
# Heat Pump Workshop

## for Space and Water Heating

## Saturday, March 9

### 8:30 a.m. to 1 p.m.

**D Street Neighborhood Center**

1301 D St., Arcata

| | |
|---|---|
| 8:30 a.m. | Meet local heat pump contractors and enjoy refreshments |
| 9-10:30 a.m. | Heat pump space heaters and Q&A |
| 10:30-11 a.m. | Refreshments and time with local contractors, our expert instructor Dan Perunko, and RCEA staff |
| 11 a.m.-12:15 p.m. | Heat pump water heaters and Q&A |
| 12:15-1 p.m. | More time with local contractors, instructor Dan Perunko, and RCEA staff |

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**www.balancepointhp.com**

**530-477-0695**

**Dan@balancepointhp.com**

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To go in-depth on any of these training topics I cover, please visit the PG&E Energy Center to learn more:

https://pge.docebosaas.com/learn/external-ecommerce;view=none;redirectURL=?ctldoc-catalog-0=se-perunko

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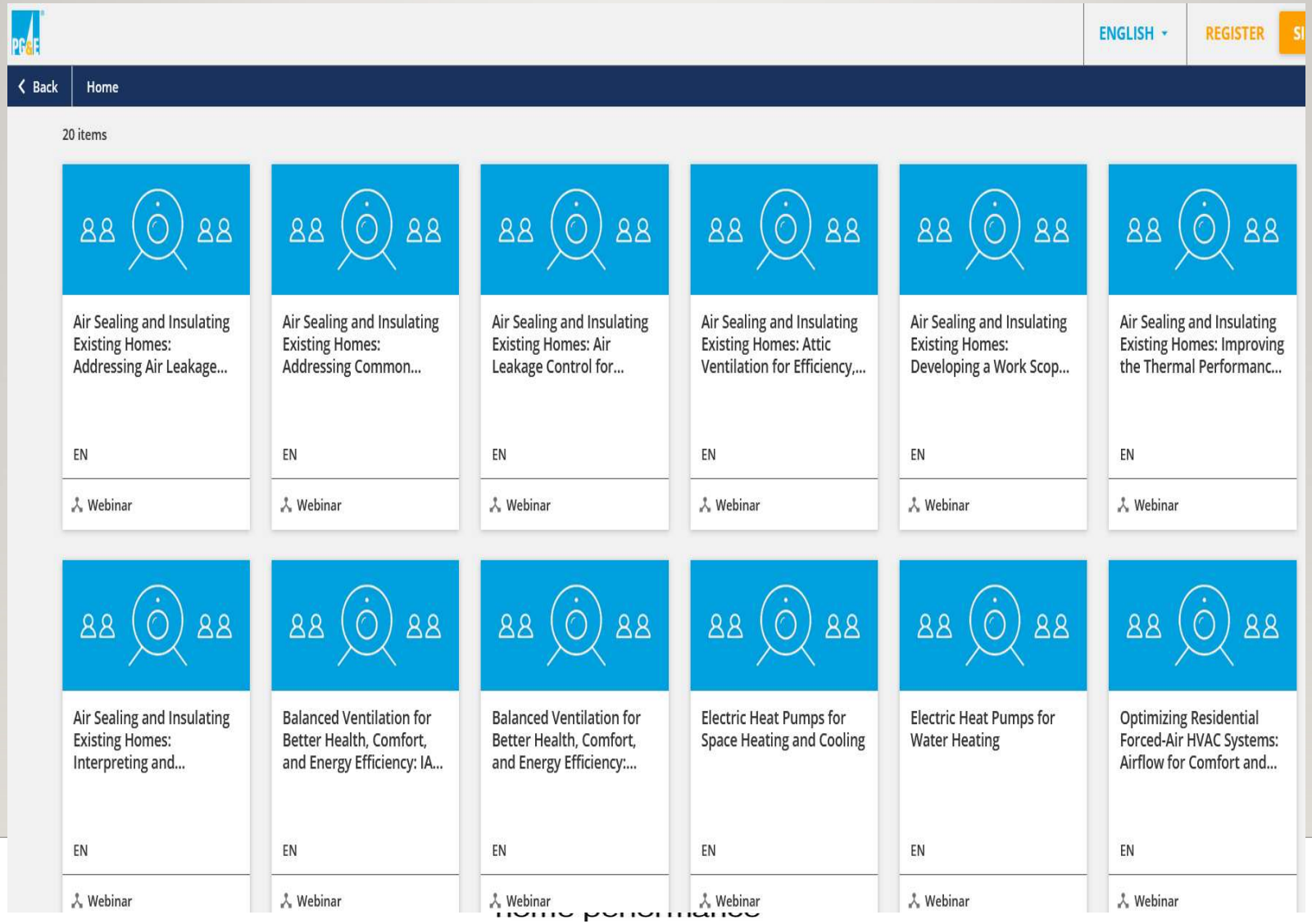
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Air Sealing and Insulating Existing Homes: Addressing Air Leakage...
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Air Sealing and Insulating Existing Homes: Attic Ventilation for Efficiency,...
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Air Sealing and Insulating Existing Homes: Interpreting and...
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Balanced Ventilation for Better Health, Comfort, and Energy Efficiency:...
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Electric Heat Pumps for Space Heating and Cooling
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Webinar
Electric Heat Pumps for Water Heating
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Webinar
Optimizing Residential Forced-Air HVAC Systems: Airflow for Comfort and...
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Webinar

# Introductions - Dan

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# Agenda Part 2

1. How do heat pump water heaters work?
2. Selection – Equipment Type & Refrigerant Options
3. Heat pump water heater design and performance
4. Sizing – Think Tank
5. Installation – Location, Location, Location
6. What about the plumbing
7. Q&A (15 minutes)

# 1. How Do Heat Pump Water Heaters Work?

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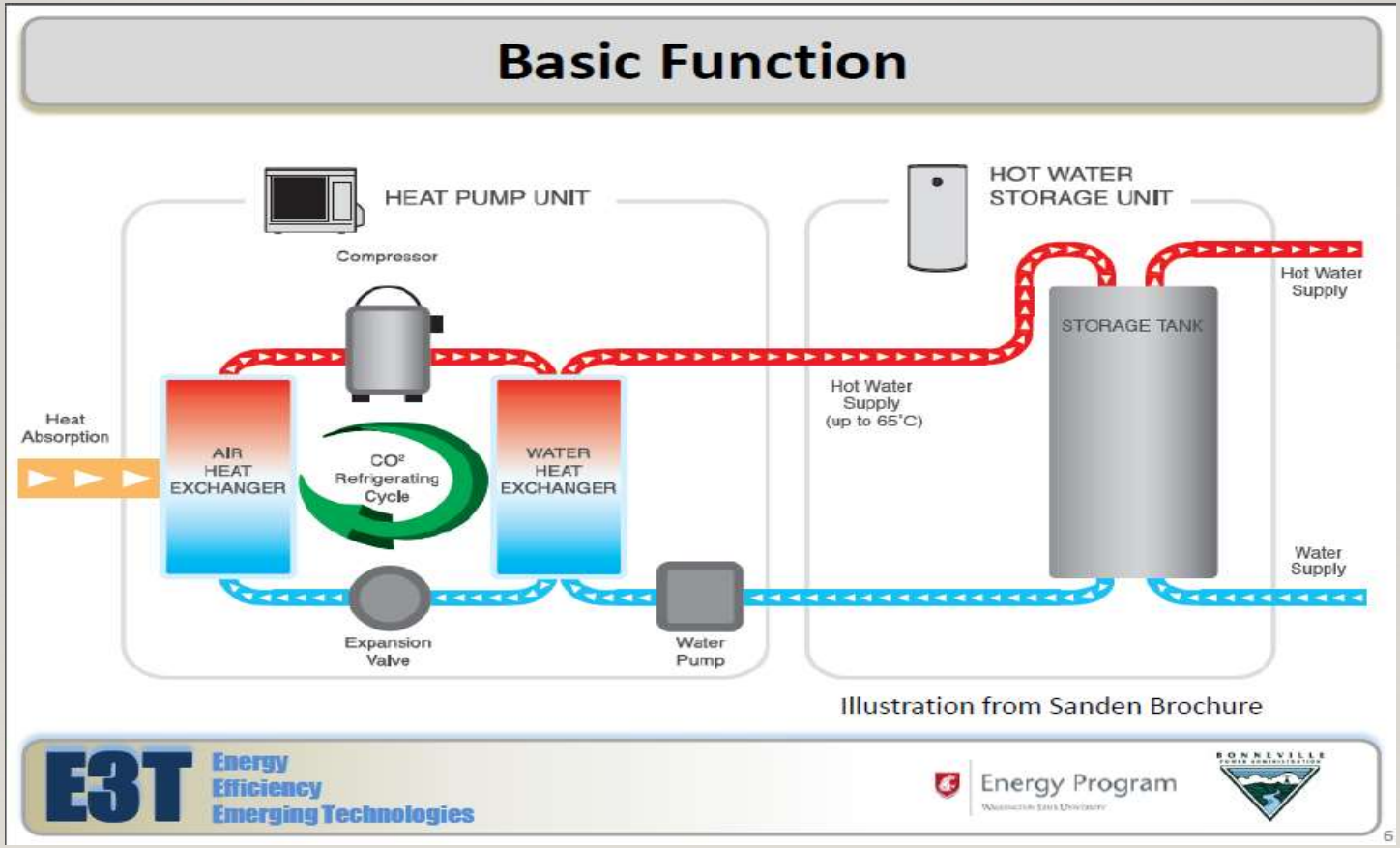
# The Same Basic Technology

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# 2. Selection – Equipment Type & Refrigerant Options

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# Heat Pump Water Heaters


Unitary


Split System

# System Type – Unitary Hybrid


## AO Smith

**RHEEM**

Has misleading function names that imply resistance electric use is the efficient mode.

