Domestic Hot Water Piping for Phius Certification

(in WUFI© Passive)

Overview

1. Introduction
2. Key Takeaways
3. Modeling in WUFI
4. Example Layouts
5. Conclusions

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Key Takeaways

- What is new:
  - New demand recirculation guidance
  - Clarifying modeling requirements
- What is still good:
  - Good takeoffs
  - One twig per fixture
  - Continuous or time based recirculation on the *General* tab
  - Unit method (Highly recommended)

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Why model DHW Piping for Phius?

- Internal heat gains!
  - Piping heat losses add to space cooling loads
  - Source energy for cooling and pumps
- Watersense
  - Required by EnergyStar and ZERH, Phius Certification pre-reqs
  - 0.5 gal in pipes for ‘TRUE’
- No continuous or temperature based for SF, MF < 6 Stories

Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. **ENERGY STAR for Homes Baseline**	☐ Certified under ENERGY STAR Qualified Homes Program Version 3, 3.1, or 3.2 (depending on state), or under ENERGY STAR Multifamily New Construction program Version 1.0 or 1.1 (depending on state) [8, 9, 10]
2. **Envelope**	☐ Fenestration shall meet or exceed ENERGY STAR requirements. See End Note for specific U, SHGC values, and exceptions. [11] ☐ Ceiling, wall, floor, and slab insulation shall meet or exceed 2015 IECC levels[12,13]
3. **Duct System**	☐ Duct distribution systems located within the home’s thermal and air barrier boundary or an optimized location to achieve comparable performance.[14] ☐ HVAC air handler is located within the home’s thermal and air barrier boundary.
4. **Water Efficiency**	☐ Hot water delivery systems (distributed and central) shall meet efficient design requirements[15] ***or*** ☐ Water heaters and fixtures shall meet efficiency criteria[16]
5. **Lighting & Appliances**	☐ All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. [17] ☐ 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets ☐ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. **Indoor Air Quality**	☐ Certified under EPA Indoor airPLUS [10]
7. **Renewable Ready**	☐ Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist are Completed [18]

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What to Model?

- Domestic Hot Water Piping
  - Trunks
  - Branches
  - Twigs
  - Insulation
- Domestic Hot Water Fixtures
  - Sinks
  - Tubs
  - Showers
- Not modeled
  - Appliance hookups (dishwasher, clothes washer etc..)
  - Cold water appliances (toilets, cold water hose bibs etc…)

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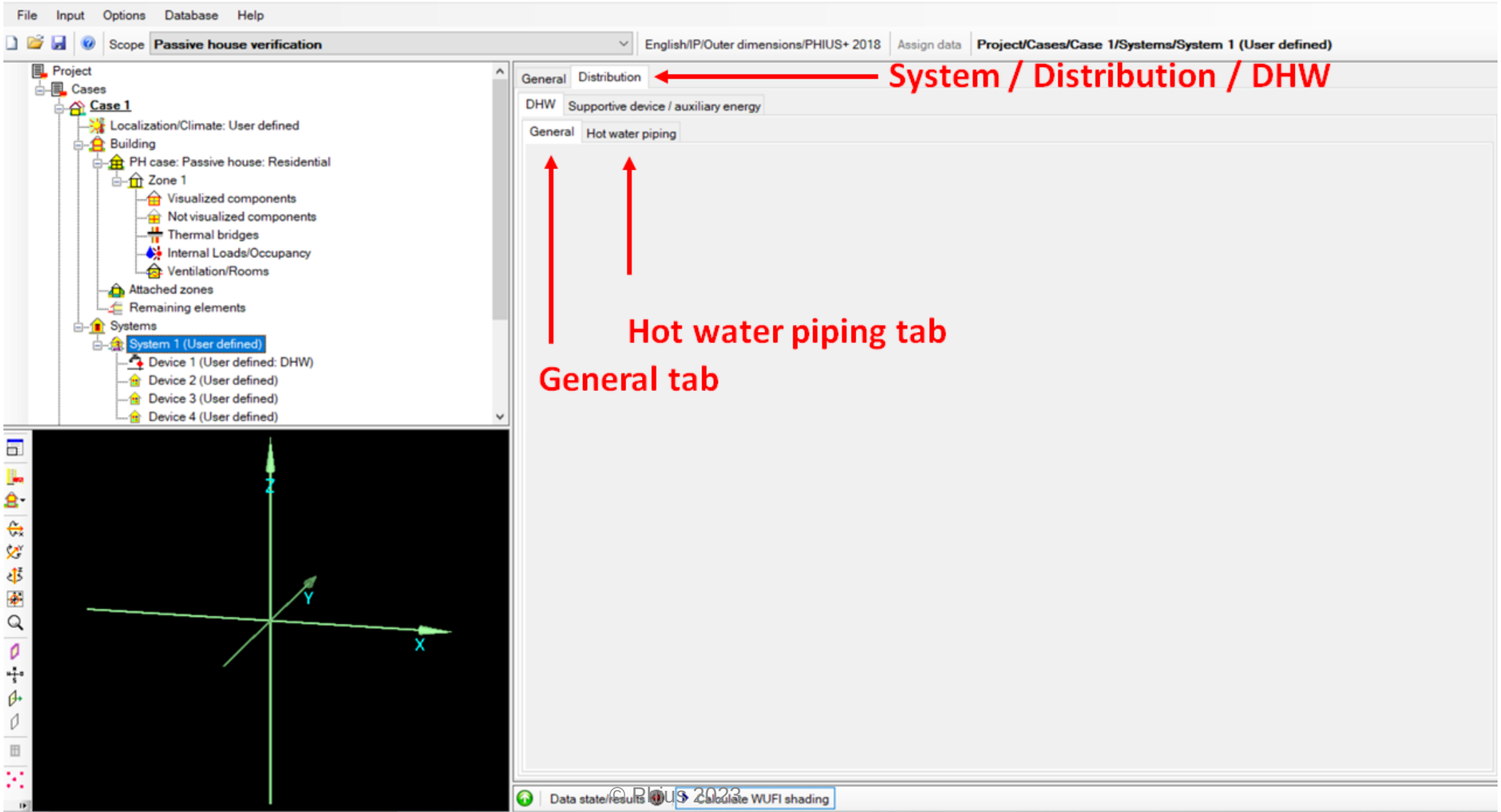
Modeling in WUFI

General



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DHW Distribution - Design flow temp.

General

General | Distribution

DHW | Supportive device / auxiliary energy

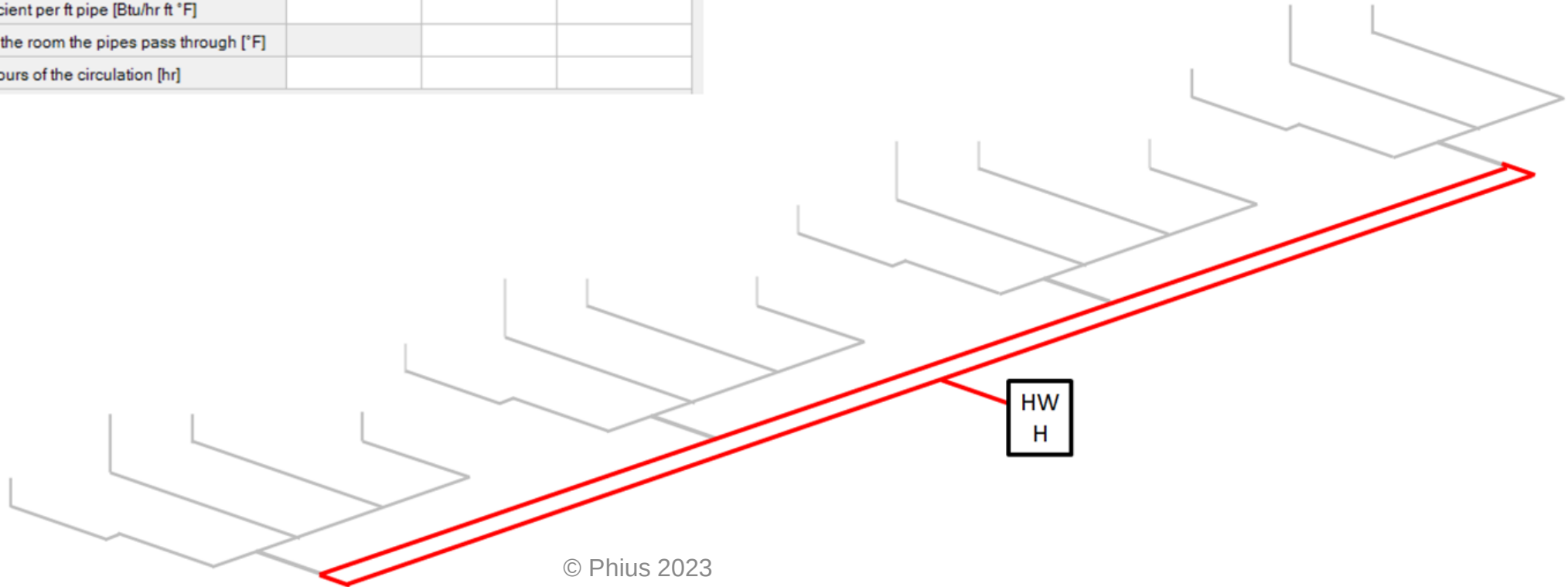
General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			

Specifies the flow temperature of the system

Typical range (120 -140 °F).



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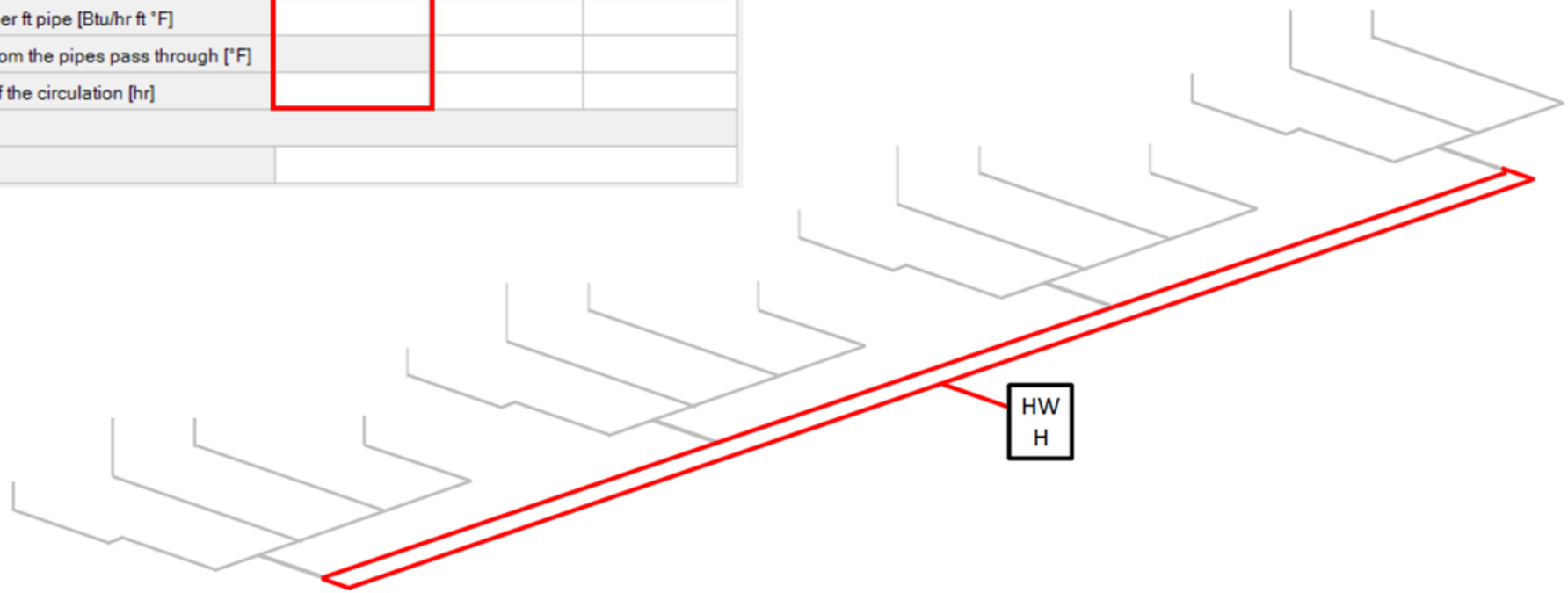
Entries for Circulation Pipes

General

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			
Individual pipes			
Calculation method			



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Circulation Pipes - Length

Building Type	Continuous or Time-Based
SF	✗
MF (≤ 5 stories)	✗
MF (> 6 stories)	✓
Non-residential	✓

A true circulation loop has hot water running through it for a certain period each day. Referred to below as ‘Continuous or time-based recirculation’. The full length of these pipes should be entered here.

- Continuous or time-based recirculation systems are only allowed in multifamily projects with more than 6 stories or in non-residential buildings.

- **Neither time-based nor continuous recirculation systems are allowed in single family homes nor multifamily projects of five stories or less. (per ZERH)**

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Circulation Pipes - Length

General

General | Distribution

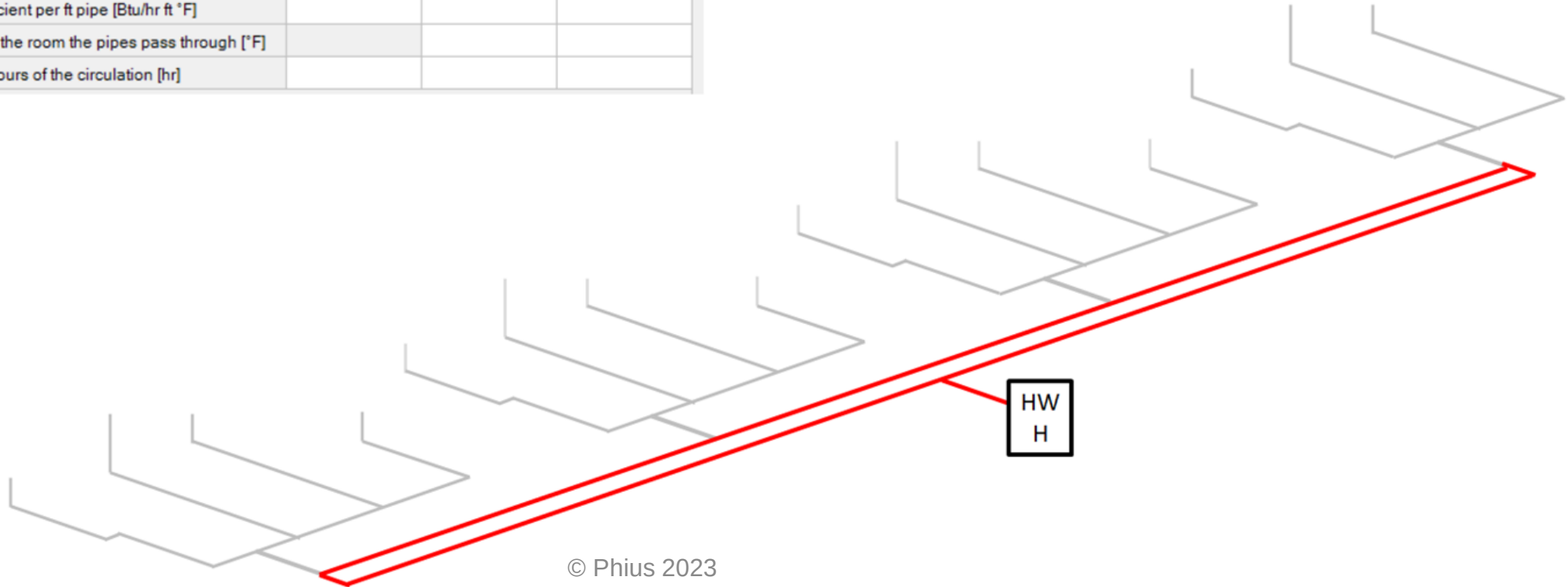
DHW | Supportive device / auxiliary energy

General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			

Time based or Continuous Recirculation Pipes entered here
110 ft. (full length).



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Circulation Pipes - Heat loss coefficient

General

General | Distribution

DHW | Supportive device / auxiliary energy

General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			

Input data

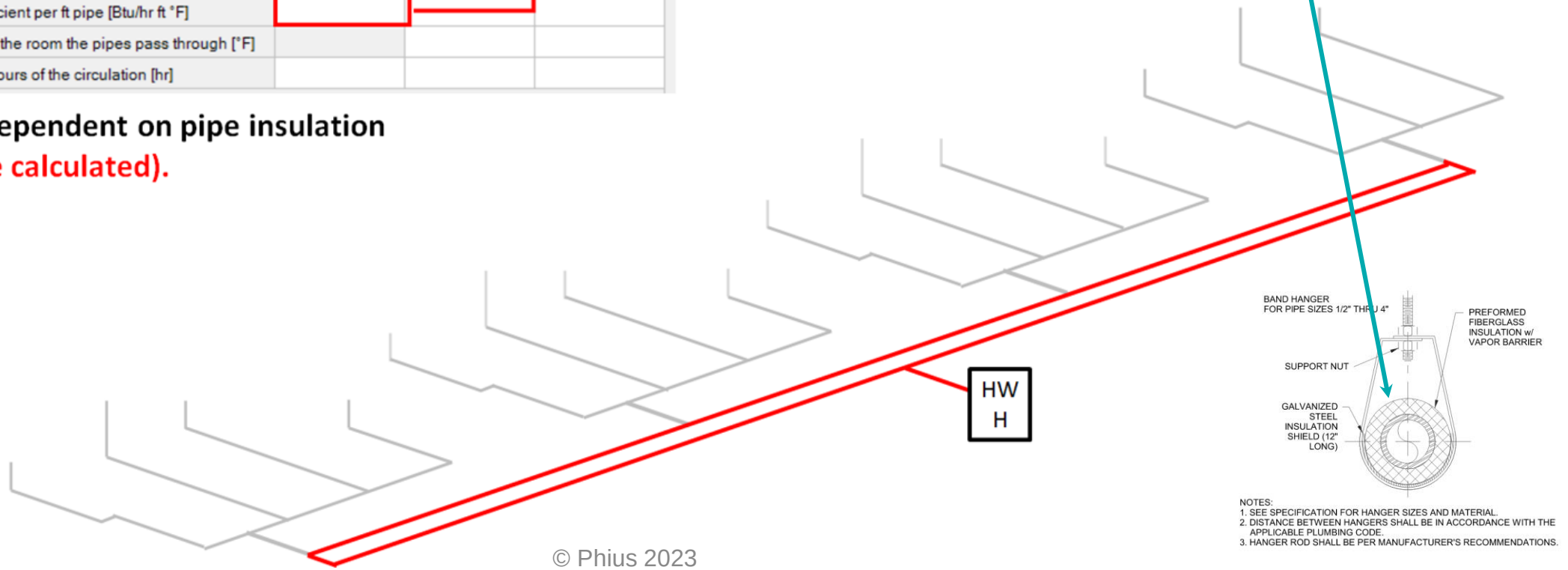
Nominal diameter [in]	
Insulation thickness [in]	
Thermal conductivity [Btu/hr ft °F]	
Is reflective	☐

[BTU/hr ft °F]:

[R per inch]:

Highly dependent on pipe insulation

(must be calculated).



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Circulation Pipes - Daily running hours

General

General | Distribution

DHW | Supportive device / auxiliary energy

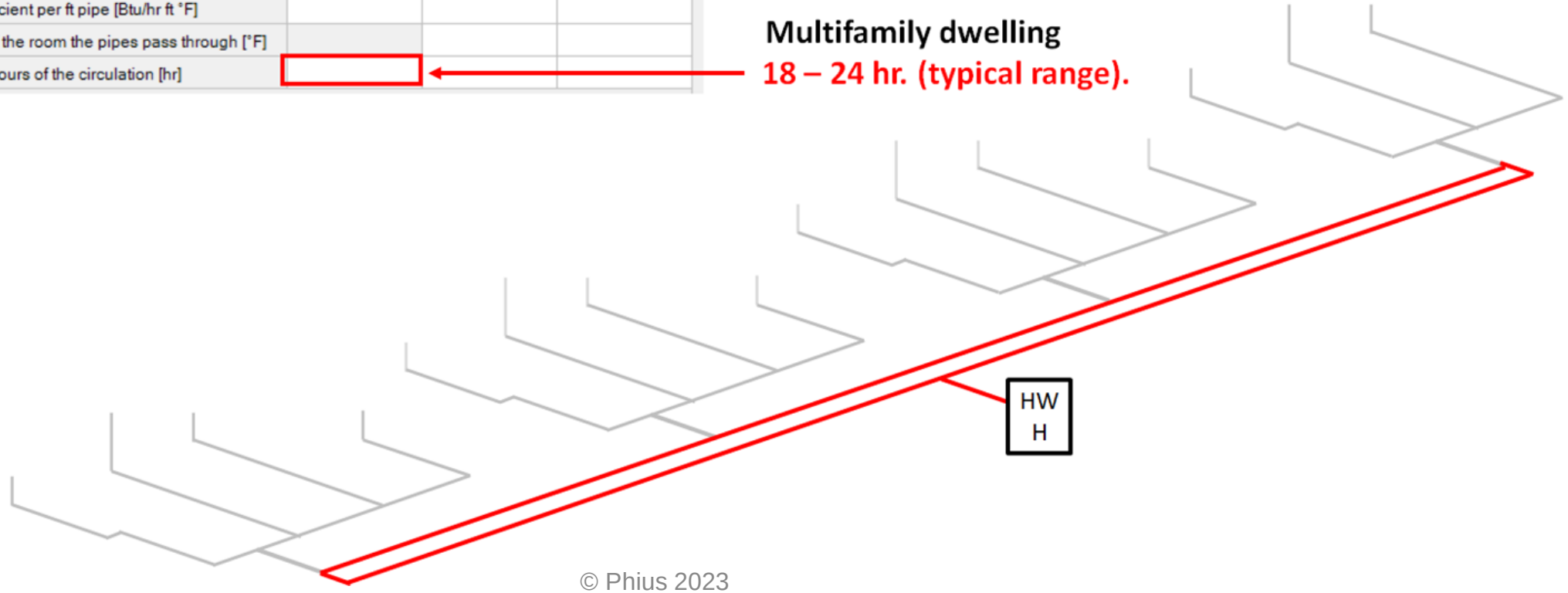
General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			

Multifamily dwelling

18 – 24 hr. (typical range).



