
City and County of Denver

FLOOD PROTECTION HANDBOOK



**Denver Office of
Emergency Management**



**Urban Drainage and
Flood Control District**

HOW TO USE THIS HANDBOOK

- **If you just heard a flood watch or flood warning, go to page 27.**
- **If you have just been flooded, go to page 31.**
- **If things are quiet and dry, start on page 1.**

Record your **IMPORTANT PHONE NUMBERS AND CONTACTS** on the inside back cover of this handbook.

This handbook was prepared by Denver's Office of Emergency Management and the Urban Drainage and Flood Control District. Copies are available free of charge at the following Denver locations:

Denver Office of Emergency Management
1437 Bannock Street, Room 3

Denver Public Library (Central)
10 West 14th Street

Urban Drainage and Flood Control District
2480 West 26th Avenue

The handbook is also available online at **www.denvergov.org/OEM**

On the cover

July 30, 1998, flooding at the I-25 / Logan Street underpass.

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Disclaimer

This handbook is not intended to replace the advice and guidance of an experienced professional, who is able to examine a building and assess a particular situation. It contains general information based on current research and comments from experienced professionals. The reader must assume responsibility for adapting this information to fit his or her specific conditions. The reader is advised to seek professional assistance and secure required permits before undertaking any major repairs, extensive building construction, or electrical alterations.



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Dear Denver Resident:

You have this handbook because you may have a flood problem. Flooding affects many Denver residents. Some face fast-moving floodwaters when rivers, creeks, or irrigation canals overflow. Others have frequent but slow-moving water problems in their streets or yards during local storms. Some people have experienced repeated floods, while others have never been affected.

Regardless of what you have experienced in the past, the next flood could be worse, and you do not have to live in a hazardous area to be threatened by floods. Floods wash people and cars away all too often. They can cause thousands of dollars in damage to your home and its contents. Floods can cost you in lost work, lost sleep, lost valuables and heirlooms, and lost money and time repairing and replacing things that could be flooded again. They can be devastating emotionally to you and your family both while they are happening and later when you have to deal with their aftermath.

We cannot ignore our flood risk. The City and County of Denver is working to reduce the threat of stream and street flooding by building and maintaining higher capacity channels, underground storm sewers, street improvements, and flood storage facilities. We have a flood monitoring and warning program to provide advance notice of the hazard. We regulate new construction to prevent things from getting worse. However, flood control projects are very expensive, may take years to complete, and will not offer 100% protection to everyone for every possible event.

While we are doing what we can, there are things that you can do too. You can prevent future damage by floodproofing your home or business and making a flood preparedness plan for your family. If you learn important flood safety rules and health precautions, you can minimize your losses during flood recovery. This handbook is specially designed to help you do all those things. If you follow the guidelines in this handbook, you will go a long way toward protecting your family and home from the next flood.

A short handbook like this cannot provide all the answers. If you have questions or would like to know more about what the City and County of Denver is doing in your neighborhood, please call the Department of Public Works Wastewater Management Division at 303-446-3400.

Mayor's Office of Emergency Management

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Chapter 1

Denver's Flood Hazards

Many folks think that if they haven't been flooded yet, they never will be. But it's just not so! Denver has had significant flood events in recent years although has been fortunate not to have had a major flood disaster in decades. This chapter reviews the types of flood hazards faced by Denver residents and how you might be affected by a flood worse than any you may have already experienced.

Local Causes of Flooding

Floods in the Denver area are generally caused by heavy rains, usually during summer storms. Sometimes snowmelt adds to the amount of water runoff during a storm. River channels, creeks, gulches, and storm sewers can only carry so much water. Even in natural settings, streams overflow their banks every year or two. Flooding can be further aggravated when debris blocks the waterway, which is a common problem at road crossings. Hail can also make flooding worse by clogging storm sewer inlets and impeding surface drainage.

Urban development changes the natural environment. Pavements and rooftops mean that less rainwater can soak into the ground. Gutters and storm sewers speed the runoff to the channels. Our pattern of streets and buildings has interrupted some of the natural drainageways and reduced the width of some channels. As a result, more water runs off more quickly, and the drainage system becomes overloaded more frequently.

The combination of heavy precipitation and an overloaded drainage system can result in three principle types of flooding:



Goldsmith Gulch flooding near Iliff and Monaco.

- (1) overbank flooding,
- (2) irrigation ditches/canals, and
- (3) streets and low-lying areas.

Each type of flooding is associated with somewhat different hazards.

(1) Overbank flooding. The most dangerous kind of flooding in Denver occurs when rivers, creeks, and smaller tributary streams overflow their banks. Overbank flooding occurs every year in Denver. Fortunately, most of these events cause little damage, usually flooding trails, parks, and open space areas. Serious overbank flooding can occur on every stream in Denver, including Denver's largest stream, the South Platte River, which originates in the mountains southwest of Denver and empties into Chatfield Reservoir near C-470 and Wadsworth Blvd. Chatfield is a large flood control dam operated by the U.S. Army Corps of Engineers and is one of three such facilities providing flood protection for Denver. Bear Creek Lake and Cherry Creek Dam are the other two. Remember that while these large dams protect Denver from most conceivable upstream events, heavy rainfall occurring downstream still poses a threat. And it is not inconceivable that a large event could fill these impoundments and overflow their spillways, causing significant damage. The worst-case scenario, however unlikely, would be a dam failure, and the consequences would be catastrophic. Safeguards are in place to warn and evacuate should something like this happen.

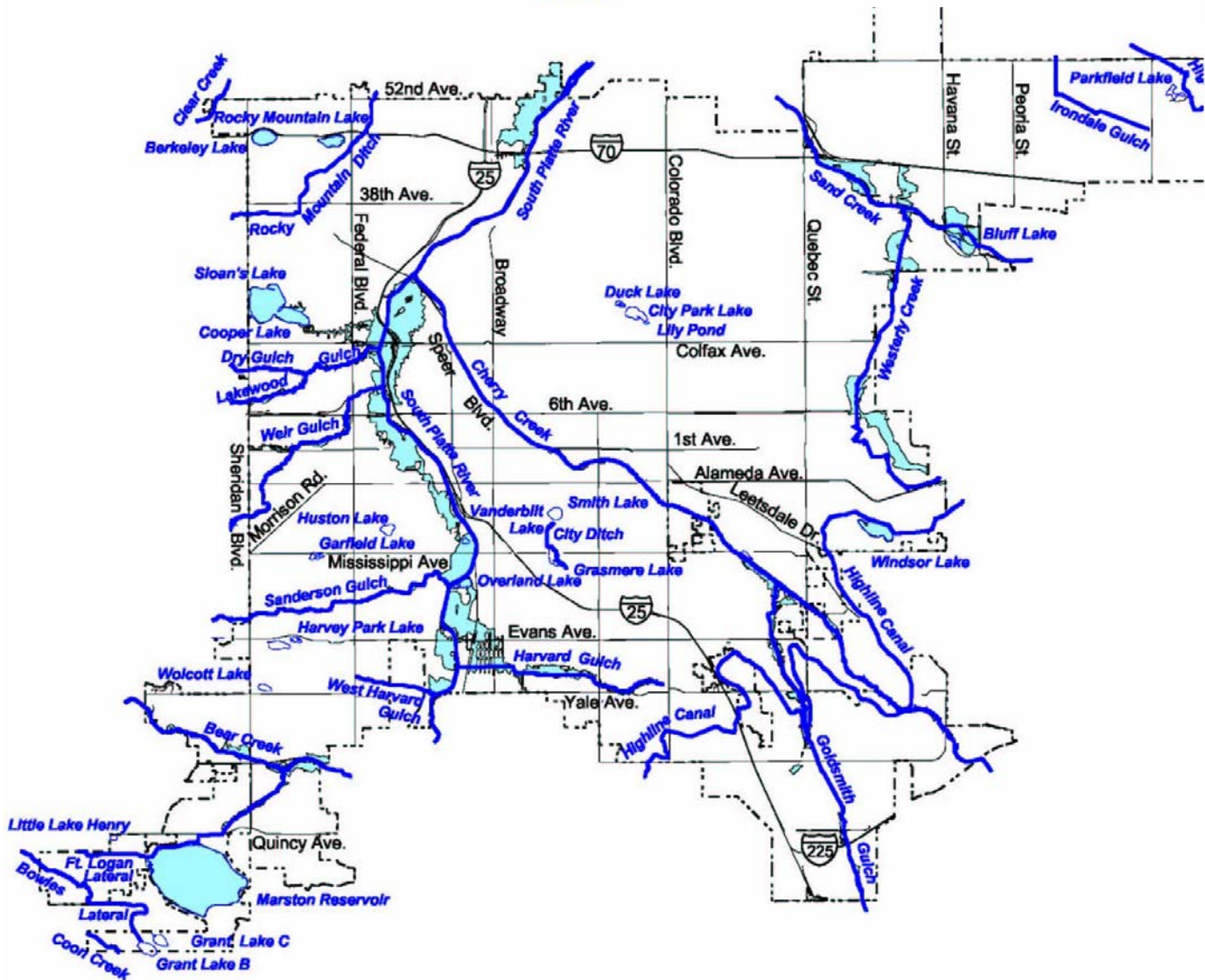
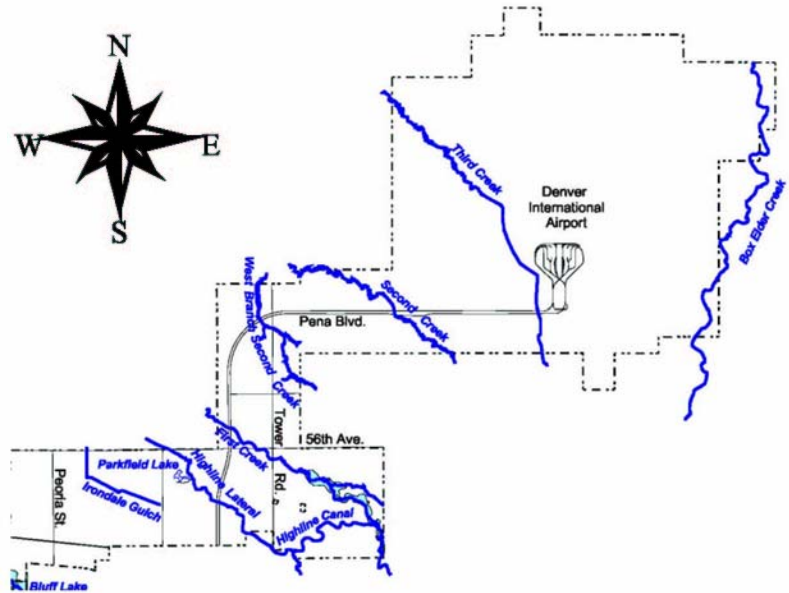
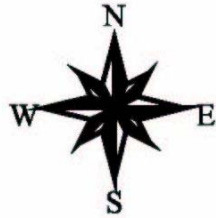
Other large streams affecting Denver include Bear Creek, Cherry Creek, and Sand Creek. Still, some smaller lesser-known tributaries like Sanderson Gulch, Weir Gulch, Lakewood Gulch, Harvard Gulch, Goldsmith Gulch, and Westerly Creek represent significant hazards to Denver residents. The map on the following page shows the location of these streams and other Denver floodplains. You should not use this map to determine whether your property is in or out of a floodplain, but it does give a general idea of what areas could be affected by overbank flooding. Check to see if your property is close to a floodplain. If so, take a look at a larger map in the library or contact the **Denver Wastewater Management Division (303-446-3400)** or the **Urban Drainage and Flood Control District (303-455-6277)** for more information.

