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Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina, Mpumalanga

Traffic Impact Assessment

Umcebo Mining (Pty) Ltd

8 September 2016

Revision: Final

Reference: 112511

Document control record

Document prepared by:

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1977/003711/07

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Document control						
Report title		Traffic Impact Assessment				
Document ID			**Project number**		112511	
File path		P:\Projects\112511 Hendrina Reserve Traffic Impact Ass\03 PRJ Del\6 REP\Final\Proposed Hendrina coal mine _TIA_Final.docx				
Client		Umcebo Mining (Pty) Ltd	**Client contact**			
Rev	**Date**	**Revision details/status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	20 July 2016	Draft	Corli Engelbrecht	Vera Mpofu	N/A	Werner Heyns
0	2 August 2016	Final	Corli Engelbrecht	Vera Mpofu	N/A	Werner Heyns
0	11 August 2016	Final	Corli Engelbrecht	Vera Mpofu	N/A	Werner Heyns
0	8 September 2016	Final	Corli Engelbrecht	Vera Mpofu	N/A	Werner Heyns
Current revision		**Final**				

Approval			
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Glossary of Terms

DoT	Department of Transport
ESIA	Environmental and Social Impact Assessment
HCM	Highway Capacity Manual
HGV	Heavy Goods Vehicles
km	Kilometre
LOS	Level of Service
NMT	Non-motorised Transport
SANRAL	South Africa National Road Agency Limited
TIA	Traffic Impact Assessment
Veh/hr	Vehicles per Hour

Declaration

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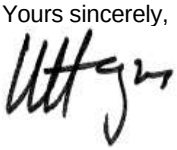
I, Werner Heyns as duly authorised representative of Aurecon South Africa (Pty) Ltd., hereby confirm my independence (as well as that of Aurecon South Africa (Pty) Ltd.) and declare that neither I nor Aurecon South Africa (Pty) Ltd have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of Digby Wells Environmental (Digby Wells), other than fair remuneration for work performed, specifically in connection with the Traffic Impact Assessment process for the proposed Hendrina Underground Coal Mine Mine project, Mpumalanga Province.

Yours sincerely,



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Executive summary

Aurecon was appointed by Digby Wells and Associates (Pty) Ltd (Digby Wells), on behalf of Umcebo Mining (Pty) Ltd (Umcebo), a subsidiary of Glencore Operations South Africa (Pty) Ltd (Glencore), to carry out a Traffic Impact Assessment (TIA) for the proposed Hendrina Underground Coal Mine in Mpumalanga. This TIA serves as input into the Environmental and Social Impact Assessment (ESIA) prepared by Digby Wells.

The proposed mine sites are located along the N11, 10 to 22km south of Hendrina. Umcebo currently holds two Prospecting Rights (PRs), namely, MP 1265 PR and MP 1266 PR, located within the Ermelo Coal Field. The total extent of MP 1265 PR (referred to as Mooivley East and Mooivlei West) is 3 923 hectares (Ha) and comprise the following farms and portions:

- Mooivley 219 IS – Potions 2, 4, 5 and Remaining Extent (RE) of the farm;
- Tweefontein 203 IS – Portions 2, 15, 16, 17 and Portion of Portion 14;
- Uitkyk 220 IS – Portions 2 and 3; and
- Orange Vallei 201 IS – Portions 1 and RE of the farm.

The total extent of MP 1266 PR (referred to as Hendrina South) is 2 787 ha and comprises the following farm and portions:

- Elim 247 IS - RE of the farm;
- Geluksdraai 240 IS – 1 and 2;
- Orpenskraal 238 IS – RE of the farm; and
- Bosmanskrans 217 IS – Potions 1, 3, 4, 6, 8, 9 and RE of the farm.

Project overview

The project area comprises three underground reserve blocks namely Mooivley East, Mooivley West and Hendrina South. Mooivley West and Hendrina South will be mined at the same time and at their completion, Mooivley East mining activities will commence. The estimated Life of Mine (LoM) will be 30 years for all mining areas with a production rate of 2.4 million tonnes per annum at full capacity. The coal product will be transported to a nearby Eskom power station (i.e. Kusile, Kendal, Kriel, Grootvlei); via the existing road network.

The implementation of the project is planned in stages comprising, construction (2019 for 2.5 years), operations (2014 -2055); and decommissioning and post closure (After 2052).

TIA purpose and objectives

The project is expected to generate additional traffic on the existing road network during construction, operations and decommissioning stages of the project. The purpose of this specialist traffic and transportation study is therefore to estimate the additional traffic that the proposed project is likely to generate and assess the impact of this additional traffic on the surrounding road network and make recommendations for mitigation or improvements.

The objectives of the study includes the following:

- Determine the additional traffic to be generated by the different activities of each stage of the project;
- Determine the impact of the additional traffic on the existing road network and traffic conditions at different stages of the project;
- Consider existing mine infrastructure layout and provide advice in relation to access control, stacking space requirements, access geometry and sight distances;

- Consider and advise on required traffic management arrangements for each stage of the project, if appropriate;
- Advice on road safety considerations in implementing safe road infrastructure compliant with design standards;
- Propose mitigation measures for the identified significant risks / impacts and enhance positive risks / impacts of the project; and
- Assessment of impacts (including cumulative impacts) associated with all stages of the project.

Approach and methodology

The broad methodology used for this specialist study is as follows:

1. Consultation with road authorities.
2. Literature review.
3. Data collection: conduct a site visit and traffic count survey.
4. Determine future scenarios traffic volumes and trip generation.
5. Intersection capacity analysis.
6. Mine access evaluation.
7. Environmental impact assessment.

Findings and recommendations

- The existing road network within the study area is operating at well below its capacity and at a good Level of Service (LOS).
- The additional mine traffic during the construction phase and operational stage is expected to have a negligible impact on the surrounding network as LOS at the analysed intersections is expected to remain the same except for the N11/R38 intersection which is expected to deteriorate from LOS C to LOS D during the operational stage. LOS D is still considered to be acceptable, therefore no road upgrades are required.
- The proposed two access roads: (1) off N11 to the Mooivley East site and (2) off Davel Road (to Mooivley West and Hendrina South sites), are expected to operate at acceptable LOS provided the following road upgrades are implemented:

– Introduce the following road upgrades at the new proposed N11/ Mooivley East Access Road intersection:

  - The intersection to be priority controlled with the mine access road stop controlled;
  - Separate 100m left lane is proposed on the N11 northern approach;
  - Separate 100m right turn lane; and
  - 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively

– The new proposed Davel Road and Mooivley West intersection to be priority controlled with Davel Road having priority.

- The queueing analysis results at the mine accesses show that vehicle stacking space for 2 vehicles will be required. It is, therefore recommended that a distance of at least 45m should be provided between N11/ Davel Road and the proposed access gates to accommodate two 20m long trucks at the respective access points.
- There is currently very little pedestrian and cyclist activity on the road network. The mine is expected to generate a notable number of pedestrians during both the construction and operation stages. The verges on either side of N11 and Davel Road are wide enough to accommodate pedestrian activity without affecting the flow of traffic.
- Overall, the increase in heavy vehicles during both construction and operation phases will accelerate the deterioration of the roads in the study area though only slightly and certainly not

noticeably. With the exception of the assess roads, all other roads that the mine generated traffic is likely to use are under the jurisdiction of the local transport authorities and SANRAL. It is this department's responsibility to repair and rehabilitate these roads and not the mining houses.

- The significance of the cumulative traffic impacts associated with the proposed project activities during construction, operations and decommissioning are considered negligible to minor. Find below the summary of recommended mitigation measures in addition to the proposed road upgrades at the new proposed access intersections.
- Heavy vehicle movements to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions.
- Prescribe routes for construction traffic to:
  - discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and
  - Discourage routing of heavy vehicles through residential areas
- The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site.
- The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.
- Drivers of heavy vehicles will be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other vehicles and Non-Motorised Transport (NMT) users on these roads; and
- Regular pedestrian and cycling activity awareness for staff working on site during all project stages, as part of regular Health and Safety briefings.

1 Introduction

Umcebo Mining (Pty) Ltd (Umcebo), a subsidiary of Glencore Operations South Africa (Pty) Ltd (Glencore) is proposing the development and operation of a new underground coal mine and associated infrastructure at a site situated approximately 10-22 kilometres (km) south east of Hendrina in the Mpumalanga Province of South Africa (the project).

Umcebo currently holds two Prospecting Rights (PRs), namely, MP 1265 PR and MP 1266 PR, located within the Ermelo Coal Field. The total extent of MP 1265 PR (referred to as Mooivley East and Mooivley West) is 3 923 hectares (ha) and comprise the following farms and portions:

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- Bosmanskrans 217 IS – Potions 1, 3, 4, 6, 8, 9 and RE of the farm.

The project area proposed to be mined (underground) has a combined footprint of 6714ha and is located within the Steve Tshwete Local Municipality (STLM) and Msukaligwa Local Municipality (MLM).

Digby Wells and Associates (Pty) Ltd (Digby Wells) has been appointed by Glencore as the independent Environmental Assessment Practitioner (EAP) for the project and is responsible for completing an Environmental and Social Impact Assessment (ESIA) required in order to obtain relevant authorisation for the proposed project.

Subsequently, Digby Wells appointed Aurecon (Pty) Ltd (Aurecon) to undertake a traffic impact assessment (TIA) for inclusion in the ESIA report.

The ESIA is separated into two phases: the Scoping Phase and the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) Phase. Consequently, the TIA investigation will also comprise of these two phases. This report forms the second phase of the investigation – the EIA and EMP Phase.

1.1 Project description

The project area comprises three underground reserve blocks - Mooivley East, Mooivley West and Hendrina South. The Mooivley Reserves comprises two inclined shafts which will be developed to gain access to the two underground areas. The Boschmanskrans Reserve comprises one underground reserve block namely Hendrina South. One inclined shaft will be developed to gain access to the underground area. Mooivley West and Hendrina South will be mined at the same time. Once Mooivley West and Hendrina South are completed, Mooivley East mining activities will commence.

The estimated Life of Mine (LoM) will be 30 years for all mining areas with a production rate of 2.4 million tonnes per annum at full capacity, with a total of approximately 78 million tonnes of Run of Mine (ROM). The mine will reach full production within the first four years.

The grade of coal is poor and therefore not suitable for export. The coal product will be transported to a nearby Eskom power station (i.e. Kusile, Kendal, Kriel, Grootvlei) via the existing road network.

Limited surface infrastructure will be established to support the mining activities. The primary structures proposed include: a package sewage treatment plant, water treatment plant, diesel generator set, fuel storage tanks, access and service roads, a conveyor belt and office and workshop buildings.

1.1 Site location

The site is located about 15km south east of Hendrina Town on the N11. It is in an agricultural area surrounded by mining activities and communities founded on the mining legacy of the area. The site enjoys good regional access in the form of national and provincial roads, with the N11 traversing the site. The N4 is situated about 40km north of the site and the N17 is situated about 40km southwest of the site. Figure 1 shows the location of the site in relation to the surrounding road network.

1.2 Terms of reference

The following terms of reference underline the traffic investigation and assessment for the proposed Hendrina Underground Coal Mine:

- Scoping Phase

  This entails assessment of the existing conditions of the study area prior to implementing any changes to the current activities and processes. The scoping phase formed the basis upon which all planned future activities' impacts were measured.

- Environmental Impact Assessment and Environmental Management Programme Phase

  A TIA is required as part of the impact assessment to demonstrate the impact of the proposed project changes on the existing and proposed future road network. As part of the TIA, access to the proposed development has been assessed and recommendations have been made as to any required upgrades and Non-Motorised Transport (NMT) and public transport facilities required.

2 Aims and objectives

The project is expected to generate additional traffic on the existing road network during construction, operations and decommissioning stages of the project. The purpose of this specialist traffic and transportation study is therefore to estimate the additional traffic that the proposed project is likely to generate and assess the impact of this additional traffic on the surrounding road network and make recommendations for mitigation or improvements.

The objectives of the study are in accordance with the terms of reference provided in section 1.2 for the EIA and EMP Phase of the project and it includes the following:

- Determine the additional traffic to be generated by the different activities of each stage of the project;
- Determine the impact of the additional traffic on the existing road network and traffic conditions at different stages of the project;
- Consider existing mine infrastructure layout and provide advice in relation to access control, stacking space requirements, access geometry and sight distances;
- Consider and advise on required traffic management arrangements for each stage of the project, if appropriate;
- Advice on road safety considerations in implementing safe road infrastructure compliant with design standards;
- Propose mitigation measures for the identified significant risks / impacts and enhance positive risks / impacts of the project; and
- Assessment of impacts (including cumulative impacts) associated with all stages of the project in accordance with the impact assessment methodology provided by Digby Wells.

