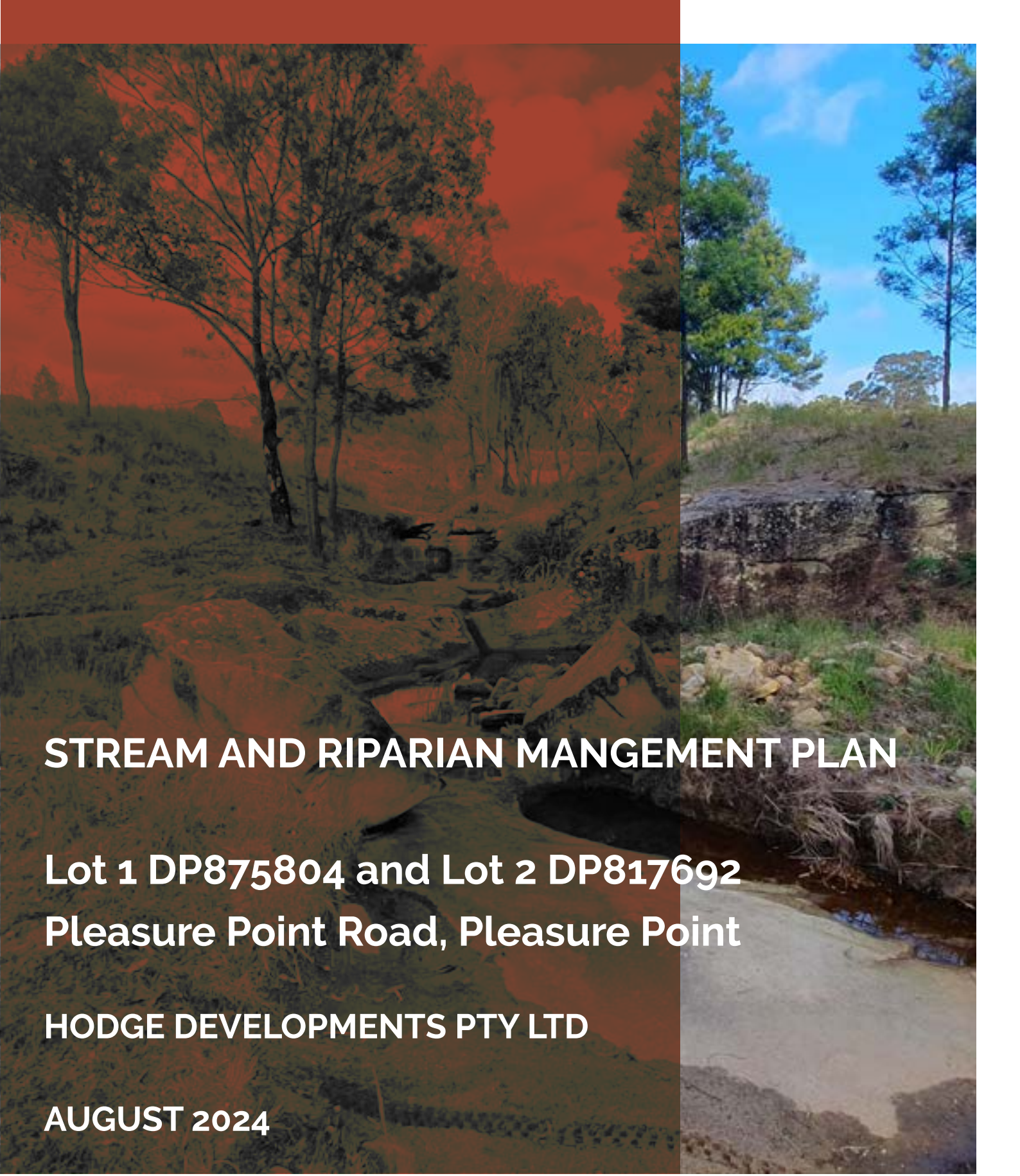




STREAM AND RIPARIAN MANAGEMENT PLAN

**Lot 1 DP875804 and Lot 2 DP817692
Pleasure Point Road, Pleasure Point**

HODGE DEVELOPMENTS PTY LTD

AUGUST 2024



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Document Control Sheet

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Table of Contents

EXECUTIVE SUMMARY	IV
1.0 INTRODUCTION	1
1.1 DEVELOPMENT DESCRIPTION	1
1.2 COUNCIL REQUIREMENTS	2
2.0 WATERCOURSE ASSESSMENT	4
2.1 EXISTING WATERCOURSES	4
2.1.1 NSW Topographic Maps	4
2.1.2 Aerial Imagery	5
2.1.3 Site Inspection.....	7
2.1.4 Site Survey	11
2.1.5 Existing Riparian Corridor Assessment Results.....	13
2.2 PROPOSED RIPARIAN CORRIDORS	14
2.3 ADOPTED WATERCOURSE	14
3.0 RIPARIAN ASSESSMENT	16
3.1 TOP OF BANK ASSESSMENT.....	16
3.1.1 Existing Watercourse Top of Bank	16
3.1.2 Proposed Watercourse	17
3.2 RIPARIAN CORRIDOR.....	19
3.2.1 VRZ Offsets	21
4.0 STREAM AND RIPARIAN MANAGEMENT	23
4.1 EXISTING CREEK CHANNELS AND VEGETATION	23
4.2 CHANNEL MODIFICATION WORKS / LONGITUDINAL SECTION	23
4.3 SEQUENCING OF WORKS	24
4.4 STREAM CONVEYANCE	24
4.5 MODIFIED DRAINAGE SYSTEM AND REACHES.....	24
4.5.1 First Order Watercourses	24
4.5.2 Second Order Watercourse - Existing	24
4.5.3 Second Order Watercourse - Proposed	25
4.6 VEGETATION MANAGEMENT PLAN.....	27
5.0 CONCLUSION	28

APPENDIX A – SITE PHOTOS

Executive Summary

ADW Johnson have been engaged by Hodge Developments Pty Ltd to provide professional civil engineering services for a proposed residential development located in Pleasure Point.

This report has been prepared to address Liverpool City Council's requirement for the preparation of Stream and Riparian Management Plan (SRMP) to accompany a Concept Development Application (CDA) DA under s4.22 of the EP&A Act that seeks consent for:

1. A Concept Approval that stipulates for the future subdivision including the general arrangement of roads, works to and dedication of public open space, riparian corridors, and delivery of stormwater infrastructure for the parcel of land comprising both Lot 1 DP875804 and Lot 2 DP817692, and
2. Stage 1 of the residential development on part of Lot 1 DP875804 including subdivision of the land in 7 stages, construction of the associated roads and intersections, dedication of part of an environmental corridor, landscaping and vegetation management works together with stormwater infrastructure to be provided on both Lot 1 DP875804 and Lot 2 DP817692 that will benefit the entire subdivision identified in the Concept Development Application.

The remaining part of Lot 1 DP875804 not included in Stage 1 and the subdivision of Lot 2 DP817692 will be the subject of one or more subsequent development application(s).

Prior to preparing the stream and riparian management plan, an assessment was undertaken to identify the watercourses required to be included in the plan. The following methods were utilised to identify watercourses on site:

- NRAR E tool – this tool identified two mapped first order watercourses and a mapped second order watercourse;
- Aerial imagery;
- Site inspection; and
- Detail site survey.

Upon review of the aerial imagery, site inspection and detailed survey, it was concluded that the two mapped first order watercourses did not display key features of a defined channel bed or banks and therefore they were discounted as watercourses and not considered in the SRMP.

The above-mentioned methods were also used to ground truth the second order watercourse to accurately identify its location. The final watercourses considered in the SRMP can be seen in **Figure E1** overleaf.