(2) Irrigation ditches/canals. These facilities divert water from mountain streams and carry that water to reservoirs for domestic and agricultural use. Most of the water that you use in your home is transported by these ditches or canals. They are called irrigation ditches because most of the water that they carry gets used by farming operations. The ditches run along hillsides, following natural contours and crossing streams and other natural drainage patterns. Consequently, they occasionally intercept stormwater runoff. For the most part, ditches are not designed to handle excess stormwater; when they do, they can spill or collapse and cause considerable property damage. Experience shows that there is little or no warning for this type of flooding.

The High Line Canal is the largest irrigation ditch that affects Denver. It crosses Goldsmith Gulch upstream of Bible Park where a large drainage separation structure has been constructed. In the past, the High Line Canal frequently spilled at this location, causing neighborhood flooding and costly bank repairs.

Denver's Flood Hazards

The City and County of Denver shall not be liable for damages of any kind arising out of the use of this information. The information is provided "as is" without warranty of any kind, either express or implied, including, but not limited to, the fitness for a particular use.



(3) Streets and low-lying areas. Except at certain underpasses, street flooding and yard ponding usually do not get deeper than a foot or two. The I-25/Logan Street underpass is one notorious location in Denver where water can get deep. This frequent problem will be nearly eliminated by the TRENCH drainage improvements.

However, other problem areas will remain for some time, including the underpasses at 6th Avenue/Perry Street, 38th Avenue/Fox Street railroad bridge, and I-70/Pecos, among others. Street flooding and yard ponding are often viewed more as a nuisance than a major hazard. Traffic is disrupted, and some streets may have to be closed for a while. Parking lots may be designed to store runoff temporarily and release the stormwater at a slower rate. This helps reduce downstream flooding for a short distance, but it also means that flooding in those parking lots may be deeper than expected. If it is raining, be aware of this possibility when parking your car, and pay attention to signs identifying stormwater detention areas.

Beware of the potential risk of entering any flooded area, especially one with moving

water. There can be high-velocity flows in areas with only shallow flooding. People and vehicles can be swept away by shallow moving water. Drainage pipes or culverts may be submerged and impossible to see. The force of the water entering these pipes can overpower you quickly. On August 17, 2000, a Denver firefighter lost his life attempting to rescue a citizen trapped in a situation like this.

Even shallow floodwaters can stop cars and wash people off their feet.



Past Floods and Flood Facts

Denver's flood history dates back to its earliest years, with the first settlements being located on the banks of Cherry Creek and the South Platte River. Much is written about the early floods, as they played a key role in the development of Denver and surrounding communities. The flood control channel along Cherry Creek is one obvious example and has become a notable recreation amenity. In recent history, the Denver floods mentioned most often are those of 1965 and 1973. Both of these events caused major damage along the South Platte and occurred before the completion of Chatfield Dam. While Chatfield and other flood control works have been effective at preventing major flood disasters, stream flooding from local storms remains a serious threat.

Historically, the most frequent flooding in this region of Colorado occurs in May and June during the snowmelt runoff season. Daily flood conditions are reported on radio, TV, and in the newspapers during this period. When the dry conditions of summer arrive and the streams return to normal levels, floods are seldom talked about. However, it is during Colorado's hot summer months when the most dangerous floods occur. These floods are called "flash floods" and are caused by intense downpours from thunderstorms. Creeks flowing through mountainous terrain are highly vulnerable to flash floods. So are most other small streams and normally dry gulches, particularly in urban areas like Denver where runoff occurs much faster due to impervious surfaces. The primary concern of local warning agencies is that flash flooding happens very quickly following heavy rain, leaving little time to warn and react.

Colorado's worst flash flood occurred during the late evening of July 31, 1976 in the Big Thompson Canyon west of Loveland. That flash flood killed more than 140 people. As bad as that flood was, much larger events have occurred in Colorado. Fortunately, those floods occurred when our state was less populated, and fewer people were affected. A more recent flash flood claimed five lives in Fort Collins during the evening of July 28, 1997. That same evening a much larger storm occurred in rural Colorado, injuring no one. Given these examples from the past, we can reasonably conclude that large floods are not uncommon, and that the associated dangers depend a great deal on where storms occur. Remember these facts when the summer rains come.

Understanding Flood Size and Frequency

The term "100-year flood" is commonly misunderstood. The reason it is talked about so much is that it represents the magnitude or size of a flood used by engineers for designing drainage and flood control facilities. It is also used by the National Flood Insurance Program as a **minimum** standard for regulating new construction and as a basis for determining insurance premiums and mapping flood hazard areas. So, what does this term mean to you when considering flood protection for your home and family? Before trying to answer this, consider the following:

There are many ways to define the 100-year flood, the most common being a flood that has a 1% chance of being equaled or exceeded each year. Statistically, this equates to a better than 1 in 4 chance of experiencing a flood of this size during a 30-year period—the length of a typical home mortgage. Regardless of what may be the best definition, the 100-year flood is simply a large event, not the worst possible. Colorado's flood history attests to this fact. Here are some illustrations to help put this in perspective:

- Many large floods have been recorded with peak flow rates exceeding the 100-year estimate. One example is the 1965 Plum Creek flood, which caused severe property damage along the South Platte River through Denver. The Big Thompson Canyon flash flood in 1976 and the 1997 Fort Collins flood are two more examples.
- The Fort Collins flood was caused by a 10-inch rainstorm. The estimated 100-year storm rainfall for the Denver area is about 3 inches.
- Nationally, more than 25% of flood insurance claims are for properties located outside the mapped 100-year floodplain.

If your property is near a mapped floodplain but not actually in a floodplain, these facts should help you make a more informed decision about your flood insurance needs. If you are located in a floodplain, it is likely that you already have flood insurance as a condition of your mortgage. More information about flood insurance is provided in Chapters 2 and 3.

Impact of Flooding

If you haven't personally experienced a flood, it is hard to envision the severity of damage that it can cause. Flooding affects people and their property in many ways:

- Flooding presents a safety hazard to people and animals.
- Flooding causes health problems, both physical and emotional.
- Flooding damages buildings and landscaping.
- Flooding damages the contents of buildings.

Safety hazards. Moving water causes more safety problems than standing water. Anything that is stored outside and not securely anchored to the ground can be carried away by floodwaters. That includes toys, firewood, fuel tanks, structures, boulders, tools, and vehicles. Floods become much more forceful as they accumulate debris. The debris can batter or impale people and structures.

Floodwaters can also conduct electrical currents and hide debris. Be sure to look for potential electrical sources and stay away from any water in contact with them. Floods may structurally damage floors and stairs, making them unstable. Sometimes animals and snakes seek refuge in flooded homes, and debris piles often become hidden dangers.

Experiments have shown that a person is less able to stand upright in a flood as depth or velocity increase. For example, a six-foot tall adult would be knocked over in four feet of water moving at a velocity of only one foot per second, or in one foot of water moving at four feet per second. Smaller people will have trouble in even shallower and slower floodwaters.

More people are killed trying to drive on flooded streets or bridges than in any other single flood situation. Cars can float in as little as 18 inches of water and flooding may hide a washed out road with what appears to be only a few inches of water.

Health hazards. Floodwaters are not clean. They carry mud, silt, road oil, and even sewage. Food, cosmetics, medicines, stuffed animals, baby toys, and any similar items that contact floodwaters become contaminated and must be thrown out. Clothes and dishes need to be washed thoroughly in clean water with soap to disinfect them. Mold spores and bacteria grow in damp areas and are difficult to remove completely. If a potable water system becomes contaminated, the health department recommends boiling all water to be used for drinking and domestic cleaning.

Floods also take a toll on people's mental health, caused by both the immediate dangers as well as future concerns. The stresses caused by flooding are aggravated by fatigue during cleanup and anxiety over lost income, health risks and damage to items that cannot be replaced. Children and the elderly are especially susceptible to negative impacts from stress. Ways of coping with these problems are discussed in Chapter 6—After the Flood.

Building and yard damage.

Standing water can seep through building walls, soak wood, dissolve wallboard, and contaminate insulation. Electrical components may short when flooded, creating a fire or shocking safety hazard. If improperly dried, wet wood will warp and plywood will split, requiring replacement of stairs, flooring, etc. Mold can cause a great deal of property damage, as well as being a health risk during floods.

As the water gets deeper, it puts more pressure on walls and floors, particularly in the basement. A flood that is over three feet deep will crack or break a standard house wall. Even very shallow flooding on the surface can put over seven feet of water pressure on a below-grade basement wall or floor, causing cracks, leaks, or even buckling.



Flooding affects property and people.

As discussed previously, moving water can transport debris from the ground surface as it flows downstream. The debris acts like a battering ram, capable of damaging or dislodging large structures, like buildings and bridges. It scours the ground, removing grass and plants, and eroding channel banks. The flood becomes more destructive as it moves downstream.

Content damage. Wet wooden furniture may be so badly warped that it can't be used. Other furnishings, like upholstery, carpeting, mattresses and books are usually not worth the cost of drying them out and restoring them. Mold and mildew will quickly spread through the remaining debris. Flooded electrical appliances and gasoline engines won't work safely until they are professionally dried and cleaned.

Chapter 2

Government Flood Programs

Fortunately, you are not alone in tackling potential flood problems. Many government-sponsored programs exist to prevent or reduce flood damage.

Public Information Programs

This handbook is only one of several ways to obtain flood protection advice. Current law requires that people purchasing flood-prone property be advised in writing of the potential flood hazard. Each year the Urban Drainage and Flood Control District sends notices to all Denver floodplain residents, reminding them of the hazard and suggesting ways they can protect themselves. There is flood information in the Denver Public Library and additional flood protection information can be obtained from the Internet sites listed near the back of this handbook.

Local Flood Warning Program

Denver participates in a local flood warning program in cooperation with the Urban Drainage and Flood Control District and the National Weather Service. Automated rain and stream gauges have been installed along Bear Creek, Sanderson Gulch, Harvard Gulch, Goldsmith Gulch, Cherry Creek, Westerly Creek, Sand Creek, the South Platte River, and at other locations. They give officials the ability to continuously monitor storm and flood conditions. A private meteorologist hired by the District has access to this gauging network and to other weather-related information. Early flood predictions and warnings are provided directly to the Denver Office of Emergency Management (OEM), which then relays this information to other key City agencies and the fire department, so they can prepare for a possible flood emergency. When flood danger is imminent, a flood warning is issued to the public.

