Appendix F
Waterway Stability Assessments

ENGENY

PEET LIMITED

Waterway Stability Assessment

Flagstone CA4

BNE00413_0013-REP-001-1

18 MAY 2026

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1. INTRODUCTION

1.1 Project Background

Engeny has been commissioned by PEET Flagstone City Pty Limited (PEET) to undertake a waterway stability assessment for the waterways adjacent to Context Area (CA) 4, in the Flagstone City Development. The Flagstone City development is located within the Greater Flagstone Priority Development Area (PDA) in Logan City Council (LCC) Local Government Area (LGA).

The assessment required the completion of a rapid geomorphology assessment, defining waterway stability issues and recommending stabilisation strategies. This assessment has been undertaken with consideration for the requirements of the State Planning Policy for Healthy Waters.

1.2 Proposed Development

The Flagstone City development covers a total area of approximately 1,261 ha made up of a combination of future development, future open space and retained natural vegetation, and is estimated to yield approximately 11,000 dwellings. The site is located along Flagstone Creek, Sandy Creek and Sandy Gully, as well as other smaller tributaries.

This report focuses on the tributaries of Sandy Creek and Sandy Gully adjacent to CA4 of the Flagstone City development.

1.3 Purpose of Waterway Stability Assessment

The purpose of the assessment is to provide a functional management document to ensure the long-term stability of the tributaries of Sandy Creek and Sandy Gully adjacent to CA4 of the Flagstone City development.

1.4 Scope and Objectives

The scope of works and objectives for this assessment are outlined below:

- Undertake an assessment of the current geomorphic condition of the waterways adjacent to the development.
- Undertake an assessment of waterway stability.
- Provide a stabilisation strategy for the waterways adjacent to the site.
- Develop a stability buffer offset line from the top of bank to development.
- Recommendations for the stormwater discharge arrangement into the waterways with consideration of waterway stability.

2. VISUAL ASSESSMENT

2.1 Study Area

The study area for this assessment is shown in Figure 2.1 and is defined as the tributaries of Sandy Creek and the section of Sandy Gully adjacent to CA4 of the Flagstone City development within Lot 907 on SP332140. Several tributaries of Sandy Creek and Sandy Gully are located within the area of the development, some of which are proposed to be infilled as part of the development. Reaches relevant to the assessment, that are to be retained, have been named as per Figure 2.1. It should be noted that the investigation focus' on instabilities in waterway banks adjacent to the CA4 development only.

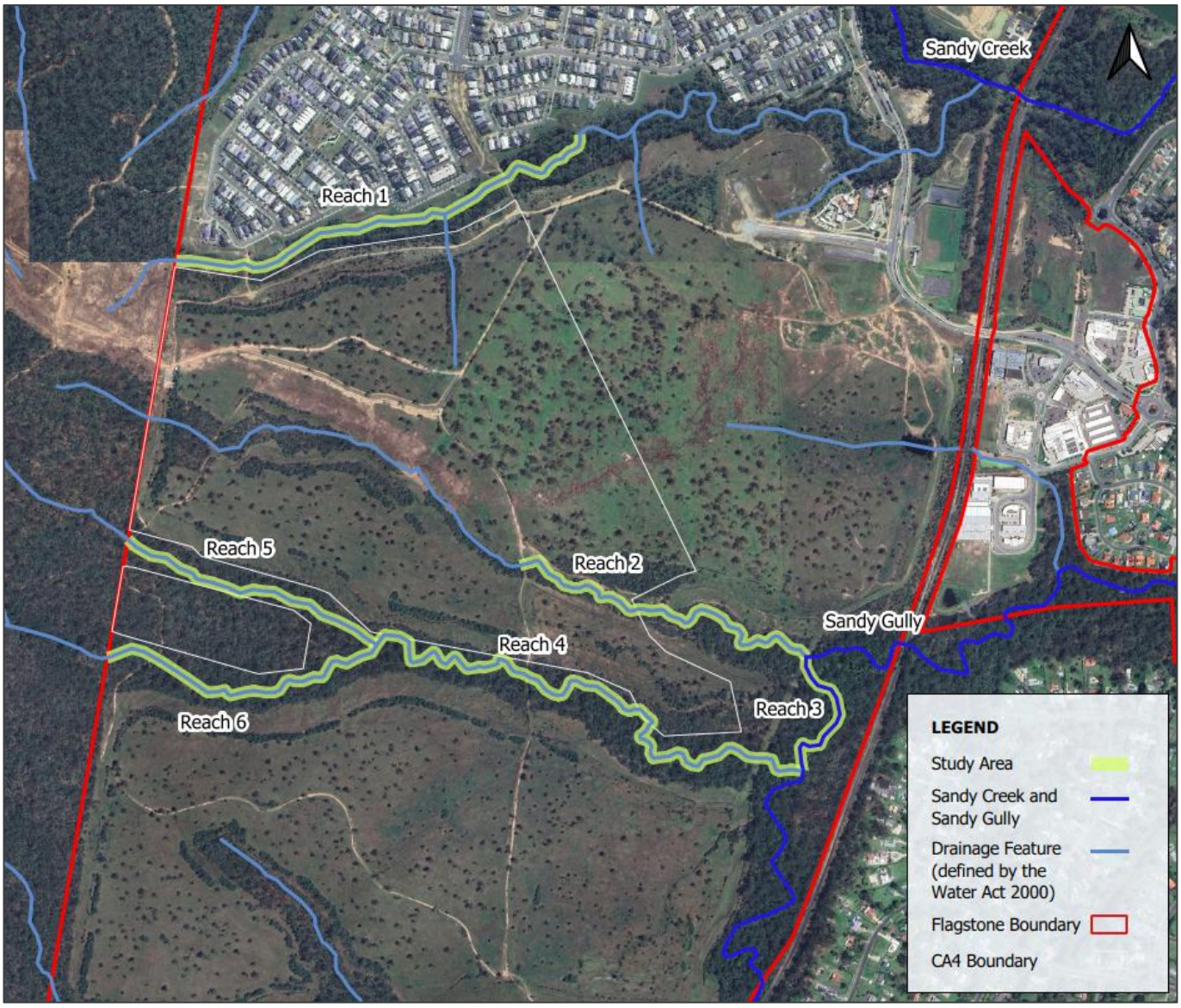


Figure 2.1: Project Study Area

2.2 Catchment Setting

The tributary of Sandy Creek is located on the northern boundary of CA4. The tributaries of Sandy Gully are located along the southern boundary and within the southern portion of CA4. The upstream catchments of both Sandy Creek and Sandy Gully are located to the west of the site. Both waterways and their tributaries flow in a north-easterly direction, ultimately draining to the Logan River.

Much of the greater catchment upstream of the study area is underlain Gatton Sandstone. Gatton Sandstone can be described as consisting of thin- to thick-bedded, coarse- to medium-grained, feldspathic to lithic feldspathic sandstone with clay matrix; subordinate intervals of granule, pebble and minor cobble polymictic conglomerate, with abundant ferruginised fossil wood logs and fragments.

The study area is within the upper reaches of the floodplain. It can be categorised as a narrow floodplain confined by the valley margins, with characteristic swathes of sand typical of sandstone draining catchments. Through the site, Gatton Sandstone is overlain by Quaternary aged Flood Plain Alluvium.

The uppermost catchments consist of largely undisturbed open eucalypt forest. The study area has experienced some disturbance as a result of previous activity, including land and riparian vegetation clearing. An aerial comparison of the immediate catchment setting between 2006 and 2025 is shown in Figure 2.2, noting that initial land clearing commenced within the study area between 2006 and 2008.



Figure 2.2: Catchment Setting Comparison 2006 to 2025 (QLD Globe)

2.3 Site Assessment

Engeny undertook a rapid geomorphic assessment on the 15th and 17th of January 2026. The assessment was completed for the tributaries of Sandy Creek, a section of Sandy Gully and tributaries of Sandy Gully as described in Section 2.1.

Observations from the site assessment are discussed in the following sections with locations of interest shown in Figure 2.3 . Supporting photos are provided in Appendix A.

Location	Reach 1
1.1	Rock control in bed
1.2	Wide channel with steep dispersive banks upstream of crossing
1.3	Stormwater conveyance beneath crossing not visible
1.4	Chain of ponds area with well vegetated buffers
1.5	Crossing location. Scour hole downstream and failed pipe
1.6	Stable area with evidence of previous rehabilitation

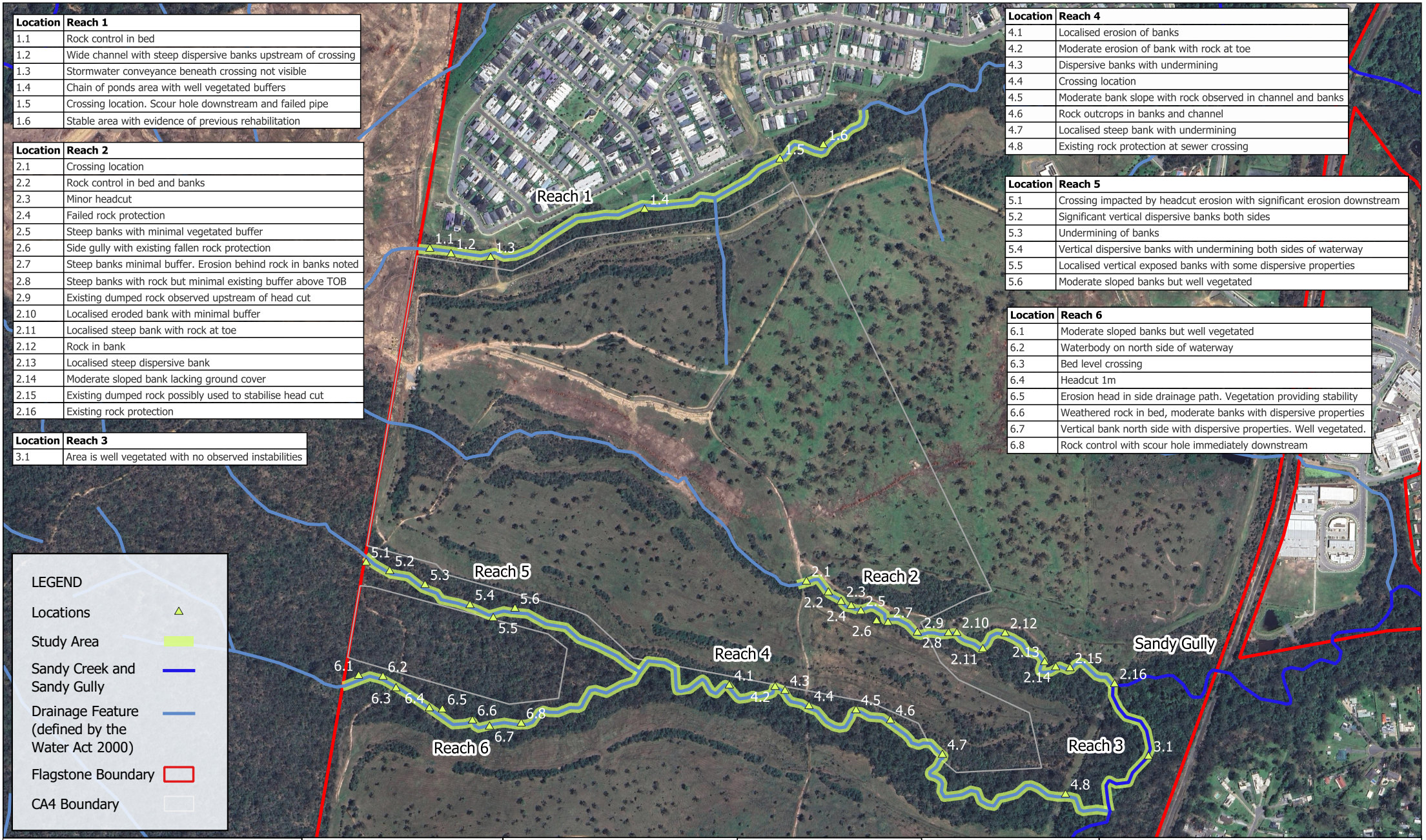
Location	Reach 2
2.1	Crossing location
2.2	Rock control in bed and banks
2.3	Minor headcut
2.4	Failed rock protection
2.5	Steep banks with minimal vegetated buffer
2.6	Side gully with existing fallen rock protection
2.7	Steep banks minimal buffer. Erosion behind rock in banks noted
2.8	Steep banks with rock but minimal existing buffer above TOB
2.9	Existing dumped rock observed upstream of head cut
2.10	Localised eroded bank with minimal buffer
2.11	Localised steep bank with rock at toe
2.12	Rock in bank
2.13	Localised steep dispersive bank
2.14	Moderate sloped bank lacking ground cover
2.15	Existing dumped rock possibly used to stabilise head cut
2.16	Existing rock protection

Location	Reach 3
3.1	Area is well vegetated with no observed instabilities

Location	Reach 4
4.1	Localised erosion of banks
4.2	Moderate erosion of bank with rock at toe
4.3	Dispersive banks with undermining
4.4	Crossing location
4.5	Moderate bank slope with rock observed in channel and banks
4.6	Rock outcrops in banks and channel
4.7	Localised steep bank with undermining
4.8	Existing rock protection at sewer crossing

Location	Reach 5
5.1	Crossing impacted by headcut erosion with significant erosion downstream
5.2	Significant vertical dispersive banks both sides
5.3	Undermining of banks
5.4	Vertical dispersive banks with undermining both sides of waterway
5.5	Localised vertical exposed banks with some dispersive properties
5.6	Moderate sloped banks but well vegetated

Location	Reach 6
6.1	Moderate sloped banks but well vegetated
6.2	Waterbody on north side of waterway
6.3	Bed level crossing
6.4	Headcut 1m
6.5	Erosion head in side drainage path. Vegetation providing stability
6.6	Weathered rock in bed, moderate banks with dispersive properties
6.7	Vertical bank north side with dispersive properties. Well vegetated.
6.8	Rock control with scour hole immediately downstream



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DRAWN	MD	APPROVED	TH
CHECKED	DSTH	DATE	17-03-2026

NOTES:

0 0.1 0.2 0.3 km

SCALE - 1:9,000

GDA2020 / MGA zone 56

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Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY
egis GROUP

PEET

Locations of Interest

Flagstone CA4
Waterway Stability Assessment

Drg Ref.

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2.3.1 Reach 1

Reach 1 is a tributary of Sandy Creek and consisted of two distinct sections, located either upstream or downstream of the informal vehicle crossing at the western extent of the tributary (located immediately downstream of location 1.3, Figure 2.3).

The section upstream of the crossing consisted of a wide channel with dispersive banks. There was no stormwater conveyance visible beneath the road crossing and therefore there is the potential for ponding to occur in this area (see locations 1.1 and 1.2). A large amount of deposited sand was noted in the base immediately upstream of the crossing. Vegetation consisted of juvenile trees with little ground cover.

The profile of the channel in the upstream extent of this section was narrower and mildly incised with a rock control observed in the base (location 1.1). There was minimal erosion observed in the upstream extent.

The section of the reach downstream of the western crossing consisted of a wide valley with an incised shallow low flow channel. The bed consisted of pools and riffles with limited sand deposits, which can likely be attributed to the western crossing limiting the movement of sediment. This portion of tributary was generally stable with dense vegetation including juvenile to mature trees, as well as grasses and Lomandra.

The waterway crossing at the eastern extent of the reach (location 1.5) was observed to have partially failed, with broken pipe and scour hole noted at the downstream extent. As a result, the invert of the broken pipe was above the level of the bed.

Rehabilitation works such as riparian planting and rock protection of the banks was observed at the downstream extent of the investigated portion of tributary (location 1.6). This portion of the reach appeared to be stable.

2.3.2 Reach 2

Reach 2 is a tributary of Sandy Gully and consisted of a narrow and incised channel with steep banks up to 2m in height.

A headcut was observed at location 2.3. It was believed the headcut had migrated from the failed dumped rock protection at location 2.4 with the failed rock protection likely placed to prevent the headcut from moving upstream. Bed rock was observed at location 2.2, 30m upstream of the headcut, which will provide a natural bed control. Additional dumped rock protection was observed at locations 2.9 and 2.15, which were considered stable.

Rock was observed throughout the tributary in both the bed and the banks, notably at locations 2.2, 2.8, 2.11 and 2.12. Steep banks were also observed throughout the reach, notably at location 2.13 where the bank was near vertical with exposed dispersive material.

Vegetation generally consisted of juvenile trees and groundcovers indicating historic clearing in the tributary. In the upstream portion of the reach there was limited vegetation beyond the top of bank. Notably there was minimal vegetated buffer above steep banks at locations 2.5, 2.7 and 2.8.

2.3.3 Reach 3

Reach 3 is a section of Sandy Gully and consisted of an incised channel with meandering low flow channel and sandy vegetated benches. The waterway was confined by the valley margins and the bed consisted of mobile sand deposits. Riparian vegetation was generally considered dense throughout the waterway with full structural diversity. Weeds such as lantana were observed throughout the reach.

2.3.4 Reach 4

Reach 4 is a tributary of Sandy Gully and consisted of similar conditions to Reach 3; however, Reach 4 was less densely vegetated having sparser tree and groundcover. Localised erosion of banks was observed at location 4.1 and 4.2 and localised steep banks with undermining and exposed dispersive material were also observed at location 4.3 and 4.7. Rock outcrops in the bank and channel were observed at location 4.6.

2.3.5 Reach 5

Reach 5 is a tributary of Sandy Gully and consisted of two distinct sections. The upstream section of the tributary consisted of an incised channel confined by gradual sloping valley margins. Steep dispersive banks with undermining were observed in this section, caused by migration of a headcut. At the time of the site visit the headcut had partially encroached into the vehicle crossing at the most upstream extent of Reach 5 (Location 5.1). The headcut was observed to be 3m high. Additional areas with vertical dispersive banks and undermining were observed at locations 5.2, 5.3, 5.4 and 5.5. The remaining section of the tributary downstream of location 5.5 was less confined with wide and gradually sloping banks and no instabilities observed. Vegetation throughout the tributary was considered dense and consisted of juvenile trees and groundcovers.

2.3.6 Reach 6

Reach 6 is a tributary of Sandy Gully generally consisted of an incised channel confined by the valley margins. The section of the reach upstream of Location 6.4 was generally considered stable. The profile of the channel was wider upstream of the crossing at location 6.3, and an area of ponded water was observed on the northern side at location 6.2.

Steep dispersive banks were observed downstream of a headcut, approximately 1m in height, located 75m downstream of the bed level crossing at the western extent of the tributary (see location 6.4). The channel downstream of the headcuts (to location 6.8) was in a state of evolution due to the propagation of the headcut with steep vertical banks in some locations such as the outer bend at location 6.6. Downstream of location 6.8, the channel became less confined with wide gradually sloping banks. Rock was noted in this section of the reach providing bed control. Vegetation throughout the tributary was considered dense and consisted of juvenile trees and groundcovers.

3. WATERWAY STABILITY ASSESSMENT

3.1 Waterway Constraints

LCC and State Government waterway mapping constraints imposed on the site are discussed below.

3.1.1 Waterway Barrier Works

Waterway barrier works classifications for the study area are shown in Figure 3.1.

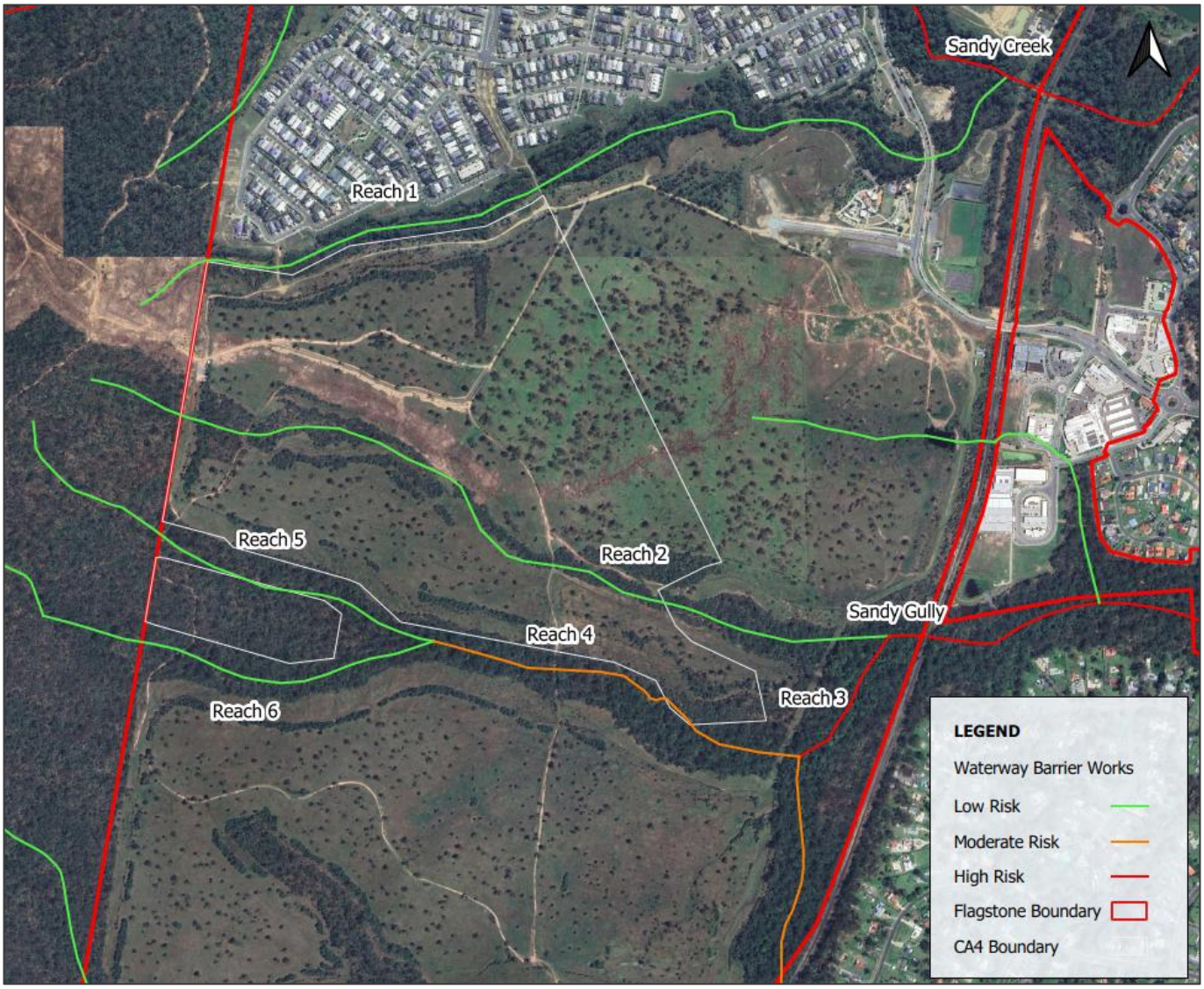


Figure 3.1: QLD Waterways for Waterway Barrier Works

A waterway investigation was completed by Fishology (28th March 2024) to determine the presence and extent of waterways on site. The results of the investigation included proposed amended upper limits for waterway barrier works extents for Reach 2 and 4 (as named as part of this assessment). The waterway investigation by Fishology was submitted to SARA for pre-lodgement advice (SARA reference: 2403-39339 SPL). The pre-lodgement advice received in response to the submission acknowledged the proposed amendments to the waterways shown as Figure 3.2. Due to the amendment of the upper limit of Reach 4, waterway barrier works classifications were also removed from Reach 5 and 6. Refer to Appendix B for more information.

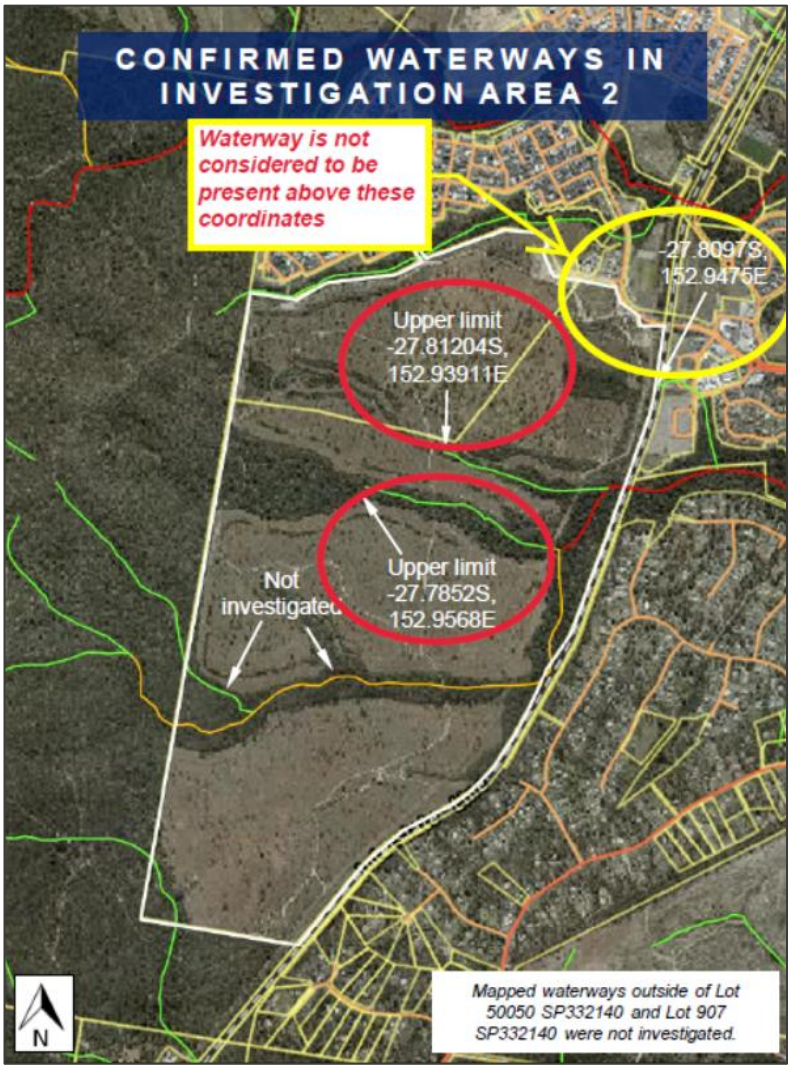


Figure 3.2: Reach 1 - Mapped Waterways Amended Upper Limits and Presence (SARA reference - 2403-39339 SPL)

The amended waterway barrier works classifications within the study are summarised in

Table 3.1. Waterway barrier works are regulated under the Fisheries Act 1994 and alterations to the alignment, shape and capacity of mapped waterways generally trigger an assessable application under the Department of Primary Industries (DPI). Any required applications to DPI will be submitted at operational works.

TABLE 3.1: STUDY AREA WATERWAY BARRIER WORKS CLASSIFICATIONS

Reach	WWBW Classification	Amended WWBW Classification
Reach 1	Low risk	Low risk
Reach 2	Low risk	Upper limit amended
Reach 3	High risk	High risk
Reach 4	Moderate risk	Upper limit amended
Reach 5	Low risk	No classification

Reach 6	Low risk	No classification

3.1.2 Logan City Council Waterway Corridors

The Logan Planning Scheme (2015 v9.2 – Table 8.2.12.3.1) outlines that development is to be located outside of the waterway areas identified on waterway corridors and wetlands overlay map OM-14.01 (shown in Figure 3.3).

The Logan Planning Scheme (2015 v9.2 - SC6.2.5 Planning scheme policy 5 – Infrastructure, Section 3.6.2.) also outlines the following requirements for waterway corridors relating to streams orders 1, 2 and 3:

- A stormwater infrastructure item may only be provided in a waterway and wetland buffer area where the buffer area is degraded to such an extent that the construction of the stormwater infrastructure item would result in an enhancement to the condition and ecological function of the buffer area.
- A stormwater infrastructure item may not be located within the waterway and wetland buffer area where the buffer area:
  - contains intact riparian vegetation; or
  - is located below the 20 year ARI flood level; or
  - adjoins a stream order 1 or 2 minor waterway as mapped in Logan City Council's Waterway corridors and wetlands overlay mapping; or
  - where the mapped waterway or wetland buffer is less than 30m in width, measured from the top bank.
- Where a stormwater infrastructure item is located within a waterway or wetland buffer area, it shall be located a minimum distance of 10 metre extending perpendicularly outwards from the top of bank for waterways of stream order 3 or minor wetlands that is retained, restored or rehabilitated.

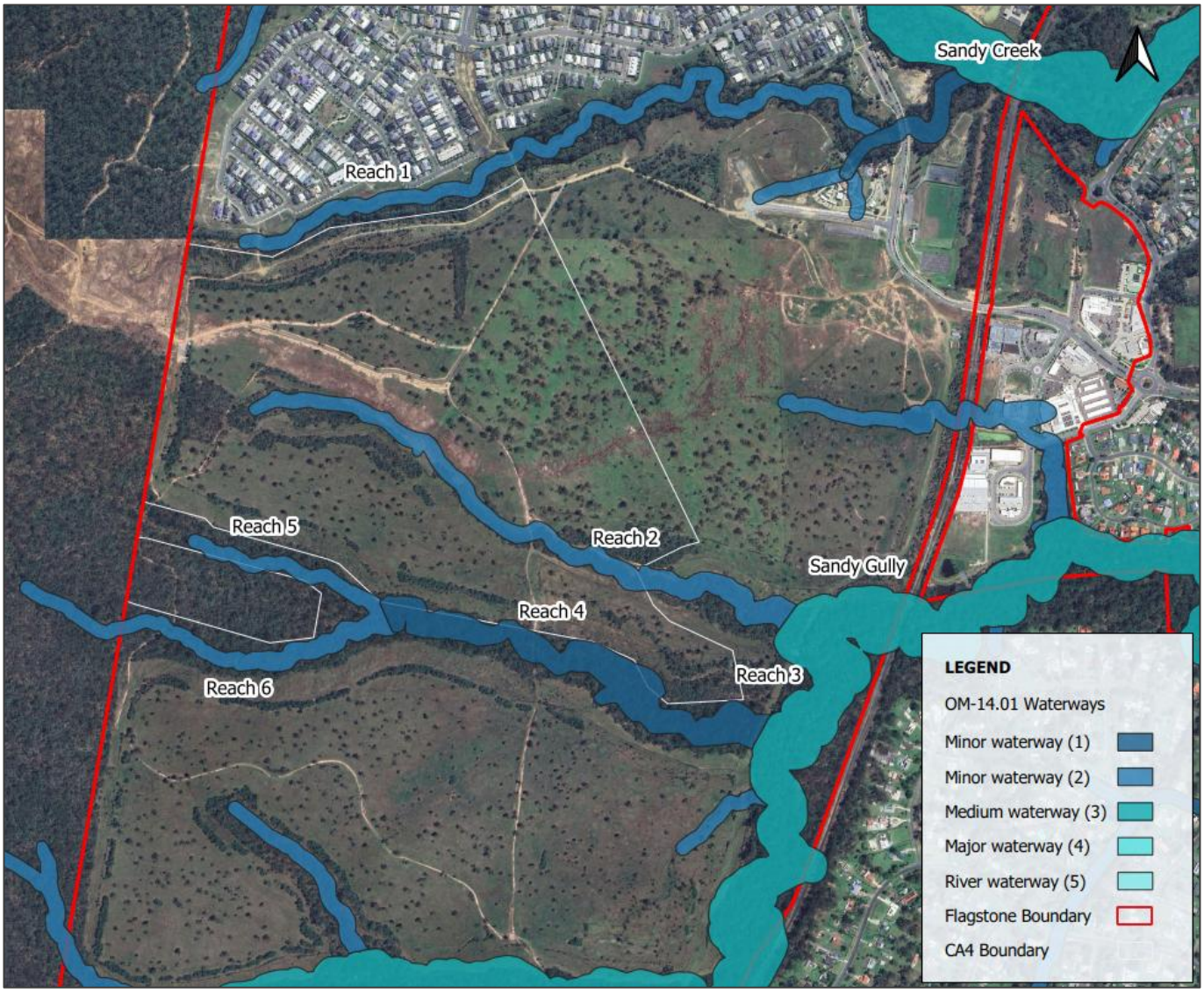


Figure 3.3: Mapping for LCC Waterway Corridors

3.1.3 Natural Environmental Site Strategy

An overarching site strategy for the management of the natural environment relating to the Flagstone development site is outlined in the Flagstone Natural Environment Site Strategy (NESS) (Saunders Havill Group, 2015). The NESS outlines the following requirements relevant to the study area:

- Undertake detailed weed management and revegetation using existing native species and pre-clear regional ecosystem communities to strengthen the riparian vegetation cover and diversity through retained creek and gully.
- Retain native vegetation within the channel, bed and banks of creeks and retain gully lines unless it is unavoidable due to waterway stability work in accordance with the endorsed waterway rehabilitation and stabilisation strategy.
- Avoid clearing of vegetation within defined watercourses and the bed and banks of site creeks and remnant gully lines, expect for essential infrastructure (such as stormwater detention water bodies), waterway stability works in accordance with the endorsed waterway rehabilitation and stabilization strategy and for CPTED principles.

