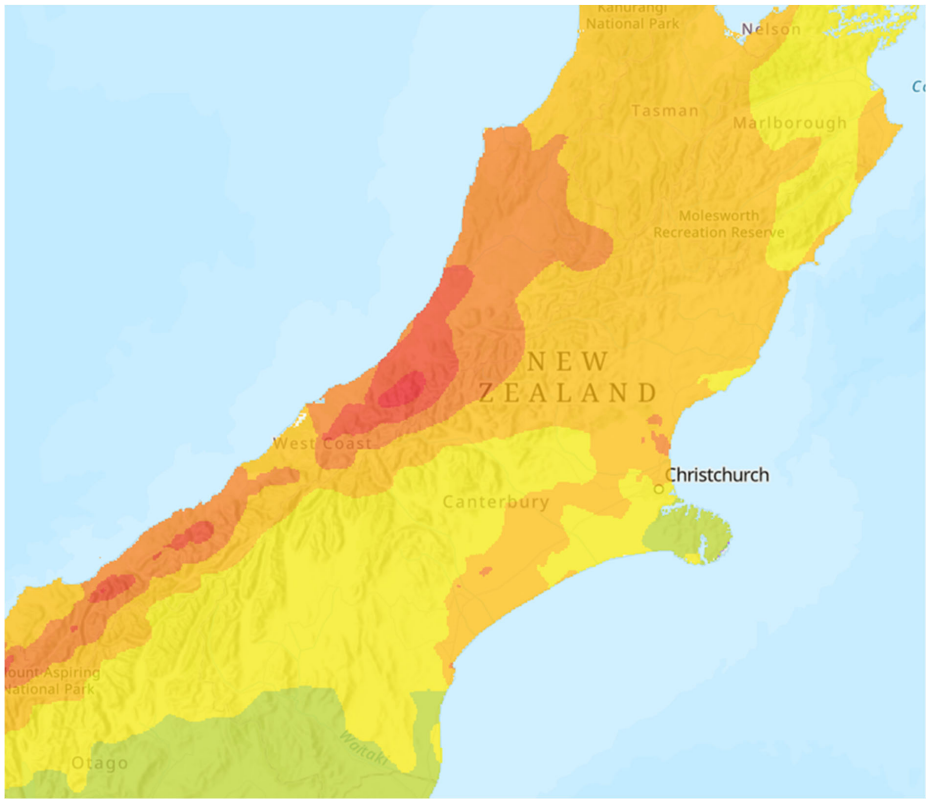
Risks and Resilience

Resilience Fund Project 2023-16: Expanding GIS-based impacts modelling across Canterbury lifelines

Final Report for NEMA Evaluation

Canterbury Civil Defence Emergency Management Group



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1.0 Introduction

1.1 Project Description

Risks & Resilience: Expanding GIS-based impacts modelling across Canterbury lifelines.

This project follows on from NEMA Resilience Fund supported Project 2021-04, which developed a Maturity Pathway for cross-sectoral resilience-focussed business cases, demonstrated by a pilot "proof of concept" process for North Canterbury. This work created building blocks and tested the methodology for conducting vulnerability assessments using GIS tools and economic impacts analysis using MERIT. Recommendations were made for further work that became the focus of this project.

This project expanded the area of geographic coverage to the entire Canterbury region with an invitation extended to all lifeline utility sectors to participate. A similar approach was adopted as for the earlier project, using the Canterbury CDEM Critical infrastructure GIS Viewer, the Urban Intelligence Resilience Explorer and MERIT, with enhancements having been made to the modelling methodology. These are explained in a series of project reports that are described below.

The project did not set out to develop a business case for resilience mitigations, but rather to demonstrate a more complete approach as described in the Maturity Pathway, with business case work being the subject of a future project.

It is anticipated that this work will also be valuable across the wider lifelines community in understanding hazard impacts and improving resilience outcomes.

1.2 Report Structure

This report is structured in the following way:

- Firstly, a high level summary of the project approach and outcomes, with further, more detailed information available in three referenced project reports.
- 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 tasks performed during each of the Milestone stages as described in the Resilience Fund application.

It also refers to project reports produced as part of this work – further information on these documents is provided in Section 7.2.

