Appendix 7

Transport Impact Assessment

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Conoble Park Pty Ltd c/o Parcel Property

North Ellenbrook (West) Precinct 1 Local Structure Plan (LSP 1)

Transport Impact Assessment

May 2026

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Executive Summary

PJA has prepared a *Transport Impact Assessment* (TIA) to support the *North Ellenbrook (West) Precinct 1 Local Structure Plan* (LSP 1) on behalf of *Conoble Park Pty Ltd c/o Parcel Property*. The TIA has been undertaken consistent with the *Western Australian Planning Commission* (WAPC) *Transport Impact Assessment Guidelines* (Vol. 2) and provides a broad-area assessment of the proposed internal and external transport networks, expected land use yields, and long-term transport integration within the *North Ellenbrook District Structure Plan West* (DSP - West) area.

Planning and Land Use Context

The local planning context has evolved since earlier DSP assessments, with key changes including:

- Replacement of the former government primary school with a private K-12 school (1,300 students).
- Reduction of the LSP 1 residential yield from 1,102 to 786 dwellings.

The structure plan proposes:

- 786 residential dwellings,
- 50,000m² GLFA District Centre,
- 1,300 student K-12 private school,
- Regional and local open space, and
- Upgraded road reservations aligning with the DSP network.

Existing Transport Conditions

The LSP 1 site is predominately Greenfields land, with limited existing internal transport infrastructure. Key regional assets include:

- Tonkin Highway, carrying approximately 17,600vpd near the site.
- The Ellenbrook train station (8km south), providing 500 long-stay bays and high-frequency rail services.
- A Principal Shared Path (PSP) along Tonkin Highway, recording around 50 cyclists per weekday.
- Existing local roads (Chudalup Road, Halden Road) of rural standard, both requiring urban-standard upgrades.

Public transport does not currently service the area. The Public Transport Authority (PTA) has identified a potential future transit corridor east of Tonkin Highway, which may support future feeder services from LSP 1.

Structure Plan Transport Network

Road Hierarchy and Path Provision

The proposed transport network adopts the hierarchy defined in Liveable Neighbourhoods (LN 2009), including:

- Integrator A (4-lane divided, 9,500vpd - 27,000vpd) supporting high through volume routes.
- Integrator B (2-lane divided, 10,500vpd - 20,000vpd) supporting staged crossing intersections for low volume side streets.
- Neighbourhood Connector B (2-lane undivided, 2,500vpd) supporting on-street parking adjacent to the private K-12 school.
- Access Streets (2-lane undivided, 300vpd – 2,500vpd) supporting residential property access.
- Laneways, and Controlled Access Places (CAP) roads to manage property access on higher-volume roads.

The typical street cross-sections incorporate 2.5–3.0m wide shared paths on the Integrators and 1.5–2.5m wide paths on all Access Streets.

Traffic Generation and Distribution

Generated Traffic

The adopted trip generation rates align with WAPC, Roads and Maritime Services (RMS, NSW) and Institute of Transportation Engineers (ITE, USA) guidance. The LSP 1 generated vehicle trips are:

- Residential (786 dwellings): 6,290vpd, 630vph in AM/PM peaks.
- District Centre (50,000m² GLFA): 25,320vpd, 570vph AM, 2,200vph PM.
- Private K-12 School (1,300 students): 3,220vpd, 1,050vph AM, 220vph PM.
- Total attracted trips are in the order of 28,540vpd, with substantial peak-hour influence between the private K-12 school and the District Centre.

Trip Distribution and Catchments

The catchment modelling followed WAPC TIA Guidelines and applies gravity-modelling traffic distribution, resulting in the following splits for trips internal/external to the wider DSP (West):

- District Centre: 64% internal, 36% external attraction.
- Private K-12 school: 49% internal, 51% external.
- Local Centre (LSP 2/4): trip attraction assumed local only (13% of residential trips).

Approximately 47% of residential trips remain internal to the wider DSP (West) which is logical given the LSP1's prominent District Centre and Community land uses, with 53% external that is distributed towards Tonkin Highway and Chudalup Road overpass.

Pedestrian, Cycling and School Access

A comprehensive path network integrates:

- Shared paths (2.0m - 3.0m wide) on key routes near trip attracting land uses.
- Pedestrian paths (1.5m – 2.0m wide) on residential streets.
- Links through public open space (POS).
- Median refuges on Integrator routes to improve pedestrian permeability.

A 'safe route to school' analysis at this LSP stage indicates:

- An 800m walking / wheeling catchment for the private K-12 school encompass all of LSP 1 residential areas.
- Portions of LSP 1 also fall within walkable / rideable catchments to/from government schools planned in future LSP 2 and LSP 4.
- Additional crossing facilities/treatments would enhance walking and wheeling modes for crossing of Chudalup Road, Halden Road, and internal north–south connectors – these design details can be part of the next stages of subdivision design.

Public Transport Considerations

While no immediate bus routes are planned by PTA, potential future bus options could include:

- Feeder routes along the THNEI and/or Warbrook Road overpass to connect with a future long term public transport transit corridor.
- Possible extensions of Route 340 via Maralla Road and Sawpit Road to Ellenbrook/The Vines.

Conclusions and Recommendations

The TIA concludes that the proposed LSP 1 land uses can be accommodated by the planned road hierarchy and intersection treatments under 2051 forecast conditions.

Contents

Section		Page
1	Introduction	1
1.1	Background	1
1.2	Purpose of a Transport Impact Assessment	1
1.3	Extent of Assessment	1
1.4	Planning Context	2
1.5	Prior Assessments	3
1.6	Key Changes from Prior Assessments	3
2	Existing Situation	5
2.1	Existing Land Uses	5
2.2	Existing Road Network	5
2.3	Existing RAV Network	5
2.4	Existing Key Intersections	5
2.5	Existing Traffic Volumes	6
2.6	Existing Public Transport Network	6
2.7	Existing Path Network	6
3	Structure Plan Proposal	7
3.1	Proposed Layout and Land Uses	7
3.2	Proposed Road Reservations	7
3.3	Proposed Road Hierarchy	8
3.4	Proposed Changes to the Transport Network	9
3.5	Proposed Intersection Controls	9
3.6	Proposed Public Transport Network	9
3.7	Proposed Path Network	10
3.8	Proposed Pedestrian Crossing Facilities	10
3.9	Indicative Typical Road Cross-Sections	11
4	Integration with Surrounding Area	12
4.1	Internal Trip Attracting Land Uses	12
4.2	Surrounding Trip Attracting Land Uses	13
4.3	Changes to the External Transport Network	13
4.4	Gaps in the Transport Network	13
5	Analysis of Transport Network	14
5.1	Assessment Years and Time Periods	14
5.2	Background Traffic	14
5.3	Structure Plan Generated Traffic	14
5.4	Distribution of Structure Plan Generated Traffic	14
5.5	Extraneous Traffic	15
5.6	Total Daily Traffic Volumes	15
5.7	Public Transport Routes	15
5.8	Pedestrian and Cycle Routes	15
5.9	Safe Routes to School	16
5.10	Spacing of Intersections	17
5.11	Total Peak Hour Traffic Volumes and Intersection Capacity Assessment	18
6	Conclusions & Recommendations	20

List of Tables

Table 1-1: Summary of Key Changes from DSP to LSP 1 2026 assessment 4
Table 3-1: Proposed LSP 1 Land Uses and Yields 7
Table 3-2: Road Hierarchy Characteristics 8
Table 3-3: Indicative Typical Street Cross-Section Details 11
Table 4-1: District Centre - Attraction Proportions 12
Table 4-2: Private K-12 School - Attraction Proportions 12
Table 5-1: Traffic Modelling Scenarios 14
Table 5-2: Adopted Trip Generation Rates for Generating Land Uses 14
Table 5-3: Resultant Structure Plan Generation of Residential Land Uses 14
Table 5-4: Adopted Trip Generation Rates for Attracting Land Uses 14
Table 5-5: Resultant Structure Plan Generation of Residential Land Uses 14
Table 5-6: Distribution Splits of DSP (West) Residential Generated Traffic 14
Table 5-7: Distribution Splits of DSP (West) External Attracted Traffic 14
Table 5-8: Intersection Model Output Performance Metrics 18
Table 5-9: Proposed Intersection Form 18
Table 5-10: Proposed Intersection Form - Performance Summary 18
Table C-1: Intersection 1 – SIDRA Site Approach Output Summary 23
Table C-2: Intersection 2 – SIDRA Network Approach Output Summary 24
Table C-3: Intersection 3 – SIDRA Network Approach Output Summary 25
Table D-4: Intersection 4 – SIDRA Site Approach Output Summary 26
Table C-5: Intersection 5 – SIDRA Site Approach Output Summary 27
Table C-6: Intersection 6 – SIDRA Network Approach Output Summary 28
Table C-7: Intersection 7 – SIDRA Network Approach Output Summary 29
Table C-8: Intersection 8 – SIDRA Network Approach Output Summary 30
Table C-9: Intersection 9 – SIDRA Network Approach Output Summary 31
Table C-10: Intersection 10 – SIDRA Site Approach Output Summary 32
Table C-11: Intersection 11 – SIDRA Network Approach Output Summary 33

List of Figures

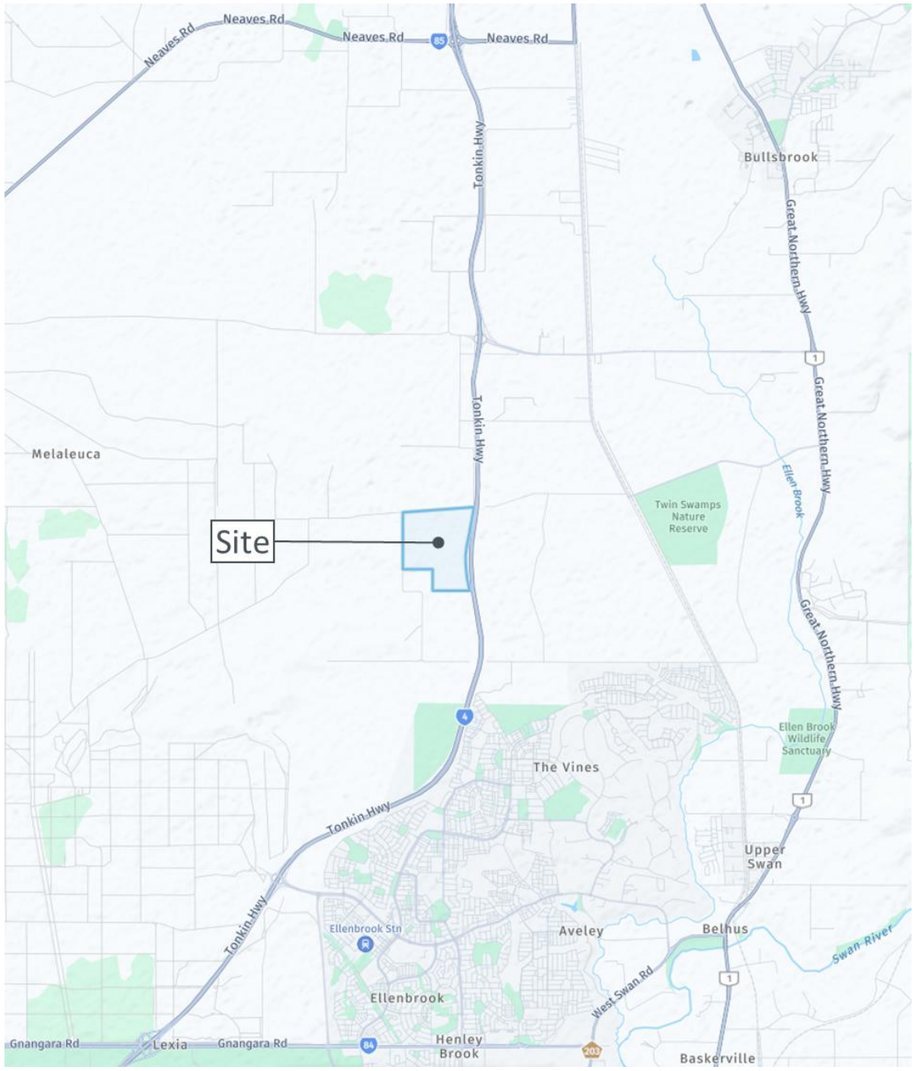
Figure 1-1: Site Location 1
Figure 1-2: WAPC Land Use / Transport Planning Process 1
Figure 1-3: Extent of Proposed Local Structure Plan (Lots 112, 114 &1808) and Land Designation 2
Figure 1-4: Land Use Planning Context 2
Figure 1-5: North Ellenbrook (West) Precinct 1-4 Masterplan with LSP 1 Masterplan Overlay 3
Figure 2-1: Existing Land Uses 5
Figure 2-2: Existing Road Hierarchy 5
Figure 2-3: Ellenbrook Line Train Stops 6
Figure 2-4: Existing Tonkin Highway Principal Shared Path 6
Figure 3-1: Proposed LSP 1 Layout 7
Figure 3-2: Proposed LSP 1 Road Reservations 7
Figure 3-3: Proposed Road Hierarchy 8
Figure 3-4: Proposed Intersection Controls 9
Figure 3-5: Proposed Path Network 10
Figure 3-6: LSP 1 Collated Proposed Road Hierarchy and Road Reserve Width 11
Figure 5-1: Ultimate (2051) Forecast Two-Way Daily Traffic Volumes – To Nearest 500vpd 15
Figure 5-2: Primary School 800m Catchment Areas 16
Figure 5-3: Secondary School 800m Catchment Areas 16
Figure 5-4: Proposed Spacing Between Intersections 17
Figure 5-5: Intersection Assessment Context 18
Figure 5-6: Proposed Indicative Intersection Layouts 19

1 Introduction

1.1 Background

PJA has been engaged by *Conoble Park Pty Ltd c/o Parcel Property* ("the Applicant") to prepare a *Transport Impact Assessment* (TIA) to support the Local Structure Planning for North Ellenbrook (West) Precinct 1 ("LSP 1") located to the west of Tonkin Highway between Ellenbrook and Bullsbrook, as shown in **Figure 1-1**.

Figure 1-1: Site Location

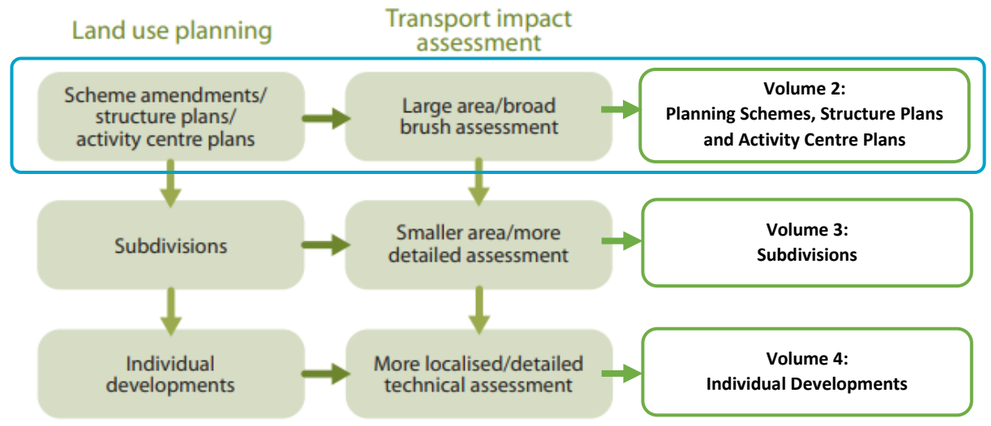


Base Image Source: Nearmap

1.2 Purpose of a Transport Impact Assessment

The planning system in Western Australia stipulates that all developments go through a process of stages to ensure that the statutory planning is consistent with the strategic planning. A more detailed assessment of the transport networks for developments is required within the land use planning stages. The *Western Australian Planning Commission* (WAPC) guidelines for a TIA indicate that a 'large area/broad brush assessment' is required for structure plans in alignment with Volume 2, as shown in **Figure 1-2**.

Figure 1-2: WAPC Land Use / Transport Planning Process



Base Image Source: Western Australian Planning Commission (WAPC)

1.3 Extent of Assessment

The key components of a TIA for a structure plan, are to:

- Assess the proposed internal transport networks with respect to accessibility, circulation, safety and priority for all modes, i.e. vehicles, public transport, pedestrians and cyclists.
- Assess the level of transport integration between the structure plan area and the surrounding land uses.
- Determine the impacts of the traffic generated by the structure plan on the surrounding land uses.
- Determine the impacts of the traffic generated by the structure plan on the surrounding transport networks.

This assessment will provide the broad level of detail required across the large land area. Opportunities for further design of movement network details are clearly and purposefully noted for continuity to the next stages of subdivision planning and design.

1.4 Planning Context

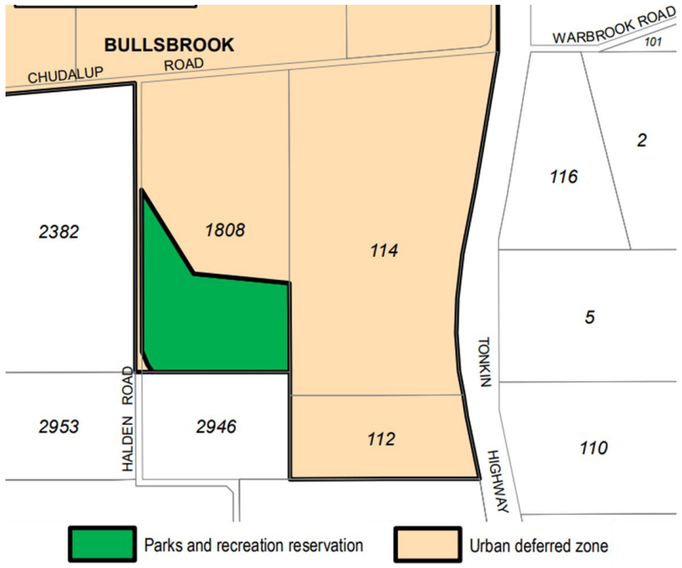
Land Use Zoning

The LSP 1 site comprises of Lots 112, 114 & 1808, which are bound by the existing road reservation of Halden Road on the west and Chudalup Road on the north. The Structure Plan area is currently zoned 'Rural' under the MRS but is subject to MRS Amendment 1409/41, shown in **Figure 1-3**, which proposes 'Urban Deferred' zoning and a 'Regional Open Space' reservation. The Amendment was recommended to the Hon. Minister for Planning following consideration by the WAPC at its November 2025 meeting.

Initiated as a 'major' amendment, MRS Amendment 1409/41 was approved by the Governor and tabled in Parliament in March 2026. It must remain tabled for 12 sitting days and, at the time of writing, is midway through this process. Subject to no disallowance, the Amendment is expected to take effect in May 2026, at which point the land will be zoned 'Urban Deferred' and partially reserved for 'Regional Open Space' under the MRS.

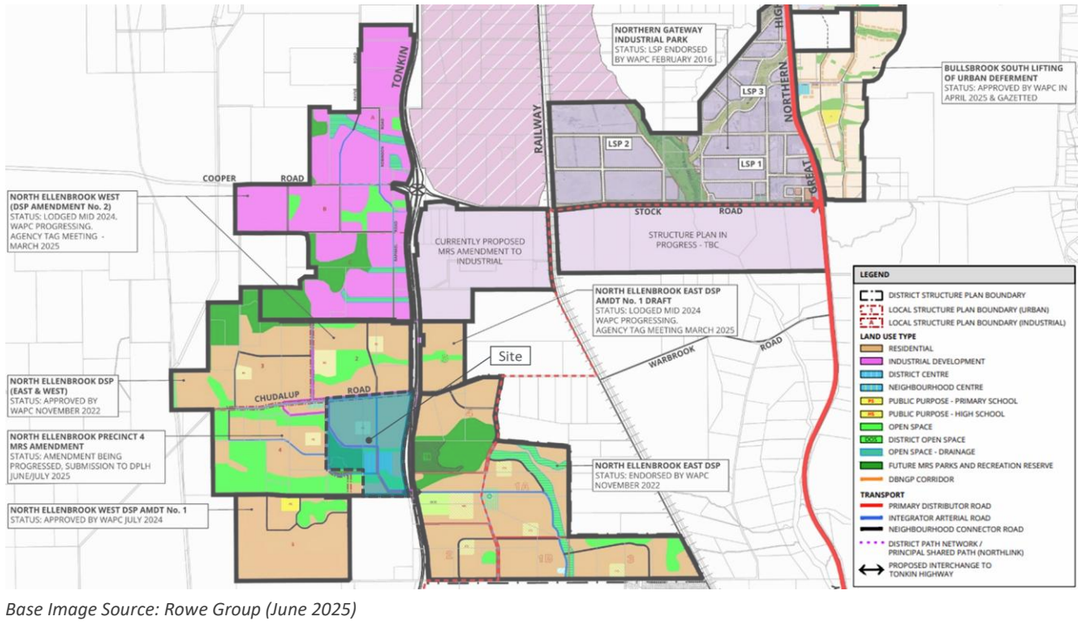
The land use plan and planning status of the wider region is shown in **Figure 1-4**, where Precinct 4 ('LSP 4' just west of LSP 1) is subject to a separate ongoing MRS Amendment to rezone the land as 'Urban Deferred'. Lots 2946, 2382 and 2953, inclusive of the proposed road reserve widening of Halden Road and an east-west road reserve on the southern boundary of the Regional Open Space (EW-1) are not part of this LSP 1 submission. This LSP 1 report must consider EW-1 in the traffic distribution but the land is not owned by Parcel Property and not part of LSP 1.

Figure 1-3: Extent of Proposed Local Structure Plan (Lots 112, 114 &1808) and Land Designation



Base Image Source: Western Australian Planning Commission (August 2024)

Figure 1-4: Land Use Planning Context



Base Image Source: Rowe Group (June 2025)

District Structure Planning

The LSP 1 site falls under the *North Ellenbrook (West) District Structure Plan* (DSP), which included some 1,102 residential lots, a District Centre and one government primary school within LSP 1.

DSP Amendment No.1 involved the inclusion of Lot 5892 to the south-west of LSP 1 as 'LSP 5', which proposes in the order of 2,250 residential lots and one government primary school.

DSP Amendment No.2 involved the rezoning of the 'LSP 2' land use, directly north of LSP 1 area, from 'industrial' to 'urban' and the extension of the DSP boundary to include a new industrial area, north of LSP 2, known as the 'Cooper Road Industrial Area'.

The primary vehicular access to/from the 'Cooper Road Industrial Area' is proposed via the existing Tonkin Highway interchange with Cooper Road / Stock Road, with a secondary vehicular access for residential work-related trips originating from the DSP.

1.5 Prior Assessments

A TIA was prepared for the *North Ellenbrook (West) DSP Amendment No.2* (DVC, July 2024) and the *Cooper Road Industrial Area Structure Plan* (DVC, June 2024). The DSP (West), meaning west of Tonkin Highway, TIA adopted a residential trip generation of 8 vehicles per day (vpd) per dwelling, with the following trip distribution applied:

- 40% of residential generated trips remaining internal to the DSP (West) area, of which:
  - 65% attraction to the proposed internal District Centre.
  - 35% attraction to the proposed local centre and school sites.
- 60% of residential generated trips attracted to land uses external to the DSP (West) area, of which:
  - 80% distributed to/from the south.
  - 20% distributed to/from the north.

The *Cooper Road Industrial Area Structure Plan* TIA adopted a 21% vehicle trips proportion (noted to be based on Main Roads WA ROM24 sub-area matrices provided to DVC) generated by the industrial land uses, to travel to/from the DSP (West) area (5,300vpd) via the DSP (West) internal road network between LSP 2 and the industrial area. The north/northeast and south/southeast catchment areas were noted as 29% and 50%, respectively, of the total trips generated by the industrial development.

A TIA was prepared for the *North Ellenbrook (East) DSP* (GHD, July 2022), prior to that DSP (East) Amendment No.1 being included as additional residential land use, north of Warbrook Road. The DSP (East) TIA was assessed on the basis of 5,500 residential lots, a Neighbourhood Centre, one government high school and four government primary schools being provided. The development yields including DSP (East) Amendment No.1, provided by *Rowe Group* (June 2025) indicate a total of 6,500 residential lots within the North Ellenbrook (East) DSP area.

A *draft North Ellenbrook District Centre Assessment* has been prepared (Urbis, February 2025), indicating the District Centre proposed within LSP 1 would have a 'primary trade area' comprising of both DSP (West) and DSP (East), a 'secondary trade area' comprising of the rural lots east of the DSP (East) and 'tertiary trade areas' comprising of Bullsbrook, The Vines and other rural areas northwest and east.

The 'Tonkin Highway North Ellenbrook Interchange' (THNEI) has undergone various deterministic and validation traffic assessments by *Urbsol*. The THNEI project is scheduled to be completed and be constructed by late 2027. The traffic modelling results of the THNEI have been provided to PJA by Main Roads WA and have been reviewed to ensure the LSP 1 proposal for the DSP (West) are aligned with the THNEI ultimate scenario traffic volumes.

