Appendix K

Flooding and Drainage

Kellyville Station Precinct

NSW GOVERNMENT | Planning & Environment

KELLYVILLE STATION PRECINCT FLOODING AND DRAINAGE PRECINCT PLANNING

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

DEPARTMENT OF PLANNING & ENVIRONMENT

KELLYVILLE STATION PRECINCT

Flooding and Drainage

Precinct Planning

Author	David Stone
Checker	Bruce Caldwell
Approver	Greg Ives
Report No	AA007617-001
Date	14 August 2015
Revision	1

This report has been prepared for Department of Planning & Environment in accordance with the terms and conditions of appointment for Kellyville Station Precinct dated 14 July 2014. Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared By	Approved By
0	13 Mar 2015	Final	DS	GI
1	14 Aug 2015	Updated Opportunity Sites Plan	DS	GI

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

This report has been prepared by Hyder Consulting (Hyder) and provides an assessment of flooding and drainage relating to the proposed rezoning of the Kellyville Station Precinct. Opportunity sites for the Kellyville Station Precinct (refer **Appendix 1**) have been identified based on an overall opportunity and constraints analysis by the urban designers in collaboration with the precinct planning team. It is primarily with respect to flooding and stormwater related to rezoning for these opportunity sites that this report provides assessment.

Data Collection and Review

The *Rouse Hill Flood Study* (RHFS)(WMAwater, 2014) provides the most recent and comprehensive information on flood behaviour in the Kellyville Station Precinct. The study included design flood estimates for storm events ranging from the 2 year to 100 year ARI and also included sensitivity analysis in relation to blockage criteria and rainfall intensities. It is noted that the *Rouse Hill Flood study* does not include modelling of the Probable Maximum Flood (PMF) event.

While the RHFS flood study provides flood information it is within the context of regional assessments. Hyder recommends that the RHFS modelling and results be reviewed in detail for the purpose of determining the extent of re-modelling necessary.

Recommendations

It is recommended that:

- Flood Planning Levels (FPLs) for the Kellyville Station Precinct be derived from flood levels included in the *Rouse Hill Flood Study*, subject to a detailed review of the flood study models and necessary refinements.
- Development controls for stormwater management and flooding be generally consistent with The Hills DCP 2012. In addition, floodplain management should comply with 'Floodplain Development Manual the management of flood liable land' (NSW Government, April 2005) and stormwater drainage design should be in accordance with Council guidelines and *Australian Rainfall and Runoff* (Institution of Engineers Australia, 1987, noting current updates).
- Water sensitive urban design pollution reduction targets be consistent with those applied to the North West Growth Centres.

Conclusion

Hyder has identified:

- available flooding information and recommended analysis and review processes necessary before application of such flood information to the opportunity sites (report Section 3.1).
- development controls applicable to the rezoning and development of the Kellyville Station Precinct (report Section 4.2) .
- the next steps in assessing of flooding and drainage related to the proposed rezoning of the Kellyville Station Precinct opportunity sites A, B, C and D as:
    - conducting the flood model review and associated assessment refinements discussed in report Section 3.1;
    - producing a development layout plan and documentation that demonstrates how compliance with the floodplain management policies and guidelines, and the meeting of pollution reduction targets, (identified in report Section 4.1), would be facilitated.

1 INTRODUCTION

This report has been prepared by Hyder Consulting (Hyder) and provides an assessment of flooding and drainage relating to the proposed rezoning of the Kellyville Station Precinct.

The Kellyville Station Precinct was announced by the NSW Government in August 2014. The precinct is one of number of 'Priority Precincts' which aim to provide for more homes, jobs and improved public spaces close to transport and services. One of the key goals for Priority Precincts is to increase housing choice and affordability by delivering increased housing supply in an environmentally, socially and economically sustainable manner.

The Kellyville Station Precinct covers approximately 437 hectares, and includes the area within an 800 metre radius, or roughly a 10 minute walk, of the new Kellyville Station. The boundary has also taken into account the surrounding road network, natural features, and the development pattern of the area.

The precinct covers two local government areas. Land on the eastern side of Old Windsor Road is located within the Hills Local Government Area, and land on the western side of Old Windsor Road is within the Blacktown Local Government Area.

The vision for the Kellyville Station Precinct is for a vibrant, predominantly residential area offering a mix of housing types within walking distance of the new station, along with local shops, community facilities, and improved open space network.

The Kellyville Station Precinct is a long term project that will be delivered over the next 25 years.

1.1 OPPORTUNITY SITES

Opportunity sites for the Kellyville Station Precinct (refer **Appendix 1**) have been identified based on an overall opportunity and constraints analysis by the urban designers in collaboration with the precinct planning team. It is primarily with respect to flooding and stormwater related to rezoning for these opportunity sites that this report provides assessment.