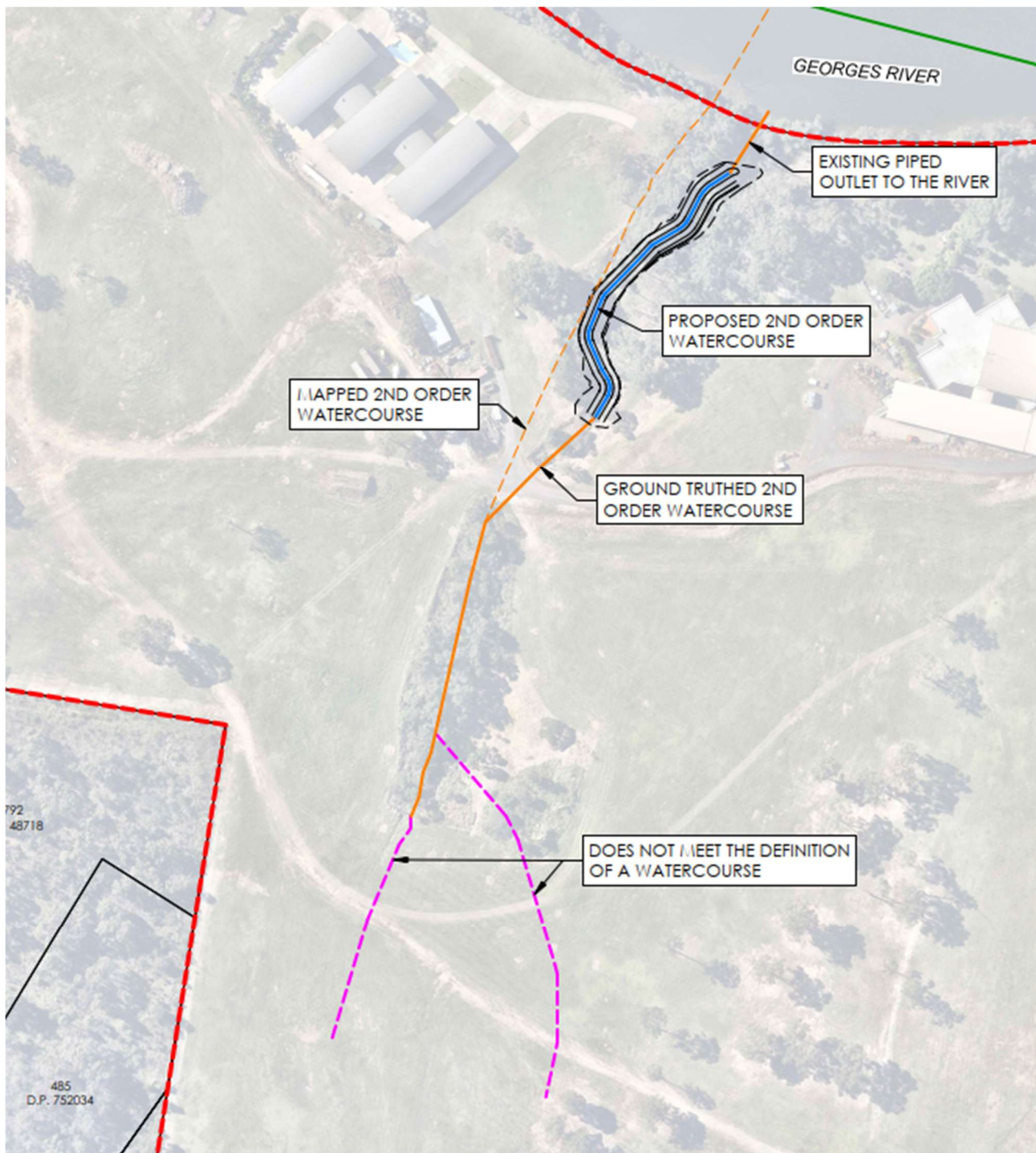


Figure E1: Adopted Watercourse

The second order watercourse did not exhibit a defined bed or banks all the way to the river and therefore it is proposed to construct a new channel through the foreshore area to provide a continuous defined drainage channel between the central corridor and the river.

The river and foreshore area are sensitive ecological areas, being identified as proximity area to a Coastal Wetland and key fish habitat. The proposed channel was therefore designed to stop short of the ecologically sensitive areas along the edge of the Georges River foreshore to preserve the estuarine vegetation and natural habitat.

Key vegetation and habitats in and around the channel are identified within the Biodiversity Development Assessment Report (BDAR) prepared by AEP. The BDAR identifies that a large portion of the riparian area of the upstream section of the adopted watercourse are void of significant vegetation. The lower reaches, associated with the area of the proposed channel are more vegetated with works requiring the removal of up to four trees.

A Vegetation Management Plan (VMP) has been prepared by Restore Environmental Consultants. The VMP outlines works proposed to enable the restoration of existing ecological communities along with the revegetation of key areas. The works proposed under the VMP will result in an improved vegetation outcome over the watercourse and foreshore areas.

Through the channel design and the works proposed under the VMP it is concluded that the proposed development will result in a significantly improved ecological outcome for the channel and foreshore areas.

1.0 Introduction

ADW Johnson have been engaged by Hodge Developments Pty Ltd to provide professional civil engineering services for a proposed residential development located in Pleasure Point.

This report has been prepared to address Liverpool City Council's requirement for the preparation of Stream and Riparian Management Plan to accompany a Concept Development Application (CDA) DA under s4.22 of the EP&A Act that seeks consent for:

1. A Concept Approval that stipulates for the future subdivision including the general arrangement of roads, works to and dedication of public open space, riparian corridors, and delivery of stormwater infrastructure for the parcel of land comprising both Lot 1 DP875804 and Lot 2 DP817692, and
2. Stage 1 of the residential development on part of Lot 1 DP875804 including subdivision of the land in 7 stages, construction of the associated roads and intersections, dedication of part of an environmental corridor, landscaping and vegetation management works together with stormwater infrastructure to be provided on both Lot 1 DP875804 and Lot 2 DP817692 that will benefit the entire subdivision identified in the Concept Development Application.

The remaining part of Lot 1 DP875804 not included in Stage 1 and the subdivision of Lot 2 DP817692 will be the subject of one or more subsequent development application(s).

1.1 DEVELOPMENT DESCRIPTION

The site, which is described as Lot 1 DP875804 and Lot 2 DP817692, is located on the corner of Pleasure Point Road and Heathcote Road, Pleasure Point, within the Liverpool City Council (LCC) local government area (LGA).

The ultimate development proposes:

- The creation of 462 low density residential allotments;
- Public open space areas, including the dedication of C3 and RE1 land to LCC;
- Construction of a new intersection at Pleasure Point and Heathcote Roads;
- Planting and revegetation of existing onsite drainage corridors; and
- Associated roads and services infrastructure.

The location of the development site can be seen in **Figure 1** below.



Figure 1: Proposed Development Site

1.2 COUNCIL REQUIRMENTS

The development of the site is subject to the controls of LCC DCP 2008 Part 2.13 – Pleasure Point (the DCP). Section 2.8 of the DCP covers Stormwater Quantity and Quality management, and aims to meet the following objectives:

- To provide an urban water management system for both stormwater quantity and quality;
- To minimise hydrological impacts on the environment;
- To protect and enhance the natural water systems and water quality;
- To manage floods, attenuate flows and maximise integration of Water Sensitive Urban Design strategies where appropriate;
- To ensure no net increase in peak discharges exiting the site;
- To mitigate flood damage to the built environment, inundation of dwellings and stormwater damage to properties;
- To provide an urban water management system that will be economically maintained and to ensure that arrangements are in place for on-going maintenance.

As part of the DCP controls, LCC require the preparation of a Stream and Riparian Management Plan (SRMP) in conjunction with a Water Cycle Management Plan (WCMP). It is noted that ADW Johnson has prepared a WCMP under separate cover, with the key elements applicable to this report being referenced as required.

This SRMP is to generally include the following elements:

- Plans showing existing creek channels, creek vegetation (including remnant native vegetation) geomorphic features and aquatic habitats;
- Detailed plans of any channel modification and stabilisation works;
- A longitudinal stream survey section (if stream works are proposed) of the existing and proposed creek channel bed in sufficient detail to identify any changes in bed level and hydraulic features;
- Details on the staging and sequencing of any works within the creek zone;
- Recommendations on how to address the modified drainage system and reaches;
- A Vegetation Management Plan.

It is noted that the DCP requires the SRMP to be prepared in conjunction with NRAR and Liverpool City Council. Therefore, this report can be considered a first draft for comment and coordination with Council and NRAR.

This report should be read in conjunction with the following reports:

- Biodiversity Development Assessment Report (BDAR) – prepared by AEP;
- Vegetation Management Plan (VMP) – Prepared by Restore Environmental Consultants;
- Water Cycle Management Plan (WCMP) – prepared by ADW Johnson.

2.0 Watercourse Assessment

Prior to preparing the SRMP an assessment has been undertaken to determine the actual watercourses, and associated riparian areas, that are required to be assessed under the SRMP guidelines.

Generally, for a channel to be considered a watercourse, it is required to exhibit the key features of a defined channel bed and banks. If these features are not present then typically it is considered a drainage gully and not a watercourse.

It is noted that the Georges River is a mapped watercourse, however as no works are proposed to the Georges River it is not considered further in this report.

2.1 EXISTING WATERCOURSES

The following sections of this report outline the methodologies used to identify channels that meet the definition of a watercourse.

2.1.1 NSW Topographic Maps

The NRAR Waterfront Land Tool maps were interrogated to identify any existing mapped watercourses on the site. The maps indicate that there are currently three mapped watercourses on the site.

In accordance with NRAR guidelines, each water course is to be assigned a stream classification based upon the Strahler system. The Strahler system is outlined in **Figure 2** below.

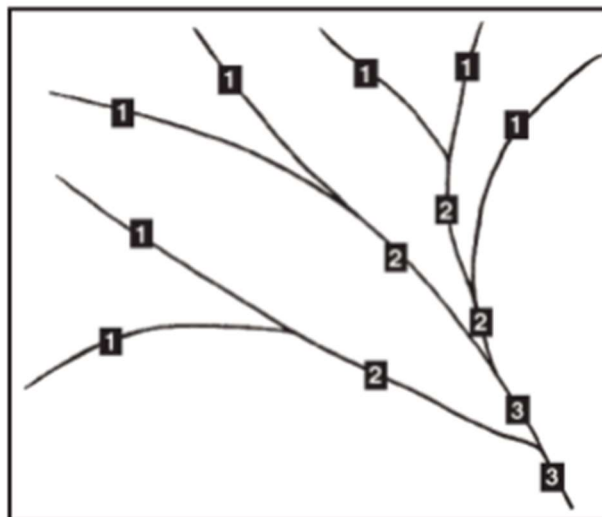


Figure 2: Strahler System

The Strahler system was utilised to assign a classification to each of the mapped watercourses. The watercourses and their classifications can be seen in **Figure 3** overleaf.

