DESIGN REPORT

ESR

Westlink Stage 2, Kemps Creek – Naturalised Trunk Drainage Channel Design

14 August 2024

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1. INTRODUCTION

This Design Report includes information on the design rationale and supporting key information used in developing the detailed concept engineering design for the Westlink Stage 2 naturalised trunk drainage channel, located at Kemps Creek. The design of the drainage channel has been developed in consultation with Sydney Water.

The Stage 2 trunk drainage channel is located within Westlink at Abbotts Road Kemps Creek within the Mamre Road Precinct and is being developed by ESR. Engineering design of the site adjacent to Stage 2 trunk drainage channel is being undertaken by others (primarily AT&L Engineers), which includes bulk earthworks, roadworks, stormwater drainage, and utility services. A flood impact assessment is being undertaken by Stantec which assesses the flood impact of the Stage 2 design. The Stage 2 channel design integrates with and should be considered in conjunction with the engineering design and flood impact assessment for the surrounding development.

Hydrology modelling has been undertaken by AT&L/Stantec and Sydney Water for the broader Mamre Road Precinct. Peak flows at the channel location have been provided from these models and adopted in this study.

Preliminary hydraulic modelling calculations have been undertaken using Hydraulic Toolbox software to assess the channel performance for key design parameters, such as flow depths, velocities and shear stresses.

The detailed concept engineering design as represented in the J. Wyndham Prince engineering design plans **110965-04-CD001 - CD080 (Issue 1)** and the supporting hydrologic and hydraulic modelling presented in this report, demonstrates that the overall design is functional, constructible and achieves the relevant design criteria established by Sydney Water.

2. THE SITE

2.1. Existing Site

The overall ESR development site is located at Kemps Creek and is part of the Mamre Road Precinct. The site falls within the Penrith City Council local government area. The site is accessed via Abbotts Road and Aldington Road from the north.

The existing site consists of rural land, including residential dwellings, agricultural land, sheds and farm dams. The western portion of the site consists of relatively flat terrain, with slopes generally between 2-5%. The eastern part of the site and land further to the east consists of steeper terrain, with slopes generally between 10-15%.

The overall ESR site and Stage 2 Trunk Drainage Channel location are shown below in Plate 2-1. The Stage 2 trunk drainage site is bordered by the 1016-1028 Mamre Road to the north (owned by others) and 1030-1048 Mamre Road to the south (owned by ESR).

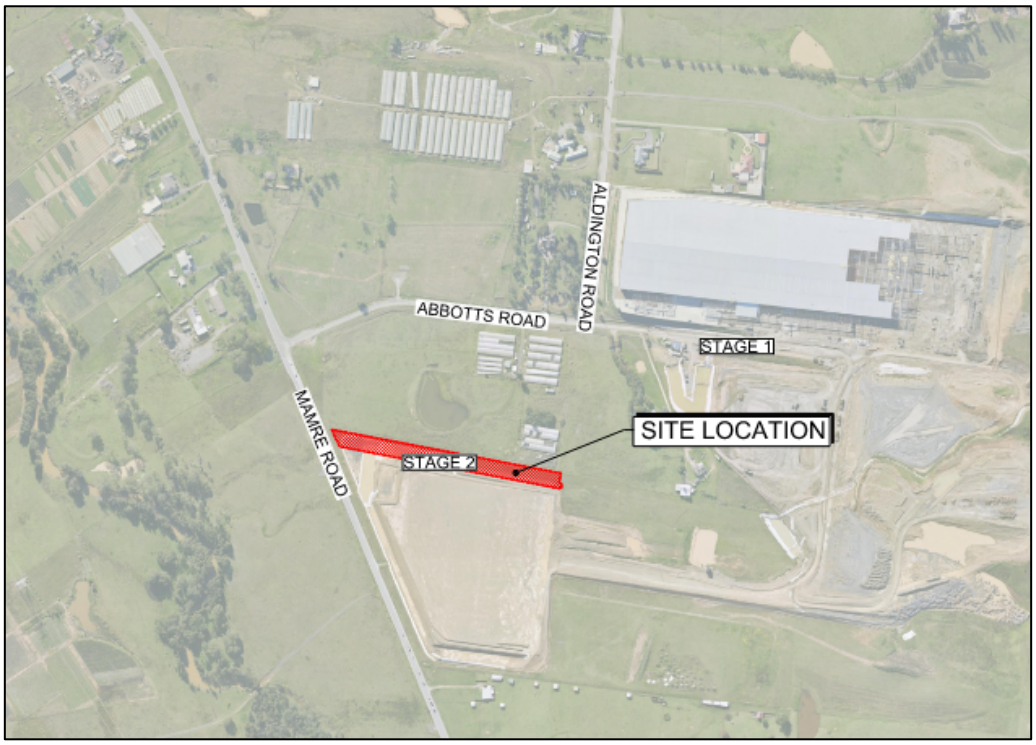

Plate 2-1 – Existing Site Location (Aerial Image from MetroMap – May 2024)

2.2. Proposed Site

The proposed Stage 2 development consists of bulk earthworks, roadworks, stormwater drainage, utility services and the construction of one (1) warehouse building (Lot 2). The Stage 2 development layout is shown below in Plate 2-2 (defined by the green shaded areas). The proposed Stage 2 trunk drainage channel is highlighted in purple. The neighbouring site to the north of the Stage 2 channel (1016-1028 Mamre Road, owned by others) is not intended to be developed in the foreseeable future and so design consideration has been given to the interface at this boundary.

