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FINAL PROJECT REPORT | MARCH 2024

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INTRODUCTION

The *Sharing Early Insights for More Resilient Communities* project (Early Insights project) developed and tested a set of resilience indicators that can be used by regional communities to monitor changes in levels of resilience resources. Monitoring the resilience of communities is more important than ever, with increasing numbers of communities across Australia experiencing consecutive natural hazard events, leaving them with little time between events to recover from the previous event or prepare for the next one (Binskin et al., 2020; Dare & Schirmer, 2021). Navigating these events while maintaining the wellbeing of people living in the community, and the functioning of a community overall, requires being able to draw on a wide range of resilience resources. These include financial resources, social support, government and community organisations, personal skills and local infrastructure, all of which play important roles in helping communities effectively navigate a wide range of challenges, including natural hazard events.

Many projects have examined resilience to natural disasters. Depending on how they conceptualise resilience, they often have very different areas of focus. Historically, resilience measurement related to natural disasters was based on the idea that natural disasters were singular, rare events (de Ruiter et al., 2020) that had several stages, including a clear stage of disaster preparation prior to an event occurring, following by active disaster response, and several stages of disaster recovery. Resilience measures were often focused on one of these stages. For example, some focus on the period of disaster response, with resilience considered to be present if a community is able to minimise damage and injury from a natural hazard event. This approach often measures resilience using indicators such as size and availability of the emergency workforce, hospital bed capacity or ability of local housing to withstand a natural hazard event with minimal damage (Cutter & Derakhshan, 2019).

However, in Australian communities it is now typical for a community to be in all these stages simultaneously, with communities recovering from one or multiple past events, possibly responding to another, and preparing for future events, at the same time. In many cases, any given resilience resources – such as a household's finances – are being used to prepare, respond and recover at the same time. This suggests a need to measure resilience without seeking to make measures specific to a single stage of the natural hazard cycle, recognising that many aspects of resilience are important across all parts of a cycle – and that there are often not distinct and separate stages of disaster preparation, response and recovery (de Ruiter et al., 2020).

This broader understanding of resilience underpins more recent resilience indexes and measures, such as the Australian Disaster Resilience Index (Parsons et al., 2016). These indexes measure resilience based on the understanding that having resilience requires having access to a range of different types of resources that can be drawn on by a person, household or community to help them respond to difficult times (and to positive opportunities) in ways that help them maintain and build wellbeing.

There remain, however, significant challenges in measuring resilience. In particular, many commonly used indicators of resilience are measured infrequently – often only once every several years. This means it is not possible to track whether often rapidly occurring events are resulting in a change in resilience levels in a given community. Additionally, some commonly used indicators of resilience assume that people with particular socio-demographic characteristics – such as those who are older – have lower resilience. Emerging evidence highlights that in many cases, these assumptions are not valid or appropriate. For example, some studies have found that older people on average have lower resilience; others have not found this; and all agree that being old is not in and of itself automatically a cause of low resilience (Brown et al. 2023).

The *Early Insights* project aimed to identify indicators that can provide a better understanding of how resilience is changing over the shorter term. This can enable more dynamic monitoring of changes in resilience, with changes in resilience levels known in timeframes that better enable decision makers to identify where investment is needed to support resilience of people and communities. The project aimed to demonstrate that it is possible to identify and report on key indicators more frequently, and to interpret what change in those indicators tells us about how resilience is changing in a community. The project was a pilot, used to explore the concept of more dynamic monitoring of resilience, develop initial approaches to doing so, and identify the future work needed to expand this approach to resilience monitoring.

The project was conducted in 2022 and 2023 and implemented via a collaborative partnership between the University of Canberra, the Southern NSW Innovation Hub and the following project partners: Australian National University, Charles Sturt University and the University of Wollongong. The project involved collaboration with other Hub partners and stakeholders at key stages, as well as partnership with SGS Economics and Planning to develop the pilot dashboard forming the final stage of the project.

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This report is the final output of a series generated as part of this project. Other reports and products produced for this project, which should be referred to together with this report, are:

- *Sharing Early Insights for More Resilient Communities: Stage 1 report* (Brown et al, 2023)
- *Early insights for more resilient communities:* rapid survey tool and data guide (Appendix D)
- Pilot *Early Insights* dashboard (a link to the pilot dashboard can be provided on request)
- Final report from University of Wollongong project partners on social media indicators (available on request)
- Final report from Charles Sturt University project partners (available on request)
- Final report from Australian National University project partners on environmental resilience indicators (available on request)
- *Early Insights for More Resilient Communities:* Technical guide Version 1.0 (available on *Early Insights* dashboard)
- *Early Insights for More Resilience Communities:* symposium presentation (Appendix E)

This report summarises key findings and learnings from the project, with a focus on key lessons for translating existing academic and theoretical understandings of resilience into practical approaches for measuring and monitoring resilience. These practical approaches are intended to support those working on the ground in local communities, enabling them to better understand levels of resilience, and how these levels are changing, in their community. This can in turn help inform practical decision making about where support and investment is needed to support different aspects of resilience.

The next section summaries key stages of the project, and key learnings from different stages. This is followed by a more detailed description of key findings of different stages, focusing on findings about the types of indicators to be measured, availability of data for these different indicators and development of a survey tool to measure new indicators, and development of the pilot *Early Insights* dashboard. Following this, recommendations are made for the future development of the pilot tools developed in this project.

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PROJECT STAGES AND OUTCOMES - SUMMARY

The *Early Insights for More Resilient Communities* was a complex project involving several stages. This section summarises the different elements of work undertaken in the project, and the key learnings and outcomes achieved from each element. These learnings were brought together to inform ultimate development of the Early insights dashboard.