Water | Residential Electric
Professional *Prestige* ProTerra
Plugin Heat Pump Water Heaters

Rheem

The new degree of comfort.®

## Professional *Prestige*® ProTerra™ Plugin Heat Pump is the most efficient water heater available

**Efficiency**
- Up to 3.0 UEF reduces operating cost
- ENERGY STAR® rated

**Performance**
- Ambient operating range: 45-140° F is widest in class designed to meet Northern Climate Spec (Tier 2)

**Easy Installation**
- Easy access side connections
- Factory installed plugin power cord, direct plugin.
- Easily replaces a standard gas water heater

**Integration**
- LED Screen with built-in water sensor alert with audible alarm[1]

EcoNet®

- Integrated EcoNet® WiFi-connected[2] technology and free mobile app gives users control over water heater, allowing for customizable temperature, vacation settings, energy savings and system monitoring at home or away. Visit Rheem.com/hybridsolutions

**Operation Modes**
- Heat Pump
- Vacation/Away: 2-28 days (or placed on hold indefinitely)

**Plus...**
- Premium grade anode rod with resistor extends the life of the tank
- 3/4" NPT water inlet and outlet; 3/4" condensate drain connections
- Easy access, top mounted washable air filters
- 2" Non-CFC foam insulation
- Enhanced flow brass drain valve
- Temperature and pressure relief valve installed
- Design certified to NSF/ANSI 372 (Lead Content)

**Warranty**
- 10-Year limited tank and parts warranty

See Residential Warranty Certificate for complete information

Units meet or exceed ANSI requirements and have been tested according to D.O.E. procedures. Units meet or exceed the energy efficiency requirements of NAECA, ASHRAE standard 90, IOC Code and all state energy efficiency performance criteria.

**Professional *Prestige* ProTerra Plugin Heat Pump**
40 and 50 Capacities
120 Volt / 1 PH
Electric

LEED Points = 3

Requires 20a 120v circuit

12,000 Btuh

**There are several brands providing these units**

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# Unitary Non Hybrid (Heat Pump Only)

Stiebel Eltron

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# Refrigerants

All of the unitary systems use high GWP refrigerants.

# One Split System Option


**Sanden** $CO_2$ Heat Pump

**Refrigerant**

**GWP 1**

**!!!**

Chiltrix

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# Ultra-Efficient Small Air-To-Water Heat Pumps / Chillers Air Conditioning & Heating & Hot Water

## CX34 Air To Water Heat Pump

## CX50 Air To Water Heat Pump

## Indoor: Heating, Cooling & Hot Water Solutions

Heating
Cooling
Hot Water
Radiant (Heating and/or Cooling)
Ductless Fan Coil Units
Ducted Systems
Mini-Duct (Concealed Ceiling)
Use any or all together.

Ceiling

Floor

U.S. DEPARTMENT OF ENERGY

EPA / ENERGY STAR
EMERGING TECHNOLOGY AWARD

**ENERGY STAR 2019**
Emerging Technology Award

5 Consecutive Years!

AHRI 2018-2020
3-Year Performance Award
AHRI 2020-2022
3 Year Performance Award

AHRI

World's Record Efficiency
The World's Most Efficient
Air-To-Water Heat Pumps

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Featured

## Space heating

- [ ] Up To 2500ft²
- [ ] Up To 4000ft²
- [ ] Up To 5000 Ft²

## Technology

- [ ] Full Inverter + Evi (-31°f)

APOLLO Heat Pump - 42k Btu / 3.5 Ton - Air To Water - EVI Inverter DC Technology

★★★★★ 7 reviews

APOLLO Heat Pump - 60k Btu / 5 Ton - Air To Water - EVI Inverter DC Technology

★★★★★ 7 reviews

APOLLO Heat Pump - 72k Btu / 6 Ton - Air To Water - EVI Inverter DC Technology

★★★★★ 8 reviews


APOLLO Heat Pump Station

★★★★★ 6 reviews

$1,758.90 USD

# 3. Heat Pump Water Heater Design and Performance

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# Heat Pump Water Heaters . . .

. . . need access to a large volume of air in order to extract heat.

a) Installs require ducting
b) Louvered doors
c) Large vents

Never vent or duct a heat pump water heater across the building's air barrier.

# Adequate Air Volume – Duct Kits

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# Resistance Heat

- Resistance heat has a large impact on system efficiency.
- Some manufacturers INCORRECTLY label the mode with resistance heat as the “efficiency” mode.

Differences in aCOP between water heaters are highly confounded by differences in draw profiles, as well as other differences in operating conditions, which makes an average COP for an individual unit difficult to interpret. Compared to the Figure 17 graph of system aCOP, Figure 18 is much more orderly because it has used the definition of hpCOP which excludes resistance element use. Consequently, we can conclude that resistance heat, used for whatever reason, is a large influence in the variability and difference in performance between sites. Moreover, it is possible conclude to that the GeoSpring had the most efficient heat pump, followed by the Voltex, and then by the ATI. Likewise, lab tests showed the same finding.

