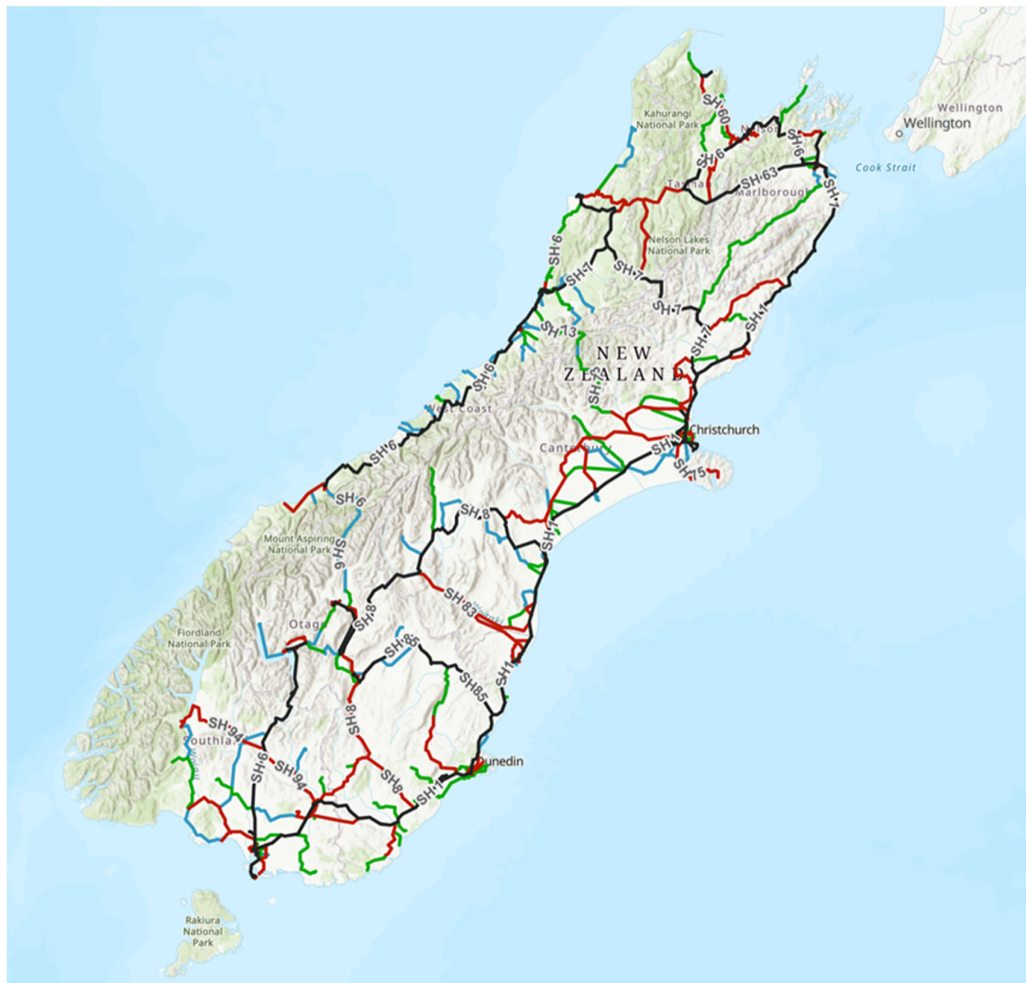# South Island Priority Routes Project

Identify the default routes for restoration following an Alpine Fault earthquake event

Final Report for NEMA Evaluation
NEMA Resilience Fund Project 2023-13

Canterbury Civil Defence Emergency Management Group

Quality Information

Document   South Island Priority Routes – Final Report for NEMA Evaluation

Ref

Date   31 July 2024

Prepared by   Mark Gordon

Reviewed by   Martyn Wooster

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	31 July 2024	Final Version	Mark Gordon	

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1.0   Introduction

1.1   Project Description

This project responds to an initiative identified by the AF8 Response Planning Group (RPG) for Lifelines and Critical Infrastructure. The South Island road network has been prioritised to help facilitate:

- Community access to essential services as quickly as possible following an AF8 event, by:
- Facilitating rapid access along important freight routes and to critical lifelines and community sites.

