INLAND RAIL

SPATIAL METHODOLOGY FOR ASSESSING FLOOD MAGNITUDES

Inland Rail – Parkes to Narromine Critical State Significant Infrastructure (SSI 7475) – Condition E24

ARTC

5-0000-240-IHY-00-RP-0001_0

Document Control

Revision History

REVISION	DATE ISSUED	DESCRIPTION
A	08/04/2020	DRAFT - Document developed for Department of Planning, Industry and Environment to support requirements of Condition of Approval E24.
0	16/06/2020	FINAL

Table of Contents

Attachments

Glossary

Specific terms and acronyms used throughout this strategy are listed and described in the table below.

TERM	DEFINITION
1D	One dimensional
2D	Two dimensional
AEP	Annual Exceedance Probability
ARF	Areal Reduction Factor
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
ARR 2016	Australian Rainfall and Runoff 2016
BoD	Basis of Design
BoQ	Bill of Quantities
BX	Storage coefficient multiplication factor – a RAFTS model parameter
CL	Continuing loss (rainfall) – a RAFTS model parameter
CoA	Conditions of Approval
DD	Detailed Design
DEM	Digital Elevation Model
DIRD	Department of Infrastructure and Regional Development
Down	'Down' direction is towards Narromine. The 'down' side of the track is on the left when facing Narromine.
DPE	NSW Department of Planning and Environment
DRAINS	An industry standard hydrology / hydraulics modelling software program
EIS	Environmental Impact Statement
EY	Exceedances per Year
FFA	Flood Frequency Analysis
FMO	Flood Management Objectives
GIS	Geographic Information System
HHIP	Hydrology and Hydraulics Investigation Plan
HPC	Heavily Parallelised Computations
IFC	Issued for Construction
IFD	Intensity-Frequency-Duration
IL	Initial loss (rainfall) – a RAFTS model parameter
IR	Inland Rail
IRDJV	Inland Rail Design Joint Venture – A joint venture of WSP Australia and Mott MacDonald set up to deliver the detailed design for the project
LX	Level Crossing
LiDAR	Light Detection and Ranging
m AHD	Metres above Australian Height Datum
MCA	Multi-Criteria Analysis

TERM	DEFINITION
P2N	Parkes to Narromine
P1	Priority 1 (part of P2N)
P2	Priority 2 (part of P2N)
RAFTS	Water Resource Engineering Software (www.wateronline.com)
RFFE	Regional Flood Frequency Estimation
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
RFI	Request for Information
RAATM	Requirements Analysis, Allocation and Traceability Matrix
R&O	Risk & Opportunity
RMS	Roads and Maritime Services
SRTM	Shuttle Radar Topography Mission
TA	Technical Adviser
TIN	Triangular Irregular Network
TOF	Top of Formation
TUFLOW	Water Flow Modelling Software (www.tuflow.com)
Up	'Up' direction is towards Parkes. The 'up' side of the track is on the left when facing Parkes.
VE	Value Engineering

1 Introduction

1.1 Background

The Australian Government has committed to deliver the Melbourne to Brisbane Inland Rail (Inland Rail), as a vital piece of infrastructure to complete the National Freight Network and to provide for a significant modal shift of freight from road to rail. On behalf of the Department of Infrastructure and Regional Development (DIRD), the Australian Rail Track Corporation (ARTC) has been tasked with preparing a 10-year delivery strategy for Inland Rail. The Parkes to Narromine (P2N) Project is one of 13 projects that comprise the Inland Rail Program and is approximately 103 km long.

The P2N Project was declared to by critical State significant infrastructure (CSSI) by virtue of Schedule 5, clause 7 of *State Environmental Planning Policy (State and Regional Development) 2011*. On 7th June 2018, the P2N Project was approved by the Minister Planning under section 5.19 of the *Environmental Planning and Assessment Act 1979* and the Inland Rail – Parkes to Narromine Conditions of Approval (CoA) (SSI 7475) were issued.

The P2N Project is generally located within the existing rail corridor between the towns of Parkes and Narromine, via Peak Hill (see **Figure 1** for exact location). P2N also includes a new, greenfield connection to the Broken Hill line, known as the Parkes North-West Connection, at the southern end of the Project near Parkes.