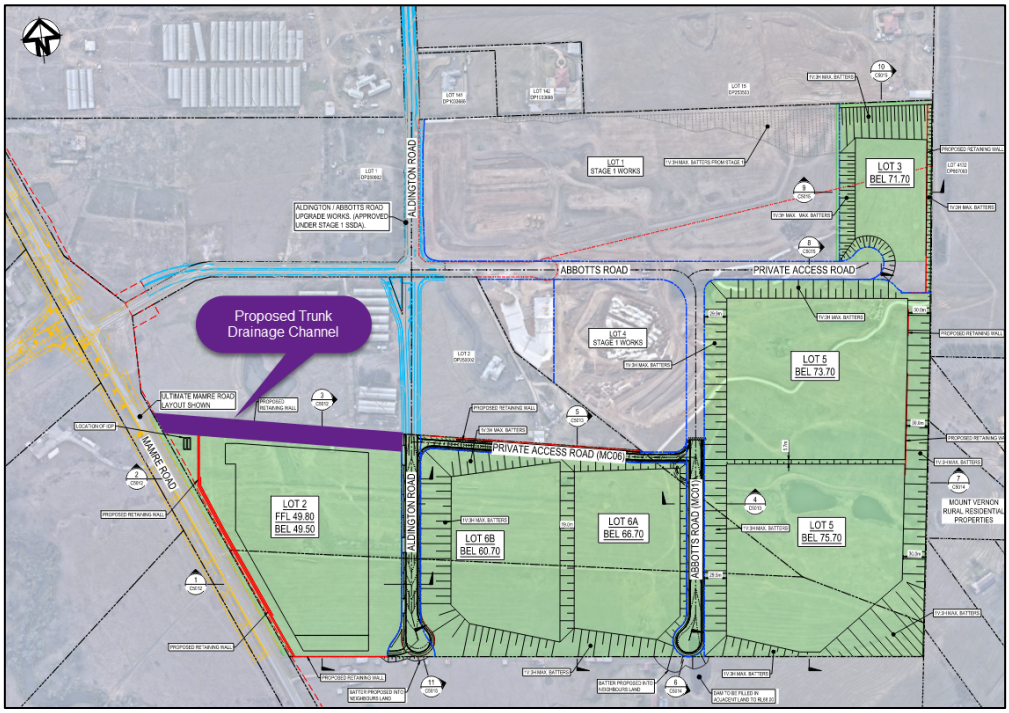

Plate 2-2 – Westlink Stage 2 Proposed Development (Source: AT&L Civil Plans)

2.3. Site Geotechnical Background

A Geotechnical investigation[1] was undertaken by Douglas Partners over the Westlink Stage 2 development site in late 2021 and this investigation included the portion of the site where the trunk drainage channel is to be constructed. The desktop investigation identified that the proposed channel falls within the Blacktown soil landscape which comprises of multiple soil horizons consisting mostly of clayey soils.

2.4. Design Controls and Standards

The design controls and standards that are relevant for the design of the Westlink Stage 2 Naturalised Drainage channel are:

- Stormwater Scheme Infrastructure Design Guideline - Draft (Sydney Water - 21 Dec 2022)
- Stormwater Scheme Infrastructure (Sydney Water -21 Dec 2022) – Trunk Drainage Checklist – issued by email from SW to ESR on 17/6/24
- Response to Submission – RtS Matrix from SW to ESR dated 29 April 2024. – (Refer to Appendix A for JWP's responses)

[1] *Report on Desktop Geotechnical Assessment, Due Diligence Assessment 1030 Mamre Road, Kemps Creek 208044.00.R.001.Rev0 (Douglas Partners September 2021)*

3. STAGE 2 TRUNK DRAINAGE CHANNEL DESIGN DEVELOPMENT

The trunk drainage channel is located immediately to the northern side of Westlink Lot 2. The design of the channel is compliant with the *Stormwater Scheme Infrastructure Guideline (Draft) (December 2022)*, prepared by Sydney Water.

3.1. Channel Design Constraints, Opportunities and Options Assessment

The design for the Stage 2 channel has been developed in conjunction with Sydney Water, ESR and the other engineering consultants involved in various components of the project (AT&L and Stantec). The concept design has been iterated to produce a suitable design outcome that considers the requirements defined by Sydney Water (in particular the hydraulic performance criteria) and the surrounding topographical constraints of the channel site.

There is a level difference between the upstream and downstream ends of the channel of approximately 2.6m over the channel length of approximately 320m. This level difference is set by the propsoed Aldington Road pipe drainage system which discharges to the head of the channel and the future Mamre Road culvert crossing at the tail end of the channel. This has resulted in a longitudinal design that incorporates a 0.7% grade for the majority of the channel with a short 27m portion of the channel to be rock-lined at a 2% grade. This configuration keeps adjacent retaining wall heights to a minimum. No drop structures are proposed, although this option was considered as an alternative to a rock-lined segment but rejected as it would interfere with the continuity of the riparian vegetation in the channel base.

The northern boundary of the drainage channel is constrained by the neighbouring site which is not under the control of ESR and which we understand is not due to be developed in the foreseeable future. Consideration has been given to the interface of the channel with the northern boundary which will require retaining walls for the majority of the channel length. This is proposed to be concrete sleeper walls for the majority of the channel length to minimise the horizontal width required to deliver a wall of a maximum height of 2.9m. This also maximises the hydraulic capacity of the channel profile without the need to impinge on the northern property. The wall on the northern side of the channel will be located outside of the designated drainage easement, so the wall will be maintained in perpetuity by the landowner (ESR).

The southern boundary of the channel interfaces with the proposed Westlink Lot 2 development being designed by AT&L. This interface will also consist of a retaining wall for the majority of the channel length which will be delivered within the Westlink Lot 2 development to the south. Refer to AT&L civil engineering plans for further details.

