Tallawarra Lands Traffic Impact Assessment

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1. INTRODUCTION

1.1 Background

The Tallawarra Lands development has been accepted by the Director General of Planning as a Major Project under Part 3A of the Environmental Planning and Assessment Act 1979. The Director General's Requirements (DGRs) for environmental assessment were issued on 28th September 2009.

Gabites Porter have been commissioned by TRUenergy to prepare the transportation and traffic components of the Environmental Assessment to meet the DGRs.

Part of those requirements involved the investigation of the effects of the development on the wider road network, with a second part investigating internal road and transport systems within Tallawarra.

The traffic and parking requirements of the DGRs (items 10 and 11) in summary are as follows

- Traffic Generation in accordance with the RTA's Guide to Traffic Generating Developments
- Road/intersection upgrades
- Access
- Loading dock(s)
- Car parking arrangements
- Impacts upon public transport (including school bus routes)
- Measures to promote public transport usage
- Measures to promote pedestrian and cycle linkages
- Staging and funding of road/intersection upgrades
- Adequacy of parking.

At this Concept Plan Stage, these all needed to be addressed at a reasonably high level. It is not appropriate, for example, to identify where loading docks are to be located, or the layout of a particular car park. However, it is appropriate to give general guidelines as to the number of loading docks required per 100m^2 of Gross Floor Area (GFA) for any particular land use, or the rate of car parks per 100m^2 of GFA for a particular land use activity or per dwelling.

1.2 Report Content

The report begins by looking at each of these requirements in turn with a brief initial comment. It then goes on to describe the technical analysis that has been carried out, and concludes by applying the results of that analysis to each of the 10 headings specified by the Director General.

2. THE DIRECTOR GENERAL'S REQUIREMENTS

2.1 Traffic Generation

The RTA's *Guide to Traffic Generating Developments* is a good starting point in that it provides a means of assessing the amount of traffic likely to be generated by each of a variety of different land uses, for example households, retail uses, offices etc. It is useful for Traffic Impact Assessments of individual site developments, but is applicable only as a rough guide for a major multi use development such as Tallawarra Lands.

The transportation model which has been developed for Wollongong City and Shellharbour City is a much more useful tool for this analysis. It has recently been updated using the latest (2006) census data, and currently future landuse patterns for 2011, 2021, and 2036 have been developed[1]. Permission to use the model for this project was obtained from Wollongong City Council and the RTA. Its use for this project is described in more detail below.

2.2 Required Road and Intersection Upgrades

The demands that the development will place on the road system was investigated at two levels. The first of these is the impact that the development will have on the wider Wollongong network, and in particular the Freeway, the Princes Highway, the roads through Koonawarra, and the nature of the principal access points servicing the development.

The second level deals with the roads within Tallawarra lands, and the need to develop an appropriate hierarchy of roads and intersections that will cater for the demands that will be placed on them. This second level requires a model with considerably more detail in it than in the full model. Accordingly, a 'window' was cut from the full model in order to develop a 'sub-area' model for the site. The full model has six traffic zones for the Tallawarra while the sub-area model allowed for 80 zones – a level of detail not appropriate in the full model.

The full model enabled analysis of the wider area effects, and provided the traffic flows at the five access points to the development and origins and destinations at a broad level within the development.

The sub-area model then enabled a more detailed analysis of the internal roading and transport system to a level that will satisfy the Director General's requirements. It is also a tool which will readily transition between the Concept Plan and the later detailed design stages.

2.3 Access

In this context, access has been assumed to mean access to the whole site at the four points identified in the Master Plan. The requirements of each of these points in terms of the number of lanes required, and the intersection treatments where the internal road system meets the wider network were identified and analysed using the full model.

[1] The recently approved Calderwood development has not been assumed in any of the land use forecasts, and the effects have therefore not been included in this analysis. That development will emphasis the need for improvements to the base network.

2.4 Loading Docks

This topic is more aligned to the development of each particular building within the site, rather than for the development as a whole. A later section of this report touches on criteria as to where and how many loading docks should be provided for each site, conforming to Wollongong City Council requirements.

2.5 Car parking Arrangements

Again this topic is more aligned to individual building development, but parking standards (minimum and maximum) have been included later. These also conform to Wollongong City Council standards. This will also address adequacy of parking as Item 11 in the DGRs.

2.6 Public Transport, Walk and Cycle.

Public transport is an important part of the design of any green fields development, but at concept design stage only general principles can be included. These are discussed later.

2.7 Staging and Funding of Road and Intersection Upgrades

The staging of road and intersection upgrades will, to a large extent, depend on the rate of development of West Dapto, and the infrastructure requirements of that development in relation to the rate of development of Tallawarra.

3. WIDER AREA ANALYSIS

3.1 Landuse Activity Development Assumptions

The start point for the analysis was the Masterplan developed by Cox Richardson *et al* in June 2009, and from which the Council LEP was based. This plan, shown in **Figure 1**, comprises 13 separate areas, including residential, office, retail, enterprise zone, and industrial land uses. In addition, there are areas separated out for environmental, or drainage reasons that will have little or no land use activity on them.

The available land in each of these areas was converted into gross floor areas of development, or the number of residential lots. The number of employees likely to be working in the retail, commercial and industrial areas were estimated using a combination of the data in the RTA publication 'Guide to Traffic Generating Developments' and our own data in a form ready for use by the transportation model developed for Wollongong City Council, the RTA, and Shellharbour City Council. This model covers the whole of the urban area from Waterfall to south of Dunmore, and is colloquially known as the Wolsh model.

The second group of assumptions was that the development in Wollongong and Shellharbour defined by Wollongong and the RTA by 2021 was the base landuse against which Tallawarra would be tested. The base network was the 'do-minimum', that is those works which are committed for construction. These works are listed in Appendix One.

From this run of the model, the works required to provide the network with 'just enough' capacity were identified – again without any development in Tallawarra. This network provides the base, and enables the effects of the Tallawarra development to be isolated.

The model was then run with Tallawarra Lands included on the assumption that it is fully developed by 2021. While this project delivery timeframe may be a little optimistic, it does permit the impacts of Tallawarra Lands to be assessed by comparison of this run against the base.

As part of the work being done to address the DGRs, the Cox Richardson Master Plan has been reviewed and updated by Warren Lee Urban Design and supported by the project design team. The main change is reduced development land – to reflect modifications to Wollongong City Council LEP, site constraints, and commercial realities. Potentially, additional development could occur at a later date if and when demand warrants it, and if technical and planning constraints can be overcome. It would be the subject of a separate development application, and the effects of this will be determined at that time.

The Warren Lee Master Plan is shown as **Figure 2**.

3.2 Data Inputs – Cox Richardson

Cox Richardson supplied the number of residential lots which would be able to be developed using their master plan and the net land areas for each of the other blocks.

From the detail of the internal structure plan, floor areas by activity type were calculated, and the expected morning and evening peak trip generation calculated using the RTA guide. The generation was checked against the generation which was calculated from the Wolsh model to ensure consistency between the models.

These were converted to Gross floor area (GFA) and likely employment using the following assumptions.

Residential	One household per lot
Retail	40% site coverage, and 150m^2 per employee
Office	30% site coverage, 2 floors and 21 m^2 per employee
Enterprise	30% site coverage, 2 floors and 50 m^2 per employee
Industrial	40% site coverage, 28 employees per ha (or 360 m^2 per employee)
Power Station	20% site coverage, 30 employees on any shift.

In total, these assumptions produced 1290 households, 14,720 m^2 of retail with 98 employees, 33,360 m^2 of office with 1589 employees, 62,820 m^2 of enterprise zone with 1256 employees, 149,240 m^2 of industrial with 415 employees, and 6,000 m^2 in the power station with 30 employees. These are the inputs to the Wolsh model, but a reconciliation of the model trip generation with the RTA guide is appropriate, given that the DGRs asks for it to be used.

The evening peak trip generation rates abstracted from the RTA guide were

Households	0.6 trips per hour
Retail	4.6 trips per 100m^2
Offices	2.0 trips per 100m^2
Enterprise	1.5 trips per 100m^2
Industry	1.0 trips per 100m^2
Power station	1.0 trips per 100m^2

The RTA guide tends to give a range of values for each landuse type, and needs careful interpretation.

The peak hour trip rate for households varies from 0.85 trips per hour for a dwelling house through 0.4- 0.65 trips per hour for medium density units and town houses to 0.24 for high density flats. Given that there will be a encouragement to move away from dependence on the private car, a mid range value of 0.60 was adopted.

The retail rate is also highly variable. The model is an average week day, and the Friday rates in the guide equate to the average day, and are 6.2 trips per hour per 100m^2 GFLA, or 4.6 trips per 100m^2 GFA.

Trip rates for offices are normally accepted as 2.0 car driver trips per 100m^2 GFA in the peak hour, for a 52% mode split as car driver. In Tallawarra a lesser mode split will be encouraged and accordingly a trip rate of 1.5 trips per 100m^2 is considered to be more reasonable.

The so-called Enterprise zone is likely to be similar to bulk retail and the RTA guide has rates that range from 0.1 trips per100 m^2 GLFA to 6.4 trips per 100m^2. A rate of 1.0 trip per 100m^2 has been adopted.

Rates for industrial uses vary greatly, and a different approach has been adopted. The RTA guide says that 68% of the employees are car drivers and that 55% of the commuter travel occurs in the peak hour. This formula has been used.

Finally, the retail, commercial and enterprise zones are within easy walking distances and the RTA guide suggests that the rates for these can be reduced by 15-20% to allow for multi use trips.

Applying these assumptions produces 2,530 trips in the evening peak period – a figure that can be compared against 2,570 generated by the model. The two independent sources produce a very consistent result.

3.3 Data Inputs – Warren Lee

The Lee plan reduced the number of lots slightly in the north east sector of the site, and allowed for part of the B7 employment zone to be developed as retirement living, with 1210 households resulting.

However, the non residential assumptions included in the Lee plan that were carried through into the model testing were that the retail would be developed along with the residential lots, and that about half of the office, enterprise and industrial uses assumed in the Cox Richardson Plan would be developed.

In total, these assumptions produced 1210 households, 5,000 m^2 of retail with 33 employees, 15,000 m^2 of office with 714 employees, 30,000 m^2 of enterprise zone with 600 employees, 50,000 m^2 of industrial with 139 employees, and 6,000 m^2 in the power station with 30 employees.

Applying the same assumptions as above, the expected trip generation would be 1796 trips compared with 1820 trips generated by the model. Again here is a high degree of consistency.

3.4 Wider Network Testing

The effects of the Tallawarra lands development was initially tested through the Wolsh model with the following assumptions.

The model was run using the 2021 landuse as agreed by Wollongong City Council, and the RTA. This included some growth in West Dapto, but not the complete potential development. The base network included only those changes that have already been committed – commonly termed the 'do-minimum' network.

Four separate runs were undertaken for each of the morning and evening peak periods. The tests were:-

Test One. The 2021 base networks and landuse with no development in Tallawarra. This run determines the performance of the network and identifies deficiencies that will occur as a result of other developments.

Test Two. Network capacity necessary to address the deficiencies in the Tallawarra area is added, and the model run with no development in Tallawarra lands. This forms the base for comparison

Test Three. Test Two but using the landuse activity and pattern under the Cox Richardson Master Plan. The comparison of this run against Test Two shows the largest effects of the development.

Test Four. Test Two but using the landuse activity and pattern under the Warren Lee master Plan and with the road link to Hayward's Bay removed.

Within the full model, a skeleton road network has been assumed for Tallawarra Lands. It includes the main spine road from the Princes Highway past the Power Station and up to Koonawarra, Single circulating lane roundabouts were initially assumed where the internal roads connect to the existing network in the west, but the testing showed that dual circulating roundabouts were required to connect with the Princes Highway.

The internal roads have been assumed as two lane pending investigation of the detailed internal traffic flow.

4. THE CONCEPT OF LEVEL OF SERVICE

Level of Service is a subjective measure of the way in which a network is operating, given the traffic demands that are placed on it. It is a concept developed by American engineers, and has been generally internationally adopted. It is being used in this study to measure the performance of both roads and intersections.

In this work, the Level of Service boundaries have been derived from the United States Transportation Research Board Highway Capacity Manual.

The results presented here focus on LoS F, E, D and C with particular attention paid to LoS F and E. The LoS boundaries are described in Table 1, which provides a description of:

- LoS definitions describing the type of conditions a driver faces under each level
- Link LoS boundaries that describe the performance of traffic moving along a section of road and a function of traffic volume and link free flow speed.
- Intersection LoS boundaries, which are based on two different criteria: Worst approach delay for priority controlled intersections; and weighted average delay across all approaches for signalised intersections and roundabouts.

This present day Level of Service provides a measure by which future network performance (and any resultant deficiencies) can be assessed, given knowledge and experience of current conditions.

As a rule of thumb, at the time that a link or intersection reaches a LoS of 'D' to 'E', design solutions should be investigated with a view to being implemented before LoS 'F' is reached.

Definitions of LOS				Table 1
LOS	AustRoads Description	Wolllongong/Shellharbour Transport Model LOS criteria		
		Link (vehicles per lane per hour)	Intersection delay (seconds/veh)	
			Priority*	Signal/Rotary**
LOS F	Forced flow. The amount of traffic approaching a point exceeds that which can pass it. Flow breakdowns occur, and queuing and delays occur.	In excess of **900-1700** depending on link type	In excess of 50 sec	In excess of 80 sec
LOS E	Traffic volumes are at or cLoSe to *capacity and there is virtually no freedom* to select desired speed and to manoeuvre within the traffic stream. Flow is unstable and *minor disturbances within the traffic stream will cause breakdowns in operation*.	Between **720-900** and **1360-1700** depending on link type	35 - 50 sec	55 - 80 sec
LOS D	Approaching unstable flow where *all drivers are severely restricted* in their freedom to select desired speed and to manoeuvre within the traffic stream. The general level of *comfort and convenience is poor* and small increases in traffic flow will cause operational problems.	Between **585-720** and **1105-1360** depending on link type	25 - 35 sec	35 - 55 sec
LOS C	Stable flow but most drivers *are restricted to some extent* in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of *comfort and convenience has declined noticeably*.	Between **450-585** and **850-1105** depending on link type	15 - 25 sec	20 - 35 sec
LOS B	Stable flow where drivers still *have reasonable freedom* to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is less than LOS A.	Between **0** and **450-850** depending on link type	0 - 15 sec	0 - 20 sec
LOS A	Free flow in which drivers are *virtually unaffected* by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high and the general level of *comfort and convenience is excellent*.			

* Relates to delay at worst approach

** Relates to average intersection delay

5. MODEL RESULTS

5.1 The Do Minimum 2021 Position – Test One

Figures[2] **3** and **4** show the levels of service which will exist in the morning and evening peak periods by 2021. Mid block LoS is represented by lines on the links, while the circles show LoS at intersections. The larger the circle, the higher the delay within a particular LoS band.

As expected, the F6, north of Fowlers Road is overloaded in both the morning and evening peaks, and an additional lane in each direction will be required. The intersections of Fowlers Road and the Princes Highway, and Cleveland Road with Marshall Street will also need additional capacity.

Closer to the Tallawarra Lands site the Princes Highway northbound in the morning peak and southbound in the evening peak are significantly overloaded north of the intersection with the Illawarra Highway, and further south in the evening peak, although this is still only at LoS 'D'. There are a couple of minor intersections with high side road delays, but the major intersection of the Princes Highway with Lake Entrance Road is showing signs of stress.

5.2 The Base Case – Test Two

Figure 5 shows the parts of the network where an additional lane has been assumed for the purposes of forming a base network. In general, the links with LoS 'E' or 'F' are on those parts of the F6 which are currently two lanes in each direction, and on the Princes Highway south of the intersection with Huntley Road.

Figures 6 and **7** show the morning and evening peak network Level of Service for 2021 without Tallawarra on the base network. There are still parts of the F6 that are at LoS 'E', but it is difficult to see how they would be taken out to 4 lanes in each direction. In the morning peak, the intersection of the Princes and Illawarra highways is also at LoS 'E', but the signalized roundabout operation is not well replicated by the model.

5.3 The Cox Richardson Master Plan – Test 3

This test is designed to show the impact of the full Tallawarra development by 2021.

The Wider Network

When Tallawarra Lands is included, the morning peak changes in traffic flow are shown on **Figure 8.** The highest concentration of traffic is from the south accessing the commercial areas of the development, with the next most important movements from the west and north. There is a small decrease in northbound traffic on the F6 as it finds destinations in Tallawarra rather than further north.

For reasons discussed below, no further analysis has been reported for this test.

[2] Note that all figures showing the wider network are taken from the model and do not reflect the local change in the spine road alignment north of the power station to avoid an archeological site. It does not affect the modeled results.

Detailed Internal Traffic

A much more detailed model of Tallawarra lands has also been developed as a 'window' from the Wolsh model. For the Masterplan design, each nominal street block has been identified as a separate traffic zone supported by the surrounding street network. The morning peak flows are shown on **Figure 9**.

Perhaps the most important point to note is the amount of traffic passing through Haywards Bay to access Tallawarra. While the network has the capacity to absorb this volume of traffic, it is not reasonable to place that amount of traffic on the Haywards residential area. Accordingly, a decision was taken not to provide the south access point connecting Haywards. This will protect the Haywards community from unwanted through traffic, but has the disadvantage that there will not be a direct connection from Haywards to the Tallawarra commercial centre.

5.4 The Warren Lee Master Plan – Test 4

As noted above, the original master plan has been modified by Warren Lee to better reflect the LEP. However, the landuse activity has been reduced from that assumed for the Cox Richardson layout.

The wider network – Morning Peak

Figure 10 shows the change in traffic flow that occurs with the landuse activity and layout assumed for the Lee master plan, and without any connection to Haywards Bay. The majority of the morning peak inbound traffic enters the site form the north from the Princes Highway. About half of this comes from the north and about half from the south via the northbound off ramp. In total, the inbound flow at the primary access is 540vph – about one third of the southbound flow on the Princes Highway north of the access.

A further 240 vph enters the site from the southern prices road access, with about *300vph entering from Cormack Avenue, and 180 vph from Gilba Road.*

There are four changes to the base network that are required with this landuse activity, and the removal of an access through to Haywards Bay. These include

- A two lane circulating roundabout at the intersection of the northbound off-ramp and the Princes Highway. Note that the base network has the Princes Highway as two lane southbound and one lane northbound.
- A two lane circulating roundabout at the intersection of Cormack Ave and the Princes Highway – in part for reasons of consistency.
- Two lane circulating roundabouts at each of the other two access points to the site off the Princes Highway
- A new roundabout at the northern access off Cormack Ave

It should be noted that all of these changes will need to be agreed by the RTA or Wollongong City Council as the Road Controlling Authorities.

Figure 11 shows the Morning Peak levels of Service with these improvements included. The LOS is very similar to the LoS on the Base network (Figure 6). The northbound off ramp on the F6 moves to LoS 'D', as does the northbound lanes on the F6 between Fowlers Road and Kanahooka Road. The intersection of the Princes and Illawarra Highways moves to 'F' but the need for improvements there has been discussed earlier.

Detailed Internal Traffic

Figure 12 shows the internal traffic flows within the site. Single lane roundabouts have been assumed at the main intersections. There are no capacity issues with the largest flow being almost 600 vph near the main commercial centre, and 800 vph southbound on the bridge over Duck Creek.

The Wider Network – Evening Peak

Figure 13 shows the change in traffic flow in the evening peak hour. In general the flows are less than the morning peak, but the conflicting demands to the west against those to the south has required the two lane circulating roundabouts.

Figure 14 shows the evening Peak Level of Service. As with the morning peak, it is similar to the position without the development, except that the southbound direction on the F6 moves to LoS 'D' for most of its length.