**Figure 18. Estimated hpCOP as a Function of Daily Draw**

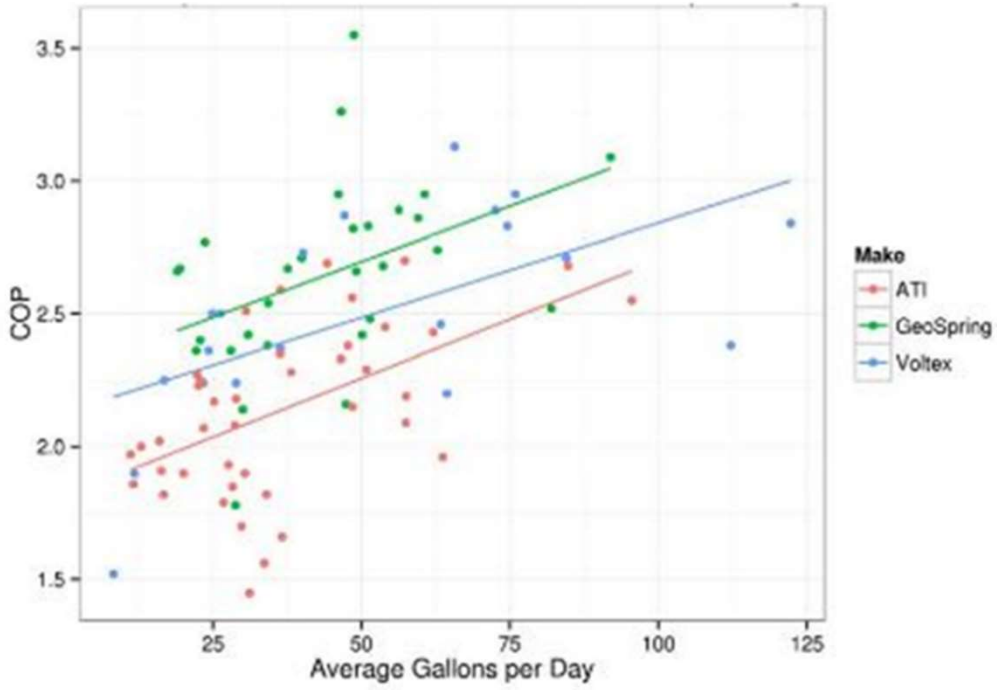
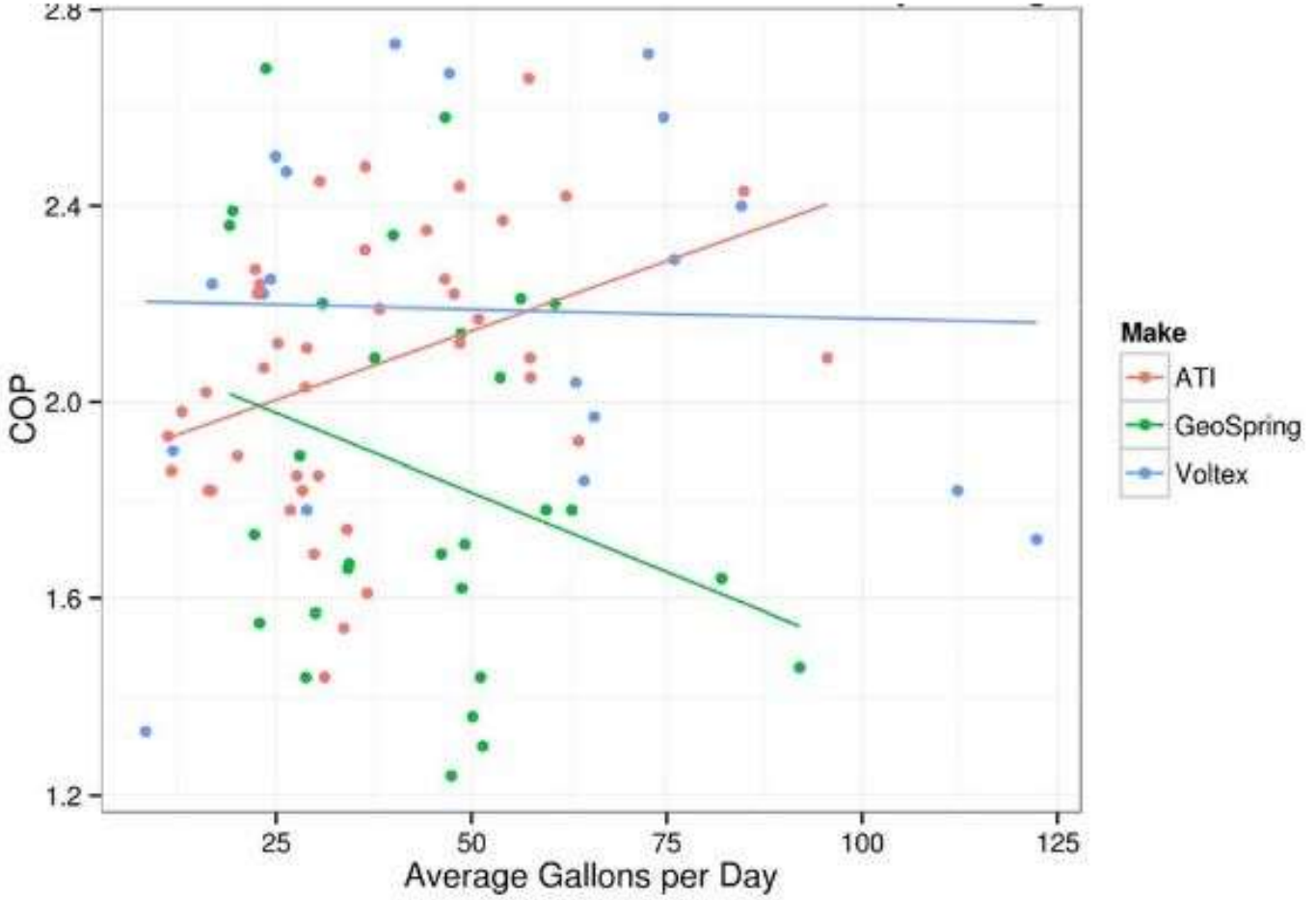


**Figure 17. aCOP as a Function of Daily Draw**



# Expansion Tanks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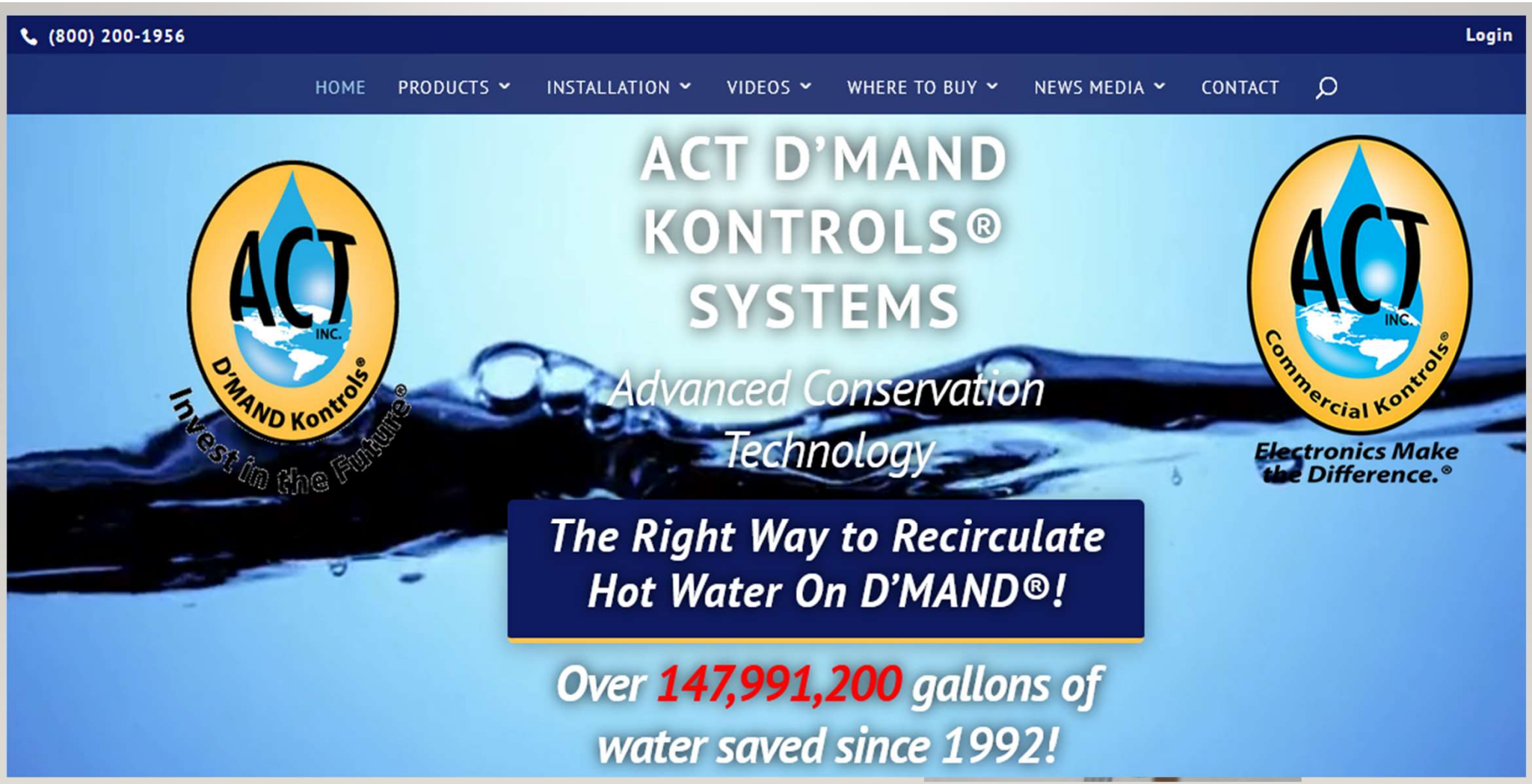
# Recirculation and Tank Temperature

- Heat pump tanks are stratified by design.
  - The heat pump pulls cold water off the bottom, heats it and deposits the heated water at the top of the tank.
- Heat pump efficiency is higher when the unheated water is colder.
- Recirculation systems de-stratify the tank. (Lowering Efficiency)
  - To minimize destratification, use ***on-demand*** recirculation.