Table 2-1 Milestone Summary

Task No.	Description	Summary
Milestone 1 – Stocktake		
Task 1	Review the outcomes and recommendations of the completed Risks & Resilience project, the status of relevant research initiatives, tools to be utilised, hazard(s) to be assessed, and opportunities for collaboration.	The *Stocktake and Participation Report* provides an overview of Project 2021-04 and the opportunities identified as a result. These include broadening to the wider region, more encompassing of critical infrastructure sectors, and implementing more of the "maturity pathway". The report also provides an update on developments in the research sector to be considered in the project, along with updates to the Urban Intelligence and MERIT visualisation and modelling tools.
Task 2	Confirm scope and focus areas based on expected availability of research outputs and key data. Document findings and confirm scope.	The *Stocktake and Participation Report* describes the approach taken in implementing the balance of this project. This includes the hazards, data acquisition, tools and applications, as well as a potential mechanism for enabling involvement by other South Island lifelines groups – although funding constraints meant that this latter option was not pursued.
Milestone 2 – Workshop 1		
Task 3	Plan for and facilitate workshops in Timaru and Christchurch with representatives of Canterbury lifeline utilities and CDEM to discuss the project and initiate involvement. This workshop will demonstrate the Risk & Resilience Explorer developed by Urban Intelligence and discuss the project methodology and expectations (e.g., data needs). It will explore the fragility/vulnerability assumptions used for the different assets – this will be followed up with individual utility conversations in the next phase. Document workshop process and results.	This workshop series was replaced with a one-on-one out-reach approach to achieve more targeted participation and initiate the data acquisition process, carried out in conjunction with the *South Island Priority Routes* project (Project 2023-13). A presentation on the North Canterbury pilot (Project 2021-04), including the GIS-based Explorer, was provided to the Canterbury Lifelines Group meeting in June 2023, along with a discussion on indicative directions for future work. Fragility relationships were developed as part of Milestone 3 Impact Models. Contact was made with most lifeline utilities across Canterbury, followed up by data acquisition as part of Milestone 4. Work up to this stage is described in the *Stocktake and Participation Report*.

Task No.	Description	Summary
Milestone 3 – Impact Models		
Task 4	Interact and collaborate with University of Canterbury research work to identify enhancements to models developed in Risks & Resilience Project 2021-04.	The *Modelling Report* provides an overview of the enhancements made to the Resilience Explorer since the completion of Project 2021-04. This includes an overview of the risk assessment process, consequence evaluation, indirect and cascading impacts and recovery of infrastructure, in addition to updates to the fragility curves applied in vulnerability models.
Task 5	Incorporate improvements including multi hazards, cascading failure impacts, fragility/vulnerability relationships, outage times, linked to emergency level of service definitions. Seek to incorporate economic loss in the Risk Explorer and update the dashboard.	The *Modelling Report* provides an overview of the hazards included in the Resilience Explorer – tsunami, AF8 earthquake, and fluvial flooding of major river systems in Canterbury. Cascade failure models are limited to the electricity sector and how failure could impact the wider community in two Districts. The recovery modelling process allows for different assumptions to be tested around timeframes. While part of the ongoing development plan, a direct link to economic modelling (MERIT) has yet to be developed.
Milestone 4 – Impacts Analysis		
Task 6	Obtain geospatial data from lifeline utilities and for the hazards to be assessed.	Obtaining appropriate infrastructure data has been a significant undertaking that cannot be underestimated. It required ongoing one-on-one liaison with lifeline utilities, mostly with a successful outcome in terms of data provision. Hazard data layers have been provided by Environment Canterbury (flooding and tsunami) using the latest research, with AF8 shaking intensities provided by Bradley et al (2017). Flooding data is mostly available for different return period events, ranging from 100 to 500 years. Climate change effects are also considered. These are all documented in the *Modelling Report*.
Task 7	Apply the updated impact models to predict damage levels, direct and indirect outages, and service restoration timeframes across the region.	Impact modelling was carried out in the Urban Intelligence Resilience Explorer, with all provided infrastructure data layers mapped against the various hazard scenarios. Where damage relationships are available, these are used to predict relative damage consequences. Cascading indirect impacts have been analysed for a 500 year flooding event for the electricity sector in the Ashburton and Waimakariri Districts. Assumptions were made about outage duration scenarios and recovery optimisation functionality was tested.