3 Approach and methodology

3.1 Literature review

This specialist traffic and transportation study referred to the following Steve Tshwete Local Municipality's planning documents to understand existing transport and traffic situation and consider any future transport and spatial plans of the municipality and Hendrina in particular:

- Integrated Development Plan 2014/2015;
- Local Economic Development Plan 2015-2020; and
- Spatial Development Framework.

The study also referred to the following guideline documents:

- Committee of Transport Officials (COTO), TMH 17 South African Trip Data Manual, 2013;
- HCM2000, Highway Capacity Manual 2000 by Transportation Research Board; and
- Department of Transport (DoT) and Statistics South Africa, National Household Travel Survey, 2013.

3.2 Study Area

The study area was determined based on the expected traffic distribution of the traffic generated by the proposed activities at the Hendrina Underground Coal Mine project. The road network that is likely to be used to access the Hendrina Underground Coal Mine site at all stages includes: Davel road R38, R542 and N11.

The following intersections were included in the study area:

- N11 and R38;
- N11 and proposed access to Mooivley East;
- N11 and Davel Road, where future access to Mooivley West and Hendrina South mining will be gained; and
- N11 and R542.

Figure 2 shows the extent of the study area.

3.3 Assessment years

This study aims to assess the traffic impact of the proposed Hendrina Underground Coal Mine activities for all stages of the project including:

- Construction - commencing in 2019 for 2.5 years. The year of commencement for the construction phase is based on an estimated timeframe of receiving the necessary licences and permits for the Project;
- Operations Phase 1 – commencing in 2024 and ending 36 years later at Mooivley East and Hendrina South. The maximum output of the mine is expected four (4) years after commencement;
- Operations Phase 2 - commencing in 2042 with the mining operations ending in 2055 at Mooivley East; and
- Decommissioning and post closure – After 2055.

The construction activities and operation activities are expected to generate significant traffic. Traffic generated due to decommissioning and post closure activities is expected be noticeable but not as intrusive as during construction and operational phases as few heavy vehicles will be required to demolish the mine and conduct post-closure monitoring. As such this study only assesses the impact of the mine during construction and operation only.

Therefore for the purposes of this study, the following scenarios have been assessed:

- Existing situation – 2016 AM and PM peak;
- Construction stage – 2019 AM and PM with construction traffic;
- Operational Phase 1 – 2024 AM and PM without and with operation traffic; and
- Operation Phase 2 – 2042 AM and PM with operation traffic.

A traffic growth rate of 3% per annum was applied to the 2016 traffic data to generate 2021 weekday AM and PM peak background traffic scenarios as no significant spatial or economic growth has been planned for Hendrina in the near future. A lower traffic growth (1%) was assumed for future scenarios after 10 years (from 2027). The growth rate is anticipated to be consistent with low traffic conditions in the area and does not include latent demand that might be generated by potential new or additional mining operations in the region (as there are no indication about their possible locality or magnitude).

3.4 Intersection capacity analysis

This TIA used SIDRA Intersection Software (SIDRA) to undertake the intersection capacity analysis, since the intersections considered are reasonably well spaced and operate simplistically in terms of traffic control and flow. SIDRA is a micro-analytical traffic evaluation tool used to assess the capacity and level of service of individual intersections.

3.5 Access evaluation

Access to the site has been analysed using SIDRA. In addition queueing analysis was undertaken to assess whether vehicle queues will form during construction and operation to determine how to mitigate any adverse impacts.

3.6 Impact assessment and mitigation measures

Any mitigation measures required for this development are identified and specified. Specific recommendations are also made to improve pedestrian movement facilities as well as public transport facilities.

In addition, an assessment of the significance of the environmental impact as a result of the proposed development from a traffic and transport point of view was conducted and is described in terms of its extent (spatial scale), magnitude and duration (time scale).

4 Assumptions and limitations

The distribution of the traffic generated by the proposed additional activities at the Hendrina Underground Coal Mine project was assumed based on the location of the towns and villages that will provide accommodation for labour; the location of potential suppliers and neighbouring towns as well as the end destination of the mined coal at Eskom power stations: Kusile, Kendal, Kriel and Grootvlei.

It was also assumed that the road network that is likely to be used for the transportation of the mined coal from the proposed Hendrina Underground Coal Mine site is expected to be towards the Hendrina central business district (CBD), using Davel Road, N11, and thereafter either branching toward the west onto R38 or proceeding along N11 to branch off west onto N4.

There is a limitation in forecasting future background traffic growth after 5 years as the predictability of future spatial and economic growth, which are the fundamental elements from which travel demand is derived, are uncertain and subject to change and speculative at best.

5 Baseline environment

5.1 Existing road network

The individual project sites are currently accessible via Davel Road which branches off the N11 and connects the site to major regional and national route. The roads likely to be affected considering the possible routes that the traffic generated by the mining activities might travel along, are described below.

	**N11** is a Class 1 road past the sites. Generally, N11 has one lane in each direction but extends at intersections to include separate turning lanes and also extends to two lanes on uphill sections to accommodate slow moving heavy vehicles, thus allowing faster moving vehicles to overtake. N11 runs in a north south direction from its intersection with the R38 in the north in Hendrina. South of the site the N11 intersects with the R542 towards Breyton. The speed limit on this road, in the vicinity of the study area, is 120 kilometer per hour (km/h). The pavement conditions of N11 is very good.
	**Davel Road** is a gravel road which links Hendrina to a small settlement south east of the three sites.
	**R542** is a Class 2 surfaced regional road with one lane in each direction. It has a speed limit of 100km/h. It is a regional road to the town of Breyton and the surrounding settlements.

	**R38** Class 2 regional dual carriageway with one lane in each direction and on-street parking on either side along its length in Hendrina CBD. The R38 provides connections to Kendal and Kusile power stations.

5.2 Existing traffic volumes

5.2.1 Site Visit

A site visit was carried out on 15 May 2016 to assess road geometric layout, intersection layout, available public and non-motorised transport modes, traffic safety aspects, road condition, traffic flow and land use.

Vehicles were observed along N11, R542 and R38 during the site visit. With the presence of a large amount of heavy vehicle traffic passing through the town of Hendrina. It should be noted that the site visit was conducted during off peak hours.

5.2.2 Traffic Survey

Classified morning and afternoon peak hour traffic counts were undertaken on Thursday, the 23rd of June 2016, between 06h00 – 09h00 and 15h00 to 18h00 at the following intersections:

- N11 and R38 (Hendrina Town);
- N11 link count, (close to the proposed Mooivley East mine access);
- N11 and Davel Road; and
- N11 and R542.

Figure 7 and Figure 8 show the 2016 weekday AM and PM peak volume distribution, respectively.

The existing traffic volumes indicate the following:

- **N11 in Hendrina CBD:** This road carries volumes of approximately 160 vehicles per hour (veh/hr) northbound and 240 veh/hr southbound during the AM peak. The PM peak has slightly higher traffic volumes, with approximately 260 veh/hr northbound and 320 veh/hr southbound.
- **R38:** This road carries traffic volumes of approximately 85 veh/hr eastbound and 110 veh/hr westbound during the AM peak. The PM peak has higher traffic volumes with approximately 175 veh/hr eastbound and 275 veh/hr westbound.
- **Davel Road**: this road carries very low traffic volumes of not more than 5 veh/hr in both directions during the AM peak. The PM peak experiences slightly higher traffic volumes of less than 15veh/hr in each direction.
- **R542:** the road carries traffic volumes of approximately 20 veh/hr per direction during the AM peak. The PM peak experiences slightly higher traffic volumes with approximately 30 veh/hr eastbound and 20 veh/hr westbound.

- **N11 from Ermelo:** this road carries traffic volumes of approximately 110 veh/hr northbound and 160 veh/hr southbound during the AM peak. The PM peak has higher traffic volumes with approximately 204 veh/hr northbound and 213 veh/hr southbound.

Considering the national and provincial road traffic volume design standards, these levels of traffic are fairly moderate to low.

5.3 Existing road conditions

The pavement condition of the N11 is in a good condition, as it is a national road maintained by SANRAL, particularly along the section that will be used by traffic generated by the Hendrina Underground Coal Mine when travelling to and from Hendrina and Ermelo. The rest of the roads are also in good condition.

5.4 Existing public transport and non-motorised transport

5.4.1 Public Transport

No modes of public transport were observed along the N11 in the vicinity of the site during the site visit. No public transport lay-bys or stopping facilities were observed along the N11 or R542, or in the vicinity of the sites. Minibus taxis were the only mode of public transport observed within Hendrina CBD. However, the traffic count survey indicates that there are taxi services along N11.

5.4.2 Non-Motorised Transport

Very few pedestrians were observed walking in the vicinity of the site. Although there are no paved sidewalks, pedestrians were seen walking on wide cleared verges on N11.

5.5 Road Safety

Based on observations, road safety conditions along N11, R38 and R542 are generally acceptable. Sight distances at intersections and around road bends are within acceptable standards. Vehicles were observed driving within the displayed speed limits ranging between 80 km/h and 120 km/h along N11. The observed traffic volumes did not appear to cause an abnormal safety risk to pedestrians.

5.6 Water courses and bridge/culvert structures

In the immediate vicinity of the sites, the Klein Olifants River crosses the N11 and Davel Road, with bridges at these locations. It is important to note that the bridge on Davel Road can only accommodate one vehicle at a time. Photographs below show the bridge along Davel Road and the road signage indicating the bridge restriction.

6 Trip generation, distribution and assignment

Traditionally, development traffic is estimated by applying trip generation rates from the South African Trip Generation Rates manual (SATGR) (DoT, 1995) or the Committee of Transport Officials (COTO) (September 2012) South African Trip Data manual. However, neither the SATGR manual nor COTO manual have recommended trip rates for proposed mines. As an alternative it was considered appropriate to estimate the mines trip generation from first principle using development and traveller characteristics (e.g. mode split, vehicle occupancy) along with estimated trip generation details provided by the project applicant from experience elsewhere.

For the purposes of this study the expected additional trips on the transport network were determined based on the numbers of employees per year of analysis and the total commodities and final products to be transported in and out of the mine during construction and operations. This data was supplied by the project applicant. .

The following sections outline the functions and data provided in estimating the site's trip generation.

6.1 Construction phase

6.1.1 Workforce and working shifts

The construction phase will require a construction workforce of approximately 600 workers during the peak of the proposed construction. The majority of the workforce will most likely be sourced from the local communities of Hendrina, Ermelo and Breyton. The remainder of the workforce will arrive from other towns and will most probably seek accommodation in close proximity to the project for the sake of convenience. None of the workers will be accommodated on site and will have to make their own arrangement to travel to and from work. Construction will be conducted 6 days a week on an eight (8) hours shift starting from 07h30 to 16h30. See figures 9 and 10 for the planned construction peak hour assignments.

6.1.2 Construction heavy vehicles

The construction activities at the proposed mine will generate additional heavy vehicle traffic on the surrounding road network as a result of the construction vehicles travelling to and from the mine, transporting equipment and construction materials. Since there are no major suppliers in study area, raw materials will be sourced from neighbouring or distant commercial sources. It is envisaged that at the peak of construction the project will generate on average 6 truck trips.

Table 1 shows the summary of construction workforce, construction working shifts and the number of delivery vehicles during construction.

Table 1: Construction phase workforce, shifts and vehicles

Trip Generators	2016 to 2019
Employees per day	600
Construction working shifts (6 day week)	07h30 to 16h30
Mining and laydown yard equipment delivery trucks	3 trucks per day at peak of construction
Construction material delivery trucks	

6.1.3 Trip generation

Given workers will not be accommodated on site and will be expected to make their own travel arrangement to the mine; a mode split was established using the National Household Travel Survey (NHTS) (2013) as a guide to understand the number of trips that will be made by different modes (i.e. private car, bus, taxi, walking and cycling). According to the NHTS, the distribution of worker trips in Mpumalanga are as shown in Table 2.

Table 2: Transport modes used by workers in Mpumalanga

Statistics	Public Transport			Private Transport		Walk all the way	Other
	Train	Bus	Taxi	Car/truck company car driver	Car/truck passenger		
Percent (%)	0.2	21.1	19.8	24.6	6.9	26.0	1.4

Since there are no bus and train services in the area and also the fact that workers will be granted a travel allowance, the bus and train modal split was added to the taxi mode. The final modal split used for workers' development traffic is displayed in Table 3 below:

Table 3: Mode split used for calculations

Mode	Bus	Taxi	Car	Walking	Other
%	**0%**	**41%**	**31%**	**26%**	**2%**

Assumptions

The following assumptions were made:

- Only 80% of construction workers arrive/depart from the mine during the AM and PM peak hours;
- Private vehicle occupancy rate of 1.5 persons per vehicle;
- Taxi vehicle occupancy rate of 15 persons per vehicle; and
- 4 of the 6 heavy vehicle trips will occur during peak hours.