The project had two primary stages, each involving a set of inter-related elements (Figure 1). The first stage of the project involved evaluating available evidence to identify indicators with potential to provide early insight into how resilience is changing. Stage 2 then involved five key elements: (i) development of indicators to be included in the pilot dashboard, (ii) identification of meaningful thresholds for levels of and change for indicators included in the pilot dashboard; (iii) development of a pilot *Early Insights* dashboard to monitor resilience levels and change in a case-study region; (iv) development of a survey tool to collect data for those indicators for which little or no data are available; and (v) identification of future priorities to further develop the work piloted in this project.
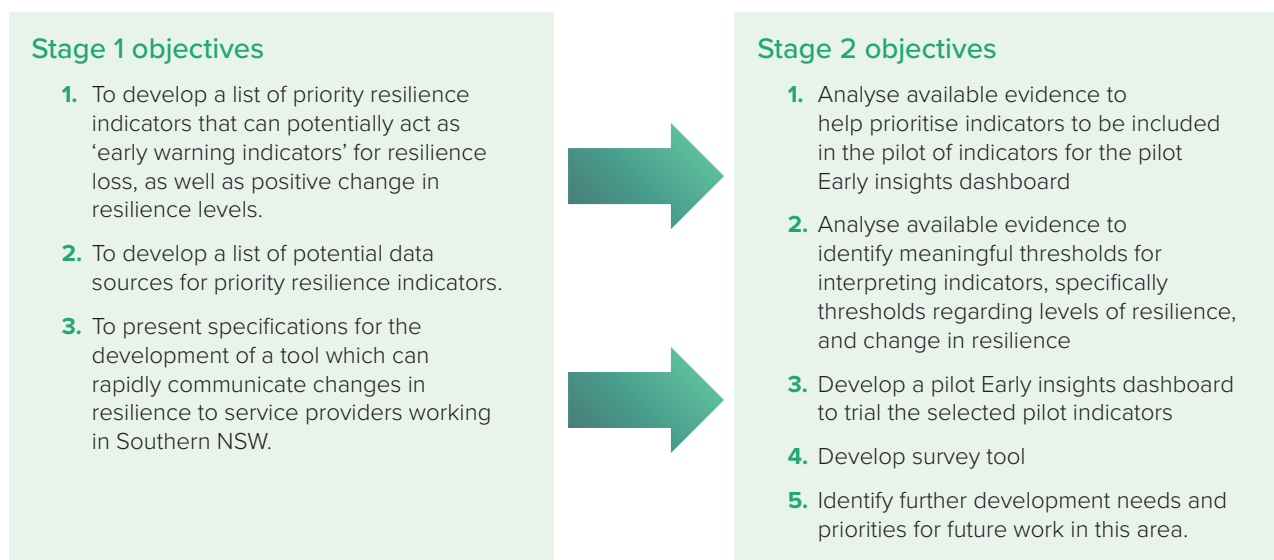
Stage 1 objectives

1. To develop a list of priority resilience indicators that can potentially act as 'early warning indicators' for resilience loss, as well as positive change in resilience levels.

2. To develop a list of potential data sources for priority resilience indicators.

3. To present specifications for the development of a tool which can rapidly communicate changes in resilience to service providers working in Southern NSW.

Stage 2 objectives

1. Analyse available evidence to help prioritise indicators to be included in the pilot of indicators for the pilot Early insights dashboard

2. Analyse available evidence to identify meaningful thresholds for interpreting indicators, specifically thresholds regarding levels of resilience, and change in resilience

3. Develop a pilot Early insights dashboard to trial the selected pilot indicators

4. Develop survey tool

5. Identify further development needs and priorities for future work in this area.

Figure 1: Objectives of the Early Insights for More Resilient Communities project

In each stage of the project, key lessons were identified for resilience monitoring in communities impacted by natural hazard events. These lessons are summarised in Table 1. The next sections of the report provide further detail about the activities undertaken in each stage, and key findings and outputs.

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Table 1 Key lessons and outputs, by project stage and work element

PROJECT STAGE	WORK ELEMENT	OBJECTIVE	PROJECT OUTPUTS[1]	KEY LESSONS LEARNED
1	Review of resilience indicators & measurement	Identify (i) potential indicators of resilience change, and (ii) critically review level of evidence for each indicator	Report 1	**1.** Several hundred resilience indicators exist, many with high similarity to each other **2.** Few resilience indicators are designed to measure change over shorter periods of time or are sensitive to small changes in resilience **3.** Many indicators are not supported by empirical evidence showing they have a clear relationship to short or long-term resilience outcomes **4.** Very few indicators have clear criteria for thresholds that indicate whether resilience is high or low, or whether there has been a meaningful change in resilience levels over a period of time.
1	Stakeholder workshops	Identify further measures of resilience change beyond those in literature; critically assess usefulness of indicators identified from literature; identify reporting needs	Report 1	**5.** Stakeholders working in the area of supporting communities impacted by natural hazards have a need for better information on resilience of the communities they work in, and how that resilience is changing **6.** Stakeholders often intuitively understand resilience but have difficulty relating this understanding to formal indicators: there is a need for clear interpretation that helps stakeholders understand what change in a given indicator means in terms of resilience **7.** Stakeholder need information on both the level of resilience and the rate of change in resilience, for any given indicator of resilience.
1 and 2	Data scan	Identify availability of data for resilience indicators, focusing on availability of time series data for small areas (started in Stage 1 & continuing into Stage 2)	Report 1 & Appendix A	**9.** For a majority of indicators, some data is available: however, typically data is measured at too large a scale to be useful to local communities, or is not measured frequently enough to provide early insights into resilience change **10.** Reflecting the lack of data availability, existing resilience indicator dashboards in Australia typically include indicators only able to be updated infrequently, and/or do not produce data for small areas; they provide useful insight into long-term resilience, but not into shorter term change **11.** Much of the data available is not currently framed as measuring aspects of resilience, so is typically reported in other contexts but without an understanding of its implications for resilience.

[1]*The resilience domains reported here differ slightly from those reported in the Stage 1 report as a decision was made to group similar domains together.*

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PROJECT STAGE	WORK ELEMENT	OBJECTIVE	PROJECT OUTPUTS[1]	KEY LESSONS LEARNED
2	Indicator prioritisation	In-depth assessment of specific indicators to identify which have the ability to provide early insights into resilience change	This report (including sub reports by project partners)	**12.** Despite the lack of overall data availability, data are available for some indicators at both small scales and over time: a subset of indicators for which data were available were selected for further investigation **13.** More in-depth investigation was undertaken of this subset of indicators, to identify which were most likely to provide early insight into resilience change. The type of investigation depended on what was feasible: for indicators where time series data were available in a larger data set, it was possible to identify which indicators were the most consistent predictors of long-term resilience outcomes. For others, in-depth investigation of current knowledge on best approaches to reporting specific metrics was examined.
2	Indicator specification	Identify specifications for each indicator including how the data are reported, and thresholds of resilience levels and change	This report (Appendix C).	**14.** Indicator specification is an area requiring considerable further development in the field of resilience monitoring, with little existing empirical work identifying (i) specific indicator metrics, or (ii) thresholds that are most appropriate for assessing resilience levels and change **14.** To address the lack of empirical data or previous investigation, for selected indicators historical data were investigated and used to identify recommended metrics and thresholds.
2	Survey tool	Design survey tool to collect data for indicators of resilience change not available elsewhere; test data collection for these indicators	This report (Appendix D).	**15.** A number of indicators identified as important by stakeholders in workshops had no available data, with no prior measurement. Others had little prior measurement. **16.** There is a need for survey tools that can be used to measure indicators for which no or little data are currently available. **17.** A survey tool was developed to measure these indicators, and data collected using the tool via the Regional Wellbeing Survey to test the new indicators being measured for the first time.
2	Early insights pilot dashboard	Develop dashboard enabling those working in communities impacted by natural hazards to identify (i) levels and (ii) change in key indicators of resilience over time	This report; dashboard; technical guide	**18.** The dashboard environment is a useful way for stakeholders to explore resilience across multiple indicators **19.** Dashboards need to include clear guidance on how to understand and interpret indicators **20.** While the dashboard is a useful data exploration environment, end users need the ability to export data for use in other environments, such as for their own reporting; offline access to data can be important for those living in areas with limited internet access

