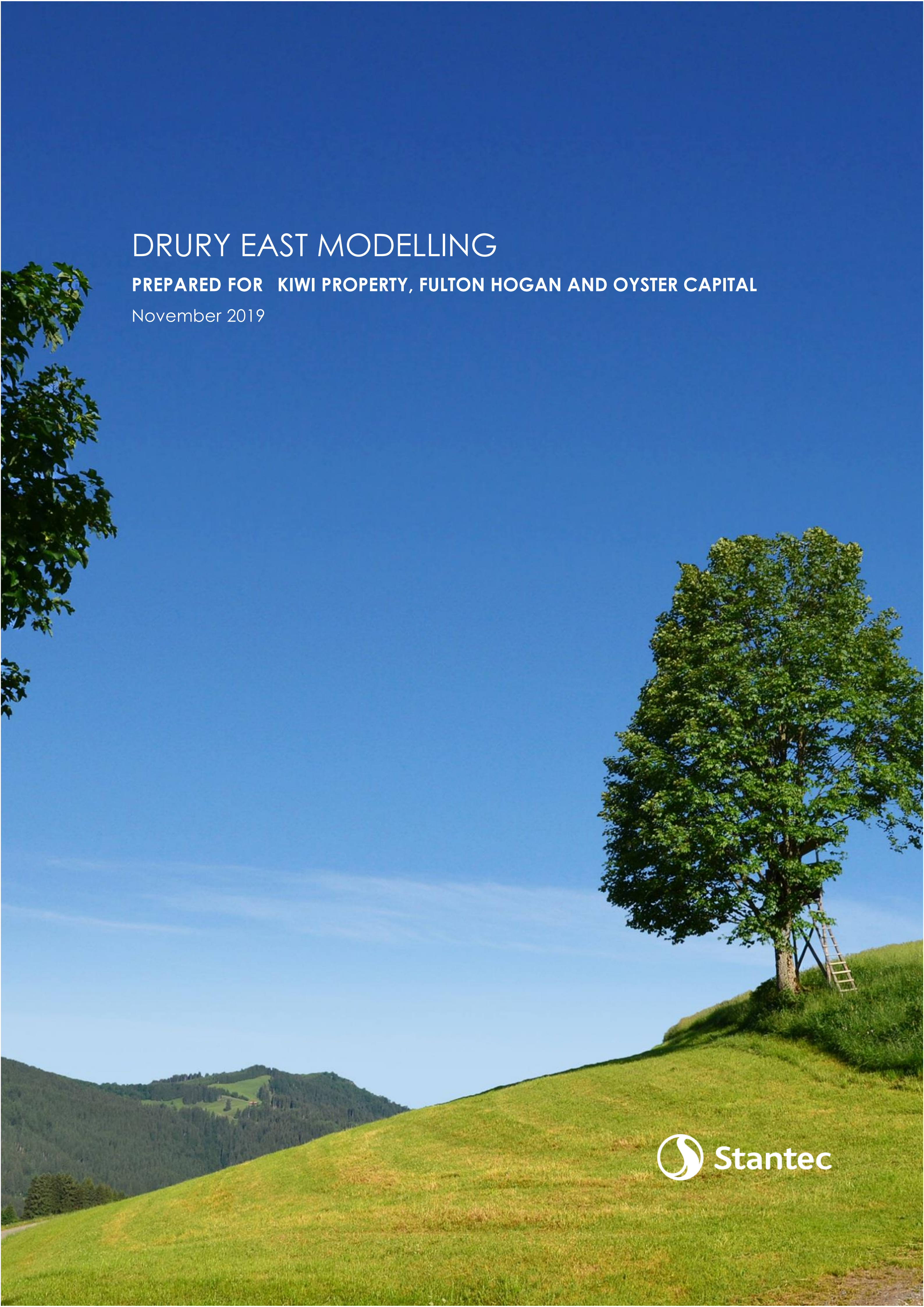
Appendix A

Drury East Modelling Report 18112019

DRURY EAST MODELLING

PREPARED FOR KIWI PROPERTY, FULTON HOGAN AND OYSTER CAPITAL

November 2019



Stantec

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Kiwi Property, Fulton Hogan and Oyster Capital

Drury East Modelling

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Executive Summary

Stantec has undertaken traffic modelling to assess the traffic effect of the proposed developments within Drury East. The modelling has considered proposed development by Kiwi Property (**Kiwi**), Fulton Hogan, and Oyster Capital. The modelling has also determined which infrastructure is required at certain decades to unlock developers' planned developments.

The traffic modelling has been undertaken using a three-tiered approach, consisting of a macro strategic model (MSM), a mesoscopic project model (SATURN), and a localised intersection operational model (Sidra Intersection). The assessment period spans three decades, between the anticipated start of the developments in 2023 through to 2048. The modelling has considered the Supporting Growth future transport network, as reported in the SGA ITA for Drury-Opaheke and Pukekohe-Paerata areas. The land use assumptions, however, have been adjusted to align with Kiwi, Fulton Hogan, and Oyster Capital's desired build rates.

The existing capacity constraint on the network surrounding Drury East due to the ongoing SH1 Southern Improvements roadworks is acknowledged. At a high level, it is assumed that the completion of the roadworks will alleviate the pressure on the network.

The modelling has remained consistent with the public transportation mode share assumptions in the MSM model. The MSM model assumed a lower public transport mode share for Drury East compared to Drury West. Given the future public transport services and infrastructure that are planned for Drury East, and the proximity of the Drury Metropolitan Centre to future train station, this assumption is considered conservative and it is expected that in reality there will be a higher uptake of public transport by Drury East residents, employees, and visitors. This will likely reflect lower traffic on the overall network compared to the demand assumed in the modelling assessment. Moreover, should the network become increasingly constrained due to the development traffic and/or the growth in background traffic, this could result in the potential to further encourage an increase in PT uptake by Drury East residents and workers.

The modelling demonstrated that the rezoning can be accommodated by the surrounding transport network, with several targeted local upgrades recommended within the first two decades.

These are primarily the provision of access to the Metropolitan Centre (preferably the direct access via Drury Interchange, if feasible), the signalisation of the Great South Road / Waihoehoe Road roundabout prior to 2028, and a network capacity upgrade prior to 2038 which could be achieved through doubling the northbound ramps at the Drury Interchange or an earlier provision of the Southern Mill Road connection to Fitzgerald Road. The 2038 and 2048+ traffic modelling is satisfactory as all the key infrastructure required to support the growth is anticipated to have been implemented within those decades.

A more conservative scenario which considers no provision of direct access to the Metropolitan Centre has also been modelled and analysed. The modelling shows that without the direct access to Metropolitan Centre, some local upgrades within the development site will need to be provided earlier such as the widening of Great South Road and Waihoehoe Road. Similar to when the direct access is provided, a network capacity upgrade prior to 2038 through doubling the northbound ramps at the Drury Interchange or an earlier provision of the Southern Mill Road connection to Fitzgerald Road will be required. Following the 2038 and 2048+ infrastructure upgrades, traffic modelling shows that the network performance will be satisfactory.

While the modelling provides indication of when and what specific upgrades are required based on the anticipated future network and development, it is noted that further refinements to the extent and timeframe of upgrades may be explored and adopted in further stages of the planning process and as the actual development progresses. The modelling has been undertaken at a level appropriate for a Plan Change and therefore has not specifically considered the potential impact of construction traffic relating to each upgrade. It is noted that any construction impact on the network will be temporary and will be managed appropriately.

Based on the modelling, it is considered that the Drury East plan change can be supported from a traffic perspective and is unlikely to have a significant adverse effect on the traffic network, given that the infrastructure required to support the developments is implemented.

1. Introduction

To accommodate further growth and to facilitate urbanisation in Drury, Council has undertaken Structure plans for Drury-Opaheke and Pukekohe-Paerata. The Drury-Opaheke area is divided into Drury East / Central / South (**Drury East**) and Drury West, as shown in **Figure 1-1** below. State Highway 1(**SH1**) separates Drury East and Drury West and provides a direct connection northbound and southbound.

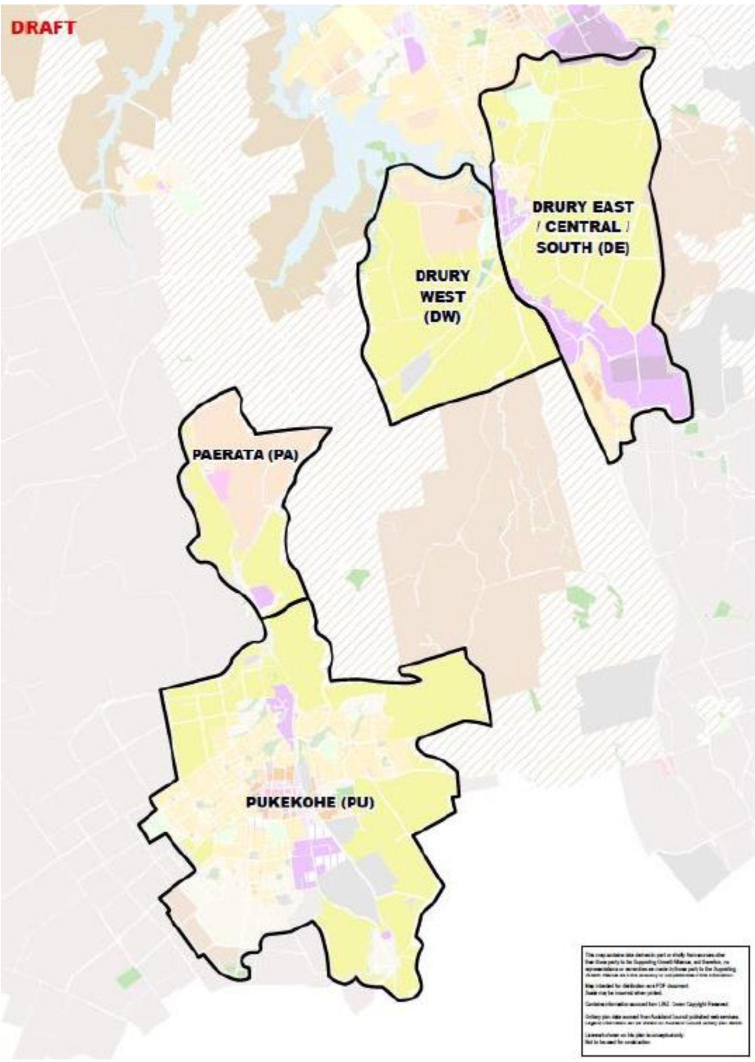


Figure 1-1: Geographic subdivisions of Structure Plan Areas (draft)

On 2 April 2019, a Draft Integrated Transport Assessment by Supporting Growth Alliance (**SGA ITA**) was released. This outlined the transportation effects of the proposed Structure Plan areas for Drury-Opaheke and Pukekohe-Paerata, as part of the Council's Future Urban Land Supply Strategy (**FULSS**). The Drury-Opaheke Structure Plan Area is shown in **Figure 1-2** below.

Whilst the SGA ITA provides further clarity to the Structure Plan, there are limitations to the level of detail provided. The majority of the modelling methodology and results focussed on the full 2048+ development, rather than the interim years (i.e. 2028 and 2038) and various inputs and assumptions are not clearly defined.

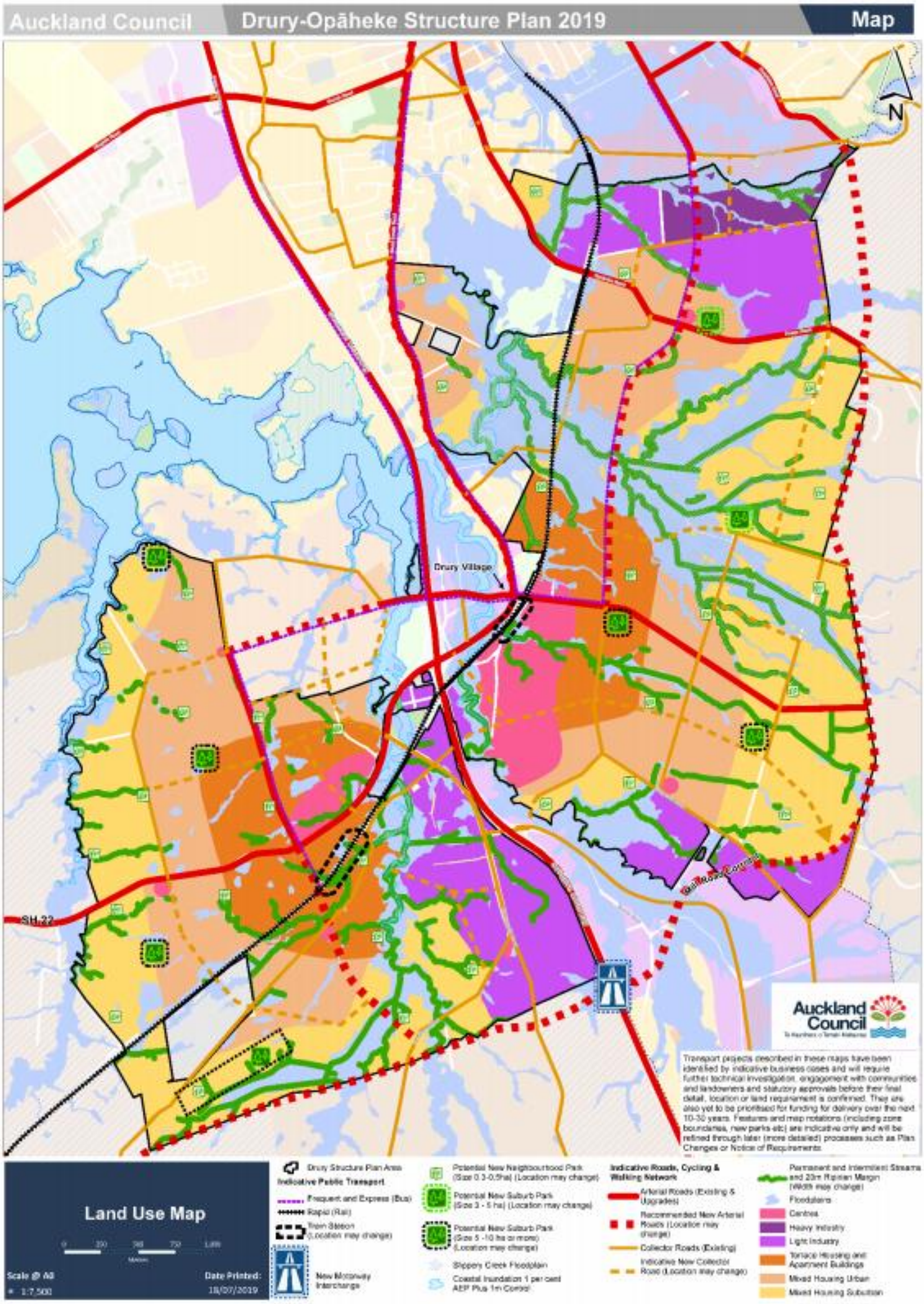


Figure 1-2: Drury-Opaheke Structure Plan 2019 (from SGA ITA)

Kiwi Property, Fulton Hogan and Oyster Capital have substantial landholdings within Drury East and are seeking to progress development ahead of the Council's current staging. Kiwi Property is proposing to develop a Metropolitan Centre (i.e. mixed use) whilst Fulton Hogan and Oyster Capital are both proposing primarily residential development. The broad proposed plan change areas for each property owner are outlined in **Figure 1-3** below.

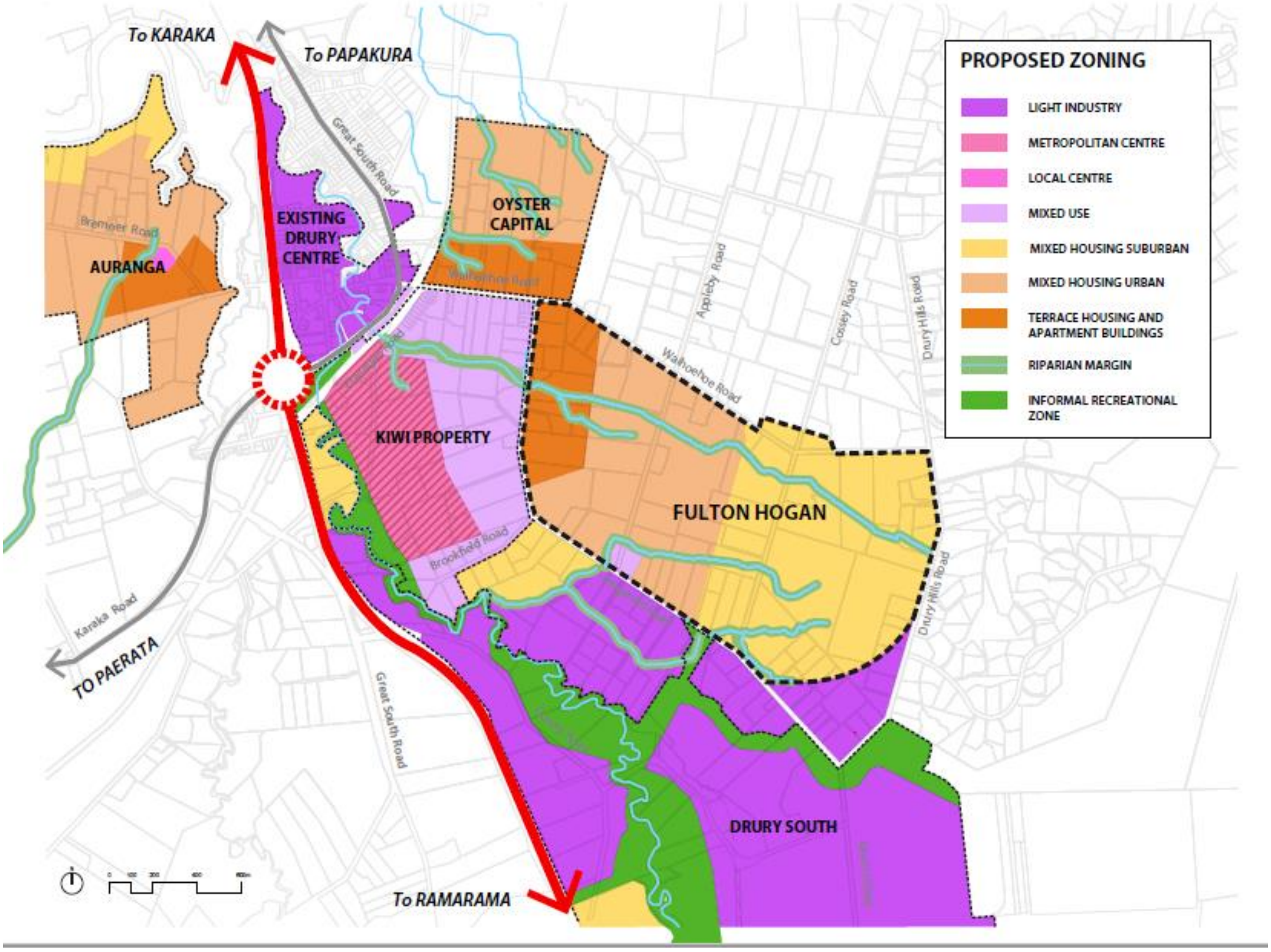


Figure 1-3: Kiwi, Fulton Hogan and Oyster Capital broad proposed plan change areas in the context of the Draft Structure Plan boundary

The traffic effects due to the proposed developments are required to be assessed on the surrounding network, and the access routes to each site also need to be considered. There is currently a high level of congestion on the surrounding network, particularly on SH1 north of Drury Interchange and Great South Road. This is primarily caused by the ongoing SH1 Southern Improvements (**SI**) roadworks north of Papakura, which encourages trip diversions via Great South Road, particularly during the morning peak in the northbound direction. As a result, the Great South Road / Waihoehoe Road roundabout is currently under a great deal of pressure and almost at capacity. It is understood that the SI roadworks are due to be completed at the end of 2019 and the construction of the SH1 Papakura to Drury widening scheme is expected to commence in 2020. This is explained in further detail in this report.

Therefore, it is important to understand what additional infrastructure will be required to enable development as desired by Kiwi, Fulton Hogan, and Oyster Capital, prior to or beyond any committed future network upgrades.

Various modelling scenarios have been undertaken to investigate whether new accesses need to be provided for the Metropolitan Centre, where these accesses could be provided and their feasibility, and what effect the combined developments have on the road network at various points in the future.

In the early stages of the study, several potential new accesses to the Metropolitan Centres were considered and assessed through SATURN modelling, including:

- Direct access via the Drury Interchange;
- Firth Street access; and
- Quarry Road access via Quarry Road off-ramp and Quarry Road / Brookfield Road connection.

The modelling assessment showed that all the above accesses will be able to accommodate the proposed land use within the first decade of development. With any of the above accesses in place, the delay on the Drury Interchange north facing ramps in peak times will not exceed 100 seconds, which is considered acceptable.

Therefore, it is considered that there are several potential access options to the Metropolitan Centre, which can be implemented at appropriate timing depending on the actual development rates of the Metropolitan Centre and the surrounding sites. From a planning perspective, a legible and direct access to the Metropolitan Centre via Drury Interchange is considered desirable, although its feasibility may be affected by the SH1 Papakura to Bombay scheme, which may include works on the Drury Interchange. This is discussed further in this report.

The traffic assessment has also considered the minimum future scenario, where no access to the Metropolitan Centre is assumed for the foreseeable future. The purpose of this consideration is to gain a firmer understanding of the necessity of a new access.

It is considered that the Fulton Hogan and Oyster Capital properties will be accessible via Waihoehoe Road and Fitzgerald Road. The Drury Interchange and the Great South Road / Waihoehoe Road intersection are considered key connections along the main development traffic routes. The modelling has therefore focussed on the future traffic effects on the aforementioned two connections.

This traffic modelling report describes the modelling methodology and land use assumptions for Drury East, outlines the various scenarios investigated and discusses the effects on the relevant surrounding road network. Through the modelling assessment, land use thresholds for infrastructure upgrades in terms of dwellings, commercial and retail Gross Floor Area (**GFA**) have been identified. The thresholds will inform the planning policy proposed as part of the Drury East Plan Changes.

2. Modelling

2.1 Background

The original modelling used Transport for Future Urban Growth (**TFUG**), now referred to as the Supporting Growth Alliance (**SGA**), SATURN models based on Auckland Forecasting Centre's (**AFC**) ART3 models for years 2026, 2036 and 2046.

The ART3 model has since been restructured and rebased to 2016 conditions (previously 2011 based) and is now called the Macro Strategic Model (**MSM**). There are some notable differences between the previous ART3 model and the new MSM model, as follows:

- The passenger transport model (MPT) has been improved and better integrated with the MSM;
- The MSM model has a revised zone system (more zones) to better represent greenfield areas;
- The land use assumptions between the ART3 model and MSM model were different. MSM results, in terms of demand, were provided by AFC for 2028, 2038 and 2048+, and these used land use inputs with Drury variations according to development staging provided by Barker and Associates (B&A), initially in February 2019. Previously obtained ART3 demands were based on standard land use assumptions and the Drury demands were then scaled to match specific Drury land use schedules; and
- Some coding differences at the key intersections, in terms of capacity allowance, have been observed between the two models.

An evaluation was then undertaken of the Council/SGA land use assumptions to provide values more reflective of the anticipated development within Drury West and Drury East. These latest assumptions were provided by B&A, the first revision is dated Friday 31 May 2019, and the second (latest at the time of report writing) is dated 1 July 2019. The land use assumptions included the proposed dwellings for each decade (2028, 2038 and 2048+) for the Drury-Opaheke area and Pukekohe-Paerata area. The land uses within Drury West included the Auranga development and the land uses in Drury East incorporated the proposed development for Kiwi Property, Fulton Hogan and Oyster Capital. These updated land uses will be discussed in further detail in this report.

2.2 Modelling Methodology

2.2.1 Modelling Approach

Traffic modelling for Drury has been undertaken primarily using a three-tiered approach, consisting of a macro strategic model, a mesoscopic project model, and a localised intersection operational model. The strategic model is the AFCs MSM. The MSM is an EMME based conventional four stage model[1] covering the wider Auckland area.

The mesoscopic model is a SATURN based multi-user class (light vehicle and heavy vehicle) user equilibrium assignment model detailing the road network and intersections in the area. The mesoscopic model takes the private vehicle and heavy vehicle demands from MSM and further disaggregates the zoning to give a greater level of detail.

Sidra Intersection was used to test the operational performance of the existing Great South Road / Waihoehoe Road roundabout over the first decade, and aid in identifying potential intervention measures to ensure an acceptable level of service is maintained.

2.2.2 Model Extent

The zoning areas for the MSM model is shown in **Figure 2-1** below. Potential staging for the Drury-Opaheke area has also been provided on **Figure 2-2**, overlaid by the MSM model zoning, to show the comparison in the areas. From this comparison, it can be seen that the MSM zoning areas do not directly align with the

[1] The four stages consist of trip generation, distribution, mode split, and assignment.

proposed staging areas. However, the staging diagram (**Figure 2-2)** is indicative only and the household breakdown per stage and decade is discussed further below.

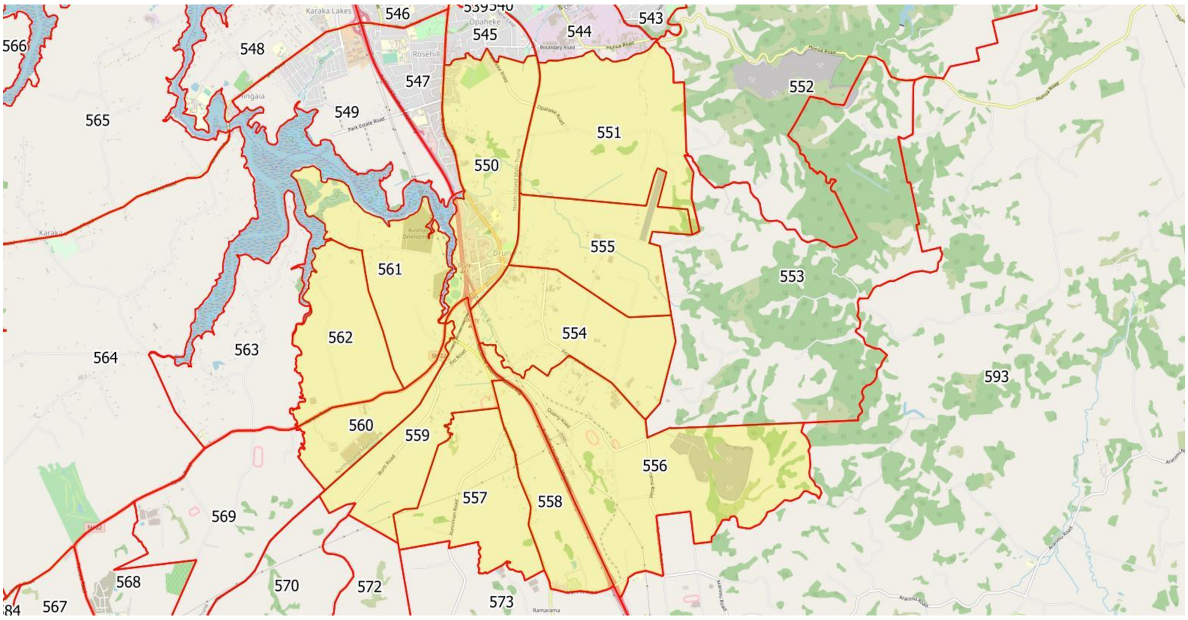


Figure 2-1: Latest MSM Model Zoning Map

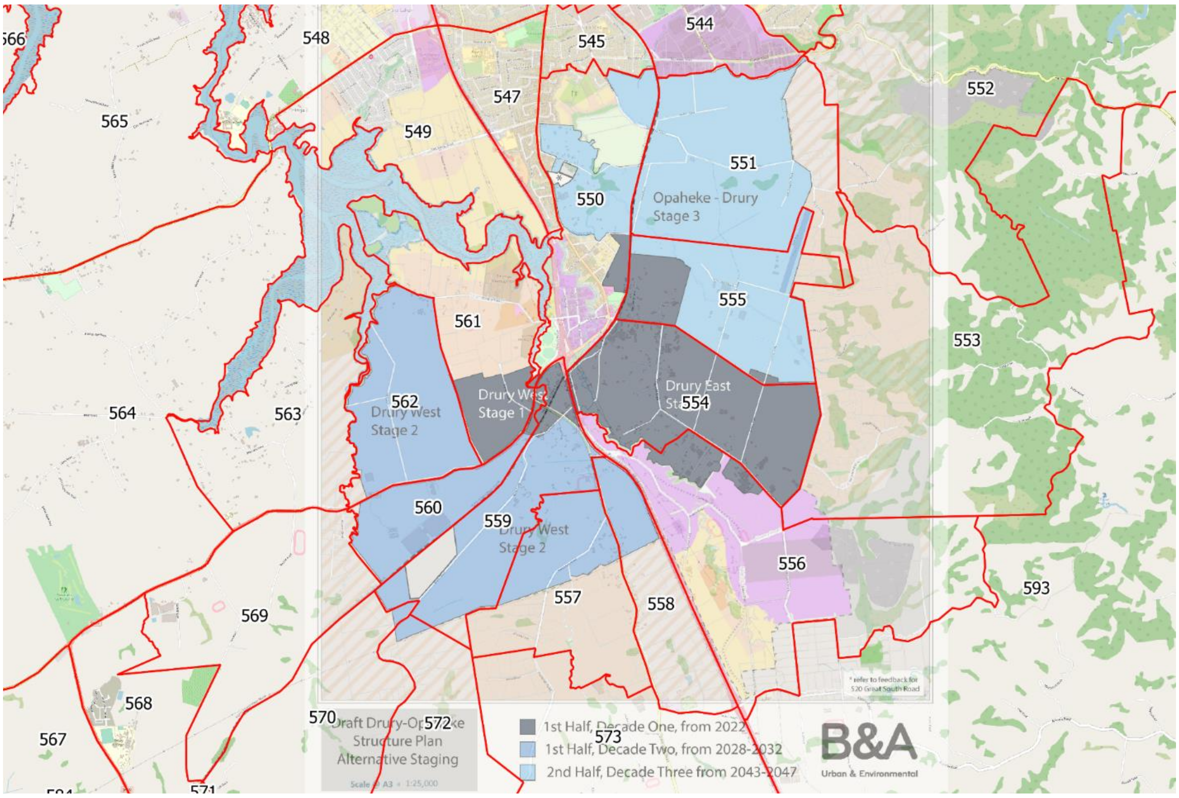


Figure 2-2: MSM Model areas overlaid on B&A Staging Plan

The MSM model was used as a base in the SATURN modelling, to allow more representative and accurate results to be determined. The extent of the SATURN model is shown in **Figure 2-3** below.

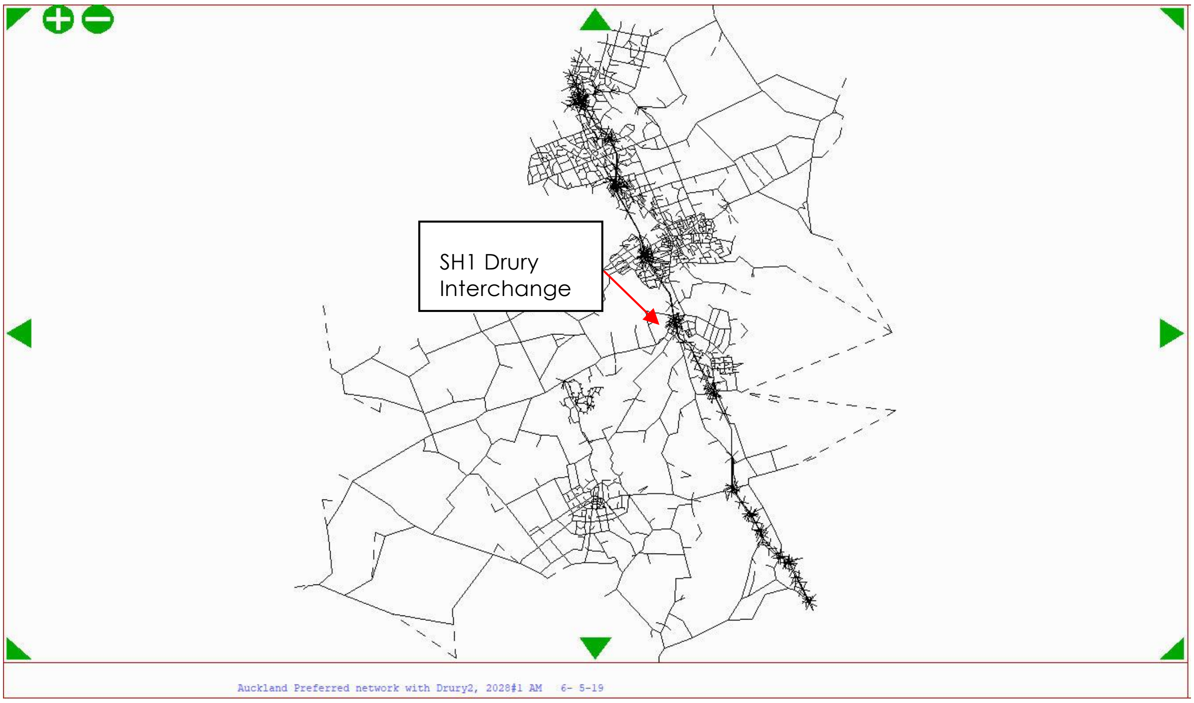


Figure 2-3: SATURN Model Extent

2.2.3 Modelling Scenarios

The land use scenarios considered in the modelling are grouped in decades, to align with the SGA infrastructure upgrades decade-timeframe and the land use assumptions (discussed in Sections 2.3 and 2.6 below);

- Prior to 2028 – This is the decade from now until 2028 before any committed infrastructure upgrades are completed, noting the sites are anticipated to develop from 2023;
- 2028 – This is the decade in which the constrained 2028 infrastructure is completed and 2028 to 2037 traffic demands are anticipated;
- 2038 – This is the decade in which most but not all of the infrastructure upgrades are anticipated, and 2038-2047 traffic demands are expected; and
- 2048+ - At this stage all of the infrastructure upgrades and the proposed development are assumed to be completed.

A breakdown of the infrastructure expected in each decade is outlined in **Table 2-6**.

2.3 Land Use Assumptions

The AFC MSM model, with the original Council land use assumptions, was used as a base model for both the Stantec modelling and the SGA model, in order to create a standard baseline.

B&A then reconfigured the land use assumptions to align with the proposed developers staging plan for the Drury Structure Plan area and refined the yield predictions for areas already live zoned and under development at Auranga and Drury South. There were several iterations of land use assumptions, and the latest revision is dated July 2019.

The land use assumptions in the MSM were re-evaluated to reflect the latest (July 2019) figures provided by B&A, as these were considered to be the most realistic yields based on known constraints and build times. The projected build out rates anticipated by the Drury East developers between 2023 to 2028 (Decade 1), contained in a B&A memo dated 27 June 2019, have also been considered and incorporated in the latest land use assumptions.

In relation to the wider context of the area, it is considered that the previous MSM results can be refactored, thus bypassing the need for a new run (and associated delays). This is a valid approach and is unlikely to have a significant impact on the accuracy of the modelling results.

The live-zoned Auranga land (2,650 dwellings) and residential land in Drury South (1,000 dwellings) have been included within the Drury West and Drury East land use assumptions outlined in **Table 2-1** below. If these areas were incorporated into the SGA model, both sets of assumptions total 26,440 dwellings at 2048+.

