FIELD GUIDE:

RAPID POST DISASTER

BUILDING USABILITY ASSESSMENT – GEOTECHNICAL




Publication

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THANKS

We gratefully acknowledge the input of a wide range of technical specialists. The agreed need for this document within the geotechnical community has enhanced its development and contents, which reflect learnings from the 2010–2011 Canterbury earthquake sequence, 2011 Nelson storm and the 2016 Hurunui/Kaikōura earthquake.

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1. WHERE YOU FIND WHAT IS IN THIS FIELD GUIDE

2. PREFACE

This Field Guide: Rapid Post Disaster Building Usability Assessment – Geotechnical, has been produced to assist geotechnical professionals in assessing the life safety risk posed by land instability hazards and their effects on building usability in a rapid building assessment (RBA) process during a State of Emergency or during a lesser event in special circumstances.

Development of this Field Guide has been informed by international emergency response documents, the lessons learnt from the 2010–2011 Canterbury earthquake sequence, 2011 Nelson storm and the 2016 Hurunui/Kaikoūra earthquake. This Field Guide is one of a suite of documents developed to promote a nationally consistent approach to rapid building usability assessments after the recommendations of the Canterbury Earthquakes Royal Commission. The suite of documents includes Field Guides for rapid post disaster building usability assessment – earthquake, flooding and geotechnical.

The Field Guides can be downloaded from:
www.building.govt.nz/managing-buildings/post-emergency-building-assessment/guidance-decision-makers-territorial-authorities/
Generic forms and placards may also be downloaded from this website.

While this field guide is meant to be largely stand-alone, more context about the management of the geotechnical aspects of the emergency and how this fits within the wider emergency response is provided in: Managing buildings in an emergency – Guidance for decision makers and territorial authorities (MBIE, 2018).

This Field Guide has been developed as a resource for geotechnical professionals involved in the geotechnical component of the RBA process. Each assessor will need to have participated in MBIE emergency geotechnical response training (including training in the use of this document) prior to responding to a hazard event. This guide may be used for reference in the field.

It is expected that those using this Field Guide have tertiary qualifications to fulfil the requirements of either a geotechnical engineer or an engineering geologist, and experience in the assessment of land instability. CPEng geotechnical engineers or PEngGeol engineering geologists may be preferred as members of the Civil Defence emergency response team.

It should be noted that the purpose of this Field Guide is not to replace existing geotechnical response systems that may have been put in place by local or regional councils or other authorities and asset owners. Rather, it is to encourage a recommended and consistent process for geotechnical assessments and data collection that can be readily integrated with territorial authorities' building control and response systems. Each territorial authority develops their specific operational plans.

The Field Guide is expected to complement the rapidly changing approaches that incorporate digital field data collection and data base support. The Field Guide and forms can be used as a standardised basis for these developments.

Tsunami and volcanic events, and their associated hazards and life-safety risks, are not covered by the processes outlined in this Field Guide.

3. INTRODUCTION AND SCOPE

The objective of the rapid building assessment is to quickly establish the usability of buildings and associated infrastructure where functions may be compromised by a hazard event with life safety, residential or business consequences. The objective of this Field Guide is to generate a consistent approach and terminology for geotechnical assessments during the rapid building assessment process.

A consistent approach is sought in process and data collection across all the RBA disciplines (i.e. earthquake, flooding and geotechnical). This enhances information management and other aspects of the response and recovery process.

The focus of the geotechnical component of the RBA process is on the safety of people and any relevant immediate actions associated with this objective. It involves the rapid assessment of the impacts of land instabilities on commercial, industrial and residential buildings that could affect the safety of people. The role of the geotechnical professional involved in the assessment is to provide advice through the appropriate organisational structures to protect people from land instabilities, typically by temporarily removing or restricting access to the hazardous area.

It should be noted that although assessments of impacts on infrastructure is the responsibility of the specific network provider, any observations made during field assessment that are relevant to the safety of people, or the future viability of a building, should be reported through the appropriate channels to inform the response.

Advising building owners on permanent land stability mitigation options is outside the scope of this document. Furthermore, this document does not give means to assess or provide advice about possible geohazards that are not affected by or influenced by the emergency event.

4. FIELD SAFETY

4.1 General

After a hazard event that causes widespread damage, many buildings may be dangerous from potential collapse, falling debris, damaged services, unsanitary conditions and other hazards. Rapid usability assessment is inherently a dangerous activity. Therefore identifying and mitigating risk is important.

Assessors must at all times be conscious of their own safety and the safety of their team members. Assessors should be briefed on health and safety issues before starting each shift.

It is of primary importance that personal safety during emergency response to land instabilities is considered. Often a post-disaster emergency environment can change rapidly and it is imperative to stay alert and aware of surroundings. Continuing land instability may occur with subsequent hazard events causing further damage to the ground, infrastructure and structures. It is important to recognise the signs if a land instability hazard may reactivate, including looking for fretting, listening for cracking within a rock mass, or identifying unstable overhanging areas. Stand down periods may also be employed to assessment teams pending on the event and hazards identified until it is considered safe to enter a property or assess a hazard.

Correct personal protective equipment (PPE) and identification must be used at all times. At a minimum, PPE should comprise a hard hat, high visibility vest, steel-capped boots and a cellphone (or other means of communication). We also highly recommend that assessors carry a torch, safety glasses, dust mask, gloves and bottled water.

In addition to the physical health risks, assessors may also have to deal with distressed home owners and occupants, which could cause additional mental stress for the assessor.

Assessors should always work in teams, and their movements should be tracked for safety reasons. Each assessment team ideally consists of two technical field staff and a person to interact with the occupants (this may be a non-technical person).

Be sure to recognise when you have reached your own limits. Take care of yourself. Eat well, take regular rests and try to get a good sleep. Watch out for signs of fatigue and stress. Get extra support when things become overwhelming. You may be able to release your emotions and tension by talking to someone you trust. This can help put things into perspective.

Remember that external help may also be available through the Red Cross, Salvation Army or a Ministry of Social Development representative. Don't wait for a situation to deteriorate. Ask for help early. This will help you and your colleagues, and will lead to a more successful completion of this work. For additional tips on how to effectively work in teams, refer to Section 12 "Working in a Team" on page 73.

Assessors may be employees of the TA, seconded from other TAs and in the case of engineers and architects contracted to the TA leading the declared State of Emergency. The Controller, on behalf of the TA, is responsible for ensuring that appropriate health and safety steps are being taken in an inherently dangerous situation.

4.2 Field safety tips

In the field, be alert to hazards form the building(s) being assessed, from neighbouring buildings, and from the surrounding environment.

- Take a few minutes before entering a site to consider site hazards and identify a safe evacuation point.
- If a site is too dangerous to enter (i.e. due to access, reactivation of hazard, potential of collapse or aggressive animals, such as dogs), develop a plan to safely return to the site with the required resources.
- Do not access damaged buildings that have the potential to collapse.
- Minimise time spent in areas of high risk, ie areas where there is potential for significant ground movement.
- Be aware of damaged buildings, uneven ground, cracks and debris, leaking services and potentially leaking hazardous fluids.
- Work in teams/groups – do not work alone. A buddy system is recommended to check no one is missing at the end of the day or some other agreed point in time

- Know where all team members are at all times.
- Take breaks to rest, rehydrate and eat.
- Know the signs of fatigue (headaches, muscle weakness, dizziness, tiredness, impaired decision making and judgement, slowed response and reflexes). Utilise a fatigue management self-assessment form.
- During aftershocks, move away from areas where further inundation or loss of ground support may occur.
- Know the proximity and location of local health centres or hospitals.
- Be aware of USAR markings.
- Check in with team members after major aftershocks or subsequent hazard events.

In general, avoid these situations:

- Travelling next to buildings or under canopies – if roads are closed to public traffic, consider travelling down the centre of the road.
- Areas where a hazardous substance may be present, or a leak may be possible and cordon off the area. Shut off the source, if you can do so safely. If you smell gas, shut off the gas if possible and cordon off the area.
- Downed power lines and any buildings or items in contact with them.
- Contamination from biohazards such as sewage.

Follow this safety advice:

- **Look up** as well as ahead. Be alert to falling debris.
- Evacuate the area if fire breaks out.
- Be careful after earthquakes/ aftershocks – if you are outside, move away from buildings or other falling hazards. If you are inside, do not run out of the building until the shaking has stopped.
- Ensure that you and other team members receive appropriate food and water, eat regularly and take a rest period.

For basic first aid procedures, refer to Section 13 "Simple first aid procedures" on page 77.

5. GEOTECHNICAL RESPONSE DURING A STATE OF EMERGENCY

5.1 General

During a State of Emergency, input from geotechnical professionals may be required to assess the impacts of land instabilities on buildings or property. A State of Emergency can range from a single incident affecting one ward area to an extremely complex hazard event, with multiple incidents across more than one district or Civil Defence Emergency Management (CDEM) Group regions. As such, organisational structures for building assessment need to take account of the scale of the emergency.

In some cases where impact is widespread, a large-scale sector-based operation may be required with a sector established to organise significant geotechnical input. In this case a Geotechnical Management Group may be established to oversee the geotechnical input to the emergency response. Weather and resources permitting, the geotechnical response lead may conduct aerial reconnaissance to understand the full extent and level of impact. This information will be used in deciding what geotechnical resources are needed and how they may be allocated and managed. The requirement for this scale of geotechnical response will depend on the actual or potential geotechnical impact(s) from the hazard event. Generally, the geotechnical response forms part of the RBA process, which is led by the territorial authority Building Response Manager (BRM).

It is the role of Fire and Emergency New Zealand Urban Search and Rescue (USAR) to execute rescue and recovery operations where required. Where geotechnical assessment is needed to support these rescue and recovery operations, input will be provided by trained geotechnical professionals operating within the USAR Engineering Team. Rescue operations will precede general (structural, civil and/or geotechnical) engineering assessments in significantly affected areas.

Other organisations may be involved in collecting geotechnical data during both the response and recovery phases and therefore clarity on roles and coordination of resources may be advantageous. These include:

- MBIE's Temporary Accommodation Service, for emergency housing.
- Fire and Emergency New Zealand, which undertakes rapid impact assessments but not rapid building assessments.
- GNS Science, NIWA and academics working in the hazard area, for assessing aftershock and tsunami risk and for collecting scientific data both in urban and remote areas.
- Infrastructure representatives from telecommunication organisations, NZTA and KiwiRail, as examples, who will be assessing infrastructure damage.
- Building insurers and the Earthquake Commission's (EQC's) assessors and their advisors, who will be looking at land and building damage for insurance compensation/ repair.
- Council advisors for their infrastructure and civic assets.
- More remotely, international organisations such as USGS and satellite owners using remote sensing may be collecting data that is valuable.

Figure 1 outlines the process used to establish the role of geotechnical professionals in an emergency response."

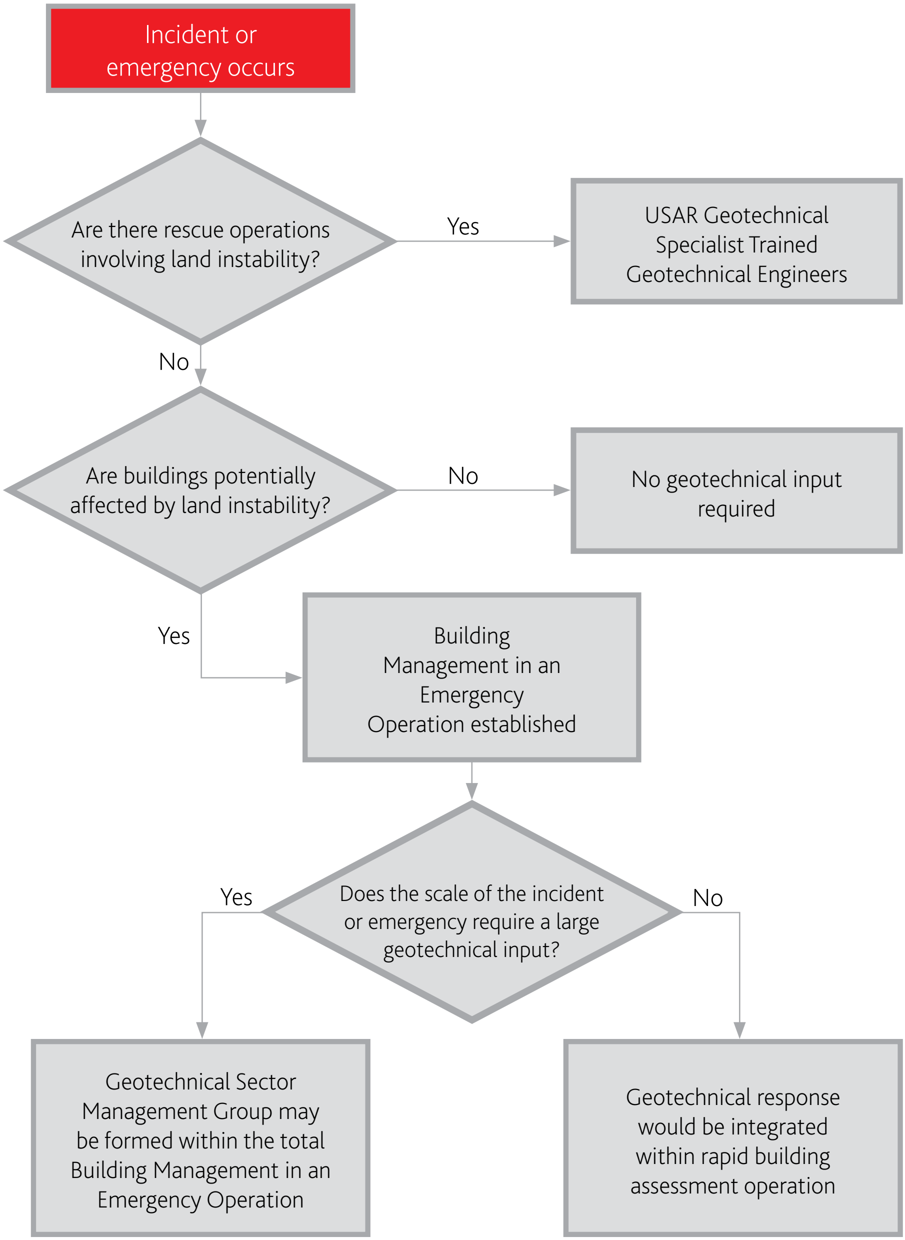


Figure 1: Process for geotechnical professional involvement during a State of Emergency.

5.2 The geotechnical role in a RBA process

Figure 2 illustrates an example of an organisational structure for an RBA process, including key roles from the MBIE Building Emergency Management Guidelines. The RBA process may be led by a territorial authority Building Response Manager (BRM) who reports into the emergency management structure. The line of RBA reporting within the structure of CDEM is discussed further in "Managing buildings in an emergency – Guidance for decision makers and territorial authorities" (MBIE, 2018). Depending on the scale of the CDEM operation the point of contact may be further delegated. The line control will be explained at induction at the start of an operation and daily as required.

The role of the geotechnical coordinator within an RBA operation is to oversee and validate the geotechnical operations. This role will typically be fulfilled by a highly experienced geotechnical professional with either Chartered Professional Geotechnical Engineer (CPEng Geotechnical) or Professional Engineering Geologist (PEngGeol) affiliation, supplemented by a geotechnical sector management group where the event requires it.

