Australia's National Science Agency

Northern Rivers Resilience Initiative – progress update

The National Emergency Management Agency (NEMA) engaged CSIRO to undertake the Northern Rivers Resilience Initiative (NRRI).

The NRRI aims to help the Australian Government understand the drivers behind the unprecedented flood events in February–March 2022 in the Northern Rivers region of NSW and develop community-supported solutions for flood mitigation and resilience investment. This initiative enables CSIRO to assess existing project proposals and identify further long-term options for reducing flood risk in the Northern Rivers region.

The NRRI consists of two phases:

1. **Rapid review and assessment** (Phase 1 – July to November 2022, completed) – This phase identified and prioritised existing flood resilience/mitigation project proposals. It characterised the catchment and climate conditions which led to the 2022 floods and analysed the most effective intervention options for allocation of the Australian Government's $150 million of funding. Residents and councils in each of the seven flood-affected Local Government Areas in the region (Ballina, Byron, Clarence Valley, Kyogle, Lismore, Richmond Valley and Tweed) were consulted to help identify and prioritise the most effective intervention options.

   Outcome – CSIRO completed the rapid review and assessment phase and submitted two related reports to NEMA on 30 November 2022. These reports and a full list of project recommendations were then considered by the Australian government. On 23 February 2023, the first 16 projects totalling $50 million were announced. On 28 July 2023, the second 20 projects totalling more than $100 million were announced. CSIRO and NEMA have now completed phase one of the NRRI with $150 million Commonwealth funding provided for flood mitigation and resilience projects in the Northern Rivers region to support the NSW Government to fast-track resilience efforts.

2. **Detailed modelling** (Phase 2 – Ongoing to June 2025) – This longer-term program of work is collecting and generating high resolution and high accuracy Light Detection and Ranging – LiDAR (a digital representation of the bare-earth's topographic surface). The data provides spatial analysis and hydrological/hydrodynamic modelling of water movement for the entire Northern Rivers region. The project is also collecting river bathymetry (continuous river cross sections) using boats for the Richmond and Tweed rivers and their main tributaries.

This high-quality data will be used to underpin a detailed hydrodynamic model for the Richmond River catchment. The model will be used for examining and evaluating possible future events and scenarios and predict their outcomes while drawing on local knowledge and expertise on the catchment and flooding.

Outcome – CSIRO will generate high quality digital elevation data sets for the Northern Rivers region based on the collected LiDAR and bathymetry data sets. This, along with other data, will be used to develop a detailed hydrodynamic model for the entire Richmond River catchment. Researchers will then use this model to undertake scenario analysis to evaluate flood mitigation actions, in the context of climate. The report for this work and fully calibrated model is due in June 2025 (noting there were some delays in data collection due to unfavourable weather conditions). Scenario testing will take place in 2025–26. The LiDAR and bathymetry datasets will be made publicly available and can be used by regional councils, Australian and state government agencies, researchers and community members across the region.

This map identifies the flood-effected Local Government Areas in the Northern Rivers region of NSW where the project is being carried out.

Frequently asked questions

What is the model that CSIRO is building for the Richmond River catchment?

The model is a hydrodynamic model (HD), which is a representation of water flows across the Richmond River catchment (more than 7000km2). The model aims to represent the key hydrological (water flow) processes related to flooding across the catchment and will be able to reproduce the past flooding history in the catchment. Once completed, the model can be used to investigate the changes in flooding associated with changed climate, as well as structural and non-structural infrastructure options designed to mitigate flooding.

The model design is based on detailed spatial representation of the catchment's biophysical characteristics such as soils (infiltration rates, soil storage capacity, etc) and landscapes (roughness, flow paths, flow direction, structures, vegetation, etc.). The landscape surface of the catchment is represented in the model with a continuous flexible mesh (millions of triangular facets) with very fine representation in the areas important for flood generation, movement, flow barriers as well as residential, commercial and industrial areas, and coarser in areas which are not impacted by floods.

The hydrodynamic model will be validated (checked for accuracy) against:

- flood extents mapped through remote sensing (using satellite products from Landsat, Sentinel, etc.)
- measurements at internal flow gauges
- on-ground observations.

This will provide confidence in the model to be used for any future climate change or flood mitigation scenario analysis.

Given the size of the Richmond River catchment, model complexity and simulation time steps (at times during wet conditions the model runs every few seconds), a complete model simulation of the catchment will take up to 3 months. On CSIRO high performance computing, this can be reduced to a run-time of close to one month.

The Richmond River catchment hydrodynamic model is specifically developed to represent water flows across the Richmond River catchment for the purpose of understanding the flooding in the catchment and for evaluating flood mitigation scenarios. It should only be used for the intended purpose and not for other purposes where we might need a different type of model.

Has Phase 2 of the NRRI been delayed and if so, why?

The Light Detection and Ranging (LiDAR) digital elevation data and the mapping of river cross sections (bathymetry) data collection commenced in July 2022 and is ongoing.

The Bathymetry data will be available for use in early 2024.

There were significant delays to the LiDAR collection due to unfavourable weather conditions across the region over the last year. The LiDAR collection for the Richmond catchment is close to completion and we anticipate that it will be complete by end of 2023. A detailed quality assessment will then be undertaken and we are expecting the final LiDAR data to be publicly available by June 2024. This high resolution and high accuracy LiDAR data set is a critical input for the Richmond River catchment hydrodynamic model.

The detailed hydrodynamic model for the Richmond River catchment is currently being built. This will use the LiDAR and bathymetry data sets, and the model will be able to evaluate future changes in flooding due to climate and mitigation scenarios at the catchment scale. Although there are some existing flood models, these represent smaller areas or only sections within the catchment, and a catchment scale model has never been built before for the Richmond River catchment. Building this model is both a complex and time-consuming process. The model needs to be done at the highest precision to get reliable estimates to underpin any future flood mitigation options.

Researchers use sonar equipment from boats like this, including remote controlled boats (inset), to collect accurate information about cross sections of the river network (known as river bathymetry) to inform their hydrodynamic modelling. This image, from geospatial experts AAM, pictures AAM personnel using sonar equipment on the water.

For further information

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Regular updates about the progress of NRRI are available on the CSIRO and NEMA websites (above). Regular updates are also provided to the project Governance and Advisory panels, the Northern Rivers Joint Organisation (NRJO), local councils, stakeholders and communities.

This project is funded by the National Emergency Management Agency

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