It is noted that the assumptions are still considered conservative, as considerable development has been predicted for areas that face unresolved environmental issues (such as the Opaheke flood plain).

The SGA ITA does not clearly outline the land use assumptions for each year and the SGA modified version of the model was not accessible to Stantec. Therefore, a year-by-year comparison between the SGA land use and the latest land use adopted in Stantec modelling cannot be stated with certainty. However, using the growth from 2016 and 2048+, as outlined in Table 7-3 of the SGA ITA, and the growth rate per year in Figure 7-3 of the ITA, a comparison between the number of households could be estimated for Drury West and Drury East. A comparison between the latest land use assumptions adopted in Stantec modelling and the SGA land use assumptions is presented in **Table 2-1**.

It is noted that Drury West includes the MSM zones 557, 558, 559, 560, 561, and 562; while Drury East includes the MSM zones 550, 551, 554, 555, and 556. The Kiwi, Fulton Hogan, and Oyster Capital development are contained within the zones 554 and 555. For zone by zone land use assumptions breakdown, refer to **Appendix A.**

Table 2-1: Land Use Assumptions for Drury- Opaheke Area

	Drury West				Drury East			
Developers Land Use Assumptions (Revised Land Use dated 1.7.19)								
	2016	**2028**	**2038**	**2048+**	**2016**	**2028**	**2038**	**2048+**
Population[2]	943	3887	15234	37413	2710	11237	16745	29425
Households / Dwellings	357	1482	5928	14946	962	3934	6402	11494
Employment / Jobs[3]	565	1540	3247	4163	1543	5787	12086	15420
SGA Land use Assumptions (provided within the SGA ITA)[4]								
	2016	**2028**	**2038**	**2048+**	**2016**	**2028**	**2038**	**2048+**
Households/Dwellings	357	2221	7701	12014	962	2307	7488	10776

Due to the staging changes, some differences can be observed between the B&A land use assumptions and the SGA households estimated from the ITA. Overall, the latest model assumes a slightly higher land use for the 2028 and 2048+ years (an additional 888 and 3,650 respectively) and assumes 2,859 less for the 2038 year. This difference in 2048+ is assumed to be due to the live-zoned areas of Auranga and Drury South residential as discussed above.

The employment assumptions for Drury East have been adjusted using an estimated target build-out of 60,000m^2 of commercial (office),107,650 m^2 of retail park, and the expected level of employment of 5,090 jobs.[5] For commercial employment, a rate of 17.6m^2/person has been adopted. This is based on the New Zealand national office density reported in the Colliers Workplace Report (2016). The remaining

[2] The population land use assumptions were not provided by B&A. These have been estimated using a ratio of the old households / new households

[3] The employment land use assumptions were not provided by B&A. These have been estimated from the Stantec Drury Modified MSM run, however have been adjusted with the indicative target full non-residential build out for Kiwi known at the time of modelling.

[4] The SGA households have been assumed from the information provided with Table 7-3 and Figure 7-3 within the ITA. These cannot be confirmed with certainty as the land use assumptions per decade are not outlined within the ITA.

[5] According to the 2048 Masterplan Vision Hybrid Concept Urban Design Framework (February 2019) by Civitas.

employment are therefore retail park-related jobs. No adjustments have been made to the Drury West employment further to the Council MSM assumptions.

Table 2-2: Land Use Assumptions for Pukekohe - Paerata Area

	Pukekohe - Paerata			
Developers Land Use Assumptions (Based on MSM land use assumptions)				
	2016	**2028**	**2038**	**2048+**
Population[6]	23137	41393	54624	57793
Households / Dwellings	8184	15018	20396	22276
Employment / Jobs[7]	8903	11702	14659	16235

Table 2-2 does not include the SGA decade-by-decade land use assumptions, as the decade-by-decade breakdown could not be determined from the SGA ITA information provided. Therefore, these could not be accurately assumed. It is noted that the above assumptions are based on the Council MSM without any further modification.

The land use assumptions, per MSM zone, have also been provided for households and employment in **Figure 2-4** and **Figure 2-5** below for the Drury-Opaheke area only. The full household, employment and population land use assumptions are broken down per MSM zone and decade (2028, 2038 and 2048+) in **Appendix A** of this report.

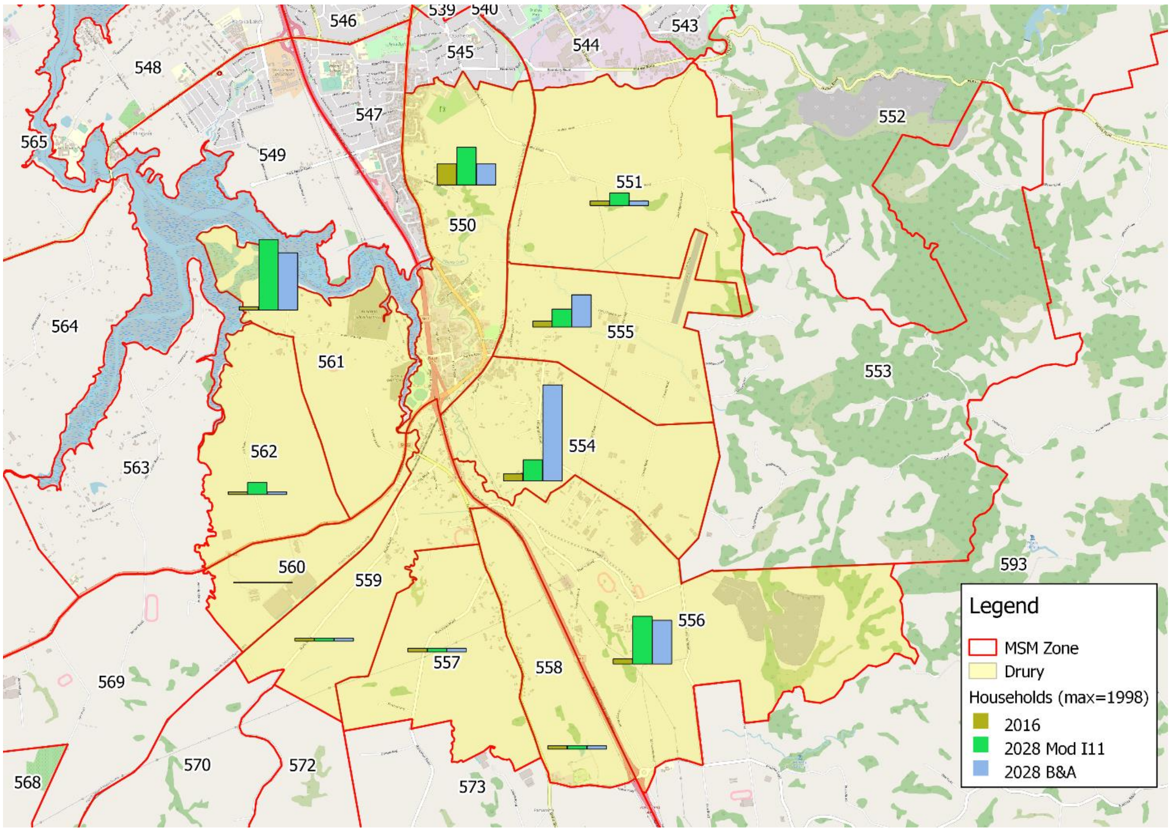


Figure 2-4: Households for 2016, 2028 (MSM standard land use assumptions) and 2028 (B&A Land use assumptions) per MSM Zone for Drury-Opaheke Area

[6] The population land use assumptions were not provided by B&A. These have been estimated using a ratio of the old households / new households

[7] The employment land use assumptions were not provided by B&A. These have been estimated from the Stantec Drury Modified MSM run.

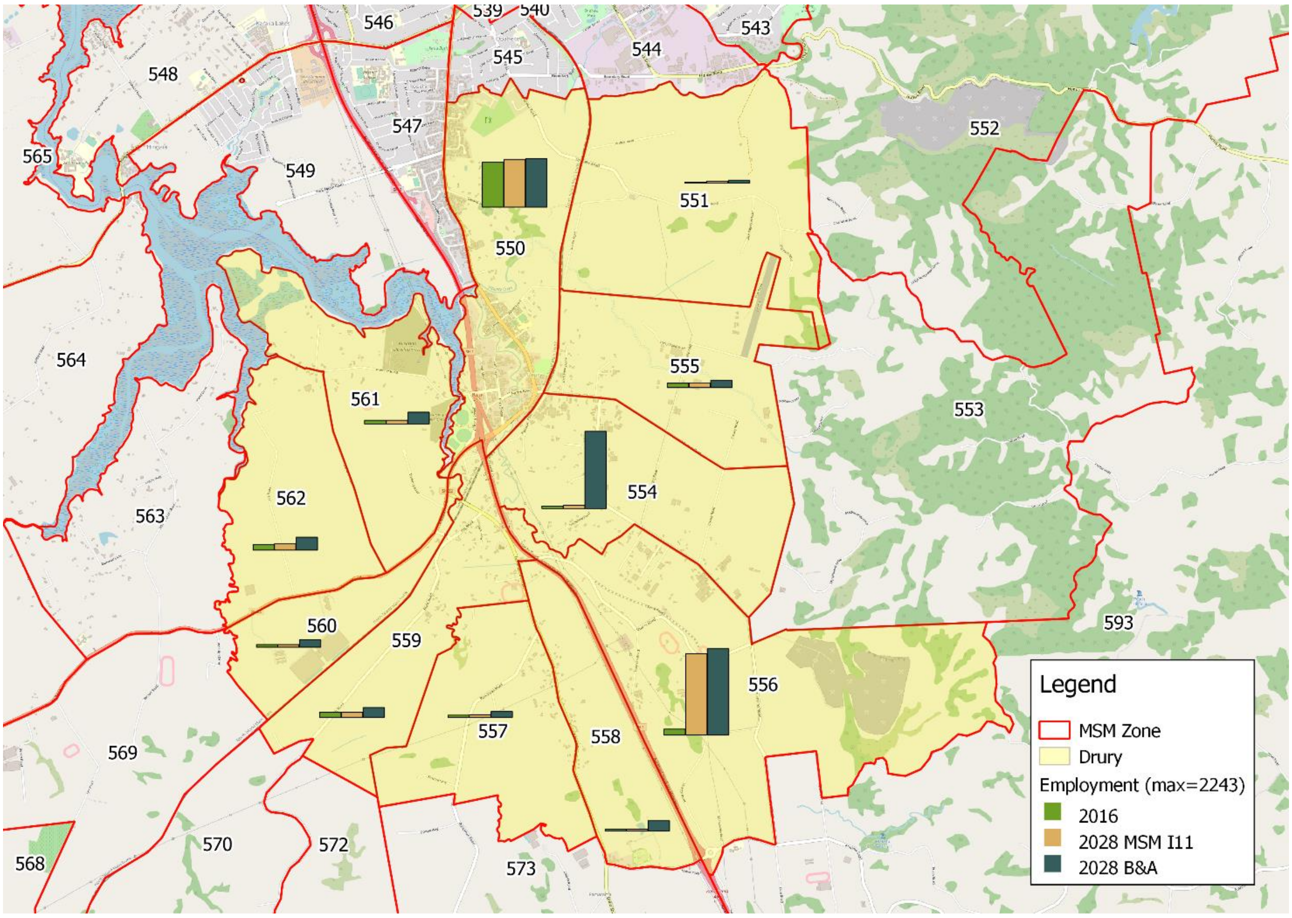


Figure 2-5: Employment for 2016, 2028 (MSM standard land use assumptions) and 2028 (B&A Land use assumptions) per MSM Zone for Drury-Opaheke area

The above two figures demonstrate that the B&A land uses assume a significant increase in households and employment within the Drury East zone (554) between 2016 to 2028.

2.4 Trip Generation

The peak hour trip rates have been assessed for each MSM zone in the relevant Drury-Opaheke area, as shown in **Appendix B**. The Drury West and Drury East total estimated car trip rates per household are summarised in **Table 2-3** below, for the peak hour periods. The residential trip rates have been undertaken on a per-household basis, as this is the common measure for such rates.

It is noted that the source of the trip generation was determined from the MSM model, as the model was validated to 2016 observed traffic and Public Transport (**PT**) data, indicating that it generates appropriate levels of travel at an aggregate level.

Table 2-3: Estimated Hourly Household Car Trip Rate[8]

	2016		2028		2038		2048+	
	AM	PM	AM	PM	AM	PM	AM	PM
East	0.96	0.83	0.72	0.64	0.69	0.63	0.64	0.59
West	0.82	0.71	0.49	0.43	0.46	0.40	0.41	0.36
Total	0.92	0.80	0.62	0.55	0.58	0.52	0.53	0.48

From **Table 2-3**, the total peak hour car trip rate per household is approximately 0.92 for the AM peak and 0.80 for the PM peak in 2016. In 2028, the car trip rate per household decreases to approximately 0.62 in the AM peak and 0.55 in the PM peak. Therefore, a larger decrease is observed in the AM peak (32% reduction) compared to the PM peak (25% reduction).

These car trip rates are affected by PT usage. For example, as the PT uptake increases from 2016 to 2028, the car trip rate is anticipated to decrease as less people are making trips via cars. The PT mode share is discussed in further detail below.

This difference between the two peak periods is likely due to the AM period encompassing a larger demographic (e.g. school children and working parents) than the PM period (which is likely to only capture the working parents and not school children). It is also more likely that school children use PT rather than driving.

It is also noted that Drury West sees a more significant reduction in future trip generation than Drury East. On further analysis, this appears to be caused by difference in model coding, with more zones and connection in Drury West than East. This is a quirk of the model which should be corrected in future iterations, however, at this time the results for Drury East should be considered very conservative. This is also discussed in **Section 2.5** below.

2.4.1 Trip Distribution

2.4.1.1 Select Link Analysis (SLA)

Select Link Analysis (**SLA**) was undertaken for the inbound and outbound trips in peak periods to understand the trip pattern on the network following the first decade (2028). The links selected for analysis are the Great South Road / Waihoehoe Road intersection and the Drury Interchange direct access, as these are the two main access points for inbound and outbound traffic to and from Drury East. SLA analysis within the Fulton Hogan or Oyster Capital plan change areas have not been included as these areas do not contain any link that provides a unique route for Drury East inbound and outbound trip.

It is noted that the analysis has considered the target 2028 development in the Kiwi, Fulton Hogan, and Oyster Capital Plan Change areas.

In the AM peak, the analysis shows that the outbound trips from the Drury Metropolitan Centre travel northbound on SH1 and Great South Road via the Drury Interchange direct access. Outbound trips from other parts of Drury East; such as trips from the Fulton Hogan and Oyster Capital plan change areas, as well as Drury South, are observed to get onto SH1 and Great South Road to travel northbound via the Great South Road / Waihoehoe Road intersection. Refer to **Figure 2-6** for the SLA plots of outbound trips.

In the PM peak, the analysis shows that the inbound trips into the Drury Metropolitan Centre travel either via the direct access or the Great South Road / Waihoehoe Road intersection. Other inbound trips access Drury East via the Great South Road / Waihoehoe Road intersection. Refer to **Figure 2-7** for the SLA plots of inbound trips.

[8] The household car trip rate is estimated from MSM home based car person trips (2hr). Divide this by HH, then convert to car trips by dividing by 1.3 (assumed car occupancy rate), and then multiplying by 0.59 (assumed 2hr to 1hr peak factor).

Figure 2-6: AM Peak - Outbound Trips via Direct Access (left) and Great South Road / Waihoehoe Road Intersection (right)

Figure 2-7: PM Peak - Inbound Trips via Direct Access (left) and Great South Road / Waihoehoe Road Intersection (right)

2.4.1.2 Existing Commuter Census Data for Drury

The latest (2013) commuter census data for Drury shows that most commuters in the area originate or end their trips outside of Drury, and that currently there is only a small proportion of internal trips. It is noted 30% of employment trips within the Drury area originate from within the Drury area unit itself. However, there is still higher level of outbound commute compared to that of inbound commute given the current land use and employment opportunity in Drury.

It is expected that in the future, as the Metropolitan Centre Transit Orientated Development (**TOD**) is developed and more jobs are created, the commuting pattern will change with more significant commuting trips originating to and from within the Drury area (East and West). As discussed in the next sections, given the future infrastructure upgrades and service, a greater proportion of these commuting trips are likely to be undertaken via alternative modes other than private cars in the future.

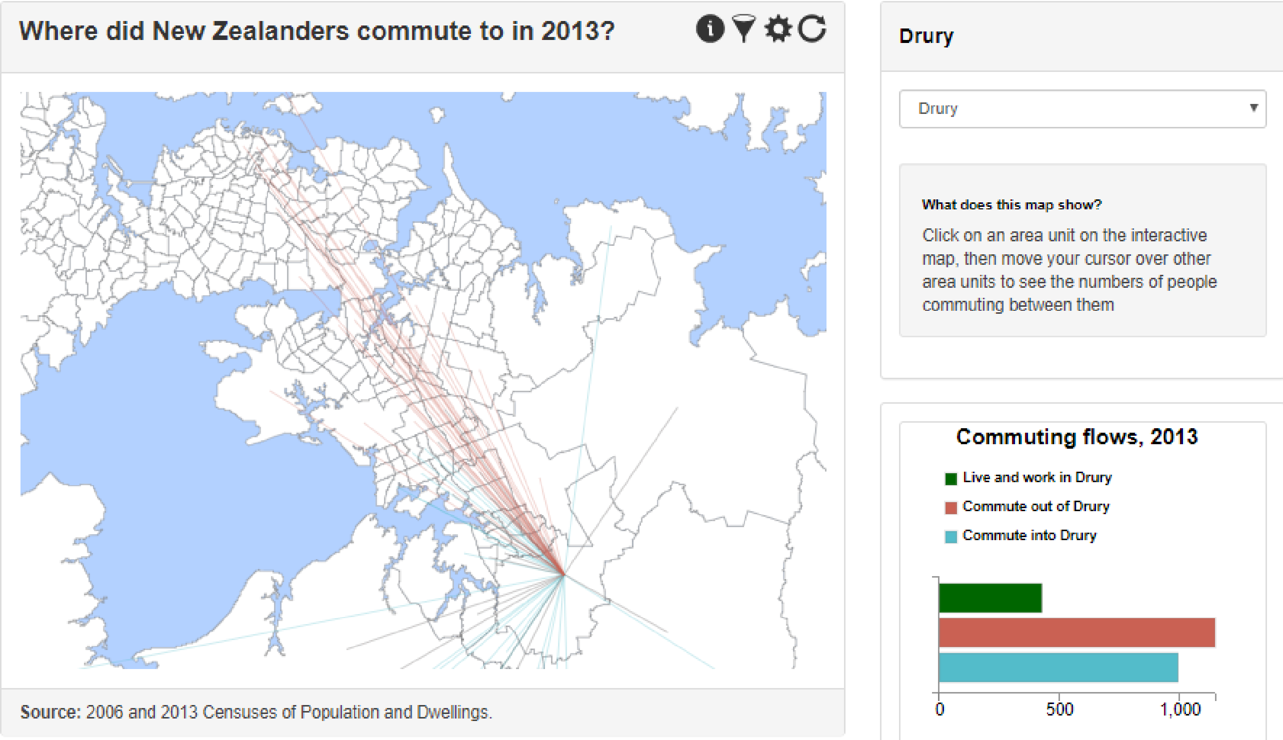


Figure 2-8: Drury Commuter Census Diagram

2.5 Public Transport Assumptions

The PT mode share is summarised for Drury West and Drury East in **Table 2-4** below. The breakdown of PT mode share per MSM model and decade is outlined in **Appendix B** of this report. The resulting mode split will vary based on the trip purpose and origin / destination of the movement.

Table 2-4: Summary of PT mode share for Drury East and Drury West for 2016 and 2028

	2016				2028			
	AM Peak		**PM Peak**		**AM Peak**		**PM Peak**	
	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination
East	7%	2%	1%	6%	14%	3%	3%	11%
West	7%	1%	1%	6%	19%	5%	6%	18%
Total	7%	2%	1%	6%	16%	3%	4%	14%

Table 2-4 shows that the total percentage of PT mode share increases by 9% between 2016 and 2028 for the AM peak period. It is anticipated that this increase in PT is due to the construction of the Drury West and Drury Central train stations (which were included within the AFC base model). From **Appendix B** it is observed that the PT increase for zone 560 (Drury West) is approximately 17%, due to the implementation of the Drury West train station. However, in zone 554 (where the Drury Central train station is located) the PT increase is only 5%. As both of these zones are proposed to have new train stations, it is suspected that this difference in PT percentage is due to the difference in model coding within the two zones, leading to very conservative modelling outcomes in Drury East.

The current PT mode share for various urban Metropolitan Centre areas adjacent to the Frequent Transit Network (**FTN**) in Auckland, have been obtained from Stats NZ Commuter View and are shown in **Table 2-5.**

Table 2-5: PT Mode Share for Various Metropolitan Centre Areas in Auckland

Area	PT Mode Share (Commuting Journey Survey 2013)
New Lynn	14%
Kingsland	22%
Newmarket	22%
Mt Albert	15%

The assumed PT mode share for Drury East falls towards the lower end of the spectrum of the Auckland areas observed above, while Drury West PT trip mode share sits in the middle of the range. Therefore, it is considered that the PT mode share for Drury East should at least be at the same level as Drury West, and that the MSM assumption of Drury East PT mode share is underestimated.

2.6 Infrastructure Upgrade Assumptions

The same infrastructure upgrade timing as the SGA for the years 2028, 2038 and 2048+ has been assumed and is presented in the **Table 2-6** below.

Table 2-6: Infrastructure Upgrade Assumptions

Decade	TFUG / SGA / Stantec Assumed Infrastructure
2028	SH1 3-laning Papakura to Drury SH22 widening to Karaka Rail Electrification Papakura to Pukekohe New Drury East and West Stations
2038	SH1 3-laning Drury to Bombay SH1 Drury South Interchange Mill Road full route (Papakura to SH1) Pukekohe Expressway full Route (SH1 to Pukekohe) Opaheke Road (Papakura to Waihoehoe Rd)
2048+	Third Main Rail Line Pukekohe to Papakura

The SH1 Papakura to Bombay is a project undertaken by the New Zealand Transport Agency[9]. These upgrades include additional vehicle lanes, wider shoulders to future-proof for bus services along the SH1 corridor, improvements to interchanges, enabling rail line electrification, and a shared walking and cycling path to support future growth in housing and employment.

The SH1 Upgrade is divided into two stages. The first stage of the SH1 Papakura to Bombay project will deliver improvements between Papakura to Drury. This stage is divided into two sub-stages (phases) for the southbound and northbound lanes, with an estimated timeframe below:

- Phase 1 is the southbound 3-laning: Phase 1 is currently in design phase, with construction anticipated to commence in 2020 and estimated completion in 2022; and

[9] https://www.nzta.govt.nz/media-releases/launch-of-sh1-papakura-to-bombay-projects-design-and-consenting-phase/

- Phase 2 is the northbound 3-laning and SH1 Drury Interchange improvement: Phase 2 is currently in the planning stage, with construction estimated to commence in 2021 (following completion of Phase 1) and estimated completion in 2024.

The second stage of the SH1 Papakura to Bombay project will deliver similar improvements to Stage 1, between Drury and Bombay. It also includes a proposed new interchange between Drury and Ramarama (referred to as 'Drury South'). The Drury South Interchange will provide a connection point for other key transport projects being planned under the Supporting Growth Programme; Mill Road Corridor Alignment and Pukekohe Expressway.

For modelling purposes, the above upgrades have been assumed to be in place in accordance to the SGA assumed timeframes, as outlined in Table 2-6. However, in order to understand the required local upgrades to support development in the immediate years (prior to 2028), the more refined timeframe for Phase 1 and Phase 2 of the SH1 Papakura to Drury project has been considered. This is explained in further detail in this report.

2.7 Local Upgrade Assumptions

The developer-led staging will generate additional traffic volumes in the Drury East area prior to the completion of key infrastructure upgrades assumed by SGA in 2028. As discussed earlier, the surrounding network is currently congested due to the on-going roadworks on SH1 and the resulting north-south trip diversions along Great South Road. Therefore, in order to access and accommodate the proposed development, it is initially assumed that some local Drury East infrastructure is required to be upgraded within the immediate vicinity of the site, within the first decade (2028). This is to ensure sufficient access capacity to and from the site.

The Metropolitan Centre can have multiple connections to the external network, which could be implemented in stages depending on the actual rate of development, while Fulton Hogan and Oyster Capital properties can be primarily accessed via Waihoehoe Road and Fitzgerald Road.

For the modelling purposes the preferred direct access via Drury Interchange has been assumed. However, it is noted that the other options (i.e. access via Firth Street or Quarry Road) will all work from a capacity perspective and therefore offer some flexibility in the future selection process. This is discussed further in **Section 2.7.1.**

Moreover, a conservative scenario has also been considered where it is assumed no new direct access will be provided to the Metropolitan Centre. Modelling under this scenario has assisted in understanding how the requirement for other local and wider upgrades are triggered should the direct access not be provided, and therefore its criticality.

Overall, the potential local infrastructure upgrades that are considered relevant to the accessibility of Drury East developments are:

- The preferred direct access to the Metropolitan Centre from the Drury Interchange;
- Great South Road / Waihoehoe Road Intersection Upgrade;
- Great South Road Upgrade;
- Waihoehoe Road Upgrade; and
- Urbanisation of Fitzgerald Road and Brookfield Road.

Explanations of what each upgrade entails are provided in the following sections. **Figure 2-9** below illustrates the location of these local upgrades in relation to the plan change areas. Traffic modelling was undertaken to confirm whether the above local upgrades are required and the approximate timeframe for those upgrades. These results are discussed in further detail within **Section 3** of this report.

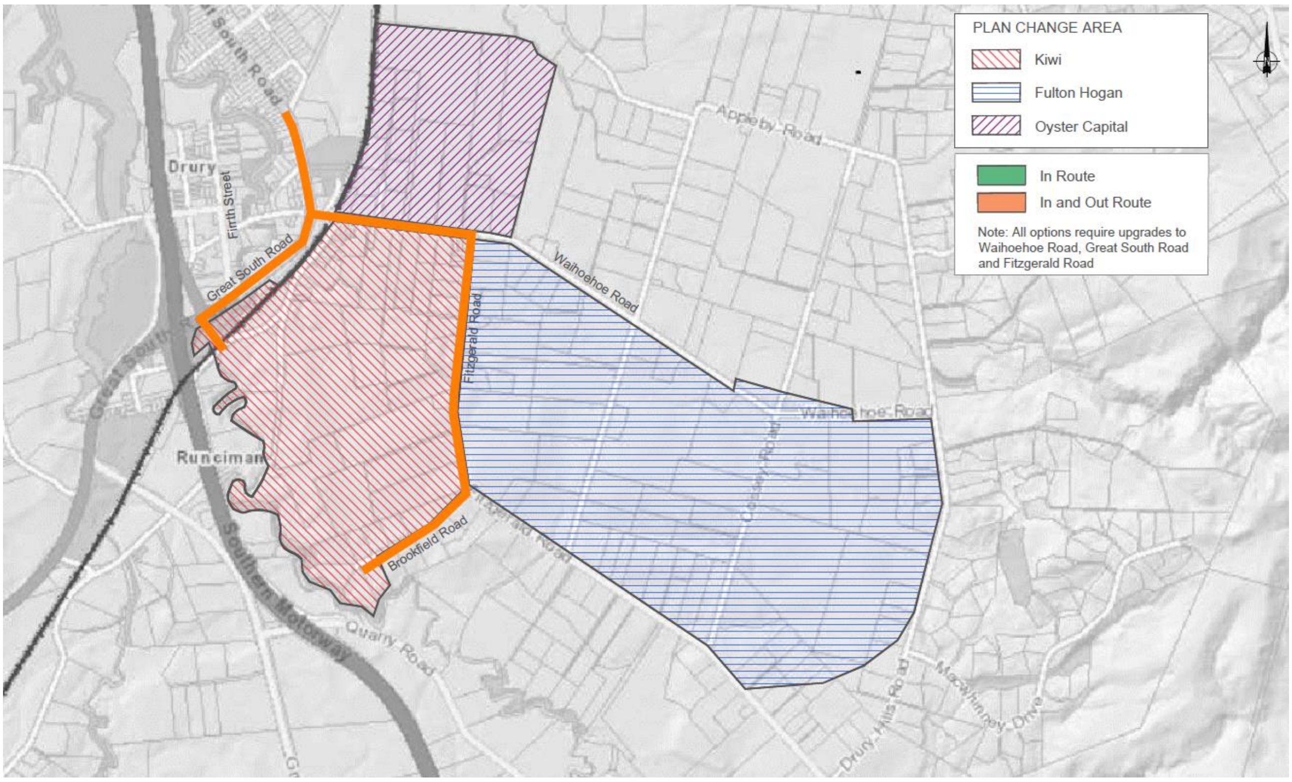


Figure 2-9: Potential Local Upgrades within Drury East (assuming preferred direct access via Drury Interchange

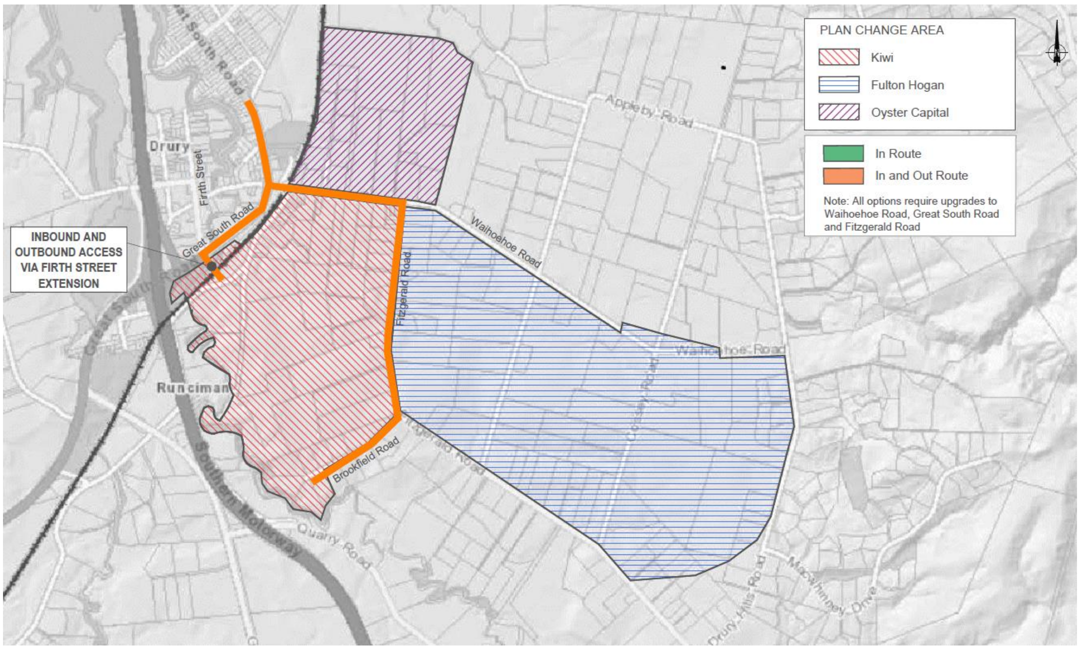
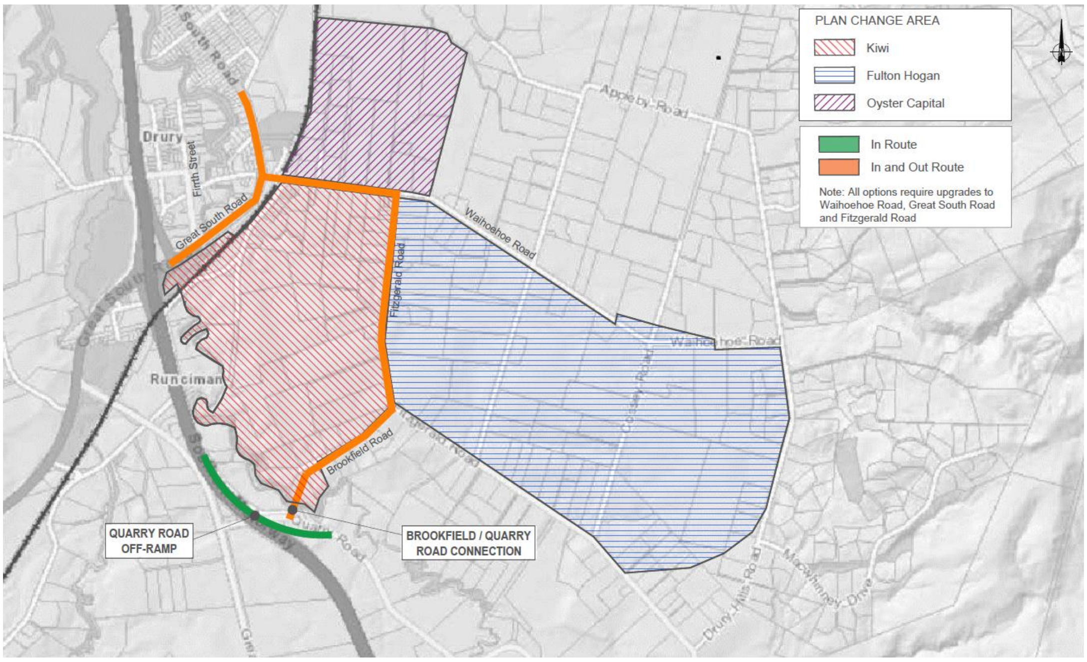
2.7.1 Access to the Metropolitan Centre

Direct and legible access is desirable to the viability of the metropolitan centre and the surrounding residential areas. One potential access location that will fulfil the criterion is a direct access from the Drury Interchange. An access at this location will provide a primary route from SH1 and Great South Road, over the rail line, directly into Drury East Metropolitan centre. From a planning perspective, a direct connection (inbound and outbound) is preferable as it aids wayfinding into the site and general convenience for users (especially in regard to active transportation).

There is also the potential to align the direct access construction with the committed SH1 Drury Interchange upgrades that are planned to occur during Phase 2 of the SH1 Papakura to Drury project. Further liaison with NZTA is required to ensure that the proposed connection is compatible with the interchange upgrade and confirmation around the timing of the Drury interchange upgrade is essential.

Alternatively, a two-way access via Firth Street or an off-ramp via Quarry Road are also feasible in the absence of the above preferred option to provide access to the centre from SH1. These alternative accesses are illustrated in **Table 2-7.**

Table 2-7: Alternative Options for Access to Metropolitan Centre

Alternative Access Options	Description and Diagram
Firth Street	Inbound and outbound via Firth Street, upgraded Great R / Waihoehoe intersection, 2028 Constrained + road upgrades to Waihoehoe Road and Fitzgerald Road. 
Quarry Road	Quarry Road Off-Ramp (Brookfield / Quarry Road Connection) + upgraded Great South Road / Waihoehoe Road intersection, road upgrades to Waihoehoe Road and Fitzgerald Road. 

