

Floodproofing

***Protect your home
against flooding***



Canada-Newfoundland
Flood Damage Reduction Program



Environment
Canada

Environnement
Canada

Conservation and
Protection

Conservation et
Protection



Department of Environment
and Lands

Water Resources Division

Introduction



If your home is located on or near a floodplain, floodproofing methods will not protect your home totally. The best protection is to avoid building on a floodplain.

Cover Photos:

Top: Flooding caused by heavy rain in Steady Brook. House was built on raised fill.

Middle: Flooding caused by high winds and tides in Placentia. Waves are overtopping berm.

Bottom: Flooding caused by ice jam in Rushton. Protection is provided by flood wall.

The Canada-Newfoundland Flood Damage Reduction Program thanks the Department of the Environment, Environmental Planning and Sciences Branch, Government of New Brunswick, for their assistance in preparing this publication.

The Province of Newfoundland has a long history of flooding, with incidents of varying severity being reported frequently since the early 1900s.

The major causes of flooding in this Province are snowmelt, rainfall, high tides and ice jams, although most floods involve combinations of these factors.

Although floods have occurred in all four seasons, most of the documented events have taken place during the late fall and early winter and the months of March, April and May.

Since flooding is a serious problem in the Province of Newfoundland and other provinces, the federal government started the Flood Damage Reduction Program in 1975. This Program is primarily designed to identify flood risk areas and to discourage people from building in these areas.

Unfortunately, some of the most desirable building sites are located beside lakes and streams, or along coastal beaches, many of them on the flat land, or floodplain. It should be stressed that there are no floodproofing methods that will protect your property totally from the effects of severe flooding. The best protection is to avoid building on a floodplain.

This booklet has been designed to help you select the most appropriate floodproofing methods for your needs, whether you are protecting an existing structure, or building a new one, on or near a floodplain. This is not a "how-to" booklet, but rather an overview of the various types of floodproofing measures available to you. A reference list is provided at the end of this booklet for details on specific methods. The floodproofing methods outlined here are best suited for buildings and property located along the fringes of a floodway, where the water flows more slowly and is shallower.

If you are considering building on land that might be within a floodplain, it is wise to first check whether the area has been mapped under the Canada-Newfoundland Flood Damage Reduction Program. These areas are shown on the map of Newfoundland on page 4. Copies of flood information maps for each of these areas are available from the Water Resources Division of the Department of Environment and Lands, or the Inland Waters Directorate, Conservation and Protection, Environment Canada. See page 16 of this booklet for addresses and telephone numbers.

If your property is located in an unmapped area, sources of flood information are agencies such as those listed above, municipal governments and public and university libraries. Long-term residents can also be excellent sources of information on the history of flooding in your area.

If you decide to floodproof your property, you should first evaluate the cost and benefits of such an undertaking. Most importantly, hire qualified people to do the work.

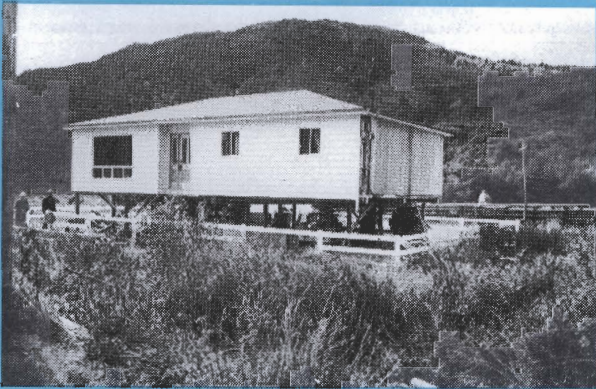
If you have any questions concerning the information provided in this booklet, please contact one of the two departments listed on page 16 of this booklet. Both departments have knowledgeable people to assist you.

Table of Contents

Introduction

What is Floodproofing?	3
Map of Newfoundland	4
Permanent Floodproofing Measures	5
Elevation on Fill	5
Elevation on Piers and Columns	6
Closures and Sealants	7
Floodwalls and Berms	8
Contingency Floodproofing Measures	9
Flood Shields	9
Watertight Doors	9
Wet Floodproofing	10
Emergency Floodproofing Measures	12
Sandbag Dykes	11
Temporary Walls	11
Floodproofing Building Services	12
How to Choose Floodproofing Methods	
Flood Hazards	14
Physical Conditions	14
How to Proceed	15
Further Information	
Flood Damage Reduction in Newfoundland	16
Emergency Measures	16
References	16

What is Floodproofing?



This house in Rushoon is being elevated on columns and fill - a preventative floodproofing measure.



The same house after being elevated.

Simply put, floodproofing is any combination of structural or non-structural changes to buildings or utilities, eg. power or sewer lines, that reduces or eliminates damage caused by floods.

