NORTHROP

MOORE POINT DEVELOPMENT

Riparian Assessment

for Panning Proposal PP-2022-1602

For Joint Landowners Group

Riparian Assessment

Date	Revision	Issue	Approved By
22/03/2024	A	For Review	M Brown
5/05/2024	B	Draft	M Brown
10/05/2024	C	Final	M Brown

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Summary

This Riparian Assessment has been prepared by Northrop Consulting Engineers on behalf of the Joint Landowners Group in relation to the Planning Proposal (PP-2022-1602) submission to Liverpool City Council (Council) for land known as Moore Point, Liverpool (the site).

This Riparian Assessment has been prepared in conjunction with a suite of specialist reports to demonstrate the proposals compliance with Water Management Act 2000, as outlined in Section 1.

Purpose

This assessment has been prepared in response to Department of Planning and Environment's Gateway Determination issued 3 April 2023, and specifically the following condition:

Amend the Riparian Strategy to address the following:

- *Demonstrate compliance with the Water Management Act 2000; and*
- *Include plans showing inner and outer riparian corridors and all structures that encroach into this area. Certain buildings or structures may be proposed to be located on a riparian corridor consistent with relevant guidelines.*

The proposal

Moore Point is the largest privately-led urban renewal project in Australia, led by a Joint Landowner Group (JLG) comprised of Coronation Property Co and Leamac Property Group.

When delivered, Moore Point will consolidate Liverpool's role as Australia's a great river city with unparalleled recreational amenity along the Georges River and Lake Moore. It will create:

- the first truly integrated riverfront development at scale. At the heart of this attraction will be a revitalised riverbank which will undergo an ecological transformation and create a natural, healthy and vibrant river ecosystem.
- a new 7-hectare linear foreshore park supported by bridge crossings from Liverpool CBD to fully accessible Georges River, Haigh Park and Lake Moore foreshores.
- a genuine riverside precinct with high levels of activation, amenity and accessibility, facilitating Council's vision of celebrating the river and prioritising great places for people.

The vision is to shape the city's eastern bank and beyond into an internationally renowned destination loved by locals and visitors alike.

The process

This Plan has been compiled from numerous sources, including:

- Detailed site inspections
- Desk top review of related reports and data
- Assessment and analysis of the proposal in the context of the Gateway Conditions
- Stakeholder Engagement - meeting with DPE Water and DPI Fisheries.

For Stakeholder Engagement, a meeting was held on 26 July 2023 with key stakeholders from agencies that aimed to provide stakeholders the upfront requirements in addressing riparian issues. It is anticipated additional engagement will occur through the exhibition process and post exhibition.

Findings

The Moore Point waterways are defined by two types of morphology (Figure 11), viz.:

- The riverine reach from Lennox Weir to Haigh Park, which has high energy during flooding, and
- The relatively low energy lake reach in Lake Moore

Various studies and data sources relating to the Georges River paint a picture of human intervention in the forms of development of the upstream catchment, riverbank clearing, floodplain filling (often with contaminated material) and sand mining (dredging). The combined effect is to cause the Georges River to adjust by deepening and widening leading to erosion. Historic bank erosion is widespread and there are numerous instances of revetment being employed to stabilise the banks, including on the bank opposite Moore Point to protect the railway line. Flooding is also a key feature of the Georges River which drives the riverine morphology of the main river channel.

At Moore Point, the river is regressing shoreward resulting in erosion of the toe of the bank. This is causing mass failure in the form of slumping. The slumping material is contaminated and this directly enters the river. There is an urgent need to arrest this erosion through bank re-grading and toe stabilisation along the length of the Georges River frontage (approximately 800m).

In contrast, the foreshore of Lake Moore is quite stable and supports good quality riparian vegetation.

Foreshore transformation

To achieve the JLG vision for the waterfront it is essential that the Georges River banks are stabilised to arrent erosion to prevent ongoing migration of the river and to prevent slumping of contaminated soils directly into the River. In order to stabilise the banks along the Georges River frontage, it is proposed to lay back the river bank batters, and to install rock revetment protection works at the toe of the bank. In addition, to providing an improved flooding outcome, this will achieve many urban design, place-making, social and community benefits. It will also enable native landscape plantings to be incorporated that will be irrigated with harvested rain/stormwater, and recycled wastewater to provide urban cooling.

The rock protection works in combination with the revegetation of the banks will create a diverse range of habitat types and it is predicted there will be no net loss of habitat as a result of the works.

Only minor changes to the Lake Moore frontage are proposed, mainly in relation to adding recreational and landscape features for community activation.

As a result of implementation of the proposed Foreshore Strategy (Mecone 2024) submitted as part of the Planning Proposal, the following beneficial outcomes will be achieved:

- no structures in the riparian zone
- the toe of the bank will be stabilised and all current active landward erosion will be arrested
- the river banks will be stabilised and made safe for the community to access the water's edge
- no ongoing slumping of contaminated material into the river
- improved flood conveyance in the Georges River channel
- new terrestrial, estuarine and aquatic habitats created

Riparian assessment

The proposed works have been assessed against the Gateway Conditions and have been found to be fully aligned and compliant with its provisions and objects, with a summary as follows:

1. ***Amend the Riparian Strategy to…demonstrate compliance with the Water Management Act 2000***

Response:

***Water Management Act* 2000 objects**	**Response (see Section 6 for more details)**
(a) to apply the principles of ecologically sustainable development	A Sustainability Statement (Mott McDonald, 2024) for the Moore Point development has been prepared and is a reference document to this Riparian Assessment. In relation to ecology, the ecology of the Lake Moore frontage will remain intact - no changes are anticipated, and enhancements are proposed to connect existing habitats to the open space / public domain with additional plantings of native vegetation. With the whole Georges River waterfront being re-modelled, it will provide free passage of movement for species. Overall, there will be a significant increase and improvement to the ecology of Moore Point as a result of restoring the waterfront from its highly degraded state.

(b) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality	Various design measures are proposed, including:
	• Subcatchment delineation to compartmentalise runoff flows
	• Drainage system design to collect and drain all flows up to the 5% AEP event delivering treated runoff directly to the Georges River and Lake Moore (where stormwater currently drains to)
	• A treatment train selected from the following:
	  ▪ Each lot may have water quality treatment in a chamber using Ocean Protect filter cartridges sized for each site.
	  ▪ Ocean Protect CDS gross pollutant traps on subcatchments as end-of-pipe treatment measure to trap gross pollutants and sediment.
	  ▪ Bioretention basins may be proposed in the public domain (i.e. foreshore and overbanks) to provide further water quality treatment, integrated with landscaping, and providing some urban cooling.
	  ▪ Street tree pit WSUD elements can be employed for subcatchments which cannot drain to a bioretention basin.
	  ▪ Bioswales can be co-located within streets, e.g. the green spine (east-west street access) in the western portion of the precinct.
	• Sewage directed to Liverpool Sewage Treatment Plant. If recycled water becomes available, it will be used to top up stormwater harvesting tanks

	• Water supply from Sydney Water, and augmented with rainwater and stormwater harvesting as outlined above Compliance with Council's DCP and the Georges River Water Quality Objectives and River Flow Objectives is demonstrated. The design represents a contemporary response to water cycle management that provides many ancillary benefits. It is appropriate and fitting for the vibrant mixed-use development at Moore Point.
(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water	The sustainable use of water at Moore Point is summarised as follows: • No extraction of surface water or groundwater • Improvement in runoff water quality through treatment • Harvesting and reuse of stormwater for public domain irrigation and urban cooling • Water efficient fittings and fixtures • Ability to connect to recycled water if it becomes available
(d) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources	The Joint Landowner Group is actively engaging with all stakeholders as they progress the planning and design of Moore Point. Key stakeholders include Liverpool City Council, Sydney Water, DPE Water, NSW Fisheries. Further consultation with a broader range of stakeholders – including community representatives will occur.
(e) to provide for the orderly, efficient and equitable sharing of water from water sources	The proposed development of Moore Point will intensify the demand on water supplies and sewerage systems in Liverpool. The Moore Point development will not seek to harvest any water from the Georges River, Lake Moore or groundwater, and so these resources can be considered to be managed equitably by the proponents. One key design intervention is the potential harvesting of stormwater for reuse in landscape irrigation.
(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna	The key elements of the current environment paint a picture of degradation resulting from human intervention on the peninsula since European occupation. The proposal seeks to intervene and reverse the current degradation that is present at Moore Point. This includes stabilisation of river banks so they cannot deposit contaminated soils in the river, and the subsequent planting of new native vegetation and the creation of habitat across the river and lake frontages.
(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users	The development proposes to be efficient by minimising demand on water supplies both in the built form and in the public domain. Further, the proposed foreshore stabilisation and habitat creation works are a demonstration of the commitment by the JLG to the concept of sharing responsibility with Government.
(h) to encourage best practice in the management and use of water	The water management measures proposed are considered to represent best practice and are consistent with the expectations of contemporary city-shaping development. Specifically, and in

	addition to other matters addressed above - the following are outcomes that will be achieved: • **Social and economic benefits to the community maximised** – the Georges River waterfront will rival the best river waterfronts in the world in relation to seamless activation of commercial, recreational and environmental use • **Floodplain management** - the only flood works are to improve the flood situation resulting from laying back the batters fronting the Georges River. The works will have minor increased and decreased impact on flood levels at Moore Point or Lake Moore. • **Existing and future risk to life and property will be minimised** – the works will provide a safe riverfront experience for users of the waterfront. Upstream and downstream of the precinct, positive or neutral flood impacts (and therefore negligible increased risk to life and property) will result. There will be minimal change to peak flow velocities across the width of the river channel for all modelled flood events. Measures are proposed to minimise risk to life and property arising from flooding, including evacuation strategy. The 1in500 year rain event has been used in the planning of Flood Planning Levels and flood evacuation. • **Land will be rehabilitated** – Moore Point waterfront is being completely rehabilitated by re-shaping the river banks which will provide various benefits including: ▪ lower flood levels and less impediment to flood conveyance, increased flood storage ▪ vastly improves the flood resilience of the river bank ▪ prevents contaminated soils from eroding and slumping into the Georges River ▪ allows for extensive revegetation of the riparian zone and an improved connection between aquatic and adjoining terrestrial habitats

2. ***Amend the Riparian Strategy to… include plans showing inner and outer riparian corridors and all structures that encroach into this area. Certain buildings or structures may be proposed to be located on a riparian corridor consistent with relevant guidelines.***

Response:

The Foreshore Strategy proposes Inner and Outer VRZs for both the Georges River and Lake Moore frontages (see also Appendix A). As identified within the Biodiversity Development Assessment Report (Eco-Logical, 2024a), Georges River is a 7th order stream as per the Strahler classification. For the purposes of applying the Riparian Corridor Guidelines, Georges River is therefore considered to be categorised as *4th order or greater,* and as a result a 40m wide riparian zone is proposed from the toe of the bank (MHWM). This results in 20m wide Inner and Outer VRZs. Prior to sand mining, the current Lake Moore frontage used to front Anzac Creek. It is therefore valid to adopt Anzac Creek as the reference waterway for assigning riparian zone. Anzac Creek is a 3rd order watercourse in this location, and so a 30m wide riparian zone is proposed from the toe of the bank (MHWM). This results in 15m wide Inner and Outer VRZs.

The Foreshore Strategy does not seek to align with the full intent of the *Guidelines for controlled activities on waterfront land: Riparian Corridors* (DPI, 2018). Because a high level of riparian

activation is proposed, an urban waterfront is proposed with associated landscaping with native vegetation. A fully structured native revegetation outcome is not proposed, and so a merit-based assessment of the foreshore strategy is sought, and this is consistent with the Guidelines.

When developed, there will be no structures (existing or proposed) in the riparian corridor fronting either Georges River or Lake Moore. Consistent with the DPI Guidelines' Riparian Corridor Matrix, the only structures being proposed in the riparian zone are the following:

- Revetment to protect the toe of the bank facing Georges River
- (small) Boat launching ramp/s
- Cabanas and pavillions
- Shared paths, boardwalks and viewing platforms
- Stormwater bioretention basins (in outer VRZ only)
- Stormwater outlets and essential services
- Bridges

The *Water Management Act* 2000 also lists principles that apply generally to all water activities and principles that apply to specific uses. The following principles associated with waterways are listed and responses to them are provided in the following table:

***Water Management Act* 2000 Principles**	**Response (see Section 6 for more details)**
Social and economic benefits to the community maximised	The rehabilitation of the Georges River frontage will prove the "missing link" connection between Lighthorse Park and Haigh Park and beyond to the Lake Moore frontage. This minimum 40m wide riverfront and lakefront park will include a shred path and a host of other recreational and environmental features to the benefit of the community. The creation and activation of the waterfront will underpin the success of the Moore Point development.
Floodplain management: • Land must be rehabilitated • Impacts of flood works minimised • Existing and future risk to life and property minimised	The currently degraded environment at Moore Point will be completely rehabilitated through the creation of the development. The flood works include laying back the banks of the Georges River frontage which will eliminate the current impacts caused by contaminated material eroding directly into the River. The proposal has adopted the 1:500 year flood event to set development pad levels in the precinct. A flood evacuation plan has been proposed to protect life in flood conditions.
Controlled activities: • No decline in native vegetation • No increase in land degradation, land must be rehabilitated	The proposal will result in a significant increase in native vegetation in the riparian corridor and beyond. Vegetation within the Lake Moore frontage will largely remain intact. Land degradation (which is currently extensive) will be halted as a result of the foreshore rehabilitation strategies.

Future Development Applications will need to be considered against the Foreshore Strategy as part of the integrated development requirements for controlled activities.

Conclusion

The Moore Point development will transform the currently degraded Georges River foreshore into a vibrant development that integrates, embraces and embellishes the waterfront. The inherently good environmental and recreational values of the Lake Moore frontage will be retained and embellished.

The Foreshore Strategy recognises different levels of use and activation of the waterfront and the retention and embellishment of existing environmental and social/recreational values by creating an urban landscaped Georges Riverfront that faces and connects to Liverpool CBD.

Assessment against the Gateway conditions and other frameworks has demonstrated compliance with the various provisions. The Foreshore Strategy represents a considered and balanced approach to creating a world class mixed use community in the precinct and allows for significant environmental improvements in the riparian corridor.

We conclude that the Gateway condition (to *Amend the Riparian Strategy to …:*

- *Demonstrate compliance with the Water Management Act 2000; and*
- *Include plans showing inner and outer riparian corridors and all structures that encroach into this area. Certain buildings or structures may be proposed to be located on a riparian corridor consistent with relevant guidelines)*

has been met through the assessment and response provided in this Riparian Assessment.

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1. Preamble

Associated reports

This report should be read in conjunction with the following:

- Advisian 2024, Moore Point Precinct Liverpool Flood Impact Assessment
- Eco Logical Australia 2024a, Moore Point Planning Proposal Biodiversity Assessment Report
- Eco Logical Australia 2024b, Moore Point Planning Proposal: Aquatic Ecology Assessment
- Mecone 2024, Moore Point Foreshore Vision and Strategy
- Mott Macdonald 2024, Moore Point Sustainability Statement
- Northrop 2024. Water Cycle Management Statement (appended to this report)
- Royal Haskoning DHV 2017, Georges River bank stability assessment
- SJB 2024, Moore Point Masterplan – Gateway Revised Planning Proposal Urban Design Report.
- Turf Studios 2024, Moore Point Liverpool Public Domain and Landscape Strategy
- Worley 2024, Moore Point Precinct Liverpool, Flood Emergency Response Plan
- Yerrabingin 2024, Moore Point Indigenous Narrative Report

Images and content in these documents have been reproduced in this Report.

About the author

- Mal Brown, Master of Natural Resources; B. Envt'l Sci (Hons)
- Mal has 39 years' experience in the environment and engineering, with strengths in waterways.

2. The Development

Moore Point is the largest privately-led urban renewal project in Australia, led by a Joint Landowner Group (JLG) comprised of Coronation Property Co and Leamac Property Group.

The 31.4 hectares site, set within the Liverpool Collaboration Area (LCA), is a unique opportunity to deliver a model for urban renewal at a metropolitan scale consistent with the strategic priorities of Government, it will be a catalyst for Liverpool City Council (Council) to realise its objectives for the LCA and the Western Parkland City.

When delivered, Moore Point will consolidate Liverpool's role as Australia's a great river city, providing a high-quality living and working environment for future generations. It will deliver homes, jobs and open space up to 2060, in a highly accessible location with unparalleled recreational amenity along the Georges River and Lake Moore.

At a glance, Moore Point will deliver:

- Approximately 11,000 dwellings set within distance of Liverpool CBD and LCA,
- A significant contribution of employment generating floorspace and associated jobs to complement the expansion of Liverpool CBD, and
- Over 10 hectares of publicly accessible open space supported by bridge crossings from Liverpool CBD to a fully accessible Georges River foreshore and Haigh Park.

The site plays a critical role in fulfilling the connectivity, liveability, productivity and sustainability priorities of the LCA and support the vision to make Liverpool Australia's next great river city. These include:

- New housing and jobs within a highly accessible location (five minutes' walk to Liverpool CBD and transport interchange) via new bridge crossings over the Georges River. This will support active and sustainable modes of travel within the LCA.
- Critical links from the CBD and LCA to the Georges River, Haigh Park and Lake Moore. This will support the creation of a new interconnected high-performance green and blue infrastructure network, which will support healthy urban growth.
- A genuine riverside precinct with high levels of activation, amenity and accessibility, facilitating Council's vision of celebrating the river and prioritising great places for people.
- A diverse range of new and enhanced social and civic infrastructure outcomes to benefit both current and future generations

The Vision

In preparing the planning proposal, the JLG have developed the following vision for Moore Point:

- Liverpool has the ambition to be the next Great River City of the world. A city where the Georges River is its beating heart unifying both sides of the river into a pulsating riverfront experience.
- The Moore Point vision will shape the city's eastern bank into an internationally renowned destination loved by locals and visitors alike. Reimagined riverfront parklands, river pools, creative heritage quarter and marketplace inspire our people and residents to be the most productive, most happy, and most healthy people on the planet.
- The proposal will create the first truly integrated riverfront development at scale. At the heart of this attraction will be a revitalised riverbank which will undergo an ecological transformation and create a natural, healthy and vibrant river ecosystem.
- The river will also offer a diverse range of recreational opportunities, providing activities that meet the needs of a diverse community, and which encourages an active outdoor lifestyle.

The Proposal

The planning proposal seeks to amend the Liverpool Local Environmental Plan 2008 (the LEP) to transform the zoning from industrial to mixed-use and public recreation, including changes to floor space ratio, height of buildings and site-specific provisions.

In response to the Gateway conditions, the planning proposal and supporting structure plan has been updated. The planning proposal has enhanced and improved many of the key elements of the originally endorsed Structure Plan and planning proposal by Council on 25 November 2020 meeting including:

- Celebrating Heritage – Enhanced heritage response, including the retention of the heritage grid, Factory 1 and the Administration Building with partial retention of Factory 2 and adaptive reuse of additional outbuildings along the Georges River foreshore.
- Foreshore Park – Embellishment of a new 7 hectare linear foreshore park and completing the missing link between Lighthorse Park and Haigh Park.
- Bridges and Community Anchors – Creation of new pedestrian bridges to Liverpool CBD and LCA, facilitating access from the wider area to a 1,000 capacity primary school, community facilities and retail amenity.
- Street Hierarchy and Boulevards – A new movement and access network to facilitate active transport from Georges River to Lake Moore and a ring road to support vehicular movement.
- Pedestrian Lanes and Pocket Parks – Creation of a diverse range of pocket parks, passive open space areas and pedestrian laneways between blocks to enhance access to open space, views and access to the waterfront.

The JLG engaged Yerrabingin to prepare an Indigenous Narrative Report. The report establishes Connecting with Country themes for the revised masterplan and public domain. This includes bringing river ecology up and over into the foreshore, including restoration of endemic/native species through naturalised revetment treatment that will support habitat.

The revised planning proposal has been informed by a suite of interdisciplinary technical consultants through an iterative process (Figure 1) to ensure the creation of a successful place that comprehensively addresses the Gateway conditions.