3.2 Waterway Stability

A waterway stability assessment was undertaken to determine how best to ensure the long-term stability of the waterway. The following sections outline the waterway stability assessment completed based on values derived from Engeny's Flagstone Creek, Sandy Creek, and Teviot Brook TUFLOW models. Note that this assessment was focused on the waterways delating to the Flagstone Development Application for Context Area 5 North and further amendments to this report will be completed if required for future context areas.

3.2.1 63.2% AEP Peak Flow Comparison

Table 3.2 provides a comparison of 63.2% AEP peak flows between pre and post-development scenarios which was completed to assess where peak flows are predicted to increase in the waterway within the development boundary. The reporting locations for the peak flow comparison is shown in Figure 3.4. Whilst there are areas of increased peak flows, this does not necessarily indicate an increased risk of potential erosion. An analysis of stream power, shear stress and velocity values was completed to provide a further analysis of waterway stability and erosion risk.

TABLE 3.2: 63.2% AEP PEAK FLOW COMPARISON

Reporting Location	Baseline Scenario (B01) Peak Flow (m3/s)	Masterplan Scenario (M01) Peak Flow (m3/s)	Peak Flow Difference (m3/s)	Peak Flow Difference (%)
T029a	0.3	0.3	0	0%
T029b	0.6	0.8	0.2	33%
T032	0.6	0.6	0	0%
T031	1.1	2.2	1.1	100%
37	1.9	2.9	1	53%
STRUC6_DS	2.2	2.3	0.1	5%
T026	2.7	2.8	0.1	4%
T043b	0.7	0.7	0	0%
T043c	0.9	1.4	0.5	56%
42	3.2	3.2	0	0%
41	4.2	4.4	0.2	5%
39	5.1	4.6	-0.5	-10%
STRUC2_DS	5.5	4.2	-1.3	-24%
38	8.3	6	-2.3	-28%
T025	11.5	8.2	-3.3	-29%

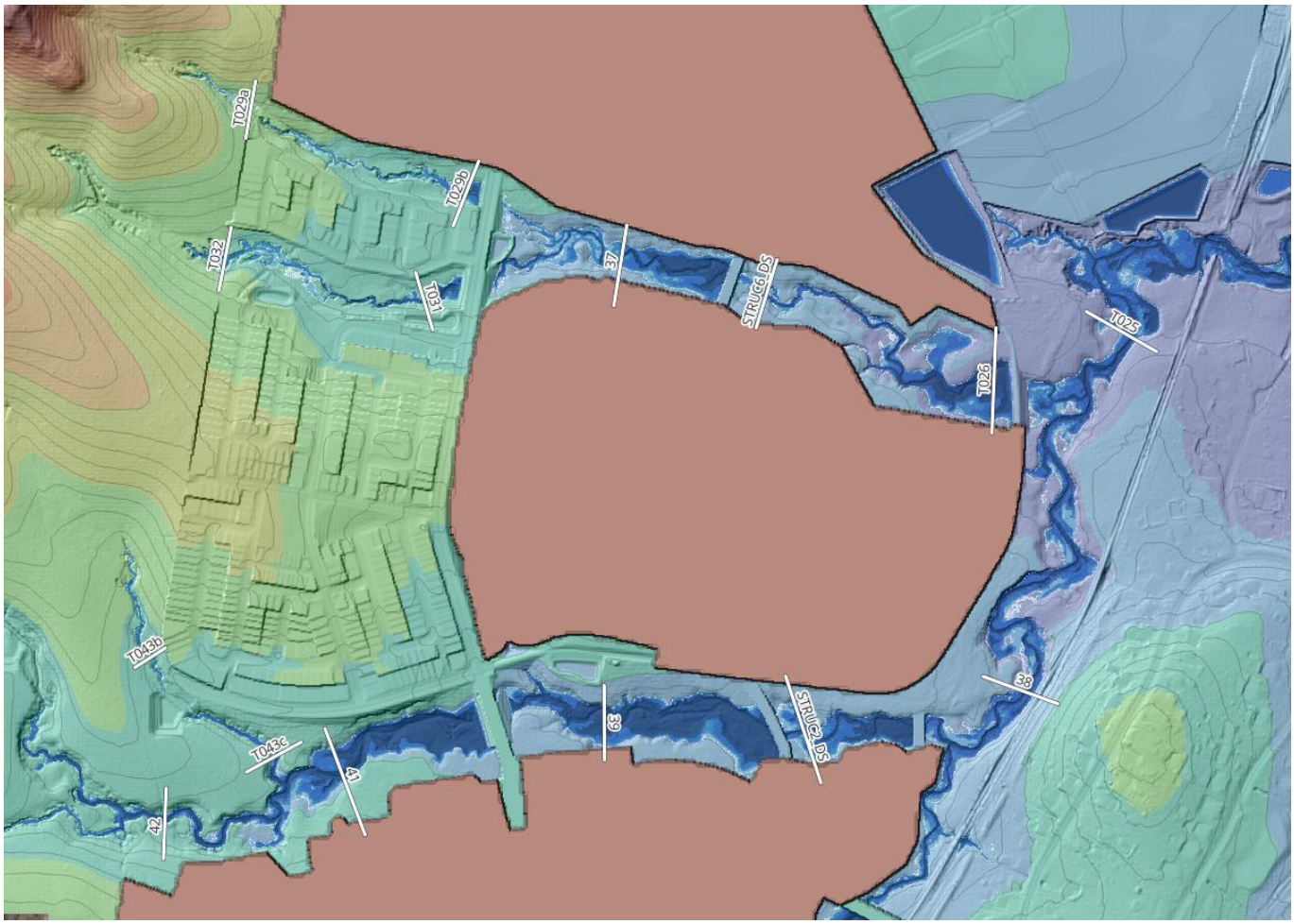


Figure 3.4: 63.2% AEP Peak Flow Reporting Locations

3.2.2 Stream Power, Shear Stress and Velocity

Shear stress, stream power and velocity values derived from the waterways included in the Engeny's Flagstone Creek, Sandy Creek, and Teviot Brook TUFLOW models were used as a guide to inform risk of potential sediment transport and identify areas susceptible to scour. Modelling was completed for major flow paths identified for the local Sandy Creek and Sandy Gully catchments. This assessment considered the results for the 50 year and 2-year AEP events using baseline and proposed masterplan topography and catchment data. The results are presented in Appendix C.

The DNRME Guideline: Works that interfere with water in a watercourse – watercourse diversions (2019) was used to inform acceptable shear stress, stream power and velocity for study area and acceptable values are shown in Table 3.3. Allowable shear stress and velocity for different materials are also shown in Table 3.4. It must be noted that the values represented in the DNRME guidelines were developed as 'channel average values' using HEC-RAS, compared with cell-specific values produced in 2D hydraulic model packages. As such, the guideline values should be used cautiously as 2D packages produced significantly higher values.

TABLE 3.3: ACCEPTABLE SHEAR STRESS, STREAM POWER AND VELOCITY VALUES

Scenario	Shear Stress (N/m2)	Stream Power (W/m2)	Velocity (m/s)
50% AEP (no vegetation)	<40	<35	<1.0
50 % AEP (vegetated)	<40	<60	<1.5
2% AEP	<50	<150	<2.5

TABLE 3.4: ALLOWABLE SHEAR STRESS AND VELOCITY FOR MATERIALS

Material	Allowable Shear Stress (N/m²)	Velocity (m/s)	Source
Long Native Grass	82	1.2 – 1.5	Fischenich, C. (2001)/ IPWEA (2017)
Hardwood trees planting	120	N/A	Fischenich, C. (2001)
Reinforced Turf	240	3.0	Catchments and Creeks (2014)
Rip rap (D_{50}=150mm)	180	2.1 – 3.1	Fischenich, C. (2001)
Rip rap (D_{50}=300mm)	244	3.0 – 3.9	Fischenich, C. (2001)
Rip rap (D_{50}=600mm)	484	4.2-5.4	Fischenich, C. (2001)

- The majority of locations generally experienced bed shear stress values within the acceptable guideline limit of 40N/m2 for both the pre-development and post-development scenarios. There was a decrease in shear stress results from the pre-development to post-development scenario.
- Isolated areas experienced higher bed shear stress values between 100N/m2 to 150N/m2. Notable areas of higher bed shear stress values in the post-development scenario include:
    - Downstream of crossing Reach 1 and 4
    - Confluence of Reach 5 and 6.
    - Central sections of Reach 5 and 6
- The majority of locations generally experienced stream power values within the acceptable guideline limit of 30W/m2 for both the pre-development and post-development scenarios. There was a decrease in shear stress results from the pre-development to post-development scenario.
- Isolated areas experienced higher stream power values between 60W/m2 to 250W/m2. Notable areas of higher stream values in the post-development scenario aligned with the locations listed above for the higher bed shear stress values.
- All locations experienced velocity values less the guideline limits of 1.5m/s for the 50% AEP and 2.5m/s for the 2% AEP events for both the pre-development to post-development scenario.
- Assessed waterways in the post developed case generally experienced velocities within the native grass planting tolerance shown in Table 3.4 which supports a vegetated waterway outcome.

3.2.3 SPP Waterway Stability Design Objectives - Erosion Risk Assessment

The *State Planning Policy (DILGP, July 2017)* (SPP) outlines design objectives relating to waterway stability and are shown in the excerpt below in Figure 3.5. The SPP specifies that the waterway stability management design objectives must be met by mitigating the 63.2% AEP peak flows in the post-developed scenario to the pre-development flows *'if development drains to an unlined waterway within or downstream of the site where a risk of increased erosion exists due to changes in hydrology'.*

All waterways within Flagstone City are considered to be unlined waterways, and these are intended to remain as natural channels with waterway works limited to those where it is needed to provide stability and access. Detailed analysis of the waterways surrounding and downstream of the CA5 North development was undertaken to determine if waterway stability management objectives outlined in the SPP apply. The outputs from the Masterplan FMS TUFLOW model were used to determine whether the development will cause increased erosion risks to the waterway if the 63.2% AEP event is discharged unmitigated.

Climatic region	Design objectives Reductions in mean annual load from unmitigated development (%)				
	Total suspended solids (TSS)	Total phosphorus (TP)	Total nitrogen (TN)	Gross pollutants >5mm	Waterway stability management
South East Queensland	80	60	45	90	Limit the peak 1-year ARI event discharge within the receiving waterway to the pre-development peak 1-year ARI discharge
Central Queensland (south)	85	60	45	90	
Central Queensland (north)	75	60	40[15]	90	
Cape York[14], wet tropics and dry tropics	80	60[16]	40	90	
Western Queensland[14]	85	60	45	90	

Notes:

- Mapping of climatic regions is available on the State Planning Policy Interactive Mapping System.
- In lieu of modelling, the default bio-retention treatment area to comply with load reduction targets for all Queensland regions in 1.5 per cent of the contributing catchment area.
- Water stability objective applies if development drains to an unlined waterway within or downstream of the site where a risk of increased erosion exists due to changes in hydrology. Local government may also require application of the waterway stability objective where there are planned future rehabilitation works to return a lined channel to a natural channel design.
- The SPP Water quality guidance material provides advice on the measures that demonstrate compliance with table B.

Figure 3.5: Waterway Stability Design Objectives (SPP July 2017, DILGP)

GIS processing of the Masterplan FMS Baseline (B01) Scenario and Masterplan (M01) Scenario flood velocity results was undertaken to identify any waterway areas at risk of increased erosion due to changes in catchment hydrology. An automated GIS process was applied to the flood velocity results to identify areas based on the following criteria thresholds:

- Masterplan (M01) Scenario flood velocities > 1.5 m/s, and
- Masterplan (M01) – Baseline (B01) Scenario flood velocity afflux > 0.1 m/s.

The adopted flood velocities are considered appropriate to identifying areas at risk of erosion within a vegetated natural waterway, based on the values shown in

Table 3.3.

The GIS process was applied for the 1%, 2%, 50%, and 63.2% AEP flood events to determine the erosion risk extent for a range of relevant design events. Each of the output trigger areas were combined into a single polygon identifying where any of these events predicts an increase in erosion downstream of the CA5 North DA area.

The erosion risk flood extent area overlaid on the four design event AEPs of interest are provided in Figure 3.6 to Figure 3.7 below. The magenta hatched areas identify where increased erosion risk due to changes in catchment hydrology might be present across all the assessed AEPs. A summary of the results is provided below:

- There are two model cells upstream of Structure 4 that meets the threshold criteria triggers within a waterway and therefore predicts potential erosion risk. It is noted that this is within the vicinity of a head cut that is proposed to be stabilised and is discussed in Section 3.2.4.
- There are three model cells upstream of Structure 1 that meets the threshold criteria triggers within a waterway. These are extremely isolated and not anticipated to cause any meaningful erosion.

Due to the insignificant magnitude and extremely isolated areas where increased erosion risk may be present, it is considered that the criteria of the SPP for applying the waterway stability objectives does not apply. As such, it is therefore proposed that Q1 detention basins and subsequent mitigation of the 63.2% AEP is not required for CA5 North based on the outcomes of this assessment. This analysis is considered suitable to satisfy the amendments in red associated with the Stormwater IMP Compliance Approval (Ref. DEV2012/209/6/16 dated 23 December 2025).

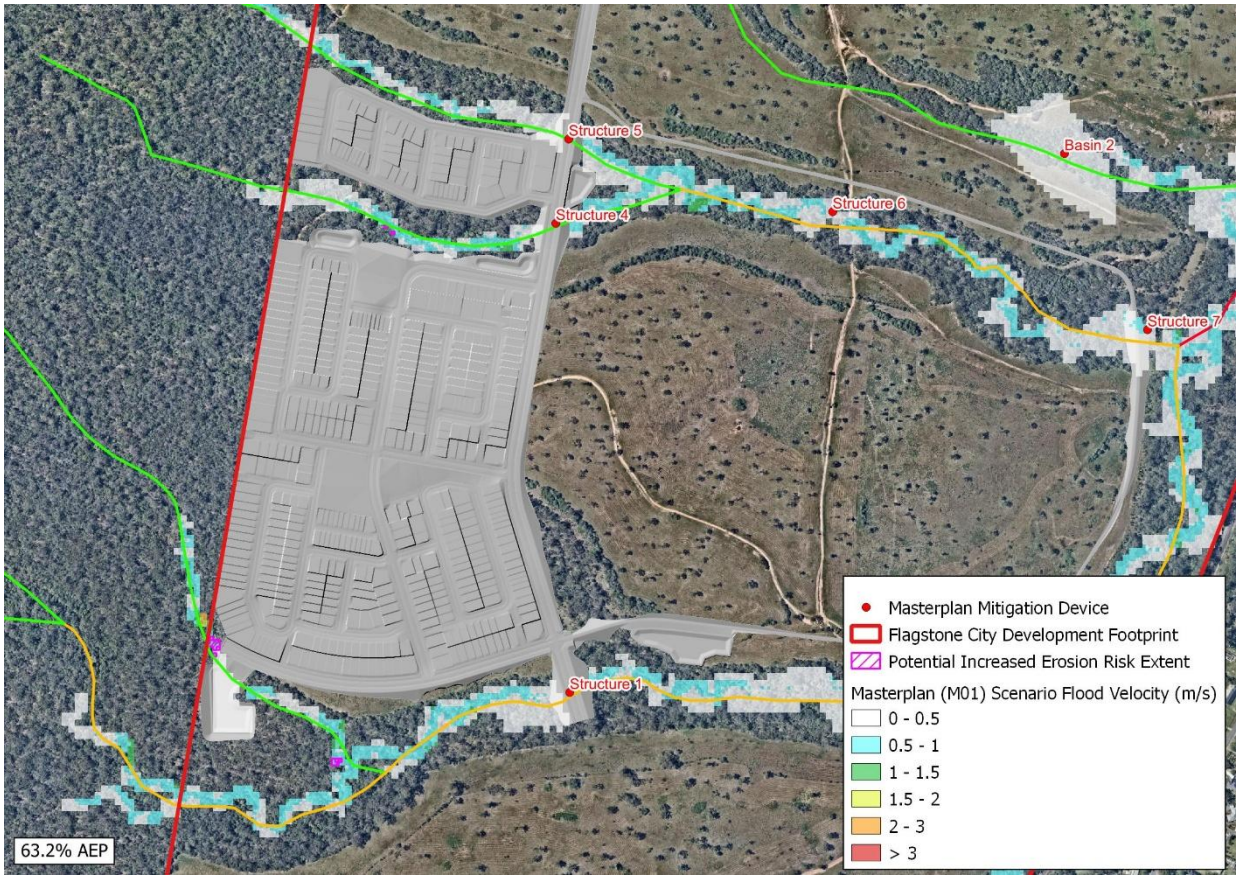


Figure 3.6: 63.2% AEP Erosion Risk Extents

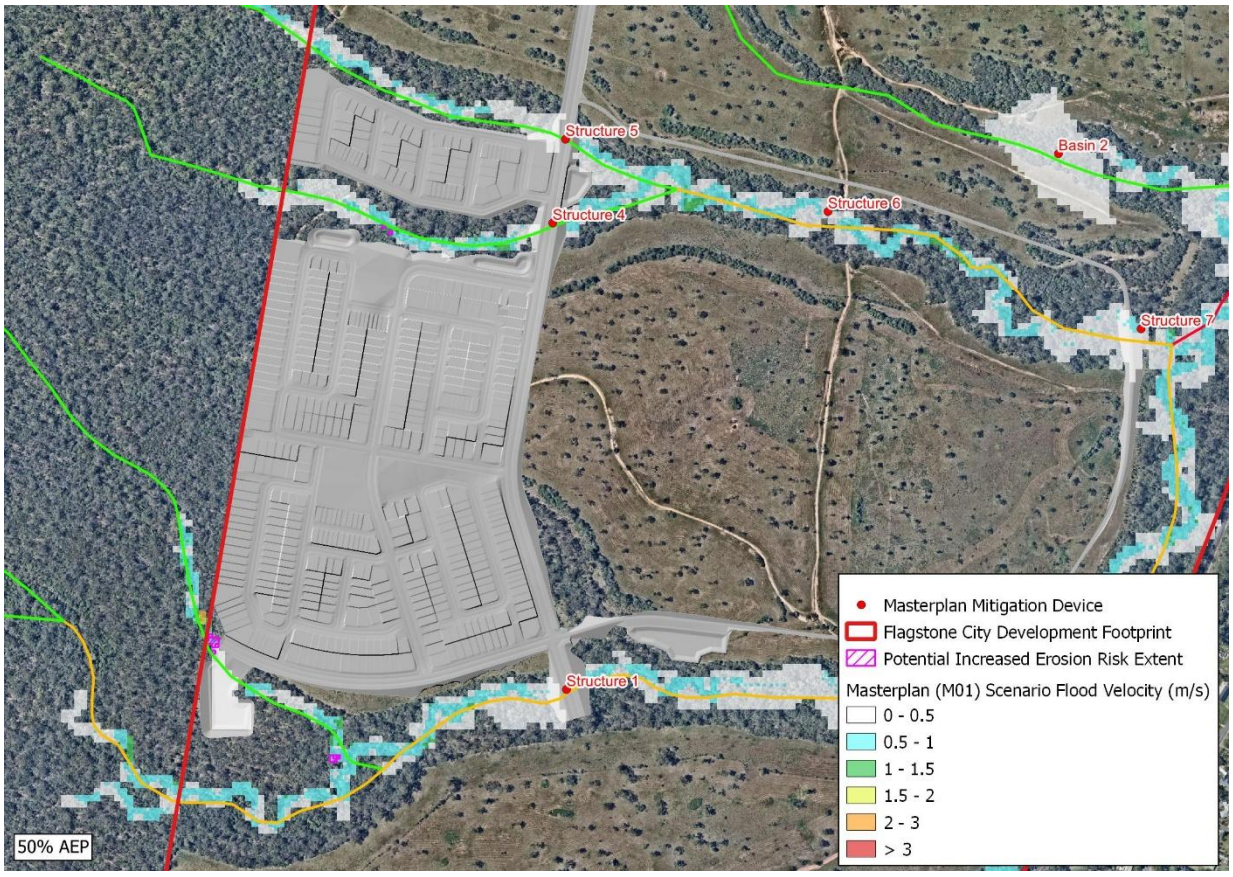


Figure 3.7: 50% AEP Erosion Risk Extents

3.2.4 Waterway Stability Recommendations

The sections of waterway adjacent to Flagstone CA4 were generally stable at the time of inspection. However, development may cause impacts to the stability of the creek if not managed appropriately. It is proposed to generally retain the natural formation of waterways to avoid removal of native vegetation which provides stability and habitat. A concept stability plan is shown in Appendix D, and the following points outline the proposed strategy:

- Provide a minimum 10m wide vegetated buffer to the development from the existing top of bank of retained waterways for stability. Noting that additional riparian buffer width maybe required under the NESS for environmental purposes. The 10m wide vegetated buffer has been based on the site assessment of waterway stability and the location of top of bank and also aligns with requirements of the Logan Planning Scheme SC6.2.5, Section 3.6.2. The recommended buffer provides a site-specific refinement of the waterway corridor provided in the Logan Planning Scheme OM-14.01 overlay map and no development is to occur within the buffer area. Development earthworks should not encroach on the stability buffer. This is with the exception works required for road crossings, stormwater outlets and waterway stability works.
- Provide an increased stability buffer to 15m from existing top of bank in the upstream section of Reach 5 due to the significant vertical banks with dispersive material located downstream of the existing crossing. The increased buffer will provide allowance for both completing recommended stability works and for achieving the minimum 10m buffer from top of bank once works are completed. The increased buffer will also provide additional buffer in areas where stabilisation works are not proposed.
- Retain existing vegetation within the waterway and stability buffer and enhance through infill planting of native riparian vegetation.
- Undertake targeted riparian planting to establish a stability buffer in locations lacking vegetation as outlined in the concept stability plan in Appendix D. Infill planting of the existing riparian buffer has also been recommended in areas where plant density was observed to be lacking.
- Manage steep dispersive banks between locations 1.2 and 2.3 through infill of the rills present in side gullies with topsoil and then planting to enhance existing stability buffer.
- It is recommended that a 1:20 grade fish passage compliant rock chute be installed to replace the western crossing which is to be removed. The rock chute will provide a controlled transition in bed level from upstream to downstream and will also assist in retaining observed existing sand deposits in the channel bed.

- The headcut located at crossing at the upstream extent of Reach 5 (Location 5.1, Figure 2.3) will be stabilised through incorporation of a rock chute to correct the bed level difference and assist in prevent further migration of the headcut.
- Reprofiling and planting of the banks immediately downstream of the headcut in Reach 5 is recommended to stabilise the vertical, dispersive banks and reduce the risk channel widening affecting the development. The extent of the banks to be reprofiled is shown in Appendix D. Where possible, construction access should be via the channel base to limit disturbance to established vegetation within the stability buffer.
- The headcuts and steep exposed banks noted in Reach 6 between locations 6.4 to 6.7 will require stabilisation to address the significant incision and ensure long term stability. It is recommended that rock riffle structures are incorporated within this area to reinstate the bed level and reduce bank heights. This form of stabilisation will reduce the impact to existing riparian vegetation with access into, and disturbance in, the waterway only being required at a couple of locations. Note this stabilisation will also address the potential erosion risk identified in this area through the erosion risk assessment in Section 3.2.3.
- Existing informal vehicle crossing areas should be reprofiled and rehabilitated.
- It is recommended that a rock cut off trench is incorporated at location 6.3 during profiling and rehabilitation works.
- Incorporation of appropriate stabilisation measures at stormwater outlets and culverts. Refer to Section 3.2.5 for additional details on outlet configuration recommendations.
- Riparian areas disturbed by pipe works should be rehabilitated to its original state with consideration for dispersive soils.
- Where road crossings are proposed, incorporation of a rock trench is recommended at the end of the downstream scour protection to provide protection to the asset from future potential headcut erosion.
- Dense rehabilitation planting should occur in waterway locations where weed removal is undertaken under a weed management plan to prevent erosion.
- All works within the waterway should adopt amelioration recommendations provided within the site dispersive soils management plan.

3.2.5 Outlet Configuration

Local stormwater outlet points will need to be designed to consider the effects on the waterway. The following should be considered when designing the outlet configuration:

- Align stormwater outlet works with areas in the riparian corridor and stability buffer already disturbed or requiring stabilisation. As an example, outlet works may seek to align with existing vehicle crossings requiring remediation or proposed road crossings. This approach seeks to limit impacts to riparian vegetation providing stability to the bank.
- Where the above outcome cannot be achieved, disturbance corridors (e.g. pipe trenches, rock chutes) within the stability buffer and riparian corridor should be limited as far as practical.
- Where possible, pipes should outlet into the waterway just above the channel invert. Consideration of mobile bed depths should be made to ensure pipes remain as low as possible while remaining free from blockage due to natural sedimentation and variations in bed level. A pipe invert approximately 300-500mm above the bed is recommended.
- Flow from any piped discharge location should be directed into the waterway as close as feasibly possible to the direction of flow. An approach angle of 45-60 degrees to the direction of flow is recommended to minimise scour of the bed and opposite bank.
- Any surface over which discharge occurs should be stabilised using appropriate erosion control measures.
- Control of overbank flow entry points will be required with appropriately sized rock chutes, having consideration for dispersive soils. The works should tie neatly into the existing bank and bed.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The above visual and quantitative assessment of the study area has assisted in informing the stabilisation strategy for the waterway. The following items summarise the findings and recommendations:

- The geomorphology assessment undertaken noted minor stability issues within isolated locations in the study area.
- A minimum 10m wide vegetated stability buffer from existing top of bank is proposed to all retained waterways, in addition to an extended 15m wide buffer in the upstream section of Reach 5. The minimum 10m wide buffer is in alignment with the requirements of the Logan Planning Scheme.
- The results of the waterway stability and erosion risk assessment indicate that the criteria of the SPP for applying the waterway stability objectives does not apply. As such, it is therefore proposed that Q1 detention basins and subsequent mitigation of the 63.2% AEP is not required for CA5 North based on the outcomes of this assessment. This analysis is considered suitable to satisfy the amendments in red associated with the Stormwater IMP Compliance Approval (Ref. DEV2012/209/6/16 dated 23 December 2025)
- Existing vegetation within the waterway and stability buffer will be retained and enhanced through infill planting with native riparian vegetation.
- Stability issues noted should incorporate stabilisation advice as detailed in Section 3.2.4
- Outlet configuration into the waterway should consider recommendations outlined in Section 3.2.5
- Any hydraulic impacts to upstream and downstream reaches were identified as negligible, suggesting that any impacts to channel morphology that may occur following the development are unlikely to be a result of the development, provided that best practice construction is adhered to at outlet structures and the stability recommendations provided herein are adopted.

5. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

  (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

  (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

(e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

(f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

(g) This Report does not provide legal advice.

6. REFERENCES

Catchments and Creeks Pty Ltd, (2014). Turf Reinforcement Mats.

DNRME, (2019). Guideline: Works that interfere with water in a watercourse – watercourse diversions

Fischenich. C (2001). Stability Thresholds for Stream Restoration Materials.

Institute of Public Works Engineering Australasia (IPWEA) (2017). Queensland Urban Drainage Manual.

APPENDIX A: SITE ASSESSMENT PHOTOS

A.1 Sandy Gully



Location 1.1 – Rock control in bed



Location 1.2 – Wide channel with steep dispersive banks upstream of crossing



Location 1.3 – Stormwater conveyance beneath crossing not visible



Location 1.4 – Chain of ponds area with well vegateted buffers



Location 1.5 – Crossing location. Scour hole downstream and failed pipe.



Location 1.6 – Stable area with evidence of previous rehabilitation

A.2 Reach 1



Location 2.1 – Crossing location (showing previously dumped rock downstream of crossing)



Location 2.1 – Rock control in bed and banks



Location 2.3 – Minor headcut



Location 2.4 – Failed rock protection



Location 2.5 – Steep banks with minimal vegetated buffer



Location 2.6 – Side gully with existing fallen rock protection



Location 2.7 – Steep banks with minimal buffer. Erosion behind rock in banks noted.



Location 2.8 – Steep banks with rock but minimal existing buffer above TOB



Location 2.9 – Existing dumped rock observed upstream of head cut



Location 2.10 – Localised eroded bank with minimal buffer



Location 2.11 – Localised steep bank with rock at toe



Location 2.12 – Rock in bank



Location 2.13 – Localised steep dispersive bank



Location 2.14 – Moderate sloped bank lacking ground cover



Location 2.15 – Existing dumped rock possibly used to stabilise head cut



Location 2.16 – Existing rock protection

A.3 Reach 3



Location 3.1 - Area is well vegetated with no obsevered instabilities

A.4 Reach 4



Location 4.1 – Localised erosion of banks



Location 4.2 – Moderate erosion in bank with rock at toe



Location 4.3 – Dispersive banks with undermining



Location 4.4 – Crossing location (looking downstream)



Location 4.5 – Moderate banks with rock observed in channel and banks



Location 4.6 – Rock outcrops in banks and channel



Location 4.7 – Localised steep bank with undermining



Location 4.8 – Existing rock protection at sewer crossing

A.5 Reach 5



Location 5.1 – Crossing impacted by headcut erosion with significant erosion downstream. 3m drop downstream of crossing



Location 5.2 – Significant vertical dispersive banks both sides.



Location 5.3 – Undermining of banks



Location 5.4 – Vertical dispersive banks with undermining both sides of waterway



Location 5.5 – Localised vertical exposed banks with some dispersive properties



Location 5.6 – Moderate banks but well vegetated

A.6 Reach 6



Location 6.1 – Moderate banks but well vegetated



Location 6.2 – Waterbody on north side of waterway



Location 6.3 – Bed level crossing (looking downstream)



Location 6.4 – Headcut 1m



Location 6.5 – Erosion head in side drainage path. Vegetation providing stability



Location 6.6 – Weathered rock in bed, moderate banks with dispersive properties



Location 6.7 – Vertical bank north side with dispersive properties. Well vegetated.



Location 6.8 – Rock control with scour hole immediately downstream

APPENDIX B: SARA PRE-LODGEMENT ADVICE – REACH 1

Queensland Government

SARA reference: 2403-39339 SPL
Applicant reference: PR110056

13 May 2024

PEET Flagstone City Pty Ltd
c/- RPS AAP Consulting Pty Ltd
emma.gurney@rpsgroup.com.au

Attention: Ms Emma Gurney

Dear Ms Gurney

Amended SARA Pre-lodgement advice - 71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark Ridge

I refer to your pre-lodgement request received on 1 March 2024 in which you sought pre-lodgement advice from the State Assessment and Referral Agency (SARA) regarding the proposed development at the above address. This notice provides advice on aspects of the proposal that are of relevance to SARA.

On 29 April 2024, the proponent requested SARA issue amended pre-lodgement advice including 2 Queensland low (green) waterways for clarity when identifying waterway barrier works in the future. To support this request, the proponent submitted an amended plan with coordinates where the 2 waterways intersect with the boundaries of investigation areas 1 and 2. SARA has annotated this plan, so it is clear there are no waterways present above these coordinates.

SARA's understanding of the project

It is understood the proponent is seeking to establish development under the Greater Flagstone Priority Development Area Development Scheme at 71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark more formally described as Lots 907 and 50050 on SP332140 and Lot 989 on RP854074 (the site).

The site contains additional Queensland low (green) waterways on the recently released updated Queensland waterway mapping on the Development Assessment Mapping System (DAMS). The proponent has advised the environmental features on the site have been investigated and considered to inform the detailed planning for several approvals and applications over the site.

Planning and Development Services
(SEQ South)
Level 9, 12-14 Marine Parade, Southport
PO Box 3290, Southport BC QLD 4215

The proponent has provided a Waterway Investigation Report, prepared by Fishology and dated 29.02.2024, and supplementary information to confirm the presence and extent of DAMS Queensland waterways on the site. The proponent requests SARA's confirmation that the revised waterways presented by Fishology are acceptable, and any works outside this are not considered to constitute waterway barrier works.

Supporting information

The advice in this letter is based on the following documentation that was submitted with the pre-lodgement request.

Drawing/report title	Prepared by	Date
Waterway Mapping within PEET Land of the Greater Flagstone PDA Request for Prelodgement Meeting with SARA (reference: PR110056)	RPS	1 March 2024
Waterway investigation within the proposed Flagstone City Centre/Context Area 4 and Context Area 3 – Lots 989 RP854074, 50050 SP332140 and 907 SP332140	Fishology	29.02.2024
Attachment 2a – Context Area 1 (Investigation Area 1)	-	-
Attachment 2b – Context Area 4 and TC (Investigation Area 2)	-	-
Email received 18/03/2024 with attachments: Attachment 1 – Response Table _18 March 2024 Attachment 2 – Waterway Mapping Attachment 3 – Concept Plans	Louisa Sloan RPS	18/03/2024
Email received 21/03/2024 with attachment: DAF comments to RFI response by Fishology	Louisa Sloan RPS	21/03/2024
Email received 28/03/2024 with attachment: Flagstone waterway investigation_survey 2_Final_28-3-2024	Louisa Sloan RPS	28/03/2024
Email received 2/05/2024 with attachment: Flagstone waterway mapping 30 4 2024	Louisa Sloan RPS	2/05/2024

Pre-lodgement advice

The following advice outlines the aspects of the proposal that are of relevance to SARA.

