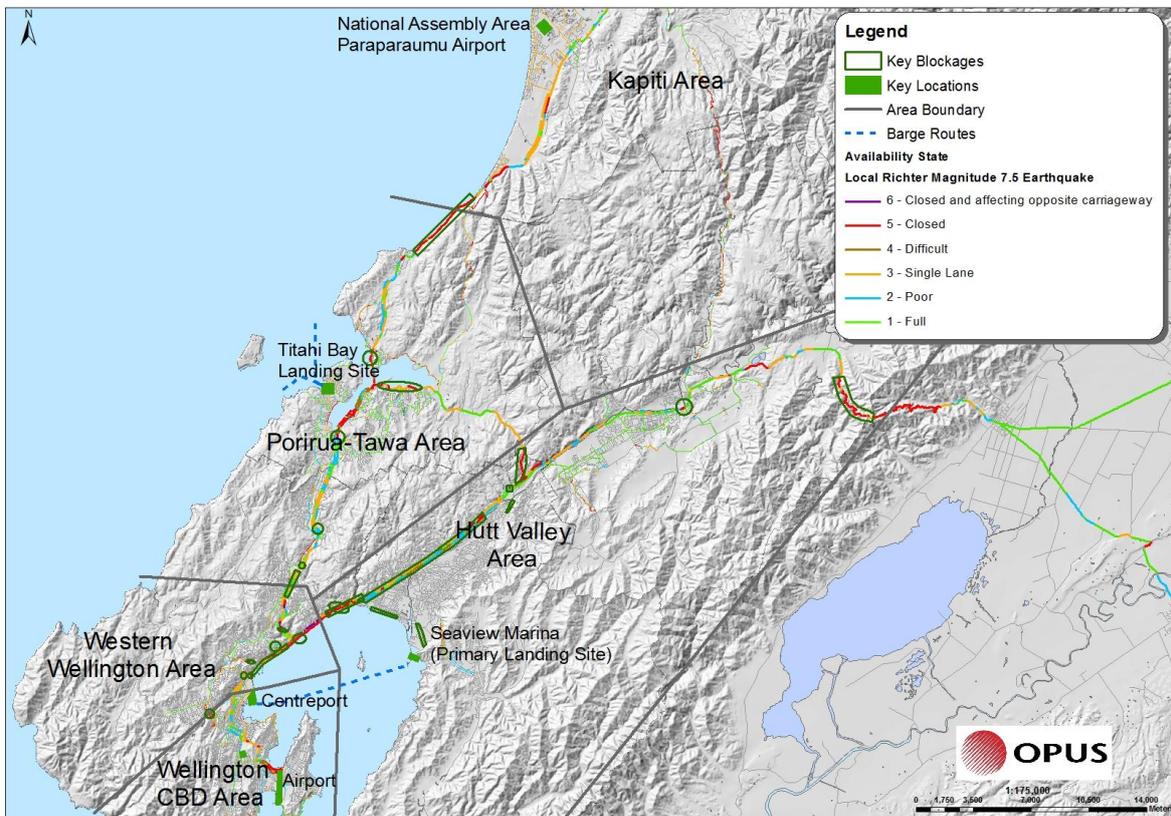


Restoring Wellington's transport links after a major earthquake



Initial Project Report

March 2013

Thanks are due to Opus International Consultants Ltd for providing the road seismic vulnerability mappings used in this report, and for their input to the various workshops conducted for this project.

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Executive summary

Recognising that it is not a matter of 'if' a major earthquake hits the Wellington metropolitan area, but 'when' it happens, this report pulls together information gained from recent work carried out by the transport infrastructure providers, including the Wellington Metropolitan area Road Controlling Authorities and CentrePort. A number of workshops were additionally held, which had as their focus how, following a major earthquake, critical supplies would be transported into and around the area. This project was carried out as a joint project, facilitated by the Wellington Lifelines Group (WeLG) and the Wellington Region Emergency Management Office (WREMO).

For analysis of transport access into and around the Wellington metropolitan area following a major earthquake, the region was split into five areas: the Kapiti Coast, Porirua and Tawa, the Hutt Valley, Western Wellington and the Wellington port/CBD/airport corridor. The results of workshops held with key stakeholders are presented in this report, followed by overall recommendations.

Transport effects of a major earthquake

- The region will become isolated by normal road access for at least 120 days. This is due to likely landslips on State Highway 1 from Paekakariki to Pukerua Bay; the Paekakariki Hill Road; the Akatarawa Road, and State Highway 2 over the Rimutaka Hill.
- In addition to isolation, the region will become fragmented due to landslips on the Haywards Hill section of State Highway 58 and the Horokiwi area of State Highway 2, in addition to other regional fragmentation for the short and medium terms.
- As work progresses to clear access, the above fragmentation will be lessened, until access is restored into and around the region.

Consequences of land access disruption

- Key lifelines, including the water, power and telecommunications sectors, will be heavily affected. Re-establishment of those lifelines is outside the scope of this project. For more information, the WeLG project (November 2012) titled 'Lifeline utilities restoration times following a Wellington fault earthquake' provides information on expected restoration times of these utilities.
- A key message for the overall document is that transport infrastructure in the region will be heavily affected. Car use will not be viable beyond individual suburbs. Supermarkets will not be re-stocked for, in some cases, weeks.
- The repatriation of internally displaced people (commuters, shoppers etc.), and the evacuation of visitors, critical personnel and others will be necessary.
- While regional access, the focus of this document, is addressed, strategies for restoring access to suburbs is not covered in this document. However, some communities may face particular access restoration difficulties, for example Miramar, Wainuiomata and Titahi Bay.

Estimated access times are as follows;

Into	Mode	Time
Wellington CBD	Sea	4-5 days
	Road	120 days
Western Wellington	Barge (via Porirua)	5-7 days
	Road connection to Porirua and Tawa	3 weeks
Porirua	Barge	5-7 days
	Road connection to the Wellington CBD area	3 weeks
Lower Hutt	Barge	5-7 days
	Road connection to the Wellington CBD area	8-10 weeks
Upper Hutt	Road connection to Lower Hutt	3 days to 2 weeks
Kapiti	Road connection to the Upper North Island	1-4 days

Required logistical arrangements

- About 90% of food, fuel and materials deliveries to the region will have to come via sea, through the CentrePort facility, or through the use of craned-container or 'break-bulk' ships unloading to barges which shuttle deliveries to the key offloading points. CentrePort is therefore a vital linchpin of the regional transport system, as is the Titahi Bay barging site for the Porirua and Tawa area, and Seaview Marina for the Hutt Valley.
- The remaining 10% of supplies will probably come from air delivery and 4WD vehicles.

Consequences for emergency plans and co-ordination

- Discussion of the transport disruptions and the likely impacts suggests that a single co-ordinated CDEM Group plan is required, which effectively ties together welfare, transport, supply and lifelines issues.
- It will be difficult to supply potable water into and around the region by barge/tankers in the quantities required. Further consideration is required on this issue, to be facilitated by WREMO.
- The responses outlined in this document assume good overall co-ordination of restoration and recovery actions. This is a matter for CDEM Group to consider, particularly regarding the Lifelines Co-ordinator role.
- Civil engineering plant and operators presently located in the Wellington region will not be sufficient to carry out all necessary works at the same time following a major earthquake. Additional resources will need to be brought into the region, along with sufficient fuel for servicing the machines. This aspect will also require CDEM Group/lifelines co-ordination input.
- Fuel availability is a further constraint to be aware of. A plan for emergency fuel supply would be beneficial to the region.
- Debris disposal is a key issue for recovering access around the region, for which an emergency debris disposal plan would be beneficial.

Logistical arrangements following a major earthquake

Entry into the Wellington region during the response phase will be primarily by sea, supplemented by airlift, airdrop (parachute), helicopter and 4WD trucks. CentrePort is the main point of entry for freight to Wellington, Western Wellington and the Hutt Valley, while a separate beach landing operation will be established for the first few weeks at Titahi Bay to allow freight access to the Porirua and Tawa area. Beach landing operations at Seaview and/or Petone foreshore will allow freight to be transferred by barge from CentrePort to the Hutt Valley. Concurrent with the sea movement of freight, roading authorities will rebuild a regional network, with key routes from the airport to CentrePort, CentrePort to Porirua, CentrePort to Lower Hutt and Lower Hutt to Upper Hutt. Opening these routes will allow road access to all of the main centres in the region, with local authorities opening access to suburbs off these key routes. In addition, major road clearing operations will operate at Paekakariki and Pukerua Bay (to reopen SH1) and possibly Upper Hutt and Featherston (to reopen SH2) to allow external road access to Wellington.

Mitigation efforts, recommendations and resulting actions

Suggestions for actions, overall recommendations and suggested actions are presented at the end of this document.

Recommending individual mitigation projects that may be considered to create more resilient transport infrastructure is outside the scope of this document. It is recommended that this aspect be progressed by the transport infrastructure providers, using this document as a basis of discussion.

1. Introduction

Recognising that it is not a matter of 'if' a major earthquake hits the Wellington metropolitan area, but 'when' it happens, this report pulls together information gained from recent work carried out by the transport infrastructure providers, including the Wellington metropolitan area Road Controlling Authorities and CentrePort. A number of workshops were additionally held, which had as their focus how, following a major earthquake, critical supplies would be transported into and around the area. It should be recognised however that pedestrian and light access will be available around the region, dependant on natural obstructions, in addition to any freight movement. This project was carried out as a joint project, facilitated by the Wellington Lifelines Group (WeLG) and the Wellington Region Emergency Management Office (WREMO).

1.1. Seismic context

A major earthquake could hit the Wellington region from a number of sources – one of the key faults running through the area (Ohariu, Wellington or Wairarapa faults), from a shorter but shallower fault in the region, or from the subduction zone that runs beneath the region. Recent work by GNS Science on the "It's Our Fault" project has outlined the likely return periods of moderate and large earthquakes. Although it is now understood that the Wellington Fault ruptures on average every 840 years, and the last rupture was around 300 years ago, the range of other faults outlined above mean that there still exists a real possibility of at least moderate earthquakes in the region. By planning for the larger events, but recognising that the small and moderate events may still cause damage, Wellington will be better prepared. In terms of actual shaking effect from a major Wellington earthquake, the majority of Wellington's infrastructure lies within a zone that would be subjected to shaking intensity of MM9 or MM10. At the fault line itself, it is anticipated that a Wellington Fault rupture would produce a maximum of 4m to 5m in horizontal movement and up to 1m in vertical movement.

Key seismic vulnerabilities exist in the Wellington transport networks. The seismic vulnerability to slips of the four roads into the area (SH1 Paekakariki to Pukerua Bay, the Paekakariki Hill Road, the Akatarawa Road and SH2 Featherston to Te Marua) mean that following a large local earthquake, the area south of the roads noted above would be effectively isolated by land access for at least 120 days (four months). Other vulnerable areas are SH58 Haywards and SH2 Horokiwi. This would lead to regional fragmentation of the Hutt Valley from the rest of the area.

1.2. Project objectives

This report outlines how food, water and critical supplies could be transported around the region following a major local earthquake. Effectively therefore, this is a document about moving freight, not people. It represents the case of 'what would happen if the earthquake struck today'. It therefore does not take into account the potential future construction of new transport infrastructure (for example the Transmission Gully motorway), but does outline some mitigation scenarios that could be considered by the relevant asset owners. The objectives of the project are as follows: -

- Identify and map the primary access routes and transport nodes for the storage and distribution of critical supplies
- Outline the indicative pre-event mitigation work required to these access routes and storage facilities, and the proposed plan to mitigate or improve resilience
- Outline the indicative post-event co-ordination arrangements that need to be developed
- Inform an update to the Wellington CDEM Group "External Supply of Resources Guideline"
- Identify the types of vehicles likely to be involved and estimate vehicle movements anticipated, recognising that demand may vary over time

This initial phase of the project will partly address the first four of the above five points. Once the implications of this report are understood, it may be that further iterations of this project are required to better address each of the objectives above.

Access, for the purposes of this project is taken to be truck access for freight movement.

