Part 3: Planning For Rebuilding – Adding Energy Efficiency

This section is offered to provide what you need to know about your house and its damage before you start to rebuild. It also provides details about the many steps you can take at this stage to add energy efficiency into your home to make it more comfortable, affordable, and energy efficient in the years to come.

Building Shell Issues

Rebuilding a flooded house can be very expensive, so it is important to understand which items you must replace, which items you can salvage, and what you can do yourself.

First, you need to estimate your building construction and technical skills. This will tell you how much work you can do yourself without hiring contractors.

Second, you need to collect information on the extent of damage, how you would like to rebuild, and your financial resources. Rebuilding is an opportunity for homeowners not only to rebuild, but to upgrade their houses in the process.

To accomplish this inexpensively you need to know:

- the degree of flood damage,
- the level of improvement you
- would like to reach during the rebuilding process,
- what you can do by yourself,
- what can be done only by professionals, and
- which materials, if any, can be reused.

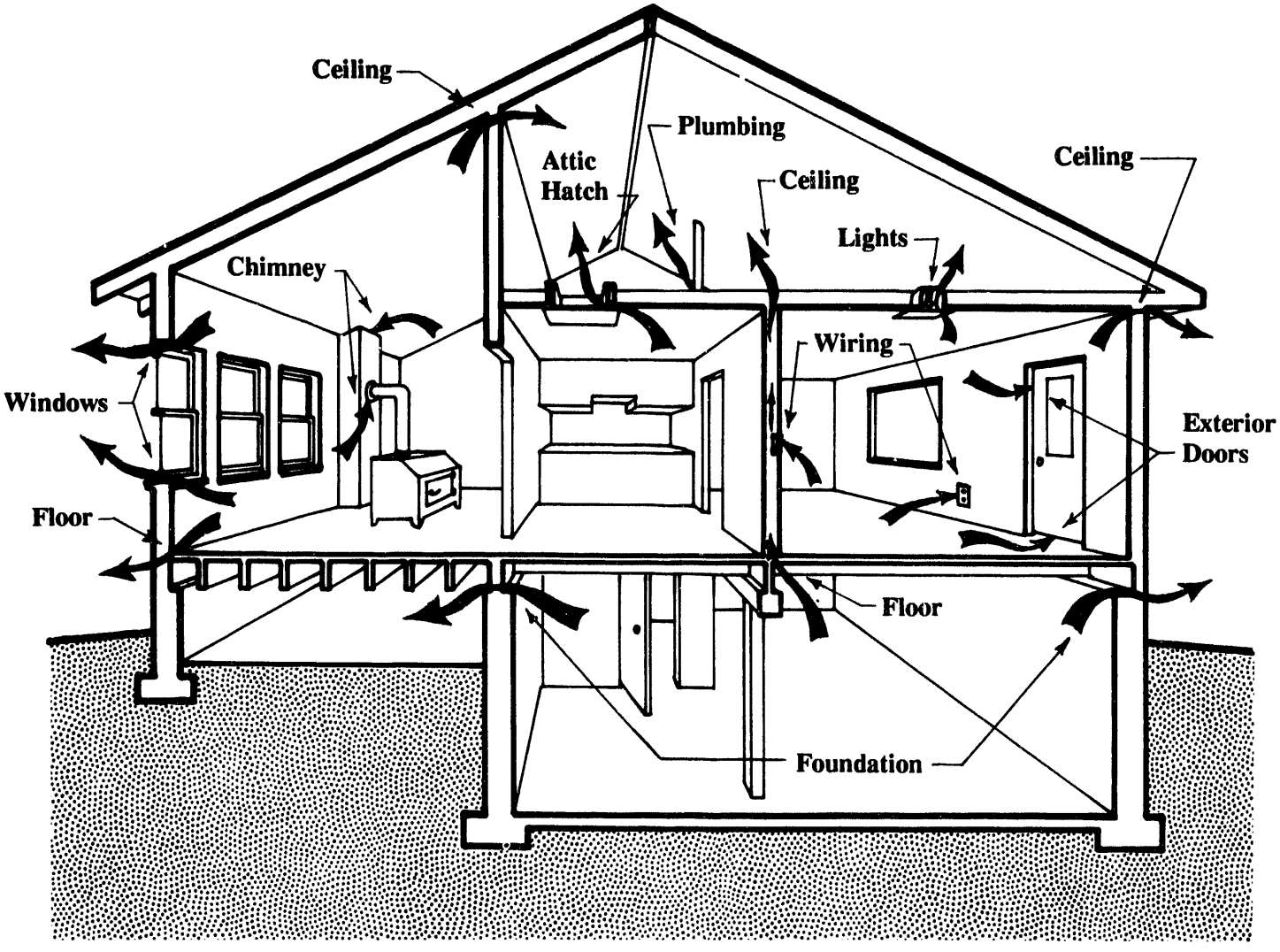
By carefully inspecting every part of your home and surrounding area, and by answering these questions, it should be possible for you to develop a work-program aimed at inexpensive rebuilding.

Air Leaks

Increasing a home's airtightness will lower its space heating and cooling requirements, allowing you to install a smaller, less expensive heating or cooling system.

Airtightness is essentially accomplished by minimizing leaks using caulking and weatherstripping. While you are repairing, pinpoint where air is leaking into the home and then seal those leaks. Common air leakage points include openings for plumbing and wiring, recessed lights, attic hatches, and at the top of foundation walls (See Figure 1).

