THE BOTTOM-UP LOGIC OF COMMUNITY-LEVEL DISASTER RESPONSE AND CLIMATE RESILIENCE

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Presentation to

Virtual workshop

CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY-WATER RESPONSE

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Summary

This paper explains why the Evans Area Resilience Network (EARN) undertook a detailed scenarios-based quantitative investigation of climate-amplified disasters in this region, how it went about this enquiry, and describes some of its preliminary results. It argues that bottom-up, community-level disaster response is an essential but overlooked complement to official and market-based emergency services. The investigation reported in the paper was prompted by the 2022 Northern Rivers flood, when Evans Head, a town of about 3,100 residents, sheltered about 1,200 flood refugees, many evacuated by a local "tinnie flotilla"—an informal community-level provision of rescue, evacuation and housing that as with many locations in the flooded region, matched or exceeded the official emergency response.

When (EARN) looked for analytic tools to prepare for future emergencies, it found almost none designed for community-level emergency energy relief and recovery for future, climate-amplified disasters. This gap prompted it to create and apply its own tool to support EARN's objective of identifying ways to enhance community resilience. In discussions with colleagues in the water sector, we found a similar gap existed which prompted this workshop.

The paper defines four terms used by EARN in this work. "Local" means the lowest level of collective effort that is not directly dependent on state agencies or markets, although who speaks for a locality is often contested and opaque; for analysis, EARN uses postcode 2473 in its analysis. "Disaster" is defined as an extreme, extraordinarily-damaging, potentially existentially-threatening, and highly disruptive event. EARN focuses on floods, bushfires, cyclones and storm surge, heatwaves and war-induced fuel scarcity. EARN modifies the term to become "climate-amplified disaster" which is a "normal" disaster that human-caused warming has made more likely, more intense, longer-lasting or more likely to combine with other hazards, marked by compound hazards, preconditioning, damage cascades, repeat events, unprecedented extremes and simultaneous regional impacts. Attribution science can estimate the share of risk due to climate change, but local vulnerability, such as new settlement on flood-prone land, also shapes impacts and must also be taken into account.

The paper defines "community resilience" as the ability to bend but not break while bouncing back better in the face of climate-amplified disasters. However, a 2026 Northern Rivers Community Foundation survey shows that although most local organizations now incorporate resilience into their core mission, largely without dedicated funding, many are exhausted to the point of collapse by the on-going demands of responding to the last (2022) crisis, let alone preparing for the next climate-amplified disaster. Replicating EARN's work in the region

therefore would entail other groups adjusting their horizon to include climate-amplification of disasters, not merely responding and adapting to past disasters; and mobilizing additional resources to do so.

In its application of the CADEER tool to Evans Head, EARN adopted Richmond Valley Council planning levels that incorporates estimated, science-based climate change impacts over the next century according to climate modelling. EARN initially adopted 3.69 m AHD (Australian Height Datum, defined below) at the site of one partner in this investigation, The Bowlo. This was set as the minimum flood level for a compound flood-heatwave scenario to be used to test The Bowlo's resilience in facing such a disaster. However, based on expert advice, the flood level was increased to a 1-in-500 years flood including climate change effects, a 4.22 m AHD) at The Bowlo.

Using energy as its lens, EARN's Team Lorikeet mapped Evans Head's energy supply and demand, load curves and greenhouse gas emissions; transport accounts for about three-quarters of energy use. The analysis identified common failure points: the town's single service station, which may lose power to pump fuel, and mobile networks that fail within hours of a power outage. This community-wide analysis of the disaster scenario provides the context for a "nested" analysis of The Bowlo's resilience. Based on preliminary results, EARN is deploying solar-powered Starlink nodes as a Backup Emergency Communication System (BEX) and is also working with The Bowlo on resilience measures that also improve routine efficiency as will be reported in other presentations at this workshop.

The paper began with a working premise that local adaptation can also drive mitigation, so that it is time to "adapt to mitigate." However, it concludes that the Northern Rivers experience raises more questions than answers as to the efficacy of this strategy. Disasters tend to centralize authority, devolution on paper has not been matched on the ground, and relations among agencies, markets and community groups were often conflictual, leaving local volunteers exhausted and with little influence.

Consequently, a revised working hypothesis is proposed in the conclusion: local capacity is substantial and should be nurtured without creating dependency, linked to official agencies through communication and coordination channels, aligned with official disaster scenarios, and shared globally through open-source and AI tools. In these circumstances, small, agile resilience groups such as EARN gain influence by documenting shortfalls and missing links, communicating insights to those able to act, and implementing iconic local initiatives. Thus, the question is left open as to whether community-level action can do more than stop-gap measures in ways that increase long-run resilience against the threats amplified by global climate change when combined with local factors that also drive vulnerability and impacts arising from climate-amplified disasters.

1. Thank you

I'd like to thank the contributing partners to this workshop—Nautilus and Pacific Institutes, Evans Area Resilience Network, and Energy Together (formerly Coalition for Community Energy).

I'd also like to acknowledge the financial support from the MacArthur Foundation's *Crossing Boundaries* program that enables MacArthur Fellows to conduct joint events like this one. I refer you to a short video linked here and on the webpage for more information on this initiative.

This paper also draws on the prior work of EARN's Team Lorikeet; and reviews by Rena Frohman and Lyuba Zarsky.

2. Why We Are Here

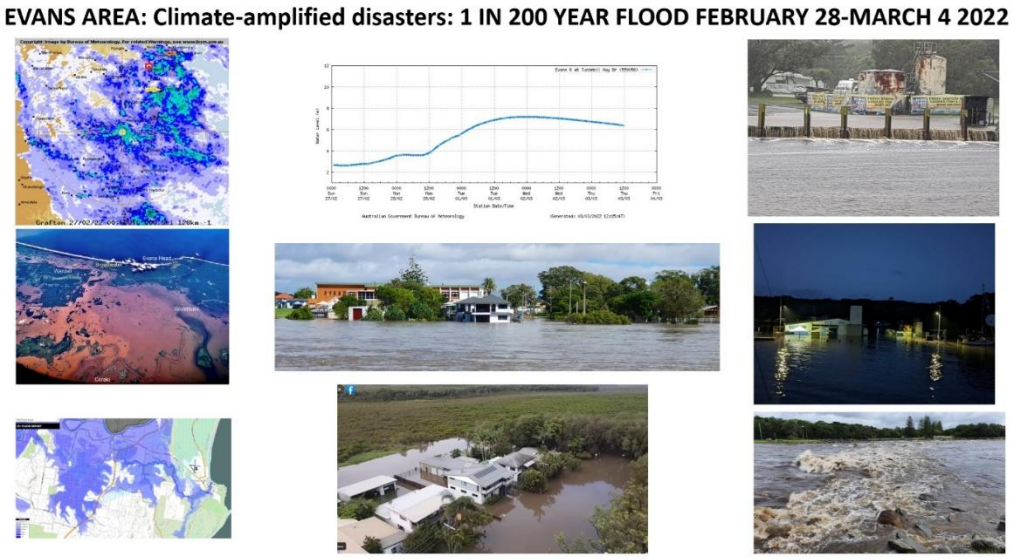
The calamitous Feb 28-March 2 (peak flood at Woodburn-Evans Head) 2022 Northern Rivers NSW flood (see Figure 1) led to the formation in Evans Head of a resilience organization—one of many that mushroomed after the floods and now organized into a regional alliance.[1] Evans Head was relatively unscathed by the regional floods—but became a site for about 1200 flood refugees (in a town with about 3100 residents) during the flood—many assisted by the local "tinnie flotilla" in their evacuation--and the relief and recovery effort in its aftermath.[2] You can view the flood in this short video[3].

[1] In early 2024, these groups formed the Northern Rivers Community Resilience Alliance.

[2] In the Northern Rivers of NSW and southern Queensland, an immense 1-in-200-years flood (14m+ at Lismore, 2.7m at Evans Head) wrecked whole towns and destroyed thousands of buildings, made thousands of people homeless flood refugees. Evans Head was spared the worst of the 14-meter floods upriver. But it had to house, feed, and care for about 1200 flood refugees who arrived overnight with nothing but their clothes and pets. They brought with them no food, bedding, and medicines. Cut off from disaster response authorities, local residents mobilized overnight to meet this challenge, starting with evacuating people on tinnies or small motor boats, and spreading to an "all-hands" effort to mobilize local resources to meet this challenge. For an overview, see *2022 Flood Inquiry Volume One: Summary report,* and *2022 Flood Inquiry Volume Two: Full report*, NSW Independent Flood Inquiry, July 29, 2022 here. About forty local groups in the Northern Rivers emerged from this disaster dedicated to building local resilience—what used to be called local self-reliance—with a specific focus on emergency preparedness. Each of these groups faces the same generic problems—provision of food, water, shelter, medical and emotional care, communications, etc. in the immediate relief, recovery and resilience building phases of disaster response—but do so in diverse and often very different circumstances defined by location, geography, scale and type of settlement, etc.

[3] Lozza Ison, "Evans head, much love to everyone and hope your all well and safe, especially in our surrounding areas!" video posted to EVANS HEAD NOTICE BOARD Facebook March 1, 2022.

Figure 1: Evans Area and the 2022 1-in-200 years flood



Good metrics to compare the self-organized, bottom-up local emergency response and relief efforts in this disaster with official and market-based emergency response are not easily available. However, even a cursory summary for two indicators—informal, private provision of evacuation and refugee housing services compared with official and market-based provision of these services—shows that the former likely matched or even exceeded the latter in the 2022 flood between February 26 and April 30 (see Appendix 1).