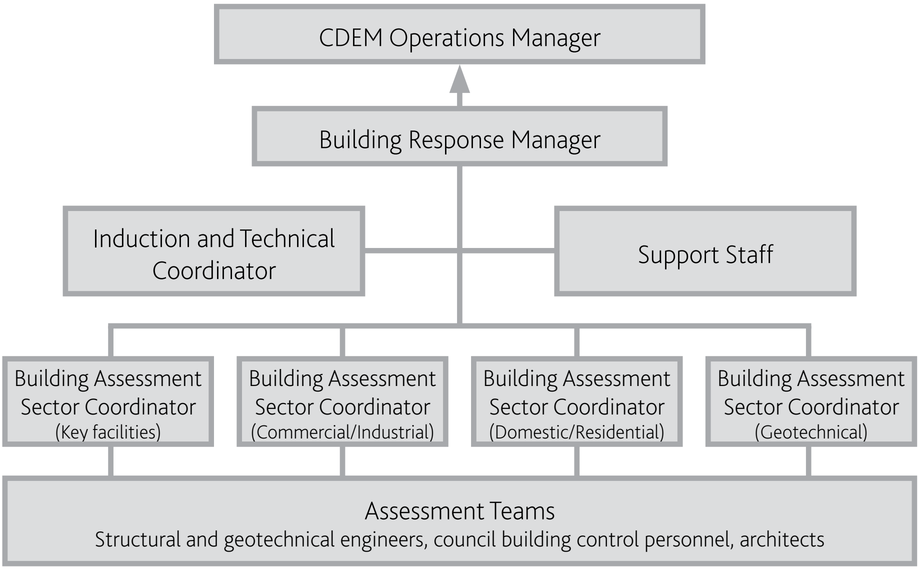


Figure 2: Example of building assessment operational structure

The geotechnical component of the RBA takes two approaches with different levels of recording and may be more global in application than the structural assessment, as the hazard can affect multiple properties.

- **The first** occurs where there is a low geotechnical requirement and it is completed in conjunction with a structural assessment. A related geotechnical hazard may be recorded in a few sentences on the structural assessment form and contribute to the placard selection decision. It is likely that relatively few geotechnical professionals will be required, and if they are, they are more likely to be working in conjunction with structural assessment teams.
- **The second** is where the geotechnical risk may be of broader impact and is being assessed in its own right, which is when the geotechnical assessment form is relevant. It is intended that a dedicated geotechnical assessment will be conducted in a single visit. Where possible it should be done alongside the Level 1 or Level 2 structural assessment to ensure the placarding is appropriate with respect to all aspects.

Where structural assessments have been undertaken in areas affected by geotechnical hazards, the structural assessors have been trained to make the placard conditional on geotechnical follow up where a hazard is identified. Further geotechnical evaluation and reassessment may be required for complex sites or where deemed necessary by a Level 2 structural assessment.

There are 6 different Rapid Assessment forms. Three for earthquake (Simple Residential Buildings, Complex Residential and all Non-Residential Buildings Level 1, and Level 2), two for flooding (Simple Residential Buildings, Complex Residential and all Non-Residential Buildings) and one for Geotechnical.

The structural assessment component of the RBA process may be conducted in two levels of rapid assessment:

- **Level 1 Rapid Assessments**, which include buildings constructed using typical residential forms and material, and external assessments of commercial and industrial buildings. This is suitable for low-rise and non-complex buildings.
- **Level 2 Rapid Assessments**, which include the internal and external aspects of buildings with two or more storeys that contain three or more household units and/or where the Level 1 Rapid Assessment identifies the need for further and more specific inspection, plus all essential facilities (hospitals, schools, police and fire stations).

5.3 Deployment

When deployed as part of an RBA operation, it is recommended that geotechnical professionals with less experience in land instability assessment are partnered with more experienced geotechnical professionals. In the case of a large complex site, this assessment will usually involve several geotechnical professionals, and should be led by a CPEng or PEngGeol. Deployment as part of an RBA operation is likely to occur at short notice, and it is expected that professionals have suitable field kits and safety equipment ready to be utilised (refer to pages 71 to 72 of this Field Guide).

As part of the deployment process, field personnel will need to:

- complete contract arrangement (Memorandum of Understanding) before initial deployment (an example is on page 80). This should be completed at the operations centre before first deployment. It is noted that work is completed on a voluntarily basis generally for the first three days or as specified on the MOU. Beyond that time, a commercial contract will need to be set up.
- do the following daily:
  - Sign in the register.
  - Stock up on forms, placards, handouts and maps.
  - Receive supplies for the day:
    - A personal ID badge (in case you don't have one already); it is important to record this ID on all assessment forms you complete.
    - Your team ID (if provided with one), which may change daily.
    - A list of important contact names and details.
    - Office supplies (staplers, tape, pens).
    - A food and drink pack for the day.
    - The property addresses allocated to your team.

Refer also to Section 11 "Resources required in the field" on page 71.

The Building Response Manager will usually hold a briefing to inform you about the current status of the event and any particular processes to be followed.

Over a long period of time, much of your work may begin to feel the same and it will become difficult to remember details that may be important at a later date, therefore it is recommended to keep a field diary to log your days activities and include information such as the directions you've received, actions you've taken and sites assessed.

Depending on the scale and nature of the hazard event, the RBA response assessment teams may comprise at least two geotechnical professionals and a structural engineer, plus territorial authority representative(s). During the assessment process, while geotechnical professionals make an assessment of the land instabilities, the territorial authority representative will speak with the resident or homeowner. The Building Response Manager (BRM) will coordinate the assessment teams and will decide on the composition of the teams or will delegate this role to the Geotechnical Management Group, if this has been set up.

6. RAPID GEOTECHNICAL ASSESSMENT PROCESS

6.1 Assessment and evaluation types

The purpose of the geotechnical assessment in the RBA process is to restrict people from accessing or occupying areas at risk from land instability. The assessment needs to provide a prompt evaluation of the life safety risk associated with land instability, with respect to the potential impact on buildings.

A variety of assessments and evaluations are required after an event severe enough to warrant a State of Emergency being declared. Overall impact assessment immediately after an event and the rapid building usability assessments would be carried out by territorial authorities immediately after declaration of a State of Emergency.

The assessment and evaluation types of all Rapid Building Usability Assessments are summarized in Table 1 below:

Table 1: Building assessment and evaluation types

Assessment Type	Implementation	Objective	Description
Rapid Impact Assessment	Undertaken within hours of the event by emergency services and the territorial authority.	To understand the overall impact and extent of affected areas. Leads to a decision on whether to declare a State of Emergency or notify a transition period.	Brief drive-by or aerial assessment of overall damage to areas. Emphasis on identifying extent of damage, priorities for rescue, areas of high impact and resources required. No formal records kept.

Assessment Type	Implementation	Objective	Description
Rapid Building Assessment	Carried out during a declared State of Emergency or transition period by mostly trained volunteer engineers, building officials and other suitability qualified professionals, acting under the authority of the Civil Defence Controller.	To quickly assess the impact of damage observed on the continued use of a building or adjacent property. The emphasis is on public safety.	Brief visual assessments of damage to individual buildings or properties with formal records. Earthquake Rapid Assessment Form – Simple Residential Buildings is used for simple residential buildings. Earthquake Rapid Assessment Form – Complex Residential and all Non-Residential Buildings Level 1, involve external inspection only, taking around 20 minutes each. Earthquake Rapid Assessment Form – Complex Residential and all Non-Residential Buildings Level 2, involve both external and internal inspection, taking 30 minutes to 2 hours each. Flooding Rapid Assessment Form – Simple Residential Buildings is used for simple residential buildings. Flooding Rapid Assessment Form – Complex Residential and all Non-Residential Buildings, involve both external and internal inspection, taking 30 minutes to 2 hours each. Geotechnical Emergency Response Form, taking around 20 minutes each.

Assessment Type	Implementation	Objective	Description
Interim Use Evaluation (IUE)	Conducted either during or after a declared State of Emergency or transition period by engineers contracted by building owners or tenants. (Unlike the Rapid Building Assessment the IUE outcome does not have a legal status.)	To quickly assess the impact of damage observed on the continued use of a building or adjacent property. The emphasis is on public safety.	Essentially similar to a Level 2 Assessment, but the evaluator identifies and observes the vertical and lateral load-resisting systems. Refer to the former Department of Building and Housing's "Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch".
Detailed Damage Evaluation (DDE)	Conducted as part of the recovery phase by engineers contracted by building owners. (Unlike the Rapid Building Assessment the DDE outcome does not have a legal status.)	To determine the full scope of repairs and rebuilds, and resource requirements. Provides confidence in the remaining building stock to assist the recovery.	• Detailed review of existing documentation • Evaluation of capacity • Identification of weaknesses • Observation of damage • Specification of repairs and/or strengthening required.

This Field Guide covers Rapid Building Usability Assessments – Geotechnical, only.

6.2 Your rights and responsibilities

The process of rapid building usability assessments is led by territorial authority building control, under the direction of the Civil Defence Emergency Management Controller (Local or Group Controller).

The general expectation is that volunteering professional inspection personnel will offer their services for up to three days. If their services are required beyond this period, a contract for services with agreed payment terms should be entered into.

Before undertaking any building assessments, you must be authorized by the Controller. After attending rapid building assessment training you will be on the register of authorised assessors. For each event there will be a Memorandum of Understanding for engineers (see sample Memorandum of Understanding on page 80). Building officials will be employees of the TA or seconded. On the day of the event a short registration process, such as signing in on a list of assessors, will ensure that you are authorised to undertake Rapid Building Assessments for the particular event. This protects your liability exposure.

6.3 Civil Defence Emergency Management Act 2002

During a declared State of Emergency, the Civil Defence Emergency Management Act 2002

(CDEM Act) and the associated regulation, the CDEM Plan, provide for TAs to issue and control the use of signs. Examples are building assessment notices such as placards, to secure or make safe dangerous structures, to require the evacuation of any premises or place (including public places) and to prohibit or restrict public access to roads and public places.

The CDEM Act provides protection from liability for any act or omission of the Crown,

CDEM Groups (including officers, employees or members of those groups), or other persons, except in cases of bad faith or gross negligence.

The November 2016 Hurunui/Kaikōura major earthquake series has led to a change to the Civil Defence & Emergency Management Act by introducing transitional arrangements.

6.4 Building Act 2004

In case no State of Emergency is declared, the Building Act 2004 allows authorised officers of a TA to enter premises to determine whether a building is dangerous, earthquake-prone, or insanitary. Building owners, occupiers, or persons engaged in building work on the premises must give "all reasonable assistance" to allow an authorised officer to make such inspections. Residential occupiers need to give permission for entry to a building under the Building Act, unless a case can be made for Section 173 of the Local Government Act to apply.

The Act authorises TAs to erect hoardings, fix warning notices to buildings, and give written notice requiring work to reduce or remove danger or remedy insanitary conditions and prohibit the use of the building. The Act requires TAs to keep information about buildings. This includes records of assessments undertaken.

The Act also provides a statutory defence against prosecutions for actions taken in emergency situations due to natural disasters as long the effects of the action are adequately mitigated or remedied after the event.

Important note: The placards specified in this field guide do not constitute official Building Act notices (under s124 and s125). This may change once proposed changes to the Building Act have been approved. The placards may however fulfil the purpose of warning notices under s124(1)(b).

The current position in advance of legislative change is that there is no satisfactory transition to the Building Act after the State of Emergency is lifted. In Gisborne, all placards issued under the CDEM Act were replaced with Building Act notices on the two days before the lifting of the State of Emergency.

Changes to the Building Act are likely and may require some future amendments to this Field Guide. However fundamental field work described here is not altered by the changing authorising environment.

6.5 The buildings owner's responsibilities

Rapid Building Assessments are undertaken by the territorial authorities to provide a rapid indication of the usability and safety of affected buildings and adjacent public spaces. Irrespective of the result and recommendations of the rapid building assessment, it is the building owner's responsibility to ensure that their building is safe before it is reoccupied. It is also the owner's responsibility to ensure that the building does not pose any danger to neighbouring buildings or public spaces.

The building owner may employ people with suitable skills to undertake a detailed evaluation of damage to determine a building's safety, or a detailed geotechnical assessment of land instability that may affect a building's safety. In these cases, one or more engineers are generally involved, and are preferably Chartered Professional Engineers. In the case of a simple residential building, an experienced builder may be suitable.

6.6 Rapid Geotechnical Assessment Process

The objective of a rapid assessment is to assess the impact of damage observed on the continued use of a building or property.

Important short-term aims for rapid assessments of geotechnical hazards include:

- safe use of streets adjacent to, within the influence or impact zone of geotechnical hazards.
- safe occupation of buildings for:
  - continued use, especially emergency facilities
  - minimising impact on commercial activity
  - minimising displacement of people
- assessing the need for temporary works or suggested further actions for building owners.
- saving buildings or property from unnecessary demolition:
  - conserving heritage fabric
  - minimising economic impact for the owners and community

There needs to be clear evidence that the risk of instability has changed from before the emergency event. This is required because many people are living in locations they possibly shouldn't be based on geomorphic evidence or past planning approvals that may not have considered such circumstances. The RBA process is not to resolve these issues.

6.7 Basic Approach

Assessors will observe the nature of the geotechnical hazard and assess its impact on people from accessing or occupying areas or buildings at risk from the geotechnical hazard.

Assessing usability is based on the assessment of life safety risk, which is the interpretation of land instability and potential or actual impacts at a site in the context of the event that has occurred. It is accepted that future events, such as large aftershocks or storms, could cause further land instability.

The focus is on applying judgement to assess future life safety risk from a land instability hazard, based on a minimum amount of specific knowledge of the hazard being assessed.

Although you are aiming to minimise risk to occupants and users of a building or property, and to the public, you also need to avoid imposing unwarranted hardship on owners and occupants when deciding on the placarding of buildings.

The assessment teams may also make recommendations for work to be done under urgency where there is a need to keep the public safe or to protect adjacent property.

Figure 3 below details the field assessment process, which includes data collection, assessment of life safety risk and recording recommendations.

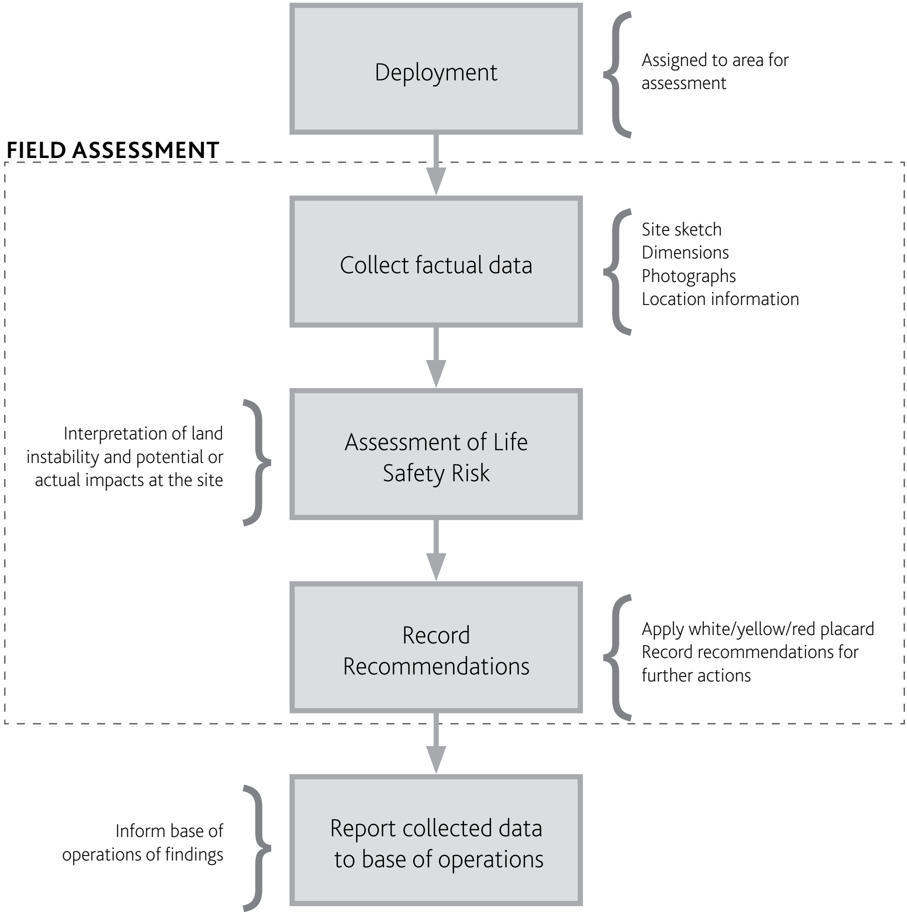


Figure 3: Field assessment process

Where the rapid geotechnical assessment is a combined quantitative and qualitative assessment with the structural engineer, this is expected to take approximately 20 minutes at each site. Where the scale and complexity of land instability warrants, more time may be required to evaluate the level of risk and extent of impact. It is more important to understand the hazard rather than cut an investigation short to move at a predetermined rate. Follow up visits when more time is available may be warranted in some cases.