Preventive floodproofing measures are more economical than corrective ones because they are applied during the construction of the building. Corrective measures applied to an existing structure, however, are still a viable means of reducing flood damages.

Dry floodproofing is preferred by most property owners because the contents of the building are kept dry and there is no need for clean up.

Wet floodproofing minimizes potential damage by allowing water into the building. Having water inside and outside the building equalizes the water pressure on the walls and floors, and in most cases, results in less structural damage.

To choose the most appropriate floodproofing measures for your building, you must first consider the history and characteristics of floods in your area.

Permanent floodproofing measures are usually more effective in reducing flood damages in areas prone to frequent or flash flooding. Always in place, these measures should also be considered for any flood prone area, particularly if there is no flood forecasting service or warning system, which is the case in most areas of Newfoundland.

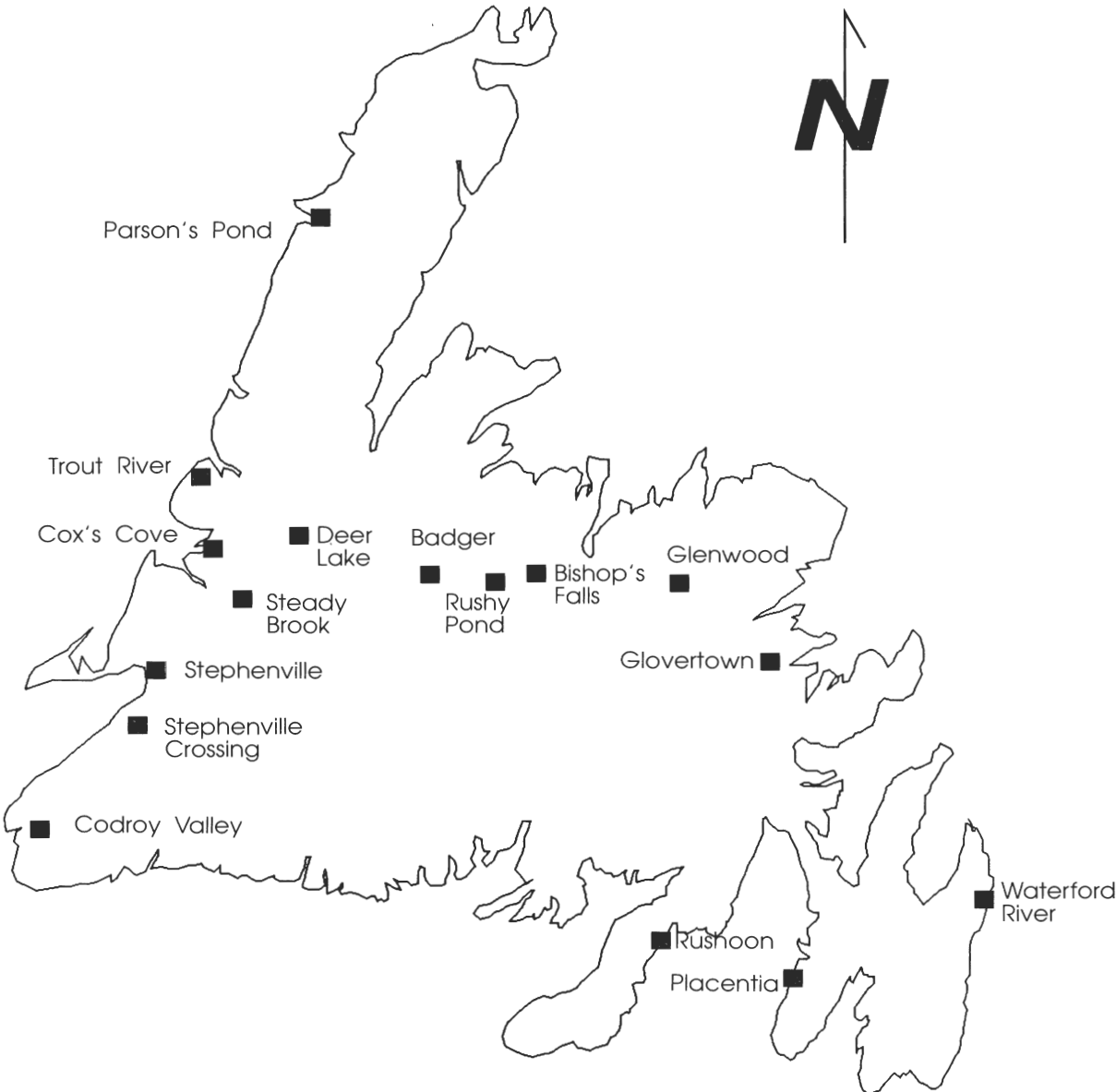
Contingency floodproofing measures are best suited to areas where the depth or risk of flooding is not too great.