Trip generation summary

By applying the development functions and assumptions discussed above, the results of the person trip estimation per mode are as shown in Table 4. The trips generated as a result of employment activity are referred to as commuter trips, which are categorised as private vehicle trips and public transport trips.

Table 4: Commuter person trip generation during AM and PM peak hour of the construction phase

Scenario	Construction	Person trips				
	Workforce	Bus	Taxi	Car	Walk	Other
2016	480	0	196	149	125	10

Assuming a vehicle occupancy rate of 1.5 persons per vehicle, workers are expected to generate 99 light vehicles trips during the AM peak hour and similarly 99 vehicle trips during the PM peak period. Using an occupancy rate of 15 persons per minibus taxi, the workers are expected to generate 13 additional minibus trips during both the AM peak hour and the PM peak hour.

The transportation of construction material will generate freight movement on the road network. Since the construction activities are expected to generate on average 6 heavy vehicle trips per day, it has been assumed that a total 4 heavy vehicle trips will occur during the AM and PM peak hours.

Table 5 summarises the vehicular trips expected to be generated by the construction activities.

Table 5: Vehicle trip generation during AM and PM peak hour of the construction phase

Scenario	Vehicle trips per hour (AM and PM)				
	Heavy vehicles	Bus	Taxi	Car	Total
2016	4	0	13	99	116

6.2 Operational phase

6.2.1 Workforce and working shift

Once fully operational the mine will employ about 371 workers. Similar to the construction phase the majority of the workforce will be sourced from the Hendrina, Ermelo and Breyton towns. The mine will operate on the basis of having three shifts as illustrated in Table 6.

Table 6: Operational phase workforce, shifts and vehicles

Trip Generators	2019 - 2052
Employees per day	371
Operation working shifts (5 day week)	06h00 – 16h00
	16h00 – 02h00
Administrative and managerial staff working shifts	07h30 – 16h00

6.2.2 Operation heavy vehicles

It is expected that 2.4 million tonnes of coal will be transported per annum for 30 years from the Proposed Hendrina Underground Coal Mine to the surrounding power stations by 30 tonne payload vehicles. It is expected that the transport operations will occur during a 5 day working week and for 18 hours a day.

6.2.3 Trip generation

Assumptions

The following assumptions were made:

- Workforce is divided into a split of 70% arrival and 30% departing during the AM peak, with the inverse applicable during the PM peak, given the two shifts during the mine operation phase;
- Only 80% of workers will arrive/depart from the mine during the AM and PM peak hours;
- Mode split as established for construction phase was also applied to operation phase workforce trips;
- Heavy vehicle arrival and departure profiles are spread evenly throughout the working shifts;
- Calculation excludes 12 annual holidays; and
- A 365 days year with 52 weeks was applied.

See figures 11 to 14 for the peak hour assignments to the peak hours respectively for each phase of the operations.

Trip generation summary

By applying the development functions and assumptions discussed above, the results of person trips estimation for the workforce are shown in Table 7.

Table 7: Commuter person trip generation during AM and PM peak hour of the operational phase

Scenario	Operations	Person trips				
	Workforce	Bus	Taxi	Car	Walk	Other
2021	371	0	148	117	100	6

Table 8 below illustrates the assumptions made in estimating the number of heavy vehicles expected to be generated by the mine in the transportation of coal.

Table 8: Heavy vehicle trips

Trip Generators	2018 - 2052
tonnes of coal transported per annum (tonne)	2,400,000

working days a year	301
tonnes of coal transported per day (tonne/day)	7668
tonnage of trucks transporting coal	30
trucks per day	266
hours of operation per day	20
trucks per hour	13
truck trips per hour	**26.00**

Table 9 shows that the mine is expected to generate about 95 vehicle trips during the operation phase of which 26 will be heavy vehicle, 30 private cars and 38 minibus taxis.

Table 9: Vehicle trip generation during AM and PM peak hour of the operational phase

Scenario	Vehicle trips per hour				
	Heavy vehicles	Bus	Taxi	Car	Total
2021	26	0	38	30	94

6.3 Trip distribution and assignment

Assumptions about the expected trip distribution were based on the location of the site and residential areas, the existing traffic volumes, traffic count turning proportions and traffic patterns based on site observations.

The following trip distribution has been used for the purpose of the construction and the operations phases:

- 60% South on N11 towards Ermelo;
- 40% North on N11 towards Hendrina;
- Additional split of 30% west on the R38; and
- 10% R542 east towards Breyton

Figure 5 and 6 indicates the trip distribution of all stages, with figures 9 to 16 showing the peak hour traffic assignment of each scenario respectively.

7 Capacity Analysis

7.1 Assessment criteria

The performance criteria used to determine an intersection's level of service (LOS), is provided in Table 7 below. The LOS and delay measurements are defined in accordance with the Highway Capacity Manual (HCM2010) methodology.

Table 7: Level of Service Criteria

Level of Service	Traffic Signal / Roundabout Controlled	Stop / Give Way (Yield) Controlled
	Measure – Average Control Delay (seconds per vehicle)	
A	d ≤ 10	d ≤ 10
B	10 < d ≤ 20	10 < d ≤ 15
C	20 < d ≤ 35	15 < d ≤ 25
D	35 < d ≤ 55	25 < d ≤ 35
E	55 < d ≤ 80	35 < d ≤ 50
F	d > 80	d ≥ 50

As illustrated in Table 7, LOS A to F are used, with LOS A indicating the best operating conditions and LOS F the worst. The LOS A to D was taken as acceptable for the purpose of this traffic impact assessment.

7.2 Analysed Intersections

The following intersections were analysed using SIDRA Intersection Software:

- **N11 and R38** is signalised 4way-junction with N11 having priority. All the approaches on N11 and R38 have one lane in each direction. Pedestrian-crossing facilities are provided at the intersection.
- **N11 and Davel Road** is a T-junction with Davel Road approach stop-controlled, giving priority to N11. N11 northern approach has two through lanes and a short right-turning lane. The northern exit has a through lane. N11 southern approach has one left-turning lane, and one through short lane. The southern exit has one through lane.
- **N11 and R542** is a T-junction with the R542 approach stop-controlled, giving the N11 priority. N11 northern approach has a through lane and a short left-turning lane, and the northern exit has a through lane. N11 southern approach has one right-turning lane, and one through lane. The southern exit has one through lane and a short converging lane.

7.3 Intersection capacity analysis results

Intersection capacity analysis in the study area was undertaken using SIDRA software. The purpose of the analysis was to determine existing and future volume/capacity (v/c) ratios, delay (sec) and LOS for different years of assessment and the associated traffic impact of the development proposal.

7.3.1 2016 Base year Traffic

Table 10: 2016 Base Year Traffic SIDRA Analysis Results

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	B	0.242	15.7	C	0.446	20.3
		East	C	0.332	26	C	0.467	29
		North	B	0.327	14.3	B	0.457	18.8
		West	C	0.187	25.8	C	0.403	28
		ALL	**B**	**0.332**	**19**	**C**	**0.467**	**23.1**
03_N11 & Davel Road	Priority Control	South	-	0.075	0.1	-	0.024	0.8
		East						
		North	-	0.077	0.1	-	0.088	0.1
		West	B	0.007	10.2	A	0.02	9.8
		ALL	**-**	**0.077**	**0.3**	**-**	**0.088**	**0.9**
04_N11 & R542	Priority Control	South	-	0.11	1.4	-	0.062	1.0
		East	B	0.09	12.3	B	0.059	10.8
		North	-	0.123	0.8	-	0.087	0.70
		West						
		ALL	**-**	**0.123**	**2.2**	**-**	**0.087**	**2.0**

The analysis results shown in Table 10 indicated that overall all intersections are currently operating at acceptable LOS. N11/ R38 intersection is operating at LOS B during the AM peak and LOS C during the PM peak, with a minimal delay of 19 seconds in the AM and 23.1 seconds in the PM peak. The other two intersections are operating at good LOS A during both AM and PM peak with minimal delays of less than 3 seconds and v/c ratio of not more than 0.123.

7.3.2 2019 Background Traffic

A growth rate of 3% per annum was applied to the 2016 data to generate 2019 weekday AM and PM peak background traffic distributions as shown in Figure 17 and 18, respectively.

Table 11: 2019 Background Traffic plus Development Traffic

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	B	0.27	16.5	C	0.51	21.6
		East	C	0.36	26.3	C	0.52	29.6
		North	B	0.36	14.6	B	0.643	19.9
		West	C	0.21	26.8	C	0.45	29.2
		ALL	**B**	**0.36**	**19.5**	**C**	**0.52**	**24.2**
03_N11 & Davel Road	Priority Control	South	A	0.082	0.1	A	0.026	0.9
		East						
		North	A	0.084	0.0	A	0.097	0.1
		West	B	0.008	10.4	B	0.021	9.9
		ALL	**A**	**0.084**	**0.2**	**A**	**0.097**	**0.9**
04_N11 & R542	Priority Control	South	A	0.068	0.9	A	0.120	1.1
		East	B	0.068	11.1	B	0.106	12.8
		North	A	0.095	0.7	A	0.135	0.8
		West						
		ALL	**A**	**0.095**	**2.1**	**A**	**0.135**	**2.1**

The analysis results shown above indicates that overall all intersections are expected to operate at acceptable level of service. N11/ R38 is expected to still operate at LOS B during the AM peak and LOS C during the PM peak, with minimal delay of 19.5 seconds in the AM and 24.2 seconds in the PM peak. The rest of the intersections are expected to continue operating at LOS A during both AM and PM peak with minimal delays of less than 3 seconds and v/c ratio of not more than 0.135. Thus the background traffic growth is expected to minimal impact on the road network and no road upgrades are required.

7.3.3 2019 Base year Traffic with Construction Phase traffic

The construction stage generated traffic was added to the 2019 weekday AM and PM peak background traffic, the traffic flows are shown in Figure 19 and 20, respectively

Table 12: 2019 Base year Traffic with construction Phase traffic SIDRA Analysis Results

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	B	0.291	16.9	C	0.545	21.7
		East	C	0.371	26.5	C	0.539	30.6
		North	B	0.367	14.6	B	0.506	19.9
		West	C	0.297	28.9	C	0.515	30.8

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
		ALL	**C**	**0.371**	**20.2**	**C**	**0.545**	**24.7**
03_N11 & Davel Road	Priority Control	South	A	0.082	1.7	A	0.026	2.5
		East						
		North	A	0.084	1.1	A	0.097	0.5
		West	B	0.089	12.6	B	0.177	11.4
		ALL	**A**	**0.089**	**2.5**	**A**	**0.177**	**3.9**
04_N11 & R542	Priority Control	South	A	0.096	0.7	-	0.132	1.0
		East	B	0.094	12.2	B	0.134	14.3
		North	A	0.107	0.7	-	0.163	0.8
		West						
		ALL	**A**	**0.107**	**2.1**	**-**	**0.163**	**2.2**

By adding the additional traffic generated by the mine during the construction phase to the 2019 base year traffic, the N11 & R38 intersection is expected deteriorate from LOS B to LOS C during the AM peak and to remain operating at LOS C during the PM peak, with negligible increases in delays and v/c ratio. Overall, the rest of the intersections will remain operating at a LOS A with insignificant delays of not more than 3 seconds.

Based on these results, it can be concluded that the traffic of the Hendrina Underground Coal Mine during the construction period has a negligible impact on the surrounding road network and thus requires no road upgrades.

7.3.4 2024 Background Traffic

A growth rate of 3% per annum was applied to the 2016 data to generate 2024 weekday AM and PM peak background traffic distributions as shown in Figure 21 and 22, respectively.

Table 13: 2024 Background Traffic plus Development Traffic

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	B	0.33	17.6	C	0.629	25.1
		East	C	0.426	27.0	C	0.617	31.4
		North	B	0.418	15.1	C	0.601	21.7
		West	C	0.249	27.2	C	0.545	30.9
		ALL	**C**	**0.426**	**20.2**	**C**	**0.629**	**26.4**
03_N11 & Davel Road	Priority Control	South	A	0.095	0.0	A	0.031	0.9
		East						
		North	A	0.097	0.0	A	0.112	0.1
		West	B	0.009	10.5	B	0.027	10.2
		ALL	**A**	**0.097**	**0.2**	**A**	**0.112**	**0.9**
04_N11 & R542		South	-	0.079	0.9	A	0.139	1.1

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
	Priority Control	East	B	0.086	11.8	B	0.136	14.0
		North	-	0.111	0.7	A	0.156	0.8
		West						
		ALL	**-**	**0.111**	**2.1**	**A**	**0.156**	**2.2**

The analysis results shown above indicates that overall all intersections are expected to operate at acceptable level of service. N11/ R38 is expected to operate at LOS C during the AM peak and LOS C during the PM peak, with minimal delay of 20.2 seconds in the AM and 26.4 seconds in the PM peak. The rest of the intersections are expected to continue operating at LOS A during both AM and PM peak with minimal delays of less than 3 seconds and v/c ratio of not more than 0.156. Thus the background traffic growth is expected to minimal impact on the road network and no road upgrades are required.

