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July 2007

Update of Tweed Road Contributions Plan (CP No. 4)

Tweed Road Development Strategy - 2007

Prepared for
Tweed Shire Council

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(06-042)

UPDATE OF
TWEED ROAD CONTRIBUTIONS PLAN (CP No.4)

TWEED ROAD DEVELOPMENT STRATEGY - 2007

Project Name	Project No.	Report Name	Version	Date	Author
Update of Tweed Road Contributions Plan (CP No.4)	06-042	Tweed Road Development Strategy - 2007	V.1	July 2007	G.Hunter

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1.0 Introduction

1.1 Background

Veitch Lister Consulting (VLC) undertook the original *Tweed Road Development Strategy Study* during 1996-1997. The findings of that study, in terms of the long-term road improvement strategy identified, formed the basis for preparation of Tweed Shire's first shire-wide Road Contributions Plan, which came into effect in June 1997.

The Shire's long-term road improvement strategy has been thoroughly re-examined and revised in recent years, during the course of several studies:

- The *Banora Point & South Tweed Heads Traffic Study*, by VLC in 2003-2004,
- The *Murwillumbah Distributor Road Network Study*, by VLC in 2005, and
- The *Lower Tweed and Pacific Highway Master Plan Study,* by the NSW Road and Traffic Authority in 2005-2006.

These various studies (particularly the RTA's) have resulted in some reasonably significant changes in the long-term road network now planned for the Shire. As a result of this, and also because of significant increases in road construction costs, the Shire Council recommissioned VLC to assist in updating the Contributions' Plan.

1.2 Purpose of this Report

As the Shire's latest road network improvement strategy has evolved from several studies over several years, the purpose of this report is to provide a comprehensive overview of the processes that have lead to the new version (5.0) of Contributions Plan No.4. Accordingly, this report examines 2 separate issues:

- The traffic studies, which have reviewed and redefined the Shire's long-term road improvement strategy, plus
- The principles, mechanisms and assumptions underlying the schedules of contributions contained in the new Contributions Plan.

1.3 Contents of this Report

This report has 8 chapters and 1 appendix. The remaining contents are as follows:

- **Chapter 2** provides further background relating to the previous and new Contributions Plan.
- **Chapter 3** summarises the *Banora Point and South Tweed Heads Traffic Study.*
- **Chapter 4** summarises the *Murwillumbah Distributor Road Network Study.*
- **Chapter 5** summarises the findings of the RTA's *Tweed Master Planning Study.*
- **Chapter 6** summarises additional traffic modelling / forecasting undertaken by VLC to finalise the Shire's road improvement strategy.
- **Chapter 7** presents the principles and mechanisms that VLC have used to apportion the road improvement costs to development.
- **Chapter 8** describes the updating of the 'cost allocation model' and reviews its outputs.
- **Appendix A** contains Figures.

2.0 Background

2.1 The Legislation

Section 94 of the (NSW) *Environment Planning and Assessment Act (1979)* empowers local governments to levy charges upon new developments in respect of the costs of community infrastructure (including roads) required to support that development:

"94(1) If a consent authority is satisfied that development .... will or is likely to require the provision of or increase the demand for public amenities and public services within an area, the consent authority may .... [require]:
(a) the dedication of land free of cost, or
(b) the payment of a monetary contribution
or both."

The Act and its supporting Regulations require that, as a fundamental precept of any such Contributions Plan, there should be a relationship or nexus between the development and the need for the community infrastructure.

Additionally, and of relevance to the new Contributions Plan, sub-section 94(3) of the Act empowers a local government to levy charges to recoup the cost of public amenities or services that were provided in preparation for anticipated development and from which that development will benefit. In effect, this means the Shire can continue to recover the costs of past improvements from future developments.

2.2 Previous Road Contributions Plans

Version 4.0 of Contributions Plan No.4, as resulted from the *Tweed Road Development Strategy (1997),* was the first Shire-wide plan to recover road infrastructure improvement costs. Prior to this, the Shire had a number of separate plans relating to individual areas. These included 'The Lower Tweed Transportation Contribution Plan No.4', which covered the urban areas north of the Tweed River, plus separate plans relating to Murwillumbah, the Tweed Coastal Villages, and one for the rural areas of the Shire.

In preparing the first Shire-wide plan (v4.0), considerable thought was given to the principles and mechanism by which to apportion the costs of road network improvements to anticipated development. The 'consumption based' philosophy adopted not only meets the requirements of the Act and Regulations, but is considered the most equitable method available. That philosophy and cost apportionment mechanism, as explained more fully in Chapter 7, have been retained in producing the current plan.

Version 4.0 of the plan was amended 9 times (versions 4.1 through 4.9) since 1997. Most of these amendments have involved individual deletions or additions to the 'Works Schedule' and/or 'Project Costings'. None of the amendments have involved changes to the schedules of contributions or a re-examination of land use patterns and traffic demand forecasts.

2.3 Formulation of the New Contributions Plan

Formulation of the new Contributions Plan has involved a number of steps over several years. In summary, these steps have been:

- ***2003-2004:*** VLC undertook *The Banora Point & South Tweed Heads Traffic Study,* for the Shire Council. The original objective of this study was to re-examine the road network improvement options in this area, including the impacts and implications of potential additional development in 'Area E' at Terranora. To undertake this study, VLC developed a new traffic model of the Shire, and also prepared detailed estimates of the Shire's future population and employment levels, based on the *Local Environmental Plan 2000.*

- ***2005:*** As a result residential development pressure in western Murwillumbah, the Shire Council engaged VLC to undertake the *Murwillumbah Distributor Road Network Study,* which examined road network options in and around Murwillumbah.

- ***2004-2006:*** The NSW Roads and Traffic Authority commissioned Parsons Brinckerhoff (PB) to undertake the design development of the *Banora Point Deviation*, a proposal to upgrade and realign the section of the Pacific Highway over Sexton's Hill, linking the Chinderah Bypass to the Tweed Heads Bypass. Early in that study, consultations with the Shire Council resulted in the scope being expanded to also consider the future needs of the Tweed Heads Bypass between Darlington Drive and the Tugun Bypass. The result was the *Lower Tweed and Pacific Highway Traffic Master Plan*, which was completed in October 2006.

- ***2006:*** With the completion of the RTA's planning study, the process of identifying the Shire's long-term road network improvement strategy was essentially complete. VLC were engaged by the Shire Council to update their previous traffic model to reflect the State's proposals, and then to finalise and confirm the Shire's own road network improvement program.

- ***2007:*** With an integrated improvement strategy for both State and Shire roads now finalised, VLC updated their 'cost allocation model' and produced the draft of the new Contributions Plan No.4.

Each of the above studies or steps are summarised in more detail in subsequent chapters of this report.

3.0 The Banora Point and South Tweed Heads Study

3.1 Introduction

VLC were initially engaged by the Shire Council, in 2003, to undertake a study of a number of future land use / transport scenarios in the Banora Point area. A pre-requisite task was to develop a detailed traffic-forecasting model covering the whole of the Shire, for two future planning horizons (2011 and on 'ultimate development'). Once this Shire-wide model was established, it was also used to review the need for and timing of road network improvements elsewhere in the Shire.

The study was essentially effected in 4 stages, which were documented in separate Working Papers, as follows:

- Working Paper No.1 : Traffic Model Calibration
- Working Paper No.2 : Future Demographic Assumptions
- Working Paper No.3 : Traffic Forecasts on Ultimate Development
- Working Paper No.4 : Traffic Forecasts for 2011

Each Working Paper is summarised in the remaining sections of this Chapter.

3.2 WP.1 (Model Calibration)

Model Development

A pre-requisite step to producing future year traffic forecasts is to first develop a 'base year' model. The base year chosen for this study was 2001, as this enabled demographic inputs to be sourced from ABS census data and, also, a comprehensive set of traffic counts from about that time (ie. 2000-2002, inclusive) was available.

The base year model was developed by amending a pre-existing VLC model of South-east Queensland, in which Tweed Shire formed part of the 'buffer area' and was therefore simplistically represented by just 34 traffic zones. The amendments involved addition of significant extra road network detail, including most 'collector' streets, and replacing the coarse zone system with one comprising 446 zones. This level of detail was necessary to accurately model traffic movements at a neighbourhood level.

Model Calibration

The purpose of model calibration is to prove that the base year model can replicate actual, observed traffic volumes from that time, with appropriate levels of accuracy. To undertake the calibration, a database of 344 daily traffic counts was assembled and encoded into the model's GIS format. These counts, which were predominantly from years 2000-2002, were obtained mainly from the Council but were supplemented with additional counts from Gold Coast City, the NSW RTA, and the Qld Main Roads.

The process of calibration involved producing initial 2001 traffic forecasts and then:

- Adjusting input travel parameters to achieve the desired total levels of traffic, and
- Refining the model road network to achieve the correct balance of volumes on individual roads.

There were some difficulties in achieving the desired level of calibration throughout the whole of Tweed, due to it being a mix of urban and rural areas. There were also difficulties modelling traffic related to passive recreation areas such as beaches and rivers, and also sightseeing trips (which do not necessarily take the shortest route between two zones).

Despite these difficulties, the level of model calibration achieved within Tweed (in terms of an indicator called the *Mean Absolute Deviation*) was better overall than VLC had achieved for the original SEQ model, as summarised below.

Table 3.1 : Calibration Comparison

Model	No. of Count Sites	Mean Absolute Deviation		
		Urban Areas	Rural Areas	Overall
SEQ Model	1906[1]	25%	35%	31%
Tweed Model	340[2]	17%	22%	20%

Notes : 1. Within the whole modelled area
2. Within and immediately around Tweed Shire

3.3 WP.2 (Future Demographic Assumptions)

As a precursor to producing the traffic forecasts for both 2011 and on 'ultimate development', VLC undertook a complete review of the Shire's demographic projections. This review involved assessing future potential households, population, education enrolments, and employment, for each of the model's 446 zones within the Shire.

The basic building block for these assessments was 'dwellings' or 'households'. The study's estimates of household numbers on 'ultimate' development, for differing localities, are summarised and compared with the assumptions used in the modelling undertaken for the original *Tweed Road Development Strategy* (TRDS1997), below.

Table 3.2 : Forecast Growth in Household Numbers, By Locality

Locality	Households			
	2001	Growth	Ultimate	(TRDS1997)
Tweed Heads	3,903	+734	4,637	(4,755)
West Tweed Heads	3,931	+7,366	11,297	(9,606)
South Tweed Heads	9,199	+5,736	14,935	(12,516)
Tweed Coast (North)	3,911	+8,510	12,421	(15,068)
Tweed Coast (South)	2,927	+3,147	6,074	(8,355)
Murwillumbah	3,209	+1,856	5,065	(3,821)
Rural	4,320	+2,402	6,722	(5,550)
Total	**31,400**	**+29,751**	**61,151**	**(59,671)**

The above comparison indicates some reasonably significant changes at the locality level, as a result of changes in planning intentions (as embodied in the LEP 2000) or as a result of more detailed appraisal of environmental and other constraints on development yields. The reasons for the local variations were examined and explained at a more detailed level in the original Working Paper.

Despite the local variations, the number of households now ultimately anticipated is about 1,500 or 2.5% more than was estimated in 1996. Based on recent development market yields of 800-1000 lots per annum, the Shire would reach 'ultimate development' sometime between 2030 and 2040.

Despite the slightly higher estimated dwellings, the Shire's ultimate population is now expected to be lower than was estimated by the TRDS1997. This is because of reducing average household sizes (ie. persons per household).

The TRDS1997 (which was largely undertaken during 1996) used 1995 as its base year for modelling purposes. The 1995 demographic estimates (from which the corresponding 'ultimate' estimates were built) were, in turn, based on the 1991 census data. However, as highlighted in the following table, there were significant reductions in average household size in the Shire between 1991-1996 and 1996-2001. VLC's new population estimate of 147,000 is based on these latest trends.

Table 3.3 : Effect of Household Size on the Shire's Population Estimates

Residential Attribute	Census 1996	Census 2001	New Ultimate	TRDS1997	
				1995	Ultimate
Households	27,301	31,400	61,151	25,308	59,671
Population	66,968	74,380	147,266	65,376	155,606
Av. Persons/HH	2.45	2.37	2.41	2.58	2.61

3.4 WP.3 (Ultimate Development Forecasts and Assessments)

The traffic forecasts and assessments undertaken for the 'ultimate development' scenario were structured into 3 packages:

1. A future 'base case' or 'do minimum' network, operating under the ultimate development traffic demands, was subjected to a deficiency review.
2. A sensitivity test, to assess the extent to which the potential development of 'Area E' contributed to the above deficiencies, was undertaken.
3. A number of road network improvement options in the Banora Point / South Tweed Heads area were tested.

Base Case Road Network (Ultimate Development)

It was agreed that the 'base case' network for the ultimate development scenario assessments should be a 'do-minimum' network, in order not to prejudge (or pre-empt) potential future road capacity needs. This base case network consisted of the 2003 network with the additions and improvements listed in Table 3.4, below.

Table 3.4: Base Case Road Network (Major Additions and Improvements)

Road / Section	Type	Standard
1. Pacific Highway (Tugun-Nerang)	Impr.	6 lanes @ 110 kph
2. Tugun Bypass	Add.	4 lanes @ 100 kph
3. Cobaki Parkway (Boyd St – Piggabeen Rd)	Add.	4 lanes @ 70 kph
4. Cobaki Parkway Extn (Scenic Dr – Piggabeen Rd)	Add.	2 lanes @ 70 kph
5. Kirkwood Road Extension	Add.	2 lanes @ 60 kph
6. Leisure Drive (Fraser – Eucalyptus)	Impr.	4 lanes @ 60 kph
7. Leisure Drive (Advocate Pl. – Tweed Bypass)	Impr.	4 lanes @ 60 kph
8. Eastlakes Drive	Add.	2 lanes @ 60 kph
9. Ozone St Link (Chinderah Rd – Elrond Dr)	Add.	4 lanes @ 60 kph
10. Ozone St Link (Elrond Dr – Kingscliff St)	Add.	2 lanes @ 60 kph
11. Turnock St – Crescent St Link	Add.	2 lanes @ 60 kph
12. Tweed Coast Road (Pacific Hwy – Cabarita)	Impr.	4 lanes @ 80 kph
13. Kings Forest Parkway (Chinderah Rd – Town Centre)	Add.	4 lanes @ 70 kph
14. Kings Forest Parkway (Duranbah Rd – Town Centre)	Add.	2 lanes @ 70 kph

Base Case Network Review (on Ultimate Development)

The review of the performance of the 'base case' network, operating under the 'ultimate' traffic demands, indicated the following potential capacity problems in the Shire:

Table 3.5 : Base Case Road Network Deficiencies

Area	Network Capacity Problems
Rural Areas	- None
Murwillumbah	- Alma Street Bridge and the adjoining section of Wollumbin Street.
Tweed Coast	- The Chinderah Road Interchange with the Pacific Highway.
Banora Point / South Tweed Heads	- The Pacific Highway over Sexton's Hill (#) - The Tweed Heads Bypass - The Leisure Drive / Minjungbal Drive Interchange with the Pacific Highway - Entry/exit capacity to the Machinery Drive / Greenway Drive commercial precinct - Fraser Drive, between Leisure Drive and Kirkwood Road (#)
Cobaki Lakes / West Tweed Heads	- Cobaki Parkway, between Piggabeen Road and Bilambil Heights collector road (#) - the whole of Kennedy Drive (#)
Tweed Heads	- some intersections in the CBD may develop problems in the peak hours.

The Working Paper noted that the network deficiencies identified in the preceding tables by a '#' could be addressed by upgrading the road sections concerned. Possible solutions to the other potential problems were discussed further, as follows:

Alma Street Bridge / Wollumbin Street – VLC suggested that the degree of over-saturation forecast did not justify the high costs of duplication of the bridge nor 4-laning of the critical sections of Wollumbin Street. It was suggested that the most cost-effective solution would be to maximise the capacity of the existing roads by implementing peak hour clearways and restricting property access.

Chinderah Road Interchange – VLC noted that while upgrading the interchange was one option, alternatives could involve providing relief, such as:

- Reconfigure the pairs of on/off ramps at Fingal Head and Waugh Street to improve their accessibility to the beachfront areas of Kingscliff.
- Adding an interchange on the Tweed Coast Motorway, connecting to the Kings Forest Parkway, once it is constructed.

Banora Point / South Tweed Heads – VLC suggested that the root of most of these problems was a shortfall in strategic (or arterial) level capacity in the north-south direction. While bridge capacity across Terranora Creek was considered the core issue, ease or directness of local access to that capacity (ie. not having to double-back to an interchange to get onto the Highway) was an important secondary issue.

'Area E' Sensitivity Test

The 'ultimate development' scenario included 'Area E' at Terranora being developed to a potential capacity of 1970 households plus 2 schools. A sensitivity test was undertaken to assess the extent to which this level of development at 'Area E' contributed to the network deficiencies noted above.

In this alternative ultimate development scenario, 'Area E' was assumed to retain its current 'Agricultural' zoning and remain lightly developed. Comparison of the alternative traffic forecasts (with and without 'Area E' developed) indicated:

- The major part of the development's impacts would be accommodated on Shire roads / streets that are either capable of absorbing them or for which improvements would be necessary, anyway.
- The potential impacts of the 'Area E' traffic on the arterial road network will be small (in percentage terms relative to the base levels, without 'Area E'). The 'Without Area E' forecasts also indicated that additional bridge capacity would be justified, anyway.

Road Network Options (Banora / South Tweed Heads)

A number of potential road network options in the Banora Point / South Tweed Heads area were tested and assessed using the 'ultimate development' model (ie. with 'Area E' developed). These options were fully described in Chapter 4 of the Working Paper. Briefly, the options and their performance were:

1. *Sexton's Hill Improvements* – the RTA improvement scheme that was tested (which is now outdated) adequately served 'through' traffic, but disadvantaged local access to the Highway and increased volumes through the Darlington Drive interchange.

2. *Kirkwood Road Ramps* – adding these ramps would have sound benefits (both economic and also reinforcement of the local road hierarchy), including appreciable relief to the Darlington Drive interchange. However, the Terranora Creek Bridge would need to be upgraded to 6 lanes, but there would still be issues with merging/diverging/weaving capacity and safety concerns relating to mixing 'local' traffic with 'long-distance' traffic.

3. *Enterprise Avenue Extension & Off-ramp* – this pair of links would attract minimal traffic, if implemented on their own, and hence provide little relief or benefits.

4. *Additional Terranora Creek Bridge* - this would also provide good benefits (both economic and reinforcement of the local road hierarchy), although not as much as achieved by the Kirkwood Road ramps.

5. *Additional Bridge plus Enterprise Avenue Extension & Off-ramp* – the two components of this scheme complement each other, and provide an overall benefit in excess of their sum. The third access route into the Greenway Drive / Machinery Drive precinct (via the new bridge and Enterprise Ave Extn.) provides sound relief to the two existing access routes. However, the off-ramp would attract 'through' traffic, and is also likely to create a weaving problem on the Bypass due to its proximity to the northbound on-ramp from Darlington Drive)

6. *Winders Place Link to Greenway Drive* – although this would provide a degree of relief to the south end of Greenway Drive, it was not enough to justify the loss of residential amenity, etc.

7. *Dry Dock Road 'Street Calming'* – implementation of speed / capacity restraints halved the volumes forecast on it, but generates appreciable travel disbenefits.

8. *Kirkwood Road Extension* – on its own, this provides small-moderate benefits, which appear enough to justify its construction, irrespective of the other options.

Recommendations (Banora / South Tweed Heads)

These initial traffic forecasts and analyses identified a number of future road capacity problems and made some progress toward identification of their solutions. VLC recommended the following directions for further study:

- *Sexton's Hill* – examine further options, possibly including a short tunnel, but which do not disadvantage local accessibility to the Highway.
- *Greenway Drive / Machinery Drive Precinct* – the extension of Enterprise Avenue to Kirkwood Road provides useful relief to the 2 current access routes, but only if combined with a new route over Terranora Creek.
- *Terranora Creek Crossing* - Three of the network options tested (ie. No's 2, 4 & 5) indicate that South Tweed Heads would benefit greatly from an additional traffic access point serving travel across Terranora Creek. Identification of a preferred solution would require a comprehensive, multi-disciplinary study.

3.5 WP. 4 (Year 2011 Forecasts)

Base Case Road Network (Year 2011)

As with the ultimate scenario, it was also necessary to make some assumptions as to the 'base case' road network that is likely to exist by 2011. Again, the agreed base network was a 'do-minimum' network, with only committed or anticipated works added. The 'base case' road network, assumed to exist by 2011, consisted of the 2003 network with the additions and improvements shown below.

Table 3.6: 2011 Base Road Network (Major Additions and Improvements)

Road / Section	Type	Standard
1. Pacific Highway (Tugun-Nerang)	Impr.	6 lanes @ 110 kph
2. Tugun Bypass (Stage 1, only)	Add.	4 lanes @ 100 kph
3. Boyd Street	Impr.	4 lanes @ 70 kph
4. Cobaki Parkway (North Section)	Add.	4 lanes @ 70 kph
5. Kirkwood Road Extension	Add.	2 lanes @ 60 kph
6. Leisure Drive (Fraser – Eucalyptus)	Impr.	4 lanes @ 60 kph
7. Leisure Drive (Advocate Pl – Tweed Bypass)	Impr.	4 lanes @ 60 kph
8. Eastlakes Drive Extension	Add.	2 lanes @ 60 kph
9. Ozone St Extn. (West section only – no thru' link)	Add.	4 lanes @ 60 kph
10. Tweed Coast Road (Pacific Hwy – Cudgen Rd)	Impr.	4 lanes @ 80 kph
11. Turnock St – Crescent St Link	Add.	2 lanes @ 60 kph
12. Local Streets, Casuarina	Add.	2 lanes @ 50kph

Road Network Review (2011)

A review of the performance of this 'base' network, operating under the 2011 traffic demands, indicated the potential capacity problems in the Shire, as in Table 3.7 on the next page.

NB. Given that the purpose of the 2011 traffic forecasts were simply to help identify the timeframe by which network capacity problems might arise, no alternative network options were tested.

Table 3.7: Road Network Deficiencies in 2011

Area	Network Capacity Problems
Rural Areas	- None
Murwillumbah	- None
Tweed Coast	- Tweed Coast Road, from Cudgen Road to Casuarina, would be approaching its capacity.
Banora Point / South Tweed Heads	- The Pacific Highway over Sexton's Hill would have reached its capacity. - The Tweed Heads Bypass would be approaching its capacity. - The Leisure Drive / Minjungbal Drive Interchange with the Pacific Highway would be approaching its capacity.
Cobaki Lakes / West Tweed Heads	- Kennedy Drive (west of the Bypass) would have reached its capacity.
Tweed Heads	- None

4.0 The Murwillumbah Road Network Study

4.1 Background

The residential development estimates (below), produced by VLC during the Banora Point Study in 2003, indicate that West Murwillumbah will accommodate the vast majority of Murwillumbah's anticipated residential growth.

Table 4.1: Estimated Growth in Households in Murwillumbah (VLC, 2003)

Area	No. of Households		
	In 2001	Ultimately	Growth
East Murwillumbah[1]	561	663	+102 (+18%)
Central Murwillumbah[2]	1,554	1,815	+261 (+17%)
West Murwillumbah[3]	1,094	2,587	+1,493 (+136%)
Total	**3,209**	**5,065**	**+1,856 (+58%)**

Notes : 1. East of the Tweed River
2. East of Barnby Street
3. West of Barnby Street

Based on these demographic estimates, VLC had forecast (during the Banora Point Study) that traffic volumes passing through the town centre (on Wollumbin Street and the Alma Street Bridge) would grow significantly, such that road capacity would become an issue.

It should be noted that VLC's development estimates were based on the areas of undeveloped land zoned "Residential" (ie. zones 2(a), (b) and (c) in LEP 2000). Accordingly, when Council received planning applications in late 2004/early 2005 to rezone or subdivide land in West Murwillumbah that was zoned "Rural" and not accounted for in the above estimates, VLC were engaged to investigate some additional road network options in and about Murwillumbah.

4.2 Scope of Study

To undertake this new study, VLC locally refined the new Zenith model of Tweed Shire. The scope of the study involved:

(a) subdivide the model's traffic zone system in the West Murwillumbah area (this increased the total number of zones in the Shire from 446 to 484);

(b) locally refine the base year (2001) model calibration in the Murwillumbah area, using demographics redistributed to the new zone system and some additional traffic count data;

(c) update and redistribute the 'ultimate development' demographic estimates to the new zone system and produce new "base case" traffic forecasts;

(d) test five potential new road links, in and about Murwillumbah as shown in **Figure 4.1** (in Appendix A), separately and in selected combinations, and assess the benefits of each.

One of the key performance measures, against which the potential new road links were to be assessed, was the degree to which they would reduce traffic volumes on Wollumbin Street and across the Alma Street Bridge.

4.2 Summary of Findings

The key findings of the study were:

Calibration of the Base Year Model

Despite additional effort, the degree of model calibration achieved in the Murwillumbah area (a Mean Absolute Deviation of 22%) was not as good as elsewhere in the Shire (20%). The model's forecast 2001 volumes tended to be low.

In examining the model's forecasts and the various counts in detail, VLC reconfirmed that there are problems in applying urban modelling techniques to rural areas and townships. VLC believe that, due to the relatively small size of the township, the following social practices may contribute to the higher trip making (than in larger urban areas) and hence higher traffic volumes in Murwillumbah:

- making several individual trips rather than a multi-purpose trip;
- going home for lunch regularly, etc.

Review of Ultimate Development Potential

The review of ultimate development potential (in West Murwillumbah) resulted in more of a redistribution of, rather than a significant increase in, the assessed household yields as summarised below.

Table 4.2: Revised Household Estimates (West Murwillumbah)

Sub-Area	Previous Estimates	New Estimates	Change
Inner West[1]	1,266	1,320	+54
Outer West[2]	1,321	1,311	-10
Total	**2,587**	**2,631**	**+44**

Notes : 1. East of Golf Club / Park Ave and west of Barnby St.
2. West of Golf Club / Park Ave. (NB. The reduction was a result of allowing for a proposed 'local centre' on Old Lismore Road that VLC had previously been unaware of. The employment demographics for the area were increased).

Options Tested *(refer Figure 4.1)*

The objective and findings in respect of each potential new road link were:

Link 1 – intended to act as a southern bypass of the township, incorporating a new bridge across the Tweed River. The additional bridge was extremely effective in this respect (used by 7,000 vehicles per day and reducing volumes on the Alma Street Bridge by 5,000 vehicles per day or 25%). Despite being forecast to yield good future economic benefits, the high cost of the bridge was likely to result in a poor Benefit / Cost ratio (ie. < 1).

Link 2 – a new collector road, intended to minimise the impacts of the proposed Barnby Street subdivision upon William Street. The traffic forecasts indicated that the link would be used by about 1,100 vehicles per day and reduce volumes on William Street by 45%. The link would also provide reasonably good economic benefits relative to its cost (some of which would be borne by the developer).

Link 3 – a new collector road which, in conjunction with Joshua Street, would form a western bypass of the town centre - plus, by connecting to Cane Road, also provide a circumferential bypass. The traffic forecasts indicated the link would be used by 3,500 vehicles per day, but would provide only minor relief to the Alma Street Bridge (-500 vpd) due to other secondary effects on traffic patterns. The link would provide

reasonable economic benefits but, with improvements to Cane Road also needed, it may only have marginal economic merit.

Link 4 – adding a new bridge across the Rouse River, to connect Numinbah Road via Joshua Street, to Byangum Road. Again, the intent would be to form a NW circumferential bypass (albeit less direct). While it proved just as effective as a "western bypass" (as Link 3), it was ineffective as a "circumferential bypass", and was not considered further.

Link 5 – this simply involved an amendment to the street network of the proposed Barnby Street subdivision, such that it connected to Byangum Road and *not* to Barnby Street. The amendment was forecast to reduce volumes on Williams Street by about 20% but, in doing so, would have a small economic disbenefit.

The study also investigated selected combinations of these links, being:

- Links 2 and 3 combined
- Links 2 and 4 combined
- Links 1, 2 and 3 combined
- Links 1, 2 and 4 combined.

Following consideration by Council and public consultation, it was decided to implement Link 2 (West End Street extension) and Link 3 (Joshua Street extension to Cane Road).

5.0 The Pacific Highway Traffic Master Plan

5.1 Introduction

In early 2004, the NSW Roads and Traffic Authority engaged Brisbane engineering consultants, Parsons Brinckerhoff Pty Ltd, to undertake the development of project options for the Banora Point Deviation. The deviation, over Sexton's Hill, was intended to provide a fully grade-separated route between the Boyds Bay Bridge and the Tweed Heads Bypass.

It became apparent, early in this planning and design project, that the scope of the study should be expanded to consider the future needs of the Tweed Heads Bypass - particularly its integration with the Shire's road network on either side of Terranora Creek (a "remaining issue" from VLC's Banora Point study). As a result, the RTA and the Shire Council jointly engaged Parsons Brinckerhoff (PB) to develop a master plan for the section of the Pacific Highway between the Chinderah Bypass and the Tugun Bypass.

5.2 Findings / Conclusions

A significant part of PB's planning efforts concentrated on examining and testing differing interchange configurations at Darlington Drive / Minjungbal Drive and at Kirkwood Road / Kennedy Drive.

The preferred options for each interchange, plus an improved arrangement over Sexton's Hill which maintains local accessibility, were combined into a single improvement scheme that could be progressively implemented by the RTA and the Shire, jointly, between 2010 and 2030, as summarised below.

Table 5.1: Elements of the Pacific Highway Master Plan

Element	Timeframe	Funding
Banora Point Upgrade	2010 – 2015	RTA
Kirkwood Road Extension	2015 – 2020	TSC
Terranora Creek (west service road)	2015 – 2020	TSC / RTA
Kirkwood Road (south facing ramps)	2015 – 2020	TSC / RTA
Terranora Creek (east service road)	2025 – 2030	TSC / RTA
Tweed Heads Bypass (widen to 6 lanes)	2025 – 2030	TSC / RTA

6.0 Finalisation of the Road Network Strategy

6.1 Introduction

Following the completion of the Pacific Highway master plan, Tweed Shire Council was in a position to finalise their road network improvement strategy. Accordingly, VLC were engaged (in late 2006) to undertake a final series of traffic forecasts for the Shire's (updated) 'ultimate development' scenario, allowing the Shire to finalise its long-term road improvement program and thence prepare new cost allocation schedules for use in the updated Contributions Plan.