Modelling of the above alternative options, along with several others, have been undertaken previously and reported in the Drury East Modelling Report Rev B dated 18 June 2019. In the aforementioned document, the preferred direct access, Firth Street access, and Quarry Road access are referred to as

Option 1A, Option 3, and Option 2B respectively. **It is noted that the modelling results show that all access options, when considered separately, result in acceptable traffic conditions.**

In reality, the implementation of any new access to the Metropolitan Centre can be provided in stages at an appropriate rate as the centre development unfolds. It is noted that a provision of access from SH1 will have more notable impact on the scale and timing of other transport upgrades in Drury East, compared to other potential access locations. Regardless, as noted before, the modelling undertaken has considered the impact of different scenarios for accessing the Metropolitan Centre; both with and without the direct access from SH1.

2.7.2 Great South Road / Waihoehoe Road Intersection Upgrade

The Great South Road / Waihoehoe Road roundabout currently serves as the main access to Drury East to and from SH1. The existing roundabout is currently constrained and congested particularly during the AM peak hour when the northbound traffic demand is high. The single lane approaches to the roundabout on the west and south legs are the key limiting factor on its current performance. It is also noted that the current SH1 roadworks associated with the Southern Corridor Improvements project is constraining the SH1 capacity and has resulted in some rat-running through the arterial network via the roundabout.

To cater for the future land use and travel demand in Drury East, an upgrade to the current intersection is needed. It is envisioned that the roundabout will be upgraded to a signalised intersection, with higher capacity on each intersection leg and provision for pedestrian crossings. This requirement for an upgrade has been assessed through modelling and is discussed in later sections. **It is noted that the upgrade can be provided in stages throughout the decades, as noted in relevant later sections.**

Future improvements to this roundabout have also been considered in the transport study for the live-Auranga precinct.

2.7.3 Other Local Upgrades

2.7.3.1 Great South Road and Waihoehoe Road Upgrades

The future upgrade to Great South Road involves four-laning the road between the Drury Interchange to approximately 400m north of the Great South Road / Waihoehoe Road roundabout. A similar upgrade to Waihoehoe Road between the roundabout and Fitzgerald Road is also considered important.

The widening of Great South Road and Waihoehoe Road will complement the upgrade to the Great South Road / Waihoehoe Road roundabout and as such should ideally be simultaneously implemented. As later discussed in **Section 3.1.3** , there will be widening required at the approaches of the signalised intersection to accommodate the turning volumes and queues.

Within the first two decades, the two-way traffic volumes at the Great South Road and Waihoehoe Road corridors can reach 22,000 and 31,000 vehicles per day **(vpd)**, respectively. Further breakdown of the link volume growth over the years in the first decade is included in **Section 3.1.** According to the Highway Capacity Manual (**HCM**), such level of daily volumes should be accommodated on a four-lane corridor. This supports the case for the four-laning of Great South Road and Waihoehoe Road within the two decades, and discussed in detail in **Section 3.1.4.**

However, as already noted above, depending on the actual rate of development in Drury East, the upgrades may be delivered progressively to suit.

2.7.3.2 Fitzgerald Road and Brookfield Road Urbanisation

Other local upgrades that are considered important to complement and serve the development are the urbanisation of Fitzgerald Road and Brookfield Road. Eventually this will result in the roads transforming to urban collector standard.

Similar to the Great South Road and Waihoehoe Road upgrades, the urbanisation will be driven by the desire to unlock the appropriate 'place-function' of the corridor, that will enhance the Town Centre. As such, this will depend on the actual development rate and can in fact be upgraded progressively as development occurs. At the current target build out rates, while it is considered ideal that these are provided within the first decade, it is noted that the necessity does not originate from a capacity perspective. Therefore, the urbanisation of the Fitzgerald Road and Brookfield Road are not considered key infrastructure upgrades and therefore have not been included in further discussions.

It is also noted that some improvements to Fitzgerald Road, including the upgrading of the right turn bay on Waihoehoe Road at the Waihoehoe Road/Fitzgerald Road intersection, are a requirement for development occurring in Drury South.

3. Modelling Results

Stantec has undertaken extensive traffic modelling of the current and future network to investigate and understand the effects of various development land use scenarios on the surrounding network and to determine which infrastructure is required at certain decades to unlock the proposed development.

The future network assumptions are based on the SGA assumptions and considers the assumed local upgrades as discussed in **Section 2.6** and **2.7**, for each decade until 2048+.

It is noted that while the modelling has considered the traffic effects on the wider network, the focus of the assessment and reporting is on the Drury Interchange and the Great South Road / Waihoehoe Road intersection, due to their relevance to the developments.

The modelling results are summarised in **Appendix C**. SATURN plots and SIDRA movement summary results are available in **Appendix D** and **Appendix E**, respectively.

3.1 Prior to 2028

Drury East developers have projected the desired build out rates prior to 2028, based on the assumption that development land will be ready by 2021 for civil works to commence in the next available earthworks season. The build out rates have been obtained from the B&A memo, dated 27 June 2019, and has been incorporated in Stantec's land use assumptions for modelling.

The SGA ITA assumed that the first set of infrastructure upgrades will be fully completed in 2028. Therefore, it is necessary to establish whether any additional infrastructure is required to enable developer land use prior to the full 2028 upgrades.

In order to determine those requirements, yearly modelling scenarios considering the developer land uses up to the year 2028 on the current (2016 MSM) network have been undertaken. The current timeframe assumptions for the SH1 Papakura to Drury, as outlined in **Section 2.6,** have been considered in the modelling to ensure that the network modelled is realistic.

The key local infrastructure upgrades that were investigated in the first decade modelling, in addition to the committed infrastructure upgrades, include:

1. Direct access to Drury East via Drury Interchange; and
2. Great South Road / Waihoehoe Road Intersection Upgrade.

In order to understand the effect of the traffic generated from the proposed development sites on the surrounding network and the required infrastructure upgrades, a modelling scenario was investigated. The modelling scenario included the future predicted traffic demand with the Great South Road / Waihoehoe Road roundabout unchanged, and without the direct Drury Interchange access into the site. In order to provide a comparison, modelling was also undertaken for the same traffic demand, but with a direct Drury Interchange access.

The effect of the development on the traffic network (in particular the Drury interchange and Great South Road / Waihoehoe Road intersection) was then assessed in further detail.

This was undertaken to illustrate how the roundabout would perform both with and without a direct access. The list of first decade (existing to 2028) scenarios modelled is included in **Table 3-1**.

Table 3-1: First decade scenarios

<table>
<tr><th>Land Use (LU)</th><th>Network Infrastructure</th><th>SH1 Papakura to Bombay</th><th>SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations</th><th>Infrastructure Additional to the Assumed Infrastructure</th></tr>
<tr><td>2023</td><td>2016</td><td>Stage 1 Phase 1 only (southbound 3 laning)</td><td>Single</td><td rowspan="8">With and without Drury Interchange Direct Access to Drury East</td></tr>
<tr><td>2024</td><td>2016</td><td rowspan="6">Stage 1 Complete (Phases 1 and 2) (northbound & southbound 3-laning)</td><td>Single</td></tr>
<tr><td>2025</td><td>2016</td><td>Single</td></tr>
<tr><td>2025</td><td>2016</td><td>Single</td></tr>
<tr><td>2026</td><td>2016</td><td>Single</td></tr>
<tr><td>2027</td><td>2016</td><td>Single</td></tr>
<tr><td>2028</td><td>2016</td><td>Single</td></tr>
<tr><td>2028</td><td>2028 (discussed in the next section)</td><td></td><td>Single</td></tr>
</table>

It is noted that the first decade modelling has assumed completion of the Phase 2 SH1 Papakura to Drury scheme in 2024. Therefore, from 2024 onwards it is considered the SH1 Papakura to Drury Northbound three-laning is complete.

3.1.1 SH1 Papakura to Bombay Three-Laning

As noted above, the primary modelling has assumed that Stage 1 of the SH1 Papakura to Bombay project is completed by 2024, where three lanes are provided in both the northbound and southbound directions.

Additional modelling has been undertaken at a high level to understand if there would be any significant difference in the local network performance should the northbound three-laning not be implemented according to the assumed timeframe, and instead provided at the end of the first decade (2028) as per the SGA broad assumption for 2028.

Given that the local road network on Drury East (particularly Great South Road and the Great South Road/Waihoehoe Road roundabout) are already constrained, there seems to be no notable differences regardless of whether an additional lane in the northbound direction is provided. The roundabout upgrade to a signalised intersection is required by 2026 regardless of the provision, consistent with the outcomes reported in **Section 3.1.3**.

However, without the three-laning, the delay on the northbound section of SH1 will continue to increase year by year to a predicted maximum of 280 seconds in 2028. This supports the case for NZTA to deliver the three-laning by 2028, as assumed by the SGA.

Therefore, despite the modelling assumption that the three-laning of SH1 Northbound is implemented by the end of 2024, there is no evidence that it is required to support the Drury East development prior to 2028, and therefore does not form part of the required upgrades within the first decade.

Similarly, although the three-laning of SH1 Southbound is assumed to be in place early within the first decade, it is not considered necessary to accommodate the Drury East development prior to 2028 and therefore does not form part of the required upgrades within the first decade.

3.1.2 Great South Road / Waihoehoe Road Roundabout

The modelling of the roundabout performance for the first decade was undertaken using Sidra Intersection, with the traffic demand originating from the SATURN model. The results for the interim years 2023 and 2028, with and without Drury Interchange direct access in place, are reported in **Table 3-2** and **Table 3-3** below.

Table 3-2: Roundabout Performance Modelling Results - without Drury Interchange Direct Access

Scenario – Without Drury Interchange direct access		Worst Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2023	AM	B	0.55	33	17
	PM	C	0.75	68	29
2024	AM	B	0.66	53	19
	PM	C	0.73	62	27
2025	AM	C	0.88	138	30
	PM	E	0.94	147	54
2026	AM	F	1.20	740	213
	PM	F	1.13	453	158
2027	AM	F	1.67	1684	627
	PM	F	1.34	953	337
2028	AM	F	1.85	2053	789
	PM	F	1.19	752	196

Table 3-3: Roundabout Performance Modelling Results – with Drury Interchange Direct Access

Scenario – With Drury Interchange Direct Access		Worst Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2023	AM	B	0.57	36	18
	PM	B	0.49	31	14
2024	AM	B	0.61	42	19
	PM	B	0.50	31	13
2025	AM	C	0.83	101	24
	PM	B	0.58	40	15
2026	AM	F	1.18	709	197
	PM	B	0.73	65	19
2027	AM	F	1.45	1246	430
	PM	C	0.86	109	28
2028	AM	F	1.75	1798	699
	PM	E	101	260	68

The modelling results show that with or without the Drury Interchange direct access to Drury East, the roundabout will have sufficient capacity until 2025. Without the Drury Interchange direct access in place, the roundabout is operating at a constrained capacity in the PM peak in 2025. The main reason for this difference in outcome is because the availability of a direct access at the Interchange means that there will be less demand on the roundabout for traffic originating to and from Drury East, and therefore is expected to ease the traffic demand at the roundabout.

At 2026, regardless of the provision of the direct access, a capacity upgrade is required, either to a larger-capacity roundabout or a signalised intersection. Given that the Drury East Metropolitan Centre development is committed to providing efficient and safe facility for non-motorised users, such as pedestrians and cyclists; **it is considered that a signalised intersection with crossing facility is preferred.**

Should a direct access be selected for implementation, the timeframe may be synchronised with the SH1 Drury Interchange upgrades, which is planned to occur with the Phase 2 of SH1 Papakura to Drury, currently scheduled for completion in 2024.

It may also be possible to delay the upgrade of the roundabout through achievement of adequate additional PT mode shift for Drury East trips. Based on the modelling results, the required additional mode shift to PT in Drury East in the critical peak period (AM Peak) was investigated.

This was assessed by comparing the number of vehicle trips at the roundabout that turn into and out of Waihoehoe Road (as these are trips that could be transferred to PT) for before and after the trigger year. The turn volumes for year 2026 (the first year where the roundabout fails) and year 2028 (the last year in the first decade) have been compared with that of year 2025 (the final year that the roundabout, in its current form, is expected to work). The difference in vehicle trips was then converted to person trips by applying a vehicle occupancy of 1.2 and the mode split recalculated. The results of this adjustment are shown below.

Table 3-4: Assessment of Required Mode Shift to PT to Sustain Roundabout Performance

	Number of trips requiring shift to PT (compared to 2025)	Total car person trips	Total PT passenger trips	Overall PT mode share
Drury East				
Mode Share in first decade (as per SGA / Council MSM		12,934	1,265	**9%**
2026	229	12,705	1,494	**10%**
2028	438	12,496	1,703	**12%**
Drury West				
Mode Share in first decade (as per SGA / Council MSM)		5,991	1,009	**14%**

Results from MSM show a lower PT mode share in Drury East (9%) compared to Drury West (14%) even though both are similarly served by PT. This difference is likely due to different connection coding and zone size (assumed centre of mass / walk distance).

The Great South Road / Waihoehoe Road roundabout capacity analysis for 2026 and 2028 tabled above demonstrates that, in the absence of a direct access to the Metropolitan Centre, the PT mode share needs to be in the order of 10% and 12% respectively to maintain an acceptable LOS. Compared to the current MSM assumptions, this is an additional 1% and 3% of mode shift to PT in 2026 and 2028 respectively.

Considering the future PT infrastructure and services that will be in proximity of the Metropolitan Centre, the required mode shares are very likely to be achieved, as well as being a more realistic assumption for Drury

East when compared to Drury West. Further, it is acknowledged that there is potential for congestion on the surrounding network to contribute to the increase in PT uptake for Drury East residents and workers.

3.1.3 Great South Road / Waihoehoe Road Intersection Initial Upgrade

Further modelling has been undertaken to understand the extent of upgrade required to the Great South Road / Waihoehoe Road intersection and how the upgrade can be staged through the decades. Through an iterative process, suitable interim and final layouts of a signalised intersection that will be able to provide an acceptable safety and efficiency performance to all modes throughout 2028, 2038, and 2048 was determined.

In 2026, the upgrade initially includes a staggered pedestrian crossing on the north arm and full pedestrian crossings on the east and south arms. The north, east, and south arms all have four approach lanes, including several short turning lanes. The initial signalised intersection layout is shown in **Figure 3-1**.

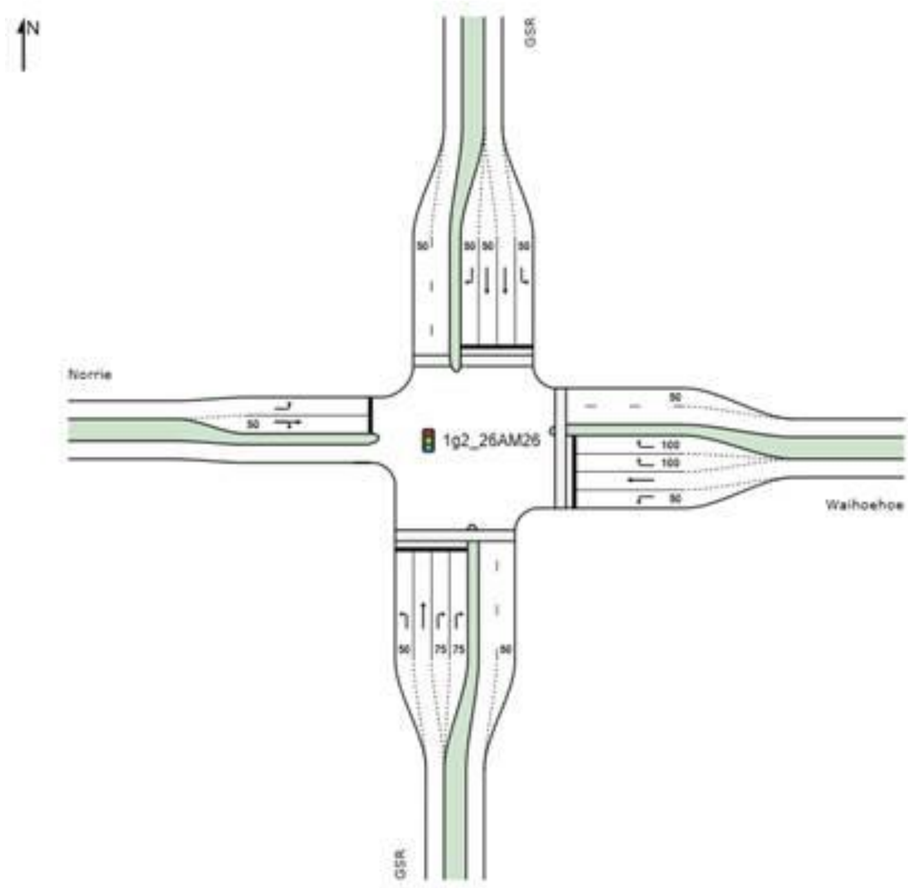


Figure 3-1: 2026 Signalised Intersection Layout

The above layout has been tested with the 2028, 2038 and 2048 land use scenarios, and the required upgrades and the potential staging to implement them have been identified. These are discussed in **Section 3.2** and **Section 3.3.**

It is noted that as the future pedestrian demand through the intersection is unknown, default pedestrian parameters in the modelling software have been retained for the modelling of the later decades; i.e. the 2038 and 2048 land use. However, for the earlier decades, an appropriate adjustment[10] has been made to the model given that low pedestrian demand is expected.

[10] A 50% reduction applied to the Pedestrian Actuation parameter for the 2028 land use modelling of the signalised intersection.

3.1.4 Local Road Upgrades

To understand the likely timeframe for the Waihoehoe Road and Great South Road upgrade, the forecast daily link volumes (in vpd) for the roads have been analysed for each year in the first decade.

The HCM general daily service volumes for urban street facilities (Chapter 16 Exhibit 16-14) indicates that for a two-lane street of similar speed environments, up to 17,900 vehicles/day can be accommodated on the road at LOS E. This is therefore used as a threshold for determining when corridor widening at Great South Road and Waihoehoe Road are needed.

The daily link volumes have been estimated by taking the forecast AM peak volumes of the Waihoehoe Road and Great South Road approaches at the Great South Road / Waihoehoe Road roundabout from the SATURN model and multiplying the peak hour volumes by 10. These volumes are presented in **Table 3-5.**

Table 3-5: Estimated Daily Link Volumes on Waihoehoe Road and Great South Road

Year	Waihoehoe Road (between Great South Road and Drury Boulevard Road) (vpd)	Great South Road (South of Great South Road / Waihoehoe Road Intersection) (vpd)	Great South Road (North of Great South Road / Waihoehoe Road Intersection) (vpd)
Without Drury Interchange Direct Access			
2023	8,700	12,500	12,800
2024	11,500	13,000	12,700
2025	15,500	14,100	13,800
2026	17,700	15,500	15,100
2027	17,500	17,000	16,500
2028	27,700	13,500	17,700
2033	28,500	16,700	18,800
2038 prior to 2038 SGA upgrades	31,000	14,600	22,300
2038 with 2038 SGA upgrades	18,200	10,200	12,500
2048	16,000	12,500	16,000
With Drury Interchange Direct Access			
2023	11,100	14,100	13,200
2024	12,100	14,400	13,700
2025	14,300	15,350	14,600
2026	16,400	15,500	15,500
2027	17,600	15,700	16,600
2028	18,200	14,800	15,700
2033	22,100	14,800	16,700
2038 prior to 2038 SGA upgrades	24,000	12,900	19,800
2038 with 2038 SGA upgrades	13,700	6,800	11,800
2048	11,500	7,800	15,100

From the above breakdown, it can be seen that with or without the Drury Interchange direct access, the daily volume of Waihoehoe Road will increase above 17,900vpd from 2028. The significant increase in the daily flow on Waihoehoe Road without the direct access in place in 2028 is primarily due to the continuously increasing traffic volumes related to the Metropolitan Centre, that would otherwise be travelling via the direct access instead.

The daily volume of Great South Road north of the roundabout will raise to 18,800vpd in 2033 without the direct access, however with direct access this level of demand is observed at some point between 2033 and 2038.

The daily volume of Great South Road south of the roundabout does not seem to exceed the threshold set for widening upgrade. However, it is recommended that the corridor is widened between the Drury Interchange and the intersection at the same time as the Great South Road north of the roundabout, due to the presence of other intersections intermittently throughout the length, its function as a primary PT route, and location of the future rail station and Park & Ride on the section. In addition, further widening on Waihoehoe Road to Fitzgerald Road ideally should be aligned with the above upgrades and the potential upgrade of the right turn lane from Waihoehoe Road to Fitzgerald Road[11].

Table 3-6 shows a summary of timeframes for corridor widening based on the results above.

Table 3-6: Timeframe for Corridor Widening

	Waihoehoe Road (between Great South Road / Waihoehoe Road intersection and Drury Boulevard Road)	Great South Road South (between Drury Interchange and the Great South Road / Waihoehoe Road intersection)	Great South Road North (between Great South Road/Waihoehoe Road intersection and East Street)
Without Direct Access	2028	2033	2033
With Direct Access	2028	2033-2038	2033-2038

3.2 2028

The primary aim of modelling the 2028 land use modelling is to understand whether the 2028 network, as planned under the Supporting Growth Programme, will be able to support the developer-led land uses.

The modelling has focused on the performance of SH1 Drury Interchange Northbound On-ramp and Southbound Off-ramp, as these are key indicators of the connectivity and capacity of the network to accommodate the proposed development. The modelling seeks to understand whether improving the Drury Interchange, in terms of its number of lanes on the north-facing ramps or bringing forward the southern Mill Road upgrade[12] is beneficial in helping unlock more land use potential.

Testing of more advanced land use scenarios (i.e. 2033 and 2038 land uses) has also been undertaken on the 2028 network and the above-mentioned network variations. The purpose of the modelling is to understand whether further upgrades will be needed prior to the implementation of the full 2038 network upgrades. The modelling has assumed some minor adjustments to the ramp meter timing, where necessary, in order to reduce delay and queuing of traffic to a reasonable level. In reality, any modification and upgrades to ramp meters are to be determined by NZTA.

The list of Decade 2 scenarios modelled is included in **Table 3-7**.

[11] Drury South Industrial Precinct Plan - I410.8.2 f(ii) noting that Drury South will carry out upgrade of the right turn bay on Waihoehoe Rd at its intersection with Fitzgerald Rd, under the scenario where development of the precinct proceeds in advance of the Mill Rd Corridor project.

[12] The Southern Mill Road upgrade comprises of SH1 Drury South interchange, connections to Great South Road on the west and Fitzgerald Road on the east (as per the SGA Extended Network)

Table 3-7: Decade two modelling scenarios

Land Use (LU)	Network	SH1 Papakura to Bombay	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Infrastructure Additional to the Assumed Infrastructure
2028	2028	As per SGA Assumptions	Single	Local Intersection Upgrades and Waihoehoe Road widening (with or without a new Metropolitan Centre access)
			Double	Local Intersection Upgrades and Waihoehoe Road widening (with or without a new Metropolitan Centre access)
			Single	Local Intersection Upgrades and Waihoehoe Road widening (with or without a new Metropolitan Centre access) + Mill Road to Fitzgerald
2033	2028	As per SGA Assumptions	Single	Local Intersection Upgrades with a new Metropolitan Centre access and Waihoehoe Road widening, or Local Intersection Upgrades with Waihoehoe Road and Great South Road widening and without a new Metropolitan Centre access.
			Double	Local Intersection Upgrades with a new Metropolitan Centre access and Waihoehoe Road widening, or Local Intersection Upgrades with Waihoehoe Road and Great South Road widening and without a new Metropolitan Centre access.
			Single	Local Intersection Upgrades with a new Metropolitan Centre access and Waihoehoe Road widening + Mill Road to Fitzgerald, or Local Intersection Upgrades with Waihoehoe Road and Great South Road widening and without a new Metropolitan Centre access + Mill Road to Fitzgerald
2038	2028	As per SGA Assumptions	Single	Local Intersection Upgrades, Waihoehoe Road, and Great South Road widening (with or without a new Metropolitan Centre access)
			Double	Local Intersection Upgrades, Waihoehoe Road, and Great South Road widening (with or without a new Metropolitan Centre access)
			Single	Local Intersection Upgrades, Waihoehoe Road, and Great South Road widening (with or without a new Metropolitan Centre access)+ Mill Road to Fitzgerald

A summary of the second decade modelling results is presented in **Table 3-8** and **Table 3-10** . For simplicity, only the delays on the SH1 Northbound On-ramp and Southbound Off-ramp are shown. Full modelling results are available in **Appendix C**.

3.2.1 Modelling Results with Provision of Direct Access to Metropolitan Centre

Table 3-8: Decade two SATURN modelling results - Drury Interchange with Direct Access to Metropolitan Centre

Land Use (LU)	Network	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Infrastructure Additional to the local upgrades + Supporting Growth Assumptions	Peak Period	Delay (s) at SH1 Drury Interchange	
					Northbound On-ramp	Southbound On-ramp
With New Access to Metropolitan Centre						
2028	2028	Single		AM	319	36
				PM	0	161
		Double		AM	35	22
				PM	1	115
		Single	Mill Road to Fitzgerald	AM	122	31
				PM	0	133
2033	2028	Single		AM	394	43
				PM	0	158
		Double		AM	15	24
				PM	1	108
		Single	Mill Road to Fitzgerald	AM	162	37
				PM	0	152
2038	2028	Single		AM	1177	62
				PM	0	215
		Double		AM	92	54
				PM	1	117
		Single	Mill Road to Fitzgerald	AM	370	47
				PM	0	161

The results show that the SH1 Drury Interchange, while constrained, will be capable of accommodating the future traffic demand in 2028 through to 2033. In 2033, the delay on the SH1 Drury Interchange northbound on-ramp, in its current single-lane form but with an optimised ramp metering, reaches 400 seconds in the AM peak. In an urban context, this level of delay at a peak period is considered acceptable. It is noted that there is opportunity to relieve some pressure at the interchange through increasing (doubling) the number of lanes at the northbound on-ramp and southbound off-ramp or bringing forward the southern Mill Road connection to Fitzgerald Road.

However, within the second decade (2033-2038), the SH1 Interchange capacity will be exceeded by the traffic demand. The model shows a delay of up to 1200 seconds in 2038 prior to the implementation of the assumed 2038 upgrades. An interim capacity upgrade will be needed to sustain the SH1 Drury Interchange until the implementation of the 2038 network upgrades. The modelling shows that either doubling the SH1 Drury Interchange on-ramp and off-ramp, or bringing forward the southern Mill Road upgrade, will relieve significant pressure on the interchange particularly on the AM peak.

As noted previously, any modification or upgrade to the SH1 ramps, including the ramp meter timing, and the potential effect on the SH1 network will be agreed through consultation with NZTA.

The proposed Great South Road / Waihoehoe Road signalised intersection layout shown in **Figure 3-1** has been modelled in Sidra Intersection software using the 2028 land use.

To accommodate the demand arising from the 2028 land use, several upgrades are needed to the Great South Road / Waihoehoe Road signalised intersection. The upgraded layout is shown in **Figure 3-2.**

The performance of the intersection is reported in **Table 3-9.**

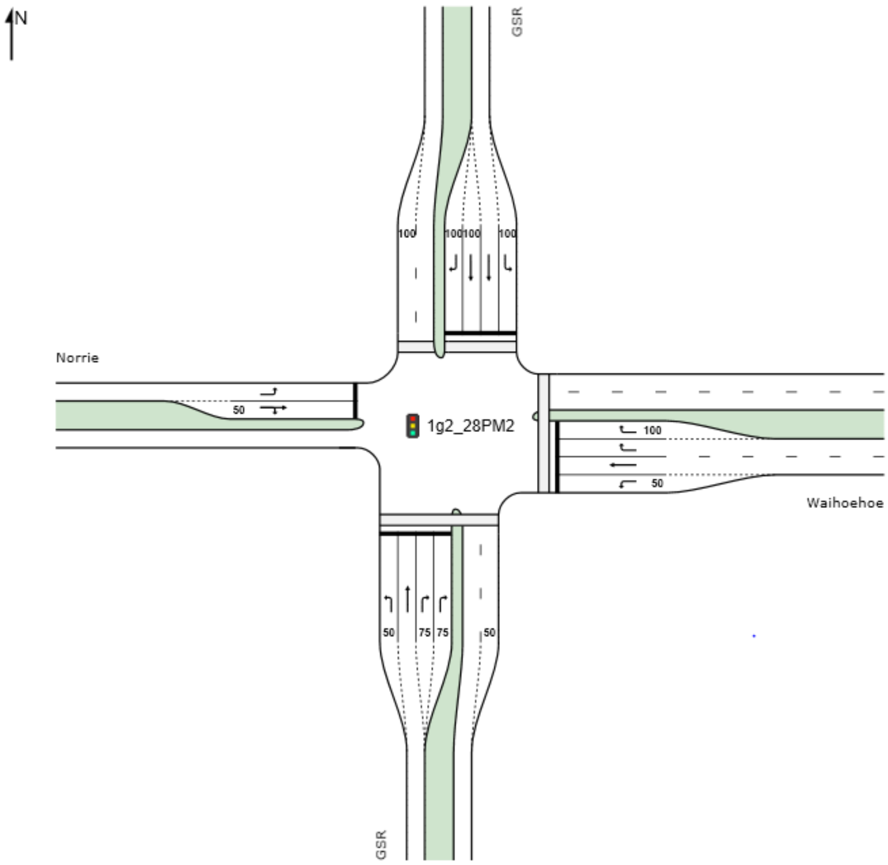


Figure 3-2: 2028 Signalised Intersection Layout

Table 3-9: Decade Two Sidra Modelling Results - Great South Road / Waihoehoe Road Intersection (With Direct Access)

Proposed Great South Road / Waihoehoe Road Signalised Intersection		Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2028	AM	D	0.89	257	69
	PM	C	0.89	210	38

The modelling shows that the signalised intersection will perform at an acceptable level of service from a capacity perspective, with a LOS D and C on the morning peak and afternoon peak, respectively, and a maximum queue length of 69m.

3.2.2 Modelling Results without Provision of Direct Access to Metropolitan Centre

Table 3-10: Decade two SATURN Modelling Results - Drury Interchange Without Direct Access to Metropolitan Centre

Land Use (LU)	Network	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Infrastructure Additional to the local upgrades + Supporting Growth Assumptions	Peak Period	Delay (s) at SH1 Drury Interchange	
					Northbound On-ramp	Southbound On-ramp
Without Direct Access to Metropolitan Centre						
2028	2028	Single		AM	364	29
				PM	0	162
		Double		AM	32	30
				PM	1	164
		Single	Mill Road to Fitzgerald	AM	115	25
				PM	0	92
2033	2028	Single		AM	432	37
				PM	0	142
		Double		AM	8	38
				PM	1	142
		Single	Mill Road to Fitzgerald	AM	148	30
				PM	0	82
2038	2028	Single		AM	1135	48
				PM	0	208

Land Use (LU)	Network	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Infrastructure Additional to the local upgrades + Supporting Growth Assumptions	Peak Period	Delay (s) at SH1 Drury Interchange	
					Northbound On-ramp	Southbound On-ramp
		Double		AM	39	55
				PM	1	204
		Single	Mill Road to Fitzgerald	AM	385	31
				PM	0	85

Modelling of the no direct access to Metropolitan Centre scenario for the second decade shows practically similar results to the previous scenario where direct access is provided. Drury Interchange will be constrained beyond 2028, however, further upgrades will not be necessary within the first half of the second decade. Without any upgrade to the interchange or the network, the delay on the northbound on-ramp in the AM peak will be just over 400 seconds. As noted previously, this is considered acceptable in an urban context.

Further within the second decade (between 2033 and 2038), the interchange capacity will be exceeded by the traffic demand. By 2038, a delay of over 1130 seconds in the AM peak on the northbound on-ramp is observed. An interim capacity upgrade between 2033 and 2038, such as the doubling of the ramps or bringing forward the southern Mill Road upgrade will alleviate the traffic demand and delays at the interchange.

The proposed signalised intersection layout shown in **Figure 3-2** has been modelled in Sidra Intersection software using the 2028 land use assuming no direct access to the Metropolitan Centre. The outcome of the modelling is shown in **Table 3-11**.

Table 3-11: Decade Two Sidra Modelling Results - Great South Road / Waihoehoe Road Intersection (Without Direct Access)

Proposed Great South Road / Waihoehoe Road Signalised Intersection		Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2028	AM	D	0.90	238	57
	PM	D	0.89	184	64

The modelling shows that the intersection has sufficient capacity without the direct access to Metropolitan Centre, where both the morning peak and afternoon peak experiences LOS D and similar level of queues and delays.

It is noted however that if the PT uptake on Drury East is similar to what has been predicted for Drury West, the future performance of the signalised intersection is expected to improve.

3.3 2038 and 2048+

By 2038 and 2048+, according to the Supporting Growth Programme, extensive network upgrades will have been delivered within the Drury-Opaheke area that will significantly increase the overall network capacity and create a conducive transport environment to housing and commercial development.

Modelling of the 2038 and 2048+ land use scenarios on the respective network has been undertaken to confirm that the developer-led land uses can be accommodated efficiently in the network particularly at the SH1 Drury Interchange. The modelling has assumed that the north-facing ramps at the interchange remain at one-lane, which is considered conservative given that it is likely to be upgraded as part of the SH1 Papakura to Drury upgrade scheduled for 2028. This is not to be confused with the model results reported in the previous sections which indicate that an interim capacity upgrade in the form of either ramp-doubling or Mill Road southern connection is required, in the absence of the assumed 2038 and 2048 Supporting Growth Programme upgrades.

The list of Decades 3 and 4 scenarios modelled is included in **Table 3-12**.

Table 3-12: Decade Three Modelling Scenarios

Land Use (LU)	Network	SH1 Papakura to Bombay	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Infrastructure Additional to the Assumed Infrastructure
2038	2038	As per SGA Assumptions	Single	All Local Upgrades (with or without a new Metropolitan Centre access)
2048+	2048+	As per SGA Assumptions	Single	All Local Upgrades (with or without a new Metropolitan Centre access)

Beyond 2038, the critical transportation network upgrades in the Drury – Opaheke area such as the full SH1 Papakura to Bombay, SH1 Drury South Interchange, Mill Road full route, and Pukekohe Expressway are expected to be in place. These upgrades altogether will significantly improve the network connectivity, capacity and resilience, and will in turn relieve the pressure on the SH1 Drury Interchange.

The modelling results for the third decade land use and network scenarios are presented in **Table 3-13** and **Table 3-14** where the direct access to Metropolitan Centre is included, and **Table 3-15** and **Table 3-16** where the direct access to Metropolitan Centre is excluded.

3.3.1 Modelling Results with Provision of Direct Access to Metropolitan Centre

Table 3-13: Decade Three SATURN modelling results - Drury Interchange

Land Use (LU)	Network	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Peak Period	Delay (s) at SH1 Drury Interchange	
				Northbound On-ramp	Southbound On-ramp
With Direct Access to Metropolitan Centre					
2038	2038	Single	AM	1	20
			PM	0	36
2048+	2048+	Single	AM	2	26
			PM	0	32

As evidenced by the modelling results, the SH1 Drury Interchange shows an acceptable capacity performance in 2038 through to 2048+. Given that all the critical upgrades are delivered, the delays on the SH1 Drury Interchange northbound on-ramp and southbound off-ramp are very low (less than 1 minute on any peak period) even with a single-lane ramp. Given the high likelihood that the SH1 Drury Interchange upgrades would result in an increase to the ramps capacity, the modelling results are considered conservative. The remainder of the SATURN network appears to also operate in a satisfactory manner.

The proposed signalised intersection layout has also been tested using the 2038 and 2048 land uses.

