AJM Joint Venture

MELBOURNE AIRPORT RAIL

MAR STATE LAND AQUATIC ECOLOGY AND GEOMORPHOLOGY IMPACT ASSESSMENT

MAR-AJM-PWD-PWD-REP-XEV-NAP-0001711

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Revision B

Prepared for Rail Projects Victoria

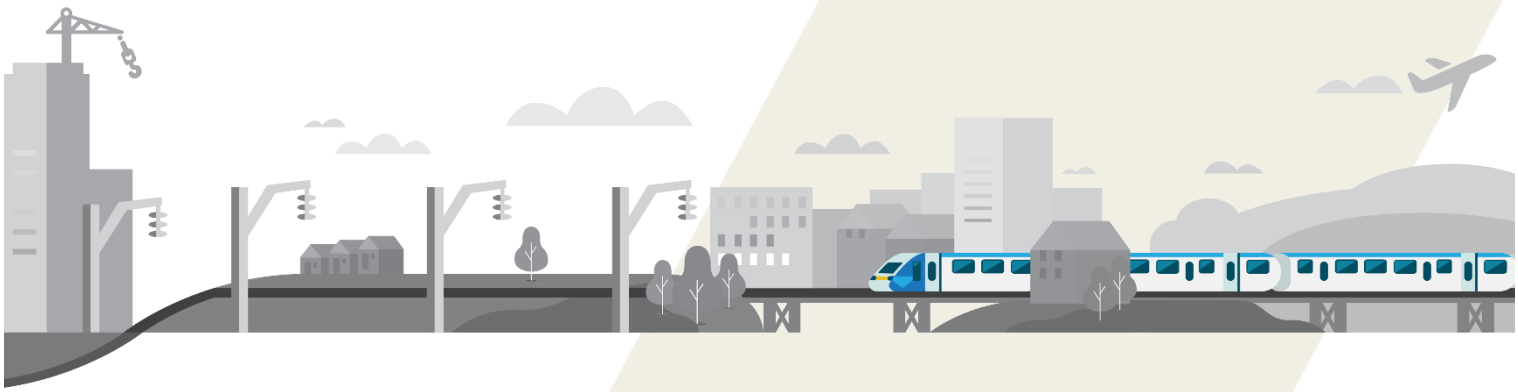

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Table 1.1 Table of Abbreviations

Abbreviation	Definition
AEP	Annual Exceedance Probability
AJM-JV	Aurecon Jacobs Mott Macdonald Joint Venture
BEPM	Best Practice Environmental Management
CaLP Act	*Catchment and Land Protection Act 1994*
CAM	Common Assessment Method
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
COR	Corridor Section
CSR	Combined Service Route
DAWE	Commonwealth Department of Agriculture, Water and Environment
DELWP	Victorian Department of Environment, Land, Water and Planning
EE Act	*Environment Effects Act 1978*
EMF	Environmental Management Framework
EMR	Environmental Management Requirements
EP Act	*Environment Protection Act 1970*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988*
MAR	Melbourne Airport Rail
MNES	Matters of National Environmental Significance
MTP	Metro Tunnel Project
NTGVVP	Natural Temperate Grassland of the Victorian Volcanic Plain, a threatened ecological community
PMST	Protected Matters Search Tool
P&E Act	*Planning and Environment Act 1987*
RPV	Rail Projects Victoria
SUN	Sunshine Section
The Guidelines	*Guidelines for the removal, destruction or lopping of native vegetation*
TPZ	Tree Protection Zone
VBA	Victorian Biodiversity Atlas
VicAdv	The Victorian Advisory Lists
WBPG	Western (Basalt) Plains Grassland, a threatened community
Wildlife Act	*Wildlife Act 1975*

1. Executive Summary

Aurecon Jacobs Mott Macdonald Joint Venture (AJM-JV) has been engaged by Rail Projects Victoria (RPV) to prepare the Melbourne Airport Rail (MAR) State Land Aquatic Ecology and Geomorphology Impact Assessment (the Impact Assessment). The purpose of the Impact Assessment includes ensuring the aquatic environment, aquatic fauna and geomorphological characteristics for the MAR project are known and potential impacts are identified and appropriately avoided or managed, and supporting State Land approvals for the MAR project.

The Melbourne Airport Rail (the Project) is a transformational public transport project connecting Melbourne Airport with a rail service for the first time. In 2018, the Victorian Government released the Melbourne Airport Rail Link Sunshine Route Strategic Appraisal (Transport for Victoria, 2018), which confirmed that the Sunshine route is the best solution for an airport rail link. This alignment is between a new railway station at Melbourne Airport and Melbourne CBD, via the Albion-Jacana rail corridor, Sunshine Station and connecting to the new tunnels provided via the Metro Tunnel Project (MTP). It is noted that only State Land along this alignment is addressed in this Impact Assessment as Commonwealth land is subject to a separate approvals process.

Waterways in the study area support a range of ecological values, including the threatened Australian Grayling (EPBC Act and FFG Act listed) and platypus (FFG Act listed) in the Maribyrnong River.

Direct impacts to waterways could occur at waterway crossings (Maribyrnong River, Steele Creek, Upper Stony Creek) where new infrastructure is being built and more broadly across a number of other waterways that may be receiving waterways for stormwater runoff along the rail corridor (Moonee Ponds Creek, Stony Creek, Kororoit Creek).

An assessment of the designs for waterway crossings (pier locations), construction methods, stormwater drainage principles and operations has shown that risks to aquatic habitats, threatened species and water quality are all likely to be low. Specifically:

- Waterway crossings will be designed with piers located outside of the river channel so that there will be no temporary or permanent change to the low-flow channel itself, including no new instream structures that could result in the loss of habitat or block fish passage. While new and replacement crossings and associated structures will be located in the high flow channel and/or floodplain, modelling indicates that they will have no or negligible impact on flows and will not result in the loss of aquatic habitat or block fish passage.
- Construction methods will be designed to limit direct impacts on waterways and hydraulic modelling shows that there is no significant increase in water levels, velocity or stream power (either during construction or operation) that would increase the risk of unacceptable erosion or scour of stream bed and banks.
- Stormwater drainage designs will be in accordance with best practice management guidelines and to the approval of relevant authorities such that water quality during the operations phase will not pose an increased risk to aquatic values.

A specific assessment against Matters of National Environmental Significance (EPBC Act) and Victorian FFG Act and EE Act criteria shows that provided the above design, construction and operational mitigation measures are adopted there is a low level of risk to MNES (Ramsar wetlands and Australian grayling) and that criteria for impact under the FFG Act and EE Act in relation to aquatic ecology, waterway health, aquatic threatened species (Australian grayling and platypus) and threatening processes that could impact on waterways are not triggered.

2. Introduction

Aurecon Jacobs Mott Macdonald Joint Venture (AJM-JV) has been engaged by Rail Projects Victoria (RPV) to prepare the Melbourne Airport Rail (MAR) State Land Aquatic Ecology and Geomorphology Impact Assessment (the Impact Assessment).

2.1 Purpose

The purpose of the Impact Assessment included the following:

- Ensure that the aquatic environment, aquatic fauna and geomorphological characteristics for the MAR project are known and potential impacts are identified and appropriately avoided or managed.
- Prepare an Aquatic Ecology and Geomorphology Impact Assessment to support State land approvals as follows:
  - > Inform the strategic justification required to support planning approval under the *Planning and Environment Act 1987* (P&E Act);
  - > Inform an assessment of the project against the *Ministerial Guidelines for Assessment of Environmental Effects under the Environment Effects Act 1978* (the Ministerial Guidelines), referred to as an *Environment Effects Act 1978* (EE Act) referral self-assessment; and
  - > Inform the need for a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Methodology

The preparation of the Impact Assessment included the following:

- Review of the scope of works and mapping presented in the 'MAR Project Description for Environmental Specialists' (MAR-AJM-PWD-PWD-MEM-XLP-NAP-0001505, Revision C) (the Project Description).
- Description of the aquatic environment, geomorphological characteristics and aquatic fauna of waterways in and surrounding the State Project Land, as determined through desktop reviews and site inspections.
- Input into and review of results of hydraulic modelling to support the design of each water crossing and identification of any impacts on stream / river flows as a result of both construction and operation.
- Identification of any impacts as a result of changes to water quality, loss or degradation of instream and riparian habitat, and the construction of in-stream structures or other structures/changes (i.e. changes to flow velocity) that could result in barriers to fish migration.
- Assessment of the impacts of the MAR project works on the aquatic environment, with specific reference to:
  - > Matters of National Environmental Significance (MNES) as protected by the EPBC Act.
  - > *Flora and Fauna Guarantee Act 1988* (FFG Act) listed matters
- Assessment of the impacts of the MAR project works in relation to the following criteria set out within the Ministerial Guidelines*:*
  - > *Potential long-term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria.*
  - > *Potential long-term change to the ecological character of a wetland listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'.*
  - > *Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term.*

> *Matters listed under the Flora and Fauna Guarantee Act 1988 (FFG):*
  - *potential loss of a significant area of a listed ecological community; or*
  - *potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or*
  - *potential loss of critical habitat; or*
  - *potential significant effects on habitat values of a wetland supporting migratory bird species.*

- Identification of the likely approval / referral requirements under relevant State and Commonwealth policies and legislation.
- Drafting of mitigation measures required to ensure the project has acceptable impacts and to manage sediment and erosion in waterways.

2.3 Assumptions and Limitations

The following assumptions and limitations apply to the Impact Assessment:

- The Impact Assessment relates only to public and privately owned State land and does not consider Commonwealth-owned land or the 'Airport' design section, as Commonwealth land is not subject to Victoria's legislative framework. Impact Assessments associated with Commonwealth land, specifically land at Melbourne Airport, will form part of a separate suite of impact assessments.
- The Impact Assessment is based on the scope of works detailed in the Project Description and State Project Land derived from MAR Project Land Revision A.7 (MAR-AJM-PWD-PWD-MAP-XLP-MMN-0111172). Information presented in the Assessment is based on available information at the time of assessment.
- Changes to legislation, policy or databases used to inform the Assessment may alter its results and conclusions.
- The Assessment reflects conditions assessed during the dates of the field assessment. Changes to ecological conditions occur over time through natural and human influences and may alter the conclusions of the Assessment.
- Aquatic field surveys have not been conducted at the watercourses. The likely presence or absence of threatened species within these watercourses has been determined based on background information including:
  - Desktop studies
  - Available survey and species record data as listed in search tools such as the EPBC Act Protected Matters Search Tool (DAWE 2020) and Victorian Biodiversity Atlas (VBA) (DELWP 2020)
  - Relevant literature as referenced throughout
  - Observations made during site inspections on the 25 September 2019 and 17 February 2021 of the Maribyrnong River, Steele Creek and Steele Creek North.
- The assessment is based on construction design and information provided by RPV from December 2020 to August 2021 outlining the construction footprint and the location of piers at waterway crossings and the associated temporary construction footprint (e.g. hardstand, sheet pile wall), If the proposed designs change, the impacts may also change.

3. Background

3.1 Strategic Context

The MAR project (the Project) is a once-in-a-generation transformation of Victoria's transport network, connecting Melbourne Airport's Integrated Terminal Precinct with a rail service for the first time.

Melbourne Airport handled more than 37 million passenger movements in 2018-19[1] and by 2038, this figure is projected to almost double to more than 67 million[2], which is an average growth of 3.2% per annum. Transport connectivity from Melbourne Airport to Melbourne's Central Business District (CBD) is currently limited to the Tullamarine Freeway, and therefore, the Victorian Government is committed to delivering an efficient, competitive alternative to cater for the ongoing increase in passenger numbers at Melbourne Airport.

In 2002, the Victorian Government considered possible corridor and alignment options for a Melbourne Airport Rail Link, ultimately selecting the Sunshine route as the preferred option. At this time, land was reserved between the Albion-Jacana rail corridor and extending through to Sharps Road, Tullamarine for the construction of a rail link.

In 2018, the Victorian Government released the Melbourne Airport Rail Link Sunshine Route Strategic Appraisal, which confirmed that the Sunshine route remains the best solution for an airport rail link. The Sunshine route would provide superior connections to regional Victoria, Melbourne's growth areas in the north and west and Melbourne's south eastern suburbs and could be delivered sooner and at a significantly lower cost than other route options.

3.2 Project Land

The State Project Land defines the land within which the Project components and construction activities are planned to be contained. It sets out the full extent of land identified as potentially required for the delivery of the Project.

The Project Land encompasses all State land areas that would be used for permanent structures and temporary construction areas. It provides the basis for and informs the Impact Assessment

Project Land relevant to State-based approvals generally includes:

- Land between Sharps Road and the Albion-Jacana rail corridor, including land crossing the M80 Freeway
- The existing Albion-Jacana rail corridor generally between Jacana and Albion Stations
- Land around Sunshine and Albion Stations, including the existing rail corridor
- Land required for the Project from Jacana Station in the north-east to Newport Station in the south-west and Middle Footscray Station in the east. This largely includes the Albion-Jacana rail corridor via Sunshine and Albion stations and land required for a new rail corridor between Sharps Road and the Albion-Jacana rail corridor.

The extent of the State Project Land is shown in Figure 3-1. Watercourses that may be impacted as a result of the project are outlined in Table 3.1.

[1] https://www.bitre.gov.au/publications/ongoing/airport_traffic_data
[2] https://www.melbourneairport.com.au/Corporate/Planning-projects/Master-plan

Table 3.1 Summary of watercourses that may be impacted as part of the proposed project, including a brief description of proposed works, and potential impacts of those works.

Watercourse	Proposed works	Potential Impacts					
		In-channel structures	Water quality - construction	Water quality – operation	Changed flow - construction	Changed flows – operation	Loss of riparian habitat - construction
Stony Creek Lower (Sunshine/Braybrook)	Minor works associated with Combined Service Route (CSR), signalling and utilities.		X				
Stony Creek Upper (Sunshine North)	Viaduct, high flow culvert replacement, drainage works.	X	X	X	X	X	X
Kororoit Creek and Jones Creek	Minor works associated with CSR, signalling and utilities.		X				
Maribyrnong River	Large crossing with pier located in the floodplain with retaining structure during construction	X	X	X	X	X	X
Steele Creek, Steele Creek North	Elevated viaduct crossing Steele Creek, the M80 Western Ring Road and Steele Creek North. Piers and hardstand (during construction) located in floodplain.	X	X	X	X	X	X
Moonee Ponds Creek	Minor works associated with CSR, signalling and utilities.		X				

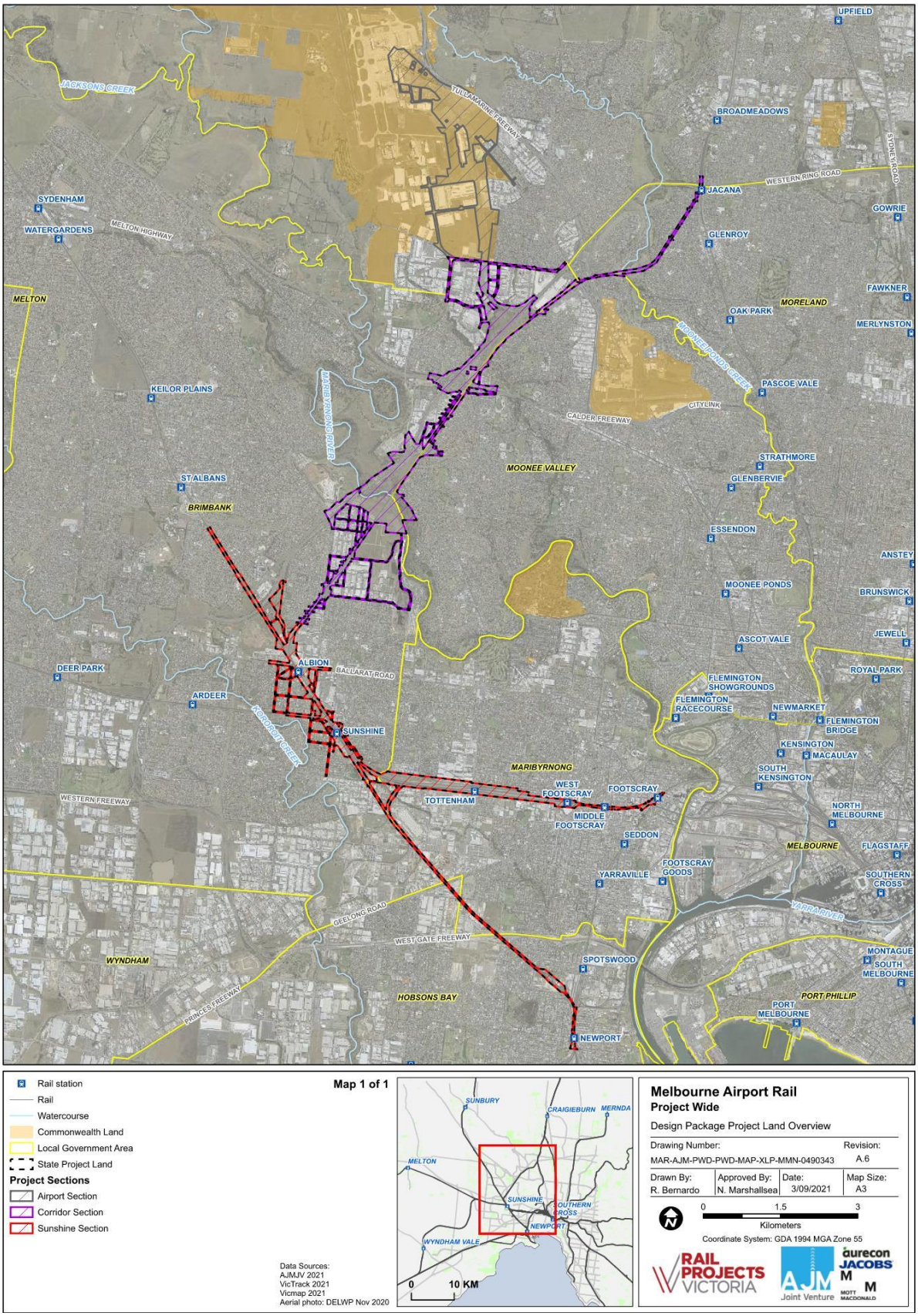

Figure 3-1 MAR State Project Land

3.3 Main Works Scope

3.3.1 Project Sections

The main works for the Project comprise of three geographically distinct sections. The sections are summarised in Table 3.2 and the location of the sections are shown in Figure 3-1.

Table 3.2 Summary of Project sections

Section	Summary
Airport section Not considered in State land approvals.	The Airport section generally includes all land relevant to the Project between Sharps Road, Tullamarine and Melbourne Airport and is located on Commonwealth owned land and is subject to a separate approvals process under the *Commonwealth Airports Act 1996*
Corridor section	The COR section generally includes the Albion-Jacana rail corridor between Jacana Station and south of Barwon Avenue, Sunshine North, as well as land between Sharps Road, Tullamarine and the Albion-Jacana rail corridor.
Sunshine section	The SUN section generally includes the existing rail corridor between Barwon Avenue, Sunshine North and Middle Footscray Station. The SUN Section also includes the Sunbury rail corridor to Ginifer Station and the Brooklyn freight corridor to Newport Station.

