Attachment 3 to Item 10.3.1.

Redbank Creek Flood Study – Final Report and Maps

Date of meeting: 8 April 2025
Location: Council Chambers
Time: 6:30pm

Hawkesbury City Council

Redbank Creek Flood Study

March 2025

FINAL

NSW GOVERNMENT

Manly Hydraulics Laboratory

Redbank Creek Flood Study

Stage 2 Report

Report MHL3008

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Foreword

The NSW State Government's Flood Prone Land Policy offers a comprehensive framework for managing flood risks and guiding mitigation efforts. The primary objective of the NSW Government's Flood prone land policy is to reduce the impacts of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. At the same time, the Policy provides a means of ensuring that any new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the Policy, Local councils are primarily responsible for managing flood-prone land. Their role includes establishing effective Flood Risk Management (FRM) governance and consultation frameworks for community input and setting development standards and implementation arrangements in alignment with state, regional, and district strategies.

The NSW Government supports councils in FRM by providing technical assistance, guidelines, and tools, subsidising flood studies and FRM studies and plans, mitigation works and measures, and developing regional and district land-use strategies under the Environmental Planning and Assessment Act 1979.

The Policy provides councils with guidance on strategically managing flood risk within their local government areas (LGAs) through the FRM framework, shown in Figure A, and collaboration across all levels of government.

Figure A Flood risk management framework

Councils are encouraged to develop and implement FRM plans through the FRM process, presented in Figure B.

Figure B Flood risk management process

The FRM process enhances understanding of flooding, evaluates risk management strategies, and informs long-term flood risk management decisions. It considers social, economic, ecological, and cultural factors alongside community aspirations. The process results in FRM plans that guide councils in managing flood risk for both existing and future developments. Implementing these plans improves community flood resilience through risk avoidance, minimisation, and mitigation, integrating FRM, emergency management, and land-use planning.

NSW government's professional specialist advisor, Manly Hydraulics Laboratory (MHL) was commissioned by Hawkesbury City Council to undertake the Redbank Creek Flood Study which constitutes the first and second stage of the management process (Data collection and Flood Study).

The report was prepared by Armaghan Severi, Matthieu Glatz and Maryam Farzadkhoo.

Executive Summary

This flood study provides a comprehensive assessment of flooding in North Richmond and the surrounding local catchment, with a particular focus on the Redbank Creek catchment and its local overland flooding mechanisms. A thorough literature review of previous flood studies identified a gap in understanding local flooding dynamics, prompting this investigation aimed at enhancing flood risk management in the area.

The study's scope does not encompass direct flooding from the Hawkesbury River, as this has been extensively addressed in the Hawkesbury-Nepean River Flood Study; however, backwater effects from the river are considered. It is essential to recognise that areas affected by riverine flooding must be evaluated accordingly. The key components of the flooding assessment included:

- A review of existing studies and data
- Community consultation
- Hydrological and hydraulic analysis and modelling
- Sensitivity analysis
- Flood mapping
- Assessment of flooding consequences on the community
- Evaluation of climate change impacts on local flooding
- Development of a draft and final flood study report

The flood mapping included a comprehensive range of events, from the 20% to the 1 in 5000 Annual Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF) scenarios, representing the critical durations and patterns for the Redbank Creek catchment.

This report acknowledges that the lack of gauging stations in the study area limits data availability for calibration. Therefore, best practice model validation has been followed, and sensitivity analyses were undertaken. Sensitivity analyses yielded the following results, which are consistent with expectations based on similar studies:

- Tailwater Level: While tailwater levels in the Hawkesbury River have minimal effect on upstream flood levels, they substantially impact the extent of flooding and water level along the low-lying areas at the downstream end of Redbank Creek.
- Losses: The removal of all losses could increase flood levels by up to 0.8 m along the creek and 0.2 m in the township. Conversely, using standard ARR 2019 loss estimates instead of adopting calibrated losses from the Hawkesbury-Nepean River Flood Study may reduce flood levels upstream by 0.2 m while increasing levels downstream by 0.1 m.
- Roughness: Increasing hydraulic roughness by 20% can lower water levels by up to 0.25 m along watercourses, while decreasing roughness produces the opposite effect.
- Blockage: A double blockage scenario could raise flood levels by 0.2 m in the township, while a no blockage scenario would result in localised changes of up to 0.1 m.