Caulking can effectively seal smaller gaps (less than about 1/4"), but be sure to select a caulk that is suitable for the materials you are sealing. For larger gaps (1/4" to 1"), use an expanding foam, or a backer rod followed by caulk. If your windows and doors have been broken or damaged due to flooding, now is an



SOURCES OF AIR LEAKAGE IN THE HOME

FIGURE 1

opportune time to upgrade their efficiencies.

A simple and quick way to cut down the heat loss from your existing widows is to seal around them with caulk. Doors should also be weatherstripped to make a tight seal when they are closed.

Windows

Windows can account for as much as 25 percent of the heat loss in homes. If existing units are in good condition, you can cost-effectively improve their performance with weatherstripping and caulk, as mentioned earlier. To double the energy efficiency of single-pane windows, install storm windows.

If your existing windows have been damaged or are in poor condition, consider replacing them with new, higher-efficiency units. Double-pane windows incorporating the new technologies of low-emissivity coatings and gas-filling for greater insulation value are now the standard with many major window manufacturers. These units could cost about 25 percent more than a standard, double-glazed unit, but they are about twice as efficient, making the cost premium worthwhile.

Select wood, vinyl, or fiberglass frames rather than metal ones. Metals such as steel or aluminum are poor insulators and can account for as much as 24 percent of a window's overall heat loss, in addition to contributing to condensation problems.

There are, however, metal windows which include a "thermal break" to avoid high heat loss. Be sure to ask for this feature if you decide to select metal windows.

And finally, windows that close against compression seals, such as casement and awning windows, tend to be more airtight than windows with sliding seals, such as double-hung and horizontal sliders.

Doors

Inspect exterior doors to be sure they are in good condition. Solid wooden doors that swell will tend to return to their original size when dry. Give them time to dry thoroughly before making adjustments. Check for warping or other structural damage if the doors have been exposed to flood water.

Quality construction, proper fit, adequate weatherstripping, airtight jambs, and tight-fitting hardware are important to a door's efficiency. Obviously, any broken glass in the door should be replaced.

Sweeps installed on the bottoms of doors can also help to ensure a tight seal. If your door is not very airtight, consider installing a storm door to reduce heat loss, or replacing the door with a new, insulated model with good weatherstripping.

Many wood doors are made from hardboard or contain hardboard spacers. However, wood products such as hardboard, plywood and oriented-strand boards will not regain their original shape when dried after substantial wetting.

Plywood and oriented-strand boards may delaminate. Hardboard swells when wet and can lose its strength. These products will have to be discarded and replaced.

Insulation

If flood water has reached the insulation of your walls, floors, or ceiling, you will need to replace it (See Figure 2). Some sources say that fiberglass insulation can be dried and reused with no loss of thermal performance. However, once **any** type of insulation has been exposed to flood water, the possibility for mold or mildew growth and the resultant potential indoor air quality problem exists. Therefore, flood-contaminated insulation should be replaced. Insulation is not the most expensive of materials and salvaging it is probably not worth the effort given the potential for problems.

Replacing your insulation provides an opportunity to select a product with a higher insulating or R-value, which will slow down the heat lost or gained within the house. For example, many homes with standard two-by-four framing have fibrous batts rated R-11. Within the same limited space, you can boost the insulating value to R-13 or R-15 by installing medium- or high-density fiberglass batts. Another option to increase your wall's R-value is to add insulating foam sheathing to the outside walls. While availability and cost of these materials may vary in different areas, they can be cost-effective especially where energy costs are high.

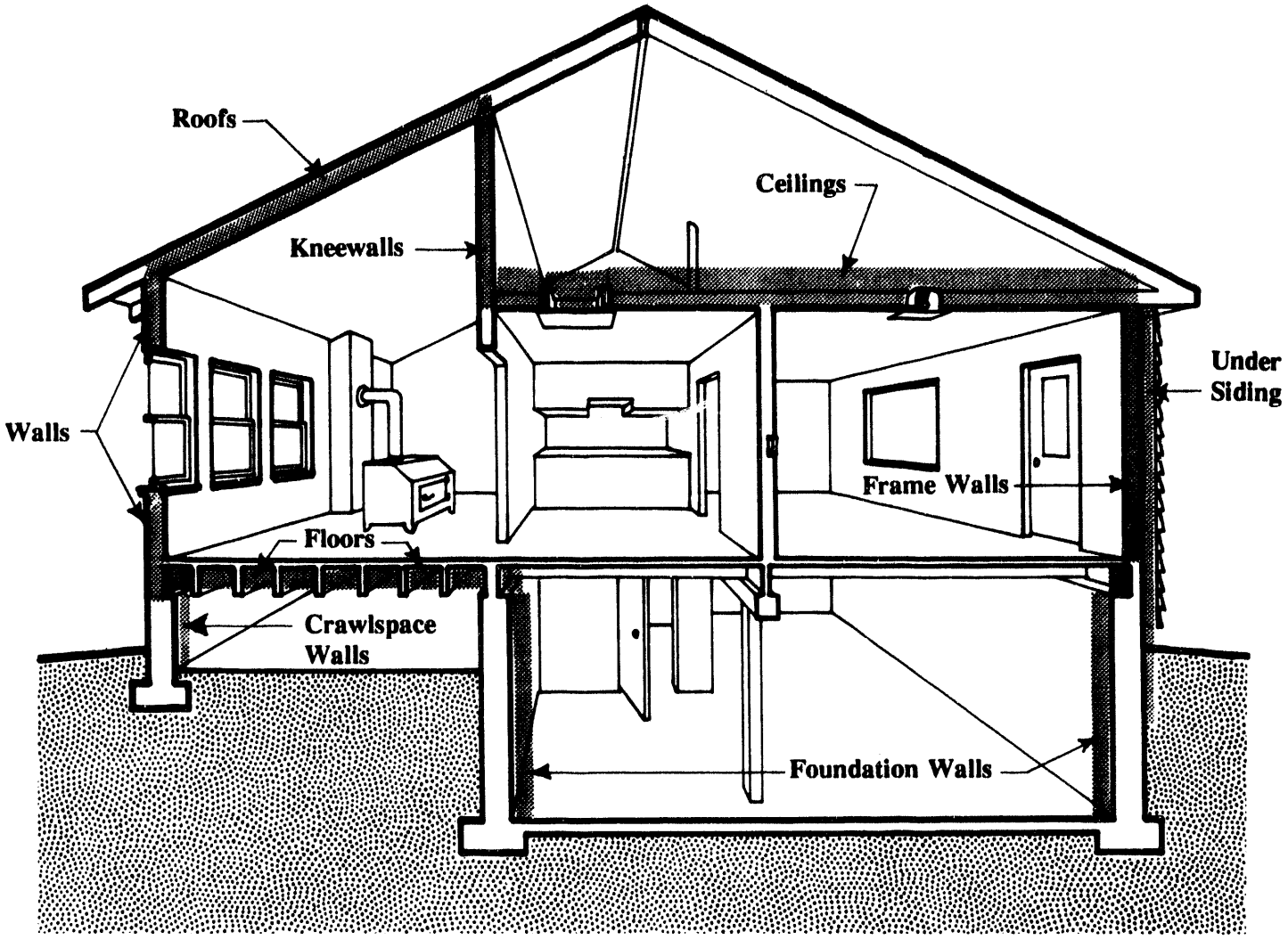
Added insulation may allow you to downsize your heating or cooling systems, saving energy and money.

