

The social, financial and economic costs of the  
2022 Victoria Rainfall and Flooding Event

August 2023

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# 1. Executive Summary

High Street, Seymour  
Source: North Central Review

# Key findings

The 2022 Victorian flood caused devastating financial and social impacts on the Local Governments of Murrindindi, Moira, Strathbogie and Mitchell. Deloitte Access Economics estimates that the flood caused \$432 million in damages and the effects of the flood will continue to be felt in the community for years to come.



The 2022 Victorian flood caused devastating economic impacts on the Local Governments of Murrindindi, Moira, Strathbogie and Mitchell.

Overall, the flood's tangible cost for the focus LGAs totalled \$432 million. This includes damages to public infrastructure, losses of agricultural produce, business disruptions, residential and commercial damages, and emergency response costs.



The economic impact of the floods outlasts the recession of waters. Infrastructure and capital will take years to be fixed or rebuilt. Tourists' perception of the LGAs will be the image of flood waters.

A long-term reduction in productivity, investment and tourism activity will occur if no actions are taken. The economic impact of these long-term effects on the focus LGAs will be \$612 million in NPV terms by 2030.



Agriculture and tourism – the economic strength of Murrindindi, Moira, Strathbogie and Mitchell – are also the sectors that suffer the most. The flood not only destroyed agricultural produces and prevented tourists from visiting the LGA but also damaged infrastructures required for agricultural and tourism activities, and decreased investor and tourist confidence in the LGA. Of the \$612 million cost to the economy, over a third is attributable to the agriculture and tourism sectors.



The economic impacts of the floods on the focus LGAs will ripple across the rest of Victoria. Economic activity in the focus LGAs is intertwined with activity across the rest of Victoria. Food manufacturing elsewhere in the state loses \$9 million between 2022 and 2030 because of the disruption to agriculture caused by the floods. The finance sector also loses \$34 million, because the flood lowers returns to the sector's investments in the LGAs. All up, floods in these four LGAs alone cost the rest of the state \$66 million between 2022 and 2030.



Beyond the economic impacts, the 2022 Victorian flood caused long-lasting social impacts on the local communities.

The event caused one fatality across the four LGAs and destroyed homes, workplaces and community facilities. Natural disasters like this flood have been linked with social issues such as increased alcohol consumption and mental health, chronic diseases and domestic family violence.

## 2. Background.

Flooding at Nagambie  
Source: Shepparton News



# This analysis

The 2022 Victorian floods (the event) had sustained impacts across the state, but effects were especially acute in the LGAs of **Mitchell, Moira, Murrindindi and Strathbogie**. The economic and demographic characteristics of these LGAs exacerbated their flood risk, and the damage will have lasting consequences on their growth trajectories. Despite this, the extent of these impacts has not been fully investigated. Deloitte Access Economics has been engaged to articulate their true nature, so that authorities investing in Victorian natural disaster resilience and recovery can make better decisions around resource allocations for these LGAs.

This report investigates the true costs of the flooding event through two different approaches. The first inputs data collected by the relevant local and state governments into Deloitte Access Economics' natural disaster costing model to assess the magnitude and type of costs associated with the event. Based on outputs from the D.Climate model, the report also investigates the extent to which these costs might affect the long-run economic growth trajectories of Mitchell, Moira, Murrindindi and Strathbogie.

**Uncovering the true costs of Victorian flood helps to build the economic case for flood resilience in affected areas.** By quantifying the tangible and intangible costs of the Victorian floods where possible, this report helps decision makers to understand the extent to which natural disasters like floods impact the affected areas. As well as the sheer magnitude of costs, a clear picture of the costs attributable to each LGA and cost category helps to identify areas of vulnerability.

**This information can inform better decision making around investment in flood resilience and recovery.** Accurate description of the scale of the costs of natural disasters is essential for ensuring that decision makers understand the importance of investing in flood resilience and recovery, and doing so in a timely manner. Knowledge of the types of costs and their geographic focus can ensure that allocations of resilience and recovery resources reflects the needs of affected areas. An incomplete understanding can undermine the effectiveness of natural disaster resilience and recovery investments. This ultimately contributes to the betterment of Victoria's natural disaster resilience and recovery policies and strategies by identifying measures needed to ensure that vulnerable communities can alleviate the impacts of future events.

**The importance of accurately depicting the costs of these events is amplified by the compounding damages attributable to climate change.** Understanding the true costs now helps to highlight the importance of immediate investment in resilience, so that as the climate warms and the intensity of extreme weather events increases, their impacts on populations are less severe. Acting on this understanding equips vulnerable LGAs with the capability to reduce the impacts of events that are practically out of their control. Doing so spurs regional growth, development and jobs.

## Report overview

- 1. Executive summary:** Provides an overview of the key findings.
- 2. Background:** Chronicles the 2022 Victorian floods and profiles the affected LGAs in the broader context of compounding natural disasters.
- 3. Social, Financial and Economic Costs:** Estimates the social, financial and economic costs of the event, broken down by damage category.
- 4. Long-term Impacts:** Uses CGE scenario modelling to describe the long-term impacts of the floods on the economic trajectories of the focus LGAs.
- 5. Technical Appendix:** Sets out the technical methodology, key assumptions, data sources and sensitivity analysis.

# Event details

Between October 6, 2022 and January 13, 2023, Victoria experienced heavy rainfall and major flooding. The most intense period was October 2022, which became the wettest Victorian October on record.<sup>1</sup>

The floods eventuated after strong rainfall in late winter and early spring saturated rivers and catchments in Victoria. This heightened flood risk in the areas around these water bodies, especially those in the low-lying Goulburn Valley.<sup>2</sup> Consequently, many of Victoria's river systems were incapable of absorbing strong October rainfall, and the exposed areas experienced widespread flooding. The flood's longevity is drawn out in Chart 1, which illustrates how the Goulburn River water level at Seymour exceeded the minor flood level for more than a month.

As Victoria has historically suffered from bushfires more than floods, the state's natural disaster resilience infrastructure reflects the state's traditional vulnerabilities. Resilience infrastructure consequently needs further strengthening as flood risk increases with climate change.<sup>3</sup>

Further, this history means that Victorians themselves are anecdotally more cognisant of bushfire risk than flood risk.<sup>4</sup> This may have exacerbated the impacts of the floods, and reinforces the importance of disaster resilience education.

**This report focuses on the LGAs of Mitchell, Moira, Murrindindi and Strathbogie.** However, these are just four of the 63 Victorian LGAs which were activated under the joint Commonwealth-State Disaster Recovery Funding Arrangements (DRFA).<sup>5</sup> These LGAs constituted a sample of the affected population, which spanned Victoria, New South Wales, South Australia and Tasmania. It is thus important to remember that the scope of the disaster extended well beyond the LGAs analysed in this report. The costs described in this report fill an information gap, but they do not purport to exhaustively catalogue the widespread impacts of the flood.

## Timeline of event<sup>6</sup>

### October 12, 2022

- BoM Victoria issues a state-wide flood warning

### October 13, 2022

- Victorian Government requests that citizens avoid unnecessary travel
- Seymour records 173mm of rainfall, eclipsing its October rainfall record in a day.

### October 14, 2022

- Victorian Government opens emergency relief payment applications for 31 LGAs.
- Goulburn River at Seymour peaks at 8.25m.

### October 15, 2022

- Deputy police commissioner predicts 'some of the largest evacuations we've ever seen'.
- The flood's first death is recorded in Rochester.

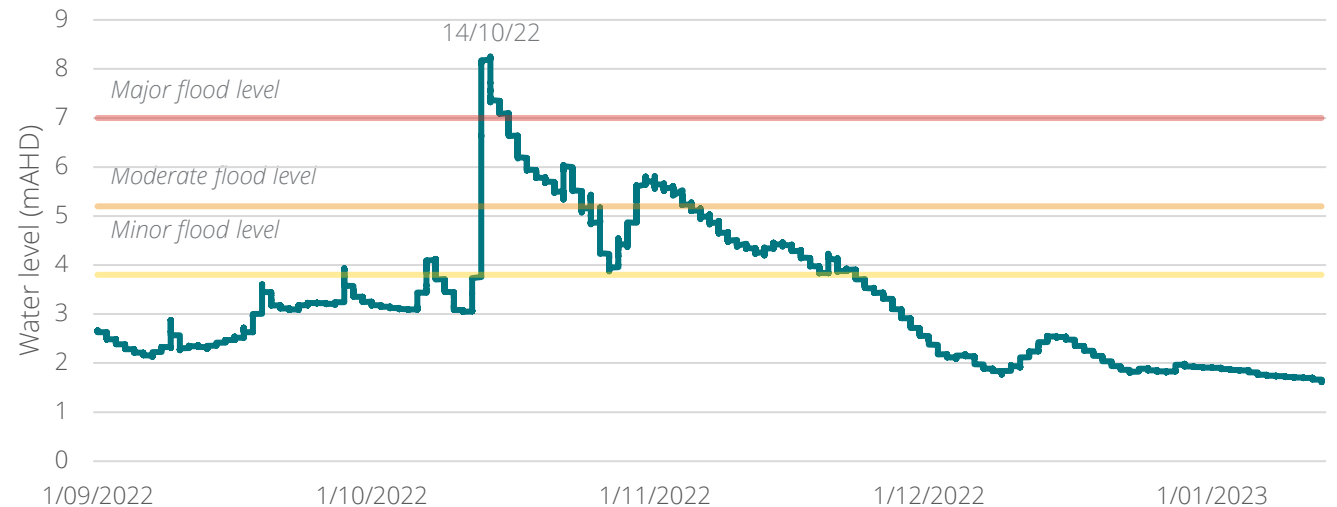
### October 16, 2022

- Victorian Government announces temporary closure of 120 schools and 100 early childcare centres across the state.
- Goulburn River at Seymour drop below the major flood level

### October 19, 2022

- ICA escalates its classification of the floods to 'catastrophe'.

Chart 2.1: Goulburn River at Seymour water level, Sep 2022 – Jan 2023



Source: BoM and Mitchell Shire Council

# Focus LGAs

## The LGAs' economic strengths are vulnerable to flooding impacts

Mitchell, Moira Murrindindi and Strathbogie are famous for their agriculture and tourism sectors. While the sectors are the economic engines of the LGAs, they are also disproportionately exposed to the impacts of natural disasters like floods. This implies that floods are capable of inflicting greater damages on these LGAs than they can inflict in LGAs with different economic strengths.

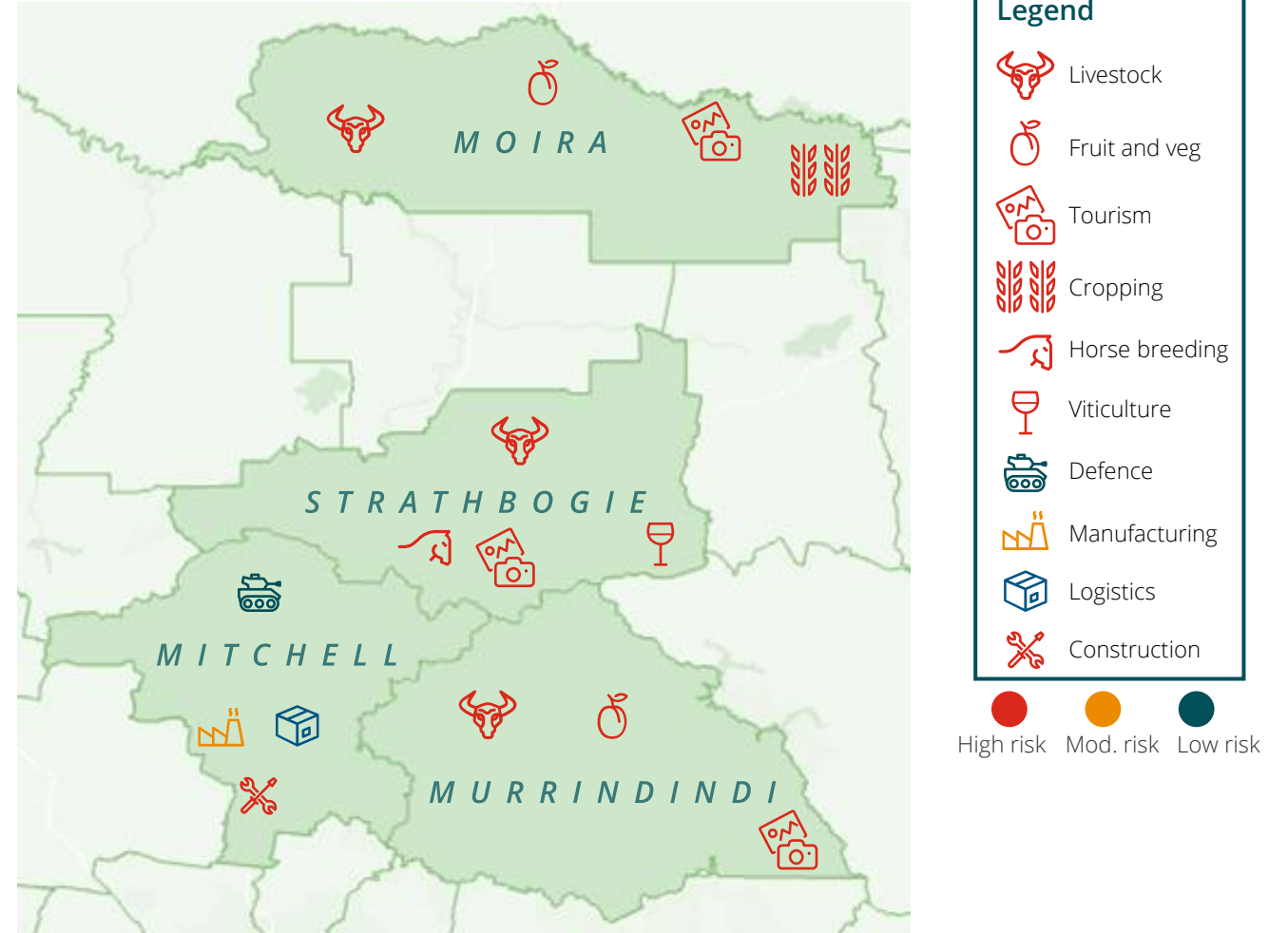
The LGAs sit in Victoria's Goulburn Valley, known as the state's 'food bowl' and one of its principal wine LGAs. Accordingly, agriculture contributes 25 per cent of GRP across the LGAs, almost seven times more than a representative Victorian LGA of their size.<sup>7</sup> Agriculture, however, is more affected by flooding than any other sector, because it relies on water-sensitive soil, flat land and immobile commodities.<sup>8</sup> As a result, the LGAs' economic strength transforms into a vulnerability when faced with a flood.

The LGAs' proximity to Melbourne and natural amenities have nurtured a large tourism sector, but one which is vulnerable to extreme weather events. These can damage tourism infrastructure, but also erodes tourists' confidence in the affected area beyond the immediate recovery period. Consequently, while tourism is an economic asset for the focus LGAs, it also increases their flood risk.

## The value of trade to the LGAs increases their exposure to floods

The focus LGAs need trade to prosper. When natural disasters shut off transport routes, they slow down. Mitchell sits on the Hume Highway, and needs open transport routes to support many key sectors.<sup>9</sup> Farmers need access to larger markets to profit from their work and ease of access from Melbourne is a key drawcard for tourists.<sup>10</sup> Conversely, the LGAs rely on outside provision for many specialised services, which facilitates access to higher-quality services (like health care) than may be available if they had to deliver themselves.<sup>11</sup> Two-way trade is thus critical to the LGAs' economic wellbeing. If floods cut off access to external markets, producers in the focus LGAs will suffer and service provision will come under stress at a time when local communities need all the benefits they can gather.