1.3. Project audiences

The intended audiences of this project are: -

- CDEM Group and MCDEM, for emergency planning purposes
- Roading authorities, for consideration of seismic upgrades and for local-level emergency planning purposes
- CentrePort, Wellington International Airport, KiwiRail and Seaview Marina for consideration of seismic upgrades and emergency planning purposes. (Note that consideration, in terms of any upgrade of infrastructure, must take into account commercial and practical considerations appropriate to the relevant entities.)

Other audiences of this report, through the work of CDEM, local councils and the transport-related Wellington lifelines organisations are:

- The NZ Defence Force, in its emergency logistics role
- The non-transport-related Wellington lifelines, for their emergency and business continuity plan update process
- Ultimately, although not a direct target audience of this report, it is the Wellington community and businesses that are the end-beneficiaries of this document.

The findings of this project will assist the following actions and issues: -

- Planning food/materials supply after an earthquake
- Managing expectations for transport access of the other Wellington Lifelines' (the telecommunications, water and energy sectors)
- Informing CDEM's community engagement
- This project may assist in the compilation of a list of materials needed in the Wellington region immediately following an earthquake

1.4. Project exclusions

It should be noted that this document is not a plan. It is an explanation of freight transport possibilities following a major Wellington earthquake. It is expected that from the basis of this information, detailed planning both of transport response and recovery, and of non-transport lifeline response and recovery functions, could be carried out.

This report focuses on the restoration of regional transport access. It does not cover the restoration of access to individual suburb level, although restoring regional access will connect many suburbs, albeit in areas. This report does not cover in adequate detail the restoration of suburbs not near main line routes. For example, communities such as Karori, Horokiwi, Miramar and some on the western and eastern Hutt Valley communities have not been addressed. Individual councils should prepare their own strategies or plans for restoring access to these areas.

Items that are 'out of scope' of this project are: -

- Transport access arrangements in the Wairarapa. This document covers the Wellington metropolitan area and the Kapiti Coast only.
- Identification of individual projects for the mitigation of transport asset seismic vulnerabilities

- Specific emergency logistical arrangements
- Emergency fuel supply issues
- Emergency water supply issues
- Debris disposal
- Emergency welfare issues
- The movement of people
- Local-level transport access arrangements to individual communities or suburbs (this aspect should be covered in local council-level plans).

2. Existing plans and information bases

This project was carried out in conjunction with the following plans and other documents: -

NZTA / KCDC / PCC / UHCC / HCC / WCC seismic vulnerability mappings

In 2012 the road-controlling authorities, the New Zealand Transport Agency (NZTA), Kapiti Coast District Council, Porirua City Council, Upper Hutt City Council, Hutt City Council and Wellington City Council collaborated to share their seismic vulnerability mappings (Opus, 2012, Wellington Region Road Network Earthquake Resilience Study). The final report on those mappings may be obtained from one of the organisations that was party to that work. The mappings produced from that project were used as a basis for analysis and discussion on this project / document.

NZTA's SH1, SH2 and SH58 seismic plans

NZTA have produced plans for access along the SH1, (DRAFT) SH2 and SH58 corridors following a major local earthquake. These plans outline how access would be regained through key corridors, and the likely time to recover access in these locations.

Thorndon Critical Area – Transport Access MoU

In order to ensure that a route from Johnsonville to Thorndon is secured as quickly as possible the asset owners NZTA (for the State Highways), Wellington City Council (for the local road network) and KiwiRail (for the rail corridor) signed a Memorandum of Understanding (MoU) with their maintenance contractors and key contractors in the area that own earthmoving equipment in the Ngauranga area (Fulton Hogan, Downer, Kiwi Point Quarry, Downer Asphalt, Allied Concrete, Higgins Concrete). The outcome of the MoU is that the above organisations will co-operate after a major earthquake to identify the best route through this corridor and work collaboratively to restore it.

Access to Wellington airport

Recognising that both Cobham Drive and Moa Point Road are vulnerable to liquefaction, and that Wellington airport's main operations are on the east side of the runway, an MoU outlines that the airport will switch some operations, such as the establishment of an assembly area, to the west side of the runway in the case of damage to the above roads. The parties to the MoU are Wellington International Airport Ltd, the New Zealand Transport Agency (for State Highway access) and Wellington City Council (for local road access).

Seaview Critical Area

This (as of November 2012) incomplete document outlines how organisations that have an impact on fuel supply will collaborate to ensure that fuel may be transported from the Seaview area as soon as practically possible.

MCDEM Wellington Earthquake National Initial Response Plan

The Ministry of Civil Defence and Emergency Management's 'Wellington Earthquake National Initial Response Plan' outlines how logistical supply chains will be opened in response to a major Wellington Earthquake. It is centred on the first few days following an earthquake, and not the following longer-term response and recovery. It outlines likely early logistical activities.

NZTA/GWRC reconnaissance plan

NZTA and the Greater Wellington Regional Council CDEM (now WREMO) have an arrangement with Helipro to conduct a fly-over reconnaissance of the key Wellington transport routes following a major earthquake. This will assist response operations considerably through an understanding of the actual impact on transport infrastructure following an event.

3. Logistics requirements

As a basis for analysis and discussion, the requirements for food, fuel and materials were assumed to be:

Food requirement	2kg per person per day
Fuel requirement	5 litres per person per day
Materials requirement (including equipment, construction and recovery items)	10kg per person per day

While a broad assumption, the above allows for discussion to progress based on approximate scales of logistical arrangements. The resulting figures are as shown in Table 1.

Table 1 - daily logistical requirements in each area

	Population (2006)	Food (tonnes)	Fuel (litres)	Materials/ equipment	Equivalent number of 20ft containers
Porirua and Tawa	60,000	97	240,000 (or 12 trucks)	600 t	70
Hutt Valley	140,000	270	700,000 (or 35 trucks)	1,400 t	167
Western Wellington	60,000	60	240,000 (or 21 trucks)	600 t	66
Wellington port/ CBD / airport	120,000	240	600,000 (or 35 trucks)	1,200 t	144
				Total	447

As individual areas open up, the majority of food, equipment and materials would be transported into the region through CentrePort. This would equate to approximately 447 20-foot containers per day. This makes access to CentrePort a vital element of any regional transport plan, not just for Wellington City, but for the Hutt Valley and Porirua as well. Similarly, the transport of fuel into the region is predominately through Seaview, through which 105 fuel trucks per day (equivalent) would be transported. This makes Seaview another critical element of any regional transport (and community) recovery plan.

The above assumes a 10-tonne load per 20-foot container. Such containers are capable of holding a maximum load of 23 tonnes. However, it is unlikely that all containers could be filled to a maximum weight, and logistically it may be preferable to split some loads. The number of container loads outlined above should therefore be taken to be an indicative quantity of transport / logistical movements.

CentrePort have achieved an average of 25 to 30 containers handled per hour using the existing container cranes. In the case that these cranes are unavailable (no power, jumped off rails, collapse or equipment failure), it should be expected that containers are delivered by conventional ships with onboard cranes that would be used for off-loading, at a rate of 6 to 10 containers each per hour. Additional supplies can be delivered via roll on, roll off vessels such as quarterdeck car carriers. Examples of these two types of ship are given in Figure 1.

It should be noted that, in an emergency, it may be preferable to transport freight not solely in containers, but potentially also in bulk, or in packages that may be offloaded by hand. This is an option that may be considered further in both planning and response phases.



Conventional ship, onboard cranes



Roll on, roll off vessel

Figure 1 - Examples of shipping types

In line with the project exclusions, separate work needs to be done on the storage, breakdown and onwards movement of freight, once off-loaded from shipping.

4. Analysis by areas

In order to break the region down into sections that could reasonably be assessed and analysed, this project considered the region in the following areas: Kapiti, Porirua and Tawa, the Hutt Valley, Western Wellington and the Wellington Port, CBD and Airport.

The areas were selected on the basis of anticipated transport infrastructure damage, which isolates each area by road from the others. The area sizes and locations are as demonstrated in Figure 2.

It should be noted that access is defined by the movement of large quantities of freight; the smallest loads considered would be 2-4 tonnes on a truck. People on foot, helicopters or 4WD vehicles will be able to access most parts of the Wellington region. However, in order to enable a response to be mounted, there must be a transport infrastructure in place that allows the movement of hundreds of tonnes of food, equipment and supplies. This is not possible with helicopters, light vehicles and foot traffic. Only trucks, ships and barges will allow the sustained transport of heavy loads across the region. Therefore an area is only considered accessible once freight can be transported to it.

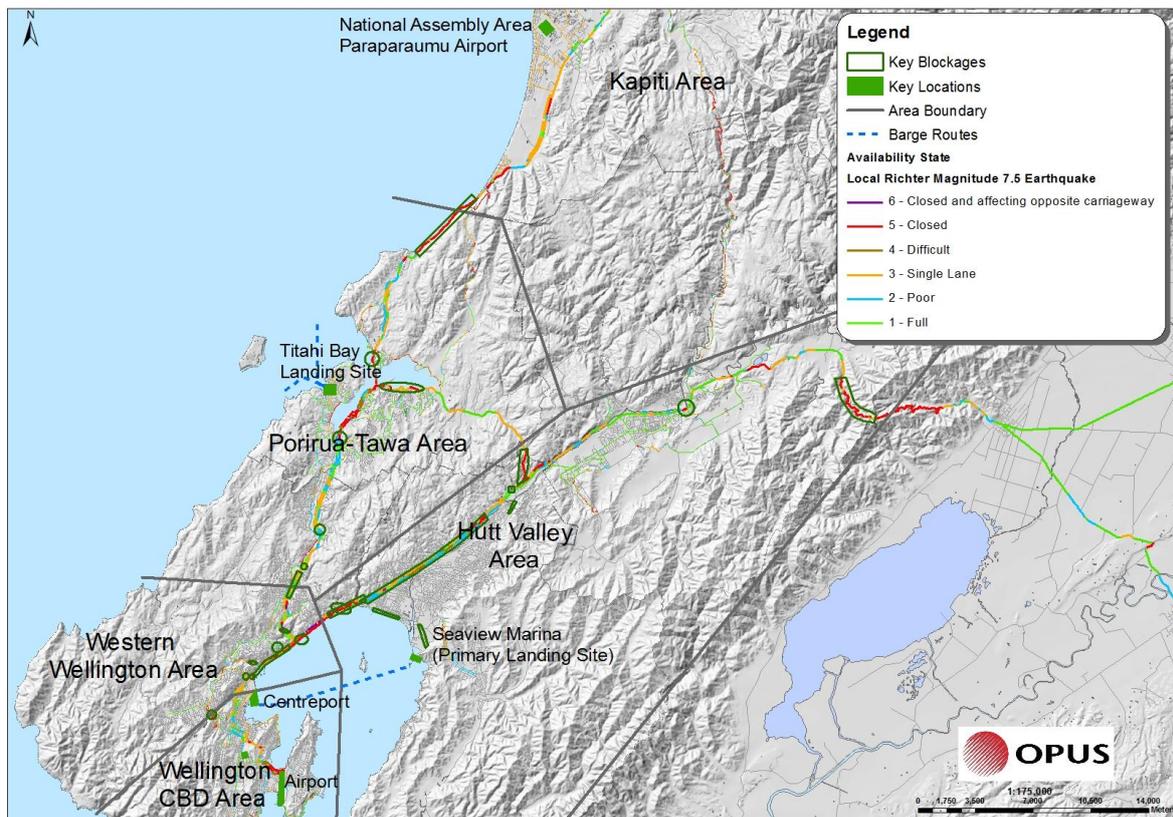
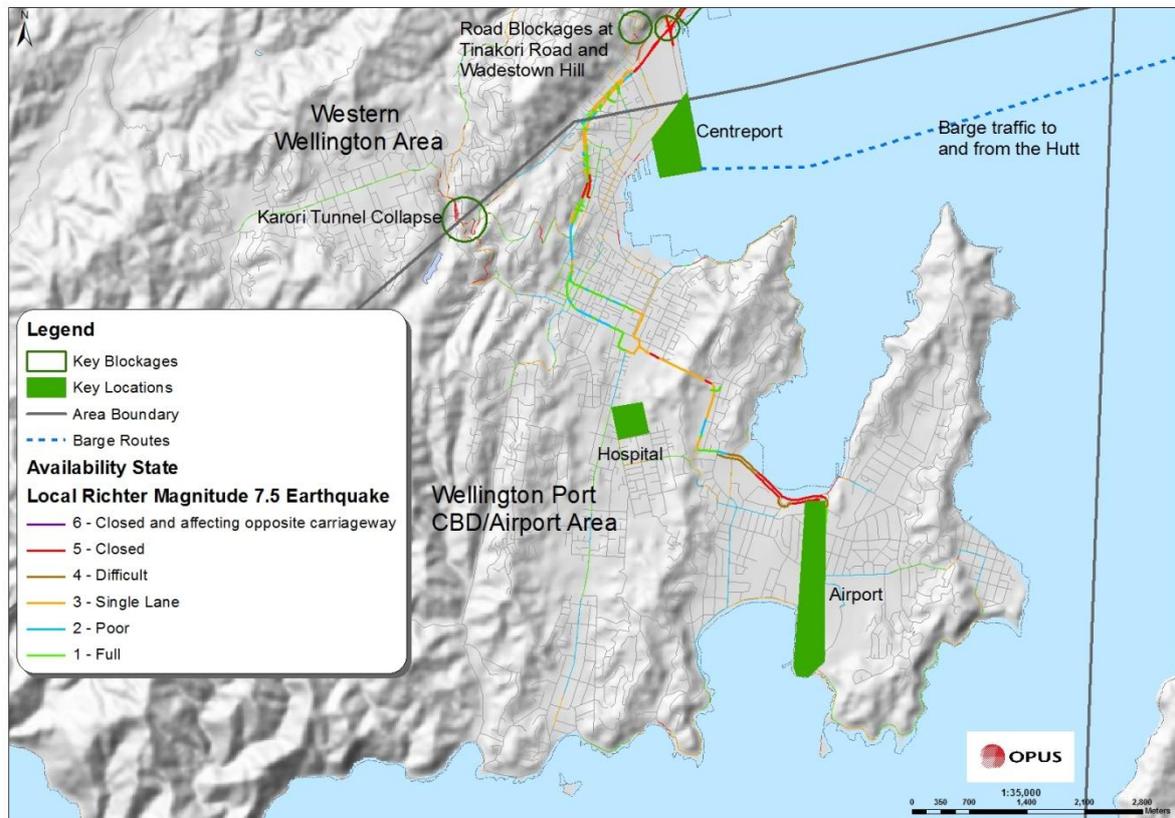