2 DATA COLLECTION

The Kellyville Station Precinct is located within the Rouse Hill Development Area (RHDA). The RHDA is defined by *Sydney Regional Environmental Plan No. 19 – Rouse Hill Development Area.* Sydney Water is the designated Trunk Drainage Authority (TDA) and is responsible for the management of Trunk Drainage Land (TDL) within the RHDA. The TDL is generally defined as land within the 100 year Average Recurrence Interval (ARI) flood extents.

Flood extents within the RHDA were originally based on a study by GHD in 1998 and subsequently refined as part of the study *Rouse Hill Integrated Stormwater Strategy Review* (SKM, 2007). Sydney Water commissioned the *Rouse Hill Flood Study* (WMAwater, 2014) to assist in further updating the TDL extents within the RHDA. The *Rouse Hill Flood Study* (WMAwater, 2014) provides the most recent and comprehensive information on flood behaviour in the Kellyville Station Precinct.

Further to the *Rouse Hill Flood Study*, in discussions with Sydney Water it was noted that they are currently undertaking a project to assess whether the TDL can be minimised along Elizabeth Macarthur Creek in order to facilitate development in these areas.

Other flood studies have also been undertaken in the area, with the largest studies being to inform the preparation of an Environmental Impact Assessment for the Sydney Metro Northwest project (previously referred to as the North West Rail Link (NWRL)). While these studies provide relevant information on flood behaviour within the Kellyville Station Precinct, the studies were prepared for different purposes and do not provide comprehensive information on flood behaviour across the entire Kellyville Station Precinct

2.1 ROUSE HILL FLOOD STUDY

Sydney Water, as the designated Trunk Drainage Land Acquisition Authority, commissioned the *Rouse Hill Flood Study* (WMAwater, April 2014) to assist in defining the TDL within the Rouse Hill Development Area (RHDA). The catchment/study area is outlined in **Appendix 2** and includes the entire Kellyville Station Precinct.

The *Rouse Hill Flood Study* involved the development of hydrologic and hydraulic models. The XP-RAFTS hydrologic model used for the study was based on a model originally developed by GHD in 1998 and subsequently updated by SKM in 2007. The SKM model was refined by WMAwater to reflect current information on ultimate catchment development conditions.

A new hydraulic model was developed for the *Rouse Hill Flood Study*. TUFLOW was used to develop a 1D/2D hydrodynamic model with a terrain surface based predominantly on LiDAR and supplemented with information from Work As Executed drawings and detailed creek survey.

The study included design flood estimates for storm events ranging from the 2 year to 100 year ARI and also included sensitivity analysis in relation to blockage criteria and rainfall intensities. It is recommended in the report that blockage of individual structures should be considered further when considering development controls and design of future structures.

It is noted that the *Rouse Hill Flood study* does not include modelling of the Probable Maximum Flood (PMF) event. While the PMF is not typically used to derive Flood Planning Levels (FPLs), it is often a key input into floodplain planning and, among other things, is used to determine evacuation requirements for extreme flood events.

2.2 NWRL EIS 2

The NWRL EIS 2, Technical Paper 7 (AECOM, 2012), was prepared to inform the NWRL EIS 2 (Stations, Rail Infrastructure & Systems). The flood modelling carried out for the NWRL project was specifically for the purpose of defining flood behaviour in the vicinity of the NWRL corridor and to address a number of particular requirements of the NWRL project, including the assessment of:

- existing and future development scenarios;
- potential impacts due to climate change;
- alternative design options/configurations;
- quantification of flood behaviour in the PMF event to manage flood risk to critical infrastructure.

Hydrologic models were developed using WBNM software. Hydraulic models were developed using either HEC-RAS or TUFLOW software depending on the creek/floodplain characteristics. Within the Kellyville Station Precinct the waterways were all modelled using TUFLOW.

3 FLOODING

The Kellyville Station Precinct has three main creeks running through the Precinct, generally from south to north. These are:

- Caddies Creek;
- Strangers Creek;
- Elizabeth Macarthur Creek.

These creeks are tributaries of Cattai Creek, which in turn is a tributary of the Hawkesbury River.

As part of the Rouse Hill Development Area (RHDA) flooding and stormwater management strategy, a number of detention basins have been constructed along these creeks within the Kellyville Station Precinct. As referenced in the *Rouse Hill Flood Study* (RHFS), these include Basins 5, 31, 32 and 33 (refer **Appendix 2**). Basin 5 is online (Caddies Creek passes through the basin) and is a prescribed dam under the Dams Safety Act 1978 (prescribed dams have significant monitoring requirements to maintain safety). Basins 31, 32 and 33 are all offline from Strangers Creek and are not prescribed. No basins were noted along Elizabeth Macarthur Creek.