Watertight barriers are one method of restricting the flow of water. These usually consist of panels of durable material, placed on the outside of ground floor doors and windows, that can be quickly closed and sealed during flooding.

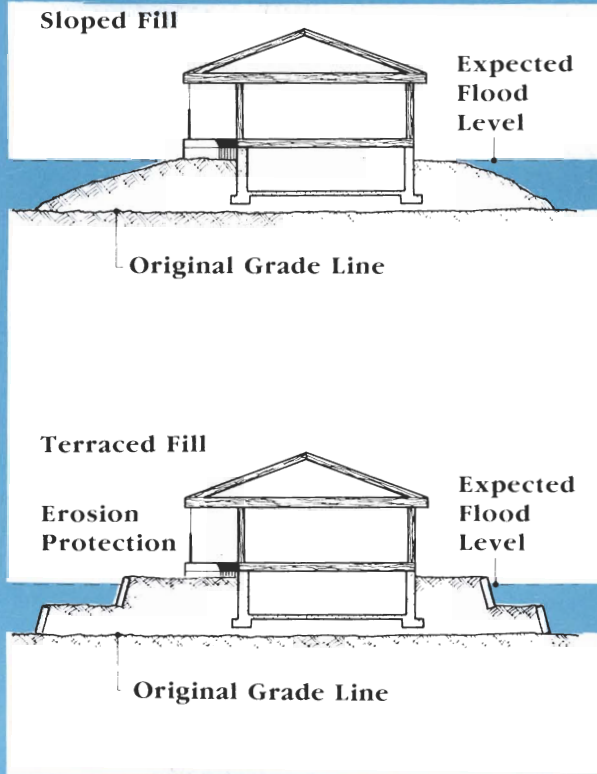
Emergency floodproofing measures are most effective in areas expected to have a shallow water depth and a slow rate of water rise during a flood. However, these measures are labour-intensive and are usually undertaken on short notice and make use of existing or stored materials to build dykes or barriers against rising water.

The following sections will discuss the three approaches to floodproofing in more detail. Some recommended techniques and examples are provided.

Flood Risk Areas



Permanent Floodproofing Measures



The elevation of buildings on fill is often the best protection from flooding. The above diagrams illustrate two methods of fill placement - sloped and terraced.

Permanent floodproofing measures are incorporated into the design of the building. They require no action by property owners at the time of a flood to be effective.

Permanent floodproofing measures include such techniques as elevation of a building on fill or on piers and columns. Some other examples include the permanent installation of closures and seals on doors and windows, and the construction of floodwalls, which remain in place.

Elevation on Fill

The elevation of buildings on fill is often the best flood protection method for small existing buildings and new buildings without basements. By raising the building above the flood level, damages to a building and its contents by flooding can be reduced or eliminated. Even if the floodwater is higher than expected and enters the building, the flood damages will be less, since the depth of the water and the length of time the building's contents are exposed will be reduced.

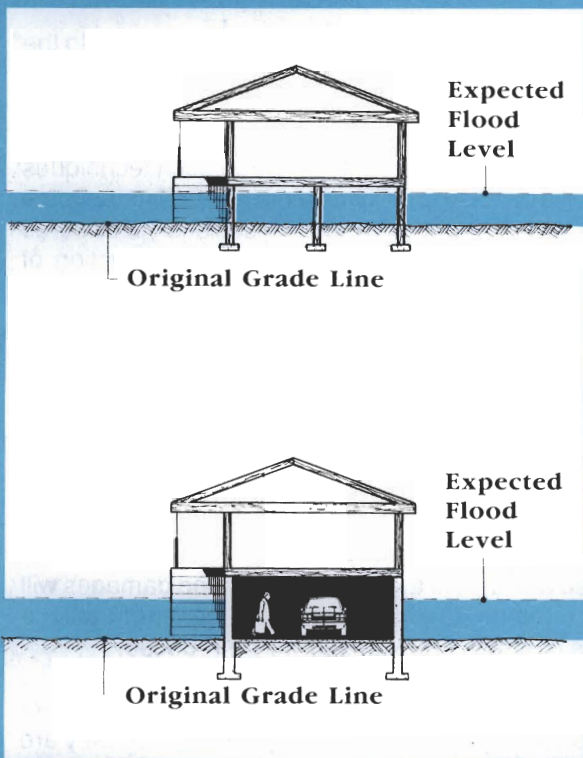
However, care must be taken in the selection and placement of fill. Choose well-graded sands and gravels since they are the most suitable soil material to support buildings. Silts and very uniform sands are undesirable as they are difficult to compact. Consideration must also be given to how the fill will settle. Engineering expertise may be required.