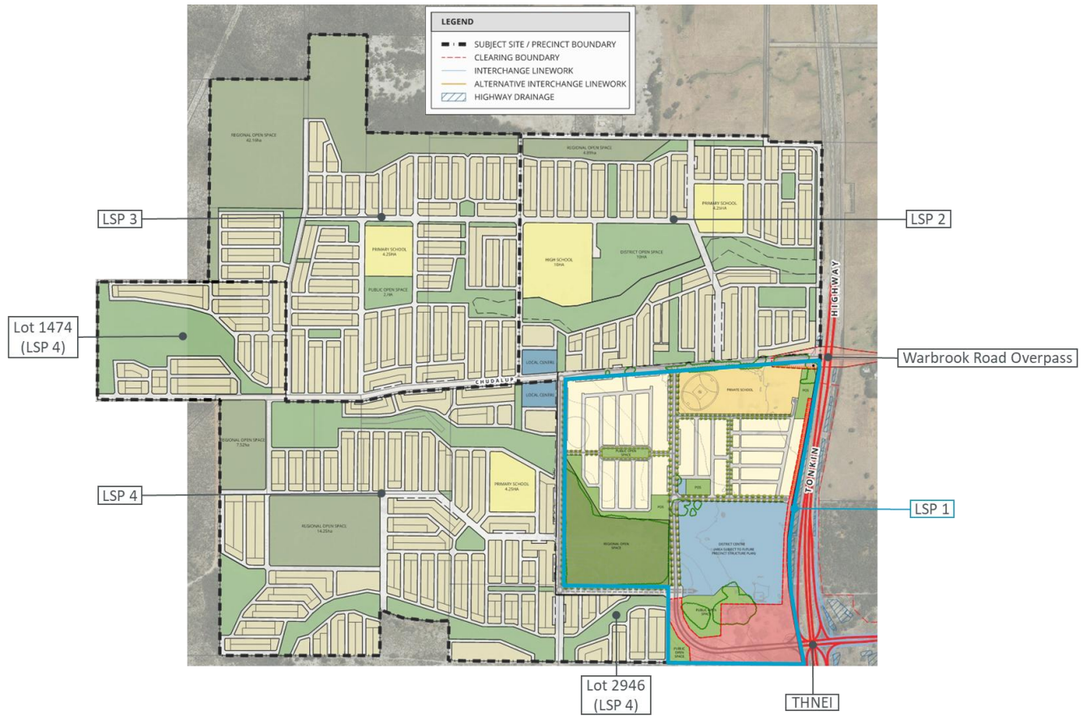
1.6 Key Changes from Prior Assessments

The land uses proposed within LSP 1 have been slightly amended from the DSP, with the government primary school proposed being replaced with a kindergarten to year 12 (K-12) private school.

The previous residential lots within LSP 1's Lot 112 (south of the District Centre) have also been removed to allow for a larger footprint of the THNEI connection to the DSP (West).

With respect to the amendments of the wider area, Lot 1474 has been reallocated from 'LSP 3' to 'LSP 4' and Lot 2946 has been reallocated from 'LSP 1' to 'LSP 4' which results in a modified residential lot yield per precinct. To better understand these planned changes holistically, the Applicant has prepared a draft masterplan for Precincts 1-4 ('LSP 1', 'LSP 2', 'LSP 3' and 'LSP 4'), shown in **Figure 1-5** (with the LSP 1 overlayed), which provides the overall indicative yields used for this assessment. The Local Centre previously proposed within 'LSP 4' (southwest of Chudalup Road/Halden Road) has also been duplicated to 'LSP 2' (northwest of Chudalup Road/Halden Road).

Figure 1-5: North Ellenbrook (West) Precinct 1-4 Masterplan with LSP 1 Masterplan Overlay



Base Image Source: Rowe Group (October 2025) / (March 2026)

A summary of the key changes between the prior transport assessments and this assessment forming this TIA for LSP 1 are provided in **Table 1-1**.

Table 1-1: Summary of Key Changes from DSP to LSP 1 2026 assessment

Key Change	DSP Assessment Assumptions	Updated LSP Assessment (2026)
LSP 1 Land Use Yields	• 1,102 residential lots • 1x government primary school	• 786 residential lots (-322 lots) • 1x K-12 private school
LSP 2 Land Use Yields	• 1,170 residential lots • 1x government primary school • 1x government high school	• 1,087 residential lots (-83 lots) • 3,500m² GFA local centre • 1x government primary school • 1x government high school
LSP 3 Land Use Yields	• 2,012 residential lots • 1x government primary school	• 1,510 residential lots (-502 lots) • 1x government primary school
LSP 4 Land Use Yields	• 1,152 residential lots • 3,500m² GFA local centre • 1x government primary school	• 2,285 residential lots (+1,133 lots) • 3,500m² GFA local centre • 1x government primary school
LSP 5 Land Use Yields	• 2,250 residential lots • 1x government primary school	• 2,200 residential lots (-50 lots) • 1x government primary school

The other notable change from the DSP (West) TIA (DVC, July 2024) is the external attraction to the area for the District Centre and the private K-12 school. It is understood that the district function was previously assessed for the area west of Tonkin Highway i.e. DSP (West) only. However, it is now understood, as part of the *draft North Ellenbrook District Centre Assessment* (Urbis, February 2025), that the District Centre would service a wider catchment. Furthermore, the addition of the private K-12 school would also increase the external attraction to the DSP (West) area. To facilitate the access between the areas east and west of Tonkin Highway and to alleviate the longer-term anticipated traffic volumes on the THNEI, the addition of an overpass between Chudalup Road and Warbrook Road has been included as part of Main Roads WA long-term road network.

2 Existing Situation

2.1 Existing Land Uses

There is a single dwelling with multiple sheds on the northern side of Lot 114. The rest of the LSP 1 site (referred to simply as "Site" for the remainder of this chapter) is Greenfields land, as shown in **Figure 2-1**.

Figure 2-1: Existing Land Uses



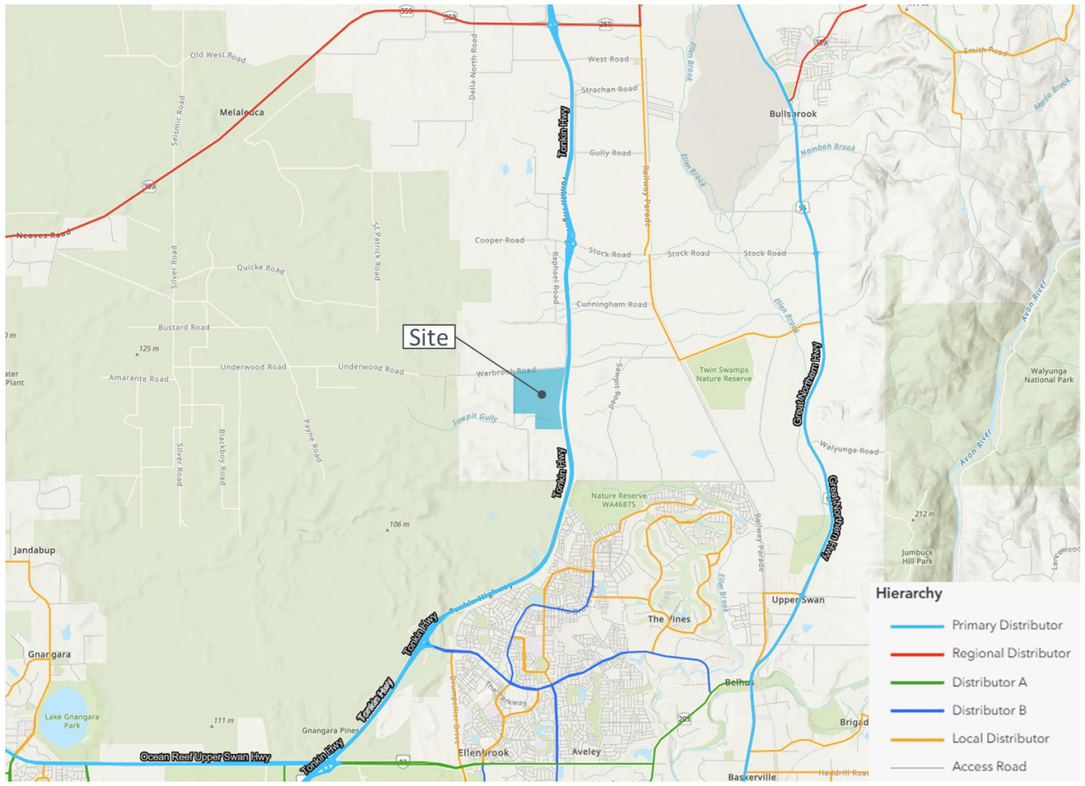
Base Image Source: Nearmap (August 2025)

2.2 Existing Road Network

There are no existing sealed roads within the Site other than the section of Halden Road which is included on the western boundary of the Site to facilitate existing quarry traffic, and Chudalup Road (previously Warbrook Road), which is located within the northern boundary of the Site (refer **Figure 2-1**).

Tonkin Highway is located on the eastern boundary of the Site. Warbrook Road was previously a through road, prior to Tonkin Highway being constructed and now deviates north into Raphael Road, connecting to Chitty Road and Cooper Road (previously Stock West Road), which is the existing main access to the Site via Tonkin Highway. The context of the existing Main Roads WA functional road hierarchy with the Site is shown in **Figure 2-2**.

Figure 2-2: Existing Road Hierarchy



Base Image Source: Main Roads WA

Chudalup Road has an existing road reserve width of 20m with around 6.4m wide sealed pavement and unsealed shoulders.

Halden Road has an existing road reserve width of 20m with around 6.2m wide sealed pavement and unsealed shoulders.

2.3 Existing RAV Network

There are no existing restricted access vehicle (RAV) permits on roads within the Site. The nearest RAV route is Tonkin Highway, which is permitted on the RAV 7 network for tandem drive vehicles (two-axle groups) and the RAV 4 network for tri drive vehicles (three-axle groups).

2.4 Existing Key Intersections

The existing intersection of Halden Road & Chudalup Road, on the northwest boundary of the Site, is a standard unmarked T-intersection with a pavement width of around 7.5m on Halden Road and 8.5m on Chudalup Road. This intersection is planned to be upgraded as part of this LSP and wider DSP.

2.5 Existing Traffic Volumes

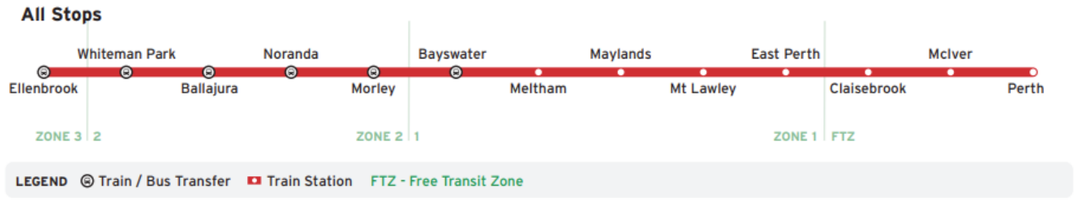
The section of Tonkin Highway between The Promenade and Stock West Road has a two-way average weekday daily traffic volume of around 17,600 vehicles per day (vpd) at Main Roads WA 24-hour count site number 53003. The adjacent principal shared path (PSP) records an average of 50 cyclists per weekday.

The AM peak hour on Tonkin Highway (section between The Promenade and Stock West Road) occurs at around 7am with an average two-way traffic volume of around 1,270 vehicles per hour (vph). The PM peak occurs around 4pm with an average two-way traffic volume of around 1,530vph. The distributional split in each peak period comprises of around 60% travelling towards Ellenbrook (i.e. southbound) in the AM peak and around 60% travelling from Ellenbrook in the PM peak.

2.6 Existing Public Transport Network

There are no existing public transport services within or directly surrounding the Site. The nearest train station is Ellenbrook which runs on the Transperth Ellenbrook Railway Line, stopping at all stations shown in **Figure 2-3**, with services every 12-minutes during peak times, 15-minutes during off-peak times and 30-minutes in the evening, 7-days a week between 5am and midnight.

Figure 2-3: Ellenbrook Line Train Stops



Source: Transperth (June 2025)

Ellenbrook Station is approximately 8km south of the Site via Tonkin Highway, The Promenade and The Parkway. There is a Transperth carpark which supplies:

- 500 long-term (24-hour) bays (including 10 EV charging bays)
- 26 short-term (15-minutes) bays
- 10 motorcycle bays
- 8 ACROD bays.

Additionally, there are bike U-rails and a separate secure bike shelter for bicycle parking.

2.7 Existing Path Network

There are no existing paths within or directly surrounding the Site. The nearest access to path infrastructure is a high-quality 4.0m wide bi-directional PSP on the eastern side of Tonkin Highway, that is within riding catchment and will be accessible once the construction of THNEI project is completed. The PSP is shown in **Figure 2-4** and falls under the care and control of *Main Roads WA*, connecting to the path network within Ellenbrook, The Vines and Aveley suburbs.

Figure 2-4: Existing Tonkin Highway Principal Shared Path



Base Image Source: Parcel Property (February 2026)

The North Ellenbrook (West) area does not capture any long-term cycle network (LTCN) routes as part of the *Department of Transport and Major Infrastructure WA* (DoTMI) Perth and Peel LTCN.

3 Structure Plan Proposal

3.1 Proposed Layout and Land Uses

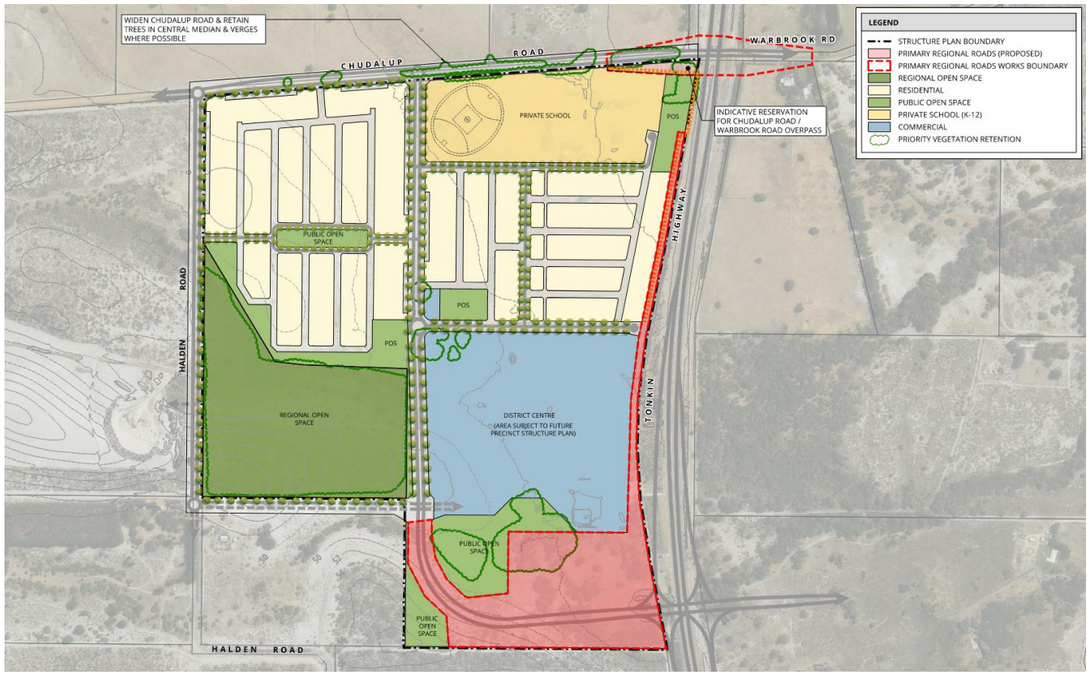
The total land area of LSP 1 comprises of 110.88ha with a developable area of 56.72ha. A breakdown of the proposed land uses is provided in **Table 3-1**.

Table 3-1: Proposed LSP 1 Land Uses and Yields

Proposed Land Use	Land Area	Indicative Trip Generating Yield
Residential	25.6 ha	786 dwellings
Private Clubs and Institutions	10.0 ha	1,300 students Private School (Kindergarten to Year 12)
District Centre	18.5 ha (including road reserves)	50,000m^2 GLFA
Regional Open Space (ROS)	15.2 ha	N/A
Public Open Space (POS)	9.5 ha	N/A
Main Roads WA Road Reservations	14.07 ha	N/A

The proposed layout of land uses within LSP 1 is shown in **Figure 3-1** and provided in **Appendix B**.

Figure 3-1: Proposed LSP 1 Layout

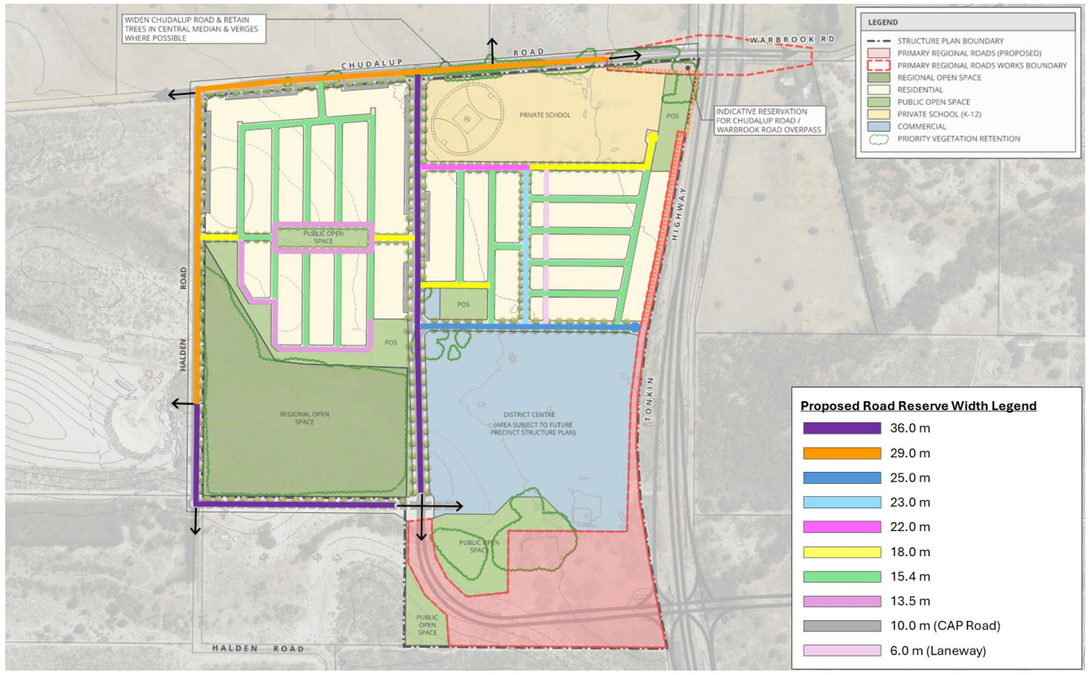


Base Image Source: Rowe Group (25/03/2026)

3.2 Proposed Road Reservations

The proposed road reservations, facilitating access within and through LSP 1 are shown in **Figure 3-2**, comprising of key wider road reserves linking to adjacent future LSP areas and the attracting land uses within LSP 1 (i.e. District Centre or Education), with narrower street reserves for residential property access.

Figure 3-2: Proposed LSP 1 Road Reservations



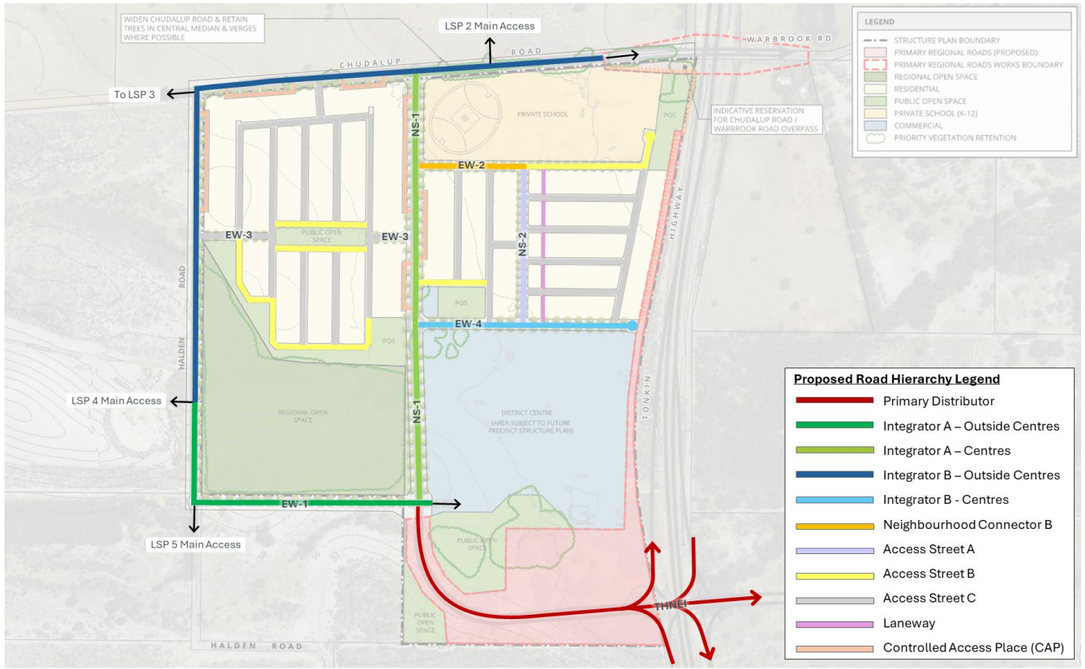
Base Image Source: Rowe Group (25/03/2026)

The residential properties fronting the key through roads are proposed to be controlled by Controlled Access Places (CAP) roads which are within a 10m wide reserve outside of the frontage road reserve width.

3.3 Proposed Road Hierarchy

The proposed functional road hierarchy has been determined based upon guidance from *Liveable Neighbourhoods 2009* (LN09) and intersection assessments undertaken in **Section 5.10**. The street types are shown in **Figure 3-3** and are consistent with the route type and characteristics of LN09.

Figure 3-3: Proposed Road Hierarchy



Base Image Source: Rowe Group (*25/03/2026*)

Halden Road (south of the main future LSP 4 access) and the east-west road ('EW-1') on the southern boundary of the regional open space are proposed as 4-lane Integrator Arterial (A) routes due to high through traffic volumes.

NS-1 (between Chudalup Road and EW-1) is proposed as a 4-lane Integrator Arterial (A) route due to high through traffic volumes and connectivity to attracting land uses (District Centre and Private K-12 School).

Chudalup Road on the northern boundary of LSP 1, Halden Road (north of the main future LSP 4 access) and EW-4 (on the northern boundary of the District Centre) are proposed to function as a 2-lane Integrator Arterial (B) routes.

The southern frontage street of the private K-12 school is proposed as a Neighbourhood Connector B / Access Street B route in order to facilitate on-street parking with a 5.5m – 7.0m wide pavement to reduce crossing distances for students and other pedestrians.

All other residential streets are proposed as typical Access Street C/D type roads.

The residential lots fronting the higher volume roads (>5,000vpd in one direction) are proposed with CAP roads to improve accessibility and manoeuvring from driveways. Additionally, a series of short laneways are proposed with the high-density residential lots for rear access to garages.

The typical characteristics of the road hierarchy street typologies are provided in **Table 3-2**.

Table 3-2: Road Hierarchy Characteristics

Hierarchy	Route Type	Movement / Place Function	Speed Environment
Integrator A – Outside Centres	Routes with 4-lanes (two in each direction) and high through midblock traffic volumes and staged vehicle crossing capabilities within the median for intersecting side streets	High / Low	High (70km/h)
Integrator A – Centres	Routes with 4-lanes (two in each direction) and commercial lots close or fronting one or both sides for staged vehicle crossing capabilities within the median for access to commercial carparks/centre streets	High / High	Low-Moderate (40-60km/h)
Integrator B – Outside Centres	Routes with 2-lanes (one in each direction) for lower through midblock traffic volumes and staged vehicle crossing capabilities within the median for intersecting side streets	High / Moderate	Moderate-High (50-70km/h)
Integrator B – Centres	Routes with 2-lanes (one in each direction) and commercial fronting lots on both sides and staged pedestrian crossing facilities	High / High	Low-Moderate (30-50km/h)
Neighbourhood Connector A	Divided local streets facilitating buses and staged pedestrian crossings/limiting two-way egress from frontage lots	Moderate / Moderate	Moderate (50km/h)
Neighbourhood Connector B	Undivided local streets facilitating buses and two-way egress from frontage lots	Moderate / Low	Moderate (50km/h)
Access Street A	Wide divided landscaped streets with residential lot frontage and on-street parking from lots with reduced setbacks	Low / Moderate	Low (30-40km/h)
Access Street B	Narrow local streets with high parking demand e.g. fronting high density residential lots or schools/parks	Low / High	Low (30km/h)
Access Street C	Wider/longer residential frontage streets to higher density lots / through routes to shorter residential streets	Low / Low	Low (40km/h)
Access Street D	Short narrow residential frontage streets to low density lots	Low / Low	Low (30km/h)
Laneway	Narrow pavement with no verge for rear access to properties	Low / Low	Very Low (15km/h)
Controlled Access Place (CAP)	Narrow service road for separating residential frontage lots from adjacent high through traffic volume roads	Low / Low	Low (30km/h)

3.4 Proposed Changes to the Transport Network

The main vehicular access to LSP 1 and the wider North Ellenbrook (West) area is proposed from the south via the THNEI, which forms a new road network.

A secondary access over Tonkin Highway is expected and encouraged to be located at Warbrook Road, forming the main road connection between both the east and west sides of North Ellenbrook. This overpass is in current Main Roads WA planning and ROM modelling to facilitate the access between the areas east and west of Tonkin Highway and to alleviate the longer-term anticipated traffic volumes on the THNEI. This has been included as part of Main Roads WA long-term road network.

Both Chudalup Road and Halden Road are proposed to be widened from the existing road reserve widths and upgraded to an urban standard as part of LSP 1 along its frontages.

3.5 Proposed Intersection Controls

The indicative proposed intersection controls are shown in **Figure 3-4**, which have been determined based upon access/amenity considerations and layout/control traffic modelling assessments undertaken in **Section 5.10**.

Figure 3-4: Proposed Intersection Controls



Base Image Source: Rowe Group (25/03/2026)

Roundabouts are proposed at locations where access to development crossovers are within close proximity and/or staged turning movements have reduced performance capabilities.

The sight distance and detailed geometric design will form part of the detailed civil design and subsequent subdivision planning stages.