3.4 Corridor Section Summary

The COR section of the Project includes the following main works:

- Construction of the new MAR tracks, comprising an approximately 8 km dual track railway and associated overhead line equipment (OHLE), combined services route (CSR) and track drainage works, including:
  - A 2.3 km long elevated twin track viaduct structure between Sharps Road, Tullamarine and the Albion-Jacana rail corridor, crossing Steele Creek and the Western Ring Road including emergency and maintenance access points.
  - New at-grade MAR tracks within the existing Albion-Jacana rail corridor, located on the Western side of the existing Australian Rail Track Corporation (ARTC) tracks.
  - An elevated twin track viaduct structure across the Maribyrnong River valley, adjacent to the Western side of the existing state significant heritage bridge.
  - Slewing of ARTC tracks between Keilor Park Drive and the Calder Freeway.
- Signalling works along the Albion-Jacana rail corridor between Jacana Station and Barwon Avenue, Sunshine North and within the new MAR corridor North of the Western Ring Road.
- Construction of an intake supply substation at Terror Street or the Northeast area of Brimbank Park and two traction substations at Fullarton Road and within the McIntyre Sidings, Sunshine North.
- Construction of two new Digital Train Radio System (DTRS) facilities one North or South of Keilor Park Drive, Keilor East and a second at Airport Drive, Tullamarine.
- Diversion, relocation and replacement works associated with utilities and underground services, including the existing ARTC CSR, high voltage (HV) transmission lines and numerous miscellaneous assets
- Protection works associated with the Joint User Hydrant Installation (JUHI) jet fuel pipeline along the Albion-Jacana rail corridor.
- Modifications to existing structures, including structural modifications and strengthening works at Calder Freeway inbound and outbound bridges, Fullarton Road bridge, Western Ring Road on-ramp and off-ramp bridges, Keilor Park Drive and McIntyre Road bridges.

- Replacement of shared use path (SUP) connections at Calder Freeway / Fullarton Road, provision of a new SUP overpass at Cranbourne Avenue, and provision of a Strategic Cycling Corridor link between Western Ring Road and Airport Drive via Steele Creek.
- The provision of retention basins at several locations along the Albion-Jacana rail corridor
- Establishment of temporary construction laydown areas, site offices, worksites, storage, parking areas and access roads

3.5 Sunshine Section Summary

The SUN section of the Project includes the following main works:

- Construction of a new 1.8 km long MAR twin track viaduct structure, including associated OHLE and CSR between Sunshine Station and the Albion-Jacana corridor, crossing Anderson Road, Ballarat Road, the Sunbury rail corridor, St Albans Road and Stony Creek.
- Signalling works, including the installation of trackside equipment along the Sunbury line towards Ginifer Station, along the Brooklyn freight corridor towards Newport Station, and along the Western rail corridor to West Footscray Station.
- Modifications to the tracks, formation, drainage, CSR, OHLE and signalling equipment for the MAR, Sunbury and Bendigo tracks from Albion to the beginning of the Jacana freight corridor
- Modifications to the Western and Eastern Albion Station forecourts and car parks.
- Modifications to Sunshine Station, including modifications to platforms, the Sunshine Station western car park and the construction of a new concourse.
- Modifications to the existing Sunshine and Sunshine West substations
- Diversion, relocation and protection of existing utilities and underground services.
- Establishment of temporary construction laydown areas, site offices, worksites, storage, parking areas and access roads

4. Legislative Framework

A summary of the legislation and policies referred to throughout the document are summarised in Table 4.1.

Table 4.1 Summary of Legislative Framework

Legislation / Policy	Summary	Relevance to Project
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act has significant implications for natural resource and environmental management in Australia. This Act provides for the listing of threatened species, threatened ecological communities and key threatening processes. The EPBC Act establishes a framework for determining whether a proposed action is likely to have a significant impact on Matters of National Environmental Significance (MNES). There are nine MNES, with those relevant to the Project being: • Ramsar Wetlands • Nationally-threatened species and ecological communities • Migratory species	Actions that are likely to represent a significant impact to MNES require referral under the EPBC Act. The native fish Australian grayling *Prototroctes maraena* (listed as Threatened under the EPBC Act) has been assumed present in the State Project Land and requires assessment in accordance with EPBC Act Significant Impact Guidelines to determine if the action represents a significant impact. There are additional terrestrial MNES including the growling grass frog (*Litoria raniformis)* that are known to occur or likely to occur in State Project Land. Refer to MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information.
State		
Flora and Fauna Guarantee Act 1988 (FFG Act)	Provides a framework for biodiversity conservation in Victoria. Threatened species and communities of flora and fauna, as well as threatening processes, are listed under the FFG Act. A number of non-threatened flora species are also listed as protected under the FFG Act. A Permit to Take is required to remove these species from public land. The FFG Act Amendment Act 2019 came into effect on 1 June 2020. As part of the amendments, all taxa of flora and fauna listed under the FFG Act, along with taxa previously listed as threatened on the DELWP Advisory lists and any taxa nominated by public submissions, were assessed in accordance with the common assessment method by a Scientific Advisory Committee overseen by DELWP. This process was completed with the gazetting of a new FFG Act threatened list in May 2021 and the DELWP Advisory lists have since been revoked. Under the FFG Act, public authorities have a duty of care to consider potential biodiversity impacts when exercising their functions, including giving proper attention to the objectives of the FFG Act.	Management measures will need to be implemented to minimise impacts to threatened species and threatened ecological communities listed under the Act and to minimise the likelihood of threatening processes, including: • Increase in sediment input into Victorian rivers and streams due to human activities; • Invasion of native vegetation by CaLP listed noxious weeds; • Input of toxic substances into Victorian rivers and streams; • Habitat fragmentation as a threatening process for fauna in Victoria; and • Invasion of native vegetation by environmental weeds. • Degradation of native riparian vegetation along Victorian rivers and streams • Prevention of passage of aquatic biota by instream structures
Planning and Environment Act 1987 (P&E Act)	Applications to remove, destroy, or lop native vegetation in Victoria invoke relevant municipal planning schemes and the P&E Act, which are given authority through the Victoria Planning Provisions (VPPs). A range of exemptions apply under the P&E Act. Depending on the scale of the native vegetation clearance, statutory referral to the DELWP may be required.	Relevant to the removal of native vegetation (see MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710) and floodway overlays in the planning schemes that apply to the waterways which require modification, including as considered by the relevant water or drainage authority.
Catchment and Land Protection Act 1994 (CaLP Act).	The CaLP Act facilitates a framework for the integrated management and protection of catchments. The Act provides a system of controls	A Construction Environmental Management Plan will be required to manage potential land

Legislation / Policy	Summary	Relevance to Project
	concerning noxious weeds and pest animals, and outlines the responsibility of landowners to take all reasonable steps to: • avoid causing or contributing to land degradation; • conserve soil; • protect water resources; • eradicate regionally controlled weeds and established pest animals; and • prevent the growth and spread of regionally controlled weeds and established pest animals. The Act defines four categories of noxious weeds: State Prohibited Weeds, Regionally Prohibited Weeds, Regionally Controlled Weeds and Restricted Weeds. Noxious weeds species and the category they are placed in is specific to individual Catchment Management Authority (CMA) regions.	degradation, including erosion and sediment inputs to waterways.
Wildlife Act 1975 (Wildlife Act)	The Wildlife Act establishes procedures for the protection and conservation of wildlife; the prevention of wildlife becoming extinct; and the sustainable use of and access to wildlife and to prohibit and regulate the conduct of persons engaged in activities concerning wildlife.	Any person employed by the Project to handle fauna (including fish) will need to have a permit to do so under the Wildlife Act.
Fisheries Act 1995	The *Fisheries Act 1995* regulates commercial and recreational fishing in Victoria.	Not relevant to the Project, impacts to threatened fish and habitats is dealt with through other legislation as described above.
Environment Protection Act 2017	The *Environment Protection Act 2017* has replaced the *Environment Protection Act 1970*. Under the 1970 Act, the State Environment Protection Policy (SEPP) (Waters) provided requirements for water quality by setting out beneficial uses of waterways and environmental quality indicators and objectives to protect them. The SEPP (Waters) establishes in law the uses and environmental values to be protected, defining the level of environmental quality required for their protection, and setting rules and obligations to ensure management actions are taken to protect water quality. SEPP (Waters) references the Best Practice Environmental Management Guidelines (1999) (BPEMG) which were developed to establish best practice performance objectives for urban stormwater (for urban development). The new EP Act which came into effect on 1 July 2021 has replaced the SEPPs with Environmental Reference Standards (ERS) which similarly identifies water values and has indicators and objectives to assess if these values are being maintained. The rules and obligations in the SEPP (Waters), including reference to the BPEMG, were not carried into the Environment Reference Standard but have become 'state of knowledge' for managing risks to environmental values. In addition there is a General Environmental Duty (GED) which states that "a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable".	For aquatic ecology, management measures will need to be implemented to minimise impacts to water quality, including: • Increased sedimentation, • Chemical spills, • Reduction in the quality of stormwater inputs. • Disturbing contaminated sediments;

5. Existing Conditions

5.1 Ecological values

Desktop assessments of waterways in the State Project Land were carried out to provide information on ecological values previously identified or modelled to occur within these systems. These assessments considered the following publicly available databases of species information:

- **Protected Matters Search Tool (DAWE, 2020):** The Protected Matters Search Tool (PMST) highlights any Matters of National Environmental Significance (MNES) relevant to the EPBC Act that are likely to occur within an area. Records were derived for each waterway crossed by the proposed works and extended 5 km upstream and downstream of the crossing points. A search was also made more broadly across the State Project Land to determine if any aquatic species had the potential to occur in the broader area that were not represented in the site-specific assessments.

- **Victorian Biodiversity Atlas (VBA) (DELWP, 2020):** This database comprises historical records of flora and fauna species from across the state. Records are added opportunistically, as flora and fauna surveys are conducted within Victoria for a variety of purposes. Records were derived for each waterway crossed by the proposed works and extended 5 km upstream and downstream of the crossing points (see Appendix B). A search was also made more broadly beyond the State Project Land to determine if any aquatic species had been recorded in the broader area that were not represented in the site-specific assessments.

The PMST report identified one Wetland of International Importance (Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands) and three Listed Threatened Species (Australian grayling, Murray cod *Maccullochella peelii* and dwarf galaxias *Galaxiella pusilla*) as potentially occurring near or within the waterways of the State Project Land (Appendix A). Growling grass frog were also identified as potentially occurring within these areas, however this species is considered in the MAR State Land Terrestrial Ecology Impact Assessment (MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710).

The VBA identified nine native fish species (including Australian grayling and Murray cod) and seven exotic species in the State Project Land (see Appendix B). Rakali (native water rat *Hydromys chrysogaster*) and long-necked turtles (*Chelodina longicollis*) have also been recorded.

Threatened fauna species records from the database searches are subject to a Likelihood of Occurrence Assessment to identify which of the species detected would likely occur within the study areas and be potentially impacted by the project. The likelihood of occurrence of a threatened species is classified into three classes; high, moderate or low. The methods for classifying the threatened species likelihood of occurrence is provided in Table 5.1.

The following sections summarise specific MNES, FFG Act listed species and individual waterway descriptions (Section 5.2).

Table 5.1 Criteria for determining the likelihood of threatened species being present within the study areas.

Likelihood	Criteria
High	Recent records (<30 years) of species from DELWP databases Review of aerial photography indicates potential habitat within the Assessment Area Review of habitat and distribution literature indicates the Assessment Area is appropriate for this species
Moderate	Historic records of species from DELWP databases Review of habitat and distribution literature indicates the Assessment Area is appropriate for this species Review of aerial photography indicates limited habitat within the Assessment Area
Low (Unlikely)	Species has not been previously recorded within DELWP databases Review of aerial photography indicates that no available habitat is present Review of literature regarding habitat and distribution indicates the Assessment Area is unlikely to be utilised by this species

5.1.1 Wetlands of international importance (Ramsar)

The PMST report identified one Wetland of International Importance (Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands) as potentially relevant to the Project (Appendix A). The Ramsar site is split across multiple locations on the western shore of Port Phillip Bay and the Bellarine Peninsula from Mud Island between the heads of Port Phillip Bay in the south to Point Cook in the north. The closest location to the project area is Point Cook situated on the shoreline of Port Phillip Bay approximately 6.5 km and 10 km west of Kororoit Creek and the Maribyrnong River mouths, respectively. Given the location and distance to the Ramsar site and the nature of the works proposed, it is considered unlikely that the Project will have a significant impact on Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands. Best practice sediment and erosion control measures as outlined in relevant Environment Protection Authority (EPA) guidelines should be implemented to prevent any impact to waterways that discharge into Port Phillip Bay.

5.1.2 Threatened Species

Threatened species from the study areas are summarised in Table 5.2 and described in more detail below. Threatened species are only likely to be present in the Maribyrnong River.

Table 5.2 Threatened fauna species that may occur within the assessment area, with their EPBC, FFG Act (current listing and provisional updated listed) and Victorian Advisory List conservation status, their preferred habitat and comment on likelihood of occurrence.

Species	EPBC Act	FFG Act	Habitat	Likelihood of occurrence
Australian Grayling (*Proctotroctes mareana*)	V	En	Rivers and streams with cool, clear moderate flows, a gravel substrate and alternating pools and riffles. (Backhouse et al 2008)	High – Maribyrnong. Low – elsewhere Recorded in the Maribyrnong River near proposed crossing, most recently in 2015.
Murray Cod (*Maccullochella peelii*)	V	En	Murray Cod are associated with deep holes in rivers which support cover such as logs, stumps, boulders and undercut banks (Lintermans 2009). Species is introduced and not indigenous to the Melbourne region.	Low Last recorded in the Maribyrnong in the vicinity of the proposed crossing in 1982. Likely to be translocated / stocked individuals. No evidence of a self-sustaining population in the Maribyrnong.
Dwarf Galaxias (*Galaxiella pusilla*)	V	En	Critical habitat features for this species is shallow, slow flowing or swamp like waterbodies containing permanent or intermittent water, that support abundant submerged and emergent vegetation (SWIFFT, 2021).	Low No records and no suitable habitat present.
Platypus (*Ornithorhyncus anatinus*)		V	Platypus inhabit a wide range of aquatic habitats including rivers, streams, lakes and dams. The critical habitat requirement for Platypus is steep and often overhanging earthen banks often with root masses for constructing burrows. Overhanging vegetation is also considered important (Grant and Temple Smith 1998).	Moderate – Maribyrnong. Low – Elsewhere Within 5 km of the project area there are four records of platypus held on the VBA, with the most recent record dating from 1998. There are more recent records held in the VBA further upstream, approximately 14 km northwest of the Maribyrnong River Bridge (MRB) (DELWP 2019). However, there are two contemporary records from Avondale Heights approximately 2 km south of the MRB held in other databases dating from 2016 (ALA 2021) and 2021 (Cesar 2021).

Notes: V = vulnerable, En = endangered.

5.1.2.1 Australian grayling

The Australian grayling is listed as Vulnerable under the EPBC Act and endangered under the Victorian FFG Act. Australian grayling is a migratory species, moving between freshwater streams, estuaries and coastal seas to complete their lifecycle (Berra, 1982). Spawning occurs in lower freshwater reaches/upper estuaries between late summer and winter (April – June), with timing determined by temperature and local environmental influences including an increase in river flows, which triggers adult grayling to migrate from upper reaches towards the estuary at spawning time. Their eggs/hatched larvae then drift downstream to the coast and remain at sea for approximately six months (possibly dispersing widely), before juveniles return to the freshwater streams around September-November.

Within the State Project Land, Australian grayling have been recorded in the Maribyrnong River at several locations and as recently as 2015 approximately ~2.5 km upstream of the existing rail crossing (Figure 5-1 and see Appendix B). Australian grayling enter the Maribyrnong River during periods of elevated flow when Solomon's Ford (Avondale Heights) – which separates the estuary from the upstream freshwaters – is overtopping. Melbourne Water is also managing environmental flows in the Maribyrnong River with the objective of encouraging the Australian grayling to enter the river. They are also known to be present in the Yarra River, of which the Maribyrnong River is a major tributary, joining the Yarra River in its estuary.

Assessment of potential impacts to Australian grayling are required to determine if the proposed action is likely to represent a significant impact in accordance with the EPBC Significance Impact guidelines.

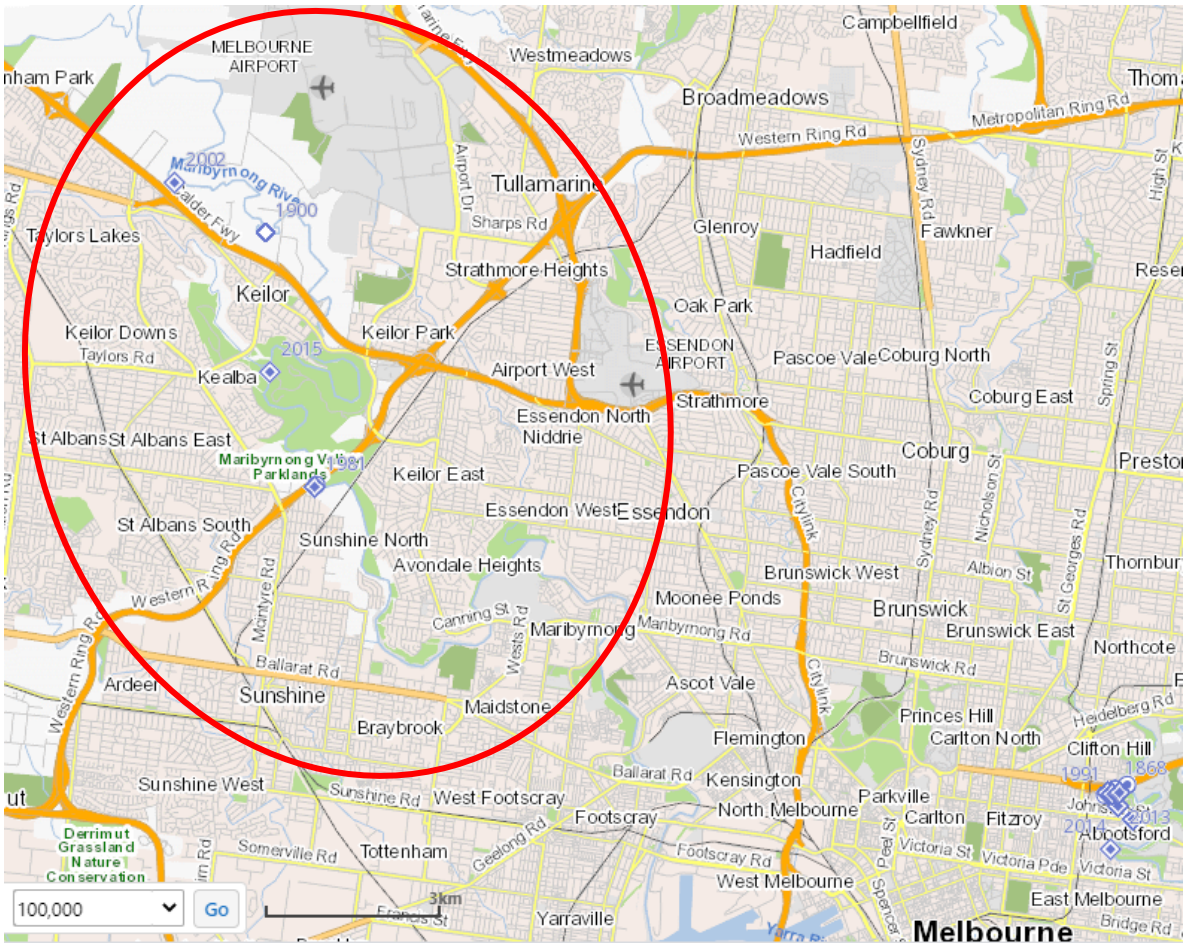

Figure 5-1 Records of Australian grayling (blue diamonds) in the general study area (red circle), and the broader Yarra River (data source Victorian Biodiversity Atlas: http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit)

Other waterways relevant to the Project are also connected to Port Phillip Bay (either directly, i.e. Kororoit Creek, or as tributaries to other streams that are connected to Port Phillip Bay i.e. Jacksons Creek, Moonee Ponds Creek, Steels Creek, Stony Creek, Jones Creek). Australian grayling have not been recorded in any

of these waterways. These waterways do not provide suitable habitat or flow regimes for Australian grayling and most contain barriers to upstream movement within the lower reaches (e.g. culverts, low level fords, concrete lined sections, piped sections, weirs etc.) that prevent Australian grayling from migrating from Port Phillip Bay into these waterways.

