# Winter Bleed Practices: Options for Preventing Frozen Municipal Water Lines

This paper outlines:

- the environmental conditions that contribute to frozen water lines;
- a summary of common winter bleed practices; and
- options to prevent freezing pipes.

***What Is Winter Bleeding?***

In colder climates, it is a common practice to continuously run a low-flow rate of water through service lines and shallow mains to prevent them from freezing; when water freezes it expands, and if there is no room for expansion, it is possible that the pipe will burst. The season for winter bleed depends on the climate, but is typically from the beginning of November and through to the end of March. Winter bleeding practices are not recommended for water utilities where there are restrictions on source capacity, where treatment or supply is expensive or where excess waste water volumes will negatively affect waste water treatment efficiency and/or cost. Treating and pumping water only to be wasted through bleed lines requires energy, which can be expensive for the taxpayer. In addition, winter bleed water is often drained to the sanitary sewer system, which reduces the effective contact time necessary for efficient biological treatment of waste water.

*Source: http://thermal.pentair.com/application/pipe-freeze-protection/residential-facilities/*

There are a number of options to explore in order to address the challenge of freezing water service lines, while also reducing water demands. Financial (cost to municipality and homeowner for capital components and operations), environmental (reduced water and energy demands, greenhouse gas emission reductions from reduced energy use), social (disruption within people's homes and the community generally) and other factors should be considered when evaluating the feasibility of the options outlined below.

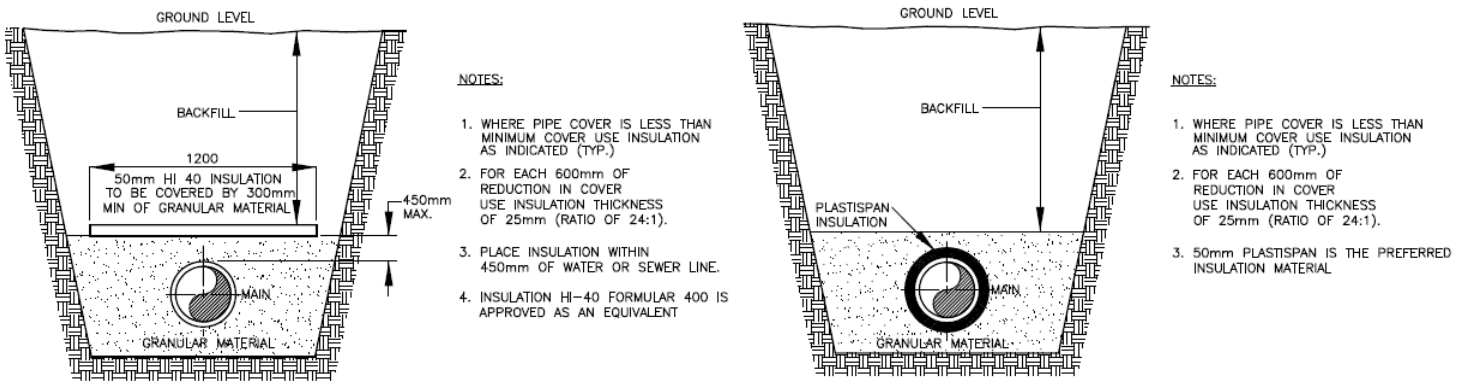
***Environmental Conditions***

Due to soil, weather and frost penetration conditions, water mains are often buried below the local frost depth or, alternatively, buried at a shallow depth with insulation for protection. In the Columbia Basin, the minimum cover for frost protection for water mains typically varies between 1.5 m and 2.6 m, often based on municipal or regional subdivision and development servicing bylaws. The installation cost of water mains increases as depth of bury increases, due to larger excavation volumes and/or specialized construction methods.

The density, conductivity of the soil particles and water content all influence the overall thermal conductivity of soil. Because clay particles have a higher insulation value than silt or sand particles, and since clay soils normally hold more moisture than silts and sands, the depth of frost penetration is

usually greater in silt and sandy soils (light-textured soils) than in clays and silty clays (heavy-textured soils).[1] The specific details of heat transfer in soils are complex and a qualified professional should be consulted to determine potential frost penetration depth.