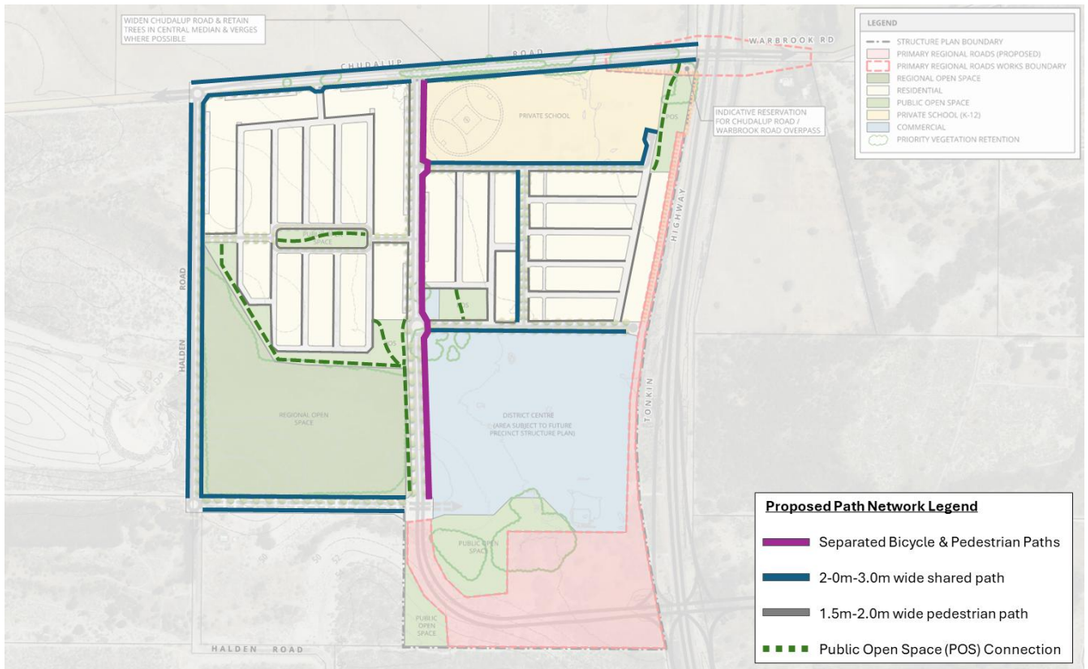
3.6 Proposed Public Transport Network

There are no current proposals to provide additional public transport routes as part of LSP 1, especially given Tonkin Highway is not supported to service bus routes by the PTA. However, there have been initial discussions with PTA as part of the North Ellenbrook Technical Advisory Group (TAG) discussing the potential future transit corridor on the eastern side of Tonkin Highway from Ellenbrook Station. LSP 1 may have the potential to connect feeder bus services via the new THNEI or the future Warbrook Road overpass to this transit corridor, should it eventuate. Alternatively, it may be feasible in the future for bus route extensions/connections via Maralla Road and Sawpit Road to connect to The Vines and Ellenbrook.

3.7 Proposed Path Network

A proposed indicative path network is shown in **Figure 3-5**, which typically comprises a path on at least one side of the street and retaining adequate reserve space for trees and landscaping. Where a higher pedestrian activity is anticipated due to the adjacent land use (i.e. District Centre/School), a shared path is proposed on the frontage side, and a pedestrian path is proposed on the opposite side. The POS lots are proposed with pedestrian paths on the perimeter, with the potential for wider shared paths or trails through the POS as more direct routes to surrounding land uses. A separated bicycle and pedestrian path is proposed along the eastern side of NS-1.

Figure 3-5: Proposed Indicative Path Network



Base Image Source: Rowe Group (25/03/2026)

There is potential for the shared or bicycle paths which connect the surrounding residential areas to the proposed District Centre to be included on the LTCN as 'Secondary' cycle routes, which "*have a moderate level of demand and connect primary routes and major activity centres such as shopping precincts, industrial areas, as well as health, education and sporting facilities*". Similarly, shared paths connecting to schools and parks could be included as 'Local' cycle routes on the LTCN, which are routes with "*a lower level of demand than primary and secondary routes, and provide access to other routes, local amenities and recreational spaces*".

3.8 Proposed Pedestrian Crossing Facilities

The type of pedestrian crossing facilities across roads would typically be dropped kerb ramps on the lower order intersecting street. However, crossing facilities and user priority should be investigated further at the subdivision stage with a finer grain of detail at intersections and individual lot layouts to ensure a continuous, convenient and safe path network is provided.

For paths primarily intended for people riding, the *Department of Transport and Major Infrastructure Planning and Designing for Bike Riding in Western Australia: Shared and Separated Paths Guideline* (September 2021) provides examples of the types of crossings at various intersections for path users, these being:

- Intersections with other paths
- Where paths cross driveways
  - Type 1: non-indented, priority
- Intersections with minor roads
  - Type 2: indented, priority
  - Type 3: indented, non-priority
  - Type 4: non-indented, non-priority
- Intersections with major roads
  - Wide median refuge (2.0m minimum, 3.0m desirable)
  - Signalised crossings
  - Underpasses/overpasses
- Intersections with roundabouts
- Cut throughs and kerb ramps.

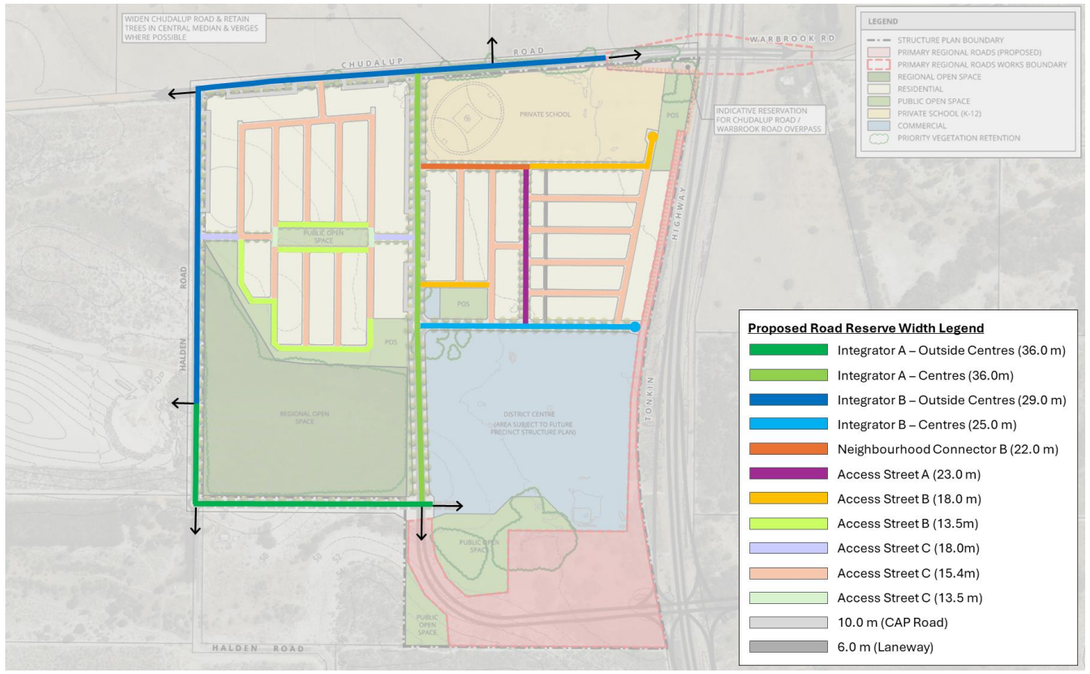
3.9 Indicative Typical Road Cross-Sections

Indicative typical cross-section provisions for the road hierarchy types are provided in **Table 3-3**, with reference to **Figure 3-6**. The key difference between an Access Street B and Access Street C is the provision of formal on-street/verge parking lanes/embayments (type B) and informal parking within the street pavement (type C), as appropriate under the *Road Traffic Code 2000*.

Table 3-3: Indicative Typical Street Cross-Section Details

Street Type (Reserve Width)	Pavement Width / Provisions	Verge Width / Provisions (Indicative Only)
Integrator A – Centres (36.0m)	23.0m • 4x 3.5m traffic lanes • 8.0m raised median (including intersection turn pockets)	8.5m (eastern side) / 5.5m (western side) • Separated bicycle & pedestrian paths (eastern side) • 1.5m-2.0m path (western side)
Integrator A - Outside Centres (36.0m)	21.0m • 4x 3.5m traffic lanes • 6.0m raised median (including intersection turn pockets)	10.0m (residential side) / 6.0m (ROS side) • 3.0m bi-directional shared path (ROS side) • 2.5m shared path (residential side)
Integrator B – Centres (25.0m)	9.0m • 2x 3.5m traffic lanes • 2.0m raised median (including intersection turn pockets)	11.0m (District Centre side) / 5.0m (residential side) • 2.5m shared path (District Centre side) • 2.0m-2.5m parking lane/embayments (District Centre side) • 1.5m – 2.0m path (residential side)
Integrator B - Outside Centres (29.0m)	13.0m • 2x 3.5m traffic lanes • 6.0m raised median (including intersection turn pockets)	8.0m (both sides) • 3.0m bi-directional shared path (one side) • 2.5m shared path (one side)
Neighbourhood Connector B (22.0m)	7.0m • 2x 3.5m traffic lanes	10.0m (school side) / 5.0m (residential side) • 3.0m bi-directional shared path (school side) • 2.0m-2.5m parking lane/embayments (school side) • 1.5m-2.0m path (residential side)
Access Street A (23.0m)	11.0m • 2x 3.5m traffic lanes • 4.0m raised landscaped median/drainage swale	7.0m (one side) / 5.0m (one side) • 3.0m bi-directional shared path (one side) • 1.5m-2.0m shared path (one side)
Access Street B (18.0m)	8.0m • 2x 3.0m traffic lanes • 2.0m parking lane/embayments (school side)	5.0m (school / POS side) / 5.0m (residential side) • 2.5m bi-directional shared path (school side) • 1.5m-2.0m path (residential side)
Access Street B (13.5m)	8.0m • 2x 3.0m traffic lanes • 2.0m parking lane/embayments (POS side)	3.5m (residential side) / 2.0m (POS side) • 1.5m-2.0m path (POS side)
Access Street C (18.0m)	7.0m • 2x 3.5m traffic lanes	5.5m (both sides) • 1.5m – 2.0m path (one side)
Access Street C (15.4m)	7.0m • 2x 3.5m traffic lanes	4.1m (both sides) • 1.5m – 2.0m path (one side)
Access Street C (13.5m)	7.0m • 2x 3.5m traffic lanes	m (residential side) / m POS side) • 1.5m – 2.0m path (one side)
CAP Road (10.0m)	4.5m • 1x 4.5m accessway/parking lane	4.5m residential side / 1.0m major road side
Laneway (6.0m)	6.0m • 2x 3.0m accessway	N/A

Figure 3-6: LSP 1 Collated Proposed Road Hierarchy and Road Reserve Width



Base Image Source: Rowe Group (25/03/2026)

4 Integration with Surrounding Area

4.1 Internal Trip Attracting Land Uses

The North Ellenbrook (West) LSP 1 proposes to provide a district level of amenity with a commercial activity centre and a private K-12 school. Consideration of future planned development in the wider area has allowed for a holistic assessment of the links between the proposed land uses within LSP 1 and the reliance from surrounding areas to travel between or through the Site. The following land uses and indicative yields are based upon the latest masterplan *(Rev E - 01/10/2025)* information provided by *Rowe Group*.

- **North Ellenbrook (West)** - Precinct 2 (LSP 2): 1,445 residential lots, a government primary school, a government secondary school and local centre.
- **North Ellenbrook (West)** - Precinct 3 (LSP 3): 1,510 residential lots and a government primary school.
- **North Ellenbrook (West)** - Precinct 4 (LSP 4): 2,285 residential lots, a local centre and a government primary school.
- **North Ellenbrook (West)** - Precinct 5 (LSP 5): 2,200 residential lots and a government primary school.
- Cooper Road Industrial Area: 317.84ha of industrial land uses.
- **North Ellenbrook (East) DSP**: 6,500 residential lots, a neighbourhood centre, a government primary school and a government high school.
- **Ellenbrook:** existing secondary activity centre (train station, major shopping centre and business park), multiple government and private schools, multiple recreational facilities.
- **Bullsbrook:** existing/proposed district activity centre, neighbourhood centre, multiple government schools, multiple recreational facilities.

North Ellenbrook (West) LSP 1 - District Centre Catchment

The *North Ellenbrook District Centre Catchment Assessment* (Urbis, February 2025) indicates that the 'Main Trade Area' is made up of the North Ellenbrook (West) and North Ellenbrook (East) DSPs, forming the 'Primary' catchment areas for the LSP 1 proposed District Centre, the rural land adjacent to the east of the North Ellenbrook (East) DSP would form the 'Secondary' catchment area. While the rural area south of Neaves Road, the existing suburbs of The Vines and Bullsbrook and the Bullsbrook North DSP form the 'Tertiary' catchment areas.

A gravity model assessment, in alignment with the WAPC TIA Guidelines, was undertaken based on the dwelling yields, level of catchment and proximity to the District Centre to determine appropriate distribution splits attracted to the Site. Given, the North Ellenbrook (East) DSP proposes another Neighbourhood Activity Centre, a higher trip attraction reluctance was applied. Similarly, as Secondary/District Centres are available in Ellenbrook and Bullsbrook, the 'Tertiary' trade areas south and north of the Site are assumed to have a lower level of prevalence. These are summarised in **Table 4-1**.

Table 4-1: District Centre - Attraction Proportions

Catchment Area	Attraction to District Centre
North Ellenbrook (West) – Precinct 1 (LSP 1)	6%
North Ellenbrook (West) – Precinct 2 (LSP 2)	11%
North Ellenbrook (West) – Precinct 3 (LSP 3)	12%
North Ellenbrook (West) – Precinct 4 (LSP 4)	18%
North Ellenbrook (West) – Precinct 5 (LSP 5)	17%
North Ellenbrook (East) DSP	29%
Other (North)	5%
Other (South)	2%

The District Centre catchment analysis accounts for 64% of trips generated internally to the North Ellenbrook (West) area and 36% generated from external areas.

North Ellenbrook (West) LSP 1 - Private K-12 School Catchment

A private K-12 school would typically have a wider catchment than a government school. A comparison of the student enrolment for Kindergarten to Year 12 (K-12) education levels of two private schools in Ellenbrook (*Swan Valley Anglican Community School* and *Ellenbrook Christian College*) indicates an average of 130 students per site hectare. Therefore, the proposed K-12 private school within LSP 1 is assumed to yield 1,300 students, with a breakdown of the student intake of surrounding areas, summarised in **Table 4-2**.

Table 4-2: Private K-12 School - Attraction Proportions

Catchment Area	Attraction to Private K-12 School
North Ellenbrook (West) – Precinct 1 (LSP 1)	5%
North Ellenbrook (West) – Precinct 2 (LSP 2)	9%
North Ellenbrook (West) – Precinct 3 (LSP 3)	9%
North Ellenbrook (West) – Precinct 4 (LSP 4)	14%
North Ellenbrook (West) – Precinct 5 (LSP 5)	14%
North Ellenbrook (East) DSP	38%
Other (North)	9%
Other (South)	2%

The private K-12 school catchment analysis accounts for 51% of trips generated internally to the North Ellenbrook (West) area and 49% generated from external areas.

4.2 Surrounding Trip Attracting Land Uses

The wider North Ellenbrook (West) DSP proposes local attractors such as a local commercial centre, four (4) government primary schools and one (1) government high school.

North Ellenbrook (West) DSP – Government Primary and Secondary School Catchment

For the purpose of determining approximate trip distributions for generating land uses within the wider DSP, analysis of the Ellenbrook suburb and locality, the ABS Census data for 2021 has been referenced and indicates the following trends:

- Of the total households, 55% had a child attending an education institution between preschool and secondary school (both government and non-government), meaning around 4,500 dwellings are considered to make education-based trips from the North Ellenbrook (West) DSP.
- Of the total households, 7% had a child attending preschool and 7% had a child attending a non-government primary or secondary school. Therefore, assuming an eighth of the preschool trips are associated with kindergarten students at non-government schools, the North Ellenbrook (West) DSP would account for around 640 students and the North Ellenbrook (East) DSP would account for around 510 students. Thus, it is considered that the external attraction (outside of North Ellenbrook) of the proposed K-12 private school (within LSP 1) would equate to 350 students.
- Of the total households, 26% had a child attending a government primary school. Therefore, applying the total dwelling yield of the North Ellenbrook (West) DSP per the total provision of government primary schools, each primary school yields an average of around 500 students.
- Of the total households, 15% had a child attending a government high school. Therefore, applying the total dwelling yield of the North Ellenbrook (West) DSP per the total provision of government high schools, the government high school (within LSP 2) yields an average of around 1,200 students.

The distribution of students among the government and private schools have been assessed on the proportion of dwellings proposed within each LSP precinct. The trips attracted to the government schools have been assessed on the basis of the calculated student yields and generation rates provided in the *ITE 9th Edition Trip Generation Handbook* for an elementary school and a high school. This accounts for 4% of the total trips generated by residential dwellings (i.e. 1% per primary school), with around 3% assigned to the government secondary school.

North Ellenbrook (West) DSP – Local Centre

The Local Centre is proposed across two lots, with one lot in LSP 2 and the other directly opposite Chudalup Road in LSP 4. The attraction of trips to the Local Centre is assumed to be local trips only from the wider North Ellenbrook (West) DSP and has been assessed on the basis of the trip generation rates provided in the *RMS Guide to Traffic Generating Developments* (2002) for shopping centres. This accounts for 13% of the total trips generated by residential dwellings within each precinct.

4.3 Changes to the External Transport Network

Tonkin Highway Extension to Muchea

The extension of Tonkin Highway as a 4-lane primary distributor from Ellenbrook to Muchea (known as the 'NorthLink WA' – northern section) was completed in February 2020.

Ellenbrook Station

A new Ellenbrook train line was delivered by Metronet in December 2024, which facilitates Transperth train services between the Perth CBD and Ellenbrook. The Ellenbrook Station is around 8km south of the Site and provides a 'Park n Ride' facility with 500 long-term parking bays.

Tonkin Highway North Ellenbrook Interchange

To support access to the North Ellenbrook (West) and North Ellenbrook (East) DSPs, a new interchange with Tonkin Highway is being delivered by the *Department of Transport and Major Transport (DoTMI)* and *Main Roads WA* at the south eastern end of the Site within Lot 112. The project also includes an underpass on the eastern side of Tonkin Highway for continuation of the existing principal shared path (PSP). Additionally, path connections to the PSP are proposed at the THNEI along the roadside with signalised pedestrian crossings. Construction is scheduled to be completed in late 2027.

Warbrook Road Overpass

The Warbrook Road overpass of Tonkin Highway, connecting to Chudalup Road, is proposed as part of the ultimate 2051+ *Main Roads WA Regional Operation Model* (ROM) *24* road network assumptions.

4.4 Gaps in the Transport Network

The key identified gap in the transport network is the lack of connectivity to public transport services with the nearest bus and train links at Ellenbrook Station (~8km away), which puts a higher reliance on vehicle-based private trips. Local trips between schools and the Local/District Centre would also benefit from a bus route to provide all residents with equitable transport access to amenities.

The *Public Transport Authority* (PTA) have indicated that a future transit corridor along the eastern side of Tonkin Highway is under consideration.

Subject to a detailed feasibility investigation, there is potential for the existing *Transperth Bus Route 340* to be extended onto Maralla Road and through both North Ellenbrook (East) and North Ellenbrook (West) via the THNEI or the future Warbrook Road/Chudalup Road overpass.

5 Analysis of Transport Network

5.1 Assessment Years and Time Periods

Given the land uses proposed within LSP 1 service a district function, the forecast development year is assumed to be 2051 and has been assessed for a typical commuter AM peak (8am – 9am) and PM peak (4pm – 5pm). The key land use and road network assumptions adopted under the assessment scenario are provided in **Table 5-1**.

Table 5-1: Traffic Modelling Scenarios

Scenario 1: 2051 Ultimate District Development	
Land Use Assumptions	• 100% of North Ellenbrook (West) DSP including Amendment No.1 & No.2 and Precinct 4 MRS Amendment • 100% of North Ellenbrook (East) DSP including Amendment No.1 • 100% of Cooper Road Industrial Area (NEDSP (West) Amendment No.2) • 100% Bullsbrook South
Road Network Assumptions	• North Ellenbrook (West) Precincts 1-4 Masterplan Ultimate Road Network • North Ellenbrook (East) DSP Ultimate Road Network • Tonkin Highway North Ellenbrook Interchange (THNEI) • Warbrook Road Overpass • Great Northern Highway connection to Tonkin Highway via Warbrook Road/Railway Parade

This assessment scenario aligns somewhere between the *Main Roads WA Regional Operational Model* (ROM) *24* for the 2051 and 2051+ forecast years.

5.2 Background Traffic

There has been no inclusion of background traffic within or through the LSP1 Site due to the Site and wider area being undeveloped.

5.3 Structure Plan Generated Traffic

Generating Land Uses

The generating land uses within LSP 1 are the 786 residential dwellings. The adopted trip generation rates are provided in **Table 5-2**.

Table 5-2: Adopted Trip Generation Rates for Generating Land Uses

Land Use	Units	Weekday	AM Peak	AM - In	AM - Out	PM Peak	PM - In	PM - Out	Source
Residential	Per Dwelling	8.0	0.8	0.2	0.6	0.8	0.5	0.3	WAPC

The resultant generation of the residential dwellings within LSP 1 are provided in **Table 5-3**.

Table 5-3: Resultant Structure Plan Generation of Residential Land Uses

LSP 1 Generation	Weekday	AM Peak	AM - In	AM - Out	PM Peak	PM - In	PM - Out
786 dwellings	6,290	630	160	470	630	390	240

Attracting Land Uses

Attracting land uses are those associated with having a trip purpose for generating land uses to be attracted to. The adopted trip generation rates are provided in **Table 5-4**.

Table 5-4: Adopted Trip Generation Rates for Attracting Land Uses

Land Use	Units	Weekday	AM Peak	AM - In	AM - Out	PM Peak	PM - In	PM - Out	Source
District Centre	Per 100m² GFA	50.64	1.14	0.71	0.43	4.40	2.11	2.29	RMS/ITE (820)
Private K-12 School	Per Student	2.48	0.81	0.49	0.32	0.17	0.07	0.10	ITE 9th Ed. (536)

The resultant generation of the trip attractors within LSP 1 are provided in **Table 5-5**.

Table 5-5: Resultant Structure Plan Generation of Residential Land Uses

LSP 1 Attraction	Weekday	AM Peak	AM - In	AM - Out	PM Peak	PM - In	PM - Out
District Centre	25,320	570	350	220	2,200	1,060	1,140
Private K-12 School	3,220	1,050	640	410	220	90	130

5.4 Distribution of Structure Plan Generated Traffic

The distribution splits of North Ellenbrook (West) residential generated trips among the identified attractors are provided in **Table 5-6**.

Table 5-6: Distribution Splits of DSP (West) Residential Generated Traffic

Distribution Direction	Distribution Split	Weekday (vpd)	AM Peak (vph)	PM Peak (vph)
District Centre (LSP 1)	25%	16,240	370	1,410
Private K-12 School (LSP 1)	2%	1,590	520	110
Local Centre (LSP 2 / LSP 4)	13%	8,470	220	860
Government High School (LSP 2)	3%	2,050	520	160
Primary Schools (LSP 2, 3, 4, 5)	4%	2,580	900	300
Cooper Road Industrial Area	8%	5,300	730	840
Chudalup Road Overpass (East)	2%	1,450	230	190
Tonkin Highway (North)	7%	4,360	690	580
Tonkin Highway (South)	36%	23,250	3,670	3,090

The distribution splits of external generated traffic attracted to LSP 1 is provided in **Table 5-7**.

Table 5-7: Distribution Splits of DSP (West) External Attracted Traffic

LSP 1 Attractor	External Split	Weekday (vpd)	AM Peak (vph)	PM Peak (vph)
District Centre	36%	9,080	200	790
Private K-12 School	51%	1,640	530	110

5.5 Extraneous Traffic

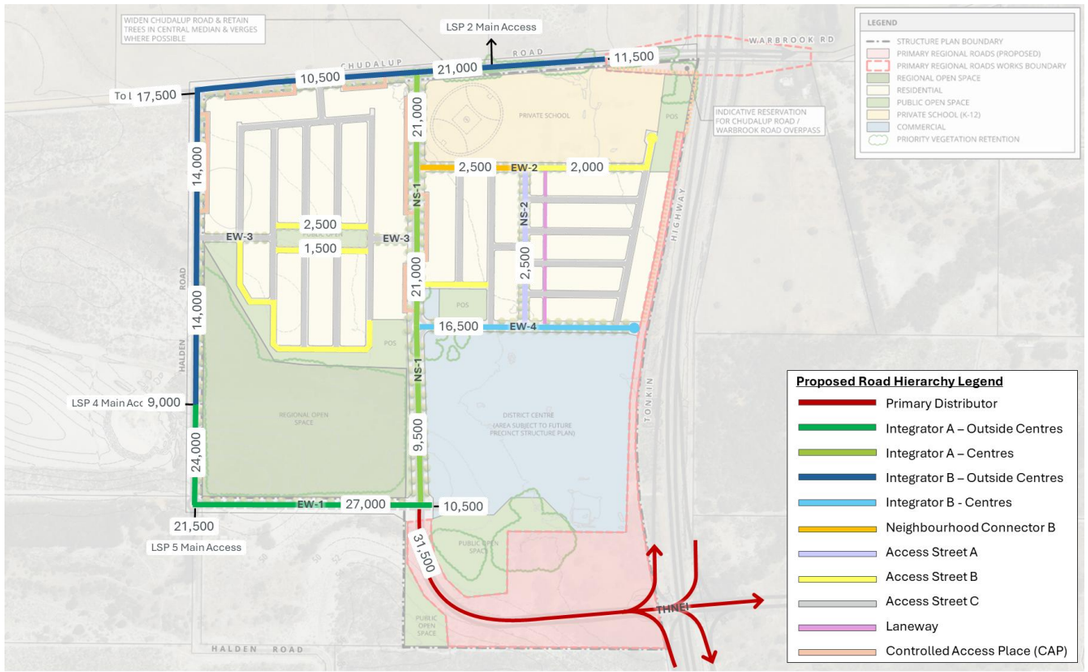
The traffic travelling through/around the LSP 1 road network comprises of the following trip purposes.

- **NS-1:** residential generated trips from LSP 2 and LSP 3 via the THNEI.
- **Halden Road:** residential generated trips from LSP 3, LSP 4 and LSP 5 via the THNEI, Local Centre, High School and Cooper Road Industrial Area.
- **Chudalup Road:** residential generated trips from LSP 2, LSP 3, LSP 4, LSP 5 and Warbrook Road overpass via the THNEI, Local Centre, High School and Cooper Road Industrial Area.