Finally, **Figure 15** shows the internal flows, all generally less than the morning peak, and there are no capacity issues. The largest flow is the 420 vph outbound to the Princes Highway on the Southern link.

6. FURTHER ANALYSIS

6.1 RTA Concerns

Following preparation of the first draft of this report, discussions were held with the Southern Region office of the RTA on 27th September 2010[3], where the following concerns were raised. These included;

- Earlier analysis undertaken by Jamieson Foley in conjunction with Paul van den Bos in October 2007 reported a number of findings that have not emerged from the analysis reported here. The RTA asked for the differences to be reconciled, if possible, and in particular for the need of north facing ramps between the Freeway and the Princes Highway to be addressed.

- The pattern of trip making in the morning and evening peak needed to be explained, in particular the proportion of traffic that had origins and destinations north and south of the site.

- The issue of the number of intersections on the Princes Highway was raised, with the suggestion that the southern access was not needed and that it is too close to the southbound merge of the Princes Highway with the expressway.

- The model is showing additional traffic on Cormack Avenue. If this is through traffic, then it would not be appropriate on the local road, and investigation to check this is required. Coupled with this is the effect of additional traffic on local area traffic sensitive land uses such as schools etc.

- The Freeway separates the communities of East Dapto and Kanahooka, and potentially East Dapto and Tallawarra. Pedestrian and Cycle links need to be investigated.

6.2 Additional tests

A further set of tests were set up to address these issues. They included:

Test Five. Addition of the north facing ramps at 2021 and 2036 both with and without any development at Tallawarra. It assumed that the minimum works shown on Figure 5 were included.

Test Six. Identification of origins and destinations for Tallawarra traffic with and without the north facing ramps

Test Seven. Removal of the southern access point

Test Eight. Removal of the access onto Cormack Avenue

These tests are described below.

[3] The meeting participants were Chris Millet and Trish McClure of the RTA, Grant Smith from Gabites Porter, and Mat Richards of Northrop

6.3 Reconciliation with the 2007 Report

The first point of difference is that the earlier work used a forecast year of 2026, as opposed to 2021 and 2036 used in this current work.

Secondly, the land use activity within Tallawarra has been scaled back from 1,630 houses and 6,595 jobs to 1,290 households and 1,790 jobs. Nevertheless, this still represents a significant, and atypical, intensity of employment within the development concept.

Thirdly, the north facing ramps were seen as '*…an integral part of the proposal for the Tallawarra Lands development'* but there does not appear to have been an analysis without the ramps to confirm that view.

As noted above, ***Test Five*** was designed to look at this issue. At 2021, in the morning peak the northbound ramp will carry some 40 vph, and the southbound nothing without Tallawarra. In the evening peak, the northbound ramp will carry about 30vph, and again nothing southbound. By 2036, the flows are 130vph northbound and 30vph southbound in the morning peak, and 64 vph northbound and 51vph southbound in the evening peak.

The lack of southbound traffic is not surprising as there is no demand in that area without the Tallawarra Lands development.

These volumes are considerably different from those reported in Table 4.3 of the Jamieson Foley report which showed 934 vph in the Peak hour (unspecified) in 2026.

With Tallawarra, the ramp flows at 2021 are 161 vph northbound and 157vph southbound. The evening peak equivalents are 137vp and 169 vph. This represents an increase caused by Tallawarra of 276 in each of the periods – about half that in the earlier report.

For the record, the 2036 flows with Tallawarra are 245vph northbound and 131 vph southbound in the morning peak, and 175 vph northbound and 180 vph southbound in the evening peak.

These flows are not of a scale to ever justify the expenditure required for the ramps, either with or without Tallawarra, given the landuse assumed for 2021 and 2026. While the landuse does not include Calderwood, and West Dapto is not fully developed by 2036, neither of these major developments would generate a demand for travel south on the Princes Highway to go north on the F6 or vice versa.

The Jamieson Foley report contained three other locations for modelled traffic flows. These were at Huntley Avenue where their model showed 4532 vph at 2026 compared with 2200 vph at 2036 in the current model. The next location was on Cormack Ave, north of the Princes Highway whey they forecast 990 vph and 1890 vph without and with Tallawarra at 2026 compared with 630 vph and 910 vph in the current model. In other words the earlier work attributed 900vph of Tallawarra generated traffic to Cormack Ave – three times more than is currently being modelled.

The fourth location reported was at Gilba Road at the site boundary where the traffic without Tallawarra is, of course, zero, and with Tallawarra is 1200 vph at 2026. The current model is showing 360 vph in the evening peak at 2036.

The differences are only partially explained by the lesser development in Tallawarra lands included in the current proposal. It is more likely that there is something amiss with the conversion from the Wollongong/Shellharbour model validated in Tracks in 2004 to the Emme/2 platform used by the earlier study. It is not possible to go further than that given existing available documentation.

6.4 The Pattern of Tallawarra Traffic

Traffic entering and leaving Tallawarra has been isolated by means of a 'select link' analysis – a technique that isolates the traffic entering and leaving at each of the four access points and identifies the routes used by that traffic throughout the network. It has been used in this case to show the routes and volumes separately for inbound and out bound traffic.

Figures 16 and **17** show morning peak inbound traffic patterns with and without the freeway ramps, and **Figures 18** and **19** the same for outbound traffic.

The major part of the traffic to the site (some 1,260vph) comes from the south and southwest, joining together north of the Illawarra Highway/Princes Highway intersection. It then passes through the northbound off ramp to then travel south along the Princes Highway – with the highest flow being 900 vph just south of the off ramp intersection. About 100 vph turn left into Cormack Ave to enter through the northern access. Some 800 vph travel further south with 570 vph entering through the main access and 230 vph through the southern access.

From the north, there are 300 vph travelling south on the Princes Highway, with 190vph on the freeway exiting at Fowlers Road. About 140vph travel through the residential area of Kanahooka to access the northern outlet. This is joined by almost 90 vph of locally generated traffic. A further 180 vph enter the site through Gibbs Road, and with 50vph from the freeway at Fowlers Road, and the rest generated locally in Koonawarra.

The pattern is the same with and without the ramps. The only difference is that the freeway traffic that has a destination in the west of the site stays on the Freeway and exits at the new ramps to enter the site at Cormack Road or the main access.

Figures 20 and **21** show evening peak inbound traffic patterns with and without the freeway ramps, and **Figures 22** and **23** the same for outbound traffic.

The evening peak exhibits a similar pattern to the morning peak. In both cases, the only cause for a little concern is the use of Cormack Avenue through Kanahooka to access the site by traffic exiting the Freeway at Fowlers Road if the ramps are not provided. The volume is small – about 100vph in both periods – and certainly not enough to justify ramps, but it may raise issues for residents along that route.

Having said that, there is considerable benefit to the residential areas north of the site in terms of increased amenity in having a readily accessibly retail and commercial centre located nearby.

In East Dapto, and Koonawarra, there are a number of schools, as shown on **Figure 24**. The additional morning peak traffic flow that will pass these are also shown on that figure. The largest increase in flow near a school is that on the Princes Highway near to

the Mt Bowen School – an additional 260 vph on top of the 2021 flows of 1,430 vph. This will produce a small increase in traffic noise at the school boundary, but as the entrance to the school is off Mt Bowen Road, there will be few other effects.

Koonawarra Primary school will experience an increase of around 110 vph (about 2 cars per minute) in addition to the 320 vph that will pass the school in 2021.

The increase in traffic alongside the other school, (Lakelands Primary, Kanahooka High and Dapto High) will be negligible.

6.5 Reduction of Access points

The Cormack Avenue issue prompted investigation as to whether that access was required, and **Figures 25** and **26** show the morning and evening flows if that access is not provided. These are flows in both directions for trips generated by and attracted to Tallawarra.

Even with the access cut, there is still traffic on Cormack Avenue from the Fowlers Road off ramp, and only slightly reduced for the flows with the access provided. However the traffic that wishes to use the access is diverted to the Cormack Ave/Princes Highway intersection, with the consequence that the Cormack Ave approach deteriorates to Level of Service 'D'.

As a result of these two effects, the Cormack Avenue access should not be deleted.

Figures 27 and **28** show the flows that will occur if the southern access is not provided, again for trips generated by and attracted to Tallawarra. The access was designed to provide a direct rote to the commercial parts of the site, as opposed to the residential and retail parts served by the main access. It is anticipated that this will be the access for heavy vehicles servicing the employment area rather than them having to access through the main entrance. To some extent it is analogous to the service entrance to a building, as opposed to the front door.

Although the southern access is desirable for design reasons and has sufficient separation from the Freeway merge as shown on **Figure 29**, the main access would accommodate the flows if the southern access is not included.

However, reliance on one access point from the Princes Highway would not be prudent, and unless there are very good reasons not to, the southern access should be provided.

7. RESPONSE TO THE DIRECTOR GENERAL'S REQUIREMENTS.

7.1 General

The transportation modelling analysis described above has been designed to address the questions posed by the Director General. This section of the report is intended to relate that analysis directly to the questions.

7.2 Traffic Generation

The traffic expected to be generated by the development has been calculated both by the Wollongong/Shellharbour transportation model, and using the methodology contained in the RTA's Guide to Traffic Generating Developments. Both sources produce about the same number of trips – namely about 2200 vph in the morning peak and 1850 vph in the evening peak.

7.3 Road and Intersection Upgrades

Within the Tallawarra lands developments the roads will be designed to meet urban design objectives. Predicted traffic flows do not require any particular intersection treatments, and no internal road needs to have four lanes.

In the wider network, there are works that are required irrespective of whether or not Tallawarra Lands proceeds. Once these are in place, no additional link capacity is required – at worst, and additional 100 vehicles per lane per hour will be added to the F6.

However, because the link through to Haywards Bay is not now proposed, there will need to be additional capacity at the intersection of the northbound off ramp and the Princes Highway as a result of the development. Also, the Give Way at the Cormack Avenue/Princes Highway intersection will need to be converted into a roundabout.

7.4 Access

Four access points are proposed to service the development, with two off the Princes Highway, one off Cormack Ave, and one to the north east from Gilba Road at Koonawarra. Of these, the most important is the southernmost intersection with the Princes Highway as it leads directly into the main employment areas of the development. Almost one third of the development traffic will use this access.

One consequence of removing the Haywards Bay access is that the two roundabouts onto the Princes Highway will need to be two lane circulating with two lane approaches from the north and east. The south bound direction on the Princes Highway will also need to be two lanes, with one lane northbound.

The northern access to Koonawarra is minor in comparison with the others.

7.5 Loading Docks

Chapter E3 of the Wollongong Development Control Plan specifies the number, location and size of the loading docks required for different land use types within any development. Tallawarra Lands will conform to these standards.

7.6 Car parking Arrangements

As with loading docks, car parking requirements for each land use type are set out in Chapter E3 and the development will comply with this.

7.7 Public Transport

It will be important that this area is well served by public transport linking the residential areas with the neighbourhood centre, and later to the business employment areas. In addition the site needs to be linked by public transport to the nearby rail stations of Albion Park and Dapto. Ideally, these services should lead development rather than follow it, thereby delaying as far as possible the decision of households to buy the second (or third) car. It does not need to be serviced initially by 50 seater buses – smaller 15 or 20 seat vehicles at reasonable frequencies will be sufficient for some time.

These smaller vehicles will penetrate the residential areas more easily than larger ones and help establish a culture of public transport usage. The system should be designed to make it as easy to use as possible, with the potential for 'on demand' boarding and alighting at least in the short term.

As noted earlier in this report, the provision of a road link between Tallawarra and Haywards Bay will cause problems for the Haywards Bay residents. As the two developments mature, it may well be useful to expand the proposed walk and cycle paths by the addition of a 'bus only' lane which could also be used by emergency vehicles.

Indicative bus routes at full development have been shown on **Figure 30**.

7.8 Walk and Cycle

The roading hierarchy including provision for pedestrians and cycles has been included in the Landscape Plan prepared by Corkery Consulting. Specific provision for generous shared footpath and cycle ways physically separated from the carriageway have been proposed for the major spine road, collector roads and roads servicing the industrial/commercial areas.

Streets in the residential areas will have footpaths separated from the carriageway, but cyclists in these areas will use the main carriageways, which are expected to be lightly trafficked.

The pedestrian and cycle network is extensive, linking the residential, employment and recreational areas including the lakefront, often on purpose built paths away from roads carrying traffic. A link to Haywards Bay has also been included.

The Freeway is a natural barrier between East Dapto and Koonawarra, and for that reason a pedestrian overpass has been built linking Deeson Place with Martin Street. This overpass is about a kilometre from the northern access from Cormack Avenue, and there may need to be improvements to Cormack Ave to provide good pedestrian and cycle access from Tallawarra to the overbridge.

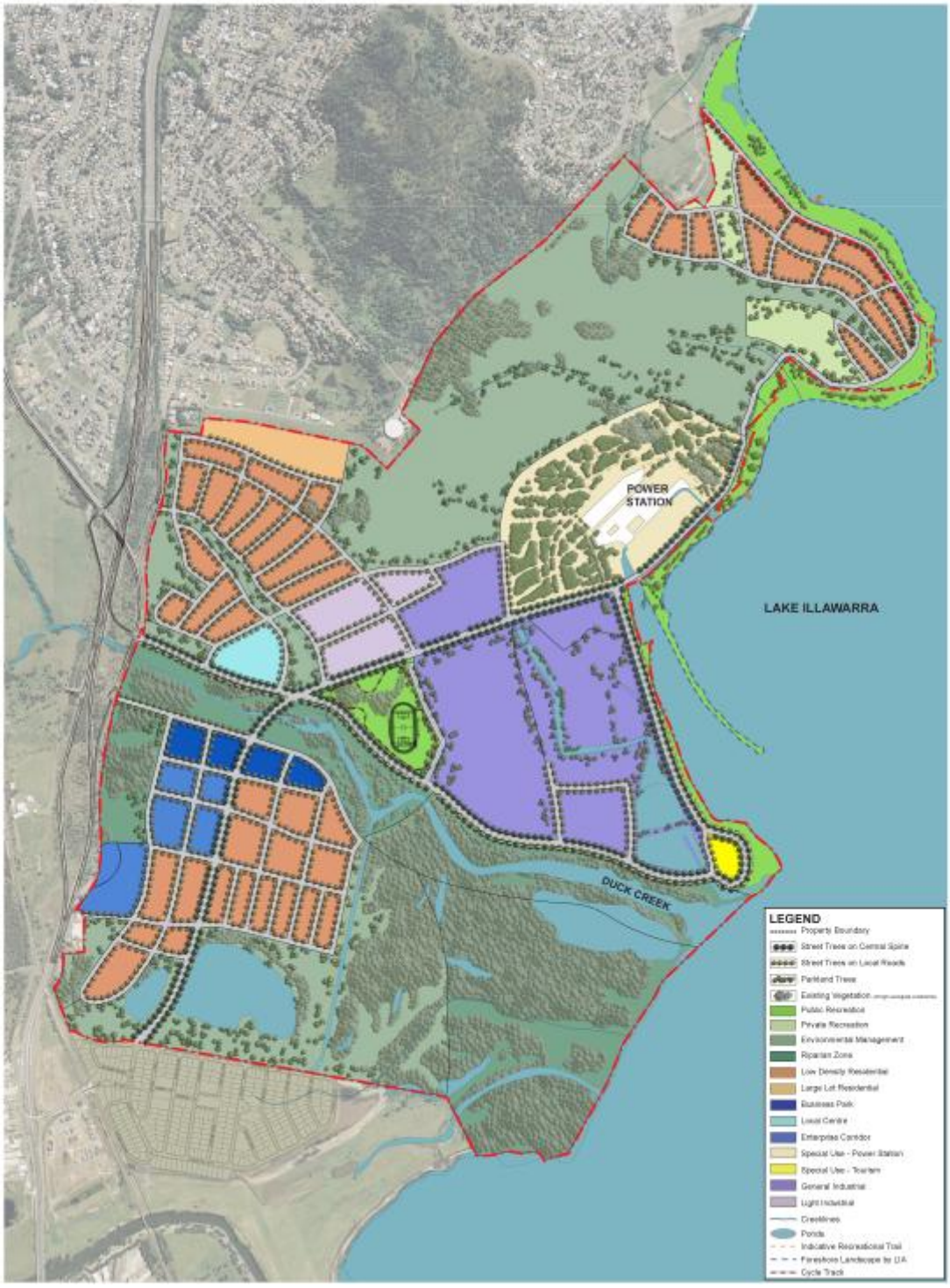
7.9 Staging and Funding of Road and Intersection Upgrades

As noted earlier, the staging of road and intersection upgrades will, to a large extent, depend on the rate of development of West Dapto, and the infrastructure requirements of that development in relation to the rate of development of Tallawarra. However, given current expectations of the rate of growth, the roading improvements noted on **Figure 5** will be required by 2021, and involve a mixture of Local Authority and State funding. It should be noted that these works are required without any development on Tallawarra Lands.

The second group of infrastructure requirements are internal to the site, and will be the responsibility of Tallawarra Lands. They will be installed at a rate which will be determined by the rate of development in that the roads will be required before development can proceed in each precinct.

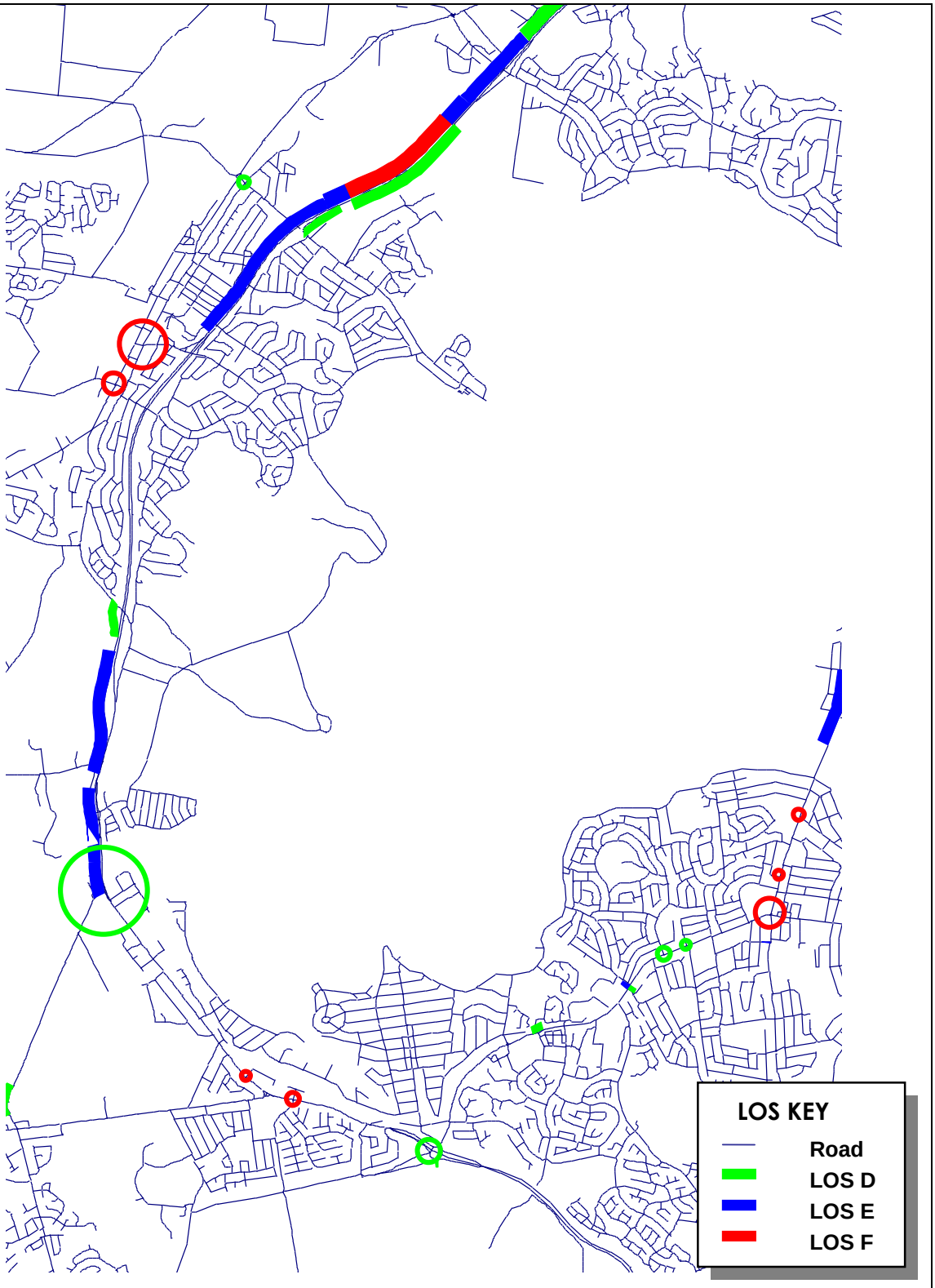
The third group of improvements are those required on the Princes Highway from Huntley Road to Haywards Bay. These include two-laning of the Princes Highway southbound and roundabouts at the northbound freeway off ramp, Cormack Avenue, Yallah Bay Road and the new access south of Yallah Bay Road. The apportionment and timing of these works are included in the Northrop report.