At best, a flash flood warning can provide a few minutes of advance notice. This can be enough time for people to move immediately to a safe place on higher ground. Flash floods overflow stream channels very quickly and may occur **without any warning**. Stay alert to your surroundings. See Chapter 3 to learn how to make a family flood response plan. Chapter 5 contains flood safety advice on what to do immediately preceding and during a flood.

Emergency Operations

When the NWS issues a flood warning, the Denver Office of Emergency Management activates the Emergency Operations Center. Periodic drills keep field personnel ready to respond to floods and other emergencies.

Flood Control Projects

No government agency can stop flooding completely, and Denver is no exception. However, flood protection can be improved by installing larger culverts and bridges, armoring channels and embankments, and building retaining walls or earthen berms to redirect flooding away from buildings.



Channel improvements on Goldsmith Gulch downstream of Monaco.

Stream Maintenance

Accumulated debris and low tree limbs are removed to keep channels clear, especially at bridges and culverts, so that stormwater can flow more readily along its drainage path. If you see debris clogging or other potential flood problems in local creeks, please report the condition to the **Denver Wastewater Management Division (303-446-3400)**.

The Urban Drainage and Flood Control District coordinates and funds flood control and maintenance projects in Denver. District maintenance activities include: mowing and clearing debris, tree thinning and channel stabilization, and replacement of culverts, retaining walls and other deteriorated structures.



Before and after photos of channel clearing project on small tributary to Cherry Creek.



George Wallace Park at the Denver Tech Center

Floodplain Parks

One of the best ways to prevent flood damage is to keep the floodplain open. If there are no buildings in the floodplain, little damage will occur. George Wallace Park along Goldsmith Gulch at the Denver Tech Center is one example of a floodplain area that has been kept open. It provides recreational opportunities; and when the rains come, it temporarily stores floodwater. This reduces property damage downstream.

Building Regulations

The City and County of Denver area has adopted specific regulations to help ensure that new construction will not make our flooding problem worse. Construction is regulated on sites that are in floodplains. Only low-damage potential improvements that do not obstruct flood flows are allowed in the floodway. *The floodway is that portion of the floodplain with the greatest flow depths and highest velocities.* Floodway uses are limited to agricultural, parking, recreation, and similar open space uses that will not increase the floodwater surface elevation. New buildings and substantial improvements to existing buildings in the floodplain must be built or floodproofed to one foot or more above the 100-year regulatory flood level.

Floodplain Mapping

Most flood construction projects and regulations are designed to protect people and property from the estimated 1% chance flood, or 100-year flood. See page 5 for discussion on understanding flood size and frequency. Floods larger than the 100-year design flood occur in Colorado nearly every year. This “100-year standard” is considered a reasonable and economical design standard for most construction projects, though some uses require different protection levels. Most 100-year floodplains on the larger rivers and streams have been mapped by the FEMA National Flood Insurance Program (NFIP). NFIP Flood Insurance Rate Maps or FIRMs are available for review at the Denver Wastewater Management Division. FIRMs can also be obtained by contacting the **Urban Drainage and Flood Control District (303-455-6277)**, or you can order a map for your property through the FEMA publications office at www.fema.gov. Internet versions of the Denver FIRM are also available.

FEMA updates the FIRMs as necessary and requires floodplain developers to obtain Letters of Map Revision if they significantly impact the floodplain. Communities may adopt more stringent floodplain regulations than the minimum standards required by FEMA.

Government Flood Programs

All construction projects in the 100-year floodplain need a building permit. This requirement includes new buildings, garages, sheds, walls, fences or grading, as well as improvements to existing properties. If you see construction near a creek or channel without a posted permit, please report it to the **Denver Wastewater Management Division (303-446-3400)**. Improperly constructed developments can obstruct flood flows or raise floodwater elevations, thereby increasing the potential damage to your property or other locations near the floodplain.

There are different building regulations for developments located outside the floodplain. However, most construction projects must submit a stormwater drainage plan demonstrating that the facilities are designed according to accepted engineering practices.

Flood Insurance

Local building regulations are an important part of the National Flood Insurance Program (NFIP) to make affordable flood insurance available to the public. The City and County of Denver participates in the NFIP by enforcing floodplain regulations. Denver also participates in another part of the NFIP—the Community Rating System (CRS). The objective of CRS is to reward communities that are doing more than meeting just the minimum NFIP requirements to reduce flood damages. This Flood Protection handbook is one way Denver helps homeowners qualify for lower flood insurance premiums.

Other Programs

Numerous other flood programs are administered by state, federal and private agencies. The U.S. Army Corps of Engineers provides technical assistance for reducing flood damages, planning assistance, and construction programs. The Colorado Office of Emergency Management, FEMA, and the American Red Cross provide disaster response and assistance. The Colorado Water Conservation Board provides floodplain development regulations, and the Colorado State Engineer and Office of Emergency Management oversee dam safety design and inspections.

When these agencies provide emergency services, the work is usually coordinated by the local jurisdiction. In addition, a large collection of information about floods and emergency preparedness is maintained at the Natural Hazards Research and Applications Information Center at the University of Colorado in Boulder. To request information from this Center call **303-492-4181**, send email to hazctr@colorado.edu or visit their website www.colorado.edu/hazards.

Chapter 3

Before the Flood

The time to protect yourself from flooding is before a flood occurs. This chapter covers three ways to do that: flood preparedness, flood response planning, and insurance. A fourth way—floodproofing—is covered in Chapter 4.

Flood Preparedness

Many preparations can be accomplished before the next flood. The following checklist will help you prepare in a logical order:

1. Determine how bad flooding could be on your property (see the box). The Denver Office of Emergency Management and the Urban Drainage and Flood Control District can help you with this.
2. Be familiar with official warning and evacuation procedures.
3. Purchase your own water alarm if your flooding comes from sewer backup or basement seepage. The alarm can give you precious extra time to keep your damage to a minimum. A water alarm, which is similar to a smoke alarm, will beep when water touches it. Water alarms cost about \$15 and are available at hardware stores.
4. Talk to your insurance agent about your homeowner's and flood insurance coverage. Consider separate flood and sewer backup insurance policies.
5. Prepare a list of emergency telephone numbers, including the number for your insurance agent. Make copies and keep them in your car, at work, or other safe locations away from your home.
6. Assemble the supplies you will need for cleanup and recovery and put them in a safe place that will stay dry during a flood. See page 32 for a list of suggested supplies.
7. Make a record of all your personal property. Go through your house room by room and make a household inventory. Take photographs of the inside and outside of your house, or videotape them. Inventory forms are available free from most insurance companies, or you can create your own.

KNOW YOUR FLOOD HAZARD

- **Identify the stream or other flooding source nearest your home.**
- **Find out how deep floodwaters can get in your neighborhood.**
- **Learn where fast-moving water or water filled with debris is likely to occur.**
- **Determine the best ways for you and your family to get a flood warning.**
- **Understand that floods can occur with little or no warning.**
- **Find out what streets are likely to be flooded or barricaded in and around your neighborhood.**

Before the Flood

8. Put photocopies of inventory records, insurance policies, deeds, automobile titles, wills, telephone numbers, bank and credit card account numbers, and other valuable papers at a location away from your house and outside the floodplain, such as a safe deposit box.
9. Write a Flood Response Plan and keep copies in your car, at work, near the utility meters, or other prominent places. The American Red Cross can provide a sample family response plan to get you started. Keep a copy of your response plan with this handbook too.
10. Check out the appropriate floodproofing options for your house in Chapter 4.

Flood Response Plan

Preparing your own Flood Response Plan will help you think through all the details that demand attention after a flood watch or warning is issued. Walk through your house with this handbook, and make notes of how to adjust these instructions to your own situation. Writing them down will help you remember everything, which is especially important when everyone is in a hurry and excited because a flood is coming. Be sure to include **Important Phone Numbers** in your plan.

The Flood Response Plan needs to be based on your own property's flood risk and how much lead time you have following a flood watch or warning. For example, **if you are warned of a life-threatening flash flood, you should get out of the area immediately**, without worrying about the backup power supply to your sump pump. Your plan should be a checklist of steps to take before floodwaters reach your house.

If you have only a few minutes to react, do the following and include these in your Flood Response Plan:

- Monitor local radio or TV stations for flood information and evacuation instructions. Radio station KOA-850 AM is Denver's Emergency Alert System (EAS) station. The backup station is KYGO-98.5 FM.
- Go to your preplanned meeting place. Your plan should identify two places where family members can meet if you become separated—one place in the neighborhood and another place outside of the flood area. These places could be friends' houses on higher ground where family members can contact each other.
- If you leave your home, take your pets, medicine, and other things you will need if you can't return home for a day or two. Leave a note explaining where you have gone, when you left, and how to contact you.
- If you leave, lock your house and follow your evacuation route to shelter.

If you have 15 to 30 minutes of warning, do these additional things:

- Read the safety precautions on the back cover of this handbook.
- Install flood shields and any other prepared floodproofing measures (see Chapter 3).
- Turn off the electricity and water. If you only expect basement flooding, you can turn off the electricity to only that area and still have power in the rest of your house. When you prepare your response plan, mark your breaker box or fuse box to show which electrical circuits serve the basement.

- **Shut off the gas only if necessary. If you turn off the gas, you will have to contact the utility company to turn the gas back on and relight your furnace pilot light.** Preplan your intended response to different flood conditions when you are writing your Flood Response Plan.
- Test the backup power supply to your sump pump.
- Move the most valuable or damage-prone contents in your house to above the flood level or to another safe place. These include small carpets, lower drawers to dressers and cabinets, and cleaning fluids or hazardous chemicals. They can be moved to the upper story of your house or placed on top of cabinets, if floodwaters will not be that deep.

While you are working on your Flood Response Plan, think about the other types of emergencies you might face, such as fires and tornadoes. The **Denver Office of Emergency Management (720-865-7600)** and the **American Red Cross (303-722-7474)** can help you with ideas to include in a flood or disaster response plan. Individual and Family Preparedness Guidelines are available at the Denver Public Library and from the Denver OEM website www.denvergov.org/OEM.

Insurance

Flood insurance is highly recommended if you live near a floodplain, especially if you don't floodproof your house or business. An advantage of insurance is that your property is covered as long as the policy is in force, even when you are not home to implement your Flood Response Plan. Most standard homeowner insurance policies **do not** cover a property for flood damage. Here are three ways you can insure your house and contents for flood damage:

(1) National Flood Insurance Program. The City and County of Denver participates in the National Flood Insurance Program (NFIP). Local insurance agents can sell a separate insurance policy under rules and rates set by the Federal Insurance Administration. Any insurance agent can sell a NFIP policy, and all agents must charge the same rates. Ask your agent to call **800-427-3880** for more NFIP information. Premiums are set on a national basis and will not increase because you file a damage claim.