Figure 2.1: Illustrative map of competitive strengths in focus LGAs



Risk indicators are based on Ulubasoglu et al.'s (2019) estimates of the effects of flooding on sectoral output. All agricultural sub-sectors are assumed to have the same risk, while approximations have been made for industries not covered by the paper, based on comparative benchmarks elsewhere in the literature.



# Focus LGAs

## The LGAs' economic and demographic characteristics exacerbate their flood risk

The differences between the focus LGAs and the rest of Victoria contribute to the unique character of these areas, but also expand the scope for damages from natural disasters like floods.

Several characteristics inhibit the focus LGAs' capacity to bear the financial cost of floods and sufficiently invest in resilience infrastructure. Median weekly household income across the focus LGAs is \$1,450, 18 percent lower than the Victorian average.<sup>12</sup> **Lower incomes weaken households' capacity to absorb the costs of flooding, but also their ability to invest in resilience that alleviates the scope of potential damages.** Similarly, 98.65% of businesses across the focus LGAs have under 20 full time equivalent (FTE) employees.<sup>13</sup> While the high concentration of small businesses in the LGAs help them to retain their rural character, it also means that they can only draw on relatively small pools of resources to recover from floods and build resilience to their impacts.

Furthermore, the LGAs experience heightened flood risk because they are generally older than the rest of Victoria. Older populations are more vulnerable to flooding because they are less physically capable of resisting flood impacts than younger populations.<sup>14</sup> Where Victoria's average age is 38, the average age across the focus LGAs is 43, and jumps to 50 when Mitchell is excluded.<sup>15</sup> Consequently, flooding is likely to have an amplified effect on the focus LGAs, when compared to the rest of Victoria.

Populations in the focus LGAs are also growing faster than they are across the rest of Victoria. This trend expands the scope for flood damages by concentrating populations in LGAs that are already susceptible. The populations of the focus LGAs grew at a compound annual growth rate (CAGR) of 2.67 percent between 2016 and 2021, compared to 1.88 percent across all of Victoria.<sup>16</sup> The growth reflects an increased preference for rural lifestyles among older cohorts and the expansion of Melbourne's peri-urban zones into Mitchell's south.

## Box 2.1: Unique structure of the Shire of Mitchell

The Shire of Mitchell has a different character to its neighbours in Moira, Murrindindi and Strathbogie. It offers a unique economic contribution to the Victorian economy. Mitchell's economy is less agriculture-intensive than the other three Shire, and instead thrives in sectors like construction, manufacturing and defence. These strengths are facilitated by its positioning along the Hume Highway, Eastern Australia's most important road freight route. The location allows producers in Hume to efficiently transport their manufactured goods to other parts of the country.

Its demographic composition is also different to its neighbours. Where Moira, Murrindindi and Strathbogie have populations more than 10 years above the Victorian average of 38, the average Mitchell resident is 36. Parts of the LGA are also affected by changes to Melbourne's urban growth boundary, which expand the range of residential development options in Mitchell's southern areas.

These factors together make Mitchell's population growth different to that of the other focus LGAs. It is the fastest, but it is also driven by young people looking to balance rural amenities with proximity to Melbourne, rather than older Victorians moving for the lifestyle benefits of rural living.

This presents its own opportunities and challenges for Mitchell with regards to flood risk. While the scale of risk is reduced by its relatively low agriculture-intensity, its risk is intensified by the importance of trade routes. When floods obstruct access, Mitchell's economic strengths are suppressed to a greater degree than they might be in LGAs less reliant on logistics-intensive industries. Furthermore, while its younger population is likely to be more agile in response to natural disasters than the older populations elsewhere, its rapid population growth increases the scale of risk in the LGA, which may cap its ongoing development.

# Compounding impacts of natural disasters

While this report focuses on the impacts of the floods as an isolated event in four LGAs, it is important to consider these impacts in the context of intensifying weather extremes and natural disasters.

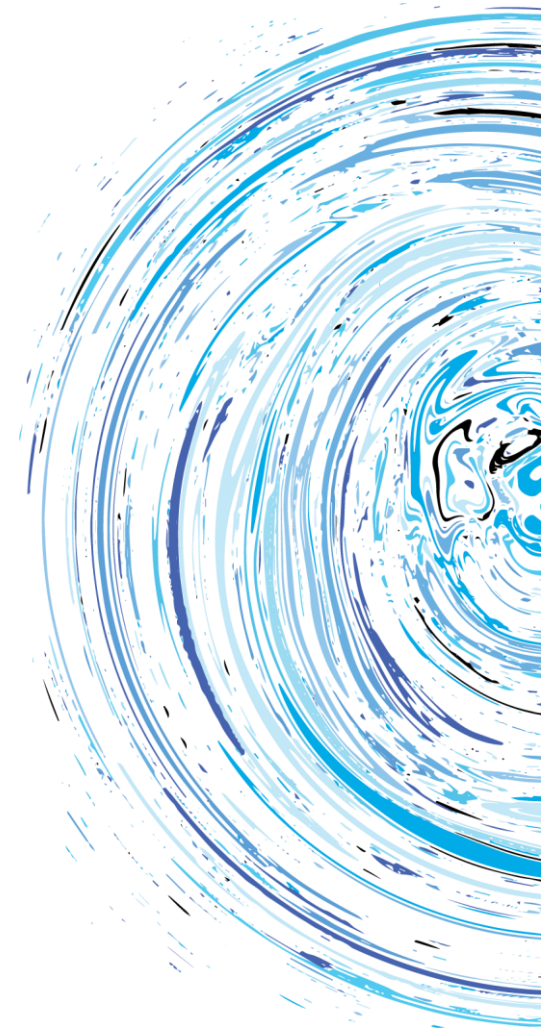
October 2022 was the wettest month in Victorian history, and the second wettest October nation-wide.<sup>17</sup> Climate scientists have attributed the extreme to two weather phenomena, the La Nina weather system and the negative Indian Ocean Dipole, both of which are expected to grow more frequent and severe as the climate warms.<sup>18</sup>

The La Nina weather system and a negative Indian Ocean Dipole encouraged stronger-than-average rainfalls in late winter and early spring. While Victoria's flood and storm infrastructure is built to resist these forces in isolation (as they have traditionally occurred), it lacks the strength to absorb them in combination. As global temperatures warm, such confluences are likely to grow more frequent and severe. This will heighten flood risk in places like Victoria, where such events have been historically uncommon.<sup>19</sup>

Further, the Victorian floods were not the only weather event triggered by these phenomena. La Nina drove another flooding event in Queensland and Northern New South Wales, which became the most expensive natural disaster in history for insurers, who have paid out \$5.8 billion in claims to date.<sup>20</sup> Deloitte Access Economics estimates that the total cost to South East Queensland alone topped \$7.4 billion.<sup>21</sup> The BoM attributed two more 2022 flooding events in New South Wales to the Indian Ocean Dipole. As climate change increases the frequency and intensity of extreme weather phenomena like La Nina and the Indian Ocean Dipole, the cumulative costs of the natural disasters they create will grow.

In a high emissions scenario, Deloitte Access Economics estimates that the annual costs of these disasters will reach \$94 billion per year by 2060 – a \$21 billion increase on estimated costs in a low-emissions scenario.<sup>22</sup> In Victoria, the net present value of these costs between 2020 and 2060 will reach \$205 billion.<sup>23</sup> Floods are the costliest of these disasters, and their impacts intensify more than any other natural disaster as the climate continues to warm. While Victoria has not traditionally faced high flood risk, it will have to adapt in response to its heightening vulnerability.

To lessen the impact on Victoria's economy and its people, **immediate and strategic investment in adaptation is essential**. A recent Deloitte Access Economics report found that by investing in adaption and resilience, Australia could avoid **\$380 billion in worsening economic costs** from climate change.<sup>24</sup>





### **3. Social, Financial & Economic Costs.**

Nathalia flood gauge.  
Source: Megan Fisher via Shepparton News

# Summary of costs

**\$ 432 million**

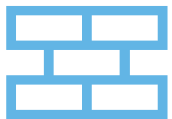
*The tangible costs of the 2022 Victorian floods to the Local Governments of Mitchell, Moira, Murrindindi and Strathbogie*



132 properties damaged



552 Kms of bridges, roads and trail walkways damaged



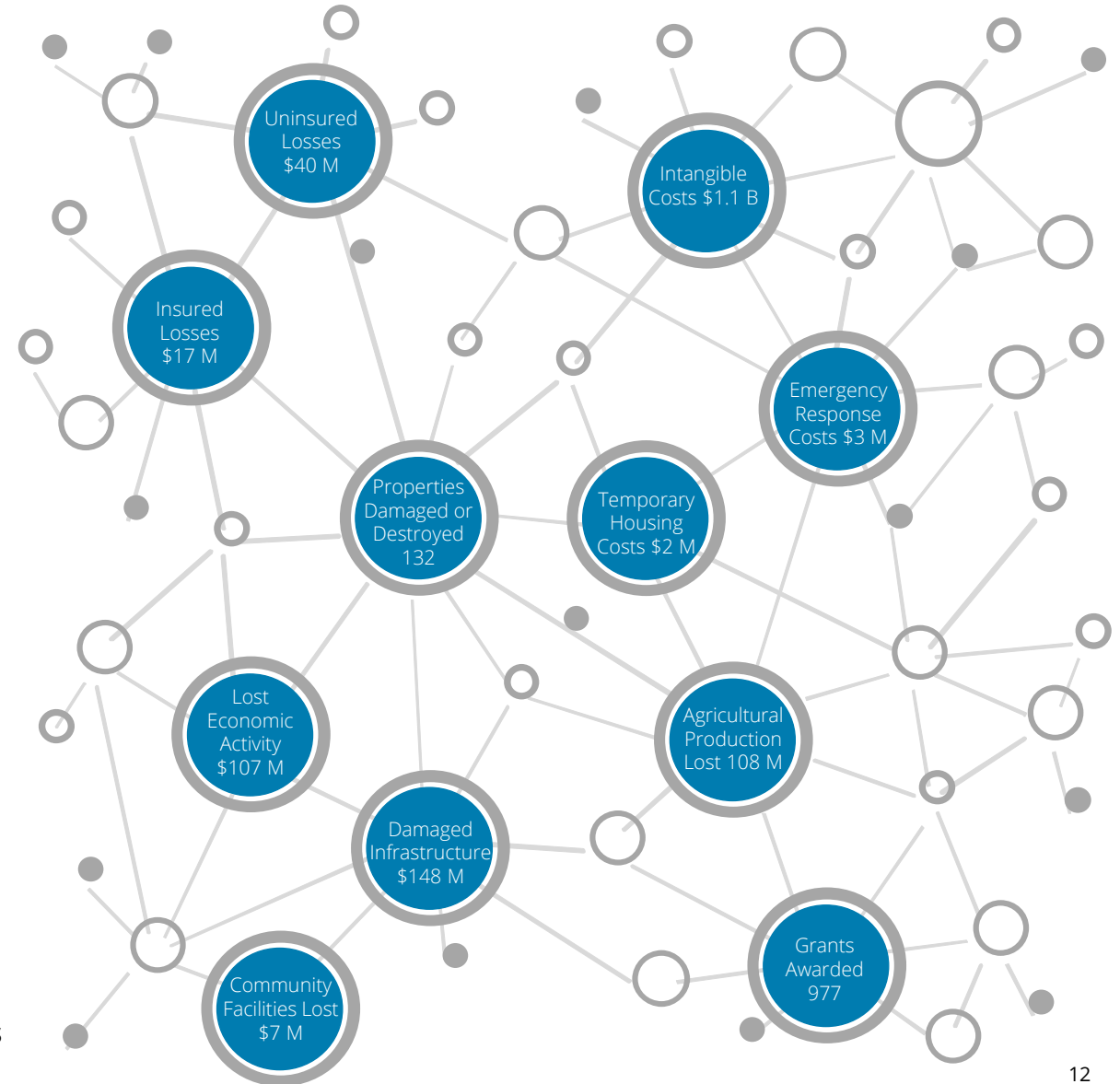
2,676 livestock lost, 1,801 Kms of fencing lost



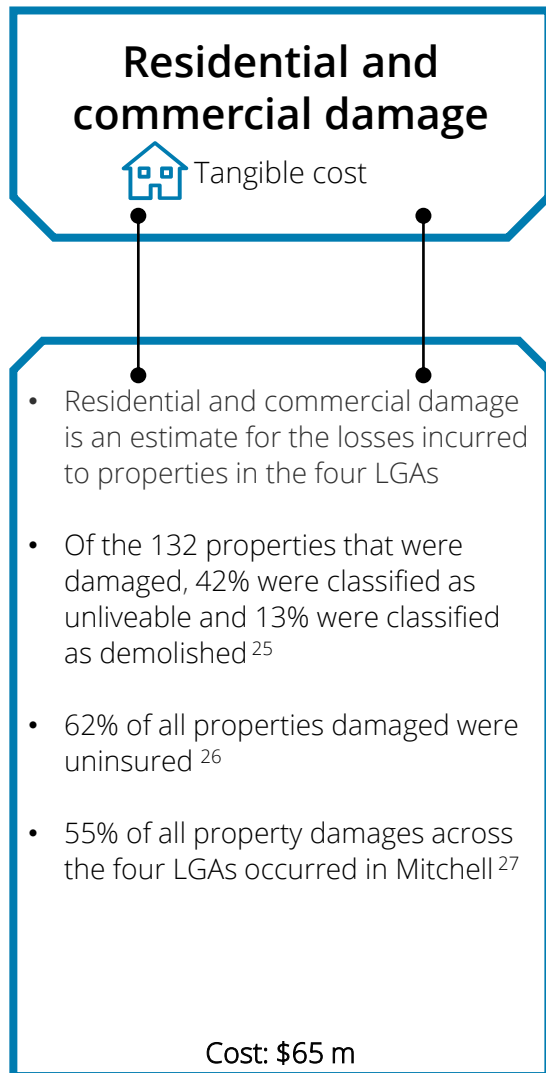
55,762 Ha of broadacre cropping, pasture and horticulture lost



23,830 T of hay/silage and stored grain lost  
53 farm infrastructures lost



# Residential and commercial damage



The event caused devastating impacts on residential and commercial properties in the four LGAs. The impact of heavy rainfall, flood waters, mud and debris caused structural and in some cases irreparable damage to many properties. Using data provided from the Local Councils to the Victorian State Government, Deloitte Access Economics has estimated **\$65 million of damage occurred to residential and commercial properties in the four local government areas.**

Damage occurred to 132 properties across the four LGAs, 59 of those properties were classified as liveable following the event while 73 properties were classified as unliveable or destroyed, and of those 52 were uninsured.<sup>28</sup> Using the number of damaged insured and uninsured properties, the average value of homes, and the average property insurance claim for the event, Deloitte Access Economics calculated **\$46 million of damage occurred to uninsured properties and \$19 million of damage occurred in insured property.**<sup>29</sup>

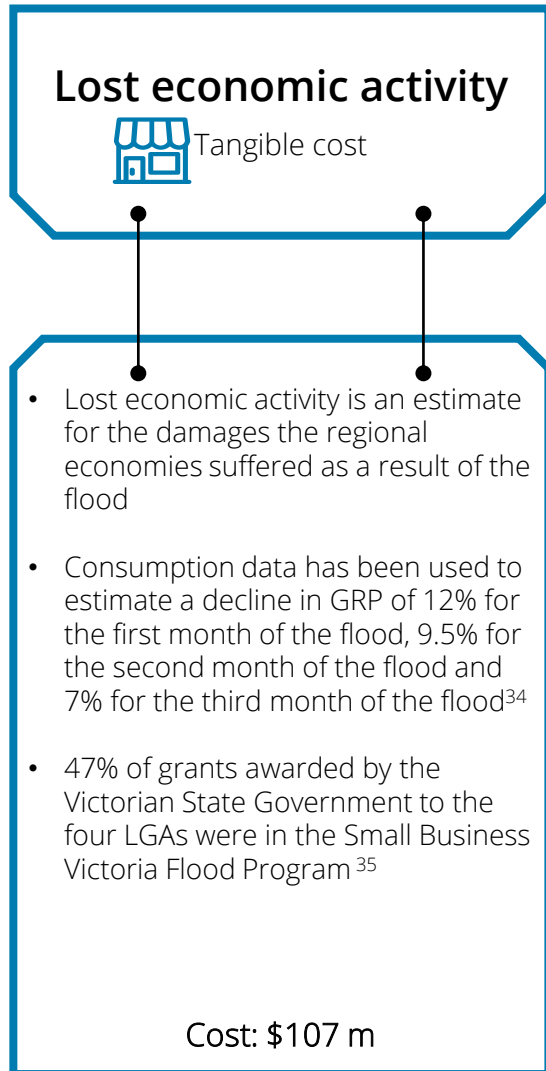
Uninsured losses are significantly higher than insured losses as a greater number of uninsured properties were damaged. Towns such as Seymour and Shepparton within the four LGAs were known for being at high risk of floods to insureds and resulted in the cost of flood cover being unaffordable for many residents and business owners, leading to 82 uninsured properties being damaged within the four LGAs.<sup>30,31</sup>

Following the event, insurance companies are now refusing to provide property insurance to certain postcodes within regional Victoria, including locations that are not at risk.<sup>32</sup> The practice of the insurance industry “red-lining” or “embargoing” entire postcodes has resulted in many regional residents struggling to insure their properties.<sup>33</sup> The extent of damage and property repairs, coupled with the lack of insurance options available, has resulted in significant costs to the communities, including the possibility of people leaving the area.