7.3.5 2024 Background Traffic with Operations Phase 1

The operation Phase 1 generated traffic was added to the 2024 weekday AM and PM peak background traffic, the traffic flows are shown in Figure 23 and 24, respectively.

Table 14: 2024 Background Traffic with Operations Phase 1 SIDRA Analysis Results

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	B	0.361	19.3	C	0.628	23.3
		East	C	0.431	27.1	C	0.618	31.5
		North	B	0.443	17.1	C	0.585	20.8
		West	C	0.321	29.0	C	0.581	32.2
		ALL	**C**	**0.443**	**21.8**	**C**	**0.628**	**25.9**
03_N11 & Davel Road	Priority Control	South	A	0.095	1.3	-	0.031	2.0
		East						
		North	A	0.061	0.8	-	0.112	0.4
		West	B	0.095	12.9	B	0.155	11.7
		ALL	**A**	**0.103**	**2.0**	**-**	**0.155**	**3.2**
04_N11 & R542	Priority Control	South	A	0.100	0.7	A	0.149	1.0
		East	B	0.106	12.5	C	0.162	15.3
		North	A	0.120	0.7	A	0.177	0.8
		West						
		ALL	**A**	**0.120**	**2.2**	**A**	**0.177**	**2.3**

By adding the additional traffic expected to be generated by the mine during the operational phase1 to the project, the N11/ R38 intersection is expected to remain operating at LOS C and LOS C with negligible increases in delays and v/c ratio, in comparison to the base year traffic capacity. The other intersections will remain operating at LOS A.

This results illustrate that the mine's additional traffic during the operational phase 1 has a negligible impact on the surrounding road network and thus requires no road upgrades.

7.3.6 2042 Background Traffic with Operations Phase 2

Depicted in figures 25 and 25 respectively.

Table 15: 2042 Background Traffic with Operations Phase 2

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
01_N11 & R38	Signalised	South	C	0.44	20.7	D	0.843	37.6
		East	C	0.524	28.8	D	0.869	47.6
		North	B	0.514	16.7	D	0.746	26
		West	C	0.394	31.2	D	0.832	45.0
		ALL	**C**	**0.524**	**22.7**	**D**	**0.869**	**37.4**
03_N11 & Davel Road	Priority Control	South	-	0.141	0.1	-	0.048	0.6
		East						
		North	-	0.127	0.1	-	0.157	0.1
		West	B	0.016	12.2	B	0.036	11.1
		ALL	**-**	**0.141**	**0.3**	**-**	**0.157**	**0.8**
04_N11 & R542	Priority Control	South	-	0.116	1	-	0.177	1.6
		East	B	0.141	13.7	C	0.242	18.3
		North	-	0.143	0.7	-	0.21	0.8
		West						
		ALL	**-**	**0.143**	**2.4**	**-**	**0.242**	**2.8**

By adding the additional traffic of the Hendrina Underground Coal Mine to the road network during the operational phase 2, no significant traffic impacts are expected and the overall LOS remains unchanged with minimal increases in delays, apart from N11/ R38 intersection.

N11/ R38 intersection is expected to deteriorate from LOS C to LOS D during the PM peak which is still acceptable in terms of national traffic impact assessment guidelines. Note, it should be noted that the impact of the background traffic growth to 2042 could not be accurately determined due to uncertainty of future growth in the area.

The above results indicate that the traffic of the mine during the all the operational phases has a negligible impact on the surrounding road network and thus no upgrades are required.

7.4 Development access

The project sites do not have existing formal road access. Therefore, access to Mooivley West is proposed off Davel Road, about 4km west of N11. Hendrina South is planned to share an access with Mooivley West. Access to Mooivley East is proposed off N11, about 6km north of Davel Road.

The access to Mooivley West will form a new T-junction with Davel Road. The proposal is to have the Mooivley West access road stop controlled with Davel Road having priority. All approaches at this intersection are planned to have one lane in each direction.

The access to Mooivley East will also form a new T-junction with N11. The proposal is to have a priority controlled intersection with N11 having priority. To maintain the mobility function of N11, a separate 100m left lane is proposed on the N11 northern approach and a separate100m right turn lane is proposed on the N11 southern approach. A 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively.

7.4.1 Access capacity analysis

The two new intersections were analysed using SIDRA and the results are illustrated in Table 15 and 16. Only the worst case scenarios were tested, i.e. 2021 Background Traffic plus operational phase 1 for proposed access on Davel Road and 2039 Background Traffic plus operational phase 2 for proposed access on N11.

Table 16: 2024 Background Traffic plus operational phase 1 for proposed access on Davel Road

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
Davel Road & Mooivley West Access	Priority Control	South						
		East	-	0.053	5.6	-	0.023	4.2
		North	A	0.027	8.9	A	0.063	8.9
		West	-	0.002	0.8	-	0.006	0.3
		ALL	**-**	**0.053**	**6.2**	**-**	**0.063**	**6.1**

Table 17: 2042 Background Traffic plus operational phase 2 for proposed access on N11

Intersection	Type of Intersection	Movement	AM			PM		
			LOS	V/C	Delay (s)	LOS	V/C	Delay (s)
N11 & Mooivley East	Priority Control	South	-	0.12	1.3	-	0.206	0.4
		East	B	0.06	12.7	C	0.179	15.7
		North	-	0.142	0.6	-	0.175	0.3
		West						
		ALL	**-**	**0.142**	**1.7**	**-**	**0.206**	**1.8**

Overall, both intersections are expected to operate at acceptable level of service LOS A. These results indicates that the proposed mine access will have minimal impact on the on the surrounding road network.

7.4.2 Queuing analysis

A queuing analysis was undertaken to determine the number of entrance or exit lanes and the stacking space required at the development access on Davel Road and the access at Mooivley East.

In all circumstances it is assumed that the access will be controlled with either a gate operated by a security guard therefore a service rate of 10 seconds was assumed resulting to 360 vehicles per hour. A 90th percentile queue length is deemed acceptable to assess the required stacking space at the access point.

The construction phase is expected to generate the most vehicle trips thus at most 116 vehicles are expected to enter the site during peak hour.

Table 18: Queuing Analysis variables

Description	Access
Peak Hour Inbound Traffic Volume	116
Average arrival rate (vph)	116
Average service rate (sec/ veh)	10
Average service rate (service / h)	360
Traffic Intensity	0.34
Number of channels (gates)	1
90^{th} percentile queue length (<n vehicles)	2
Average number of vehicles in the system	0.5
Average Delay (sec)	15.1

The results above show that vehicle stacking space for 2 vehicles will be required. It is, therefore recommended that a distance of at least 45m should be provided between the N11 and the proposed gate to accommodate the stacking / queuing of two 20m trucks.

8 Public transport and Non-Motorised Transport

8.1 Public transport

Based on the trip generation results, the development is expected to generate about 13 minibus taxi trips per hour in 2016 (construction phase) and 8 minibus taxi trips per hour in 2021 (operational phase) during both the AM and PM peak.

It recommended that taxi lay-by be provided along Davel Road in the vicinity of the Mooivley West site, preferable in close proximity to the entrance of the site. For the Mooivley East site, a public transport facility is recommended on site as a bus/taxi lay-bys are not recommended on a Class 1 road (N11). The introduction of public transport facilities will greatly enhance the sites' sustainability from a transport point of view and its integration with the wider existing public transport network

8.2 Non-motorised transport

During our site visit few pedestrians were observed along the N11. The trip generation results show that about 125 non-motorised transport trips per hour (both AM and PM peak) are expected to access the site during construction and this number is expected to decrease to less than 77 trips during the operational phases of the mine.

9 Environmental assessment of traffic and transport impact

9.1 Methodology used in Determining and Ranking the Nature, Significance, Consequence, Extent, Duration and Probability of Potential Environmental Impacts and Risks

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts.

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this TIA. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 19, which is extracted from Table 20. The description of the significance ratings is discussed in Table 21.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 19: Impact Assessment Parameter Ratings

Rating	Intensity / Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

Rating	Intensity / Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.

Rating	Intensity / Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 20: Probability/Consequence Matrix

Probability \ Significance	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 21: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

9.2 Project Activities

A list of project activities to be assessed for the project has been discussed Table 21.

Table 22: Description of Activities to be assessed

Project Phase	Project Activity	Project Structures
Construction	Site Clearance	Topsoil Stockpiles
	Blasting and Excavation	Two Shafts per mining right area
	Construction of Surface Infrastructure	Crushing and Screening Plant Mine Offices Change House Workshop Overburden and Product Stockpiles Site Fencing Access and Service Roads (with weighbridge) Overland Conveyor Sewage Treatment Plant Three Pollution Control Dam Water Treatment Plant Diesel Storage Tanks Ventilation Shaft per mining right area
	Water Abstraction and Use	Water Tanks and Pipes
	Waste Generation and Disposal	Waste Skips
	Power Generation	Diesel Generator
Operations	Underground Blasting and Mining	Heavy Machinery and Equipment
	Stockpiling	Waste Rock Berms Product Stockpile
	Hauling/Conveying of Coal	Overland Conveyor Belt Haul and Access Roads
	Plant and Equipment Operations	Crushing and Screening Plant Workshop and Diesel Storage Tanks
	Water Use and Storage	Pollution Control Dam and Jo Jo Tanks
	Waste Generation and Storage	Sewage Treatment Plant Waste Skips
	Power Generation	Diesel Generator
Mine Decommissioning and Closure	Removal of infrastructure and surface rehabilitation	Crushing and Screening Plant Mine Offices Change House Workshop Overburden and Product Stockpiles Site Fencing Access and Service Roads (with weighbridge)

Project Phase	Project Activity	Project Structures
		Overland Conveyor Sewage Treatment Plant Three Pollution Control Dam Water Treatment Plant Diesel Storage Tanks Ventilation Shaft per mining right area
	Waste Generation and Disposal	Waste Skips

9.3 Impact assessment

As mentioned earlier in this report, the construction, operations and decommissioning activities listed above are expected to generate additional private vehicle, public transport and pedestrian traffic on the existing road within the study area as a result of workers travelling to and from work; and the transportation of construction materials and mined coal. During the three stages of the project (i.e. construction, operations and decommissioning), the additional traffic is expected to have direct or indirect impacts on the following:

- Increase in traffic volumes and vehicle delays;
- Increase in delays for cyclists and pedestrians as result of the additional traffic on the network
- Road safety conditions could be impacted negatively by an increase in heavy vehicles; and
- Impact on road surface conditions of the local road network as a result of an increase in heavy vehicles.

The ESIA also examines other areas in which transport is part of the overall impact. These additional impacts are:

- Noise;
- Visual impacts;
- Vibration;
- Air Quality;
- Ecological; and
- Heritage and conservation areas.

9.3.1 Construction Phase

Impact description

Impact on traffic condition and driver delays

During construction period, the peak hour volume along N11 in the vicinity of the site is expected to increase by no more than 10%. This could have had a relatively noticeable impact on the traffic flow had the current and future background traffic volumes been high but considering this road carries low traffic volumes, a minor impact on traffic flow and intersection operations are anticipated. Drivers are expected to experience an increase in delays of not more than 35 seconds, which is negligible.

Impact on pedestrians and cyclists

As previously stated in this report, the mine plans to employ people from the nearby residential areas thus the majority of construction workers are likely to reside within a reasonable walking distance from the mine. As discussed in Section 6, the mine is expected to generate about 125 NMT trips per day during the construction phase (both AM and PM peak).

Impact on road safety conditions

During construction, the mine is expected to generate about 4 additional heavy vehicle trips on to the road network during both AM and PM peak. This is a negligible increase of heavy vehicle. However to promote safety in the vicinity of the site it is recommended that measures be introduced to reduce the frustration experienced by the motorist on public roads due to heavy vehicles. It is therefore recommended that the drivers

of all heavy vehicles be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other vehicles on these roads.

Impact on road conditions

The impact of heavy vehicles during construction is very low as only 4 vehicle trips are expected per peak hour and the duration of the impact is expected over 3 years only.

