Saddleback Mountain Road, Kiama Heights, Bushfire Strategic Study

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Template 2.8.1

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1. Introduction

1.1 Background

This Strategic Bushfire Study (the Study) has been prepared to inform and assist with the preparation of a rezoning proposal for lands situated within the Kiama Municipal Council (KMC) Local Government Area (LGA). The objectives of the proposal is the rezoning of Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP1077617, Part Lot 102 DP 1077617, Lot 8 DP258605 and Part Lot 3 DP1077617 (Subject Land) from their current status of RU2 (rural landscape) to R2 (low density residential), for future residential subdivision (**Figure 1** and **Figure 2**).

While the Subject Land is not mapped as bush fire prone land (BFPL) by KMC, it is in close proximity to BFPL to the west of the Subject Land and under current BFPL guidelines (RFS, 2015), grassland adjacent to the western boundary is likely to meet the requirements of Category 3 bush fire prone vegetation. Furthermore, remnant riparian corridors and rainforest vegetation along the eastern boundary of the subject land are likely to be allowed to regenerate as part of this proposal and may then constitute as bush fire prone vegetation and will likely be mapped as BFPL by KMC at a later date.

Under the Ministerial Direction 4.4 (Planning for Bushfire Protection (PBP)) issued under Section 9.1 of the Environmental Planning and Assessment Act, where a proposal includes or is in close proximity to BFPL, the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service (RFS) following receipt of a gateway determination. The gateway determination (IRF No 19/6452) issued by the Department of Planning and Environment (DPE) for this proposal, therefore requires consultation with the RFS prior to public exhibition.

PBP (RFS, 2019) outlines broad principles and assessment considerations for strategic planning. It also specifies that bushfire protection measures need to be considered at the strategic planning stage to provide an opportunity to assess the suitability of future land uses within the broader bush fire hazard setting to ensure that future land use can meet the objectives of PBP. As such, this study addresses the minimum requirements for a strategic study, as listed in Table 4.2.1 of PBP 2019, with additional information provided where necessary and summarised in **Table 1** below. This study has been prepared to inform and assist with the preparation of the rezoning proposal for the subject land.

Table 1 – Summary of requirements for a strategic bush fire study (PBP 2019).

Issue	Detail
Bush fire landscape assessment	A bush fire landscape assessment considers the likelihood of a bush fire, its potential severity and intensity and the potential impact on life and property in the context of the broader surrounding landscape.
Land use assessment	The land use assessment will identify the most appropriate locations within the masterplan area or site layout for the proposed uses.
Access and egress	A study of the existing and proposed road networks both within and external to the masterplan area and site layout.
Emergency services	An assessment of the future impact of the new development on emergency services provision.
Infrastructure	An assessment of the issues associated with infrastructure provision.
Adjoining land	The impact of new development on adjoining landowners and their ability to undertake bush fire management.

1.2 Planning process

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislation and instruments are integrated with the EP&A Act, including the *Rural Fires Act 1997* (RF Act).

1.2.1 Direction 4.4 – 'Planning for Bush Fire Protection'

When investigating the capability of bushfire prone land to be rezoned for residential purposes, councils must have regard to s.9.1 (2) Direction 4.4 – 'Planning for Bushfire Protection' of the EP&A Act. The objectives of Direction 4.4 are:

- To protect life, property, and the environment from bushfire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas; and
- To encourage sound management of bush fire prone areas.

Direction 4.4 instructs councils on the bushfire matters which need to be addressed when drafting LEPs. This includes:

- Consultation with the Commissioner of the NSW RFS, and take into account any comments so made;
- Draft LEPs shall have regard to PBP*;* and
- Compliance with numerous bushfire protection provisions where development is proposed.

After the rezoning stage, future subdivision and the construction of buildings will also require an assessment against PBP. These assessments are based on a final development application for these uses.

1.2.2 Rural Fires Act 1997 (RF Act)

The objects of RF Act are to provide:

> "(a) for the prevention, mitigation and suppression of bush and other fires in local government areas (or parts of areas) and other parts of the State constituted as rural fire districts, and
> (b) for the co-ordination of bush fire fighting and bush fire prevention throughout the State, and

(c) for the protection of persons from injury or death, and property from damage, arising from fires, and
(c1) for the protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires, and
(d) for the protection of the environment by requiring certain activities referred to in paragraphs (a)-(c1) to be carried out having regard to the principles of ecologically sustainable development described in section 6 (2) of the *Protection of the Environment Administration Act 1991*."

Key requirements of the RF Act in relation to this project include:

- All landowners to exercise a duty of care to prevent bush fire from spreading on or from their land under section 63 of the RF Act. This involves taking steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of a bush fire on or from any land vested in or under its control or management. This relates to the appropriate provision and maintenance of Asset Protection Zones (APZs), landscaping and any retained vegetation when developing land (NSW Rural Fire Service (RFS), 2006; 2019); and
- Under Section 64 obligations, if a fire is burning at any time during a bush fire danger period, the occupier immediately on becoming aware of the fire must take all possible steps to extinguish the fire, and if unable without assistance to extinguish the fire, inform the appropriate officer (RFS, Fire and Rescue NSW, Office of Environment and Heritage.) of the existence and locality of the fire if it is practicable to do so without leaving the fire unattended.

1.3 Aims and Objectives

The Study provides an assessment of the landscape bushfire risk and the residual risk for development following the provision of bushfire protection measures. It includes the following strategic assessment considerations in PBP (RFS 2019):

- ensuring land is suitable for development in the context of bush fire risk;
- ensuring future development on BFPL will comply with PBP 2019;
- minimising reliance on performance-based solutions;
- providing infrastructure associated with emergency evacuation and firefighting operations; and
- facilitating appropriate ongoing land management practices.

1.4 Study Area

The subject land is 42 hectares (ha) in extent and located approximately 150 kilometres (km) south of Sydney, situated to the south-west of the Kiama CBD, within the Municipality of Kiama. The location of the study area is shown in **Figure 1**.

1.5 Bushfire Prone Land Status

BFPL is mapped by the RFS in accordance with legislative requirements and published by the Department of Planning (2020) (**Figure 3**).

Categories of mapped BFPL for the study area and adjoining areas, are shown in **Figure 3**, with each BFPL category defined at the state level as follows:

- Vegetation Category 1 is the most hazardous vegetation category;
- Vegetation Category 2 are smaller, isolated pockets of vegetation that have lower combustibility and/or limited potential fire size due to the vegetation area shape and size, land geography and management practices;
- Vegetation Category 3 is considered to be medium bush fire risk vegetation; and
- Vegetation buffer are areas in which developments and people are most likely to be affected by a bushfire. The buffer extends for a distance of 100 m from the Category 1 areas and 30 m from Category 2 areas.

The presence of mapped BFPL requires that any new development on BFPL must satisfy the aim and objectives of PBP (RFS 2019). On formally mapped BFPL an assessment is required to consider the vegetation hazard and effective slope within the site and adjoining areas, in order to develop site specific bush fire protection measures in relation to proposed development. Bushfire protection measures, including requirements for APZ, are identified in the following sections.

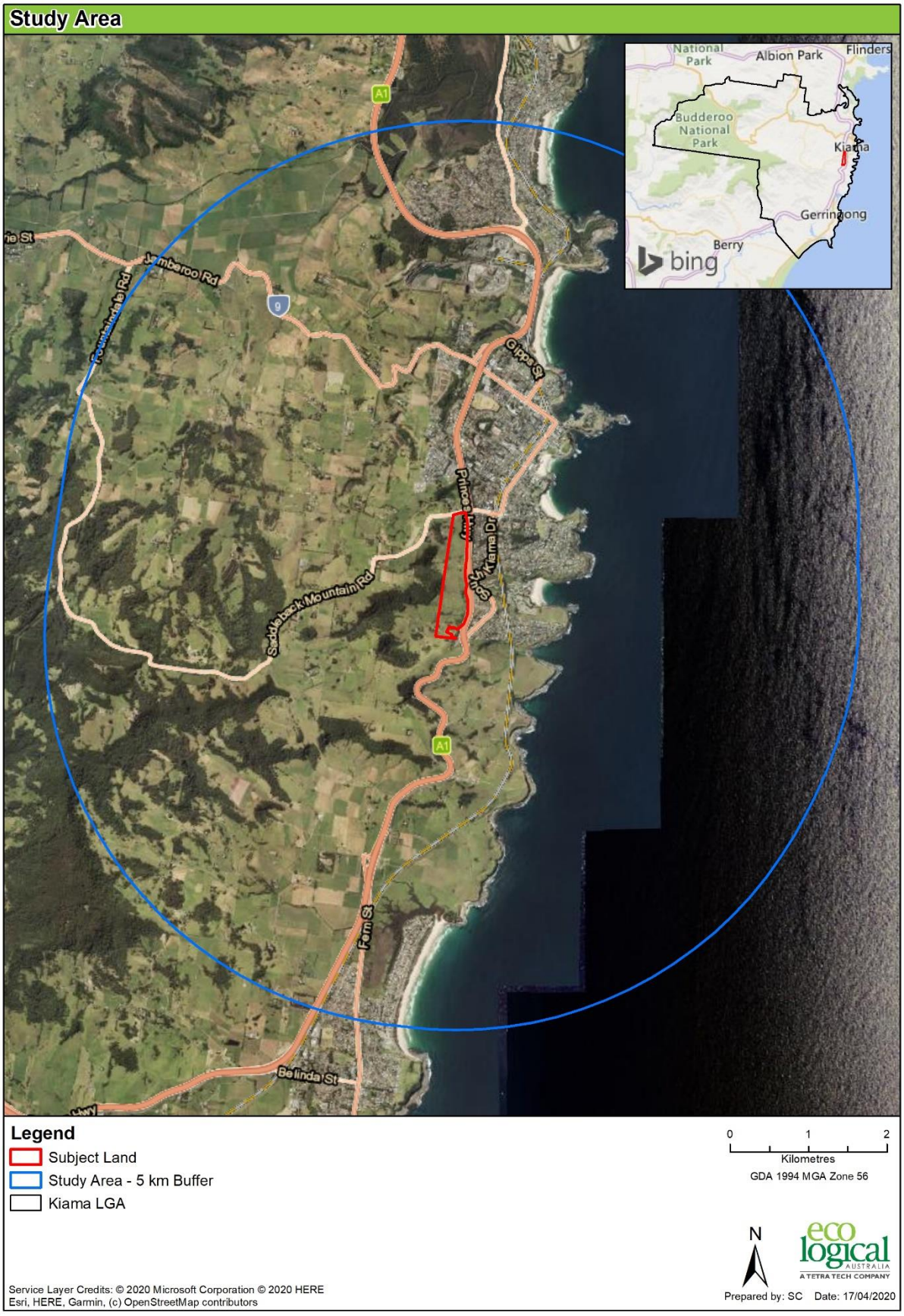

Figure 1: Study area

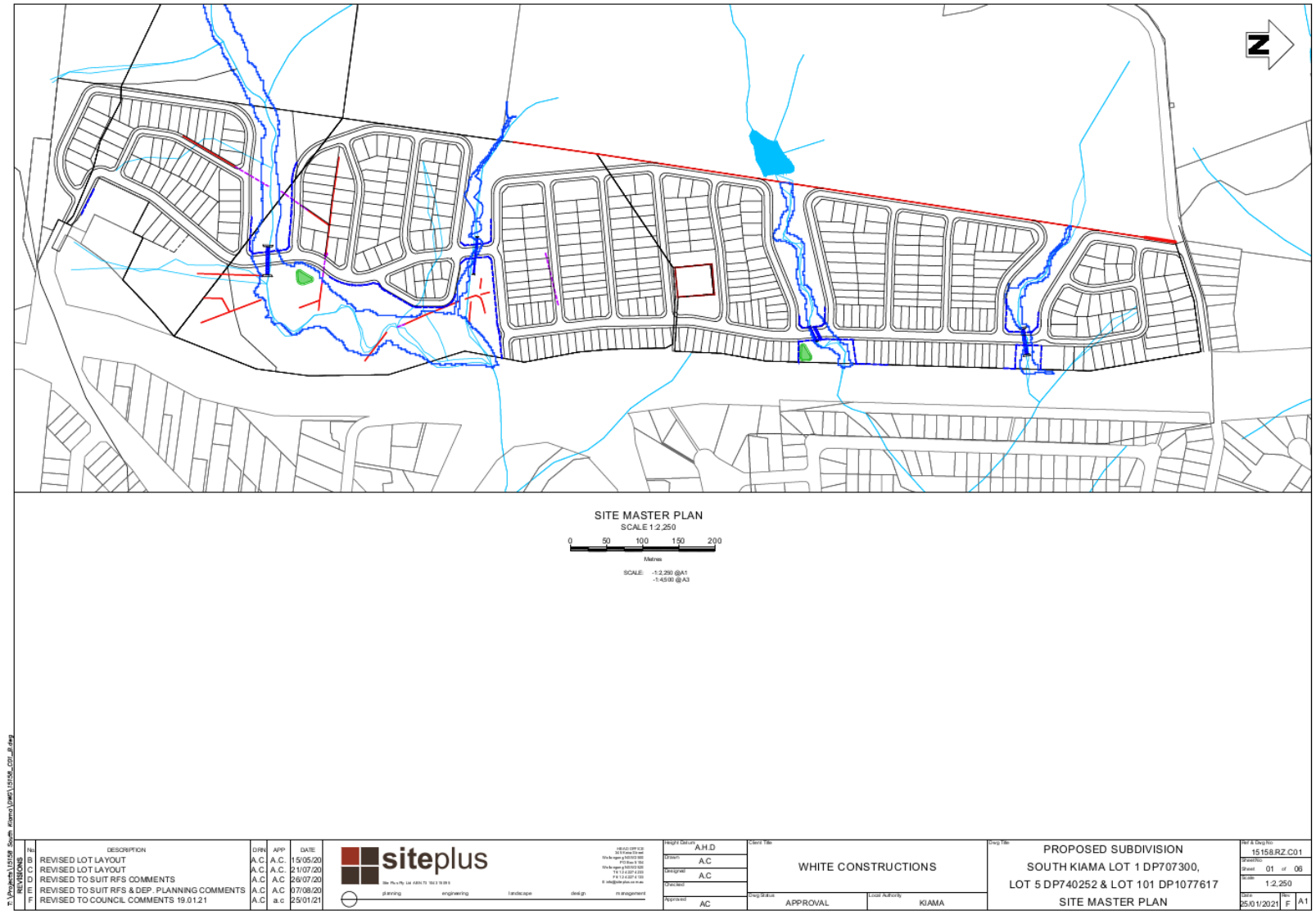

Figure 2: Indicative future layout

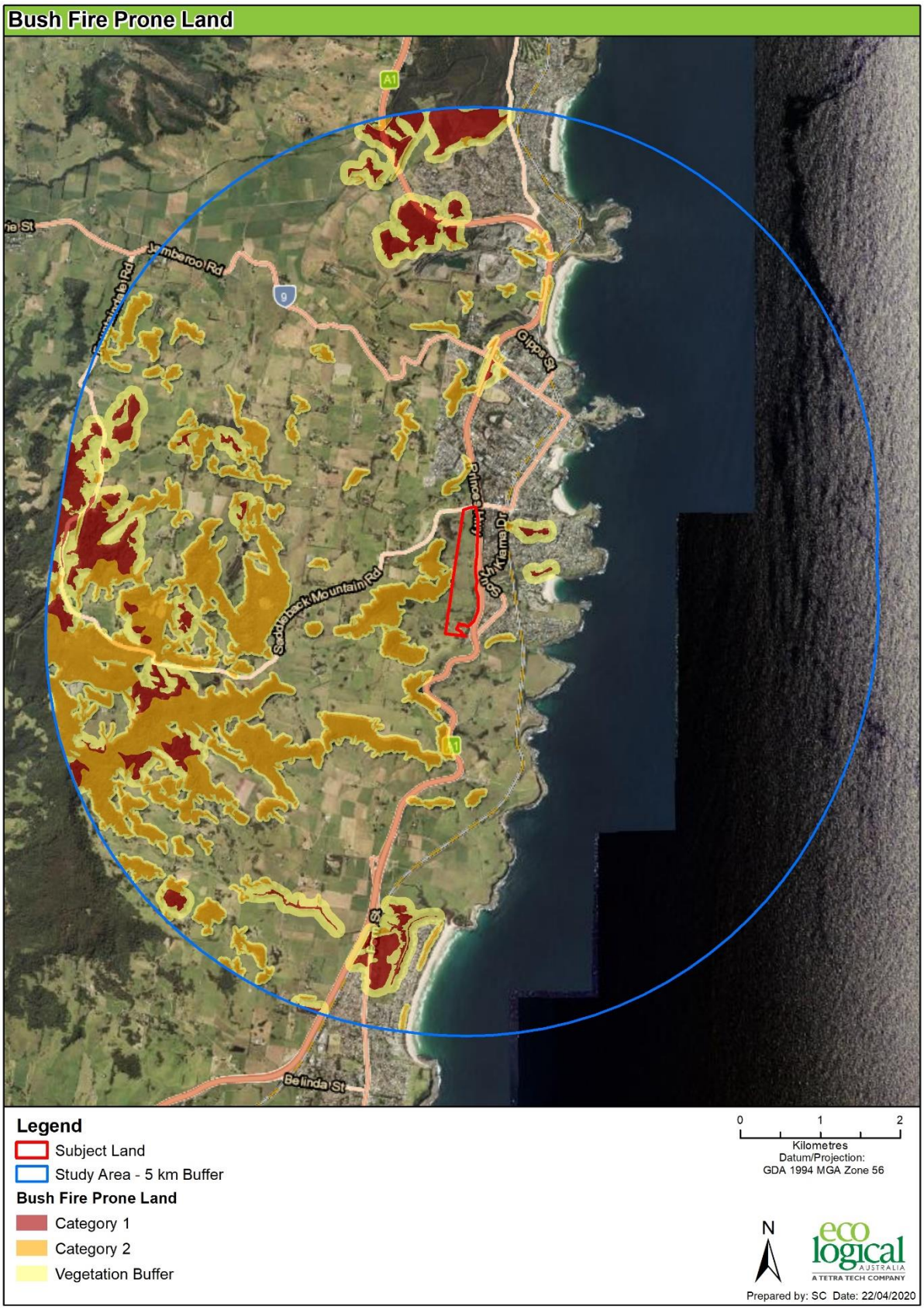

Figure 3: Bush fire prone land

2. Bushfire Landscape Risk Assessment

The landscape bushfire risk includes assessment of bushfire hazard, potential fire behaviour and bushfire history within a 5 km radius of the Subject Land, herein called the 'study area'.

2.1 Bushfire Hazard

Whilst the Subject Land has not been classified as BFPL, it is located within a wider landscape of BFPL. It is further likely that future regeneration of riparian corridors within the Subject Land will constitute BFPL, and that unmapped grassland to the west of the proposed development would be classified as Vegetation Category 3 under updated BFPL guidelines (RFS 2015). Therefore, the bushfire hazard to the west, with the inclusion of grassland, presents a continuous enough matrix of vegetation to potentially expose the subject land to bushfire under favourable conditions.

Bushfire hazard has been classified using the PBP methodology through assessment of vegetation and slope.

2.1.1 Vegetation

The study area presents with rural landscape to the west, comprised predominantly of rainforest vegetation as evident in the Illawarra Vegetation Mapping (OEH 2016) (**Figure 4**). Small areas of wet sclerophyll forest are also present in the western portion of the study area. The addition of grassland vegetation in rural areas as shown in **Figure 5**, has facilitated a conservative approach to the assessment of bushfire vegetation in this study. Within the subject land, vegetation is comprised primarily of rural pasture.

Classification of vegetation formation for unassigned vegetation types are also listed in **Table 2**.

Vegetation has been classified into Keith Formations and Keith Class (Keith 2004) and assigned a potential total fuel load (tonnes / hectare) using Table A1.2.8 from PBP (RFS 2019). **Figure 5** and **Table 2** show the vegetation

Table 2: Vegetation formation, class and fuel allocation for the study area

Vegetation formation	Keith Class	Overall fuel including bark and canopy (t/ha)*
Forested Wetland	Coastal Swamp Forest; Coastal Floodplain Wetlands	15.1
Forest	South Coast Sands DSF; North Coast WSF; Southern Escarpment WSF; Plantation; Mixed Miscellaneous Forest	36.1
Freshwater Wetlands	Artificial Wetlands; Coastal Freshwater Lagoons	4.4
Grasslands	Maritime Grasslands; Pasture	6
Rainforest	Southern Warm Temperate Rainforests; Dry Rainforests/ Subtropical Rainforest; Littoral Rainforests; Fig Trees	13.2

Vegetation formation	Keith Class	Overall fuel including bark and canopy (t/ha)*
Saline Wetlands	Mangrove Swamps; Saltmarshes	Non Combustible
Short Heath	Sydney Coastal Heaths	15
Tall Heath	Acacia Scrub; Coastal Headland Heaths; Southern Montane Heaths	36.9
Woodland	Unassigned Vegetation; Weeds and Exotics	20.2

2.1.2 Topography and Slope

Figure 6 shows that elevation within the Study Area is generally lower to the east, with higher elevations evident in the west. Topography within the Subject Land shows less variation, however changes in elevation are evident and associated with creek lines.

Slope has been captured from a Digital Elevation Model (DEM) generated from 10 m contours and classified into the following PBP 2019 slope classes (see **Figure 7**):

- Upslope and flat;
- >0° – 5° downslope;
- >5° – 10° downslope;
- >10° – 15° downslope;
- >15° – 20° downslope; and
- >20° downslope.

Steeper areas where fire control is typically more difficult occur in the western portion of the subject land and adjacent study area.

2.1.3 Bushfire Weather

The climate in the Illawarra Bush Fire Management Committee Area is typically humid temperate with an average rainfall of 1329 mm annually. Adverse fire weather conditions associated with the bush fire danger period in the Illawarra region is related to strong South-westerly to North-westerly winds accompanied by high daytime temperatures before the onset of summer rains. The fire season generally extends from Summer through to Autumn when low rainfall is experienced. Lightning activity is common but generally focussed on the escarpment area, west of the study area.

If fires were to occur under a Fire Danger Rating (FDR) of Very High or above within the steeper rainforest areas to the west, it may be difficult to respond quickly due to the varied slope and topography. However, given the lower fuel load of rainforest vegetation, they are likely to be of lower intensity and slower moving. Days of Very High FDR or above occur on average about 7.5 days per year based on data analysed from the National Bushfire Weather Data set Nowra weather station (station number 068072) (Lucas 2010).

Weather data developed by Lucas (2010) under the National Historical Fire Weather Dataset (1972-2015) incorporates the daily FFDI, where suitable inputs are available from over 70 weather stations

across Australia. Data from the Nowra weather station (the closest weather station within the National Historical Fire Weather Dataset) was analysed to determine the maximum FFDI for a 1 in 50-year event, being the accepted recurrence period for land use planning (RFS 2006).

The dataset for each site was split into subsets based on wind directions including:

- North to south-east (clockwise);
- South-east to South-west (clockwise); and
- South-west to North (clockwise).

To determine the 1:50 recurrence value, a Generalised Extreme Value (GEV) analysis method was undertaken to calculate the FFDI value within each data subset (**Table 3**). Although the GEV model has been used in other disciplines for analysing extreme events (i.e. flooding recurrence values), it is only in recent times to have been considered appropriate for bushfire weather analysis (Douglas 2017). The GEV methodology and its use to analyse bushfire weather data is discussed in a number of papers by Douglas et al (2014; 2016).

Table 3: FFDI for a 1 in 50-year event

Weather Station	Max Recorded FFDI	N to SE	SE to SW	SW to N
Nowra	120	47	64	117

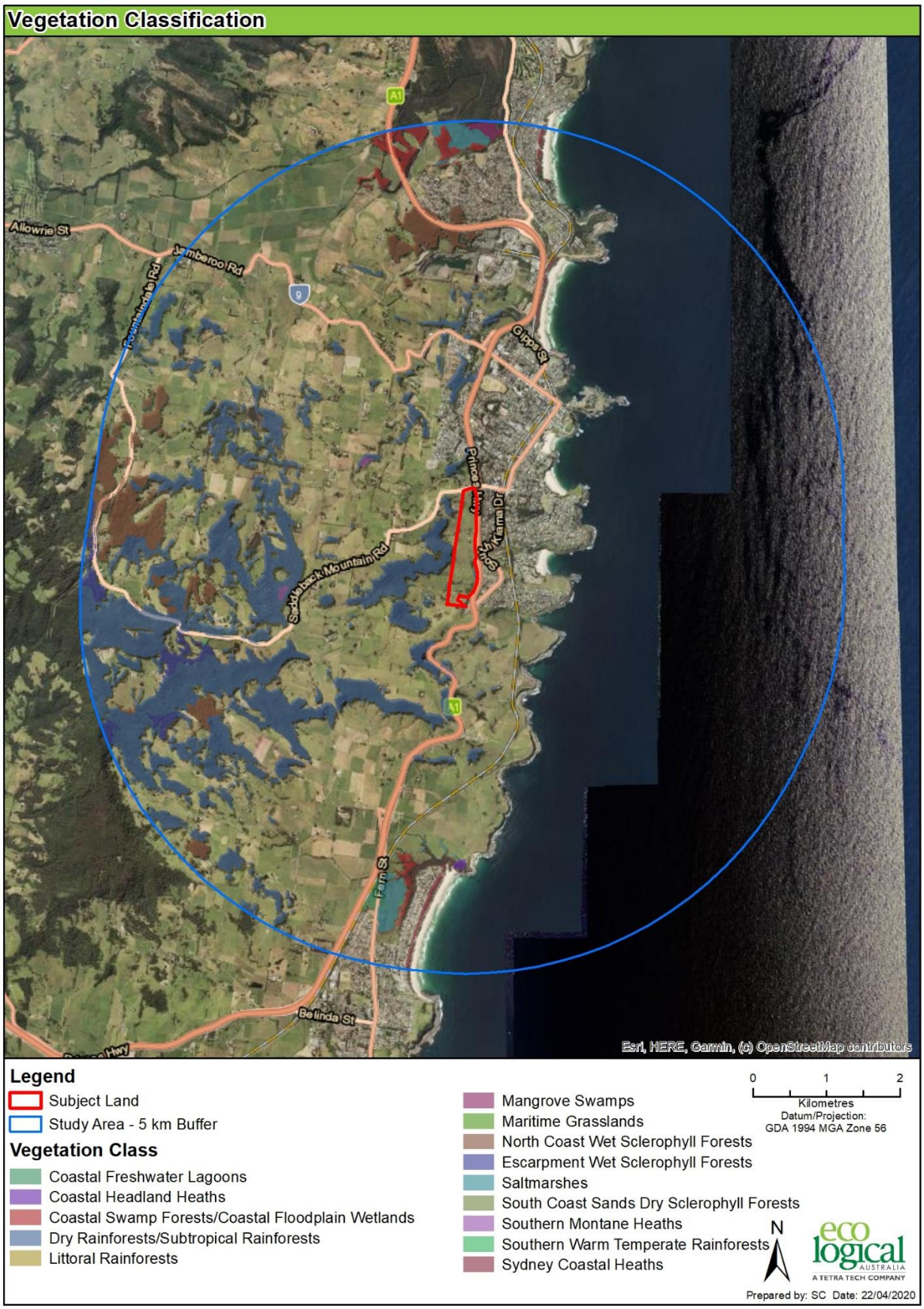

Figure 4: Vegetation Class (OEH Illawarra vegetation mapping, 2016).