During the assessment it is important to discuss with team members any assessment decisions and the implications for the property in question.

There are circumstances where only a geotechnical assessment is required. This can range from single to multiple properties under threat from the hazard.

Assessment of land features remote from residential areas may be needed because they may give rise to risks to residences or communities below. Consideration of the wider context is especially important in these situations.

At the end of your assessment and if instructed, provide an information sheet to the building owner. This explains the placarding system and what the next steps for the building owner are. The information sheets are designed to help you avoid getting involved in discussions with the owner or occupiers because this can be time consuming and unproductive. Your priority should be to assess the buildings allocated to your team.

6.8 Data collection

During the field assessment, it is important to gather as much information about the land instability and area of impact as practically possible in a short period of time. The data you collect forms the basis for the classification of the land instability and estimated risk level. The data needs to be clear to show your thinking and support how you arrived at your conclusion, in a logical manner. If there are areas of information that may be lacking, note it on your assessment sheet as it may be a critical element in your decision making process.

The information recorded during the initial assessment may provide a means of comparison, if further failure occurs. Section 8 (page 51) provides detailed information on how to complete the assessment forms, including how to collect factual data and interpret the data as part of the assessment process.

6.9 Assessment of life safety risk

A key output from the rapid geotechnical assessment process is the estimation of the likely consequences associated with land instability. The primary concern is the risk to life safety that may exist due to the presence of people within the area of land instability. This includes:

- the area below land instability that may be subject to inundation of material.
- the area above land instability that may be affected by:
  - downslope movement of soil or rock.
  - regression of a land mass causing tension cracking.

– loss of ground support.

- areas adjacent to the land instability that may be subject to ground deformation.

It is important to note the use of the terms building and property within the rapid assessment process from a geotechnical perspective, do not mean the same thing. A geotechnical hazard may impact or threaten a building which is located on a property, and poses a risk to the safe occupation of that building. However, a geotechnical hazard may pose a life safety risk to part of a property, but not to the building located on that property, i.e. a cliff collapse may not pose a threat to a building if it is far enough away. Refer further to 'placarding criteria' on page 33.

As with general landslide risk assessments, the assessor must first characterise the land instability and estimate the likelihood of further failure. Based on this information, the assessor then needs to estimate the likely consequences of failure by evaluating the impacts of the land instability on the elements at risk, eg buildings and properties.

During the rapid assessment process, it should be appreciated that generally there is limited time or information to carry out a thorough quantitative assessment. As such, a qualitative assessment of risk, based on site observations and engineering judgement is required. It is important that decisions on risk level and the management of the risk are made collaboratively with input from team members, including experienced geotechnical professionals.

When considering the level of life safety risk associated with land instability, the following questions should be considered:

- Is there a credible risk of further failure that could be life threatening, given consideration of the likelihood of aftershocks or weather-related events?
- If there is a credible risk of further failure, what are the potential impacts on any part of the property or building?

When quantifying these impacts and effects of further failure it is important to consider:

- the existing damage to the property as a result of the event
- the extent of potential damage on the property, and
- the consequences for life safety risk.

If further failure is likely to only impact a specific portion of the property it may be appropriate to restrict access to the area by placing barrier tape in a way that minimises the restrictions on passing traffic and pedestrians. Alternatively, if the risk is significant and is likely to encompass an extensive area, it may be appropriate to install a barricade, or recommend closure of a wider area to restrict access to the area.

6.10 Placarding system

General

During a State of Emergency or in a formal transition period, the RBA process and associated placarding can provide a means to enforce the restricted use of properties. It is required that geotechnical professionals placing placards on a building whilst assessing geotechnical hazards have attended the appropriate MBIE geotechnical assessor training or are working in conjunction with a trained rapid building assessor. Decisions regarding the assignment of placards should be agreed by more than one professional on the assessment team. Decisions around the use of placards with restrictions where a life safety risk is present from a land instability hazard, should be advised by a CPEng or PEngGeol geotechnical professional, or as a minimum, a trained RBA Tier 2 assessor as recommended by MBIE.

Because the RBA process considers structural and geotechnical assessments, the final placard decision will be based on the worst of the two assessments of their combined effect, and must clearly convey that.

The type of placard appropriate for the building is based on:

- Risk to life safety
- the factual data
- likely consequences of failure, and impact the failure may have on a building or property
- perceived level of risk based on the assessed conditions and current level of knowledge.

It's natural to proceed with caution to address uncertainties when assessing geotechnical hazards that can be a 'life-risk' issue. Your decision on assigning a placard needs to be based on your assessment of the post-event geotechnical hazard and the immediate risk that it poses to the building/ property based on a limited inspection time.

However, if there is uncertainty, do not automatically defer to applying a red or yellow placard to address the uncertainty. You will need to make a decision at the time. It may be appropriate in some cases to defer to a more conservative placard and recommend further assessment or review.

The placards

Rapid assessments combining structural and geotechnical information will result in one of the following, depending on the perceived level of risk associated with the land instability:

- a white placard
- a yellow placard
- a red placard.

Typically, immediately after a hazard event, the level of uncertainty around the situation can lead to an over-estimation of the perceived level of risk. Over time, this view of the risk level may decrease as more is learnt about the situation and the implications on life safety risk.

Although the perceived level of risk may be high immediately post event, it is preferable that a yellow placard (Y1) are applied where possible to allow as many residents as practically possible are able to stay in their homes.

Assessment of existing damage to a building will require an assessment from a structural engineer to determine the integrity of the building. It is not the role of the geotechnical professional to undertake this assessment, and as such, geotechnical engineers are unlikely to apply a R2 placard.

Table 2: Rapid assessment placards

Risk level	Rapid assessment outcome	Placard
Low risk ie light or no damage or life risk is expected	CAN BE USED No ***immediate*** further evaluation required	**CAN BE USED** (WHITE)
Moderate risk to life safety ie minor or localised damage to property or surrounding area	**Y1** RESTRICTED ACCESS TO PART(S) OF THE PROPERTY ONLY No entry to parts of the property with significant damage	**RESTRICTED ACCESS** (YELLOW)
	Y2 RESTRICTED ACCESS – SHORT TERM ENTRY ONLY with or without supervision	
High risk to life safety ie severe damage to property or surrounding area likely	**R1** ENTRY PROHIBITED At risk from ground failure	**ENTRY PROHIBITED** (RED)
	R2 ENTRY PROHIBITED Significant damage	

Placarding criteria

The placards are designed to apply to buildings that are regularly occupied by people. There are no specific geotechnical feature placards. This is because during rapid assessment the attention is on buildings and land behaviour that affects buildings. Therefore, make sure that the placards are applied to buildings, even though the land instability hazard may affect other parts of a property, and not necessarily a building.

CAN BE USED (white)

CAN BE USED

NO RESTRICTIONS ON ACCESS

There has been a quick visual inspection of this building:

- No obvious structural problems were observed, but;
- This does not mean that the building is completely safe
- This does not mean that the building is not damaged
- Aftershocks may cause more damage that may change this assessment

The following items have generally not been inspected:

- Utilities (electrical, gas, water, sanitary facilities, etc)
- Secondary elements (ceilings, windows, fittings, etc)

Building owners and tenants have an important role in regard to the future safety of occupants and the public:

- The owner should organise for someone to look at the building more thoroughly
- Tell the authority if you find anything that could be dangerous

Building Name and Address: ____________

This building has been subject to a rapid assessment:

- ☐ Exterior Only
- ☐ Exterior and Interior

Assessor ID: ____________

Date: ____________ Time: ____________

This placard has been placed on behalf of the Civil Defence Emergency Management Controller under the authority of the Civil Defence Emergency Management Act 2002.

For further information:

- www.building.govt.nz/managing-buildings/post-emergency-building-assessment
- For enquires about this building: ____________

DO NOT REMOVE THIS NOTICE

A 'CAN BE USED' (white) placard indicates that no immediate risk from land instabilities has been observed that may increase the risk to people, above that which is acceptable.

This placard means that occupancy and use is permitted with no restrictions.

If there appears to be no immediate risk of further failure, or light or no damage to the building/ property is expected, there is a low risk to life safety. It will be appropriate to assign the building a white placard, subject to other assessments, eg a structural building usability assessment. From a geotechnical perspective this means:

- low risk of falling hazards present or likely
- low risk of land instability above or below the property.

A building that has received a 'CAN BE USED' (white) placard from a geotechnical assessment:

- can be at risk from subsequent hazard events (such as aftershocks or heavy rainfall), which may warrant re-inspection and result in a change to the previous assessment outcome
- needs the structural assessment of the building to be considered, which may determine a different outcome
- needs the condition of services to be considered, eg electrical, water and energy supplies and sanitary facilities for health and safety in built up areas. Note their ability to impact on the geotechnical hazard.

A white placard as an outcome from a geotechnical rapid assessment is appropriate in situations where a building is located at a distance away from the hazard such that it is unlikely to be affected should the hazard occur, or where there may be some form of natural or man-made feature that provides protection from the hazard.

A white placard may also be appropriate in situations where a hazard may exist, but the event has had no visible effect on the hazard and there has been NO change (increase) in the risk to the building. Situations where a white placard has resulted from a geotechnical rapid assessment include:

- A building is located near the base of a cliff; fresh debris is observed at the base of the cliff, but at a distance well-away from the building. The building is located outside the potential inundation area.
- A building is located very near the base of a cliff; a post-event inspection extending over multiple properties finds neither evidence of newly fallen debris nor any visible cracking in the cliff face. There has been no change in risk due to the event.
- A building is located on a slope; an outcrop situated upslope has produced substantial rockfall; a deep, prominent gully is present between the rockfall source and the building. A natural feature provides protection to the building.

Note: a 'CAN BE USED' (white) placard does NOT mean safe.

RESTRICTED ACCESS (yellow)


RESTRICTED ACCESS

- ❑ TO PART(S) OF THE BUILDING ONLY
- ❑ SHORT TERM ENTRY ONLY
  - ❑ Access to be supervised by a person authorised by the issuing Territorial Authority

There has been a quick visual inspection of this building:

- This building has been damaged and its structural safety is questionable
- Enter only at own risk
- Future events may cause more damage that may change this assessment

Description of hazard observed: ______________________

Restricted areas are: ______________________

Restrictions on use:

- ❑ Removal of essential documents/valuables only
- ❑ Removal of property
- ❑ Other: ______________________

❑ Diagram attached showing restricted areas

Building Name and Address: ______________________

This building has been subject to a rapid assessment:

- ❑ Exterior Only
- ❑ Exterior and Interior

Assessor ID: ______________________

Date: ______________ Time: ______________

This placard has been placed on behalf of the Civil Defence Emergency Management Controller under the authority of the Civil Defence Emergency Management Act 2002.

For further information:

- www.building.govt.nz/managing-buildings/post-emergency-building-assessment
- For enquires about this building: ______________

DO NOT REMOVE THIS NOTICE

A 'RESTRICTED ACCESS' (yellow) placard indicates that the risk is considered to be moderate, or damage or further failure may only impact a portion of the property, or there remain further actions to adequately assess the risks may be appropriate.

'RESTRICTED ACCESS' can be the most difficult to assign, but a high number of rapid building assessments may result in this category being assigned.

This placard indicates that the building or property requires some restriction on its use. Two types of restrictions are possible:

- Y1 RESTRICTED ACCESS TO PART(S) OF THE BUILDING ONLY:

  Use restricted to parts of the building only, ie prohibit entry to certain areas due to land instability that does not threaten the remainder of the building.

- Y2 RESTRICTED ACCESS – SHORT TERM ENTRY ONLY:

  No entry, except on short-term essential business, to part or all of the building for emergency purposes. This may be supervised or unsupervised by a person authorised by the territorial authority.

Restrictions on building or property use must be clearly identified on both the assessment form and the placard. Unsafe areas must be clearly and physically marked off with, for example, barricades, barrier tape and signs. Further action needs to be identified in the assessment form and placard, to reduce the risk in and around the building or property.

If only parts of the building or property could be assessed, and the condition of the unassessed parts is unknown, clearly state this on the forms and placards. In most cases these unassessed areas should have restricted access and be barricaded off accordingly, with a follow-up assessment made as soon as safe access is possible.

A yellow (Y1) placard as an outcome from a geotechnical rapid assessment may be appropriate in cases where the geotechnical hazard is relatively small in scale and where the potentially affected area is limited in size. Examples of situations where a Y1 placard may be appropriate are:

- A building is situated at the base of a relatively low cliff; there is newly-fallen debris near the back of the building; a relatively small mass of potentially unstable material is observed on the cliff face above the building, but the rest of the cliff face appears undamaged; if the unstable mass fell, it could impact the building. Access is to part of the building with the nearest to the cliff face being restricted.
- A building is situated on a slope; minor ground movement has occurred and has affected the posts supporting a deck attached to the building. Access to the deck is restricted.

A geotechnical Y2 placard may be appropriate in cases where the building is situated at a location where it could potentially be affected by a geotechnical hazard This may be the case where the building is situated within, but near the outer limits of the area that could be affected by a hazard. Examples of situations where a geotechnical Y2 placard may be appropriate are:

- A building is situated on the lower part of a slope; an outcrop situated upslope has produced substantial rockfall; boulders have passed and impacted buildings upslope; relatively fewer boulders have reached or passed the lower part of the slope where the building is located. The risk associated with boulders impacting a portion of the building is assessed as moderate, with further actions required to adequately assess the risk.
- A building is situated near the toe of a cliff; recent fallen debris is present at the base of the cliff; the building is located near the debris toe, but it is around the limit of where debris could be expected to run out. The risk associated with debris impacting a portion of the building is assessed as moderate, with further actions required to adequately assess the risk.

ENTRY PROHIBITED (red)


ENTRY PROHIBITED

(THIS IS NOT A DEMOLITION ORDER)

DO NOT REMOVE THIS NOTICE

An 'ENTRY PROHIBITED' (red) placard indicates that the building or parts of the building are subject to a high risk of land instability that may affect the building and pose an unacceptable danger to people.

This means that entry to this building is prohibited. Two types of placards are possible:

- R1 – ENTRY PROHIBITED: Damage from external factors pose a significant hazard to the building
- R2 – ENTRY PROHIBITED: The integrity of the building is severely damaged and poses a hazard

If there is thought to be an immediate risk from land instability that could cause loss of life or injury, ie the risk to life safety is high, then evacuation and the application of an 'ENTRY PROHIBITED' (R1) property use restriction placard may be the most appropriate form of action. From a geotechnical perspective this would result from:

- a high risk of land instability, sufficient to put occupants of a buildings lives in danger
- land damage that has the potential to significantly threaten the stability of the building and, as a consequence, people in or around the building .

A red (R1) placard as an outcome from a geotechnical rapid assessment may be appropriate in cases where the event has caused a change in geotechnical hazard and where there is a significantly increased likelihood that the building could be affected by the hazard. This is especially the case where the building is situated well within the potential runout/ inundation/ instability area. The building may or may not have already been affected by the hazard. Examples of this are:

- A building is situated very near the base of a cliff; there is newly-fallen debris; cracking and potentially unstable material is observed on the cliff face.
- A building is located on a hill slope below a damaged rock outcrop; there are numerous newly fallen boulders that have passed the building.
- A building is located at the toe of a soil slope; a newly-formed landslide with a substantial volume of loose debris is present on the slope above the building.
- A building is situated at the top of a cliff, near the edge; fresh ground cracking has been observed along the cliff edge over multiple properties; some cracks are observed to extend very near or beneath the building.