However, in practical terms all of these works should be constructed as one project to minimise the degree of disruption that will inevitably occur during construction, even if that means that the roundabouts are constructed a little ahead of the need for them.

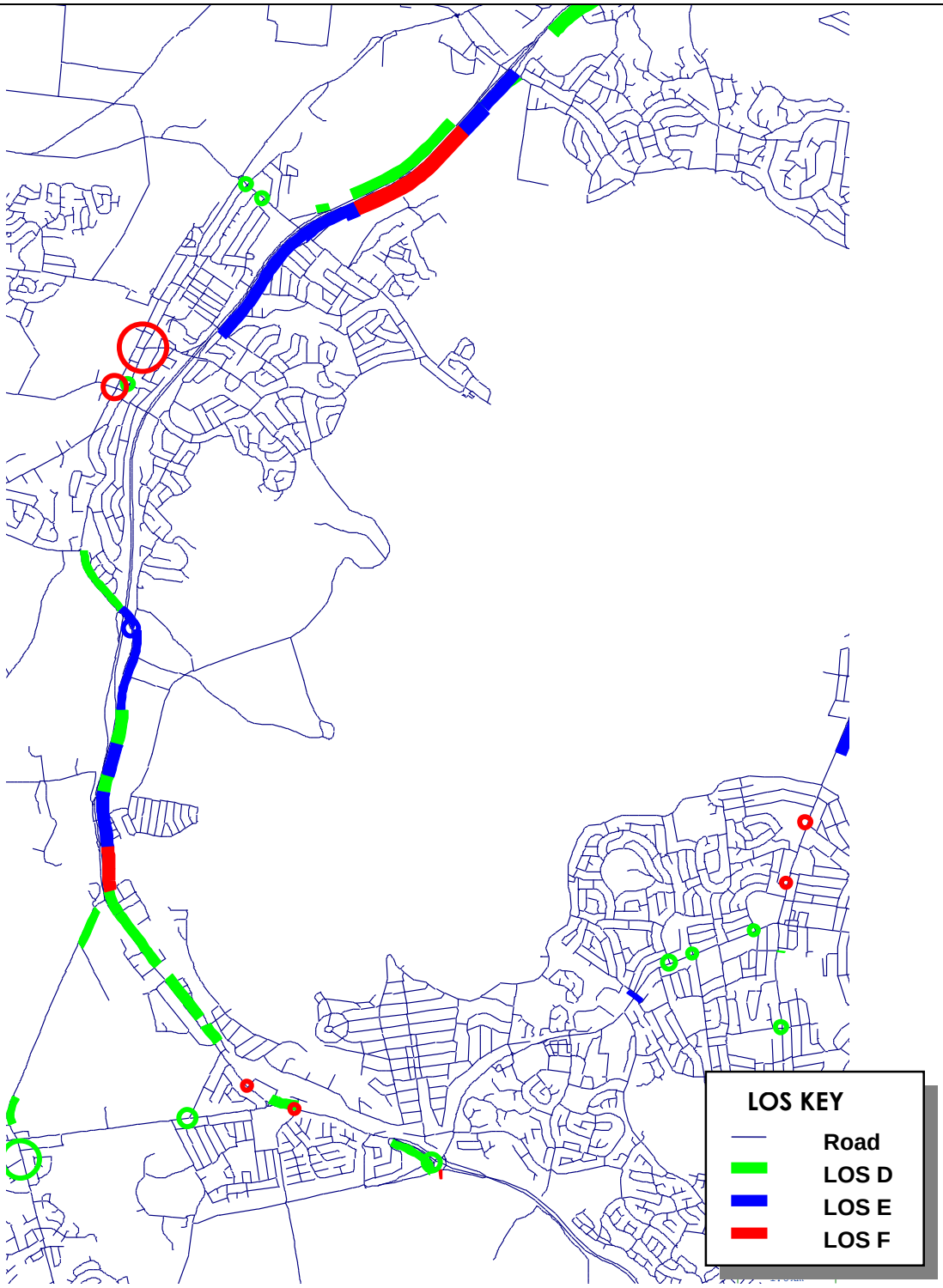


Tallawarra Lands	**Cox Richardson Masterplan**	**Figure 1**
Gabites Porter		

Tallawarra Lands	**Warren Lee Masterplan**	**Figure 2**
Gabites Porter		

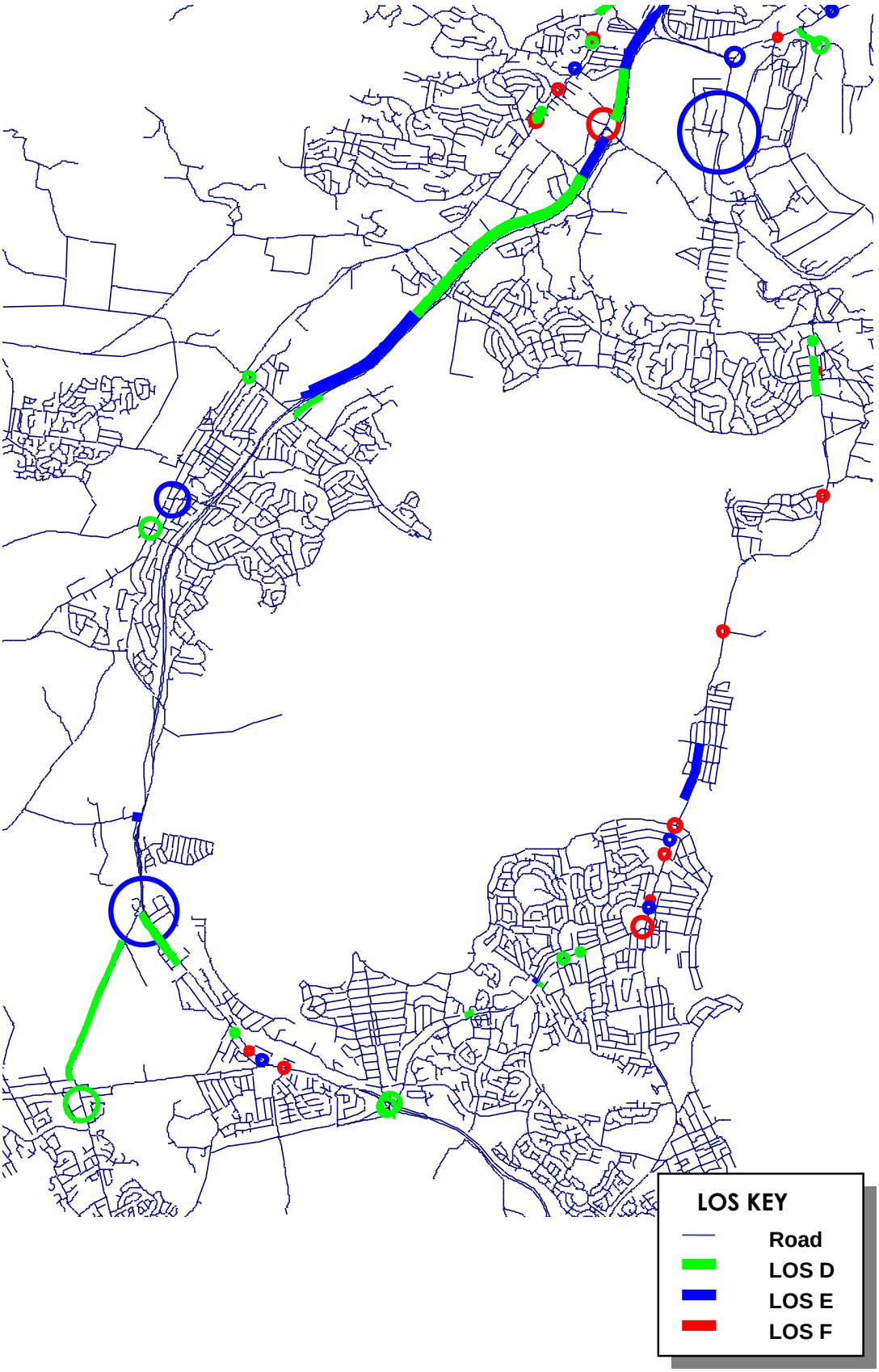


Tallawarra Lands	**Without Tallawarra Development** **Do Minimum Network** **2021 AMP Levels of Service**	**Figure 3**
Gabites Porter		

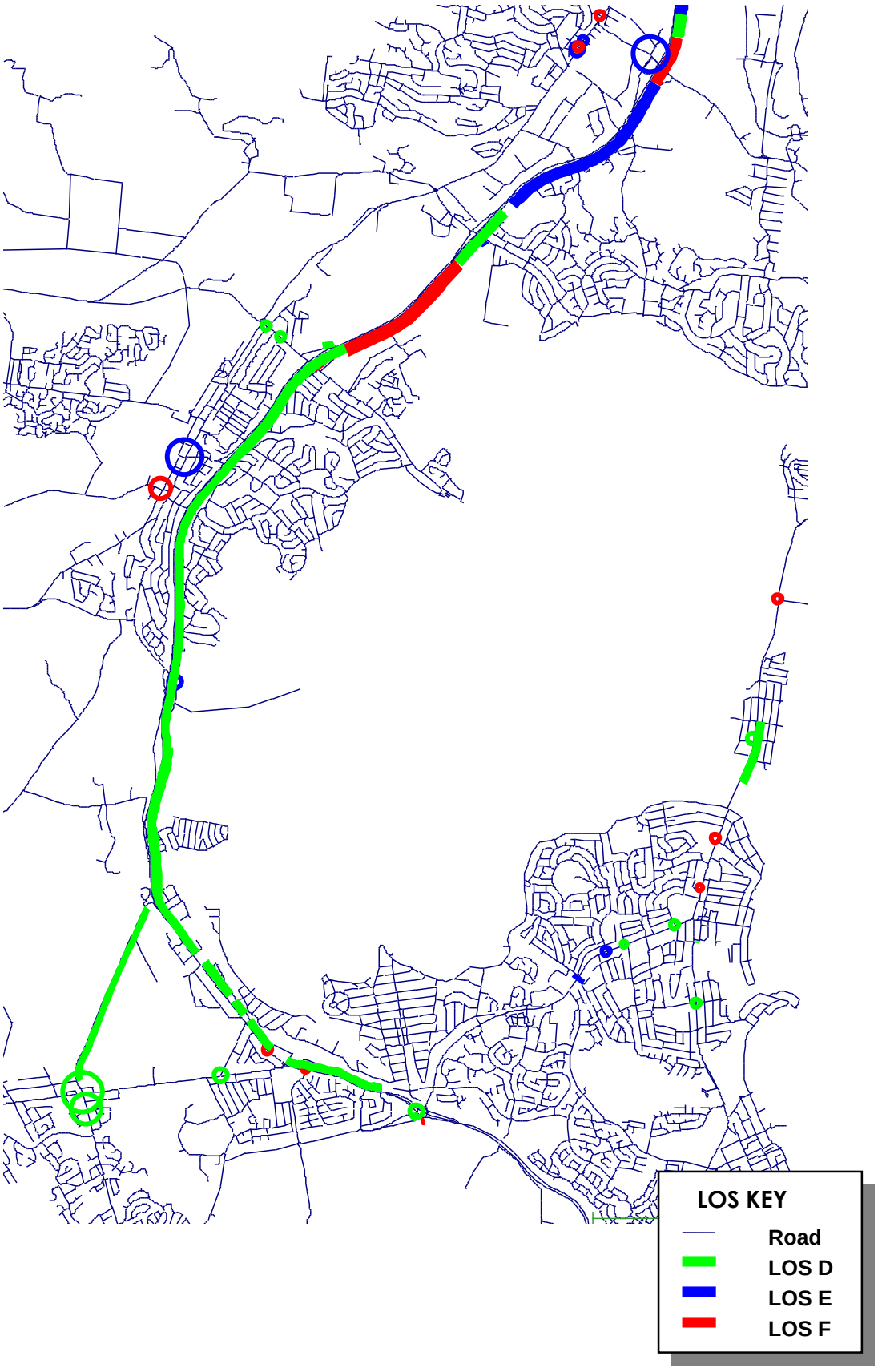


Tallawarra Lands	**Without Tallawarra Development** **Do Minimum Network** **2021 PMP Levels of Service**	**Figure 4**
Gabites Porter		

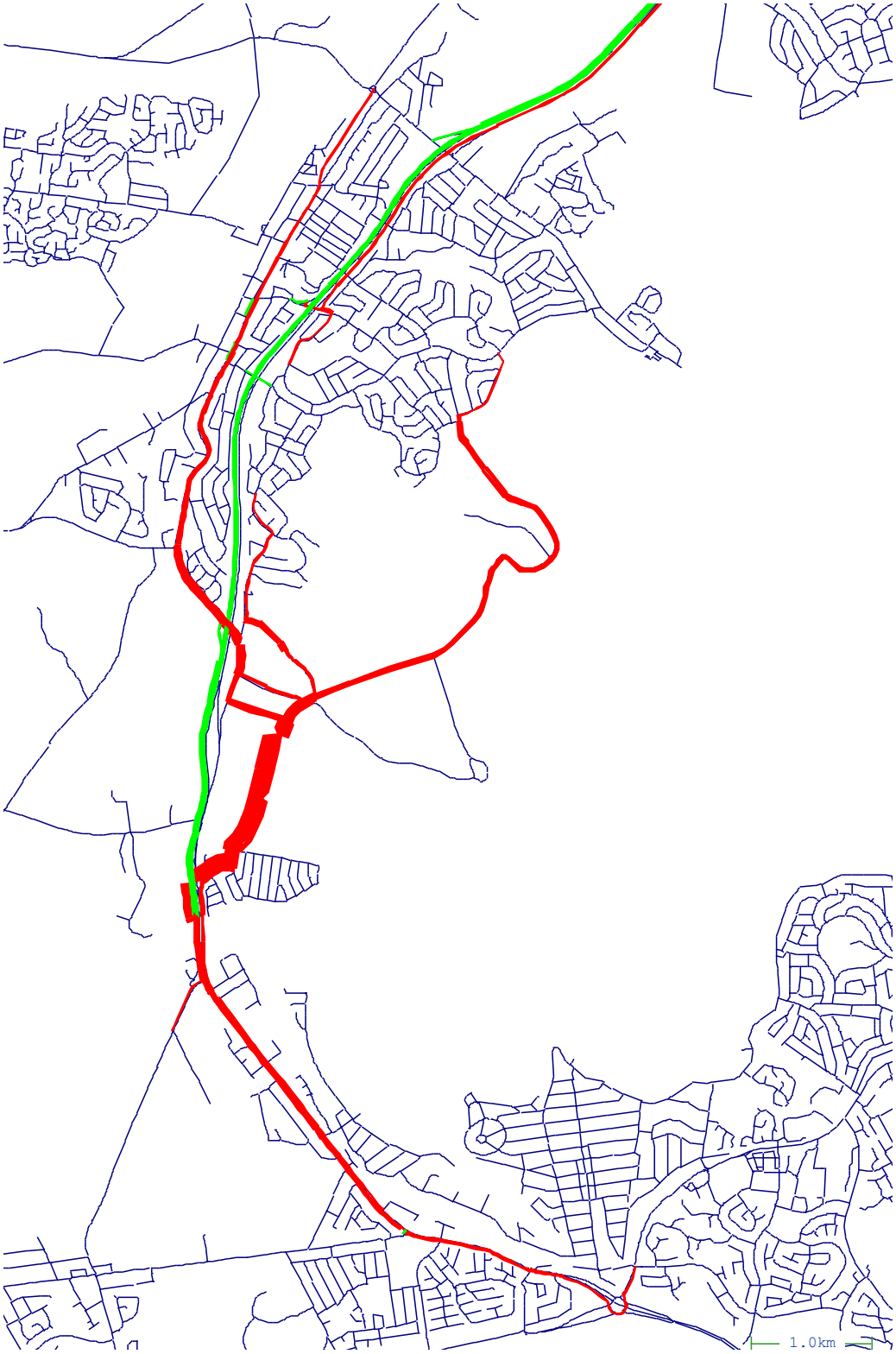
Tallawarra Lands Gabites Porter	**Works Required to Form the Base Network (Independent of any Development at Tallawarra)**	**Figure 5**