The upgraded signalised intersection layout that needs to be provided to accommodate the 2038 demand is shown in **Figure 3-3.** In addition to the 4-laning of the Great South Road and Waihoehoe Road as discussed in **Section 3.1.4**, it includes the following upgrades:

- Waihoehoe Road (east arm): Reallocation of turning lanes
- Norrie Road (west arm): Additional left-turn short lane
- Conversion to full pedestrian crossing on the north arm (from staggered)

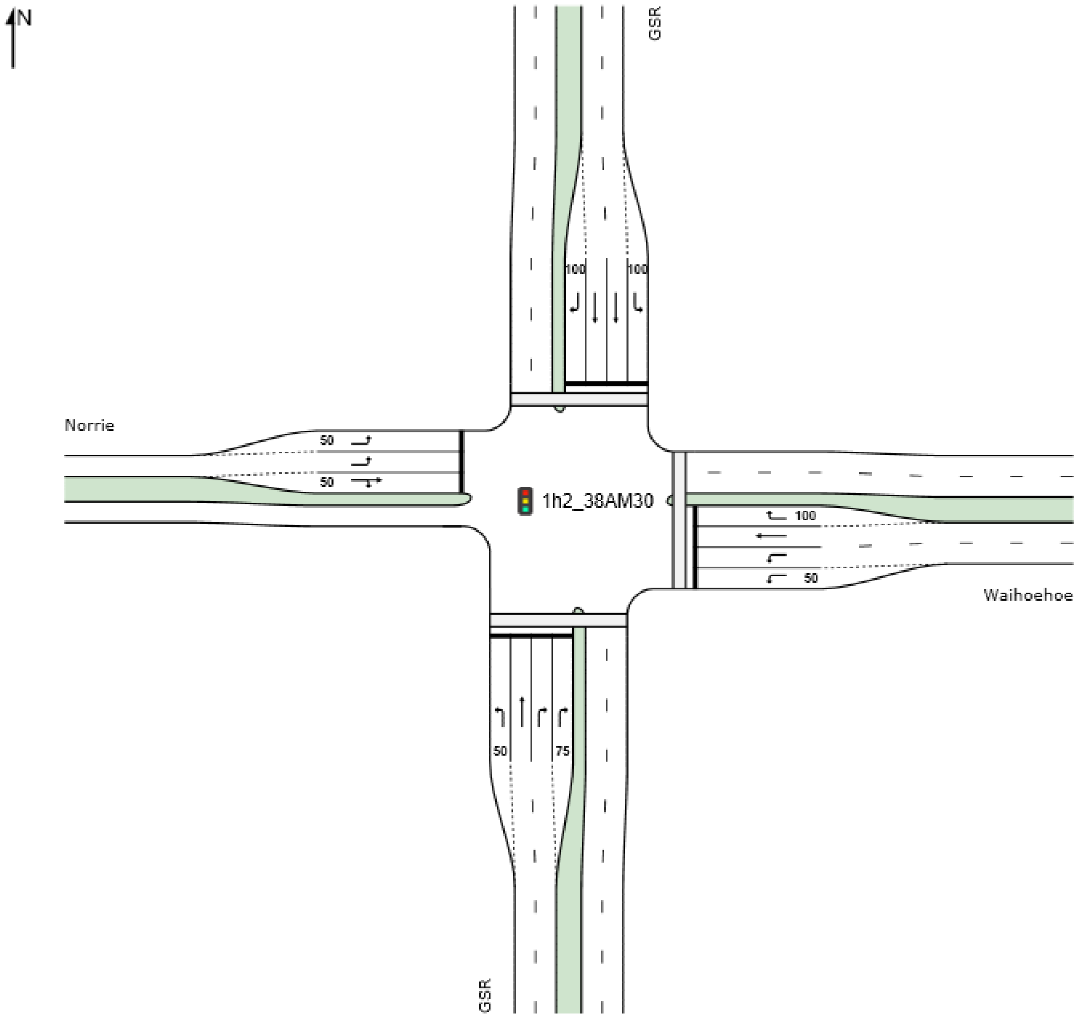


Figure 3-3: 2038 Signalised Intersection Layout

The upgraded signalised intersection layout that needs to be provided to accommodate the 2048 demand is shown in **Figure 3-4.** Additional upgrades that are required further to the 2038 layout shown above are the reallocation of turning lanes on the Great South Road North and Waihoehoe Road, the lengthening of the left-turn short lane on Waihoehoe Road, and the provision of additional short exit lane on Norrie Road.

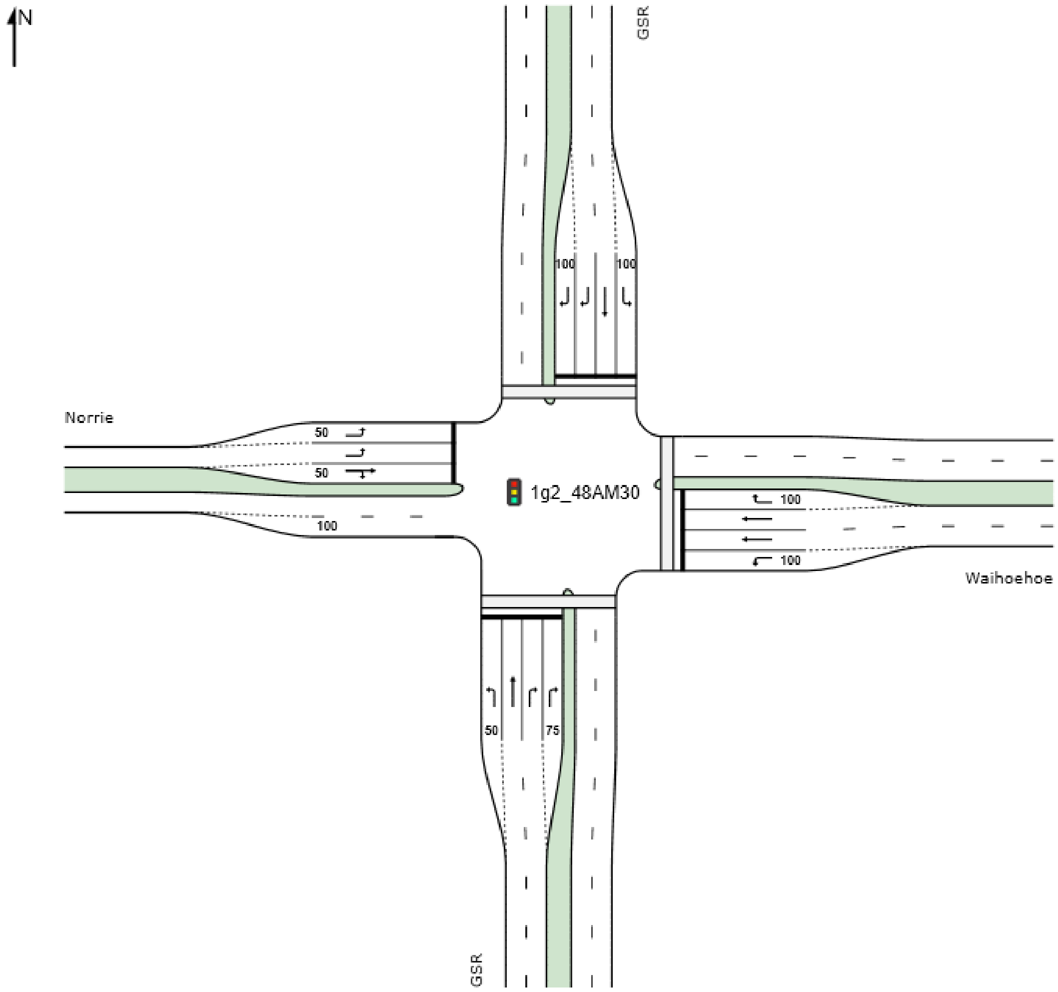


Figure 3-4: 2048 Signalised Intersection Layout

The outcome of the modelling of the signalised intersection with the 2038 and 2048 demand, with direct access in place, is shown in **Table 3-14.**

Table 3-14: Decade Three Sidra Modelling Results - Great South Road / Waihoehoe Road Intersection (With Direct Access)

Proposed Great South Road / Waihoehoe Road Signalised Intersection		Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2038	AM	D	0.85	69	44
	PM	D	0.87	216	56
2048	AM	D	0.86	100	44
	PM	D	0.85	182	61

The modelling shows that the signalised intersection will perform at an acceptable LOS D throughout the second and third decades. However, there is generally a reduction in the maximum predicted queue length compared to 2028, particularly in the morning peak. This was expected given the extensive network upgrades that will take place by 2038 and will take more pressure off the Great South Road / Waihoehoe Road Intersection. It is noted again that by 2038, the staggered pedestrian crossing across the north intersection arm can be converted into a full crossing. The conversion will benefit active-users travelling east – west at the intersection.

3.3.2 Modelling Results without Provision of Direct Access to Metropolitan Centre

Table 3-15: Decade Three SATURN modelling results - Drury Interchange

Land Use (LU)	Network	SH1 Drury Interchange Northbound On-ramp & Southbound Off-ramp Configurations	Peak Period	Delay (s) at SH1 Drury Interchange	
				Northbound On-ramp	Southbound Off-ramp
Without new access to Metropolitan Centre					
2038	2038	Single	AM	1	15
			PM	0	25
2048+	2048+	Single	AM	1	21
			PM	0	24

The modelling results show that without the direct access, the SH1 Drury Interchange also shows an acceptable capacity performance in 2038 throughout to 2048+. Similar to the scenario where direct access is in place, the satisfactory results are expected as all key upgrades to the infrastructure have been delivered by 2038. The remainder of the SATURN network appears to also operate in a satisfactory manner.

The proposed signalised intersection layouts shown in **Figure 3-3** and **Figure 3-4** have also been tested using the 2038 and 2048 land uses respectively, assuming no direct access to the Metropolitan Centre. The outcome of the modelling is shown in **Table 3-16.**

Table 3-16: Decade Three Sidra Modelling Results - Great South Road / Waihoehoe Road Intersection (Without Direct Access)

Proposed Great South Road / Waihoehoe Road Signalised Intersection		Level of Service (LoS)	Degree of Saturation (DoS)	Maximum Queue Length (m)	Maximum Delay (s)
2038	AM	D	0.77	91	40
	PM	D	0.85	110	45
2048	AM	D	0.90	183	63
	PM	E	1.00	293	115

The modelling shows that the signalised intersection will perform at LOS D through the second decade, with a slight drop in performance to LOS E in the third decade. Although this indicates that there may be further optimisation required to the intersection beyond 2048, the timeframe is very far into the future and therefore cannot be predicted with certainty.

Therefore, it is concluded that beyond 2038, the signalised intersection with full pedestrian crossings across the north, east, and south arms will be sufficient for the future traffic demand, regardless the provision of the direct access to Metropolitan Centre.

4. Development Threshold

Triggers for infrastructure upgrades have been identified based on the modelling results and the predicted Drury East developers' land use assumptions. These triggers are referred to as the 'development thresholds'.

The development thresholds are presented in two formats:

1. The level of land use for residential (in dwelling units), and commercial and retail park in gross floor area (**GFA**). **Table 4-1** summarises the thresholds given that the direct access to Metropolitan Centre is provided, and **Table 4-2** summarises the thresholds should the direct access to Metropolitan Centre not be provided.
2. The inbound and outbound trips generated in vehicles per hour (**vph**), in the morning and the afternoon peak hours. **Table 4-3** summarises the thresholds given that the direct access to Metropolitan Centre is provided, and **Table 4-4** summarises the thresholds should the direct access to Metropolitan Centre not be provided.

The land use thresholds indicate the new and additional development that can be implemented within the Drury East area, on top of what currently exists. The residential land use is determined in accordance with the methodology set out in Section 2.3. The commercial and retail park development thresholds have been approximated based on the land use assumptions within the MSM and adjusted using the developers target commercial and retail build rates. The thresholds correspond to the land use within MSM Zone 554 and 555, within which Kiwi, Fulton Hogan, and Oyster Capital properties are contained.

The inbound and outbound trips thresholds indicate the overall inbound and outbound trips in the peak hours, to and from the MSM Zone 554 and 555. The access points considered in the assessment are the direct access (where assumed available), the Great South Road/Waihoehoe Road intersection, Quarry Road, Opaheke Road (following its implementation), and Mill Road southern connection (following its implementation).

The thresholds correspond to the MSM Zone 554 and 555, within which Kiwi, Fulton Hogan, and Oyster Capital properties are contained.

Therefore, given the current understanding of the networks, the additional number of dwellings, retail and commercial GFA (in sqm), or the overall trip generation within the Drury East Zone 554 and 555 should not reach or exceed the following thresholds outlined respectively in **Table 4-1** and **Table 4.2**, or **Table 4-3** and **Table 4-4**, until such time that the identified infrastructure upgrades are constructed.

The precinct provisions for Drury East development contain a number of methodology options for assessing the development triggers based on the thresholds set out below.

Table 4-1: Development Thresholds for Infrastructure Upgrades – With Drury Interchange Direct Access

<table>
<tr><th rowspan="2">Timeframe</th><th colspan="3">Drury East Development Threshold</th><th rowspan="2">Infrastructure Upgrade Required</th></tr>
<tr><th>Residential (Dwellings)</th><th>Retail (GFA)</th><th>Commercial (GFA)</th></tr>
<tr><td colspan="5">With Direct Access to Metropolitan Centre</td></tr>
<tr><td>2026</td><td>1,310 units</td><td>23,680m²</td><td>13,200m²</td><td>Upgrade to the Great South Road/Waihoehoe Road intersection</td></tr>
<tr><td>2028</td><td>2,172 units</td><td>39,830m²</td><td>22,200m²</td><td>Upgrade Waihoehoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard.
Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach
SH1 three-laning to Drury (funded)
SH22 widening to Karaka (funded)
Rail Electrification Papakura to Pukekohe (funded)
New Drury East and West Stations (not funded but temporary stations can be provided as part of rail electrification to Pukekohe)</td></tr>
<tr><td>2033-2038</td><td>4,023 units</td><td>73,200m²</td><td>40,800m²</td><td>Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection.
Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road.
And one of the following upgrades in addition to the above upgrades:
• Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or
• Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road.</td></tr>
<tr><td>2038</td><td>4,640 units</td><td>83,960m²</td><td>46,800m²</td><td>Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left-hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach.
SH1 3-laning Drury to Bombay
SH1 Drury South Interchange
Mill Road full route
Pukekohe Expressway full route
Opaheke Road (Papakura to Waihoehoe Road)</td></tr>
<tr><td>2048</td><td>6,428 units</td><td>107,650m²</td><td>60,000m²</td><td>Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach.
Third Main Rail Line Pukekohe to Papakura</td></tr>
</table>

Table 4-2: Development Thresholds for Infrastructure Upgrades – Without Drury Interchange Direct Access

Timeframe	Drury East Development Threshold			Infrastructure Upgrade Required
	Residential (Dwellings)	Retail (GFA)	Commercial (GFA)	
Without Direct Access to Metropolitan Centre				
2026	1,310 units	23,680m2	13,200m2	Upgrade to the Great South Road/Waihoehoe Road intersection
2028	2,172 units	39,830m2	22,200m2	Upgrade Waihoehoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard. Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach SH1 three-laning to Drury (funded) SH22 widening to Karaka (funded) Rail Electrification Papakura to Pukekohe (funded) New Drury East and West Stations (not funded but temporary stations can be provided as part of rail electrification to Pukekohe)
2033	3,406 units	62,430m2	34,800m2	Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection. Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road
2033 - 2038	4,023 units	73,200m2	40,800m2	One of the following upgrades: • Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or • Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road
2038	4,640 units	83,960m2	46,800m2	Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left-hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach SH1 three-laning Drury to Bombay SH1 Drury South Interchange Mill Road full route Pukekohe Expressway full route Opaheke Road (Papakura to Waihoehoe Road)
2048	6,428 units	107,650m2	60,000m2	Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach. Third Main Rail Line Pukekohe to Papakura

Table 4-3 Trip Generation Thresholds for Infrastructure Upgrades – With Drury Interchange Direct Access

Time-frame	Drury East Trip Generation Thresholds		Infrastructure Upgrade Required
	Inbound Trip Generation in vehicles per hour (vph)	Outbound Trip Generation in vehicles per hour (vph)	
With Direct Access to Metropolitan Centre			
2026	AM Peak: 910 PM Peak: 1,430	AM Peak: 1,230 PM Peak: 1,150	Upgrade to the Great South Road/Waihoehoe Road intersection
2028	AM Peak: 1,130 PM Peak: 1,870	AM Peak: 1,660 PM Peak: 1,410	Upgrade Waihohoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard. Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach SH1 three-laning to Drury (funded) SH22 widening to Karaka (funded) Rail Electrification Papakura to Pukekohe (funded) New Drury East and West Stations (not funded but temporary stations can be provided as part of rail electrification to Pukekohe)
2033-2038	AM Peak: 1,630 PM Peak: 2,220	AM Peak: 2,160 PM Peak: 1,790	Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection. Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road. And one of the following upgrades in addition to the above upgrades: • Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or • Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road.
2038	AM Peak: 1,850 PM Peak: 2,470	AM Peak: 2,450 PM Peak: 2,000	Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left-hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach. SH1 three-laning Drury to Bombay SH1 Drury South Interchange Mill Road full route Pukekohe Expressway full route Opaheke Road (Papakura to Waihoehoe Road)
2048	AM Peak: 3,230 PM Peak: 4,320	AM Peak: 3,780 PM Peak: 4,300	Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach. Third Main Rail Line Pukekohe to Papakura

Table 4-4: Trip Generation Thresholds for Infrastructure Upgrades – Without Drury Interchange Direct Access

<table>
<tr><th rowspan="2">Timeframe</th><th colspan="2">Drury East Trip Generation Thresholds</th><th rowspan="2">Infrastructure Upgrade Required</th></tr>
<tr><th>Inbound Trip Generation in vehicles per hour (vph)</th><th>Outbound Trip Generation in vehicles per hour (vph)</th></tr>
<tr><td colspan="4">Without Direct Access to Metropolitan Centre</td></tr>
<tr><td>2026</td><td>AM Peak: 790
PM Peak: 1,110</td><td>AM Peak: 1,100
PM Peak: 840</td><td>Upgrade to the Great South Road/Waihoehoe Road intersection</td></tr>
<tr><td>2028</td><td>AM Peak: 970
PM Peak: 1,600</td><td>AM Peak: 1,490
PM Peak: 1,150</td><td>Upgrade Waihohoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard.
Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach
SH1 three-laning to Drury (funded)
SH22 widening to Karaka (funded)
Rail Electrification Papakura to Pukekohe (funded)
New Drury East and West Stations (not funded but temporary stations can be provided as part of rail electrification to Pukekohe)</td></tr>
<tr><td>2033</td><td>AM Peak: 1,360
PM Peak: 1,820</td><td>AM Peak: 1,810
PM Peak: 1,430</td><td>Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection.
Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road</td></tr>
<tr><td>2033 - 2038</td><td>AM Peak: 1,500
PM Peak: 2,130</td><td>AM Peak: 2,030
PM Peak: 1,700</td><td>One of the following upgrades:
• Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or
• Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road</td></tr>
<tr><td>2038</td><td>AM Peak: 1,640
PM Peak: 2,430</td><td>AM Peak: 2,240
PM Peak: 1,960</td><td>Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach
SH1 three-laning Drury to Bombay
SH1 Drury South Interchange
Mill Road full route
Pukekohe Expressway full route
Opaheke Road (Papakura to Waihoehoe Road)</td></tr>
<tr><td>2048</td><td>AM Peak: 3,160
PM Peak: 4,200</td><td>AM Peak: 3,720
PM Peak: 4,190</td><td>Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach.
Third Main Rail Line Pukekohe to Papakura</td></tr>
</table>

5. Conclusions

Modelling has been undertaken to assess the effect of the proposed development within Drury East by Kiwi Property, Fulton Hogan, and Oyster Capital. The assessment period spans three decades, between the start of the development in 2023 through to 2048. The assessment has considered the SGA's future transport network, and further adjusted the SGA land use assumptions to align with the developers target build rates.

In general, the modelling has found that the rezoning can be accommodated by the surrounding transport network, with several targeted local upgrades recommended within the first two decades. These are primarily the provision of access to the Metropolitan Centre (preferably the direct access via Drury Interchange, if feasible), the signalisation of the Great South Road / Waihoehoe Road roundabout prior to 2028, and a network capacity upgrade prior to 2038 which could be achieved through doubling the northbound ramps at the Drury Interchange or an earlier provision of the Southern Mill Road connection to Fitzgerald Road. The 2038 and 2048+ traffic modelling is satisfactory as all the key infrastructure required to support the growth is anticipated to have been implemented within those decades.

A more conservative scenario which considers no provision of direct access to the Metropolitan Centre has also been modelled and analysed. The modelling shows that without the direct access to Metropolitan Centre, some local upgrades within the development site will need to be provided earlier, such as the widening of Great South Road and Waihoehoe Road between Drury Boulevard Road and Fitzgerald Road. Similar to when the direct access is provided, a network capacity upgrade prior to 2038 through doubling the northbound ramps at the Drury Interchange or an earlier provision of the Southern Mill Road connection to Fitzgerald Road will be required. Following the 2038 and 2048+ infrastructure upgrades, traffic modelling shows that the network performance will be satisfactory.

It is noted that the provision of the new access to the Metropolitan Centre does not affect the Great South Road / Waihoehoe Road signalised intersection upgrade staging, as the modelling has demonstrated.

Therefore, the Drury East plan change can be supported from a traffic perspective and is unlikely to have a significant adverse effect on the traffic network, given that the infrastructure required to support the development is implemented.

Further refinement to the design of the additional upgrades identified in the memo will be undertaken as the consenting process progresses.

Summary of the infrastructure upgrades that will be required through the next three decades, as assumed by the SGA and as found by the Drury East Modelling is shown in **Table 5-1.**

Table 5-1: Summary of Drury Infrastructure Upgrades

Year	TFUG / SGA Assumed Infrastructure	Other Infrastructure Upgrades as per Drury East Modelling
With Drury Interchange Direct Access to Metropolitan Centre		
2026		Upgrade to the Great South Road/Waihoehoe Road intersection
2028	SH1 3-laning Papakura to Drury SH22 widening to Karaka Rail Electrification Papakura to Pukekohe New Drury East and West Stations	Upgrade Waihohoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard. Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach
2033 - 2038		Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection; and Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road; And one of the following: Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road.
2038	SH1 3-laning Drury to Bombay SH1 Drury South Interchange Mill Road full route (Papakura to SH1) Pukekohe Expressway Full Route (SH1 to Pukekohe) Opaheke Road (Papakura to Waihoehoe Road)	Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left-hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach
2048	Third Main Rail Line Pukekohe to Papakura	Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach.

Without Drury Interchange Direct Access to Metropolitan Centre		
2026		Upgrade to the Great South Road/Waihoehoe Road intersection
2028	SH1 3-laning Papakura to Drury SH22 widening to Karaka Rail Electrification Papakura to Pukekohe New Drury East and West Stations	Upgrade Waihoehoe Road to increase to four lanes between Great South Road/Waihoehoe intersection and the Drury Boulevard. Upgrade to Great South Road/Waihoehoe Road intersection to lengthen the approach, turning and exit lanes on Great South Road northern approach
2033		Upgrade to Great South Road to increase to four lanes between the Drury Interchange and to 400m north of the Great South Road/Waihoehoe Road intersection. Upgrade Waihoehoe Road to increase from two lanes to four lanes between Drury Boulevard and Fitzgerald Road.
2033 - 2038		Upgrade the Drury Interchange to double the northbound on-ramp and south bound off-ramps at the Drury interchange; or Upgrades to provide the Drury South Interchange and the Mill Road Corridor from Drury Interchange to Fitzgerald Road.
2038	SH1 3-laning Drury to Bombay SH1 Drury South Interchange Mill Road full route (Papakura to SH1) Pukekohe Expressway Full Route (SH1 to Pukekohe) Opaheke Road (Papakura to Waihoehoe Road)	Upgrade to Great South Road/Waihoehoe Road intersection to add an additional left-hand turn lane on the Norrie Road approach and reallocate lanes on the Waihoehoe Road approach
2048	Third Main Rail Line Pukekohe to Papakura	Upgrade to Great South Road/Waihoehoe Road intersection to provide an additional exit lane on Norrie Road, reallocate lanes on the Waihoehoe and Great South Road approaches, and increase the length of the left-turn lane on the Waihoehoe Road approach.

Appendices

Appendix A Land Use Assumptions (dated 1.7.19[13]) per MSM Zone for each decade

[13] The Land use assumptions for households were provided by Barkers and Associates dated 1.7.19 and did not include population or employment assumptions. The population land use was interpolated by Stantec using a linear relationship with the households.

Table A-1: Drury - Opaheke Area

		2016			2028			2038			2048+		
MSM Zone	Location	Pop	HH	Emp	Pop	HH	Emp	Pop	HH	Emp	Pop	HH	Emp
550	East	1250	438	1169	1181	438	1258	1130	438	1300	3411	1369	1407
551	East	340	99	32	298	99	81	279	99	1538	6681	2472	1739
554	East	421	148	69	5362	2050	2006	11216	4318	4213	10841	4318	5349
555	East	369	168	117	1834	438	199	1666	638	306	6119	2426	863
556	East	330	109	156	2563	909	2243	2453	909	4729	2372	909	6063
557	West	221	79	65	206	79	157	795	322	331	2271	952	425
558	West	132	76	51	124	76	273	152	97	576	230	152	739
559	West	186	59	134	173	59	262	2579	972	553	8578	3342	709
560	West	34	13	70	32	13	196	1947	718	413	6568	2498	530
561	West	195	70	100	3193	1195	311	6894	2696	656	10169	4117	840
562	West	175	60	144	158	60	340	2868	1123	717	9596	3885	920
	East	2710	962	1543	11237	3934	5787	16745	6402	12086	29425	11494	15420
	West	943	356	565	3887	1482	1540	15234	5928	3247	37413	14946	4163
	Total	3653	1318	2108	15124	5416	7327	31979	12330	15333	66838	26440	19582

Table A-2: Pukekohe - Paerata Area

	2016			2028			2038			2048+		
MSM Zone	Pop	HH	Emp	Pop	HH	Emp	Pop	HH	Emp	Pop	HH	Emp
569	221	75	97	937	329	100	1793	657	99	1729	657	99
574	3072	972	296	4819	1665	306	7022	2573	302	8289	3203	300
575	3979	1354	976	4349	1579	1418	4503	1711	1951	4446	1752	2199
576	4062	1298	298	4901	1695	316	5301	1929	316	5302	2004	315
577	700	332	2331	1123	553	2678	1437	722	2881	1659	846	3038
578	2769	974	517	5320	1987	594	6033	2352	599	6017	2432	601
580	161	63	73	2043	762	632	2774	1077	1492	2879	1158	1916
581	6708	2640	3750	7182	2745	4004	7571	2809	4216	7808	2829	4339
582	143	48	56	134	48	60	125	47	61	123	48	61
583	167	56	155	1087	393	379	1561	591	843	1664	653	1096
567	169	58	21	1331	463	21	2149	779	21	2338	878	21
568	158	48	74	4981	1739	76	8321	3039	75	9353	3544	75
571	151	45	88	2567	839	615	4958	1707	607	4766	1720	604
579	678	221	171	621	221	502	1076	403	1195	1419	552	1572
Total	23137	8184	8903	41393	15018	11702	54624	20396	14659	57793	22276	16235

Appendix B PT Mode Share and Household Car Trip Rates

Table B-1: Public Transport Mode Share per MSM zone

	2016				2028				2038				2048+			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
MSM Zone	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination
550	6%	2%	1%	5%	12%	4%	3%	10%	15%	8%	7%	14%	18%	9%	8%	16%
551	10%	0%	1%	9%	16%	2%	3%	14%	14%	6%	6%	12%	17%	7%	7%	15%
554	9%	1%	1%	8%	14%	3%	4%	12%	15%	6%	6%	13%	15%	8%	7%	13%
555	9%	0%	1%	7%	16%	3%	3%	14%	17%	5%	6%	15%	18%	6%	7%	16%
556	8%	0%	0%	7%	11%	1%	2%	8%	11%	5%	4%	9%	11%	6%	5%	9%
557	6%	0%	0%	6%	12%	4%	5%	13%	12%	6%	7%	14%	13%	6%	8%	15%
558	6%	0%	0%	6%	7%	5%	5%	8%	7%	8%	8%	9%	7%	10%	9%	10%
559	8%	1%	1%	6%	23%	6%	8%	21%	24%	7%	10%	22%	27%	8%	11%	25%
560	6%	1%	2%	4%	23%	5%	7%	20%	26%	7%	11%	24%	28%	8%	12%	26%
561	7%	0%	1%	6%	20%	6%	7%	19%	18%	5%	7%	17%	21%	6%	8%	19%
562	7%	1%	1%	6%	16%	4%	4%	14%	18%	6%	7%	17%	20%	6%	8%	19%
East	7%	2%	1%	6%	14%	3%	3%	11%	14%	6%	6%	13%	15%	7%	7%	13%
West	7%	1%	1%	6%	19%	5%	6%	18%	20%	6%	8%	19%	23%	7%	9%	21%
Total	7%	2%	1%	6%	16%	3%	4%	14%	17%	6%	6%	15%	19%	7%	7%	17%

Table B-2: Household Car Trip Rate per MSM Zone

	2016		2028		2038		2048+	
MSM Zone	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
550	1.25	1.08	0.94	0.82	0.71	0.62	0.55	0.48
551	0.67	0.56	0.56	0.48	0.77	0.70	0.55	0.49
554	0.62	0.53	0.66	0.59	0.64	0.57	0.65	0.61
555	0.72	0.63	0.52	0.44	0.47	0.40	0.45	0.39
556	0.82	0.71	1.11	1.05	1.11	1.07	1.23	1.21
557	0.68	0.57	0.49	0.45	0.48	0.45	0.45	0.42
558	0.48	0.41	0.92	0.89	1.38	1.33	1.43	1.39
559	0.99	0.85	0.49	0.42	0.43	0.38	0.39	0.34
560	1.56	1.35	0.43	0.37	0.43	0.37	0.39	0.33
561	0.84	0.74	0.49	0.42	0.46	0.40	0.40	0.36
562	1.07	0.97	0.51	0.44	0.46	0.40	0.41	0.36
East	0.96	0.83	0.72	0.64	0.69	0.63	0.64	0.59
West	0.82	0.71	0.49	0.43	0.46	0.40	0.41	0.36
Total	0.92	0.80	0.62	0.55	0.58	0.52	0.53	0.48

Appendix C SATURN Summary Results

Table C-1: SATURN Modelling Results for Drury Interchange

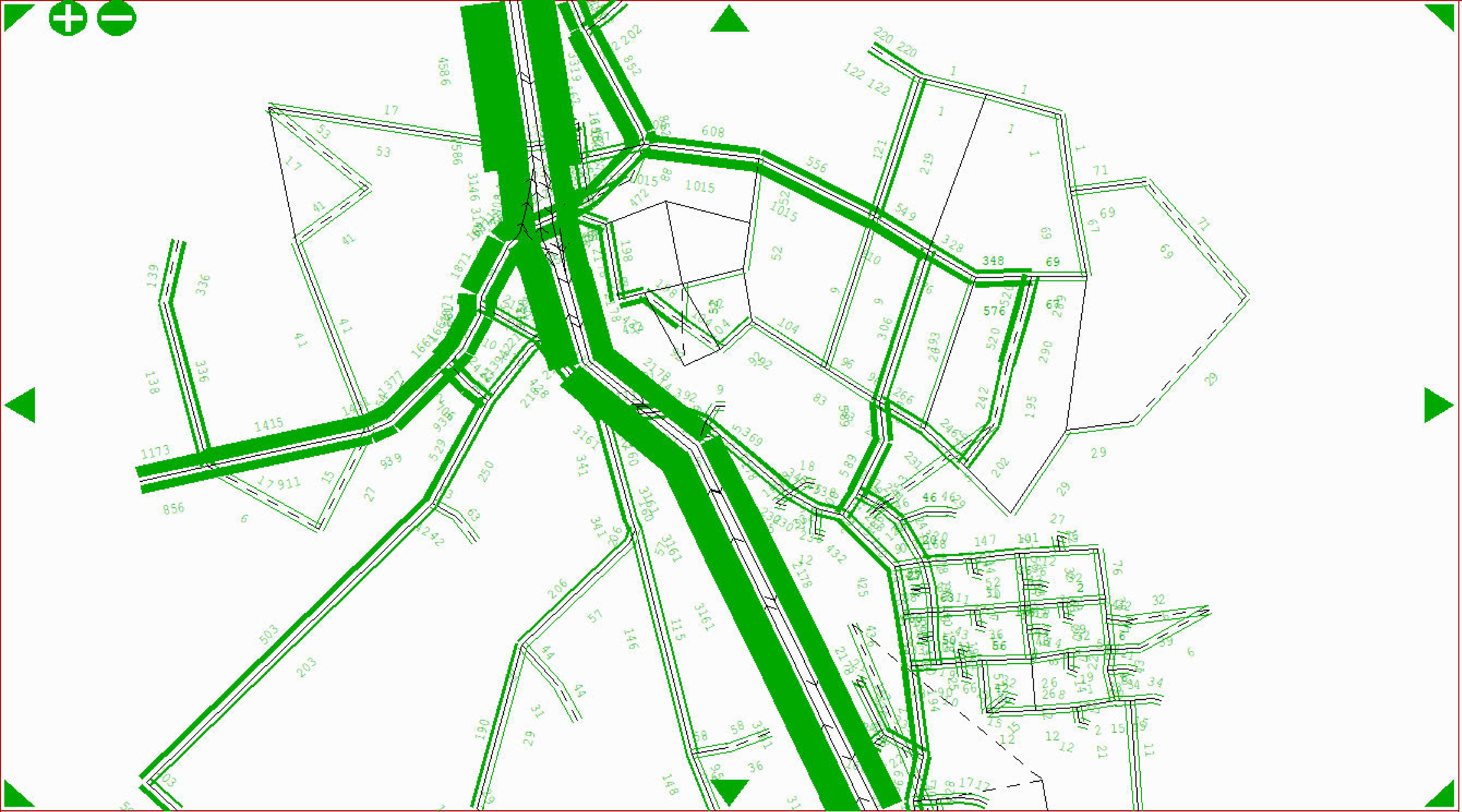
Land Use	Network	No. lane on the on/off ramps	Peak	Drury Interchange: Northbound On-ramp Flow (veh)	Northbound On-ramp Delay (sec)	Southbound Off-ramp Flow (veh)	Southbound Off-ramp Delay (sec)	Great South Road Through Eastbound Flow (veh)	Great South Road Through Eastbound Delay (sec)	Great South Road Through Westbound Flow (veh)	Great South Road Through Westbound Delay (sec)
With Drury Interchange Direct Access to Metropolitan Centre											
2023	2016 SH1 Northbound 2-lane	Single	AM	1428	27	934	23	974	22	1117	21
			PM	1052	0	1612	58	388	44	2117	22
2028	2016 SH1 Northbound 2-lanes	Single	AM	1423	167	1170	34	848	25	1424	21
			PM	1374	0	1876	58	343	47	2345	22
	2016 SH1 Northbound 3-lanes	Single	AM	1392	318	1241	35	822	24	1404	18
			PM	1526	0	1902	59	244	49	2393	23
2028	2028	Single	AM	1408	319	1258	36	774	23	1454	18
			PM	1446	0	1750	161	271	51	2208	25
		Double	AM	2170	35	1304	22	810	25	1595	41
			PM	1474	1	1859	115	274	49	2262	25
	2028 + Mill Rd to Fitzgerald	Single	AM	1388	122	1124	31	984	23	1306	17
			PM	1265	0	1690	133	306	29	2029	22
2033	2028	Single	AM	1419	394	1409	43	1093	34	1685	21
			PM	1521	0	1746	158	270	56	2228	25
		Double	AM	2147	15	1485	24	1097	28	1758	35
			PM	1586	1	1852	108	268	52	2230	25
	2028 + Mill Rd to Fitzgerald	Single	AM	1376	162	1264	37	1083	24	1400	17
			PM	1392	0	1582	152	332	27	1955	21
2038	2028	Single	AM	1671	1177	1597	62	842	52	1835	31
			PM	1614	0	1761	215	237	66	2215	25
		Double	AM	2238	92	1676	54	721	39	1815	92
			PM	1677	1	1954	117	230	60	2283	26