The scope of this final process was:

- the 2001 base year model, containing 486 zones in the Shire (as resulted from the Murwillumbah study) was utilised without amendment;
- the "ultimate" demographics (as resulted from the Murwillumbah update) were amended to reflect Council's decision to allow Tweed City shopping centre to expand rather than establish a new 'District Centre' on the Tweed Coast;
- the "ultimate" scenario traffic model's road network was amended to reflect the Pacific Highway master plan;
- this new "base" network was then used to examine two final issues / refinements:
  - whether there should be a full or partial interchange between the proposed Cobaki Parkway and the Tugun Bypass;
  - to examine the benefits of a new local access link, east of Tweed City, connecting Kirkwood Road East with East Lakes Drive and also to the Darlington Drive interchange.

6.2 The Cobaki Interchange

The updated base network for these final option tests incorporated the proposals from the Pacific Highway master plan, but had no interchange between Cobaki Parkway and the Tugun Bypass (ie. Cobaki Parkway simply passed over the Bypass to connect to Boyd Street).

Traffic forecasts for this new "ultimate development" base network were produced and reviewed for any deficiencies that may have arisen on the Shire's local roads as a result of the proposed changes to the Highway and its interaction with the shire road network. None were found.

Against this new base, two configurations for an interchange with Cobaki Parkway were examined:

- first, with just north-facing ramps linking to the Tugun Bypass;
- secondly, with both north and south-facing ramps.

North-facing Ramps Only

These ramps would allow about 18,000 vehicles a day to gain direct access to/from the north on the Highway. The relief provided to primary roads within Gold Coast City would be significant:

- Boyd Street (down 17,000 vpd)
- Gold Coast Highway, north of Boyd Street (down 12,000 vpd).

The only adverse impact of significance would be a 20% increase in volumes on the section of the Tugun Bypass, between the Cobaki Parkway and Stewart Road interchanges, that would require it to be widened to six lanes.

The economic benefits were found to be significant ($7.2m per annum, in the ultimate horizon), due to about 16,000 vpd being able to take a considerably shorter route.

Both Sets of Ramps

The second assessment examined the additional benefits of adding the south-facing ramps to the partial interchange, above. Compared with the traffic forecasts for the partial interchange, the equivalent forecasts for the full interchange indicated that:

- the 2 southern ramps would be used by about 7,000 vehicles per day (in total), and increase volumes on the southern section of the Tugun Bypass by 5,000 vehicles per day;
- availability of the new route (from Cobaki Interchange to the Tweed Bypass) would reduce volumes on alternative routes, as follows:
  - Gold Coast Highway (south of Boyd St), down by 3,000 vpd
  - Kennedy Drive (west of the Tweed Bypass), down by 1,600 vpd.

While the usage of this second pair of ramps would be less than half of that for the north ramps, the economic benefits were even lower (about $2m per annum, in the ultimate horizon). Despite this, the ramps are justifiable and their ability to reduce volumes on the critical, western section of Kennedy Drive is highly desirable.

6.3 The East Lakes Drive Extension

Council's decision in 2006 to allow expansion of the Tweed City shopping centre acknowledged that further improvements to road capacity in the vicinity would be necessary. The improvement conceived was to provide a new "local bypass" to the east of the centre by:

- extending Davey Street southward to Soorley Street, opposite East Lakes drive, permitting the centre to be accessed from a third (eastern frontage), and
- a further link from East Lakes Drive to the Darlington Drive interchange.

The benefits of this additional bypass and access route were tested in the "ultimate development" model. The findings were:

- the new southern section (between Darlington Drive and East Lakes Drive) would carry about 5,500 vehicles per day;
- the section north of Soorley Street would carry about 3,500 vehicles per day, of which about 2,700 would be to/from the shopping centre;
- the new route would provide relief on Minjungbal Drive, of between 2,500 and 2,800 vehicles per day (being an 8-10% reduction). Although this is a relatively small percentage reduction, it should be noted that almost all would have involved right turn access movements to the shopping centre, hence the improvement to intersection capacity would be greater.

  Economic analysis of the link indicated it would have reasonably good travel benefits (about $1m per annum, in the ultimate horizon). Irrespective of the moderate relief and travel benefits, it is suggested that simply having an alternative route available in emergency or maintenance situations is justification alone.

6.4 The Finalised Network

Based on the preceding forecasts and assessments, the Shire Council confirmed that both network additions (ie. the full interchange and the East Lakes Drive extension) were to be included in the Shire's long-term road network strategy.

With this confirmation, VLC then finalised the 'ultimate development' traffic model. The finalised model network included all road network additions (other than local access streets) and all significant improvements (ie. excluding seal widening, intersection and safety improvements) as summarised in the following tables and shown in the corresponding figures in Appendix A. **NB.** The tables also indicate assumptions as to who will fund the works. Where roads are to be constructed by developers:

- at their own cost, without contributions credits, then "Dev".
- at their own cost, but receive a contributions credit, then "TSC".

West Tweed Heads Area - Refer to **Figure 6.1**, and details below.

Table 6.1: Additions and Improvements (West Tweed Heads)

Road / Section	Type	Funding	Standard
A. Pacific Highway (Tugun-Nerang)	Impr.	MRD	6 lanes @ 110 kph
B. Stewart Road	Impr.	GCC	4 lanes @ 70 kph
C. Tugun Bypass (Stewart Rd to Boyd St)	Add.	MRD	6 lanes @ 100 kph
D. Boyd Street (GC Highway to Inland Dr)	Impr.	MRD	4 lanes @ 60 kph
E. Boyd Street Extn. (Tugun Bypass to Inland Dr)	Add.	MRD	4 lanes @ 70 kph
F. Tugun Bypass (Boyd St to Tweed Bypass)	Add.	RTA	4 lanes @ 100 kph
G. Cobaki Parkway (Tugun Bypass – Piggabeen Rd)	Add.	**TSC**	4 lanes @ 70 kph
H. Cobaki Parkway Extn (Scenic Dr – Piggabeen Rd)	Add.	**TSC**	2 lanes @ 70 kph
I. Cobaki Collector 1 (Town Centre Section)	Add.	**TSC**	4 lanes @ 60 kph
J. Cobaki Collector 1 (Balance)	Add.	**TSC**	2 lanes @ 60 kph
K. Cobaki Access Streets (various)	Add.	*Dev.*	2 lanes @ 60 kph
L. Cobaki Collector 2 (Collector 1 – Cobaki Parkway)	Add	Dev.	2 lanes @ 70 kph
M. Piggabeen Road (Skyline Dr – Cobaki Parkway)	Impr.	**TSC**	2 lanes @ 70kph
N. Kennedy Drive (Cobaki Creek – Barrett St)	Impr.	**TSC**	Pk Hour Clearways
O. McAllisters Road Extension	Add.	**TSC**	2 lanes @ 60 kph
P. McAllisters Road (Existing Section)	Impr.	**TSC**	2 lanes @ 60 kph

Banora Point Area – refer to **Figure 6.2** and details below.

Table 6.2: Additions and Improvements (Banora Point)

Road / Section	Type	Funds	Standard
A. Tugun Bypass / Tweed Heads Bypass Interchange	Add.	RTA	various
B. Northbound Service Road (Nth Section)	Add.	**TSC**	2 lanes Nb @ 70 kph
C. Southbound Service Road (Nth Section)	Add.	**TSC**	2 lanes Sb @ 70 kph
D. Northbound Service Road (Sth Section)	Add.	**TSC**/RTA	2 lanes Nb @ 70 kph
E. Southbound Service Road (Sth Section)	Add.	**TSC**/RTA	2 lanes Sb @ 70 kph
F. Kirkwood Road Extension	Add.	**TSC**	2 lanes @ 60 kph
G. Kirkwood Road On/Off Ramps	Add.	RTA	1 lane @ 70 kph
H. Fraser Drive (Botanical Circuit – Kirkwood Rd)	Impr.	**TSC**	4 lanes @ 70 kph
I. Enterprise Avenue Extension	Add.	**TSC**	2 lanes @ 60 kph
J. Tweed Heads Bypass (Darlington Dr – Kirkwood Rd	Impr.	RTA	6 lanes @ 100 kph
K. Davey Street Extension (to Soorley St)	Add.	**TSC**	2 lanes @ 60kph
L. Darlington Drive / Minjungbal Dr Interchange	Impr.	RTA	various
M. East Lakes Drive Extension	Add.	**TSC**	2 lanes @ 60 kph
N. Elsie Street Extension	Add.	**TSC**	2 lanes @ 50 kph
O. Leisure Drive (Fraser Dr – Woodlands Dr)	Impr.	**TSC**	4 lanes @ 60 kph
P. Leisure Drive (Advocate Pl – Darlington Dr East)	Impr.	**TSC**	4 lanes @ 60 kph
Q. Darlington Drive East (Leisure Dr – Pacific Hway)	Impr.	**TSC**	4 lanes @ 60 kph
R. Old Pacific Hway (Sexton's Hill) incl. Laura St Opass	Add.	RTA	4 lanes @ 70 kph
S. New Pacific Highway (Sexton's Hill)	Add.	RTA	6 lanes @ 100 kph
T. New Collector (Area E)	Add.	**LAC**	2 lanes @ 70 kph
U. New Collectors (Area E)	Add.	*Dev.*	2 lanes @ 60 kph

Tweed Coast Area – refer to **Figure 6.3** and details below.

Table 6.3: Additions and Improvements (Tweed Coast)

Road / Section	Type	Funds	Standard
A. Tweed Coast Road (Pacific Hwy – Cabarita)	Impr.	**TSC**	4 lanes @ 80 kph
B. Ozone Street Extn (Elrond Dr – Chinderah Rd)	Add.	**TSC**	4 lanes @ 60 kph
C. Ozone Street Realignment (Kingscliff St – Elrond Dr)	Add.	**TSC**	2 lanes @ 60 kph
D. Elrond Drive Extension (Beach St – Ozone St)	Add.	**TSC**	2 lanes @ 60 kph
E. New Collector Street (Turnock St – Kingscliff St)	Add.	*Dev.*	2 lanes @ 60 kph
F. Crescent Street Realignment	Add.	*Dev.*	2 lanes @ 60 kph
G. New Access Streets	Add	*Dev.*	2 lanes @ 50 kph
H. New Distributor (Chinderah Rd – Turnock St)	Add.	**TSC**	2 lanes @ 70 kph
I. John Robb Way Extension (to Crescent St)	Add.	*Dev.*	2 lanes @ 50 kph
J. Kingsforest Collector 1	Add.	*Dev.*	2 lanes @ 60 kph
K. Kingsforest Parkway (Duranbah Rd – Town Ctr.)	Add.	**LAC**	2 lanes @ 70 kph
L. Kingsforest Parkway (Chinderah Rd – Town Ctr.)	Add.	**LAC**	4 lanes @ 70 kph
M. Kingsforest Collector 2	Add.	*Dev.*	2 lanes @ 60 kph
N. Casuarina Collector	Add.	**LAC**	2 lanes @ 50 kph
O. Koala Beach – Seabreeze Connector	Add.	**LAC**	2 lanes @ 50 kph
P. New Access Streets	Add.	*Dev.*	2 lanes @ 50 kph
Q. Tweed Coast Road	Impr.	**TSC**	2 lanes @ 70 kph
R. Extension of Collector Road	Add.	*Dev.*	2 lanes @ 60 kph

Murwillumbah Area – refer to **Figure 6.4** and details below.

Table 6.4: Additions and Improvements (Murwillumbah)

Road / Section	Type	Funds	Standard
A. Cane Road (Qld. Rd – Tweed Valley Way)	Impr.	**TSC**	2 lanes @ 100 kph
B. Numinbah Road (Tomewin Rd – North Arm Rd)	Impr.	**TSC**	2 lanes @ 80 kph
C. Cane Road Extn. (Qld. Rd – West End St Extn.)	Add.	**TSC**	2 lanes @ 80 kph
D. West End Street Extn (incl. link to Frances St)	Add.	**TSC**/Dev.	2 lanes @ 60 kph
E. Joshua Street Extn (to West End St Extn.)	Add.	**TSC**	2 lanes @ 60 kph
F. New Access Streets	Add.	Dev.	2 lanes @ 50 kph
G. Riverview Street (Eyles Ave – Wollumbin St)	Impr.	**TSC**	2 lanes @ 60 kph
H. North Arm Road (Numinbah Rd – Castlefield Dr)	Impr.	**TSC**	2 lanes @ 100 kph
I. Castlefield Drive Extension	Add.	Dev.	2 lanes @ 60 kph
J. Old Lismore Road (Riveroak Dr – North Arm Rd)	Impr.	**TSC**	2 lanes @ 60 kph
K. Riveroak Drive Extension	Add.	Dev.	2 lanes @ 60 kph

6.5 Traffic Forecasts (Finalised Network)

The traffic volumes forecast on the finalised long-term road network, on "ultimate development" of the Shire are presented in the following figures:

Table 6.5: Summary of Traffic Forecasts

Area	Daily	AM Peak	PM Peak	
Cobaki	Figure 6.5	Figure 6.5a	Figure 6.5b	*
Various Interchanges	Figure 6.6	Figure 6.6a	Figure 6.6b	*
Banora	Figure 6.7	Figure 6.7a	Figure 6.7b	
Tweed Coast	Figure 6.8	Figure 6.8a	Figure 6.8b	
Murwillumbah	Figure 6.9	Figure 6.9a	Figure 6.9b	
Rural	Figure 6.10	Figure 6.10a	Figure 6.10b	

7.0 The Underlying Philosophy of the Plan

7.1 Background

Version 3.0 of Contributions Plan No.4, as resulted in 1990 from the Lower Tweed Transportation Study (LTTS), pioneered such contributions' plans in NSW, if not Australia. The underlying philosophy embodied in that plan is still valid today.

Preparation of the first Shire-wide plan (Version 4.0) encompassed a thorough review of the LTTS based plan, taking account of:

- Experience with practical application of the Tweed plan,
- Advancements in analytical methods, and
- Refinements made to the original principles, when applying them in other jurisdictions.

The TRDS-1997 presented and justified a number of refinements to the principles and processes to be used in allocating the road network improvement costs, from those used in the LTTS.

Before presenting and examining the actual principles and numeric methods used by TRDS-1997, it is first useful to review some of the issues relevant to transport demands and networks.

7.2 The Dynamics of Transport Systems

Transport systems or, more particularly road networks, have a number of idiosyncrasies that make them different from other public utility networks (eg. sewerage and water) that are also covered by Section 94 Contributions Plans. The primary differences are:

Open/Closed Networks

Water and sewerage networks are, by and large, "closed" networks. For example, a water reticulation network branches out (using diminishing pipe sizes) from the reservoir to the households or consumers that it serves. The network is "closed", in that the potential demands on the reservoir, or for that matter on any link in the pipe network, can be attributed to a specific group of households.

However, road networks are "open", in that they generally provide multiple routes (from A to B) and also connect to external jurisdictions (allowing 'through traffic').

Static/Dynamic Demands

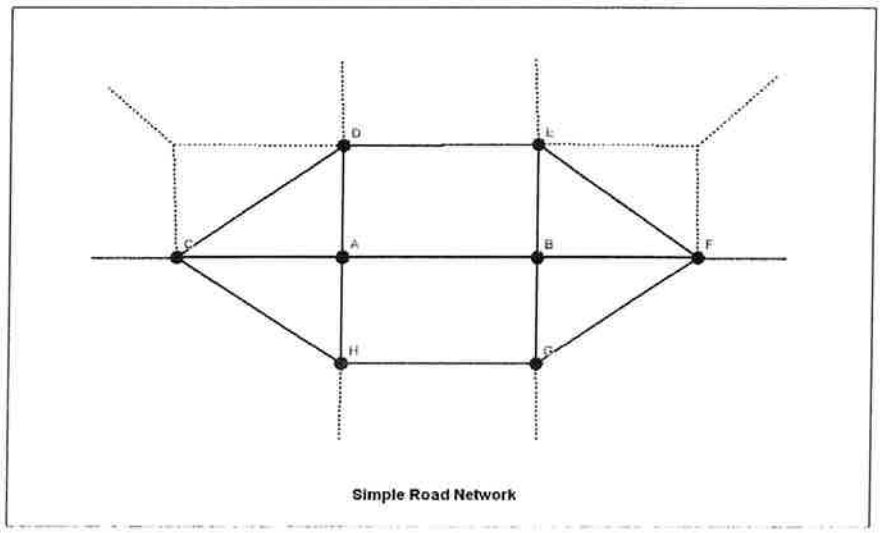
The demands on any link in a water reticulation network can be clearly attributed to a specific group of consumers. If a new sub-branch is added to serve a new subdivision, one or more upstream links (or downstream in the case of sewers) may need to be upgraded. However, in determining the required upgrade, the demand pattern of the existing consumers on that link will not change as a result of the upgrade. In other words, the demands of the consumers are 'static' and additive.

Traffic demands are, however, 'dynamic'. Not only will differing drivers potentially take differing routes (between the same 2 places), but some may vary their route by time of day. Additionally, as the extra demands of new development is added to the network, the dynamics act as follows:

- If a road link is upgraded, 'existing' demands can change in two ways:
  - route changes – because of the improved level of service on the upgraded link, some drivers making 'existing' trips may divert onto it from their previously preferred route;
  - trip changes – the upgraded link will provide improved 'accessibility' to some destinations relative to others. As a result, some people may change their travel patterns (eg. shopping at a different supermarket that is now easier to get to).
- If a link is not upgraded, the reduction in level of service resulting from the new users can result in the 'existing' users of the link diverting to a differing route (eg. a rat-run). This may cause the level of service on this second route to also diminish, even though none of the new traffic uses it. Again, if the service reduction on the original link is significant, choice of destination may change.

The Effects of Augmentation

The 'dynamics' of traffic demands upon an 'open' network, provides transport planners the opportunity to address a forecast deficiency by providing a new or upgraded link elsewhere in the network, rather than upgrade the deficient link itself. For example, consider the schematic road network below.



Simple Road Network

By considering just the "solid" lines in this diagram, the network could represent a rural town through which a main highway passes. By also considering the additional "dotted" links, the network could represent part of a more extensive urban network.

In either (urban or rural) scenario, let's say Links C-A-B-F is the main road and is already carrying reasonable volumes of 'through traffic' (i.e. from C and beyond, to F and beyond), such that Link A-B is nearing its design capacity. If further development is envisaged at both nodes A and B, the expected growth in traffic on Link A-B would result in an unsatisfactory level of service.

However, rather than upgrade Link A-B (possibly due to land acquisition costs), it is considered more cost-effective to improve Link D-E, such that Links C-D-E-F act as a bypass or a more attractive alternative for some trips that would otherwise pass through both A and B. In this situation, little if any traffic generated by any of the anticipated developments at A or B would reasonably choose to travel from A to B or vice versa using the improved Link D-E, yet the improvement is necessary to support the anticipated developments.

This is just one example of the complexities of transport planning, but it serves to demonstrate that the need for a new or improved road link can not be directly attributed to the developments whose traffic will ultimately use it. As a result, TRDS-1997 formulated a new 'whole of network' approach to allocating the cost of road network improvements to future development – a consumption-based approach.

7.3 The Objectives of the Plan

As a prerequisite to refining the Plan's cost allocation principles, TRDS-1997 stated its objectives as:

- A need for transparency,
- A mechanism which is fair and equitable, both location-wise and over time,
- A need to reflect the nexus between development and its impact on transport capacity requirements,
- A charging regime which encourages efficient land use patterns in terms of transport provision, and
- That no pre-existing development should pay for future road network capacity, after existing deficiencies have been redressed.

7.4 The Core Philosophy and Relevant Issues

The essence of the philosophy used by TRDS-1997 was to allocate the cost of road network improvements to future development based on the value of road space 'consumed' by such development in the future network.

This simple philosophy only became possible with advancements in numeric methods, which VLC pioneered at the time. Despite its simplicity, a great deal of thought and discussion was involved in justifying and confirming the acceptability of this methodology. Several of the critical questions, which had to be answered, were:

- Is future development being charged for use of existing roads?
- Why use differential charges rather than a Shire-wide average?
- Where is the nexus between the charges and the improvements?
- How are existing deficiencies accounted for?
- How are the costs of accommodating 'through traffic' accounted for?
- Is future development charged for the residual capacity of the improvements?

Charging for existing roads?

The values of road space consumed by future development are calculated using the ultimate development traffic loadings on the long-term road network, which necessarily includes the existing network. However, the plan is not charging for use of existing roads - the consumption valuations are simply the means by which part of the road improvement costs are apportioned to future development in different locations (rather than use a Shire-wide average charge).

Why have differential charges?

Although a Shire-wide average charge could be calculated such that both methods could recover the same total cost, the differential locality-based charges are considered more equitable, in that:

- they better reflect the nexus between road capacity requirements and the developments that generate that need, and
- they promote more efficient land settlement by discouraging the (early) development of land that is costly to service.

Where is the Nexus?

The nexus between the long-term road improvement strategy and the anticipated development in the Shire was examined and demonstrated in the various traffic studies and assessments that were undertaken in the lead up to preparing the new Plan. Each of these studies has, in some way, started with existing or 'do-minimum' road networks and, after deficiency analysis, has examined and tested various improvement options in an effort to identify an optimal road network solution, that balances cost and functionality.

Charging for Existing Deficiencies?

The required nexus between future development and the road improvements implicitly excludes the cost of addressing existing deficiencies. TRDS-1997 argued that this separate evaluation step was not necessary. The basis of this contention was that, under the consumption-based method, Council would only recoup the cost of that part of the capacity required to serve future development. By way of example:

- Consider a section of road that currently carries 9,000 vehicles per day (vpd) but only has a design capacity of 8,000. The cost of supplying the additional 1,000 vpd capacity is $1X; this is Council's deficiency obligation. Council could invest $1X, but then the road has no capacity to sustain future growth.
- However, if Council invested $8X to provide a road with a capacity of 16,000 vpd, it would redress the deficiency and have surplus capacity of 7,000 vpd with which to accommodate future development. Council could ultimately recover the extra $7X invested by 'selling' the capacity to future development.
- In both cases, Council is ultimately 'out of pocket' for the $1X needed to redress the deficiency. What is important is that adequate capacity is provided, although Council may have to carry the extra cost for some time.

While TRDS-1997's arguments are valid, it should be noted that, at the effective commencement of the Plan (ie. Version 3.0 in 1991), the existing (capacity) deficiencies were minimal and their historic costs are now an insignificant part of the overall improvement program.

Charging for Residual Capacity?

When roads are improved, they are normally improved in single lane increments. Accordingly, there are numerous situations where the additional future traffic will trigger (and sometimes, 'just' trigger) the need for such an upgrade, such that the improved road will have significant spare or residual capacity. The dilemma is then whether the future development (in total) should:

- fund the full cost of the improvements necessitated by them, or
- fund only that part of the improved capacity which is expected to be utilised.

The Act is not specific on this; other than to suggest only a 'reasonable' contribution may be imposed. In terms of reasonableness:

- it would be unreasonable for future development to utilise existing spare capacity free of charge and then expect the existing community to 'buy back' the unused (or residual) component of the improvement, if the level of service after improvement and traffic growth is much the same as currently exists or is worse.
- it would be unreasonable for future development to pay for the full cost of the improvements, if the existing community ultimately benefits from an improved level of service.

Basically, it comes down to whether, ultimately (after the improvements and the additional traffic), the existing community benefits from improved overall levels of

service or not. In this respect, there are several ways of assessing whether the existing community ultimately benefits or not:

- by comparing overall level of service (in terms of a performance indicator know as the Volume/Capacity or V/C ratio), and/or
- by comparing the value of the reserve capacity in the base year and future networks.

The latter approach has 2 useful aspects:

- it yields a $ value, by which the existing community could be considered to benefit (if, in fact, it does) and hence the proportion of the improvement program that they (as opposed to the future development) should reasonably fund, plus
- it enables a concept of the Council acting as a merchant custodian of the community's reserve capacity, whereby it can sell existing road capacity to new development and then replenish its stocks by purchasing a road improvement.

Council, the Merchant Custodian

This analogy of the Council acting as a merchant custodian of the community's reserve capacity allows rationalisation of a number of practical issues:

- Reserve capacity in different areas can be considered different products. If the market demand for reserve capacity in an area is high, the Council must replenish inventory of that particular product (to maintain levels of service). In reverse, if market demand in a different area is slow it can sell down its inventories of that product, before it needs to restock.
- In situations where non-conforming uses arise, as a result of planning applications, then subject to a traffic impact assessment:
  - If impacts are small and sustainable, Council may simply sell existing reserve capacity, without replenishing inventories and without re-evaluating its unit costs.
  - If impacts are large and require a new product, Council has the option of saying 'buy it yourself' or 'we'll buy in the capacity, but because we don't think we can sell much of the surplus, we'll charge you a higher margin."
- This latter (adverse impact) situation is effectively what the Local Area Works programs are all about. These are works items, which almost entirely benefit specific groups of developments. Because their reserve capacity is of no use to the wider community (even in the future), then Council apportions the full cost of these works to the said developments via a Local Area Contribution. NB. These LAC roads are excluded from the road space consumption valuations.
- If the cost to Council of purchasing road improvements increases, then its inventory of spare capacity should be revalued and its sales prices adjusted.
- A significant change to the future land use pattern, either through a major rezoning or a total reveiw of the planning scheme, could be likened to a change of ownership (from the 'previous existing' community to the new 'current existing' community). In this situation, a full inventory stock-take and balance sheet would need to be prepared before the transfer.

Costs of 'through traffic'?

The TRDS-1997 discounted the costs of accommodating 'through traffic' (ie. trips with neither end in the Shire), using the same arguments as it applied to existing deficiencies. Given that the RTA's Pacific Highway serves by far the majority of the Shire's 'through traffic', its impacts on the Shire's own roads are largely confined to the Tweed Heads / Coolangatta border area and are relatively small.

Many of the preceding issues are examined, using the 'cost allocation model' outputs, in the next Chapter.

7.5 Concluding Comments

VLC see no reason why the TRDS-1997 charging philosophy and apportionment mechanisms should not be reused in the proposed update of the plan, subject to the following:

- Any principal roads (ie. capable of carrying 'non-local' or 'through' traffic), which will be constructed by developers at their own cost and without credit toward contributions due, should not be included in the network valuations used to determine the generalised charge rates.
- Similarly, roads that are the subject of a 'local area contribution' should similarly be excluded from the network valuation.
- For transparency, 'existing deficiencies' and future 'through traffic costs' should be specifically accounted for.

8.0 The Consumption Model

8.1 Introduction

As discussed more fully in the previous chapter, it was agreed with the Shire Council that the consumption-based approach, developed and adopted by TRDS-1997, is still valid and appropriate for continued use in the new (Version 5.0) Plan.

The actual numeric processes involved in calculating the unit values of road space consumed are as follows:

a) Value all roads in the future Shire network, at current day replacement cost.
b) Assign the future traffic demands to the future network.
c) Determine the value of Tweed Shire road space (excluding those in Local Area Plans and those constructed by developers at their own cost) consumed by all trips generated or attracted by all modelled zones within Tweed Shire:
   - Where both trip-ends would be within the Shire, half of the consumed value is attributed to origin zone and half to the destination zone.
   - Where one trip-end would be external to the Shire, the full value of the Tweed road space consumed is attributed to the Tweed zone.
d) The zonal values of road space consumption are aggregated to the 14 sectors, as are the number of trip-ends generated or attracted by each sector.
e) The 'average value' of road space consumed per trip-end in each sector is calculated from these aggregated road space values and trip-ends.

Some of the inputs and outputs of these steps are described in the following sections.

8.2 Review of Sector Boundaries

The sectors or areas used in TRDS-1997 for calculating the differential charges were based on the TRDS-1997 traffic model (which represented the Shire by 239 zones). The boundaries were chosen, as far as possible, to coincide with natural and community boundaries.

The new traffic model, used for these new calculations, contains a much finer zone system in many areas (a total of 486 traffic zones within the Shire). Using this new model to update the Contributions' Plan provided the opportunity to review the sector boundaries, in the context of the model's more detailed zone system.

The agreed changes, as resulted from the review, are shown and compared with the previous boundaries in **Figure 8.1**, and are:

- One of the principal changes was to split Sector 12 into 2 sectors, as it was thought that this would be more equitable in terms of the resulting charges.
- Sector 5 (Terranora) was expanded to include areas accessed from Terranora Road or McAuley's Road, north of the Tweed River, plus areas accessed from Bilambil Road, south of Bilambil Creek.
- Sector 6 (Kingscliff) was expanded to include land accessed from Cudgen Road and Plantation Road.
- A number of the boundaries were 'cosmetically' refined to coincide with cadastral lot boundaries and the new traffic zone system.

8.3 Encoding of Road Valuations

A pre-requisite step to the modelling process is to estimate a (current day) value for every link in the 'ultimate development' model's road network. Clearly, given the diversity of road standards, intersection treatments, etc, which exist in the actual road network at present, it is impractical to inspect, measure and cost every feature of every road. To produce this road network valuation, a simplified and generic approach, involving relatively broad assumptions, was needed.

A starting point in this valuation exercise was to review the schedule of 'project costings', provided by the Shire, with particular attention given to completely new road links for which land acquisition costs had been estimated. The Shire's schedule of 'unit costs' (as was used to calculate individual project costs) was also closely examined. Based on this review, a set of generic (per kilometre) valuations was derived for eight typical road types, as follows.