The sides of the fill should be protected against erosion, and sloped in such a way as to prevent sliding.

Elevating a building on fill in the floodway is not recommended since this area carries the largest volume of floodwater. Here, the water moves very fast and rises to great heights. Not only does soil erosion occur rapidly, but the fill causes a restriction to water flow and may result in more flooding.

In some areas, depending on how easily water can percolate through the underlying soil, and on the groundwater level, it may be desirable to build the structure on a concrete slab rather than on a typical foundation with a basement.

Elevation on Piers and Columns



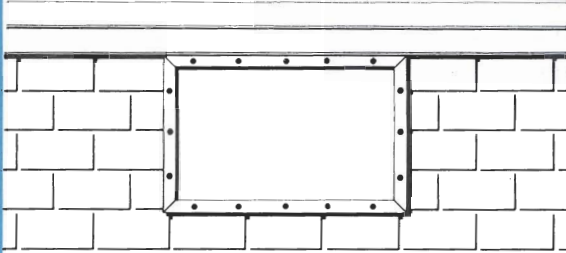
During construction, buildings can be elevated on piers and columns as a method of floodproofing. The open area under the building can be used for other purposes, such as parking, outside of the flood season.

The elevation of a building on piers and columns is usually limited to new or small structures, since it is often too expensive for large or heavy buildings to be raised.

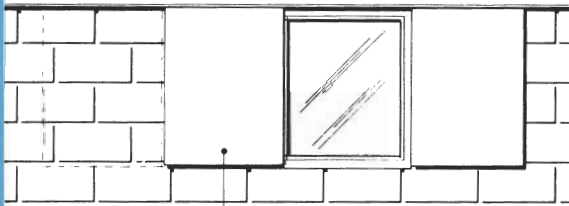
Engineering or architectural expertise should be obtained because the supporting piers and columns must also be designed to withstand the force of the floodwaters and the possible impact of ice and debris, as well as to support the structure. Care must also be taken to protect water and sewer lines from freezing.

Outside of the flood season, the open area under the building can be used for other purposes such as parking or as a sheltered play area.

**Flood shield for
entire window**



Window Shutters



Shutter in closed position

Flood shields or window shutters are usually applied for openings near the ground surface.

Closures and Sealants

A closure refers to the covering of existing window, door or other openings with a water-resistant material. Once a sealant is applied, the opening can no longer be used.

Waterproof coatings or sealants can also be applied to wall surfaces to reduce or eliminate seepage.

Before extensive use is made of closures and sealants, engineering expertise should be obtained to determine if the foundation and basement floor of the building are strong enough to withstand the water pressure.

Generally these methods should only be applied for openings near the ground surface, and in buildings where these windows and doors are no longer required.

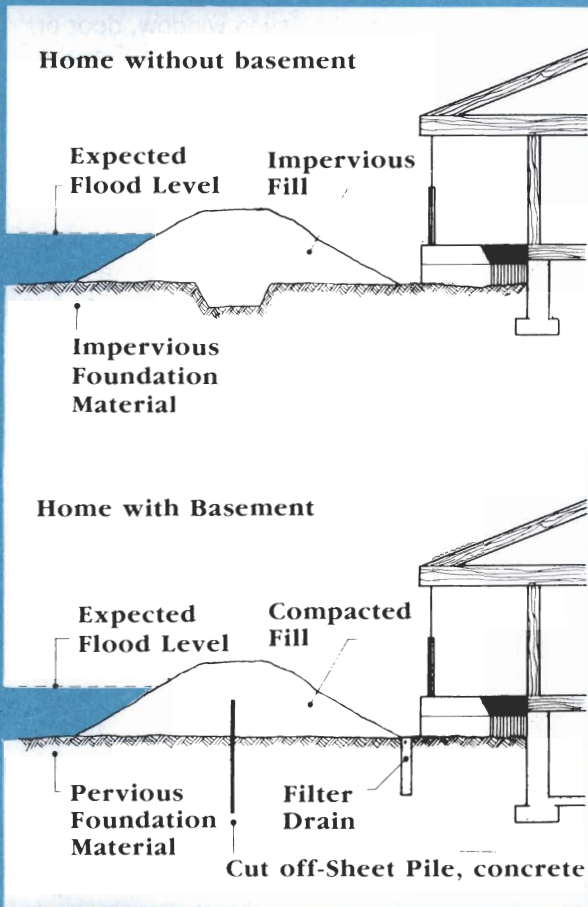
Floodwalls and Berms

Floodwalls and berms are barriers intended to keep water away from any type of building or structure. Many people prefer this method of floodproofing because it requires no change to the building.

Floodwalls are generally constructed of masonry or concrete, and are designed to meet the conditions at a particular site. Berms are low embankments of earthen fill with moderate side slopes and a wide top.