Coverage—Any walled and roofed structure can be covered by a flood insurance policy. Detached garages and accessory buildings are covered under the policy for the lot's main building. Separate coverage can be obtained for the building's contents, except for money, valuable papers, and the like. The structure generally includes everything that stays with a house when it is sold, including the furnace, cabinets, built-in appliances, and wall-to-wall carpeting. Coverage is unavailable for things outside the house, like the driveway and landscaping. Renters may purchase coverage for the contents of their homes.

Basements—The NFIP considers any below grade floor as a basement. For example, the lower level of a split-level house is considered a basement and so is a crawlspace. A National Flood Insurance policy does not cover damage to most contents in a basement. Structural coverage covers only the structural parts of basement walls and floor, not finishings like wallpaper or paneling, and selected items such as the furnace, water heater, washer, and sump pump. The NFIP does not insure buildings for subsurface flooding, including groundwater seepage or sewer backup.

Mandatory Purchase—If you are located in a "Special Flood Hazard Area" identified on a Flood Insurance Rate Map or FIRM, you must buy flood insurance coverage as a condition for obtaining a federally backed mortgage, home improvement loan, or federal disaster assistance. In some cases, a private flood insurance policy will satisfy this requirement, but usually the lender or granting agency will ask to see an NFIP policy.

Before the Flood

Waiting Period—There is a 30-day waiting period before NFIP flood coverage takes effect. Don't wait for the next flood watch to buy insurance protection. Contact your insurance agent for more information on rates and coverage.

Cost—The cost of a flood insurance policy depends on the amount of coverage you desire, the location and elevation of the insured structure with respect to expected flood elevations, and the date the building was constructed. For example, a building located outside the mapped floodplain has less flood risk than a similar building located within the floodplain. Therefore, the cost of insurance for that building is less. Buildings constructed in Denver after the City joined the NFIP (making flood insurance available) are required to have the lowest floor elevated above the 100-year flood level. Thus, those buildings are less likely to be flooded, and so the cost of insurance may have lower rates than older buildings in the same location. Structures within the floodplain built before Denver joined the NFIP may be at greater risk to flood damages, but are “grandfathered,” qualifying the owner for subsidized NFIP rates.

Your flood insurance cost can be reduced even further by choosing higher deductibles amounts, just like your standard homeowner's insurance policy. Each structure is different however, so only your insurance agent can calculate exactly what your policy will cost. For a building to be fully insured, the coverage must be 80% of the building's replacement cost. If you have a basement in a mapped floodplain, you must have 80% coverage in order for the limited basement coverage to take effect.

Flood insurance is also available for buildings located outside the mapped floodplain. As in the example above, the cost is reduced because the risk of being flooded is lower. However, more than 25% of all NFIP claims nationwide are for properties located outside the mapped floodplain. Be aware that you could be flooded outside the floodplain for reasons including debris, snow, or hail blocking culverts or street curb inlets, a small localized drainage or ponding area, or a flood larger than the 100-year event (see page 5). The reason so many claims are paid outside the floodplain is that those property owners being flooded have purchased flood insurance, which in many cases may be their least expensive form of protection.

(2) Basement backup insurance. Several insurance companies have sump pump failure or sewer backup coverage that can be added to a homeowner's insurance policy. Contact your insurance agent for more information.

(3) Private flood insurance. A few private insurance companies sell their own flood insurance policies, although the coverage and rates are different from the NFIP's. Some mobile home insurance covers flood losses. Be sure your coverage won't be cancelled if you submit a claim.

Chapter 4

Floodproofing

This chapter covers changes that you can make to your building or lot to prevent or reduce damage by floodwaters. This handbook can only introduce the topic. Before you invest much money in floodproofing, talk to an engineer or architect, or an experienced contractor. Floodproofing measures are explained in more detail in materials available from libraries or Internet websites.

Different floodproofing techniques are appropriate for different types of buildings and flood hazards. Use the following guidelines to select applicable techniques:

- If you have a basement, read about basement cracks, sump flooding, sewer backup, barriers, and wet floodproofing.
- If your house is built on a slab foundation and the 100-year flood is estimated to be less than three feet deep on your first floor, read about barriers and dry floodproofing.
- If your house has a crawlspace and the 100-year flood is estimated to be less than three feet deep on your first floor, read about barriers, wet floodproofing, and elevation.
- If the 100-year flood is estimated to be over three feet deep on your first floor or will include high velocities and/or debris, read about relocation.

It is important that people understand that the predicted 100-year flood elevation is only an estimate, based on current technical standards for hydrology. Many times the floodwater elevation is higher than anticipated due to larger storms, saturated ground from prior storms, or large volumes of debris in the water.

HELPFUL PUBLICATIONS IN THE DENVER PUBLIC LIBRARY

Homeowners Guide to Retrofitting- Six Ways to Protect Your Home From Flooding, FEMA June 1998. An extensive review that discusses protecting an existing house from flood damage.

"Best Build 3: Protecting a Flood-Prone Home," FEMA/National Association of Home Builders. A 30-minute video overview of floodproofing techniques.

Colorado Floodproofing Handbook, October 1986. Colorado Water Conservation Board and Colorado Water Resource Research Institute, Colorado State University.

Floodproofing—How to Evaluate Your Options, U.S. Army Corps of Engineers, July 1993. A guidebook on selecting the most appropriate and cost-effective flood protection measures.

Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings, FEMA-259, January 1995. A technical design manual of floodproofing techniques, with cost-efficiency tools.

Internet websites: www.denvergov.org/OEM, www.colorado.edu/hazards, www.fema.gov

Basement Cracks

Groundwater can seep into your basement around pipes or through cracks in the walls or floor. The seepage path may be difficult to determine if the walls have been covered with paneling or other finishing. The best way to deal with a groundwater problem is to waterproof the walls and relieve the water pressure through a footing drain system and sump pump (see next section on Sump Flooding).

Cracks can be repaired and the walls can be waterproofed from inside or outside, although waterproofing on the outside is more effective because groundwater pressure forces the sealer into the foundation. The best technique is to dig a ditch around the basement wall so that you can apply a commercial sealant to the exterior walls. This can be done by a handy person (many home maintenance manuals have instructions for this) or by a commercial waterproofing company.

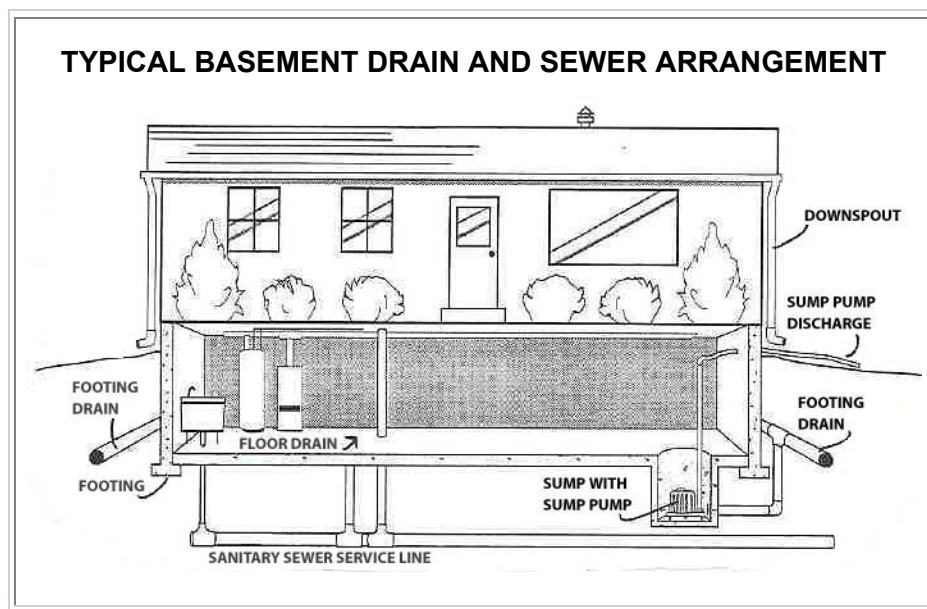
Precautions. Waterproofing alone is recommended only for groundwater problems. Surface water will put much more pressure on the building's walls and can even break them. If the building will be affected by surface flooding, the owner should also install a barrier and an underground drain.

There have been many instances of disreputable contractors doing basement waterproofing because the work is hidden, and sloppy work may not show up for several years. Therefore, before you sign a contract, ask the waterproofing supplier or company to provide references of buildings in your area that have used their material or technique.

A homeowner can seal up cracks from the inside with a tube of sealant. The services of a commercial waterproofing company to completely seal the exterior of all the basement walls will cost more.

Sump Flooding

Basement flooding caused by saturated ground can be corrected by installing a footing drain around the foundation. The drain collects groundwater and directs it to a sump. When the sump fills, water is pumped out to a drainageway or onto the ground away from the building. Depending on local conditions, the drain and pumping system may have to handle large volumes of water.



If the pump is blocked with debris, overloaded, or loses power, the system designed to keep groundwater out of your basement can act as a conduit to bring water in. You can prevent sump flooding by doing one or more of these floodproofing projects:

- Clean the pump intake to remove blockages;
- Install a larger sump pump or add more pumps;
- Connect the pump to a backup power supply, like a battery system or generator;
- Disconnect the downspouts from the footing drain; or
- Redirect the downspouts and sump pump discharge further away from the house.

Precautions. When the basement is full of water, it is hard to tell how it got in. It's a good idea to check for cracks in the walls in advance and install sewer backup protection. Turn off the electricity before entering a flooded area. If your backup source of electricity is a generator, be sure it is set up outside or vent it to the outside to exhaust deadly carbon monoxide fumes. Set the backup power supply above the expected flood level.

Sewer Backup

The previous illustration shows the sewer arrangements for a typical house with a basement. The sanitary sewer line drains toilet waste, laundry tubs, and the basement floor drain to the sanitary sewer main in the street or to the septic system. Downspouts, footing drains, and sump pumps handle clean stormwater and groundwater.

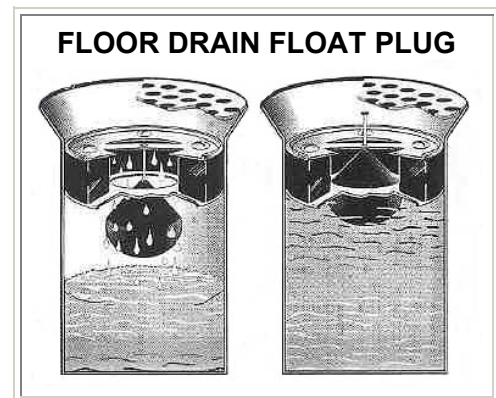
Often basement flooding is caused by these two sewer systems being interconnected. Some houses have the downspouts, footing drain, and/or the sump pump connected to the sanitary sewer service. During a heavy rain, excessive amounts of stormwater can enter the sanitary sewers, causing backups into the house or overloading the treatment facility. For these reasons, interconnected sewers are prohibited in most jurisdictions. Clean stormwater should be discharged away from your foundation into drainageways, the street, or the storm sewer.