A red (R2) placard as an outcome from a geotechnical rapid assessment may be appropriate where the building has been significantly damaged as a result of a falling hazard (rockfall, landslide, cliff collapse, debris flow inundation) or where it is situated upon ground that has moved and/ or cracked and which has affected the integrity of the building. It is however, more likely that Structural RBA teams will be applying this type of placard, however Geotechnical RBA teams may apply this type of placard if they arrive before a Structural RBA team, and/ or depending on the circumstances of the event.

An 'ENTRY PROHIBITED' placard does not necessarily indicate that the risk of land instability will be ongoing, just that it was relevant at the time of the assessment. Nor does it necessarily indicate that demolition of a building is required.

6.11 Posting of placards

Only trained assessors can placard buildings. Placards should be filled out using a thin-tip permanent marker pen (biros will fade), and be securely fixed at a clearly visible location near the entrance of the building on the property assessed. If there is more than one entrance to the building, placards should be posted at each entrance. Take a photo of the posted placard as a record.

Use only one placard classification per building or property. Different occupancies in the same building cannot have different placards.

A "RESTRICTED ACCESS" placard may indicate different restrictions for different parts of a building or property. If an area is considered unsafe and should not be occupied or entered, barricades or caution tape should be placed to designate the area.

If a yellow "RESTRICTED ACCESS" placard is posted, it is important that the placard also identifies any areas that were not accessible and have not been assessed. Otherwise the reader may assume that these areas are safe.

6.12 Changing placards

A placard may need to be changed at some point, and this must be done by an assessor approved by the BRM to change the specific type of placard.

Some reasons for changing a placard include:

- a follow up inspection with more time than was initially available reveals more data/ evidence that changes the view of the level of risk
- correcting an oversight, mistake in judgement or following a second opinion
- a re-evaluation after emergency stabilisation work has been undertaken
- following another significant hazard event (note that a new placard should be placed with a new inspection date, even if the assessment result remains unchanged).

Some reasons for changing to a more restrictive placard:

- Previously unobserved damage or land instability has been found, or the territorial authority believes that a second opinion is warranted.
- Further events (for example, heavy rainfall, aftershocks) have significantly worsened the condition of the building.
- Further degradations of ground instability have been observed.

If the assessor believes that a less restrictive placard could be recommended, they would need to recommend that in writing to the territorial authority.

6.13 Removing placards

A placard cannot be removed during a State of Emergency, but it can be changed to a different colour following the process described in the previous section.

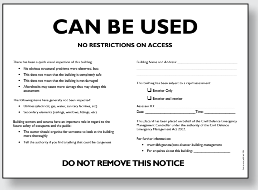
No current legislation applies to placards after the State of Emergency is lifted. These rules will change once proposed changes to the Building Act have been approved.

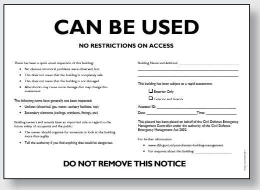
Currently, after the State of Emergency or transition period is lifted, placards no longer have effect. Depending on the circumstances placards issued for geotechnical reasons have sometimes been replaced by a notice issued under section 124 of the Building Act 2004. This work would normally be undertaken by a geotechnical professional working directly for the territorial authority and is outside the RBA process and may take a different view to the level of risk assumed if they had more time or access to surrounding areas/ information compared to during the RBA assessment.

Rules about who can access placarded buildings or properties

This table outlines the rules about who can access placarded buildings.

Table 3: Access rules for placarded buildings

Event phase	Placard	To access placarded buildings, a person must:
During the State of Emergency	No placard	• be authorised by the Controller* or • have permission from the building owner, occupier or otherwise authorised person
		• be authorised by the Controller* or • have permission from the building owner, occupier or otherwise authorised person
		• be authorised by the Controller* or If access is only permitted under supervision: • any person with permission from the building owner, occupier or otherwise authorised person accompanied by someone authorised by the Controller* If access is permitted without supervision: • any person with permission from the building owner, occupier or otherwise authorised person within the restrictions specified on the placard
		• be authorised by the Controller*

Event phase	Placard	To access placarded buildings, a person must:
After the State of Emergency is lifted	No placard or 	• have permission from the building owner, occupier or otherwise authorised person
		• Yellow and red placards may fulfil the purpose of warning notices under Building Act s124(1)(b). The building owner is responsible for the safety of any person entering the building.

Notes:

*1. The Controller may issue general authorities; for example, to all CPEng registered engineers, or all authorised assessors to enter any placarded building.

2. The Controller may also delegate the task of authorising building access to someone else; for example, the Building Response Manager.

Cordoning, Barricades and Barrier Tape

When considering if it may be appropriate to isolate an area that is exposed to a risk of land instability impacting a portion of a property, the assessor needs to consider what type of isolation technique is used.

There is a difference between implementing cordons, barricades and barrier tape. Descriptions of these isolations, examples and assessor roles is outlined in Table 4 below.

Table 4: Cordoning, Barricading and Barrier Tape

	Cordoning	Barricading	Barrier Tape
Defined as…	Ordinarily a larger area where access is prohibited whether for a short/fixed period or on a more permanent basis	A 'fence-like' structure to protect people from collapse of a building or structure	Temporary warning or lower risk (e.g. chimney or flooded room)
Who makes the decision?	The Controller	The Building Response Manager (BRM)	The Assessor
The role of the T2 Assessor	Possibly involved in making recommendations to the BRM that support the cordoning decisions of Controller	Makes recommendations about where barricades should be set	Possibly sets it out, or specifies it where others are tasked with setting out the barrier tape
Considerations		Consider the construction materials of the building and the likely failure mode: • Concrete panels typically fall 1.0 x height • Brick walls typically spill 1.5 x height • Potential for full building collapse (consider full building height) • Limited to top storey collapse (consider height of top storey)	

Further to the table above when considering cordoning off an area, the urgency of the required cordon must also be considered and communicated to the Controlling Authority via the assessment form. If urgent, this must be verbally communicated at the time of inspection.

Post-emergency recommendations

Based on the characteristics of the land instability and the consequences of further failure, further assessment and/or monitoring may be recommended to follow the initial rapid assessment, to allow a better assessment of life risk to be made. If this is the case, it is important that this is recorded on the assessment form and the sector leader is advised on the day, when the assessor returns to the response coordination centre or emergency operations centre (commonly referenced as EOC).

While it is not the purpose of the RBA process, it may be appropriate to provide recommendations for follow-up action by the territorial authority if these actions will reduce the risk of further instability.

These could include:

- placing barriers as protective structures (eg containers)
- road closures or diversions
- diversion overland storm water flows away from land instability
- further examination of the wider vicinity, if a larger land instability is suspected
- clearing blocked drains and/or piping water seepage to controlled points
- turning off leaking/broken water mains
- sealing cracks and covering bare soils
- removing destabilising loads from the crest of unstable land
- terminating of earthworks, if undermining slope.
- installation of land instability monitoring systems

Note that also land damage assessment for insurance purposes generally do not consider life risk issues. Recommendations such as propping of retaining walls are likely to be assessed and provided by Structural Engineers as part of their work. It is important to make sure that clear objectives have been set for each member of the team of who is to assess these structures during the RBA process.

Reporting and information management

Assessment reports for each building must be entered into a register. The format of the register may vary between territorial authorities. The register may be computer-based or paper-based. Follow the instructions at your briefing. Entering assessment results on the register may be a back-office function, so writing clearly on the assessment forms is important.

The information on the placards, on the assessment form and in the register must be consistent. Efforts should be made to repeat the statements on the placards as closely as possible on the assessment form and the register.

Complete forms and documents neatly and accurately. BLOCK CAPITALS are recommended for legibility.

Check that the building identification, such as the address, is correct.

Completed forms are given to the territorial authority and are likely to be included in the property file.

Timely collection and provision of geotechnical information is a valuable contribution to the assessment of the impact of an emergency. Initial geotechnical information will also inform decisions about any need for further resources in subsequent days of the response phase.

Standardised reporting is important, particularly for large events because the information from the field, although collected locally, is likely to be made available at national level to feed into response and recovery planning.

Debriefing

The return to base is an essential part of keeping the assessors safe. It should/ will also involve debriefing, depending on the extent of the hazard, for example, to assist with transport logistics planning for the next assessments.

When your team returns to the base of operations, you will need to:

- log in that you have returned from the field
- report to your Sector Coordinator (or other designated person)
- submit your assessment forms with any photos taken to the person responsible for preparing the database (or Sector Coordinator)
- discuss any technical or process problems with the Sector Coordinator and/ or the Induction and Technical Coordinator, including the need for additional barricades

Ensure you receive clear instructions about your next involvement (that is, next assignment or stand-down). And take the opportunity to report any welfare concerns you have about yourself or others.

Building Identification

The assessment teams may or may not have maps, aerial photographs, official street addresses, legal descriptors, and any heritage listings.

Commercial buildings may not have street numbers, or may have different numbers from their official address, particularly if a building occupies a corner site or has access from more than one street. Record the official address on the sheet, and record a short name or any observed variance as 'Other ID or access'. If the building has a name, this is helpful for identification.

Use the 'Other ID or access' field to physically describe the position of a building or land instability hazard where there are multiple buildings or hazards on a single property. This may be particularly common on large rural properties. For commercial and industrial buildings, it is helpful to record the name of the business that occupies the premises – for example, the prominent tenancy (usually ground floor).

GPS coordinates are particularly useful in this situation. Wherever possible record the GPS coordinates of the building. A useful reference place to record the coordinates is at the building entrance. The preferred GPS format is in decimal degrees to five decimal places with South negative and East positive to suit Google Earth, for example, -41.11385, 174.84676.

If practical, take a photograph of the building near the entrance where the GPS coordinates were taken, and with the placard posted. This is useful for identification purposes, for future monitoring, and after worsening conditions. If you are taking additional photos, we recommend you always do one of the following things, so that you can later match photos to buildings:

- show the assessment form or placard with the building identification in the foreground of each photo or
- take a photo of the building identification first before taking photos of the building; for example, street view with street number or assessment form.

Make a plan sketch showing the location of the buildings of the property and clearly identify the buildings at risk, the location of the geotechnical hazard(s) in relation to the buildings, and what placards have been applied to which buildings. Include streets or a north arrow on the sketch so that it can be correctly oriented.

Hot topics

Historic post-disaster experiences during the assessment process have highlighted a number of recurring issues. Make sure that you:

- write clearly
- give a clear and unambiguous building or property descriptions. Add general descriptions if necessary; for example, “The big white building on the corner of xxx and yyy street”
- record the building name, if it has one
- use permanent marker pens on placards – ballpoint pens fade with time
- state your assessor ID (if provided) clearly on the form and placard
- placard all entrances in the same way – some could be on a different street.

7. GEOTECHNICAL RAPID ASSESSMENT FORM

The format of this form and a description of the information required follow. The form for geotechnical assessments is on the following pages.

GEOTECHNICAL RAPID ASSESSMENT FORM

This form is not to be used for insurance assessments or purposes other than that intended by the RBA process.
Fields with asterisks (*) are mandatory, others are optional.

ASSESSMENT

1 Assessor Name*

Assessor ID* Territorial Authority*

2 Assessment Date* Day Month Year Assessment Time* Hour Minute *(to nearest half hour)* A ◯ AM B ◯ PM

PROPERTY OR BUILDING IDENTIFICATION

3 Unit / Number* /

Street*

City/Town*

GPS (Degree with 5 decimals after comma) South – , East ,

Other ID or access Photo taken A ◯ No B ◯ Yes Photo ID.

4 Contact Name

Type A ◯ Owner B ◯ Tenant C ◯ Other

Phone (with area code) (0)

5 Existing Placard* ◯ None ◯ W ◯ Y1 ◯ Y2 ◯ R1 ◯ R2 Date* Day Month Year Team ID* (if provided)

SITE DESCRIPTION

6 Structures Present
- ◯ Commercial building
- ◯ Residential dwelling
- ◯ Accessory buildings (garage, shed)
- ◯ Retaining wall
  - ◯ < 1.5 m
  - ◯ > 1.5 m
- ◯ Other

7 Topographic Setting
- ◯ Flat Ground
- ◯ Flat Ground, adjacent to slope:
  - ◯ Slope above / below buildings
  - ◯ Slope height (m) ____________
  - ◯ Distance to slope (m) ____________
- ◯ Sloping Ground:
  - ◯ Gentle < 10 deg
  - ◯ Moderate 10 to 20 deg
  - ◯ Steep > 20 deg

8 Other Relevant Features (e.g. River, stream, gulley)

Describe, including distance to structures

HAZARD IDENTIFICATION (Factual information)

9 Hazards Observed

◯ Landslide	◯ Debris Flow	◯ Ground Cracking	Sketch included
◯ Boulder roll	◯ Lateral Spreading	◯ Slope Creep	◯ Yes
◯ Cliff Collapse	◯ Debris avalanche	◯ Other ____________	◯ No

More information about hazards observed (include slope heights, instability volumes, block sizes, crack lengths, distance to buildings, etc.)

Has hazard affected structure(s)?	◯ Yes	◯ No		If yes, list structure(s) ____________
Has hazard affected access?	◯ Yes	◯ No		
Has hazard affected utilities?	◯ Yes	◯ No	◯ Unknown	If yes, list utilities ____________
Has hazard affected multiple properties?	◯ Yes	◯ No	◯ Unknown	If yes, provide details ____________

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ASSESSMENT OF LIFE SAFETY RISK

(10)

List all hazards observed	Potential to Affect Structure				Assessed Life Safety Risk			Structure(s) affected
	Unlikely	Possible	Likely	Impacted	Low	Moderate	High	
	◯	◯	◯	◯	◯	◯	◯	
	◯	◯	◯	◯	◯	◯	◯	
	◯	◯	◯	◯	◯	◯	◯	
	◯	◯	◯	◯	◯	◯	◯	
	◯	◯	◯	◯	◯	◯	◯	

(11) **Is life safety risk mitigated by natural or man-made protection?** (if Yes, describe)

◯ Yes ◯ No

(12) **Is there likely to be further failure of land instability?** ◯ Yes ◯ No

If yes, estimated time frame of failure ◯ Hours ◯ Days ◯ Weeks ◯ Months

(13) **Are there any health hazards that may be present?** (if Yes, describe)

◯ Yes ◯ No

ASSESSMENT OUTCOME – PLACARDS

(14)

Low Risk	W ◯ **CAN BE USED**	
Moderate Risk	Y1 ◯ **RESTRICTED ACCESS TO PART(S) OF THE PROPERTY ONLY**	
	Y2 ◯ **RESTRICTED ACCESS – SHORT TERM ENTRY ONLY**	Access to be supervised A ◯ Yes B ◯ No
High Risk	R1 ◯ **ENTRY PROHIBITED (At risk from external factors)**	
	R2 ◯ **ENTRY PROHIBITED (Severe damage to building)**	

(15)

Survey Extent of Hazard*	
Exterior	A ◯ Partial
	B ◯ Complete
Interior	C ◯ Not accessed
	D ◯ Partial
	E ◯ Complete

Assessor Signature*

SUGGESTED FURTHER ACTIONS

(16)

Recommended further Assessment*	Safety Cordon*	Barricades*	Urgency of suggested action*
A ◯ None B ◯ Level 2 Rapid Assessment (tick below if particular expertise is required) B1 ◯ Structural Engineer B2 ◯ Geotechnical Engineer B3 ◯ Geotechnical Area Wide Assessment B4 ◯ Other: C ◯ Further evaluation to be arranged by building owner: D ◯ Welfare visit required? ◯ Yes ◯ No	A ◯ None required B ◯ Cordon required Describe extent (add diagram on separate sheet if required)	A ◯ None required B ◯ Barricades already in place C ◯ Barricades required Describe extent (add diagram on separate sheet if required)	A ◯ Standard B ◯ Immediate action required

Immediate Actions

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GEOTECHNICAL RAPID ASSESSMENT FORM

NOTES

(17)

RAPID BUILDING ASSESSMENT – GEOTECHNICAL SKETCH SHEET

Assessor Name*

Assessor ID* Assessment Date* (Day / Month / Year) Action Required?* A ◯ Yes B ◯ No

Unit / Number* / Street*

City/Town*

Show building damage, access restrictions or cordoning areas. Identify the building on the sketch and staple the sheet to this assessment form and add any notes if required. Include cross section(s) if helpful.