Not long after EARN was formed, it established Team Lorikeet (see Figure 2), an energy task force that set out to explore how to build community-level resilience through an energy lens, including a detailed analysis of routine energy supply and demand, of power supply vulnerability and outages, and of ways to increase robust energy supply able to meet energy needs during a climate-amplified disaster. This approach included understanding in detail the interlinkage between the energy supply and demand system in Evans with public health, water supply and disposal, communications, shelter, and food in the relief, recovery, and resilience building phases of responding to climate-amplified disasters.[4]

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[4] The results of application of the CADEER tool are reported here: Lyuba Zarsky, "Energy Resilience: Learning from Northern Rivers Communities," Workshop 3 report, November 8, 2025, download here; EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, download here; Heather Smith, "Load breakdown calculator and other things Northern Rivers, download here; related work by sister organizations in the region is reported on by Matthew Wittemeier, "Empowering Resilient Communities Through Sustainable Energy," Rainbow Power, November 8, 2025, download here; Graham Truswell, "Can I persuade you? The transition to renewable energy," November 8, 2025, download here

Figure 2: EARN's Team Lorikeet



Along the way, EARN conducted workshops on how to read a power bill and how to manage blackouts, shared lessons learned and experience with other resilience groups in the region at two workshops, and engaged major stakeholders in Evans Head to provide insight into specific strategies while implementing a community-based emergency communication network (see Figure 3).

Our goal was to not only serve Evans Area and the Northern Rivers; but to create an Open Source toolkit where we could share the methods we used with other groups around the world. We set out to find what tools existed but were surprised to find that there were almost none at the bottom-up community level whether at the refugee-camp, village, or township level. At the city level, there were tools—often developed with climate-driven adaptation in mind—but these were mostly top-down, not bottom-up.[5] One of the few exceptions was the load calculation tool developed by Heather Smith which we immediately adopted in parallel with the development of EARN's tool, Climate Amplified Disaster Emergency Energy Response (CADEER).

[5] Our search for tools included approaching UNDP which offers tools that support their Capacity for Disaster Reduction Initiative (CADRI) with 20 partners, primarily governments and UN country teams but not local community-level organizations; the Asian Development and World Banks; the Pacific Disaster Centre in Honolulu that offers DisasterAWARE®, also a top-down tool primarily for governments at various levels; Sandia National Laboratory's Resilient Node Cluster Analysis Tool (ReNCAT) that "Finds the best mix and placement of microgrids within a community. It aims to restore critical services to the most outage-affected people at the lowest cost" created in 2023, but no longer available; and Energy Restoration Needs Assessment Tool (ERNAT), a "web-based tool developed by the U.S. Department of Energy (DOE) to help utilities, emergency managers, and government agencies assess energy restoration needs after a disaster" (except, as it turned out, this was a complete hallucination generated by ChatGPT in June 2024 in response to a colleague's search for such a tool! A. Carothers, "Responding to Climate Amplified Disasters," email to author, June 13, 2024)—at which point we stopped looking and concluded we needed to build our own tool. Relatedly, in the climate-adaptation world, a survey of local, community-level adaptation projects around the world found 374 candidate projects of which only 22 turned out to be truly local bottom-up community-level as against top-down projects. See S. Tye, W. Suarez, *LOCALLY LED CLIMATE ADAPTATION: WHAT IS NEEDED TO ACCELERATE ACTION AND SUPPORT?* World Resources Institute Working Paper, 2021.

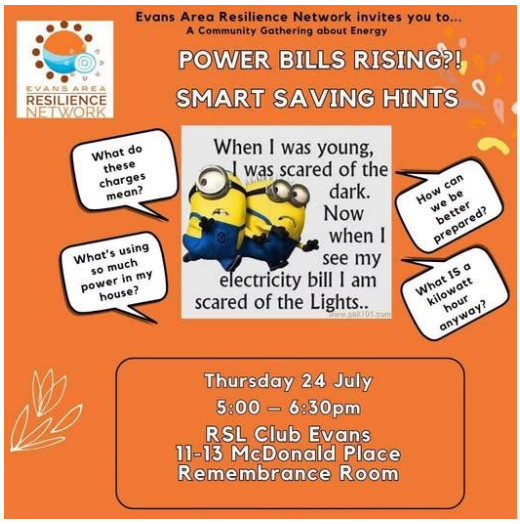
Figure 3: EARN 2025 workshops on power outages, reading power bills, and backup energy projects



Lessons from Prior Projects: Household: essential vs enough

Breakdown	Essential	Enough
Heating & Cooling	10%	80%
Cooking	50%	80%
IT&HE	50%	100%
Lighting	20%	80%
Other Equipment	25%	75%
Transport		
Water Heating		25%
White Goods	100%	100%

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Concurrently, in discussions with colleagues in the US about community-level energy tools, I asked Peter Gleick if the same questions and development of tools for community-level emergency water disaster response was underway. Surely, I thought, such tools would be widely available in the water world if not in the energy world. However, this turned out not to be the case.

The paucity of case studies and available tools led us to conclude that it is timely to convene this session as a small first step to launching the concept of such bottom-up strategies for community resilience and disaster response.

In the time that it has taken to organize this workshop, a number of organizations have begun to develop programs and tools in exactly these areas.

I am grateful therefore to each of you for stepping forward today in what we hope will be the first of many such discussions around the world about developing tools to build community-level resilience starting with water and energy.

3. DEFINITIONS

In such an effort, it is critical that we start out with and maintain conceptual clarity on the terms we are using, especially when working across cultural, linguistic, and disciplinary boundaries.

First, the term "local." By local, we mean the lowest level of collective effort to respond to a disaster that is not directly and immediately dependent on state agencies and market entities. Often, these are referred to as civil society organizations.[6] They interact with local government, local emergency authorities and first responders etc., but are autonomous. Most important, confronted with urgent necessity on the ground, they cross bureaucratic boundaries that otherwise limit the speed, scale and effectiveness of disaster response. They also facilitate communication with official agencies and market entities at the supra-local level (city, shire/county, state/provincial, national, and sometimes cross-border and/or international levels). They particularly identify and ensure that support is provided to vulnerable sectors of local populations that may otherwise be left to fend for themselves.

We should note here that this definition contains some problematic dimensions. Sometimes local leaders are an integral part of the pre-existing *de facto* power structure in a local community that excludes or at least neglects some populations. Also, it is often unclear who has authority to speak as a local, what exactly constitutes a "local," and who gets to decide who has the legitimacy and the authority to speak or act as a local leader—especially if there is no transparent and defined local decision-making structure in the midst of a disaster.[7] In fact, this is an accurate description of decision-making in Evans Head which is constituted as part of Richmond Valley shire and has no locale-specific representation or decision-making processes. Who "runs" Evans Head is therefore almost completely opaque although people sense the influence of non-resident and distant owners of real estate and commercial entities such as the pub; and the weight of service organizations like The Bowlo, Club Evans RSL (Returned & Services League of Australia), and the Surf Life Saving Club.

Thus, it is critically important that local resilience groups engage not only with local government, state and federal agencies, and major market infrastructure managers such as energy,

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[6] S. Patel, M. Brooke Rogers, R. Amlot, G. Rubin, "What Do We Mean by 'Community Resilience'? A Systematic Literature Review of How It Is Defined in the Literature," *PLOS Currents*, February 1, 2019, at**:** 10.1371/currents.dis.db775aff25efc5ac4f0660ad9c9f7db2

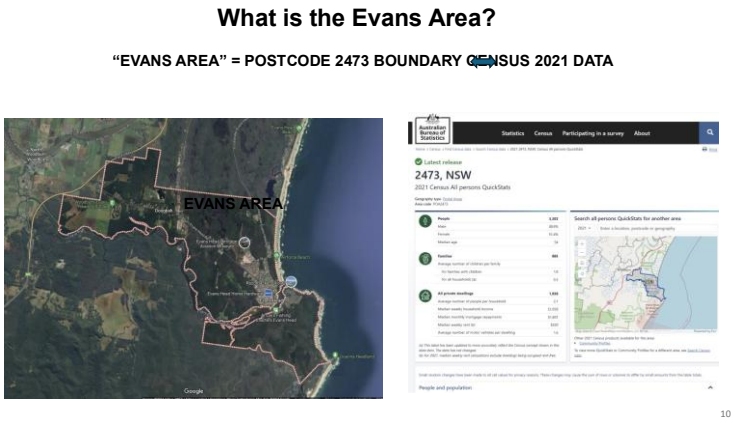
[7] This issue is discussed in the context of climate adaptation in M. Rahman et al, "Locally led adaptation: Promise, pitfalls, and possibilities," *Ambio*, 52, 2023, p. 1548 at: https://doi.org/10.1007/s13280-023-01884-7

communications, and water utilities but also with local stakeholders, especially the business and services sectors such as clinics, pharmacies, churches, sports clubs, and schools. During disasters they do so not as victims or consumers, but as local actors with substantial capacity that supplements, complements, and sometimes substitutes for top-down official and market-based organizations that are unable to render local assistance due to the severity of the disaster.

However, it is important to be precise when we define local. EARN decided early on to include the whole area that falls within the purview of its community-level emergency response mission. Accordingly, EARN addresses needs that may arise not only in the township and immediate surrounds, but also in other towns such as Woodburn and Broadwater which relied heavily on Evans Head during the 2022 flood for evacuation and immediate relief for about 1200 flood refugees.

EARN excluded some of this broader area when it adopted the postcode 2473 as the boundary for energy-analytic purposes (see Figure 4). Doing so ensured that not only the main township but outlying settlements (Riverside) and distributed rural households were included. This boundary also coincided with detailed demographic, social, cultural, and asset profiles collected by the Australian Bureau of Statistics through the national Census. In the energy context, therefore, what counts is energy supply and demand inside the postcode boundaries, and any fuel that crosses the boundary is either an import or an export, and any activity outside the boundary is excluded from the supply-demand model in both routine and emergency conditions.

Figure 4: What is "Evans Area"



Second, what do we mean by *disaster*? A good definition of disaster in this context is given by Jennifer Shea:

> Disasters are non-routine, unexpected, often severe events that disrupt communities by interfering with normal activities and causing substantial damage. Distinct from routine emergencies, disasters challenge existing capacities and require responses outside of usual

protocols…Disasters can be large in scale, with widespread regional impacts, or small in scale, impacting a single community. They can be caused by natural or man-made phenomena.[8]

In the Evans Area context, EARN decided to focus on floods, bushfires, cyclones and storm surge, heatwaves, and war-induced fuel scarcity (this category was adopted before the Iran war-induced price surge in 2026!). EARN set aside droughts, extreme pandemics, and tsunami disasters for now. EARN decided to not address earthquakes, snow and ice storms, and large-scale technological failures (such as reactor meltdowns) due to its location.