Sewer system backups can also be caused by events not related to storms or flooding. Individual service lines can be plugged by grease, waste, tree roots, breaks in the pipe, or improper disposals. The owner or the utility company can fix or prevent these problems by using proper maintenance, disposal procedures and planning. For example, planting trees and shrubs at least 10 feet away from sewer lines will minimize potential root damage.

The following section describes ways to deal with sanitary sewer or septic backup that occurs when the downstream pipe is overloaded. There are four ways to stop sewer backup. Each of the following measures will prevent sewer backups in buildings with below-grade floors: a floor drain plug, a floor drain standpipe, an overhead sewer, and a backup valve.

Floor drain plug. The simplest way to stop sewer backup is to plug the opening where it first occurs at the floor drain, the sanitary sewer system's lowest opening in the house. Commercial plugs are available that can be placed in the floor drain below the grate. Bolts on metal end pieces are tightened, causing a rubber gasket to expand and seal the plug in the pipe.

A plug stops water from flowing in either direction. Therefore, if the laundry tub overflows or other spillage occurs, the water will stay in the basement unless the plug is removed. Because of this, it may be best to leave the plug out under normal circumstances.



Floodproofing

One variation is a plug with a float. It allows water to drain out of the basement (see illustration, left). When the sewer backs up, the float rises and plugs the drain (see illustration, right). A permanently installed float plug will not interfere with the floor drain's normal operation.

Precautions—A plug left in the floor drain may contribute to a wet basement if spillage cannot drain out. Float plugs are known to jam open with just a small amount of debris. A floor drain plug does not stop backup from coming out of the next lower opening, like a laundry tub or basement toilet. Sealing the base of the toilet to the floor will protect you until the water backs up higher than the top of the bowl.

A plug does not tell you if there is a problem in your sewer service line. If the plug is not tight enough, pressure can eject it. Increased pipe pressure may break the sewer lines under the basement floor if they are clay tile, but cast iron sewers are unlikely to break.

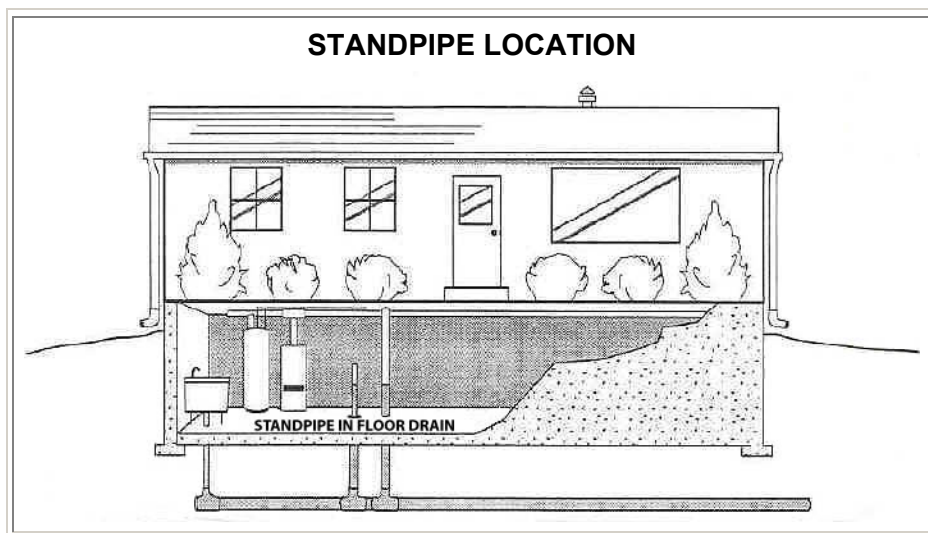
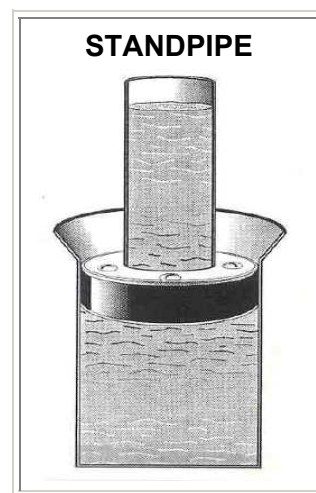
The great advantage of a plug is its low cost and ease of installation. A floor drain plug can be purchased at most local hardware stores or plumbing suppliers.

Standpipe. A standpipe is an inexpensive alternative to a floor drain plug. A "donut" with metal end pieces and a rubber gasket in the middle is placed in the floor drain. A length of pipe is placed in the "donut hole." Bolts are tightened, and the metal end pieces squeeze the gasket to make a tight seal on both the floor drain and the pipe.

When the sewer backs up, the water stays in the pipe. Water pressure cannot build up to blow a properly installed standpipe out of the floor drain. The system works unless the backup is so deep that it goes over the top of the pipe.

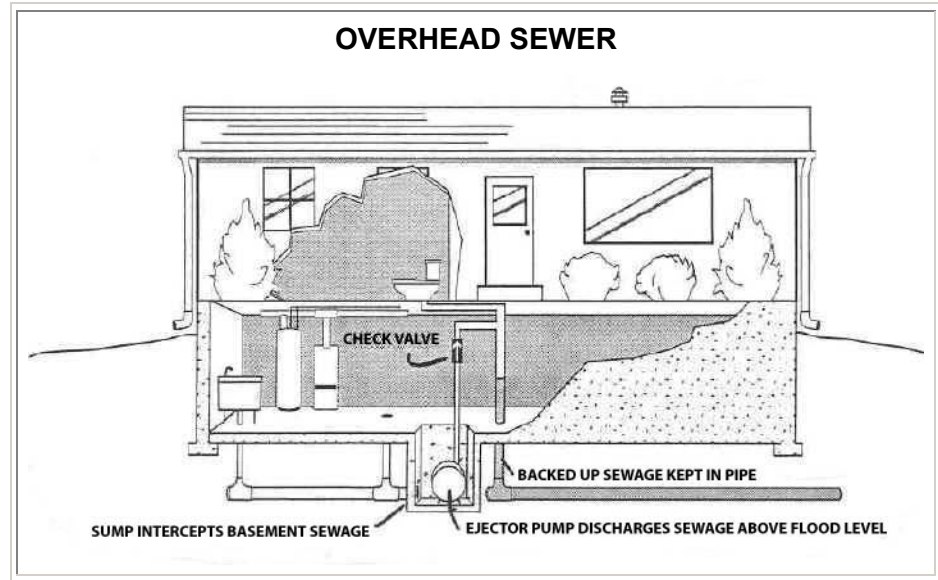
Precautions—A standpipe left in the floor drain may contribute to a wet basement if spillage cannot drain out. A standpipe only protects up to its height, normally three feet. Deeper flooding will flow over the top. A standpipe does not stop backup from coming out of the next lower opening, such as a laundry tub or toilet in the basement. Sealing the base of the toilet to the floor will protect you until the water backs up higher than the top of the bowl.

Because water pressure depends on the height of water in the pipes, a standpipe does not reduce the pressure in the pipes. Standpipes should be limited to three feet and are only recommended for buildings with cast iron sewer lines.



Overhead Sewer. An overhead sewer acts like a standpipe, but without the problems. A sump is installed under the basement floor to intercept sewage flowing from basement fixtures and the basement floor drain. An ejector pump in the sump pumps sewage up above the flood level. From there, it can drain by gravity into the sewer service line. Plumbing fixtures on the first floor will not be affected.

It is unlikely that sewers will back up above ground level. If water does go higher, a check valve in the pipe from the ejector pump will keep it in the pipes. Backed up sewage is enclosed in the sewer pipes so it can't overflow basement toilets or tubs.



Another advantage is that you don't have to be home during the storm because an overhead sewer is a permanent alteration to the plumbing. The only concern is that during a power outage, the ejector pump won't work. However, this only limits the use of the facilities in the basement that need the pump. The upstairs plumbing still works and the sewer is still prevented from backing up.

Precautions. This work requires a licensed plumber and a building permit. The ejector pump requires maintenance and electricity to work properly. The basement is disrupted during construction. The contractor may have to run the overhead pipes through one or more basement rooms. Care must be taken not to break existing under-floor sewers by increasing pressure too much, especially if the old sewer is clay tile.

Although more dependable than a standpipe, an overhead sewer is more expensive. A plumbing contractor must reconstruct the pipes in the basement and install the ejector pump.

Barriers

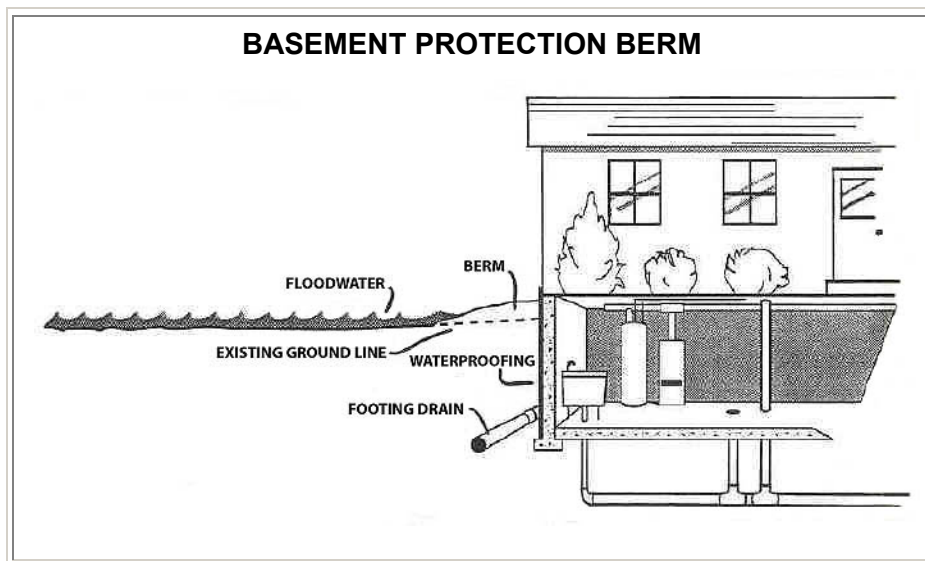
Barriers keep surface floodwaters from reaching a building. There are three types: large engineered earthen levees, smaller earthen berms, and concrete or steel floodwalls. Barriers can surround the building entirely or connect to adjacent high ground.

Most earthen barriers are made from locally available fill. Their strength comes from their mass, so they require a lot of space. The standard design is three horizontal feet for each vertical foot (3:1 slope). As a result, you should plan on at least six feet of ground for each foot in height, plus the top width. A berm must be properly compacted and anchored in place to prevent sliding.

Reinforced concrete or steel floodwalls are used where there is not enough room for a berm or levee. Floodwalls must be watertight and properly anchored to withstand lateral hydrostatic pressure.