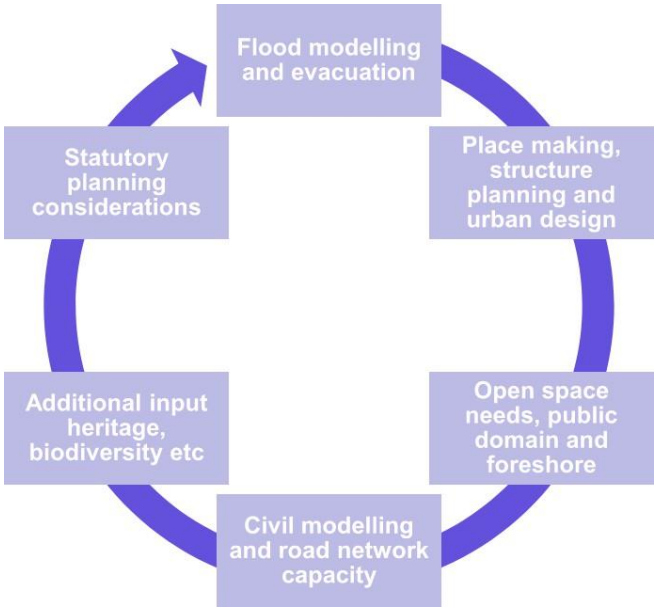
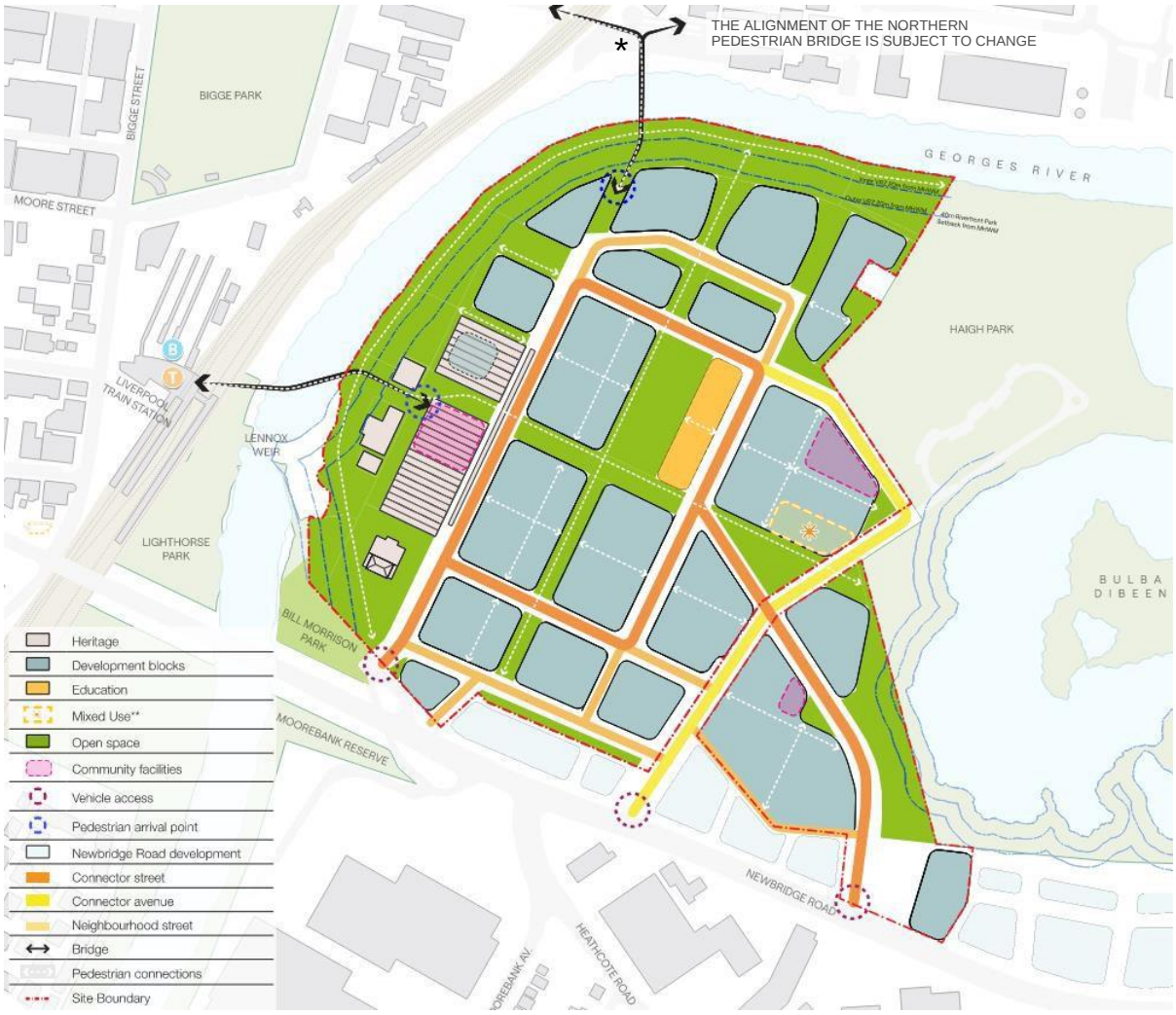


Figure 1: *Planning Proposal inclusions*

Structure Plan

The planning proposal is supported by a structure plan which sets out the spatial parameters for Moore Point that will remain constant throughout the delivery of the project.



* The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Figure 2: *Structure Plan (SJB 2024)*

3. Site Context

Moore Point is located east of Liverpool CBD across the Georges River in the suburb of Moorebank. It is located within the LCA and comprises 31.4 hectares of the 38 hectare Georges River North Precinct.

The site is defined by the Georges River along the western and northern edge and Lake Moore along the eastern edge. Part of the site contains heritage items including the Former MM Cables Factory and Cable Makers Australia Factory Pty Ltd Group, including inter-war administration building, factory and interiors.

The land subject of the planning proposal relates to the land owned and under the control of the JLG, as defined in Figure 3.

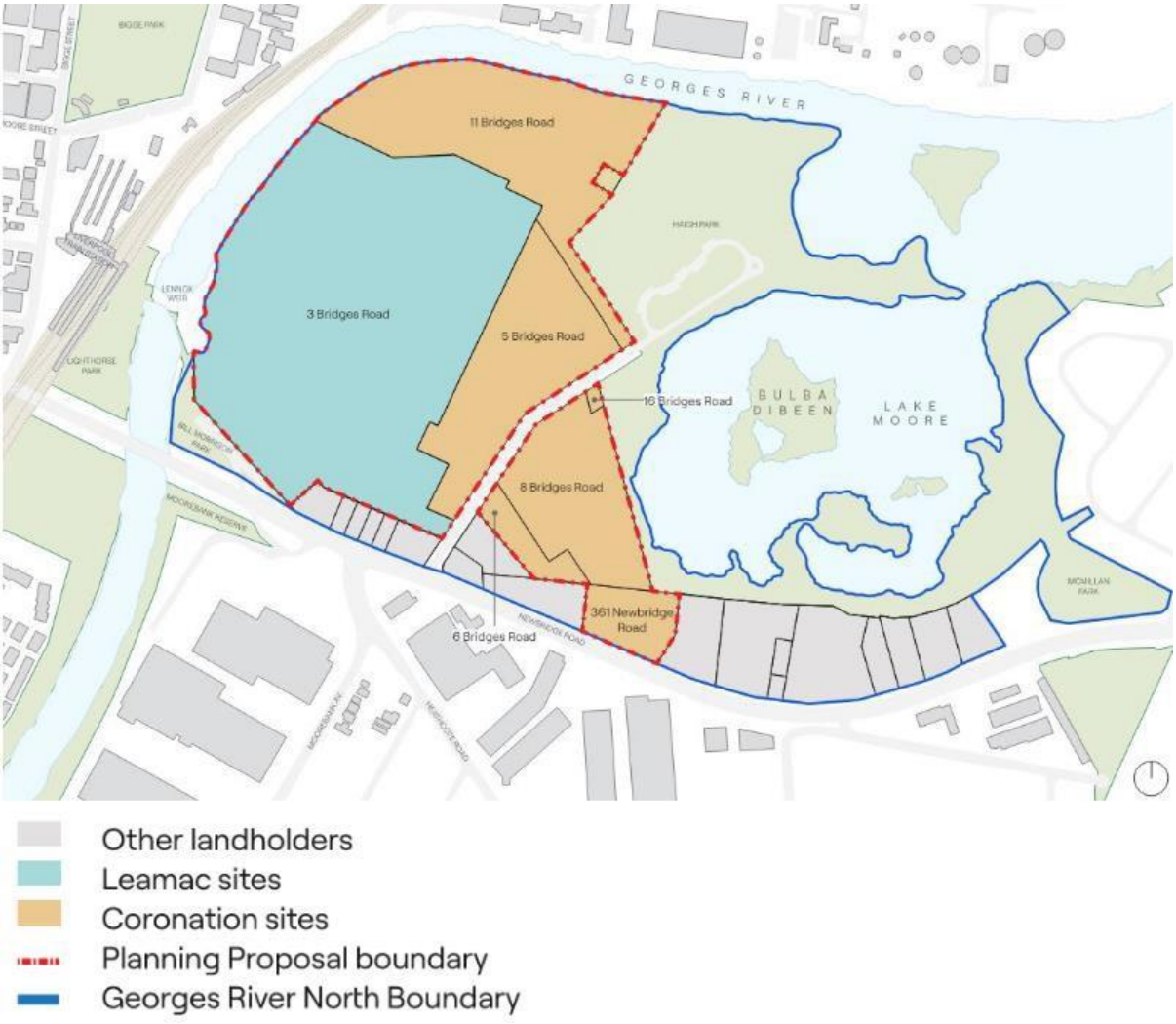


Figure 3: *The site of the Planning Proposal*

3.1 Catchment context

The Georges River is around 100km in length, covering an area of approx. 960km^2 (Figure 4) and is home to a population of 1.5 million people. Upstream of Anzac Creek/Moore Point, the catchment is 368km^2 in area. This includes a native forest areas in the headwaters, and developed areas in the LGAs of Wollondilly, Campbelltown and Liverpool.

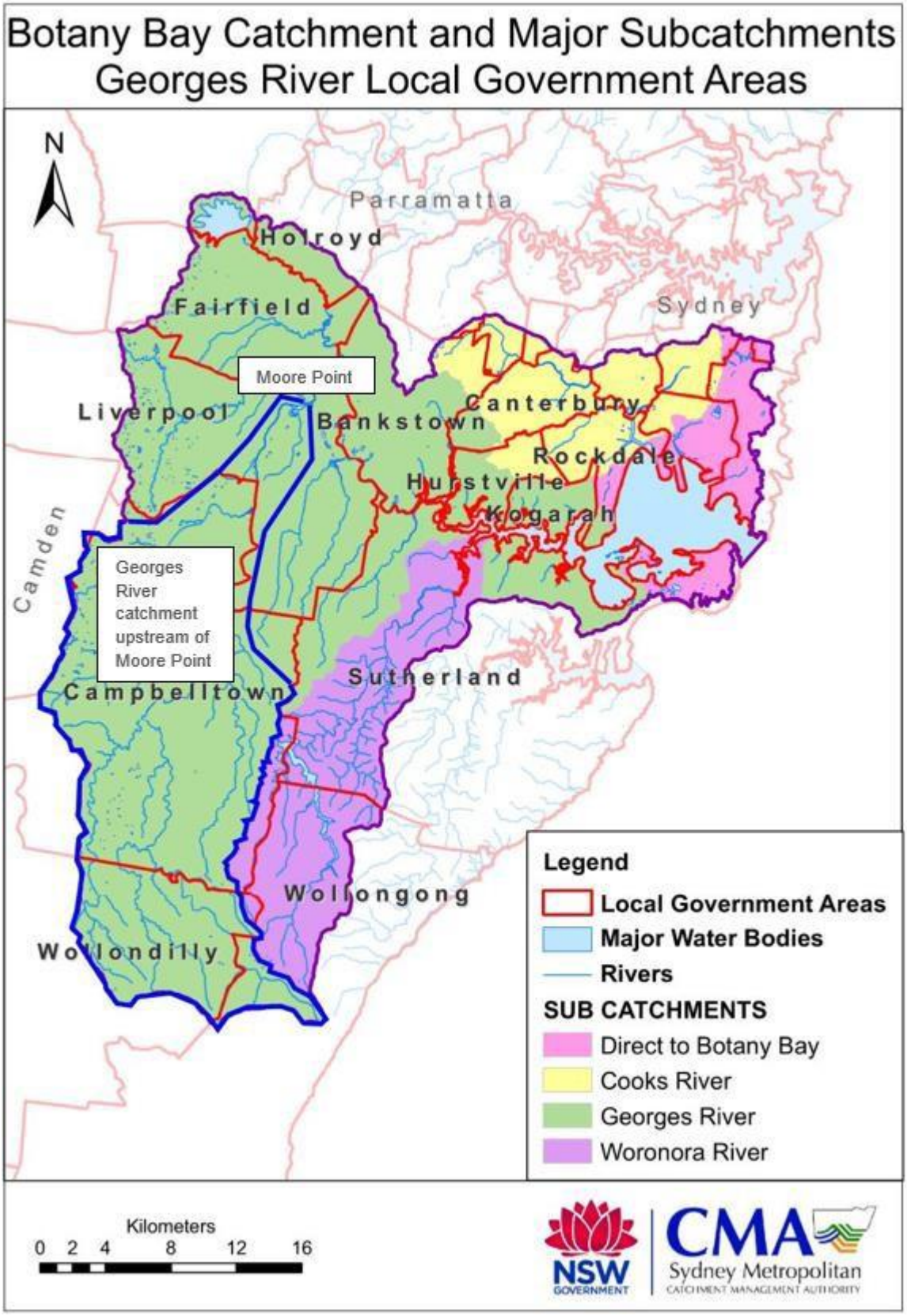


Figure 4: *Georges River catchment map*

Downstream of Moore Point is Chipping Norton Lakes which was sand mined in the 1950s, and then converted to a flooded wildlife reserve (Figure 5).

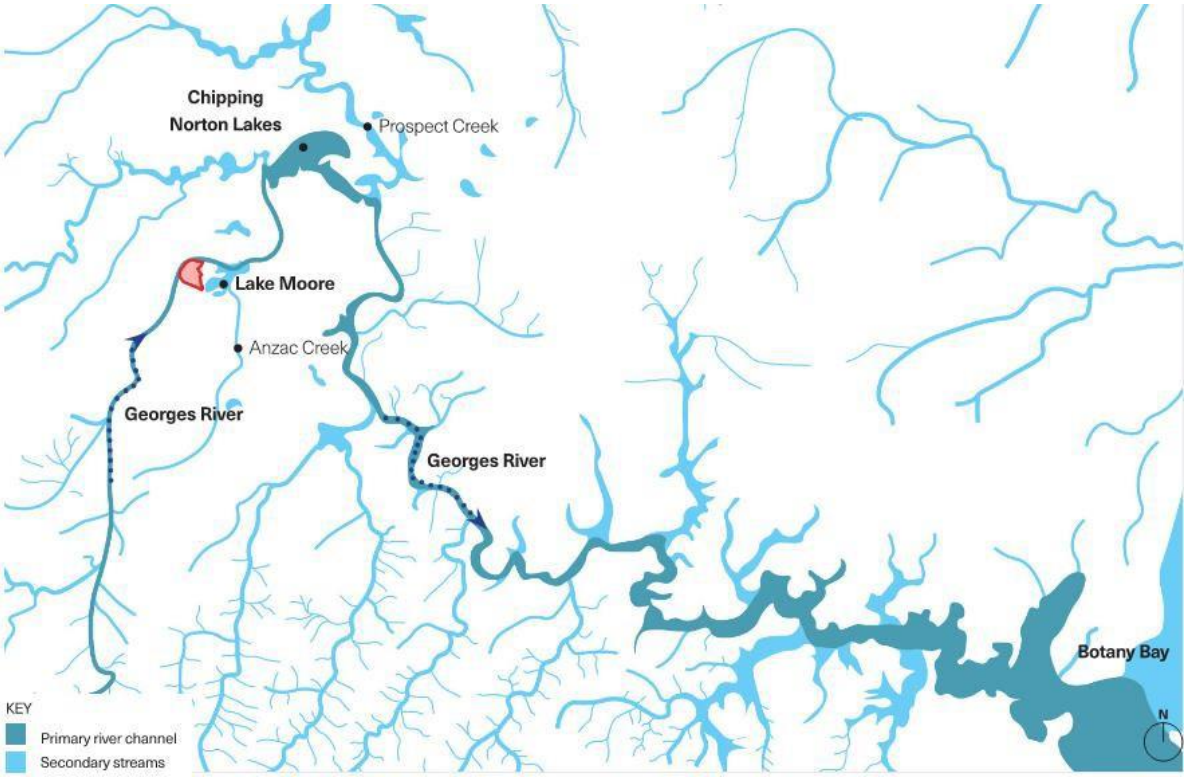


***Figure 5**: Moore Point in the context of Georges River*

3.2 Riverine environment

3.2.1 Georges River history

Moore Point and the Georges River can be viewed in an historic context from ancient times, through pre-European to the present day (Figure 6).

Image 1 depicts Ancient Sydney (20,000 years BP) with lower sea levels. The Georges River incised into the ancient sandstone geology.

Image 2 shows Pre-European conditions with sea levels risen to drown out the Georges River.

Image 3 shows the present day with the level of development in the catchment indicated.

Figure 6: *Georges River catchment history*

The fluvial (riverine) morphology of Moore Point in 1943 is shown in Figure 7. Lake Moore was a remnant oxbow lake/billabong. The area (including riverbanks) was largely cleared and the alluvial floodplain supported horticulture. Lake Moore was subsequently formed by sand mining, connecting it to the Georges River.

Figure 7: *Moore Point in 1943 (Source: Six Maps)*

Today, Moore Point and Lake Moore supports more vegetation, largely from plantings around the Lake and Haigh Park and limited natural regeneration around the river (Figure 8).

Figure 8: *Moore Point and Lake Moore today (Source: Six Maps)*

3.3 Riparian connections

Relevant subregional analysis for the river showing its broader riparian connections are shown in Figure 9.

Figure 05: river corridors diagram

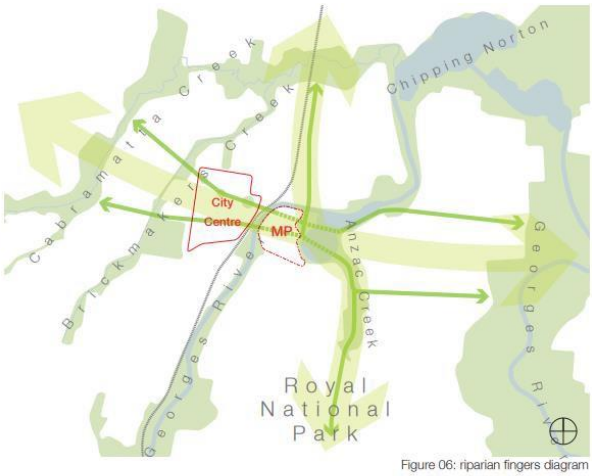


Figure 06: riparian fingers diagram

1) River corridors

There is an opportunity to reinstate the Georges River corridor as the pre-eminent recreational arterty through south-western Sydney. Historically, transportation, culture, economy and leisure for local people was focused along the river which connects the the broader system of creeks and joins Liverpool to Botany Bay and broader Sydney.

2) Riparian fingers

Linking green corridors is a policy priority in the GSC 'Blue and Green Grid Strategy'. Moore Point presents the opportunity to connect two of four riparian fingers which lead into the Georges River and significantly strengthen the subregional network of open spaces as has been demonstrated at Shepherd Street to the south.

Figure 9: *Sub-regional riparian connections (SJB, 2023)*

3.4 Moore Point fluvial geomorphology

Moore Point and Lake Moore are bounded by the main channel of the Georges River as it meanders eastward at the Liverpool CBD reach (Figure 10).

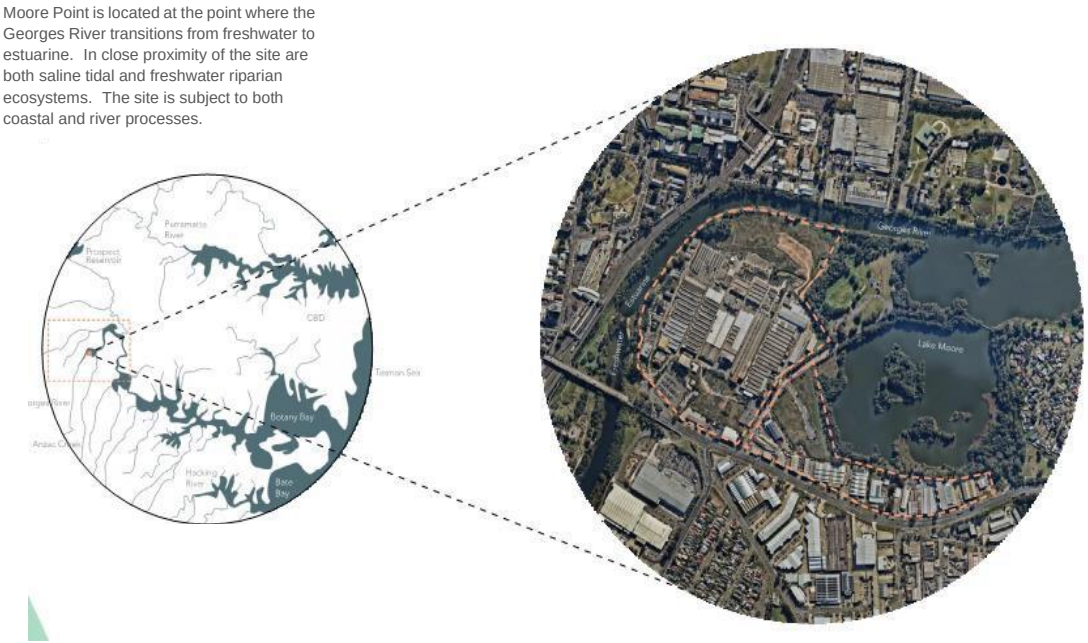


Figure 10: *Moore Point and Lake Moore in the context of the Georges River*

The Moore Point waterways are defined by two types of morphology (Figure 11), viz.:

- The riverine reach from Lennox Weir to Haigh Park, which is high energy during flooding, and
- The relatively low energy lake reach in Lake Moore

Anzac Creek flows into Lake Moore in its eastern extent (Figure 11). This prevents Lake Moore from becoming stagnant, however, it also introduces urban pollutants into the lake. Flooding in Anzac Creek is generally caused by the flooding of the Georges River which causes backwater flooding in the Anzac Creek floodplain (BMT WBM 2008).