You should also insulate attics and floors above unconditioned spaces to at least the minimum recommended levels. To determine what these levels are for your area, see Figure 3.

As you replace your insulation, you will discover that drywall and wood framing may also be wet. While you'll want to replace your insulation and drywall as soon as you can, be aware that it can take weeks or months for a house to completely dry out. The house must be completely dry before it is re-insulated to avoid later damage to building materials and serious health problems for your family that may develop if moisture, mold, and mildew are allowed to go untreated in your house.

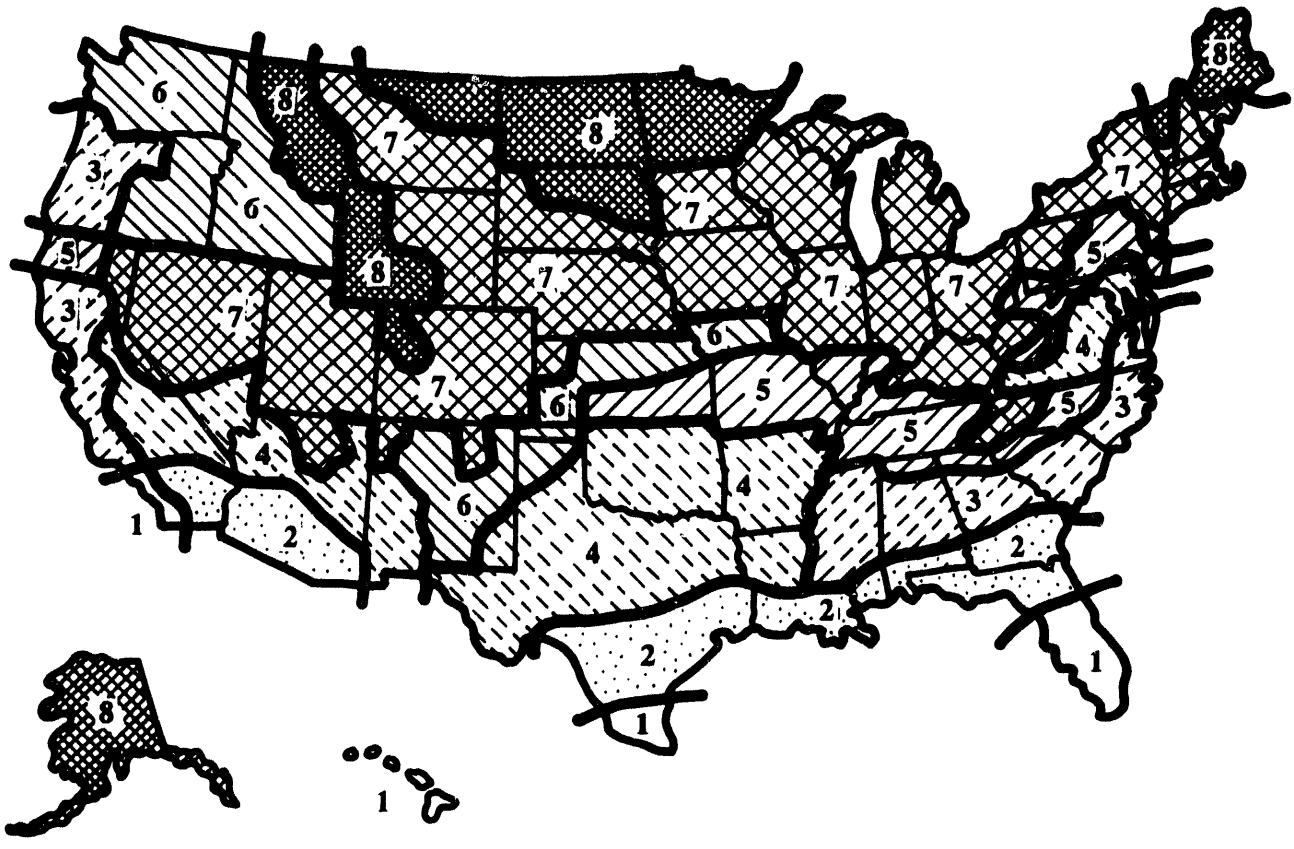
Foundations

Wet or flooded foundations will be a continuous source of moisture, and can increase the time needed to dry the rest of the house. Homes with basements require special attention during the aftermath of a flood.