The key features of the Project include:

- Upgrading the track, track formation and culverts within the existing Rail Corridor including signal upgrade between Parkes and Narromine
- Providing three new crossing loops within the existing Rail Corridor at the nominated locations
- Providing a 5.3 km long rail connection between Inland Rail and the Broken Hill line to the west of Parkes ('the Parkes North-West Connection').

This report has been produced to supplement CoA E24 of the Parkes to Narromine Conditions of Approval (SSI 7475), which has been conditionally approved for the project. Condition E24 states:

> *E24 The Proponent must develop a methodology for spatially defining how the length(s) of the rail corridor impacted by a flood event will be determined for the purposes of Condition E23. The methodology must be developed in consultation with OEH and submitted to the Secretary for approval prior to the commencement of operation of the CSSI.*

All information presented below has been sourced from:

- Parkes to Narromine Flood Study Report (Rev 2) Volumes 1 (3-0001-240-IHY-00-RP-0003) and 2 (3-0001-240-IHY-00-RP-0004); and
- Internal ARTC procedures.

The Parkes to Narromine Flood Study Report (Rev 2) Volumes 1 (3-0001-240-IHY-00-RP-0003) and 2 (3-0001-240-IHY-00-RP-0004) documents are publicly available on the Inland Rail Parkes to Narromine Project website as per condition E21 of the P2N Conditions of Approval.