Management Objectives

- Minimise the impact of addition traffic on vehicle delays;
- Minimise conflict between through traffic movements and turning traffic movements at site access roads;
- Minimise the impact of delays on pedestrian and cyclists;
- Minimise conflict between vehicles and pedestrians, especially in the vicinity of the sites;
- Minimise road safety risk due to increase heavy vehicles on the road network; and
- Minimise deterioration of infrastructure including road surface and bridges/ culverts.

Management Actions and Targets

- Introduce the following road upgrades at the new proposed N11/ Mooivley East Access Road intersection:
  - The intersection to be priority controlled with the mine access road stop controlled.
  - Separate 100m left lane is proposed on the N11 northern approach;
  - Separate 100m right turn lane; and
  - 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively.
- The new proposed Davel Road and Mooivley West intersection is to be priority controlled with Davel Road having priority.
- Heavy vehicle to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions.
- Prescribe routes for construction traffic to:
  - discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and
  - Discourage routing of heavy vehicles through residential areas
- The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site.
- The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.
- Drivers of heavy vehicles be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other vehicles and NMT users on these roads; and
- Regular pedestrian and cycling activity awareness for staff working on site during all project stages, as part of regular Health and Safety briefings

Impact ratings

The table below is a summary of the significance impact rating during construction.

Table 23: Potential Impacts of the development traffic during construction

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Construction)			
Impact Description: Increase in traffic volumes and vehicle delays			
Prior to Mitigation/Management			
Duration	Medium term (3)	The construction phase in not expected to last more than 3 years.	Minor (negative) -50
Extent	Local (3)	Most of the impact will be on the local road network, more so in the vicinity of the site. Although the development traffic will make use of regional freight corridors, the number of vehicles assigned to any individual route will reduce as multiple route choices exist outside the study area. The increased delays are therefore only expected on the local road network.	
Intensity x type of impact	On-going serious social issues (4)	Increased traffic will result in minor increase in delays across most of the network. The proposed access to Mooivley East off N11 is expected to lower the mobility standards of N11 as a Class 1 road, with speed limit of 120km/h, as vehicles accessing the mine will slow down to turn into the mine access road and thus slowing down through traffic.	
Probability	Likely (5)	It is likely that the additional development traffic could result in slight increase in average vehicle delays and minor deterioration of service levels on the surrounding road network.	
Nature	Negative	Increase delays are negative to both the environment and driver behaviour.	
Mitigation/Management Actions			
▪ Introduce the following road upgrades at the new proposed N11/ Mooivley East Access Road intersection: o Priority controlled intersection with mine access road stop controlled. o Separate 100m left lane is proposed on the N11 northern approach; o Separate 100m right turn lane; and o 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively. ▪ The new proposed Davel Road and Mooivley West intersection is to be priority controlled with Davel Road having priority; and ▪ Heavy vehicle to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions.			

Post-Mitigation			
Duration	Medium term (3)	The construction phase in not expected to last more than 3 years.	Negligible (negative) – 32
Extent	Local (3)	Most of the impact will be on the local road network as discussed above.	
Intensity x type of impact	Minor medium term social impact (2)	With mitigation, the impact of the additional development traffic will be minor.	
Probability	Probable (4)	The separate turning lanes will reduce the conflict between through and turning movements.	
Nature	Negative (-1)	Increased delays are negative to both the environment and driver behaviour.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Construction)			
Impact Description: Increase in delays for cyclists and pedestrians as result of the additional traffic on the network.			
Prior to Mitigation/Management			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years.	Minor (negative) -36
Extent	Local (3)	Most of the impact will be on the local road network.	
Intensity x type of impact	On-going social issues (3)	There is currently low level of pedestrian and cycling activity. The construction activities are expected to increase pedestrian volumes notably in the vicinity of the sites.	
Probability	Probable (4)	As a result of increases in pedestrians and vehicles on the road network, there would be an increase in the probability of pedestrian and vehicle conflicts.	
Nature	Negative (-1)	Increased delays are negative to both the environment and NMT users	
Mitigation/Management Actions			
▪ Regular pedestrian and cycling activity awareness by drivers as part of the formal driver training and regular Health and Safety briefings; and ▪ Site related heavy vehicles need to avoid low order roads in residential areas, as far as reasonably practicable.			
Post-Mitigation			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years	Negligible (negative) -24
Extent	Local (3)	Most of the impact will be on the local road network	
Intensity x type of impact	On-going social issues (2)	With mitigation, there impact of the additional development traffic will be minor.	
Probability	Probable (3)	Even with mitigation, pedestrians and cyclist delays would still experience some delay. However providing NMT infrastructure and avoidance of roads that are prone to pedestrian and cycling traffic can reduce the probability of delays increasing significantly.	
Nature	Negative (-1)	Increased delays are negative to both the environment, NMT and driver behaviour.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Construction)			
Impact Description: Road safety conditions could be impacted negatively by an increase in heavy vehicles.			
Prior to Mitigation/Management			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years.	Minor (negative) -40
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple routes (i.e. either using N4 or R38) choices become available.	
Intensity x type of impact	On-going social issues (4)	Increase in heavy vehicles could result in increased speed differential on the major roads. Some drivers may not be tolerant of heavy vehicles on their path and this could lead to increased driver aggressiveness. Heavy vehicles require more time when turning right at major intersections. There is a risk of drivers taking less than optimal gaps if the delays are high.	
Probability	Probable (4)	It is probable that an increased number of heavy vehicles on the network could trigger some deterioration in the road safety conditions on the local road network.	
Nature	Negative (-1)	Deterioration of road safety conditions is negative in nature.	
Mitigation/Management Actions			
▪ Regular driver awareness campaigns / training; ▪ Prescribe routes for construction traffic to: – discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and – Discourage routing of heavy vehicles through residential areas ▪ Heavy vehicle deliveries to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of HGVs waiting to access the site or at road junctions.			
Post-Mitigation			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years.	Negligible (negative) -27
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple routes (i.e. either using N4 or R38) choices become available.	
Intensity x type of impact	On-going social issues (3)	With mitigation, the severity of road safety impact by the development is expected to reduce.	
Probability	Likely (3)	The probability of the road safety conditions deteriorating is likely to be reduced with implementation of the recommended mitigation measures.	
Nature	Negative (-1)	Deterioration of road safety conditions is negative in nature.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Construction)			
Impact Description: Impact on road surface conditions of the local road network as a result of an increase in heavy vehicles.			
Prior to Mitigation/Management			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years.	Negligible (negative) -18
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple routes (i.e. either using N4 or R38) choices become available.	
Intensity x type of impact	On-going social issues (3)	Heavy vehicles increase the rate at which road surfacing wear out and other structural pavement defects / deformations that could lead to formation of potholes.	
Probability	Minimal (2)	The minimal increase of heavy vehicles on the network will not have a large influence in the road conditions on the local road network.	
Nature	Negative (-1)	Deterioration of road surface conditions is negative in nature.	
Mitigation/Management Actions			
▪ The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site; and ▪ The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.			
Post-Mitigation			
Duration	Medium Term (3)	The construction phase in not expected to last more than 3 years.	Negligible (negative) -16
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple routes (i.e. either using N4 or R38) choices become available.	
Intensity x type of impact	On-going social issues (2)	Heavy vehicles volumes during construction are very low. The mitigation measures are expected to minimise impact.	
Probability	Minimal (2)	The minimal increase of heavy vehicles on the network will not have a large influence in the road safety conditions on the local road network	
Nature	Negative (-1)	Deterioration of road surface conditions is negative in nature.	

9.3.2 Operation Phase

Impact description

Impact on traffic condition and driver delays

During the operational period, peak hour volumes along N11 past the site are expected to increase by less than 5%. These volumes decrease when compared to the construction period, the additional traffic generated by the proposed mine is not expected to have any significant impact on background traffic. Drivers are expected to experience negligible delays of no more than 2 seconds, close to the proposed site, and not more than 35 seconds delay in the town of Hendrina.

Impact on pedestrians and cyclists

The number of NMT users is expected to decrease to 77 trips per day (AM and PM peak) during the operational phase of the mines. Similarly, sidewalks as describe above are recommended.

Impact on road safety conditions

The mine is expected to generate 26 heavy vehicle trips per hour (AM and PM) during the operation period contributing to about 10% increase of heavy vehicle in the vicinity of the site during both the AM and PM. Safety precautions as discussed in the section above are also recommended.

Impact on road condition

Overall, the increase in heavy vehicles during both construction and operation phases will accelerate the deterioration of these roads although only slightly and certainly not noticeably. With the exception of the Mine Access Road, all other roads that the mine generated traffic are likely to use are under the jurisdiction of the Mpumalanga Department of Transport and South African National Road Agency (Ltd) SANRAL. It is these departments' responsibilities to maintain, repair and rehabilitate these roads.

It is, however, proposed that the mine make a contribution to the maintenance of the section of N11 between Ermelo and Hendrina. This action demonstrates to the roads authorities the conscientiousness and willingness of the project applicant to contribute and the care for the area in which it operates.

Management Objectives

The objectives during this stage are similar to the construction stage.

Management Actions and Targets

Mitigation measure for the construction stage also apply for the operational stage.

Impact Ratings

The impact of the mine's traffic on the condition of the surrounding public road network and traffic conditions is quantified below.

Table 24: Potential Impacts of the development traffic during Operations

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Operations)			
Impact Description: Increase in traffic volumes and vehicle delays.			
Prior to Mitigation/Management			
Duration	Project life (5)	Duration of the project will be 36 years.	Negligible (negative) -22
Extent	Local (3)	Most of the impact will be on the local road network. Although the development traffic will make use of regional freight corridors, the number of vehicles assigned to any individual route will reduce as multiple route choices exist outside the study area. The increased delays are therefore only expected on the local road network.	
Intensity x type of impact	On-going serious social issues (3)	Increased traffic will result in minor increase in delays across most of the network. The proposed access to Mooivley East off N11 is expected to lower the mobility standards of N11 as a Class 1 road, with speed limit of 120km/h, as vehicles accessing the mine will slow down to turn into the mine access road and thus slowing down through traffic.	
Probability	Minimal (2)	Additional traffic is likely to increase average vehicle delays on the network, however this delays are minimal.	
Nature	Negative (-1)	Increased delays are negative to both the environment and driver behaviour.	
Mitigation/Management Actions			
▪ Maintenance of proposed road upgrades at the new proposed N11/ Mooivley East Access Road and Davel Road/ Mooivley West Access Road ; and ▪ Heavy vehicle to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions.			
Post-Mitigation			
Duration	Project life (5)	Duration of the project will be 36years.	Negligible (negative) – 20
Extent	Local (3)	Most of the impact will be on the local road network.	
Intensity x type of impact	On-going serious social issues (2)	With mitigation, there impact of the additional development traffic will be minor.	
Probability	Minimal (2)	It is probable for delays to occur on the local road network, this not expected to occur on regular basis.	
Nature	Negative (-1)	Increased delays are negative to both the environment and driver behaviour.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Operations)			
Impact Description: Increase in delays for cyclists and pedestrians as result of the additional traffic on the network due to the proposed development.			
Prior to Mitigation/Management			
Duration	Project Life (5)	Duration of the project will be 36 years.	Negligible (negative) -20
Extent	Local (3)	Most of the impact will be on the local road network.	
Intensity x type of impact	Minor medium Term social impact (2)	There is currently low volume of pedestrian and cycling activity on the affected roads. The development impact on pedestrians and cyclist is therefore expected to be minor.	
Probability	Minimal (2)	As a result of increases in pedestrians and vehicles on the road network, there would be an increase in the probability of pedestrian and vehicle conflicts.	
Nature	Negative (-1)	Increased delays are negative to both the environment and driver behaviour.	
Mitigation/Management Actions			
▪ Regular pedestrian and cycling activity awareness by drivers as part of the formal driver training and regular Health and Safety briefings; and ▪ Site related heavy vehicles need to avoid low order roads in residential areas, as far as reasonably practicable.			
Post-Mitigation			
Duration	Project Life (5)	Duration of the project.	Negligible (negative) -18
Extent	Local (3)	Most of the impact will be on the local road network, with some traffic distributing on the key freight corridors beyond the extent of the study area.	
Intensity x type of impact	Low level of impact (1)	Reduced routing of development related traffic and better awareness of other road users will result in reduced friction between drivers and pedestrians / cyclist.	
Probability	Minimal (2)	Even with mitigation, pedestrians and cyclist delays would still experience some delay. However avoidance of roads that are prone to pedestrian and cycling traffic can reduce the probability of delays increasing significantly.	
Nature	Negative (-1)	Increased delays are negative to both the environment and driver behaviour.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Operations)			
Impact Description: Road safety conditions could be impacted negatively by an increase in heavy vehicles due the proposed development.			
Prior to Mitigation/Management			
Duration	Project life (5)	Duration of the project.	Minor(negative) -36
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple route choices become available.	
Intensity x type of impact	On-going serious social issues (4)	Increase in heavy vehicles could result in increased speed differential on the major roads. Some drivers may not be tolerant of heavy vehicles on their path and this could lead to increased driver aggression and impatience. Heavy vehicles require more time when turning right at major intersections. There is a risk of drivers taking less than optimal gaps if the delays are long.	
Probability	Likely (3)	It is likely that increased number of heavy vehicles on the network could trigger some deterioration in the road safety conditions on the local road network.	
Nature	Negative (-1)	Deterioration of road safety conditions is negative in nature.	
Mitigation/Management Actions			
▪ Regular driver awareness campaigns / training; ▪ Prescribe routes for delivery vehicles to: – discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and – Discourage routing of heavy vehicles through residential areas ▪ Heavy vehicle deliveries to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of HGVs waiting to access the site or at road junctions.			
Post-Mitigation			
Duration	Project life (5)	Duration of the project.	Negligible (negative) -30
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple route choices become available.	
Intensity x type of impact	Minimal (2)	With mitigation, the severity of road safety impact by the development is expected to reduce.	
Probability	Likely (3)	The probability of the road safety conditions deteriorating is likely to be reduced with implementation of the recommended mitigation measures.	
Nature	Negative	Deterioration of road safety conditions is negative in nature.	