**Footnote:** The estimated costs calculated depend on the accuracy of the data provided by the Local Governments to the Victoria State Government, and any future revisions to the number of properties impacted in the four LGAs will impact the cost of residential and commercial damage.

Note: some numbers may not add due to rounding.

# Lost economic activity



Flood events can cause significant disruption to local economic activities, particularly in regional areas where small businesses form the backbone of the economy. Within the regional communities of Murrindindi, Mitchell, Strathbogie and Moira, 99% of business in the local economy are small businesses employing 0-20 employees, and as such do not have the same capital or resources as larger businesses do to quickly recover from a natural disaster.<sup>36</sup>

Many small businesses such as the local Seymour Motel were unable to secure flood cover due to a lack of insurance options, and as such all flood repairs will be an out of pocket cost.<sup>37</sup> Whilst other businesses who may not have suffered significant physical damage to their properties, have suffered a decline in trade. Damages to roads and infrastructure prevented easy access to caravan parks in Murrindindi and Strathbogie, resulting in significant economic activity losses. Victoria's Murray Tourism LGA, which includes all four focus LGAs, was the most affected tourism LGA and suffered a 22% decline in domestic visitors as a result of the flood, with 88% of surveyed businesses experiencing cancellations during the peak tourism season for the LGA.<sup>38,39</sup> Business owners in Mitchell continue to worry people will reconsider traveling to the Shire due to perceptions that their holiday experience will not be as enjoyable as a result of ongoing flood damages and repairs.<sup>40</sup> To calculate the damages to business and the loss of income and trade Deloitte Access Economics has declined GRP (Gross Regional Product) for the duration of the flood, and estimates a **\$107 million loss occurred as a result of the event.**


Due to the significant losses many business may not reopen, creating long term repercussions to the local economy. The closure of a major bank branch in Seymour has limited access to in-person banking and financial information, with many residents having to drive to alternative branches in in Shepparton or Kyneton to access services.<sup>41,42</sup> The impact of the bank closure will be particularly felt by vulnerable community members who don't have access to online banking through digital technologies, and will face additional costs and security risks to access or deposit cash.<sup>43</sup> Consequences will also be felt small by business owners and farmers who will instead have to rely on call centres or bank staff they do not have a banking relationship with for their business needs, potentially resulting in lost opportunities.<sup>44</sup> Past bank closures in regional communities have resulted in bank employees finding it challenging to find a new job, thus demonstrating how far reaching the consequences of business closures on the local economy.<sup>45</sup>

Note: some numbers may not add due to rounding.

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# Agricultural damage

## Agricultural Damage

 Tangible cost

- Agricultural damage represents the loss of agricultural assets as a result of the floods
- 35% of agricultural asset losses in the Hume region occurred in the LGAs of Murrindindi, Moira, Strathbogie and Mitchell <sup>46</sup>
- 47% of grants awarded by the Victorian State Government to the four LGAs were in the Agriculture Victoria Flood Program <sup>47</sup>
- Across the four LGAs 29% of gross regional product is derived from agricultural production <sup>48</sup>

Cost: \$108 m

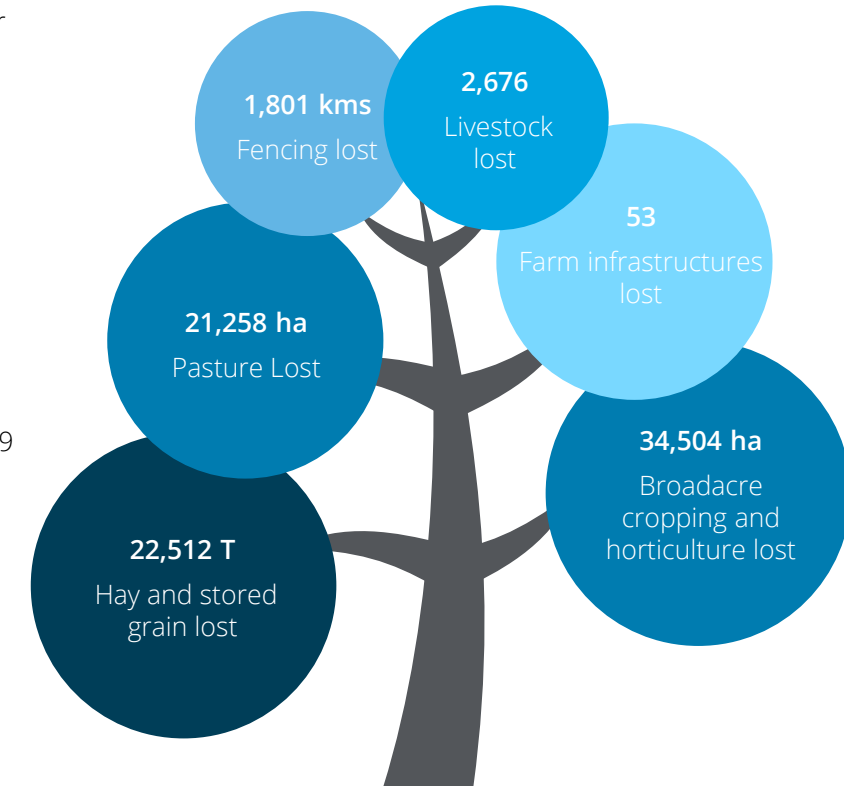
Agricultural production is very important to the regional communities within the four Local Government areas. The LGAs are known for their production in commodities such as fruit and nuts, wheat, meat cattle, canola and flower nurseries.<sup>49</sup>

The event wrecked havoc on the agriculture sector of the communities with losses including 21,258 hectares of pasture, 22,512 tonnes of hay and stored grain, 34,504 hectares of broadacre cropping and horticulture and 2,676 livestock.<sup>50</sup> In addition, losses also occurred to agriculture infrastructure and machinery with 1,801 kilometers of fencing lost and the destruction of 53 farm infrastructures, including grain storage facilities, packaging and handling systems and water storage.<sup>51</sup>

The Victorian State Government has estimated agricultural assets losses of \$21.2 million for Murrindindi, \$64.7 million for Moira, \$22.4 million for Strathbogie and \$4.9 million for Mitchell resulting in total losses of **\$108 million**.<sup>52</sup>

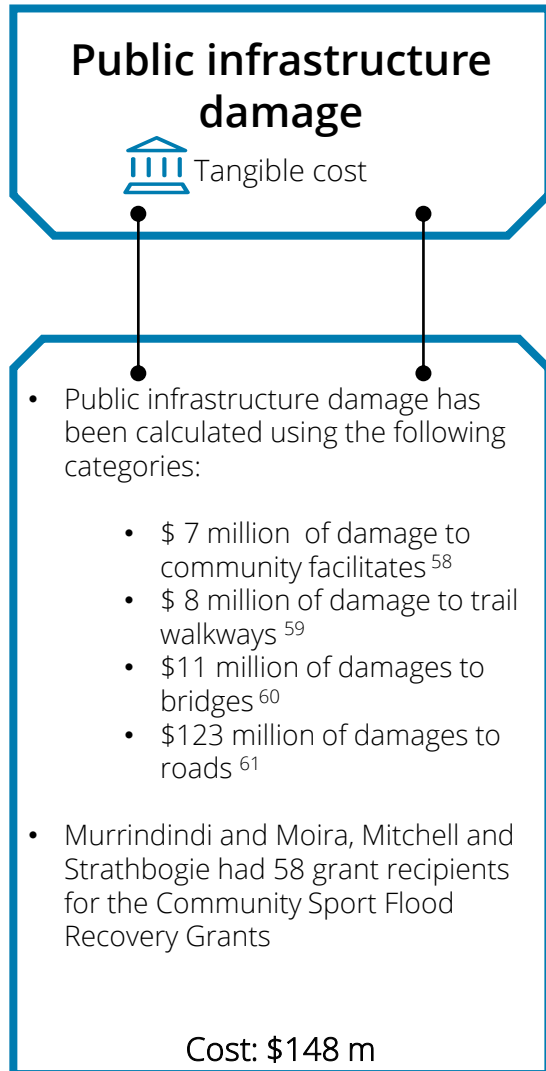
The impact of the agricultural damage was far reaching into food supply chains with many dairy processors, fruit and vegetable growers and producers of plant-based products suffering. Considerable logistic challenges arose due to the loss of power, limited staff access and damage to raw materials.<sup>53,54</sup> Milk collection was particularly challenging due to the power outages and road closures, with some dairy farmers having to throw out uncollected milk.<sup>55</sup>

The Victorian government has set up an Agricultural Recovery Team to provide information and support to Victorian producers that were impacted by the flood.<sup>56</sup> The recovery support included the Agriculture Victoria Flood Grant Program, of which 462 grants were awarded to four Local Government areas of focus.<sup>57</sup>



Note: some numbers may not add due to rounding.

# Public infrastructure damage



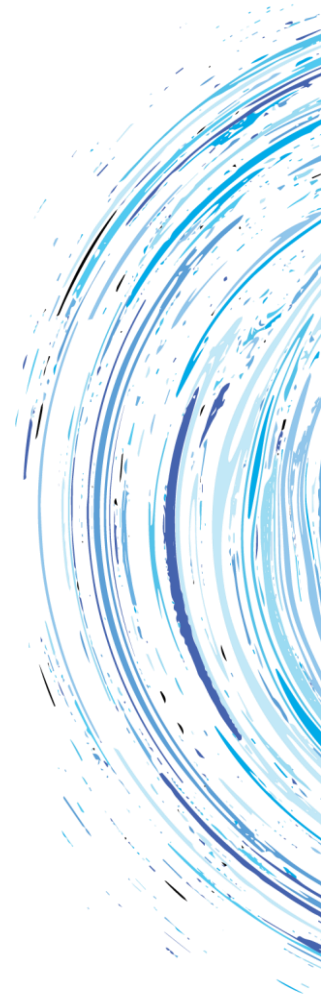
Local communities rely on public infrastructure to operate business, schools, essential services and connect residents, as such damages to public infrastructure can significantly disrupt community operations and impact residents in multiple ways. The event caused considerable damage to the four local governments' roads, bridges, trail walkways, and community and education facilities.

The closure of key infrastructure such as the historic Acheron Breakaway Bridge in Murrindindi has caused significant economic impact as a result of residents suffering increased commute times, lost business trade and damage to private properties.<sup>62</sup> Since the Goulburn River flooded in October the Archeron Breakaway Bridge has been closed, causing some residents to suffer increased travel costs to commute to work.<sup>63</sup> Whilst local small businesses who rely on domestic tourists are worried some visitors are not reaching their business due to the additional travel required.<sup>64</sup> The bridge has also caused further structural damage with the debris left on the bridge diverting water from the river onto resident's properties, causing damages to land and fencing.<sup>65</sup>

Damage to transport infrastructure was not the only loss, education facilities also incurred significant damages and as a result disrupted learning in schools, colleges and vocation training centres. The newly re-developed \$5.9 million health and community services training GOTAFE Campus in Seymour, was closed for a week due to the severe flooding in its surroundings.<sup>66</sup> Whilst the GOTAFE William Orr Campus, a 120-hectare property on the outskirts of Shepparton, was closed for over a week due to the extensive damage from the floods.<sup>67,68</sup> As a result of the closures to campuses, vocation students had classes cancelled as many courses rely on the training centre's tools and equipment to conduct classes.

To estimate damages to community facilities, roads, bridges and trail walkways Deloitte Access Economics has used data provided by the Victorian State Government and data on the cost to repair infrastructure following a flooding event. Across the four Local Governments **the total cost to public infrastructure damage is \$148 million.**

To support the local community in the recovery, the Victorian State government has provided Business and Community Sport Flood Recovery grants to help restore the facilities that provide residents' with numerous health and social benefits.<sup>69</sup> The grants are designed to provide not-for-profit community sport and active recreation organisations grant funding, to cover expenses related to the replacement of play equipment, injury prevention and first aid equipment, participation and maintenance equipment and canteen or clubroom items.<sup>70</sup>





# Case study: Kirwans Bridge

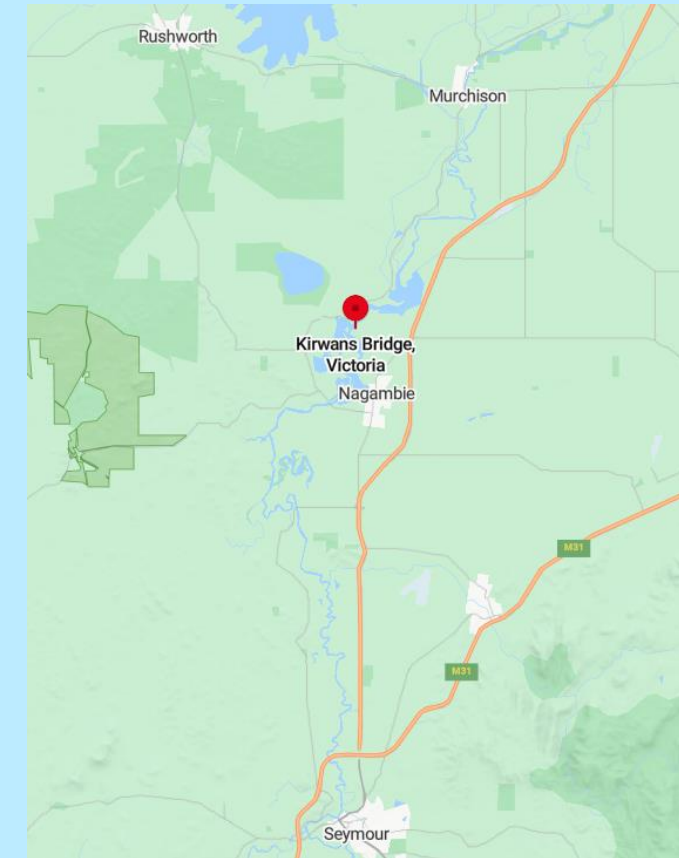
The Kirwans Bridge closure captures how public infrastructure damages amount to much more than the cost of replacement. Kirwans Bridge is an important piece of public infrastructure located north of Nagambie, which is the second largest town in Strathbogie Shire. The 133-year-old heritage-listed bridge connects Nagambie to towns further north, like Murchison and Rushworth.<sup>71</sup> As the 2022 Victorian floods compromised the bridge's structural integrity, the bridge has been closed since then. Extensive repairs will be needed before it is usable again, and there is no definite timeline for reopening.