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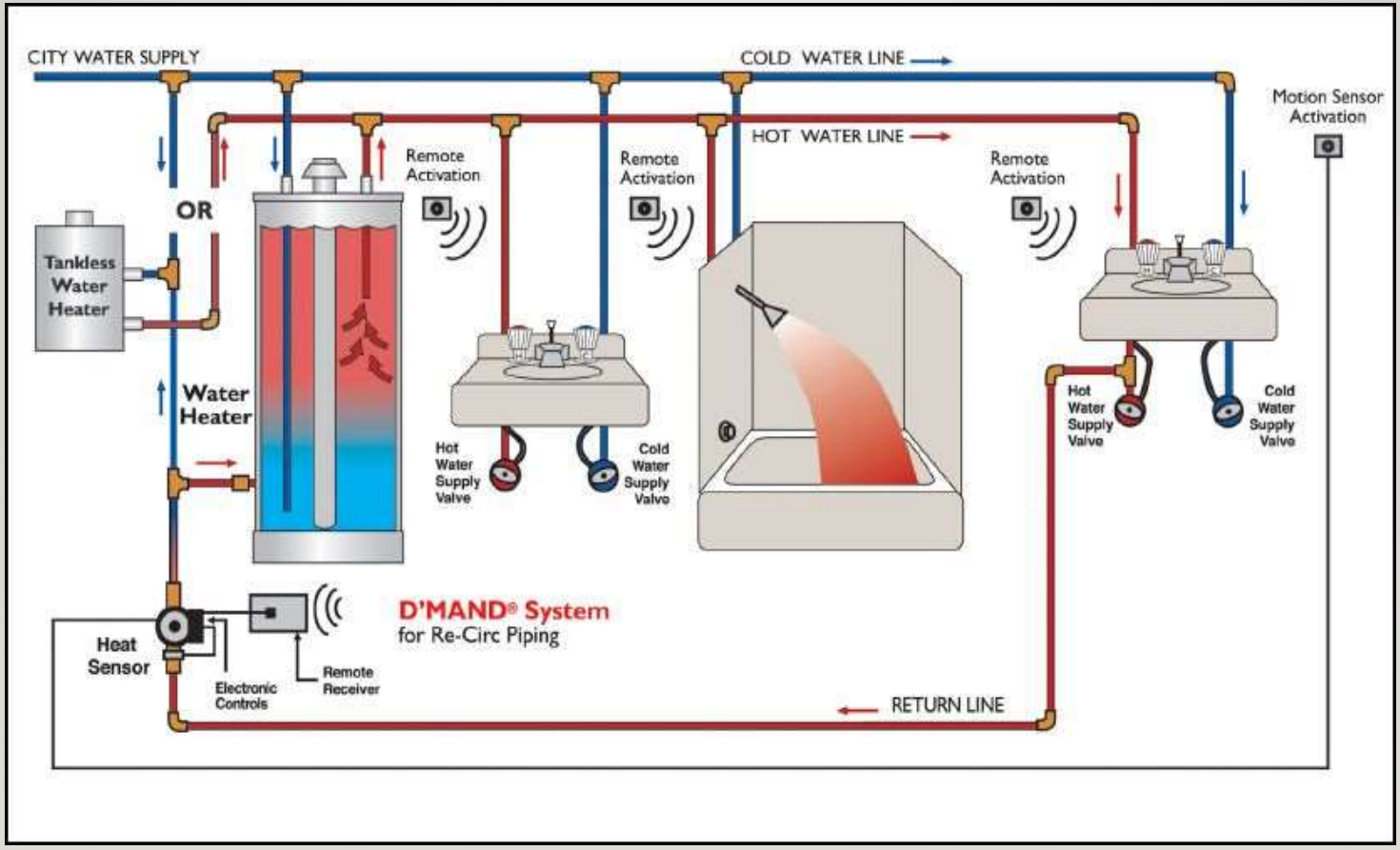
# Hot Water Circulation

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# Controls

D'MAND Button

D'MAND Motion Sensor


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# Heat Pump Water Heaters….

…have smaller heating capacity than gas water heaters.

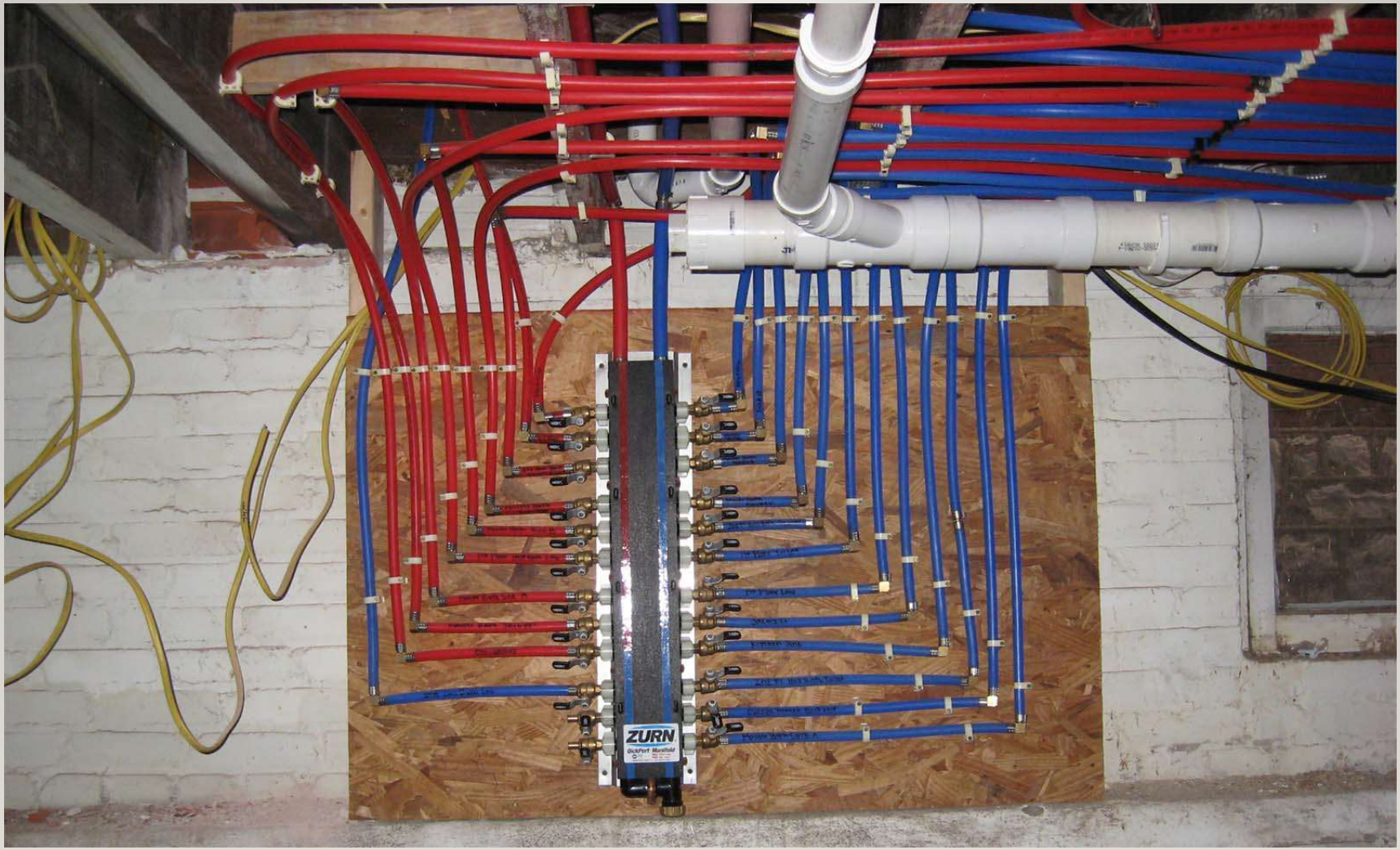
We need to reduce waste with

a) Low flow fixtures
b) Pipe insulation
c) Structured plumbing / Smarter plumbing

# Insulate the water pipes

# It turns out the shape and size of the plumbing matters

## Both fittings and pipe

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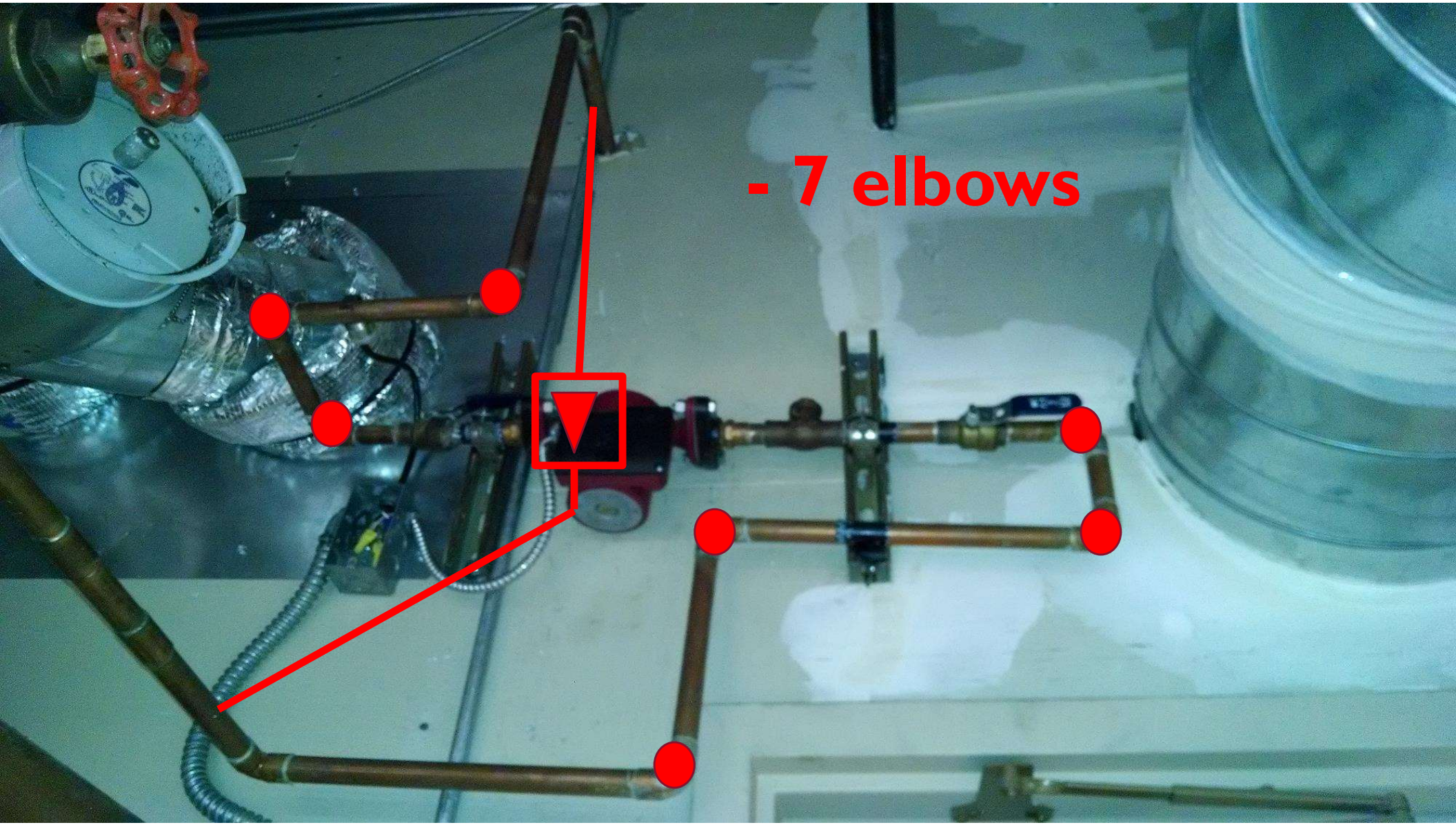
- 7 elbows