Figure 5: Recent Potential Climate-Amplified Events in Evans Head



EARN does not only prepare for a repeat of past disasters of these types. Rather, it aims to anticipate ***climate-amplified*** **disasters in each category**. It is necessary therefore to ask what makes a disaster "climate-amplified"?

A *climate-amplified disaster* is one where human-caused warming has made the hazard more likely, more intense, longer-lasting, or more likely to combine with other hazards, so the harm is bigger than the same event would have caused in a cooler climate. Although no single event can be attributed directly to climate change, it is now possible to estimate the extent to which humans have changed the scale and probability of single events.[9]

The features that distinguish climate-amplified disasters from the previous events include:

- **Compound Hazards.** The IPCC defines *compound* events as multiple drivers or hazards occurring together, one after another, or in connected places. The resultant impacts may be "much larger than the sum" of each hazard alone. As the IPCC put it in 2021:

  "The probability of compound events has *likely* increased in the past due to human-induced climate change and will *likely* continue to increase with further global warming. Concurrent heatwaves and droughts have become more frequent, and this trend will

[8] J. Shea, "The Community Resilience Approach to Disaster Recovery: Strategies Communities Can Use," chapter 23 in R. Cnaan C. Milofsky Ed, *Handbook of Community Movements and Local Organizations in the 21st Century*, Springer, 2018, pp. 371-390.

[9] IPCC, Chapter 11: Weather and Climate Extreme Events in a Changing Climate, sixth assessment report, 2021, at: **https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-11/?embed=true**

continue with higher global warming (*high confidence*). Fire weather conditions (compound hot, dry and windy events) have become more probable in some regions (*medium confidence*) and there is *high confidence* that they will become more frequent in some regions at higher levels of global warming. The probability of compound flooding (storm surge, extreme rainfall and/or river flow) has increased in some locations (*medium confidence*), and will continue to increase due to sea level rise and increases in heavy precipitation, including changes in precipitation intensity associated with tropical cyclones (*high confidence*). The land area affected by concurrent extremes has increased (*high confidence*). Concurrent extreme events at different locations, but possibly affecting similar sectors (e.g., critical crop-producing areas for global food supply) in different regions, will become more frequent with increasing global warming, in particular above 2°C of global warming (*high confidence*)."[10]

"The future occurrence of low-likelihood, high-impact events linked to climate extremes is generally associated with *low confidence*, but cannot be excluded, especially at global warming levels above 4°C. Compound events, including concurrent extremes, are a factor increasing the probability of low-likelihood, high-impact events (*high confidence*). With increasing global warming, some compound events with low likelihood in past and current climates will become more frequent, and there is a higher chance of occurrence of historically unprecedented events and surprises (*high confidence*). However, even extreme events that do not have a particularly low probability in the present climate (at more than 1°C of global warming) can be perceived as surprises because of the pace of global warming (*high confidence*)."[11]

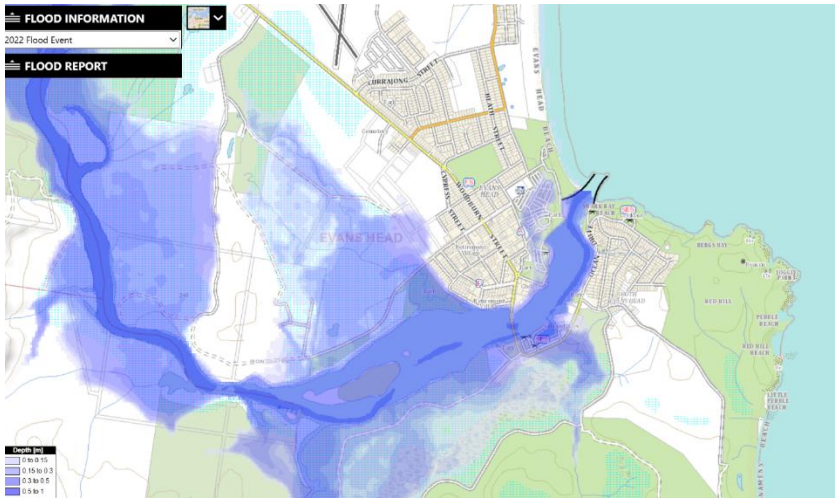
- **Prior conditions.** A preconditioned event is one where an earlier condition, such as soils already soaked by a La Niña, makes the next hazard worse. In 2022, for example, wet catchments from repeated rain set up record floods in eastern Australia.
- **Damage cascades.** Floods knock out power, which causes knock-on human and financial harm. These cascades depend more on how vulnerable people and systems are than on the hazard itself.
- **Disasters repeat before recovery ends.** Eastern Australia flooded several times in 2022, so households and volunteers faced the next event before recovering from the last.
- **Extreme Events:** In Lismore in the 2022 flood, the Wilsons River reached 14.4 m, more than 2 m above any previous flood. Residents had been told to prepare for 11 m. The historical record and planning levels stop being reliable guides.
- **Many places are hit at once.** When several regions are affected together, outside help is stretched thin, so local groups carry more of the load.

Almost all the disaster types that EARN is concerned about are climate-amplified—even those that have no direct climatic dimension such as tsunamis. Tsunamis caused by deep tectonic plate movements are the result of Earth's heat, not surface climate. However, climate change may also increase coastal zone vulnerability to tsunamis by raising baseline sea levels, which extends their reach inland, and by degrading coastal buffers such as mangroves, coral reefs, and barrier islands that provide frictional resistance to tsunami intrusion.

[10] IPCC, Chapter 11, op. cit.
[11] IPCC, Chapter 11, op. cit.

It is therefore necessary to not only look backwards—for example, at the 2022 flood level in Evans Head shown below in Figure 6—but also forwards, taking into account climate change drivers of major disasters as well as changes in social, demographic, and other variables that determine vulnerability to disaster in a given location. Looking backwards provides realistic insight into the minimum plausible disaster scenario that should be taken into account.

Figure 6: Flood Level Evans Head, Feb 28-March 2 2022



Source: WaterRIDE, Richmond Valley Council, at: https://waterride.net/flooddata/richmondvalley/

But realism also obliges local community resilience organizations to peer into the future and to estimate possible and probable climate amplification in each disaster category.

For this reason, EARN's current research examines the ability of major stakeholders in Evans Head to provide essential relief services to affected local residents and refugees in compound disasters (a three day flood and a subsequent four day severe heatwave), taking into account not only the known impacts from the 2022 flood (estimated to have been a 1 in 200 year flood), but future rainfall intensity and sea level rise, plus the possible coincidence of storm surge and a king tide on flood levels.

The 2026 revised Richmond Valley Shire planning guidelines for floods at Evans Head define the DFE or Defined Flood Event level for approval of development applications to be the 1%AEP (Annual Exceedance Probability) or 1 in 100 year flood (based on more accurate LIDAR measurements of topography and bathymetry and more detailed three-dimensional flood modelling for the riverine watershed feeding floodwater into the Evans River) plus a CC3 climate change scenario addition based on a 10% increased rainfall intensity and a 0.9 meter increase in sea level at the tidal boundary at the river mouth by 2080. This level is site specific.

At one stakeholder (The Bowlo), for example, the DFE is 3.19m AHD (Australian Height Datum) based on the 1% AEPCC3 flood level for this site. This figure accounts for tidal influence but not storm surge. The Bowlo is the large brown building in Figure 7.

Figure 7: Defined Flood Event map for The Bowlo, Evans Head (3.19m AHD)



Source: WaterRIDE, Richmond Valley Council, at: https://waterride.net/flooddata/richmondvalley/

To this level, 0.5 m of freeboard (for wave and splash effects) is added, making the Flood Planning Level (FPL) for planning approval 3.69 m AHD (see Figure 8).

Figure 8: Flood Planning Level for The Bowlo, Evans Head (3.69 m AHD)



Source: WaterRIDE, Richmond Valley Council, at: https://waterride.net/flooddata/richmondvalley/

More recent communications with flood planning authorities at the Richmond Valley Council recommend, given that The Bowlo is to be used as an emergency shelter, that a flood level for planning purposes (FPL, or Flood Planning Level) be set based not on the 1 in 100-year AEP flood, but actually on the **1 in 500-year (or 0.2%) event, the 0.2% AEP CC3 modelled flood event**, which raises the level of flood that should be considered for planning purposes **to 3.72 m AHD**. For planning related to flood protection infrastructure changes, such as protection of generators and water/fuel tanks at The Bowlo, as well as protecting the buildings that will house flood refugees, **another 0.5 meters** of freeboard is often added to the AHD, meaning that the Council's recommendations should be taken as considering a flood **of 4.22 meters AHD**, shown below in Figure 10.

Figure 10: Flood Planning Level for The Bowlo, Evans Head (4.22 m AHD)



Source: WaterRIDE, Richmond Valley Council, at: https://waterride.net/flooddata/richmondvalley/

EARN has therefore adopted a minimum of 4.22 meters AHD as a conservative minimum (although it does not include the impact of a coincident storm surge-king tide) for its compound flood-heatwave scenario in its current research with stakeholders, many of whom are not aware of these planning and modelling levels, and do not have easy access to contour maps to estimate their site's altitude relative to forecast flood levels (they can apply to council and pay a fee to obtain this precise level at this site).

As can be seen, the detail matters. A detailed contour map (see Figure 11) shows that the FPL of 3.69 meters AHD level inundates some of The Bowlo's cabins (orange arrow), threatens its main building and generator shed (red arrow), and may require the potable water tanks to be anchored (yellow arrow). A 4.22 meter AHD level seriously threatens the generator building and approaches the roughly 5 meter AHD level of the main building concrete slab.

