



Understanding and Improving Your Residential Drainage



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The Municipal Collection System

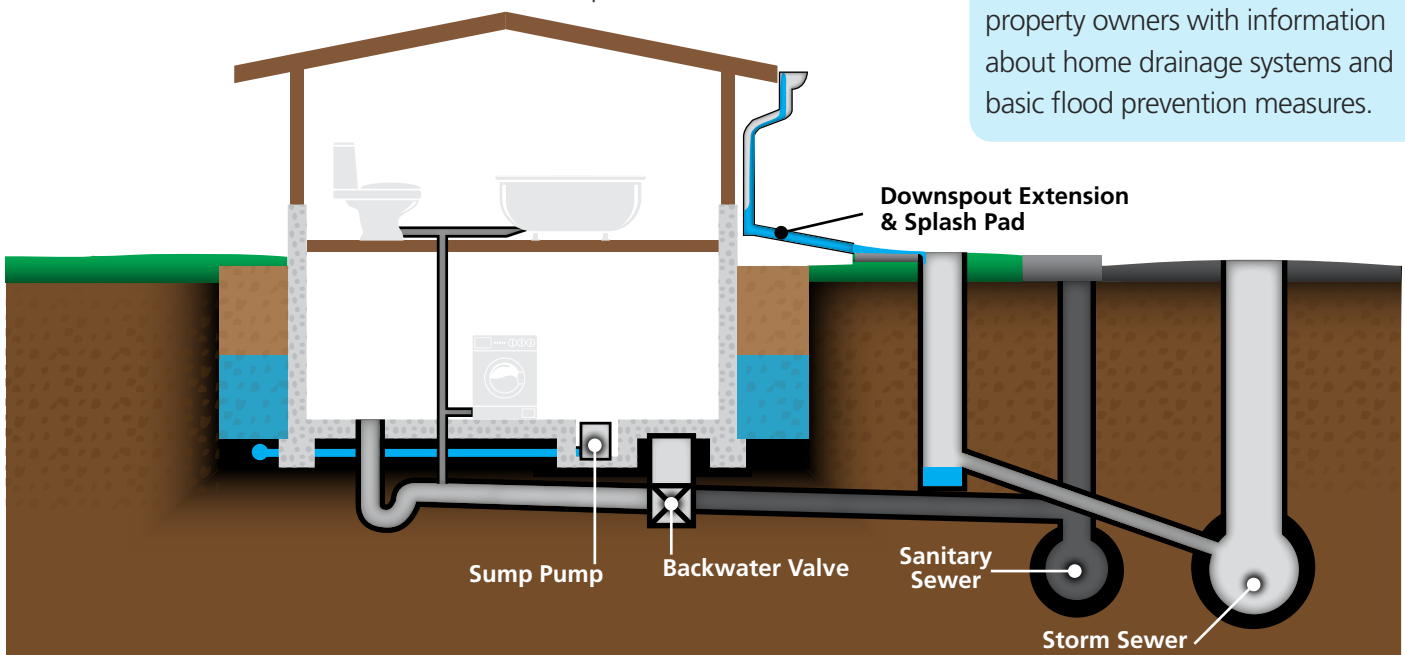
The municipal collection system, operated and maintained by the City of Thunder Bay, works in conjunction with the private components of residential and commercial buildings to ensure that both stormwater and wastewater are safely removed from buildings and streets. Thunder Bay's municipal collection system is composed of 3 main components: sanitary sewer main, storm sewer main, or a combined sewer system. The City of Thunder Bay maintains 357km of sanitary sewers (including 34,000 sanitary sewer connections to homes & buildings), 179km of storm sewers, 32 combined sanitary/storm sewer manholes, 4 sanitary and 4 storm sewer pumping stations.

Sanitary sewer main: The underground collection system that transports sewage and greywater (wastewater generated by toilets, sinks, drains and other home water uses) to the Atlantic Avenue Wastewater Treatment Plant for processing. The water is treated using physical, chemical and biological processes before being released into Lake Superior.

Storm sewer main: The system that collects and transports stormwater (rainwater, snow melt) that runs from some weeping tile, streets, parking lots, roofs, driveways, and other impermeable surfaces. The storm sewer releases the water, mostly untreated, directly into Lake Superior. In some newer Thunder Bay developments, stormwater passes through an oil/grit separator system or settlement pond before being released into Lake Superior.

Combined sewer: A small percentage of Thunder Bay's drainage system is a combined sewer. This sewer collects both wastewater and stormwater to be treated at the Atlantic Avenue Water Pollution Control Plant before being released into Lake Superior.

To ensure optimal functioning of the municipal collection system, homeowners are responsible for maintaining the private components of their residential drainage system. This manual aims to provide residential property owners with information about home drainage systems and basic flood prevention measures.



Understanding the Path of Water

Through the hydrologic cycle, water falls to Earth as precipitation (rain, snow, sleet or hail). Some water falls directly into larger bodies of water such as lakes or streams; other precipitation lands on a permeable surface where it slowly infiltrates into the soil. The process of infiltration helps to filter the water of pollutants before it re-enters the water table. In urbanized areas, precipitation often lands on impermeable surfaces, such as roadways, parking lots, driveways and rooftops. This surface runoff, called stormwater, is typically directed towards the street and into the municipal storm sewer main which empties directly into streams, lakes or other water bodies.

The Hydrologic Cycle

Condensation

When the water vapour rises into the cooler air above the earth, it condenses or turns back into liquid water droplets. The droplets then collect and form clouds.

Precipitation

As the clouds cool and become saturated, they release the water back to the earth as rain, hail or snow.

Percolation and Runoff

Some of the precipitation moves downwards, percolating through pores and cracks in soil and rock. The excess becomes overland runoff into creeks, rivers, and lakes.