Snow clearing on roadways will reduce the thermal insulation provided by snow, and surface traffic will push the frost down further than in the surrounding untravelled ground. If local conditions do not allow for an increased depth of bury, it is possible to replace depth of cover with insulation. Two types of insulation commonly used in this region are rigid polystyrene boards and pipes coated with polyurethane. For the rigid polystyrene boards, a minimum of 1.2 m of width over the pipe is required.[2] Smaller pipes will freeze more quickly than larger pipes due to the decreased specific and latent heat of the water within the pipe. Prefabricated water mains with a polyurethane insulation coating the pipe is available as an alternative to increase the time it takes for the pipe to freeze. By reducing the depth of cover, the cost of the more expensive pipe can, in some cases, be offset by the reduction in excavation or blasting costs for the size of trench that would be required.




*Example of trench detail for pipes with insulation. Source: Focus Corporation*

***Common Winter Bleed Practices***

There is only a risk of water lines freezing when the water temperature drops below 1 degree Celsius. Some communities implement bylaws that include, among other provisions, the suggestion that property owners install and use a bleeder valve on their water service line for use during the winter period. However, there are many winter days during which continuously running water through the lines is not necessary. The recommended bleed rate will vary dependent on the configuration of the water system as a whole, and may differ in various locations given the environmental considerations described above.

*Manual Open Tap*

The simplest method of winter bleeding in residential applications is to leave a tap running continuously. This is also the most wasteful method. The amount of water can vary quite substantially depending on

[1] http://www.nrc-cnrc.gc.ca/eng/ibp/irc/cbd/building-digest-26.html

[2] Typically a ratio of 24:1 soil to rigid foam insulation is used. For example, a 600 mm depth of soil can be replaced by 25 mm of polystyrene insulation with a thermal resistance of 5 ft2•h•°F/BTU.

how much water is allowed to run. For example, a common practice is to leave a bathroom tap half open for the duration of the winter season. This practice, while effective in preventing freezing, could waste two to four litres per minute (0.5 to 1 gallon per minute), resulting in approximately 822,000 litres per house per season, or enough water to fill an Olympic-sized swimming pool (2.5 ML) one-third full.

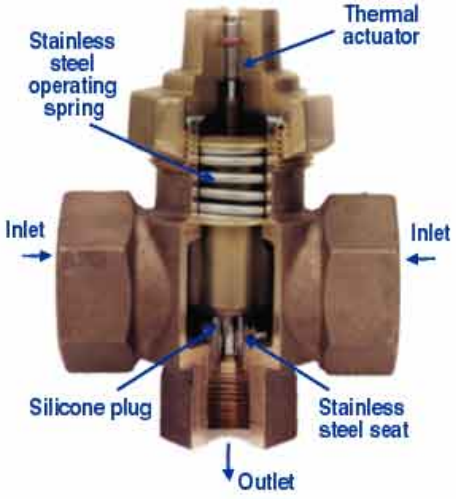
The effective bleed rate for each service is dependent on a number of factors, including the pipe diameter, service length, minimum water main temperature and minimum ambient air temperature. A typical 19 mm diameter service line 10 m long can be maintained free flowing at -10 C with a bleed rate of approximately four litres per minute.[3]

*Manual Bleeder Valve*

Near the main water shut-off valve inside the home, a tee and valve are cut into the supply line with a piece of tubing directed to the floor drain. To prevent cross-connection to the sanitary sewer, there must be an air gap between the end of the tubing and the flood level rim of the drain. The size of the bleed line can be regulated (smaller than a faucet) and the homeowner can regulate how often it is opened. For example, if there are only a few weeks during which the temperatures drop below 1 C, then the bleed line may not have to run all winter long.

*Automatic Bleeder Valve*

The automatic bleeder valve is installed similarly to the manual bleeder valve and operates based on the temperature of the water main. The valve contains a thermal actuator that contracts when exposed to colder water temperatures. This contraction allows the valve to open so water can flow. As the water temperature in the valve warms, the thermal material expands and closes the valve. In this way, cold water is eventually bled from the system and replaced by warmer resupply water from the main. This provides a non-electric, thermally controlled freeze protection system. The setpoint temperatures vary dependent on the actuator, but typically range from 1.6 C to 4.4 C. This system requires that the water in the main remain at a temperature higher than 4.4 C in order to warm the service line. The approximate installation cost for this system is $1,500.