Figure 11: 0.5 m Contour Map for The Bowlo, Evans Head



Source: 0.5 m contour map for Evans postcode provided by Richmond Valley Council to EARN, November 2 2026

A cautionary note on the phrase "climate-amplified disaster" is called for, however. It is a phrase that connects the underlying science of climate change with the vulnerability and impacts associated with specific disasters. As Allison Agsten wrote shortly after the January 2025 fires that devastated Los Angeles:

> As we continue to plow through the data connecting climate change to the fires, and as we begin the long process of recovery, we must speak honestly and forcefully about what happened: in L.A., we experienced a climate amplified disaster. In other words, climate change supercharged the fires here, making a devastating situation even worse… Check out climate attribution resources to confirm a climate connection, then use words that work. I prefer the phrase "climate amplified disaster" because it unites the issue with the impact. It also acknowledges that climate change is not the only reason a weather event became catastrophic as a confluence of factors are often at play.[12]

It is possible to measure the extent of the influence of anthropogenic climate change via attribution science which compares the probability that a climate-driven disaster occurs versus the probability that it would have taken place in a counter-factual world without climate change induced by humans, that is, climate amplification is measured as the fraction of attributable risk (FAR), that is, the share of the event's probability that is due to human-driven climate change.[13] Here, the incremental risk is simply the probability that the event occurred, not the risk of its impact increased due to what humans have done to increase or decrease their vulnerability to the event, nor the resulting change of the estimated impacts resulting from the interaction of increasing event risk with the risk arising from changes in human vulnerability. Separately, the intensity of the event may also have changed, which must also be factored into the climate-amplified event given its probability and the vulnerability of the location to the event leading to the impacts attributable to the climate

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[12] A. Agsten, "Say These Words: Climate-Amplified Disaster," blog post, USC Annenberg Center for Climate Journalism and Communication, February 22, 2025, at: https://climatecenter.usc.edu/say-these-words-climate-amplified-disaster/

[13] R. Newman, I. Noy, "The global costs of extreme weather that are attributable to climate change," *Nature Communications*, September 29, 2023, at: https://doi.org/10.1038/s41467-023-41888-1

amplification effect. Thus, in the Los Angeles fire context, human-induced climate change was found to have made the peak fire-weather conditions that month (measured by the Fire Weather Index) about 6% more intense and about 35% more likely (albeit the precise estimates are still uncertain due to how the models work and the non-linear impact on outcomes of variables such as wind).[14]

In the Evans Head context, a flood event likely has a substantial FAR due to climate change now reflected in future flood estimates and the planning levels; but the scale of the resulting disaster (event times impact) is also the result of non-climatic factors such as the planned development of Iron Gates, a large new adjacent settlement that is vulnerable to flood levels known to occur, and almost certainly highly vulnerable to future flood events. In this case, the marginal impact will be due to myopic humans occupying the Iron Gates site in harm's way, assuming it is ever built, not the climate system affected by humans.

Why is it important to include "climate amplified" when we talk about disasters at the local community level? After all, the community responds to all disasters, climate-amplified or not. The main reason to do so is to connect the impacts from disasters caused in part by anthropogenic climate change with the drivers of anthropogenic climate change, in particular, greenhouse gas emissions but also climate impacts of landscape modification and destruction of carbon stocks such as forests, soil carbon, etc.

To the extent that local communities can develop disaster response strategies that help them to adapt to climate change that also reduce routine and long-run greenhouse gas emissions, local community disaster response strategies to adapt to climate change will begin to drive mitigation. The cumulative, mosaic and networked effect of millions of local communities adapting to climate change out of necessity in order to prepare for and respond to climate-amplified disasters may create powerful bottom-up social and political pressures sufficient to overcome the structural obstacles and entrenched special interests that have largely blocked societal-level mitigation in many countries.

Third, how might we define *community resilience*? C.S. Holling defined the concept of ecological resilience in 1973[15] as the ability of a system to be perturbed and return to its initial state up to a threshold at which point it shifts to a new state. There are literally scores of definitions of resilience today but in the context of disaster response a reasonable definition is the ability of a community to bend but not break; to be flexible and adaptable when faced with disaster or its aftermath; and to restore a semblance of pre-disaster normality while recognizing that nothing will ever be the same.

Exactly how that translates into meaningful local building of resilience is driven by local circumstances, imperatives, and constraints. It may mean riparian regeneration to slow the velocity of flooding. It may mean retreating from flood-prone areas altogether. It may mean strengthening a community hub with emergency systems able to withstand recent or future levels of disaster impact. What is central is that the building and then employment of resilient capacity lends agency to such community-level organizations. They tap local knowledge as needed, create new capacity to respond, exercise leadership, nurture relationships and local networks, conduct communications to

[14] "Climate change increased the likelihood of wildfire disaster in highly exposed Los Angeles area," World Weather Attribution, January 28, 2025, at: https://www.worldweatherattribution.org/climate-change-increased-the-likelihood-of-wildfire-disaster-in-highly-exposed-los-angeles-area/

[15] C.S. Holling, "Resilience and stability of ecological systems," *Annual Review of Ecology, Evolution, and Systematics,* 4, 1973, pp. 1–23, at: https://www.annualreviews.org/content/journals/10.1146/annurev.es.04.110173.000245

coordinate and collaborate with partners, stakeholders and official agencies to anticipate, prepare for and respond to disasters more effectively. An essential attribute is that they learn iteratively from lived experience and address blind spots and gaps that are neglected by official agencies and market entities.

That said, most of the civil society organizations involved in disaster response in the Northern Rivers are only secondarily involved in building resilience in the aftermath of the 2022 flood. In 2026, the Northern Rivers Community Foundation found that of 119 community organizations surveyed, the largest group (25%) identified community development or neighbourhood centres as their primary focus, followed by arts, culture and heritage (10%) and disaster preparedness, response and recovery (10%).[16] At the same time, the majority were involved in the recovery from the 2022 flood, and by 2026 disaster recovery was included in the remit of 62% and resilience-building against future disasters in that of 55%.[17] The kinds of activities they undertook included household disaster preparation (30%), educational materials (27%), holding preparedness events (22%) and building community hubs, systems and infrastructure that strengthen local resilience (22%), largely, as the Foundation found, "without additional or specialist funding."[18]

4. WHY ENERGY?

In 2023**,** EARN decided to undertake a detailed examination of community-level strategies to respond to multiple disasters, using energy as the window through which to identify where to build resilience—by which we meant resilience to respond and adapt to future-oriented, science-based estimates of climate-amplified disasters--and otherwise missing capacity to respond to a disaster. One could just as well have studied water or public health, shelter, or food security and then explored how each is interdependent with the other and with the energy sector. But basic needs are all connected and energy was an analytic capacity or tool that EARN was able to offer.
It's dwelling briefly on what we mean by *tool.* We all understand what is meant by a hammer or a spanner—it's a tool that's designed to resolve a specific problem—drive a nail into wood, or turn on nut on a bolt. Some tools are specialised—like a tap hammer used to sound wood for rot. Others are flexible--like a shifting spanner that can fit a wide range of nuts and bolts. How a tool is used is *technique*; and the assembly of a set of tools apt to address a set of problems to which to the tools "fit" into a tool kit combined with what become standard operating procedures (SOPs) and routinized practices or rules of thumb (ROTs) constitute an organization's distinctive problem-solving style.

EARN's Lorikeet task force began by using a standard energy supply-demand tool to create an energy-balance (input-output) matrix, visualized as a Sankey diagram, broken down by primary and secondary energy supply of fuel types distributed across standard end-use categories such as household, commercial, transport etc. To this end, EARN was able to draw on the tools and techniques embodied by its participating local members including power supply, water science, communications, and also by its partners, Nautilus Institute and the Coalition for Community Energy now Energy Together which brought two well-developed tools to the table.

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[16] Northern Rivers Community Foundation, *2026 State of the Northern Rivers Community and Not for Profit Sector,* p. 10, at: https://nrcf.org.au/wp-content/uploads/2026/08/NRCF-2026-State-of-the-Sector-Final_Web.pdf

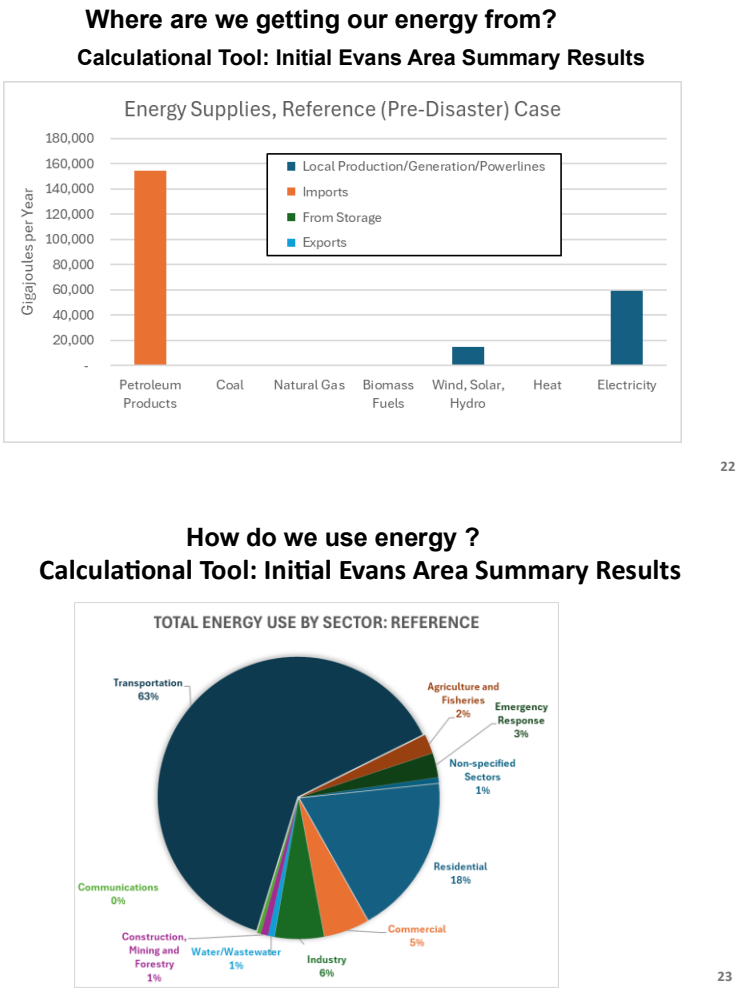
[17] Northern Rivers Community Foundation, op. cit., p. 20.
[18] Northern Rivers Community Foundation, op. cit., p. 21.