Task No.	Description	Summary
		The *Modelling Report* provides further information.
Task 8	Assess the economic (using MERIT), social and cultural impacts.	Market Economics carried out economic analysis for the Ashburton and Waimakariri Districts in terms of GDP economic impacts of the 500 year flooding event using the outages output provided from the Resilience Explorer. A separate "case study" assessment was made of potential financial losses to infrastructure arising from the flooding. This made a number of assumptions about damage state using the consequence data in the Resilience Explorer and assumed asset replacement / reinstatement cost. Additional layers have been incorporated in the Resilience Explorer to facilitate the assessment of social and/or cultural impacts.
Task 9	Document approach and results.	The *Modelling Report* provides detailed information about the impacts modelling, economic modelling, and financial loss modelling described above.
Milestone 5 – Workshop 2		
Task 10	Workshops to share the results of the modelling and analysis. Interactive use of the Risk & Resilience Explorer to view and test results sector by sector. Begin discussion on the recovery optimisation process. Refine assumptions as appropriate. Identify potential mitigations to improve resilience taking account of interdependent effects. Document workshop process and results.	Two workshops were convened, allowing participants to view the exposure of their networks and the assets affected by the three hazard scenarios using the Resilience Explorer. Topics of discussion also included MERIT economic modelling, financial loss modelling, indirect impacts, recovery optimisation, possible mitigations, and future options for developing the tools further. The Workshops are described in the *Implementation Report.*
Milestone 6 – Update analysis and final report and dashboard		
Task 11	Repeat the assessment of impacts based on the mitigation interventions being in place, identifying the investment benefits.	A simplified approach was adopted due to budget limitations and the significant amount of re-modelling work that would have been required to test the effectiveness of particular mitigation interventions. This approach looked at the economic benefits of reducing outage duration, such that the best value would be obtained from interventions offering the greatest benefit:cost ratio.
Task 12	Document the findings and produce final report.	The *Implementation Report* provides further information. This *Evaluation Report* constitutes the final report.

3.0 Successes & Challenges

3.1 Project Achievements

The purpose and broad approach proposed for this project is described in the table below. Alongside these paragraphs is a summary of how the project has addressed the original intent.

Table 3-1 Project Purpose and Approach

Funding Submission – Summary	Project Achievements
The purpose of this application is to build on the outcomes of the currently funded Risks & Resilience project, expanding coverage to the wider Canterbury region and encompassing additional lifelines sectors, in particular Ports, Airports, Fuel, and FMCG. It also involves the enhancement of the modelling approach to improve interdependency and cascade failure impacts analysis across multiple well-beings, the use of fragility curves, outage estimation, recovery capacity, and create the foundation for making future progress on optimisation of recovery.	The project covers the whole of Canterbury and all lifelines sectors, including Ports, Airports, Fuel, and FMCG, that were invited to participate. The modelling approach has been enhanced to facilitate cascading impacts. While functionality in the Resilience Explorer links electricity disruption to community outages it does not yet tie this directly to affected lifelines assets such as water treatment plants. This is an opportunity for further development. Enhancements also include fragility relationships (although there are opportunities to develop these further for seismic impacts to infrastructural elements), outage duration modelling, and the process of recovery optimisation based on restoring service to the greatest number of customers affected. "Contextual" data layers, such as population and the NZ deprivation index, have been added to the Resilience Explorer allowing broad social assessment of impacted areas.
It will leverage off University of Canterbury PhD research and provide a natural link to "emergency levels of service". As with the current project, infrastructure asset data and hazard layers (likely to be selected from flooding, tsunami, AF8 / earthquake) will be brought together in the GIS-based portal. A series of workshops will ensure the involvement and input of lifeline utilities and CDEM stakeholders.	The Canterbury CDEM Critical Infrastructure GIS portal houses the data layers for this project, and they are therefore available to both CDEM staff and lifeline utilities through log-in arrangements. These layers are uplifted by the Resilience Explorer for modelling and visualisation purposes – examples of screenshots are provided in the *Modelling Report*. Current PhD research in the recovery optimisation field at the University of Canterbury has been factored into the Resilience Explorer to allow users to explore options for recovery and where assigning resources would have the greatest benefit during recovery. This is currently conceived for full or no service to particular areas, but could be enhanced to allow for "partial" service. This is more relevant to water supply say, rather than whether or not electricity is available. Workshops towards the end of the project in Woodend and Timaru were well attended by lifeline utilities and CDEM staff, with presentations on the hazards and a demonstration of the Resilience Explorer followed by a "test drive" by participants. The workshops also discussed outage assumptions, financial loss modelling, resilience mitigations and directions for implementation.
Impacts analysis is to be broadened beyond economic to include asset value loss analysis, social, and	Financial loss analysis has not yet been fully automated in the Resilience Explorer. However, the damage state ratios determined by the models provide a broad basis for assessing relative levels of asset damage which can be