Figure 2 - the five areas studied for Transport Access

Attendees at the various workshops are as shown in Appendix 2. The findings of the various area workshops are as shown in the following sections.

4.1. Wellington port, CBD and airport area



Assumptions

The Wellington port/CBD/airport area contains a community of around 120,000 (2006 figure). Its transport requirements have been assumed for this study as:

- Food (assuming 2kg/person/day) 240 tonnes/day
- Fuel (assuming 5kg/person/day) 600,000 litres/day
- Plant, materials and other items (assuming 10kg/person/day) 1,200 tonnes/day

The above would equate to approximately 144 20-foot containers and 30 fuel trucks per day.

As long as the Wellington metropolitan area (Porirua, the Hutt Valley and Wellington) is isolated by land, and as the various areas open up, the transport requirement though CentrePort becomes, (assuming a total population of 360,000 [2006 figure]), as follows:

- Food (assuming 2kg/person/day) 667 tonnes/day
- Fuel (assuming 5kg/person/day) 1,780,000 litres/day
- Plant, materials and other items (assuming 10kg/person/day) 3,800 tonnes/day

This would equate to approximately 447 20-foot containers and 85 fuel trucks per day. This makes access to CentrePort a vital element of any regional transport plan, not just for Wellington City, but for the Hutt Valley and Porirua as well.

Time required to link up with neighbouring areas

Estimated access times to the Wellington CBD area are as follows;

From	Mode	Time
Rest of New Zealand	Sea	4-5 days
Wellington West	Road	3 weeks
Hutt Valley	Barge	5-7 days
	Road	8-10 weeks
Porirua and Tawa	Road	3 weeks

Concepts

The following concepts have been developed for transport relating to the Wellington port/CBD/airport area: -

- The Wellington port/CBD/airport area will be isolated from the Western Wellington and Porirua areas for around 3 weeks, and isolated from the Hutt Valley area for at least 8 weeks.
- This area is at the start of the food/materials delivery supply chain, assuming supply by sea into Wellington Port, but the end of the lifeline chain for water and electricity supply. This will present additional challenges in this area for both community and lifelines response and recovery.

The concepts of access response and recovery are:

- As a first priority, to create an access corridor along the route from the Airport to Wellington Hospital, to CentrePort, and from there to the Western Wellington area.
- CentrePort is expected to receive around 90% of the food/materials deliveries for, at first the Wellington port/CBD/airport area, and later the wider Wellington metropolitan area until access to the remainder of the North Island is restored.
- The airport is key for rapid response, evacuation and urgent/high priority supplies.

Access *into* the area

If an earthquake happened today, the response for short and medium term (from 0 weeks to 16 weeks) would be to take the following actions:

- Carry out a survey of the harbour for available water depths for shipping. It should be noted that it is presently anticipated that there will be adequate harbour depth to accommodate essential shipping, even after a major fault movement.
- Wellington Airport to assess the damage to the runway and inform key stakeholders of the available runway length, and enact the airport Business Continuity Plan for operations to re-start. It should be assumed that the airport is only operable for military and turbo-prop aircraft and for helicopters, for a period dependent on damage levels, but potentially for a number of weeks.
- A temporary Wellington airport assembly area may be located on the west side of the runway with cross-runway access to the normal operations area on the East side of the runway.
- CentrePort to assess the post-event damage and inform key stakeholders of the operational capability of the port.
- If none of the CentrePort wharves is available for use, the alternative will be to off load cargo directly from a craned-ship to barges located within the harbour, and to offload the barges at shallow beaches in the harbour area.
- The movement of freight into the Hutt Valley will rely on barges and landing craft. These are likely to operate from CentrePort. It is easier to unload a ship and then crossload to a barge tied up at CentrePort, rather than trying to load a barge from a ship in the middle of the harbour. Therefore, CentrePort will be a key link in the transport chain to the Hutt Valley.

Access around the area

If an earthquake happened today, the response for short and medium term (from 0 weeks to 16 weeks) would be to explore the following options:

- A road reconnaissance must be held in the first few days after an event to identify preferred routes through the airport-hospital-port-Western Wellington corridor.
- It is anticipated that, due to a number of alternative route options, an access corridor should be available in the Airport-Hospital-Port corridor within a few days of a major earthquake, depending on contractor resource.
- Access from the CentrePort Wharf area to Thorndon Quay (the most likely available access out of the port area) is likely to be through the rail yard, south of the Westpac Stadium.
- Access from the CentrePort wharf area to the remainder of the region might be dependent on plant shipped in from outside Wellington. There is limited plant and construction machinery close to Thorndon Container Wharf in normal circumstances.
- At Wellington airport, access over the runway may be arranged when/where aircraft are not using the runway, providing access to/from Miramar. This will be co-ordinated by Wellington airport.
- Carry out ground reconnaissance and road structure inspections to provide greater detail and clarity on damage states.

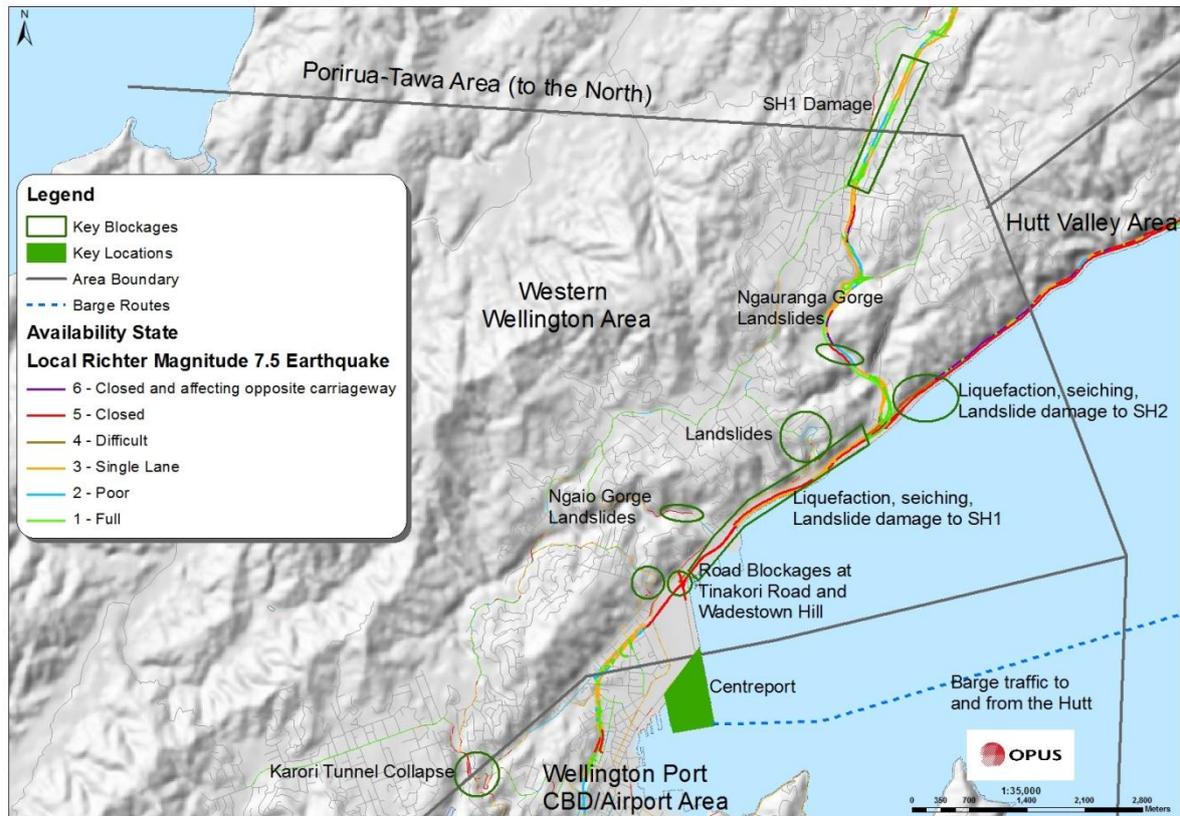
Wellington port, CBD and airport actions

Action points for the Wellington port, CBD and airport area are as follows, and are also summarised in appendix 1.

Action point	Issue	Implementer	Recommended date for completion
1.01	Create a plan for offloading ships at CentrePort. This should take into account available crane access and any power-supply requirements. This action will require collaboration between CentrePort and Wellington Electricity	CentrePort	by end 2013
1.02	Investigate the suitability of Burnham Wharf (for supply of food and materials to Miramar post disaster)	CentrePort	by end 2013
1.03	Wellington airport to proactively engage its engineer to establish the seismic vulnerability of the runway	Wellington Airport	by April 2013
1.04	Establish who will manage the logistical operations from the port and airport – is this to be WREMO or the existing logistical operators (logistical contractors presently located at or near the Airport and Port)	Facilitated by WREMO, with input from MCDEM, CentrePort, WIAL and existing logistics operators	by end 2013
1.05	Consider how water could be transported into the region, including potential temporary storage at CentrePort	WREMO / CentrePort	By end 2013

Additional common and generic actions are captured also in appendix 1.

4.2. Western Wellington area



The Western Wellington area incorporates Johnsonville at its northernmost extreme, the Ngauranga Gorge, and the Wellington City suburbs west of the Wellington fault line (i.e. Khandallah, Ngaio, Wilton, Karori). The fault line was chosen not for the likelihood of its rupture (which represents only one earthquake scenario for the region) but because adjacent to the faultline is a steep hill (from Wadestown to Kelburn) which must be traversed to gain access to the other side of the faultline. Along with the harbour, this would present a natural barrier for transport access in the region. It is therefore a logical boundary for the eastern side of the Western Wellington area.