Flood behaviour in the creeks has been modelled as part of both the *Rouse Hill Flood Study* and the *NWRL EIS 2* study, both of which adopted similar modelling approaches. The *Rouse Hill Flood Study* is considered the more appropriate information source to use for current planning purposes due largely to the fact that the specific aims of the study were to define flood levels and extents for planning purposes which is largely the same objective as the current study. The *NWRL EIS 2* study was developed specifically for the purpose of assessing flood risk and potential impacts for the NWRL project which covers only part of the Precinct. The *NWRL EIS 2* study did not aim to assess flood behaviour across the Precinct as a whole and hence is considered less suitable to use for precinct planning purposes.

3.1 ADEQUACY OF INFORMATION

The opportunity sites identified have been superimposed onto Figure 16 (Peak Flood Depths and Level Contours, 1% AEP Event) of the RHFS (refer **Appendix 2**). As seen, Areas A, B, C and D are all located adjacent to, or within, the creek corridors of Elizabeth Macarthur Creek and Caddies Creek.

While the RHFS flood study (and the NWRL EIS 2 study) provides flood information, both are within the context of regional assessments. To more adequately define flow regimes including floodways, flood extents and depths for the opportunity sites, Hyder recommends that the RHFS modelling and results be reviewed in detail and refined where necessary. In particular Hyder notes (from the RHFS report) that necessary refinements may include:

- discretising of sub-catchment areas;
- improved/additional ground survey of overbank areas, the creek waterways, and waterway structures;
- refinement of the 5m grid size (to say 2m);
- detention basin representation;
- blockage assessments of waterway structures;
- modelling of the underground drainage systems to facilitate assessment of local waterway flooding (beyond the mainstream flooding);

- climate change impacts;
- the PMF event.

Such refinements would be expected to involve floodplain model adjustments and running.

Depending on the scope of refinements (determined as necessary), it may be more expedient to extract hydraulic parameters from the regional RHFS model, and generate a site focused flooding and drainage model covering areas A, B, C and D.

Also, further consultation should be undertaken with Sydney Water to determine the current status of any projects which may modify flood levels behaviour in TDL.

3.2 FLOOD PLANNING LEVELS

It is recommended that Flood Planning Levels (FPLs) for the Kellyville Station Precinct be derived from flood levels included in the *Rouse Hill Flood Study*, subject to the review and refinements discussed above. FPLs and development controls are discussed in the following report Section 4.

4 DEVELOPMENT CONTROLS

4.1 THE HILLS DCP 2012

The Hills Development Control Plan 2012 (The Hills DCP 2012), adopted by Council in March 2013, provides development controls that apply to the majority of land within The Hills Shire LGA.

Part B includes controls that apply across the LGA to different development types. In general, these require drainage systems to be designed in accordance with Council guidelines and *Australian Rainfall and Runoff* (Institution of Engineers Australia, 1987). While there are some requirements for Water Sensitive Urban Design (WSUD) to be implemented, the controls do not include pollution reduction targets.

Part C, Section 6 (Flood Controlled Land) defines flood planning levels (FPLs) relative to 20 year ARI, 100 year ARI and PMF flood levels for different land uses. Habitable floor levels for most land uses are required to be no lower than the 100 year ARI flood level plus 0.5 m freeboard.

Part D includes site specific controls for a number of areas including the Balmoral Road Release Area and the Kellyville Rouse Hill Release Area which fall partly within the boundaries of the Kellyville Station Precinct. The site specific controls for stormwater management differ between the Balmoral Road and Kellyville Rouse Hill Release Areas, however the key controls are generally consistent, including:

- Minor drainage systems are required to capture and convey the 10 year ARI design storm.
- Owners of properties adjoining TDL are required to contact Council/Sydney Water to confirm the 100 year ARI flood levels and extents.
- Discharge to or construction within TDL will require approval of Sydney Water
- All residential, employment and commercial developments will be required to provide rainwater tanks

No on-site detention (OSD) is required as part of any development within the RHDA as this has been provided by Sydney Water at a regional level. However, consideration still needs to be given to the potential impact of development on any existing or proposed local drainage systems and OSD may be appropriate in some instances.

4.2 RECOMMENDED CONTROLS

It is recommended that controls for stormwater management and flooding be generally consistent with The Hills DCP 2012. However, also complying with the NSW ‘Floodplain Development Manual the management of flood liable land’ (April 2005), and following Council guidelines and *Australian Rainfall and Runoff* (Institution of Engineers Australia, 1987, noting current updates) with respect to drainage design.