5.1.2.2 Murray cod

Murray cod is listed as Vulnerable under the EPBC Act and endangered under the FFG Act. The PMST search indicated the potential for habitat to be present in the Maribyrnong River. Murray cod are endemic to rivers of the Murray Darling Basin. Typical habitat is slow flowing lowland rivers with abundant aquatic habitat, however they are regularly stocked in rivers, lakes and reservoirs within and outside of their natural range (Koehn & Harrington, 2005). They were translocated to the Yarra River around Eltham and Warrandyte (from the Goulburn River catchment) in the early 1900s and have since formed a small self-sustaining population in the Yarra River (Cadwallader & Gooley, 1984). They are often stocked in farm dams and are occasionally stocked in closed waters (lakes and dams) outside their natural range to support recreational fishing activities. There are two historical records of Murray cod in the Maribyrnong River (1970 and 1981) from a location approximately 11 km upstream of the current railway crossing (Figure 5-2). It is likely that these are translocated/stocked individuals and there is no evidence of the establishment of a self-sustaining population. Given the study area waterways are outside the natural range of Murray cod and there is no evidence of a self-sustaining population it is considered that Murray cod are unlikely to occur in the Assessment Area and no further assessment of impacts is required.

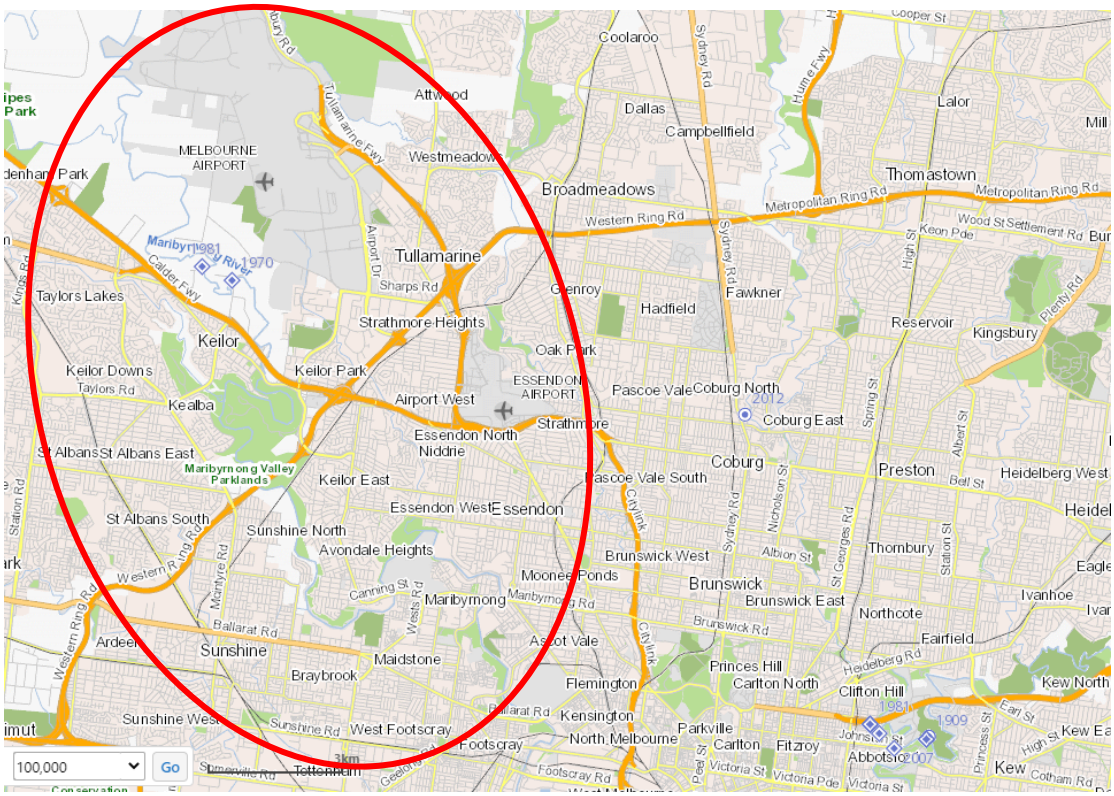

Figure 5-2 Records of Murray cod (blue diamonds) in the general study area (red circle), and the broader Yarra River (data source Victorian Biodiversity Atlas: http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit)

5.1.2.3 Dwarf galaxias

Dwarf galaxias are listed as Vulnerable under the EPBC Act and endangered under the FFG Act. The PMST search indicated the potential for habitat to be present in the waterways cross the study area. Dwarf galaxias prefer slow and still habitat supporting dense submerged vegetation and swamp scrub riparian vegetation (Sadlier *et al*. 2010). There are numerous records of Dwarf galaxias in urban waterways and wetlands south east of Melbourne, but their recorded range does not extend to waterways of the western plains and there

are no records in the study area (Figure 5-3). The nearest records to the east are from the wildlife ponds at Latrobe University and are likely to be of translocated individuals. Given the study area waterways are outside the recorded range of Dwarf galaxias it is considered they are unlikely to occur in the Assessment Area and no further assessment of impacts is required.

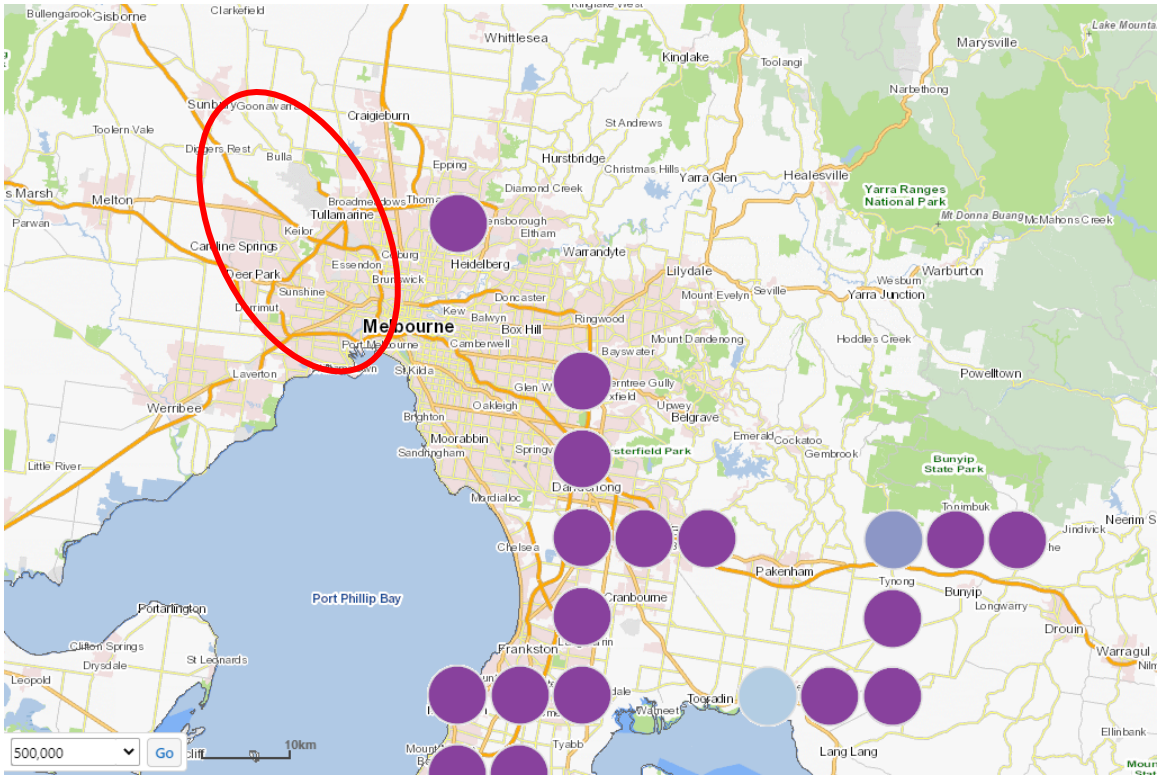

Figure 5-3 Records of Dwarf galaxias (purple spots) in the general study area (red circle), and the broader metropolitan and South Gippsland area (data source Victorian Biodiversity Atlas: http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit)

5.1.2.4 Platypus

Platypus were recently listed as vulnerable under the FFG Act. Platypus have relatively broad habitat requirements and can be found in rivers, streams, natural and manmade lakes and dams, including urban areas. The critical habitat requirement for platypus is steep and often overhanging earthen banks, regularly with root masses for constructing burrows. Overhanging riparian vegetation and coarse woody debris are also considered important. Breeding occurs from July to March, with exact timing dependent on latitude (i.e. more northerly populations commence breeding earlier than southern populations). Adult platypus generally occupy small home ranges, but can have occasional longer forays. Juveniles are thought to be more dispersive. Platypus can move overland between waterbodies and across catchments (Grant and Temple Smith 1998).

There are numerous records of platypus from the Melbourne region, with the majority of contemporary records from the Yarra River and associated tributaries upstream of Dights Falls. Within the Maribyrnong Catchment the majority of records are from upstream of the Calder Freeway, with just a handful of records downstream (Figure 5-4) (DELWP 2019, ALA 2021, Cesar 2021). There are four records of platypus within 5 km of the State Project Land held in the VBA, with the most recent dating from 1998 (DELWP 2019). However there are recent records from Avondale Heights approximately 2 km south of the MRB dating from 2016 (ALA 2021) and 2021 (Cesar 2021) (Figure 5-4).

Based on the results of the desktop assessment there is a moderate likelihood that Platypus may occur in the vicinity of the proposed MRB. Assessment of potential impacts to platypus are required to determine if the proposed action is likely to represent an impact in accordance with the Victorian EE Act and FFG Act.

Platypus are unlikely to be present in other catchments relevant to the project.

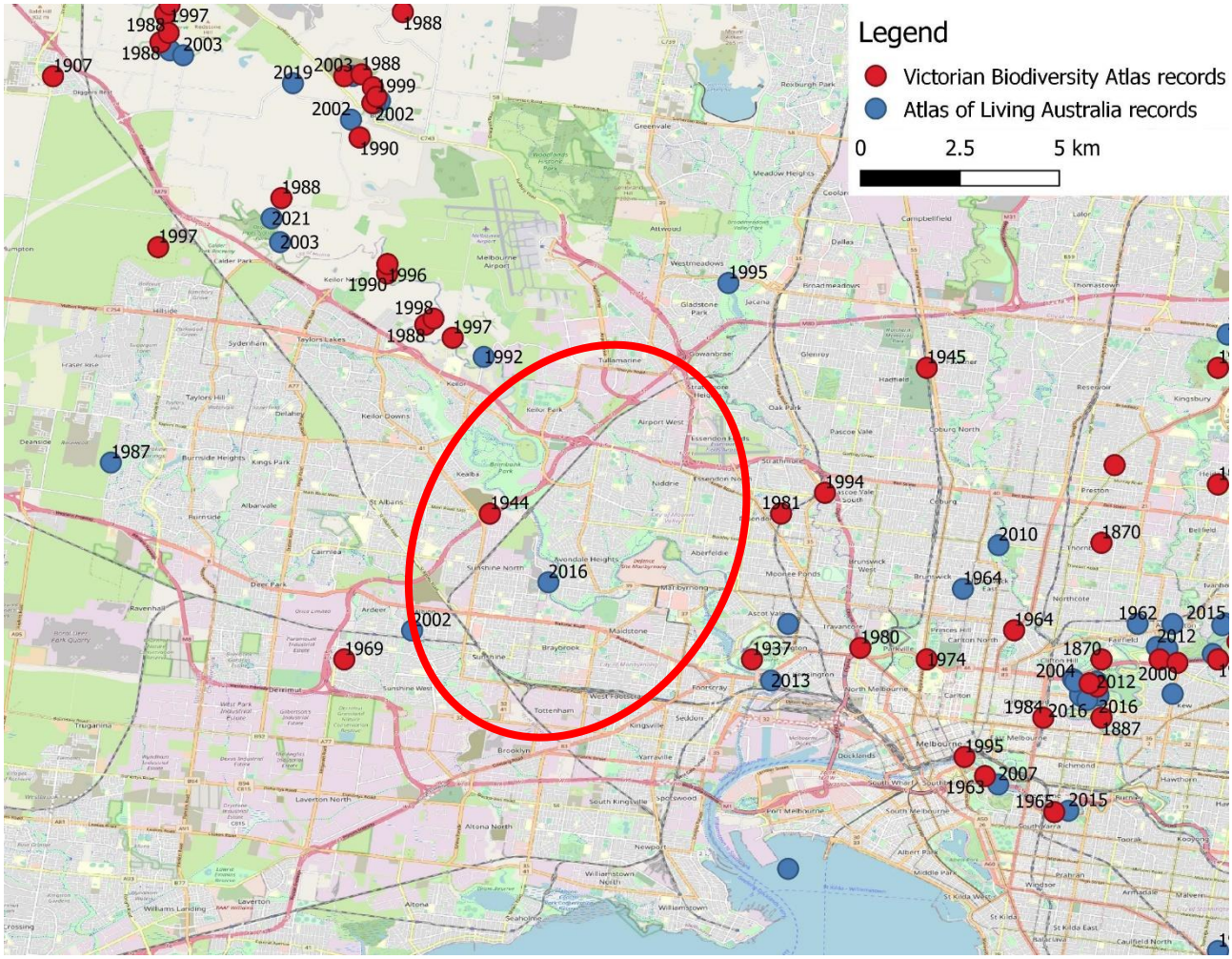

Figure 5-4 Records of platypus (dots) with date of record in the general study area (red circle) and surrounds. Data from DELWP (2019) and ALA (2021)

5.2 Waterway descriptions

This assessment encompasses waterways that traverse an area that is referred to as the Western Plains. The Western Plains are a low-lying undulating plain formed on volcanic and sedimentary rocks. These plains are comprised of numerous larval flows upon which streams have incised their course (Rees, 2000). The following sections describe the current geomorphic and ecological condition of each waterway in the Project Land. Condition is based on site inspections and relevant database searches and literature reviews.

5.2.1 Maribyrnong River

5.2.1.1 Geomorphology

The geomorphology of the Maribyrnong River within the vicinity of the rail corridor has previously been investigated by Gippel and Walsh (2000). The river is an actively eroding stream, with some sections being more susceptible to erosion because of high stream powers, high and steep banks, low width/depth ratio, confinement of floods and poor riparian vegetation cover.

The bed of the river is stable, being controlled by a series of artificial weirs, rock grade control structures and natural rock bars (Gippel & Walsh, 2000). Bank erosion, particularly on meander bends has previously been cited as an issue of concern. Evidence of large slump failure is also visible in historical aerial photographs

and, although considered infrequent events, are considered likely to occur again in the future (Gippel & Walsh, 2000).

The river within the vicinity of the project location has been described as having a confined alluvial channel RiverStyle with floodplain pockets (Melbourne Water, 2019). Table 5.3 shows geomorphic condition scores for Maribyrnong River extracted from the Physical Form database (Melbourne Water, 2019). The river has been described as having a low geomorphic condition. It is categorised as having a medium catchment level stress level given the urban development in the catchment. Overall, the river was categorised as having a medium geomorphic risk.

Table 5.3 Maribyrnong River geomorphic condition, sensitivity, stress level and risk categories and scoring (from Physical Form database).

Geomorphic condition	Geomorphic sensitivity	Catchment stress level	Geomorphic risk
Low (3.5)	High (7.8)	Medium (4)	Medium (5.1)

A rapid visual assessment was undertaken of the Maribyrnong River. The geomorphological condition of the channel and potential for erosion is considered not to have changed from that described by Gippel and Walsh (2000). Selected photographs showing condition of banks and bank erosion (notching, undercutting and slumping) are presented in Figure 5-5.

Figure 5-5 Maribyrnong River in the vicinity of the proposed rail crossing – Left, bare areas with little grass cover, indicative of ongoing bank erosion, also notching and undercutting of bank within the vicinity of water level. Right – slumping of bank adjacent to pedestrian path.

5.2.1.2 Aquatic ecology

Rail upgrades proposed to the Maribyrnong River crossing pass over a stretch of the river that comprises a range of pool and riffle habitats with a near continuous riparian vegetation creating diverse habitat conditions, including presence of woody habitat and littoral vegetation (Figure 5-6).

Overall stream condition is rated moderate using the Index of Stream Condition assessment (DEPI, 2013b). Specifically, Streamside Zone and Physical Form metrics were rated 7/10 and 9/10 respectively indicating good to excellent structural habitat condition. However, Water Quality and Flow and metrics were rated 3/10 and 4/10 respectively, indicating that the flow regime is influenced by upstream extractions for water supply and irrigation purposes and water quality is impacted by urban development and poor quality stormwater runoff.

Despite the relatively poor flow and water quality conditions, the high-quality habitat at the MRB provides suitable conditions for a range of native fish, including the EPBC and FFG listed Australian grayling (Appendix B). The FFG act listed platypus is also known from the catchment, with two recent records from 2 km downstream of the MRB. Other species recorded in the vicinity of the proposed crossing include a range

of relatively common and widespread small bodied native fish, including species that migrate between freshwater and estuary/marine environments. There are historic records of Murray cod (EPBC and FFG listed), but these are likely to have been stocked individuals as the study area is outside the natural range of Murray cod and no self-sustaining population currently exists with the study area.

Figure 5-6 Maribyrnong River in the vicinity of the proposed rail crossing – Upper left, existing rail crossing. Upper right, riffle habitat. Lower left, pool habitat. Lower right, wood habitat (Photos: T. Lovell)

5.2.2 Steele Creek

5.2.2.1 Geomorphology

Steele Creek is a tributary of the Maribyrnong River. Its form has been highly modified over the years with the creek alignment severely altered due to industrial and urban development associated with the urbanisation of the area. The creek has previously been reported as highly disturbed with stream health seriously impaired by impacts from the predominantly urbanised catchment (City of Mooney Valley, 2019). Although not assessed in this investigation, given the historical changes in land use and industrial development, it is possible that the creek sediments are contaminated.

Steele Creek North between the Western Ring Road and Airport Drive supports a deeply incised creekline (vertical banks >1m high), and throughout much of the site it retains a natural, sinuous form. The creek supports sections of short riffles and runs, with narrow pools (<2m wide) however, where the viaduct will cross the creek there are a few larger pools up to ~5m wide. The creek bed was a combination of sand, rocks, boulders as well as bars that were appeared to be dense clay/mud There was visible scour along much of the creek through the site, likely accentuated by recent heavy rainfall (February 2021).

Steele Creek within the vicinity of the project location has been described as having an anthropogenic shaped channel RiverStyle (Melbourne Water, 2019). Table 5.4 shows geomorphic condition scores for Steele Creek extracted from the Physical Form database (Melbourne Water, 2019). The creek has been categorised as having a low geomorphic condition. Due to the high level of urban development in the catchment it has been categorised as having a very high catchment stress level. Overall, the creek was categorised as having a high geomorphic risk.

Table 5.4 Steele Creek reach geomorphic condition, sensitivity, stress level and risk categories and scoring (from Physical Form database).