Groundwater

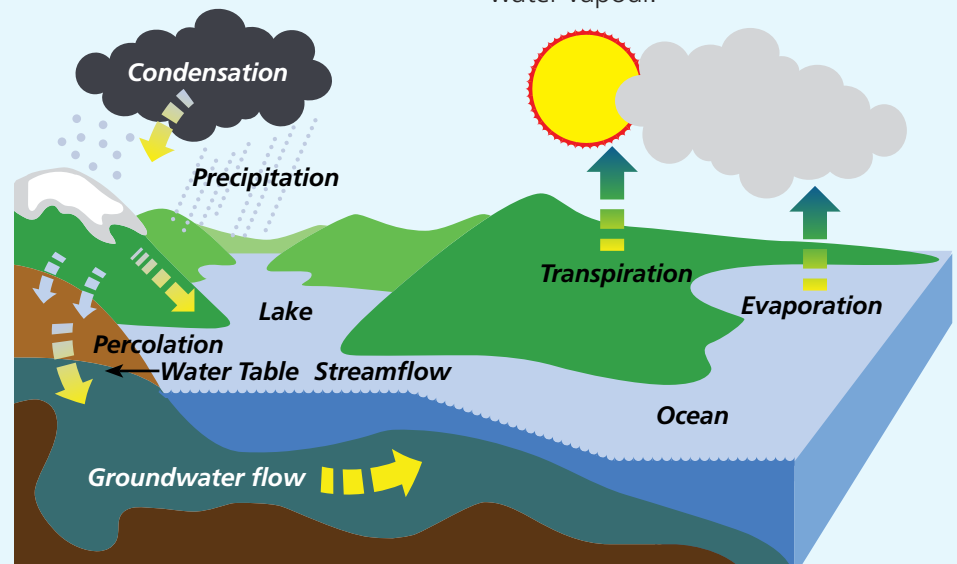
Some of the water returned to the earth soaks into the ground and replenishes underground reserves.

Transpiration

Water vapour absorbs into the air from leaves of trees and other plants.

Evaporation

The sun heats the water in oceans, rivers, puddles, and even laundry hanging on clotheslines. The droplets heat up and evaporate into the air as water vapour.



Storage

Some precipitation falls into lakes and streams or is fed directly to these water bodies and water courses over land or via the water table.

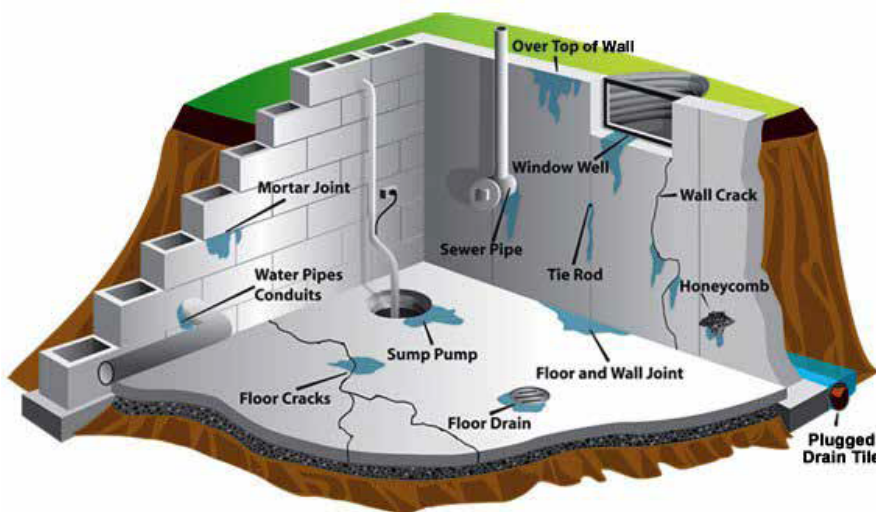
Why Does Residential Flooding Happen?

There are a variety of methods by which water can enter your house. The three main ways are infiltration through cracks in your foundation walls or floor, overland through open windows, doors or other unsealed entrances to the house, or from sewer backup, a result of a blocked connection or when municipal infrastructure is no longer able to carry stormwater or wastewater away from your house (also called sewer surcharge).

Infiltration

Infiltration flooding happens when the amount of groundwater adjacent to a building increases to the point that existing drainage infrastructure (weeping tile, lot drainage) is unable to move the water away from the foundation and floor. This situation often occurs after an extended period of rainfall, during an extreme rainfall event or during the spring snow melt. Groundwater can infiltrate into basements through cracks

in the basement floor and your foundation. Infiltration flooding can be a significant problem in older houses with rock and rubble foundations or where mortar has weakened and cracks have formed in concrete or block foundations. Homes without weeping tile or where the weeping tile has not been maintained are more susceptible to infiltration flooding. Poor lot drainage is also a significant contributor to infiltration flooding.



Why do basements flood?

- A leak or crack in your basement walls
- Poor lot drainage
- A blockage in your weeping tiles
- Overflowing eavestroughs and/or plugged downspouts
- A blockage in the main sewer line between the house and the sanitary sewer main
- A back-up of wastewater or combined wastewater/stormwater in the city sewer (sewer surcharge)
- Sump pump failure



Overland



Development standards are in place province-wide to ensure that stormwater run-off during peak rainfall events is properly directed to avoid flooding. Streets, ditches, swales, parks, underground storm sewers and overland flow routes are all designed specifically to direct runoff away from residential developments.

Underground piping is very expensive to design and install. Because of the significant expense, storm sewer pipes are designed to handle stormwater flow from rainstorms that occur, on average, **once every two years** (or, in other words, have a 50% chance of occurring each year). In most new Thunder Bay subdivisions overland flow routes (down streets and along sidewalks) have been designed to handle rainfall events that exceed the capacity of underground storm sewer pipes. Overland flow routes are designed to handle flows from rainstorms that occur, on average, **once every one hundred years** (or have a 1% chance of happening each year).

Overland flooding may occur when a rainfall and/or snowmelt event exceeds the capacity of the

municipal stormwater infrastructure. The probability of flooding increases if overland flow routes are blocked or catchbasins are plugged with ice or debris. Basement flooding happens when overland flows enter a basement through windows, doors, vents and other openings.

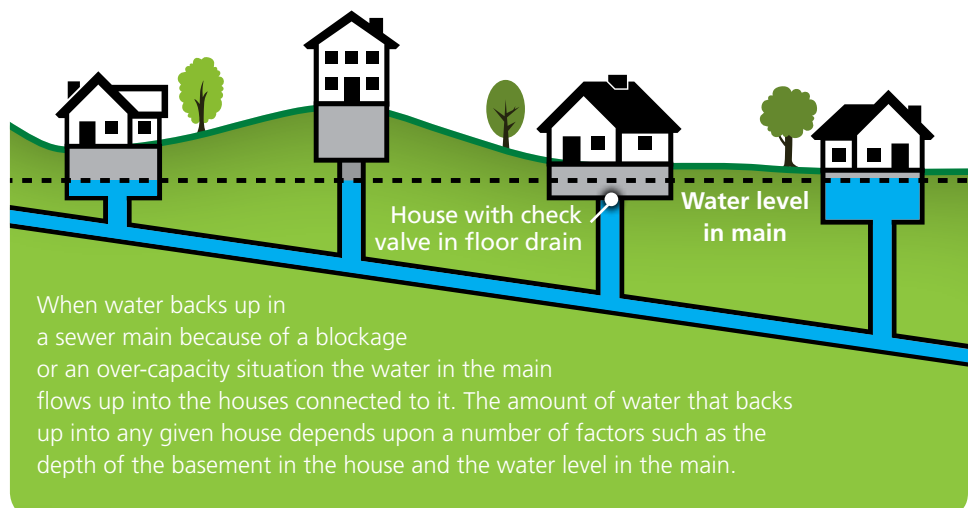
Overland flooding may also occur during less severe rain events and snow melt situations if household drainage systems are not maintained. Proper lot grading and properly installed and maintained eavestroughs and downspout connections can greatly reduce the risk of overland flooding.