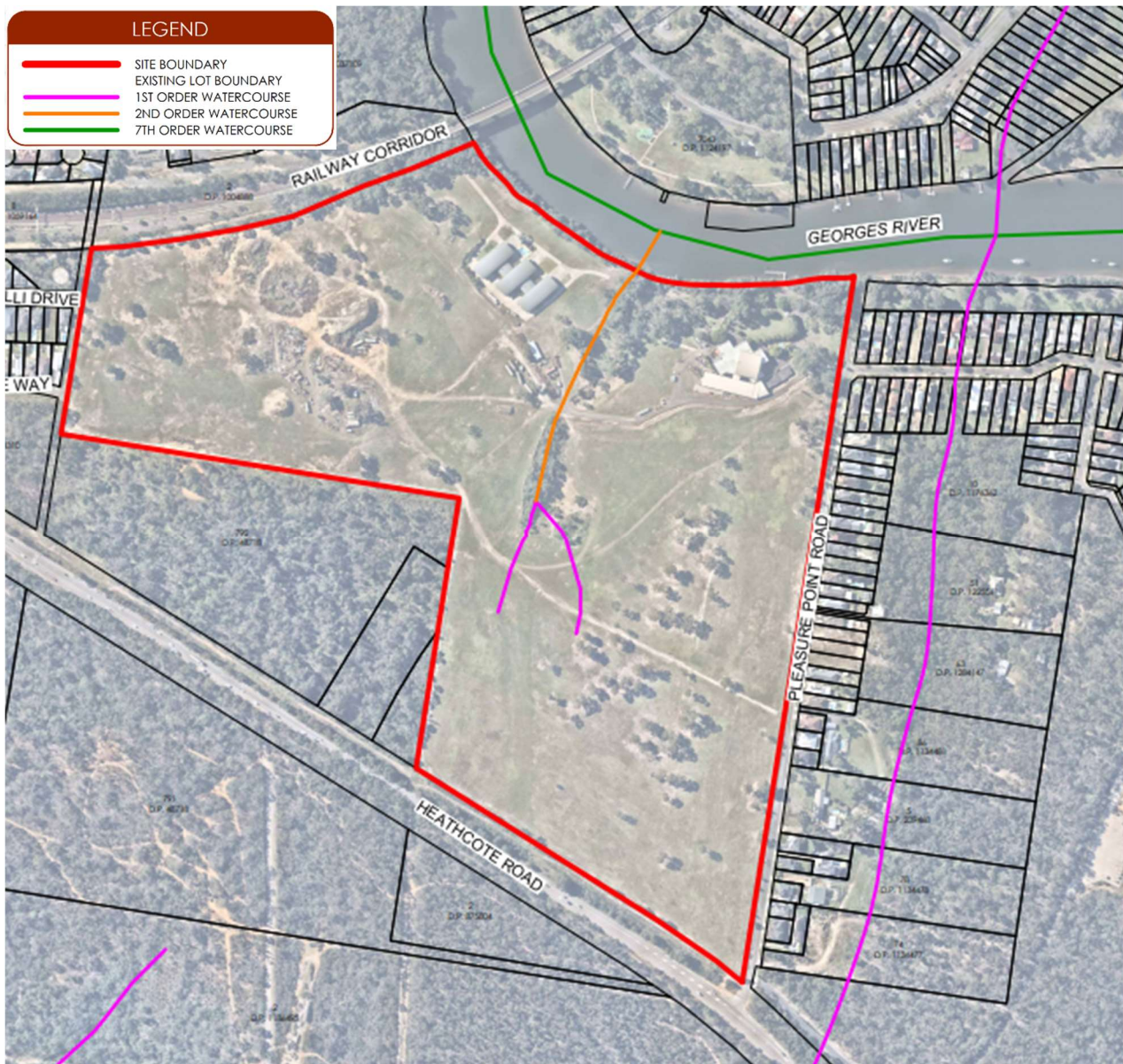


Figure 3: Mapped Watercourses

The NRAR “Guidelines for riparian corridors on waterfront land” document states “where a watercourse does not exhibit the features of a defined channel with bed and banks, the department may determine that the watercourse is not waterfront land for the purposes of the WM Act”. Accordingly, the following sections of the report outline the methodologies undertaken to confirm if there is the presence of defined bed and banks for each of the mapped watercourses.

2.1.2 Aerial Imagery

Nearmap imagery was reviewed to determine if clear bed and banks could be seen in the location of the identified watercourses. The imagery, at the location of each watercourse can be seen in **Figures 4 and 5** respectively.

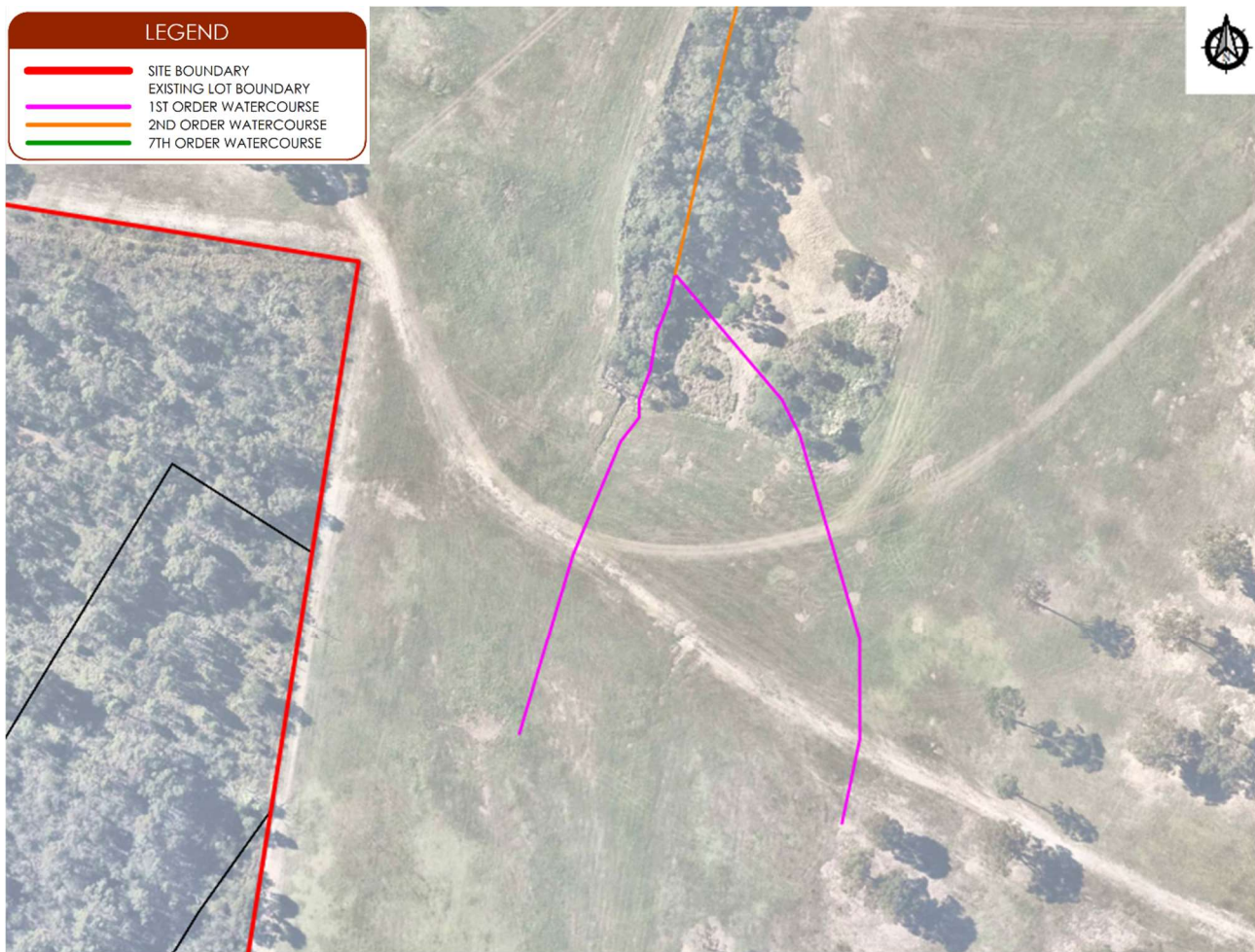


Figure 4: Mapped First Order Watercourse Aerial Overlay

It can be seen from **Figure 4** that there are no defined bed or banks in the location of the two first order streams.



Figure 5: Mapped Second Order Watercourse Aerial Overlay

Figure 5 shows that bed and banks, along with significant areas of vegetation, are visible in and around the location of the upper reaches of the second order watercourse. The bed and banks seem to dissipate downstream of the existing culvert crossing.

2.1.3 Site Inspection

A site inspection was undertaken by a registered surveyor on the 31st July 2024 in which the location of the watercourses was walked and numerous photographs taken. Key photographs of each of the watercourse areas can be seen in **Figures 7 – 13** below, whilst all photos taken during the inspection can be seen in **Appendix A**.



Figure 6: Current Outlet to Georges River (slightly east of mapped watercourse)



Figure 7: Looking Upstream along Second Order Watercourse South of Existing Culverts



**Figure 8: Looking Downstream at end of Formed Channel
(note - the watercourse formation disappears)**



Figure 9: Existing Culverts



Figure 10: Looking Upstream along Second order Blue Line – north of existing culverts



Figure 11: Looking Upstream from top of Second order Blue Line



Figure 12: Looking Downstream along Location of Western First order Blue Line



Figure 13: Looking Downstream along Eastern First order Blue Line

2.1.4 Site Survey

A detailed site survey was undertaken on the 15th March 2024. The detail survey covered the entirety of the subject site, including the areas associated with the mapped watercourses.

Extracts of the detail survey in the location of each watercourse can be seen in **Figures 14 and 15** below.