PLACES WHERE INSULATION WILL REDUCE HEAT LOSS IN THE HOME

FIGURE 2



Recommended R-Values for Existing Houses in Eight Climate Zones

ZONE	Ceilings & Roofs		Floors over an Unheated Space		Exterior Wood Framed Walls		Crawlspace Walls	
	oil,gas, ht.pump	elect. resist.	oil,gas, ht.pump	elect. resist.	oil,gas, ht.pump	elect. resist.	oil,gas, ht.pump	elect. resist.
1	19	30	0	0	0	11	11	11
2	30	30	0	0	11	11	19	19
3	30	38	0	19	11	11	19	19
4	30	38	19	19	11	11	19	19
5	38	38	19	19	11	11	19	19
6	38	38	19	19	11	11	19	19
7	38	49	19	19	11	11	19	19
8	49	49	19	19	11	11	19	19

Thicknesses for Common Insulations to Obtain R-Values (Inches)

R-Value	Fiberglass Batts or Blanket	Blown-in Fiberglass	Blown-in Cellulose	Blown-in Rockwool	Polystyrene Foam (EPS)	Polystyrene Foam (XPS)	Polyurethane-isocyanurate Foam
R-11	3.25-3.75	4.00-5.25	3.75	3.50	2.75	2.20	1.60-1.80
R-19	5.75-6.25	7.00-8.75	6.50	6.25	4.75	3.80	2.70-3.20
R-30	9.00-9.50	11.0-14.0	10.5	9.75	7.50	6.00	4.30-5.00
R-38	11.5-12.0	14.0-17.75	13.0	12.25	9.50	7.60	5.40-6.30
R-49	15.0-15.5	18.0-23.0	17.0	16.0	12.25	9.80	7.00-8.10

FIGURE 3

Do not be in too big a hurry to pump water out of your basement. Water in the ground outside your house is pushing hard against the outside of your basement walls. At the same time, the water inside your basement is pushing back. It is important to keep these two forces balanced as the water subsides. If the forces become unbalanced by pumping too rapidly, the basement floors or walls may crack.

It's important to keep basement floor drains open and clear as flood water recedes to allow the pressures from outside and inside the foundation walls to equalize.

Crawl spaces require special attention as well. First, remove and discard all wet insulation and plastic sheeting you find there. Next, dry out the crawl space using natural or powered ventilation such as a fan if necessary.

This may be a good time to check with local building officials to determine if your crawl space is adequately vented. Finally, crawl spaces should have continuous plastic ground covers installed once standing water has been drained or pumped out of the crawl space. Damp ground that is not covered will continue to be a major moisture source. Crawl spaces should be ventilated as much as possible to dry them out.

Floors and Flooring

Unfortunately, most floor coverings will not survive a flood and should probably be replaced. If you can remove them yourself, you can save a lot of time and money. By removing them you will also be helping the house to dry. And doing so doesn't require any special equipment or experience. If the floodwater reached wall-to-wall carpeting, you should discard it. To make this job easier, cut carpet and padding into strips that are small enough to carry.

Tile, vinyl, and linoleum should also be removed to speed the drying of the floor. Although a good floor finish helps by preventing the water from penetrating the surface from above, the underside of the floor allows water to penetrate from below and cause swelling and damage. When the floor is dry, you can sometimes correct "cupping" by sanding and refinishing. Otherwise, you must replace the flooring.

Tile, vinyl, and linoleum are usually installed over an underlayment, which in turn is installed on a structural subfloor. Water can loosen these materials directly or through swelling of the underlayment so it may be necessary to replace the flooring material and probably even the underlayment.

Structural subflooring is usually plywood or oriented-strand board. Older types of plywood made for interiors are especially susceptible to damage since they may not have waterproof glue between the veneers. Water penetrates the unfinished edges and surfaces of the plywood causing the veneers to soften, swell and delaminate. If this has occurred, you may need to replace the structural

subfloor as well. If in doubt, check with your local building department or a contractor.

Before you begin to rebuild or refinish, it's important that the wood structure of the home be completely dry. Refer to the earlier section on drying and decontaminating your home.

Walls

Interior Finish

In most homes, ceilings and walls are covered by either plaster or drywall. Plaster can regain its strength when dried, however it can not be decontaminated. Therefore, wet plaster should be removed and discarded.

Drywall acts like a sponge drawing water up above the flood level. Drywall becomes very fragile if it stays wet for a long time, and it will fall apart when bumped. Drywall can't be decontaminated either and should also be discarded. Because new drywall will be installed horizontally, a good line to remove old drywall to will be about 48" above the floor.

Check to make sure that the insulation above this line is dry and hasn't wicked water any higher. Insulation can act like a paper towel does with a counter spill, pulling up water much higher than the point of contact with flood water. If it is wet, remove all drywall.

All wall coverings inhibit drying so they should be removed and discarded, even in homes where the flood water has not actually reached the walls. New wall coverings can be installed once the building has been dried and decontaminated.

Wood construction is durable and will normally be structurally sound even after being in water. But once the water recedes, the moist contaminated environment allows decay organisms to flourish. If the environment persists, the decay will cause structural damage. Therefore, you must dry the structure.