5.6 Total Daily Traffic Volumes

The forecast two-way daily traffic volumes for an ultimate design year (2051), to the nearest 500vpd, are shown in **Figure 5-1**.

Figure 5-1: Ultimate (2051) Forecast Two-Way Daily Traffic Volumes – To Nearest 500vpd



Base Image Source: Rowe Group (25/03/2026)

The *Liveable Neighbourhoods 2009* (LN09) guidance notes that the indicative volume range needs to consider the route type and function as well as through traffic needs. The general guide indicates that traffic volumes up to 20,000vpd is acceptable on 2-lane roads (one lane in each direction), provided that detailed design addresses intersections, parking, access and bus movement. Divided roads with a central median are recommended where there is a need for staged pedestrian crossing (minimum of 2.0m wide), tree planting (2.5m - 4.0m wide) or staged vehicle crossing at intersections/drainage swales (6.0m wide or greater). The proposed 8.0m wide median on NS-1 allows for overlapping right-turn lanes between the intersections with EW-2 and EW-3, if required.

5.7 Public Transport Routes

There is no public transport routes proposed through LSP 1 at this stage. However, proposed lane widths of 3.2m on divided roads and 3.5m on undivided roads would be more than sufficient to accommodate any future bus routes servicing the area and consistent with PTA requirements.

5.8 Pedestrian and Cycle Routes

The proposed 1.5m - 2.0m wide paths are primarily for low pedestrian volumes on residential streets.

The proposed 2.0m – 3.0m wide shared paths on corridors with moderate to high anticipated demand facilitate two-way or same direction passing of two path users (walking or riding).

The WAPC guide for two-way peak hour traffic volumes affecting the permeability of non-priority pedestrian crossings with median refuge is in the order of 1,600vph for 4-lane streets and 2,800vph for 2-lane streets. These indicative thresholds increase on undivided roads to 1,100vpd (2-lanes) and 700vpd (4-lanes). Other factors such as crossing length, speed of approaching traffic, walking speed of crossing users and sight lines also impact the ability of a pedestrian to cross a road safely and efficiently.

The provision of median refuge islands favourably reduce the crossing distance and gap acceptance, improving the pedestrian permeability. However, some sections of Chudalup Road, Halden Road and NS-1 are anticipated to have sections where the peak hour traffic volume exceeds 1,600vph (4-lanes). Therefore, additional crossing treatments or diverted pedestrian routes to more appropriate crossing locations on these sections are to be considered at the subdivision stage.

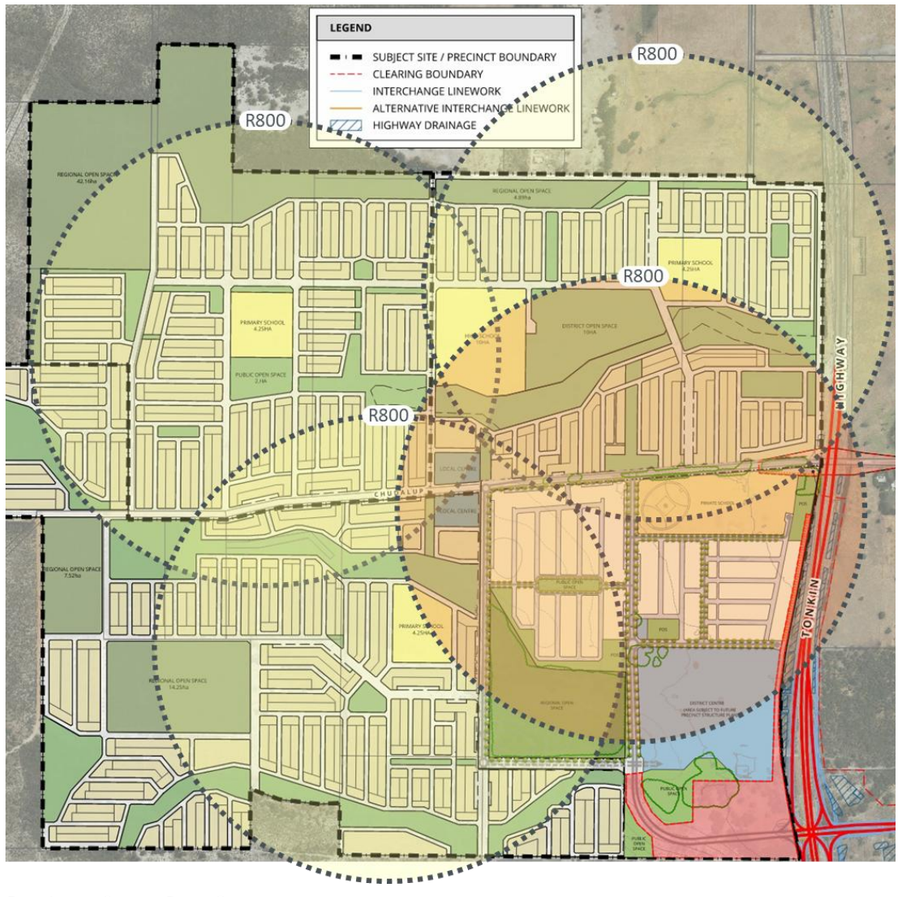
5.9 Safe Routes to School

The typical 800m walkable catchment (approximately 10-minutes) for schools within the LSP1-4 Masterplan is shown in **Figure 5-2** for primary schools (including the Private K-12 School) and **Figure 5-3** for secondary schools (including the Private K-12 School).

The 800m catchment area for the Private K-12 School primarily captures all of the residential zones within LSP 1, where desire lines through the public open space (POS) in each surrounding precinct could provide safe routes to school, separated from vehicular traffic and minimising the crossing of side streets.

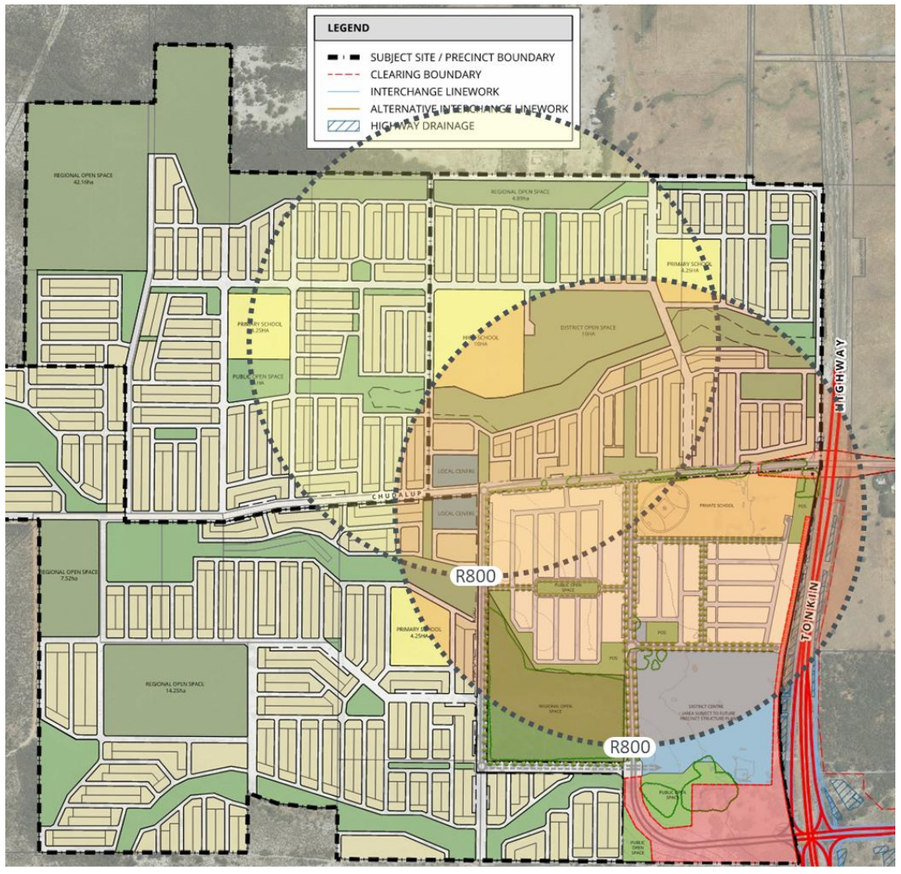
Pedestrian crossing facilities would be required on Chudalup Road, Halden Road and southern/western boundaries of the Private K-12 School site to facilitate access from adjacent residential areas.

Figure 5-2: Primary School 800m Catchment Areas



Base Image Source: Rowe Group

Figure 5-3: Secondary School 800m Catchment Areas



Base Image Source: Rowe Group

5.10 Spacing of Intersections

In discussions with *Main Roads WA* Road *Access and Planning Directorate* at the LSP1 pre-lodgement meeting, the location of Intersection 1 and its proximity to the THNEI to was highlighted as an area to be addressed within this TIA. The location of Intersection 1 is restricted by the land identified as Regional Open Space within the LSP1 area, which is currently subject to a conservation covenant with the *Soil and Lands Commission*, with the intent that the area be rehabilitated and retained in perpetuity. Given the 'conservation' status of the land, no alternative uses are permitted within this area.

From a technical point of view, the guidance for spacing between signalised intersections is provided as follows:

- Desirable spacing of 5-seconds travel time at the design speed between an intersection and the start of auxiliary lanes for the next downstream intersection (*Main Roads WA Supplement to Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*).
  - At a 60km/h design speed, this equates to 83m.
  - At a 70km/h design speed, this equates to 97m.
- Minimum spacing of 350m or 500m on Integrator A street types with a 60km/h or 70km/h design speed, respectively – typically used in town centres/city centres (*Liveable Neighbourhoods*, 2009).
- Desirable spacing of 500m-750m or 750m-1,000m on Integrator A street types with a 60km/h or 70km/h design speed, respectively – depending on signal cycle length and need for two-direction signal coordination (*Liveable Neighbourhoods*, 2009).

The spacing provisioned between the THNEI stop line and the intersection stop lines is **~725m**, which exceeds the minimum spacing for town centre streets and is within the desirable spacing bounds.

The proposed spacing between auxiliary lanes in the concept civil design plans is **~265m**, which exceeds the desirable MRWA spacing of 97m at a 70km/h design speed.

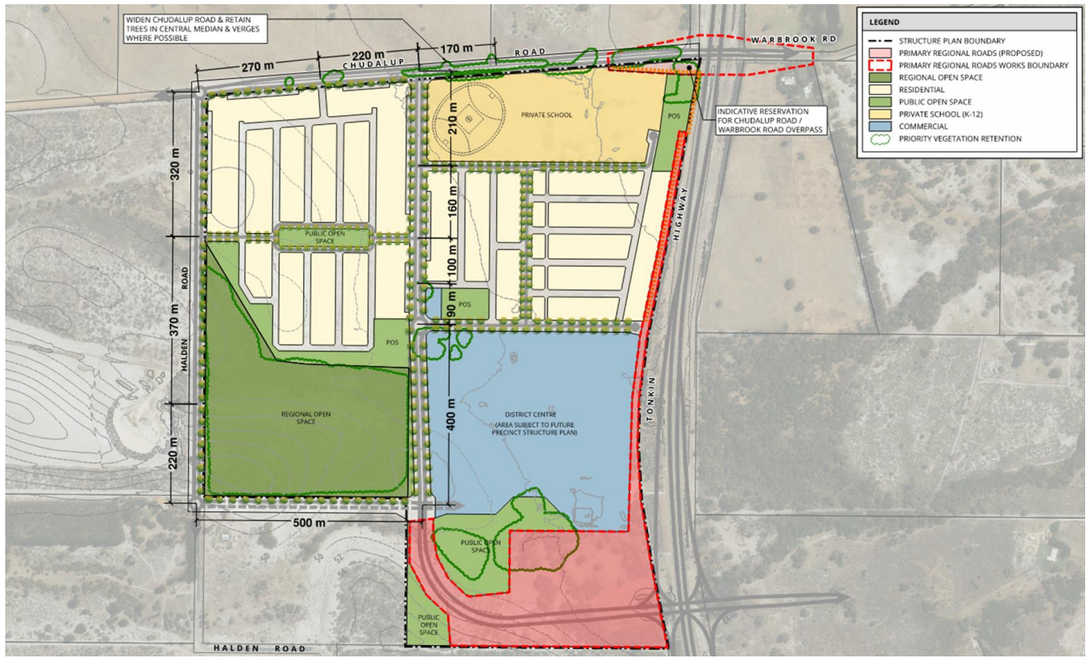
The Stopping Sight Distance (SSD) using a Main Roads WA desirable 2.5s reaction time, a coefficient of deceleration of 0.36 and a longitudinal grade of -1.0% equates to 104m for a 70km/h design speed, which is similar to 5s of travel time and this would allow for a vehicle approaching the traffic signals to observe signal phasing changes and stop safely before the stop line.

The *Liveable Neighbourhoods 2009* recommended spacing between full movement intersections is 20m for Access Streets and 40m for side streets on Neighbourhood Connector street types. The recommended spacing for Integrator street types, the distance varies depending on the location of side streets and the design speed, as follows.

- Integrator B (left/right staggered T-intersections): 60m
- Integrator B (right/left staggered T-intersections or same side T-intersections): 40m
- Integrator A – 60km/h (left/right staggered T-intersections): 150m
- Integrator A – 60km/h (right/left staggered T-intersections or same side T-intersections): 110m
- Integrator A – 70km/h (left/right staggered T-intersections): 190m
- Integrator A – 70km/h (right/left staggered T-intersections or same side T-intersections): 130m.

The recommended spacings assume typical deceleration lengths/right-turn storage requirements and that there is no provision for overlapping turns, noting that shorter distances can be achieved where lower storage requirements and/or overlapping right-turns are feasible. The proposed spacing between intersections as shown in **Figure 5-4**, satisfy the recommended spacing between intersections. A design speed of 60km/h will be appropriate for the Integrator A – Centres ('NS-1') street type.

Figure 5-4: Proposed Spacing Between Intersections



Base Image Source: Rowe Group (25/03/2026)

5.11 Total Peak Hour Traffic Volumes and Intersection Capacity Assessment

The operational capacity of each intersection has been analysed using the computer software *SIDRA Intersection v10*. The key outputs of SIDRA are summarised below:

- **Degree of Saturation (DoS)**: the ratio of the volume of traffic observed making a particular movement compared to the maximum capacity for that movement.
- **Average Delay**: the delay time that can be expected overall vehicles making a particular movement in the peak hour.
- **Level of Service (LOS)**: a qualitative measure of the average delay in categories from A to F.
- **95th Percentile (95th %ile) Queue**: represents the maximum queue length that can be expected in 95% of observed queue lengths in the peak hour.

The metric levels used for assessing the intersection performance are provided in **Table 5-8**.

Table 5-8: Intersection Model Output Performance Metrics

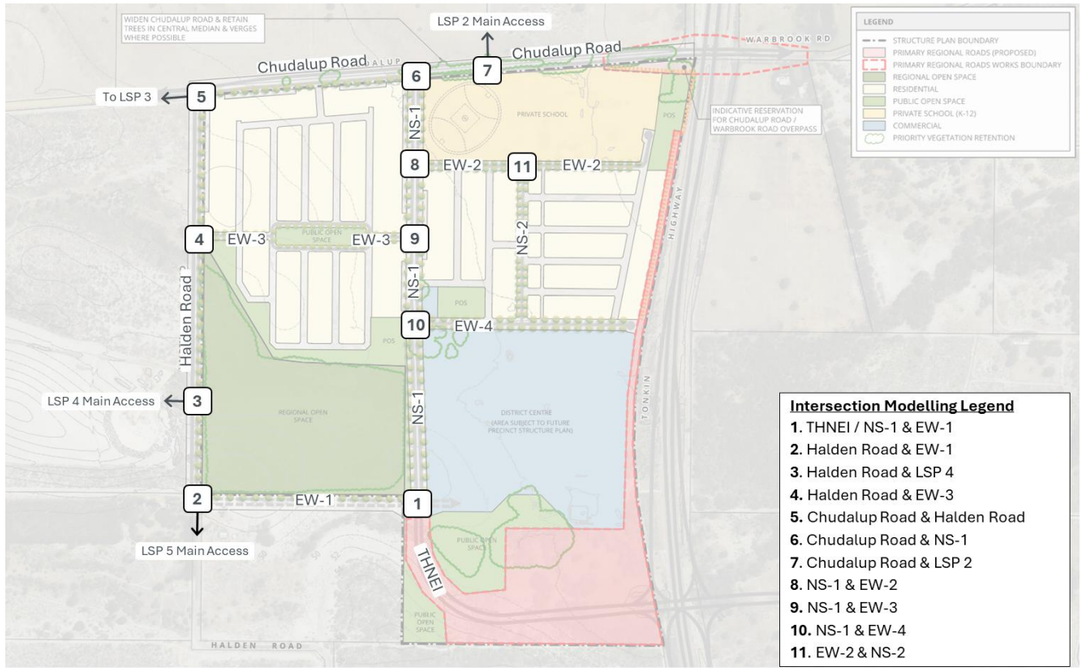
Metric	Excellent	Very Good	Good	Fair	Poor	Very Poor
Degree of Saturation	< 0.6	0.6 – 0.7	0.7 – 0.8	0.8 – 0.9	0.9 – 1.0	> 1.0
Level of Service (LOS)	A	B	C	D	E	F
Queue Storage Ratio	< 0.6	0.6 – 0.7	0.7 – 0.8	0.8 – 0.9	0.9 – 1.0	> 1.0

The intersections shown in **Figure 5-5** have been assessed to determine appropriate intersection controls and geometric layouts under the forecast anticipated peak hour traffic volumes, with the resulting proposed intersection forms provided in **Table 5-9** and shown in **Figure 5-6**. Where there is a high potential for lane changing over a 250m distance or less between intersections for the desired turning movements on the proposed 4-lane roads, the intersections have been modelled as a network. The scenario testing for intersection controls and layouts is provided in **Appendix C**, with the detailed SIDRA outputs provided in **Appendix D** and the intersection performance summary provided in **Table 5-10**.

Table 5-9: Proposed Intersection Form

Intersection	Proposed Intersection Form
1. THNEI/NS-1 & EW-1	Traffic Signals with double right-turn lanes on EW-1
2. Halden Rd & EW-1*	Traffic Signals with double right-turn lanes on EW-1 and the LSP 5 approach
3. Halden Rd & LSP 4	Priority Controlled Staged Crossing T-Intersection with right-turn added lane and left-turn lane drop-off
4. Halden Rd & EW-3	Priority controlled staged crossing T-intersection with additional short right-turn lane on Halden Road
5. Chudalup Rd & Halden Rd	3-leg single lane roundabout with additional short turn lanes on all approaches
6. Chudalup Rd & NS-1	3-leg single/dual lane roundabout with additional short turn lane on eastern leg approach
7. Chudalup Rd & NS-2	3-leg single lane roundabout with additional short turn lanes on all approaches
8. NS-1 & EW-2	Priority controlled staged crossing T-intersection with additional short turn lanes on all approaches
9. NS-1 & EW-3	Priority controlled staged crossing T-intersection with additional short right-turn lane on NS-1
10. NS-1 & EW-4	3-leg dual/single lane roundabout
11. EW-2 & NS-2	Priority controlled standard T-intersection

Figure 5-5: Intersection Assessment Context

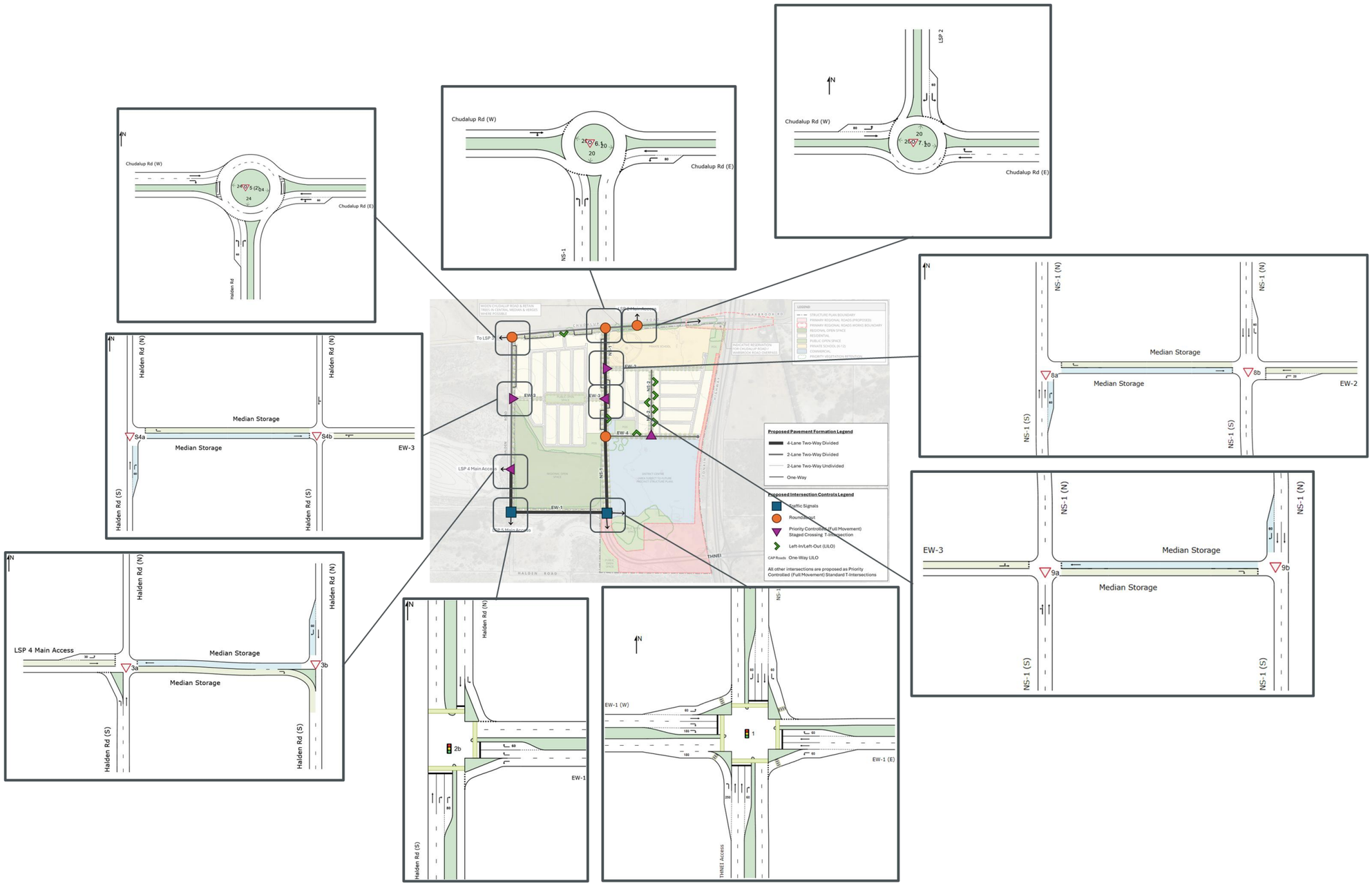


Base Image Source: Rowe Group (25/03/2026)

Table 5-10: Proposed Intersection Form - Performance Summary

Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Intersection 1	0.858	0.855	31.8	30.2	LOS C	LOS C	210.8	141.4
Intersection 2*	0.809	0.854	22.4	22.0	LOS C	LOS C	106.6	91.3
Intersection 3	0.455	0.415	5.0	4.7	LOS A	LOS A	22.5	17.8
Intersection 4	0.405	0.466	2.3	1.0	LOS A	LOS A	7.0	2.2
Intersection 5	0.469	0.567	6.6	9.0	LOS A	LOS A	24.6	43.4
Intersection 6	0.661	0.898	9.4	13.6	LOS A	LOS B	53.4	139.8
Intersection 7	0.396	0.448	8.3	6.6	LOS A	LOS A	21.8	28.1
Intersection 8	0.747	0.315	9.7	4.1	LOS A	LOS A	35.4	8.1
Intersection 9	0.227	0.411	3.1	2.6	LOS A	LOS C	7.8	13.1
Intersection 10	0.289	0.758	7.8	10.1	LOS A	LOS B	14.0	61.7
Intersection 11	0.783	0.079	6.8	3.0	LOS C	LOS A	53.6	1.8

Figure 5-6: Proposed Indicative Intersection Layouts



Base Image Source: Rowe Group (25/03/2026) / SIDRA Solutions

6 Conclusions & Recommendations

The Transport Impact Assessment (TIA) prepared to support the Local Structure Planning (LSP) for North Ellenbrook (West) Precinct 1 ("LSP 1") details the following conclusions and recommendations:

1) The proposed land uses within LSP 1 generate (786 residential dwellings) in the order of 5,290 vehicles per day (vpd) or 630 vehicles in a peak hour (vph) and attract (50,000m^2 GLFA District Centre and 1,300 student private K-12 school) in the order of 28,540vpd or 1,620vph in the AM peak and 2,420vph in the PM peak.
2) The distribution of residential generated trips for LSP 1 and the wider North Ellenbrook (West) precincts accounts for around 47% of attraction to other internal land uses and 53% of attraction to external land uses.
3) The District Centre catchment analysis accounts for 64% of trips generated internally to the North Ellenbrook (West) area and 36% generated from external areas.
4) The private K-12 school catchment analysis accounts for 49% of trips generated internally to the North Ellenbrook (West) area and 51% generated from external areas.
5) The trips attracted to the government schools within the DSP (West) area accounts for 4% of the total trips generated by the LSP 1-5 residential dwellings, with around 3% assigned to the government secondary school.
6) The attraction of trips to the Local Centre is assumed to be local trips only from the wider North Ellenbrook (West) DSP and accounts for 13% of the total trips generated by residential dwellings within each precinct.
7) The proposed roads within LSP 1 comprise of the following road hierarchies and two-way daily traffic volume range:
   - **Integrator A:** 9,500vpd – 27,000vpd (4-lane divided roads for staged intersection movements).
   - **Integrator B:** 10,500vpd – 20,000vpd (2-lane divided roads for staged intersection movements), and noting the higher volumes are only on one short segment of road between Intersection 6 and 7 (refer **Figure 5-5**).
   - **Neighbourhood Connector B:** 2,500vpd (2-lane undivided/divided roads for pedestrian crossing refuge).
   - **Access Streets:** 300 – 2,500vpd (2-lane undivided roads).
8) The proposed indicative path network within LSP 1 (subject to detailed design) comprises of the following infrastructure, per road hierarchy:
   - **Integrator A:** 2.0m - 3.0m wide paths on both sides.
   - **Integrator B:** 2.0m - 3.0m wide paths on both sides.
   - **Neighbourhood Connector B:** 1.5m - 3.0m wide paths on both sides.
   - **Access Street A**: 2.0m - 3.0m wide paths on both sides.
   - **Access Street B:** 1.5m – 2.0m wide path on one side.
   - **Access Streets C/D:** 1.5m - 2.0m path on one side.
9) The proposed intersections within LSP 1 typically comprise of the following controls on the basis of the AM and PM peak hour intersection assessments using *SIDRA Intersection v10* software:
   - **Integrator A & Integrator A:** traffic control signals.
   - **Integrator A & Integrator B:** staged crossing T-intersection/roundabout.
   - **Integrator A & Neighbourhood Connector B/Access Street:** staged crossing T-intersection or left-in/left-out.
   - **Integrator B & Access Street:** staged crossing T-intersection or left-in/left-out.
10) On-street or embayed parking is expected and provisioned for on Access Streets adjacent to public open space (POS) and the private K-12 school.
11) An 800m catchment radius for the private K-12 school captures all of the residential zones within LSP 1, around half of the residential zones in LSP 2 and a small portion of the residential zones within LSP 4. Additionally, the residential zone within the western side of LSP 1 falls within an 800m catchment radius for the proposed government primary school within LSP 4 and the northwest residential zone within LSP 1 falls within an 800m catchment radius for the proposed government high school within LSP 2.
12) There are no current proposals to provide additional public transport routes as part of LSP 1, especially given Tonkin Highway is not supported to service bus routes by the PTA. However, there have been initial discussions with PTA as part of the North Ellenbrook Technical Advisory Group (TAG) discussing the potential future transit corridor on the eastern side of Tonkin Highway from Ellenbrook Station. LSP 1 may have the potential to connect feeder bus services via the new THNEI or the future Warbrook Road overpass to this transit corridor, should it eventuate. Alternative, it may be feasible in the future for bus route extensions/connections via Maralla Road and Sawpit Road to connect to The Vines and Ellenbrook.