Sewer Backup

There are three types of municipal sewers: sanitary sewers, storm sewers and combined sewers. Sanitary sewers accept only wastewater generated by toilets, sinks, drains and other indoor home water uses. A storm sewer

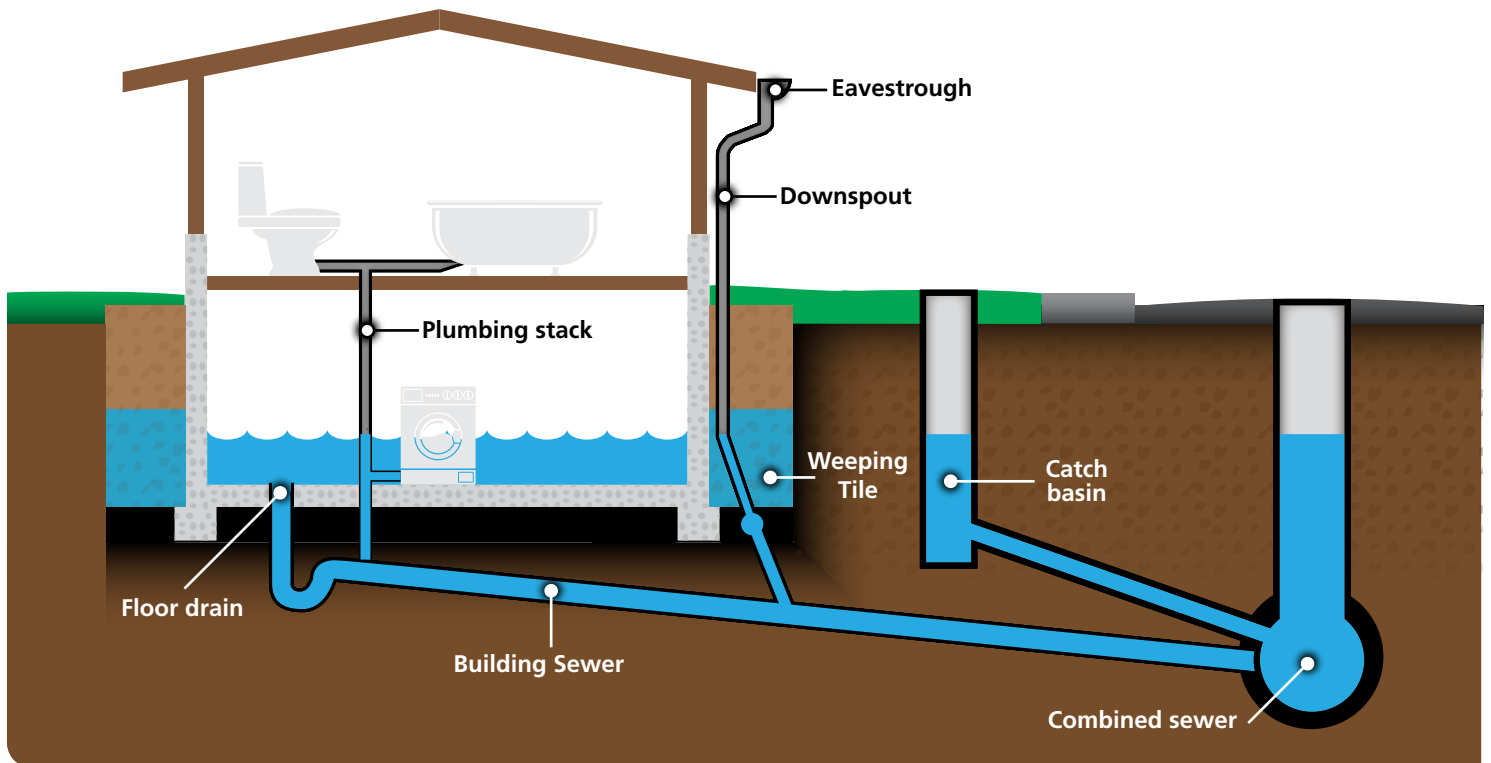
is built to accept runoff from rainfall, snowmelt and water from weeping tiles around buildings. If a sewer is collecting stormwater and wastewater then it is called a combined sewer. Sanitary sewers and combined sewers are typically directed to a wastewater treatment plant while storm sewers are allowed to flow back into lakes, rivers and streams.

Sewer backup occurs when municipal sanitary, storm or combined sewers receive more water than they can handle. Excess water causes the sewers to “surcharge” or push water back into home sewer laterals and out through basement floor drains, showers, toilets and sinks. Sewer backup can be sanitary sewage, stormwater or a combination of both. Excessive surcharge in the municipal sewer can cause high water pressures underneath the basement floor and around the foundation which may cause structural damage to the home.



Maintaining & Improving Your Drainage System

There are a number of initiatives that homeowners can take to protect themselves from flooding. Some projects are simple, inexpensive, do-it-yourself tasks, while others may require additional resources or the work of a contractor. Please review the following sections to determine what you can do to maintain and improve your home drainage system.