Funding Submission – Summary	Project Achievements
cultural, thus implementing more of the maturity pathway.	related to asset replacement cost. In some cases, asset valuation data has been provided as part of the lifelines input, but this is atypical. For the project, a proof of concept "off-line" sample financial loss analysis was carried out. Social and cultural impact assessments can be carried out in the Resilience Explorer using "contextual" layers, and this can easily be expanded to include assessment of any types of sites for which geospatial data is available. For example, marae or sites of cultural significance.
This project potentially has wider South Island appeal, and neighbouring groups will be invited to participate in workshops as appropriate to improve their awareness and understanding of the work.	While other SI groups were aware of this project, participation was limited to Canterbury lifelines – including national agencies such as NZTA, the telecommunications sector, Transpower, Meridian, etc. The outcomes of the project will be presented to the NZ National Lifelines Forum in October 2024. All of the technical reports are readily available to the lifelines community and the approach can be replicated in any region or territorial area.
Funding Submission – Outcomes / Benefits to Sector	**Project Achievements**
The project, together with outputs from the current project (2021-04), will deliver a structured methodology, improved modelling capability, tools, and GIS-based Explorers that integrate hazard layers, infrastructure layers (networks and nodes), and the outputs of impacts analysis. It will utilise this methodology across the Canterbury region in assessing the impacts of specific hazards (e.g., flooding, AF8, tsunami).	These two projects have demonstrated the value and utility of an end-to-end process methodology that integrates geospatial hazard data, infrastructure data and impacts modelling functionality to produce both visualisation and quantitative vulnerability outputs. Impact models can be interlinked with affected communities and through service outage analyses the economic impacts determined. The methodology extends to the identification of mitigation options and the relative impacts of those interventions in terms of outage and recovery times. This information can be used as an input to business case development.
These outputs can be applied or further developed by CDEM groups and lifeline utilities to improve their understanding of interdependent, cascade impacts of different hazard events and the economic, social and cultural impacts on their communities. *For lifeline utilities, this information can improve resilience investment decision-making and be reflected in their Asset Management Plans.* *For CDEM groups, this will help inform planning for response and recovery*	The Resilience Explorer and MERIT Tool are commercial products that can be developed for similar purposes in other regions, providing the base GIS data layers are available – hazards, infrastructure, and contextual layers as required. The application reported on here is cross-sectoral, enabling users to view the impacts on infrastructure networks and systems other than their own. The Resilience Explorer can also be applied for individual agencies in looking at just their own networks and conducting vulnerability analyses. The outputs, along with any proposed resilience actions, are valuable inputs to asset management decision-making processes. For CDEM, the ability to view different hazards and the potential impacts on lifelines infrastructure is valuable in considering imminent events, or during an event such as major rainfall and flooding.

3.2 Challenges

Specific challenges addressed by the project largely relate to data acquisition and hazard impact modelling. These topics are further discussed below.

3.2.1 Lifeline Utility Data Acquisition

Engagement with the lifeline utilities in Canterbury was positive, and they recognise the benefits of this work and the value of modelling platforms to their own future resilience planning work. Having visibility of other utility asset locations with interdependent relationships also helps close a gap in current knowledge.

The capture of data from infrastructure owners was coordinated with the Priority Routes project, and the challenges are therefore similar. This allowed for a single data request to providers that could also be digitally shared across multiple lifeline groups. The entities were individually contacted via email and invited to participate in the two projects and an online meeting requested. This was followed up by emails and online meetings with each entity to further outline the intent of the projects and nature of the request. The data request and capture process, while not being technically challenging, has been a critical and time-consuming component of the project.