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PROJECT STAGE	WORK ELEMENT	OBJECTIVE	PROJECT OUTPUTS[1]	KEY LESSONS LEARNED
2	Stakeholder symposium	Discuss dashboard and findings for indicators with diverse group of end users; identify priorities for further development based on discussion	This report (Appendix E)	**21.** The symposium highlighted high demand for a data product that provides regularly updated, local data together with easy to understand interpretation of indicators and the insights they provide into resilience and how it is changing

22. A diversity of organisations from local to nation-wide, and both government and non-government, have interest in using the dashboard

23. There is strong interest in expanding the scope and coverage of the dashboard |
| 2 | Priorities for future work | Identify priorities for further development of the pilot tool developed in this project (including the indicators of resilience, their measurement, and their reporting in a data dashboard) | This report | **24.** Several priorities for further development were identified, including:

i) Expand geographic coverage

ii) Expand number of indicators included (through a range of actions including exploring and entering agreements to use new data sources)

iii) Invest in specific work to identify how to develop and incorporate indicators and reporting of indicators for First Nations communities

iv) Explore potential to compare resilience of different groups of people, in addition to resilience of different geographic areas

iv) Further build evidence base to assist in interpreting what change in different indicators means in terms of changing resilience levels. |

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STAGE 1 FINDINGS

A large and rapidly expanding body of work – both academic and non-academic – examines how to measure and monitor resilience. The first step in this project was to review this large body of work and identify what insights it provides into how best to monitor change in resilience, including defining and understanding resilience, and indicators of resilience. Findings for Stage 1 are reported in detail in Brown et al. (2023); this section provides a summary of the key findings.

DEFINING RESILIENCE

In Stage 1, an initial definition of resilience was developed, in which resilience was defined as "The capacity of individuals and communities to prepare for, respond to, recover from, and adapt to natural hazard events, with this capacity supporting a reduction in negative impacts and more rapid recovery from those negative impacts that do occur" (see Brown et al. 2023 for detail). Subsequent work, including discussion with those working to build resilience, suggested a need for an updated definition that focused on achieving positive outcomes rather than reducing negative impacts; and on responding to all types of challenges. This led to the followed revised definition of resilience:

> The capacity of individuals and communities to prepare for, respond to, recover from, and adapt to challenges including natural hazard events, in ways that support healthy levels of personal and community wellbeing over the long-term.

The revised definition enables a focus on resilience across all stages of the natural hazard cycle, but also recognises the intersection of challenges other than natural hazards and their impacts on resilience. The revised definition also provided a clearer strengths-based approach to resilience with a focus on supporting individual and community wellbeing. Although focusing on reducing the negative impacts is an important aspect of resilience, development of indicators highlighted a need to be able to measure the outcomes being sought when resilience is present – in this case, personal and community wellbeing. The project focused on indicators that measure changes in different aspects of the capacity and resources of individuals and community that are known to support resilience, with their usefulness shown in their strong association with positive outcomes for personal and community wellbeing amongst those experiencing natural hazards and other challenges. The definition also shifts towards our focus on how resilience indicators can be used to track changes to inform our understanding of long-term resilience, rather than more short-term focus on recovery and management of impacts of natural hazard events.

A definition of resilience loss was also developed in Stage 1, and was not subsequently altered:

> The loss of capacity and resources that individuals and communities can draw on in preparing, responding, recovering, and adapting to natural hazard events.

This definition focuses on understanding how capacity of people and communities is changing, based on their level of access to a wide range of resources known to be important to enabling natural hazard preparation, response and recovery. This is particularly important in the context of cumulative natural hazard events where communities are likely to be simultaneously preparing for future events while recovering from past challenges. Moreover, it recognises that resilience can be change at any time due to the decline in resources as a result of challenges other than those specifically related to natural hazard events.

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REVIEW OF RESILIENCE INDICATORS & MEASUREMENT

A rapid review of the literature identified over 500 indicators that examined some aspect of resilience or resilience change and were assessed as having potential to provide early insight into how resilience is changing in a community. It also, however, identified that despite the many indicators proposed to measure resilience, there are many gaps in both knowledge and data. In particular:

- Many indicators lack empirical evidence as to whether they successfully predict resilience outcomes
- Many indicators have not been tracked over time to identify whether they are sufficiently sensitive to show changes in resilience when they occur
- For many indicators, there is a lack of agreed standards regarding the specific measure that should be used for the indicator
- There is almost no agreement regarding what thresholds should be considered to indicate low, moderate or high levels of resilience for each indicator; similarly, there is little consideration of what magnitude of change should be considered to represent a meaningful change in levels of resilience over a given period of time.
- Many indicators in the literature were not well suited to tracking changes in resilience across individual and community levels as they often conflate some unchangeable sociodemographic characteristics with low resilience.
- Some resilience measures were focused on one stage of the of the natural hazard cycle such as preparation or immediate recovery, and were not designed for people experiencing multiple parts of the cycle simultaneously.

The review did identify strong consensus around the types of indicators that are important to include when understanding resilience. Specifically, global work on resilience increasingly agrees that it is important to include indicators that measure the following aspects of resilience[2]:

- **Financial/economic resources** – Monetary and non-monetary resources that enable individual, households and communities to maintain or improve their standard of living. These range from resources at the community scale (strength of the economy, job availability, cost of living), to those at the household and individual scale (e.g. insurance coverage, access to savings, debt levels, stability and level of income, and household costs).
- **Human resources (health, wellbeing, psychological, skills and education)** – The resources that are individual to a person, including their health and wellbeing, and their skills and personal capacity to cope with challenges.
- **Social resources** (also referred to as social capital) – The resources provided by a person or community's social networks, including availability of volunteers to support others in the community; sharing of knowledge and resources between groups of people; and ability of a person to access emotional, financial and practical support from friends and family when needed. These resources also include the ability of people to get along well together in communities (community cohesion), which supports sharing of resources, skills and knowledge.
- **Access to infrastructure and services** – A wide range of types of infrastructure and services help people and communities prepare for, respond to and recover from natural hazards and other challenges. These range from physical infrastructure such as roads and telecommunications network infrastructure, to availability and accessibility of health and social services.
- **Institutional resources** – The presence of effective, transparent, and accountable governance and a diverse range of functioning organisations (government and non-government) is important to the functioning and resilience of communities and the wellbeing of the people in them.
- **Ecosystem services** – These resources affect the quality of a range of resources available to people living in a community, including availability of clean water, food, good air quality, shade and vegetation cover and biodiversity, amongst others.
- **Liveability of community** – The overall liveability of a community, including its amenity, safety, and other aspects of the physical, economic and social environment, is a resilience resource that supports quality of life of those living in that community.
- **Natural hazard resources** – These resources are those that specifically help individuals, households and communities to prepare for, respond to and recover from natural hazards. They can range from specific types of preparation such as having an emergency kit or making changes to homes to reduce risk of damage in an event such as a storm, to long-term changes to vegetation and groundcover management to increase water holding capacity of soil, to give just three examples. These resources also include the specific skills and capacity of people in the community to prepare, respond and recover.