- 9 elbows

# Pipe Choice and Water Flow

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# Swoops

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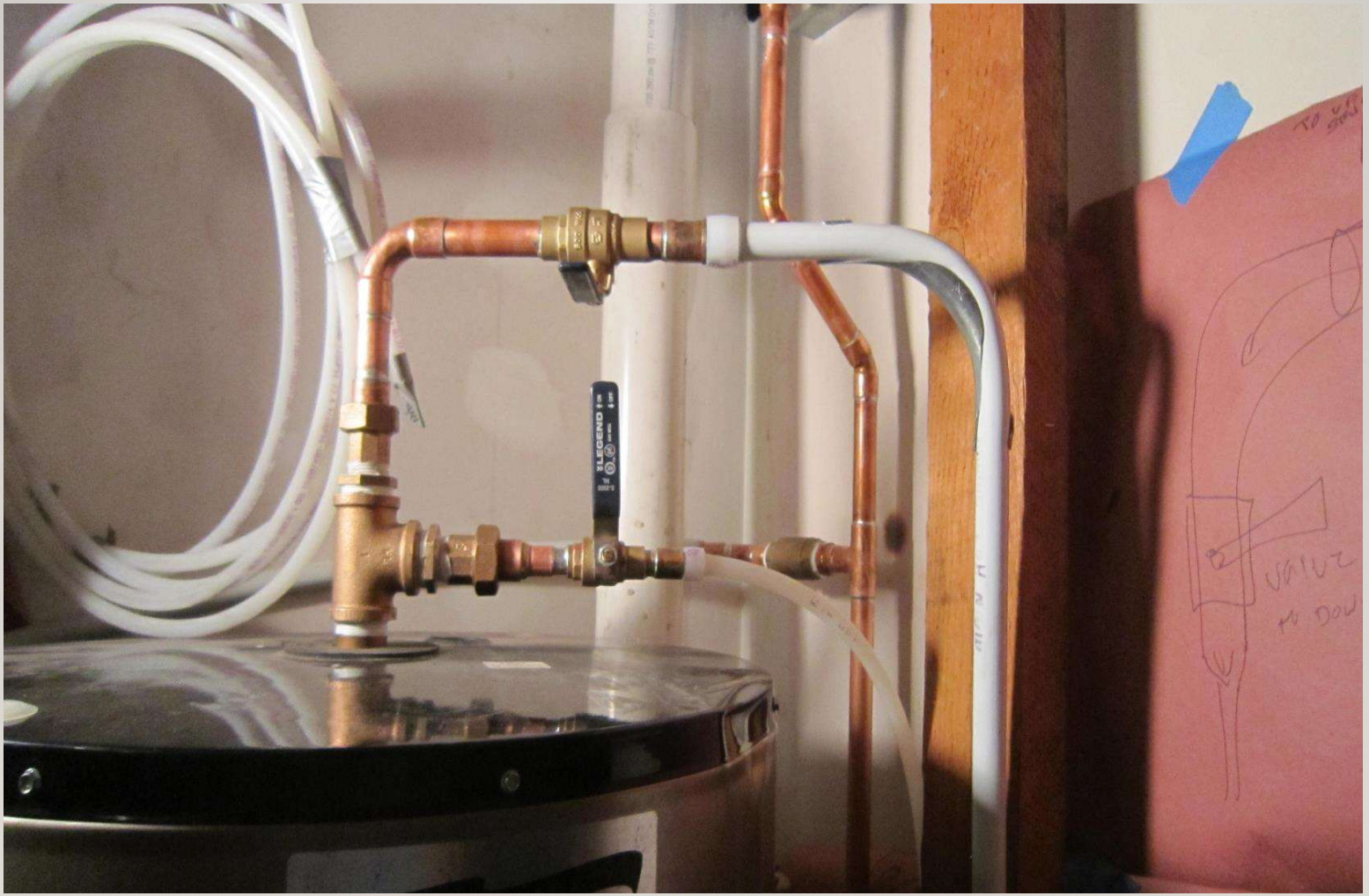


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# Valves


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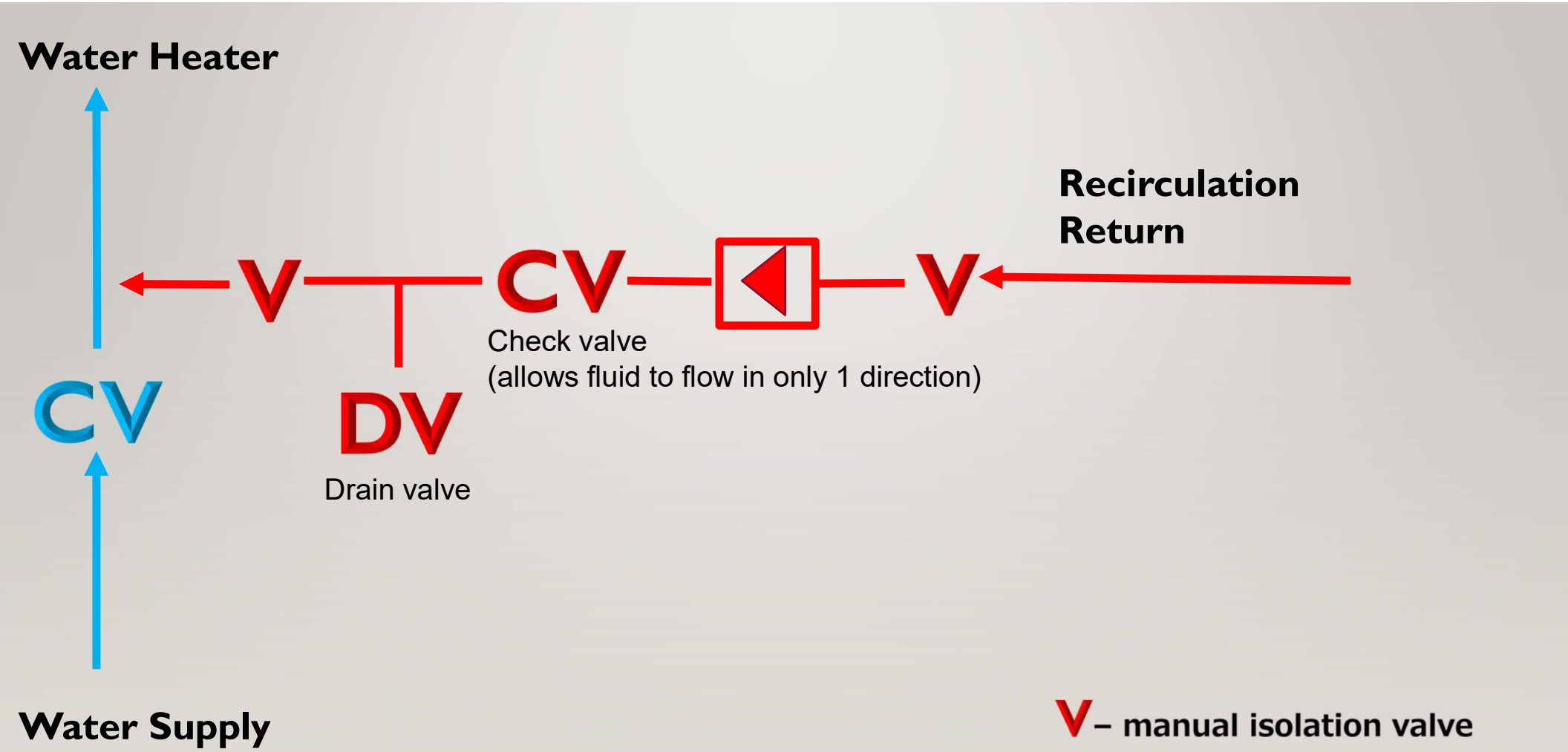
Water Heater
Recirculation
Return
V
CV
V
Check valve
(allows fluid to flow in only 1 direction)
CV
DV
Drain valve
Water Supply
V – manual isolation valve


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# 4. Sizing – Think Tank

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# Sizing

- All heat pump water heaters have an hourly output of 12 to 15 KBtu.
- This is significantly less than even a small gas water heater and roughly the same as an older electric resistance water heater.
- This is not a problem.
- To minimize this issue, install the largest tank that the budget and the space will allow.  (If necessary, further increases in available capacity can be achieved by using a higher tank temperature and a mixing valve.)