N

If required add a sketch on a separate sheet of paper showing building damage, access restrictions or cordoning areas. Identify the building on the sketch and staple the sheet to this assessment form.

Sketch included on separate page? ◯ Yes ◯ No

END OF INSPECTION DATA ENTRY – EMERGENCY OPERATIONS CENTRE USE ONLY

Data entry completed ◯ Yes ◯ No Date (Day / Month / Year)

Completed by:

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PAGE 3 OF 3 GEOTECHNICAL RAPID ASSESSMENT FORM

Refer to Section 8 "Instructions on how to complete the assessment form" on page 51 for guidance on the sections and questions on the form. The form can be downloaded at: **www.building.govt.nz/managing-buildings/post-emergency-building-assessment/field-guides-and-tools-for-building-assessment/**

8. INSTRUCTIONS ON HOW TO COMPLETE THE ASSESSMENT FORMS

These instructions refer to the sections of the form with corresponding numbers. Complete the forms in BLOCK CAPITALS to improve the quality of data entry, minimise revisits and facilitate scanning, which may be an option in a large event.

Field marked with an (*) are mandatory, others are optional.

1. Enter your name, your assessor ID and the TA under which jurisdiction you are undertaking the assessment. If more than one person is completing the form use the name and the ID of the team leader.
2. Enter date and time of the assessment. The time only needs to be accurate to the nearest half hour.
3. Identify the building. At a minimum the street number and name are required. Any additional information would improve later identification. Commercial buildings sometimes have names. Enter whether and how many photos you have taken. When taking photos name the files in a way that allows later matching with the building (building name, address, Council register ID, etc.). If access to the building is from multiple addresses or the access is from a different address than the official building address, enter this in the "Other ID or access" field. Please also refer to Section 5.8 "Building Identification" on page 38 for practical ways to identify buildings. Make sure to provide sufficient descriptions (including sketches if required) if assessing multiple buildings on a single property (for example, a rural property or farm).
4. If available enter the contact details of the building owner, occupant or building manager. This will usually be the person whom you and/or the Controller will inform about the results of the assessment. In the times when no owner is present, you may wish to record 'not met/ encountered'. This section is not mandatory.
5. Enter details of any existing placards, including the Team or Assessor ID. Complete this section even if your own assessment concludes with the same placarding as the existing one.

6, 7 & 8. Enter the site description details. Enter high level details of structures that may be present, including retaining walls. The topographic setting in relation to the buildings should also be noted. Any other features that may impact the site should also be noted (natural drainage, focusing gully, etc). This section is not mandatory.

9. Enter the hazards observed. There may be multiple hazards. Describe the observed damage. Use the text fields at the bottom to describe any further observations relevant to the damage. During the field assessment, it is important to gather as much information about the land instability and area of impact as practically possible in a short period of time. This information forms the basis for the classification of the land instability and estimated risk level of the hazard. Section 9 "Assessing Specific Geotechnical Hazards" on page 54 provides specific guidance on geotechnical hazard observations.

10, 11, 12, 13 & 14. If you have entered in any hazards identified in Item 9 'Hazard Identification', please indicate in these sections whether the hazard has a significant risk of affecting the structure in the future. The intent here is assessing any relationships between the structure and the area of instability and of any run-out zones (i.e. from falling hazards). The assessed life safety risk allows consideration of varying hazards and varying structures. There may also be health hazards identified at the site that may not necessarily pose a risk to life safety (for example, broken sewer pipes, contamination), however this is where you record any hazards that may pose a risk to the health of assessors, the property owner or the wider public.

15. Enter your placarding decision. In general you will apply a white "CAN BE USED" placard only if you have in all of questions in Sections 10, 11,12 & 13 only identified no or light risks and damage. If in any of the questions you have a "high" risk assessment the placard will usually be red "ENTRY PROHIBITED". Also refer to Section 5.4.2 "Placarding Criteria" on page 33 for guidance on placarding decisions. If you decide on a yellow "RESTRICTED ACCESS" placard it is important that you describe the restrictions in the notes field of the form. As much as practical this text should be the same as the text on the placard. It is important to also note whether and which parts of the building have not been assessed and their damage and risk is therefore unknown.

16. Enter the survey extents completed of the hazard and/ or property being assessed.

17. Recommend any suggested further actions to be undertaken under Civil Defence legislation or by the building owner. Note that only CDEM Assessments are managed by the Controller under the Civil Defence Act. Any other recommendations or detailed assessments are the responsibility of the property owner. The Civil Defence Controller or delegate is the sole authority for placard removal or replacement during the State of Emergency. After the State of Emergency is lifted these accountabilities lie with the TA. If relevant identify what particular expertise is required for further assessments and evaluations. Specify whether barricades have already been installed or are required. If appropriate complete a sketch on the separate sketch sheet and staple it to the assessment form. Also complete a sketch on the provided sketch placard and attach it next to the assessment placard. Specify whether further action is urgently required to allow the disaster management team to prioritise. Your urgency assessment may reflect whether any risks are inherent to the current status of the building or are more likely to be triggered by future events, such as aftershocks.
18. Use this space for additional comments that were not yet covered in any other sections. In the case of a red "ENTRY PROHIBITED" placard you can use the space to describe barriers for example. In the case of a yellow "RESTRICTED ACCESS TO PART(S) OF THE BUILDING ONLY" placard describe areas when access is not permitted. In case of a yellow "RESTRICTED ACCESS – SHORT TERM ENTRY ONLY" specify whether access is permitted without supervision or not. If any parts of the building were not assessed specify them here, as well.

If useful add a sketch of the building or building part on the provided sketch sheet to identify risks and access restrictions. Make sure that the sketch clearly identifies the building address and the assessment date so that it can be matched with the assessment form in case they get separated. It is important to include a north arrow or other markings to orient the sketch (if drawings in plan), and other markings if drawings sections Staple the sketch to the completed assessment form.

9. ASSESSING SPECIFIC GEOTECHNICAL HAZARDS

This section provides guidance on assessing specific geotechnical hazards within the context of the RBA process.

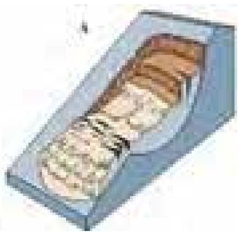
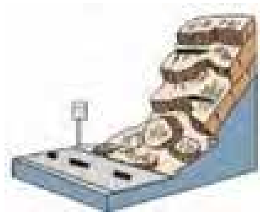
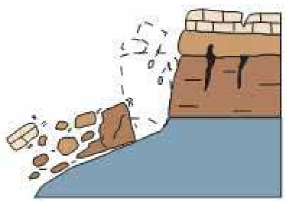
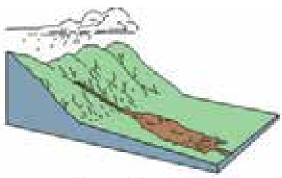
In assessing the geotechnical hazards and land instability that has or may affect a building, the key aspects to be considered are:

- Type of hazard or land instability present
- Nature of the damage caused by the event
- Potential for further land instability to occur
- Size and extent of the area that has been or could potentially be affected
- Potential consequences to the building being assessed (and its occupants)
- Possibility of hazard affecting other structures, access, utilities or multiple properties
- Natural or man-made structures that may mitigate the identified life safety risk

9.1 Land instability classification

Land instabilities can range from discrete localised events to large scale mass movements. There are four main types of geotechnical hazards that have posed life-safety risks during large-scale natural disaster events in New Zealand. These geotechnical hazards, listed in Table 3, are the ones most likely to be encountered as part of the RBA process.

Table 5: Examples of land instabilities previously encountered in large scale disaster response

Land stability	Diagram	Description
Landslide (ie mass movement and shallow instability)		A landslide in this context is a downslope movement of a soil or rock mass in either Rotational or translational movement. Rotational slides move along a surface rupture feature within the slope that is curved and concave. For a translational slide, the mass displaces along a planar or undulating surface within the slope.
Boulder roll (rockfall)		Boulder rolls are abrupt, downward movements of individual rocks that detach or are ejected from steep slopes or cliffs. The falling mass may break on impact, may begin rolling on steeper slopes, and may continue until the terrain flattens.
Cliff collapse (rockfall)		A cliff collapse begins with the detachment of soil and/or rock from the cliff, most often along a pre-existing fracture or weakness. The material subsequently descends, mainly by falling, and may break up in flight or on impact and accumulate as a debris wedge or cone at the base of the cliff.
Debris flow		Debris flows are the mobilisation of a mass of material downslope caused by saturation of the material, usually from inundation of a large volume of water. They often descend rapidly and can scour a channel in the slope during descent. The material in a debris flow can consist of soil, rock boulders, timber and other debris.

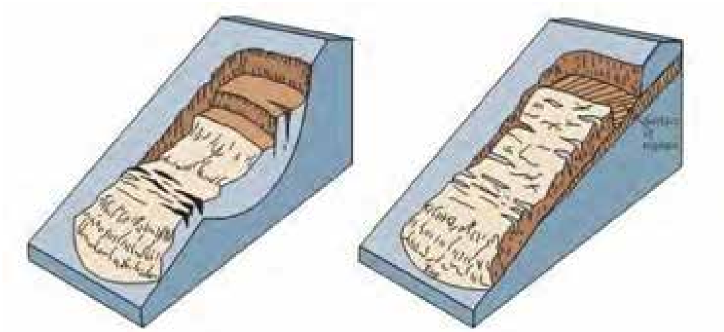
Credit: U.S. Geological Survey/ landslide, boulder roll, cliff collapse and debris flow figures by Margo Johnson.

Other types of hazards and land instabilities that may occur, but which are less likely to be evaluated as part of the geotechnical RBA process – either because they would be assessed by others or because they usually do not pose a life-safety risk – include:

- Landslide dams
- Surface faulting
- Liquefaction and lateral spreading
- Ground settlement
- Land instability associated with retaining wall failure.

9.2 Landslide

A landslide in this context is a downslope movement of a soil or rock mass in either rotational or translational movement. Rotational slides move along a surface rupture feature within the slope that is curved and concave (Cruden and Varnes, 1994). In a translational slide, the mass moves displaces along a planar or undulating surface of rupture within the slope (Cruden and Varnes 1994). The velocity of landslides can range significantly, however they are typically less rapid than debris flows.



Rotational landslide **Translational landslide**

Figure 4: Examples of rotational and translational landslide mechanisms

The material that has displaced during the landslide can cause mass inundation at the toe of the slope, potentially presenting a life safety risk to people occupying the base of the slope. In addition to this, displacement of the material down slope can form compression features or 'bulging' that can lead to deformation of foundations and structures.

The removal of material at the top of the slope, and the presence of tension cracks, can cause sudden loss of support of foundations and/or damage to the structure as the ground deforms. Dwellings situated on the displaced material mass can potentially suffer damage due to the deformation of the ground.

Figure 5: An example of the impact landslides can have in residential areas. Abbotsford, Dunedin, 1978

Aspects to consider during the assessment of landslides include:

- buildings on the mobilised material
- buildings at the toe of the mobilised material
- buildings near the head or sides of the landslide
- natural or man-made protection
- potential for the back scarp of the slope failure to regress further
- location and extent of head scarp , and its proximity to the building
- bulging of toe, any observed water
- volume of mobilised material
- velocity of movement (If failure is considered likely then describe the likely rate of movement as slow/fast – ie debris flows or rockfall will generally move fast whereas deep-seated land instability in soil may be slower moving). An example of a velocity scale for landslides is presented in Table 5 below.

- indicators of active movement (eg ground cracks, recent cracks in building walls and floors, depressions, leaning trees, displaced fences, displaced kerbs, seepage, blocked drains, tilting retaining walls, etc).

Table 6: Landslide velocity scale after Cruden and Varnes, 1996

Velocity scale				
Velocity class	**Description**	**Velocity (mm/sec)**	**Typical velocity**	**Human response**
7	Extremely rapid	$5x10^{3}$	5m/sec	Nil
6	Very rapid	$5x10^{1}$	3m/min	Nil
5	Rapid	$5x10^{-1}$	1.8m/hr	Evacuation
4	Moderate	$5x10^{-3}$	13m/month	Evacuation
3	Slow	$5x10^{-5}$	1.6m/year	Maintenance
2	Very slow	$5x10^{-7}$	16mm/year	Maintenance
1	Extremely slow			Nil

- Ref: Cruden, D.M. and Varnes, D.J., 1996. Landslide Types and Processes/Landslide Investigation and Mitigation Special Report 247, Transportation Research Board – National Research
- Council. A. Keith Turner, Robert L Schuster editors, pp. 36-75

Landslide characterisation

The following table has been developed to provide an example of the possible characteristics that may result in low or high risk classification of the site.

Table 7: Example of possible characteristics used in risk classification of a site for landslides

Risk level	Possible characteristics
Low risk –Can Be Used (white) placard	• Flat ground or gentle slope < 10 • No evidence of past or recent landslides • No geomorphic signs of historic rapid failure
High risk – Consider Restricted Access (yellow) or Entry Prohibited (red) placard	• Historical geomorphic evidence of landslides • Active landslide features (tension cracks, compression, leaning trees or retaining walls, etc) • Recent change in slope profile • Evidence of concentrated water flow on the slope

9.3 Boulder roll

Boulder rolls (rockfall) are abrupt, downward rock movements that detach from steep slopes or cliffs. The falling mass may break on impact, and typically descend downslope until the terrain flattens. Upon impact, boulder roll can cause considerable damage to structures and present a life safety risk to people occupying the area below the source area.

The risk associated with boulder roll is dependent on the interaction of a variety of factors including:

- size and number of boulders
- height and slope inclination
- distance from the source area to the site being assessed.

Aspects to consider during the rapid assessment include:

- proximity of fallen new and historic boulders to property/dwelling
- boulder size
- number of boulders
- distance to/from source area or exposed rock face to site
- height and slope inclination
- natural or man-made protection
- ground conditions for boulder travel path.

Figure 6: Boulder roll damage to a house in Rapaki, Christchurch during the 2010–2011 Canterbury earthquake sequence

Boulder roll placard classification and a flow chart that may be applicable

Detailed assessment of the potential for boulder roll to impact a dwelling frequently requires many hours of fieldwork per property. Most of that time is spent in the relatively dangerous source area, assessing both the characteristics and distribution of the various potential boulder sources and the nature and topography of the runout slope.

During a State of Emergency, gaining this level of detail is impracticable. Even if the base of all the potential boulder sources can be determined, actually measuring shadow angles from the rear of a building is frequently hampered by vegetation, retaining walls and accessory structures.

For this reason the initial assessment and placarding of properties needs to be based on relatively simple criteria, often other than shadow angle (primarily fallen boulder distribution). In most cases, this assessment does not readily allow for Restricted Access (yellow) placard classification. With time, and the reliable confirmation of potential source locations and shadow angles, it may be possible to establish local site-specific criteria as a basis to change Entry Prohibited (red) placards to Restricted Access (yellow) placards. Site-specific 2D rock-fall analysis is another potential tool available to help refine the initial assessment.

While every disaster will have its own location specific factors (geology, topography, climate, etc) the simple flow chart below worked well during the immediate identification of dwellings at risk from boulder roll during the 2010–2011 Canterbury earthquake sequence.

Boulder Roll Characterisation

The following table has been developed to provide an example of the possible characteristics that may result in low or high risk classification of the site for boulder roll.