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Individual Pipes - Calculation Method

General

General | Distribution

DHW | Supportive device / auxiliary energy

General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]			
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			
Individual pipes			
Calculation method	Hot water piping calculator (unit method)		

Hot Water Piping Calculator (**unit method**)

- Residential (SF & MF) Phius 2021, PHIUS+ 2018, PHIUS+ CORE

Simplified Individual Pipes

- Non-Residential Phius 2021, PHIUS+ 2018, PHIUS+ CORE
- All PHIUS+ 2015

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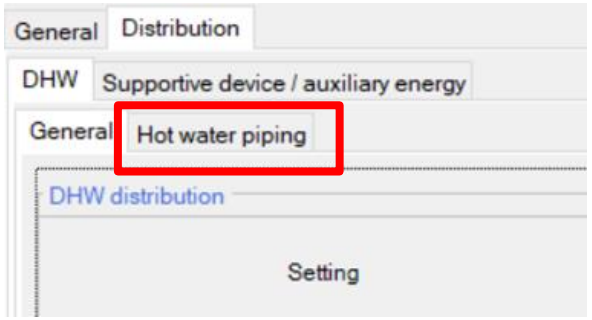
Hot Water Piping tab



- Estimates
  - **DHW Distribution Losses**
  - 'Time to hot' for **DHW Distribution Network*** design
    - EPA WaterSense Delivery requirement
- Used only for **Demand-based recirc and typical trunk/branch/twig** networks.

***DHW Distribution Network**: Hot water source, full path from hot water source to each individual tap (dishwashers and clothes washers are ignored)

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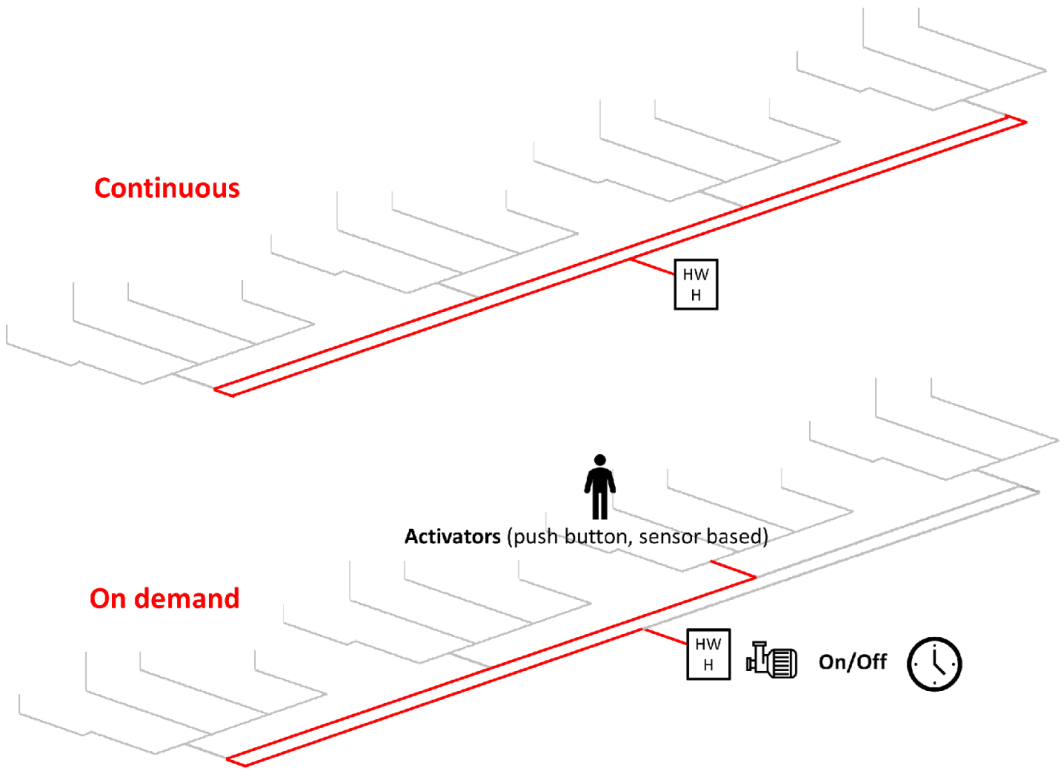
Hot water piping tab - Demand recirc box

Recirc Types



General | Hot water piping

Setting	In conditioned space
Design flow temperature [°F]	120
Circulation pipes	
Length of circulation pipes [ft]	1000
Heat loss coefficient per ft pipe [Btu/hr ft °F]	0.0759
Temperature of the room the pipes pass through [°F]	
Daily running hours of the circulation [hr]	18-24 hr

General | Hot water piping

Demand recirculation
☐

Setting	In conditioned space
Design flow temperature [°F]	120
Circulation pipes	
Length of circulation pipes [ft]	
Heat loss coefficient per ft pipe [Btu/hr ft °F]	
Temperature of the room the pipes pass through [°F]	
Daily running hours of the circulation [hr]	0 hr

Demand recirculation
☑

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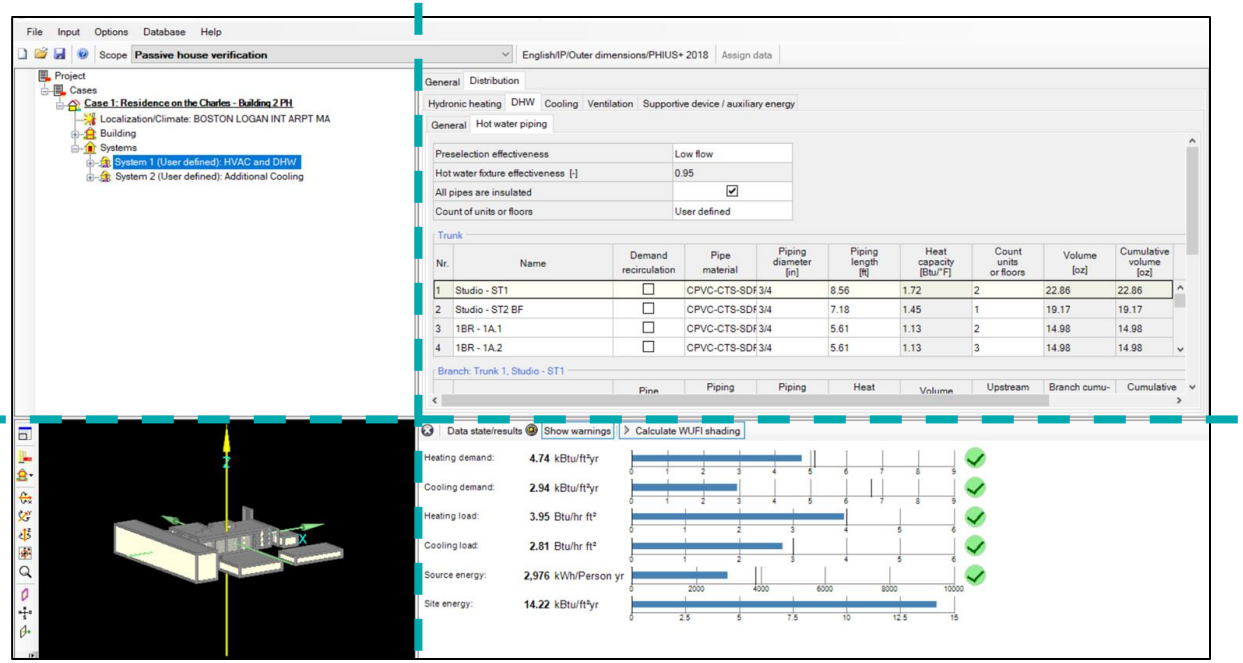
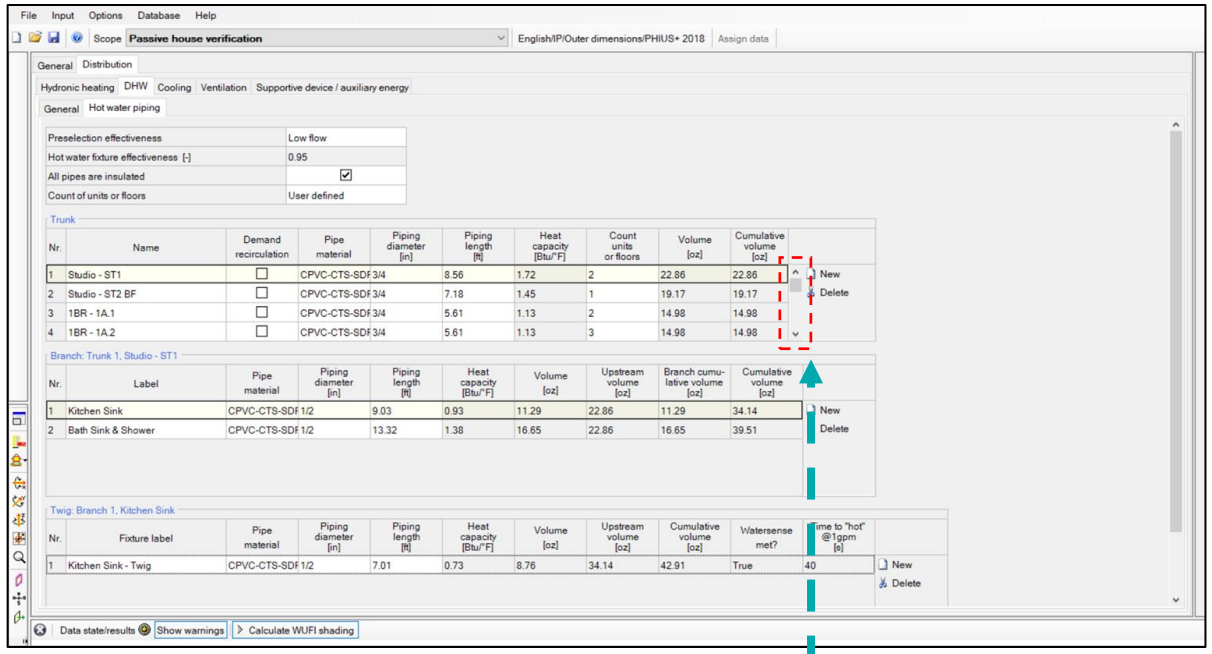
Hot Water Piping tab - Tips & Tricks

Increase window size to view all trunk-branch-twig structure





[Sliders](#)

To extend the 'HW Piping' tab on the screen

[Right sidebars](#)

To see all entries when there are more than four

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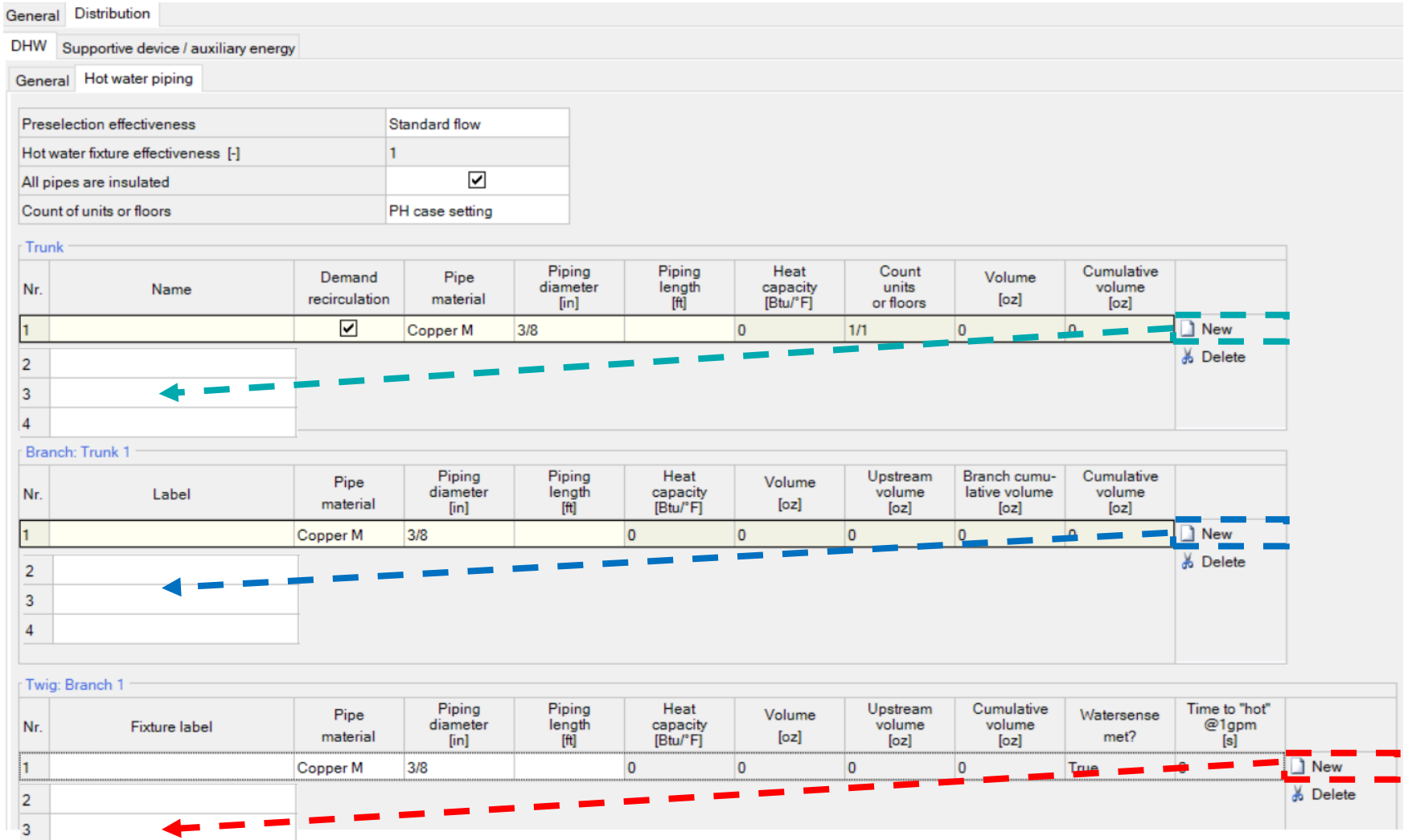
Hot Water Piping tab

Structure – Adding piping trunks, branches and twigs



Trunk: Add a trunk by clicking on the ‘new’ button on the right side at the ‘Trunk table’ on the ‘Hot Water Piping’ tab

Branch: Add a branch by clicking on the ‘new’ button on the right side at the ‘Branch table’ on the ‘Hot Water Piping’ tab

Twig: Add a twig by clicking on the ‘new’ button on the right side at the ‘Twig table’ of the ‘Hot Water Piping’ tab

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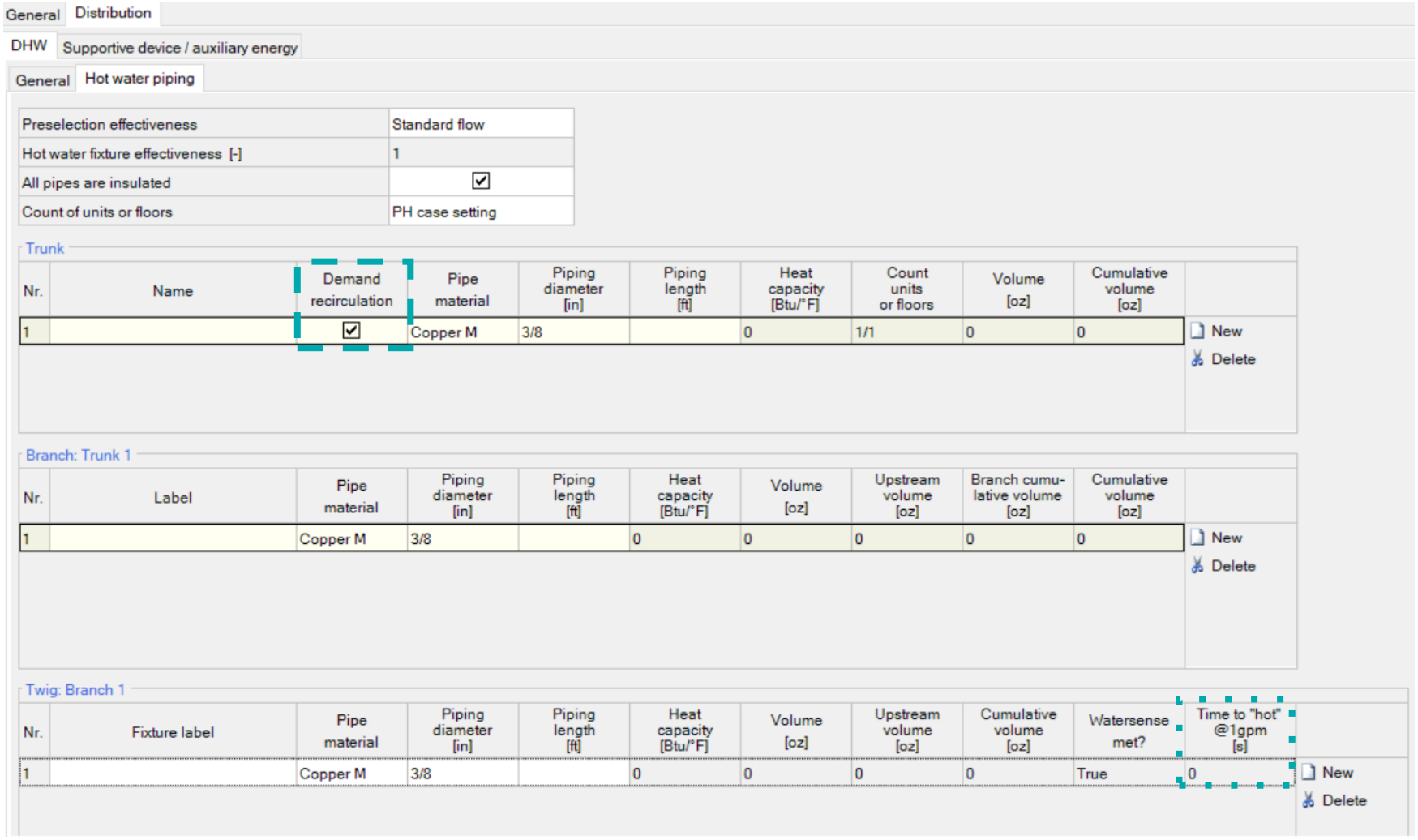
Domestic Hot Water Design Requirements

Definitions



Demand Circulation: Checking this box resets the 'up-stream volume' for the EPA WasterSense Hot Water Delivery test.

- The on-demand recirculation pipes must still be entered to accurately account for DHW pipe distribution losses, even though it resets the volume in the trunk for the 'time to hot' calculation.