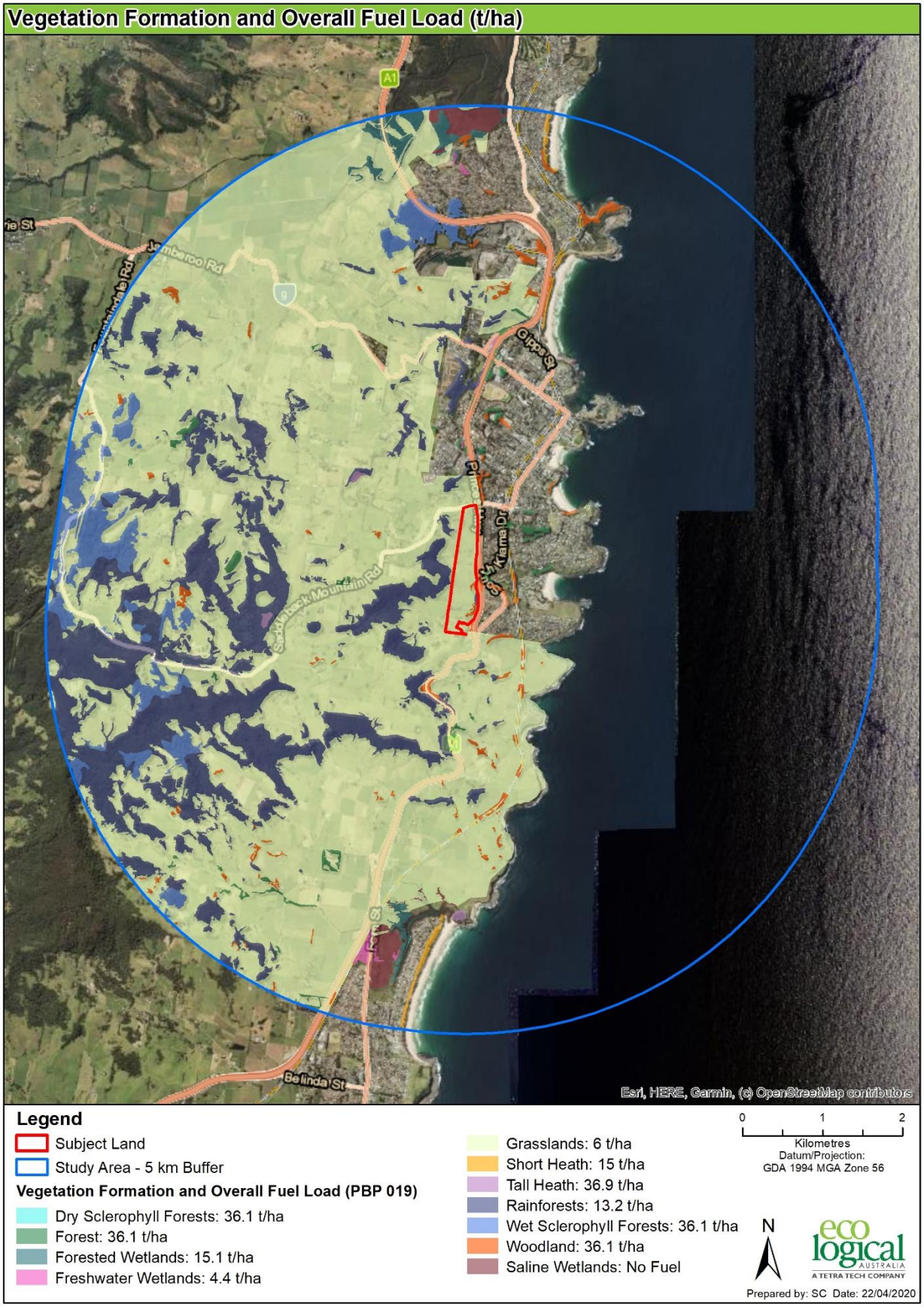

Figure 5: Vegetation formation and fuel classification of the subject Land and study area.

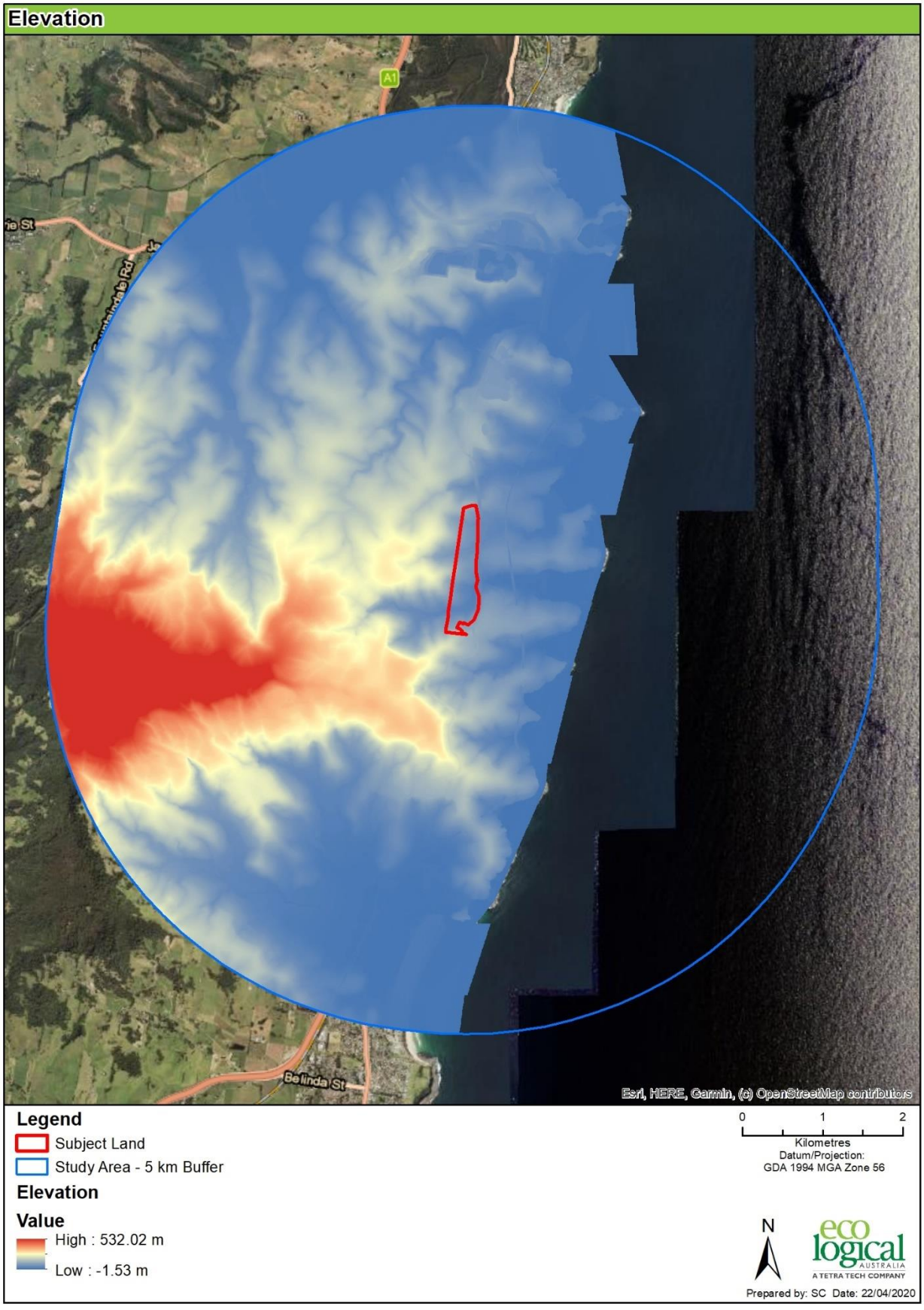

Figure 6: Elevation within the study area.

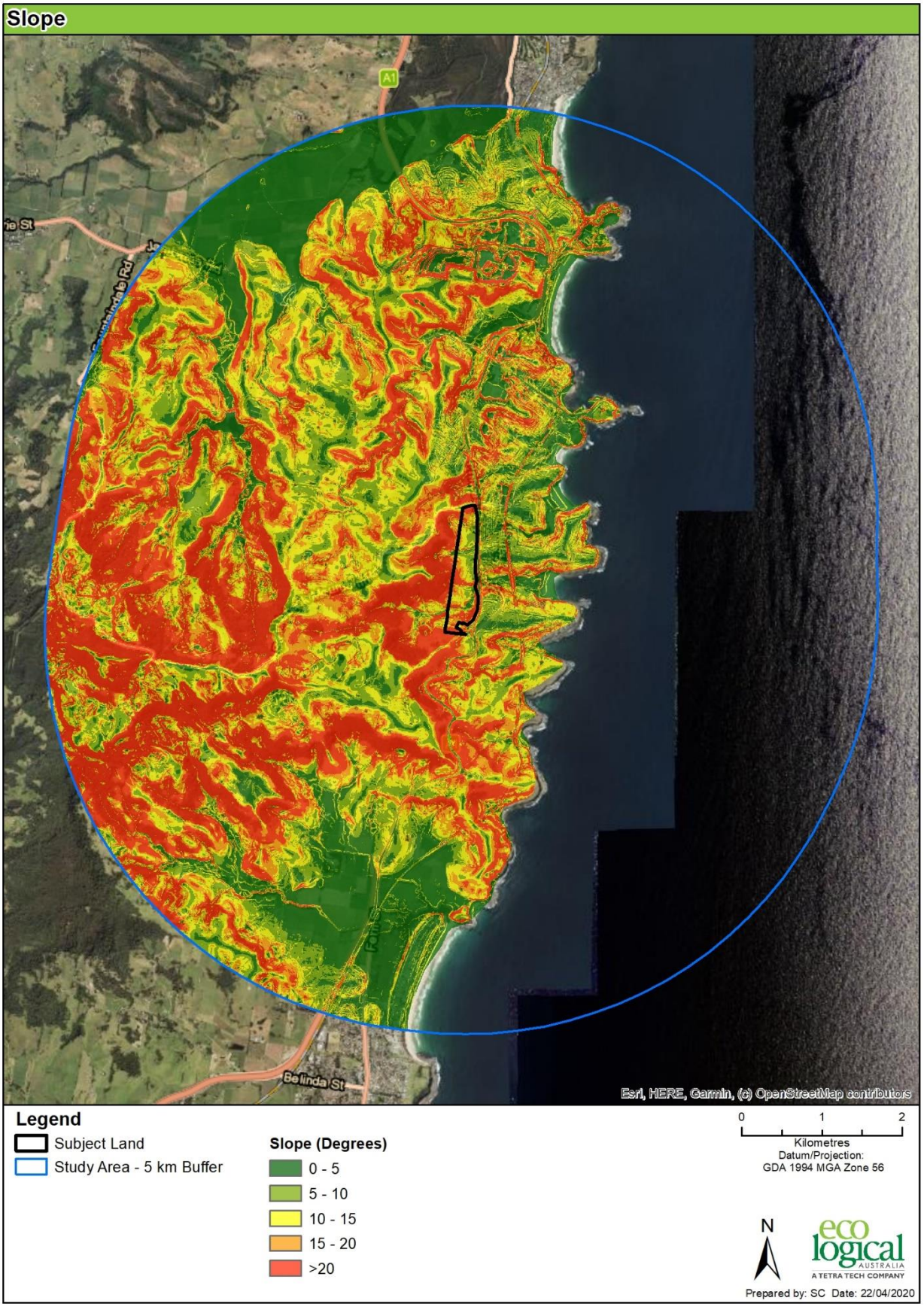

Figure 7: Slope within the 5 km study area

2.2 Potential Fire Behaviour

Bushfire intensity prediction models have been used to review major bushfire potential from various directions with the potential head fire intensity modelled using fire intensity formulae of McArthur (for Forest, Woodland and Wetlands) and Catchpole (for Heath). Three models where prepared for the following bushfire attack scenarios:

- Bushfire attack from the north to south-east direction (clockwise) at FFDI 47 (**Figure 8**);
- Bushfire attack from the south-west to north direction (clockwise) at FFDI 117 (**Figure 9**); and
- Bushfire attack from the south-east to south-west direction (clockwise) at FFDI 64 (**Figure 10**).

The models show that the greatest intensities occur in grassland vegetation which is prevalent to the west of the Subject Land, and to a lesser extent, smaller forest patches also situated to the west. It also reveals that fire intensity is likely to be most intense under scenarios where bushfire attack occurs from the south-west to north. It is, however, important to note that these outputs are based on a conservative modelling approach that includes agricultural land as grassland. Given rural properties in the study area demonstrate a mosaic of management regimes and pasture improved land, the actual fuel load is likely to be lower, which would therefore result in a slower rate of spread and less intense fires.

It is noted that each bushfire event is different, responding to changes in fuel, weather conditions and FFDI. Thus, the model predictions are indicative of what could be experienced under a bushfire likely to be experienced by the expected weather and fire spread through nearby fuels and terrain.

It is important to note that the models of potential fire intensity do not provide ignition risk or the rate of spread of a bushfire; and these are important considerations in likelihood and evacuation risk (respectively). They also do not consider extreme fire behaviour / weather including such phenomena as:

- Spotting/Fire storm;
- Fire tornado/whirls;
- Lateral vortices;
- Junction zones (Jump fires);
- Eruptive fires;
- Conflagrations;
- Downbursts; and/or
- Pyro-convective events.

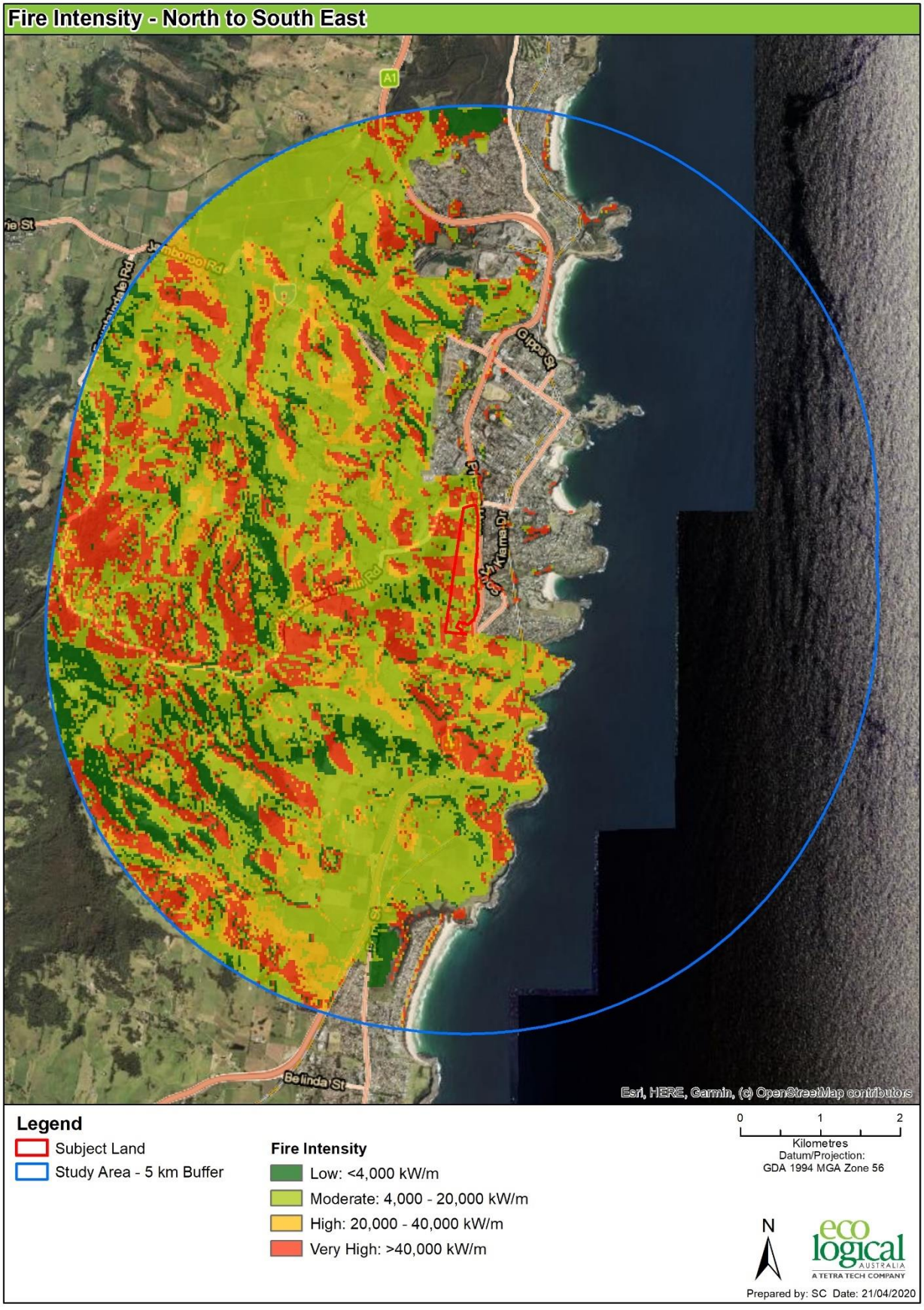

Figure 8: Potential fire intensity across the study area (North to south-east wind, FFDI 47).

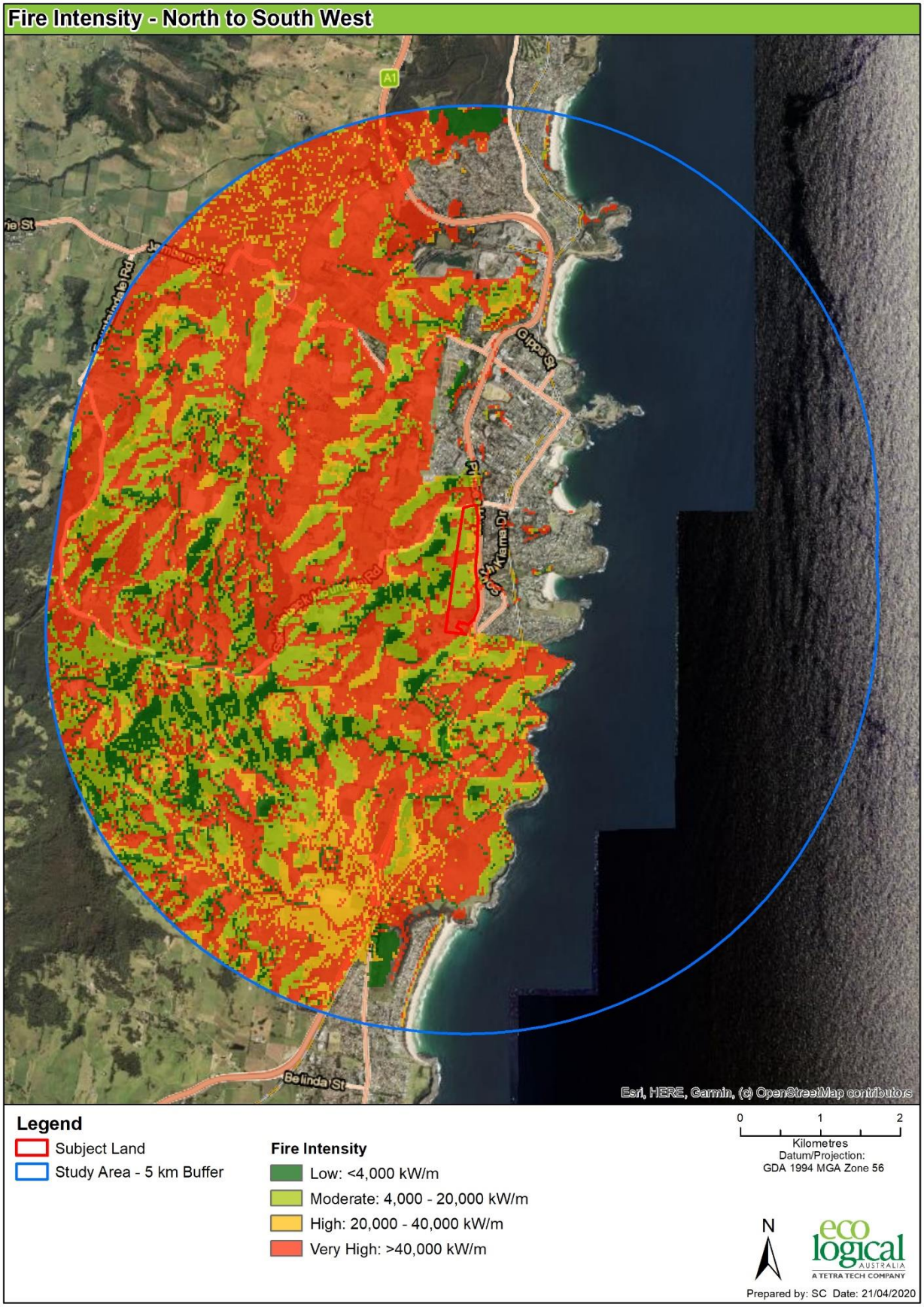

Figure 9: Potential fire intensity across the study area (North to south-west wind, FFDI 117).

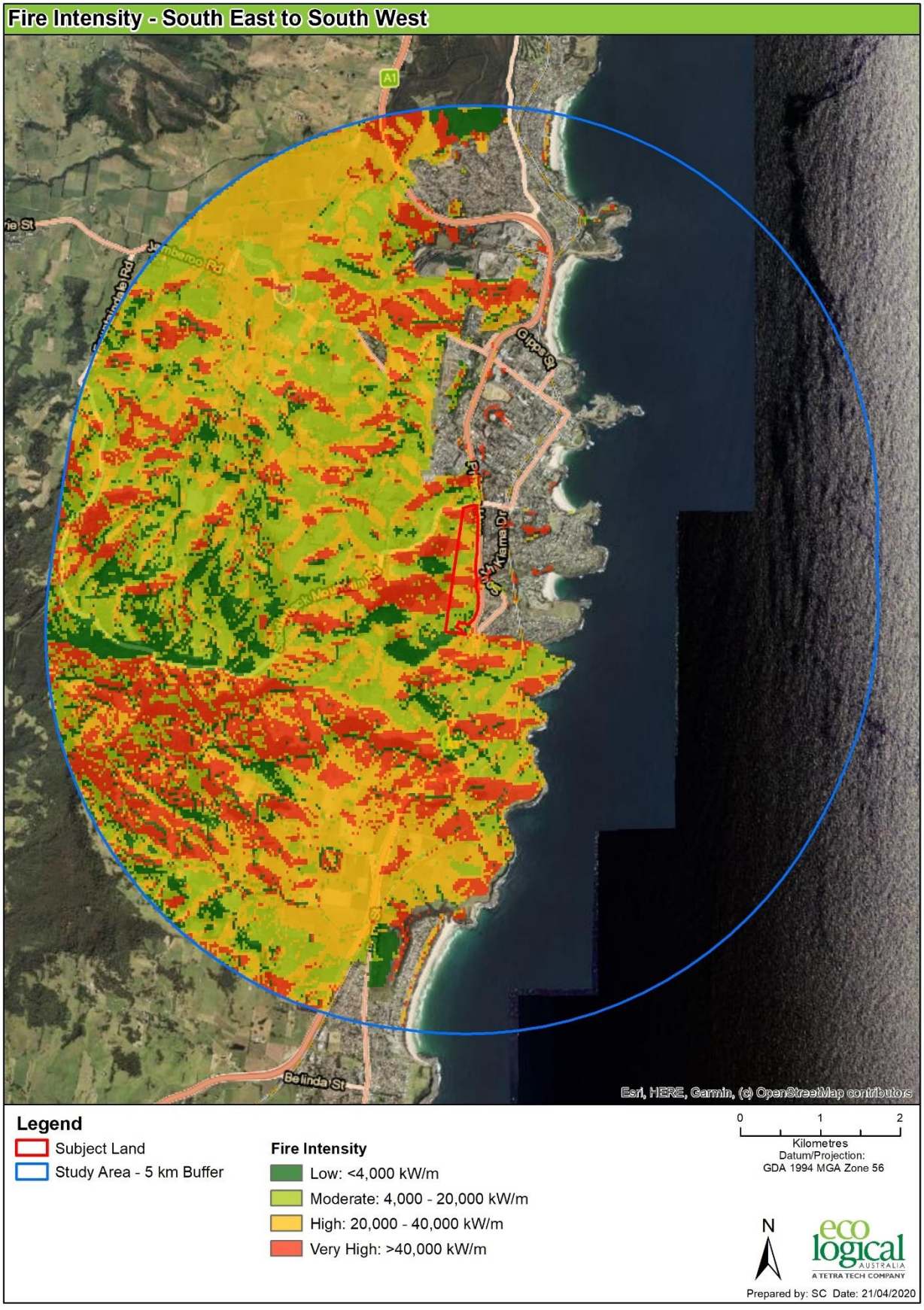

Figure 10: Potential fire intensity across the study area (South-east to south-west wind, FFDI 64).

2.3 Bushfire History

The Illawarra Bush Fire Risk Management Plan (BFRMP) (BFMC 2017) identifies that the main sources of ignition in the Illawarra BFMC area are:

- Arson and incendiarism;
- Car dumping;
- Lightning;
- Electrical power lines;
- Escapes from legal burning; and
- Illegal burning activities.

Figure 11 shows the fire history for the study area from 1968 to 2018 for both prescribed burns and unplanned fire (wildfire) from the NPWS fire history mapping data set. As shown, no wildfires have occurred within the broader study area and subject land during this period. The closest fires have occurred further west of the study area and have been contained before reaching the study area.

2.4 Summary of landscape bushfire risk assessment

The landscape risk analysis indicates that the potential for attack by larger bushfires exist in most years, if not all, due to weather conditions and fuel continuity. It is also reasonably foreseeable that Bushfire Attack Levels (BAL) under Catastrophic Fire Danger Rated days could occur and therefore assessment of individual allotment risks under the PBP 2019 benchmarks are appropriate.

BALs are primarily a predictor of the potential consequence of bushfire attack on a building but does not adequately consider likelihood which can be understood from:

- the likelihood and location of ignitions within the landscape coinciding with adverse fire weather conditions that move a fire toward the Subject Land; and
- factors related to wildfire mitigation and suppression such as reduced fuel areas, timing of fire runs compared to suppression deployment and capability, and the coincidence of these with landscape fire advantages such existing roads, waterways, and infrastructure, as well as existing areas of development and land management (existing cleared and agricultural land).

Analysis of fire history indicates that fires within the surrounding area have occurred, and whilst they have been infrequent, there is still a risk of future fires occurring. However, there are landscape fire advantages that can be achieved within subject land enabling appropriate bushfire protection measures, and therefore the rezoning proposal is not in an unacceptable bushfire landscape. In particular, the subject land can facilitate APZ's without extensive vegetation clearing and design mechanisms including perimeter roads, managed open space and larger lots can be strategically placed along the western boundary to increase separation between future dwellings and the hazard.

The landscape risk analysis indicates a risk level where it is feasible to design and build resilience into the community that matches or exceeds the bushfire risk in the landscape. The total elimination of bushfire risk is not necessary or feasible; as is the situation for any bush fire prone land.

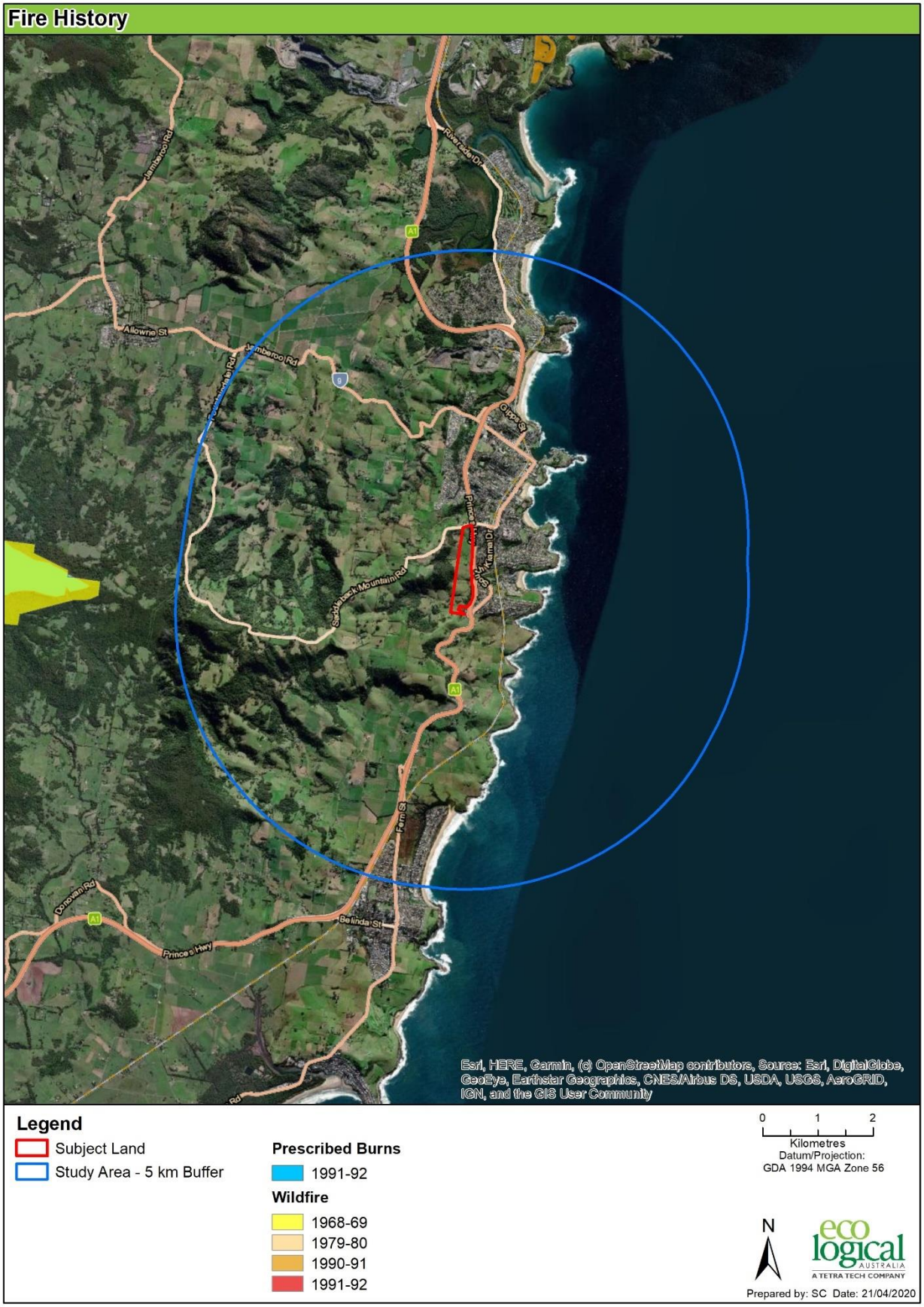

Figure 11: Fire History in the Study Area.