3.2. Channel Configuration

With consideration of all the above constraints, the preferred channel option consists of a channel profile with 0.7% longitudinal grade for the first 216 metres, a brief 27 metre portion of the channel with 2% longitudinal grade, and then a final 80 metre portion of the channel at 0.7% grade. The channel ultimately drains to a future set of box culverts under Mamre Road (refer to AT&L plans for details).

The channel consists of a 0.5 metres deep low flow channel with 1:3 batter slopes. The low flow channel is to be primarily vegetated/grassed, except for the portion at 2% grade which will be rock lined due to the higher velocities and shear stresses experienced.

The channel overbanks generally grade at 1% from the edge of the low-flow channel to maximise the hydraulic capacity and minimise overall flow depth. A 3.5 m wide maintenance track runs adjacent to the channel for the full length. The maintenance track generally runs at the same grade as the channel, except where it connects to Aldington Road.

The overall width of the channel between the southern Westlink Lot 2 boundary and the northern neighbouring property (1016-1028 Mamre Road) is 18.9 metres (being 20 m less the 1.1 m width of the concrete sleeper walling required to support the northern property). The typical channel section is shown below on Plate 3-1.

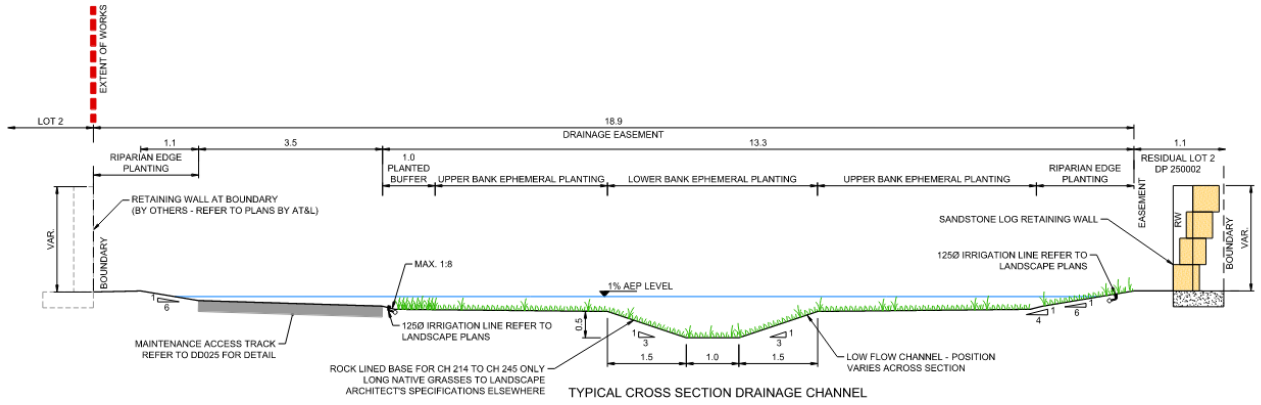

Plate 3-1 – Typical Channel Cross Section

3.2.1 Sinuosity

The low-flow channel has been designed with sinuosity generally in accordance with the Sydney Water design guidelines. A minimum radius of 12 metres has been adopted for the bends. The sinuosity has been configured to be as irregular as possible within the overall channel width and other channel constraints. The Sinuosity parameters attained are outlined in Table 3-1.

Table 3-1 – Channel Sinuosity Calculations

Sinuosity Parameter	SW Target	Value	Compliance
Low Flow Channel Top Width (W)	-	4 m	
Average Wavelength	10 W or greater	15 m	3.75 W
Minimum Centreline Radius Curvature	3 W or greater	12 m	3 W
Minimum Outer Radius Curvature	3.5 W or greater	14 m	3.5 W
Sinuosity Factor	1.05 or greater		1.05

While the Sydney Waters targets for the sinuosity (i.e. average wavelength) have not been fully achieved, it is considered that this is a reasonable design outcome given the site constraints.

4. HYDROLOGY

Hydrology modelling for Westlink Stage 2 was developed by AT&L. Sydney Water has also advised on peak 1% AEP channel flow rates relevant for the design of the Stage 2 Channel.

The relevant 12EY, 20% AEP, 5% AEP, and 1% AEP design flow rates for the Stage 2 channel were obtained from the Westlink Industrial Estate – Civil Infrastructure & Water Management Strategy Stage 2 report (AT&L, August 2024). The adopted peak flows are summarised in Table 4-1 below.

Table 4-1 – Peak Design Flow Rates

FLOW LOCATION	**AT&L Derived Peak Flows**					**SYDNEY WATER VALUE**
Storm Event	12EY (m^3/s)	20% AEP (m^3/s)	5% AEP (m^3/s)	1% AEP (m^3/s)	PMF (1987) (m^3/s)	1% AEP (m^3/s)
Channel - Upstream end	0.766	1.787	3.07	6.01		4.3
Lot 2 OSD Basin Outlet	0.086	0.346	1.04	1.84		
Channel - Downstream of Lot 2 OSD outlet	0.791	2.09	4.01	7.42	28*	5.1

*PMF have been extrapolated from the 1% AEP peak flows at a similar ratio (approximately 400%) to the flow rates reported in the Stage 1 Trunk Drainage Design Report (JWP, 2024).

5. HYDRAULICS

5.1. Channel Modelling

5.1.1 Concept Phase

Preliminary hydraulic modelling was undertaken using Hydraulic Toolbox software to determine key design results that have informed the options assessment and concept channel design.

The assessment considered both the establishment and ultimate phases of the channel delivery and assesses these conditions in the key storm events which dictate the design of the channel profile. The events that have been assessed in the channel include 0.5 x 12EY for the sizing of the low flow channel and the 1% AEP for the overall capacity of the channel.