In addition to having access to a range of resilience resources, the resilience of a person, household or community will vary depending on how much demand there has been on those resilience resources. This can be examined through indicators that identify the level of **exposure to natural hazards** over time.

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[2]The resilience domains reported here differ slightly from those reported in the Stage 1 report as a decision was made to group similar domains together.

STAKEHOLDER WORKSHOPS

Following the rapid review, nine workshops were held over two weeks in March 2023 with 40 stakeholders who work in and with NSW communities, particularly communities across the Southern NSW Innovation Hub project region. Participants were asked to identify signs of changing resilience they had observed in their work, and review those identified in the rapid review. This enabled identification of indicators of resilience change not considered in the current literature, and helped prioritise the likely usefulness of indicators identified in the rapid review based on the views of stakeholders working to support resilience in NSW communities.

Feedback from stakeholder workshops helped to identify multiple resilience indicators that were not available through existing data sources but were considered to be important indicators of resilience change for those working and living in disaster impacted communities. In particular, resilience indicators related to aspects of community liveability, social resources such as community cohesion, and psychological resources including mental health were commonly identified by workshop participants.

The stakeholder workshop discussions were also an opportunity to identify the ways those working on the ground in communities impacted by natural hazards think about resilience in their day to day work. This in turned helped inform how resilience was defined and discussed in the project going forward, and shaped initial scoping of the design of the *Early Insights* dashboard.

A key issue raised by participants was the need to reconsider the concept of measuring change in resilience. The project to this point had focused attention on identifying indicators of what were term *early warning signals* of resilience loss. Participants identified that it was important to ensure change in resilience was measured in the context of also understanding the overall level of resilience. This was particularly important as a loss of resilience in a community that previously had very high levels of resilience is unlikely to be as high a priority for intervention and investment of resources compared to a community that is experiencing resilience loss from an already low base. It may be more important to invest resources to continue supporting a community that is growing resilience from a very low base, compared to investing them in a community in which resilience has declined slightly but remains relatively high overall. Based on these insights, from this point on the project focused on defining indicators for which both overall resilience levels, and change in those levels, could be identified. These insights also informed the design and function of the *Early Insights* dashboard, which was designed to ensure users could easily access information on both the overall level of resilience, and change in resilience.

Overall, key insights gained from the stakeholder workshops included the following:

- The types of indicators identified as important by those who work to support resilience in communities often differ to those proposed in the academic literature – and many have rarely been measured and reported in existing resilience dashboards
- Some resilience indicators commonly used in the literature were rarely considered important signs of resilience change by those working on the ground
- Workshop participants identified a number of novel ideas for resilience indicators that are not typically considered to be resilience measures in the current literature, for example participation in preventative health programs such as Breastscreen
- It is important to include indicators that measure change in resources irrespective of whether those changes are caused by a natural hazard event
- It is critical to ensure that indicators provide insight into not only change in resilience, but also the overall level of resilience that is present, to ensure that the impacts of experiencing long-term low levels of resilience in particular is recognised.

These insights guided subsequent prioritisation of a shorter list of indicators considered likely to have potential as indicators of change in resilience over time (described further below).

RECOMMENDED INDICATOR LIST & INITIAL DATA SCAN

The final part of Stage 1 involved identifying a 'short list' of resilience indicators that would be further investigated in the second stage of the project. This short list of 146 indicators (see Brown et al. 2023 for the full list) was identified based on the findings of the rapid review and stakeholder workshops. It includes all indicators identified as (i) being relevant to those working in communities impacted by natural hazard events, and (ii) having good potential to be used to measure change in resilience levels over time. Indicators were selected irrespective of whether data was currently available, or needed to be collected via new data collection, with these aspects explored in the second stage of the project.

For the 146 indicators, an initial data scan was conducted to identify whether any data were available for the indicator. The availability and quality of data from existing data sources was then further assessed in Stage 2 of the project.

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STAGE 2 FINDINGS

Stage 2 focused on implementing measurement, monitoring and reporting of a pilot set of indicators. This included:

- Developing a pilot set of indicators for inclusion in the pilot *Early Insights* dashboard, based on (i) assessing availability of data, (ii) assessing which indicators were the strongest predictors of key resilience outcomes, and (iii) identifying appropriate measures and interpretation
- Developing the pilot *Early Insights* dashboard, using the pilot set of indicators
- Developing a survey tool for collecting data for those indicators for which little or no existing data are collected
- Testing the survey tool, with the survey used to collect data for these indicators as part of the Regional Wellbeing Survey.

This activity resulted in production of a suite of tools to support measurement of resilience that can be used to provide early insights into change in resilience when it occurs. Three key tools were developed:

- Technical guide to indicators
- Survey
- Pilot *Early Insights* dashboard.

SELECTION & DEVELOPMENT OF PILOT INDICATORS

A total of 146 indicators were identified as having potential to show change in resilience over relatively short periods of time in Stage 1 of the project. In Stage 2, a subset of these was selected to be included in a pilot dashboard. The objective was to select indicators for the dashboard that (a) could be realistically sourced and processed during the lifetime of the project, and (b) were known to be good measures of resilience change. These were selected based on two steps:

- Data scan: This was used to identify whether time series data were available at suitable scales for the indicators. Indicators for which data were not readily available, or not available at all, were not included in the pilot dashboard but flagged for either collection via the survey tool developed in Stage 2, or for development beyond this pilot project.
- Indicator prioritisation: Where feasible, data mining techniques were used to investigate which of the relatively large number of indicators identified as having potential to measure resilience change were the best predictors of key resilience outcomes.

Once selected, indicators were then developed further (discussed in the next section).

DATA SCAN

The data scan assessed current availability and quality of suitable data for each potential indicator, as well as examining whether indicators are already used in existing resilience or other dashboards.

To be included in the pilot dashboard, data sources needed to fulfil the majority of the following criteria (developed based on Wand & Wang, 1996; World Health Organization, 2017):

i. *Availability.* Data able to be accessed within the time-frame required for the project

ii. *Geography.* Data available at local government area (LGA) level, or at a larger scale that has relevance to the LGA scale.

iii. *Completeness.* Data was collected across all of NSW.

iv. *Frequency.* Data was collected at least annually.

v. *Recency.* Data from 2021 (or later) is available.

vi. *Time series.* Data are available for more than one time period, and ideally for five or more years. If data are not yet available for more than one time period, intention to continue data collection into the future was accepted as evidence for meeting this criterion.