Floodproofing

Depending on the soil porosity and the duration of flooding, your barrier may need a subsurface drain to handle leaks, seepage of water underneath, and rain that falls inside the perimeter of the barrier. You will need a sump or drain to collect the internal groundwater and surface water, as well as a pump and pipe to pump the internal drainage over the barrier.



For safety, non-engineered barriers should not exceed three feet high, since they pose potential risks due to sudden, catastrophic failure. Deeper flooding may be addressed better by wetproofing to save the structure. Although any type of building can be protected with barriers, buildings with basements will be more susceptible to underseepage. A levee or floodwall should be as far from the building as possible to reduce the threat of seepage and to reduce hydrostatic pressure on basement walls.

Precautions. Construction of barriers/berms, subsurface drains and floodwalls requires a building permit. These structures should be designed by a licensed engineer. Stormwater patterns cannot be diverted if the proposed discharge would negatively impact adjacent or downstream properties. An overview of potential stormwater impacts is necessary to prevent transferring drainage problems to adjacent properties.

Dry Floodproofing

This term covers several techniques for sealing up a building to ensure that floodwaters cannot get inside it. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings (doors, windows, and vents) are closed, either permanently with removable shields or with sandbags. A sewer backup protection measure is installed. Many dry floodproofed buildings do not look any different from those that have not been modified.

Dry floodproofing is most appropriate for buildings on concrete slab floors (without basements) with no cracks, and subject to less than three feet of water. To ensure that the slab is watertight and sound, a careful inspection is recommended. A subsurface drainage system with a sump pump is needed in areas where waters will stay at flood stage for more than a few hours.

Precautions. A dry floodproofing project may require a building permit. Footing drains should be designed and inspected during installation by a licensed engineer. Check with the Denver Building Department (720-865-2710 for residential, 720-865-2720 for commercial) to be sure that your project does not violate any code requirements.

A building should not be dry floodproofed if floodwaters may be more than three feet deep or move faster than five feet per second. It is very tempting for the owner of a dry floodproofed building to try to keep the flood out, even if floodwaters get deeper than two or three feet. This can result in collapsed walls, buckled floors, and danger to the occupants.

Basements should not be dry floodproofed if the floodwater will touch the walls because of the potentially destructive water pressure on the walls and floors. Basement walls can be waterproofed to protect them from high groundwater by installing a footing drain to keep the water pressure from building up. See the following section on Wet Floodproofing to protect subgrade foundation walls and floors.

Many commercial waterproofing compounds are made to protect wood from rain, but they will not withstand the pressures of standing water. Some deteriorate over time, so check with the supplier to be sure the waterproofing compound is appropriate for sealing your basement walls from water. Closing openings depends on having adequate warning time and having someone present who knows what to do.

Dry floodproofing can range from simply applying a waterproofing compound to a more secure and attractive approach.

Wet Floodproofing

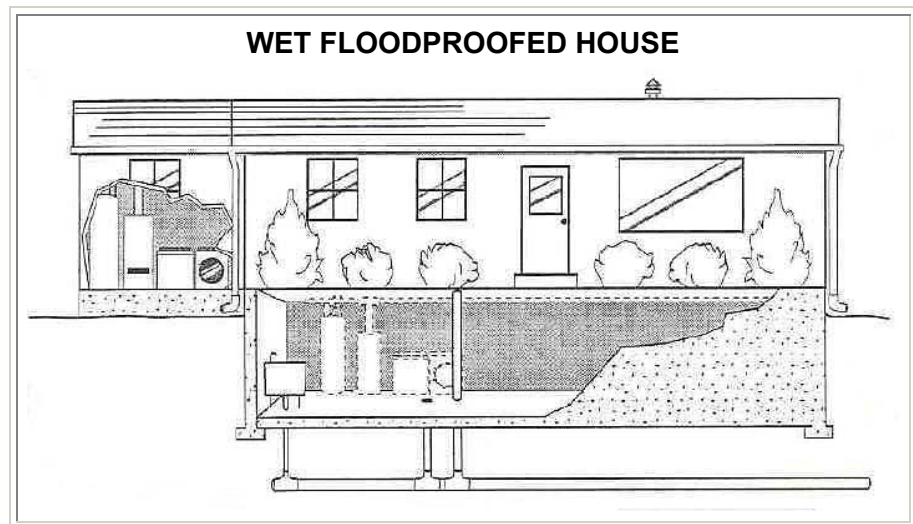
If floodwaters in your yard are touching the house, they are probably also seeping down between the soil and the exterior of the basement walls. Even if the outside water is only a few feet deep at the ground surface, it is putting pressure on the basement walls and floor equal to that of a standing body of water seven or more feet deep, about 750 pounds of pressure per square foot. A similar depth of dry soil exerts less than 100 pounds per square foot.

Most walls and floors are not built to withstand that kind of pressure. As a result, waterproofed basement walls and floors can be cracked, buckled, or broken by the pressure of floodwater. Instead of just a wet basement, you may end up with both a wet basement and broken walls.

One way to deal with this is to remove everything that could be damaged by a flood and let the water in. This is called wet floodproofing. Several modification methods can be used to minimize potential damage to the building and its contents if floodwaters are allowed inside. These techniques range from moving a few valuable items to higher elevations within the house to rebuilding the floodable area.

In the latter case, structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater, and laundry facilities are permanently relocated to a higher level. In the illustration below, these items are relocated to a small room added onto the house. Another approach is to raise these items on blocks or platforms where the flooding is not deep.

Many people wet floodproof their basements, crawlspaces, garages, and accessory buildings simply by relocating all hard-to-move valuables, such as heavy furniture and electrical appliances. Vents can be



Floodproofing

placed on the foundation walls to ensure that floodwaters can get into and out of the crawlspace to equalize water pressure on walls and floors.

Wet floodproofing has one advantage over the other approaches: no matter how little you do, you will reduce your damages. Simply moving furniture and electrical appliances out of the flood-prone area can prevent thousands of dollars in damage.

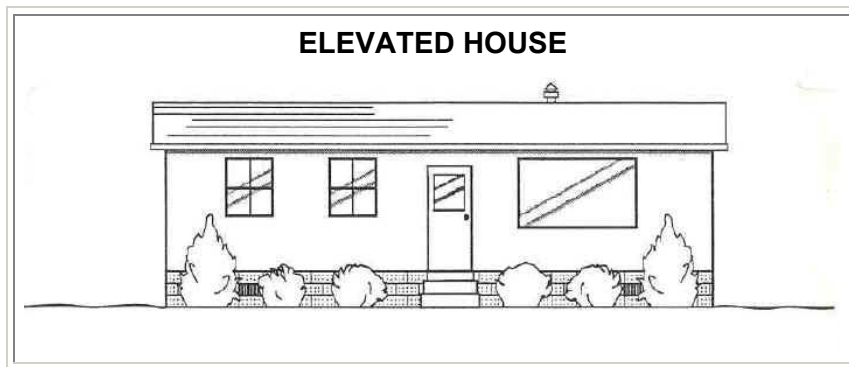
Precautions. Moving water lines or furnaces requires a building permit from the Denver Building Department (720-865-2710 for residential, 720-865-2720 for commercial). Moving contents is dependent on adequate warning time and the presence of someone who knows what to do. The flooding of an area where there is electricity, paint, gasoline, pesticides, or other hazardous materials can create a safety hazard. There will still be a need for cleanup, with its accompanying health problems.

You can accomplish some wet floodproofing just by moving valuables and hazardous materials out of the floodable area. Reconstructing a floodable area with water-resistant materials and relocating utilities can be much more expensive.

Elevation

Short of removing a structure from the floodplain, the best way to protect it from surface flooding is to raise it at least one foot above the 100-year regulatory flood level. This works well in flat areas with slow-rising water. The area below the flood level is either filled in or left with openings to allow floodwaters to flow under the building, causing little or no damage.

Many qualified contractors know techniques for elevating a building. The house will be jacked up and set on cribbing while a new foundation is built underneath. The



foundation walls are raised to the flood protection level and the house is lowered onto the new foundation. Utility lines are extended and reconnected, steps are built, and, in some cases, the perimeter is backfilled or landscaped to mask the change. If the lower area is not filled in, it must have openings to allow water to flow under the building. This keeps the water pressure from endangering the foundation walls.

Where floodwaters are not very deep, the appearance of the elevated house is similar to that of a house on a two- or three-foot crawlspace. If the house is raised two feet, the front door would be three steps higher than before. If the house is raised eight feet, the lower area can be wet floodproofed for a garage or for storage of items not subject to flood damage.

Precautions. Structural modifications require a building permit from the Denver Building Department (720-865-2710 for residential, 720-865-2720 for commercial). The purpose of wet floodproofing is to minimize damage to the structure and contents by allowing the lower area to flood. This floodproofing method is relatively expensive, but it is **the only option that can lower your flood insurance premium.**

Relocation

The surest and safest way to protect a building from flooding is to move it to higher ground. If your house is subject to deep flooding or high velocities, you should seriously consider relocating out of the floodplain. Several federal programs are interested in acquiring buildings that have been repetitively damaged by floods, or that are located in federally designated disaster areas. Often the property acquisitions are a more cost-effective solution than paying repetitive insurance claims for flood damages. The community may have funds to purchase additional properties, particularly if they are adjacent to parks or other public land. The property acquisitions can provide benefits to the community as well as the landowner.

Small wood frame buildings on crawlspaces are easiest to relocate. Larger buildings, those on slabs, or those built of masonry may be too expensive to move and are usually demolished after the City or other entity purchases them. The land can then be kept open for various public or open space uses, in addition to flood conveyance and storage. The land is then kept open for public or open space use. For more information, contact the **Denver Office of Emergency Management (720-865-7600)**.

Chapter 5

During the Flood

Storms and floods can occur very quickly in our area. You should be on alert when you see storms brewing. When in doubt, turn on your radio or television and listen for weather information. Stay away from streams and dry creek beds.

Flood Warnings

The National Weather Service (NWS) issues three basic types of flood notices:

- **Flood Watch** means river flooding or flash flooding is possible.
- **Flash Flood Warning** means flash flooding is imminent or occurring.
- **Flood Warning** means that river flooding is imminent or occurring.

A fourth type of notice is sometimes issued to warn that nuisance flooding is possible or occurring. This statement is called an **Urban and Small Stream Flood Advisory**.

The City and County of Denver and the Urban Drainage and Flood Control District work with the NWS to monitor conditions as they develop. If flooding is likely to occur, these agencies will issue warnings in many ways:

- **NOAA Weather Radio:** This is a radio station operated by the NWS on frequency 162.55 Mhz. You can buy a battery-operated weather radio at an electronics store for \$20-\$35.