Table 8.1: Generic Road Type Valuations

Road Type	Cost per Kilometre ($000)					
	Land	**Costn.**	**Int'sectn**	**Lighting**	**Drainage**	**Total**
Rural – 2 lanes:						
Primary	1,200	1,040	38	13	-	2,290
Secondary	800	715	5	13	-	1,532
Tertiary	400	495	-	-	-	895
Urban – 2 lanes:						
Primary	3,000	1,235	240	126	20	4,621
Secondary	2,040	900	267	105	20	3,332
Tertiary	1,400	560	100	85	20	2,165
Urban – 4 lanes:						
Suburban	4,500	2,090	500	252	20	7,362
Commercial	7,000	2,375	1,110	252	20	10,757

These road valuations were encoded into the future model network. Additionally, the estimated cost of major bridges was added to the relevant links in the model network, using the estimated cost of the proposed bridges or a value of $2,500 per m^2 of bridge deck for those existing,

Further, in order to differentiate between funding sources, 'funding responsibility' was assigned to each link in the model network. These alternatives were:

- 'Twd' – where the Shire owns the existing or funds the proposed road
- 'RTA' – where the State owns the existing or funds the proposed road.
- 'LAC' – where the road will be paid for by a Local Area Contribution, and
- 'Dev' – where the road will be constructed by a developer, at their own cost without receiving a credit from the scheme.

Based on the above, the current day value of the principal roads in Tweed Shire's ultimate road network (ie. only those modelled) was estimated as $1,699m.

8.4 The Consumption Model Outputs

The forecast travel demands of the Shire's 'ultimate development' scenario were assigned to the planned, long-term road network, using VLC's road space consumption software. The values of Tweed Shire road space consumed by the various attributable sources (ie. the Tweed sectors and by external through traffic) is summarised, along with computations of the average value of Shire road space consumed by each future trip-end, in the following table.

Table 8.2: Future Consumption of Tweed Shire Road Space

Sector	Value of Tweed Shire[1] Road Space Consumed	Vehicular Trip-ends (2035)	Average Value of Shire Road Space per Trip-end
1. Tweed Heads	$ 53.0m	94,010	$ 564
2. Banora	$ 120.0m	149,032	$ 805
3. Cobaki	$ 31.2m	36,352	$ 859
4. Bilambil	$ 66.9m	42,727	$ 1,566
5. Terranora	$ 36.2m	27,612	$ 1,313
6. Kingscliff	$ 46.9m	63,352	$ 740
7. Cabarita	$ 62.7m	76,362	$ 821
8. Pottsville	$ 26.2m	27,880	$ 941
9. Murwillumbah	$ 55.6m	55,379	$ 1,003
10. Rural Inner (E)	$ 38.6m	28,067	$ 1,376
11. Burringbah	$ 6.6m	6,825	$ 965
12a. Rural Inner (N)	$ 8.1m	3,984	$ 2,027
12b. Rural Inner (W)	$ 18.6m	10,470	$ 1,773
13. Rural Outer	$ 21.1m	10,373	$ 2,034
Sub-total (Tweed)	**$ 591.7m**	**632,425**	**$ 936**
Through Traffic	**$ 11.9m**	-	-
Total Consumption	**$ 603.6m**	-	-

Notes: 1. Excludes roads funded by Local Area Charges and by Developers

8.5 Change in the Balance Sheet

Based on comparable outputs from both the 2001 and 2035 traffic models, the change in values of road space available and consumed are summarised as follows:

Table 8.3: Road Network Balance Sheet

Item	Road Network Valuations		
	2001	2035	Change
Road Space Consumed by:			
External (ie. Through) Traffic	$ 5.6m	$ 11.9m	+$ 6.3m
Tweed Generated Traffic	$ 347.9m	$ 591.7m	+$ 243.2m
Total Road Space Consumed	$ 353.5m	$ 603.6m	+$ 249.5m
Value of Network	$ 1,492.4m	$ 1,699.1m	+$ 206.7m[1]
Value of Reserve Capacity	$ 1,138.9m	$ 1,095.5m	-$ 43.4m

Notes: 1. The increase in the value of the model network is less than the cost of the General Works Program, as some past improvements are already included in the base year network, plus the generic 'per km' valuations do not fully reflect high cost intersection improvements.

The above shows that the increase in the value of road space consumed exceeds the (modelled) value of the Shire's network improvements, such that the value of the network's reserve capacity diminishes. This reflects the fact that many of the Shire's existing roads are capable of accommodating future traffic growth, without improvement.

As discussed in the previous chapter, the reduction in overall reserve capacity represents a disbenefit to the existing community, in terms of the level of service that they will be provided with (compared with currently).

8.6 Potential Revenue Computations

The value of future road space consumed per trip-end, as calculated in Table 8.2, is not necessarily the contribution that needs to be levied. It should be noted that:

- If the 'existing' network had plenty of spare capacity in locations where future development needed it, the value of road space consumed by additional future traffic would exceed the cost of a relatively small improvement program.
- If the 'existing' network had minimal spare capacity, just small levels of future development could trigger the need for an improvement program well in excess of the value consumed by the additional traffic

Depending on which of the above situations, the values of unit consumption can be factored up or down to recover an equitable and reasonable proportion of the cost of the works program from future development (ie. the consumption valuations simply provide the relativity for the proposed charges).

As a first estimate of charges and hence revenue, the average values of future road space consumption per trip-end (ex Table 8.2) have been used as the rate of the 'standard contribution'. The potential revenue (excluding potential discounts and the 5% administration surcharge) from all development occurring between 2001 and 2035 would be $267m, as calculated below.

Table 8.4: Initial Assessment of Potential Revenue (2001 – 2035)

Sector	Increase in Trip-ends (2001 – 2035)	Potential Charge per Trip-end	Potential Revenue ($m)
1. Tweed Heads	22,388	$ 564	$ 12.62
2. Banora	41,138	$ 805	$ 33.12
3. Cobaki	35,992	$ 859	$ 30.92
4. Bilambil	21,285	$ 1,566	$ 33.33
5. Terranora	19,406	$ 1,313	$ 25.48
6. Kingscliff	28,406	$ 740	$ 21.01
7. Cabarita	65,703	$ 821	$ 53.94
8. Pottsville	15,792	$ 941	$ 14.85
9. Murwillumbah	15,544	$ 1,003	$ 15.60
10. Rural Inner (E)	8,351	$ 1,376	$ 11.49
11. Burringbah	2,279	$ 965	$ 2.20
12a. Rural Inner (N)	48	$ 2,027	$ 0.10
12b. Rural Inner (W)	2,399	$ 1,773	$ 4.25
13. Rural Outer	4,120	$ 2,034	$ 8.38
Total	**282,851**	-	**$267.29**

Assuming constant linear growth, between 2001 and 2035, the potential revenue (past and future) from the on-going plan would be as follows:

- Revenue to date (1991 – end 2006) = $ 19.0m (as advised by Council)
- Potential Revenue 2007-2035 = $ 220.1m (28/34^{ths} of $267.3m)

  $ 239.1m

Before confirming any adjustment to these initial 'trial' rates, it is appropriate to examine the 'cost' side of the ledger (ie. how much of the improvement program is or should be funded by future development). The estimated cost of the road improvement works necessary to support the growth in development in Tweed, between 1991 and 2035, is now estimated as $277.2m, in the following table.

Table 8.5: The Cost of Accommodating the Anticipated Development

Item	Cost / Value
Estimated Cost of General Works Program less Cost of 'Existing' Deficiencies (in 1991)	$285.5m -$2.0m
Expenditure to accommodate all traffic growth less Value Consumed by Growth in Through Traffic	$283.5m -$6.3m
Expenditure to accommodate Tweed traffic growth	**$277.2m**

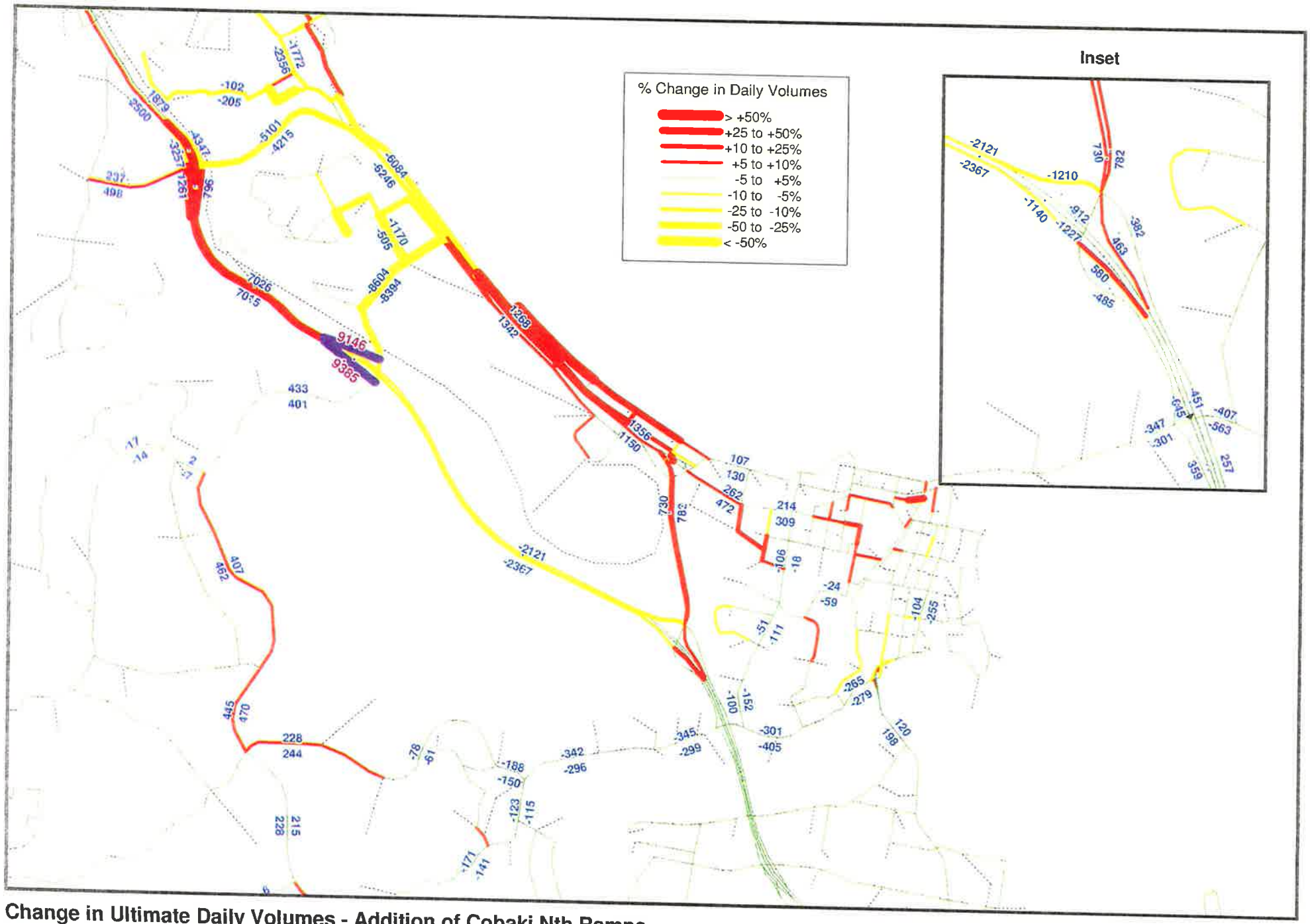
The preceding indicates that, if the average values of future road space consumed were used as the Plan's 'Standard Contributions', then the on-going Plan would recover a total of $239m (or 86%) of the assessed cost ($277m) of accommodating the future traffic generated by Tweed developments.

The balance of $38m would need to be funded by the Council, with about $8m of this sum being considered Council's obligation in respect of 'existing deficiencies' and 'future through traffic'.

Given that Table 8.3 indicates that the existing community will incur a loss of service overall, there would appear to be no grounds for Council to contribute to the improvements on the existing community's behalf.

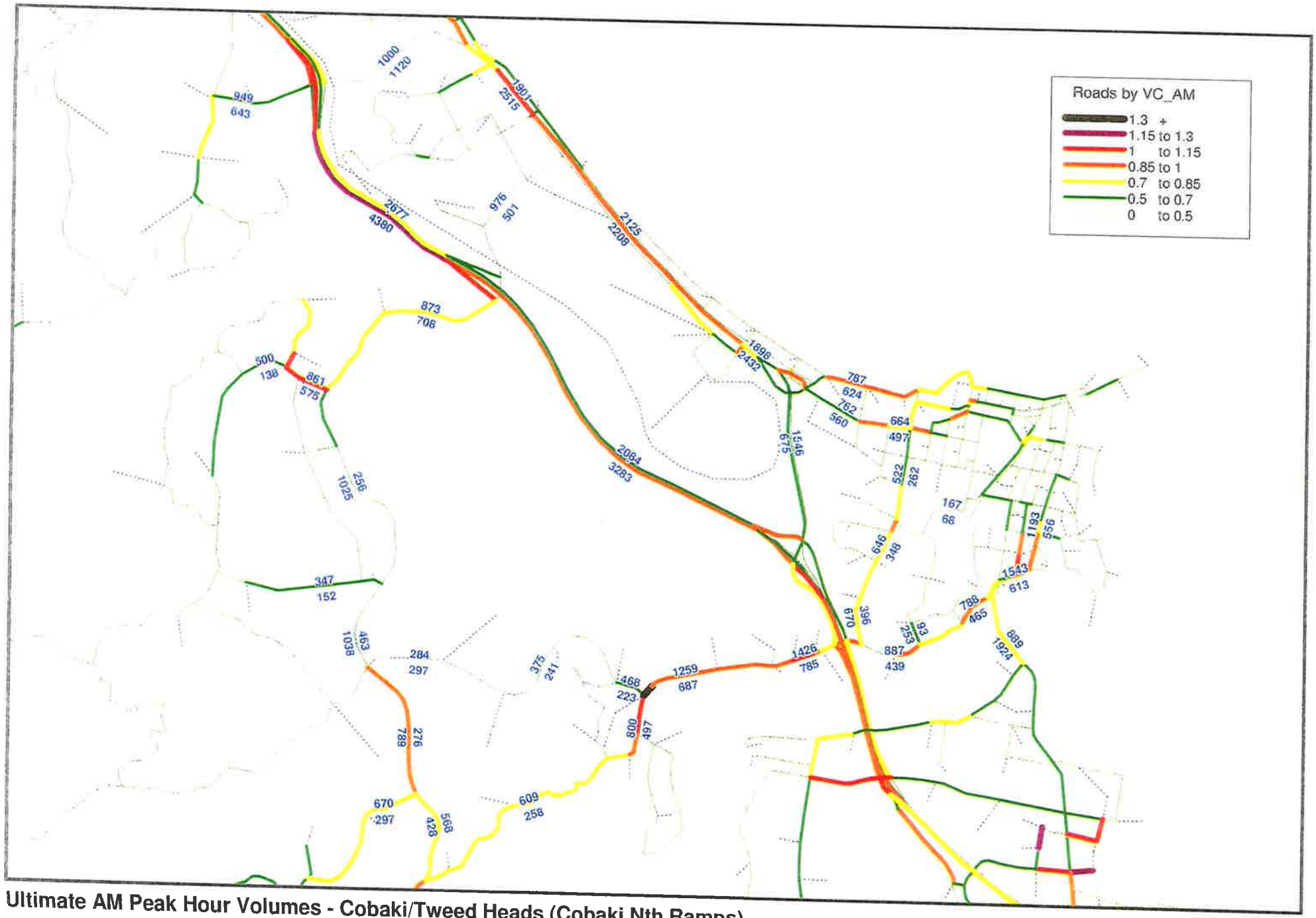
After considering all issues, Council has decided to set the 'Standard Contribution' rates for the new Version 5.0 of the Plan at 1.007 times the unit road space consumption values in the last column of Table 8.2.

Appendix A: Figures



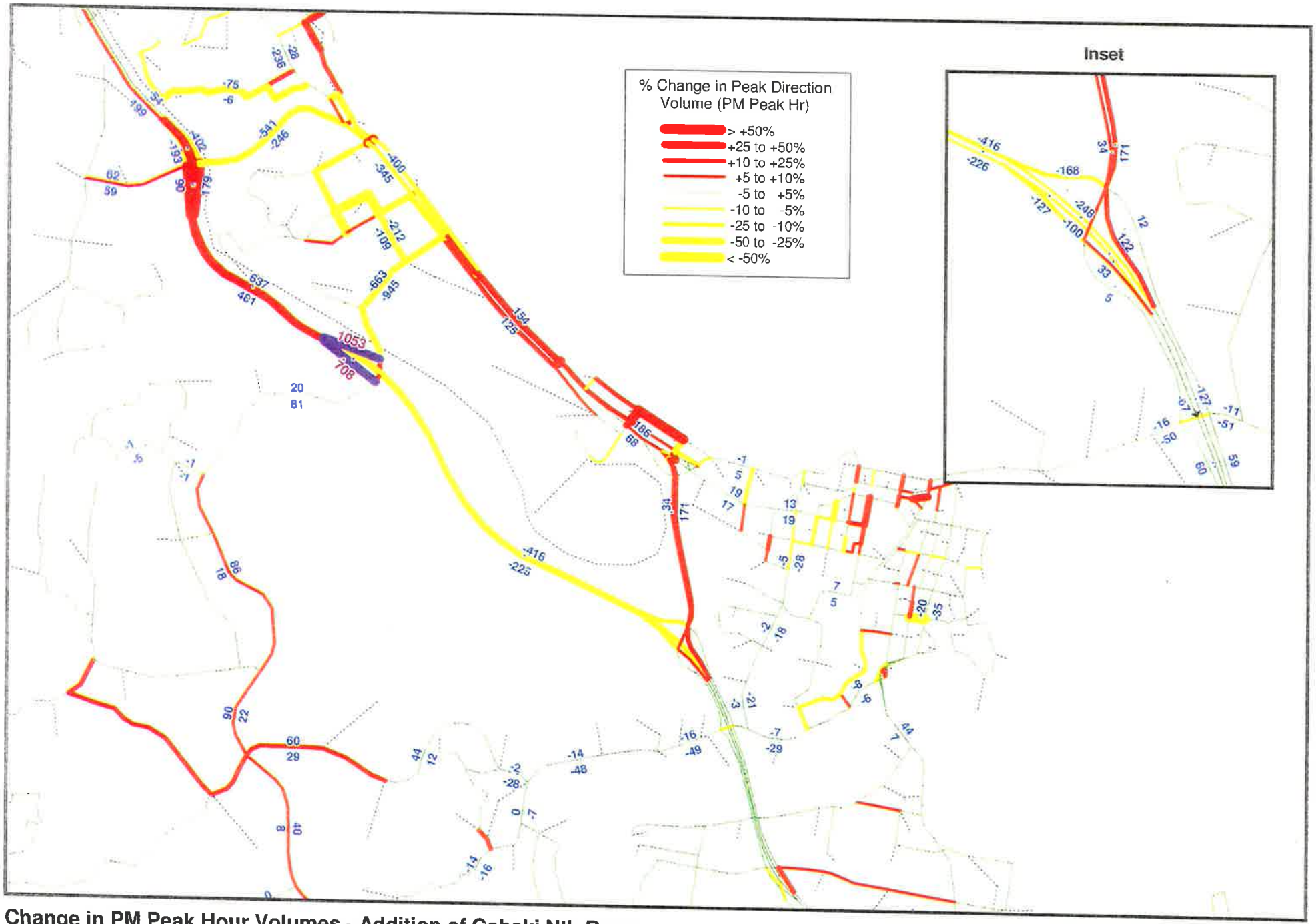
Change in Ultimate Daily Volumes - Addition of Cobaki Nth Ramps

Figure 2.1



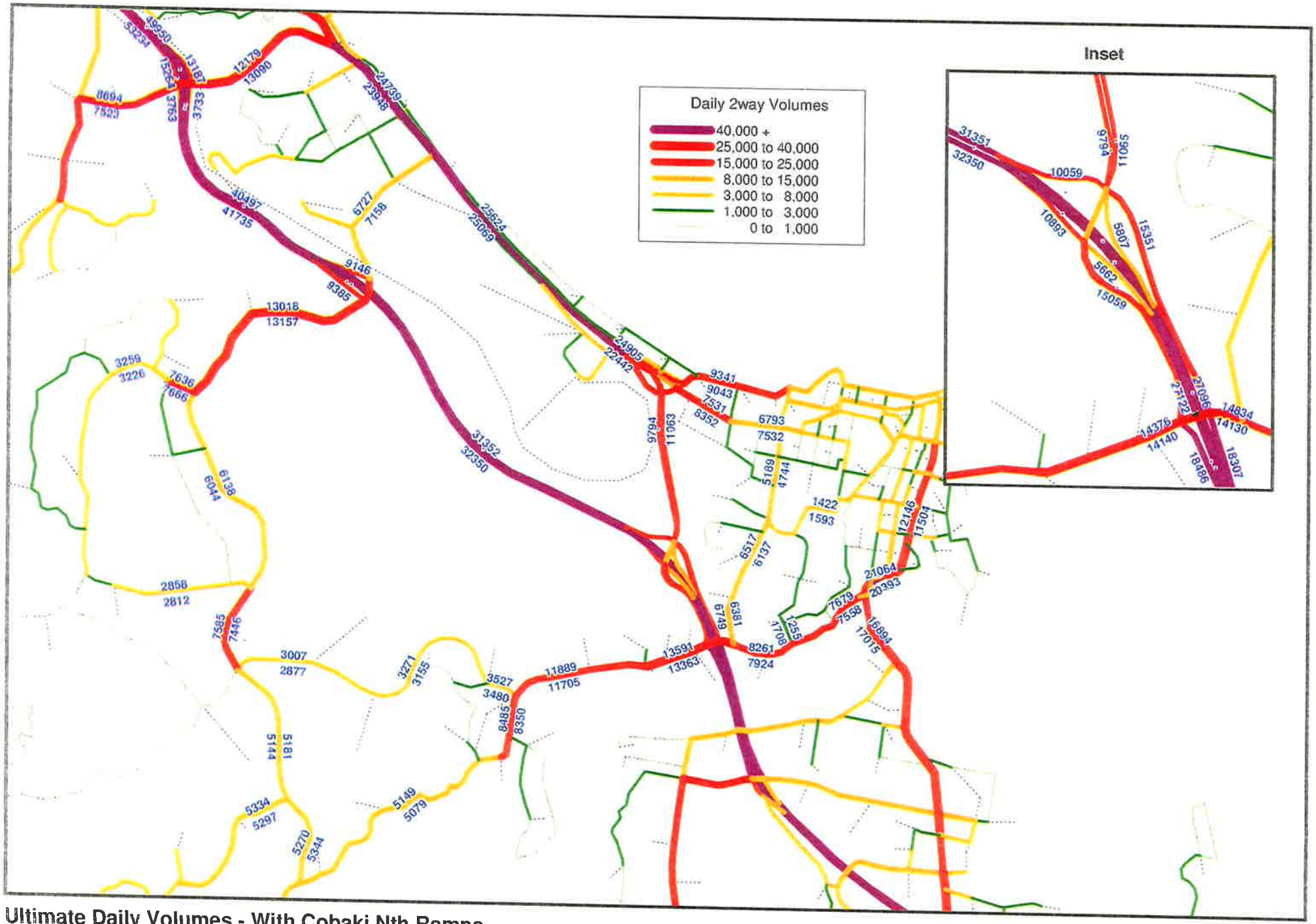
Ultimate AM Peak Hour Volumes - Cobaki/Tweed Heads (Cobaki Nth Ramps)

Figure 2.1a



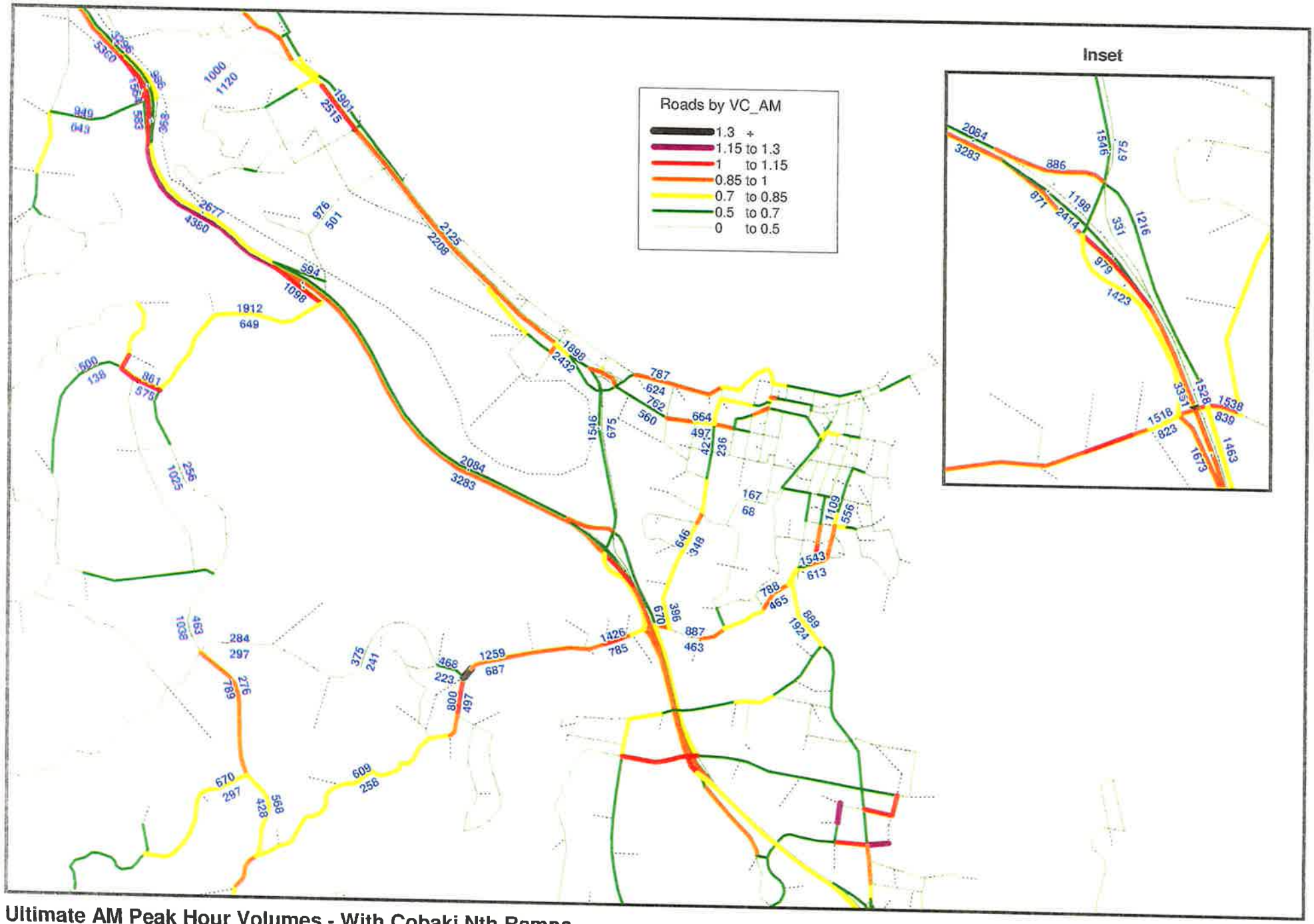
Change in PM Peak Hour Volumes - Addition of Cobaki Nth Ramps

Figure 2.1b



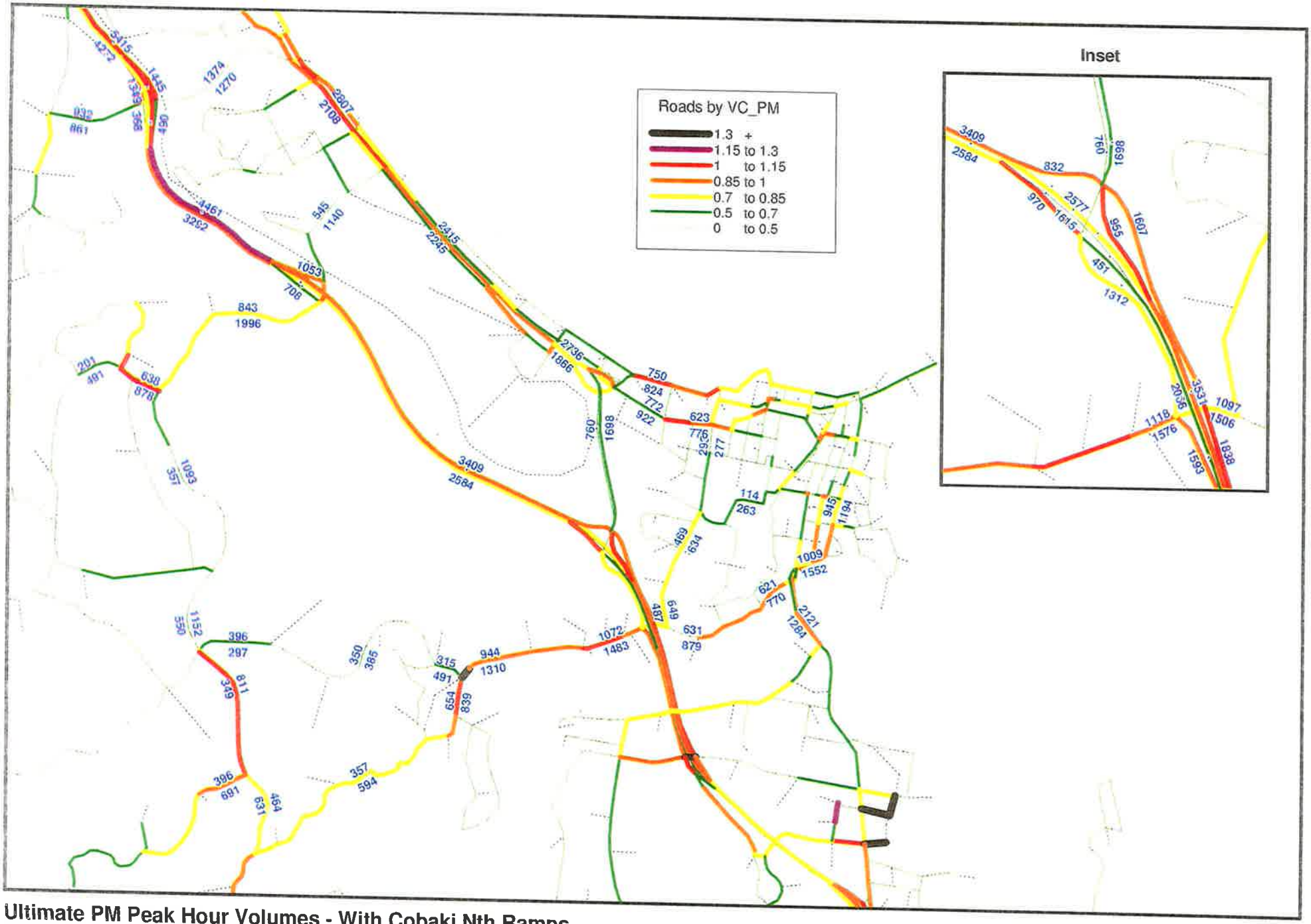
Ultimate Daily Volumes - With Cobaki Nth Ramps