Assumptions

The following are broad-brush transport requirements for the Wellington West population of 60,000 (assumed estimate):

- | | |
|---|--------------------|
| • Food (assuming 2kg/person/day) | 60 tonnes/day |
| • Fuel (assuming 5 litres/person/day) | 300,000 litres/day |
| • Plant, materials and other items (assuming 10kg/person/day) | 600 tonnes/day |

The above would equate to approximately 66 20-foot containers and 15 fuel trucks per day. It is unlikely that water could be provided by tanker into this area in this scenario. This is an aspect that should be captured in any Wellington emergency water supply plan.

Time required to link up with neighbouring areas

Estimated access times to the Western Wellington area are as follows;

From	Mode	Time
Wellington CBD	Road	3 weeks
Porirua	Road	1 week
Hutt Valley	Road	8-10 weeks

Concepts

The key actions following an earthquake for this area will be to establish which are the most viable routes for restoring access from Wellington City through to Porirua and the Hutt Valley. This will be achieved through early reconnaissance operations and through co-operation between NZTA, WCC, KiwiRail and key contractors, as identified in the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'. A concentration of available resources will be given to the best access route once this has been identified.

Once a clear access route from the west side of the Wellington faultline (relatively high ground) to the east side (relatively low ground) is achieved, restoring an access 'spine' between Johnsonville towards the Karori Tunnel area will be an early requirement. From a practical perspective, it is likely that access via the Crofton Downs-Wilton-Wadestown route is likely to be the route that can be opened early (even though with restricted capacity, being a narrow road). The access into Karori is likely to be through Crofton Downs-Wilton-Karori route.

For improved connectivity between CentrePort and the other Wellington metropolitan areas, the recovery of the Hutt Road between Ngauranga and Thorndon will also be key, followed by restoration of access along SH2 between Petone and Ngauranga.

Access into the area

Providing access to the Porirua and Tawa and Wellington port/CBD/airport areas will be a priority.

SH1 Ngauranga to Thorndon

The Southern Rail Overbridge (Hutt Rail Line overbridge) and the Thorndon Overbridge are seismically vulnerable, and are at risk of failure in an earthquake. The catch frames on the Thorndon Overbridge will prevent the concrete beams from falling into the railyard below, but are not strong enough to support traffic on the structure. It is anticipated that it will take more than 3 months to restore access along this key section of SH1. The Southern Rail Overbridge is more vulnerable and may fail in a non-Wellington Fault rupture event.

Thorndon Quay, from the rail station to the Tinakori Road/Hutt Road intersection

Thorndon Quay, particularly at its northern end, is vulnerable to large landslips from above. Specifically at the intersection with Tinakori Road the potential failure of buried services mean that this intersection may become heavily damaged and inaccessible for a number of days to weeks. It is the subject of the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'. Access around this area may be preferable, dependant on the relative damage states of the relevant areas.

Karori Tunnel area

It is anticipated that the road through the Karori Tunnel, and the roads immediately to the west of it will suffer damage, affecting access into/out of the Karori area. It appears worthwhile carrying out further work on understanding access in this specific area. The access to Karori is likely to be along Churchill Drive-Wilton Road-Curtis Street, based on Wellington City Council studies of road resilience and priority routes.

Ngauranga Gorge area

The hills above the Ngauranga Gorge are seismically vulnerable and the Gorge is expected to be inundated by slips in some areas, through which it would take a number of days to restore access. This area is the subject of the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'.

Hutt Road – Ngauranga to Thorndon

The hills above the Hutt Road between Ngauranga and Thorndon are seismically vulnerable and are expected to slip in some areas. It is anticipated that it will take around three weeks to restore single-lane access through this corridor. This area is the subject of the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'.

SH2 Horokiwi

The hills above SH2 between Petone and Ngauranga are seismically vulnerable and are expected to slip in some areas. NZTA's SH2 plan outlines that it would take 8-10 weeks to recover access through this corridor. It is understood that NZTA are in discussions with KiwiRail and the Horokiwi Quarry regarding seismic plans for restoring access in this area. Production of this plan should remain a priority.

'Lateral' roads connecting Churchill Drive to the Hutt Road (through Wadestown, the Ngaio Gorge and Onslow Road)

Assuming that the Hutt Road will take around three weeks to recover single-lane access between Ngauranga and Thorndon, recovery of at least one of the above lateral roads may be feasible before the recovery of the Hutt Road. The focus for regional access (as well as for the communities concerned) will be to carry out reconnaissance and recover access on at least one of these roads. This area is the subject of the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'.

The Karori to Makara route

This route is unlikely to be viable following a major earthquake, and has not been considered for regional access needs. Access by land to the Makara area is likely to be unavailable for a prolonged period.

Access around the area

The Johnsonville to Karori 'spine' (Churchill Drive and other roads)

Access along the corridor from Johnsonville, through Khandallah, Ngaio and Wilton towards Karori may be relatively feasible, albeit with single-lane access in some parts. This area is the

subject of the 'Thorndon Critical Area plan for road access Ngauranga to Thorndon (May 2012)'.

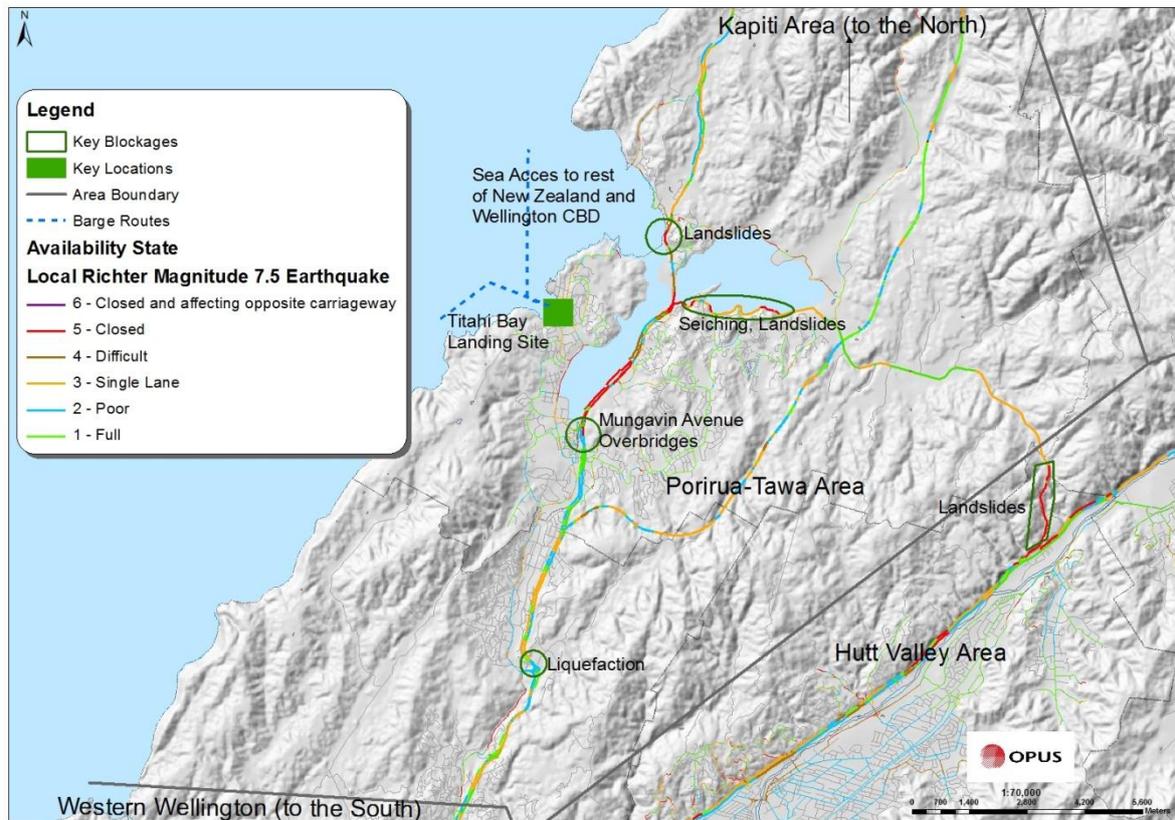
Western Wellington action points

Action points for the Western Wellington area are as follows, and are also summarised in appendix 1.

Action point	Issue	Implementer	Recommended date for completion
2.01	Create a plan for access to Karori (some route options appear available). Such a plan should include consideration of a possible Karori Dam failure	WCC	by the end of 2016
2.02	Create a plan to recover access on SH2 between Petone and Ngauranga	NZTA	by end 2013

Additional common and generic actions are captured also in appendix 1.

4.3. Porirua and Tawa area



Assumptions

The following are broad-brush transport requirements for an assumed Porirua and Tawa population of 65,000 (in 2006, there were 48,546 residents in Porirua):

- Food (assuming 2kg/person/day) 97 tonnes/day
- Fuel (assuming 5 litres/person/day) 240,000 litres/day
- Plant, materials and other items (assuming 10kg/person/day) 600 tonnes/day

The above would equate to approximately 70 20-foot containers and 12 fuel trucks per day.

Time required to link up with neighbouring areas

Estimated access times to the Porirua-Tawa area are as follows;

From	Mode	Time
Rest of New Zealand	Barge	5-7 days
Wellington West	Road	Approximately 1 week
Wellington CBD	Road	3 weeks
Kapiti	Road	120+ days
Hutt Valley	Road	12 weeks

Concepts and priorities

Due to likely large landslips south of Paekakariki on State Highway 1, on the Paekakariki Hill Road, State Highway 2 (Featherston to Te Marua) and SH58 Haywards, transport access to the north will be cut by land for at least 120 days.

Priorities for restoring transport access will be, with top priority first: -

- Until access to Wellington Harbour is achieved, create a barging access into Titahi Bay for supply of food and materials to the Porirua and Tawa area.
- Restore access, via Johnsonville, to the Wellington Harbour area (likely to take around 3 weeks).
- Restore access around the Porirua area.
- Commence earthmoving operations to reopen State Highway 1, starting at Pukerua Bay and working north towards Paekakariki.
- Commence earthmoving operations to reopen State Highway 58 to the Hutt Valley.
- Investigate the viability of using the old coach track over the Belmont Hills towards the Hutt Valley.

Access into the Porirua and Tawa area

The first priority of access restoration will be to create a beach landing site and barge access at Titahi Bay, through the low-lying bay on the west side of the peninsula. This will be a difficult operation and a tenuous lifeline, but will likely be the only means of moving freight into this area until road access to the Wellington CBD is restored. This will require access to be created through the western Elsdon area where some moderate vulnerabilities exist. This operation is seen as being more feasible than the use of the Whitirea Park access to the north end of the Titahi Bay peninsula (due to shallow water and a vulnerable single-lane track to the shore) or access to Hongoeka Bay (also a shallow area) in Plimmerton which has a gravel beach (which would be awkward to access) and is also at the end of a seismically vulnerable road (Steyne Avenue). Staging a barging operation into Titahi Bay may be a good task for HMNZS Canterbury (or similar) due to the shallow water in this bay and due to the versatility of use of this vessel for such operations.

The second priority is to secure access to the Wellington City area, as this allows access to the Wellington Harbour area, where greater capacity of logistical supply will be possible. It is likely it will take around 3 weeks before this access can be restored.

A further priority for the recovery of land access will be to stage a large earthmoving operation to reopen SH1, heading north from Pukerua Bay to Paekakariki. This operation may be primarily managed from the Paekakariki end of the road.

If an earthquake happened 'today', the response would be to:

- Create a barging operation bringing supplies ashore at western side of the Titahi Bay peninsula. A route on the western side of Elsdon would have to be created due to the vulnerability of the Titahi Bay causeway (Titahi Bay Road).
- Reopen State Highway 1 towards the south, creating access to Wellington harbour and the more open logistical supply route that presents.
- Commence the excavation of landslip material on SH1 between Paekakariki and Pukerua Bay.
- Commence operations to reopen SH58 at Haywards.
- Investigate a potential 4WD-type track over the Belmont Hills to the Hutt Valley over the old coach road. This may be feasible, and could bring considerable benefit both to the Porirua and Hutt Valley areas.

- Carry out ground reconnaissance and road structure inspections to provide greater detail and clarity on damage states.