3. Land use assessment

The EP&A Act and the RF Act are the primary legislative instruments relevant to bushfire planning for the site. PBP is called up by these legislation as the subject land is mapped as bush fire prone land, and it is a critical guide in assessing the bushfire risk suitability of the proposal.

PBP (RFS 2019) outlines broad principles and assessment considerations for strategic planning. It also specifies that bushfire protection measures need to be considered at the strategic planning stage to ensure that the future development can comply with PBP (as specified in Chapters 5-8 of PBP 2019).

The aim and objectives of PBP (RFS 2019) below provide additional guidance for land use assessment within a Strategic Bushfire Study:

> *The aim of PBP is to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment.*
>
> The objectives are to:
>
> *i afford buildings and their occupants protection from exposure to a bush fire;*
> *ii provide for a defendable space to be located around buildings;*
> *iii provide appropriate separation between a hazard and buildings which, in combination with other measures, minimises material ignition;*
> *iv ensure that appropriate operational access and egress for emergency service personnel and residents is available;*
> *v provide for ongoing management and maintenance of bush fire protection measures; and*
> *vi ensure that utility services are adequate to meet the needs of firefighters.*

3.1 Risk profile

The feasibility of the proposal to comply with the bushfire protection measures within PBP (RFS 2019) is fundamental consideration of the Study. Whilst bushfire protection measures and their performance requirements are a benchmark for approval of a development, a strategic level study needs also to evaluate these measures within the landscape risk context. This Study has therefore considered the:

- The bushfire landscape and any need for adjustment of the protection measures given the landscape risks;
- Pattern and potential bushfire resilience of the bushland interface;
- Potential cumulative risk associated with the bushfire protection measures;
- Risk profile of different areas and their appropriate landuse; and
- Potential for application of innovative or emerging bushfire protection measures.

The following landuse risk profile has been identified in the Study:

- There is opportunity along the western boundary to locate APZ and other bushfire protection measures to meet the acceptable solutions within PBP 2019;
- Perimeter roads around proposed riparian corridors are also feasible in the design and further discussed in section 5;

- There is further opportunity within the riparian corridor to manage revegetation using native plant species that are less fire prone;
- Managed land adjoining the western boundary provides bushfire risk management opportunities and an ongoing management agreement should be demonstrated as part of further detailed design requirements; and
- No unusual cumulative risks have been identified. Complementary and consistent risk management through landscape and building design, and community programs are also feasible.

4. Feasibility of Asset Protection Zones

Based on the landscape scale assessment of vegetation and slope, preliminary APZ have been determined to indicate the separation distance required between a structure and the vegetation hazard. This analysis considers the existing vegetation within and adjoining the site. Indicative APZs identified in **Figure 12** are for a scenario of residential development only. APZ dimensions are provided in **Table 4** and represent the required minimum standards in PBP (2019). Final APZ dimensions should be determined based on the final vegetation configuration and topography and approved by RFS.

The following assumptions are made in relation to the proposed APZs:

- All APZ are contained within the development site and not on adjoining lands;
- APZs that relate to vegetation within the site may vary depending upon the final configuration and management of that vegetation;
- A conservative approach to grassland hazards has been applied in this assessment due to the differing management regimes of rural land in the study area and also considering surrounding vegetation was not validated;
- The APZ slope class used to determine APZ dimensions was determined using 10 m contours, finer scale topographic survey should be applied at the detailed design phase to refine slope class;
- The indicative APZ widths proposed are based on PBP 2019, which requires that residential buildings are subject to a maximum heat exposure of no more than 29 kW/m^2. Best practice is that all residential subdivisions meet this standard;
- The introduction of new vegetation through landscaping or habitat restoration will need to be assessed from a bushfire perspective. In some instances, the hazard line in this assessment used is indicative based on preliminary design plans to determine potential APZ requirements within the subject land;
- The addition or rehabilitation of any vegetation within the site (such as for unmanaged public open space, environmental protection areas, riparian corridors) may influence APZ requirements, for the purposes of this assessment. Indicative riparian corridors have been assessed as Rainforest in this assessment. The final configuration of these aspects at detailed design may influence the slope and vegetation as assessed in this study.
- Agreement for the ongoing management of adjoining land can be achieved as part of the detailed design phase of the project, as it is not feasible to seek agreement at the concept stage.
- Vegetation that is introduced through landscaping or restoration can avoid the need for further APZs if:
    - Individual patches of vegetation within 100 m of properties are <0.25 ha per patch;
    - The perpendicular width of linear strips of vegetation is <20 m when measured perpendicular to structures;
    - Any vegetation within 100 m of properties meets the definition of ‘managed vegetation’ under PBP. In general this means that the vegetation has low flammability, low fuel loads and is structured in a way that avoids the spread of fire.

APZ for future dwellings will need to meet the requirements of PBP. **Table 4** identifies the potential slope and vegetation types present within the study area and the required APZs under PBP 2019.

Table 4: APZs for each to achieve BAL 29

Slope[1]	Vegetation Formation[2]	PBP required residential APZ / BAL-29 (m)[3]
All upslopes and flat land	Grassland	10
Downslope >0 to 5 degrees	Grassland	12
All upslopes and flat land	Rainforest	11
Downslope >0 to 5 degrees	Rainforest	14
Downslope >10 to 15 degrees	Rainforest	23

[1] Slope most significantly influencing the fire behaviour of the site having regard to vegetation found as per PBP.
[2] Predominant vegetation is identified, according to PBP.
[3] Assessment according to Table A1.12.2/A1.12.5 of PBP 2019.

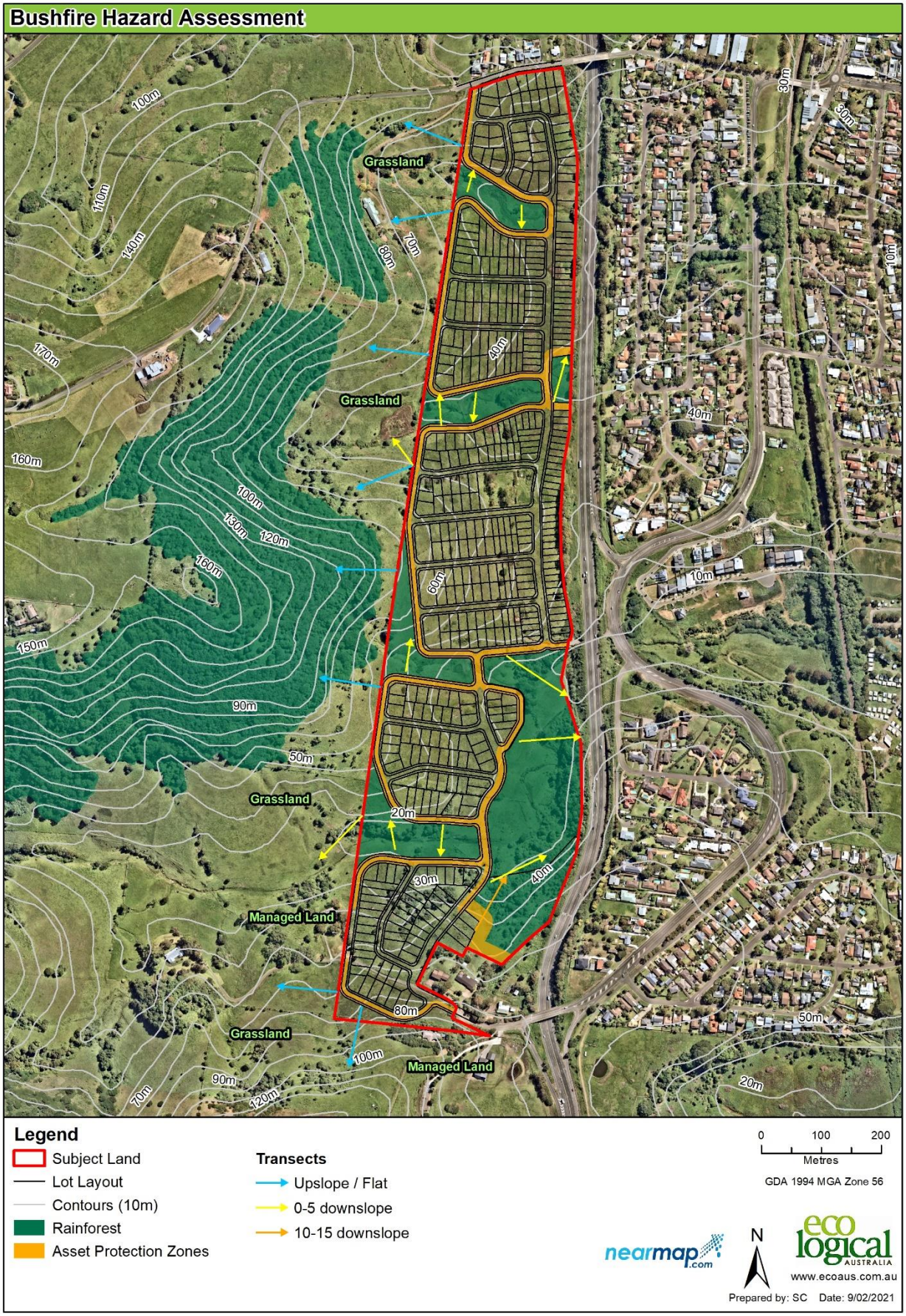

Figure 12: Preliminary Bushfire Hazard Assessment

5. Access and egress

The proposal provides two-way access to the Subject Land via Saddleback Mountain Road in the north and Weir Street in the south (see Figure 2). Access is available to the site from the Saddleback Mountain Road access point either by South Kiama Drive and Saddleback Mountain Road or west along Saddleback Mountain then either left or right onto Old Saddleback Mountain with various available routes to the Princes Motorway, Kiama or Jamberoo. An additional access point via a culvert under the Princes Highway provides 'one-way' access to the site from South Kiama Drive.

Consideration has been given to using the culvert for either emergency access use only or as a public road egress route from the site. RFS have requested the vehicle culvert is upgraded to a two-way access. Council have advised that due to the close proximity of the culvert to the South Kiama Drive off ramp from the freeway that no right turn into or out of the culvert would be supported. As such, if it was to be used as an emergency vehicle accessway, vehicles travelling south along South Kiama Drive would need to perform a U turn at David Smith Place to access the culvert. Additionally, analysis of the existing culvert under the Princess Motorway shows that the width, height and geometrical cross section of the culvert cannot facilitate two way public road access that meet the required vertical clearance height of 4m as per A3.1 of PBP and demonstrated in Figure 13.

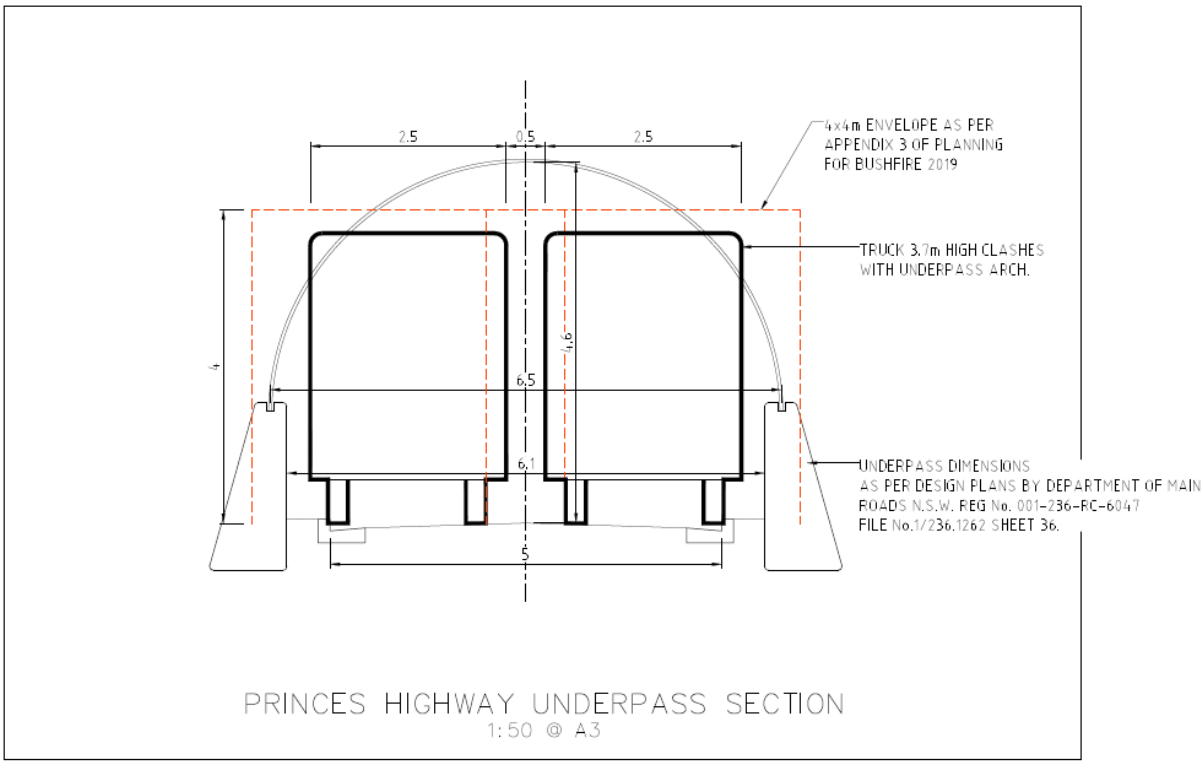

Figure 13: Princes Highway vehicle underpass dimensions

Concerns have also been raised regarding maintenance and responsibility for opening and closing gates across the culvert. Council have also advised in writing that their preference would be for the culvert to be used as a one way egress from the site with left turn only permitted onto South Kiama Drive. A copy of Council's email is attached in Appendix E. This view was also expressed in the traffic report undertaken in support of the Planning Proposal. A copy of the Traffic Report is attached in Appendix D. Based on

the above, the proposal is to use the culvert for egress from the site. Under this scenario there are four exit routes from the site and three ingress routes to the site as shown in Figure 15.

All road widths and longitudinal grades will satisfy the requirements of PBP, and be clearly demonstrated as part of the detailed design stage addressing access requirements in more detail as per PBP 2019 (see **Table 5 Appendix A**). Final plans should facilitate a road design that provides:

- safe access and egress for residents and emergency service personnel, including multiple access/egress options for each area; and
- adequate capacity to facilitate satisfactory emergency evacuation.

In meeting the above requirements, traffic studies conducted by Bitzios Consulting (2020) (**Appendix D** indicate that based on a maximum yield of 630 dwellings based on dual occupancy on lots >450 m_2, (noting that under the Kiama LEP the maximum yield achievable is 500 lots), the four key intersections in proximity to the proposed development have capacity to meet the projected increased demand and that no external upgrades to the immediate road network are required. The traffic study demonstrates that based on projected traffic movements (134 traffic movements in and 313 traffic movements out in the AM, and 295 traffic movements in and 197 traffic movements out in the PM), all intersections assessed performed satisfactorily in terms of Degree of Saturation (DOS), Level of Service (LOS) and did not exceed existing capacity mechanisms. The analysis showed that all intersections operated at the highest level possible at peak times.

When consideration was given to utilisation of the culvert under the Princes Motorway as a designated emergency vehicle access only, Bitzios Consulting (2020) redistributed traffic generated from the development to rerun the SIDRA intersection analysis described above for the main intersections adjacent to the development in peak times. Under this scenario, traffic predicted to use the culvert to exit the site was redistributed onto Weir Street and Saddleback Road. A copy of Bitzios Consulting addendum report is attached in **Appendix D**. The addendum report shows that with just two exit points all adjacent intersections still operate at a level of service A and no traffic mitigation measures are required at intersections as a result of the development traffic. The Bitzios Consulting Traffic Studies have been reviewed and given approval by both Council's Manager of Design and Development and Transport for NSW. Therefore, there are no key concerns in relation to access and egress resulting from the development.

The preliminary internal road design also provides perimeter roads around the key hazard areas, including the proposed riparian corridor and western boundary (see Figure 2, Figure 3 & Figure 14). Lots 389 – 391 are to be provided a trafficable surface for emergency management as part of the APZ that will be established on lot 389. Lots 389 At the detailed design stage, there is opportunity to further refine access requirements. However, it is important to note, this will be dependent on the final corridor design, vegetation structure and opportunities for managed open space.

Overall, the preliminary design presents a suite of access measures that are suitable within the assessed bushfire risk setting, with provision for multiple access points, intersection upgrades at access points and a lot yield that does not impede the carrying capacity of the existing road network. The subdivision will also be supported by additional measures to ensure active transport links to Kiama High School and South Kiama Drive.

6. Emergency Services

The following is recommended for strategic land use planning to achieve the objectives and strategic planning principles of PBP 2019 relating to emergency management. Strategic emergency management planning is undertaken in collaboration with emergency service organisations within the strategic land use planning process, to establish preferred future outcomes (i.e. emergency evacuation) that have implications for land use planning, including:

a. Emergency evacuation planning; and
b. Evacuation adequacy assessment.

Emergency Vehicle Access to the Site

6.1 Emergency vehicle access to the site

The Planning Proposal for the site proposes public road access to the site via Saddleback Mountain Road and Weir Street. A culvert under the Princess Motorway also links the site to South Kiama Drive. The culvert was constructed by RMS in conjunction with the construction of the Motorway to provide access to a lot which was land locked due to the construction of the motorway. The culvert is only wide enough to provide one way traffic flow. A cross section of the culvert is shown in Figure 13. The culvert is proposed to be used as an exit road only from the development. The culvert is only 105m south of the exit ramp from the Motorway and the acceleration lane in South Kiama Drive for vehicles turning right from the motorway exit extends past the culvert. There is not enough distance to provide a right turn lane to the culvert. The close proximity of David Smith Place intersection, the 3 x 3000mm diameter culverts under the motorway immediately south of the access culvert under the motorway and the large flood plain upstream of the drainage culverts also means a new culvert entrance to the site cannot be provided at this location. Kiama Council, who are the road authority, confirms that a right turn into the culvert from South Kiama Drive cannot be supported due to site constraints. A copy of Council's letter confirming this is attached in **Appendix E**.

Emergency vehicles travelling to the site from North of Kiama would travel along the Princes Motorway and access the site from the southbound exit ramp from the motorway onto South Kiama Drive. Emergency vehicle could then either turn right into South Kiama Drive then merge into Weir Street that leads directly into the site or turn left into South Kiama Drive and then left into Saddleback Mountain Road. The distance from the motorway exit ramp to the site via South Kiama Drive and Weir Street is 1.4km and via South Kiama Drive and Saddleback Mountain Road is 1.5km These routes are shown on Figure 15.

Emergency vehicles travelling from south of the site would turn left from the Weir Street exit ramp of the motorway. The site is 100m from the motorway exit ramp. Alternatively vehicles could turn right onto Weir Street and access the site along the South Kiama Drive /Saddleback Mountain Road route - a distance of 2.9kms.

Emergency vehicles travelling from Kiama and Jamberoo could access the site from the

(i) Princes Motorway,

(ii) via multiple routes within the Kiama township leading onto Manning Street, or

(iii) via Jerarra Road and Saddleback Mountain Road.

6.1.1 Access Road Details

(i) Motorway southbound exit onto South Kiama Drive

The left turn exit from the motorway divides into separate left and right turn lanes for vehicles turning onto South Kiama Drive.

(ii) South Kiama Drive from Motorway Exit Ramp to Weir Street

A 105m long acceleration lane is provided for vehicles turning right from the motorway exit onto South Kiama Drive. There are four intersections along this section of South Kiama Drive/Weir Street and the site. South Kiama Drive/Weir Street has priority at each intersection. The only right turn intersection for south bound traffic is David Smith. A right turn storage bay is provided at this intersection. South Kiama Drive is also a controlled access road with all individual properties on the eastern side if the road being provided with a service road which access South Kiama Drive via the Attunga Street intersection. Individual properties on the western side of South Kiama Drive have direct access to the road. However the old painted median island has been converted into a continuous right turn lane meaning there are no delays caused to traffic travelling south along this section of South Kiama Drive

(iii) South Kiama Drive from Motorway Exit Ramp to Saddleback Mountain Road

Vehicles turning left from the motorway exit onto South Kiama Drive into their own lane. The lane merges with the north bound through lane of South Kiama Drive 320 from the motorway exit. There are three intersection along this section of South Kiama Drive. South Kiama Drive has priority at each of the intersections. Separate right turn bays are provided at Surfleet Place and Mark Street intersections. This section of the road is also an access controlled road with no individual properties on the western side of the road having access directly onto the road. There are approx. 6 properties on the eastern side of South Kiama Drive that have direct frontage to the road.

(iv) Saddleback Mountain Road

Saddleback Mountain Road between South Kiama Drive and the motorway is 9.2m wide which allows one parking lane and two travelling lanes. Adjacent to Kiama High School there are no parking zones adjacent to the school which allows the drop off of students. On the southern side of the road there are No Stopping signs between the hours of 8.00 to 9.30am and 2.00 to 4.00pm. These signs enforce that there are two travelling lanes along this section of Saddleback Mountain Road. West of the Motorway Saddleback Mountain Road will be constructed to satisfy the requirements of PBP 2019 and Kiama Municipal Council's DCP. It is noted that the school bus bay is off the end of Shoalhaven Street. A culvert under the Princess Motorway also links the site to South Kiama Drive. The culvert was constructed by RMS in conjunction with the construction of the Motorway to provide access to land locked due to the construction of the motorway. There is also staff and additional student parking off Shoalhaven Street.

The above demonstrates that emergency access routes to the site provide two way vehicular access under all normal operating conditions and gives priority to vehicles travelling along the emergencies access routes

6.2 Location of Emergency Services

RFS Brigades in Close Proximity of the site include

- Gerringong Brigade. Located 8km south of the site with an estimated travel time of 8minutes via the Princes Motorway off ramp at Weir Street.

- Jamberoo Brigade. Located 10.2kms NW of the site with an estimated travel time of 12 minutes via Jamberoo Road, Jerarra Road and Saddleback Mountain Road. Alternate access is available via Jamberoo Road and Princes Motorway and Jamberoo Road, Terralong Street and Manning Street.
- Foxground Brigade. Located 14.4km south west of the site with an estimated travel time of 13minutes via Foxground Road, Donovan Road, the Princes Motorway and the Princes Motorway exit ramp at Weir Street.
- Albion Park Brigade. Located 21.5km from the site with a travel time of 17minutes via Tongarra Road, Princes Motorway and Motorway exit ramp at South Kiama Drive Alternative access is available via Jamberoo Road, Jerarra Road and Saddleback Mountain Road. Distance 20.7km with a travel time of 23 minutes
- Dunmore Brigade. Located 16.9 km from the site with a travel time of 13 minutes via the Princes Motorway exit ramp at South Kiama Drive.

NSW Fire & Rescue Stations in close proximity to the site include

- Kiama Station. Access to the site via Terralong Street, Thomson Street, Bong Bong Road and Manning Street is 3.2km with an estimated travel time of 6 minutes. Access via the Princes Motorway is 5.1km with an estimated travel time of 5 minutes.
- Berry Fire Station. Located 19.6km from the site with an estimated travel time of 15 minutes via the Princes Motorway exit ramp at Weir Street.
- Albion Park Fire Station. Located 22.2km from the site with a travel time of 20 minutes via Tongarra Road and Princes Motorway. Alternate access is available via Jamberoo Road, Jerarra Road and Saddleback Mountain Road. Distance is 20.3km with an estimated travel time of 24 minutes.
- Shellharbour Fire Station. Located 15.2 km from the site with an estimated travel time of 11 minutes via Shellharbour Road and the Princes Motorway.

Ambulance Services in close proximity to the site include

- Kiama Ambulance Station. Access to the site via Terralong Street, Thomson Street, Bong Bong Road and Manning Street is 3.1km with an estimated travel time of 6 minutes. Access via the Princes Motorway is 5.2km with an estimated travel time of 5 minutes
- Berry Ambulance Station. Located 21km from the site with an estimated travel time of 15 minutes via the Weir Street exit ramp from the Princes Motorway.
- Warrawong Ambulance Station. Located 28.5km from the site with an estimated travel time of 26 minutes via Shellharbour Road and Princes Motorway.
- Oak Flats Ambulance Station is located 19.4km from the site with an estimated travel time of 15 minutes via Lake Entrance Road and Prince Highway.

Police Stations in close proximity to the site include

- Kiama Police Station. Located 2.1km from the site with an estimated travel time of 4 minutes via Terralong Street, Manning Street and Saddleback Mountain Road.
- Berry Police Station. Located 20.3kms with an estimated travel time of 16 minutes via the Princes Motorway exit ramp at Weir Street.
- Lake Illawarra Police Station. Located 18.2km from the site with an estimated travel time of 13 minutes via Pioneer Drive, Lake Entrance Road and Princes Motorway.

SES Depots in close proximity to the site include

- Kiama Depot. Located 5.4km from the site with an estimated travel time of 6minutes via the Princes Motorway.
- Nowra Depot. Located 40km from the site with an estimated travel time of 36 minutes.
- Shellharbour Depot. Located 22km from the site with an estimated travel time of 19 minutes via Tongarra Road and the Princes Motorway.

It is noted that by mid 2021 travel times for all emergency services travelling to the site from Albion Park will be reduced with the opening of the Prince Motorway bypass of Albion Park Rail.

Figures 16, 17 and 18 show the emergency services access routes to the site.

6.3 Development Lot Yields

The indicative lot layout for the site shows a total of 444 lots consisting of 156 small lots (>300m²), 285 lots (>450m²) and 3 R5 large lots(>1,000m²). 26 of the 285 lots >450m² are greater than 600m².

Clause 4.1.E (4) of Kiama's LEP states " In the case of land to which this clause applies that is not located in Jamberoo, development consent must not be granted to development for the purpose of dual occupancies and multi dwelling housing unless the site area per dwelling is equal to or greater than 300m² for the following purposes:

(i) Dual occupancy: and
(ii) Terraces.

Therefore only R2 zoned lots greater than 600m² can be developed as dual occupancies. This means that the site has the potential for a maximum lot yield of 470 lots.

Section 4.1D of Kiama's LEP details exemptions to minimum subdivision lot sizes for dual occupancies in Zones R2 and R3. Council's Acting Director of Environmental Services has advised "*Clause 4.1D only applies to the subdivision of dual occupancies. Clause 4.1E requires that each dwelling associated with a dual occupancy/multi dwelling has a minimum of 300sqm. That being said this clause could be varied under clause 4.6. But the intention is dual occupancies shouldn't be on land less than 600sqm*". The Acting Director also advised that this clause would be reviewed in the next review of the LEP to resolve any discrepancies between these clauses.

When the original Planning Proposal for the site was developed it was permissible to subdivide lots >450m² as dual occupancy sites. To be consistent with the original traffic studies and to err on the side conservatism all the traffic studies and evacuation reports for the site have assumed yields of 630 lots for the site. This means that all traffic flows estimated for the site are approximately 25% higher than actual.

6.4 Intersection Analysis

Bitzios Consulting (2020) has undertaken intersection analysis on the main intersections near the site. The analysis included existing traffic counts during peak times, increasing those flows by a compounding rate of 1.5% for 10 years and superimposing traffic generated from the subdivision assuming a yield of 630 lots. The intersections were then analysed using the SIDRA intersection computer program. All the results showed the intersections operated at level of service of A which is the highest operating level achievable. A copy of the traffic study for the development is attached in **Appendix D**.