*Thermo-actuated automatic bleeder valve. Source: Ogontz Corporation (http://www.midwestprocesscontrols.com/Steam_Products.html)*

*Communications*

Some communities with known water line freezing problems implement bylaws requiring residents in certain areas to run winter bleed lines continuously during winter months to

[3] Tallos, Nick, OCTOBER 1997, Winter's Coming – Use Freeze Protection Valves to Keep Lines Flowing, CHEMICAL ENGINEERING PROGRESS 66-69.

prevent mains from freezing. Others have files on which properties or neighbourhoods have winter bleed lines so that excessive metered usage is rationalized and they are not billed for that consumption.
If a home or neighbourhood is known to have issues with freezing service lines, it is important to discuss the issue with the homeowner(s). From a risk management point of view, the water utility can provide information to homeowners with registered problems on locally recommended solutions when temperatures hit predetermined low points. It is also important for the utility to communicate with homeowners again when temperatures increase and bleed lines are no longer needed. Communications from the water utility should be noted on property files to ensure a new owner is aware of issues.

***Alternatives to Winter Bleed Lines***

*Heat Tracing*

Installing an electrical heat trace to water lines is a simple and common alternative to winter bleed lines. It involves either wrapping the outside of the pipe with heat trace tape when the service is installed or placing the heat trace line in a conduit or channel next to the pipe. There are self-regulating heating cables available that integrate insulation around the service pipe to save in power consumption. For retrofit projects, there are products that can be installed inside the service pipe. The downside to the heat trace is that it is difficult to monitor its effectiveness until the pipes freeze. Alternatively, if the controlling thermostat is not functioning properly, too much energy can be used, resulting in excessive costs.

The supply costs can range from $3 – 6 per metre for a self-regulating system, to $1 – 2 per metre for a conventional system, plus approximately $200 – 300 for the installation of a new system.

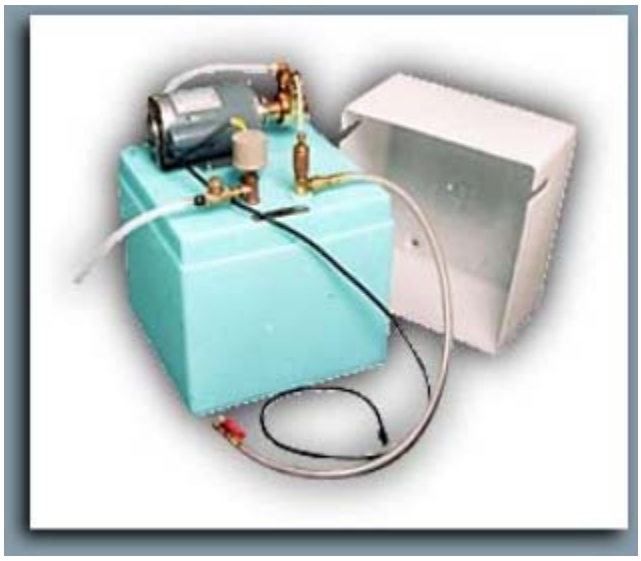

*Self-regulating heat trace cable. Source: http://www.heatline.com/pdfs/cut_to_length_srf_pds.pdf*

*Re-circulating Services*

A recirculation system to protect water services requires an incoming water service, a recirculation pump in the house and a recirculation line back to the water main. Water flows into the house using the water pressure from the main. A tee is installed on the incoming water service and a recirculation pump installed on the branch, which returns the water back to the main in a separate water line installed in

the same trench. This system works best if the water in the main is heated, and adds heat to the service line. None of the Basin communities currently heat the water in their mains.