# 4. Installation – Location, Location, Location

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SANDEN


SANDEN

# Location, Location, Location

What matters most ...

- Is the space large enough to provide the heat pump system with enough ambient air for heat exchange?
  - Check the manufacturer's specifications. Available air volume is more important than any other physical location detail.
  - If ambient air volume is limited, use a unit that can be ducted to a space with adequate air volume.

# Equipment Location

Keeping adequate air volume in mind

- Locate the equipment as close to the water uses as possible.
- To get hot water to the tap, the system has to displace roughly twice the standing volume of water that is in the pipes between the tank and the tap.

# 5. What About the Plumbing?

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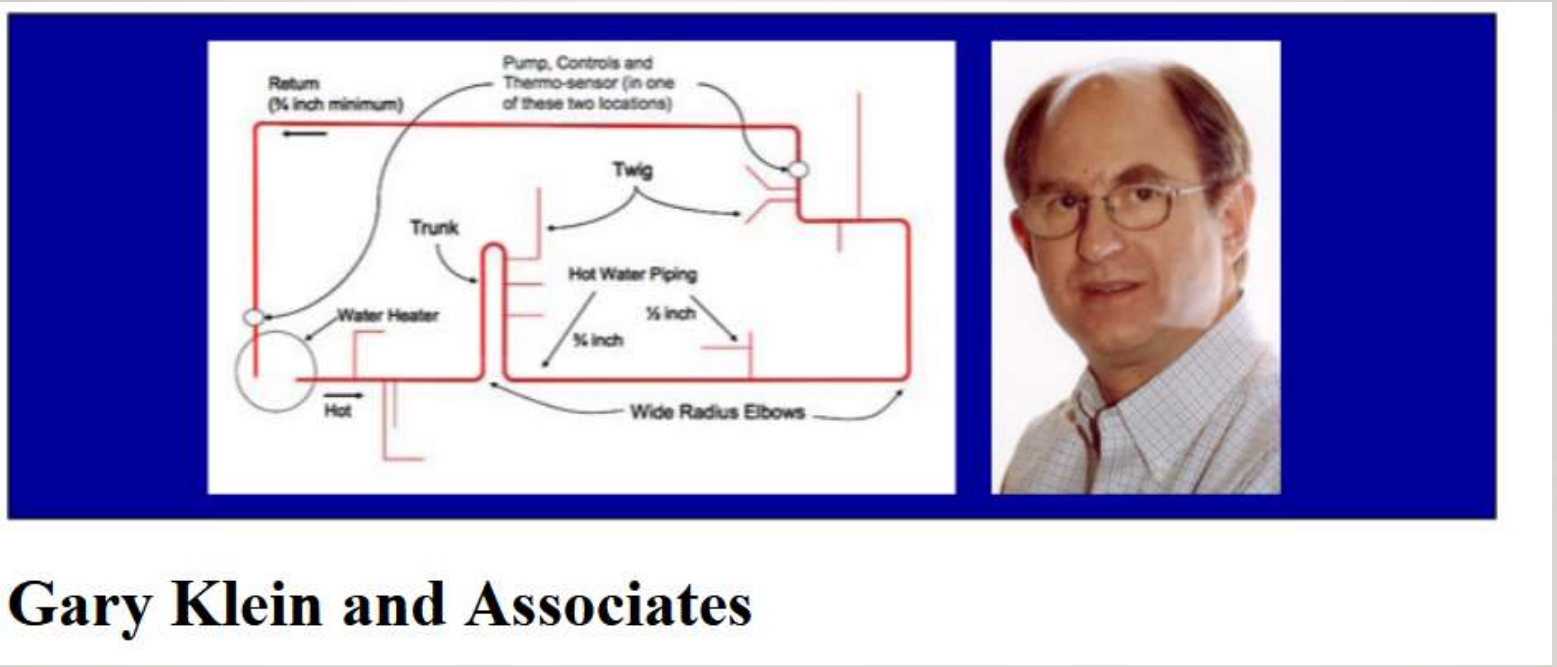
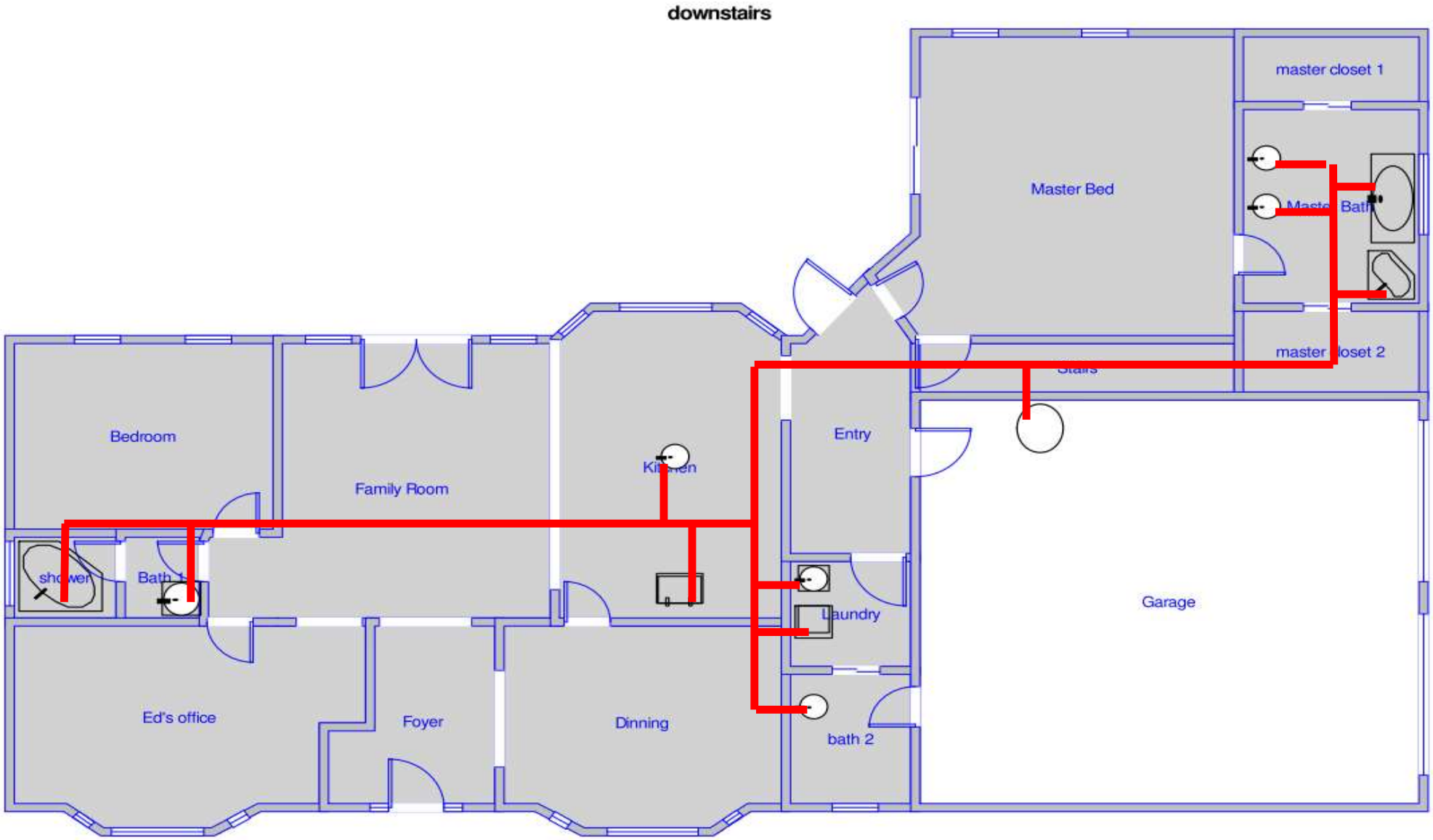
# Structured / Practical Plumbing