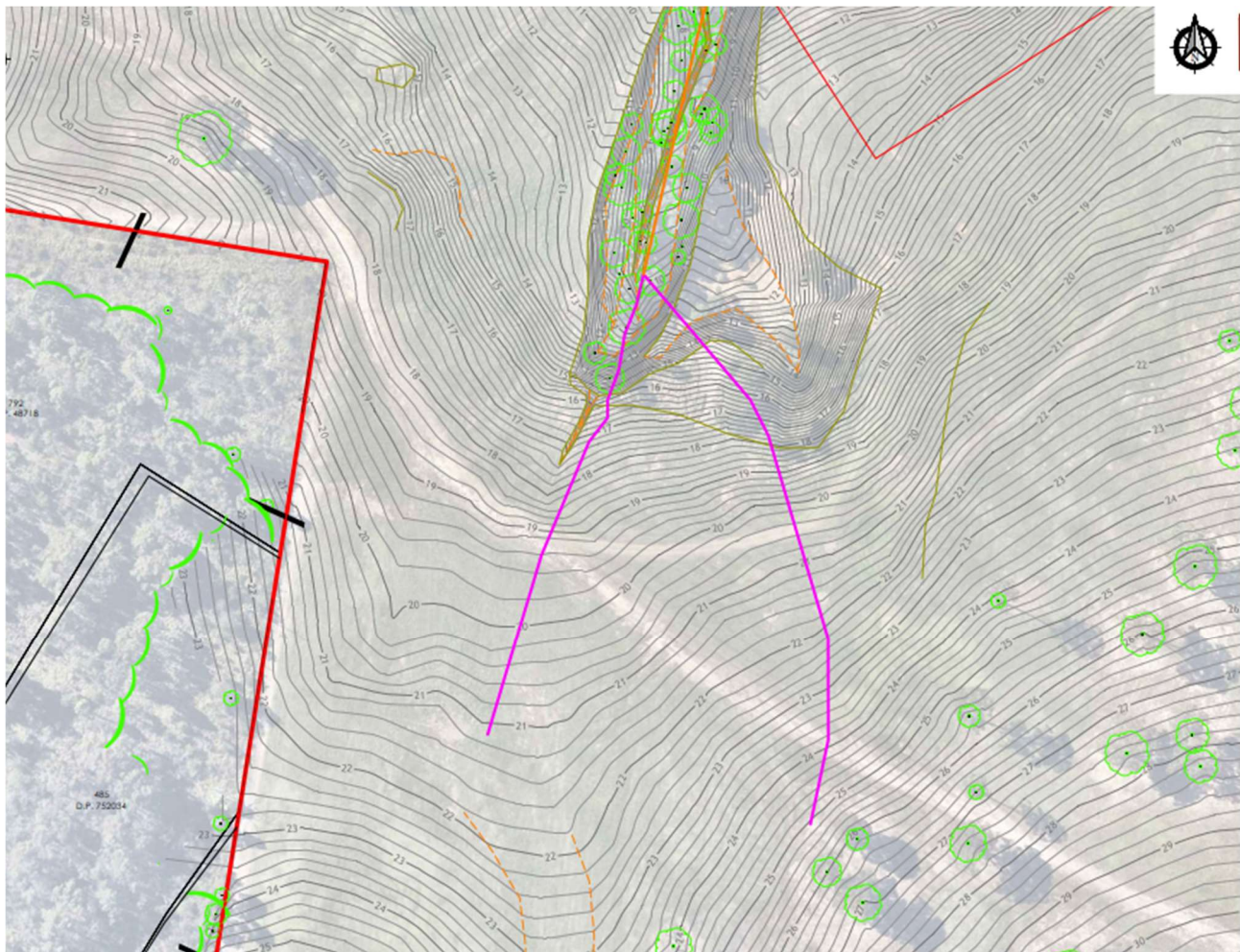


Figure 14: Mapped First order Watercourse Survey Overlay

It can be seen from **Figure 14** that the site survey matches the findings from the site inspection, with no visible bed or banks within the vicinity of the mapped first order watercourses.

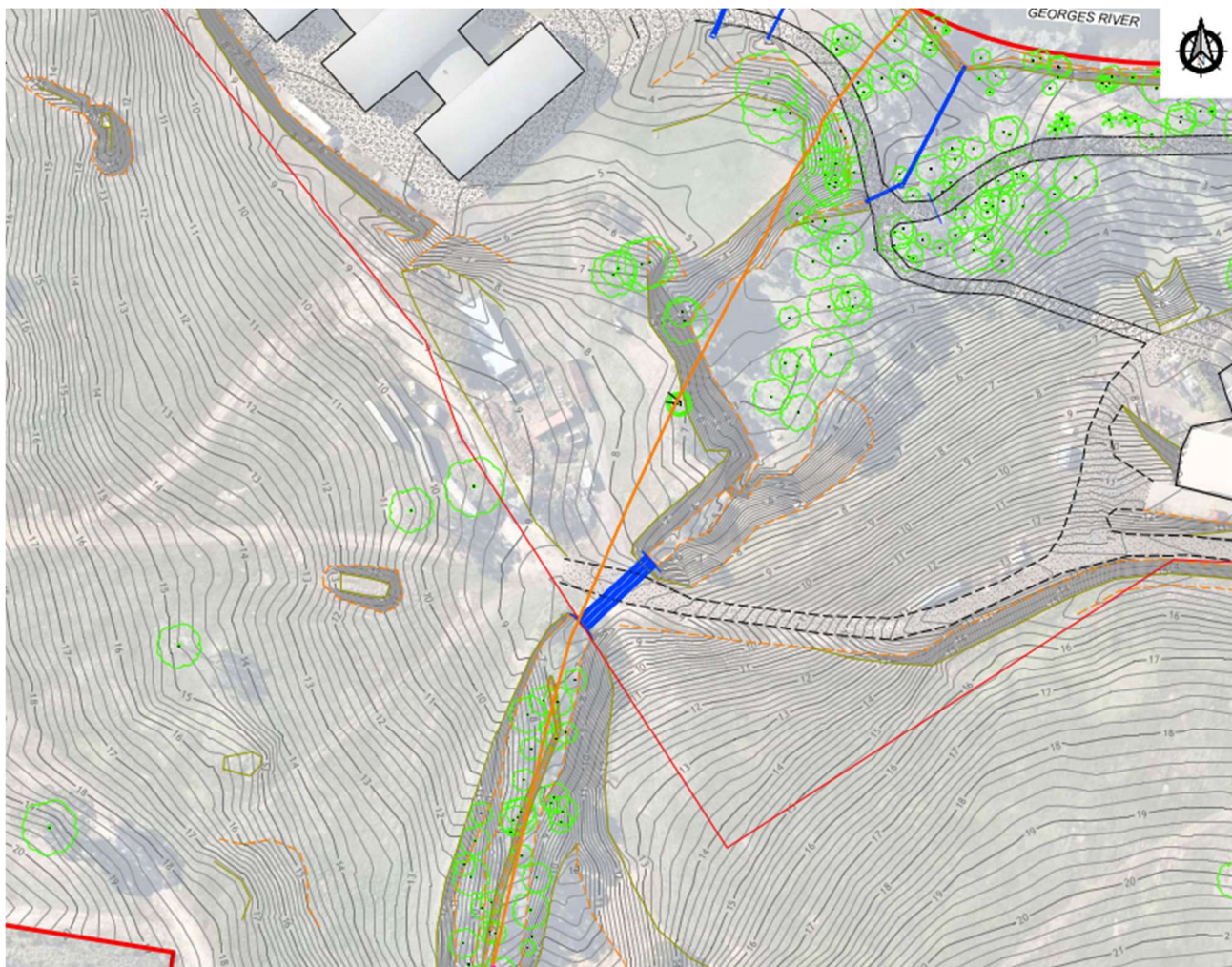


Figure 15: Mapped Second order Watercourse Survey Overlay

It can be seen from **Figure 15** that the site survey matches the findings from the site inspection, with visible bed and banks in the central location of the mapped second order watercourse. The defined channel formation seems to disperse approximately 15m downstream of the existing culverts which was also seen onsite.

It is noted that the mapped watercourse downstream of the existing culvert does not align with any defined bed or banks.

2.1.5 Existing Riparian Corridor Assessment Results

There are currently three mapped watercourses on the subject site according to the Waterfront Land Tool. Multiple assessment methodologies indicate that the two mapped first order watercourses do not exhibit defined bed or banks and therefore do not meet the criteria of a watercourse.

The second order watercourse exhibits clearly defined bed and banks for the upper portion of the mapped blue line; however, these features no longer exist in the lower portions.

Based upon the above information, it is concluded that the two first order streams do not meet the definition of a watercourse and are therefore discounted from further analysis.

The second order stream only partially exhibits the features of a watercourse; however, this stream will be extended further downstream during the proposed works (refer to Section 2.2). Based upon Appendix 5 of the NRAR Waterfront Land Tool, the existing watercourse has been identified as a type 4 watercourse.

Based upon the Strahler system, the removal of the first order watercourses would result in the second order stream being reclassified as a first order. Despite this, for the purposes of this assessment it has been adopted that the second order classification is to remain.

2.2 PROPOSED RIPARIAN CORRIDORS

As the lower reach of the second order watercourse does not exhibit the features of a watercourse, and does not provide a formalised drainage channel, it is proposed to construct a new channel from the existing culvert crossing to the Georges River foreshore.

The extent of the proposed drainage channel can be seen in **Figure 16** below, with further details on the construction of channel being seen in Section 4.5.

2.3 ADOPTED WATERCOURSE

For the purpose of preparing the SRMP, the combination of the existing second order watercourse and the proposed drainage channel have been adopted as the sites only watercourse. The extent of the adopted watercourse can be seen in **Figure 16** below.