Figure 2.2



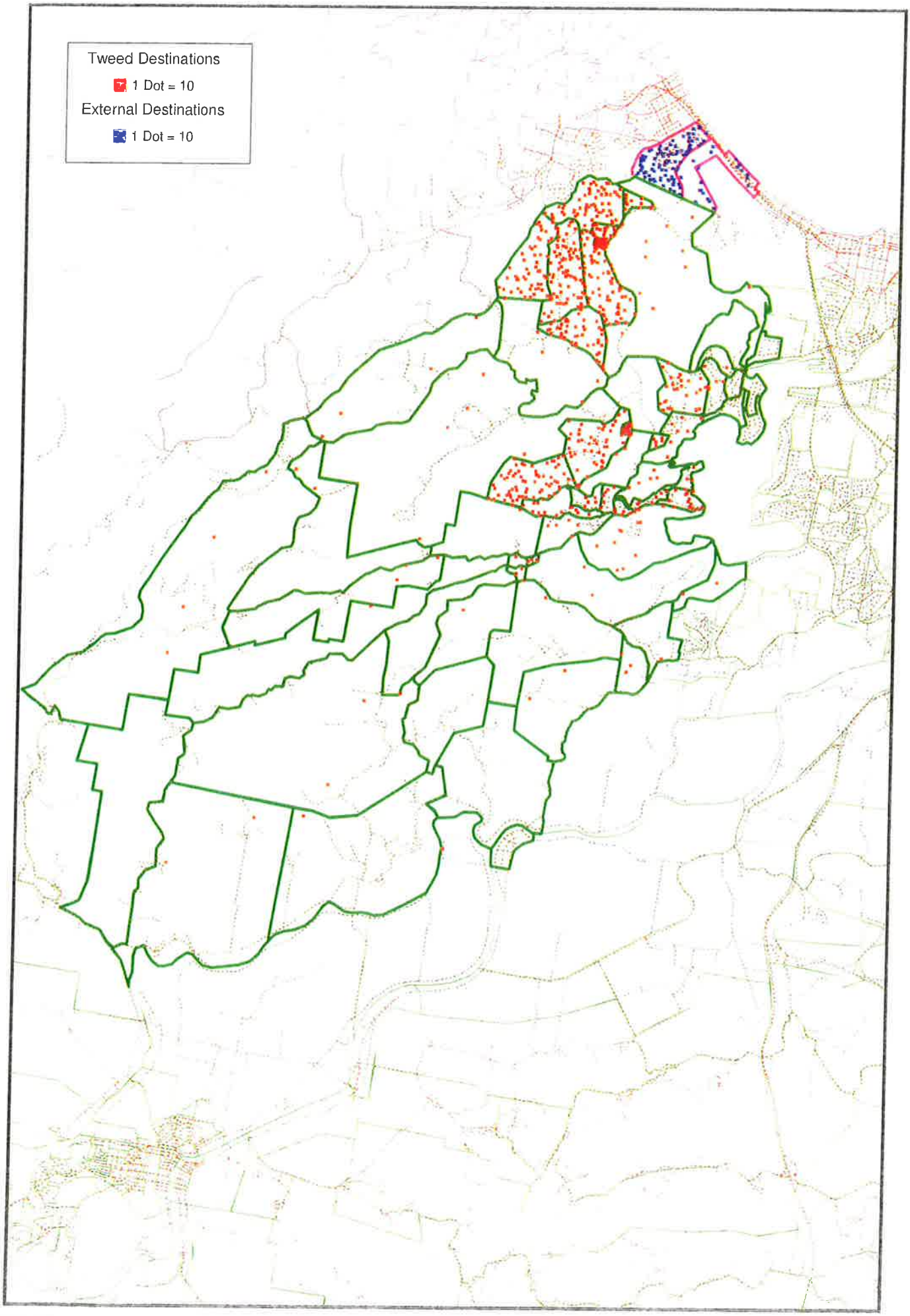
Ultimate AM Peak Hour Volumes - With Cobaki Nth Ramps

Figure 2.2a

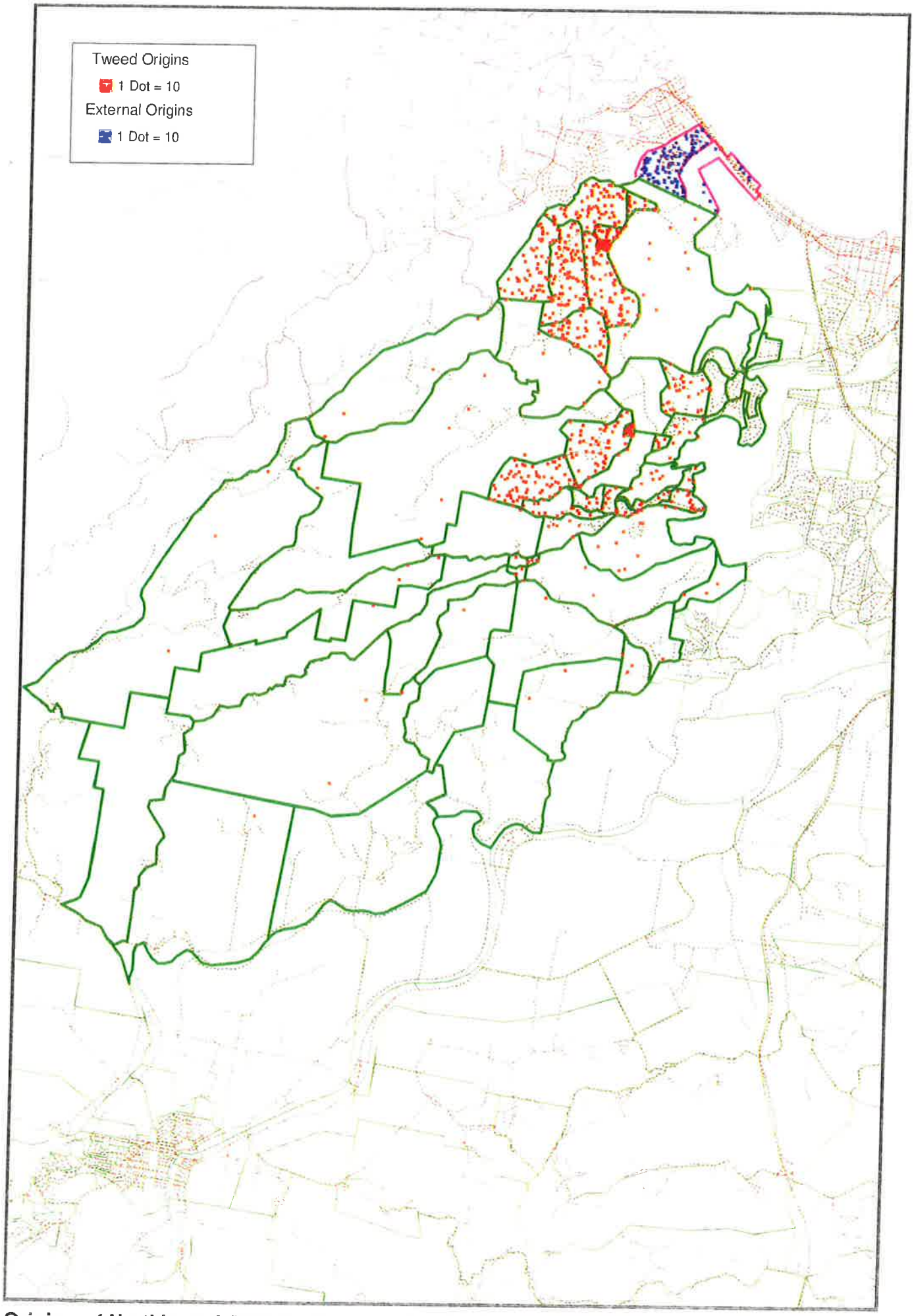


Ultimate PM Peak Hour Volumes - With Cobaki Nth Ramps

Figure 2.2b

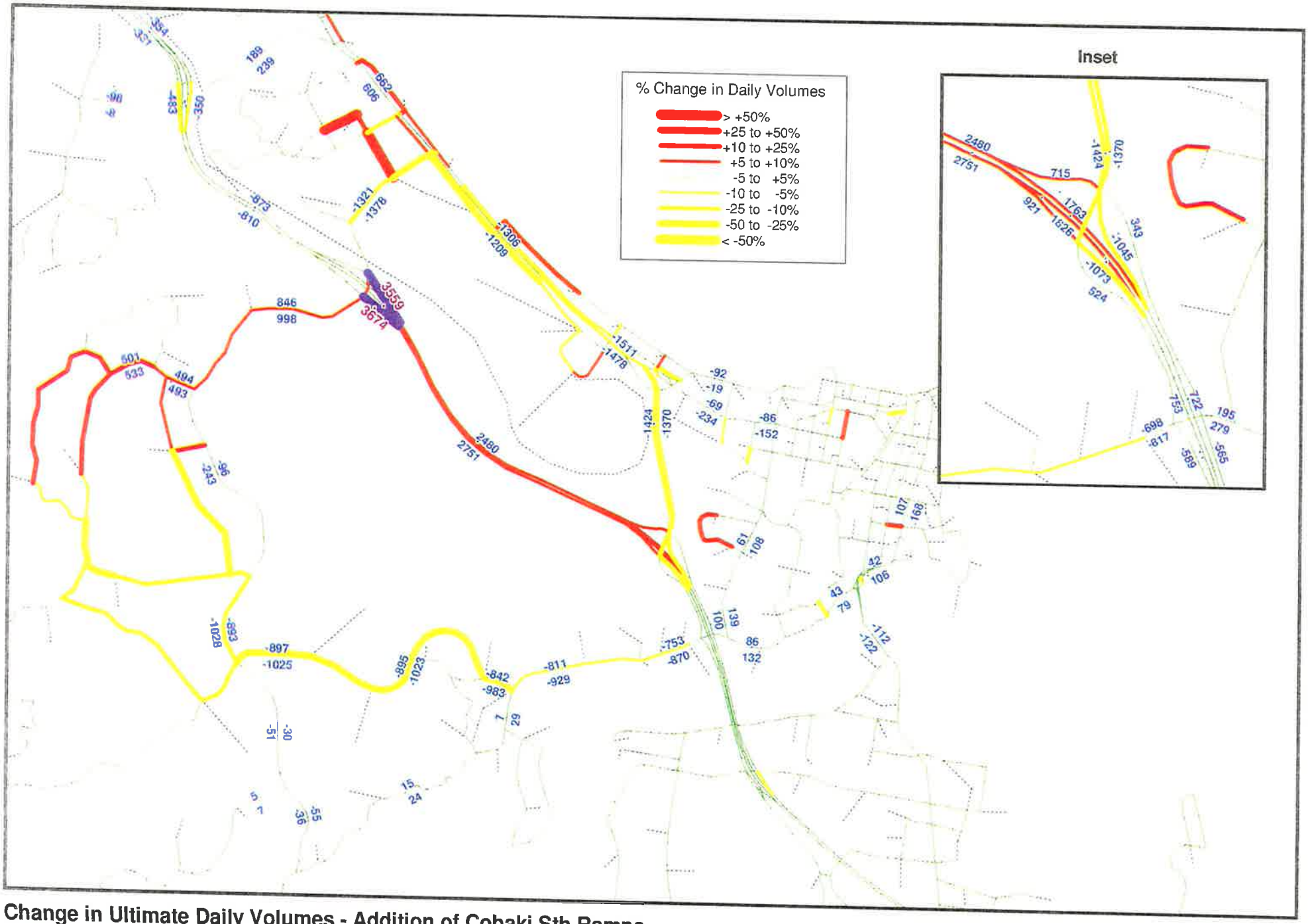


Destinations of Southbound Offramp Traffic (Ultimate Daily) **Figure 2.3a**



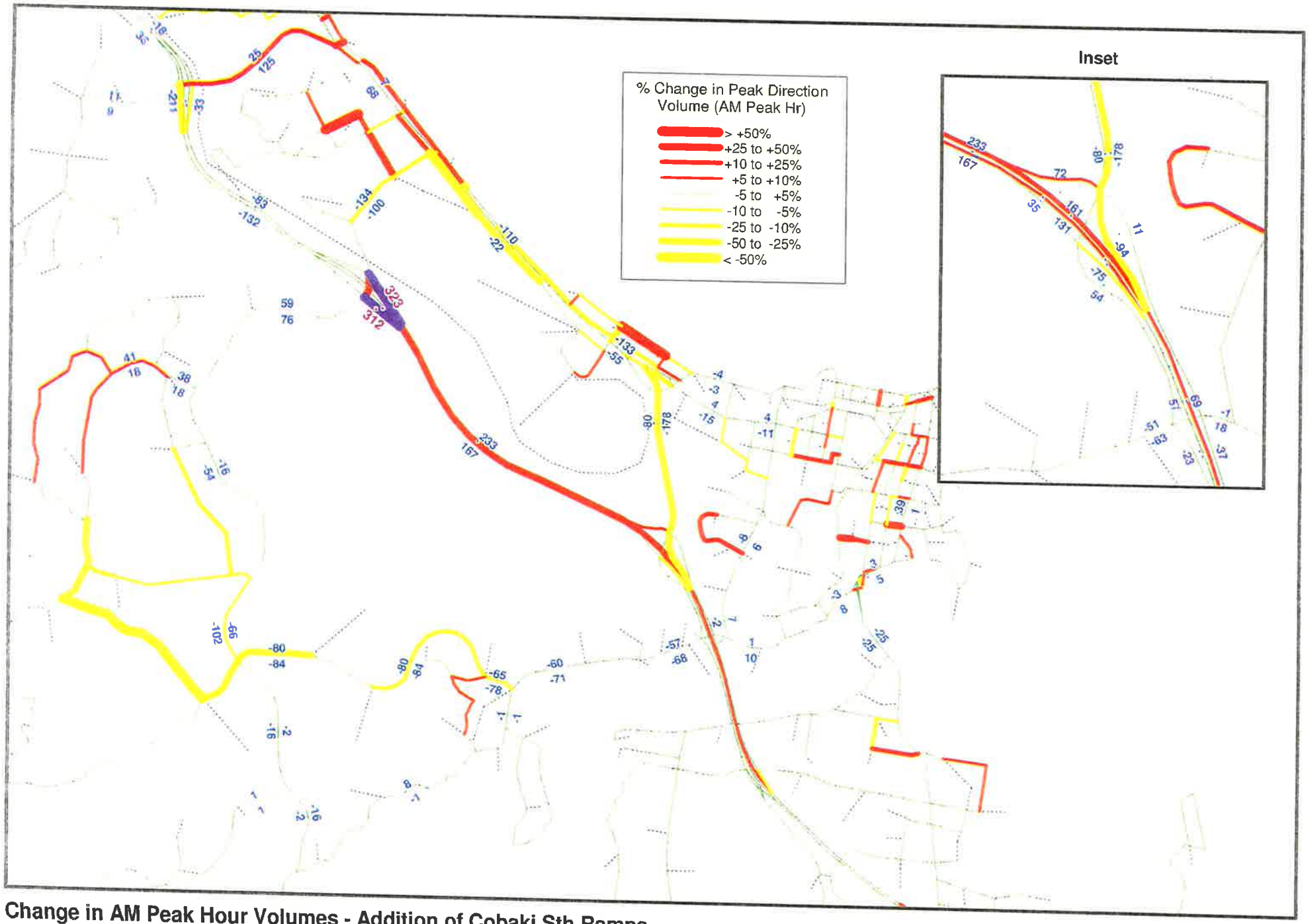
Origins of Northbound Onramp Traffic (Ultimate Daily)

Figure 2.3b



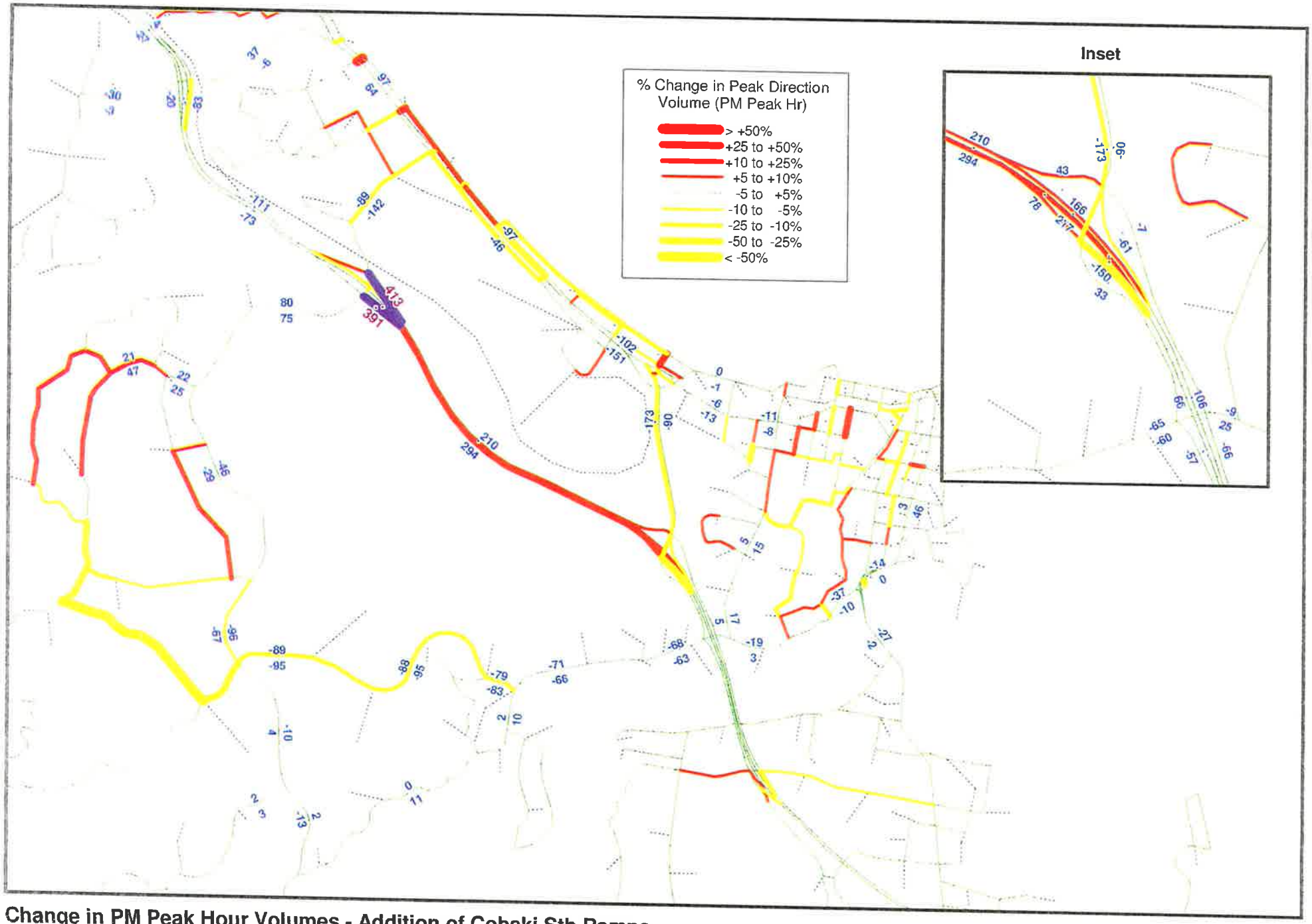
Change in Ultimate Daily Volumes - Addition of Cobaki Sth Ramps

Figure 3.1



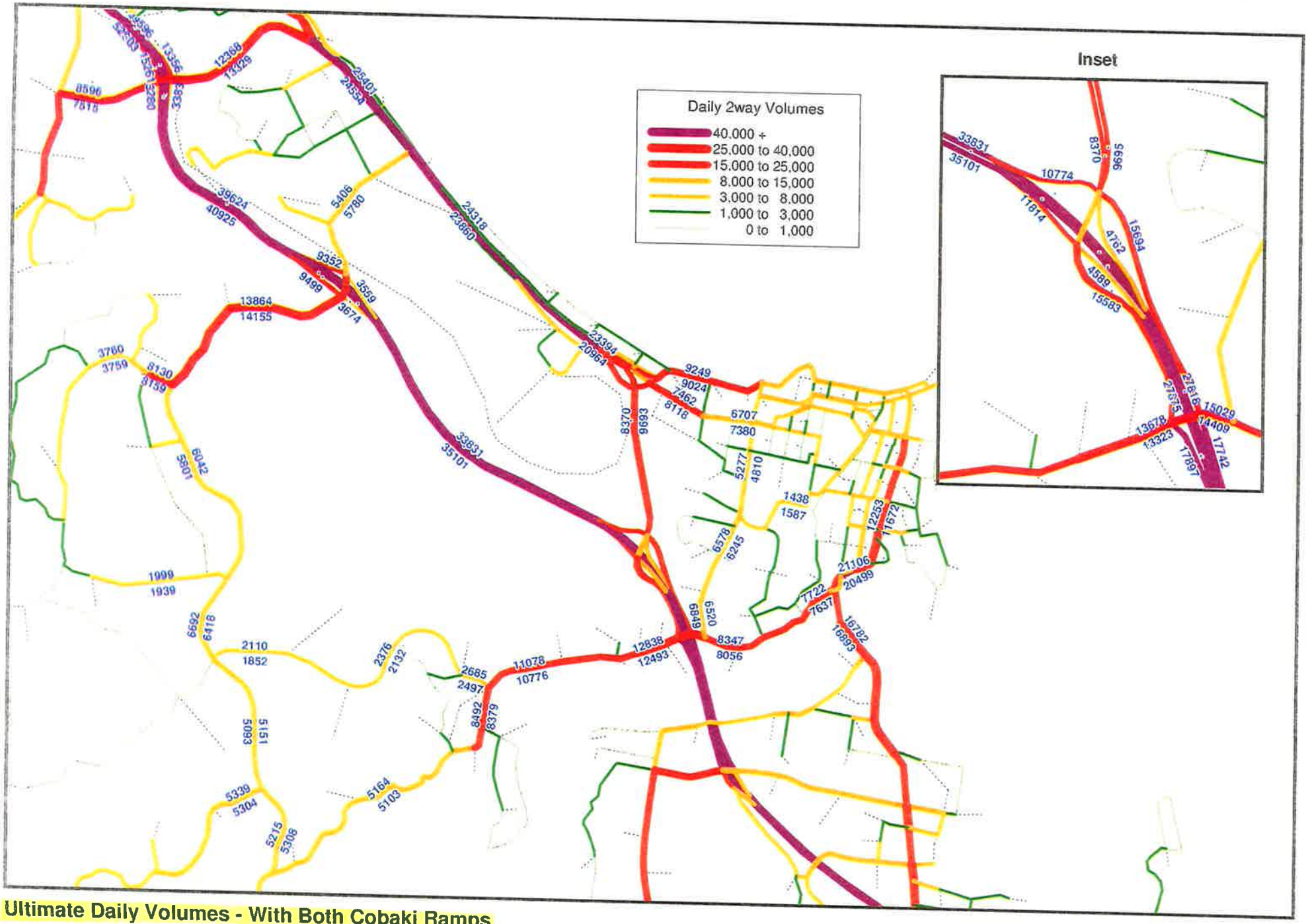
Change in AM Peak Hour Volumes - Addition of Cobaki Sth Ramps

Figure 3.1a



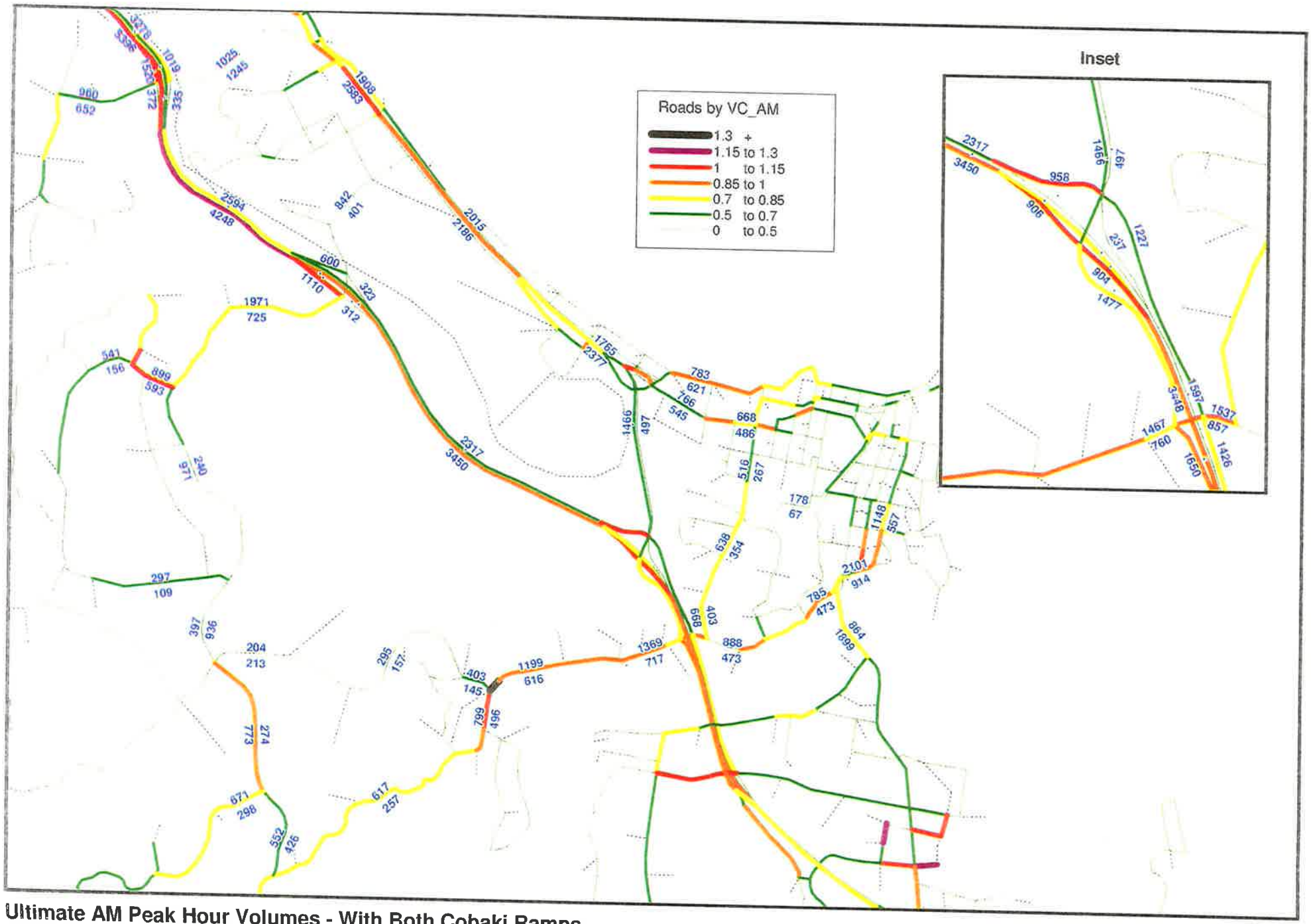
Change in PM Peak Hour Volumes - Addition of Cobaki Sth Ramps

Figure 3.1b



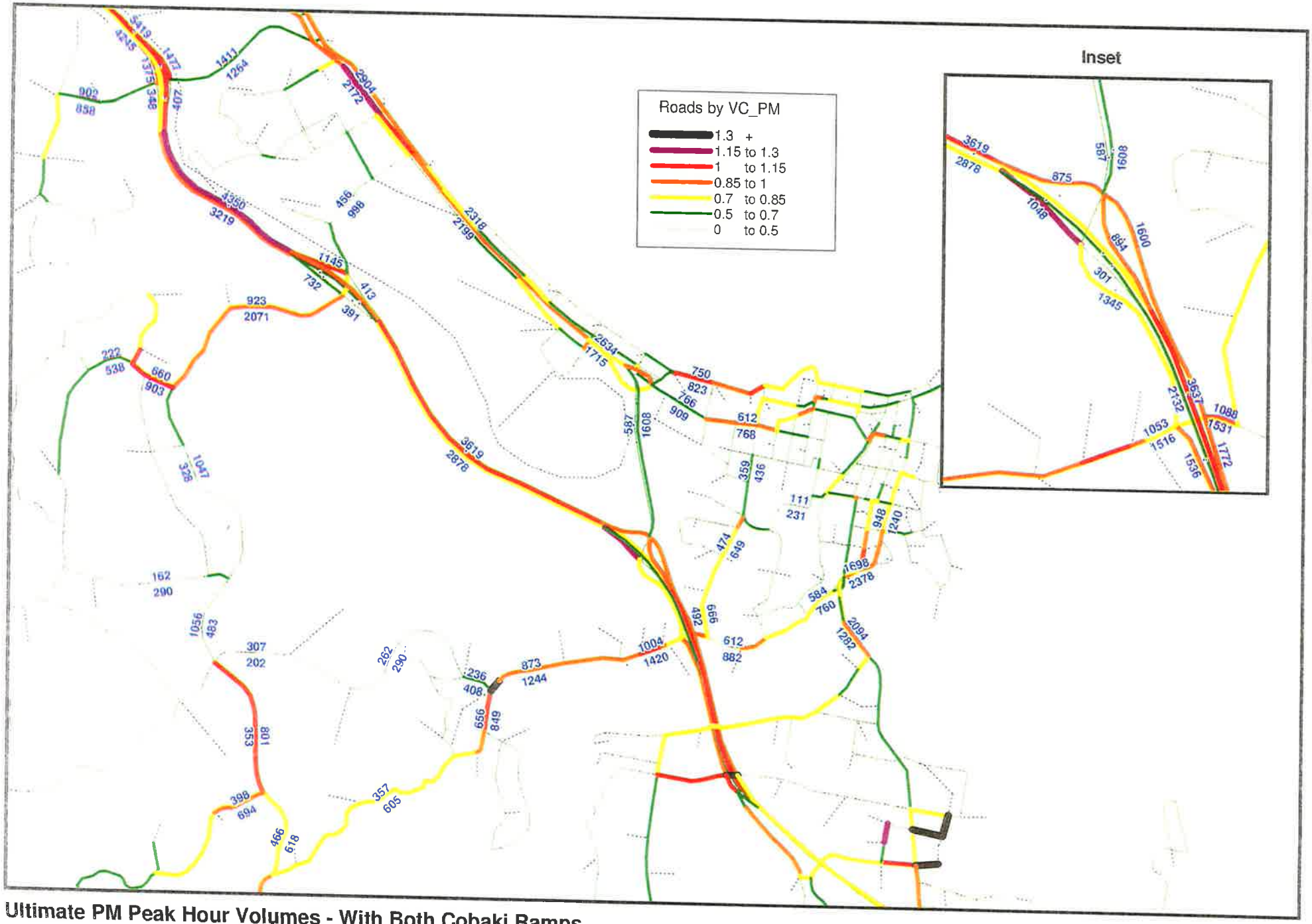
Ultimate Daily Volumes - With Both Cobaki Ramps