In addition to these ‘water quantity’ controls, current best practice for water sensitive urban design (WSUD) in Sydney goes beyond such requirements. Current best practice requirements for WSUD include demonstrating compliance with pollution reduction targets. Consistent with targets applied to the North West Growth Centres, it is recommended that pollution reduction targets, relative to post-development loads without treatment, be applied and include:

- 85% Total Suspended Solids;
- 65% Total Phosphorus;
- 45% Total Nitrogen;
- 90% Gross Pollutants.

5 CONCLUSION

Hyder has:

- identified available flooding information and recommended analysis and review processes necessary (in report Section 3) before application of such regional flood information to the opportunity sites; and
- listed flooding and stormwater management and development controls applicable to the rezoning and development of the Kellyville Station Precinct.

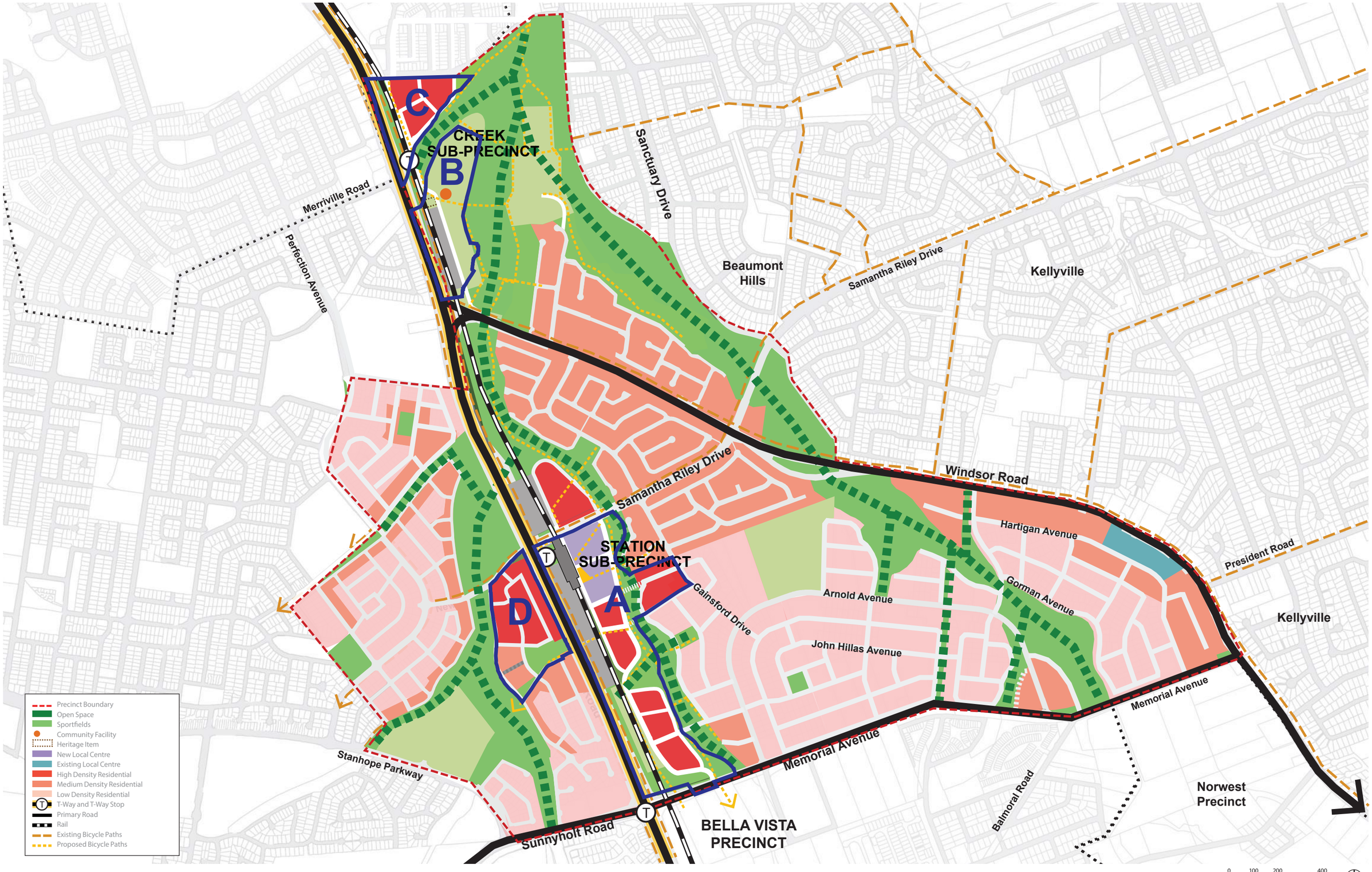
The next steps in assessing of flooding and drainage related to the proposed rezoning of the Kellyville Station Precinct opportunity sites A, B, C and D, should involve:

- conducting the flood review and associated assessment refinements, discussed in report Section 3.1);
- producing a development layout plan and documentation that demonstrates how compliance with the floodplain management policies and guidelines, and the meeting of pollution reduction targets, identified in report Section 4.1, would be facilitated.