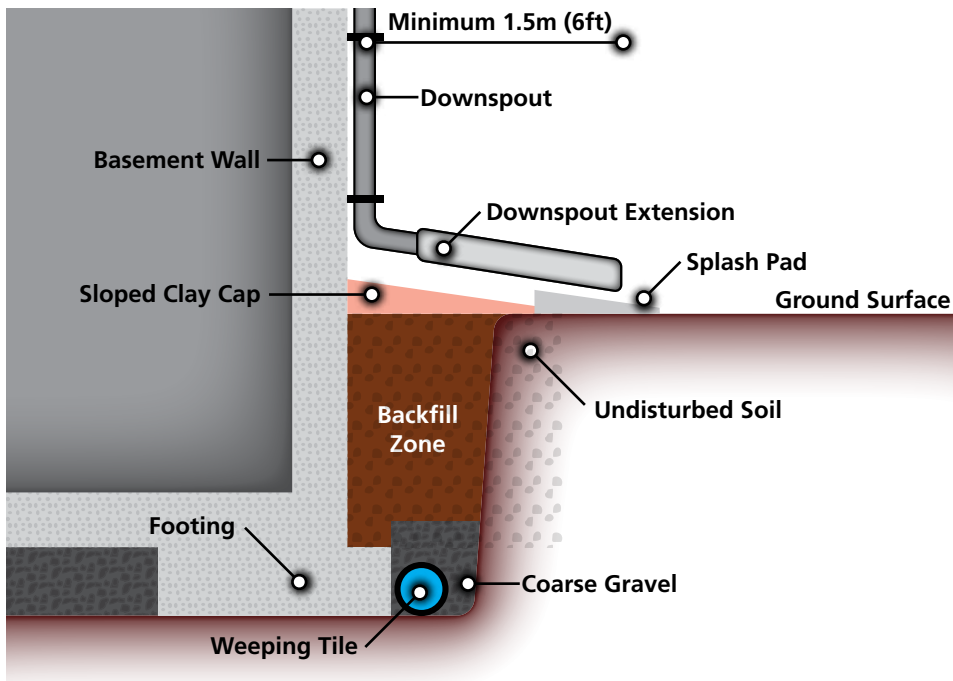


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Eavestroughs & Downspouts



How do eavestroughs & downspouts work?

Most houses are equipped with eavestroughs, which run along the edge of the roof to collect and move water through downspouts and away from the base of the house. Historically, downspouts were connected to the municipal sewer system. Today, however, it is recognized that adding stormwater from downspouts to the municipal sewer system puts undue pressure on both the sewer main and the wastewater treatment plant. Thunder Bay has passed a by-law requiring that all downspouts be disconnected from the municipal sewer system.

What if my downspout is connected to the sanitary sewer?

Disconnecting your downspout from the sewer connection is one

of the easiest and most important things you can do to protect against flooding. By disconnecting the downspout from the sewer pipe, you are preventing the water from reaching the sanitary sewer and thus decreasing the volume and stress on the system.

Disconnecting your downspout is both easy and inexpensive; simply cap the sewer pipe and re-direct the downspout through an extension pipe to an area of the property where additional water can be managed, at least 1.5m from the house. To prevent problems of infiltration, downspouts must be re-directed away from the foundation of the house; they are commonly re-directed into rain barrels, onto a permeable surface such as a lawn or rain garden, where the water can naturally soak into the ground.

How do I maintain my eavestroughs?



Eavestroughs should be checked and cleaned twice annually, in the spring and fall. Clear out any debris to ensure that rain and snow melt can flow freely. During a rainfall event, look to see if your eavestroughs are sagging or leaking anywhere. A sagging eavestrough will likely need to be replaced. Leaks can often be filled with caulking

Where should my downspouts drain?

Water from the downspouts should be directed either onto a permeable surface, where water can naturally infiltrate into the ground, or into a storage tank such as a rain barrel or cistern. Make sure that any outflow from the rain barrel is re-directed at least 1.5 meters away from the foundation of your house (and your neighbour's house). Rain barrels should be emptied prior to the next rainfall.

What is a cistern?

A rainwater cistern is a system for collecting rainwater and storing it until it is needed for watering lawns and gardens, washing vehicles and other circumstances where non-potable water can be used. Rainwater cisterns can either be above ground, or an underground concrete or masonry tank.



Homeowner Checklist:

- ✓ Respect your neighbours! The re-directed outflow should be at least 1.5 meters away from the foundation of both your home and your neighbour's houses, and needs to be constrained to your property.
- ✓ Keep them clean! Remove all leaves and debris from your eavestroughs and downspouts each season.
- ✓ Check your eavestroughs for sagging or leaks regularly. Repair or replace any damaged sections.
- ✓ Be sure to direct stormwater onto a permeable surface or into a storage tank. Water that is redirected onto an impermeable surface (driveway, sidewalk, etc) will flow directly into the storm sewer, contributing to peak flows in the storm system.
- ✓ Use a splash pad at the end of the downspout to avoid soil erosion.

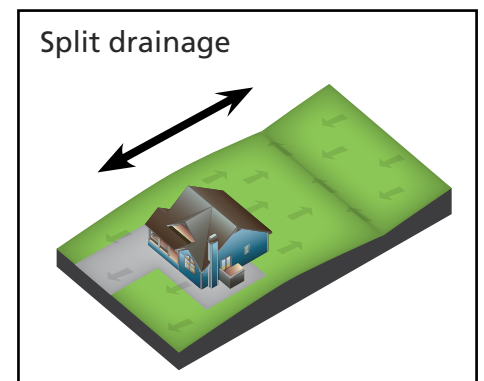
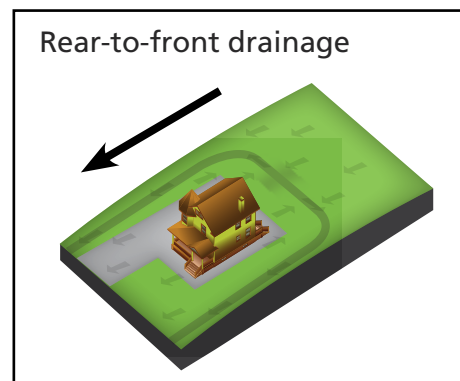
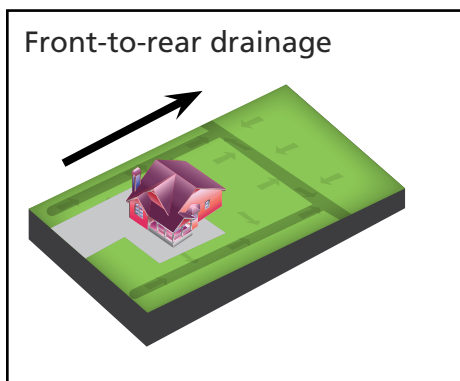
Lot Drainage

What is lot drainage?

There are three basic types of residential lot drainage, front-to-rear drainage, rear-to-front drainage, and split drainage. If the front or rear lot line is the highest point on your lot, you will notice that surface water drains into side yard swales toward

the rear/front of the property. If the highest elevation is near the middle of your property, you have a split drainage situation where surface water flows towards the street and the back lane. No matter which type of lot drainage your property

has, it is very important that surface water has somewhere to drain. If the lot is not properly graded, or if the construction of sheds, decks, retaining walls, etc., has interfered with lot grading, flooding is likely to occur.



How can I tell if I have a problem with lot drainage?

Do you notice any of these things happening after a rainstorm or snow melt? If so, you likely have a problem with lot drainage.

- ✓ Ponding (water pools in one part of your yard)
- ✓ Water seepage along basement windows or foundation
- ✓ Basement dampness
- ✓ Basement settlement (signs include sloping floors or cracks in walls)
- ✓ Erosion around the foundation



How can I improve lot drainage?