Geomorphic condition	Geomorphic sensitivity	Catchment stress level	Geomorphic risk
Low (2.5)	Low (3.3)	Very High (10)	High (5.3)

5.2.2.2 Aquatic ecology

Steele Creek (Figure 5-7) contains poor quality aquatic habitat values comprising small areas of open water separated by sections of channel containing dense emergent macrophytes, mostly common reed (*Phragmites* spp.). The majority of channel is modified in some way, including stretches that are concrete lined downstream of the assessment site but Steele Creek North between Airport Drive and the Western Ring Road supports a more natural form with riffles, runs and narrow pools with little emergent vegetation. The riparian zone in the vicinity of proposed works is dominated by weeds with areas of mostly revegetated native vegetation. Downstream areas contain scattered native trees in urban park settings. There are historical (2008) records of 2 native fish (Short-finned eel and Common galaxias) and 1 exotic fish (Oriental Weatherloach) from Steele Creek (Appendix B). Short-finned eel and Common galaxias are species that are common and widespread across the urban area. During the site inspection, small fish most likely the introduced Eastern Gambusia *Gambusia holbrooki*, were observed in the creek.

Figure 5-7 Steele Creek in the vicinity of the proposed rail crossing and viaduct. Upper left and right, Steele Creek at the Western Ring Road (Photos: T. Lovell). Middle left, Steele Creek North between the Western Ring Road and the proposed crossing. Middle right and bottom left, Steele Ck North downstream of Airport Drive. Bottom right Steele Ck North between the proposed crossing and Airport Drive (Photos: M. Le Feuvre).

5.2.3 Moonee Ponds Creek

5.2.3.1 Geomorphology

Moonee Ponds lies deeply incised within the surrounding volcanic plain. At the project location the creek has been described as having an Anthropogenic shaped channel RiverStyle (Melbourne Water, 2019). Historically the creek at this location is likely to have been drained and straightened. The channel is also likely to have been subject to a high level of engineering works to maintain its form and function in conveying stormwater runoff.

Table 5.5 shows selected geomorphic condition scores for Moonee Ponds Creek extracted from the Physical Form database (Melbourne Water, 2019). Due to the high level of urban development in the catchment it has been categorised as having a very high catchment stress level. Overall, the creek was categorised as having a medium geomorphic risk.

Table 5.5 Moonee Ponds reach geomorphic condition, sensitivity, stress level and risk categories and scoring (from Physical Form database).

Geomorphic condition	Geomorphic sensitivity	Catchment stress level	Geomorphic risk
Fair (4.2)	Medium (4.2)	Very High (8)	Medium (4.9)

5.2.3.2 Aquatic ecology

Moonee Ponds Creek is a tributary of the Yarra River estuary, flowing from a semi-rural area north of Melbourne Airport. At the project location the creek flows in a modified natural channel. Habitat comprises alternating shallow open water pools and dense emergent vegetation, mostly Common reed. The riparian zone comprises scattered native trees and a mix native and introduced ground cover. Much of the broader floodplain is mown urban parkland. Downstream reaches of the creek are heavily modified concrete lined channel.

Figure 5-8 Moonee Ponds Creek

Three native fish species have been recorded in the creek in the vicinity of the State Project Land, namely Shortfin eel (*Anguilla australis*), Common galaxias (*Galaxias maculatus*) and Flathead gudgeon (*Philypnodon grandiceps*) (Appendix B). All of these are common species that are widespread across the urban area. Rakali (native water rat) and eastern snake-neck turtle have also been recorded. All records are over ten years old. No threatened fish have been recorded in the creek, however, growling grass frogs (*Litoria raniformis*) have been recorded further upstream, in the Jacana wetlands, and are dealt with in the terrestrial assessment.

5.2.4 Stony Creek

5.2.4.1 Geomorphology

At the project location Stony Creek has been described as having an Anthropogenic shaped channel RiverStyle (Melbourne Water, 2019). The morphology of the channel has been extensively modified in this section. Table 5.6 shows geomorphic condition scores for Stony Creek extracted from the Physical Form database (Melbourne Water, 2019). The creek has been categorised as having a low geomorphic condition. Due to the high level of urban development in the catchment it has been categorised as having a very high catchment stress level. Overall, the creek was categorised as having a high geomorphic risk.

Table 5.6 Stony Creek reach geomorphic condition, sensitivity, stress level and risk categories and scoring (from Physical Form database).

Geomorphic condition	Geomorphic sensitivity	Catchment stress level	Geomorphic risk
Low (3.3)	High (7.5)	Very High (10)	High (6.9)

5.2.4.2 Aquatic ecology

Stony Creek rises in St Albans and flows in a south east direction through modified natural channel, piped sections and concrete lined channel to discharge to the lower Yarra River. Upper Stony Creek has been diverted and now discharges into Kororoit Creek. The State Project Land runs adjacent to Stony Creek in some areas with the catchment a mix of residential, commercial and heavy industry. The ecological condition of the creek is a function of its history of industrial land use and stormwater drainage function. Water quality is generally poor and the creek contains limited aquatic habitat and supports a low diversity macroinvertebrate and fish community (2 native fish species have been recorded in the freshwater reaches – Appendix B) tolerant of poor water quality (Melbourne Water, 2020). However, sections of the creek flow though urban parklands, with scattered native riparian vegetation and the creek corridor is highly regarded by the local community (Melbourne Water, 2020).

A factory fire in 2018 in Tottenham caused a significant pollution event in the creek that resulted in the death of over 2300 fish (Melbourne Water, 2020). The effects of the fire and genuine community concern for the health of the creek have led to the development of a comprehensive rehabilitation plan for the creek (Melbourne Water 2020).

5.2.5 Kororoit Creek and Jones Creek

5.2.5.1 Geomorphology

Kororoit Creek within the vicinity of the project location in Albion has been described as having a confined alluvial channel RiverStyle with floodplain pockets (Melbourne Water, 2019). Historically the creek at this location is likely to have been drained and straightened. The channel is also likely to have been subject to a high level of engineering works to maintain its form and function in conveying stormwater runoff. Table 5.7 shows geomorphic condition scores for Kororoit Creek extracted from the Physical Form database (Melbourne Water, 2019). The creek has been categorised as having a low geomorphic condition. Due to the high level of urban development in the catchment it has been categorised as having a very high catchment stress level. Overall, the creek was categorised as having a high geomorphic risk.

Table 5.7 Kororoit Creek reach geomorphic condition, sensitivity, stress level and risk categories and scoring (from Physical Form database).

Geomorphic condition	Geomorphic sensitivity	Catchment stress level	Geomorphic risk
Low (3.3)	High (7.6)	Very High (8)	High (6.3)

5.2.5.2 Aquatic ecology

Kororoit Creek rises in rural land around Plumpton and flows in a south easterly direction through Deer Park and Altona North to Port Phillip Bay. Jones Creek is a short urban tributary of Kororoit Creek that rises east of St Albans and flows through predominantly residential areas to discharge to Kororoit Creek in Albion.

The Index of Stream Condition (DEPI, 2013) rates Kororoit Creek as moderate condition with good Hydrology and Physical Form (8/10), but poor Streamside Zone (3/10) and moderate Water Quality (6/10). The good quality physical form translates to good quality aquatic habitat in some areas comprising pools and rockbar / riffle habitats. Conditions do deteriorate to some extent through urban areas.

Blind Creek is a modified natural channel in the upper reaches and concrete lined channel in the lower reaches prior to discharge to Kororoit Creek. There is no ISC assessment for Blind Creek.

Four native fish have been recorded from the freshwater reaches of Kororoit Creek, namely Shortfin eel, Common galaxias, Flathead gudgeon and Australian smelt (Appendix B). Eastern snake-necked turtle has also been recorded. These species are relatively common and widespread across the urban areas where suitable habitat exists and their presence in Kororoit Creek infers high ecological value. No fish have been recorded from Jones Creek, although it is possible that species recorded in Kororoit Creek may inhabit parts of Jones Creek if suitable habitat exists.

6. Impact Assessment

The MAR project involves construction works and ongoing operational activities. The construction and operational phases of the project have the potential to affect instream and riparian habitat, water quality, and threatened flora and fauna species in the study area.

This section discusses potential impacts, mitigation measures and residual impacts, with particular reference to impacts on MNES, including Ramsar Sites and threatened aquatic species listed under the EPBC Act, as well as FFG Act listed species. The aquatic environment, potential impacts and associated impacts on aquatic life have been considered as part of this investigation, and an overall assessment made based on the EPBC Significant Impact Guidelines.

6.1 Potential Impacts

6.1.1 Instream structures

The construction of instream structures such as bridge footings and associated temporary works (e.g. partial coffer dams, sheet pile/retaining walls) may result in disturbance to instream and/or riparian habitat and sediment. This can result in loss of instream or riparian habitat under the footprint of the structure, disturbance of aquatic fauna, and disturbance to banks and bed sediments resulting in generation of sediment and instream turbidity. Instream construction works can also result in spills or pollution impacts on water quality (see Section 6.1.2).

The permanent presence of bridge piers or other instream structures can also cause barriers to fish movement, and these impacts are particularly acute for migratory fish. Many fish species (including the EPBC listed Australian Grayling) are migratory and rely on unimpeded movement between upper stream reaches and coastal seas to complete their life cycle. Instream structures can directly block fish movements between stream reaches upstream and downstream of the bridge site. Barriers to migration can be as a result of direct blocking of movement, loss of channel connectivity, or indirect effects such as structures causing changes to flow velocity or water depth. Increased flow velocity can act as a barrier to upstream migration, while changes to water depth and flow can result in loss of connection between wetted habitat areas (i.e. shallow areas being cut off from each other).

In stream barriers can also limit platypus movements, however platypus are capable of overland travel over short distances so barriers created by in stream structures may be more permeable for this species. There are risks associated with overland travel – for example the risk of predation from red fox or domestic dogs are elevated during overland travel (Grant and Temple-Smith 2003; Hawke et al. 2019).

Construction of instream structures also creates noise and vibration, which has the potential to change animal behaviour and potentially migration patterns (Popper and Hawkins 2019). Construction noise and vibration may impact the migration of Australian grayling.

The construction and permanent presence of bridge footings in the waterway can also cause hydraulic changes (i.e. changes in velocity and shear stress) that could induce unacceptable scour and erosion of bed and bank material. Changes to flow patterns and flow velocity can have indirect impacts including changes to bank or bed erosion, channels, and habitat types (i.e. mix of deep/shallow, riffle/pool). The bridge structure (including footing and bridge span) can also cause shading of the stream.

6.1.1.1 Maribyrnong River

AJM-JV has undertaken hydraulic modelling of the rail bridge design and construction method for the Maribyrnong River using HECRAS hydraulic model. Hydraulic modelling was undertaken of seasonal flows and a design flow event (50% Annual Exceedance Probability (AEP) for the construction method to assess potential geomorphology and aquatic impacts. The 50% AEP was selected as it was likely to be relevant to the duration of the construction of the pier (18 months) and also represents a flow in which a working platform adjacent to the channel is overtopped. Representative seasonal flow inputs were derived using gauge data available from the Maribyrnong River at Keilor (Station 230200) for the period February 1908 to February 2021. From this data the peak flow in each month of the data was used to calculate the median

peak flow for each calendar month (Table 6.1). Model input/assumptions are documented in Table 6.2. For example, the median peak flow for April is 0.5 m^3/s. This means 50% of the recorded years would have a peak flow in April above 0.5 m^3/s, and 50% of recorded years would have a peak flow in April below 0.5 m^3/s. April and October were chosen as these two months represent the periods and ranges of flows over for which fish movement is critical. August was also chosen because it is the month with the highest median peak flow. These flows were modelled in steady state.

Table 6.1 Median monthly peak flows.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Median monthly peak flow (m3/s)	0.3	0.3	0.3	0.5	0.8	2.3	4.3	13.3	11.9	3.7	1.9	0.8

Table 6.2 Model input/assumptions.

Input	Source
Topography	1m Lidar (WGCMA) Bathymetry data at specific survey locations (AJM-JV).
Low Flow channel invert	1.84-1.92 mAHD at proposed bridge
Manning's n	Ranges between 0.035 (lightly vegetated) and 0.09 (heavily vegetated)
DS Boundary Condition	Normal depth calculation, slope = 0.0004

The construction method (piers and concrete platform) was modelled and compared with the base case (or existing conditions). The construction method involves permanent retaining structures (e.g. sheet piles) and establishment of a safe working platform around Pier 8. The location of the MRB Pier 8 safe working platform is on the south side of Maribyrnong River, west of the existing Albion-Jacana Rail bridge and in-line with the existing trestle structure. A safe working platform is required for Pier 8 substructure construction works, superstructure construction works and bridge maintenance requirements. To construct the safe working platform, a retaining wall system is required between the Pier 8 pile cap and the Maribyrnong River due to the steep terrain. Typical retaining wall systems that can be adopted as part of the works include but not limited to, sheet-pile retaining wall, piled retaining wall and gravity retaining wall. In the hydraulic model a pier and platform was added, the position and dimensions of this matching that proposed as the construction method based on information provided by RPV in August 2021. The estimated duration of the construction for Pier 8 and works proposed is approximately 18 months (July 2023 – Nov 2024).

Results for water level, velocity and bed shear stress were extracted at five locations within the vicinity of the proposed bridge and are shown in Table 6.3:

- 30 m upstream of proposed bridge
- 7 m upstream of proposed bridge, upstream end of platform
- At proposed bridge, upstream extent
- At proposed bridge, downstream extent and end of platform
- 100 m downstream of proposed bridge

Plots of velocity and bed shear stress at the proposed bridge for Base Case (Existing Conditions) and Construction and Final Constructed (Pier and Platform) are presented in Figure 6-1.

Selected cross-sections for the proposed bridge location showing extent to which bridge piers and platform structure form an obstruction to flows are presented in Figure 6-2 and Figure 6-3. A map showing the location of cross-sections included in the hydraulic model is presented in Figure 6-4. Results are compared against critical shear stresses that are likely to initiate or promote scour of bed and banks depending on bank composition (Table 6.4).

Table 6.3 Modelled water levels, velocities and bed shear stresses at five sites at or near the proposed bridge. Each cross section (XS) value is the number of meters upstream from the downstream end of the hydraulic model (i.e. XS 9650 is 9650 m upstream of the downstream end of the model).

Flow	Flow Value (m^3/s)	Water Level (m AHD)			Velocity (ms^{-1})			Bed Shear Stress (N/m^2)		
		Base Case (Existing Conditions)	Construction and Final Constructed (Pier and Platform)	Difference	Base Case (Existing Conditions)	Construction and Final Constructed (Pier and Platform)	Difference	Base Case (Existing Conditions)	Construction and Final Constructed (Pier and Platform)	Difference
30m upstream of proposed bridge (XS 9650)										
Median Peak April	0.5	2.13	2.13	0.00	0.3	0.3	0.00	2.48	2.41	-0.07
Median Peak October	3.7	2.45	2.5	0.05	0.57	0.5	-0.07	9.91	7.44	-2.47
Median Peak August	13.3	3.2	3.31	0.11	0.65	0.58	-0.07	9.78	7.83	-1.95
6 month	80	5.83	6	0.17	0.92	0.87	-0.05	17.13	15.48	-1.65
50% AEP (1 in 2)	210	8.01	8.18	0.17	1.18	1.12	-0.06	29.71	26.81	-2.90
7m upstream of proposed bridge (XS9627), upstream end of platform										
Median Peak April	0.5	2.07	2.08	0.01	0.4	0.36	-0.04	4.02	3.01	-1.01
Median Peak October	3.7	2.36	2.45	0.09	0.79	0.64	-0.15	11.42	6.93	-4.49
Median Peak August	13.3	3.17	3.29	0.12	0.79	0.7	-0.09	8.96	6.88	-2.08
6 month	80	5.8	5.96	0.16	1.04	1.08	0.04	13.57	13.53	-0.04
50% AEP (1 in 2)	210	7.97	8.12	0.15	1.34	1.4	0.06	22.72	25.87	3.15
At proposed bridge (XS 9620, upstream extent)										
Median Peak April	0.5	2.03	2.07	0.04	0.48	0.34	-0.14	6.21	2.81	-3.40
Median Peak October	3.7	2.34	2.44	0.10	0.76	0.6	-0.16	9.87	5.6	-4.27
Median Peak August	13.3	3.16	3.29	0.13	0.77	0.68	-0.09	7.3	5.63	-1.67
6 month	80	5.79	5.95	0.16	1.16	1.1	-0.06	13.81	12.31	-1.50
50% AEP (1 in 2)	210	7.93	8.1	0.17	1.53	1.46	-0.07	29.5	26.73	-2.77
At proposed bridge (XS 9610, downstream extent), downstream end of platform										
Median Peak April	0.5	1.92	1.92	0.00	0.64	0.64	0.00	11.91	11.91	0.00
Median Peak October	3.7	2.33	2.33	0.00	0.6	0.6	0.00	5.77	5.77	0.00
Median Peak August	13.3	3.16	3.16	0.00	0.67	0.67	0.00	5.64	5.64	0.00
6 month	80	5.79	5.79	0.00	1.1	1.1	0.00	12.43	12.43	0.00
50% AEP (1 in 2)	210	7.93	7.93	0.00	1.49	1.5	0.01	26.99	27.78	0.79
100m downstream of proposed bridge (XS 9500)										
Median Peak April	0.5	1.63	1.63	0.00	0.13	0.13	0.00	0.31	0.31	0.00
Median Peak October	3.7	2.22	2.22	0.00	0.34	0.34	0.00	2.22	2.22	0.00
Median Peak August	13.3	3.05	3.05	0.00	0.57	0.57	0.00	6.24	6.24	0.00
6 month	80	4.33	4.33	0.00	0.87	0.87	0.00	14.02	14.02	0.00
50% AEP (1 in 2)	210	5.61	5.61	0.00	1.09	1.09	0.00	22.44	22.44	0.00

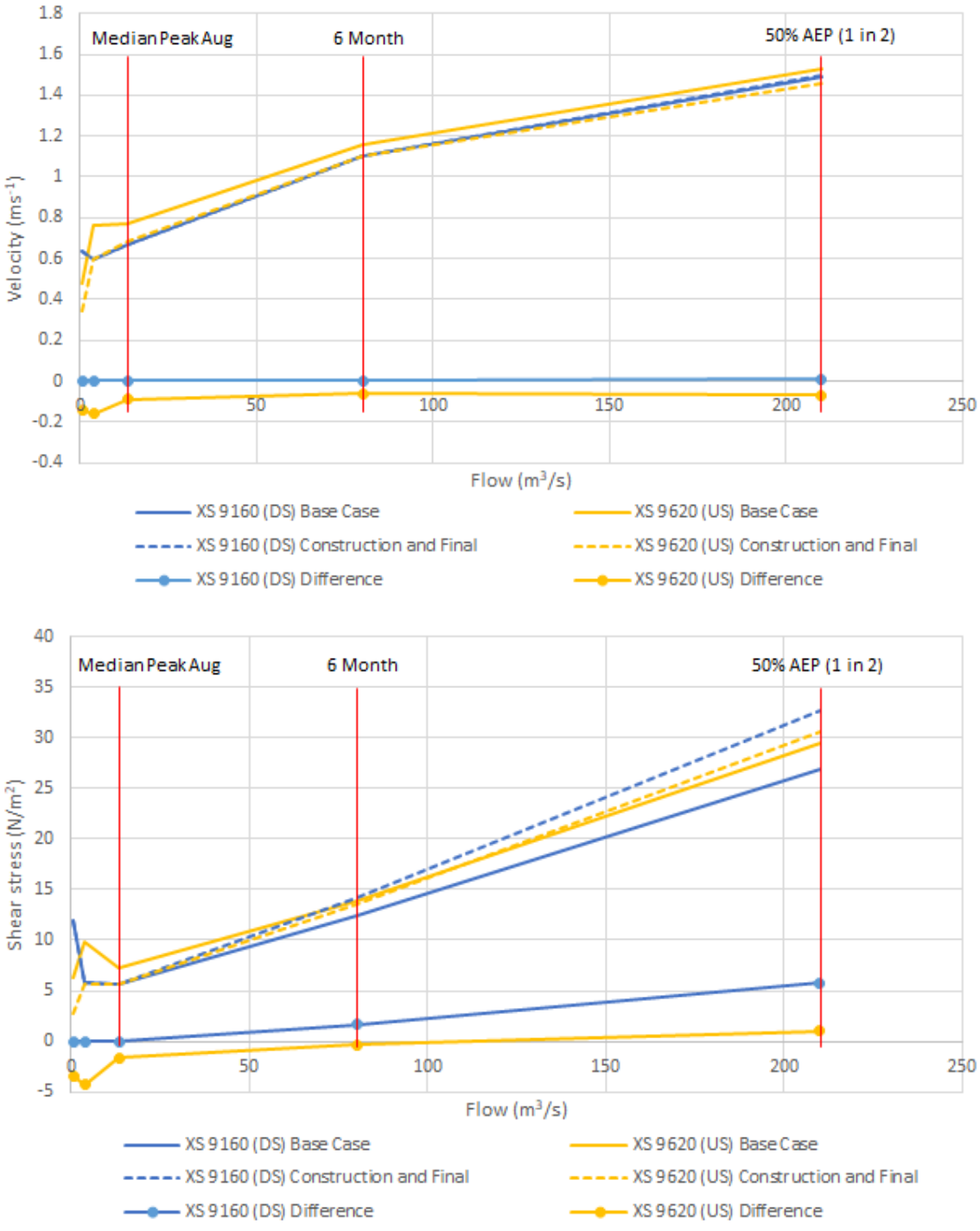

Figure 6-1 Plots showing velocity and bed shear stress values and differences for Base Case (Existing Conditions) and Construction and Final Constructed (Pier and Platform) at the proposed bridge (XS 9160, downstream extent and XS 9620, upstream extent).