The parameters and results of the preliminary hydraulic modelling for the channel are summarised below in Table 5-1.

Table 5-1 – Summary of Concept Stage Hydraulic Modelling Results

Chainage 0.00 to 215.96

Max Channel Slope = 0.7%

1% AEP Flow Rate = 6.0 m3/s	0.5 x 12EY Flow Rate = 0.38 m3/s

Design Conditions

Mannings n Low Flow Channel = 0.05

Mannings n Overbanks = 0.08

Parameter	Value	Units	Parameter	Value	Units
Flow	6.000	cms	Flow	0.380	cms
Depth	0.859	m	Depth	0.325	m
Area of Flow	6.558	m^2	Area of Flow	0.642	m^2
Wetted Perimeter	18.753	m	Wetted Perimeter	3.057	m
Hydraulic Radius	0.350	m	Hydraulic Radius	0.210	m
Average Velocity	0.915	m/s	Average Velocity	0.592	m/s
Top Width (T)	18.540	m	Top Width (T)	2.951	m
Froude Number	0.491		Froude Number	0.405	
Critical Depth	0.711	m	Critical Depth	0.199	m
Critical Velocity	1.520	m/s	Critical Velocity	1.193	m/s
Critical Slope	0.02985	m/m	Critical Slope	0.04854	m/m
Critical Top Width	16.761	m	Critical Top Width	2.196	m
Calculated Max Shear Stress	58.941	N/m^2	Calculated Max Shear Stress	22.312	N/m^2
Calculated Avg Shear Stress	23.997	N/m^2	Calculated Avg Shear Stress	14.421	N/m^2
Composite Manning's n Equ...	Lotter ...		Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0454		Manning's Roughness	0.0500	

Establishment Conditions

Mannings n = 0.03

Parameter	Value	Units
Flow	6.000	cms
Depth	0.756	m
Area of Flow	4.709	m^2
Wetted Perimeter	17.495	m
Hydraulic Radius	0.269	m
Average Velocity	1.274	m/s
Top Width (T)	17.299	m
Froude Number	0.780	
Critical Depth	0.711	m
Critical Velocity	1.520	m/s
Critical Slope	0.01191	m/m
Critical Top Width	16.761	m
Calculated Max Shear Stress	51.860	N/m^2
Calculated Avg Shear Stress	18.468	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0274	

Parameter	Value	Units
Flow	0.380	cms
Depth	0.252	m
Area of Flow	0.443	m^2
Wetted Perimeter	2.595	m
Hydraulic Radius	0.171	m
Average Velocity	0.858	m/s
Top Width (T)	2.513	m
Froude Number	0.653	
Critical Depth	0.199	m
Critical Velocity	1.193	m/s
Critical Slope	0.01747	m/m
Critical Top Width	2.196	m
Calculated Max Shear Stress	17.299	N/m^2
Calculated Avg Shear Stress	11.711	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0300	

Chainage 215.96 to 242.84

Max Channel Slope = 2%

1% AEP Flow Rate = 6.0 m3/s	0.5 x 12EY Flow Rate = 0.38 m3/s

Design Conditions

Mannings n Low Flow Channel = 0.04

Mannings n Overbanks = 0.08

Parameter	Value	Units
Flow	6.000	cms
Depth	0.716	m
Area of Flow	4.031	m^2
Wetted Perimeter	17.011	m
Hydraulic Radius	0.237	m
Average Velocity	1.488	m/s
Top Width (T)	16.822	m
Froude Number	0.971	
Critical Depth	0.711	m
Critical Velocity	1.520	m/s
Critical Slope	0.02105	m/m
Critical Top Width	16.761	m
Calculated Max Shear Stress	140.379	N/m^2
Calculated Avg Shear Stress	46.454	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0364	

Parameter	Value	Units
Flow	0.380	cms
Depth	0.223	m
Area of Flow	0.373	m^2
Wetted Perimeter	2.413	m
Hydraulic Radius	0.155	m
Average Velocity	1.019	m/s
Top Width (T)	2.340	m
Froude Number	0.814	
Critical Depth	0.199	m
Critical Velocity	1.193	m/s
Critical Slope	0.03107	m/m
Critical Top Width	2.196	m
Calculated Max Shear Stress	43.792	N/m^2
Calculated Avg Shear Stress	30.313	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0400	

Establishment Conditions

Mannings n = 0.03

Parameter	Value	Units
Flow	6.000	cms
Depth	0.671	m
Area of Flow	3.302	m^2
Wetted Perimeter	15.519	m
Hydraulic Radius	0.213	m
Average Velocity	1.817	m/s
Top Width (T)	15.335	m
Froude Number	1.250	
Critical Depth	0.711	m
Critical Velocity	1.520	m/s
Critical Slope	0.01191	m/m
Critical Top Width	16.761	m
Calculated Max Shear Stress	131.544	N/m^2
Calculated Avg Shear Stress	41.708	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0277	

Parameter	Value	Units
Flow	0.380	cms
Depth	0.192	m
Area of Flow	0.303	m^2
Wetted Perimeter	2.217	m
Hydraulic Radius	0.137	m
Average Velocity	1.252	m/s
Top Width (T)	2.154	m
Froude Number	1.065	
Critical Depth	0.199	m
Critical Velocity	1.193	m/s
Critical Slope	0.01747	m/m
Critical Top Width	2.196	m
Calculated Max Shear Stress	37.721	N/m^2
Calculated Avg Shear Stress	26.837	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0300	