Slope:



Check the slope of the ground around the foundation of your house. It is very important that the soil or ground cover next to your house is 15 cm higher than the ground 1.5 meters away. This slope should also be maintained under any stairs or decks. If the ground has settled, resulting in insufficient slope, stormwater is more likely to pool around your foundation, causing overland or infiltration flooding. It is a good idea to regularly inspect the slope around your foundation, fixing any settlement problems as they may occur.

Seal foundation:



You should regularly examine the inside of your basement walls and floor to identify any moisture or leaks. Be sure to seal any cracks you may find.

Swales:



A swale is a shallow vegetated channel, often located along property lines, that collects and drains stormwater. Swales should be maintained by regular mowing and clearing any debris that could block the passage of water.

Window Wells:



A properly installed window well on any basement window will help to ensure that water infiltrates into the weeping tile while preventing seepage into your home. Window wells are inexpensive and easy to install.

Window Wells: Proper Installation



Measure your window to ensure that you buy the correct size window well. The window well should fit firmly against the foundation wall with the edges fitting comfortably around the window.

The window well should be dug down at least one foot below the

bottom of the window sill. Clear all dirt and debris from inside the window well and backfill with gravel or pea stone to 4 inches below the window sill.

Make sure the dirt or sod surrounding the window well is properly graded like the rest of the house.

Backwater Valves

What is a backwater valve?

A backwater valve is a mechanical device that prevents sewage in an overloaded main sewer line from backing up into your home through basement outlets such as sinks, toilets, showers, and laundry tubs. It is installed in your home's sewage outflow line, and is designed so that the valve closes automatically if sewage backs up from the main sewer.

One style of valve commonly used is the Mainline Fullport backwater valve. This normally open backwater valve allows the free flow of air to vent through it while simultaneously ensuring that the gate floats into a closed position to prevent backflow in the event of a sewer backup. Installing the valve on the main building drain protects the entire building from backflow with just one valve.



Should I install a backwater valve? How?

Does your home have a history of sewer surcharge? Are you living in a low-lying area? Does your insurance coverage require that a backwater

valve be installed in order to be covered for sanitary backup? If you answered 'yes' to any of these questions, you should consider having a backwater valve installed. Both a permit and inspection are

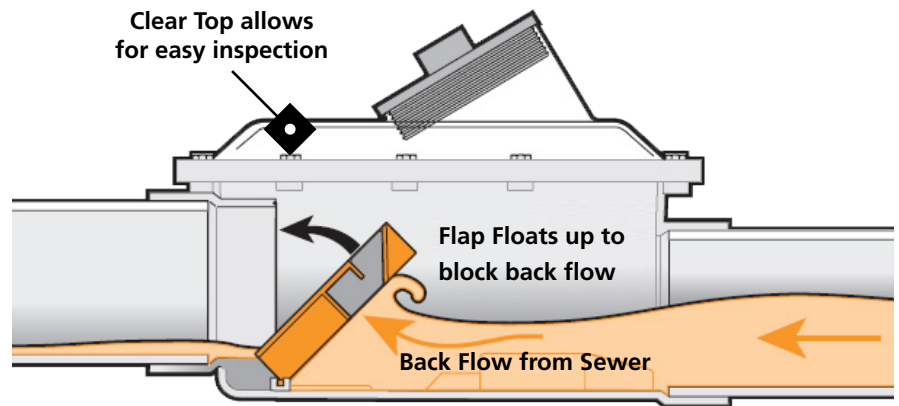
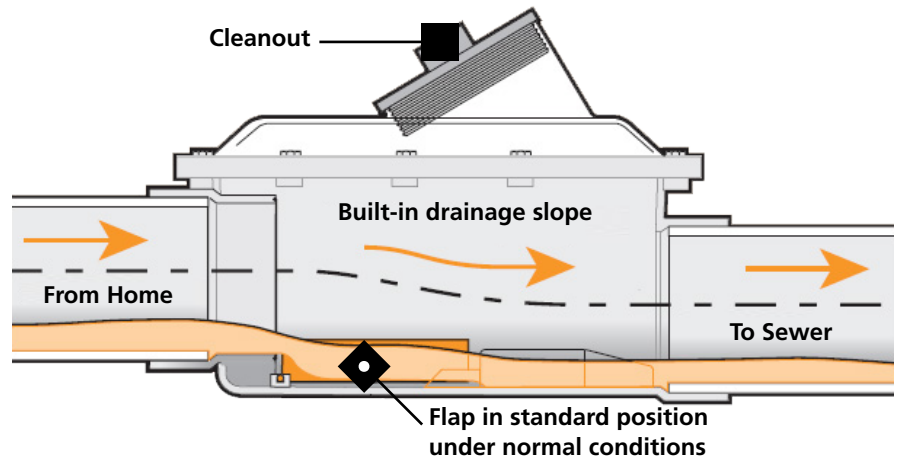
required in order to install a new backwater valve in your home. Due to the potential to damage your main sewer connection and the significant labour involved, it is advisable that you hire a licensed plumbing contractor.

How much does it cost to install a backwater valve?

A backwater valve itself costs about \$200. However, the actual cost of hiring a licensed contractor to install a new backwater valve can range from \$1000 to \$3500 depending on the amount of work required to access the sewer lateral(s) from the house.

How to maintain your backwater valve

Backwater valves that have been installed and maintained according to the specifications of the manufacturer and in accordance with the Ontario Building Code should not cause any problems. However, it is important to check and maintain your backwater valve every 6 months. Backwater valves are required to be installed with an access hatch that allows you (or a



maintenance provider) to ensure that the device is free and clear of debris. If you are having a new backwater valve installed, be sure to ask the contractor to show you how to check and maintain the device.



How to check your backwater valve

1. Remove the cleanout plug on the top of the valve and do a visual inspection.
 2. Use a flashlight or trouble light to see inside the valve body.
 3. Inspect for debris build-up on the body, gate and beneath the gate.
 4. If debris build-up is found, flush clean using a hose or bucket.
 5. Inspect o-ring and replace if necessary. The valve's gate seals against an o-ring on the body (in the closed position).
 6. Ensure gate freely moves up and down.
 7. Reinstall cleanout plug
- * If damage is found on the gate, or a more thorough cleaning of the valve is required, remove the bolted cover.
- Important:** if you have difficulty maintaining your backwater valve, contact your plumber.

Weeping Tile

What is weeping tile?



Weeping tile is a perforated plastic pipe or clay tile pipe that runs underground along the bottom of a home's footing. As water percolates down through the soil, the water flows into the holes/gaps in the weeping tile and is drained away from the foundation of your home. Weeping tile is typically connected to a sump pump and a sump pit and drains either into the storm sewer or into a dry well. It is important to disconnect any weeping tile that may be connected to the sanitary sewer main.