Prior to the flood, approximately 4000 vehicles used Kirwans Bridge every week, with strong patronage reflecting the relative absence of other options to access nearby towns.<sup>72</sup> The only viable alternative route is Weir Road, an unpaved road which is considered much more dangerous to drivers than Kirwans Bridge.<sup>73</sup> As a result, the bridge closure has significantly impacted locals already suffering from the impacts of the flooding. Additional fuel costs and travel time to visit loved ones have caused concern across the population. Bus services for local schoolchildren have been cut, making education less accessible and increasing the time costs of transportation for parents who may otherwise be working.<sup>74</sup>

The impact of the bridge closure is especially significant for vulnerable populations. Locals are concerned about ambulance delays, with one resident considering purchasing a defibrillator to insure against extended wait times.<sup>75</sup> Furthermore, costs for at-home care have increased, with travel costs growing around 300 percent in some instances.<sup>76</sup>

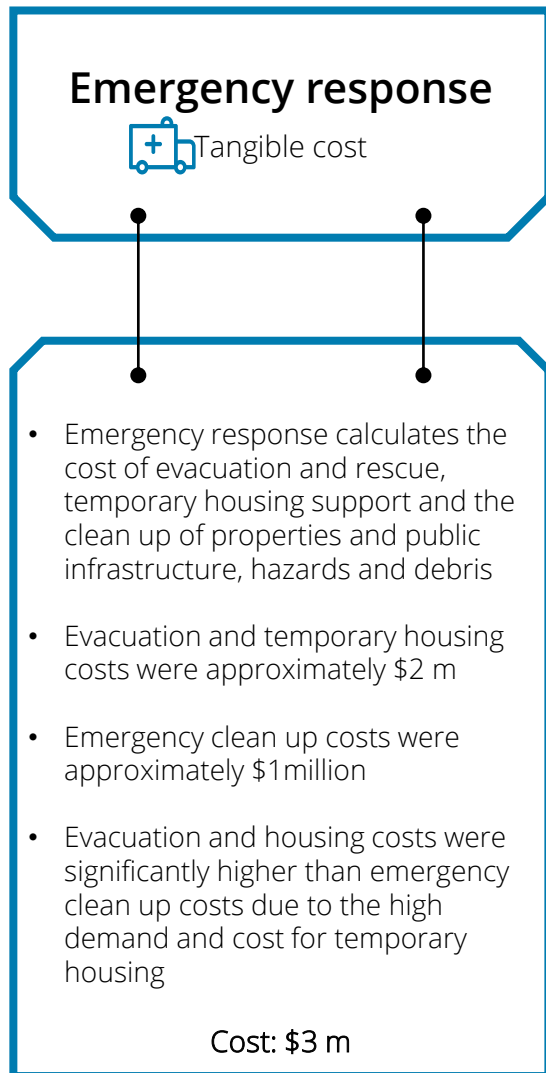
The bridge closure also illustrates how the consequences of one natural disaster can exacerbate the risks associated with another. Strathbogie is highly vulnerable to bushfires, and Kirwans Bridge was a key evacuation route.<sup>77</sup> The Black Saturday bushfires inquiry revealed that fewer lives were lost in areas with multiple evacuation routes. Given the importance of Kirwans Bridge for bushfire evaluation, locals worry that the bridge's closure will unnecessarily endanger lives and livelihoods.<sup>78</sup>

Figure 3.1: Kirwans Bridge, Strathbogie Shire



Source: Google Maps

# Emergency response and clean up costs



The four Local Government Areas of focus suffered extensive damage to properties, businesses and infrastructure, as such a significant emergency response program was required to assist the residents and help the communities recover.

## Emergency response and clean-up costs:

The Victorian State Government worked alongside the Local Governments, the Australian Defence Force and community volunteers to assist in the recovery. The ADF assisted the communities in flood-affected areas by filling and distributing sandbags, transporting isolated families and emergency services stakeholders, diverting water and door-knocking to support flood-affected residents.<sup>79</sup> Whilst many community facilities, such as Seymour’s football and netball club, helped coordinate hundreds of volunteers to clear out destroyed furniture, plaster and flooring.<sup>80</sup>

To further assist communities in the clean-up and recovery the State Government provided disaster recovery funding for Local Governments and waived tip fees for flood waste.<sup>81</sup> The disaster recovery funding was designed to support the collection of water transportation costs, staffing and the restoration of community services and facilities.<sup>82</sup>

## Evacuation and temporary housing:

A significant number of the properties damaged were uninhabitable following the event, with many being uninsured, as a result temporary housing has been provided by the State Government, and in some cases insures.<sup>83</sup> In the aftermath of the event, the Shepparton and Mooroopna Housing Taskforce was formed to assist in providing a community-led approach, due to approximately 600 people from Greater Shepparton needing crisis accommodation.<sup>84</sup> In April 2023 following consultation with the taskforce the Victorian State Government announced a \$4.6 million Homes at Home program, and will deliver caravans or modular homes for 40 properties in the Greater Shepparton LGA for up to 12 months.<sup>85</sup> Residents who were uninsured from the flood will be prioritised for the program, given some insures have provided customers with temporary housing units.<sup>86,87</sup>

To calculate the emergency response and clean-up costs, Deloitte Access Economics applied a ratio developed using data from similar events. The cost of temporary housing during the flooding event was estimated using data on the number of uninhabitable or destroyed houses, average household size per dwelling and Victorian State Government data on the cost of temporary housing per person per night. Deloitte Access has therefore estimated the **total cost of the emergency response and clean-up to be \$3 million.**

Note: some numbers may not add due to rounding.

Note: some numbers may not add due to rounding.

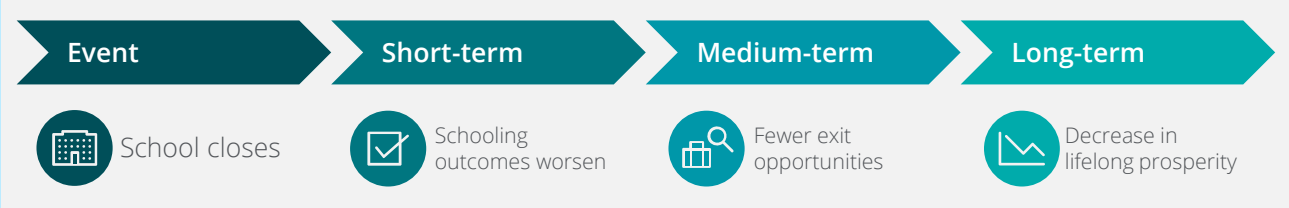
# Case study: Seymour College closure

Seymour College is a vital education institution for the Seymour community. As the only government school in the area, Seymour College is responsible for educating 750 students between Foundation and Year 12 in a town with a population of about 6,500.<sup>88</sup> When Seymour bore the effects of the 2022 Victorian floods, Seymour College was not spared from the consequences; the event necessitated the school's closure from October 13 until October 19, a period which coincided with VCE examinations for the graduating cohort.<sup>89</sup>

While online learning may have mitigated some of the adverse consequences of the school's closure, the effects were exacerbated by the timing of the closure, which was especially disruptive for the graduating cohort, and the isolating nature of the event, which prevented students and families from retrieving the belongings necessary to learn as they would at school.<sup>90</sup>

**There is an established negative relationship between physical school closures and student outcomes in the short-, medium- and the long-term.**<sup>91</sup> The effects of closures can linger in students' adult lives, ultimately impairing their economic potential and that of their community.

Figure 3.2: Short-, medium- and long-term outcomes of school closures on students



Source: Deloitte Access Economics, based on Kousky (2016)

It is critical to note that Figure 2.2 only captures a selection of the effects of school closures on students. **Among the most reported impacts of closures on students are mental health-related.** Some of these impacts manifest in schooling outcomes, but they are also evident in the behaviour of students following these disasters.

Stakeholders involved with the school are reporting noticeable changes in behaviour aligned with these expectations. **One key stakeholder has reported that the school is experiencing substance misuse, truancy and police interventions on a scale unmatched in their 15 years of engagement with the College.**

These flood costs are often underreported because they are not explicitly identifiable as flood impacts. Nevertheless, it is important to bring light to these costs, so that investment in resilience and recovery adequately reflects the adverse effects of these events on school students.

Figure 3.3: Aerial view of the flooding in Seymour



Source: WIN News

# Human, social and community impacts

A range of direct and indirect health and social impacts are estimated to have occurred to the impacted population in four local government areas. A select number of impacts have been monetised to estimate the total social costs due to the intangible nature, as not all the impacts can be monetised due to the intangible nature.

Figure 3.4: Discarded possessions outside a flooded home



Source: ABC News

## Fatalities and injuries

The event caused one fatality across the four LGAs. The economic costs of these incidents are calculated using the value of statistical life from the Office of Best Practice Regulation, which considers the lifetime cost of death and the effect of injuries on life quality.

## Alcohol misuse

Exposure to natural disasters can lead to dangerous levels of alcohol consumption, particularly in regional areas where drinking levels are higher than in urban areas.<sup>92</sup> The increased level and frequency of drinking can negatively impact the life of the affected population, with limited or inaccessible access to alcohol treatment services preventing many from seeking help and support.<sup>93</sup> The Deloitte Access Economics cost model covers the prevalence of risky or increased alcohol consumption within the population as opposed to the number of people that have been assisted for alcohol and drug misuse following the event.

## Chronic disease

Natural disasters can exacerbate or induce chronic disease even more than in rural areas due to poorer access to healthcare services.<sup>94</sup> People living in rural areas often have worse health outcomes than people living in urban areas.<sup>95</sup> Thus, rural populations will face more significant health consequences, from illness or injury sustained during the disaster or from being separated from medicine or services due to road closures or other disruptions. This report has estimated the additional impact of natural disasters on diabetes, chronic obstructive pulmonary disease, and stroke within the population as opposed to the number of people seeking assistance for Chronic Diseases following the event.

## Family violence

An increase in domestic and family violence following a natural disaster is correlated to the traumatic and high-stress nature of the event, particularly in rural areas where rates of domestic and family violence are higher.<sup>96</sup> As a result, the affected people and communities suffer considerable health and social costs.

## Mental health

Natural disasters can have a heavy toll on mental health, particularly in rural areas where access to mental health services are limited.<sup>97</sup> This report quantifies the impact of natural disasters on mental health as the estimated additional incidence of reported psychological distress across the affected population and the prevalence of psychological distress following the natural disaster as opposed to the number of people seeking mental health support.

# Case study: Cobram Agricultural Show

The cancelled Cobram Agricultural Show illustrates how intangible effects can amplify the severity of natural disasters like the Victorian floods, even when the consequences appear contained in tangible costs. Cobram is the largest town in Moira Shire, and its Agricultural Show – which has run since 1899 – is regarded as the ‘biggest event in the town’.<sup>98</sup> The Show was scheduled to take place on October 22 and 23 in 2022, and, following two years of COVID-19-related cancellations, organisers had hoped that the enforced break would entice strong patronage.<sup>99</sup>

This history intensified the community pain when floods forced the Show’s cancellation just six days before it was due to commence. The rainfall impacted the grounds to an ‘unacceptable degree’, and flooding elsewhere in the Shire had meant that many exhibitors, attendees and participants were unable to access transport routes to reach the Show.<sup>100</sup>

The consequences of the cancellation for the Shire are diverse. Most directly, it means that the resources invested in preparing for the Show are unrecoverable. Beyond the direct operation of the Show, however, **the exhibitions and competitions provide a valuable marketing opportunity for many local businesses.** For these businesses, the cancellation may intensify the economic hardships brought on by the direct impact of the flooding. Furthermore, the Show attracts visitors to Cobram, whose expenditure creates additional benefits for businesses across town. The cancellation is costly for these businesses, who also have to invest additional resources to prepare for the increased demand from Showgoers.<sup>101</sup>

**The most meaningful costs of the Show’s cancellation, however, may not show up on balance sheets.**

Prior to the floods, Show president Jodie Wilson told Shepparton News that:

*‘the Cobram Show has always been about bringing the community together. COVID has restricted so much of what we considered normal, so we want everyone to be able to get out and enjoy what we have to offer’.*<sup>102</sup>

The statement makes it clear that the primary value of the Show is its impact on the welfare of the Cobram community. Consequently, losing the Show – especially after two years where community connection had been forcibly limited – has likely eroded the mental health of the community, evident in Council’s platforming of a psychologist to assist locals struggling to cope with the effects of the floods.<sup>103</sup> While the psychological effects of floods are less recognised than their physical effects, the Cobram Agricultural Show’s cancellation illustrates how their impacts can be greater.

Figure 3.5: A ride leaves the showgrounds following cancellation



Source: Cobram Courier



## 4. Long-term Impacts

A landslide caused by flooding at Kinglake National Park.  
Source: Parks Victoria

# The costs of floods are not static

Although floods occur in short, intense windows, their effects can linger long after the waters recede. For flood-exposed regions, these effects can materially influence their development trajectory. This means that, in the long run, **economic prosperity in flooded regions is lower than it would be without the flood**.

The 2022 Victorian flood has a long-term impact on Mitchell, Moira, Murrindindi and Strathbogie because:

- The costs of recovery must draw on resources that would otherwise be spent advancing other objectives and cannot occur overnight.
- The perception of flood risk can permanently tarnish the reputations of affected regions, disincentivising migration and tourism to the areas.
- Intangible costs also persist well beyond the flood itself. While many victims psychologically recover from natural disasters like floods, some suffer for years following the event, impacting their ability to work and engage with their communities.

For Mitchell, Moira, Murrindindi and Strathbogie, these long-term impacts can be especially damaging. Agriculture is integral to the economic wellbeing of these areas, and the relatively lower concentration of infrastructure intensifies the importance of every road, bridge and telecommunications tower. Access to capital and resources is typically weaker in areas like the focus LGAs that it is in than large, urban areas. Each of these characteristics of regional areas increases their vulnerability to the effects of flooding and dampens their capacity to recover quickly.

Long-term impacts also leave regions more vulnerable if they are exposed to another disaster. If roads used for evacuation, for example, are inadequately restored after flood damage, community resilience to subsequent disasters is compromised. Consequently, not only can long-term impacts damage affected regions' growth trajectories, but they can also exacerbate their risk profile to future natural disasters. The latter effect is likely to further reinforce the former, decreasing the region's attractiveness for prospective investors and residents.

The danger that events like the Victorian floods pose for the long-term development of Australia's LGAs reinforces the importance of building resilience. Communities not only need to prepare to minimise the initial impact of a natural disaster but also need appropriate response and recovery mechanisms in place so that their regions can bounce back and reach their economic potential.

Figure 4.1: The Acheron Breakaway Bridge, which remains closed following the flood.