Two important considerations in the design of floodwalls and berms are the rate at which the water flows through the underlying soil and the soil's ability to support the floodwall or berm. If the soil is porous, seepage underneath could be a problem. However, the use of cutoff walls (eg. steel sheet piles) beneath the floodwall or berm may help ensure the water does not seep into a building's basement. It is often useful to install suitably sized sump pumps to control basement flooding. In some areas, it may not be feasible to incorporate a basement into the building because of high groundwater levels. In such cases, a slab-on-ground foundation should be considered.

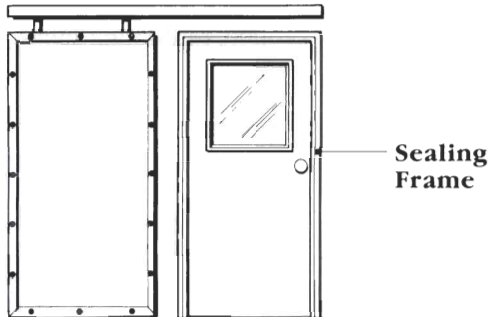
Consideration must also be given to the drainage of the area within the floodwall or berm, and to the control of sewer backup.



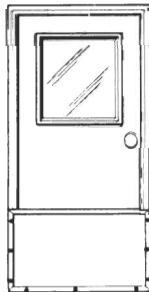
An important consideration in the design of a berm is the ability of the soil to permit the passage of water. If the soil is porous, seepage into the basement of the nearby home is possible. The use of cutoff walls, or blanket drains beneath the berm are one way to prevent such seepage.

Contingency Floodproofing Measures

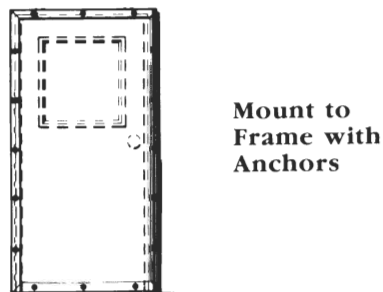
Sliding Flood Shield for Door



Bolt-on Partial Flood Panel



Watertight Door



Sliding flood shields, bolt-on flood panels and watertight doors are barriers designed to prevent the passage of water through windows and doors.

Contingency floodproofing measures are put into place immediately before the flood, and restrict building access and use for the duration of the flood. These measures are designed to keep floodwaters out, and include such techniques as flood shields, watertight doors and wet floodproofing.

These measures are often used in areas where sufficient warning time is provided by flood forecasters or emergency officials to allow floodproofing fixtures to be installed.

Flood Shields

Flood shields are watertight barriers designed to prevent the passage of water through windows and doors. They usually consist of panels of any durable material (usually metal) that can be readily installed and sealed using rubber or special sealants placed around the openings.

To ensure easy and speedy installation during a period of immediate flood risk, flood shields should be (1) stored close to the openings to be sealed; (2) colour-coded or numbered as to location and installation priority, and (3) held in place by simple, quick-connect fasteners and latching devices.

To ensure flood shields will be effective when installed, periodic inspection and testing is advised.

Watertight Doors

Watertight doors are permanently installed, but are designed to be closed and sealed only during floods.

They are heavy and expensive and are more suited to commercial and industrial buildings.



The speed of floodwaters should always be considered when choosing the appropriate floodproofing method.

Wet Floodproofing

In some situations, particularly in sandy soils, water pressure on the foundation walls and floor can be so severe that buildings can be heaved out of the ground, or off their foundations, by the forces of the water.

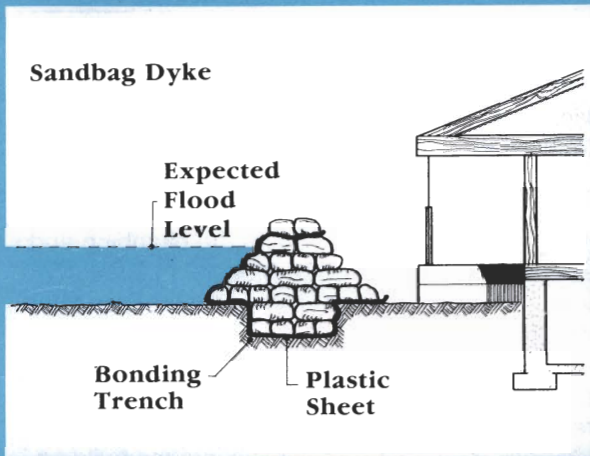
In these circumstances, wet floodproofing (the deliberate flooding of a structure to balance the water pressure on the interior and exterior) may be necessary.

If wet floodproofing is used, the building should be flooded with clean water, if readily available. Although floodwater may be used, the building clean-up will be more difficult.