How do I know if my house has weeping tile?

It is impossible to see if your house has weeping tile because it is buried underground. Unless you know for sure, the only way to tell if you have weeping tile is to dig down to the bottom of your home's foundation. In Thunder Bay, most houses built after 1960 have some form of foundation drainage (that may or may not be weeping tile). The Ontario Building Code currently requires the installation of weeping tile on all newly built homes.

Should I install weeping tile?

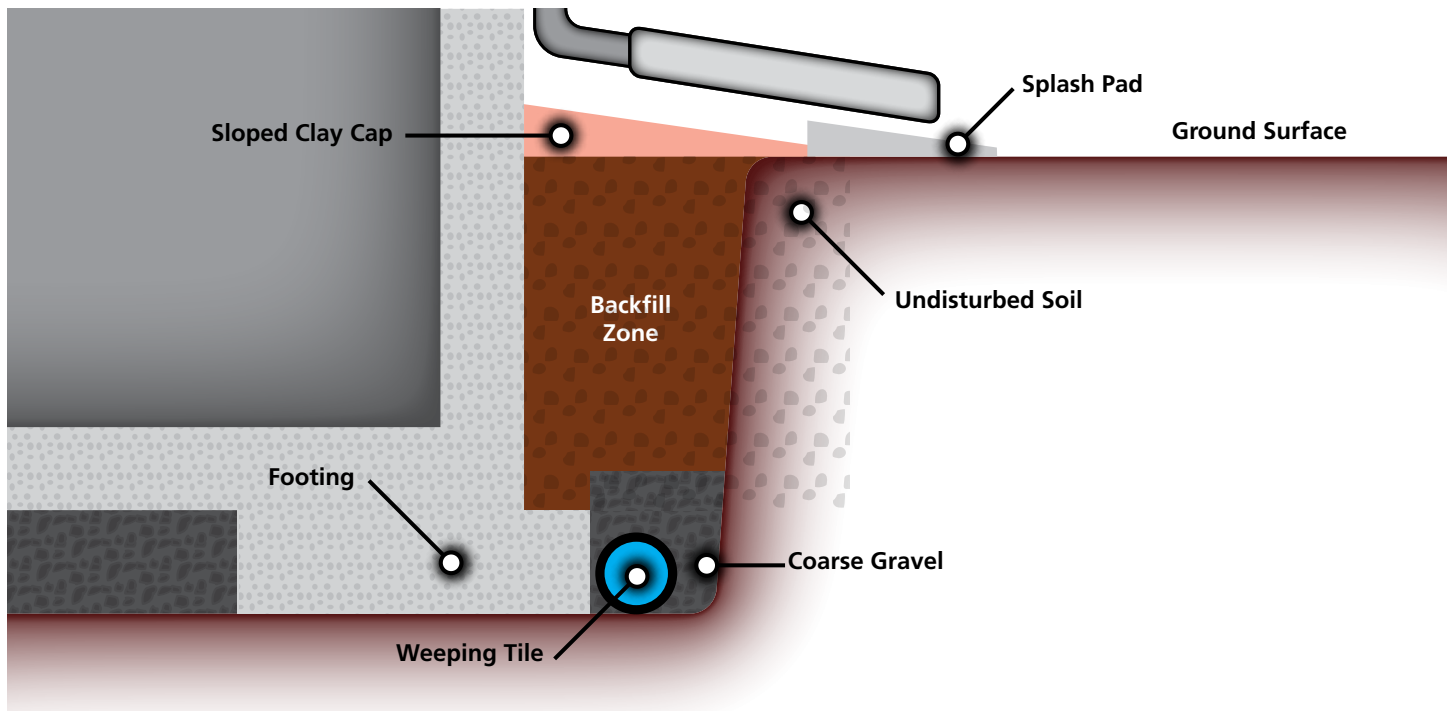
Weeping tile, in combination with basement wet-proofing, is very effective at preventing infiltration flooding. The installation of weeping tile and basement wet-proofing is highly recommended if you experience water seepage through your basement floors or through the foundation walls of your home.

How much does it cost to install weeping tile?

The cost of installing weeping tile can vary significantly depending on many factors, including the size of your home, the type of soil surrounding your home's foundation, and other conditions around your house (ie: decks, patio stones, driveway). Most weeping tile installations cost from \$5,000 to \$20,000 and will depend on several factors including the size of the house.

Common problems with weeping tile

Effectively installed weeping tile should not present problems to a homeowner. Occasionally, improper construction (such as improper slope of the pipes) can impede the effectiveness of the weeping tile. It should also be noted that weeping tile can sometimes become contaminated by the infiltration



of silt and clay. This problem is more common in areas with silty and clayey soil. The most common problems with weeping tile drainage are associated with the sump pump and sump pit rather than with the weeping tile

Does weeping tile require any maintenance?

Newer weeping tile is generally installed with a form of cleanout to the surface (or just below). If you are experiencing problems, this cleanout allows you to access the weeping tile via a high pressure hose to clear any blockage that may have

accumulated. If you do not have this sort of access you may be able to maintain the weeping tile through the sump pit in the house, if it is accessible.

Why should I disconnect my house's weeping tile from the sanitary or storm sewer?