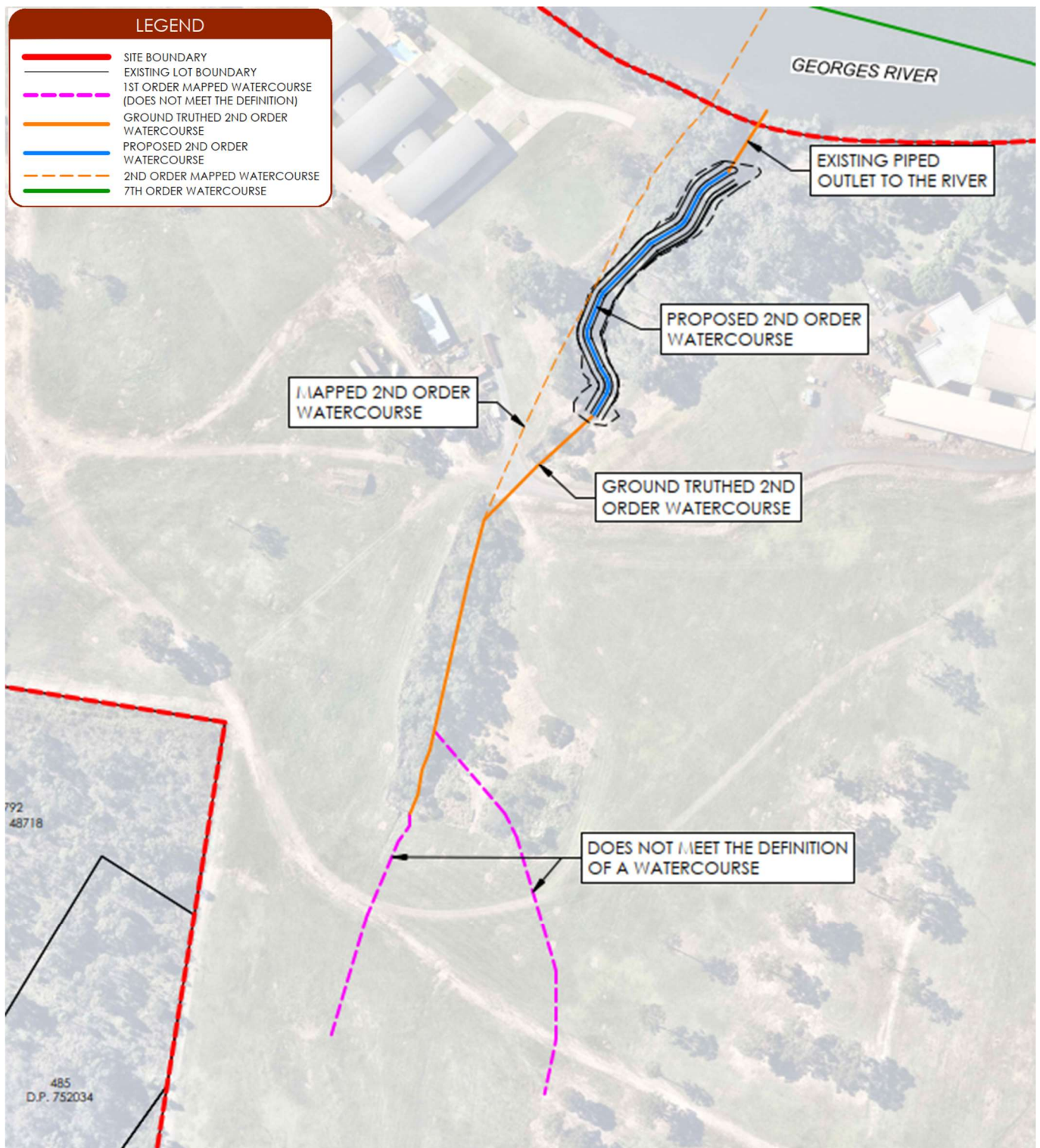


Figure 16: Adopted Watercourse

3.0 Riparian Assessment

A key element of any watercourse is the Vegetated Riparian Zone (VRZ). The VRZ for a given watercourse is based upon the adopted top of bank and the stream classification. VRZ widths to be adopted can be seen in **Figure 17** below.

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1 st order	10 metres	20 m + channel width
2 nd order	20 metres	40 m + channel width
3 rd order	30 metres	60 m + channel width
4 th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Figure 17: VRZ width table (NRAR Guidelines)

As the adopted watercourse has a stream classification of 2nd order, the VRZ width is to be 20m either side of the channel, with the channel width being dictated by the top of bank.

3.1 TOP OF BANK ASSESSMENT

It is noted that typically watercourses will have multiple bank locations. For the purpose of determining the extent of the VRZ, the top of bank to be adopted is the lowest top of bank that contains everyday flows.

A review of the adopted watercourse has been undertaken to determine the top of bank location.

3.1.1 Existing Watercourse Top of Bank

To determine the VRZ top of bank for the existing portion of the channel, the detailed site survey was utilised. An extract of the survey can be seen in **Figure 18** below.

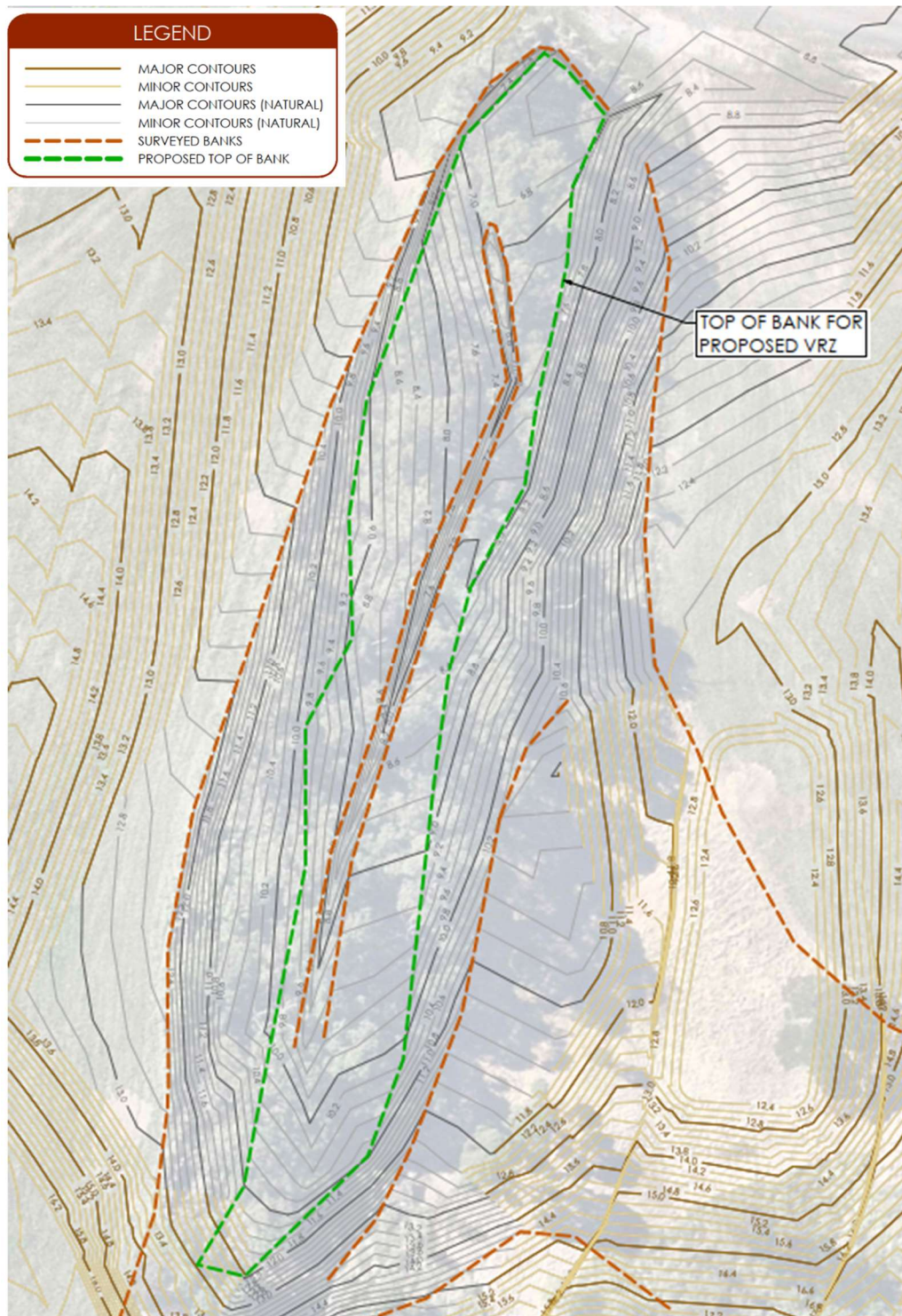


Figure 18: Top of Bank – Existing Watercourse

It can be seen from **Figure 18** that the channel has multiple banks on either side. As per Section 3.1, it is proposed to adopt the lowest top of bank that could convey everyday flows.

3.1.2 Proposed Watercourse

The proposed section of the watercourse has been designed with a defined top of bank that is capable of containing the 20% AEP storm event. The top of bank for this section of

the channel can be seen in **Figure 19** below. Refer to Section 4.5.3 for details on the proposed channel design.