While good asset data was captured for most infrastructure and community service providers that were contacted, there were some gaps and this remains an ongoing challenge. A full schedule of the types of data received from each agency is provided in the *Modelling Report*.

Notable data issues experienced in both the previous project (2021-04) and current projects that need to be recognised through future work include:

1. Openly or publicly sourced data sets were used for supplementary asset location data for the telecommunications, three waters and transport sectors. This information is available from utilities directly; however, this does involve a significant time commitment to process the request.
2. Some data layers, such as for stopbanks, flood protection assets and irrigation networks, that were highlighted for inclusion in the project, have not yet been acquired. This is an aspect that will be addressed in the post-project consolidation process.
3. While much data was obtained in shapefile or MS Excel format (some with geospatial coordinates), other data was provided in KMZ or PDF format. This data, while valuable source information that can be referenced in the Canterbury CDEM Lifelines Viewer, does not directly lend itself to spatial inclusion, visualisation, and vulnerability assessment within the Resilience Explorer.
4. Some 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 data needed.
5. 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.
6. The One Network Road Classification (ONRC) dataset maintained by NZTA does not currently hold bridge and tunnel location information. A supplementary data set has been utilised from LINZ for the project as an interim measure. This knowledge gap should be resolved as part of future work.

Commented [MW1]: I'm not sure that this was loaded into the RE, I know we published it in the AF8 platform.

3.2.2 Hazard Impact Modelling

Modelling service outages, and ultimately the economic, financial and social impacts of those outages, requires a good understanding of the exposure of infrastructure assets to hazards, along with reasonably robust assessments of damage state and service loss over time.

While hazard knowledge is good and being informed and updated by science over time, there is still a lack of fragility relationships for infrastructure elements, e.g., seismic. This is not surprising as whether or not an asset or facility will be damaged depends on a range of factors, including design, material type, the level of protection, ground conditions, etc. Still, this is a body of knowledge that could be improved.

Commented [MW2]: And tsunami?

Another aspect relates to complex sites with multiple asset types, a relatively simple example being a water, wastewater or stormwater pumping station comprising buildings, pumps, valves, pipework, mechanical and electrical plant. Ports, bulk fuel facilities, airports and electricity generation and transmission sites also fall into this category. It is more complex to model and display the behaviour of different asset types in a single geographic location than, say, a linear network.

While this project began to consider interdependencies and the impacts of cascade failure, this too is an area where the modelling process can be further developed.

The robustness of this process can be improved through expert elicitation, a potentially time consuming process across a large region, or through refinement of fragility relationships in the New Zealand context. Other work being done in this area, for example in RiskScape2.0, offers the potential for more comprehensive analysis in the future. It is important to note that the more sophisticated the approach, the more resource and funding is required.

3.2.3 Resilience Mitigations and the Business Case Approach

While a range of generalised types of mitigation were identified and discussed these have not yet been refined to specific implementation actions and taken through a cost:benefit or business case approach. Ideally, this would entail a comprehensive cross-sector approach considering interdependencies and a range of potential mitigation strategies. The challenge is having the capability and modelling capacity to assess post-intervention damage states, outages, and recovery pathways over time so that the relative benefits of intervention can be assessed.

This points towards the need to develop a scenario-based vulnerability modelling approach that can test the response of interconnected lifelines systems with and without interventions to hazards, moving that through the financial, economic and social analysis processes.

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 and asset management.
- Urban Intelligence
- Market Economics
- ResOrgs

Project management activities included the following:

- Regular 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

People	Organisation	Main Involvement
Mark Gordon	IAM Consulting | Canterbury Lifelines Programme Manager	Project Manager
Martyn Wooster	IAM Consulting	Technical Lead, lifelines liaison and data acquisition
Logan Brunner	Urban Intelligence	UI Resilience Explorer modelling input
Garry MacDonald	Market Economics	Lead for MERIT economic analysis
Charlotte Brown	Resilient Organisations	Project review and advice, workshops

5.0 Funding Arrangements

5.1 Project Revenue

The original budget proposed for this project was $185,000 with co-funding proposed from Canterbury CDEM, summarised in Table 5-1 below. Actual funding was $168,500 as shown below, although final costs are yet to be processed. The amount approved through the NEMA Resilience Fund ($150,000) has been fully invoiced to NEMA, with the balance of the required funding being managed through Environment Canterbury CDEM.