Results from the data scan are summarised in Appendix A by the source of data. Some data sources measured multiple indicators identified as having potential to measure change in resilience: for example, the Regional Wellbeing Survey has historically measured more than 20 of the indicators identified as having potential utility. A total of nine data sources, which could be used to measure up to 44 individual indicators, were identified as meeting all the criteria for inclusion in the pilot of indicators.

In addition to identifying a subset of indicators that had sufficient data available to be considered for inclusion in the pilot *Early Insights* dashboard, the data scan identified that:

- Current data is available for the majority of indicators, however for most the data available is not suitable for use as an early insights indicator as the data is measured at too large a scale or too infrequently to provide early insights for local communities.

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- While some indicators are used in existing resilience indicator dashboards in Australia, they typically have the challenges noted above, with data able to be updated only relatively infrequently: this means they provide useful insight into long-term resilience across large regions, but are more limited in their ability to provide insight into shorter term or local-scale change.
- Increased data availability is needed for many indicators if they are to be used as measures of change in resilience over the shorter term, with a need for both more frequently collected data, and increased scope of data collection.
- Where data are available, it is common that the indicators in question is not typically described or understood as providing insight into resilience: This means that existing reporting of many indicators is difficult to use as the indicator has not been specifically measured in ways that focus on its implications for resilience.

INDICATOR PRIORITISATION

Indicator prioritisation was the second step undertaken to determine which potential indicators would be included in the *Early Insights* dashboard. This step focused on assessing the strength of evidence supporting the use of the indicator as a measure of resilience change. This process involved an in-depth assessment of each proposed indicator, drawing on current evidence in the literature, documentation of data collected by data custodians, and where possible bespoke analysis by the project team to identify the strength of the association between the indicator and resilience outcomes such as personal and community wellbeing. The indicators prioritised as a result of this process are summarised in Appendix B. The Technical guide produced for this report provides detailed information for each of the prioritised indicators.

As part of prioritising indicators, three specific investigations were undertaken into potential for specific types of indicators to be used to provide early insights into resilience change. These investigations focused on three specific types of indicators, each of which required specific investigation to progress development of *Early Insights* indicators (including both those ultimately included in the pilot dashboard, and those requiring further development beyond this pilot project):

- Indicators based on data from social media platforms
- Indicators of natural hazards and ecosystem services provision
- Indicators measured as part of the Regional Wellbeing Survey.

These three areas of specific investigation were identified as high priorities for developing potential *Early Insights* indicators, based on findings of the first stage of the project. Key findings from each are summarised below.

INVESTIGATION OF POTENTIAL TO USE SOCIAL MEDIA AS A DATA SOURCE FOR INDICATORS

Social media posts have significant potential to provide insight into how resilience is changing in a community, and to produce data that can be updated on a regular basis. However, it can be challenging to measure reliable indicators based on social media data analysis, with rapidly changing levels of use of different social media platforms over time.

In Stage 1, it was identified that several indicators had potential to be measured using data from social media, with 10 indicators identified as having high potential (measuring aspects of financial resources, social resources, liveability, skills/capacity and infrastructure/services). However, no existing social media-based measures of these indicators had previously been developed. Given this, in Stage 2 an investigation was undertaken into the feasibility of developing and implementing measures of these indicators that use data from social media. This review focused on the feasibility of using social media data to continuously monitor changes in resilience over time and capture early signals of changes in resilience levels, and was undertaken by researchers from the University of Wollongong.

Key findings from this investigation were that:

- At this point in time, social media indicators should not be included in the *Early Insights* dashboard due to both recent changes in key platforms, and a need for further work to enable development of reliable indicators
- The significant changes occurring at X (previously Twitter) in 2023 were a key reason for this recommendation: with the majority of existing work exploring social media data and resilience being based on Twitter data, and the changes to the platform appearing to result in significantly reduced likelihood of future affordable access to data from the platform, ability to develop the indicators with the greatest evidence base was poor
- There is a need to investigate levels of use of different social media platforms in rural communities, and to identify methods for managing differences in use levels when producing indicator data
- Developing robust indicators of resilience based on social media requires additional investment to enable development of larger test-sets of potential indicators, and validation of these indicators using data such as measurement of the same concepts via surveys conducted in the same communities.

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INVESTIGATION OF NATURAL HAZARD & ECOSYSTEM SERVICES INDICATORS

In Stage 1, it was identified that there was a need to explore further which types of (i) ecosystem services and (ii) natural hazard exposure indicators are most relevant for the Australian context. International literature included many suggestions for indicators in these areas, many of which were not highly relevant to Australia, or had different definitions. In particular, identifying thresholds appropriate for the Australian context was important.

Research partners at the Australian National University investigated multiple potential indicators of ecosystem services and natural hazard exposure, to identify recommended indicators. Where possible, datasets were generated for indicators. This investigation led to the recommendation of a set of pilot indicators, which are included in the technical guide available on the *Early Insights* dashboard.

Other key findings included:

- Indicators should not be based on data that relies on government disaster declarations, with high inconsistency in criteria used for disaster declaration over time and between jurisdictions
- While soil health is an important indicator of resilience, the complexity of measuring soil health, and significant debate about the best indicators of soil health, mean this is not recommended to be used as an indicator of ecosystem service provision
- For many of the indicators proposed, there is limited availability of data: these indicators were documented and it may be possible to populate these with data in future depending on changes in levels of investment in monitoring, and in making monitoring data available in a timely manner.

REGIONAL WELLBEING SURVEY (RWS) DATA

A unique opportunity existed to prioritise resilience indicators, in the form of the longitudinal Regional Wellbeing Survey (RWS) dataset. In Stage 1, it was identified that data measured in the RWS dataset over the last decade had potential to be used to monitor more than 30 of the proposed indicators (and potentially more). The large dataset available included both these potential indicators, and measures of resilience outcomes – meaning the things that are typically present if resilient is high. Specifically, if resilience is maintained, this is usually seen in the presence of ongoing healthy levels of personal and community wellbeing, both concepts measured in the RWS. The availability of this large dataset meant there was potential to prioritise indicators by analysing which indicators were the strongest predictors of resilience outcomes.

In Stage 2 of the project, advanced artificial intelligence (AI) techniques were used by researchers at Charles Sturt University (CSU) to help identify which indicators from the RWS were more important to resilience outcomes. Key findings are documented in the Technical guide, which documents how the findings of the AI analysis were used to guide selection of specific indicators. In addition to its use to prioritise which indicators from the RWS would be included in the pilot dashboard, other key findings from this analysis were that:

- Initial exploratory analysis of RWS data suggests that the use of AI methods to measure and predict changes in resilience has high potential, and further exploration of these methods are warranted.
- Most indicators were strong predictors of resilience overall, irrespective of the type of natural hazard a person was exposed to, the geographic region they lived in, or whether they were employed in farming or other occupations, with these factors making relatively little difference to overall strength of the association between an indicator and resilience outcomes
- This suggests that indicators of resilience can be developed that are relevant across all of Australia, different types of natural hazard, and different life circumstances.

