BULLETIN

BRANZ
BUILDING ON KNOWLEDGE

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RESTORING A HOUSE AFTER FLOOD DAMAGE

- People who live in low-lying, flood-prone areas should always have an evacuation plan and emergency supplies prepared.
- If your house has a notice placed on it by the local council proclaiming it is uninhabitable, then you cannot live in it until the sign is removed.
- Flood debris should be cleared away as soon as possible so drying can start.
- **NO** finishing work should be done until the house is fully dry.
- All services must be made safe before any remedial work begins.

1.0 INTRODUCTION

1.0.1 This Bulletin is intended to assist with the "putting right" that is so important after a flood. As well as the human drama that takes place during the event, there are many things that need to be considered later as the occupants' or owners' lives are reinstated.

1.0.2 A house is usually a person's largest investment. There is often an emotional attachment to the house which needs to be taken into consideration during the restoration.

1.0.3 Being a flood victim will always be a traumatic experience, even when it has a happy ending. Immediate concerns are often whether the damage is covered by insurance, where to live in the interim, where are the pets etc? This Bulletin relates to the restoration works only.

1.0.4 The Earthquake Commission (EQC) provides additional cover for those with house and contents insurance. It covers flood damage to land within defined criteria and also house and contents damage due to natural disaster. These circumstances are not covered by this Bulletin.

Figure 1. The building paper should be inspected closely for damage and the framing condition and treatment determined.

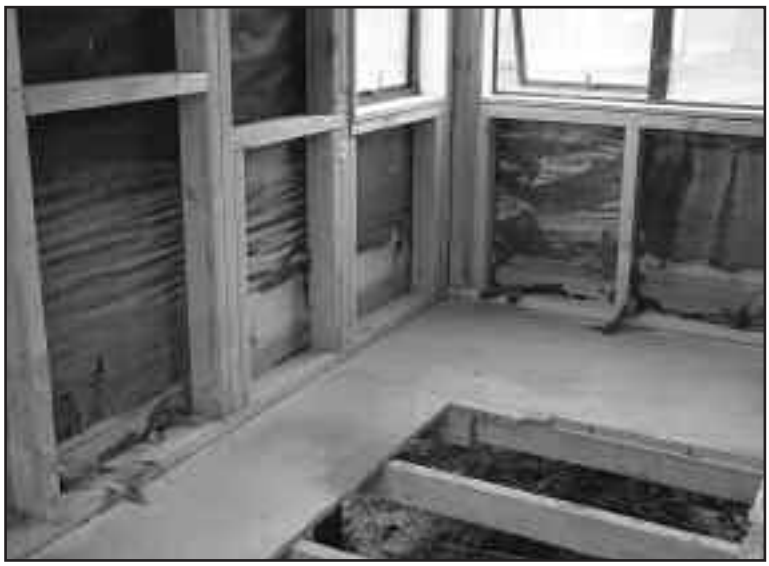

Figure 2. This building paper will need replacing necessitating the removal of the exterior cladding.

2.0 FIRST ACTIONS

2.0.1 After a house has been flooded, Civil Defence Emergency Management Group personnel will advise householders when they are permitted to return to the house. Although this procedure gives a chance for owners to return and recover items of immediate concern, it does not necessarily mean that the house is safe or can be occupied. The Territorial Authority (local council) will usually have placed an "uninhabitable" notice on the affected house and it will not be able to be lived in until that notice is lifted. This may be for structural or for health reasons.

2.0.2 Before starting the clean-up, check that the property presents no immediate danger to the people involved. This will mean that:

- the floodwaters have receded enough to make it safe to enter and remain at the property
- the Electrical Supply Authority has either cut the power supply or checked that the supply and installation is safe. Appliances will need to be individually checked
- the gas supply has been checked and tagged as safe or disconnected
- the house is structurally safe – an engineer, building consultant or experienced builder should confirm this
- the sewage system is safe and presents no health danger to workers cleaning. Flooded septic tanks should be pumped out as soon as possible and the disposal fields cleared of any silt.