Table 5-1 Funding Sources (submission)

Funding Source	Details	Amount Sought	Amount Available
CDEM Resilience Fund	Successful project funding application.	$166,500	$150,000
Canterbury CDEM	From Programme Management budget	$16,500	$16,500
Total Submission Budget		$185,000	
Total Funding Available			$166,500

5.2 Project Expenditure

Project tasks were structured as a sequence of Milestones. The table below compares the original budget submission split with the actual or current costs for each. Some final costs have yet to be accounted for as noted below.

Actual expenditure to 30 September was around $174,000 as shown in Table 5-2. The amount approved through the NEMA Resilience Fund ($150,000) has been fully invoiced to NEMA, with the balance of the required funding being managed through Environment Canterbury CDEM.

Table 5-2 Expenditure Details

Item	Tasks	Budget	Cost (Actual)
Project Management	0	$5,000	$3,735
Milestone 1 – Stocktake	1-2	$7,000	$9,649
Milestone 2 – Workshop 1	3	$13,000	$7,523
Milestone 3 – Impacts Models	4-5	$52,000	$47,509
Milestone 4 – Impacts Analysis	6-9	$72,000	$72,317
Milestone 5 – Workshop 2	10	$17,000	$12,188
Milestone 6 – Update analysis, final report, etc	11-12	$19,000	$20,993
	Total	**$185,000**	**$173,913**

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
Research and Knowledge	There is a substantial body of research work, both available and developing, that needs to be continually monitored and used where it adds value to the approaches used by lifelines to understand vulnerability and improve resilience.	This is an ongoing task at local, regional and national levels. It includes improved understanding of hazards and the effects of hazards on infrastructure, as well as social and cultural implications.
Community Sites	There are numerous stakeholder groups each with a range of sites that depend on lifelines operability.	They need to be part of any vulnerability assessments and resilience planning.
Resources and Time	Projects such as this, with multiple stakeholders, substantial data acquisition and modelling needs, consume substantial resources and time. Constraints can compromise the ability to deliver on the aspiration.	Realistic allowances need to be made in setting project budgets and timeframes for inherent complexities.
Asset Data	Supply of the correct level of attribute data is essential if the impacts are to be accurately modelled and risk of failure better understood.	Common factors preventing the supply of core attribute data need to continue to be further explored with utilities in future work.
Asset Data	Developing a comprehensive fit for purpose data set is an iterative process.	Maintain momentum by continuing to share data and insights within the GIS Lifelines Viewers and the Resilience Explorer platform.
Fragility	Asset fragility relationships for different hazard events are not sufficiently documented to cover all core asset types and hazards of interest.	This will improve over time as more natural hazard events occur and are studied by the international research community. Could be a focus for NZ research and the sharing of models developed by different providers.
Fragility	Practitioner workshops can be used to develop a framework of asset damage / service impacts with varying levels of event severity.	A generalised approach to estimating vulnerability levels for the main asset and hazard types is an effective way to bridge the gap in fragility information.
Shared Platform	A shared risk assessment platform such as the Resilience Explorer can deliver benefits to both individual utilities and regional groups.	Continue to promote the benefits of a shared platform with lifeline utilities in Canterbury. Seek opportunities for live asset data feeds / updates to facilitate agile analysis
Resilience Mitigations	The level of effort in justifying infrastructure options for improving resilience in a business case approach should consider the financial, economic, social and cultural benefits and be appropriate to the scale of the potential impacts.	A business case approach can be carried out at different levels – e.g., high level with assumptions to test potential impacts, to more detailed and comprehensive approaches where the impacts are more significant and interdependencies need to be recognised.

7.0 Communicating Outcomes

7.1 Dissemination

The outputs of this project will be disseminated as follows:

- Publication of the project reports on the NEMA website.
- Publication of the project reports on the national Lifelines shared folder, administered by the NZ Lifelines Council.
- Development of a slide pack for communication purposes.
- Presentation to National Lifelines Forum later in 2024, and discussion at Lifelines Programme Managers meetings.
- Provision of links to demonstration tools (subject to current data confidentiality agreements relating to the project).