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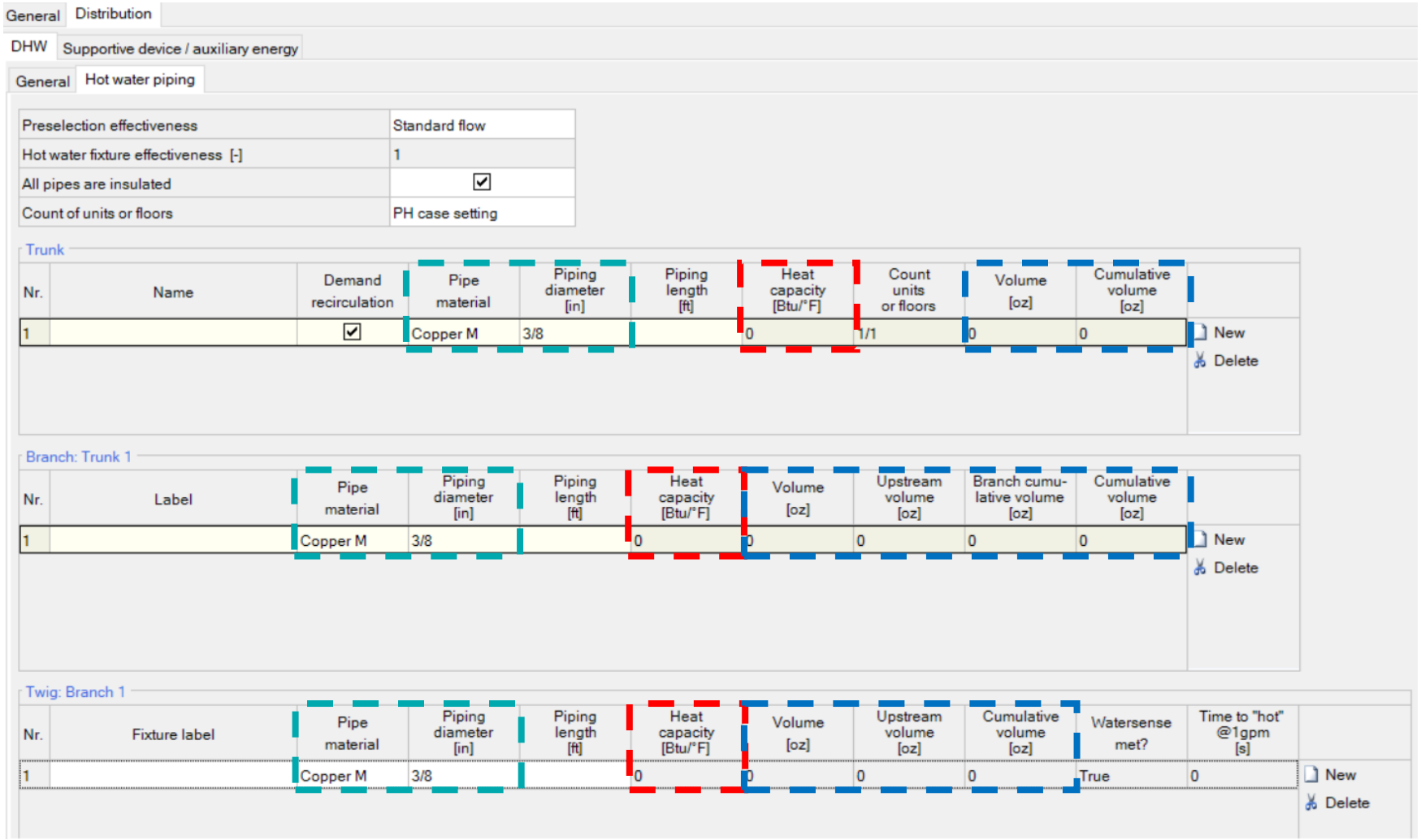
Domestic Hot Water Design Requirements

Definitions



Pipe material: Update the pipe material as shown in the floor plans. The most common pipe types are Copper L and PEX-AL-PEX.

Pipe diameter: This should be verifiable from the floor plans and input in WUFI Passive to match.

Heat Capacity: This is calculated based on the type of piping chosen, piping diameter and piping length.

Volume [oz]: The calculated total volume of water stored in this pipe based on the pipe material, piping diameter and piping length.

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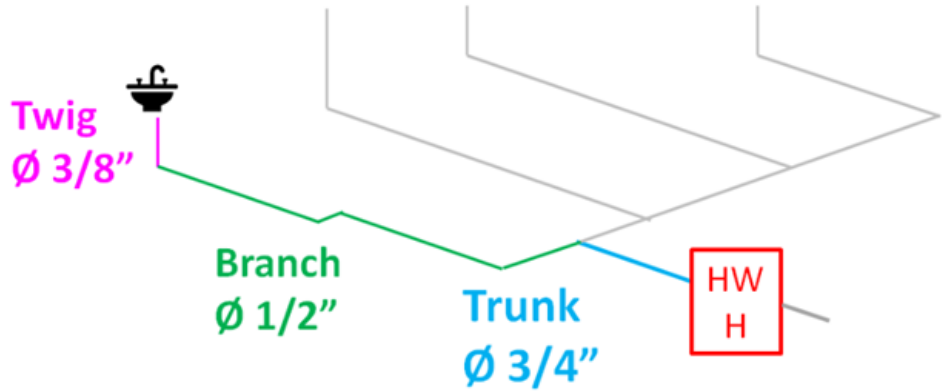
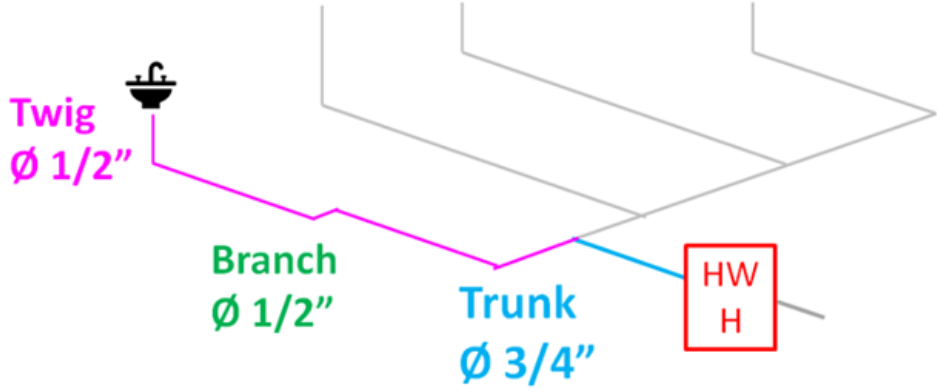
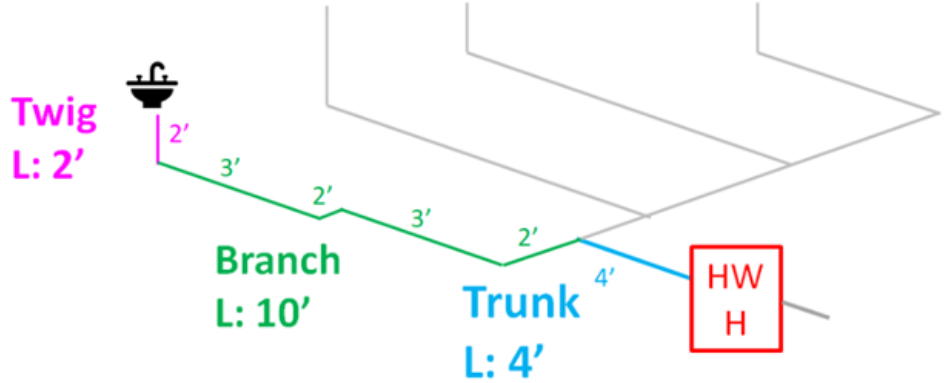
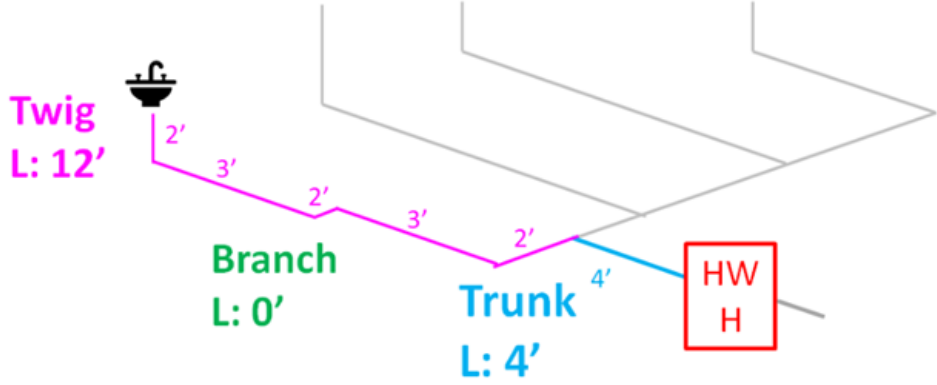
Hot water piping tab - pipe sizes

Documentation alternatives (Piping Diameter)

	3 pipe sizes	1 or 2 pipe sizes
Pipe diameters		
Length entries for WUFI		

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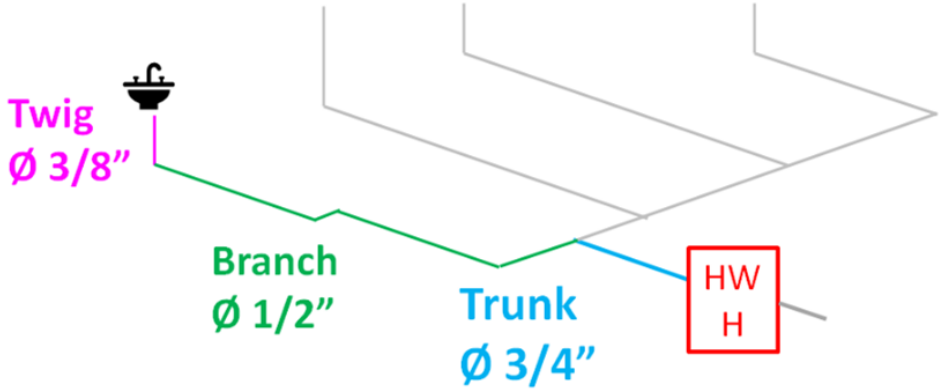
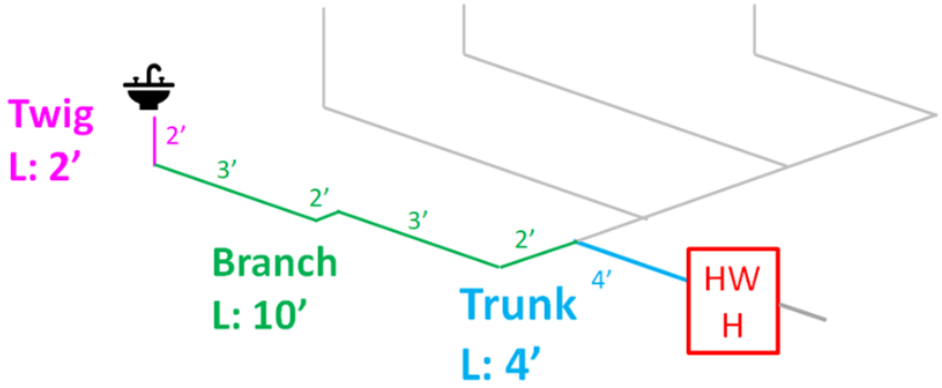
Domestic Hot Water Design Requirements

Documentation Alternatives (Piping diameter)

3 pipe sizes





Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Trunk	☑	Copper M	3/4	4	1.01	1/1	13.72	0

Branch: Trunk 1, Trunk

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Branch	Copper M	1/2	10	.28	16.9	0	16.9	16.9

Twig: Branch 1, Branch

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?
1	Twig	Copper M	3/8	2	.16	2.12	16.9	19.02	True

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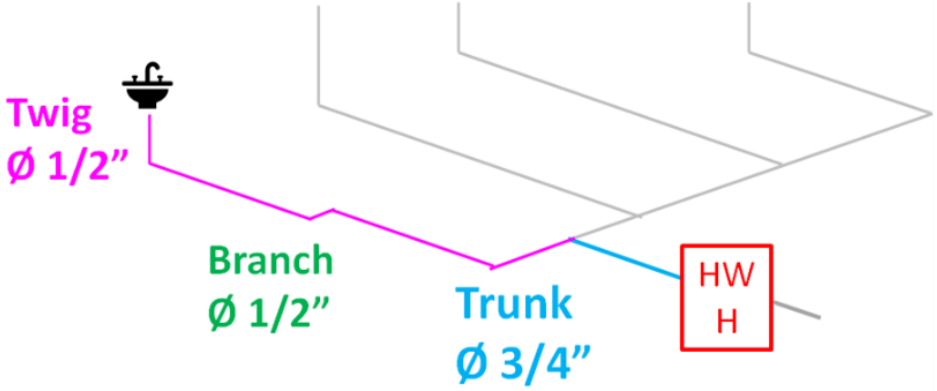
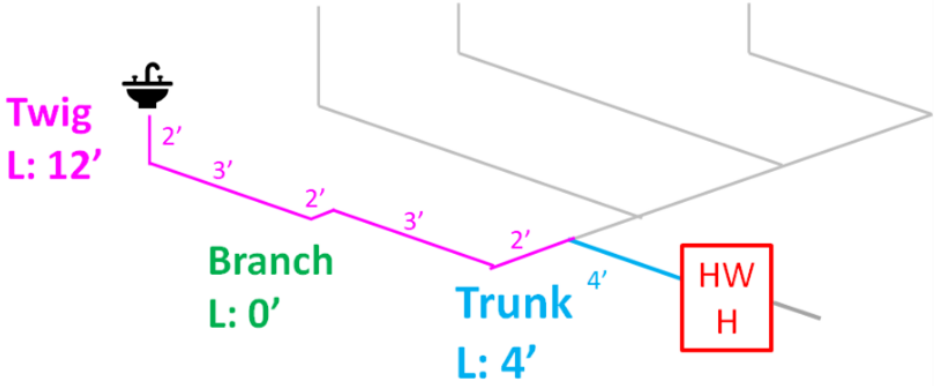
Domestic Hot Water Design Requirements

Documentation Alternatives (Piping diameter)

1 or 2 pipe sizes





Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Trunk	☑	Copper M	3/4	12	3.04	1/1	41.16	0

Branch: Trunk 1, Trunk

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Branch	Copper M	1/2	0	0	0	0	0	0

Twig: Branch 1, Branch

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?
1	Twig	Copper M	1/2	4	0.51	6.76	0	6.76	True

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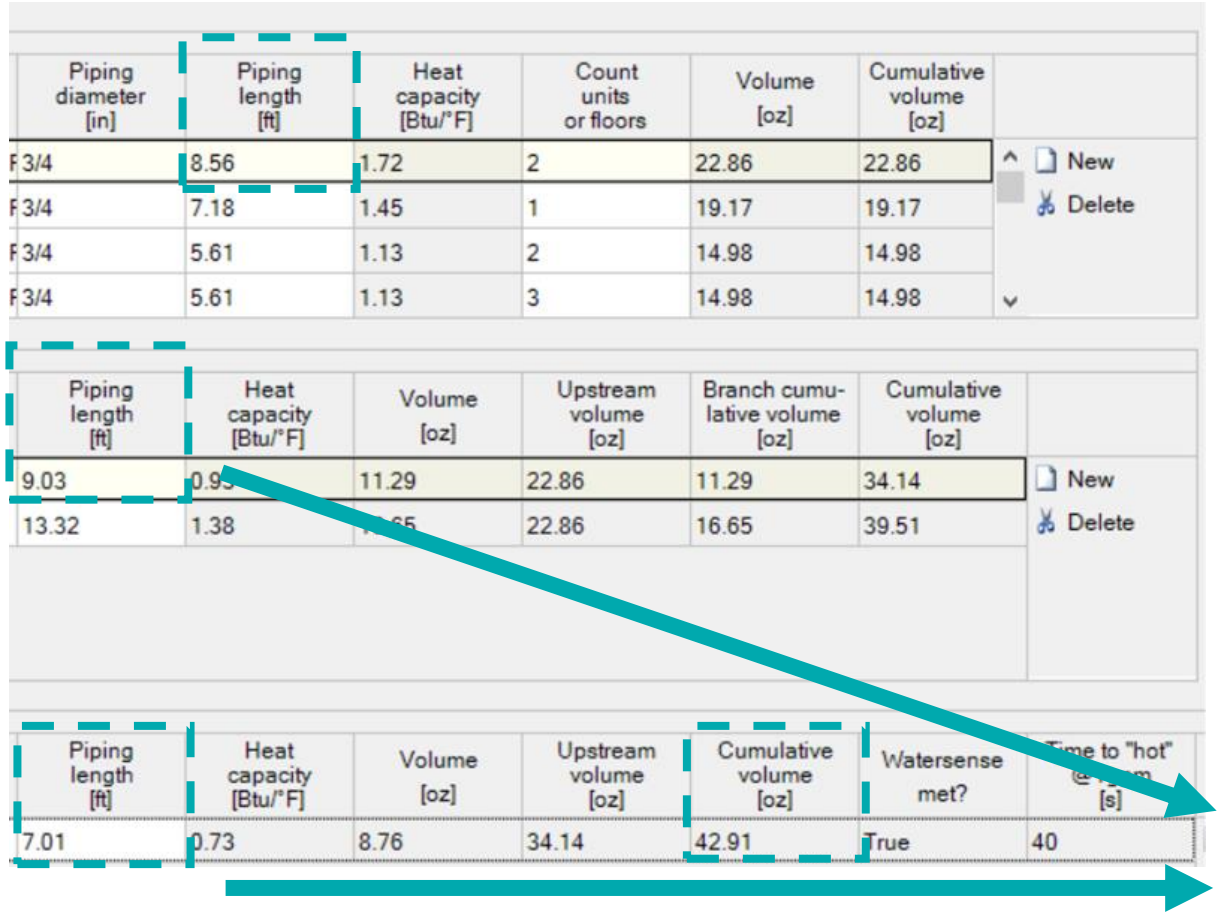
Domestic Hot Water Design Requirements

Documentation Alternatives (Piping Lengths)



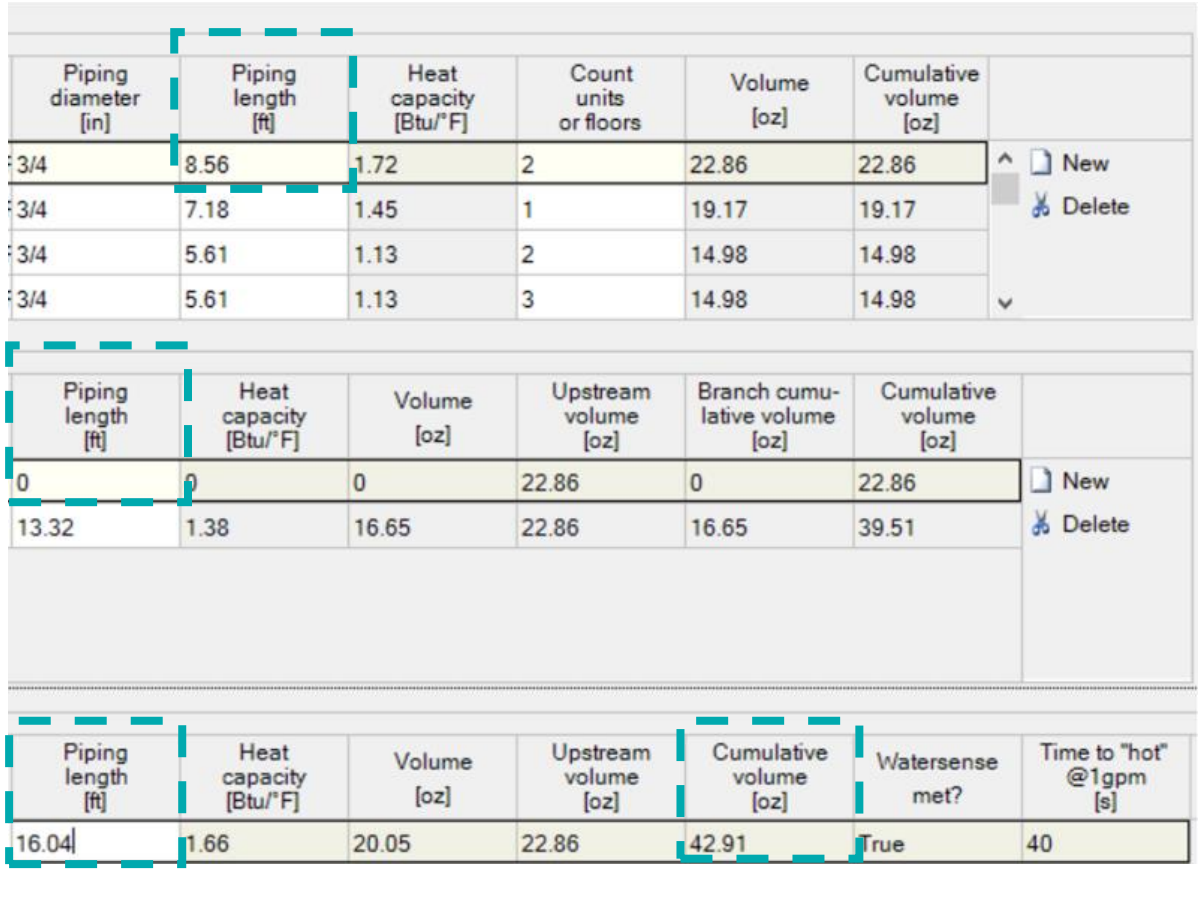
Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
3/4	8.56	1.72	2	22.86	22.86
3/4	7.18	1.45	1	19.17	19.17
3/4	5.61	1.13	2	14.98	14.98
3/4	5.61	1.13	3	14.98	14.98

New
Delete

Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
9.03	0.99	11.29	22.86	11.29	34.14
13.32	1.38	16.65	22.86	16.65	39.51

New
Delete

Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
7.01	0.73	8.76	34.14	42.91	True	40



Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
3/4	8.56	1.72	2	22.86	22.86
3/4	7.18	1.45	1	19.17	19.17
3/4	5.61	1.13	2	14.98	14.98
3/4	5.61	1.13	3	14.98	14.98

New
Delete

Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
0	0	0	22.86	0	22.86
13.32	1.38	16.65	22.86	16.65	39.51

New
Delete

Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
16.04	1.66	20.05	22.86	42.91	True	40

Lengths entered on Trunk, Branch & Twig

Lengths entered on Trunk & Twig

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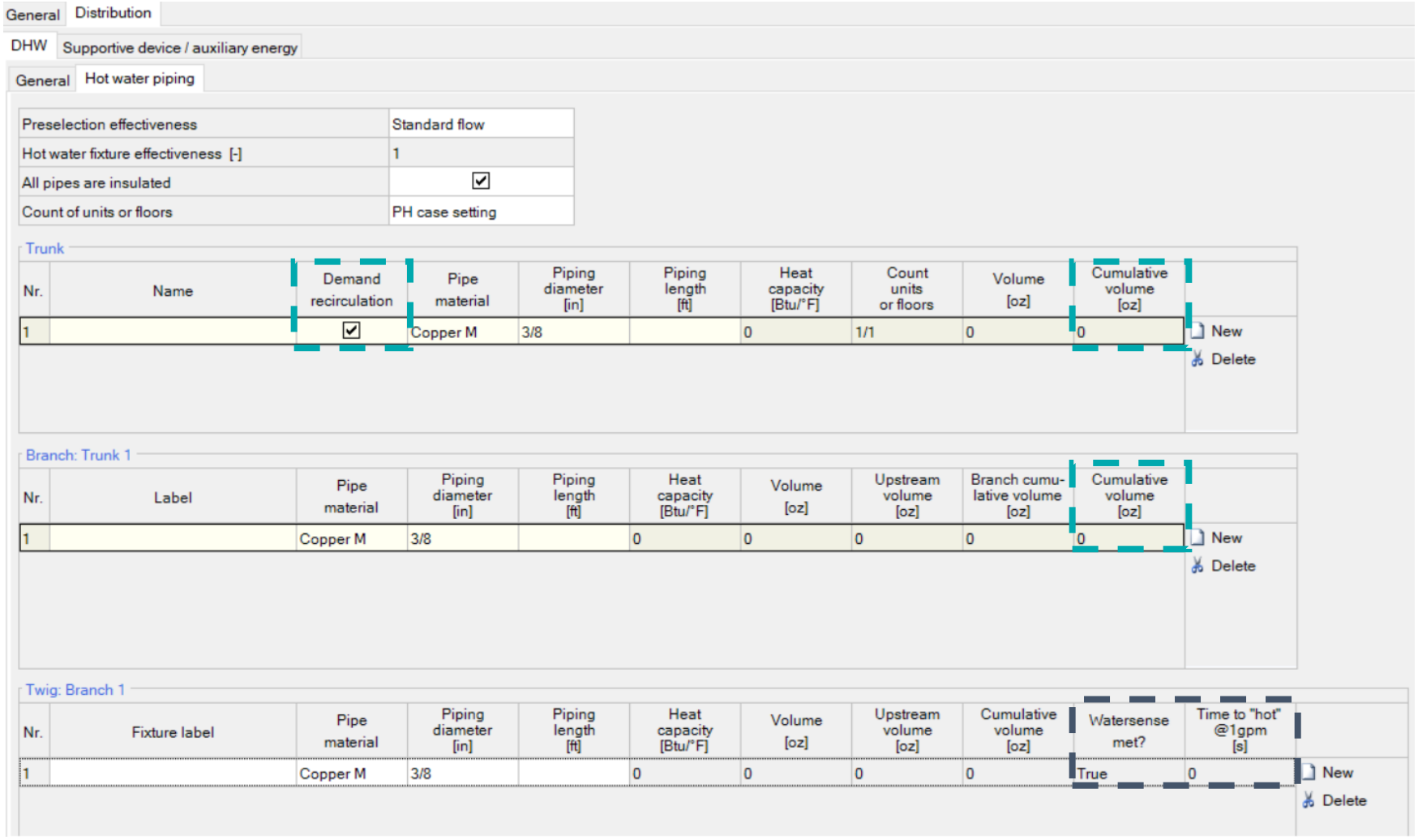
Domestic Hot Water Design Requirements

Definitions



Cumulative volume [oz]: This calculated volume is used to determine a project's compliance with the Watersense Test.

Watersense Met? & Time to "hot" @ 1 gpm [s]: Calculates an estimate of how long it will take the water to rise 10F in seconds based on the cumulative volume of water in the pipes. 60 seconds coincides with failing the Watersense test.

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Steps for the ‘Hot Water Piping Calculator’

Individual Pipes

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Hot water piping tab – Step 1

Fill out the upper portion of the Hot water piping tab.

Preselection effectiveness: Determined by the type of hot water fixtures used in the project. If 'Low-Flow' fixtures are used as defined by the EPA WaterSense, choose 'Low flow'. This should be verifiable with a fixture schedule.

All pipes insulated: Check this box if all hot water piping will be insulated. This should be verifiable from a note in the plans.

Count of units or floors:

- PH case setting is the default and can be used for projects with a single unit configuration for water distribution (ie. single family homes with a single water heater and multifamily projects with identical dwelling units with individual water heaters).
- For all other cases, this entry should be set to 'User Defined' so that the actual quantity of unique units can be input in Step 3 noted below.

Preselection effectiveness	Standard flow
Hot water fixture effectiveness [-]	1
All pipes are insulated	☑
Count of units or floors	PH case setting

Preselection effectiveness	Standard flow
Hot water fixture effectiveness [-]	1
All pipes are insulated	☑
Count of units or floors	User defined

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Paths to follow – Step 2

Identify the **water distribution configuration** and follow the Path from the chart below.

Recirculation Type	Path
None	A
On-Demand	B
Continuous or Time-Based	C

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Path A

For DHW distribution systems where **no recirculation** is provided

Recirculation Type	Path
None	**A**
On-Demand	B
Continuous or Time-Based	C

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Path A – Step 3A

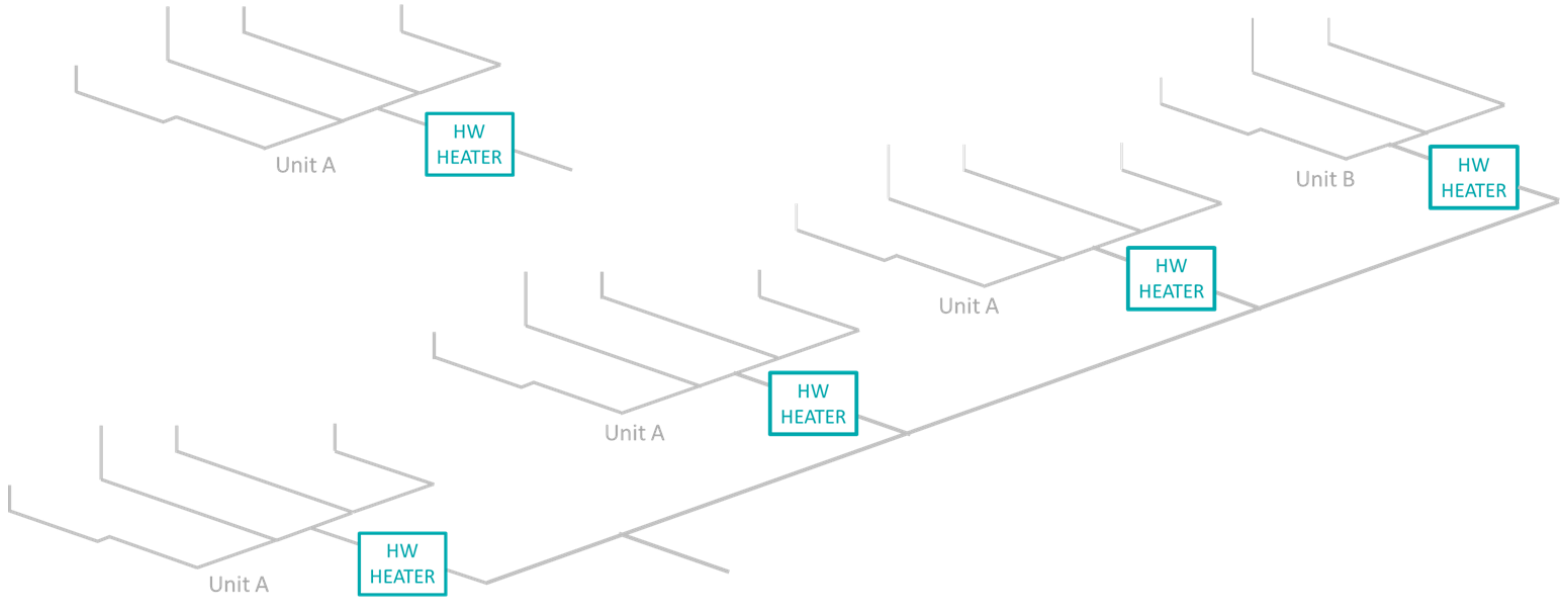
For DHW distribution systems where **no recirculation** is provided

1

Unit count	Single
HWH	At unit
Recirc type	None

2

Unit count	Multiple
HWH	At unit
Recirc type	None



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Path A – Step 3A

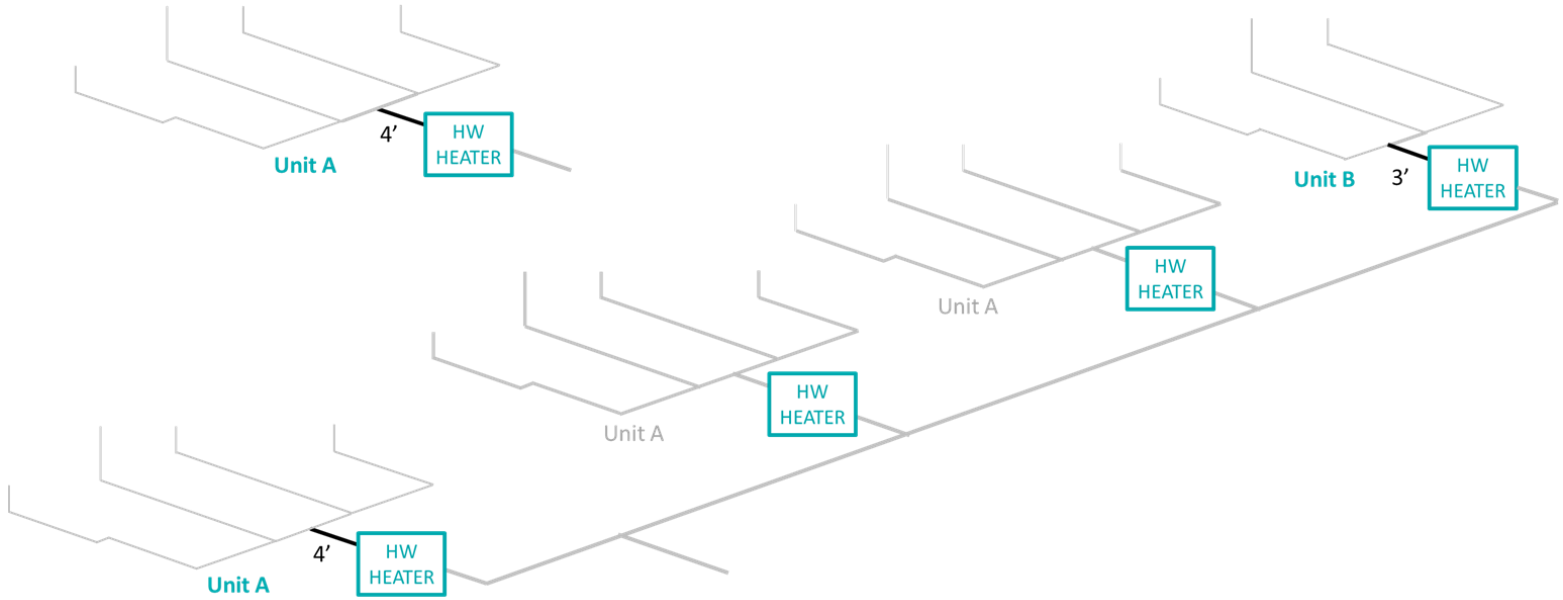
- Summarize DHW trunks (create a list of each unique unit types).
- A unit type is designated as ‘unique’ if it has a unique DHW layout.
- Name: name trunk based on Unit Type (i.e. A, B, C, etc).
  - For single unit buildings, only one trunk should be included from the water heater to where the first branch diverges
- Length: The trunk always starts at the water heater and should end where the first branch diverges from it.
  - Takeoffs should be provided to verify this input.

1

Trunk name	Piping Length (ft)
Unit A	4

2

Trunk name	Piping Length (ft)
Unit A	4
Unit B	3



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Path A – Step 3A

- Demand recirculation: Leave unchecked if no on-demand recirculation is planned.
- Count of units or floors: Number of times this unique unit occurs. Override this input as
- needed as noted in Step 1.
- Pipe material, diameter, heat capacity, volume [oz] and cumulative volume [oz]: Review definitions in N-11.2.

1

Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Unit A	☐	Copper M	3/4	4	1.01	1/1	13.72	13.72

2

Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Unit A	☐	Copper M	3/4	4	1.01	3	13.72	13.72
2	Unit B	☐	Copper M	3/4	3	0.76	1	10.29	10.29

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Path A – Step 4A

- Summarize DHW twigs (create a list of hot water fixtures in each unique unit type)
- The twig is the small diameter piping that serves an individual fixture.
- Name: based on DHW tap in the unique units listed above, with a 'T' at the front or end.
- Length: A twig only serves one fixture. To determine twig length, work from the fixture back to a central pipe that serves more than one fixture (branch).
  - Enter the entire twig length from the adjoining branch for each fixture no matter how many turns/twists.

1

UNIT A

Fixture Label	Piping Length (ft)
KS-T	14
BS-1-T	10
S-1-T	8
BS-2-T	10

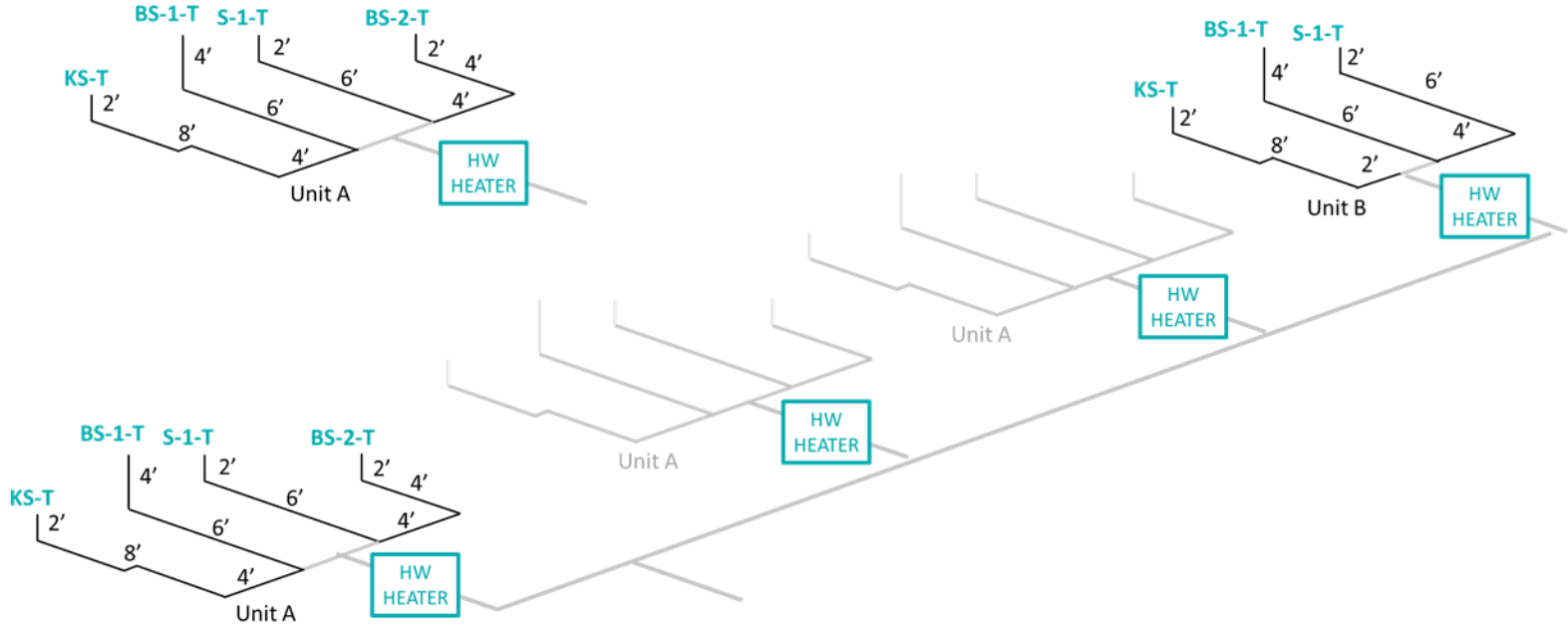
2

UNIT A

Fixture Label	Piping Length (ft)
KS-T	14
BS-1-T	10
S-1-T	8
BS-2-T	10

UNIT B

Fixture Label	Piping Length (ft)
KS-T	12
BS-1-T	10
S-1-T	12



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Path A – Step 5A

- Summarize DHW branches (create list of branches connecting trunk to twig)
  - Each twig will have its own branch, running from the trunk to the twig.
- Name: based on DHW tap in the unique units listed above (same as twig but without ‘T’)
- Length: Total length between twigs and trunks above.
  - If a twig connects directly to a trunk, enter a branch with a length of ‘0’ and connect the twig to that branch.
  - Sometimes a branch off the trunk may only serve one fixture. In that case, it could all be considered a twig, or could be split into a branch and a twig. If the pipe dimension and material are the same, either method will yield the same results.

1

UNIT A

Label	Piping Length (ft)
KS	2
BS-1	2

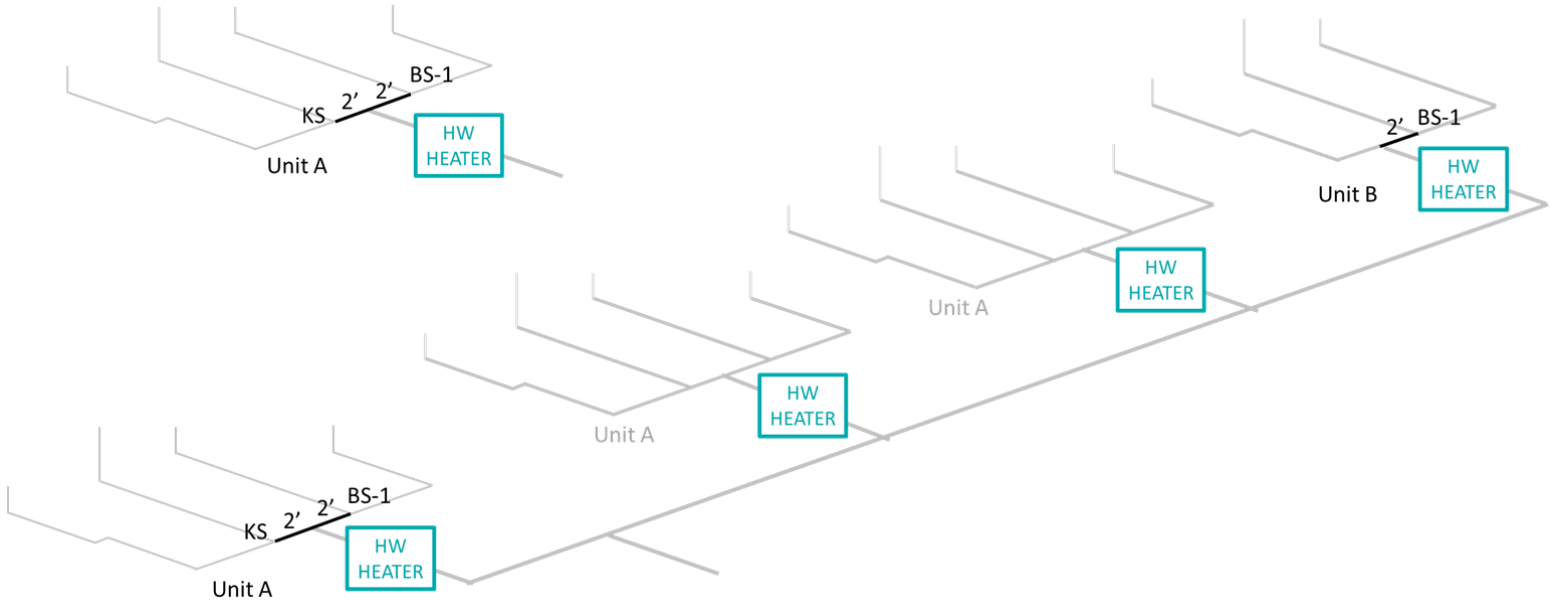
2

UNIT A

Label	Piping Length (ft)
KS	2
BS-1	2

UNIT B

Label	Piping Length (ft)
BS-1	2



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Path A – Step 6A

- Enter information from spreadsheet above into WUFI Passive.
  - A segment must be entered first with the trunk, then connecting branch, then connecting twig.
  - To ‘connect’ a branch to a trunk, you must first click on the trunk, then add that branch.
  - To ‘connect’ a twig to a branch, you must first click on the branch, then add that twig.
  - Be careful to ensure you are always connecting the appropriate segments.