FLASH FLOOD SAFETY

- **Flash floods can happen without warning. Have a plan!**
- **Know your flood hazard:** If you are at home, at work, or in your car, know whether you could be affected by a flash flood.
- **If it is raining and you are near a mountain stream, keep listening to a local radio or television station. If you hear a "flash flood watch" for your area, play it safe and move to high ground.**
- ***If you hear a flash flood warning or a loud crashing noise—climb to higher ground immediately!***
- **Leave your car and other belongings. You may have only moments to escape.**
- **Never try to drive or run downhill to outrace a flash flood. Avoid flooded areas and fast-flowing water. Do not try to cross flooded streams on foot or in your car. Roadbeds can wash away, and 18 inches of water can carry away most cars. Be especially cautious at night when it is harder to recognize flood dangers.**

During the Flood

- **Local radio and TV stations:** Radio Station **KOA-850 AM** is Denver's Emergency Alert System station. The backup station is **KYGO-98.5 FM**. Most local radio and television stations will keep you posted on the flood status.
- **Emergency vehicles:** Police and fire vehicles may be sent to the threatened areas. The emergency vehicles have sirens and mobile public address systems that will announce hazard warnings. They may tell you to evacuate. If so, follow their instructions and the steps detailed below. If there are no specific directions given, turn on your radio or television to find out what to do.

The flood status will be updated on local radio and television stations. Once the agencies are sure that the danger has passed, they will issue an "all clear" message. **Remember: You may not hear a flash flood warning before flooding actually begins. Play it safe in stormy weather—be alert to conditions around you, and read the next section.**

What You Should Do When You Hear a Flood Watch or Warning

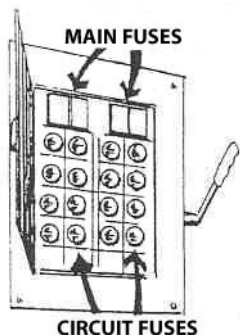
1. Follow announced radio, television, or emergency vehicle instructions.
2. If a **Flash Flood Warning** has been issued and you are in a mountainous area:
 - Climb to high ground as fast as possible.
 - Do not try to take your gear with you—your life is more important!
 - Do not try to run or drive downhill to outrace a flash flood.
3. Implement your Flood Response Plan if you have one (see page 14).
4. If a **Flood Watch** was issued, you may have a little time to quickly prepare a Flood Response Plan (see page 14).
5. If a **Flood Warning** was issued and you are in a mapped floodplain:
 - Turn off the electricity and gas if necessary.
 - Read "**Flood Safety Outdoors**" on the back cover.
 - Lock your doors and move to higher ground immediately.
 - If you don't have a safe place to stay on high ground, listen to the radio or TV for information on public shelter locations.
6. If you are not in the mapped floodplain, it is unlikely that you will be flooded deeply. If the streets are flooding, you may be safer staying in your house.
 - Read "**Flood Safety Indoors**" on the back cover.
7. If you are not in the mapped floodplain, but your basement floods:
 - Turn off the basement electricity.
 - Turn off the gas, if you expect the pilot light to be flooded.
 - Move valuables upstairs.
 - Stay out of the basement if floodwater is touching the house outside.

Turning Off the Utilities

Turn off your utilities to prevent greater damage. This section provides directions on how you can do this safely. If you are unsure of how to do these things, ask a friend or neighbor to help you, or don't do them at all. *If your house is in danger of a flash flood, it's more important that you get to safety quickly.*

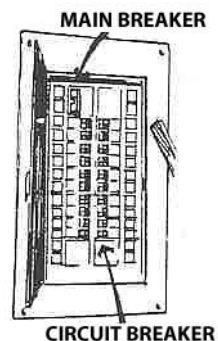
Electricity. The most important utility to turn off is the electricity. You have a fuse box or a breaker box for your house, either inside or outside. The breaker box is more common in newer buildings or if you have had some electrical work done in the past 20 years. The illustration below shows how to turn off the power.

TURNING OFF THE ELECTRICITY



Fuse Box

1. Make sure that you are not standing in water and that the box is dry.
2. If your box has a handle on the side, pull the handle to "OFF."
3. Open the box door.
4. One or two large fuses will be marked "Main." Pull them out by their handles and put them in a dry place.



Breaker Box

1. Make sure that you are not standing in water and that the box is dry.
2. Open the box door.
3. One or two breakers at the top will be marked "Main." Switch them to "OFF."

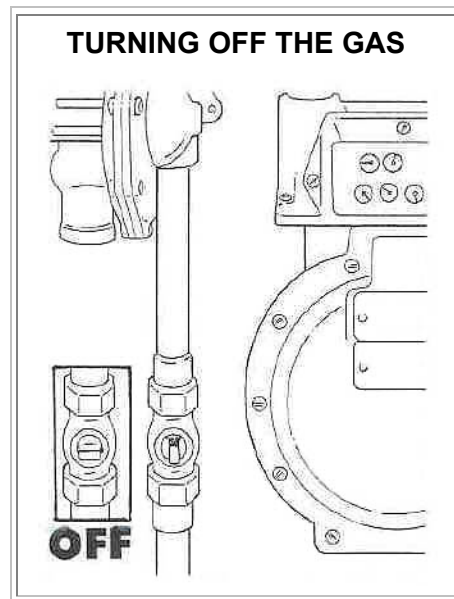
During the Flood

Gas. Floodwaters may knock out pilot lights and silt may get into burners. If there is a chance that the pilot light could be flooded, you should turn off the gas before you leave to prevent a fire or potentially explosive safety hazard.

There is a valve next to the gas meter. If the valve handle is parallel to the pipe, the gas is on. **To shut the gas off**, turn the handle 90 degrees, a quarter turn, so the handle is perpendicular to the pipe. You may need pliers or a wrench to turn the valve.

Most gas meter valves have a hole in the handle that lines up with a hole in the valve body when the gas is shut off. This hole is used by the gas company to lock or seal the valve closed when the building is vacant. When the holes are lined up, you know that the gas supply has been shut off.

IMPORTANT: After the flood, contact your utility company to check the furnace, turn on the gas, and re-ignite the furnace pilot light.



Fuel oil tanks. If you have a fuel oil or propane tank, turn off the fuel valve at the tank. **After the flood, contact your utility company to check the furnace, turn on the gas, and re-ignite the furnace pilot light.**

Water. Since your water faucets are usually turned off, you shouldn't worry about turning off the water to the house. However, if your washing machine is in the basement, or if the floodwaters around your house could be several feet deep, the floodwaters could get into the water lines through the appliances. If you have the time, turn off the water supply to the house. There usually is a valve near the water meter or where the service line enters the house. The water valve has a handle similar to a faucet knob. Turn it all the way clockwise.

Chapter 6

After the Flood

If you have been flooded, you should get a copy of *Repairing Your Flooded Home*, published by the American Red Cross and the Federal Emergency Management Agency. Copies of the book are available free at the Denver Office of Emergency Management (720-865-7600).

This chapter covers the three steps you should take the first few days after a flood. Additional steps are explained in *Repairing Your Flooded Home*.

Step 1. Take Care of Yourself

You and your family have been through a disaster. It has disrupted your life, and you must allow time for things to return to normal. You should recognize that the flood can take its toll on you as well as your property. You need to look after yourself and your family while you focus on cleanup and recovery.

Your hidden enemy is stress. Watch for signs like short tempers, getting upset over little things, having difficulty sleeping, bad dreams, aches, pains, stomach problems, apathy, and depression. These are ways your body tells you that times are difficult.

Reactions to stress are common and usually temporary. Here are some things you and your family can do to relieve your tensions.

Keep the family together. Togetherness provides mutual support.

Discuss your problems. Talk to family and friends. Share your anxieties. Let others talk to you to help release tension. Crying is a natural response to a disaster. It's also a great way to release pent-up emotions.

Rest often and eat well. You are more likely to suffer from stress and health problems when you are weak.

Set a manageable schedule. Make a priority list of jobs to do one at a time.

HEALTH HINTS

- **Wash your hands thoroughly.** This is especially important before eating, cooking, or smoking.
- **Confirm that the water is clean and safe.** Don't drink it or wash dishes until you are sure.
- **Disinfect dishes and all items that floodwaters touched.**
- **Watch out for fatigue.** When your body is tired, you are more prone to accidents, back strain, and depression.
- **Report health hazards.** Call the Denver Department of Environmental Health (720-865-5452) if there are dangerous chemicals or other health hazards on your property. Call the Denver Department of Solid Waste (720-865-6900) if there are animal carcasses, rats, or other solid waste hazards on your property.

After the Flood

Watch for signs of stress. Signs of stress are often noticed by other people more readily than by the person experiencing the stress. Listen to them.

Seek help. If you can't shake feelings of despair and stress, get professional help. Contact the American Red Cross (303-722-7474) or your local mental health clinic.

Floodproof as you rebuild. Nobody likes being subject to the whims of nature. Preparing for the next flood can give you a sense of control over the future.

Care for your children. Watch your children closely. Be understanding of their fears and stress symptoms. Avoid scolding children for behavior that might be flood-related, such as bedwetting, thumb sucking, or clinging to you. Remember, they are going through a rough time too.

Stay healthy. When you work in an area that has been flooded, you will likely be exposed to dangerous chemicals and germs. Minimize contact with floodwater and debris by wearing protective clothing like rubber boots and gloves. You may also need a mask or respirator.

WHAT TO BRING WHEN IT IS SAFE TO RETURN TO YOUR HOUSE

- Flashlight and batteries
- First aid kit
- Battery-operated radio
- Waterproof boots or waders
- Hard hat, boots with hard soles
- Camera or video camera to record damage
- Tools: crowbar, hammer, saw, pliers, etc.
- Drinking water
- Trash bags
- A wooden stick for turning things over and scaring away small animals
- Cleaning supplies:
 - Shovels
 - Buckets, hose
 - Trash bags
 - Mops, brooms, brushes
 - Rubber gloves
 - Rags
 - Cleaners and disinfectants
 - Lubricating oil

Step 2. Give Your Home First Aid

Each year more than 150 people die in the United States because of floods. Many of those fatalities are due to electrocution or other accidents that occur after the floodwaters have gone down. Your first job is to make sure everything is safe before you enter the area. Read the safety precautions on the back cover of this handbook and follow these steps:

1. **Stay tuned to a radio or TV** to find out when you can go back home. Denver may issue special instructions or make building inspectors available to help you check out your house.
2. **Check with your insurance agent** to find out what cleanup and repair work is covered. This will help you to prepare a plan to restore your property.
3. **Walk around the outside of your house** and check for loose power lines and gas leaks. You can detect leaking gas by the rotten egg smell of chemicals that have been added to make a gas leak noticeable. **Report utility problems to Xcel Energy (1-800-895-1999).**