SARA's jurisdiction and fees	
1.	Under the Planning Regulation 2017, works involving constructing or raising waterway barrier works must be undertaken in accordance with the relevant accepted development requirements (ADR) or under a development approval (assessable development). In the instance any works do not comply with the ADR, a development permit will be required for constructing or raising waterway barrier works. In this instance, lodgement to SARA as the assessment manager is required under the following provision of the Planning Regulation: • Schedule 10, Part 6, Division 4, Subdivision 2, Table 1, Item 1 – Operational works for waterway barrier works. The associated fee is unable to be determined at this stage, as the application fee depends on the nature of the work. To assist with determining the correct fee for a development

	application, a schedule of fees converting the fee units to dollar values is available on the Department of Housing, Local Government, Planning and Public Works website available at: https://dsdmipprd.blob.core.windows.net/general/planning-regulation-2017-fee-schedule.pdf.
Key matters and action items	
2.	The Waterway Investigation Report, prepared by Fishology and dated 29.02.2024, provides evidence of the upper extent of the waterways through surveys for the presence of habitat throughout the length of the waterways and via a fish survey on the site. Based on the results of these surveys, the Department of Agriculture and Fisheries (DAF) agrees with the proponent that the 'upper limit' of 3 waterways for which advice was sought (**Attachment 1**) is: • Lot 989 on RP854074: -27.79453S 152.83141E (**Attachment 2**) • Lot 907 on SP332140: -27.81204S 152.93911E and -27.7852S 152.9568E (**Attachment 3**). In addition, DAF also agrees that 2 waterways are not present above the coordinates below: • Lot 989 on RP854074: -27.78711S 152.93476E (**Attachment 2**) • Lot 907 on SP332140: -27.8097S 152.9475E (**Attachment 3**). If any work is proposed downstream of the agreed upper limit of the waterway, the works would need to be undertaken as per the ADR, and where this is not possible, would require a development permit. If a development permit is required, the 'SDAP Guideline for State Code 18' is available at: https://www.publications.qld.gov.au/dataset/fisheries-development-activities/resource/36cc6985-f44d-426d-b499-4d20ed606f70, will assist in the preparation of a development application and responding to the relevant Performance Outcomes for assessable development impacting waterways. Note: Some waterway coordinates have changed slightly from the original pre-lodgement advice although this is considered minor.
Lodgement material	
3.	If a development permit is required, it is recommended that the following information is submitted, as a minimum, when lodging an application to SARA: • DA form 1. • Landowner's consent. The prescribed application fees. • Relevant plans as per the DA Forms guide, available at: https://dsdmipprd.blob.core.windows.net/general/guide-da-forms.pdf. Response to State code 18: Constructing or raising waterway barrier works in fish habitats of the SDAP.

This advice outlines aspects of the proposed development that are relevant from the jurisdiction of SARA. This advice is provided in good faith and is:

- based on the material and information provided to SARA
- current at the time of issue
- not applicable if the proposal is changed from that which formed the basis of this advice.

This advice does not constitute an approval or an endorsement that SARA supports the development proposal. Additional information may be required to allow SARA to properly assess the development proposal when a formal application has been lodged.

If you require further information please contact Amanda Hosken, Principal Planning Officer, on (07) 5644 3216 or via email SEQSouthPlanning@dsdilgp.qld.gov.au who will be pleased to assist.

Yours sincerely

Signature placeholder

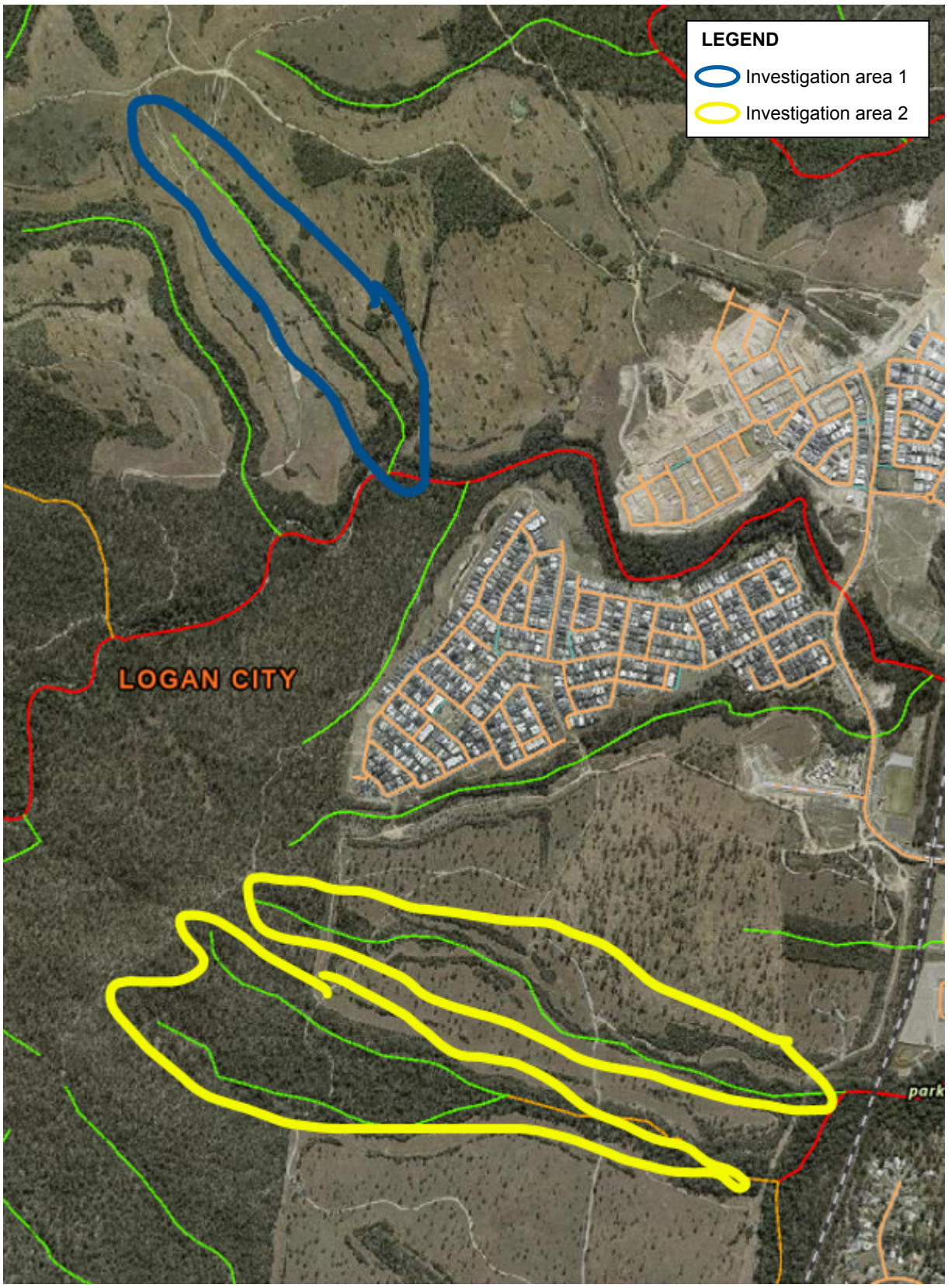
Grace Heatherley
A/Principal Planning Officer, Planning and Development Services (SEQ South)

Encl

Attachment 1 - Waterways for which this advice relates to located in investigation area 1 (blue circle) and investigation area 2 (yellow circles)
Attachment 2 - Coordinates of the agreed upper limit of the waterway in investigation area 1 (circled red) and waterway not present above coordinates on boundary of investigation area 1 (cicled in yellow)
Attachment 3 - Coordinates of the agreed upper limit of the waterway in investigation area 2 (circled red) and waterway not present above coordinates on boundary of investigation area 2 (circled in yellow)

Development details	
Proposal:	Development under the Greater Flagstone Priority Development Area Development Scheme
Street address:	71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark
Real property description:	Lots 907 and 50050 on SP332140 and Lot 989 on RP854074
SARA role:	Assessment Manager
Assessment Manager:	SARA
Assessment criteria:	State code 18 of the SDAP
Existing use:	Unimproved
Relevant site history:	Greater Flagstone Priority Development Area and associated approvals

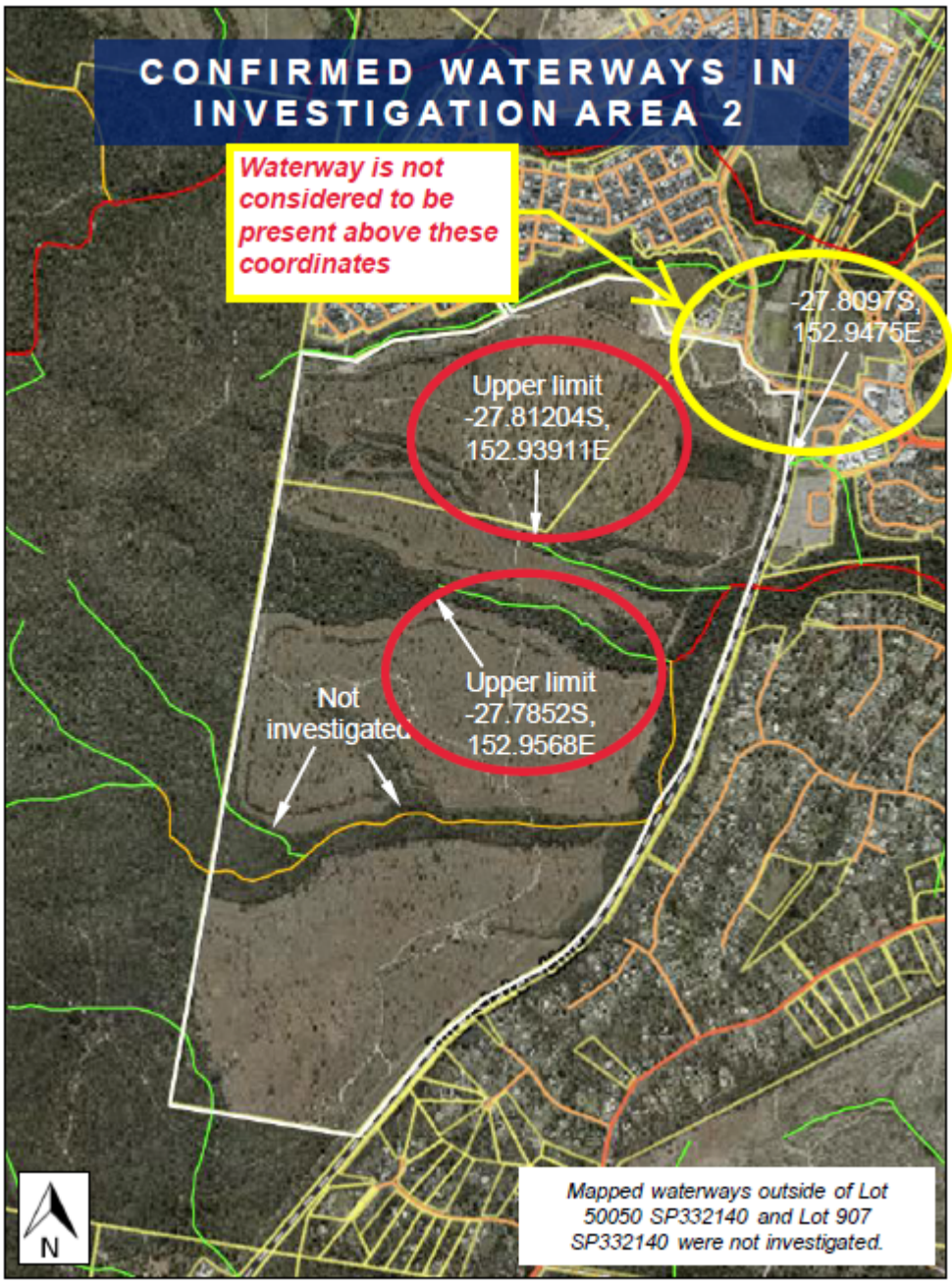
Attachment 1 - Waterways for which this advice relates to in investigation area 1 (blue circle) and investigation area 2 (yellow circles)



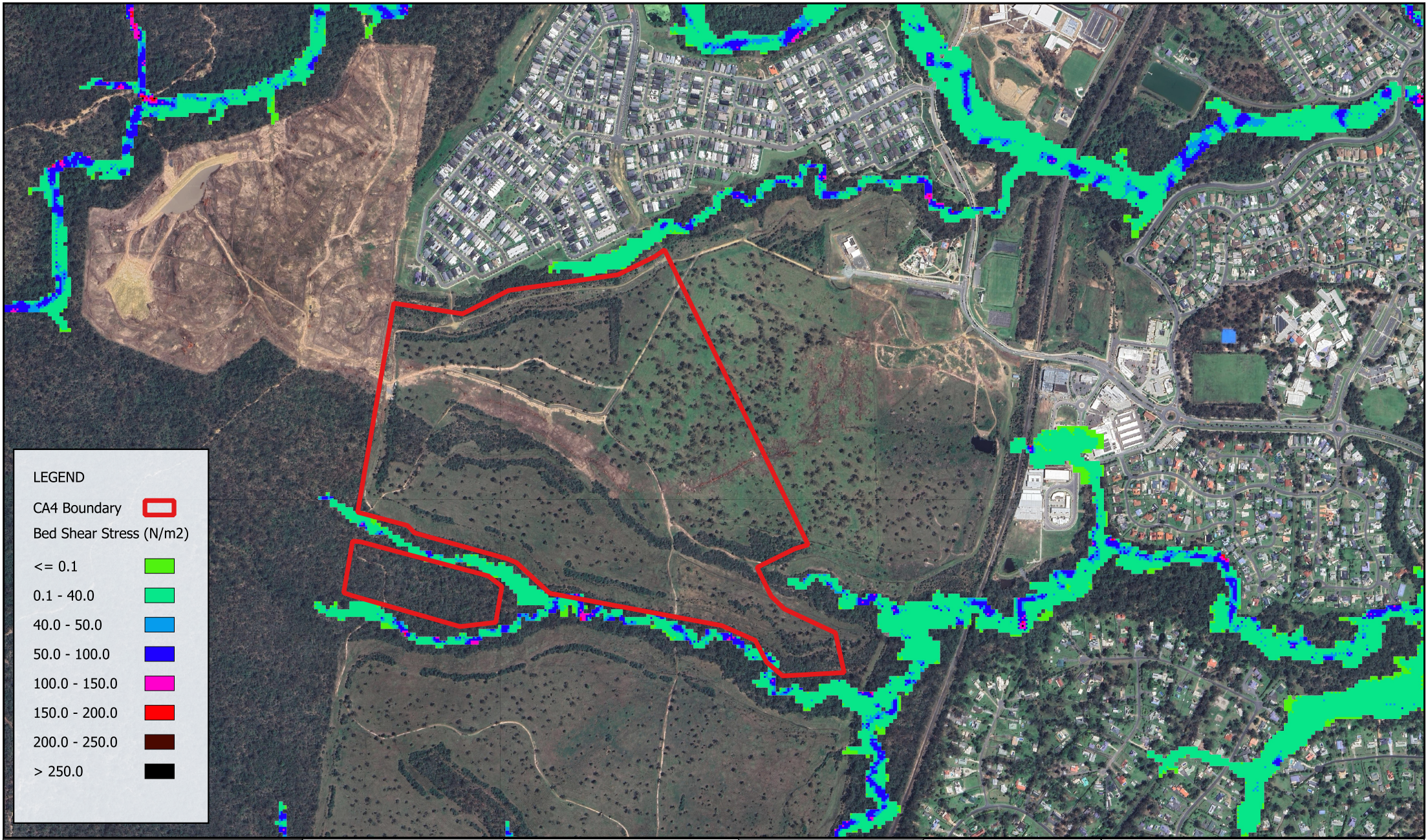
Attachment 2 – Coordinates of the agreed upper limit of the waterway in investigation area 1 (circled red) and waterway not present above coordinates on boundary of investigation area 1 (circled in yellow)



Attachment 3 – Coordinates of the agreed upper limit of the waterway in investigation area 2 (circled red) and waterway not present above coordinates on boundary of investigation area 2 (circled in yellow)


CONFIRMED WATERWAYS IN INVESTIGATION AREA 2
Waterway is not considered to be present above these coordinates
-27.8097S, 152.9475E
Upper limit -27.81204S, 152.93911E
Upper limit -27.7852S, 152.9568E
Not investigated
N
Mapped waterways outside of Lot 50050 SP332140 and Lot 907 SP332140 were not investigated.

APPENDIX C: SHEAR STRESS, STREAM POWER AND VELOCITY MAPPING



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DRAWN	JC	APPROVED	MD
CHECKED	TF	DATE	02-03-2026

NOTES:

0 0.2 0.4 km

SCALE - 1:12,500

GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

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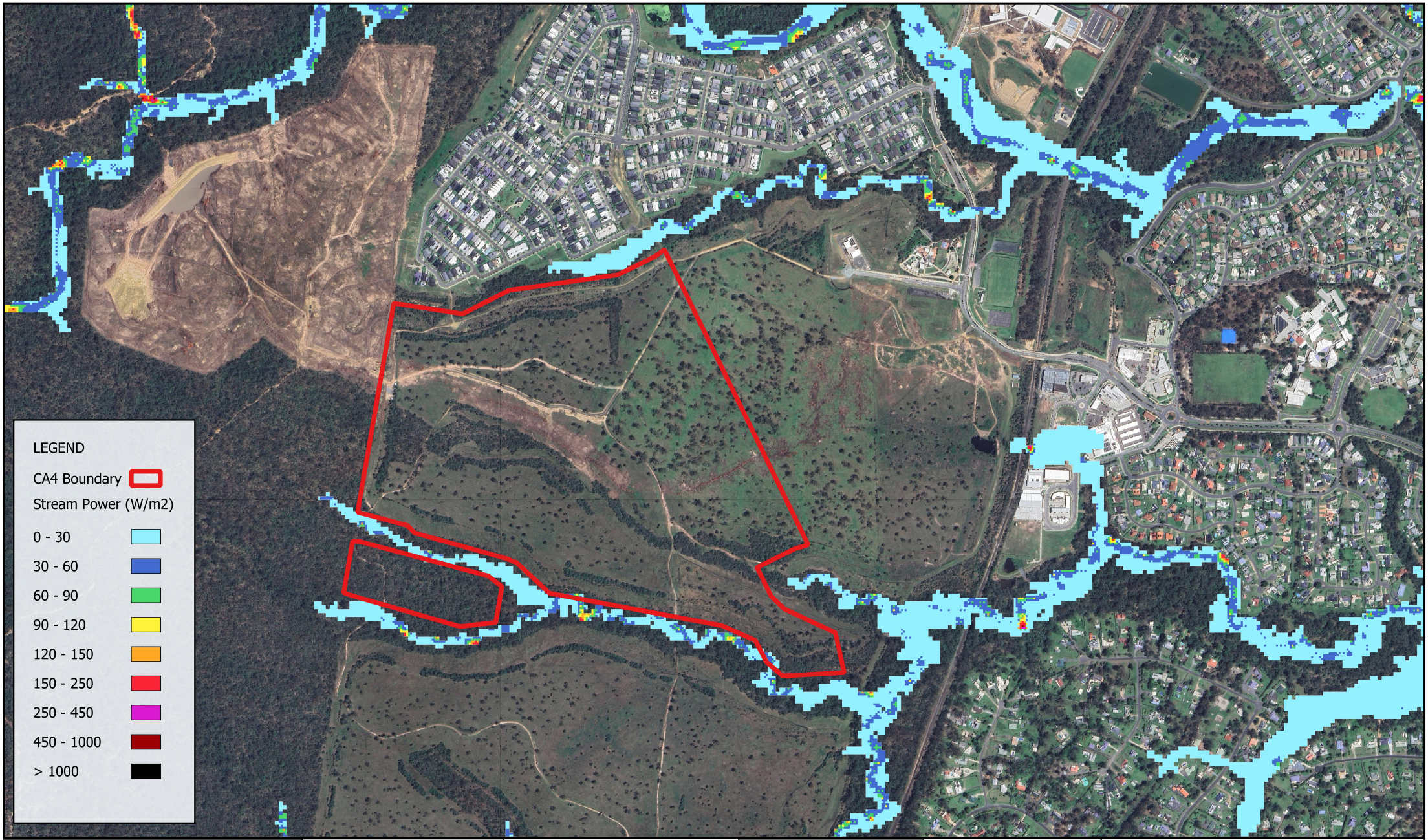
Appendix C

Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
50% AEP Bed Shear Stress

Drg Ref.

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CHECKED	TF	DATE	02-03-2026

NOTES:

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SCALE - 1:12,500

GDA94 / MGA zone 56

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DATA SOURCE
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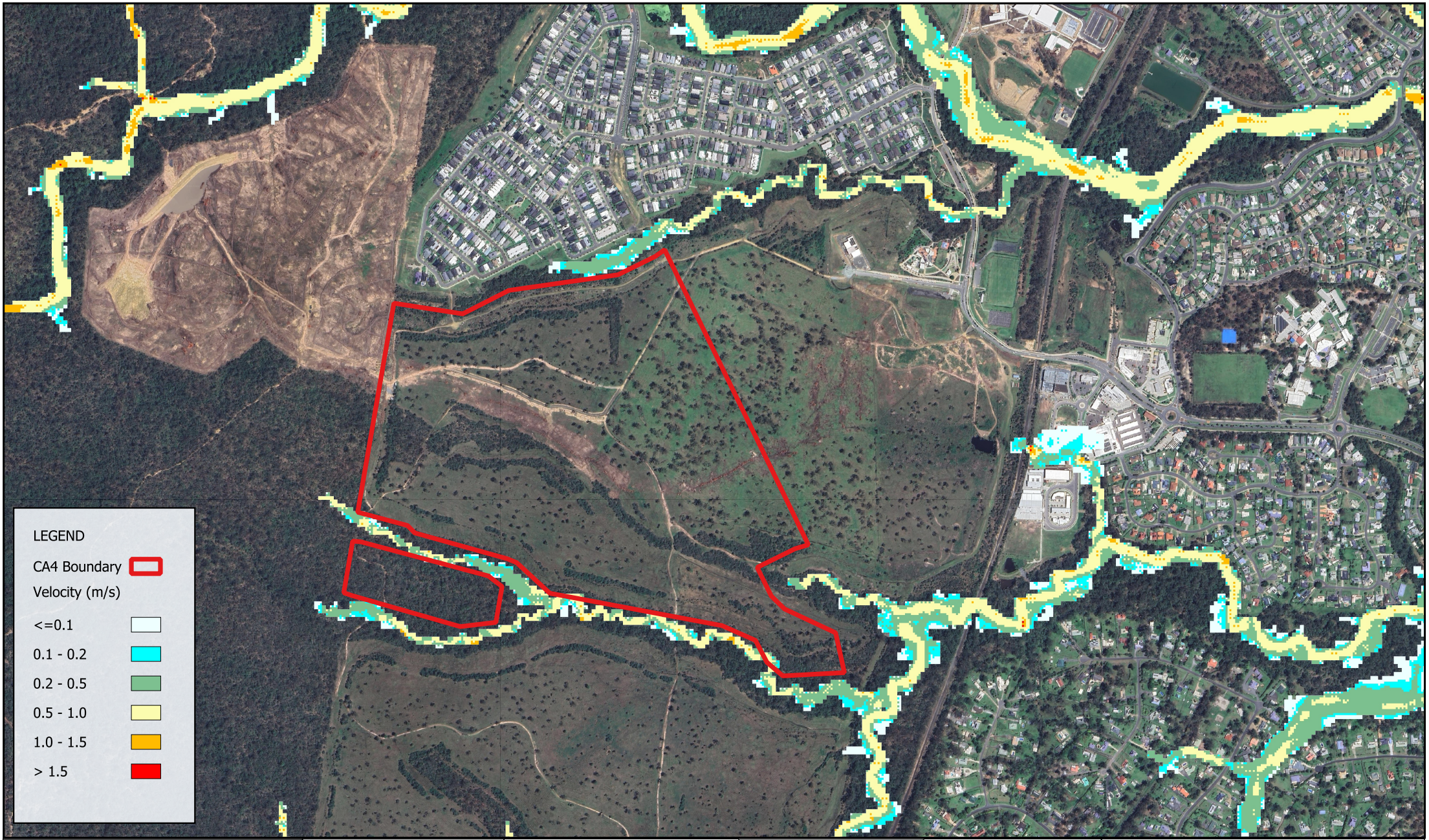
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Appendix C

Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
50% AEP Stream Power

Drg Ref.



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CHECKED	TF	DATE	02-03-2026

NOTES:

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SCALE - 1:12,500

GDA94 / MGA zone 56

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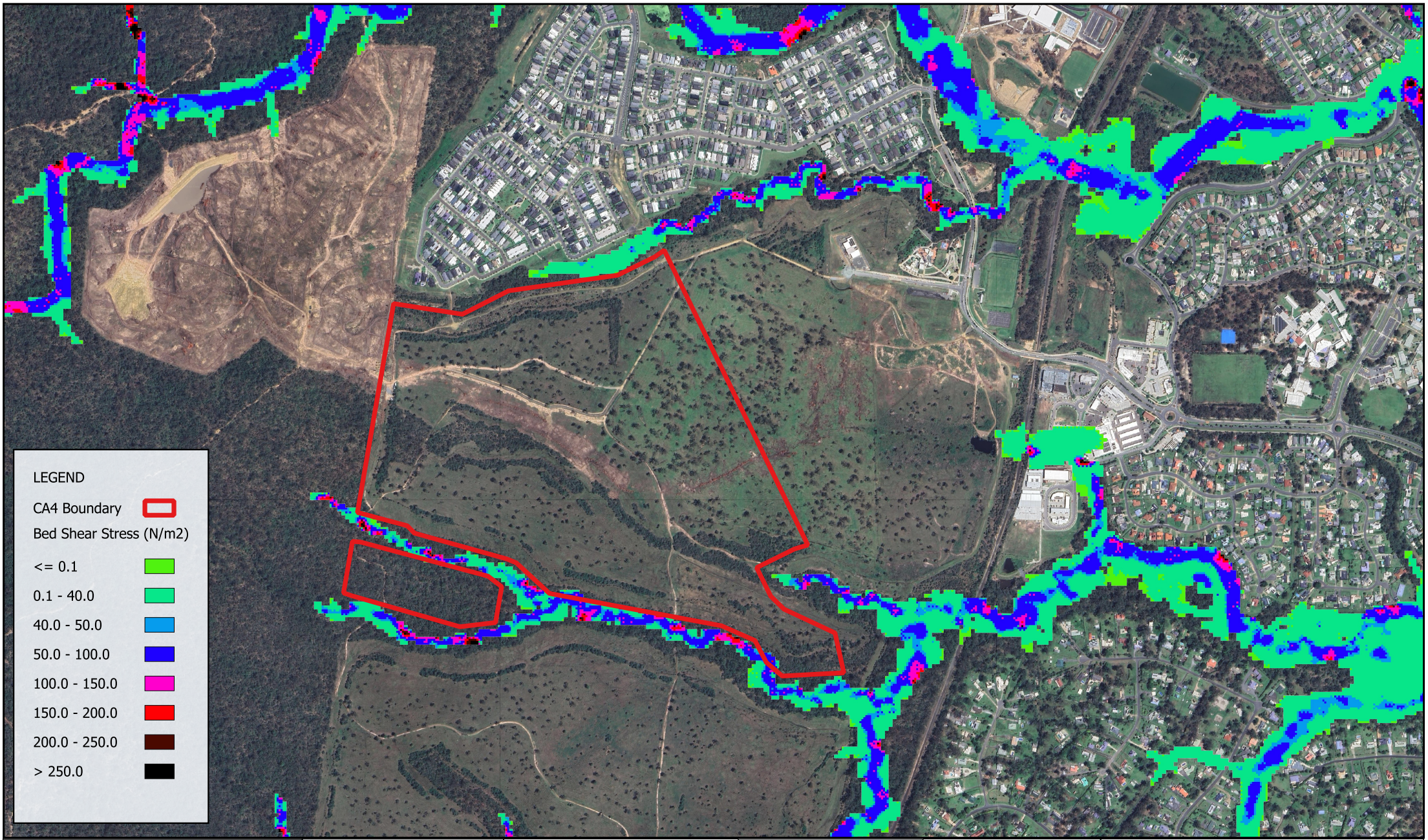
Appendix C

Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
50% AEP Velocity

Drg Ref.