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DEVELOPMENT OF PILOT INDICATORS

After selecting pilot indicators to include in the *Early Insights* dashboard, it was necessary to fully develop each indicator. This involved specifying the indicator (identifying what specific form it should take and what measure would be reported), and identifying the thresholds considered to represent low versus healthy levels of resilience, and to represent a meaningful change in those levels.

Developing the pilot indicators was a resource-intensive process, as for most indicators there was no agreed approach in the literature to the way the indicator should be measured based on available data, the way that measure should be presented as an indicator of resilience, or the thresholds that should be used to interpret whether resilience is high or low, or has changed significantly over time.

To begin to fill these gaps, practical measures were first developed for each indicator based on what was possible with available data collections. Where specific approaches to measuring indicators and associated thresholds for interpreting what levels represented high and low resilience had already been developed and were available from past studies, these existing thresholds were used.

Where this information was not available from past work, a qualitative assessment was conducted to identify and recommend specifications for the indicator, with a particular focus on recommendations for thresholds to be used. This process involved analysing available data sets for the indicator, and assessing:

• Variation in scores across time and regions: some indicators have relatively little variation and others change considerably over time, and between regions. This information was used to identify the range within which an indicator can be expected to vary under typical circumstances, to identify 'average' levels of the indicator (considered to indicate moderate resilience unless alternative information suggested otherwise), and to identify the thresholds indicating a significant departure from this average level.

• Associations between levels of the indicator and other indicators of resilience for the same region. For example, if one local government area was known to have low scores for several other indicators of resilience that measure similar concepts to the one being examined, and another to have high scores for these other indicators, this was used to identify if there was a similar variation in levels of the indicator for which thresholds were being set.

Appendix C summarises the thresholds and other specifications identified; the Technical Guide (current version available on *Early Insights* dashboard) provides more detail for each individual indicator.

The initial set of specifications for each indicator, presented in Appendix C and in the Technical Guide, should be considered a starting point, with further development recommended in future.

SURVEY TOOL

The data scan process identified that, for a relatively large number of the indicators identified in Stage 1, no existing data were available. Either the indicator had not been measured in NSW, or if it had, data were not measured regularly and/or were only measured at large scales not suitable for this project. In addition, some indicators relied on data from existing surveys that do not always produce data at the scale of the local government area.

A survey tool was developed to provide a way of measuring key resilience indicators not readily able to be measured using existing publicly available information. This survey tool was tested via measurement of the indicators as part of the Regional Wellbeing Survey (RWS). This occurred in two stages: an initial set of indicators was measured in the RWS in May to June 2023. After this point, ongoing assessment of data availability identified that further indicators needed to be measured via survey, as existing data sets were not fit for purpose for use in the dashboard. The survey tool was updated and expanded to include these additional indicators, and data were collected in a second RWS conducted in December 2023. The final survey tool is provided in Appendix D. The methods used to collect data in the RWS are described in detail in the RWS User Guide (Schirmer et al. 2024).

A subset of the indicators included in the survey tool were included in the pilot dashboard, focusing on those for which there was a longer history of data collection in the RWS prior to this project. This enabled testing ability to observe change in resilience levels over time. The remaining indicators collected via the survey tool are being made publicly available in the short-term via public data tables published for each wave of the RWS; this ensures these data are available for use in future development of this tool, ideally as a time series showing change over time after collecting indicators in further waves of the survey. Findings for these indicators are also included as part of the stakeholder symposium slides, provided in Appendix E.

DEVELOPMENT OF THE PILOT *EARLY INSIGHTS* DASHBOARD

The final activity in the project was development of the *Early Insights* dashboard. This was designed to demonstrate the concepts of enabling stakeholders to explore change in resilience over shorter periods of time via an online data dashboard. As the aim was to develop a proof of concept, the dashboard included a pilot set of indicators that represent a subset of those identified as having potential utility for providing early insights into resilience change in earlier stages of the project. SGS Economics and Planning worked in collaboration with the project team to develop the dashboard using this pilot set of indicators.

The pilot dashboard enables users to explore how resilience has changed over time in different local government areas using the pilot set of indicators. Users are able to explore the data in different ways, depending on their needs, with a focus on enabling understanding of:

- How resilience is changing over time for each indicator in the local region the user is most interested in
- Comparing resilience levels, and change, to other comparison regions, including nearby local government areas and averages for larger regions
- Comparing resilience levels and/or resilience change across several local regions.

Many users will be familiar with some of the indicators included in the dashboard from other contexts in which the same or similar indicators are used. However, in many cases the user will not be aware that the indicator in question provides useful insights into the resilience of their community and how it is changing. The unique contribution of the *Early Insights* dashboard is to help users understand what these indicators can tell them about the changing nature of resilience in different communities. Other indicators report data that users have not had opportunity to engage with previously: in these cases, the dashboard provides an easy to understand introduction to the indicator and how the user should interpret it.

The dashboard was developed using the following steps:

- Indicator data and the technical guide for interpreting indicators was provided to the dashboard development team
- The dashboard development team developed initial concepts for the dashboard and workshopped these with the project team
- User needs workshops were held with intended end users of the dashboard, who included people working in the following areas of natural hazard resilience and community development:
  - Staff of non-governmental organisations that work to support communities to recover from disasters and prepare for future disasters; these included people from charities with a national focus to those from locally established and focused charities
  - Local government authority staff working to support disaster preparation, response and/or recovery in their local area

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- State government agencies with a role in disaster recovery- Community development and social service organisations whose work includes supporting people affected by disasters, as well as more broadly supporting those experiencing challenging times in their lives
- Development of the full pilot dashboard
  - Testing of the pilot dashboard by end users in workshops and via feedback from a set of end users who were provided access to the dashboard and asked to explore the dashboard and provide feedback on it.

While some end user testing of the pilot dashboard was undertaken further end user testing should be conducted beyond that included in this project, to enable further development of aspects of the dashboard such as clarity of explanations of how to interpret different indicators.

The process of dashboard development highlighted that the key need for many end users is to have easy to understand information that enables them to easily access and understand what may otherwise present of technical data whose meaning is hard to understand or interpret. Central to doing this is having a clear and readily understandable interpretation of what each indicator means when used as an indicator of resilience. The final pilot dashboard provides easy to understand explanations of each indicator as it is presented, including how to interpret change in the indicator, and what levels are considered to represent low versus healthy levels of resilience.

The provision of easy to understand explanations, together with visualisation of change over time in each indicator, enables users of the dashboard to rapidly identify and understand how different aspects of resilience are changing in the communities they work in and with. Users do not need to have prior knowledge of resilience to use the dashboard.