Dimension	Rating	Motivation	Significance
Activity and Interaction (Development Traffic during Operations)			
Impact Description: Impact on road surface conditions of the local road network.			
Prior to Mitigation/Management			
Duration	Project life (5)	Duration of the project.	Negligible (negative) -33
Extent	Local (3)	Most of the impact will be on the local road network. The number of heavy vehicles assigned to roads outside the study area will reduce as multiple route choices become available.	
Intensity x type of impact	On-going issues (3)	Although the number of heavy vehicles is expected to increase during operations, the impact is expected to be minimal.	
Probability	Likely (3)	It is probable that increased number of heavy vehicles on the network could trigger some deterioration in the road safety conditions on the local road network.	
Nature	Negative	Deterioration of road surface conditions is negative in nature.	
Mitigation/Management Actions			
▪ The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site; and ▪ The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.			
Post-Mitigation			
Duration	Project life (5)	Duration of the project	Negligible (negative) -33
Extent	Local (3)	Most of the impact will be on the local road network.	
Intensity x type of impact	On-going issues (3)	The mitigation measures are expected to further minimise impact.	
Probability	Likely (2)	Regular maintenance of the road conditions would minimise the wearing out of the road surface.	
Nature	Negative	Deterioration of road surface conditions is negative in nature.	

10 Environmental Management Plan

The objective of an EMP is to present mitigation to (a) manage undue or reasonably avoidable adverse impacts associated with the development of a project and (b) enhance potential positives.

Mitigation measures will sometimes be built into the base of a project and should be considered as part of the “pre-mitigation” scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives of environmental and social management plans are to give mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the EISA;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;
- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary;
- Provide an auditable management plan that can follow the Deming Cycle;
- Gauge if predicted benefits of the project are being achieved and maximized; and
- Gain information for improving similar projects and EIA practice in the future.

10.1 Summary of Mitigation and Management

Table 24 provides a description of the mitigation and management options for the environmental impacts anticipated during the construction, operations and decommissioning stages.

Table 25: Mitigation and Management Plan

Activities	Potential Impact	Size and scale of disturbance	Aspects Affected	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Workers transportation and the transportation of construction materials, produced coal during operation and decommissioning materials	Increase in traffic volumes and vehicle delays	▪ Construction – 116 additional vehicle trips during AM and PM peak hour ▪ Operation – 99 additional vehicle trips during AM and PM peak hour ▪ Decommissioning – 39 additional vehicle trips during AM and PM peak hour	road capacity and driver delays	Construction, operational and decommissioning	▪ Introduce the following road upgrades at the new proposed N11/ Mooivley East Access Road intersection: – The intersection to be priority controlled with the mine access road stop controlled. – Separate 100m left lane is proposed on the N11 northern approach; – Separate 100m right turn lane; and – 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively. ▪ The new proposed Davel Road and Mooivley West intersection to be priority controlled with Davel Road having priority. ▪ Heavy vehicle to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions. ▪ Prescribe routes for construction traffic to: – discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and – Discourage routing of heavy vehicles through residential areas	SANRAL and local roads authorities standards	Commencement of construction.
	Increase in delays for cyclists and pedestrians as result of the additional traffic on the network.	▪ Construction – 125 additional pedestrian trips during AM and PM peak hour ▪ Operation – 99 additional pedestrian trips during AM and PM peak hour	Pedestrian and cyclist delays and intimidation	Construction, operational and decommissioning	▪ Regular pedestrian and cycling activity awareness for staff working on site during all project stages, as part of regular Health and Safety briefings	SANRAL and local roads authorities standards	Commencement of construction and throughout the project to closure

		▪ pedestrian trips during AM and PM peak hour					
	Road safety conditions could be impacted negatively by an increase in heavy vehicles.	▪ Construction – 6 heavy vehicles trips per day ▪ Operation – 26 heavy vehicle trips per day ▪	Safety of all road users including vehicles and NMT	Construction, operational and decommissioning	▪ Drivers of heavy vehicles be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other vehicles and NMT users on these roads; and	Road safety standards	Commencement of construction and throughout the project to closure
	Impact on road surface and road structures conditions of the local road network as a result of an increase in heavy vehicles.	▪ Construction – 6 heavy vehicles trips per day ▪ Operation – 26 heavy vehicle trips per day	Road pavements and road structures (bridges and culverts)	Construction, operational and decommissioning	▪ The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site. ▪ The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.	SANRAL and local roads authorities standards	Commencement of construction and throughout the project to closure

11 Consultations undertaken

As part of the preparation and development of the TIA, Aurecon had discussions with SANRAL on 20 June 2016 to discuss the scope of the project and the methodology as well as their requirements. The broad outcome of the discussions was that SANRAL will support the TIA if all SANRAL standards have been considered.

12 Conclusions and Recommendations

The aim of the TIA study was to assess the impact of the additional traffic expected to be generated by proposed mine activities for all stages of the project including: construction, operation and decommissioning. For the purpose of this study, the impact of construction and operation activities only were assessed as these phases are expected to generate the most traffic volumes.

Our conclusions and recommendations are summarized below:

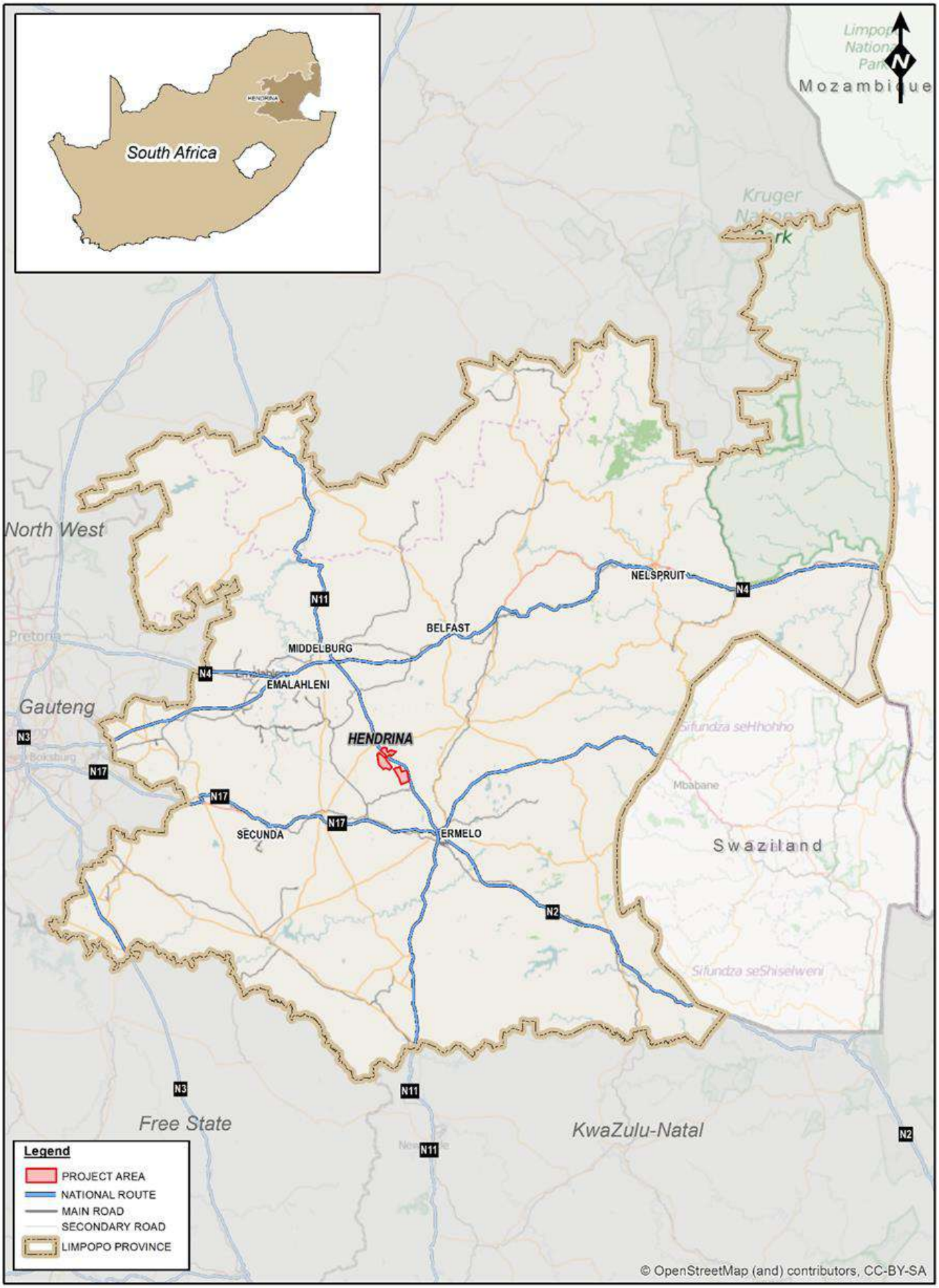
- Traffic counts were undertaken at affected intersections to establish baseline traffic conditions on which the impact of the traffic generated by the proposed mining activity can be assessed. A site visit was undertaken to assess current road network, transport modes using the route, traffic safety aspects, road condition, traffic flow and land use.
- The traffic counts and the capacity analysis indicated that the existing road network within the study area is operating at well below its capacity and at a good LOS with all analysed intersections operating at an overall LOS A to LOS C.
- Calculations of traffic generation revealed that the construction phase will generate 116 vehicle trips during both the AM and PM peak hours and the operational stage of the proposed project will generate 99 vehicle trips during both the AM and PM peak hours.
- The capacity analysis results show that the additional mine traffic during the construction phase and operational stage are expected to have a negligible impact on the surrounding network as LOS at the analysed intersections is expected to remain the same except for the N11/R38 intersection which is expected to deteriorate from LOS C to LOS D during the operation stage. LOS D is still considered to be acceptable, therefore no road upgrades are required at analysed intersections.
- One access point has been proposed off N11 (6km north of Davel Road) to the Mooivley East site and another access off Davel Road (4km west of N11) to serve both Mooivley West and Hendrina South sites. The proposed access roads will form a T-junctions with either N11 or Davel Road.
- The following intersection configuration is recommended at the new proposed N11/ Mooivley East Access Road intersection:
  - The intersection to be priority controlled with the mine access road stop controlled;
  - Separate 100m left lane on the N11 northern approach;
  - Separate 100m right turn lane on the southern approach; and
  - A 100m right-turn refuge lane and 100m taper acceleration lane are recommended on the northern and southern approaches respectively.
- The new proposed Davel Road and Mooivley West intersection to be priority controlled with Davel Road having priority.
- The queueing analysis results at the mine accesses show that vehicle stacking space for 2 vehicles will be required. It is, therefore recommended that a distance of at least 45m should be provided between N11/ Davel Road and the proposed access gates to accommodate two 20m trucks at the respective access points.
- There is currently very little pedestrian and cyclist activity on the road network. The mine is expected to generate about 125 NMT trips per hour (both AM and PM peak) during construction. The number of NMT users is expected to decrease to 77 trips per hr (AM and PM peak) during the operational phase. The majority of the NMT trips are expected to be made by pedestrians walking from the nearby residential area of Hendrina and from public transport facilities. The verges on either side of N11 and Davel Road are wide enough to accommodate pedestrian activity without affecting the flow of traffic.