Furthermore, the prioritisation framework can be applied to the identification and justification of risk "reduction" or "asset hardening" measures on the road network.

The project was established as a series of four sequential stages, shown here.

1. Identify Priority Sites
- Sites that are critical to the recovery of the community following a disaster.

2. Assess Road Network Vulnerability
- Using available hazard and asset information to understand *exposure* and *vulnerability* to hazards.

3. Identify Priority Routes by region/area
- Considering movement of freight, access to priority sites, alternate routes for vulnerable roads.

4. Collate and Moderate
- Bring together all information, moderate assessments across areas, ensure connectivity of whole South Island network.
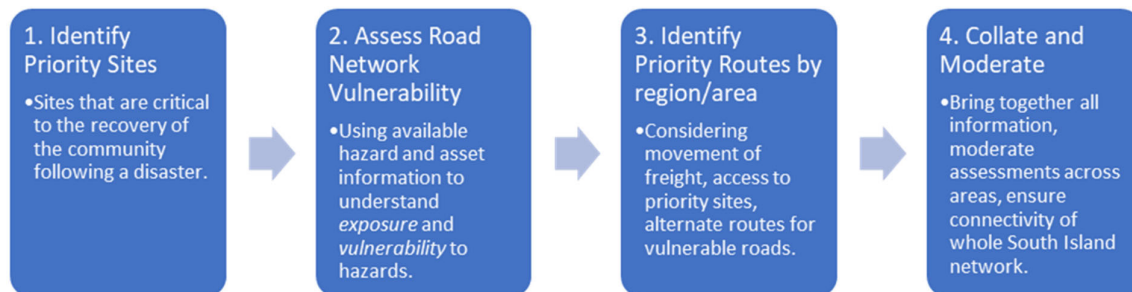
Figure 1-1 Four Stage Process

The project applied the results of University of Auckland vulnerability modelling for both local roads and state highway networks across the South Island to an Alpine Fault (AF8) earthquake. It established priorities for the restoration of road networks based on the relative priorities of sites and corridors requiring access, including critical lifeline utility sites, emergency services sites, or sites of economic, social or cultural importance following the event.

Priorities were established through facilitated workshops in each region. Results were collated and moderated across the six regions and brought into a GIS platform hosted by the AF8 programme. This mapping application shows four priority levels:

1. Open up regional access / spine and access to hospital
2. Alternate spine and access to some priority sites
3. Access into suburbs / settlements and remaining priority sites
4. Access to remaining population and seasonal sites

1.2   Report Structure

This report is structured in the following way:

- Firstly, content that provides a summary of the project approach and outcomes.
- Secondly, sections that address other requirements, including:
  - Successes and challenges
  - Management approach
  - Funding arrangements
  - Lessons identified
  - Communicating outcomes and accessing content
  - Future direction

2.0   Project Approach and Outcomes

2.1   Milestone Summary

The following table provides a summary of the approach based on the four steps given above.

Table 2-1   Milestone Summary

No.	Milestone Description	Status Summary
1	**Identify priority sites** – map and prioritise sites in GIS that are critical to the recovery of the community following a disaster.	A data schema was developed defining data needs, and data was acquired from a wide range of lifeline utilities and emergency service entities. These were mapped, either in regional CDEM GIS Viewers for local/regional data or an AF8 GIS platform for South Island-wide data. Priorities were assessed during the workshops under Milestone 3 below.
2	**Assess road network vulnerability** – use available hazard and asset information to understand exposure and vulnerability to hazards, produce GIS maps. This stage is led by the University of Auckland and includes regional workshops.	Research conducted by the University of Auckland was compiled and presented to the regional workshops below to help inform an understanding of likely road status following an AF8 event. This was based on a geospatial landslide model, which assessed the probability of a landslide initiating within each cell of a 25m grid across the South Island. A road blockage model was then applied to 100m segments of the road network to determine road vulnerability.
3	**Identify priority routes by region / area** – consider movement of freight, access to priority sites, alternate routes for vulnerable roads, mapped outputs. Regional workshops approach.	Eight regional workshops were convened to determine road priorities. These were attended by relevant stakeholders including CDEM and road network management staff, project team members, the AF8 programme, and GIS support. Controller's objectives for Priorities 1 to 4 were established and agreed prior to the workshops and used alongside the data layers obtained in Milestone 1 in assigning road priorities.
4	**Collate and moderate** – bring together all information, moderate assessments across areas, ensure connectivity of whole South Island network. Produce final report and GIS mapping application.	This process was conducted on completion of the workshops, to address inconsistencies, issues identified by workshop participants / stakeholders, and to finalise an agreed set of priorities. In parallel, the AF8 GIS application was developed and populated with the Priority Route maps.