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DRAWN	JC	APPROVED	MD
CHECKED	TF	DATE	02-03-2026

NOTES:

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SCALE - 1:12,500

GDA94 / MGA zone 56

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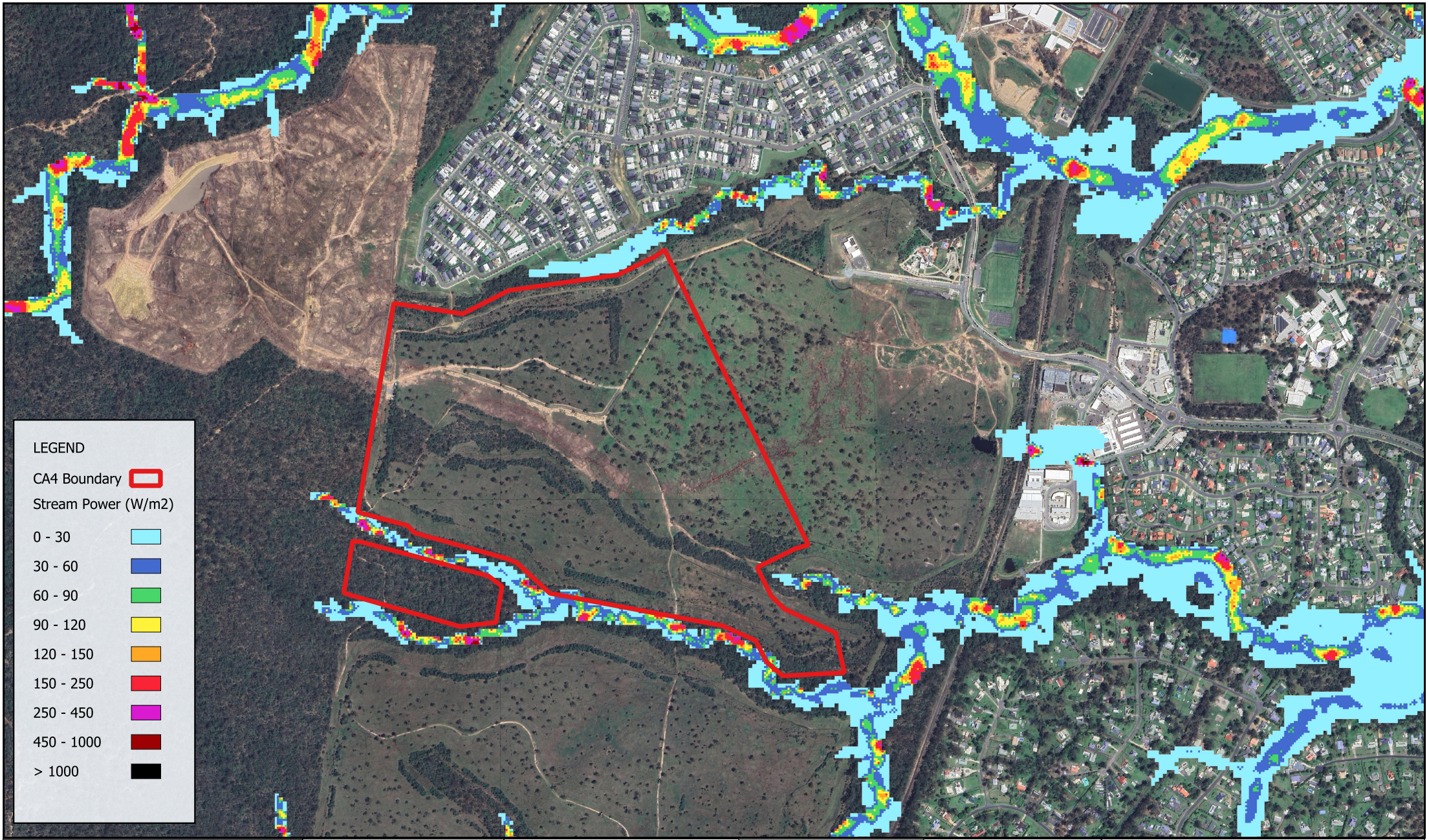
Appendix C

Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
2% AEP Bed Shear Stress

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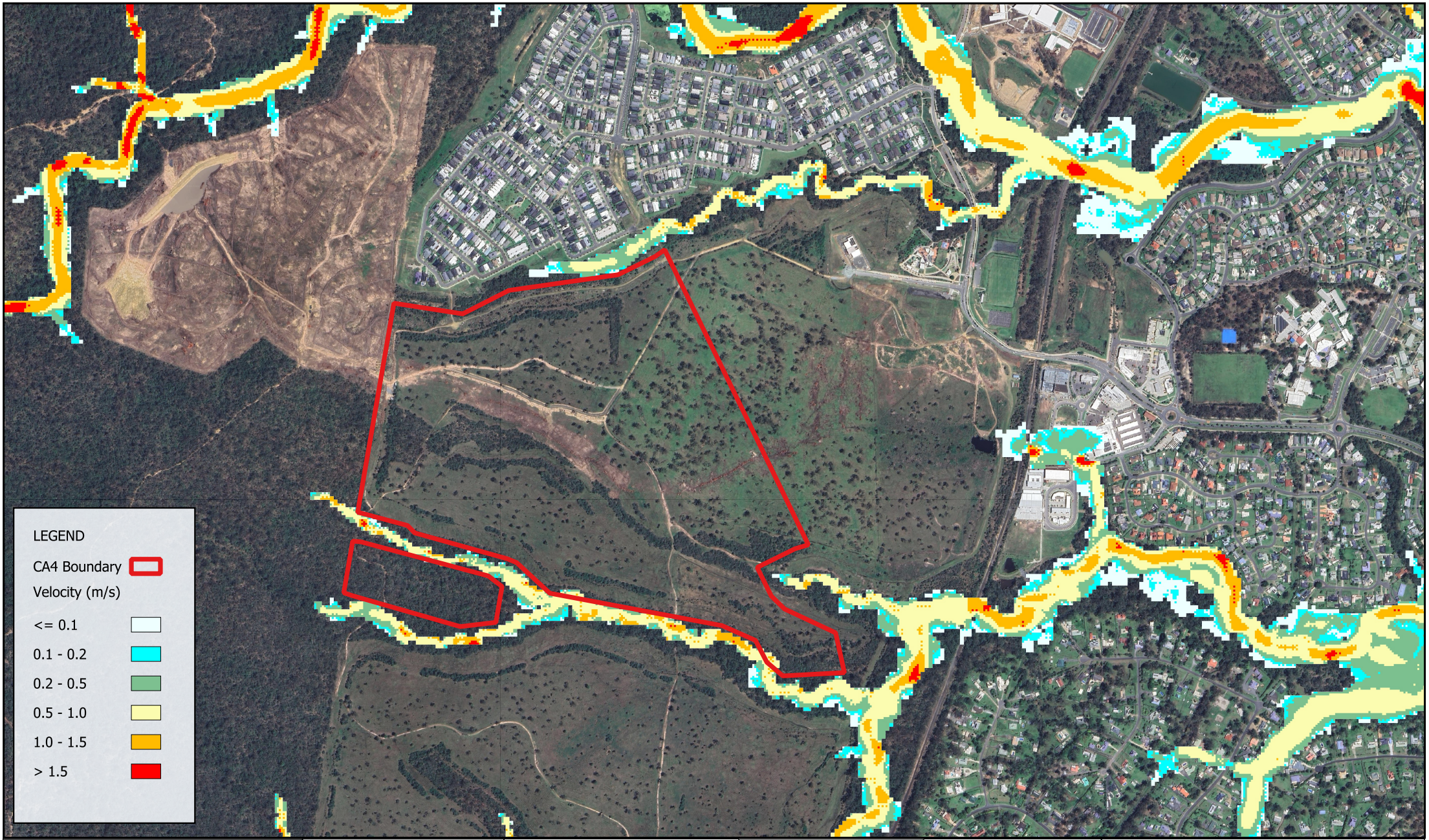
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Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
2% AEP Stream Power

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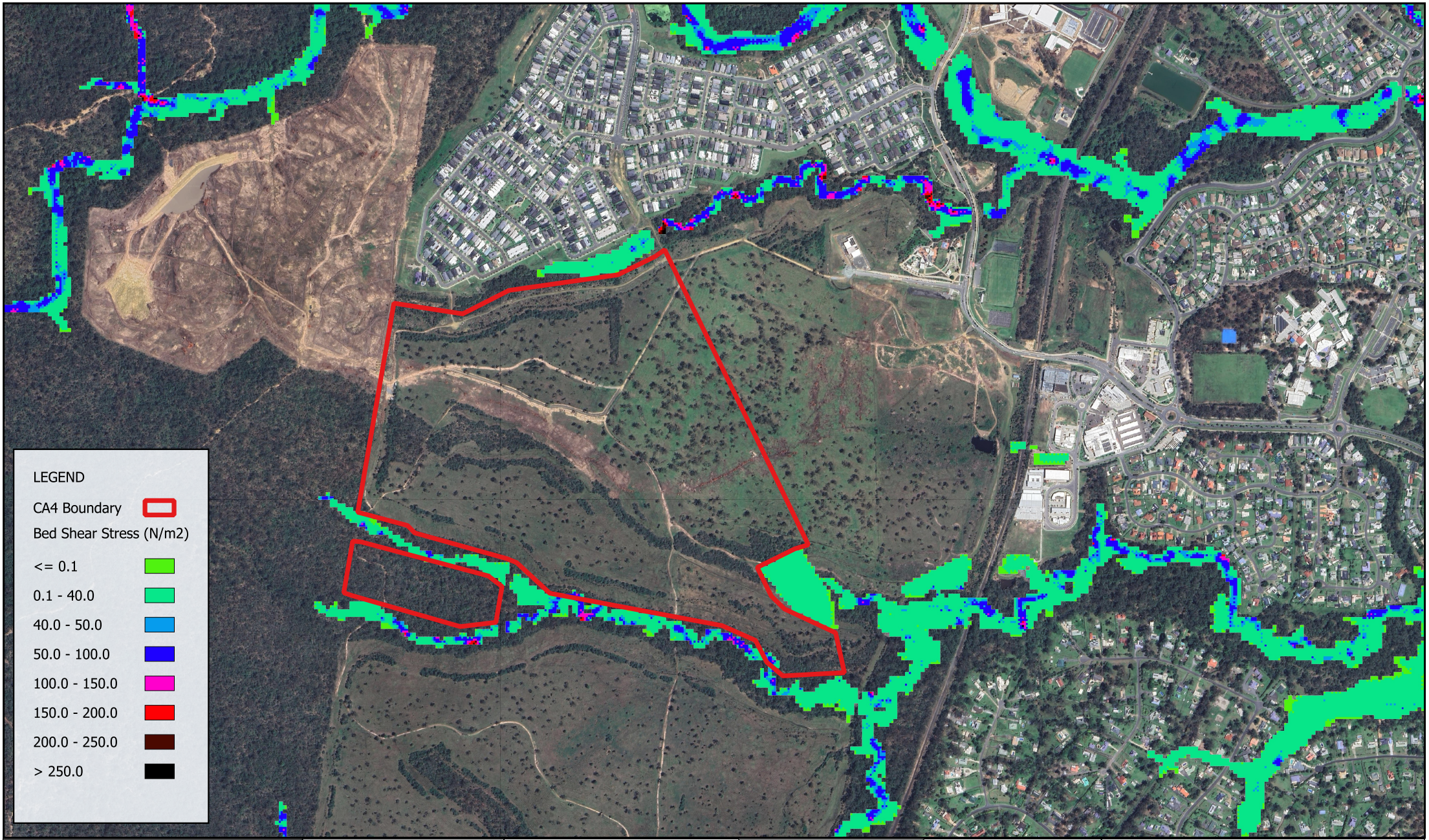
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Flagstone Creek CA4
Waterway Stability Assessment

Baseline Scenario
2% AEP Velocity

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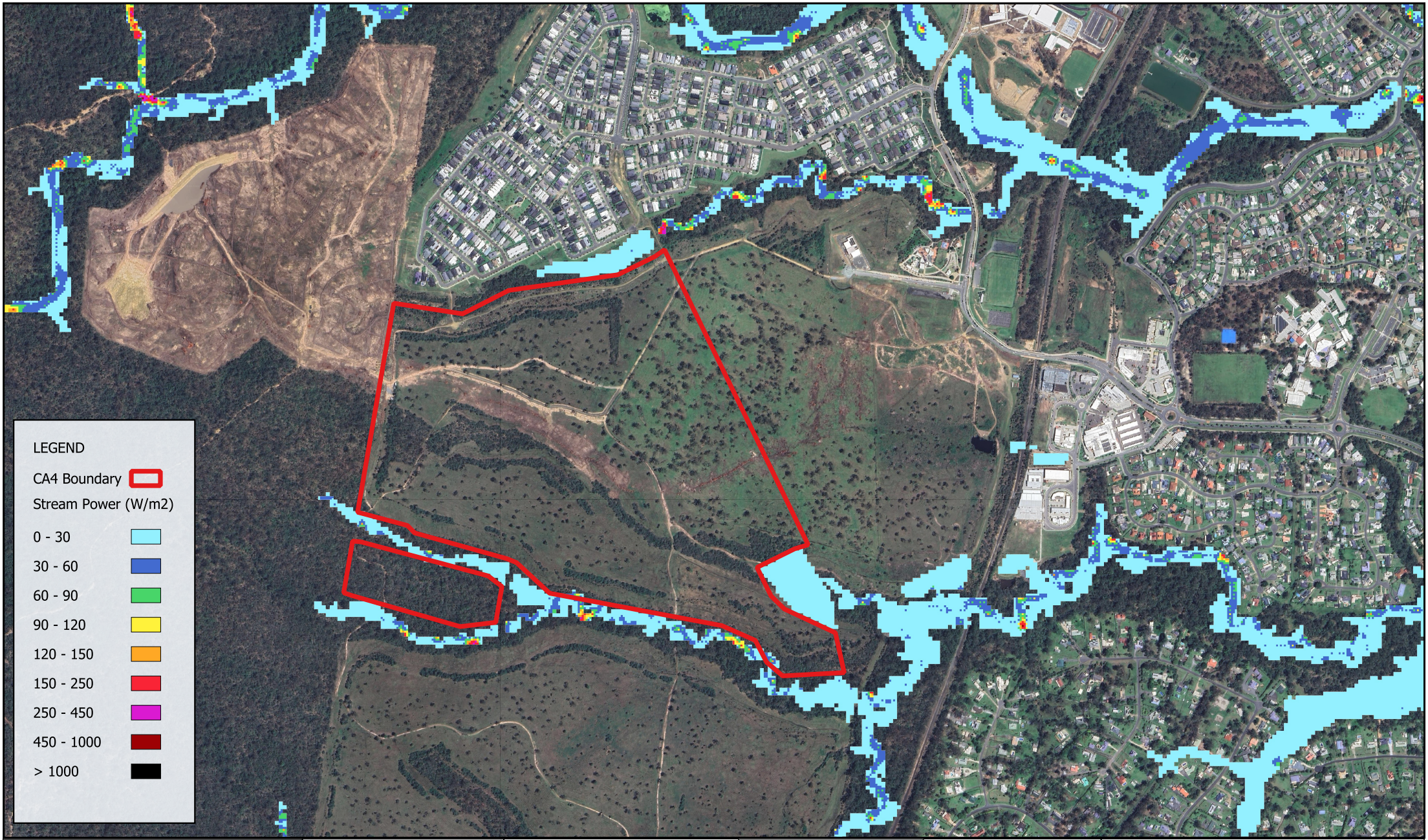
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Flagstone Creek CA4
Waterway Stability Assessment

Masterplan Scenario
50% AEP Bed Shear Stress

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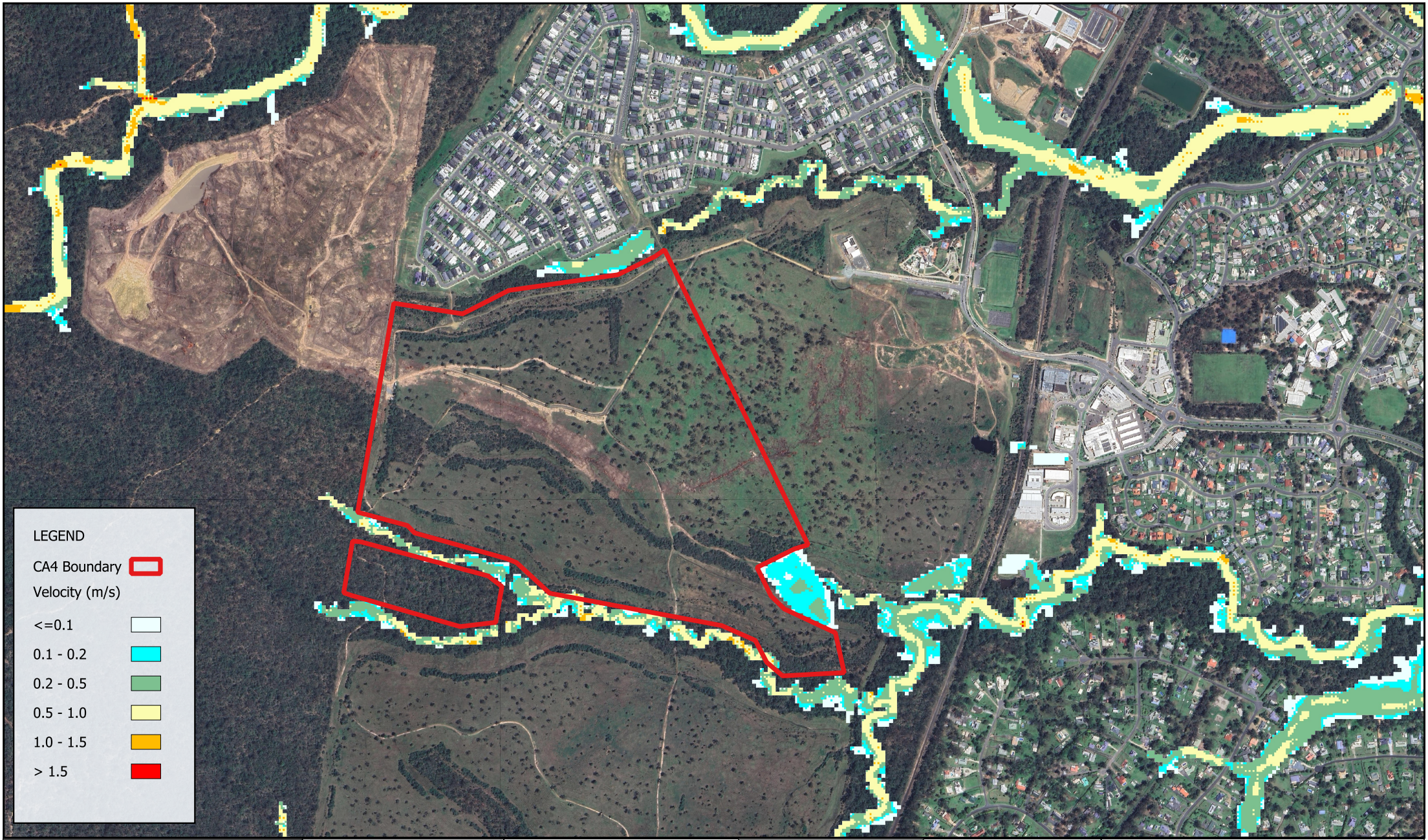
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Flagstone Creek CA4
Waterway Stability Assessment

Masterplan Scenario
50% AEP Stream Power

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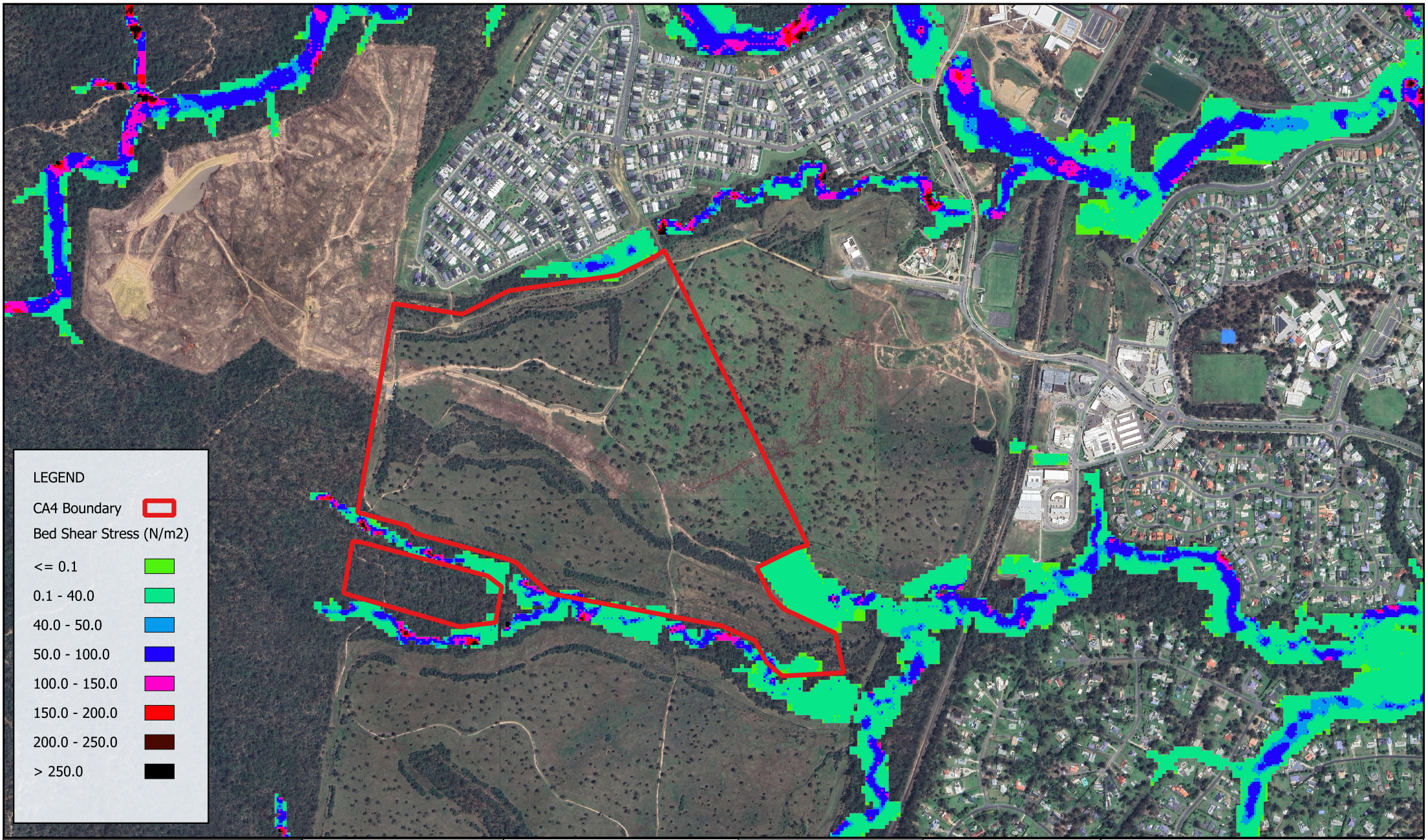
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Flagstone Creek CA4
Waterway Stability Assessment

Masterplan Scenario
50% AEP Velocity

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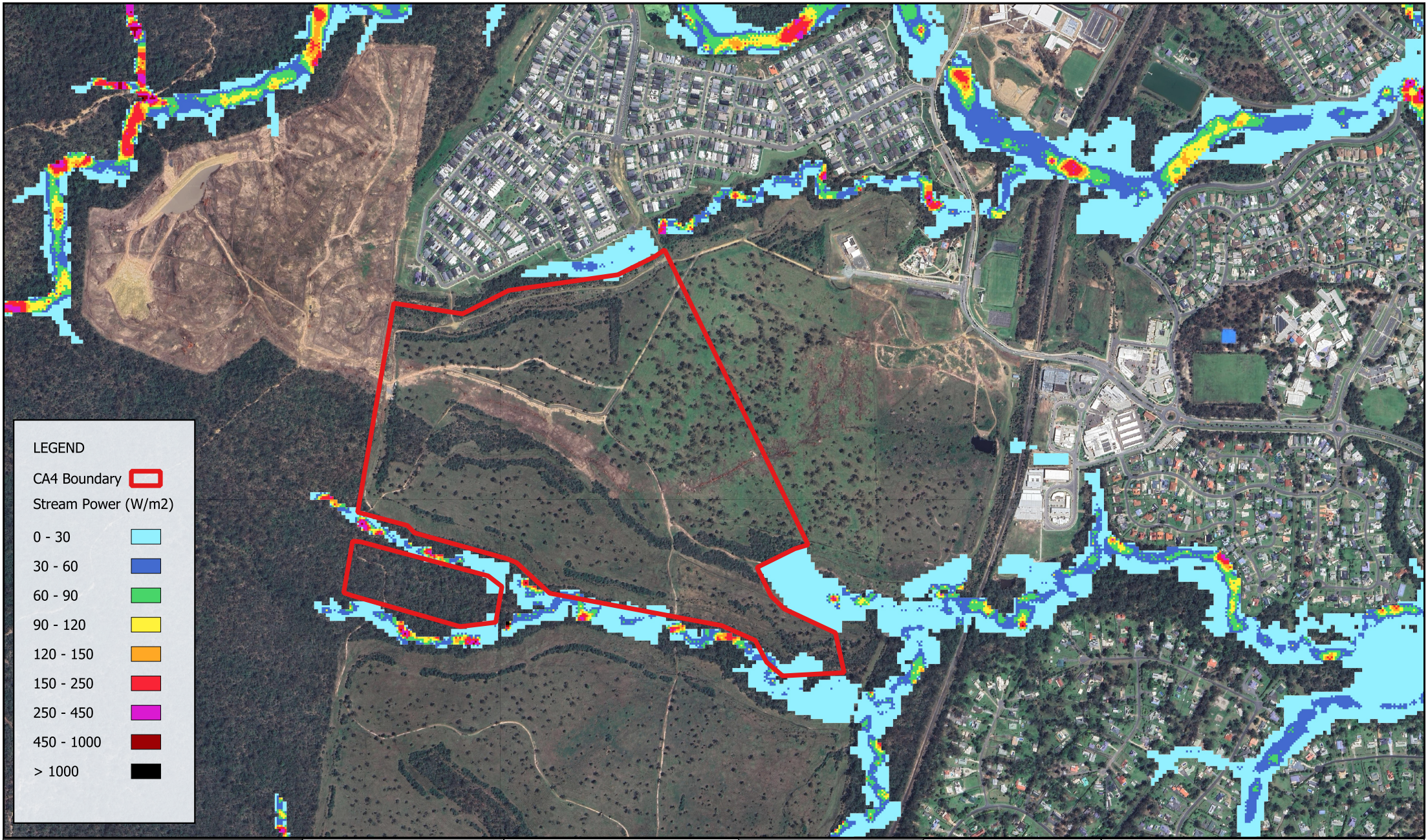
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Flagstone Creek CA4
Waterway Stability Assessment

Masterplan Scenario
2% AEP Bed Shear Stress

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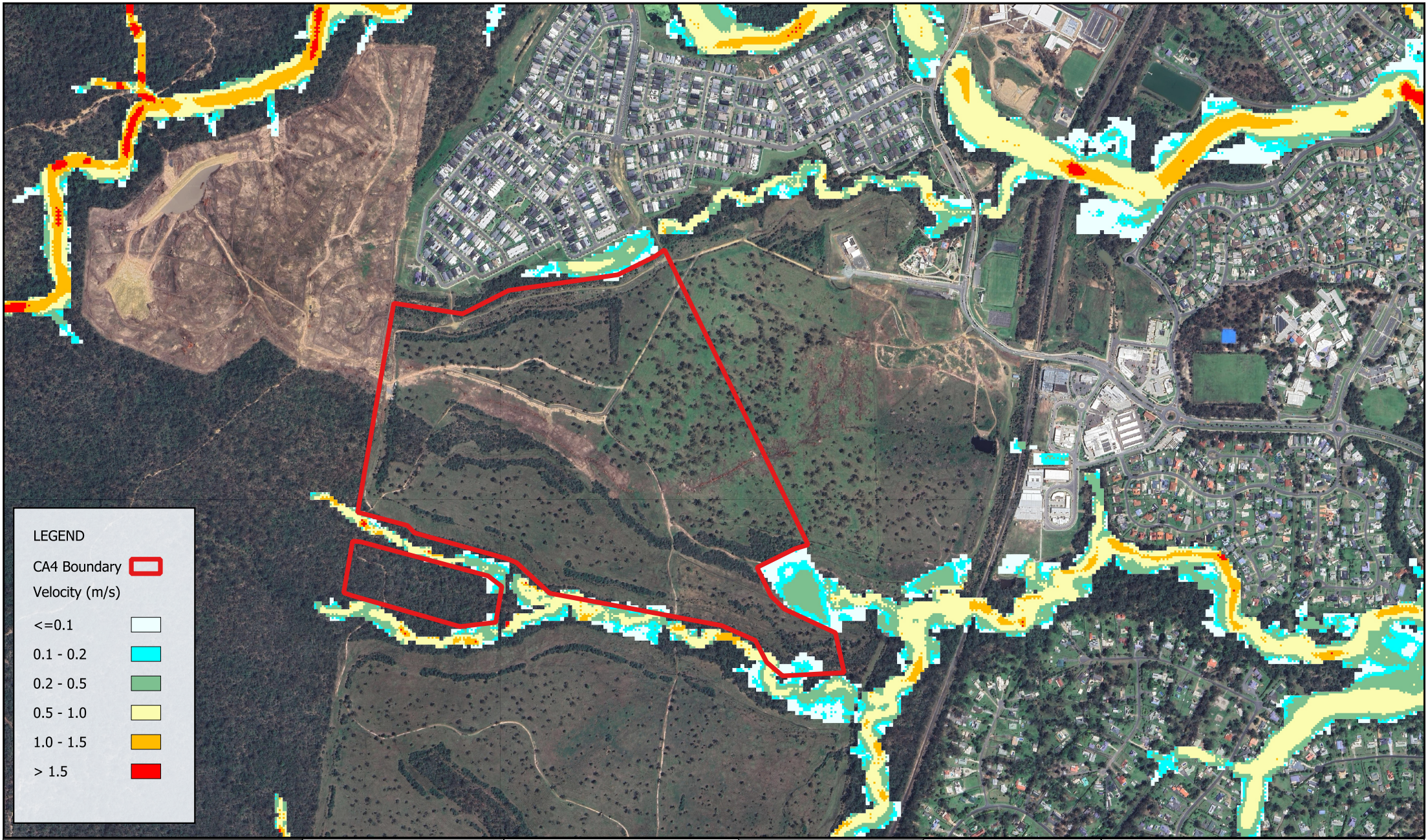
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Waterway Stability Assessment

Masterplan Scenario
2% AEP Stream Power

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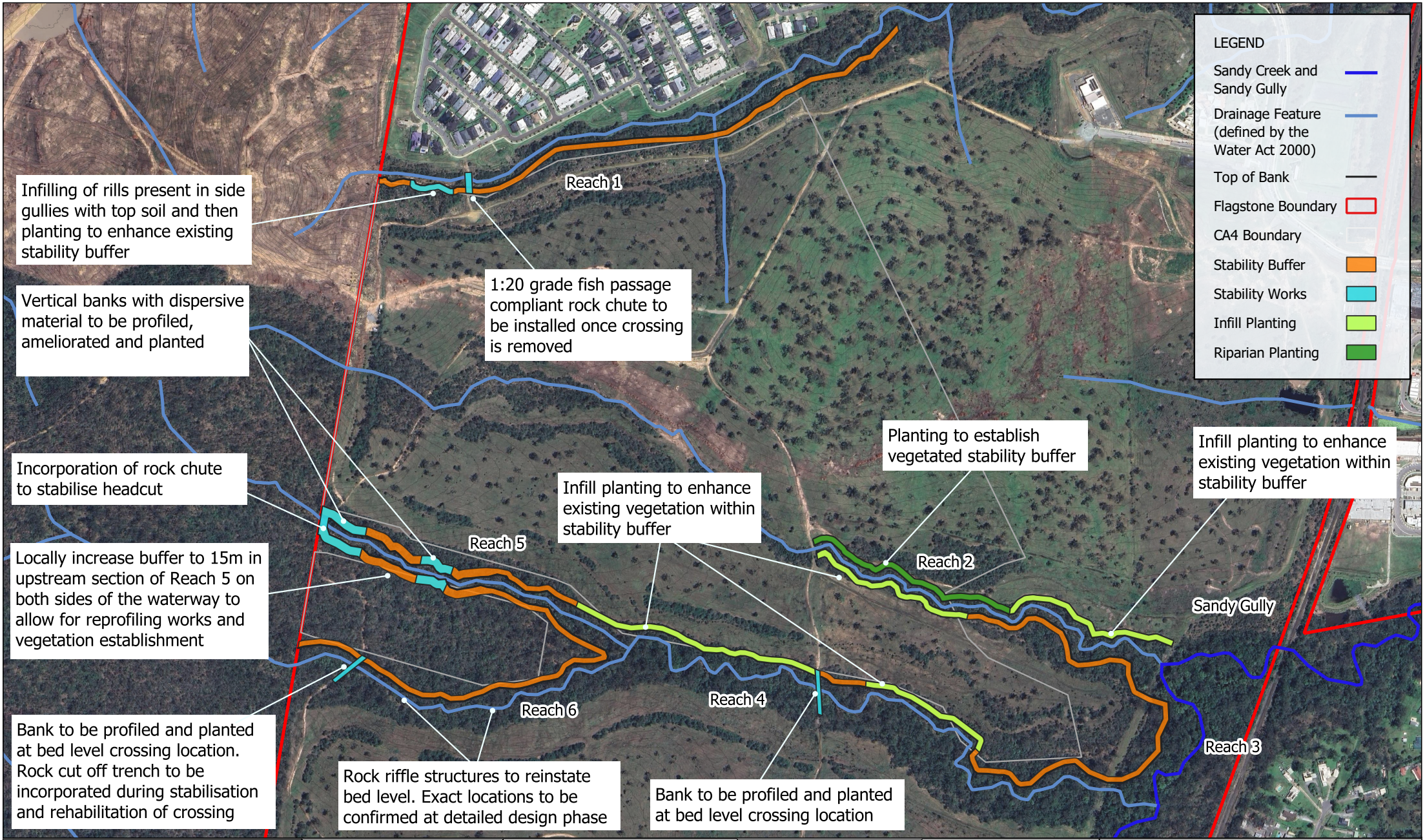
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Waterway Stability Assessment

Masterplan Scenario
2% AEP Velocity

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APPENDIX D: CONCEPT STABILITY PLAN



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Concept Stability Plan

Flagstone CA4
Waterway Stability Assessment

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PEET LIMITED

Waterway Stability Assessment

Flagstone CA5

BNE00413_0010-REP-001-2

18 MARCH 2026

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	30/09/2025	Draft Issue	Marcus Dryden	Tiffany Hart	Tiffany Hart	David Sexton
1	25/03/2025	Client Issue	Marcus Dryden	Tiffany Hart	Tiffany Hart	David Sexton
2	18/05/2026	Client Issue	Marcus Dryden	Tiffany Hart	Tiffany Hart	David Sexton
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1. INTRODUCTION

1.1 Project Background

Engeny has been commissioned by PEET Flagstone City Pty Limited (PEET) to undertake a waterway stability assessment for the waterways adjacent to Context Area (CA) 5, in the Flagstone City Development. The Flagstone City development is located within the Greater Flagstone Priority Development Area (PDA) in Logan City Council (LCC) Local Government Area (LGA).

The assessment required the completion of a rapid geomorphology assessment, defining waterway stability issues and recommending stabilisation strategies. This assessment has been undertaken with consideration for the requirements of the State Planning Policy for Healthy Waters.

1.2 Proposed Development

The Flagstone City development covers a total area of approximately 1,261 ha made up of a combination of future development, future open space and retained natural vegetation, and is estimated to yield approximately 11,000 dwellings. The site is located along Flagstone Creek, Sandy Creek and Sandy Gully, as well as other smaller tributaries.

This report focuses on Sandy Gully and its tributaries, and the Teviot Brook tributary, adjacent to CA5 of the Flagstone City development.

1.3 Purpose of Waterway Stability Assessment

The purpose of the assessment is to provide a functional management document to ensure the long-term stability of the tributaries of Sandy Gully and Teviot Brook adjacent to CA5 of the Flagstone City development. The results of the assessment will also support the development application for CA5.

1.4 Scope and Objectives

The scope of works and objectives for this assessment are outlined below:

- Undertake an assessment of the current geomorphic condition of the waterways adjacent to the development.
- Undertake an assessment of waterway stability.
- Provide a stabilisation strategy for the waterways adjacent to the site.
- Develop a stability buffer offset line from the top of bank to development.
- Recommendations for the stormwater discharge arrangement into the waterways with consideration of waterway stability.

2. VISUAL ASSESSMENT

2.1 Study Area

The study area for this assessment is shown in Figure 2.1 and is defined as Sandy Gully and its tributaries, and the Teviot Brook tributary, adjacent to context area 5 of the Flagstone City development, within Lot 907 on SP332140. Several tributaries of Sandy Gully are located within the area of the development, some of which are proposed to be infilled as part of the development. Reaches relevant to the assessment have been named as per Figure 2.1.