Kiln-dried or well-seasoned wood used for residential framing can absorb water and will swell as a result. However, as the wood dries it will often return to its original shape and strength. Remember that even if this occurs, you will need to decontaminate.

Exterior Finish

Most homes will have either siding or brick on the exterior. To facilitate drying, walls can also be opened from the exterior. In the case of wood-lapped siding, plastic wedges can be inserted under the siding at the horizontal lap joint. Use a pry bar carefully. Place a wedge beside each nail. The wedges will stay in place permanently and will improve paint performance. These wedges under siding are only an additional measure, not an alternative measure — you must still open and completely expose all exterior walls from the inside of the home.

In the case of brick, generally good quality brick masonry can withstand flooding over long periods. Most types of brick will dry out and show no permanent damage from water. However, if the mortar is old or of poor quality, damage can occur from strong water currents or wave action. In addition, a disturbance or subsidence of the foundation can cause cracks in brick masonry. Do a careful inspection or get professional help. Even tiny cracks may be evidence of much larger and costly problems with the foundation.

Electrical

Electrical wiring in walls may suffer damage from wetting. The damage will depend on how well-sealed and impervious its shielding is. In many homes, plastic coated wiring is used, and it is fairly waterproof. Plastic-coated wiring will probably not need to be replaced after a flood.

Any outlet or switch, and all connections that have been under water for any period, however, may corrode. It is cheaper and safer to replace outlets and switches and to redo connections than to repair them. All electrical work should only be done by a qualified electrician.

During the rebuild, you may want to consider adding or moving outlets, switches and fixtures. Ground fault interrupters installed in each branch of an electrical circuit are a good idea to consider as well. If the house is old, it is possible the existing electrical service maybe undersized. Consult your contractor about the feasibility of adding a larger service entry and more breakers.

Since you'll be doing electrical work anyway to recover from the flood and the walls will be open for easy access, it may be a timely opportunity to consider electrical system improvements. Also, cabling for television, audio, and even security systems will be easy to install at this time.

Ceilings

A ceiling may not have been touched by flood water, but it can still be damaged by humidity. Check to see if drywall has swelled or pulled away from the framing. If it has, replacement will probably be necessary. If sections of the ceiling are sagging, carefully punch a few small holes at the low spots to drain collected water.

If flood water reached a drywall ceiling, you should remove and replace it. If the ceiling is plaster, it will dry eventually but will likely sag or crack, so it should also be removed and replaced. Remove all ceiling insulation to allow the joists to dry.

Consider upgrading the ceiling insulation as you rebuild. Remember, once the insulation contractor is on site to reinsulate walls, the extra cost of additional ceiling or attic insulation could be relatively minor.

Building Systems and Equipment Issues

Flooding Effects on Equipment and Appliances

Residential heating and cooling systems, refrigerators, water heaters and other appliances in contact with flood water can pose an extreme risk to the homeowner.

CAUTION: Gas and electricity are dangerous and if not properly handled and controlled, can result in explosion, electrical shock, and even death.

Therefore, from a safety standpoint, it is essential to restore heating and cooling systems and appliances to safe operating condition through repair or replacement **before** restoring power.

In addition to safety, there are health concerns associated with equipment and appliances affected by floods. Always assume that flood water brings contaminants. If equipment in the home has been in contact with flood water, the equipment could be contaminated by harmful bacteria and organics from the flood water.

It is essential to eliminate these substances from appliances, particularly those used for food storage and preparation, and any equipment in contact with potable water. While thorough cleaning of all surfaces with a disinfectant is necessary, you need to do more to return equipment to safe operation. The general procedure involved is cleaning, disinfecting, drying, and having a qualified professional inspect equipment.

Repairing your home and replacing its various systems represents a big opportunity for you to save significant amounts of energy and money in the long term. If your heating system, water heater, air conditioner and other major appliances have been damaged, you can upgrade to more energy-efficient models.

Some energy-efficient appliances cost no more than their inefficient counterparts. And while an energy-efficient furnace or air conditioner may cost you more initially, it will be cheaper to operate and will pay for itself in energy savings in just a few years.

For example, if your gas furnace is only about 60-percent efficient, as many older models are, upgrading to a 90-percent efficient model can lower your annual heating bill by about one-third. A new energy-efficient refrigerator will consume about half the electricity of a model built 15 years ago. Depending on your local electric rates, a new model could save you up to $100 per year.

Additionally, your utility may offer rebates for the purchase of high-efficiency furnaces, water heaters, air conditioners or refrigerators. Utilities, along with government and private agencies in your area, are ready to help you make informed energy-saving decisions as you rehabilitate your flood-damaged home.

The Federal Government sets energy consumption limits on furnaces, clothes washers, water heaters, dishwashers, refrigerators and freezers, room air conditioners, central air conditioners and heat pumps, and fluorescent lamp ballasts. As a result, today appliances are more energy-efficient than their predecessors. However, many appliances are more efficient than the minimum standards. Use the EnergyGuide labels to compare efficiencies of appliances. These labels display the appliance's annual energy cost, based on estimated annual hours of use and on a national average energy price.

Because energy prices vary from region to region, the labels also include a cost table that allows consumers to estimate operating costs based on local rates.

An excellent reference to help you choose energy efficient heating, cooling, and water-heating equipment is the **Consumer Guide to Home Energy Savings**, which lists the most energy efficient models available in all of these categories and more. See other sources of information in Appendix 2.