The outcomes of this project have wider South Island and National appeal, and other regional lifelines groups will be invited to participate in future work as appropriate to improve their awareness, understanding and ability to make use of the tools.

7.2 Accessing Project Outputs

The submitted project report will be able to be accessed via the CDEM Resilience Fund website. They are also available from Environment Canterbury's CDEM office or the Canterbury Lifelines Group Programme Manager, Mark Gordon.

The GIS Lifelines Portal and Urban Intelligence Platform contain asset data layers supplied by a Canterbury lifeline utilities on the basis that access would be limited to the project team for confidentiality reasons. Please refer to the contact details below to request a demonstration or restricted access to the respective platforms.

It is anticipated that concerns around data security can be explored further with lifeline utilities during the next phase of this work with the aim of establishing data sharing agreements and enabling access to a wider CDEM and lifelines community audience.

Table 7-1 Where to find Project Outputs

Output	Format	Date	Access
Stocktake and Participation Report	Document	January 2024	Download a copy from the CDEM Resilience Fund website: https://www.civildefence.govt.nz/cdem-sector/cdem-resilience-fund/
Modelling Report	Document	July 2024	
Implementation Report	Document	August 2024	
GIS Lifelines Portal	CDEM GIS Critical Infrastructure Viewer	August 2024	Contact Steve Ferris at Canterbury Civil Defence Emergency Management to request access: Steve.Ferriss@cdemcanterbury.govt.nz www.cdemcanterbury.govt.nz
UI Resilience Explorer	Urban Intelligence Platform	August 2024	Contact Tom Logan or Mitch Anderson at Urban Intelligence Limited to request access: tom.logan@urbanintelligence.co.nz mitchell.anderson@urbanintelligence.co.nz www.urbanintelligence.co.nz

8.0 Future Direction

This project and its predecessor Project 2021-04 have already been discussed in various forums across the lifelines community, and there is interest in continuing to make improvements to enhance vulnerability assessments and develop a business case approach.

In particular, it would be desirable to:

- Continue to improve the capture of infrastructure data, including financial value, and other data such as community sites, marae, and enable sharing across regional GIS lifelines viewers.
- Leverage off research and continue to improve the quality and currency of hazards data and our understanding of the fragility of different asset types to hazard events. Capture other hazards layers – additional to those used in the current project.
- Further develop the library of asset fragility relationships, particularly in relation to seismic hazard.
- Continue to enhance the modelling approach and further improve interdependency and cascade failure impacts analysis across multiple well-beings, the use of fragility curves, outage estimation, recovery capacity, etc.
- Develop a regional cross-sector resilience programme business case, integrating with national perspectives on priorities.
- Utilise “asset criticality” data to help inform prioritisation in the business case process.
- Work with the CDEM community across response and recovery functions to identify ways in which these approaches and tools could be better understood and further developed for the benefit of all stakeholders.

An application was submitted to the CDEM Resilience Fund in February 2024 requesting further support in building on the outcomes of this project in developing a “proof of concept” indicative programme business case for the Canterbury CDEM region, in relation to an AF8 earthquake event. This would:

- Utilise critical infrastructure data across multiple lifelines sectors in Canterbury[1], with much of this data having already been captured.
- Model the vulnerability of the assets to an AF8 earthquake event in the Urban Intelligence Resilience Explorer platform, noting that some further work would be needed in relation to fragility relationships.
- Test the wider economic impacts associated with service disruption using MERIT.
- Use the results in developing a resilience-focussed programme business case across multiple hazards, integrating this both with agencies’ work to date and national perspectives on priorities.
- Assess the economic justification for interventions, considering sector interdependencies and cascading impacts

The outputs of such a project, including vulnerability models and geospatial analysis and visualisation tools, could be adapted for use by other regions or expanded to multiple regions in addressing cross-regional hazard events.

The funding application was unsuccessful, but a new submission will be made for the 2025 funding round. It is anticipated that co-funding will also be sought from the lifelines community and, potentially, other CDEM groups in the South Island. This would enable further progress to be made, and also ensure collaboration with other initiatives such as the AF8 Programme.

[1] Including electricity, telecommunications, fuel, transport, water supply, wastewater, solid waste, and fast moving consumer goods