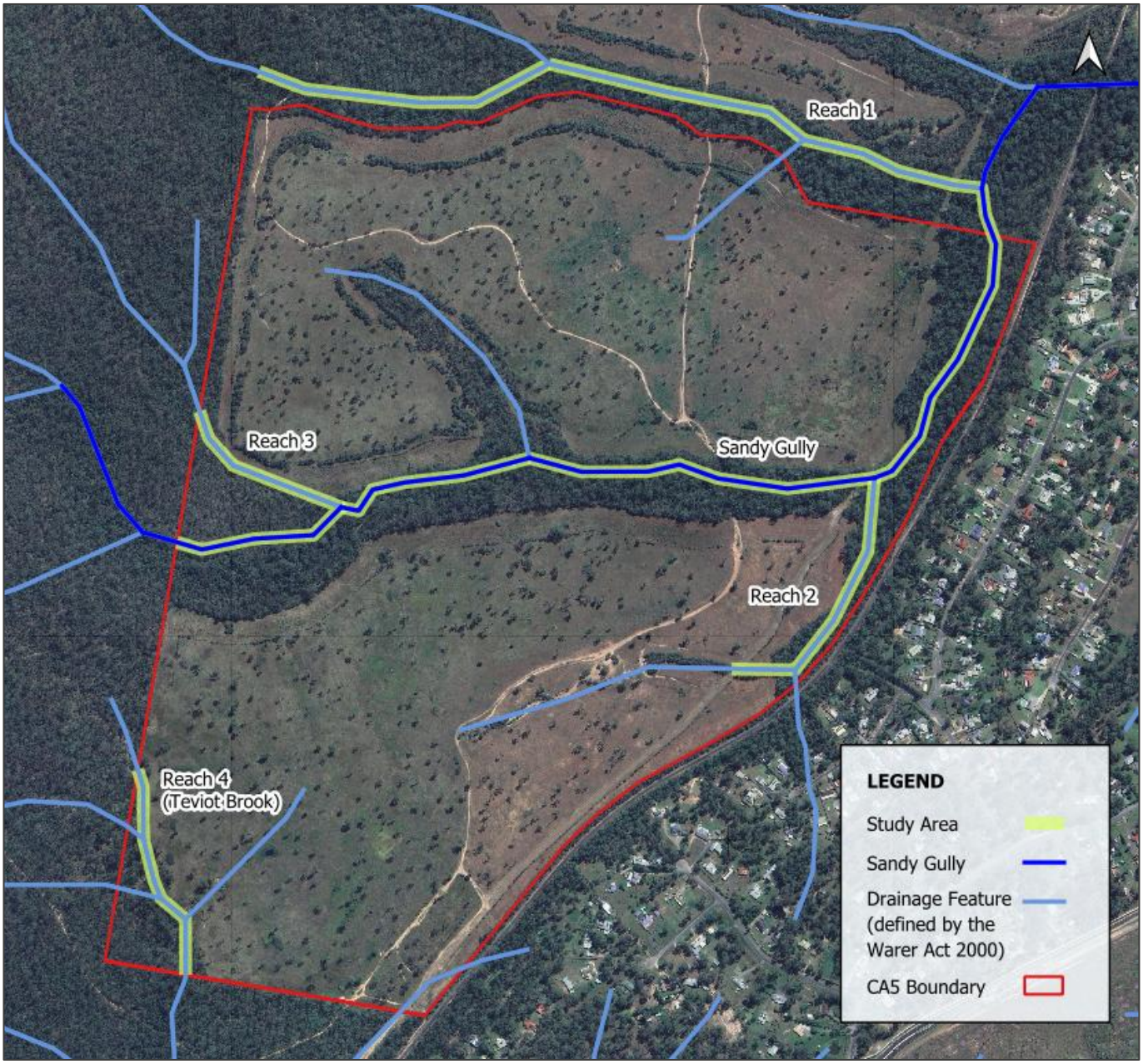


Figure 2.1: Project Study Area

2.2 Catchment Setting

Sandy Gully traverses the eastern and central portion of the Flagstone CA5 development. The waterway flows in a north-easterly direction from the upstream catchment areas located west of the study area. Additionally, a tributary of Teviot Brook is located in the south-western corner of the site. This tributary flows in a southern-easterly direction and meets Teviot Brook approximately 1.5km from the site. Both Sandy Gully and Teviot Brook ultimately drain to the Logan River.

Much of the greater catchment upstream of the study area is underlain Gatton Sandstone. Gatton Sandstone can be described as consisting of thin- to thick-bedded, coarse- to medium-grained, feldspathic to lithic feldspathic sandstone with clay matrix; subordinate intervals of granule, pebble and minor cobble polymictic conglomerate, with abundant ferruginised fossil wood logs and fragments.

The study area is within the upper reaches of the floodplain. It can be categorised as a narrow floodplain confined by the valley margins, with characteristic swathes of sand typical of sandstone draining catchments. Through the site, Gatton Sandstone is overlain by Quaternary aged Flood Plain Alluvium.

The uppermost catchments consist of largely undisturbed open Eucalypt forest. The study area has experienced some disturbance as a result of previous activity, including land and riparian vegetation clearing. An aerial comparison of the immediate catchment setting between 2006 and 2024 is shown in Figure 2.3, noting that initial land clearing commenced within the study area between 2006 and 2008.

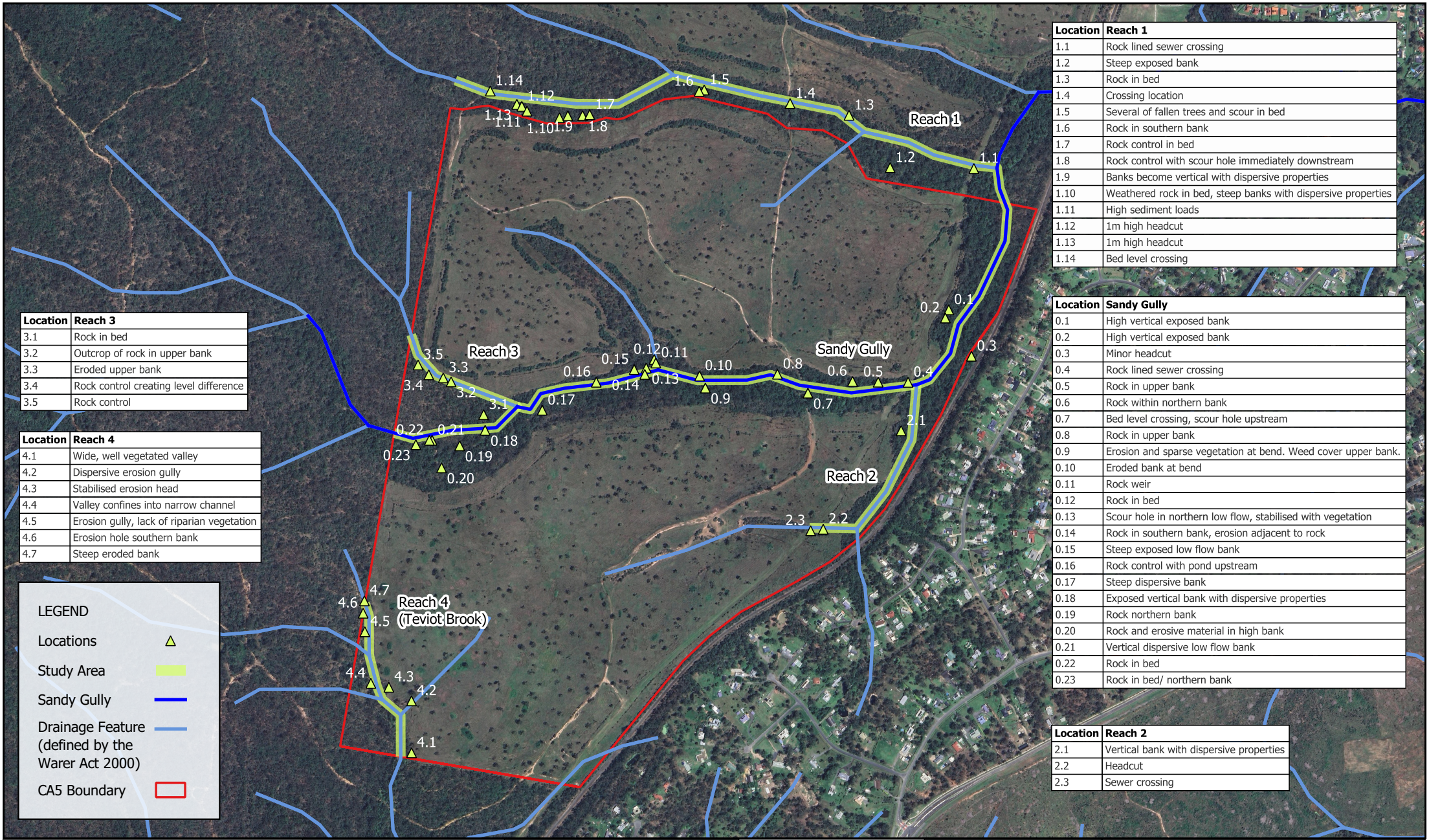


Figure 2.2: Catchment Setting Comparison 2006 to 2024 (QLD Globe)

2.3 Site Assessment

Engeny undertook a rapid geomorphic assessment on the 17th and 25th June 2025. The assessment was completed for the sections of Sandy Gully and the Teviot Brook tributary described in Section 2.1. Supporting photos are provided in Appendix A.

Observations from the site assessment are discussed in the following sections for the Teviot Brook tributary, and Sandy Gully and its respective tributaries, with locations of interest shown in Figure 2.3 .



Location	Reach 1
1.1	Rock lined sewer crossing
1.2	Steep exposed bank
1.3	Rock in bed
1.4	Crossing location
1.5	Several of fallen trees and scour in bed
1.6	Rock in southern bank
1.7	Rock control in bed
1.8	Rock control with scour hole immediately downstream
1.9	Banks become vertical with dispersive properties
1.10	Weathered rock in bed, steep banks with dispersive properties
1.11	High sediment loads
1.12	1m high headcut
1.13	1m high headcut
1.14	Bed level crossing

Location	Sandy Gully
0.1	High vertical exposed bank
0.2	High vertical exposed bank
0.3	Minor headcut
0.4	Rock lined sewer crossing
0.5	Rock in upper bank
0.6	Rock within northern bank
0.7	Bed level crossing, scour hole upstream
0.8	Rock in upper bank
0.9	Erosion and sparse vegetation at bend. Weed cover upper bank.
0.10	Eroded bank at bend
0.11	Rock weir
0.12	Rock in bed
0.13	Scour hole in northern low flow, stabilised with vegetation
0.14	Rock in southern bank, erosion adjacent to rock
0.15	Steep exposed low flow bank
0.16	Rock control with pond upstream
0.17	Steep dispersive bank
0.18	Exposed vertical bank with dispersive properties
0.19	Rock northern bank
0.20	Rock and erosive material in high bank
0.21	Vertical dispersive low flow bank
0.22	Rock in bed
0.23	Rock in bed/ northern bank

Location	Reach 3
3.1	Rock in bed
3.2	Outcrop of rock in upper bank
3.3	Eroded upper bank
3.4	Rock control creating level difference
3.5	Rock control

Location	Reach 4
4.1	Wide, well vegetated valley
4.2	Dispersive erosion gully
4.3	Stabilised erosion head
4.4	Valley confines into narrow channel
4.5	Erosion gully, lack of riparian vegetation
4.6	Erosion hole southern bank
4.7	Steep eroded bank

Location	Reach 2
2.1	Vertical bank with dispersive properties
2.2	Headcut
2.3	Sewer crossing

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Figure 2.3: Locations of Interest

Flagstone Creek CA5 South
Waterway Stability Assessment

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2.3.1 Sandy Gully

Sandy Gully generally consisted of an incised channel with meandering low flow channel and sandy vegetated benches. The banks varied between moderate to steep and were generally stable and vegetated. The waterway was confined by the valley margins and the bed consisted of mobile sand deposits. Riparian vegetation was generally considered dense throughout the waterway with full structural diversity. Weeds such as lantana were observed throughout the reach.

Rock was observed in the bed and banks in locations throughout the waterway and dispersive material in the banks was observed at locations 0.17, 0.18, 0.21 in the upper portion of the reach. A bed level crossing was noted at location 0.7 with a scour hole forming on the upstream side.



Figure 2.4: Sandy Gully Typical Waterway Condition

2.3.2 Reach 1

Reach 1 is a tributary of sandy gully that consisted of a defined narrow, meandering channel confined by the sloping valley margins. Mobile sand deposits were observed in the channel bed. Riparian vegetation generally consisted of regenerative growth, especially in the upper portion of the waterway, including juvenile trees and sparse undergrowth.

A sewer crossing was noted at location 1.1. Gabion mattress was observed on bed and banks at this location to provide protection to the sewer.

Vehicle crossings were observed at location 1.4 and 1.14. A single concrete pipe was noted under the crossing at location 1.4. The pipe was buried with sedimentation having occurred upstream of the crossing. The crossing at location 1.14 was a bed level crossing. Approximately 85m downstream of the crossing location, two 1m high active erosion heads were observed (locations 1.12 and 1.13). The channel downstream of the headcuts (to location 1.9) was in a state of evolution due to the propagation of the headcut with steep vertical banks.

2.3.3 Reach 2

Reach 2 is a tributary of sandy gully that consisted of an incised channel confined by gradual sloping valley margins. The channel was densely vegetated, however generally lacked vegetation beyond the top of bank. Weed species, notably lantana, were observed through sections of the reach.

A steep eroded bank with dispersive properties was noted at location 2.1 on the development side of the channel. However, vegetation was beginning to establish in the area. Additionally, a 0.5m high headcut was observed at location 2.2, 30m downstream of a sewer crossing at location 2.3. The sewer was protected by gabion mattress on the bed and banks.

2.3.4 Reach 3

Reach 3 is a tributary of sandy gully that consisted of an incised channel confined by gradual sloping valley margins. Rock outcrops were observed in the reach with notable rock controls at locations 3.1, 3.2, 3.4 and 3.5 Vegetation within the reach generally consisted of regenerative growth with a distinct lack of riparian vegetation past the top of bank on the northern side of the waterway.

2.3.5 Reach 4

Reach 4 is a tributary of Teviot Brook. The downstream portion of the reach (downstream of location 4.4) can be described as a wide valley with floodplain characteristics and dense vegetation. The upstream section can generally be defined as a narrow channel with moderate vegetation cover, consisting of a combination of pastoral grasses and weeds, low-lying undergrowth and small to medium sized trees. Features of note include erosive gullies at locations 4.2 and 4.5, in addition to steep, eroded banks with reduced vegetation cover in the upstream section at location 4.6 and 4.7.

3. WATERWAY STABILITY ASSESSMENT

3.1 Waterway Constraints

LCC and State Government waterway mapping constraints imposed on the site are discussed below.

3.1.1 Waterway Barrier Works

Waterway barrier works classifications for the study area are shown in Figure 3.1.

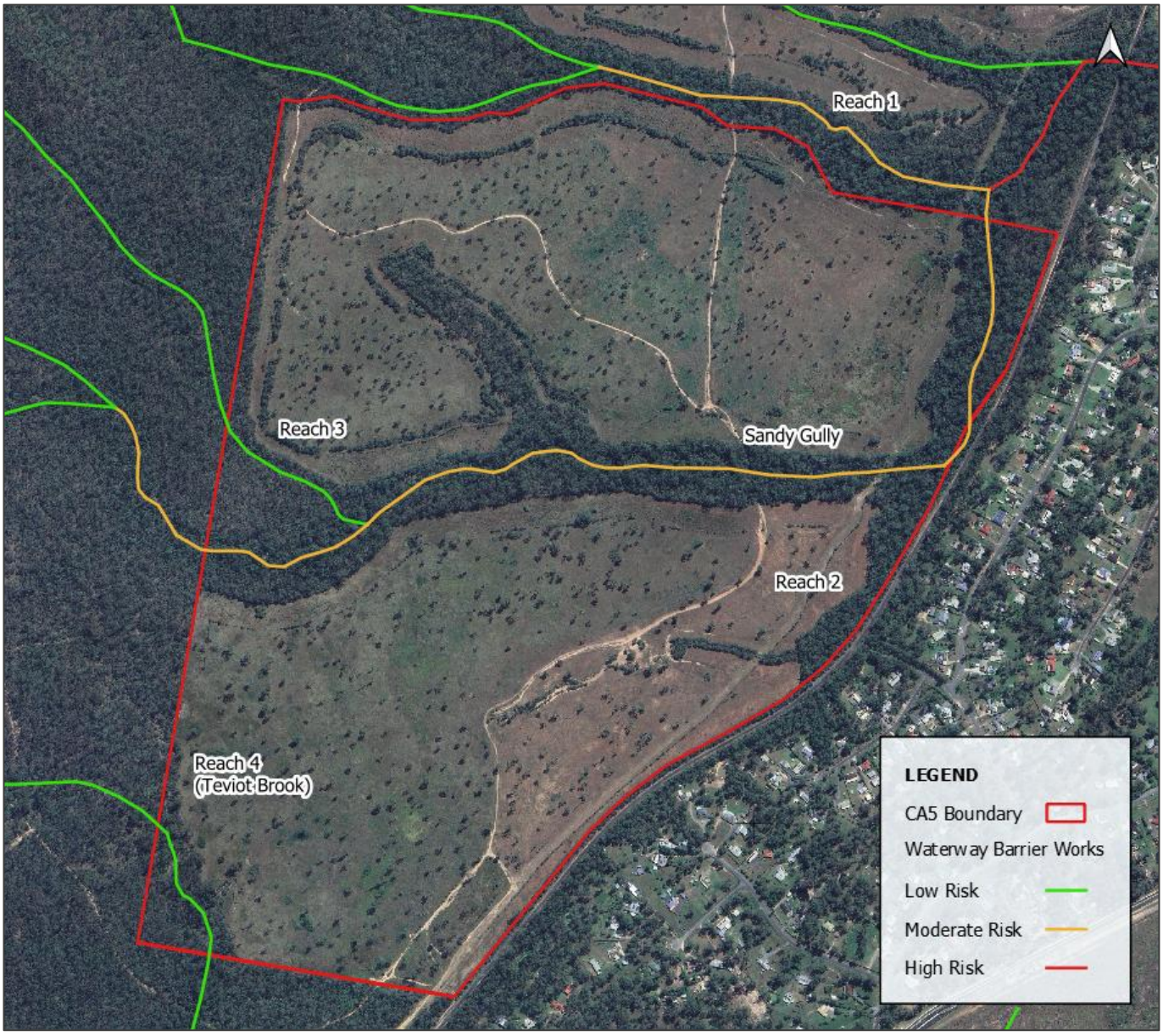


Figure 3.1: QLD Waterways for Waterway Barrier Works

A waterway investigation was completed by Fishology (28th March 2024) to determine the presence and extent of waterways on site. The investigation found that the Sandy Gully Reach 1 was considered to have the attributes of a low risk waterway barrier works classification, compared to the mapped moderate risk classification. Additionally, an amended upper limit of the feature was proposed. These findings are summarised in Figure 3.2. The waterway investigation by Fishology was submitted to SARA for pre-lodgement advice (SARA reference: 2403-39339 SPL). The pre-lodgement advice received in response to the submission, acknowledged the proposed amendment to the waterways shown Figure 3.2, including Sandy Gully Reach 1. Refer to Appendix B for more information.

An additional waterway investigation was undertaken by Engeny in June 2025 which determined that the tributary of Teviot brook (Reach 4) was not conducive to fish passage. The waterway investigation by Engeny was submitted to SARA for pre-lodgement advice (SARA reference: 2508-47867 SPL). The pre-lodgement advice received in response to the submission, acknowledged that the waterway was not conducive to fish movement and fish passage considerations do not apply to the section of Reach 4 within the site. Refer to Figure 3.3 and Appendix C for more information.

The amended waterway barrier works classifications within the study are summarised in Table 3.1.

TABLE 3.1: STUDY AREA WATERWAY BARRIER WORKS CLASSIFICATIONS

Reach	WWBW Classification	Amended WWBW Classification
Sandy Gully	Moderate risk	Moderate risk
Reach 1	Moderate risk and low risk	No classification in upstream section (from confluence of tributaries) Low risk
Reach 2	No classification	No classification
Reach 3	Low risk	Low risk
Reach 4	Low risk	No classification within site boundary

Waterway barrier works are regulated under the Fisheries Act 1994 and alterations to the alignment, shape and capacity of mapped waterways generally trigger an assessable application under the Department of Agriculture and Fisheries (DAF). Any required applications to DAF will be submitted at operational works.

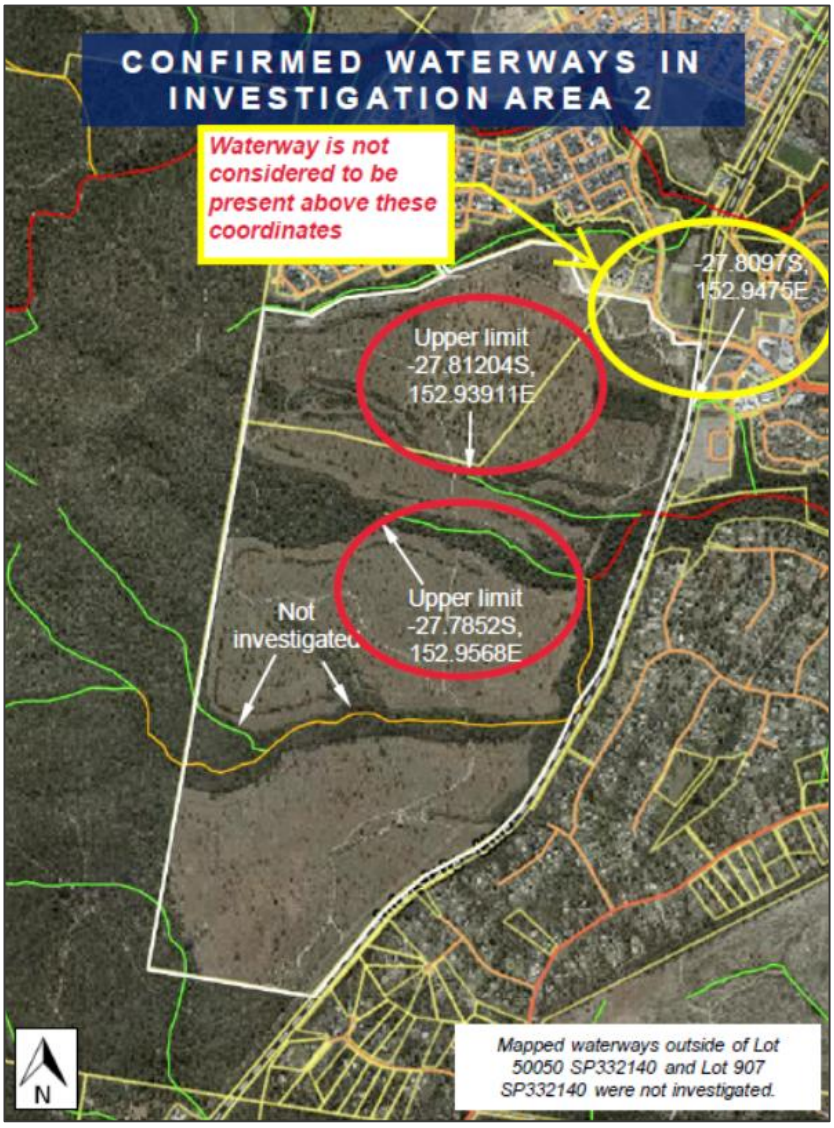


Figure 3.2: Reach 1 - Mapped Waterways Amended Upper Limits and Presence (SARA reference - 2403-39339 SPL)



Figure 3.3: Reach 4 (labelled as Feature 1) - Mapped Waterways Amended Upper Limits and Presence (SARA reference - 2508-47867 SPL)

3.1.2 Logan City Council Waterway Corridors

The Logan Planning Scheme (2015 v9.2 – Table 8.2.12.3.1) outlines that development is to be located outside of the waterway areas identified on waterway corridors and wetlands overlay map OM-14.01 (shown in Figure 3.4).

The Logan Planning Scheme (2015 v9.2 - SC6.2.5 Planning scheme policy 5 – Infrastructure, Section 3.6.2.) also outlines the following requirements for waterway corridors relating to streams orders 1, 2 and 3:

- A stormwater infrastructure item may only be provided in a waterway and wetland buffer area where the buffer area is degraded to such an extent that the construction of the stormwater infrastructure item would result in an enhancement to the condition and ecological function of the buffer area.
- A stormwater infrastructure item may not be located within the waterway and wetland buffer area where the buffer area:
  - contains intact riparian vegetation; or
  - is located below the 20 year ARI flood level; or
  - adjoins a stream order 1 or 2 minor waterway as mapped in Logan City Council's Waterway corridors and wetlands overlay mapping; or
  - where the mapped waterway or wetland buffer is less than 30m in width, measured from the top bank.
- Where a stormwater infrastructure item is located within a waterway or wetland buffer area, it shall be located a minimum distance of 10 metre extending perpendicularly outwards from the top of bank for waterways of stream order 3 or minor wetlands that is retained, restored or rehabilitated.

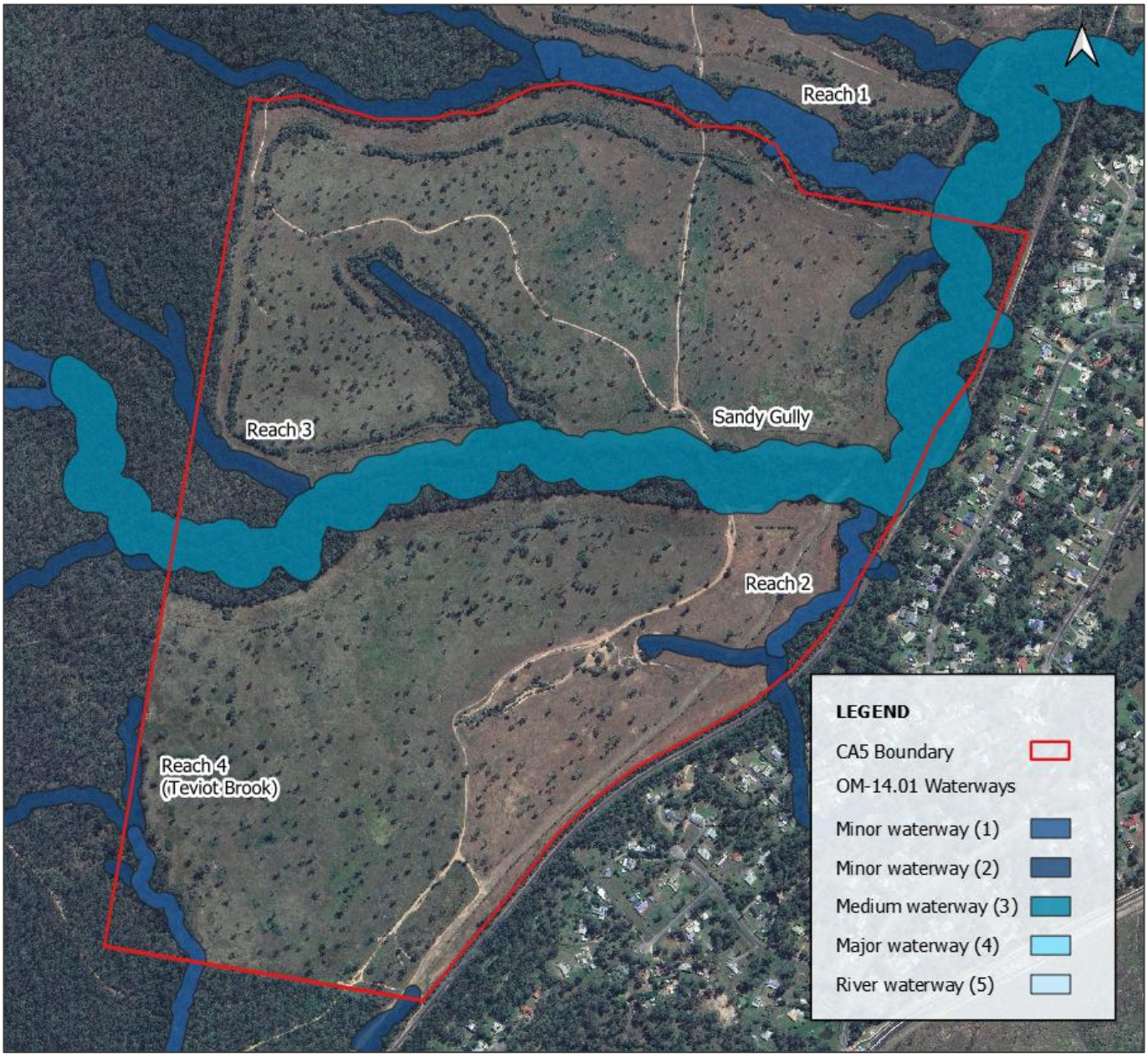


Figure 3.4: Mapping for LCC Waterway Corridors

3.1.3 Natural Environmental Site Strategy

An overarching site strategy for the management of the natural environment relating to the Flagstone development site is outlined in the Flagstone Natural Environment Site Strategy (NESS) (Saunders Havill Group, 2015). The NESS outlines the following requirements relevant to the study area:

- Undertake detailed weed management and revegetation using existing native species and pre-clear regional ecosystem communities to strengthen the riparian vegetation cover and diversity through retained creek and gully.
- Retain native vegetation within the channel, bed and banks of creeks and retain gully lines unless it is unavoidable due to waterway stability work in accordance with the endorsed waterway rehabilitation and stabilisation strategy.
- Avoid clearing of vegetation within defined watercourses and the bed and banks of site creeks and remnant gully lines, expect for essential infrastructure (such as stormwater detention water bodies), waterway stability works in accordance with the endorsed waterway rehabilitation and stabilization strategy and for CPTED principles.

3.2 Waterway Stability

A waterway stability assessment was undertaken to determine how best to ensure the long-term stability of the waterway. The following sections outline the waterway stability assessment completed based on values derived from Engeny's Flagstone Creek, Sandy Creek, and Teviot Brook TUFLOW models. Note that this assessment was focused on the waterways delating to the Flagstone Development Application for Context Area 5 North and further amendments to this report will be completed if required for future context areas.

3.2.1 63.2% AEP Peak Flow Comparison

Table 3.2 provides a comparison of 63.2% AEP peak flows between pre and post-development scenarios which was completed to assess where peak flows are predicted to increase in the waterway within the development boundary. The reporting locations for the peak flow comparison is shown in Figure 3.5. Whilst there are areas of increased peak flows, this does not necessarily indicate an increased risk of potential erosion. An analysis of stream power, shear stress and velocity values was completed to provide a further analysis of waterway stability and erosion risk.