The dashboard development process also identified a number of other lessons for development of this type of tool for people who work in rural and regional communities, and in the areas of natural hazard preparation, response and recovery. The key lessons identified were that it is important to:

- Enable offline as well as online access to data: Many organisations may be working in regions in which they cannot always operate in a fully online environment. Being able to export data and visualisations from the dashboard can assist those working in a rural area or an area where a natural hazard has negatively impacted quality or reliability of internet access.
- Enable users to download data in simple forms they can then use elsewhere: Most end users intended not only to explore data within the dashboard, but to use the data in the dashboard for purposes such as reporting on progress, developing proposals, or local tools tracking change in the community. All of these ideally required the ability to export the data shown in the dashboard into easy to use spreadsheets or other reports that can be readily used for these other purposes.
- Provide contextual data quality information specific to each local area: With very different population sizes in different regional and rural areas, sometimes the data for an indicator may vary in reliability depending on which local government area is being examined. Having some information about the quality of an indicator for each LGA was requested by some users to help them assess how best to use the data for the local region they were examining.
- Enable easy comparison of each local region to averages for the state as a whole, to better understand whether an area with low resilience for a particular indicator was experiencing unique conditions, or was instead part of a larger region across all of which there had been a decline in resilience. This was evidence for indicators such as those related to cost of living, where many regions experienced a loss of resilience due to larger economy-wide changes that reduced affordability of living costs across most of NSW in recent years. When this occurs, it is important both to know that resilience has declined in a specific local area, but also to understand that this was a common experience being driven by larger-scale factors.
- Have information on both level of an indicator, and change in that indicator, over time. Each of these types of information were considered useful by dashboard end users, and as likely to be used.
- The presentation of resilience indicators themed by the type of 'resilience resource' involved was generally considered useful by participants, and as a helpful way of reducing the complexity of understanding how resilience is changing.

The dashboard testing process also identified multiple areas for potential further development beyond the pilot dashboard. These are discussed in the 'priorities for future work' section of this report.

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On January 22nd 2024, a final symposium was held to showcase the pilot tools developed for this project. The *Early Insights* dashboard was the principal tool showcased, together with findings from the survey tool, and more broadly the insights developed from the different indicators of resilience selected as providing insight into how resilience is changing. See Appendix E for the material presented at the symposium.

The symposium explained the concepts underlying the dashboard, followed by presenting examples of indicators of different types of resilience resources, and the functionality of the pilot dashboard.

A total of just under 100 people attended the symposium, with participants including people involved in the following types of organisations and activities:

• Australian Government: emergency management, drought management, and community development
• State Government: emergency management, drought management, regional and community development
• Local governments: a range of staff from several NSW local governments attended with responsibilities ranging from specific roles in disaster recovery to broader roles in community development, local government administration and management
• Non-government organisations: A number of organisations involved in disaster and natural hazard preparation, response and recovery activities, including organisations with a focus on specific NSW regions and others conducting nationwide activities. Additionally, representatives of some NGOs not specifically focused on natural hazards attended; these typically had a focus on providing social services and community development work.
• Farming and natural resource management organisations.

Participants provided very positive feedback regarding the dashboard. No negative feedback was received, and multiple suggestions were made for areas of potential further development. Participants were keen to access and use the dashboard. Participant suggests for areas of further development are summarised in the next section of this report.

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PRIORITIES FOR FUTURE WORK

The *Early Insights* project was initiated with the aim of developing pilot tools that demonstrate the potential to monitor and report on resilience in a more dynamic way than currently occurs in Australia. The pilot tools developed – the *Early Insights* dashboard, technical guide to measuring and understanding different indicators of resilience change, and survey tool - are based on the idea that to best support communities experiencing natural hazards, it is critical to understand how their resilience is changing over time, as well as the level of resilience at a given point in time.

This project differed to others in its focus on resilience change. This was initially conceptualised as a focus on having the ability to identify 'early warning signals' of resilience loss. Stakeholder discussions through the project highlighted the need to shift this focus, to one of understanding both the *level* of resilience at a given point in time, and *change* in that level over time – ideally over relatively short periods of time. The tools developed are designed to support measurement of annual change. Many of the indicators included in the final dashboard, technical guide, and survey tool can be measured more frequently than once a year, if this is needed to provide a more rapid picture of change in a community known to be experiencing rapid change or particularly challenging times.

A key objective in the final stage of the project was to identify the scope of work required to develop the concept beyond the pilot demonstration developed in this project. The process of developing the pilot dashboard, recommended indicators, and survey tool, enabled identification of the areas of work whether investment is needed to fully develop the concepts demonstrated in the project. These areas are detailed below. In identifying these, priority has been given to the future development needs identified by the many people working in and with communities impacted by a range of natural hazards, who commented on these needs as part of Stage 1 project discussions, dashboard development consultations, and the stakeholder symposium. Additionally, some potential areas for further development identified by project partners are described; where these were not also flagged as a priority area by end users, this is clearly identified. Each of the following is described in detail subsequently in this section:

- *Early Insights* **dashboard expansion**
  - Indicators
  - Geographic coverage
  - Inclusion of communities of interest as well as geographic communities
- **Grow data availability**
  - Develop data access agreements to enable inclusion of further indicators
  - Collect survey data for indicators for which no/little data are available, to provide time series data
- **Grow ability to use *Early Insights* data to inform on-ground decision making**
  - Supporting communities to use the dashboard to inform their decision making
  - Working with end users to develop case studies showing how tool can be used
  - Developing dashboard, survey and technical guide into an integrated suite of resources end users can draw on and readily use
- **Grow understanding of resilience change in Australian communities**
  - Build more precise interpretation of indicators: More specific and nuanced thresholds indicating low, moderate and high levels of resilience, and what should be considered to indicate positive and negative change in resilience, are needed, with large gaps in knowledge in these areas
  - Critically test assumptions about resilience against emerging evidence – which indicators over time provide the best predictors of resilience change?
  - Grow functionality of the dashboard to enable more interactive engagement and analysis.

Each of these is described in the following sections. All are important areas that would further develop the work begun in this pilot project, to ensure Australian communities have the tools they need to monitor changing resilience over time, and to diagnose where support is needed to help support and grow resilience.

A. *Early Insights* dashboard expansion

The pilot dashboard developed in this project contains a subset of the indicators identified as having potential to provide early insights into resilience change in Australian communities. The dashboard has been explicitly designed to be expanded to include a larger number of indicators in future, as well as to have Australia-wide coverage. End users strongly supported this expansion, with a strong desire for a wider range of information that enabled them to evaluate different aspects of resilience change in their communities.

Key development activities identified are:

- **Project A1:** Expand dashboard to include all indicators for which data are currently available, and to expand geographic coverage to all of Australia for all indicators in the database. As part of this pilot project, availability of data was

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documented, and a set of additional indicators beyond those identified in the pilot dashboard identified as being able to be rapidly incorporated in the dashboard beyond the pilot stage. Beyond this, the pilot project also identified multiple opportunities to grow availability of data to enable further expansion of indicators (see B. Grow data availability for details).