This task force assembled field data and identified sources of relevant information at a usable resolution in the Evans context. The supply-demand balance was done for off-peak (when the town had about 3000 residents) and on-peak (when about 10000 visitors descend on the town during holidays) periods, and weekdays and weekends. It also obtained a decade of half-hour power supply figures for the two feeder lines from Essential Energy (the local power distribution utility) that also identified outages and enabled a load curve to be built for the four different periods.

This approach enabled EARN to portray the basic, non-disaster pattern of energy supply-demand for Evans Head and surrounds (within the 2473 postcode that includes about 10 percent of the residents in the district).

Unsurprisingly, supply was dominated by refined oil products, primarily for transport that accounts for about 75 percent of energy use; and electrical power that accounts for most of the rest distributed across households, commerce, industry, etc. (see Figure 12).

Figure 12: Energy Supply and Demand, Evans Head 2024

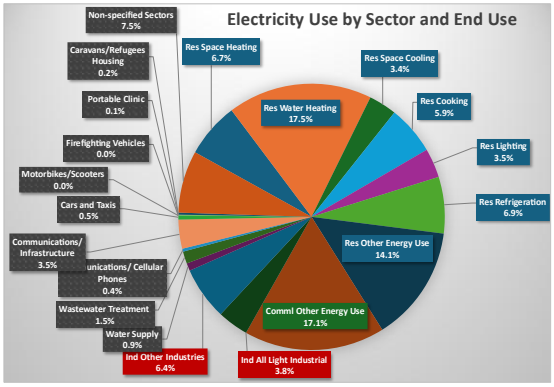


Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

We can also look more closely at the power sector and break out different end use sectors (see Figure 13).

Figure 13: Electricity Supply and Demand

REFERENCE CASE
ELECTRICITY DEMAND BY SUBSECTOR/END USE
(GJ AND MWH/YR)



27

Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

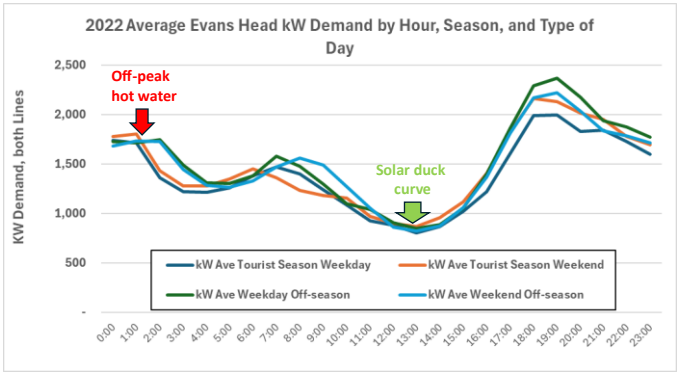
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The load curve shows a peak in the evening (and early morning when hot water heaters are turned on, red arrow in Figure 14 below); and a depressed demand over time in the mid-afternoon as solar panels were deployed, primarily in the household sector (green arrow is relative to 2019).

Figure 14: Evans Head Load Curve 2022

2022

Evans Head Power Load Curve
tourist/non-tourist and weekday/weekend



Source: Essential Energy dataset provided to the study

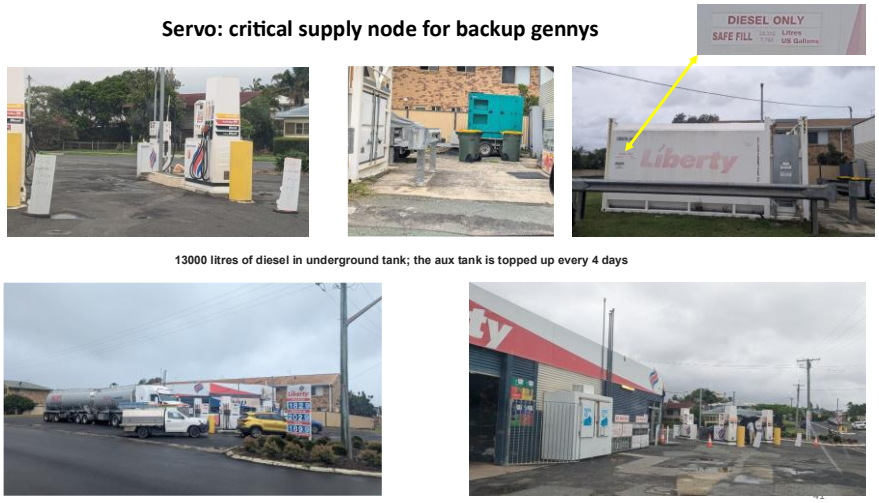
29

Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

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From these preliminary results, EARN quickly determined that there were some common points of failure in an emergency. In a flood or bushfire scenario in which the township is cut off from external supply, limited stocks of diesel, petrol, and gas are held at the only local petrol station (the "Servo") and in tanks attached to end-use equipment (such as generators, vehicles, BBQs, etc.). The large diesel generators share a possible weak link: there is no guarantee that the Servo will have power to pump fuel from its stores, and on-site storage at the generators holds less than one day's operating fuel (see Figure 15).

Figure 15: The Servo—A Common Failure Point?



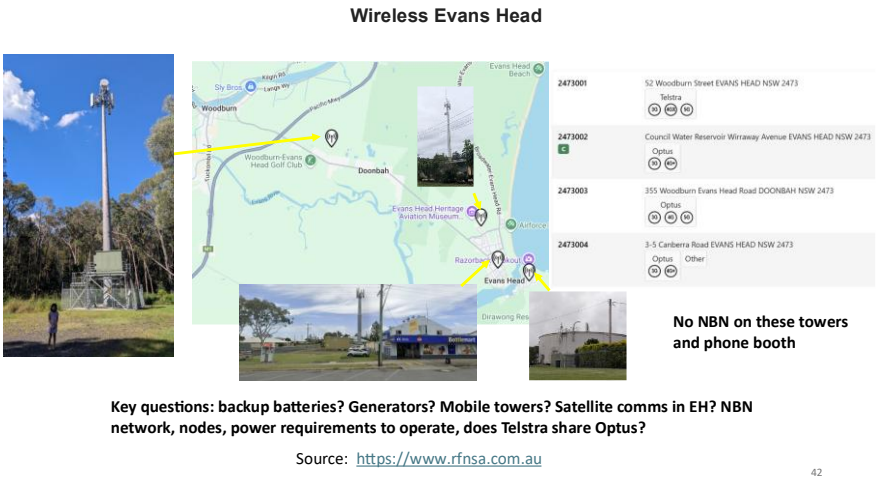
Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

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EARN also observed that in both routine planned and unplanned outages, communications are particularly vulnerable due to the inability of the cell phone companies to operate their local or distant repeater towers for more than a few hours with batteries or rapidly deployed generators. This presents a major problem for small businesses which lose substantial revenue and shut down even for a short outage given the uncertainty posed by the grid. Moreover, in the 2022 flood, businesses not only lost trading days but also major stocks—the chemist, for example, reportedly lost upwards of A$40,000 of refrigerated vaccines and medicines.

EARN also learned from other regional resilience organizations that their range of potential missions narrowed as the years passed. Many decided that communication is the most critical missing element at the local level. After examining closely the redundancy offered by mobile (cell) phone service providers to Evans Head (see Figures 16 and 17), EARN concluded that these systems remained vulnerable to routine and unplanned power outages, especially in major disasters.

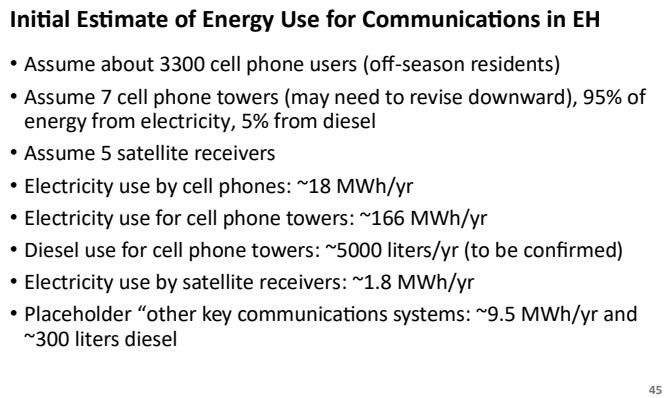
Figure 16: Mobile Phone Service to Evans Head Area



Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

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Figure 17: Mobile Phone Energy Supply and Demand Estimate



Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

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In 2026, EARN undertook to provide multiple Starlink nodes with solar-powered Bluetti power systems to enable the community in Evans Head and area to communicate, coordinate, and

collaborate—a societal function that is necessary for almost all the local level responses to provide food, shelter, fuel, medicine and information for the duration of a disaster. EARN's Backup Emergency Communication System or BEX (see Figure 18) should be operational in November 2026.

Figure 18: First EARN Starlink Deployment Exercise, November 9 2026

Where are the Backup Emergency Communication Posts?

Each of the four posts has a different set-up for storage and activation. At the end of this guide, you will see specific instructions for each location.