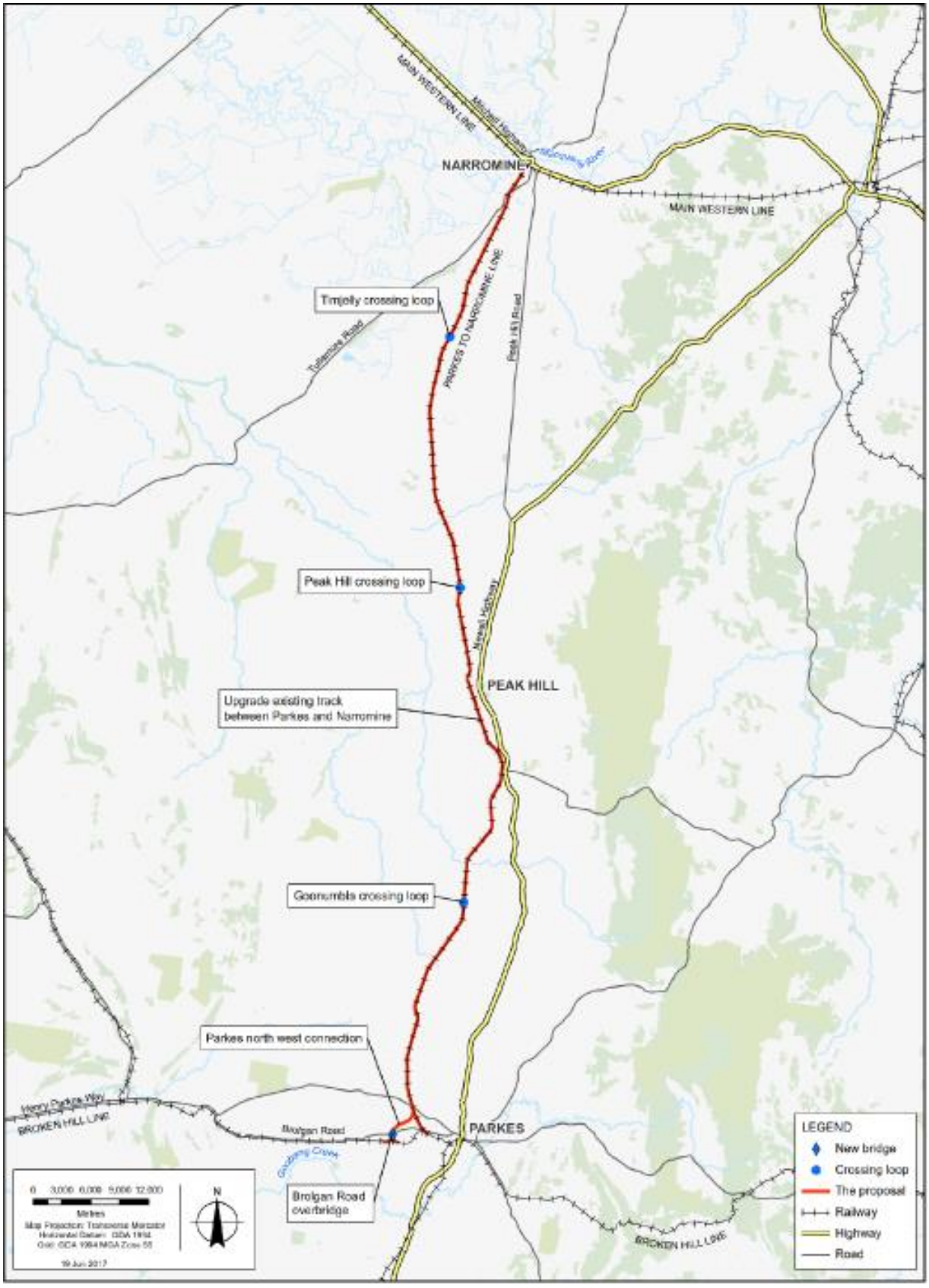

Figure 1 – P2N Project Location

2 History of P2N Flooding Conditions E21 and 24

2.1 Condition E21 – Flood Design Report

Condition E21 of the Parkes to Narromine Conditions of Approval states the following:

> *E21 Further flood modelling based on the detailed design of the CSSI must be undertaken for flood impacts (including downstream impacts of the CSSI). The results of the modelling must be detailed in a Flood Design Report. The Flood Design Report must be prepared in consultation with OEH and the relevant councils and include:*
>
> *a) the results of the downstream flood assessment for the 5 year ARI event, 20 year ARI event, 100 year ARI event;*
>
> *b) provide consideration of the consequences of extreme flood events greater than the 100 year ARI event;*
>
> *c) flood height changes to a resolution no coarser than one (1) centimetre;*
>
> *d) a comparison of the results with the requirements of Condition E22;*
>
> *e) the mitigation and management measures that will be undertaken in the event that the assessment indicates that the flooding characteristics exceed the design objectives specified in Condition E22;*
>
> *f) changes in the depths of inundation including locations where previously there would have been no inundation;*
>
> *g) flow changes in all watercourses and overland paths;*
>
> *h) an assessment of the impacts of the CSSI including impacts on sedimentation, erosion, scouring, and bank and stream stability;*
>
> *i) mitigation measures to minimise potential adverse impacts and respond to actual impacts in accordance with the DPI's Guidelines for Controlled Activities on Waterfront Land; and*
>
> *j) a description of the cross-sectional dimensions and location of all proposed spoil mounds associated with the CSSI.*
>
> *The Flood Design Report must be reviewed and endorsed by a suitably qualified and experienced hydrologist who is independent of the person who prepared the Flood Design Report and whose appointment must be approved by the Secretary. The hydrologist's endorsement must include a statement verifying that new and replacement culverts have been designed in accordance with the requirements of Conditions E29 and E30.*
>
> *The Flood Design Report must be submitted to the Secretary and OEH for information at least one (1) month prior to the commencement of construction of permanent works that may impact on flooding.*

To fulfil the requirements of CoA E21, the following steps were undertaken in compiling the Flood Study Report (Rev 2) and providing the Flood Study Report to the Biodiversity Conservation Division of the Department of Planning, Industry and Environment (formerly the Office of Environment and Heritage (OEH)) for their consultation.

- The Flood Study Report (referred to in CoA E21 as the Flood Design Report) Volumes 1 and 2 were initially submitted to the Department of Planning, Industry and Environment (DPIE, the Department) for information on 21 December 2018. This package included an Independent Hydrology Assessment by [redacted], who reviewed and endorsed the report as a suitably qualified and experienced hydrologist. Additionally, the appointment of [redacted] as the suitably qualified and experienced hydrologist was approved by the Department.
- Concurrently, the Flood Study Report and associated information (Vol 2) was initially provided as "Revision 1" to Councils and [redacted] of OEH for their review on 21 December 2018. No issues were raised by OEH regarding the Flood Study Report at this time.
- Minor culvert sizes were revised as part of the final design which required an updated Flood Study Report to be drafted and resent for review to OEH.
- The Flood Study Report and associated information (Vol 2) was updated as a consolidated "Rev 2" document to account for the minor changes of culvert sizes along the alignment.
- The Flood Study Report Rev 2 documents were finalised and sent to [redacted] of OEH on 08 August 2019, in which it was noted to OEH that the Rev 2 document changes were minor in nature

and would not have any material change from the Rev 1 documents. It was advised by [redacted] that he was moving on, with all future correspondence to be provided to [redacted] of OEH (Senior Conservation Planning Officer) in the interim who will facilitate an appropriate OEH reviewer.