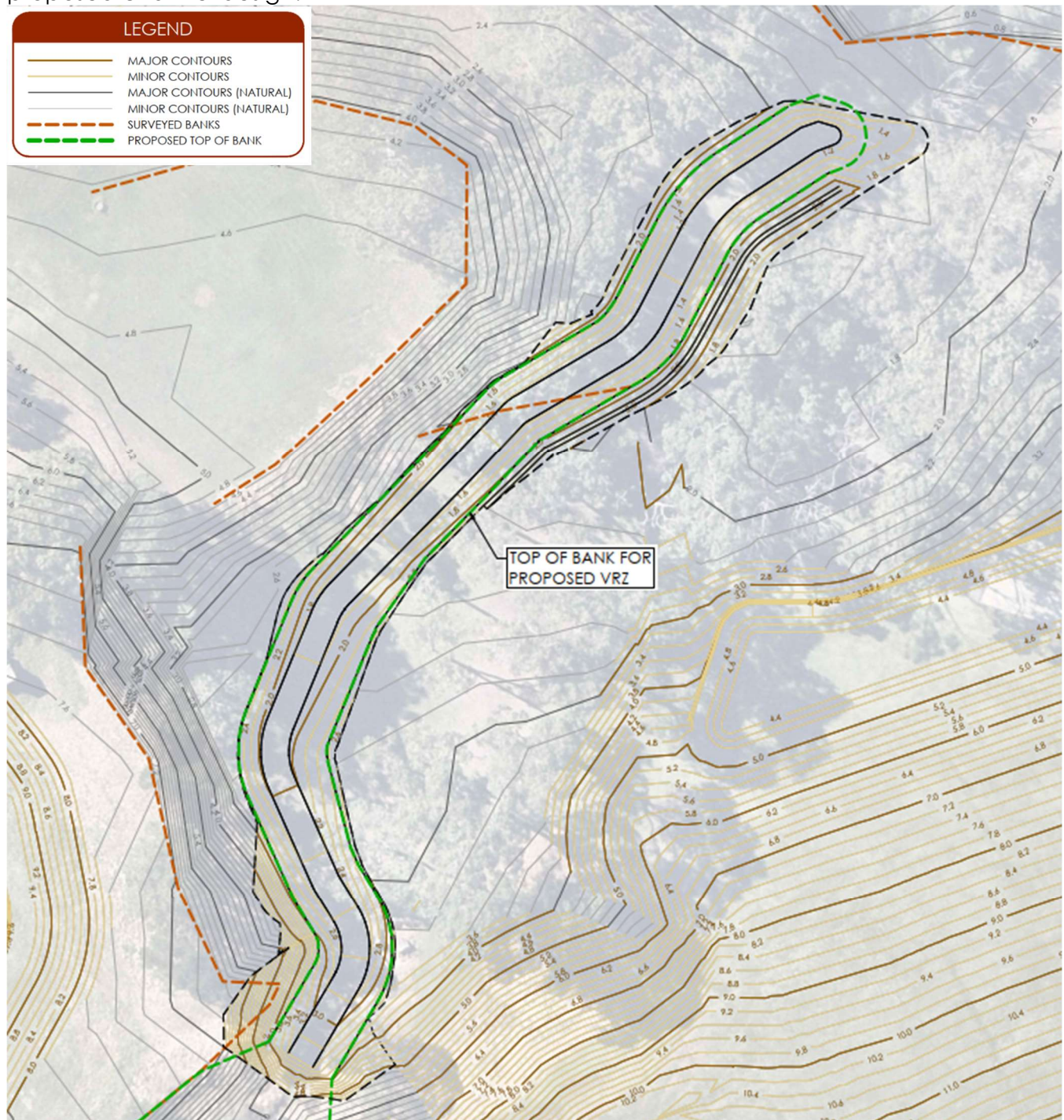


Figure 19: Top of Bank – Proposed Watercourse

3.2 RIPARIAN CORRIDOR

The VRZ for the watercourse can be seen in **Figures 20 and 21**. Refer to Section 4.5.3 for details on the proposed channel design.

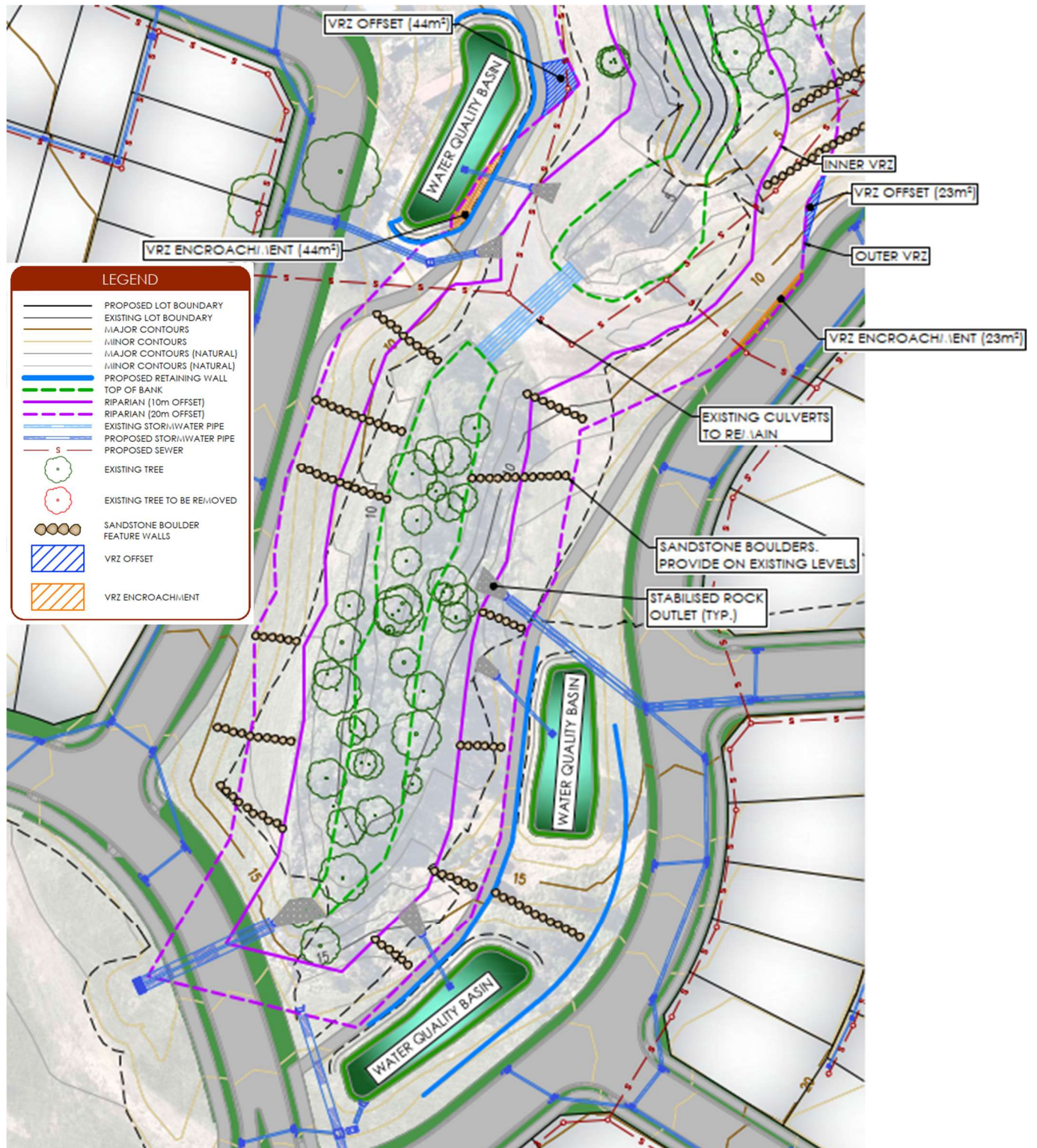


Figure 20: Riparian Corridor – Existing Channel

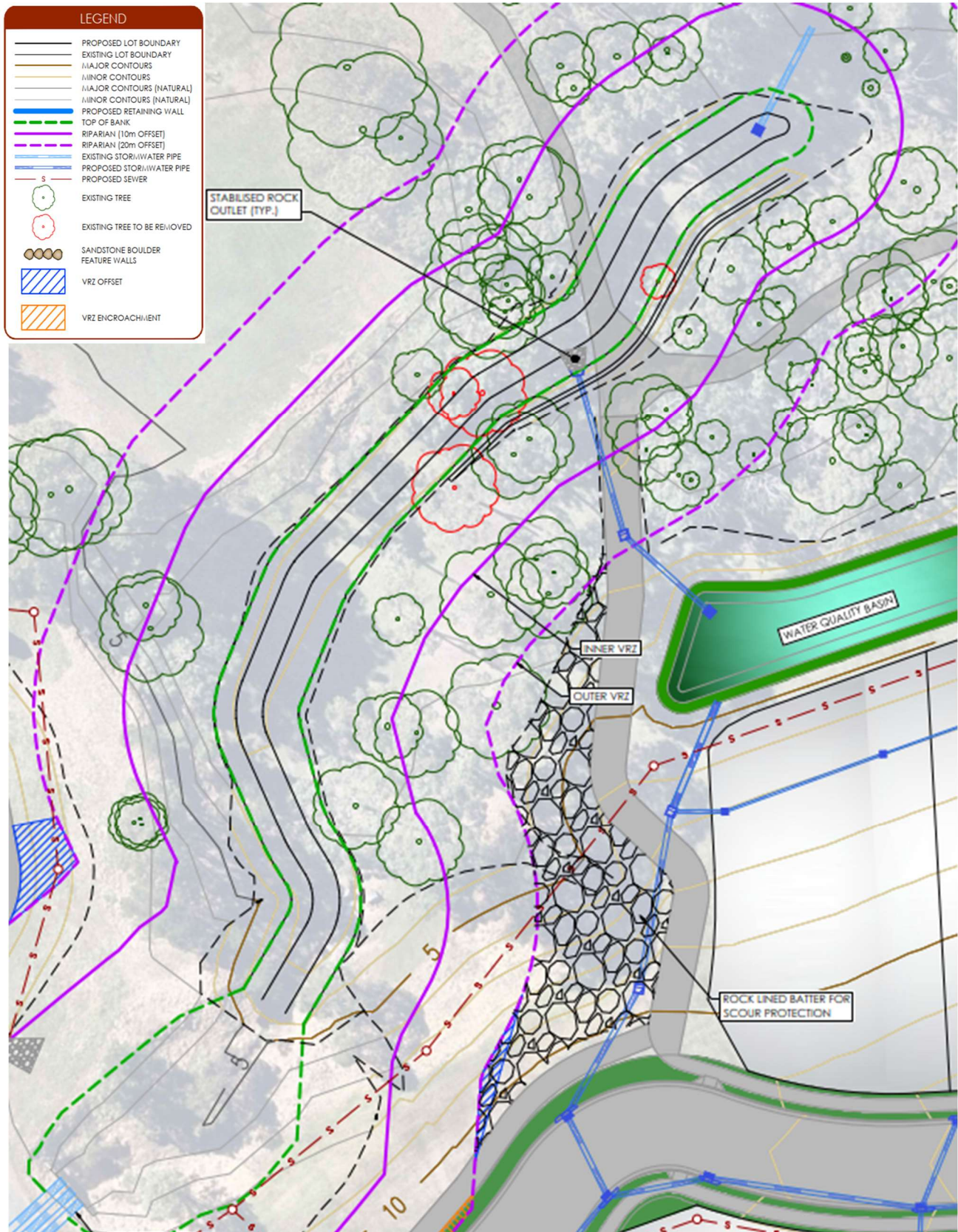


Figure 21: Riparian Corridor – Proposed Channel

It can be seen that for the majority of the VRZ in the upper portion of the channel the existing site is void of any significant vegetation. A small pocket of vegetation near the proposed basins will be required to be removed; however, this area of vegetation is isolated from the main channel and is nominated to be in a poor condition in the BDAR.

In the area proposed for the new channel, there is more significant existing vegetation, including pockets of Endangered Ecological Communities in close proximity to the Georges River edge. As seen in **Figure 21** four trees will be required to be removed in this area to facilitate the construction of the new channel.