6.5 Evacuation

Initial assessment of emergency evacuation has occurred and includes the following:

- An analysis of the most relevant bushfire attack scenarios, including rate of spread (ROS) modelling based on ignition in the rainforest vegetation to the west, and grassland vegetation to the north, north-west and south as shown in **Figure 14**);
- Identification of evacuation and refuge locations (**Section 6.5.1**); and
- An evaluation of evacuation adequacy and option for the shortcomings identified.

Figure 15 shows that the proposed road network has the ability for residents to evacuate and emergency services to ingress the site if the site came under attack from a bushfire. Key evacuation routes are to the north and south of the site via Saddleback Mountain Road and Weir Street, then east onto South Kiama Drive. An additional access point for emergency vehicles only is provided centrally via the underpass off South Kiama Drive (see Section 5, Figure 13). The general direction of egress/ingress is considered sufficient given it is anticipated that a fire would approach the site from the west.

It is also noted that in the event of a bushfire, given the lower fuel loads associated with adjoining grassland and rainforest vegetation, it would be unlikely that the entire development would be subject to imminent risk, and therefore it would be expected that residents could also evacuate to unaffected parts of the development if necessary. Furthermore, the traffic study prepared by Bitzios Consulting (**Appendix D**) indicates that the proposed and existing road network can support the projected increase in vehicle movements and no additional mechanisms are required.

Using Austroads Guide to Traffic Management Part 3 Transport Study and Analysis Methods (Austroads, 2020), Bitzios Consulting have undertaken an evacuation assessment for the site (provided as **Appendix C**) and established the following outcomes regarding the capacity of the road network for evacuation:

- Typical Mid-block Capacity of Urban Roads with Interrupted Flow – Kerb Lane (Adjacent to Parking Lane) – 900 pc/hr.
- Two Exit Scenario – ~40 minutes to evacuate based on 500 lot yield or 50 minutes for 630 lot yield. It is noted the maximum lot yield for the site is now 470 lots. This is based on the following assumptions:
    - Average of two (2) passenger cars per residency.
    - Single lane operating at each exit point to allow entry of emergency services vehicles in the ingress direction.
    - All residents in their vehicles are ready to leave and commence their evacuation trip at the same time
    - Route choice and resultant trip assignment and delays at decision points (e.g. exiting driveways, intersections) have not been considered.
- With a three exit scenario as currently proposed evacuation time would be less than 30 minutes.

In considering the time to evacuate the site, **Figure 14** demonstrates the predicted ROS scenarios for each fire danger rating, based on:

- Rainforest fuel loads to the west;
- Grassland fuel loads to the north, north west and south; and
- Slope class of 0-5° downslope.

The outputs of this modelling give an indication of the geographic distance from the subdivision that a fire may be capable of spreading within 1 hour based on fire danger index (FDI) associated with the fire danger rating (FDR) categories. What the modelling reveals is that given the lower fuel loads associated with the predominant landscape hazard (i.e. rainforest and grassland vegetation), even under catastrophic fire conditions, a fire igniting 2 km west of the subdivision, would still afford residents 60 minutes to safely evacuate. Therefore, the time to evacuate the site based on the two exits scenario varies between approximately 30 minutes during a work day and 50 minutes outside of normal work hours. This is based on a theoretical lot yield of 630 lots; however the absolute maximum development potential is 500 lots with a probable development yield of 470 lots in accordance with Kiama Council LEP that only allows lots >600m2 to be used for dual occupancies. Therefore some additional redundancy and conservatism has been used in the evacuation assessment.

It would only be if a fire started within approximately 1 km west of the subdivision under a catastrophic fire danger rating that evacuation of the site may not be possible. The likelihood of this occurring is considered low noting the following

- The evacuation assessment has been based on a development yield of 500 and 630 lots. The maximum number of lots permissible is 470 lots;
- The evacuation assessment has been based on a two exit point scenario. However there are three exit points to the development and three entry points. The exit points are Weir Street, the Culvert under the Princes Motorway and Saddleback Mountain Road; and
- The mosaic of management to the west of the site resulting in reduced fuel loads and low fuel loads across the site resulting from development likely to result in reduced fire behaviour.

6.5.1 Assessment of Neighbourhood Safer Places (NSPs)

There are no existing NSPs in proximity to the subject land, however the Kiama CBD is situated 4 km north of the Subject Land. Egress to the Kiama CBD is dependent on access options remaining open, as discussed in Section 5, and with main egress options provided to the east and away from the hazard to the west and potential direction of fire attack this is expected to be the likely situation. It is not expected that there would be a requirement to establish a NSP on the subject land given the close proximity of Kiama CDB, ability to provide adequate APZ and construction standards.

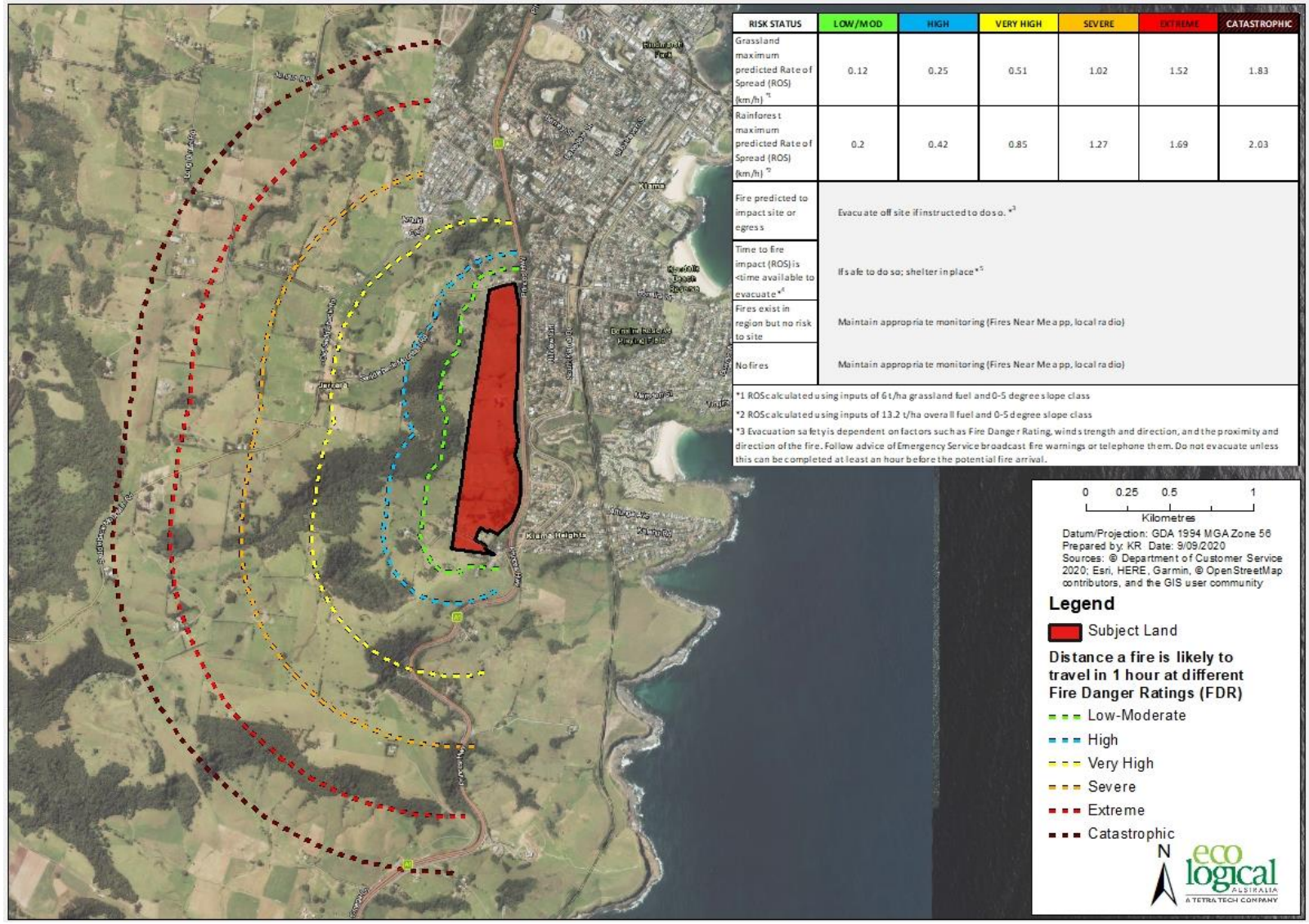

Figure 14: Indicative distance of fire travel in 1 hour based on predicted ROS for Fire Danger Ratings

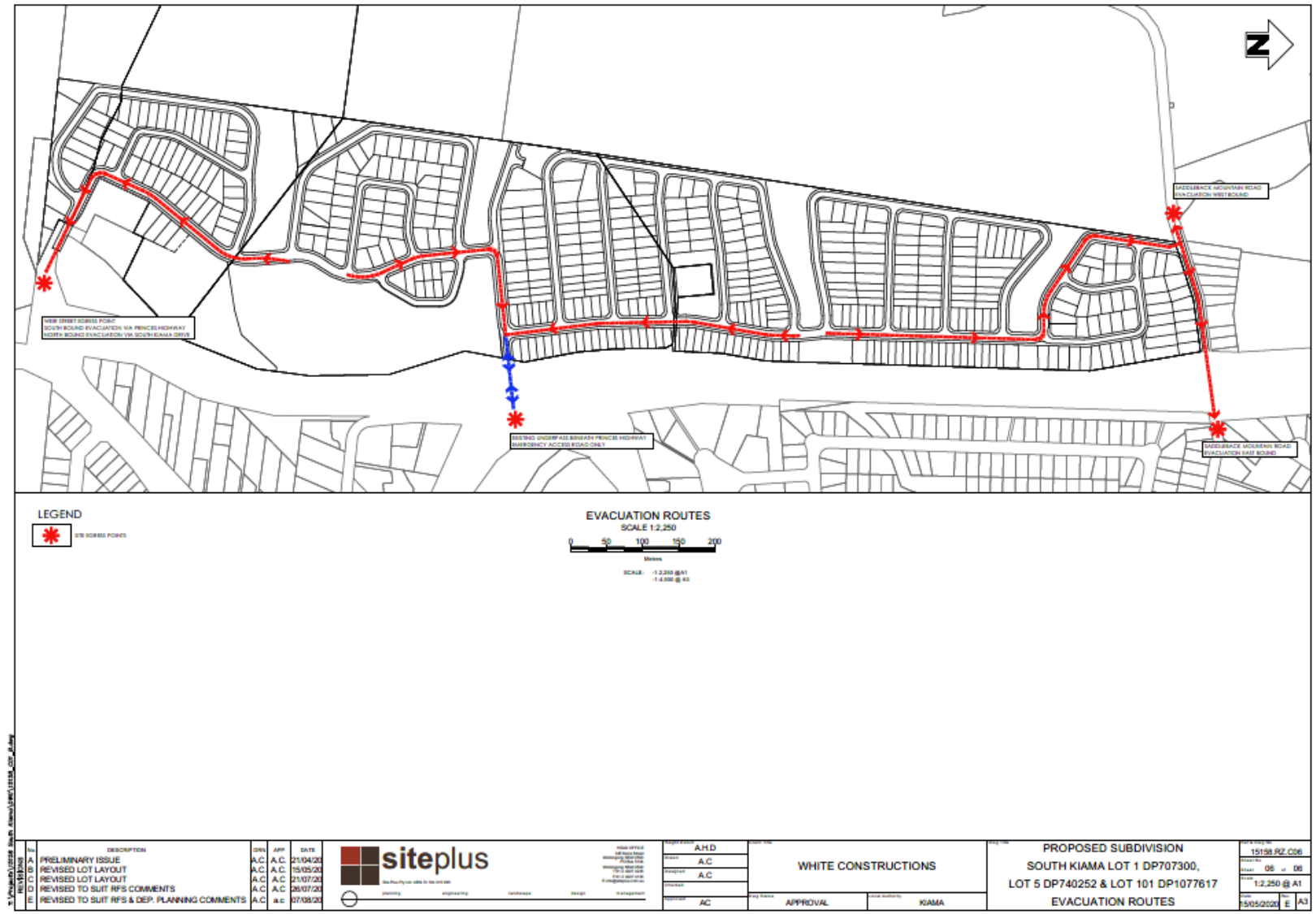

Figure 15: Indicative evacuation plan

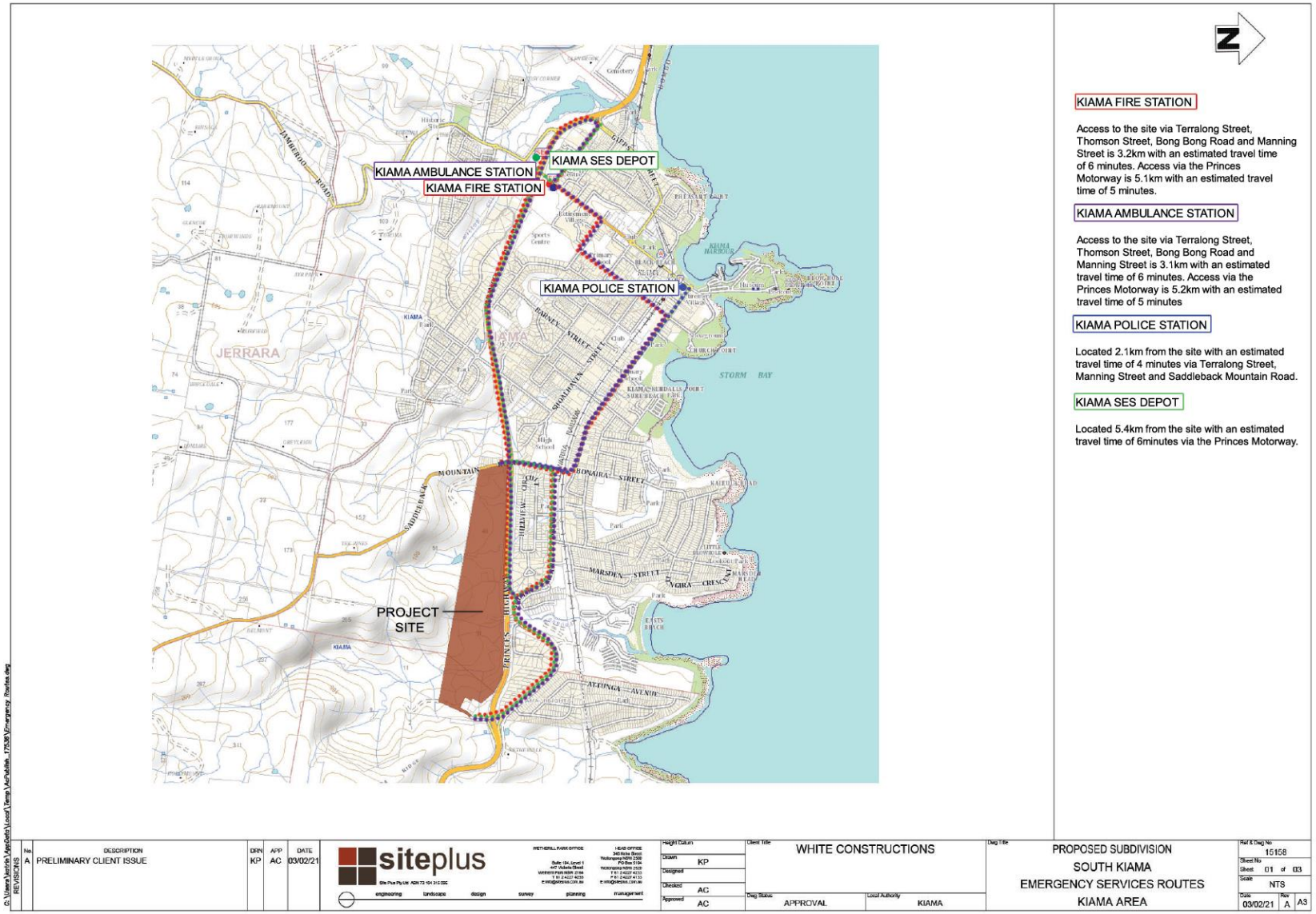

Figure 16. Emergency Services Routes Kiama area

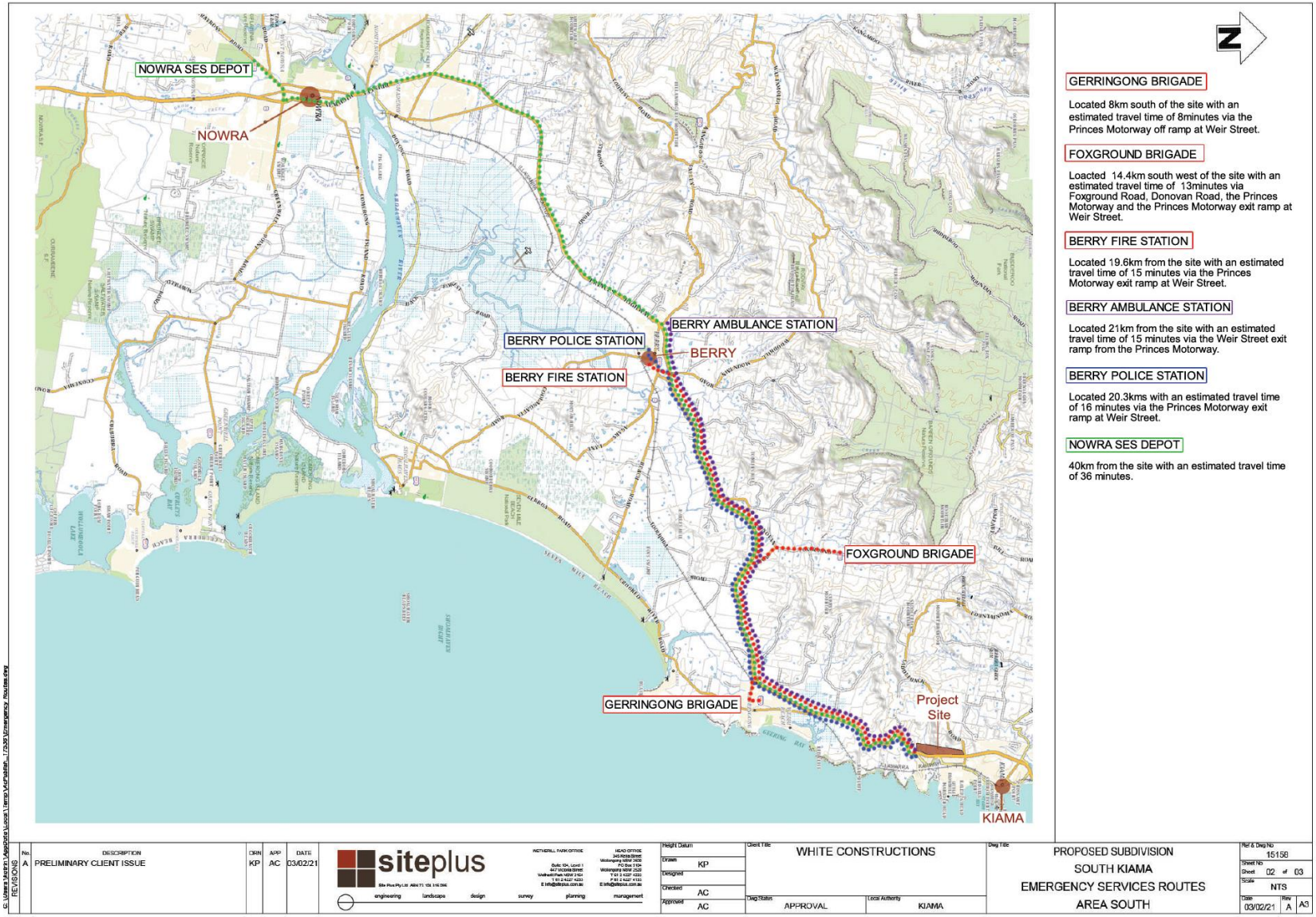

Figure 17. Emergency Services Routes to south of site

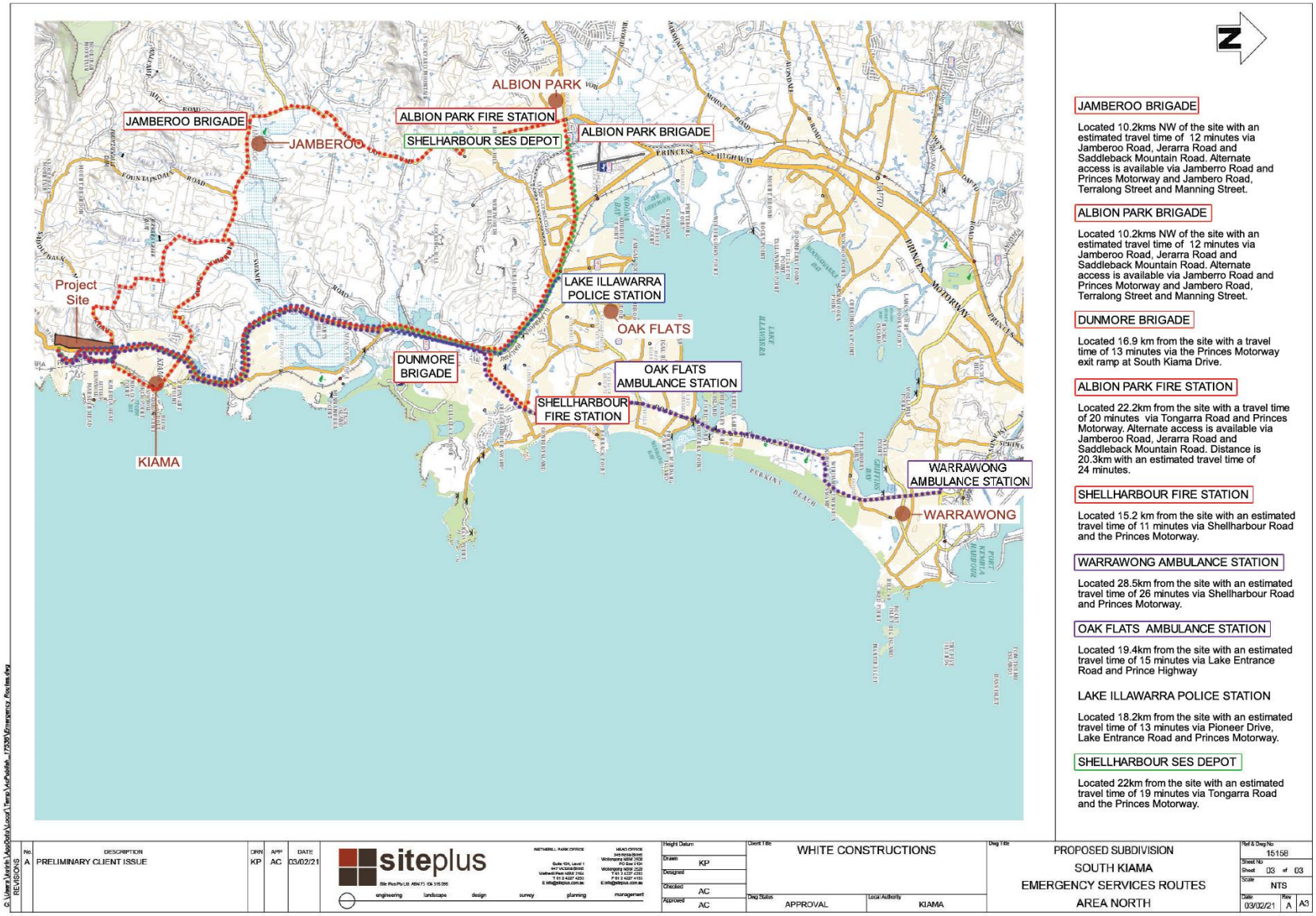

Figure 18. Emergency Services Routes to north of site

7. Infrastructure

7.1 Water

To comply with PBP, the subject site should be serviced by reticulated water. Fire hydrant spacing, sizing and pressures should comply with AS 2419.1 – 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles. Fire hydrants should not be located within any road carriageway. All above ground water and gas service pipes external to the building are metal, including and up to any taps.

Table 6 identifies the acceptable solution requirements of Section 5.3.4 of PBP, while **Table 7** identifies the requirements for lots that may require a static water supply (i.e. if >70 m from hydrant points).

The PBP acceptable solution requirements for water is achievable.

7.2 Electricity and gas

Underground electricity supply to the subject land is compliant with PBP. If the electrical transmission line to the subject land is above ground, no part of a tree is to be closer than 0.5 m to the powerline conductors.

Reticulated or bottled gas on the lot is to be installed and maintained in accordance with Australian Standard AS/NZS 1596 'The storage and handling of LP Gas' (Standards Australia 2014) and the requirements of relevant authorities (metal piping must be used).

Details for compliance with PBP 2019 are provided in **Table 6**.

8. Adjoining land

Future development should not be reliant on any off-site bushfire mitigation measures. All buildings and use should be designed to be resilient to bushfire attack in circumstances where no additional fuel management occurs outside of APZs etc.

Local Bushfire Management Committees will be updated annually of the bushfire protection measures in-built. The proposed land uses should not have a deleterious impact on the ability for bushfire management activities to be undertaken on adjoining land. Given the adherence to PBP 2019 and other land use planning requirements, the proposed land uses should not increase bushfire management needs for retained and/or adjoining bushfire prone vegetation.

Notwithstanding this, the future subdivision may influence fire management to some extent, particularly for hazard management on rural land holdings to the west of the subject land. As discussed in **Section 6**, the NSW RFS Illawarra District Office would seek contact with local brigade(s) as future residents occupy dwellings to assess access and egress and discuss Bush Fire Survival Plans.

9. Conclusions

This bushfire assessment will need to be updated once the future landform (slope) and vegetation have been determined at the detailed design phase. The current proposal generally meets the objectives of PBP and can achieve required APZs and other bushfire mitigation measures. Rate of spread analysis under various fire danger ratings did not reveal any key concerns in relation the capacity of the subdivision to evacuate. The proposal does not impose additional mitigation actions on adjoining land, however detailed design phase should demonstrate evidence for the ongoing management of existing managed land. At the detailed design phase, infrastructure, access and construction plans are required to meet the specifications outlined in PBP 2019, however, the re-zoning application has provisions for this to occur smoothly and achieve the deemed to satisfy standards within NSW.

It is concluded that the planning proposal is consistent with Ministerial Direction 4.4 (Planning for Bushfire Protection) issued under section 9.1(2) of the EP&A Act subject to the inclusion of the inclusion of the bushfire risk reduction strategies identified in this report.

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Appendix A : Access Specifications

The following access specifications are reproduced from PBP (RFS 2019).

Intent of measures**:** To provide safe operational access to structures and water supply for emergency services while residents are evacuating an area.

Table 5: Performance criteria for access for residential and rural residential subdivisions

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	property access roads are two-wheel drive, all‑weather roads, and perimeter roads are provided for residential subdivisions of three or more allotments; and subdivisions of three or more allotments have more than one access in and out of the development; and traffic management devices are constructed to not prohibit access by emergency services vehicles; and maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient; and all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end; and where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road; and where access/egress can only be achieved through forest, woodland or heath vegetation, secondary access shall be provided to an alternate point on the existing public road system.
the capacity of access roads is adequate for firefighting vehicles	the capacity of perimeter and non-perimeter road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges/causeways are to clearly indicate load rating.
there is appropriate access to water supply	hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression; hydrants are provided in accordance with AS 2419.1:2005; there is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available.
access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management on the interface	perimeter roads are two-way sealed roads; and 8m carriageway width kerb to kerb; and parking is provided outside of the carriageway width; and hydrants are located clear of parking areas; and there are through roads, and these are linked to the internal road system at an interval of no greater than 500m; and curves of roads have a minimum inner radius of 6m; and the maximum grade road is 15° and average grade is 10°; and the road crossfall does not exceed 3°; and

Performance Criteria	Acceptable Solutions
	a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating	minimum 5.5m width kerb to kerb; and parking is provided outside of the carriageway width; and hydrants are located clear of parking areas; and roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m; and curves of roads have a minimum inner radius of 6m; and the road crossfall does not exceed 3°; and a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
firefighting vehicles can access the dwelling and exit safely	No specific access requirements apply in an urban area where a 70 metre unobstructed path can be demonstrated between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles (i.e. a hydrant or water supply). In circumstances where this cannot occur, the following requirements apply: minimum carriageway width of 4m; in forest, woodland and heath situations, rural property access roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m at the passing bay; and a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches; and provide a suitable turning area in accordance with Appendix 3; and curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress; and the minimum distance between inner and outer curves is 6m; and the crossfall is not more than 10°; and maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads; and a development comprising more than three dwellings has formalised access by dedication of a road and not by right of way. Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.

Appendix B : Services Specifications

The following services specifications (provision of water, gas and electricity) are reproduced from PBP (RFS 2019).