- ARTC forwarded the Flood Study Report Rev 2 documents to [redacted] on 15 August 2019 for review. Note: Due to multiple file transfer issues, the Vol 2 information was only able to be downloaded by OEH on 06 September 2019.
- ARTC provided the Flood Study Report Rev 2 documents to the independent hydrologist to facilitate his review whilst OEH undertook their own updated review. The independent hydrologist undertook his review and provided his conditional support and endorsement of the FDR Rev 2 on 22 August 2019.
- On 20 September 2019, the Project provided the Flood Study Report (Revision 2) Volumes 1 and 2 to the Department. This transmittal also included the two Independent Hydrology Assessments for Revisions 1 and 2 of the Flood Study Report from [redacted].
- On 9 October 2019, the Project received correspondence from the Biodiversity and Conservation Division (BCD) (formerly OEH), which thanked the Project for consulting with BCD as required by the Conditions of Approval and recommended providing the Flood Study to the Department without comment from BCD.
- Following this, the Flood Study Report (Revision 2) Volumes 1 and 2 were uploaded to the Parkes to Narromine website, on 06 March 2020.

The methodology for spatially defining how the length(s) of the rail corridor impacted by a flood event for the purposes of Condition E23 is outlined in the Flood Study Report and is therefore related to CoA E24.

2.2 Condition E24 - Methodology for spatially defining how the length(s) of the rail corridor impacted by a flood event will be determined

On 20 September 2019, letter *CSSI 7475 Inland Rail – Parkes to Narromine – Condition E24 – Flood Review (Spatial Methodology)* (ARTC REF # 5-0000-240-EAP-00-LT-0055) (the spatial methodology letter) was emailed to the Department of Planning, Industry and Environment (DPIE, the Department) in preparation for the operation of the North-West Connection component of the P2N Project. This letter and its referenced documents provided evidence of the development of spatially defining rail corridor lengths that may be impacted by a flood event. The spatial methodology letter referenced a list of flood maps, which originate in the Flood Study Report (referenced as the Flood Design Report in CoA E21), to identify key areas of sensitivity to flooding along the rail corridor and to inform the detailed methodology for the preparation of the Flood Review Reports that are required by CoA E23. The spatial methodology letter cross referenced the maps in the Flood Study Report, rather than attaching the maps to the letter for the following reasons:

- The maps provide detailed spatial information about flooding under varying event conditions along the alignment and, consequently, number in the hundreds; and
- Cross referencing the maps in the Flood Study Report, rather than duplicating them in the letter allows the project to maintain one source of truth for the maps.

Following submission of the spatial methodology letter on 20 September 2019 to the Department, the Project received letter *Spatial methodology for Flood Review Report: Condition E24 Inland Rail: Parkes to Narromine (CSSI 7475)* on 25 September 2019, **which conditionally approved the spatial methodology**, **as outlined in the spatial methodology letter, pursuant to condition E24** (refer Attachment 1). The conditional aspect of this approval required the Project to complete consultation with Environment Energy Science (formerly the Office of Environment and Heritage) and update the revision 2 of the Flood Study Report (referred to as the Flood Review Report incorrectly) to address any comments received from EES on the spatial methodology and resubmit to the Department for information by 30 October 2019.

On 9 October 2019, the Project received correspondence from the Biodiversity and Conservation Division (BCD) (EES, formerly OEH), which thanked the Project for consulting with BCD as required by the Conditions of Approval and recommended providing the Flood Study Report (which includes the methodology) to the Department without comment from BCD (refer Attachment 2).