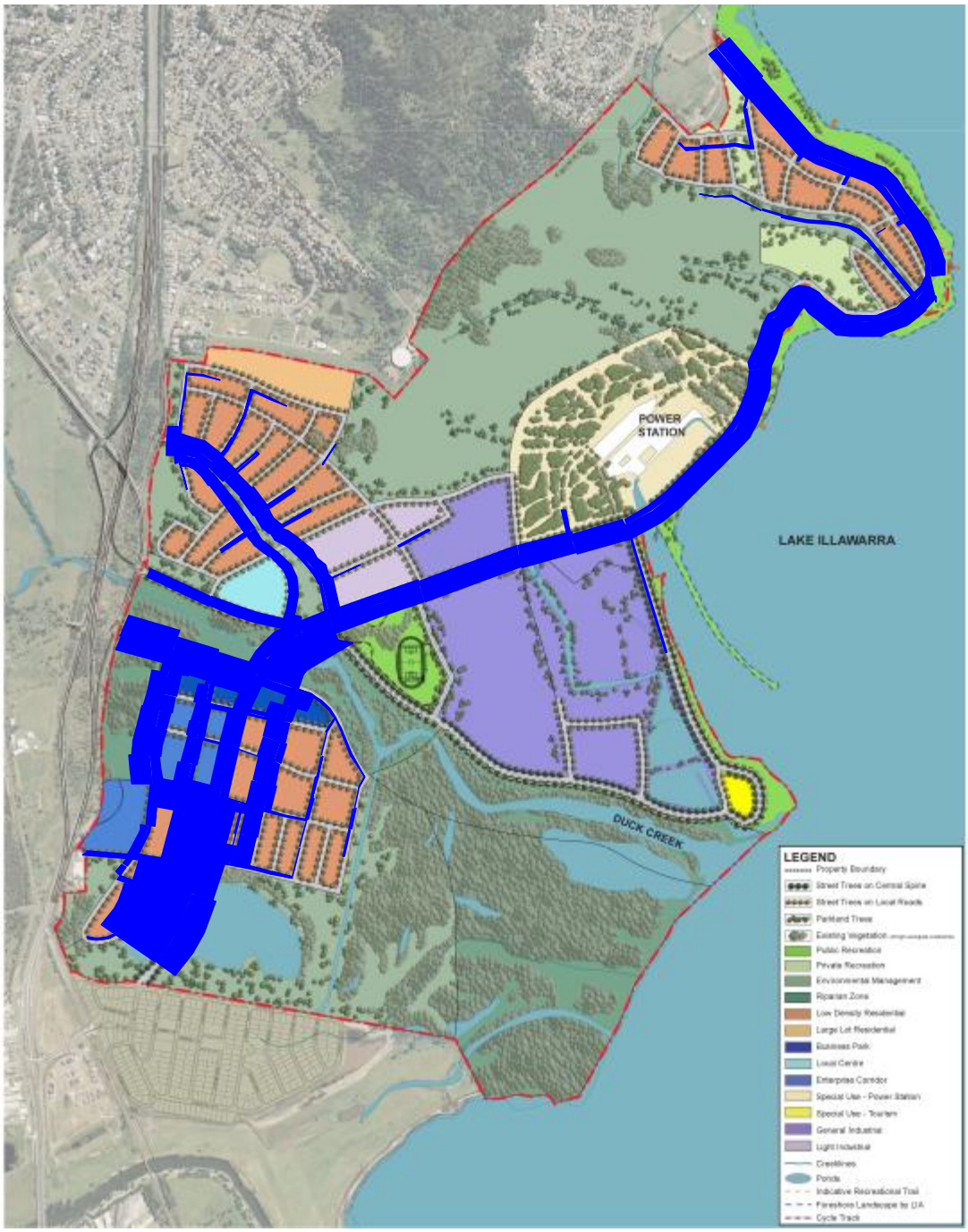
Tallawarra Lands	**Without Tallawarra Development** **2021 AMP Levels Of Service on the Base Network**	**Figure 6**
Gabites Porter		



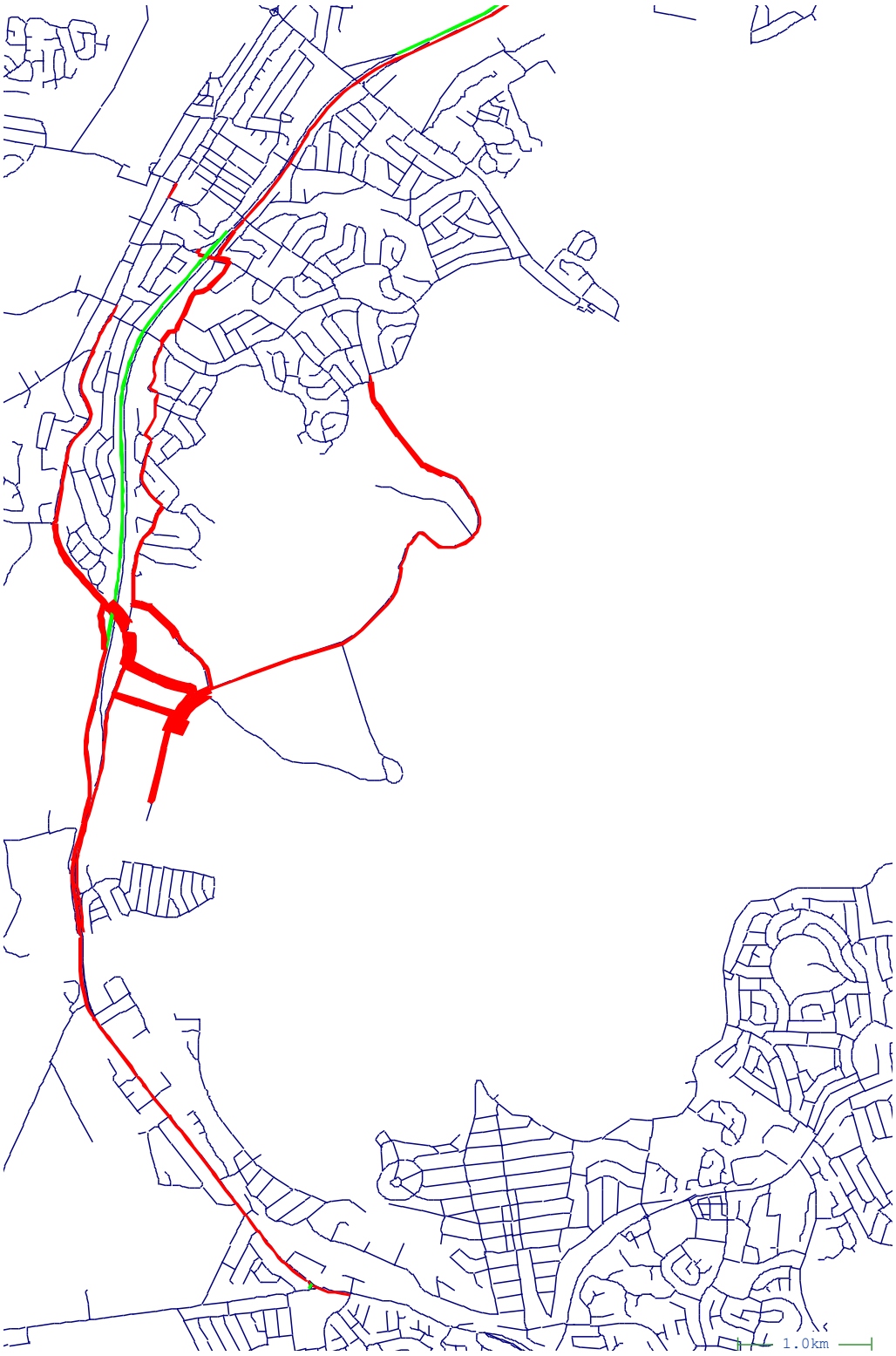
Tallawarra Lands Gabites Porter	**Without Tallawarra Development** **2021 PMP Levels Of Service on the Base Network**	**Figure 7**



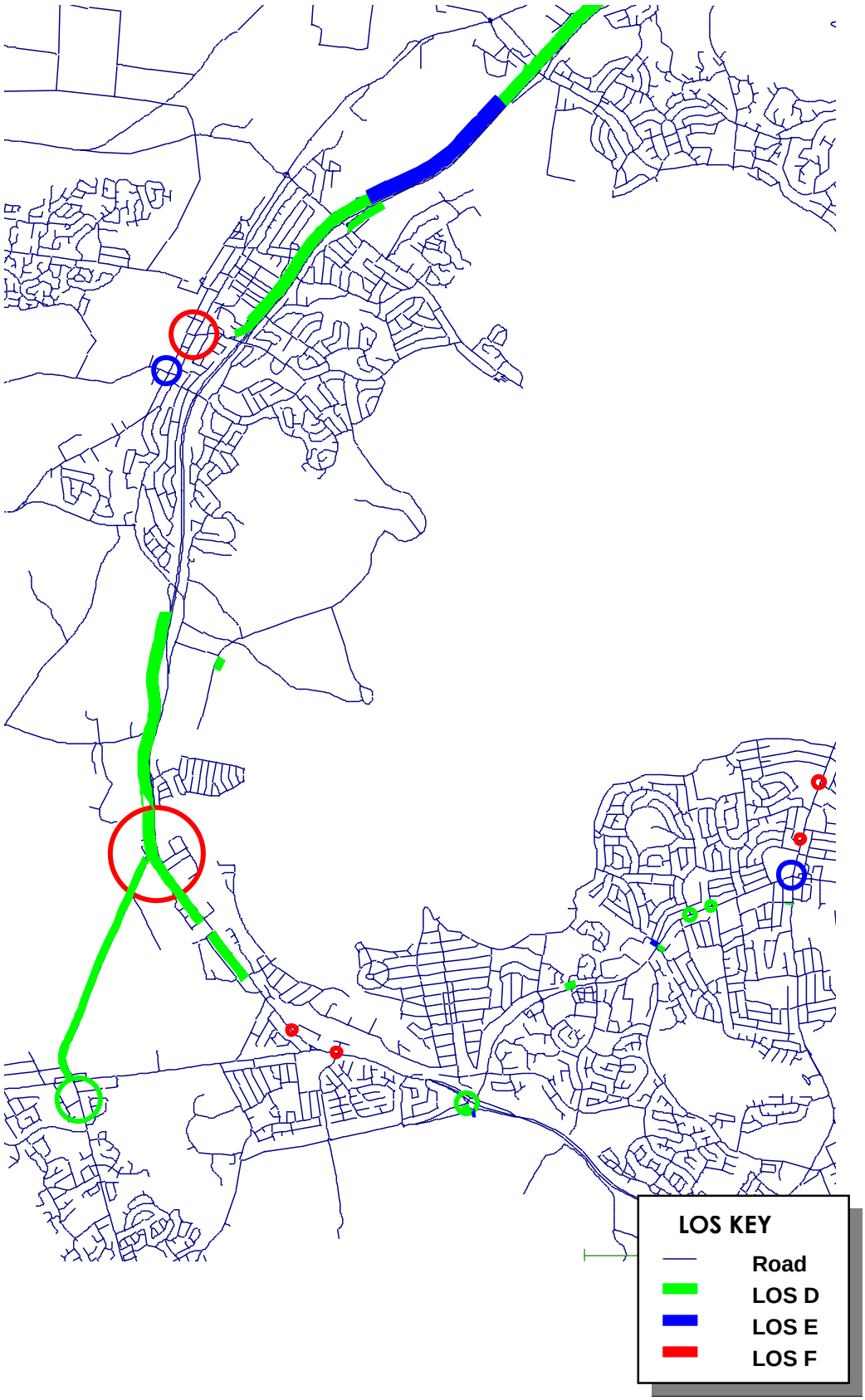
Tallawarra Lands	**Change in Traffic Flow caused by the Tallawarra Development – AM Peak**	**Figure 8**
Gabites Porter	**Cox Richardson Masterplan**	



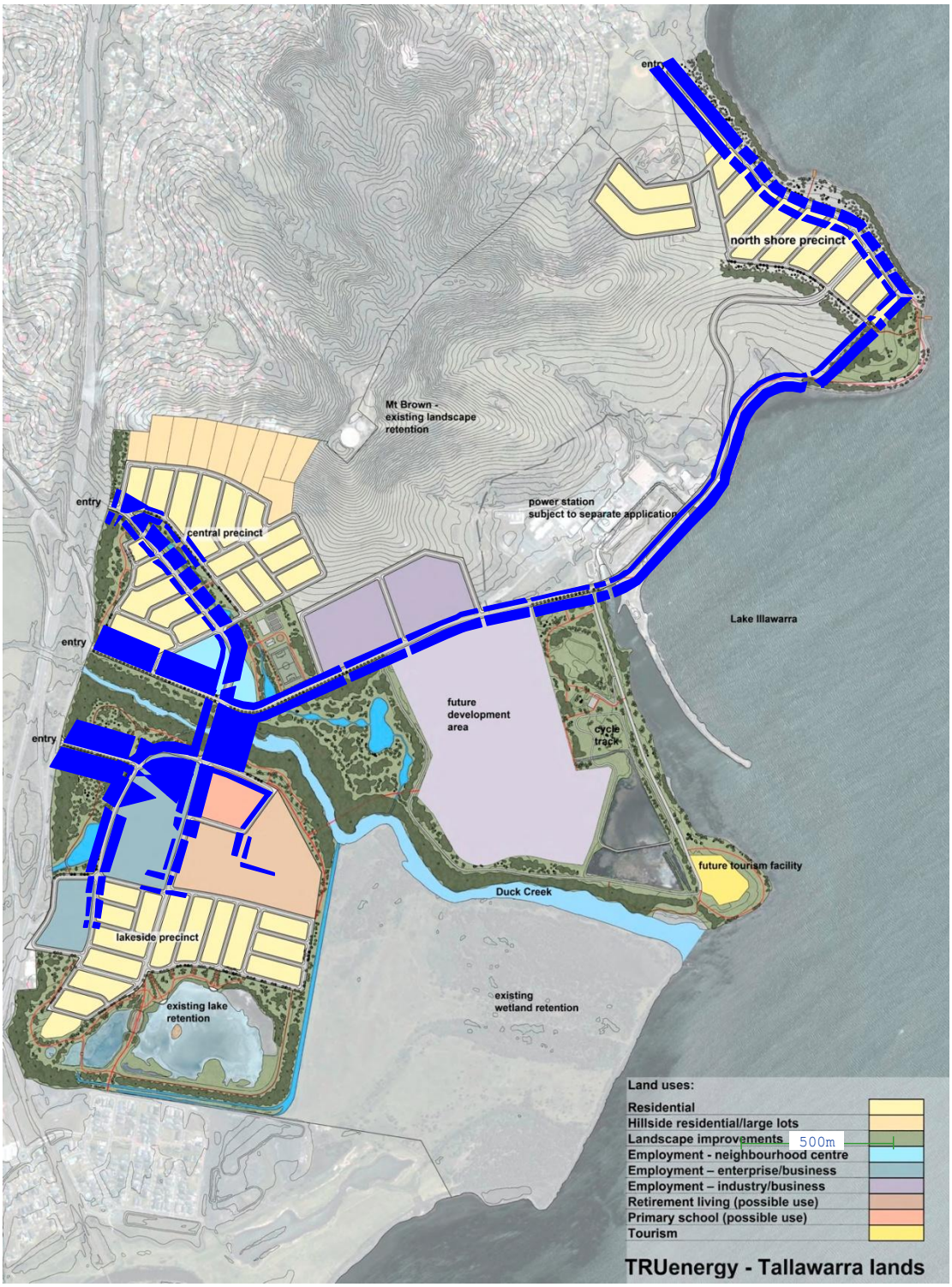
Tallawarra Lands	**Tallawarra Master Plan** **Morning Peak Traffic Flows** **Cox Richardson Masterplan**	**Figure 9**
Gabites Porter		



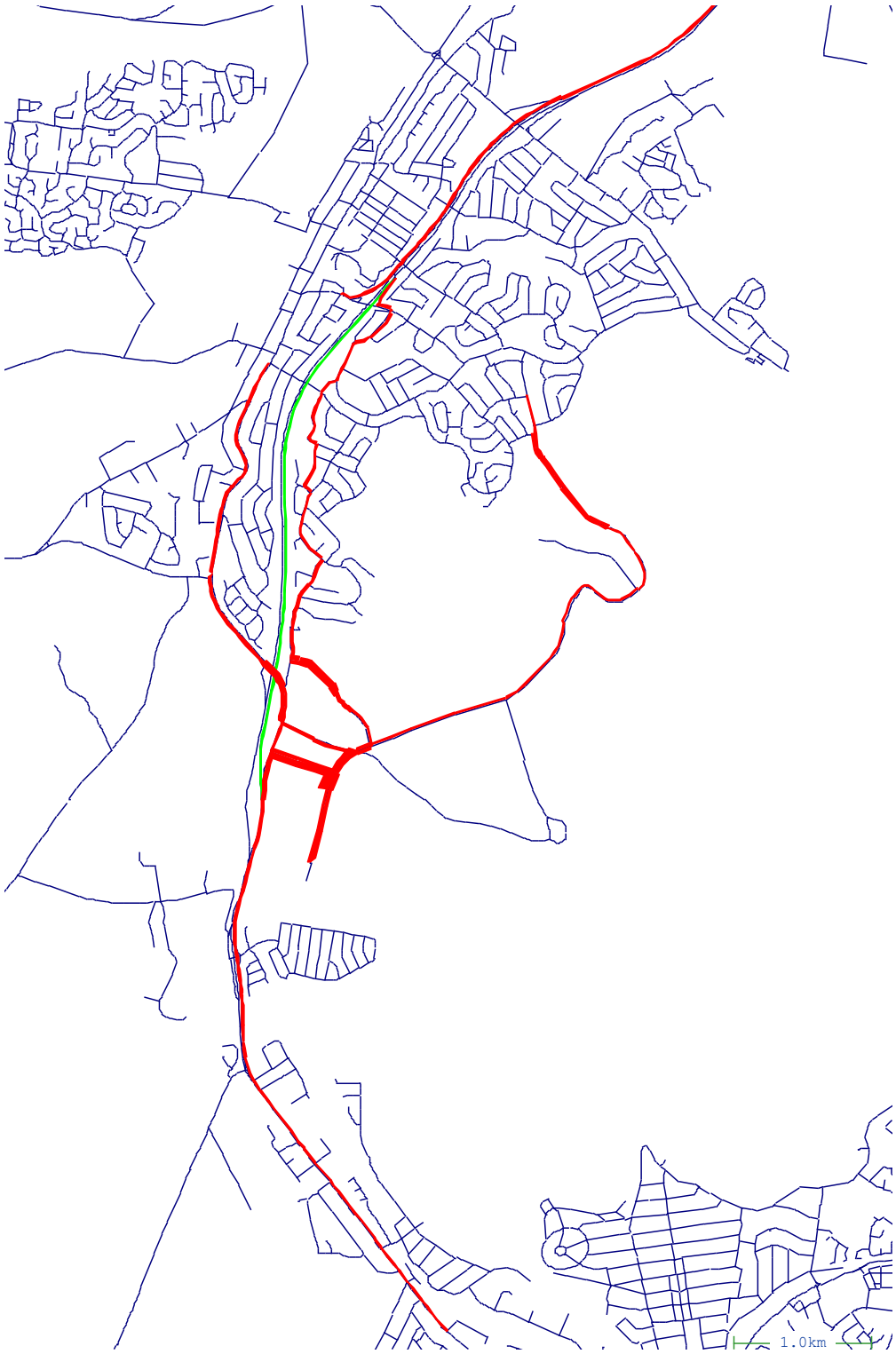
Tallawarra Lands	**With Tallawarra Development** **2021 AMP Change in Traffic Flow** **Warren Lee Masterplan**	**Figure 10**
Gabites Porter		



