>  
emissions avoided



20

Vermont jobs directly created

# Why Zero Energy Modular (ZEM)?

- zero energy
- resilient
- healthy



AFFORDABLE

# How do we achieve zero energy?

1

Reduce energy demand & control loss





**R-40 floor/walls  
R-60 roof**



**<1.0 ACH50  
& Triple-glazed  
windows**



**Continuous  
insulation w/ no  
thermal bridging**

# How do we achieve zero energy?

1

Reduce energy demand & control loss

2

Incorporate efficient mechanical systems



**Appliances & lighting**



**Air source heat pump**



**Balanced ventilation**



**Heat pump water heater**

# How do we achieve zero energy?

1

Reduce energy demand & control loss

2

Incorporate efficient mechanical systems

3

Reach zero energy with solar production





# Why Zero Energy Modular (ZEM)?

- zero energy
- resilient
- healthy



AFFORDABLE

# ZERO ENERGY MODULAR HOME

**FLOOR** R-40  
**WALLS** R-43  
**ROOF** R-60

12" Structural Insulated Panel (SIP) with Neopor insulation

Airtight ducts inside house

6" overhang

Durable, maintenance-free siding (metal, vinyl, cedar, composite)

5/8" sheetrock & no-VOC paints

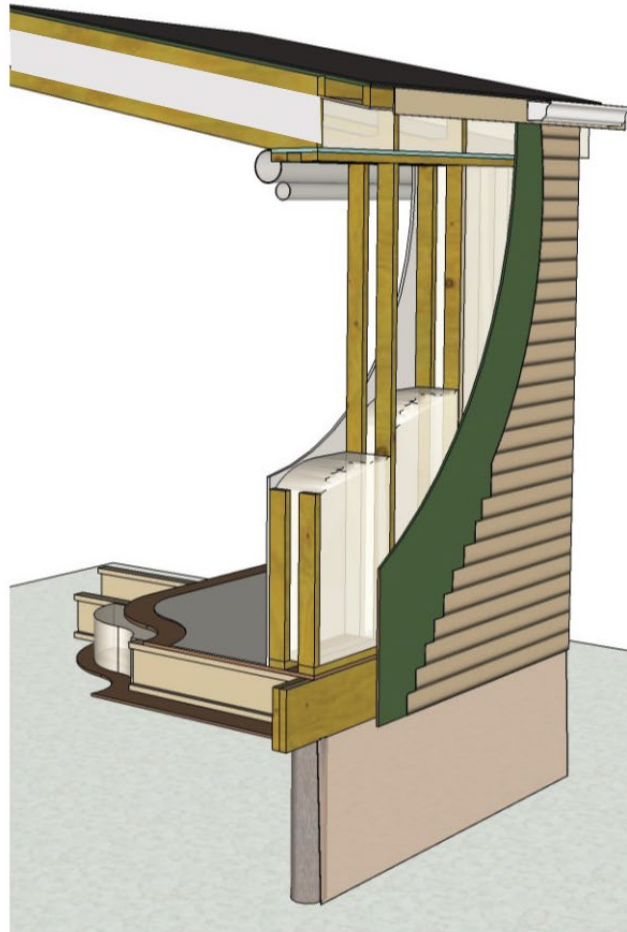
Double stud walls, 10" cavity

OSB decking and sheathing with no added urea formaldehyde

9.5" floor system

Moisture-tight underbelly

Frost protected foundation

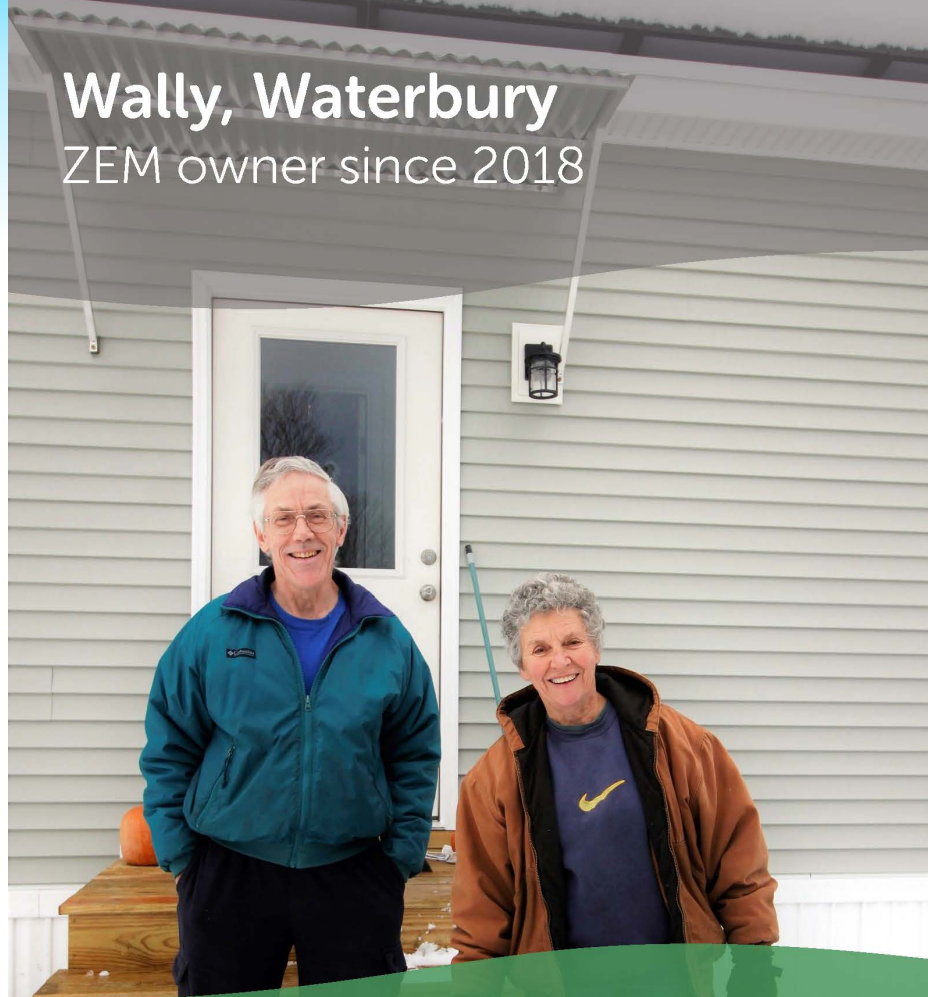


- durable materials
- quality craftsmanship
- latest in building science



# Wally, Waterbury

ZEM owner since 2018



“Winter outages were stressful in my old house. When the power went out in my new home, I stayed in a t-shirt! The temperature hardly dropped.”

ZEM (Zero Energy Modular) is a project of:





# Why Zero Energy Modular (ZEM)?

- zero energy
- resilient
- **healthy**



**AFFORDABLE**

High-quality materials reduce off-gassing





Fresh air ventilation  
maintains superior  
indoor air quality





# Spencer & Cliff, Duxbury

ZEM owners since 2017



“We love the peace of mind, knowing that we are assured good indoor air quality. I just changed the filters today!”

ZEM (Zero Energy Modular) is a project of:



# Why Zero Energy Modular (ZEM)?

- zero energy
- durable
- healthy

**AFFORDABLE**

Bill and Pauline, Hardwick, VT



# Affordability

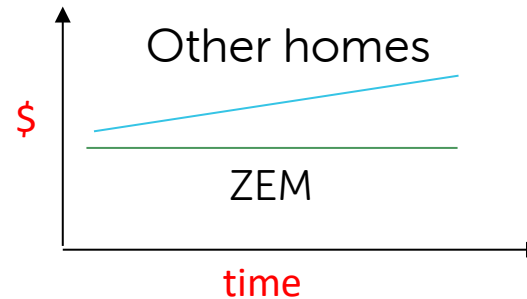
For low- and moderate-income homebuyers

# Affordability

Cash Flow on a monthly basis at or below \$1200/month including energy costs

ZEM homes are **affordable**.