Recommended actions:

- MCDEM to investigate the present availability of shipping in and around New Zealand to conduct the scale of shipping/barging operations outlined in this document.
- MCDEM to investigate the feasibility of use of airstrips in the Porirua area, including: -
 - On the Belmont Hills.
 - At Steven's Farm in Titahi Bay.
 - To the east of SH1, north of Plimmerton, almost as far north as the Whenua Tapu Cemetery.
- Porirua City Council to investigate the feasibility of use of the old coach track over the Belmont Hills, creating access to the Hutt Valley.

Access *within* the Porirua and Tawa area

While work to create access into the Porirua and Tawa area is ongoing, a further priority will be to restore access throughout the Porirua area, which is likely to be possible through roads that have suffered damage but are passable or have alternates. This is likely to provide access through the area within a few days after an event. Key locations to manage however will be Goat Point on SH1 between Mana and Plimmerton and access over the Kenepuru Stream. Goat Point on SH1 between Plimmerton and Mana has an alternative route through local roads (including Pope Street) which may be passable.

Crossing the Kenepuru Stream is presently possible by the Mungavin Bridges and 'the Ramp Bridge' (slip road onto/off SH1 near Pak 'N Save/Countdown). The importance of the Mungavin Bridges is high, and it is advised that Porirua City Council conduct a seismic assessment of these structures. In order to ensure access across this corridor, and until the seismic assessment is complete, it may be worth creating a plan for access across the Kenepuru Stream, perhaps just south of Porirua train station.

If an earthquake happened 'today', and while access into the Porirua and Tawa area is being restored the response for restoring the local transport network would be:

- Assess the roading network and clear areas where necessary. It is anticipated that access will be possible around the majority of the Porirua and Tawa area either by main routes or by alternates.
- If access across the Mungavin Bridges (over the Kenepuru Stream) is not possible, create a ford or causeway across the Kenepuru Stream just south of Porirua train station. Using the southern station access bridge may be the most feasible option.
- Investigate local road alternatives around Goat Point (Pope Street and nearby alternatives).

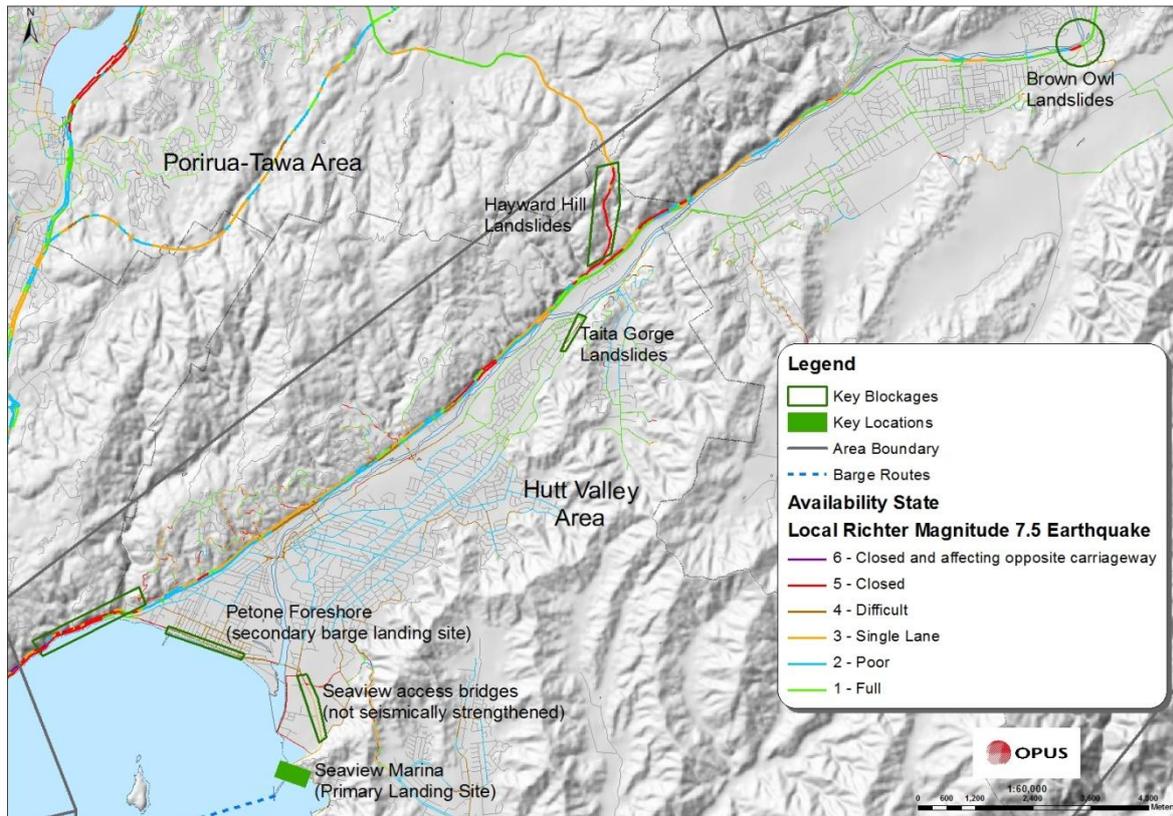
Porirua and Tawa Actions

Action points for the Porirua and Tawa area are as follows, and are also summarised in appendix 1.

Action point	Issue	Implementer	Recommended date for completion
3.01	Investigate the feasibility of use of airstrips in the Porirua area, including: - <ul style="list-style-type: none"> - On the Belmont Hills. - At Steven's Farm in Titahi Bay. - To the east of SH1, north of Plimmerton, almost as far north as the Whenua Tapu Cemetery. 	MCDEM	June 2013
3.02	Investigate the feasibility of use of the old coach track over the Belmont Hills, creating access to the Hutt Valley	Facilitated by Porirua City Council	Dec 2014
3.03	Conduct a seismic assessment of the Mungavin Avenue bridges	Porirua City Council	Dec 2014
3.04	Conduct seismic assessments of Steyne Avenue Bridge and the Gray's Road retaining walls near the Plimmerton Bowling Club	Porirua City Council	Dec 2014
3.05	Create a plan for the construction of a ford or causeway over the Kenepuru Stream, just south of Porirua train station	Porirua City Council	Dec 2014

Additional common and generic actions are captured also in appendix 1.

4.4. Hutt Valley area



Assumptions

The following are broad-brush transport requirements for the Hutt Valley population of 136,116 (2006 figure):

- Food (assuming 2kg/person/day) 270 tonnes/day
- Fuel (assuming 5 litres/person/day) 700,000 litres/day
- Plant, materials and other items (assuming 10kg/person/day) 1,400 tonnes/day

The above would equate to approximately 167 20-foot containers and 30 fuel trucks per day.

Time required to link up with neighbouring areas

Estimated access times to the Hutt Valley area are as follows;

From	Mode	Time
Wellington CBD	Barge	5-7 days
Wellington West	Road	8-10 weeks
Porirua-Tawa	Road	12 weeks
Lower Hutt to Upper Hutt	Road	3 days to 2 weeks

Restoration of access overview

Food, fuel and materials will be transported into the Hutt Valley via the harbour foreshore, supplemented by air delivery and 4WD transport.

The long-term priority will be on restoring access from Wellington via State Highway 2, Petone to Ngauranga. NZTA's SH2 plan outlines that it will take 8-10 weeks to restore truck access along this corridor. Access over each of the SH2 Rimutaka Hill Road and through SH58 Haywards is anticipated to take 'more than 3 months'. Therefore direct transport access to the Hutt Valley not using State Highway 2 or State Highway 58 should be developed for the short to medium term of the response and recovery.

Fuel deliveries through the Seaview area remain critical for the response and recovery activities of the region, and access through this area requires particular attention. The Seaview Marina will probably present the most feasible location for loading/unloading barges and landing craft.

Within the Hutt Valley, effort would be concentrated on establishing a route from Seaview/Petone to Te Marua. As SH2 is likely to be heavily affected in this area, the local road route would provide the most feasible access option. The most likely difficulties in this corridor would be the road structures across the Waiwhetu Stream at the northern extent of the Seaview area, and at the Taita Gorge and Brown Owl.

Access into the Hutt Valley

If an earthquake happened 'today', the response for short and medium term (0 weeks to between 8 and 10 weeks) would be to explore the following options:

- Utilise 4WD-type tracks into the region. The military and 4WD clubs intend to explore all possible options after a large seismic event. This option includes the potential use of the Rimutaka Rail Tunnel, which is assumed will be structurally sound, although access at either end of the tunnel will impede large flows of people or freight.
- Utilise airstrips at Trentham and Belmont for helicopter and light aircraft (note – the payload of a Chinook helicopter is about 10 tonnes).
- Air drops from Hercules-type aircraft options would be explored (note the payload for one Hercules is about 10 tonnes).

It is likely that 4WD and air delivery would yield about 150 tonnes of goods per day into the Hutt Valley, depending on routes, aircraft types and availability.

The remainder of food, fuel and materials would have to be via the harbour. Access via the harbour would be explored through the following locations:

- Due to road structure (bridge) vulnerabilities, Seaview and the areas to the east and south would be cut off. This has particular fuel-delivery consequences. Access over these bridges therefore becomes critical. Bailey Bridge availability could be key.
- Lowry Bay has a concrete boat ramp and small marshalling area, but access from Lowry Bay to both the north (Seaview) and south (Eastbourne) is likely to be compromised by landslips for 'two weeks to three months' and therefore may not be viable.
- The Seaview Marina has a good boat ramp and marshalling area and would be capable of accommodating medium-sized barges up to about 60-tonnes capacity. A Titan Crane yard is less than 1km away, on Port Road. Larger barges could be accommodated if about 12,600m³ of material was dredged from the Marina on specific channels. An example of such barge access at Seaview Marina is shown in **Figure 3**.

- In addition to the Seaview Marina, a deeper water ramp may be constructed just outside the breakwater adjacent to the Marina on the Port Road.
- The Petone foreshore, from the west end (near SH2) to the Winstone's gravel yard at the easternmost end is a potential landing area. This area has a gentle gradient foreshore and may be suitable for barges or landing craft. The NZDF is to consider this location as a potential landing site.
- The Seaview wharf, when not being used for fuel deliveries, could be considered for some cargo discharge, subject to wharf availability and axle loading limits (currently 10 tonnes per axle).



Figure 3 - An example of a barge at Seaview Marina

Recommended actions:

- Consider whether slip quantities on SH2 between Petone and Ngauranga could be limited in some way.
- Consider deepening the Seaview Marina along specific channels for larger barge/landing craft access.
- Consider a plan for creating rail bridges either side of the Rimutaka Rail Tunnel for the use of a shuttle-freight train transporting goods into the region. Some physical advance works may be beneficial in the area to increase the chances of success of this option.

Access around the Hutt Valley

'If an earthquake happened today', the concentration of effort would be on:

- The three main critical points, which are the bridges at Seaview, the Taita Gorge and Brown Owl. These areas are all currently vulnerable to seismic damage and all of these will prevent the establishment of an open route from Seaview to Te Marua.
- The access from Maoribank to the north end of the Taita Gorge on local roads is, from the vulnerability mapping, relatively robust. From the Taita Gorge to the northern edge of the Petone area there is a diversity of routes, all expected to suffer 'minor' damage. Access is

likely to be restored quickly along these routes. However, these routes should be checked and cleared of any building or other rubble, and of any damage.

- Access along the Seaview Road would be addressed by contractor response and would be expected to take 2-4 weeks.
- Obtaining and placing Bailey bridges for accessing over the seismically vulnerable structures, particularly at the northern end of the Seaview area would be a priority. (Note – skilled operatives would be required. Bailey bridges are known to be presently stored in Christchurch and Napier.)
- Access through the Taita Gorge would be addressed by contractor response, and would be expected to take 'between three days and two weeks'.
- Access through Maoribank would be addressed by contractor response. (Note – it appears that there is limited benefit in carrying out detailed geotechnical assessments or producing plans for this location at present due to the topography in this area.)
- Access over the Wainuiomata Road is anticipated to be broadly achievable within a relatively short period of time, assuming contractor resource is available.
- Access to Haywards, for Transpower, Wellington Electricity and GWRC Water, would have to be from along State Highway 2. Potential access is not quickly recognisable from existing information, so a plan may be required for this route.
- NOTE – the present clearance under the rail bridge at Silverstream is 4.1m. This may create a logistical difficulty of moving taller trucks through the Hutt Corridor. There is no easily identifiable alternative until the State Highway is reopened.
- Carry out ground reconnaissance and road structure inspections to provide greater detail and clarity on damage states.