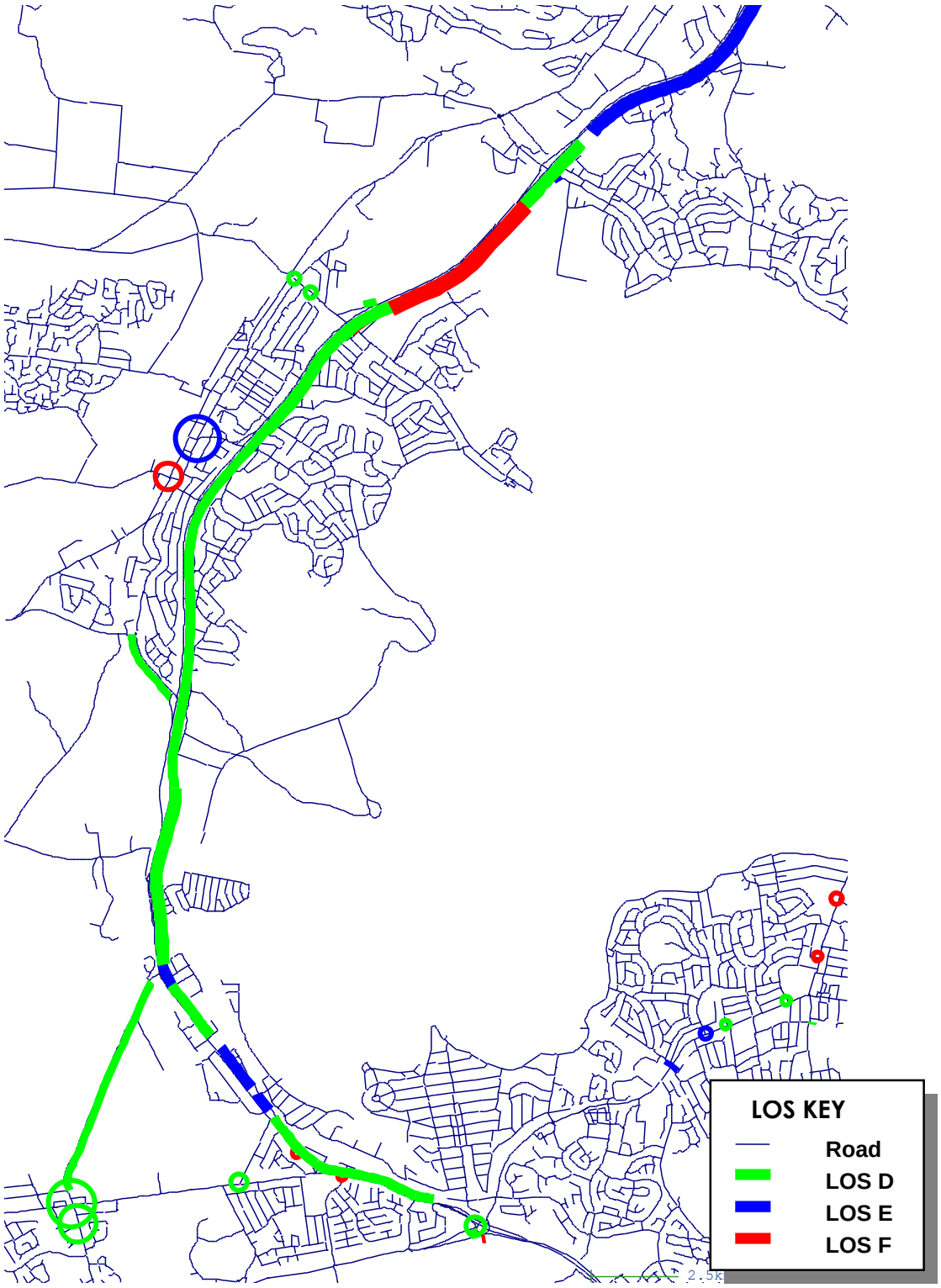
Tallawarra Lands	**With Tallawarra Development** **AMP Levels Of Service on the Improved Network** **Warren Lee Masterplan**	**Figure 11**
Gabites Porter		



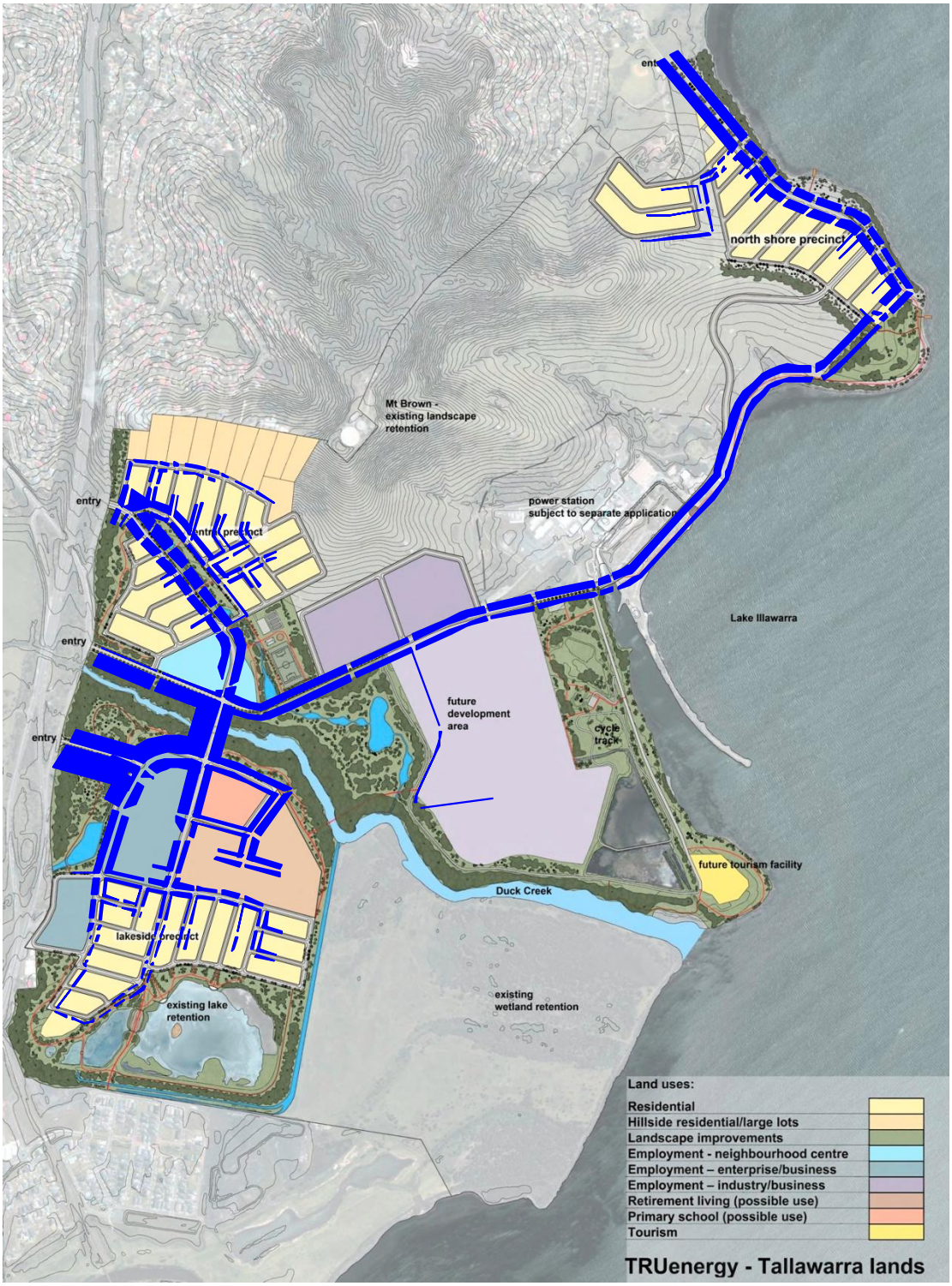
Tallawarra Lands	**Detailed Internal Area** **Morning Peak Traffic Flows**	**Figure 12**
Gabites Porter		



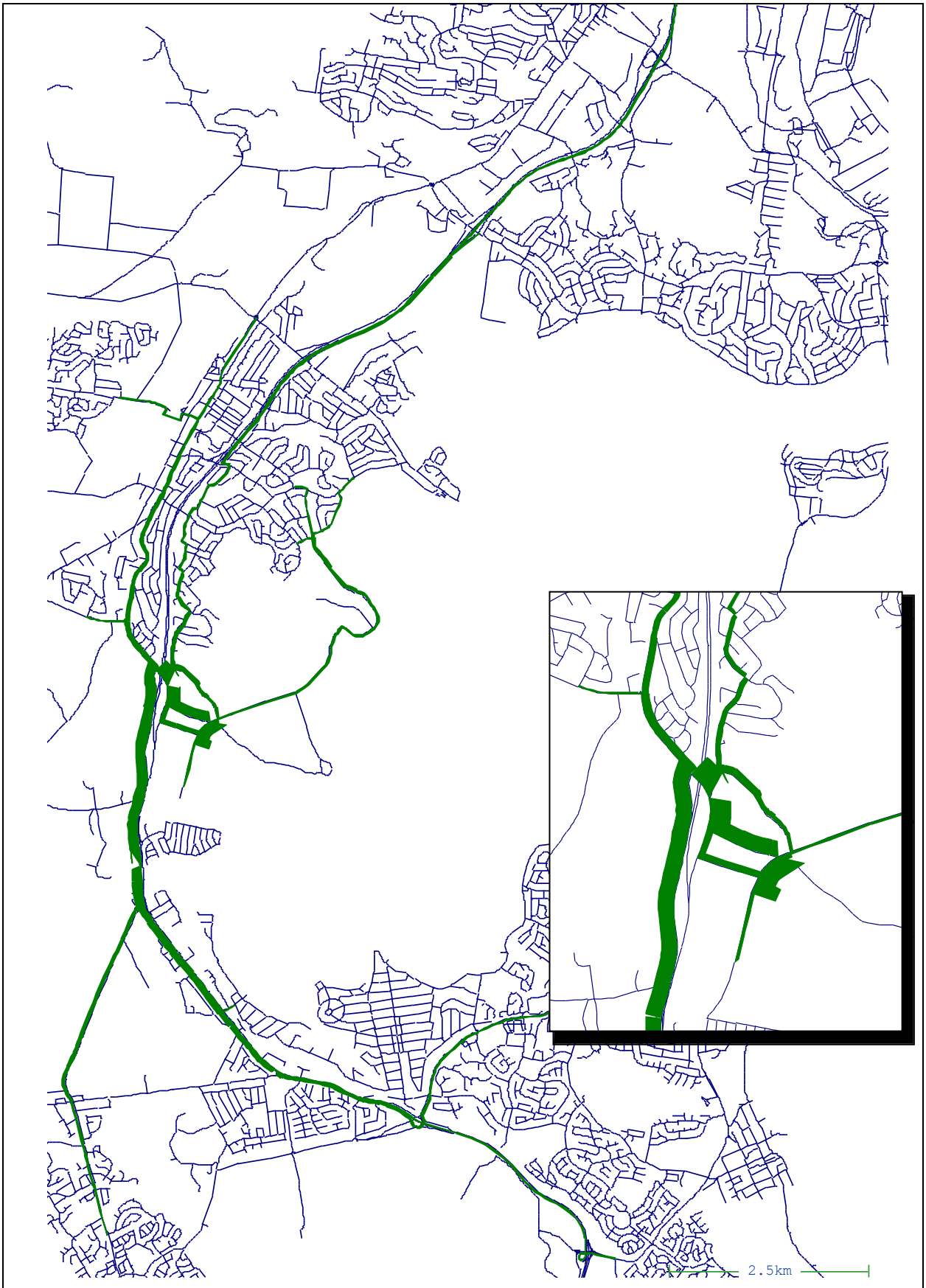
Tallawarra Lands	**With Tallawarra Development** **2021 PMP Change in traffic flow** **Warren Lee Masterplan**	**Figure 13**
Gabites Porter		



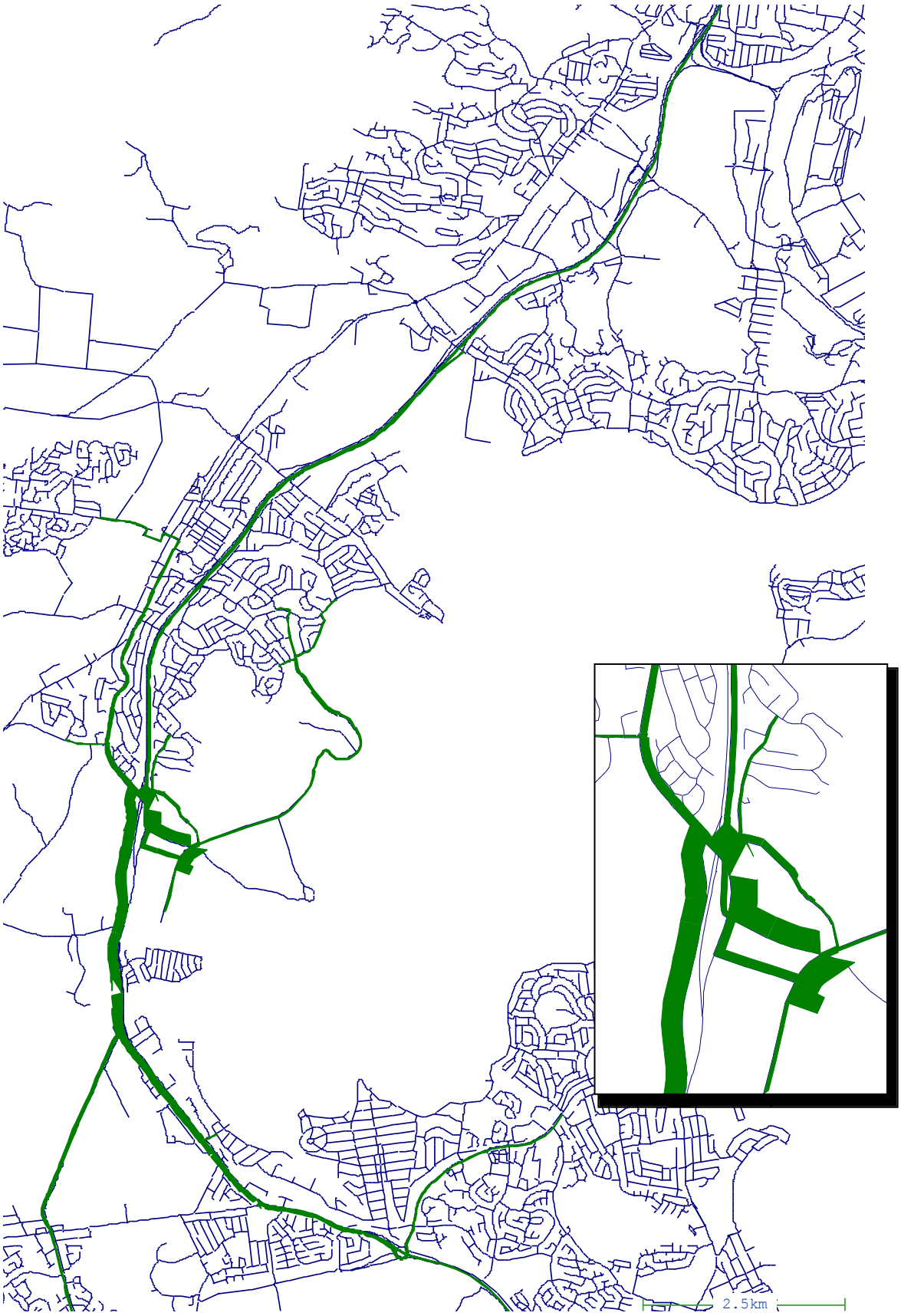
Tallawarra Lands	**With Tallawarra Development** **PMP Levels Of Service on the improved Network** **Warren Lee Masterplan**	**Figure 14**
Gabites Porter		



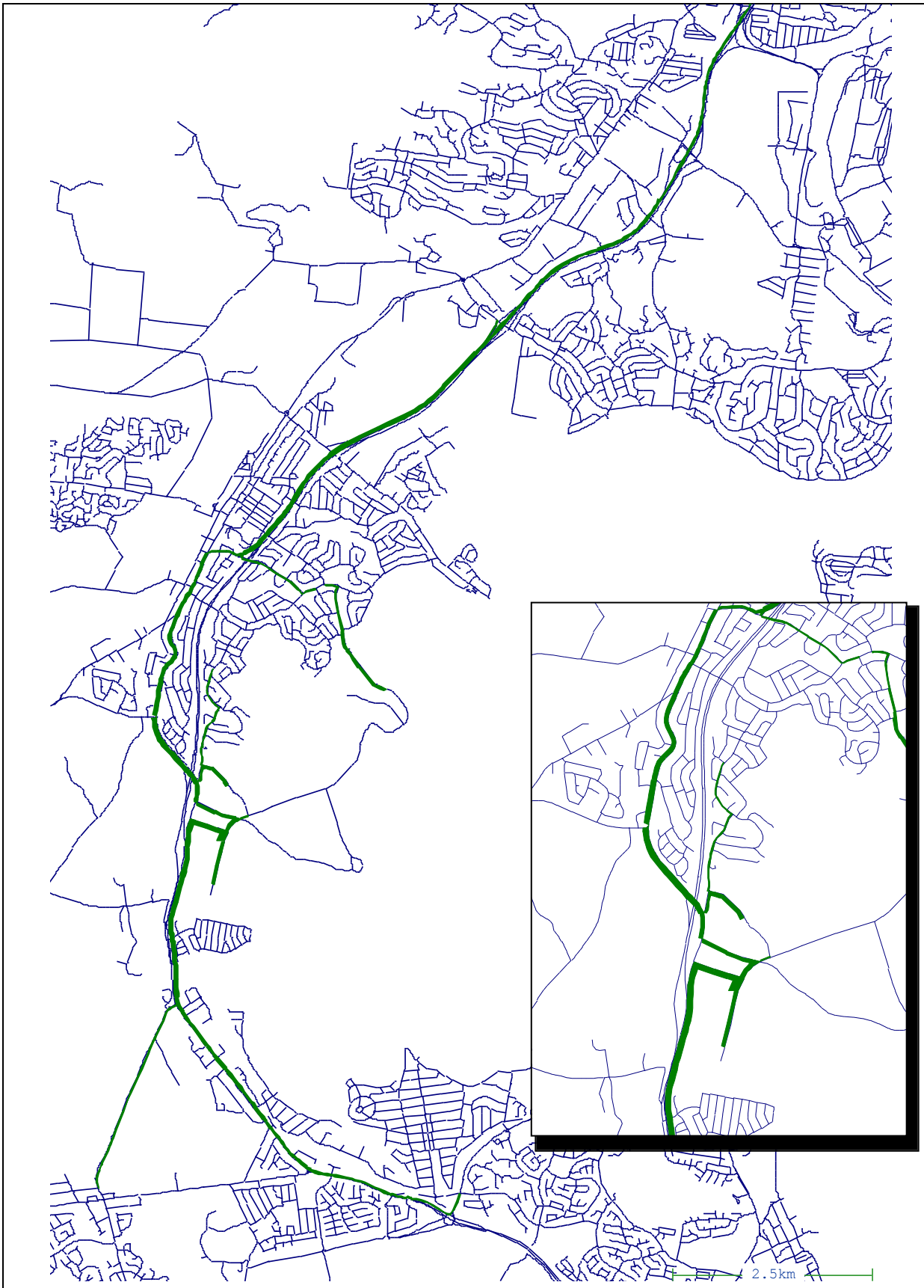
Tallawarra Lands	**Detailed Internal Area** **Evening Peak Traffic Flows**	**Figure 15**
Gabites Porter		