Upstream of Moore Point, the Georges River is a freshwater pool formed by Lennox Weir (Figure 12) which defines the upper extent of the tide (brackish water).

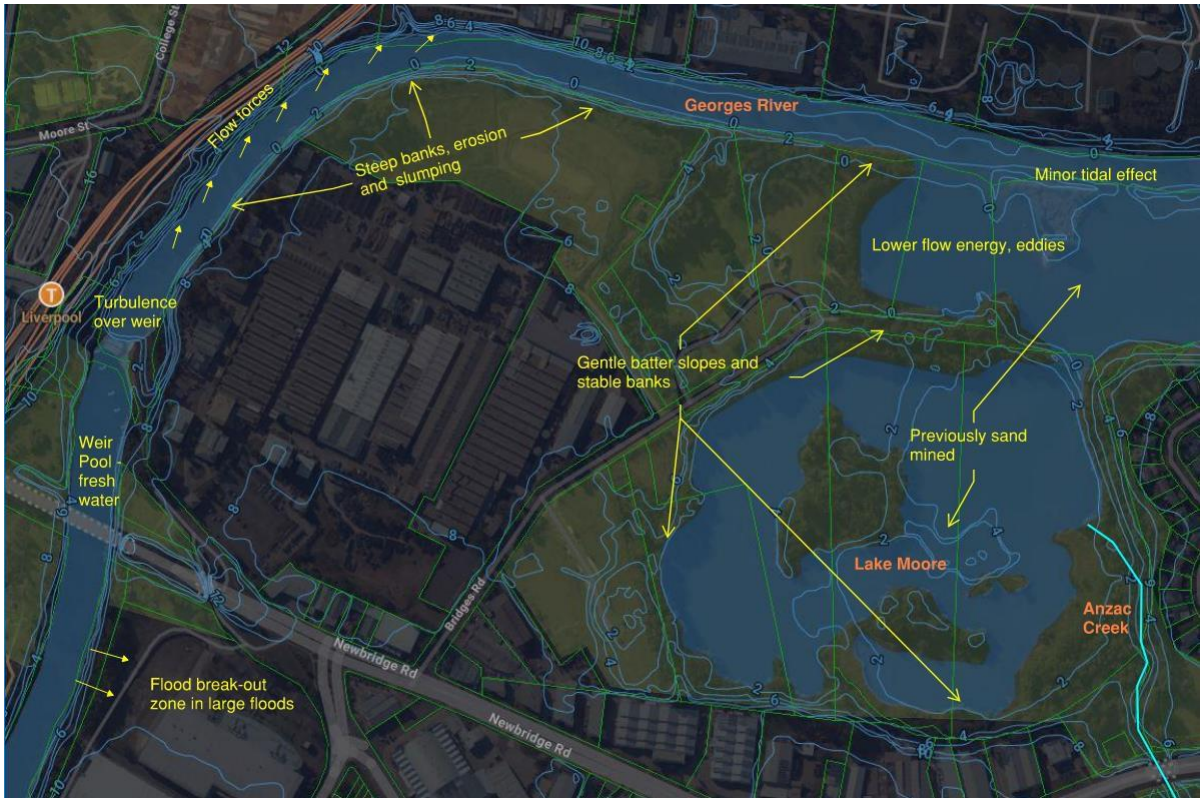


Figure 11: *Riverine morphology at Moore Point (Map source: Mecone Mosaic)*

On the western side of Moore Point is the Lennox Weir which forms a physical barrier between the tidal (brackish) water downstream, and non-tidal, fresh water upstream (Figure 12).

Figure 12: *Lennox Weir on Georges River at Moore Point.*

3.5 Georges River instability at Moore Point

3.5.1 Results of Estuary Process Study SMEC (2008)

The *Georges River Data Compilation and Estuary Process Study* listed the following summary of findings pertaining to Moore Point:

- Tidal range is relatively constant with differences in levels of less than 0.1m between Liverpool Weir (mean spring range of 1.31m) and Botany Bay (mean spring range of 1.25m)
- Salinity levels are low at Liverpool Weir – 0-10ppt and this zone is subject to daily tidal action. This influences marine life
- There is a veneer of fine sediment overlying the coarse sands between Liverpool Weir and Lake Moore, indicating a low tidal influence
- Historic bank erosion is widespread
- Between Liverpool Weir and East Hills (upstream of Moore Point) is a geology consisting predominately of dispersive clays and shales, which amplifies the turbidity in the channel
- Dredging too close to the riverbanks has caused slumping and significant erosion issues and scouring of the bed
- Two major kinds of erosion are identified along the Georges River, i.e.
    - Scouring of bed and toes of banks
    - Mass failure, especially where banks are steep, as a result of scouring of the toe
- Other factors at Moore Point known to contribute to erosion include: erosion-prone materials in river banks; change in flow regime at the weir, Lake Moore Inlet

3.5.2 Results of Georges River Banks Stabilisation assessment

Specialist riverine environmental engineers (Royal Haskoning DHV, 2017) conducted a geomorphic and geotechnical assessment of the Georges River banks from the M5 Motorway bridge to the Lennox Weir at Liverpool CBD. This is the river reach immediately upstream of Moore Point totalling 1.8km in length. Key findings are listed as follows:

- This reach of the river has its (low flow) water level determined by the level of the Lennox Weir, 2.79m AHD
- The western bank is higher and steeper than the eastern bank. The western bank has slopes to 1V:1H and the banks are unstable. Landslides have occurred along the western bank since the 1930s
- River banks at Shepherd Street precinct (western bank) slumped in June 2016, coinciding with a moderate flood event. In part, the mechanism of failure was unconsolidated fill placed on the river bank. Another suspected failure mechanism is “drawdown” where river water rises during flooding to saturate the banks. As it recedes it is too heavy to support the additional weight of water and it slumps
- Scour was occurring at stormwater outlet structures along the reach

Royal Haskoning DHV and JK Geotechnics proposed a revetment design at Shepherd Street precinct (800m upstream of Moore Point) to stabilise the western riverbank (Figure 13). These works are now constructed (Figure 14).

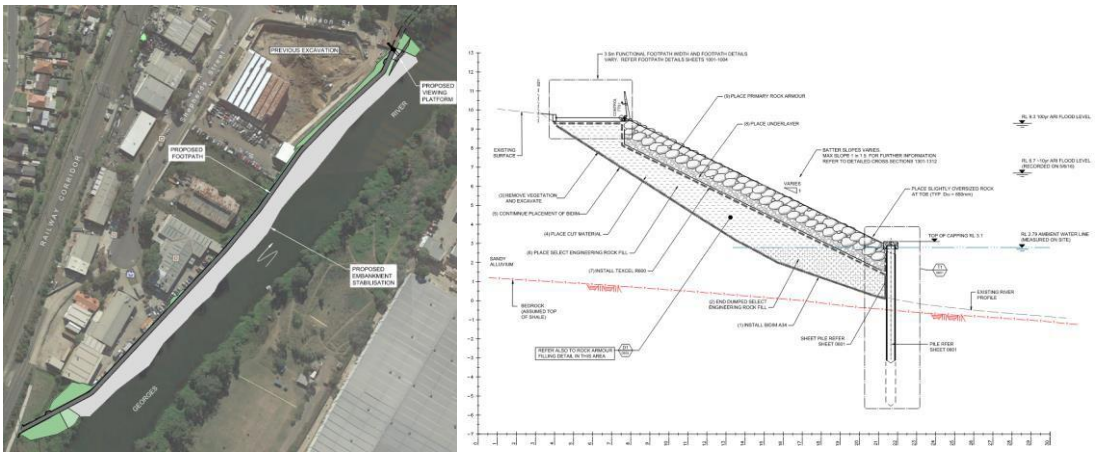


Figure 13: *Concept design extent of revetment stabilisation works on the western river bank at Shepherd Street Precinct*

Figure 14: *Constructed river bank revetment works at Shepherd Street Precinct*

RHDHV (2017) also reported scour protection works associated with the abutments of the M5 bridge over the Georges River (Figure 15).

Figure 15: *Gabion revetment stabilisation of western river bank at M5 bridge*

Transport for NSW (Sydney Trains and NSW Trains) operate the railway line at Liverpool. The river embankment suffered scour and undercutting. The train line above was threatened by this instability and needed stabilisation. The revetment is now constructed and extends for a 200m long stretch of the river bank opposite the western side of Moore Point (Figure 16).

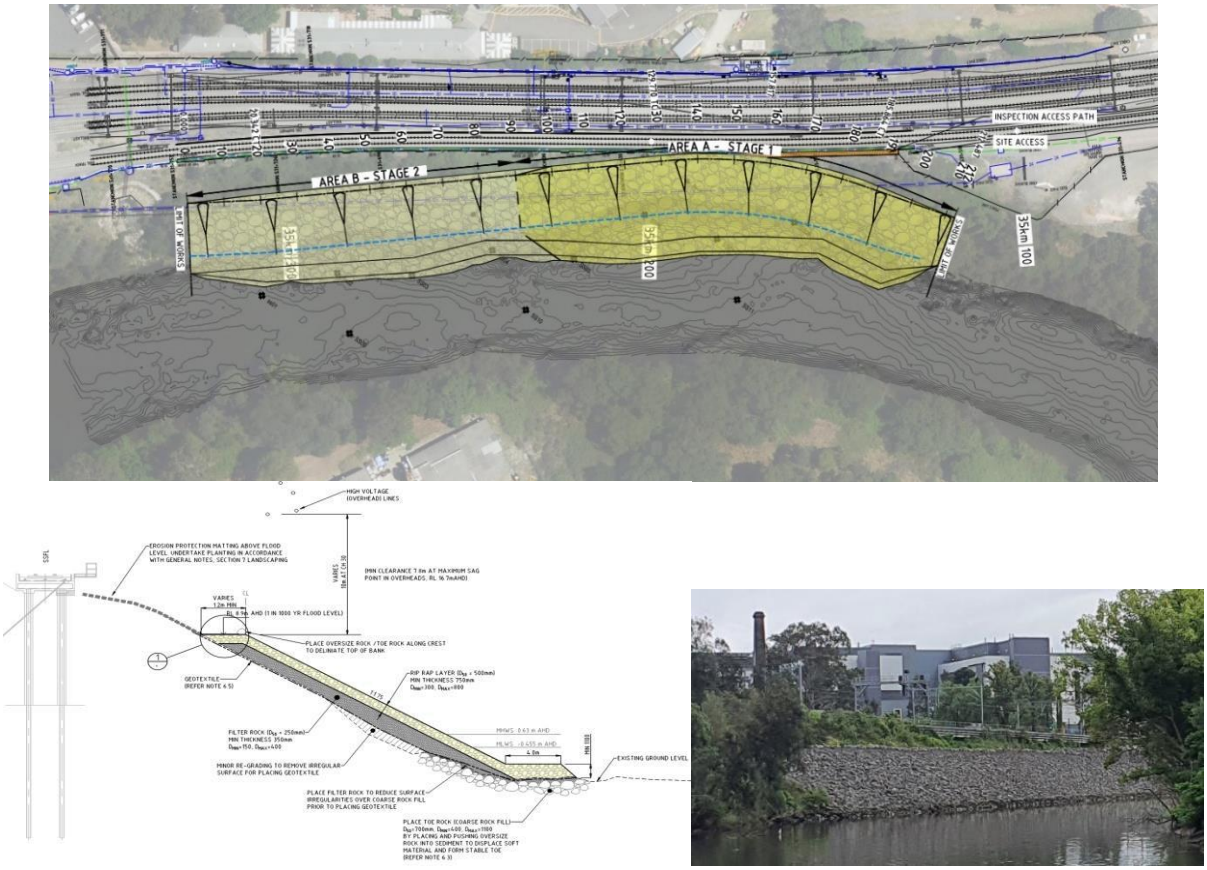


Figure 16: *Revetment stabilisation section of the railway line embankment opposite Moore Point (Source: Jacobs)*

3.5.3 River and lake transects

Bathymetric data was sourced from the Office of Environment and Heritage data portal. This data contains records of Georges River hydrographic surveys for the period 1976-97. The cross-sections for this time period demonstrate a deepening and widening of the river and regression of the river bank adjoining the Moore Point development site. This means that over time the toe of the river bank has eroded and the banks that are supported by the toe can become unstable, leading to slumping (RHDHV, 2021).

3.5.4 Flood forces on the river bank at Moore Point

Using a Tuflow flood model of the Georges River at Moore Point, RHDHV was able to indicatively determine the peak flow velocities and bed shear stress associated with flood events at Moore Point (Figure 17).

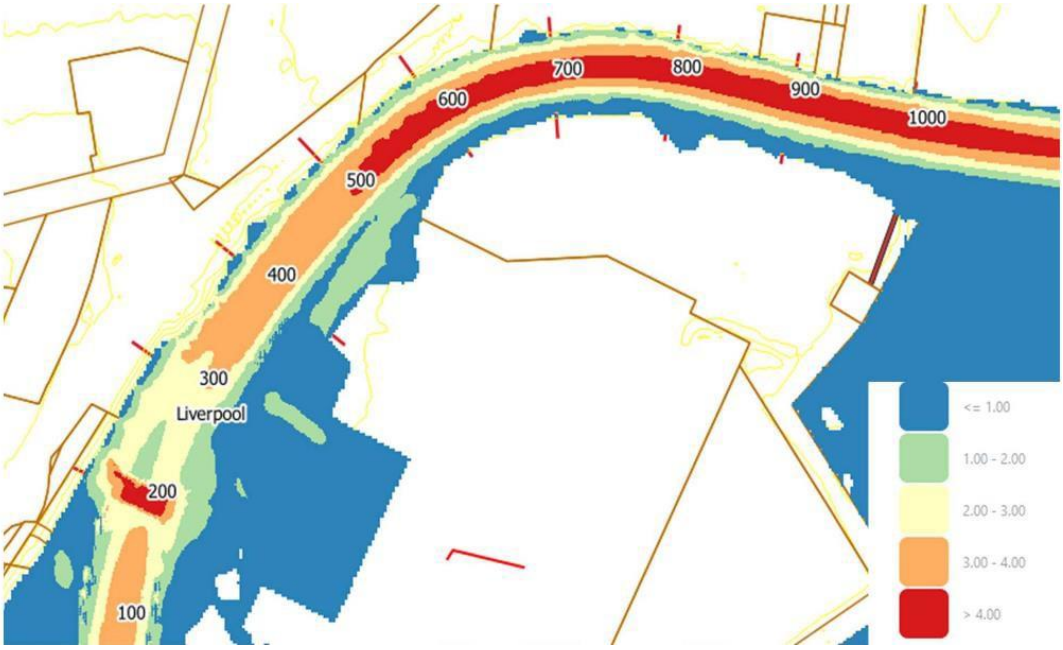


Figure 17: *Indicative 1% AEP Flood Velocities (Source: RHDHV 2021)*

The results indicate the velocity in the middle of the river exceeds 4m/s in the 1% AEP event, whereas, the predicted velocity on the river bank is typically below 1.5m/s for events up to the 1% AEP.

3.5.5 Riverbank erosion at Moore Point

Royal Haskoning conducted on-river inspections of the river banks at Moore Point in November 2021. They compiled a section-by-section description of the erosion processes and backed this up with site photography (Appendix B). They found that bank erosion is ongoing and widespread on the steep western and northern riverbanks fronting the Georges River, including:

- Slumping at the weir spillway
- Slip failures and bank slumping resulting in localised sand deposition and collapsed trees
- Undercutting of the toe of the bank – exposing tree roots and predisposing them to collapse

Some instability was observed at Haigh Park where it fronts the Georges River.

Two items of infrastructure were also located along this bank, i.e. a Sydney Water sewer overflow structure, and a Jemena gas pipeline.

The following observations are made from the site inspection:

- Overall, the majority of the length of riverbank appears to be undergoing regression and failure of the upper bank area. In particular, the regression can be attributed, in part, to the influence of tidal and fluvial processes in the zone around 1 metre above the mean sea level. This in turn is undermining the upper part of the embankment and appearing to result in a slumping failure.
- Together with this, it is apparent that the existing embankment is unstable, with ongoing regression and failure of the embankment observed.
- Re-construction of the gabion wall downstream of the existing weir is likely to be required.
- While there may be localised areas containing mature native vegetation that are nominated for retention, given the regression observed along the length of the embankment, protection measures are considered necessary within this location also.

In February 2020, a relatively large rainfall event affected the Georges River. Inspection of the riverbank at Moore Point (northern part of site) after flood waters receded revealed that erosion (slumping) of the riverbank occurred (Figure 16). This emphasises the inherent instability of the riverbanks at Moore Point. Note also this is contaminated material which is directly entering Georges River, causing ongoing pollution.

Figure 18: *Riverbank erosion at Moore Point Feb 2020. Source: Georges Riverkeeper*

3.5.6 Summary of Georges River stability

In summary, steep banks of the Georges River have a history of instability requiring substantial engineering intervention to stabilise them. All previous revetment stabilisation was in relation to protecting assets against riverine bed and toe erosion and mass failure. These erosion mechanisms remain active at Moore Point on the Georges River frontage.

3.6 Flooding

The Georges River is particularly susceptible to flood due to its morphology. Upstream of Moore Point, the narrow river valley confines waters causing it to back up and breach the banks. Significant flooding (>7.0m AHD) has not occurred since 1986. The highest recorded flood level is 10.5m AHD in 1873, though this flood level has been extrapolated from anecdotal data, as opposed to a measurement. Moore Point is situated where this confined river reach terminates, before opening out into Lake Moore.

Manly Hydraulics Laboratory gauged river levels at Moore Point from 1980 to the present day. An analysis of this data shows the following:

- Flood levels exceed 4.9 mAHD four times over the past 40 years
- Flood levels exceed 4.0 mAHD eight times over the past 40 years
- Flood levels exceed 2 mAHD twenty-one times over the past 40 years

The data was further analysed to determine durations of inundation. For a 1in10year (approx.) event in 2016, the flood level exceeded 3 mAHD for about 20 hours, and exceeded 4.5m for about 13 hours.

We conclude that the foreshore needs to be designed to be resilient for these flood levels and durations.

3.6.1 Existing flood conditions

Under existing conditions, the site remains largely flood free during events up to and including 5% AEP flood. Flooding in a 1% AEP event will result in shallow flooding across parts of the existing site with typical depths of no greater than 0.3 m (Figure 19).

***Figure 19**: Predicted flood extents for key flood levels in existing conditions (Source: Worley, 2024)*

3.6.2 Post-development Conditions

A summary of Advisian's (2024) findings are provided as follows:

- The proposed redevelopment of the site involves filling to raise areas of the precinct to the flood planning level (1% AEP plus 0.5 m) which is at least 0.1 m above the predicted peak level of the 1 in 500 AEP flood. This will ensure that the majority of the proposed development will remain flood free during floods up to and including the 1 in 500 AEP event.
- For the 5%, 1% and 1 in 500 AEP events, the development is predicted to result in reductions to flood levels upstream of the site by up to 0.06 and 0.03 metres.
- The reduction in flood levels upstream of Newbridge Road during a 1% AEP event is predicted to benefit over fifty residential properties to the west of the Georges River and to the east of Moorebank Avenue. Approximately ten industrial/commercial properties would also benefit from the reduction in flood levels predicted upstream of Newbridge Road.
- The development is also predicted to cause flood level increases outside of the site during the 5% and 1% AEP flood events of up to 0.05 and 0.08 metres, respectively. The extent of these

maximum impacts is largely limited to the Georges River channel and the adjacent railway embankment.

- During a significant flood event such as the 1 in 500 AEP flood, the proposed development is predicted to generate both increases and decreases to flood levels outside of the site. The extent and magnitude of the predicted decreases exceed the impacts that occur across areas in close proximity to the Georges River.
- The reduction in flood levels upstream of Newbridge Road during a 1 in 500 AEP event is predicted to benefit over two hundred (200) residential properties, consisting of both apartment buildings to the west of the Georges River and residential properties to the east of Moorebank Avenue, with reduced peak flood levels of up to 0.13 metres.
- Further to the above benefits to existing residential and commercial/industrial properties, the predicted impacts are considered acceptable.
- The proposed development is predicted to cause minor increases to peak flow velocities during the 5%, 1% and 1 in 500 AEP events for the majority of areas outside of the development site. The vast majority of velocity increases are predicted to occur within the site and along the Georges River foreshore. These localised increases are expected based on the excavation and foreshore re-shaping that is proposed.
- The flood velocities along the riverbank are relatively minor with velocities along the river bank typically less than 1 m/s for the 20% AEP and 1%. Vegetation is able to withstand frequent velocities up to 1m/s and can withstand infrequent velocities up to 2m/s during larger and rarer events. In these larger events vegetation may be temporarily impacted but is able to self-recover over time. Velocities in Lake Moore are low and less than 1 m/s and hence do not pose any risks to vegetation.