Chainage 242.84 to 323.05

Max Channel Slope = 2%

1% AEP Flow Rate = 7.4 m3/s	0.5 x 12EY Flow Rate = 0.40 m3/s

Design Conditions

Mannings n Low Flow Channel = 0.05

Mannings n Overbanks = 0.08

Parameter	Value	Units
Flow	7.400	cms
Depth	0.910	m
Area of Flow	7.525	m^2
Wetted Perimeter	19.161	m
Hydraulic Radius	0.393	m
Average Velocity	0.983	m/s
Top Width (T)	18.900	m
Froude Number	0.497	
Critical Depth	0.748	m
Critical Velocity	1.616	m/s
Critical Slope	0.03041	m/m
Critical Top Width	17.209	m
Calculated Max Shear Stress	62.471	N/m^2
Calculated Avg Shear Stress	26.948	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0456	

Parameter	Value	Units
Flow	0.400	cms
Depth	0.333	m
Area of Flow	0.667	m^2
Wetted Perimeter	3.109	m
Hydraulic Radius	0.215	m
Average Velocity	0.600	m/s
Top Width (T)	3.001	m
Froude Number	0.406	
Critical Depth	0.205	m
Critical Velocity	1.207	m/s
Critical Slope	0.04818	m/m
Critical Top Width	2.231	m
Calculated Max Shear Stress	22.879	N/m^2
Calculated Avg Shear Stress	14.721	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0500	

Establishment Conditions

Mannings n = 0.03

Parameter	Value	Units	Parameter	Value	Units
Flow	7.400	cms	Flow	0.400	cms
Depth	0.795	m	Depth	0.259	m
Area of Flow	5.401	m^2	Area of Flow	0.460	m^2
Wetted Perimeter	17.976	m	Wetted Perimeter	2.636	m
Hydraulic Radius	0.300	m	Hydraulic Radius	0.174	m
Average Velocity	1.370	m/s	Average Velocity	0.870	m/s
Top Width (T)	17.773	m	Top Width (T)	2.552	m
Froude Number	0.793		Froude Number	0.655	
Critical Depth	0.748	m	Critical Depth	0.205	m
Critical Velocity	1.616	m/s	Critical Velocity	1.207	m/s
Critical Slope	0.01159	m/m	Critical Slope	0.01734	m/m
Critical Top Width	17.209	m	Critical Top Width	2.231	m
Calculated Max Shear Stress	54.567	N/m^2	Calculated Max Shear Stress	17.754	N/m^2
Calculated Avg Shear Stress	20.615	N/m^2	Calculated Avg Shear Stress	11.961	N/m^2
Composite Manning's n Equ...	Lotter ...		Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0274		Manning's Roughness	0.0300	

An additional assessment has been undertaken to demonstrate the hydraulic performance of the proposed channel design in a PMF event. The estimated PMF flow at the downstream end of the channel has been conservatively adopted at the upper channel profile. Refer to the hydraulic output in Table 5-2 below. The table indicates that an average velocity of 1.65 m/s will be experienced across the channel in a PMF event. These velocities would be sufficiently withstood by the proposed retaining walls on either side of the channel.

Table 5-2 – Summary of PMF Modelling Results

Parameter	Value	Units
Flow	28.000	cms
Depth	1.409	m
Area of Flow	16.952	m^2
Wetted Perimeter	20.159	m
Hydraulic Radius	0.841	m
Average Velocity	1.652	m/s
Top Width (T)	18.901	m
Froude Number	0.557	
Critical Depth	1.119	m
Critical Velocity	2.441	m/s
Critical Slope	0.02570	m/m
Critical Top Width	18.900	m
Calculated Max Shear Stress	96.694	N/m^2
Calculated Avg Shear Stress	57.701	N/m^2
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0451	

5.2. Sydney Water Design Comments

An advance copy of the Trunk Drainage Channel engineering design plans was issued to Sydney Water on about 16th October 2023 for review and comment. The draft design plans were subsequently reviewed by Sydney Water and a Response to Submission (RtS) register was issued by email on 29th April 2024. A copy of this comments register, with JWP's responses to each of the matters raised, is included in Appendix A of this report.

6. CONCLUSION

A naturalistic trunk drainage channel design has been developed and documented for the 320 m long naturalised trunk drainage channel to be constructed within Westlink Stage 2 at Kemps Creek. The channel is designated as a component of the Stormwater Infrastructure scheme within the Mamre Road Precinct which is managed by Sydney Water as the Regional Stormwater Authority. The design for the drainage channel was developed in close collaboration with Sydney Water's Wianamatta Stormwater team and responds to Sydney Waters evolving /draft design guidelines being established for this urban release area.

Preliminary assessment and modelling of the hydraulic performance of the system have been undertaken in support of the design process using Hydraulic Toolbox software in conjunction with the engineering design documentation of the channel. The modelling demonstrates that the channel complies with the design requirements established by Sydney Water for this infrastructure.

The detailed concept engineering documentation for the channel is represented by the engineering plans **110965-04-CD001- CD080**. The supporting hydrologic and hydraulic modelling presented in this report demonstrates that the overall design is functional, constructible and achieves the relevant design criteria established by Sydney Water. The design will be further refined at the detailed design stage and this will be supported by a 2D hydraulic modelling to confirm the system performance.