Table 8: Example of possible characteristics used in risk classification of a site for boulder roll

Relative risk level	Characteristics
Low risk – Can Be Used (white) placard	• Boulders did not reach/pass position where building is located on slope • Limited rockfall source with no to minimal damage • Natural or man-made protection is present • No evidence of historic boulder fall near the building
High risk – Consider Restricted Access (yellow) or Entry Prohibited (red) placard	• Many fallen boulders have reached and passed building • Substantial, damaged rockfall source present • No or limited natural/man-made protection present • Topographic feature (eg. a valley) directs boulders toward building • Historic evidence of boulder fall near the building

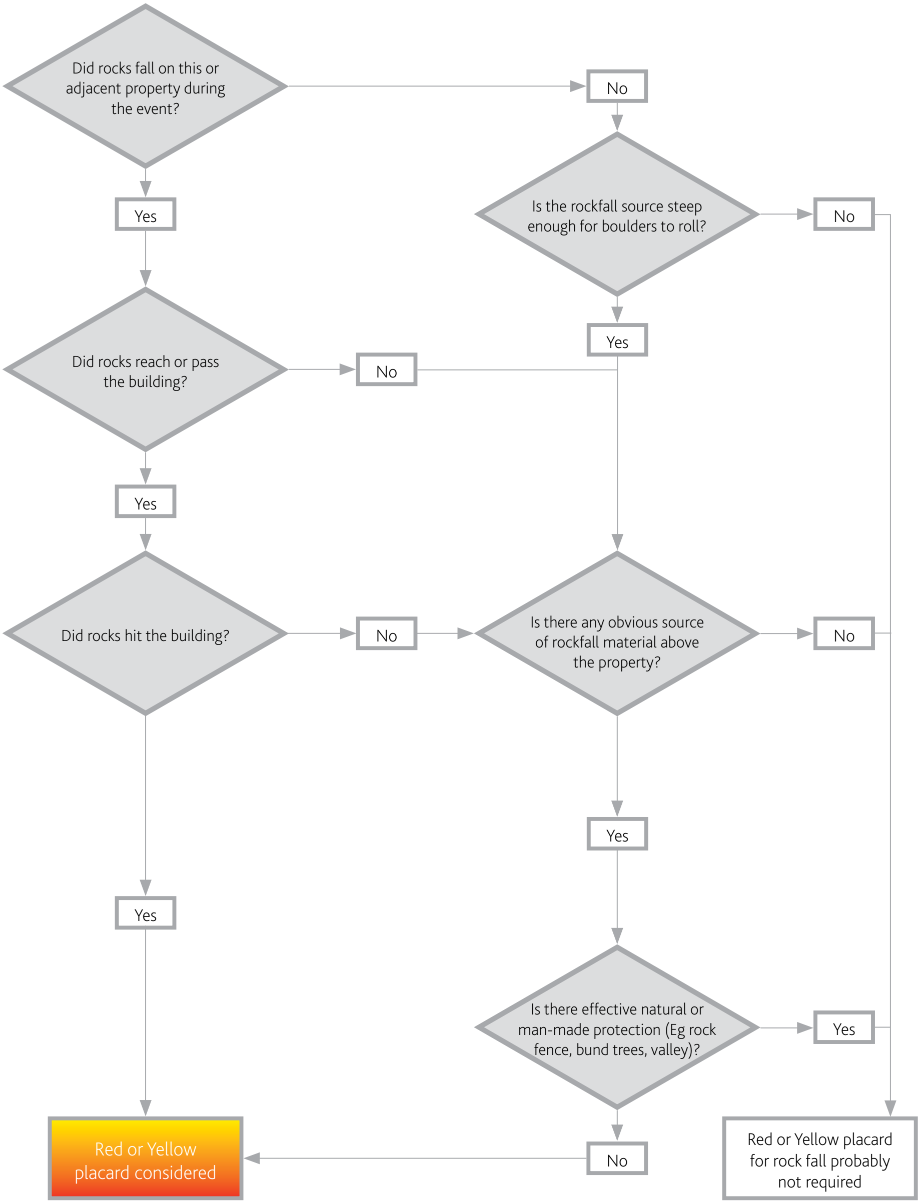


Figure 8: An example of a process flow chart to assist placarding for rockfall risk assessment (this is not a national standard and may be altered)

9.4 Cliff collapse

A cliff collapse begins with the detachment of soil and/or rock from the cliff, most often along a pre-existing fracture or weakness. The material subsequently descends, mainly by falling, and may break up in flight or on impact and accumulate as a debris wedge or cone at the base of the cliff.

The assessment of risk associated with cliff collapse is dependent on the proximity of a dwelling or structure to the cliff where there is evidence of potential collapse. The debris released during the cliff collapse process can cause mass inundation at the toe of the slope that can present a life safety risk to persons occupying the base of the slope. In addition to this, the removal of material at the top of the slope and the presence of tension cracks can cause loss of support of foundations and/or damage to the structure as the ground deforms.

Aspects to consider during the rapid assessment include:

- presence of loose material on the cliff and freshly fallen material at the base
- presence of tension cracks at the top of the cliff
- distance to dwelling – is the property within the run-out zone of the potential debris?
- natural or man-made protection

Figure 9: Cliff collapse in Redcliffs, Christchurch during the 2010–2011 Christchurch earthquake sequence

9.5 Debris flow

Debris flows are the mobilisation of a mass of material downslope, caused by the material being saturated by a large volume of water. They often descend very rapidly and can scour a channel in the slope during descent. The material in a debris flow can consist of soil, rock boulders, timber and other debris.

Due to its velocity, the debris can cause severe damage to properties and affect the usability of the buildings. Properties located within the run-out zone of debris flow can be partially or fully buried by debris. Debris can also penetrate windows and flood rooms without affecting the building structure. Because inundation of debris at the base of the slope occurs very quickly, there can often be a limited time period for evacuation.

Aspects to consider during the assessment of debris flows include:

- impact of the debris flow on the dwelling, ie is the structure partially or fully buried?
- proximity of the debris flow to the site and valley source.
- natural or man-made protection

If possible, it may be useful to consider:

- size of remaining source area
- amount of potentially mobile material within drainage channels
- likelihood of further failure
- changes in drainage channels that could direct debris into other areas
- historic evidence of land damage, eg relic landslides, relic debris fans.

Extensive debris flows occurred in the Tasman region during the 2011 Nelson storm event and the Bay of Plenty during the 2005 Matata floods. Examples of debris flow are presented in Figure 10 and Figure 11.

Figure 10: Impact of debris flows on a property after the 2011 Nelson storm. Credit: Tonkin & Taylor, 2011

Figure 11: Impact of debris flows on a property after the 2005 Matata floods.

Examples of debris flow placard classification

Table 9: Debris flow placard classification

Risk level	Possible characteristics
Low risk – Can Be Used (white) placard	• Property on shallow slope – with no obvious valley immediately behind • Slope above property is competent rock • Slope well vegetated • No running water on slope or discharge on to slope • No obvious geomorphic evidence of a debris fan at the building site
High risk – Consider Restricted Access (yellow) or Entry Prohibited (red) placard	• Recent slippage on steep hill side or in a valley behind property • Property or house has been inundated • Drainage channel from steep hillside or valley comes through site • Evidence of historic debris fans at this location or nearby • Heavy and persistent rainfall • Concentrated discharge onto slope

9.6 Important observations during geotechnical rapid assessments

Larger scale hazards that affect a wider area – particularly landslides -- may not be readily visible while conducting individual property assessments. If a large feature is suspected, then a more comprehensive walk over or aerial inspection via helicopter or UAV (unmanned aerial vehicle) may provide additional useful information. In addition, topographic surveys and aerial imagery from LIDAR or aerial/satellite photography that can be accessed at short notice may provide valuable intelligence. These may or may not be available depending on the location of the affected area and the resources available during the event.

When assessing the hazard, note the ground damage that has occurred as a result of the event, the current condition of the ground, and the area affected by the damage.

During the field assessment process a best estimate of the cause of the geotechnical hazard is required (i.e. boulder roll from earthquake, cliff collapse from heavy rainfall). This becomes particularly important if events subsequent to the initial hazard event cause instability, eg aftershocks or burst waterlines. The assessor should also make a qualitative assessment of the impact of possible future hazard events and their effect on stability.

9.7 Other Types of Hazards (Land Instability)

Other types of geotechnical hazards that may occur during an event, but which are unlikely to be assessed as part of the geotech RBA process, include landslide dams, liquefaction and lateral spreading.

Landslide dams

Landslide dams are unlikely to be assessed by geotechnical teams as part of the RBA process, however landslide dams may pose a life-safety risk and assessors should be aware of them. The recent 2016 Hurunui/Kaikōura earthquakes highlighted the possibility of landslide dams in certain landscapes, which have the potential to cause loss of life a significant distance from the landslide itself (Figure 16). During this event, assessments were undertaken by GNS and flood teams from Environment Canterbury.

Buildings most at risk are those situated near streams sourced from long valleys in hilly or mountainous areas.

Landslide dams are the natural damming of a river or stream caused by a landslide, debris flow or rock avalanche. Depending on the size of the dam and the nature of the stream valley, a significant volume of water may be impounded behind the dam.

Because of their loose nature and the absence of a controlled spillway, landslide dams have the potential for catastrophic rupture generating downstream flooding. This noted, most landslide dams do not fail in this manner – instead they are more likely to be gradually overtopped and eroded in the days and weeks following the event, resulting in flows that are within the range of typical flood events.

Landslide dams are responsible for two types of flooding:

- back-flooding (upstream inundation) upon creation.
- down-stream flooding upon failure.

Compared with potentially catastrophic downstream flooding, the relatively slow back-flooding typically presents little life-safety hazard, but property damage can be substantial.

Changes in groundwater conditions in the vicinity of the landslide dam reservoir may initiate additional landslides; if these fall into the reservoir, they could lead to overtopping and rapid failure of the landslide dam.

Figure 12: Landslide dam in the Clarence River, north of Kaikoūra, November 2016

Liquefaction and Lateral spreading

Liquefaction, while potentially widespread as a result of an earthquake event, is usually not considered a life-safety hazard in the same sense as the hazards identified above. The potential life-safety risk related to liquefaction is predominantly due to structural building damage, which will be assessed by structural engineering teams who are considering the buildings integrity. Geotechnical professionals may be involved in evaluating the potential of further liquefaction at a site, however this would more likely occur outside of the RBA process.

Lateral spreading is more likely to be assessed by structural RBA teams in terms of the damage that it causes to buildings.

Lateral spreading is characterised by horizontal displacement, creating cracks/fissures in ground generally parallel to a stream, river or estuary (Figures 13 and 14). They also form in areas adjacent to old river beds or edges of drained swamps.

Figure 13: Lateral spreading of soil and damage to a bridge in Canterbury 2011

While the effects can be significant, often affecting foundations and inducing tilt settlements in dwellings and buildings, they may not in themselves be life threatening. Lateral spreading in the Christchurch earthquake sequence was not known to cause any fatalities in its own right, although most lateral spread occurred in residential locations. Lateral spread is likely to impact more significantly on older, structurally weaker buildings such as unreinforced concrete masonry buildings that have a low tolerance to different settlement or tension cracking.

Assessment of the risk of building collapse would normally involve both a geotechnical and structural engineer.

Figure 14: Lateral spreading adjacent to the Avon River, Christchurch

9.8 Events not assessed by Geotechnical Professionals

Tsunami and volcanic events, and their associated hazards and life-safety risks, are not covered by the processes outlined in this Field Guide.

Tsunami events will generally not be assessed by geotechnical teams. If a tsunami were to occur, it is likely that house-to-house inspections would not be needed, assuming catastrophic damage. However, for areas where minor inundation may occur, it would be similar to a flooding type event and as such would be assessed by others. If required, geotechnical assessments could likely be undertaken using the existing process, with the cause of land instability being flood-induced.

The potential for future life-safety risk posed by tsunami is best evaluated by using tsunami inundation maps, which are generally undertaken by TAs using GIS resources or other specialists.

Volcanic hazards are outside the scope of this Field Guide. This type of event and its associated hazards will likely be assessed by specialists, such as volcanologists working with GNS. It is highly unlikely that house-to-house inspections of the type outlined in this field guide will be required in response to a volcanic event.

10. STRUCTURAL AND FLOODING HAZARDS

It is important to be aware of other hazards surrounding a building or property before and during your geotechnical assessment and identification of land instability hazards. Specific structural hazards (being assessed by a Structural Engineer) can pose life safety risks to building owners and occupiers, and to the assessors, therefore it is important to be mindful of the following:

Hazards from buildings

Timber framed buildings – chimney separation, collapse or cracking; house sliding off foundations and/ or overhanging land instability hazards (such as landslides); racking of walls and failure of subfloor bracing.

Reinforced concrete or masonry wall construction buildings – diagonal shear cracking in piers, walls and spalling of boundary elements; floor or roof separation; parapet damage; walls out of plumb or storey leaning; concrete cracking at openings and buckling of column reinforcement.

Precast concrete tilt-up structures – wall separation from diaphragm; outward leaning panels or storey leaning; spalling of exterior panel face at cast-in bolt connections.

Hazards from flooding

Damage to wastewater systems and supply; damage to storm water systems; damage to electrical and gas networks, and evidence of hazardous materials or processes that may have been impacted.

Please refer to the Earthquake and Flooding Field Guides for further details.

11. RESOURCES REQUIRED IN THE FIELD

Supplied by the TA during the briefing for Assessors:

- Briefing sheets with all necessary information, such as reporting requirements, contact points, communication arrangements
- Information handouts for occupants – including information on referrals to support agencies
- Official identification or authorization – secure clip-on badges lanyard or similar
- Geotechnical Rapid Assessment Forms
- Placards and duct tape
- Office supplies
  - A4 foldable clip boards inside plastic bag to protect forms from the environment
  - Pens
  - Indelible marker pens – use thin-tip permanent markers for writing placards
  - Stapler and staples to attach sketches to assessment forms
  - Thumb tacks or plastic sleeves for placards
  - Scissors
  - USB data sticks
- Security cordoning or barrier tape, and pegs/ stakes
- Street maps
- Aerial photographs and site-specific information, if available
- Communication radios
- Food

Resources assessors should bring:

- Rapid Post Disaster Building Usability Assessment – Geotechnical (this A5 booklet)
- Resources that the assessor is to supply:
- Proof of identity such as organisational ID card or drivers licence
- Hard hat, high visibility vest, steel-capped boots or shoes
- Other personal protective clothing such as gloves (light/ useable and heavy/ durable pairs), dust masks, eye protection, wet weather gear
- Mobile phone and charger(s)

- Electronic camera and charger(s)
- Torch and batteries
- Tape measures and clinometer
- Binoculars
- GPS
- First aid kit
- Laptop or tablet (if required)
- Large-scale topography maps
- Geological/ geotechnical hazard maps
- Significant infrastructure plans
- Travel pack with sleeping bag, warm clothes, rain jacket, toothbrush, small pieces of food (muesli bars, fruit etc)

12. DEALING WITH PEOPLE

12.1 Working in a team

Working in a post-disaster environment will inevitably create tense situations. As conflict is natural especially when tired, overworked and stressed, it has to be viewed as essentially normal.

It is important that the roles within the team are clear from the start. The teams must agree on each team member's responsibility before being deployed in the field. Consider using a checklist to make sure that the various tasks are covered. Typical tasks include:

- who will assess what aspects of a hazard or building
- filling out the assessment form
- posting the placards
- placing barrier tape
- taking photos
- communicating with owners or occupants who are present, including leaving information sheets with the owner or occupant or in the letter box
- entering the building into the register
- ensuring that there are enough forms available
- communicating with the emergency operations centre.

If team conflicts arise, these tips[1] may help to resolve them quickly and constructively.

1. **Ask questions**

   Conflict can arise from poor communication – someone didn't say what they meant to say or perhaps misstated what was intended. Before you allow an escalation, ask questions. It won't cause any loss of face, and may bring a quick resolution.