2.0.3 When entry to the house is permitted, security may be difficult to maintain. Remove any valuables which were not able to be taken at evacuation time and relocate them somewhere safe for storage. This may include large appli-

PREPARATION

BEFORE FLOODING OCCURS

If you live in an area which could or has previously flooded, you should be prepared by:

- assuming that you will at some stage have to cope with a flood
- informing yourself about flood protection and evacuation procedures for your locality
- knowing how high the worst previous flood had risen
- keeping a survival kit ready at all times. The kit should be stocked to enable self-sufficiency for three days. The inside cover of the phone book gives EQC and Civil Defence recommendations.

WHEN A FLOOD IS LIKELY

The impending flooding of a house is a traumatic experience. If there is sufficient time house occupants should take the following steps:

- make up a “get away” kit to take with you if you have to be evacuated. Include personal papers such as birth certificates, passports, insurance policies, essential medications, baby needs, cheque book. Only if time and space permits should food, photos, small family heirlooms and the like be included
- get warm and waterproof clothing ready and include some blankets
- lift all moveable items as high as is safely possible within the house Store items on top of tables, in top cupboards, in the roof space or upstairs in two-storey houses. Don’t stack items on tallboys or cupboard units that might tip over when the flooding occurs
- when leaving turn off the electricity, gas and water mains supplies if it can be done safely
- close all the doors, including internal doors, to minimise the amount of debris able to enter rooms
- cover glazed doors and low-level windows on the outside with protective materials if available and there is time to do so safely
- make sure all poisons and hazardous chemicals will be secure and safe during flooding
- if possible, prepare pets for transport
- make ancillary buildings secure and protect where practical
- listen to the radio for information on flood conditions and possible evacuation procedures. Strictly follow Civil Defence instructions during any flood.

ances, as well as all the smaller household items and personal items such as passports, insurance policies etc.

2.0.4 Take photos of the damage and any items you are disposing of, especially if this has to be carried out before your insurance company has a chance to inspect them.

3.0 HEALTH AND SAFETY

3.0.1 Occasionally a house will be able to be lived in while the restoration and repair work is being carried out. The house could be lived in when:

- living there will not constitute a health risk
- the initial clean-up of water, mud and debris is completed
- the power supply has been safely restored
- all sources of potable water supply and sewage systems have been checked, repaired if necessary, tested and declared safe for use
- the local authority lifts any “uninhabitable” notice placed on the house.

3.0.2 Floodwater is often contaminated by the presence of dead animals, sewage etc. Strict health precautions must be followed:

- bury all accumulations of faecal matter, animal bodies etc as a first priority
- drink only purified water until the normal water supply is safely drinkable
- discard all food which has been exposed to the flood, except that in airtight containers
- carefully clean food containers before opening them. If the flood did not enter a relatively full freezer, the food may survive for about three days (without power) without loss of quality
- thawed food, if sound, should be cooked immediately and then refrozen

Figure 3. Floor coverings and wall linings have been removed to allow the framing to dry.

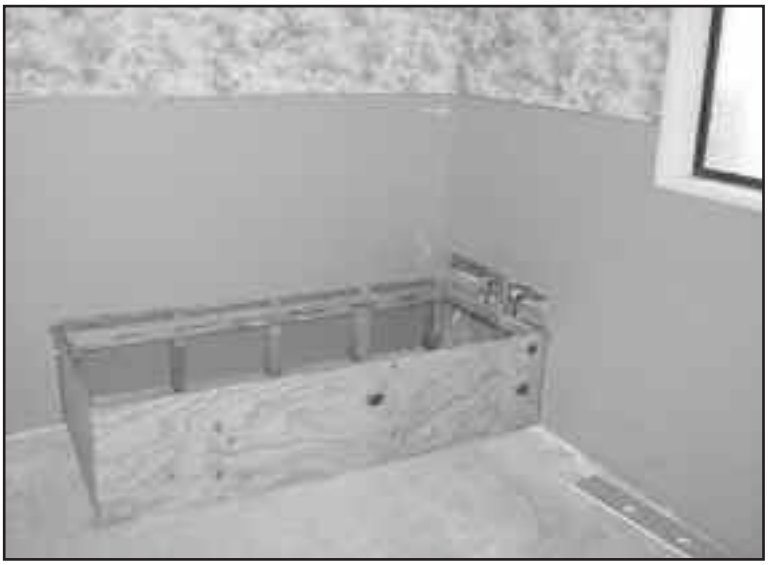

Figure 4. In this instance a full sheet width of plasterboard has been replaced and the bath framing renewed.