The complete list of flood maps is provided in Tables 1 and 2 (below). **The maps in the Parkes to Narromine Flood Study Report (Rev 2) Volumes 1 (3-0001-240-IHY-00-RP-0003) and 2 (3-0001-240-IHY-00-RP-0004) remain to be the one source of truth and are to be referenced when used to determine flooding events for the purposes of CoA E23.**

Table 1 List of existing conditions flood mapping sets

NO.	DESCRIPTION	FIGURE / MAP REFERENCES	WHERE PROVIDED IN FLOOD STUDY REPORT (SOURCE OF TRUTH)
1	Existing flood extent and depth for 39% AEP event	EX39L1 to EX39L25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
2	Existing flood extent and depth for 18% AEP event	EX18L1 to EX18L25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
3	Existing flood extent and depth for 10% AEP event	EX10L1 to EX10L25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
4	Existing flood extent and depth for 5% AEP event	EX5L1 to EX5L25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
5	Existing flood extent and depth for 2% AEP event	EX2L1 to EX2L25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
6	Existing flood extent and depth for 1% AEP event	EX1L1 to EX1L25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
7	Existing flood extent and depth for 0.05% AEP event	EX0.05L1 to EX0.05L25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
8	Existing flood velocity for 39% AEP event	EX39V1 to EX39V25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
9	Existing flood velocity for 18% AEP event	EX18V1 to EX18V25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
10	Existing flood velocity for 10% AEP event	EX10V1 to EX10V25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
11	Existing flood velocity for 5% AEP event	EX5V1 to EX5V25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
12	Existing flood velocity for 2% AEP event	EX2V1 to EX2V25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
13	Existing flood velocity for 1% AEP event	EX1V1 to EX1V25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)

NO.	DESCRIPTION	FIGURE / MAP REFERENCES	WHERE PROVIDED IN FLOOD STUDY REPORT (SOURCE OF TRUTH)
14	Existing flood velocity for 0.05% AEP event	EX0.05V1 to EX0.05V25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
15	Existing flood duration for 39% AEP event	EX39D1 to EX39D25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
16	Existing flood duration for 18% AEP event	EX18D1 to EX18D25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
17	Existing flood duration for 10% AEP event	EX10D1 to EX10D25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
18	Existing flood duration for 5% AEP event	EX5D1 to EX5D25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
19	Existing flood duration for 2% AEP event	EX2D1 to EX2D25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
20	Existing flood duration for 1% AEP event	EX1D1 to EX1D25	Appendix B of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
21	Existing flood duration for 0.05% AEP event	EX0.05D1 to EX0.05D25	Appendix A of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)

Table 2 List of design case flood mapping sets

NO.	DESCRIPTION	FIGURE / MAP REFERENCES	WHERE PROVIDED IN FLOOD STUDY REPORT (SOURCE OF TRUTH)
1	Flood level change (afflux) for 39% AEP event	DE39A1 to DE39A25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
2	Flood level change (afflux) for 18% AEP event	DE18A1 to DE18A25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
3	Flood level change (afflux) for 10% AEP event	DE10A1 to DE10A25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
4	Flood level change (afflux) for 5% AEP event	DE5A1 to DE5A25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
5	Flood level change (afflux) for 2% AEP event	DE2A1 to DE2A25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)

NO.	DESCRIPTION	FIGURE / MAP REFERENCES	WHERE PROVIDED IN FLOOD STUDY REPORT (SOURCE OF TRUTH)
6	Flood level change (afflux) for 1% AEP event	D1A1 to D1A25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
7	Flood level change (afflux) for 1% AEP event with climate change	DE1CCA1 to DE1CCA25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
8	Flood level change (afflux) for 0.05% AEP event	DE0.05A1 to DE0.05A25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
9	Flood velocity change for 39% AEP event	DE39VC1 to DE39VC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
10	Flood velocity change for 18% AEP event	DE18VC1 to DE18VC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
11	Flood velocity change for 10% AEP event	DE10VC1 to DE10VC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
12	Flood velocity change for 5% AEP event	DE5VC1 to DE5VC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
13	Flood velocity change for 2% AEP event	DE2VC1 to DE2VC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
14	Flood velocity change for 1% AEP event	DE1VC1 to DE1VC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
15	Flood velocity change for 1% AEP event with climate change	DE1CCVC1 to DE1CCVC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
16	Flood velocity change for 0.05% AEP event	DE0.05VC1 to DE0.05VC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
17	Flood duration change for 39% AEP event	DE39DC1 to DE39DC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
18	Flood duration change for 18% AEP event	DE18DC1 to DE18DC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
19	Flood duration change for 10% AEP event	DE10DC1 to DE10DC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)