				Drury Interchange							
				Northbound On-ramp		Southbound Off-ramp		Great South Road Through Eastbound		Great South Road Through Westbound	
Land Use	**Network**	**No. lane on the on/off ramps**	**Peak**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**
	2028 + Mill Rd to Fitzgerald	Single	AM	1423	370	1469	47	902	33	1612	18
			PM	1414	0	1696	161	291	34	1955	21
2038	2038	Single	AM	1233	1	871	20	422	21	924	39
			PM	954	0	1229	36	157	49	1380	21
2048	2048	Single	AM	1248	2	1175	26	379	21	1048	33
			PM	1054	0	1211	32	171	49	1332	20
Without Drury Interchange Direct Access to Metropolitan Centre											
2023	2016 SH1 Northbound 2-lane	Single	AM	1434	10	865	20	889	14	1034	14
			PM	982	0	1558	45	400	14	2099	23
2028	2016 SH1 Northbound 2-lanes	Single	AM	1398	114	1216	27	981	17	1168	14
			PM	1254	0	1667	52	421	16	1838	21
	2016 SH1 Northbound 3-lanes	Single	AM	1410	316	1292	29	917	19	1205	14
			PM	1432	0	1789	196	300	14	2076	23
2028	2028	Single	AM	1415	364	1298	29	748	17	1473	20
			PM	1413	0	1778	162	309	13	2209	25
		Double	AM	2166	32	1308	30	757	17	1511	42
			PM	1454	1	1779	164	297	13	2218	25
	2028 + Mill Rd to Fitzgerald	Single	AM	1384	115	1171	25	946	16	1211	16
			PM	1295	0	1783	92	314	14	2241	25
2033	2028	Single	AM	1443	432	1413	37	903	17	1559	20
			PM	1508	0	1778	142	316	12	2344	27
		Double	AM	2131	8	1454	38	959	20	1650	34
			PM	1553	1	1777	142	302	12	2345	27
		Single	AM	1382	148	1284	30	1055	17	1323	15

				Drury Interchange							
				Northbound On-ramp		Southbound Off-ramp		Great South Road Through Eastbound		Great South Road Through Westbound	
Land Use	**Network**	**No. lane on the on/off ramps**	**Peak**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**
	2028 + Mill Rd to Fitzgerald		PM	1413	0	1777	82	317	13	2275	25
2038	2028	Single	AM	1678	1135	1607	48	791	19	1740	27
			PM	1563	0	1765	208	197	11	2277	26
		Double	AM	2175	39	1681	55	855	21	1755	50
			PM	1607	1	1761	204	187	11	2278	26
	2028 + Mill Rd to Fitzgerald	Single	AM	1457	385	1371	31	799	21	1388	15
			PM	1456	0	1776	85	229	12	2321	26
2038	2038	Single	AM	1182	1	849	15	469	8	900	37
			PM	893	0	1226	25	233	8	1471	20
2048	2048	Single	AM	1283	1	1198	21	421	10	1049	34
			PM	1081	0	1862	24	233	7	1676	20

Appendix D SATURN Plots

With Direct Connection



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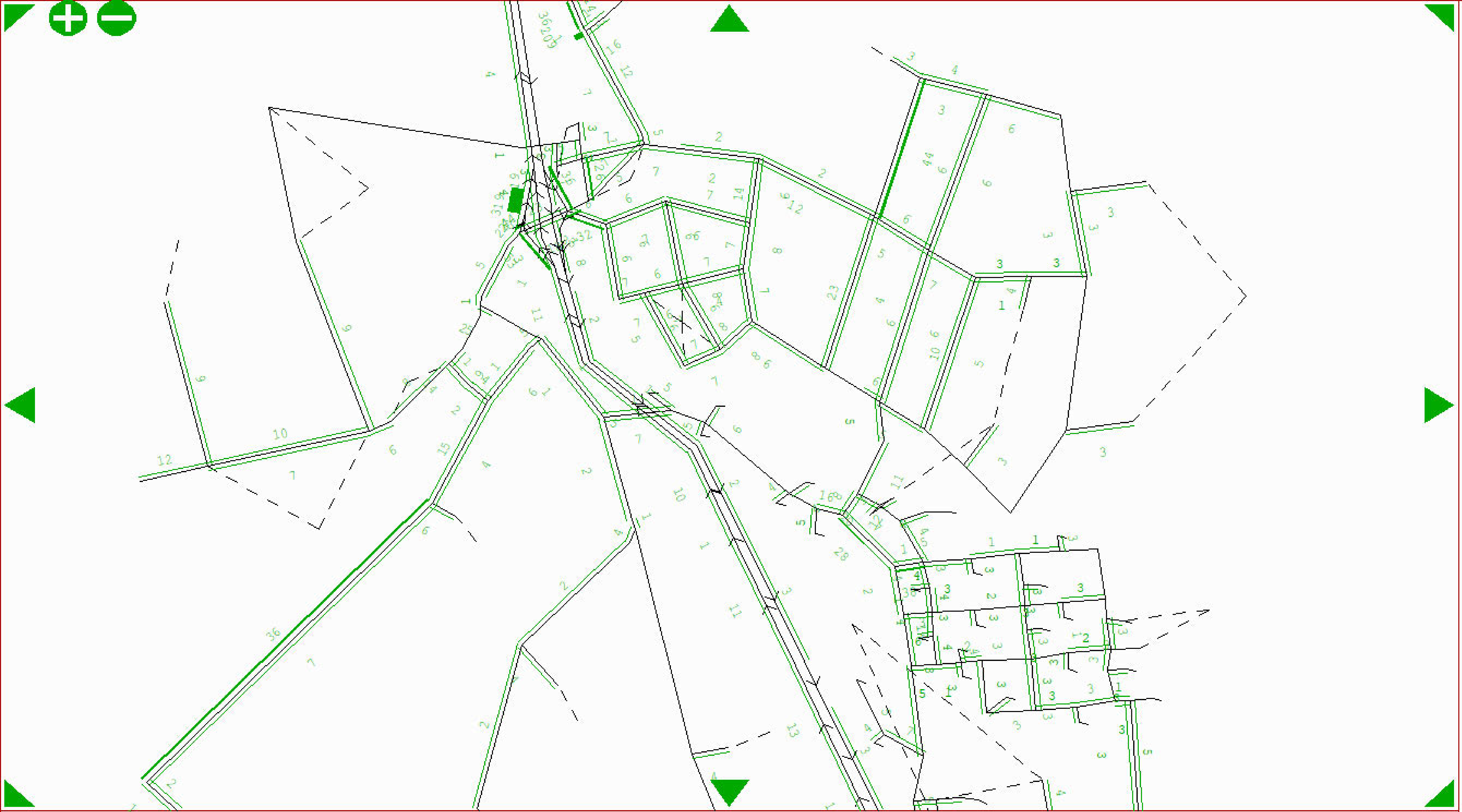

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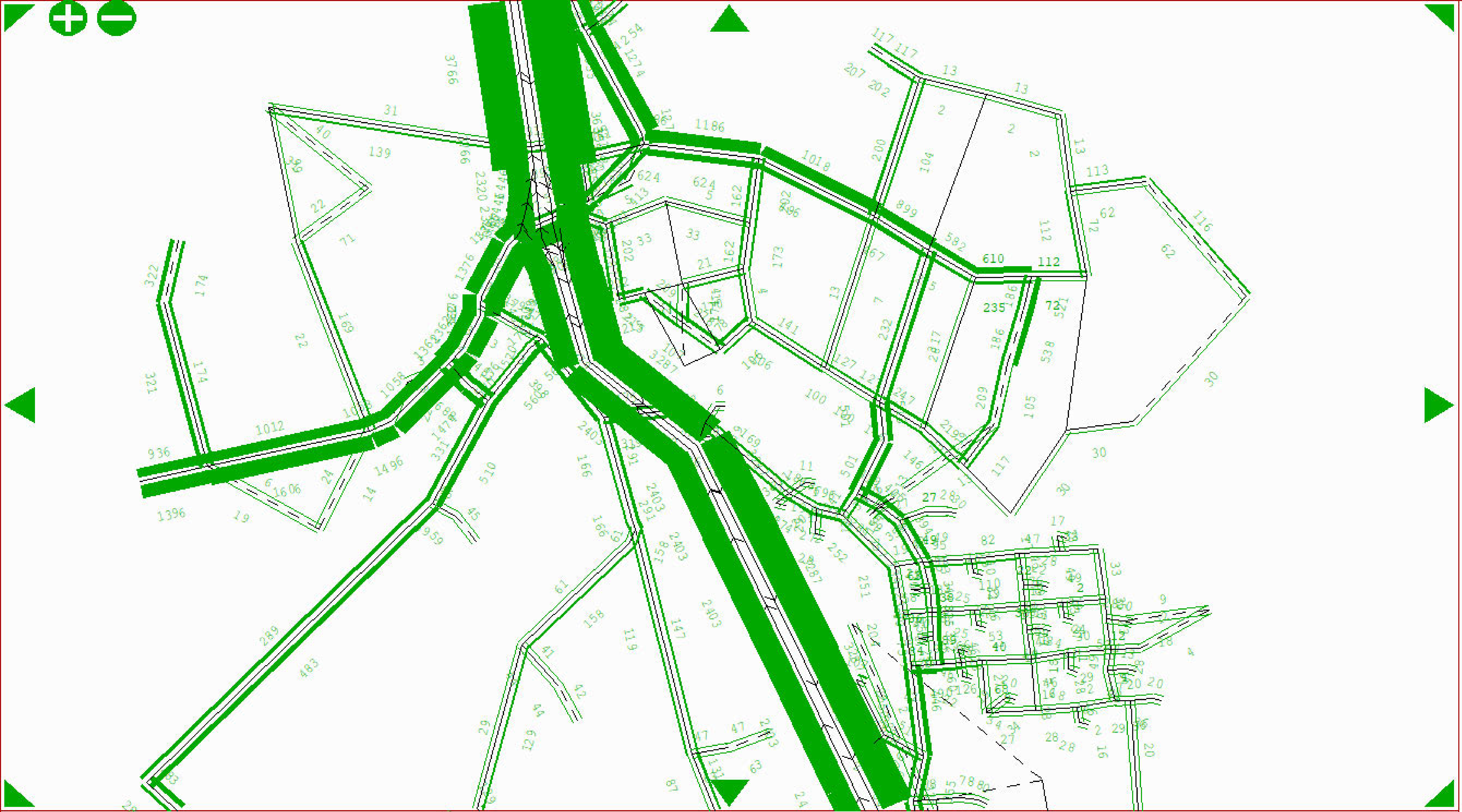

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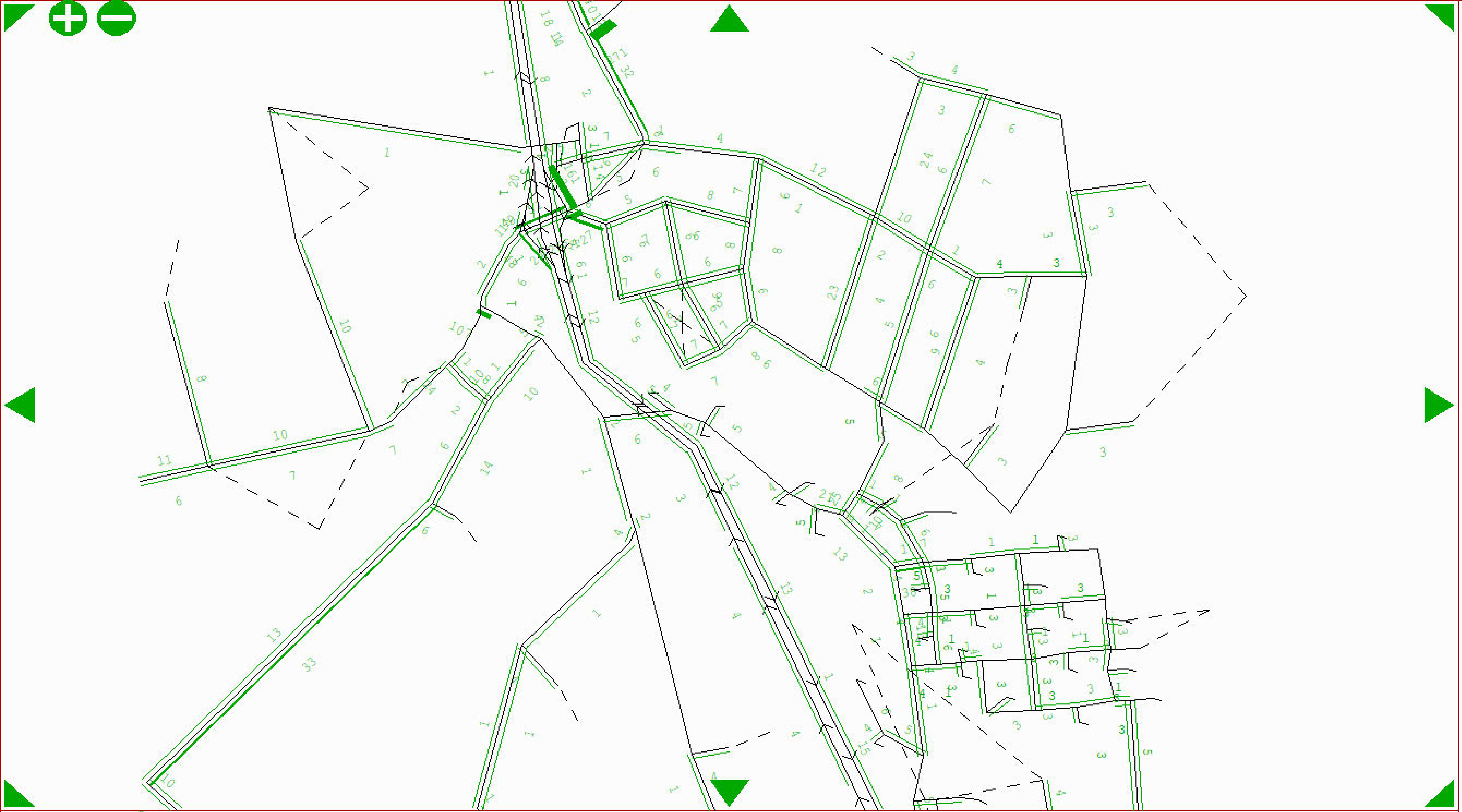

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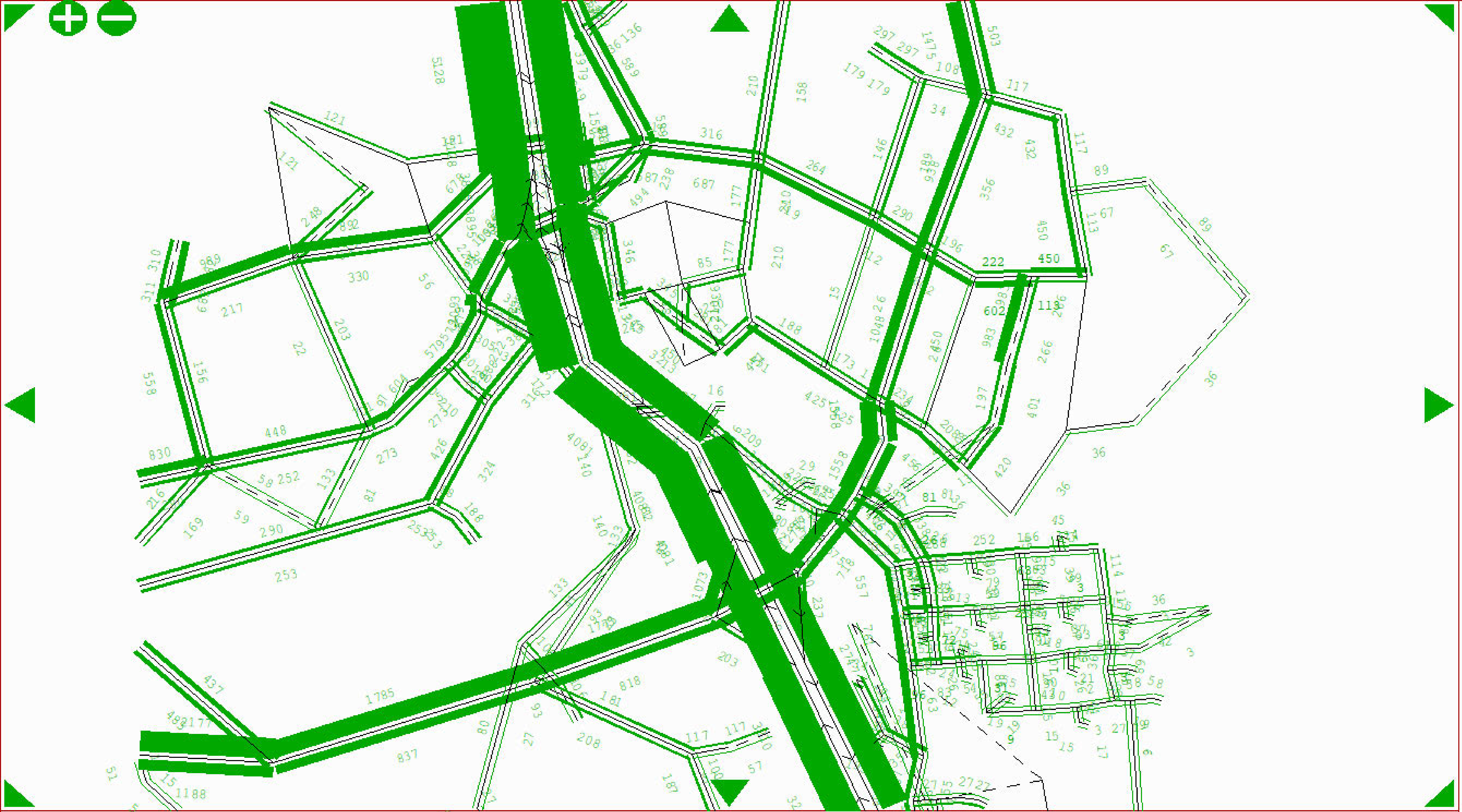

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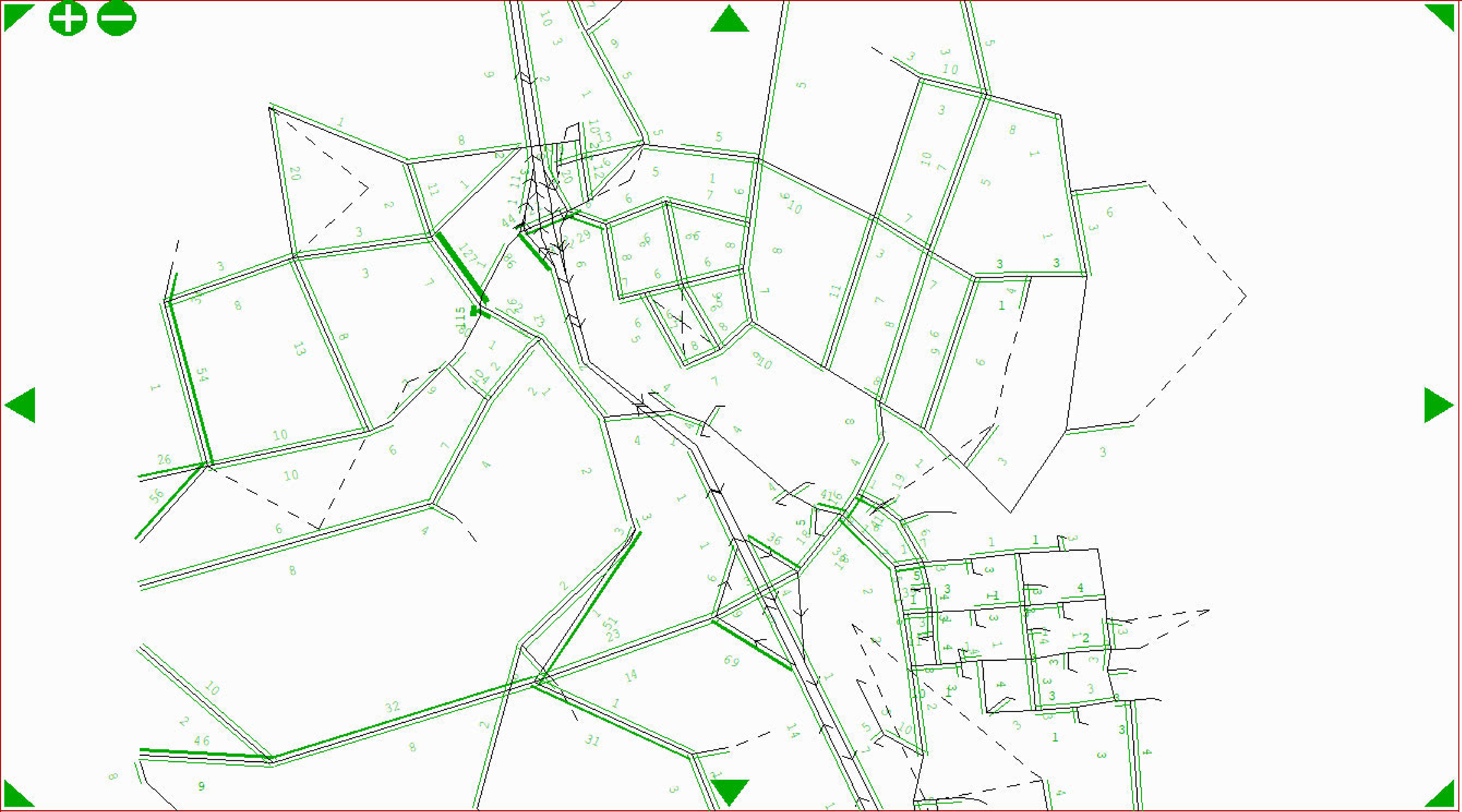

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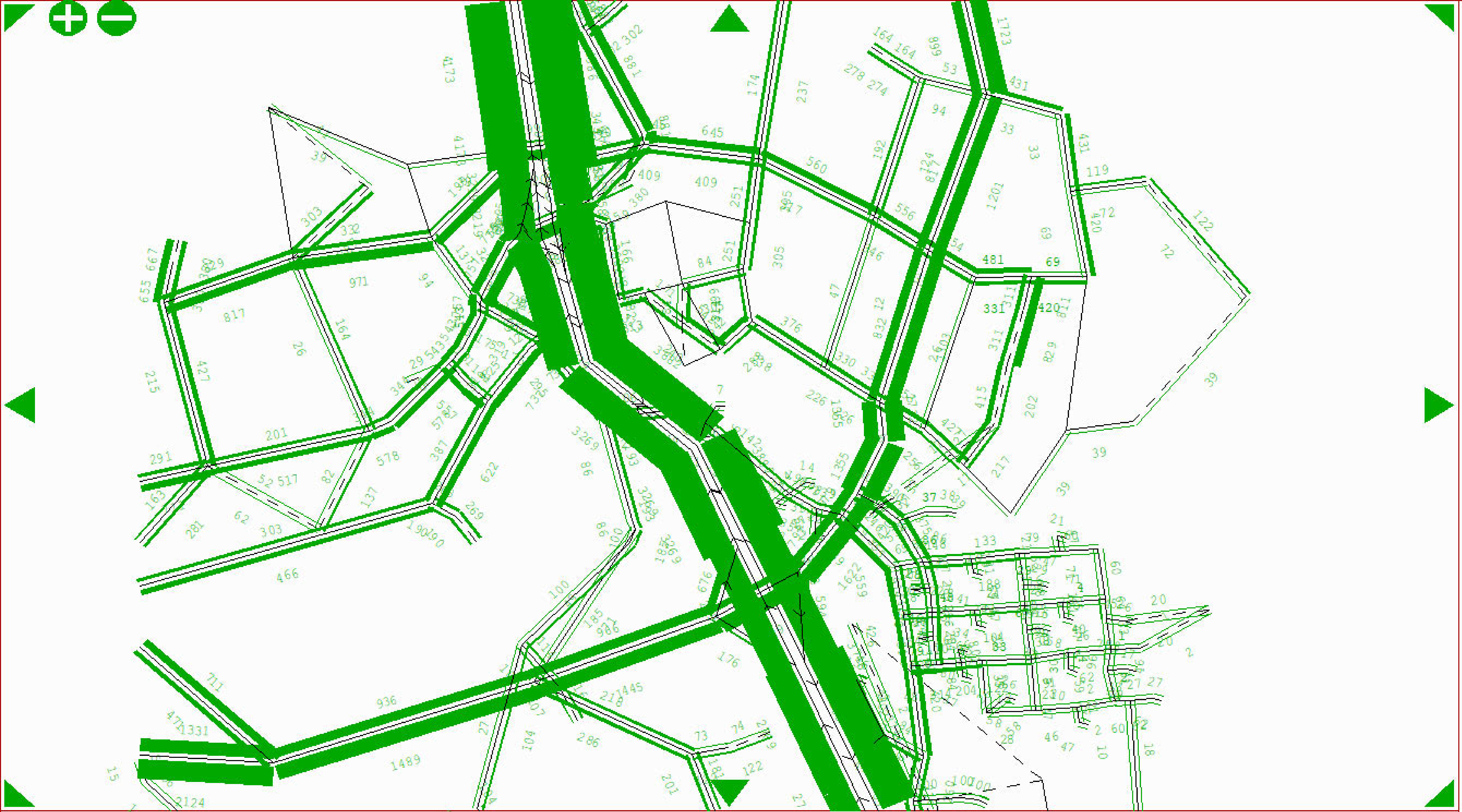

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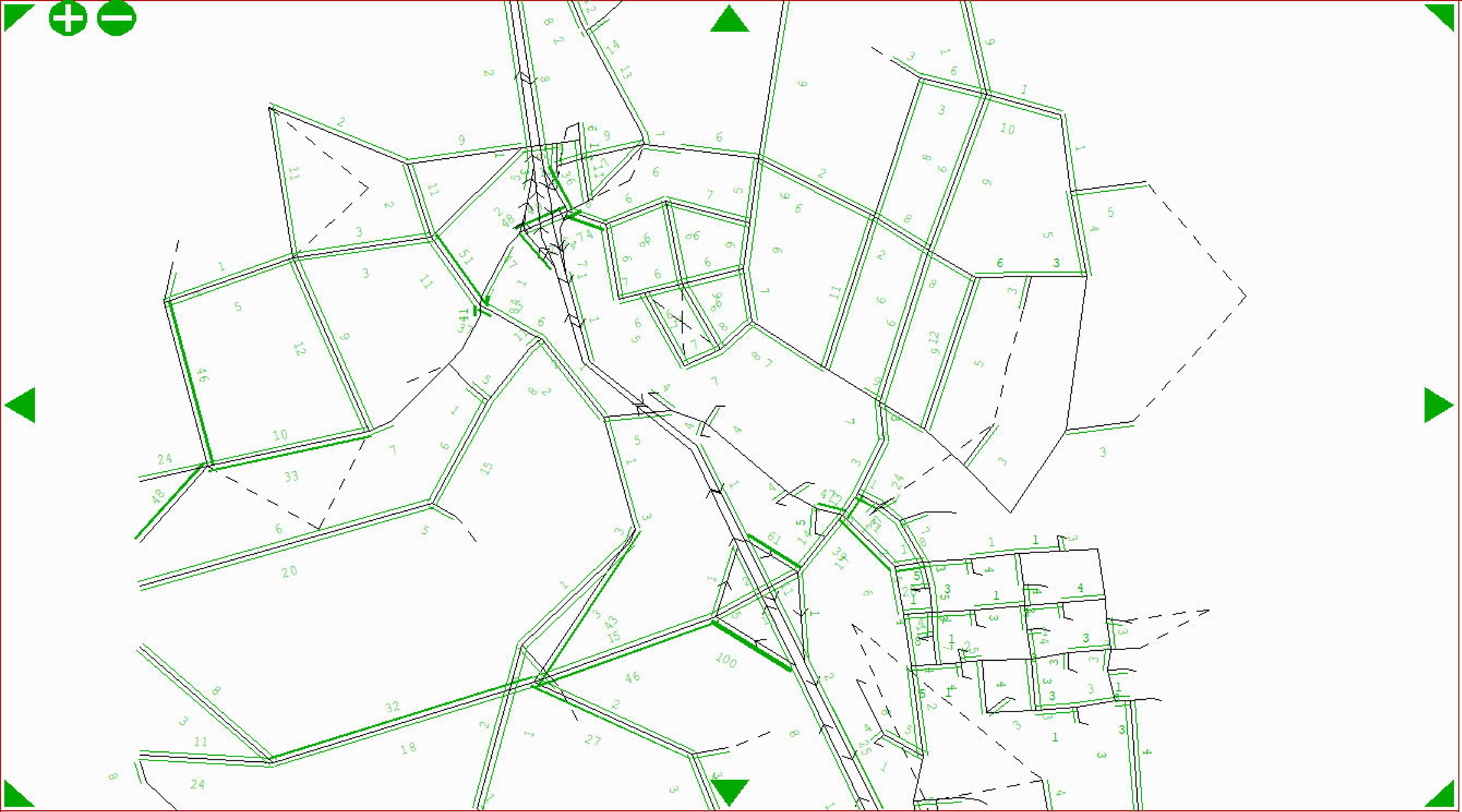

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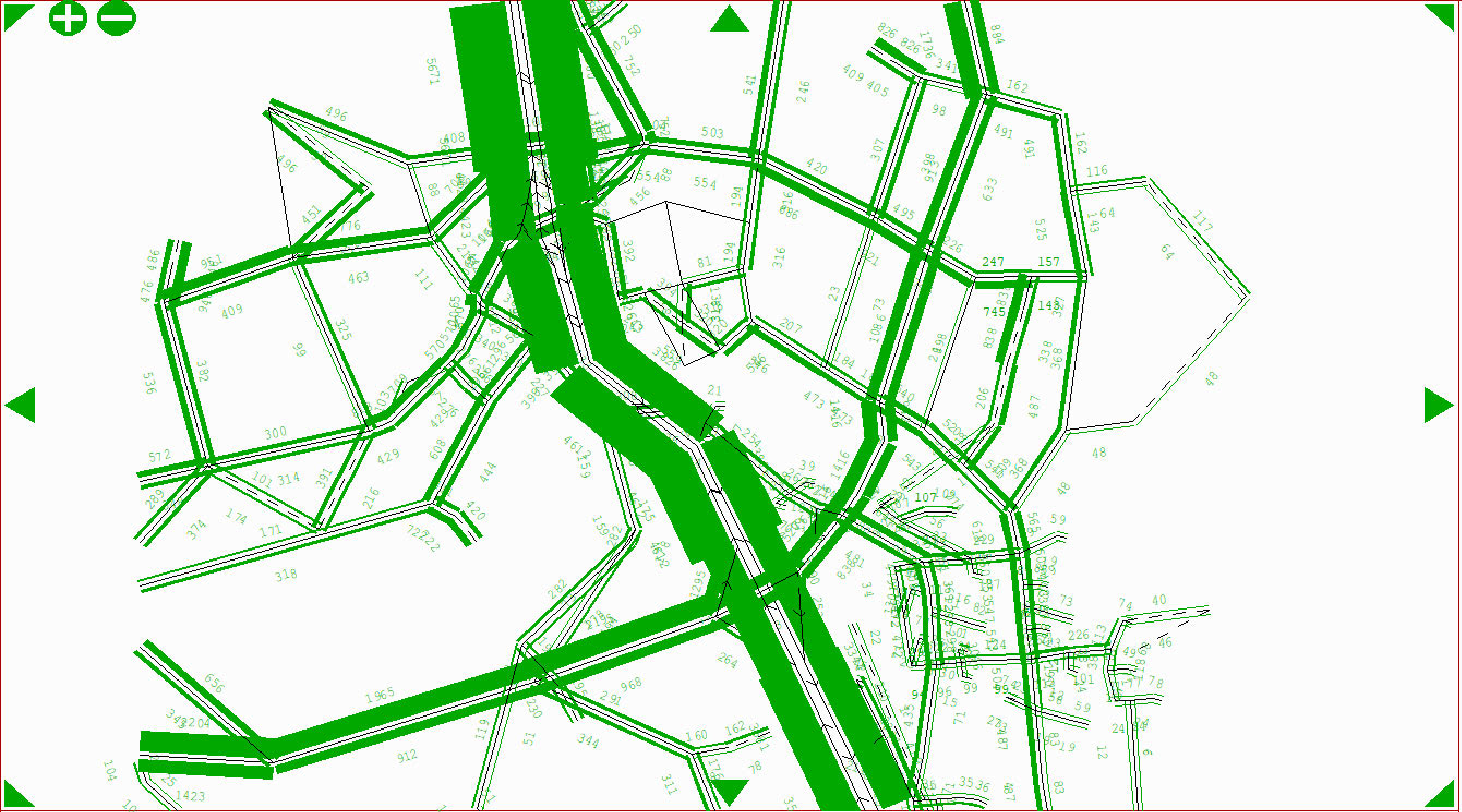