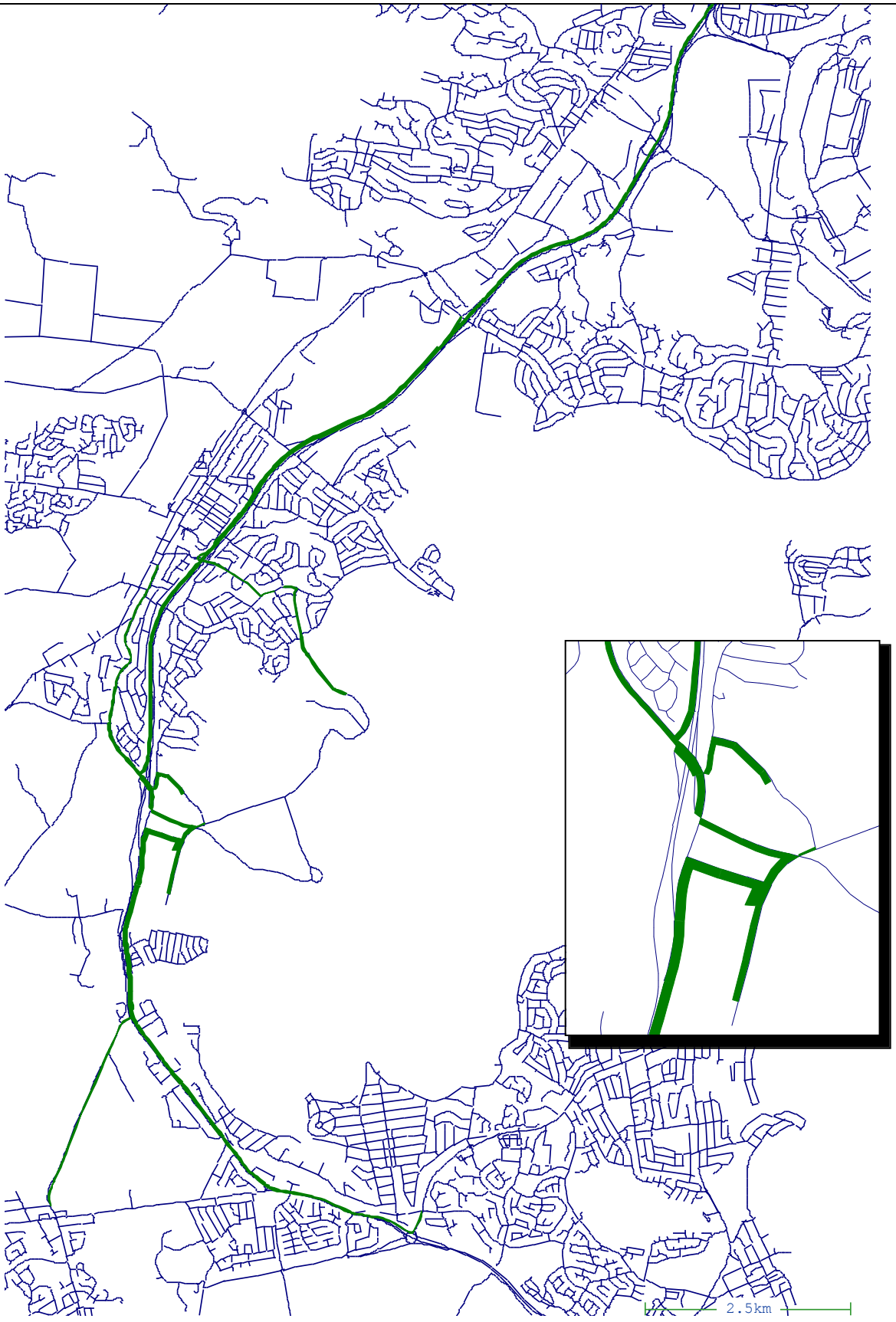
Tallawarra Lands	**Morning Peak Inbound Traffic Flow (no Freeway ramps)**	**Figure 16**
Gabites Porter		



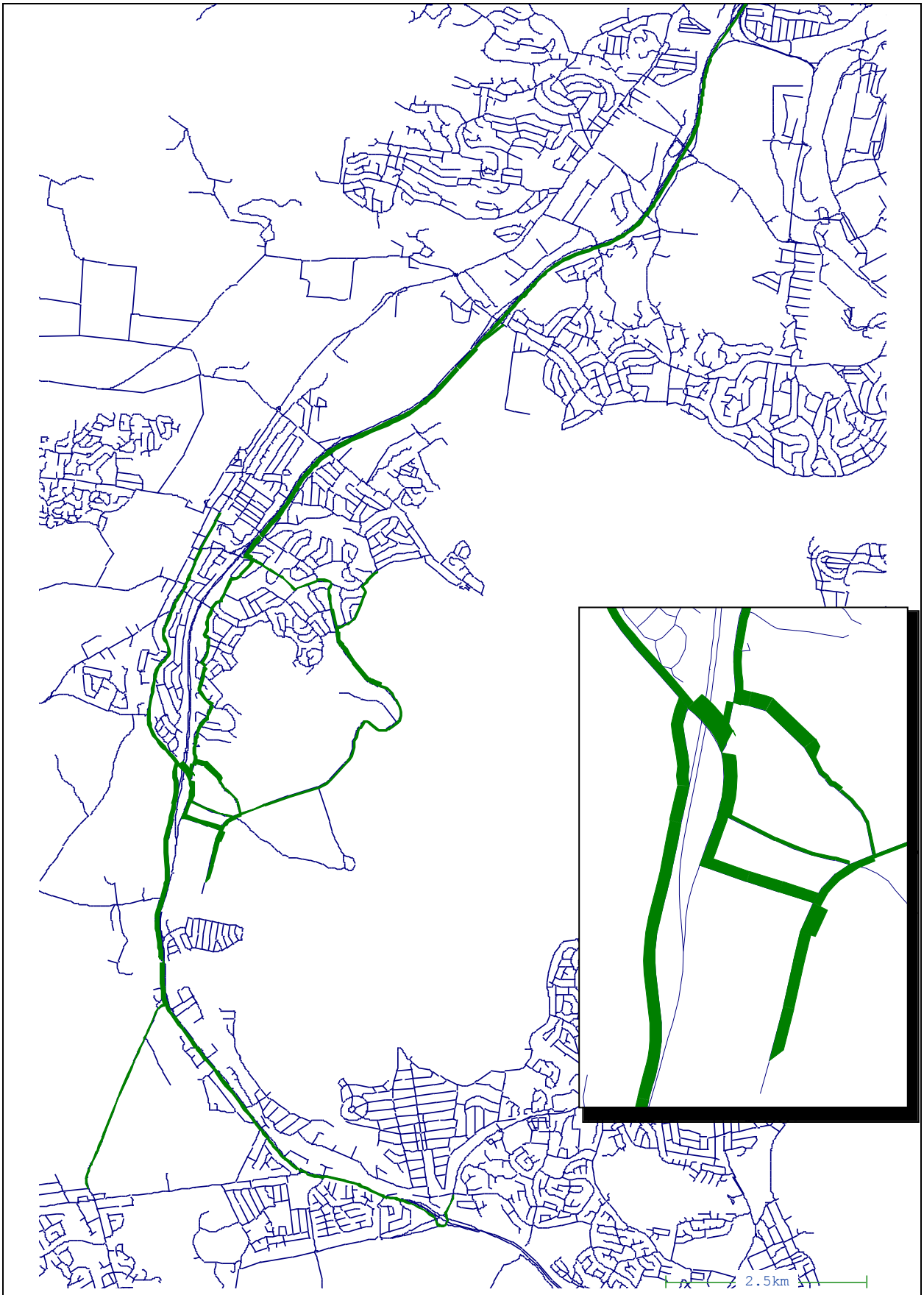
Tallawarra Lands	**Morning Peak Inbound Traffic Flow (with Freeway ramps)**	**Figure 17**
Gabites Porter		



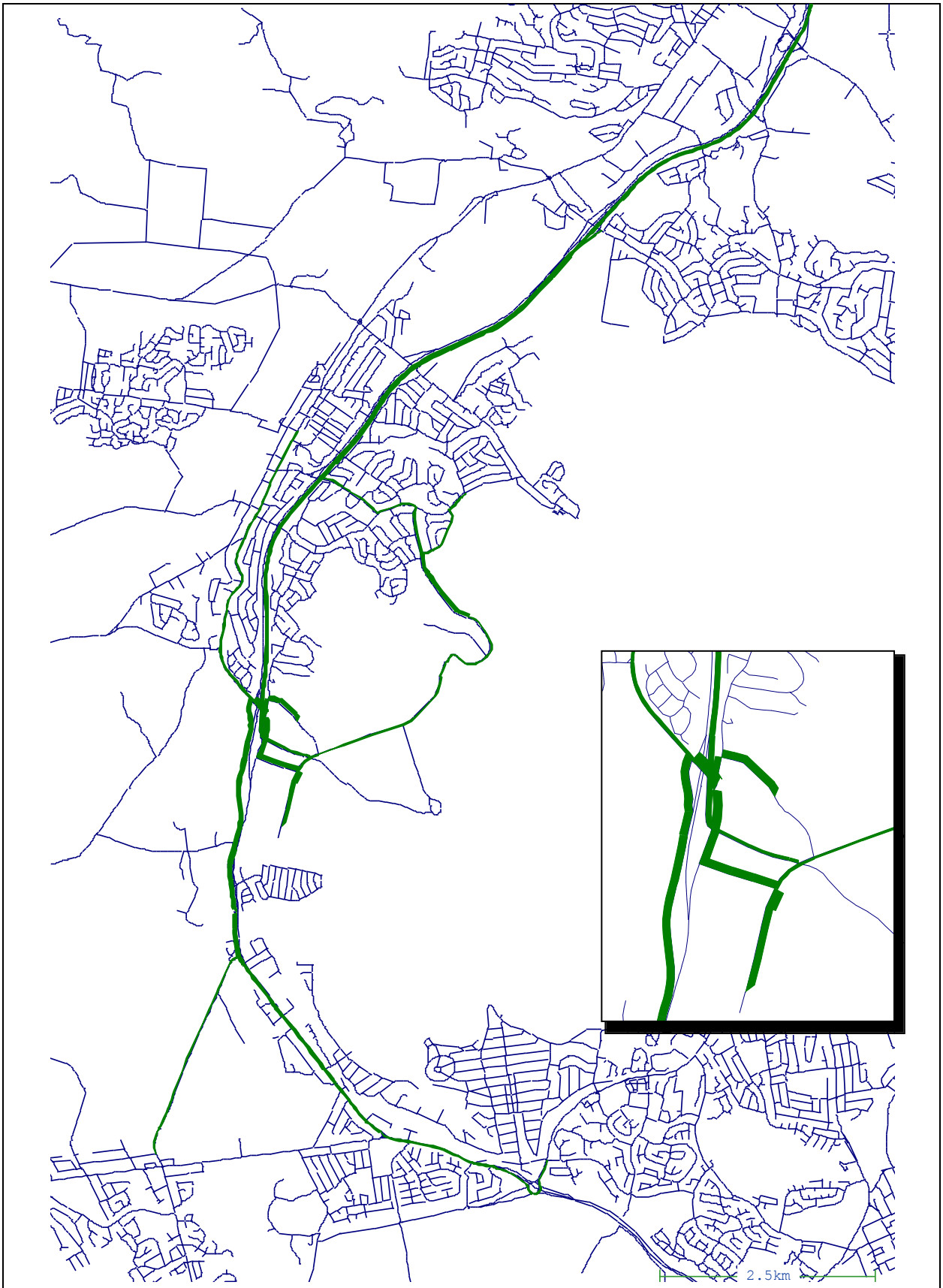
Tallawarra Lands	**Morning Peak Outbound Traffic Flow (No Freeway ramps)**	**Figure 18**
Gabites Porter		



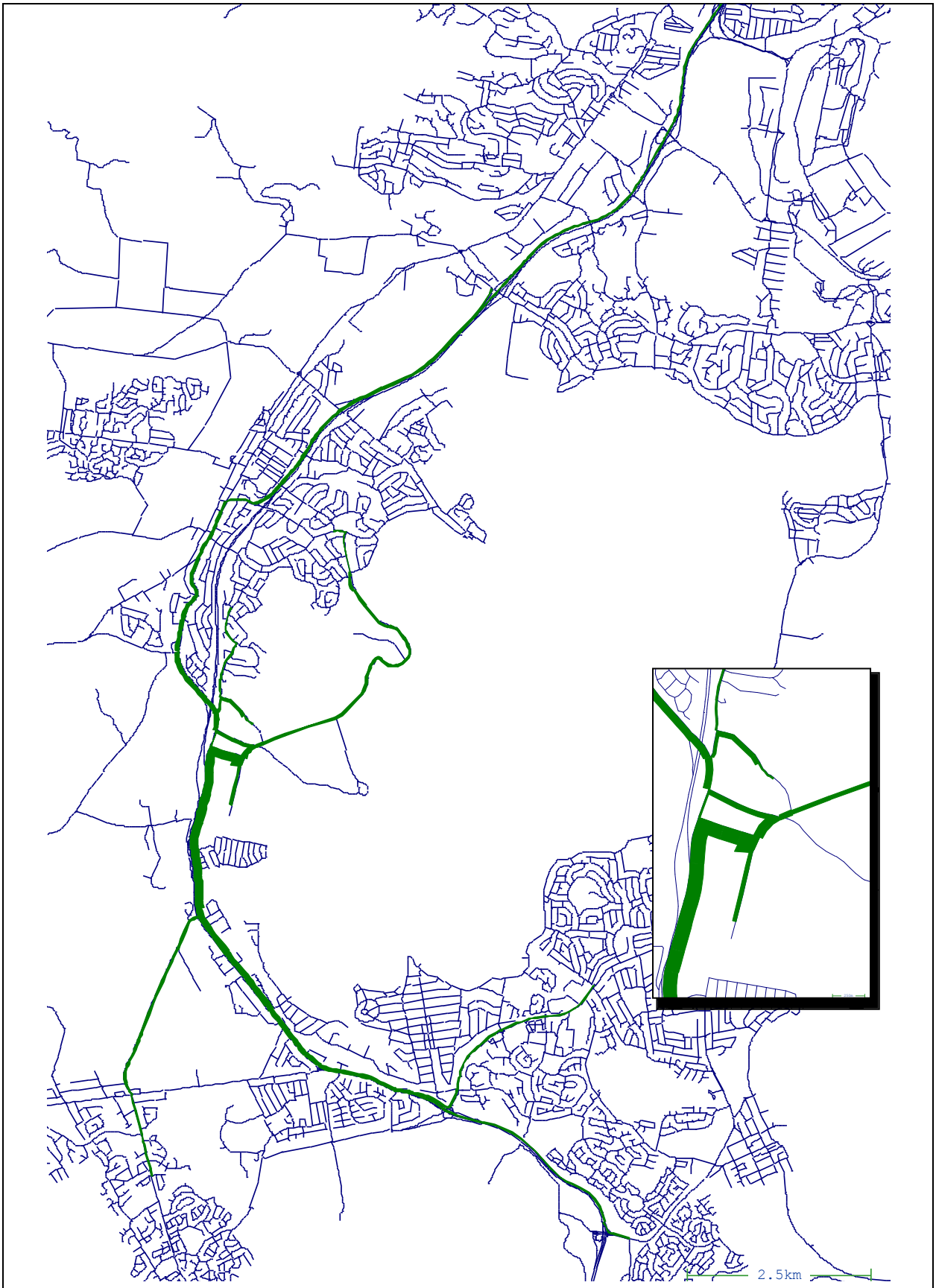
Tallawarra Lands	**Morning Peak Outbound Traffic Flow (With Freeway ramps)**	**Figure 19**
Gabites Porter		



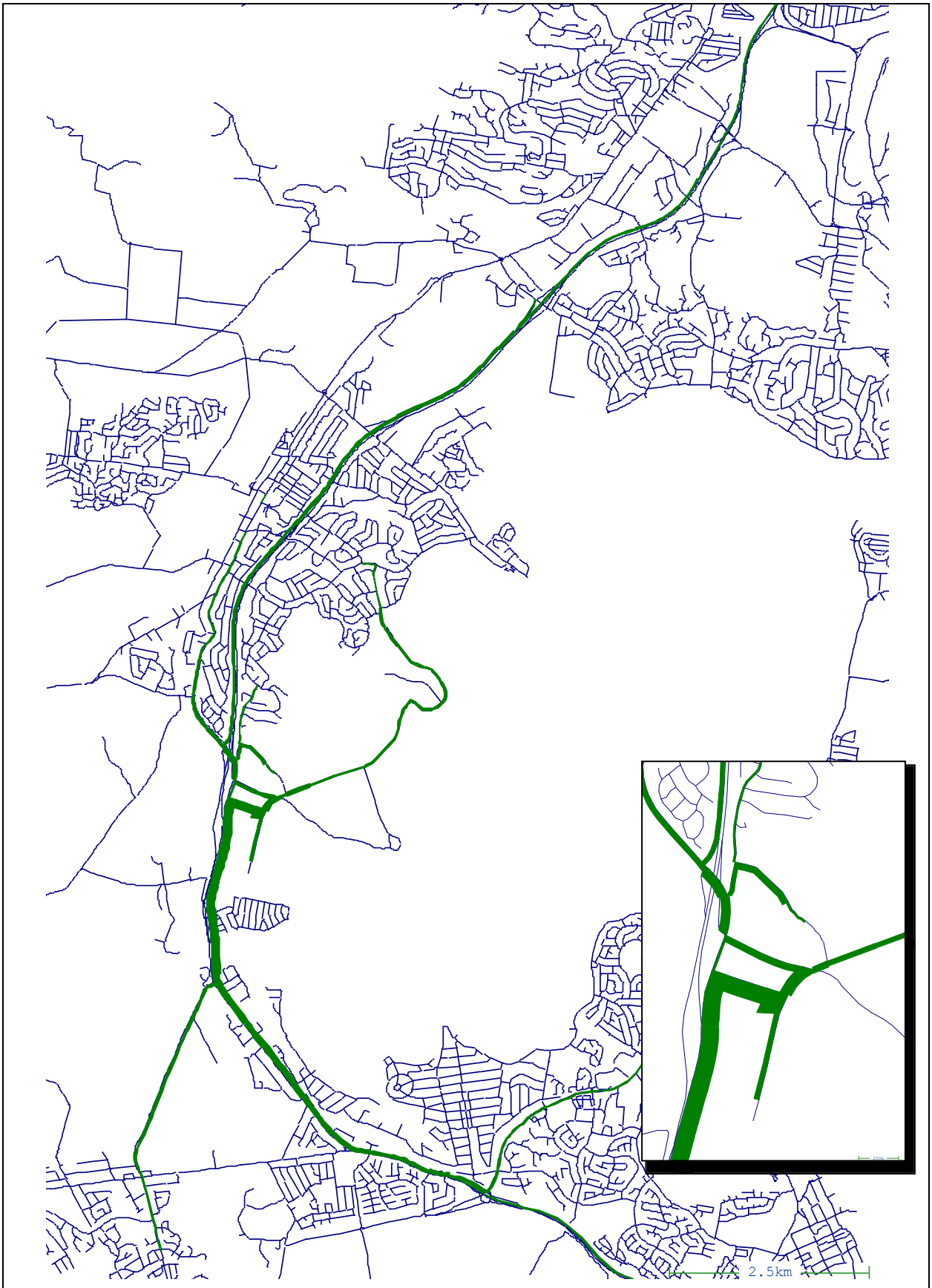
Tallawarra Lands	**Evening Peak Inbound Traffic Flow (No Freeway ramps)**	**Figure 20**
Gabites Porter		