NO.	DESCRIPTION	FIGURE / MAP REFERENCES	WHERE PROVIDED IN FLOOD STUDY REPORT (SOURCE OF TRUTH)
20	Flood duration change for 5% AEP event	DE5DC1 to DE5DC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
21	Flood duration change for 2% AEP event	DE2DC1 to DE2DC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)
22	Flood duration change for 1% AEP event	DE1DC1 to DE1DC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
23	Flood duration change for 1% AEP event with climate change	DE1CCDC1 to DE1CCDC25	Appendix C of Flood Study Report Volume 1 (3-0001-240-IHY-00-RP-0003)
24	Flood duration change for 0.05% AEP event	DE0.05DC1 to DE0.05DC25	Appendix B of Flood Study Report Volume 2 (3-0001-240-IHY-00-RP-0004)

3 Methodology for assessing flood magnitude against the hydraulic models in the Flood Study Report

Information relevant to developing a methodology for spatially defining how the length(s) of the rail corridor impacted by a flood event has been included in the current report to support the requirements of Condition E24.

3.1 Methodology for spatially defining the lengths of the rail corridor

In the Flood Study Report, which was developed to comply with Condition E21, maps were developed that modelled:

- The current extent of flooding under existing condition (Table 1); and
- the extent of flooding under future conditions (using the proposed P2N Project design case) (Table 2).

In modelling these flood extents, the flood models spatial defined the lengths of the corridor within their associated catchment. Along the P2N rail corridor there are three catchments, including

- Lachlan River Catchment;
- Bogan River Catchment; and
- Macquarie River Catchment.

For the purposes of the flood hydraulic models, these catchments were broken down further into the following five study areas: LA01, BOG01, BOG03, BOG05, MAC01. Table 3 outlines what catchment the study areas correspond to, as well as the relevant chainages and approximate locations (referencing landmarks).

Table 3 Spatial lengths of the P2N Rail Corridor

CATCHMENT	HYDRAULIC MODEL	CHAINAGES	APPROXIMATE LOCATIONS
Lachlan River Catchment	LAC01	449.2km- 464.0km	North- West Link to approximately 1 km south of Bogan Road
Bogan River Catchment	BOG01	464.0km- 485.0km	Approximately 1 km south of Bogan Road to the intersection of Penryn Lane and Mickibri Road
	BOG03	485.0km – 505.8km	The intersection of Penryn Lane and Mickibri Road to approximately 6 km north of Peak Hill
	BOG05	505.8km- 540.88km	Approximately 6 km north of Peak Hill to approximately Hargraves Road, Narromine
***Macquarie River Catchment**	MAC01	540.7km to 547.55km	Approximately Hargraves Road, Narromine to approximately 9 km south of Narromine
***It should be noted that the Macquarie Catchment occurs north of the Project area and consequently, the catchment does not have a regional influence on flooding in this northerly section of the P2N rail corridor.**			

The flood maps in the Flood Study Report model potential flood behaviour within the above three catchments using the following three criteria:

- Flood level;
- Flood duration; and
- Velocities for existing and design conditions.

The flood behaviour has been modelled for the future permanent works on the P2N project for the following scenarios: 39%, 18%, 10%, 5%, 2%, 1% and 0.05% Annual Exceedance Probability (AEP). As Condition E23 requires reporting against flood magnitudes outlined in Average Recurrence Interval (ARI), Table 4 below provides as approximate conversation between AEP, the unit used to develop the hydraulic models in the Flood Study Report and ARI, the unit specified in the Conditions of Approval.

Table 4 Hydrological design events (from Table 4-4 of the Flood Study Report)

DESIGN EVENT AEP	APPROXIMATE EQUIVALENT ARI	PURPOSE OF EVENT ANALYSIS
39%	2.5-year ARI	Low order event for impact assessment
18%	5-year ARI	Low order event for impact assessment
10%	10-year ARI	Medium event for flood impact assessment and potential lower standard adopted for hydraulic design
5%	20-year ARI	Medium event for flood impact assessment and potential lower standard adopted for hydraulic design
2%	50-year ARI	Medium event for flood impact assessment and potential lower standard adopted for hydraulic design
1%	100-year ARI	Typical standard for hydraulic design
1% AEP with climate change	100-year ARI with climate change	Climate change scenario simulated to inform the project sustainability assessment
0.05%	2000-year ARI	Extreme event for impact assessment

For the requirements CoA E23, for the first 15 years of operation, the proponent must prepare a Flood Review Report(s) for the first defined flood event for any of the following flood magnitudes that occur: 5 to 10 year, 10 to 20 year and 20 to 100-year ARI. The flood magnitudes that trigger reporting requirements are converted in approximate equivalent AEP in Table 5 below.