APPENDIX A Agency Response to Submission For ESR Stage 2 Trunk Drainage Channel

ESR WESTLINK STAGE 2
RESPONSE TO SUBMISSIONS

REF	COMMENT	TOPIC	RtS RESPONSE
A	The proponent should alter the riparian corridor to be in accordance with the Guidelines for Controlled Activities on Waterfront Land - Riparian Corridors.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been field verified by CTEnvironmental in 2020 (refer Appendix F of the *Mamre Rd Flood Riparian Corridor and Integrated Water Cycle Management Strategy* (Sydney Water 2021)). The watercouse was identified as "Unamed Trib Kenps Creek 1" and was confirmed as not having defined bed and banks. The inspection also validated that the mapped lower section within Lot 2 in DP 250002 was not present. This assessment informed the Precinct planning process for MRP.
A	The proponent should incorporate a flow path into the design of the riparian corridor if the connection between the watercourse and the online dam to the north of the site is to be retained.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). There is no clear defined overflow path from the dam and flows can be received by the channel along the length of the common boundary
A	A Vegetation Management Plan should be developed for both sections (within the project site and the section of re-alignment to the west between Kemps Creek and Mamre Road) of the watercourse re-alignment.	Trunk Drainage	This is not waterfront land and so a riparian type VMP is not required. Sydney Water is the caretaker of the future Drainage Channel. A suitable landscape design will be proposed consistent with Sydney Waters documented landscape design objectives.
A	Works within waterfront land including outlet structures, crossings and vegetation management plans should be in accordance with the Guidelines for Controlled Activities on Waterfront Land	Trunk Drainage	This is not waterfront land. However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice.
A	The proponent has committed to preparing a Soil and Water Management Plan. This is supported and it is recommended to be developed in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom 2004).	Trunk Drainage	A soil and water management plan was developed for the trunk drainage channel and is included on JWP Engineering Drawings CD070 -072. Similarly, an updated Soil and water management Plan has been developed for the proposed Stage 2 Civil works and this is presented in XXX plans YYYYY
Penrith City Council			
A	The site has a mapped waterway at the north-western corner near Mamre Road. Any works to the waterway will need to be undertaken in accordance with Water Management Act and the requirements of the Department of Climate Change, Energy, the Environment and Water.	Trunk Drainage	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice.
A	In relation to the trunk drainage, it will be important that Sydney Water approve the design and that it is designed in accordance with any of their requirements and technical guidelines	Trunk Drainage	The trunk drainage detailed engineering concept design has been developed based on the extensive consultation with Sydney Water that occurred for the recent similar Stage 1 Channel works, The naturalistic channel design documented on JWP engineering concept design plans 110695-04-CD001-080 are compliant with Sydney Waters documented design objectives. Suitable consent conditions are anticipated
A	The development includes the provision of temporary stormwater management basins, temporary irrigation of undeveloped areas, proprietary treatment devices and rainwater tanks. It is indicated that ultimately the site will connect to Sydney Water's drainage network. Interim arrangements are proposed although it is noted that additional information is required to demonstrate compliance with the requirements outlined in the MRP DCP. It is noted that no MUSIC modelling was made available, but the Department should review this.	Stormwater	Music model provided
A	No primary objections are raised regarding waterways health, as the proposed development includes commitments to connect to the regional stormwater scheme once available. However, it is recommended that DPHI ensure that the controls are met in terms of compliance with the stormwater and waterway health targets (for both the construction and operational stages). MUSIC modelling and design of stormwater temporary infrastructure should be prepared in accordance with the Technical guidance for achieving Wianamatta South Creek Penrith City Council PO Box 60, Penrith NSW 2751 Australia T 4732 7777 F 4732 7958 penrith.city stormwater management targets. This is likely to require additional information prior to determination of the application.	Stormwater	Noted Music model now provided