Through the proposed development works, the VRZ area along the entirety of the existing and proposed channel will be revegetated in accordance with the Vegetation Management Plan (VMP). Given the lack of existing vegetation within the VRZ of the upper portion of the channel, the proposed development will result in a significantly improved ecological outcome for the riparian corridor when compared to the existing scenario.

Despite being required to remove four trees in the lower reaches, the works outlined in the VMP will ensure an improved ecological outcome by:

- Restoring vegetation that is currently in a poor condition; and
- Planting of new vegetation to provide a continuous riparian corridor.

3.2.1 VRZ Offsets

It can be seen in **Figure 20** above that some design elements encroach within the outer 50% of the VRZ. In accordance with **Figure 22** below (taken directly from NRAR's guidelines), encroachments into the outer 50% of the VRZ are permissible, subject to these areas being offset. Critical services such as stormwater and sewer and footpath encroachments do not need to be offset.

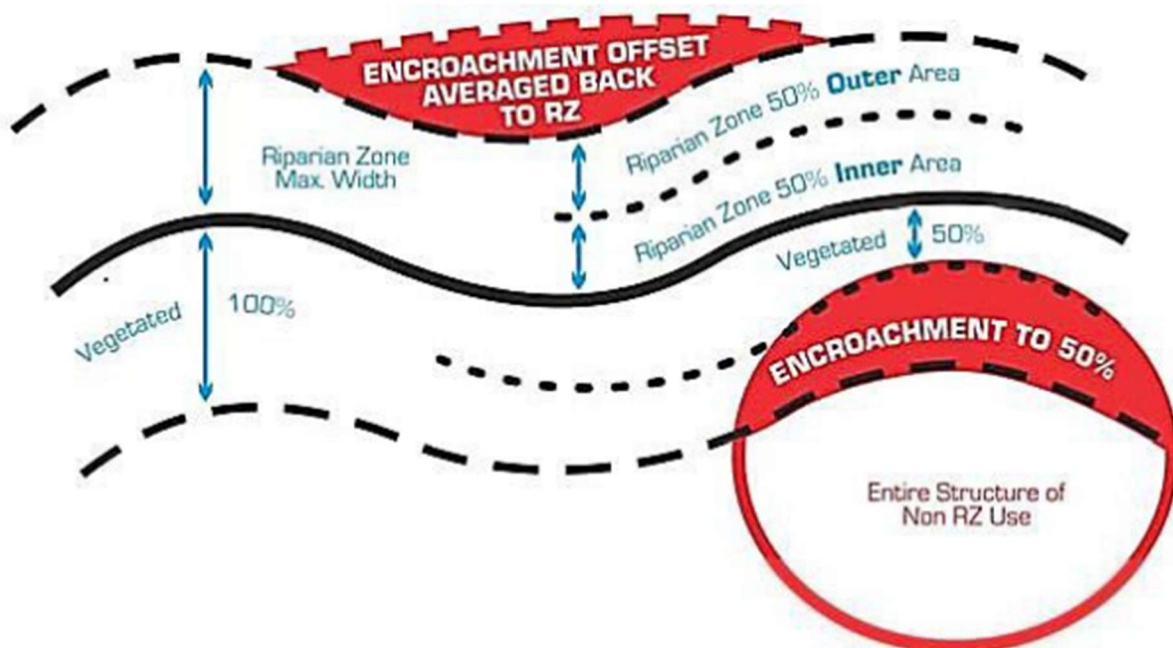


Figure 22: VRZ Offsets (NRAR guidelines)

It is noted that the encroachments within the VRZ are largely limited to areas void of any existing vegetation. As shown in **Figure 20** above, the encroachments are only within the outer 50% of the VRZ and are adequately offset in accordance with NRAR guidelines.

For further details on channel works and revegetation refer to Section 4.0.

4.0 Stream and Riparian Management

In accordance with the DCP a Stream and Riparian Management Plan (SRMP) is required for any watercourses onsite. The SRMP is to address the following points:

- Plans showing existing creek channels, creek vegetation (including remnant native vegetation) geomorphic features and aquatic habitats;
- Detailed plans of any channel modification and stabilisation works;
- A longitudinal stream survey section (if stream works are proposed) of the existing and proposed creek channel bed in sufficient detail to identify any changes in bed level and hydraulic features;
- Details on the staging and sequencing of any works within the creek zone;
- Recommendations on how to address the modified drainage system and reaches;
- A Vegetation Management Plan.

The SRMP has been prepared for the adopted watercourse and VRZ as outlined in Sections 2 and 3.

4.1 EXISTING CREEK CHANNELS AND VEGETATION

Existing vegetation and fauna habitats over the site can be seen in the Biodiversity Assessment Report (BDAR).

Gunninah have undertaken an assessment of the channel and note the following:

- The existing portion of the channel contains ephemeral pools and ponds;
- There is evidence of brown algae;
- Overall, the condition of the watercourse is considered poor.

As there are no works proposed within the existing portion of the channel, any ephemeral pools and ponds will remain intact. Upstream water quality devices to be installed as part of the development and will assist in cleaning the water and removing the algae issues.

The revegetation and restoration work proposed with the development, along with the water quality devices will assist in improving the condition of the channel.

4.2 CHANNEL MODIFICATION WORKS / LONGITUDINAL SECTION

It is noted that no works are proposed within the existing channel and therefore there will be no change to any existing structures or hydraulic features.

The proposed channel has been designed to safely convey flows from the existing culvert location to the river. Through the detailed design phase, in conjunction with the project ecologist, additional features can be added to the proposed section of the channel to enhance the ecological outcomes.

4.3 SEQUENCING OF WORKS

Sequencing of works will be undertaken to minimise disturbance and impacts on the existing stream and surrounding retained vegetation. The VMP provides a detailed breakdown of the sequencing of works to ensure impacts are minimised as much as possible.

4.4 STREAM CONVEYANCE

The conveyance capacity of the existing and proposed watercourse has been assessed as part of the flood analysis outlined within the WCMP. In summary, the flood analysis concludes the following with respect to the watercourses:

- All flows up to the 1% AEP event are contained within the existing portion of the channel;
- All flows up to the 50% AEP event are contained within the proposed watercourse, with larger events spilling at the downstream end;
- Velocities in all events are less than 2 m/s meaning no erosion of vegetation is to be expected.

4.5 MODIFIED DRAINAGE SYSTEM AND REACHES

The following sections outline the proposed changes to the existing watercourse.

4.5.1 First Order Watercourses

As the mapped first order watercourses do not meet the definition of a watercourse they are to be discounted from assessment as watercourses and the land filled to suit the proposed development.

4.5.2 Second Order Watercourse - Existing

It is largely proposed to maintain the existing portion of the 2nd order watercourse in its current form. Minor changes to this area will include:

- Provision of stabilised rock stormwater outlets from the proposed basins (to be constructed in accordance with NRAR guidelines);
- Provision of footpaths at the edge of the outer VRZ (with some minor encroachments into the outer VRZ which will be offset according to the averaging rule).

In order to convey flows under the proposed collector road passing over the existing watercourse, a culvert system is to be installed. The culverts will be twin 1.2m wide x 0.9m high box culverts and have a large (3m x 1.5m) inlet pit to enable the conveyance of the 1% AEP event. The proposed culvert crossing arrangement includes a stabilised headwall outlet on the downstream side of the road crossing, resulting in the removal of a single tree within the existing channel (refer to **Figure 20**). The loss of this tree will be offset by the significant areas of revegetation and regeneration to be undertaken.

It is recommended to maintain the existing culvert crossing near the lower reaches of the watercourse, to ensure the operation of the watercourse remains as close to existing as possible and to ensure no adverse impacts during works that would impact the function of the culvert. Revegetation will be undertaken within the VRZ over the existing culvert crossing to provide a continuous riparian corridor.

4.5.3 Second Order Watercourse - Proposed

As discussed in Section 2.2, downstream of the existing culverts, the formalised section of the watercourse dissipates, with the terrain flattening out towards the foreshore area. To provide a connection from the central corridor to the river it is proposed to provide a formalised drainage channel through the foreshore area.

The foreshore of the Georges River, in the vicinity of the proposed channel, has high ecological value, being mapped as a proximity area for Coastal Wetlands and a Key Fish habitat. Given the sensitivity of the area, the channel design has been stopped short of the river's edge; with an existing DN600 stormwater outlet pipe being used to convey flows from smaller storm events to the river. Flows in larger events will overtop the channel bank and sheet flow to the river, matching existing conditions. It is noted that in larger storm events this section of the channel will be inundated from the Georges River and therefore the sheet flow in larger events will not have any adverse impact on the foreshore area.

By stopping the channel short and utilising the existing stormwater pipe, excavation works within the river and adjacent area is not required, avoiding:

- Potential excavation of acid sulphate soils;
- Damage to estuarine vegetation associated with the Coastal Wetland;
- Potential damage to fish habitats;
- Potential sedimentation of the river's edge during works.

As the proposed channel, and the works proposed under the VMP, will provide an improved ecological connection from the watercourse to the river, resulting in restoration and revegetation of existing vegetation and avoids any damage to the sensitive river habitat it is concluded that the development will result in a significantly improved ecological outcome for the site.

The proposed channel works are proposed to be undertaken during sub stage 8 to coincide with the timing of the dedication of the foreshore area to LCC.

The extent of the channel, including the outlet pipe can be seen in **Figure 23** below.