It was observed that flow within the North Richmond township primarily follows both Redbank

Creek and the main drainage channel through the township the during majority of events up to and including the 1 in 2000 AEP event. Key flood-prone areas are highlighted below, noting that the described impacts are based on flooding that affects the floor level of buildings on properties:

- Properties located at the northern end of William Street, Elizabeth Street, Susella Crescent, Merrick Place and O'Dea Place are impacted from the 1 in 500 AEP event; however, road access may be affected by events as frequent as the 20% AEP event;
- A few Properties along the northern side of Flannery Avenue are impacted from the 1 in 200 AEP event; however, their access may be affected by event as frequent as a 5% AEP event;
- A few properties at the north-west corner of Pansy Crescent are impacted by events as frequent as the 10% AEP event;
- Properties located along the main drainage channel between Pecks and Elizabeth Streets are affected due to the 1 in 5000 AEP and PMF events.
- A few properties located between Stephen and Pecks Streets are impacted by events as frequent as the 10% AEP event.
- Properties situated between Tyne Crescent, Stephen Street and north end of Yvonne Place are impacted by events as frequent as the 5% AEP event.
- A secondary overland flow path was observed through the North Richmond township, from the sag point along Enfield Avenue through a few properties towards the south end of Monti Place, continuing towards the intersection of Charles and Elizabeth Streets. These areas are impacted by events as frequent as the 10% AEP event;
- Properties located at the southernmost corner of Tyne Crescent are impacted by events as frequent as the 5% AEP event;
- A few properties located at the north-east corner of the intersection of Charles and William Streets are impacted by events as frequent as the 5% AEP event;
- Properties near the intersection of Charles and Elizabeth Streets are impacted by floods as frequent as the 5% AEP event such as North Richmond Community Centre.

It was observed that the North Richmond Community Centre lot, while used as an evacuation centre for the township of North Richmond, is impacted by an overland flow as frequent as a 20% AEP event to depths up to 0.25 m. The North Richmond Community Centre buildings are impacted above the floor level by the overland flow as frequent as a 20% AEP event to a depth of 0.03 m above the floor. Moreover, access to this venue by residents of various parts of the township may be restricted. It is therefore recommended the careful consideration be given to the design and management of the evacuation centre. Moreover, Turnbull Oval is also used as an evacuation centre for the township of North Richmond and, while it is outside of the extent of a PMF event, access to the oval by residents of northern parts of the township may be restricted from a 1 in 200 AEP event and from a 1 in 5,000 AEP event, Terrace Road access will become limited for the majority of residents.

An economic impact assessment of flooding was undertaken by estimating the flood damages in the catchment. The preliminary flood damage assessment involved analysing 5,250

buildings and the associated lots within the study area. A total Annual Average Damage of approximate $1.5 million for residential properties and $373,510 for non-residential properties was estimated in the Redbank Creek catchment. To improve accuracy, a comprehensive floor level survey is recommended for any further flood risk management investigations in the area including flood risk management studies and plans.

Moreover, climate change scenarios projected for 2040, 2090, and 2100 indicate substantial increases in rainfall intensity, which could exacerbate flood conditions. Specifically:

- 2040 Conditions: A 9.5% increase in rainfall intensity and 0.40 m rise in Hawkesbury River water level may lead to a 0.20 m increase in localised overland and Redbank Creek flooding.
- 2090 Conditions: A 19.7% increase in rainfall intensity and 0.9 m rise in Hawkesbury River water level could result in a 0.30 m increase in localised overland and Redbank Creek flooding.
- 2100 Conditions: A 30% increase in rainfall intensity and 1.3 m rise in Hawkesbury River water level might cause a 0.50 m increase in localised overland and Redbank Creek flooding levels.

This study lays a robust technical foundation for ongoing flood risk management and further investigations in the Redbank Creek Catchment, contributing to enhanced resilience against future flooding events.

Contents

TABLES

FIGURES

1 Introduction

NSW Government's Manly Hydraulics Laboratory (MHL) was engaged by Hawkesbury City Council (Council) to undertake a flood study of Redbank Creek with financial support from the NSW State Government Floodplain Management Program, managed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The Hawkesbury-Nepean River Flood Study (Rhelm and Catchment Simulation Solutions, 2024) was completed in 2024, covering a large geographic area and focusing on mainstream regional scale flooding. However, this study did not include shorter-duration local catchment flooding or overland flow inundation, and a finer resolution flood study is required to define flood behaviour and risk in the Redbank Creek catchment.