Flood levels for the 1% AEP flood in developed conditions are as shown in Figure 20.

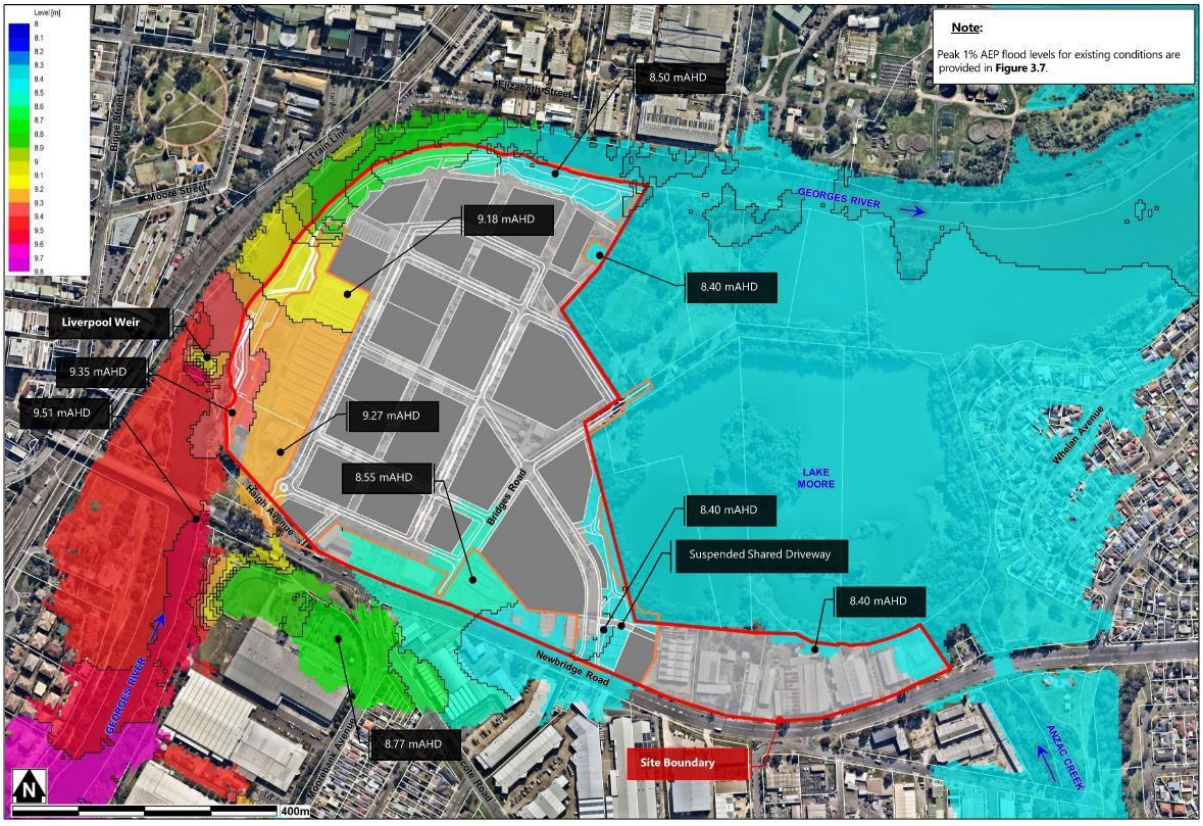


***Figure 20**: Predicted flood levels at the peak of the 1% AEP event for post-developed conditions (Source: Advisian, 2024)*

In relation to flood evacuation, Worley (2024) concluded the following:

- There are four potential vehicular evacuation routes from the development to Newbridge Road, with varying levels of flood immunity.
- Two pedestrian footbridges connecting to the Liverpool CBD are proposed which will facilitate evacuation.
- 7.25 hours of evacuation time is predicted, which is considered adequate to evacuate the development
- Any people remaining within the Moore Point Precinct that were not able to, or did not elect to evacuate by vehicle or by foot, will be required to shelter in place within apartments or nominated communal gathering areas. As a risk mitigation measure, all habitable floors and back-up infrastructure will be at or above the predicted peak PMF level of 12.2 mAHD

3.7 Aquatic ecology

EcoLogical Australia (2024a) have reported on habitat types at Moore Point with the key findings in Figure 21. They report on three key fish habitat sensitivity types – Highly, Moderately and Minimally Sensitive. There is little key fish habitat extent in the development extent facing the Georges River. Most habitat values are associated with Lake Moore.

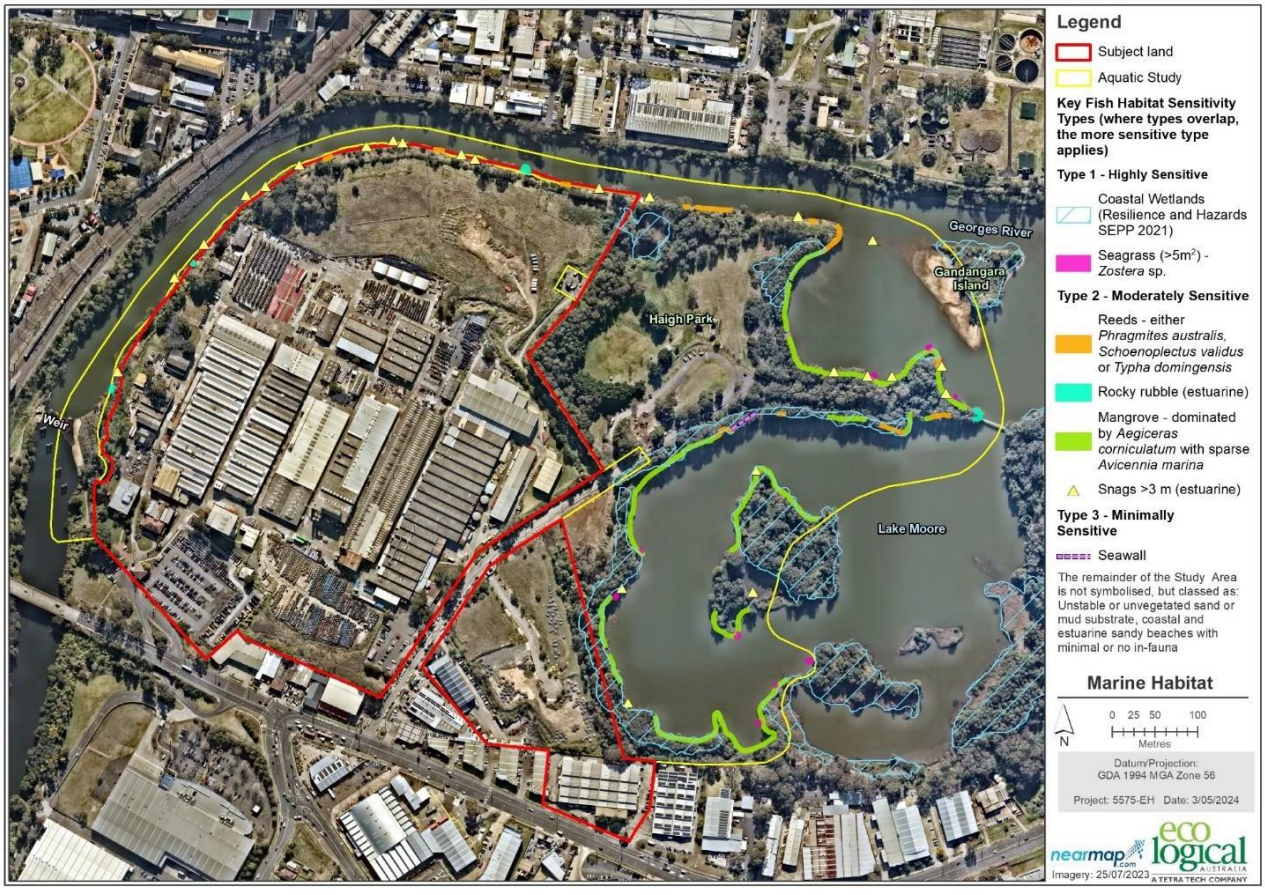


Figure 21: *Key fish habitat types at Moore Point (EcoLogical Australia, 2024a)*

In their assessment of impact on key fish habitat, ELA state that bank re-shaping will result in the loss of Minimally Sensitive fish habitat and 800m of riparian vegetation on the bank, however, it will be replaced by riparian and intertidal habitats and conclude that no net loss of habitat is likely. Lake Moore fish habitat will be relatively unaffected.

3.8 Remnant Ecology

Eco Logical Australia (ELA) conducted a study of the existing vegetation at the site (Figure 22). They found that vegetation on site could be characterised as one of three vegetation communities, viz.:

- Swamp Oak Floodplain Forest (SOFF) – an endangered ecological community (EEC)
- River Flat Eucalypt Forest (RFEF) – an EEC
- Planted native or exotic vegetation

SOFF was recorded on the fringes of the Georges River primarily in the northeast of the study area and parts of edges of Lake Moore. Total area occupied by SOFF was estimated at 1.5 ha. ELA field assessment found that this EEC was highly degraded but did have some of the characteristic species present that define this EEC.

Similarly, the field assessment of RFEF found it was in highly degraded condition but did possess some of the necessary species to define it as RFEF. On site this EEC occupied approximately 2.17Ha and was found on the eastern, northern and western fringes of the study area along the banks of the Georges River and Lake Moore.

Remediation of riparian corridors should follow the distribution of the mapped EECs, and restore these ecological communities. Additionally, new areas of SOFF or RFEF could be reinstated, increasing the overall size of the EECs and enhancing the biodiversity value of the site.

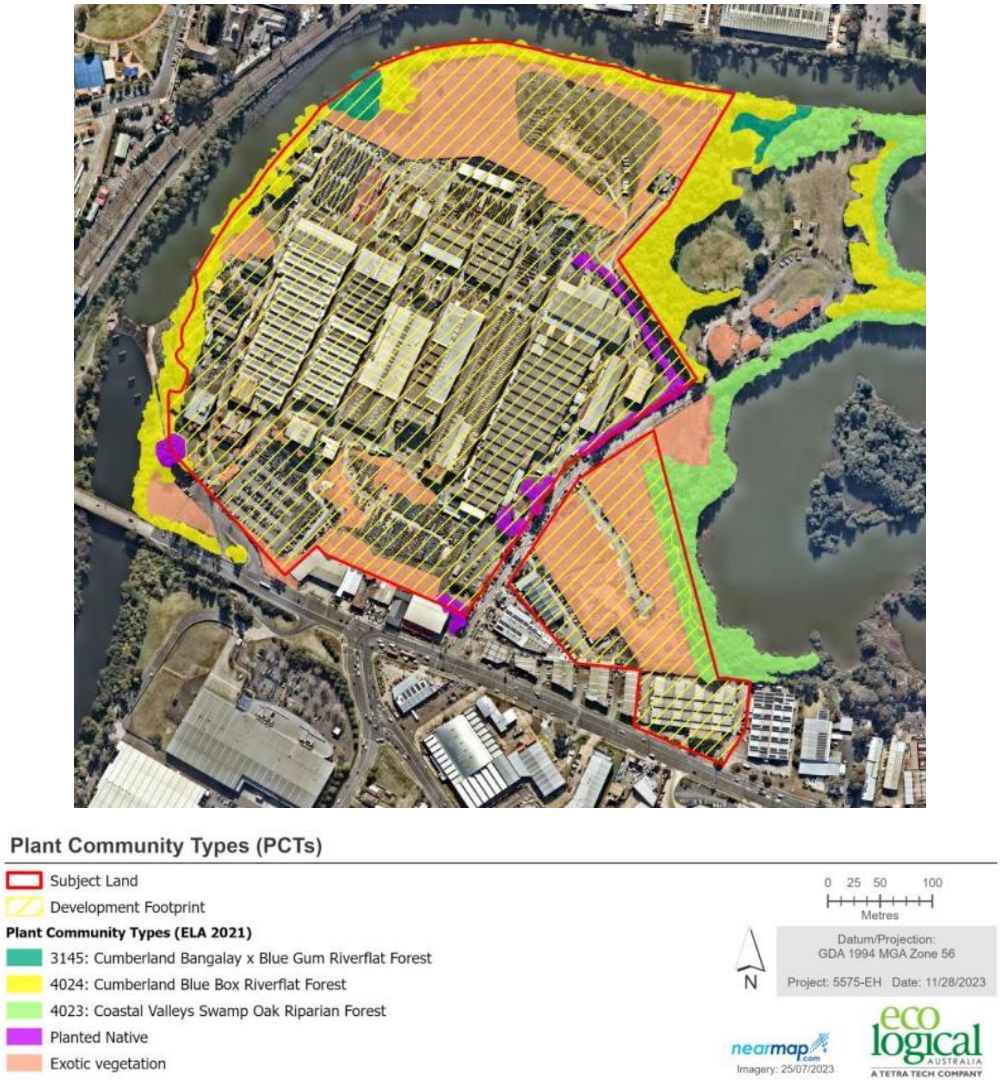


Figure 22: *Plant community types and native vegetation extent (Source: Eco Logical Australia, 2024)*

3.9 Site contamination

Moore Point was originally low lying farm lands until the 1940s. It was filled to create pads for industrial development. In addition, the industries at Moore Point have operated for decades resulting in the escape of contaminants into the soil profile.

As a consequence, contaminated soil profiles are common across the site, and including within the riparian zone (EI Australia, 2024a). When bank failure occurs, contaminated material directly enters the Georges River.

3.10 Acid Sulphate soils

Eco Logical Australia have prepared a map of Potential Acid Sulphate Soils at Moore Point (Figure 23). It indicates that excavation on the Georges River to create revetment and areas fronting Lake Moore will almost certainly encounter Acid Sulphate Soils. It will be important to manage and mitigate any potential contamination arising from the disturbance of them.

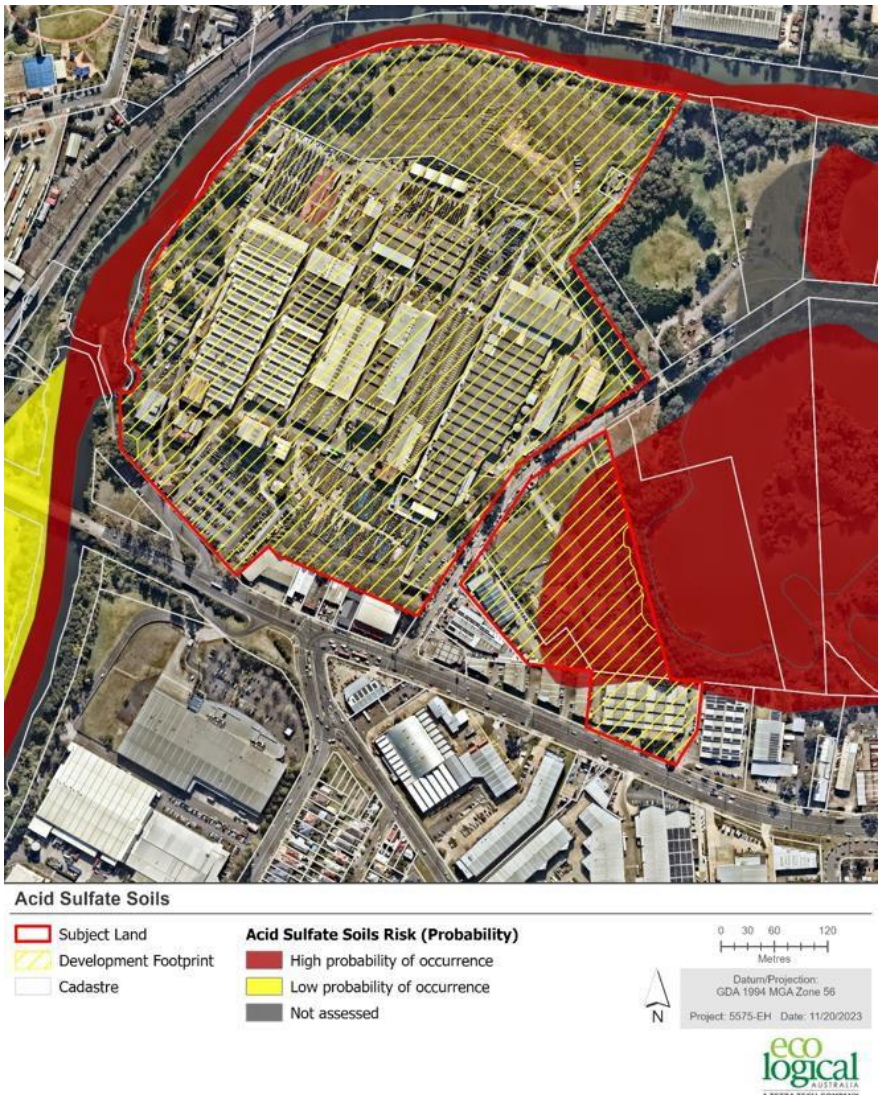


Figure 23: *Potential Acid Sulphate Soils risk map (Source: Eco Logical Australia, 2024)*

EI Australia (2024b) conducted further assessment of ASS across the precinct and confirmed the likely (high probability) presence of Acid Sulphate Soils.

4. Policy & statutory framework

4.1 Legislative Context

4.1.1 *Water Management Act* 2000

The objects of the Water Management Act 2000 are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The objectives of the Act are listed below:

> *(a) to apply the principles of ecologically sustainable development, and*
> *(b) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*
> *(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including—*
> > *(i) benefits to the environment, and*
> > *(ii) benefits to urban communities, agriculture, fisheries, industry and recreation, and*
> > *(iii) benefits to culture and heritage, and*
> > *(iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,*
> *(d) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,*
> *(e) to provide for the orderly, efficient and equitable sharing of water from water sources,*
> *(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,*
> *(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,*
> *(h) to encourage best practice in the management and use of water.*

The *Water Management Act 2000* also lists principles that apply generally to all water activities and principles that apply to specific uses. The following principles associated with waterways are listed below:

- Social and economic benefits to the community maximised
  - Floodplain management:
  - Land must be rehabilitated
  - Impacts of flood works minimised
  - Existing and future risk to life and property minimised
- Controlled activities:
  - No decline in native vegetation
  - No increase in land degradation, land must be rehabilitated

The Joint Landowners commit to achieving each of the objectives and incorporating these principles into the riparian corridor of the precinct. Refer to Section 6.1 where this is demonstrated.

5. Design of the riparian corridor

5.1 Delineation of riparian zones

5.1.1 Historical context

In this report, the history of Moore Point has been described which depicts extensive human intervention since European times, including:

- Dredging of the river channel
- Sand mining which has altered river and creek morphology
- Fill placement to create steep banks. The fill is contaminated.
- Native vegetation clearing
- Industrial operations leading to localised contamination

This sustained human activity is causing ongoing land degradation. Other than a few features, the whole peninsula has been so heavily modified as to make it almost unrecognisable from its natural state.

The Georges River frontage is steep, unstable and eroding. Contaminated material slumps into the river and the river and is tending to migrate landwards over time, creating ongoing instability. Relatively poor quality vegetation exists on this frontage. The Lake Moore frontage has gentle banks and is stable and well-vegetated. Flooding is a feature of the precinct with high energy forces along the Georges River frontage.

This is important context to inform riparian assessment.

5.1.2 Riparian strategy

The Joint Landowners Group for Moore Point are proposing to create a vibrant mixed-use development that embraces, embellishes and enhances the environmental and community benefits of the riparian corridor at Moore Point and Lake Moore.

To achieve this, it is essential that the Georges River banks are stabilised to arrent erosion to prevent ongoing migration of the river and to prevent slumping of contaminated soils directly into the River. In order to stabilise the banks along the Georges River frontage, it is proposed to lay back the river bank batters, and to install rock revetment protection works at the toe of the bank. In addition, to providing an improved flooding outcome, this will achieve many urban design, place-making, social and community benefits. It will also enable native landscape plantings to be incorporated that will be irrigated with harvested rain/stormwater, and recycled wastewater to provide urban cooling.

Only minor changes to the Lake Moore frontage are proposed, mainly in relation to adding recreational and landscape features for community activation.

The Foreshore Strategy (Mecone 2024) does propose Inner and Outer VRZs for both the Georges River and Lake Moore frontages. However, the Foreshore Strategy does not seek to align with the full intent of the *Guidelines for controlled activities on waterfront land: Riparian Corridors* (DPI, 2018). Because a high level of riparian activation is proposed, an urban waterfront is proposed with associated landscaping with native vegetation. A fully structured native revegetation outcome is not proposed, and so a merit-based assessment of the Foreshore Strategy is sought, and this is consistent with the Guidelines.

As identified within the Biodiversity Development Assessment Report (Eco-Logical, 2024a), Georges River is a 7th order stream as per the Strahler classification. For the purposes of applying the Riparian Corridor Guidelines, Georges River is therefore considered to be categorised as *4th order or greater,* and as a result a 40m wide riparian zone is proposed from the toe of the bank (MHWM)). This results in 20m wide Inner and Outer VRZs.