4. **Check the foundation** for cracks or other damage. Examine porch roofs and overhangs to be sure their supports are structurally sound. Look for gaps between the steps and the house. If you see obvious damage, have a building inspector check the house before you enter. For help, call **Denver Public Safety Building Inspections (720-865-2630)**.
5. **Turn off the electricity** at your house, even if Xcel Energy has turned off the main supply line (*they may turn it back on when you're not ready*). Call an electrician if you have to go through water to get to your fuse box or breaker box, if the boxes are wet, or if you are not comfortable with electrical matters.
6. **Turn off the gas only if necessary** by following the instructions on page 30. **DO NOT ENTER AN AREA IF YOU SMELL GAS FUMES.** Call **Xcel Energy (1-800-895-1999)** from a safe offsite place to report a suspected gas leak.
7. **Enter carefully.** It may be better to enter your house through a window if the door will not open easily. Look carefully at the ceiling, before you go in to be sure it is not ready to fall. Do not smoke or use candles, gas lanterns, or other open flames until the house has been well ventilated. Use a flashlight as there may be explosive gases. **DO NOT ENTER AN AREA IF YOU SMELL GAS FUMES.** Alert someone outside of the house that you intend to enter, and ask them to call for help if you do not return or answer their call.
8. **Photograph the flood damage** for insurance claim purposes prior to beginning cleanup operations.
9. **Rescue your most valuable items.** Find and protect the "irreplaceables" like jewelry, insurance papers, photographs, family heirlooms, and money. Wash the mud off before it has a chance to dry. Wrap wet photographs and important papers in plastic bags and temporarily freeze them, until you have time to clean and dry them. Place sturdier items in a safe dry place inside a plastic bag if possible, or take them to a friend's home for safekeeping.
10. **Keep the damage from getting worse.** Open the windows and doors (if weather permits) to reduce the interior humidity and ventilate any odors or gas fumes. Check the basic structural integrity of the building before attempting to cover holes in the roof, walls, or windows with boards, tarps, or plastic sheeting to keep out the wind and rain. Save labor and material receipts for insurance reimbursement.
11. **Repair sagging floors or roof sections.** Use 4 x 4's or other heavy lumber to brace weak areas. If you are uncertain how to shore-up floor or ceiling joists, call a contractor. Save labor and material receipts for insurance reimbursement.
12. **Remove tree limbs and other debris** that may have landed on or floated into the house. Save disposal receipts for insurance reimbursement.
13. **Check for broken or leaking water pipes.** If you find any, cut off the water supply by turning off the valve at your water meter. If the water pipes are not leaking, you can use your tap water for hosing things down and cleaning. However, do not drink or cook with tap water until Denver health officials declare it safe. If in doubt, call the **Denver Water Department Quality Control (303-628-5973)**.

- 14. Drain your basement slowly.** The water in saturated ground puts tremendous pressure on your basement walls and floors. The water inside your flooded basement is counteracting this pressure. If you do not follow the instructions for emptying the basement gradually, your walls and floor may lose the support they need to counteract the pressure from the outside water. The weight of the saturated earth could then cause the walls to crack and collapse, buckling the floors and seriously damaging your home. Follow the checklist of steps provided to safely drain your basement.

- 15. Get rid of the mud and silt.** Most of the health hazards brought by a flood are in the mud and silt that are left after the water drains away. Therefore, it is very important to clean it out as soon as possible. This is more effective if you do it before the mud dries out. Follow the steps below:

- First, shovel out the mud and debris, and move your furniture and other household goods outside.
- Next, **make sure the electricity is turned off**. Remove all light bulbs from sockets that have been flooded. Disconnect and throw away flooded wall switches and outlets. They should be replaced later with new ones.
- Finally, hose the house down, inside and out. If you have an attachment that sprays soap, first wash and then rinse the walls and floors. Hose the opened electrical outlets, switch boxes and light sockets. ***Do not let the water sit on the floor too long, especially if your floor is particleboard or another wood product that falls apart when wet.***

HOW TO DRAIN A BASEMENT

Follow these steps:

1. **Make sure the electricity is off.**
2. **If there is no floodwater on top of the ground, start pumping the water out of the basement.**
3. **Pump the water level down two to three feet. Mark the level and wait overnight.**
4. **Check the water level the next day. If the water went back up, it is still too early to drain the basement.**
5. **Wait overnight. Then pump the water down two to three feet again. Check the level the next day.**
6. **When the water stops going back up, pump down another two to three feet and wait overnight. Repeat steps 4 through 6 until all water is pumped out of the basement.**

Step 3. Get Organized

Before you try to clean up and repair everything, you need to assess your damage and develop a recovery plan. Follow the steps below to make the best use of your time and money.

1. **Call your insurance agent.** How much of your loss is covered will depend on your policy. Your agent will also tell you what to throw away and what to save for the adjuster to examine. Find out if your insurance covers living expenses while your house is being repaired. If you do not have flood coverage, your agent can still advise you where to get help with cleanup and repairs.
2. **Check for structural damage.** Broken basement or foundation walls, shifted stairs, or slanted floors and walls could mean that these items will have to be rebuilt from the ground up. Repair safety hazards such as broken stairs before you proceed any further.
3. **If you have structural damage, check with the Denver Building Department** before you start any reconstruction or sign any repair contracts. You will need a building permit to repair structural damage. If the damage to your house's structure exceeds 50%

of the value of your house, the federal government and the City's code will require you to elevate it above the 100-year regulatory flood level

4. **Ask the big question.** Odds are that the area where you live will flood again. Before you spend a great deal of money and effort repairing and rebuilding, ask yourself, *"Do I really want to be flooded again?"* If you think you would be better off in a different location, talk with the Denver Office of Emergency Management to see if Denver or other agencies would like to buy your property and change the floodplain to open space use.
5. **Start listing the damage** room by room. If possible, take pictures or videotapes of the damaged items as you clean up. Keep receipts for cleanup supplies, equipment rental, hired help, and temporary housing expenses. Keep a sample of items such as a piece of carpet, to show the value of what you have thrown away. Good records are needed for insurance claims, applications for disaster assistance, and income tax deductions.
6. **Make a recovery plan**, which is simply a list of jobs that need to be done. Planning can help you save time and money. In addition, being methodical and keeping everyone busy can ease tension. You will start seeing progress as you finish each project. Start making lists. Begin with the major projects, such as "replace furnace" and "dry the walls."
7. **Decide what you can and cannot do yourself.** Obviously, you can save money by doing much of the cleanup and repair work yourself. However, jobs like shoring-up broken foundations and replacing electrical service boxes are best left to the professionals. Save all receipts for material, equipment rental, labor, and disposal fees for insurance reimbursement records.
8. **Decide if you need financial assistance.** After a flood, there are usually extra sources of help if you need assistance replacing items or hiring professionals. Check the local newspapers and listen to radio and TV stations for notices about Red Cross, church, and government disaster programs. Even if you are insured or think you can cover all your expenses, it makes sense to take advantage of whatever help is available. In the case of government assistance, you have already paid for it with your tax dollars.
9. **Keep the windows open** as much as possible to begin drying out things.
10. **Get a copy of *Repairing Your Flooded Home*** from the **Denver Office of Emergency Management (720-865-7600)**. It will explain additional steps to take to finish cleaning and repairing your building. If you have followed all the steps listed in this chapter, start with Step 4 in *Repairing Your Flooded Home*.

TIPS ON INSURANCE CLAIMS

- You are supposed to be reimbursed fairly for your loss, but you are not supposed to profit from a disaster.
- You cannot collect more than the face value of your policy.
- You cannot collect for uninsured items, like landscaping.
- There are no financial incentives to encourage the adjuster to give you a small claim payment.
- Your adjuster will probably be from out of town. Get his or her name, company, and telephone number.
- In most cases, you will be reimbursed for the actual cash value of an item, not its replacement cost.
- Your policy should list an office and telephone number to call with questions.

WEBSITES:

Denver Office of Emergency Management – www.denvergov.org/OEM

Urban Drainage and Flood Control District – www.udfcd.org

American Red Cross Family Disaster Plan – www.redcross.org/services/disaster/beprepared/familyplan.html

Federal Emergency Management Agency – www.colorado.edu/hazards

Natural Hazards Research and Applications Information Center – www.colorado.edu/hazards

U.S. Army Corps of Engineers – www.usace.army.mil

IMPORTANT PHONE NUMBERS AND CONTACTS

Emergencies: Police, Fire, Ambulance.....911

To report gas or electrical hazards, call **Xcel Energy** **1-800-895-1999**

To report flooding during normal business hours (7:00 a.m. – 4:00 p.m.)..... **303-446-3400**

To report flooding after normal business hours call Street Maintenance **720-865-6855**

American Red Cross (24-hour line)..... **303-722-7474**

Denver Emergency Alert System (EAS) Radio Stations KOA and KYGO **AM 850 and FM 98.5**

Family Meeting Place _____

Alternate Family Meeting Place _____

Non-Emergencies in Denver..... 720-913-2000

Denver Water Department (for questions related to whether the water is drinkable) **303-893-2444**

Other Local Non-Emergency Contacts:

Police Department _____

Fire Department _____

Insurance Agent _____

Insurance Company Name / Policy No. _____

Flood Insurance Company Name / Policy No. / Agent _____
(if different from above)

Other Important Contacts _____

Call the **Wastewater Management Division (303-446-3400)** if you see dumping or debris in a creek or ditch.

Flood Safety Outdoors

- **Do not walk through flowing water.** Many flood deaths are the result of drowning. Six inches of moving water can knock you off your feet. Use a pole to test the depth of standing water before you proceed.
- **Do not drive through a flooded area.** More drowning deaths occur in cars than anywhere else. Do not drive around road barriers as they indicate danger ahead. Two feet of water will carry away most automobiles.
- **Stay away from power lines and electrical wires.** Electricity can travel through water. Electrocution is a major cause of death during floods. Report broken power lines to **Xcel Energy 1-800-895-1999 or call 911.**

Flood Safety Indoors

- **Turn off your electricity if your building is flooded.** Some appliances can shock you, even after they have been unplugged. Do not use appliances or motors that have gotten wet, unless they have been taken apart, cleaned, and dried.
- **Watch out for hiding animals.** Small animals and snakes may seek shelter in your home once they've been flooded out of their own.
- **Look before you step.** Mud can be very slippery to walk on. Broken glass, nails, and other debris may be deposited by receding floodwaters.
- **Be alert for gas leaks.** Leave the area immediately if you smell gas fumes, and after you reach a safe place, **call 911**. Use a flashlight to inspect for damage. Do not smoke or use open flames unless you are sure that the gas has been turned off and the area has been ventilated.
- **Carbon monoxide is deadly.** Only use a generator or any gas-powered machine outdoors in a well-ventilated area. This includes camping stoves and lanterns. Fumes from charcoal grills are especially noxious, and charcoal-fueled grills must not be used indoors.
- **Clean everything that got wet.** Floodwater can be contaminated with sewage and hazardous chemicals. Do not consume anything that has contacted floodwater. Contaminated food, cosmetics, and medicines are health hazards and must be disposed of. Before using dishes and other washable items, clean them with soap and potable water.
- **Take good care of yourself and your family.** Recovering from a flood includes taking care of both physical and emotional needs. The psychological impacts of a disaster may last a lot longer than the physical impacts. Learn how to recognize and care for anxiety, stress, and fatigue.