Appendix A TIA Checklist

Item	Provided	Comments/Proposals
Summary	Executive Summary	
Introduction / Background	1.1	
Structure Plan Proposal		
Regional context	1.4	
Proposed land uses	3.1	
Table of land uses and quantities	3.1	
Major attractors / generators	3.1	
Specific issues	N/A	
Existing Situation		
Existing land uses within structure plan	2.1	
Existing land uses within 800m of structure plan area	2.1	
Existing road network within structure plan area	2.2	
Existing pedestrian / cycle network within structure plan area	2.7	
Existing public transport services within structure plan area	2.6	
Existing road network within 2 (or 5) km of structure plan area	2.2 / 2.3	
Traffic flows on roads within structure plan area (PM and/or AM peak hours)	2.5	
Existing pedestrian / cycle networks within 800m of structure plan area.	2.7	
Existing public transport services within 800m of structure plan area.	2.6	
Proposed Internal Transport Networks		
Changes / additions to existing road network or proposed new road network	3.2 / 3.3 / 3.4	
Road reservation widths	3.2	
Road cross-sections & speed limits	3.9	
Intersection controls	3.5	
Pedestrian / cycle networks and crossing facilities	3.7	
Changes to External Transport Networks		
Road network	4.3	
Intersection controls	4.3	
Pedestrian/cycle networks and crossing facilities	4.3	
Public transport services	4.3	
Integration with surrounding area		
Trip attractors / generators within 800 metres	4.1	
proposed changes to land uses within 800 metres	4.2	
travel desire lines from development to these attractors/ generators	4.1 / 4.2	
adequacy of external transport networks	4.4	
deficiencies in external transport networks	4.4	
remedial measures to address deficiencies	4.4	
Analysis of internal transport networks		
assessment years	5.1	
time periods	5.1	
Structure plan generated traffic	5.3	
Extraneous (through) traffic	5.5	
Design traffic flows (that is, total traffic)	5.6	
Road cross-sections	3.9	
Intersection controls	5.10	
Access strategy	5.4	
Pedestrian / cycle networks	5.8	
Safe routes to schools	5.9	
Pedestrian permeability & efficiency	5.10	
Access to public transport	5.7	
Analysis of external transport networks	N/A	
Extent of analysis		
Base flows for assessment year(s)		
Total traffic flows		
Road cross-sections		
Intersection layouts and controls		
Pedestrian / cycle networks		
Conclusions	6	

Appendix B Precinct 1 (LSP 1) Indicative Subdivision Concept Plan



INDICATIVE SUBDIVISION CONCEPT

LOTS 112, 114 & 1808 CHUDALUP ROAD
NORTH ELLENBROOK WEST

DRAFT

N

0 150 m
SCALE @ A3: 1:6000

2270-CON-37-I

DRAWN: WC
DATE CREATED: 2026.03.25
PROJECTION: PCG2020
CADASTRE: LANDGATE

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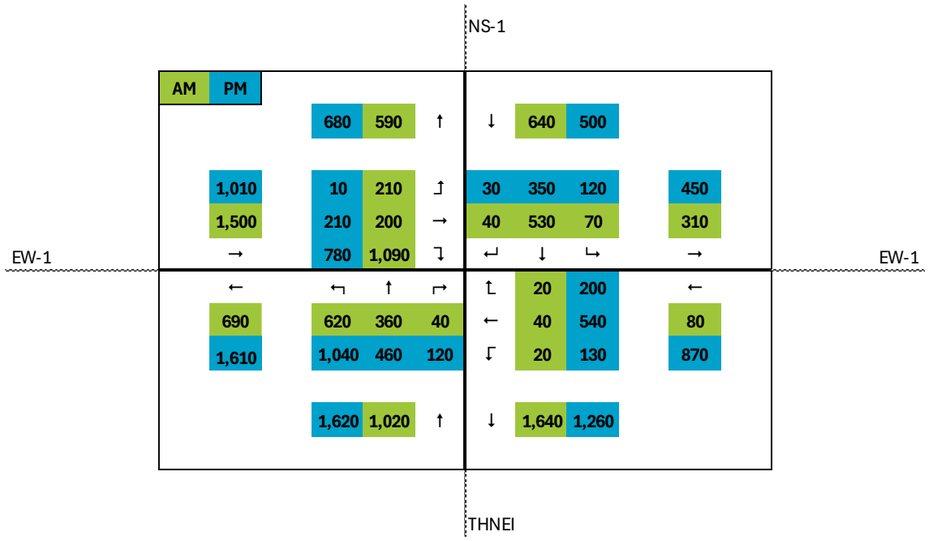
ROWE GROUP DESIGN

Appendix C Traffic Modelling Scenario Summary

Intersection 1: THNEI / NS-1 & EW-1

The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 1 are shown in **Figure C-1**. Pedestrian crossing volumes were adopted from traffic signal surveys conducted at Joondalup Drive & Cord Street, opposite Lakeside Joondalup, with the highest crossing leg being around 15 pedestrians per hour and has been applied to each crossing leg.

Figure C-1: Intersection 1 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



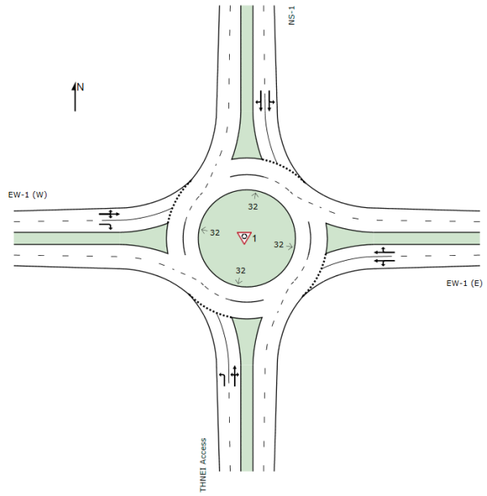
As noted in **Section 5.8**, the indicative two-way hourly traffic volume affecting the ability of a pedestrian to cross a 4-lane divided road is around 1,600vph. The 2051 approach flows on the southern and western legs exceed this volume in both peak periods by around 600-1,400vph. Therefore, measures to improve pedestrian crossing amenity and safety are noted in the WAPC TIA Guidelines to include zebra crossings, signalised pedestrian crossings (mid-block), crossing facilities at signalised intersections, or overpasses/ underpasses (where appropriate).

The intersection layouts assessed for Intersection 1 are shown in **Figure C-2**. These include a 4-lane roundabout and a traffic control signal (TCS) due to considerations for movement capacity, spatial constraints (if applicable) and pedestrian crossing amenity and safety.

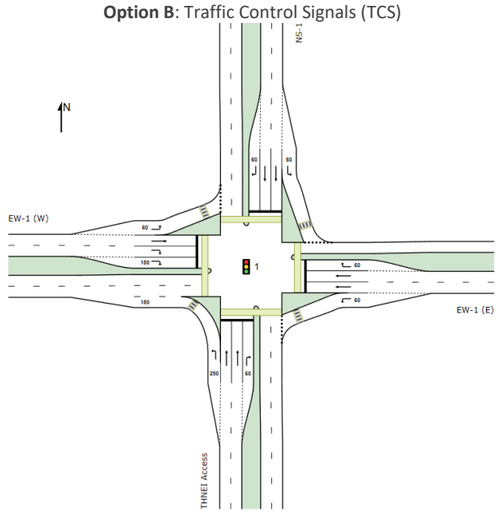
The optimum cycle time output in the AM peak and PM peak was 95s and 85s, respectively, for split phasing on the east and west legs and diamond phasing for the north and south legs.

Figure C-2: Intersection 1 – Intersection Layout Diagrams

Option A: Dual Lane Roundabout



Option B: Traffic Control Signals (TCS)



Source: SIDRA Solutions

The isolated intersection outputs as a summary of each approach are provided in **Table C-1**, with a detailed lane summary report provided in **Appendix D**.

Table C-1: Intersection 1 – SIDRA Site Approach Output Summary

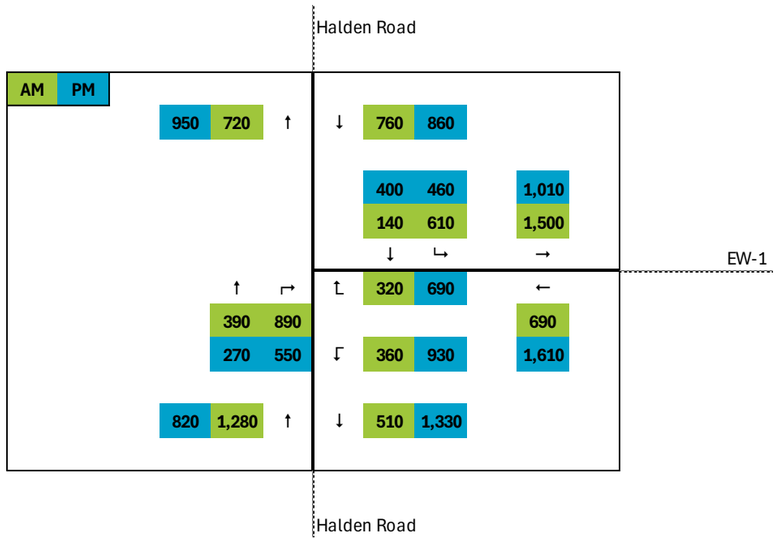
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Roundabout								
South: THNEI Access	0.372	0.985	4.1	30.1	LOS A	LOS C	17.0	187.1
East: EW-1	0.077	0.661	10.1	11.7	LOS B	LOS B	3.2	40.4
North: NS-1	0.543	0.395	9.6	7.4	LOS A	LOS A	28.5	18.0
West: EW-1	0.709	0.775	12.8	22.5	LOS B	LOS C	59.8	84.7
Intersection	**0.709**	**0.985**	**9.3**	**21.4**	**LOS A**	**LOS C**	**59.8**	**187.1**
Option B: Traffic Control Signals								
South: THNEI Access	0.544	0.855	20.7	18.9	LOS C	LOS B	62.1	70.4
East: EW-1	0.090	0.855	32.2	39.5	LOS C	LOS D	7.4	102.3
North: NS-1	0.791	0.472	40.8	27.4	LOS D	LOS C	100.7	52.3
West: EW-1	0.858	0.855	35.6	41.7	LOS D	LOS D	210.8	141.4
Intersection	**0.858**	**0.855**	**31.8**	**30.2**	**LOS C**	**LOS C**	**210.8**	**141.4**

The outputs, with respect to the operation of vehicles only, are found to generally perform better as a dual-lane roundabout with double turn lanes for movements between the west and the THNEI. However, given this intersection is proposed on the corner of a District Centre, it may be difficult for pedestrians to achieve safe crossing gaps in traffic. Therefore, a TCS intersection would be more appropriate for pedestrian crossing amenity and safety.

Intersection 2: Halden Road & EW-1

The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 2 is shown in **Figure C-3**. Intersection 2 is a future intersection to be delivered by others.

Figure C-3: Intersection 2 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes

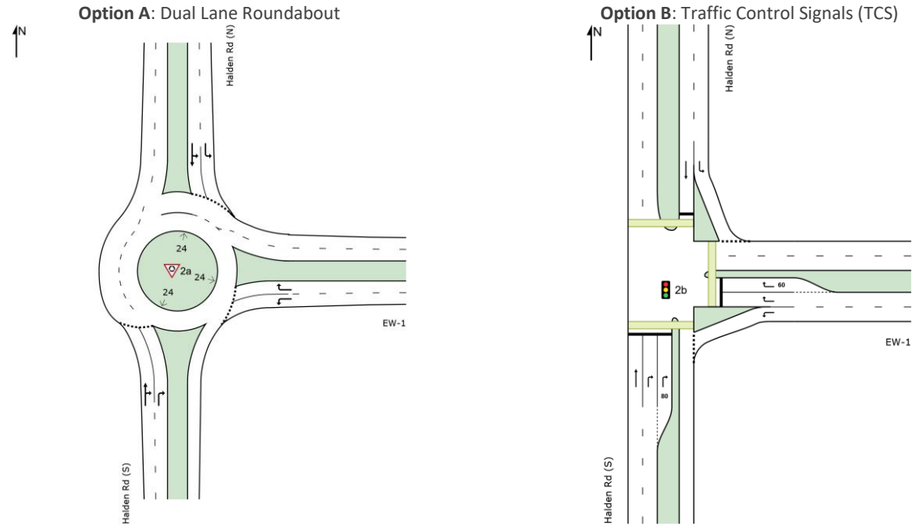


As noted in **Section 5.8**, the indicative two-way hourly traffic volume affecting the ability of a pedestrian to cross a 4-lane divided road is around 1,600vph. The approach flows on all legs approach or exceed this volume in both peak periods by up to 1,100vph. Therefore, measures to improve pedestrian crossing amenity and safety are noted in the WAPC TIA Guidelines to include zebra crossings, signalised pedestrian crossings (mid-block), crossing facilities at signalised intersections or overpasses/ underpasses (where appropriate).

The intersection layouts assessed for Intersection 2a are shown in **Figure C-4**. These include a 4-lane roundabout and a traffic control signal (TCS) due to considerations for movement capacity, spatial constraints (if applicable) and pedestrian crossing amenity and safety.

The optimum cycle time output in the AM peak and PM peak was 60s and 50s, respectively, for split phasing on the east leg and diamond phasing on the south leg.

Figure C-4: Intersection 2 – Intersection Layout Diagrams



Source: SIDRA Solutions

The Intersection 2 outputs when networked with Intersection 3 as a summary of each approach are provided in **Table C-2**, with a detailed lane summary report provided in **Appendix D**.

Table C-2: Intersection 2 – SIDRA Network Approach Output Summary

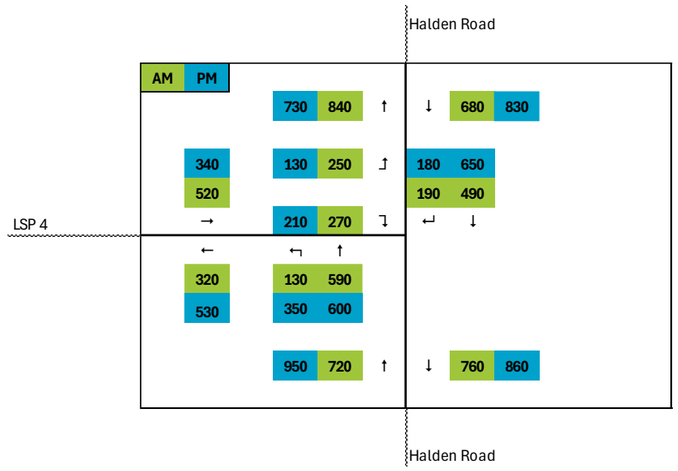
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Roundabout								
South: Halden Road (S)	0.520	0.518	10.7	14.0	LOS B	LOS B	31.6	39.3
East: EW-1	0.261	0.774	8.0	13.1	LOS A	LOS B	13.0	87.1
North: Halden Road (N)	0.479	0.469	8.7	7.2	LOS A	LOS A	22.6	21.6
Intersection	**0.520**	**0.774**	**9.5**	**11.8**	**LOS A**	**LOS B**	**31.6**	**87.1**
Option B: Traffic Control Signals								
South: Halden Road (S)	0.809	0.854	30.8	29.8	LOS C	LOS C	106.6	61.5
East: EW-1	0.597	0.854	19.7	21.2	LOS B	LOS C	36.8	91.3
North: Halden Road (N)	0.416	0.854	10.6	16.1	LOS B	LOS B	40.3	89.2
Intersection	**0.809**	**0.854**	**22.4**	**22.0**	**LOS C**	**LOS C**	**106.6**	**91.3**

The outputs, with respect to the operation of vehicles only, are found to generally perform better as a dual-lane roundabout with double turn lanes on the north and south legs for eastbound movements. However, given this intersection is proposed between a residential area and the District Centre, in addition to being adjacent to regional open space and south of a primary school, it will be difficult for pedestrians to achieve safe crossing gaps in traffic on Halden Road and EW-1. Therefore, a TCS intersection would be more appropriate for pedestrian crossing amenity and safety.

Intersection 3: Halden Road & LSP 4

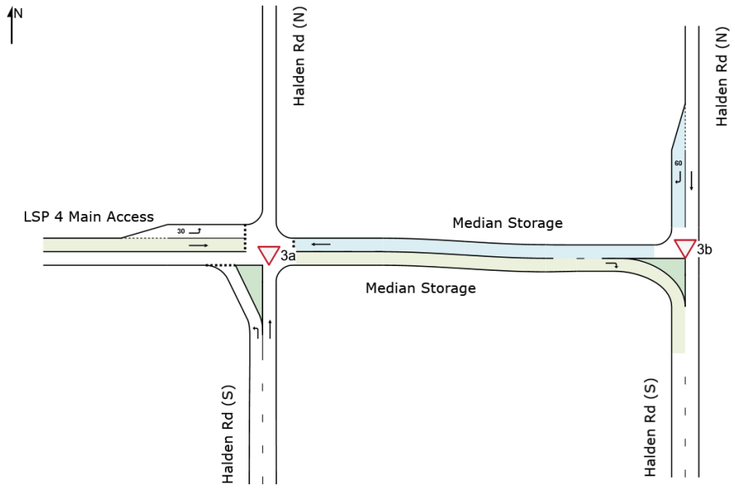
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 3 is shown in **Figure C-5**.

Figure C-5: Intersection 3 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure C-6**, which includes a staged crossing T-intersection with a continuous added lane to the south and the left-turn lane from the south dropping off, where there are 2-lanes to the north of the intersection and 4-lanes to the south.

Figure C-6: Intersection 3 – Intersection Layout Diagram



Source: SIDRA Solutions

The Intersection 3 outputs when networked with Intersection 2 as a summary of each approach are provided in **Table C-3**, with a detailed lane summary report provided in **Appendix D**.

Table C-3: Intersection 3 – SIDRA Network Approach Output Summary

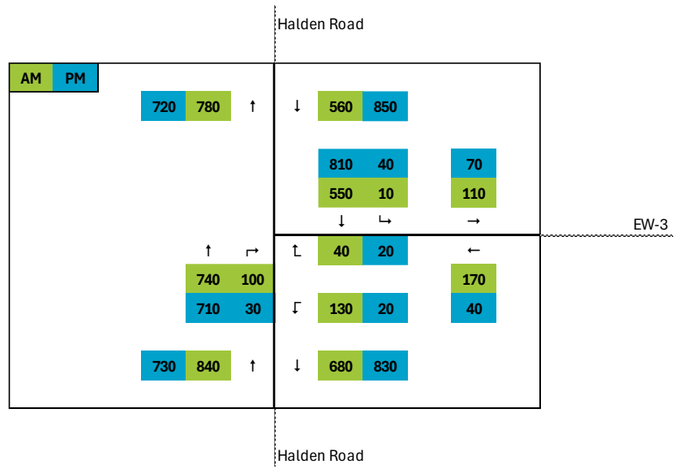
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Staged Crossing T-Intersection with Roundabout at Intersection 2								
South: Halden Road	0.318	0.325	1.2	2.5	LOS A	LOS A	3.6	11.7
North: Halden Road	0.266	0.352	1.6	1.3	LOS A	LOS A	0.0	0.0
West: LSP 4	0.556	0.540	12.4	14.2	LOS C	LOS B	25.0	21.6
Intersection	**0.556**	**0.540**	**5.6**	**5.4**	**LOS A**	**LOS A**	**25.0**	**21.6**
Option B: Staged Crossing T-Intersection with Traffic Control Signals at Intersection 2								
South: Halden Road	0.318	0.325	1.2	2.5	LOS A	LOS A	3.0	10.1
North: Halden Road	0.266	0.352	1.6	1.3	LOS A	LOS A	0.0	0.0
West: LSP 4	0.455	0.415	10.8	11.6	LOS B	LOS B	22.5	17.8
Intersection	**0.455**	**0.415**	**5.0**	**4.7**	**LOS A**	**LOS A**	**22.5**	**17.8**

The performance outputs for Intersection 3 improve slightly with traffic signals at Intersection 2 due to the time between phasing, creating gaps in traffic and allowing vehicles to turn right from the western approach with less vehicle conflict to the south i.e. vehicle platooning.

Intersection 4: Halden Road & EW-3

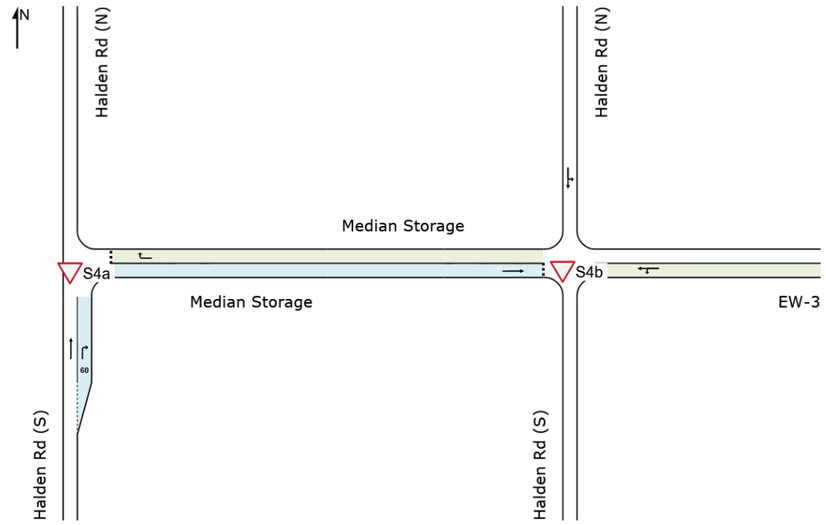
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 4 is shown in **Figure D-7**.

Figure D-7: Intersection 4 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure D-8**, which includes a staged crossing T-intersection with a right-turn lane for the Halden Road northbound approach.

Figure D-8: Intersection 4 – Intersection Layout Diagram



Source: SIDRA Solutions

The Intersection 4 outputs as a summary of each approach are provided in **Table D-4**, with a detailed lane summary report provided in **Appendix D**.

Table D-4: Intersection 4 – SIDRA Site Approach Output Summary

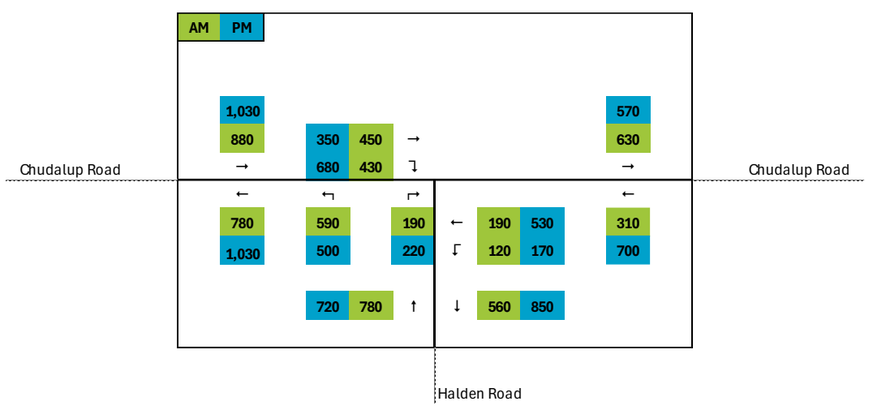
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Staged Crossing T-Intersection								
South: Halden Road	0.405	0.386	0.8	0.3	LOS A	LOS A	0.0	0.0
East: EW-3	0.233	0.089	9.1	12.9	LOS A	LOS B	7.0	2.2
North: Halden Road	0.304	0.466	0.1	0.4	LOS A	LOS A	0.0	0.0
Intersection	**0.405**	**0.466**	**2.3**	**1.0**	**LOS A**	**LOS A**	**7.0**	**2.2**

The intersection performance outputs for Intersection 4 as a staged crossing T-intersection are very good and thus could be the recommended treatment for this intersection.