Special Considerations For Electric Motors

There are a considerable number of electric motors in your home. The furnace, whether gas or electric, washer, dryer, air-conditioner, dishwasher, refrigerator, and freezer all have an electric motor which may be damaged by exposure to flood water. As always, safety should be your first consideration.

CAUTION: Don't start up any heating, cooling, or other electrical equipment that has come in contact with flood water. Serious damage and life-threatening injury can occur. Be sure that all electrical equipment is either unplugged or power to it has been disconnected at the main breaker.

Any electrical equipment that has an electric motor and has been subjected to flood water will need to be inspected and evaluated individually by appropriate professionals before using.

Contact your insurance adjuster to determine your coverage for repair versus replacement, especially of heating and air conditioning equipment. Also check your warranty, if possible. Flood damage to this equipment may not be covered by warranty. The objective is to make an informed decision on whether repair or replacement is the best course. Successfully repairing an electric motor depends on the following considerations:

- the length of time the motor was under water,
- the age of the motor,
- the type of bearings involved and how they are lubricated, and
- the type of contaminants in the flood water.

Repair costs, particularly for heating and cooling equipment that has been exposed to flood water will likely be extensive. Manufacturers usually recommend that all motors, electrical components, safety controls, and (in the case of gas appliances) gas valves be replaced. A detailed and thorough cleaning and disinfecting of all components is also recommended.

Given the likely expense of attempting to have equipment repaired, replacement may be the best option. Especially considering the potential for selecting new equipment which is much more energy efficient.

Space Heating Systems

Gas Furnaces and Boilers

Natural gas furnaces, space heaters and boilers all have gas valves and controls that are especially vulnerable to water damage from floods. Corrosion begins inside the valves and controls, and damage may not be readily visible, even if the outside of the device is clean and dry. At a minimum, this damage can result in reliability problems. More severe consequences could be fire or explosion. If there is any question whether flood water has reached a gas appliance, have the unit checked by a professional. In all cases where you have decided to try to salvage the unit, you will need to replace gas valves, pilot and burner orifices, controls, and the filter. This work should only be done by a qualified professional.

There are differing opinions regarding replacement versus repair of flood-damaged heating systems; however, most experts recommend replacement. Even if a furnace has been cleaned of debris and mud, and disinfected (often at great cost), and seems to be working properly, parts may later corrode or malfunction and you may also lose your warranty coverage. The older a heating system is, the more likely it is to be inefficient, so you may be better off replacing yours even if it hasn't sustained much damage.

Replacing a heating system is a complex matter, difficult under any circumstances. Yet, as a result of flood damage, you may have no choice but to replace your furnace. You can turn misfortune into opportunity by considering a new, energy-efficient model that will lower your future heating bills. Depending on the type of fuel you use — oil, electricity, propane, wood or natural gas — this may be also a good time to consider switching fuels. See the worksheet in Appendix 3 to help determine which fuel will be cheapest for you. Also ask your local utility about available rebates for new energy-efficient gas or propane furnaces.

If you have a central forced-air furnace in the house you are repairing, devote some attention to your ductwork too. Do not try to salvage duct insulation that has been in contact with flood water. It is impossible to decontaminate. Next, clean, dry and disinfect the ductwork. Doing a thorough job will require disassembling the ductwork. Since

many ducts are leaky, uninsulated, and lose a tremendous amount of heat, this is also your opportunity to eliminate wasteful heat loss. The best approach is to carefully seal all joints in the ductwork, and insulate all ducts located in unconditioned spaces such as attics and crawl spaces.

Special Considerations for Propane Systems

Propane-fired heating equipment should be dealt with the same way as indicated for natural gas-fired equipment. In every case, you should replace all valves and controls that have been in contact with flood water. Propane systems also require attention to their gas pressure regulator. This regulator contains a small vent hole in its body to sense outside pressure. For effective gas regulation, this hole must always remain unobstructed. During a flood, debris can easily plug the hole, causing dangerous malfunction and corrosion.

CAUTION: You must replace all pressure regulators used in propane systems affected by flood water.

Unlike natural gas, propane is heavier than air. Consequently, propane can settle to the floor or to the basement of a home, and being invisible, would produce a hazardous situation that could easily go unnoticed. Basements and other low places are locations where propane would tend to collect. This makes working around areas where propane has leaked quite dangerous. Use extreme caution where there is the potential for propane leaks and get propane equipment checked, repaired and/or replaced by a qualified professional as quickly as possible.

Electric Heat

Electric resistance space heating for homes exists in a variety of configurations, but the most common type is the wall- or baseboard-mounted units. Although they can be costly to operate depending on the price of electricity in your area, these systems have flexibility in providing heat to individual rooms in a house and can even be operated from individual thermostats in each room or zone of a house.

The baseboard-mount types have no moving parts and unless they are damaged by an electrical short, they will withstand flood conditions.

Before returning these systems to operation, disconnect electrical power to each unit by switching off the main breaker. All connections at the heater and control thermostat should be allowed to dry carefully and thoroughly. Before restoring electrical power, a qualified electrician should check for shorts on all heating circuits. You can then restore electrical power and use the heaters to help dry out the interior of the house.

Sometimes in emergencies, stand-alone, plug-in heaters are used by homeowners as a source of temporary supplemental heat. These heaters, however, usually

contain a small fan, and its motor will likely need special attention after being submerged.

A second type of electric space heat is the central electric furnace. This furnace consists of electrically heated coils, a fan to provide air circulation across the coils, and controls which include safety relays. Just like the gas forced-air furnace, the electric forced-air system is susceptible to corrosion and damage, resulting in reliability problems or safety hazards. If there is any question whether flood water has reached an electric furnace, have the unit checked by a professional. In all cases where you have decided to try to salvage the unit, a qualified professional will need to replace all controls, safety interlocks, and probably motors.