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[1] http://www.techrepublic.com/blog/10-things/10-tips-and-tactics-for-dealing-with-conflict

2. **Analyse expectations**

Conflicts may develop as a result of unmet expectations on one side. If the other party expected something they didn't get or something that didn't happen, the whole conversation can become negative and closed. If a conversation seems to be getting rocky, take a step back and review it with the other person to try to uncover what just occurred.

3. **Recognise differing perspectives**

Keep in mind that conflict may arise due to people having different perceptions. You, or the other person, saw things differently. This can happens when someone comes from another organisation, background, or culture. It's easy to believe that we all see things the same way and then get derailed unexpectedly.

4. **Identify mistakes**

Honest and unintended mistakes may result in conflict. Before you let temperatures rise, do a reality check of your understanding with the other person(s). Mistakes, even small ones, can erode credibility – someone made a mistake.

5. **Watch out for emotional triggers**

Beware of emotions. Fear of someone or somebody, loss of face, whether real or perceived, anger, and surprisingly even excitement can all result in unintended conflict. Your interaction can go downhill.

6. **Focus on preventing escalation**

Conflict resolutions start with one or both parties making an honest attempt to avoid escalation. Even one person recognising this can bring about an objective review.

7. **Take action to control the situation**

Escalation-avoidance tactics may involve one or more key steps, including separating the parties, changing the location of the discussion, and signalling empathy to the other involved.

8. **Commit to working it out**

Take charge of the process by committing to working it out. A powerful impact occurs when one person makes a statement about working out. It can turn down the temperature immediately.

9. De-escalate the conflict

Make a joint statement of the facts at hand, always eliminating exaggerations, embellishments or personalities, which may inadvertently apply judgments and re-create the cycle of escalation.

10. Stay calm

Cooler heads prevail in the most difficult conflicts. Whether you're in a business or personal situation, you can take control of it by keeping calm. And when you're keeping calm, it will be easier for others involved to get back to the task at hand.

12.2 Dealing with affected building owners and occupants

Try not to communicate directly with the building owner or occupant. It can be time-consuming, lead to misunderstandings and distract from your objective to conduct assessments. The territorial authority will provide consumer-friendly information sheets that will answer common questions about placarding and what to do next, and give important emergency support contacts. Information sheets should be left on site (in the letter box for example) or handed to the owner or occupant if present.

If talking to the building occupants is unavoidable, clearly explain the purpose of the placarding, the implications for building owners, and the process for changing the status of placards. Explain possible disaster damage scenarios to building owners. Explain what this means about the building's safety or about health issues around insanitary building conditions and tell them what to do.

Affected building owners and occupants are usually in a state of distress and uncertainty. They may have lost family members or friends. Losing access to their home or business will add significant pressure. Stay rational in your decisions, while showing empathy when communicating with affected people. An effective way to split roles in your team is for one of you to focus on the technical assessment while the other deals with the people involved.

Make sure that you follow the allocated assessment schedule and do not yield to public pressure to reprioritise the order of buildings to be assessed.

As potential first point-of-contact, you may need to refer building occupants to a range of services. The Emergency Operations Centre should have provided you with communication material such as handouts that provide information on services, including:

- food and water supply
- social wellbeing and medical services
- welfare centres and contact for alternative accommodation
- sanitary facilities and requirements, and
- contact details for a call centre to answer further queries.

12.3 Dealing with emergencies

If there are immediate serious dangers to health and life of the public and no appropriate help is available (Urban Search and Rescue, NZ Fire Service, Police, etc.) you may manage the danger situation and also provide first aid if required.

Always put your own safety first.

12.4 Dealing with the media

Building assessors should not give any information to the media. If a member of the media approaches you, refer them to the Media Liaison Person or a call centre, if one is set up.

13. SIMPLE FIRST AID PROCEDURES

You may come across seriously injured people during your assessment. If no other help is around you may need to give emergency first aid. You must ensure your own safety before you attend to an injured person.

Building assessors always work in teams. While one team member attends to the injured person, the other should look for help.

13.1 Bleeding

Deep cuts

Deep cuts in the veins produce dark blood that seeps out slowly and steadily. It can be stopped by pressing gently on the wound with a sterile or clean cloth, then applying a clean or sterile bandage.

These wounds may need sewing or gluing, so medical treatment will be necessary after first aid.

Arterial bleeding

Bleeding from an artery can cause death in a few minutes, so urgent first aid is essential. This type of bleeding pulsates and squirts blood as the pulse beats. The blood is often a light red colour.

Arterial bleeding must always be treated by a doctor. To manage bleeding from an artery:

- apply hard pressure on the wound, and keep this up until the patient receives medical treatment
- press with a sterile cloth or just use your hand, if nothing else is available
- put a bandage on the wound if possible – if the blood soaks through the bandages, press harder until the bleeding stops
- do not remove the soaked bandages, but place another on top if necessary
- do not attempt to clean the wound.

Make the person lie down, preferably with their head lower than the rest of their body. This will help oxygen get to the brain.

If possible, position the wounded area higher than the rest of their body – to reduce the pressure, and therefore the bleeding.

13.2 Shock

Shock occurs when too little blood circulates to the brain. This means that the brain is not getting enough oxygen, which leads to a feeling of faintness, disorientation and dizziness.

Shock may occur after accidents that cause loss of fluids or blood, or after serious burns.

When the flow of blood in the body is too slow, blood pressure drops and too little oxygen circulates through the body. A person in shock may:

- go pale
- turn sweaty, clammy and cold
- become dizzy
- become anxious or restless
- have a weak, fast pulse
- have low blood pressure
- have slow, weak breathing
- lose consciousness.

What to do if someone is in shock?

1. Lie the person on their back with their feet raised – to help the blood get to the brain.
2. Keep the person warm, comfortable and covered by a blanket if possible.
3. Do not give them anything to drink, because they could choke, or may need surgery.
4. If the person vomits or bleeds from the mouth, place them on their side to prevent choking.
5. A person in shock must always be treated by a doctor.

13.3 Breathing difficulties

If someone stops breathing, talk to them or touch them on the shoulder to see if they respond.

In adults, the problem is usually the heart rather than the lungs, so cardiac compressions come first and rescue breaths second.

Do not waste time checking for a pulse, if the patient does not respond.

Cardiac compressions

1. Place the heel of your hand in the middle of the chest above the breasts, that is the middle of the lower half of the breastbone (not over the ribs or stomach).
2. Place the heel of your other hand on top of the first. Keep your fingers off the chest by locking them together. Apply pressure through the heels of your hands.
3. Keep your elbows straight, and bring your body weight over your hands to make it easier to press down.
4. Press down firmly and quickly with a downwards movement of 4 to 5cm, then relax and repeat the compression.
5. Do this about 100 times a minute (CPR is fast and hard work – you can help your timing and counting by saying out loud 'one and two and three and four…' and so on)
6. Do this 30 times.

Breathing

7. Now open the airway by positioning the head with the chin pointing upward.
8. Pinch the nostrils shut with two fingers to prevent air leaking out.
9. Take a normal breath, and seal your own mouth over the person's mouth, making sure there's a good seal.
10. Breathe slowly into the person's mouth – it takes about two seconds to inflate the chest.
11. Do this twice.
12. Check to see if the chest rises as you breathe into the patient's mouth.
13. If it does, enough air is going in.
14. If there's resistance, try to hold the head back further and lift the chin again.

Repeat

15. Continue with 30 chest compressions, then two rescue breaths – and only stop if the victim starts to breathe.
16. If you are able to continue do not stop for any other reason, until someone else can take over from you. If possible switch with another person every couple of minutes, without interrupting compressions. If there are two rescuers: one can do breaths and the other compressions.

14. SAMPLE MEMORANDUM OF UNDERSTANDING (MOU)

Memorandum of understanding for engineers, geologists and architects volunteering to assist territorial authorities in a state of emergency or transition period.

The purpose of this form is to provide standard agreement conditions for building assessor volunteers to assess the usability of buildings during a state of emergency. An example of an MOU is provided below.

A The parties
Between
(name of the CDEM Controller or delegate/or Building Response Manager)
And
(name of person engaged and their qualifications)
Situation
Location

B Scope and nature of services
i) Rapid building assessments in the interests of public safety per the MBIE guidelines
ii) Or specify below

C Duration of Services		
Start date	until	date; or for the maximum period of three days

D Information or services to be provided by the territorial authority

i) The territorial authority will provide the building assessor with the means of identification to authorise them to undertake this work or they will use the MBIE issued identification as an authorised rapid building assessor

ii) The territorial authority will ensure the building assessor is provided with appropriate safety equipment and will be supported by at least one other person in the field

iii) The territorial authority will ensure that building assessor is provided with the standard assessment forms and placards as required

iv) The territorial authority will have procedures in place for tracking deployed engineers or registered architects

v) The territorial authority will ensure that the building assessor is briefed by the rapid building assessment team before deployment as to the procedures in place

vi) The territorial authority will ensure building owners are advised that detailed damage evaluations are to be subsequently and separately arranged by owners

E Information or actions binding on the building assessor

i) The building assessor will follow the instructions of the Civil Defence controller or their delegate such as the rapid building assessment manager or emergency services personnel or in event of no declared emergency the nominated Building assessment manager

ii) The building assessor verifies that the qualifications stated in G below and in relation to the prior training are correct

iii) The building assessor will not operate outside their field of expertise unless under the supervision of another suitably qualified building assessor

iv) The building assessor will not pass judgement on any facility that is known to be covered by a priority response agreement unless this is specified under B above

v) The building assessor will not release confidential information received in the execution of these duties to any other party or for any other purpose save for the rapid building assessment for this event

vi) The building assessor will not talk to the media or make any public statement unless authorised to do so during or after the work

F Special conditions (Additional conditions if any to be specified here)

G Prior training
This building assessor confirms they have attended prior training sessions on post disaster building assessment procedures Yes/No if Yes specify date of course

H Signed By:

For territorial authority on behalf of the Controller or delegate or Building Response Manager Name Signature Date	For building assessor Name Signature Date Registration #

NOTES TO MEMORANDUM OF UNDERSTANDING

1. The territorial authority and the building assessor agree that the services are required during a declared state of local or national emergency or there is a situation that requires rapid building assessment. The legislative base for a declared event is the Civil Defence Emergency Management Act 2002. This agreement relates only to the special case for procuring rapid assessments of usability of structures in the context of public safety or there is a situation that requires rapid building assessment of usability but a state of emergency is not declared.

2. This agreement is for provision of engineering or architectural services to a territorial authority for the purpose of assisting in assessment of the usability of structures. It does not apply to those personnel working for an urban search and rescue task force, or other rescue team.

3. It is understood by both parties that these services are provided in a voluntary capacity for the duration as specified above, under conditions of a State of Emergency or an undeclared event that requires rapid building assessments. There will be no remuneration for this work. Expenses incurred for travel and accommodation will be met by the territorial authority.

4. Should work proceed beyond the duration indicated or for purposes other than emergency response, a commercial contract will be signed.

5. The building assessor shall perform services for assessment of the usability of structures in accordance with rapid building assessment guidelines as produced by MBIE. No other services shall be supplied without express instructions from the territorial authority.

6. In providing the services, the building assessor shall exercise skill, care, and diligence expected of a competent professional. The building assessor should advise the territorial authority of any training or knowledge they have of building usability assessment systems as in (5) above.

7. The territorial authority shall assist in providing to the building assessor the cooperation of other emergency management personnel and equip them as appropriate. This includes providing identification and safety equipment, and providing induction in the territorial authority's emergency procedures, as in (D).

8. The territorial authority will ensure that the building assessor is accompanied by another person (not necessarily an engineer or architect) and that communication and tracking procedures are explained and accepted by the building assessor and his/her accompanying person(s).

9. The building assessor completing these tasks is aware of the special safety issues associated with entering or approaching the buildings or other structures.
10. The territorial authority shall provide to the building assessor any information in its power to obtain that may relate to the services.
11. Neither the engineer nor registered architect nor territorial authority will be liable for operating without full information, where it would be impractical to obtain it within the timeframe necessary to complete the assessment.
12. The building assessor is protected from liability under Section 110 of the Civil Defence Emergency Management Act 2002 in respect of their services carried out under the direction of the CDEM Controller, including liability for health and safety or will be indemnified by the territorial authority in the case of a non-declared event.
13. The building assessor shall not be considered liable for any loss or damage resulting from any occurrence during the period where the services are undertaken under the direction of the CDEM Controller or delegate or the Building Response Manager.
14. The building assessor will not assume any obligation as the 'client's agent' or otherwise pursuant to the Health and Safety at Work Act 2015 arising out of this engagement. The territorial authority will be the person who controls the place of work. The engineer or registered architect will act in a considered manner regarding his/her own safety in any area that is, by measure of the emergency situation, a hazardous area.
15. The provisions of the Consumer Guarantees Act 1993 do not apply.
16. Either party may suspend all or part of the services by notice to the other party. It is understood that these services are undertaken under emergency conditions and circumstances as to the engineer's or registered architect's availability, the nature of the situation, or the requirements of the controlling authority, may change.
17. This agreement is governed by New Zealand law; the New Zealand courts have jurisdiction in respect of this agreement.

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16 CONTACTS

You will receive a list of contact details at the daily briefing. Remember to take the list with you.

APPENDIX 1

Recent Emergency Assessment Experience

This appendix presents specific information about geotechnical life-safety assessment processes used in Christchurch during the 2010-2011 Canterbury earthquake sequence. This information is provided as an example only, and is not necessarily intended for use in other events that may occur around New Zealand. This information may provide a useful basis for establishing processes applicable to different areas of New Zealand in different geologic settings (and relevant to other Territorial Authorities).

Characteristics of boulder roll hazard and observations from the 2010–2011 Canterbury earthquake sequence

Following the 2010–2011 Canterbury earthquake sequence, the data collected on the distribution of more than 5,000 fallen boulders and their source areas was analysed by GNS Science and used to derive life safety risk zones. These were based on shadow angle, occupancy and the estimated future levels of seismicity (Massey et al, 2012a).

Based on this analysis the following characteristics were found:

- No rocks in the database of more than 5,000 boulders travelled further than a shadow angle of 21 degrees from the base of the source slope.
- At shadow angles greater than 25 degrees, the life risk was generally high.
- Typically, rocks do not simply roll in straight lines. Therefore, the potential source area is not just the slope directly uphill of the house, but a cone widening up from the house allowing for a 30 degree variation each side of the most direct fall line.

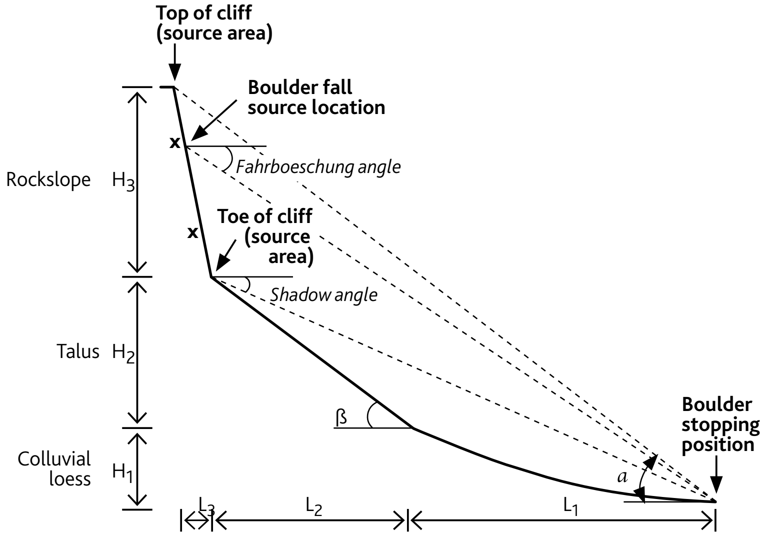


Figure 15: Schematic diagram illustrating the shadow angle for boulder roll

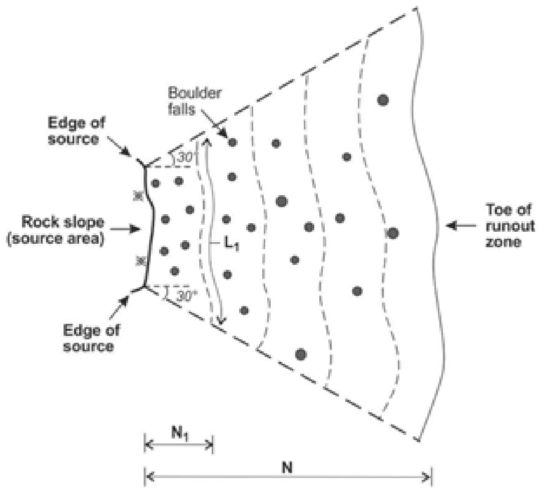


Figure 16: Cone widening of rockfall from potential source area

While the actual numerical levels of life risk will always vary from place to place, in accordance with the site and its expected seismicity level, these observations provide an important and useful initial guide.