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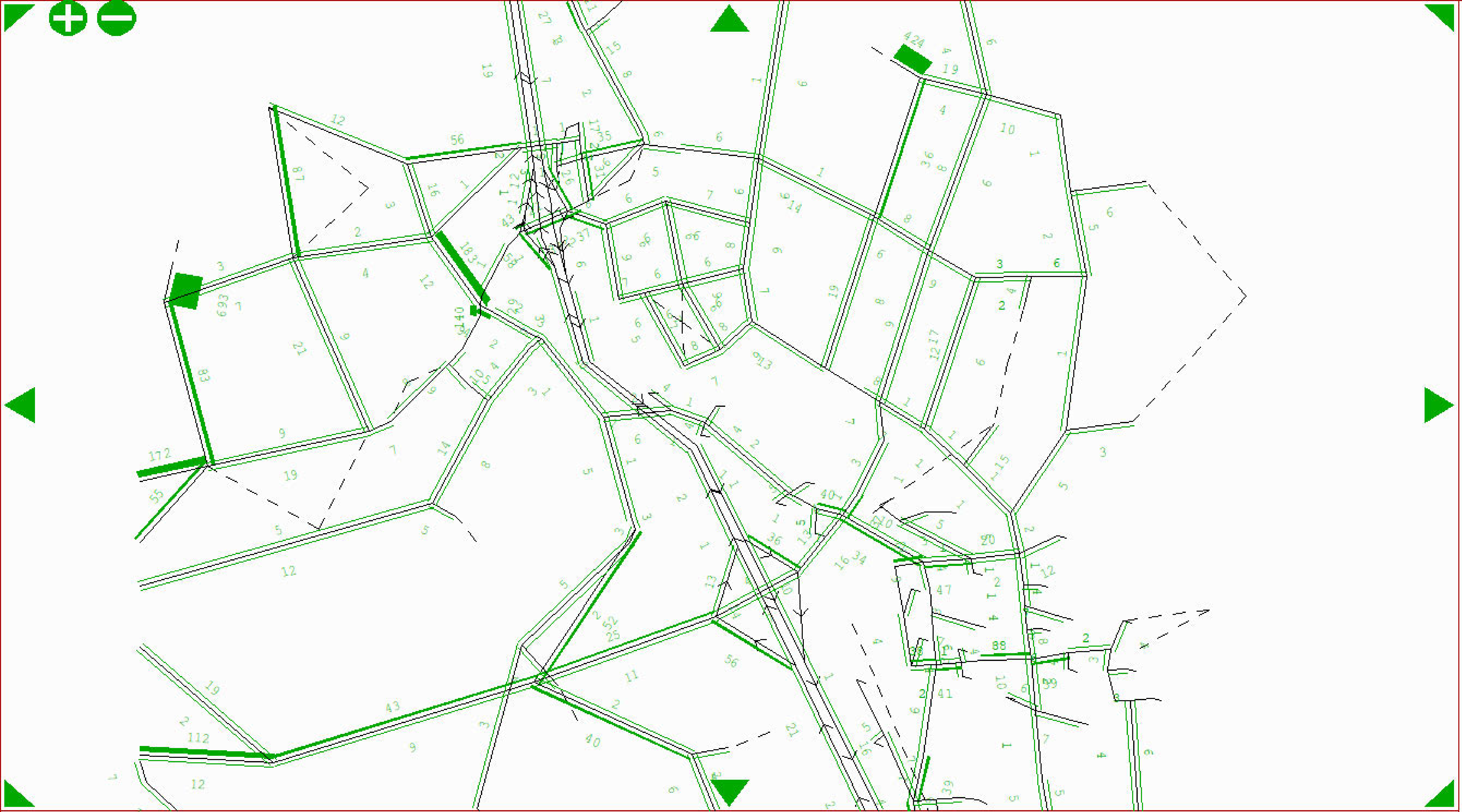

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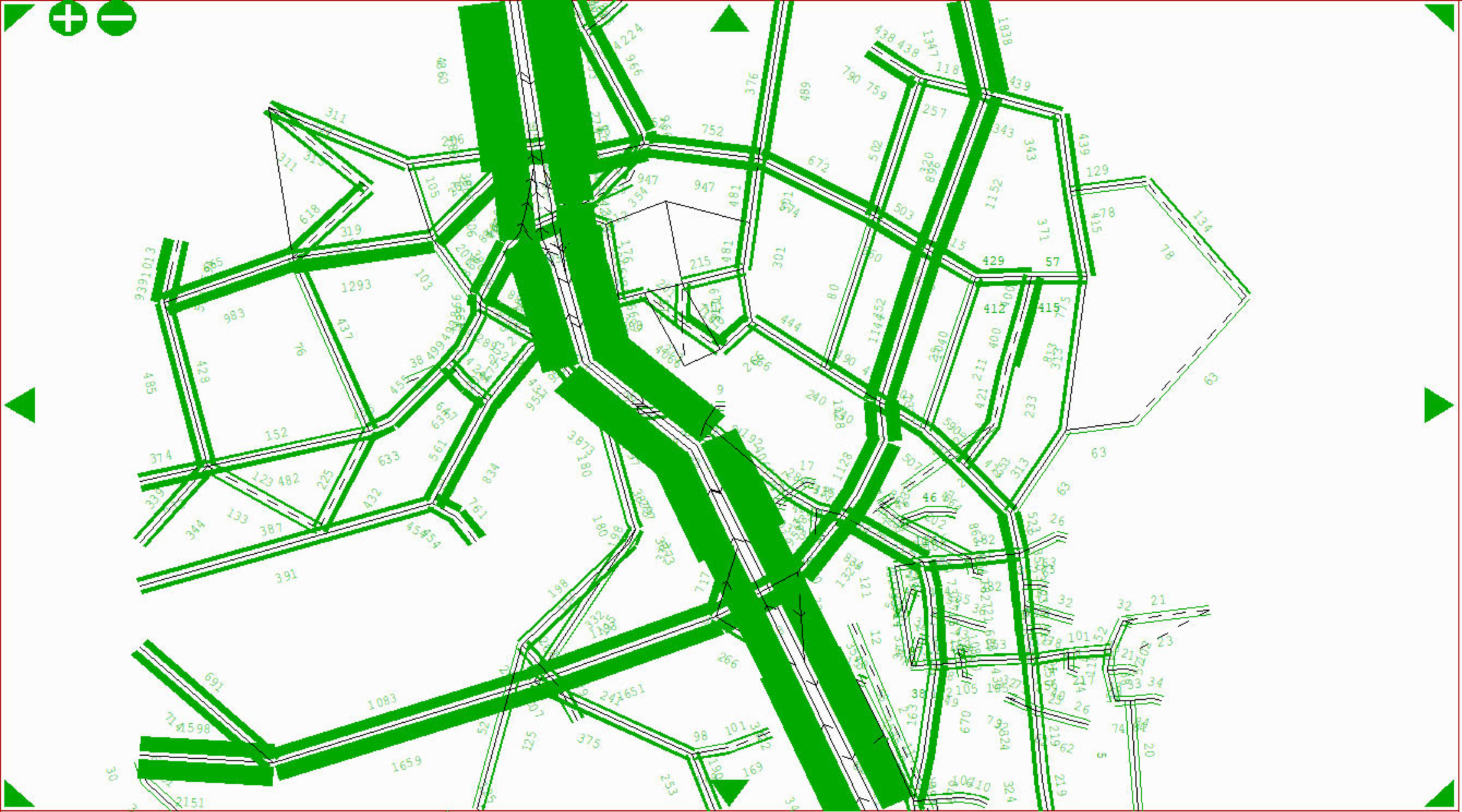
Auckland Preferred network with Drury2, 2048#10 AM 4- 7-19



Annotation:

Actual flow

Display of >
link anno

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More data >

Add temp dat x

Actual flow

to the D.B.

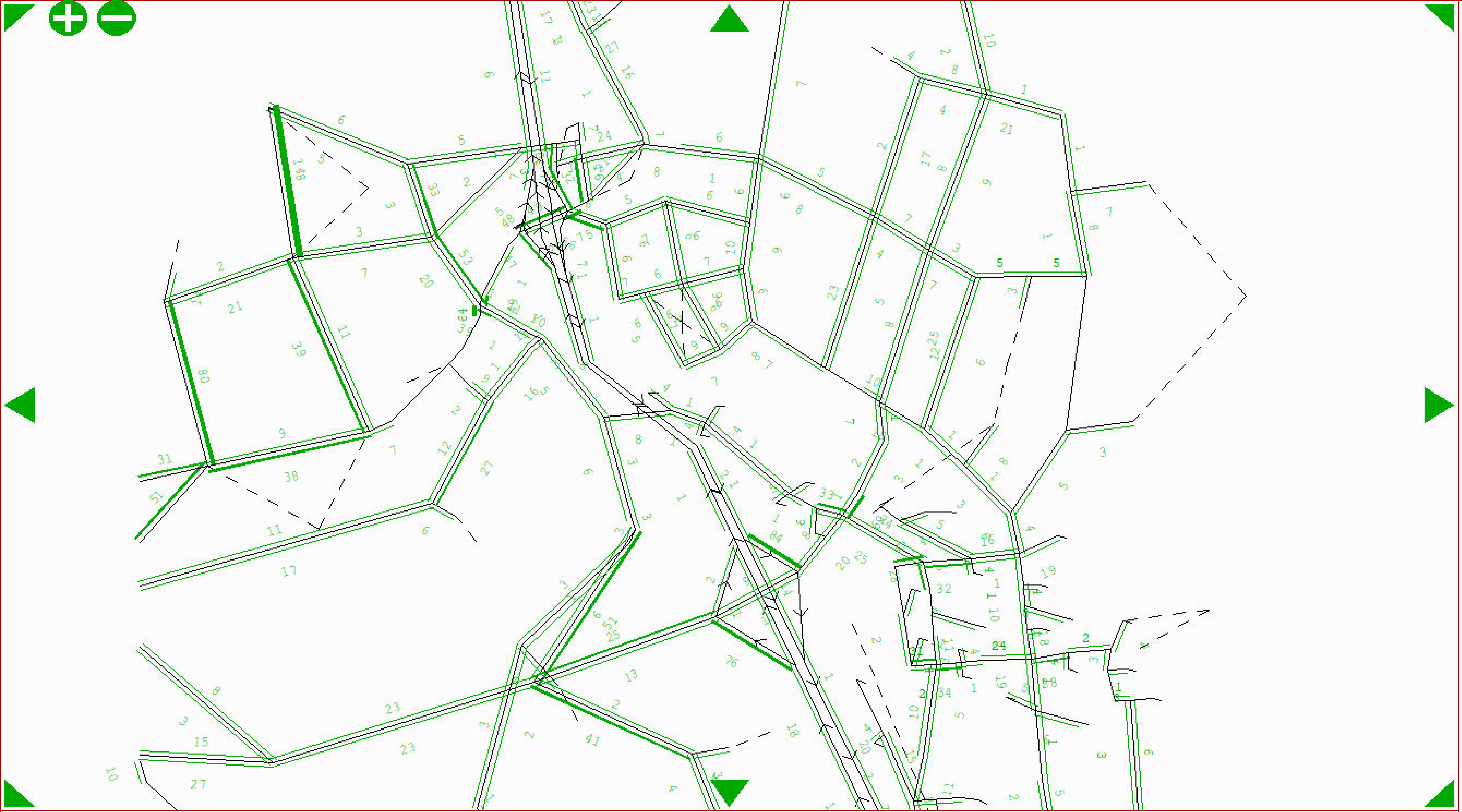
Options: >

-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury2, 2048#10 PM 4- 7-19



Annotation:

Delay sec

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More data >

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to the D.B.

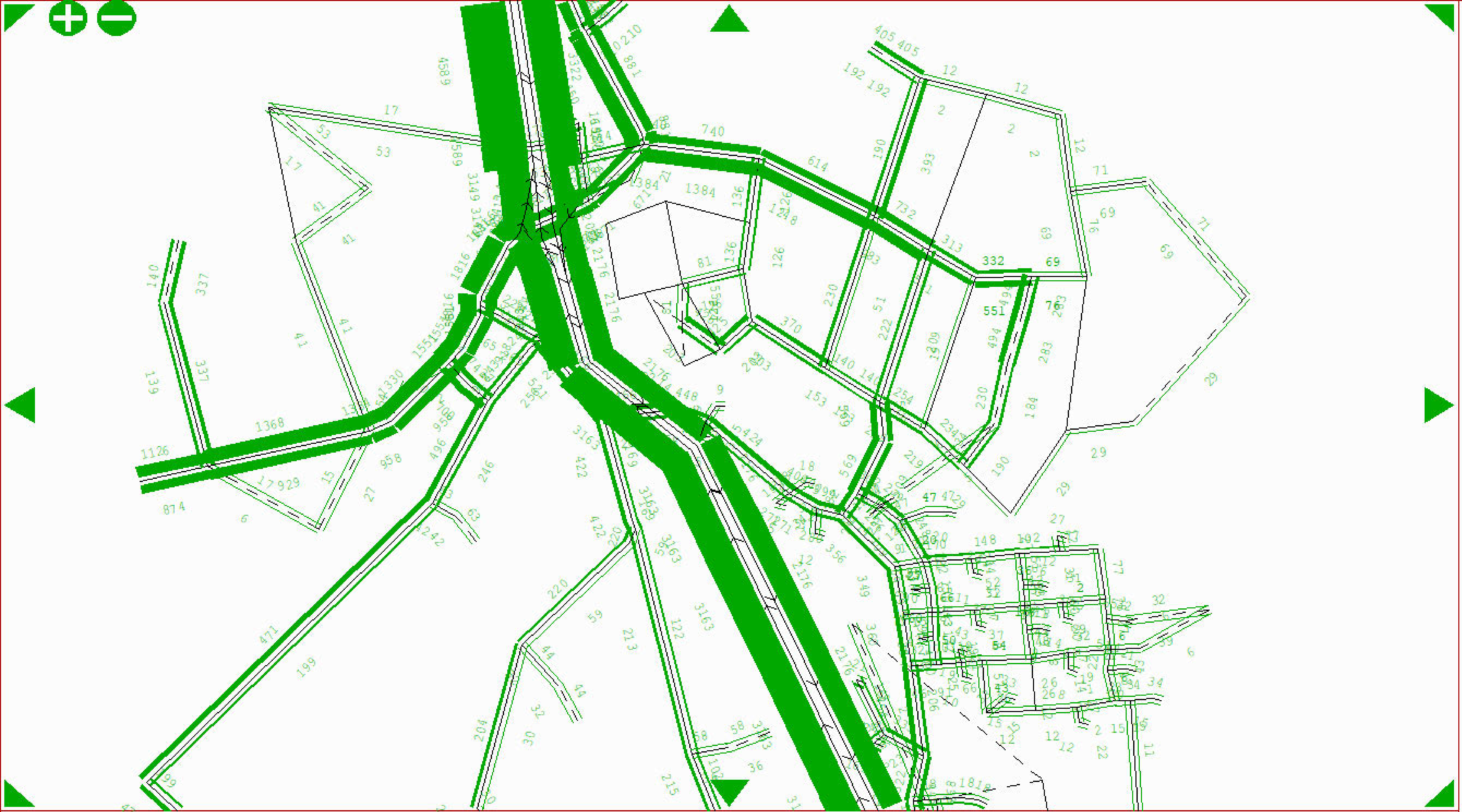
Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury2, 2048#10 PM 4- 7-19

Without Direct Connection



Annotation:

Actual flow

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Banner/Title >

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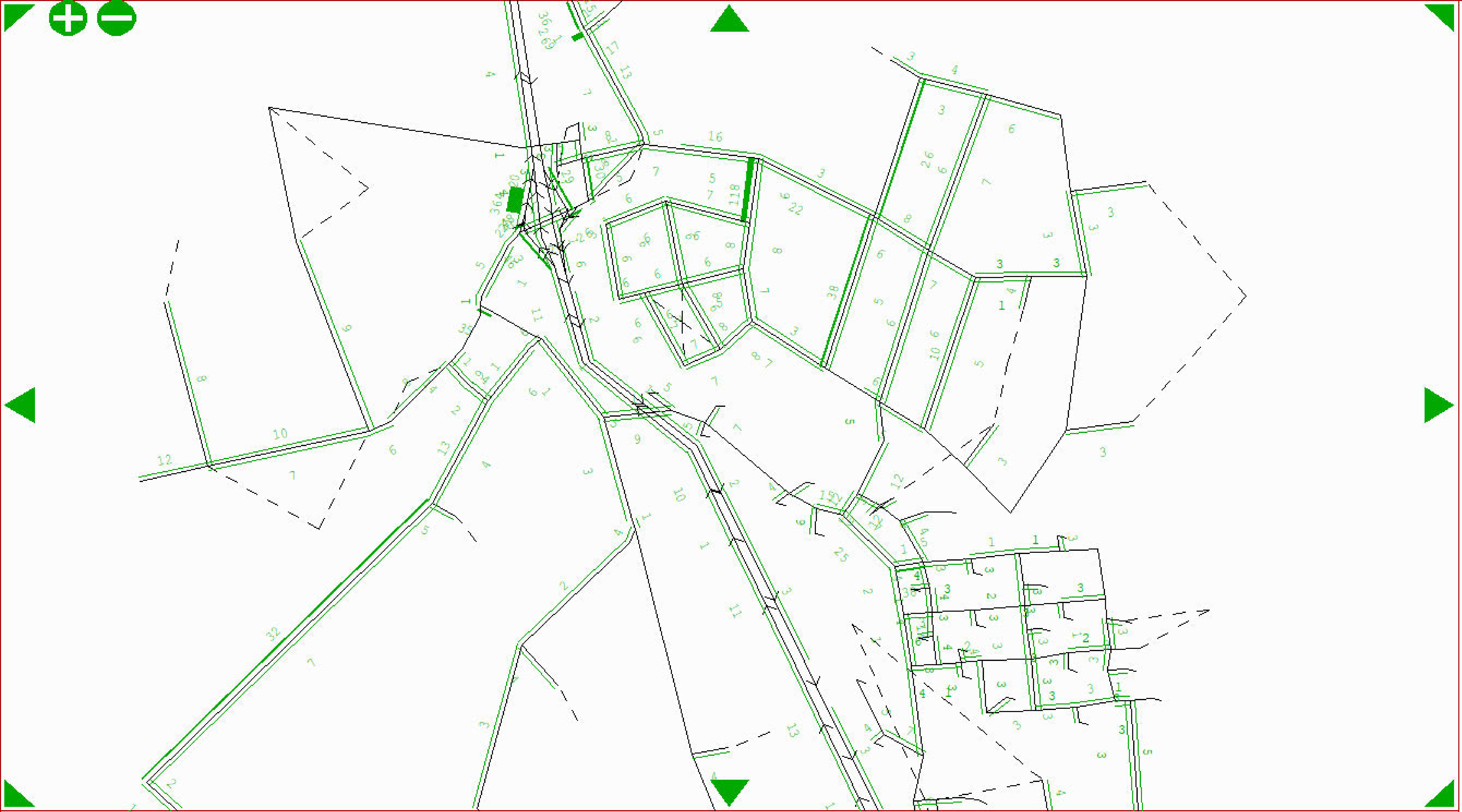
Actual flow
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2028#10v3 AM 6- 9-19



Annotation:

Delay sec

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Banner/Title >
General >

More data >

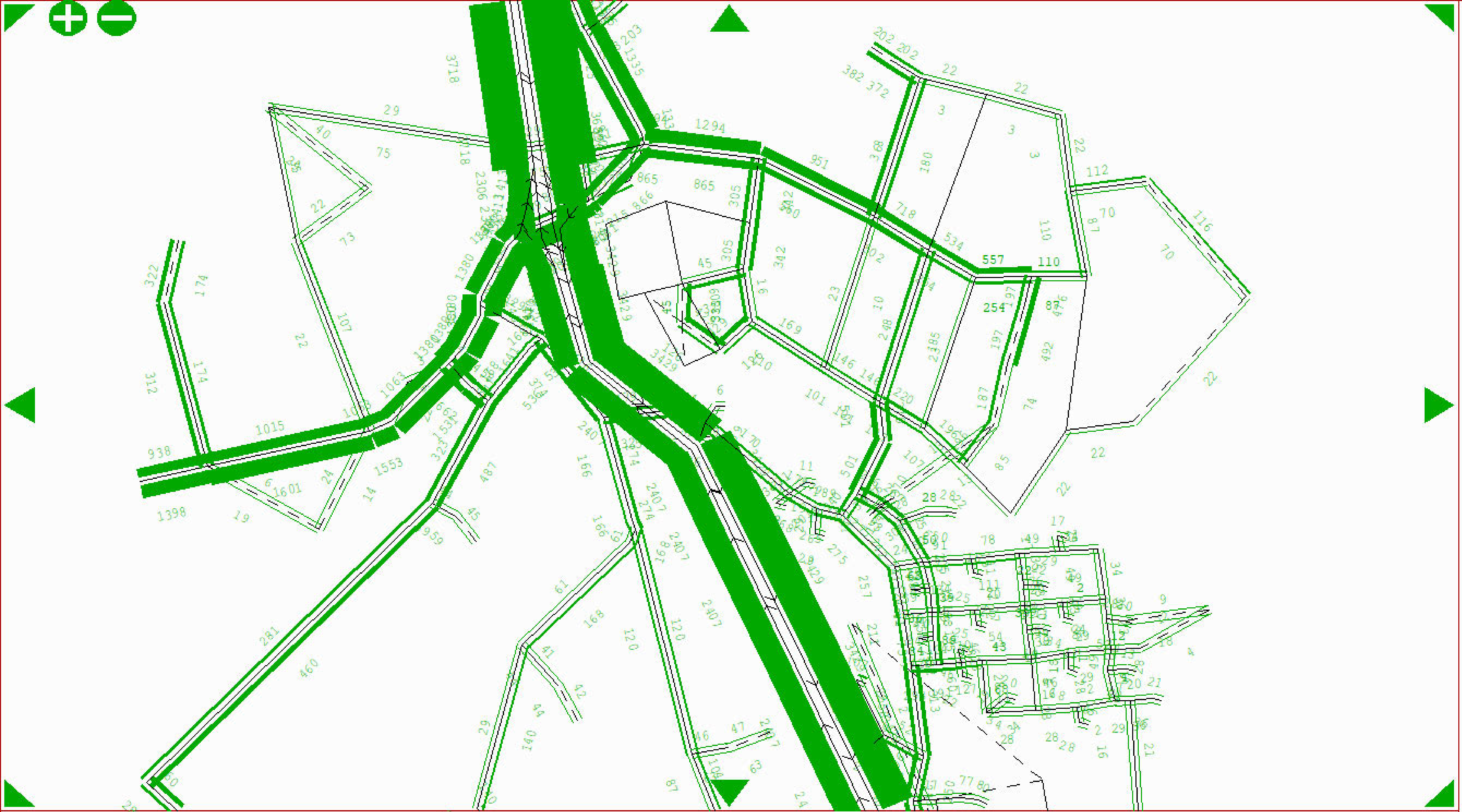
Add temp dat x
Delay sec
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2028#10v3 AM 6- 9-19



Annotation:

Actual flow

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link anno

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Banner/Title >

General >

More data >

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Actual flow
to the D.B.

Options: >
-UC,MCC etc.

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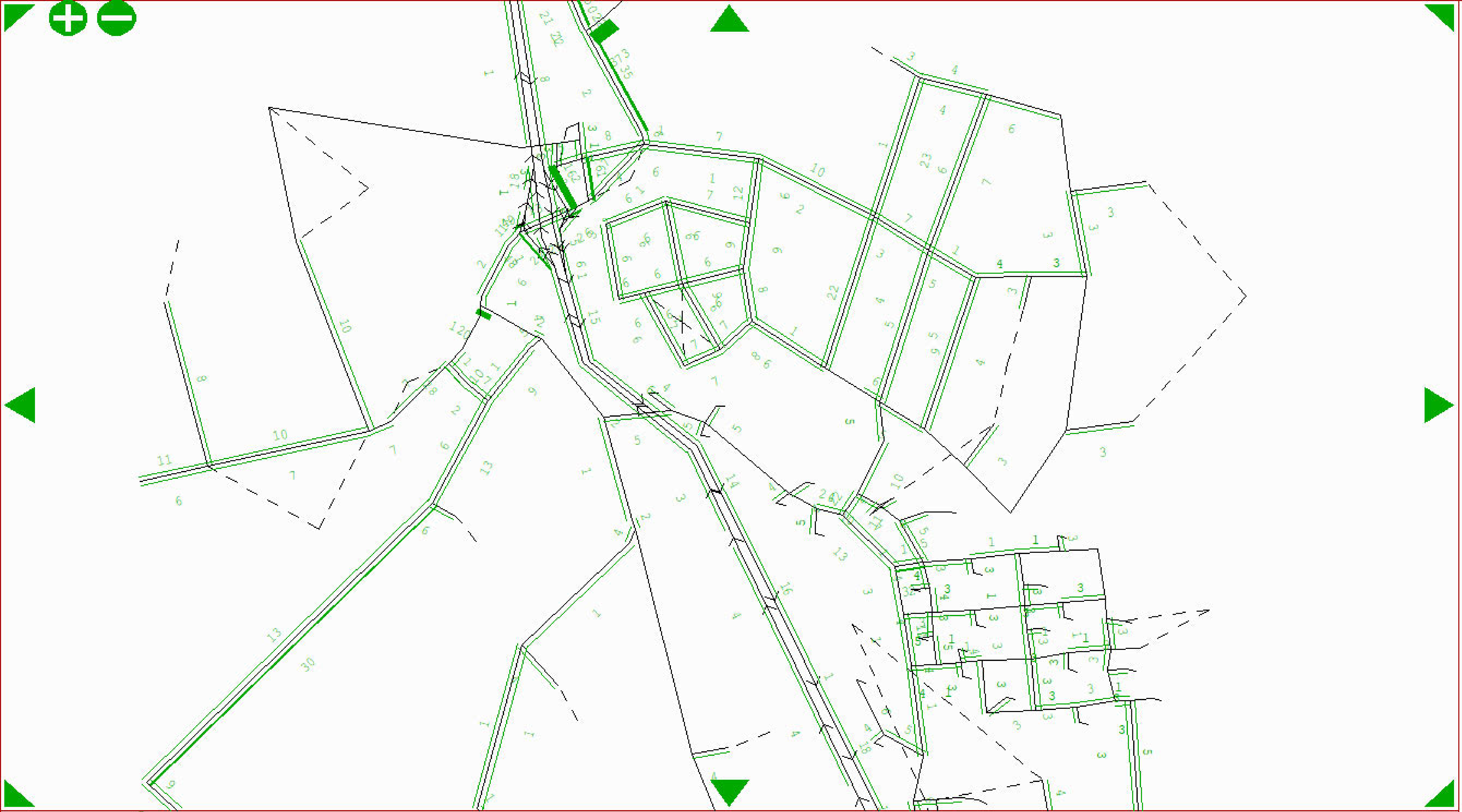
Auckland Preferred network with Drury30, 2028#10v3 PM 6- 9-19



Annotation:

Delay sec

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link anno
Link display >
Banner/Title >
General >

More data >

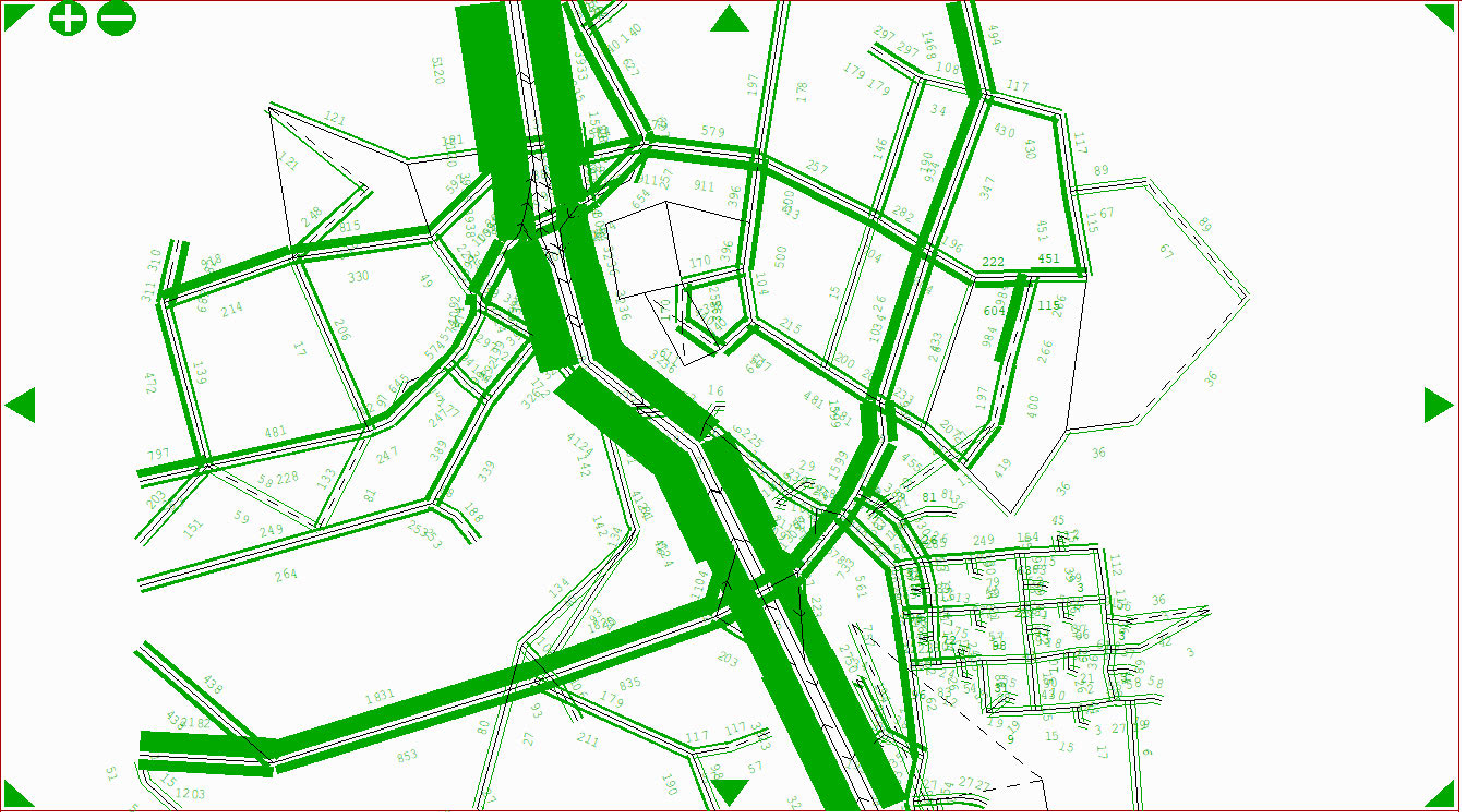
Add temp dat x
Delay sec
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2028#10v3 PM 6- 9-19



Annotation:

Actual flow

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link anno

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Banner/Title >

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More data >

Add temp dat x

Actual flow

to the D.B.

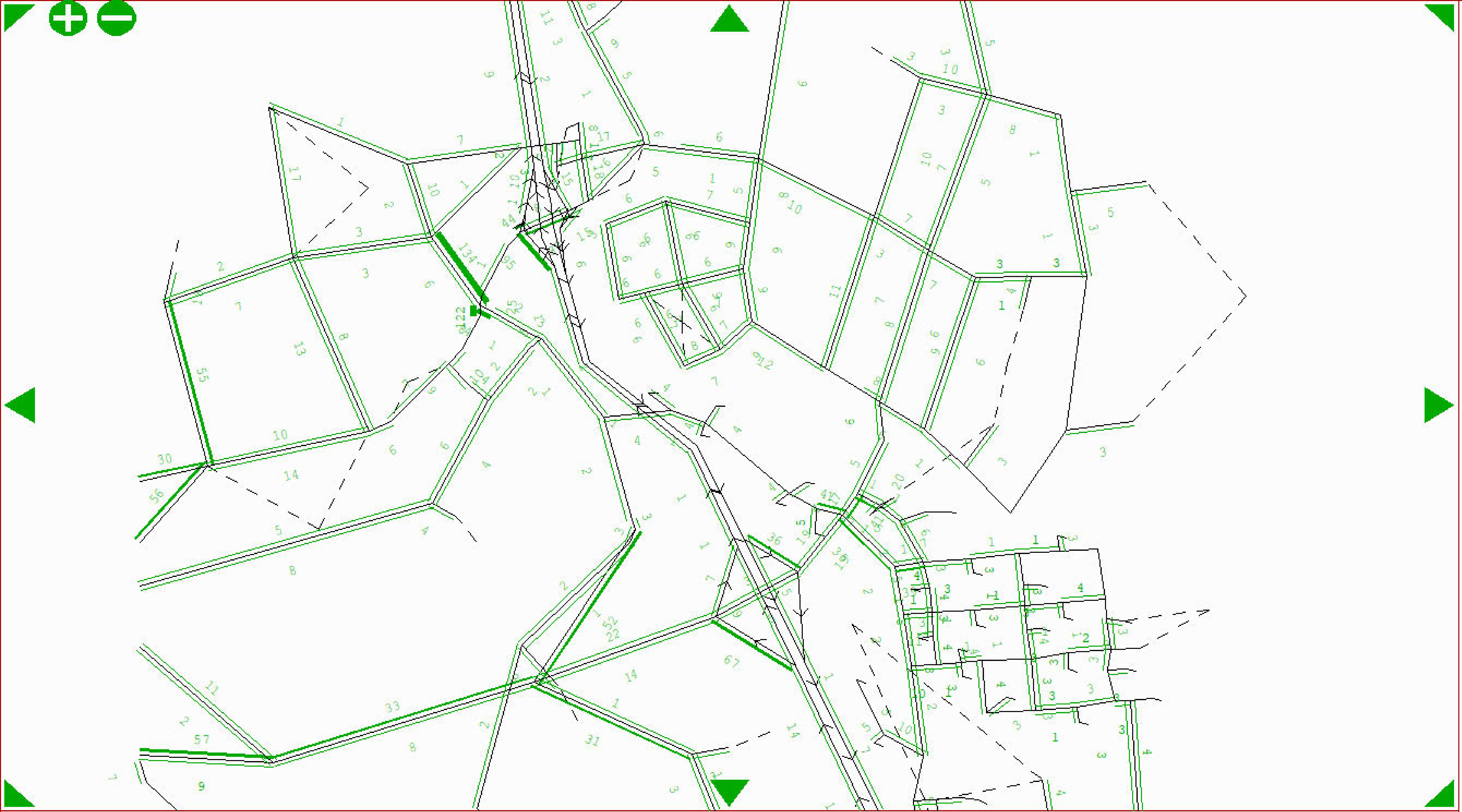
Options: >

-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2038#10 AM 6- 9-19



Annotation:

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Delay sec
to the D.B.

Options: >
-UC,MCC etc.

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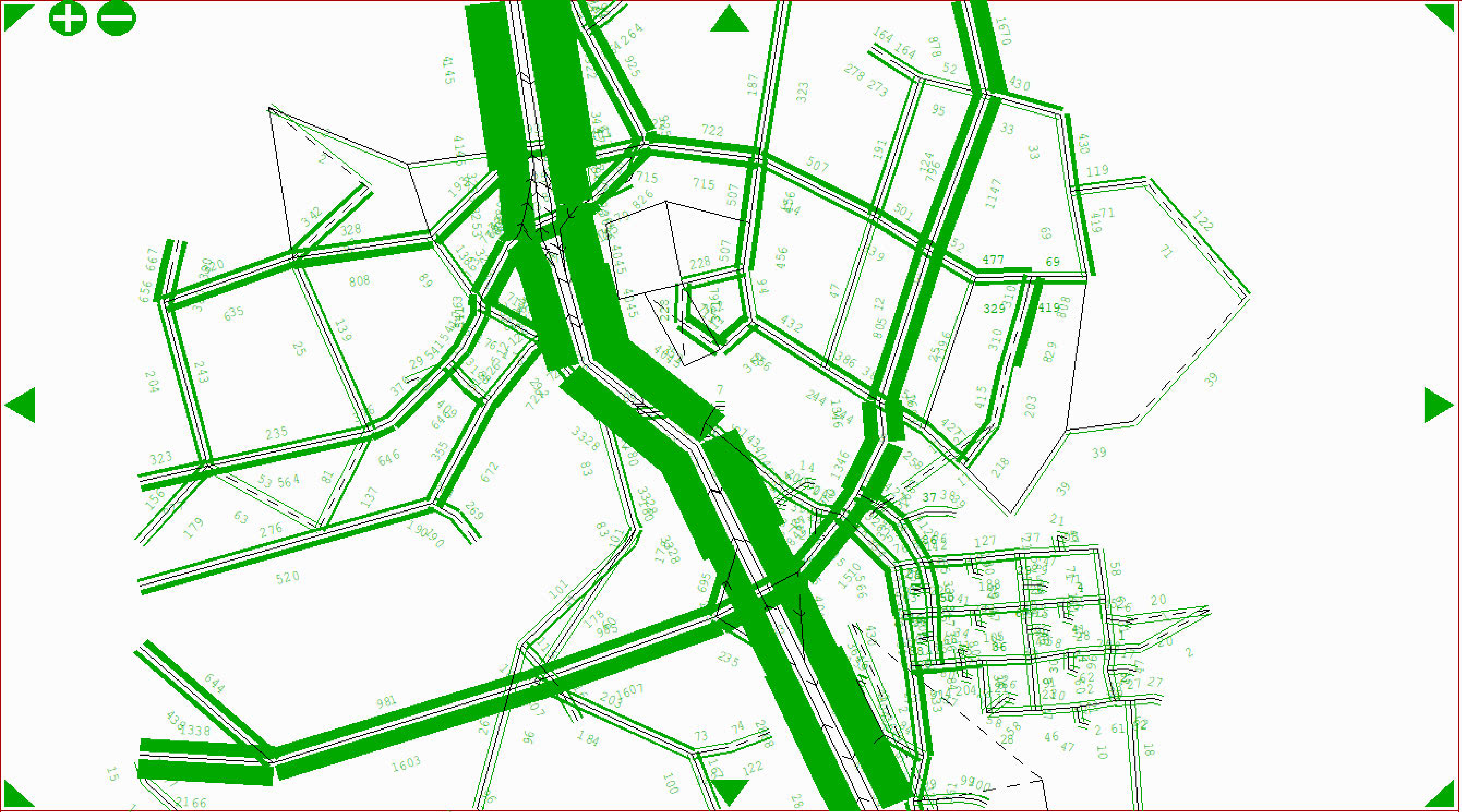
Auckland Preferred network with Drury30, 2038#10 AM 6- 9-19



Annotation:

Actual flow

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Banner/Title >

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More data >

Add temp dat x

Actual flow

to the D.B.