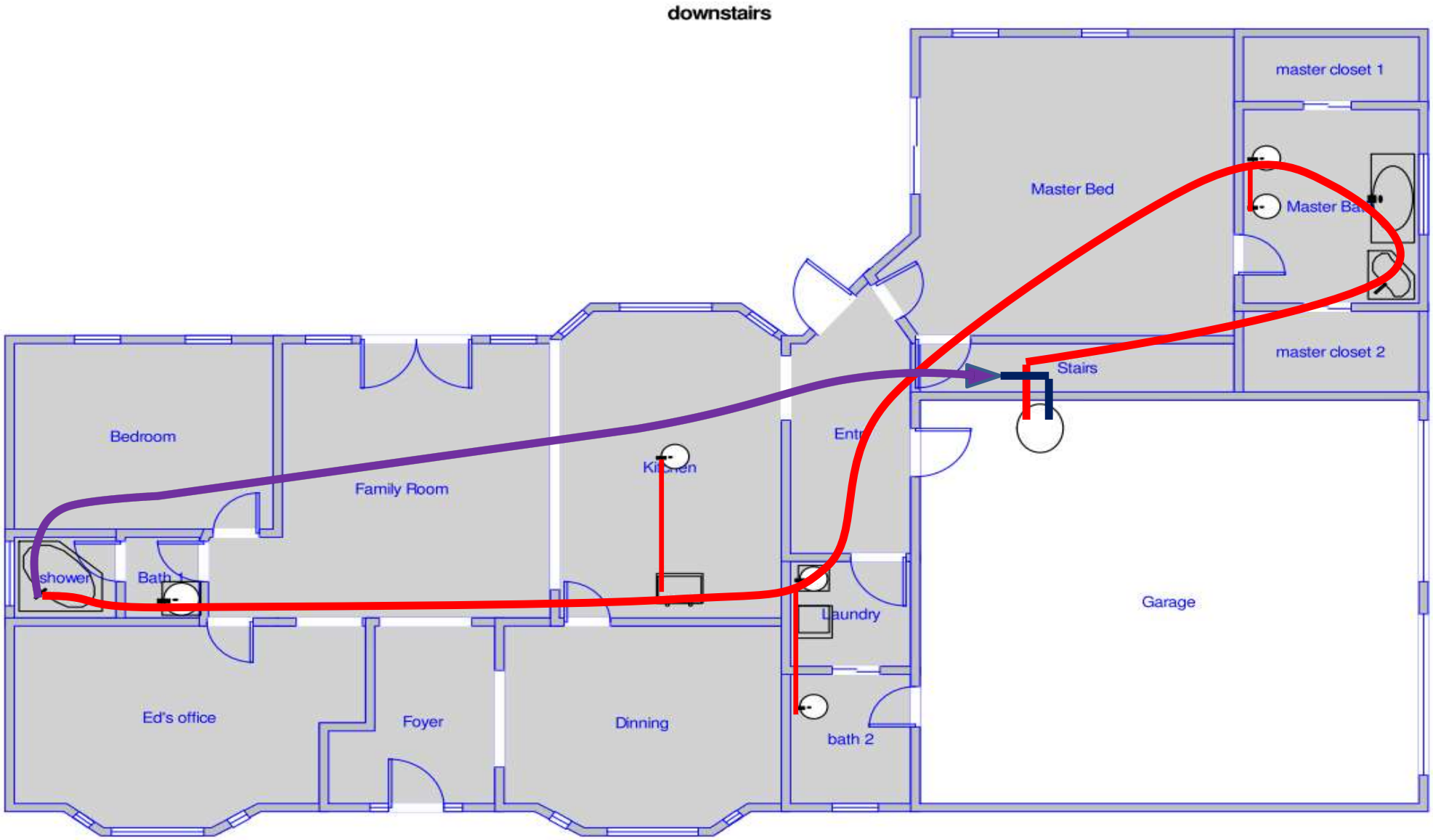
- Entrained water
- Pipe insulation
- Time to tap