Cliff collapse characteristics from the 2010–2011 Canterbury earthquake sequence

Studies of cliff collapse hazard from the 2010–2011 Canterbury earthquake sequence have provided examples of some of the key characteristics of typical low or high risk settings for the Christchurch geology and topography. These are presented in the table below.

Table 10 – Relative risk levels (make as rule of thumb)

Risk level	Possible characteristics
Low risk –Can Be Used (white) placard	• Building located beyond the 31 degree Fahrboeschung angle • No evidence of cracking or loosening of material at the top of the slope • No recent collapse of cliff material • Cliff height <20m and/or slope inclination <50 degrees
High risk – Consider Restricted Access (yellow) or Entry Prohibited (red) placard	• Building located within the 31 degree Fahrboeschung angle • Cliff height >20m and/or slope inclination >60 degrees • Evidence of recent and/or historic cliff debris in vicinity of building

Note: The cliff height descriptions presented in this table are not a national standard, and were developed from experience gained during the 2010-2011 Christchurch earthquake sequence. These cliff heights may be different pending on the size of the event, geology type, geographic location and the like.

Extensive cliff collapse occurred in the Redcliff to Sumner area of Christchurch during the 2010–2011 Canterbury earthquake sequence giving rise to debris runoff as presented in Figure 9.

In general the Fahrboeschung angle (refer figure 9) was found to be a simple and reliable guide that can be easily and quickly measured at virtually every property. While the exact Fahrboeschung angle beyond which no debris will roll depends on specific geology, climate and topography, the Christchurch experience provides a very useful initial guide.

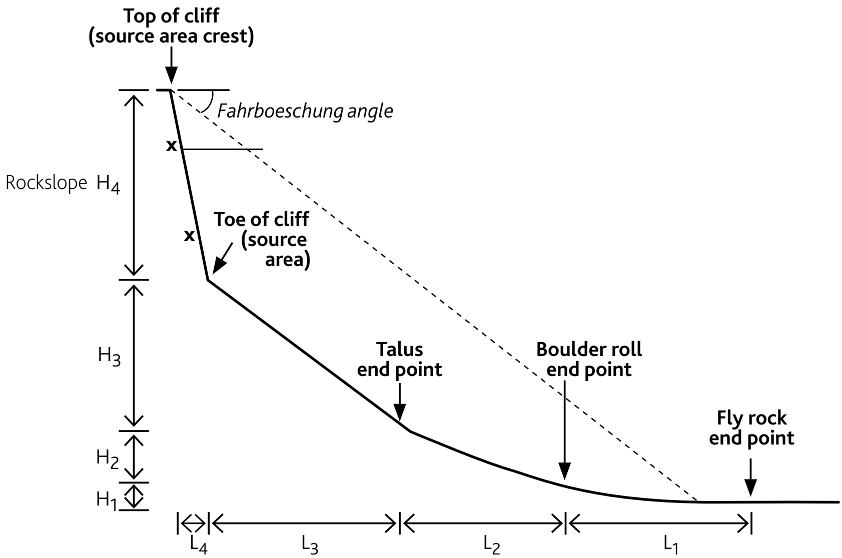


Figure 17: Schematic diagram illustrating the terrain parameters used in this study to assess the runout of debris avalanches (Massey et al, 2011)

It is important to note that, in Christchurch, the original slope at the base of the cliff was essentially flat (coastal cliff bases) and the nature of the materials and climate meant that debris flows did not occur. Debris flows have the potential to mobilise debris considerably further than the 31 degree Fahrboeschung angle (refer debris flow section).

Port Hills Geotechnical Group Flow Charts

Flow charts appended were developed following the 2011 Christchurch earthquake sequence as a means to document and aid in the decision-making process for assigning Section 124 Notices to buildings affected by geotechnical hazards. These were developed for the following scenarios:

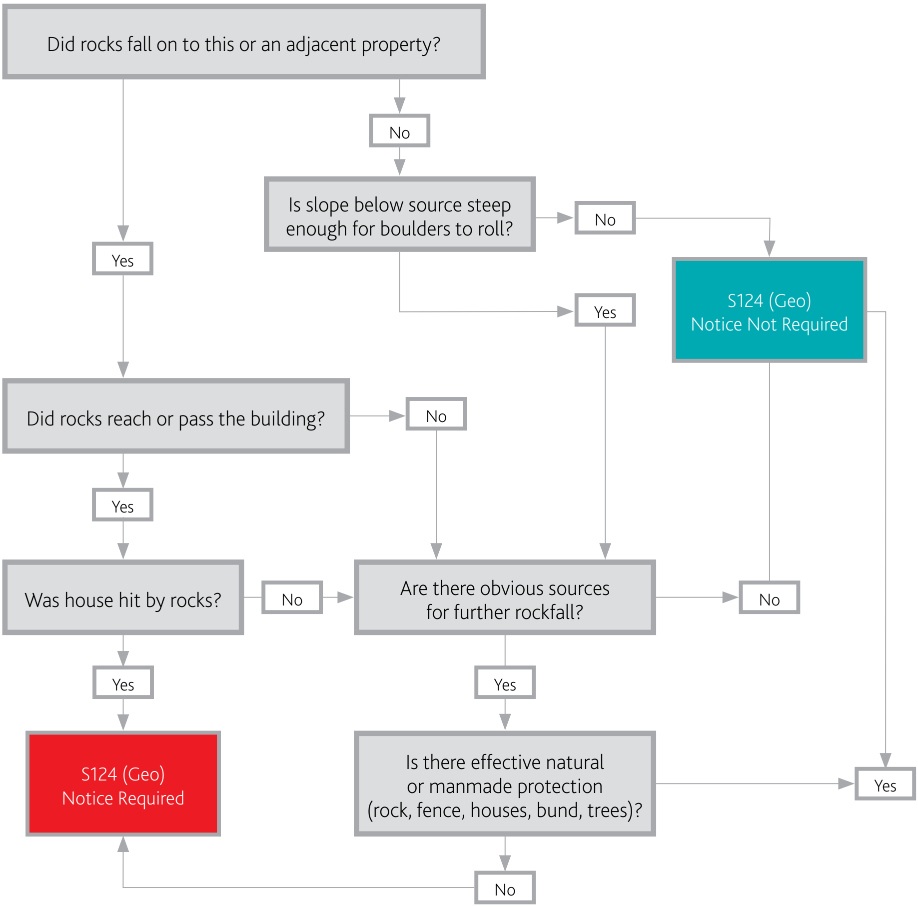
- Boulder Roll
- Cliff Collapse
- Cliff-top Setting
- Retaining Wall

These flow charts are provided solely as an example of the decision-making process used during the Christchurch event. It is not intended for use in future events without modification to consider the event, local authority and current Building Act legislation.

Port Hills Geotechnical Group
s124 (geo) Notice Application Decision Process – Boulder Roll

Address of property: ____________ Review date: ____________

Owner: ____________ Valuation No.: ____________



Check Yes/No boxes as applicable to lead to the decision.

Assessed by: ____________ Checked by: ____________

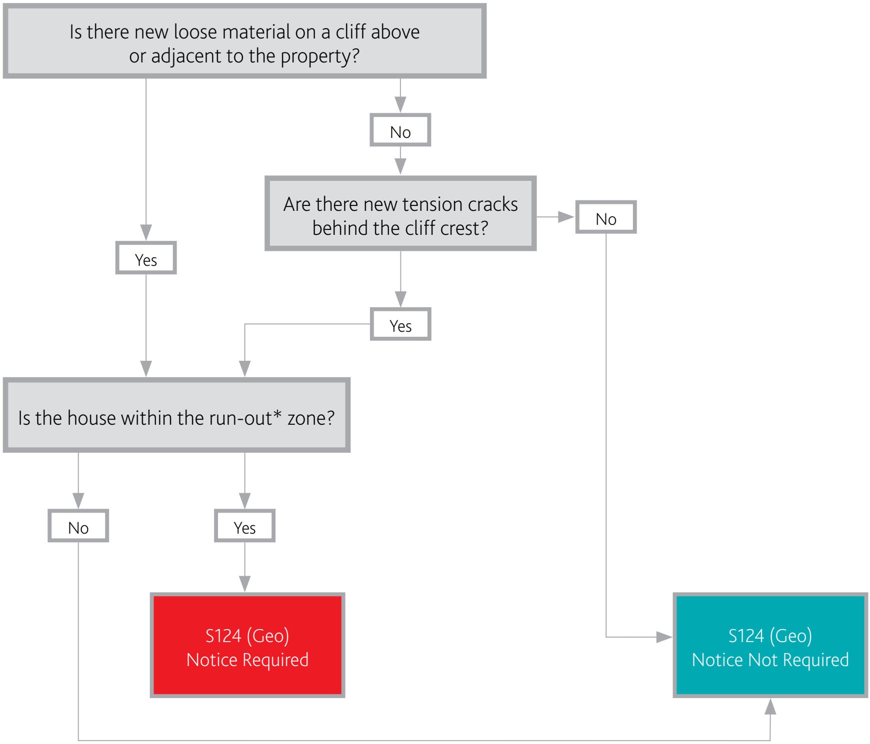
Comments:

Port Hills Geotechnical Group

s124 (geo) Notice Decision Process – Cliff Collapse

Address of property: | Review date:

Owner: | Valuation No.:



*Note: Extent of run-out zone is conservatively recognised as a 30-33° Fahrboeschung Angle from the cliff crest. Engineering judgement is required.

Check Yes/No boxes as applicable to lead to the decision.

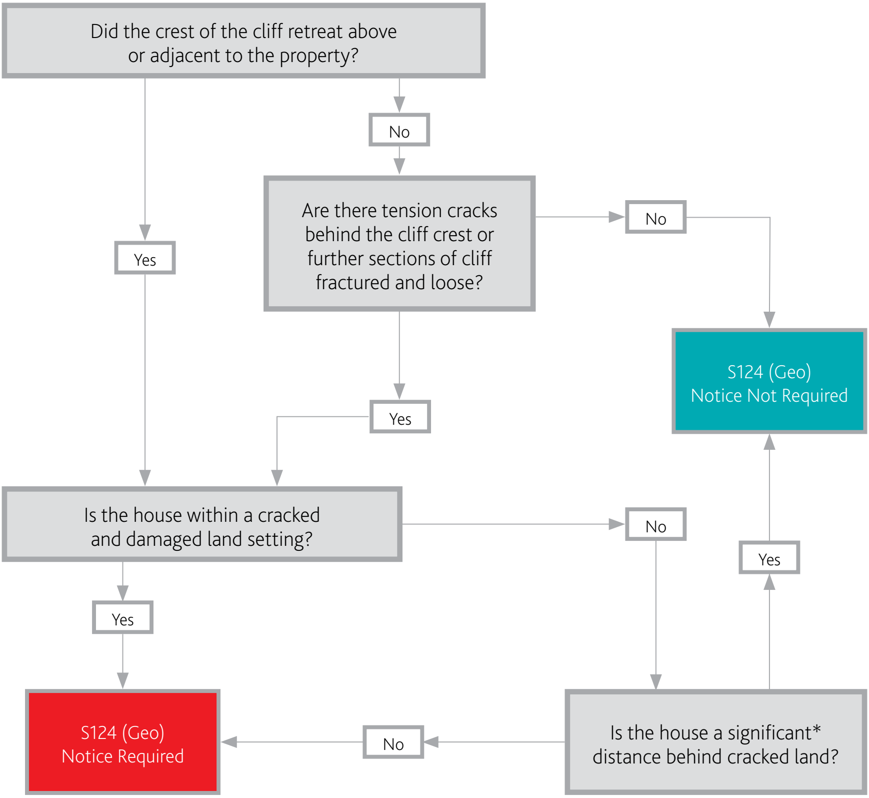
Assessed by: | Checked by:

Comments:

Port Hills Geotechnical Group
s124 (geo) Notice Decision Process – Cliff-top Setting

Address of property: ______ Review date: ______

Owner: ______ Valuation No.: ______



*Note: use comments box to describe judgement of significance.

Check Yes/No boxes as applicable to lead to the decision.

Assessed by: ______ Checked by: ______

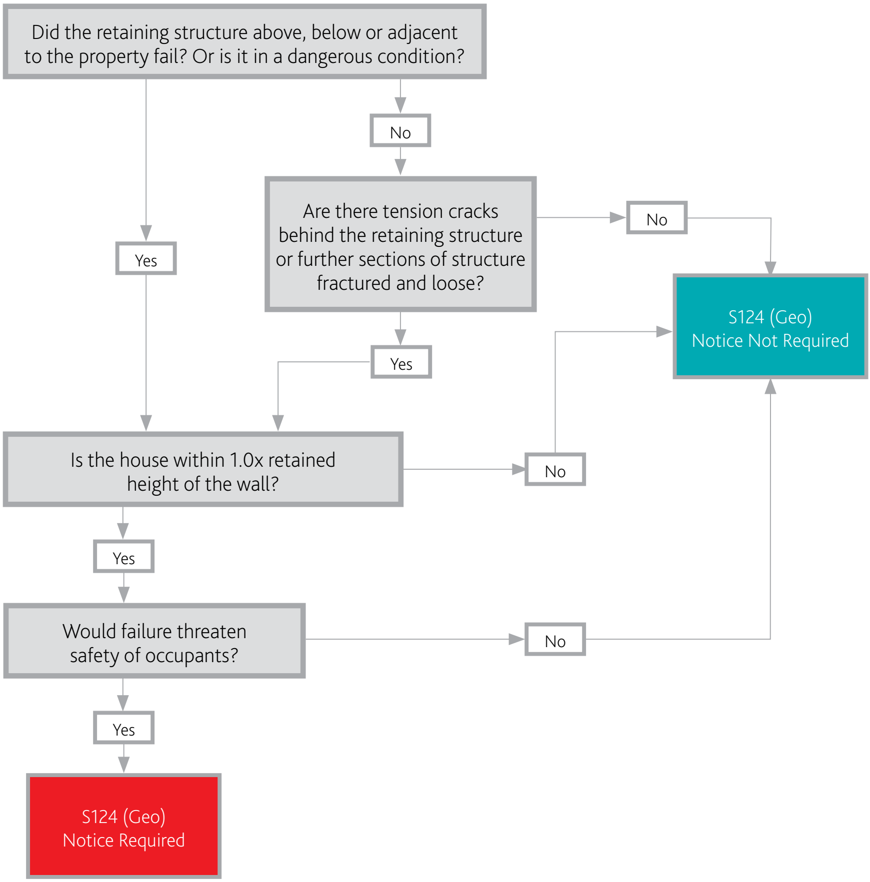
Comments:

Port Hills Geotechnical Group

s124 (geo) Notice Decision Process – Retaining Wall

Address of property: | Review date:

Owner: | Valuation No.:



Check Yes/No boxes as applicable to lead to the decision.

Assessed by: | Checked by:

Comments: