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Submission: Please refer the attached submission on behalf of the University of Sydney in response to the Western Sydney Aerotropolis Plan.

URL: <https://pp.planningportal.nsw.gov.au/draftplans/exhibition/western-sydney-aerotropolis-planning-package>

[REDACTED]



Greg Robinson
Chief University Infrastructure Officer

28 February 2020

Attention: Andrew Jackson
Director, Western Sydney Planning Partnership
PO Box 257,
Parramatta NSW 2124

Dear Mr Jackson,

Re: Draft Western Sydney Aerotropolis Plan

As a research and education institution, the University of Sydney (the University) is increasingly constrained by funding pressures and is reliant on realising value from its landholdings within the Aerotropolis to support its continued growth and evolution. Significantly, its Western Sydney landholdings are important to the University's plans to further invest in education, research and innovation in Western Sydney. As the Government itself has shown in its documentation, the University's land is at the heart of the Aerotropolis area and is some of its most valuable – both from a readiness for delivery perspective but also from a simple dollar value as well as the broader value of having the University investing in Sydney's west.

We refer to the draft *Western Sydney Aerotropolis Plan* ("WSAP") and associated key documents exhibited by the Department of Planning, Industry and Environment (the Department) which outlines the vision and planning framework for the Western Sydney Aerotropolis ("Aerotropolis"). Our commentary attached should be considered in the context of this lost value at many levels to the State and not just the University.

As noted, the University is the owner of a significant and consolidated landholding (344 hectares) in the Aerotropolis known as McGarvie Smith and Fleurs Farms (refer **Attachment A**). These landholdings, which spread across four precincts within the Aerotropolis, have strategic significance as the principal northern gateway to the new Western Sydney International (Nancy-Bird Walton) Airport ("Airport").

The draft WSAP now proposes to introduce additional rezoning and infrastructure restraints which limits the availability of developable land at the principal northern gateway on land earmarked for employment uses as proposed by the Western Sydney Employment Area ("WSEA") strategy. The changes to zoning and the introduction of significant infrastructure impacts as shown in **Attachment B**, have resulted in the University's prime developable land being reduced to just 26% (or 88 hectares out of 344 hectares) of the gross area of land that the University owns. While the University supports the rezoning of land in the Aerotropolis, the WSAP, if adopted in its current form, will lead to a significant reduction in developable land value and consequently, a reduction in realising the education, research and employment opportunities for the University's landholdings.

As the Department and Western Sydney Planning Partnership ("WSPP") are aware, the University has been very open and collaborative around its intention to work with the relevant government bodies and agencies to bring the very best of the University's research and teaching capabilities to the Aerotropolis. Our vision has always been to maximise this once in a life-time opportunity for NSW.

The University has invested considerable funds, time and effort in preparing for the rezoning of its landholdings and submitted its planning proposal to Penrith City Council and the Department in February 2018. In this proposal, the University outlined its intentions to bring its world leading capabilities in defence, artificial intelligence, advanced manufacturing, robotics, agriculture and aerospace industries to support the focus of the Aerotropolis.



The University's vision for its land was always aligned with the Government's strategy for the WSEA, which was to ensure the lands around the Airport were zoned for high employment use.

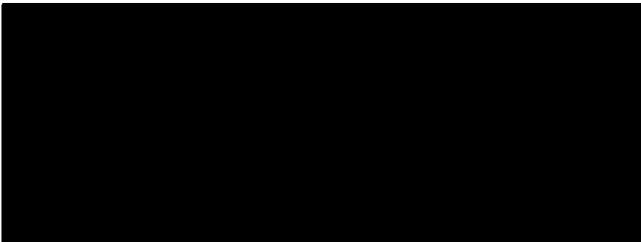
In the context of the WSAP, it is the University's strong view that land use at the arrival point and principal entrance to the Airport presents an ideal opportunity for high 'employment' activities supporting the Aerotropolis, as demonstrated in successful airports precincts globally, rather than the current proposed infrastructure, utilities and public uses which may be better located elsewhere. The University therefore makes the following suggestions:

- **East-West Rail Link** – relocate the proposed East-West rail link and associated stabling yards further north so it can be multi-connected to serve population zones or existing centres that can benefit from economic and employment uplift;
- **Sydney Water Factory** – consider the relocation of the Sydney Water Factory and related Recovery Plant to allow the Kemps Creek precinct to be zoned for employment uses;
- **Regional Parklands** – the Aerotropolis already has a significant amount of area zoned as Environment and Recreation, and these parklands are poorly located at the northern gateway to the Aerotropolis. We recommend that these lands be zoned for employment uses so it can deliver on the Government's vision to create jobs in Western Sydney and directly support the Airport;
- **Rezoning of dams** – the dams should not be rezoned as Environment and Recreation as they will attract birdlife leading to increased risks of bird strike, are not structurally sound, require ongoing maintenance and will not contribute to the urban design outcomes required for employment uses;
- **Land fragmentation** – ensure public authorities avoid individual strategic infrastructure corridors, and instead seek to coordinate a whole of government agency approach with a view to minimise its land requirements and allow development across adjoining landowner boundaries;
- **100 year cut and fill restrictions** – allow landowners the opportunity to access land below the 1 in 100 flood level in situations where performance solutions can be put in place to increase the extent of developable land without creating any flood impact; and
- **Regional road connectivity** – accelerate the preparation of a coherent consolidated transport network plan to ensure that the Aerotropolis precincts and surrounding lands are adequately connected including the re-assessment of the alignment and elevation of the M12 and its access onto Elizabeth Drive.

We urge that the Department and WSPP reconsider the WSAP and supporting documentation in the context of the opportunities that the University's land presents for economic growth and employment, research and industry partnerships in the area. Leaving the University with just 88 hectares of developable land will impact the University's ability to invest in Western Sydney and limit our opportunity to be a key partner in the Aerotropolis and more importantly lead to a loss of broader value at the Aerotropolis itself.

We seek an urgent meeting to discuss the matter.

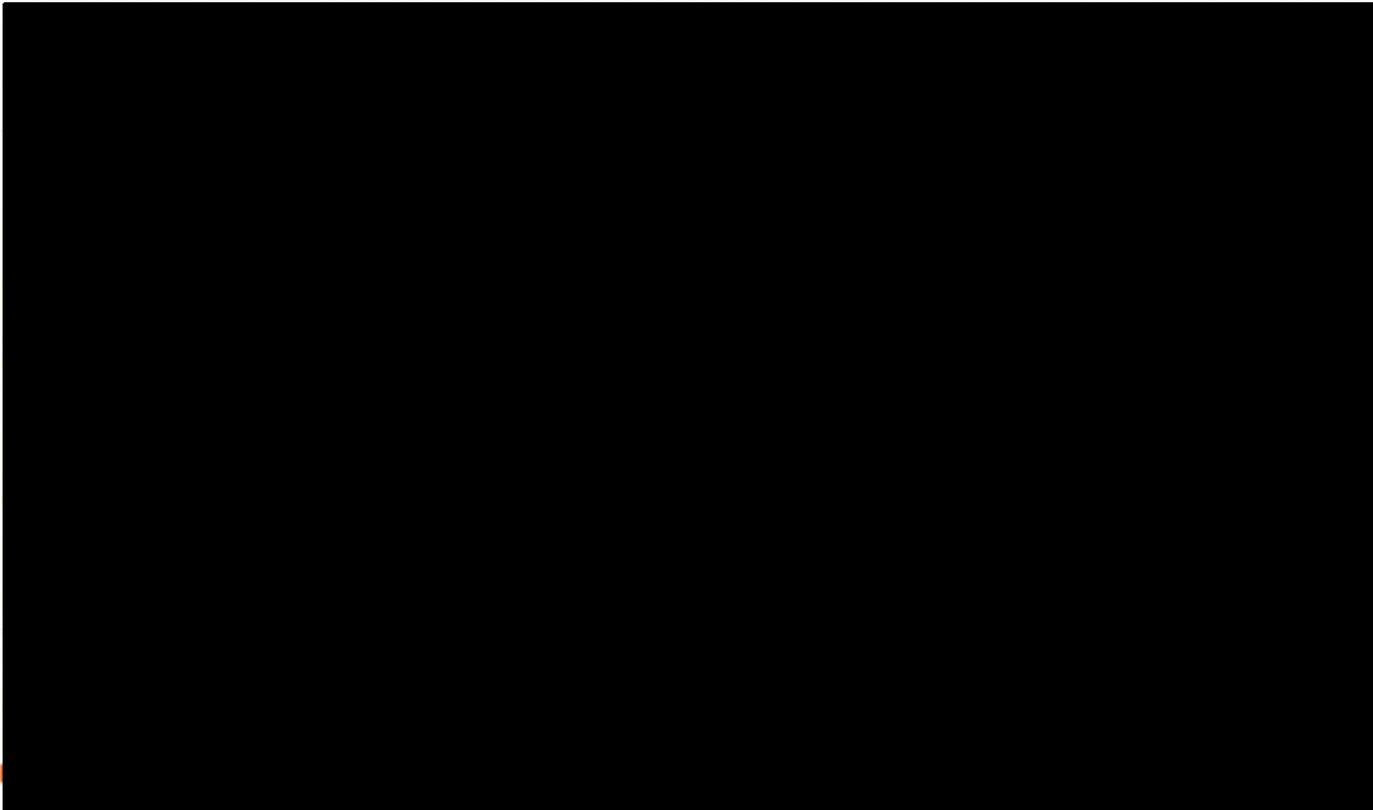
If you have any questions about our submission, please do not hesitate to contact me on [REDACTED] or via email [REDACTED]





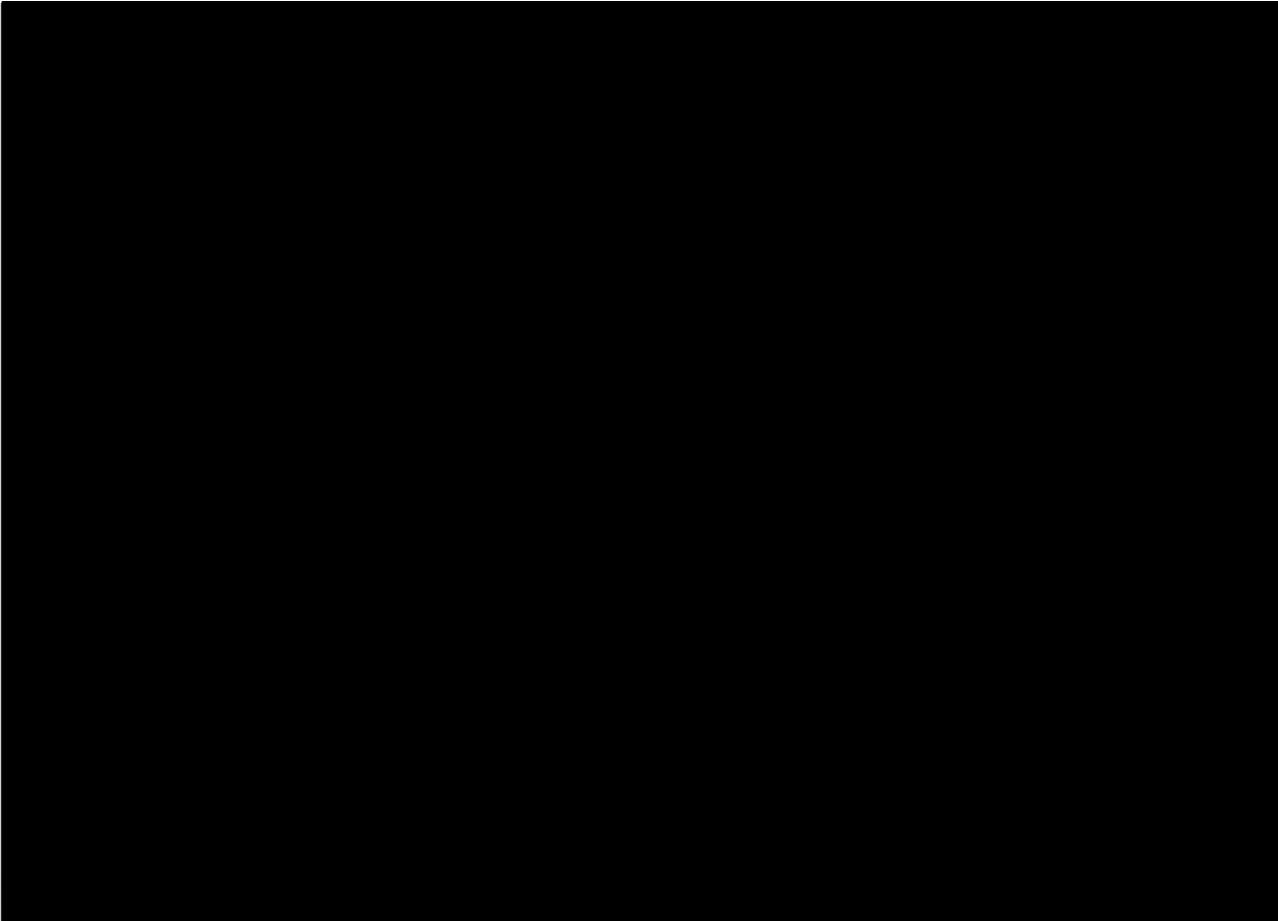
ATTACHMENT A – UNIVERSITY LANDS

The University's land holdings of 344 hectares known as the McGarvie Smith and Fleurs Farms consist of the following lots and are directly located on Elizabeth Drive directly opposite the new Airport.





ATTACHMENT B –LAND AFFECTATIONS



Land Area Calculation	Gross Development Area (ha)		
	WSAP - Dec 19		
	McGarvie Smith (ha)	Fleurs (ha)	Total Impact (ha)
Total Land Area (ha)	161	183	344
1. E2 Environment Zones	22	77	99
2. M12 Corridor	20	11	31
3. North South Rail Link	8	0	8
4. HIAL Reservation	1	0	1
5. East West Rail Link	7	14	21
6. Sydney Water / Regional Parklands	0	41	41
7. Rezoning of Dams	12	0	12
8. Losses due to Land Fragmentation	21	9	30
10. Loss of developable land below 1 in 100 year flood line	2	11	13
Sub total - Land Rezoning Impacts	93	163	256
Gross Developable Area (ha)	68	20	88



SUBMISSION TO THE EXHIBITION OF DRAFT WESTERN SYDNEY AEROTROPOLIS PLAN AND RELATED DOCUMENTS

**Prepared for
The University of Sydney**

**By
BBC Consulting Planners
with inputs from Cardno, Arcadis and at&I**

Job No. 17-226D

Draft WSAP and SEPP Discussion Paper University of Sydney Submission.docx

February 2020



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ATTACHMENTS

- Attachment 1: Land Affection Drawing prepared by at&I
- Attachment 2: Flooding Advice prepared by Cardno
- Attachment 3: Biodiversity Advice prepared by Arcadis
- Attachment 4: Civil Engineering Advice prepared by at&I

1. INTRODUCTION

This submission responds to the exhibition of the following documents dated December 2019 as drafts for public comment:

- *Western Sydney Aerotropolis Plan* (the “WSAP”);
- *Western Sydney Aerotropolis Discussion Paper on the Proposed State Environmental Planning Policy* including accompanying Maps (the “SEPP Discussion Paper”); and
- *Western Sydney Aerotropolis Development Control Plan 2019 Phase 1* (the draft DCP).

This submission draws on the University’s detailed and technical knowledge of its land in recommending further development and evolution of the rezoning and planning approval pathway for the Western Sydney Aerotropolis (“WSA”).

The University of Sydney (the “University”) is the owner of a significant land holding in Western Sydney.

Of particular interest in this context is its 344 hectares of land in the WSA (see **Figure 1**) and within the broader Western Sydney Employment Area. Its land holdings are known as McGarvie Smith Farm at No’s [REDACTED], Badgerys Creek and Fleurs Farm at [REDACTED], Kemps Creek (“the Property”).

The University has had a strong presence in Western Sydney for more than 80 years. It is intended that the income generated from its Property will be invested in research and teaching opportunities throughout the region and will be used to underpin the University’s investment in any major initiatives in Western Sydney. More than 20 per cent of its students are from the region and Western Sydney is critical to the University’s strategic objectives.

As the University is increasingly constrained by funding pressures, it relies on realising value from its land holdings to support its continued growth and evolution, particularly in Western Sydney. The Property is important to the University’s plans to further invest in education, research and innovation in Western Sydney.

The Property has strategic significance at the front door and as the northern gateway to the Western Sydney International (Nancy-Bird Walton) Airport (“Airport”) and can be used to engage with new and evolving industries as part of the Western Parkland City. Through placements, jointly funded research, and by leveraging the University’s existing expertise and industry partnerships in defence, AI, advanced manufacturing, robotics, agriculture and aerospace industries, the University can actively and effectively support new jobs and economic opportunity in Western Sydney.

The WSAP, if adopted in its current form, would lead to a significant reduction in both developable land and the associated value of the University’s Property through changes to zoning and the introduction of infrastructure impacts which were not previously raised with the University’s planning team prior to the release of the WSAP in December 2019.

The aggregate loss of developable land as a result of new infrastructure impacts from various different Government agencies, has an inequitable impact on the University’s position as



compared with other adjoining land owners and the University feels strongly that some balance needs to be restored.

The Department of Planning, Industry and Environment (“the Department”) is aware that for some time the University has been preparing for, and is committed to, rezoning the Property and through this process has consistently consulted with the Department, the Greater Sydney Commission (“GSC”), Western Sydney Planning Partnership (“WSPP”), Penrith City Council (“PCC”), Roads and Maritime Services (“RMS”) and Transport for NSW (“TfNSW”). Part of that process included a planning proposal submitted to Government and Council in October 2016 (“Planning Proposal”).

The outcome from this consultation was the lodgement by the University of a revised, more detailed Planning Proposal in February 2018 which was formally accepted by PCC with the required fees being paid. The University’s Planning Proposal was also supplied to the GSC and to the Department.

Since that time the University has engaged with PCC on the Planning Proposal, including lodgement of an addendum to the University’s Planning Proposal on 20 August 2018. The addendum included a report prepared by Tactical Project Management, emphasising the need for urgent rezoning and subsequent approvals to permit commercial operations to be in line with the opening of the Airport in 2026. In May and August 2019, at the request of PCC, the University provided further detailed specialist technical evidence based on studies and investigations on the capability and suitability of the Property for urban development. While PCC committed to providing feedback on these reports, this remains outstanding.

It is also of concern that since 2016, the University has invested considerable funds in initially preparing and submitting its Planning Proposal and then updating the technical reports some of it at the request of PCC. It is apparent from the University’s perspective that none of this has been taken into consideration in preparing the WSAP.

In November 2018 the University made a detailed and constructive submission to the *Western Sydney Aerotropolis: Draft Land Use and Infrastructure Implementation Plan Stage 1: Initial Precincts* (“LUIIP”) including a technical review by a number of consultants. The key matters raised in this submission and the WSAP response are indicated in the following table.

Table 1: Summary of LUIP Issues

University Submission to LUIP – Key Issues	WSAP Status
The LUIP should not delay the University's existing Planning Proposal from progressing.	SEPP Discussion Paper contains potential mechanisms for proceeding before, or in conjunction with the precinct planning process although details of these alternative process have not been provided.
Land above 1 in 100 flood line should not be in the South Creek Precinct.	The WSAP states that the boundary to the Wianamatta-South Creek Precinct is now the 1 in 100 year flood line. However, there is a lack of clarity on development controls on land both above and below the flood planning level.
Fragmentation of the Property into smaller lots discourages economic investment.	The WSAP further fragments the Property as a result of additional infrastructure affectations and isolation of land. This result contradicts the Government's original intention of encouraging consolidated land for economic development close to the Airport.
Fragmentation of land within the immediate environs on the approach to the new Airport should be mitigated by improved local road connections.	No details of local road connections are shown for the Property unlike other precincts. Access to isolated parcels remain uncertain and unclear.
Land below the 1 in 100 year flood level should be able to be developed in accordance with Council guidelines relating to flood hazard risk, impact on areas of biodiversity significance and flooding of adjoining sites.	Restriction on any development below the 1 in 100 year flood line remains in the WSAP.
The adoption of hard boundaries around the South Creek Precinct have “knock-on impacts” by creating inflexible zones that unreasonably limit job creation.	Inflexibility remains with heavy restrictions on development below the 1 in 100 year flood line.
The LUIP approach to stormwater management will undermine the prospects of providing quality open space.	The WSAP does not envisage any stormwater management works below the 1 in 100 year flood line.
The second stage LUIP could consider incorporating a simple mechanism for promoting accelerated development of consolidated land holdings including circumstances where the land holdings extend across fragmented Precinct boundaries.	SEPP Discussion Paper contains potential mechanisms for proceeding before, or in conjunction with the precinct planning process although details of these alternative process have not been provided.

Despite the ongoing process of consultation between the University and relevant Government stakeholders around the University's Property and its Planning Proposal, the University was concerned to find additional adverse affectations on the Property in the WSAP that were not previously raised in any discussions with authorities including:

- a corridor for a potential East-West Rail Link;
- stabling yards accessed from the East-West Rail Link;
- Sydney Water's proposed Upper South Creek Water Factory and associated Recovery Plant (including Wastewater Treatment Facility) on Fleurs Farm;
- a regional parkland investigation area affecting Fleurs Farm;
- rezoning farm dams and associated lower order streams on McGarvie Smith Farm as Environment and Recreation; and
- loss of development potential due to further fragmentation of land and the 1 in 100 year cut and fill restrictions.

These are in addition to the proposed Environment and Recreation Zone, the M12 Corridor, the North-South Rail Link and the High Intensity Approach Lighting ("HIAL") Reservation identified in the LUIP.

Despite being clear about the importance of this land for the University's future across a range of consultations and submissions, the University does not believe it has been treated fairly nor with any degree of transparency.

2. SUMMARY

This report identifies issues and concerns, with potential solutions for, the WSAP and SEPP Discussion Paper as exhibited. These are summarised in Table 3.

The WSAP severely constrains the Property's economic development potential as summarised in Table 2 and Diagram 1 below and as shown in the diagram in **Attachment 1**.

Table 2: Summary of affectations on the Property

Land Area	LUIIP Ha	WSAP Ha	Total Impact Ha
Gross Land Area			344
Less			
Proposed Environment and Recreation Zone (main creeks). <i>Note: The area impacted by the M12 corridor, East/West Rail and 1:100 flood line is included below.</i>			-99
Net Residual Area			245
M12 Corridor	-31		-31
North-South Rail Link	-8		-8
HIAL	-1		-1
East-West Rail Link		-21	-21
Sydney Water Factory and/or Regional Parkland		-41	-41
Dams and lower order streams zoned Environment and Recreation		-12	-12
Losses due to land fragmentation		-30	-30
Loss of developable land below 1 in 100 year flood line		-13	-13
Total Land Impacts	40	117	157
Remaining Developable Area			88

The Property forms part of the highly strategic Northern Gateway Precinct through which the vast majority of all passengers using the Airport will pass. Additionally, around 80% of all air freight will pass through this Precinct. It is a reasonable expectation for owners of land within the Northern Gateway Precinct to optimise the orderly and economic use and development of their land.

If the WSAP is adopted with the impacts as noted in Table 2, this will result in the following outcomes for the developable land on the Property:

- areas within the Property shown as Environment and Recreation that are also impacted by road and rail infrastructure and the 1 in 100 year flood line, are included within the 'M12 Corridor', 'East/West Rail Link' and 'land below 1 in 100 year flood line' as noted in Table 2. Taking this into consideration, the University's residual property area becomes **245 hectares**;

- the area of the Property that has been affected by the LUIIP and WSAP by road and rail infrastructure, rezoning of man-made dams, utilities and land fragmentation is **157 hectares**;
- the area of the Property that has been affected and solely attributable to the WSAP is **117 hectares**; and
- with all the rezoning impacts outlined in the WSAP, the remaining land suitable for development is only **88 hectares**.

As highlighted in Diagram 1 below, the **88 hectares** of remaining land on the Property that is residual for redevelopment represents just **26%** of the entire Property – this is a significant reduction in developable land within the Property.

The issues and potential mitigations summarised below, are addressed in detail in Section 3, and are supported by the expert reports that are attached to his report (see **Attachments 2, 3 and 4**).

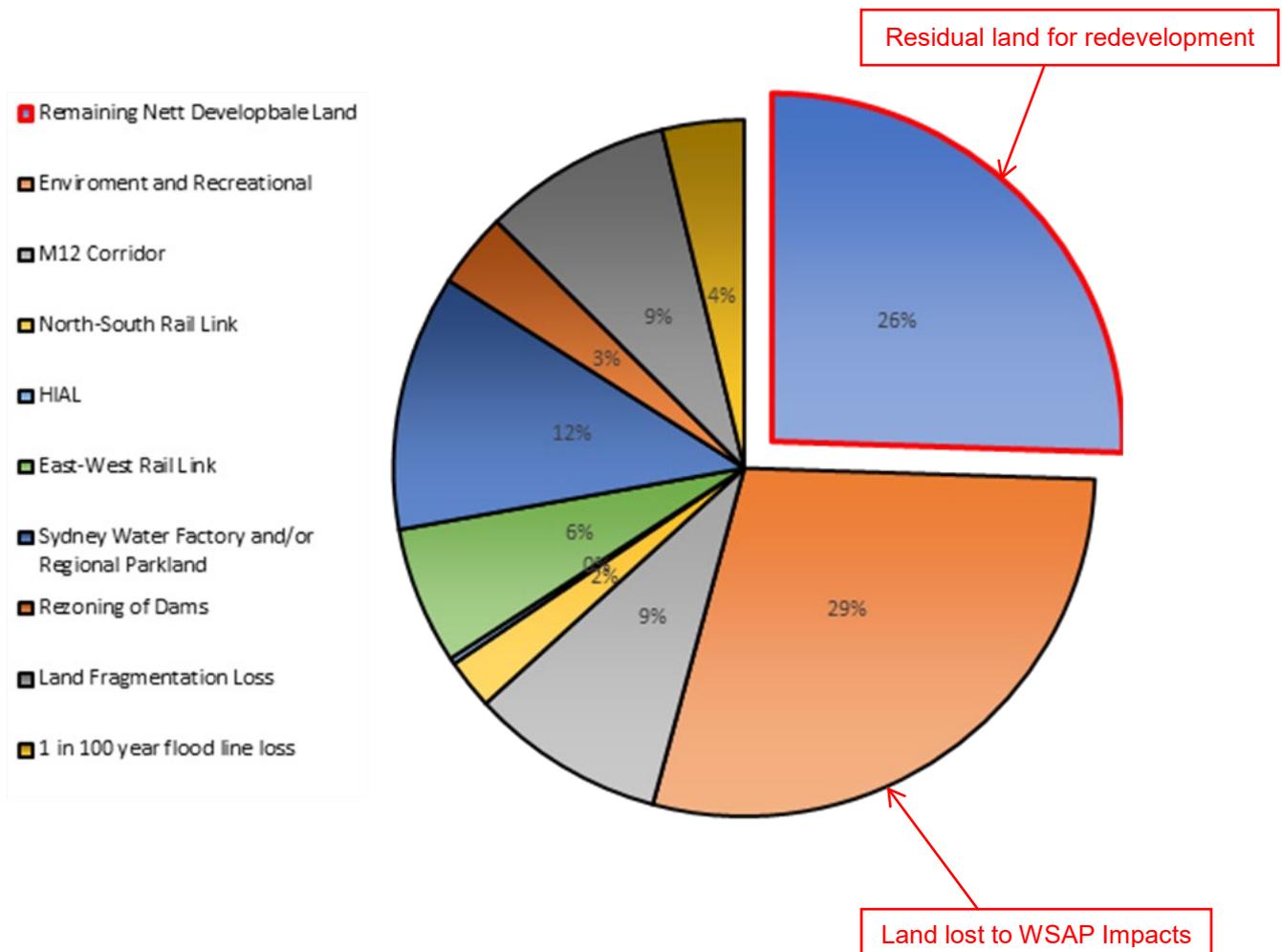


Diagram 1: University’s Land – WSAP Impacts

Table 3: Summary of issues / concerns

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
<p>The University's Planning Proposal before PCC is well-reasoned and was prepared, in direct consultation with and direction by relevant Government agencies, so that it was consistent with the Western Sydney District Plan which was the current guide for future development in this area. The WSAP and SEPP Discussion Paper process should enable the University to benefit from a speedy approval process.</p> <p>The University is concerned over the delays to the planning process resulting from its Planning Proposal being overtaken by the WSAP and its planning pathways. It is also concerned that the detailed investigations on the Property have not informed the WSAP or suggested planning controls in the SEPP Discussion Paper.</p>	<p>The University believes that it is appropriate to progress the development of the University's Property so as to ensure the availability of employment land at the gateway to the new Airport in time for its opening.</p> <p>The University is keen to ensure that the planning pathways included in the final WSAP and proposed SEPP enable the evidence based investigations supporting the University's Planning Proposal to be utilised and taken into consideration to expedite the rezoning and development approval pathways. This can be prepared through the completion of the precinct planning process, a proposed alternative development application pathway or an optional master planning process.</p> <p>The University recommends that all planning pathways allow greater flexibility in land use permissibility and development controls on either side of the 1 in 100 year flood line for mainstream flooding. As an example, in the case of the Fleurs Farm, this affects the boundary between the Environment and Recreation Zone and other urban zones such as the Enterprise Zone.</p> <p>There should be flexibility in development control along the edges of the 1 in 100 year flood level which is also the boundary between land in the Environment and Recreation Zone and the Enterprise Zone. This can be achieved by including a flexible zone boundary that allows development in the Environment and Recreation Zone for uses permissible in the adjoining zone (in this case the Enterprise Zone) subject to specified criteria.</p>	<p>Refer Section 3.1 of this report</p>
<p>Loss of developable land through additional infrastructure affectation not previously raised. The WSAP Structure Plan includes additional land</p>	<p>Land use at the arrival point and principle entrance to the Airport presents an ideal opportunity for high 'employment' activities supporting the WSA as opposed to a plethora of</p>	<p>Refer Section 3.2 of this report</p>

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
<p>affectations and cumulative impacts that the University was unaware of including:</p> <ul style="list-style-type: none"> • a corridor for a potential East-West Rail Link; • stabling and maintenance yards accessed from the East-West Rail Link; • Sydney Water's proposed Upper South Creek Water Factory and associated Recovery Plant (including Wastewater Treatment Facility) on Fleurs Farm; • A regional parkland investigation area affecting Fleurs Farm; • Rezoning farm dams and associated drainage depressions in McGarvie Smith farm as Environment and Recreation; and • Further fragmentation of land and 1:100 year cut & fill restrictions. <p>There has been no previous consultation with the University on these additional affectations which result in approximately 117 hectares of University's land that is lost.</p>	<p>infrastructure and utilities which may be better located elsewhere. The University recommends:</p> <ul style="list-style-type: none"> • Removal of the Sydney Water Factory and associated Recovery Plant; • Remove Environment and Recreation Zone from man-made farm dams and associated drainage lines; • Delete northern Regional Parkland also noting the extent of parkland already available through the Environment and Recreation zoning; • Relocate the East-West railway and stabling yards • It is noted that the East-West link is not funded nor are alternatives being investigated. The project is not yet committed. 	
<p>Through further consultation with PCC and WSPP, the University understands there is the potential for a further loss of developable land resulting from the designation of a Public Safety Area by Airport regulators.</p> <p>It is a concern at this stage on airport planning that the WSAP has not articulated this significant potential impact and that it has the potential to delay in making the SEPP.</p>	<p>As this has not been presented in the WSAP and SEPP, the University is unable to comment on the potential impacts to its landholdings.</p> <p>However, it is expected that any requirements regarding a Public Safety Area will be consulted with the relevant landowners prior to public exhibition.</p>	Refer to Section 3.2 of this report
<p>There appears to be no cogent local and regional transport network plan to ensure that suitable and adequate links to future employment lands,</p>	<p>The immediate environs of the approach to the new airport are critical to the logistics industry. Many logistical businesses seek to occupy this zone</p>	Refer Section 3.4 of this report

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
<p>opportunities for improved vehicle capacity and bridging connections is coordinated across precincts, particularly to the north of Elizabeth Drive and including the fragmented Property.</p> <p>Fragmentation of land within the immediate environs on the approach to the new Airport should be mitigated by improved local road connections.</p>	<p>around major airports. This area is the most “at risk” high value area around major infrastructure and the University recommends that it should be facilitated to be as constraint free as possible in order that as many critical businesses as possible can be housed there.</p> <p>As such the University recommends a coherent consolidated transport network plan be implemented, which is consistent with plans for the WSA incorporating the Northern Gateway Precinct, the Mamre Road Precinct, the M12 Motorway, the Elizabeth Drive Project, Airport road access points and all other land north of Elizabeth Drive in the Badgerys Creek and Kemps Creek Precincts. This will ensure the Precincts are adequately connected.</p>	
<p>There are no M12 planned connections to Elizabeth Drive resulting in the need for non-Airport related traffic to circulate within the Airport. This will lead to significant disruption in the event of a closure of the Airport access route and bring unnecessary traffic flows within the Airport.</p> <p>Elizabeth Drive is designated as an ‘arterial road’ and ‘on’ and ‘off’ ramps at Elizabeth Drive at the Airport gateway must be provided as part of the M12 Motorway project to protect regional planning objectives and deliver the most optimal outcome for employment in the WSA and the new Airport.</p> <p>It is unreasonable to suggest that Elizabeth Drive is the only access to the WSAP employment land precincts.</p>	<p>The WSPP and the Department should encourage TNSW / RMS to provide access to Elizabeth Drive from the M12 Motorway at the Airport gateway.</p> <p>This issue has been previously raised by the University in its submissions to the M12 EIS and draft Mamre Road Precinct Structure Plan.</p>	Refer Section 3.5 of this report
<p>Of a total site area of 344 hectares, only 88 hectares remains for development. This represents 26% of the site area and is significantly less than the University’s Planning Proposal prepared in response to the ‘Western Employment Lands’ Strategy.</p>	<p>The recommendations to minimise the WSAP impacts on the University’s Property has been outlined in detail in Section 3 of this Submission.</p>	Refer Section 3 of this report

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
<p>The total (cumulative) impacts caused by the above affectations has significantly fragmented the University's land so it is now inefficient for development.</p>	<p>The WSAP should be amended to show access arrangements to the remaining parcels of the Property. Maximum effort should be made to ensure efficient and direct access to the University's land.</p> <p>Public authorities should avoid individual strategic infrastructure corridors, and instead seek to coordinate a whole of government agency approach towards the dedication of these corridors with a view to minimise their land requirements.</p>	<p>Refer Section 3.3 of this report</p>
<p>Limiting stormwater management works in the Environment and Recreation Zone – WSAP and the new SEPP should make it clear that land within the proposed Environment and Recreation Zone is appropriate for stormwater management works</p>	<p>Clarify that land within the Environment and Recreation Zone outside areas of high flood hazard and areas of biodiversity significance is suitable for stormwater management systems. Drainage and artificial waterbodies should be permissible in the Environment and Recreation Zone.</p>	<p>Refer Cardno Report in Attachment 2</p> <p>Refer Section 3.6.1 of this report</p>
<p>The adoption of hard boundaries to the Wianamatta-South Creek Precinct has “knock-on impacts” by creating inflexible zones that unreasonably limit job creation.</p>	<p>When business parks are developed, flooding impacts on land are required to be flood neutral. However, land owners (with planning approval) are permitted to manage the landscape to design appropriate flood storage.</p> <p>By adopting a strict 1-in-100 flood line it limits the ability of owners to manage flood storage and hence limits the utility of employment lands (even those above the flood line). These issues can be flexibly and appropriately dealt with by local governments via design guidelines and the DA process.</p> <p>This can be achieved by including a flexible zone boundary provision that allows development in the Environment and Recreation Zone for uses permissible in the adjoining zone (in this case the Enterprise Zone) where it can be established that such development:</p> <ul style="list-style-type: none"> • is not located in a high hazard flood risk area; 	<p>Refer Cardno Report in Attachment 2</p> <p>Refer Section 3.6.2 of this report</p>

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
	<ul style="list-style-type: none"> • has no significant impact on areas of biodiversity value; and • has negligible impact on flood characteristics in adjoining lands. <p>In addition, the WSAP and SEPP provisions should allow for flexible arrangements so that subsequent planning pathways as described in Part 8 of the SEPP Discussion Paper can be inconsistent with provisions of the WSAP, a precinct plan or the zoning of land where justified.</p>	
<p>Inappropriate use of flood planning level controls with no urban land uses permitted on land below the flood planning level and no alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks to be permitted.</p>	<p>These controls are inconsistent with the NSW Flood Prone Land Policy and the standard practice in development controls on flood prone land which should be based on the 1 in 100 Annual Exceedance Probability flood. Any development above or below the level of the 1 in 100 Annual Exceedance Probability flood should have a floor level set at or above the flood planning level.</p>	<p>Refer Section 3.6.3 of this report</p>
<p>Concerns over the impacts of revegetation proposals on flooding of adjoining land.</p>	<p>Plans to revegetate the floodplain need to be monitored to ensure that flood characteristics on adjoining land are not adversely impacted</p>	<p>Refer Cardno Report in Attachment 2</p> <p>Refer Section 3.6.5 of this report</p>
<p>Zoning of farm dams and associated drainage depressions as Environment and Recreation</p>	<p>Man-made farm dams within the Northern Gateway Precinct should be zoned Enterprise for the following reasons:</p> <ul style="list-style-type: none"> • the Northern Gateway is the only precinct that zones farm dams and drainage depressions Environment and Recreation with landowners being inequitably treated in this regard; • Environment and Recreation zone boundaries are too complicated and intricate, with very high perimeter to area ratios, hinder biodiversity 	<p>Refer reports in Attachments 2, 3 and 4</p> <p>Refer Section 3.7</p>

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
	<p>outcomes and the efficient planning and design of development including the location of roads and pathways that might form an edge to the Environment and Recreation zone;</p> <ul style="list-style-type: none"> • adverse impact on airport operations with dams in the flightpath posing a potential bird strike risk for incoming and outgoing aircraft; • no justification to retain dams for flood control or stormwater management purposes; • no justification to retain dams for biodiversity reasons; and • dam instability is a potential risk for urban development. 	
<p>In light of the importance of land zoned Environment and Recreation as an infrastructure element to the WSA and the Western Parkland City it should be included in the Land Reservation Acquisition Map for acquisition by a public authority. Land identified for other public purposes such as infrastructure or regional parklands should also be included in the Land Reservation Acquisition Map for acquisition by a public authority.</p>	<p>It is expected that land to be zoned Environment and Recreation or for any other public purpose will be acquired by the Government. The WSAP/SEPP will need to include land zoned Environment and Recreation and land identified for any other public purpose in the Land Reservation Acquisition Map for acquisition by a public authority.</p>	<p>Refer Section 3.8</p>
<p>The University is supportive of any planning pathway that will enable it to build on the site investigations undertaken for the purpose of its Planning Proposal. The incorporation of simple mechanisms for promoting accelerated development of consolidated land holdings is strongly supported.</p>	<p>The University requests that consideration be given to the following:</p> <ul style="list-style-type: none"> • All planning pathways should allow greater flexibility in land use permissibility and development controls on either side of the 1 in 100 year flood line for mainstream flooding that generally forms the boundary between the Environment and Recreation Zone and other urban zones such as the Enterprise Zone; and • All planning pathways should incorporate the flexibility to vary 	<p>Refer Section 3.9</p>

<u>Issue / Concern</u>	<u>Possible solutions and Recommendations</u>	<u>Reference</u>
	<p>the WSAP Structure Plan and zone boundary where justified by further investigations;</p> <p>Allowing development on consolidated landholdings where they cross precinct boundaries and precinct release proposals.</p>	
Further details of SEPP provisions required	Given the lack of detail on proposed controls and pathways, it is not possible to fully assess the implications of such controls. Therefore, a final draft SEPP and all proposed accompanying controls and maps should be exhibited for public comment prior to finalisation.	Refer Section 3.10
Universities as a Public Authority	The University is expressly listed as being prescribed to be a “public authority” in the <i>Environmental Planning and Assessment Regulation 2000</i> so as to allow it to be a determining authority for the purpose of Part 5 of the <i>Environmental Planning and Assessment Act 1979</i> (NSW) (“EP&A Act”) for development that is permitted without consent under the State Environmental Planning Policy (Infrastructure) 2007 or the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 on land that the University owns, leases or otherwise controls and manages. In the University’s view, this should be extended to include development permitted under the new SEPP.	Not Applicable

3. MATTERS FOR CONSIDERATION

3.1 The University's Planning Proposal process

3.1.1 Planning Proposal background

The University's Planning Proposal was submitted to PCC in February 2018 and was preceded by detailed planning investigations by the University and discussions with PCC from October 2016. This process commenced two years prior to the release of the draft LUIP.

Following on-going consultation with PCC and government agencies, further detailed investigations were submitted to PCC in May and August 2019. Extensive investigations into the suitability and capability of the site for urban development consistent with metropolitan and district planning strategies and with the intentions of the Western Sydney Employment Area framework were undertaken including:

- detailed site survey;
- an economic assessment and market analysis;
- a traffic and transport analysis;
- a biodiversity assessment;
- geotechnical and contamination assessments
- an Aboriginal Heritage assessment;
- a Heritage assessment;
- a flood assessment;
- a surface water analysis;
- servicing strategies;
- civil infrastructure report; and
- urban design analysis.

Since February 2018 there has been regular University consultation with relevant agencies with documents issued to key agencies to outline the University's planning intent. The University has also consulted with, and continues to consult with, PCC, WSPP, TfNSW, RMS, Sydney Water, WSA Co and other related agencies during this process.

3.1.2 Concern over delay

The University's Planning Proposal appears to have been overtaken and ignored by the WSAP and the SEPP Discussion Paper. It is important for the University to ensure that the planning and approval process for its Property is not further delayed by this WSAP/SEPP process.

The University is keen to ensure the availability of developed land at the gateway to the new Airport at the time of its opening in 2026 and seeks assurance that the approval pathways available through the WSAP and the proposed new SEPP will enable the University to proceed expeditiously with the planning and development of its Property.

3.1.3 Information not considered in the WSAP planning process

Extensive investigations into the suitability and capability of the site for urban development as requested by PCC has not been taken into consideration in the preparation of the WSAP.

3.1.4 Expected outcome

The University is keen to ensure that the planning pathways included in the final WSAP and proposed SEPP enable the evidence based investigations supporting the University's Planning Proposal to be utilised and taken into consideration to expedite the rezoning and development approval pathways, whether this be through the completion of the precinct planning process, a proposed alternative development application pathway or an optional master planning process.

The University is also keen to ensure that:

- all planning pathways allow greater flexibility in land use permissibility and development controls on either side of the 1 in 100 year flood line for mainstream flooding that generally forms the boundary between the Environment and Recreation Zone and other urban zones such as the Enterprise Zone; and
- all planning pathways should incorporate the flexibility to vary any adopted WSAP Structure Plan and zone boundary (where justified) by further investigations.

3.2 Loss of developable land through additional infrastructure affectations not previously raised

3.2.1 Additional affectations

The LUIP exhibited in 2018 and subsequent consultation with agencies included a number of property affectations as outlined in Table 2:

- M12 corridor;
- South Creek Environmental Zone;
- North-South Rail Link; and
- HIAL Reservations.

The WSAP Structure Plan includes an **additional** 117 hectares of land affectations that the University was unaware of, despite extensive consultation with all the relevant agencies, including:

- a corridor for a potential East-West Rail Link;
- stabling and maintenance yards accessed from the East-West Rail Link;
- Sydney Water's proposed Upper South Creek Water Factory and associated Recovery Plant (including Wastewater Treatment Facility) on Fleurs Farm;
- a regional parkland investigation area affecting Fleurs Farm; and
- rezoning farm dams and associated drainage depressions as Environment and Recreation.

3.2.2 Lack of consultation on additional land loss

There has been no consultation on the additional Government land requirements prior to the release of the draft WSAP for comment despite ongoing consultation in 2018 and 2019 with the relevant agencies. These infrastructure matters affect some 74 hectares of the Property and has impacted the University's planning.

Furthermore, further fragmentation of the land caused by the above impacts together with inflexibility around the 1 in 100 year flood level has resulted in a further potential loss of another 43 hectares of developable land. In total, the WSAP has resulted in a further loss of 117 hectares of developable land since the lodgement of the University's Planning Proposal.

Not only has this come as a complete surprise to the University but the lack of agency consultation on matters of importance to the University is regrettable.

3.2.3 East-West Rail Link and stabling yard and maintenance facility

The University has a number of concerns with this new affectation to the Property, including:

- loss of developable land;
- there has been no consultation with the University about these matters prior to WSAP;
- further fragmentation of the Property and loss of connectivity to parts of the Property including the north western part of McGarvie Smith and northern part of Fleurs Farm;
- insufficient detail on the land requirements;
- there is no indication that alternative sites have been considered and no justification as to why the University's land is targeted.
- it is understood that this project is currently unfunded by Government with no certainty as to when it will proceed which creates a concern as to the sterilisation of the University's Property in the long term; and
- there is a lack of detail on the relationship between the East-West Link and the North-South link as it passes through McGarvie Smith farm – are there two corridors or a shared corridor;

3.2.4 Sydney Water Factory

A significant amount of the developable land on Fleurs Farm is affected by the proposed Upper South Creek Water Factory and associated Recovery Plant. This is located at the centre of a proposed Regional Parkland with the area impacted as noted in Section 3.2.5.

The University has a number of concerns with this new affectation to the Property, including:

- loss of developable land;
- there has been no consultation with the University prior to WSAP;
- there is no indication in the WSAP that alternative sites have been considered and no justification as to why the University's Property is targeted; and
- the potential for land to be sterilised during the planning process for this project.

3.2.5 Regional Parkland

WSAP identifies investigation areas for regional parks in the north and south of the WSA along the Wianamatta–South Creek corridor. The northern investigation area affects approximately 46 hectares of Fleurs Farm (including the site for the Sydney Water Factory).

The University has a number of concerns with this new affectation to the Property, including:

- loss of developable land;
- there has been no consultation with the University prior to WSAP; and
- the need for this parkland has not been established, particularly in the context of the proximity to the Western Sydney Parkland;
- the suitability of the site as a regional parkland having regard to matters such as:
 - proximity to road and rail infrastructure including rail stabling yard and maintenance facility;
 - potentially containing a sewage treatment plant (these uses are totally incompatible); and
 - isolation and separation from surrounding residential areas.
- the designation of this part of the Property as an investigation area will create uncertainty as to the timing of the rezoning of this land within the Kemps Creek Precinct for employment purposes as otherwise indicated on the Structure Plan;
- the potential for land to be sterilised during the investigation process for this regional park; and
- insufficient detail on the land take requirements.

3.2.6 Public Safety Area

PCC and WSPP have advised the University of further potential land use restrictions on the Property under consideration by Airport regulators relating to public safety area (PSA).

A PSA is a designated area of land at the end of an airport runway within which development may be restricted in order to control the number of people on the ground at risk of injury or death in the event of an aircraft accident on take-off or landing.

The impacts on the Property are not yet understood but there is likely to be a further impact either in loss of developable area or other restrictions on development such as restrictions on number of people in the area, building density, form, height and land use.

The University is concerned that the WSAP has not articulated this significant potential impact and that it has the potential to delay in making of the SEPP.

3.2.7 Disproportionate distribution of impacts

The University understands the need for road and rail corridors, utility infrastructure and open space to serve the WSA. However, it is clearly evidenced by the WSAP that the precincts in which the Property is located, have been disproportionately disadvantaged.



As noted in Table 4, the siting of multiple transport corridors, parklands and critical infrastructure in precincts as well as the rezoning impacts proposed by the WSAP in precincts occupied by the University, is overwhelmingly disproportionate when compared to all the other precincts.

The University is concerned and disheartened that its Property has been targeted in this way as it indicates a lack of coordinated planning between the various agencies.

Table 4 – Precinct Impacted Land

Land Impacts	University of Sydney Landholdings				Other Precincts					
	Northern Gateway	Badgerys Creek	Wianamatta Sth Creek	Kemps Creek	Aerotropolis Core	Mamre Road ¹	Agribusiness	Rossmore	Dwyer Road	North Luddenham
M12 Corridor	✓	✓	✓	✓						✓
Proposed Metro Greater West	✓				✓					
HIAL Reservation	✓									
Potential East-West Rail Link & Stabling Infrastructure	✓	✓	✓	✓						
Critical Utility / Infrastructure (SW)				✓						
Regional Parklands			✓	✓	✓	✓ Open Space		✓		
Rezoning of Dams	✓	✓								
Land Fragmentation	✓	✓	✓	✓						
Loss of land below 1 in 100 year flood		✓		✓						
Proposed Transport Corridor	✓	✓	✓	✓						✓
Proposed Future Rail Links					✓					
Proposed Western Freight Line						✓				
Potential Intermodal Terminal						✓				

Note 1: The impacts indicated for the Mamre Road precinct are based on the Mamre Road Precinct - Draft Structure Plan, November 2019

3.3 Fragmentation of University's Property and loss of access

The University is the owner of a significant and consolidated land holding which is severely impacted by the WSAP. The total loss of developable land outlined in the LUIIP and WSAP is up to 157 hectares. The extent of the affectations is shown in the Table 2.

The total (cumulative) impacts caused by the affectations has significantly fragmented the University's Property, inhibiting efficient development and impacting on development sequencing. It results in land severance and a lack of connectivity to and between the various remaining parcels of the Property.

Of a total University land area of 344 hectares, only 88 hectares or 26% remains available for development.

In a number of cases corridors are not co-located leaving potentially developable land isolated between planned infrastructure corridors including the M12 Motorway, the North-South Rail and the East-West Rail. The University questions whether there has been any coordination between agencies on land requirements and the cumulative impacts on landowners.

Further fragmentation of holdings reduces opportunities to develop impacted parcels in conjunction with adjoining landowners.

The combined effect of transport corridors and rail stabling and maintenance yards completely severs the northern part of Fleurs Farm from the remainder of the Property with proposed access arrangements not known.

3.4 Structure Plan lacks road network detail

The WSAP Structure Plan lacks detail of proposed access to precincts north of Elizabeth Drive and to the fragmented parcels of University's Property. There is a lack of connectivity to and between the various remaining parcels of the land and the Government has not shown how it plans to provide adequate road access to land that has been fragmented or any other mechanism for dealing with this land. While there is uncertainty about how the University's Property which has already been fragmented by the WSAP will be serviced, the lack of access and connectivity between the various parcels owned by the University creates development difficulties and inefficiencies. There does not seem to be coordination between traffic planners and the Department and WSPP.

This issue has been raised by the University in its submissions to the M12 EIS and draft Mamre Road Precinct Structure Plan.

There appears to be no cogent local and regional transport network plan to ensure that suitable and adequate links to future employment lands, opportunities for improved vehicle capacity and bridging connections is coordinated across precincts, particularly to the north of Elizabeth Drive.

As such a coherent consolidated transport network plan that is consistent with plans for the Aerotropolis incorporating the Northern Gateway Precinct, the Mamre Rd Precinct, the M12 Motorway, the Elizabeth Drive Project, Airport road access points and all other land north of

Elizabeth Drive in the Badgerys Creek Precinct and Kemps Creek Precinct is recommended and should be accelerated to ensure the precincts are adequately connected.

3.5 M12 connections to Elizabeth Drive

The M12 Motorway design currently proposes no 'on' and 'off' ramps to the main road (Elizabeth Drive) intersecting the entrance to the Airport. It only serves the Airport. As a result, traffic will need to follow a loop through the Airport in order to connect and access future employment lands in the surrounding Aerotropolis precincts north of Elizabeth Drive. This will lead to significant disruption in the event of a closure of the Airport access route and bring unnecessary traffic flows within the Airport.

Airport Security may be compromised in the case of an event occurring on the M12 Motorway with no way off or on immediately prior to entering the Airport zone.

Elizabeth Drive is designated as an 'arterial road' and 'on' and 'off' ramps at Elizabeth Drive at the Airport gateway should be provided as part of the M12 Motorway project to protect regional planning objectives and deliver the most optimal outcome for employment in the Aerotropolis and the new Airport.

The University's position on this issue is aligned with WSA Co. and surrounding landowners.

The University is concerned about how its Property, which has already been fragmented by the WSAP, will be serviced.

It is unreasonable to suggest that Elizabeth Drive is the only access to WSAP employment lands precincts.

3.6 Zoning and planning controls for the Wianamatta-South Creek Precinct

The Wianamatta-South Creek Precinct boundary has generally been defined using 1 in 100 year flood level and is proposed to be zoned Environment and Recreation. The University raises a number of concerns relating to the WSAP provisions and the SEPP Discussion Paper in respect of zoning and planning controls for this Precinct as it affects the Property.

3.6.1 Prohibiting stormwater management works in the Environment and Recreation Zone is unreasonable and unnecessary

Section 4.1 of SEPP Discussion Paper 1 states in part:

Wianamatta-South Creek and its tributaries will be protected from urban runoff, by retaining the hydrologic characteristics of the catchment and providing water in the landscape for amenity, urban cooling, and high quality green space;

This can result in a situation where stormwater quantity (OSD) and quality measures (GPTs, biofilters) would need to be installed and maintained at all stormwater discharge points into the land zoned Environment and Recreation. This would require the installation of a highly distributed series of measures which would forego opportunities to rationalise and co-locate such measures within the Enterprise Zone and the Wianamatta-South Creek corridor noting this this corridor is up to 1 km wide. Preventing such infrastructure in the Environment and

Recreation Zone inhibits the implementation of more centralised management systems that are more cost efficient in terms of construction and maintenance.

Further the following works typically associated with stormwater management systems are prohibited on land within the Environment and Recreation Zone:

Drainage; Waterbodies (artificial)

Prohibiting stormwater management systems in this zone would be inconsistent with the provisions of State Environmental Planning Policy (Infrastructure) 2007 which specifically allow stormwater management systems on any land to be permitted with and without development consent.

Large areas of the Property that will be likely zoned Environment and Recreation are suitable for a range of in-system management measures include private, community and regional detention and retention measures. Community measures are typically medium sized stormwater storage facilities constructed in public areas, including public open space.

The University's investigations into the site indicates that:

- substantial portions of the Environment and Recreation Zone are not of conservation value and have not been excluded by the Cumberland Plain Conservation Plan on biodiversity grounds (Figure 3 of the SEPP discussion paper). There is no biodiversity reason to prevent stormwater management systems within the Environment and Recreation Zone;
- there is no flooding or hydrological reason for prohibiting stormwater management systems on land within the Environment and Recreation Zone in areas not subject to high flood hazard; and
- the use of this land within the Environment and Recreation Zone for stormwater management systems in appropriate locations is entirely appropriate and consistent with best practice water sensitive design and the object of the EP&A Act encouraging the orderly and economic use and development of land.

3.6.2 Prohibiting earthworks (cut and fill) and other appropriate development in the Environment and Recreation Zone is unreasonable and unnecessary

- WSAP Planning Principle SU16 states: *Prohibit cut and fill to alter the 1% AEP flood extent.*
- Section 4.2 of SEPP Discussion Paper 1: *Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks is not desirable. Under the proposed SEPP these types of works will not be permitted below the flood planning level and will be discouraged in other areas of the floodplain.*

The aim of any Flood Impact Assessment is to assess the impact of development including cut and fill to limit the impacts of planned development on flood characteristics of adjoining properties. Planning principle SU16 outlined above and associated controls prohibit earthworks and a range of other development within the 1% AEP flood extent (but outside floodways and high hazard areas) which is contrary to the primary objective of the NSW Flood Prone Land Policy which recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

Investigations undertaken by the University indicate that there are parts of the site where development can occur below the 1 in 100 year flood level in a manner that has no significant biodiversity impact and negligible impact on flood characteristics on other sites. Restricting reasonable development in these circumstances has the effect of sterilising land capable of development.

The University is of the view that there should be flexibility in development control along the edges of the 1 in 100 year flood level which is also the boundary between land in the Environment and Recreation Zone and the Enterprise Zone. This can be achieved by including a flexible zone boundary provision that allows development in the Environment and Recreation Zone for uses permissible in the adjoining zone (in this case the Enterprise Zone) where it can be established that such development:

- is not located in a high hazard flood risk area;
- has no significant impact on areas of biodiversity value; and
- has negligible impact on flood characteristics in adjoining lands.

In addition, the WSAP and SEPP provisions should make it clear that subsequent planning pathways as described in Part 8 of the SEPP Discussion Paper can be inconsistent with provisions of the WSAP, a precinct plan or the zoning of land where justified.

3.6.3 Concern over flood planning level controls

Section 4.2 of the SEPP Discussion Paper proposes the following controls for the flood planning area:

No urban land uses, including additional dwellings, will be permitted on land below the flood planning level.

Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks is not desirable. Under the proposed SEPP these types of works will not be permitted below the flood planning level and will be discouraged in other areas of the floodplain.

The flood planning level is defined as the level of the 1 in 100 chance per year flood (1 in 100 Annual Exceedance Probability flood), plus 0.5 metres freeboard.

These controls are inconsistent with the NSW Flood Prone Land Policy and the standard practice in development controls on flood prone land which should be based on the 1 in 100 Annual Exceedance Probability flood. Any development above or below the level of the 1 in 100 Annual Exceedance Probability flood should have a floor level set at or above the flood planning level.

The flood planning level should not be used as a zone boundary or development prohibition control.

3.6.4 Permissible land uses are too restrictive

The only purposes for which development is permissible with or without consent are:

Environmental protection works, Flood mitigation work, Environmental facility, Information and education facility, Kiosk, Recreation area, Recreation facilities (outdoor), Water recreation structure, Road

Consistent with uses permissible in the E2 Environmental Conservation Zone under the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (“Growth Centres SEPP”), the following purposes should be included:

Drainage; Waterbodies (artificial)

Flexible zone boundary provisions as outlined above in Section 3.6.2 should also be incorporated into the new SEPP.

3.6.5 Concerns over the impacts of revegetation proposals on flooding of adjoining land

The WSAP seeks to retain and increase the urban tree canopy and green cover across the Aerotropolis including edge of creek corridors and floodplain revegetation. This raises issues of flood impacts on adjoining lands. The flood impacts of addition vegetation in the floodplain has been investigated by Cardno (**Attachment 2**)

The proposed revegetation of the floodplain has the potential to locally increase 1% AEP flood levels by up to 0.6 m depending on the extent and density of revegetation. Adverse local increases in PMF levels could be up to 1.2 m. For context, in this location the difference between the 100 yr ARI flood level and the PMF level is around 1.5 m only.

Significant increases in flood levels due to revegetation of the complete floodplain would cause unsafe conditions on Elizabeth Drive and on any other similar roads to be experienced in more frequent floods, pose greater risks to vehicles due to greater flood depths and would be more prolonged than under current conditions.

The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including that peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site.

Many other Council's do not accept adverse impacts greater than 0.01-0.02 m on any adjoining property arising from a development proposal. If the approach of Penrith City Council and other Council's is applied, then the level of revegetation of the floodplain which could be achieved would be limited.

Plans to revegetate the floodplain need to be monitored to ensure that flood characteristics on adjoining land are not adversely impacted.

3.7 Zoning of ‘perceived’ farm dams and associated drainage depressions in Northern Gateway Precinct

The ‘perceived’ farm dams are man-made artificial depressions and do not serve the function of a dam as implied by the WSAP. Furthermore, the dams are no longer used by the University and are redundant.

The SEPP Discussion Paper and accompanying maps zone the existing man-made farm dams and associated drainage depressions *Environment and Recreation* with significant restrictions on land use and development including limited permissible uses and stringent development controls. It is understood that the intention is for dams to be protected to support water retention in the landscape.

This directly affects approximately 12 hectares of the Property which contains 10 constructed farm dams used for agricultural purposes and indirectly impacts on the potential to efficiently develop land adjoining the farm dams.

This is a new affectation and there has been no consultation with the University on this proposal.

The University has a number of significant concerns with this approach.

3.7.1 Inconsistency in the application of the controls

The Northern Gateway is the only precinct that zones farm dams and drainage depressions in this manner. The WSAP Structure Plan does not indicated farm dams as Environment and Recreation in any other precincts and they are not zoned as such on the Zoning Map for other precincts.

Similarly farm dams have not been zoned E2 Environmental Conservation in the Mamre Road Precinct draft Land Zoning Map recently placed on exhibition. A consistent approach should be adopted with these dams and associated drainage depressions in the Northern Gateway Precinct being zoned tributaries in the areas being zoned Enterprise. This will enable these matters to be determined at precinct planning, master planning or development application planning pathways.

Landowners in the Northern Gateway Precinct (of which the University has significant landholdings) are being inequitably treated in this regard.

3.7.2 Zone boundary too complicated and intricate

The use of the 1 in 100 year flood level and inclusion of all farm dams and connecting drainage depressions gives the Environment and Recreation Zone a very high perimeter to area ratio. Vegetation patches with a high perimeter to area ratio are difficult and expensive to manage for conservation since they are subject to extensive edge effects. Consolidated patches with low perimeter to area ratios would result in better biodiversity outcomes. Significant boundary rationalisation for the current zone boundary would be required to achieve this.

Further such an irregular zone boundary hinders efficient planning and design of development including the location of roads and pathways that might form an edge to the Environment and Recreation zone providing desired access.

The zone boundary should be simplified focussing on mainstream flooding and not including farms dams and associated drainage depressions or isolated smaller areas of flood prone land. The planning process should retain the flexibility to alter precinct and zone boundaries at the interface between the Environment and Recreation Zone and other urban zones such as the enterprise zone.

3.7.3 Negative impact on efficient use of land

The inclusion of the man-made farm dams in the Environment and Recreation zone with strict limitations on permissible uses and other proposed restrictive planning controls reduces the ability to plan and efficient urban structure and form for development in the Enterprise Zone. The nature of development in the Enterprise Zone requires that building footprints and subdivision block sizes are larger and road networks having moderate bends to accommodate larger vehicles. The inclusion of farm dams in the Environment and Recreation Zone and a complicated and intricate boundary line between zones makes it difficult to efficiently plan development and results in loss of developable land, further fragmenting the Property and restricting its development potential.

The proposed restrictive land use controls prevent the area occupied by farm dams from being used for any purposes permissible in the Enterprise Zone. Any part of an overall development that is characterised as a permissible use in the Enterprise Zone (such as light industry or warehouse and distribution centre) would not be permissible in this area significantly affecting the efficient use of the land. This hinders the orderly and economic use and development of land and is inconsistent with the objectives of the EP&A Act.

Provision for drainage and landscape should be determined as part of the development design process rather than being predetermined on an arbitrary basis. Any planning intent for retaining or providing water in the landscape should not be achieved by zoning but by appropriate incentives in the Development Control Plans.

3.7.4 Impact on Airport operations

All farm dams have been indiscriminately included within the Environment and Recreation Zone, regardless of their ecological value in either the current or future landscape. The dams within the McGarvie Smith Farm are in the flightpath for the northern runway. This could pose a potential bird strike risk for incoming and outgoing aircraft. Further, the draft Australian Noise Exposure Concept Map is predicting greater than 30 ANEC units of noise exposure across these dams which could detrimentally affect native fauna.

3.7.5 No justification to retain dams for flood control or stormwater management purposes

The farms dams and associated drainage depressions have been identified in a 2006 PCC overland flow study as conveying water in storm events. This is distinct from mainstream flooding experienced in the main creek systems. The similarity between the overland flood affectation and the land zoned Environment and Receptions indicates that all farm dams are to be retained simply because they were mapped in the 2006 study and includes disconnected fragments of flooded areas and isolated farm dams. The removal of these dams has no impact on downstream flooding characteristics.

Further civil engineers at&I (**Attachment 4**) advise;

From a civil engineering perspective, there is no merit in re-zoning the land associated with the dams and associated overland flow paths into an 'Environmental and Recreation' zone for the following reasons:

- 1) *The dams and downstream overland flow paths are man-made watercourses – they are not natural watercourses and were constructed to essentially provide water storage capacity for livestock on the farms.*
- 2) *The dams serve to capture local overland flow paths and store water runoff. Once full, they overtop and flow overland into Badgerys Creek to the east.*
- 3) *As part any future development of the site, a stormwater management system will need to be created to ensure all stormwater runoff generated on the site will be detained within above ground basins and/or underground tanks and treated to ensure nutrient removal to Penrith City Council's requirements.*
- 4) *The new stormwater management system will fully comply to the Penrith City Engineering guidelines and comprise:*
 - *new pipe/pit and swale systems to ensure all stormwater runoff is captured and stored to ensure discharge rates into Badgerys Creek do not exceed pre-developed rates, and*
 - *new basins/tanks to detain all stormwater runoff and discharge at controlled rates to ensure peak flow rates into Badgerys Creek are not increased.*
- 5) *As the new basins/tank will be needed to comply with Council's requirements during the Development Application and Construction Certificate stages of development, this will result in all existing dams becoming redundant and need to be removed.*

On the basis of the information presented above, it is our view the existing dams and associated overland flow paths upstream of the 1:100-year flood zone will not in any way contribute to the flood management objectives outlined in the WSAP or Aerotropolis SEPP.

Furthermore, as the dams and downstream overflow paths will be removed to allow for new systems to be installed to comply to the Penrith City Council's Engineering Guidelines, we do not consider that the dams and associated overland flow paths should be rezoned 'Environment and Recreational' and should retain the surrounding zoning as 'Flexible Employment'.

3.7.6 Dam stability is an issue for urban development

There are significant potential safety issues in respect of any future development downstream of the constructed farm dams. It is unlikely that the embankments of any farm dams have been constructed to the standards required for water retaining structures within urban areas and therefore, the embankments would need to be removed and reconstructed in accordance with current design standards if the footprint of the farm dams are to be "protected".

3.8 Land zoned Environment and Recreation and land identified for other public purposes should be included in the Land Reservation Acquisition Map

3.8.1 Environment and Recreation Zone

The WSAP considers the Wianamatta–South Creek Precinct an *Opportunity for public acquisition to support the open space needs of the Aerotropolis* (page 66). It is described as the *structuring blue and green infrastructure spine of the Aerotropolis and broader Western Parkland City*. It is identified as an important part of the Wianamatta–South Creek corridor and a key piece of ‘infrastructure’ and a central defining element of the urban design and urban structure of the Aerotropolis.

As discussed in Section 3.6, the range of land uses permissible in the Environment and Recreation Zone is limited and more restrictive than environmental conservation zones and public open space zones under other environmental planning instruments such as the Growth Centres SEPP and the objectives of the zone reflect the public purpose intentions of the zoning.

In view of the importance of this infrastructure element to the Aerotropolis and the Western Parkland City it should be included in the Land Reservation Acquisition Map for acquisition by a public authority.

3.8.2 Land required for other public purposes

The WSAP identifies part of the Property as required for public purposes including roads, rail and related infrastructure, waste water treatment and regional parkland. This land to be reserved for a public purpose should be included in the Land Reservation Acquisition Map.

3.9 Future planning pathways

Part 8 of the SEPP Discussion Paper describes in general terms:

- the proposed precinct planning process; and
- alternatives to the precinct planning process including:
 - development applications lodged prior to precinct planning; and
 - an optional master planning process to be available for sites with a minimum site area of 100 hectares which could enable site investigations to be acknowledged prior to and concurrently with precinct planning. It could also be utilised following the completion of the precinct planning.

The University is supportive of any planning pathway that will enable it to build on the site investigations undertaken as part of the University’s Planning Proposal. The incorporation of simple mechanisms for promoting accelerated development of consolidated land holdings is strongly supported.

The University requests that consideration be given to the following:

- all planning pathways should allow greater flexibility in land use permissibility and development controls on either side of the 1 in 100 year flood line for mainstream flooding that generally forms the boundary between the Environment and Recreation Zone and other urban zones such as the Enterprise Zone;
- all planning pathways should incorporate the flexibility to vary any adopted WSAP Structure Plan and zone boundary where justified by further investigations; and
- allowing development on consolidated landholdings where they cross precinct boundaries.

3.10 Details of controls in the proposed SEPP are missing

The SEPP Discussion Paper refers to a range of matters that are to be further developed into specific provisions of the SEPP including additional maps and alternative planning pathways. Given the lack of detail on proposed controls and pathways, it is not possible to fully assess the implications of such controls. Therefore, a final draft SEPP and all proposed accompanying controls and maps should be exhibited for public comment prior to finalisation.

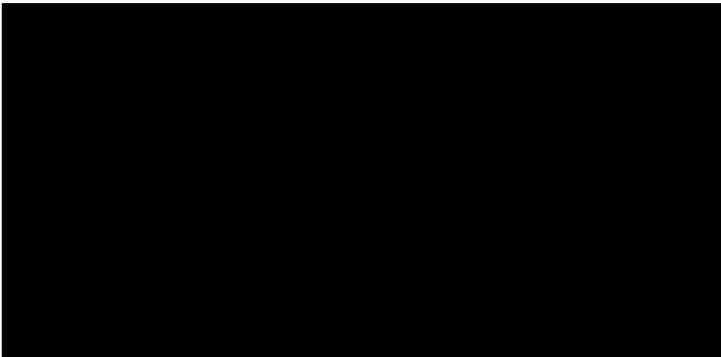
4. CONCLUSION

This submission identifies significant issues and University concerns with the draft WSAP and related documents. These need to be addressed and resolved in finalising planning for WSA.

The aggregate loss of developable land based on all of the infrastructure impacts from a variety of agencies has an adverse impact on the University's position and will impact the University's ongoing discussions and scale of investment in education and research roles in Western Sydney. The University feels strongly that some balance needs to be restored.

The Western Sydney Planning Partnership is requested to takes these matters into account in finalising the WSAP and the SEPP.

BBC Consulting Planners





FIGURES



ATTACHMENTS



ATTACHMENT 1

Land Affectation



ATTACHMENT 2

Stormwater and Flooding, Advice prepared by Cardno

Western Sydney Aerotropolis

Review of Planning Documents
(LUIIP#2)

59919022

Prepared for
University of Sydney

28 January 2020



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Executive Summary

The NSW Department of Planning, Industry and Environment has recently placed on display a number of documents relating to the Western Sydney Aerotropolis including:

- (i) Western Sydney Aerotropolis – Summary of Key Planning Documents;
- (ii) Western Sydney Aerotropolis Plan – Draft for public comment (LUIP#2),
- (iii) Discussion Paper on the proposed State Environmental Planning Policy;
- (iv) Western Sydney Aerotropolis Development Control Plan, Phase 1 – Draft for public comment

The purpose of this report is to review the Western Sydney Aerotropolis documents on exhibition and identify and discuss issues related to flooding and drainage that have the potential to impact on the proposed development of the property and to prepare a concise report on any issues of concern.

The following issues were identified and actions are recommended as follows.

Issue: Performance Outcomes for Flooding

Section 4.2 Flooding of the draft Western Sydney Aerotropolis DCP 2019

Concern: Section 4.2 Flooding of the draft Western Sydney Aerotropolis DCP 2019 proposes performance outcomes for flooding. While these performance outcomes are supported in general terms, the proposed flooding requirements for development need to comply with the primary objective of the NSW Flood Prone Land Policy which recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved

It is considered that a number of the planning principles which are proposed to deliver the performance outcomes for flooding are contrary to the primary objective of the NSW Flood Prone Land Policy.

Recommendation: It is recommended that the planning matrix approach and the development controls adopted by Liverpool City Council which are based on flood risk precincts be adopted. This approach is outlined in Appendix B.2 and is codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk.

Alternatively, the planning matrix approach and development controls adopted by Liverpool City Council be adapted to the Flood Planning Constraints Categories mapped in the 2019 Draft South Creek Floodplain Risk Management Study and Plan (Advisian, 2019) (refer Appendix B.6).

The expected adaption would be for High Flood Risk Precinct controls to apply to FPCC1 and probably FPCC2, Medium Flood Risk Precinct controls to apply to FPCC3 and Low Flood Risk Precinct controls to apply to FPCC4.

Issue: Flood management infrastructure and planning should account for climate change and the reforestation of the Blue–Green Grid as part of the landscape- led approach.

Western Sydney Aerotropolis Plan - Draft for Public Comment
6.4.2 Floodplain management

Concerns: While the need to account for climate change is supported this is a generic objective which is lacking any detail on the proposed time horizon or RCP scenario which is proposed and the ramifications for flooding.

The estimated reduction in peak flow in South Creek (in comparison to current estimates based on the 1987 edition of ARR would (refer **Appendix C.2**):

- offset the impact of adopting RCP4.5 rainfall intensities (and still yield an overall lower peak flow in the year 2100); or
- offset the impact of adopting RCP8.5 rainfall intensities such that the peak flow would be around the same value in the year 2100 as currently adopted.

Likewise, the proposed reforestation is driven by landscape considerations only and ignores the flooding ramifications of such a strategy.

It was concluded from an assessment of the local impact of reforestation of the Wianamatta-South Creek precinct that reforestation to a “Floodplain with moderately dense trees” (n = 0.1)) will increase 1% AEP flood levels on the property by around 0.2 m – 0.45 m depending on location or reforestation to a “Floodplain with dense trees” (n = 0.12) will increase 1% AEP flood levels on the property by around 0.3 m – 0.6 m depending on location. These impacts are far in excess of the flood impacts that Penrith City Council and many other Council’s would accept for any proposed change in land use. The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including “Peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site”

Significant increases in flood levels due to revegetation of the complete floodplain would also cause unsafe conditions on Elizabeth Drive and on any other similar roads to be experienced in more frequent floods, pose greater risks to vehicles due to greater flood depths and would be more prolonged than under current conditions.

Recommendation: Any consideration of climate change should be undertaken in the context of the 2019 edition of Australian Rainfall & Runoff.

Recommendation: Any landscape-led approach based on reforestation needs to be based on an assessment of the flood impacts of such an approach and the limits on impacts adopted by Penrith City Council and other Councils.

- Issue: SU16 Prohibit cut and fill to alter the 1% AEP flood extent
- Western Sydney Aerotropolis Plan - Draft for Public Comment
Planning Principles for A resilient and adaptable Aerotropolis*
- Concern: Planning principle SU16 is contrary to Penrith City Council's relevant development controls as detailed in Chapter 3.5 on flooding constraints on developments in Penrith DCP 2014 and the provisions of Liverpool DCP 2008 Part 1, Section 9 Flooding Risk because it prohibits development in the Medium Flood Risk Precinct.
- Planning principle SU16 is contrary to the primary objective of the NSW Flood Prone Land Policy because it sterilises valuable flood-prone land by precluding its development.:
- Recommendation: It is recommended that the relevant development controls codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk be adopted.
- Issue: Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks will not be permitted below the flood planning level and discouraged in other areas of the floodplain.
- Western Sydney Aerotropolis - Discussion Paper on Proposed SEPP
Part 4 – Precinct specific controls
4.2 Wianamatta-South Creek Precinct Boundary and Flood Planning Levels*
- Concerns: The aim of any Flood Impact Assessment is to assess the impact of proposed cut and fill and to limit the impacts of planned development on adjoining properties. This planning principle prohibits the consideration of earthworks within the 1% AEP flood extent (but outside floodways and high hazard areas) which is contrary to the primary objective of the NSW Flood Prone Land Policy. It also appears to prohibit earthworks on land which lies between the 1% AEP flood extent and the extent of the Flood Planning Level (FPL). If the grade of the land is flat, say 1% grade, then this sterilises a further 50 m wide zone beyond the 1% AEP flood extent.
- This planning principle is contrary to the provisions of Liverpool DCP 2008 Part 1, Section 9 Flooding Risk because it prohibits any earthworks in the Medium Flood Risk Precinct and part of the Low Flood Risk precinct.
- Recommendation: It is recommended that the relevant development controls codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk be adopted.
- Issue: To achieve the Blue-Green Grid, the following principles for planning and development in the Aerotropolis will be identified in the proposed SEPP and accompanying precinct planning:
1. *Wianamatta-South Creek and its tributaries will be protected from urban runoff, by retaining the hydrologic characteristics of the catchment and providing water in the landscape for amenity, urban cooling, and high quality green space;*
- Western Sydney Aerotropolis - Discussion paper on Proposed SEPP
Part 4 – Precinct specific controls
4.1 Wianamatta-South Creek the central spine of the Blue- Green Grid*

Concern: If it is proposed that the tributaries of South Creek include un-named drainage lines which convey runoff to the creeks, then in order to protect these “tributaries” from urban runoff it would be necessary to install and maintain stormwater quantity (OSD) and quality measures (GPTs, biofilters) at all stormwater discharge points into the “tributaries”. This would require the installation of a highly distributed series of measures which would forego opportunities to rationalise and co-locate such measures within the Wianamatta-South Creek corridor noting this this corridor is up to 1 km wide.

It is unclear if the relevant Councils who will be required to maintain stormwater quantity and quality measures are willing to accept the responsibility of maintaining a multitude of highly distributed measures.

If it is proposed that trunk drainage not be permitted in un-named drainage lines because it is deemed to be incompatible with the proposed zoning of un-named drainage lines as “Environment and Recreation” then a likely consequence of this decision would be the need for the wholesale importation of fill to raise the ground level 2 m or more adjacent to the un-named drainage lines in order that local drainage lines and any stormwater management measures could discharge into the un-named drainage lines.

Recommendation: It is recommended that un-named drainage lines not be zoned as “Recreation and Environment” and that instead these drainage lines be included in the Mixed Use zone.

Issue: To achieve the Blue-Green Grid, the following principles for planning and development in the Aerotropolis will be identified in the proposed SEPP and accompanying precinct planning:

4. *Suitably sized and located farm dams will be protected to support water retention in the landscape;*

*Western Sydney Aerotropolis - Discussion paper on Proposed SEPP
Part 4 – Precinct specific controls*

4.1 Wianamatta-South Creek the central spine of the Blue- Green Grid

Concern: This planning principle conveys the intent that selected farm dams but not all farm dams will be protected. It implies that farm dams selected for protection are to remain in their current state. However, depending on the location of any selected farm dam and if it is proposed to develop downstream of the dam then dam safety considerations become a significant issue.

It is likely that the embankment of any farm dam has not been constructed to the standards required for water retaining structures within urban areas and that farm dam embankment would need to be removed and reconstructed in accordance with current design standards if the footprint of the farm dam is to be “protected”. Alternatively, the farm dam embankment could be removed which would likely significantly reduce the water storage and surface area if the farm dam was constructed based on a balanced earthworks ie. soil was excavated and placed to form the embankment.

There is also no indication as to the selection criteria for farm dams to be protected.

North of Elizabeth Drive the draft Flood Extent map includes overland flowpaths and farm dams which were mapped in the 2006 Penrith Overland Flow Flood Overview Study (refer Section B.3). The mapping reflects the legacy of past rural uses which constructed farm dams to harvest runoff and/or modified overland flowpaths. The map indicates that all farm dams are to be retained simply because they were mapped in the 2006 study. The mapped 100 year Flood Area includes disconnected fragments of flooding and isolated farm dams and is not coherent.

Recommendation: Adopt the following indicative benchmark criteria developed for the upper catchment of South Creek when assessing if a farm dam is a regional farm dam whose active flood storage may need to be matched by compensatory flood storage in the event the regional farm dam is removed during development, namely:

- A catchment area greater than 125 ha;
- A dam full supply surface area to catchment area ratio which exceeds 0.05; and
- Active storage which exceeds 50,000 m³.

If a farm dam is not classified as a regional farm dam then the farm dam can be removed as part of development without having a significant detrimental impact on flooding.

Based on these criteria, none of the farm dams on the University of Sydney Western Lands would be classified as a regional farm dam individually nor as a cascade of dams on several drainage lines. Where farm dams on un-named drainage lines are not deemed to be regional farm dams then these farm dams should not be zoned as "Recreation and Environment" and instead these farm dams should be included in the Mixed Use zone.

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Appendix A Composite Flood Map

Appendix B Previous Studies

Appendix C 2019 Edition of Australian Rainfall & Runoff

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- Figure 1 Location of University of Sydney Western Lands
- Figure 2 Subcatchment Boundaries in the overall XP-RAFTS Catchment Model
- Figure 3 South Creek and Kemps Creek Roughness Zones (after Worley Parsons, 2015)
- Figure 4 South Creek Flood Risk Precincts (based on results from Worley Parsons, 2015)

1 Introduction

1.1 Purpose of this Report

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- (iv) Western Sydney Aerotropolis Development Control Plan, Phase 1 – Draft for public comment

These documents have been placed on exhibition between 6 December 2019 and 28 February 2020.

The purpose of this report is to review the Western Sydney Aerotropolis documents on exhibition and identify and discuss issues related to flooding and drainage that have the potential to impact on the proposed development of the University of Sydney Western Lands and to prepare a concise report on any issues of concern.

1.2 Location

The location of the University of Sydney Western Lands is indicated in **Figure 1**.

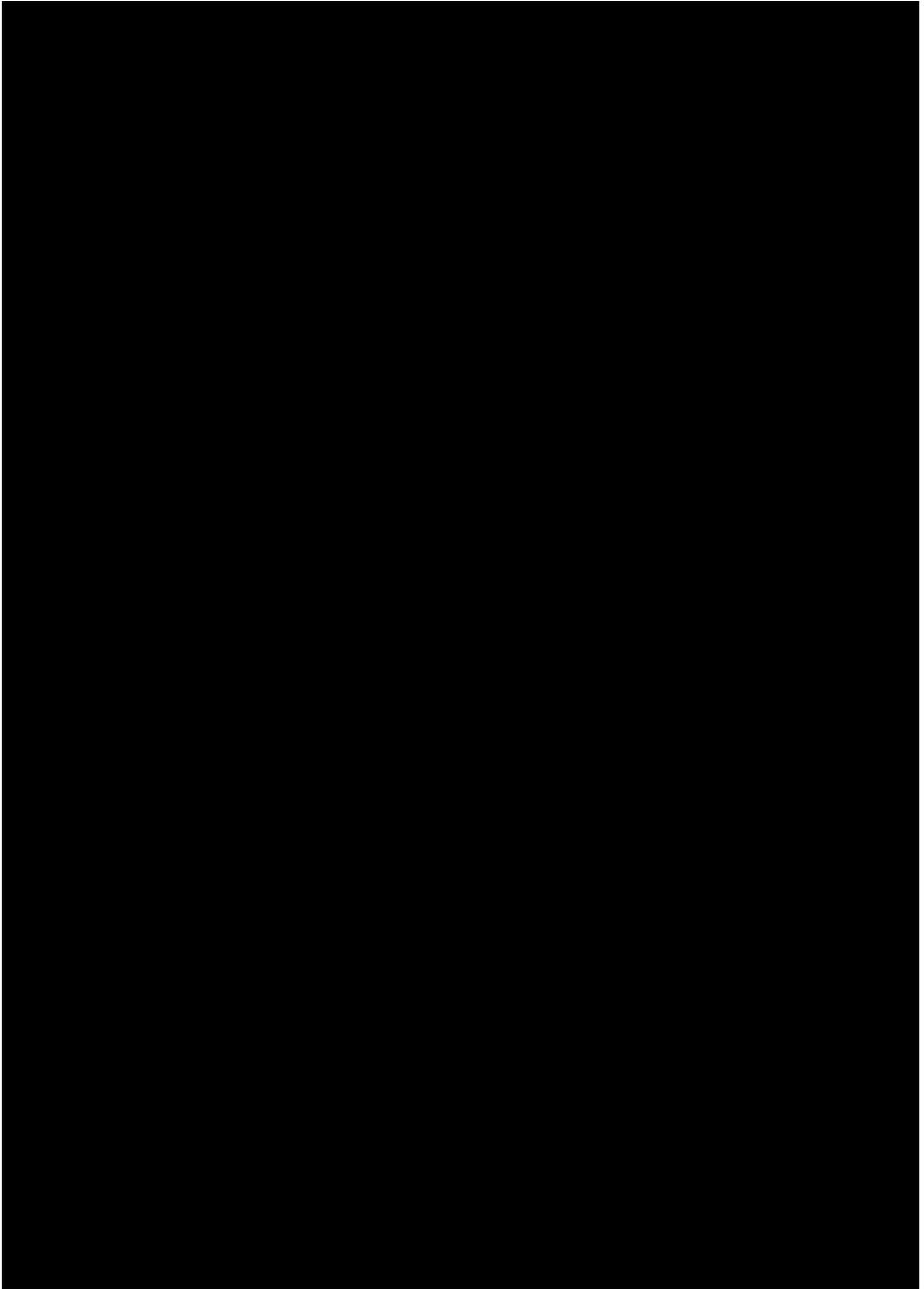


Figure 1 Location of University of Sydney Western Lands

2 Previous Studies

A series of studies have been undertaken in the South Creek catchment since 1991. These have included assessments to define the existing flooding behaviour and associated hazards, and to investigate possible mitigation options to reduce flood damage and risk. This has included consideration of planning controls to guide future development in the catchment.

These studies include:

- 1991 South Creek Floodplain Risk Management Study
- 2004 South Creek Floodplain Risk Management Study and Plan for the Liverpool Local Government Area
- 2006 Penrith Overland Flow Flood Overview Study
- 2015 Updated South Creek Flood Study
- 2019 Upper South Creek Floodplain Risk Management Study and Plan
- 2019 Draft South Creek Floodplain Risk Management Study and Plan

These studies are summarised in **Appendix B** and provide the context for the review of the Western Sydney Aerotropolis planning documents.

3 Review of Western Sydney Aerotropolis Documents

3.1 Summary of Key Planning Documents

Key flooding issues are identified and discussed as follows.

Key issues and/or key themes and/or key words are highlighted in this colour.

Section 1.7 Managing flood zones

The NSW Government's Flood Prone Land Policy aims to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone land.

Flood data used in the SEPP Discussion Paper and draft Flood Map (figure 8) is based on current Penrith City Council and Liverpool City Council data.

- Refer to the discussion in Section B.3 2006 Penrith Overland Flow Flood Overview Study for the basis of flood mapping and example maps in the Penrith LGA;
- Refer to composite map of Liverpool City Council Flood Mapping attached in **Appendix A**:
 - While mapping of several watercourses has been clearly undertaken and is described in Council studies there are extensive areas where farm dams and drainage lines have been mapped but there is no indication on how this was undertaken. This appears to be GIS mapping based on terrain and not flood modelling. No overland flow flood studies in the western area of the LGA are available in the public domain.
- The 2015 Updated South Creek Flood Study did not include an assessment or mapping of overland flows notwithstanding Council mapping of farm dams and drainage lines within the study area.
- Figure 8 is inconsistent with LCC mapping. In some areas it relies on the mapping while in others it appears to ignore the mapping. The mapping in the Agribusiness zone southwest of the WSIA precinct partially aligns with LCC mapping by including the elongated farm dam but ignores other mapped farm dams. The Agribusiness zone west of WSIA in Luddenham appears to ignore mapped farm dams and drainage lines.

The SEPP will define the flood planning level as the level of the 1 in 100 chance per year flood, plus 0.5 metres freeboard to manage development for the purposes of floodplain management. Flood prone land (the floodplain) is defined in the NSW Government Floodplain Development Manual (2005) as land susceptible to flooding by the probable maximum flood (PMF).

Areas of the Wianamatta–South Creek floodplain located below the 1 in 100 chance per year flood level, as mapped on the draft Flood Map, are proposed for flood-compatible land uses and activities such as recreation and public spaces. This means that no additional dwellings will be permitted on land below the defined flood planning level.

Urban development on flood prone land above this flood planning level will be permitted, subject to risk-based flood-related development controls, encouraging more intensive development in areas of lower flood risk.

Precinct planning will further investigate the flood extent across the Aerotropolis and inform the water cycle management strategy that will confirm land needed for water detention and treatment.

More detailed studies to be undertaken by Council? NSW DPIE?

Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks will not be permitted below the flood planning level and discouraged in other areas of the floodplain.

If it can be demonstrated that through filling and excavation that the flood storage capacity is not altered, then will this be permitted?

For more detail on flood management, see Section 6.4 of the Draft WSAP

3.2 Western Sydney Aerotropolis Plan - Draft for Public Comment

Key flooding issues are identified and discussed as follows.

6.4.2 Floodplain management

The NSW Government's Flood Prone Land Policy aims to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone land. The NSW Floodplain Development Manual (2005) guides the process of floodplain risk management. Floodplain risk management studies and plans identify and prioritise ways to reduce risk of damage from flooding.

The current (overall) South Creek Floodplain Risk Management Study was released in February 1991¹.

A Floodplain Risk Management Study and Plan were also prepared for the reach of South Creek in the Liverpool LGA by Bewsher Consulting in 2004².

The South Creek flood study was updated in 2015.

In 2019 a draft South Creek Floodplain Risk Management Study³ and draft Plan⁴ were placed on Public Exhibition from 31 October to 28 November 2019.

It is unclear what standing these studies have in relation to the proposed Western Sydney Aerotropolis Plan.

¹ Willing & Partners (1991) "South Creek Floodplain Risk Management Study" Final report, 2 Vols, prepared for the Department of Water Resources, pp 80 + Apps

² Bewsher Consulting (2004) "South Creek Floodplain Risk Management Study and Plan, for the Liverpool Local Government Area, *Final Report*, 2 Vols, prepared for Liverpool City Council, May.

³ Advisian (2019) "South Creek Floodplain Risk Management Study", *Exhibition Draft Report*, prepared for Penrith City Council, August, 142 pp + Apps.

⁴ Advisian (2019) "South Creek Floodplain Risk Management Plan", *Exhibition Draft Report*, prepared for Penrith City Council, September, 25 pp + Apps

*The Blue–Green Grid provides an ideal opportunity to accommodate and manage flooding through innovative **stormwater retention strategies** without unnecessarily sterilising land.*

It is unclear if the term retention is used on purpose or if detention was intended. The structural source control and in-system management measures include stormwater detention and stormwater retention which are defined by Argue (2013/2014)⁵ as follows:

Detention is defined as holding of runoff for short periods to reduce peak flowrates and releasing the stored volume in a controlled manner to the natural or artificial watercourses to continue its path in the hydrological cycle. Any reduction in the volume of surface runoff involved in this process is minimal and therefore the reduction in volume is considered to be nil;

Retention is defined as the procedures and schemes whereby stormwater is held for considerable periods causing water to continue in the hydrological cycle via infiltration, percolation, evapotranspiration, and reuse and only the overflows are discharged directly to the natural or artificial watercourses. The volume of surface runoff is reduced.

Source control measures can include On-Site Detention (OSD) for the control of peak flowrates and On-Site Retention (OSR) for the control of peak flowrates and runoff volume. Both OSD and OSR can reduce stormwater pollutant loads discharged to receiving waters, however, OSR has been shown to be more efficient in removing the pollutants in stormwater than OSD. For further information on urban stormwater pollutant generation and control, the reader is referred to the Australian Runoff Quality guidelines (Engineers Australia, 2006). OSD and OSR are typically small stormwater storages installed on individual residential, commercial and industrial lots and are considered off-line in relation to the council or public drainage system.

In-system management measures can include community and regional detention and retention measures. Community measures are typically medium sized stormwater storage facilities constructed in public areas, including public open space. Generally, the community structural detention and retention systems are combined with other community uses such as public sporting grounds, recreational areas and parks and other community facilities (e.g. libraries, community halls). Community measures can be off-line in relation to trunk drainage lines, but may be on-line in relation to local drainage lines.

Regional measures are typically large community storage facilities constructed on-line in the downstream reach of a catchment near to the receiving water.

Flood management infrastructure and planning should account for climate change and the reforestation of the Blue–Green Grid as part of the landscape- led approach.

Any consideration of climate change should be undertaken in the context of the 2019 edition of Australian Rainfall & Runoff.

As discussed in **Section C.3**, hydrological modelling of the South Creek catchment was undertaken in 2015 at the catchment scale using XP-RAFTS. The hydrological model assembled by Worley Parsons in 2015 was based on ARR1987 IFD.

⁵ Argue, J R (Ed, 2004/2013) "*WSUD: basic procedures for 'source control of stormwater – a Handbook for Australian practice'*". Urban Water Resources Centre, University of South Australia, 7th Printing, Adelaide, 245 pp + Apps

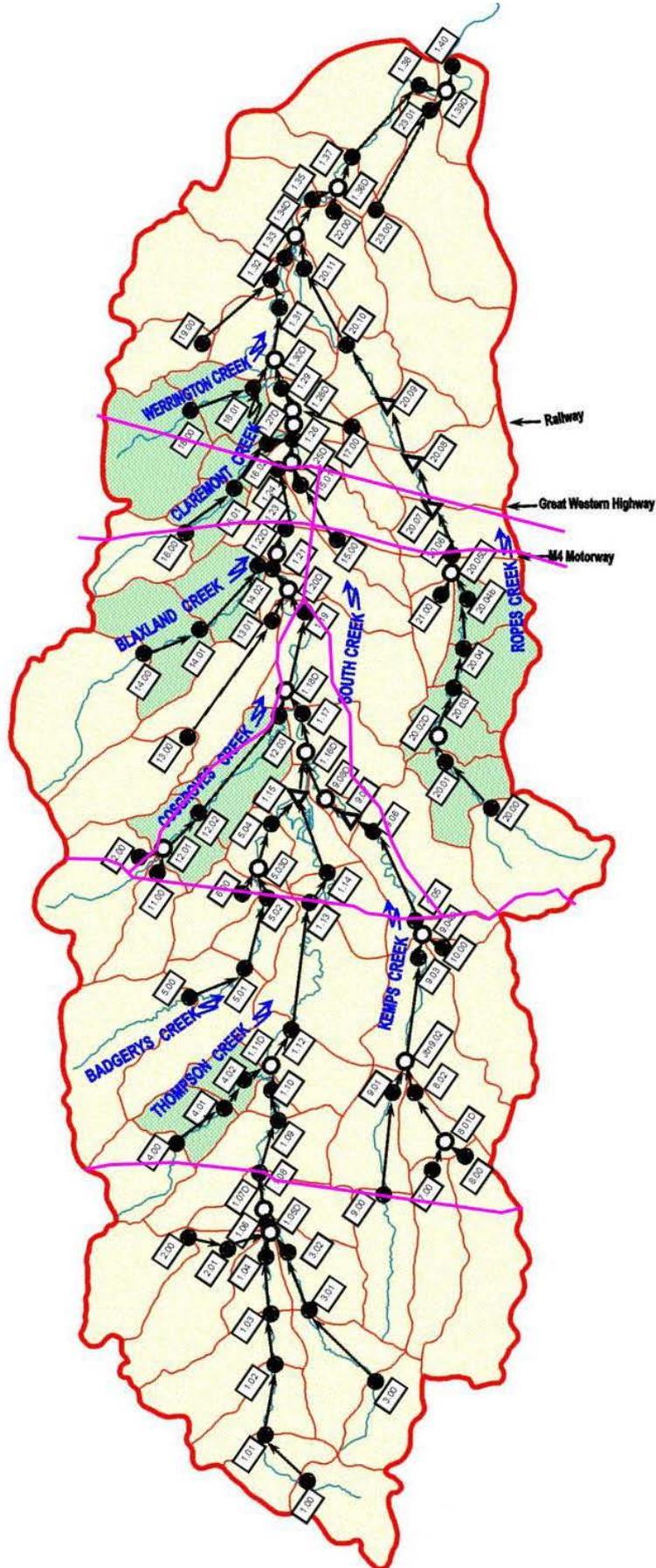


Figure 2 Subcatchment Boundaries in the overall XP-RAFTS Catchment Model

An assessment has been recently undertaken of a local catchment (around 130 ha) located within the larger South Creek subcatchment 1.17 based on both ARR1987 and ARR2019 IFD.

It was also of interest to compare the estimated peak flows at local catchment outlet with the estimated peak flows in South Creek in the vicinity of the local catchment at Node 1.17 (refer **Figure 2**).

It was noted that the indicative peak flow under ARR2019 at Node 1.17 was lower (by around 24%) than estimated under ARR1987 and the critical storm burst duration reduces from 36 hours to 9 hours.

The reduction in peak flow in South Creek would (refer **Section C.2**):

- offset the impact of adopting RCP4.5 rainfall intensities (and still yield an overall lower peak flow in the year 2100); or
- offset the impact of adopting RCP8.5 rainfall intensities such that the peak flow would be around the same value in the year 2100 as currently adopted.

An indicative assessment of the potential impact of complete revegetation of the South Creek and Kemps Creek floodplain within the 1% AEP extent has been undertaken in the vicinity of the confluence of South Creek and Kemps Creek.

Figure 3 provides an overlay of the property boundary and indicative PMF flood extents over a map of the roughness zones adopted for flood modelling purposes in the 2015 study. It will be noted that substantial areas of the floodplain inundated within the PMF extents are mapped as “Grassed floodplain and sparse trees” ($n = 0.05$). If the vision is to revegetate the corridor, then this revegetation could have a substantial adverse impact (increase) on flood levels in the 1% AEP flood and the PMF.

Two scenarios were assessed:

- Revegetation Scenario 1 Uniform revegetation across watercourses and the floodplain to “Floodplain with moderately dense trees” ($n = 0.1$)
- Revegetation Scenario 2 Uniform revegetation across watercourses and the floodplain to “Floodplain with dense trees” ($n = 0.12$)

Table 1 Flood Level Differences resulting from Revegetation of the 1% AEP Flood Extent

Reference Location	1% AEP Flood				
	Current Vegetation (m AHD)	Revegetated Scenario 1 (m AHD)	Flood Level Difference (m)	Revegetated Scenario 2 (m AHD)	Flood Level Difference (m)
	a	b	b-a	c	c-a
P1	37.88	38.10	0.22	38.19	0.31
P2	37.92	38.20	0.27	38.30	0.38
P3	38.40	38.81	0.41	38.94	0.54
P4	39.05	39.46	0.41	39.61	0.55
P5	37.76	38.14	0.38	38.27	0.51
P6	38.62	39.07	0.45	39.23	0.60
Min			0.22		0.31
Max			0.45		0.60

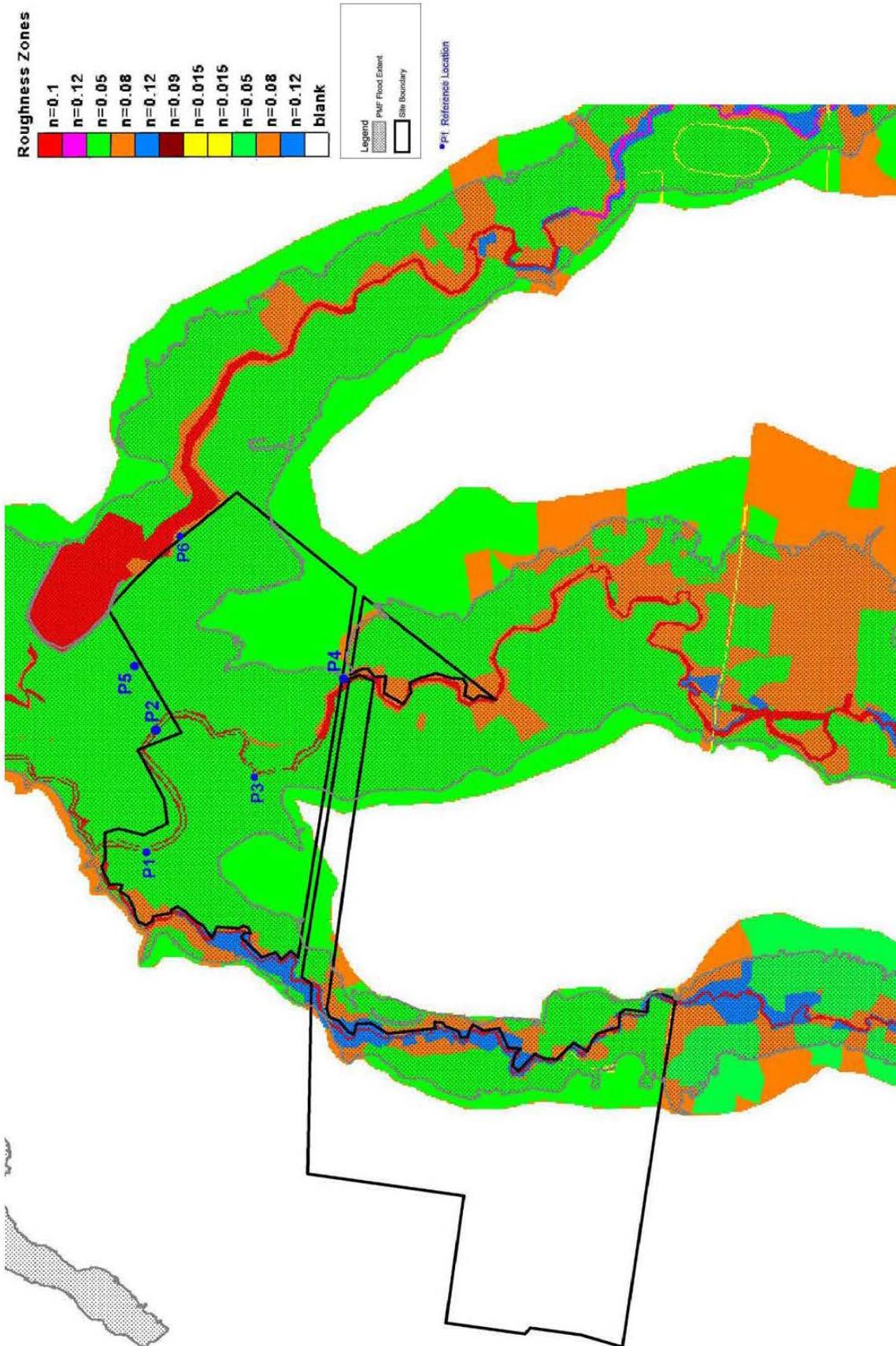


Figure 3 South Creek and Kemps Creek Roughness Zones (after Worley Parsons, 2015)

The results are given in **Table 1** of the indicative assessment at six reference locations on South Creek and its floodplain within the property boundary which are identified in **Figure 3**.

It is concluded that under Revegetation Scenario 1 the 1% AEP flood levels are increased on the property by around 0.2 m – 0.45 m depending on location and, under Revegetation Scenario 2, the 1% AEP flood levels are increased on the property by around 0.3 m – 0.6 m depending on location.

These impacts are far in excess of the flood impacts that Penrith City Council and many other Council's would accept for any proposed change in landuse.

The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including:

Current Criteria -	Peak flood levels not increased by more than 0.1 m (100 mm) (DCP reference C.14.a.i)
Recommended Criteria	Peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site

Likewise, many Council's do not accept adverse impacts greater than 0.01-0.02 m on any adjoining property arising from a development proposal.

Significant increases in flood levels due to revegetation of the complete floodplain would also cause unsafe conditions on Elizabeth Drive and on any other similar roads to be experienced in more frequent floods, pose greater risks to vehicles due to greater flood depths and would be more prolonged than under current conditions.

Precinct planning will need to consider floodplain risk management measures such as safe evacuation routes, cut and fill and development issues for the entire floodplain. Development controls will apply to land within the 1 in 100-year flood area in line with each Council's relevant policy.

The map on page 55 shows the flood extents for the Aerotropolis based on the 1 in 100-year flood area and are subject to future detailed precinct planning

Refer to discussion above in Section 3.1 regarding the draft Flood Map.

Planning Principles

Objective 6

A resilient and adaptable Aerotropolis

SU15 Plan for compatible land uses within the floodplain, provide safe evacuation and egress from flood events and consider climate change, culvert blockage and floodplain revegetation

The proposed revegetation of the floodplain has the potential to locally increase 1% AEP flood levels by up to 0.6 m depending on the extent and density of revegetation. Adverse local increases in PMF levels could be up to 1.2 m. For context, in this location the difference between the 100 yr ARI flood level and the PMF level is around 1.5 m only.

Significant increases in flood levels due to revegetation of the complete floodplain would cause unsafe conditions on Elizabeth Drive and on any other similar roads to be experienced in more frequent floods, pose greater risks to vehicles due to greater flood depths and would be more prolonged than under current conditions.

Penrith City Council and many other Council's do not accept adverse impacts greater than 0.01-0.02 m on any adjoining property arising from a development proposal. If the approach of Penrith City Council and other Councils is applied, then the level of revegetation of the floodplain which could be achieved would be limited.

Any consideration of climate change should be based on ARR2019 guidance.

A recent assessment of the indicative peak flow under ARR2019 at Node 1.17 (just downstream of the property) is lower (by around 24%) than estimated under ARR1987 and the critical storm burst duration reduces from 36 hours to 9 hours. The reduction in peak flow in South Creek would (refer **Appendix C.2**):

- offset the impact of adopting RCP4.5 rainfall intensities (and still yield an overall lower peak flow in the year 2100); or
- offset the impact of adopting RCP8.5 rainfall intensities such that the peak flow would be around the same value in the year 2100 as currently adopted.

The consideration of design flood flows and climate change under ARR2019 may lead to lower 1% AEP flood levels than currently adopted and could provide some leeway for revegetation without increasing 1% AEP flood levels above current adopted levels.

SU16 Prohibit cut and fill to alter the 1% AEP flood extent

The NSW Flood Prone Land Policy is produced within Section 1.1 of the 2005 Floodplain Development Manual. The primary objective of the NSW Flood Prone Land Policy recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

Planning principle SU16 is contrary to the primary objective of the NSW Flood Prone Land Policy.

As stated in part in Section 6.4.2 of the Draft Western Sydney Aerotropolis Plan

Development controls will apply to land within the 1 in 100-year flood area in line with each Council's relevant policy

Planning principle SU16 is contrary to Penrith City Council's relevant development controls as detailed in Chapter 3.5 on flooding constraints on developments in Penrith DCP 2014.

- SU17 Design, build and manage flood management assets to benefit native habitat, aesthetics, public recreation and amenity.*
- SU18 Protect, maintain and improve the water quality and flow to meet the NSW Government waterway health targets*
- SU19 Protect high value terrestrial and aquatic ecosystems to enhance biodiversity and protect environmental values*
- SU20 Adopt an integrated water management approach that considers urban form and streetscape, trunk drainage land and assets, waterway health and flood management*

3.3 Western Sydney Aerotropolis - Discussion Paper on Proposed State Environmental Planning Policy

Key flooding issues are identified and discussed as follows.

Part 4 – Precinct specific controls

4.1 Wianamatta-South Creek the central spine of the Blue- Green Grid

.... The Greater Sydney Commission’s A Metropolis of Three Cities’ vision for the Wianamatta-South Creek Corridor is to transform water management, while using the creek corridor to form the spine of the Western Parkland City. This conceptualises a green corridor that will provide sites for parks, walking and cycling trails, community, leisure and cultural facilities, and ecological services including nutrient capture, urban cooling, and local habitat. To create a cool and green Western Parkland City, the Aerotropolis needs to be structured around the landscape with Wianamatta-South Creek and its tributaries acting as the defining structural element.

Within the bounds of the Western Sydney Aerotropolis the tributaries of South Creek include Kemps Creek, Badgerys Creek and Cosgroves Creek. It is unclear if the SEPP defines tributaries to include un-named drainage lines which convey runoff to the creeks.

To achieve the Blue-Green Grid, the following principles for planning and development in the Aerotropolis will be identified in the proposed SEPP and accompanying precinct planning:

- 1. Planning for the Aerotropolis will start with and be guided by the principles of Country, suitably identifying, protecting, interpreting and integrating Country considerations into the future of the Aerotropolis;*
- 2. Wianamatta-South Creek and its tributaries will be protected from urban runoff, by retaining the hydrologic characteristics of the catchment and providing water in the landscape for amenity, urban cooling, and high quality green space;*

If it is proposed that the tributaries of South Creek include un-named drainage lines which convey runoff to the creeks then in order to protect these “tributaries” from urban runoff then stormwater quantity (OSD) and quality measures (GPTs, biofilters) would need to be installed and maintained at all stormwater discharge points into the “tributaries”. This would require the installation of a highly distributed series of measures which would forego opportunities to rationalise and co-locate such measures within the Wianamatta-South Creek corridor noting this this corridor is up to 1 km wide.

It is unclear if the relevant Councils who will be required to maintain stormwater quantity and quality measures are willing to accept the responsibility of maintaining a multitude of highly distributed measures.

3. *The provision of regional parks to support the Aerotropolis will be investigated;*
4. *Suitably sized and located farm dams will be protected to support water retention in the landscape;*

This planning principle conveys the intent that selected farm dams but not all farm dams will be protected. It implies that farm dams selected for protection are to remain in their current state. However, depending on the location of any selected farm dam and if it is proposed to develop downstream of the dam then dam safety considerations become a significant consideration.

It is likely that the embankment of any farm dam has not been constructed to the standards required for water retaining structures within urban areas and that farm dam embankment would need to be removed and reconstructed in accordance with current design standards if the footprint of the farm dam is to be "protected". Alternatively, the farm dam embankment could be removed which would likely significantly reduce the water storage and surface area if the farm dam was constructed based on a balanced earthworks ie. soil was excavated and placed to form the embankment.

There is also no indication as to the selection criteria for farm dams to be protected. Indicative benchmark criteria for classification of a farm dam as a regional farm dam in the South Creek catchment whose active flood storage may need to be matched by compensatory flood storage in the event the regional farm dam is removed during development are:

- A catchment area greater than 125 ha;
- An area ratio which exceeds 0.05; and
- Active storage which exceeds 50,000 m³.

Based on these indicative benchmark criteria none of the farm dams on the property would be classified as a regional farm dam individually nor as a cascade of dams on several drainage lines. Consequently, where the boundary of the South Creek catchment includes farm dams within the subject property then the boundary should be adjusted to remove the farm dams from the precinct eg. adjacent to Elizabeth Drive west of South Creek.

5. *South Creek's waterway health will be protected and managed to achieve the waterway health outcomes set out in Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions;*
6. *Remnant vegetation, tree canopy and other areas of significant vegetation will be identified and protected, enabling planning within the Aerotropolis to be built around landscape elements;*
7. *Ridges will be protected from inappropriate development to preserve view lines and enable provision of open space for active and passive recreation; and*
8. *When identifying suitable land uses, particularly those in centres, development will be oriented to access and face green spaces and water, to improve amenity and liveability.*

4.2 Wianamatta-South Creek Precinct Boundary and Flood Planning Levels

The proposed SEPP utilises a different boundary for the Wianamatta-South Creek Precinct to the Stage 1 Land Use and Infrastructure Implementation Plan. The new boundary no longer uses the Probable Maximum Flood line to determine the precinct, instead using the 1 in 100 chance per year flood planning level.

The proposed SEPP will define the flood planning level as the level of the 1 in 100 chance per year flood (1 in 100 Annual Exceedance Probability flood), plus 0.5 metres freeboard. Urban development on flood prone land above the flood planning level will be permitted, subject to risk-based flood-related development controls, encouraging more intensive development in areas of lower flood risk. No urban land uses, including additional dwellings, will be permitted on land below the flood planning level. Areas of the South Creek floodplain located below the 1 in 100 chance per year flood level as mapped on the draft Flood Extent Map are proposed for flood-compatible land uses and activities such as recreation and public spaces.

North of Elizabeth Drive the draft Flood Extent map includes overland flowpaths and farm dams which were mapped in the 2006 Penrith Overland Flow Flood Overview Study (refer **Section B.3**). The mapping reflects the legacy of past rural uses which constructed farm dams to harvest runoff and/or modified overland flowpaths. The map indicates that all farm dams are to be retained simply because they were mapped in the 2006 study. The mapped 100 year Flood Area includes disconnected fragments of flooding and isolated farm dams.

It is further noted that if the mapping approach is applied to urban areas with drainage systems with say a 5 year ARI capacity then roads would be mapped as “100 year flood areas” and according to the draft land zoning map should be classified as “Environment and Recreation”.

Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks is not desirable. Under the proposed SEPP these types of works will not be permitted below the flood planning level and will be discouraged in other areas of the floodplain. This approach is consistent with the principles set out in the Western City District Plan (Greater Sydney Commission, March 2018, p.137).

The principles set out in the Western City District Plan (Greater Sydney Commission, March 2018, p.137) included:

avoiding alterations to flood storage capacity of the floodplain and flood behaviour through filling and excavation ('cut and fill') or other earthworks

The aim of any Flood Impact Assessment is to assess the impact of proposed cut and fill and to limit the impacts of planned development on adjoining properties.

The NSW Flood Prone Land Policy is produced within Section 1.1 of the 2005 Floodplain Development Manual. The primary objective of the NSW Flood Prone Land Policy recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

This aspect of the proposed SEPP is contrary to the primary objective of the NSW Flood Prone Land Policy.

As stated in part in Section 6.4.2 of the Draft Western Sydney Aerotropolis Plan:

Development controls will apply to land within the 1 in 100-year flood area in line with each Council's relevant policy

This aspect of the proposed SEPP is contrary to Penrith City Council's relevant development controls as detailed in Chapter 3.5 on flooding constraints on developments in Penrith DCP 2014.

Flood data used to prepare the draft Flood Map and to inform the proposed Environment and Recreation Zone is based on current flood data sourced from Penrith and Liverpool City Councils. Precinct planning will further investigate the flood extent across the Aerotropolis and inform the water cycle management strategy that will confirm land needed for water detention and treatment

3.4 Western Sydney Aerotropolis Development Control Plan 2019 – Draft for public comment

As stated in the draft Western Sydney Aerotropolis DCP 2019:

This Phase 1 DCP identifies the precinct planning principles, objectives and performance outcomes to allow precinct planning to progress.

The Phase 2 DCP will be released once precinct planning for the initial precincts within the Western Sydney Aerotropolis (Aerotropolis) is finalised. The Phase 2 DCP will identify:

- *additional performance outcomes including specific precinct outcomes;*
- *acceptable solutions for all performance outcomes; and*
- *the objectives, performance outcomes and acceptable solutions for all development and subdivision types that are envisaged within the Aerotropolis (which have not been considered under this Phase 1 DCP).*

The DCP aims to provide controls which guide development to achieve connectivity, liveability, productivity, and sustainability.

In Section 4.2 Flooding, the draft Western Sydney Aerotropolis DCP 2019 proposes the following performance outcomes for flooding:

4.2 Flooding

4.2.1 Objectives

- a) *Minimise the flood risk to life and property.*
- b) *Ensure development does not adversely impact flood functions.*
- c) *Provide protection of the natural environment.*
- d) *Floodplains are to be used for amenity and recreation opportunities as well as flood function, where appropriate.*

4.2.2 Performance Outcomes

- PO1 Ensure the siting and layout of development responds to flooding affectation and maintains personal safety at all times. The site layout and ultimate footprint of the development should be compatible with the flood risk. This includes applying subdivision design for greater resilience to flooding.*
- PO2 Manage the passage of floodwaters through the floodplain.*
- PO3 Avoid intensification and new development on land subject to the 1 in 100-year flood event.*
- PO4 Fill should not reduce the capacity of the floodplain.*
- PO5 Fill should remain stable and not be affected by erosion and scour.*
- PO6 Development must not change the flood characteristics of the area, and is to consider cumulative impacts of development, outside the site including:*
- a) loss of flood storage;*
 - b) loss of or changes to flood flow paths;*
 - c) acceleration or obstruction of flood flows;*
 - d) increase in the depth, duration or velocity of flood waters; or*
 - e) any reduction in flood warning times elsewhere on the floodplain.*
- PO7 Prevent intensification of inappropriate use of land within high flood risk areas or floodways.*
- PO8 Ensure development is sited to enable vehicular egress in the event of a flood.*
- PO9 Ensure public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.*
- PO10 Ensure essential services infrastructure within a site (including electricity, gas, water supply, wastewater and telecommunications) maintains its function during and immediately after flood events.*
- PO11 Development must be designed and constructed so that it remains structurally sound for the life of the development, considering the flood events likely to impact the structure, foundations/footing system and external walls. Development must be designed to prevent flotation, collapse or permanent lateral movement (as per ASCE24-14).*
- PO12 Flooding and drainage characteristics upstream or downstream of the site are not worsened by development, including any proposed works on natural creeks. The development is to also avoid significant adverse effects on the floodplain environment that would cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank/watercourse.*
- PO13 Fencing must be designed and constructed so that it does not impede and/or direct the flow of floodwaters, add debris to floodwaters or increase flood affectation on surrounding land.*
- PO14 Development is to be in accordance with NSW Governments Flood Prone Land Policy and Floodplain Development Manual.*

While these performance outcomes are supported in general terms, the proposed flooding requirements for development need to comply with the primary objective of the NSW Flood Prone Land Policy which recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

It is considered that a number of the planning principles which are proposed to deliver the performance outcomes for flooding are contrary to the primary objective of the NSW Flood Prone Land Policy.

Instead the already established planning matrix approach and development controls adopted by Liverpool City Council which is based on flood risk precincts should be adopted. This approach is outlined in Appendix B.2 and is codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk. The extents of the flood risk precincts in the vicinity of the University of Sydney Western Lands mapped from the results of the 2015 South Creek flood study are plotted in **Figure 4**.

Refer also to the discussion above of the planning principles for a resilient and adaptable Aerotropolis.

3.5 2019 Draft South Creek Floodplain Risk Management Study and Plan

The 2019 draft study report and draft plan were prepared by Advisian (part of the WorleyParsons Group) on behalf of the South Creek Floodplain Risk Management Committee acting in association with Penrith City Council and the Office of Environment & Heritage (OEH). It was placed on Public Exhibition from 31 October to 28 November 2019.

Key flooding issues are identified and discussed as follows.

Flood Planning Constraints Categories

As described by Advisian, 2019

Flood Planning Constraints Categories (FPCC) is a holistic approach to assessing the relative severity of flood risks and constraints to development across the floodplain. The approach is recommended within the Australian Institute of Disaster Resilience (ADR) Guideline 7-5 Flood Information to Support Land Use Planning Activities as a tool to assist land use planners with strategic decision making.

FPCC mapping simplifies the process of assessing flood risks and hazard across the floodplain by considering the following key flood related factors:

*frequency of exposure to flooding;
hydraulic categories; i.e., floodway, flood storage and flood fringe;
flood hazard; and,
evacuation constraints in accordance with the SES mapping of Emergency Response Planning Communities (ERPC).*

In accordance with ADR Guideline 7-5, FPCC mapping has been prepared for the South Creek floodplain based on the delineation of four (4) FPC Categories. The relative severity of the flood constraint is highest for FPCC1 reducing through to the lowest constraint for FPCC4.

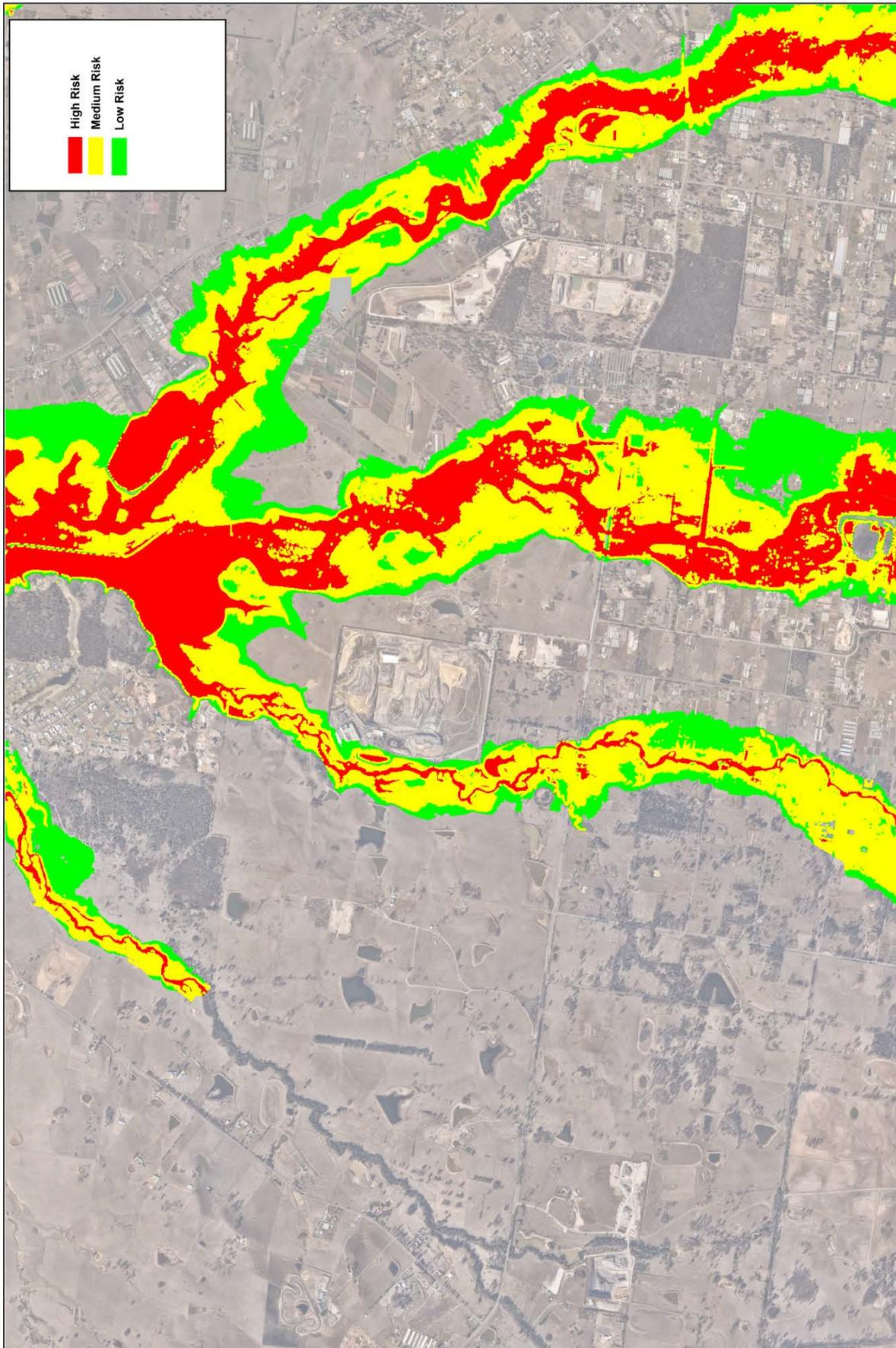


Figure 4 South Creek Flood Risk Precincts (based on results from Worley Parsons, 2015)

The criteria adopted for defining each FPC Category is listed in Table 6-2. Each FPC Category is made-up of one or more flood criteria that are based on the key flood related factors outlined above.

The Australian Institute of Disaster Resilience (ADR) Guideline 7-5 Flood Information to Support Land Use Planning Activities describes the flood planning constraints categories, in part, as follows.

FPCC1 - identifies the most significantly constrained areas, and should be based on the flood behaviour in the DFE. Intensification of use in FPCC1 is generally very limited except where uses are compatible with flood function and hazard.

FPCC2 - areas are the next least suitable for intensification of land use or development because of the effects of flooding on the land, and the consequences to any development and its users.

Some areas of FPCC2 will be unsuitable for intensification of use. Other areas in FPCC2 will have the potential for more intense use but with significant constraints

FPCC3 - can generally be determined based on the area within the flood planning area, but excluding areas within FPCC1 and FPCC2. This is the area of the floodplain where more traditional flood-related development constraints, based on minimum floor and minimum fill levels, will apply.

Development controls will generally apply to key community facilities—such as emergency hospitals, emergency management headquarters and evacuation centres—that have an important community role during a flood event, or to key utility services that need to be readily re-established after an event to aid recovery.

Constraints will also apply to developments where there are significant consequences to the community if failed evacuations occur, particularly where the difference in level between a DFE and a PMF or extreme flood is great. An example is residential aged care facilities, where occupants likely have mobility issues and, therefore, more difficulty during an evacuation.

FPCC4 - is the area inundated in the PMF (extent of flood- prone land), but outside FPCC2 and FPCC3. Few flood- related development constraints would be applicable in this area. Constraints may apply to key community facilities and developments where there are significant consequences to the community if failed evacuations occur.

The mapping of the flood planning constraints categories north of Elizabeth Drive is given in **Appendix B** (see **Attachment D**).

Flood Planning

Council's existing planning controls, instruments and policies have been reviewed in the context of floodplain management and flood related development controls, with the primary objective of identifying ways in which the development preparation and assessment process can be improved across the Penrith LGA, with South Creek as an example catchment/floodplain.

Existing land use zonings throughout the study area were reviewed against the predicted flood related constraints, including the floodway corridor, variations in flood hazard, the Flood Planning Area (FPA) and Probable Maximum Flood (PMF) extent. The review determined that existing land use zonings were generally appropriate with the exception of several properties located within the

floodway corridor such as at Werrington and Llandilo or where flood risks and potential for damages were high such as at Werrington along Rance Road.

A review of the Penrith Development Control Plan (DCP) 2014 led to the following recommendations:

- *Updateable annexures be added to the DCP to include 'True Flood Hazard Mapping' and 'Hydraulic Category Mapping' prepared as part of the FRMS;*
- *Future Floodplain Risk Management Studies for watercourses within the Penrith LGA be required to prepare Flood Planning Constraints Category (FPCC) mapping similar to the FPCC prepared for South Creek and included as Appendix D. Once FPCC mapping is available for the LGA, it is recommended that DCP controls be updated to ensure development is guided by the FPCC mapping.*

Recommended amendments to Penrith DCP 2014

The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including:

Increase in Peak Flood Levels

- | | |
|-------------------------------|--|
| <i>Current Criteria -</i> | <i>Peak flood levels not increased by more than 0.1 m (100 mm) (DCP reference C.14.a.i)</i> |
| <i>Recommended Criteria -</i> | <i>Peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site</i> |

Change in Velocities and Redistribution of flows

- | | |
|-------------------------------|---|
| <i>Current Criteria -</i> | <i>Downstream velocities are not increased by more than 10% by the proposed filling (DCP reference C.14.a.ii)</i> |
| | <i>Proposed filling does not distribute flows by more than 15% (DCP reference C.14.a.iii)</i> |
| <i>Recommended Criteria -</i> | <i>On the development site itself, flood hazard is not increased to greater than "low" based on current ARR criteria for hazard. Low hazard zones are defined in ARR as where $D.V < 0.4 \text{ m}^2/\text{s}$ for children and $D.V < 0.6 \text{ m}^2/\text{s}$ for adults and should be applied depending on the type of development. Isolated areas of high hazard may be considered at Council's discretion where people are prevented from entering the area i.e. dedicated flow paths. Hazard should never increase to exceed $0.8 \text{ m}^2/\text{s}$ as this is the limiting working flow for experienced personnel such as trained rescue workers. Flood hazard should be assessed for the duration of the event and is not necessarily the flood hazard at the time of the peak flood level.</i> |
| | <i>Flood hazard on surrounding properties should not increase.</i> |

Cumulative Effects

- | | |
|-------------------------------|---|
| <i>Current Criteria -</i> | <i>The potential for cumulative effects of possible filling proposals in that area is minimal (DCP reference C.14.a.iv)</i> |
| <i>Recommended Criteria -</i> | <i>The potential for cumulative effects of possible development proposals in that area is minimal.</i> |

Alternative Options for Flood Storage

Current Criteria - There are alternative options for flood storage (DCP reference C.14.a.v)

Recommended Criteria - Where possible, any losses in floodplain storage are to be offset by compensatory cut at the same or a similar elevation

Development Potential of Surrounding Properties and Flood Liability of Surrounding Properties

Current Criteria - The development potential of surrounding properties is not adversely affected by the filling proposal (DCP reference C.14.a.vi)

The flood liability of buildings on surrounding properties is increased (DCP reference C.14.a.vii)

Recommended Criteria - The flood liability and flood hazard of surrounding land is not adversely affected by the development.

Local Drainage/Runoff Problems

Current Criteria - No local drainage flow/runoff problems are created by the filling (DCP reference C.14.a.viii)

Recommended Criteria - No local drainage flow/runoff problems are created by the development.

4 Issues of Concern and Recommendations

A review of the Western Sydney Aerotropolis documents which have been on exhibition identified a number of issues related to flooding and drainage that have the potential to impact adversely and unreasonably on the proposed development of the University of Sydney Western Lands.

The following issues were identified and actions are recommended as follows.

Issue: Performance Outcomes for Flooding

Section 4.2 Flooding of the draft Western Sydney Aerotropolis DCP 2019

Concern: Section 4.2 Flooding of the draft Western Sydney Aerotropolis DCP 2019 proposes performance outcomes for flooding. While these performance outcomes are supported in general terms, the proposed flooding requirements for development need to comply with the primary objective of the NSW Flood Prone Land Policy which recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved

It is considered that a number of the planning principles which are proposed to deliver the performance outcomes for flooding are contrary to the primary objective of the NSW Flood Prone Land Policy.

Recommendation: It is recommended that the planning matrix approach and the development controls adopted by Liverpool City Council which are based on flood risk precincts be adopted. This approach is outlined in Appendix B.2 and is codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk.

Alternatively, the planning matrix approach and development controls adopted by Liverpool City Council be adapted to the Flood Planning Constraints Categories mapped in the 2019 Draft South Creek Floodplain Risk Management Study and Plan (Advisian, 2019) (refer Appendix B.6). The expected adaption would be for High Flood Risk Precinct controls to apply to FPCC1 and probably FPCC2, Medium Flood Risk Precinct controls to apply to FPCC3 and Low Flood Risk Precinct controls to apply to FPCC4.

Issue: Flood management infrastructure and planning should account for climate change and the reforestation of the Blue–Green Grid as part of the landscape- led approach.

*Western Sydney Aerotropolis Plan - Draft for Public Comment
6.4.2 Floodplain management*

Concerns: While the need to account for climate change is supported this is a generic objective which is lacking any detail on the proposed time horizon or RCP scenario which is proposed and the ramifications for flooding.

The estimated reduction in peak flow in South Creek (in comparison to current estimates based on the 1987 edition of ARR would (refer **Appendix C.2**):

- offset the impact of adopting RCP4.5 rainfall intensities (and still yield an overall lower peak flow in the year 2100); or
- offset the impact of adopting RCP8.5 rainfall intensities such that the peak flow would be around the same value in the year 2100 as currently adopted.

Likewise, the proposed reforestation is driven by landscape considerations only and ignores the flooding ramifications of such a strategy.

It was concluded from an assessment of the local impact of reforestation of the Wianamatta-South Creek precinct that reforestation to a “Floodplain with moderately dense trees” (n = 0.1)) will increase 1% AEP flood levels on the property by around 0.2 m – 0.45 m depending on location or reforestation to a “Floodplain with dense trees” (n = 0.12) will increase 1% AEP flood levels on the property by around 0.3 m – 0.6 m depending on location. These impacts are far in excess of the flood impacts that Penrith City Council and many other Council’s would accept for any proposed change in land use. The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including “Peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site”

Significant increases in flood levels due to revegetation of the complete floodplain would also cause unsafe conditions on Elizabeth Drive and on any other similar roads to be experienced in more frequent floods, pose greater risks to vehicles due to greater flood depths and would be more prolonged than under current conditions.

Recommendation: Any consideration of climate change should be undertaken in the context of the 2019 edition of Australian Rainfall & Runoff.

Recommendation: Any landscape-led approach based on reforestation needs to be based on an assessment of the flood impacts of such an approach and the limits on impacts adopted by Penrith City Council and other Councils.

Issue: SU16 Prohibit cut and fill to alter the 1% AEP flood extent

*Western Sydney Aerotropolis Plan - Draft for Public Comment
Planning Principles for A resilient and adaptable Aerotropolis*

Concern: Planning principle SU16 is contrary to Penrith City Council’s relevant development controls as detailed in Chapter 3.5 on flooding constraints on developments in Penrith DCP 2014 and the provisions of Liverpool DCP 2008 Part 1, Section 9 Flooding Risk because it prohibits development in the Medium Flood Risk Precinct.

Planning principle SU16 is contrary to the primary objective of the NSW Flood Prone Land Policy because it sterilises valuable flood-prone land by precluding its development.:

Recommendation: It is recommended that the relevant development controls codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk be adopted.

Issue: Alterations to flood storage capacity and flood behaviour through filling and excavation or other earthworks will not be permitted below the flood planning level and discouraged in other areas of the floodplain.

*Western Sydney Aerotropolis - Discussion Paper on Proposed SEPP
Part 4 – Precinct specific controls
4.2 Wianamatta-South Creek Precinct Boundary and Flood Planning Levels*

Concerns: The aim of any Flood Impact Assessment is to assess the impact of proposed cut and fill and to limit the impacts of planned development on adjoining properties. This planning principle prohibits the consideration of earthworks within the 1% AEP flood extent (but outside floodways and high hazard areas) which is contrary to the primary objective of the NSW Flood Prone Land Policy. It also appears to prohibit earthworks on land which lies between the 1% AEP flood extent and the extent of the Flood Planning Level (FPL). If the grade of the land is flat, say 1% grade, then this sterilises a further 50 m wide zone beyond the 1% AEP flood extent.

This planning principle is contrary to the provisions of Liverpool DCP 2008 Part 1, Section 9 Flooding Risk because it prohibits any earthworks in the Medium Flood Risk Precinct and part of the Low Flood Risk precinct.

Recommendation: It is recommended that the relevant development controls codified in the Liverpool DCP 2008 Part 1, Section 9 Flooding Risk be adopted.

Issue: To achieve the Blue-Green Grid, the following principles for planning and development in the Aerotropolis will be identified in the proposed SEPP and accompanying precinct planning:

2. *Wianamatta-South Creek and its tributaries will be protected from urban runoff, by retaining the hydrologic characteristics of the catchment and providing water in the landscape for amenity, urban cooling, and high quality green space;*

*Western Sydney Aerotropolis - Discussion paper on Proposed SEPP
Part 4 – Precinct specific controls
4.1 Wianamatta-South Creek the central spine of the Blue- Green Grid*

Concern: If it is proposed that the tributaries of South Creek include un-named drainage lines which convey runoff to the creeks, then in order to protect these “tributaries” from urban runoff it would be necessary to install and maintain stormwater quantity (OSD) and quality measures (GPTs, biofilters) at all stormwater discharge points into the “tributaries”. This would require the installation of a highly distributed series of measures which would forego opportunities to rationalise and co-locate such measures within the Wianamatta-South Creek corridor noting this this corridor is up to 1 km wide.

It is unclear if the relevant Councils who will be required to maintain stormwater quantity and quality measures are willing to accept the responsibility of maintaining a multitude of highly distributed measures.

If it is proposed that trunk drainage not be permitted in un-named drainage lines because it is deemed to be incompatible with the proposed zoning of un-named drainage lines as “Environment and Recreation” then a likely consequence of this decision would be the need for the wholesale importation of fill to raise the ground level 2 m or more adjacent to the un-named drainage lines in order that local drainage lines and any stormwater management measures could discharge into the un-named drainage lines.

Recommendation: It is recommended that un-named drainage lines not be zoned as “Recreation and Environment” and that instead these drainage lines be included in the Mixed Use zone.

Issue: To achieve the Blue-Green Grid, the following principles for planning and development in the Aerotropolis will be identified in the proposed SEPP and accompanying precinct planning:

5. Suitably sized and located farm dams will be protected to support water retention in the landscape;

*Western Sydney Aerotropolis - Discussion paper on Proposed SEPP
Part 4 – Precinct specific controls*

4.1 Wianamatta-South Creek the central spine of the Blue- Green Grid

Concern: This planning principle conveys the intent that selected farm dams but not all farm dams will be protected. It implies that farm dams selected for protection are to remain in their current state. However, depending on the location of any selected farm dam and if it is proposed to develop downstream of the dam then dam safety considerations become a significant consideration.

It is likely that the embankment of any farm dam has not been constructed to the standards required for water retaining structures within urban areas and that farm dam embankment would need to be removed and reconstructed in accordance with current design standards if the footprint of the farm dam is to be “protected”. Alternatively, the farm dam embankment could be removed which would likely significantly reduce the water storage and surface area if the farm dam was constructed based on a balanced earthworks ie. soil was excavated and placed to form the embankment.

There is also no indication as to the selection criteria for farm dams to be protected.

North of Elizabeth Drive the draft Flood Extent map includes overland flowpaths and farm dams which were mapped in the 2006 Penrith Overland Flow Flood Overview Study (refer Section B.3). The mapping reflects the legacy of past rural uses which constructed farm dams to harvest runoff and/or modified overland flowpaths. The map indicates that all farm dams are to be retained simply because they were mapped in the 2006 study. The mapped 100 year Flood Area includes disconnected fragments of flooding and isolated farm dams and is not coherent.

Recommendation: Adopt the following indicative benchmark criteria developed for the upper catchment of South Creek when assessing if a farm dam is a regional farm dam whose active flood storage may need to be matched by compensatory flood storage in the event the regional farm dam is removed during development, namely:

- A catchment area greater than 125 ha;
- A dam full supply surface area to catchment area ratio which exceeds 0.05; and
- Active storage which exceeds 50,000 m³.

If a farm dam is not classified as a regional farm dam then the farm dam can be removed as part of development without having a significant detrimental impact on flooding.

Based on these criteria, none of the farm dams on the University of Sydney Western Lands would be classified as a regional farm dam individually nor as a cascade of dams on several drainage lines. Where farm dams on un-named drainage lines are not deemed to be regional farm dams then these farm dams should not be zoned as "Recreation and Environment" and instead these farm dams should be included in the Mixed Use zone.

5 References

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Western Sydney Aerotropolis

APPENDIX A
COMPOSITE FLOOD MAP

Flood Risk Category

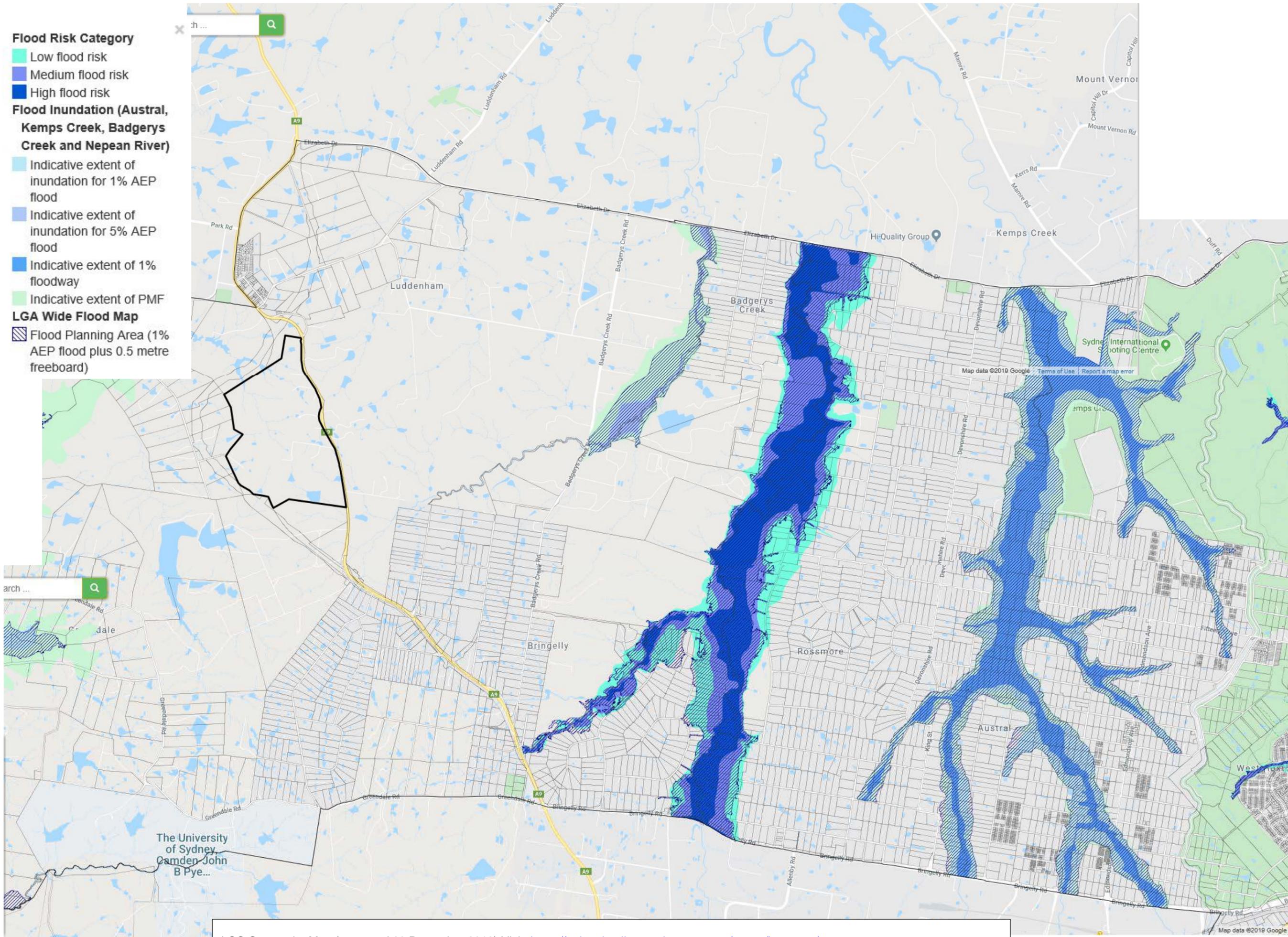
- Low flood risk
- Medium flood risk
- High flood risk

Flood Inundation (Austral, Kemps Creek, Badgerys Creek and Nepean River)

- Indicative extent of inundation for 1% AEP flood
- Indicative extent of inundation for 5% AEP flood
- Indicative extent of 1% floodway
- Indicative extent of PMF

LGA Wide Flood Map

- Flood Planning Area (1% AEP flood plus 0.5 metre freeboard)



LCC Composite Map (accessed 23 December 2019) Visit: <https://eplanning.liverpool.nsw.gov.au/pages/lcc.maps/maps.aspx>

Western Sydney Aerotropolis

APPENDIX B
PREVIOUS STUDIES

B.1 1991 South Creek Floodplain Risk Management Study

The current (overall) South Creek Floodplain Risk Management Study was released in February 1991⁶. As described by Willing & Partners, 1991:

The need for the floodplain management study has arisen largely as a result of plans for large scale urban developments in the catchment, mainly in the South Creek Valley Sector (SCVS). The principal requirement of the study is to identify and assess works and measures aimed at reducing the impact and losses relating to flooding. This applied to present problems and to the avoidance of problems resulting from future developments in the catchment. Flood problems in the catchment have been highlighted by the occurrence of several large floods in the last four years.

The study addresses:

- *the existing flood problem, including the hazards and extent of inundation;*
- *water quality and the stream environment, both existing and future;*
- *impacts of possible short-term and long-term large scale urban and non-urban development on flood behaviour, and the constraints imposed by flooding on such development;*
- *structural and non-structural measures to mitigate the effects of flooding on existing and proposed development;*
- *the social and economic effects of floods, including assessment of tangible and intangible damages and the importance of flood preparedness;*
- *the environmental impact of any proposed works;*
- *trunk drainage, flood mitigation, water quality and environmental parameters to be used as guidelines for future new urban developments;*
- *means of implementing, monitoring, co-ordinating and revising the management plan, and recommends the most appropriate means.*

B.2 2004 South Creek Floodplain Risk Management Study and Plan for the Liverpool Local Government Area

As summarised by Bewsher, 2004⁷, in part:

The primary objective of the South Creek Floodplain Risk Management Study and Plan for the Liverpool Local Government Area (LGA) is to bring together, and place in appropriate context, all past, current and proposed future activities related to flood risk in the study area. In broad terms, the current study has investigated what can be done to minimise the effects of flooding in the South Creek study area and recommended a strategy in the form of a recommended Floodplain Risk Management Plan. This study and plan constitute key components of the NSW Government's floodplain risk management process as outlined in the Floodplain Management Manual.

The study area of this Floodplain Risk Management Study covers only a small portion of the total South

⁶ Willing & Partners (1991) "South Creek Floodplain Risk Management Study" Final report, 2 Vols, prepared for the Department of Water Resources, pp 80 + Apps

⁷ Bewsher Consulting (2004) "South Creek Floodplain Risk Management Study and Plan for the Liverpool Local Government Area", Final Report, Volume 1 – Study report and Recommended Plan, Prepared for Liverpool City Council, December, 174 pp + Apps

Creek catchment.

Modelling in the study area over the years has now evolved into the '2003 MIKE-11' model (established as part of this study) that covers all of the study area and includes all the flood mitigation works completed in the study area. This '2003 MIKE-11' model for the South Creek and Thompsons Creek floodplains is now the best representation available for the current flood behaviour in the study area.

PLANNING CONTROLS AND POLICIES

Land use planning, development controls and specific flood-related policies are key mechanisms by which Council can manage flood-affected areas. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. Without comprehensive floodplain planning, existing problems may be exacerbated and opportunities to reduce flood risks may be lost.

It will therefore be important that Council ensure that the planning outcomes derived from this study are integrated with all other existing and future floodplain risk management studies currently under preparation in their LGA, to provide a consistent platform for dealing with the issue of flooding with future development.

The Planning Matrix Approach

The Planning Matrix Approach to floodplain risk management considers the range of land uses, and their potential risk to flooding, within the floodplain up to the level of the probable maximum flood. Using this approach, a matrix of development controls, based on the flood hazard and the land use, can be developed which balances the risk exposure across the floodplain.

The Flood Risk Management Development Control Plan

The most appropriate mechanism for specifying detailed planning and development controls (associated with the Planning Matrix) to be applied to new development to manage issues of floodplain risk, would be a Flood Risk Management Development Control Plan (DCP).

Liverpool City Council is currently preparing a comprehensive Flood Risk Management DCP, which is yet to be adopted by Council, pending the outcome of other studies such as those for the Georges River.

The Flood Risk Management DCP (updated as part of this study) involves a preamble of provisions that establishes a framework to allow for the outcomes of multiple Floodplain Risk Management Studies to be incorporated into the document, of which the current study will be one.

Flood Risk Precincts

A key component of the Planning Matrix Approach is to divide the floodplain into different areas of similar risk, known as Flood Risk Precincts. Different parts of the floodplain are subject to different degrees of flood hazard and different degrees of flood risk. This study recognises that different development controls should apply to different flood risk areas, or precincts.

It should be noted that 'flood hazard' and 'flood risk' are not interchangeable terms. Once the 'flood hazard' has been determined for a particular location, and considered together with the consequences of that flooding, the 'flood risk' can then be determined.

Whereas 'flood hazard categories' describe the severity of the flood behaviour on development and people,

'flood hydraulic categories' describe the severity of development activity on flood behaviour. Like flood hazard, 'flood hydraulic categories' are also a key tool used to determine the suitability of future types of land use in the floodplain.

Three Flood Risk Precincts have been recommended for the South Creek Study Area, namely 'high risk', 'medium risk' and 'low risk', defined as follows:

- *High Flood Risk Precinct*—refers generally to land below the 100 year flood level subject to a high hydraulic hazard in a 100 year flood (in accordance with the provisional criteria outlined in the Floodplain Management Manual). The High Flood Risk Precinct is where high flood damages, potential risk to life, or evacuation problems would be anticipated;
- *Medium Flood Risk Precinct*— refers generally to land below the 100 year flood level subject to low hydraulic hazard in a 100 year flood. In this precinct, there may still be a significant risk of flood damage or risk to life, but these could be minimised with application of appropriate development controls;
- *Low Flood Risk Precinct* — refers to all other land within the floodplain that is not in a High or Medium Flood Risk Precinct, i.e. land above the 100 year flood level and below the level of the probable maximum flood (PMF). The Low Flood Risk Precinct would be where risk of damages would be low for most land uses and so most land uses would be permitted within this precinct. One of the main purposes of the Low Flood Risk Precinct is to identify and recognise the potential flood risk for all persons and properties affected by the PMF, regardless of whether any specific development controls are to be applied.

Some Proposed Development Controls

Some of the development controls in the Planning Matrix are as follows:

- *Low Risk Precinct* — in this precinct, there would be practically no change in development potential. Generally all land uses would be permitted, except 'critical uses and facilities', including hospitals, nursing homes and those that are likely to have a high impact on the emergency management resources in times of flood;
- *Medium Risk Precinct* — in this precinct, generally most land uses would be permitted, except 'critical' and 'sensitive uses and facilities'. 'Sensitive' land uses include assisted accommodation, housing for older persons or the disabled, as well as industries that store dangerous materials. Filling activities would be strictly controlled. All permitted development would be subject to flood-related building controls such as minimum floor levels, flood-compatible building components, structural integrity in times of flood, minimum levels for car-parking and driveways to aid in evacuation, and no increased reliance on NSW State Emergency Service (SES) resources in times of flood;
- *High Risk Precinct* — most development would not be permitted in this precinct. No additional residential properties would be permitted and there could be no subdivision of land. Filling activities would be very strictly controlled. It is important to note, however, that existing development in this Precinct would not be sterilised. House extensions, sheds and garages would all be permitted with limits as to the size of the development. Rebuilding an existing house with the same size but less flood risk (e.g. a raised house) would also be permitted. Any permitted development would have strict building controls, similar in nature to those listed above for a Medium Flood Risk Precinct, and would be subject to Council approval;

- *Commercial and Industrial Development* — This type of development would not be permitted in a High Flood Risk Precinct. In a Medium or Low Risk Precinct, the development would be subject to a range of flood-related building controls similar in nature to those listed above for a Medium Flood Risk Precinct and would be subject to Council approval;
- *Subdivision of Land* — This type of development would not be permitted in a High Flood Risk Precinct. In a Medium Flood Risk Precinct, an engineer's report would be required to certify that the development would not increase flood effects elsewhere and it would have to be demonstrated that the development could be evacuated in accordance with the requirements of the Flood Risk Management DCP. All subdivisions would be subject to Council approval;
- *Filling of Land* — to assist Council in assessing when filling of land is and is not acceptable in the floodplain, guidelines have been prepared as part of this study entitled "Guidelines for the Assessment of Earthworks and Filling in Floodplain Areas of Non-Urban land in Liverpool" in accordance with the draft Flood Risk Management DCP and the Planning Matrix for South Creek;

B.3 2006 Penrith Overland Flow Flood Overview Study

In 2006 a study was undertaken to generate sufficient information to define flood risk and prioritise flood risk management across the Penrith LGA⁸. The results from this study provide Council with a sound basis upon which to undertake a program of more detailed overland flood studies. This will ultimately lead to a complete Floodplain Risk Management Plan for the LGA.

The study area covers the LGA and was divided into the following three zones:

- Zone 1 – 'Central Urban'
- Zone 2 – 'Northern Rural'
- Zone 3 – 'Southern Rural'.

The majority of the population resides within Zone 1, which also includes the Penrith CBD.

The primary objectives of the study were to:

- Identify, validate and map all major overland flow paths within the Study Area;
- Identify and map sub catchments for all catchments within the Study Area;
- Identify properties at risk of major overland flooding;
- Define local flood behaviour in the Study Area by producing information on flows, flood levels, depth of flows and velocities for the 20 year, 100 year ARI and the PMF events under existing catchment conditions;
- Assess provisional flood hazard for properties at risk from flooding for the 20 year and 100 year ARI events and the PMF; and
- Rank the nominated sub-catchment areas in terms of severity of flooding for further investigations. Council may also consider landuse, known flood affected areas and cost of potential mitigation works when prioritising the sub-catchments.

⁸ Cardno Lawson Treloar (2006) "Penrith Overland Flow Flood "Overview Study", Report J2453/R2251, Version 4, prepared for Penrith City Council, August.

The above objectives were achieved through detailed hydrological/hydraulic modelling of the entire LGA as described in the report. It is to be noted that ranking of the sub-catchments for further investigation was the main objective of the study and the majority of the other objectives were achieved through the process of establishing the sub-catchment rankings.

As described by Cardno Lawson Treloar, 2006:

Since rainfall was used as an input to the hydraulic model, flow was generated in the entire modelled grid area. However, only those areas with a flow depth greater than 0.15 m were considered to be 'flood affected'. Such areas were delineated using a GIS data analysis tool (MapInfo query) to produce the preliminary flood extents. Further refinement of the preliminary flood extents was carried out manually to remove anomalies. Final flood extents generated from all of the fine-scale grids were combined into a single GIS layer.

The mapped extents of overland flow flooding in the vicinity of the property are given in **Attachment A**. It will be noted that the 100 yr ARI flood extent (mainstream flooding) was excluded from the study.

B.4 2015 Updated South Creek Flood Study

The Updated South Creek Flood Study was prepared by Worley Parsons Services on behalf of Penrith City Council, acting in association with Liverpool, Blacktown and Fairfield City Councils. As described by Worley Parsons, 2015⁹:

This flood study covers the South Creek catchment extending from Bringelly Road in the south to the Blacktown/Richmond Road Bridge crossing in the north. The total study area is about 240 km² and lies within the Hawkesbury, Penrith, Blacktown, Liverpool and Fairfield LGAs.

The hydrologic modelling for this study is based on the previous RAFTS (Runoff Analysis and Flow Training Simulation) hydrologic modelling (Version 2.56, 1991) that was developed by the Department of Water Resources for the 'South Creek Flood Study' (1990). As part of this study, the RAFTS model of the South Creek catchment has been updated to Version 6.52 (2005) XPRAFTS.

As part of the current study, the sub-catchment delineation and break-up was compared against the latest topographic data available for the study area to determine whether the sub-catchment boundaries required adjustments. Some further refinement of subcatchments was undertaken in order to improve the inter-relationship between the XPRAFTS model and the RMA-2 hydraulic flood model. This improved the interconnectivity between the hydrologic and hydraulic models and made possible the creation of additional localised inflows within the RMA-2 model.

The adopted roughness parameters for each sub-catchment were also reviewed against aerial photography in order to determine any changes in vegetation and/or floodplain development that may have occurred since 1990.

Intensity-Frequency-Duration (IFD) data was developed for the study catchment according to the standard procedures outlined in Chapter 2 of 'Australian Rainfall & Runoff – A Guide to Flood

⁹ WorleyParsons (2015) "Updated South Creek Flood Study", *Final Report*, 2 Vols, prepared for Penrith City Council, acting in association with Liverpool, Blacktown and Fairfield City Councils, 74 pp + Apps

Estimation' (1987). Due to the significant spatial extent of the study area, across which numerous local catchments and tributaries apply, a total of nine (9) different IFDs were adopted.

As no definitive loss rate data is available for the catchment of South Creek and its tributaries, the adopted rainfall loss rates were based on data contained in the 1990 Flood Study. ...

The validation of the updated XP-RAFTS model was based on a comparison between the peak discharge and hydrograph shape produced by the RAFTS model developed for the 1990 Flood Study and the results of the latest XP-RAFTS model.

*In order to undertake validation of the model, the updated XP-RAFTS model was used to simulate the 100 year ARI storm with a **critical storm duration of 36 hours**.*

Since completion of the 1990 Flood Study, there have been many changes occur across the South Creek catchment. These changes include the implementation of a number of measures recommended in the South Creek Floodplain Management Study, including works upstream of Elizabeth Drive, at Overett Avenue, and at South St Marys. Major development of the ADI site at St Marys and small areas on the fringe of Erskine Park has also occurred. Changes have also occurred to areas of the floodplain including the construction of levees and earthworks that have the potential to alter flooding patterns.

Accordingly, a two-dimensional hydrodynamic model of the South Creek system has been developed using the RMA-2 software package. The model is based on the latest topographic data for the catchment, which was derived from Light Detection and Ranging (LiDAR) data that was gathered for the entire South Creek floodplain between 2002 and 2006. ...

.... The computer models identified in Sections 4 and 5 were used to derive design flood estimates for the 20, 50, 100, 200 and 500 year recurrence floods as well as an Extreme Flood.

The calculated 1% AEP flood depths within the Aerotropolis are plotted in **Attachment B**.