Recommended actions:

- As a priority, seismically upgrade at least two of the bridges across the Waiwhetu Stream at the northern end of the Seaview area.
- Seismically upgrade the Wingate Overbridge.
- Carry out a geotechnical investigation of the Taita Gorge. Note – Hutt City Council presently intend to complete such an investigation in the 12/13 financial year.
- Consider storing Bailey bridges at least within the Wellington metropolitan area, or potentially within the Hutt Valley, rather than in Christchurch or Napier.
- Check the existing locations of pre-cast yards, with a plan of where culvert sections could be utilised to regain quick access around the Hutt Valley.
- NZTA should consider plans with the Horokiwi Quarry for re-establishing access along State Highway 2 between Petone and Ngauranga, and plans with the Dry Creek and Belmont Quarries for access along SH2 and SH58 Haywards.

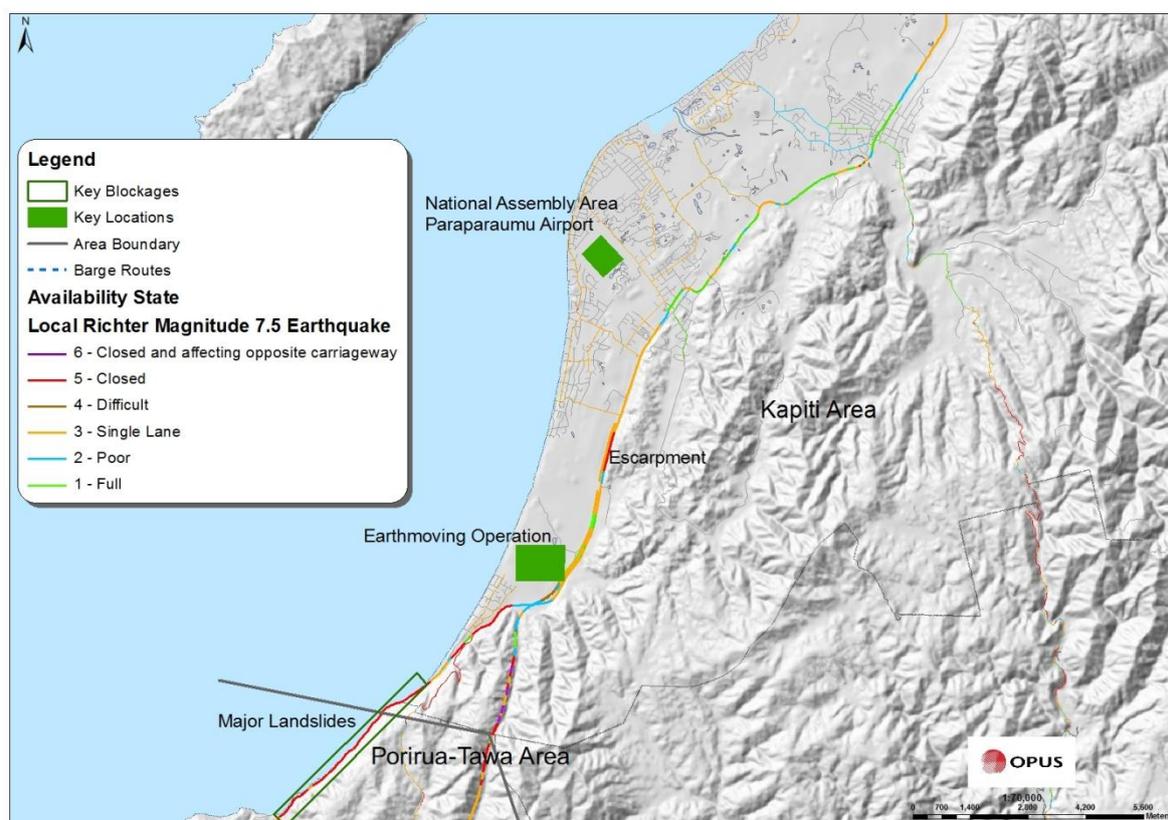
Action points

Action points for the Hutt Valley area are as follows, and are also summarised in appendix 1.

Action point	Issue	Implementer	Recommended date for completion
4.01	Consider whether quantities of spoil from landslips on SH2 between Petone and Ngauranga could be limited in some way.	NZTA	by end 2013
4.02	Consider deepening specific channels in the Seaview Marina for larger-capacity barge/landing craft access	HCC	by end of 2013
4.03	As a priority, seismically upgrade at least two of the road structures at the northern end of the Seaview area	HCC, subsidy by NZTA	by end of 2015
4.04	Carry out a geotechnical investigation of the Taita Gorge with a view to making this road corridor more robust	HCC	by the end of the 12/13 financial year
4.05	Check the existing locations of pre-cast yards, with a plan of where culvert sections could be utilised to regain quick access around the Hutt Valley	HCC and UHCC	by end of 2013
4.06	Consider plans with the Horokiwi Quarry for re-establishing access along State Highway 2 between Petone and Ngauranga	NZTA	by end of 2013
4.07	Consider a plan for creating railbridges either side of the Rimutaka Rail Tunnel for the use of a shuttle-freight train transporting goods into the region. Some physical advance works may be beneficial in the area to increase the chances of success of this option	KiwiRail	by end 2013
4.08	Complete 'Seaview Critical Area' 'Statement of Best Practice' as a plan for addressing fuel supply from the Seaview area	HCC	May 2013
4.09	Consider creating a plan for creating access from SH58 Haywards to the Hutt Valley local road system, taking into account likely outages on State Highway 2 in the area	NZTA / HCC	By the end 2013

Additional common and generic actions are captured also in appendix 1.

4.5. Kapiti area



Assumptions

The following are estimated transport requirements for the Kapiti Coast population of 46,197 (2006 figure):

- Food (assuming 2kg/person/day) 92 tonnes/day
- Fuel (assuming 5 litres/person/day) 230,000 litres/day
- Plant, materials and other items (assuming 10kg/person/day) 450 tonnes/day

The above would equate to approximately 55 20-foot containers and 15 fuel trucks per day.

It should be noted that following a major earthquake, resources will also be required to supply likely logistical operations at Paraparaumu Airport in accordance with MCDEM's Wellington Initial National Emergency Response Plan, and an earthmoving operation restoring land access to the Wellington Metropolitan area. It would be expected that such resources would be sourced from elsewhere in the North Island.

If the earthquake occurs during work hours, around 5,000 – 10,000 commuters would need to return home from the Wellington metropolitan area to the Kapiti Coast. It is recommended that WREMO consider a plan for the movement of these people from Wellington to their homes.

Time required to link up with neighbouring areas

Estimated access times to the Kapiti area are as follows;

From	Mode	Time
Rest of New Zealand	Road	5-10 days
Porirua-Tawa	Road	120+ days

Concepts

Due to likely large landslips south of Paekakariki on State Highway 1, on the Paekakariki Hill Road and the Akatarawa Road, transport access to the Wellington Metropolitan area will be cut by land. Food, fuel and materials will be transported into the Kapiti Coast from the north via State Highway 1 and the rail network. Earthmoving operations are likely to be staged from the Kapiti Coast area for restoring land access to the Wellington Metropolitan area and a large logistical operation will be based at Paraparaumu Airport managing helicopter access around the region. There may be some welfare centre requirements in the Paekakariki or Paraparaumu areas in the case of individual attempts at self-evacuation from the Wellington Metropolitan area.

Although timeframes for restoring access from further north (the Manawatu area) can only be broadly assumed as a matter of 5 to 20 days, this does not change the strategy of securing access along the State Highway 1/rail network spine as the most convenient, and likely highest-volume, access route.

The likely key locations of access difficulties for securing a viable route from further up the North Island are likely to be:

- The Otaki River (for both road and rail due to potential bridge collapse).
- Just south of Paraparaumu train station (the rail network, due to landslips).
- Raumati South area (State Highway 1, due to landslips).
- South of Fisherman's Table, Paekakariki (both road and rail due to landslips).

Access into the Kapiti Coast area

Due to the expected large landslips on State Highway 1 south of Paekakariki, on the Paekakariki Hill Road and the Akatarawa Road, it is anticipated that all land access to the Kapiti Coast area will be via State Highway 1 and from the rail network from the north. Liaison with the Manawatu CDEM Group and NZTA region north (NZTA Wanganui West) of Kapiti Coast will be required, and some planning may be beneficial. It is recommended that WREMO consider planning activity to ensure that access and logistical arrangements are in place for this activity.

A large earthmoving operation is likely to be staged from the Kapiti Coast, either (or both) concentrating on restoring access along State Highway 1 south of Fisherman's Table (where large landslips are anticipated) and the Transmission Gully route/corridor. The route(s) chosen by any such earthmoving operation will depend on the quantities of slip material and the circumstances at the time.

There is a possibility that some people may attempt to get out of Wellington under their own steam either along the Paekakariki Hill Road and/or the Transmission Gully route. Due to the distance involved and likely landslips along the way, many may not complete the route, and WREMO may consider managing such attempts in some way.

WREMO and NZTA, in conjunction with Helipro, have a plan to conduct reconnaissance of the roading network following a major earthquake. A film from a fly-over of the road network will be conducted, with a resulting DVD delivered to WREMO within 24 hours of a major earthquake.

If an earthquake happened 'today', the response would be to:

- Reopen the State Highway 1 / rail network spine, starting at the north and heading south.
- Set up a helicopter-based staging area at Paraparaumu Airport, in line with the Wellington Earthquake National Initial Response Plan.
- CDEM to liaise with the military and 4WD clubs on investigating any/all options for accessing the area south.

- Conduct a reconnaissance fly-over of the transport network. Reconnaissance along the SH1 route is tasked to NZTA and WREMO, and to NZDF (air recon) in the MCDEM Wellington Earthquake National Initial Response Plan.
- Carry out ground reconnaissance and road structure inspections to provide greater detail and clarity on damage states.

Recommended actions:

- Produce a seismic vulnerability analysis (for embankments/cuttings and structures) for the rail network (KiwiRail).
- Ensure SH1 plans are up-to-date and key stakeholders updated as necessary (NZTA).
- The MacKays Crossing to Peka Peka 'Road of National Significance' presently being assessed by NZTA would provide greater seismic resilience to this transport corridor.
- The Transmission Gully Motorway, presently being considered by NZTA, would reduce the recovery time to the Porirua and Tawa area and the Wellington CBD area from around 120 days to 40 days, and would therefore mitigate the longer land transport recovery periods for the Wellington metropolitan area.

Access *within* the Kapiti Coast area

It is anticipated that in the area broadly west of State Highway 1, the major community connectors, or local arterial roads, within the Kapiti area will be affected through liquefaction. It is expected, however, that while this will cause disruption, access routes are likely to be passable within a matter of days through/around damaged areas. Where there is greater damage, the flat and wider road corridor through some sections of the Kapiti Coast road network means that temporary access around damaged road may be possible through adjacent land, once landowner considerations have been taken into account.

The Kapiti Coast will host staging areas for the support of the Wellington metropolitan area. Paraparaumu airport is planned to be a key helicopter-based supply chain node supplying Wellington (for details see the MCDEM Wellington Initial National Emergency Response Plan). Road access to the airport is therefore a priority for the regional response operation.

The feasibility of barging supplies from a coastal location within the Kapiti Coast southwards to Porirua and the Wellington metropolitan area is low because barging access to the Kapiti Coast would be restricted due to shallow beaches. This means that any such barging operation would likely be conducted from wharves or ports further north up the North Island or from the South Island. The possibility of the Kapiti Coast hosting barging operations has therefore not been considered further.

Due to the large amount of earthmoving and welfare activity at Paekakariki, it may be advisable to restrict access to the area to residents and contractor staff only. WREMO may consider some form of access restriction to this area.