Electric forced-air heating systems have essentially the same ductwork as gas-forced air systems, so the same actions are in order. Discard any wet duct insulation. Disassemble, clean, disinfect, and dry the ductwork. Take extra care in reassembling the ductwork to avoid leaks. Carefully insulate all ducts in unconditioned spaces.

Radiant Ceiling Heat

In this type of heating system, electrically-heated cables are embedded in the plaster or drywall ceiling. The cables warm the ceiling, which in turn warms the room by radiant heat.

If the ceiling becomes wet from a flood, the plasterboard will weaken, and perhaps crack and the ceiling will need replacement. Although the electrical cables themselves may appear to be undamaged due to their tough, waterproof coating, there may have been large mechanical stresses on the cable, and a qualified electrician should be consulted to determine whether the cable is reusable.

Heat Pumps And Air Conditioning Systems

Heat pumps extract heat from the outside air and transport this heat into the house with the aid of a refrigerant. Reversing this process allows the same heat pump system to provide air conditioning for the home, eliminating the need for a separate cooling system. Some heat pumps (the unitary type) are simple wall-or window-mount, and some (split systems) are more elaborate, with part of the components indoors and part outdoors.

Of the various types of split-system heat pumps that are in use, two things they have in common are the power and control wiring between the indoor and outdoor parts of the system, and the piping that moves the refrigerant from inside to outside the home and back. The refrigeration circuit of virtually all residential heat pump (and air conditioning) systems is sealed at the factory. In a split system it is sealed by the contractor during installation.

Even if the system is in contact with flood water for a long period, this sealed system is likely to remain intact. However, if flood water has repositioned either the indoor or outdoor units of a split system by only a small amount, there is the potential for a breached refrigerant system. The heat pump (or air conditioning system) will then require major repair or full replacement.

If the refrigerant system remains intact after the flood, the entire system should be cleaned, dried, and disinfected. You should have a qualified electrical or refrigeration mechanic check all electrical and refrigeration connections for both indoor and outdoor units, including all control circuits. The decision to repair or replace should be made by a qualified professional on a case-by-case basis.

As with the other types of heating systems, the heat pump system will also have a system of distribution ducts. The same procedures of disassembling, cleaning, disinfecting, and drying are in order. Remember to carefully reassemble the ductwork without leaks, and to insulate those portions of the ducts that go through unconditioned spaces.

If you need to replace your existing heat pump, or if you are considering switching to a heat pump because your existing heating system is beyond repair, consider the most energy-efficient model available. If electricity is the only energy source available, and the climate requires considerable cooling and heating during the year, a heat pump system can be more cost-effective than electric resistance heating with a separate air-conditioning system. Using the worksheet in Appendix 3, you can analyze the relative costs of various fuels and heating systems.

To compare the energy efficiency of residential heat pumps, consult the Seasonal Energy Efficiency Ratio (SEER) for cooling and the Heating Seasonal Performance Factor (HSPF) for heating. Efficiency ratings for heat pumps are listed in the **Consumer Guide to Home Energy Savings, Third Edition**. More extensive ratings of heat pumps can be found in an annual directory published by the Air-Conditioning and Refrigeration Institute (ARI). You may be able to obtain this directory in a library or from a contractor. See Appendix 2 for sources of both references.

Space Cooling Systems

Whether your home has been cooled with a central air conditioning system, a heat pump, or room air conditioners, you can replace flood-damaged units with energy-efficient models that can cut energy use by more than 20 percent. A professional can help you select a unit based on the size and tightness of your home. Your local utility may offer rebates on the purchase of energy-efficient air conditioners, too.

Consumers can compare the efficiency of central air conditioners and heat pumps (in the cooling cycle) using the SEER. The higher the SEER, the more efficient the unit. Room air conditioners are rated by a counterpart system called the Energy Efficiency Ratio (EER).

The American Council for an Energy Efficient Economy recommends central air conditioners with a SEER of at least 12, and room conditioners with an EER of at least 9. No matter what type of system you choose, make sure that it is sized properly by a qualified air-conditioning technician. If your cooling needs are modest, then room air conditioners are probably your best choice.

Water Heating Systems

Whether your water heater is gas or electric, if it was exposed to flood water, the unit should be replaced. A new water heater is a relatively small investment, and replacing it is fairly easy to do.

In a gas unit, valves and controls will likely corrode. In an electric unit, the thermostat and controls will likely corrode. In both types, the insulation surrounding the unit will be contaminated and will be nearly impossible to disinfect. Additionally, the insulation would take a long time to dry, leading to corrosion of the tank from the outside.

Even if water heater components have been cleaned and the unit seems to operate properly, parts may corrode in the future. Both gas and electric water heaters have a pressure relief valve that can corrode and stick after being exposed to flood water. Be sure, therefore, to replace this valve as well.

Next to space heating, water heating uses the most energy in the home. As with furnaces, new energy-efficient models are available. Insulation levels in new gas and electric water heaters are higher today than in the past. Some utilities offer rebates on their purchase. You may even be able to get a package deal from your heating supplier on a furnace and a water heater. And, as with furnaces, you may want to look at the operating costs of electric versus gas water heaters. Depending on your electric rates and availability of gas, a gas water heater can be cheaper to operate.