ESR WESTLINK STAGE 2
RESPONSE TO SUBMISSIONS

REF	COMMENT	TOPIC	RtS RESPONSE
A	Regarding the GPTs, while the plans indicate locations, additional details (such as access arrangements and type) is required on the engineering plans. Further, the GPTs need to be prepared as per the specifications outlined in Sydney Water Technical Design Guidelines. It is noted that the GPT's will be the responsibility of the developer / property owners to maintain. Conditions will need to be included in any consent requiring this.	Stormwater	SQUIDEP compliant Pit Inserts are proposed across the industrial lots on Westlink Stage 2 development in lieu of wet sump GPT's. A SQUIDEP compliant wet sump GPT is proposed at the Eastern end of the drainage channel and has suitable maintenance access.
A	It is suggested that additional details of the stormwater infrastructure are required. Functional design drawings of the temporary ponds, Hume filter, temporary irrigation systems and associated infrastructure should be provided. The plans should include additional details to demonstrate they can function and include details of levels, cross sections, access arranagements and the like. This should include details of a functional design and an operation and maintenance manual/s for the infrastructure. The maintenance manual should be provided prior to determination and conditions should be applied to ensure interim (and permanent) measures are maintained to the required standards.	Stormwater	No temporary ponds are proposed for Stage 2. Functional design drawings are not necessary for development consent but will be developed at the detailed design stage. A section showing the interconnection between the Stage 2 OSD system and the drainage channel is included oin JWP engineering drawing CD051
A	Should the application be approved, adequate conditions will need to be in place to ensure that all temporary infrastructure is maintained until the regional ifnrastructure is available. The conditions should ensure that future development on the site achieves compliance with the Integrated Water Cycle Management (IWCM) controls in the MRP DCP in accordance with the Technical Guidance for achieving Winamatta South Creek Stormwater Management Targets (NSW Government 2022).	Stormwater	Appropriate development conditions pertaining to the operation and maintenance of all stormwater infrastructure, including the removal of all interim measures are anticipated.
A	Conditions should be applied to ensure that adequate land is reserved for initial stages of the development's treatment and management of stormwater (such as irrigation of undeveloped land).	Stormwater	Appropriate development conditions pertaining to the implementation of interim irrigation disposal area are anticipated.
A	Conditions should also be used to ensure that all stormwater infrastructure, including GPTs, rainwater tanks, irrigation systems, temporary ponds (and the like) remain under the ownership, control and care of the registered proprietor of the lots. It is suggested that positive covenants and restrictions of use should be placed to ensure that all privately owned systems will be maintained in perpetuity. It is acknowledged some infrastructure will not be required once the regional scheme is available. Conditions may need to be included to manage the transition and decommissioning of the infrastructure once connection to the regional infrastructure is available.	Stormwater	Appropriate development conditions pertaining to the operation and maintenance of all stormwater infrastructure , including the removal of all interim measures is anticipated.
A	With respect to waterways, it is noted that a mapped waterway is located on the site. Any works will need to be undertaken in accordance with Water Management Act and the Department of Climate Change, Energy, the Environment and Water requirements.	Stormwater	The mapped Hydroline in this location does not correlate with the landform. The corresponding Riparian corridor has also been extinguished during the Precinct planning process for MRP (refer Biosis report). However the Sydney Water drainage channel design objectives will be achieved which will ensure the works are consistent with naturalistic drainage channel design best practice. Suitable consent conditions are anticipated
A	In relation to the trunk draiange, it is noted that a naturalised channel will be provided. It is relevant that Sydney Water approve the designa nd that it is designed in accordane with any of their requirements and technical guidelines.	Trunk Drainage	The trunk drainage detailed engineering concept design has been developed based on the extensive consultation with Sydney Water that occurred for the recent similar Stage 1 Channel works, The naturalistic channel design is compliant with Sydney Water's documented design objectives. Suitable consent conditions are anticipated
Biodiversity, Conservation and Science Group			
A	Provide an updated MUSIC model and flow spreadsheet which accounts for the influence of any external catchments which will flow through the treatment devices.	Stormwater	Music model now provided. LB to confirm
A	Drawing 20-748-C6144 (Lot 2 OSD Tank) - why has the OSD tank and HumeFilter been set so far below pavement level? This creates several issues, including backwater from the trunk drainage channel of the pipe as it is only 30mm above the channel invert. The 1% AEP level in the trunk drainage channel is alo different (lower) than shown on the JWP plan. Conservative design of flood levels for the trunk drainage channel should be adopted, given the uncertainty over the final design of Mamre Road culverts. Additional details are required in relation to wildlife hazard.	Stormwater	The level of the OSD tank is dicatated by the overall pipe lengths needed to drain the site and the need to drain undercroft parking areas. Surface levels above the tank have now been reduced. Darins modelling of the OSD tank confirms the system performance with an appropriate tailwater level. No open water systems are propsed so Wildlife hazrads are not anticipated.

ESR WESTLINK STAGE 2
RESPONSE TO SUBMISSIONS

REF	COMMENT	TOPIC	RtS RESPONSE
A	Recommendation - Revise levels of on-lot system (OSD, HumeFilter) to ensure system is not affected by backwater from trunk drainage channel and final outlet pipe will not be at elevated risk due to blockage - ensure consistent flood levels with JWP plans and that conservative flood levels have been adopted, reflective of the uncertainty of the Mamre Road culvert design - provide an overall drainage plan for the estatw which shows finished contours and all drainage infrastructure - as the site is within proximity of the airport, provide a wildlife hazard assessment and wildlife maangement plan and make any required changes to the design of the sediment basins and retention ponds to mitigate the hazard - extend the landscape drawing set to encompass the on-lot pond and incorporate recommendations from the wildlife hazard assessment and management plan - why does the LandPartners plan of subdivision use different lot numbering to the civil engineering plans?	Stormwater	See response above
A	Provide updated bulk earthworks drawings which include interim drainage measures which will manage runoff both generated within the lots and for external catchments, such that flows are directed to the underground drainage system in a controlled manner and without causing erosion.	Stormwater	Updated civil drawings have been providied indictaing how developed Lot 2 drains via underground network into the OSD tank in the north west corner of the lot. Refer to AT&L drawings 20-748 -C6000 series for details. All future lots drain via open swales into ERSED basins and discharge into the open trunk drainage channel. Refer to AT&L drawings 20-748 C5000 series for details
Sydney Water			
A	For Sydney Water to accept connection to the regional stormwater scheme, the development must demonstrate that the following will be implemented: - the documentation must clearly demonstrate that the mandatory 15% pervious area has been provided for the ultimate state of development - adequately sized and SQIDEP approved GPT must be installed across the development - passively irrigated street trees are to be installed on all roads within the development. The street trees act as a stormwater retention device and will assist the regional stormwater infrastructure strategy but also help achieve government canopy targets and urban cooling. Street trees are to be delivered under Council's guidance and nominally spaced at 8m centres.	Trunk Drainage	- the hydrologic modelling has adopted 15% pervious for all development sites consistent with the MRP DCP - SQUIDEP compliant Pit Inserts are proposed for all industrial lots within the Westlink Stage 2 development. - Passively irrigated street trees compliant with Penrith Councils approved details will be provided in all public and private roads
A	The channel as shown in the sketch below will have flows impacting the base of the retaining walls. This is considered a potential point of failure and should be designed to align with the Design Guidelines.	Trunk Drainage	The proposed Drainage Stage 2 channel typical cross section has been modified to ensure 1% AEP flows are contained within the channel batters consistent with Sydney Waters standard channel section details. Refer to JWP Plan no CD016 for details of the supporting hydraulic calculations.
A	"The peak 1% AEP are at a maximum of 7.4m3/s at the Mamre Road end. According to the design guideline, the channel should therefore be 25m wide a. 20m - 4.5m3/s b. 25m - 11m3/s c. 30m - 20m3/s	Trunk Drainage	An 18.9 m wide channel is proposed and this is supported by detailed hydraulic assessment that demonstrate its capacity and compliance with key design objectives, consistent with Sydney Waters Channel Design checklist (page 6). At the detailed design stage this will be further supported by TUFLOW 2D hydraulic modelling and mapping that assesses velocity and shear stresses at a suitable level of detail to support construction stage
A	Catchment boundaries are to be provided overlaying existing natural catchments with design catchments in shape or CAD files to understand the gap with SW evaluation.	Trunk Drainage	Need to reference AT&L and/or Stantec reported catchment plans
A	Modelling parameters to be aligned with the design guidelines	Trunk Drainage	Need to reference AT&L and/or Stantec reported modelling parameters
A	Retaining wall at the border of the property (north) should be replaced with a batter 1:4 to avoid impacting the neighbouring lot	Trunk Drainage	The small parapet wall at the Mamre Road end of the channel has been removed. Flows for the South west corner of Lot 2 DP250002 can freely drain to the channel. Future development of Lot 2 may result in the formalising of the drainage corridor batters to a future fill level on Lot 2 if required. The Stantec updated Flood impact assessment demonstrates that flood impacts are within acceptable thresholds.
A	Demonstrate that low flow invert channel coveys 12EY	Trunk Drainage	The Hydraulic assessment presented on JWP engineering plan CD016 demonstrates that 0.5 x 12EY flows are contained within the low flow channel. This approach is consistent with Sydney Waters standard Channel section