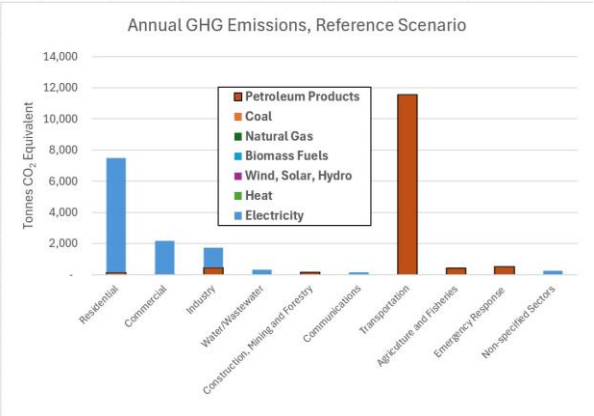
Post 1	**Evans Head South Side**	Storage: shed at 15 Sunderland Street	Deployment: Razorback Lookout
Post 2	**Evans Head CBD**	Storage and deployment: The Bowlo 2 Beech Street	Permanent position
Post 3	**Evans Head Sporting Area**	Storage and deployment: The Evans Head Tennis Club (33 Ash Street)	Permanent position
Post 4	**Evans Head North (Thyme Estate)**	Storage: Thyme Estate House	Deployment: Thyme Estate

Source: EARN "Backup Emergency Communication System (The Bex)," Volunteer guide • version 2 21 October 2026

In 2026, EARN decided to work closely with partners in Evans Area to develop disaster-based resilience strategies in these areas starting with "The Bowlo"—the local bowling club. The Bowlo was a leading player in the 2022 flood response. Working with the Bowlo's leadership, EARN is investigating what it can do to become more resilient against the compound flood-heatwave scenario for the Australian summer 2026-27 described above while also increasing routine business efficiency. David von Hippel will report on some early results of this analysis at this workshop.

Finally, as noted in the Definitions section above, EARN aims to link the local impacts and response to climate-amplified disasters with global climate change. Greenhouse gas emissions are the key drivers of anthropogenic climate change. The energy profile of Evans Head enables us to also view its contribution to global climate change via its own emissions, detailed by fuel type and end use. As can be seen in Figure 19, transport and the household sectors predominate, providing clues to where the most potent levers within this community are to be found that link disaster response strategies to emissions reduction and mitigation of climate change itself.

Figure 19: Evans Head, annual greenhouse gas emissions



Source: EARN Climate-Amplified Disaster Energy Task Force, "CLIMATE-AMPLIFIED DISASTER EMERGENCY ENERGY RESPONSE, Application of a Calculational Tool, Evans Head Community, NSW," November 8, 2025, here

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5. CONCLUSION

I began writing this essay with the following chain of logic as a working framework.

- Climate change impacts are upon us and many are now irreversible over meaningful individual and generational human time frames.
- Local communities are autonomously adapting to climate change, especially climate-amplified disasters.
- Many (not all) of their strategies to respond to disasters would increase resilience and at the same time, mitigate greenhouse gas contributions that drive climate change.
- The cumulative, aggregate effect of local adaptation driven by urgent survival imperatives may mobilize political will to overcome the influence of vested interests that have stymied climate change mitigation in the past.

In short, it is now time to adapt to mitigate.[19]

Upon reflection, I admit that the experience and data presented above in Evans Area and beyond present more questions than answers to the overarching question of the role of local communities in disaster response and the realization of long-term resilience in the face of climate-amplified disasters.

The Northern Rivers post-flood experience suggests—as is the case in many countries—that the shock of disasters *increases* the centralization of authority in central government, especially in regional or peripheral areas far from capital cities.[20] In many cases, local organizations are impaired by the effects of the disaster and their personnel and resources are debilitated and eventually exhausted by the recovery effort. All too often—including in the Northern Rivers—devolution of disaster response on paper and in legislation is not matched on the ground. Indeed, in many instances, implementation was distorted by post-flood conflict and competition for scarce relief and recovery resources. Much of the relief effort and post-flood recovery resources were wasted due to bureaucratic inefficiency; some were captured by vested interests in unjust and ineffective ways; and many of the most vulnerable people were neglected, ignored, or displaced, especially in rural areas.

Four long years after the floods, Lismore--the region's largest residential, administrative and commercial centre inundated by the flood—resembles an abandoned war zone in many residential areas. "Downtown" is a shadow of its pre-flood self—already battered by the 2017 flood.[21]

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[19] US National Academies of Sciences, Engineering, and Medicine. 2024. *Public Infrastructure for Effective Climate Mitigation and Adaptation: Proceedings of a Workshop-in Brief,* The National Academies Press, p. 9, at: https://doi.org/10.17226/27866

[20] S.M. Han *et al*, "Nature Made the State: Exploring the Effect of Disasters on Centralization," *Comparative Political Studies*, 59:8, 2026, pp 1642–1677 at: https://journals.sagepub.com/doi/pdf/10.1177/00104140251349661

[21] Sea&Star, *LISMORE FLOODING IMPACTS & RECOVERY STATEMENT*, report to Lismore City Council, July 2022, took stock immediately after the February-March 2022 flood, at: https://www.lismore.nsw.gov.au/files/assets/public/v/1/2.-community/8.-natural-hazards-and-emergencies/lismore-flooding-impacts-and-recovery-statement.pdf Only half of the reconstruction projects

One vision of post-disaster adaptation to a world convulsed by extreme climate events was articulated by proponents of "polycentric" governance wherein each social entity develops its own norms and rules in its own domain, implying multiple governing entities operate at different scales and coordinate across and within overlapping domains and jurisdictional boundaries.[22] In contrast, the Northern Rivers post-flood experience suggests that climate-amplified disasters now vastly exceed the response capacities anticipated in pre-flood emergency response norms and rules at the federal, state, and local (especially land use planning) levels. The result is fragmented, multilevel, and complex interactions between official agencies, market-based entities, and civil society organizations that more often than not are conflictual rather than synergistic, cooperative, or collaborative in nature.

During the transition from immediate relief—often led by community groups that stepped up to the challenge—to official response and recovery, with agencies arriving late or ill-informed, trust in government and market entities was shattered in many instances.[23] Community-level and civil society organizations in the Northern Rivers were confronted during and after the floods with sudden and major shifts in federal and state flood recovery policy, stop-start funding, and endless bureaucratic process with little or no consultation or say. Unsurprisingly, they report low or very low influence over official decisions at the local, shire, state, or federal levels.[24] In the phrasing of one study, the post-flood period was characterised by social innovation *and* institutional deadlock[25] that left many local leaders and volunteers exhausted and burned out, unable to continue their vital work.

In light of this broad outcome, a revised working hypothesis to frame EARN's on-going work on the energy-climate link in Evans area therefore is in order.

1. Millions of communities and billions of households are now affected by climate change and are vulnerable to the effects of climate-amplified disasters or super-events.
2. Mitigation of greenhouse gas emissions remains a critical priority to slow the rate of accelerating climate change; but many, perhaps most communities place a higher priority on adapting to climate change because they have no option but to do so given autonomous adaptation's direct correspondence with self-interest and even survival.
3. Many effective adaptation measures at the local level involve not only individual and household actions, but collective, community-level efforts to anticipate and prepare for climate-amplified disasters.

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have been completed. "Lismore hits halfway in massive flood rebuild," *North Coast Times*, October 3, 2026, and for many locals, the situation remains dire. J. Beazley, "A tale of two cities: hope and despair within Lismore after the flooding," *The Guardian*, October 18, 2026, at: https://www.theguardian.com/australia-news/ng-interactive/2026/oct/18/frustration-hope-mingle-post-flood-lismore

[22] A. Jordan et al, "Governing climate change: The promise and limits of polycentric governance," in A. Jordan et al, eds, *Governing climate change: Polycentricity in action?* Cambridge University Press, 2018, pp. 359-383.

[23] As documented in Northern Rivers Community Foundation, *Housing and Homelessness in a Flood Recovery Final Report*, September 12, 2022, at: https://nrcf.org.au/wp-content/uploads/2022/12/Housing-and-Homelessness-in-a-Flood-Recovery.pdf

[24] Northern Rivers Community Foundation, *State of the Northern Rivers Community and Not for Profit Sector: A snapshot of sector strengths, challenges and opportunities,* 2026, p. 19, at: https://nrcf.org.au/wp-content/uploads/2026/08/NRCF-2026-State-of-the-Sector-Final_Web.pdf

[25] R. McNaught *et al.*, "Innovation and deadlock in governing disasters and climate change collaboratively - Lessons from the Northern Rivers region of New South Wales," *International Journal of Disaster Risk Reduction*, 105, 104366, April 15, 2024, at https://researchportal.scu.edu.au/esploro/outputs/journalArticle/Innovation-and-deadlock-in-governing-disasters/991013176512302368

4. Many (but not all) of these adaptation measures entail upgrading routine operations of local energy supply and demand systems in order to make them more resilient. In such cases, the cost of preparing for emergency response is already partly or wholly covered by self-interest without regard to emergencies. Those that are not—or are neglected due to market failure and entrenched centralized infrastructure and organizational practices—are where local community civil society organizations can act with high payoff in reducing the cost of disasters.
5. Driven by necessity, in aggregate such efforts already provide a substantial resource that supplements and may surpass that of emergency response capacity by centralized official and market entities. The reliance on local, improvised capacity to respond to the 2022 flood noted above has been documented longitudinally in the Northern Rivers Community Foundation flood impact studies. One Southern Cross University study found that 63% of displaced survey respondents bypassed official evacuation centres entirely.[26] In many instances, grassroots networks were the only entities capable of reaching and servicing isolated, desperate households.