The project report describes more fully the approach and results of the project, refer:

South Island Priority Routes – Identify the default routes for restoration following an Alpine Fault earthquake event, Final Report, 31 July 2024

3.0   Successes & Challenges

3.1   Project Achievements

The expected outcomes described in the Resilience Fund application for this project are described in the table below. Alongside these paragraphs is a summary of how the project has addressed these intentions.

Table 3-1   Project Outcomes and Achievements

Outcomes / Benefits Proposed	Project Achievements
The project will improve our understanding of road network vulnerability across the South Island, information that can be utilised by lifeline utilities (such as telecommunications, fuel, water, electricity, FMCG, etc.) in their own planning and provision of infrastructure or services. This information will also assist Road Controlling Authorities (RCAs) to identify pinch points in their networks, identifying restoration priorities and, potentially, opportunities for improving resilience	Road network vulnerability has been assessed for landslides and liquefaction risks across both state highways and local roads, with input parameters and outputs mapped on GIS. These results were considered alongside local knowledge and anecdotal evidence during the workshops. This information is available for lifeline utilities, RCAs and CDEM to use in their own planning processes. Refer to Section **Error! Reference source not found.**.
It will contribute to the planning and response functions of emergency services agencies (including CDEM, fire, police, health, etc), providing them with a better understanding of the state and availability of the road network following an AF8 event.	Both NEMA and regional CDEM staff participated in each of the regional workshops, including EMOs and Controllers. Their participation helped inform road network priorities and the workshops enabled collaboration with local road and state highway managers. Mapped site locations for emergency services, community sites and lifelines sites are overlaid against road network vulnerabilities and priorities for restoration. This information provides important intelligence for response planning.
The participation of other stakeholders will help inform understanding of accessibility to other key sites, such as other transport modes (ports, airports, rail), and economic, social, and cultural sites of significance, again helping inform restoration priorities. This also links into impacts on freight routes.	Participation of other lifeline utilities has focussed on information sharing in relation to the project and its intent, along with the provision of data to help inform regional priorities. Key nodes, such as airports, ports and sites of significance were considered during the workshops in determining road priorities, along with routes that would be important for freight transport following an AF8 event. Road network vulnerability, the relationships between different sectors and types of site (e.g., hospitals), and accessibility are woven together in the AF8 GIS platform created for the project.
Dissemination will also include: • *Report(s) being made available to the wider lifelines community and NZ Lifelines Council* • *Presentation(s) to National Lifelines Forum and other stakeholder groups*	Dissemination has occurred by way of presentations and information sharing within the wider Lifelines community. Refer also to Section 7.0 for future intentions.

3.2 Challenges

3.2.1 General

The following key challenges were noted during delivery of the project programme.

1. Resourcing specialist GIS skills to develop the AF8 priority route platform plus limit GIS resources amongst utilities to compile and submit data sets in the requested format. This could be an ongoing limitation to geospatial based projects as the talent pool shrinks.

2. The landslide locations identified by the vulnerability models did not always match the expectations of the local roading managers. This was managed by the workshop facilitator and attributed in part due to landslips being triggered by earthquakes rather than extreme weather events.

3. Access to data on bridge seismic ratings to support vulnerability judgements and route selection during the workshops. Assumptions were made the most state highway bridges would remain intact following the earthquake. This is a fundamental assumption that should be tested once seismic data can be sourced and may lead to priority route adjustments.