Intersection 5: Chudalup Road & Halden Road

The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 5 is shown in **Figure C-9**.

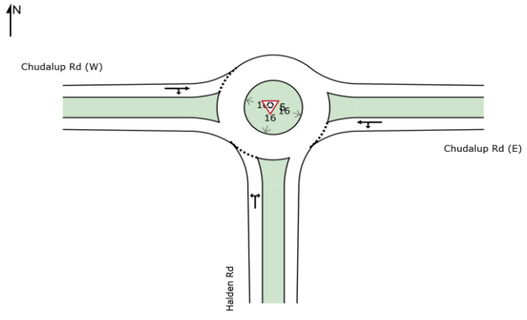
Figure C-9: Intersection 5 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layouts assessed are shown in **Figure C-10**. These include a staged crossing T-intersection with turning lanes and a single lane 3-leg roundabout.

Figure C-10: Intersection 5 – Intersection Layout Diagrams

Option A: Single Lane Roundabout



Option B: Single Lane Roundabout with Turn Lanes



Source: SIDRA Solutions

The Intersection 5 outputs as a summary of each approach are provided in **Table C-5**, with a detailed lane summary report provided in **Appendix D**.

Table C-5: Intersection 5 – SIDRA Site Approach Output Summary

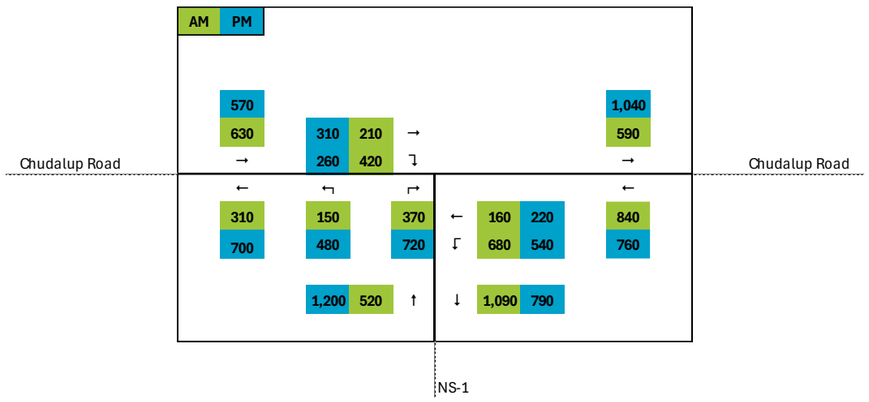
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Single Lane Roundabout								
South: Halden Road	0.700	0.904	7.5	23.1	LOS A	LOS C	60.2	148.8
East: Chudalup Road	0.390	1.246	7.4	243.6	LOS A	LOS F	20.9	791.4
West: Chudalup Road	0.782	0.965	9.9	25.3	LOS A	LOS C	86.6	258.3
Intersection	**0.782**	**1.246**	**8.6**	**86.9**	**LOS A**	**LOS F**	**86.6**	**791.4**
Option B: Single Lane Roundabout with Turn Lanes								
South: Halden Road	0.220	0.567	6.2	9.3	LOS A	LOS A	24.6	38.8
East: Chudalup Road	0.159	0.557	5.8	9.3	LOS A	LOS A	7.6	43.4
West: Chudalup Road	0.358	0.491	7.3	8.5	LOS A	LOS A	18.3	31.9
Intersection	**0.469**	**0.567**	**6.6**	**9.0**	**LOS A**	**LOS A**	**24.6**	**43.4**

The performance outputs for Intersection 5 show that for a single lane roundabout, the approaches at near or over capacity in the PM peak. However, with the addition of turn lanes on all legs, the intersection performance is very good in both AM and PM peaks. Therefore, it is recommended that a roundabout control be investigated further as part of subsequent planning stages due to the interfaces with potential accesses to the Local Centre across LSP 2 and LSP 4, as well as the north-south connection on the boundary between LSP 2 and LSP 3, located approximately 180m to the west of the intersection. Furthermore, a roundabout provides a good level of circulation for residents living on properties fronted by CAP roads.

Intersection 6: Chudalup Road & NS-1

The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 6 is shown in **Figure C-11**.

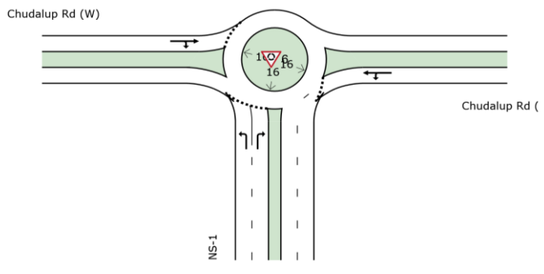
Figure C-11: Intersection 6 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



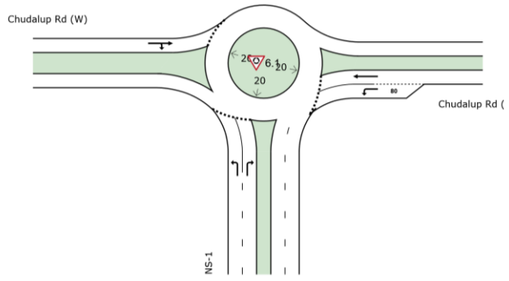
The SIDRA Intersection layouts assessed are shown in **Figure C-12**. These include a staged crossing T-intersection with turning lanes and a single lane 3-leg roundabout.

Figure C-12: Intersection 6 – Intersection Layout Diagrams

Option A/B: Single/Dual Lane Roundabout



Option B: Roundabout with Turn Lanes



Source: SIDRA Solutions

The Intersection 6 outputs when networked with Intersection 7 as a summary of each approach are provided in **Table C-6**, with a detailed lane summary report provided in **Appendix D**.

Table C-6: Intersection 6 – SIDRA Network Approach Output Summary

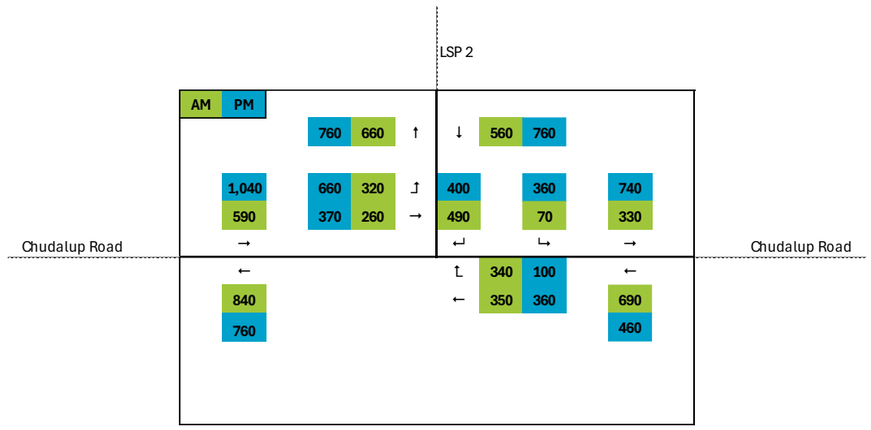
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Single/Dual Lane Roundabout with Staged Crossing T-Intersection at Intersection 7								
South: NS-1	0.283	0.579	8.1	8.5	LOS A	LOS A	15.8	41.9
East: Chudalup Road (E)	0.902	0.744	21.3	8.7	LOS C	LOS A	152.1	76.8
West: Chudalup Road (W)	0.683	0.955	12.9	49.4	LOS B	LOS D	58.1	186.9
Intersection	**0.902**	**0.955**	**14.9**	**17.8**	**LOS B**	**LOS B**	**152.1**	**186.9**
Option B: Single/Dual Lane Roundabout with Single Lane Roundabout at Intersection 7								
South: NS-1	0.288	0.580	8.2	8.5	LOS A	LOS A	16.0	42.1
East: Chudalup Road (E)	0.987	0.750	40.5	8.9	LOS D	LOS A	273.2	78.8
West: Chudalup Road (W)	0.685	0.956	12.9	49.7	LOS B	LOS D	58.6	188.1
Intersection	**0.987**	**0.956**	**23.3**	**17.9**	**LOS C**	**LOS B**	**273.2**	**188.1**
Option C: Roundabout with Turn Lanes at Intersection 6 and 7								
South: NS-1	0.275	0.553	8.2	8.4	LOS A	LOS A	14.2	36.6
East: Chudalup Road (E)	0.635	0.442	8.0	5.6	LOS A	LOS A	52.6	28.0
West: Chudalup Road (W)	0.661	0.898	12.2	35.2	LOS B	LOS D	53.4	139.8
Intersection	**0.661**	**0.898**	**9.4**	**13.6**	**LOS A**	**LOS B**	**53.4**	**139.8**

Intersection 6 performs best as a roundabout with turn lanes and with a roundabout with turn lanes at Intersection 7 (Option C) as the 95th percentile back of queue length under Option B extends beyond the distance between Intersection 6 and 7. Thus could be the recommended intersection configuration for Intersection 6.

Intersection 7: Chudalup Road & LSP 2

The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 7 is shown in **Figure C-13**.

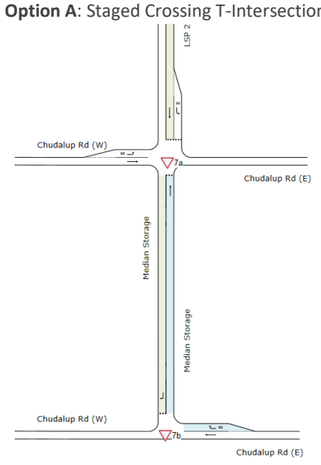
Figure C-13: Intersection 7 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



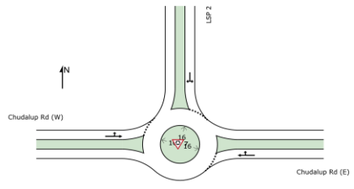
The SIDRA Intersection layouts assessed are shown in **Figure C-14**. These include a staged crossing T-intersection with turning lanes and a single lane 3-leg roundabout.

Figure C-14: Intersection 7 – Intersection Layout Diagrams

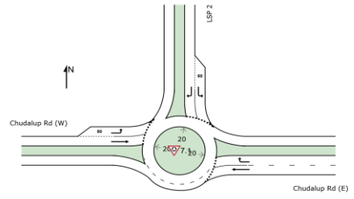
Option A: Staged Crossing T-Intersection



Option B: Single Lane Roundabout



Option C: Roundabout with Turn Lanes



Source: SIDRA Solutions

The Intersection 7 outputs when networked with Intersection 6 as a summary of each approach are provided in **Table C-7**, with a detailed lane summary report provided in **Appendix D**.

Table C-7: Intersection 7 – SIDRA Network Approach Output Summary

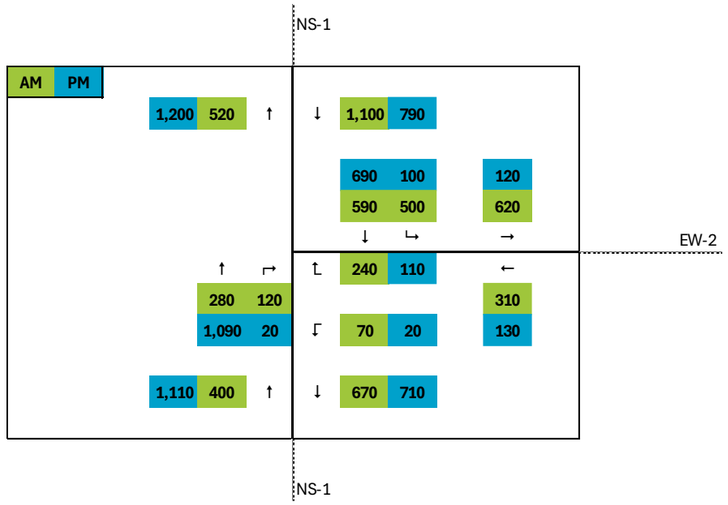
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Staged Crossing T-Intersection with Single/Dual Lane Roundabout at Intersection 6								
East: Chudalup Road (E)	0.347	0.194	2.9	1.3	LOS A	LOS A	0.0	0.0
North: LSP 2	1.184	1.017	168.3	40.2	LOS F	LOS E	443.4	165.5
West: Chudalup Road (W)	0.183	0.377	3.1	3.6	LOS A	NA	0.0	0.0
Intersection	**1.184**	**1.017**	**65.3**	**18.5**	**LOS F**	**LOS B**	**443.4**	**165.5**
Option B: Single Lane Roundabout with Single/Dual Lane Roundabout at Intersection 6								
East: Chudalup Road (E)	1.015	0.564	59.1	9.6	LOS E	LOS A	277.3	39.2
North: LSP 2	0.682	0.865	11.9	18.8	LOS B	LOS B	51.3	126.3
West: Chudalup Road (W)	0.663	0.809	9.0	5.7	LOS A	LOS A	55.8	100.0
Intersection	**1.015**	**0.865**	**28.8**	**10.9**	**LOS C**	**LOS B**	**277.3**	**126.3**
Option C: Roundabout with Turn Lanes at Intersection 6 and 7								
East: Chudalup Road (E)	0.396	0.324	9.3	7.3	LOS A	LOS A	20.9	17.2
North: LSP 2	0.391	0.371	9.6	8.7	LOS A	LOS A	21.8	18.4
West: Chudalup Road (W)	0.280	0.448	5.9	4.7	LOS A	LOS A	14.7	28.1
Intersection	**0.396**	**0.448**	**8.3**	**6.6**	**LOS A**	**LOS A**	**21.8**	**28.1**

Intersection 7 performs best as a roundabout with turn lanes and with a roundabout with turn lanes at Intersection 6 (Option C) as the 95th percentile back of queue length under Option B extends beyond the distance between Intersection 6 and 7. Thus could be the recommended intersection configuration for Intersection 6.

Intersection 8: NS-1 & EW-2

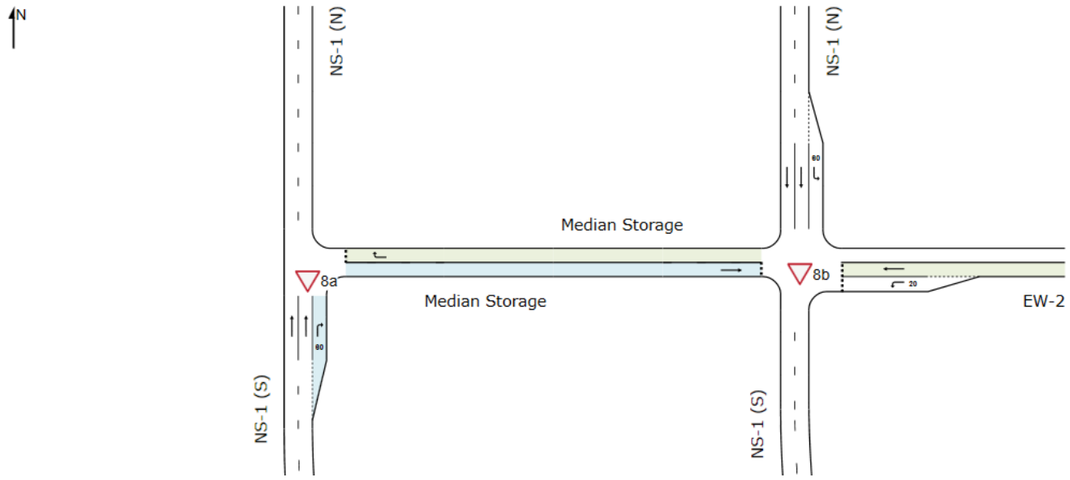
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 8 is shown in **Figure C-15**.

Figure C-15: Intersection 8 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure C-16**, which includes a 3-leg roundabout with dual lanes on the north and south legs and a single lane on the eastern leg.

Figure C-16: Intersection 8 – Intersection Layout Diagram



Source: SIDRA Solutions

The networked intersection outputs as a summary of each approach are provided in **Table C-8**, with a detailed lane summary report provided in **Appendix D**.

Table C-8: Intersection 8 – SIDRA Network Approach Output Summary

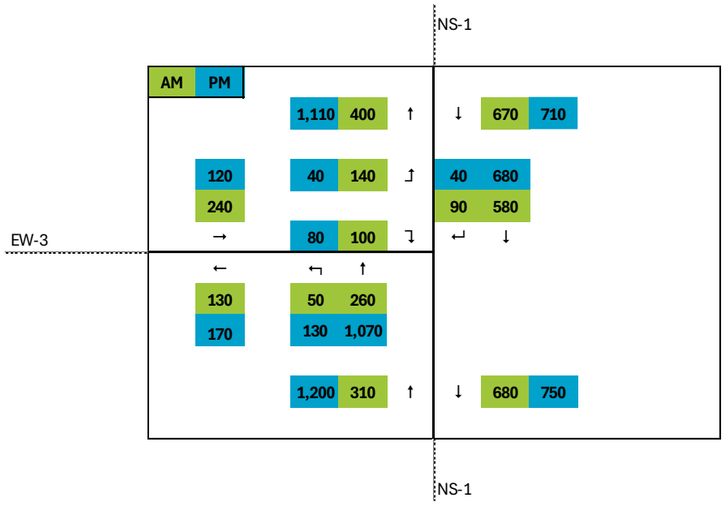
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Roundabout								
South: NS-1	0.100	0.298	1.7	0.1	LOS A	LOS A	0.0	0.0
East: EW-2	0.747	0.315	21.7	12.3	LOS C	LOS B	35.4	8.1
North: NS-1	0.289	0.189	2.6	0.7	LOS A	LOS A	0.0	0.0
Intersection	**0.747**	**0.315**	**9.7**	**4.1**	**LOS A**	**LOS A**	**35.4**	**8.1**

The intersection performance outputs for Intersection 8 as a staged crossing T-intersection are very good and thus could be the recommended treatment for this intersection.

Intersection 9: NS-1 & EW-3

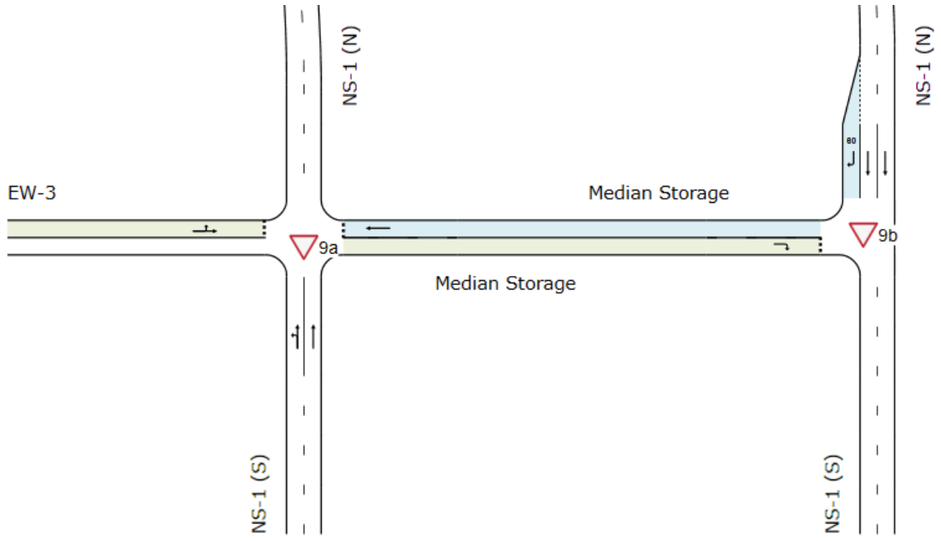
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 9 is shown in **Figure C-17**.

Figure C-17: Intersection 9 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure C-18**, which includes a staged crossing T-intersection with a right-turn lane for the NS-1 southbound approach.

Figure C-18: Intersection 9 – Intersection Layout Diagram



Source: SIDRA Solutions

The networked intersection outputs as a summary of each approach are provided in **Table C-9**, with a detailed lane summary report provided in **Appendix D**.

Table C-9: Intersection 9 – SIDRA Network Approach Output Summary

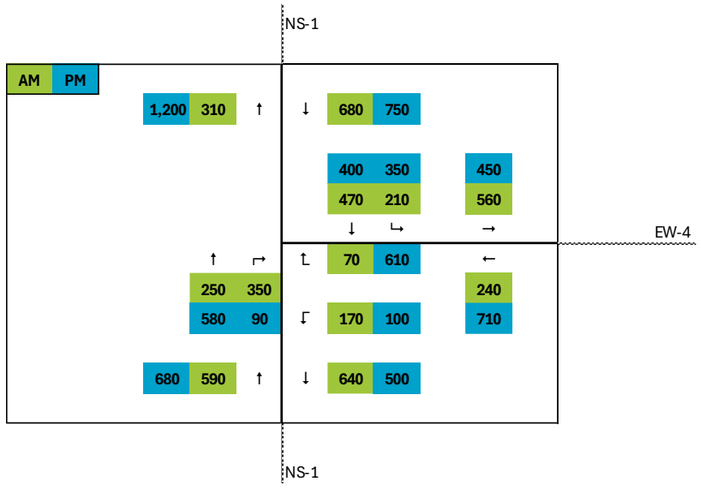
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Staged Crossing T-Intersection								
South: NS-1	0.085	0.326	0.9	0.6	LOS A	LOS A	0.0	0.0
North: NS-1	0.157	0.183	0.8	0.3	LOS A	LOS A	0.0	0.0
West: EW-3	0.227	0.411	6.7	20.4	LOS A	LOS C	7.8	13.1
Intersection	**0.227**	**0.411**	**3.1**	**2.6**	**LOS A**	**LOS C**	**7.8**	**13.1**

The intersection performance outputs for Intersection 9 as a staged crossing T-intersection are very good and thus could be the recommended treatment for this intersection.

Intersection 10: NS-1 & EW-3

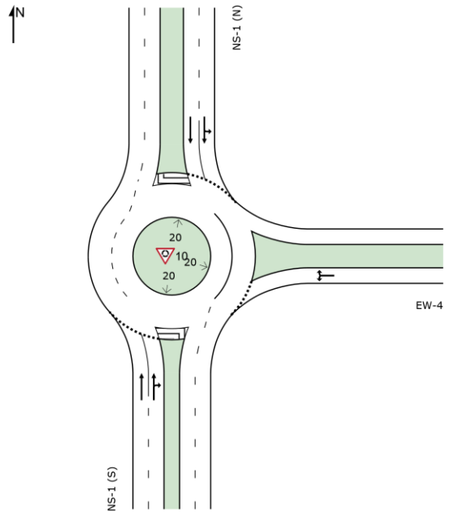
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 10 is shown in **Figure C-19**.

Figure C-19: Intersection 10 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure C-20**, which a 3-leg roundabout with dual lanes on the north and south legs and single lanes on the eastern leg.

Figure C-20: Intersection 10 – Intersection Layout Diagram



Source: SIDRA Solutions

The isolated intersection outputs as a summary of each approach are provided in **Table C-10**, with a detailed lane summary report provided in **Appendix D**.

Table C-10: Intersection 10 – SIDRA Site Approach Output Summary

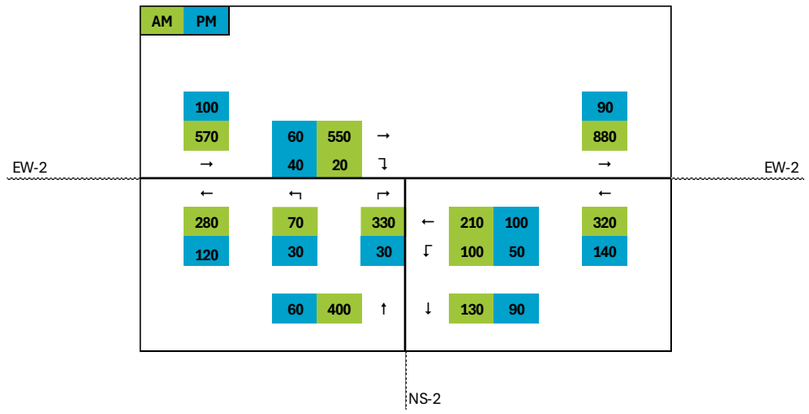
Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Roundabout								
South: NS-1	0.219	0.402	10.3	11.1	LOS B	LOS B	10.7	22.8
East: EW-4	0.275	0.758	8.3	15.1	LOS A	LOS B	9.7	61.7
North: NS-1	0.289	0.265	7.1	5.7	LOS A	LOS A	14.0	14.7
Intersection	**0.289**	**0.758**	**7.8**	**10.1**	**LOS A**	**LOS B**	**14.0**	**61.7**

The intersection performance outputs for Intersection 10 as a roundabout is very good, thus could be the recommended treatment for this intersection. However, the form of this intersection is subject to further detail of access locations and land use components as part of the District Centre precinct structure planning stage.

Intersection 11: EW-2 & NS-2

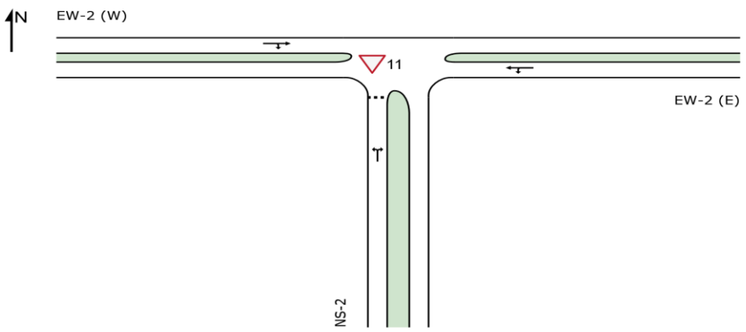
The forecast anticipated peak hour turning volumes (to the nearest 10vph) at Intersection 11 is shown in **Figure C-21**.

Figure C-21: Intersection 11 – Turning Volume Diagram for Anticipated Ultimate 2051 Peak Hour Traffic Volumes



The SIDRA Intersection layout assessed is shown in **Figure C-22**, which includes a standard T-intersection with 2-lanes on each leg.

Figure C-21: Intersection 11 – Intersection Layout Diagram



Source: SIDRA Solutions

The networked intersection outputs as a summary of each approach are provided in **Table C-11**, with a detailed lane summary report provided in **Appendix D**.