The key factor of the Redbank Creek Flood Study is the requirement for high quality design flood data, which will be used as an effective planning and advice tool for the community, Hawkesbury City Council, DCCEEW, the Department of Planning, Housing and Industry and emergency response agencies. This flood study is of vital importance to the understanding of flood behaviour, flood risk and the development of future potential mitigation options for the North Richmond community.

2 Background

2.1 Study area

The focus of the present investigation is the Redbank Creek catchment and the township of North Richmond in the Hawkesbury Local Government Area (LGA), located approximately 55 km northwest of Sydney. Redbank Creek flows east for approximately 12 km from about 450 m southeast of the Patterson Lane and Grose Vale Road roundabout to the Hawkesbury River (1.5 km downstream of the current North Richmond Bridge).

The upstream section of Redbank Creek flows through rural zoned land that is used for residential purposes. The middle portion of Redbank Creek flows through a combination of existing residential development and a greenfield development site named Redbank. The downstream section of the creek flows through rural zoned properties.

The Redbank Creek catchment is characterised by a large number of minor waterbodies, tributaries and drainage lines flowing in a north-south direction into Redbank Creek. The large number of surface water features within the study area are likely attributed to the historical land use of a Keyline dam system developed as part of an experimental farm. This type of farming primarily aims to conserve as much rainfall as possible, reduce evaporation rates, and use the conserved moisture for the improvement of soil fertility.

The study area is bounded by Grose Vale Road in the south and west, Bells Line of Road and Kurmond Road in the north, the Hawkesbury River in the southeast and some natural high ground between Kurmond Road and the Hawkesbury River in the east. The catchment size is estimated to be approximately 27 km^2.

The study area is presented in **Figure 2.1**.

2.2 History of flooding and rainfall

The Redbank Creek catchment can be impacted by two types of flooding mechanisms including:

- Local overland flooding; and
- Mainstream flooding due to:
    - Flooding from Redbank Creek; and
    - Flooding and backwater effects from the Hawkesbury River propagating into the Redbank Creek catchment.

The focus of the present study is to improve understanding of the flood behaviour within Redbank Creek catchment and the local overland flooding mechanisms. Direct flooding from the Hawkesbury River is not part of the scope of the current study as it is extensively covered by the Hawkesbury-Nepean River Flood Study (Rhelm and Catchment Simulation Solutions, 2024). However, backwater effects will be considered.

Recent occurrences of flooding of North Richmond include:

- The July 2022 flood event which is the most recent major flood event. The July 2022

flood was a typical single-peaked event. Peak flood level of 14.85 m AHD were recorded at North Richmond gauge (212200) at 3:00 am on Monday 4th of July 2022 and classified as a 10% Annual Exceedance Probability (AEP) event. North Richmond Bridge was flooded to a level of about 15.39 m AHD in August 1990 (Infrastructure NSW, 2023);