4. Differing perspectives on the priority on routes connecting two regions depending on the available alternate options for each region. Conflicting priority scores for the same route were reviewed during the second moderation workshop and a compromise reached which respected both regions.

5. Insufficient time to seek feedback from the lifeline utilities on the route proposals and impact on infrastructure networks. This was due to limited project timing and the number of utility stakeholders across the South Island. This review step will be managed as part of the six regional lifelines group operations over the coming year.

6. This important resilience project attracted interest from a wide range of external stakeholders who wanted to be kept informed about progress and outputs. This level of interest reinforced the importance of the priority routes project but did create extra demands on the project team.

3.2.2 Lifeline Utility Data Acquisition

Engagement with the lifeline utilities was positive overall, and they recognised the benefits that this project could deliver for their own future resilience planning work. There was recognition of the insights that such a project can collectively offer to the region. Having visibility of other utility asset locations with interdependent relationships also helps close a gap in current knowledge.

However, there are several data issues that should be considered as part of future work:

1. Open or publicly sourced data sets were used to supplement asset information where this could not be directly sourced from the asset owner for critical infrastructure. Feedback suggests that this information could be obtained directly if more time was available for the utility to process the request.

2. Several larger utilities publish data layers at a high level for selected asset types and locations. These data sets while being easy to access can hold limited specific attribute information making it more time consuming to obtain the additional data needed.

3. Provision of attributes was varied and usually centred on name, type and internal technical codes. This usually reflected the data that could be readily accessed by the utility along with their understanding of the project requirements. Another potential factor is the level of trust necessary before asset owners are comfortable sharing more sensitive data.

4. The One Network Road Classification (ONRC) dataset maintained by NZTA does not currently hold bridge and tunnel location information. A supplementary data set was sourced from NZTA to cover State Highway bridges as an interim measure. Information on local bridges would need to be sourced from the individual district and city councils.

4.0   Management Approach

4.1   Project Team

Key personnel involved in delivering the project are listed Table 4-1 below. Expertise was drawn from a number of organisations and personnel including:

- IAM Consulting (M Gordon) Ltd – led the project, having long-term experience with Canterbury lifelines, transport networks, and asset management.
- Richard Mowll Consulting Ltd – having Priority Routes experience in the North Island
- AF8 Programme – as a supporting participant and project sponsor
- Kaeppler Geospatial Ltd – for GIS technical support
- University of Auckland – for road network vulnerability modelling

There was close collaboration with Environment Canterbury, in particular around GIS and hazards data acquisition, and NZTA in relation to the role of state highways in the project.

Project management activities included the following:

- Progress meetings with the project delivery team on an as required basis.
- Management and coordination of activities and providing direction for the project team.
- Review of project outputs and approval for finalization.
- Tracking of physical and financial progress against the programme.
- Monthly invoicing to Environment Canterbury CDEM.
- Quarterly reporting to NEMA.

Table 4-1   Project Team Members

People	Organisation	Main Involvement
Mark Gordon	IAM Consulting | Canterbury Lifelines Programme Manager	Project Manager
Martyn Wooster	IAM Consulting	Technical Lead Data acquisition, liaison with lifelines, workshop facilitation
Richard Mowll	Richard Mowll Consulting Ltd	Workshop facilitation, technical input
Alice Lake-Hammond	AF8 Programme	Workshop participant and GIS advice
Jana Kaeppler	Kaeppler Geospatial Ltd	GIS set-up and technical support
Liam Wotherspoon	University of Auckland	Vulnerability modelling

5.0   Funding Arrangements

5.1   Project Revenue

The original budget for this project was $100,000 with "time in kind" support from the AF8 Programme, NZTA, and CDEM regions across the South Island, summarised in Table 5-1 below.