To lessen the interior damage caused by wet floodproofing, you should have a contingency plan to remove the building's contents and place electric motors, appliances, etc., and valuable possessions above the anticipated water level.

Wet floodproofing is an extreme method and is most often used as a last resort to prevent the collapse of walls or the uplift of basement floors. It should not be undertaken without professional advice.

Emergency Floodproofing Measures



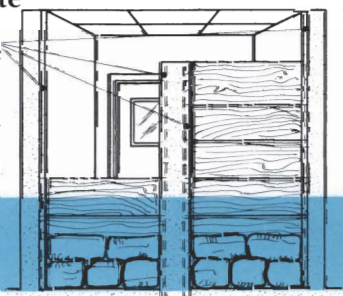
The diagram above illustrates how to construct a sandbag dyke quickly and efficiently to form a barrier against rising floodwaters.

Temporary Walls

Front View
Flood Side

Grooved Concrete or Steel Channel to Accommodate Planks

Expected Flood Level



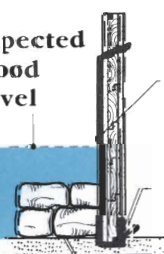
Side View

Expected Flood Level

Plastic Sheet Locked in Place at Top and Bottom

Wedge

Alternate Directional Rows of Sand Bags



Temporary walls constructed from planks, plastic sheets and sandbags can also provide effective protection during flooding. This diagram provides a side view and front view of a temporary wall.

Emergency floodproofing measures are put into place on short notice. The techniques commonly used involve building dykes or barriers using whatever natural or stored materials may be on hand at the site.

Although this work is generally inexpensive, it is hard work, and requires a pre-determined plan of action to ensure materials, labour and equipment are available at the time of flooding.

Emergency floodproofing measures should never be used as a substitute for permanent floodproofing measures. This is especially true in areas prone to ice jam flooding or where flash flooding occurs frequently.

Sandbag Dykes

Sand-filled bags, stacked in such a way as to form a barrier against rising floodwaters, is the most common emergency floodproofing technique. Many people can recall seeing this technique on television.

The bags must be strong enough to hold the sand or fill and withstand contact with water indefinitely. (Burlap and plastic bags can be purchased which are specially made to be filled with sand.)

Water exerts pressures against the sandbag dyke. If possible, a trench should be dug to prevent the dyke from moving. Other methods of anchoring the dyke include, but are not limited to placing the bottom of the dyke against or on ditches, raised roadbeds, foundation walls, or other permanent features.

The bags should not be totally filled with sand. This allows one to overlap the other, which serves to lock the bags together. In addition, the bags should be placed so that each layer is placed at right angles to the layers above and below. This adds stability to the dyke.

A durable plastic sheet should be used to prevent the seepage of water through the dyke.

Temporary Walls

A temporary wall can be constructed by stacking small wooden planks on top of each other to prevent the passage of water through them. The temporary wall is usually covered by a plastic sheet, and a double layer of sandbags is placed at the base to reduce seepage and provide stability.

Floodproofing of Building Services



Even building services, such as electrical systems and furnaces, need to be floodproofed. To prevent electrocution, electricity should be shut off before water enters the home.

Building services such as power systems and furnaces also need to be floodproofed. (Refer to Table 1.)

In the case of a building's electrical and mechanical systems, the best protection is achieved by placing the plumbing and wiring above flood levels. Obviously, it is easier to floodproof building services for a new building during construction than it is for an existing one.

Sewer backup can also cause major damage and inconvenience. This results when sewer outlets become flooded and water is forced back through the sewer line into the building. Even buildings situated in areas where there are no visible signs of surface flooding can be affected.

Sewer backup can be prevented by plugging floor drains and by installing anti-back flow valves in sewer lines. However, this usually means the sewer lines and systems must be shut down until the flooding is over.