- keep small children away during cleaning up
- use liberal amounts of disinfectant when cleaning, and wash hands thoroughly before eating, drinking or smoking
- disinfect cuts immediately and cover with a waterproof dressing
- thoroughly wash and cook all garden vegetables before eating.

3.0.3 Sun and wind are good cleansing agents, but a sprinkling of hydrated lime on the garden will help to speed up the process.

4.0 CLEANING UP INSIDE

4.0.1 Everything that is wet (furniture, bedding, carpets, clothing, appliances, books, papers etc) should be taken outside for cleaning and drying whenever weather permits or for disposal.

4.0.2 Absorbent items that have been saturated by contaminated waters and cannot be cleaned must be disposed of. This will include wetted areas of plasterboard or other wall linings, glass fibre insulation and may also include mattresses, lounge furniture, carpets, etc.

4.0.3 Leave nothing inside the house that can trap moisture and prevent or slow the drying out process. (When clean, store in a dry area.)

4.0.4 Gaining access to pockets of trapped water and debris will necessitate:

- removing skirtings, cupboard kick panels and front panels to showers and baths
- removing internal wall linings sufficiently to allow the cleaning out of the wall cavity and the removing (and replacement) of wet insulation materials
- drilling holes in, or removing, ceilings when water is trapped above them
- removing the ground floor ceiling in two-storied houses if water was above that level
- removing electrical switch plates and fittings (ensuring power supply is disconnected).

4.0.5 Remove the mud and silt trapped:

- underneath the bath and shower tray
- in and below the bottom shelf of cupboards

- under stairs
- under floorboards
- in basements
- in wall cavities between internal linings and claddings
- in the fireplace, chimney or wood-burner
- above the ceiling or between the first floor and the ceiling in two-storied houses in severe flooding (remove all wet insulation)
- in electrical switchboards, wall sockets
- in sanitary fittings such as toilets, bidets and cisterns
- in masonry veneer cavities.

4.0.6 Remove mud and debris with shovels and squeegees. Then, if sufficient clean water is available, use a hose with a reasonable nozzle pressure to clean out the mud and dirt, starting from the top or upper limit of the flooding and work downward to the floor or basement. Insert the hose into the concealed spaces to flush out dirt as work proceeds.

4.0.7 After hosing down, surfaces should be wiped or washed down with a disinfectant to reduce the risk of flood-carried infections.

4.0.8 It is usually easier to clean the framing wall cavities from the inside of the house, because of the presence of building paper on the outer face of the framing and the need to replace insulating materials. If the flood water was heavily silt laden, there is a probability that there will be silt trapped between the outside wall cladding and the building paper. If this is the case, then the cladding should also be removed sufficiently to allow the silt to be removed because the silt will affect the performance of the building paper (more detail in section 9.0).

4.0.9 Hard linings like wood paneling or wallboard can be scrubbed with a stiff bristle brush, plenty of water and a detergent so that dirt is removed from cracks, corners and crevices. The surfaces should be well-rinsed with cold clean water.

4.0.10 Gypsum plasterboard has a low tolerance to water and will almost always have to be removed and replaced if it has been immersed in water. Depending on the wall finishes being reinstated, it may be possible to remove a strip 300 mm higher than the flood damaged zone. However, for a high level of finish, a better result will be achieved if full sheets are removed and replaced after the framing has dried.

4.0.11 Where gypsum plasterboard is used as a bracing component, it must be removed and complete sheets replaced. Removing bracing elements introduces the need for temporary bracing, particularly when the building requires an extended period for drying. This should be done in consultation with an engineer, building consultant or experienced builder.