   The irony of this situation is obvious. To the extent that local communities can take care of their own—and possibly of many refugees landing in their midst without notice—they relieve the pressure on emergency response agencies to focus on truly desperate response, relief and recovery efforts. Moreover, to the extent that local communities become competent in anticipating and responding to disasters, they may provide critically urgent missing capacities such as measuring and reporting upper watershed flood levels, evacuating people at-risk (the tinnie flotillas in the Northern Rivers) or fielding missing capacities (assured local and regional networked communication systems).
6. It is therefore important to ensure that such local efforts are nurtured without creating new types of dependency. Concurrently, it is important that communication and coordination channels are established to enable local community-level civil society organizations to coordinate with official agencies and market entities and to actively mediate across domains and levels.[27]
7. Local community civil society organizations should pay particular attention in the pre-disaster context to identifying the gaps in official emergency response services to avoid duplicating or even inhibiting them, especially where inequalities in access to services existed already among vulnerable populations such as elderly, sick, disabled, poor, and isolated populations.
8. Creating and testing protocols for post-disaster communication and coordination at the local level (such as mesh networks) and regional levels (such as satellite links) may provide a new layer of emergent self-organization that is commensurate with the pace and magnitude of the event and offer official agencies and market entities high-resolution and timely data that increases their ability to deliver emergency response services.[28]

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[26] J. Birch, H. Luke, The Northern Rivers Flood Recovery Study, Southern Cross University, December 2022, p. 3, at: https://www.scu.edu.au/media/scu-dep/news/images/2023/Flood-Recovery-Survey_Preliminary-Results.pdf

[27] As noted earlier, this is precisely the mission of the newly established Northern Rivers Community Resilience Alliance the purpose of which is "To develop a self-sustaining, trusted Alliance of place-based, community-led resilience groups and organisations. The Alliance will share knowledge and resources; provide mutual support and wellbeing; take collective action,and advocate for identified community needs." See https://www.nrcra.org.au/about

[28] Charles Kennel and Sally Daultry prefigured this approach that is based on matching local information needs with regional level expert climate assessment on a reciprocal basis in "Knowledge Action Networks: Connecting regional climate change assessments to local action," UCSD Sustainability Solutions Institute, 2010, at: https://escholarship.org/uc/item/8gd6j0k5

9. Developing consistent disaster scenarios (or using the same where applicable) to develop community-level strategies and initiatives as are used by local governments and emergency response lead agencies is important to aligning local efforts with official agencies and market-based entities. Tools such as WaterRIDE flood mapping for Richmond Valley Shire, SES reference tsunami maps etc. provide baseline scenarios that align local communities with policy goals and objectives set at higher levels of governance but need proactive inculcation that only local communities can achieve.
10. Sharing the analysis and tools developed at the local community level via open-source sites combined with AI tools deployed by civil society organizations may enable thousands, even millions of local communities to develop effective disaster response strategies and to increase their resilience to climate-amplified disasters. Such networks operating on a global scale may become a foundational element of a new geo-ecological global order as states and markets find their centralized structures unable to respond to the severity and complexity of the threats arising from accelerating climate change.
11. A local community is a complex social entity constituted of diverse civil society organizations, governmental services, and market entities. Few of these civil society organizations have disaster response or social resilience as part of their mission, yet many have begun to incorporate both these imperatives into their core work. In this local ecosystem, tiny agile players like EARN have influence by virtue of their ability to
    a) identify and document gaps that need filling at times of stress;
    b) communicate insights to official and private stakeholders with the ability to act on them, and
    c) work with community leaders to implement iconic initiatives that embody a broad vision of a sustainable future facing the challenge of climate-amplified disasters.

APPENDIX 1: COMPARISON OF OFFICIAL, MARKET AND COMMUNITY-BASED DISASTER RESPONSE IN THE NORTHERN RIVERS FLOODS, FEBRUARY 26 TO APRIL 30 2022

Rescue and evacuation (26 Feb – 5 Mar 2022) and post-flood housing (26 Feb – 30 Apr 2022), compiled from published records. This analysis was prepared with Perplexity Computer, running on Claude Opus 5.5, Anthropic's model. Claude ran the searches, read the source documents (the NSW Flood Inquiry, the parliamentary inquiry report, the NSW Audit Office's housing review, NSW SES operational updates and the university studies), and wrote the tables, source notes and summaries. Every figure is copied from a published source listed in the notes.

Notes on method: figures are copied from the cited records without adjustment. Where a figure covers a wider area or period than the requested window, this is stated in the Caveat column. Gaps are reported as "No count" rather than estimated. Informal community figures are partial tallies and may overlap.

Table 1. Rescue and evacuation capacity, 26 February – 5 March 2022

ID	Sector	Provider	Figure	What is counted	Place / period
R1	Official	NSW SES (incl. partner-agency rescues it logged)	**1,683**	Flood rescues, cumulative	All NSW, 22 Feb – 3 Mar 2022 (16:00)
R2	Official	NSW SES	**1,100+**	Flood rescues	Northern Rivers, whole Feb–Mar event
R3	Official	NSW SES	**862**	Flood rescue activations (jobs, not persons), of 1,900 requests	Lismore, 28 Feb 2022
R4	Official	NSW SES	**up to 3,000**	Calls for assistance lost / never actioned	Lismore
R5	Official	NSW SES	**17 boats**	Rescue boats at Lismore City Unit at height of flood	Lismore
R6	Official	NSW SES	**215 / 426**	Accredited in-water / on-water flood-rescue operators	All NSW
R7	Official	Fire and Rescue NSW	**150+ / 150+ / 60**	Rescued (Casino) / evacuated (Coraki) / rescues (Mullumbimby)	Northern Rivers, Feb–Mar 2022
R8	Official	Australian Defence Force (aviation)	**113**	People rescued by helicopter, 71 missions	SE Queensland + northern NSW, 25 Feb – 7 Mar
R9	Official	NSW Rural Fire Service (aviation)	**77**	People rescued by helicopter	NSW, Feb – Apr 2022
R10	Official	Marine Rescue NSW	**131**	People evacuated (86 on-water tasks)	1 – 10 Mar 2022
R11	Official	Surf Life Saving NSW	**880**	Members of the public assisted	NSW, Feb–Mar event
R12	Official	NSW Police Force	**No count**	Flood rescues not published; 100+ extra officers arrived 3 Mar	Richmond and Tweed/Byron districts
C1	Informal	Lismore 'Boatie Brigade' (tinnie army)	**~1,079**	People rescued by 43 surveyed citizen rescuers (Flood Diaries)	Lismore, from 28 Feb
C2	Informal	Woodburn / Evans Head local boats	**300–400**	People rescued by 20–30 local boats	Woodburn, from 1 Mar
C3	Informal	Joblin family (commercial fishermen)	**~300**	People rescued in three days	Lower Richmond River

ID	Sector	Provider	Figure	What is counted	Place / period
C4	Informal	Jali Local Aboriginal Land Council	**200**	Residents evacuated in ~1.5 hours, no emergency-service help	Cabbage Tree Island, 28 Feb
C5	Informal	Community rescuers (survey share)	**34 of 47 (~75%)**	Share of rescues of survey respondents done by community; 9 by emergency services	NSW + Qld survey sample
C6	Informal	Community rescuers (inquiry finding)	—	'Community rescues significantly outnumbered SES rescues' in the Northern Rivers	Northern Rivers
E1	Self-evacuation	Residents	**~4,000**	Evacuees, vs ~500 planned for	Lismore
E2	Self-evacuation	Residents	**2,500**	People who accessed evacuation centres	Ballina
E3	Self-evacuation	Residents	**1,200 peak (2,000–3,000 over several days)**	People at Southern Cross University evacuation centre (built for 200–350)	Lismore
E4	Self-evacuation	Residents	**37%**	Share of displaced survey respondents who used evacuation centres	Northern Rivers survey (n=248)
E5	Self-evacuation	Residents	**No total**	Overall self-evacuation count	Northern Rivers

Source notes (figure IDs refer to the table above)

[S1] NSW SES Operational Update 19, Event 261/2122 (3 Mar 2022). Figures: R1. https://files-em.em.vic.gov.au/public/IILU/NSW2022/IncidentSituationReport19.pdf

[S2] NSW SES Annual Report 2021/22. Figures: R2. https://www.ses.nsw.gov.au/sites/default/files/2024-02/nsw-ses-annual-report-2021-2022-dble-pg_lowres.pdf

[S3] AIDR Knowledge Hub, Flood – New South Wales, 2022. Figures: R3. https://knowledge.aidr.org.au/resources/flood-flooding-new-south-wales-2022

[S4] 2022 NSW Flood Inquiry, Volume Two (O'Kane & Fuller). Figures: R4, R6, R9, R10, R11, R12, C1, C2, C6, E3, E5. https://www.nsw.gov.au/sites/default/files/noindex/2022-08/VOLUME_TWO_Full%20report.pdf

[S5] NSW Legislative Council, Report No 1 – Response to major flooding across NSW in 2022. Figures: R5, R10, C4, E1, E2. https://www.parliament.nsw.gov.au/lcdocs/inquiries/2866/Report%20No%201%20-%20Response%20to%20major%20flooding%20across%20New%20South%20Wales%20in%202022.pdf

[S6] Fire and Rescue NSW, Northern Rivers flood awards (Ballina). Figures: R7. https://www.fire.nsw.gov.au/incident.php?record=recegBwvH0OJgmsPd

[S7] Department of Defence, Operation Flood Assist daily briefing (7 Mar 2022). Figures: R8. https://www.defence.gov.au/news-events/releases/2022-03-07/operation-flood-assist-daily-briefing

[S8] ABC News, 'Have we learned the lessons from the 2022 Lismore flood' (27 Feb 2023). Figures: C3. https://www.abc.net.au/news/2023-02-27/have-lessons-been-learned-from-2022-lismore-flood-disaster/101863278

[S9] Natural Hazards Research Australia, Community experiences of the Jan–Jul 2022 floods – final report (2023). Figures: C5. https://naturalhazards.com.au/sites/default/files/2023-07/Community%20experiences%20Jan%20July%202022%20floods%20NSW%20QLD_final%20report_v1.1_0.pdf

[S10] Southern Cross University, Northern Rivers Flood Recovery Study – preliminary results. Figures: E4. https://www.scu.edu.au/media/scu-dep/news/images/2023/Flood-Recovery-Survey_Preliminary-Results.pdf

[S11] NSW Police Force, 'Additional officers deploy across flood-affected communities' (4 Mar 2022). Figures: R12. https://www.police.nsw.gov.au/news/news?sq_content_src=+dXJsPWh0dHBzJTNBJTJGJTJGZWJpenByZC5wb2xpY2UubnN3Lmdvdi5hdSUyRm1lZGlhJTJGMTAwMzY2Lmh0bWwmYWxsPTE=

[S12] ABC News, quoting the Flood Inquiry (29 Sep 2022). Figures: C6. https://www.abc.net.au/news/2022-09-29/nsw-new-flood-warning-system-after-horror-season/101485482

[S13] Southern Cross University submission to the NSW Legislative Council inquiry. Figures: E3. https://www.parliament.nsw.gov.au/lcdocs/submissions/78755/034%20Southern%20Cross%20University.pdf

Summary: official plus market versus informal rescue and evacuation

Official plus market capacity. Official agencies logged roughly 1,100 or more flood rescues in the Northern Rivers over the whole event (R2), plus about 190 people lifted by ADF and RFS helicopters, although those counts also include Queensland or later dates (R8, R9). In Lismore on 28 February alone the SES had 862 rescue jobs and up to 3,000 lost calls (R3, R4). It worked from 17 boats (R5), drawing on a statewide pool of only 641 accredited flood-rescue operators (R6). Marine Rescue used only 24 of about 80 vessels (R10), and police published no rescue figures (R12). There was no market supply for rescue: no commercial operators were tasked.