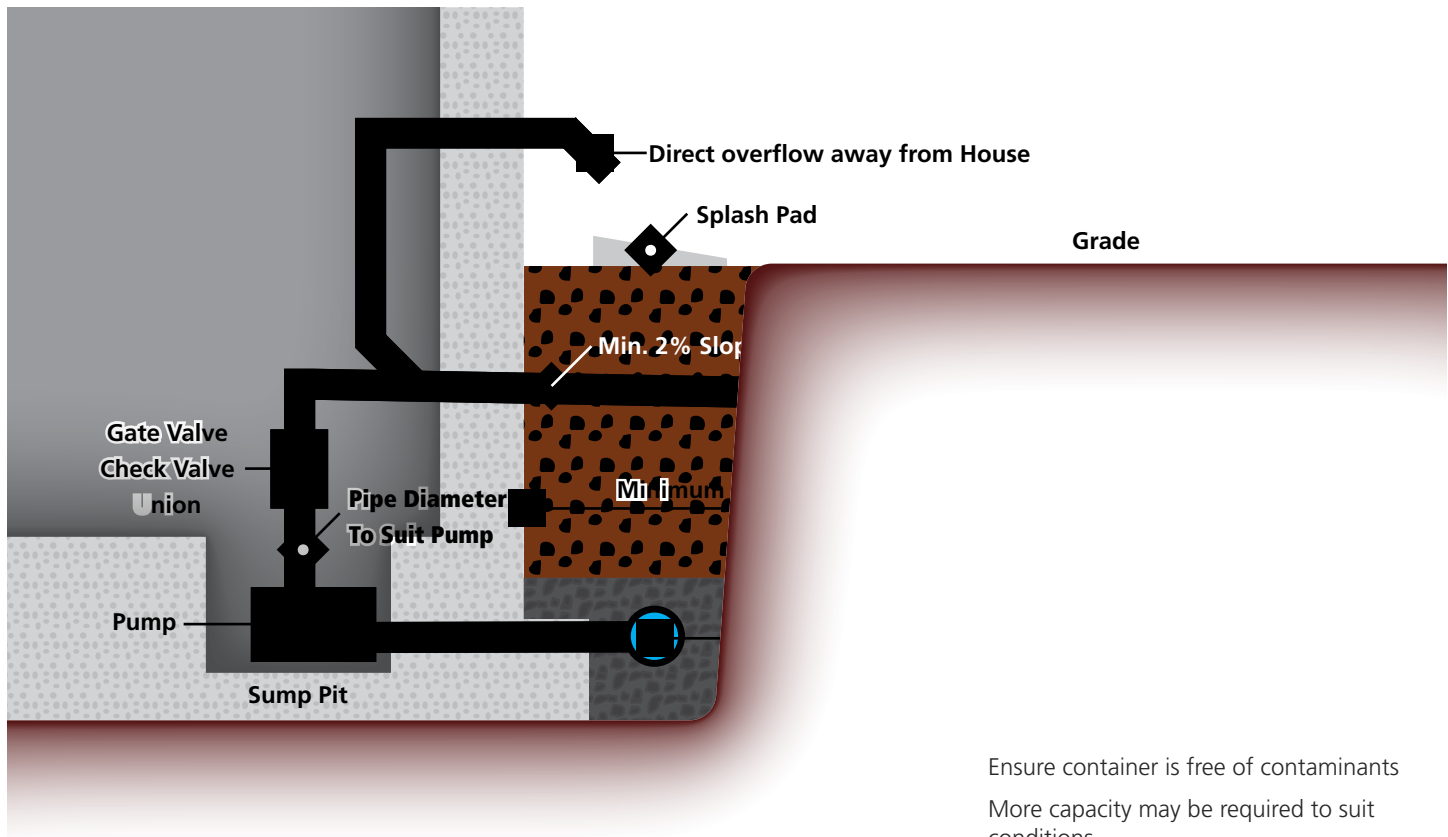
It is important that all weeping tile is disconnected from the sanitary sewer. This helps to prevent sewer surcharge by lessening the load on the sanitary main during times of heavy rainfall or snow melt. Disconnecting weeping tile from the sanitary sewer requires that you

install a sump pump, sump pit and dry well. Though it is preferable for weeping tile to drain into a dry well, it is not illegal for the water to drain into the storm sewer.

If the weeping tile is improperly connected to the storm sewer lateral, water can be pushed back into the weeping tile during a storm sewer surcharge. This can result in structural damage to the home (including cracking or heaving in foundation walls and basement floors) and increased rates of infiltration flooding.



Sump Pumps & Sump Pits



Ensure container is free of contaminants
More capacity may be required to suit conditions

Sump Pumps & Sump Pits

A sump pump is a pump that works to drain water that has collected in a sump pit. Sump pits accumulate water that drains from weeping tile or from ground water if your basement is below the level of the water table.



Should I install a sump pump?

How?

It is advisable to install a sump pump if you have issues with any type of flooding on your property. Sump pits and sump pumps should be installed in the lowest part of your basement.

A permit should be obtained to install a new sump pump. Any work that involves connecting to the main plumbing stack must be completed by a licensed plumber.

How much does it cost to install a sump pump?

Installing a new sump pit and sump pump can cost anywhere from \$500

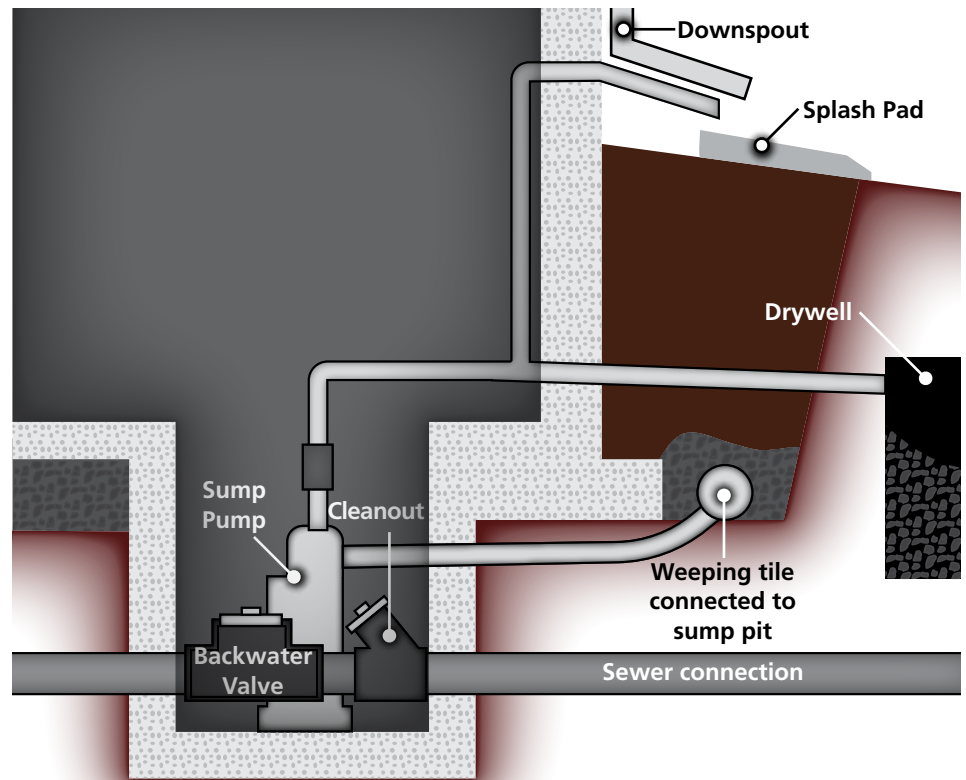
to upwards of \$2500, in addition to the cost of installing weeping tile. Replacing an existing sump pump is cheaper because there is less disturbance to your basement floor.

Common problems with sump pumps

The floats of a sump pump sometimes become fouled by contaminants or tangled. If the floats are not set correctly, the pump may not be able to cycle properly. Many sump pumps are plugged in to an electrical outlet. If you experience a power outage during a flood event, an electric sump pump will fail to work unless you have a battery backup.