1

Trunk

Nr.	Name	Piping length [ft]
1	Unit A	4

Branch: Trunk 1

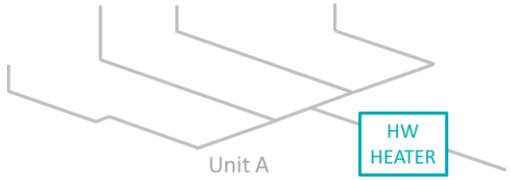
Nr.	Label	Piping length [ft]
1	KS	2
2	BS-1	2

Twig: Branch 1, KS

Nr.	Fixture label	Piping length [ft]
1	KS-T	14
2	BS-1-T	10

Twig: Branch 2, BS-1

Nr.	Fixture label	Piping length [ft]
1	S-1-T	8
2	BS-2-T	10



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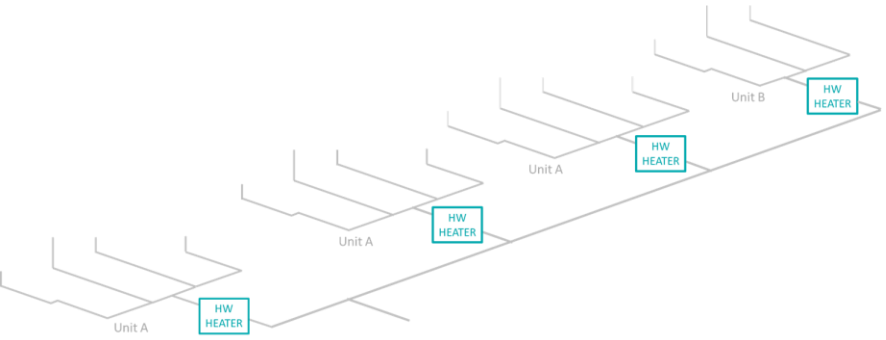
Path A – Step 6A

2

Trunk

Nr.	Name	Piping length [ft]	Count units or floors
1	Unit A	4	3
2	Unit B	3	1



Branch: Trunk 1

Nr.	Label	Piping length [ft]
1	KS	2
2	BS-1	2

Twig: Branch 1, KS

Nr.	Fixture label	Piping length [ft]
1	KS-T	14
2	BS-1-T	10

Twig: Branch 2, BS-1

Nr.	Fixture label	Piping length [ft]
1	S-1-T	8
2	BS-2-T	10

Branch: Trunk 2, Unit B

Nr.	Label	Piping length [ft]
1	KS	0
2	BS-1	2

Twig: Branch 1, KS

Nr.	Fixture label	Piping length [ft]
1	KS-T	12

Twig: Branch 2, BS-1

Nr.	Fixture label	Piping length [ft]
1	BS-1-T	10
2	S-1-T	12

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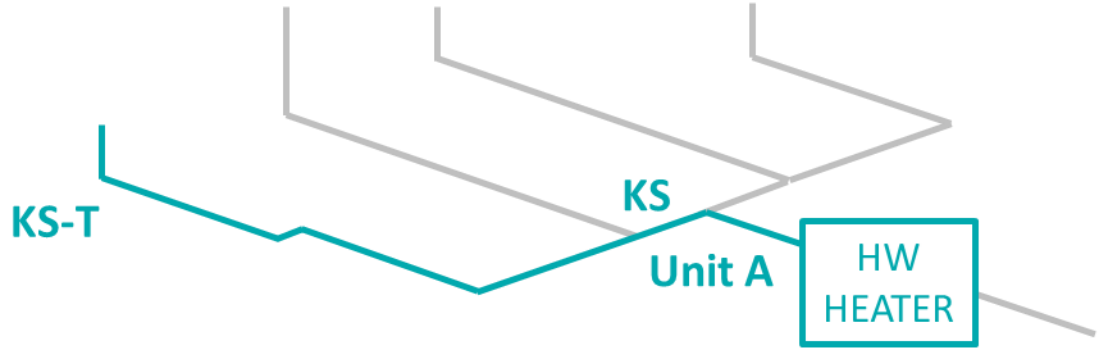
Path A – Step 7A

- Use the ‘Watersense met?’ column built into the twig entries to estimate whether all fixtures will pass the EPA WaterSense Hot Water Delivery requirement.
  - This is an on-site test that applies to all residential projects with individual water heaters.
  - Exception: No requirement for centralized DHW systems in multifamily projects.
- This tool is used to aid in the design of a DHW distribution network that will pass on-site testing, but it does not guarantee it.
  - If a twig is not passing in the model, it is recommended to revise the tap location or circulation strategy for that tap.

Twig: Branch 1, Kitchen Sink (KS)

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	KS-T	Copper M	3/8	2	0.16	2.12	40.76	42.88	True	40



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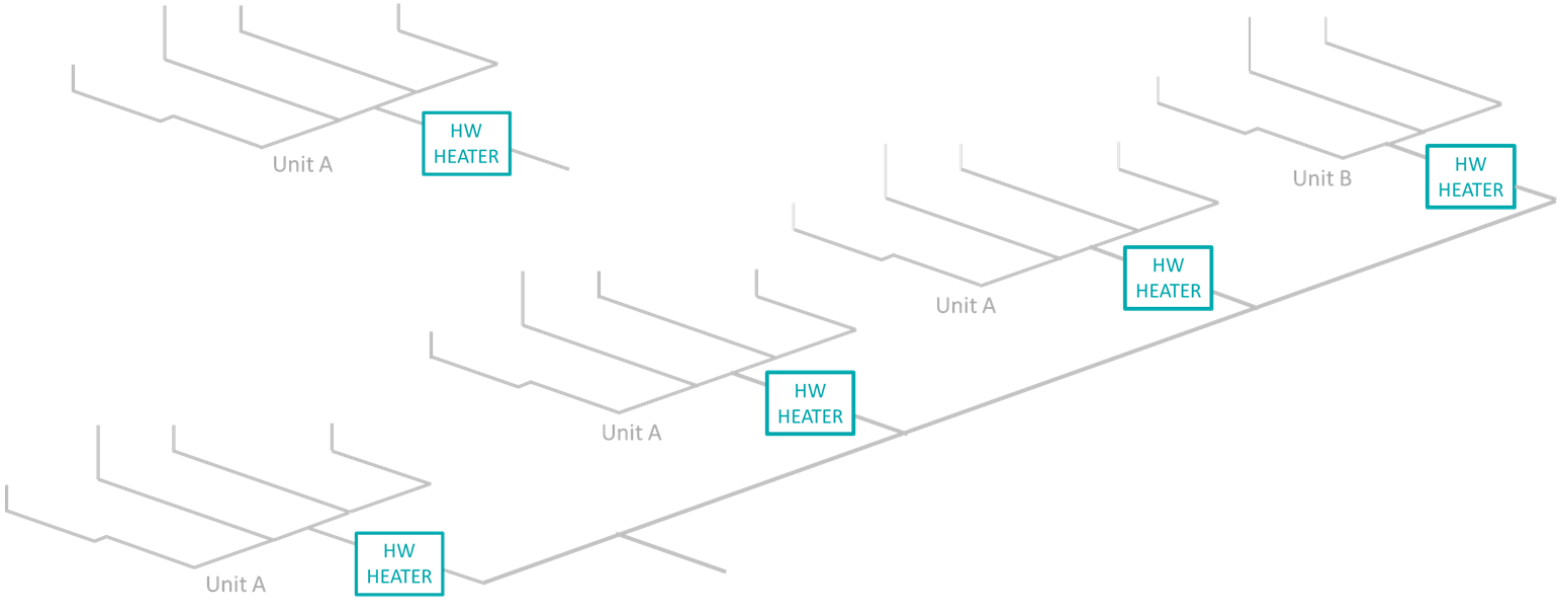
Path A – Step 8A

- Double check entries:
  - All trunks must have branch entries
  - All branches must have twigs connected (one per each fixture).
  - Quantities must appropriately represent the building distribution network.

1

2



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Path B

For systems employing a **demand recirculation strategy** that is verifiable from the plumbing plans and includes a sequence of operations that designates the demand controls provided

Recirculation Type	Path
None	A
On-Demand	**B**
Continuous or Time-Based	C

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Path B – Step 3B

For systems employing a **demand recirculation strategy** that is verifiable from the plumbing plans and includes a sequence of operations that designates the demand controls provided

4

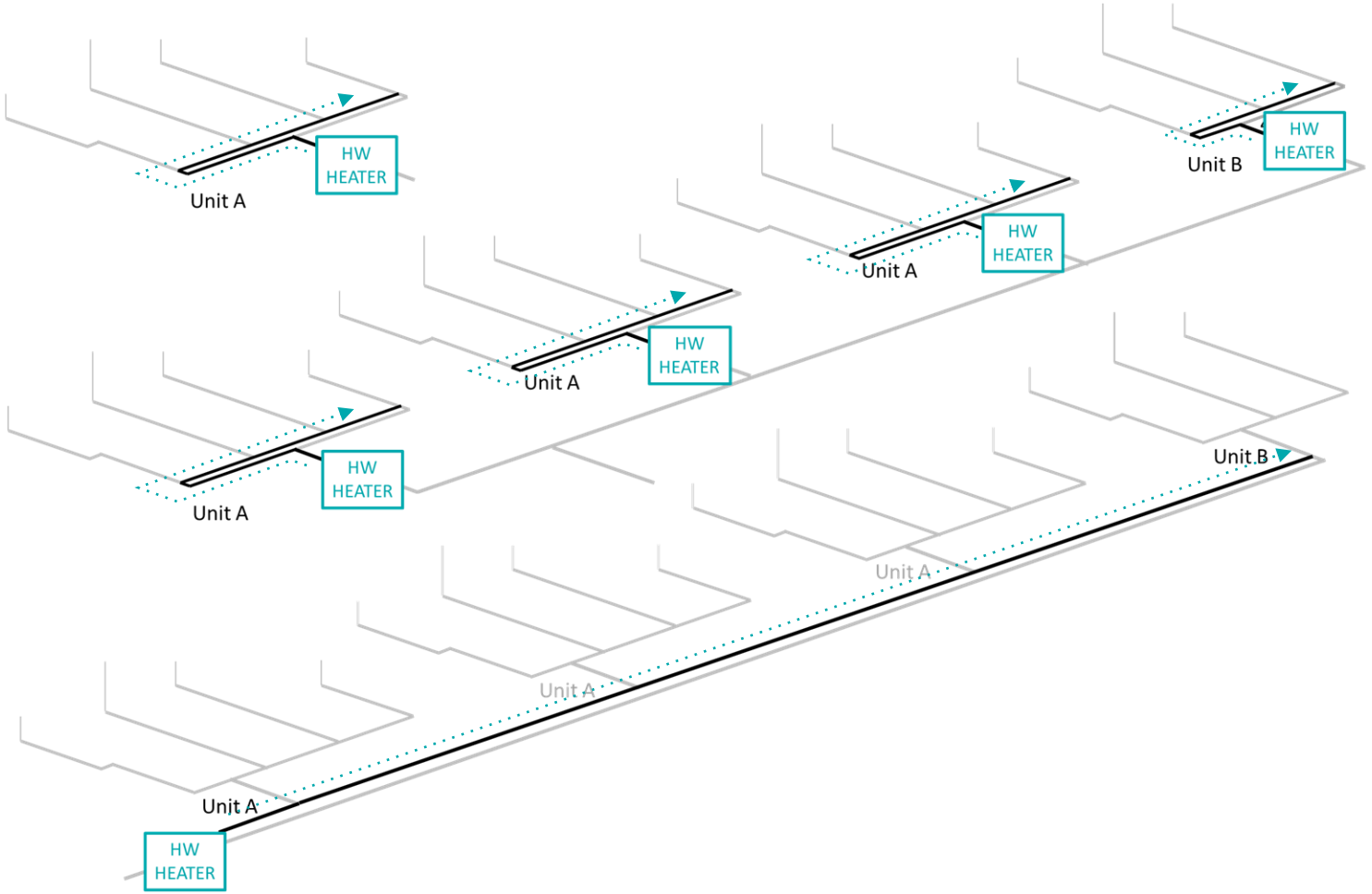
Unit count	Single
HWH	At unit
Recirc type	On-Demand

5

Unit count	Multiple
HWH	At unit
Recirc type	On-Demand

6

Unit count	Multiple
HWH	Centralized
Recirc type	On-Demand



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Path B – Step 3B

DHW trunks: designate a trunk or trunks to account for the on-demand recirculation loop.

- Demand Recirculation: Check this box and review Appendix N-11.2 for description.
  - On-demand trunk entries in multi-unit buildings are the only type of trunk that does not require a branch to be attached to it.
  - For multiple unit buildings, additional trunks that are not part of the on-demand recirculation loop need to be included

Name: Varies by trunk type.

- On-Demand Trunks
  - Name 'On-Demand'
- Trunks to individual units off of circulation loop
  - Name based on unit number (i.e. 401, 402, 403).

Length: Varies by trunk type.

- On-Demand Trunks
  - Enter the total length of the Supply side of the loop, omit Return portion (downstream of last fixture and recirc pump temperature sensor.)

Count of units or floors: Number of times this unique trunk condition occurs. Override this input as needed as noted in Step 1.

- On-Demand Trunks
  - Multiple demand recirculation trunks are only required if the pipe diameter varies along the on-demand loop.
- Trunks to individual units off of circulation loop
  - Should match the quantity of each unique unit configuration.

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Path B – Step 3B

4

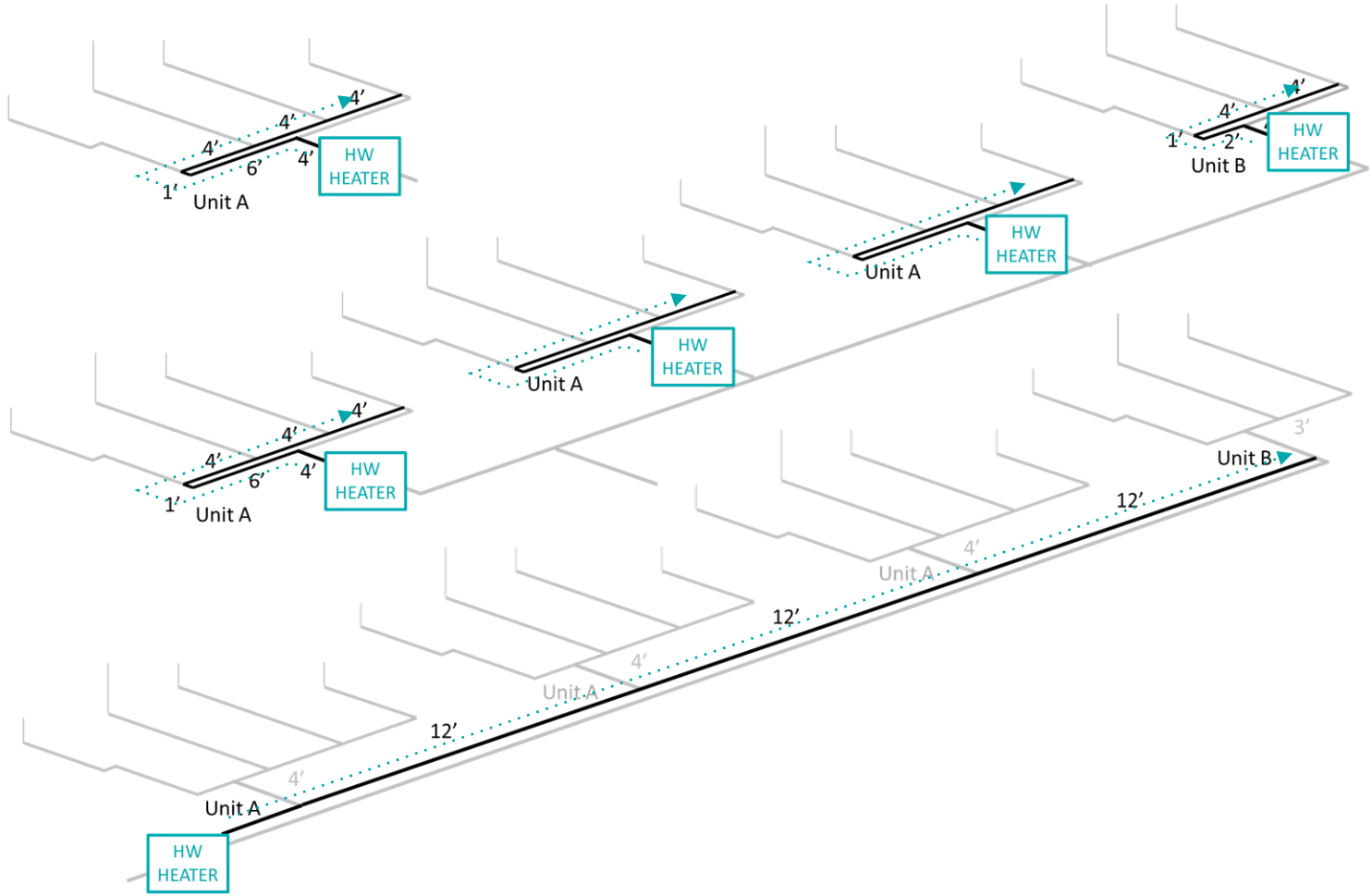
Trunk name	Piping Length (ft)
On-demand	23’

5

Trunk name	Piping Length (ft)	Count of units or floors
On-Demand Unit A	23’	3
On-Demand Unit B	15’	1

6

Trunk name	Piping Length (ft)	Count of units or floors
On-Demand	40’	1
Unit A	4’	3
Unit B	3’	1



On-Demand Trunks

Enter the total length of the Supply side of the loop, omit Return portion (downstream of last fixture and recirc pump temperature sensor.)

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Path B – Steps 4B, 5B, and 6B

- Refer to step Path A configuration that best aligns with the planned layout.