Table 5-1   Funding Sources (submission)

Funding Source	Details	Amount	Secured
CDEM resilience fund contribution	Successful project funding application.	$100,000	Yes
CDEM Groups – local time commitment	Canterbury CDEM contribution, co-funding from other CDEM regions, plus CDEM personnel and lifeline utilities "time in kind".	Not costed	NA
AF8 Programme	"Time in kind" support for some GIS mapping and participation in regional workshops.	Not costed	NA
University of Auckland	"Time in kind" research and provision of content relating to road vulnerability	Not costed	NA
NZTA	"Time in kind" support for workshops and technical input and advice.	Not costed	NA
Total Submission Budget		$100,000	
Total Funding Available		$100,000	

5.2   Project Expenditure

Project tasks were structured as a sequence of Milestones. Table 5-2 below compares the original budget submission split with the actual costs for each. Some final costs have yet to be accounted for as noted.

Actual expenditure was $131,503 as shown below. The amount approved through the NEMA Resilience Fund ($100,000) has been fully invoiced to NEMA, with the balance of the required funding being managed through Environment Canterbury CDEM with co-funding by regional CDEM groups.

Reasons for the differences are highlighted in the table.

Table 5-2   Expenditure Details

Item	Tasks	Budget	Cost (Actual)	Comment
Project Management	0	$5,000	$3,753	Difference is minor
Milestone 1 – Identify priority sites	1-2	$15,000	$21,595	Significant effort was required in liaising with lifeline utilities, regional CDEM groups and the AF8 Programme in securing data layers for the project
Milestone 2 – Assess road network vulnerability	3-7	$35,000	$17,063	"Time in kind" contributions by UoA kept the "cost to project" of this activity at a much lower level. There was also some interplay between this activity and the workshops process under Milestone 3 with costs being captured there.

Item	Tasks	Budget	Cost (Actual)	Comment
Milestone 3 – Identify priority routes by region / area	8-9	$25,000	$65,263	This was the most intensive activity within the project. It included preparation for workshops, participation in workshops by project team members, development of GIS applications and GIS support at workshops.
Milestone 4 – Collate and moderate	10-13	$20,000	$23,829	Costs include refinements to the AF8 Priority Routes GIS app and final report writing.
	Total	$100,000	$131,503	

Communication and liaison with stakeholders has been extensive, with a significant amount of effort devoted to defining priority routes, the moderation process and agreeing a coordinated set of priorities.

As a result, a valuable resource has been developed that has the support of all local authorities across the South Island. Furthermore, NZTA are incorporating the project outputs into their recovery planning processes

6.0 Lessons Identified

6.1 Lessons by Theme

Observations can be made in a number of areas categorized below by theme.

Table 6-1   Lessons Identified by Theme

Theme	Lesson	Takeaway
Resources	Specialist resources can be lost or re-prioritised during delivery of the project programme.	Team structure and resources can change, make allowance in budget for contracting additional specialists.
High Profile	High profile projects can attract interest from external parties that needs to be managed, placing additional load on project management time.	Be mindful of project profile and potential to attract interest from a wider group of stakeholders. Make time in the programme for additional meetings and keeping people informed.
Collaboration	This was one of the first major projects to be delivered using a collaborative model with the six South Island lifelines groups. This demanded additional time for learning and coordination.	Provision allowance in the programme and budget for additional communication and coordination time particularly when the project is novel and/or spans multiple regions.
Regional Differences	Each regional group is likely to be operating at a different level of resilience maturity. This variation should be expected and allowed for within the programme.	Take time to stocktake maturity and baseline for each collaboration partner. Allow for this variability in the project programme, additional support may be required to achieve a common output.
Funding	The project may evolve beyond what was envisaged at the time of estimating the original budget. This can be due to scope refinement and better appreciation of project inputs.	Be realistic with budget estimates and scale back the programme if required. Allowances should be made in the project contingency to reflect complexity and scale.

7.0 Communicating Outcomes and Accessing Content

7.1 Project Outputs

The project outputs comprise the Final Report and the GIS based Priority Routes application hosted by the AF8 Programme.

In addition, data layers have either been acquired or utilised from regional CDEM GIS Viewers as part of this project. These, and the respective access arrangements, are summarized below.