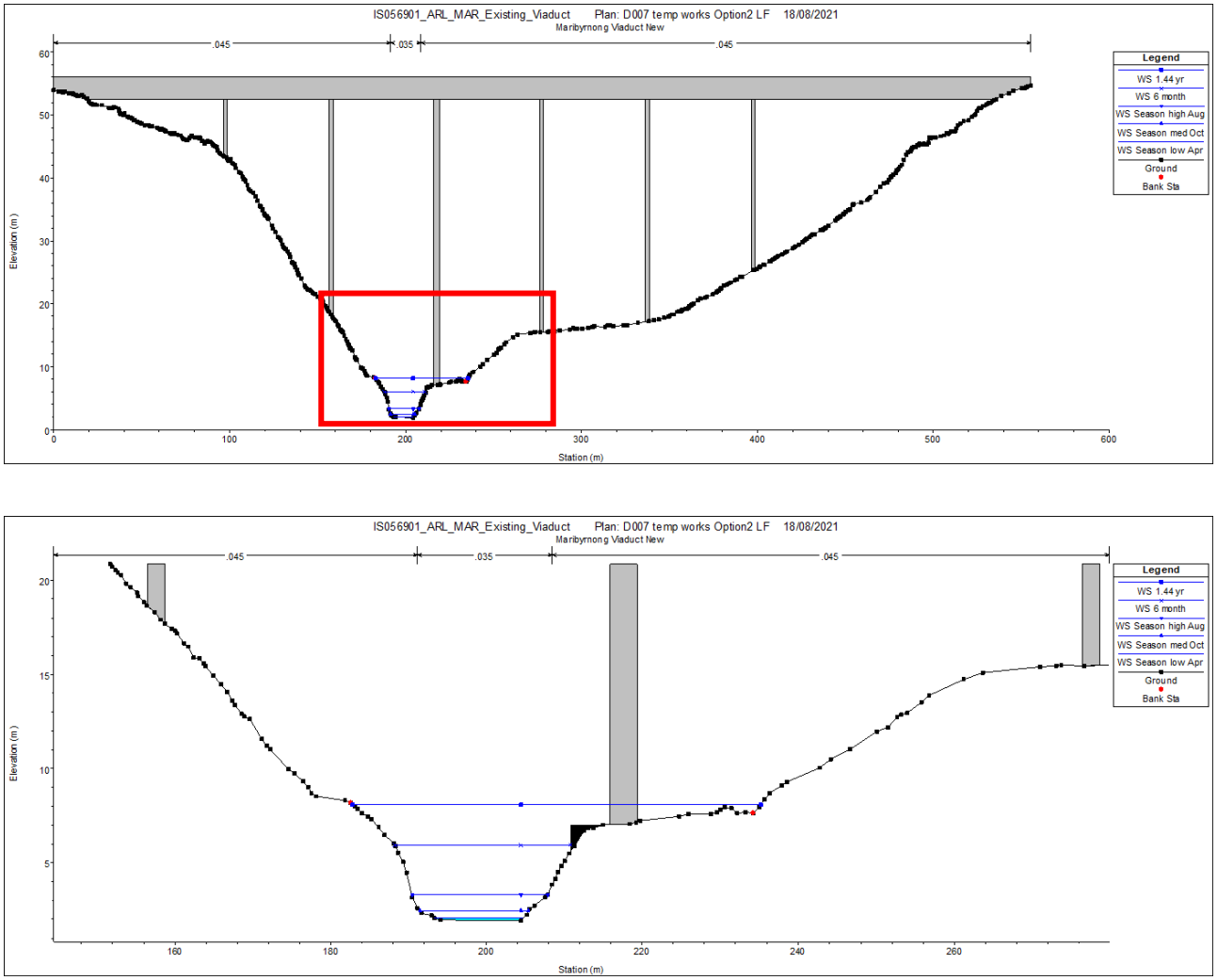

Figure 6-2 Modelled water levels at proposed bridge showing the extent to which the platform forms an obstruction to flows at the upstream extent of the bridge (XS9620).The upper plot shows the full cross section, lower plot is an insert from the upper plot showing the waterway in greater detail (the extent is indicated by the red box on the upper plot).

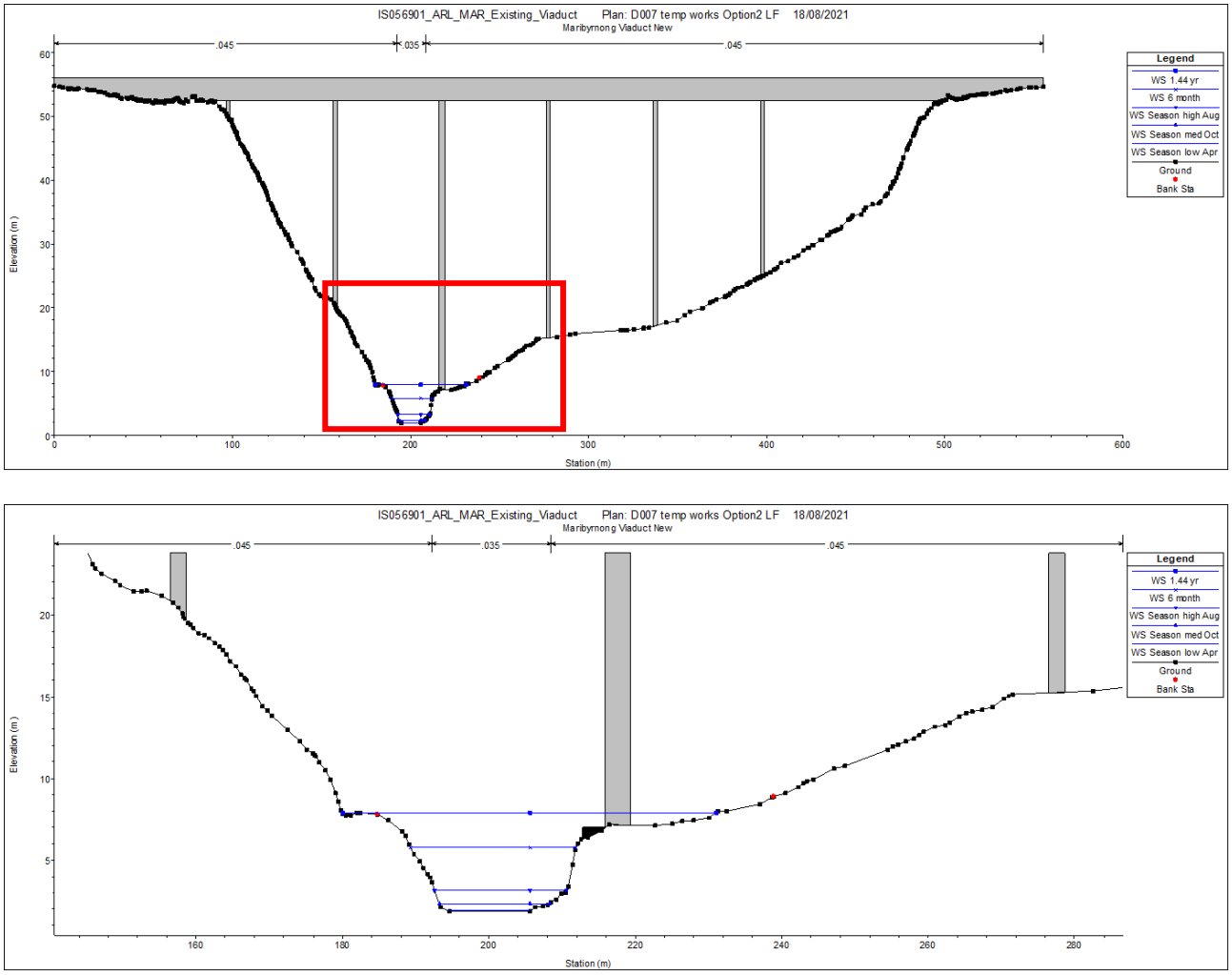

Figure 6-3 Modelled water levels at proposed bridge showing the extent to which the platform forms an obstruction to flows just downstream of the bridge (XS9610).The upper plot shows the full cross section, lower plot is an insert from the upper plot showing the waterway in greater detail (the extent is indicated by the red box on the upper plot).

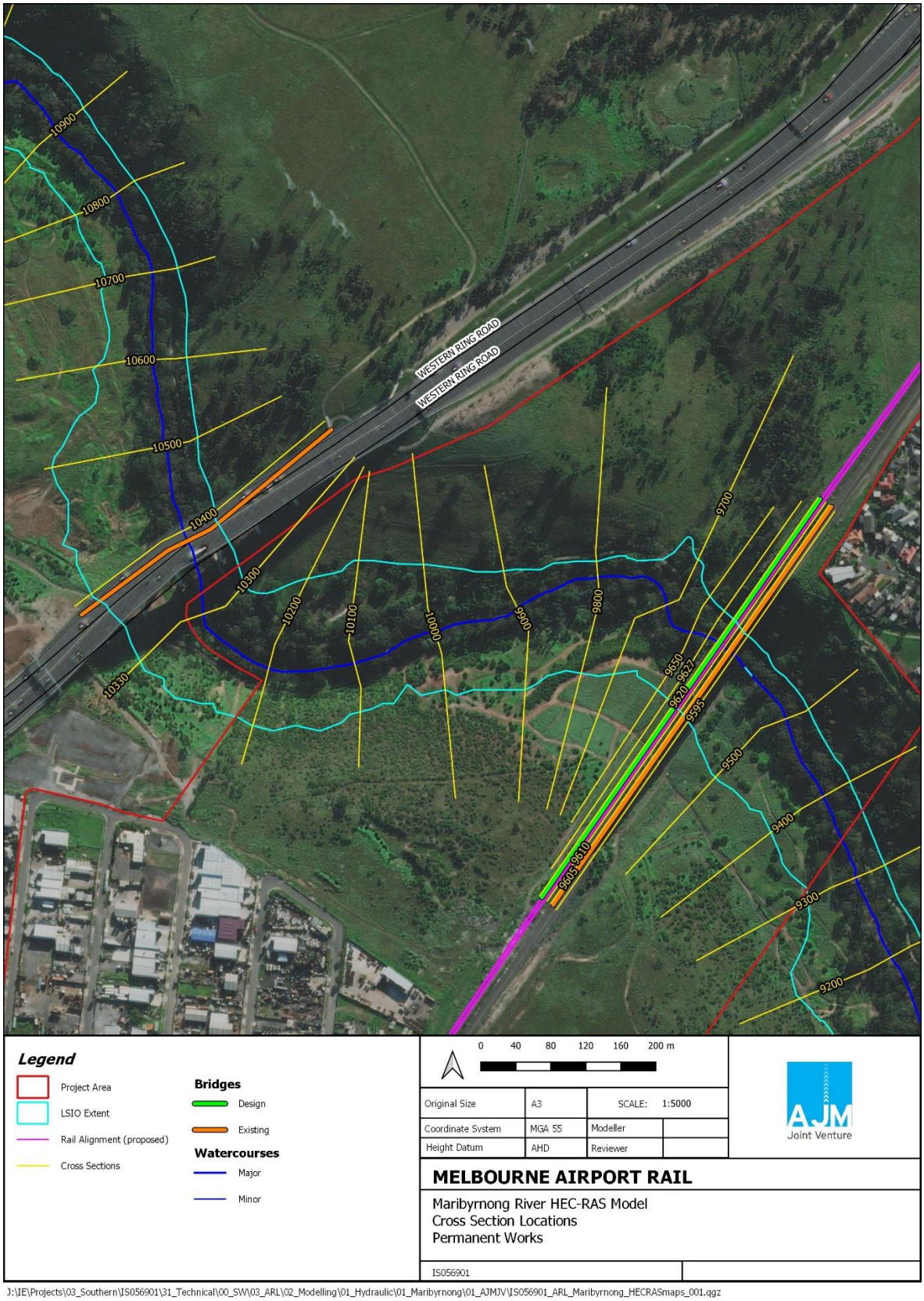

Figure 6-4 Maribyrnong River HEC-RAS Model cross section locations.

The median flows in April, August and October are not obstructed by the pier and platform structures, and as such it is expected that there would be no change in water levels, velocities or bed shear stress for these flows. It is noted that the there is still a modelled difference in values reported at three XS upstream of the bridge (XS9650, XS9627) and the upstream extent of the bridge (XS9620). Modelled differences are very small (water level, 0.04 to 0.13 m; velocity, -0.16 to 0 m/s; bed shear stress, -4.49 to -0.07 N/m^2).

This is an artefact of the model, which introduces additional calculations to take into account the bridge structure. HEC-RAS is a 1D model that performs hydraulic calculations between specified cross-sections. The flow and section properties variation is rarely linear, so the calculations must be performed using averaged and weighted parameters. Adding a 'bridge' element introduces additional calculation points located within the bridge structure. The with-bridge case therefore performs additional calculations and may use different weighting parameters regardless of whether part of the bridge is in contact with the flow. The differences are usually minor and within the accuracy of the hydraulic loss calculations. The differences observed in the low-flow calculations are magnified in the Maribyrnong modelling due to the shallow flow and steepness of channel. The differences are considered to be within tolerances of accuracy governed by the calculations, accuracy of the survey and other factors, and are not considered significant.

The 6 month flow in August is only slightly obstructed by the platform at XS9620 but it still has no or negligible impact on water levels, velocities and bed shear stress (water level, 0.00 to 0.17 m; velocity, -0.06 to 0.04 m/s; bed shear stress, -1.65 to 0 N/m^2). Under both construction and operation scenarios shear stresses do not increase to the extent that they jump to another disturbance category (based on Table 6.4) and there is no increased risk in bed or bank erosion that would impact on instream habitat.

The 50% AEP flow (210 m^3/s) approximates a bankfull flow and is partly obstructed by the construction. However, the 50% AEP flow would only result in minor changes in water levels, velocities and bed shear stress in the river at the bridge location (water level, 0 to 0.17m; velocity, -0.07 to 0.06 m/s; bed shear stress, -2.90 to 3.15 N/m^2). Under both construction and operation scenarios shear stresses do not increase to the extent that they jump to another disturbance category (based on Table 6.4) and there is no increased risk in bed or bank erosion that would impact on instream habitat.

Based on the outcomes of the detailed design phase, scour protection may be required between the proposed safe work platform and the Maribyrnong River, which may extend into the low flow channel (equivalent level for winter base flow, as represented by June Median Flow of 2.3 m^3/s). If scour protection is required, its design and extent will need to be assessed by an aquatic ecologist to ensure any impacts to aquatic ecological values are eliminated or minimised. In addition, a terrestrial ecologist will need to review the proposed scour protection to ensure the terrestrial values, in particular MNES, are not impacted.

Table 6.4 Critical shear stress competent in scouring different sediment and vegetation types.

Material	Critical Shear Stress (N/m^2)	Source
Sediment type		
Silt	~0.065-0.11	(Hanson & Simon, 2001; Hawley & Vietz, 2015; Julien, 1998; Simon & Thomas, 2002)
Soft clay	5	
Stiff clay	50	
Sand	~0.11-0.47	
Gravel	~1.26-53	
Cobbles	~53-223	
Boulder	>223	
Vegetation type		
Aquatic swampy vegetation	105	(Prosser & Slade, 1994)
Tussock and sedge	240	
Riparian trees	>250	

6.1.1.2 Steele Creek North

AJM-JV has undertaken hydraulic modelling of the Steele Creek North area to assist in assessing the potential impacts of the proposed construction works on geomorphology and ecology values. The outcomes of hydraulic modelling are presented for the 1%, 2% and 10% AEP peak flow conditions. Results for the 10% AEP event (the more frequent event) are presented in Figure 6-5 and Figure 6-6 for depths and velocities respectively. Results for the 1% and 2% AEP events are presented in Appendix C.

Construction areas (hardstand roads, piers) would be impacted by larger infrequent events (1% and 2% AEP). Flows impacting on these areas are generally 0-0.5 m depth, with low velocities in the range of 0-0.5 m/s. There are some areas that will experience deeper and higher velocity flows and these also correspond with the location of piers.

Lower magnitude flows, as represented by the 10% AEP would have minimal impact on construction areas (hardstand roads, piers). These flows are generally confined to the creek. Overall the geomorphology of the channel, processes of erosion, sediment transport and storage are not expected to change in this section of the creek with the proposed construction of the viaduct as proposed works are set back from and will not form an obstruction to the main channel. Modelling was presented for 10% AEP as is this was the lowest flow where potential impacts as a result of the piers and associated construction footprint were recorded, for more frequent events (i.e. 20%, 50%) there is likely to be even less or no impact.

On this basis there will be no physical risk to instream habitats that would impact on ecological values.

A shared user path (SUP) will also be constructed along Steele Creek North, including a crossing adjacent to the Airport Drive road bridge. The SUP will mostly follow existing tracks in the area. The exact location and design of the SUP crossing is to be finalised. If the SUP bridge piers and/or any associated structures are within the 1% AEP, the design will need to be reviewed by an aquatic ecologist, and additional hydraulic modelling be conducted where required. If the design is found to likely impact local geomorphology and/or aquatic ecology, the design should be modified to eliminate impacts, or additional control will need to be put in place.