ESR WESTLINK STAGE 2
RESPONSE TO SUBMISSIONS

REF	COMMENT	TOPIC	RtS RESPONSE
A	Demonstrate water level at PMF, 5%AEP and 20%AEP	Trunk Drainage	The Hydraulic assessment presented on JWP engineering plan CD016 demonstrates that 1% AEP flows are contained within the channel. Further 2D hydraulic assessment will be undertaken at the detailed design stage for the full range of additional storm events including 12 EY, 20%, 5%, 1% and PMF events
A	Provide retaining wall longsection on channel longsection to show wall to invert and maintenance track relationship	Trunk Drainage	The maintenance access track no longer has a role in providing interim site access for effluent removal for Westlink and as a consequence will now be consistent with Sydney Waters standard channel details.
A	Please provide the dimensioning of the different elements of the trunk draiange: access road, riparian edge, upper bank and lower bank	Trunk Drainage	Additional details and dimensions have been included on the channel typical section included on JWP Engineering plan CD016. Upper and lower bank profiles are included on the Channel longitudinal profile (refer CD015)
A	As per design guidelines: "all corridors will require a 3.5m wide maintenance/ access track suitable for light vehicles. A 1m planted buffer is required adjacent to the access track"	Trunk Drainage	The required 1m buffer has been included on the channel typical section and is indicated on JWP Engineering plan CD016
A	Drop structure should be installed where a grade is at 2%. Please provide shear force modelling to inform if drop structure are required. Erosion protection to be provided as an alternative to drop structure	Trunk Drainage	The hydraulic assessment provided on JWP engineering Plan CD016 demonstrates that the short rock lined section meets performance requirements. The extent of rockwork of approx 120 m2 is a relatively small footprint and allows for an uninterrupted habitat along the channel length (unlike a drop structure and aprons)
A	Velocities and shear force at bank/retaining wall interface to be provided as this location is vulnerable to erosion	Trunk Drainage	The channel section has been modified to avoid flows impacting upon adjoining walls. Additional detailed shear stress modelling will be undertaken at the next design stage
A	Plot PMF level against the retaining wall	Trunk Drainage	The Channel performance during a PMF flood event has been assesed and is reported in the Concept Design Stage Design report at Section 5.3. Average channel velocities for this extreme event are 1.65 m/s and therefore doesn't exceed the capbility of the wall to withstand the applied loads (subject to structural design)
A	Retaining walls need to be certified by structural engineer: stability and reslience to flooding up to the PMG need to be engineered	Trunk Drainage	Consistent with the Stage 1 Channel design process. Structural engineering of all walls and drop structures greater than 0.9 m in height will be provided at the detailed design stage for the channel
A	Sydney Water will not own and maintain the retaining wall along the trunk drainage channel that is adjacent and supporting the development site and the neighbouring lot. As such should be clear of the 1% AEP trunk flows	Trunk Drainage	Consistent with the approach agreed with Sydney Water for the Westlink Stage 1 channel, the northern retaining wall will remain outside of the proposed drainage easement which has been narrowed slightly for this purpose. Refer to the typical channel section on JWP engineering plan CD016
A	At the downstream end of the channel the retaining wall is also blocking flows from undeveloped property to the north. This shall be designed to ensure there is no adverse stormwater flow impact to this property	Trunk Drainage	The small parapet wall at the Mamre road end of the channel has been removed. Flows for the South west corner of Lot 2 DP 250002 can freely drain to the channel. Future development of Lot 2 may result in the formalising of the drainage corridor batters to a future fill level on Lot 2 if required. The Stantec updated Flood impact assessment demonstrates that flood impacts are within acceptable thresholds.
A	The undeveloped case 50% AEP flood model shall be mapped to confirm upstream and downstream inflow and outflow points. These points shall be used to assess if the proposed development is maintaining status quo for developed flows. Peak flows shall be extracted at these points for comparison to developed flows.	Flood	The agreed Stage 2 channel position does not align with the low point on the landform so peak flows cannot be readily compared. Nevertheless, all post development landforms can be directed to the new channel which delivers flows to Sydney Water future water management basins west of Mamre Road in an agreed manner. The channel design does not impede runoff from the residual (undeveloped) land on the northern side of the channel - noting that this land does not have any clearly defined flow paths.