B.5 2019 Upper South Creek Floodplain Risk Management Study and Plan

Camden Council is preparing a Floodplain Risk Management Study and Plan (FRMSP) for the Upper South Creek study area to define the existing flooding behaviour and associated hazards, and to investigate possible mitigation options to reduce flood damage and risk.

As described by Cardno, 2019¹⁰:

The Flood Study of 2012¹¹ defined flood behaviour in the Study Area under existing conditions without consideration of the ongoing urban development in precincts such as Oran Park and Turner Road. The TUFLOW model prepared for the Flood Study was updated in this project to represent an Interim Development Scenario.

The key changes made to the model were:

¹⁰ Cardno (2019) "Upper South Creek Floodplain Risk Management Study and Plan", *Final Report*, prepared for Camden Council, June, 60 pp + Apps.

¹¹ WMAwater (2012) "Upper South Creek Flood Study", *Final Report 2011 Revision 1*, prepared for Camden Council, May, 39 pp + Apps.

- *Inclusion of the Bringelly Road upgrade design.*
- *South West Rail Line (SWRL) TUFLOW model DTM for ground topography of Kemps, Scalibrini and Bonds Creeks in addition to 1D elements of the bridge crossings.*
- *Upgrade of Camden Valley Way (CVW) at Rileys Creek.*
- *Addition of Bonds Creek to the Study Area which was not included in the Flood Study.*
- *Replication of urban development of the SWGC precincts Turner Road, Catherine Field, Leppington North and Oran Park by reducing initial loss, adjusting roughness and filling. The filling components involved delineation of the urban development extents that encroach onto the floodplain together with removal of farm dams. Significant regional storage facilities were retained in the model as shown in the flood maps.*
- *Inclusion of the Leppington Precinct (Preliminary Rezoning Phase) by reducing initial loss and adjusting roughness. No filling of the floodplain was included in this precinct.*

The flood study based the initial water levels in the large farm dams on levels taken from the LiDAR data. As such, the dams were not a full supply during the original flood study runs, resulting in additional storage being available. In the current study, the dams were assumed to be full at the start of the storm event, in order to define the peak flood levels for the study area.

The calculated 1% AEP flood depths within the study area are plotted in **Attachment C**.

As described by WMAwater, 2012

Design flood extent mapping uses peak flood levels from the two hour event for Kemps and Bonds creeks and the nine hour event for Upper South Creek. Depths less than 150 mm have been removed from the plot as its considered that flood waters less than 150 mm deep should not necessarily be indicative of whether an area is subject to flooding or not. Modelling results are provided where the flowpath's contributing area is larger than 15 ha. Flowpaths with contributing catchment areas smaller than the 15 ha threshold are likely to appear poorly defined (i.e. "puddles" along watercourse alignments may be observed). Flood extents within Turner Road and Oran Park precincts have not been mapped. As development is currently being carried out in those precincts, flood extents and peak do not provide consistency by the time the hydraulic model was built. Therefore, any result shown within those areas will not be consistent to those with the rest of the catchment.

B.6 2019 Draft South Creek Floodplain Risk Management Study and Plan

The 2019 draft study report and draft plan were prepared by Advisian¹² (part of the WorleyParsons Group) on behalf of the South Creek Floodplain Risk Management Committee acting in association with Penrith City Council and the Office of Environment & Heritage (OEH). It was placed on Public Exhibition from 31 October to 28 November 2019.

¹² Advisian (2019) "South Creek Floodplain Risk Management Study", *Exhibition Draft Report*, prepared for Penrith City Council, August, 142 pp + Apps.

As described by Advisian, 2019

The study is the culmination of many months of investigation, analysis and flood modelling, which has been supported by valuable contributions from representatives of the community of Penrith and Penrith City Council.

It has been prepared by incorporating contributions from individuals from the local community and key stakeholders. Contributions from members of the Floodplain Risk Management Committee have been essential to the formation of management strategies that have been considered as part of the Study ...

The draft study and plan were prepared to assist Council in identifying and assessing management options to reduce the existing flood problem for the South Creek catchment and to manage flooding into the future.

Options to address the flood risks and potential flood damages are typically separated into the following categories:

- **Flood modification measures.** *These are typically structural works, such as flood protection levees, flood detention basins or bypass floodways, which act to reduce flood damages.*
- **Property modification measures.** *These measures include flood planning controls for future development to ensure that land uses are compatible with flood risk. They can also include voluntary house raising and purchase, or flood-proofing of buildings, which can act to reduce flood damages.*
- **Response modification measures.** *These typically include emergency response management measures, flood predictions and warnings and community flood awareness and preparedness.*

.....

As described by Advisian, 2019

Emergency Response Planning Communities

The SES guidelines highlight the need to identify Flood Management Communities. The delineation of communities within the SES' wider Operational Areas allows emergency response to be tailored for areas with differing degrees of vulnerability. Classification provides an indication of the relative vulnerability of communities located on the floodplain and helps identify the information required by SES to manage the risk. Community risk may be influenced by such factors as flooding patterns, topography and the availability of safe access and egress routes.

....

*Areas with **Rising Road Access** are those areas where access roads rising steadily uphill and away from the rising floodwaters. The community cannot be completely isolated before inundation reaches its maximum extent, even in the PMF. Evacuation can take place by vehicle or on foot along the road as floodwater advances. People should not be trapped unless they delay their evacuation from their homes. For example, people living in two storey homes may initially decide to stay but reconsider after water surrounds them.*

These communities contain low-lying areas from which people will be progressively evacuated to higher ground as the level of inundation increases. This inundation could be caused either by direct flooding from the river system or by localised flooding from creeks.

Indirectly Affected Areas

These are areas outside of the limit of flooding and therefore will not be inundated nor will they lose road access. However, they may be indirectly affected as a result of flood damaged infrastructure or due to the loss of transport links, electricity supply, water supply, sewage or telecommunications services and they may therefore require resupply or in the worst case, evacuation.

The mapping of the land north of Elizabeth Drive is reproduced in **Figure 2**. It is classified as either Rising Road Access or Indirectly Affected Area.

Flood Planning Constraints Categories

As described by Advisian, 2019

Flood Planning Constraints Categories (FPCC) is a holistic approach to assessing the relative severity of flood risks and constraints to development across the floodplain. The approach is recommended within the Australian Institute of Disaster Resilience (ADR) Guideline 7-5 Flood Information to Support Land Use Planning Activities as a tool to assist land use planners with strategic decision making.

FPCC mapping simplifies the process of assessing flood risks and hazard across the floodplain by considering the following key flood related factors:

*frequency of exposure to flooding;
hydraulic categories; i.e., floodway, flood storage and flood fringe;
flood hazard; and,
evacuation constraints in accordance with the SES mapping of Emergency Response Planning Communities (ERPC).*

In accordance with ADR Guideline 7-5, FPCC mapping has been prepared for the South Creek floodplain based on the delineation of four (4) FPC Categories. The relative severity of the flood constraint is highest for FPCC1 reducing through to the lowest constraint for FPCC4.

The criteria adopted for defining each FPC Category is listed in Table 6-2. Each FPC Category is made-up of one or more flood criteria that are based on the key flood related factors outlined above.

The Australian Institute of Disaster Resilience (ADR) Guideline 7-5 Flood Information to Support Land Use Planning Activities describes the flood planning constraints categories, in part, as follows.

FPCC1 - identifies the most significantly constrained areas, and should be based on the flood behaviour in the DFE. Intensification of use in FPCC1 is generally very limited except where uses are compatible with flood function and hazard.

FPCC2 - areas are the next least suitable for intensification of land use or development because of the effects of flooding on the land, and the consequences to any development and its users.

Some areas of FPCC2 will be unsuitable for intensification of use. Other areas in FPCC2 will have the potential for more intense use but with significant constraints

FPCC3 - *can generally be determined based on the area within the flood planning area, but excluding areas within FPCC1 and FPCC2. This is the area of the floodplain where more traditional flood-related development constraints, based on minimum floor and minimum fill levels, will apply.*

Development controls will generally apply to key community facilities—such as emergency hospitals, emergency management headquarters and evacuation centres—that have an important community role during a flood event, or to key utility services that need to be readily re-established after an event to aid recovery.

Constraints will also apply to developments where there are significant consequences to the community if failed evacuations occur, particularly where the difference in level between a DFE and a PMF or extreme flood is great. An example is residential aged care facilities, where occupants likely have mobility issues and, therefore, more difficulty during an evacuation.

FPCC4 - *is the area inundated in the PMF (extent of flood-prone land), but outside FPCC2 and FPCC3. Few flood-related development constraints would be applicable in this area. Constraints may apply to key community facilities and developments where there are significant consequences to the community if failed evacuations occur.*

The mapping of the flood planning constraints categories north of Elizabeth Drive is given in **Attachment D**.

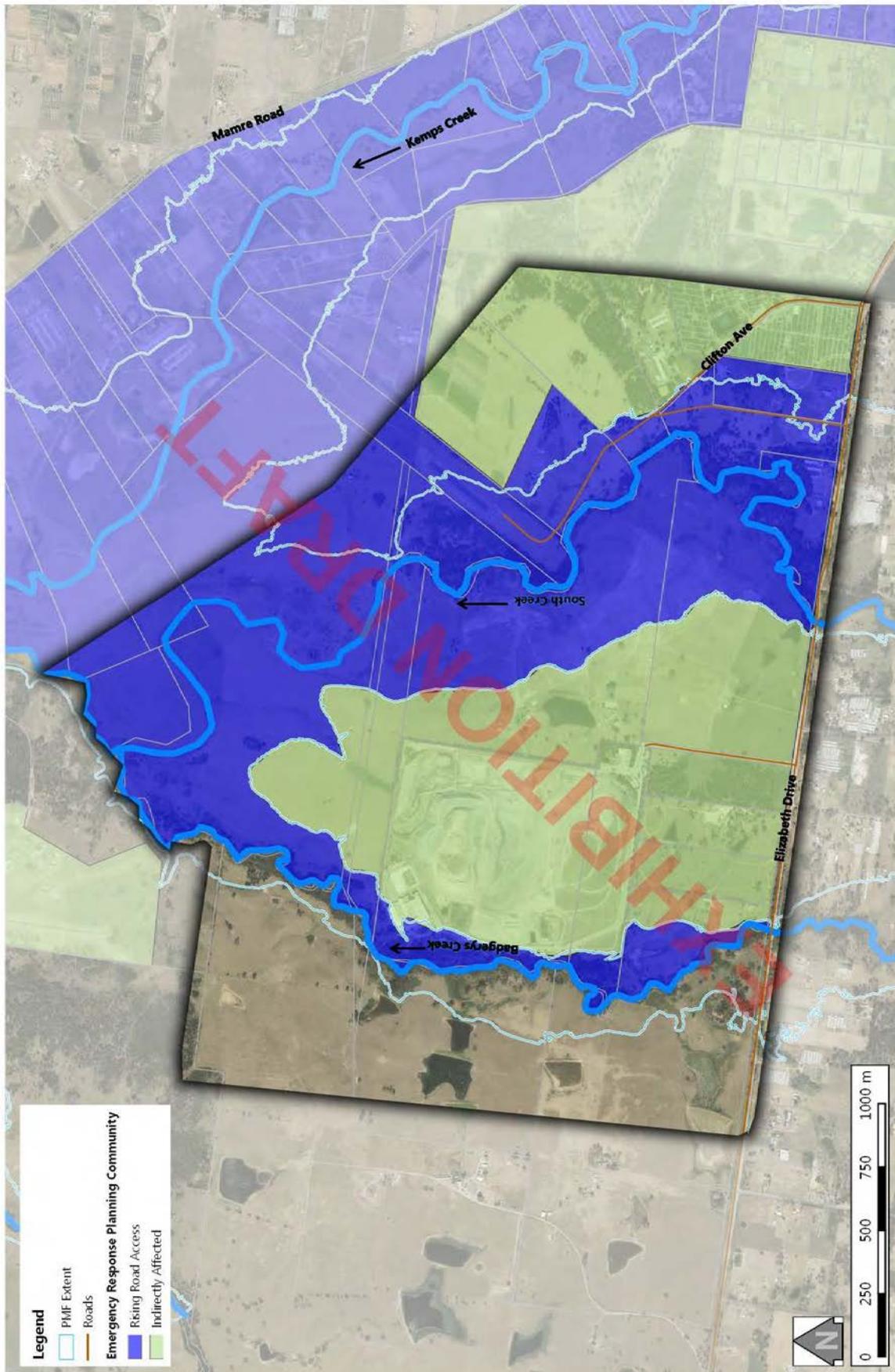
Flood Planning

Council's existing planning controls, instruments and policies have been reviewed in the context of floodplain management and flood related development controls, with the primary objective of identifying ways in which the development preparation and assessment process can be improved across the Penrith LGA, with South Creek as an example catchment/floodplain.

Existing land use zonings throughout the study area were reviewed against the predicted flood related constraints, including the floodway corridor, variations in flood hazard, the Flood Planning Area (FPA) and Probable Maximum Flood (PMF) extent. The review determined that existing land use zonings were generally appropriate with the exception of several properties located within the floodway corridor such as at Werrington and Llandilo or where flood risks and potential for damages were high such as at Werrington along Rance Road.

A review of the Penrith Development Control Plan (DCP) 2014 led to the following recommendations:

- *Updateable annexures be added to the DCP to include 'True Flood Hazard Mapping' and 'Hydraulic Category Mapping' prepared as part of the FRMS;*
- *Future Floodplain Risk Management Studies for watercourses within the Penrith LGA be required to prepare Flood Planning Constraints Category (FPCC) mapping similar to the FPCC prepared for South Creek and included as Appendix D. Once FPCC mapping is available for the LGA, it is recommended that DCP controls be updated to ensure development is guided by the FPCC mapping.*



**Figure B.1 Flood Emergency Response Planning Communities North of Elizabeth Drive
(after Figure G.14, Advisian, 2019)**

- *Amendments to the DCP be made to update development controls relating to:*
 - *Extensions to existing development,*
 - *Change of use, and*
 - *Rural Development*
- *Development controls be revised relating to the assessment of flood impacts; and*
- *Additional clauses be added to the DCP relating to:*
 - *Critical facilities (e.g. schools, hospitals, aged care facilities, etc),*
 - *Requirements for flood impact assessments and flood risk assessments commensurate to the development size, type and flood risk, and*
 - *Climate change*
- *The format of the DCP be revised to set out different development types and flood risk into a matrix approach.*

The 2019 Draft South Creek Floodplain Risk Management Study proposes a number of amendments to the Section C.14 of the Penrith DCP 2014 including:

Increase in Peak Flood Levels

- Current Criteria - Peak flood levels not increased by more than 0.1 m (100 mm) (DCP reference C.14.a.i)*
- Recommended Criteria - Peak flood levels not increased by more than 0.02 m (20 mm) outside of the development site*

Change in Velocities and Redistribution of flows

- Current Criteria - Downstream velocities are not increased by more than 10% by the proposed filling (DCP reference C.14.a.ii)*
- Proposed filling does not distribute flows by more than 15% (DCP reference C.14.a.iii)*
- Recommended Criteria - On the development site itself, flood hazard is not increased to greater than "low" based on current ARR criteria for hazard. Low hazard zones are defined in ARR as where $D.V < 0.4 \text{ m}^2/\text{s}$ for children and $D.V < 0.6 \text{ m}^2/\text{s}$ for adults and should be applied depending on the type of development. Isolated areas of high hazard may be considered at Council's discretion where people are prevented from entering the area i.e. dedicated flow paths. Hazard should never increase to exceed $0.8 \text{ m}^2/\text{s}$ as this is the limiting working flow for experienced personnel such as trained rescue workers. Flood hazard should be assessed for the duration of the event and is not necessarily the flood hazard at the time of the peak flood level.*
- Flood hazard on surrounding properties should not increase.*

Cumulative Effects

- Current Criteria - The potential for cumulative effects of possible filling proposals in that area is minimal (DCP reference C.14.a.iv)*
- Recommended Criteria - The potential for cumulative effects of possible development proposals in that area is minimal.*

Alternative Options for Flood Storage

Current Criteria - There are alternative options for flood storage (DCP reference C.14.a.v)

Recommended Criteria - Where possible, any losses in floodplain storage are to be offset by compensatory cut at the same or a similar elevation

Development Potential of Surrounding Properties and Flood Liability of Surrounding Properties

Current Criteria - The development potential of surrounding properties is not adversely affected by the filling proposal (DCP reference C.14.a.vi)

The flood liability of buildings on surrounding properties is increased (DCP reference C.14.a.vii)

Recommended Criteria - The flood liability and flood hazard of surrounding land is not adversely affected by the development.

Local Drainage/Runoff Problems

Current Criteria - No local drainage flow/runoff problems are created by the filling (DCP reference C.14.a.viii)

Recommended Criteria - No local drainage flow/runoff problems are created by the development.

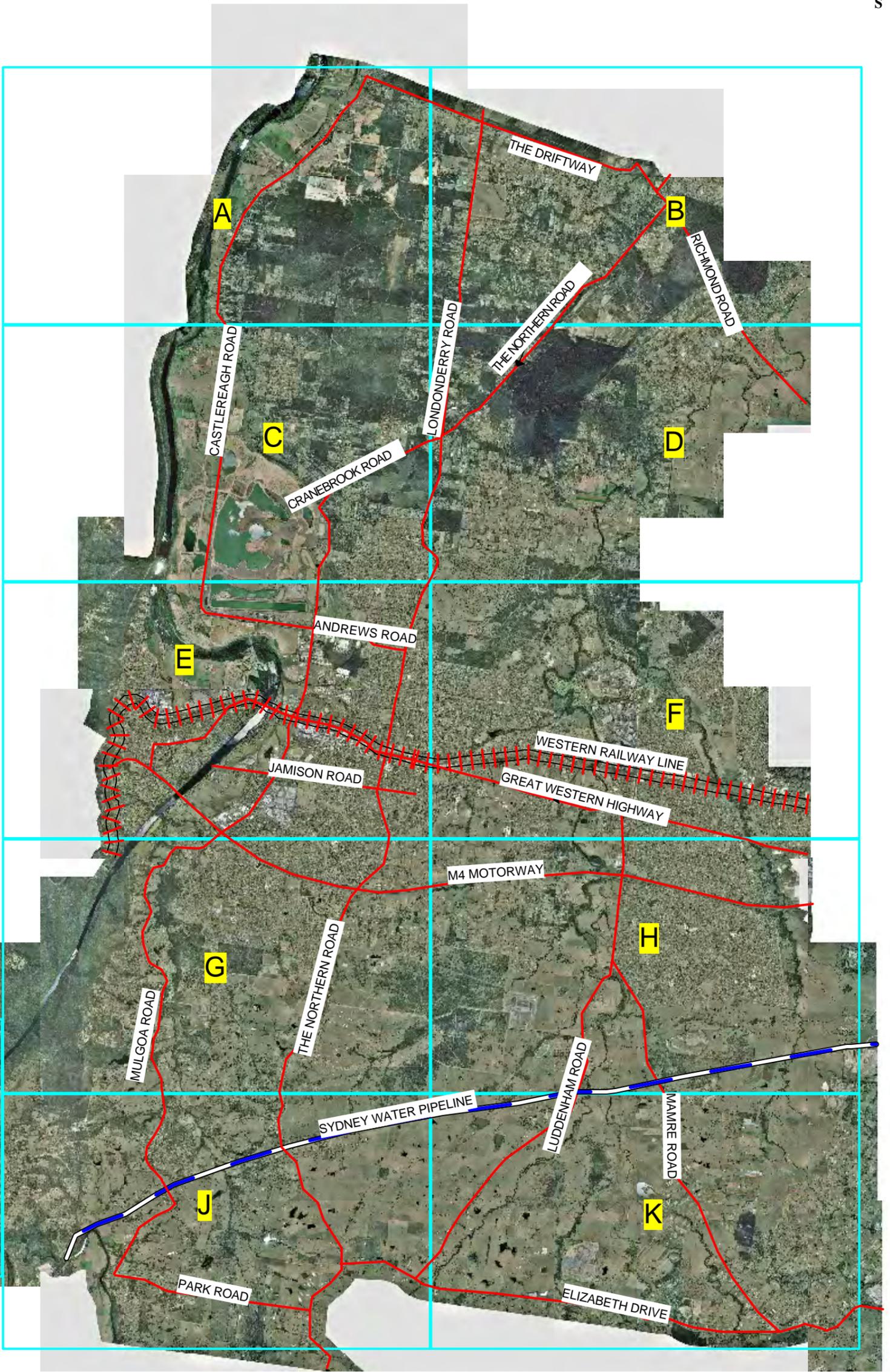
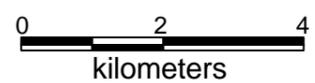
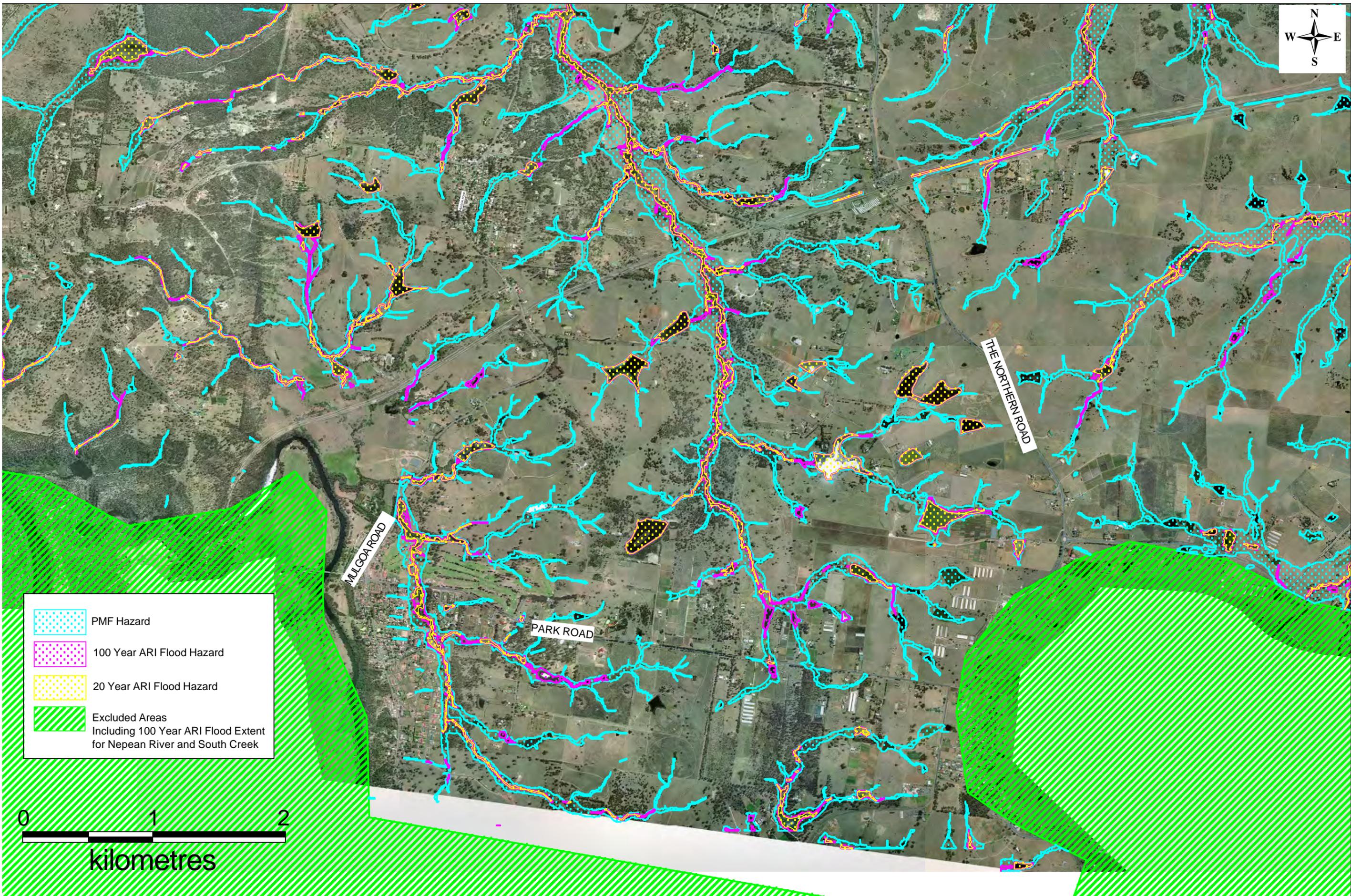


FIGURE INDEX

FIGURE 6.1 A-K: FLOOD EXTENT MAPS FOR PMF, 100 YEAR AND 20 YEAR ARI EVENTS

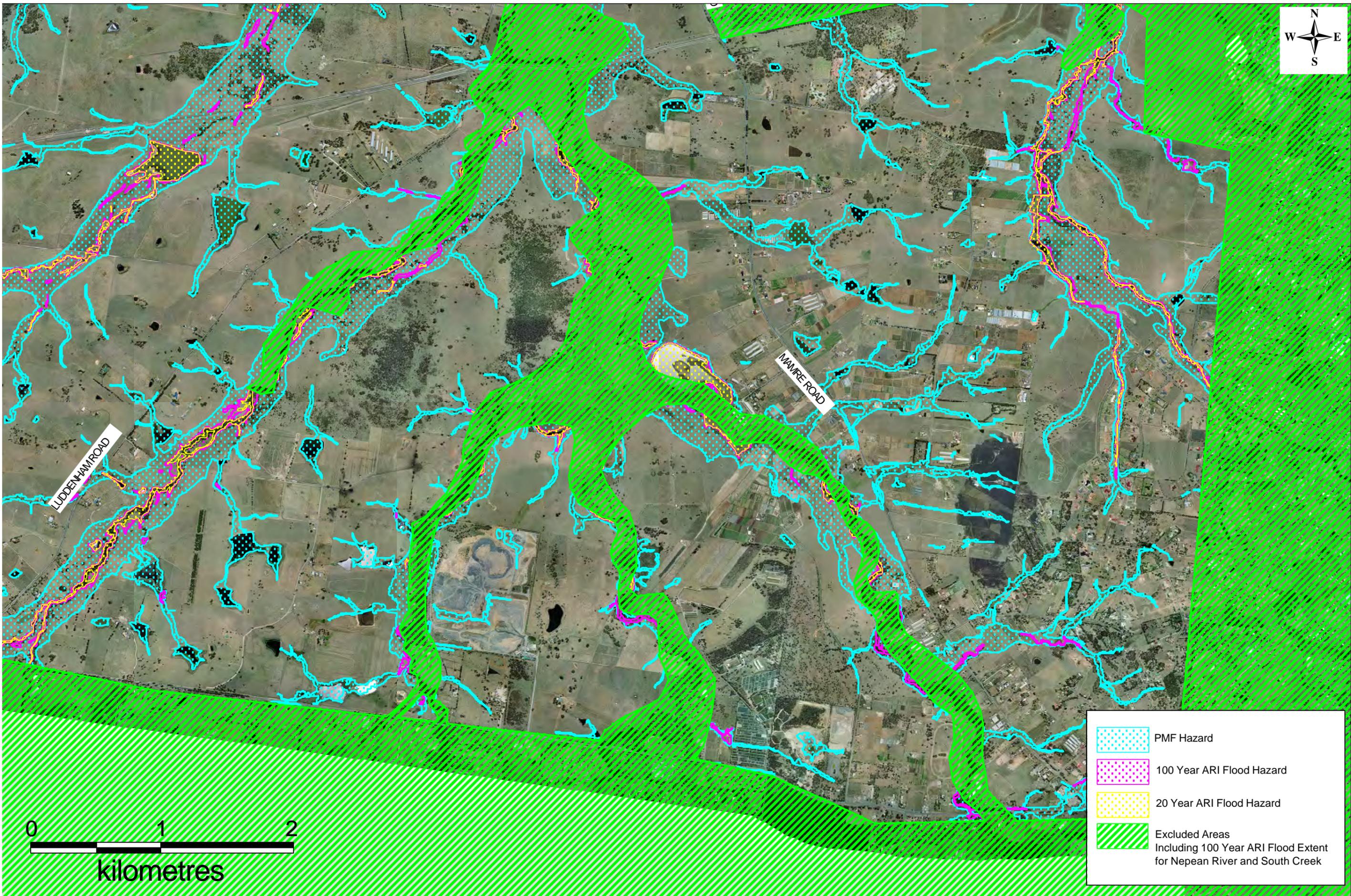
FIGURES 6.2 A-K: PROVISIONAL FLOOD HAZARD MAPS FOR PMF, 100 YEAR AND 20 YEAR ARI EVENTS





-  PMF Hazard
-  100 Year ARI Flood Hazard
-  20 Year ARI Flood Hazard
-  Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