APPENDIX 1

OPPORTUNITY SITES

Kellyville


C
CREEK
SUB-PRECINCT
B
Merriville Road
Perfection Avenue
Sanctuary Drive
Beaumont
Hills
Samantha Riley Drive
Kellyville
Windsor Road
Samantha Riley Drive
STATION
SUB-PRECINCT
D
A
Gainsford Drive
Arnold Avenue
John Hillas Avenue
Hartigan Avenue
Gorman Avenue
President Road
Kellyville
Memorial Avenue
Memorial Avenue
Stanhope Parkway
Sunnyholt Road
BELLA VISTA
PRECINCT
Balmoral Road
Norwest
Precinct
Precinct Boundary
Open Space
Sportfields
Community Facility
Heritage Item
New Local Centre
Existing Local Centre
High Density Residential
Medium Density Residential
Low Density Residential
T-Way and T-Way Stop
Primary Road
Rail
Existing Bicycle Paths
Proposed Bicycle Paths
0
100
200
400

APPENDIX 2

ROUSE HILL FLOOD STUDY EXTRACTS

FIGURE 1
STUDY AREA

Basin 42A
Basin 42B
Basin 41
Basin 40
Second Ponds Creek
Basin 24
Basin 24A
Stanhope Parkway
Schofields Road
THE PONDS
ROUSE HILL
Basin 28
Wet Basin 1
PARKLEA
Sunnyholt Road
Windsor Road
Commercial Road
Withers Road
Basin 20
Basin 21
KELLYVILLE RIDGE
STANHOPE GARDENS
Basin 29
Basin 5
Caddies Creek
Caddies Creek
Smalls Creek
GLENWOOD
Forman Avenue
Basin 13
Old Windsor Road
Strangers Creek
Sanctuary Drive
Elizabeth Macarthur Creek
BEAUMONT HILLS
Caltal Creek
Basin 31
Basin 32
Samantha Riley Drive
Withers Road
Smalls Creek
KELLYVILLE
Basin 33
KELLYVILLE STATION PRECINCT
Basin 35
Fairway Drive
Memorial Avenue
Windsor Road
Basin 9
BELLA VISTA
Basin 9B
Basin 16A/B
President Road

N

Basin
Catchment

0 1 2 3 4 km

J:\Jobs\113050\ArcGIS\ArcMaps\ReportFigures\Figure01_Study_Area.mxd

FIGURE 16

PEAK FLOOD DEPTHS AND LEVEL CONTOURS
1% AEP EVENT

Basin 42A
Basin 42B
Basin 41
Basin 40
Basin 24
Basin 24A
Second Ponds Creek
THE PONDS
ROUSE HILL
Basin 28
Wet Basin 1
PARKLEA
Sunnyholt Road
Stanhope Parkway
Schofields Road
Withers Road
Windsor Road
Commercial Road
Basin 20
Basin 21
STANHOPE GARDENS
KELLYVILLE RIDGE
Area B
Area C
Basin 29
Basin 5
Caddies Creek
Smalls Creek
Cattai Creek
GLENWOOD
Forman Avenue
Basin 13
Area D
Old Windsor Road
Area A
Elizabeth Macarthur Creek
Strangers Creek
Sanctuary Drive
BEAUMONT HILLS
Basin 31
Basin 32
Samantha Riley Drive
KELLYVILLE
Basin 33
Basin 35
Fairway Drive
Memorial Avenue
Basin 9
BELLA VISTA
Basin 16A/B
Basin 9B
President Road

Peak Water Level (m AHD)
- Major Contours (5m interval)
- Minor Contours (1m interval)
- Basin
- Catchment

Depth (m)
- < 0.10
- 0.10 to 0.25
- 0.25 to 0.50
- 0.50 to 1.00
- 1.00 to 5.00
- > 5.00

0 1 2 3 4 km

J:\Jobs\113050\ArcGIS\ArcMaps\ReportFigures\Figure16_Peak_Flood_Depths_and_Level_Contours_1%AEP_Event.mxd