If an earthquake happened 'today', and while access into the region is being restored, the response for restoring the local transport network would be to:

- Restore access from State Highway 1 into the local road network, concentrating in priority order on:
 - Restoring access to Paraparaumu airport
 - Restoring the major community connectors/arterial roads, and then
 - Restoring the local community connectors/minor roads.
- If access to the Wellington metropolitan area is cut, NZTA and KiwiRail will stage earthmoving operations to restore access south. The route by which this access is restored will depend on landslip quantities and circumstances at the time. It is likely that the operations could be centred at MacKays Crossing or at Paekakariki, with logistical support carried out from a location in/near Paraparaumu. Access, through the local road network, would be required.

Recommended actions:

- Liaise with the owners of Paraparaumu airport, asking whether any seismic vulnerability analysis of the runway, wider airport land and/or building facilities has been carried out. Consider the feasibility of any potential upgrades – action by KCDC and airport owners.

Kapiti Coast key issues – summary

The following is a list of the issues regarding post-earthquake access into and through the Kapiti Coast: -

- Access from State Highway 1 further north will be key to allowing supply to the Kapiti Coast from further north. NZTA to finalise emergency access arrangements.
- Recovery of the rail network from further north will allow supply chains to reopen. KiwiRail is encouraged to carry out a rail network seismic vulnerability analysis.
- Access to the Wellington metropolitan area is likely to be cut due to landslips on all three routes from Kapiti into that area. A large earthmoving operation is therefore likely to be staged from the Kapiti Coast area to recover that access.
- A logistical operation will be staged from Paraparaumu airport to the Wellington metropolitan area, moving personnel and relatively small quantities of supplies. Road access to the airport is therefore an early priority.

Kapiti Coast action points

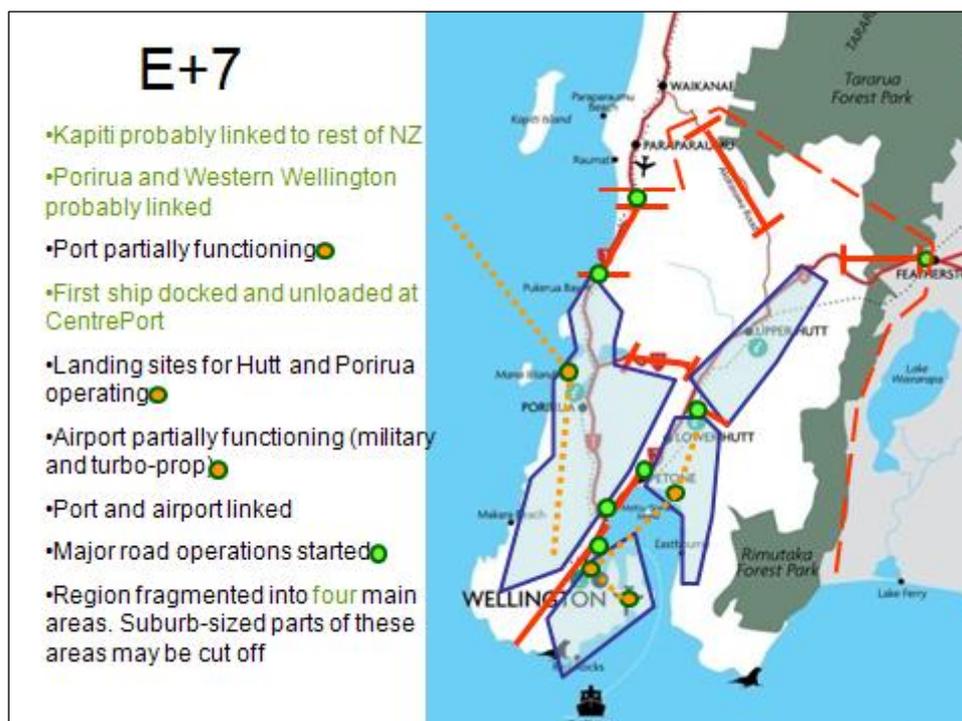
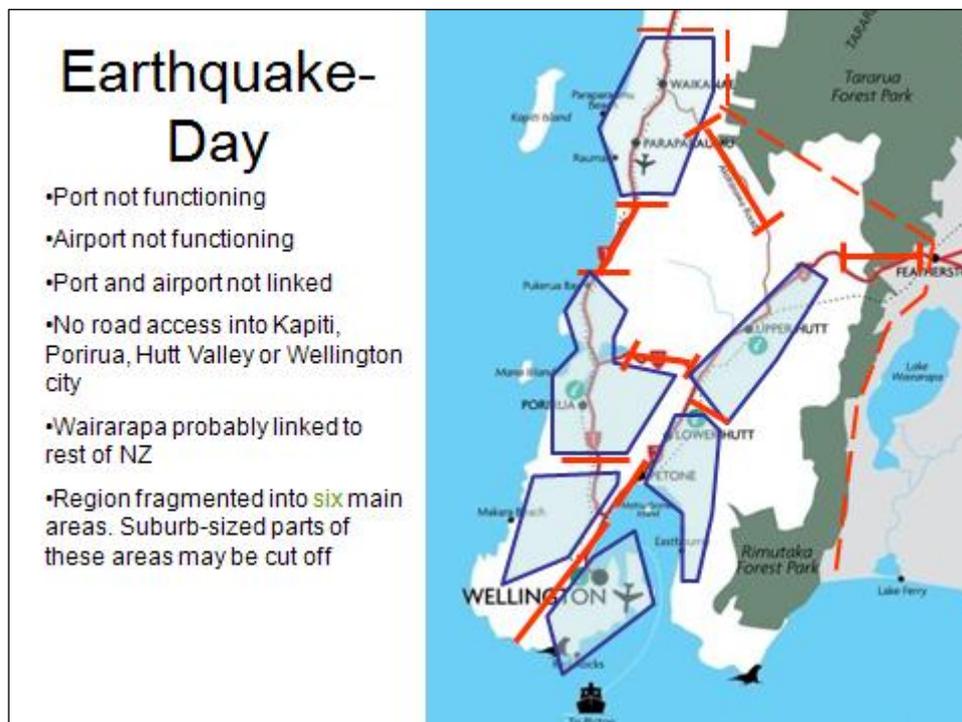
Action points for the Kapiti area are as follows, and are also summarised in Appendix 1.

Action point	Issue	Implementer	Recommended date for completion
5.01	Liaise with the owners of Paraparaumu airport, asking whether any seismic vulnerability analysis of the runway and wider airport land has been assessed. Consider the feasibility of any potential upgrades	KCDC, in liaison with Paraparaumu airport owners	June 2013
5.02	Liaise with the Manawatu CDEM regarding potential planning on restoring access from the north	WREMO	June 2013
5.03	Liaise with the NZTA region north of the Kapiti Coast for some planning on the restoration of the state highway network	NZTA	June 2013
5.04	Due to the large amount of earthmoving and welfare activity at Paekakariki, it may be advisable to restrict access to the area to residents and contractor staff only. WREMO may consider some sort of access restriction to this area.	WREMO	Dec 2013
5.05	Produce a seismic vulnerability analysis (for embankments/cuttings and structures) for the rail network	KiwiRail	Dec 2013

Additional common and generic actions are captured also in appendix 1.

5. Summarising access availability and likely work areas

The following is a summary of access availability, and the likely access work areas, following a major local earthquake in the Wellington area:



E+14

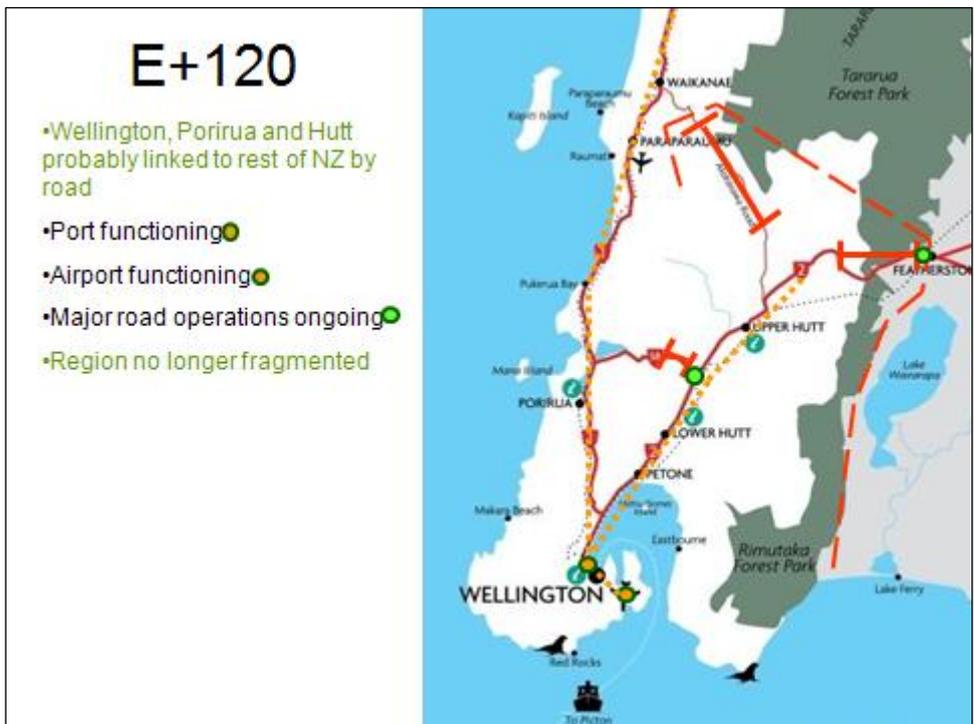
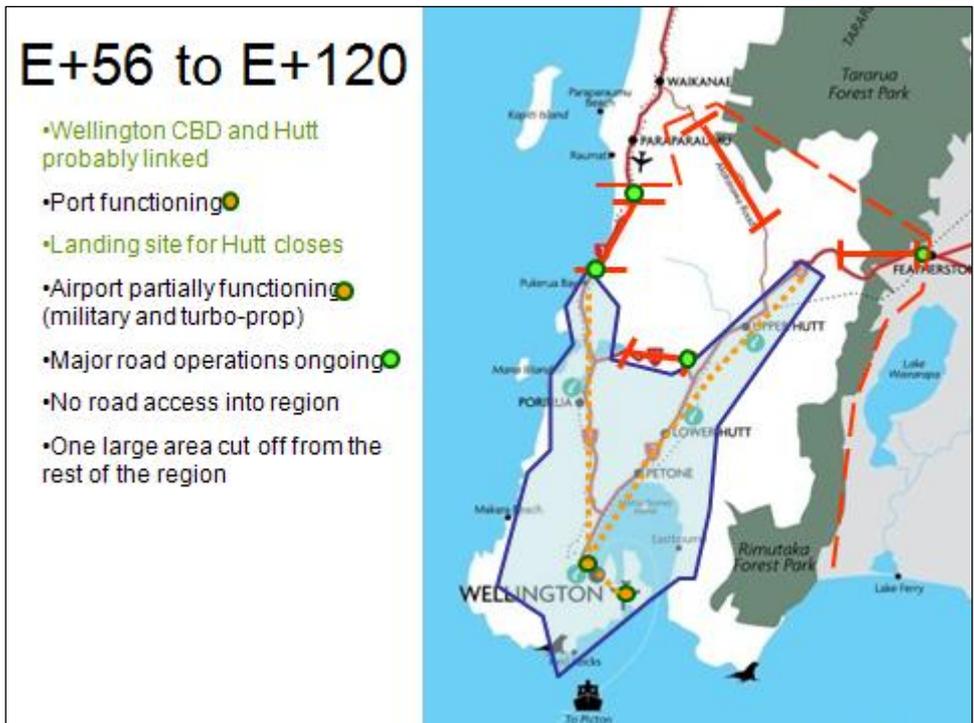
- Lower and Upper Hutt probably linked
- Port partially functioning
- Landing sites for Hutt and Porirua operating
- Airport partially functioning (military and turbo-prop)
- Major road operations ongoing
- No road access into region
- Region fragmented into **three** main areas. Suburb-sized parts of these areas may be cut off



E+21

- Wellington CBD and Porirua probably linked
- Porirua beach landing ends
- Port partially functioning
- Landing site for Hutt ongoing
- Airport partially functioning (military and turbo-prop)
- Major road operations ongoing
- No road access into region
- Region divided into **two** main areas, with access within each area probably restored





6. Key issues and recommendations

Key issues

Key issues identified through this report are as follows.