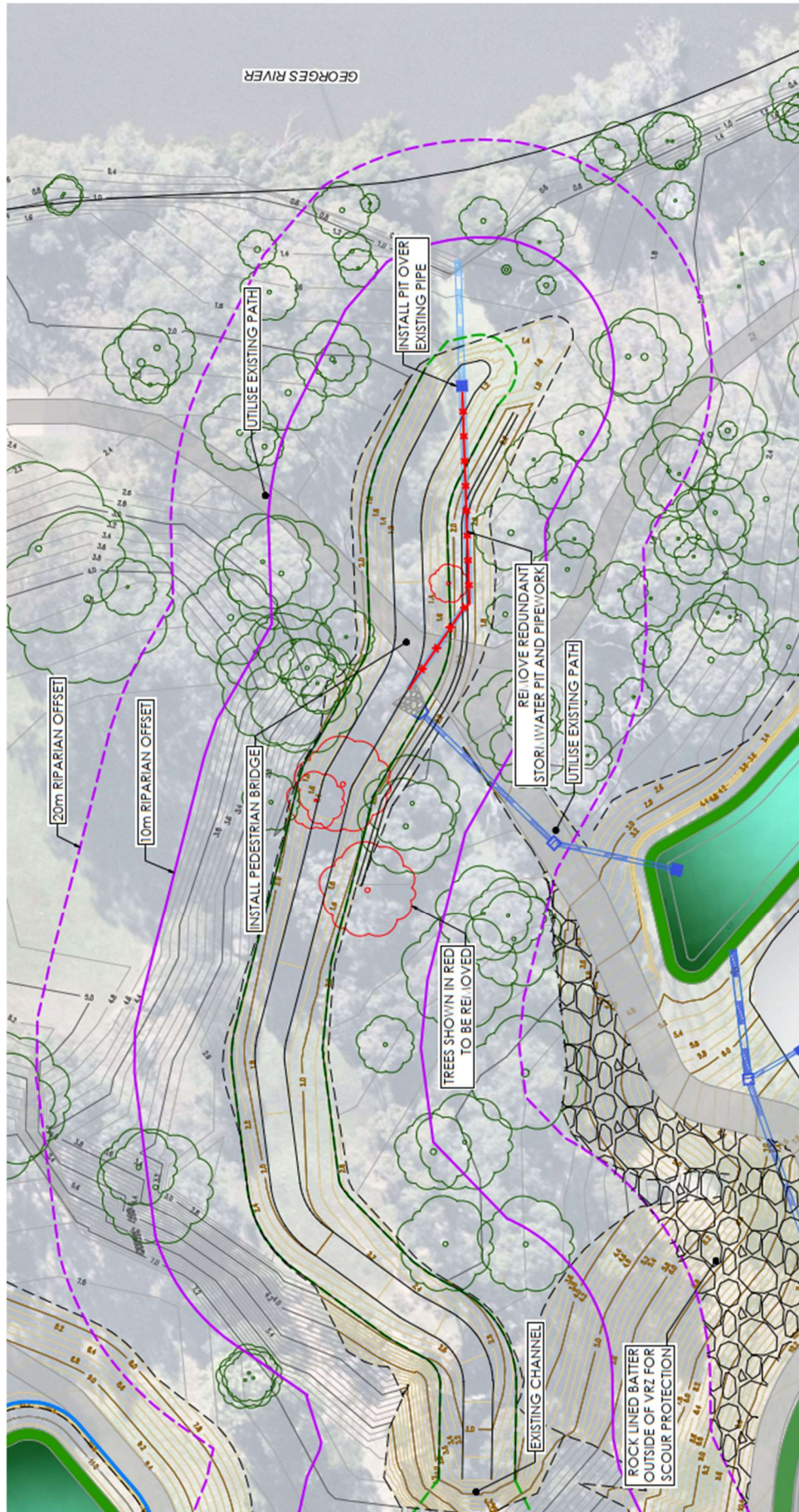


Figure 23: Extent of Proposed Channel

4.6 VEGETATION MANAGEMENT PLAN

A VMP has been prepared by Restore Environmental Consultants and should be read in conjunction with this report. The VMP provides a comprehensive outline of the proposed revegetation of the riparian corridor and foreshore area along with details on proposed regeneration of existing vegetation communities.

The VMP works, along with the works outlined within this report, will ensure an improved ecological outcome around the riparian and foreshore areas.

5.0 Conclusion

This SRMP has been prepared to assess the mapped watercourses found on the subject site and determine appropriate actions to be undertaken to ensure a positive ecological outcome for the site.

An assessment was undertaken of the mapped watercourses and it was found that two existing first order streams did not display the key features of a defined channel bed or banks. They were therefore discounted from the riparian management plan. The remainder of the existing mapped stream (a 2nd order) was ground-truthed using a site inspection and detailed site survey data.

The 2nd order stream stopped short of the Georges River and therefore a new section of channel is proposed to be constructed in the foreshore area to provide a continuous defined drainage channel connecting the central corridor to the Georges River. The channel was designed to minimise vegetation removal and to avoid the sensitive ecological communities along the river's edge.

A Vegetation Management Plan was prepared to outline restoration and revegetation works in and around the existing and proposed watercourse and foreshore area. These works will enable the restoration of existing communities, offset any vegetation lost due to the development and increase the vegetation throughout the watercourse and foreshore areas.

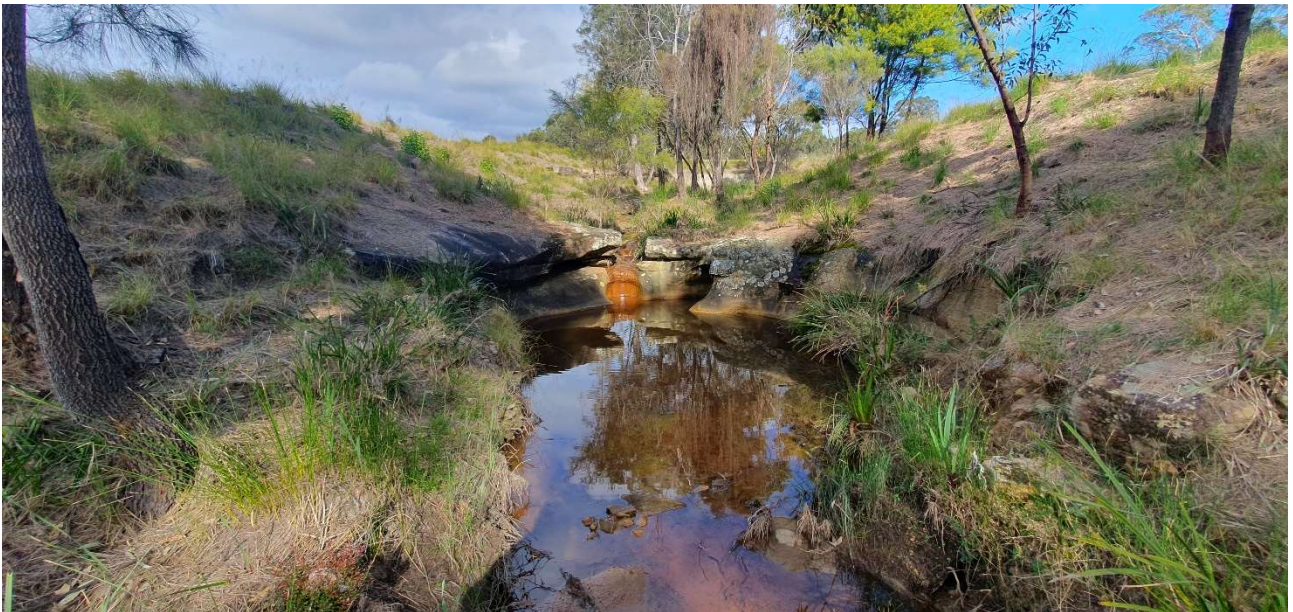
Through the channel design and the works proposed under the VMP it is concluded that the proposed development will result in a significantly improved ecological outcome for the channel and foreshore areas.

Appendix A

SITE PHOTOS



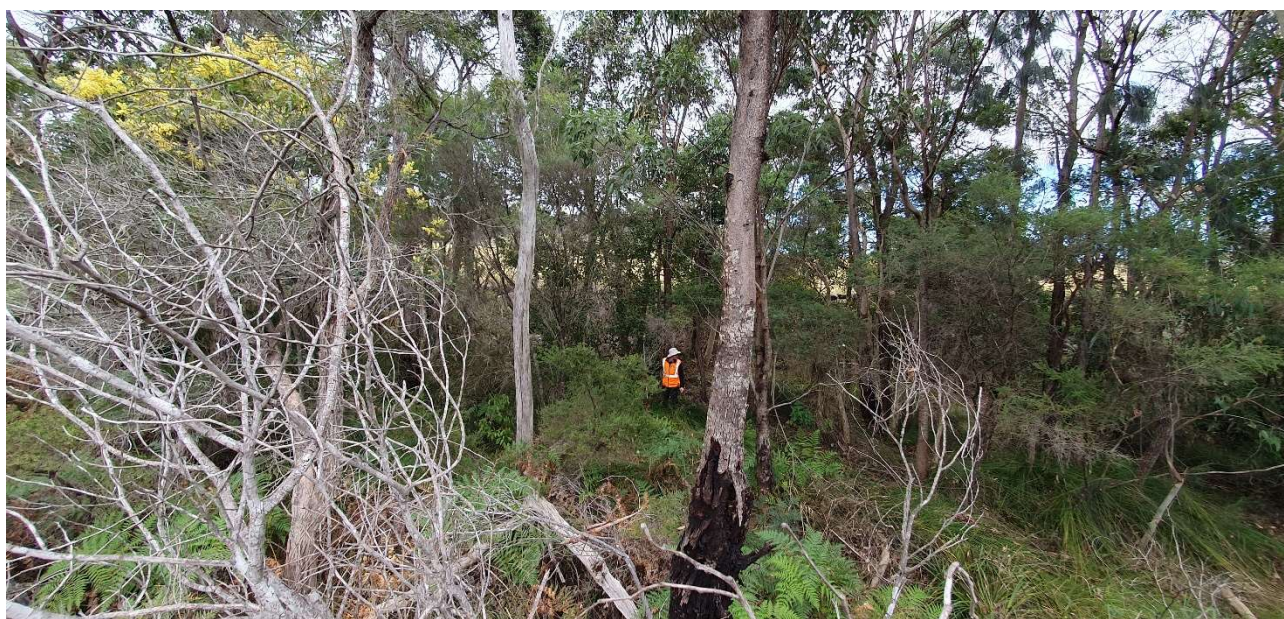




































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