Prior to sand mining, the current Lake Moore frontage used to front Anzac Creek. It is therefore valid to adopt Anzac Creek as the reference waterway for assigning riparian zone. Anzac Creek is a 3rd order watercourse in this location, and so a 30m wide riparian zone is proposed from the toe of the bank (MHWM). This results in 15m wide Inner and Outer VRZs.

No structures are proposed in the riparian corridor.

The delineation of riparian corridors and the position of structures external to it are shown in Figure 24 and Appendix A.

***Figure 24**: Riparian zone delineation at Moore Point*

As a result of implementation of the proposed Foreshore Strategy, the following beneficial outcomes will be achieved:

- the toe of the bank will be stabilised and all current active landward erosion will be arrested
- the river banks will be stabilised and made safe for the community to access the water's edge
- no ongoing slumping of contaminated material into the river
- improved flood conveyance in the Georges River channel
- new terrestrial, estuarine and aquatic habitats created

5.2 Riverbank stability design (RHDHV, 2021)

RHDHV (2021) have recommended that the following riverbank stabilisation methods be incorporated into the foreshore at Moore Point:

- The toe of the river bank at Moore Point is undergoing regression over time. This needs to be arrested with toe and bank protection.
- Embankments should typically be designed at 1V:6H. Where this occurs, toe and bank protection needs to extend to 1.5m AHD. Where steeper embankments are proposed and at Lennox Weir, revetment should extend further up the bank. It is possible that the extent of protection can be reduced below the weir if boat wash does not need to be considered in the design.
- Toe and bank treatments could include rock revetment or cut sandstone. It is possible to blend the two such that cut sandstone is laid over rock revetment – to provide a better urban design outcome. A self-launching toe should be included in the design.
- Peak flow velocities on the foreshore will be typically below 1.5m/s which is unlikely to lead to erosion of surfaces stabilised by rock or vegetation. Therefore, standard landscaping measures can be considered for the river banks.
- Foreshore works need to consider the 1EY flood level in relation to inundation and subsequent maintenance

5.3 Interdisciplinary design

The Moore Point design team has collaboratively developed a design of the waterfront (riparian zone) The resulting design responds to the myriad constraints and seizes the opportunity to create a world class river frontage development in Liverpool LGA. Some representative images of the design – with commentary – are provided in Figures 25-30.

More design depictions are provided in the Moore Point River Foreshore Vision and Strategy (Mecone 2024) and the Moore Point Liverpool Public Domain and Landscape Strategy (Turf Studios 2024).

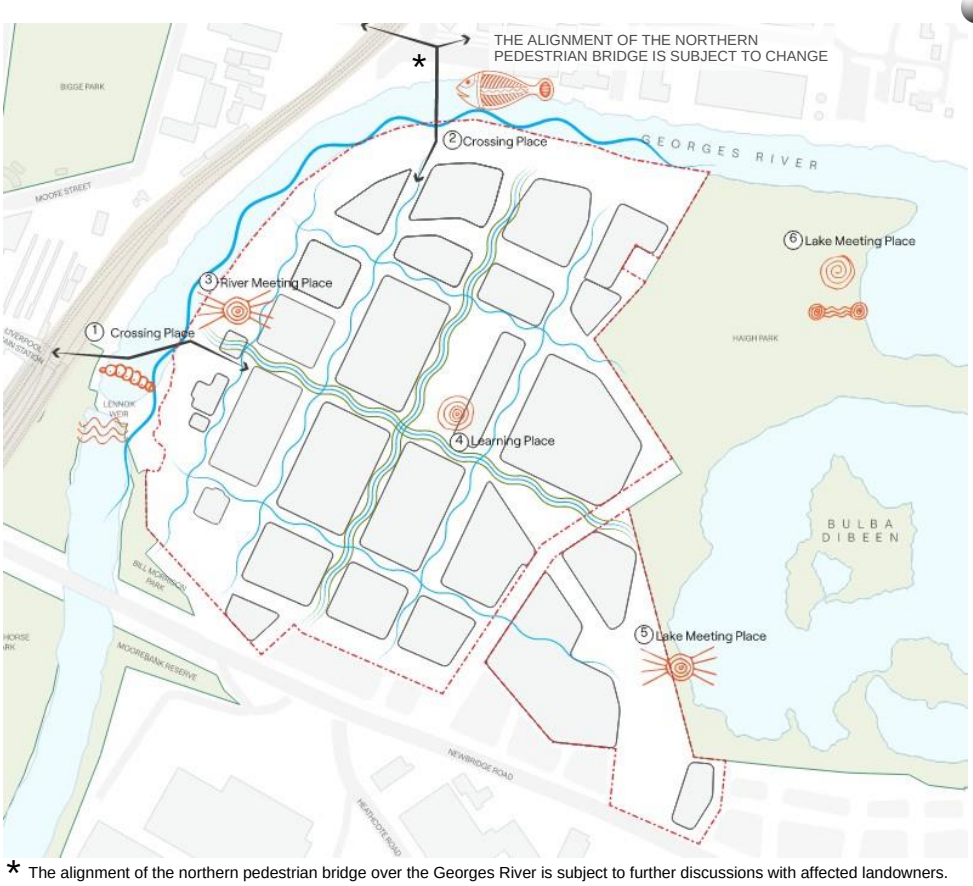
* The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

***Figure** 25: Illustrative masterplan for Moore Point (SJB, 2024)*

Key features:

Creation of a revegetated riparian zone fronting both Georges River and Lake Moore – and connecting with existing riparian vegetation

Bridge crossings to connect Moore Point to key locations making it walkable to the CBD



* The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Figure 26: *Connecting to Country (Yerrabingin, 2024)*

Key features:

Water Sensitive Urban Design to filter flows that are conveyed into the waterfront

Functional description of key places

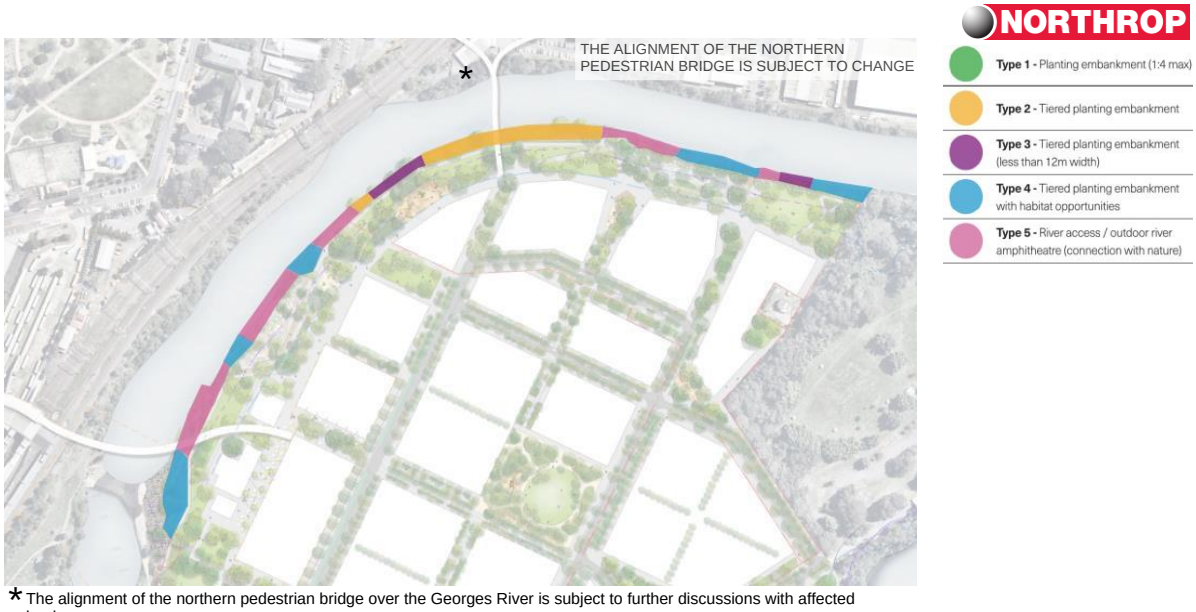
Endemic vegetation and biodiversity at waterfront

The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Key features:

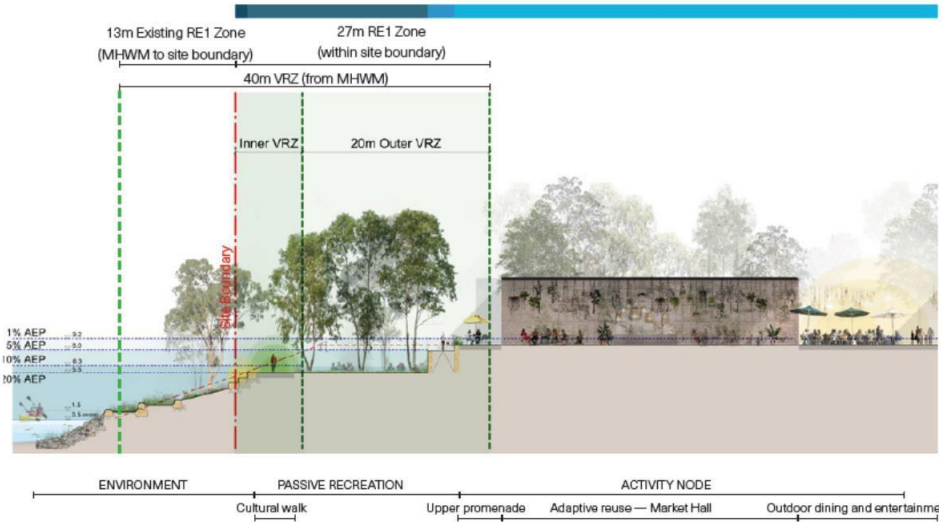
Waterfront activated with recreation opportunities balanced with native revegetation to create continuous riparian zone.

Figure 27: *Illustrative depiction of Georges River frontage (SLB, 2024)*



* The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Figure 28: *Riverbank typologies (Turf Studios, 2024)*



Key features:

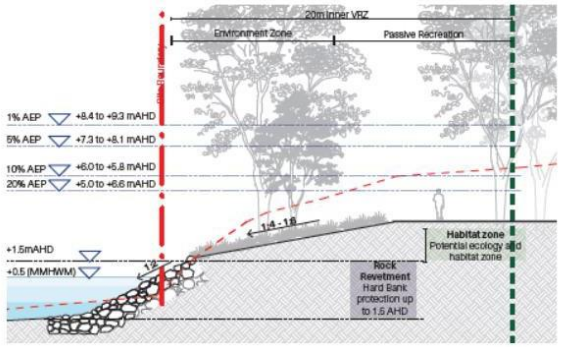
Responds to flood levels and resisting the energy of flows

Creates a tiered approach to optimise activation

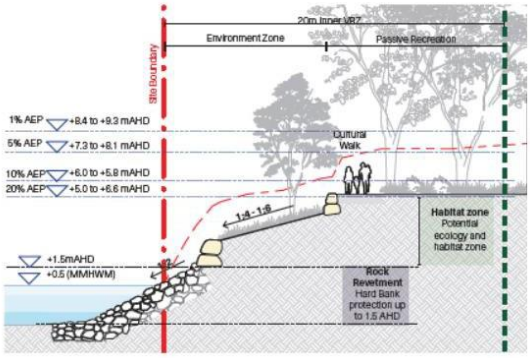
People can engage in the environment at the river's edge

Figure 29: *Typical section of western waterfront on Georges River (Turf Studios, 2024)*

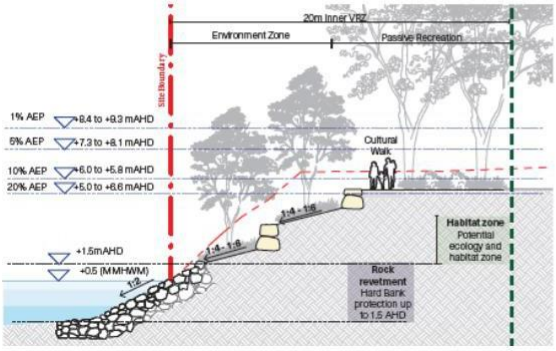
Riverbank — Type 1



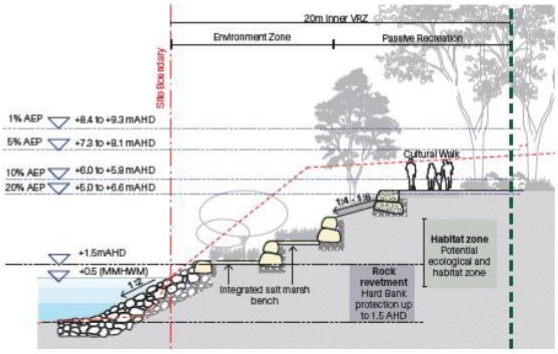
Riverbank — Type 2



Riverbank — Type 3



Riverbank — Type 4



Riverbank — Type 5

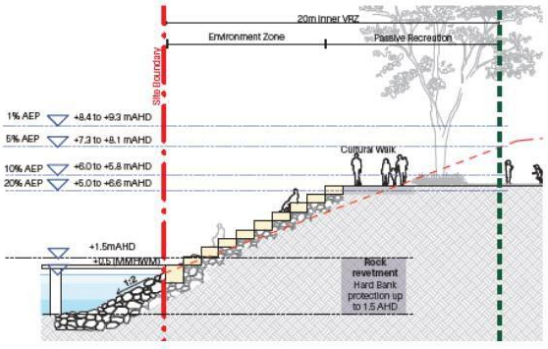


Figure 30: *(Turf Studios, 2024)*

Key features of the interdisciplinary design of the foreshore include:

- No structures in the riparian zone
- A development that integrates, embraces and embellishes the waterfront
- Recognition of different levels of use and activation of the waterfront: i.e. active, passive, lakefront and existing open space (Haigh Park).
- Retention and embellishment of existing environmental and social/recreational values in and beyond the waterfront

- Provision of an urban landscaped Georges Riverfront that faces and connects to Liverpool CBD
- The waterfront at the centre of Sydney's 3rd CBD comprising a world-class precinct with urban activation and recreation on the river and foreshore

This represents a considered and balanced approach to creating a mixed use community in the precinct, and allows for significant environmental improvements in the riparian corridor.

5.4 Biodiversity on the foreshore

Turf Studios (2024) propose a variety of Georges River foreshore design responses at Moore Point (Figure 31). These will provide habitat diversity and lead to improved biodiversity.

- sandstone revetment with tidal pools and saltmarsh (top row in Figure 31)
- crevices, ledges and gaps for crustaceans and crabs (second top row)
- riparian vegetation including diverse riparian vegetation including raingardens and freshwater wetlands (third row from top) with freshwater pools
- intertidal habitat (bottom row) for fish including rocky intertidal substrate and
- structures for fish with integrated intertidal habitat (bottom row)

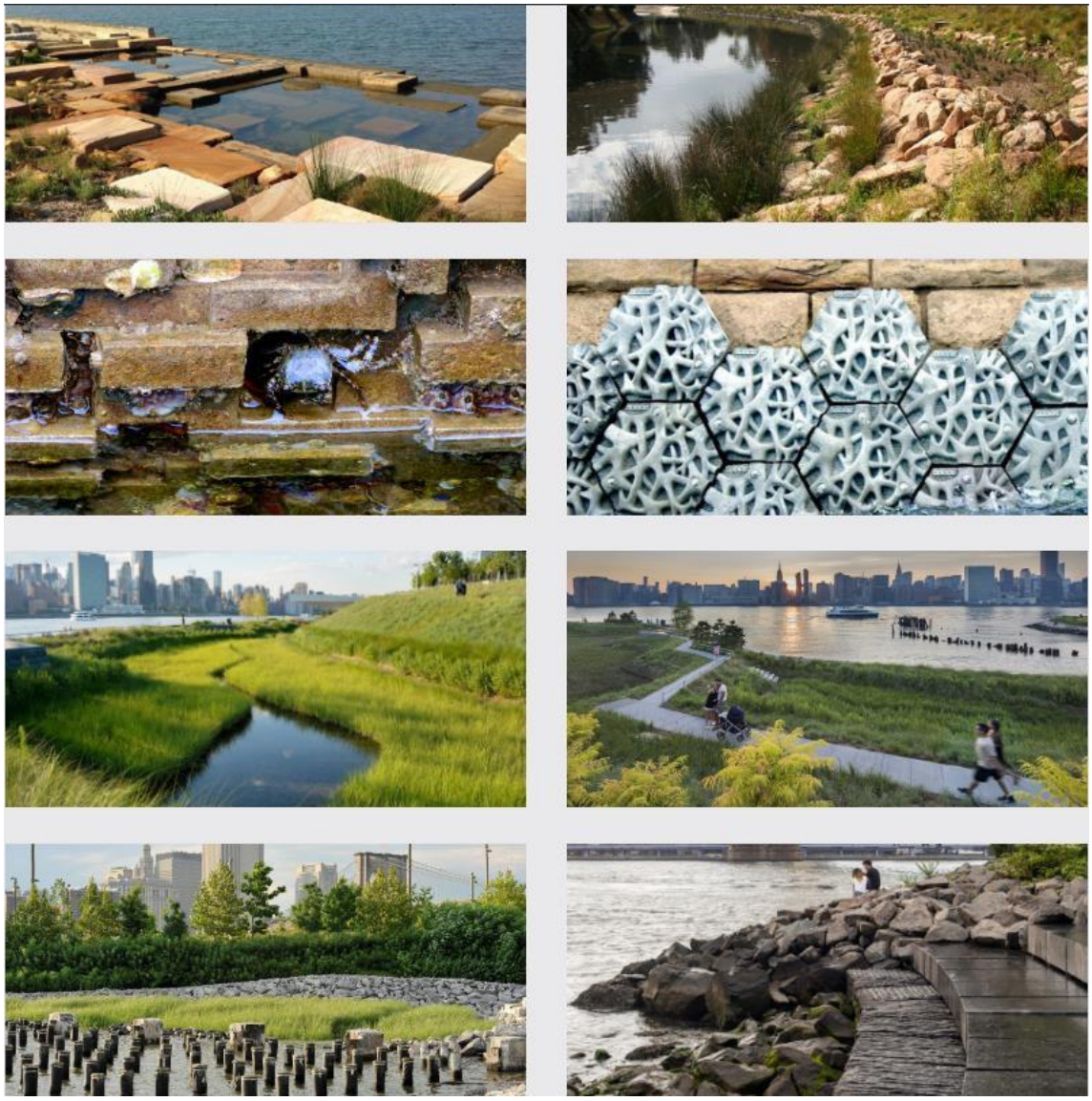


Figure 31: *Indicative foreshore treatments to provide habitat diversity*

5.4.1 Riparian zone planting

Turf Studios (2024) provide lists of plants for different situations on the foreshore. The planting of the foreshore is selected from the planting palette as advised by Yerrabingin. These species are familiar to the Cabrogal people and are all natives (Table 1).

Table 1: *Foreshore planting palette*

Estuarine and foreshore species	Parkland and foreshore species
SALT MARSH:	SWAMP FOREST:
1 *Juncus kraussii* - Salt marsh rush	1 *Casurina glauca* - Swamp oak
2 *Sporobolus virginicus* - Seashore dropseed	2 *Callistemon salignus* - Willow bottlebrush
3 *Samolus repens* - Creeping brookweed	3 *Leptospermum juniperinum* - Prickly tea tee
FORBS:	4 *Eucalyptus robusta* - Swamp mahogany
4 *Blechnum camfieldii* - Water fern	5 *Melaleuca quinquenervia* - Broad- levaed paperbark
5 *Blechnum catilagineum* - Soft water fern	6 *Banksia oblongifolia* - Fern- leaved banksia
6 *Gahnia clarkei* - Saw sedge	7 *Callistimon linearis* - Bottlebrush
7 *Gonocarpus micranthus* - Creeping raspwort	8 *Melaleuca nodosa* - Prickly- leaved paperbark
	9 *Xanthorrhoea fulva* - Wallum grass tree
	Other suggested species:
	• *Clematis glycinoides* - Headache vine
	• *Lomandra filiformis*- Wattle mat rush

6. Assessment of riparian proposals

6.1 Moore Point riparian zone assessment against *Water Management Act* 2000

Gateway condition: *Amend the Riparian Strategy to…demonstrate compliance with the Water Management Act 2000.*

The objectives of the *Water Management Act* 2000 are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The objectives of the Act and our responses are listed and described below:

(i) to apply the principles of ecologically sustainable development

Response:

Mott Macdonald (2024) have prepared a Sustainability Statement for the development.

Beyond this, the ecology of Moore Point is a central consideration of the development design. The ecology of Lake Moore will remain intact – no changes are anticipated, and enhancements are proposed to connect existing habitats to the open space / public domain with additional plantings of native vegetation.

Due to the bank instability resulting in contaminated soils entering the Georges River, contaminated material will be removed from the river bank, and replaced by clean fill to re-profile the river banks. While this will result in short term impacts and loss of vegetation, overall the net gain and improvement to the riparian bank, growing conditions and groundwater outweigh the temporary loss of degraded ecological communities.