- **Project A2:** Expand scope of dashboard to enable examination of communities of interest, in addition to the current focus on geographic communities. Multiple stakeholders consulted during the pilot project identified a strong preference to be able to investigate not only differences in the resilience of people living in different geographic locations, but to also be able to examine differences in the resilience of different groups living in these communities. This might for example include differences by gender, age group, cultural background, housing type, and occupation or the industry a person works in. Amongst the indicators already included in the dashboard, data are available for communities of interest for approximately half. However, it is not typically possible to examine data by both geographic community (local government area) and by community of interest – for example, limited sample sizes and privacy considerations usually mean data for a particular LGA cannot be further broken down to identify differences within that LGA between people of different ages and gender. However, it is likely to be possible to build the capability for larger regions that comprise multiple LGAs, for at least some indicators. Project A2 would seek to build this capability for a pilot set of 15 to 25 indicators, and modify the dashboard to enable exploration of communities of interest.

- **Project A3:** Develop appropriate processes to identify and include indicators for First Nations people. This project would work to identify resilience indicators of importance for different First Nations, data availability, and appropriate data governance for collecting, analysing and reporting indicators that followed Indigenous Data Sovereignty principles.

B. Grow data availability

A key constraint to reporting early insights on resilience change is lack of availability of data. A large number of the indicators of resilience identified as having potential to provide early insight do not have data available that enables these early insights to be produced. This lack of availability is typically the result of one of the following two issues:

- Data are collected, but not publicly available: Many indicators have potential to be monitored using data that are currently collected but not publicly available. These include things such as tax and social service records, or data collected by commercial companies. Developing and reporting these indicators requires two distinct areas of work:

  - **Project B1:** Access and generate data in the Australian Bureau of Statistics *Person Level Integrated Data Asset (PLIDA)* system. This would take an estimated 18-36 months of a full-time specialist in data access and analytics depending on the extent of data generated, together with in-kind input from data end users to review and test the data generated. It could be used to generate data for between 15 and 45 of the indicators proposed as potential early insights indicators for which data are not currently available. This estimate is large as it is not known how many of the datasets identified as having potential for this development would ultimately be able to be populated with data using the PLIDA system. This project has significant potential to generate a range of additional indicators that measure resilience on an annual basis. After initial development, ongoing annual work would be needed to continue generating updated data as new data become available within the PLIDA system.

  - **Project B2:** Develop processes for accessing data from private sector providers, for indicators for which data are not currently made available. Examples include data on road closures over time from Google Maps, or on active businesses from Google Search. In the pilot project, initial contact was made with some, but not all, potential private sector providers of data. In most cases, initial discussions indicated a need for an extended discussion and co-development of data access and reporting processes with the provider. Project 2 would involve further establishing potential to access data, scoping the processes required, and identifying the costs involved. This would result in a detailed proposal to access and report data for different indicators reliant on private sector generated data. Project 2 would not involve accessing the data in question, but would provide a detailed assessment of which indicators to pursue in future, and the costs involved in doing so.

- Data are not currently collected regularly, or at the small scales needed, to support generation of early insights:

  - **Project B3:** Collect two sets of annual data for additional indicators not currently measured, via the annual Regional Wellbeing Survey, to expand the current baseline data collected in the pilot project into an initial time series that is then included in the dashboard. This would enable analysis and identification of appropriate thresholds for interpreting indicators, and expansion of the dashboard to include these new indicators. This would require a two year project. Total costs would vary depending on the scope of data collected.

- Build further automation of data processing to enable rapid updating of indicators as new data become available.

  - **Project B4:** Work to develop automated processes for data processing and production in the dashboard when new data are available, for those indicators where the pilot dashboard has not already developed these backend processes. In some cases, this may involve developing an API or other data sharing agreements with the organisations that collects the data used for an indicator.

C. Grow ability to use *Early Insights* data to inform on-ground decision making

Project C1: Some of the dashboard end users consulted in the course of this project identified that it would be helpful to develop in-depth case studies showing how communities and organisations can use data in the dashboard to inform their work. A project in which project staff work with end users to support them to use the dashboard, to identify lessons for modifying and further developing the dashboard to improve ease of use, and to produce a set of case studies demonstrating how the tool can be used (in the form of things such as short online videos, brief reports, and other online resources linked to the tool), would speed adoption and use of the *Early Insights* tool.

D. Grow understanding of resilience change in Australian communities

Project D1: The final area of further work identified is the 'behind the scenes' technical work needed to improve the evidence base for interpreting resilience indicators. A key finding of the pilot project was that, despite a large body of work being produced on resilience indicators, very little of this work has confirmed that the indicators proposed do in fact predict resilience outcomes they are hypothesised to predict. Additionally, there is almost no work available to confirm what thresholds (levels) indicate that a person, household or community has healthy versus unhealth levels of resilience. While the work conducted in this project has begun to address some of these gaps, this initial work requires significant further development to ensure communities have access to indicators that they can interpret with confidence. This is particularly important to ensure that decisions about where and how to invest to support resilience can be made with confidence based on the information produced in resilience indexes. This area of work is one that is large, and could support an ongoing program of work over multiple years. However, even a small investment in this area to further develop thresholds for key indicators could make a significant difference in the shorter term.

Project D2: Invest in further development of indicators, to identify which indicators are the best for understanding resilience change. For example, additional work to develop indicators of availability of environmental services and natural hazard severity was identified as a priority.

Project D3: Invest in building capacity to use the data in the dashboard to support 'what if' scenario analysis by end-users that helps identify how resilience is likely to change if there is change in particular circumstances of the community, or in levels of resilience resources. This was identified as a priority by project team members and less so by end users.

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CONCLUSIONS

Resilience can change rapidly in communities experiencing multiple challenging events in a short period of time. With the frequency and intensity of natural hazards increasing in Australia, it is important to develop systems that allow regular monitoring of the resilience of communities. While recent years have seen development of many resilience indicators and indexes, these have typically measured resilience at a single point in time, with the data they rely on being updated only infrequently. As a result, information on resilience may not reflect rapidly changing conditions in many communities.

The *Early Insights for More Resilient Communities* project has proposed and demonstrated the potential to measure and monitor resilience of Australian communities in a more dynamic way, which can enable change in resilience to be tracked on a more regular basis. This type of monitoring can provide more timely information needed by the many organisations and individuals working to support resilience in communities impacted by natural hazards. These include government agencies seeking to understand the level of demand for services likely to occur in a community, to charities and NGOs wanting to understand how best to support healthy levels of resilience.

The project identified a large suite of resilience indicators that have potential to provide 'early insights'. This means their levels can be measured regularly, enabling not only identification of whether overall levels of resilience are healthy at a given point in time, but earlier identification that resilience is changing in a community than is possible with many existing indicators. For a subset of pilot indicators for which data were able to be sourced, a pilot *Early Insights* dashboard was developed to demonstrate how early insights can work. Where little or no data were available, a tool was developed to enable collection of data in local communities. A number of opportunities to further build capacity to provide rapid and regular insights into the resilience of local communities were also identified.

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