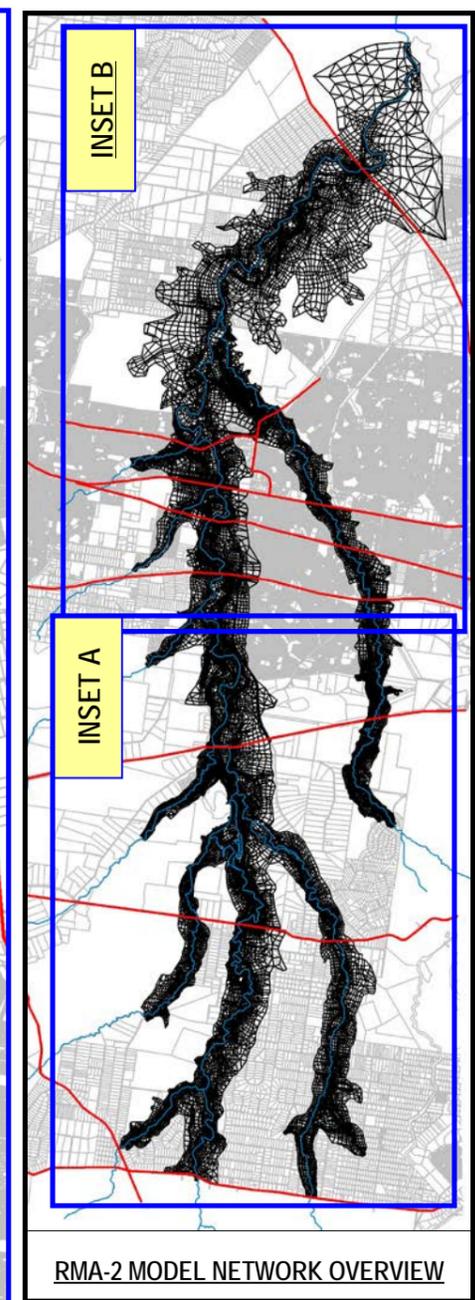
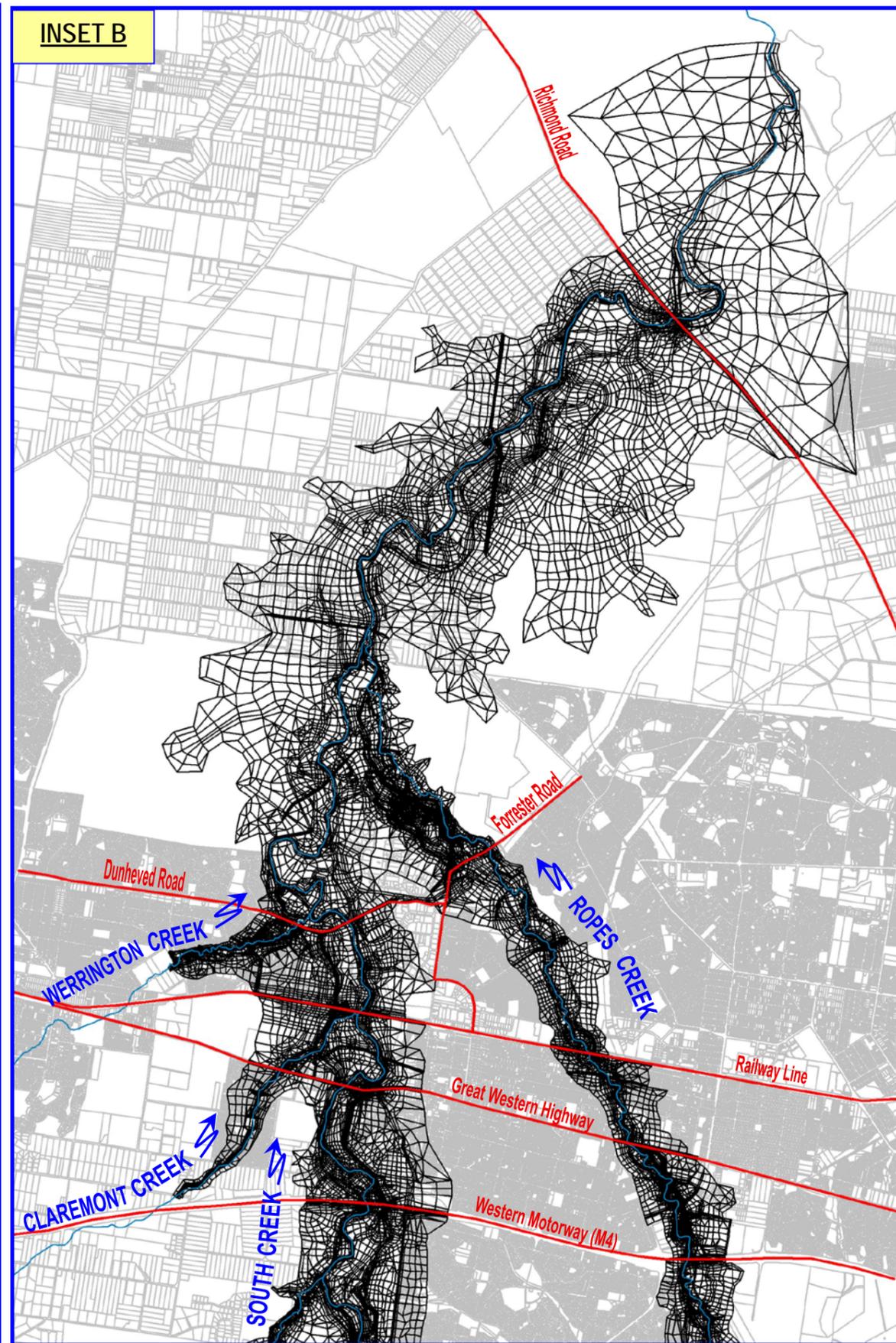
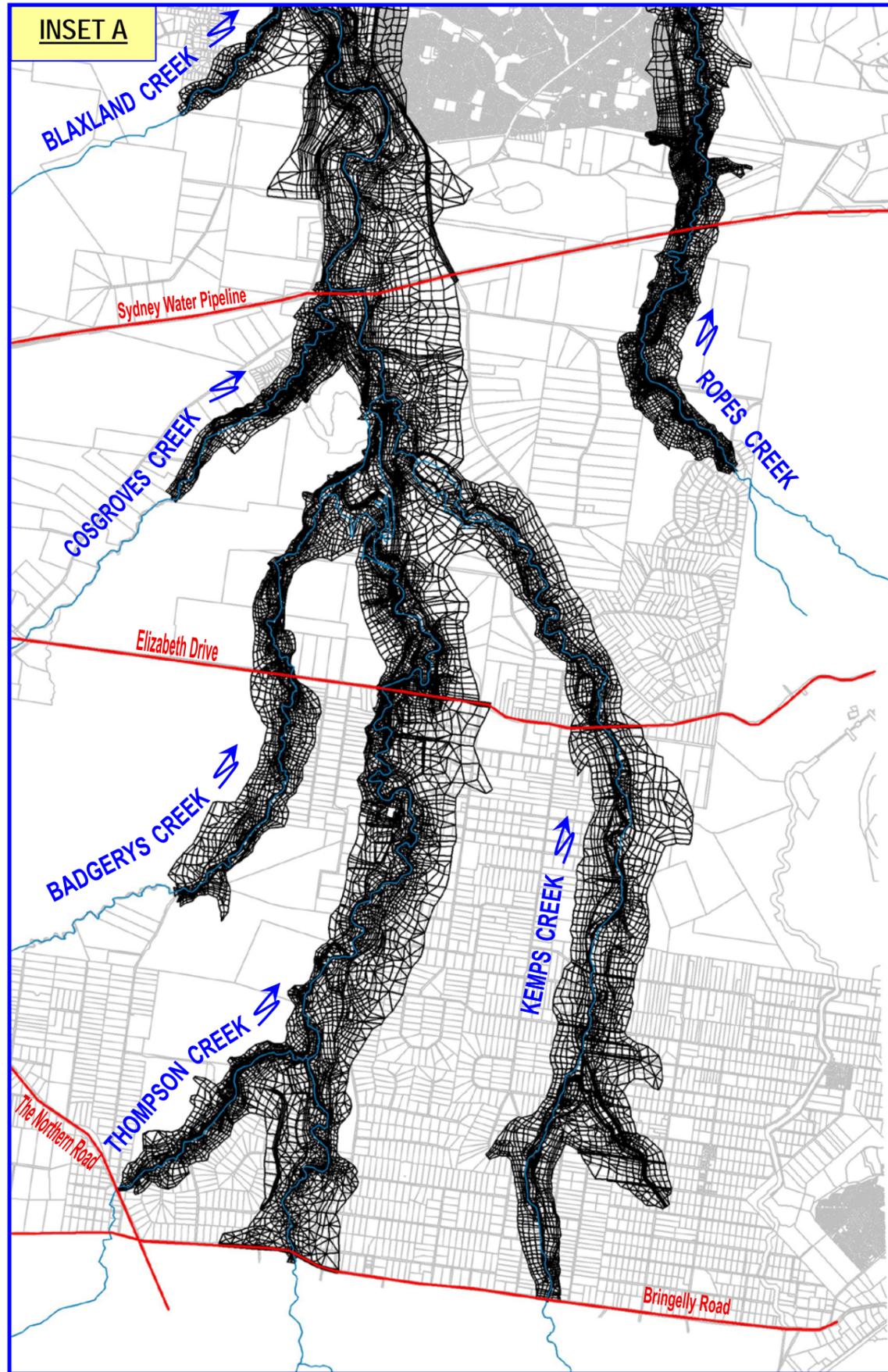
FIGURE 6.2 J
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD



-  PMF Hazard
-  100 Year ARI Flood Hazard
-  20 Year ARI Flood Hazard
-  Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

0 1 2
kilometres

FIGURE 6.2 K
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

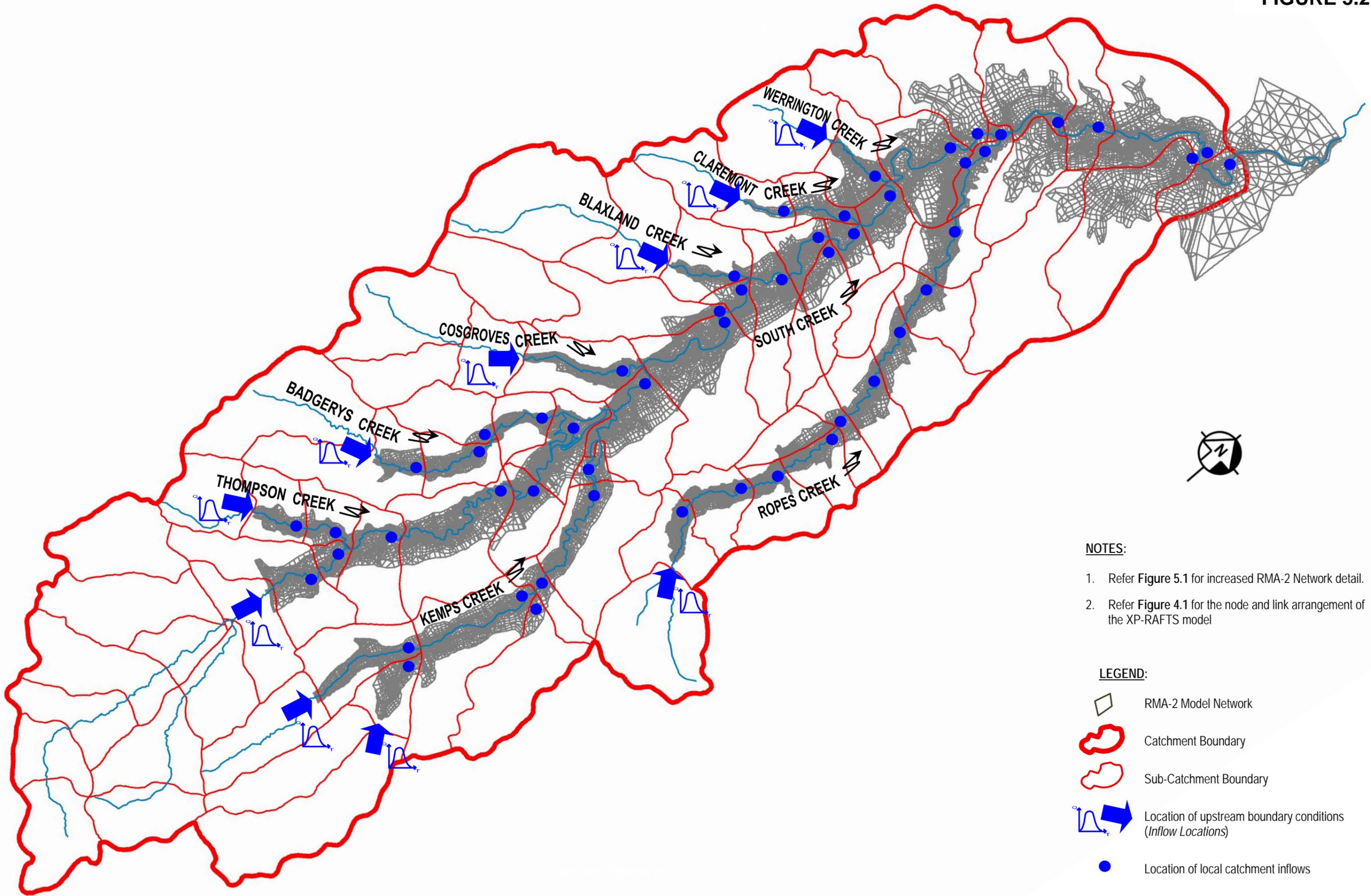


RMA-2 MODEL NETWORK OVERVIEW



LEGEND:
 RMA-2 Model Network

FIGURE 5.2



NOTES:

1. Refer Figure 5.1 for increased RMA-2 Network detail.
2. Refer Figure 4.1 for the node and link arrangement of the XP-RAFTS model

LEGEND:

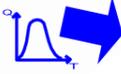
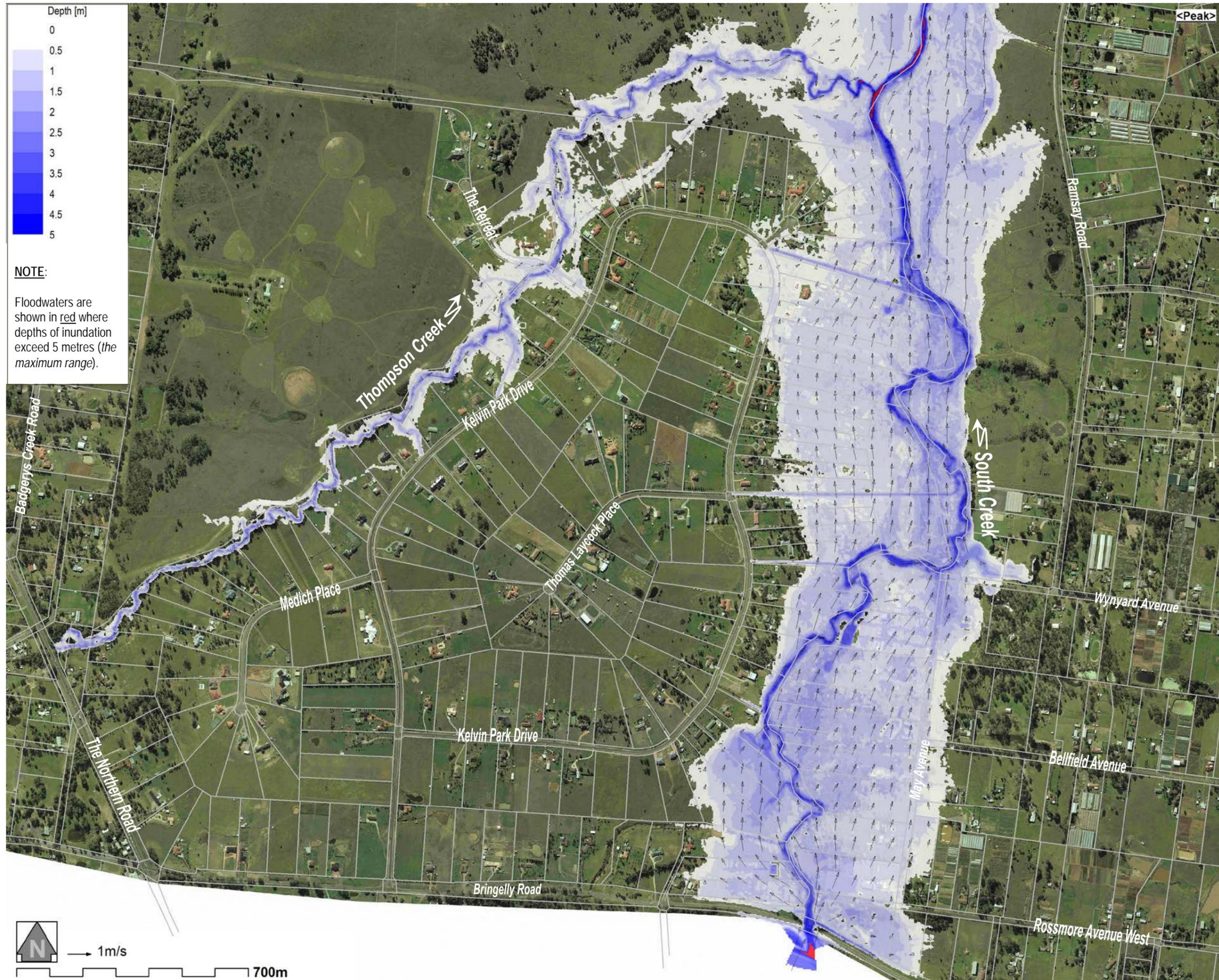
-  RMA-2 Model Network
-  Catchment Boundary
-  Sub-Catchment Boundary
-  Location of upstream boundary conditions (Inflow Locations)
-  Location of local catchment inflows

FIGURE 6.107



PREDICTED FLOOD DEPTHS AND VELOCITIES AT THE PEAK OF THE 100 YEAR RECURRENCE FLOOD [EXTENT 1 OF 17]

FIGURE 6.108

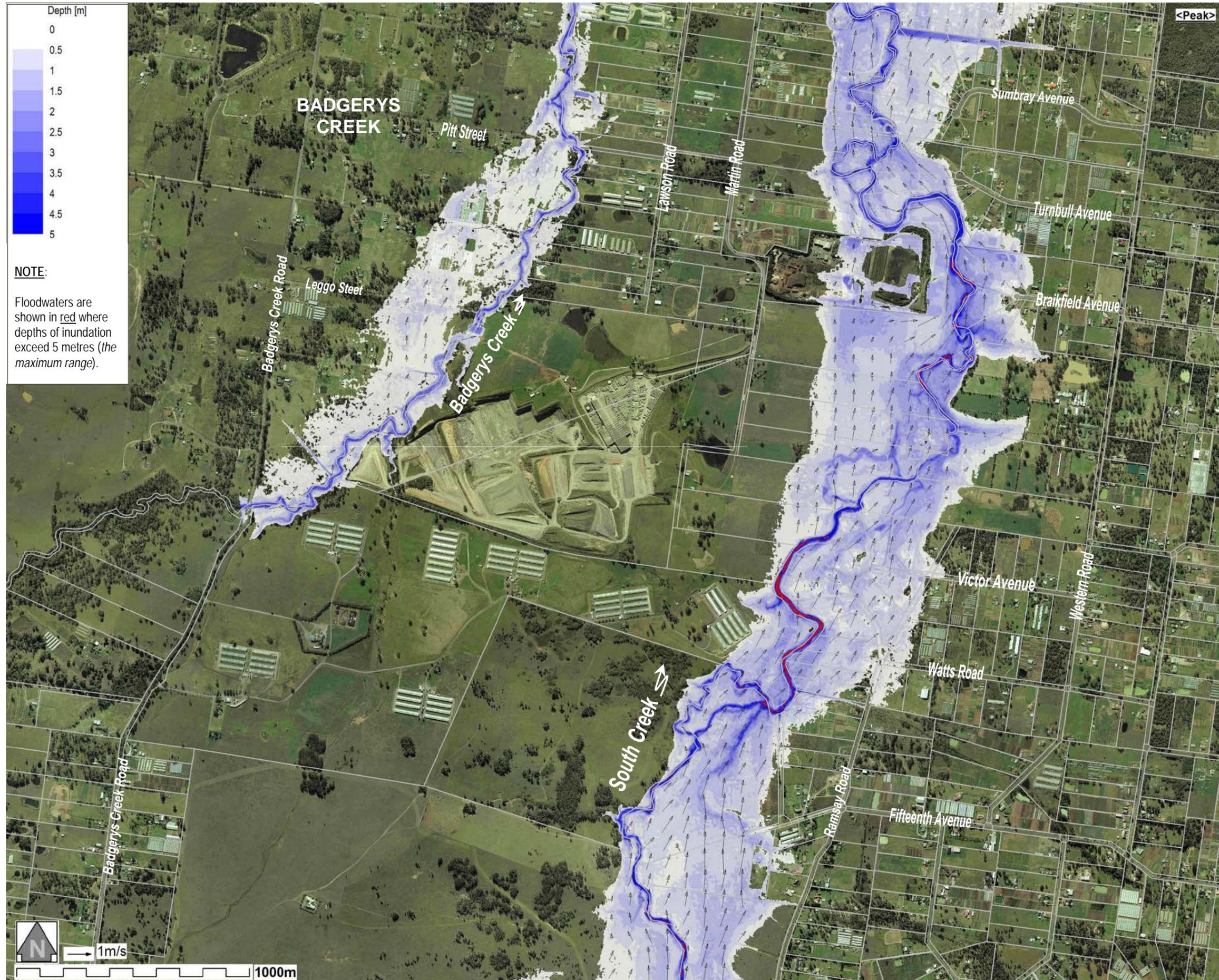


FIGURE 6.109

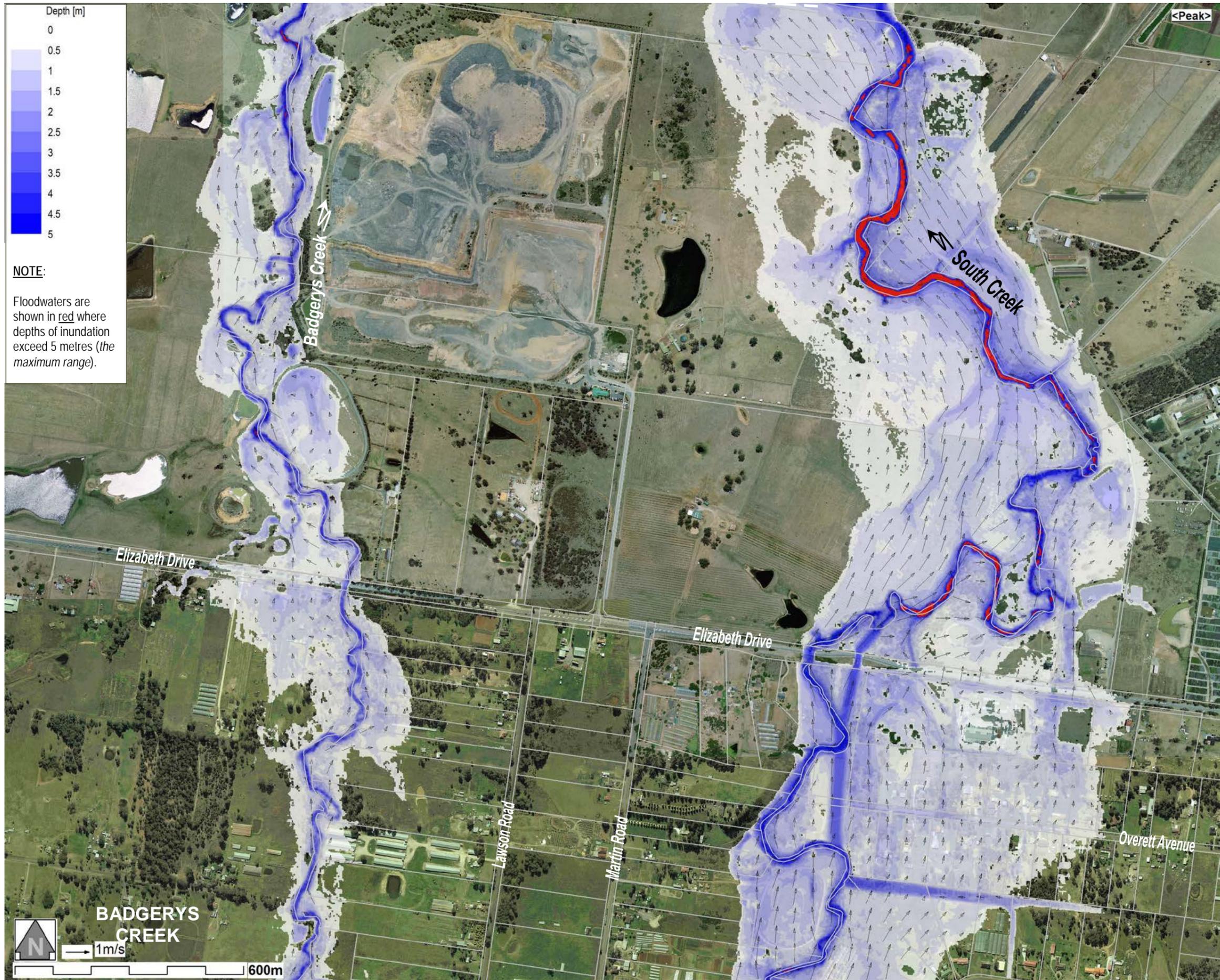


FIGURE 6.110

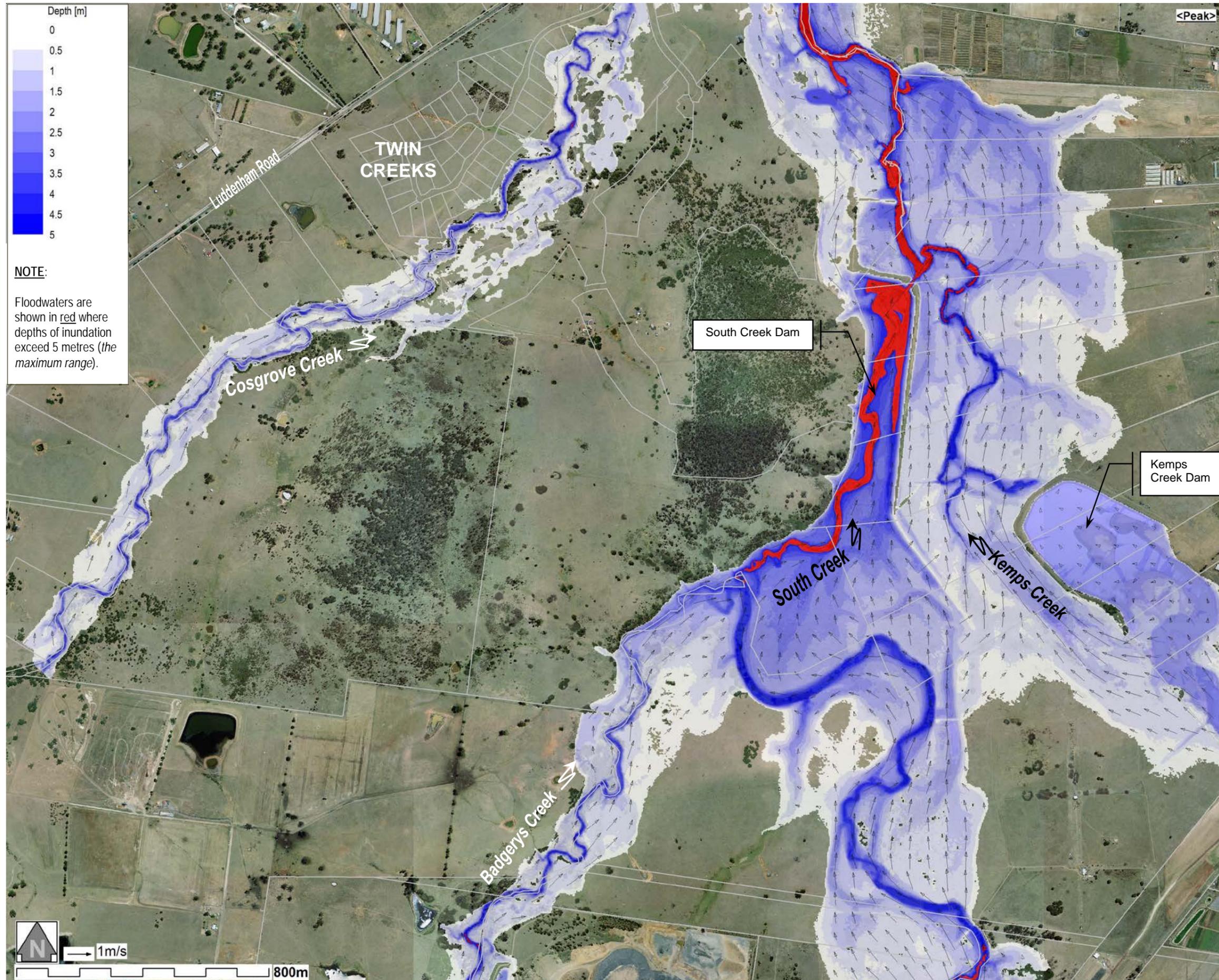
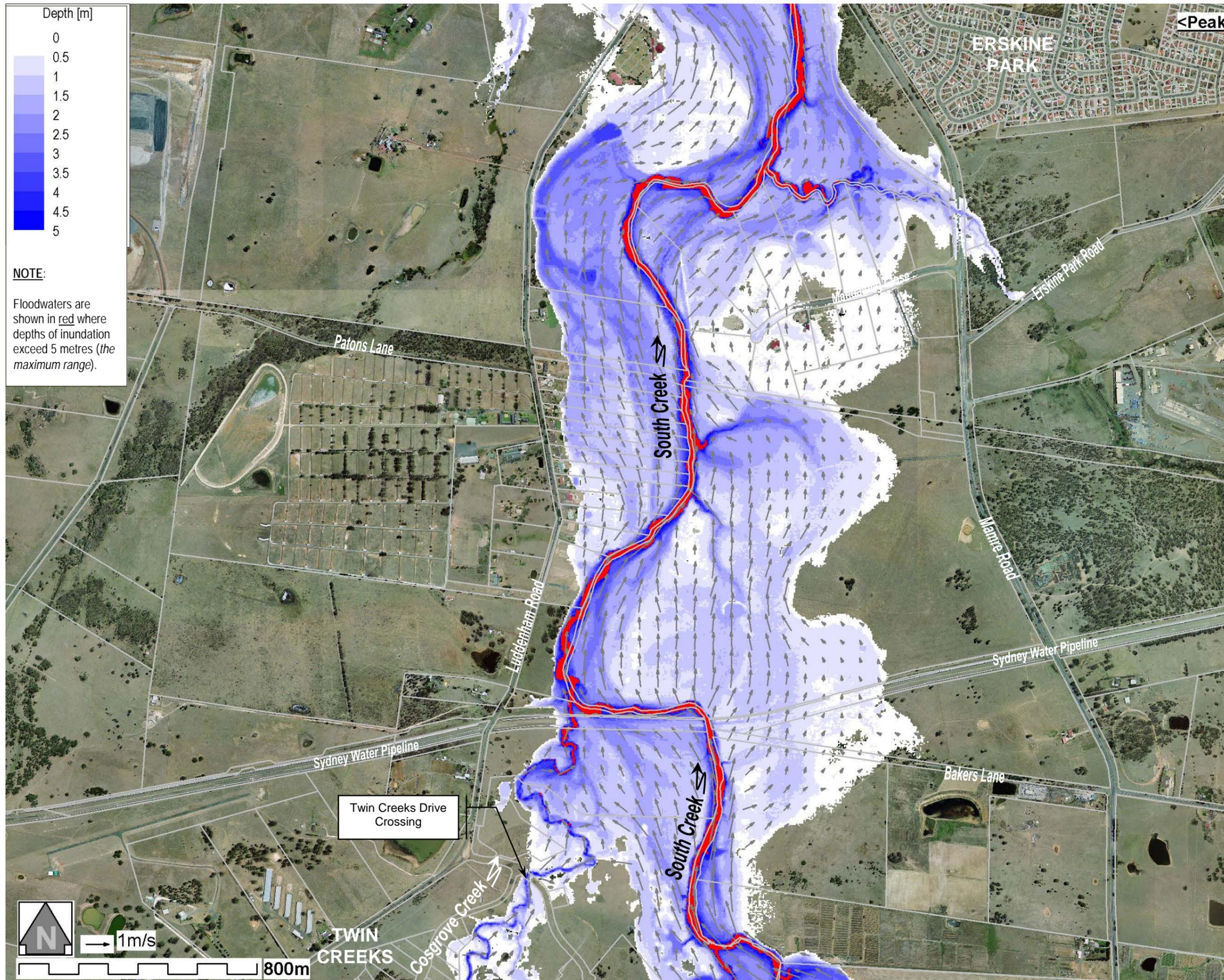
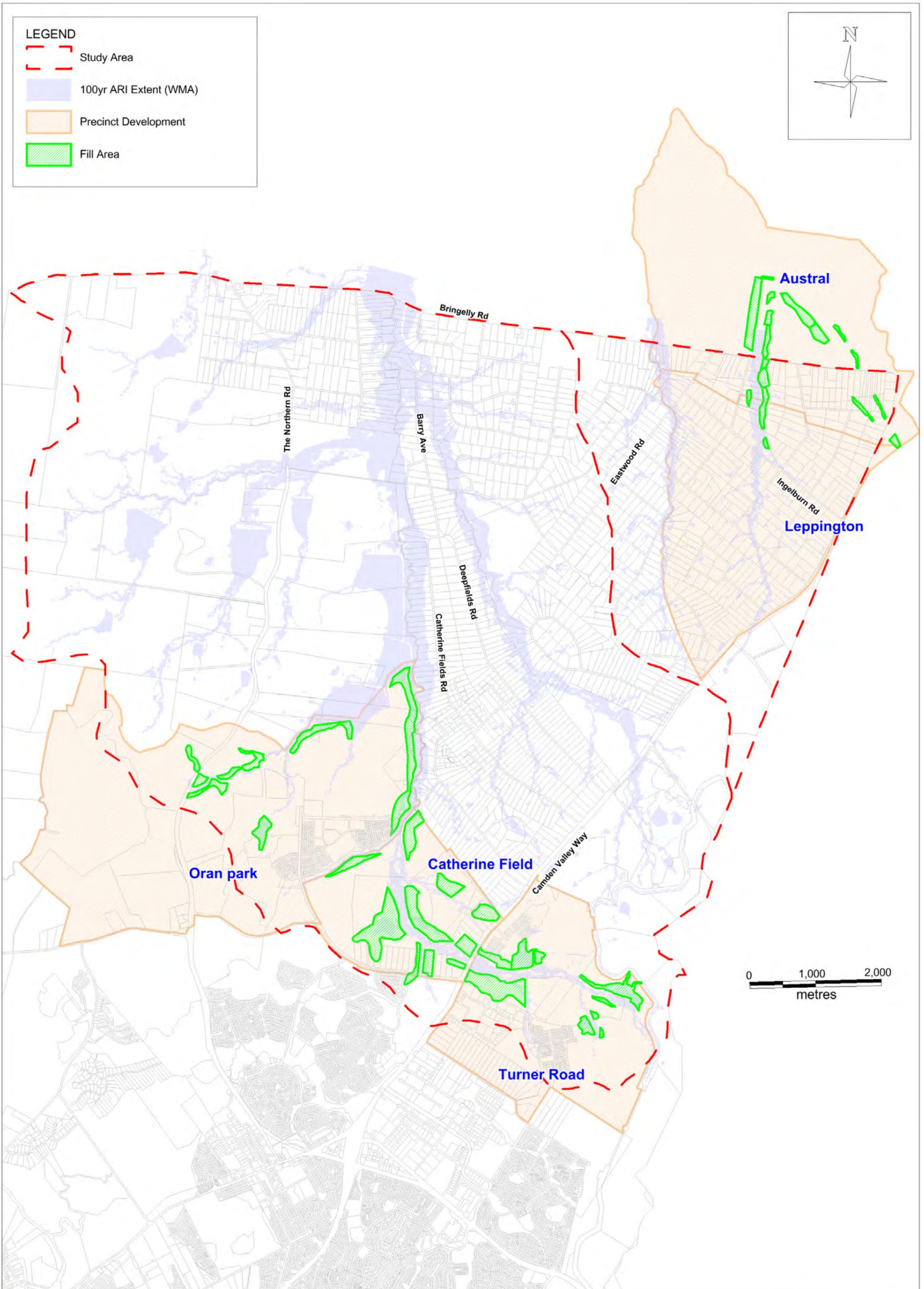
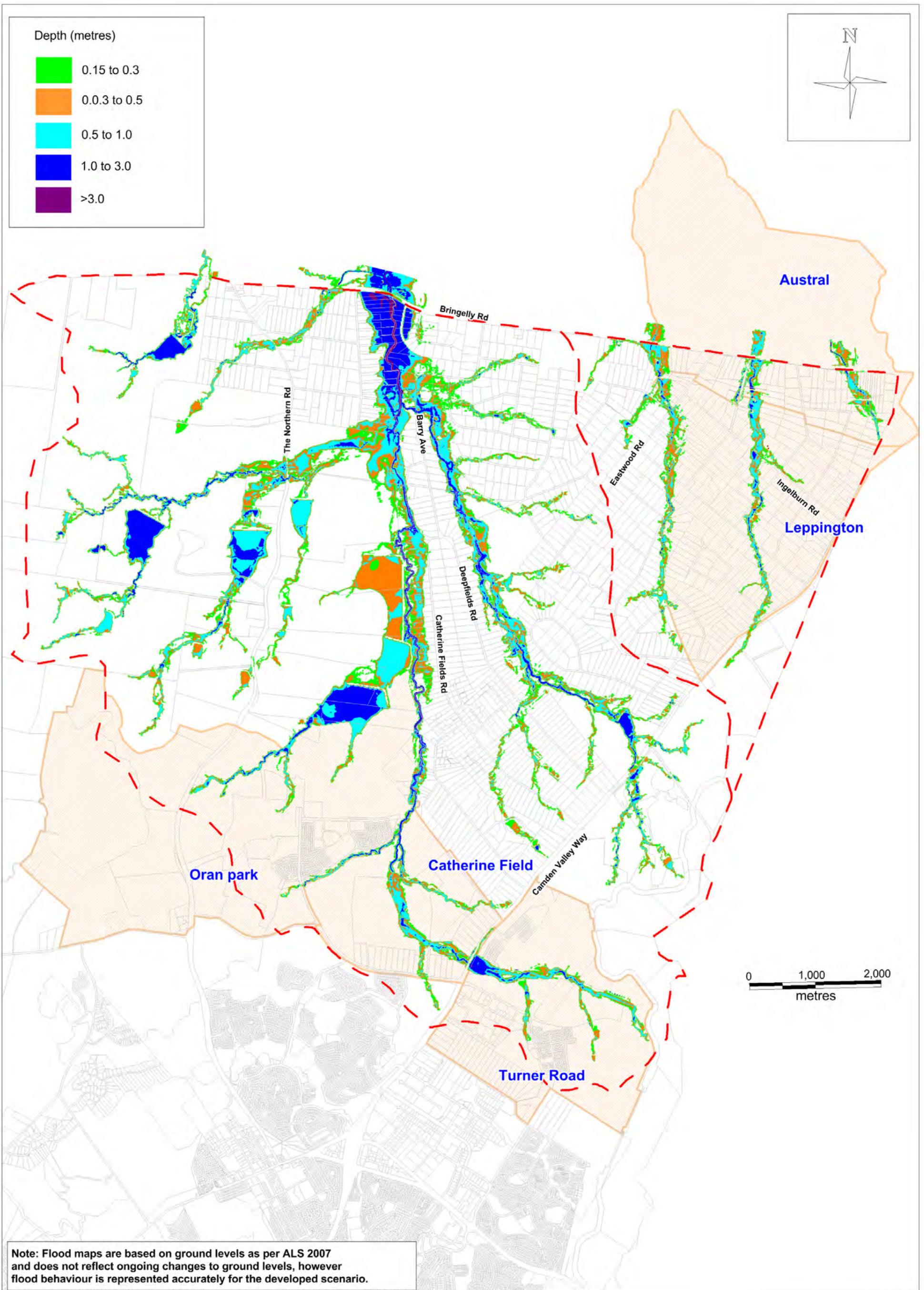