7.1.1 Project Report

The submitted project report will be able to be accessed via the CDEM Resilience Fund website. It is also available from Environment Canterbury's CDEM office.
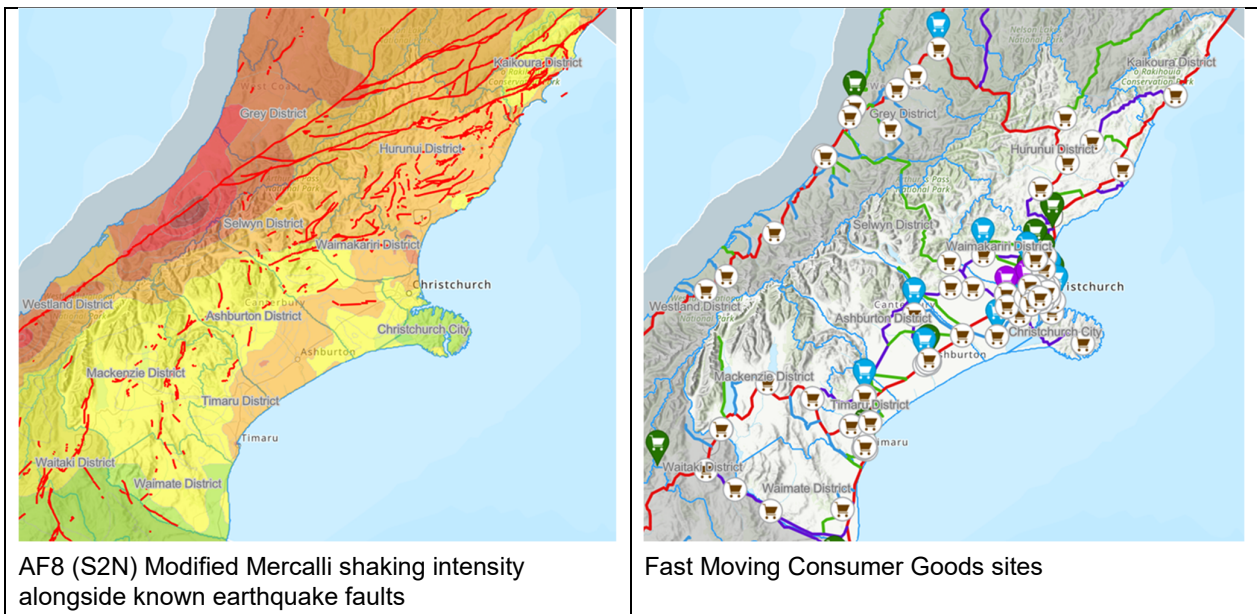
7.1.2 Regional CDEM Lifelines Viewers

Each of the six South Island regions have their own GIS Viewers that contain a range of regional network and site data that has been utilised in the project.

7.1.3 Canterbury CDEM Lifelines GIS Portal

The GIS Lifelines Portal and associated GIS Viewer contain data supplied by lifeline utilities in the Canterbury region on the basis that access would be limited to CDEM and Canterbury lifelines stakeholders for confidentiality reasons. It is one of the six viewers referred to above.

It also contains the south to north AF8 scenario assumed for the vulnerability assessment for Priority Routes, along with other hazard information affecting the Canterbury region.

This information is used for other lifelines resilience work in Canterbury. Example images are shown below.

AF8 (S2N) Modified Mercalli shaking intensity alongside known earthquake faults

Fast Moving Consumer Goods sites

7.1.4 AF8 Platform

The AF8 Programme has supported the South Island Priority Routes project since its beginnings as part of its inter-regional networking and collaboration role – facilitating planning meetings, coordinating shared project files and attending workshops.

AF8 is also helping to digitise the workshop outputs in ArcGIS. These outputs will be hosted on the AF8 Research & Readiness (R&R) Hub, an ArcGIS-based hub designed to support AF8 coordinated research and planning.

The hub and the outputs of this project will be launched in late-August 2024 (https://af8.org.nz/).

Priority routes are mapped on the AF8 GIS platform established for the purpose, which also includes "wider then region" information, such as Transpower assets, state highways, fuel stations, emergency services, etc. Data sharing protocols are in place, with the AF8 Sharing Level 2 'Controlled' meaning that emergency management and utilities can gain access by invitation only.