Informal private capacity. Four partial community tallies alone come to about 1,880–1,980 people rescued or evacuated: about 1,079 by 43 Lismore boaties, 300–400 at Woodburn and Evans Head, about 300 by one fishing family and 200 from Cabbage Tree Island (C1–C4). The tallies may overlap, they are not a census, and many rescuers were never surveyed. In a residents' survey about three-quarters of rescues were done by community members (C5). The Inquiry found that community rescues significantly outnumbered SES rescues in the Northern Rivers (C6).

Self-evacuation. No total exists (E5). Lismore had about 4,000 evacuees against about 500 planned for (E1). Ballina centres saw 2,500 people (E2), and the main Lismore centre peaked at 1,200 (E3). Only 37% of displaced survey respondents used any evacuation centre (E4), so most evacuees housed themselves with family, friends or elsewhere.

Balance. Between 26 February and 5 March, documented informal rescues match or exceed the official Northern Rivers rescue count, and self-evacuation outside the official centres was probably larger than either. The official figures are better recorded but cover wider areas and dates. The informal figures are fragmentary, so they are a floor, not a total.

Table 2. Housing for flood-displaced people, 26 February – 30 April 2022

ID	Sector	Provider / housing type	Figure	What is counted	Date / period
D1	Demand	Housing lost	**4,055 / 10,849**	Properties uninhabitable / damaged	Northern Rivers, late Feb – early Apr 2022
D2	Demand	Displaced households	**70%**	Share of households in emergency accommodation who were renting before the flood	At first contact with the Housing Contact Centre
D3	Demand	Temporary-housing need	**1,642 → 1,653**	Households estimated to need temporary housing	14 Apr → 20 Apr 2022
G1	Official	Evacuation centres	**54 centres (of 80); 8,188 registrations**	Government evacuation centres and registrations	Feb–Mar 2022 (registrations are statewide)
G2	Official	Southern Cross University evacuation centre	**1,200 peak**	People sheltering	Lismore, operated about 6 weeks
G3	Official (state-purchased market supply)	DCJ emergency accommodation in hotels, motels and caravan parks	**788**	People housed	First two weeks after 28 Feb
G4	Official (state-purchased market supply)	DCJ emergency accommodation	**1,200+**	People in emergency accommodation	10 Mar 2022
G5	Official (state-purchased market supply)	DCJ emergency accommodation	**1,440 (peak)**	People staying at local accommodation providers	27 Apr 2022
G6	Official	DCJ camp-style facilities (4 sites)	**356**	People housed at one point	March 2022
G7	Official	DCJ hired motorhomes (3 caravan-park sites)	**40 → 124**	Motorhomes in place	First two weeks → 22 Mar 2022
G8	Official	Resilience NSW caravans	**250+**	Caravans secured	Over the whole response
G9	Official	Temporary housing villages (pods / modular homes)	**0 in window**	Dwellings occupied by 30 Apr; 664 being procured in April; 546 eventually placed on 11 sites	April 2022 onward
M 1	Market (open)	Private rental listings, Lismore	**62 (0.5% vacancy)**	Dwellings listed for rent	Mid-Feb 2022, pre-flood
M 2	Market (open)	Private rental vacancy, Lismore	**0.4%**	Rental vacancy rate	Pre-flood (Lismore City Council)
M 3	Market (open)	One Lismore agency's rent roll	**~50 of 280; 2 listed**	Rentals made uninhabitable; homes on market (60+ inquiries each)	Mid-Apr 2022
M 4	Market (open)	Short-term rentals (Airbnb)	**6,260 (4,006 high availability)**	Listings in the region	2022
M 5	Market (state-subsidised)	Rental Support Payment	**2,286 recipients ($20.8m)**	Payments for private accommodation of 14+ nights	24 Mar – 30 Jun 2022

ID	Sector	Provider / housing type	Figure	What is counted	Date / period
M6	Market (state-subsidised)	Rental Support Payment (Mar 2022 round)	**15,082 applied / 3,216 approved ($28.9m)**	Applications and approvals	To 30 Jun 2023
M7	Market (open)	Market condition	**<1%**	Rental vacancy, Northern Rivers	Mid-2022
I1	Informal	Family, friends, tents, sheds, damaged homes	**No count**	People in informal shelter	Feb – Apr 2022
I2	Informal	Displaced persons not using centres	**63%**	Share of displaced survey respondents who did not use evacuation centres	Northern Rivers survey (n=248)
I3	Informal	Homeless after flood (estimate)	**2,000+**	People made homeless	Lismore LGA, Mar–Apr 2022

Source notes (figure IDs refer to the table above)

[H1] Audit Office of NSW, Flood housing response (2024). Figures: D1, D2, D3, G3, G5, G6, G7, G8, G9, I1. https://www.audit.nsw.gov.au/our-work/reports/flood-housing-response

[H2] Rappler / Reuters, 'Thousands of Australians return to uninhabitable homes' (10 Mar 2022). Figures: G4. https://www.rappler.com/world/asia-pacific/australian-floods-updates-march-10-2022

[H3] AHURI, Floods and the future for housing insurance (24 Mar 2022). Figures: M1. https://www.ahuri.edu.au/research/brief/Floods-and-the-future-for-housing-insurance

[H4] Sydney Morning Herald, Domain rent report (14 Apr 2022). Figures: M3. https://www.smh.com.au/property/news/cashed-up-sydney-tree-changers-send-regional-rents-to-record-highs-20220414-p5adi7.html

[H5] Tenants' Union of NSW news digest (citing Inside Airbnb). Figures: M4. https://www.tenants.org.au/digestitems/list?page=755

[H6] NSW Government, Act of grace payments register. Figures: M5. https://www.nsw.gov.au/departments-and-agencies/customer-service/publications-and-reports/act-of-grace-payments

[H7] Service NSW, Closed programs – statistics. Figures: M6. https://www.service.nsw.gov.au/performance-dashboard/closed-programs-statistics

[H8] NSW Legislative Council, Report No 1 – Response to major flooding across NSW in 2022. Figures: G1. https://www.parliament.nsw.gov.au/lcdocs/inquiries/2866/Report%20No%201%20-%20Response%20to%20major%20flooding%20across%20New%20South%20Wales%20in%202022.pdf

[H9] Southern Cross University submission to the NSW Legislative Council inquiry. Figures: G2. https://www.parliament.nsw.gov.au/lcdocs/submissions/78755/034%20Southern%20Cross%20University.pdf

[H10] 2022 NSW Flood Inquiry, Volume One summary (SMH-hosted copy). Figures: M7. https://www.smh.com.au/interactive/hub/media/tearout-excerpt/9172/VOLUME_ONE_Summary_report.pdf

[H11] UNSW City Futures, Housing vulnerability and climate disaster recovery: 2022 Northern Rivers floods. Figures: I1. https://www.unsw.edu.au/content/dam/pdfs/ada/city-futures/Northern-Rivers-postflood-housing-20221102.pdf

[H12] Lismore City Council, Flood Response report (Apr 2022; copy hosted on Scribd). Figures: M2, I3. https://www.scribd.com/document/671353661/Flood-Response-Final

[H13] Southern Cross University, Northern Rivers Flood Recovery Study – preliminary results. Figures: I2. https://www.scu.edu.au/media/scu-dep/news/images/2023/Flood-Recovery-Survey_Preliminary-Results.pdf

Summary: official plus market versus informal housing

Demand. About 4,055 homes were uninhabitable and 10,849 damaged (D1). By mid-April the state estimated that about 1,650 households needed temporary housing (D3), 70% of them former renters (D2).

Official plus market capacity. The government's main tool was buying commercial rooms. DCJ housed 788 people in hotels, motels and caravan parks in the first fortnight, more than 1,200 by 10 March and a peak of 1,440 on 27 April (G3–G5). Purpose-built official capacity was small during the window: 356 camp beds, 124 motorhomes by 22 March and some of the 250+ caravans (G6–G8). The pod villages delivered no dwellings before 30 April (G9). The open rental market was close to empty: Lismore had just 62 listings at 0.5% vacancy before the flood (M1), and one large agency had 2 homes on the market in April after losing about 50 rentals (M3). Rental Support Payments (2,286 recipients statewide to 30 June) helped households buy into this very thin market rather than adding stock (M5, M6). At any one time, official and market supply together sheltered roughly 1,200–1,500 people, plus evacuation-centre populations in the first weeks (G1, G2).

Informal private capacity. No agency counted people housed by family and friends, in tents, sheds or vehicles, or in their own damaged homes (I1). The available indicators suggest this was the largest sector: 63% of displaced survey respondents did not use evacuation centres (I2), and Lismore Council estimated more than 2,000 people homeless in its area alone (I3). Set against roughly 4,000 lost dwellings and 1,650 households needing temporary housing, the 1,440-person official peak suggests most displaced people were absorbed informally between 26 February and 30 April.

Balance. Official housing was mostly market accommodation bought by the state, and it peaked at about 1,440 people. The open rental market added only dozens of homes. The informal sector carried the remainder, which is unmeasured but probably several thousand people.