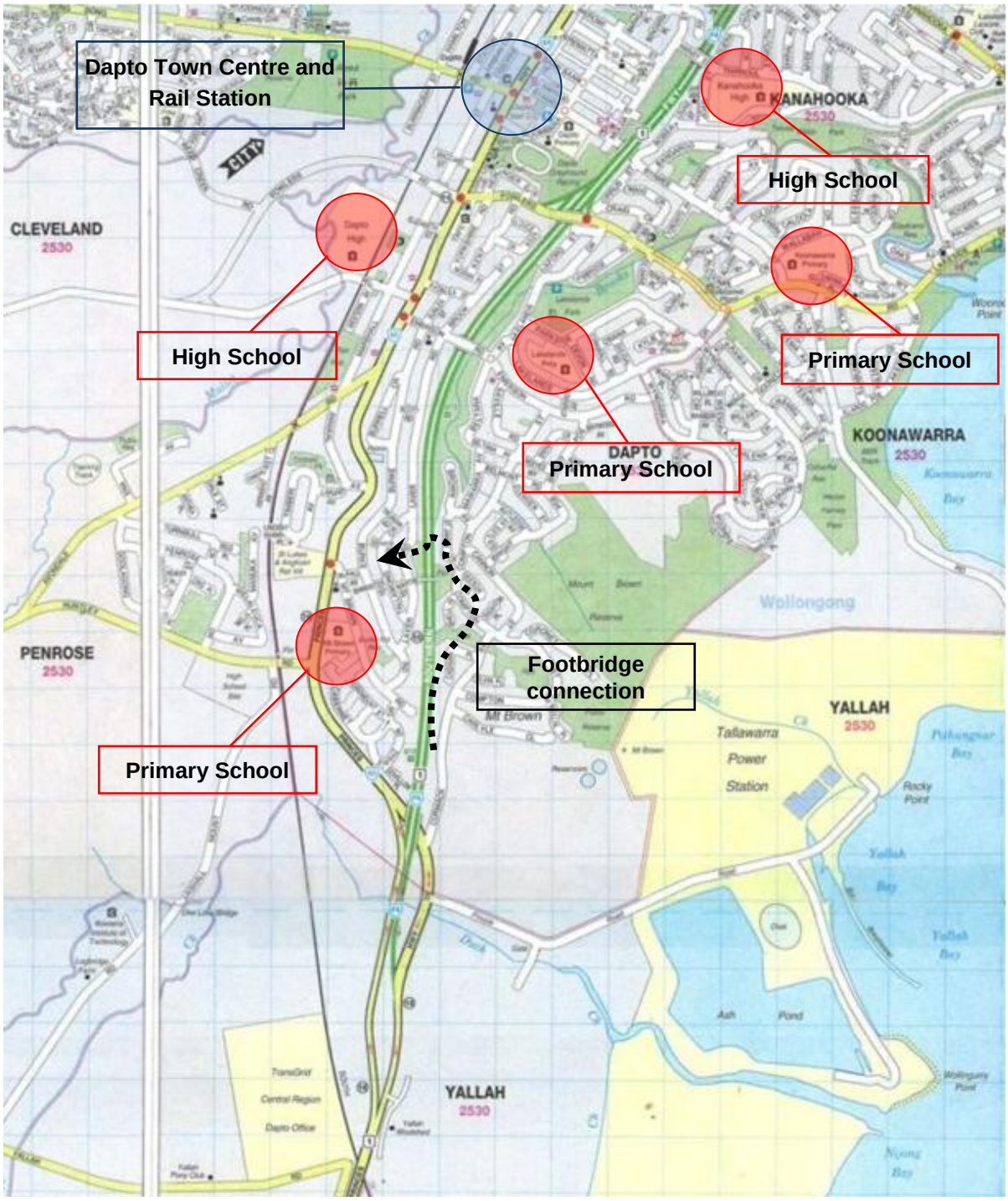
Tallawarra Lands	**Evening Peak Inbound Traffic Flow (With Freeway ramps)**	**Figure 21**
Gabites Porter		



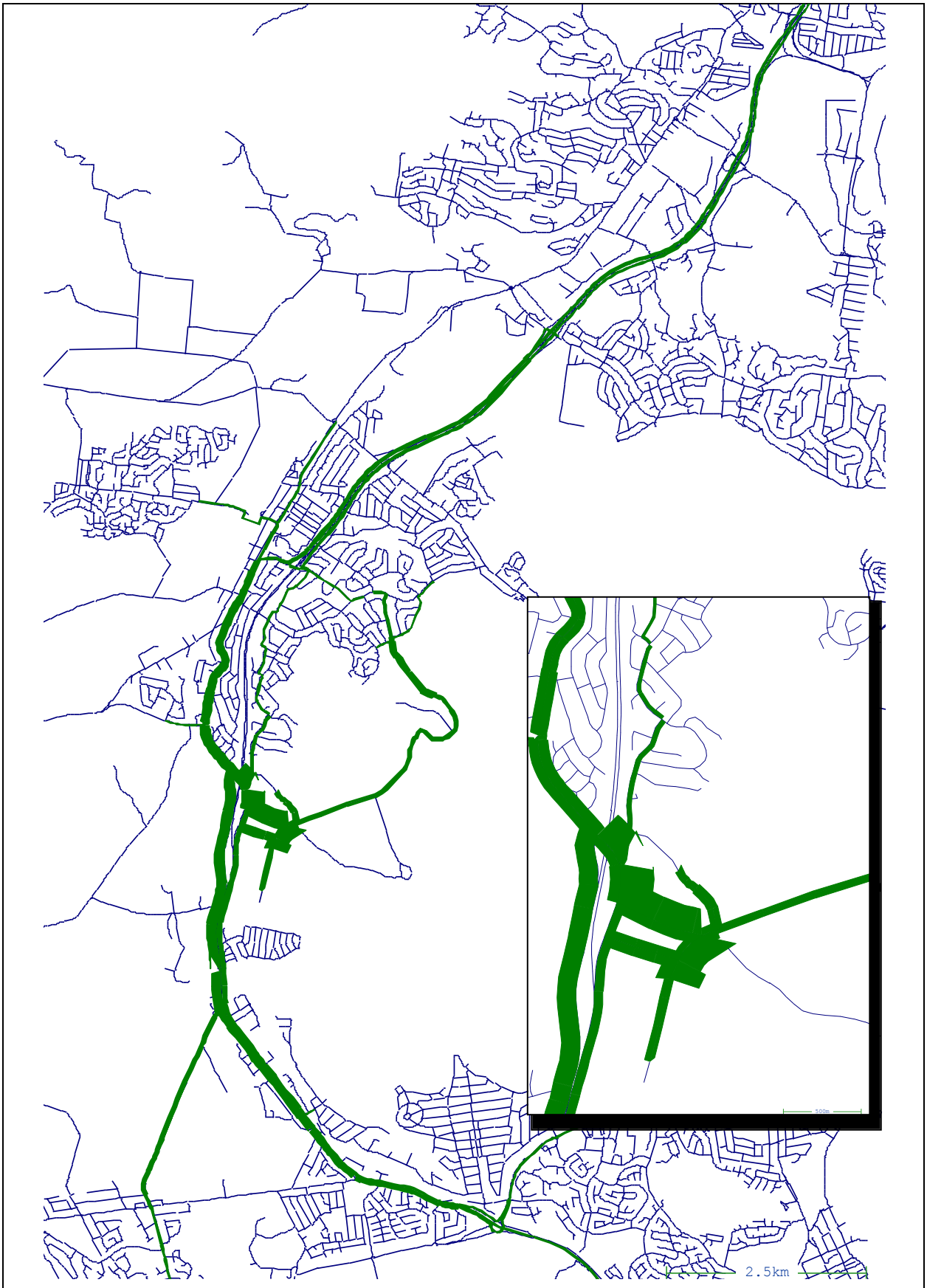
Tallawarra Lands	**Evening Peak Outbound Traffic Flow (No Freeway ramps)**	**Figure 22**
Gabites Porter		



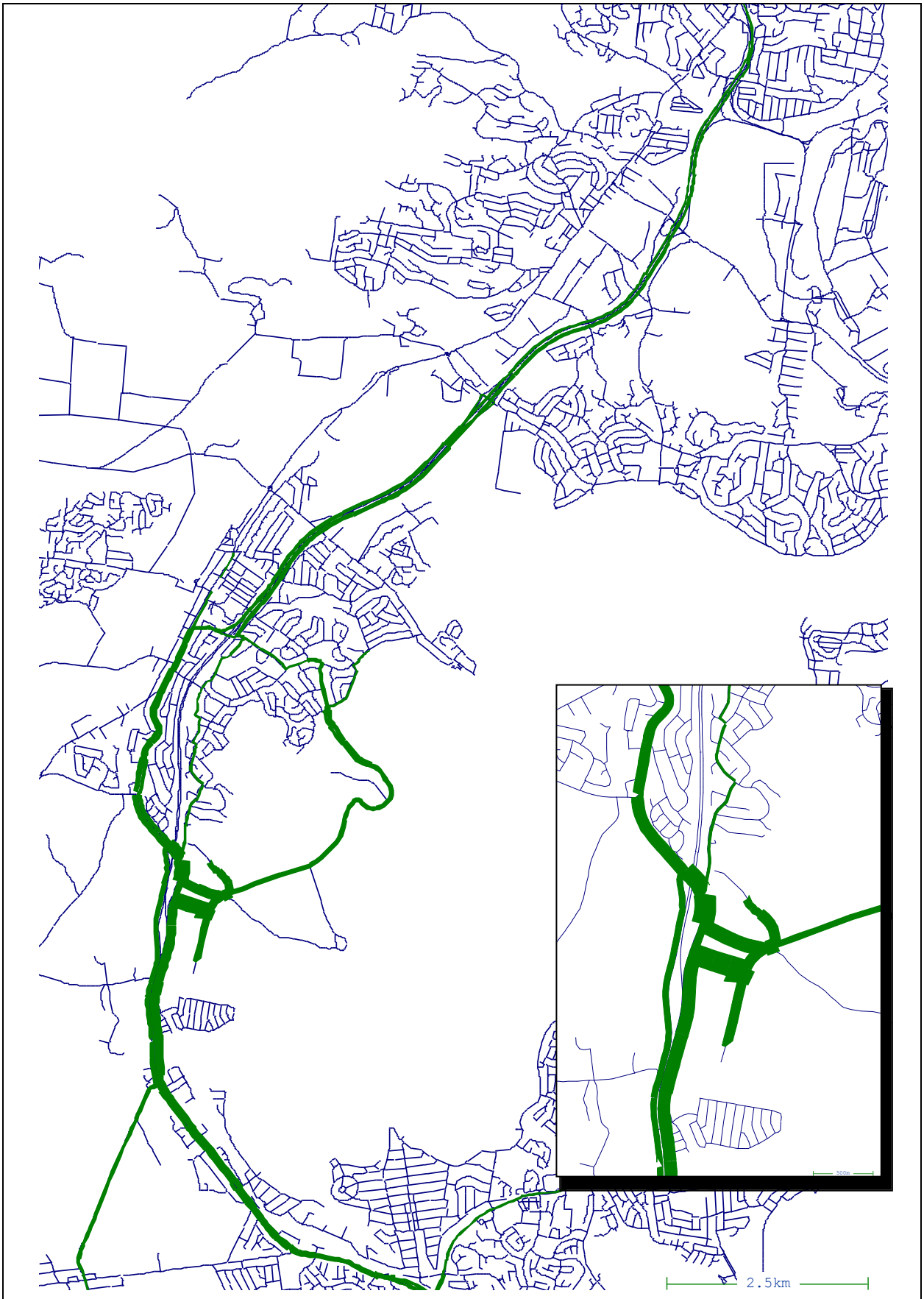
Tallawarra Lands	**Evening Peak Outbound Traffic Flow (With Freeway ramps)**	**Figure 23**
Gabites Porter		



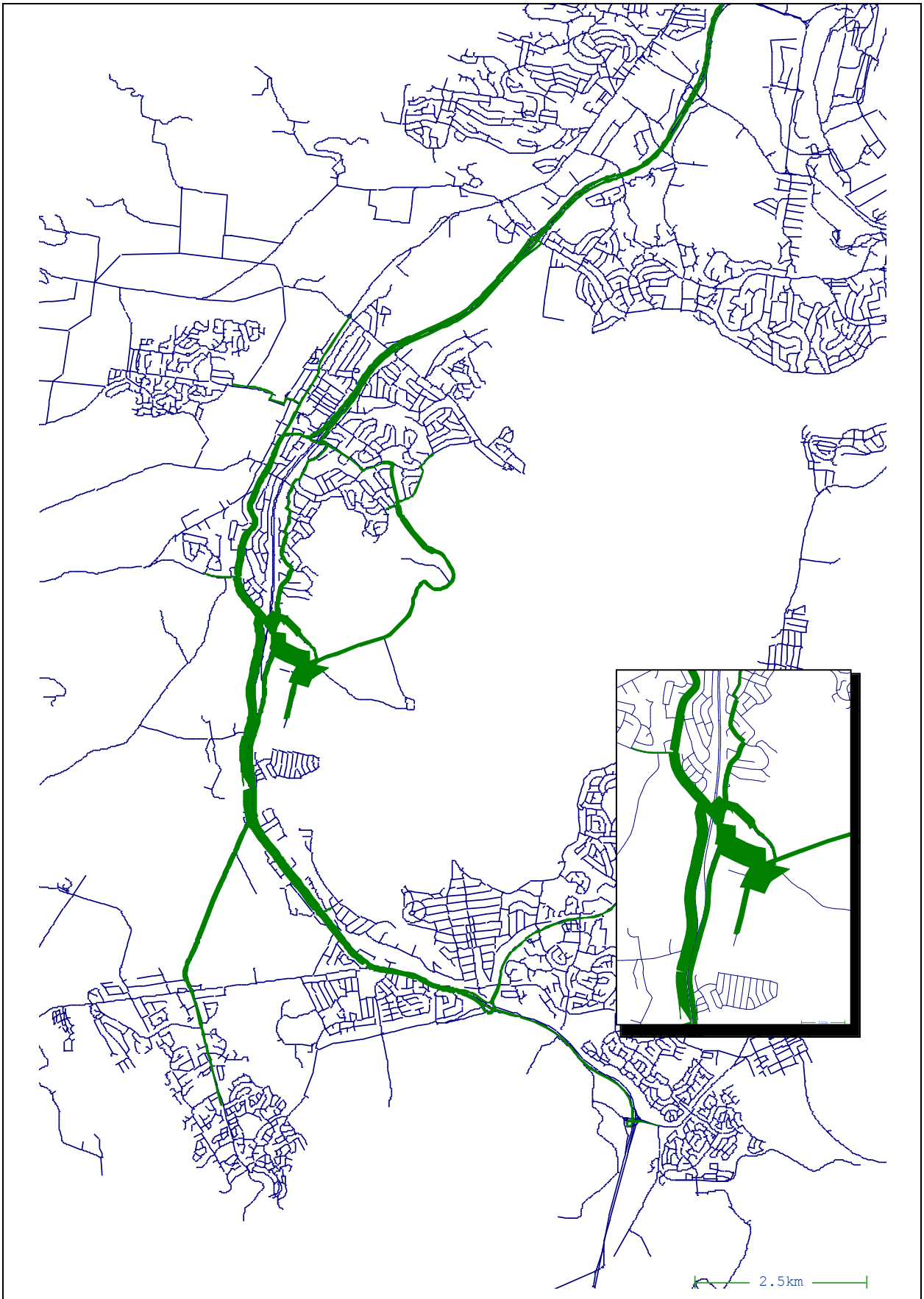
Tallawarra Lands	**Local Area Generators**	**Figure 24**
Gabites Porter		



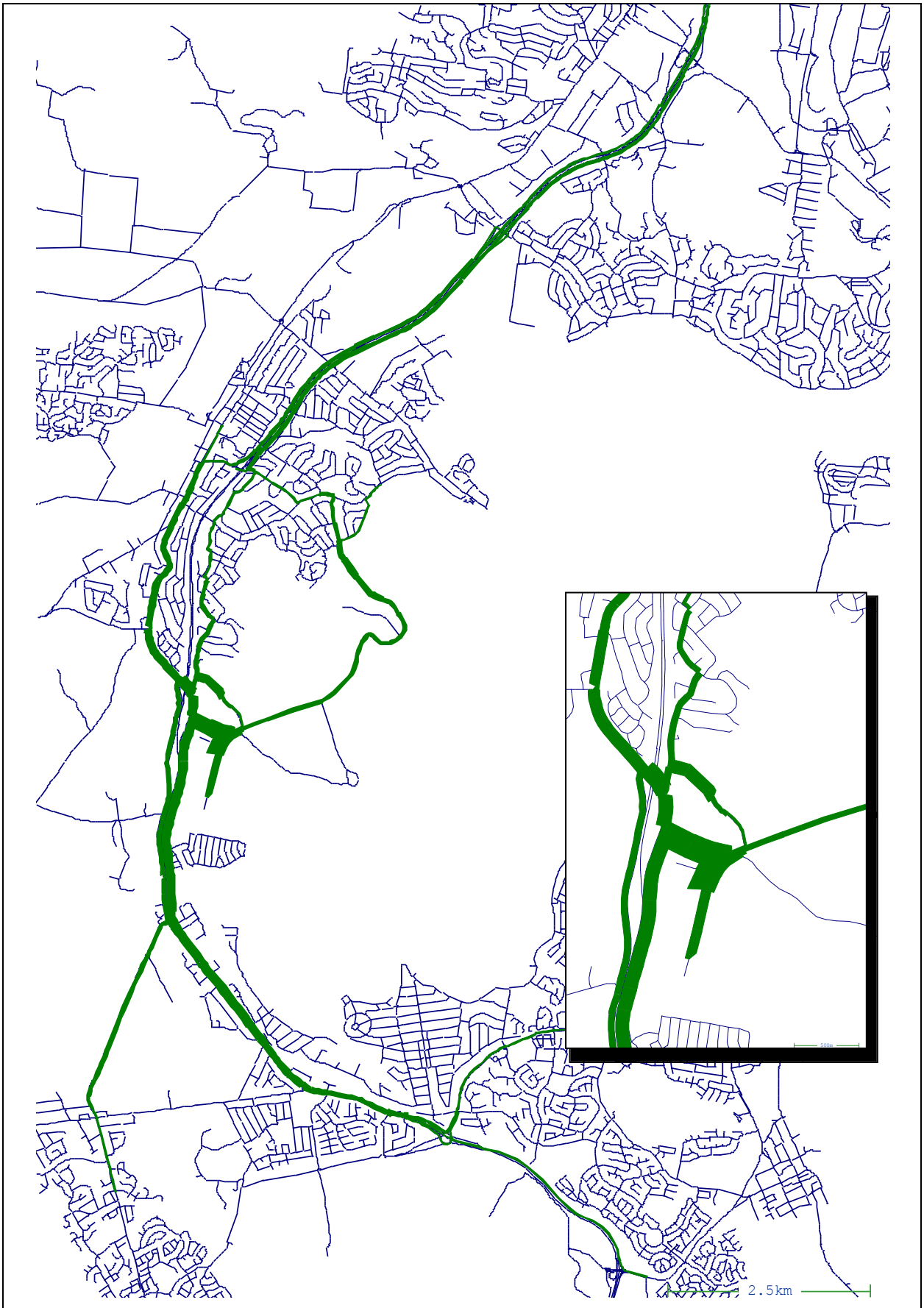
Tallawarra Lands	**Cormack Avenue Closed** **Morning Peak Tallawarra Traffic Flow**	**Figure 25**
Gabites Porter		



Tallawarra Lands	**Cormack Avenue Closed** **Evening Peak Tallawarra Traffic Flow**	**Figure 26**
Gabites Porter		