How do I maintain my sump pump?

It is important that you inspect and test your sump pump at least twice a year, in the spring and fall. If you find that the sump pump is not working properly, you should troubleshoot according to the manufacturer's instructions. If you are unable to resolve the problem, you may want to call a contractor. If you find that the sump pump is broken and cannot be fixed, it is time to invest in a new pump. It is a good idea to rinse out or pressure wash the sump pit occasionally.



Landscape Design

There are a number of landscape design initiatives a homeowner can take to improve lot drainage and prevent flooding.

Rain Gardens

A rain garden is a landscaped depression that will soak up rainwater runoff from the roof of a house or garage, or other hard surfaces like parking areas. The rain garden reduces runoff by allowing the rainwater to percolate into the ground rather than flow into storm drains and local waterways. By slowing the flow of stormwater, rain gardens reduce erosion, water pollution and flooding. Often planted with native wildflowers and other plants, rain gardens enhance the beauty of yards and

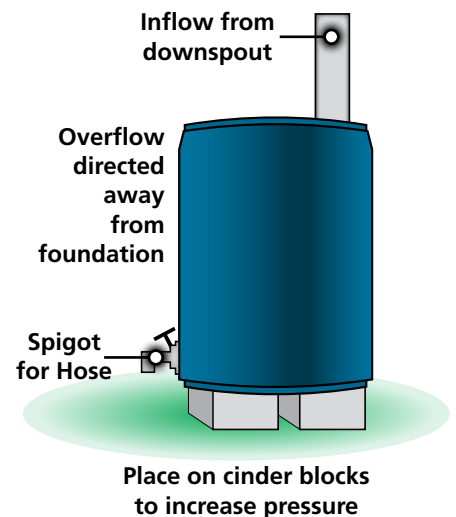
communities while providing valuable habitat and food for birds and pollinators.

Rainwater harvesting

Rainwater harvesting refers to systems to capture and store rain to be used for daily water needs. Rain barrels, which collect water runoff from the roof to be used for outdoor irrigation, are an inexpensive and easy-to-use rainwater harvesting system. More complex systems could involve pumping water from cisterns (either buried or above ground) as either a replacement or supplement to the municipal water supply.

Rainwater harvesting is an excellent way to help protect our water supply; by storing seasonal rain

water for re-use in dry times we can reduce our demand on the municipal water supply. In addition, harvesting systems help to reduce the incidence of property flooding by capturing significant amounts of runoff from a house.



Did you know?

Rain gardens allow about 30% more water to soak into the ground than a conventional patch of grass. They also require minimal maintenance and lend a unique aesthetic to your yard.



Residential water use typically increases more than 40% in the summer months. Reduce your use, and your water bill, by collecting water in a rain barrel and re-using it on your garden or lawn in dry times!

Five Quick, Inexpensive Ways To Get You Started

An assessment of your home drainage system may have pointed out a number of deficiencies. So where do you start? Here are some quick, inexpensive actions you can take that will make a difference in reducing your flood risk.

1. Plug the leaks. A ladder, silicone, and time are all you need to seal holes or cracks in your eavestroughs, downspouts, downspout extensions, sidewalks, patio and driveway.
2. Repair or replace downspout extensions. This might be a matter of simply putting down the extension that's already there or putting back the splash pad. Purchasing and installing extensions or splash pads is inexpensive but very important in getting water away from foundation walls. Do not direct the downspout extensions towards a neighbouring property unless it is over 10ft away.
3. Clean your eavestroughs and downspouts. The downspout extensions have little value if leaves and other debris are preventing water from getting down the downspout. A gloved hand (or garden spade), ladder and garden hose are the tools you need to get the job done.
4. Backfill under steps and decks. This is often the weak spot in lot grading. Dirt and some shovel work is all it takes to fill the depression and get the ground sloping downhill away from the house again.
5. Top up sunken areas around the foundation. Ground around your basement settles over time. Raising the yard level up with some dirt and shovel work will re-establish a positive slope (grade) again at little or no cost.

Hiring a Contractor

When should I hire a contractor?

Some flood prevention measures are simple, inexpensive tasks that you may feel comfortable undertaking yourself. Other projects may be more cumbersome or require the expertise of a contractor. It is advisable to hire a licensed plumbing contractor to do any work involving the main plumbing infrastructure in your house. Keep in mind that you can discuss with a

contractor if there are elements of the work that you could do yourself. This may help to reduce the cost of your project.

How much does a contractor cost?

The cost of hiring a contractor can vary widely depending on the amount and type of work being done. It is important that you get at least 2 (or more) written estimates before choosing a contractor. Be

sure to keep these written estimates in a safe, accessible place so that you can refer back to them if needed.

Do I need to get any permits?

Permits are generally required for all drainage work. Please contact the City of Thunder Bay Building Department to confirm if the work you are doing requires a permit.

Looking to hire a contractor? Consider the following:

- Choose a qualified professional who is licensed to practice in Ontario.
- Ask for recommendations from family and friends.
- Ask for a detailed breakdown of associated costs.
- Obtain multiple quotes.
- Ask if you can set a payment schedule based on project benchmarks.
- Put your agreement in writing.
- Contact the Better Business Bureau to obtain a reliability report.
- Ask for (and be sure to check) references.
- Call each of your potential contractors and ask questions regarding the work you would like performed including confirmation of who is responsible for taking out any required permits.

Resources

Many resources are available to answer your questions regarding Residential Drainage and Flooding. The following is a list of resources that can help you to understand the flow of water on and around your property:

Local Flooding Information and Flood Prevention Measures

EcoSuperior Environmental Programs

562 Red River Road
Thunder Bay, ON
P7B 1H3
807-624-2140

City of Thunder Bay - Infrastructure & Operations

Victoriaville Civic Centre
111 Syndicate Ave. S
P.O. Box 800
Thunder Bay, ON
P7C 5K4
807-625-2266

Regional Flood Forecasting and Flood Status

Lakehead Region Conservation Authority

P.O. Box 10427
130 Conservation Road
Thunder Bay, ON
P7B 6T8
807-344-5857

Additional Resources

Environment Canada

www.ec.gc.ca/eau-water

Ministry of the Environment and Climate Change

www.ontario.ca/law-and-safety/floods

Canada Mortgage and Housing Corporation

www.cmhc-schl.gc.ca

Institute for Catastrophic Loss Reduction

www.iclr.org

Green Communities Canada

www.slowrain.ca

United States Environmental Protection Agency

www.epa.gov/naturalevents/flooding.html



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562 Red River Road,
Thunder Bay, Ontario
P7B 1H3

www.ecosuperior.org