4.0.12 Items made from composite wood materials like MDF (medium-density fibreboard) or particleboard have a low tolerance to being immersed in water and will need replacing if the flood water has caused the fibres to swell. This may include such things as doors, skirtings, architraves, scotias, window jamb linings and joinery units.

4.0.13 Untreated timber framing (native timbers and those marked KD chem-free) should be dried as quickly as possible, and if there is any sign of mould growth, this should be removed and the affected surfaces should be wiped with a 10% bleach solution. When the framing is dry, it should be treated with a proprietary brush-on decay preventative surface treatment containing copper napthenate. Replace timber which has developed rot or significant mould growth.

5.0 CLEANING UP OUTSIDE

5.0.1 Remove, bury or burn driftwood, rubbish and decaying vegetation.

5.0.2 Keeping the weatherskin of the house in the best possible condition will help later drying by keeping out any rain.

5.0.3 The outside of the external walls should be cleaned with water and detergent as soon as possible as dirty surfaces will keep it damp. Use a stiff nylon or bristle brush for brick or blockwork, and a soft brush or cloth for timber. Do not waterblast, as this is too aggressive and can do more harm than good.

5.0.4 In houses with masonry veneer cladding the cavity should be cleaned

out by inserting a hose through the perpend drain points or, in more extreme cases, by removing bricks or blocks in the bottom course to make access ports to flush out the silt from behind the bricks or blocks.

5.0.5 Wedging out or removing the bottom two or three weatherboards will allow the draining and flushing out of the bottom of the wall cavity where it continues past the inside floor level. This will also give much better ventilation to the wall and assist in the drying process. For sheet clad houses, the sheets may span from top to bottom and might have to be removed completely.

5.0.6 All monolithic claddings (stucco, EIFS, flush stopped fibre-cement sheet etc) should be closely inspected for damage. Some of these are quite absorbent. Fibre-cement sheet, for example, will need to be able to dry before linings are re-attached.

6.0 SUBFLOOR SPACES

6.0.1 It also is very important to clean out the space under the floor of the house to prevent excess moisture remaining, and as a means of reducing the risk of future rot problems.

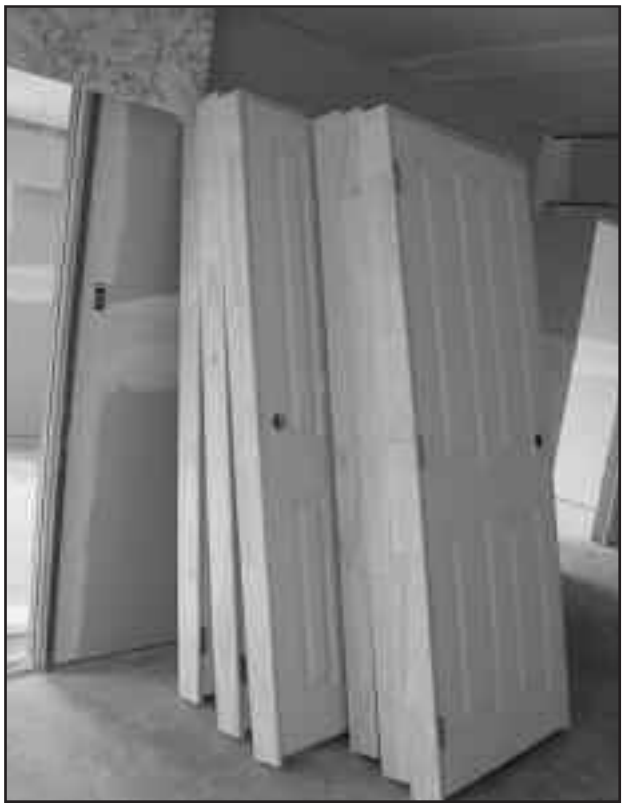

Figure 5. It is probable that new doors and frames will be needed if the water immersion has been anything other than brief.

6.0.2 Drain away the water under the floor by:

- digging drainage channels to drain the water out
- pumping water out
- digging a pit to drain the water into, then pumping the collected water out.