TABLE 3.2: 63.2% AEP PEAK FLOW COMPARISON

Reporting Location	Baseline Scenario (B01) Peak Flow (m3/s)	Masterplan Scenario (M01) Peak Flow (m3/s)	Peak Flow Difference (m3/s)	Peak Flow Difference (%)
T029a	0.3	0.3	0	0%
T029b	0.6	0.8	0.2	33%
T032	0.6	0.6	0	0%
T031	1.1	2.2	1.1	100%
37	1.9	2.9	1	53%
STRUC6_DS	2.2	2.3	0.1	5%
T026	2.7	2.8	0.1	4%
T043b	0.7	0.7	0	0%
T043c	0.9	1.4	0.5	56%
42	3.2	3.2	0	0%
41	4.2	4.4	0.2	5%
39	5.1	4.6	-0.5	-10%
STRUC2_DS	5.5	4.2	-1.3	-24%
38	8.3	6	-2.3	-28%
T025	11.5	8.2	-3.3	-29%

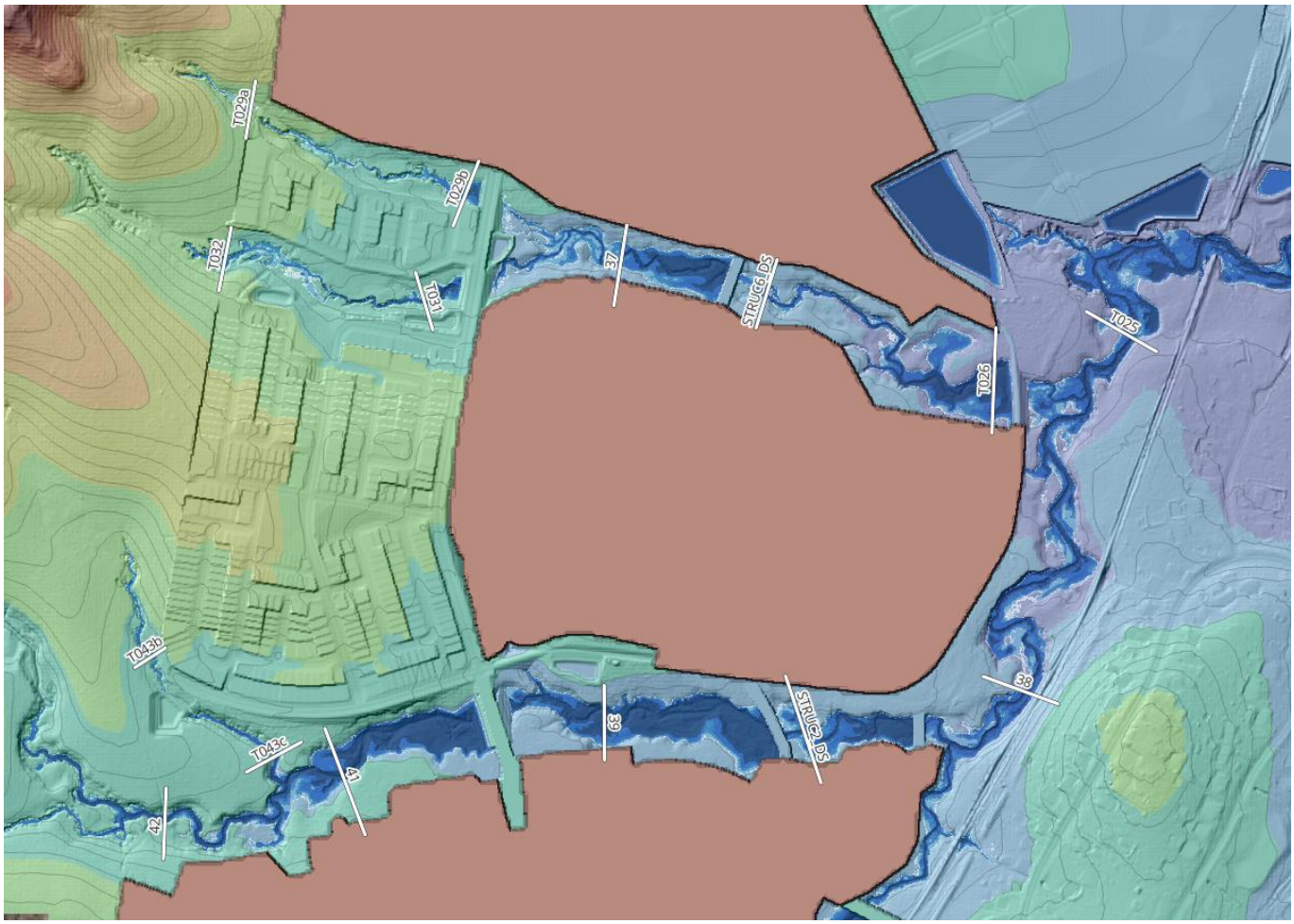


Figure 3.5: 63.2% AEP Peak Flow Reporting Locations

3.2.2 Stream Power, Shear Stress and Velocity

Shear stress, stream power and velocity values derived from the waterways included in the Engeny's Flagstone Creek, Sandy Creek and Teviot Brook TUFLOW models were used as a guide to inform risk of potential sediment transport and identify areas susceptible to scour. Modelling was completed for major flow paths identified for the local Sandy Gully and Teviot Brook catchments. This assessment considered the results for the 50 year and 2-year AEP events using existing and proposed topography and catchment data. The results are presented in Appendix D.

The DNRME Guideline: Works that interfere with water in a watercourse – watercourse diversions (2019) was used to inform acceptable shear stress, stream power and velocity for study area and acceptable values are shown in Table 3.3. Allowable shear stress and velocity for different materials are also shown in Table 3.4

It must be noted that the values represented in the DNRME guidelines were developed as 'channel average values' using HEC-RAS, compared with cell-specific values produced in 2D hydraulic model packages. As such, the guideline values should be used cautiously as 2D packages produced significantly higher values.

TABLE 3.3: ACCEPTABLE SHEAR STRESS, STREAM POWER AND VELOCITY VALUES

Scenario	Shear Stress (N/m2)	Stream Power (W/m2)	Velocity (m/s)
50% AEP (no vegetation)	<40	<35	<1.0
50 % AEP (vegetated)	<40	<60	<1.5
2% AEP	<50	<150	<2.5

TABLE 3.4: ALLOWABLE SHEAR STRESS AND VELOCITY FOR MATERIALS

Material	Allowable Shear Stress (N/m²)	Velocity (m/s)	Source
Long Native Grass	82	1.2 – 1.8	Fischenich, C. (2001)
Hardwood trees planting	120	N/A	Fischenich, C. (2001)
Reinforced Turf	240	3.0	Catchments and Creeks (2014)
Rip rap (D_{50}=150mm)	180	2.1 – 3.1	Fischenich, C. (2001)
Rip rap (D_{50}=300mm)	244	3.0 – 3.9	Fischenich, C. (2001)
Rip rap (D_{50}=600mm)	484	4.2-5.4	Fischenich, C. (2001)

- For the pre-development scenario, bed shear stress for the 50% AEP event was generally within the acceptable guideline limit of 40N/m2 in most areas. There were isolated areas of exceedance of the guideline limit of 50N/m2 in 2% AEP event.
- There was a significant decrease in bed shear stress results for the post-development scenario, with the majority of areas within guidelines limits. The majority of locations experienced shear stress within the hardwood and native grass planting tolerances shown in Table 3.4 which supports a vegetated waterway outcome.
- For the 2% AEP post-development scenario, there were isolated sections of higher bed shear stress (approximately 100 to 150N/m2) as listed below:
  - Upstream extent and eastern sections of Sandy Gully.
  - Downstream of the confluence of Reach 3 and Sandy Gully.
  - Confined central section of Reach 2.
  - Outer bends of Reach 1 upstream of location 1.7 and downstream of the existing vehicle crossing at location 1.4.
- Stream power for the 2% and 50 % AEP events was generally under the acceptable thresholds. There were isolated sections of exceedance in the same sections as listed above for bed shear stress during the pre-development scenario 50% AEP event.
- There was a significant decrease in stream power for the post development results with most locations within acceptable thresholds.
- The majority of locations were below the acceptable velocity thresholds for the 50% AEP and 2% AEP events in both the pre and post-development scenarios. Assessed waterways generally experienced velocities within the native grass planting tolerance shown in Table 3.4 which supports a vegetated waterway outcome.

3.2.3 SPP Waterway Stability Design Objectives – Erosion Risk Assessment

The *State Planning Policy (DILGP, July 2017)* (SPP) outlines design objectives relating to waterway stability and are shown in the excerpt below in Figure 3.6. The SPP specifies that the waterway stability management design objectives must be met by mitigating the 63.2% AEP peak flows in the post-developed scenario to the pre-development flows *'if development drains to an unlined waterway within or downstream of the site where a risk of increased erosion exists due to changes in hydrology'.*

All waterways within Flagstone City are considered to be unlined waterways, and these are intended to remain as natural channels with waterway works limited to those where it is needed to provide stability and access. Detailed analysis of the waterways surrounding and downstream of the CA5 North development was undertaken to determine if waterway stability management objectives outlined in the SPP apply. The outputs from the Masterplan FMS TUFLOW model were used to determine whether the development will cause increased erosion risks to the waterway if the 63.2% AEP event is discharged unmitigated.

Climatic region	Design objectives Reductions in mean annual load from unmitigated development (%)				
	Total suspended solids (TSS)	Total phosphorus (TP)	Total nitrogen (TN)	Gross pollutants >5mm	Waterway stability management
South East Queensland	80	60	45	90	Limit the peak 1-year ARI event discharge within the receiving waterway to the pre-development peak 1-year ARI discharge
Central Queensland (south)	85	60	45	90	
Central Queensland (north)	75	60	40[15]	90	
Cape York[14], wet tropics and dry tropics	80	60[16]	40	90	
Western Queensland[14]	85	60	45	90	

Notes:

- Mapping of climatic regions is available on the State Planning Policy Interactive Mapping System.
- In lieu of modelling, the default bio-retention treatment area to comply with load reduction targets for all Queensland regions in 1.5 per cent of the contributing catchment area.
- Water stability objective applies if development drains to an unlined waterway within or downstream of the site where a risk of increased erosion exists due to changes in hydrology. Local government may also require application of the waterway stability objective where there are planned future rehabilitation works to return a lined channel to a natural channel design.
- The SPP Water quality guidance material provides advice on the measures that demonstrate compliance with table B.

Figure 3.6: Waterway Stability Design Objectives (SPP July 2017, DILGP)

GIS processing of the Masterplan FMS Baseline (B01) Scenario and Masterplan (M01) Scenario flood velocity results was undertaken to identify any waterway areas at risk of increased erosion due to changes in catchment hydrology. An automated GIS process was applied to the flood velocity results to identify areas based on the following criteria thresholds:

- Masterplan (M01) Scenario flood velocities > 1.5 m/s, and
- Masterplan (M01) – Baseline (B01) Scenario flood velocity afflux > 0.1 m/s.

The adopted flood velocities are considered appropriate to identifying areas at risk of erosion within a vegetated natural waterway, based on the values shown in Table 3.3.

The GIS process was applied for the 1%, 2%, 50%, and 63.2% AEP flood events to determine the erosion risk extent for a range of relevant design events. Each of the output trigger areas were combined into a single polygon identifying where any of these events predicts an increase in erosion downstream of the CA5 North DA area.

The erosion risk flood extent area overlaid on the four design event AEPs of interest are provided in Figure 3.7 and Figure 3.8 below. The magenta hatched areas identify where increased erosion risk due to changes in catchment hydrology might be present across all the assessed AEPs. A summary of the results is provided below:

- There are two model cells upstream of Structure 4 that meets the threshold criteria triggers within a waterway and therefore predicts potential erosion risk. It is noted that this is within the vicinity of a head cut that is proposed to be stabilised and is discussed in Section 3.2.4.
- There are three model cells upstream of Structure 1 that meets the threshold criteria triggers within a waterway. These are extremely isolated and not anticipated to cause any meaningful erosion.

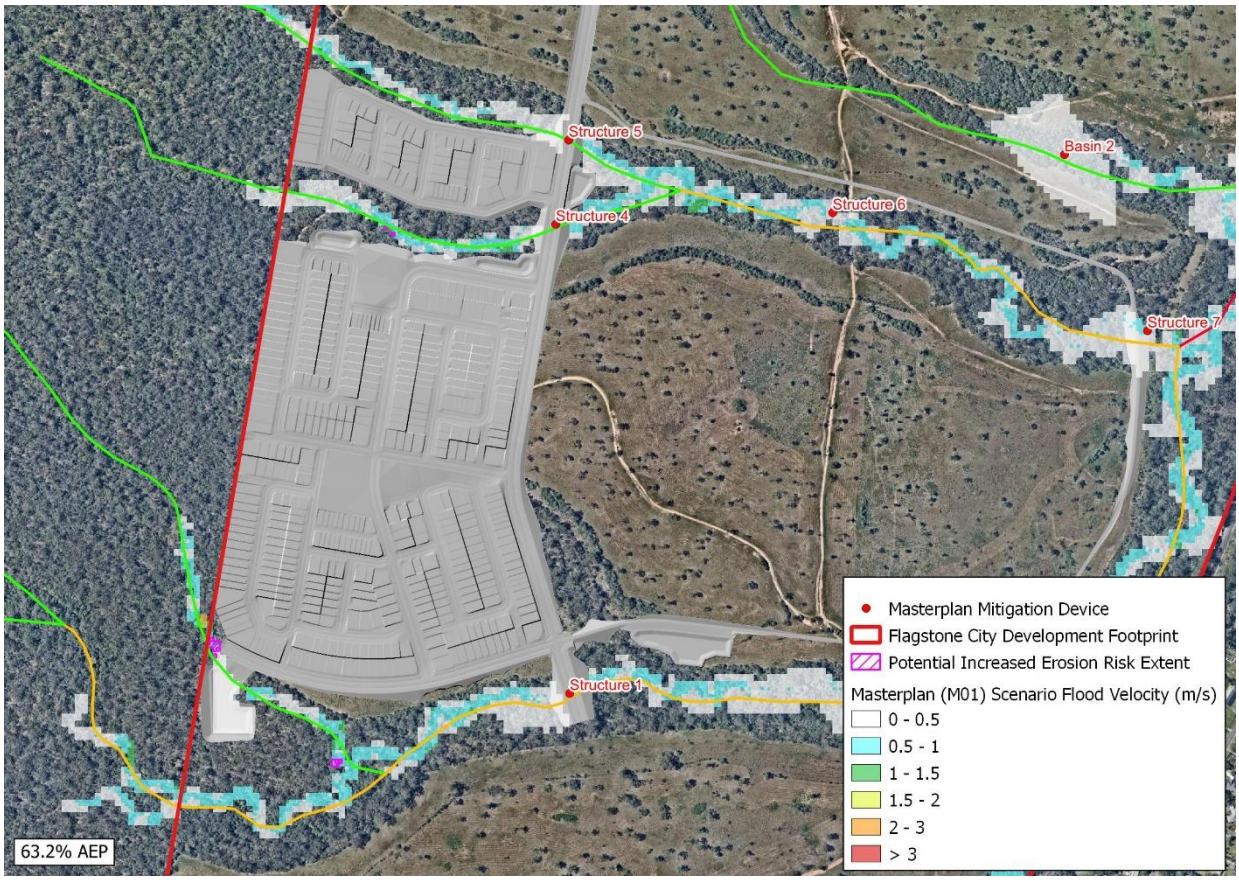


Figure 3.7: 63.2% AEP Erosion Risk Extents

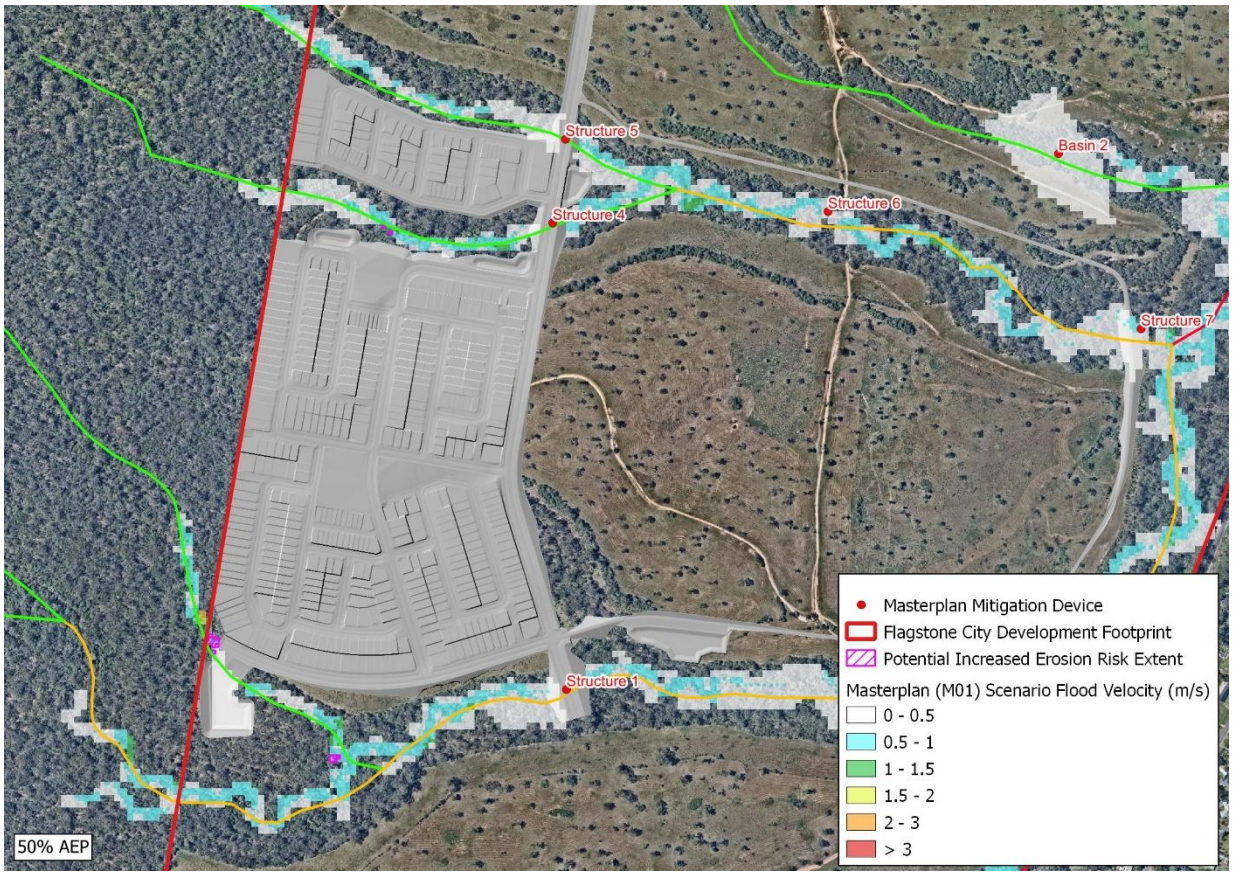


Figure 3.8: 50% AEP Erosion Risk Extents

3.2.4 Waterway Stability Recommendations

The sections of waterway adjacent to Flagstone CA4 were generally stable at the time of inspection. However, development may cause impacts to the stability of the creek if not managed appropriately. It is proposed to generally retain the natural formation of waterways to avoid removal of native vegetation which provides stability and habitat. A concept stability plan is shown in Appendix E, and the following points outline the proposed strategy:

- Provide a minimum 10m wide vegetated buffer to the development from the existing top of bank of retained waterways for stability. Noting that additional riparian buffer width maybe required under the NESS for environmental purposes. The 10m wide vegetated buffer has been based on the site assessment of waterway stability and the location of top of bank and also aligns with requirements of the Logan Planning Scheme SC6.2.5, Section 3.6.2. The recommended buffer provides a site-specific refinement of the waterway corridor provided in the Logan Planning Scheme OM-14.01 overlay map and no development is to occur within the buffer area. Development earthworks should not encroach on the stability buffer. This is with the exception works required for road crossings, stormwater outlets and waterway stability works.
- Increased stability buffer to 15m at location 0.1 in Sandy Gully due to the high, steep bank and lack of existing vegetation beyond the top of bank.
- Retain existing vegetation within the waterway and stability buffer and enhance through infill planting of native riparian vegetation.
- Undertake targeted riparian planting in stability buffer locations lacking vegetation as outlined in the concept stability plan in Appendix E.
- Development earthworks should not encroach on the stability buffer. This is with the exception works required for road crossings, stormwater outlets and waterway stability works.
- The headcuts and steep exposed banks noted in Reach 1 between locations 1.9 to 1.13 will require stabilisation to address the significant incision and ensure long term stability. It is recommended that rock riffle structures are incorporated within this area to reinstate the bed level and reduce bank heights. This form of stabilisation will reduce the impact to existing riparian vegetation with access into, and disturbance in, the waterway only being required at a couple of locations.
- Infill and rehabilitate the eroding gully head at location 4.2.
- Existing vehicle crossing areas should be reprofiled and rehabilitated.
- It is recommended that a rock cut off trench is incorporated at location 1.14 during profiling and rehabilitation works.
- Incorporation of appropriate stabilisation measures at stormwater outlets and culverts. Refer to Section 3.2.5 for additional details on outlet configuration recommendations.
- Riparian areas disturbed by pipe works should be rehabilitated to its original state with consideration for dispersive soils.
- Where road crossings are proposed, incorporation of a rock trench is recommended at the end of the downstream scour protection to provide protection to the asset from future potential headcut erosion.
- Dense rehabilitation planting should occur in waterway locations where weed removal is undertaken to prevent erosion.
- All works within the waterway should adopt amelioration recommendations provided within the site dispersive soils management plan.

Refer to concept stability plan in Appendix E for more information.

3.2.5 Outlet Configuration

Local stormwater outlet points will need to be designed to consider the effects on the waterway. The following should be considered when designing the outlet configuration:

- Align stormwater outlet works with areas in the riparian corridor and stability buffer already disturbed or requiring stabilisation. As an example, outlet works may seek to align with existing vehicle crossings requiring remediation or proposed road crossings. This approach seeks to limit impacts to riparian vegetation providing stability to the bank.
- Where the above outcome cannot be achieved, disturbance corridors (e.g. pipe trenches, rock chutes) within the stability buffer and riparian corridor should be limited as far as practical.
- Where possible, pipes should outlet into the waterway just above the channel invert. Consideration of mobile bed depths should be made to ensure pipes remain as low as possible while remaining free from blockage due to natural sedimentation and variations in bed level. A pipe invert approximately 500mm above the bed is recommended.
- Flow from any piped discharge location should be directed into the waterway as close as feasibly possible to the direction of flow. An approach angle of 45-60 degrees to the direction of flow is recommended to minimise scour of the bed and opposite bank.
- Any surface over which discharge occurs should be stabilised using appropriate erosion control measures.
- Control of overbank flow entry points will be required with appropriately sized rock chutes, having consideration for dispersive soils. The works should tie neatly into the existing bank and bed.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The above visual and quantitative assessment of the study area has assisted in informing the stabilisation strategy for the waterway. The following items summarise the findings and recommendations:

- The geomorphology assessment undertaken noted minor stability issues within isolated locations in the study area.
- A minimum 10m wide vegetated stability buffer from top of bank is proposed to all retained waterways. The minimum 10m wide buffer is in alignment with the requirements of the Logan Planning Scheme. Existing vegetation with the waterway and stability buffer will be retained and enhanced through infill planting with native riparian vegetation.
- The results of the waterway stability and erosion risk assessment indicate that the criteria of the SPP for applying the waterway stability objectives does not apply. As such, it is therefore proposed that Q1 detention basins and subsequent mitigation of the 63.2% AEP is not required for CA5 North based on the outcomes of this assessment. This analysis is considered suitable to satisfy the amendments in red associated with the Stormwater IMP Compliance Approval (Ref. DEV2012/209/6/16 dated 23 December 2025)
- Stability issues noted should incorporate stabilisation advice in Section 3.2.2.
- Outlet configuration into the waterway should consider recommendations outlined in Section 3.2.3
- Any hydraulic impacts to upstream and downstream reaches were identified as negligible, suggesting that any impacts to channel morphology that may occur following the development are unlikely to be a result of the development, provided that best practice construction is adhered to at outlet structures and the stability recommendations provided herein are adopted.

5. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

  (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

  (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

(e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

(f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

(g) This Report does not provide legal advice.

6. REFERENCES

Brisbane City Council (2003). Stormwater Outlets in Parks and Waterways.

Catchments and Creeks Pty Ltd, (2014). Turf Reinforcement Mats.

Department of Agriculture and Fisheries (2017). Queensland Waterways for Waterway Barrier Works.

DNRM (2019). Guideline: Works that interfere with water in a watercourse – watercourse diversions (DNRME, 2019)

Fischenich. C (2001). Stability Thresholds for Stream Restoration Materials.

APPENDIX A: SITE ASSESSMENT PHOTOS

A.1 Sandy Gully



Location 0.1 – High vertical bank with limited vegetation beyond tob of bank



Location 0.2 – High vertical bank with limited vegetation beyond tob of bank.



Location 0.3 - Minor headcut



Location 0.4 - Rock lined sewer crossing



Location 0.5 - Rock in upper portion of northern bank



Location 0.6 - Rock in northern bank



Location 0.7 - Bed level crossing, scour hole upstream



Location 0.8 - Steep bank, rock in upper bank



Location 0.9 - Erosion and sparse vegetation at bend. Weed cover on upper bank.



Location 0.10 - Erosion at bend northern bank



Location 0.11 - Rock weir



Location 0.12 - Rock in bed



Location 0.13 - Stabilised scour hole at northern low flow channel bank, sediment deposition area



Location 0.14 - Rock in southern bank, erosion adjacent



Location 0.15 - Steep exposed low flow bank at bend



Location 0.16 - Rock control with pond upstream



Location 0.17 - Steep dispersive bank



Location 0.18 – Exposed vertical bank with dispersive properties



Location 0.19 - Rock in northern bank



Location 0.20 - Rock and erosive material in high bank



Location 0.21 - Vertcial dispersive low flow bank



Location 0.22 - Rock in bed



Location 0.23 - Rock in bed/ northern bank

A.2 Reach 1



Location 1.1 - Rock lined channel at sewer crossing



Location 1.2 - Steep exposed southern bank



Location 1.3 - Rock in bed



Location 1.4 - Crossing location. Heavily silted upstream including pipe crossing



Location 1.5 - Several fallen trees creating scour in bed and minor erosion to lower bank



Location 1.6 - Rock in southern bank



Location 1.7 – Rock control in bed



Location 1.8 - Rock control with scour hole immediately downstream (facing upstream)



Location 1.8 - Rock control with scour hole immediately downstream (facing downstream)



Location 1.9 - Low flow channel banks become steep with dispersive properties



Location 1.10 - Weathered rock in bed. Low flow channel banks steep with dispersive properties



Location 1.11 - High sediment loads



Location 1.12 - 1m headcut



Location 1.13 - 1m headcut - southern fork



Location 1.14 - Bed level crossing

A.3 Reach 2



Location 2.1 - Exposed vertical bank with dispersive properties



Location 2.2 – Headcut



Location 2.3 - Rock lined sewer crossing

A.4 Reach 3



Location 3.1 - Rock in bed



Location 3.2 – Outcrop of rock in upper bank



Location 3.3 - Eroded upper bank



Location 3.4 - Rock control creating level difference



Location 3.5 - Rock control

A.5 Reach 4



Location 4.1 - Wide well vegetated valley



Location 4.2 - Dispersive erosion gully



Location 4.3 - Stabilised erosion head



Location 4.4 – Valley confines into narrow channel



Location 4.5 - Erosion gully, sparse vegetation on bank/past top of bank



Location 4.6 – Erosion hole at southern bank. Stabilised with vegetation



Location 4.7 – Steep eroded bank

APPENDIX B: SARA PRE-LODGEMENT ADVICE – REACH 1

Queensland Government

SARA reference: 2403-39339 SPL
Applicant reference: PR110056

13 May 2024

PEET Flagstone City Pty Ltd
c/- RPS AAP Consulting Pty Ltd
emma.gurney@rpsgroup.com.au

Attention: Ms Emma Gurney

Dear Ms Gurney

Amended SARA Pre-lodgement advice - 71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark Ridge

I refer to your pre-lodgement request received on 1 March 2024 in which you sought pre-lodgement advice from the State Assessment and Referral Agency (SARA) regarding the proposed development at the above address. This notice provides advice on aspects of the proposal that are of relevance to SARA.

On 29 April 2024, the proponent requested SARA issue amended pre-lodgement advice including 2 Queensland low (green) waterways for clarity when identifying waterway barrier works in the future. To support this request, the proponent submitted an amended plan with coordinates where the 2 waterways intersect with the boundaries of investigation areas 1 and 2. SARA has annotated this plan, so it is clear there are no waterways present above these coordinates.

SARA's understanding of the project

It is understood the proponent is seeking to establish development under the Greater Flagstone Priority Development Area Development Scheme at 71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark more formally described as Lots 907 and 50050 on SP332140 and Lot 989 on RP854074 (the site).

The site contains additional Queensland low (green) waterways on the recently released updated Queensland waterway mapping on the Development Assessment Mapping System (DAMS). The proponent has advised the environmental features on the site have been investigated and considered to inform the detailed planning for several approvals and applications over the site.

Planning and Development Services
(SEQ South)
Level 9, 12-14 Marine Parade, Southport
PO Box 3290, Southport BC QLD 4215

The proponent has provided a Waterway Investigation Report, prepared by Fishology and dated 29.02.2024, and supplementary information to confirm the presence and extent of DAMS Queensland waterways on the site. The proponent requests SARA's confirmation that the revised waterways presented by Fishology are acceptable, and any works outside this are not considered to constitute waterway barrier works.

Supporting information

The advice in this letter is based on the following documentation that was submitted with the pre-lodgement request.

Drawing/report title	Prepared by	Date
Waterway Mapping within PEET Land of the Greater Flagstone PDA Request for Prelodgement Meeting with SARA (reference: PR110056)	RPS	1 March 2024
Waterway investigation within the proposed Flagstone City Centre/Context Area 4 and Context Area 3 – Lots 989 RP854074, 50050 SP332140 and 907 SP332140	Fishology	29.02.2024
Attachment 2a – Context Area 1 (Investigation Area 1)	-	-
Attachment 2b – Context Area 4 and TC (Investigation Area 2)	-	-
Email received 18/03/2024 with attachments: Attachment 1 – Response Table _18 March 2024 Attachment 2 – Waterway Mapping Attachment 3 – Concept Plans	Louisa Sloan RPS	18/03/2024
Email received 21/03/2024 with attachment: DAF comments to RFI response by Fishology	Louisa Sloan RPS	21/03/2024
Email received 28/03/2024 with attachment: Flagstone waterway investigation_survey 2_Final_28-3-2024	Louisa Sloan RPS	28/03/2024
Email received 2/05/2024 with attachment: Flagstone waterway mapping 30 4 2024	Louisa Sloan RPS	2/05/2024

Pre-lodgement advice

The following advice outlines the aspects of the proposal that are of relevance to SARA.

SARA's jurisdiction and fees	
1.	Under the Planning Regulation 2017, works involving constructing or raising waterway barrier works must be undertaken in accordance with the relevant accepted development requirements (ADR) or under a development approval (assessable development). In the instance any works do not comply with the ADR, a development permit will be required for constructing or raising waterway barrier works. In this instance, lodgement to SARA as the assessment manager is required under the following provision of the Planning Regulation: • Schedule 10, Part 6, Division 4, Subdivision 2, Table 1, Item 1 – Operational works for waterway barrier works. The associated fee is unable to be determined at this stage, as the application fee depends on the nature of the work. To assist with determining the correct fee for a development

	application, a schedule of fees converting the fee units to dollar values is available on the Department of Housing, Local Government, Planning and Public Works website available at: https://dsdmipprd.blob.core.windows.net/general/planning-regulation-2017-fee-schedule.pdf.
Key matters and action items	
2.	The Waterway Investigation Report, prepared by Fishology and dated 29.02.2024, provides evidence of the upper extent of the waterways through surveys for the presence of habitat throughout the length of the waterways and via a fish survey on the site. Based on the results of these surveys, the Department of Agriculture and Fisheries (DAF) agrees with the proponent that the 'upper limit' of 3 waterways for which advice was sought (**Attachment 1**) is: • Lot 989 on RP854074: -27.79453S 152.83141E (**Attachment 2**) • Lot 907 on SP332140: -27.81204S 152.93911E and -27.7852S 152.9568E (**Attachment 3**). In addition, DAF also agrees that 2 waterways are not present above the coordinates below: • Lot 989 on RP854074: -27.78711S 152.93476E (**Attachment 2**) • Lot 907 on SP332140: -27.8097S 152.9475E (**Attachment 3**). If any work is proposed downstream of the agreed upper limit of the waterway, the works would need to be undertaken as per the ADR, and where this is not possible, would require a development permit. If a development permit is required, the 'SDAP Guideline for State Code 18' is available at: https://www.publications.qld.gov.au/dataset/fisheries-development-activities/resource/36cc6985-f44d-426d-b499-4d20ed606f70, will assist in the preparation of a development application and responding to the relevant Performance Outcomes for assessable development impacting waterways. Note: Some waterway coordinates have changed slightly from the original pre-lodgement advice although this is considered minor.
Lodgement material	
3.	If a development permit is required, it is recommended that the following information is submitted, as a minimum, when lodging an application to SARA: • DA form 1. • Landowner's consent. The prescribed application fees. • Relevant plans as per the DA Forms guide, available at: https://dsdmipprd.blob.core.windows.net/general/guide-da-forms.pdf. Response to State code 18: Constructing or raising waterway barrier works in fish habitats of the SDAP.

This advice outlines aspects of the proposed development that are relevant from the jurisdiction of SARA. This advice is provided in good faith and is:

- based on the material and information provided to SARA
- current at the time of issue
- not applicable if the proposal is changed from that which formed the basis of this advice.

This advice does not constitute an approval or an endorsement that SARA supports the development proposal. Additional information may be required to allow SARA to properly assess the development proposal when a formal application has been lodged.

If you require further information please contact Amanda Hosken, Principal Planning Officer, on (07) 5644 3216 or via email SEQSouthPlanning@dsdilgp.qld.gov.au who will be pleased to assist.