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Path B – Step 6B

4

Demand recirculation
☑

Trunk

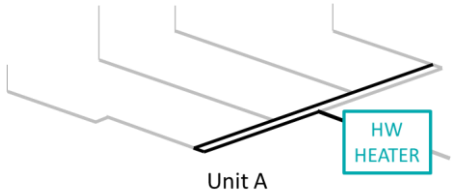
Nr.	Name	Piping length [ft]
1	Unit A	23

Branch: Trunk 1

Nr.	Label	Piping length [ft]
1	Generic Branch	0

Twig: Branch 1, Generic Branch

Nr.	Fixture label	Piping length [ft]
1	KS-T	14
2	BS-1-T	10
3	S-1-T	8
4	BS-2-T	10



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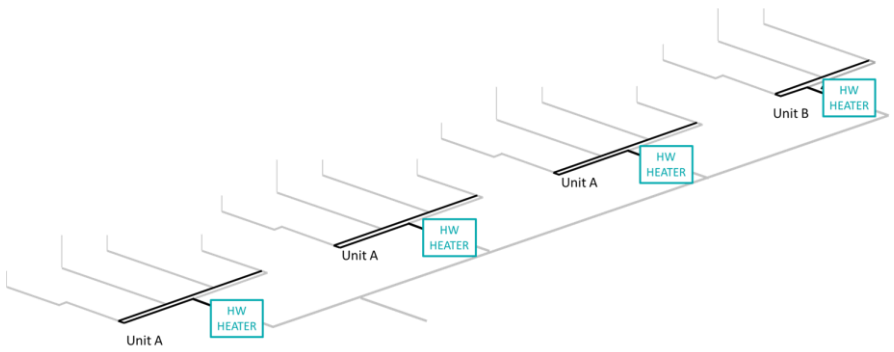
Path B – Step 6B

5

Demand recirculation
☑

Trunk

Nr.	Name	Piping length [ft]	Count units or floors
1	On-Demand Unit A	23	3
2	On-Demand Unit B	15	1



Branch: Trunk 1

Nr.	Label
1	Generic Branch

Piping length [ft]
0

Twig: Branch 1, Generic Branch

Nr.	Fixture label	Piping length [ft]
1	KS-T	14
2	BS-1-T	10
3	S-1-T	8
4	BS-2-T	10

Branch: Trunk 1

Nr.	Label
1	Generic Branch

Piping length [ft]
0

Twig: Branch 2, Generic Branch

Nr.	Fixture label	Piping length [ft]
1	KS-T	12
2	BS-1-T	10
3	S-1-T	12

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Path B – Step 6B

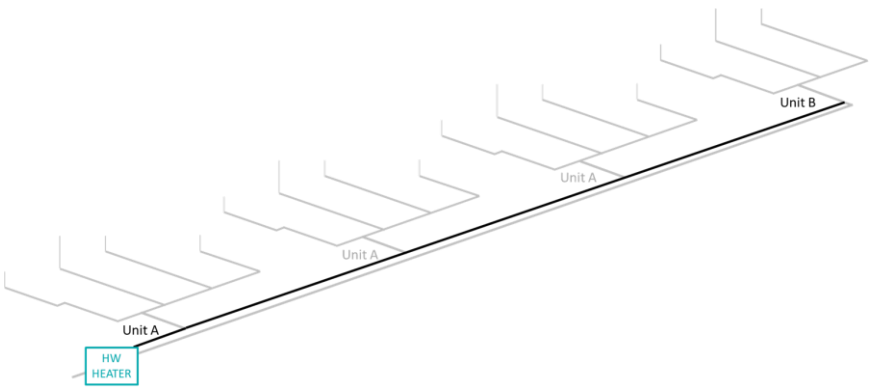
6

Demand recirculation
☑

Demand recirculation
☐

Trunk

Nr.	Name	Piping length [ft]	Count units or floors
1	On-Demand	40	1
2	Unit A	4	3
3	Unit B	3	1



Branch: Trunk 1

Nr.	Label
1	Generic Branch

Piping length [ft]
0

Twig: Branch 1, Generic Branch

Nr.	Fixture label	Piping length [ft]
1	KS-T	14
2	BS-1-T	10
3	S-1-T	8
4	BS-2-T	10

Branch: Trunk 1

Nr.	Label
1	Generic Branch

Piping length [ft]
0

Twig: Branch 2, Generic Branch

Nr.	Fixture label	Piping length [ft]
1	KS-T	12
2	BS-1-T	10
3	S-1-T	12

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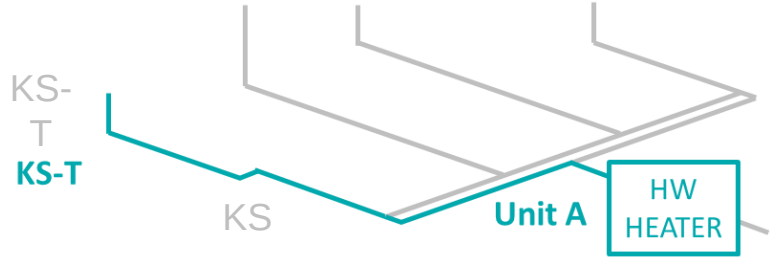
Path B – Step 7B

- Refer to the step 7A configuration that best aligns with the planned layout

Twig: Branch 1, Kitchen Sink (KS)

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	KS-T	Copper M	3/8	2	0.16	2.12	40.76	42.88	True	40



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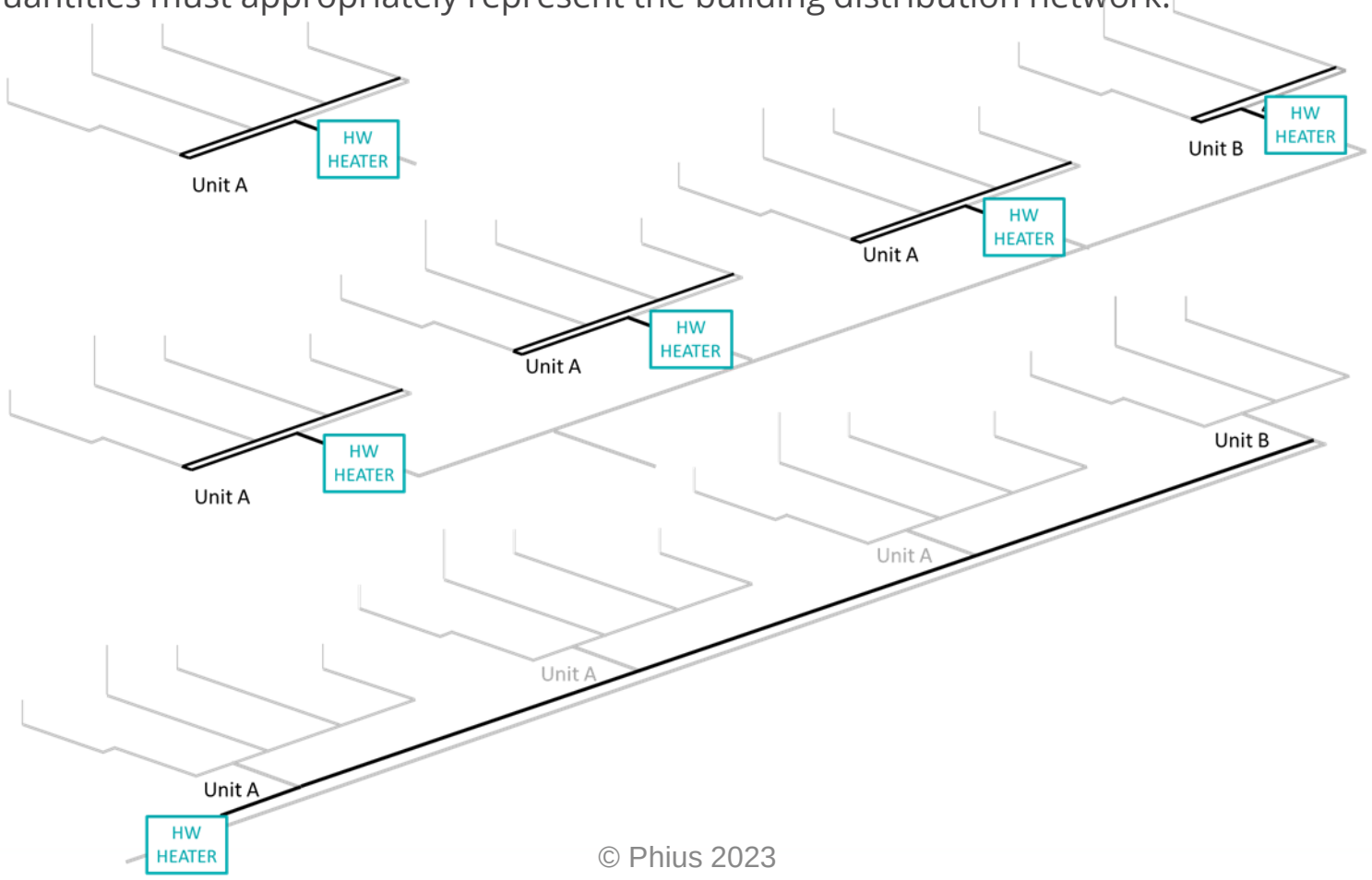
Path B – Step 8B

Double check entries:

- All trunks must have branch entries
  - **Exception: On-Demand trunks in multiple units buildings should not have a branch and twig.**
- All branches must have twigs connected.
- Quantities must appropriately represent the building distribution network.



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Path C

For systems employing a **continuous or time-based recirculation** strategy that is verifiable from the plumbing plans and includes a sequence of operations that designates the controls provided.

Recirculation Type	Path
None	A
On-Demand	B
Continuous or Time-Based	**C**

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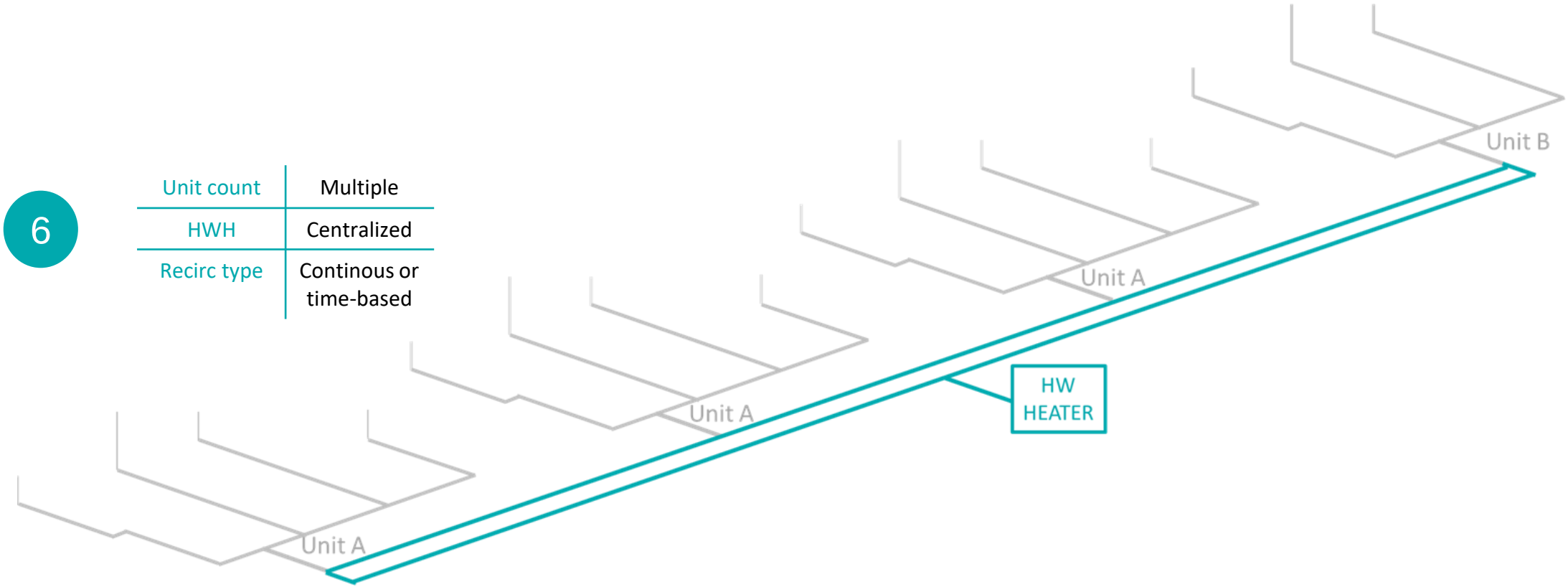
Path C

For systems employing a **continuous or time-based recirculation** strategy that is verifiable from the plumbing plans and includes a sequence of operations that designates the controls provided.

6

Unit count	Multiple
HWH	Centralized
Recirc type	Continous or time-based



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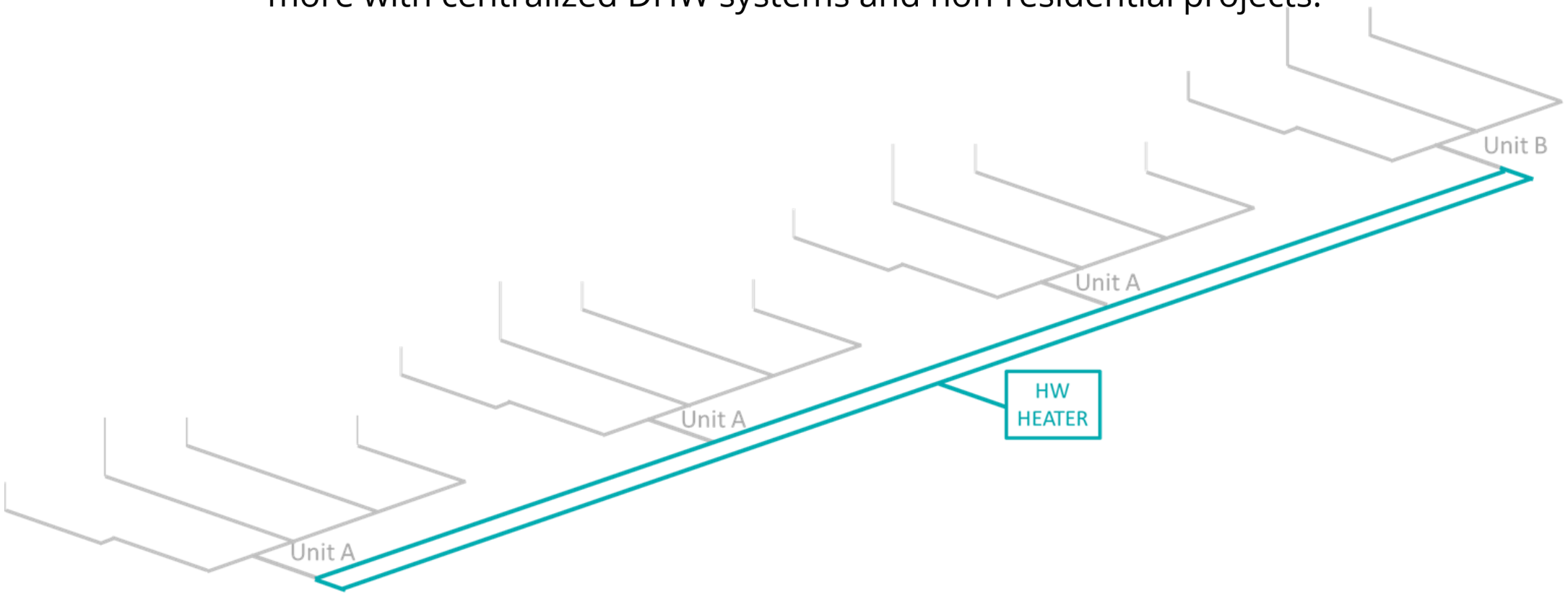
Path C – Step 3C

Distribution / DHW / General : Follow the instructions from Section 6.10.1.1

- This type of recirculation system is only allowed in multifamily buildings of 6 stories or more with centralized DHW systems and non-residential projects.



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Path C – Step 4C

- Follow the same steps as Path A.

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Red-flag - Piping Diameter

Same piping diameter across trunk-branch-twig circuit

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Studio - ST1	☑	CPVC-CTS-SDR	3/4	8.56	1.72	2	22.86	0

Branch: Trunk 1, Studio - ST1

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Kitchen Sink	CPVC-CTS-SDR	3/4	9.03	1.82	24.11	0	24.11	24.11

Twig: Branch 1, Kitchen Sink

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Kitchen Sink - Twig	CPVC-CTS-SDR	3/4	7.01	1.41	18.72	24.11	42.83	True	40

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Red-flag - Piping Material

Same piping material across trunk-branch-twig circuit

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Studio - ST1	☑	CPVC-CTS-SDR	3/4	8.56	1.72	2	22.86	0

Branch: Trunk 1, Studio - ST1

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Kitchen Sink	CPVC-CTS-SDR	3/4	9.03	1.82	24.11	0	24.11	24.11

Twig: Branch 1, Kitchen Sink

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Kitchen Sink - Twig	CPVC-CTS-SDR	3/4	7.01	1.41	18.72	24.11	42.83	True	40

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Red-flag – Material Alternatives

Data for material selection

Piping Materials	Commonly used
Copper K	
Copper L	x
Copper M	
CPVC-CTS-SDR	
CPVS-SCH-40	
PE-AL-PE	
PEX-AL-PEX	x
PEX-CTS-SDR-9	

See Appendix:

N-1 DHW Distribution Pipe Materials and Sizes
Cert Guidebook (Version 3.1 | July 2022)

Available comparative data on:

- Ounces of water per foot of hot water tubing [oz/ft]
- Outside diameter [in]
- Inside diameter [in]
- Weight empty [lb/ft]
- Empty pipe heat capacity [Btu/ft.F]
- Pipe + water heat capacity [Btu/ft.F]

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Red-flag – Piping Length

HW tank from the fixture more than 40’

Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	Studio - ST1	☑	CPVC-CTS-SDF	3/4	40.56	8.16	2	108.3	0

Branch: Trunk 1, Studio - ST1

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumu-lative volume [oz]	Cumulative volume [oz]
1	Kitchen Sink	CPVC-CTS-SDF	3/4	9.03	1.82	24.11	0	24.11	24.11

Twig: Branch 1, Kitchen Sink

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Kitchen Sink - Twig	CPVC-CTS-SDF	3/4	7.01	1.41	18.72	24.11	42.83	True	40

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WUFI Assignment (PH verification)

Total heat losses of the DHW system

DHW AND DISTRIBUTION		
DHW consumption per person per day:	**6.6**	gal/Person/day
Average cold water temperature supply:	**41.3**	°F
Useful heat DHW:	**49,565**	kBtu/yr
Specific useful heat DHW:	**7,005.7**	Btu/ft²yr
Total heat losses of the DHW system:	**6,302.4**	kBtu/yr
Specific losses of the DHW system:	**890.8**	Btu/ft²yr
Performance ratio DHW distribution system and storage:	**1.1**	
Utilization ratio DHW distribution system and storage:	**0.9**	
Total heat demand of DHW system:	**55,867.4**	kBtu/yr
Total specific heat demand of DHW system:	**7,896.5**	Btu/ft²yr
Total heat losses of the hydronic heating distribution:	**0**	kBtu/yr
Specific losses of the hydronic heating distribution:	**0**	Btu/ft²yr
Performance ratio of heat distribution:	**100**	%

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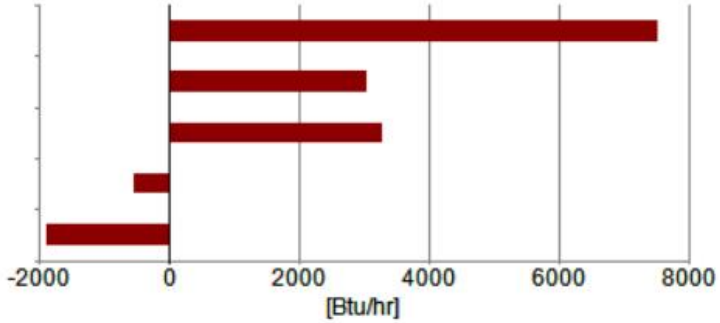
WUFI Assignment (PH verification)

Internal Heat Gains Summer

INTERNAL HEAT GAINS

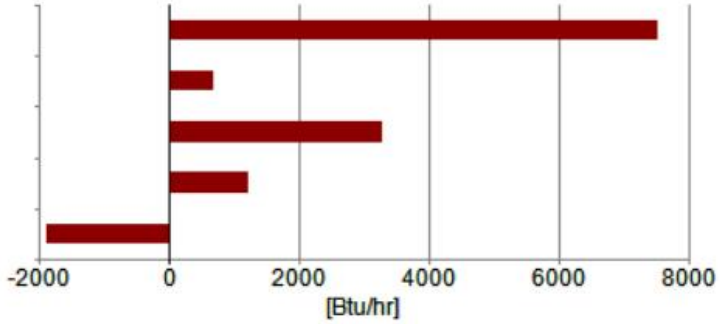
Heating season

Electricity total:	**7,530.1**	Btu/hr
Auxiliary electricity:	**3,057**	Btu/hr
People:	**3,303**	Btu/hr
Cold water:	**-538.5**	Btu/hr
Evaporation:	**-1,876.7**	Btu/hr
Σ:	**11,467.9**	Btu/hr
Specific internal heat gains:	**1.6**	Btu/hr ft²



Cooling season

Electricity total:	**7,530.1**	Btu/hr
Auxiliary electricity:	**688.4**	Btu/hr
People:	**3,303**	Btu/hr
Cold and hot water:	**1,231.4**	Btu/hr
Evaporation:	**-1,876.7**	Btu/hr
Σ:	**11,467.9**	Btu/hr
Specific internal heat gains:	**1.6**	Btu/hr ft²



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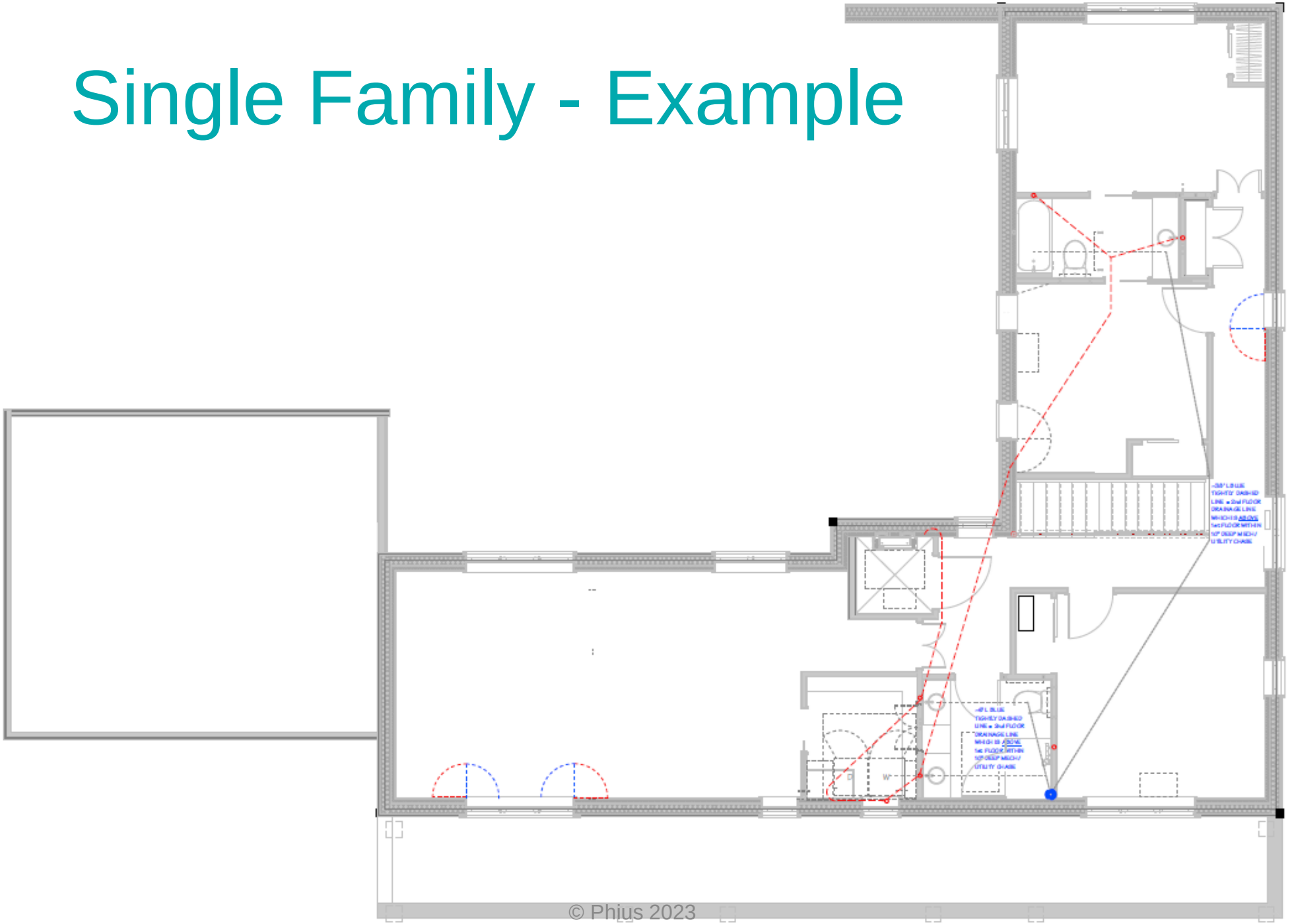
Single Family - Example