- Overall, the increase in heavy vehicles during both construction and operation phases will accelerate the deterioration of the roads in the study area though only slightly and certainly not noticeably. With the exception of the Hendrina Underground Coal Mine Access Road, all other roads that the mine generated traffic is likely to use are under the jurisdiction of the local transport authorities and SANRAL.
- The significance of the cumulative traffic impacts associated with the proposed project activities during construction, operations and decommissioning are considered negligible to minor. The table below show the summary of impacts and recommended mitigation measures.

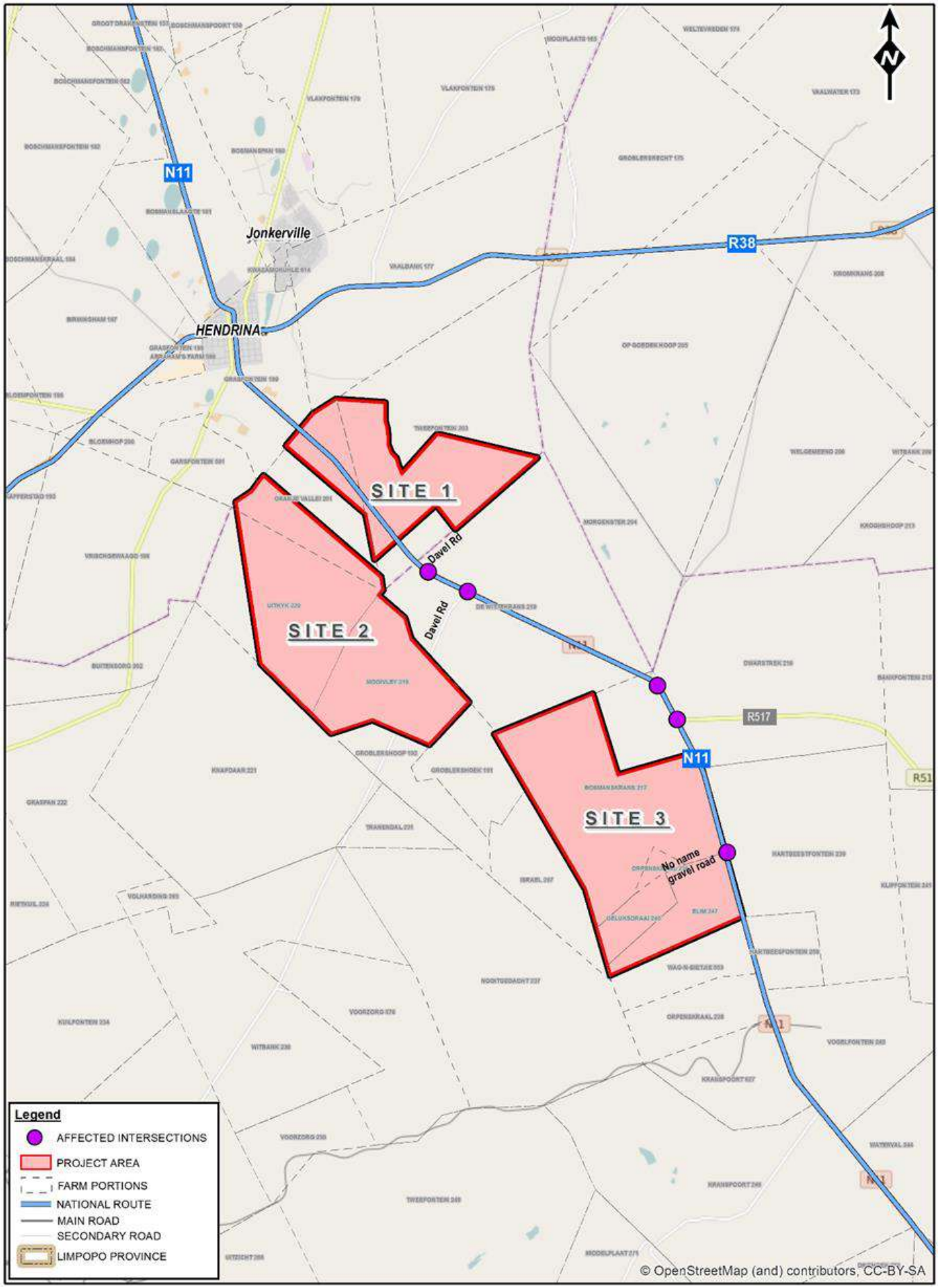
Potential Impact	Mitigation Type/Measures
Increase in traffic volumes and vehicle delays	■ Introduce road upgrades at proposed new mine access intersection points with N11 and Davel Road as stated above. ■ Heavy vehicle movements to be scheduled outside peak hours to minimise the potential for platooning and, therefore, queues of heavy vehicles waiting to access the site or at road junctions. ■ Prescribe routes for construction traffic to: – Discourage right turns by heavy vehicles on busy roads where heavy vehicles have to give way to fast moving vehicles; and – Discourage routing of heavy vehicles through residential areas.
Increase in delays for cyclists and pedestrians as result of the additional traffic on the network.	■ Regular pedestrian and cycling activity awareness for staff working on site during all project stages, as part of regular Health and Safety briefings
Road safety conditions could be impacted negatively by an increase in heavy vehicles.	■ Drivers of heavy vehicles be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other vehicles and NMT users on these roads.
Impact on road surface and road structures conditions of the local road network as a result of an increase in heavy vehicles.	■ The developer should engage with the planning authorities concerning maintenance of public roads near the development sites, this includes the existing bridges/ culverts along Davel Road to/from Mooivley West site. ■ The developer should ensure that the access roads are maintained regularly and to acceptable maintenance standards.

Provided that the above comments and recommendations are adhered to, the proposed application can be supported from a traffic engineering perspective.

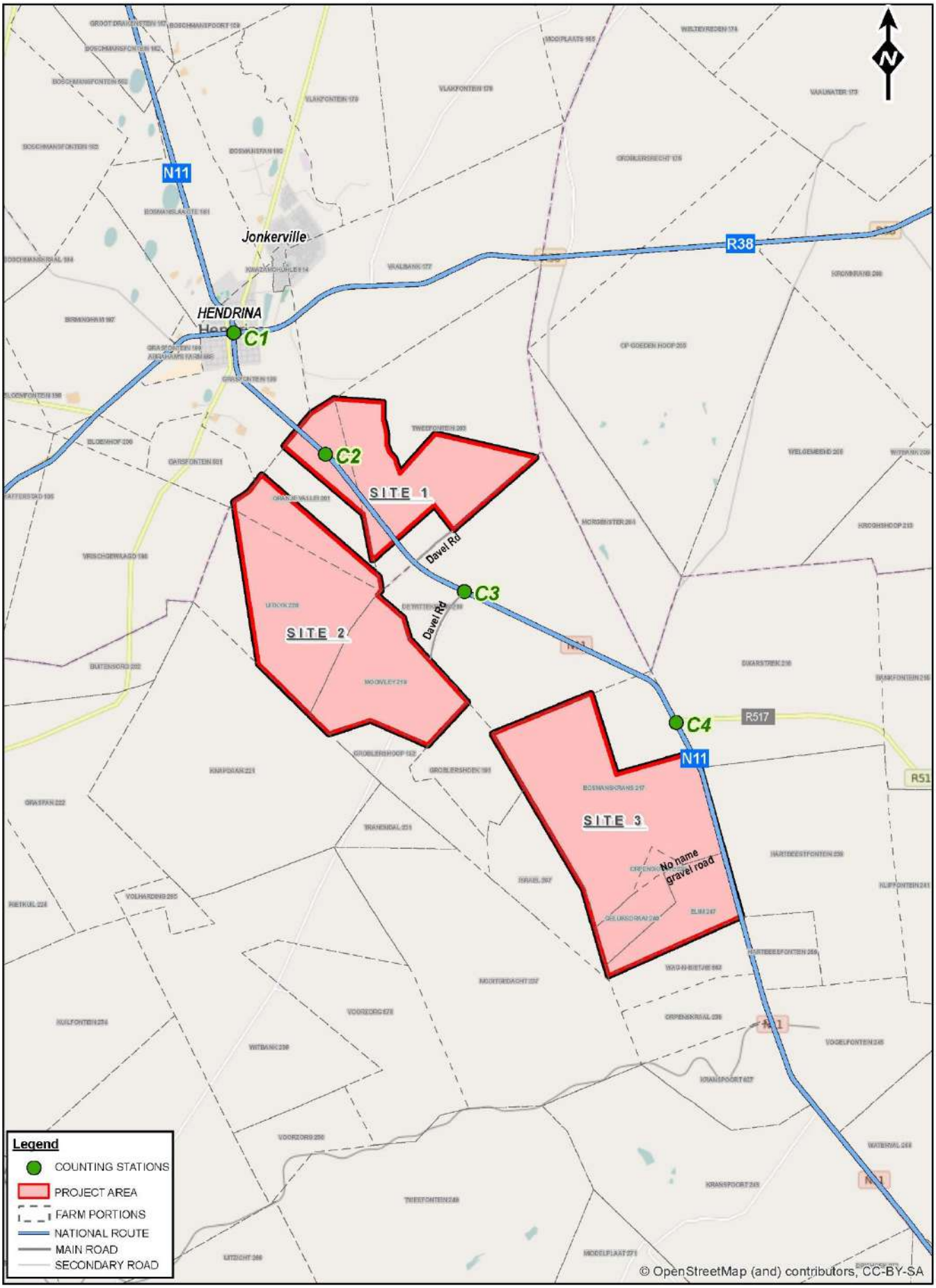
Figures



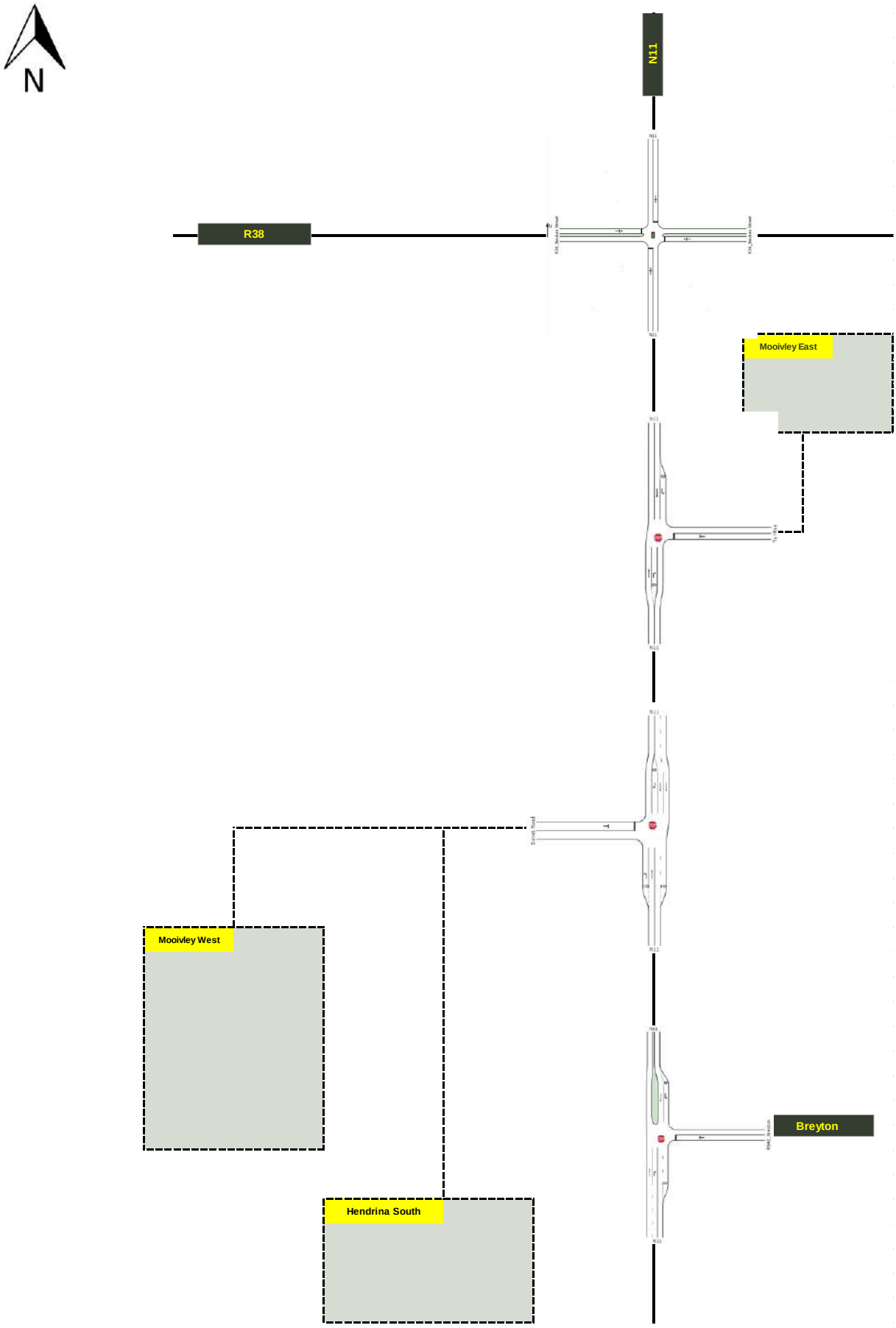
aurecon	Project: Hendrina Reserve TIA	Locality Map	Figure: 1