6.0.3 The water taken from under the house should be disposed of as far away from the house as is practicable. Where the subfloor is lower than most of the surrounding ground it may, because of natural water seepage, take some time for water to stop gathering under the house.

6.0.4 Once the subfloor water has been drained, the dirt and debris which has been deposited under the house should be removed. An exception is where there are no foul odours present, the foundation vents are not blocked and there is at least 400 mm between the lowest timber and the ground. If it contains no organic matter, solid debris such as silt could be left, but experience shows that leaving the silt slows the drying process.

6.0.5 Foil insulation, if soiled, is no longer effective and must be removed. Removing the foil releases any water trapped between the foil and the floor as well as allowing a wet floor to dry more quickly. The underfloor insulation should be re-instated to the level required by the current Building Code after the subfloor is dry.

6.0.6 The underfloor area, particularly around the perimeter, in all the nooks and crannies and the underside of the flooring, must be hosed down to remove dirt and debris. Dirt, if it is left, will hold dampness, slow the drying and may cause the onset of rot.

6.0.7 Underfloor services such as drains, pipes, wiring and conduits should be checked for damage and repaired. Silt can be taken by the floodwater into the sewage and stormwater drains through the gulley traps. This may necessitate flushing with clean water.

6.0.8 The best way to dry the underfloor space is to maximise the airflow beneath the floor by:

- clearing debris on the outside of

the building which is blocking ventilation openings
- knocking out the grilles to underfloor vents to increase the airflow
- cutting back plants which are obstructing vents
- removing items stored under the house
- leaving access doors wide open
- removing part of the foundation enclosure such as base boards or sheet linings, or
- forming new ventilation openings (ensuring there is no structural compromise) in concrete foundations.

7.0 DRYING OUT THE HOUSE

7.0.1 Once all the wet materials have been removed and the house has been thoroughly cleaned, drying out can begin. Be warned that the drying out, particularly in winter, can take more than 3–4 months.

7.0.2 Quick drying is preferable. The removal of linings will speed the drying of concealed places. Internal linings can be readily replaced when the house is dry. Re-lining should not be carried out until the moisture content in the timber wall framing has dropped to 12–16% and the framing must show no signs of rot.

7.0.3 On dry days, keep all windows and doors open to maximise ventilation and therefore drying. They may have swelled as a result of the water and be difficult to open. On wet days, leave the windows ajar – so there is still some ventilation. Leaving cupboard doors and drawers open will speed the drying of these items.

7.0.4 Heaters (and fans, dehumidifiers) can be used to dry out moisture, but care must be taken to not use too much heat because it will cause wood to warp and split. An inside air temperature of approximately 20°C (or at least 8°C above the outside air temperature) will increase the drying rate without creating additional problems. It is essential to use some ventilation as well as heating to remove the warm moist air from the house. Do not light a fire within a brick fireplace to help with the drying unless it has already dried fully (refer 9.15).

7.0.5 Particleboard floors, if under water for less than a week, should remain serviceable. The floor must be dry before its strength can be checked.

7.0.6 Drying of the floor can be helped by:
- sanding or using a heat gun to remove any varnish or sealer
- making sure there is good ventilation both inside the house and under the floor
- lifting water-resistant floor coverings like vinyl sheet, vinyl tiles and ceramic tiles.

7.0.7 Do not attempt to straighten warped or buckled timber floors until all of the house has dried completely and the moisture content of the timbers is 16% or less.

8.0 MISCELLANEOUS CLEANING

8.0.1 A number of items within the house must be removed for cleaning if covered by floodwaters. Those items which must be carefully cleaned, decontaminated and checked before being reinstalled and/or reused include:
- electrical outlets and fittings – it is probable that flooded electrical outlets and fittings will need to be replaced but the wiring may well be usable
- fixed electric and gas heaters
- stoves and cookers
- hot water cylinders
- central heating systems
- central vacuum systems
- wood burners
- toilet pans
- the interior of stormwater and waste pipes
- toilet cisterns
- header tanks (even if not inundated they may have been filled with contaminated water during the flooding)
- floor coverings.