Yours sincerely

Signature placeholder

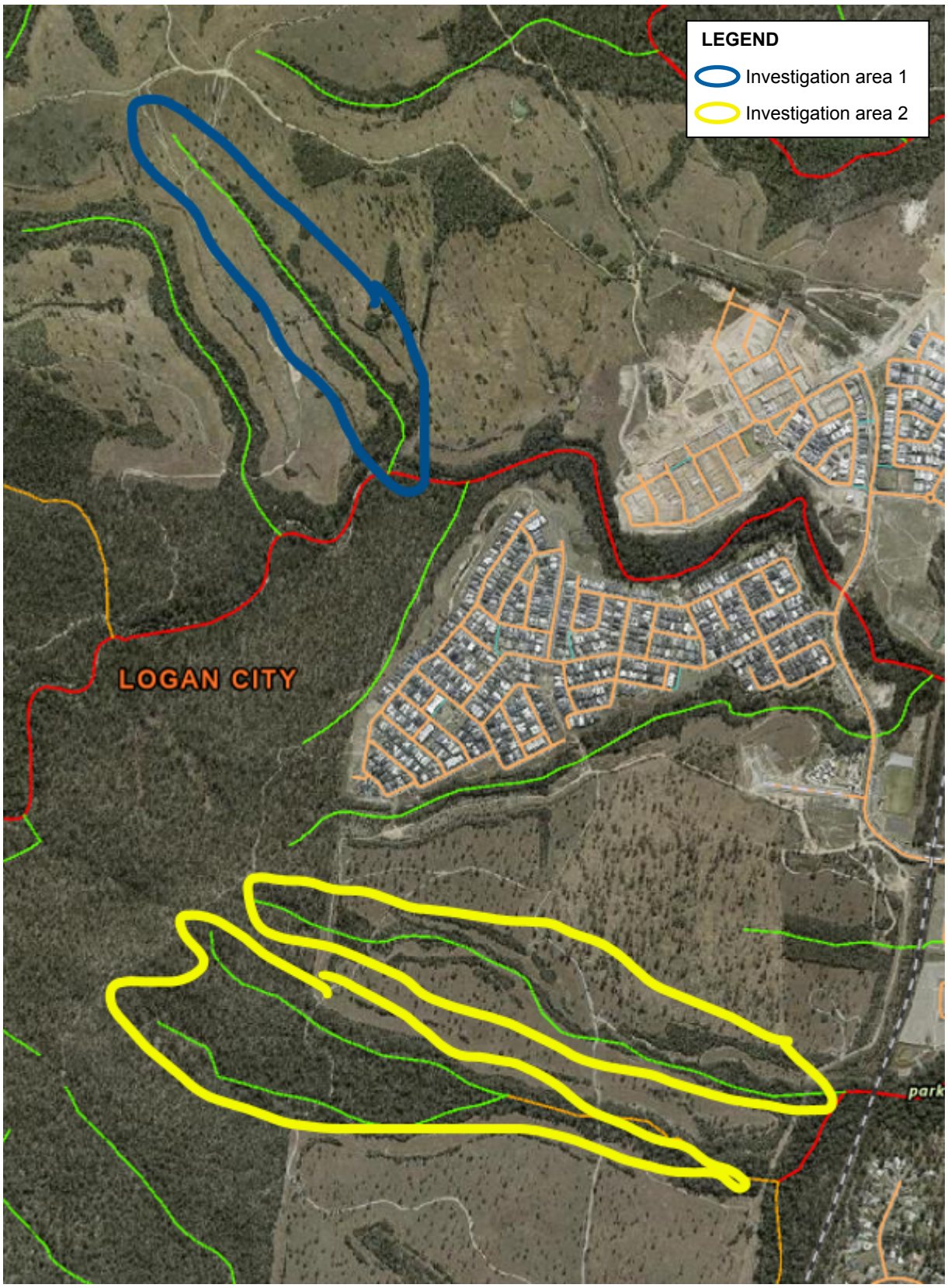
Grace Heatherley
A/Principal Planning Officer, Planning and Development Services (SEQ South)

Encl

Attachment 1 - Waterways for which this advice relates to located in investigation area 1 (blue circle) and investigation area 2 (yellow circles)
Attachment 2 - Coordinates of the agreed upper limit of the waterway in investigation area 1 (circled red) and waterway not present above coordinates on boundary of investigation area 1 (cicled in yellow)
Attachment 3 - Coordinates of the agreed upper limit of the waterway in investigation area 2 (circled red) and waterway not present above coordinates on boundary of investigation area 2 (circled in yellow)

Development details	
Proposal:	Development under the Greater Flagstone Priority Development Area Development Scheme
Street address:	71 Flagstonian Drive and Parklands Drive, Flagstone and New Beith Road, Silverbark
Real property description:	Lots 907 and 50050 on SP332140 and Lot 989 on RP854074
SARA role:	Assessment Manager
Assessment Manager:	SARA
Assessment criteria:	State code 18 of the SDAP
Existing use:	Unimproved
Relevant site history:	Greater Flagstone Priority Development Area and associated approvals

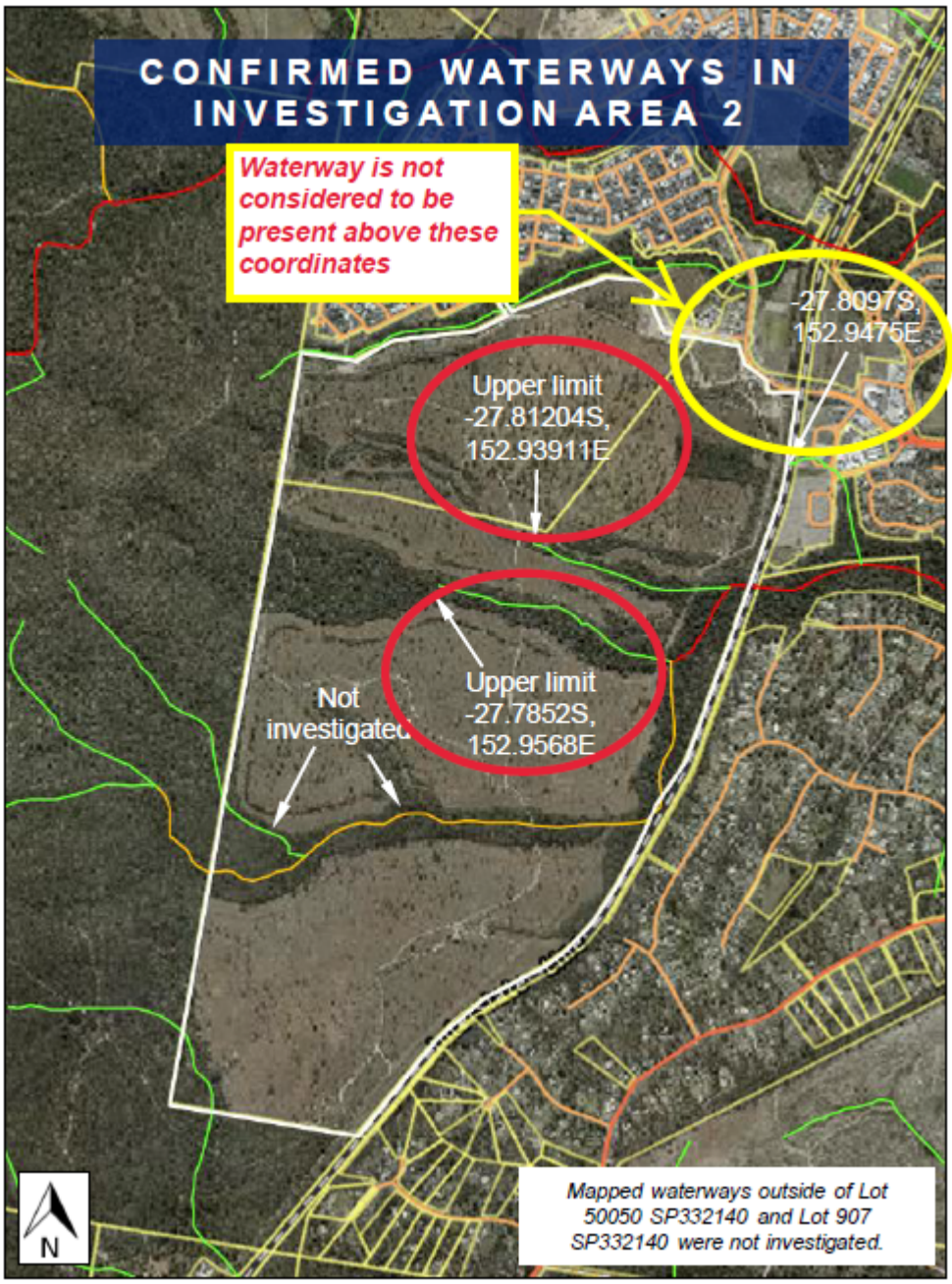
Attachment 1 - Waterways for which this advice relates to in investigation area 1 (blue circle) and investigation area 2 (yellow circles)



Attachment 2 – Coordinates of the agreed upper limit of the waterway in investigation area 1 (circled red) and waterway not present above coordinates on boundary of investigation area 1 (circled in yellow)



Attachment 3 – Coordinates of the agreed upper limit of the waterway in investigation area 2 (circled red) and waterway not present above coordinates on boundary of investigation area 2 (circled in yellow)


CONFIRMED WATERWAYS IN INVESTIGATION AREA 2
Waterway is not considered to be present above these coordinates
-27.8097S, 152.9475E
Upper limit -27.81204S, 152.93911E
Upper limit -27.7852S, 152.9568E
Not investigated
N
Mapped waterways outside of Lot 50050 SP332140 and Lot 907 SP332140 were not investigated.

APPENDIX C: SARA PRE-LODGEMENT ADVICE – REACH 4

DELIVERING FOR QUEENSLAND | Queensland Government

Department of
State Development,
Infrastructure and Planning

SARA reference: 2508-47867 SPL

4 September 2025

Mr Marcus Dryden
marcus.dryden@engeny.com.au

Dear Mr Dryden

SARA Pre-lodgement advice – Lot 907 on SP332140

I refer to your pre-lodgement request received on 19 August 2025 in which you sought pre-lodgement advice from the State Assessment and Referral Agency (SARA) regarding a waterway determination at the above address. This notice provides advice on aspects of the proposal that are of relevance to SARA.

SARA's understanding of the project

It is understood your request for advice is to determine whether a mapped Low (Green) Queensland waterway for waterway barrier works within the boundary of the Greater Flagstone PDA City Context Area 5, located at Lot 907 on SP332140 (approximate location -27.82892, 152.92836) is a waterway for the purposes of waterway barrier works.

On 5 August 2025, SARA provided pre-lodgement advice about the waterway determination confirming that the mapped waterway meets the definition of a waterway under the *Fisheries Act 1994* and recommending further investigations to assess fish passage and habitat connectivity to inform future development planning (SARA reference 2507-47109 SPL). On 19 August 2025, additional information has been provided to SARA and based on the information provided, amended pre-lodgement advice has been prepared.

Supporting information

The advice in this letter is based on the following documentation that was submitted with the pre-lodgement request.

Drawing/report title	Prepared by	Date
Letter re SARA pre-lodgement advice – Lot 907 on SP332140	Engeny Australia	19 August 2025

Planning Services (SEQ South)
Level 9, 12-14 Marine Parade, Southport
PO Box 3290, Southport BC QLD 4215

Pre-lodgement advice

The following advice outlines the aspects of the proposal that are of relevance to SARA.

Waterway mapping advice	
1.	The unnamed tributary of Fish Creek - Feature 1 (refer to **Appendix 1**), upstream of -27.82892, 152.92836, is displayed as a green waterway on the Queensland waterways for waterway barrier works mapping. Based on mapping, aerial imagery and on-site investigations: • Feature 1 is mapped as a drainage feature on the watercourse identification mapping. • Elevation data available through the "hillshade traditional" layer on Queensland Globe shows defined bed and banks within the mapped feature. However, connection downstream is not visible. • Aerial imagery indicates a lack of a connected or well-defined channel downstream of the feature. • Provided site photos show isolated pools of standing water within the landscape where Feature 1 is mapped, however these pools only persist for a short duration after heavy rain events. • The catchment area upstream of Feature 1 is limited in size and is unlikely to provide adequate flow of water required to sustain basic ecological processes and habitats. • Images provided of the site show a drainage gully with a lack of connection between sections of defined bed and banks. Additionally, no evidence of fish habitat was observed in the lower sections of the feature, including a lack of aquatic macrophytes/standing water/flowing water/large woody debris. • Wetland mapping does not display wetlands adjacent to or upstream of Feature 1. • Additional site investigations around the rail line show the culvert and bed gradients do not provide an avenue for upstream fish passage due to steep gradients of 15%. Based on the above points, it is unlikely fish or fisheries resources would be present upstream of -27.82892, 152.92836 in Feature 1. Based on the current assessment, it has been determined that any works within Feature 1 would not constitute waterway barrier works.

This advice outlines aspects of the proposed development that are relevant from the jurisdiction of SARA. This advice is provided in good faith and is:

- based on the material and information provided to SARA
- current at the time of issue
- not applicable if the proposal is changed from that which formed the basis of this advice.

This advice does not constitute an approval or an endorsement that SARA supports the development proposal. Additional information may be required to allow SARA to properly assess the development proposal when a formal application has been lodged.

If you require further information please contact Elly Wong, A/Senior Planning Officer, on (07) 5644 3215 or via email SEQSouthPlanning@dsdilgp.qld.gov.au who will be pleased to assist.

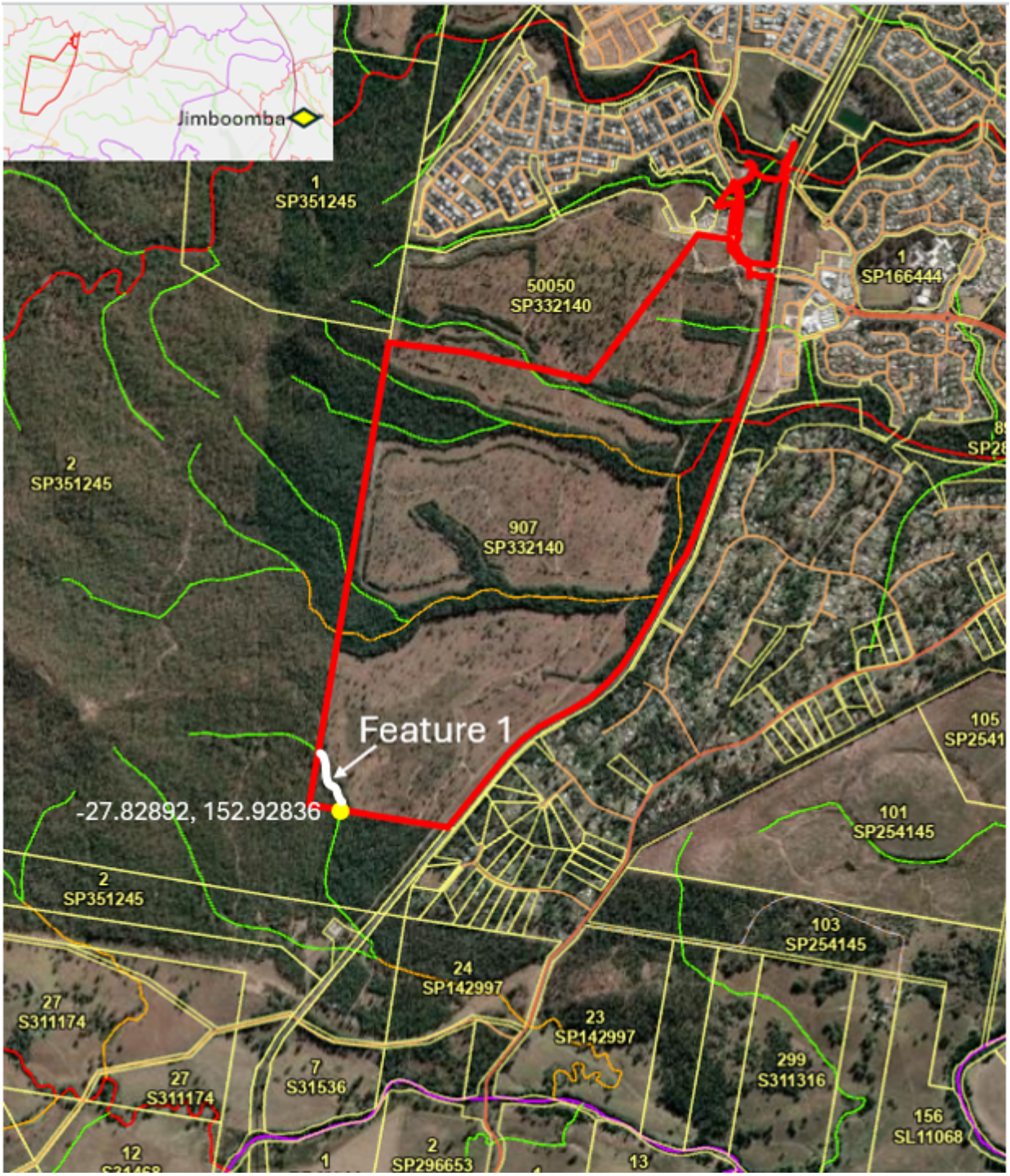
Yours sincerely



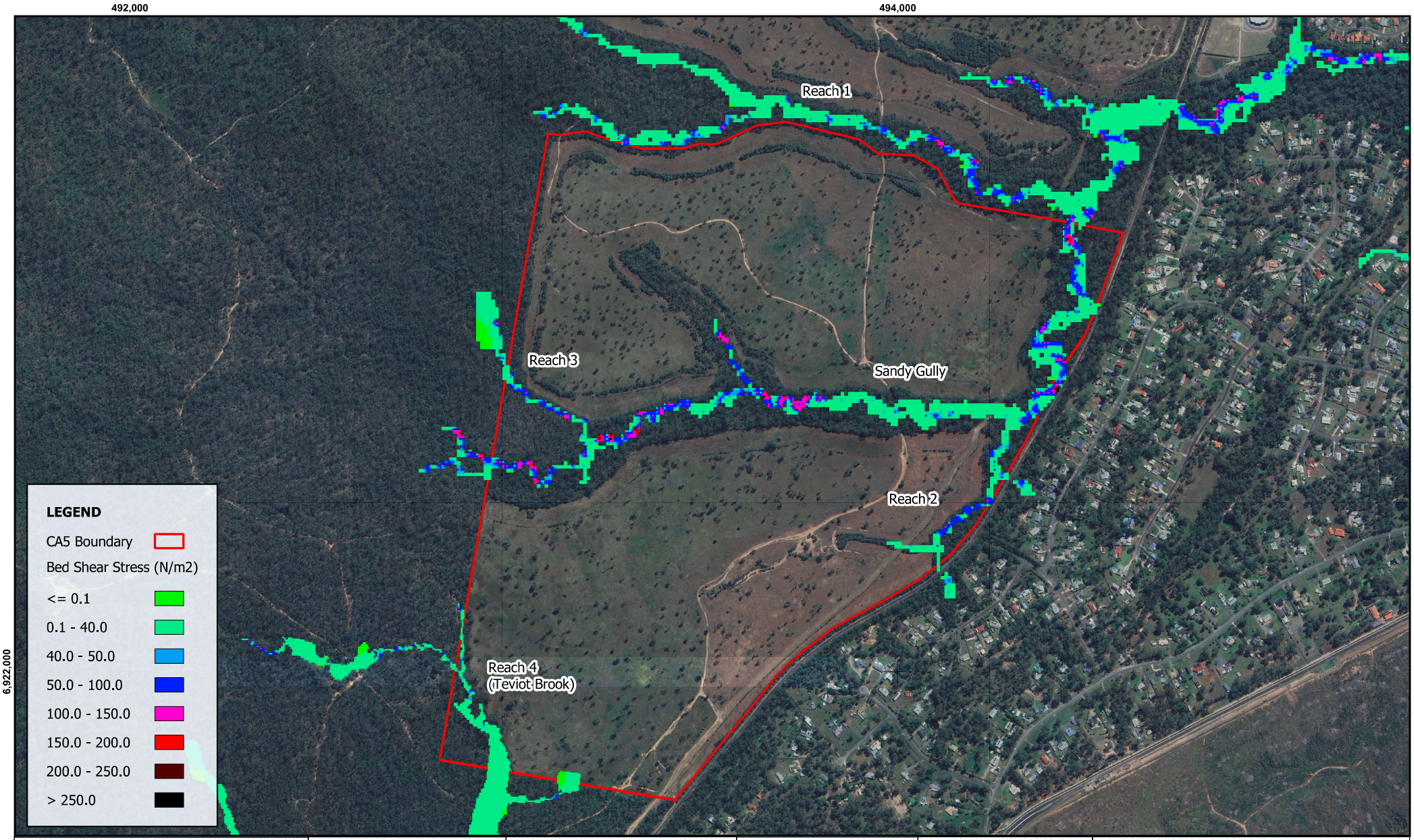
Ashleigh Slater
Acting Manager - Planning Services (SEQ South)

Development details	
Proposal:	To be confirmed
Street address:	Flagstone
Real property description:	Lot 907 on SP332140
SARA role:	To be confirmed
Assessment Manager:	To be confirmed
Assessment criteria:	If the works constitute Operational work for constructing or raising waterway barrier works the assessment criteria includes the latest version of State code 18: Constructing or raising waterway barrier works in fish habitats of the State Development Assessment Provisions

Appendix 1 - Unnamed waterway marked in white, within Lot 907 on SP332140 upstream from point -27.82892, 152.92836.



APPENDIX D: SHEAR STRESS, STREAM POWER AND VELOCITY MAPPING



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CHECKED	TF	DATE	26-08-2025

NOTES:

0 0.2 0.4 km

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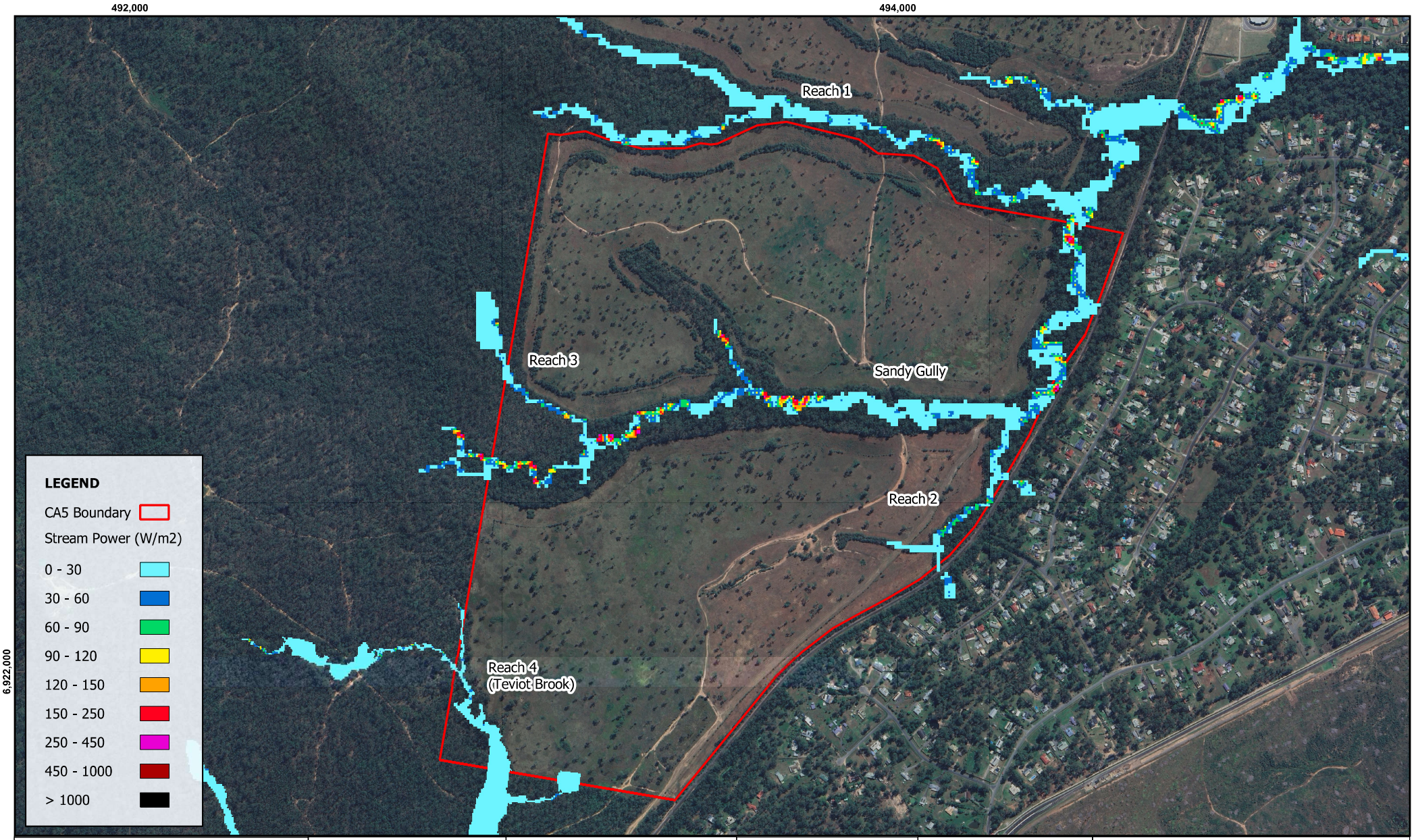
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
50% AEP Bed Shear Stress

Drg Ref.

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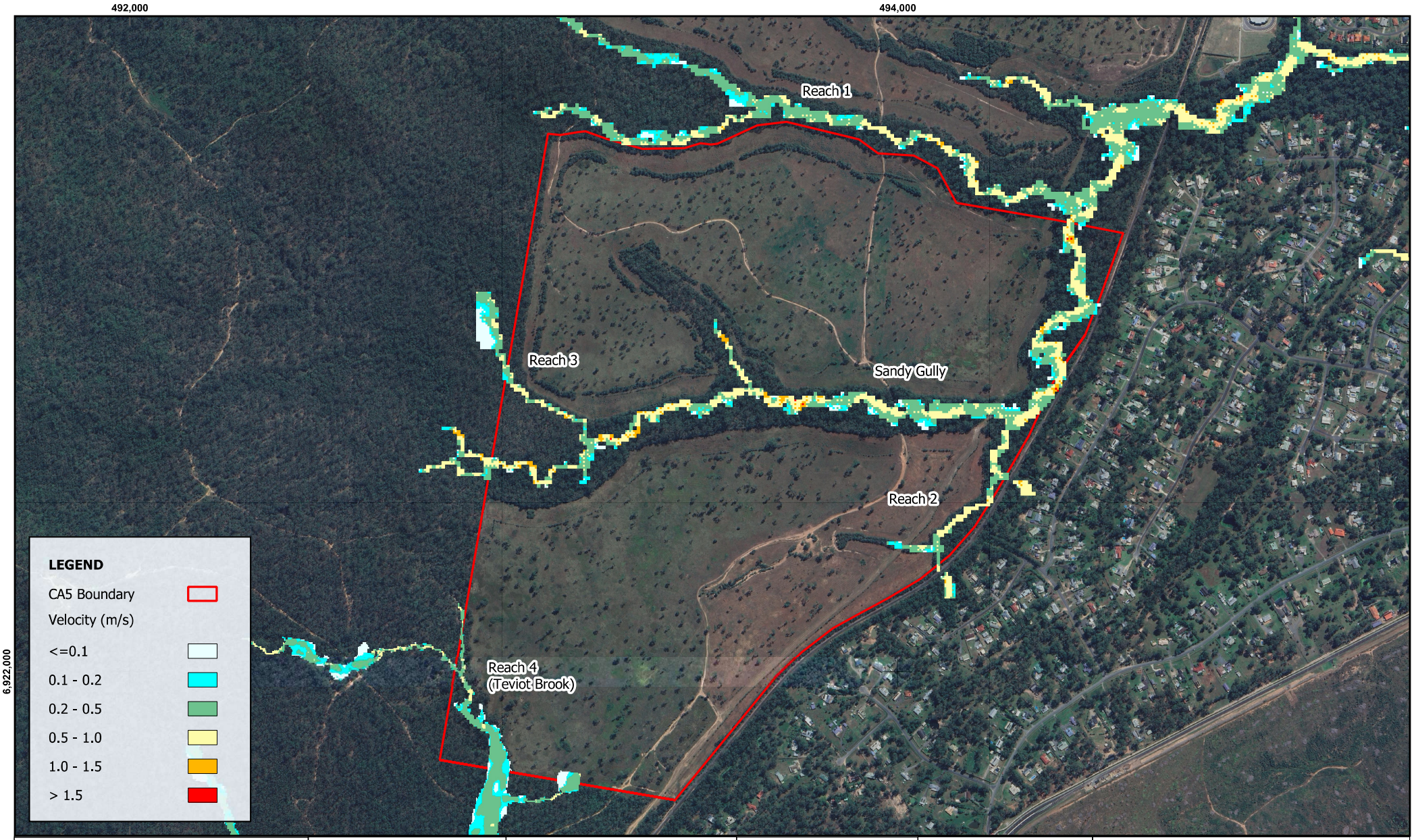
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Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
50% AEP Stream Power

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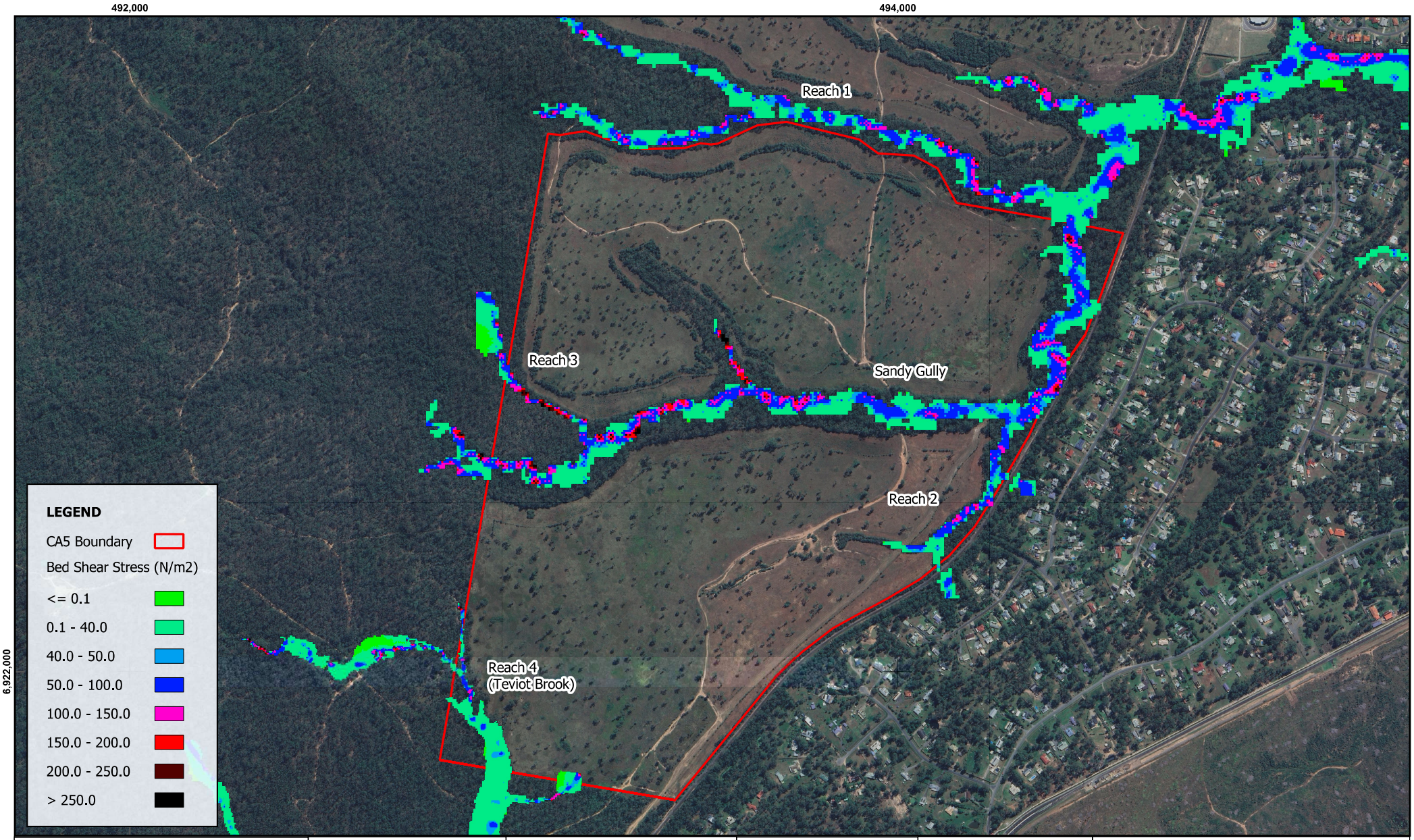
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
50% AEP Velocity

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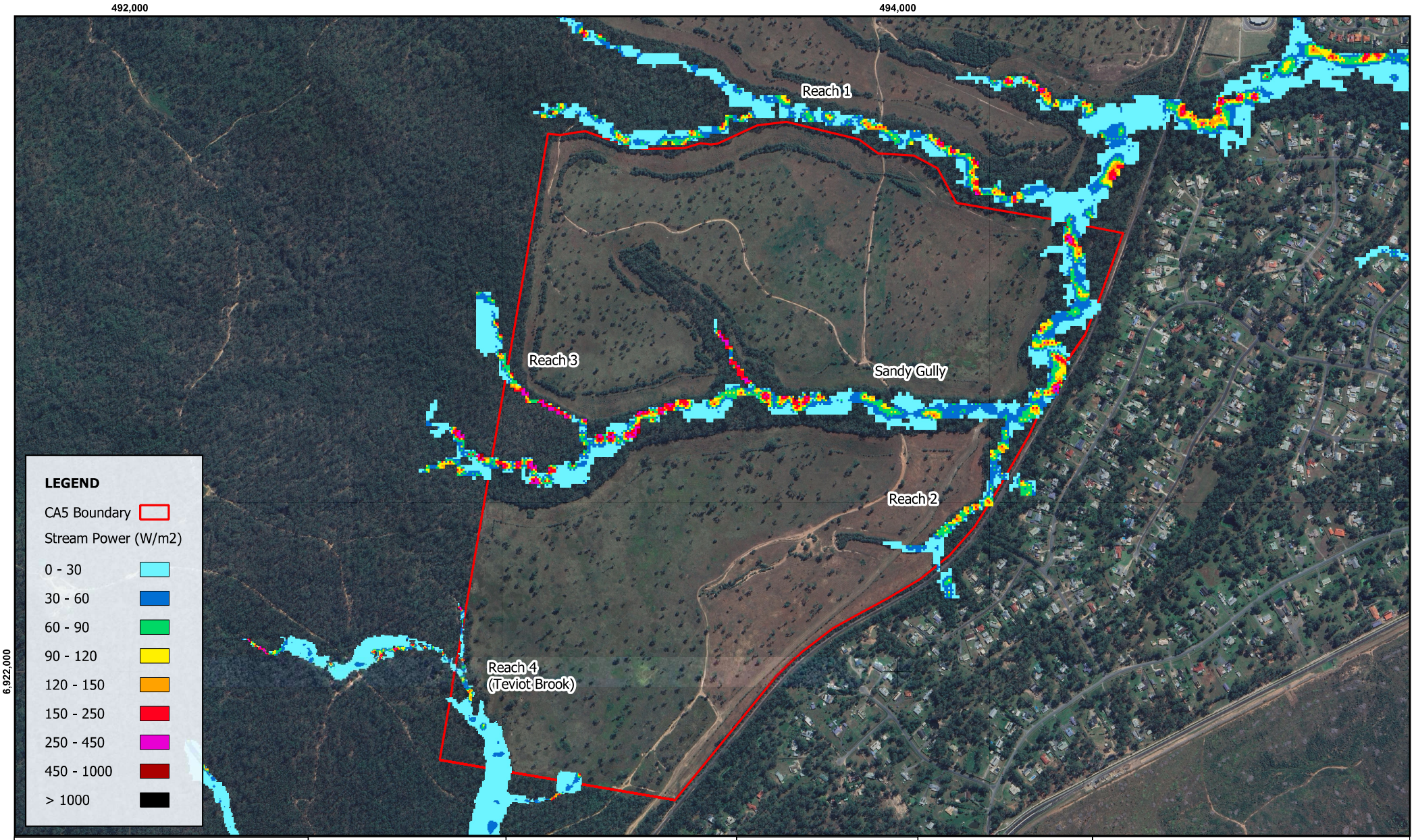
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
2% AEP Bed Shear Stress

Drg Ref.