7.1.5   "Islands" and Disruption Times

The workshops also identified "islands" across the South Island, where disruption to routes would impact on accessibility between townships, nodes or sub-District areas. Indicative disruption outage times were also estimated in a matrix table, although some further work is required in refining these.

7.2   Dissemination

7.2.1   Report

The Final Report will be published on the NEMA Resilience Fund website. In addition, it will be shared with members of the Canterbury Lifeline Utilities Group and be made available to other Lifelines groups within New Zealand.

7.2.2   Presentations

A number of presentations have already been delivered to sector groups, including the South Island Regional Transport Chairs and some CDEM regional lifelines groups.

It is planned to provide a presentation to the National Lifelines Forum in October 2024.

7.3   Access Details

Below are access arrangements for the final version of the project report, the AF8 Priority Routes platform, and the regional lifelines GIS Viewers. and the two GIS portals that contain layer information and priority route details.

Table 7-1   Access to Project Resources

Resource	Format	Date	Access Arrangements
South Island Priority Routes – Final Report	Document	July 2024	Download a copy from the CDEM Resilience Fund website: https://www.civildefence.govt.nz/cdem-sector/cdem-resilience-fund/
AF8 Priority Routes GIS app	AF8 GIS Platform	NA	Contact Alice Lake-Hammond, AF8 Programme Manager to request access: alicelh@af8.org.nz https://af8.org.nz/
Regional Lifelines Viewers	GIS Platforms	NA	Contact regional CDEM staff at Southland, Otago, West Coast, Nelson-Tasman, Marlborough
Canterbury CDEM GIS Lifelines Portal	GIS Platform	NA	Contact Steve Ferris at Canterbury Civil Defence Emergency Management to request access: Steve.Ferriss@cdemcanterbury.govt.nz www.cdemcanterbury.govt.nz

8.0 Future Direction

8.1.1 Key Actions

With the successful completion of this project a number of further actions related to Priority Routes and the AF8 Programme have been identified, including:

- Socialise the platform and priority routes with utility providers and key stakeholder. This can be coordinated as part of regional lifelines group operations. See also Section 0.

- Connect the AF8 platform to the six regional lifelines viewers allowing for two-way data sharing within the GIS ecosystem.

- Publish results of the NZTA recovery time analysis for each route once available.

- Develop a process for maintaining and reviewing platform content to ensure currency.

- Continue to work with infrastructure owners to capture missing data and complete the network picture for each sector.

- Work with the New Zealand Lifelines Council to promote the national criticality rating system amongst the sector to enable improved reporting of priority sites.

- Promote a similar project and platform for the North Island if funding can be secured.

- Start work on the next AF8 collaboration project to improve South Island resilience. There are a number of initiatives identified by the AF8 Lifelines RPG that can be pursued given the same collaborative model used in this project. It may be appropriate to seek future NEMA Resilience Fund support for such initiatives.

8.1.2 Links to other Workstreams

There are a number of related activities, both specific transport resilience programmes as well as resilience focussed business case and improvement work. These include:

- Vulnerability assessments conducted by South Island regional lifelines groups

- Impacts modelling and resilience business case work being carried out at a regional or cross-regional basis – for example Canterbury's Risks and Resilience project "Expanding GIS-based impacts modelling across Canterbury lifelines" (NEMA resilience Fund Project 2023-16).

- Work programmes being carried out by NZTA, City and District Councils on their roading networks, such as NZTA's South Island Resilience business case work.

- Planning investigations focussing on transport system resilience, such as a road infrastructure resilience project being conducted by Environment Canterbury on behalf of the South Island Regional Transport Chairs group.

- Freight corridor planning, typically by road controlling authorities and regional transport officers.

- Supply chain logistics work, some of which is being carried out by Universities under various research programmes.

It's also important to note the role of Priority Routes outputs in RCA decision-making. An example is a recent decision by Christchurch City Council to make an increased investment in the Pages Road bridge replacement project, due to the road's significance as an identified Priority Route for CDEM purposes.