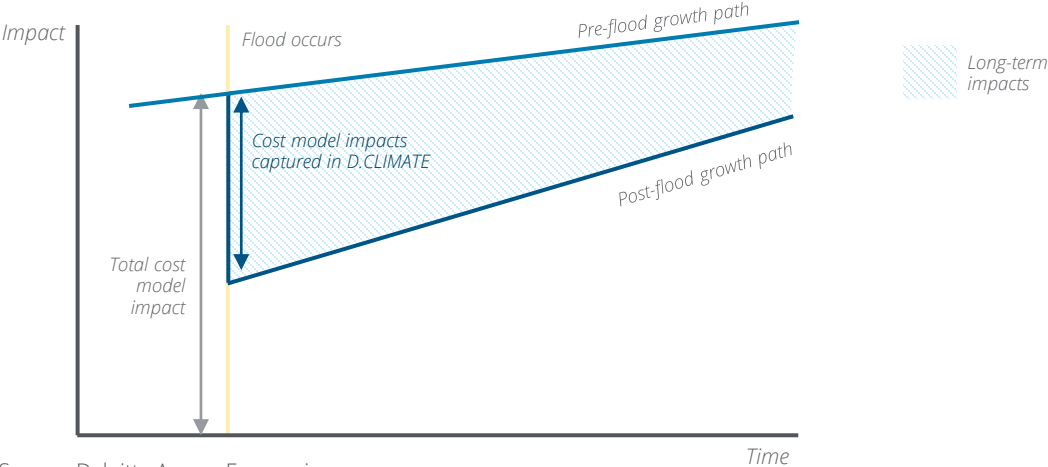


Source: ABC News

# Long-term impact methodology

Deloitte Access Economics has used its in-house Computable General Equilibrium (CGE) model to capture the economic impact of the Victorian floods on the LGAs of Mitchell, Moira, Murrindindi and Strathbogie. The economic impact is the difference between the economic trajectories before and after the flood.

Figure 4.2: Illustrative example of the relationship between cost model impacts and long-term impacts



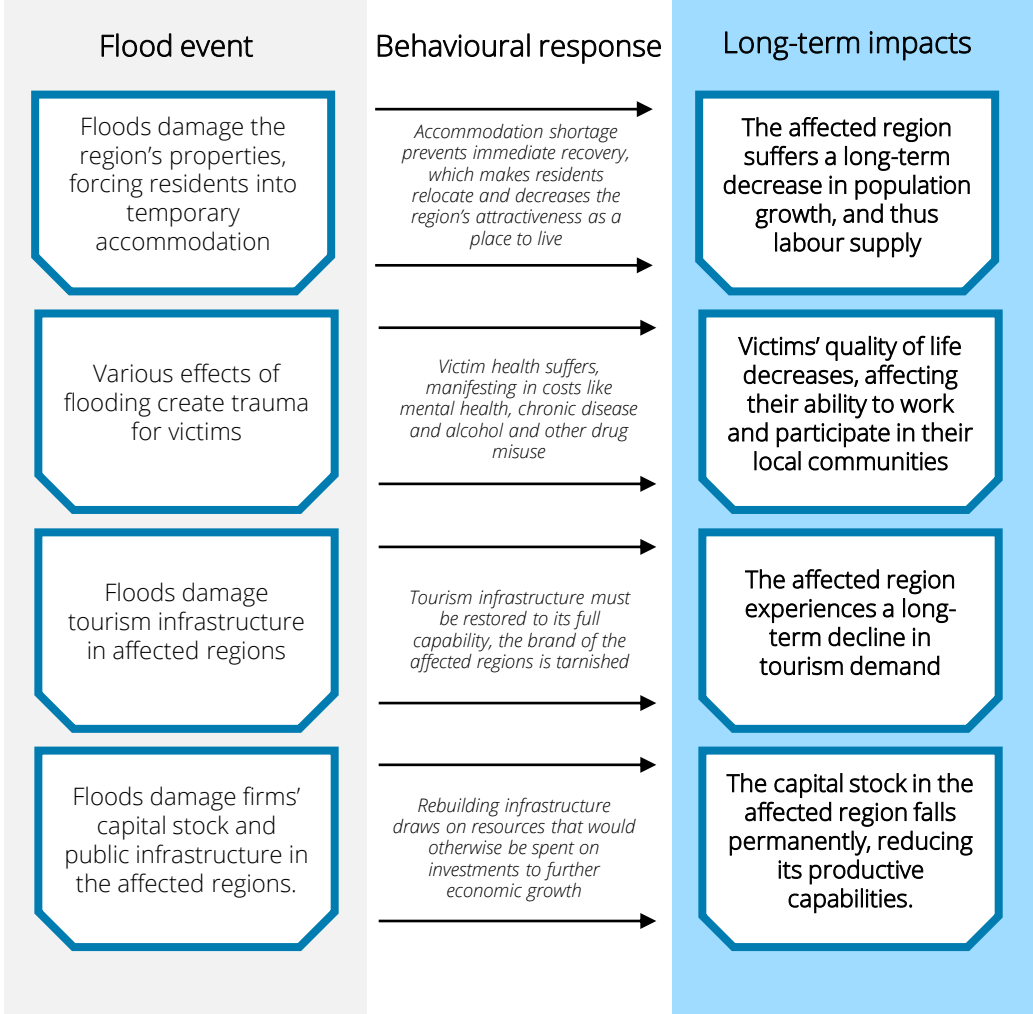
Source: Deloitte Access Economics

The impacts that are captured in the model are illustrated in Figure 11, and described below:

- A decrease in **population growth**, due to a decrease in accommodation options and a perceived decrease in the regions' desirability
- A decrease in **labour productivity**, due to ongoing mental health impacts
- A decrease in **tourism expenditure**, due to erosion of tourist infrastructure and negative perceptions of the affected regions
- A decrease in the **capital stock** due to resource limitations in public infrastructure recovery and market exits from affected businesses.

This list does not fully capture the long-term impacts of flooding on the focus LGAs, but they nevertheless provide an indication of how the floods may impact their economic growth trajectories.

Figure 4.3: Captured long-term flood impacts and their causes



Source: Deloitte Access Economics



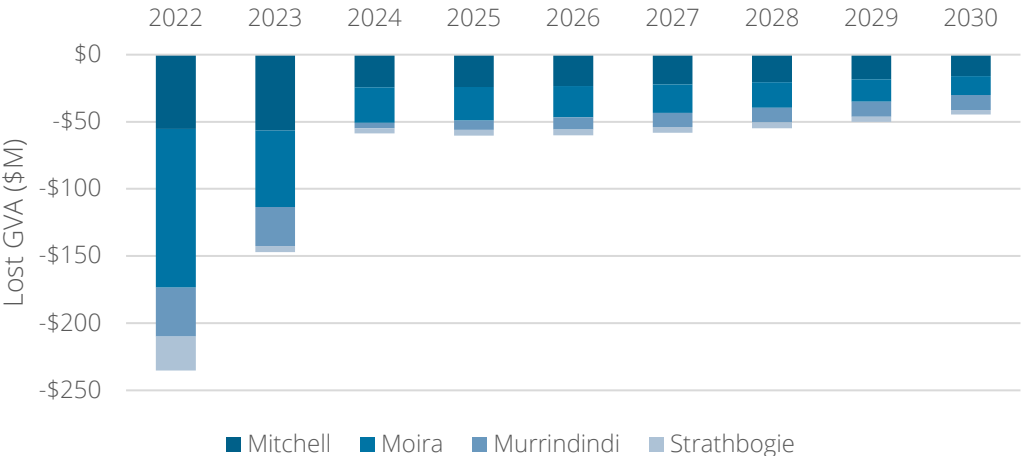
# Long-term impacts of the floods

Deloitte Access Economics has estimated that the Victorian floods will decrease GRP in the focus LGAs by **\$612M** (in NPV terms) between 2022 and 2030. The loss reflects a sharp drop in GRP in the immediate aftermath of the event, followed by a gradual recovery (albeit one that does not return GRP to its original trajectory by 2030).

The floods also have a negative impact on employment in the LGAs across the 10 years. On average, there are **580 fewer jobs in the focus LGAs** across the modelled period as a result of the floods. The impact is strongest (1,142 fewer jobs) in 2022, but there are persistent negative impacts across the modelled timeframe, with 287 fewer jobs across the LGAs in 2030 as a result of the floods.

The recovery staging (Chart 3.1) reflects short-term recovery for affected firms and individuals with sufficient resources to bounce back within the year. In the longer term, however, slower recovery speed reflects resource constraints that prevent immediate restoration, but also heightened perceptions of the LGAs' flood risk from prospective residents, tourists and investors. These perceptions can stifle the focus LGAs' recovery by stymying inflows of economic resources.

Chart 4.1: Year by year flood impacts on each of the affected LGAs



Source: Deloitte Access Economics

Table 4.1: Flood impacts on each of the affected LGAs

	Mitchell	Moira	Murrindindi	Strathbogie
NPV (GVA)	-\$203M	-\$261M	-\$101M	-\$47M
Average annual employment impact	-192	-293	-47	-48

Source: Deloitte Access Economics

### State-wide impacts in the long-term

The results also reveal the importance of the focus LGAs for the rest of Victoria.

The floods are especially damaging for industries that trade with the focus LGAs. Food manufacturing suffers an NPV loss of \$9M, indicating that the relatively lower agriculture output from the focus LGAs inhibits the productive capability of food manufacturers elsewhere in Victoria. Losses are greatest, however, in industries that have invested in the focus LGAs. When the floods dampened the economic potential of the focus LGAs, it decreased the projected value added by the Victorian finance and business services industries outside these LGAs by an estimated NPV of \$54 million between the floods and 2030.

These effects demonstrate the intractable links between the fortunes of Victoria's LGAs. If the state wishes to continue reaping the benefits of trade, it must also form a united front of natural disaster resilience. Without this, vulnerable regions will continue to suffer intensely from natural disasters, and interdependencies among these regions will cause damages to ripple through the economy.

Table 3.2: Flood impacts outside the affected LGAs

	NPV (GVA)	Average annual employment impact	NPV (food manufacturing)	NPV (finance)
Rest of Victoria	-\$66M	-51	-\$9M	-\$34M

Source: Deloitte Access Economics

# Long-term sectoral impacts

Driving the large reduction in long-term output for the focus LGAs is an underlying vulnerability to flooding that is driven by its sectoral composition. The Shires' strengths are critical for their economic well-being and competitiveness, but they also become weaknesses with flood exposure, which undermines their long-term economic performance.

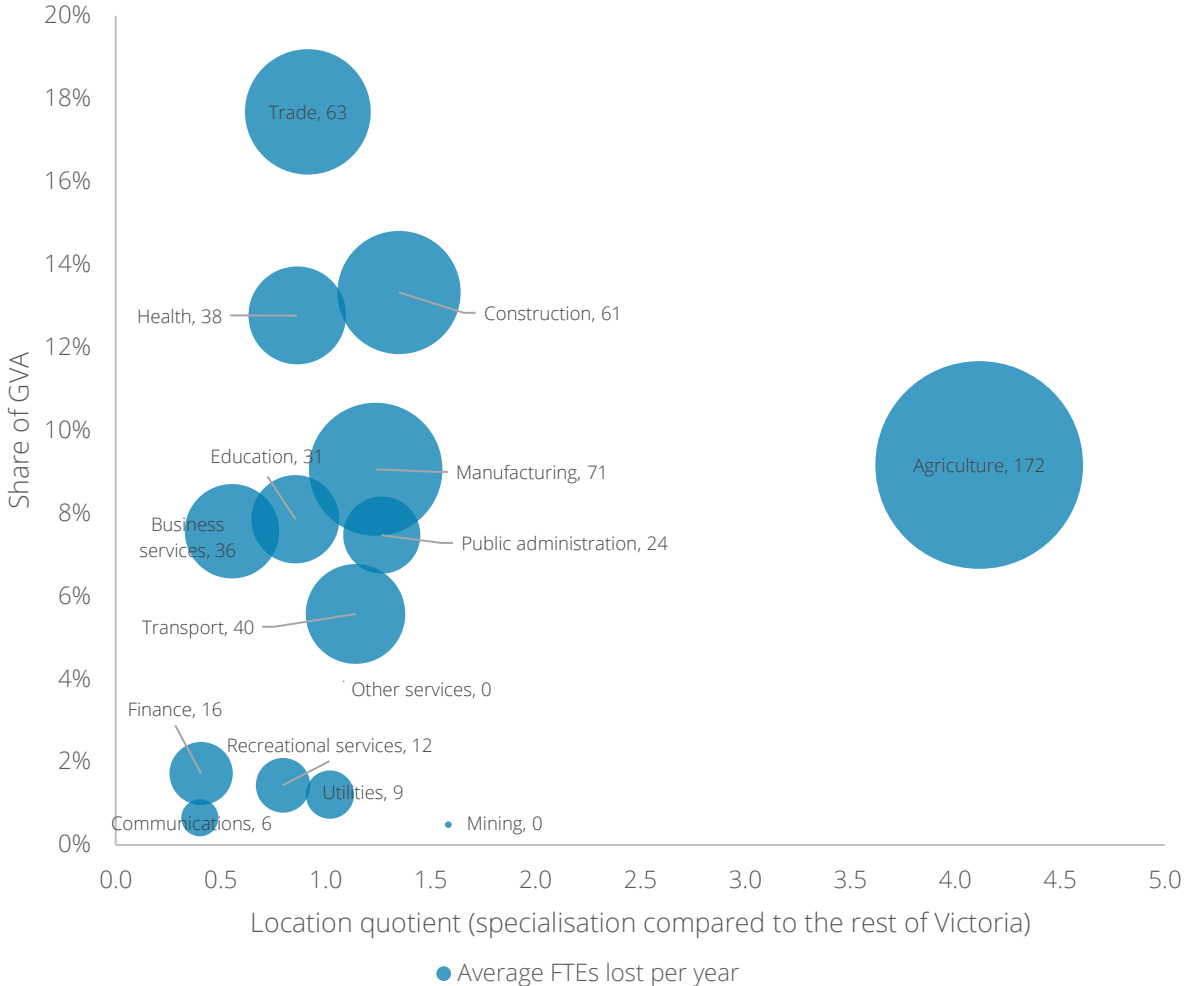
Agriculture is the most important sector across the focus LGAs. **Their combined economies are more than four times more agriculture-intensive than Victoria's**, with the sector contributing over 9% of jobs across the four LGAs. This indicates that their agriculture is valuable to both the focus LGAs and their state; their contribution to Victoria's food basket comfortably exceeds their size, but the employment is also vital to sustaining local communities.

The concentration of agriculture in the focus LGAs, however, increases their flood exposure. **Employment in their agriculture sector is an average of 172 jobs lower across the modelled period** due to the flood's impacts. Agriculture also experiences the largest NPV loss of any sector due to the flood, with damages totalling \$144M. This amounts to approximately 24% of the NPV of damages across the focus economies.

Impacts are also prominent in other sectors where the LGAs have competitive advantages over the rest of Victoria. The trade workforce, which captures a large portion of the LGAs' tourism activity, loses an average of 63 jobs a year between 2022 and 2030 because of the floods. Large job losses are also observable in other sectors of strength for the LGAs, including construction and manufacturing.

The correlation between flood vulnerability and the competitive strengths of the focus LGAs underscores the value of resilience at the sectoral level. The fact that certain sectors are so overrepresented in the economic structures of these Shires indicates that they are better suited to operate in these industries than most places, and that this buyers recognise this advantage across the rest of the state. Consequently, flood resilience will not only fortify the Shires' competitive strengths, but also ensure that buyers along the supply chain have access to the best products on the market.