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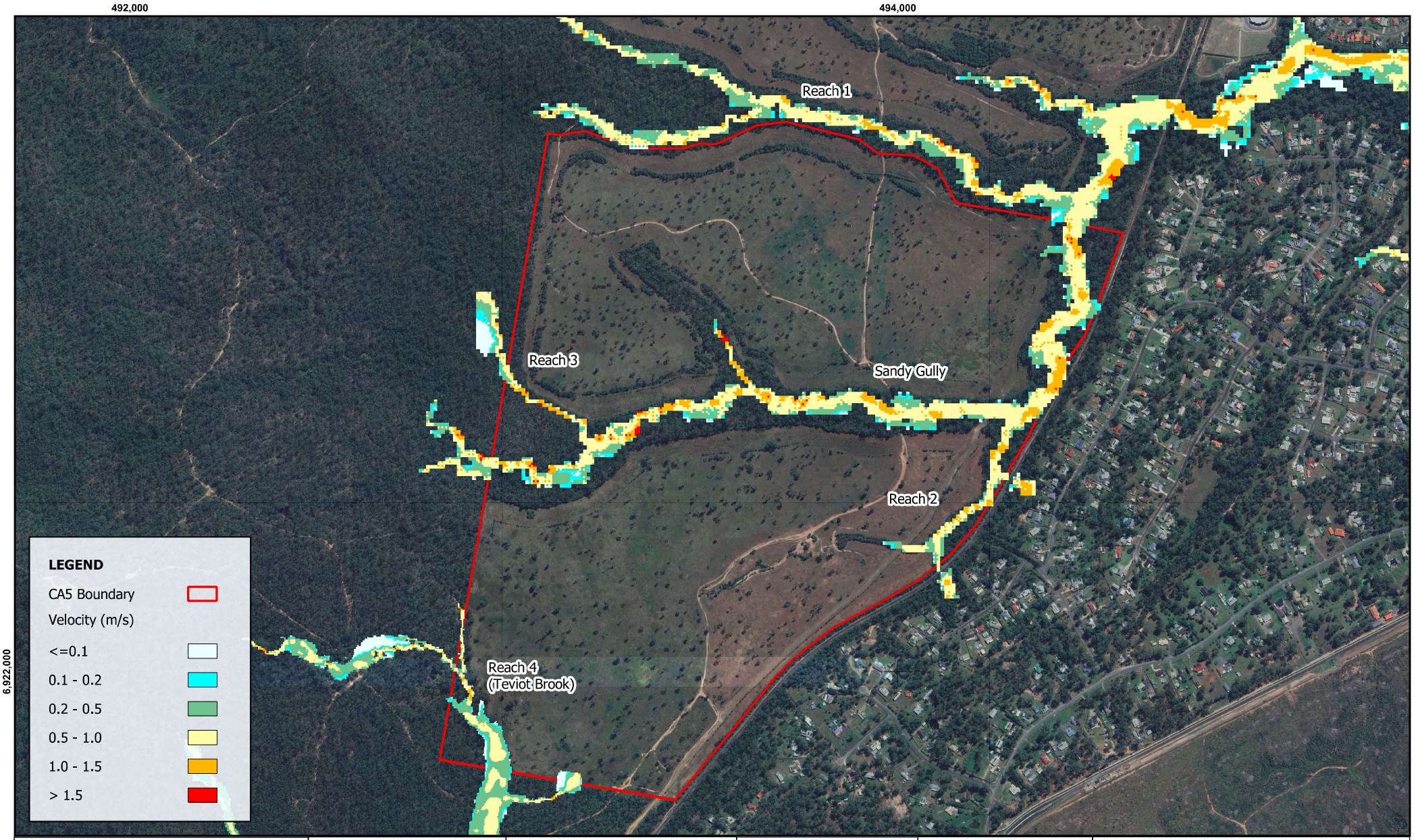
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
2% AEP Stream Power

Drg Ref.

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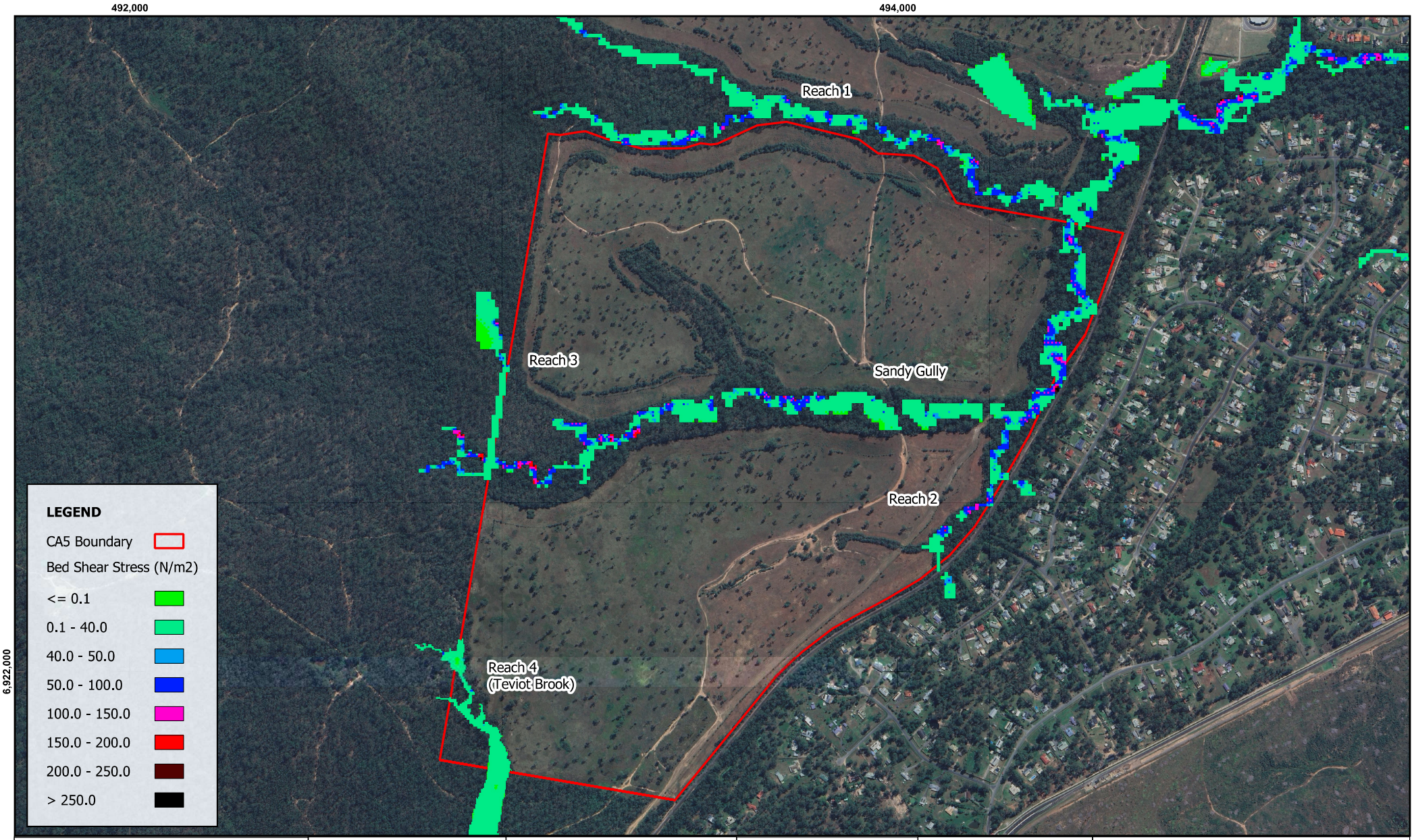
Appendix C

Flagstone Creek CA5 South
Waterway Stability Assessment

Baseline Scenario
2% AEP Velocity

Drg Ref.

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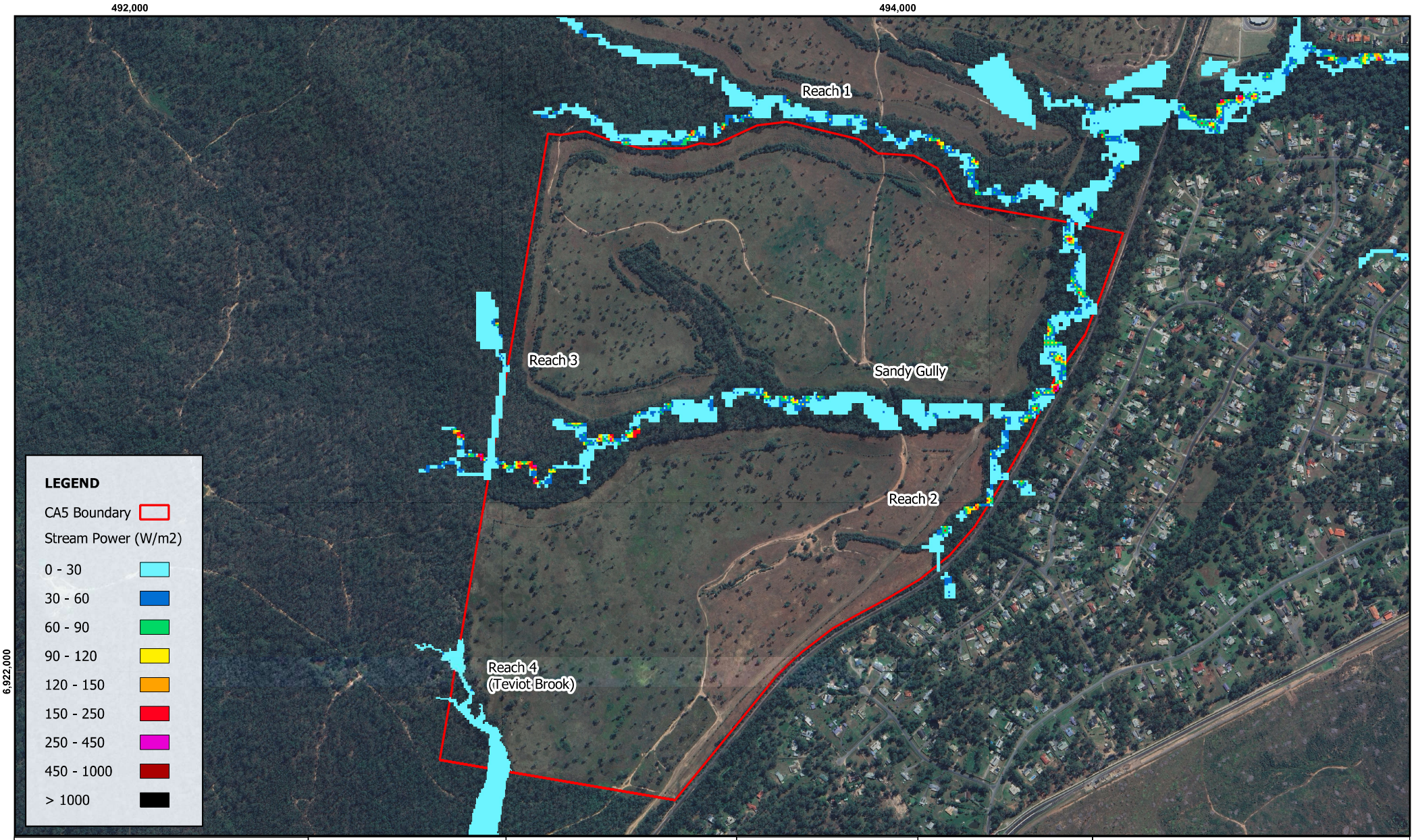
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
50% AEP Bed Shear Stress

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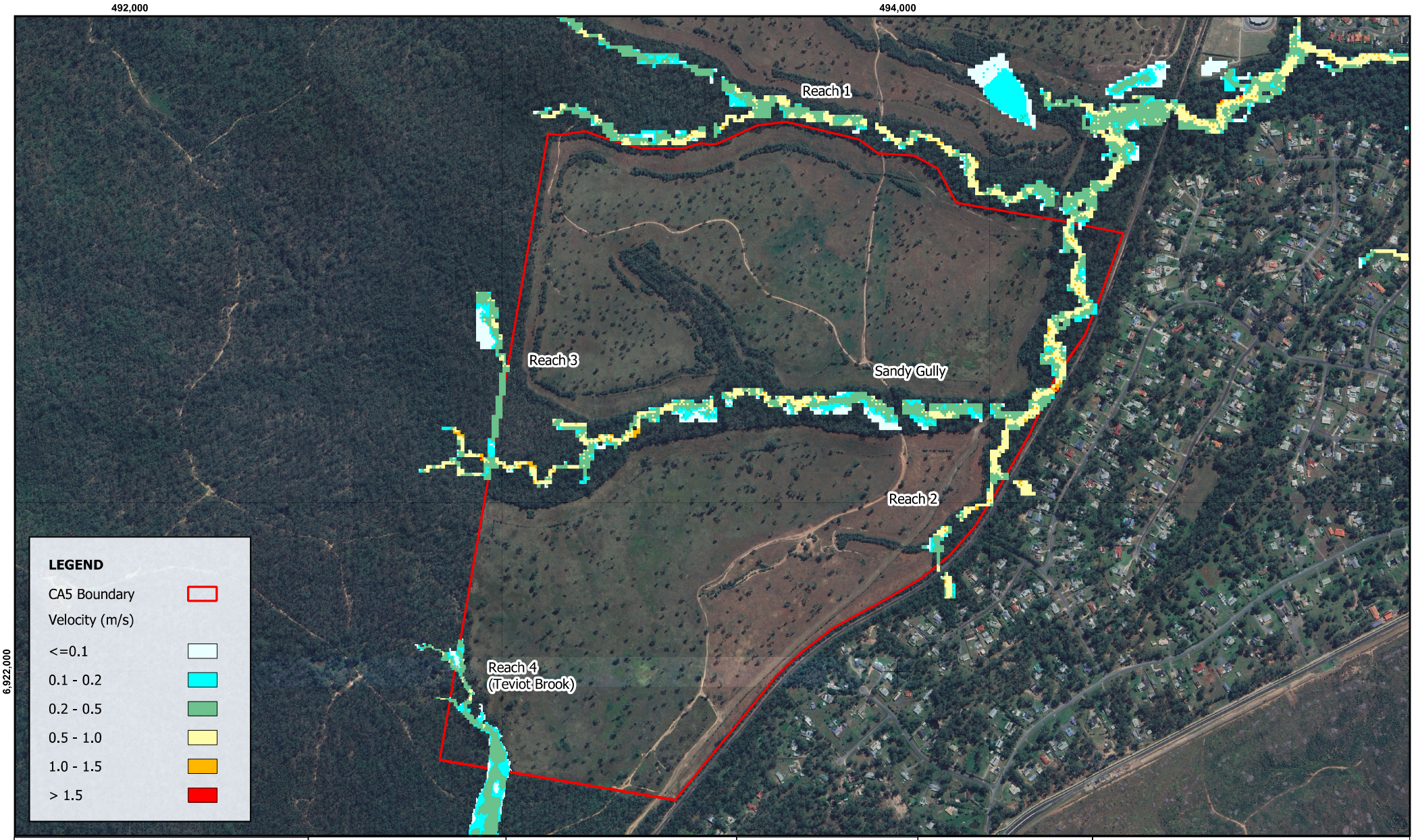
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Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
50% AEP Stream Power

Drg Ref.

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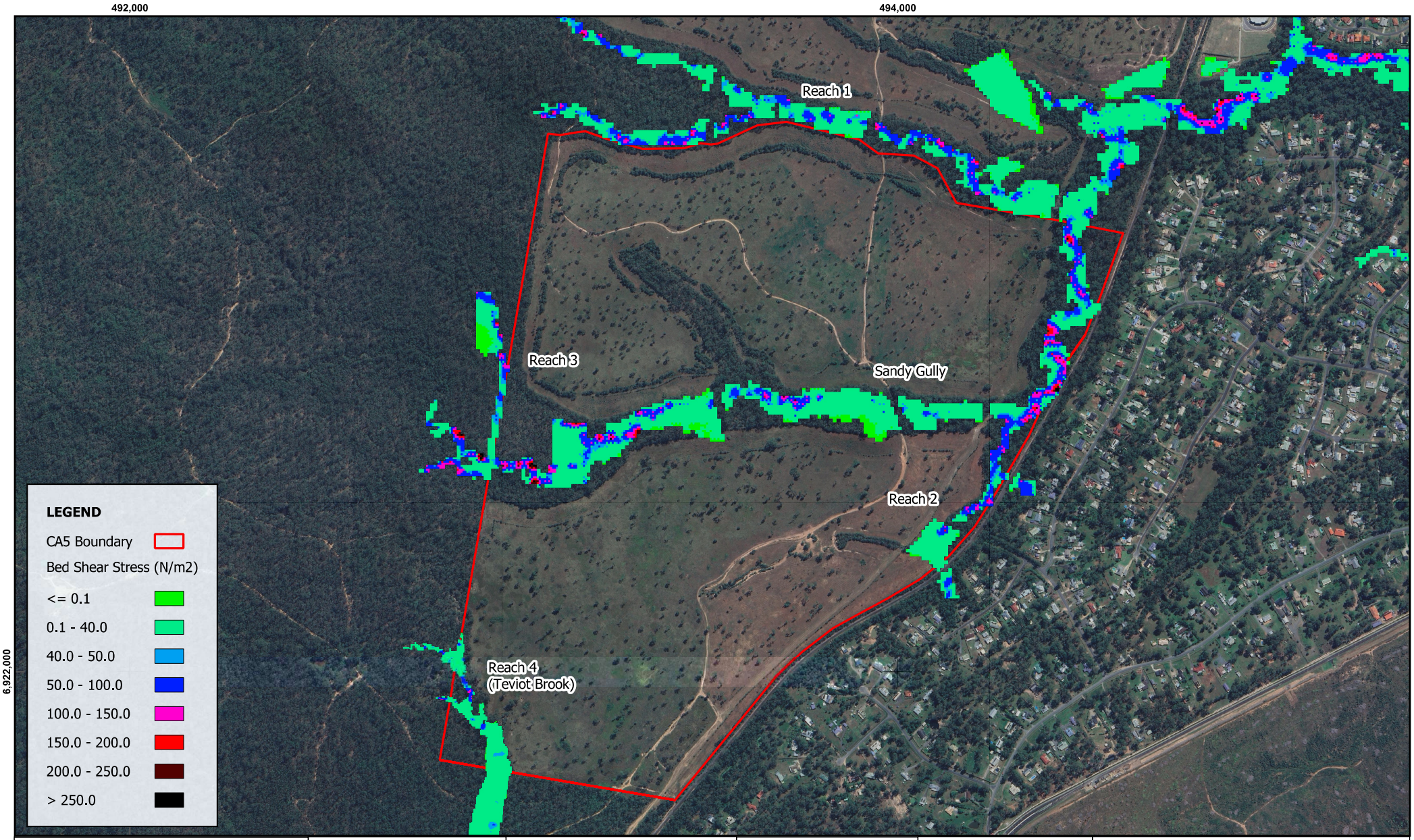
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Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
50% AEP Velocity

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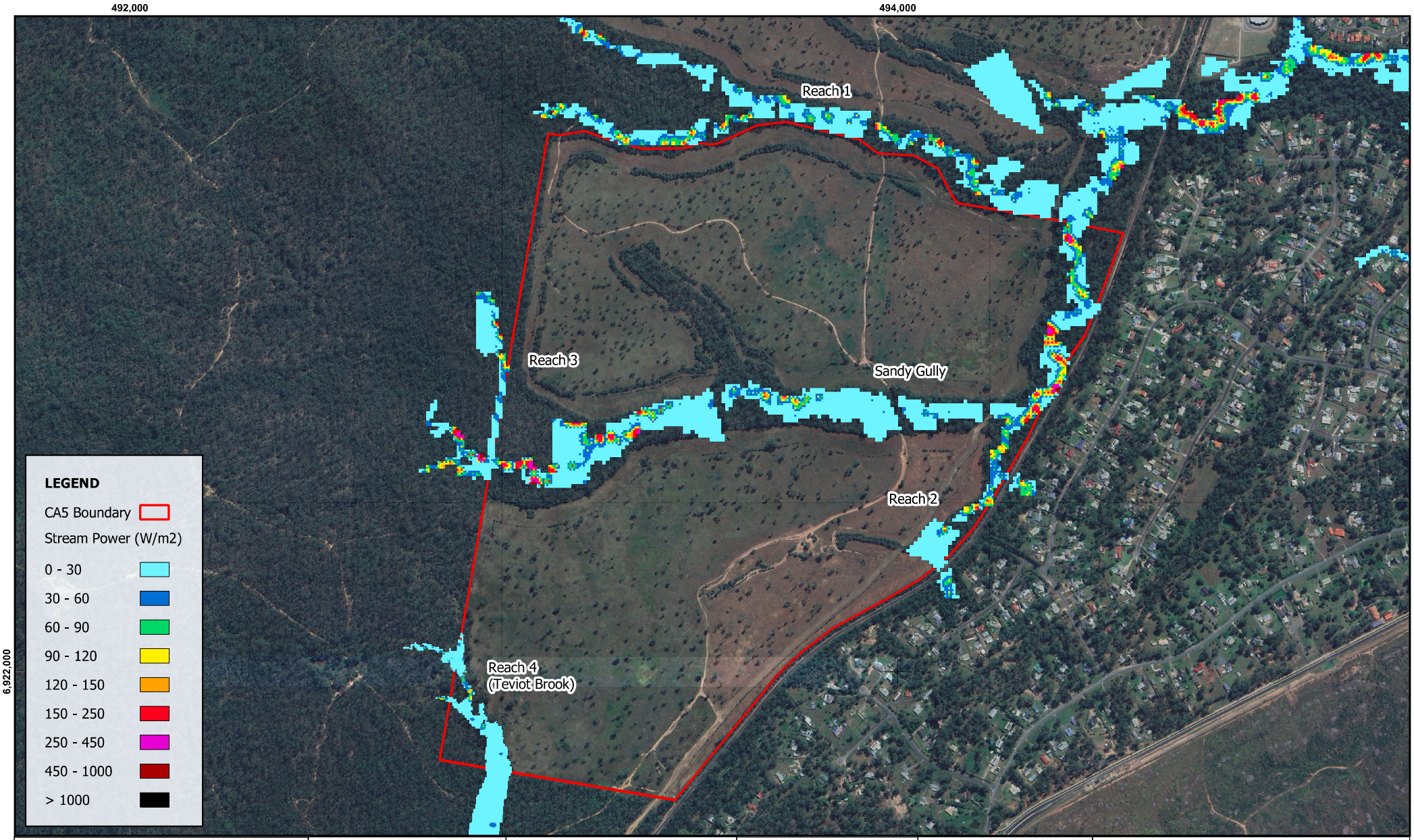
Appendix D

Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
2% AEP Bed Shear Stress

Drg Ref.

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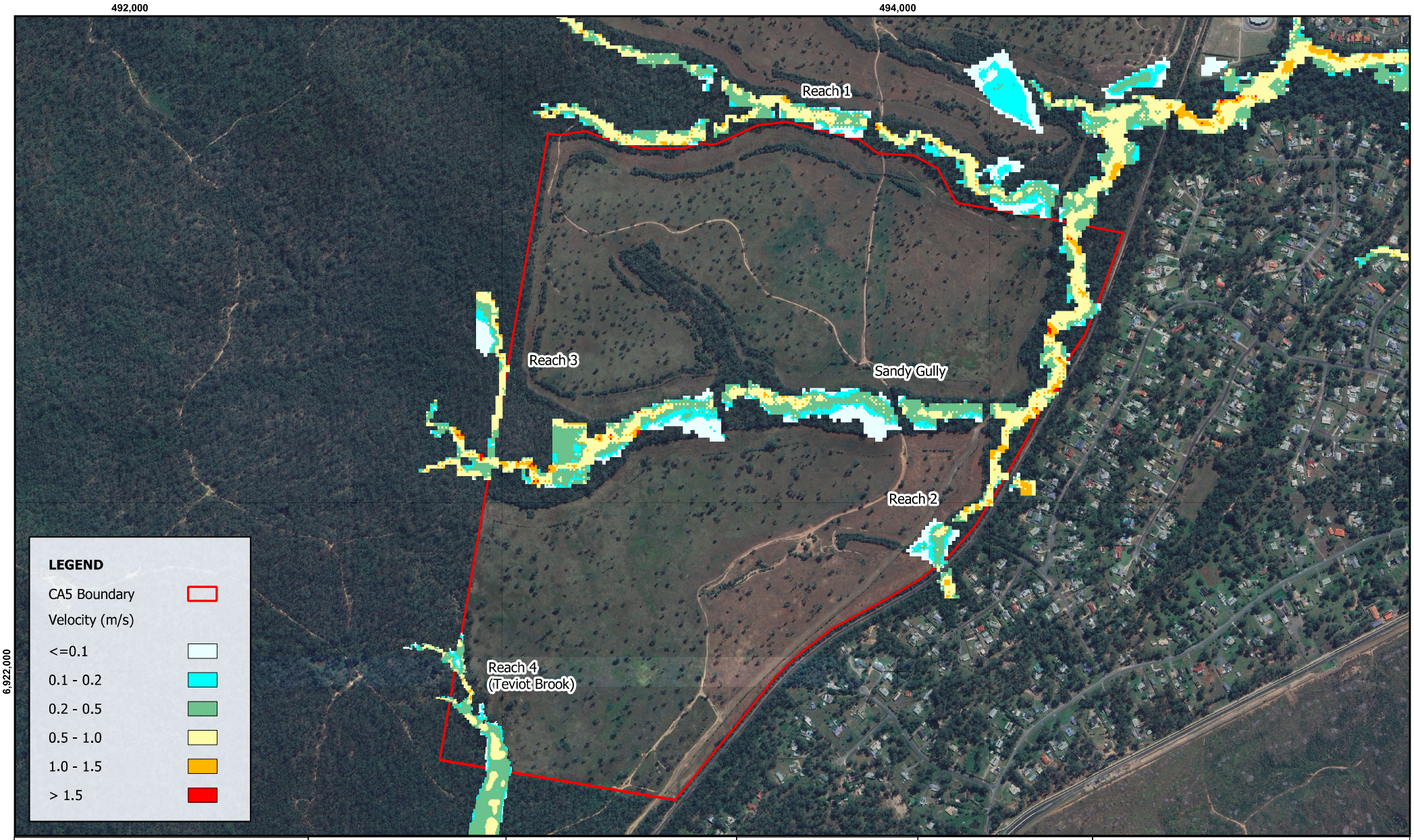
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Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
2% AEP Stream Power

Drg Ref.

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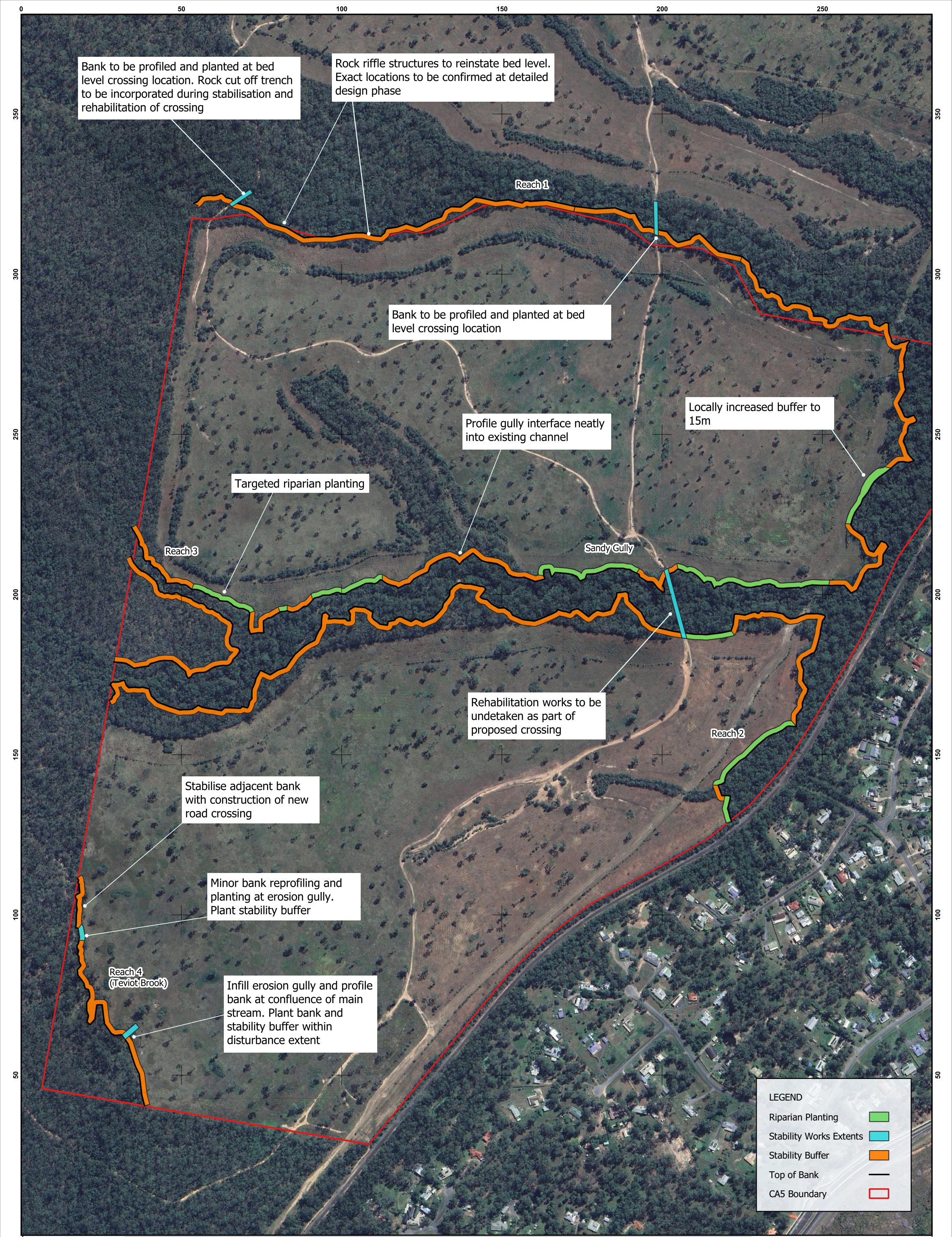
Flagstone Creek CA5 South
Waterway Stability Assessment

Masterplan Scenario
2% AEP Velocity

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APPENDIX E: CONCEPT STABILITY PLAN



R	DETAILS	DATE
1	Final Issue	22-09-2025

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This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	MD	CHECKED	DS
APPROVED	TH	DATE	22-09-2025

NOTES:

0 50 100 150 m

SCALE - 1:6,000

GDA2020 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY egis GROUP

PEET

Appendix E - Concept Stability Plan

Flagstone Creek CA5 South
Waterway Stability Assessment

Drg Ref.

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