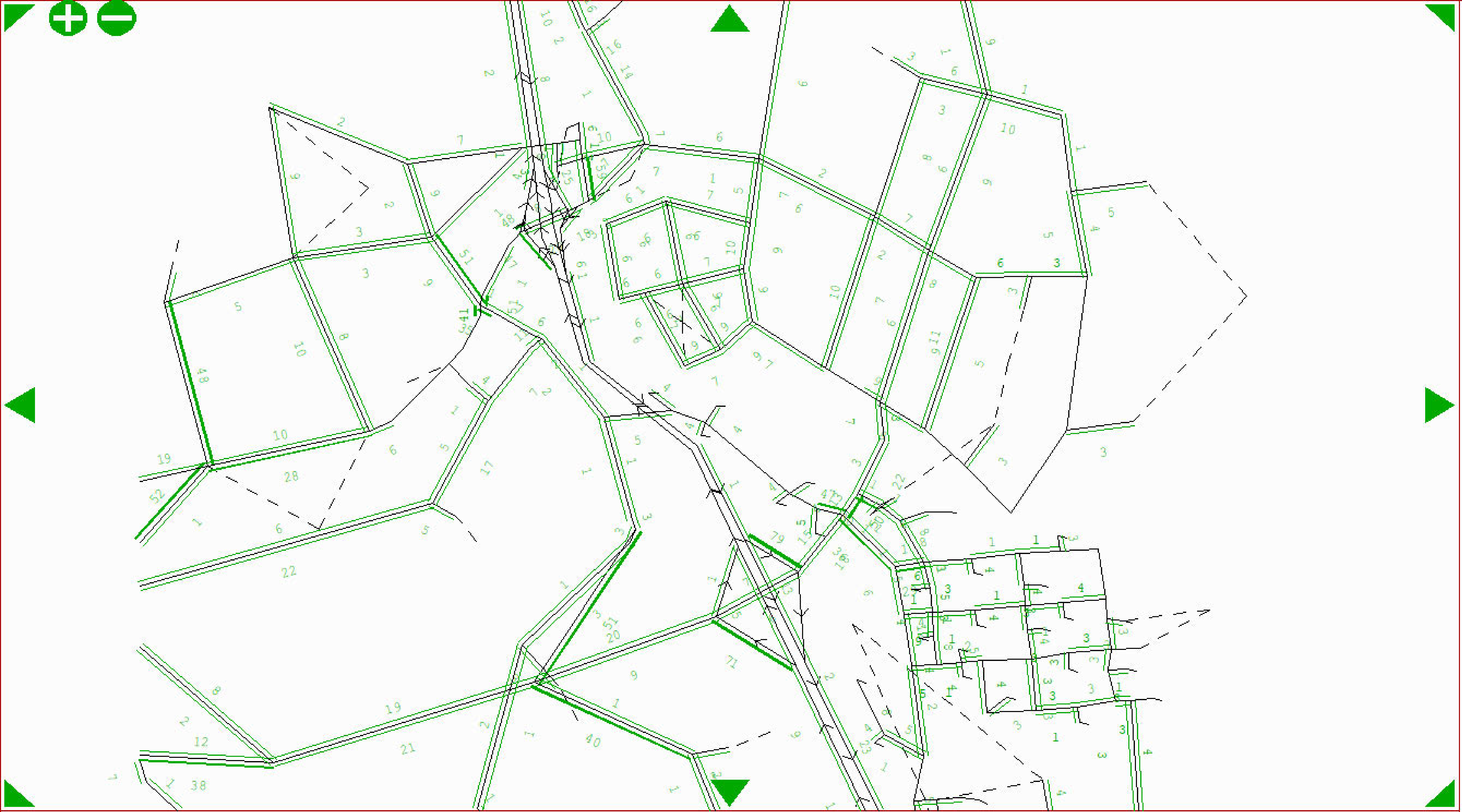
Options: >

-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2038#10 PM 6- 9-19



Annotation:

Delay sec

Display of >
link anno
Link display >
Banner/Title >
General >

More data >

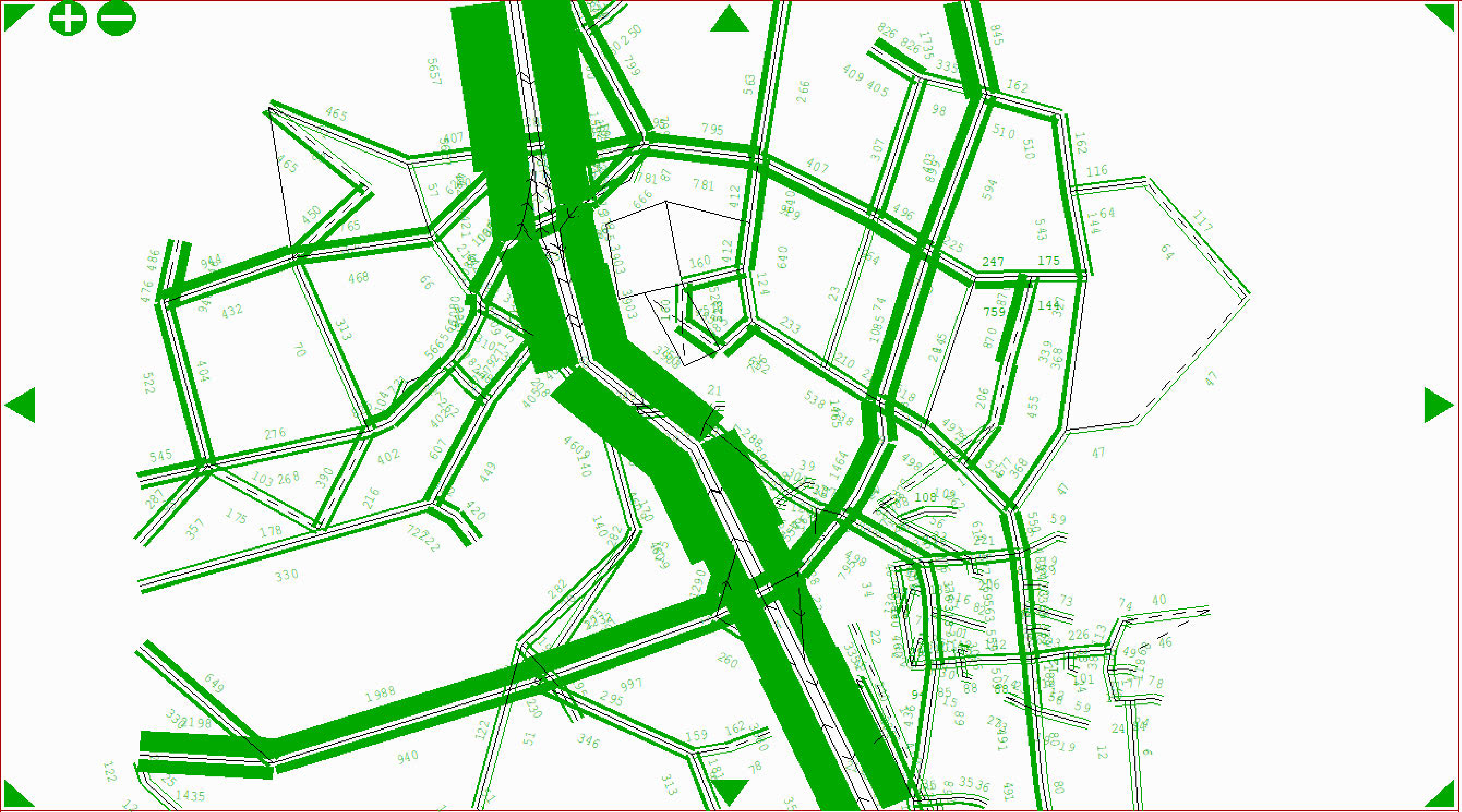
Add temp dat x
Delay sec
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2038#10 PM 6- 9-19



Annotation:

Actual flow

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Banner/Title >

General >

More data >

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Actual flow

to the D.B.

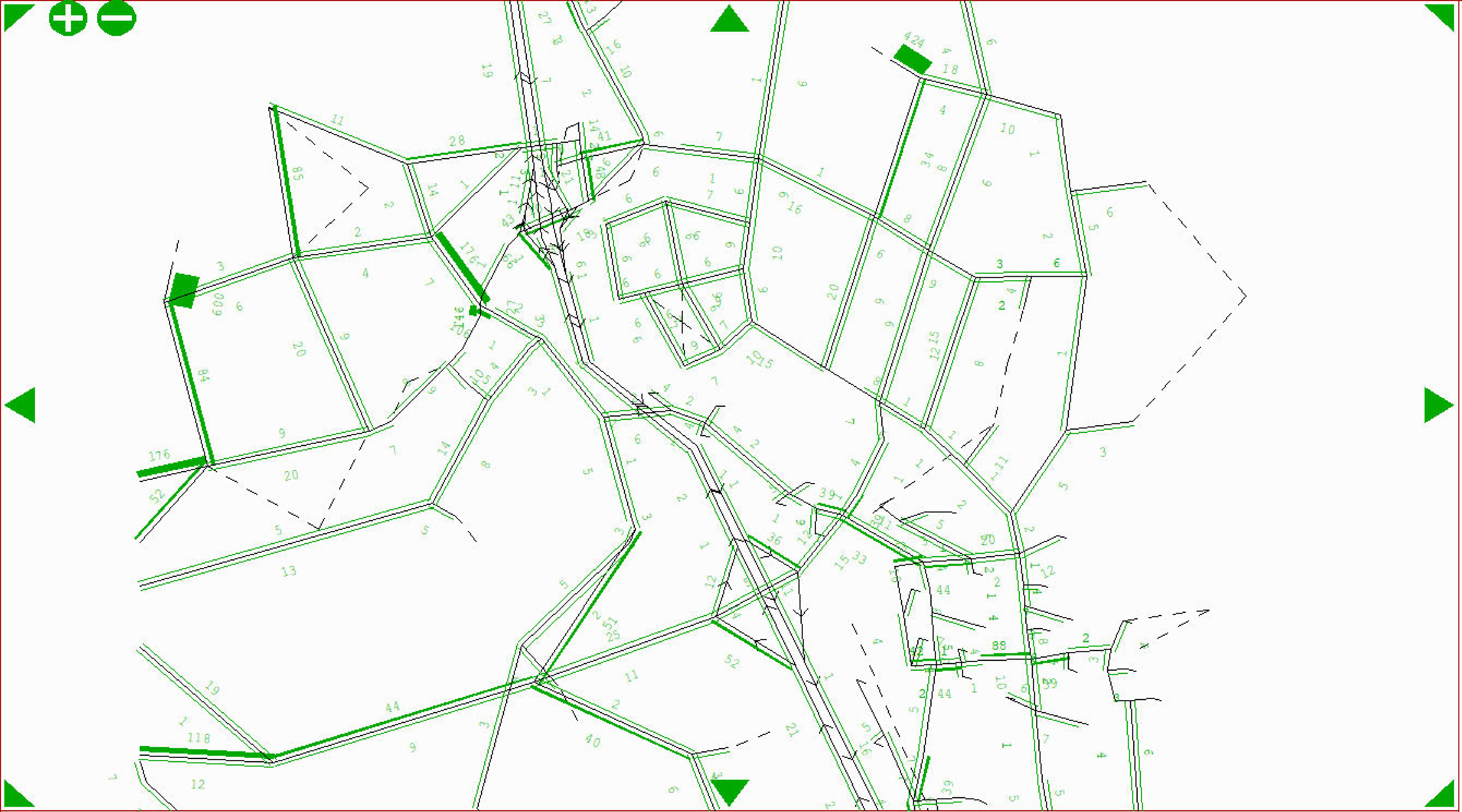
Options: >

-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2048#10 AM 6- 9-19



Annotation:

Delay sec

Display of >
link anno

Link display >

Banner/Title >

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Delay sec

to the D.B.

Options: >

-UC,MCC etc.

Q - Return

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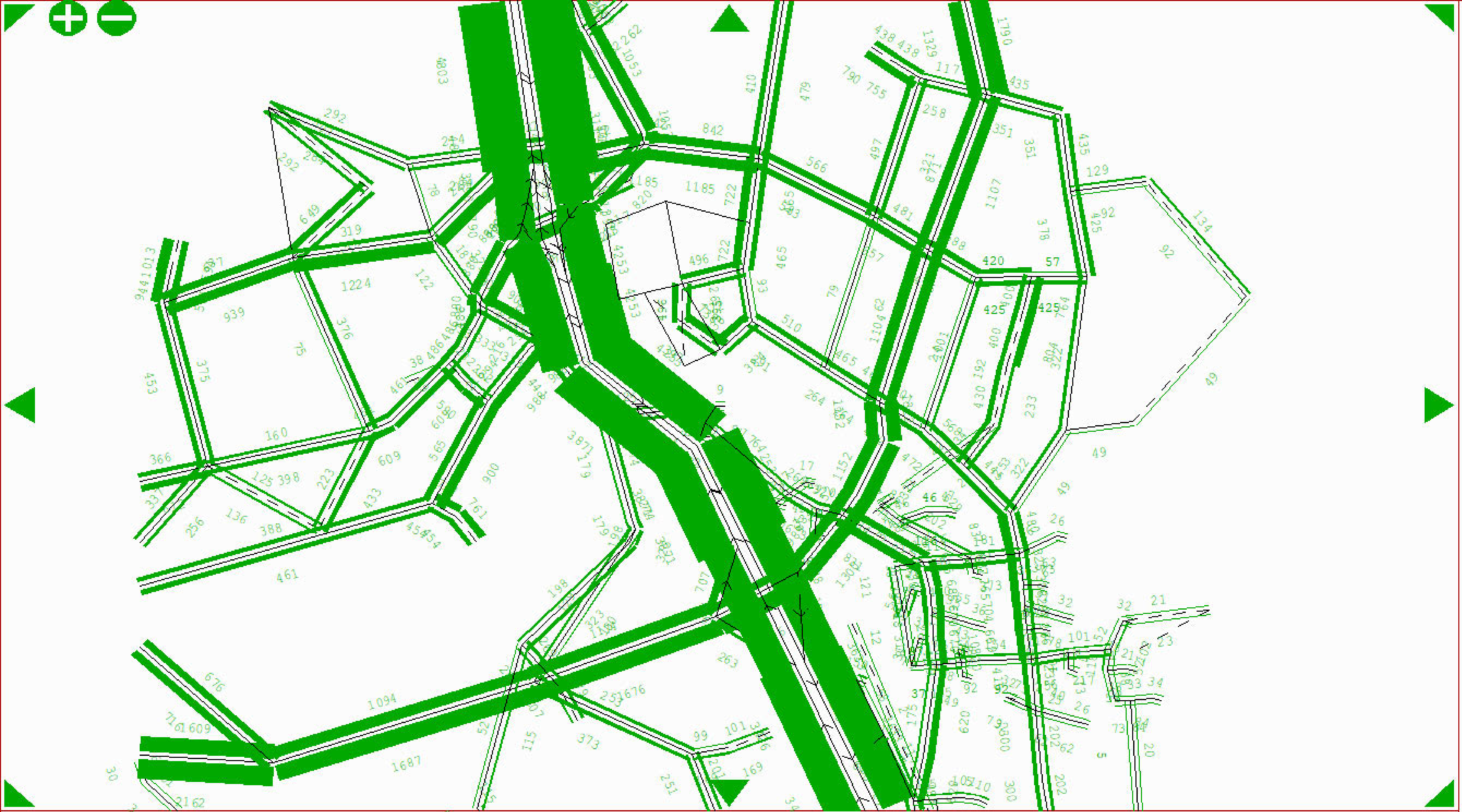
Auckland Preferred network with Drury30, 2048#10 AM 6- 9-19



Annotation:

Actual flow

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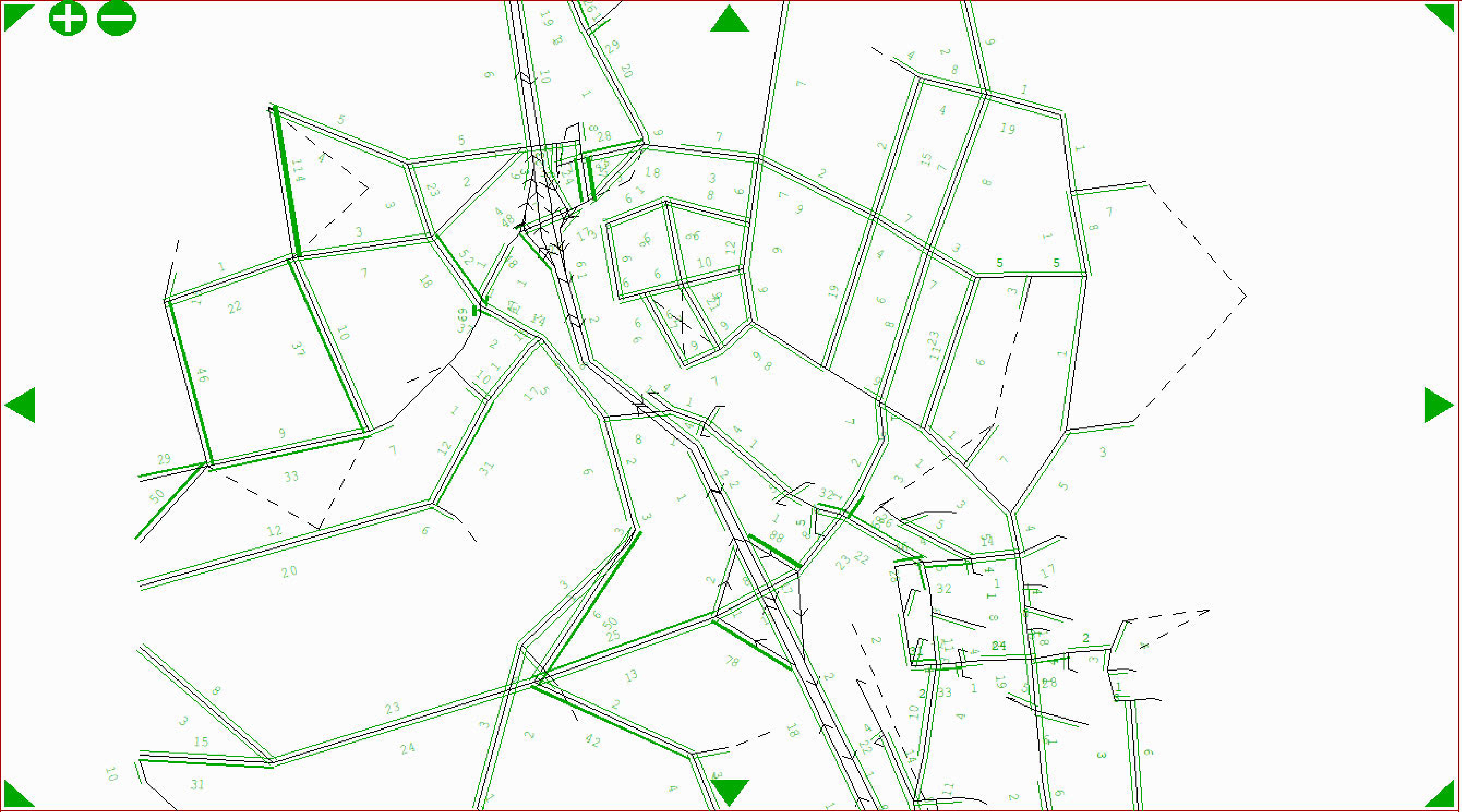
Actual flow
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2048#10 PM 6- 9-19



Annotation:

Delay sec

Display of >
link anno

Link display >

Banner/Title >

General >

More data >

Add temp dat x
Delay sec
to the D.B.

Options: >
-UC,MCC etc.

Q - Return

+ Menu bar!

Auckland Preferred network with Drury30, 2048#10 PM 6- 9-19

Appendix E SIDRA Results

With Direct Connection

MOVEMENT SUMMARY

Site: 1g2_28AM2 [AM Peak 2028 Net2 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds]

AM Peak 2028 Net2 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 110 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.001	15.8	LOS B	0.0	0.2	0.57	0.57	0.57	40.8
11	T1	574	9.9	0.897	47.1	LOS D	33.8	256.6	0.97	1.04	1.19	30.5
12	R2	206	8.7	0.811	66.3	LOS E	6.1	45.9	1.00	0.93	1.32	26.3
Approach		781	9.6	0.897	52.2	LOS D	33.8	256.6	0.98	1.01	1.22	29.3
East: Waihoehoe												
1	L2	201	2.1	0.288	21.0	LOS C	5.7	40.9	0.73	0.75	0.73	38.5
2	T1	39	24.3	0.075	28.7	LOS C	1.5	12.4	0.74	0.56	0.74	36.0
3	R2	720	13.2	0.876	48.5	LOS D	26.9	209.6	0.95	0.92	1.09	30.1
Approach		960	11.3	0.876	42.0	LOS D	26.9	209.6	0.90	0.87	1.00	31.7
North: GSR												
4	L2	372	6.5	0.284	9.7	LOS A	6.5	48.1	0.36	0.65	0.36	43.7
5	T1	346	11.9	0.370	25.5	LOS C	9.8	75.9	0.74	0.62	0.74	37.1
6	R2	108	8.7	0.853	68.5	LOS E	6.6	49.4	1.00	0.97	1.41	25.7
Approach		826	9.0	0.853	24.1	LOS C	9.8	75.9	0.60	0.68	0.66	37.5
West: Norrie												
7	L2	74	24.3	0.853	71.0	LOS E	4.5	38.4	1.00	0.97	1.48	25.2
8	T1	16	33.3	0.191	57.4	LOS E	0.9	8.2	0.99	0.69	0.99	28.0
9	R2	1	0.0	0.191	61.9	LOS E	0.9	8.2	0.99	0.69	0.99	28.0
Approach		91	25.6	0.853	68.5	LOS E	4.5	38.4	1.00	0.92	1.39	25.7
All Vehicles		2658	10.6	0.897	40.3	LOS D	33.8	256.6	0.83	0.86	0.97	32.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P1	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P21	North Stage 1	53	49.3	LOS E	0.2	0.2	0.95	0.95
P22	North Stage 2	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

MOVEMENT SUMMARY

Site: 1g2_28PM2 [PM Peak 2028 Net2 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds]

PM Peak 2028 Net2 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 60 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	12.7	LOS B	0.0	0.1	0.71	0.57	0.71	42.2
11	T1	167	14.5	0.563	26.3	LOS C	4.8	37.7	0.97	0.79	0.98	36.8
12	R2	387	6.0	0.816	37.8	LOS D	6.5	47.5	1.00	1.00	1.38	33.0
Approach		556	8.5	0.816	34.3	LOS C	6.5	47.5	0.99	0.93	1.26	34.1
East: Waihoehoe												
1	L2	58	0.0	0.085	11.5	LOS B	0.6	4.2	0.68	0.68	0.68	42.8
2	T1	21	30.0	0.055	19.7	LOS B	0.5	4.3	0.80	0.58	0.80	39.4
3	R2	542	6.0	0.826	31.6	LOS C	11.3	83.1	0.97	0.93	1.16	34.9
Approach		621	6.3	0.826	29.3	LOS C	11.3	83.1	0.93	0.89	1.10	35.7
North: GSR												
4	L2	751	10.0	0.895	33.6	LOS C	27.6	210.1	0.98	1.06	1.32	34.0
5	T1	359	8.8	0.862	32.0	LOS C	9.2	69.3	0.98	0.98	1.32	34.9
6	R2	159	9.3	0.684	34.5	LOS C	4.9	37.2	1.00	0.87	1.16	33.7
Approach		1268	9.5	0.895	33.3	LOS C	27.6	210.1	0.98	1.01	1.30	34.2
West: Norrie												
7	L2	194	7.1	0.822	38.2	LOS D	6.5	48.2	1.00	1.00	1.40	32.6
8	T1	49	14.9	0.213	26.5	LOS C	1.4	11.0	0.93	0.69	0.93	36.7
9	R2	1	0.0	0.213	31.0	LOS C	1.4	11.0	0.93	0.69	0.93	36.7
Approach		244	8.6	0.822	35.8	LOS D	6.5	48.2	0.98	0.94	1.30	33.4
All Vehicles		2689	8.5	0.895	32.8	LOS C	27.6	210.1	0.97	0.96	1.25	34.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P1	East Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P21	North Stage 1	53	24.4	LOS C	0.1	0.1	0.90	0.90
P22	North Stage 2	53	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		211	24.4	LOS C			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

MOVEMENT SUMMARY

Site: 1f4_38AM2 [AM Peak 2038 Net2 - GSR / Waihoehoe - 4ln WithPeds]

AM Peak 2038 Net2 - GSR / Waihoehoe - 4ln WithPeds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	12.0	LOS B	0.0	0.1	0.64	0.57	0.64	42.6
11	T1	165	31.8	0.551	29.3	LOS C	5.4	48.0	0.96	0.78	0.96	35.8
12	R2	133	4.0	0.234	33.5	LOS C	2.1	15.0	0.91	0.74	0.91	34.3
Approach		299	19.4	0.551	31.1	LOS C	5.4	48.0	0.94	0.76	0.94	35.1
East: Waihoehoe												
1	L2	484	2.0	0.841	42.7	LOS D	9.4	67.0	1.00	1.00	1.36	31.4
2	T1	82	7.7	0.238	27.0	LOS C	2.5	18.4	0.89	0.69	0.89	36.6
3	R2	129	8.1	0.397	32.7	LOS C	4.1	30.4	0.92	0.78	0.92	34.6
Approach		696	3.8	0.841	39.0	LOS D	9.4	67.0	0.97	0.92	1.22	32.5
North: GSR												
4	L2	133	4.8	0.398	32.7	LOS C	4.1	30.2	0.92	0.78	0.92	34.3
5	T1	249	11.4	0.370	27.9	LOS C	3.9	29.8	0.92	0.73	0.92	36.3
6	R2	194	4.9	0.687	37.4	LOS D	6.8	49.4	1.00	0.87	1.11	33.0
Approach		576	7.7	0.687	32.2	LOS C	6.8	49.4	0.94	0.79	0.98	34.7
West: Norrie												
7	L2	478	5.3	0.850	43.5	LOS D	9.4	68.8	1.00	1.01	1.39	31.1
8	T1	53	4.0	0.152	26.4	LOS C	1.6	11.4	0.87	0.66	0.87	36.8
9	R2	1	0.0	0.152	31.0	LOS C	1.6	11.4	0.87	0.66	0.87	36.7
Approach		532	5.1	0.850	41.8	LOS D	9.4	68.8	0.99	0.97	1.34	31.6
All Vehicles		2102	7.4	0.850	36.7	LOS D	9.4	68.8	0.96	0.87	1.15	33.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P1	East Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P2	North Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
All Pedestrians		158	29.3	LOS C			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1f4_38PM2 [PM Peak 2038 Net2 - GSR / Waihoehoe - 4ln WithPeds]

PM Peak 2038 Net2 - GSR / Waihoehoe - 4ln WithPeds
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	89	0.0	0.156	21.0	LOS C	2.3	16.1	0.76	0.72	0.76	38.6
11	T1	117	9.0	0.410	46.3	LOS D	5.8	43.7	0.95	0.75	0.95	30.7
12	R2	445	2.8	0.345	32.6	LOS C	8.8	62.8	0.78	0.77	0.78	34.6
Approach		652	3.6	0.410	33.4	LOS C	8.8	62.8	0.81	0.76	0.81	34.3
East: Waihoehoe												
1	L2	115	3.7	0.089	29.8	LOS C	2.0	14.6	0.70	0.70	0.70	35.3
2	T1	85	14.8	0.310	45.5	LOS D	4.2	32.8	0.93	0.73	0.93	30.9
3	R2	214	2.0	0.755	56.2	LOS E	11.7	83.5	1.00	0.89	1.12	28.3
Approach		414	5.1	0.755	46.7	LOS D	11.7	83.5	0.90	0.80	0.96	30.5
North: GSR												
4	L2	104	10.1	0.389	50.9	LOS D	5.2	39.3	0.94	0.78	0.94	29.3
5	T1	252	14.2	0.456	46.8	LOS D	6.3	49.5	0.96	0.77	0.96	30.6
6	R2	533	2.4	0.872	49.5	LOS D	30.2	216.0	0.98	0.97	1.16	29.8
Approach		888	6.6	0.872	48.9	LOS D	30.2	216.0	0.97	0.89	1.07	29.9
West: Norrie												
7	L2	280	5.3	0.221	31.2	LOS C	5.2	38.3	0.74	0.74	0.74	34.8
8	T1	109	6.7	0.383	46.0	LOS D	5.5	40.4	0.94	0.75	0.94	30.8
9	R2	1	0.0	0.383	50.6	LOS D	5.5	40.4	0.94	0.75	0.94	30.7
Approach		391	5.7	0.383	35.4	LOS D	5.5	40.4	0.80	0.74	0.80	33.5
All Vehicles		2344	5.3	0.872	42.0	LOS D	30.2	216.0	0.88	0.81	0.93	31.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P1	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		158	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1f4_48AM2 [AM Peak 2048 Net2 - GSR / Waihoehoe - 4ln WithPeds]

AM Peak 2048 Net2 - GSR / Waihoehoe - 4ln WithPeds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 80 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	13.7	LOS B	0.0	0.1	0.66	0.57	0.66	41.8
11	T1	196	19.9	0.648	35.1	LOS D	7.5	61.7	0.98	0.84	1.03	33.9
12	R2	161	3.3	0.197	32.1	LOS C	2.6	18.7	0.85	0.74	0.85	34.8
Approach		358	12.4	0.648	33.7	LOS C	7.5	61.7	0.92	0.79	0.95	34.3
East: Waihoehoe												
1	L2	273	2.3	0.663	36.4	LOS D	10.1	72.2	0.97	0.84	1.00	33.2
2	T1	129	5.7	0.248	31.3	LOS C	2.8	20.7	0.89	0.69	0.89	35.1
3	R2	168	7.5	0.546	38.3	LOS D	6.2	46.5	0.96	0.80	0.96	32.8
Approach		571	4.6	0.663	35.8	LOS D	10.1	72.2	0.95	0.79	0.96	33.5
North: GSR												
4	L2	175	4.8	0.556	38.4	LOS D	6.5	47.3	0.96	0.80	0.96	32.6
5	T1	276	10.3	0.862	43.6	LOS D	12.4	94.2	1.00	1.06	1.36	31.4
6	R2	298	3.5	0.467	33.7	LOS C	6.6	47.7	0.90	0.78	0.90	34.1
Approach		748	6.3	0.862	38.4	LOS D	12.4	94.2	0.95	0.89	1.08	32.7
West: Norrie												
7	L2	663	3.3	0.819	42.3	LOS D	13.9	100.3	1.00	0.95	1.22	31.5
8	T1	179	6.5	0.550	33.7	LOS C	6.7	49.2	0.96	0.78	0.96	34.3
9	R2	1	0.0	0.550	38.2	LOS D	6.7	49.2	0.96	0.78	0.96	34.3
Approach		843	4.0	0.819	40.4	LOS D	13.9	100.3	0.99	0.92	1.16	32.0
All Vehicles		2520	6.0	0.862	37.8	LOS D	13.9	100.3	0.96	0.86	1.06	32.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P1	East Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		158	34.3	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1f4_48PM2 [PM Peak 2048 Net2 - GSR / Waihoehoe - 4ln WithPeds]

PM Peak 2048 Net2 - GSR / Waihoehoe - 4ln WithPeds
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	337	0.0	0.587	22.6	LOS C	8.7	61.1	0.90	0.82	0.90	37.9
11	T1	122	6.9	0.423	46.4	LOS D	6.1	45.0	0.95	0.76	0.95	30.7
12	R2	467	2.7	0.441	38.8	LOS D	10.2	73.4	0.86	0.79	0.86	32.7
Approach		926	2.3	0.587	33.9	LOS C	10.2	73.4	0.89	0.80	0.89	34.1
East: Waihoehoe												
1	L2	164	1.9	0.308	37.3	LOS D	6.9	48.9	0.82	0.77	0.82	32.9
2	T1	552	2.5	0.829	46.8	LOS D	19.6	139.8	0.97	0.90	1.07	30.6
3	R2	283	1.5	0.706	48.8	LOS D	14.5	102.7	0.98	0.86	1.01	30.0
Approach		999	2.1	0.829	45.8	LOS D	19.6	139.8	0.95	0.87	1.02	30.8
North: GSR												
4	L2	114	7.4	0.295	43.7	LOS D	5.2	38.4	0.88	0.77	0.88	31.1
5	T1	179	21.8	0.678	49.7	LOS D	9.5	79.0	1.00	0.85	1.05	29.9
6	R2	707	1.9	0.848	47.0	LOS D	25.6	181.8	0.95	0.90	1.05	30.3
Approach		1000	6.1	0.848	47.1	LOS D	25.6	181.8	0.95	0.88	1.03	30.3
West: Norrie												
7	L2	441	4.5	0.421	38.7	LOS D	9.6	69.9	0.86	0.79	0.86	32.5
8	T1	238	4.0	0.846	56.4	LOS E	13.9	100.7	1.00	1.00	1.25	28.3
9	R2	1	0.0	0.846	60.9	LOS E	13.9	100.7	1.00	1.00	1.25	28.3
Approach		680	4.3	0.846	44.9	LOS D	13.9	100.7	0.91	0.87	1.00	30.9
All Vehicles		3605	3.7	0.848	43.0	LOS D	25.6	181.8	0.93	0.85	0.98	31.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P1	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		158	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Without Direct Connection