Table 5 ARI Flood Magnitude Reporting Thresholds - ARI and AEP

FLOOD MAGNITUDES THAT TRIGGER FLOOD REVIEW REPORTING REQUIREMENTS (IN ARI)	EQUIVALENT AEP (USED IN HYDRAULIC MODELLING)
5 to 10-year ARI	18%- 10% AEP
10 to 20-year ARI	10%- 5 % AEP
20 to 100-year ARI	5% to 1% AEP

Following the first defined flood event that triggers the requirement to produce a Flood Review Report in accordance with ranges outlined in Condition E23, ARTC will produce a Flood Review Report. A copy of the Flood Review Report will be provided to the Secretary, BCD and relevant councils within three months of finalising the report.

Attachment 1 Conditional approval of spatial methodology from DPIE

NSW GOVERNMENT | Planning, Industry & Environment

Our Ref: SSI 7475

[redacted]
Project Director – P2N, Inland Rail
Australian Rail Track Corporation
GPO Box 2462
BRISBANE QLD 4000

BY EMAIL ONLY [redacted]

Dear [redacted]

Spatial methodology for Flood Review Report: Condition E24
Inland Rail: Parkes to Narromine (CSSI 7475)

I refer to your submission requesting approval of the spatial methodology ARTC has developed to define how the length(s) of rail corridor impacted by a flood event will be determined for the purposes of the Flood Review Report, in accordance with condition E24 of the CSSI 7475 project approval.

I note the following in relation to your request:

- The letter reference 5-0000-240-EAP-00-LT-0055 submitted on 20 September 2019 explains the development of the spatial methodology;
- The letter reference 5-0000-240-EAP-00-LT-0054 details consultation that ARTC has conducted with Environment Energy Science (EES, formerly the Office of Environment and Heritage, OEH) to date and states that consultation will be completed by 30 September 2019; and
- contains the information required by the conditions of approval.

As delegate of the Planning Secretary, I conditionally approve the spatial methodology, as outlined in your correspondence, pursuant to condition E24. You are required to complete consultation with EES and update the Flood Review Report, Revision 2 to address EES's comments on the spatial methodology and resubmit it to the Department for information by 30 October 2019.

You are reminded that if there is inconsistency between the Flood Review Report and the conditions of the approval, then the requirements of the conditions of approval will prevail.

Please ensure you make this conditional approval publicly available on the project website as part of the project's operational management once approved. You are reminded that operation cannot commence until all other relevant conditions are met.

If you have any questions, please contact [redacted] at [redacted].

Yours sincerely

[redacted]

[redacted]
Director – Infrastructure Management
Planning and Assessment
As delegate of the Planning Secretary
Copied to: [redacted]

[redacted] GPO Box 39 Sydney 2001 | dpie.nsw.gov.au | 1

Attachment 2 Evidence of consultation with BCD regarding the Flood Study Report

Planning, Industry & Environment

Our ref: DOC19/841173
Your Ref:

[redacted]
Senior Environmental Advisor – Assurance
Inland Rail Project
[redacted]

Dear [redacted]

Parkes to Narromine Inland Rail Flood Study Report (July 2019)

Thank you for your e-mail on the 5 September 2019 to the Biodiversity and Conservation Division (BCD) with attached Flood Study Report (July 2019 version) for the Inland Rail Parkes to Narromine project. BCD also thank you for providing the independent hydrology assessment of the flood study report dated 22 August 2019 which was completed by [redacted].

BCD notes that the Conditions of Approval for the project require the Flood Design Report to be submitted to BCD (formerly OEH) for information (condition E21). In addition, a methodology must be developed in consultation with BCD for defining how the length of the rail corridor impacted by a flood event will be determined (condition E24).

Thank you for consulting with BCD as required by the Conditions of Approval. We recommend that you provide the Flood Study Report (which includes the methodology) to the Planning and Assessment Group of the Department of Planning, Industry and Environment without comment from BCD.

If you require any further information regarding this matter, please contact [redacted] Senior Conservation Planning Officer, via [redacted] or [redacted]

Yours sincerely

[redacted] 9 October 2019
[redacted]
A/Director North West Branch
Biodiversity and Conservation Division

Cc [redacted]

[redacted] dpie.nsw.gov.au | 1