Remember, too, that many different measures are available to reduce hot water consumption and thereby decrease water heating costs. For example, low-flow shower heads use 1 to 4 gallons per minute (gpm), compared to standard-flow shower heads, which generally use 5 to 10 gpm. A shower head flow restrictor can save as much as 6 gpm. Similarly, insulating hot water pipes in your home can reduce the amount of energy (and water) lost while waiting for water to become hot at the tap.

For more useful information on conserving water in the home, consult **Water Efficiency for Your Home: Products and Advice Which Save Water, Energy, and Money** (See Appendix 2).

Appliances

Large Appliances

Large appliances include stoves, refrigerators, freezers, washing machines and dryers. Evaluate these items one-by-one and determine whether it is more prudent to salvage or replace them. In all cases, there are some general guidelines to follow.

Stoves

With stoves, an assessment by a qualified appliance technician will help the homeowner decide if it is better to replace or to refurbish the damaged stove. As a start, disconnect the stove and remove the back cover to expose portions of the insulation. Allow the insulation to dry thoroughly before turning the stove on.

If the controls and rheostats have gotten wet, have them replaced. With gas stoves, you should always replace the pilot orifices and gas control system if water was present. The interior surfaces must be cleaned and disinfected. Once the stove is operable, an extented "bake out" period is recommended. The high operating temperature of a stove will help eliminate residual moisture that could cause later problems.

If your refrigerator or freezer was submerged in flood water, these appliances should be replaced.

Refrigerators and Freezers

Refrigerators and freezers contain insulation that could be wet if the units were under water. This insulation is difficult to reach without destroying the cabinet of the unit. It will dry very slowly since the cabinet walls remain relatively cool while the appliance is on. Mullion heaters in some refrigerators, which eliminate condensation, are of further concern in water-soaked cabinets because they present a shock hazard. Further, the slow dry-out of the insulation in refrigerator/freezers is conducive to the formation and growth of bacteria carried between the walls of the cabinet by the flood. This also presents a health hazard.

Refrigerators alone can account for as much as 15 percent of a home's energy budget, so replacing an old unit with a newer energy-efficient one can save considerable amounts of money and energy. A typical new refrigerator with automatic defrost and a top-mounted freezer uses about 800 kilowatt-hours (kWh) per year; a typical 20-year-old model uses about 2,000 kWh per year.

When shopping for a new refrigerator, keep in mind that different features can have an impact on energy consumption. For example, side-by-side refrigerator/freezer units typically consume about 18 percent more energy than units with a top-mount freezer. Of course, larger units consume more than smaller ones,

and units with automatic defrost tend to use more energy than their manual defrost counterparts. Select an energy-efficient refrigerator with only the features that you need. The expected long life of refrigerators coupled with high efficiencies available in the newer models will produce savings to the homeowner for years to come.

If flood water covered only a few inches of the kitchen floor, it is likely that the insulation for refrigerator/freezers is dry, and you will only need to check the refrigeration system along the bottom and back of the unit. Like heat pump and air conditioning units, the refrigeration system is sealed in refrigerators and freezers. Unless punctured during the flood, they should be in good shape.

Check all electrical controls including the defrost timer, thermostats and other safety interlocks in refrigerators and replace them if there is significant water damage.

Washers and Dryers

As with other appliances, clean, dry and disinfect your washing machine and dryer and have an electrician or appliance technician check all electrical contacts and connections. Replacement of the timer controls of these units will likely be necessary.

If you decide to replace your clothes washer, you should be aware that most of the energy used by washing machines is used to heat the water. Look for machines that offer several water temperature selections for both the wash and rinse cycles. A load of laundry washed and rinsed in hot water can cost as much as 20 times more than one using cold water for both cycles. Also look for machines that allow you to select different water levels.

If you decide to replace your clothes dryer, you should be aware that newer models are able to sense dryness and automatically shut off. Compared with the older models, which operate on a timer, these new models can save between 10 and 15 percent on energy costs.

Dishwashers

As with other appliances, clean, dry and disinfect your dishwasher and have an electrician or appliance technician check all electrical contacts and connections. Replacement of the timer control system will likely be necessary.

If you need to replace the dishwasher, consider a new energy efficient model. Most dishwashers today use about 8 to 14 gallons of water per wash. Most of the energy used by dishwashers goes toward heating water, so units using less water also use less energy. Many dishwashers available have energy-saving features, such as "no heat" drying cycles and light wash cycles, which can save both water and energy. Units equipped with booster heaters will heat water to the higher levels necessary to adequately clean and

disinfect dishes (generally 140 degrees F). This feature allows you to keep your water heater at a lower setting, thus reducing your household water-heating costs. For each ten degrees you can reduce your water heater temperature, you will save about 3 to 5 percent.

Small Appliances

You will need to unplug, clean, dry, and disinfect small appliances including microwave ovens, TV's, etc. inside and out. Examine them carefully and determine whether to repair or to replace them. In some cases, simply drying the entire unit with careful attention to the electrical parts will be enough. Allow an extended drying time before testing the appliance.

Lighting

Incandescent bulbs are the most common source of lighting in American homes, and they waste a lot of energy. Ninety percent of the energy consumed is dissipated as heat. Fluorescent lamps have much greater efficiency than incandescent lamps, especially when combined with the high-efficiency electronic ballasts now on the market. Compact fluorescent lights are available that can replace incandescents using the same fixture, and save considerable energy for the same light output.

Compact fluorescent lamps are more expensive than incandescents, costing about $15 to $20 each. But they last much longer and use a great deal less electricity. Depending on how long your lights are typically on each day, installing compact fluorescents could save you quite a bit of money over time. And, if your utility offers rebates that lower the initial cost of these lamps, they'll pay for themselves even more quickly.