FIGURE 6.111







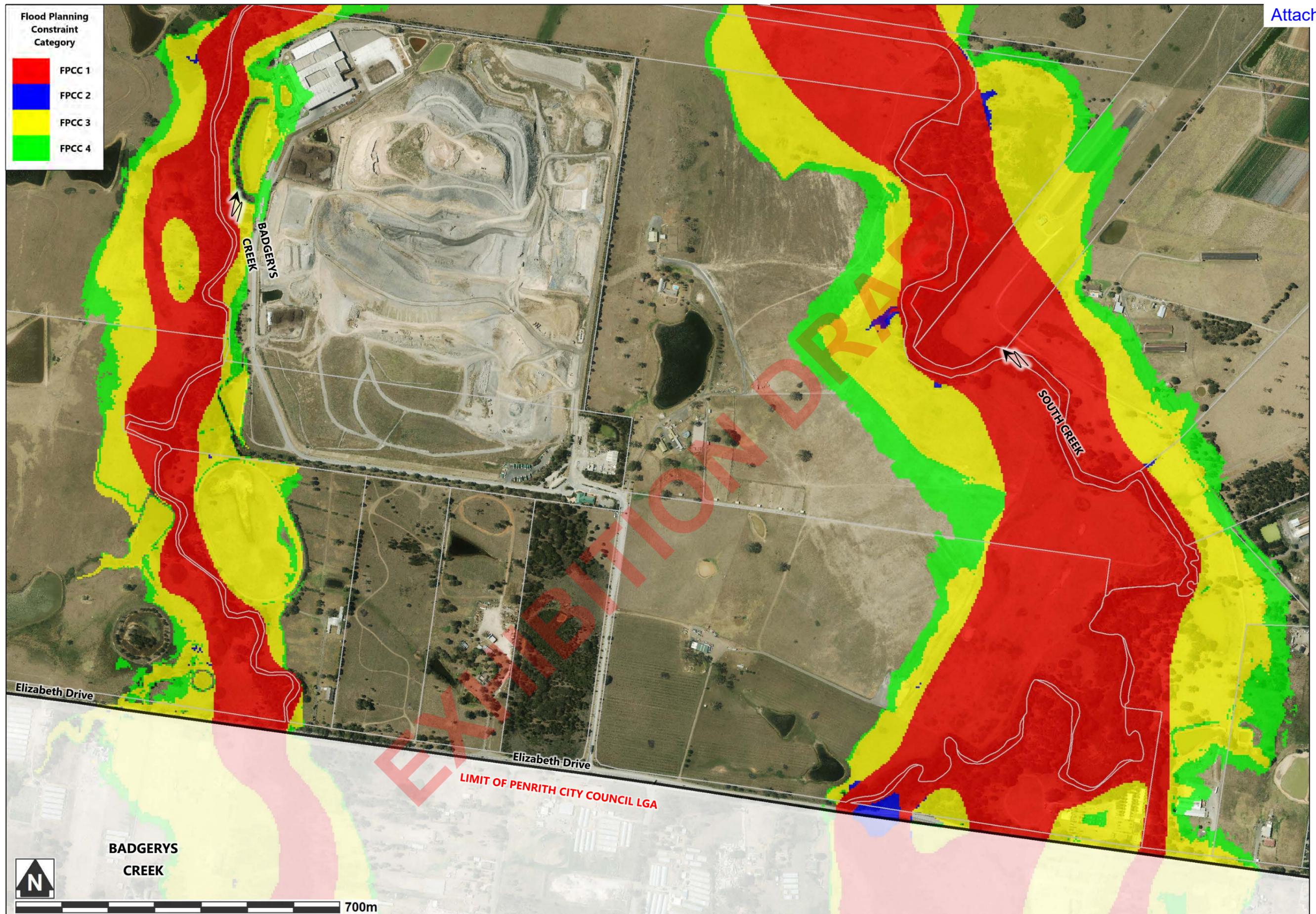


FIGURE D.1 FLOOD PLANNING CONSTRAINT CATEGORY MAPPING [EXTENT 1 OF 12]

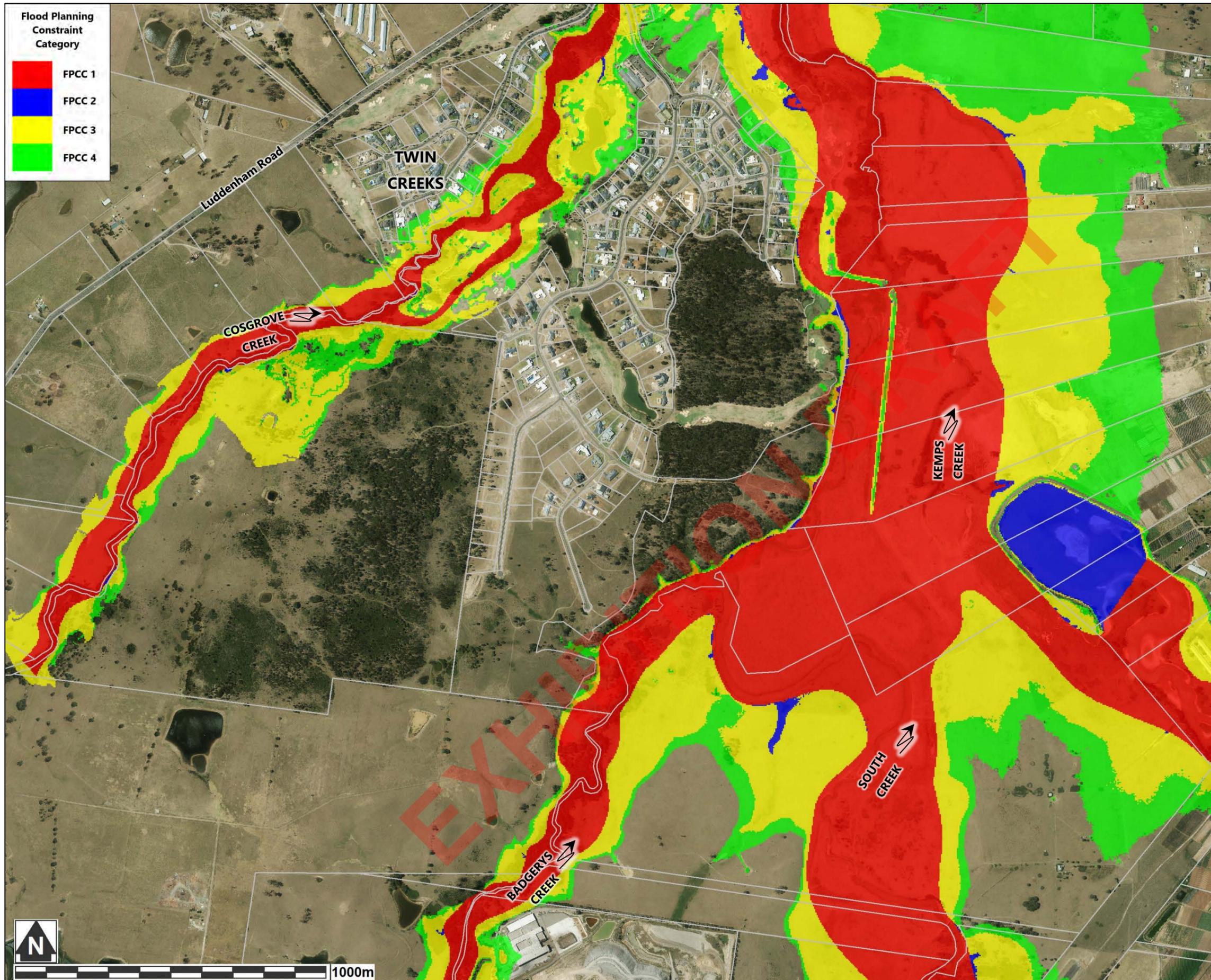


FIGURE D.2 FLOOD PLANNING CONSTRAINT CATEGORY MAPPING [EXTENT 2 OF 12]

Western Sydney Aerotropolis

APPENDIX C
2019 EDITION OF AUSTRALIAN
RAINFALL & RUNOFF

C.1 Terminology

Book 1, Chapter 2, Section 2.2.5. Adopted Terminology in Australian Rainfall & Runoff, 2019 describes the adopted terminology as follows:

To achieve the desired clarity of meaning, technical correctness, practicality and acceptability, the National Committee on Water Engineering has decided to adopt the terms shown in Figure 1.2.1 and the suggested frequency indicators.

Navy outline indicates preferred terminology. Shading indicates acceptable terminology which is depends on the typical use. For example, in floodplain management 0.5% AEP might be used while in dam design this event would be described as a 1 in 200 AEP.

Frequency Descriptor	EY	AEP (%)	AEP	ARI
			(1 in x)	
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	20
	0.02	2	50	50
	0.01	1	100	100
Very Rare	0.005	0.5	200	200
	0.002	0.2	500	500
	0.001	0.1	1000	1000
	0.0005	0.05	2000	2000
Extreme	0.0002	0.02	5000	5000
			↓	
			PMP/ PMPDF	

Figure 1.2.1. Australian Rainfall and Runoff Preferred Terminology

As shown in the third column of Figure 1.2.1, the term Annual Exceedance Probability (AEP) expresses the probability of an event being equalled or exceeded in any year in percentage terms, for example, the 1% AEP design flood discharge. There will be situations where the use of percentage probability is not practicable; extreme flood probabilities associated with dam spillways are one example of a situation where percentage probability is not appropriate. In these cases, it is recommended that the probability be expressed as 1 in X AEP where 100/X would be the equivalent percentage probability.

For events more frequent than 50% AEP, expressing frequency in terms of annual exceedance probability is not meaningful and misleading, as probability is constrained to a maximum value of 1.0 or 100%. Furthermore, where strong seasonality is experienced, a recurrence interval approach would also be misleading. An example of strong seasonality is where the rainfall occurs predominately during the Summer or Winter period and as a consequence flood flows are more likely to occur during that period. Accordingly, when strong seasonality exists, calculating a design flood flow with a 3 month recurrence interval is of limited value as the expectation of the time period between occurrences will not be consistent throughout the year. For example, a flow with the magnitude of a 3 month recurrence interval would be expected to occur or be exceeded 4 times a year; however, in situations where there is strong seasonality in the rainfall, all of the occurrences are likely to occur in the dominant season.

Consequently, events more frequent than 50% AEP should be expressed as X Exceedances per Year (EY). For example, 2 EY is equivalent to a design event with a 6 month recurrence interval when there is no seasonality in flood occurrence

The terminology adopted herein depends on the edition of Australian Rainfall and Runoff provide the IFD data. In the case of assessments based on ARR1987 the ARI terminology was adopted design floods. In the case of assessments based on ARR2019 the AEP terminology was adopted design floods.

C.2 Climate Change

As outlined by Babister et al, 2016:

The Australian Rainfall and Runoff (ARR) revision projects have produced a large number of spatial design inputs that practitioners need to access in order to undertake design flood estimation. These inputs will be updated as improvements in terms of data record and methodology are made or anomalies are addressed. The ARR data hub www.data.arr.org.au was created to provide a one stop shop for practitioners to access current inputs in a simple easy manner.

The online data hub has the advantage of documenting the version of the data used and allowing improved reproducibility of past results. This new approach represents a significant shift in practice with practitioners accessing data at the start of a study and software vendors not embedding datasets within their software platform.

As outlined in ARR, 2019:

Projected changes from Global Climate Models (GCMs) can be explored for 14 20-year periods and the four Representative Concentration Pathways (RCPs) for greenhouse gas and aerosol concentrations that were used to drive the GCMs.

The RCPs are designated as 2.6, 4.5, 6.0 and 8.5, and are named according to radiative forcing values ($W m^{-2}$) in the year 2100 relative to pre-industrial values. Use of RCPs 4.5 and 8.5 (low and high concentrations, respectively) is recommended for impact assessment.

The ARR Datahub provides a table of temperature increases and percentage increase in rainfall for a set of forecast years and RCP 4.5, 6 and 8.5 emissions schemes (CSIRO and BoM, 2015). ARR recommends the use of RCP4.5 and RCP 8.5 values. These values for Parramatta are tabulated as follows.

Interim Climate Change Factors (Design Rainfall Increase in %)

Year	RCP4.5	RCP8.5
2030	4.3%	4.9%
2040	5.3%	6.8%
2050	6.4%	9.0%
2060	7.5%	11.5%
2070	8.5%	14.2%
2080	9.2%	16.9%
2090	9.5%	19.7%

C.3 South Creek Catchment

Hydrological modelling of the South Creek catchment was undertaken in 2015 at the catchment scale using XP-RAFTS. The hydrological model assembled by WorleyParsons in 2015 was based on ARR1987 IFD. An assessment has been recently undertaken of a local catchment (around 130 ha) located within the larger South Creek subcatchment 1.17 based on both ARR1987 and ARR2019 IFD.

It should be noted that the 2015 study identified the critical storm burst duration for South Creek downstream of Bringelly Road to be 36 hours. While any future development would be expected to have an adverse impact of peak flows in short duration storm bursts it is likely that any future development will have minimal or nil adverse or beneficial impact on peak flows in a 36 hour storm due to the duration of the storm and timing effects due to runoff from impervious areas occurring more rapidly than runoff from pervious areas.

A local hydrological model was created to assess runoff under benchmark conditions and to facilitate the assessment of impacts of proposed development.

An issue which was considered was whether the airspace in existing farms dams is to be included in the benchmark conditions. An initial assessment was undertaken of the regional significance or otherwise of the farm dams based on criteria formulated in the upper South Creek catchment.

It was concluded that:

- (i) The combined capacity in 8 farm dams within the local catchment is just under the criterion for classification as a regional farm dam system; and on this basis;
- (ii) the farm dams have been ignored when assessing "Benchmark Conditions".

Hydrological assessments were undertaken using both ARR1987 and ARR2019.

Design rainfall and storm burst patterns were obtained from ARR1987 for 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events.

The Probable Maximum Precipitation (PMP) was estimated using The Estimation of Probable Maximum Precipitation in Australia: Generalised Short – Duration Method (Bureau of Meteorology, 2003). The PMP depths were obtained for ellipses A and were applied to each subcatchment in the local model.

For the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events the adopted initial rainfall loss = 15 mm and continuing rainfall loss = 1.5 mm/h. For the PMF the adopted rainfall losses were an initial loss = 1 mm and a continuing loss = 0 mm/h.

Design rainfall and storm burst patterns were obtained from ARR2019 were obtained from the ARR Data Hub for 50%, 20%, 1%, 0.5% and 0.2% AEP events.

For the for 50%, 20%, 1%, 0.5% and 0.2% AEP events the adopted initial burst rainfall loss (IL) varied while a constant continuing rainfall loss (CL) = 2.3 mm/h was adopted. The adopted average initial burst losses were as follows.

AEP	Burst IL (mm)	CL (mm/h)
50%	28.5	2.3
20%	16	2.3
10%	14	2.3
5%	13.5	2.3
2%	12	2.3
1%	10	2.3
0.5%	10	2.3
0.2%	10	2.3

The peak flows estimated at the local catchment outlet for the various events are summarised as follows.

Summary of Estimated Peak Flows from Local Catchment

ARR1987 Hydrology			ARR2019 Hydrology		
ARI (yrs)	Peak Flow (m ³ /s)	Critical Duration (hrs)	AEP	Peak Flow (m ³ /s)	Critical Duration (hrs)
2	6.31	9	50%	3.23	6
5	9.09	4.5	20%	7.73	2
100	21.0	2	1%	23.3	0.75
200	24.4	2	0.50%	26.2	0.75
500	29.2	2	0.20%	30.9	0.75
PMF	233	0.75	PMF	233	0.75

It should be noted, as discussed above, that 2 yr ARI equates to 39% AEP while 5 yr ARI equates to 18% AEP.

It was also noted that the

- Critical storm burst durations for ARR2019 storm burst are all shorter than the critical storm burst durations for ARR1987 storm burst;
- The 1% AEP peak flow at local catchment outlet is around 11% higher than the estimated 100 yr ARI peak flow at local catchment outlet.

It was also of interest to compare the estimated peak flows at local catchment outlet with the estimated peak flows in South Creek in the vicinity of the local catchment at Node 1.17 (refer **Figure 2**). The estimated peak flows at Node 1.17 are summarised as follows.

Summary of Estimated Peak Flows in South Creek at Node 1.17

Event	Storm Burst			
	2 hr	9 hr	36 hr	
2 yr ARI	13.6	151	305	ARR1987 - Worley Parsons, 2015 Model
100 yr ARI	360	774	956	ARR1987 - Worley Parsons, 2015 Model
1% AEP	558	727	563	ARR2019 - Modified Worley Parsons, 2015 Model

It was noted that the indicative peak flow under ARR2019 is lower (by around 24%) than estimated under ARR1987 and the critical storm burst duration reduces from 36 hours to 9 hours.

The indicative ARR2019 peak flows were obtained by modifying the 2015 Worley Parsons model by adopting a global storm (not catchment dependent storms) and a uniform initial burst loss across the catchment. An areal reduction factor was not applied to the rainfall intensities obtained from the ARR Data Hub.



ATTACHMENT 3

Biodiversity Advice prepared by Arcadis

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Sydney NSW 2000
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13/02/2020

Western Sydney Aerotropolis Plan – Ecological advice

Dear Ron

This letter has been prepared in response to the Western Sydney Aerotropolis Plan (WSAP), placed on public display by the Department of Planning Industry and Environment (DPIE) in December 2019. The WSAP includes the following documents:

- Draft Western Sydney Aerotropolis Plan
- Draft Western Sydney Aerotropolis DCP
- Western Sydney Aerotropolis proposed SEPP Discussion Paper
- Western Sydney Aerotropolis Summary
- Aerotropolis SEPP Maps

In 2019, Arcadis were engaged by the University of Sydney to conduct a flora and fauna assessment of their property at Badgerys Creek, known as the 'McGarvie Smith Farm' and 'Fleurs Farm'. The purpose of this letter is to consider the proposed land use zoning in the WSAP in the context of the findings of the ecological assessment.

The Arcadis (2019) assessment identified that about 22 hectares of native vegetation, comprising three threatened ecological communities, occurs on the property. No threatened flora species were recorded however the following threatened fauna species were recorded:

- Cumberland Plain Land Snail
- White-bellied Sea-Eagle
- Freckled Duck.

Several additional threatened fauna species were considered likely to occur on the basis of habitat being present. The biodiversity constraints present are largely confined to the riparian corridors of South Creek and Badgerys Creek and substantial portions of South Creek that have been entirely cleared of vegetation. Much of the remainder of the property has been historically cleared and is in a highly degraded state, providing little or no biodiversity value.

The WSAP proposes an Environment and Recreation Zone that will largely include the Wianamatta-South Creek Precinct on land that occurs below the 1 in 100 year average reoccurrence interval (ARI) for flooding. The zone will include vegetation protected

under the existing Biodiversity Certification program and the Strategic Assessment program and all Cumberland Plain Conservation Plan vegetation. The objectives of the Environment and Recreation Zone are:

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
- To prevent development that could destroy, damage or otherwise have an adverse effect on ecological or recreational values.
- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To ensure that development is secondary and complementary to the use of land as public open space, and enhances public use, and access to, the open space.
- To encourage, where appropriate, key regional pedestrian and cycle connections.

The use of flood-prone land for biodiversity conservation does have some merit. It can provide foraging and breeding resources as well as connectivity corridors across the landscape on land that is otherwise of low development value. There are, however, some concerns regarding the Environment and Recreation zone, as proposed in the WSAP, that have been summarised below.

- All man-made farm dams have been included within the Environment and Recreation Zone, regardless of their ecological value in either the current or future landscape. The Arcadis (2019) assessment found that most of the dams present were ephemeral in nature and provided no habitat for threatened fish. Further, the dams within the McGarvie Smith Farm are directly on the flightpath for the northern runway and could pose a potential bird strike risk for incoming and outgoing aircraft. The draft Australian Noise Exposure Concept Map (included in the WSAP) predicts greater than 30 ANEC units of noise exposure across these dams which could detrimentally affect their use by native fauna. The retention of these dams on the basis of biodiversity conservation is also likely to conflict with the surrounding (future) Enterprise land use that will remove much of the potential foraging habitat for species utilising these dams. As such, it is considered that the retention of all dams within the property is inconsistent with future Aerotropolis land uses.
- The use of the 1:100 year flood level and inclusion of all farm dams and connecting links gives the Environment and Recreation Zone a very high perimeter to area ratio. Vegetation patches with a high perimeter to area ratio are difficult and expensive to manage for conservation since they are subject to extensive edge effects. Consolidated patches with low perimeter to area ratios would result in better biodiversity outcomes. If the vegetation within the Environment and Recreation zone is to be afforded in-perpetuity protection and management, the proposed boundary is unlikely to result in viable Biodiversity Stewardship sites based on the high levels of management that would be required. Significant boundary rationalisation would likely be required to achieve this i.e. the greater the area to perimeter ratio and the more low biodiversity value land that is included within the Environment and Recreation zone, the less likely it is that the objectives of the zone will be met from a conservation perspective.
- The Arcadis (2019) assessment found that substantial portions of the South Creek Environment and Recreation zone are of low conservation value. This is due to historical clearing and intensive grazing leaving exotic vegetation with little fauna habitat value. These areas have also not been avoided by the Cumberland Plain Conservation Plan on biodiversity grounds (Figure 3 of the SEPP discussion paper).

Without significant intervention and ongoing management, these areas will continue to be of no conservation value.

Existing dams that are of little conservation value and could actually be detrimental to the future operation of the Western Sydney Airport should be removed. By including these dams within the Environment and Recreation zone, there could potentially be an increase to bird strike risk for aircraft and a detrimental effect on the potential viability of future Stewardship Sites.

Should you require any further advice, please don't hesitate to contact the undersigned.

Yours sincerely



Ed Cooper
Technical Discipline Leader - Ecology





ATTACHMENT 4

Civil Engineering Advice prepared by at&I

30th January 2020

The University of Sydney
University Infrastructure
Level 1, 22 Codrington Street
Darlington NSW 2008

Your Ref:
Our Ref: LTR0021-02-18-584
Civil Response to WSAP
Draft Plan
Direct phone: 02 9439 1777

Attention Ron Meyer

Dear Ron,

WESTERN SYDNEY AEROTROPOLIS PLAN- DAM REZONING CIVIL ENGINEERING ADVICE

This letter is written in response to the draft Western Sydney Aerotropolis Plan (WSAP) released for public comment by the NSW Government in December 2019.

The *Structure Plan - Northern Gateway* on Page 65 of the WSAP proposes to rezone the land associated with the existing dams and downstream overland flow paths (associated with the dams) as an 'Environmental and Recreation' zone. Refer to Attachment A.

We have reviewed the flood management objectives outlined in the WSAP and related draft Aerotropolis SEPP and provide the response herein in relation to the existing dams within The University of Sydney's landholdings at Badgerys Creek is affected by the WSAP.

From a civil engineering perspective, there is no merit in re-zoning the land associated with the dams and associated overland flow paths into an 'Environmental and Recreation' zone for the following reasons:

- 1) The dams and downstream overland flow paths are man-made watercourses – they are not natural watercourses and were constructed to essentially provide water storage capacity for livestock on the farms.
- 2) The dams serve to capture local overland flow paths and store water runoff. Once full, they overtop and flow overland into Badgerys Creek to the east.
- 3) As part any future development of the site, a stormwater management system will need to be created to ensure all stormwater runoff generated on the site will be detained within above ground basins and/or underground tanks and treated to ensure nutrient removal to Penrith City Council's requirements.
- 4) The new stormwater management system will fully comply to the Penrith City Engineering guidelines and comprise:
 - new pipe/pit and swale systems to ensure all stormwater runoff is captured and stored to ensure discharge rates into Badgerys Creek do not exceed pre-developed rates, and
 - new basins/tanks to detain all stormwater runoff and discharge at controlled rates to ensure peak flow rates into Badgerys Creek are not increased.

- 5) As the new basins/tank will be needed to comply with Council's requirements during the Development Application and Construction Certificate stages of development, this will result in all existing dams becoming redundant and need to be removed.

Based on the information presented above, it is our view the existing dams and associated overland flow paths upstream of the 1:100-year flood zone will not in any way contribute to the flood management objectives outlined in the WSAP or Aerotropolis SEPP.

Furthermore, as the dams and downstream overflow paths will be removed to allow for new networks to be installed to comply to the Penrith City Council's Engineering Guidelines, we do not consider that the dams and associated overland flow paths should be rezoned 'Environment and Recreational' and should retain the surrounding zoning as 'Flexible Employment'.

Should you have any queries with this advice please don't hesitate in contacting me on the number below.

Yours sincerely



Andrew Tweedie

Associate Director



Attachment A: Structure Plan- Northern Gateway