Figure 3.2



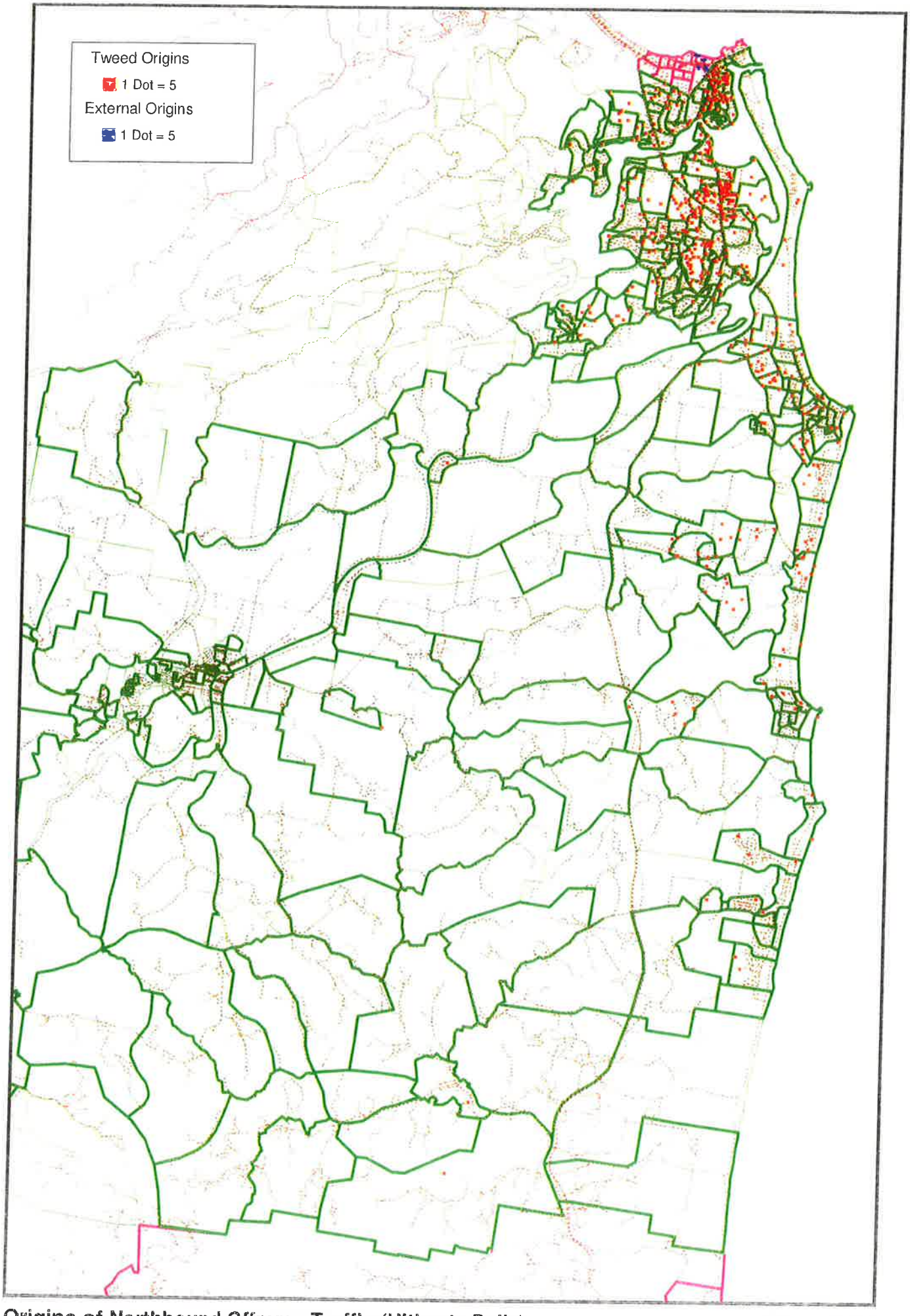
Ultimate AM Peak Hour Volumes - With Both Cobaki Ramps

Figure 3.2a



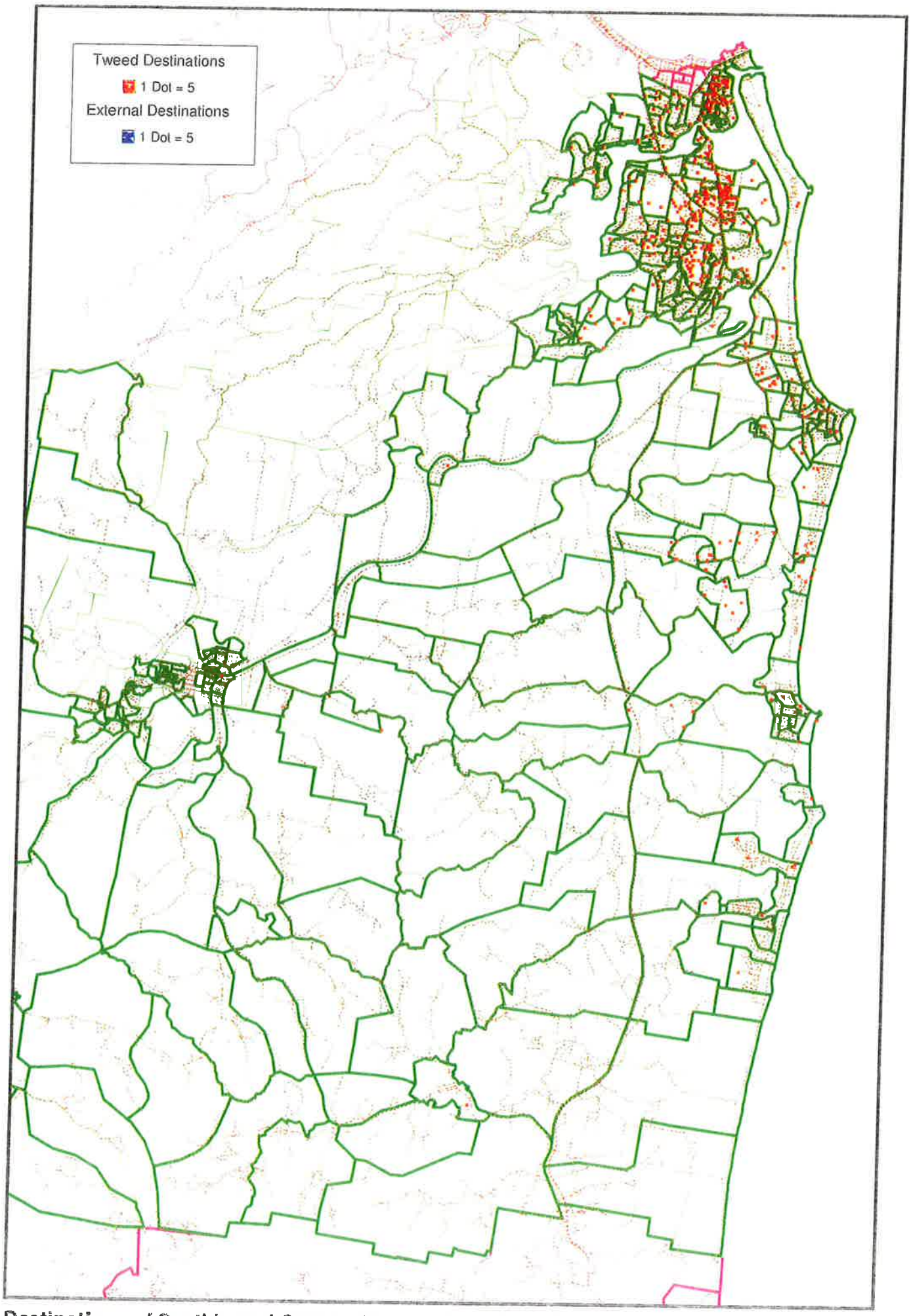
Ultimate PM Peak Hour Volumes - With Both Cobaki Ramps

Figure 3.2b



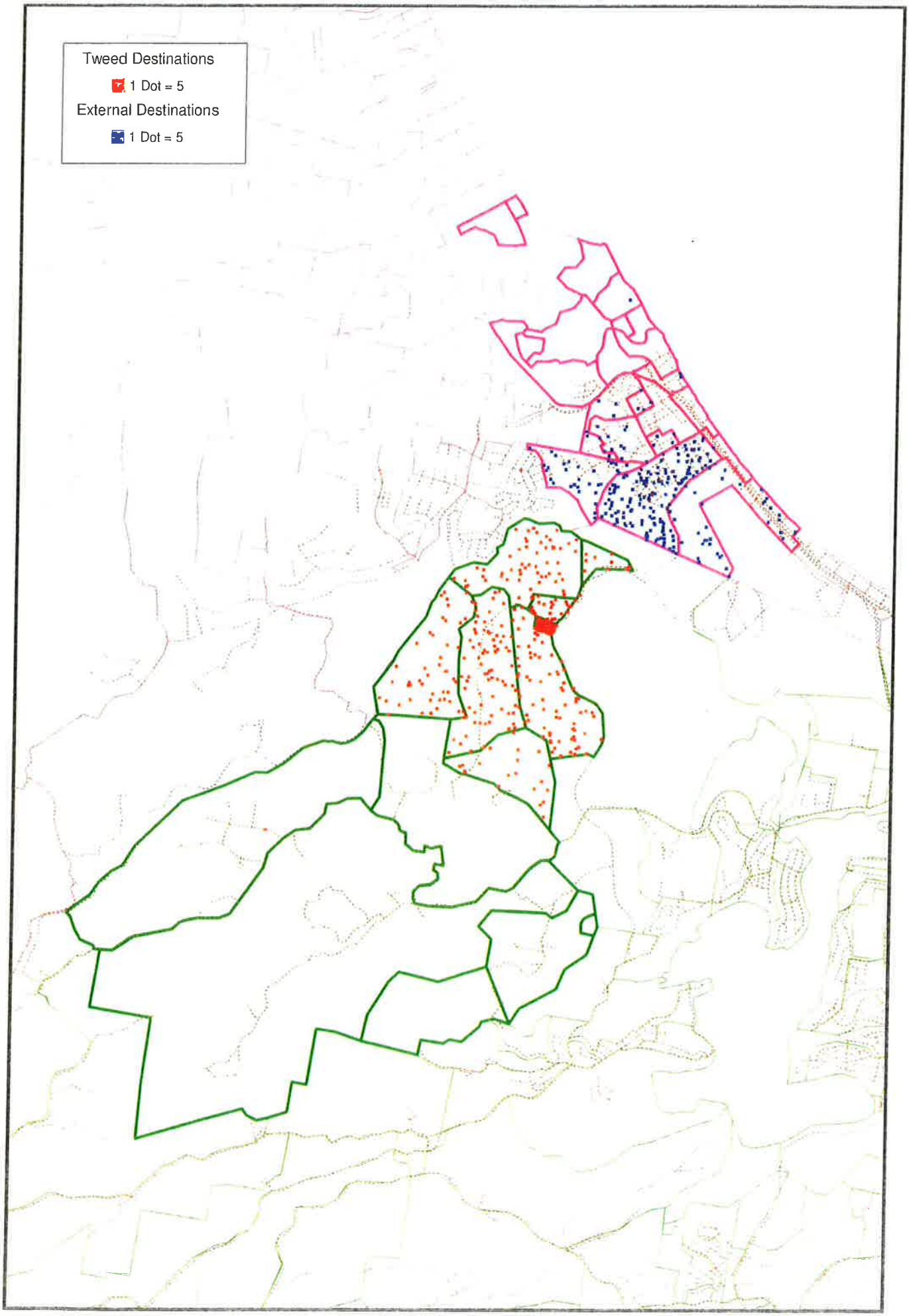
Origins of Northbound Offramp Traffic (Ultimate Daily)

Figure 3.3a



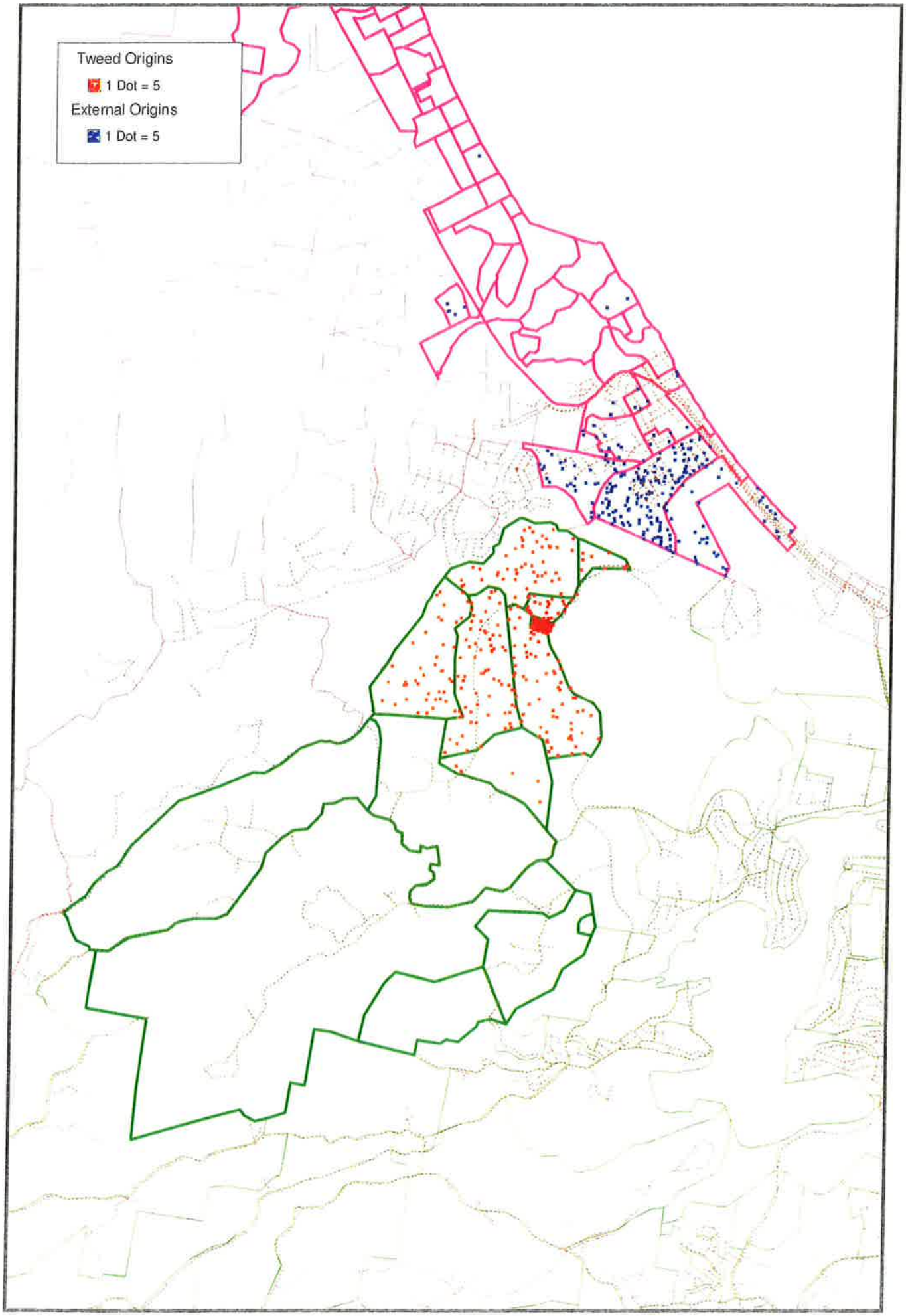
Destinations of Southbound Onramp Traffic (Ultimate Daily)

Figure 3.3b

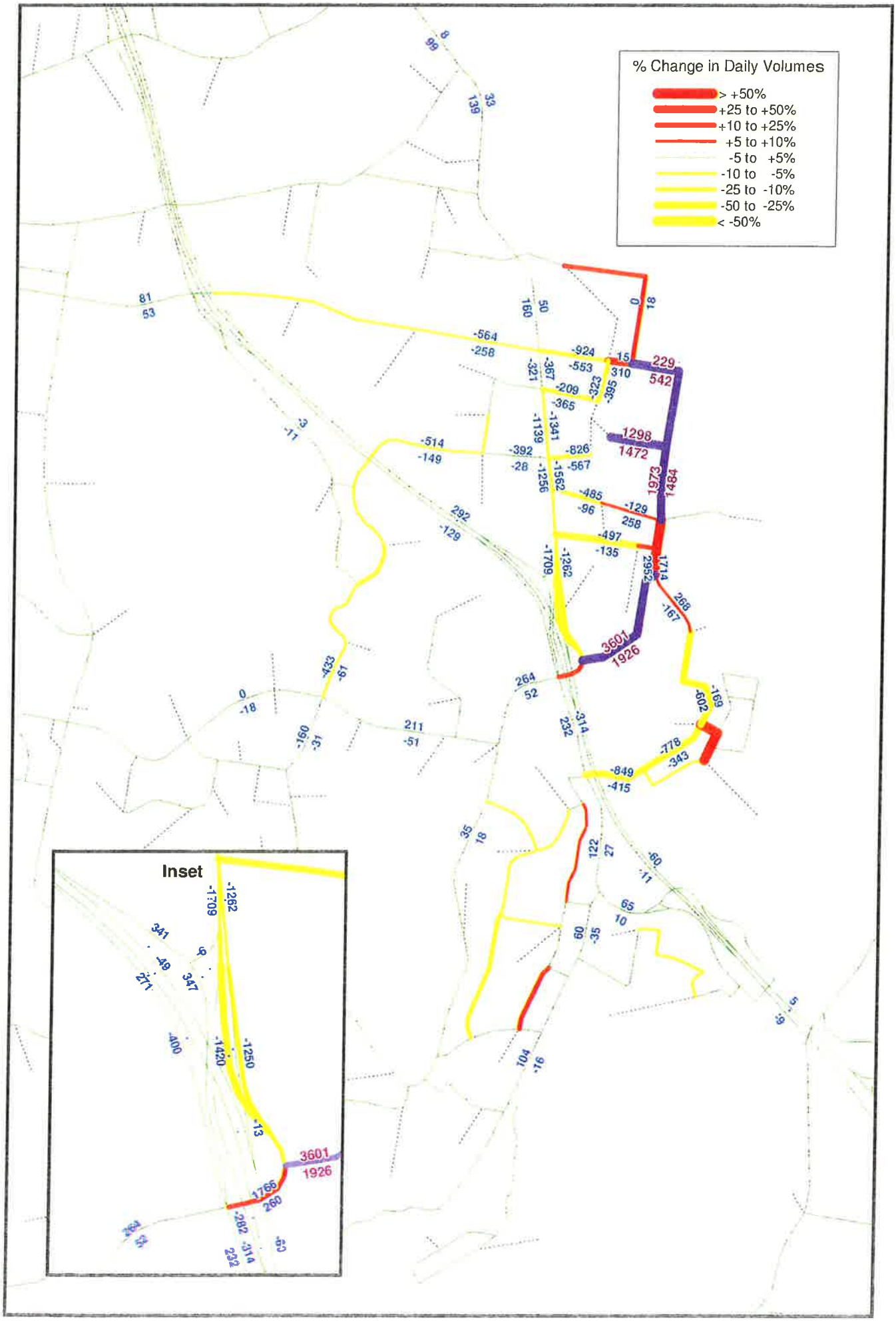


Destinations of Northbound Offramp Traffic (Ultimate Daily)

Figure 3.4a

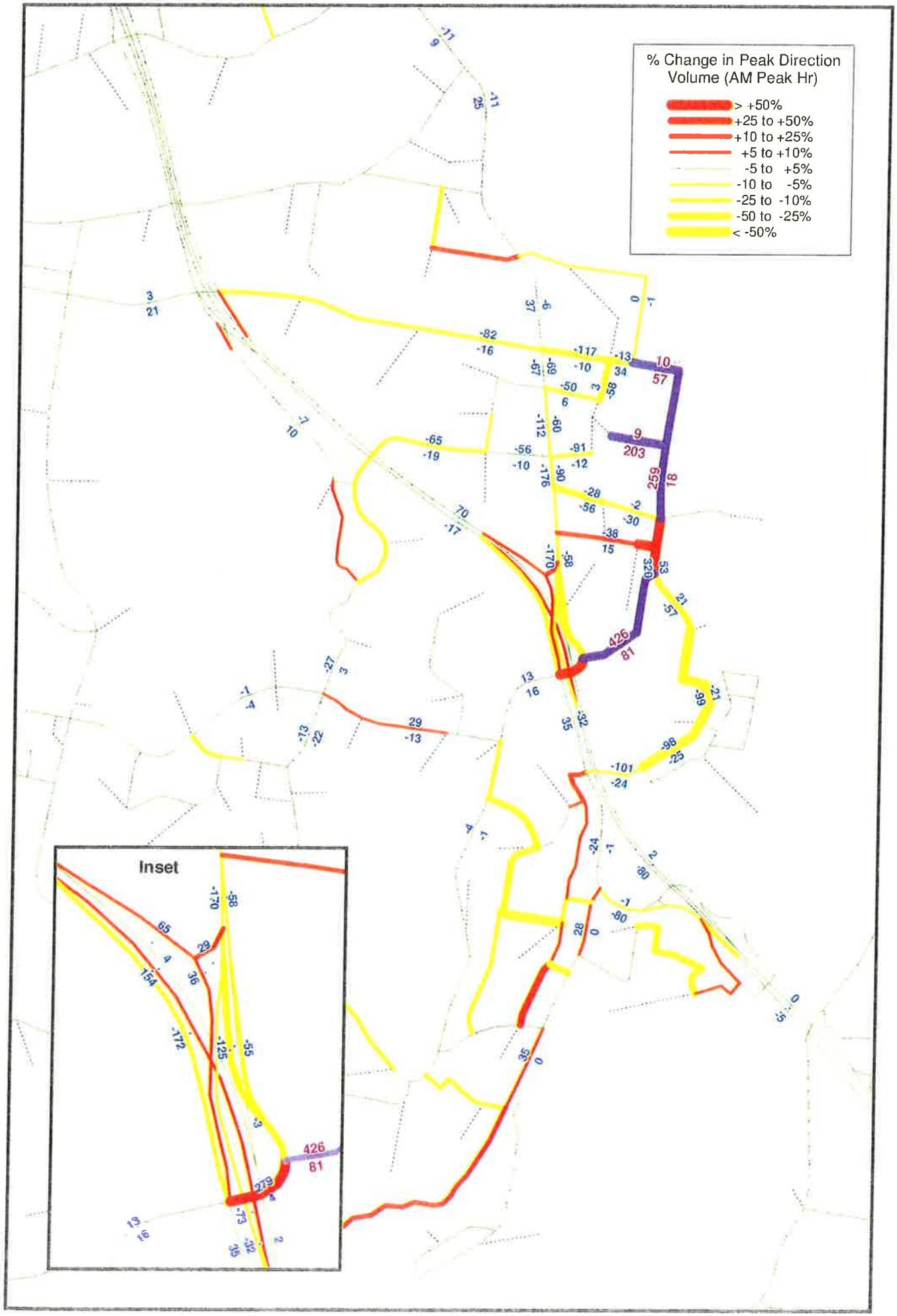


Origins of Southbound Onramp Traffic (Ultimate Daily) Figure 3.4b

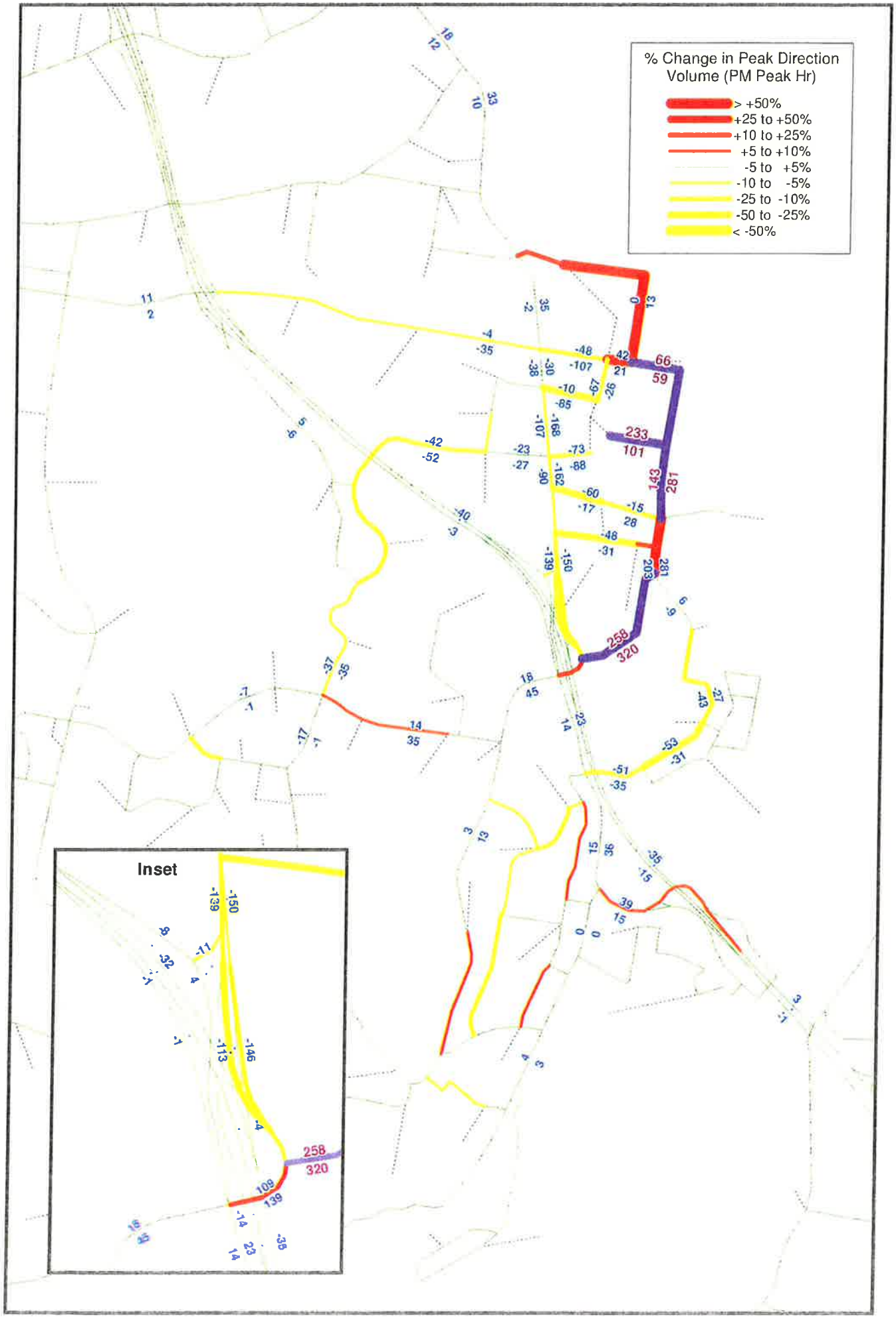


Change in Ultimate Daily Volumes - With Eastlakes Drive Extn.

Figure 4.1

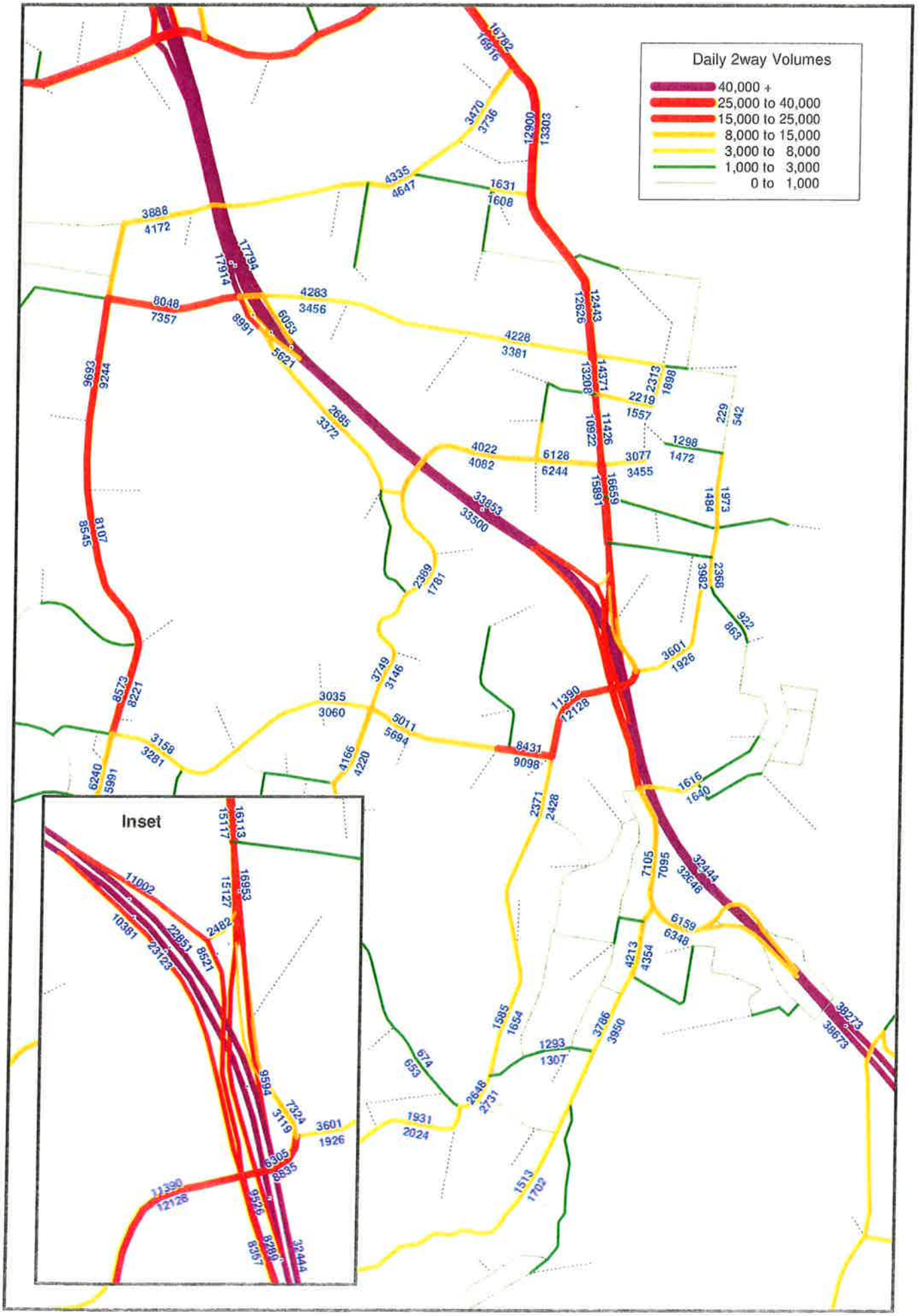


Change in AM Peak Hour Volumes - With Eastlakes Drive Extn. **Figure 4.1a**



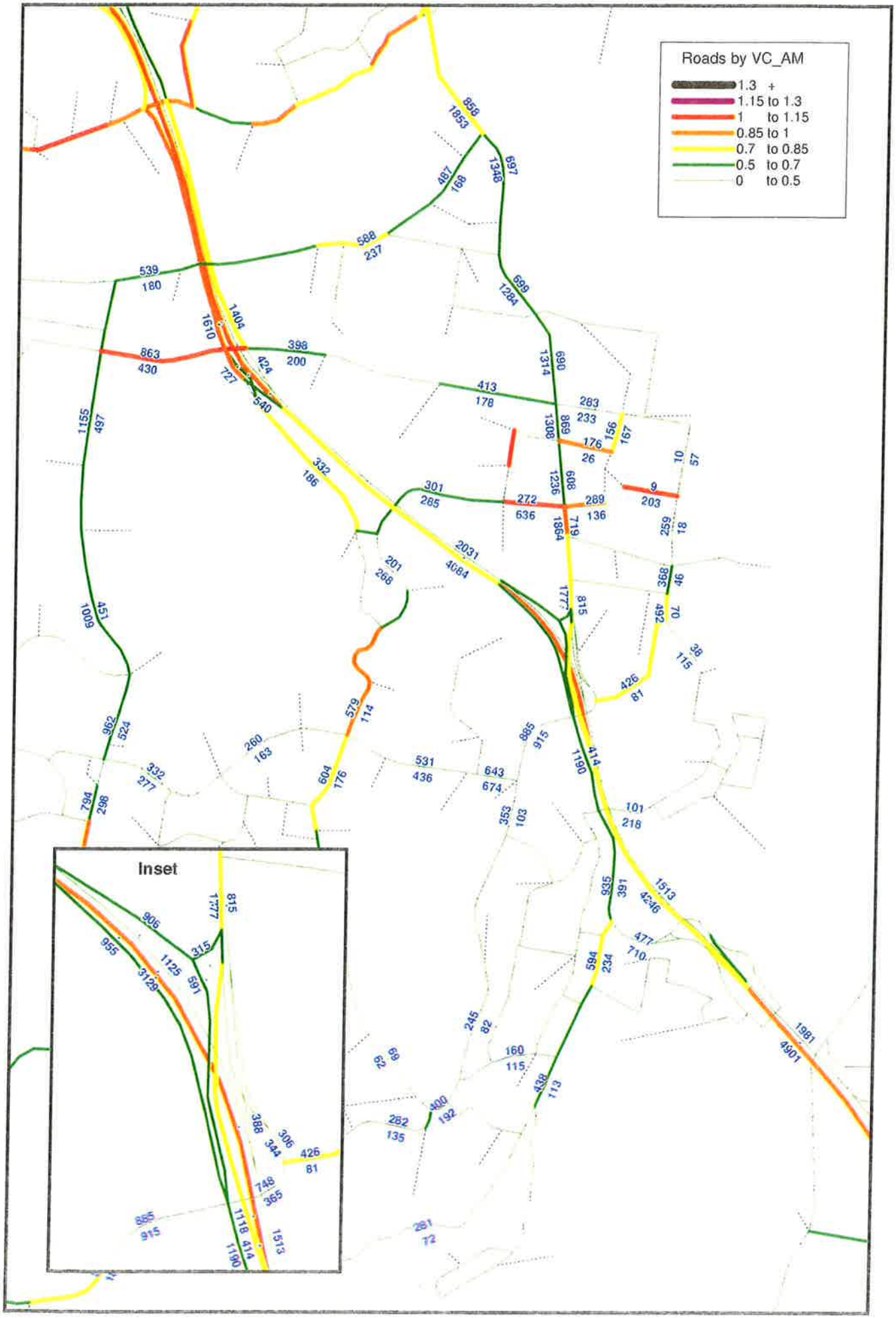
Change in PM Peak Hour Volumes - With Eastlakes Drive Extn.

Figure 4.1b

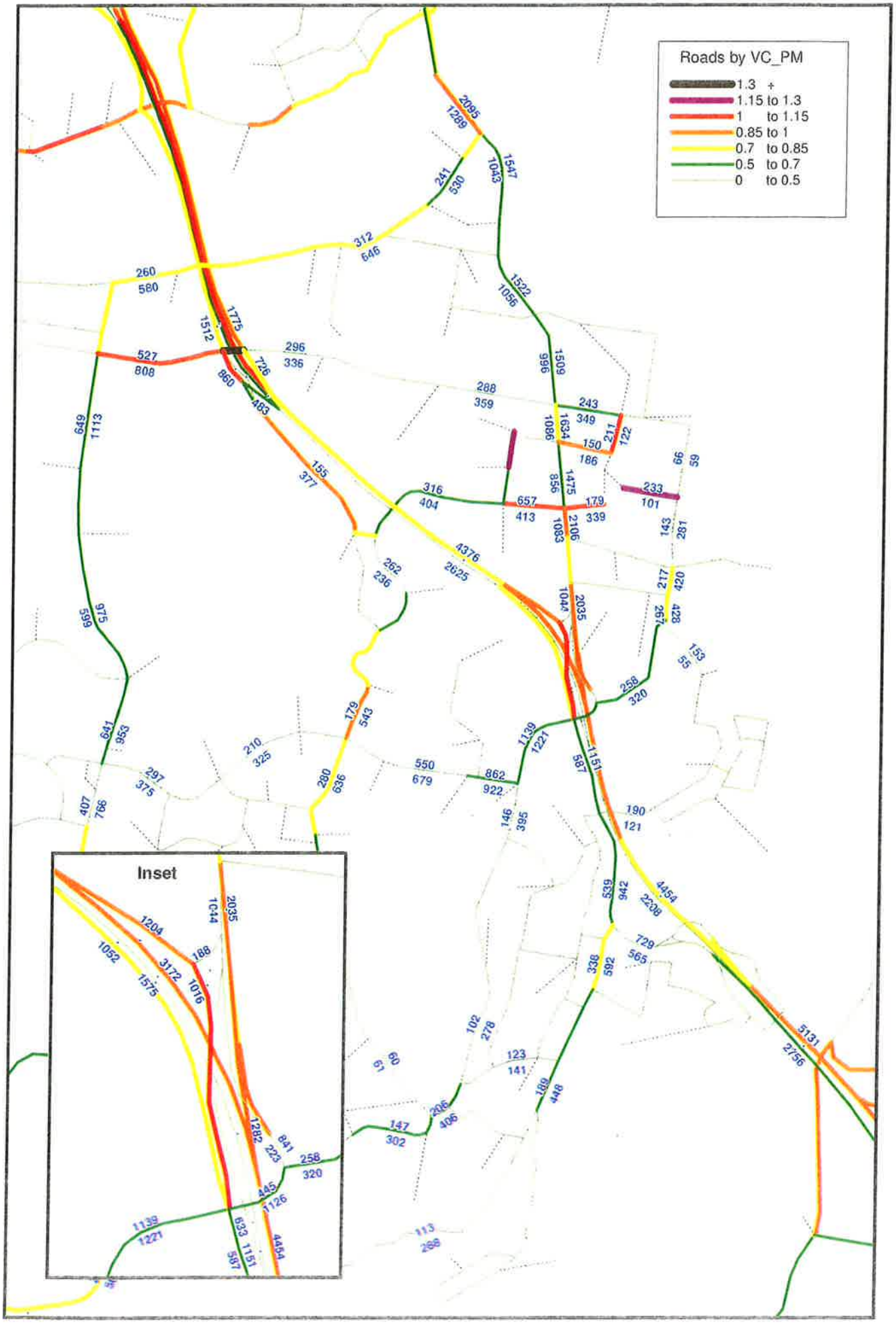


Ultimate Daily Volumes - With Eastlakes Drive Extn.

Figure 4.2

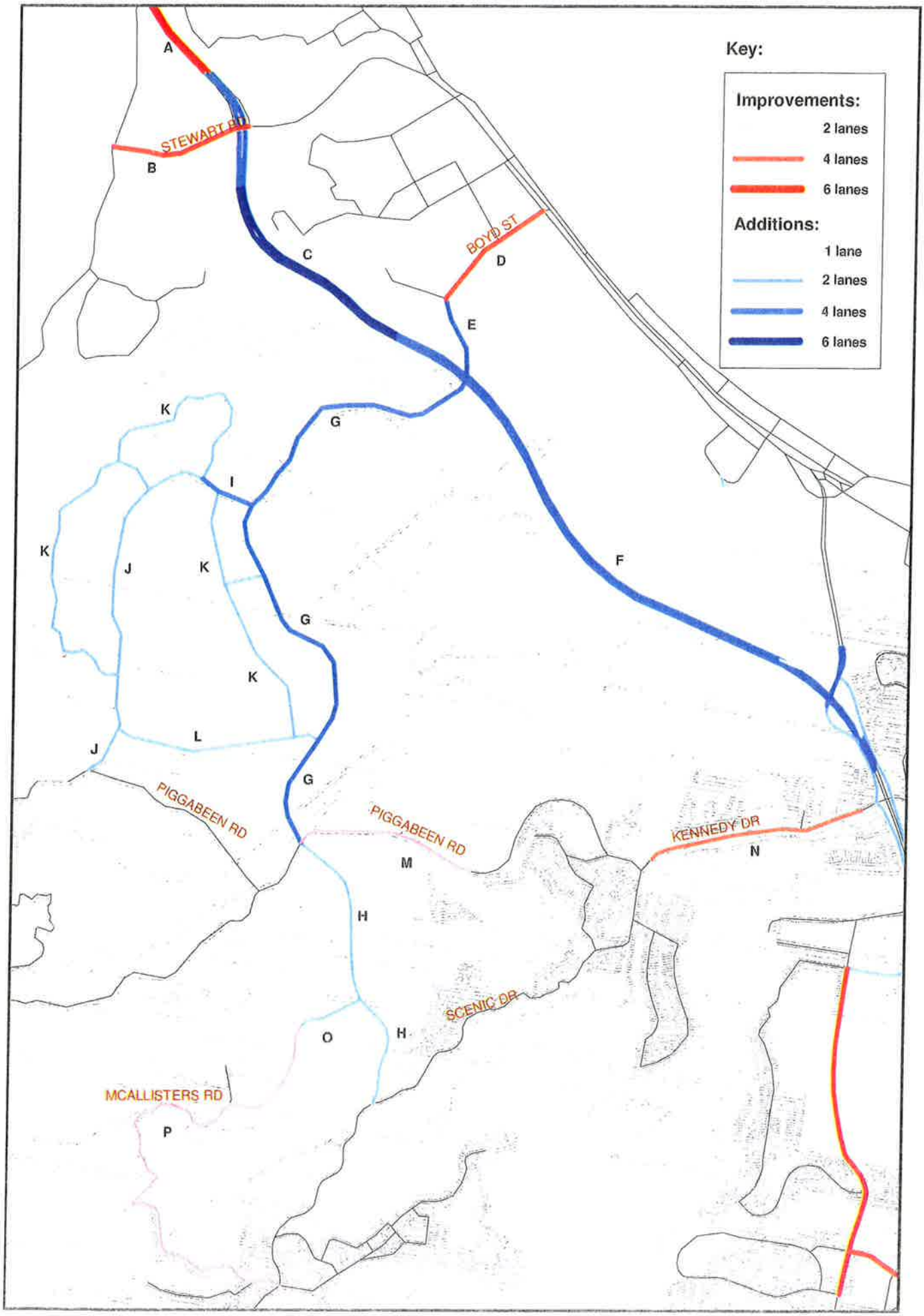


Ultimate AM Peak Hour Volumes - With Eastlakes Drive Extn. Figure 4.2a

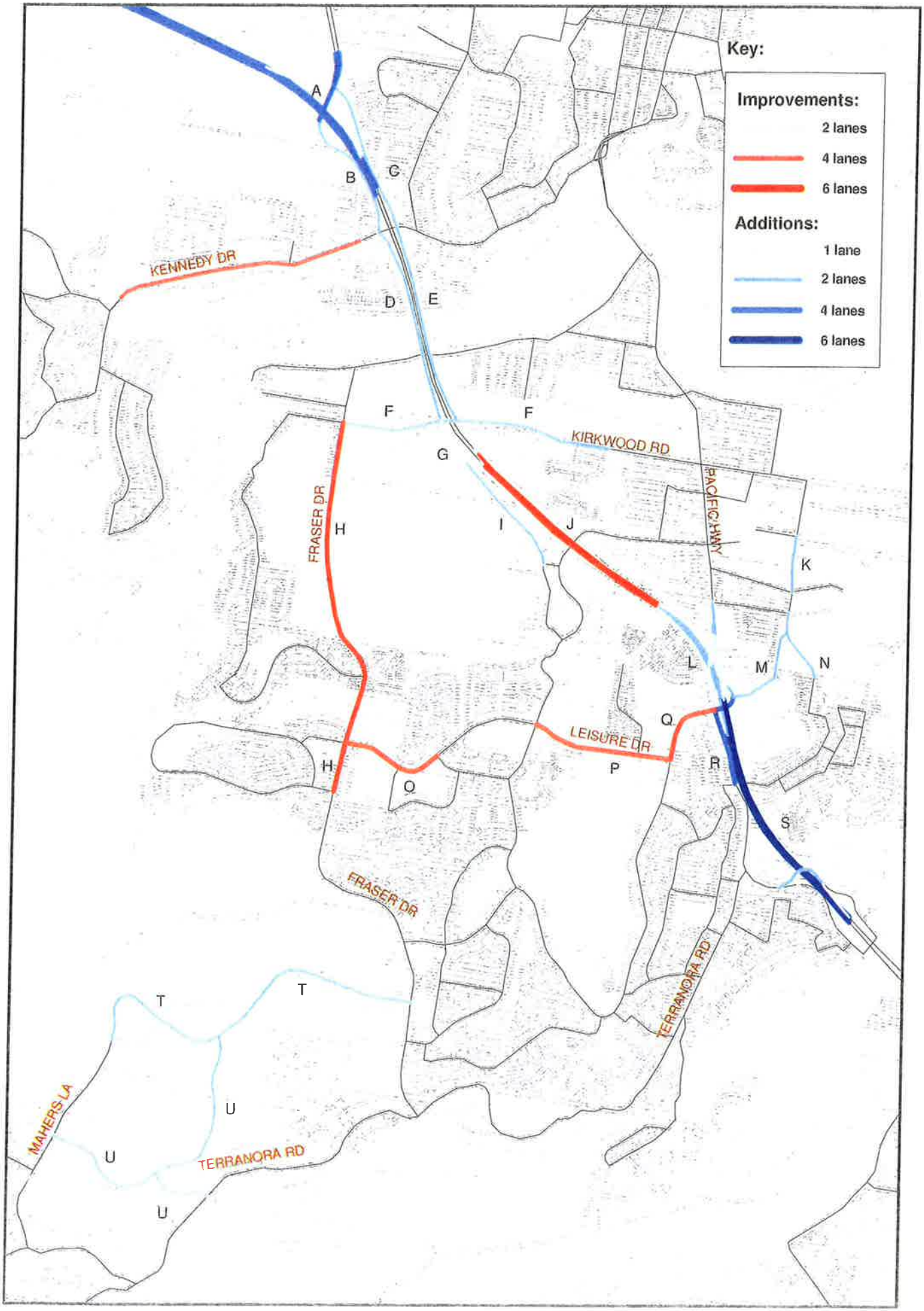


Ultimate PM Peak Hour Volumes - With Eastlakes Drive Extn.

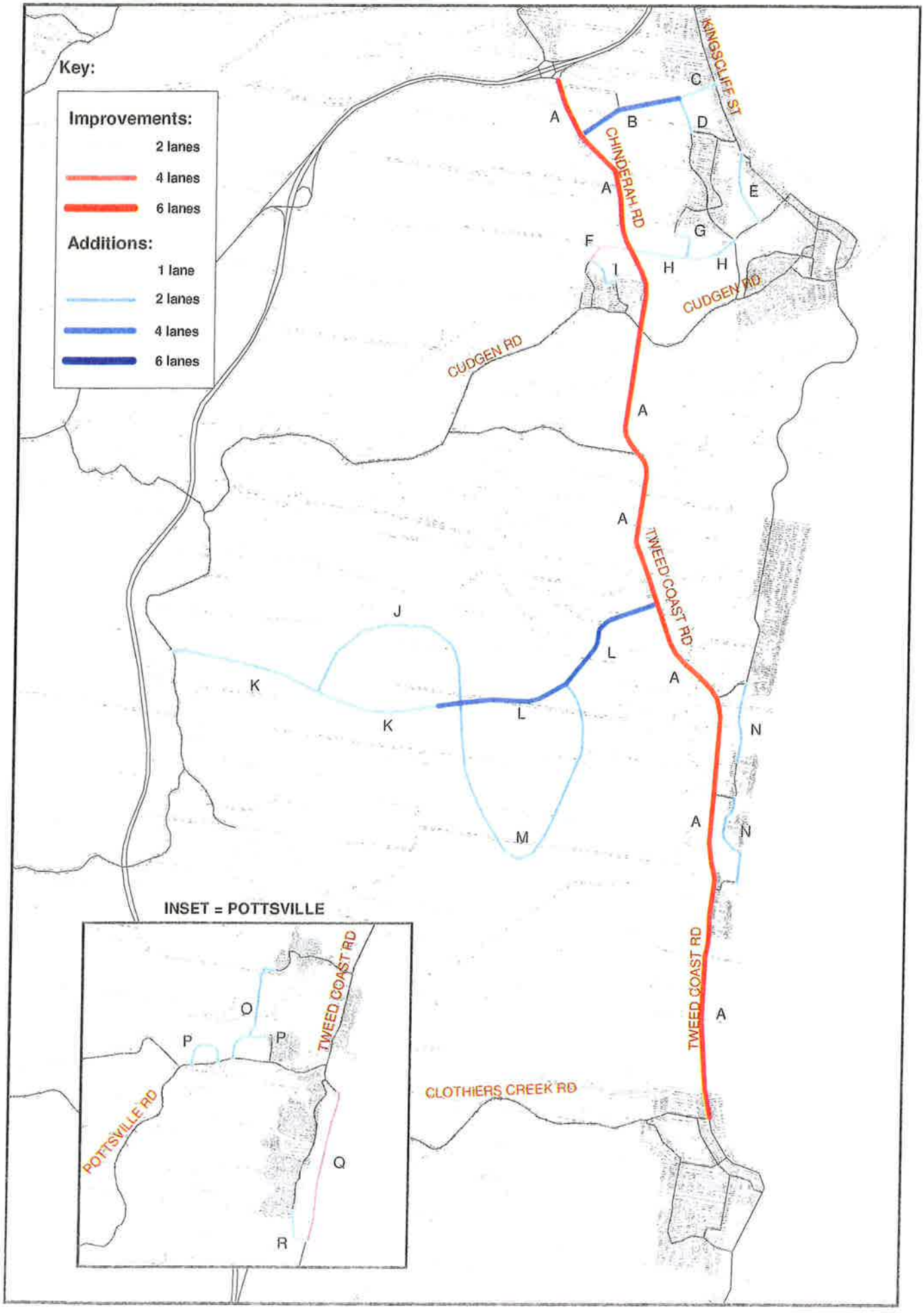
Figure 4.2b



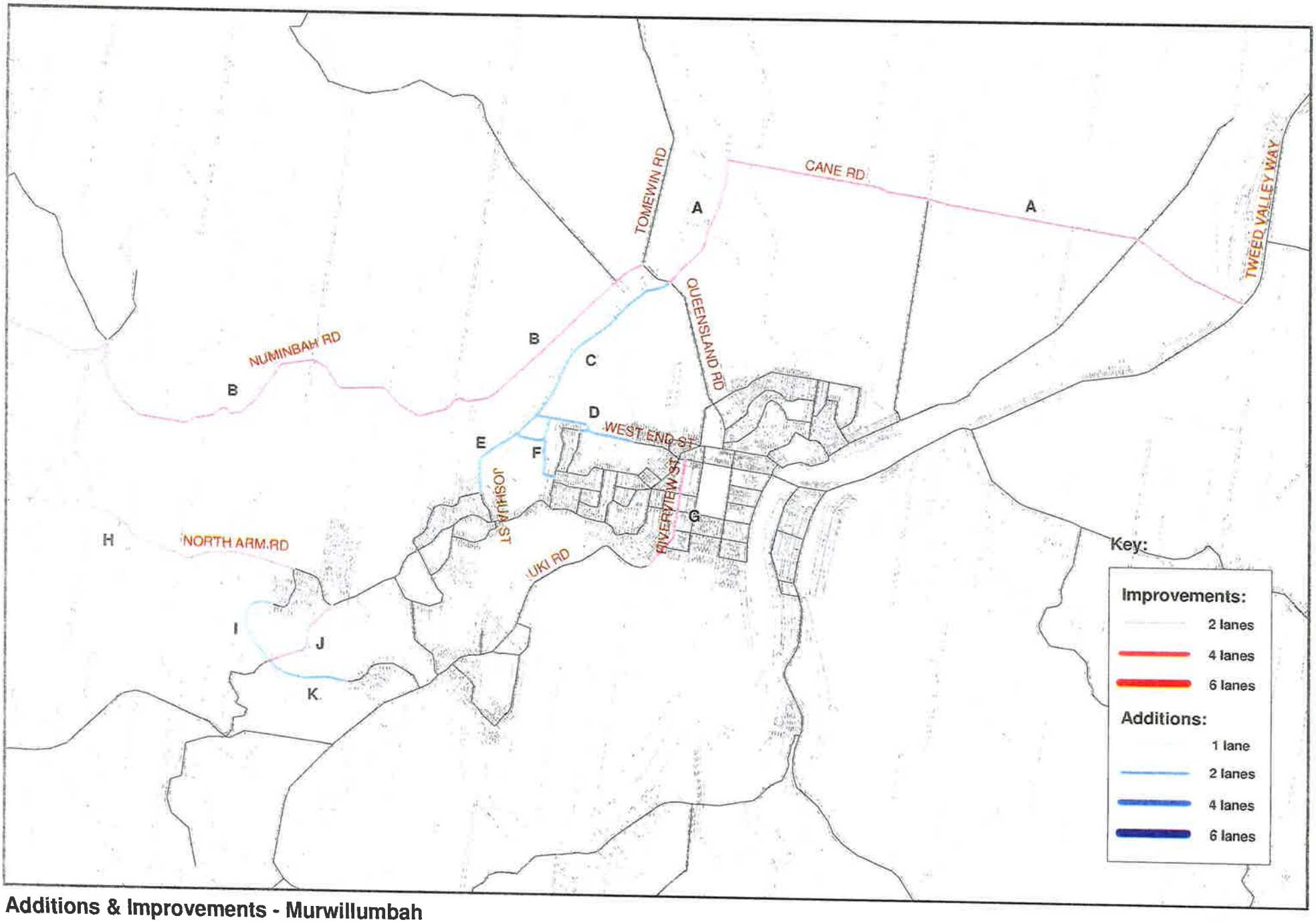
Additions & Improvements - West Tweed Heads **Figure 6.1**