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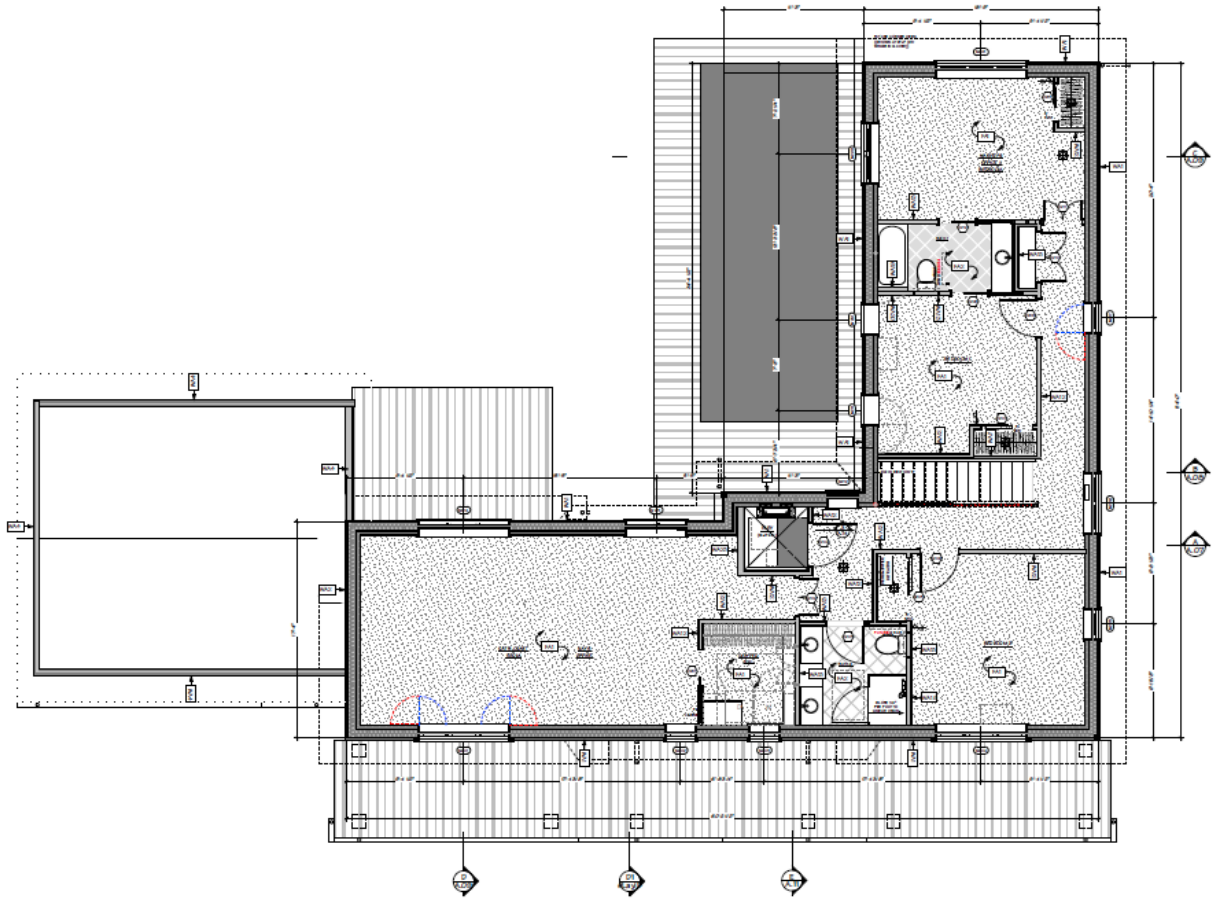
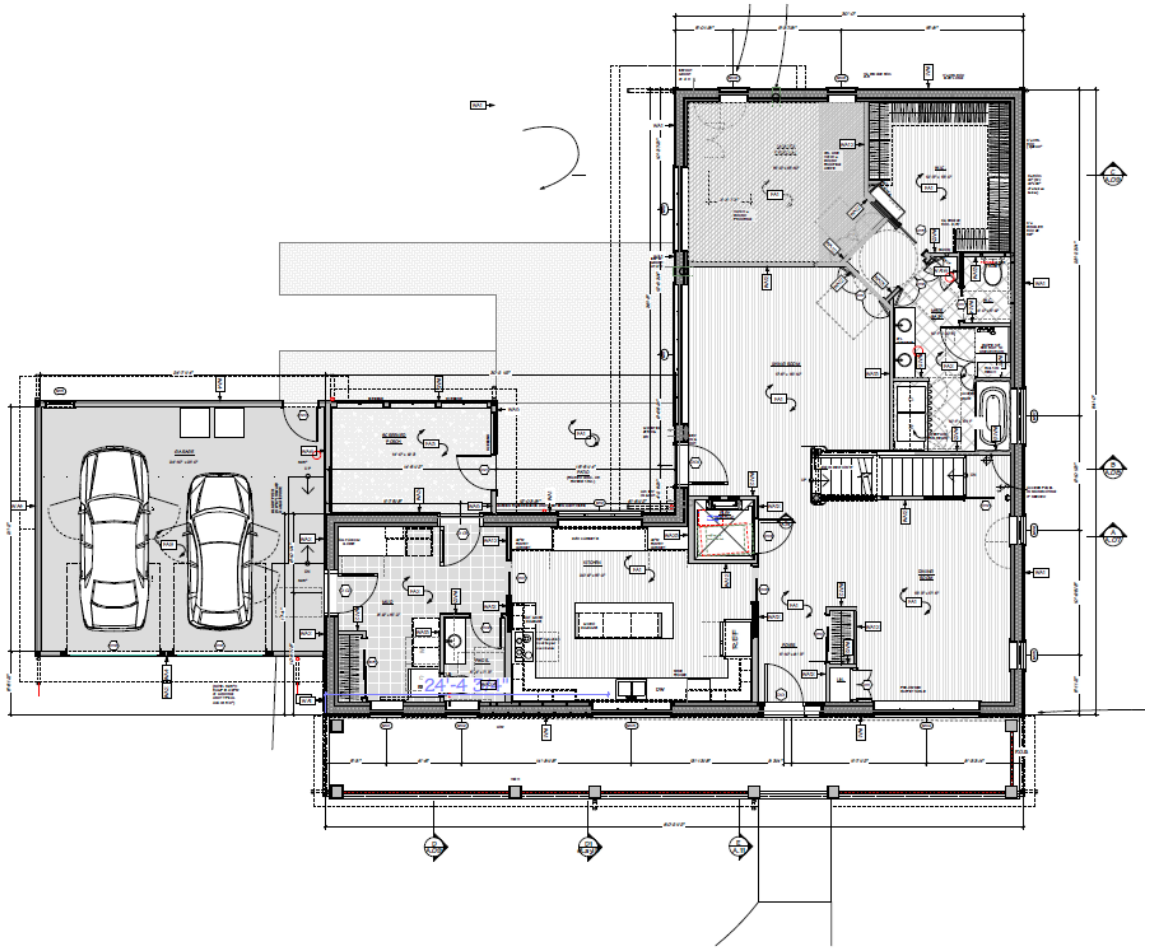
Single Family - Example





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Single Family - Example

General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]	120		
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			
Individual pipes			
Calculation method	Hot water piping calculator (unit method)		

MAIN FLOOR & SECOND FLOOR
HOT WATER RECIRCULATION LOOP SYSTEM

THE HOT WATER RECIRC LOOP IS ACTIVATED BY BUTTONS THAT CAN BE PUSHED NEAR PLUMBING FIXTURES. ALL PLUMBING LINES FEATURE R-3.3 ARMAFLEX PLUMBING INSULATION.

TRUNK "1" RECIRC LOOP IS 47' LONG. THIS TRUNK, SERVING THE LOWER LEVEL, LOCATED IN DROPPED SOFFIT CLG IN THE LOWER LEVEL.

TRUNK "1" - BASEMENT RECIRC LOOP, TOTAL LENGTH: 47'

TRUNK "1" LENGTH: 43.8' (PORTION BELOW 1ST FLOOR)

TRUNK "1" VERTICAL PORTIONS: 2'

TRUNK "1" VERTICAL PORTIONS: 2'

Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	MAIN TRUNK "A" Demand-recirculat	☑	PEX-AL-PEX	3/4	101.4	30.76	13	343.75	0
2	Lower Level Trunk "1" Demand Reci	☑	PEX-AL-PEX	3/4	47	14.26	3	159.33	0

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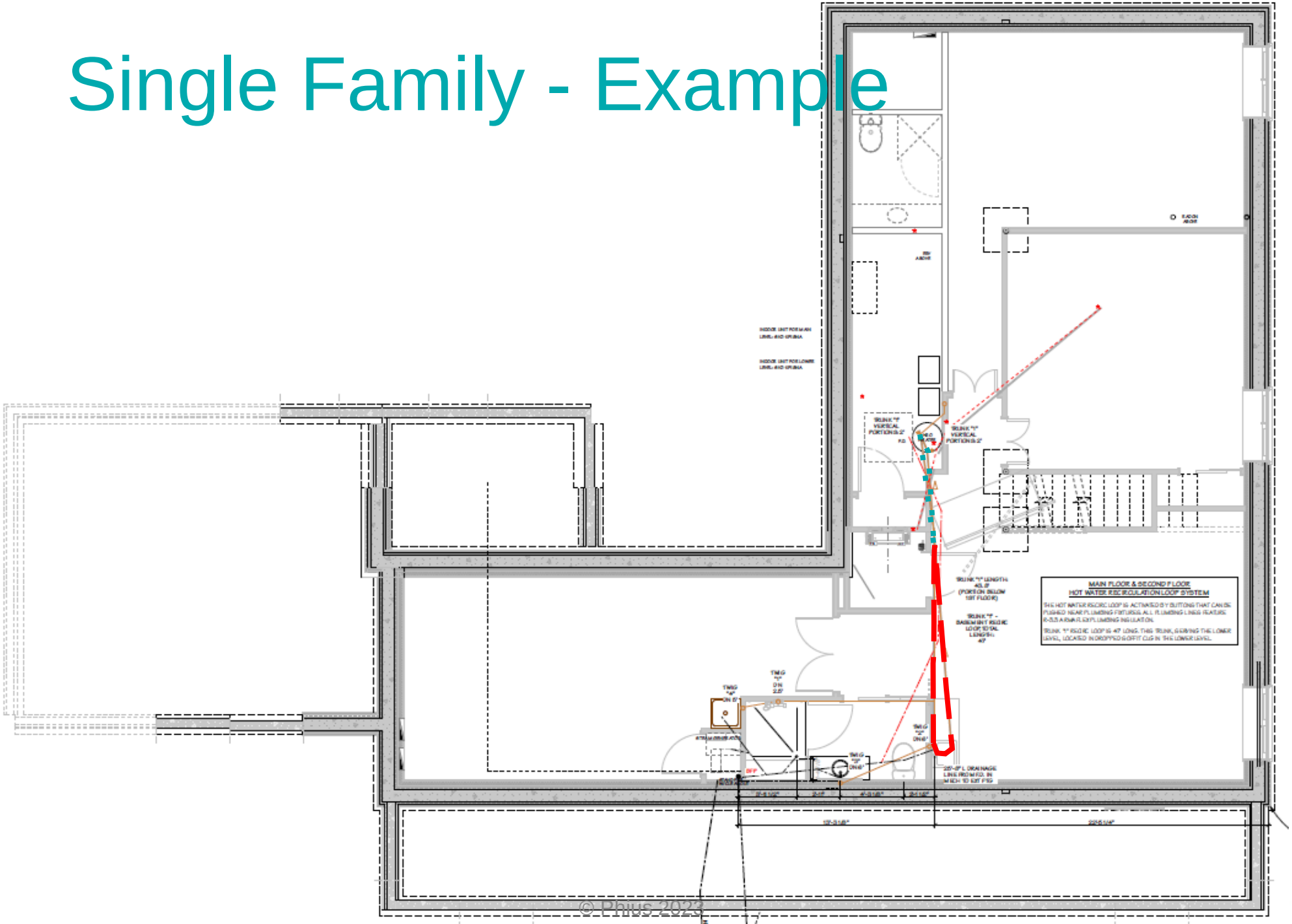
Single Family - Example



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Single Family - Example

General | Hot water piping

DHW distribution

Setting	In conditioned space	Outside conditioned space 1	Outside conditioned space 2
Design flow temperature [°F]	120		
Circulation pipes			
Length of circulation pipes [ft]			
Heat loss coefficient per ft pipe [Btu/hr ft °F]			
Temperature of the room the pipes pass through [°F]			
Daily running hours of the circulation [hr]			
Individual pipes			
Calculation method	Hot water piping calculator (unit method)		

Trunk

Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]	Cumulative volume [oz]
1	MAIN TRUNK "A" Demand-recirculat	☑	PEX-AL-PEX	3/4	101.4	30.76	13	343.75	0
2	Lower Level Trunk "1" Demand Reci	☑	PEX-AL-PEX	3/4	47	14.26	3	159.33	0

TRUNK "A" - MAIN RECIRC LOOP, TOTAL LENGTH: 101.4'

TRUNK "A" LENGTH: 19.1' (PORTION BELOW 1ST FLOOR)

TRUNK "A" LENGTH: 62.3' (PORTION ABOVE 1ST FLOOR)

TRUNK "A" VERTICAL PORTIONS: 2'

TRUNK "A" VERTICAL PORTIONS: 2'

TRUNK "A" VERTICAL PORTIONS: 8'

TRUNK "A" VERTICAL PORTIONS: 8'

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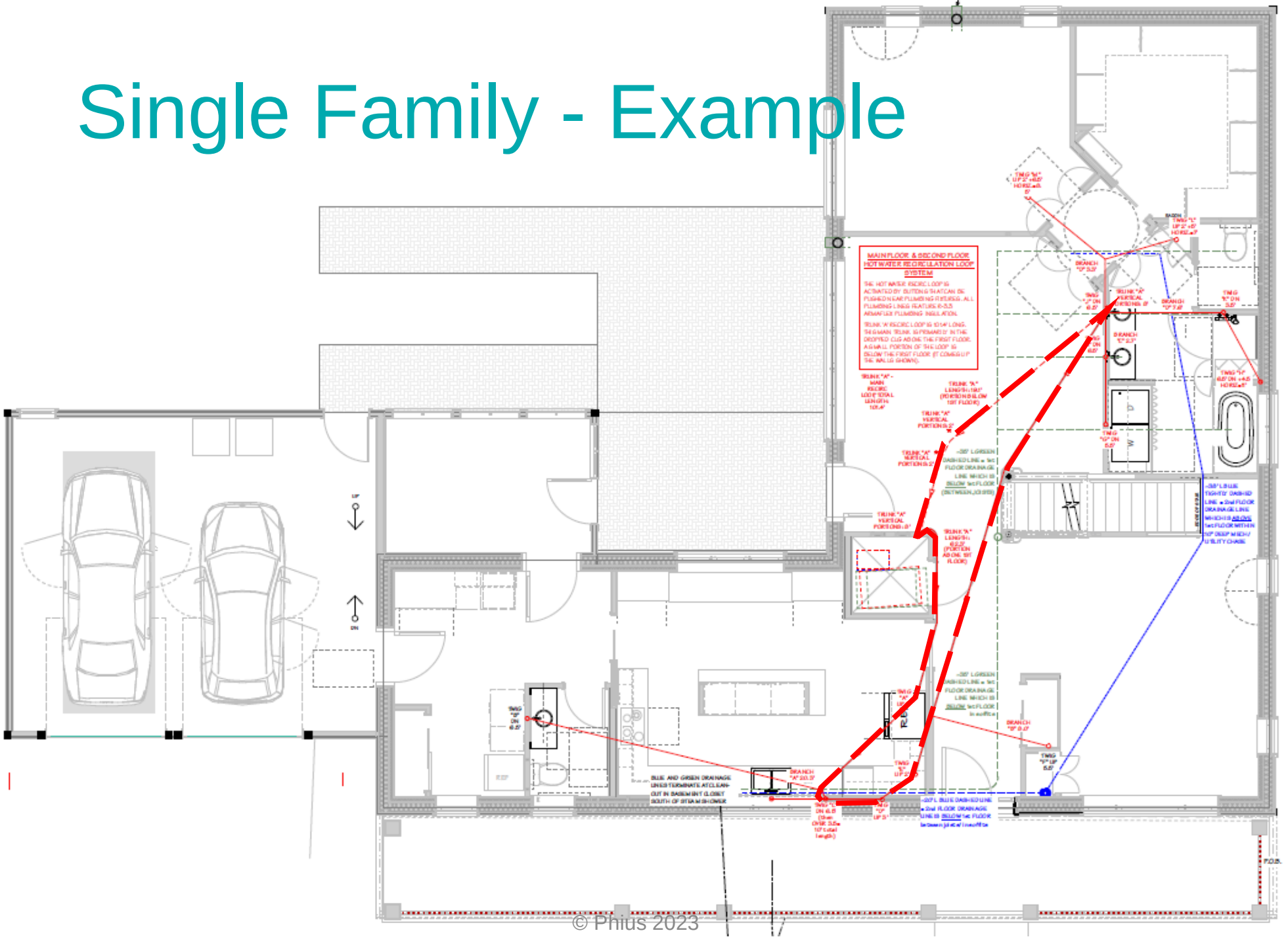
Single Family - Example



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Single Family - Example

Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Misc.	PEX-AL-PEX	1/2	0	0	0	0	0	0
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96
6	Branch E	PEX-AL-PEX	1/2	3.3	0.41	4.32	0	4.32	4.32

Branch: Trunk 2, Lower Level Trunk "1" Demand Recirculation Loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Branch 1	PEX-AL-PEX	3/8	12	0.91	7.56	0	7.56	7.56
2	Branch 2	PEX-AL-PEX	3/8	0.1	0.01	0.06	0	0.06	0.06

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Single Family - Example

Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Misc.	PEX-AL-PEX	1/2	0	0	0	0	0	0
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96

New

Delete

Twig: Branch 1, Misc.