Table C-11: Intersection 11 – SIDRA Network Approach Output Summary

Approach Leg	Degree of Saturation		Average Delay (s)		Level of Service (LOS)		95th%ile Queue Length (m)	
	AM	PM	AM	PM	AM	PM	AM	PM
Option A: Standard T-Intersection								
South: NS-2	0.783	0.048	20.0	6.2	LOS C	LOS A	53.6	1.3
East: EW-2	0.174	0.079	1.9	1.9	LOS A	LOS A	0.0	0.0
West: EW-2	0.314	0.063	0.3	2.8	LOS A	LOS A	1.6	1.8
Intersection	**0.783**	**0.079**	**6.8**	**3.0**	**LOS C**	**LOS A**	**53.6**	**1.8**

The intersection performance outputs for Intersection 11 as a standard T-intersection is very good and thus could be the recommended treatment for this intersection.

Appendix D SIDRA Intersection Modelling Outputs

Intersection 1 - THNEI / NS-1 & EW-1

2051 AM - Intersection 1 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: THNEI Access															
Lane 1 d	572	2	572	2	1538	0.37	100	3.9	LOS A	2.3	17	Full	500	0	0
Lane 2	502	2.2	502	2.2	1350	0.37	100	4.4	LOS A	2.2	16.7	Full	500	0	0
Approach	1074	2.1	1074	2.1		0.37		4.1	LOS A	2.3	17				
East: EW-1 (E)															
Lane 1 d	51	5	51	5	668	0.08	100	7.8	LOS A	0.4	3.2	Full	200	0	0
Lane 2	35	5	35	5	454	0.08	100	13.4	LOS B	0.4	2.7	Full	200	0	0
Approach	86	5	86	5		0.08		10.1	LOS B	0.4	3.2				
North: NS-1															
Lane 1 d	389	2.6	389	2.6	716	0.54	100	8.5	LOS A	3.8	28.5	Full	280	0	0
Lane 2	281	2	281	2	517	0.54	100	11.1	LOS B	3.3	24.8	Full	280	0	0
Approach	669	2.3	669	2.3		0.54		9.6	LOS A	3.8	28.5				
West: EW-1 (W)															
Lane 1 d	850	2.7	850	2.7	1199	0.71	100	11	LOS B	7.9	59.8	Full	460	0	0
Lane 2	727	2	727	2	1024	0.71	100	14.8	LOS B	7.7	57.5	Full	460	0	0
Approach	1577	2.4	1577	2.4		0.71		12.8	LOS B	7.9	59.8				
All Vehicles	3406	2.4	3406	2.4		0.71		9.3	LOS A	7.9	59.8				

2051 PM - Intersection 1 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: THNEI Access															
Lane 1 d	953	2	953	2	968	0.99	100	27.8	LOS C	24.9	187	Full	500	0	0
Lane 2	754	2.5	754	2.5	766	0.99	100	33.1	LOS C	22.3	168	Full	500	0	0
Approach	1707	2.2	1707	2.2		0.99		30.1	LOS C	24.9	187				
East: EW-1 (E)															
Lane 1 d	529	5	529	5	800	0.66	100	9.5	LOS A	5.2	40.4	Full	200	0	0
Lane 2	391	5	391	5	592	0.66	100	14.7	LOS B	4.6	35.8	Full	200	0	0
Approach	920	5	920	5		0.66		11.7	LOS B	5.2	40.4				
North: NS-1															
Lane 1 d	299	3.2	299	3.2	757	0.4	100	6.7	LOS A	2.4	18	Full	280	0	0
Lane 2	225	2	225	2	570	0.4	100	8.3	LOS A	2.1	16.1	Full	280	0	0
Approach	524	2.7	524	2.7		0.4		7.4	LOS A	2.4	18				
West: EW-1 (W)															
Lane 1 d	591	3.2	591	3.2	762	0.78	100	20.6	LOS C	11.2	84.7	Full	460	0	0
Lane 2	480	2	480	2	619	0.78	100	24.9	LOS C	9.9	74.2	Full	460	0	0
Approach	1071	2.7	1071	2.7		0.78		22.5	LOS C	11.2	84.7				
All Vehicles	4222	3	4222	3		0.99		21.4	LOS C	24.9	187				

2051 AM - Intersection 1 - Option B (Traffic Signals)- Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: THNEI Access															
Lane 1	649	2	649	2	1407	0.46	100	6.9	LOS A	1.8	13.5	Short	250	0	NA
Lane 2	192	2	192	2	352	0.54	100	40.2	LOS D	8.3	62.1	Full	500	0	0
Lane 3	192	2	192	2	352	0.54	100	40.2	LOS D	8.3	62.1	Full	500	0	0
Lane 4	41	5	41	5	114	0.36	100	56	LOS E	2	15.2	Short	60	0	NA
Approach	1074	2.1	1074	2.1		0.54		20.7	LOS C	8.3	62.1				
East: EW-1 (E)															
Lane 1	25	5	25	5	784	0.03	100	10.7	LOS B	0.3	2.5	Short	60	0	NA
Lane 2	19	5	19	5	270	0.07	100	38.9	LOS D	0.8	6	Full	200	0	0
Lane 3	19	5	19	5	270	0.07	100	38.7	LOS D	0.8	6	Full	200	0	0
Lane 4	23	5	23	5	257	0.09	100	44.6	LOS D	1	7.4	Short	60	0	NA
Approach	86	5	86	5		0.09		32.2	LOS C	1	7.4				
North: NS-1															
Lane 1	75	5	75	5	1236	0.06	100	6	LOS A	0.2	1.7	Short	60	0	NA
Lane 2	278	2	278	2	352	0.79	100	44.5	LOS D	13.4	101	Full	300	0	0
Lane 3	278	2	278	2	352	0.79	100	44.5	LOS D	13.4	101	Full	300	0	0
Lane 4	38	2	38	2	117	0.32	100	54.8	LOS D	1.8	13.5	Short	60	0	NA
Approach	669	2.3	669	2.3		0.79		40.8	LOS D	13.4	101				
West: EW-1 (W)															
Lane 1	219	2	219	2	1255	0.18	100	6.3	LOS A	1.3	9.8	Short	60	0	NA
Lane 2	209	5	209	5	690	0.3	100	23.4	LOS C	7	53.8	Full	480	0	0
Lane 3	574	2	574	2	669	0.86	100	43.5	LOS D	28.1	211	Full	480	0	0
Lane 4	574	2	574	2	669	0.86	100	43.5	LOS D	28.1	211	Short	180	0	NA
Approach	1577	2.4	1577	2.4		0.86		35.6	LOS D	28.1	211				
All Vehicles	3406	2.4	3406	2.4		0.86		31.8	LOS C	28.1	211				

2051 PM - Intersection 1 - Option B (Traffic Signals) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: THNEI Access															
Lane 1	1100	2	1100	2	1407	0.78	100	7.4	LOS A	6.6	49.2	Short	250	0	NA
Lane 2	242	2	242	2	393	0.61	100	35.4	LOS D	9.4	70.4	Full	500	0	0
Lane 3	242	2	242	2	393	0.61	100	35.4	LOS D	9.4	70.4	Full	500	0	0
Lane 4	124	5	124	5	145	0.86	100	56.9	LOS E	5.9	45.8	Short	60	0	NA
Approach	1707	2.2	1707	2.2		0.86		18.9	LOS B	9.4	70.4				
East: EW-1 (E)															
Lane 1	135	5	135	5	1049	0.13	100	8.2	LOS A	1.2	9.5	Short	60	0	NA
Lane 2	285	5	285	5	333	0.86	100	46.3	LOS D	13.2	102	Full	200	0	0
Lane 3	285	5	285	5	333	0.86	100	44.7	LOS D	13.2	102	Full	200	0	0
Lane 4	216	5	216	5	316	0.68	100	43.3	LOS D	8.9	68.7	Short	60	0	NA
Approach	920	5	920	5		0.86		39.5	LOS D	13.2	102				
North: NS-1															
Lane 1	124	5	124	5	1236	0.1	100	6.1	LOS A	0.4	3.4	Short	60	0	NA
Lane 2	186	2	186	2	393	0.47	100	33	LOS C	7	52.3	Full	300	0	0
Lane 3	186	2	186	2	393	0.47	100	33	LOS C	7	52.3	Full	300	0	0
Lane 4	28	2	28	2	148	0.19	100	47.3	LOS D	1.2	8.8	Short	60	0	NA
Approach	524	2.7	524	2.7		0.47		27.4	LOS C	7	52.3				
West: EW-1 (W)															
Lane 1	14	2	14	2	1123	0.01	100	6.6	LOS A	0.1	0.5	Short	60	0	NA
Lane 2	233	5	233	5	497	0.47	100	29	LOS C	8.3	63.9	Full	480	0	0
Lane 3	412	2	412	2	482	0.86	100	45.8	LOS D	18.8	141	Full	480	0	0
Lane 4	412	2	412	2	482	0.86	100	45.8	LOS D	18.8	141	Short	180	0	NA
Approach	1071	2.7	1071	2.7		0.86		41.7	LOS D	18.8	141				
All Vehicles	4222	3	4222	3		0.86		30.2	LOS C	18.8	141				

Intersection 2 - Halden Road & EW-1

2051 AM - Intersection 2 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1 d	748	0	748	0	1439	0.52	100	9.2	LOS A	4.3	31.6	Full	500	0	0
Lane 2	596	0	596	0	1147	0.52	100	12.6	LOS B	4.1	29.8	Full	500	0	0
Approach	1344	0	1344	0		0.52		10.7	LOS B	4.3	31.6				
East: EW-1															
Lane 1 d	383	0	383	0	1549	0.25	100	5.4	LOS A	1.7	12.7	Full	440	0	0
Lane 2	342	0	342	0	1311	0.26	100	11	LOS B	1.8	13	Full	440	0	0
Approach	725	0	725	0		0.26		8	LOS A	1.8	13				
North: Halden Rd (N)															
Lane 1 d	442	0	442	0	923	0.48	100	8.2	LOS A	3.1	22.6	Full	220	0	0
Lane 2	355	0	355	0	742	0.48	100	9.3	LOS A	2.9	21.2	Full	220	0	0
Approach	797	0	797	0		0.48		8.7	LOS A	3.1	22.6				
All Vehicles	2866	0	2866	0		0.52		9.5	LOS A	4.3	31.6				

2051 PM - Intersection 2 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1 d	493	0	493	0	952	0.52	100	12	LOS B	5.3	39.3	Full	500	0	0
Lane 2	366	0	366	0	705	0.52	100	16.8	LOS B	4.8	35.4	Full	500	0	0
Approach	859	0	859	0		0.52		14	LOS B	5.3	39.3				
East: EW-1															
Lane 1 d	975	0	975	0	1260	0.77	100	10.6	LOS B	11.9	87.1	Full	440	0	0
Lane 2	722	0	722	0	1001	0.72	100	16.5	LOS B	9.3	68	Full	440	0	0
Approach	1697	0	1697	0		0.77		13.1	LOS B	11.9	87.1				
North: Halden Rd (N)															
Lane 1 d	483	0	483	0	1053	0.46	98 5	6.9	LOS A	2.9	21.5	Full	220	0	0
Lane 2	423	0	423	0	902	0.47	100	7.7	LOS A	2.9	21.6	Full	220	0	0
Approach	906	0	906	0		0.47		7.2	LOS A	2.9	21.6				
All Vehicles	3462	0	3462	0		0.77		11.8	LOS B	11.9	87.1				

2051 AM - Intersection 2 - Option B (Traffic Signals) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	412	0	412	0	509	0.81	100	27.4	LOS C	13	95.2	Full	500	0	0
Lane 2	466	0	466	0	576	0.81	100	32.2	LOS C	14.5	107	Full	500	0	0
Lane 3	466	0	466	0	576	0.81	100	32.2	LOS C	14.5	107	Short	80	0	NA
Approach	1344	0	1344	0		0.81		30.8	LOS C	14.5	107				
East: EW-1															
Lane 1	383	0	383	0	1599	0.24	100	6.7	LOS A	1	7.3	Full	440	0	0
Lane 2	171	0	171	0	286	0.6	100	34.1	LOS C	5	36.8	Full	440	0	0
Lane 3	171	0	171	0	286	0.6	100	34.1	LOS C	5	36.8	Short	60	0	NA
Approach	725	0	725	0		0.6		19.7	LOS B	5	36.8				
North: Halden Rd (N)															
Lane 1	645	0	645	0	1551	0.42	100	8.4	LOS A	5.5	40.3	Full	220	0	0
Lane 2	152	0	152	0	509	0.3	100	20.1	LOS C	3.7	27.1	Full	220	0	0
Approach	797	0	797	0		0.42		10.6	LOS B	5.5	40.3				
All Vehicles	2866	0	2866	0		0.81		22.4	LOS C	14.5	107				

2051 PM - Intersection 2 - Option B (Traffic Signals) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	282	0	282	0	495	0.57	100	18.6	LOS B	6.3	46.4	Full	500	0	0
Lane 2	288	0	288	0	338	0.85	100	35.2	LOS D	8.4	61.5	Full	500	0	0
Lane 3	288	0	288	0	338	0.85	100	35.2	LOS D	8.4	61.5	Short	80	0	NA
Approach	859	0	859	0		0.85		29.8	LOS C	8.4	61.5				
East: EW-1															
Lane 1	975	0	975	0	1336	0.73	100	11.7	LOS B	12.4	91.3	Full	440	0	0
Lane 2	361	0	361	0	423	0.85	100	34	LOS C	10.4	76.7	Full	440	0	0
Lane 3	361	0	361	0	423	0.85	100	34	LOS C	10.4	76.7	Short	60	0	NA
Approach	1697	0	1697	0		0.85		21.2	LOS C	12.4	91.3				
North: Halden Rd (N)															
Lane 1	483	0	483	0	1472	0.33	100	7.1	LOS A	1.9	13.9	Full	220	0	0
Lane 2	423	0	423	0	495	0.85	100	26.4	LOS C	12.1	89.2	Full	220	0	0
Approach	906	0	906	0		0.85		16.1	LOS B	12.1	89.2				
All Vehicles	3462	0	3462	0		0.85		22	LOS C	12.4	91.3				

Intersection 3 - Halden Road & LSP 4

2051 AM - Intersection 3 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	136	2	136	2	1172	0.12	100	6.5	LOS A	0.5	3.6	Full	220	0	0
Lane 2	618	2	618	2	1945	0.32	100	0	LOS A	0	0	Full	220	0	0
Approach	754	2	754	2		0.32		1.2	LOS A	0.5	3.6				
East: Median Storage															
Lane 1	196	2	196	2	775	0.25	100	3.4	LOS A	1	7.2	Full	8	0	4
Approach	196	2	196	2		0.25		3.4	LOS A	1	7.2				
West: LSP 4 Main Access															
Lane 1	265	2	265	2	830	0.32	100	9.4	LOS A	1.5	11.2	Short	30	0	NA
Lane 2	281	2	281	2	505	0.56	100	15.2	LOS C	3.3	25	Full	500	0	0
Approach	546	2	546	2		0.56		12.4	LOS B	3.3	25				
All Vehicles	1496	2	1496	2		0.56		5.6	NA	3.3	25				

2051 AM - Intersection 3 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
North: Halden Rd (N)															
Lane 1	517	2	517	2	1945	0.27	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	196	2	196	2	1776	0.11	100	5.7	LOS A	0	0	Short	60	-4 N3	NA
Approach	713	2	713	2		0.27		1.6	NA	0	0				
West: Median Storage															
Lane 1	281	2	281	2	1831	0.15	100	0.7	LOS A	0	0	Full	8	0	0
Approach	281	2	281	2		0.15		0.7	NA	0	0				
All Vehicles	994	2	994	2		0.27		1.4	NA	0	0				

2051 PM - Intersection 3 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	373	2	373	2	1182	0.32	100	6.7	LOS A	1.6	11.7	Full	220	0	0
Lane 2	632	2	632	2	1945	0.33	100	0	LOS A	0	0	Full	220	0	0
Approach	1004	2	1004	2		0.33		2.5	LOS A	1.6	11.7				
East: Median Storage															
Lane 1	187	2	187	2	760	0.25	100	3.5	LOS A	0.9	7	Full	8	0	2.9
Approach	187	2	187	2		0.25		3.5	LOS A	0.9	7				
West: LSP4 Main Access															
Lane 1	141	2	141	2	814	0.17	100	8.8	LOS A	0.7	4.9	Short	30	0	NA
Lane 2	222	2	222	2	411	0.54	100	17.7	LOS C	2.9	21.6	Full	500	0	0
Approach	363	2	363	2		0.54		14.2	LOS B	2.9	21.6				
All Vehicles	1555	2	1555	2		0.54		5.4	NA	2.9	21.6				

2051 PM - Intersection 3 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
North: Halden Rd (N)															
Lane 1	685	2	685	2	1945	0.35	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	187	2	187	2	1796	0.1	100	5.7	LOS A	0	0	Short	60	-2.9 N3	NA
Approach	873	2	873	2		0.35		1.3	NA	0	0				
West: Median Storage															
Lane 1	222	2	222	2	1831	0.12	100	0.7	LOS A	0	0	Full	8	0	0
Approach	222	2	222	2		0.12		0.7	NA	0	0				
All Vehicles	1095	2	1095	2		0.35		1.2	NA	0	0				

2051 AM - Intersection 3 - Option B (Staged Crossing T-Intersection with Traffic Signals at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	Aver. Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	136	2	136	2	1172	0.12	100	6.5	LOS A	0.4	3	Full	220	0	0
Lane 2	618	2	618	2	1945	0.32	100	0	LOS A	0	0	Full	220	0	0
Approach	754	2	754	2		0.32		1.2	LOS A	0.4	3				
East: Median Storage															
Lane 1	196	2	196	2	853	0.23	100	3.2	LOS A	1	7.7	Full	8	0	5.8
Approach	196	2	196	2		0.23		3.2	LOS A	1	7.7				
West: LSP4 Main Access															
Lane 1	265	2	265	2	918	0.29	100	9	LOS A	1.5	11.4	Short	30	0	NA
Lane 2	281	2	281	2	618	0.46	100	12.5	LOS B	3	22.5	Full	500	0	0
Approach	546	2	546	2		0.46		10.8	LOS B	3	22.5				
All Vehicles	1496	2	1496	2		0.46		5	NA	3	22.5				

2051 AM - Intersection 3 - Option B (Staged Crossing T-Intersection with Traffic Signals at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	Aver. Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
North: Halden Rd (N)															
Lane 1	517	2	517	2	1945	0.27	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	196	2	196	2	1744	0.11	100	5.7	LOS A	0	0	Short	60	-5.8 N3	NA
Approach	713	2	713	2		0.27		1.6	NA	0	0				
West: Median Storage															
Lane 1	281	2	281	2	1831	0.15	100	0.7	LOS A	0	0	Full	8	0	0
Approach	281	2	281	2		0.15		0.7	NA	0	0				
All Vehicles	994	2	994	2		0.27		1.4	NA	0	0				

2051 PM - Intersection 3 - Option B (Staged Crossing T-Intersection with Traffic Signals at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	Aver. Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	373	2	373	2	1182	0.32	100	6.7	LOS A	1.3	10.1	Full	220	0	0
Lane 2	632	2	632	2	1945	0.33	100	0	LOS A	0	0	Full	220	0	0
Approach	1004	2	1004	2		0.33		2.5	LOS A	1.3	10.1				
East: Median Storage															
Lane 1	187	2	187	2	839	0.22	100	3.3	LOS A	1	7.4	Full	8	0	4.6
Approach	187	2	187	2		0.22		3.3	LOS A	1	7.4				
West: LSP4 Main Access															
Lane 1	141	2	141	2	902	0.16	100	8.6	LOS A	0.7	5.4	Short	30	0	NA
Lane 2	222	2	222	2	535	0.42	100	13.4	LOS B	2.4	17.8	Full	500	0	0
Approach	363	2	363	2		0.42		11.6	LOS B	2.4	17.8				
All Vehicles	1555	2	1555	2		0.42		4.7	NA	2.4	17.8				

2051 PM - Intersection 3 - Option B (Staged Crossing T-Intersection with Traffic Signals at Intersection 2a) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	Aver. Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
North: Halden Rd (N)															
Lane 1	685	2	685	2	1945	0.35	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	187	2	187	2	1765	0.11	100	5.7	LOS A	0	0	Short	60	-4.6 N3	NA
Approach	873	2	873	2		0.35		1.3	NA	0	0				
West: Median Storage															
Lane 1	222	2	222	2	1831	0.12	100	0.7	LOS A	0	0	Full	8	0	0
Approach	222	2	222	2		0.12		0.7	NA	0	0				
All Vehicles	1095	2	1095	2		0.35		1.2	NA	0	0				

Intersection 4 - Halden Road & EW-3

2051 AM - Intersection 4 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	780	2	780	2	1925	0.41	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	103	2	103	2	1831	0.06	100	5.8	LOS A	0	0	Short	60	0	NA
Approach	883	2	883	2		0.41		0.8	NA	0	0				
East: Median Storage															
Lane 1	40	2	40	2	923	0.04	100	2.5	LOS A	0.1	0.7	Full	8	0	0
Approach	40	2	40	2		0.04		2.5	LOS A	0.1	0.7				
All Vehicles	923	2	923	2		0.41		0.8	NA	0.1	0.7				

2051 AM - Intersection 4 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: EW-3															
Lane 1	177	2	177	2	758	0.23	100	9.1	LOS A	0.9	7	Full	500	0	0
Approach	177	2	177	2		0.23		9.1	LOS A	0.9	7				
North: Halden Rd (N)															
Lane 1	584	2	584	2	1924	0.3	100	0.1	LOS A	0	0	Full	300	0	0
Approach	584	2	584	2		0.3		0.1	NA	0	0				
West: Median Storage															
Lane 1	103	2	103	2	812	0.13	100	2.7	LOS A	0.4	3.3	Full	8	0	0
Approach	103	2	103	2		0.13		2.7	LOS A	0.4	3.3				
All Vehicles	864	2	864	2		0.3		2.3	NA	0.9	7				

2051 PM - Intersection 4 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd (S)															
Lane 1	743	2	743	2	1925	0.39	100	0.1	LOS A	0	0	Full	380	0	0
Lane 2	29	2	29	2	1831	0.02	100	5.7	LOS A	0	0	Short	60	0	NA
Approach	773	2	773	2		0.39		0.3	NA	0	0				
East: Median Storage															
Lane 1	17	2	17	2	955	0.02	100	2.3	LOS A	0	0.3	Full	8	0	0
Approach	17	2	17	2		0.02		2.3	LOS A	0	0.3				
All Vehicles	789	2	789	2		0.39		0.4	NA	0	0.3				

2051 PM - Intersection 4 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: EW-3															
Lane 1	37	2	37	2	415	0.09	100	12.9	LOS B	0.3	2.2	Full	500	0	0
Approach	37	2	37	2		0.09		12.9	LOS B	0.3	2.2				
North: Halden Rd (N)															
Lane 1	895	2	895	2	1920	0.47	100	0.4	LOS A	0	0	Full	300	0	0
Approach	895	2	895	2		0.47		0.4	NA	0	0				
West: Median Storage															
Lane 1	29	2	29	2	492	0.06	100	5.7	LOS A	0.2	1.4	Full	8	0	0
Approach	29	2	29	2		0.06		5.7	LOS A	0.2	1.4				
All Vehicles	961	2	961	2		0.47		1	NA	0.3	2.2				

Intersection 5 - Chudalup Road & Halden Road

2051 AM - Intersection 5 - Option A (Single Lane Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd															
Lane 1 d	820	2	820	2	1172	0.7	100	7.5	LOS A	8	60.2	Full	300	0	0
Approach	820	2	820	2		0.7		7.5	LOS A	8	60.2				
East: Chudalup Rd (E)															
Lane 1 d	329	2	329	2	845	0.39	100	7.4	LOS A	2.8	20.9	Full	480	0	0
Approach	329	2	329	2		0.39		7.4	LOS A	2.8	20.9				
West: Chudalup Rd (W)															
Lane 1 d	925	2	925	2	1184	0.78	100	9.9	LOS A	11.5	86.6	Full	180	0	0
Approach	925	2	925	2		0.78		9.9	LOS A	11.5	86.6				
All Vehicles	2075	2	2075	2		0.78		8.6	LOS A	11.5	86.6				

2051 PM - Intersection 5 - Option A (Single Lane Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd															
Lane 1 d	760	2	760	2	841	0.9	100	23.1	LOS C	19.8	148.8	Full	300	0	0
Approach	760	2	760	2		0.9		23.1	LOS C	19.8	148.8				
East: Chudalup Rd (E)															
Lane 1 d	735	2	735	2	590	1.25	100	244	LOS F	105.5	791.4	Full	480	0	22.6
Approach	735	2	735	2		1.25		244	LOS F	105.5	791.4				
West: Chudalup Rd (W)															
Lane 1 d	1081	2	1081	2	1120	0.97	100	25.3	LOS C	34.4	258.3	Full	180	0	16.9
Approach	1081	2	1081	2		0.97		25.3	LOS C	34.4	258.3				
All Vehicles	2576	2	2576	2		1.25		86.9	LOS F	105.5	791.4				

2051 AM - Intersection 5 - Option B (Single Lane Roundabout with Turn Lanes) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd															
Lane 1 d	623	2	623	2	1330	0.47	100	4.9	LOS A	3.3	24.6	Short	60	0	NA
Lane 2	197	2	197	2	894	0.22	100	10.2	LOS B	1.1	8.2	Full	300	0	0
Approach	820	2	820	2		0.47		6.2	LOS A	3.3	24.6				
East: Chudalup Rd (E)															
Lane 1	129	2	129	2	979	0.13	83 5	6.2	LOS A	0.8	5.8	Short	60	0	NA
Lane 2 d	200	2	200	2	1257	0.16	100	5.6	LOS A	1	7.6	Full	480	0	0
Approach	329	2	329	2		0.16		5.8	LOS A	1	7.6				
West: Chudalup Rd (W)															
Lane 1 d	469	2	469	2	1515	0.31	100	4.7	LOS A	2.1	15.6	Full	180	0	0
Lane 2	456	2	456	2	1274	0.36	100	10.1	LOS B	2.4	18.3	Full	180	0	0
Approach	925	2	925	2		0.36		7.3	LOS A	2.4	18.3				
All Vehicles	2075	2	2075	2		0.47		6.6	LOS A	3.3	24.6				