Chart 4.2: Sectoral employment impacts of the floods



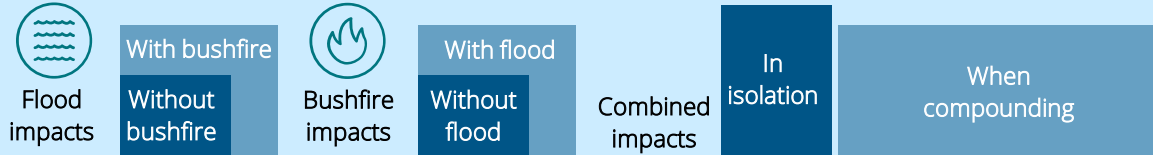
Source: Deloitte Access Economics, ABS

# Case study: Compounding costs in Murrindindi

Murrindindi Shire is emblematic of the 'compound disasters' faced by many Australian communities. In a trend that will intensify as climate change makes disasters more frequent and severe, a community faces 'compound disasters' when it faces one disaster without adequate time to recover from the effects of another.<sup>104</sup>

Murrindindi's exposure to the floods comes less than 15 years after it bore the brunt of Australia's deadliest natural disaster since colonisation, the Black Saturday bushfires. While the floods destroyed over \$20 million in agricultural assets – 10% of the gross value of agricultural production in the LGA<sup>105</sup> – Black Saturday left an inimitable mark on the Shire. One hundred and six of the 173 that died in the bushfires lived in Murrindindi, and the fires torched over 40 percent of the its landmass.<sup>106</sup> Although over \$400 million was raised to assist the Shire, it has continued to suffer in Black Saturday's aftermath.<sup>107</sup>

Figure 4.4: Compound disasters and their impacts on affected communities



Source: Deloitte Access Economics, based on CSIRO (2021)

There is evidence that compound disasters intensify the consequences for affected regions.<sup>108</sup> If resources are being spent addressing the costs of one disaster, the task of addressing another becomes more challenging. Compound disasters also exacerbate the burden on victims' mental health, with Red Cross research indicating that compound disaster exposure increases feelings of 'hopelessness for the future'.<sup>109</sup>

It is critical that decision-making around natural disaster resilience does not consider their effects in isolation, but instead adopt a resilience approach that accounts for the increasing risk of compound disasters. Without resilience frameworks that account for compound disaster risk in places like Murrindindi, the long-term economic consequences of disasters will snowball and dampen growth trajectories in vulnerable communities.<sup>110</sup>

Figure 4.5: Destroyed properties in Marysville, Murrindindi Shire, following the 2009 Black Saturday bushfires.



Source: ABC.

# Appendix 1: Regional profiles.

Breakaway Bridge, Acheron, following flood  
damage.  
Source: Joel Bramley Photography

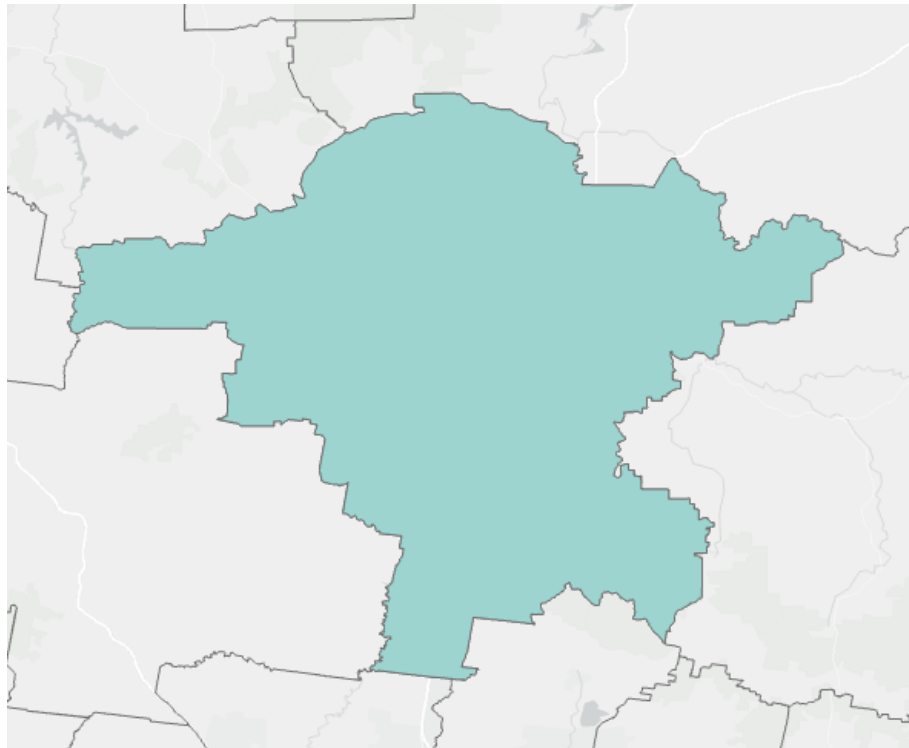


# Regional Profile – Shire of Mitchell

## Mitchell Overview

The Shire of Mitchell is headquartered in Seymour. It has a population of 49,460 and a median age of 36, making it the largest and youngest of the focus LGAs. It has a gross regional product of \$1,786 million, driven by construction, logistics and defence. These strengths are supported by its strategic location on the Hume Highway. While Mitchell's reliance on efficient transport routes adds an element of flood risk, its stronger economic diversity is an asset for resilience.

Figure A1.1 Map of Mitchell



## Headline Statistics (2021)

GRP (\$ million)	Median age	Population (5 year CAGR)	Total dwellings	Businesses (% <20 FTEs)
1,786	36	49,460 (3.86%)	14,948	3,437 (98.6%)

Source: RDV; ABS (Census 2021, Count of Australian Businesses)

## Top 7 Industries (2021)

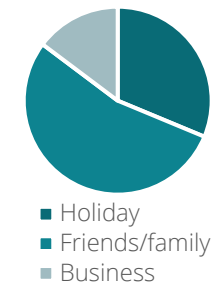
Industry	Employees	Businesses
Construction	3439	948
Health and social assistance	2782	119
Public administration and safety	2284	13
Manufacturing	2030	160
Retail	1914	167
Education	1740	50
Transport, postal and warehousing	1576	409

Source: ABS (Census 2021).

## Tourism (2019)

Key tourism statistics	
Tourism businesses	339
Annual visitors	748,000
Annual visitor expenditure	\$89 million

### Reasons to visit



Source: TRA (Local Government Area Profiles)

## Top Industries of Specialisation

Industry	Location Quotient
Public administration and safety	1.77
Construction	1.56
Transport, postal and warehousing	1.44

Source: ABS (Census 2021)

Mitchell's specialisation in **public administration and safety** arises from the **Puckapunyal Army Base**, which sits in the Shire's north. **Strong residential development** in its south and its **strategic positioning on the Hume Highway** drive its specialisation in **construction** and **transport** respectively. Unlike the other three focus LGAs, Mitchell does not specialise in agriculture relative to the rest of Victoria.

## Natural Disaster Context (2016)

### Flood risk: 39<sup>th</sup> percentile of national LGAs

According to Insurance Australia Group modelling, 2% of properties in Mitchell will be flooded in a 1 in 100 year flooding event. This places it in the 39<sup>th</sup> percentile of Australian LGAs, where the 1<sup>st</sup> percentile contains the most at-risk LGAs

### Disaster Resilience: Moderate

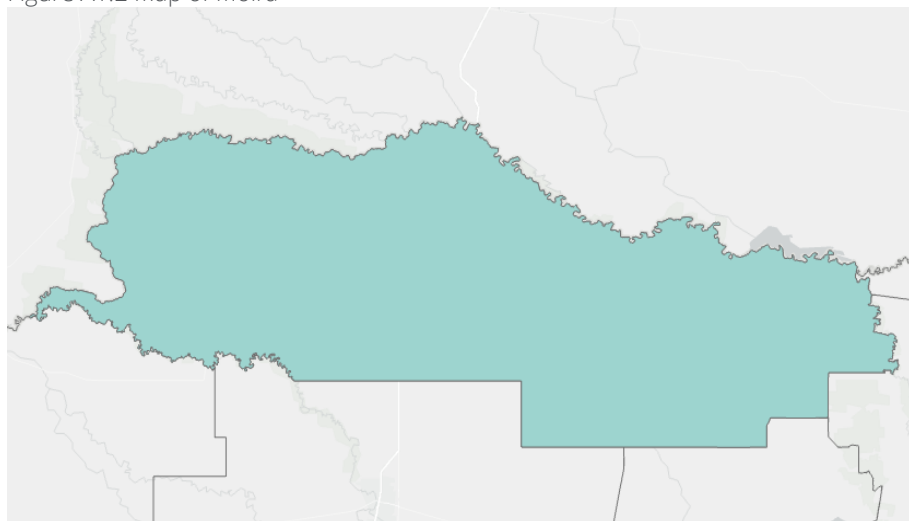
The Australian Disaster Resilience Index (ADRI) rates Mitchell's resilience as 'moderate'. The ADRI estimates a region's capacity to respond to a disaster by assessing its community, social and economic resources, disaster risk management and governance.

# Regional Profile – Shire of Moira

## Moira Overview

Moira Shire Council governs a population of 30,522 from its headquarters in Cobram. The median age in the Shire is 45, and population growth has been slow compared to other Shires. Agriculture contributes over 40% of the Shire's \$1,657 million GRP. The agricultural underpinnings of Moira's economy are diverse, with competitive strength in a number of livestock and cropping sub-sectors, as well as a range of fruits and nuts. Moira's location on the Murray River also supports a range of tourist activities.

Figure A1.2 Map of Moira



## Headline Statistics (2021)

GRP (\$ million)	Median age	Population (5 year CAGR)	Total dwellings	Businesses (% <20 FTEs)
1,657	45	30,522 (0.95%)	14,948	3,060 (98.5%)

Source: RDV; ABS (Census 2021, Count of Australian Businesses)

## Top 7 Industries (2021)

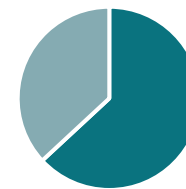
Industry	Employees	Businesses
Agriculture	1,995	1,116
Health and social assistance	1,700	86
Manufacturing	1,414	136
Construction	1,248	414
Retail	1,181	148
Food/accommodation services	932	130
Education	910	17

Source: ABS (Census 2021).

## Tourism (2019)

Key tourism statistics	
Tourism businesses	114
Annual visitors	367,000
Annual visitor expenditure	\$60 million

### Reasons to visit



- Holiday
- Friends/family

Source: TRA (Local Government Area Profiles)

## Agriculture (2020-21)

Key commodities	Value (\$m)	Location quotient
Fruit and nuts	147	19.35
Dairy	140	13.80
Wheat	121	24.51
Meat cattle	85	9.29
Canola	74	31.09
<b>Total</b>	<b>679</b>	<b>11.37</b>

Source: ABARES

## Natural Disaster Context (2016)

### Flood risk: 11<sup>th</sup> percentile of national LGAs

According to Insurance Australia Group modelling, 14% of properties in Mitchell will be flooded in a 1 in 100 year flooding event. This places it in the 11<sup>th</sup> percentile of Australian LGAs, where the 1<sup>st</sup> percentile contains the most at-risk LGAs.

### Disaster Resilience: Moderate

The Australian Disaster Resilience Index (ADRI) rates Moira's resilience as 'moderate'. The ADRI estimates a region's capacity to respond to a disaster by assessing its community, social and economic resources, disaster risk management and governance.

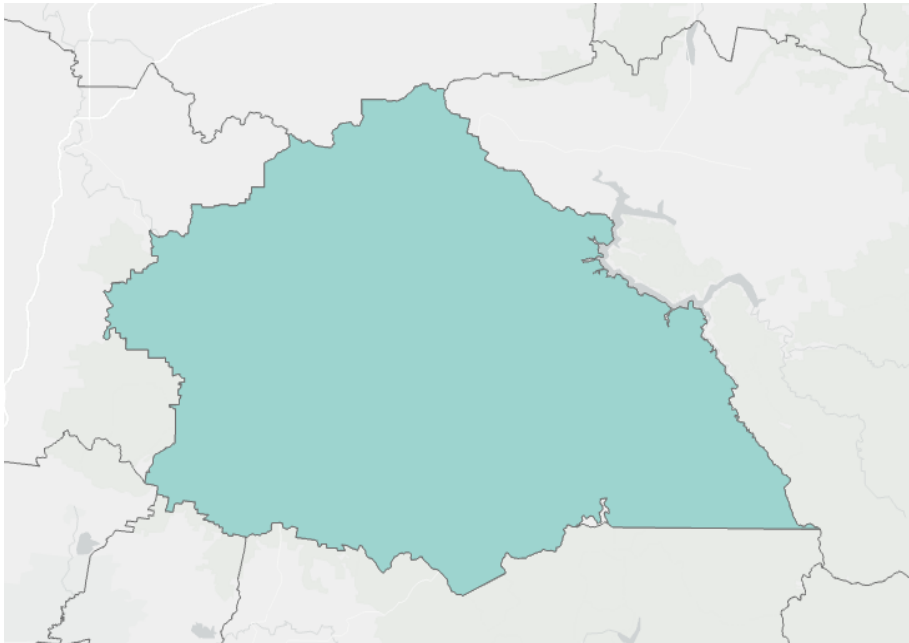
# Regional Profile – Shire of Murrindindi

## Murrindindi Overview

The Shire of Murrindindi is headquartered in Alexandra. It has a population of 15,197 and a median age of 50. The shire's \$564 million gross regional product is supported by a strong agriculture sector with presences in a diverse range of animal- and plant-based sectors. Tourism is also a large employer in the shire, and it has a growing houseboat industry.

Murrindindi was severely affected by the 2009 Black Saturday bushfires. Across the shire, 106 lives were lost and over 40% of the land was burnt. The bushfires hardened disaster resilience across the Shire, though its investments have not generally targeted floods.

Figure A1.3 Map of Murrindindi



## Headline Statistics (2021)

GRP (\$ million)	Median age	Population (5 year CAGR)	Total dwellings	Businesses (<20 FTEs)
564	50	15,197 (2.59%)	8,349	1,800 (98.8%)

Source: RDV; ABS (Census 2021, Count of Australian Businesses)

## Top 7 Industries (2021)

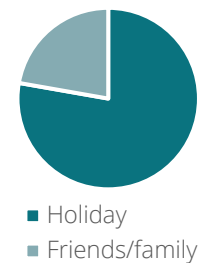
Industry	Employees	Businesses
Construction	968	378
Health and social assistance	799	33
Agriculture	707	524
Education	598	20
Retail	509	90
Food/accommodation services	598	20
Public administration and safety	439	5

Source: ABS (Census 2021).

## Tourism (2019)

Key tourism statistics	
Tourism businesses	192
Annual visitors	1,004,000
Annual visitor expenditure	\$114 million

## Reasons to visit



Source: TRA (Local Government Area Profiles)

## Agriculture (2020-21)

Key commodities	Value (\$m)	Location quotient
Meat cattle	58	18.62
Flower nurseries	45	73.77
Poultry	25	23.30
Cherries	24	153.15
Sheep and lambs	19	6.02
<b>Total</b>	<b>191</b>	<b>9.39</b>

Source: ABARES

## Flood risk (2016)

**Flood risk: 20<sup>th</sup> percentile of national LGAs**

According to Insurance Australia Group modelling, 14% of properties in Mitchell will be flooded in a 1 in 100 year flooding event. This places it in the 20<sup>th</sup> percentile of Australian LGAs, where the 1<sup>st</sup> percentile contains the most at-risk LGAs.