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig A: Bath 2 sink	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	True	10
2	Twig E: Bath 2 sink	PEX-AL-PEX	1/2	2	0.25	2.62	0	2.62	True	2
3	Twig D: Craft WIC /Laundry Washer	PEX-AL-PEX	3/8	3	0.23	1.89	0	1.89	True	2
4	Twig C: Kitchen sink	PEX-AL-PEX	3/8	10	0.76	6.3	0	6.3	True	6
5	Twig J: M Bath sink	PEX-AL-PEX	3/8	6.5	0.49	4.1	0	4.1	True	4

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Single Family - Example

Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

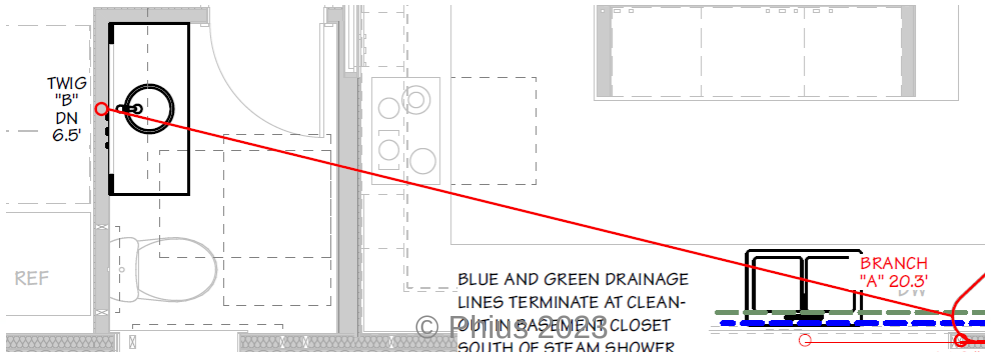
Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
1	Misc.	PEX-AL-PEX	1/2	0	0	0	0	0	0
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96

New

Delete

Twig: Branch 2, Branch A

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig B: Pwdr sink/washer	PEX-AL-PEX	3/8	6.5	0.49	4.1	26.59	30.69	True	29



Single Family - Example

Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

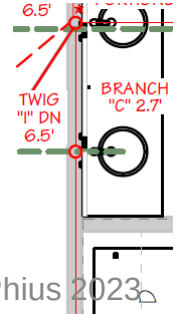
Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96
6	Branch E	PEX-AL-PEX	1/2	3.3	0.41	4.32	0	4.32	4.32

New

Delete

Twig: Branch 3, Branch C

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig I: M Bath sink	PEX-AL-PEX	3/8	6.5	0.49	4.1	3.54	7.63	True	7



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Single Family - Example

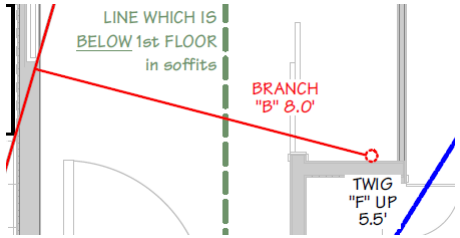
Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96
6	Branch E	PEX-AL-PEX	1/2	3.3	0.41	4.32	0	4.32	4.32

New
Delete

Twig: Branch 4, Branch B

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig F: Bath 2 shower	PEX-AL-PEX	3/8	5.5	0.42	3.47	10.48	13.95	True	13



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Single Family - Example

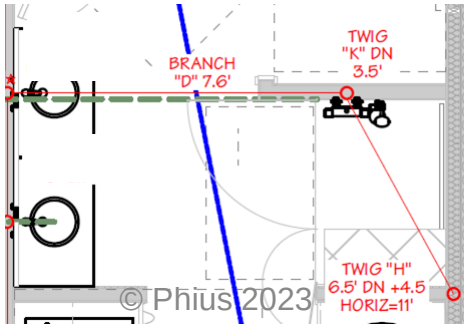
Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumu-lative volume [oz]	Cumulative volume [oz]
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96
6	Branch E	PEX-AL-PEX	1/2	3.3	0.41	4.32	0	4.32	4.32

New
Delete

Twig: Branch 5, Branch D

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig K: M Bath shower	PEX-AL-PEX	3/8	3.5	0.26	2.21	9.96	12.16	True	11
2	Twig H: M Bath tub	PEX-AL-PEX	3/8	11	0.83	6.93	9.96	16.89	True	16



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Single Family - Example

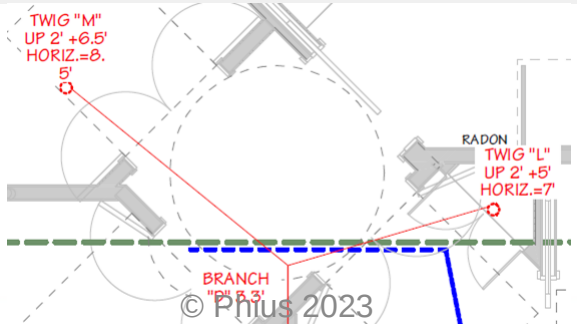
Branch: Trunk 1, MAIN TRUNK "A" Demand-recirculation loop

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]	Cumulative volume [oz]
2	Branch A	PEX-AL-PEX	1/2	20.3	2.5	26.59	0	26.59	26.59
3	Branch C	PEX-AL-PEX	1/2	2.7	0.33	3.54	0	3.54	3.54
4	Branch B	PEX-AL-PEX	1/2	8	0.99	10.48	0	10.48	10.48
5	Branch D	PEX-AL-PEX	1/2	7.6	0.94	9.96	0	9.96	9.96
6	Branch E	PEX-AL-PEX	1/2	3.3	0.41	4.32	0	4.32	4.32

New
Delete

Twig: Branch 6, Branch E

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]	Watersense met?	Time to "hot" @1gpm [s]
1	Twig L: Bath 1 sink	PEX-AL-PEX	3/8	7	0.53	4.41	4.32	8.73	True	8
2	Twig M: Bath 1 tub	PEX-AL-PEX	3/8	8.5	0.64	5.36	4.32	9.68	True	9



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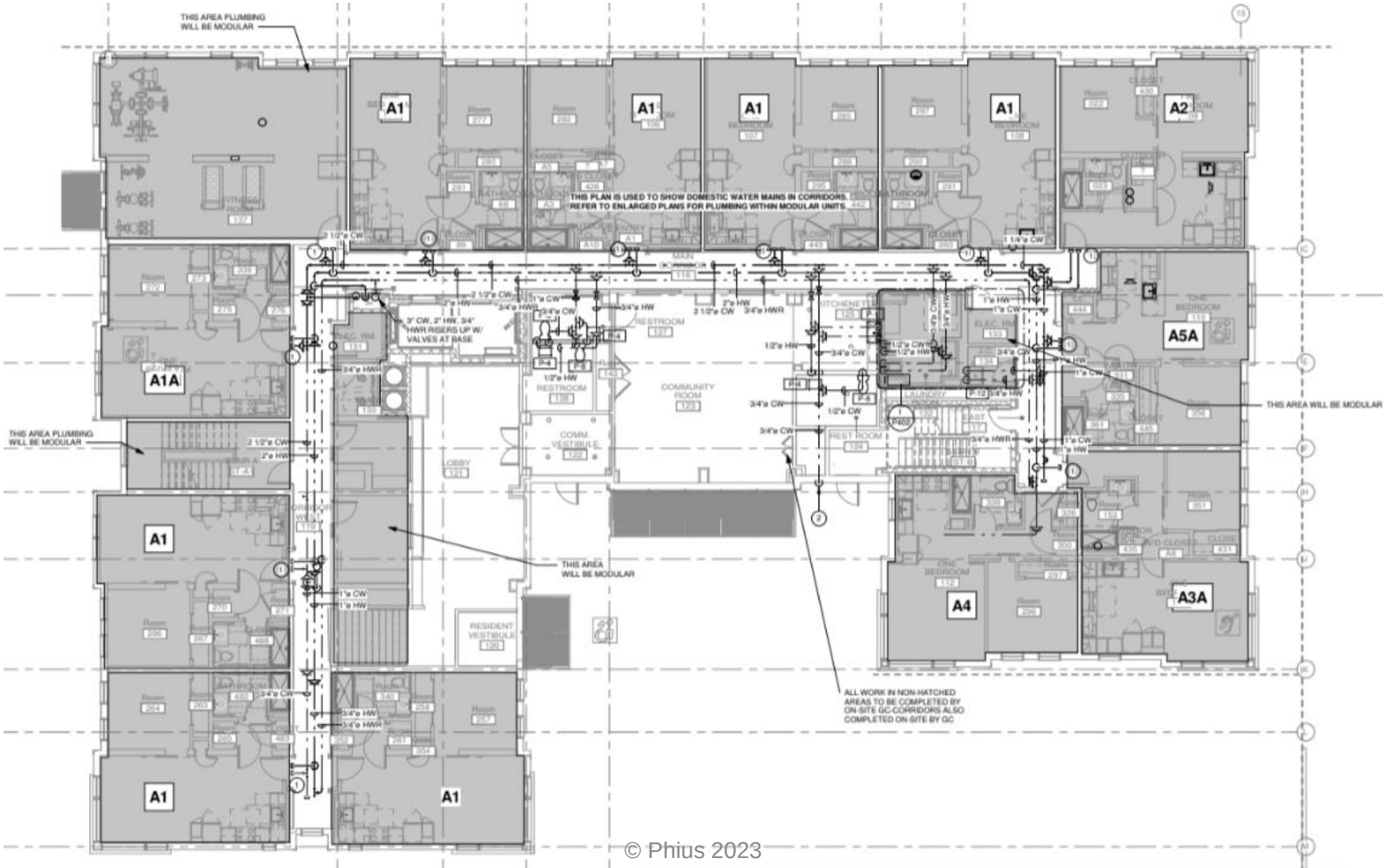
Multifamily - Example



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Round of Review	3	Helpful Webinar Here:	https://www.youtube.com/watch?v=VrO4zL63tTg																	
DHW	TRUNKS	Date:	9/20/2022					BRANCHES	Date:	9/20/2022			TWIGS	Date:	9/20/2022					
		PHIUS comments							PHIUS comments					PHIUS comments						
	# Name	Demand Recirc?	Pipe Material	Pipe Diameter	Pipe Length	Unit/Floor Count	CPHC Response	# Name	Pipe Material	Pipe Diameter	Pipe Length	CPHC Response	# Name	Pipe Material	Pipe Diameter	Pipe Length	Watersense	CPHC Response		
Hot Water Piping	1 Unit A1 Trunk	Ok, unchecked	Ok, PEX-AL-PEX	Ok, 3/4"	Ok, values entered below per take-off (blue dimensions for trunks) 10	Ok, entries below per A-124: 40		1 Unit A1 Branch 1 (Bath)	Ok, PEX-AL-PEX	Ok, values entered below: 3/4"	Ok, values entered below per take-off (green dimensions for branches) 4.25		1 Unit A1 Twig 1 (Tub)	Ok, PEX-AL-PEX	1/2"	Ok, values below per '1887_LaMora_DHW supporting calcs' 13.83	TRUE			
													2 Unit A1 Twig 1 (Sink)	"	"	14.6	"			
													3 Unit A1 WD	"	"	9.18	"			
								2 Unit A1 Branch 2 (Kitchen)	"	1/2"	0		1 Unit A1 Twig 1 (Kitchen)	"	"	13.75	"			
	2 Unit A2 Trunk	"	"	"	35	4		1 Unit A2 Branch (placeholder)	"	3/4"	0		1 Unit A2 Twig 1 (Tub)	"	"	7.6	"			
													2 Unit A2 Twig 2 (Bath sink)	"	"	7.83	"			
													3 Unit A2 Twig 4 (Sink)	"	"	19.75	"			
	3 Unit A3 Trunk	"	"	"	29.75	4		1 Unit A3 Branch (Placeholder)	"	1/2"	0		1 Unit A3 Twig 1 (Sink)	"	"	9.25	"			
													2 Unit A3 Twig 2	"	"	7.75	"			
													3 Unit A3 Twig 3 (Sink)	"	"	13.1	"			
	4 Unit A4 Trunk	"	"	"	22.5	4		1 Unit A4 Branch (Placeholder)	"	"	0		1 Unit A4 Twig 1 (Sink)	"	"	11.5	"			
													2 Unit A4 Twig 2	"	"	12	"			
													3 Unit A4 Twig 3 (Sink)	"	"	5	"			
	5 Unit A5 Trunk	"	"	"	23	4		1 Unit A5 Branch (Placeholder)	"	"	0		1 Unit A5 Twig 1 (Sink)	"	"	27.58	"			
													3 Unit A5 Twig 3 (Sink)	"	"	6.75	"			
													4 Unit A5 Twig 4 (Sink)	"	"	14.5	"			
	6 Unit B1 Trunk	"	"	"	32	4		1 Unit A5 Branch (Placeholder)	"	"	0		1 Unit B1 Twig 1 (Sink)	"	"	5	"			
													2 Unit B1 Twig 1	"	"	6	"			
													4 Unit B1 Twig 1 (Sink)	"	"	12.6	"			
	7 Recirculation loop (supply side only)	Ok, checked	"	"	Ok, 864.5' per '1887_LaMora_DHW supporting calcs'	1														

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Trunk

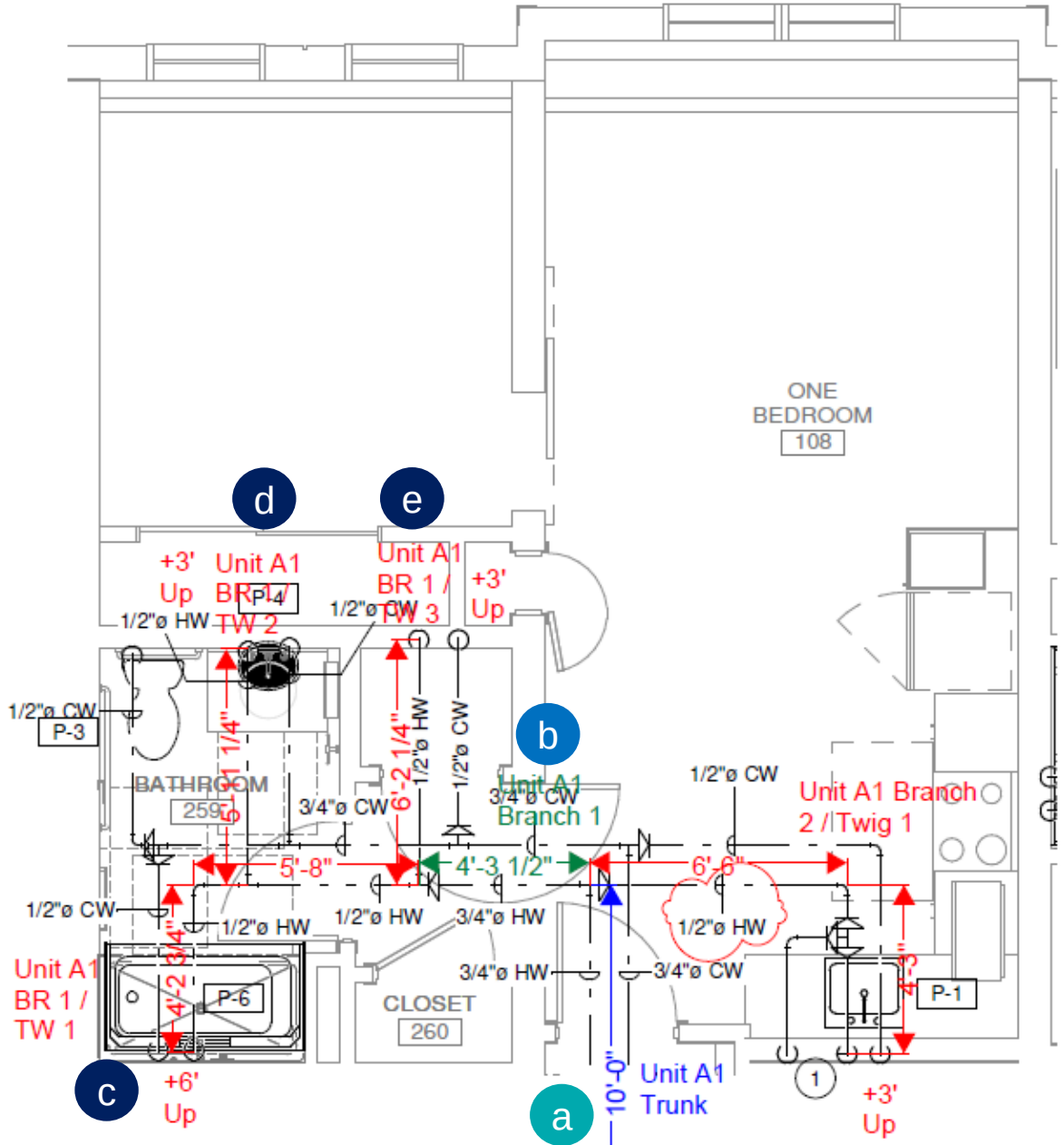
Nr.	Name	Demand recirculation	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Count units or floors	Volume [oz]
1	Unit A1 Trunk	☐	PEX-AL-PEX	3/4	10	3.03	40	33.9
2	Unit A2 Trunk	☐	PEX-AL-PEX	3/4	35	10.62	4	118.65
3	Unit A3 Trunk	☐	PEX-AL-PEX	3/4	29.75	9.03	4	100.85
4	Unit A4 Trunk	☐	PEX-AL-PEX	3/4	22.5	6.83	4	76.28

Branch: Trunk 1, Unit A1 Trunk

Nr.	Label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Branch cumulative volume [oz]
1	Unit A1 Branch 1 (Bath)	PEX-AL-PEX	3/4	4.25	1.29	14.41	33.9	14.41
2	Unit A1 Branch 2 (Kitchen)	PEX-AL-PEX	1/2	0	0	0	33.9	0

Twig: Branch 1, Unit A1 Branch 1 (Bath)

Nr.	Fixture label	Pipe material	Piping diameter [in]	Piping length [ft]	Heat capacity [Btu/°F]	Volume [oz]	Upstream volume [oz]	Cumulative volume [oz]
1	Unit A1 Twig 1 (Tub)	PEX-AL-PEX	1/2	13.83	1	18.12	48.31	66.42
2	Unit A1 Twig 1 (Sink)	PEX-AL-PEX	1/2	14.6	1.13	19.13	48.31	67.43
3	Unit A1 W/D	PEX-AL-PEX	1/2	9.1875	1.13	12.04	48.31	60.34



1 PLUMBING ENLARGED PLAN - DOMESTIC - UNIT A1

1/4" = 1'-0"

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Key Takeaways

- All demand recirculation should be input as a trunk
- Clear takeoffs help Phius help you
- One twig per fixture
- Continuous or time based recirculation on the *General* tab
- Unit method (Strongly recommended)

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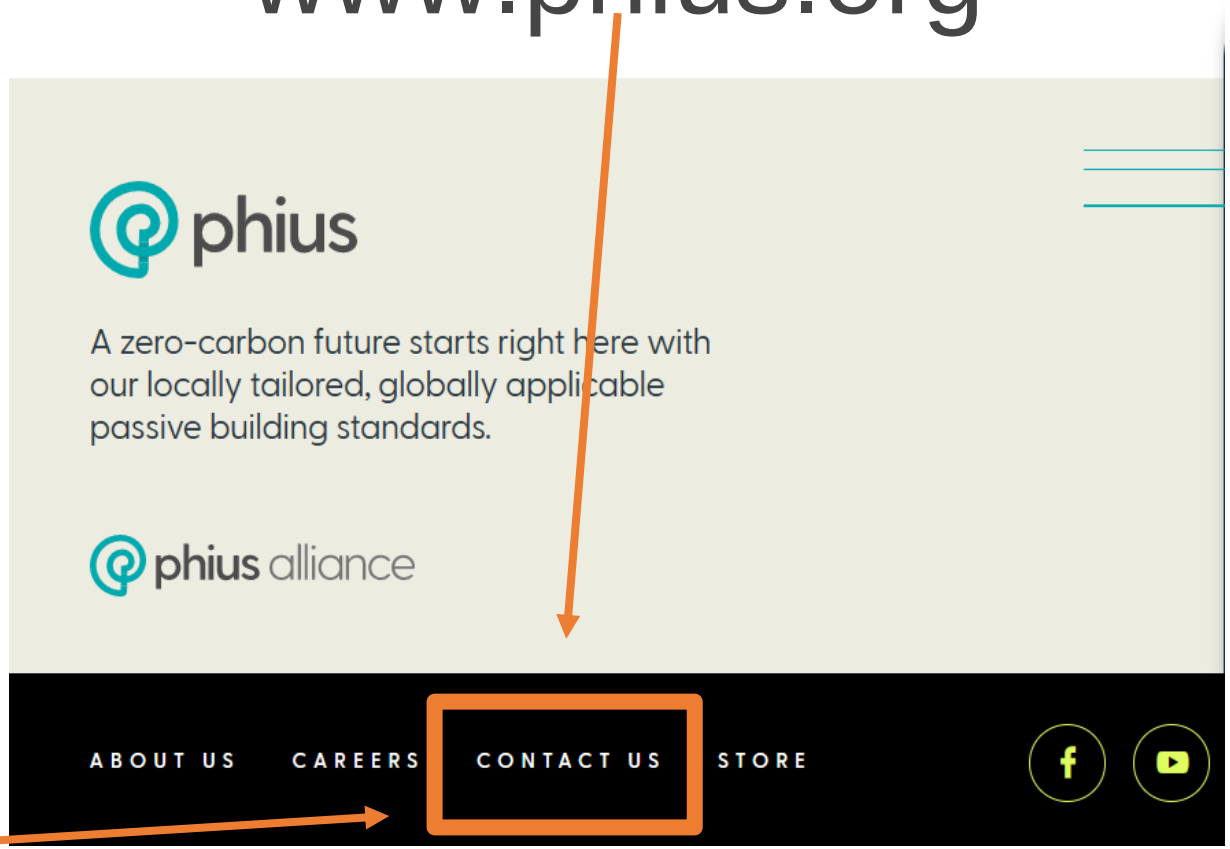
Questions?

Andres Pinzon, Al Mitchell
Phius Staff

www.phius.org

SCAN ME



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