Additions & Improvements - Banora Point Figure 6.2

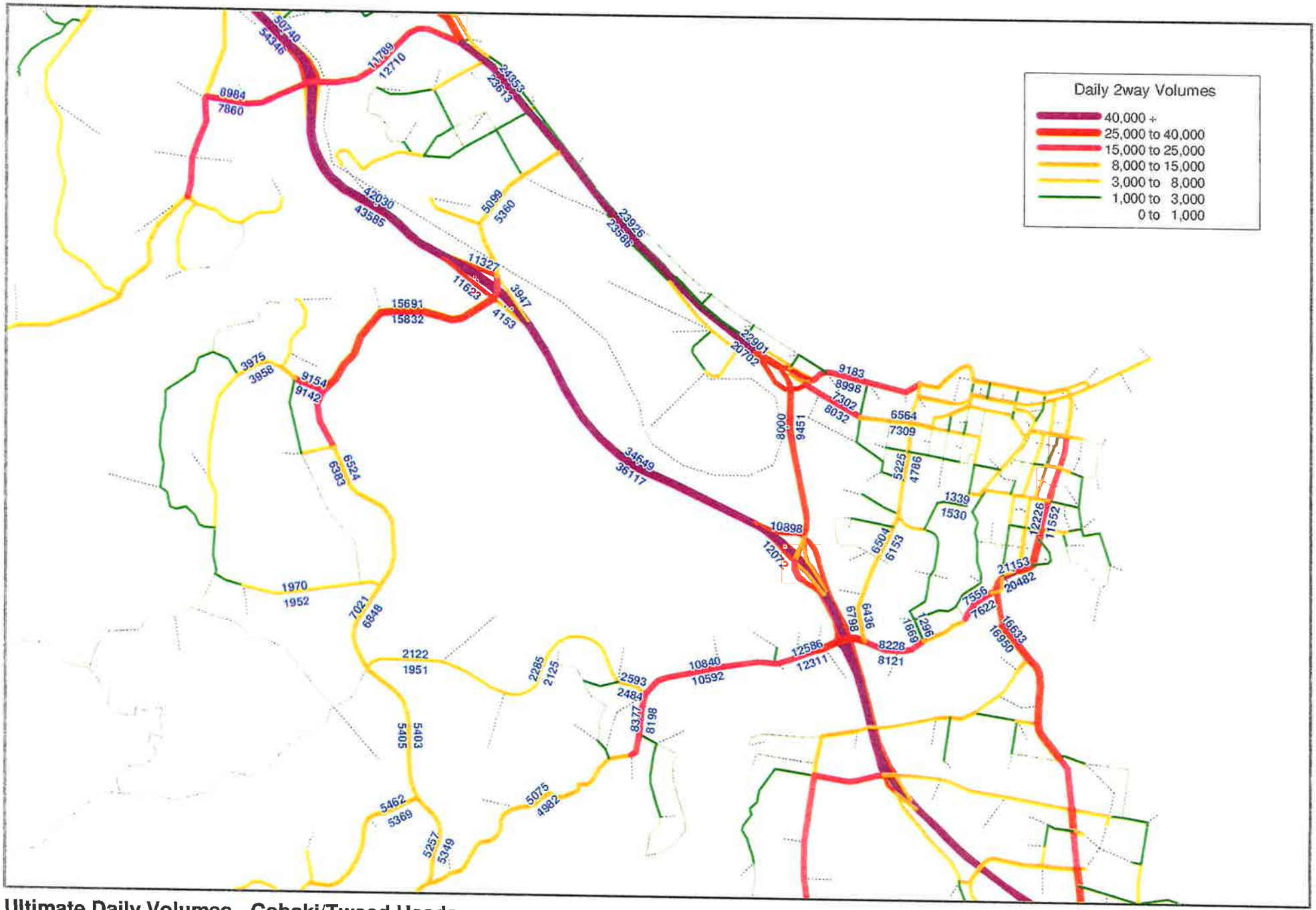


Additions & Improvements - Tweed Coast **Figure 6.3**



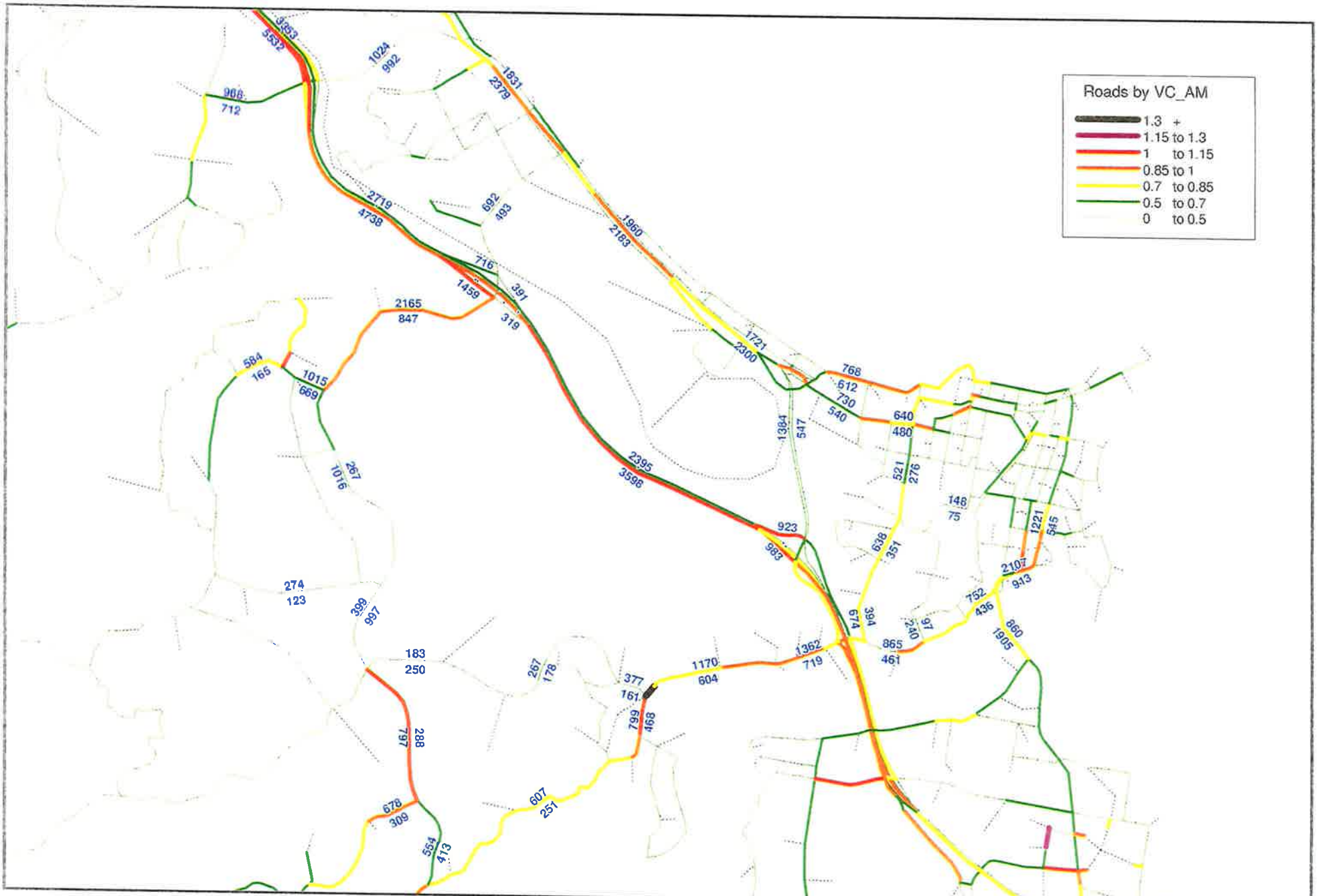
Additions & Improvements - Murwillumbah

Figure 6.4



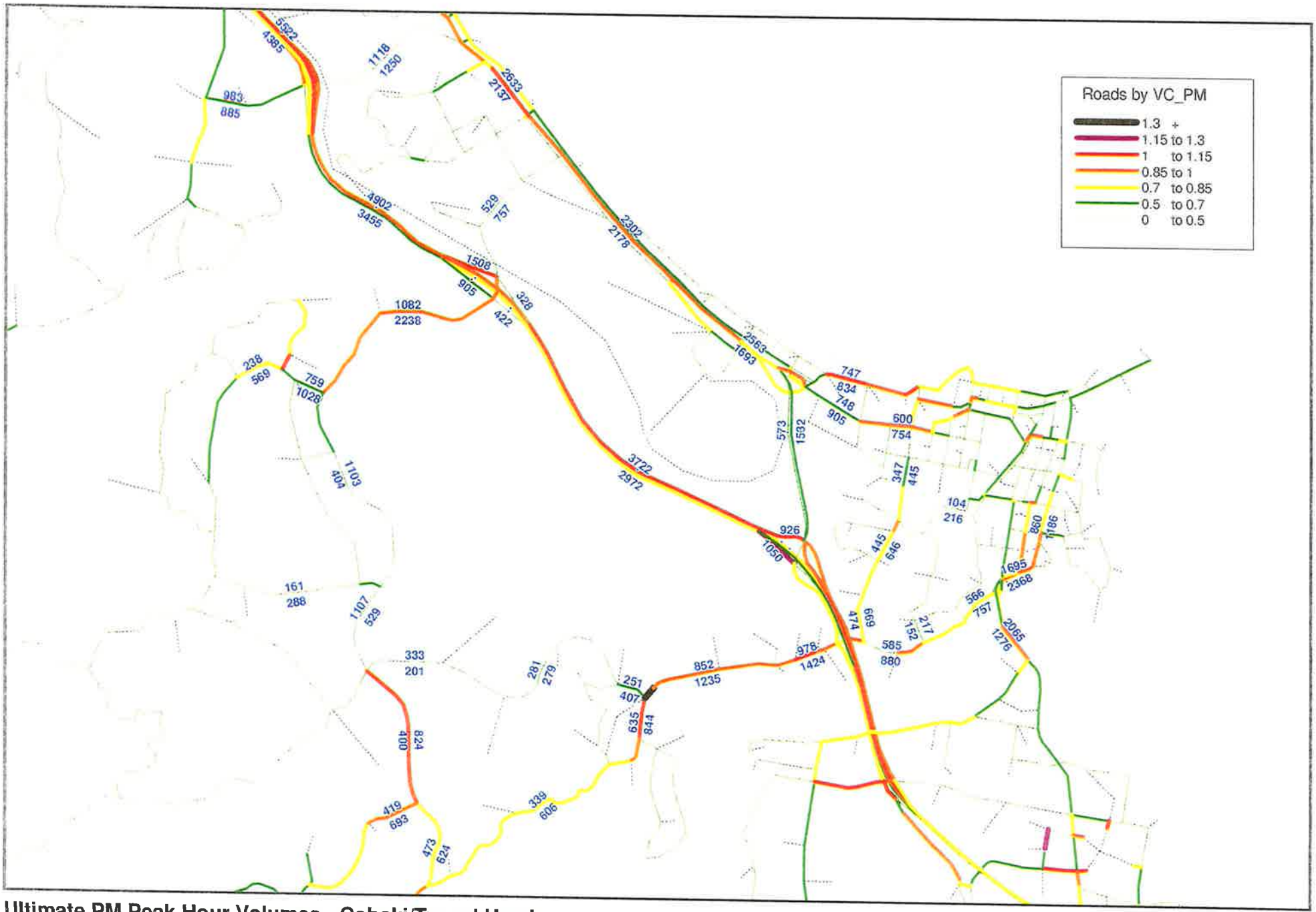
Ultimate Daily Volumes - Cobaki/Tweed Heads

Figure 6.5



Ultimate AM Peak Hour Volumes - Cobaki/Tweed Heads

Figure 6.5a

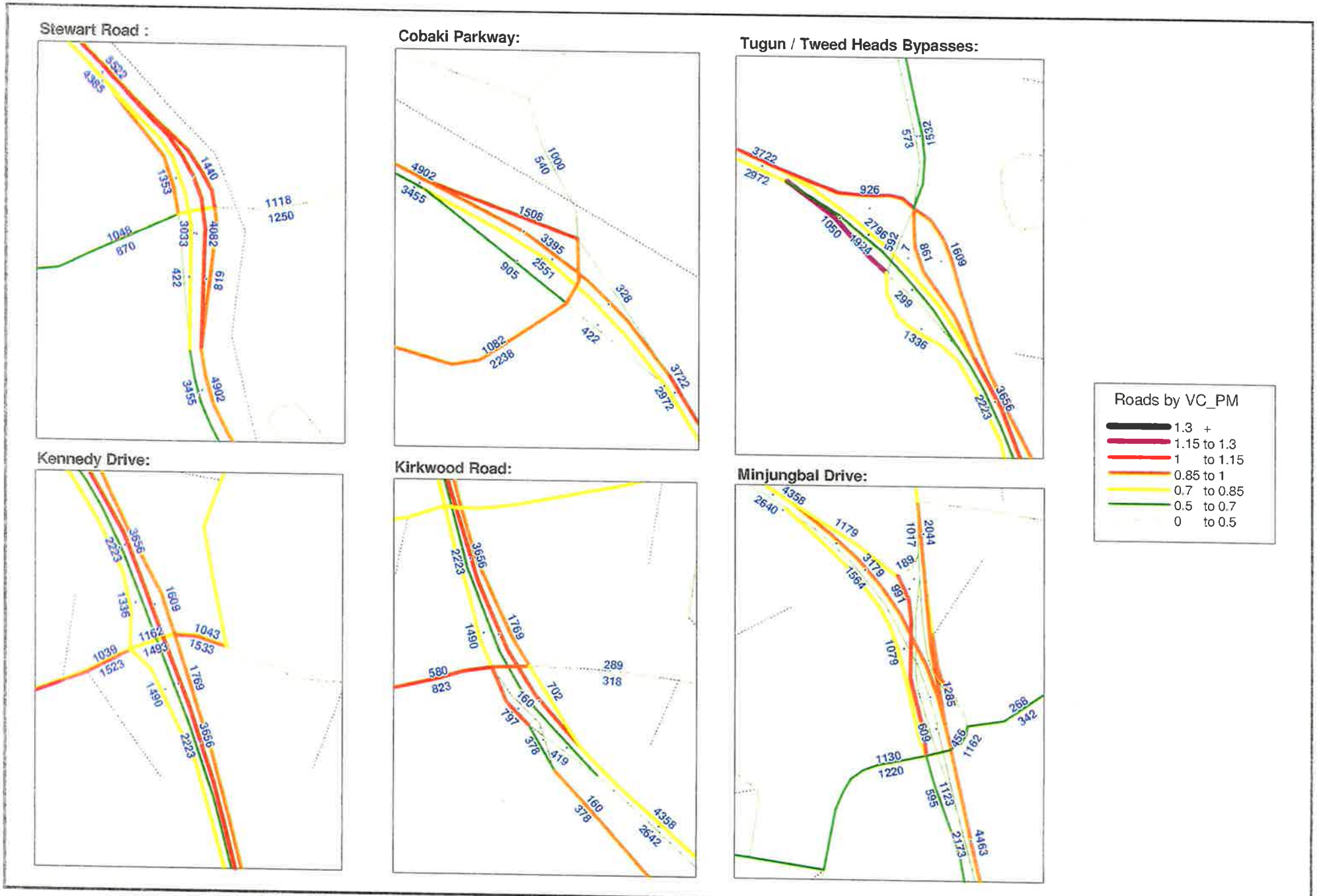


Ultimate PM Peak Hour Volumes - Cobaki/Tweed Heads

Figure 6.5b

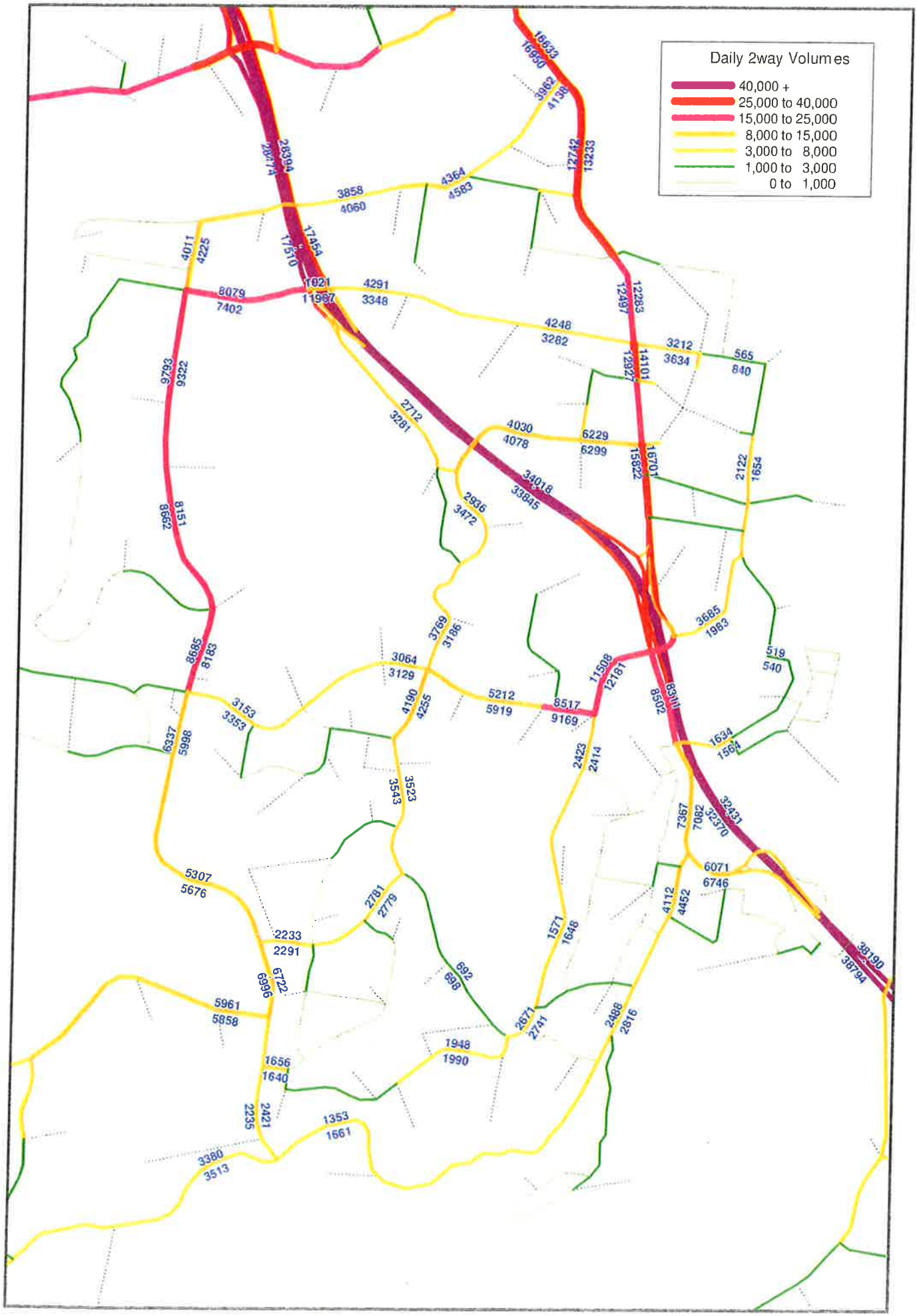
Ultimate Daily Volumes - Interchanges

Figure 6.6

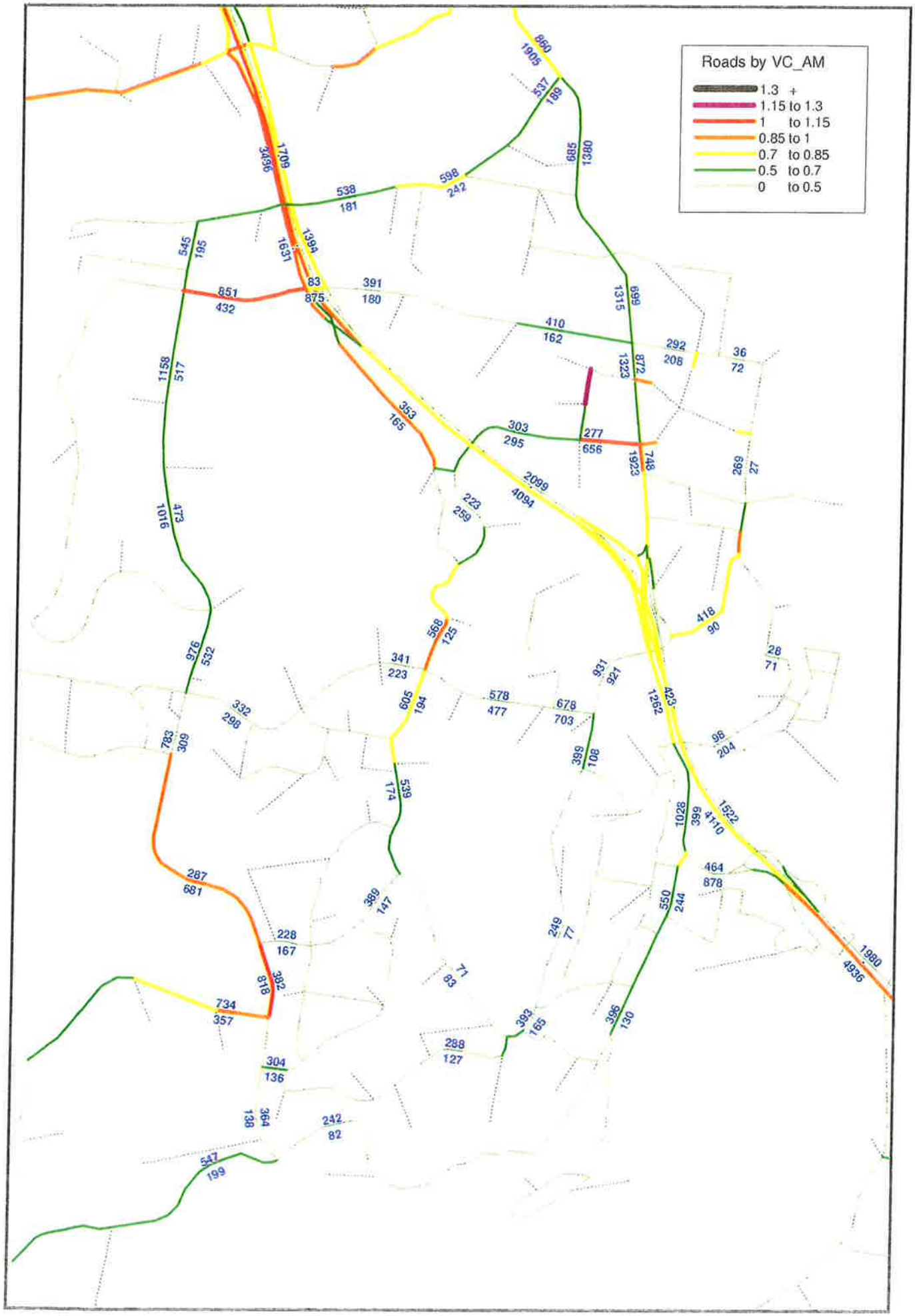


Ultimate PM Peak Hour Volumes - Interchanges

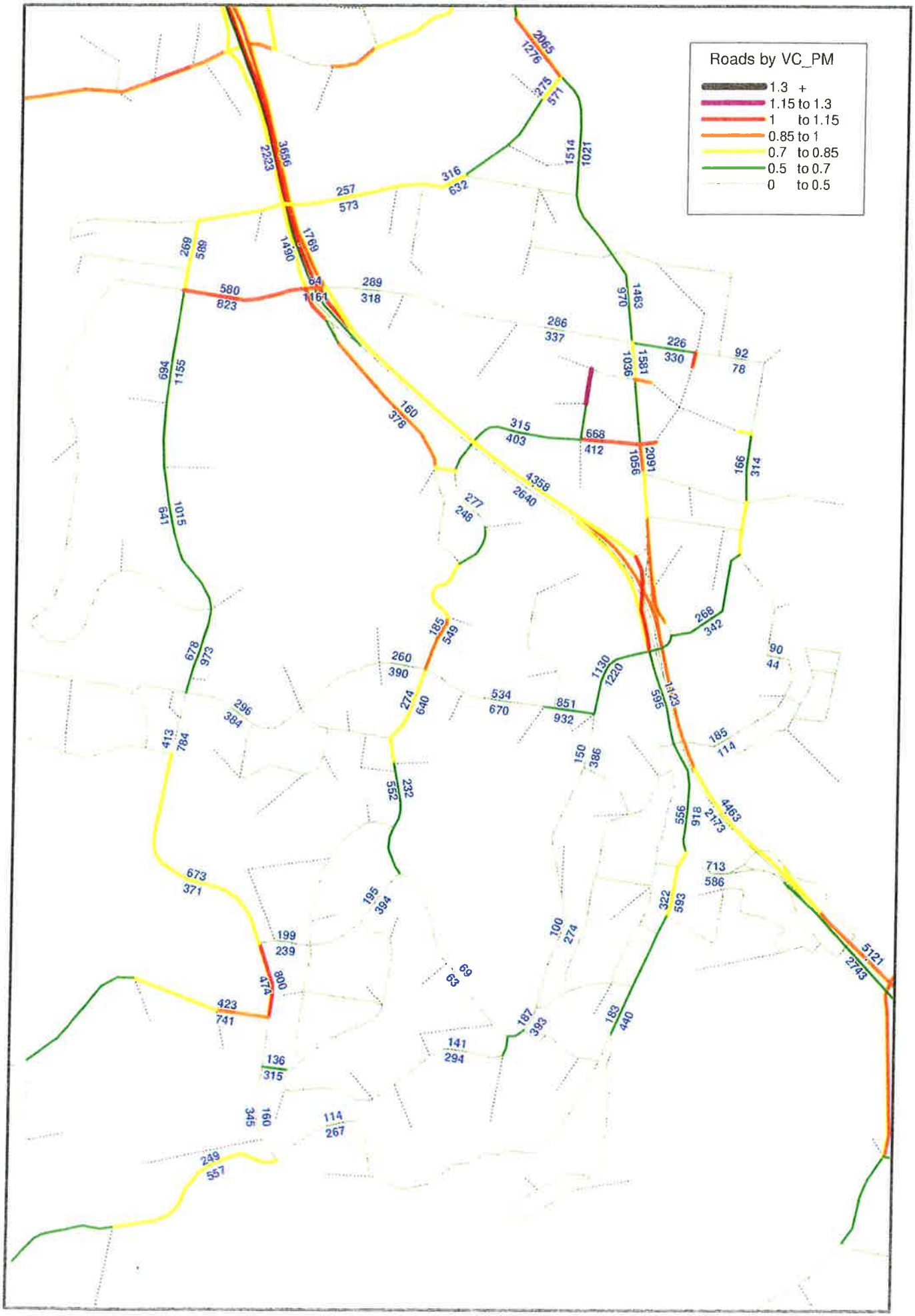
Figure 6.6b



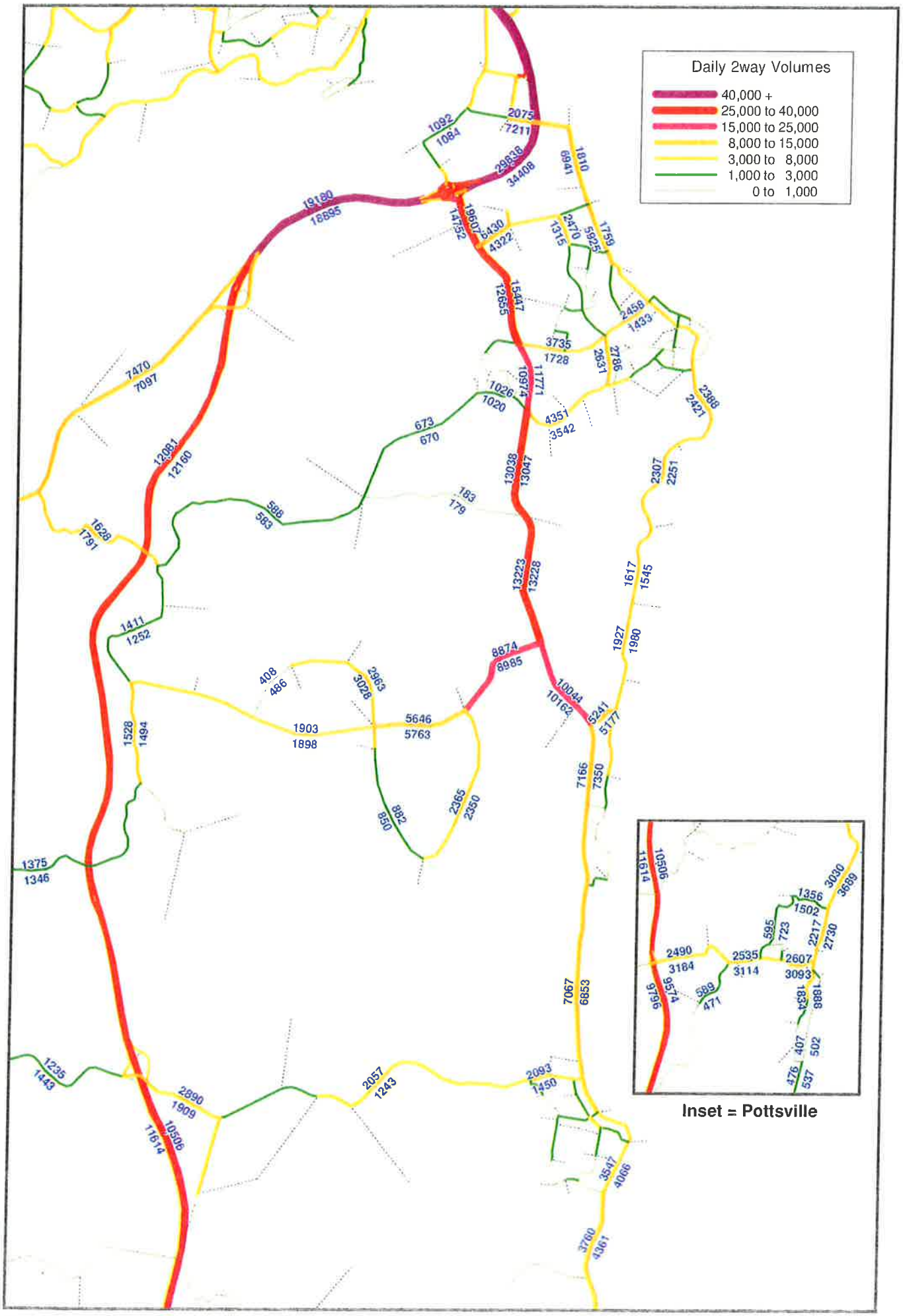
Ultimate Daily Volumes - Banora Point **Figure 6.7**