Transport effects of a large earthquake

- Due to likely landslips on the SH1 Coast Road (Paekakariki to Pukerua Bay), the Paekakariki Hill Road, the Akatarawa Road, and the SH2 Rimutaka Hill Road (Featherston to Te Marua), the region will become isolated by normal road access for around 120 days.
- In addition to isolation, the region will become fragmented due to landslips on the SH58 Haywards Hill and the SH2 Horokiwi area, in addition to other regional fragmentation for the short and medium terms.

Consequences of land access disruption

- A key message for the overall document is that transport infrastructure in the region will be heavily affected. Car use will not be viable beyond individual suburbs. Supermarkets will not be restocked for, in some cases, weeks.
- The repatriation of internally displaced people (commuters, shoppers etc.), and the evacuation of visitors, critical personnel and others will be necessary.
- While regional access, the focus of this document, is addressed, strategies for restoring access to suburbs is not covered in this document. However, some communities may face particular access restoration issues, for example Miramar, Wainuiomata and Titahi Bay.

Required logistical arrangements

- Air delivery and 4WD-type trucks will probably account for around 10% of the food and materials delivery needs of the region.
- The remainder (around 90%) of food, fuel and materials deliveries to the region will be via the sea, which may include use of CentrePort wharves and cranes or the use of craned-container ships unloading to barges which shuttle deliveries to the key offloading points.

Consequences for overarching emergency plans and co-ordination

- It will be difficult to supply potable water in the quantities required through transport by barge/tankers. Further consideration is required on this issue, to be facilitated by WREMO.
- Debris disposal will be a key activity in the scenario outlined in this document. An emergency debris disposal plan should be created for the region.
- Fuel supply will also be a key activity in this scenario. An emergency fuel distribution plan should be created for the region.
- The responses outlined in this document assume good overall co-ordination of restoration and recovery actions. This is a matter for WREMO to consider, particularly regarding the Lifelines Co-ordinator role.
- Civil engineering plant and operators presently located in the Wellington region will not be sufficient to carry out all necessary works at the same time following a major earthquake. Additional resources will need to be brought into the region, along with sufficient fuel for servicing the machines. This aspect will also require WREMO/Lifelines co-ordination input.
- Other lifelines should be considered when transport access providers consider physical upgrades to their infrastructure, allowing for co-ordinated upgrade approaches, therefore providing a more resilient infrastructure base.
- This study has identified significant cross-over issues with welfare, supply, lifelines, debris disposal and reconnaissance issues. The issues in this document should be used as a basis for integrated planning for a single, cohesive emergency response plan.

Recommendations

Key recommendations of this report are:

- Actions identified in appendix 1 are carried out by the various organisations.
- Individual mitigation projects should be investigated by the transport infrastructure providers (road and rail), using this document as a basis of discussion, with a view to implementation. An integrated programme of work should be developed to ensure a co-ordinated and prioritised approach is taken.
- Other lifelines should be considered when transport access providers consider physical upgrades to their infrastructure, allowing for co-ordinated upgrade approaches, therefore providing a more resilient infrastructure base.
- The Wellington CDEM Group use this document to improve community resilience through:
 - Public education
 - Management of public expectations
- This study has identified significant cross-over issues with welfare, supply, lifelines, debris disposal and reconnaissance issues. The issues in this document should be used as a basis for integrated planning for a single, cohesive emergency response plan.
- The implications of the findings in this report should be considered by WeLG and WREMO in planning future projects.
- Wellington lifelines organisations and other interested parties should take the findings of this report into consideration in planning for major seismic events.

Appendices

Appendix 1 – Summarised action points

Appendix 2 – Workshop dates and attendees

Appendix 1 – Summarised action points

Common actions

Action point	Issue	Implementer	Recommended date for completion
C.01	All organizations must have workable Business Continuity Plans. These should take into account likely transportation, fuel, water and electricity availability	All	Ongoing

Generic actions

Action point	Issue	Implementer	Recommended date for completion
G.01	Create a list of essential materials, equipment and equipment operators to be transported into Wellington on the first ships	Facilitated by WREMO, with input from MCDEM and lifeline organisations	by end 2013
G.02	Consider a plan for evacuation of tourists / key people, bearing in mind likely availability of only turbo-prop and military aircraft for first weeks after earthquake. Consider also residents that wish to temporarily leave the region.	WREMO, MCDEM, KiwiRil (for the Interislander), Blue Bridge and Wellington Airport	June 2013
G.03	Assess the availability of ships/barges/landing craft in New Zealand for use in the scenarios outlined in this document	MCDEM	by end 2013
G.04	Create a reconnaissance plan to establish how access to the various suburbs/communities not included in this document would be re-established	WCC, HCC, UHCC, PCC, KCDC	by end 2013
G.05	Consider a regional plan for the repatriation of internally displaced people (commuters, shoppers etc.), and for the evacuation of visitors, critical personnel and others	WREMO	Dec 2013
G.06	Ensure that any emergency water distribution plan does not require trucking in water into this, or other, areas, due to existing transport constraints highlighted in this document	WREMO	Note
G.07	Consider storing Bailey bridges at least within the Wellington Metropolitan area, or potentially within the Hutt Valley, rather than in Christchurch or Napier	NZTA, HCC and UHCC	by end 2013
G.08	Create a regional emergency fuel distribution plan	WREMO / WeLG	June 2014
G.09	Produce a desktop seismic vulnerability analysis (for embankments/cuttings and structures) for the rail network	KiwiRail	Dec 2013
G.10	Ensure State Highway plans are up-to-date and key stakeholders updated as necessary	NZTA	June 2013

Area specific actions – Wellington Port / CBD / Airport

Action point	Issue	Implementer	Recommended date for completion
1.01	Create a plan for offloading ships at CentrePort. This should take into account available crane access and any power-supply requirements. This action will require collaboration between CentrePort and Wellington Electricity	CentrePort	by end 2013
1.02	Investigate the suitability of Burnham Wharf (for supply of food and materials to Miramar post disaster)	CentrePort	by end 2013
1.03	Wellington airport to proactively engage its engineer to establish the seismic vulnerability of the runway	Wellington Airport	by April 2013
1.04	Establish who will manage the logistical operations from the port and airport – is this to be WREMO or the existing logistical operators (logistical contractors presently located at or near the Airport and Port)	Facilitated by WREMO, with input from MCDEM, CentrePort, WIAL and existing logistics operators	by end 2013
1.05	Consider how water could be transported into the region, including potential temporary storage at CentrePort	WREMO / CentrePort	By end 2013

Area specific actions – Western Wellington

Action point	Issue	Implementer	Recommended date for completion
2.01	Create a plan for access to Karori (some route options appear available). Such a plan should include consideration of a possible Karori Dam failure	WCC	by the end of 2016
2.02	Create a plan to recover access on SH2 between Petone and Ngauranga	NZTA	by end 2013

Area specific actions – Porirua and Tawa

Action point	Issue	Implementer	Recommended date for completion
3.01	Investigate the feasibility of use of airstrips in the Porirua area, including: - - On the Belmont Hills. - At Steven's Farm in Titahi Bay. - To the east of SH1, north of Plimmerton, almost as far north as the Whenua Tapu Cemetery.	MCDEM	June 2013
3.02	Investigate the feasibility of use of the old coach track over the Belmont Hills, creating access to the Hutt Valley	Facilitated by Porirua City Council	Dec 2014
3.03	Conduct a seismic assessment of the Mungavin Avenue bridges	Porirua City Council	Dec 2014
3.04	Conduct seismic assessments of Steyne Avenue Bridge and the Gray's Road retaining walls near the Plimmerton Bowling Club	Porirua City Council	Dec 2014
3.05	Create a plan for the construction of a ford or causeway over the Kenepuru Stream, just south of Porirua train station	Porirua City Council	Dec 2014

Area specific actions – Hutt Valley

Action point	Issue	Implementer	Recommended date for completion
4.01	Consider whether quantities of spoil from landslips on SH2 between Petone and Ngauranga could be limited in some way.	NZTA	by end 2013
4.02	Consider deepening specific channels in the Seaview Marina for larger-capacity barge/landing craft access	HCC	by end of 2013
4.03	As a priority, seismically upgrade at least two of the road structures at the northern end of the Seaview area	HCC, subsidy by NZTA	by end of 2015
4.04	Carry out a geotechnical investigation of the Taita Gorge with a view to making this road corridor more robust	HCC	by the end of the 12/13 financial year
4.05	Check the existing locations of pre-cast yards, with a plan of where culvert sections could be utilised to regain quick access around the Hutt Valley	HCC and UHCC	by end of 2013
4.06	Consider plans with the Horokiwi Quarry for re-establishing access along State Highway 2 between Petone and Ngauranga	NZTA	by end of 2013
4.07	Consider a plan for creating railbridges either side of the Rimutaka Rail Tunnel for the use of a shuttle-freight train transporting goods into the region. Some physical advance works may be beneficial in the area to increase the chances of success of this option	KiwiRail	by end 2013
4.08	Complete 'Seaview Critical Area' 'Statement of Best Practice' as a plan for addressing fuel supply from the Seaview area	HCC	May 2013
4.09	Consider creating a plan for creating access from SH58 Haywards to the Hutt Valley local road system, taking into account likely outages on State Highway 2 in the area	NZTA / HCC	By the end 2013

Area specific actions – Kapiti Coast

Action point	Issue	Implementer	Recommended date for completion
5.01	Liaise with the owners of Paraparaumu airport, asking whether any seismic vulnerability analysis of the runway and wider airport land has been assessed. Consider the feasibility of any potential upgrades	KCDC, in liaison with Paraparaumu airport owners	June 2013
5.02	Liaise with the Manawatu CDEM regarding potential planning on restoring access from the north	WREMO	June 2013
5.03	Liaise with the NZTA region north of the Kapiti Coast for some planning on the restoration of the state highway network	NZTA	June 2013
5.04	Due to the large amount of earthmoving and welfare activity at Paekakariki, it may be advisable to restrict access to the area to residents and contractor staff only. WREMO may consider some sort of access restriction to this area.	WREMO	Dec 2013
5.05	Produce a seismic vulnerability analysis (for embankments/cuttings and structures) for the rail network	KiwiRail	Dec 2013

Appendix 2 – Workshop dates and attendees

Kapiti Coast Area

Workshop was held on Thursday 20 September 2012 at the KCDC Offices, Paraparaumu.

Attendees were: Sean Mallon, Bernie Goedhart, Tony Martin (KCDC), Des O’Sullivan (NZTA), Walter Rushbrook (KiwiRail), Keith Evans, Tane Woodley (MCDEM), Paul Nickalls, Dave Jack (WREMO), Brabha (Opus), Richard Mowll (WeLG).

Porirua Area

Workshop was held on Thursday 27 September 2012 at the PCC Office, Porirua.

Attendees were: Geoff Marshall (PCC), Des O’Sullivan (NZTA), Tane Woodley (MCDEM), Dave Jack (WREMO), Patrick Atwood (Harbourmaster’s Office), Richard Mowll (WeLG).

Hutt Valley Area

Workshop was held on Thursday 6 September 2012 at the UHCC Office.

Attendees were: Horace Parker (UHCC), Ron Muir (HCC), Patrick Atwood (GWRC Harbourmaster’s office), Tane Woodley (MCDEM), Dave Jack (WREMO), Richard Mowll (WeLG).

Western Wellington Area

Workshop was held on Wednesday 3 October 2012 at the WCC Offices.

Attendees were: Neil Johnstone (WCC), Tane Woodley (MCDEM), Paul Nickalls, Dave Jack (WREMO), Richard Mowll (WeLG).

Wellington port / CBD / airport Area

Workshop was held on Friday 5 October 2012 at the NZTA Traffic Operations Centre, Johnsonville.

Attendees were: Neil Johnstone (WCC), Keith Evans and Tane Woodley (MCDEM), Paul Nickalls, Dave Jack (WREMO), Des O’Sullivan (NZTA), Louise Stephenson (Wellington International Airport Ltd.), Patrick Atwood (Harbourmaster’s Office), Tristan Reynard (CentrePort), Brabha (Opus), Richard Mowll (WeLG).