## Monthly costs of ownership

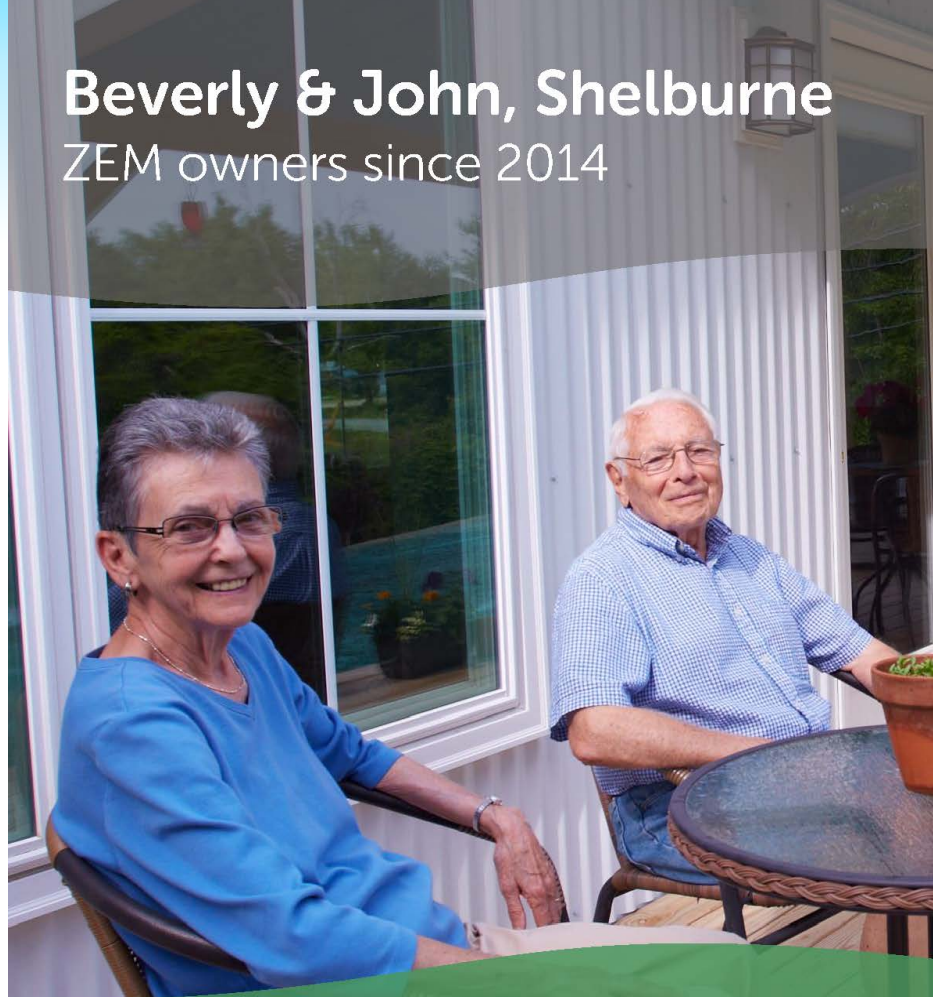


- In the short term, owners save with no energy costs.
- In the long term, owners avoid maintenance expenses and invest in an asset that holds its value over time.



# Beverly & John, Shelburne

ZEM owners since 2014



"I'm always thrilled to open my electric bill. With the money we've saved, we have helped out family members and paid medical bills."

ZEM (Zero Energy Modular) is a project of:

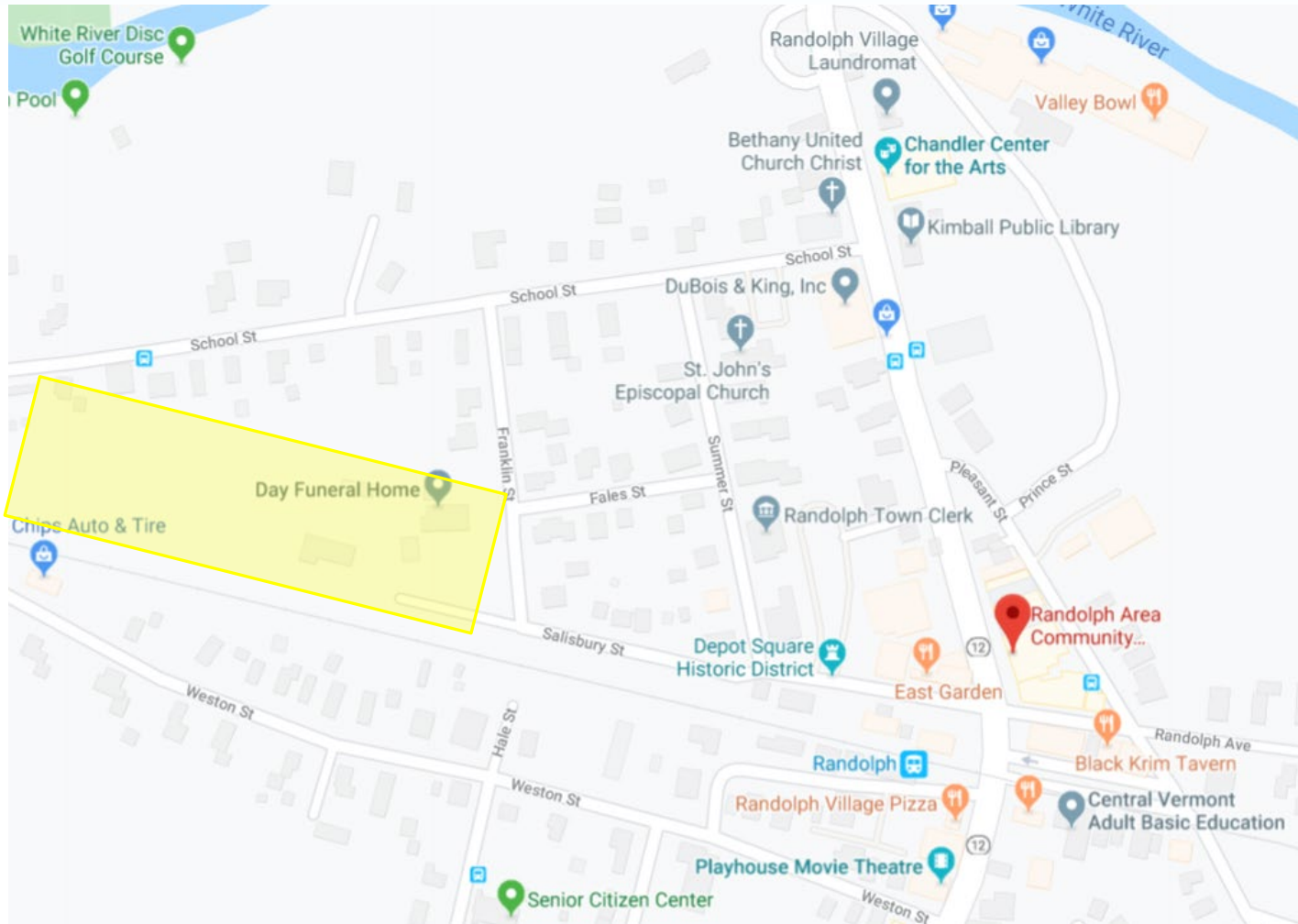




# ZEM Applications

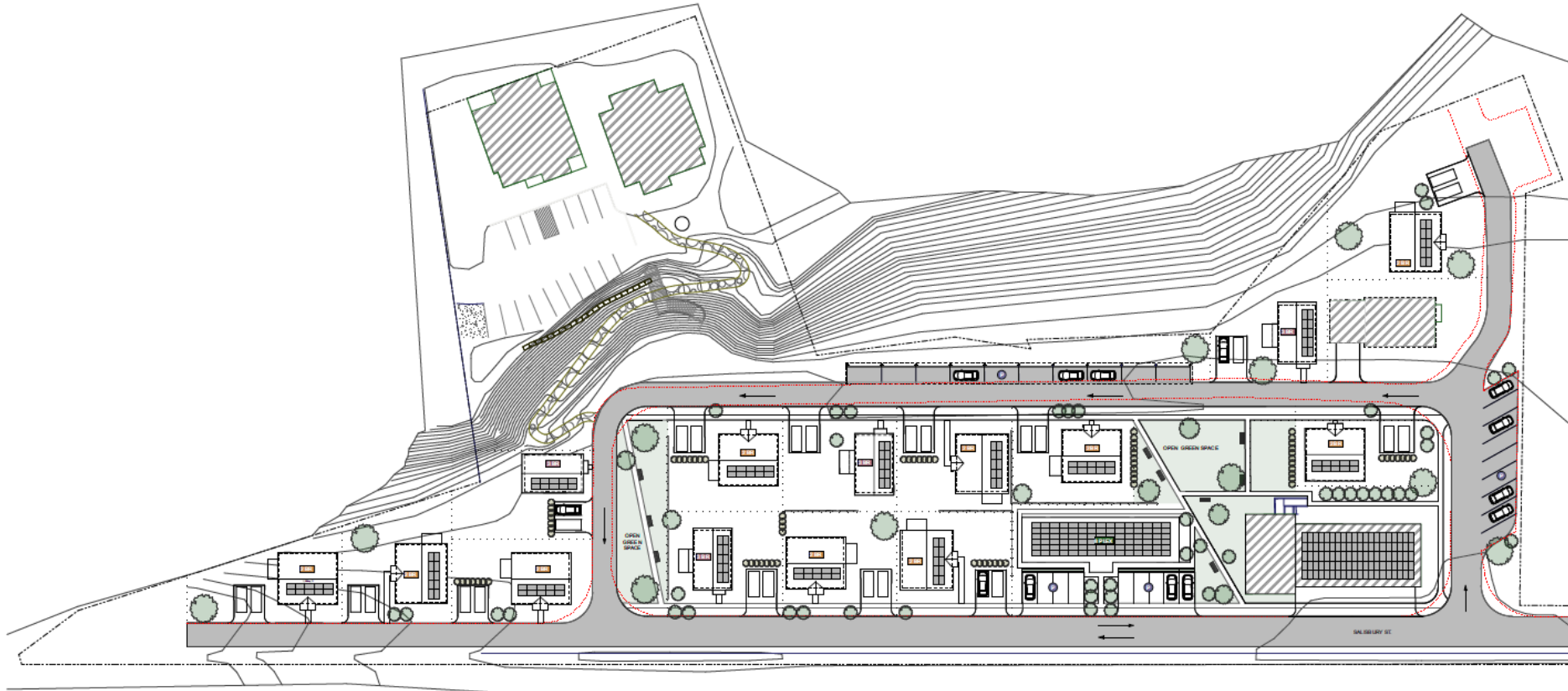
# New Communities

## Salisbury Square | Randolph



# New Communities

## Salisbury Square | Randolph



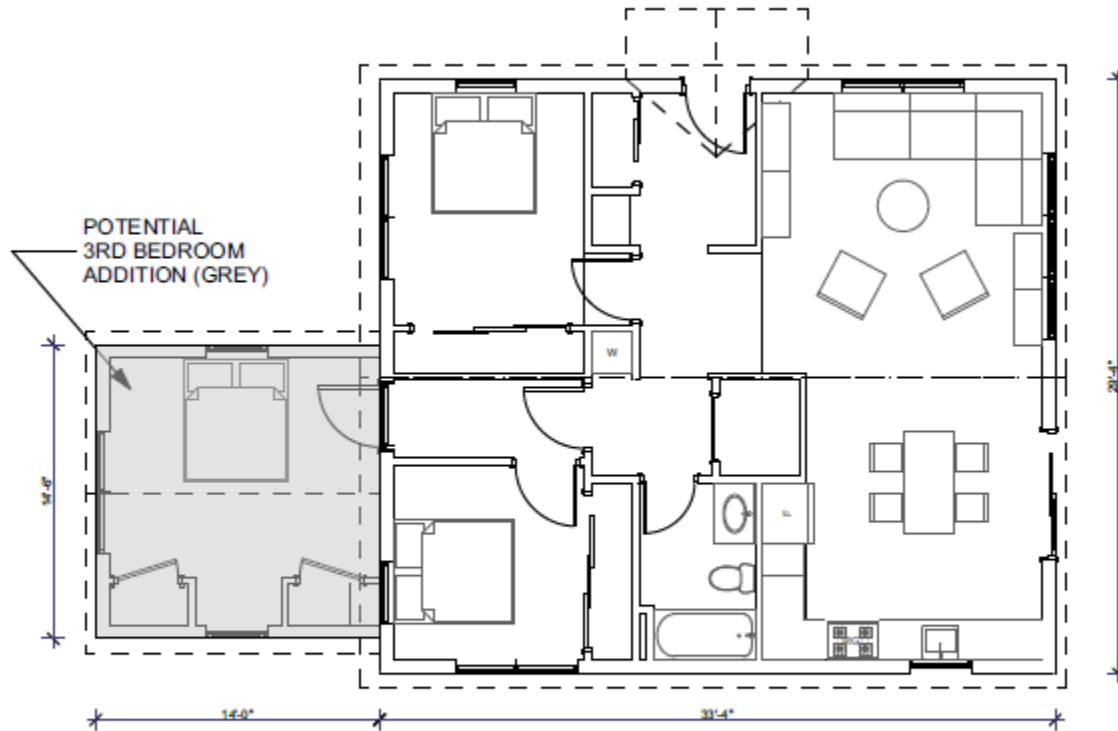
# New Communities

Salisbury Square | Randolph



# New Communities

## Salisbury Square | Randolph

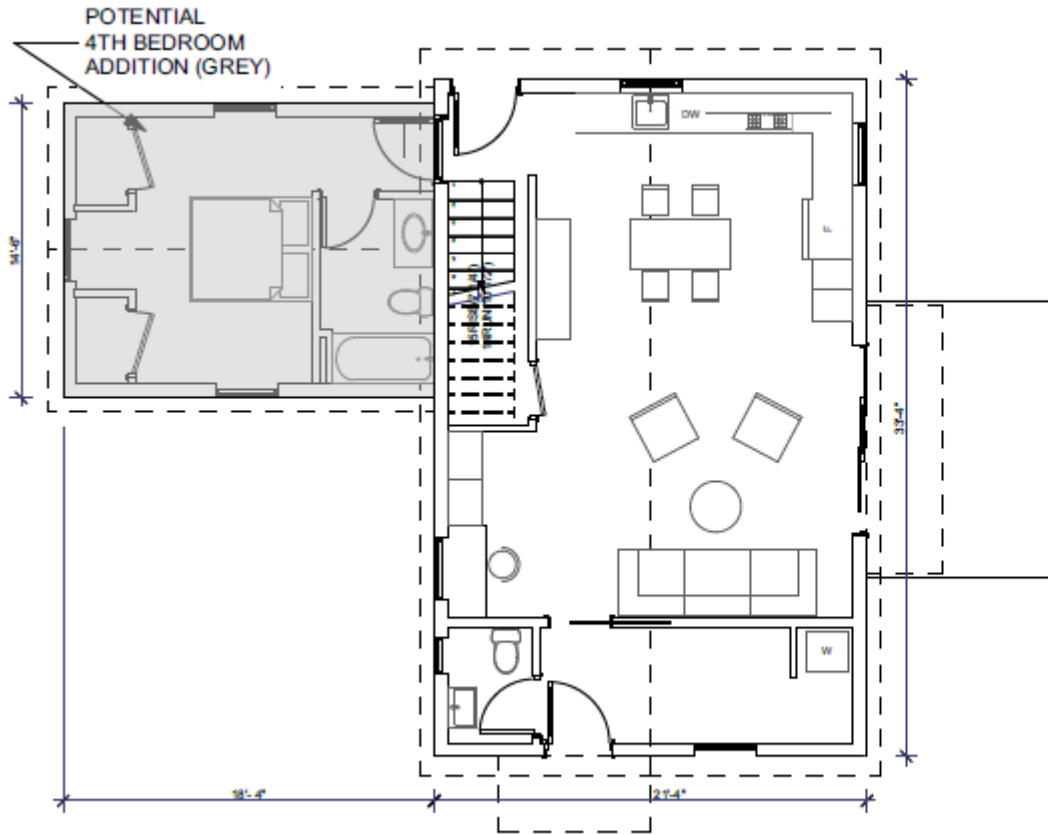


1st FLOOR PLAN 2BR UNIT

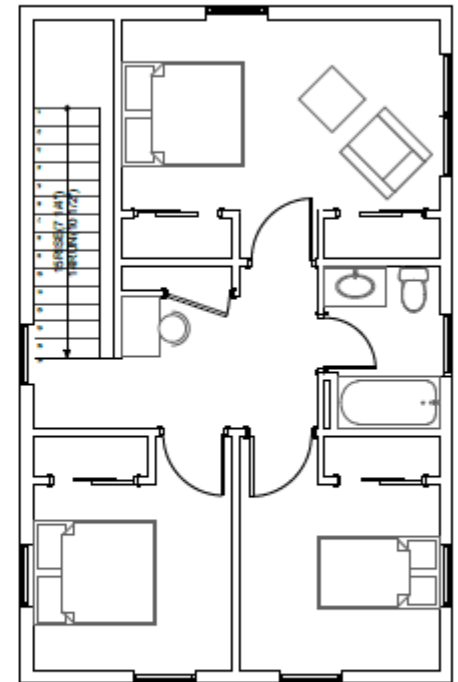


# New Communities

## Salisbury Square | Randolph



1st FLOOR 3BR UNIT



2nd FLOOR 3BR UNIT

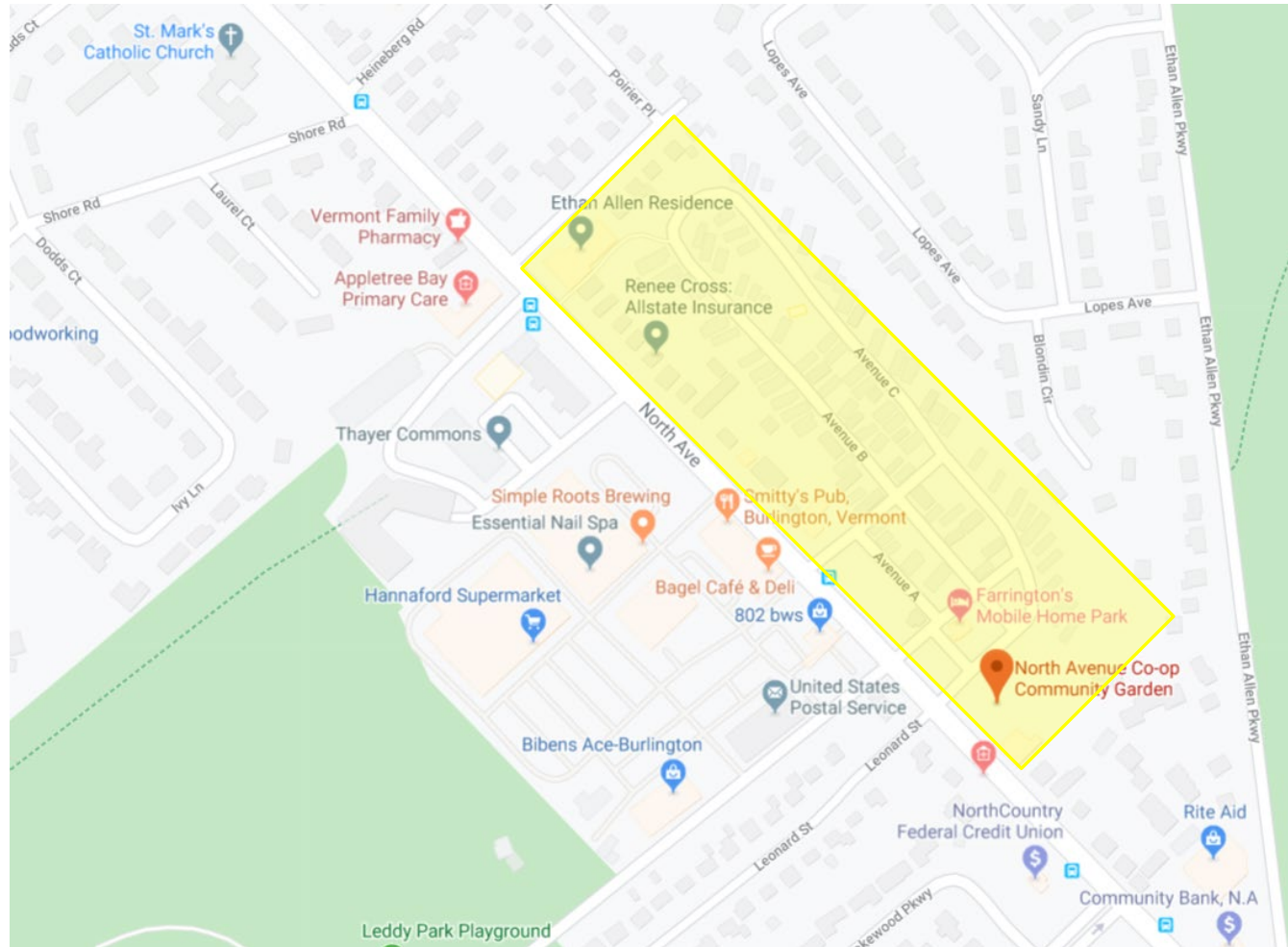
# New Communities

Salisbury Square | Randolph



# Habitat Collaboration

## North Ave Coop | Burlington





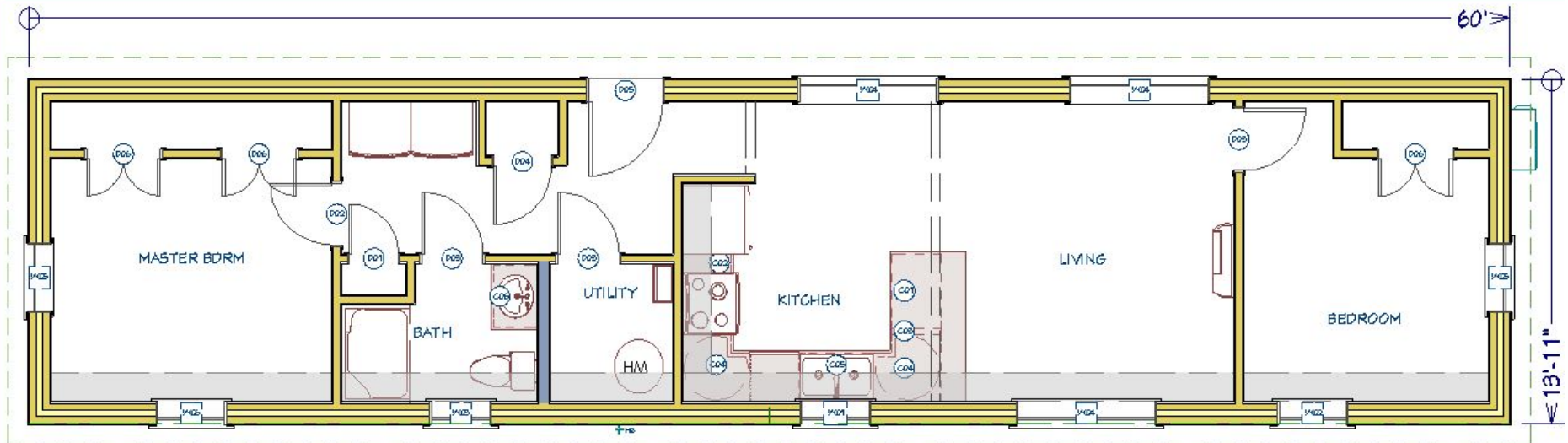
# Habitat Collaboration

North Ave Coop | Burlington



# Habitat Collaboration

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# Habitat Collaboration

## North Ave Coop | Burlington



### More Information

Contact Green Mountain Habitat for Humanity at  
(802) 872-8726 ext. 9 or visit  
[www.vermonthabitat.org](http://www.vermonthabitat.org)

<b>Estimated monthly costs</b>	
Monthly mortgage payment	\$485
Co-op fee	\$393
Property taxes (estimate)	\$174
Insurance	\$60
<b>Total monthly housing costs</b>	<b>\$1112</b>

### Household income limits apply:

1 person : \$50,250      3 person : \$64,750  
2 person : \$57,550      4 person : \$71,900

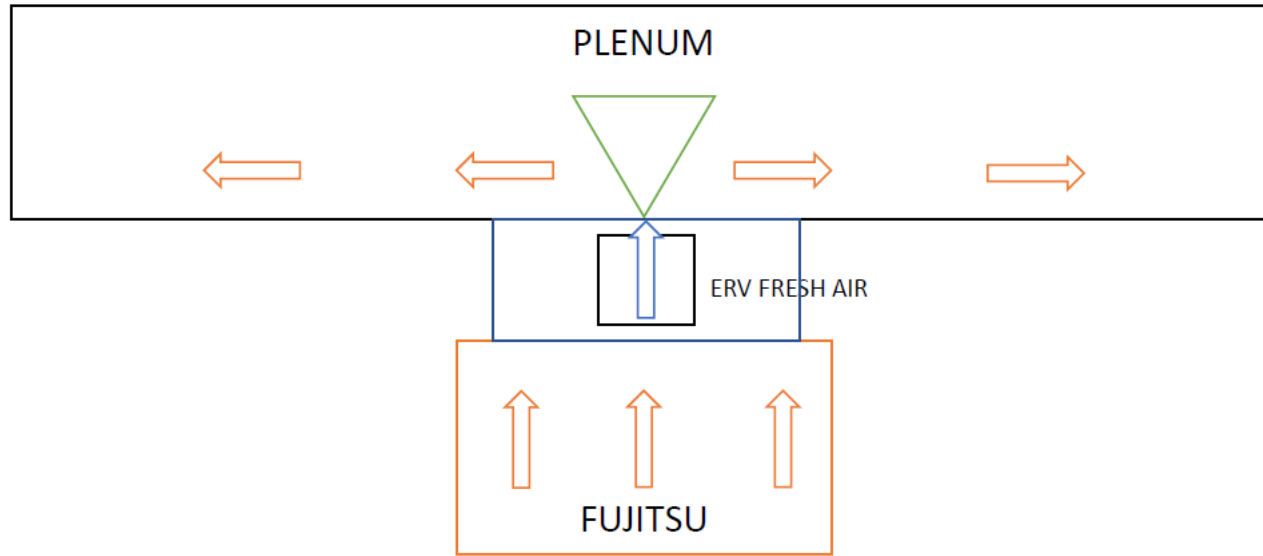
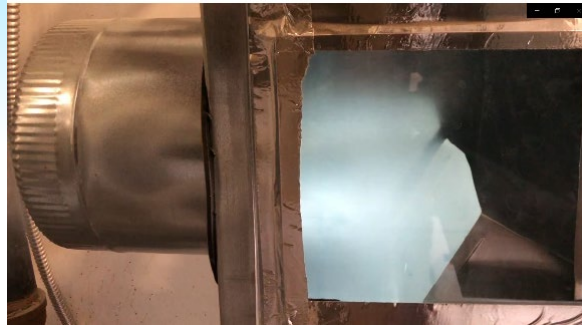


# Habitat Collaboration

North Ave Coop | Burlington

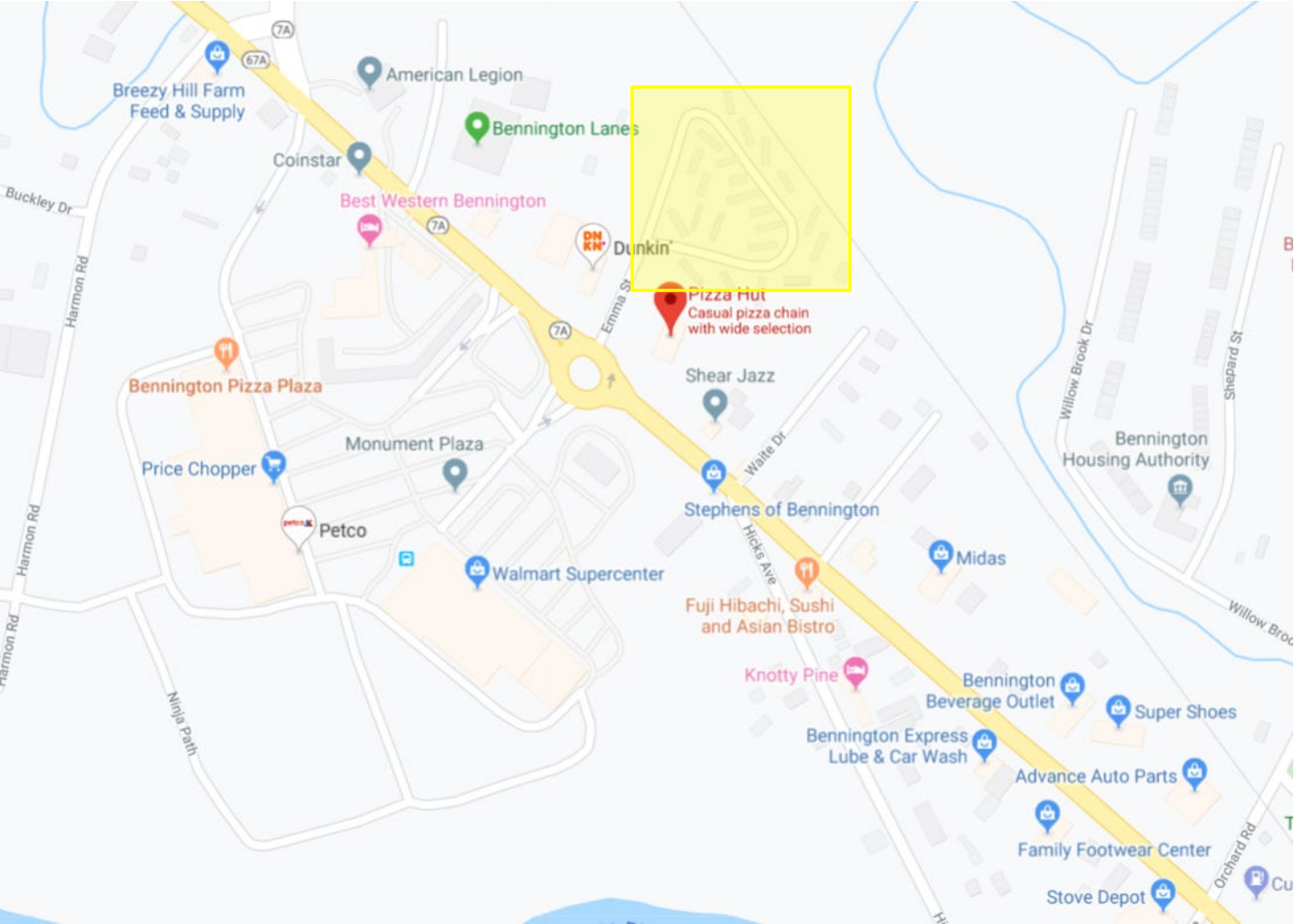






# Neighborhood Revitalization

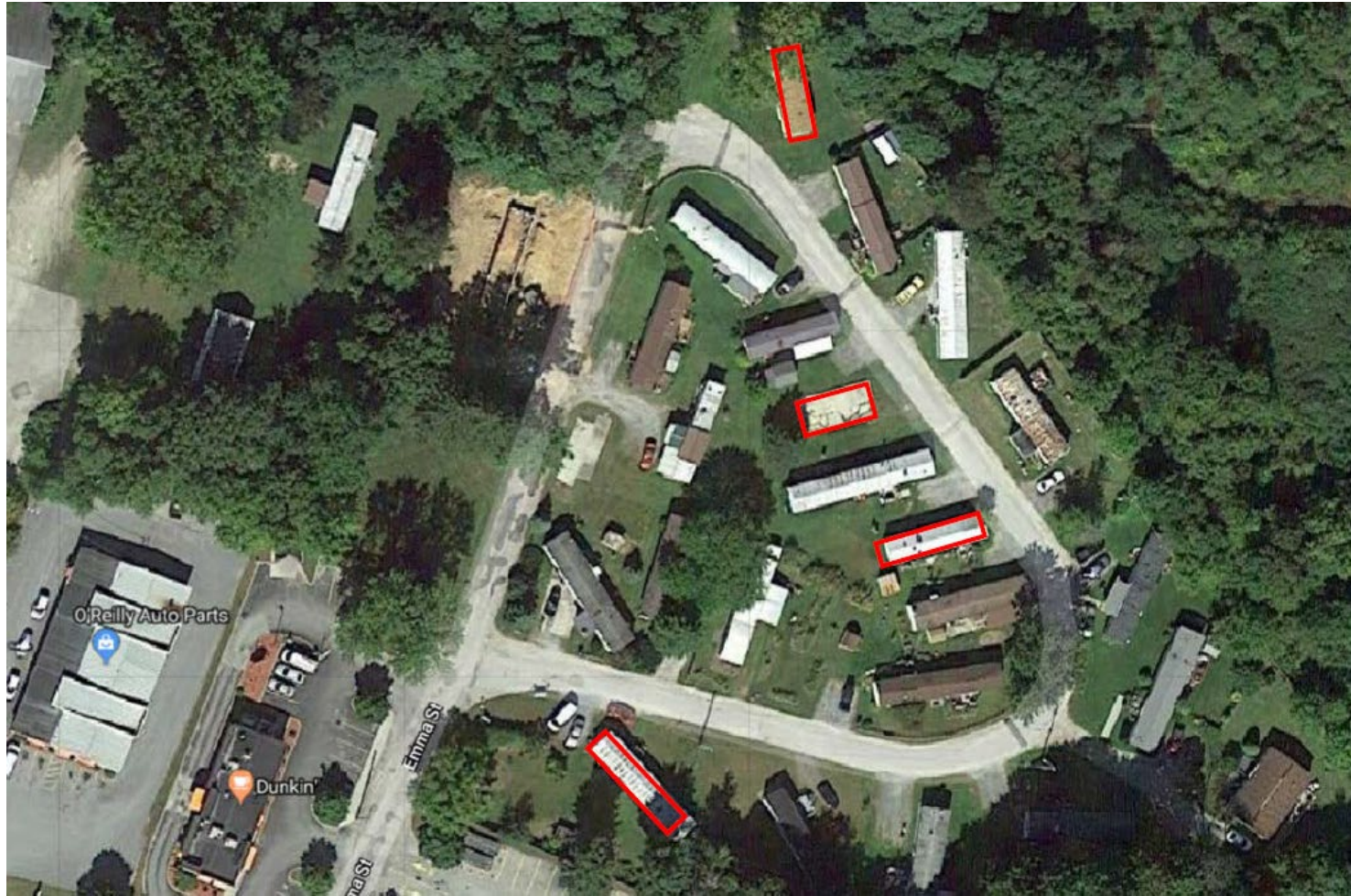
## Willows | Bennington





# Neighborhood Revitalization

## Willows | Bennington





# Neighborhood Revitalization

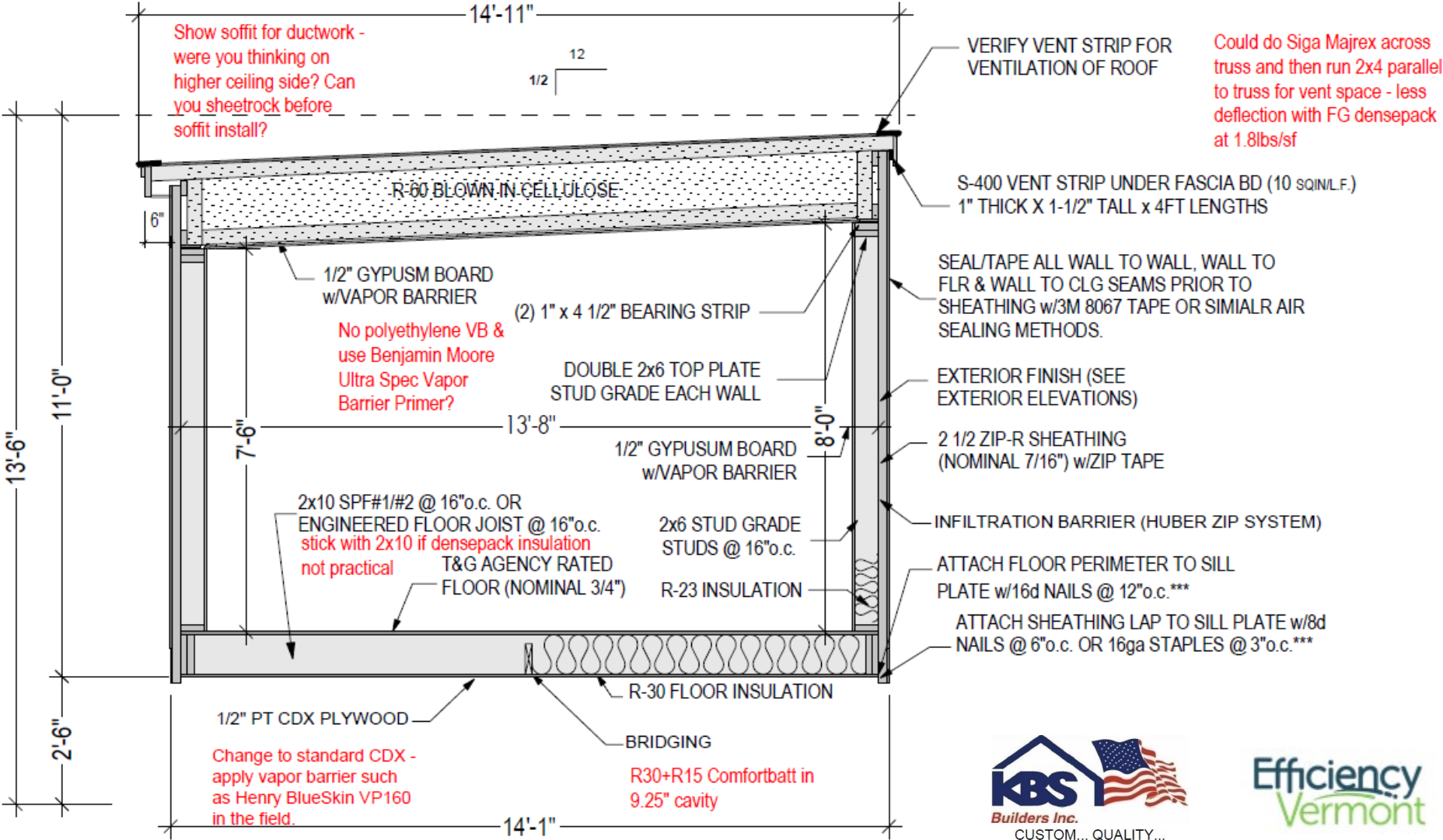
Willows | Bennington





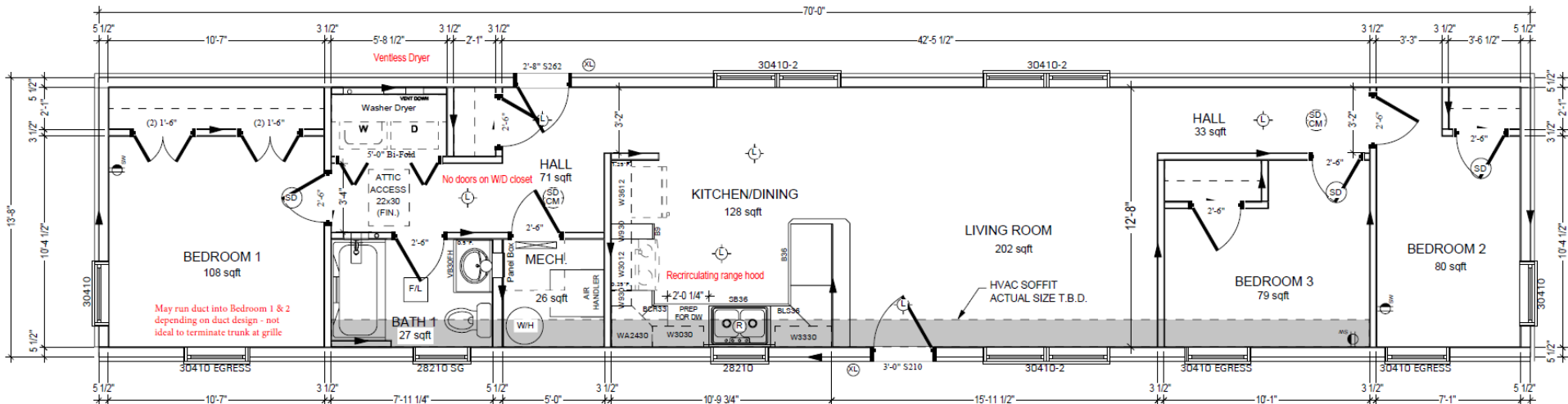
# Neighborhood Revitalization

## Willows | Bennington



# Neighborhood Revitalization

## Willows | Bennington



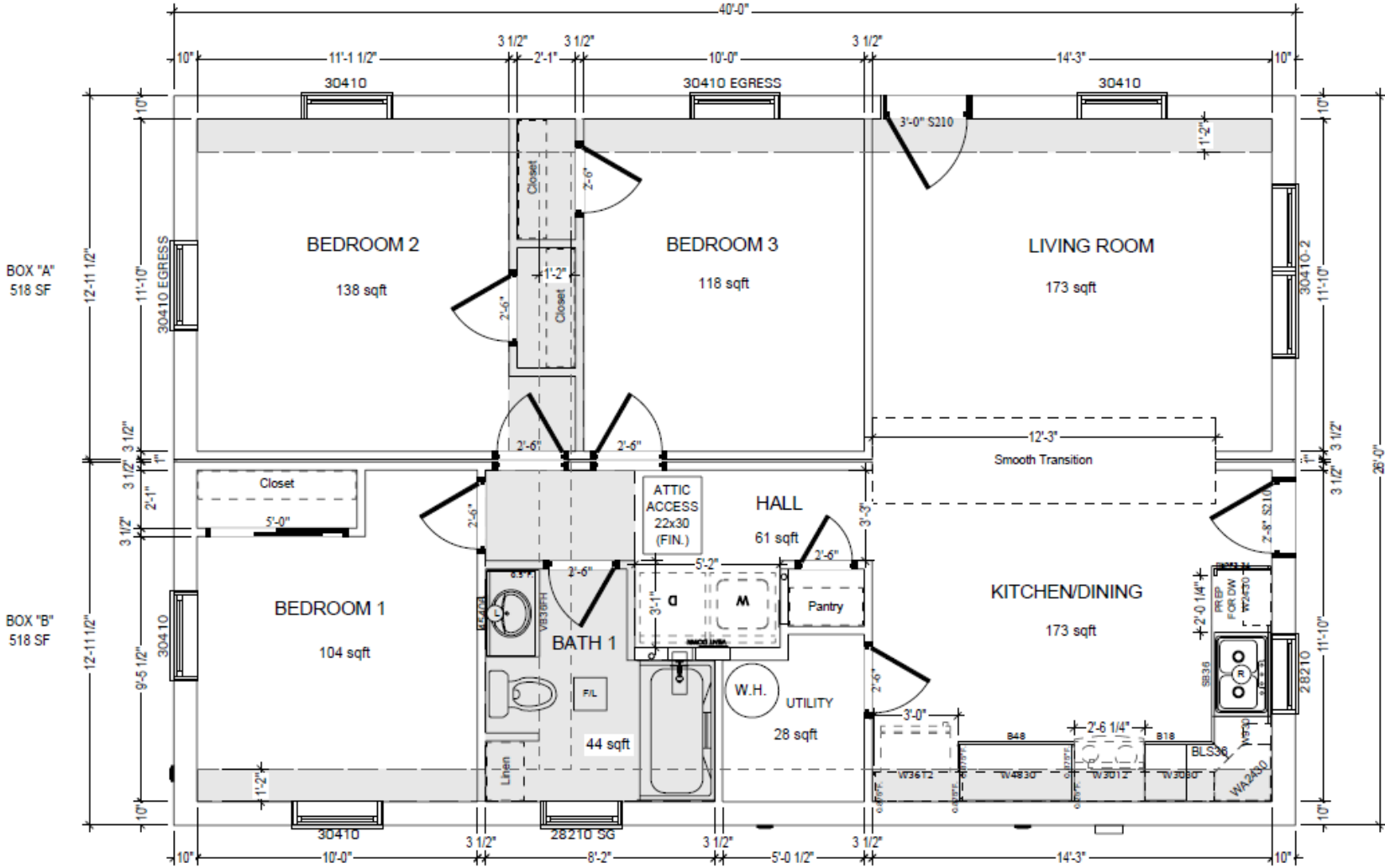
May run duct into Bedroom 1 & 2 depending on duct design - not ideal to terminate trunk at grille

Ducted heat pump installed on site - locate compressor outside mech room if on high side and not under dripping eave

Mechanical Room layout and duct design needed - ensure electrical main panel 3' from water heater - evaluate requirements for Tesla Powerwall2 with Tesla installer - done on site but need design for electrical rough-in

# Neighborhood Revitalization

## Willows | Bennington



# Neighborhood Revitalization

## Willows | Bennington





# Neighborhood Revitalization

Willows | Bennington



# Commercial

St. Albans City School | St. Albans









# Commercial

St. Albans City School | St. Albans





# Commercial

St. Albans City School | St. Albans



# Commercial

St. Albans City School | St. Albans





# Commercial

St. Albans City School | St. Albans





# Commercial

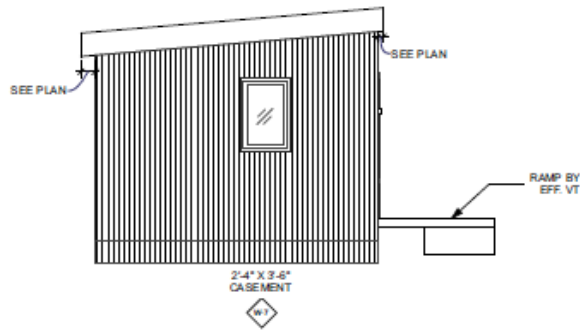
## Other Potential Applications

- Job site trailers i.e. transfer stations
- Temporary housing / barracks i.e. pilot quarters
- Disaster relief i.e. alternative to FEMA trailers
- Pump Houses
- Restrooms
- Remote Sales Offices
- Daycare
- Training Centers
- Healthcare
- ...