Ultimate AM Peak Hour Volumes - Banora Point **Figure 6.7a**

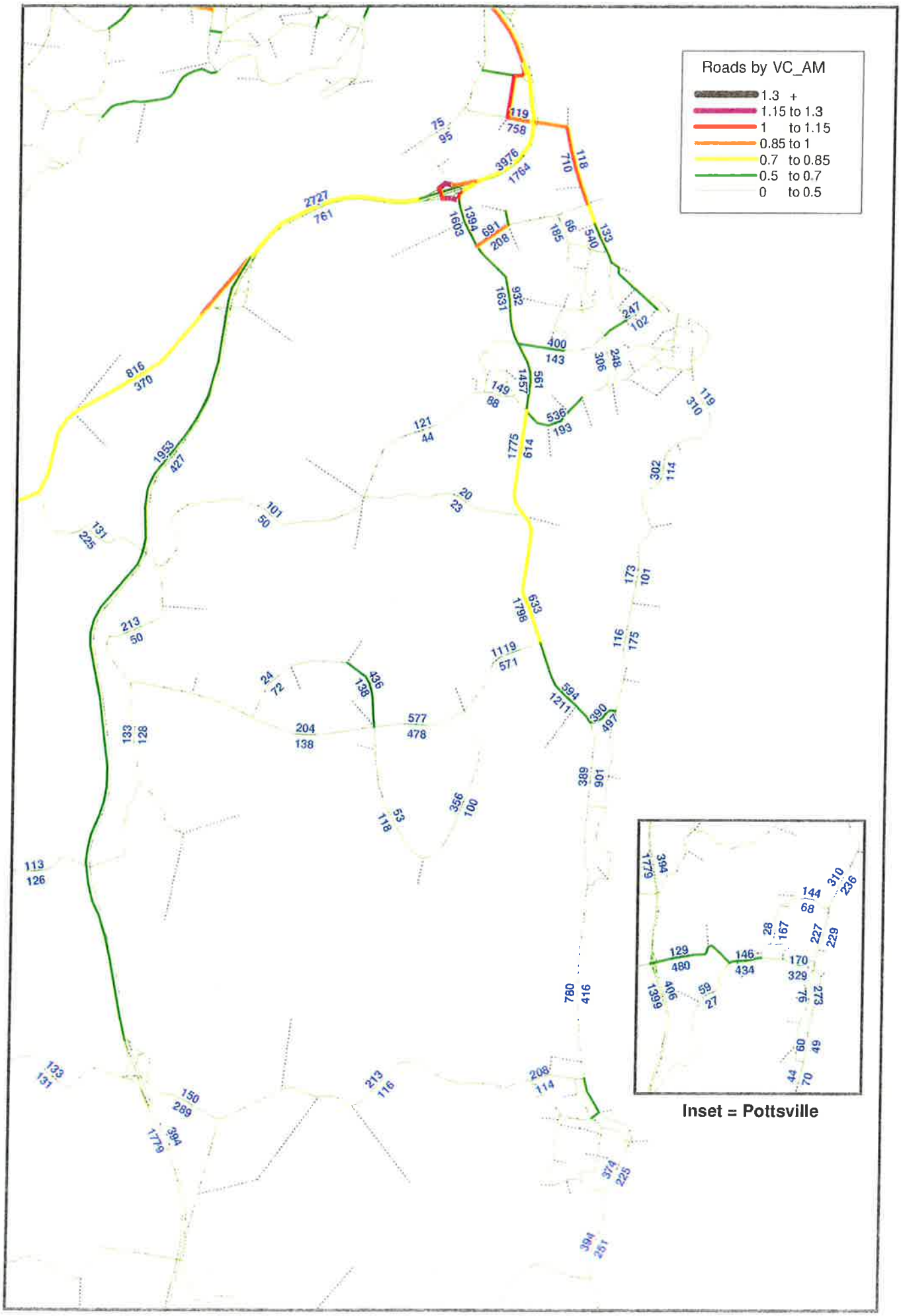


Ultimate PM Peak Hour Volumes - Banora Point **Figure 6.7b**

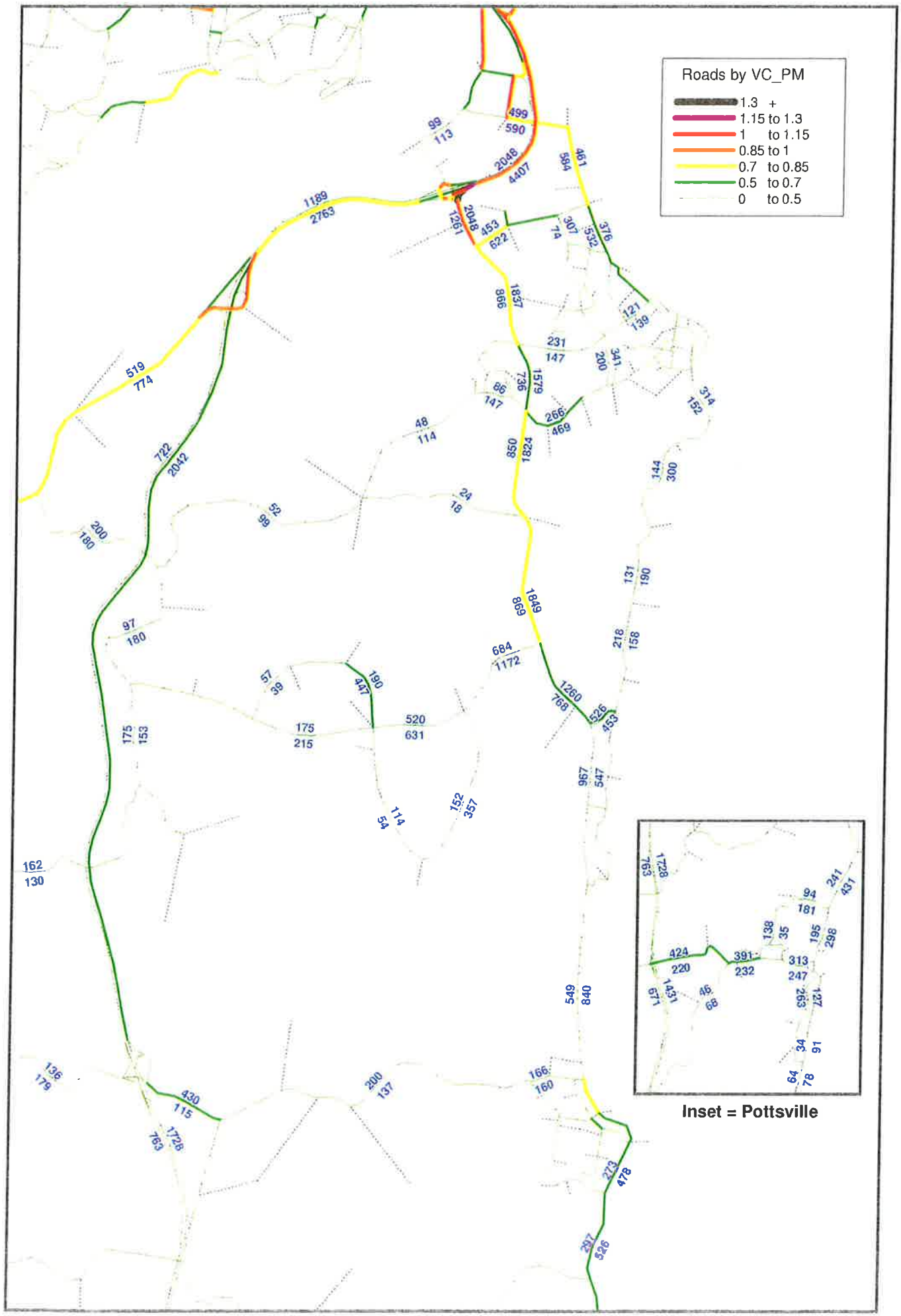


Ultimate Daily Volumes - Tweed Coast

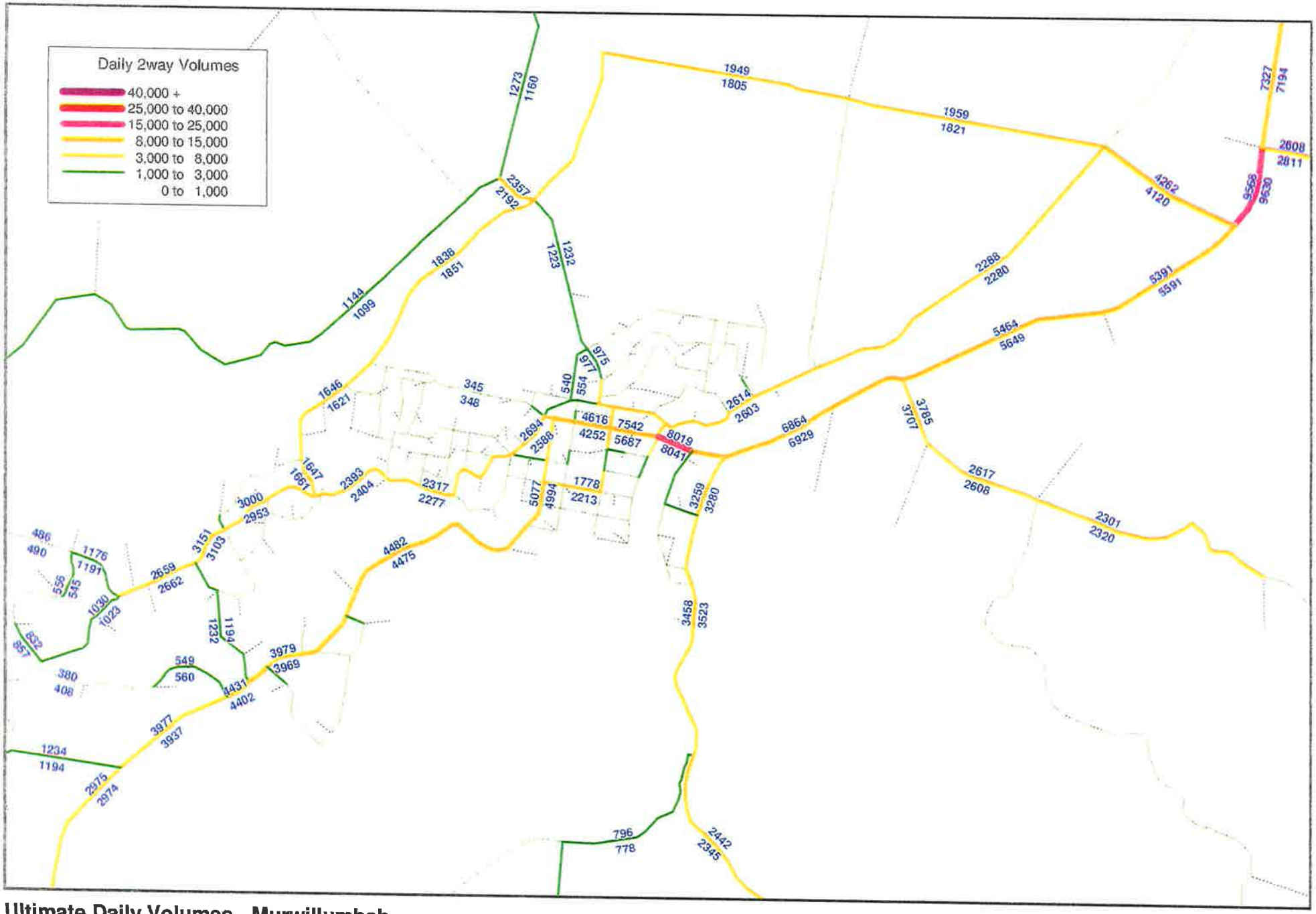
Figure 6.8



Ultimate AM Peak Hour Volumes - Tweed Coast **Figure 6.8a**

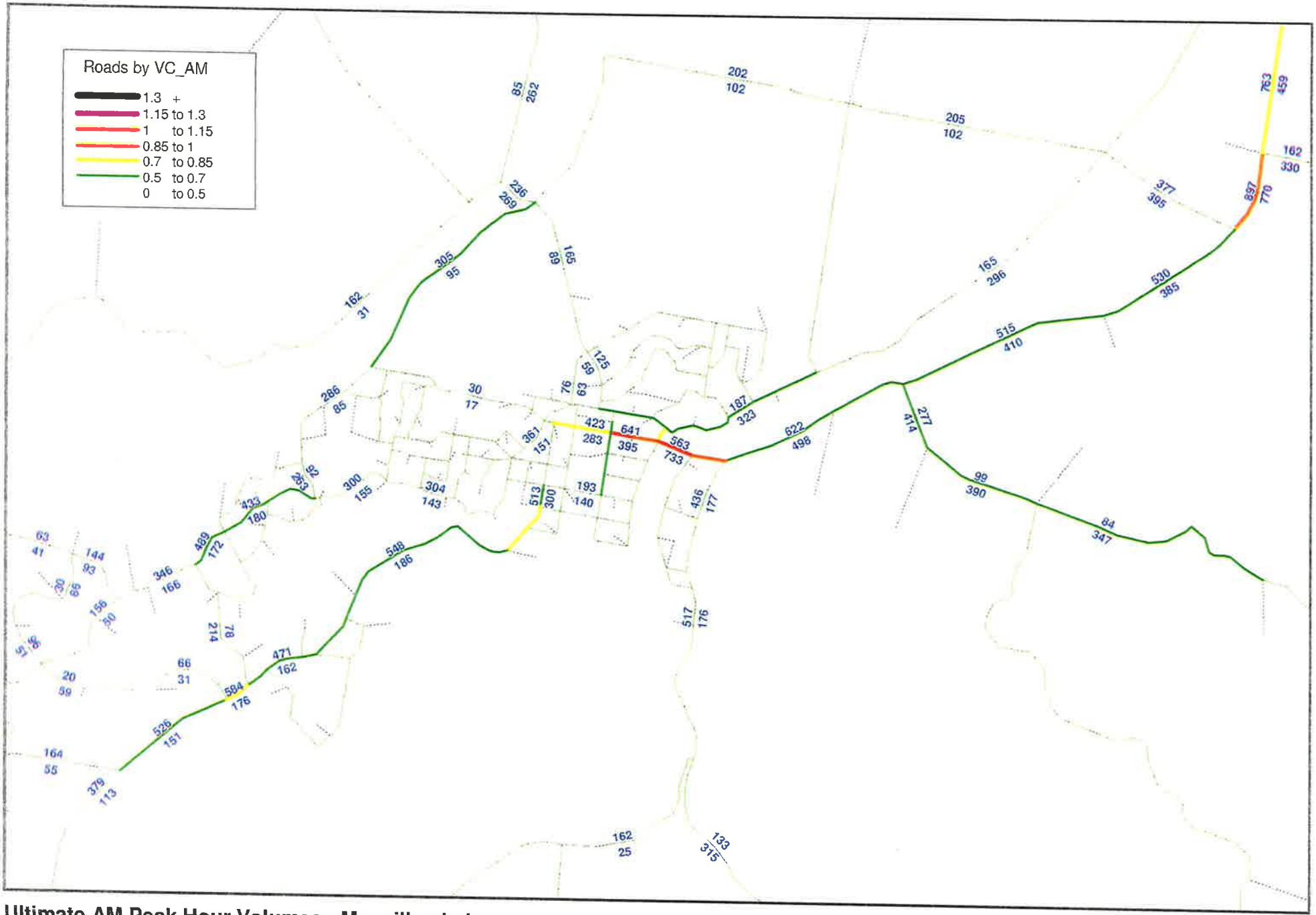


Ultimate PM Peak Hour Volumes - Tweed Coast **Figure 6.8b**



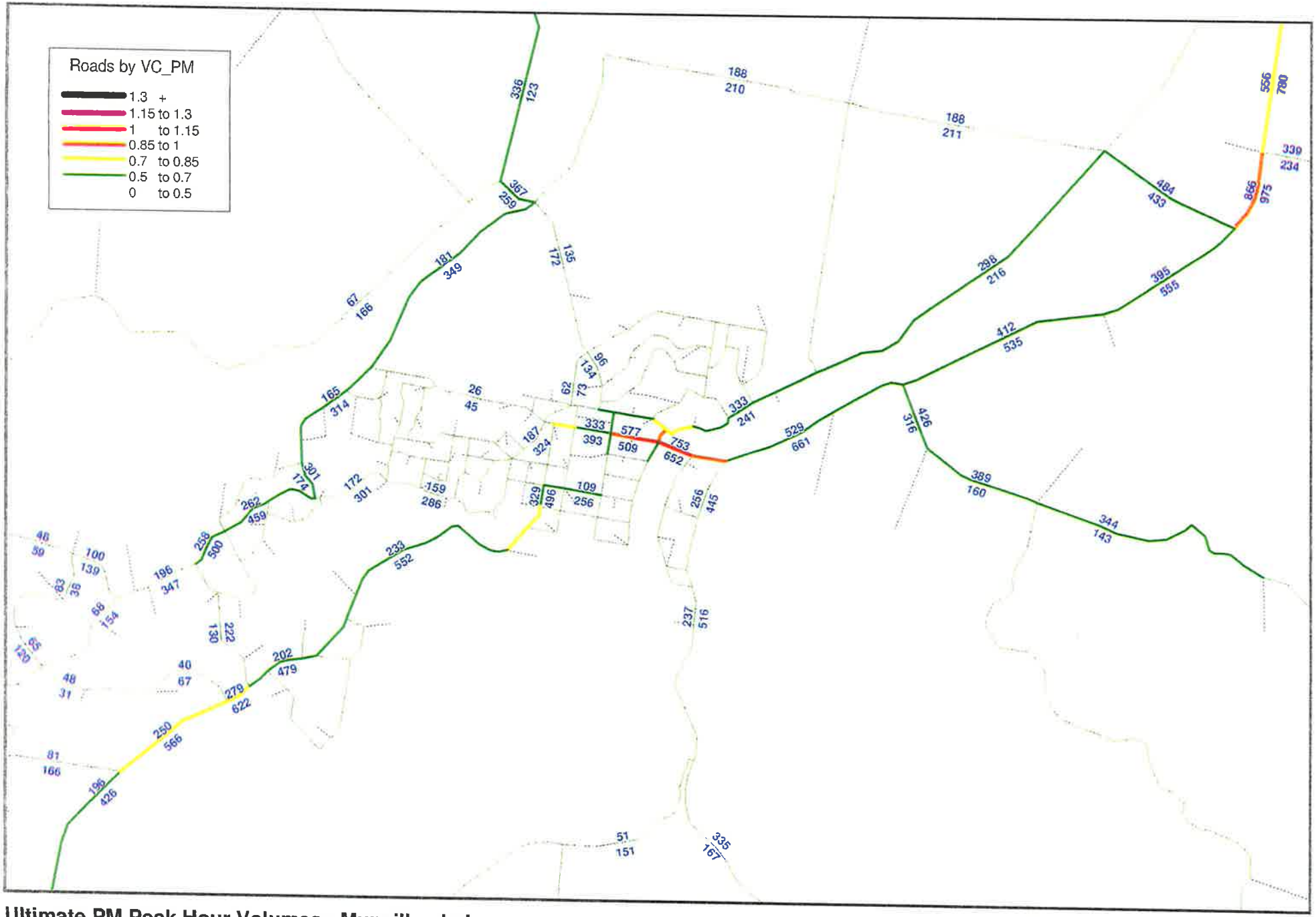
Ultimate Daily Volumes - Murwillumbah

Figure 6.9



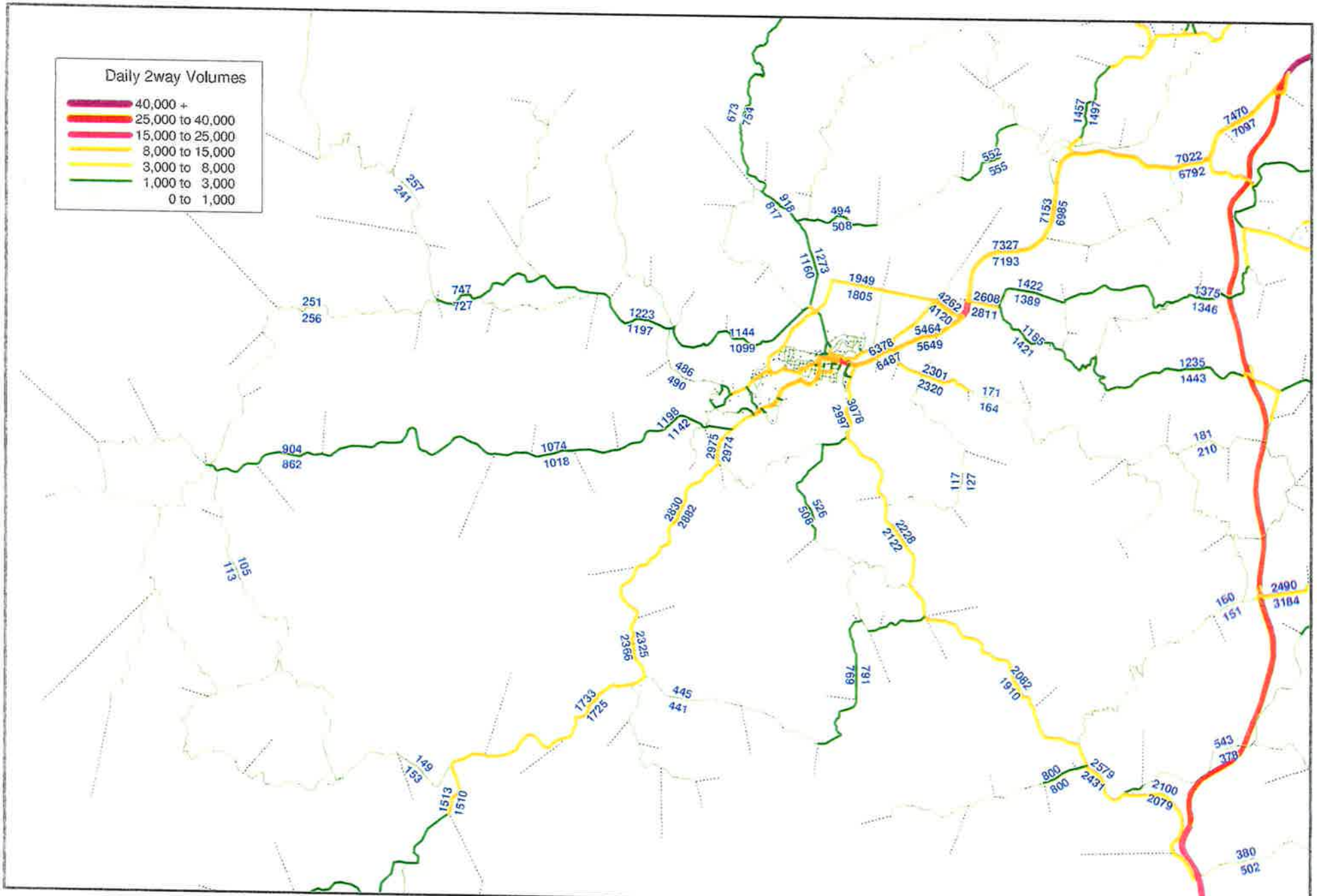
Ultimate AM Peak Hour Volumes - Murwillumbah

Figure 6.9a



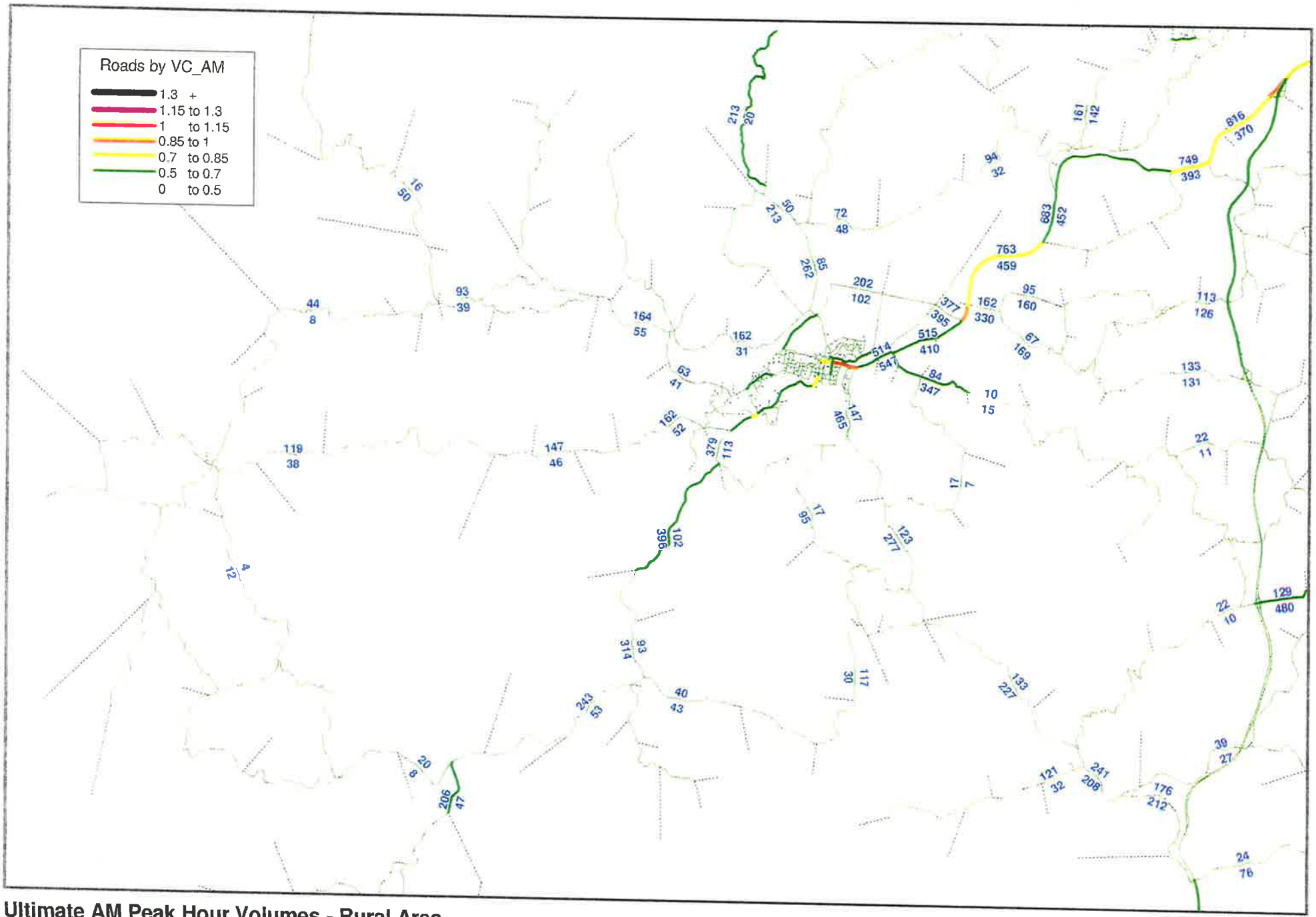
Ultimate PM Peak Hour Volumes - Murwillumbah

Figure 6.9b



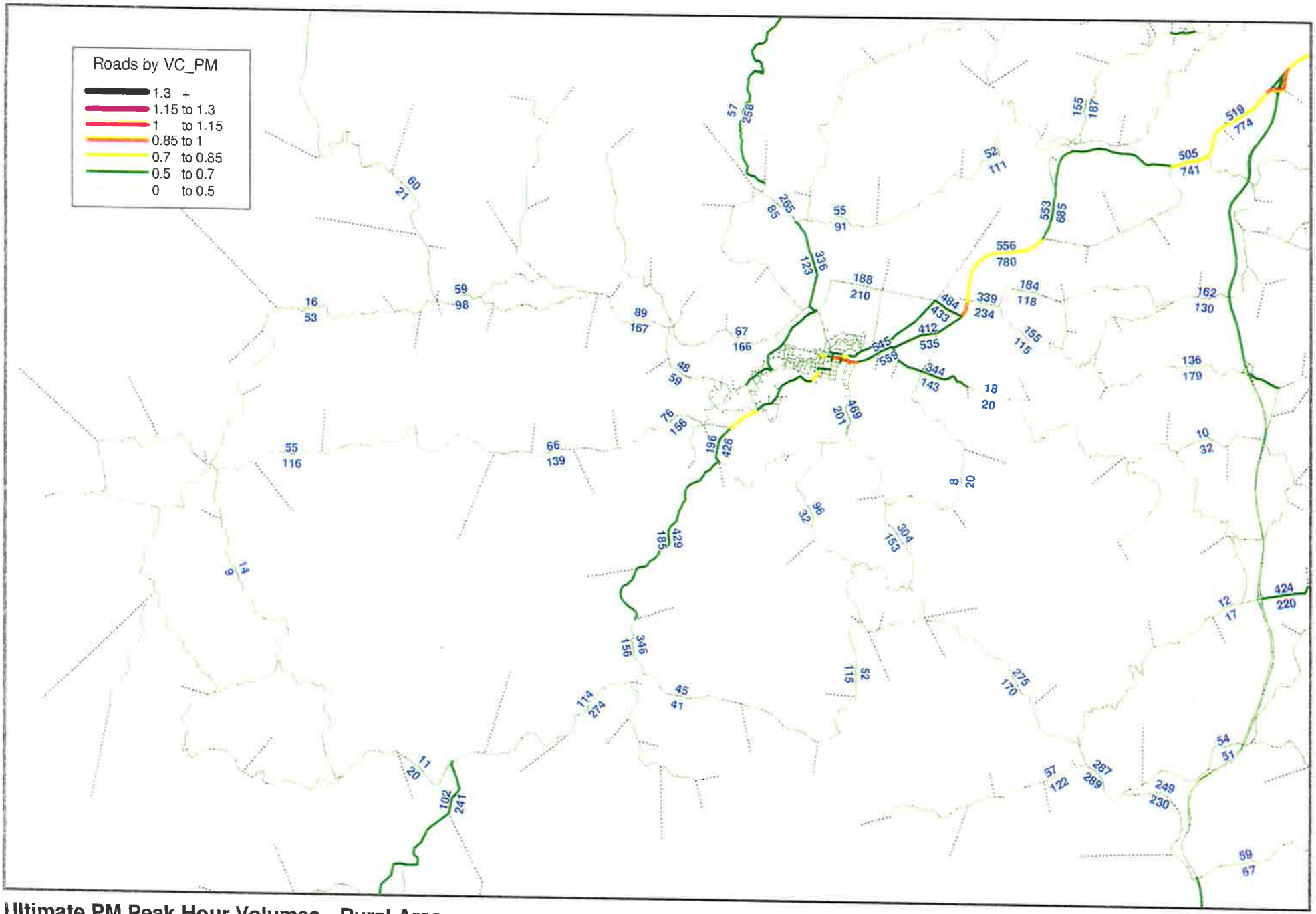
Ultimate Daily Volumes - Rural Area

Figure 6.10



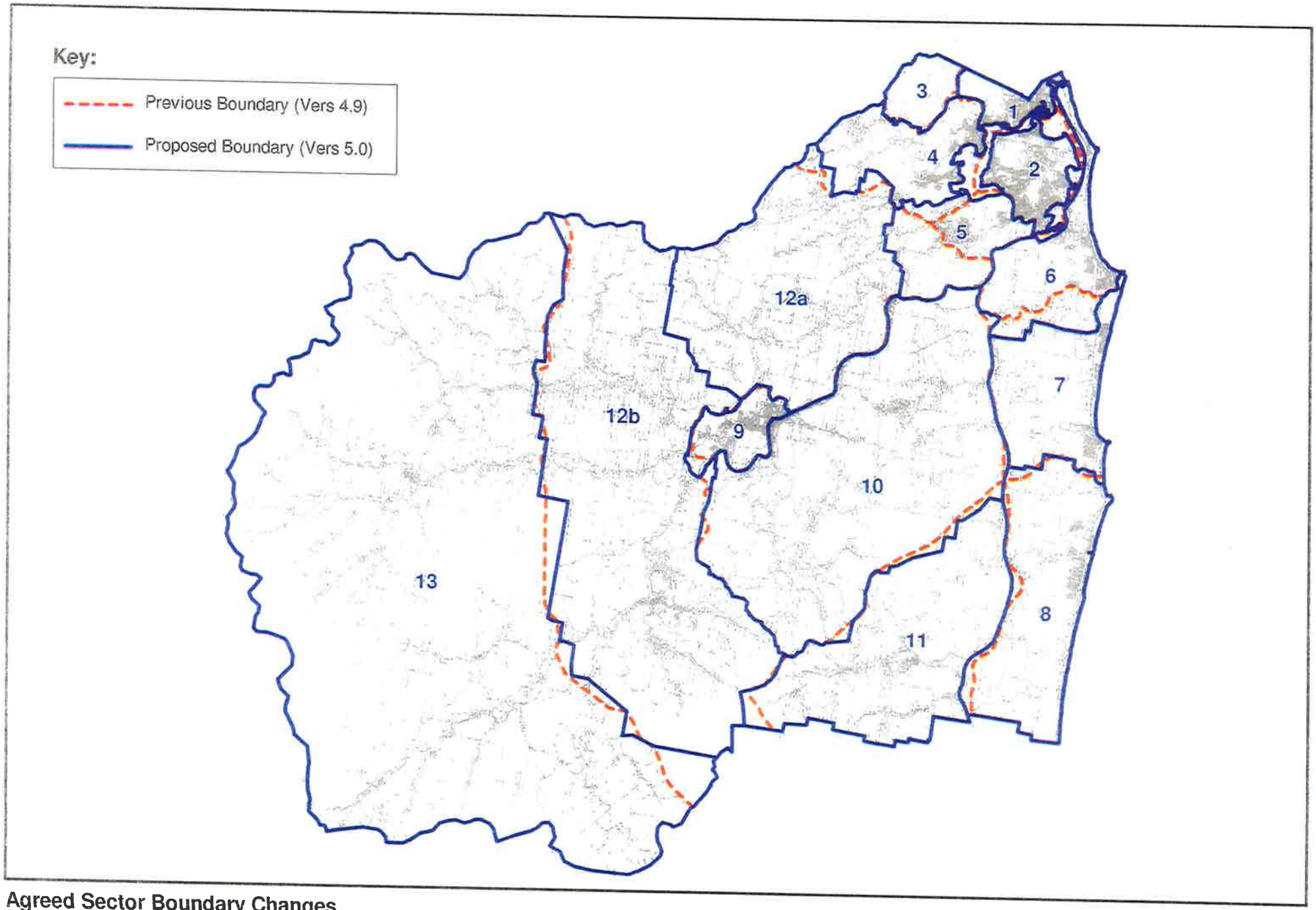
Ultimate AM Peak Hour Volumes - Rural Area

Figure 6.10a



Ultimate PM Peak Hour Volumes - Rural Area

Figure 6.10b



Agreed Sector Boundary Changes

Figure 8.1