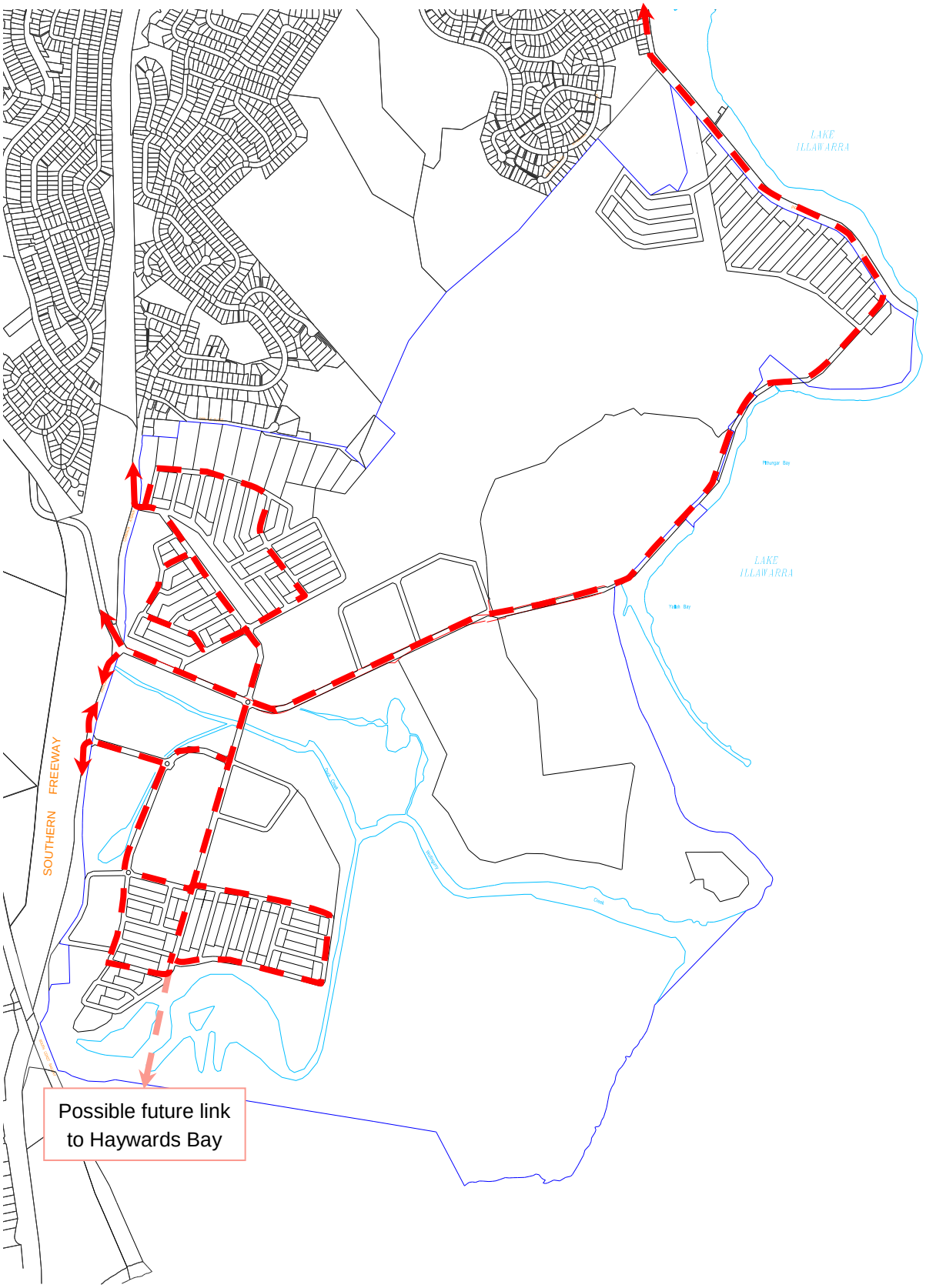


Tallawarra Lands	**Southern Access Closed** **Morning Peak Tallawarra Traffic Flow**	**Figure 27**
Gabites Porter		



Tallawarra Lands	**Southern Access Closed** **Evening Peak Tallawarra Traffic Flow**	**Figure 28**
Gabites Porter		

Tallawarra Lands	**Network Improvements required as result of Tallawarra**	**Figure 29**
Gabites Porter		



Tallawarra Lands	**Indicative Bus Routes**	**Figure 30**
Gabites Porter		

Appendix One
Committed Works

The road networks for 2011, 2021 and 2036 are all based on the 2006 road network. Wollongong City Council has provided changes from the 2006 network for each of the three future years. This has been derived from a study into future road network deficiencies undertaken by Gabites Porter

By **2011**, the following changes will have been made:

- In Wollongong and Shellharbour

- Intersection of Princes Highway/ Colden Drive at Oak Flats changed from priority to signals.
- Intersection of Corrimal Street/ Gipps Street/ Georges Place, Wollongong changed from priority to signals.
- Intersection of Harbour Street/ Cliff Street, Wollongong changed from priority to signals.
- Intersection of Shellharbour Road/Addison Avenue, Lake Illawarra median closure, banned right turn in and banned right turn out.
- Shellharbour Road changed to two lanes in each direction between Wattle Road and Cove Boulevard.
- Single lane roundabout added at intersection of Wentworth Street/Towns Street, Shellharbour
- Single lane roundabout added at intersection of Central Avenue/ Deakin Street, Oak Flats
- Single lane roundabout added at intersection of College Avenue/ Benson Avenue, Shellharbour
- Northern Distributor Extension (you may already have this network coded into the old WOLSH model) - See NDE.pdf
- Lawrence Hargrave Drive / Bulli Pass Interchange upgrade - see LHD_Bulli Pass_HW1.pdf
- Oak Flats to Dunmore, new road alignment + interchange - See Oak Flats to Dunmore.pdf
- Signals added at intersection of Railway Parade/Lawrence Hargrave Drive
- Northern Distributor in place Bellambi Lane to Princes Highway at Molloy Street (refer to RTA for plans)
- Single lane roundabout added at intersection of Kulgoa Road/Park Road
- Single lane roundabout added at intersection of Carrington Street/Campbell Street
- Signals added at intersection of Cliff Road/Bourke Street
- Cliff Road between George Hanley Drive and Marine Drive (+ existing Marine Dr) is traffic calmed, i.e 40 km/h max
- Single lane roundabout added at intersection of Swan Street/Kembla Street
- Single lane roundabout added at intersection of Gladstone Avenue/Lowden Street
- Right turn banned from Osborne Street to Gladstone Avenue
- Right turn banned from Gladstone Avenue to Frederick Street
- Intersection of Masters Road/Drummond Street – left in left out only (median closed in Masters Road)

- Crown Lane From Regent Street to Princes Highway is one-way (east bound direction)
- Left turn banned from Keira St to Princes Highway
- Right turn banned from Keira Street to Burelli Street for both north and south approaches
- Puckey Avenue is a new access road to Innovation Campus from Montague Street –zone 272 also connects to Puckey Avenue
- Third access point to the University from Robsons Road is now open
- Intersection of Murray Park Rd/Uralba St/Bellevue Rd is actually two roundabouts, but code as one
- Gibsons Rd traffic calmed between Cordeaux Rd and Princes Hwy with speed humps
- Right turn banned from Corrimal Street to Ross Street
- Right turn banned from Kemblawarra Road to King Street
- Right turn banned from Hoskins Avenue to King Street
- Right turn from F6 northbound off ramp to Northcliffe Drive permitted
- Signals added at intersection of West Dapto Road/ Princes Highway signals added

- Around Horsley and West Dapto

- Fairwater Drive in Horsley will be extended west to Bong Bong Road and a single lane roundabout added at intersection of Fairwater Drive/ Bong Bong Road
- Fairwater Drive in Horsley will be extended east from Sierra Dr to Cleveland Rd, as per 2026 model layout, with a roundabout at Sierra Dr intersection and at Cleveland Rd intersection
- Signals added at intersection of Cleveland Road/ Marshall Street
- Fowlers Road extended west from Princes Highway to Marshall Street. This link is four lanes, and a two lane roundabout added at intersection of Marshall Street/Fowlers Road
- Right turn banned from Elizabeth Street to Princes Highway
- Right turn banned from Maccabe Street to Princes Highway
- Signals added at intersection of Bong Bong Road/Osborne Road
- Right turn banned from Marshall Street to Bong Bong Rd
- Compton Street between Emerson Road and Cormack Avenue calmed by speed humps
- Single lane roundabouts added at intersections of Weringa Avenue/Karrabah Crescent and Weringa Avenue /Anna Avenue
- Two lane roundabout added at intersection of Princes Highway/Parkes Street

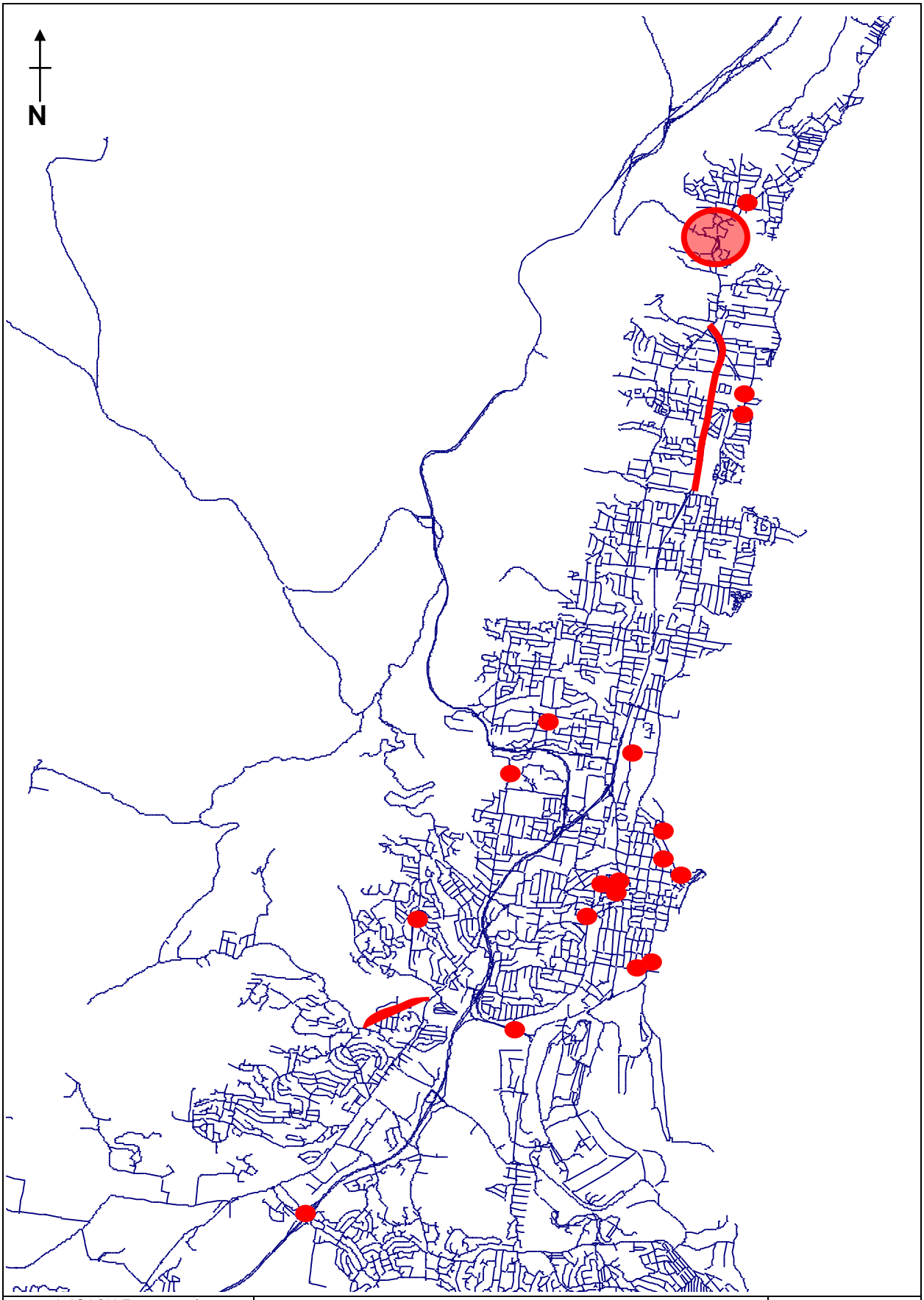
By **2021**, the following changes will be made:

- Skeleton internal network for Stages 1 and 2 of the West Dapto development
- Skeleton internal network for Tallawarra development

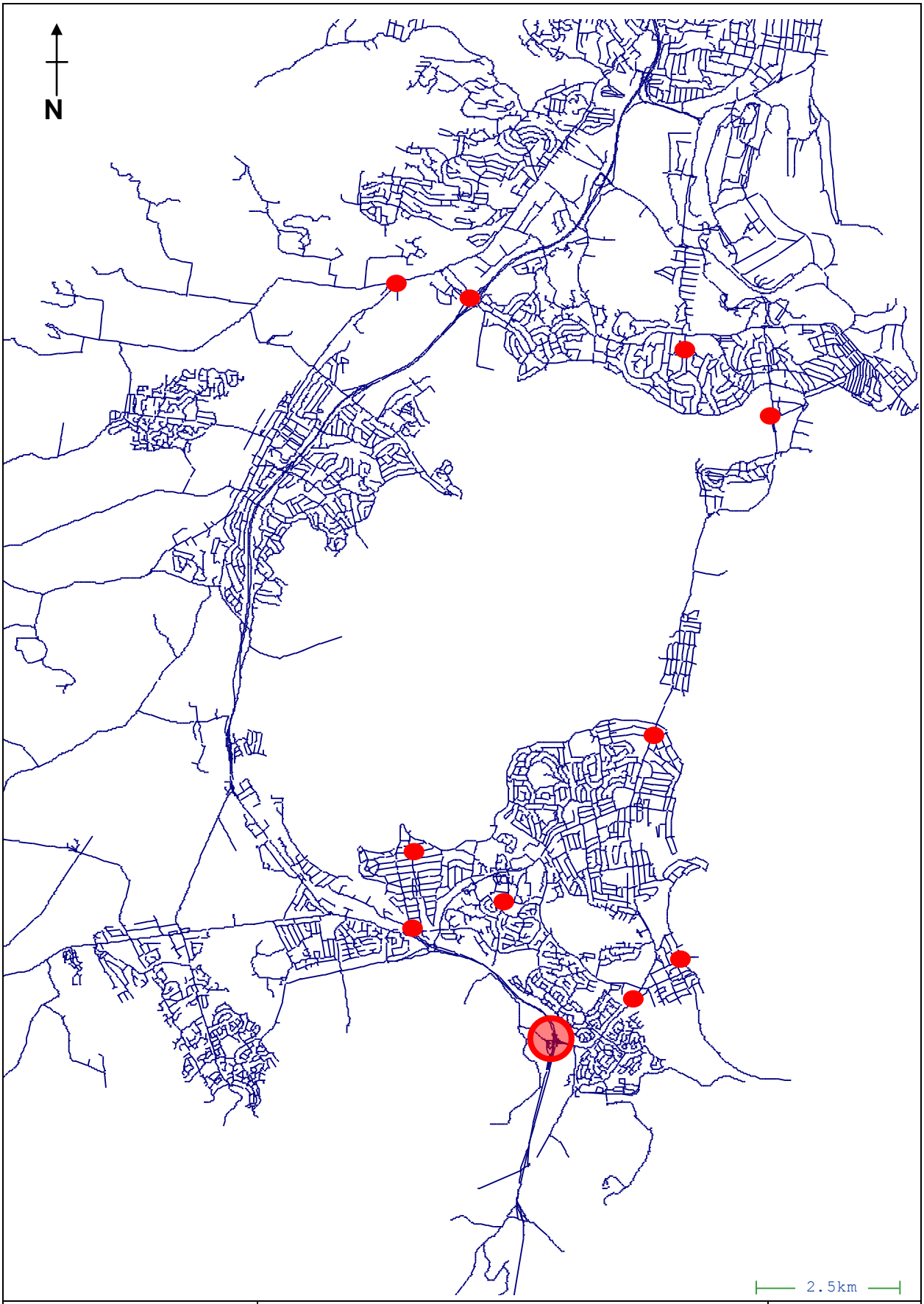
By **2036**, the following changes are made:

- Skeleton internal network for remaining stages of the West Dapto development

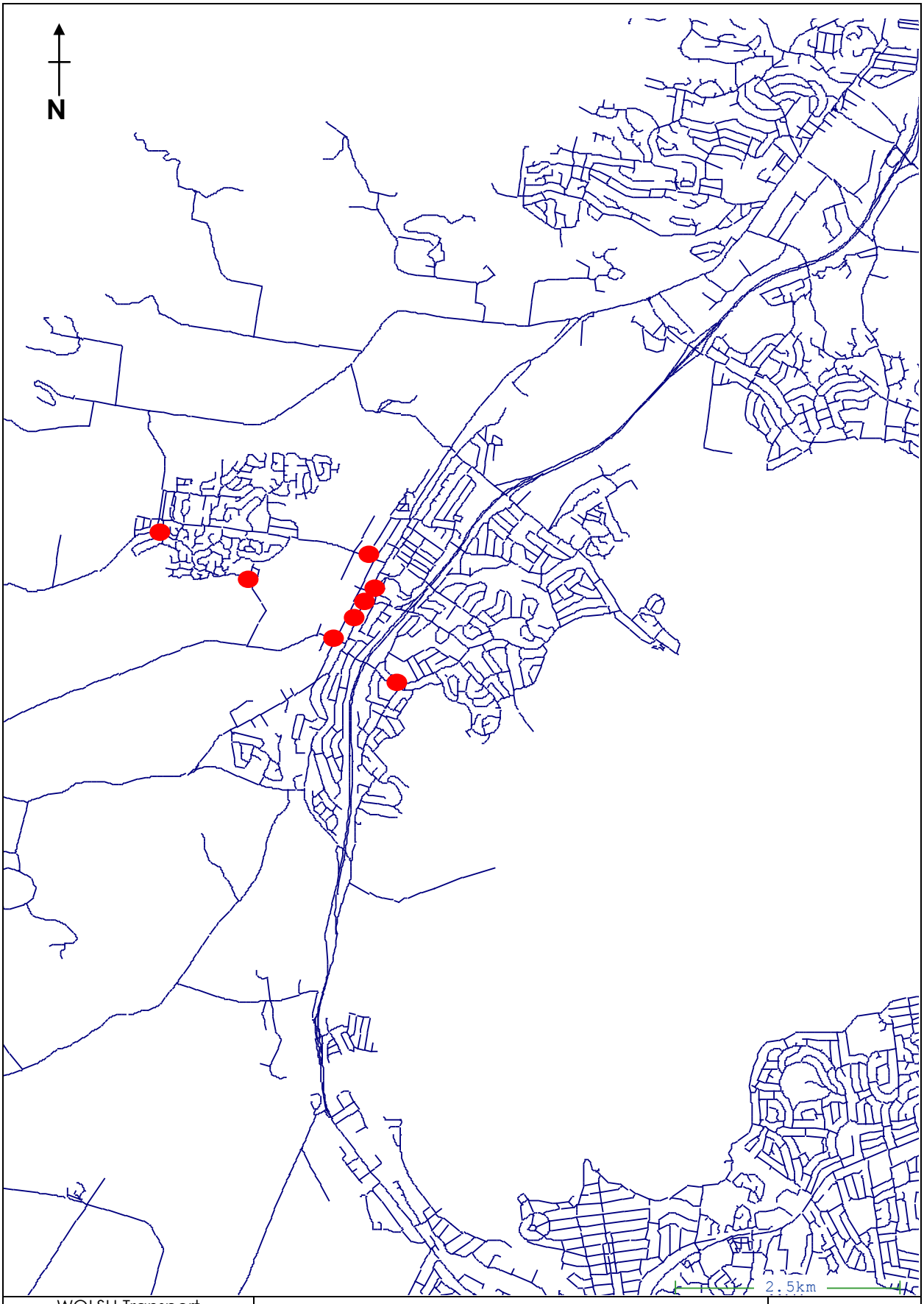
The above road network changes for each year are shown in **FigureA1** through **Figure A5.**



WOLSH Transport Deficiency Assessment 2006/2011/2021/2036	**Wollongong/Shellharbour Network changes – 2006-2011 Northern Area**	**Figure A1**
Gabites Porter		



WOLSH Transport Deficiency Assessment 2006/2011/2021/2036	**Wollongong/Shellharbour Network changes – 2006-2011 Southern Area**	**Figure A2**
Gabites Porter		



WOLSH Transport Deficiency Assessment 2006/2011/2021/2036	**Around West Dapto** **Network changes – 2006-2011**	**Figure A3**
Gabites Porter		

WOLSH Transport Deficiency Assessment 2006/2011/2021/2036	**Stages 1 and 2 West Dapto / Tallawarra Network** **Network changes – 2011-2021**	**Figure A4**
Gabites Porter		

WOLSH Transport Deficiency Assessment 2006/2011/2021/2036	**West Dapto Remaining Stages Network changes – 2021-2036**	**Figure A5**
Gabites Porter		