In addition, a range of diverse habitat features will be provided for aquatic species, including:

1. Rock revetment comprising varying rock sizes and shapes – containing crevices and voids that can be colonised
2. Microhabitats placed in the intertidal zone for creatures such as crabs
3. Plantings of aquatic species in and around the placed rock
4. Revegetation of the banks with a range of native species

With the whole Georges River waterfront being re-modelled, it will provide free passage of movement for species. Overall, there will be a significant increase and improvement to the ecology of Moore Point as a result of restoring the waterfront from its highly degraded state.

(j) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality

Response:

The current development is heavy industrial and this land use is known to typically contribute the highest pollution loads to waterways. Changing land use to mixed use will reduce the amount of pollutants in runoff and certain types of pollution will be less likely to be present, e.g. heavy metals and other toxicants. The unstable river banks are resulting in contaminated soils slumping and otherwise eroding into the river.

Existing water quality in the river and Lake Moore fluctuates depending on antecedent rainfall, which adds pollutants to the flow. At certain times in between rainfall events, the river water is of suitable quality for swimming.

The joint landowners are proposing a suite of management interventions that are intended to achieve all of the following:

- Provide effective drainage to minimise nuisance flooding across the precinct

- Provide sanitary sewer disposal to Liverpool wastewater treatment plant for treatment and reuse (wastewater recycling).
- Provide water supply to each property, with mains water consumption minimised through:
    - All roofs (other than the existing heritage ones on the western side of the site) will have a minimum 10kL rainwater tank in its basement. This water will be plumbed internally and externally for non-potable uses.
    - Treated stormwater may be harvested in underground tanks. Any treated stormwater may be used to irrigate landscape plantings which will contribute to urban cooling.
    - Top-up of tanks with recycled water can be provided if it becomes available and if this proves to be feasible.
    - Only discharge treated runoff water that complies with contemporary water quality criteria that will not compromise the values of the Georges River (achieved through water quality treatment)
- The ecology of the Georges River banks will be enhanced. The ecology of Lake Moore will be maintained and improved
- No significant exacerbation of flooding or alteration of flooding patterns
- No part of the system is visually obtrusive, with most elements underground, or landscaped

Various design measures are proposed which deliver on these outcomes, including:

- Subcatchment delineation to compartmentalise runoff flows
- Drainage system design to collect and drain all flows up to the 5% AEP event delivering treated runoff directly to the Georges River and Lake Moore (where stormwater currently drains to)
- A Water Sensitive Urban Design treatment measures will be selected from the following:
    - Each lot may have water quality treatment in a chamber using Ocean Protect filter cartridges sized for each site.
    - Ocean Protect CDS gross pollutant traps on subcatchments as end-of-pipe treatment measure to trap gross pollutants and sediment.
    - Bioretention basins may be proposed in the public domain (i.e. foreshore and overbanks) to provide further water quality treatment, integrated with landscaping, and providing some urban cooling.
    - Street tree pit WSUD elements can be employed for subcatchments which cannot drain to a bioretention basin.
    - Bioswales can be co-located within streets, e.g. the green spine (east-west street access) in the western portion of the precinct.
- Sewage directed to Liverpool Sewage Treatment Plant. If recycled water becomes available, it will be used to top up stormwater harvesting tanks
- Water supply from Sydney Water, and augmented with rainwater and stormwater harvesting as outlined above
- Stormwater will be directed to outlets that either enter the Georges River or Lake Moore directly. The stormwater from each outlet will be treated before discharge. Outlets will be designed to comply with Council's DCP and the DPI riparian guidelines using soft engineering comprising rock, geofabrics and plants. The design will take into account flood flow forces to ensure their stability and longevity.
- In order to facilitate safer swimming and water recreation, the Lake Moore outlets are located away from the current and proposed beach areas in Haigh Park. Where they discharge to Georges River, the outlets will be integrated within rock protection works at the toe of the river bank. They will be angled to discharge flows in a downstream direction.

An indicative layout of WSUD options is provided in Figure 32.

Figure 32: *Indicative WSUD options layout (Source: Turf Studios 2024)*

The performance of the future Water Cycle Management Plan incorporating WSUD measures will be tested with a MUSIC model. The results will be compared to the DCP water quality targets (Table 2), the Georges River Water Quality Objectives (Table 3) and the Georges River Water Flow Objectives (Table 3) for compliance purposes.

Table 2*: Water quality compliance framework – Council's DCP*

Pollutant	Liverpool LCC DCP 2008 Pollutant retention	Georges River Water Quality Objectives Pollutant Concentration
Total Nitrogen	45%	300ug/L
Total Phosphorus	65%	30ug/L
Total Suspended Solids	85%	
Gross Pollutants	90%	

***Table 3**: Assessment in relation to Georges River Water Quality Objectives*

Aquatic ecosystems		**Compliance Response**
Indicator	**Criteria**	
Chlorophyll a	4 ug/L	The proposal will not provide a point source of Chlorophyll to receiving waters. Chlorophyll in receiving waters is a function of the amount of algae present, and this is addressed below
Turbidity	0.5-10 NTU	During construction, there is an elevated chance of releasing turbid waters. This will be managed using standard Erosion and Sediment Controls, the details of which would be provided with DA documentation. Protection of the Georges River from sediment will occur using a combination of silt curtains (within the river channel), sediment fences, sediment basins, diversion of upstream flows . During operational stage of the development, the proposed treatment train will reduce turbidity in runoff. In particular, the proposed biobasins will provide filtering of the flows.
Dissolved Oxygen	80-110%	Dissolved Oxygen is a function of the temperature of the runoff. The runoff will be ambient temperature and it is expected that DO will mostly fall within this range.
pH	7.0 – 8.5	In urban runoff, pH is mostly affected by water flowing through concrete pipes, which elevates it. The final filtering of runoff in biobasins is expected to buffer increases in pH.
Temperature	0-35^{o}	It is expected that almost all runoff from the site will be in this temperature range.
Chemical contaminants	ANZECC 2000 Guidelines, chapter 3.4 and table 3.4.1.	It is expected that few if any contaminants will form part of the runoff from the site. An exception is Heavy Metals and Hydrocarbons from vehicle use on roads. The Treatment Train proposed is capable of removing almost all heavy metals and hydrocarbons in the runoff.
Biological	Algae & blue-green algae	The development is unlikely to be a source of algal cells. Algal cells form in waters that have high nutrient levels. All runoff will be treated in bioretention basins that will reduce nutrient levels to achieve compliance with Council's DCP.

Visual Amenity		
Indicator	**Criteria**	**Compliance Response**
Visual clarity & colour	Natural visual clarity, hue and reflectance not adversely reduced	The only pollutant from the development likely to affect this is sediment. Sediment treatment is proposed during both construction (erosion and sediment controls) and operation (gross pollutant traps and bioretention basins).
Surface films and debris	Oils and petrochemicals not noticeable as a visible film, nor detectable by odour. Waters should be free from floating debris and litter.	Litter will be filtered in Gross Pollutant Traps. Only trace amounts of hydrocarbons (from road runoff) would be present in

		drainage waters. This will be treated in biobasins.
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches not present in unsightly amounts	The treatment of nutrients will prevent any of these factors worsening in Georges River.
Secondary contact recreation		
Indicator	**Criteria**	**Compliance Response**
Faecal coliforms	Median <1,000 faecal coliforms per 100 mL, with 4 out of 5 samples <4,000/100 mL	The only source of pathogens to the River would be from pet faeces in landscaped areas. Biobasins would reduce the concentrations of organisms from this source.
Enterococci	Median < 230 enterococci per 100 mL (max number in any one sample: 450-700 organisms/100 mL).	
Chemical contaminants	No waters containing toxic or irritating chemicals to the skin or mucous membranes. Should not exceed values in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines.	The only way this could occur is as a result of accidental spills, which is highly unlikely. The treatment system – in particular biobasins – would assist to mitigate the impact of any spill
Algae & blue-green algae	< 15 000 cells/mL	The treatment of nutrients emanating from the development in bioretention basins will prevent algae worsening in Georges River.

***Table 4**: Assessment in relation to River flow objectives for the Georges River*

Requirement	Proposed actions
Maintain or rehabilitate estuarine processes and habitats	Dredging is not part of the proposal Only the toe of bank at Georges River frontage will be affected. Controls required to minimise escape of acid waters. Proposed water-based activities will have minimal impact on fish habitat Tidal wetlands continue to receive tidal flushing Change of land use from heavily polluting heavy industry to mixed use. Stormwater will be treated. Banks which currently contain contaminants slump into the River. This will cease.
Maintain the natural inundation patterns + distribution of floodwaters supporting natural wetland + floodplain ecosystems	Inundation and drying will not change. The floodplain will be expanded when Georges River banks are laid back and stabilised Maintain natural inundation and drying patterns in wetlands and native floodplain ecosystems. More wetland areas will be created Flooding patterns will not be significantly altered. The river flows dwarf the runoff flows generated by the development
Maintain natural rates of change in water levels	Maintain rates of rise and fall of river heights within natural bounds The river flows dwarf the runoff flows generated by the development

Maintain natural flow variability	Maintain or mimic natural flow variability in all streams The river flows dwarf the runoff flows generated by the development
Maintain natural rates of change in water levels	Maintain rates of rise and fall of river heights within natural bounds The river flows dwarf the runoff flows generated by the development
Protect natural water levels in pools of rivers + wetlands during periods of no flow	No water extraction proposed The river flows dwarf the runoff flows generated by the development
Protect or restore a proportion of moderate flows ('freshes') and high flows	Manage stormwater in such a way that there is no increase in the height or flow rate of high flows. The river flows dwarf the runoff flows generated by the development
Maintain groundwater within natural levels + variability, critical to surface flows + ecosystems	Linkage maintained. Alteration of flow patterns by creation of basements. Shallow groundwaters to remain directly linked to flows in river and wetlands. It will continue provide base flows in rivers during dry periods.

The design represents a contemporary response to water cycle management that provides many ancillary benefits. It is appropriate and fitting for the vibrant mixed-use development at Moore Point.

(k) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water

Response:

The sustainable use of water at Moore Point is summarised as follows:

- No extraction of surface water or groundwater
- Improvement in runoff water quality through treatment
- Harvesting and reuse of stormwater for public domain irrigation and urban cooling
- Water efficient fittings and fixtures
- Ability to connect to recycled water if it becomes available and if it is feasible

(l) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources

Response:

The Joint Landowner Group is actively engaging with all stakeholders as they progress the planning and design of Moore Point. Key stakeholders include:

- Liverpool City Council
- Sydney Water
- DPE Water
- NSW Fisheries

Further consultation with a broader range of stakeholders will occur.

(m) to provide for the orderly, efficient and equitable sharing of water from water sources,

Response:

The proposed development of Moore Point will intensify the demand on water supplies and sewerage systems in Liverpool. Applications for connections will be assessed by Sydney Water and they will apply their own high standards to determine the granting of connections. They also operate to their own strategic objectives around efficiency and equity in the supply of their services.

The Moore Point development will not seek to harvest any water from the Georges River, Lake Moore or groundwater, and so these resources can be considered to be managed equitably by the proponents.

One key design intervention is the potential harvesting of stormwater for reuse in landscape irrigation, with the benefit of providing urban cooling. Other benefits include reducing the quantity of pollution discharged from the development into Georges River and Lake Moore.

(n) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna

Response:

The Joint Landowner Group has been planning for the re-development of Moore Point and Lake Moore over the past 10 years. Over that time they have commissioned numerous and diverse studies which have informed the strategic frameworks that resulted in the current development proposal. Every study and piece of work has been analysed to provide a coordinated and coherent management response.

The key elements of the current environment paint a picture of degradation resulting from human intervention on the peninsula since European occupation. The proposal seeks to intervene and reverse the current degradation that is present at Moore Point. This includes stabilisation of river banks so they cannot deposit contaminated soils in the river, and the subsequent planting of new native vegetation and the creation of habitat across the river and lake frontages.

(o) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users

Response:

The development proposes to be efficient by minimizing demand on water supplies both in the built form (rainwater tanks and water efficient appliances, fixtures and fittings) and in the public domain (stormwater harvesting used to irrigate landscapes resulting in urban cooling). Further, the proposed foreshore stabilisation and habitat creation works are a demonstration of the commitment by the Joint Landowner Group to the concept of sharing responsibility with Government.

(p) to encourage best practice in the management and use of water

Response:

The water management measures proposed are considered to represent best practice and are consistent with the expectations of contemporary city-shaping development. Specifically, and in addition to other matters addressed above - the following are outcomes that will be achieved:

- **Social and economic benefits to the community maximised** – the Georges River waterfront will rival the best river waterfronts in the world in relation to seamless activation of commercial, recreational and environmental use

- **Floodplain management** - the only flood works are to improve the flood situation resulting from laying back the batters fronting the Georges River. The works will have no impact on flood levels at Moore Point or Lake Moore.
- **Existing and future risk to life and property will be minimised** – the works will provide a safe riverfront experience for users of the waterfront. Upstream and downstream of the precinct, no flood impact (and therefore increased risk to life and property) will result – in fact in some areas it will be reduced. Measures are proposed to minimise risk to life and property arising from flooding, including evacuation and stay-in-place strategies. The 1in500 year rain event has been used in the planning of Flood Planning Levels and flood evacuation.
- **Land will be rehabilitated** – Moore Point waterfront is being completely rehabilitated by re-shaping the river banks which will provide various benefits including:
    - lower flood levels and less impediment to flood conveyance, increased flood storage
    - vastly improves the flood resilience of the river bank
    - prevents contaminated soils from eroding and slumping into the Georges River
    - allows for extensive revegetation of the riparian zone to provide EECs and an improved connection between aquatic and adjoining terrestrial habitats

The *Water Management Act* 2000 also lists principles that apply generally to all water activities and principles that apply to specific uses. The following principles associated with waterways are listed and responses to them are provided in Table 5.

***Table 5**: Assessment in relation to Water Management Act 2000 Principles*

***Water Management Act* 2000 Principles**	**Response (see Section 6 for more details)**
Social and economic benefits to the community maximised	The rehabilitation of the Georges River frontage will prove the "missing link" connection between Lighthorse Park and Haigh Park and beyond to the Lake Moore frontage. This minimum 40m wide river and lakefront park will include a shred path and a host of other recreational and environmental features to the benefit of the community. The creation and activation of the waterfront will underpin the success of the Moore Point development.
Floodplain management: • Land must be rehabilitated • Impacts of flood works minimised • Existing and future risk to life and property minimised	The currently degraded environment at Moore Point will be completely rehabilitated through the creation of the development. The flood works include laying back the banks of the Georges River frontage which will eliminate the current impacts caused by contaminated material eroding directly into the River. The proposal has adopted the 1:500 year flood event to set development pad levels in the precinct. A flood evacuation plan has been proposed to protect life in flood conditions.
Controlled activities: • No decline in native vegetation • No increase in land degradation, land must be rehabilitated	The proposal will result in a significant increase in native vegetation in the riparian corridor and beyond. Vegetation within the Lake Moore frontage will largely remain intact. Land degradation (which is currently extensive) will be halted as a result of the foreshore rehabilitation strategies.

6.2 Built form in the Riparian Zone

Gateway condition: *Include plans showing inner and outer riparian corridors and all structures that encroach into this area. Certain buildings or structures may be proposed to be located on a riparian corridor consistent with relevant guidelines.*

When developed, there will be no structures (existing or proposed) in the riparian corridor fronting either Georges River or Lake Moore. Consistent with the DPI Guidelines' Riparian Corridor Matrix, the only structures being proposed in the riparian zone are the following:

- Revetment to protect the toe of the bank facing Georges River
- (small) Boat launching ramp/s
- Cabanas and pavillions
- Shared paths, boardwalks and viewing platforms
- Stormwater bioretention basins (in outer VRZ only)
- Stormwater outlets and essential services
- Bridges

6.3 Assessment against DPI Riparian Guidelines

DPI Water's 2018 *Guideline for Controlled Activities on waterfront land* sets out the assessment considerations for controlled activities (works) on waterfront lands (riparian corridors). As this project is at planning proposal stage, no works are proposed and no controlled activity approval is sought at this stage.

Northrop have reviewed the proposed structure plan with consideration for the Guideline to confirm compliance is achievable, either through strict compliance or a merit approach. A preliminary assessment of the planning proposal and proposed structure plan is provided in Table 6. Future development applications will be required to demonstrate consistency with the Guideline and will be subject to a merit assessment to insure that the proposals meet the requirements of the Water Management Act.

***Table 6**: Preliminary assessment in relation to DPI Water riparian Guidelines*

NRAR Guideline criteria		Assessment
Riparian corridor functions	providing bed and bank stability and reducing bank and channel erosion	Georges River frontage to be remodelled and stabilised against ongoing erosion. Lake Moore waterfront is stable and the development will provide minor recreational enhancements.
	protecting water quality by trapping sediment, nutrients and other contaminants	Water quality is treated for the entire development. Full WSUD treatment train. Compliance with targets is achieved
	providing diversity of habitat for terrestrial, riparian and aquatic plants (flora) and animals (fauna)	New habitats provided along the foreshore associated with rock revetment, with microhabitats provided. The existing habitat on the Lake Moore frontage is being retained intact.
	providing connectivity between wildlife habitats	Improved habitat connectivity will be provided as a result of full revegetation of the riparian zone, and connecting with existing quality habitat upstream (Georges River) and downstream in Lake Moore.

	conveying flood flows and controlling the direction of flood flows	Improved flood conveyance will result from re-modelling that banks of the Georges River. The direction of flood flows will not be altered.
	providing an interface or buffer between developments and waterways	Minimum 40m wide VRZ established on the frontage to Georges River. Minimum 30m wide VRZ established on the Lake Moore frontage. Refer to Drawing in Appendix A.
	providing passive recreational uses	Both passive and active recreational opportunities are optimised in the riparian zone and adjoining public domain connections to it.
Riparian corridor matrix	Vegetated Riparian Zone	Minimum 40m wide VRZ established on the frontage to Georges River (Inner VRZ=20m=Outer VRZ). Minimum 30m wide VRZ established on the Lake Moore frontage. (Inner VRZ=15m=Outer VRZ). The riparian zone widths are based on Georges River being a 7th order waterway (4th or greater per the Guidelines) and Lake Moore (Anzac Creek) being a 3rd order waterway. Refer to Drawing in Appendix A.
	Off-setting for non-RC uses	No non-RC uses are proposed in the riparian corridor. Offsetting is not relevant.
	Cycleways and paths	A shared path is proposed within the riparian corridor and this will provide foreshore connectivity up- and downstream of Moore Point. Many other pedestrian and cycle paths will connect to the riparian zone.
	Detention basins	Stormwater bioretention basins and possible stormwater harvesting storage tanks may be proposed within the riparian zone
	Stormwater outlet structures and essential services	There are existing essential services that pass through the riparian zone, e.g. sewer and electricity. The management of these and minor additional services (e.g. power for lighting and water for irrigation) will be integral in the design of the riparian zone.
	Stream realignment	The river or Lake are NOT being realigned .
	Road crossings	No road crossings are proposed in the riparian corridor. Bridge landings are proposed for pedestrians and these are planned outside the riparian corridor

6.4 Moore Point Foreshore Vision and Strategy

The Moore Point Foreshore Vision and Strategy Document (Mecone, 2024) provides a broad strategy for the development and management of waterfront land. The document outlines the objectives and intended outcomes for the river foreshore, as well as development controls required to facilitate the intended foreshore outcomes. Specifically, the document sets out place and environmental based objectives as a touchpoint for all future development, as well as more detailed layouts and sections of key foreshore character areas.

The planning proposal aligns with the Foreshore Vision and Strategy document and this document provides an appropriate control framework to guide future works with consideration for the legislative framework.

7. Conclusions

The Joint Landowners Group for Moore Point are proposing to create a vibrant mixed-use development that embraces, embellishes and enhances the environmental and community benefits of the riparian corridor at Moore Point and Lake Moore.

The Moore Point development has frontages to both the Georges River and Lake Moore. The Georges River frontage is steep, unstable and eroding. Contaminated material can slump into the river and the river is tending to migrate landwards over time, creating ongoing instability. Relatively poor quality vegetation exists on this frontage.

The Lake Moore frontage has gentle banks and is stable and well-vegetated with native species.

Flooding is a feature of the precinct with high energy forces along the Georges River frontage.

In order to stabilise the banks along the Georges River frontage, it is proposed to lay back the river bank batters, and to install rock protection works. In addition to providing an improved flooding outcome, this will achieve many urban design, place-making, social and community benefits. It will also enable native landscape plantings to be incorporated.

Only minor changes to the Lake Moore frontage are proposed, mainly in relation to embellishing existing vegetation and adding recreational and landscape features for community activation.

The design of the riverfront and lakefront represents a combined and coordinated effort between the following disciplines:

- Landscaping – recreational elements and planting
- Urban Design – integration with built form
- Place making – connectivity, activation
- Civil/Stormwater/WSUD – discharge points and stormwater harvesting and reuse
- Flood – ensuring flood forces are considered, and no creating flood impact
- Ecologically Sustainable Development – establishing a framework for sustainability

The works have been assessed against the of the *Water Management Act* 2000 and have been found to be fully aligned and compliant with its provisions and objects.