Intent of measures**:** provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building.

Table 6: Performance criteria for services provision for residential and rural residential subdivisions

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
a water supply is provided for firefighting purposes	reticulated water is to be provided to the development, where available; a static water supply is provided where no reticulated water is available.
water supplies are located at regular intervals the water supply is accessible and reliable for firefighting operations	fire hydrant spacing, design and sizing comply with the Australian Standard AS 2419.1:2005; hydrants are not located within any road carriageway; reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.
flows and pressure are appropriate	fire hydrant flows and pressures comply with AS 2419.1:2005.
the integrity of the water supply is maintained	all above-ground water service pipes external to the building are metal, including and up to any taps.
location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings	where practicable, electrical transmission lines are underground; where overhead, electrical transmission lines are proposed as follows: lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas; no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.
location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used; all fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side; connections to and from gas cylinders are metal; polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not used; above-ground gas service pipes are metal, including and up to any outlets.

Table 7: Water supply requirements for non-reticulated developments or where reticulated water supply cannot be guaranteed (Table 5.3d of PBP)

Development Type	Water Requirements
Residential lots (<1000m²)	5000L/lot
Rural-residential lots (1000-10,000m²)	10,000L/lot
Large rural/lifestyle lots (>10,000m²)	20,000L/lot
Multi-dwelling housing (including dual occupancies)	5000L/dwelling

Appendix C: Traffic Evacuation Impact Assessment (Bitzois 2020)

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11 December 2020

White Constructions
C/- Unicomb Development Services
Blackbutt NSW 2529

Attention: **Trevor Unicomb**

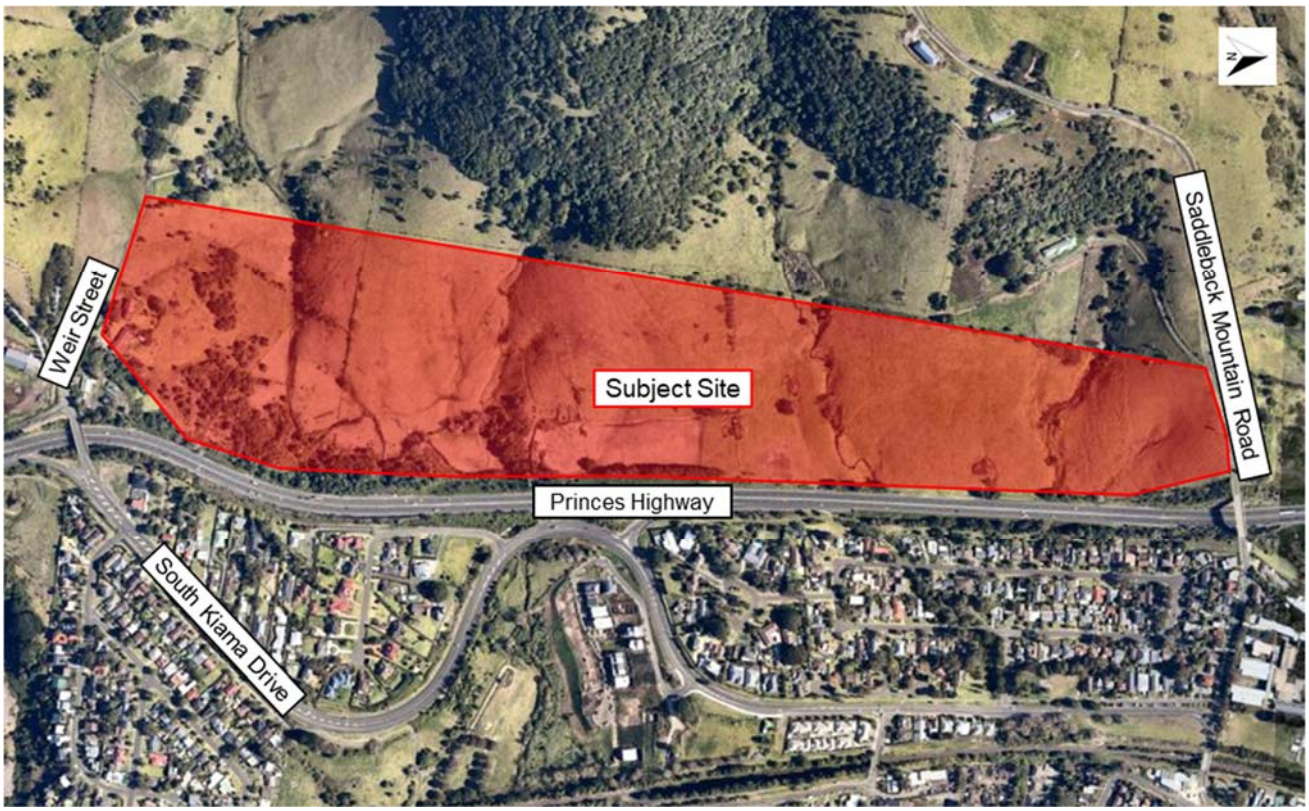
Sent via email: uds@aapt.net.au

Dear Trevor,

RE: EVACUATION TRAFFIC IMPACT ASSESSMENT: KIAMA SOUTH SUBDIVISION PLANNING PROPOSAL

1.0 INTRODUCTION

Bitzios Consulting (Bitzios) has been engaged by White Constructions Pty Ltd (the applicant) to prepare an evacuation traffic impact assessment for the proposed Kiama South subdivision. The location of the proposed site is shown in Figure 1.1.



Source: Nearmap

Figure 1.1: Development Site

1.1. Scope

The scope to undertake this traffic evacuation impact assessment includes:

- Reviewing the development access to the external road network
- Establishing lane capacities of Saddleback Mountain Road and Weir Street fronting the development
- Establishing the total traffic volume of the proposed development during a bushfire evacuation
- Establishing the evacuation time.

2.0 DEVELOPMENT DETAILS

2.1. Development Yield

The proposal is for rezoning of existing land to a residential subdivision comprising of 460 lots. The subdivision includes the following:

- 290 single dwelling R2 zoned lots
- 150 R2 zoned lots > 450m^2
- 20 R5 zoned lots > 1000m^2.

In accordance with Kiama LEP, lots smaller than 600m^2 are not to be developed for dual occupancies. As such, the maximum lot yield for the development is 500 dwellings, including dual occupancy sites. However, for the purpose of this assessment, a conservative approach has been adopted to assume all lots larger than 450m^2 are developed as dual occupancies, resulting in 630 dwellings for the subject site.

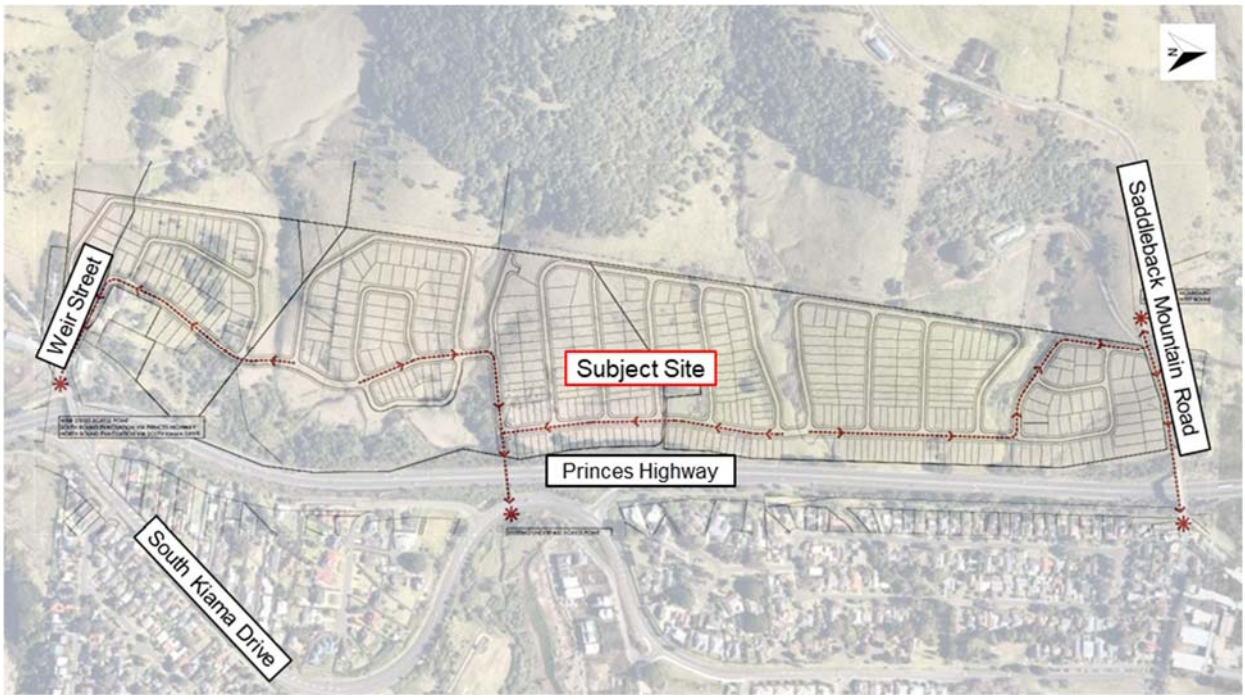
The current proposed development subdivision layout is provided in **Attachment A**.

2.2. Proposed Development Access

The development will access the external road network through three roads, including:

- Saddleback Mountain Road
- Weir Street
- Princes Highway underpass access road.

It is noted the Princes Highway underpass access road will be used for active transport and emergency vehicle access only. Figure 2.1 shows the major roads and their connection to the development.



Source: Nearmap

Figure 2.1: Development Access

The attributes of these roads are detailed in Table 2.1. It is noted the roads included in Table 2.1 are not anticipated to change as part of the development.

Table 2.1: Major Road Attributes

Road Name	No. of Lanes	Speed Limit	Divided	Jurisdiction	Hierarchy	Estimated Capacity[1]
Saddleback Mountain Road	2	50km/h	No	Council	Local Road	600veh/h
Weir Street	2	50km/h	No	Council	Local Road	900veh/h

1 – Road capacity estimated based on Austroads Guide to Traffic Management: Part 3 – Transport Study and Analysis Methods Table 6.1.

3.0 EVACUATION

3.1. Scenarios

A number of scenarios were considered to determine the evacuation time of the development in the event of a bush fire. Table 3.1 details the scenarios considered to assess the ability of the road network to support an evacuation.

Table 3.1: Evacuation Scenarios

Ref.	Scenario Name	Parameters	Description
1A	Total evacuation, outside of typical work hours, maximum development yield	▪ All residents to be evacuated ▪ Average vehicle trips during evacuation assumed to be 2 vehicles per dwelling ▪ A total of 1,000 trips during evacuation based on the development yield	Evacuate the entire development using Weir Street and Saddleback Mountain Road in the morning, evening or holiday period.
1B	Total evacuation, during typical work hours, maximum development yield	▪ All residents to be evacuated ▪ Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling ▪ A total of 750 trips during evacuation based on the development yield	Evacuate the entire development using Weir Street and Saddleback Mountain Road during working hours.
2A	Total evacuation, outside of typical work hours, conservative development yield	▪ All residents to be evacuated ▪ Average vehicle trips during evacuation assumed to be 2 vehicles per dwelling ▪ A total of 1,260 trips during evacuation based on the development yield	Evacuate the entire development using Weir Street and Saddleback Mountain Road in the morning, evening or holiday period.
2B	Total evacuation, during typical work hours, conservative development yield	▪ All residents to be evacuated ▪ Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling ▪ A total of 945 trips during evacuation based on the development yield	Evacuate the entire development using Weir Street and Saddleback Mountain Road during working hours.

A number of assumptions have been made in the above scenarios:

- None of the access roads are impacted by the bush fire event and are accessible to all residents in the event of an evacuation
- All residents are in their vehicle ready to leave
- All residents commence their evacuation trip at the same time.

3.2. Results

The potential impact of an emergency evacuation is measured as the length of time estimated for all residents to clear the development. This is calculated by dividing the total number of evacuation trips by the total capacity of the access roads. The results for each scenario are detailed in Table 3.2.

Table 3.2: Evacuation Scenarios

Ref.	Scenario Name	Estimated Time to Clear the Development
1A	Total evacuation, outside of typical work hours, maximum development yield	40 minutes
1B	Total evacuation, during typical work hours, maximum development yield	30 minutes
2A	Total evacuation, outside of typical work hours, conservative development yield	50 minutes
2B	Total evacuation, during typical work hours, conservative development yield	37 minutes

It is noted the results do not consider delays at decisions points such as exiting driveways or at intersections, as well as delays experienced from other behaviours likely to occur during an evacuation.

4.0 Conclusion and Recommendation

Based on the assumptions and methodology adopted, the estimated evacuation time for each scenario is as follows:

- Total evacuation using Saddleback Mountain Road and Weir Street could be achieved in 40 minutes or less with 500 dwellings based on the external road capacity
- Total evacuation using Saddleback Mountain Road and Weir Street could be achieved in 50 minutes or less with 630 dwellings based on the external road capacity.

Yours faithfully,

Luke Johnston

Senior Traffic Engineer and Transport Planner

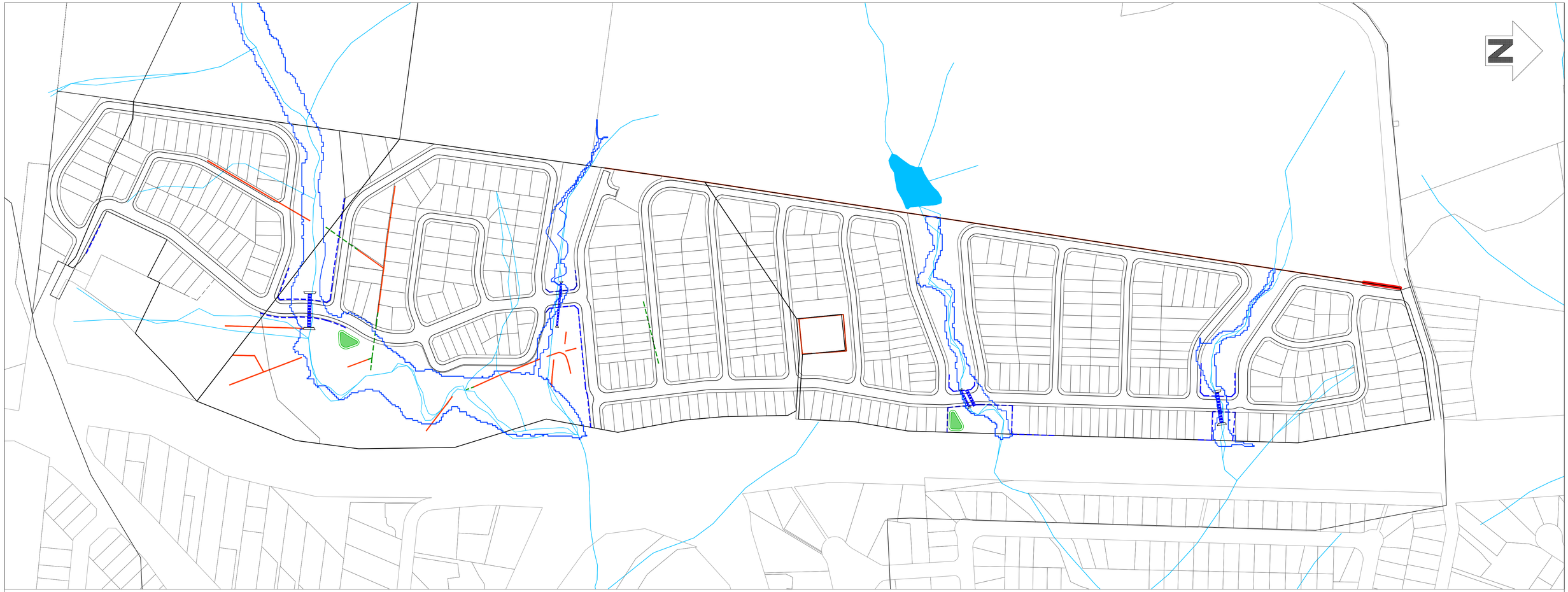
BITZIOS CONSULTING

Attachments:

A: Development Plans

Attachment A

Development Plans



SITE MASTER PLAN

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Metres

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Approved	AC

Client Title: WHITE CONSTRUCTIONS

Dwg Status: APPROVAL

Local Authority: KIAMA

Dwg Title: PROPOSED SUBDIVISION
SOUTH KIAMA LOT 1 DP707300,
LOT 5 DP740252 & LOT 101 DP1077617
SITE MASTER PLAN

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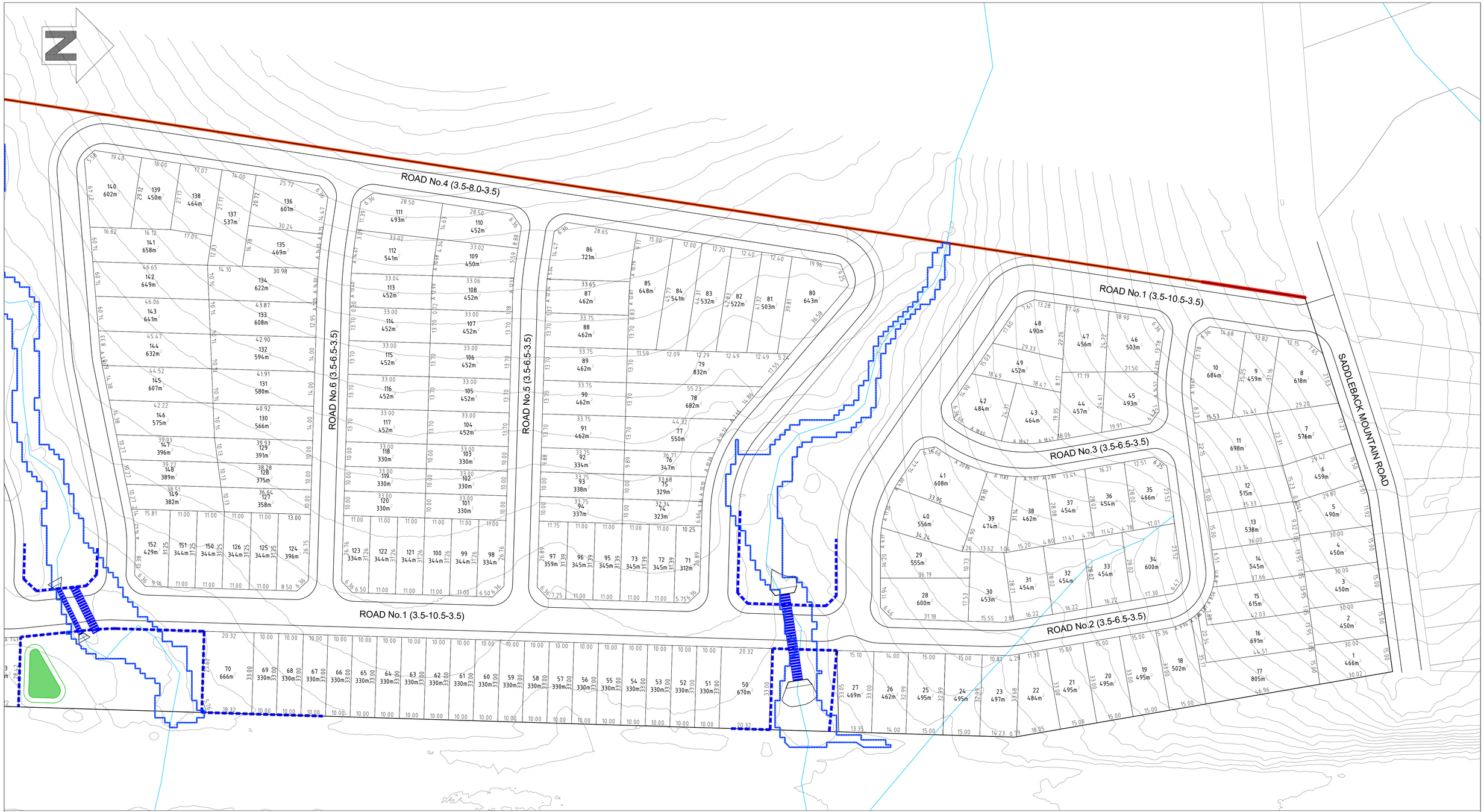

LEGEND

- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE RETAINED
- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE REMOVED
- LOCATION OF PROPOSED RETAINING WALLS

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Date	15/05/2020
Rev	E
	A3

AREA TOO STEEP FOR FIRE TRAIL

ROAD No.8 (3.5-8.0-3.5)

ROAD No.1 (3.5-10.5-3.5)

ROAD No.12 (3.5-6.5-3.5)

ROAD No.11 (3.5-6.5-3.5)

ROAD No.10 (3.5-6.5-3.5)

ROAD No.9 (3.5-6.5-3.5)

ROAD No.7 (3.5-8.0-3.5)

ROAD No.1 (3.5-10.5-3.5)

N

LEGEND

- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE RETAINED
- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE REMOVED
- LOCATION OF PROPOSED RETAINING WALLS

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DETAILED SUBDIVISION LAYOUT 2

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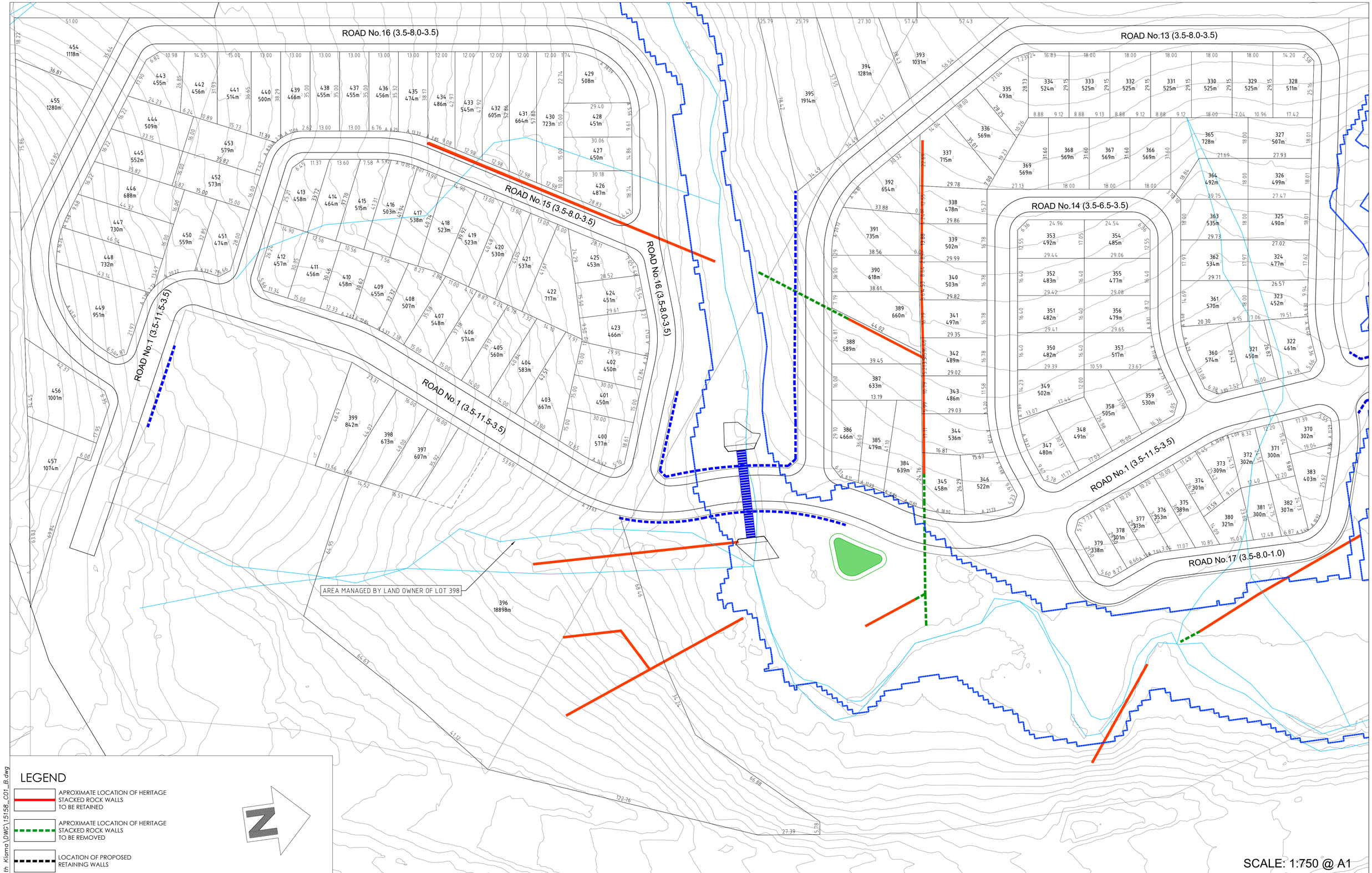

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DETAILED SUBDIVISION LAYOUT 3

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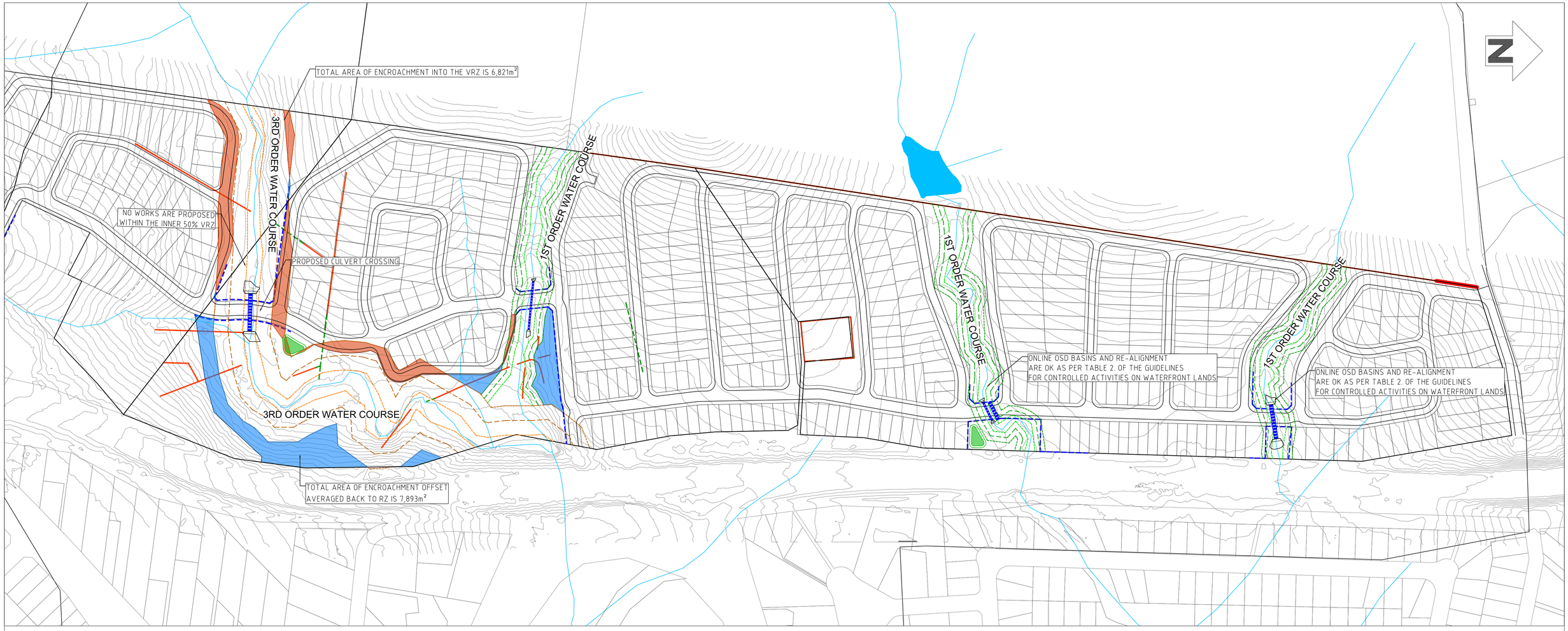

LEGEND

- 1ST ORDER TOP OF BANK
- 1ST ORDER INNER VRZ 5m FROM TOP OF BANK
- 1ST ORDER OUTER VRZ 10m FROM TOP OF BANK
- 3RD ORDER TOP OF BANK
- 3RD ORDER INNER VRZ 15m FROM TOP OF BANK
- 3RD ORDER OUTER VRZ 30m FROM TOP OF BANK
- ENCROACHMENT INTO OUTER VRZ
- ENCROACHMENT OFFSET AVERAGED BACK TO RZ

THE ABOVE DATA IS BASED ON LiDAR DATA FROM 2019. FINAL BANK LOCATIONS ARE SUBJECT TO GROUND SURVEY AND WILL BE REVISED AT DA STAGE.