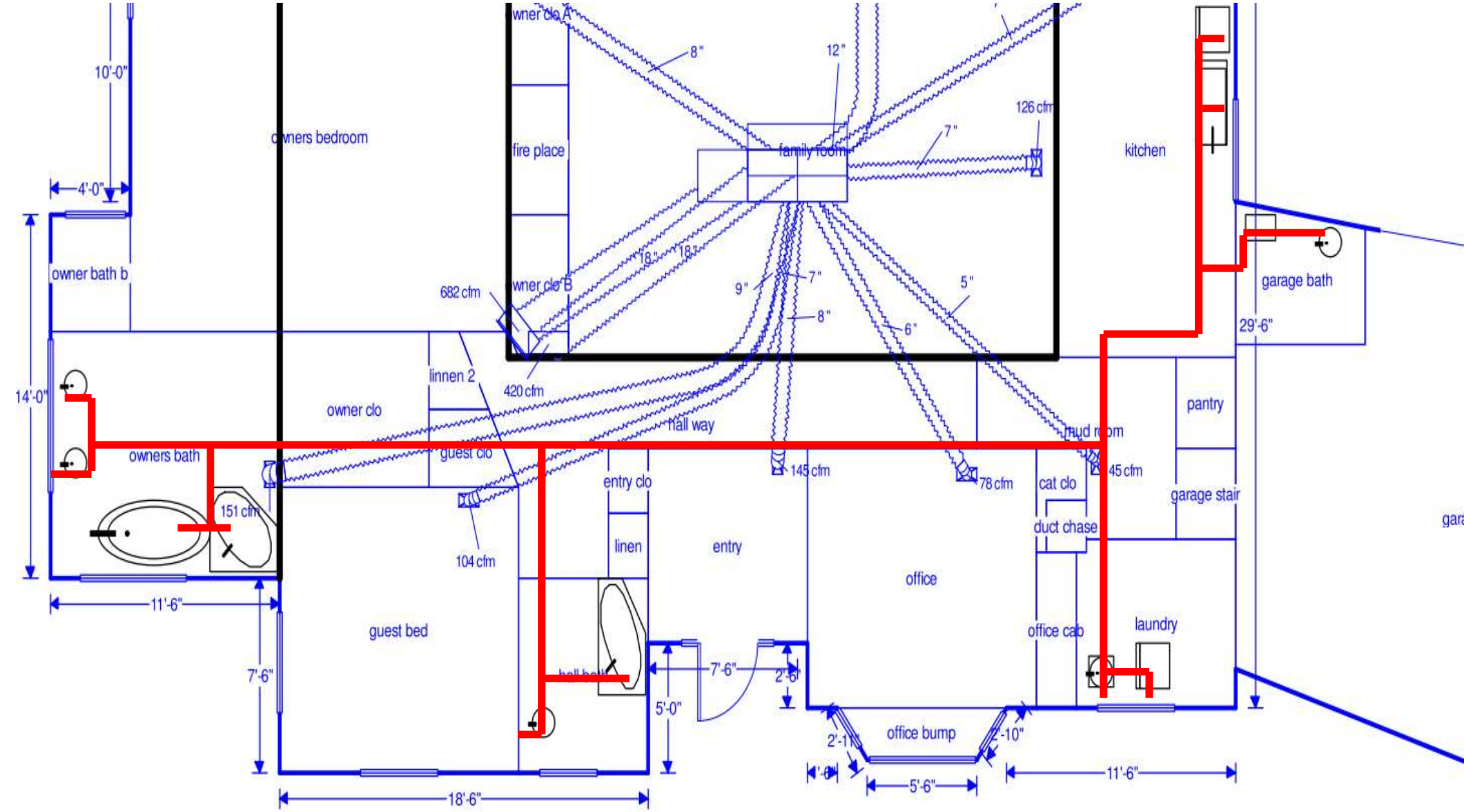


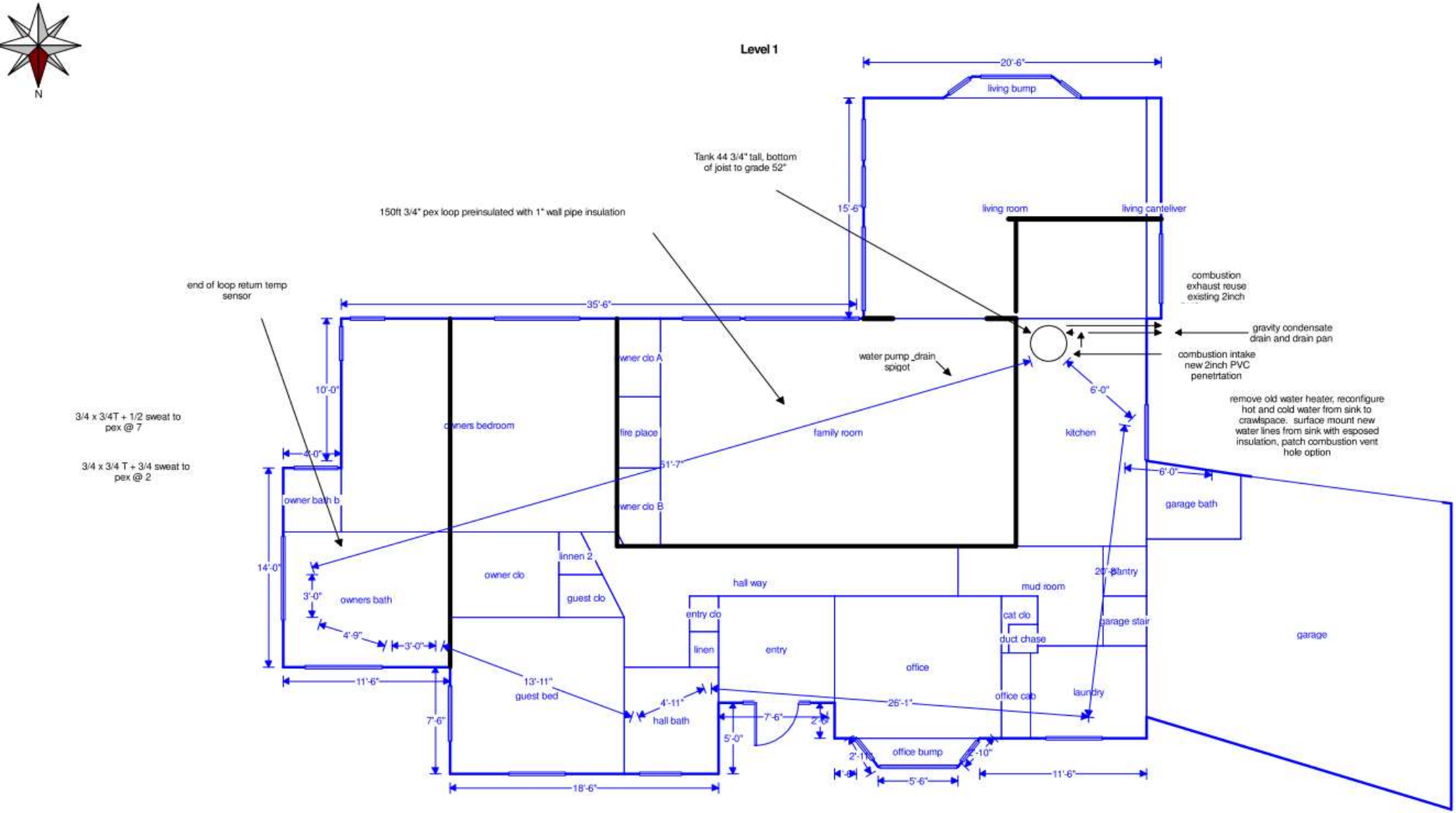

# https://www.garykleinassociates.com/

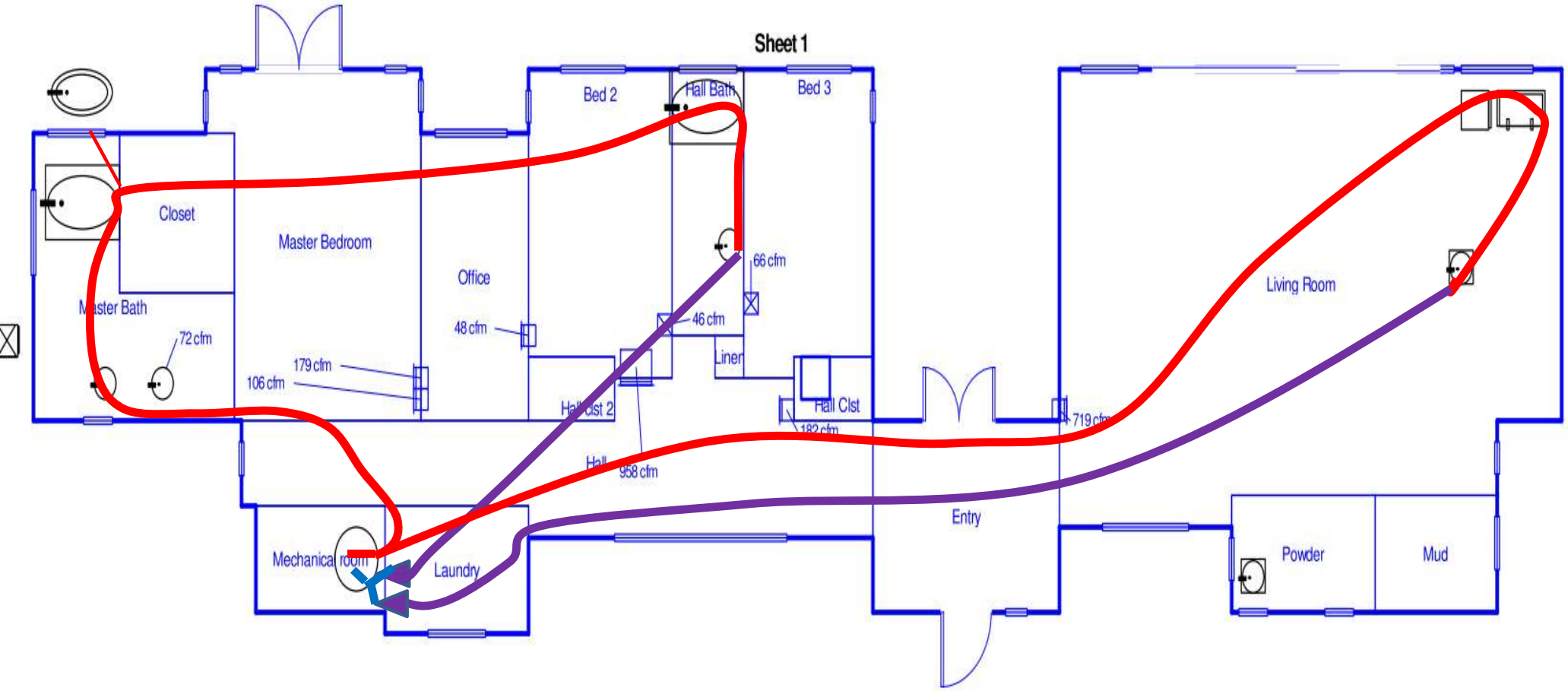
**Practical Plumbing Layouts: Part One** https://www.youtube.com/watch?v=hiY09Ps1SS8


downstairs
master closet 1
Master Bed
master closet 2
Bedroom
Family Room
Entry
Garage
Laundry
Ed's office
Foyer
Dinning
bath 2


downstairs
master closet 1
Master Bed
Master Bath
master closet 2
Stairs
Bedroom
Family Room
Kitchen
Entr
Garage
shower
Bath 1
Laundry
Ed's office
Foyer
Dinning
bath 2


owners bedroom
fire place
family room
kitchen
owner bath b
owner clo A
owner clo B
682 cfm
420 cfm
linnen 2
owner clo
hall way
owners bath
guest clo
151 cfm
104 cfm
entry clo
linen
entry
145 cfm
78 cfm
cat clo
45 cfm
pantry
garage stair
duct chase
office
office cab
laundry
mud room
garage bath
29'-6"
guest bed
office bump
10'-0"
4'-0"
14'-0"
11'-6"
7'-6"
18'-6"
5'-0"
2'-6"
5'-6"
8"
12"
126 cfm
7"
18"
9"
5"
6"


Level 1
N
20'-6"
living bump
Tank 44 3/4" tall, bottom of joist to grade 52"
150ft 3/4" pex loop preinsulated with 1" wall pipe insulation
15'-6"
living room
living canteliver
end of loop return temp sensor
35'-6"
combustion exhaust reuse existing 2inch
gravity condensate drain and drain pan
combustion intake new 2inch PVC penetrtation
water pump _drain spigot
6'-0"
remove old water heater, reconfigure hot and cold water from sink to crawlspace. surface mount new water lines from sink with esposed insulation, patch combustion vent hole option
3/4 x 3/4T + 1/2 sweat to pex @ 7
3/4 x 3/4 T + 3/4 sweat to pex @ 2
10'-0"
owners bedroom
owner clo A
fire place
51'-7"
family room
kitchen
4'-0"
owner bath b
owner clo B
6'-0"
garage bath
14'-0"
linnen 2
owner clo
hall way
mud room
20'-8"
pantry
3'-0"
owners bath
guest clo
entry clo
cat clo
garage stair
4'-9"
3'-0"
linen
entry
duct chase
garage
office
11'-6"
13'-11"
guest bed
4'-11"
hall bath
26'-1"
office cab
laundry
7'-6"
7'-6"
2'-0"
5'-0"
office bump
2'-10"
2'-10"
5'-6"
11'-6"
18'-6"


Sheet 1
Bed 2
Hall Bath
Bed 3
Closet
Master Bedroom
Office
Master Bath
72 cfm
179 cfm
106 cfm
48 cfm
66 cfm
46 cfm
Liner
Hall Clst 2
Hall Clst
182 cfm
719 cfm
Hall
958 cfm
Living Room
Entry
Mechanical room
Laundry
Powder
Mud


# Questions

?

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Dan Perunko