A Vegetated Riparian Zone has been established for the Georges River frontage (40m VRZ) and for Lake Moore frontage (30m VRZ). The proposal seeks to adopt a merit assessment for the riparian zone. This is because the waterfront will be designed to have a mix of landscape features to provide activation and access to the water's edge. A fully structured native revegetation outcome is not being sought.

When developed, there will be no structures (existing or proposed) in the riparian corridor. Consistent with an activated and functional waterfront, the following will be provided: paths, pontoons, cabanas/pavilions, boardwalks/viewing platforms, etc. Stormwater structures (outlets, bioretention basins and stormwater harvesting tanks may also be proposed.

We conclude that the Gateway condition (to *Amend the Riparian Strategy to address the following:*

- *Demonstrate compliance with the Water Management Act 2000; and*
- *Include plans showing inner and outer riparian corridors and all structures that encroach into this area. Certain buildings or structures may be proposed to be located on a riparian corridor consistent with relevant guidelines)*

has been met through the assessment and response provided in this Riparian Assessment.

References

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- BMT WBM 2008. Anzac Creek Floodplain Risk Management Study and Plan
- DPI 2018. *Guideline for Controlled Activities on Waterfront Land: Riparian Corridors*
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- Mecone 2024, Moore Point Foreshore Vision and Strategy
- Mott Macdonald 2024, Moore Point, Liverpool Sustainable Statement
- OEH Data Portal. Bathymetric Data at Scrivener Street Georges River
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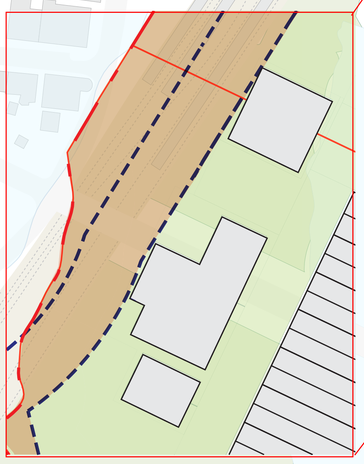
- SJB 2024, Moore Point Masterplan – Gateway Revised Planning Proposal Urban Design Report.
- SMEC 2008, Georges River Data Compilation and Estuary Process Study
- Turf Studios 2024, Moore Point Liverpool Public Domain and Open Space Report
- Yerrabingin 2024, Moore Point Indigenous Narrative Report
- Worley 2024, Moore Point Precinct Liverpool, Flood Emergency Response Plan

Appendix A – Riparian Analysis Drawing

Riparian zone delineation and demonstration of no structure (building) encroachment (SJB 2024)

Inner VRZ 20m from MHWM

Outer VRZ 20m



No encroachment into Outer VRZ

Inner VRZ 15m from MHWM

Outer VRZ 15m

MOORE POINT FORESHORE STRATEGY

Scale
1:2000 @a1

Date
08/05/2024

Revision no.
03

Project no.
6832

Project Name
Moore Point Revised PP

Project address
Moorebank

Client
Coronation & Leamac

Appendix B – Water Cycle Management Statement

Title: Water Cycle Management Statement for Planning Proposal PP-2022-1602 (Northrop 2024)

NORTHROP

MOORE POINT

Water Cycle Management Statement

for Planning Proposal PP-2022-1602

For Joint Landowners Group

Water Cycle Management Statement

Date	Revision	Issue	Prepared By	Reviewed By
25/03/24	A	For Review	M Brown	B Lawrence
02/05/24	B	For Review		M Brown
07/05/24	C	Final		M Brown

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Executive Summary

This Water Cycle Management Statement has been prepared by Northrop Consulting Engineers on behalf of the Joint Landowner Group, for the development known as Moore Point, Liverpool. It is intended that this Statement is an Appendix (Appendix C) of the related report titled Moore Point Riparian Assessment for Planning Proposal PP-2022-1602 (Northrop, 2024).

The Joint Landowners Group own land at Moore Point currently used for heavy industrial use, or currently vacant. On this land, they seek to create a vibrant mixed use development that will transform the precinct and Liverpool. To achieve this, the landowners are proposing a suite of water cycle management interventions that are intended to achieve all of the following:

- Provide effective drainage to minimize nuisance flooding across the precinct
- Provide sanitary sewer disposal to Liverpool wastewater treatment plant for treatment and reuse (wastewater recycling).
- Provide water supply to each property, with mains water consumption minimized through:
    - BASIX to reduce water consumption within premises
    - Harvesting and reuse of roof water within individual development sites (rainwater harvesting)
    - Possible harvesting, treatment and reuse stormwater for irrigation of landscaping (stormwater harvesting).
    - If recycled water becomes available to the precinct, and if feasible, could be used for
- Only discharge treated runoff water that complies with contemporary water quality criteria that will not compromise the values of the Georges River (water quality treatment)
- The stability and integrity of the Georges River bed and banks will be enhanced (refer also to Moore Point Riparian Assessment, Northrop 2024)
- The ecology of the Georges River banks will be enhanced
- No exacerbation of flooding or alteration of flooding patterns
- No part of the system is visually obtrusive, with most elements underground, or landscaped

Various design measures are proposed which deliver on these outcomes, including:

- Subcatchment delineation to compartmentalize runoff flows
- Drainage system design to collect and drain all flows up to the 5% AEP event delivering treated runoff directly to the Georges River and Lake Moore (where stormwater currently drains to)
- A treatment train comprising selections of the following:
    - Rainwater harvesting on each of each lot with harvested water used for irrigation and other non-potable uses
    - Chamber water quality treatment on each lot with Ocean Protect filter cartridges
    - Gross Pollutant Traps
    - Bioretention basins, WSUD street trees and bioswales for polishing/treatment of stormwater prior to discharge
    - Possible stormwater harvesting - harvested water used for landscape irrigation providing urban cooling
- Sewage directed to Liverpool Sewage Treatment Plant. If recycled water becomes available, it may be used
- Water supply from Sydney Water, and augmented with rainwater and possibly stormwater harvesting as outlined above

Compliance with Council's DCP will be demonstrated quantitatively (MUSIC modelling and MUSIC Link) and qualitatively. Compliance is also demonstrated against the *Georges River Water Quality Objectives* and *River Flow Objectives*.

The design represents a contemporary response to water cycle management that provides many ancillary benefits. It is appropriate and fitting for the vibrant mixed-use development at Moore Point.

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1. The Development

The Joint Landowner Group own land that encompasses Moore Point on the Georges River and part of Lake Moore. The layout of the development is shown in the masterplan (Figure 1).

Figure 1: *Illustrative masterplan for Moore Point development (Source: SJB, 2024)*

2. Site Context

2.1 Catchment context

Moore Point fronts the Georges River which is around 100km in length and covers an area of approx. 960km^2 and is home to a population of 1.5 million people. Upstream of Anzac Creek/Moore Point, the catchment is 368km^2 in area (Figure 2).

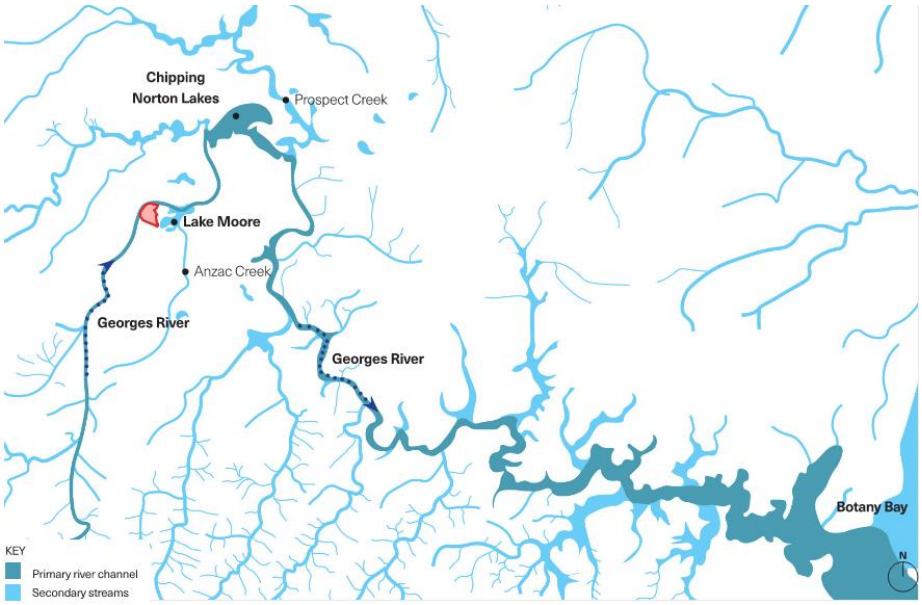

Figure 2: *Moore Point in the context of Georges River*

2.2 Existing environment

Moore Point and Lake Moore currently supports industrial land uses (Figure 3). The precinct (excluding Haigh Park) is approximately 70% impervious.

Figure 3: *Moore Point existing development (Source: Six Maps)*

2.3 Topography and flow paths

The Moore Point precinct comprises a plateau to the west of Bridges Road ranging to about 10m AHD at Newbridge Road, and tipping to the west and northeast (Figure 4). Haigh Park – which is in the centre of the precinct, and owned by Council - has lower levels than the surrounding precinct lands. The eastern arm of the precinct comprises lakefront land which drains directly into Lake Moore. There are steep areas which are the river banks sloping down to the foreshore in the west and north. For the remainder, slopes are gentle.

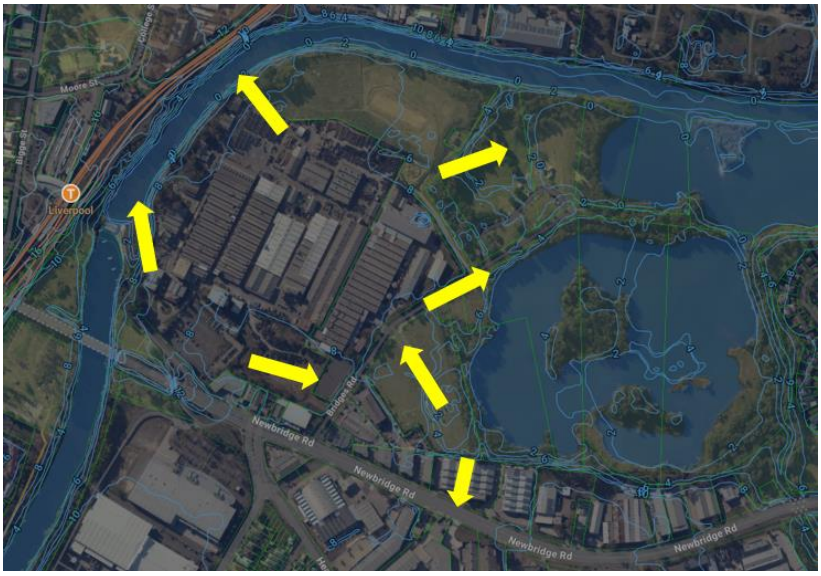

***Figure 4**: Moore Point Existing flow paths and drainage points*

2.4 Flooding

The Georges River is particularly susceptible to flood due to its morphology. The 1% AEP (or 1 in 100 year) flood extent is shown in Figure 5.

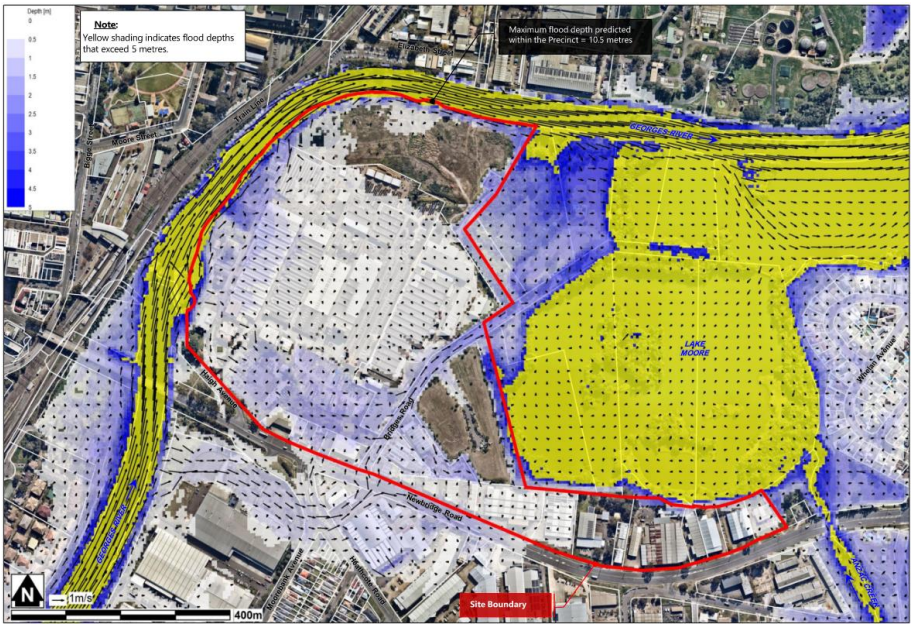

***Figure 5**: Predicted flood depths and velocity vectors at the peak of the 1% AEP event for existing conditions (Source: Advisian, 2023)*

2.5 Existing water quality

Liverpool City Council reports water quality on a quarterly basis. They provide a snapshot report in relation to the suitability of uses in relation to the quality of the water tested. The snapshot for the first quarter of 2021 is shown in Figure 6. The reporting over the various quarters on Council's website (https://www.liverpool.nsw.gov.au/environment/water-and-waterways/water-quality) indicates variability of results over time and in response to antecedent weather conditions at sampling. For Quarter 2 2023, there was no algae present (upstream or downstream), and waters were typically suitable for secondary contact recreation. Primary contact recreation was not typically advisable at the time of sampling, although it is suitable for other sampling dates that are not shown here.

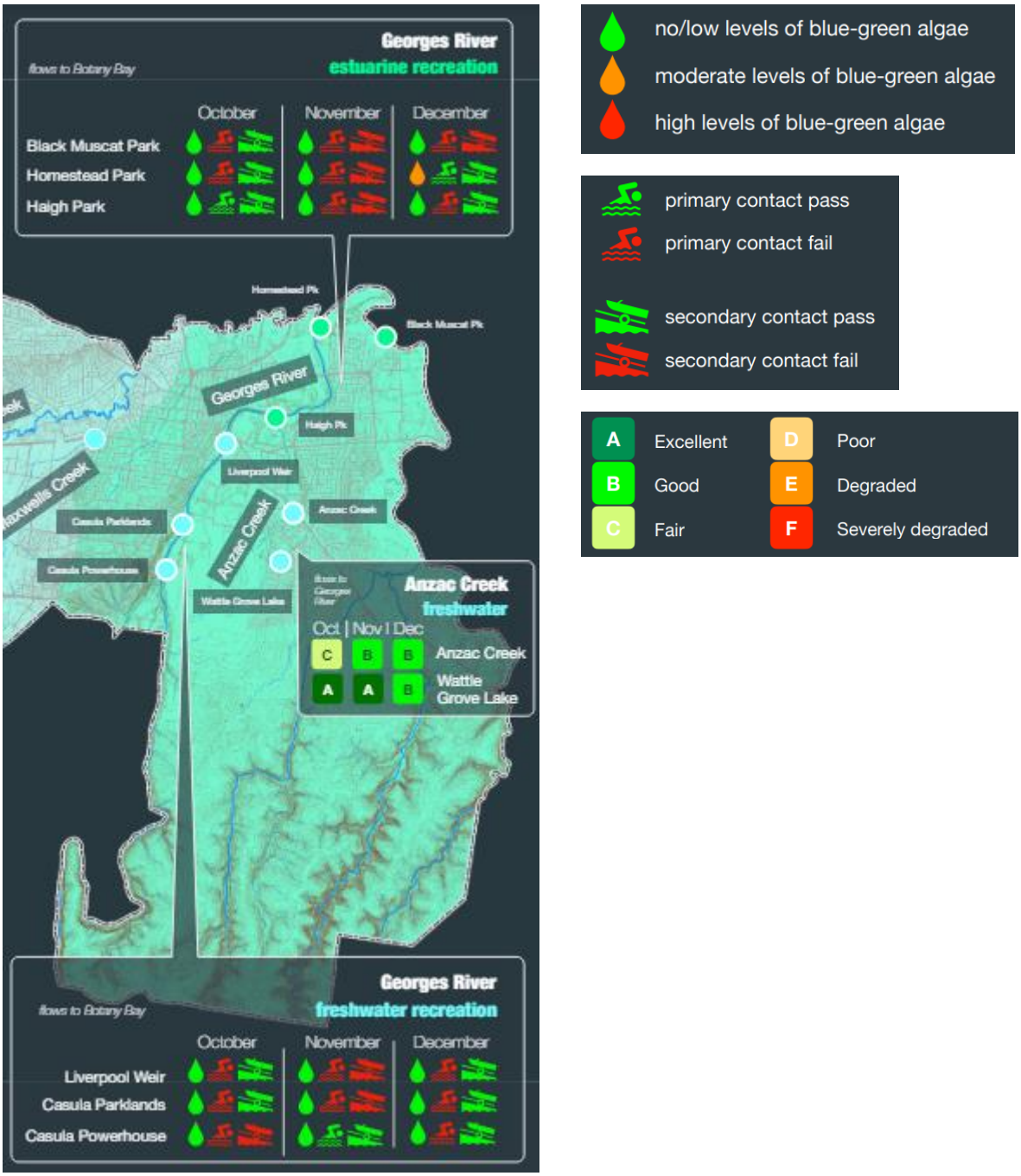

Figure 6: *Georges River and Anzac Creek water quality snapshot for Quarter 2, 2023.*

Further desktop research by EcoLogical Australia (2024a) identified the following:

Dataset or literature	Result	Relevance to proposal
Georges River Data Compilation and Estuary Processes Study (SMEC 2010)	SMEC note in their study the following water, sediment and erosion features in or close to the study site: Tidal range is relatively constant along the River with differences in levels of less than 0.1 m between the Liverpool Weir (mean spring range of 1.31 m) and Botany Bay (mean spring range of 1.25 m). The strong tidal influences associated within the lower reaches of the estuary, towards Botany Bay, is reflected by the higher salinity levels (34 – 37 ppt) in Dolls Point, comparable to sea water. This salinity gradually decreases with increasing distance upstream to 0-10 ppt at Liverpool Weir. The upper estuary is typically dominated by freshwater but is subject to daily tidal action. There is a veneer of fine surface sediment overlaying medium to coarse sands between Liverpool Weir and Lake Moore, indicating a low tidal influence (low flow and low tidal velocities). The geology of the upper section of the Georges River, between Liverpool Weir and East Hills which consists predominantly of dispersive clays and shales, which amplifies turbidity in the channel. The upper sections of the Georges River, between Liverpool Weir and East Hills, experience higher turbidity levels, and recovery after rainfall is slower than less affected downstream areas towards the mouth of the river. Tidal exchange especially in the upper reaches does not contribute strongly to the recovery rate; rather sedimentation is likely to be the primary mechanism for recovery. However, clear water spilling from the weir would assist in flushing turbid water downstream. Dredging too close to the riverbanks has caused slumping and significant erosion issues and scouring of the bed. A bed scour depth ranging from 3 to 9 m has been predicted between Liverpool Weir and East Hills. Two major kinds of erosion are identified along the Georges River: Scouring – in the form of bed scouring and toe scouring; Mass failure – common in high and steep riverbanks which results commonly from toe scour. Some erosion prone riverbank materials, presence of dispersive clay and change in flow regime at the Weir, Lake Moore inlet, river bend downstream of William Long Bridge and inlet to Chipping Norton Lake are also amongst the major contributing factors to erosion.	The key points of the study by SMEC confirm: There is low salinity levels near the site, which would influence what marine species can use the site. Historic bank erosion is widespread (Figure 3) and supports the justification that stabilisation is required. Turbidity is high compared to downstream, and sedimentation is more likely due to less tidal flushing. This would influence the type of marine species that could tolerate the site (e.g. light would not penetrate far into the water column to support subtidal macrophytes like seagrasses, but macroalgae may be more tolerant).

2.6 Existing stormwater servicing

Stormwater from the far western side of the precinct currently drains to the Georges River. Stormwater from 6-16 and 5-9 Bridges Road currently drains to the Council-owned network in Bridges Road, which in turn discharges into Lake Moore. Stormwater from 361 Newbridge Road drains to Newbridge Road, which in turn flows into the stormwater network in Bridges Road.

2.7 Existing water and sewer servicing

Wastewater servicing is provided to the precinct by Sydney Water Corporation (SWC). All wastewater is directed to the Liverpool Water Recycling Plant (1km north of the precinct) for

secondary treatment before transporting recycled water to Malabar and/or re-used at Liverpool Golf Course and Warwick Farm racecourse. A sewer pump station exists on Coronation Property land adjoining the western flank of Haigh Park. Occasionally the system discharges direct to the Georges River in wet weather.