**Disaster Resilience: Moderate**

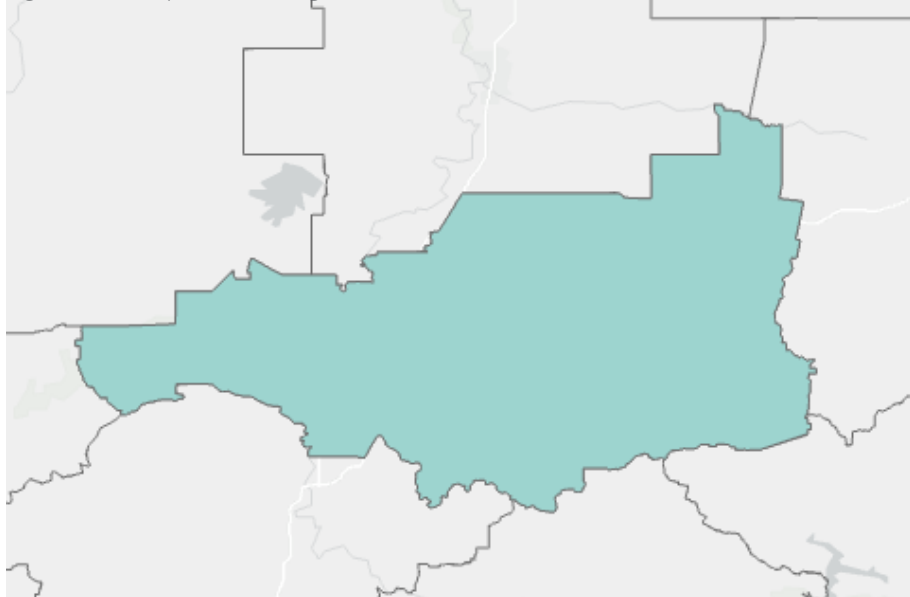
The Australian Disaster Resilience Index (ADRI) rates Murrindindi's resilience as 'moderate'. The ADRI estimates a region's capacity to respond to a disaster by assessing its community, social and economic resources, disaster risk management and governance.

# Regional Profile – Shire of Strathbogie

## Strathbogie Overview

The Shire of Strathbogie is headquartered in Euroa. It has a population of 11,455 and a median age of 53, both of which have increased over the past five years as the LGA has become a more desirable lifestyle market for older Victorians. The Shire has a gross regional product of \$506 million, over a third of which derives from its agriculture sector. The Shire's unique agricultural strength is its equine industry, which has led Strathbogie to be coined 'Victoria's Thoroughbred Homeland'. Its manufacturing and construction sectors are also relatively large, and its aging population has expanded its health care workforce.

Figure A1.4 Map of Strathbogie



## Headline Statistics (2021)

GRP (\$ million)	Median age	Population (5 year CAGR)	Total dwellings	Businesses (% <20 FTEs)
506	53	11,455 (2.20%)	6,164	1,427 (99.2%)

Source: RDV; ABS (Census 2021, Count of Australian Businesses)

## Top 7 Industries (2021)

Industry	Employees	Businesses
Agriculture	909	637
Health and social assistance	602	23
Construction	478	175
Education	355	12
Retail	326	43
Public administration and safety	316	3
Manufacturing	307	61

Source: ABS (Census 2021)

## Tourism (2019)

Key tourism statistics	
Tourism businesses	114
Annual visitors	367,000
Annual visitor expenditure	\$60 million

### Reasons to visit



■ Holiday  
■ Friends/family

Source: TRA (Local Government Area Profiles)

## Agriculture (2020-21)

Commodity	Value (\$m)	Location quotient
Sheep and lambs	19	26.86
Poultry	43	44.67
Meat cattle	24	8.59
Wheat	9	5.97
Cherries	8	56.90
<b>Total</b>	<b>182</b>	<b>9.98</b>

Source: ABARES

## Flood risk (2016)

**Flood risk: 4<sup>th</sup> percentile of national LGAs**

According to Insurance Australia Group modelling, 29% of properties in Mitchell will be flooded in a 1 in 100 year flooding event. This places it in the 4<sup>th</sup> percentile of Australian LGAs, where the 1<sup>st</sup> percentile contains the most at-risk LGAs.

**Disaster Resilience: Low**

The Australian Disaster Resilience Index (ADRI) rates Strathbogie's resilience as 'low'. The ADRI estimates a region's capacity to respond to a disaster by assessing its community, social and economic resources, disaster risk management and governance.



# Appendix 2: Overview of costs.

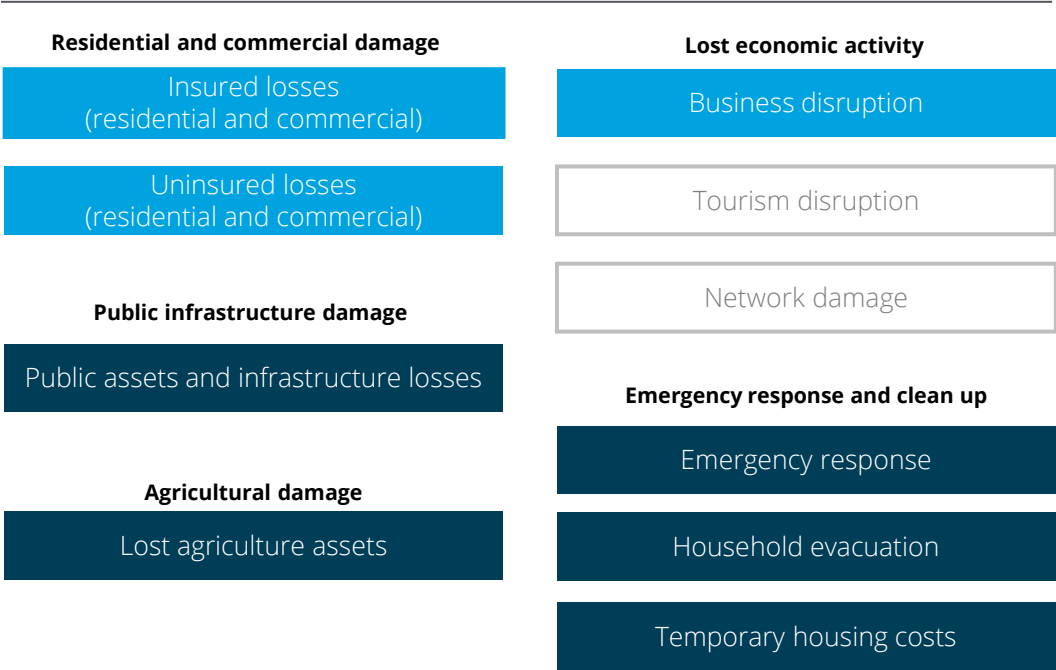
Breakaway Bridge, Acheron, following flood  
damage.  
Source: Joel Bramley Photography



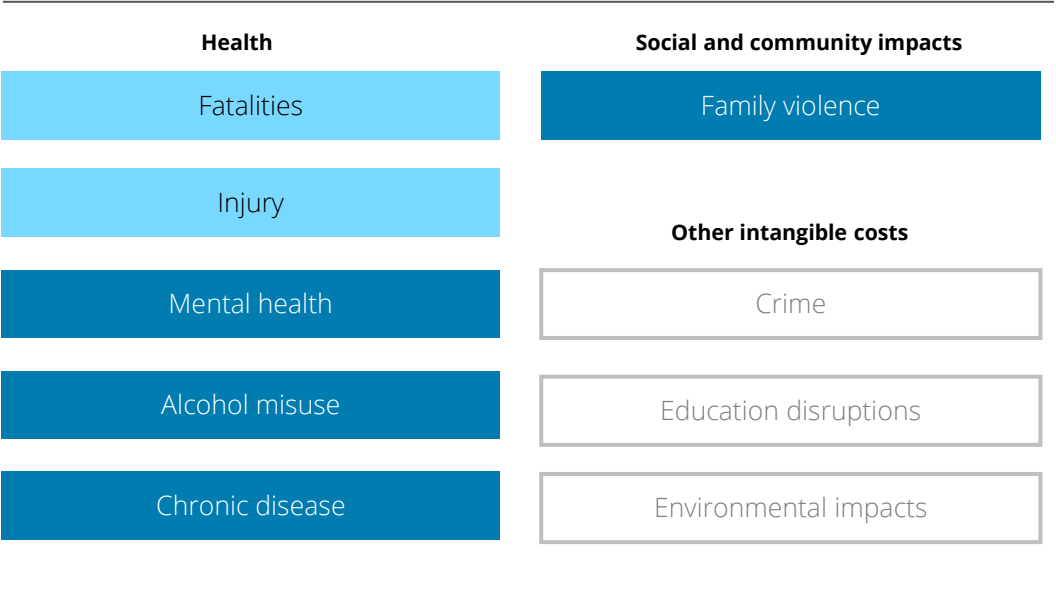
# Overview of social, financial and economic costs

Deloitte Access Economics has estimated the social, financial and economic costs of the 2022 Victorian floods on the shires of **Mitchell, Moira, Murrindindi** and **Strathbogie** with the following framework, which categorises and values the costs associated with natural disasters. The framework has previously been used to estimate the cost of natural disasters across Australia, including the 2011 and 2022 South East Queensland floods and the 2019 North and Far North Queensland Monsoon. Under this framework, two key types of costs, tangible and intangible, were identified within which specific and relevant costs were categorised. For this analysis, the focus has been tailored to reflect the unique economic structure of the focus LGAs – namely, the importance of agriculture and tourism to the economic health of the affected LGAs.

## Tangible Costs



## Intangible Costs



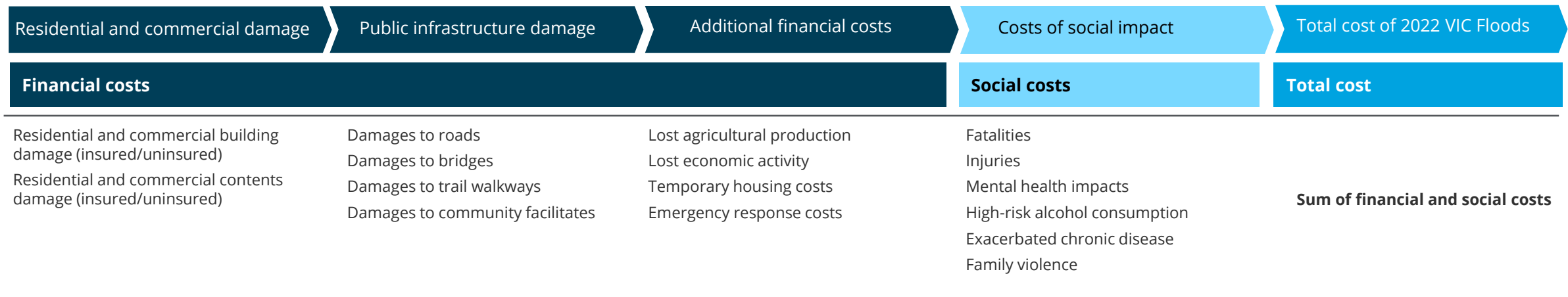
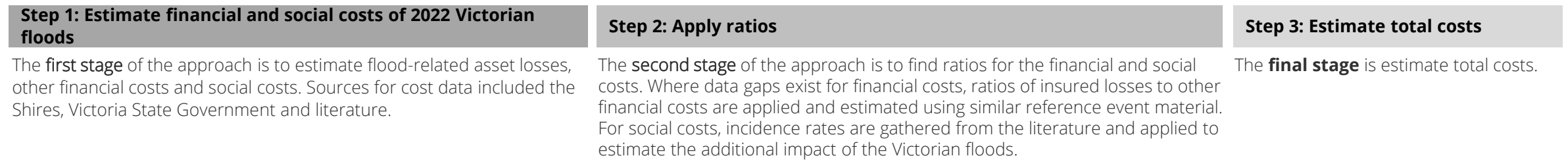
### Key

- Financial costs from private asset damage
- Other financial costs
- Death and injury
- Other social costs
- Items not included in cost estimates

# Approach

Deloitte Access Economics used the following methodology to estimate the social, financial and economic costs of the 2022 Victorian floods on the Shires of Mitchell, Moira, Murrindindi and Strathbogie. There are three main steps in this methodology: 1) estimating the cost associated with each cost category; 2) estimating any ratios or incidence rates; and 3) summing the financial and social costs associated with the event. Financial costs are assumed to occur fully in the financial year of the flood, social costs are measured with NPVs to capture their tendency to impact affected populations over 76 years. Refer to the Technical Appendix for further detail on the approach.

The data collection process ran between March 2023 and June 2023.



# Technical methodology

## Overview

The methodology utilised in this paper is aligned to the methodologies used by Deloitte Access Economics in previous costings of natural disasters, particularly the South East Queensland Floods, as the scale of the events are similar. The approach taken has drawn on the following reports:

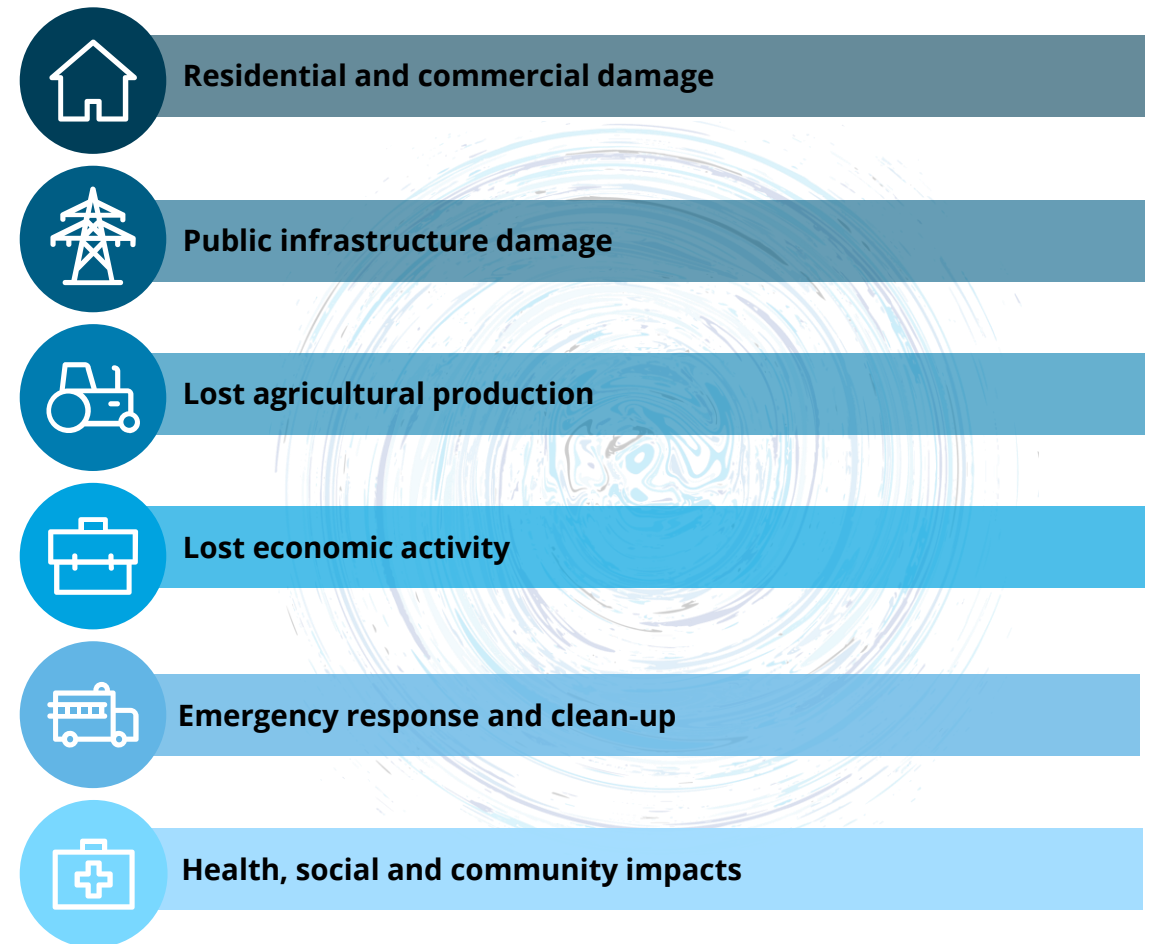
- A **BTE 2001**<sup>111</sup> report which developed a framework for estimating the economic cost of natural disasters. This report has become a standard piece of literature to inform approaches and methodologies in costing natural disasters.
- **Deloitte Access Economics**<sup>112</sup> report commissioned by the Australian Business Roundtable to estimate the economic cost of the social impact of natural disasters. This report revised the BTE framework to enable the estimation of broader, longer-term social costs of natural disasters, including impacts on health and wellbeing.
- **Deloitte Access Economics**<sup>113</sup> report which utilised this established methodology and applied it to the Monsoon Trough in 2019. This report utilised a bottom-up approach to costing the disaster, whilst also applying the ratios developed in previous reports to fill in data gaps.