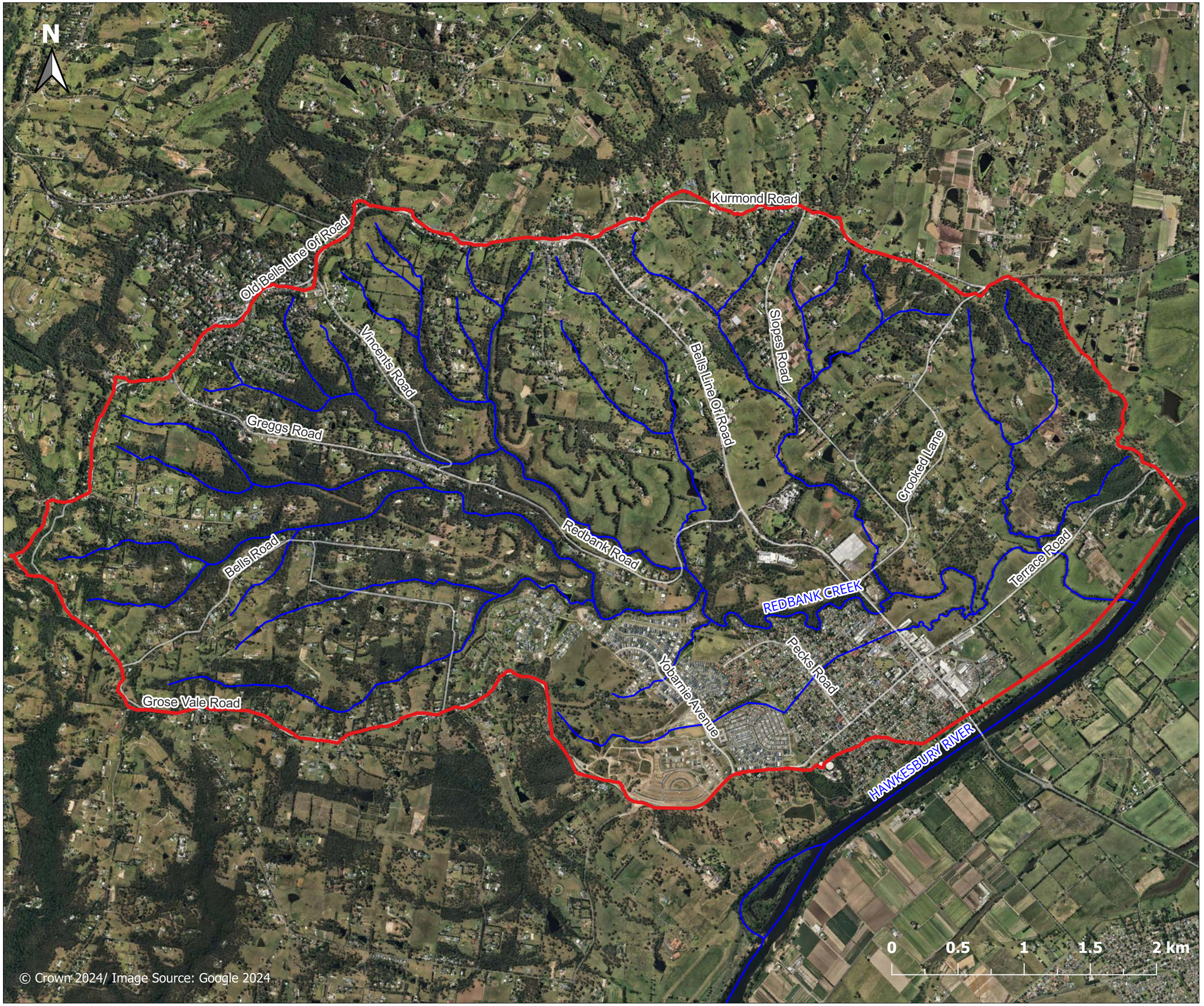
- The March 2022 flood event was a high-volume flood with two distinct peaks about 5 days apart. Peak flood level of 14.66 m AHD were recorded at North Richmond gauge (212200) at 12:15 am on Wednesday 9th of March 2022 and classified as a 20% to 10% AEP event. North Richmond Bridge was flooded to a level of about 14.8 m AHD. The March 2022 event led to significant evacuations in North Richmond associated with fear of dam failure occurring at Redbank Dams 13 and 14 (Infrastructure NSW, 2023);
- The March 2021 flood event is considered one of the most significant flood events in the historical record since 1990 (SES 2022). This flood led to evacuation in North Richmond. A distinctive characteristic was its double peak in upstream areas. It resulted in a large volume of inflows to Warragamba Dam. At North Richmond, the arrival of the floodwaters from Warragamba, plus inflows from the Grose River, saw the Hawkesbury River rise steeply on Saturday 20 and Sunday 21 March, peaking with major flooding at 14.91 m AHD. While a lower, second peak was observed on Wednesday 24 March (13.94 m AHD), it was less pronounced compared to sites upstream (Infrastructure NSW, 2021). North Richmond and Windsor experienced flooding with an estimated magnitude of the 10% to 5% AEP events. During moderate floods, the Yarramundi, Windsor and North Richmond bridges are all likely to be closed (Infrastructure NSW, 2021).
- The February 2020 flood event was the first moderate flood since the 1990 flood and flooded the North Richmond bridge.

The largest flood on record in the Richmond/Windsor floodplain occurred in June 1867 with a level of 20.14 m AHD at North Richmond Bridge (recorded by SES as the record flood at this location). Other large floods occurred in 1961, 1986, 1988 and 1990 (SES, 2022).

Some photographs of past events are provided in **Figure 2.2** to **Figure 2.4**.

Figure 2.1

Locality map



Legend

- Study area
- Watercourses

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