9.0 REPAIRS

9.0.1 While owners want to get their house back to what it was before the flood as soon as possible, it is essential that the house is sufficiently dry before repair work is carried out.

9.0.2 Undertaking repairs to the structure and finishes before the house is dry enough can result in:
- mould developing

- poor adhesion (blistering) of finishes
- materials continuing to move as they finish drying resulting in cosmetic cracking to plaster and paintwork
- lifting and bubbling of vinyl floor coverings
- health problems for occupants.

9.0.3 Timber in houses normally has an in-service moisture content of between 12% and 20%. After standing in water, the timber will absorb moisture and may take months for the moisture content to return to what it was. It must drop to 12–16% before the wall linings are permitted to be replaced (see section 10.0).

9.04 Damaged wall wrap or building paper (in external walls) may need to be replaced. This will require the cladding to be removed on the outside of the house where the damage occurs. It is not sufficient to staple a new piece between the studs on the inside.

9.0.5 When reinstating insulation, take the opportunity to upgrade to the best practice recommended by SNZ/PAS 4244:2003 Insulation of lightweight framed and solid-timber houses if possible (R2.6 for walls, R3.3 for roofs with non-solid wall construction, R4.6 for roofs with solid wall construction).

9.0.6 All reinstatement work must be carried out in accordance with the Building Code. There were significant bracing changes in 1999 in NZS 3604 for timber-framed construction, and if the reinstatement work is beyond replacing “like with like” then the new requirements apply. With the introduction of NZS 3604:1999, there were no longer published bracing ratings for generic systems, such as diagonal boarding, and only tested proprietary systems can be used. BRANZ recommends upgrading to current bracing requirements wherever possible.

9.0.7 If there is doubt concerning what bracing was used at the time of construction, the consent plans held by the local authority should be referred to. If the construction dates from before 1978, a bracing schedule should be re-calculated by an architect or engineer using NZS 3604 and reinstatement of linings carried out according to its guidelines.

9.0.8 Where appropriate, the opportunity should be taken to add tie-down straps between the studs and bottom plates, and the number of foundation holding-down bolts checked and added to if necessary.

9.0.9 Replace doors (including cupboard doors) which have been damaged as a result of swelling and/or blistering or peeling surfaces. In some instances existing frames may be retained, but it will often be more viable to install new pre-hung doors complete with new hardware.

9.0.10 Check particleboard floors for swelling at the joints by using a long straight edge. If swelling is more than 4 mm the floor should be sanded flat. If it exceeds 6–8 mm, replace the floor.

9.0.11 Once the house is cleaned out and the building fabric dried the following items can, after cleaning and/or repair or replacement, be reinstalled:
- appliances
- hot water cylinders
- heaters
- central vacuum and heating systems
- toilet cisterns, shower mixers
- electrical fittings
- carpet which does not have rubber backing or rubber underlay (rubber underlay will restrict the final drying).

9.0.12 No decorating should be carried out until the moisture levels have dropped to the acceptable levels for relining.

9.0.13 Under the floor, insulation which has been removed should be replaced. Under most floors the perforated foil can be fixed directly to the underside of the floor joists, but adding timber battens will prevent fixings pulling through. The use of purpose-made polystyrene panels or glass fibre insulation fitted between the joists is an alternative, but they must be a tight fit between the floor joists.

9.0.14 Ventilation holes in foundation walls should be made vermin proof if they have been damaged or removed to assist drying. Any base boards which have been removed should be replaced when the drying is complete.

9.0.15 Fires should not be lit in brick fireplaces until they have fully dried because if there is still moisture present, steam will be created which will cause damage as it expands. It can blow the mortar and bricks apart.

10.0 TESTING FOR MOISTURE

10.0.1 Before any wall linings are replaced there should be a pre-lining inspection by the Territorial Authority. The person doing this inspection will have a moisture meter and will ascertain if the framing moisture level has dropped to a suitable level. While the Building Code requires a moisture content of less than 20%, it must be noted that plasterboard manufacturers will usually require a level of 12–16% for normal use and 8–10% if air conditioning or central heating is to be used.