MOVEMENT SUMMARY

Site: 1g2_28AM30 [AM Peak 2028 Net30 - GSR / Waihoehoe - 2ln NWS With Staggered % Peds]

AM Peak 2028 Net30 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 90 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	19.2	LOS B	0.0	0.2	0.72	0.57	0.72	39.3
11	T1	352	10.2	0.866	45.8	LOS D	17.4	132.8	1.00	1.06	1.28	30.8
12	R2	301	8.0	0.857	56.6	LOS E	7.6	56.6	1.00	1.02	1.42	28.2
Approach		654	9.2	0.866	50.8	LOS D	17.4	132.8	1.00	1.04	1.35	29.6
East: Waihoehoe												
1	L2	334	2.5	0.374	13.2	LOS B	6.0	42.9	0.67	0.74	0.67	42.0
2	T1	56	22.6	0.084	18.6	LOS B	1.5	12.9	0.66	0.51	0.66	39.9
3	R2	918	14.2	0.907	40.9	LOS D	30.3	238.0	0.93	0.96	1.12	32.1
Approach		1307	11.6	0.907	32.9	LOS C	30.3	238.0	0.85	0.88	0.99	34.4
North: GSR												
4	L2	400	6.8	0.339	11.5	LOS B	7.5	55.4	0.46	0.69	0.46	42.8
5	T1	349	11.1	0.639	34.1	LOS C	10.5	80.8	0.93	0.77	0.94	34.2
6	R2	103	9.2	0.592	49.3	LOS D	4.6	35.0	1.00	0.80	1.04	29.7
Approach		853	8.9	0.639	25.3	LOS C	10.5	80.8	0.72	0.74	0.73	37.0
West: Norrie												
7	L2	74	24.3	0.698	54.6	LOS D	3.5	30.0	1.00	0.86	1.21	28.4
8	T1	21	35.0	0.207	46.1	LOS D	1.0	8.9	0.98	0.69	0.98	30.7
9	R2	1	0.0	0.207	50.6	LOS D	1.0	8.9	0.98	0.69	0.98	30.6
Approach		96	26.4	0.698	52.7	LOS D	3.5	30.0	0.99	0.82	1.16	28.9
All Vehicles		2909	10.7	0.907	35.3	LOS D	30.3	238.0	0.85	0.87	1.00	33.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
P1	East Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
P21	North Stage 1	53	39.3	LOS D	0.1	0.1	0.94	0.94
P22	North Stage 2	53	39.3	LOS D	0.1	0.1	0.94	0.94
All Pedestrians		211	39.3	LOS D			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1g2_28PM30 [PM Peak 2028 Net30 - GSR / Waihoehoe - 2ln NWS With Staggered % Peds]

PM Peak 2028 Net30 - GSR / Waihoehoe - 2ln NWS With Staggered %Peds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 100 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.001	14.5	LOS B	0.0	0.1	0.62	0.57	0.62	41.4
11	T1	194	17.9	0.411	32.6	LOS C	7.8	63.4	0.87	0.72	0.87	34.7
12	R2	554	13.5	0.860	56.6	LOS E	15.2	118.4	1.00	0.99	1.29	28.2
Approach		748	14.6	0.860	50.3	LOS D	15.2	118.4	0.97	0.92	1.18	29.7
East: Waihoehoe												
1	L2	281	3.4	0.378	16.7	LOS B	6.1	44.2	0.74	0.76	0.74	40.4
2	T1	26	32.0	0.074	33.5	LOS C	1.0	9.1	0.82	0.61	0.82	34.4
3	R2	553	6.3	0.895	52.8	LOS D	20.0	147.7	0.97	0.95	1.19	29.1
Approach		860	6.1	0.895	40.4	LOS D	20.0	147.7	0.89	0.88	1.03	32.2
North: GSR												
4	L2	641	13.3	0.724	22.9	LOS C	23.0	179.6	0.80	0.83	0.80	37.7
5	T1	607	6.1	0.885	44.7	LOS D	24.9	183.6	0.96	0.98	1.15	31.1
6	R2	89	14.1	0.279	42.8	LOS D	3.8	29.9	0.90	0.76	0.90	31.3
Approach		1338	10.1	0.885	34.1	LOS C	24.9	183.6	0.88	0.89	0.97	34.0
West: Norrie												
7	L2	188	7.3	0.889	63.6	LOS E	10.7	79.8	1.00	1.02	1.44	26.6
8	T1	49	14.9	0.260	44.6	LOS D	2.6	20.0	0.95	0.72	0.95	31.0
9	R2	6	0.0	0.260	49.1	LOS D	2.6	20.0	0.95	0.72	0.95	30.9
Approach		244	8.6	0.889	59.3	LOS E	10.7	79.8	0.99	0.95	1.33	27.5
All Vehicles		3191	10.0	0.895	41.5	LOS D	24.9	183.6	0.91	0.90	1.06	31.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P1	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P21	North Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P22	North Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		211	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1h2_38AM30 [AM Peak 2038 Net30 - GSR / Waihoehoe - 4ln With Peds (2038 net)]

AM Peak 2038 Net30 - GSR / Waihoehoe - 4ln With Peds (2038 net)
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 80 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	13.7	LOS B	0.0	0.1	0.66	0.57	0.66	41.8
11	T1	155	31.3	0.546	33.9	LOS C	5.8	51.2	0.96	0.78	0.96	34.2
12	R2	306	5.8	0.382	33.6	LOS C	5.2	38.2	0.89	0.78	0.89	34.3
Approach		462	14.4	0.546	33.7	LOS C	5.8	51.2	0.91	0.78	0.91	34.3
East: Waihoehoe												
1	L2	613	6.4	0.766	39.6	LOS D	12.3	90.5	0.99	0.91	1.13	32.2
2	T1	105	11.0	0.331	32.2	LOS C	3.7	28.5	0.92	0.72	0.92	34.8
3	R2	168	13.1	0.567	38.6	LOS D	6.3	48.9	0.96	0.80	0.96	32.7
Approach		886	8.2	0.766	38.6	LOS D	12.3	90.5	0.98	0.87	1.08	32.6
North: GSR												
4	L2	140	6.8	0.452	37.7	LOS D	5.1	37.7	0.94	0.79	0.94	32.8
5	T1	282	9.7	0.439	32.9	LOS C	5.1	38.7	0.94	0.75	0.94	34.6
6	R2	191	5.0	0.472	34.3	LOS C	6.6	48.4	0.92	0.80	0.92	33.9
Approach		613	7.6	0.472	34.4	LOS C	6.6	48.4	0.93	0.77	0.93	33.9
West: Norrie												
7	L2	458	5.3	0.569	35.2	LOS D	8.2	59.9	0.94	0.81	0.94	33.5
8	T1	128	4.1	0.390	32.5	LOS C	4.6	33.5	0.93	0.74	0.93	34.7
9	R2	1	0.0	0.390	37.0	LOS D	4.6	33.5	0.93	0.74	0.93	34.6
Approach		587	5.0	0.569	34.6	LOS C	8.2	59.9	0.94	0.80	0.94	33.8
All Vehicles		2548	8.4	0.766	35.8	LOS D	12.3	90.5	0.95	0.81	0.98	33.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P1	East Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		158	34.3	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1h2_38PM30 [PM Peak 2038 Net30 - GSR / Waihoehoe - 4ln With Peds (2038 net)]

PM Peak 2038 Net30 - GSR / Waihoehoe - 4ln With Peds (2038 net)
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 80 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.002	13.7	LOS B	0.0	0.1	0.66	0.57	0.66	41.8
11	T1	192	6.6	0.585	33.9	LOS C	7.1	52.8	0.97	0.79	0.97	34.2
12	R2	515	8.8	0.655	36.3	LOS D	9.5	71.7	0.96	0.84	0.99	33.4
Approach		707	8.2	0.655	35.6	LOS D	9.5	71.7	0.96	0.83	0.98	33.6
East: Waihoehoe												
1	L2	325	3.6	0.399	33.7	LOS C	5.5	40.0	0.90	0.78	0.90	34.0
2	T1	186	6.8	0.570	33.8	LOS C	6.9	51.3	0.97	0.79	0.97	34.3
3	R2	218	1.9	0.680	40.1	LOS D	8.5	60.2	0.99	0.86	1.06	32.4
Approach		729	3.9	0.680	35.6	LOS D	8.5	60.2	0.94	0.81	0.96	33.5
North: GSR												
4	L2	96	11.0	0.318	36.8	LOS D	3.4	25.9	0.92	0.76	0.92	33.0
5	T1	477	10.4	0.746	37.3	LOS D	9.6	73.3	1.00	0.92	1.14	33.2
6	R2	348	3.3	0.854	45.0	LOS D	15.3	110.4	1.00	0.99	1.29	30.9
Approach		921	7.8	0.854	40.1	LOS D	15.3	110.4	0.99	0.93	1.17	32.3
West: Norrie												
7	L2	279	5.3	0.346	33.4	LOS C	4.7	34.3	0.88	0.77	0.88	34.1
8	T1	103	6.1	0.373	32.4	LOS C	4.3	31.8	0.93	0.74	0.93	34.5
9	R2	19	0.0	0.373	36.9	LOS D	4.3	31.8	0.93	0.74	0.93	34.4
Approach		401	5.2	0.373	33.3	LOS C	4.7	34.3	0.90	0.76	0.90	34.2
All Vehicles		2759	6.5	0.854	36.8	LOS D	15.3	110.4	0.96	0.85	1.03	33.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P1	East Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		158	34.3	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1g2_48AM30 [AM Peak 2048 Net30 - GSR / Waihoehoe - 4ln With Peds]

AM Peak 2048 Net30 - GSR / Waihoehoe - 4ln With Peds
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	1	0.0	0.001	15.4	LOS B	0.0	0.1	0.61	0.57	0.61	41.0
11	T1	235	14.3	0.658	44.7	LOS D	11.9	93.5	0.98	0.82	0.98	31.1
12	R2	357	5.3	0.378	40.5	LOS D	7.9	57.7	0.87	0.78	0.87	32.2
Approach		593	8.9	0.658	42.1	LOS D	11.9	93.5	0.91	0.80	0.91	31.8
East: Waihoehoe												
1	L2	412	6.6	0.880	58.0	LOS E	24.8	183.5	1.00	0.98	1.24	27.7
2	T1	161	7.2	0.352	45.3	LOS D	5.0	37.0	0.93	0.72	0.93	31.0
3	R2	199	12.2	0.753	56.6	LOS E	11.0	84.8	1.00	0.89	1.13	28.2
Approach		772	8.2	0.880	55.0	LOS D	24.8	183.5	0.98	0.91	1.15	28.5
North: GSR												
4	L2	176	4.8	0.633	53.1	LOS D	9.1	66.6	0.99	0.82	1.00	28.8
5	T1	331	9.6	0.900	60.3	LOS E	20.7	156.7	1.00	1.10	1.33	27.5
6	R2	287	3.7	0.385	39.9	LOS D	8.1	58.7	0.85	0.77	0.85	32.3
Approach		794	6.4	0.900	51.3	LOS D	20.7	156.7	0.94	0.92	1.08	29.3
West: Norrie												
7	L2	584	3.6	0.701	44.0	LOS D	14.2	102.4	0.93	0.84	0.96	31.0
8	T1	276	5.0	0.891	58.3	LOS E	16.7	121.7	0.99	1.08	1.34	27.9
9	R2	1	0.0	0.891	62.8	LOS E	16.7	121.7	0.99	1.08	1.34	27.9
Approach		861	4.0	0.891	48.6	LOS D	16.7	121.7	0.95	0.92	1.08	29.9
All Vehicles		3019	6.7	0.900	49.7	LOS D	24.8	183.5	0.95	0.89	1.07	29.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P1	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		158	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 1g2_48PM30 [PM Peak 2048 Net30 - GSR / Waihoehoe - 4ln With Peds]

PM Peak 2048 Net30 - GSR / Waihoehoe - 4ln With Peds
Site Category: (None)
Signals - Fixed Time Isolated   Cycle Time = 150 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: GSR												
10	L2	248	0.0	0.304	19.3	LOS B	6.3	44.2	0.69	0.75	0.69	39.3
11	T1	185	5.7	0.462	55.5	LOS E	11.8	87.0	0.92	0.77	0.92	28.5
12	R2	559	8.9	0.738	62.5	LOS E	19.1	143.5	0.97	0.86	1.00	27.0
Approach		993	6.0	0.738	50.4	LOS D	19.1	143.5	0.89	0.81	0.91	29.6
East: Waihoehoe												
1	L2	373	3.1	0.926	85.0	LOS F	31.6	227.3	1.00	1.00	1.29	23.0
2	T1	578	2.4	1.007	95.4	LOS F	36.6	261.2	0.99	1.11	1.33	21.7
3	R2	289	1.5	0.815	71.9	LOS E	21.5	152.7	1.00	0.91	1.11	25.3
Approach		1240	2.4	1.007	86.8	LOS F	36.6	261.2	0.99	1.03	1.27	22.9
North: GSR												
4	L2	103	8.2	0.304	60.6	LOS E	6.5	48.6	0.90	0.77	0.90	27.2
5	T1	362	15.4	1.002	115.2	LOS F	37.0	293.2	1.00	1.29	1.54	19.5
6	R2	617	2.2	0.964	83.4	LOS F	35.3	252.1	0.97	0.97	1.22	23.3
Approach		1082	7.2	1.002	91.9	LOS F	37.0	293.2	0.98	1.06	1.30	22.2
West: Norrie												
7	L2	400	5.0	0.510	58.0	LOS E	12.8	93.6	0.91	0.81	0.91	27.7
8	T1	237	4.0	0.988	105.4	LOS F	30.7	220.0	0.99	1.22	1.51	20.4
9	R2	85	0.0	0.988	109.9	LOS F	30.7	220.0	0.99	1.22	1.51	20.4
Approach		722	4.1	0.988	79.7	LOS E	30.7	220.0	0.95	0.99	1.18	23.9
All Vehicles		4037	4.9	1.007	77.9	LOS E	37.0	293.2	0.96	0.98	1.17	24.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P4	South Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P1	East Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P2	North Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	69.3	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Appendix B

Revised Transport Modelling

Revised Transport Modelling – Drury East

Assumptions

Modelling scenarios below, all with and without the direct interchange connection to the metro centre:

- **Year 2026** – with upgrades #1a, 2, 3, 4, 5, 7. Also including sensitivity test (explained below) with higher lower PT mode share representing a scenario without Drury Central train station.
- **Year 2028** – with the upgrades above, plus upgrades #1b, 6, and 8
- **Year 2033** – with all the above upgrades.
- **Year 2038** – with all the above upgrades, plus upgrades #9, 10, 12.
- **Year 2048** – with all the above upgrades, plus upgrade #11.

Table 1: Modelling Assumptions and Infrastructure Upgrades

#	Upgrade Package	Completion	Funding and Delivery
Funded with Committed Delivery Timeframes			
1a	Mill Road (Southern and Papakura Section)	In stages from 2025/2026 to 2027/2028, with consent application lodged by early 2021 for the Southern and Papakura Section.	NZTA
1b	Mill Road (Northern section, i.e Manukau to Papakura)	Therefore assuming completion years: • By 2026 : Papakura to Drury South section completed • By 2028: Manukau to Papakura section completed	
2	Drury Central and Drury West stations (funded)	Late 2024	NZTA
3	Rail electrification Papakura to Pukekohe (funded)	Mid – late 2024	NZTA
4	SH1 Papakura to Drury South Widening, interchange improvements and new Drury South interchange, walking and cycling path (funded)	Late 2025	NZTA
Non-funded, target delivery timeframes as per the DTIP staging (Dec 2019), funding and delivery strategy are being explored by Auckland Council, and will be further discussed between relevant parties this year.			
5	Waihoehoe Road Upgrade (Note the model has not included any upgrade to the Waihoehoe Rd/Great South Rd roundabout with this package)	2025	To be confirmed
6	Jesmond Road Extension - SH22 - NIMT - Burtt Road	2027	To be confirmed

7	East West Arterial - Bremner Road realignment and bridge upgrades	2026	To be confirmed
8	SH22 Improvements (for future urban extent of SH22)	2027	To be confirmed
9	Great South Road FTN Upgrade to Papakura	2037	To be confirmed
10	Pukekohe Expressway Stage 1	2038	To be confirmed
11	Opaheke North South Arterial	2042	To be confirmed

We anticipate an early provision of interim safety upgrade to the Great South Road / Waihoehoe Road roundabout, such as raised table for pedestrian and cyclist crossing on all arms. the funding and delivery of this upgrade is to be discussed between the Plan Change team, SGA and Auckland Transport.

Sensitivity Test: Considering the uncertainty around the timeframe for completion of the Drury Central station, and the frequency of services around the time of opening, we will undertake sensitivity tests by adjusting trip rates for prior to 2028 to reflect the no train station situation.

SATURN Network Flows and Delay Output

Refer to Table 3 and 4 for the flows and delays for each modelled year, with and without the direct access.

The results show that the network has acceptable capacity performance throughout the decades, with the longest delay (100 seconds) experienced in 2028 on the northbound on-ramp in AM peak. This is considered minor and considered acceptable. Sensitivity test using an increased trip rate (no Drury Central train station) in 2026 results in practically the same flows and delays than the normal 2026 scenario, indicating that the network has sufficient capacity at that point of time.

SIDRA Intersection Modelling – Great South Road / Waihoehoe Road intersection

Existing Roundabout Performance

Table 2: SIDRA Results - Roundabout vs Signal - WIth Direct Access

With direct access	Existing Roundabout		Signalised Intersection with Full Crossings	
Year	DoS	Worst LOS	DoS	Worst LOS
2026 AM	0.35	B	-	-
2026 PM	0.32	B	-	-
2028 AM	0.62	C	-	-
2028 PM	0.59	B	-	-
2033 AM	0.59	C	-	-
2033 PM	0.66	C	-	-

2038 AM	0.74	B	0.85	E
2038 PM	0.98	F	0.87	E
2048 AM	0.64	B	0.79	D
2048 PM	2.31	F	0.90	E

Without direct access

Table 3: SIDRA Results - Roundabout vs Signal - Without Direct Access

Without direct access	Existing Roundabout		Signalised Intersection with Full Crossings	
Year	DoS	Worst LoS (general)	DoS	LoS (general)
2026 AM	0.59	B	-	-
2026 PM	0.49	B	-	-
2028 AM	0.74	C	-	-
2028 PM	0.97	E	-	-
2033 AM	0.86	C	0.89	E
2033 PM	1.34	F	0.94	E
2038 AM	1.14	F	0.90	E
2038 PM	1.49	F	0.90	E
2048 AM	1.14	F	0.79	D
2048 PM	3.02	F	0.96	E

Table 2 and Table 3 above show that the existing roundabout has sufficient capacity in the first decade, however needs capacity upgrade by 2038 (with direct access) and by 2033 (without direct access). The SIDRA modelling has assumed and tested some indicative intersection layout, however, **detail design of the intersection, and its funding and implementation strategy will be determined through continuous liaison between SGA, Auckland Transport and the Plan Change team which will occur later this year.**

The modelling has considered active modes and PT, at a high level, through provision of full crossings on all arms of the signalised intersection, and reduction to the lengths of approach and exit short lanes to minimise potential conflict with the potential bus priority corridor (the design is currently being developed by SGA, however is not accessible to Stantec).

Revised Thresholds and Infrastructure Upgrades – refer to Attachment 1 and 2

SATURN Results

Table 4: SATURN results - With Direct Interchange

		Drury Interchange							
		Northbound On-ramp		Southbound Off-ramp		Great South Road Through Eastbound		Great South Road Through Westbound	
WITH DIRECT INTERCHANGE									
Land Use	**Peak**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**
2026	AM	1559	51	986	24	567	22	1311	19
	PM	1098	0	1420	48	229	44	1680	16
2026 – no train station (sensitivity test)	AM	1551	49	987	24	561	22	1313	19
	PM	1121	0	1460	50	232	44	1717	16
2028	AM	1405	111	1100	29	998	25	1303	20
	PM	1217	0	1801	73	275	48	2394	26
2033	AM	1407	102	1250	34	1262	31	1435	22
	PM	1324	0	1778	66	339	49	2419	25
2038	AM	1323	2	1043	25	366	22	1016	38
	PM	1151	0	1440	36	125	52	1349	21
2048	AM	1312	2	1299	32	399	21	1162	37
	PM	1223	0	1797	31	164	51	1467	21

Table 5: SATURN Results - Without Direct Interchange

		Drury Interchange							
		Northbound On-ramp		Southbound Off-ramp		Great South Road Through Eastbound		Great South Road Through Westbound	
WITHOUT DIRECT INTERCHANGE									
Land Use	**Peak**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**	**Flow (veh)**	**Delay (sec)**
2026	AM	1566	41	984	20	577	13	1326	19
	PM	1085	0	1410	30	288	13	1698	16
2026 – no train station (sensitivity test)	AM	1562	44	986	20	590	13	1337	20
	PM	1094	0	1406	30	289	12	1710	16
2028	AM	1391	89	1098	24	966	14	1212	21
	PM	1224	0	1785	57	340	11	2462	27
2033	AM	1416	83	1228	30	1198	16	1356	21
	PM	1305	0	1771	49	426	11	2587	28
2038	AM	1325	2	1054	19	356	11	1065	35
	PM	1129	0	1531	26	162	11	1402	20
2048	AM	1341	2	1327	26	382	13	1171	35
	PM	1168	0	1987	26	195	11	1609	20

Appendix C1

Revised Threshold – with direct access

Timeframe	Development Threshold			Trip Generation Thresholds				**Revised (2020) Modelling – Infrastructure Upgrades Required**	**Revised Modelling assumptions and other notes** **(can be provided outside of the table)**
	Residential (Dwellings)	Retail (GFA)	Commercial (GFA)	Inbound Trip (vehicles/hour)	Inbound Public Transport Trip (persons/hour)	Outbound Trip (vehicles/hour)	Outbound Public Transport Trip (persons/hour)		
WITH DIRECT ACCESS									
2026	1,310 units	23,680m^2	13,200m^2	AM: 1,240 PM: 2,080	AM: 50 PM: 330	AM: 1,560 PM: 1,800	AM: 330 PM: 70	**Funded, and assumed to be delivered in NZTA timeframes:** • Drury Central and Drury West train stations – by 2024 • Rail electrification Papakura to Pukekohe – by 2024 • Mill Road (Papakura and Southern) – by 2025/2026 **DTIP Upgrades assumptions:** **Not funded, not required capacity-wise but important for public transport, active modes and safety:** • Waihoehoe Road Upgrade – by 2025 • East West Arterial – Bremner Road realignment and bridge upgrades – by 2026	**DTIP Upgrades Explanation:** <ins>Waihoehoe Road Upgrade</ins>: Four-laning of Waihoehoe Road between Great South Road / Waihoehoe Road roundabout to Fitzgerald Road. The project SATURN model has not assumed any bus priority lanes, and **has not included any upgrade to the Great South Road / Waihoehoe Road roundabout.** The Waihoehoe Road upgrade is not considered critical from a capacity perspective, due to the output flows on the corridor through to 2048. <ins>East West Arterial – Bremner Road realignment</ins>: As per the preferred option outlined in the SGA consultation material (Dec 2019), this includes an upgrade (4-laning) to Bremner Road and Norrie Road (east) with a new bridge over Hingaia Stream, new intersections at Creek Street and Firth Street and a closure to Norrie Road (west). **It excludes any upgrade to the Great South Road / Waihoehoe Road roundabout. The Waihoehoe Road upgrade is not considered critical for a capacity perspective, due to the lower flows expected on the corridor through to 2048.** This project is not considered critical from a capacity perspective, due to the output flows on the corridors through to 2048.
2028	2,172 units	39,830m^2	22,200m^2	AM: 1,590 PM: 2,480	AM: 60 PM: 400	AM: 2,040 PM: 2,080	AM: 430 PM: 80	**Funded, and assumed to be delivered in NZTA timeframes:** • Mill Road (Northern) – by 2028 **DTIP Upgrades assumptions:** **Not funded, not required capacity-wise but important for public transport, active modes and safety:** • SH22 Improvements (for future urban extent of SH22) – by 2027 • Jesmond Road Extension – SH22 – NIMT – Burtt Road – by 2027	**DTIP Upgrades Explanation:** <ins>SH22 Improvements</ins>**:** The model assumes four laning of SH22 between the Drury Interchange and Oira Road (edge of FUZ) and some intersection improvements. **The SATURN model assumes that Great South Road (between the Drury Interchange and GSR/Waihoehoe Rd) will also be four-laned at this point.** The project SATURN model has not assumed any bus priority lanes along the corridor. **However, based on the output flows on Great South Road, four-laning is not actually necessary capacity-wise for general traffic, therefore not restrictive to the implementation of bus priority lane.** Nonetheless, this upgrade is considered important as it will improve public transport and active modes, as well as safety for all users. <ins>Jesmond Road Extension – SH22 – NIMT – Burtt Road</ins> connection is not considered critical in terms of capacity for general traffic, especially as at this stage it will not have connection to the future Pukekohe Expressway. However this upgrade is important as it provides connection for PT and active modes.
2038	4,640 units	83,960m^2	46,800m^2	AM: 2,670 PM: 3,870	AM: 110 PM: 620	AM: 3,270 PM: 3,410	AM: 690 PM: 140	Upgrade the Great South Road / Waihoehoe Road roundabout to signal. **DTIP Upgrades assumptions:** **Not funded, required capacity-wise:**	This assumes that no capacity upgrade to the Great South Road / Waihoehoe roundabout has taken place until this stage. The upgrade will require 3rd party land take on the Great South Road (north) and Waihoehoe Road (east). Funding and delivery strategy will be discussed between the Plan Change team, SGA and NZTA.

Timeframe	Development Threshold			Trip Generation Thresholds				Revised (2020) Modelling – Infrastructure Upgrades Required	Revised Modelling assumptions and other notes (can be provided outside of the table)
	Residential (Dwellings)	Retail (GFA)	Commercial (GFA)	Inbound Trip (vehicles/hour)	Inbound Public Transport Trip (persons/hour)	Outbound Trip (vehicles/hour)	Outbound Public Transport Trip (persons/hour)		
								• Pukekohe Expressway Stage 1 – by 2038	Pukekohe Expressway Stage 1: In the absence of information regarding what 'Stage 1' of the expressway includes, the model has assumed a connection between the Drury South interchange to SH22 (Paerata Road) by Glenbrook Road. This upgrade is considered important capacity-wise at this point.
2048	6,428 units	107,650m^2	60,000m^2	AM: 3,600 PM: 4,990	AM: 150 PM: 800	AM: 4,110 PM: 4,640	AM: 870 PM: 190	Widening of the Great South Road/Waihoehoe Road intersection to provide higher capacity. **DTIP Upgrades assumptions:** **Not funded, required capacity-wise to enable better movement for PT, active modes and general traffic:** • Opaheke North South Arterial – by 2042	The upgrade will require additional land take on all arms of the intersection. Funding and delivery strategy will be discussed between the Plan Change team, SGA and NZTA. Opaheke North South Arterial: New connection to provide for frequent PT, vehicles, and walking and cycling. This is considered important to enable better movement of people within the area, including PT, and walking/cycling. **However, it is considered more appropriate to be a collector road, rather than arterial.**

Other upgrades that are considered in the modelling, however not forming part of the thresholds table above:

Great South Road / Waihoehoe Roundabout interim safety upgrade

Scope: installation of raised table serving as crossing facilities for pedestrians and cyclist at the approaches to the roundabout.

By when: The need for a safety upgrade is not triggered by the Drury East development, rather, it is considered necessary for the overall safety of all road users from the outset. This should be put in place as soon as practicable.

By who: the funding and delivery of this upgrade is to be discussed between the Plan Change team, SGA and Auckland Transport.

SH1 Papakura to Drury South (funded):

Scope: The upgrade has been modelled as 3-lane of general traffic each direction between Papakura and Drury South. The Drury Interchange improvement assumes one additional short-lane on the southbound off-ramp eastbound. The Drury South Interchange assumes a standard interchange configuration. This is considered fairly conservative assumptions given that there is potential for an additional public transport or high-capacity lane on each direction, as well as more advanced upgrades to the interchanges. Regardless, there is very little perceived risk of a significantly late delivery or reduction in scope of the upgrade, and therefore this upgrade has not been included within the thresholds table above.

By when: 2025, as per NZTA timeframe

By who: NZTA

Appendix C2

Revised Threshold – without direct access

Timeframe	Development Threshold			Trip Generation Thresholds				Revised (2020) Modelling – Infrastructure Upgrades Required	Revised Modelling assumptions and other notes (can be provided outside of the table)
	Residential (Dwellings)	Retail (GFA)	Commercial (GFA)	Inbound Trip (vehicles/hour)	Inbound Public Transport Trip (persons/hour)	Outbound Trip (vehicles/hour)	Outbound Public Transport Trip (persons/hour)		
WITHOUT DIRECT ACCESS									
2026	1,310 units	23,680m^2	13,200m^2	AM: 1,200 PM: 1,880	AM: 50 PM: 300	AM: 1,520 PM: 1,600	AM: 320 PM: 60	**Funded, and assumed to be delivered in NZTA timeframes:** • Drury Central and Drury West train stations – by 2024 • Rail electrification Papakura to Pukekohe – by 2024 • Mill Road (Papakura and Southern) – by 2025/2026 **DTIP Upgrades assumptions:** **Not funded, not required capacity-wise but important for public transport, active modes and safety:** • Waihoehoe Road Upgrade – by 2025 • East West Arterial – Bremner Road realignment and bridge upgrades – by 2026	**DTIP Upgrades Explanation:** Waihoehoe Road Upgrade: Four-laning of Waihoehoe Road between Great South Road / Waihoehoe Road roundabout to Fitzgerald Road. The project SATURN model has not assumed any bus priority lanes, and **has not included any upgrade to the Great South Road / Waihoehoe Road roundabout.** The Waihoehoe Road upgrade is not considered critical from a capacity perspective, due to the output flows on the corridor through to 2048. East West Arterial – Bremner Road realignment: As per the preferred option outlined in the SGA consultation material (Dec 2019), this includes an upgrade (4-laning) to Bremner Road and Norrie Road (east) with a new bridge over Hingaia Stream, new intersections at Creek Street and Firth Street and a closure to Norrie Road (west). **It excludes any upgrade to the Great South Road / Waihoehoe Road roundabout. The Waihoehoe Road upgrade is not considered critical for a capacity perspective, due to the lower flows expected on the corridor through to 2048.** This project is not considered critical from a capacity perspective, due to the output flows on the corridors through to 2048.
2028	2,172 units	39,830m^2	22,200m^2	AM: 1,550 PM: 2,390	AM: 60 PM: 380	AM: 1,990 PM: 1,990	AM: 420 PM: 80	**Funded, and assumed to be delivered in NZTA timeframes:** • Mill Road (Northern) – by 2028 **DTIP Upgrades assumptions:** **Not funded, not required capacity-wise but important for public transport, active modes and safety:** • SH22 Improvements (for future urban extent of SH22) – by 2027 • Jesmond Road Extension – SH22 – NIMT – Burtt Road – by 2027	**DTIP Upgrades Explanation:** SH22 Improvements**:** The model assumes four laning of SH22 between the Drury Interchange and Oira Road (edge of FUZ) and some intersection improvements. **The SATURN model assumes that Great South Road (between the Drury Interchange and GSR/Waihoehoe Rd) will also be four-laned at this point.** The project SATURN model has not assumed any bus priority lanes along the corridor. **However, based on the output flows on Great South Road, four-laning is not actually necessary capacity-wise for general traffic, therefore not restrictive to the implementation of bus priority lane.** Nonetheless, this upgrade is considered important as it will improve public transport and active modes, as well as safety for all users. Jesmond Road Extension – SH22 – NIMT – Burtt Road connection is not considered critical in terms of capacity for general traffic, especially as at this stage it will not have connection to the future Pukekohe Expressway. However this upgrade is important as it provides connection for PT and active modes.
2033	3,406 units	62,430m^2	34,800m^2	AM: 1,890 PM: 2,860	AM: 80 PM: 460	AM: 2,340 PM: 2,470	AM: 500 PM: 100	Upgrade the Great South Road / Waihoehoe Road roundabout to signal.	This assumes that no capacity upgrade to the Great South Road / Waihoehoe roundabout has taken place until this stage. The upgrade will require 3rd party land take on the Great South Road (north and south) and Waihoehoe Road (east). Funding and delivery strategy will be discussed between the Plan Change team, SGA and NZTA.

Timeframe	Development Threshold			Trip Generation Thresholds				Revised (2020) Modelling – Infrastructure Upgrades Required	Revised Modelling assumptions and other notes (can be provided outside of the table)
	Residential (Dwellings)	Retail (GFA)	Commercial (GFA)	Inbound Trip (vehicles/hour)	Inbound Public Transport Trip (persons/hour)	Outbound Trip (vehicles/hour)	Outbound Public Transport Trip (persons/hour)		
2038	4,640 units	83,960m^2	46,800m^2	AM: 2,620 PM: 3,730	AM: 110 PM: 600	AM: 3,220 PM: 3,270	AM: 680 PM: 130	Widening of the Great South Road/Waihoehoe Road intersection (on western arm only) to provide higher capacity. **DTIP Upgrades assumptions:** **Not funded, required capacity-wise:** • Pukekohe Expressway Stage 1 – by 2038	The intersection will need to be upgraded on the western arm to provide higher exit capacity. **Note this capacity upgrade could be provided in 2033 instead to minimise upgrade occurrences.** Pukekohe Expressway Stage 1: In the absence of information regarding what 'Stage 1' of the expressway includes, the model has assumed a connection between the Drury South interchange to SH22 (Paerata Road) by Glenbrook Road. This upgrade is considered important capacity-wise at this point.
2048	6,428 units	107,650m^2	60,000m^2	AM: 3,510 PM: 4,910	AM: 140 PM: 790	AM: 4,020 PM: 4,560	AM: 850 PM: 180	Widening of the Great South Road/Waihoehoe Road intersection to provide higher capacity. **DTIP Upgrades assumptions:** **Not funded, required capacity-wise to enable better movement for PT, active modes and general traffic:** • Opaheke North South Arterial – by 2042	The upgrade will require additional land take on all arms of the intersection. Funding and delivery strategy will be discussed between the Plan Change team, SGA and NZTA. Opaheke North South Arterial: New connection to provide for frequent PT, vehicles, and walking and cycling. This is considered important to enable better movement of people within the area, including PT, and walking/cycling. **However, it is considered more appropriate to be a collector road, rather than arterial.**

Other upgrades that are considered in the modelling, however not forming part of the thresholds table above:

Great South Road / Waihoehoe Roundabout interim safety upgrade

Scope: installation of raised table serving as crossing facilities for pedestrians and cyclist at the approaches to the roundabout.

By when: The need for a safety upgrade is not triggered by the Drury East development, rather, it is considered necessary for the overall safety of all road users from the outset. This should be put in place as soon as practicable.

By who: the funding and delivery of this upgrade is to be discussed between the Plan Change team, SGA and Auckland Transport.

SH1 Papakura to Drury South (funded):

Scope: The upgrade has been modelled as 3-laning each direction between Papakura and Drury South. The Drury Interchange improvement assumes one additional short-lane on the southbound off-ramp eastbound. The Drury South Interchange assumes a standard interchange configuration. There is very little perceived risk of a significantly late delivery or change in scope of the upgrade, and therefore this has not been included within the thresholds table above.

By when: 2025, as per NZTA timeframe

By who: NZTA