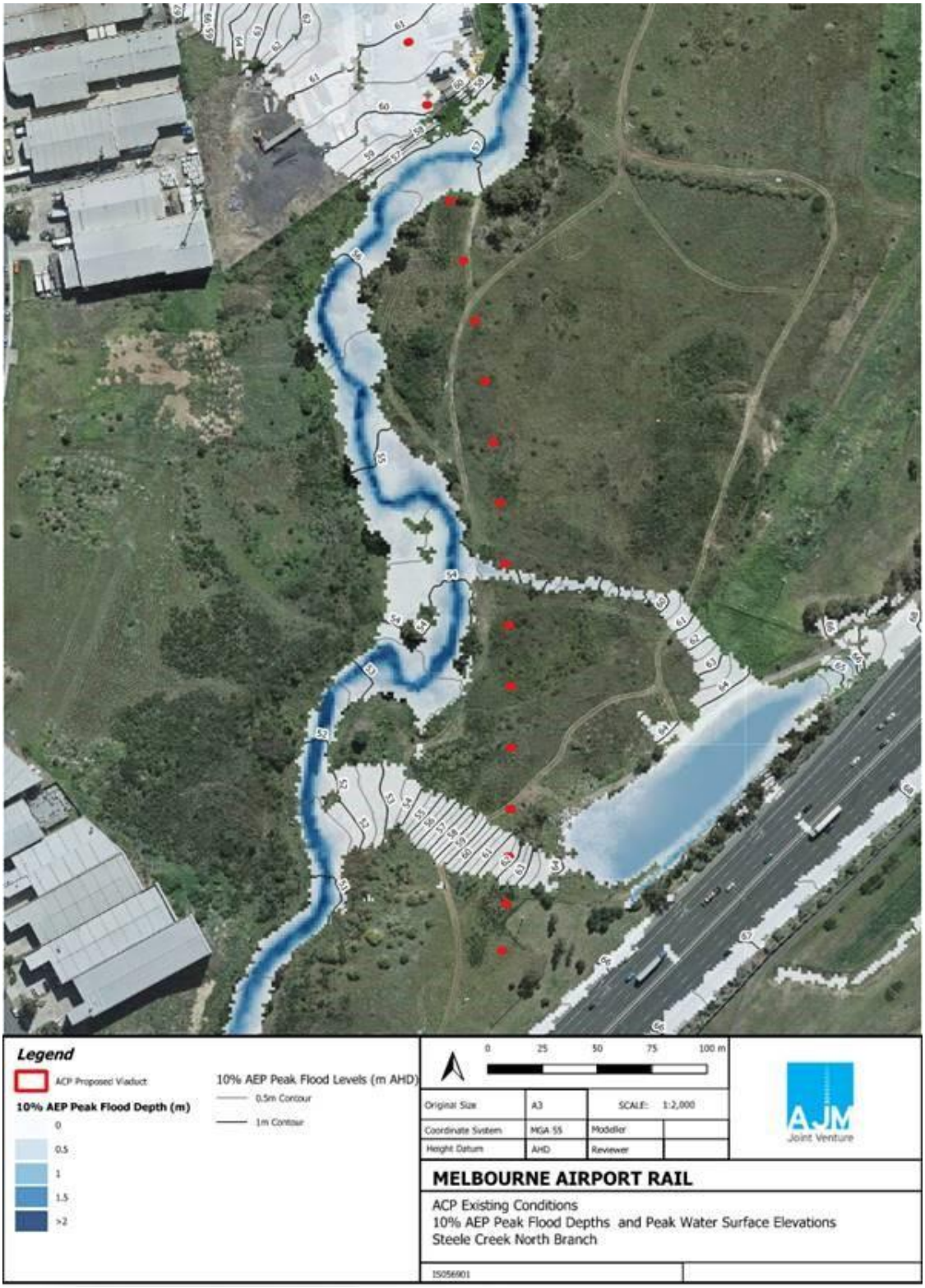

Figure 6-5 Steele Creek North Branch 10% AEP flood depths and peak water surface elevations. Position of proposed viaduct piers also shown on map.

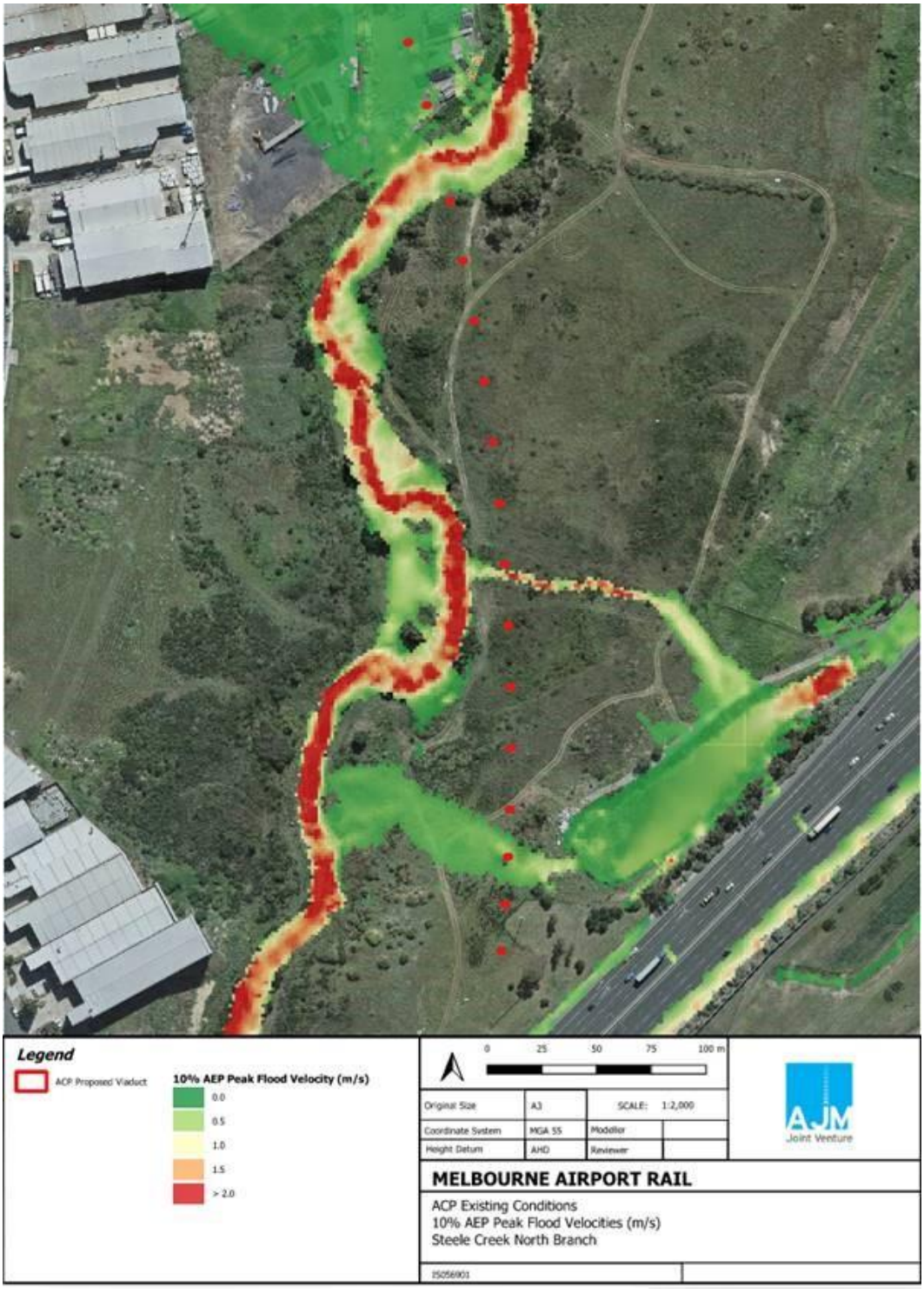

Figure 6-6 Steele Creek North Branch 10% AEP peak flood velocities. Position of proposed aqueduct piers also shown on map.

6.1.1.3 Upper Stony Creek

The proposed viaduct will cross Upper Stony Creek where low flow channel flows through an existing culvert which passes under Gilmour Road, Sunshine North and the existing Albion-Jacana rail corridor. An additional pier will be located adjacent to the existing high flow channel (Figure 6-7). Flow velocities and

associated bed sheer stress will not be impacted during low flows and are unlikely to be significantly impacted as a result of the proposed works at Upper Stony Creek.

In addition, the existing bridge over the high flow will be replaced with three box culverts, as the existing bridge is in poor condition. Modelling suggests this high flow channel currently receives limited flow, even during high flow events and the current design for the replacement culvert shows no negative impact to flooding.

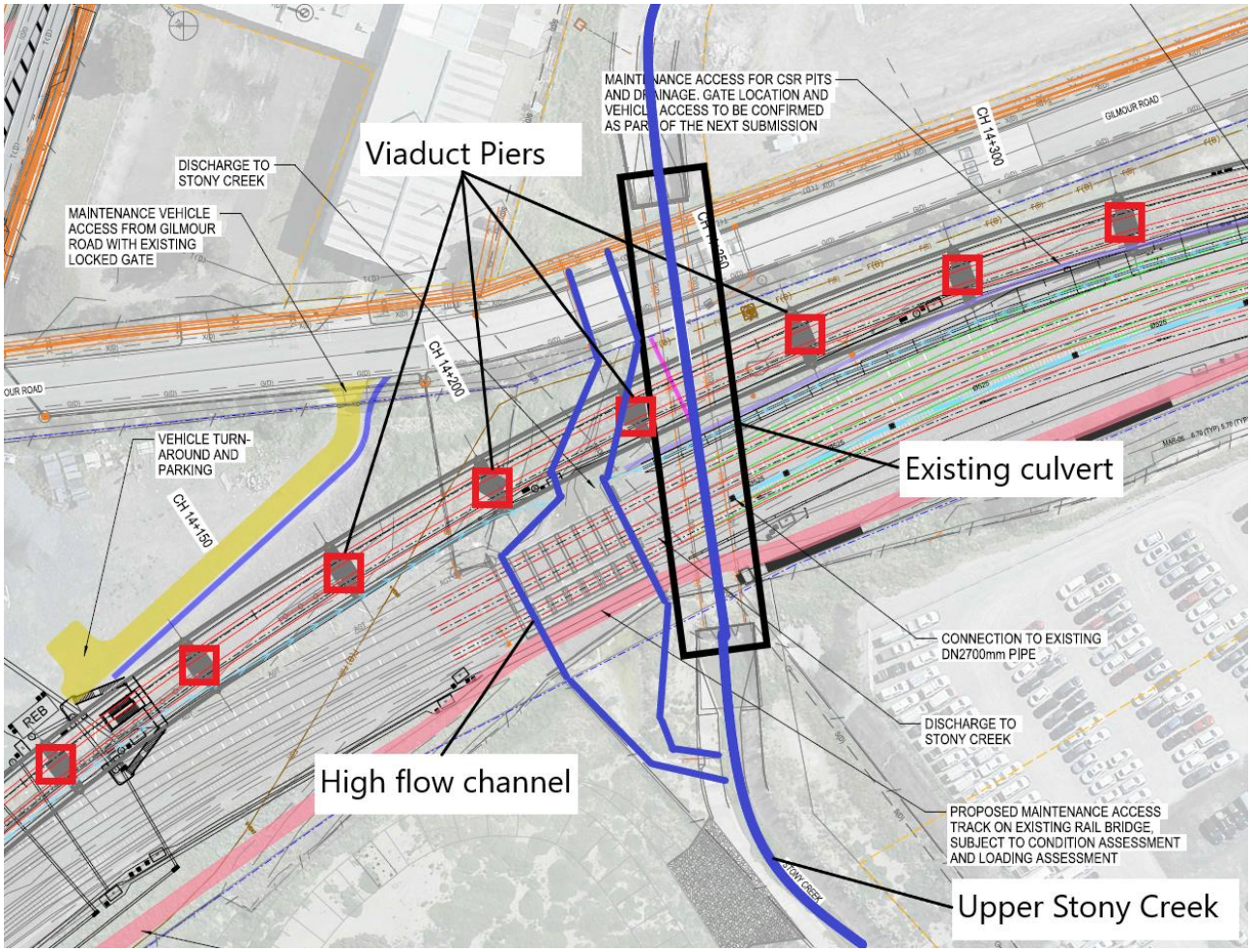

Figure 6-7 Indicative location of viaduct piers in relation to Upper Stony Creek main channel, the existing culvert and the additional high flow channel.

6.1.2 Water quality impacts

The proposed MAR Project Works have the potential to impact water quality and these impacts are documented in detail in the MAR State Land Surface Water Assessment (MAR-AJM-PWD-PWD-REP-XLP-NAP-0001723). The following section provides a summary of potential impacts to surface water as a result of the project. The project may impact water quality during construction through sediment runoff, mobilising contaminated soils and accidental pollutant spills and during operations through surface water (stormwater) drainage discharge to waterways. Increased sediment input into the waterways can lead to increased turbidity in the water column, affecting aquatic fauna and potentially causing shading and impacts on primary productivity. There are also potential impacts on benthic habitat as sediment settles out of the water and interstitial habitat in bed substrates are infilled with fine sediment. Pollutants can have both lethal and sublethal effects (e.g. changed physiology, reproduction and behaviour) on biota via both acute (short term) and chronic (long term) exposure.

At Upper Stony Creek, an existing drainage swale that runs along the north-western side of the existing Albion-Jacana rail corridor will be infilled to accommodate the additional at ground level tracks to be constructed. If left untreated, this change to stormwater infrastructure combined with additional impervious surfaces as a result of the project will likely impact water quality values in upper Stony Creek. A stormwater treatment design is being developed to reduce impacts to water quality at Upper Stony Creek and this design must be approved by Melbourne Water. With a Melbourne Water approved stormwater treatment design for the site, the risk of impacts to water quality in upper Stony Creek are low. More generally, during construction, water quality may be impacted due to:

- Increased sediment input to waterways as a result of:
  - > Runoff from construction areas, including areas where soil disturbance occurs, laydown areas, construction access tracks and hardstand.
  - > Increased erosion due to the removal of riparian vegetation.
  - > Increased erosion due to changed hydrology from permanent and temporary instream structures (see section 6.1.1) or altered inflows.
  - > Changed stormwater quality entering the waterways as a result of construction.
  - > Accidental releases of untreated stormwater.
- Increased pollution due to polluted runoff, chemical and fuel spills, and the disturbance of contaminated soils.

Following construction and during operation water quality may be impacted due to:

- Increased sediment input into waterways due to:
  - > Poor rehabilitation of construction footprint and removed riparian vegetation leads to increased sediment runoff.
  - > Increased erosion due to changed hydrology as a result of permanent instream structures.
- Changed stormwater quality entering waterways following construction depending on drainage design.

Impacts to water quality are possible at all watercourses in the project area during construction, and at Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North during operations.

6.1.3 Stream flow impacts

Hydrology may change as a result of construction and operations. Changed hydrology can alter the quality and extent of habitat and create barriers to movement.

During construction and operation changes to hydrology may occur as a result of:

- The construction of temporary or permanent in stream structures (see section 6.1.1)
- Temporary or permanent diversion of runoff.
- Increased in the area of impervious surfaces
- Changes to stormwater inflows depending on drainage design.

Impacts to hydrology are possible at Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North during construction and operation.

6.1.4 Loss of riparian habitat

During the construction of MAR, there will be the direct loss of small areas of riparian vegetation during the construction phase of this project. This may lead to a reduction in habitat quality in these areas and increased risk of scour and erosion. These impacts are likely to be limited to the construction phase as any habitat will be rehabilitated, except for at the immediate footprint of any bridge/viaduct piers and associated retaining structures and work platform (Maribyrnong River only) where vegetation loss will be permanent.

In addition, based on the outcomes of the detailed design phase scour protection may be required between the proposed safe work platform and the Maribyrnong River, which may extend into the low flow channel. This will lead to further permanent loss or reduction in quality of riparian habitat. If scour protection is required, its design and extent will need to be assessed by an aquatic ecologist to ensure any impacts to aquatic ecological values including riparian habitat are minimised. In addition, a terrestrial ecologist will need to review the proposed scour protection to ensure the terrestrial values, in particular MNES, are not impacted.

Impacts to riparian habitat could occur at Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North depending on specific construction footprints.

6.2 Mitigation Measures

The following mitigation measures are recommended across the study area to control potential impacts to the aquatic ecological values.

These measures will be formalised through an Environmental Management Framework (EMF), prepared and approved in accordance with the relevant planning approval. The EMF will provide a transparent and integrated governance framework to manage the environmental aspects of the Project and will detail Environmental Management Requirements (EMR) that must be implemented by the delivery partner.

If measures are incorporated into the design process, construction and operations, risks to waterway values are considered low.

6.2.1 Instream structures

The following mitigation measures are recommended to control potential impacts associated with the construction of instream structures (i.e. pier pylons and associated temporary and permanent structures) during the construction and operation phases. These mitigation measures are applicable to Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North during construction and operation:

- Place piers and temporary structures as far outside main channel as possible to avoid creating barriers to fish movement. Modelling indicates that at the Maribyrnong and Steele Creek sites, during median peak flows the piers and temporary structures will be outside channel, the only exception being the Maribyrnong River where the temporary structure could be impacted during the August median peak flows (the highest flow month), but there will be no or negligible impacts to flow velocity, water levels or bed shear stress (see Section 6.1.1).

- Extent of hardstand on creek side of viaduct and at creek crossings along Steele Creek and Steele Creek North will be minimised as far possible to further minimise any impacts to hydrology and riparian vegetation.

- Construction of piles and pile caps for pier 8 and associated safe work platform adjacent to the Maribyrnong River will occur outside the Australian grayling migration periods (April to June and September to November). Noise and vibration have the potential to alter Australian grayling migration patterns. The construction of piles and pile caps for pier 8 and platform will create the most noise and vibration, so this has been scheduled between December and March, and July – August. The December-March period also coincides with the lowest flows.

- Modelling based on the current design indicates that the replacement culvert in the upper Stony Creek high flow channel should not negatively impact flooding.

6.2.2 Water Quality

The following mitigation measures are recommended to control potential impacts to water quality during the construction and operation phases and apply to all sites.

- Implement best practice environmental management (BPEM) for erosion and sediment control in accordance with EPA Victoria construction guidelines, the MAR State Land Surface Water Assessment (MAR-AJM-PWD-PWD-MEM-XLP-NAP-0001723) and site-specific environmental management plans.
- Project will be designed and constructed to comply with the requirements stipulated by the Catchment Management Authority (Melbourne Water) and Local Council requirements. Modelling based on the reference design shows compliance with the State Environment Protection Policy (Waters) that will protect beneficial uses of waterway and mitigate any significant impact to a human community from adverse water quality. The stormwater treatment system will be integrated into the design in accordance with the EPA Victoria Best Practice Environmental Management Guidelines for Urban Stormwater, as outlined in the MAR State Land Surface Water Assessment (MAR-AJM-PWD-PWD-MEM-XLP-NAP-0001723).
- A construction site environmental management plan should be developed and should include measures to contain and treat surface water runoff, to contain any accidental discharge to waterways and include a monitoring program that will enable reporting of potential impacts.
- During construction, soil disturbance including establishing access tracks and the construction footprint, should be minimised as much as possible. Areas to be impacted and protected should be clearly demarcated.
- Avoid disturbance to areas of instream or riparian vegetation/habitat as far as possible. Any habitat disturbed will be rehabilitated, and rehabilitated area monitored until appropriate vegetation is fully established.
- Design temporary and permanent in stream structures so they have negligible impact on scour an erosion.
- Construction stockpiles, machinery, roads, and other infrastructure placed away from waterways; and placed in previously cleared or hardstand areas wherever possible.
- To prevent chemical and fuel spills, chemical and fuel sources will be appropriately handled and stored well away from water courses. Spill kits will be available to clean up spills. Plant and equipment will be properly maintained and inspected daily to ensure there are no leaks.
- Use water sensitive urban design to capture and treat any stormwater captured in construction areas and in constructed areas following construction.
- Any waterways/ bodies to be excavated will require water quality monitoring to ensure construction works do not elevate physicochemical indicators above the relevant State Environment Protection Policy (Waters) levels.
- Avoid orientating access tracks parallel to direction of flow to reduce erosion.
- Design and implement scour protection works as required.
- Where possible attach any cabling, signalling and utilities to bridges to prevent further impacts to watercourses from trenching or boring.