Drinking water is provided by SWC from Potts Hill Water Delivery System, sourced from Warragamba Dam. Water mains are located:

- along Bridges Road from Newbridge Road
- along Anchor Place
- along Haigh Avenue

Sydney Water currently does not provide recycled water to Moore Point precinct, however, options to utilise the adjacent water treatment facilities / pump station to provide a recycled water treatment system are being explored.

3. Policy & legislative framework

3.1 Council compliance framework

The *Liverpool City Council Development Control Plan (2008)* identifies the following in relation to Water Cycle Management (Chapter 6 of the DCP). This is the minimum requirements for compliance.

Objectives

- To ensure that there is no adverse impact from stormwater runoff on downstream properties as a result of development in the catchment for all storm events up to and including a 100-year ARI event.
- To collect and use rainwater from roof tops to reduce town water consumption.
- To ensure adequate drainage is provided for developments.
- To protect properties from localised flooding.
- To prevent contaminated run-off from entering watercourses.
- To minimise erosion and reduce the volume of waste water entering waterways.
- To minimise sedimentation and pollution in waterways and drainage systems.
- To maintain and enhance the quality of natural water bodies such as creeks, rivers and groundwater.
- To reduce cost of providing and maintaining water infrastructure.

Controls

- Drainage – gravity drainage to Council system
- Pumped flows only allowed in basements and NOT connected to kerb
- Stormwater drainage concept plan required with submission
- Drainage structures visually unobtrusive
- Surface flow paths to include provision for emergency overland flow capable of conveying 1% AEP flows with 300mm freeboard
- Surface flows from upstream properties not impeded
- On-site detention is not required where a site is substantially inundated by flooding
- Gravity drainage to river:
    - buildings set back min 40m from bank
    - treat for nutrients
    - erosion protection at outlets
- Gross Pollutant Traps not located within riparian zones
- Stormwater runoff quality – reduction targets:
    - Total Nitrogen 45%
    - Total Phosphorus 65%
    - Total Suspended Solids 85%
    - Gross pollutants 90%
- Verify water quality model using MUSIC link (at DA)
- Lifecycle costing for min 20yrs to be provided
- Sewage treatment plant – development within 400m of Scrivener Street STP to be referred to Sydney Water for assessment – this applies to the Coronation Property land known as Lot 11 only
- Water Conservation

- Residential to comply with BASIX
- Non-residential
    - Consideration of separate recycled water pipework for non-potable purposes
    - Operational details for swimming pools
    - Rainwater tanks required with top-up
- Soil & Water Management Plan required

In relation to environmental flows, we consider that discharge to a major river with perennial flows will not derive any benefit from the provision of environmental flows. Similarly, in relation to On-site detention, the precinct is flood affected and so OSD is not proposed.

3.2 Georges River Water Quality Objectives

The following information is summarized from the NSW Government environment web site: https://www.environment.nsw.gov.au/ieo/GeorgesRiver/report-02.htm#P134_16430

The associated mapping shows that the Georges River below Lennox Weir is classified as estuarine. The relevant estuarine Indicators and Criteria are listed in Table 1.

***Table 1**: Water Quality Objectives for estuarine waters in the Georges River*

Aquatic ecosystems		**Visual Amenity**	
Indicator	**Criteria**	**Indicator**	**Criteria**
Total Phosphorus	30 ug/L	Visual clarity & colour	Natural visual clarity, hue and reflectance not adversely reduced
Total Nitrogen	300 ug/L	Surface films and debris	Oils and petrochemicals not noticeable as a visible film, nor detectable by odour. Waters should be free from floating debris and litter.
Chlorophyll a	4 ug/L	Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches not present in unsightly amounts
Turbidity	0.5-10 NTU	**Secondary contact recreation**	
Dissolved Oxygen	80-110%	**Indicator**	**Criteria**
pH	7.0 – 8.5	Faecal coliforms	Median < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL
Temperature	0-35º	Enterococci	Median < 230 enterococci per 100 mL (max number in any one sample: 450-700 organisms/100 mL).
Chemical contaminants	ANZECC 2000 Guidelines, chapter 3.4 and table 3.4.1.	Chemical contaminants	No waters containing toxic or irritating chemicals to the skin or mucous membranes. Should not exceed values in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines.
Biological		Algae & blue-green algae	< 15 000 cells/mL

The ANZECC 2000 Guidelines advocate a risk-based approach to water quality assessment and management. That is, the intensity of assessment of current water quality status or impacts on water quality should reflect the risk of impacts on the achievement/protection of the Water Quality Objective.

Trigger values are the numeric criteria that if exceeded indicate potential for harmful environmental effects to occur. The default trigger values provided in ANZECC 2000 Guidelines are essentially conservative and precautionary. If they are not exceeded, a very low risk of environmental damage can be assumed. If they are exceeded, further investigation is "triggered" for the pollutant concerned. Assessing whether the exceedance means a risk of impact to the Water Quality Objective requires site-specific investigation, using decision trees provided in the Guidelines.

Urban runoff typically contains the following pollutants in varying concentrations:

- Sediment - measured as Total Suspended Solids and Turbidity, and contributing to water clarity
- Nutrients – measured as Total Phosphorus and Total Nitrogen
- Hydrocarbons – often detected as a film or sheen on the surface of water
- Pathogens – measured as bacterial coliforms
- Heavy metals
- Other contaminants

In addition, urban runoff can have variable pH and salinity.

In relation to compliance with these guideline criteria, we will quantitatively report against Total Phosphorus and Total Nitrogen. The other criteria pertain to the receiving waters in the Georges River and Lake Moore.

3.3 Georges River - River Flow Objectives

Flow patterns in many rivers have been significantly altered and will not return to natural flow regimes. Communities and the Government have identified important areas where adjustments can be made to maintain or improve river health while continuing to benefit from water use. The following information Table 2) is summarized from the NSW Government environment web site:

https://www.environment.nsw.gov.au/ieo/GeorgesRiver/maptext-04.htm#rf01

***Table 2**: River flow objectives and proposed responses for the Georges River*

Requirement	**Our proposed actions**
Maintain or rehabilitate estuarine processes and habitats	*Dredging will only occur in order to stabilize the toe of the Georges River frontage* *Only toe of bank at Georges River frontage affected. Controls required to minimize escape of acid waters.* *Proposed water-based activities will have minimal impact on fish habitat* *Tidal wetlands continue to receive tidal flushing* *Change of land use from heavily polluting heavy industry to mixed use. Stormwater will be treated. Banks which currently contain contaminants slump into the River. This will cease.*
Maintain the natural inundation patterns and distribution of floodwaters supporting natural wetland and	*Inundation and drying will not change. The floodplain will be expanded when Georges River* *Maintain natural inundation and drying patterns in wetlands and native floodplain ecosystems. More wetland areas will be created*

floodplain ecosystems	*Flooding patterns will not be significantly altered. The river flows dwarf the runoff flows generated by the development*
Maintain natural rates of change in water levels	*Maintain rates of rise and fall of river heights within natural bounds* *The river flows dwarf the runoff flows generated by the development*
Maintain natural flow variability	*Maintain or mimic natural flow variability in all streams* *The river flows dwarf the runoff flows generated by the development*
Maintain natural rates of change in water levels	*Maintain rates of rise and fall of river heights within natural bounds* *The river flows dwarf the runoff flows generated by the development*
Protect natural water levels in pools of rivers and wetlands during periods of no flow	*No water extraction proposed* *The river flows dwarf the runoff flows generated by the development*
Protect or restore a proportion of moderate flows ('freshes') and high flows	*Manage stormwater in such a way that there is no increase in the height or flow rate of high flows.* *The river flows dwarf the runoff flows generated by the development*
Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems	*Linkage maintained. Alteration of flow patterns by creation of basements. Shallow groundwaters to remain directly linked to flows in river and wetlands. It will continue provide base flows in rivers during dry periods.*

Riparian provisions

- Demonstrate that the development is not likely to have an adverse impact on the following:
  - (i) the water quality in any waterway
  - (ii) the natural flow regime, including groundwater flows to any waterway
  - (iii) aquatic and riparian species, populations, communities, habitats and ecosystems
  - (iv) the stability of the bed, shore and banks of any waterway
  - (v) the free passage of native aquatic and terrestrial organisms within or along any waterway and riparian land
  - (vi) public access to, and use of, any public waterway and its foreshores,
    - a. any opportunities for rehabilitation or re-creation of any waterway and its riparian areas,
    - b. any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.
- Locally harvested rainwater should be the primary source of non-potable water for new development, to reduce stormwater runoff and minimise the impacts of stormwater quantity on sensitive receiving waters.
- Rainwater tanks are to be provided when any of the following are present in the development:
  - An irrigated area more than 50 m^2
  - Any car or other vehicle washing facilities
  - Commercial laundry facilities

  - Three or more toilets
  - A cooling tower
- Rainwater tanks or other alternative water sources need to be designed to meet the following requirements:
  - At least 90% of roof area shall be connected to rainwater storage(s)
  - Rainwater supply schemes may be supplemented with recycled water where connection to recycled water supply is available.
  - Connect rainwater tanks to irrigation, car washing, toilets, water features, washing machines, hot water systems and cooling towers.
- Where non-potable demand within a development site is low, alternative uses for roof water such as landscaping, roof gardens, as well as off-site re-use, should be considered to minimise the volume of stormwater discharged to local waterways.

Stormwater quality and quantity targets

The following is consistent with many existing DCPs. It combines the strongest elements of existing examples.

- Post development mean annual pollutant loads must be reduced by the following amounts:
  - Gross pollutants (90%),
  - Total suspended solids (85%)
  - Total phosphorus (65%)
  - Total nitrogen (45%).
  - Post-development mean annual runoff volume must be reduced by 10%.

Post-development mean annual pollutant loads and runoff volume need to be estimated using a MUSIC model.

When accounting for post-development runoff, include all stormwater runoff as well as any other water discharged to the stormwater system. If the development includes a basement pump-out system that discharges to the stormwater system, this volume needs to be accounted for. To demonstrate compliance with these targets, proponents will need to submit a WSUD report and MUSIC model, and a Deemed to comply checklist.

Vegetated treatment should always be used as part of the stormwater treatment train, unless it can be clearly shown that this type of treatment is not possible at a particular site.

Erosion and sediment control

Provide appropriate Erosion and Sedimentation Control measures to control runoff, mitigate soil erosion and trap pollutants before they can reach downslope lands and receiving watercourses. Soil erosion and sediment control measures shall be designed in accordance with the document *Managing Urban Stormwater–Soils & Construction Volume 1* (2004) by Landcom (the “Blue Book”).

Development applications must include a draft construction management plan addressing the requirements set out in the Blue Book. The final Plan must be submitted with an application for a construction certificate.

3.4 Summary of strategic context

For assessment purposes, this report provides an intent to demonstrate compliance with the *Liverpool DCP* 2008 for DA submission, as a minimum. To summarise, this includes all provisions for stormwater drainage, water quality treatment, flooding, erosion & sediment controls and use of recycled water (if feasible).

We do not report on environmental flows, Stream Erosion Index or On-site Detention. This reason for not reporting On-site Detention is because the site is affected by flooding and is a major river where these provisions have no bearing.

We take into account the *Georges River Water Quality Objectives* by adopting Best Practice stormwater management, including WSUD measures. We consider the concentration criteria for Total Nitrogen, Total Phosphorus and Total Suspended Solids as stretch targets.

We list a suite of measures that are consistent with the *Georges River River Flow Objectives*. We note that that quantum of precinct runoff flows is negligible in relation to Georges River flows, and so have little bearing on the riverine environment.

The adopted policy framework can be used for assessment of future detailed Development Application submissions.

4. Water Cycle Management

4.1 Catchment plan

Up to six subcatchments will be defined based on the site grading.

4.2 Drainage

New pit and pipe drainage will be provided across the development to drain the various subcatchments to the Georges River, or to Lake Moore. A minor/major system is proposed with all runoff up to and including the 5% AEP will enter the pit and pipe system. When the stormwater network capacity is exceeded, runoff will flow down streets as the overland flow paths.

4.3 Rainwater and stormwater harvesting and reuse and recycled water

All roofs (other than the existing heritage ones on the western side of the site) will have a minimum 10kL rainwater tank in its basement. This water will be plumbed internally and externally for non-potable uses.

Treated stormwater may be harvested in underground tanks. Any treated stormwater may be used to irrigate landscape plantings which will contribute to urban cooling.

Top-up of tanks with recycled water can be provided, if it becomes available and if this proves to be feasible.

4.4 Water Sensitive Urban Design

WSUD treatment measures will be selected from the following:

- Each lot may have water quality treatment in a chamber using Ocean Protect filter cartridges sized for each site.
- Ocean Protect CDS gross pollutant traps on subcatchments as end-of-pipe treatment measure to trap gross pollutants and sediment.
- Bioretention basins may be proposed in the public domain (i.e. foreshore and overbanks) to provide further water quality treatment, integrated with landscaping, and providing some urban cooling.
- Street tree pit WSUD elements can be employed for subcatchments which cannot drain to a bioretention basin.
- Bioswales can be co-located within streets, e.g. the green spine (east-west street access) in the western portion of the precinct.

An indicative layout of WSUD options is provided in Figure 7.

Figure 7: *Indicative WSUD options layout (Source: Turf 2024)*

The performance of the Water Cycle Management plan incorporating WSUD measures will be tested with a MUSIC model. The results will be compared to the DCP water quality targets and the Georges River Water Quality Objectives for compliance purposes (Table 3).

Table 3*: Water quality compliance framework and high level assessment*

Pollutant	Liverpool LCC DCP 2008 Pollutant retention	Georges River Water Quality Objectives Pollutant Concentration
Total Nitrogen	45%	300ug/L
Total Phosphorus	65%	30ug/L
Total Suspended Solids	85%	
Gross Pollutants	90%	

***Table 3 cont**: Water quality compliance framework and high level assessment*

Georges River Water Quality Objectives compliance assessment

Aquatic ecosystems		**Compliance Response**
Indicator	**Criteria**	
Chlorophyll a	4 ug/L	The proposal will not provide a point source of Chlorophyll to receiving waters. Chlorophyll in receiving waters is a function of the amount of algae present, and this is addressed below
Turbidity	0.5-10 NTU	During construction, there is an elevated chance of releasing turbid waters. This will be managed using Erosion and Sediment Controls. During operational stage of the development, the proposed treatment train will reduce turbidity in runoff through the filtering of the flows.
Dissolved Oxygen	80-110%	Dissolved Oxygen is a function of the temperature of the runoff. The runoff will be ambient temperature and it is expected that DO will mostly fall within this range.
pH	7.0 – 8.5	In urban runoff, pH is largely affected by water flowing through concrete pipes, which elevates it. The filtering of runoff in biobasins, WSUD street trees and bioswales is expected to buffer increases in pH.
Temperature	0-35^{o}	It is expected that almost all runoff from the site will be less than 35 degrees.
Chemical contaminants	ANZECC 2000 Guidelines, chapter 3.4 and table 3.4.1.	It is expected that few if any contaminants will form part of the runoff from the site. An exception is Hydrocarbons from vehicle use on roads. The treatment measures proposed are capable of removing almost all hydrocarbons in the runoff.
Biological	Algae & blue-green algae	The development is unlikely to be a source of algal cells. Algal cells form in waters that have high nutrient levels, dealt with above.

Visual Amenity		
Indicator	**Criteria**	**Compliance Response**
Visual clarity & colour	Natural visual clarity, hue and reflectance not adversely reduced	The only pollutant from the development likely to affect this is sediment. Sediment treatment is proposed during both construction and operation.
Surface films and debris	Oils and petrochemicals not noticeable as a visible film, nor detectable by odour.	Only trace amounts of hydrocarbons (from road runoff) would be present in

	Waters should be free from floating debris and litter.	drainage waters. This will be treated in WSUD measures.
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches not present in unsightly amounts	The treatment of nutrients will prevent any of these factors worsening in Georges River.
Secondary contact recreation		
Indicator	**Criteria**	**Compliance Response**
Faecal coliforms	Median <1,000 faecal coliforms per 100 mL, with 4 out of 5 samples <4,000/100 mL	The only source of pathogens to the River would be from pet faeces in landscaped areas. WSUD measures would reduce the concentrations of organisms from this source.
Enterococci	Median < 230 enterococci per 100 mL (max number in any one sample: 450-700 organisms/100 mL).	
Chemical contaminants	No waters containing toxic or irritating chemicals to the skin or mucous membranes. Should not exceed values in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines.	The only way this could occur is as a result of accidental spills. The treatment system – in particular WSUD measures – would assist to mitigate the impact of any spill
Algae & blue-green algae	< 15 000 cells/mL	The treatment of nutrients will prevent algae worsening in Georges River.

4.5 Stormwater outlets

Stormwater will be directed to outlets that either enter the Georges River or Lake Moore directly. The stormwater from each outlet will be treated before discharge.

Outlets will be designed to comply with Council's DCP and the DPI riparian guidelines using soft engineering comprising rock, geofabrics and plants. The design will take into account flood flow forces to ensure their stability and longevity.

In order to facilitate safer swimming and water recreation, the Lake Moore outlets are located away from the current and proposed beach areas in Haigh Park. Where they discharge to Georges River, the outlets will be integrated within rock protection works at the toe of the river bank. They will be angled to discharge flows in a downstream direction.

4.6 Water and Sewer servicing

4.6.1 Sewer

To allow for construction and servicing of the development, the following alteration works are potentially required as part of precinct early works:

- A new wastewater gravity connection from the development site to adjacent wastewater mains on Bridges Rd.

- A new wastewater gravity connection from the proposed development plant room to the existing Sydney Water sewer pump station [SP0287]
- Potential upgrade or relocation of the existing Sydney Water sewer pump station [SP0287]
- Existing sewer mains on precinct area to be removed.

4.6.2 Water

To allow for construction and servicing of the development, the following alteration works are potentially required:

- New connections to the existing Sydney Water potable mains on Newbridge Road and Bridges Road along with any required amplification works
- A new internal potable water line with a connection to the proposed development lots
- Completion of the Liverpool water reservoir

Additionally, the opportunity to provide a recycled water treatment system is being explored with Sydney Water.

Summary and Conclusions

The Joint Landowners seek to create a vibrant mixed use development that will transform the Moore Point precinct and Liverpool. To achieve this, the landowners are proposing a suite of water cycle management interventions that are intended to achieve all of the following:

- Provide effective drainage to minimise nuisance flooding across the precinct
- Provide sanitary sewer disposal to Liverpool wastewater treatment plant for treatment and reuse (wastewater recycling).
- Provide water supply to each property, with mains water consumption minimized through:
    - BASIX to reduce water consumption within premises
    - Harvesting and reuse of roof water within individual development sites (rainwater harvesting)
    - Harvesting, treatment and reuse stormwater from each subcatchment for irrigation of landscaping (stormwater harvesting). If recycled water becomes available to the precinct, and if feasible, would be used for top-up of irrigation water
- Only discharge treated runoff water that complies with contemporary water quality criteria that will not compromise the values of the Georges River (water quality treatment)
- The stability and integrity of the Georges River bed and banks will be enhanced (refer also to Riparian Strategy)
- The ecology of the Georges River banks will be enhanced
- No exacerbation of flooding or alteration of flooding patterns
- No part of the system is visually obtrusive, with most elements underground, or landscaped

Various design measures are proposed which deliver on these outcomes, including:

- Subcatchment delineation to compartmentalize runoff flows
- Drainage system design to collect and drain all flows up to the 5% AEP event delivering treated runoff directly to the Georges River and Lake Moore (where stormwater currently drains to)
- A treatment train comprising selections of the following:
    - Rainwater harvesting on each of each lot with harvested water used for irrigation and other non-potable uses
    - Chamber water quality treatment on each lot with Ocean Protect filter cartridges
    - Gross Pollutant Traps
    - Bioretention basins, WSUD street trees and bioswales for polishing/treatment of stormwater prior to discharge
    - Possible stormwater harvesting - Harvested water used for landscape irrigation giving rise to ongoing urban cooling
- Sewage directed to Liverpool Sewage Treatment Plant. If recycled water becomes available, it may be used
- Water supply from Sydney Water, and augmented with rainwater and possibly stormwater harvesting as outlined above

Compliance with Council's DCP and will be demonstrated quantitatively (MUSIC modelling and MUSIC Link) and qualitatively. Compliance is demonstrated against the *Georges River Water Quality Objectives* and *River Flow Objectives*.

The design represents a contemporary response to water cycle management that provides many ancillary benefits. It is appropriate and fitting for the vibrant mixed-use development at Moore Point.

References

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- Liverpool City Council 2008. Development Control Plan
- SJB 2024, Moore Point Masterplan – Gateway Revised Planning Proposal Urban Design Report.
- Mott Macdonald 2024, Moore Point, Liverpool Sustainable Statement
- Northrop 2024, Moore Point Riparian Assessment.
- NSW Government environment web site – Water Quality Objectives for the Georges River: https://www.environment.nsw.gov.au/ieo/GeorgesRiver/report-02.htm#P134_16430
- NSW Government environment web site: River Flow Objectives. https://www.environment.nsw.gov.au/ieo/GeorgesRiver/maptext-04.htm#rf01