This approach has been refined and validated over time, and has now been applied to the 2022 Victorian floods in order to estimate the tangible and intangible costs associated with the flood disaster. These are defined as follows:

- **Intangible costs** are the direct and indirect impacts that cannot be easily monetised. These can include the social costs associated with fatality, injury, and disease. These costs tend to persist over a person's lifetime.
- **Tangible costs** are the direct and indirect impacts that are easily monetised. These costs are often one-off costs that are associated with the natural disaster being investigated. These can include the financial costs associated with infrastructure damage, contents damage, business disruption and clean-up costs.

See Figure A2.1 for an overview of the costs included in this estimation.

Figure A2.1: Monetised costs in this report



# Technical methodology

## Assumptions and methodology

### Population

This report has considered the social impact of the Victorian flood to four impacted LGAs. ABS 2020 population data assumed to be equal to affected population.

### Estimating the incidence of social impacts

The incidence of social impacts included in this cost estimate was largely determined through a literature review. Through this literature review, the following social impacts were identified as having sufficient evidence to be quantified:

- Fatalities and physical injury
- Mental health issues
- Alcohol misuse
- Chronic disease
- Family violence

Notably, there was no published figures on injuries sustained in the 2022 Vic Floods. As such, injuries incurred during the 2011 floods was used as a proxy, scaled by the number of houses affected in each disaster.

Incidence rates were derived from literature, alongside the additional impact caused by the natural disaster. Evidence also suggests that the incidence of social impacts due to natural disasters drops off slowly after the event occurs. As such, the incidence rate is applied fully in the first year, and then drops by one-third every year, to 5% of the rate by the fourth year post-disaster. This reflects the spike in social impacts associated with the event, but also evidence that after this spike, most people will recover over the medium- to long- term. It is important to note, however, that not everyone will ever recover from a traumatic event, such as the floods, as such it is assumed that a small proportion of people will experience life-long impacts.

These life-long impacts are estimated using the average remaining life expectancy for the affected population, split by Adult Male (32), Adult Female (34), Child Male (73) and Child Female (77). This calculation utilised ABS life tables of remaining life expectancy at each age.

Beyond literature research, Household, Income and Labour Dynamics in Australia (HILDA) survey data was also utilised to find incidence rates for certain social impacts. This was derived from a 2017 difference-in-difference of HILDA data used in the DAE report commissioned for the ABR, and it was assumed that the impact of floods on these social impacts is unlikely to have changed significantly from when this analysis was last conducted. The incidence rates derived from this analysis was compared between those who experienced a natural disaster and those who did not to identify the additional incidence of those impacts caused by natural disasters.

### Estimating the unit cost of social impacts

A literature review was also utilised to identify the associated unit cost of each of the social impacts quantified. Each unit cost was indexed to 2022 dollars, and multiplied by the incidence of social impacts.

In some cases, a unit cost could not be found, however, the literature review was able to identify the proportion of the total costs for each outcome that could be attributed to each of the cost categories. This largely involved identifying studies that had investigated a larger population level, and the cost by each category identified was then divided by the total cost to determine the proportion. This proportion was then applied to the total costs of each outcome.

# Technical methodology

## Assumptions and methodology (cont.)

### Estimating the tangible costs

Victorian State Government provided estimates for some of the tangible costs included in this report. However, some data gaps remained that could not be filled, and as such, where primary data could not be used, these costs were estimated using Building our Nation's Resilience to Natural Disasters methodology.

Given that total insured losses was able to be estimated using average houses prices and average loss data, this report utilised previous ratios estimated for the 2010-11 floods and applied them to financial cost categories with data gaps. These ratios can be seen in Table 2.

Table A2.1: Tangible cost estimates for 2010-11 Queensland Floods

	% of total cost	\$m (2011)
Insured	47.9	\$1,266
Uninsured	22.4	\$593
Cat B	26.3	\$696
Agricultural production losses	0.002	\$0.04
Evacuated	0.003	\$0.09
Homeless	0.6	\$16
Homes – damaged	0.2	\$6
Commercial – damaged	0.04	\$1
Emergency response costs	2.5	\$65
<b>Total</b>	<b>100</b>	<b>\$2,644</b>

Source: Deloitte Access Economics, The social financial and economics costs of the 2022 South East Queensland Rainfall and flooding event (2022)

### Data limitations

This report was constructed in a relatively short-time frame after the event, and as such data is still being collected and the full impact is still being discovered (as an example, it can take up to three years for insurance claims to be collected on a particular disaster event).

As such, the social and economic cost estimate derived in this report is based on available data and information at the time of writing as at July 2023. This is likely a conservative estimate given data limitations, and as such, additional data is expected to most likely increase this estimate.

Furthermore, costs included in this report should not be considered as a 'total cost' assessment. Some of the costs estimated are temporary one-off costs, such as clean-up costs, whilst others are likely to have long-lasting impacts on affected populations, such as mental health and chronic disease. A cost-benefit analysis has not been undertaken to account for the timing and duration of identified impacts.

# Technical methodology

Data from the Victorian State Government was requested in reference to the Victoria Rainfall and Flooding event. The data collection process ran between April 2022 and June 2022. The specific dates of data provided to Deloitte Access Economics, is specified below.

## List of data sources

Type of cost	Damage category	Magnitude of impact	Source
Tangible	Residential and commercial damage	<ul style="list-style-type: none"> <li>Number of damaged properties, 132 damaged, 59 liveable, 56 unliveable and 17 destroy/demolished</li> </ul>	Emergency Recovery, Victoria State Government
		<ul style="list-style-type: none"> <li>Average value of properties in Mitchell \$631,381, Moira \$558,952, Murrindindi \$6115.23 and Strathbogie \$500,233</li> </ul>	Department of Transport and Planning, Victoria State Government
		<ul style="list-style-type: none"> <li>Average loss value of properties in the Victorian, NSW and Tasmanian floods</li> </ul>	Insurance Council of Australia
Tangible	Public infrastructure damage	<p>Across Mitchell, Moira, Murrindindi and Strathbogie the following damages to public infrastructure occurred:</p> <ul style="list-style-type: none"> <li>43 km of bridges damaged</li> <li>479 km of roads damaged</li> <li>30 kms of trail walkways damaged</li> </ul>	Emergency Recovery, Victoria State Government
		<ul style="list-style-type: none"> <li>Approximately \$6.6 M of damage to community facilities</li> </ul>	Emergency Recovery, Victoria State Government
		<ul style="list-style-type: none"> <li>Ratio of approximately \$256,000/km of road damaged has been estimated</li> </ul>	DAE, The social, financial and economic costs of the 2022 South East Queensland Rainfall and Flooding Event
Tangible	Lost economic activity	<ul style="list-style-type: none"> <li>Gross regional Product Numbers for each of the four Local Government Areas</li> </ul>	regional Development Victoria, Victoria State Government
		<ul style="list-style-type: none"> <li>Consumption data for October and November and estimations used for December</li> </ul>	Department of Jobs, Skills, Industry and Regions, Victoria State Government
Tangible	Agricultural damage	<ul style="list-style-type: none"> <li>Agricultural Asset Losses of \$108 million for Mitchell, Moira, Murrindindi and Strathbogie</li> </ul>	Department of Jobs, Skills, Industry and Regions, Victoria State Government

# Technical methodology

## List of data sources

Type of cost	Damage category	Magnitude of impact	Source
Tangible	Emergency response and clean-up costs	<ul style="list-style-type: none"> <li>Temporary housing costs \$150 - \$170 per night per person</li> </ul>	Emergency Recovery, Victoria State Government
		<ul style="list-style-type: none"> <li>Average household size for Mitchell, Moira, Murrindindi and Strathbogie</li> </ul>	Emergency Recovery, Victoria State Government
		<ul style="list-style-type: none"> <li>0.007% ratio of insured to evacuation costs has been estimated</li> </ul>	DAE, The economic cost of the social impact of natural disasters.
		<ul style="list-style-type: none"> <li>5.1% ratio of insured to emergency clean-up costs has been estimated</li> </ul>	DAE, The economic cost of the social impact of natural disasters.
Intangible	Human, social and community impacts	<p>Following the flood event the following health data has been provided for Mitchell, Moira, Murrindindi and Strathbogie:</p> <ul style="list-style-type: none"> <li>133 people were impacted by (or assisted for) their mental health</li> <li>23 people were assisted for alcohol and drug misuse</li> <li>37 people were assisted for chronic disease</li> </ul>	Emergency Recovery, Victoria State Government



# Technical methodology

## Sensitivity Analysis

### Social discount rate

In this report, a 7% discount rate was utilised to find the present value costs of lifelong health and social costs. This value was used as it is standard practice for infrastructure and financial cost analysis, however, many of the costs estimated in relation the Victoria 2022 Rainfall and Flooding event are social in nature. Social discount rates are typically lower given that they place higher value on future costs.<sup>1</sup> As such, we tested the sensitivity of the result using a 4% social discount rate.

In order to examine the reasonableness of assumptions regarding the social discount rate utilised, Table 3 represents the estimated health and social costs under a social discount rate of 4%. Lowering the social discount rate puts a greater weight on the future costs to health and society from the current disaster, and thus increases the present day value of those social costs.

Under a scenario where the social discount rate of 4% is used, the health and social costs are estimated to be a total of \$1.7 billion.

As such, a lower social discount rate does not drastically affect the overall value of health and social costs. This is largely due to the assumptions utilised in estimating the health and social costs, which spread these costs such that the largest impact occurs in the first two years following the event, before the impacts diminish significantly over the lifetime of affected individuals (refer to Page 27).

Table A2.2: Sensitivity Analysis, Social Discount Rate 4%

Type of cost	Damage category	Cost (\$ million)
Tangible	Financial costs	\$423
Intangible	Fatality	\$4
	Injury	\$0.5
	Mental health	\$605
	Alcohol misuse	\$7
	Chronic disease	\$355
	Family violence	\$286
<b>Total</b>		<b>\$1,681</b>

# Appendix 3: CGE Modelling.

Breakaway Bridge, Acheron, following flood  
damage.  
Source: Joel Bramley Photography



# Modelling the long-term impacts of the floods

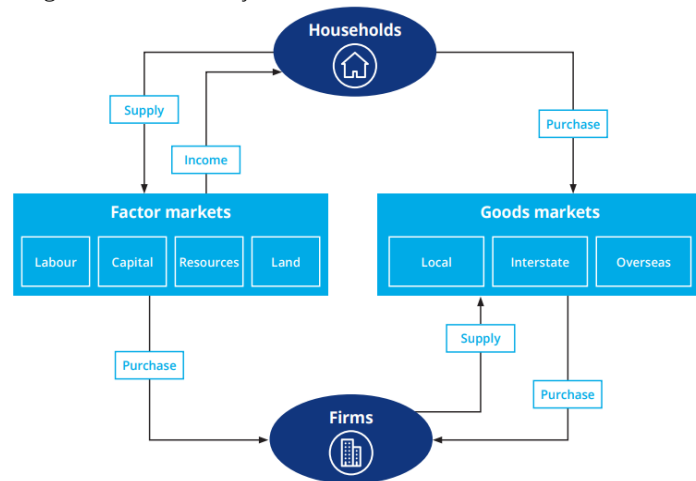
## CGE Modelling

The full impacts of the floods cannot be captured with a point-in-time estimate, because the consequences affect behaviour in the economy for years after the flood occurs. To understand how the Victorian floods impact these areas in the long run, this report uses Deloitte Access Economics' in-house computable general equilibrium (CGE) D.CLIMATE model. CGE modelling is a preferred tool for understanding the long-term impact of economic changes because it incorporates:

- resource constraints (the use of labour or capital by one activity or industry comes at the expense of its use elsewhere)
- the possibility of changes in the mix of inputs used in production due to changes in relative prices or technology
- responsiveness of prices and other variables to economic changes affecting things like budgetary support to industry, productivity and workforce participation.

In the context of the Victorian floods, using CGE modelling allows the long-term impact estimate to capture the responses of actors to the flood's effects. For example, CGE modelling will capture an outflow of agriculture workers if agricultural capital is destroyed, but it will also show that many of these workers will then become employed in similar, less affected sectors like construction.

**Figure A3.1:** Stylised representation of how DAE-RGEM models the impacts of 'shocks' throughout the economy.



Source: Deloitte Access Economics

## Scenario Description

Within the CGE framework, the Victorian floods are represented by shocks to **population growth**, **labour productivity**, **tourism** and the **capital stock** in the affected LGAs. It is important to note that this is not an exhaustive list of the economic impacts of the floods, but instead reflects those that can be supported by a robust evidence base. These aspects of the project are introduced to the shock scenario, with effects tapering in subsequent years in accordance with the literature.

## Modelling the Project

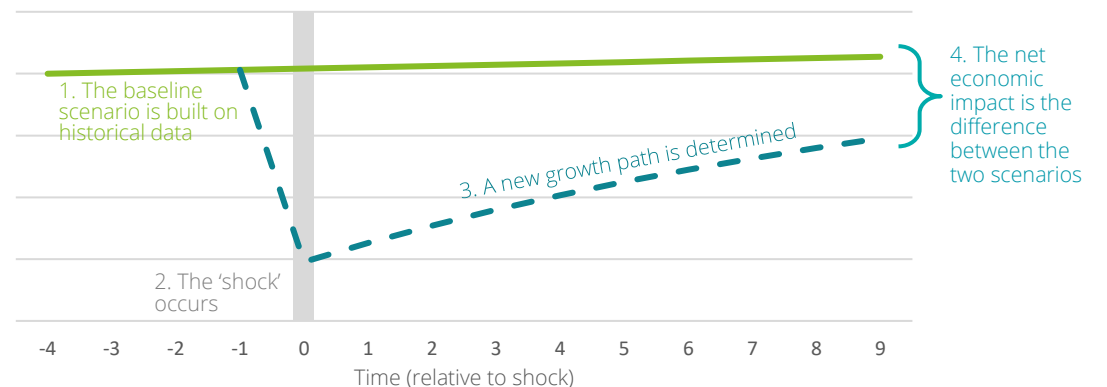
CGE models estimate economic impacts by comparing a policy scenario against a baseline. Figure 1 provides a stylised representation of the CGE modelling methodology.

The baseline (1) refers to a world without the Victorian floods. The policy – or, in this case, flood – scenario (3) is developed by introducing the shock to the baseline scenario (2). The shock to the baseline for this analysis apply to **population growth**, **labour productivity**, **tourism** and the **capital stock**.

CGE models then solve for the market-clearing (equilibrium) levels of demand and supply across all specified goods and factor markets in the economy. This effectively creates a new path for the economy over time (3). This new path is typically referred to as the flood scenario.

Comparing the growth path for the flood scenario to that of the baseline (where the change does not occur), shows the economic impact of the project (4).

**Figure A3.2:** Stylised representation of economic impact modelling using a CGE framework



Source: Deloitte Access Economics

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Sobraon Street, Shepparton.  
Source: Megan Fisher



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