10.0.2 For concrete floors, the most reliable test for dryness is a flooring hygrometer. If one is not available, the following method will give a general indication of the moisture level: tape all four edges of a 1 m x 1 m piece of clear polyethylene sheet to the floor in an area away from direct sunlight. Cover with a blanket and leave for 24 hours. If condensation forms on the underside of the polyethylene the floor is too damp for laying vinyl or carpet with rubber underlay or backing. Lift the polyethylene, and if the floor is too wet place another piece in a few days (do not leave the piece attached to the floor). Wait until polyethylene taped in place stays dry for two to three days before laying the floor covering.

11.0 STATUTORY REQUIREMENTS

11.0.1 If the remedial work involves replacing “like for like” then there may not be a requirement for a building consent, but the local Territorial Authority should be consulted.

11.0.2 If the work involves an upgrade or an alteration, the work will always need to comply with the Building Code and may require a building consent.

12.0 FURTHER READING

12.0.1 Civil Defence publication: *Will you cope when disaster strikes?*

12.0.2 www.civildefence.govt.nz.

12.0.3 Insurance policy.

SUMMARY CHECKLIST

Before returning to the property, check:

- ✔ with Civil Defence that return to the property is allowed
- ✔ that floodwaters have safely receded from around the property
- ✔ with the local power companies that the electrical and gas supplies to your house are safe or disconnected.

On return to the property:

- ✔ check for damage to the land such as undermining and subsidence
- ✔ have an engineer, building consultant or experienced builder check for structural damage to the house. If damage is significant notify insurer
- ✔ if the house is structurally damaged, the decision has to be made as to whether it can be restored satisfactorily. If not, salvageable items should be removed and arrangements made for demolition. A consent will be required for demolition
- ✔ check and remove any sources of contamination on the site and particularly under the house
- ✔ have a plumber or drainlayer check the effluent level of the septic tank (if present) and empty if necessary, also checking for structural damage.

On re-entering the house:

- ✔ have an engineer, building consultant or experienced builder check the house for internal structural damage and for unsafe conditions
- ✔ have an electrician check that the electrical system is safe or turned off
- ✔ have a plumber or drainlayer check and reinstate the plumbing and drainage services if safe to do so
- ✔ take all removable wet items out of the house for cleaning and drying (remember to arrange dry storage)
- ✔ remove all food, disposing of the spoiled items and suitably storing non-perishables
- ✔ remove electrical fittings and wetted wall linings and insulation where necessary and clean and disinfect the house
- ✔ begin drying out the structure
- ✔ clean under the house and ancillary buildings
- ✔ have an electrician hook up temporary electrical services if it is safe to do so.

When the house has fully dried out:

- ✔ obtain building consent to carry out remedial construction work (this may not be required but is a worthwhile protection)
- ✔ install insulation, wall linings and finishing trim
- ✔ complete electrical work
- ✔ re-establish plumbing, connect waste pipes
- ✔ recommission gas pipework and appliances
- ✔ redecorate
- ✔ refurnish the house.

BRANZ
BUILDING ON KNOWLEDGE

MISSION

To provide innovative and creative solutions to the industry by means of research, testing, consulting and information transfer.

HEAD OFFICE AND RESEARCH STATION

Moonshine Road, Judgeford
Postal Address – Private Bag 50 908, Porirua City, New Zealand.
Telephone – (04) 237 1170, Fax – (04) 237 1171
http://www.branz.co.nz

NEW ZEALAND REGIONAL OFFICES

AUCKLAND
Telephone – (09) 303 4902
Fax – (09) 303 4903
The Building Technology Centre
Victoria Park, 17 Drake Street
Auckland
PO Box 90 524
Auckland Mail Centre

CHRISTCHURCH
Telephone – (03) 366 3435
Fax – (03) 366 8552
GRE Building
79-83 Hereford Street
PO Box 496
Christchurch

AUSTRALIAN OFFICE

SYDNEY
Telephone – (00612) 9972 9366
Fax – (00612) 9972 9322
11/2 Fielding Street, Collaroy, NSW 2097, Australia
PO Box 99, Collaroy, NSW 2097, Australia

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