TABLE 1

Floodproofing Building Services

	Advantages	Disadvantages
<p>Electrical Services Elevation or enclosure of major permanent equipment (enclosures opened for servicing only)</p> <p>Separate waterproof circuits for use below design flood level and separate circuits for emergency flood equipment</p>	<ol style="list-style-type: none"> 1. Elevated circuitry completely protected from damage 2. Involves no human intervention or flood warnings 3. Automatic disconnection switches prevent short-circuits below design flood level 4. Easily adapted to new buildings 5. Avoids costly "behind the wall" failures 	<ol style="list-style-type: none"> 1. Not easily adaptable to existing buildings 2. Minor servicing inconvenience 3. Circuits below flood level should not exceed 120 volts
<p>Mechanical Services Elevation of major components of heating, ventilating and air-conditioning equipment</p> <p>Enclosure of major equipment (to be opened only for servicing)</p>	<p style="text-align: center;">Advantages</p> <ol style="list-style-type: none"> 1. No human intervention needed 2. Easily applied in new buildings 3. Hot water or electrically heated buildings may not be damaged at all <p style="text-align: center;">Advantages</p> <ol style="list-style-type: none"> 1. No human intervention needed 2. Adaptable to most buildings 3. Hot water heated buildings are least susceptible to residual damage 	<p style="text-align: center;">Disadvantages</p> <ol style="list-style-type: none"> 1. Difficult to introduce in existing buildings 2. Duct work must allow for drainage following flooding 3. Insulation in flood prone portions of a building should be non-porous to permit rapid drying. <p style="text-align: center;">Disadvantages</p> <ol style="list-style-type: none"> 1. Minor servicing inconvenience
<p>Water Supply/Sewer Services Automatic anti-back flow valves on all water and sewer lines with manual back-up</p> <p>Elimination of gravity flow drains below design flood level, and pumping drainage above</p>	<p style="text-align: center;">Advantages</p> <ol style="list-style-type: none"> 1. Prevents sewers from backing up when flooding occurs 2. Prevents siphoning of flood water supply mains 3. Adaptable to all buildings <p style="text-align: center;">Advantages</p> <ol style="list-style-type: none"> 1. Prevents sewage from backing up when flooding occurs 2. Useful if anti-back flow valves on sewer lines are prohibited by building code 3. Adaptable to all new and most existing buildings 	<p style="text-align: center;">Disadvantages</p> <ol style="list-style-type: none"> 1. Anti-back flow valves on sewer lines may cause increased pressure in sewer mains <p style="text-align: center;">Disadvantages</p> <ol style="list-style-type: none"> 1. Consumes energy for all uses below design flood level 2. Freeboard required to contend with surge of floodwater within sewers
<p>Fuel Supply Automatic shutoff valves</p>	<p style="text-align: center;">Advantages</p> <ol style="list-style-type: none"> 1. A fundamental safety requirement for the prevention of fire and explosion 2. Adaptable to most buildings 	<p style="text-align: center;">Disadvantages</p> <ol style="list-style-type: none"> 1. Minor post-flood maintenance may be required 2. Freeboard required to contend with surge of floodwater within sewers

How to Choose Floodproofing Methods



An important factor in selecting appropriate floodproofing methods is the extent of flooding in your area. Newspaper accounts and local residents may provide information on past flooding.

To select the appropriate floodproofing measures for your home or property, you must carefully consider the nature of the flood hazard, the physical conditions of the site, the function and use of the building, and its structural characteristics.

Flood Hazards

When evaluating flood hazard, you must consider the extent of flooding, the depth and the speed of floodwaters, the rate of water rise, and the duration of the flooding. These factors are essential to determining the most cost-effective method for your needs.

In Newfoundland, flood risk maps have been prepared for many flood-prone areas. These maps identify the extent and elevation of surface water flooding during flood events. A map showing most of the major flood risk areas has been included on Page 4.

In areas that have not been mapped, historical records, newspaper accounts, or local residents may provide information on past flooding.

The depth of flooding is a major factor in choosing floodproofing measures, as some methods may be inappropriate if the depth of flooding is excessive.

Building access during flooding is also an important factor to consider during the design of floodproofing measures. It is important to remember that some of the floodproofing measures outlined restrict the use of doors and windows.

Physical Conditions

Some site conditions limit the selection of certain floodproofing measures. The bedrock type, particularly fractured rock, and soil conditions, such as the presence of porous sands and gravel, are important considerations. Other factors to consider include municipal support systems, such as the elevation of the sewer line with respect to the basement, as well as zoning and property boundaries.

The function and use of a building has a direct bearing on the need for floodproofing, and whether it is economically practical.

Consideration must also be given to the safety of people in the building and to the structure should floodproofing measures fail. The collapse of a structure on piers or columns, for example, would have devastating consequences.

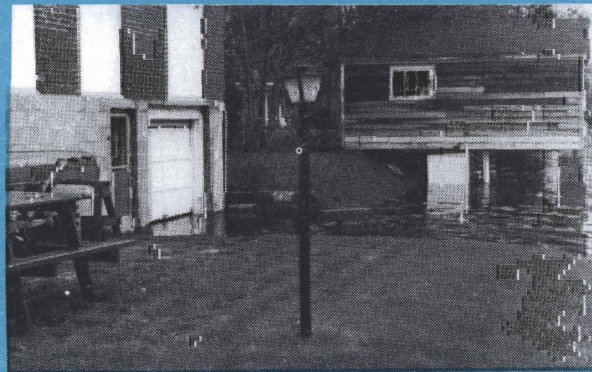
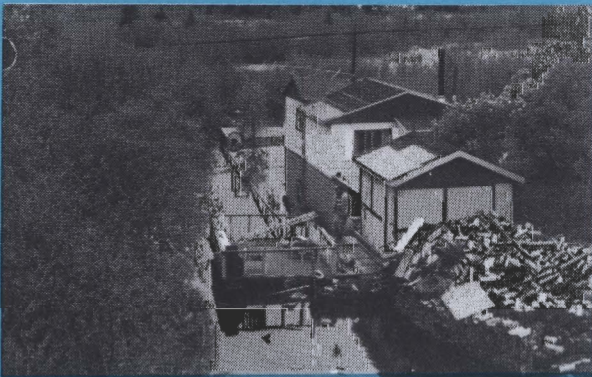