6.2.3 Stream flows

The following mitigation measures are recommended to control potential impacts to hydrology during the construction and operation phases and are applicable to Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North during construction and operation.

- Design in-stream structures so they do not impact hydrology (See section 6.2.1)
- Implement BEPM in accordance with the MAR State Land Surface Water Assessment (MAR-AJM-PWD-PWD-MEM-XLP-NAP-0001723) and site-specific environmental management plans so hydrology is not affected
- Implement water sensitive urban design (e.g. stormwater wetlands) to mitigate changes to water inflows due to increased cover of impervious surfaces.

- Rehabilitate impacted areas so that natural surface flows are maintained.
- Avoid orientating access tracks parallel to direction of flow along watercourses, as they may create new flow paths.
- A construction site environmental management plan should be developed and should include measures to contain and treat surface water runoff.

6.2.4 Loss of riparian habitat

The following mitigation measures are recommended to control potential impacts to riparian vegetation and habitat during the construction phase and are applicable to Upper Stony Creek, Maribyrnong River, Steele Creek and Steele Creek North during construction and operation.

- If during the detailed design phase it is determined that scour protection is required at the Maribyrnong River below the safe work platform, the extent of scour protection should be minimised as far as possible. The proposed scour protection will be reviewed by aquatic and terrestrial ecologists to determine if it is appropriate.
- Avoid/minimise disturbance to areas of instream or riparian vegetation/habitat as far as possible.
- Clearly demarcate areas to be cleared and areas to be retained.
- During construction soil disturbance including establishing access tracks and the construction footprint, should be minimised as much as possible, and off road driving minimised.
- Construction stockpiles, machinery, roads, and other infrastructure placed in previously cleared or hardstand areas wherever possible.
- Rehabilitate cleared areas as soon as possible with suitable, indigenous vegetation. Rehabilitation should be monitored until appropriate vegetation has established, with supplemental planting undertaken as required.

6.3 MNES Impact Assessment

The potential impacts on threatened species and other MNES under the EPBC Act have been considered in general terms in this report. A more specific assessment is included in this section to determine whether the proposed project will have a significant impact on MNES under the criteria set by the Australian Government.

Under the EPBC Act, an action (i.e. a proposed project) will require approval from the Minister for the Environment if the action 'has, will have, or is likely to have, a significant impact on a matter of national environmental significance'. The "Matters of National Environmental Significance - Significant Impact Guidelines" are published by the Government to assist project proponents in deciding whether to submit a referral to the Government for a decision on whether assessment and approval is required under the EPBC Act. The guidelines help to determine whether a project will have a significant impact on a MNES and therefore whether referral is appropriate. The guidelines define a significant impact as "an impact which is important, notable, or of consequence, having regard to its context or intensity" (Department of Environment, 2013).

6.3.1 Significant impact assessment guidelines for MNES – Ramsar Wetlands

Guidelines exist for Wetlands of International Importance (Ramsar Wetlands), with specific criteria published to determine whether an impact is likely to be significant. A summary of these criteria, with assessment for this project, is presented in Table 6.5. As the closest section of the Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands Ramsar site (Point Cook) is located on the shoreline of Port Phillip Bay in a separate catchment to the project area, it is not likely to be impacted by the proposed works.

Table 6.5 Significant impact assessment – Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands.

Significant impact criteria	Risk (Likelihood of a significant impact) to MNES without measures	Mitigation measure(s)	Risk to MNES with mitigation measures
1. Areas of the wetland being destroyed or substantially modified	**Low** No wetland areas will be directly disturbed or destroyed by the project	Minimise any hydrological, water quality, or ecological impacts at the project site to avoid downstream impacts	**Low**
2. A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland	**Low** There is potential for minor, localised changes to flow at the work sites in the Maribyrnong River and Steele Creek. No persistent downstream changes to the hydrological regime in either waterway. PPBBPW Ramsar site hydrologically isolated from the impacted waterways.	Minimise flow effects at the site to avoid any downstream impacts	**Low**
3. The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	**Low** There will be no direct impact on wetland areas or species. Impacts at the site and indirect downstream impacts could affect species that migrate through the area and rely on both riverine and estuarine/coastal environments, for example Australian Grayling.	Minimise site impacts, particularly instream barriers that could affect the migratory requirements of species that use the river.	**Low**
4. A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health	**Low** There is some potential for the bridge construction to cause water quality issues associated with construction and operation runoff, particularly spills, and increased sediment runoff in the Maribyrnong River and Steele Creek and to a lesser extent Moonee Ponds Creek, Stony Creek, Kororoit Creek and Jones Creek. There is also potential for proposed bridge structures on Maribyrnong River and Steele Creek to cause localised changes to flow; if these result in increased erosion, the input of sediment could also lead to an increase in nutrient and pollutant inflow to Port Phillip Bay. Water Quality changes are likely to be low and can be readily managed with BEPM. Any changes in water quality will be insignificant in the context of natural variation and other catchment inputs.	Appropriate sediment, spills and runoff controls at the site to avoid any impacts to site water quality that could persist downstream.	**Low**
5. An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	**Low** Invasive plants present at the works site are unlikely to be spread to PPBBPW Ramsar site as a result of project	Manage sediment and erosion; weed propagules would be managed through the broader runoff management requirement.	**Low**

Significant impact criteria	Risk (Likelihood of a significant impact) to MNES without measures	Mitigation measure(s)	Risk to MNES with mitigation measures
	actions. No works are occurring in the wetland.		

Assuming that project construction is suitably managed and appropriate mitigation measures are implemented, the assessment shows that with the proposed construction options, impacts to the Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands Ramsar site can be appropriately controlled and any potential residual impacts are not expected to meet the criteria for Significant Impact under the EPBC Act assessment guidelines.

6.3.2 Significant impact assessment guidelines for MNES – Nationally Threatened Species

Australian Grayling are MNES listed under the EPBC Act. According to the review of existing species records and known species habitat and distribution, the Maribyrnong River is known to support Australian Grayling. Recommendations for mitigation during construction have assumed that these species are present and considered what measures would be required to minimise any impacts on these species.

Australian Grayling is found in the study area. As such an assessment of potential impacts on this fish species has been undertaken in accordance with the EPBC Significant Impact Assessment Guidelines (Table 6.6).

Table 6.6 Significant impact assessment – Nationally threatened species (Australian Grayling).

Significant impact criteria	Risk (Likelihood of a significant impact) to MNES without measures	Mitigation measure(s)	Risk to MNES with mitigation measures
1. Lead to a long-term decrease in the size of an important population of a species	**Low** Some temporary habitat disturbance may occur during construction. Any in-stream structures that represent a barrier to migration pose a risk to the local population. Destruction of fringing or instream vegetation or habitat could also impact the species. Along with other regional populations (i.e. Yarra River, Bunyip River) the Maribyrnong population is considered an important population (DELWP 2015). As the area to be affected is small and impacts are likely to be negligible, any local impacts are unlikely to impact the Maribyrnong population or other important local populations.	Maintain habitat and flow connectivity. Temporary and permanent instream structures will be designed and constructed to avoid creating or maintaining barriers to instream migration (e.g. by positioning piers and working platform outside the low flow channel). These barriers can be physical (i.e. bridge footings) or created indirectly by increasing flow velocity or gradient. Modelling conducted indicates that the proposed design will not meaningfully impact flow velocities or gradients. Avoid works creating the most noise and vibration (i.e. constructing piles and pile caps) during critical breeding and or migration periods for Australian Grayling (April-June, September - November).	**Low**
2. Reduce the area of occupancy of an important population	**Low** No permanent changes are expected to the species area of occupancy, provided that no barriers to migration result from the construction and that piers and platforms are located outside the low flow channel.	As above	**Low**

Significant impact criteria	Risk (Likelihood of a significant impact) to MNES without measures	Mitigation measure(s)	Risk to MNES with mitigation measures
	The works will not reduce the area of habitat available to the species to the extent that it would impact on the population of an important species.		
3. Fragment an existing important population into two or more populations	**Low** Instream structures have the potential to create barriers to migration that could result in lack of life cycle completion or permanent loss of upstream populations Works have the potential to result in a temporary barrier to movement, but will not result in a permanent barrier that would fragment an important population.	As above	**Low**
4. Adversely affect habitat critical to the survival of a species	**Low** Permanent impacts on habitat are expected to be restricted to the footprint of the pier and platform structures, with potential for some additional habitat loss for scour protection. In addition there will be some temporary impacts to fringing or instream vegetation and/or habitat elsewhere. Construction impacts are temporary and small in extent, and operational impacts are negligible. Habitat critical to the survival of the species will not be impacted.	The placement of these structures will be designed to minimise habitat loss. Bridge design (with piers outside of the low flow channel) and construction footprint will be as small as practical to minimise instream aquatic habitat loss. Footings and construction areas will be placed to minimise impacts to riparian vegetation which supports instream habitat.	**Low**
5. Disrupt the breeding cycle of an important population	**Low** Australian Grayling is likely to migrate through the project site. Any barriers to migration or impacts on suitable habitat or water quality in this area has potential to disrupt the breeding, spawning and migratory life cycle of this species. However works are temporary and permanent structures are located outside the low flow channel, and will not result in a long term impact on breeding cycles to the extent that an important population is disrupted or prevented from breeding.	Minimise instream structures and design with due consideration to avoiding creation of instream barriers Minimise impacts to water quality and other habitat values. The highest intensity activities (pile construction and capping) will be conducted outside Australian grayling breeding season at piers adjacent to the Maribyrnong River, thus reducing potential noise and vibration impacts.	**Low**
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Low** Minor impacts on habitat would be expected in the immediate site area. Instream structures have the potential to create barriers to migration that could result in lack of life cycle completion or permanent loss of upstream habitats for Australian grayling. Construction impacts are temporary and small in extent, and operational impacts are negligible. Therefore habitat availability and quality will not decline to the extent that the species is likely to decline	Minimise habitat loss in the site area through design, management and mitigation measures. Any habitat loss will be rehabilitated, except for the footprint of the piers, and at the Maribyrnong River Bridge the associated retaining wall and work platform. Any scour protection works at MRB developed during detailed design will be reviewed by aquatic and terrestrial ecologists and updated as required. Instream structures will be designed and constructed to	**Low**

Significant impact criteria	Risk (Likelihood of a significant impact) to MNES without measures	Mitigation measure(s)	Risk to MNES with mitigation measures
		avoid creating or maintaining barriers to instream migration	
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Low** Conditions are not expected to alter in such a way as to significantly favour invasive species. Invasive species are already known to be present in the river and the works will not increase their presence or change the nature of any current risks.	Avoid changes in condition that create favourable environment for invasive species. For example, manage sediment and water quality to ensure that dissolved oxygen does not drop; native species require minimum DO levels but some invasive species (e.g. Gambusia) can survive in near-anoxic conditions	**Low**
8. Introduce disease that may cause the species to decline, or interfere substantially with the recovery of the species.	**Low** Project not expected to result in introduction of disease affecting Australian Grayling		**Low**

Based on current available design information the proposed construction method for the Maribyrnong River bridge has been assessed and appropriate methods for mitigating risks have been identified. All methods avoid or minimise impacts on the aquatic environment, in particular, the Australian Grayling. If project construction is suitably managed and appropriate mitigation measures are implemented, the assessment shows that impacts to Australian Grayling can be appropriately controlled and any impacts are not expected to meet the criteria for Significant Impact under the EPBC Act assessment guidelines.

6.4 Impacts under Victorian legislation

6.4.1 Environment Effects Act 1978 Self-Assessment Criteria

The EE Act is relevant to the Project as it provides for the assessment of proposed projects that may have a significant effect on the environment. The Ministerial Guidelines under the EE Act provide the criteria used to determine whether a project warrants referral to the Minister for Planning. A project proponent is responsible for assessing whether its project will have potential adverse environmental effects that could be significant in a regional or State context.

As part of this Impact Assessment, consideration has been given to the criteria specifically relevant to aquatic ecology and geomorphology only to determine the potential extent of aquatic and geomorphology effects. The referral criteria relevant to this Impact Assessment and the associated response is provided in Table 6.7 below.

Criteria relevant to other environmental matters are addressed in the relevant impact assessment.

Table 6.7 Aquatic Ecology and Geomorphology Assessment of EE Act Referral Criteria for aquatic ecosystems and species

EE Act Self-Assessment Criteria	Aquatic Ecology and Geomorphology Response	Criterion for referral met?
Potential long-term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria.	The MAR State Land Aquatic Ecology and Geomorphology Impact Assessment concluded that one FFG Act and EPBC Act aquatic species is located in the study area (Australian grayling at the Maribyrnong River) and one FFG Act listed aquatic species has a moderate likelihood of regular occurrence in the study area (platypus at the Maribyrnong River). The project will not impact on the Maribyrnong River nor will result in the loss of a significant population of Australian grayling or platypus within Victoria. Some temporary habitat disturbance may occur during construction. Any in-stream structures that represent a barrier to migration pose a risk to the local populations. Destruction of fringing or instream vegetation or habitat could also impact these species. However, results of the assessment indicate that both construction and operation of the proposed new rail crossing on the Maribyrnong River will not result in a loss of habitat or impact on the populations of Australian grayling and platypus in the Maribyrnong River. See MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information regarding terrestrial species.	Criterion not met (for aquatic species)
Potential long-term change to the ecological character of a wetland listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'.	There are no Ramsar wetlands, Directory of Important Wetlands in Australian or mapped DELWP wetlands in the State Project Land, or in the vicinity of the State Project Land. The nearest downstream Ramsar wetland is the Port Phillip Bay (western shoreline) and Bellarine Peninsula Wetlands Ramsar site. This wetland is hydrologically isolated from waterways potentially impacted by Project and would not be impacted by the Project.	Criterion not met.
Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term.	Based on the assessment presented in this report, there is unlikely to be any extensive or major impacts on the health or biodiversity of aquatic (freshwater, estuarine or marine) ecosystems over the short or long term. In summary: • The extent of temporary and permanent aquatic and riparian habitat loss will be small. • Any instream structures are located outside the low flow channel, and hydrological modelling indicates they will not meaningfully impact flow rates and shear stresses during higher flows. • With appropriate mitigation measures, water quality and hydrology will not be meaningfully impacted during construction and operation as a result of the project.	Criterion not met.

Matters listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act): i) potential loss of a significant area of a listed ecological community; or ii) potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or iii) potential loss of critical habitat; or potential significant effects on habitat values of a wetland supporting migratory bird species.	**Potential Loss of a Listed Threatened Ecological Community** There are no listed aquatic ecological communities in the project area. See MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information regarding terrestrial threatened ecological communities. **Potential loss of a genetically important population of a threatened species** Australian grayling are recorded widely across southern Victoria. The Maribyrnong River population is part of the broader Yarra River and Western Port Bay (Cardinia Creek, Bunyip River, Lang Lang river populations) population identified within the Port Phillip and Westernport Catchment. The assessment concludes that the project will not impact on the Maribyrnong River Australian grayling population or on populations more broadly across Victoria. Platypus are recorded widely across Victoria. It is likely that the core Maribyrnong River population(s) are located >10 km upstream of the MRB in Deep and Jacksons creeks, with a small number of individuals dispersing downstream from these core areas. The assessment concludes that the project will not impact on the Maribyrnong River platypus population or on populations more broadly across Victoria. Hence, there will no loss of a genetically important population of an endangered or threatened aquatic species. See MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information regarding terrestrial species. **Potential loss of critical habitat and potential significant effects on habitat values of a wetland supporting migratory bird species** No DELWP mapped wetlands occur in the Project Area. Migratory bird species have potential to occur in the general region. However, it is considered the habitats in the Project Area do not provide critical habitat for any migratory bird species. See MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information.	Criterion not met (for aquatic species and ecological communities)

6.4.2 Flora and Fauna Guarantee Act 1988

The FFG Act provides for the assessment of proposed projects (works) that can have a significant effect on the environment. An assessment against the relevant criteria for determining potential impacts to aquatic ecosystems (through threatening processes) and listed aquatic species under this act is provided in Table 6.8. The assessment concluded that criterion under this act are not met in relation to impacts to aquatic ecosystem or aquatic threatened species in Victoria.

Table 6.8 Impact assessment for aquatic ecosystems and aquatic species threatened in Victoria under the FFG Act

Criteria	Assessment
Flora and Fauna Guarantee Act	
Threatened communities of flora and fauna	There are no threatened communities of aquatic flora or fauna in the project area
Threatened species	One FFG Act and EPBC Act aquatic species is located in the study area (Australian grayling in Maribyrnong River) and an FFG Act listed species has a moderate likelihood of regular occurrence in the project area (platypus in Maribyrnong River). Some temporary habitat disturbance may occur during construction and small areas of riparian habitat will be permanently lost. Any in-stream structures that represent a barrier to migration pose a risk to the local population. Destruction of fringing or instream vegetation or habitat could also impact these species. However, results of the assessment indicate that both construction and operation of the proposed new rail crossing on the Maribyrnong River will not result in a meaningful loss of habitat or impact on the populations of Australian grayling and platypus in the Maribyrnong River The assessment concludes that the project will not impact on the Maribyrnong River and will not result in the loss of a significant population of Australian grayling or platypus within Victoria.
Threatening processes	There is potential for seven threatening processes that could impact on aquatic ecosystems as a result of construction works within the project area: • Increase in sediment input into Victorian rivers and streams due to human activities; • Invasion of native vegetation by CaLP listed noxious weeds; • Input of toxic substances into Victorian rivers and streams; • Habitat fragmentation as a threatening process for fauna in Victoria; • Invasion of native vegetation by environmental weeds; • Degradation of native riparian vegetation along Victorian rivers and streams; and • Prevention of passage of aquatic biota by instream structures. Any impacts associated with these threats will be managed through pier and platform design and location (outside of waterways), drainage design to meet best practice stormwater runoff requirements and through construction management to mitigate construction risks associated with sediment runoff to waterways and accidental spills.
Protected flora	No protected aquatic flora was detected in the study area. See MAR State Land Terrestrial Ecology Impact Assessment MAR-AJM-PWD-PWD-REP-XEV-NAP-0001710 for further information.

7. Conclusion

Waterways in the study area support a range of ecological values, including the threatened Australian grayling (EPBC Act and FFG Act listed) and platypus (FFG Act listed) in the Maribyrnong River.

Direct impacts to waterways could occur at waterway crossing (Maribyrnong River, Steele Creek, Upper Stony Creek) where new infrastructure is being built and more broadly across a number of other waterways that may be receiving waterways for stormwater runoff along the rail corridor (Moonee Ponds Creek, Stony Creek, Kororoit Creek).

An assessment of the designs for waterway crossings (pier locations), construction methods, stormwater drainage principles and operations has shown that risks to aquatic habitats, threatened species and water quality are all likely to be low. Specifically:

- Waterway crossings will be designed with piers located outside of the river channel so that there will be no temporary or permanent change to the low-flow channel itself, including no new instream structures that could result in the loss of habitat or block fish passage. While new and replacement crossings and associated structures will be located in the high flow channel and/or floodplain, modelling indicates that they will have no or negligible impact on flows and will not result in the loss of aquatic habitat or block fish passage.
- Construction methods will be designed to limit direct impacts on waterways and hydraulic modelling shows that there is no significant increase in water levels, velocity or stream power (either during construction or operation) that would increase the risk of unacceptable erosion or scour of stream bed and banks.
- Stormwater drainage designs will be in accordance with best practice management guidelines and to the approval of relevant authorities such that water quality during the operations phase will not pose an increased risk to aquatic values.