RIPARIAN CORRIDOR PLAN

SCALE 1:2,000

0 50 100 150 200

Metres

SCALE: -1:2,000 @A1
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RIPARIAN CORRIDOR PLAN

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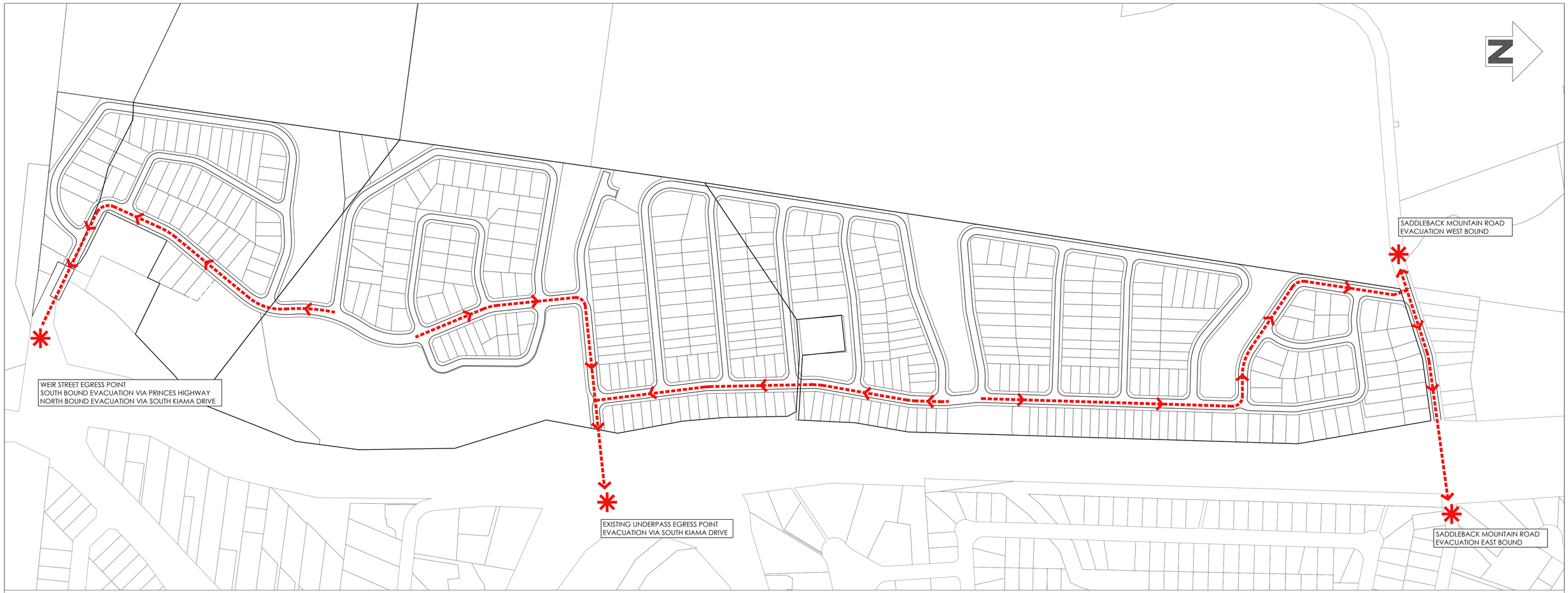

LEGEND

SITE EGRESS POINTS

EVACUATION ROUTES

SCALE 1:2,250

0 50 100 150 200

Metres

SCALE: -1:2,250 @A1
-1:4,500 @ A3

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EVACUATION ROUTES

Ref & Dwg No	15158.RZ.C06
Sheet No	Sheet 06 of 06
Scale	1:2,250 @ A1
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	A3

Appendix D: Traffic Impact Assessment Addendum Report(Bitzois 2020)

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11 December 2020

White Constructions
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Attention: **Trevor Unicomb**

Sent via email: uds@aapt.net.au

Dear Trevor,

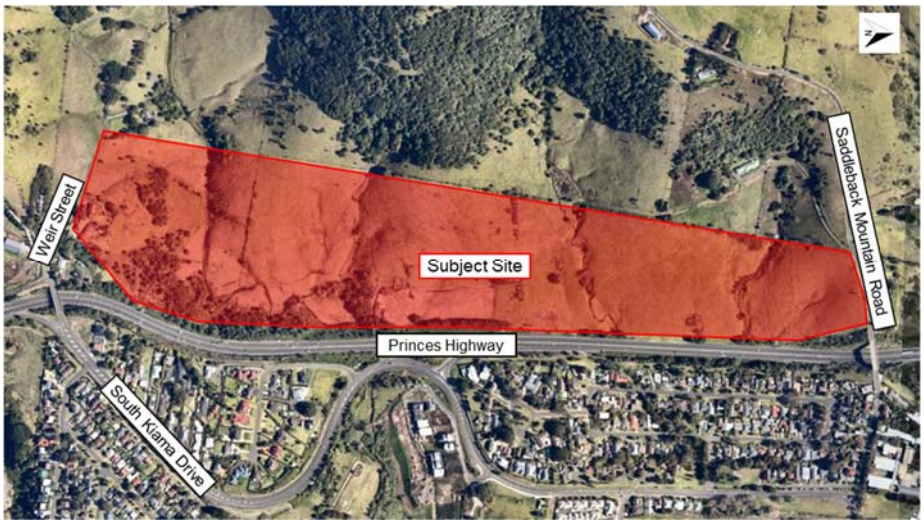
RE: UPDATED TRAFFIC IMPACT ASSESSMENT: KIAMA SOUTH SUBDIVISION PLANNING PROPOSAL

1.0 INTRODUCTION

1.1. Background

Bitzios Consulting (Bitzios) was engaged by White Constructions Pty Ltd (the applicant) to undertake a traffic impact assessment (TIA) for the proposed Kiama South subdivision. Kiama Municipal Council (Council) and Transport for New South Wales (TfNSW) reviewed and requested additional information, which was addressed by Bitzios in the previous TIA (*Ref.: P4688.002R South Kiama Subdivision PP RFI Report*) dated 28 July 2020.

To address concerns surrounding emergency access to the development, the Princes Highway underpass access road is proposed to be closed to vehicular traffic and used for active transport and emergency vehicles access only. This letter provides an updated assessment of the traffic impacts under the new access arrangement. The location of the proposed site is shown in Figure 1.1.



Source: Nearmap

Figure 1.1: Development Site Location

1.2. Development Details

The proposal is for rezoning of existing land to a residential subdivision. The previous TIA identified the subdivision would comprise of 460 lots with a maximum lot yield of 500 dwellings. However, the development was conservatively assessed for 630 dwellings.

The lot yield of the development has since reduced to 457 lots; however, this assessment will maintain the conservative assessment of 630 dwellings.

The current proposed development subdivision layout is provided in **Attachment A**.

1.3. Scope

The scope to undertake this updated traffic assessment is limited to assessing the impacts on the external road network which includes the following:

- Redistributing development traffic to the external road network for the AM and PM peak hours based on closure of the Princes Highway underpass access road
- Assessing the proposed development's traffic impacts on the external road network with consideration to the previous TIA.

2.0 TRAFFIC ASSESSMENT

2.1. Background Traffic

Background traffic volumes from the previous TIA (*Ref.: P4688.002R South Kiama Subdivision PP RFI Report*) have been adopted.

2.2. Design Traffic

Design traffic volumes from the previous TIA (*Ref.: P4688.002R South Kiama Subdivision PP RFI Report*) have been adopted and are summarised in Table 2.1.

Table 2.1: Development Traffic Generation

Lot Type	Quantity	Dwellings	AADT	AM Trip Rate	PM Trip Rate	AM Trips	PM Trips
Lots<450m^2	290	290	2900	0.71	0.78	206	226
Lots>450m^2	158 (dual occupancy)	316	3160	0.71	0.78	224	246
Lots South Weir Street	12 (dual occupancy)	24	240	0.71	0.78	14	19
Total						**447**	**491**

It is noted that under Council's LEP, the subject site has a maximum lot yield (including dual occupancies) of 500 dwellings. However, as a conservative approach, it has been assumed all lots larger than 450m^2 will be developed as dual occupancies resulting in a yield of 630 dwellings.

Typical IN and OUT trip splits for a residential development have been adopted and are detailed in Table 2.2.

Table 2.2: Development IN and OUT Trip Splits

Lot Type	AM % Split		PM % Split		AM Trips		PM Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Lots<450m^2	30%	70%	60%	40%	62	144	136	90
Lots>450m^2	30%	70%	60%	40%	67	157	148	99
Lots South Weir Street	30%	70%	60%	40%	5	12	11	7
Total					**134**	**313**	**295**	**197**

2.3. Distribution and Assignment

The trips generated by the proposed development have been distributed on to the external road network based on the outputs from the Strategic Model (TRACKS) for the Kiama area as per the previous TIA (*Ref.: P4688.002R South Kiama Subdivision PP RFI Report*). The trip distributions are:

- 64% to/from the north (i.e. 51% north to/from Wollongong and other surrounding towns, 33% to/from northern Kiama)
- 6% to/from the south (i.e. 16% south to/from Gerringong, Shoalhaven, etc.).

Trip distributions to/from Kiama (i.e. internal trips) are expected to occur north of Saddleback Mountain Road as there are no trip attractors (i.e. beach access, shops, etc.) south of Saddleback Mountain Road.

The expected IN and OUT distributions at each of the access points for the subdivision development are detailed in Table 2.3 to Table 2.6. The development previously proposed three access points as assessed in the previous TIA (*Ref.: P4688.002R South Kiama Subdivision PP RFI Report*). The Princes Highway underpass access road is now proposed to be used for active transport and emergency vehicle access only. As such, no development traffic will use this access.

Table 2.3: OUT Distribution to the North

OUT to North	Distribution
From Saddleback Mountain Road	90%
From Access Road (no longer proposed)	0%
From Weir Street	10%

Table 2.4: OUT Distribution to the South

OUT to South	Distribution
From Saddleback Mountain Road	0%
From Access Road (no longer proposed)	0%
From Weir Street	100%

Table 2.5: IN Distribution from the North

IN from North (via Off-ramp)	Distribution
From Saddleback Mountain Road	59%
From Access Road (no longer proposed)	0%
From Weir Street	41%

Table 2.6: IN Distribution from the South

IN from South	Distribution
From Saddleback Mountain Road	0%
From Access Road (no longer proposed)	0%
From Weir Street	100%

The anticipated development trip distribution and the development generated traffic are presented in **Attachment B**.

The traffic generated by the proposed subdivision development has been assigned to the background traffic volumes to determine design traffic volumes (i.e. 'with development' scenarios). The year-of-opening (2020) and 10-year design horizon (2030) design traffic volumes are provided in **Attachment B**.

2.4. SIDRA Intersection Assessment

SIDRA intersection assessments were undertaken for four intersections as part of the previous TIA, including:

- Bland Street / Eugene Street / Princes Highway On-ramp roundabout
- Princes Highway Off-ramp / South Kiama Drive priority-controlled intersection
- Saddleback Mountain Road / South Kiama Drive priority-controlled intersection
- Weir Street / South Kiama Drive / Princes Highway priority-controlled intersection.

Design traffic volumes at the Bland Street / Eugene Street / Princes Highway On-ramp roundabout and Weir Street / South Kiama Drive / Princes Highway intersection will not change with the closure of the Princes Highway underpass access road. As such, only the following intersections with be reassessed:

- Princes Highway Off-ramp / South Kiama Drive priority-controlled intersection
- Saddleback Mountain Road / South Kiama Drive priority-controlled intersection.

Princes Highway Off-ramp / South Kiama Drive Priority-Controlled Intersection

The Princes Highway Off-ramp / South Kiama Drive priority-controlled intersection has been assessed in SIDRA 8 intersection modelling software. All background and design scenarios have been analysed to determine the intersection's operational performance during the AM and PM peak hours. The intersection geometry layout is illustrated in Figure 2.1

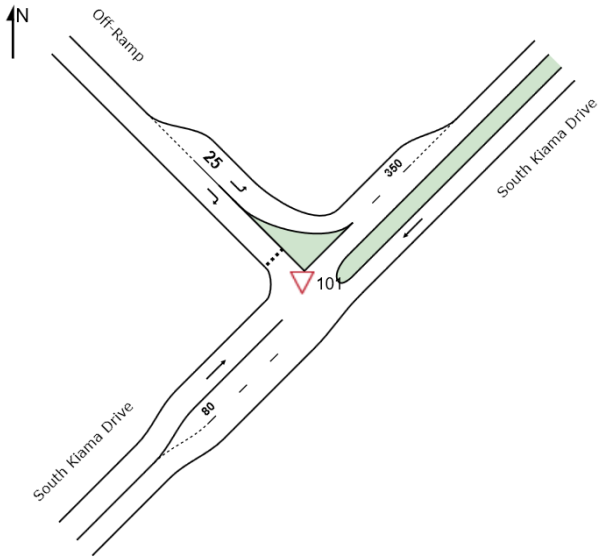


Figure 2.1: Princes Highway Off-ramp / South Kiama Drive Intersection Layout

The SIDRA results for year-of-opening (2020) and 10-year design horizon (2030) are summarised in Table 2.7 and

Table 2.8.

Table 2.7: 2020 Princes Highway Off-ramp / South Kiama Drive Intersection Results

Approach	2020 AM				2020 PM			
	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)
Background								
South Kiama Drive (NE)	0.13	0	NA	0	0.16	0	NA	0
Princes Highway Off-ramp (NW)	0.06	7	A	2	0.06	7	A	2
South Kiama Drive (SW)	0.18	0	NA	0	0.14	0	NA	0
Design								
South Kiama Drive (NE)	0.13	0	NA	0	0.16	0	NA	0
Princes Highway Off-ramp (NW)	0.12	7	A	4	0.17	7	A	5
South Kiama Drive (SW)	0.19	0	NA	0	0.15	0	NA	0

Table 2.8: 2030 Princes Highway Off-ramp / South Kiama Drive Intersection Results

Approach	2030 AM				2030 PM			
	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)
Background								
South Kiama Drive (NE)	0.15	0	NA	0	0.19	0	NA	0
Princes Highway Off-ramp (NW)	0.10	7	A	3	0.08	7	A	2
South Kiama Drive (SW)	0.21	0	NA	0	0.16	0	NA	0
Design								
South Kiama Drive (NE)	0.15	0	NA	0	0.19	0	NA	0
Princes Highway Off-ramp (NW)	0.15	8	A	5	0.21	8	A	6
South Kiama Drive (SW)	0.22	0	NA	0	0.17	0	NA	0

The Princes Highway Off-ramp / South Kiama Drive priority-controlled intersection performs satisfactorily in terms of DOS, LOS, average delay and queue length. None of the performance results exceed capacity mechanisms. Therefore, no mitigation measures are required at this intersection as a result of the development traffic. Detailed SIDRA results are provided in **Attachment C**.

It is noted the intersection performs slightly better in the design scenario compared to the previous TIA as a result of the Princes Highway underpass access road closure.

Saddleback Mountain Road / South Kiama Drive Priority-Controlled Intersection

The Saddleback Mountain Road / South Kiama Drive priority-controlled intersection has been assessed in SIDRA 8 intersection modelling software. All background and design scenarios have been analysed to determine the intersection's operational performance during the AM and PM peak hours. The intersection geometry layout is illustrated in Figure 2.2.

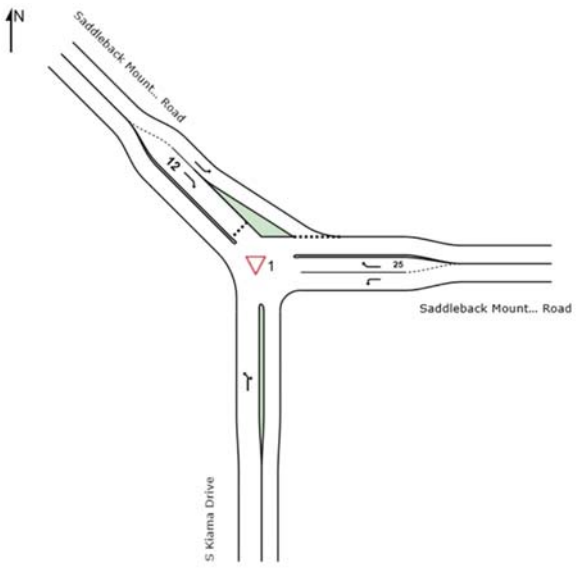


Figure 2.2: Saddleback Mountain Road / South Kiama Drive Intersection Layout

The SIDRA results for year-of-opening (2020) and 10-year design horizon (2030) are summarised in Table 2.9 and Table 2.10.

Table 2.9: 2020 Saddleback Mountain Road / South Kiama Drive Intersection Results

Approach	2020 AM				2020 PM			
	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)
Background								
South Kiama Drive (S)	0.27	2	NA	0	0.20	3	NA	0
Saddleback Mountain Road (E)	0.10	4	NA	2	0.16	3	NA	1
Saddleback Mountain Road (NW)	0.14	5	A	4	0.14	7	A	4
Design								
South Kiama Drive (S)	0.31	3	NA	0	0.27	3	NA	0
Saddleback Mountain Road (E)	0.12	4	NA	4	0.16	4	NA	4
Saddleback Mountain Road (NW)	0.37	6	A	14	0.26	6	A	8

Table 2.10: 2030 Saddleback Mountain Road / South Kiama Drive Intersection Results

Approach	2030 AM				2030 PM			
	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)	DOS (v/c)	Delay (s)	LOS	95%ile Queue (m)
Background								
South Kiama Drive (S)	0.31	3	NA	0	0.23	3	NA	0
Saddleback Mountain Road (E)	0.12	4	NA	2	0.19	3	NA	1
Saddleback Mountain Road (NW)	0.18	6	A	5	0.19	8	A	5
Design								
South Kiama Drive (S)	0.35	3	NA	0	0.30	3	NA	0
Saddleback Mountain Road (E)	0.15	5	NA	4	0.19	4	NA	4
Saddleback Mountain Road (NW)	0.42	7	A	18	0.28	7	A	9

The Saddleback Mountain Road / South Kiama Drive priority-controlled intersection performs satisfactorily in terms of DOS, LOS, average delay and queue length. None of the performance results exceed capacity mechanisms. Therefore, no mitigation measures are required at this intersection as a result of the development traffic. Detailed SIDRA results are provided in **Attachment C**.

It is noted the intersection performs slightly better compared to the previous TIA as a result of the Princes Highway underpass access road closure.

It is noted the South Kiama Drive (S) leg performs better in the design scenarios compared to the previous TIA as a result of the Princes Highway underpass access road closure. The Saddleback Mountain Road (NW) leg has increased in DOS by a maximum of 0.06 and increased in queue by a maximum of five metres. These increases are not considered to be significant and have no impact on the overall operation of the intersection.

3.0 CONCLUSION

The two intersections assessed have been shown to perform satisfactorily with regard to typical capacity mechanisms stipulated in the Roads and Maritime Services *Traffic Modelling Guidelines* (2013). None of the performance results exceed the capacity mechanisms and the closure of the Princes Highway underpass access road has no significant impact on intersection operations. As such, no mitigations measures are required.

Yours faithfully

Luke Johnston

Senior Traffic Engineer and Transport Planner

BITZIOS CONSULTING

Attachments:

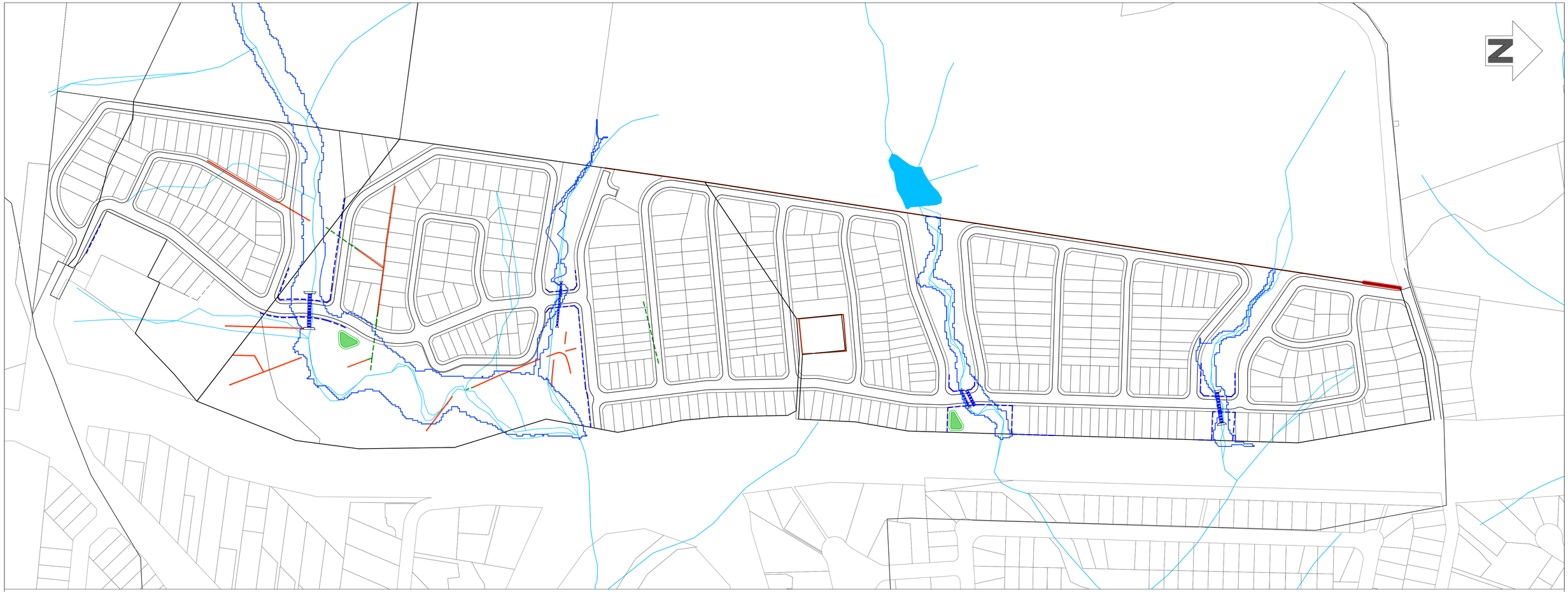
A: Development Plans

B: Traffic Volume Diagrams

C: SIDRA Results

Attachment A

Development Plans



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Designed	A.C
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Approved	AC

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SOUTH KIAMA LOT 1 DP707300,
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SITE MASTER PLAN

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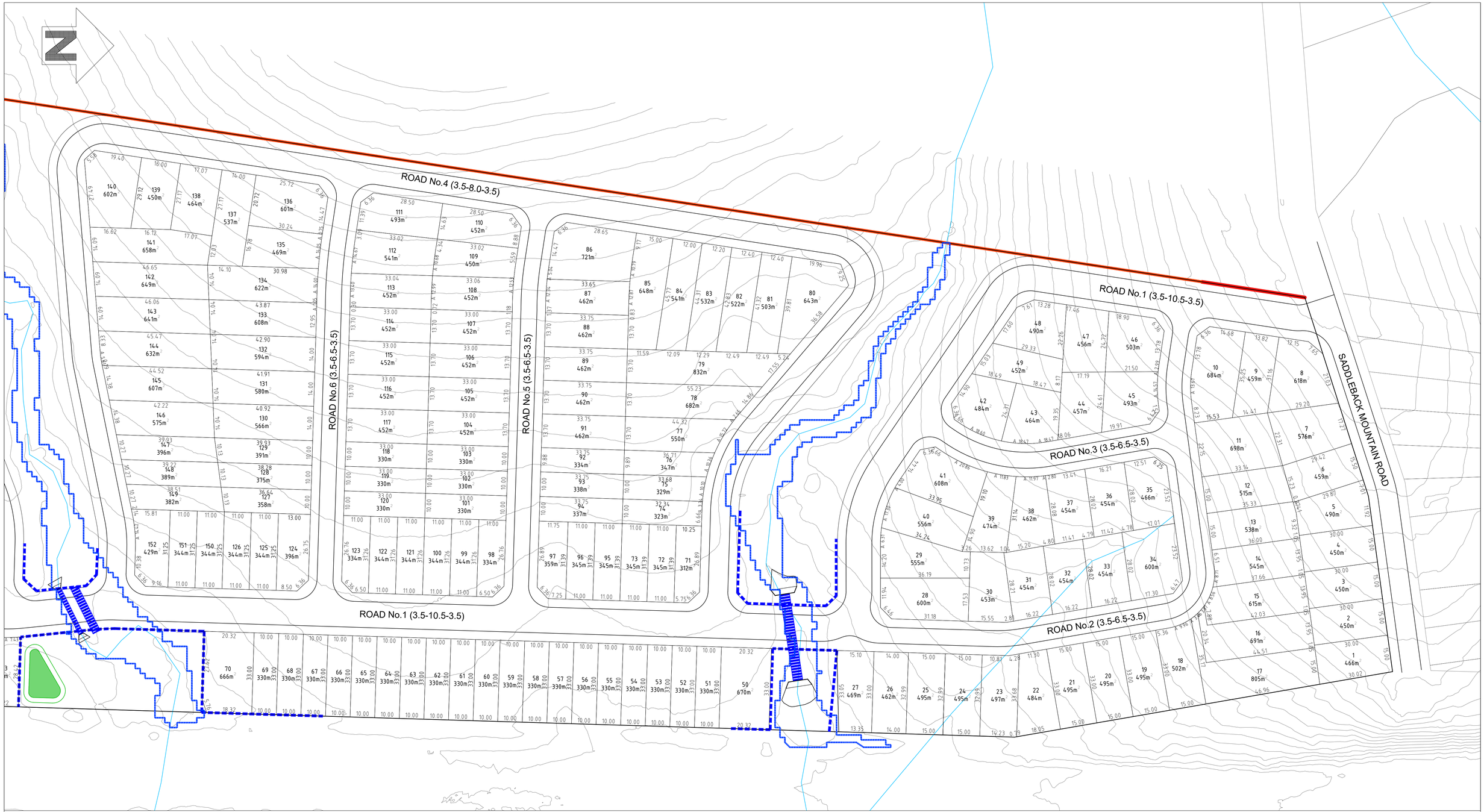

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- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE RETAINED
- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE REMOVED
- LOCATION OF PROPOSED RETAINING WALLS

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Date	15/05/2020
Rev	E
	A3

AREA TOO STEEP FOR FIRE TRAIL

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ROAD No.1 (3.5-10.5-3.5)

ROAD No.12 (3.5-6.5-3.5)

ROAD No.11 (3.5-6.5-3.5)

ROAD No.10 (3.5-6.5-3.5)

ROAD No.9 (3.5-6.5-3.5)

ROAD No.7 (3.5-8.0-3.5)

ROAD No.1 (3.5-10.5-3.5)

N

LEGEND

- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE RETAINED
- APROXIMATE LOCATION OF HERITAGE STACKED ROCK WALLS TO BE REMOVED
- LOCATION OF PROPOSED RETAINING WALLS