For homes that are heated, an alternative to the recirculation system is a bleed, capture, return method and requires a single service to the home, allowing easy retrofit for existing services. The water enters the home into a holding tank through an orifice. The tank fills and is warmed by the heat of the home. At a preset temperature level, a pump is started and pumps the water through a check valve back into the water service line and water main. The cycle time of the pump running is approximately five minutes per hour. In cases of power failure, there is an overflow line that connects to the floor drain. The supply and install cost for this system is approximately $1,500.



*Re-circulating freeze protection water system.*
*Source: http://www.aqua-flo.net/*

As this system relies on circulating water between the public water system at the main and the private water system in the home, there are inevitable cross-connections issues with this system. For this reason, re-circulating systems are not recommended and not permitted in any municipality with a cross-connection control bylaw.

***Determining Which Solution to Implement***

There is no single solution for frozen water mains or services. Some questions (by no means an exhaustive list) to ask to determine the best practice to prevent water line freezing for a specific municipal water system are:

1. What is the reason for running winter bleed lines in your system? Are services being bled to keep the main from freezing or the services from freezing?

<u>Water Mains</u>

1. *How deep is the water main buried?*
   The water main should be buried to a depth appropriate to the local climate and soil conditions to avoid long-term frozen pipe problems.

2. *What are the soil types?*
   For new systems, ensure that well-draining bedding material is used within the pipe trench. Soils should be assessed by a qualified professional to determine susceptibility to frost penetration.

3. *Is the water main insulated and, if so, how?*

Pipes should be insulated if the proper depth of bury is not possible.

4. *Is the water re-circulated in a looped system or are there dead ends in the distribution system where water can stagnate and potentially freeze?*
   Water mains should be looped where possible to ensure continuous flow of water.

5. *What is the minimum water temperature in the main? At the source?*
   Systems operators should monitor water temperature in the distribution system to provide advance warning when there may be problems. Online temperature gauges can be economically installed at pressure-reducing or pumping stations. Depending on the systems control and monitoring installed, temperature data can be fed back to a SCADA system to track temperature variations and produce alarms at preset low temperatures.

Water Services

1. *How deep are the services?*
   Water services should be buried to a depth appropriate to the local climate and soil conditions to avoid long-term frozen pipe problems.

2. *Is the service insulated or has electrical heat trace installed?*
   If services have not or cannot be buried deep enough to avoid frost penetration, investigate alternatives such as insulation and electrical heat tracing. If heat tracing has been installed, it may no longer be working, requiring the need to excavate and replace/repair the line.

3. *Is the service located at the end of a dead-end water main?*
   Water mains should be looped where possible to ensure continuous flow of water. Water temperature could be monitored at dead ends.

4. *Is the home occupied and heated regularly during the winter?*
   If a home is not occupied during the winter, the water service should be turned off when the premises are left. If the home is intermittently occupied and heated, the bleed valve should be monitored.

5. *Does the home have a septic system or is it connected to a municipal sewage treatment system?*
   Most winter bleed lines drain to the sanitary sewer system. Excessive water entering a septic system can overload it and cause failure of the system.

***Conclusion***

Thawing frozen water pipes is an inconvenient, expensive and time-consuming process for municipal water systems operators and managers. Winter bleed lines have commonly been used, as they are simple to operate and the cost of delivering water has been relatively low in many communities within the Basin. As water conservation measures become more of a priority to Basin communities, eliminating or reducing the effect of winter bleed lines should become more prevalent.

Each of the solutions presented above comes with a cost, but that cost is relatively low considering the resources required to thaw a frozen water main using conventional methods. Consideration of the environmental factors that can contribute to freezing water lines prior to installation may increase the capital cost of installation, but likely save time and resources in the future.

***Other Resources***

- Cold Regions Utilities Monograph (1996). Third Edition. American Society of Civil Engineers and Canadian Society of Civil Engineering
- Cold Climate Utilities Delivery (1979). United States Environmental Protection Agency, United States Corps of Engineers, and Environment Canada
- Utilities Delivery in Arctic Regions (1977). Environment Canada
- Preventing Frozen Water Pipes, 96-14E, Manitoba Water Use Efficiency Program, Province of Manitoba, 1996. http://www.gov.mb.ca/conservation/pub-archive/publs96/bul9614e.html