2051 PM - Intersection 5 - Option B (Single Lane Roundabout with Turn Lanes) - Lane Use and Performance

	Demand [Total veh/h	HV] %	Arrival [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Halden Rd															
Lane 1 d	526	2	526	2	929	0.57	100	8	LOS A	5.2	38.8	Short	60	0	NA
Lane 2	234	2	234	2	703	0.33	100	12.3	LOS B	2.1	15.4	Full	300	0	0
Approach	760	2	760	2		0.57		9.3	LOS A	5.2	38.8				
East: Chudalup Rd (E)															
Lane 1	181	2	181	2	710	0.26	46 5	8.6	LOS A	1.7	12.8	Short	60	0	NA
Lane 2 d	554	2	554	2	994	0.56	100	9.5	LOS A	5.8	43.4	Full	480	0	0
Approach	735	2	735	2		0.56		9.3	LOS A	5.8	43.4				
West: Chudalup Rd (W)															
Lane 1	367	2	367	2	1133	0.32	100	5.3	LOS A	2.2	16.8	Full	180	0	0
Lane 2 d	714	2	714	2	1455	0.49	100	10.1	LOS B	4.2	31.9	Full	180	0	0
Approach	1081	2	1081	2		0.49		8.5	LOS A	4.2	31.9				
All Vehicles	2576	2	2576	2		0.57		9	LOS A	5.8	43.4				

Intersection 6 - Chudalup Road & NS-1

2051 AM - Intersection 6 - Option A (Roundabout with Staged Crossing T-Intersection at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	158	2	158	2	1034	0.15	100	5.4	LOS A	0.9	7	Full	500	0	0
Lane 2 d	393	2	393	2	1389	0.28	100	9.2	LOS A	2.1	15.8	Full	500	0	0
Approach	551	2	551	2		0.28		8.1	LOS A	2.1	15.8				
East: Chudalup Rd (E)															
Lane 1 d	882	2	802	2	889	0.9	100	21.3	LOS C	20.3	152.1	Full	180	0	0.2
Approach	882	2	802	2		0.9		21.3	LOS C	20.3	152.1				
West: Chudalup Rd (W)															
Lane 1 d	665	2	665	2	974	0.68	100	12.9	LOS B	7.7	58.1	Full	480	0	0
Approach	665	2	665	2		0.68		12.9	LOS B	7.7	58.1				
All Vehicles	2098	2	2018	2.1		0.9		14.9	LOS B	20.3	152.1				

2051 PM - Intersection 6 - Option A (Roundabout with Staged Crossing T-Intersection at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	502	2	502	2	1086	0.46	100	6.1	LOS A	3.7	27.9	Full	500	0	0
Lane 2 d	763	2	763	2	1318	0.58	100	10	LOS B	5.6	41.9	Full	500	0	0
Approach	1265	2	1265	2		0.58		8.5	LOS A	5.6	41.9				
East: Chudalup Rd (E)															
Lane 1 d	799	2	792	2	1064	0.74	100	8.7	LOS A	10.2	76.8	Full	180	0	0
Approach	799	2	792	2		0.74		8.7	LOS A	10.2	76.8				
West: Chudalup Rd (W)															
Lane 1 d	600	2	600	2	628	0.96	100	49.4	LOS D	24.9	186.9	Full	480	0	0
Approach	600	2	600	2		0.96		49.4	LOS D	24.9	186.9				
All Vehicles	2664	2	2657	2		0.96		17.8	LOS B	24.9	186.9				

2051 AM - Intersection 6 - Option B (Roundabout with Roundabout at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	158	2	158	2	1016	0.16	100	5.5	LOS A	1	7.1	Full	500	0	0
Lane 2 d	393	2	393	2	1364	0.29	100	9.3	LOS A	2.1	16	Full	500	0	0
Approach	551	2	551	2		0.29		8.2	LOS A	2.1	16				
East: Chudalup Rd (E)															
Lane 1 d	882	2	882	2	894	0.99	100	40.5	LOS D	36.4	273.2	Full	180	0	19.1
Approach	882	2	882	2		0.99		40.5	LOS D	36.4	273.2				
West: Chudalup Rd (W)															
Lane 1 d	665	2	665	2	971	0.69	100	12.9	LOS B	7.8	58.6	Full	480	0	0
Approach	665	2	665	2		0.69		12.9	LOS B	7.8	58.6				
All Vehicles	2098	2	2098	2		0.99		23.3	LOS C	36.4	273.2				

2051 PM - Intersection 6 - Option B (Roundabout with Roundabout at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	502	2	502	2	1083	0.46	100	6.1	LOS A	3.7	28	Full	500	0	0
Lane 2 d	763	2	763	2	1315	0.58	100	10	LOS B	5.6	42.1	Full	500	0	0
Approach	1265	2	1265	2		0.58		8.5	LOS A	5.6	42.1				
East: Chudalup Rd (E)															
Lane 1 d	799	2	799	2	1065	0.75	100	8.9	LOS A	10.5	78.8	Full	180	0	0
Approach	799	2	799	2		0.75		8.9	LOS A	10.5	78.8				
West: Chudalup Rd (W)															
Lane 1 d	600	2	600	2	627	0.96	100	49.7	LOS D	25.1	188.1	Full	480	0	0
Approach	600	2	600	2		0.96		49.7	LOS D	25.1	188.1				
All Vehicles	2664	2	2664	2		0.96		17.9	LOS B	25.1	188.1				

2051 AM - Intersection 6 - Option C (Roundabout inc. Turn Lanes with Roundabout inc. Turn Lanes at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	158	2	158	2	1067	0.15	100	5.2	LOS A	0.9	6.4	Full	500	0	0
Lane 2 d	393	2	393	2	1426	0.28	100	9.4	LOS A	1.9	14.2	Full	500	0	0
Approach	551	2	551	2		0.28		8.2	LOS A	1.9	14.2				
East: Chudalup Rd (E)															
Lane 1 d	711	2	711	2	1119	0.64	100	8.2	LOS A	7	52.6	Short	80	0	NA
Lane 2	172	2	172	2	721	0.24	100	7.3	LOS A	1.4	10.9	Full	180	0	0
Approach	882	2	882	2		0.64		8	LOS A	7	52.6				
West: Chudalup Rd (W)															
Lane 1 d	665	2	665	2	1007	0.66	100	12.2	LOS B	7.1	53.4	Full	480	0	0
Approach	665	2	665	2		0.66		12.2	LOS B	7.1	53.4				
All Vehicles	2098	2	2098	2		0.66		9.4	LOS A	7.1	53.4				

2051 PM - Intersection 6 - Option C (Roundabout inc. Turn Lanes with Roundabout inc. Turn Lanes at Intersection 7) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1															
Lane 1	502	2	502	2	1128	0.45	100	5.8	LOS A	3.3	25	Full	500	0	0
Lane 2 d	763	2	763	2	1379	0.55	100	10.1	LOS B	4.9	36.6	Full	500	0	0
Approach	1265	2	1265	2		0.55		8.4	LOS A	4.9	36.6				
East: Chudalup Rd (E)															
Lane 1 d	566	2	566	2	1282	0.44	100	5.6	LOS A	3.7	28	Short	80	0	NA
Lane 2	233	2	233	2	954	0.24	100	5.7	LOS A	1.6	11.9	Full	180	0	0
Approach	799	2	799	2		0.44		5.6	LOS A	3.7	28				
West: Chudalup Rd (W)															
Lane 1 d	600	2	600	2	668	0.9	100	35.2	LOS D	18.6	139.8	Full	480	0	0
Approach	2664	2	2664	2		0.9		13.6	LOS B	18.6	139.8				

Intersection 7 - Chudalup Road & LSP 2

2051 AM - Intersection 7 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Median Storage															
Lane 1	358	2	358	2	828	0.43	100	4.2	LOS A	2.4	17.7	Full	8	0	44.3
Approach	358	2	358	2		0.43		4.2	LOS A	2.4	17.7				
North: LSP 2															
Lane 1	72	2	72	2	1254	0.06	100	6.5	LOS A	0.2	1.7	Short	30	0	NA
Lane 2	514	2	514	2	434	1.18	100	191	LOS F	59.1	443.4	Full	500	-8.3 N3	1.6
Approach	585	2	585	2		1.18		168	LOS F	59.1	443.4				
West: Chudalup Rd (W)															
Lane 1	338	2	338	2	1850	0.18	100	5.6	LOS A	0	0	Short	90	0	NA
Lane 2	278	2	278	2	1945	0.14	100	0	LOS A	0	0	Full	180	0	0
Approach	616	2	616	2		0.18		3.1	NA	0	0				
All Vehicles	1559	2	1559	2		1.18		65.3	NA	59.1	443.4				

2051 AM - Intersection 7 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1	368	2	368	2	1925	0.19	100	0	LOS A	0	0	Full	500	-1	N3	0
Lane 2	358	2	358	2	1031	0.35	100	5.9	LOS A	0	0	Short	60	-44	N3	NA
Approach	726	2	726	2		0.35		2.9	NA	0	0					
North: Median Storage																
Lane 1	514	2	434	2	1256	0.35	100	1.6	LOS A	1.1	8.1	Full	8	-1	N3	7.2
Approach	514	2	434	2		0.35		1.6	LOS A	1.1	8.1					
All Vehicles	1240	2	1160	2.1		0.35		2.4	NA	1.1	8.1					

2051 PM - Intersection 7 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
South: Median Storage																
Lane 1	104	2	104	2	428	0.24	100	8.2	LOS A	0.9	6.4	Full	8	0		0.5
Approach	104	2	104	2		0.24		8.2	LOS A	0.9	6.4					
North: LSP 2																
Lane 1	381	2	381	2	1104	0.35	100	7.7	LOS A	1.8	13.3	Short	30	0		NA
Lane 2	422	2	422	2	415	1.02	100	69.5	LOS F	22.1	165.5	Full	500	-5.7	N3	0
Approach	803	2	803	2		1.02		40.2	LOS E	22.1	165.5					
West: Chudalup Rd (W)																
Lane 1	698	2	698	2	1850	0.38	100	5.6	LOS A	0	0	Short	90	0		NA
Lane 2	395	2	395	2	1945	0.2	100	0	LOS A	0	0	Full	180	0		0
Approach	1093	2	1093	2		0.38		3.6	NA	0	0					
All Vehicles	2000	2	2000	2		1.02		18.5	NA	22.1	165.5					

2051 PM - Intersection 7 - Option A (Staged Crossing T-Intersection with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1	377	2	377	2	1945	0.19	100	0	LOS A	0	0	Full	500	0		0
Lane 2	104	2	104	2	1841	0.06	100	5.7	LOS A	0	0	Short	60	-0.5	N3	NA
Approach	481	2	481	2		0.19		1.3	NA	0	0					
North: Median Storage																
Lane 1	422	2	415	2	1262	0.33	100	1.6	LOS A	1	7.4	Full	8	0		4.8
Approach	422	2	415	2		0.33		1.6	LOS A	1	7.4					
All Vehicles	903	2	896	2		0.33		1.4	NA	1	7.4					

2051 AM - Intersection 7 - Option B (Roundabout with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1 d	726	2	726	2	715	1.02	100	59.1	LOS E	37	277.3	Full	500	-11	N3	0
Approach	726	2	726	2		1.02		59.1	LOS E	37	277.3					
North: LSP 2																
Lane 1 d	585	2	585	2	858	0.68	100	11.9	LOS B	6.8	51.3	Full	500	-17	N3	0
Approach	585	2	585	2		0.68		11.9	LOS B	6.8	51.3					
West: Chudalup Rd (W)																
Lane 1 d	616	2	616	2	928	0.66	100	9	LOS A	7.4	55.8	Full	180	0		0
Approach	616	2	616	2		0.66		9	LOS A	7.4	55.8					
All Vehicles	1927	2	1927	2		1.02		28.8	LOS C	37	277.3					

2051 PM - Intersection 7 - Option B (Roundabout with Roundabout at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1 d	481	2	481	2	852	0.56	100	9.6	LOS A	5.2	39.2	Full	500	0		0
Approach	481	2	481	2		0.56		9.6	LOS A	5.2	39.2					
North: LSP 2																
Lane 1 d	803	2	803	2	928	0.87	100	18.8	LOS B	16.8	126.3	Full	500	0		0
Approach	803	2	803	2		0.87		18.8	LOS B	16.8	126.3					
West: Chudalup Rd (W)																
Lane 1 d	1093	2	1093	2	1350	0.81	100	5.7	LOS A	13.3	100	Full	180	0		0
Approach	1093	2	1093	2		0.81		5.7	LOS A	13.3	100					
All Vehicles	2377	2	2377	2		0.87		10.9	LOS B	16.8	126.3					

2051 AM - Intersection 7 - Option C (Roundabout inc. Turn Lanes with Roundabout inc. Turn Lanes at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1 d	368	2	368	2	1090	0.34	100	6.7	LOS A	2.5	18.4	Full	500	0		0
Lane 2	358	2	358	2	905	0.4	100	12	LOS B	2.8	20.9	Full	500	0		0
Approach	726	2	726	2		0.4		9.3	LOS A	2.8	20.9					
North: LSP 2																
Lane 1	72	2	72	2	849	0.08	100	6	LOS A	0.4	3.3	Short	60	0		NA
Lane 2 d	514	2	514	2	1312	0.39	100	10.1	LOS B	2.9	21.8	Full	500	0		0
Approach	585	2	585	2		0.39		9.6	LOS A	2.9	21.8					
West: Chudalup Rd (W)																
Lane 1 d	338	2	338	2	1208	0.28	100	5.8	LOS A	2	14.7	Short	80	0		NA
Lane 2	278	2	278	2	1013	0.27	100	6.1	LOS A	1.8	13.6	Full	180	0		0
Approach	616	2	616	2		0.28		5.9	LOS A	2	14.7					
All Vehicles	1927	2	1927	2		0.4		8.3	LOS A	2.9	21.8					

2051 PM - Intersection 7 - Option C (Roundabout inc. Turn Lanes with Roundabout inc. Turn Lanes at Intersection 6) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: Chudalup Rd (E)																
Lane 1 d	377	2	377	2	1164	0.32	100	6.1	LOS A	2.3	17.2	Full	500	0		0
Lane 2	104	2	104	2	777	0.13	100	11.5	LOS B	0.7	5.6	Full	500	0		0
Approach	481	2	481	2		0.32		7.3	LOS A	2.3	17.2					
North: LSP 2																
Lane 1	381	2	381	2	1028	0.37	100	6.6	LOS A	2.5	18.4	Short	60	0		NA
Lane 2 d	422	2	422	2	1220	0.35	100	10.7	LOS B	2.4	17.7	Full	500	0		0
Approach	803	2	803	2		0.37		8.7	LOS A	2.5	18.4					
West: Chudalup Rd (W)																
Lane 1 d	698	2	698	2	1557	0.45	100	4.7	LOS A	3.7	28.1	Short	80	0		NA
Lane 2	395	2	395	2	1259	0.31	100	4.8	LOS A	2.2	16.2	Full	180	0		0
Approach	1093	2	1093	2		0.45		4.7	LOS A	3.7	28.1					
All Vehicles	2377	2	2377	2		0.45		6.6	LOS A	3.7	28.1					

Intersection 8 - NS-1 & EW-2

2051 AM - Intersection 8 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
South: NS-1 (S)																
Lane 1	149	2	149	2	1925	0.08	100	0	LOS A	0	0	Full	150	0		0
Lane 2	149	2	149	2	1925	0.08	100	0	LOS A	0	0	Full	150	0		0
Lane 3	126	2	126	2	1266	0.1	100	5.8	LOS A	0	0	Short	60	-31	N3	NA
Approach	425	2	425	2		0.1		1.7	NA	0	0					
East: Median Storage																
Lane 1	252	2	252	2	961	0.26	100	2.6	LOS A	1.2	8.8	Full	8	0		10
Approach	252	2	252	2		0.26		2.6	LOS A	1.2	8.8					
All Vehicles	677	2	677	2		0.26		2	NA	1.2	8.8					

2051 AM - Intersection 8 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: EW-2																
Lane 1	78	2	78	2	1212	0.06	100	6.7	LOS A	0.3	1.9	Short	20	0		NA
Lane 2	252	2	252	2	337	0.75	100	26.3	LOS D	4.7	35.4	Full	250	-10	N3	0
Approach	329	2	329	2		0.75		21.7	LOS C	4.7	35.4					
North: NS-1 (N)																
Lane 1	528	2	528	2	1831	0.29	100	5.6	LOS A	0	0	Short	60	0		NA
Lane 2	313	2	313	2	1925	0.16	100	0	LOS A	0	0	Full	200	0		0
Lane 3	313	2	313	2	1925	0.16	100	0	LOS A	0	0	Full	200	0		0
Approach	1154	2	1154	2		0.29		2.6	NA	0	0					
West: Median Storage																
Lane 1	126	2	126	2	288	0.44	100	17.7	LOS C	1.9	14.6	Full	8	0		30.9
Approach	126	2	126	2		0.44		17.7	LOS C	1.9	14.6					
All Vehicles	1609	2	1609	2		0.75		7.7	NA	4.7	35.4					

2051 PM - Intersection 8 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
South: NS-1 (S)																
Lane 1	573	2	573	2	1925	0.3	100	0	LOS A	0	0	Full	150	0		0
Lane 2	573	2	573	2	1925	0.3	100	0	LOS A	0	0	Full	150	0		0
Lane 3	19	2	19	2	1831	0.01	100	5.7	LOS A	0	0	Short	60	0		NA
Approach	1165	2	1165	2		0.3		0.1	NA	0	0					
East: Median Storage																
Lane 1	118	2	118	2	276	0.43	100	17.8	LOS C	1.7	13	Full	8	0		24.7
Approach	118	2	118	2		0.43		17.8	LOS C	1.7	13					
All Vehicles	1283	2	1283	2		0.43		1.7	NA	1.7	13					

2051 PM - Intersection 8 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
East: EW-2																
Lane 1	20	2	20	2	1146	0.02	100	6.8	LOS A	0.1	0.5	Short	20	0		NA
Lane 2	118	2	118	2	374	0.32	100	13.2	LOS B	1.1	8.1	Full	250	-25	N3	0
Approach	138	2	138	2		0.32		12.3	LOS B	1.1	8.1					
North: NS-1 (N)																
Lane 1	107	2	107	2	1831	0.06	100	5.6	LOS A	0	0	Short	60	0		NA
Lane 2	365	2	365	2	1925	0.19	100	0	LOS A	0	0	Full	200	0		0
Lane 3	365	2	365	2	1925	0.19	100	0	LOS A	0	0	Full	200	0		0
Approach	837	2	837	2		0.19		0.7	NA	0	0					
West: Median Storage																
Lane 1	19	2	19	2	476	0.04	100	6.5	LOS A	0.1	1.1	Full	8	0		0
Approach	19	2	19	2		0.04		6.5	LOS A	0.1	1.1					
All Vehicles	994	2	994	2		0.32		2.4	NA	1.1	8.1					

Intersection 9 - NS-1 & EW-3

2051 AM - Intersection 9 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
South: NS-1 (S)																
Lane 1	163	2	163	2	1915	0.09	100	1.7	LOS A	0	0	Full	200	0		0
Lane 2	166	2	166	2	1945	0.09	100	0	LOS A	0	0	Full	200	0		0
Approach	328	2	328	2		0.09		0.9	NA	0	0					
East: Median Storage																
Lane 1	92	2	92	2	1116	0.08	100	1.1	LOS A	0.3	2.2	Full	8	0		0
Approach	92	2	92	2		0.08		1.1	LOS A	0.3	2.2					
West: EW-3																
Lane 1	251	2	251	2	1105	0.23	100	6.7	LOS A	1	7.8	Full	500	0		0
Approach	251	2	251	2		0.23		6.7	LOS A	1	7.8					
All Vehicles	671	2	671	2		0.23		3.1	NA	1	7.8					

2051 AM - Intersection 9 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh m	Dist] m	Lane Config	Lane Length m	Cap. Adj. %		Prob. Block. %
North: NS-1 (N)																
Lane 1	306	2	306	2	1945	0.16	100	0	LOS A	0	0	Full	150	0		0
Lane 2	306	2	306	2	1945	0.16	100	0	LOS A	0	0	Full	150	0		0
Lane 3	92	2	92	2	1850	0.05	100	5.7	LOS A	0	0	Short	60	0		NA
Approach	703	2	703	2		0.16		0.8	NA	0	0					
West: Median Storage																
Lane 1	104	2	104	2	843	0.12	100	3	LOS A	0.4	3	Full	8	0		0
Approach	104	2	104	2		0.12		3	LOS A	0.4	3					
All Vehicles	807	2	807	2		0.16		1	NA	0.4	3					

2051 PM - Intersection 9 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1 (S)															
Lane 1	626	2	626	2	1923	0.33	100	1.3	LOS A	0	0	Full	200	0	0
Lane 2	634	2	634	2	1945	0.33	100	0	LOS A	0	0	Full	200	0	0
Approach	1260	2	1260	2		0.33		0.6	NA	0	0				
East: Median Storage															
Lane 1	39	2	39	2	352	0.11	100	9.2	LOS A	0.3	2.6	Full	8	0	0
Approach	39	2	39	2		0.11		9.2	LOS A	0.3	2.6				
West: EW-3															
Lane 1	125	2	125	2	304	0.41	100	20.4	LOS C	1.7	13.1	Full	500	0	0
Approach	125	2	125	2		0.41		20.4	LOS C	1.7	13.1				
All Vehicles	1424	2	1424	2		0.41		2.6	NA	1.7	13.1				

2051 PM - Intersection 9 - Option A (Staged Crossing T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
North: NS-1 (N)															
Lane 1	355	2	355	2	1945	0.18	100	0	LOS A	0	0	Full	150	0	0
Lane 2	355	2	355	2	1945	0.18	100	0	LOS A	0	0	Full	150	0	0
Lane 3	39	2	39	2	1850	0.02	100	5.7	LOS A	0	0	Short	60	0	NA
Approach	749	2	749	2		0.18		0.3	NA	0	0				
West: Median Storage															
Lane 1	82	2	82	2	760	0.11	100	3.6	LOS A	0.3	2.6	Full	8	0	0
Approach	82	2	82	2		0.11		3.6	LOS A	0.3	2.6				
All Vehicles	832	2	832	2		0.18		0.6	NA	0.3	2.6				

Intersection 10 - NS-1 & EW-4

2051 AM - Intersection 10 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1 (S)															
Lane 1	258	2	258	2	1394	0.19	84 [5]	5.7	LOS A	1.1	8.5	Full	500	0	0
Lane 2 [d]	368	2	368	2	1682	0.22	100	10.3	LOS B	1.4	10.7	Full	500	0	0
Approach	626	2	626	2		0.22		8.4	LOS A	1.4	10.7				
East: EW-4															
Lane 1 [d]	251	2	251	2	911	0.28	100	8.3	LOS A	1.3	9.7	Full	440	0	0
Approach	251	2	251	2		0.28		8.3	LOS A	1.3	9.7				
North: NS-1 (N)															
Lane 1 [d]	396	2	396	2	1369	0.29	100	6.8	LOS A	1.9	14	Full	220	0	0
Lane 2	319	2	319	2	1101	0.29	100	7.4	LOS A	1.8	13.3	Full	220	0	0
Approach	715	2	715	2		0.29		7.1	LOS A	1.9	14				
All Vehicles	1592	2	1592	2		0.29		7.8	LOS A	1.9	14				

2051 PM - Intersection 6 - Option A (Roundabout) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-1 (S)															
Lane 1 [d]	405	2	405	2	1006	0.4	100	8.7	LOS A	3.4	25.7	Full	500	0	0
Lane 2	308	2	308	2	765	0.4	100	11.1	LOS B	3	22.8	Full	500	0	0
Approach	713	2	713	2		0.4		9.7	LOS A	3.4	25.7				
East: EW-4															
Lane 1 [d]	749	2	749	2	988	0.76	100	15.1	LOS B	8.2	61.7	Full	440	0	0
Approach	749	2	749	2		0.76		15.1	LOS B	8.2	61.7				
North: NS-1 (N)															
Lane 1 [d]	430	2	430	2	1624	0.27	100	5.5	LOS A	2	14.7	Full	220	0	0
Lane 2	362	2	362	2	1366	0.27	100	5.9	LOS A	1.9	14.1	Full	220	0	0
Approach	793	2	793	2		0.27		5.7	LOS A	2	14.7				
All Vehicles	2255	2	2255	2		0.76		10.1	LOS B	8.2	61.7				

Intersection 11 - EW-2 & NS-2

2051 AM - Intersection 11 - Option A (Standard T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-2															
Lane 1	419	2	419	2	535	0.78	100	20	LOS C	7.1	53.6	Full	350	0	0
Approach	419	2	419	2		0.78		20	LOS C	7.1	53.6				
East: EW-2 (E)															
Lane 1	334	2	334	2	1913	0.17	100	1.9	LOS A	0	0	Full	300	0	0
Approach	334	2	334	2		0.17		1.9	NA	0	0				
West: EW-2 (W)															
Lane 1	599	2	599	2	1906	0.31	100	0.3	LOS A	0.2	1.6	Full	250	0	0
Approach	599	2	599	2		0.31		0.3	NA	0.2	1.6				
All Vehicles	1352	2	1352	2		0.78		6.8	NA	7.1	53.6				

2051 PM - Intersection 11 - Option A (Standard T-Intersection) - Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: NS-2															
Lane 1	58	2	58	2	1209	0.05	100	6.2	LOS A	0.2	1.3	Full	350	0	0
Approach	58	2	58	2		0.05		6.2	LOS A	0.2	1.3				
East: EW-2 (E)															
Lane 1	152	2	152	2	1912	0.08	100	1.9	LOS A	0	0	Full	300	0	0
Approach	152	2	152	2		0.08		1.9	NA	0	0				
West: EW-2 (W)															
Lane 1	108	2	108	2	1733	0.06	100	2.8	LOS A	0.2	1.8	Full	250	0	0
Approach	108	2	108	2		0.06		2.8	NA	0.2	1.8				
All Vehicles	318	2	318	2		0.08		3	NA	0.2	1.8				