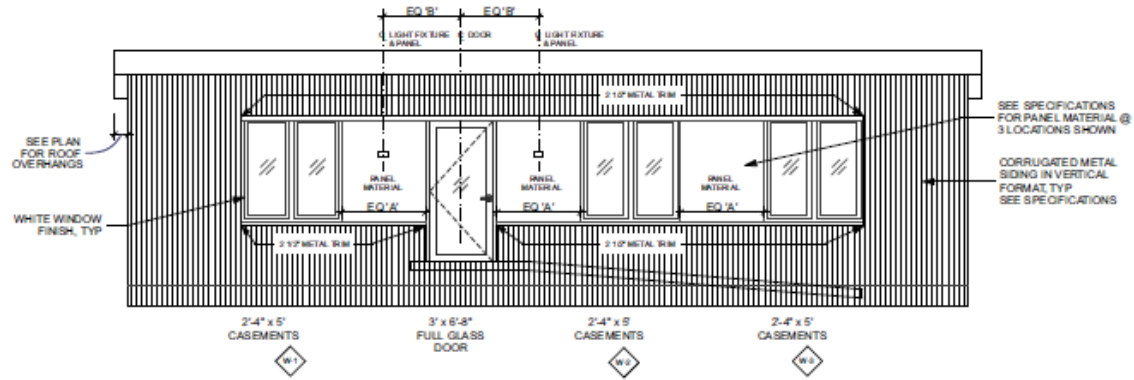
# Model Home

ZEM on Tour | A Town Near You

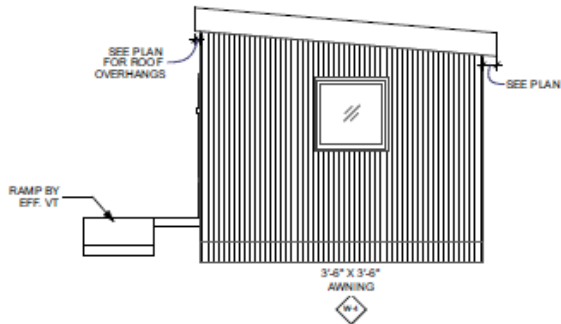




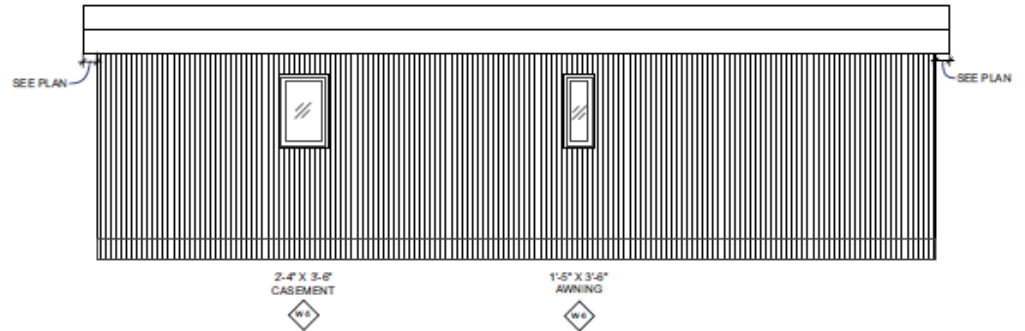
**4 WEST ELEVATION**  
SCALE: 1/4" = 1'-0"



**3 SOUTH ELEVATION**  
SCALE: 1/4" = 1'-0"



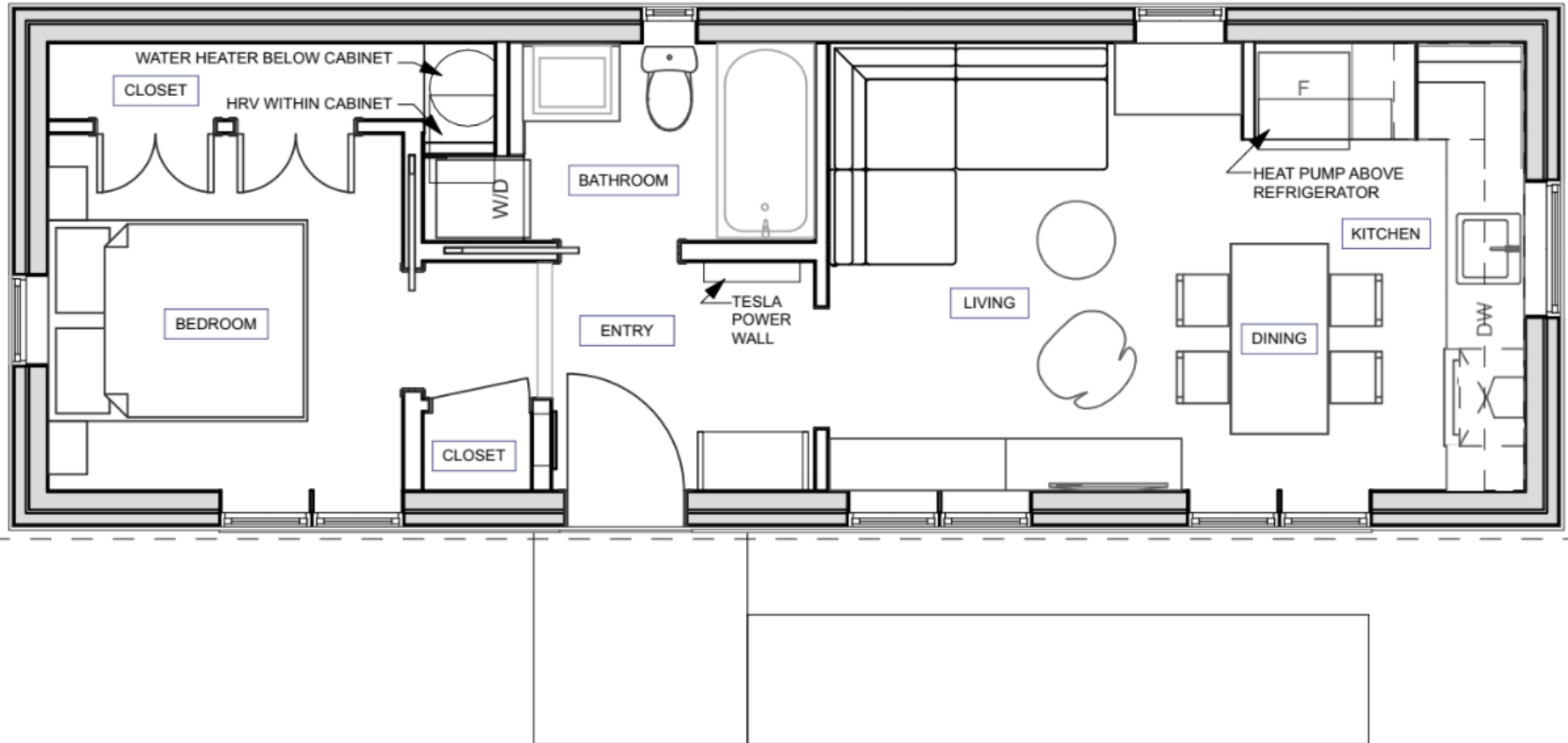
**2 EAST ELEVATION**  
SCALE: 1/4" = 1'-0"



**1 NORTH ELEVATION**  
SCALE: 1/4" = 1'-0"

# Model Home

ZEM on Tour | A Town Near You





# Model Home

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# Model Home

ZEM on Tour | A Town Near You





# Model Home

ZEM on Tour | A Town Near You



# Challenges & Discussion



# Integrated Design & Finances

- High touch business model
- Smart design to meet tight budgets
- Accessing subsidies often require a lot of time
- Many prospective homebuyers need to time and support to get mortgage ready



# Developer Role

Delivering small, high performance homes to low and moderate income buyers.

- In mobile home parks
- On private land
- New developments

# State of Mobile Home Parks

- Marketability
- Small Scale Capital Needs
- Large Scale Capital Needs
- Operational and Financial Sustainability
- Flood Danger



# Connecting to the Ground

- Trailer on pad
- Crawlspace
- Basement
- Piers
  - Helical auger-driven
  - Concrete





# HUD Manufactured Home Standard



# HUD Manufactured Home Standard



# Service Contract

Homeowners expect their new home to deliver on low maintenance and energy costs.

5-year, \$500/year service contract rolled into mortgage (\$10/month) = two site visits per year to check on home.



Thank you.