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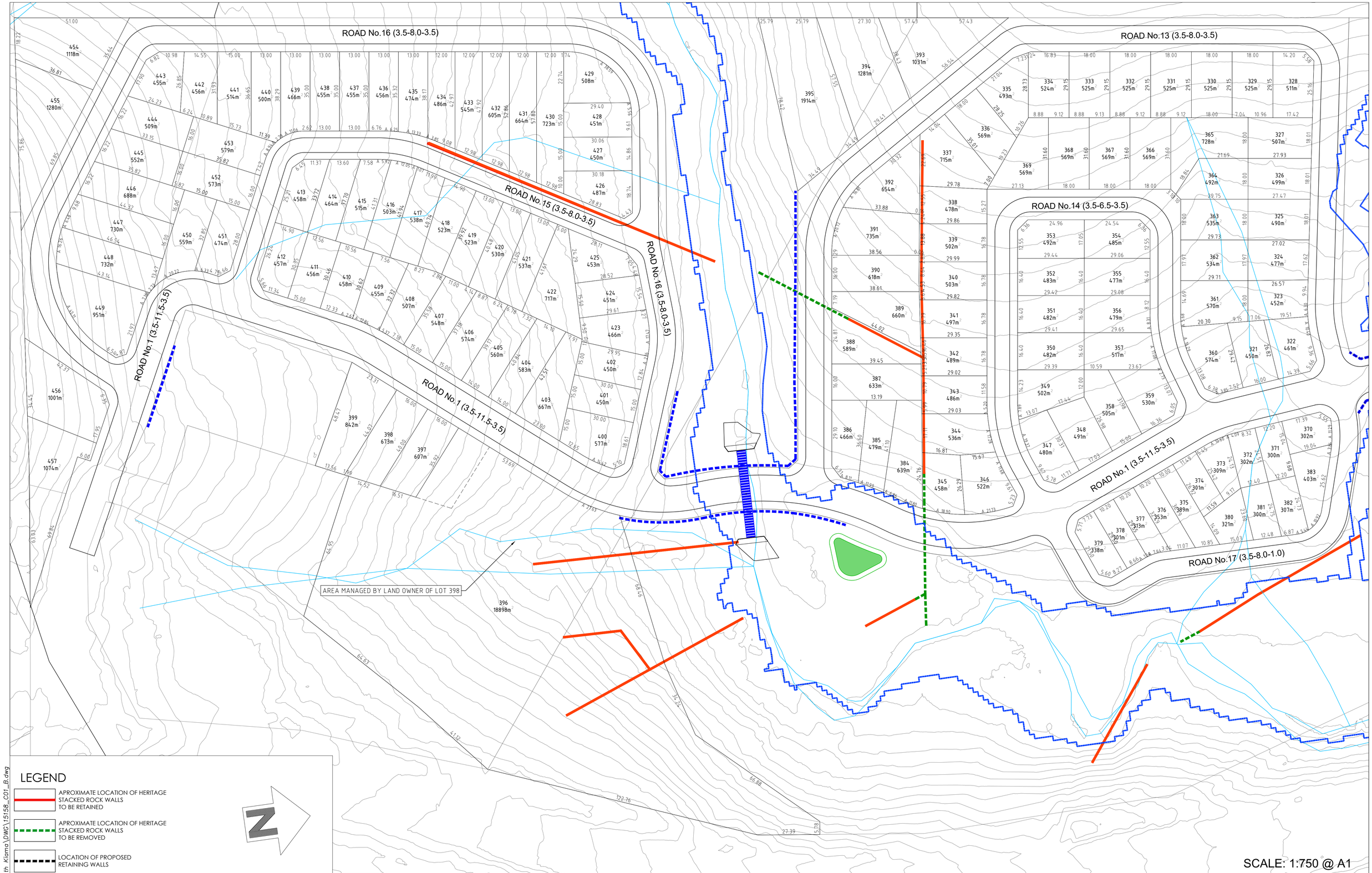

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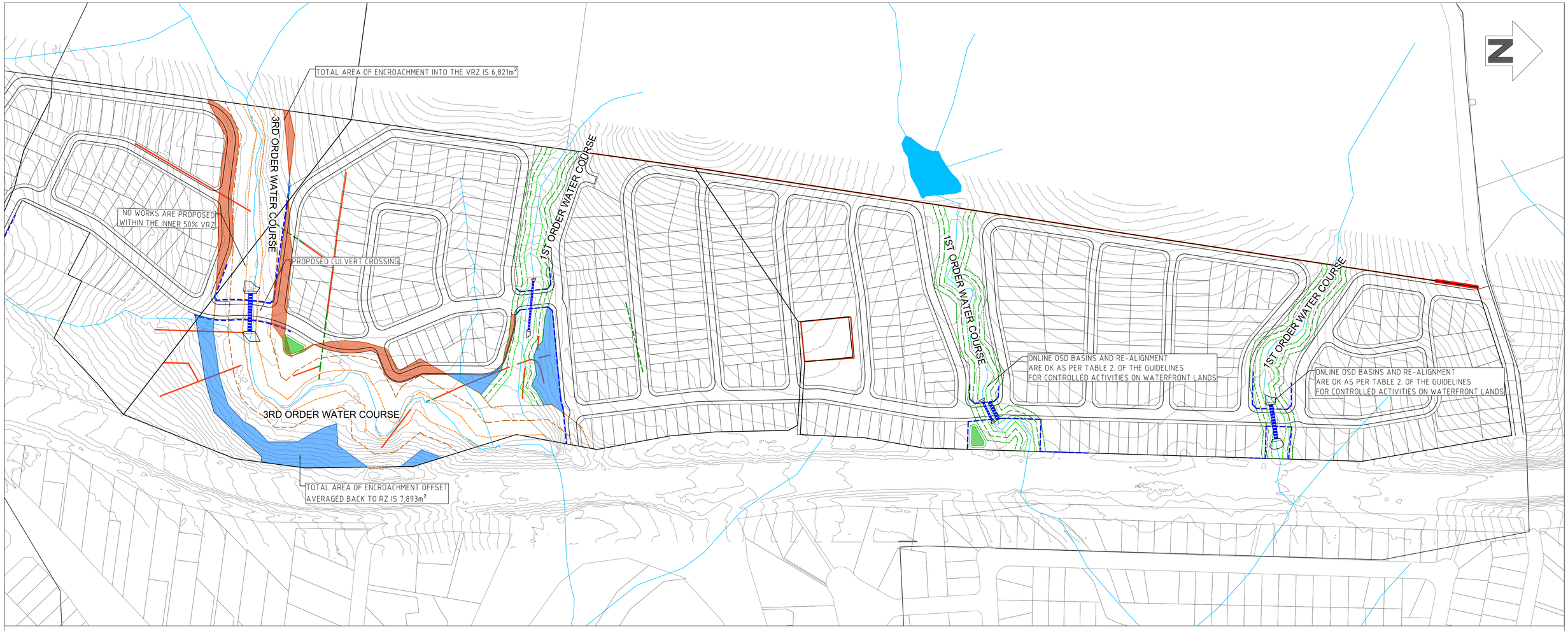

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- 1ST ORDER INNER VRZ 5m FROM TOP OF BANK
- 1ST ORDER OUTER VRZ 10m FROM TOP OF BANK
- 3RD ORDER TOP OF BANK
- 3RD ORDER INNER VRZ 15m FROM TOP OF BANK
- 3RD ORDER OUTER VRZ 30m FROM TOP OF BANK
- ENCROACHMENT INTO OUTER VRZ
- ENCROACHMENT OFFSET AVERAGED BACK TO RZ

THE ABOVE DATA IS BASED ON LiDAR DATA FROM 2019. FINAL BANK LOCATIONS ARE SUBJECT TO GROUND SURVEY AND WILL BE REVISED AT DA STAGE.

RIPARIAN CORRIDOR PLAN

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Metres

SCALE: -1:2,000 @A1
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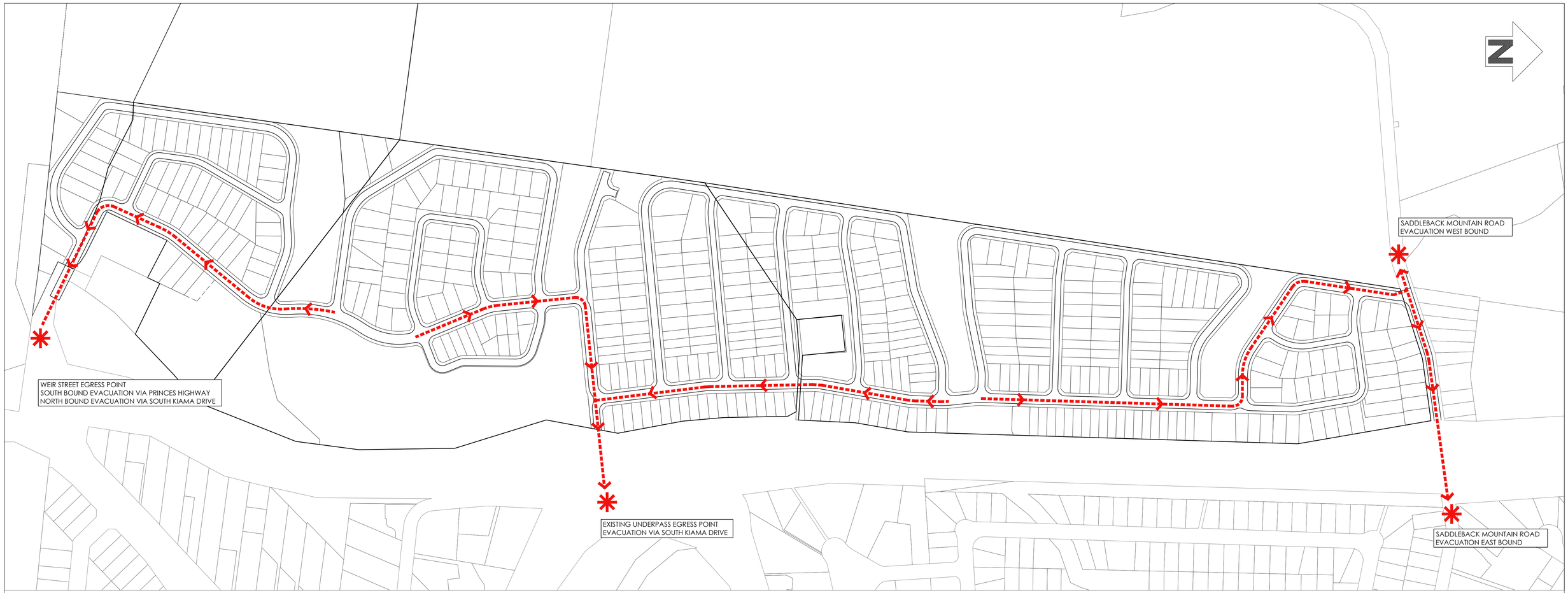

LEGEND

SITE EGRESS POINTS

EVACUATION ROUTES

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Metres

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EVACUATION ROUTES

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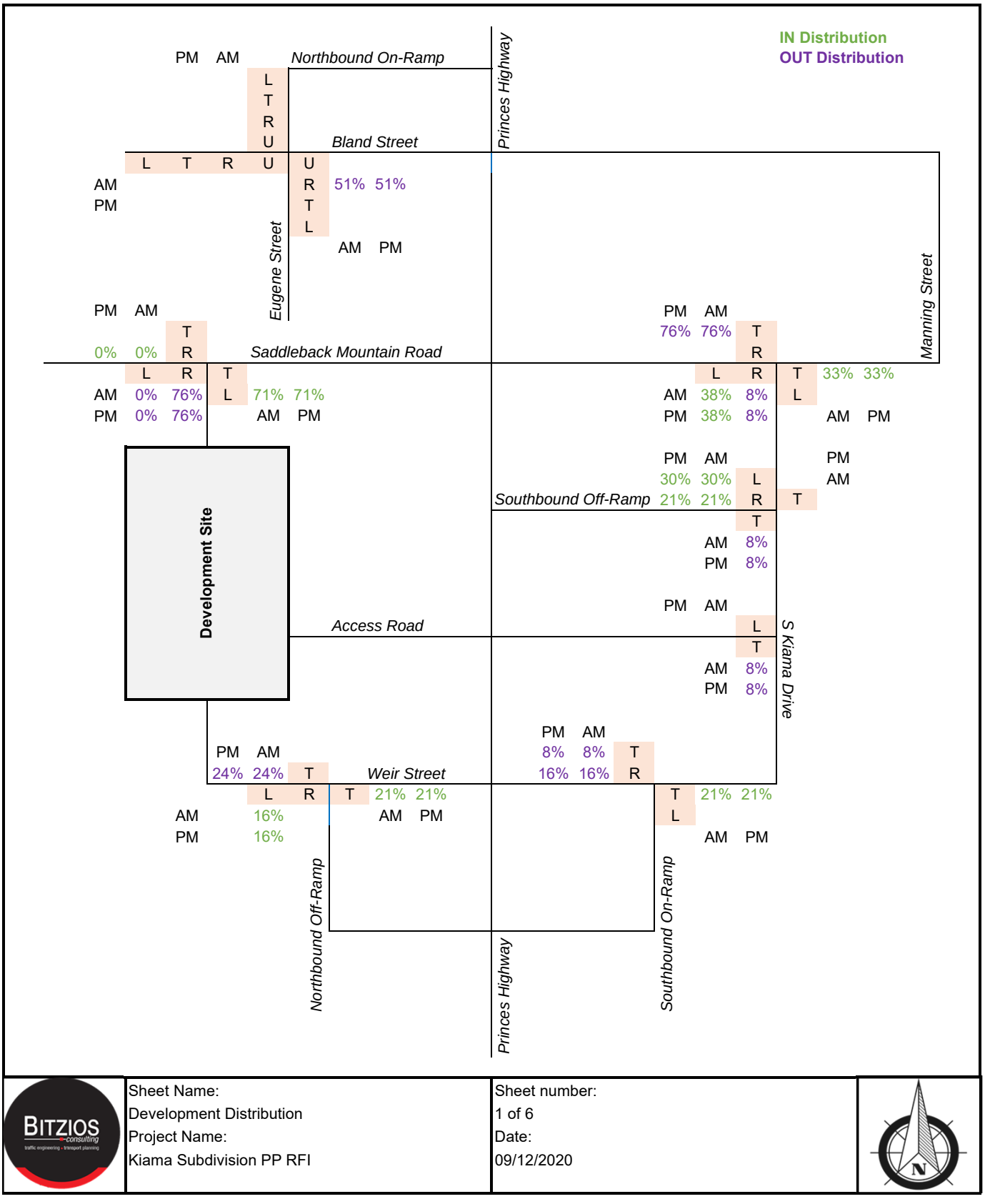
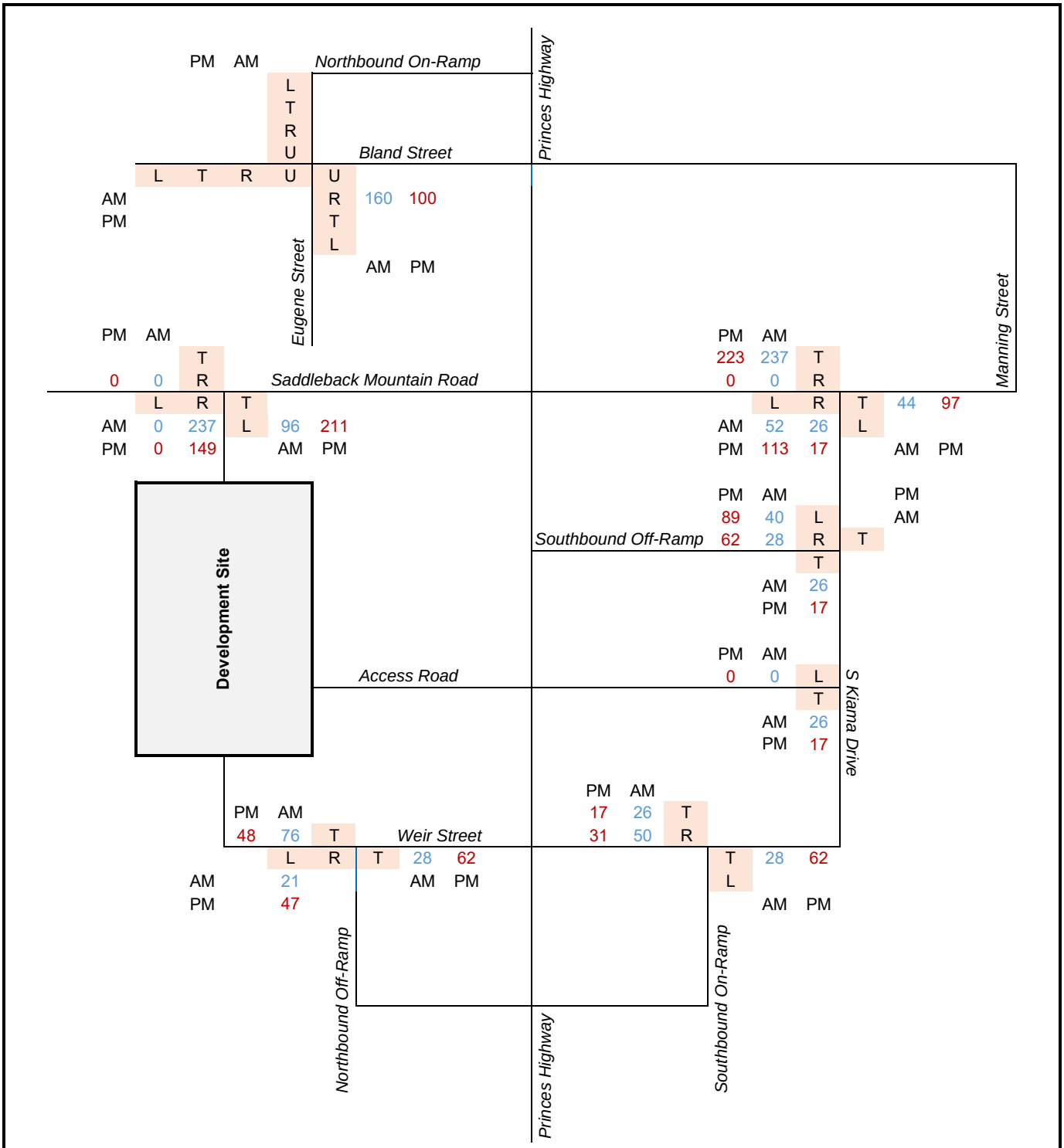
Attachment B

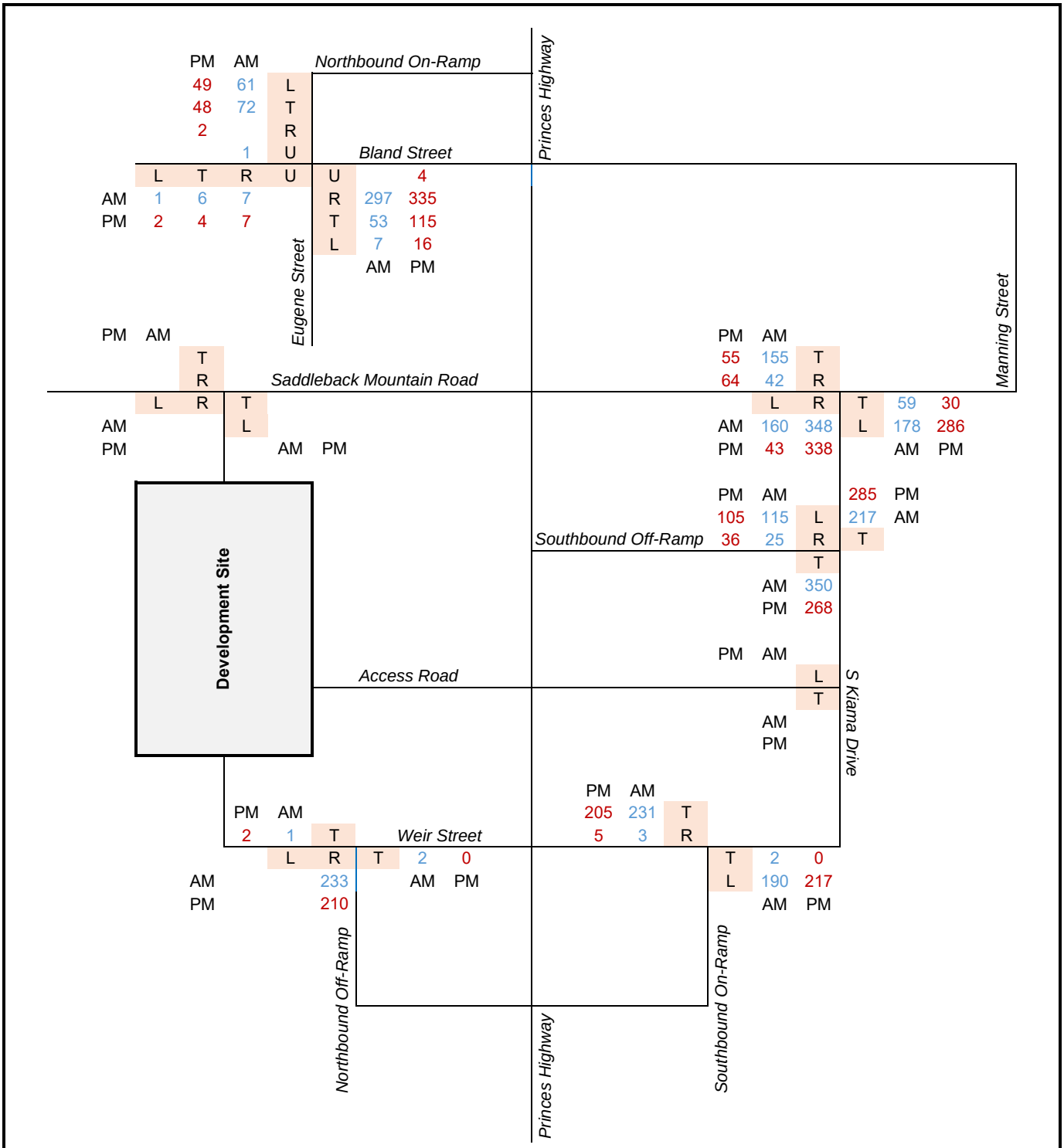
Traffic Volume Diagrams



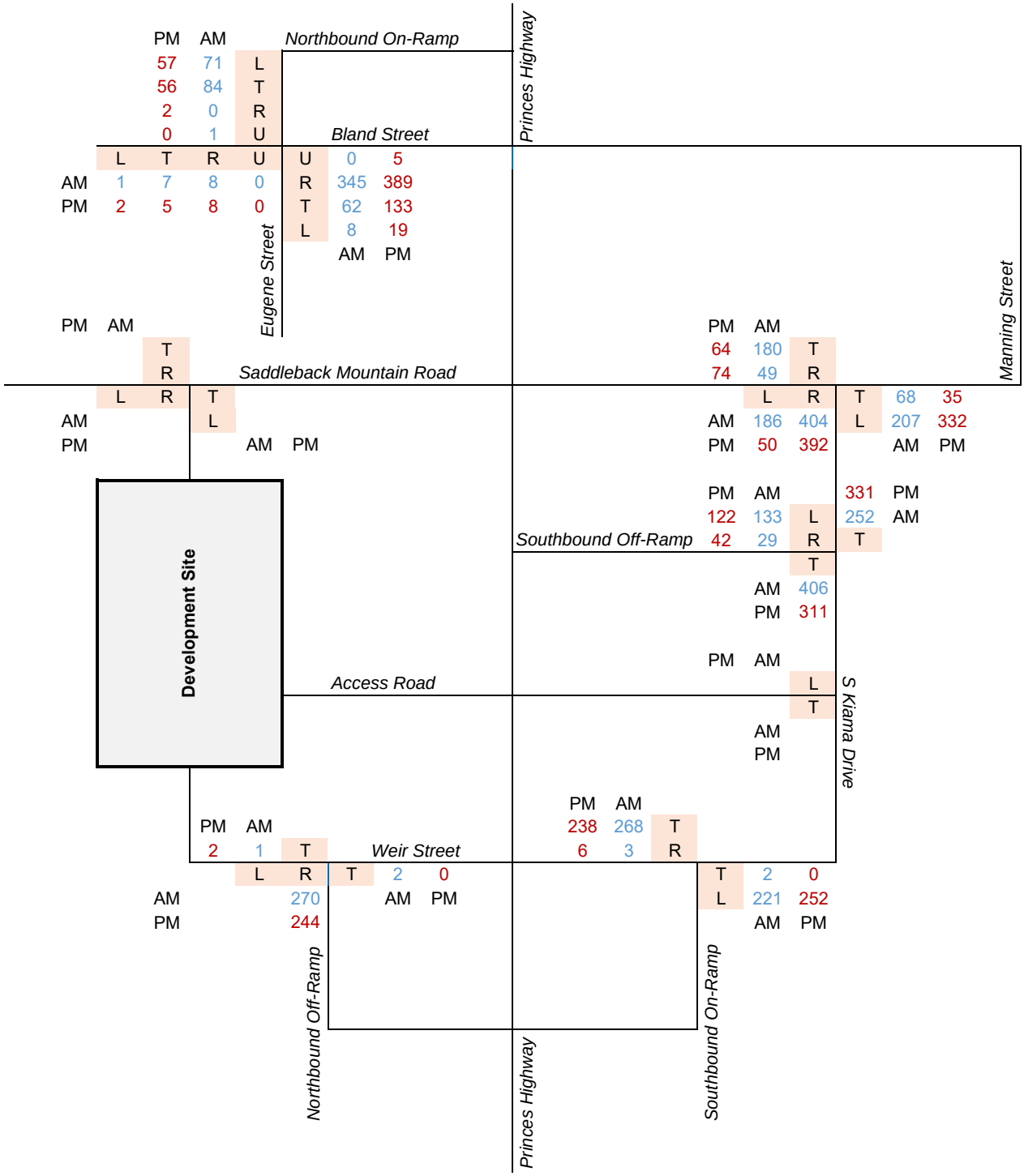
BITZIOS consulting	Sheet Name: Development Distribution Project Name: Kiama Subdivision PP RFI	Sheet number: 1 of 6 Date: 09/12/2020



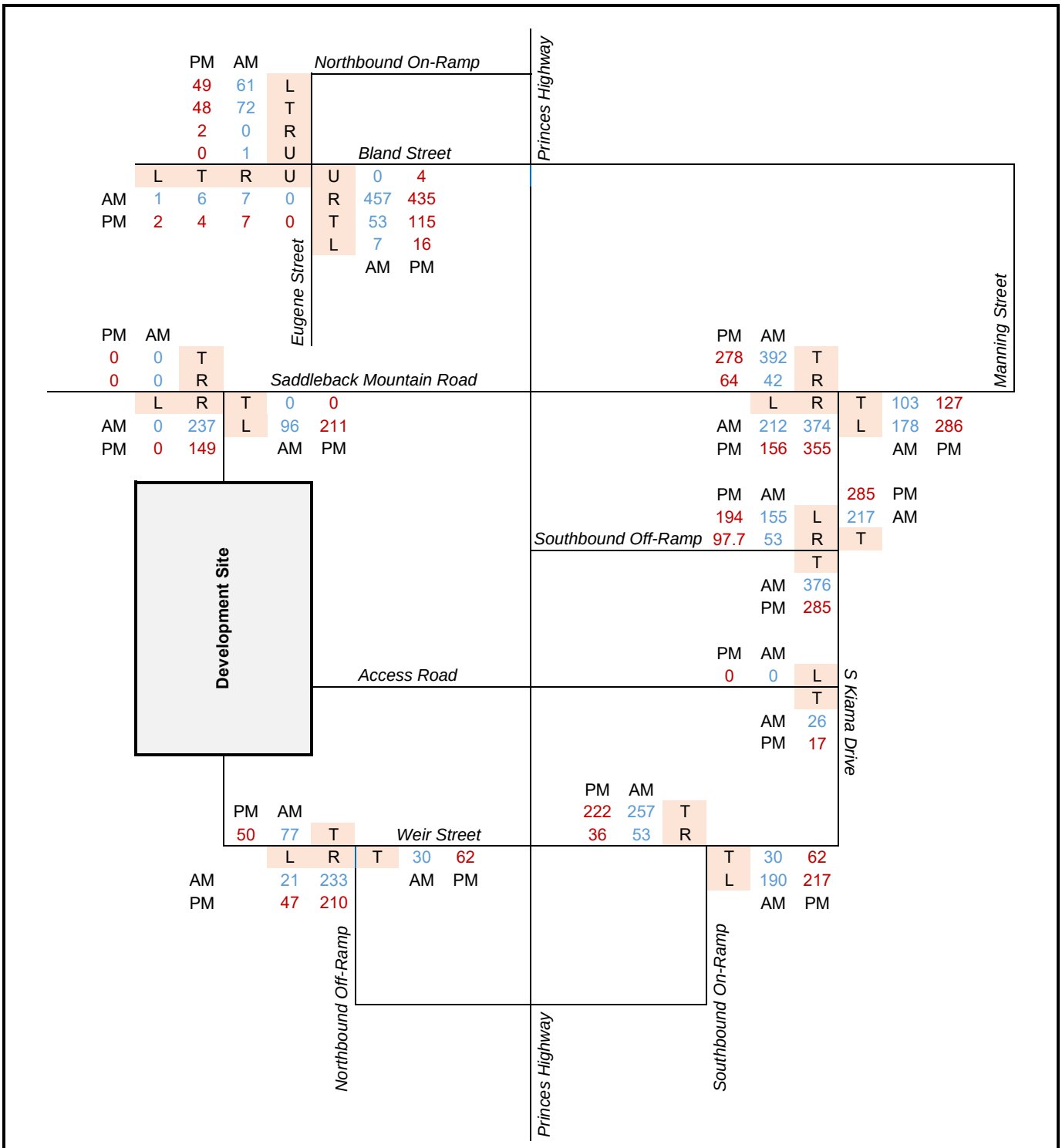
BITZIOS consulting	Sheet Name: Development Volumes Project Name: Kiama Subdivision PP RFI	Sheet number: 2 of 6 Date: 09/12/2020