Site conditions are important to consider when selecting floodproofing methods. Some soil types are prone to erosion and provide little protection against rushing floodwaters.

How to Proceed



Learn as much as you can about flooding in your community.



1. Learn as much as you can about flooding in your community.

If your site is located in one of the areas mapped under the Canada-Newfoundland Flood Damage Reduction Program, you can receive **detailed information** on flood levels from the agencies listed on the **following page**.

If you are located in an unmapped area, good sources of flood **information** are the same federal and provincial government agencies, as well as your municipal government and local libraries. The **memories** of long-term residents of the area can also be useful.

It is **important** to properly evaluate the flood hazard in your area. **Factors** to consider include the extent of flooding, the speed of **floodwaters**, the rate of rise in water levels, and the duration of flooding.

Remember, the best protection is to avoid building in areas prone to flooding.

2. Learn more about floodproofing.

Information can be obtained from public and university libraries, or from agencies such as the Canada Mortgage and Housing Corporation. Local contractors, as well as engineering and architectural firms, can also provide useful information regarding water resistant materials and construction practices.

3. Select an appropriate method of floodproofing.

There are several methods for floodproofing buildings. Selecting a **method** of floodproofing requires consideration of:

- the characteristics of the flood hazard
- the physical conditions at the site
- the building's function, operation and use
- the type and condition of the building

In areas prone to frequent or flash flooding, it is recommended that **permanent** floodproofing methods be undertaken. As these **floodproofing** measures are always in place, there is little chance of being unprepared when flooding occurs.

Always seek expert advice when required because improper floodproofing can cause serious structural damage to buildings.

4. Evaluate the costs and benefits of floodproofing.

Determine the cost of floodproofing your property and weigh it against the cost of future flood damages. You should also consider the personal danger and hardship you and your family may face if you do not floodproof.

5. Plan your floodproofing project, and hire qualified people to do the work.

6. Know the extent of any remaining flood risk, because you can never eliminate it entirely.

Further Information

References

For more information, the following reference material has been listed to provide you with additional assistance in making important floodproofing decisions.

Canada Mortgage and Housing Corporation, ***Problem Lands: Building in a Flood Risk Area***, Booklet, 13 pages.

Canada Mortgage and Housing Corporation, ***Technical Builders' Bulletin***.

Illinois Department of Transportation, ***Protect Your Home from Flood Damage***, Division of Water Resources, Local Assistance Series 3B, 34 pages.

James F. MacLaren Limited, ***Floodproofing - A Component of Flood Damage Reduction***. A report prepared for Department of Fisheries and Environment Canada, March 1978. Over 80 pages plus appendices and supplemental portfolio of cases.

Alberta Municipal Affairs, ***Residential Guidelines for Floodplain Construction***, November 1987. 121 pages plus appendices.

British Columbia Ministry of Environment, ***Floodproofing New Residential Buildings in British Columbia***, 43 pages.

Environment Canada and Newfoundland Department of Environment and Lands, ***Flood Damage Reduction in Newfoundland***. Canada-Newfoundland Flood Damage Reduction Program Brochure.

U.S. Federal Emergency Management Agency, ***Floodproofing Non-Residential Structures***, May 1986, 199 pages.

Flood Damage Reduction in Newfoundland

For information on floodproofing and other flood damage reduction efforts in Newfoundland, or to determine if you are located in a flood-prone area mapped under the Canada-Newfoundland Flood Damage Reduction Program, contact:

Water Resources Division
Department of Environment and Lands
P.O. Box 8700
St. John's, Newfoundland
A1B 4J6
(709) 576-2563

or

Inland Waters Directorate
Conservation and Protection
Environment Canada
4th Floor, Queen Square
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6
(902) 426-3266

Emergency Measures

For emergency assistance during a flood, or self-help brochures, please contact:

Emergency Measures Organization
Department of Municipal and Provincial Affairs
P.O. Box 8700
St. John's, Newfoundland
A1B 4J6
(709) 576-3703

Emergency Preparedness Canada
P.O. Box 188, Station C
St. John's, Newfoundland
A1C 5J2
(709) 772-5522



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