A specific assessment against Matters of National Environmental Significance (EPBC Act) and Victorian FFG Act and EE Act criteria shows that provide the above design, construction and operational mitigation measures are adopted there is a low level of risk to MNES (Ramsar wetlands and Australian grayling) and that criteria for impact under the FFG Act and EE Act in relation to aquatic ecology, waterway health, aquatic threatened species (Australian grayling and platypus) and threatening processes that could impact on waterways are not triggered.

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APPENDIX A
PMST SEARCH RESULTS

Appendix A PMST Search Outcomes

Table A.1 Outcomes of Protected Matters Search for aquatic ecology values in the State Project Land.

Waterway	Dwarf Galaxias	Australian grayling	Murray Cod	Wetlands of international importance
State Project Land				
Maribyrnong River	Species or species habitat **likely** to occur	Species or species habitat **known** to occur	Species or species habitat **may** occur	Port Phillip Bay (Western shoreline) and Bellarine Peninsular Ramsar site (downstream)
Steele Creek	Species or species habitat **likely** to occur	Species or species habitat **may** occur	Species or species habitat **may** occur	
Moonee Ponds Creek	Species or species habitat **likely** to occur	Species or species habitat **may** occur	Species or species habitat **may** occur	
Kororoit Creek and Jones Creek	Species or species habitat **likely** to occur	Species or species habitat **may** occur	Species or species habitat **may** occur	Port Phillip Bay (Western shoreline) and Bellarine Peninsular Ramsar site (downstream)
Stony Creek	Species or species habitat **likely** to occur	Species or species habitat **may** occur	Species or species habitat **may** occur	Port Phillip Bay (Western shoreline) and Bellarine Peninsular Ramsar site (downstream)

APPENDIX B
VBA SEARCH RESULTS

Appendix B VBA Search

Table B.1 VBA and platypus Spot extract from waterways within the study area likely to be impacted by works associated with a new bridge crossing in the State Project Land.

Scientific Name	Common Name	Origin	conservation status		Maribyrnong River	Steels Ck	Moonee Ponds Ck	Kororoit Ck	Stony Ck
			EPBC	FFG					
Fish									
Anguilla australis	Southern Shortfin Eel	Native			2015	2008	2009	2009	
Cyprinus carpio	European Carp	Exotic			2004			2009	
Galaxias maculatus	Common galaxias	Native			2015	2008	2009	2009	2009
Galaxias ornatus	Ornate mountain galaxias	Native			2004				
Gambusia holbrooki	Eastern Gambusia	Exotic			2015		2009	2009	2009
Macquaria colonorum	Estuary Perch	Native			2009				
Maccullochella peelii peelii	Murray cod	Native	Vu	En	1981				
Misgurnus anguillicaudatus	Oriental Weatherloach	Exotic			2015	2008			
Perca fluviatilis	Redfin	Exotic			2015			2009	
Philypnodon grandiceps	Flathead Gudgeon	Native			2015		2009	2009	
Prototroctes maraena	Australian grayling	Native	Vu	En	2015				
Pseudaphritis urvillii	Congolli	Native			2015				
Retropinna semoni	Australian Smelt	Native			2009			2009	
Rutilus rutilus	Roach	Exotic			2015				
Salmo trutta	Brown Trout	Exotic			1996				
Tinca tinca	Tench	Exotic			2009			2009	
Mammals									
Ornithorhynchus anatinus	Platypus	Native		Vu	1998				
Hydromys chrysogaster	Rakali	Native					2009		
Reptiles									
Chelodina longicollis	Eastern snake-neck Turtle	Native					2009	2009	

L – denotes that a species is listed as threatened, Vu – denotes that a species is listed as vulnerable, En denotes that a species is listed as endangered

APPENDIX C
HYDRAULIC MODELLING – STEELE CREEK

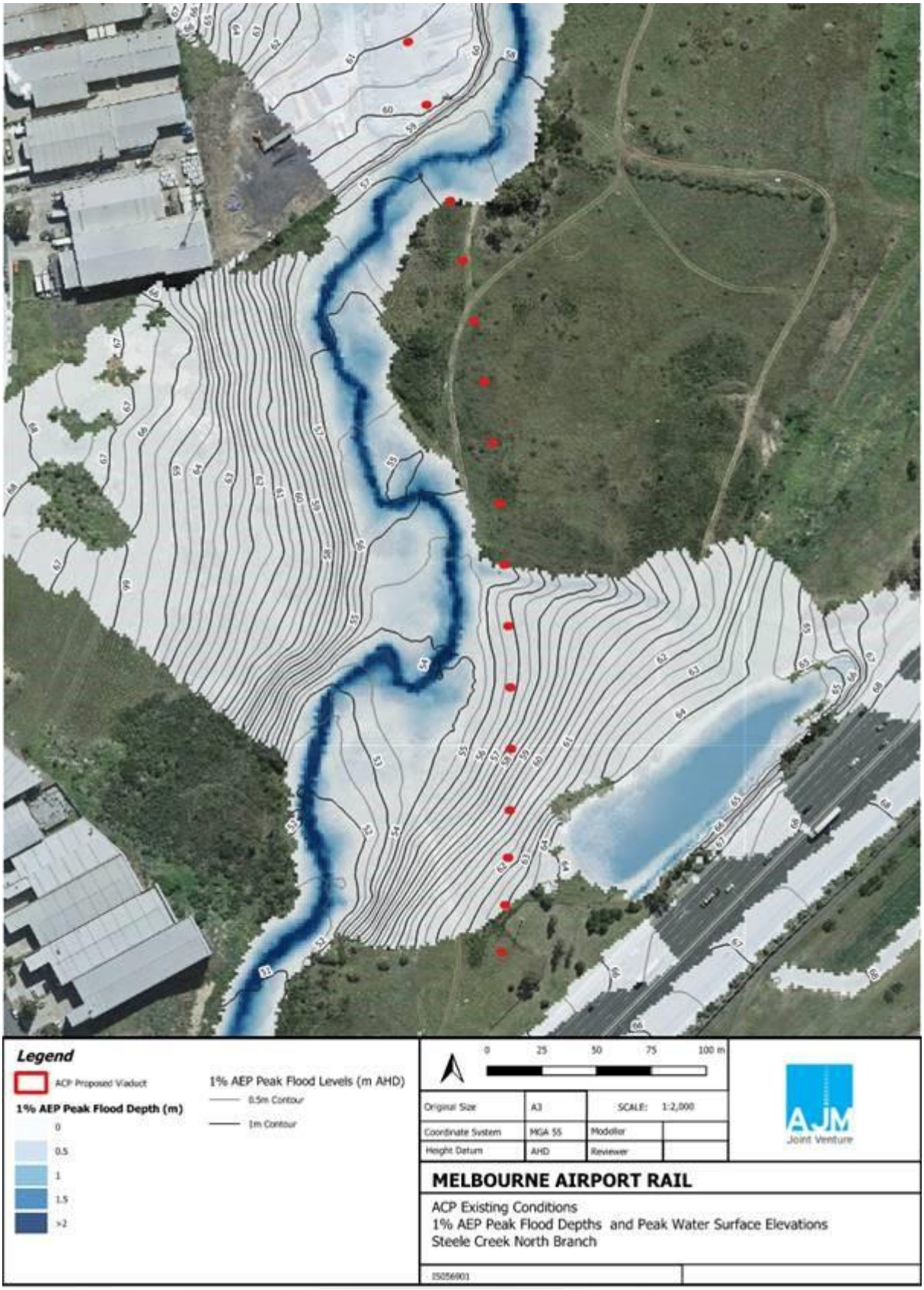

Figure C.1 Steele Creek North Branch 1% AEP peak flood depths and peak water surface elevations. Position of proposed aqueduct piers also shown on map.

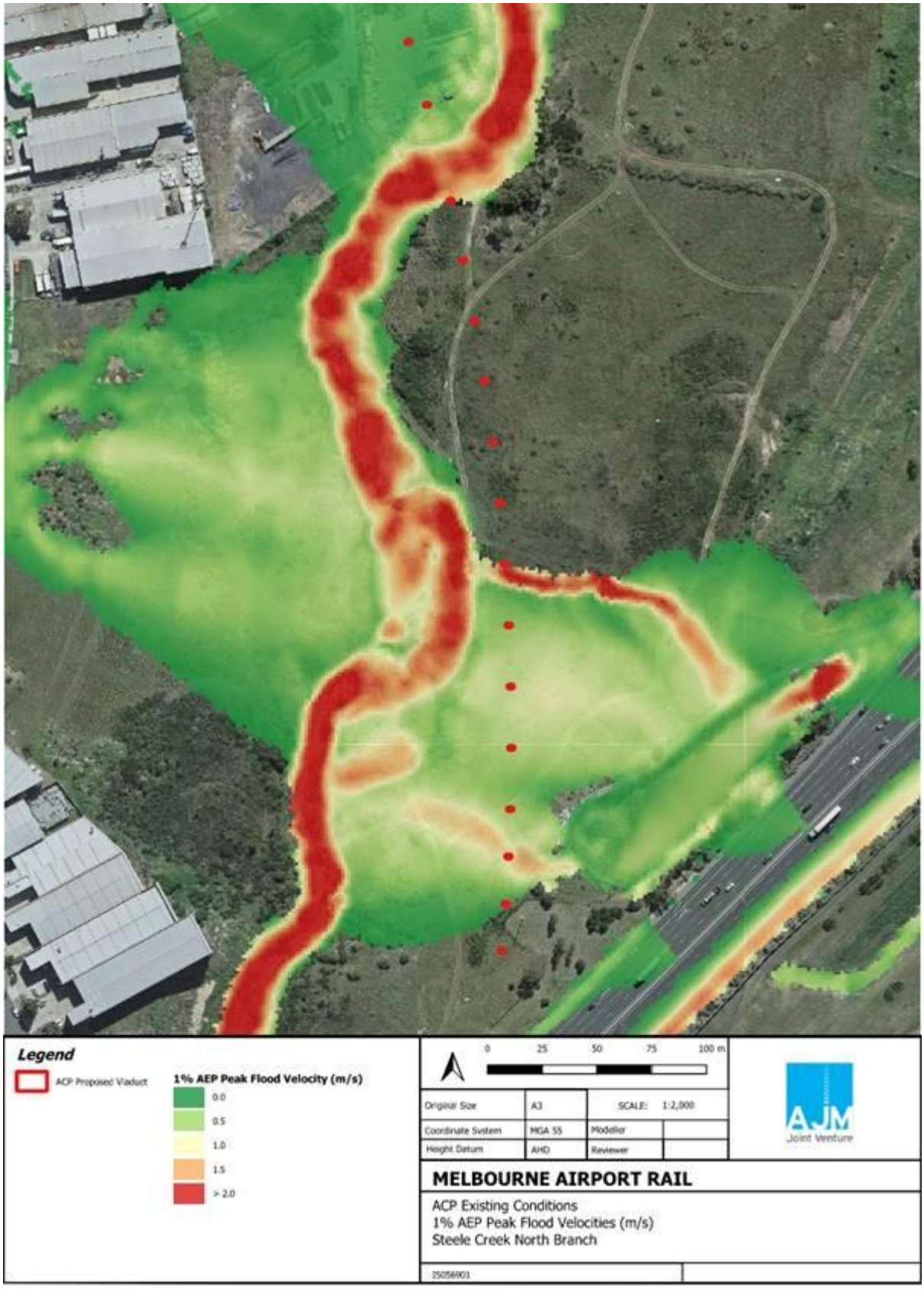

Figure C.2 Steele Creek North Branch 1% AEP peak flood velocities. Position of proposed aqueduct piers also shown on map.

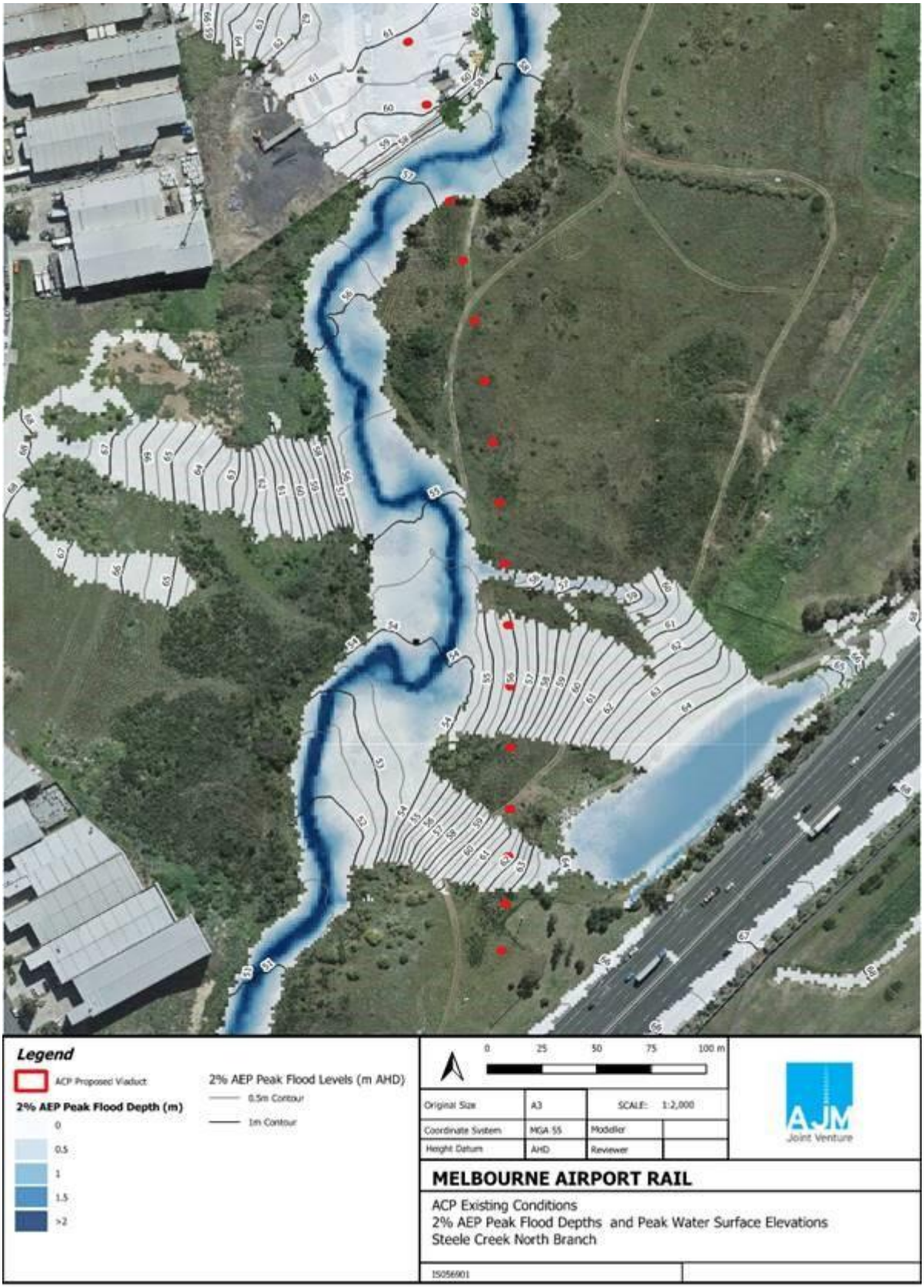

Figure C.3 Steele Creek North Branch 2% AEP peak flood depths and peak water surface elevations. Position of proposed aqueduct piers also shown on map.

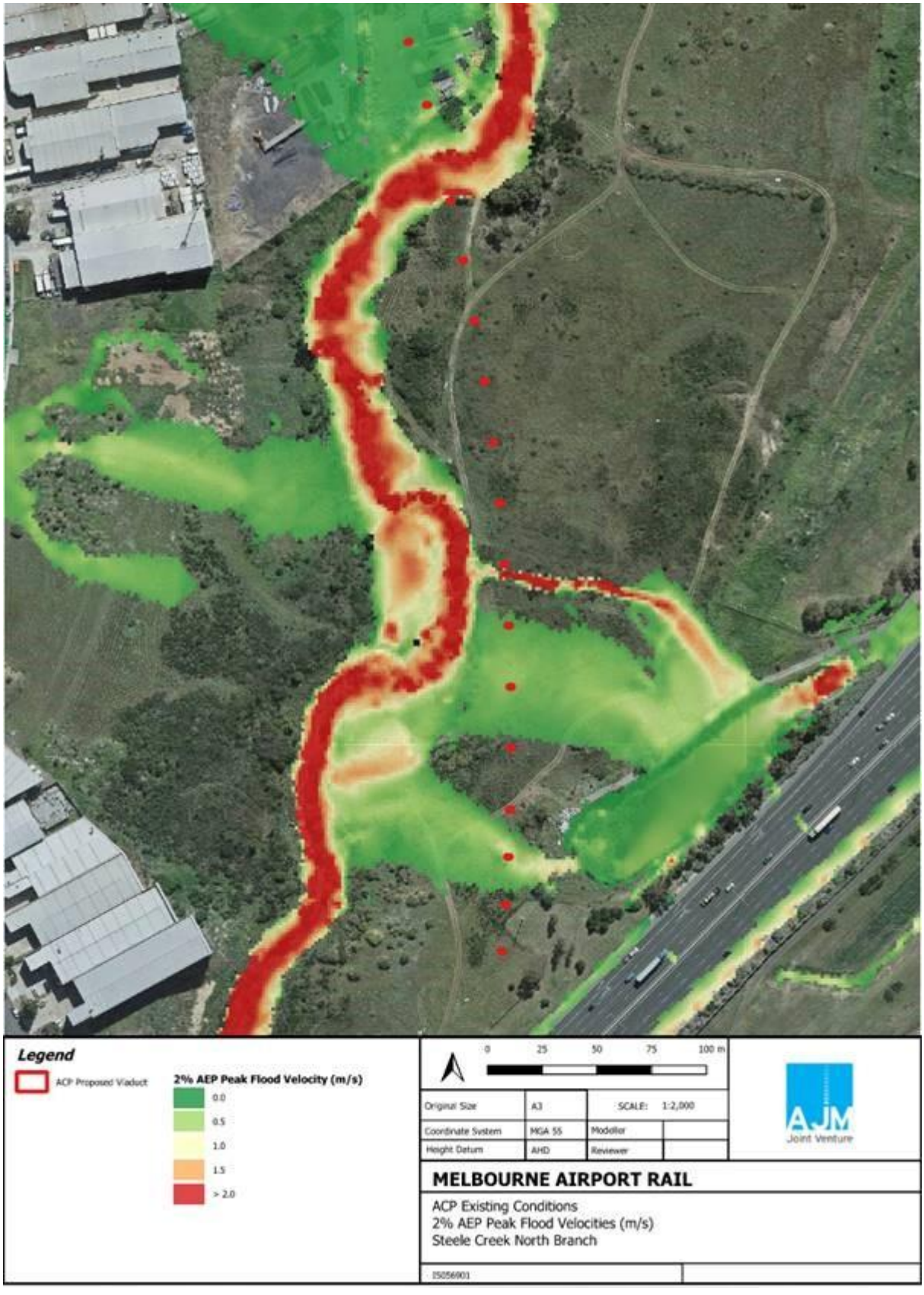

Figure C.4 Steele Creek North Branch 2% AEP peak flood velocities. Position of proposed aqueduct piers also shown on map.

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