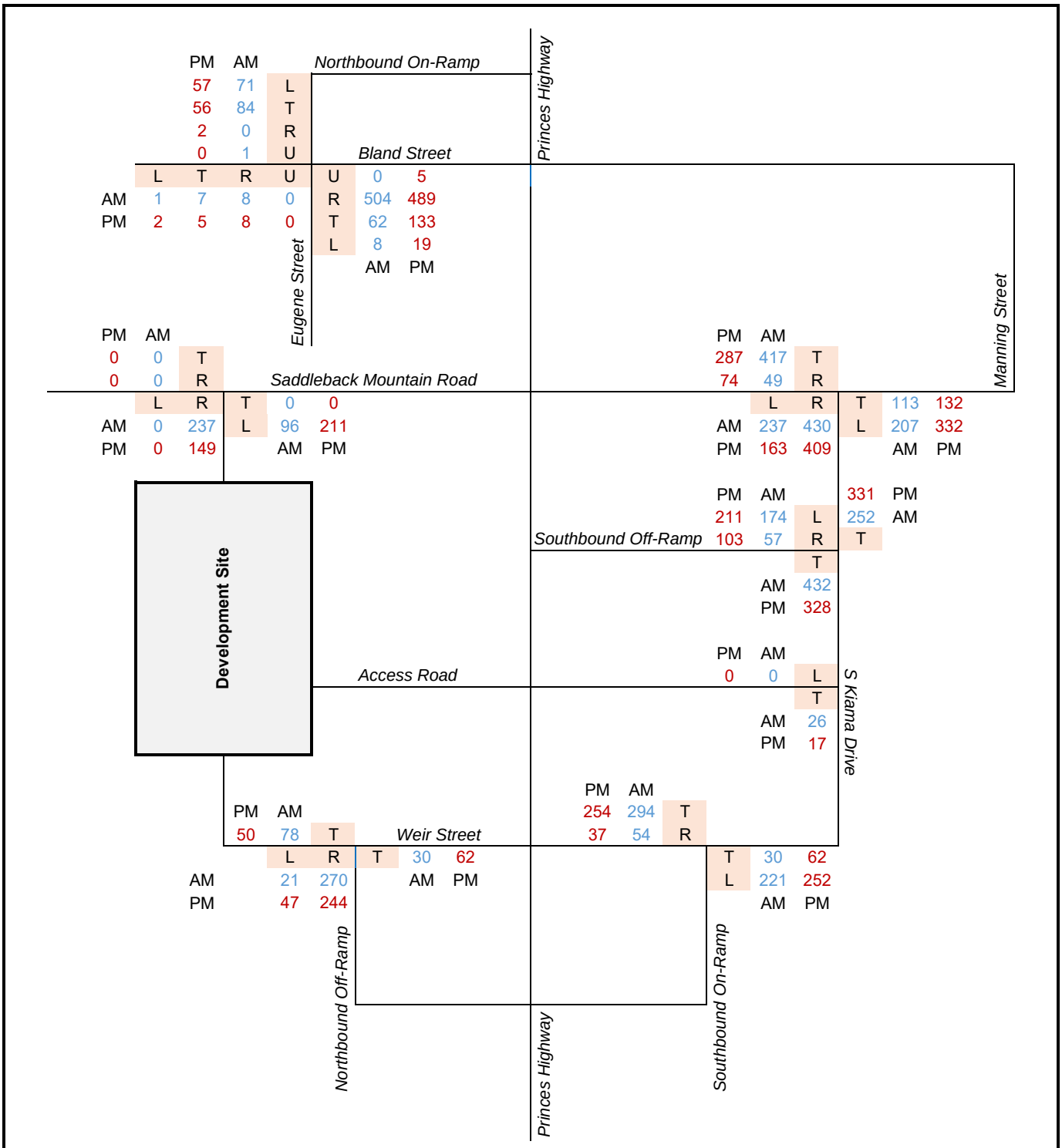
BITZIOS consulting	Sheet Name: 2020 Background Volumes Project Name: Kiama Subdivision PP RFI	Sheet number: 3 of 6 Date: 09/12/2020



BITZIOS consulting	Sheet Name: 2030 Background Volumes Project Name: Kiama Subdivision PP RFI	Sheet number: 4 of 6 Date: 09/12/2020



Sheet Name:	Sheet number:
2020 Design Volumes	5 of 6
Project Name:	Date:
Kiama Subdivision PP RFI	09/12/2020



BITZIOS consulting	Sheet Name: 2030 Design Volumes Project Name: Kiama Subdivision PP RFI	Sheet number: 6 of 6 Date: 09/12/2020

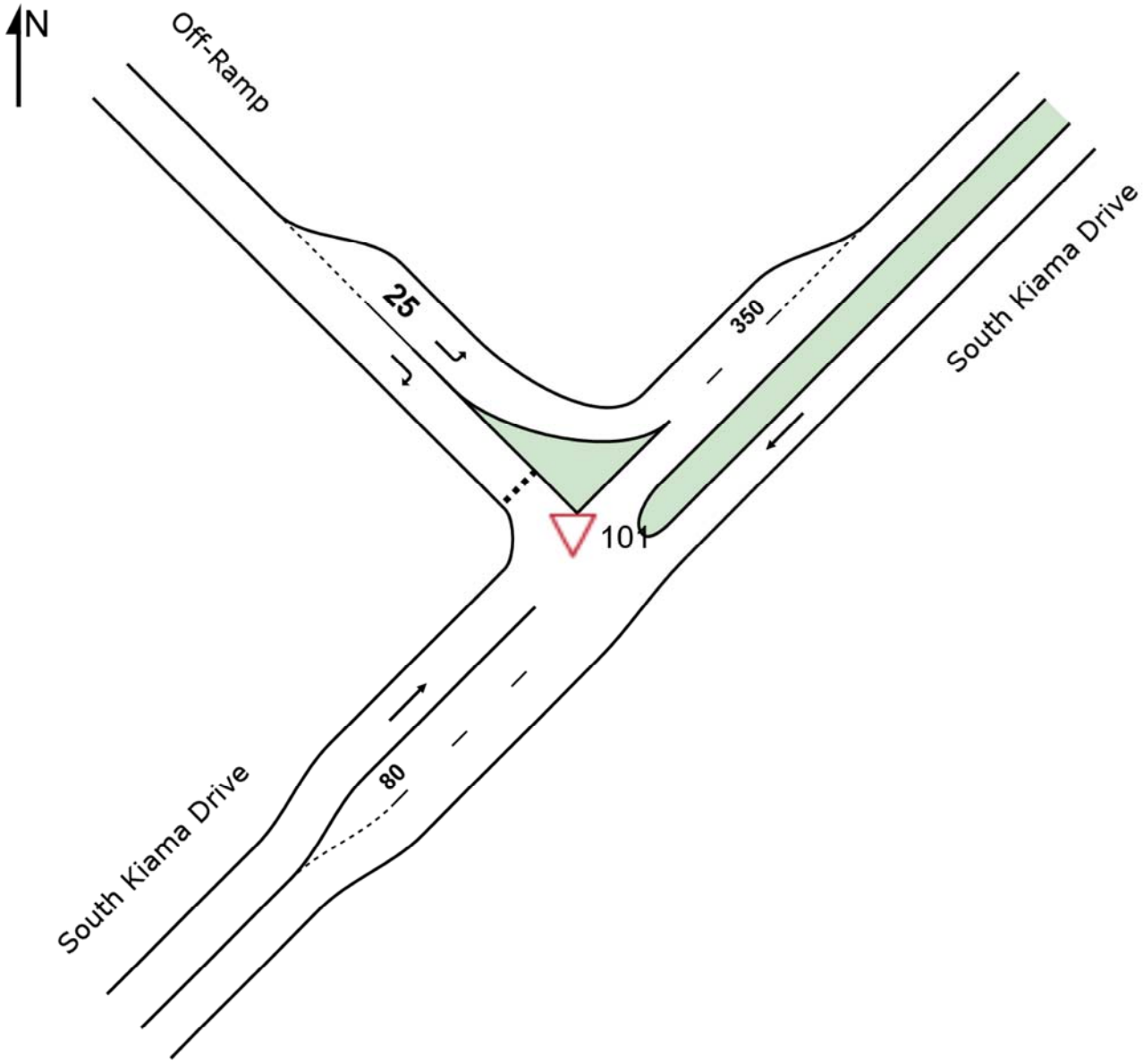
Attachment C

SIDRA Results

SITE LAYOUT

Site: 101 [2020 AM | BG]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)



Organisation: BITZIOS CONSULTING | Created: Wednesday, 9 December 2020 3:27:55 PM
Project: P:\P4688 Kiama Subdivision PP RFI\Technical Work\Models\P4688.002M Off Road_S Kiama Dr_Priority Controlled.sip8

MOVEMENT SUMMARY

Site: 101 [2020 AM | BG]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	228	7.4	0.127	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		228	7.4	0.127	0.0	NA	0.0	0.0	0.00	0.00	0.00	80.0
NorthWest: Off-Ramp												
7	L2	121	7.0	0.065	5.6	LOS A	0.0	0.0	0.00	0.52	0.00	54.6
9	R2	26	48.0	0.065	12.7	LOS B	0.2	2.4	0.63	0.83	0.63	43.1
Approach		147	14.3	0.065	6.9	LOS A	0.2	2.4	0.11	0.58	0.11	52.2
SouthWest: South Kiama Drive												
11	T1	368	3.7	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		368	3.7	0.181	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		744	6.9	0.181	1.4	NA	0.2	2.4	0.02	0.11	0.02	72.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2020 AM | DES]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	228	7.4	0.127	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		228	7.4	0.127	0.0	NA	0.0	0.0	0.00	0.00	0.00	80.0
NorthWest: Off-Ramp												
7	L2	163	5.2	0.087	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.7
9	R2	56	22.6	0.118	11.7	LOS B	0.4	3.7	0.62	0.85	0.62	48.2
Approach		219	9.6	0.118	7.2	LOS A	0.4	3.7	0.16	0.61	0.16	52.9
SouthWest: South Kiama Drive												
11	T1	396	3.5	0.194	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		396	3.5	0.194	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		843	6.1	0.194	1.9	NA	0.4	3.7	0.04	0.16	0.04	70.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2020 PM | BG]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	300	4.6	0.163	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		300	4.6	0.163	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	111	2.9	0.058	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.8
9	R2	38	2.8	0.062	9.6	LOS A	0.2	1.7	0.56	0.76	0.56	54.0
Approach		148	2.8	0.062	6.6	LOS A	0.2	1.7	0.14	0.59	0.14	54.6
SouthWest: South Kiama Drive												
11	T1	282	4.9	0.140	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		282	4.9	0.140	0.0	NA	0.0	0.0	0.00	0.00	0.00	80.0
All Vehicles		731	4.3	0.163	1.4	NA	0.2	1.7	0.03	0.12	0.03	73.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2020 PM | DES]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	300	4.6	0.163	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		300	4.6	0.163	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	204	1.5	0.106	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.9
9	R2	103	1.0	0.170	10.1	LOS B	0.7	4.7	0.59	0.83	0.59	54.1
Approach		307	1.4	0.170	7.1	LOS A	0.7	4.7	0.20	0.63	0.20	54.6
SouthWest: South Kiama Drive												
11	T1	300	4.6	0.148	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		300	4.6	0.148	0.0	NA	0.0	0.0	0.00	0.00	0.00	80.0
All Vehicles		907	3.5	0.170	2.4	NA	0.7	4.7	0.07	0.21	0.07	69.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2030 AM | BG]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	265	7.5	0.147	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		265	7.5	0.147	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	140	6.8	0.075	5.6	LOS A	0.0	0.0	0.00	0.52	0.00	54.6
9	R2	31	48.3	0.092	15.0	LOS C	0.3	3.3	0.70	0.88	0.70	41.9
Approach		171	14.2	0.092	7.3	LOS A	0.3	3.3	0.13	0.59	0.13	51.8
SouthWest: South Kiama Drive												
11	T1	427	3.7	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		427	3.7	0.210	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		863	7.0	0.210	1.5	NA	0.3	3.3	0.02	0.12	0.02	72.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2030 AM | DES]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	265	7.5	0.147	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		265	7.5	0.147	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	183	5.2	0.097	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.7
9	R2	60	24.6	0.154	13.7	LOS B	0.6	4.8	0.70	0.88	0.70	46.6
Approach		243	10.0	0.154	7.6	LOS A	0.6	4.8	0.17	0.61	0.17	52.5
SouthWest: South Kiama Drive												
11	T1	455	3.5	0.223	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		455	3.5	0.223	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		963	6.2	0.223	1.9	NA	0.6	4.8	0.04	0.15	0.04	70.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2030 PM | BG]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	348	4.5	0.190	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		348	4.5	0.190	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	128	2.5	0.067	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.8
9	R2	44	2.4	0.083	10.8	LOS B	0.3	2.2	0.60	0.82	0.60	53.2
Approach		173	2.4	0.083	6.9	LOS A	0.3	2.2	0.15	0.60	0.15	54.4
SouthWest: South Kiama Drive												
11	T1	327	4.8	0.162	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		327	4.8	0.162	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		848	4.2	0.190	1.4	NA	0.3	2.2	0.03	0.12	0.03	72.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2030 PM | DES]

Intersection of Off-Ramp / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

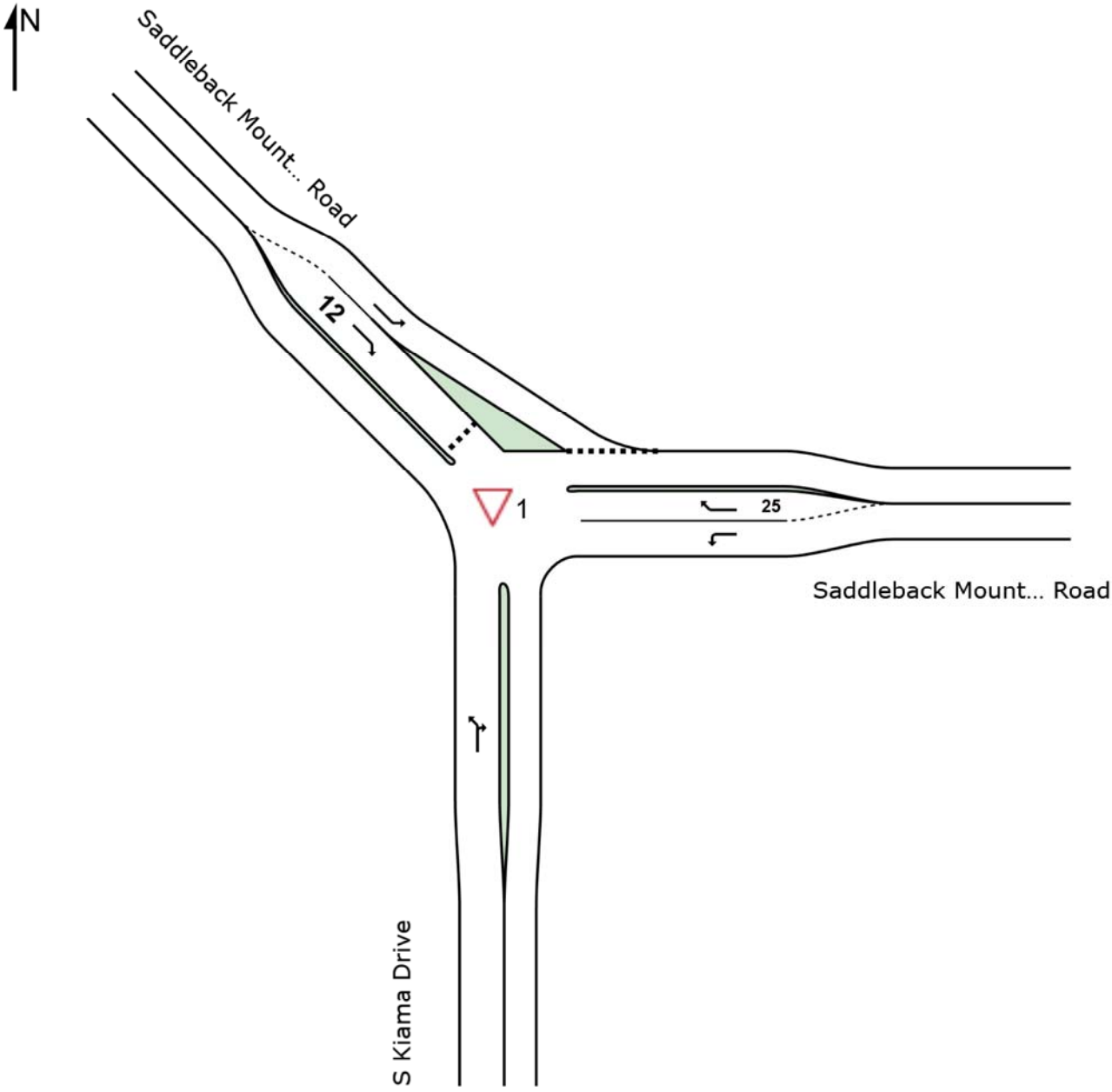
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
NorthEast: South Kiama Drive												
5	T1	348	4.5	0.190	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		348	4.5	0.190	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
NorthWest: Off-Ramp												
7	L2	222	1.4	0.115	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	54.9
9	R2	108	1.0	0.206	11.3	LOS B	0.8	5.6	0.64	0.86	0.64	53.1
Approach		331	1.3	0.206	7.5	LOS A	0.8	5.6	0.21	0.64	0.21	54.3
SouthWest: South Kiama Drive												
11	T1	345	4.6	0.171	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		345	4.6	0.171	0.0	NA	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		1024	3.5	0.206	2.4	NA	0.8	5.6	0.07	0.21	0.07	69.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 1 [2020 AM | BG]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 1 [2020 AM | BG]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	168	1.3	0.270	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	366	5.7	0.270	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		535	4.3	0.270	3.2	NA	0.0	0.0	0.00	0.45	0.00	38.2
East: Saddleback Mountain Road												
4	L2	187	10.1	0.105	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.8
6a	R1	62	3.4	0.063	4.9	LOS A	0.3	1.8	0.53	0.61	0.53	36.8
Approach		249	8.4	0.105	3.8	NA	0.3	1.8	0.13	0.49	0.13	37.6
NorthWest: Saddleback Mountain Road												
27a	L1	163	0.6	0.143	4.3	LOS A	0.6	4.1	0.43	0.58	0.43	36.9
29a	R1	44	0.0	0.093	8.9	LOS A	0.3	2.3	0.63	0.79	0.63	36.4
Approach		207	0.5	0.143	5.3	LOS A	0.6	4.1	0.47	0.62	0.47	36.8
All Vehicles		992	4.6	0.270	3.8	NA	0.6	4.1	0.13	0.50	0.13	37.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2020 AM | DES]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	223	0.9	0.310	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	394	5.3	0.310	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		617	3.8	0.310	3.2	NA	0.0	0.0	0.00	0.45	0.00	38.3
East: Saddleback Mountain Road												
4	L2	187	10.1	0.105	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.8
6a	R1	108	1.9	0.121	5.5	LOS A	0.5	3.5	0.58	0.70	0.58	36.4
Approach		296	7.1	0.121	4.2	NA	0.5	3.5	0.21	0.54	0.21	37.3
NorthWest: Saddleback Mountain Road												
27a	L1	413	0.3	0.371	5.1	LOS A	2.0	14.3	0.52	0.70	0.60	36.5
29a	R1	44	0.0	0.109	10.5	LOS A	0.4	2.7	0.69	0.82	0.69	35.8
Approach		457	0.2	0.371	5.6	LOS A	2.0	14.3	0.54	0.71	0.60	36.4
All Vehicles		1369	3.3	0.371	4.2	NA	2.0	14.3	0.23	0.56	0.25	37.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2020 PM | BG]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	45	0.0	0.203	2.7	LOS A	0.0	0.0	0.00	0.46	0.00	38.5
3	R2	356	3.8	0.203	3.5	LOS A	0.0	0.0	0.00	0.46	0.00	37.8
Approach		401	3.4	0.203	3.4	NA	0.0	0.0	0.00	0.46	0.00	38.0
East: Saddleback Mountain Road												
4	L2	301	3.8	0.162	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
6a	R1	32	0.0	0.026	3.9	LOS A	0.1	0.8	0.44	0.51	0.44	37.2
Approach		333	3.5	0.162	3.5	NA	0.1	0.8	0.04	0.46	0.04	37.8
NorthWest: Saddleback Mountain Road												
27a	L1	58	1.8	0.050	4.1	LOS A	0.2	1.4	0.40	0.53	0.40	37.0
29a	R1	67	0.0	0.141	9.0	LOS A	0.5	3.6	0.64	0.79	0.64	36.3
Approach		125	0.8	0.141	6.8	LOS A	0.5	3.6	0.53	0.67	0.53	36.6
All Vehicles		859	3.1	0.203	3.9	NA	0.5	3.6	0.09	0.49	0.09	37.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2020 PM | DES]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	164	0.0	0.269	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	374	3.7	0.269	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		538	2.5	0.269	3.2	NA	0.0	0.0	0.00	0.45	0.00	38.2
East: Saddleback Mountain Road												
4	L2	301	3.8	0.162	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
6a	R1	134	0.0	0.131	4.9	LOS A	0.6	3.9	0.54	0.65	0.54	36.8
Approach		435	2.7	0.162	3.9	NA	0.6	3.9	0.17	0.51	0.17	37.5
NorthWest: Saddleback Mountain Road												
27a	L1	293	0.4	0.256	4.5	LOS A	1.1	7.9	0.47	0.61	0.47	36.8
29a	R1	67	0.0	0.184	12.0	LOS A	0.7	4.6	0.74	0.85	0.74	35.3
Approach		360	0.3	0.256	5.9	LOS A	1.1	7.9	0.52	0.66	0.52	36.4
All Vehicles		1333	2.0	0.269	4.2	NA	1.1	7.9	0.19	0.53	0.19	37.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2030 AM | BG]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	196	1.1	0.314	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	425	5.7	0.314	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		621	4.2	0.314	3.3	NA	0.0	0.0	0.00	0.45	0.00	38.2
East: Saddleback Mountain Road												
4	L2	218	10.1	0.122	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.8
6a	R1	72	2.9	0.081	5.5	LOS A	0.3	2.3	0.57	0.67	0.57	36.4
Approach		289	8.4	0.122	4.0	NA	0.3	2.3	0.14	0.51	0.14	37.5
NorthWest: Saddleback Mountain Road												
27a	L1	189	0.6	0.177	4.7	LOS A	0.7	5.1	0.48	0.62	0.48	36.8
29a	R1	52	0.0	0.131	10.9	LOS A	0.5	3.2	0.70	0.83	0.70	35.7
Approach		241	0.4	0.177	6.0	LOS A	0.7	5.1	0.52	0.67	0.52	36.4
All Vehicles		1152	4.5	0.314	4.0	NA	0.7	5.1	0.15	0.51	0.15	37.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2030 AM | DES]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	249	0.8	0.353	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	453	5.3	0.353	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		702	3.7	0.353	3.2	NA	0.0	0.0	0.00	0.45	0.00	38.2
East: Saddleback Mountain Road												
4	L2	218	10.1	0.123	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.8
6a	R1	119	1.8	0.151	6.3	LOS A	0.6	4.3	0.62	0.76	0.62	35.9
Approach		337	7.2	0.151	4.5	NA	0.6	4.3	0.22	0.56	0.22	37.1
NorthWest: Saddleback Mountain Road												
27a	L1	439	0.2	0.423	5.9	LOS A	2.6	18.0	0.57	0.80	0.73	36.1
29a	R1	52	0.0	0.155	12.9	LOS A	0.5	3.8	0.75	0.86	0.75	35.0
Approach		491	0.2	0.423	6.6	LOS A	2.6	18.0	0.59	0.81	0.74	35.9
All Vehicles		1529	3.4	0.423	4.6	NA	2.6	18.0	0.24	0.59	0.28	37.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2030 PM | BG]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	53	0.0	0.235	2.7	LOS A	0.0	0.0	0.00	0.46	0.00	38.5
3	R2	413	3.8	0.235	3.5	LOS A	0.0	0.0	0.00	0.46	0.00	37.8
Approach		465	3.4	0.235	3.4	NA	0.0	0.0	0.00	0.46	0.00	38.0
East: Saddleback Mountain Road												
4	L2	349	3.9	0.188	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
6a	R1	37	0.0	0.033	4.3	LOS A	0.1	1.0	0.48	0.55	0.48	37.1
Approach		386	3.5	0.188	3.5	NA	0.1	1.0	0.05	0.46	0.05	37.8
NorthWest: Saddleback Mountain Road												
27a	L1	67	1.6	0.062	4.4	LOS A	0.2	1.7	0.44	0.57	0.44	36.9
29a	R1	78	0.0	0.195	11.1	LOS A	0.7	5.0	0.71	0.84	0.72	35.6
Approach		145	0.7	0.195	8.0	LOS A	0.7	5.0	0.58	0.71	0.59	36.0
All Vehicles		997	3.1	0.235	4.1	NA	0.7	5.0	0.10	0.50	0.10	37.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [2030 PM | DES]

Intersection of Saddleback Mountian Road / S Kiama Drive
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: S Kiama Drive												
1a	L1	172	0.0	0.301	2.7	LOS A	0.0	0.0	0.00	0.45	0.00	38.6
3	R2	431	3.7	0.301	3.5	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
Approach		602	2.6	0.301	3.3	NA	0.0	0.0	0.00	0.45	0.00	38.2
East: Saddleback Mountain Road												
4	L2	349	3.9	0.188	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	37.9
6a	R1	139	0.0	0.149	5.4	LOS A	0.6	4.4	0.57	0.70	0.57	36.5
Approach		488	2.8	0.188	4.0	NA	0.6	4.4	0.16	0.52	0.16	37.5
NorthWest: Saddleback Mountain Road												
27a	L1	302	0.3	0.282	4.8	LOS A	1.2	8.7	0.51	0.66	0.51	36.7
29a	R1	78	0.0	0.258	15.6	LOS B	1.0	6.8	0.80	0.92	0.90	34.1
Approach		380	0.3	0.282	7.0	LOS A	1.2	8.7	0.57	0.71	0.59	35.9
All Vehicles		1471	2.1	0.301	4.5	NA	1.2	8.7	0.20	0.54	0.21	37.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix E: Council correspondence regarding use of existing culvert underpass for vehicle access

TRevor Unicomb

From: Darren Brady <darrenb@kiama.nsw.gov.au> on behalf of Council <council@kiama.nsw.gov.au>
Sent: Wednesday, 3 February 2021 10:29 AM
To: TRevor Unicomb
Cc: Edward Paterson
Subject: South Kiama Planning Proposal - use of existing culvert underpass for vehicle access

Good morning Trevor,

Following our recent discussions regarding the use of the existing Highway underpass to provide access to South Kiama Drive, Council would like to advise as follows:

1. The existing arched underpass that was installed as part of the original Princes Highway construction provides vehicle and pedestrian access from South Kiama Drive to the properties to the west of the Princes Highway and the historic Kendalls Cemetery. The underpass is currently gated to prevent unauthorised vehicle access and is only of sufficient width for a single vehicle of limited height.
2. Due to its location being only ~100m from the Highway off-ramp, with an acceleration lane for right turning vehicles exiting the Highway onto South Kiama Drive extending past the underpass entrance, Council would not be supportive of right turns from or onto South Kiama Drive from the underpass, due potential traffic safety conflicts.
3. While relocation or duplication of the underpass would be subject to approval of Transport for NSW, Council foresee a number of geotechnical constraints on maintaining the structural integrity of the Highway. In additional the underpass cannot be moved south as it would conflict with the three x 3000mm diameter culverts that drain Munna Munnora Creek under the Highway.

Based on the above, if the underpass is to be utilised for vehicle access, Council's preference would be to limit it to left turn egress only.

I trust the above provides clarification on this matter.

Regards

Darren Brady
Manager Design and Development
Kiama Municipal Council
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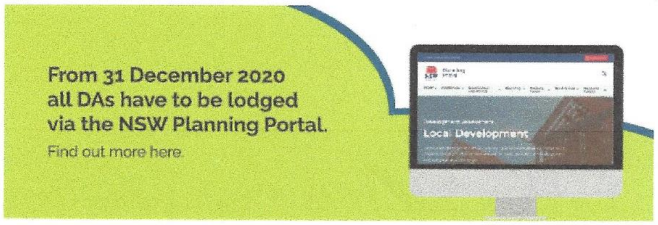
PO Box 75, Kiama NSW 2533
www.kiama.nsw.gov.au



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