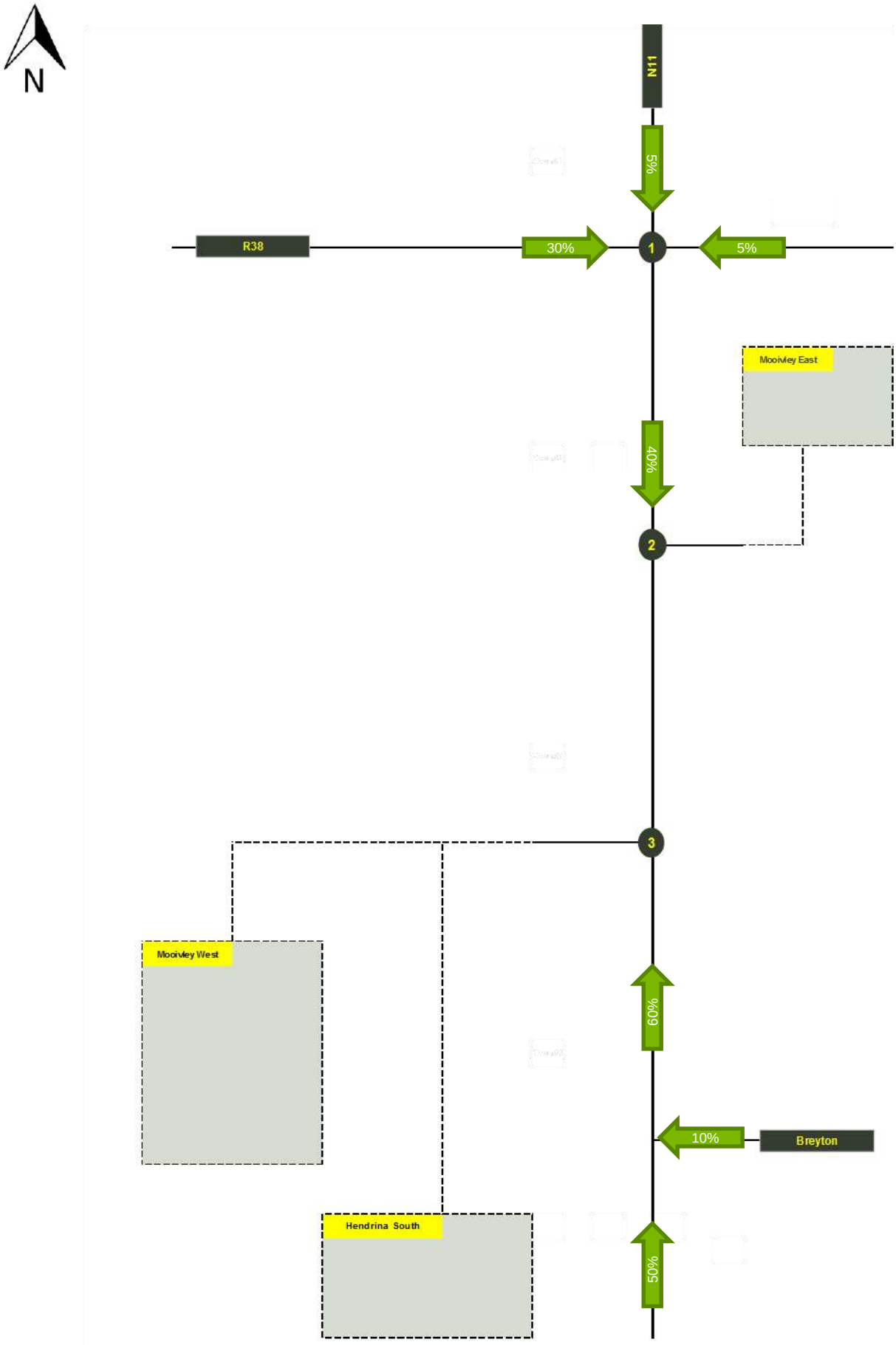
aurecon	Project: Hendrina Reserve TIA	Site Context	Figure: 2



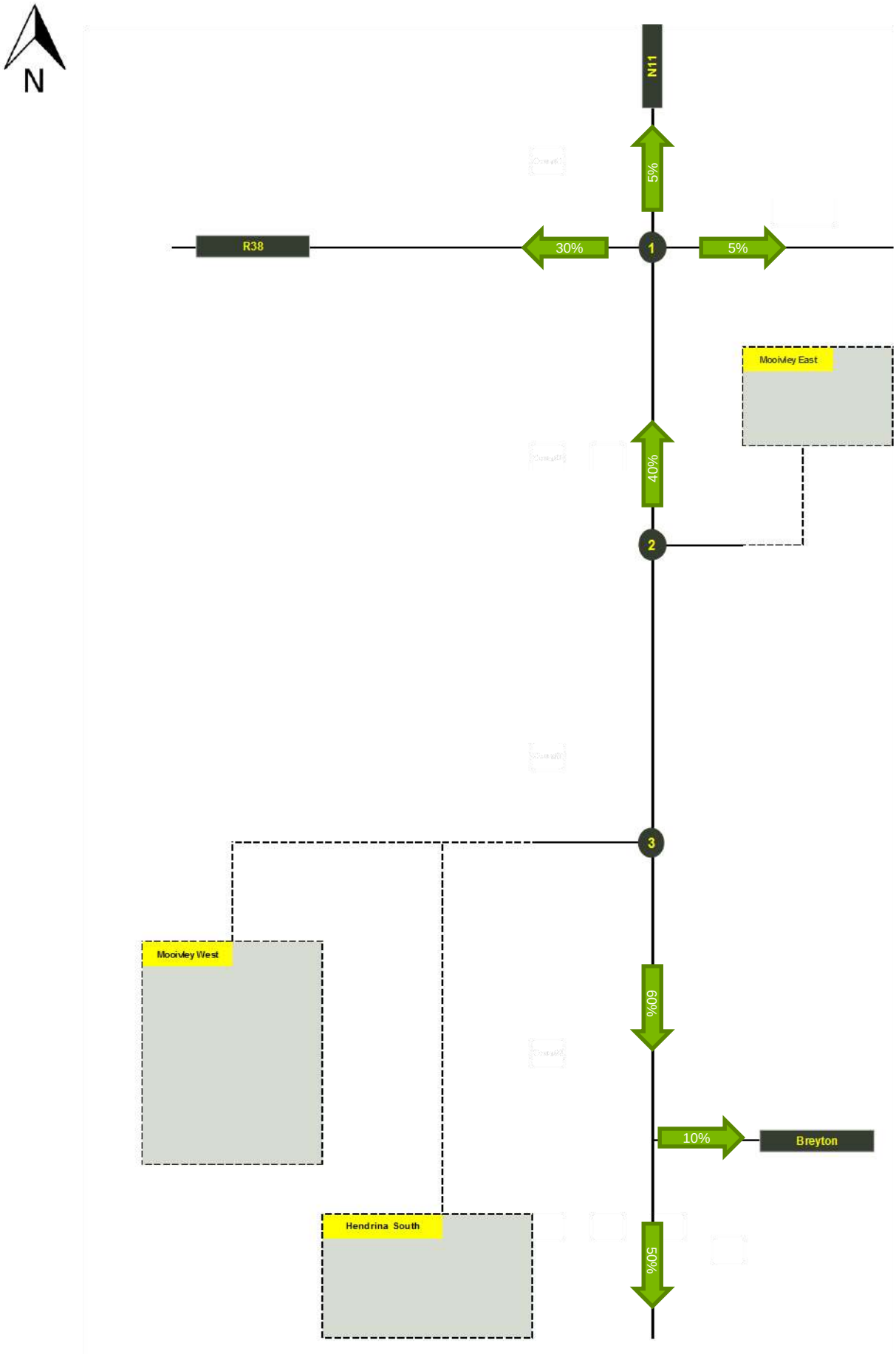
aurecon	Project: Hendrina Reserve TIA	Traffic Survey Points	Figure: 3



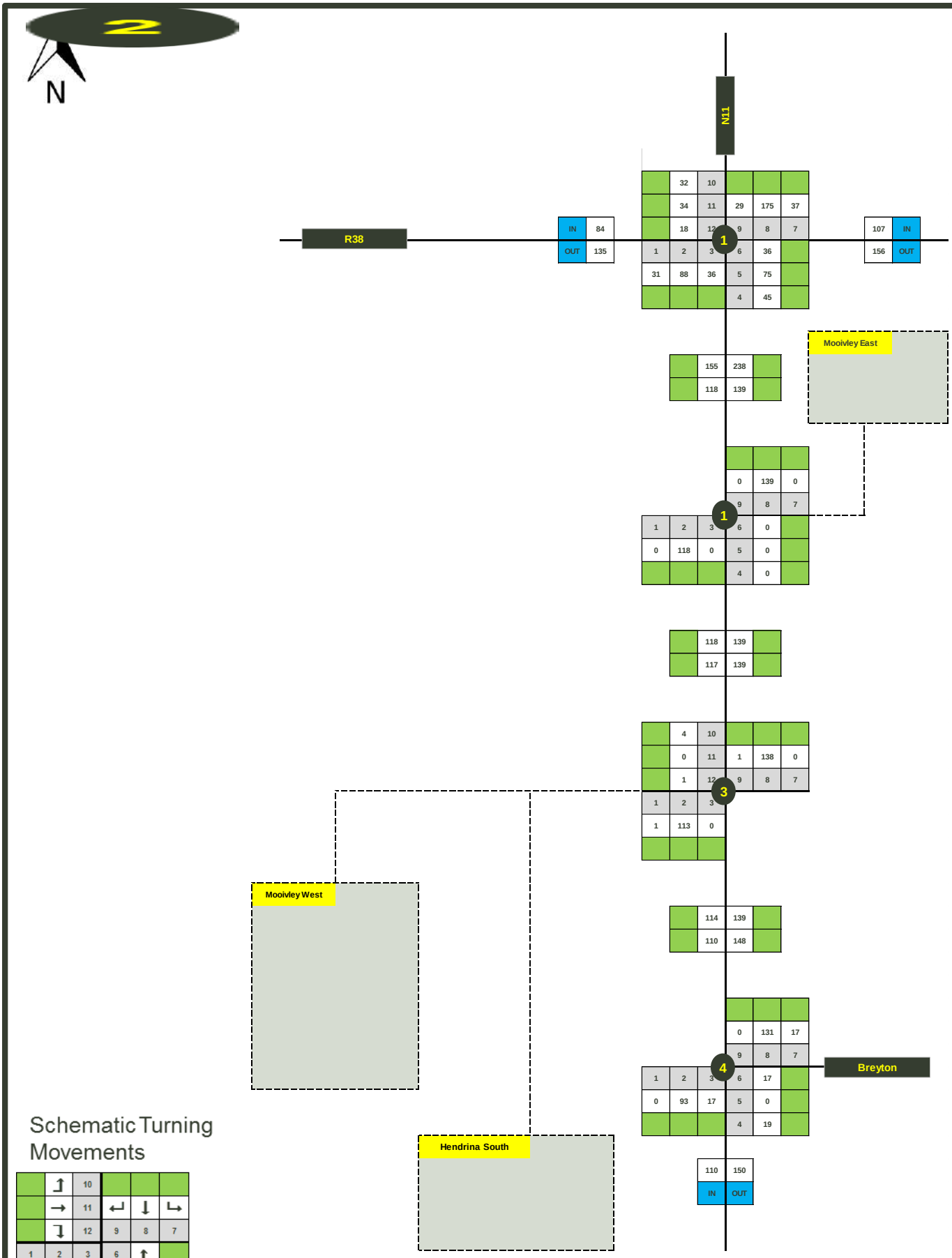
aurecon	Project: Hendrina Reserve TIA	Geometric layout (Schematic)	Figure: 4



aurecon	Project: Hendrina Reserve TIA	Traffic Distribution Directional Split AM Assignments	Figure: 5

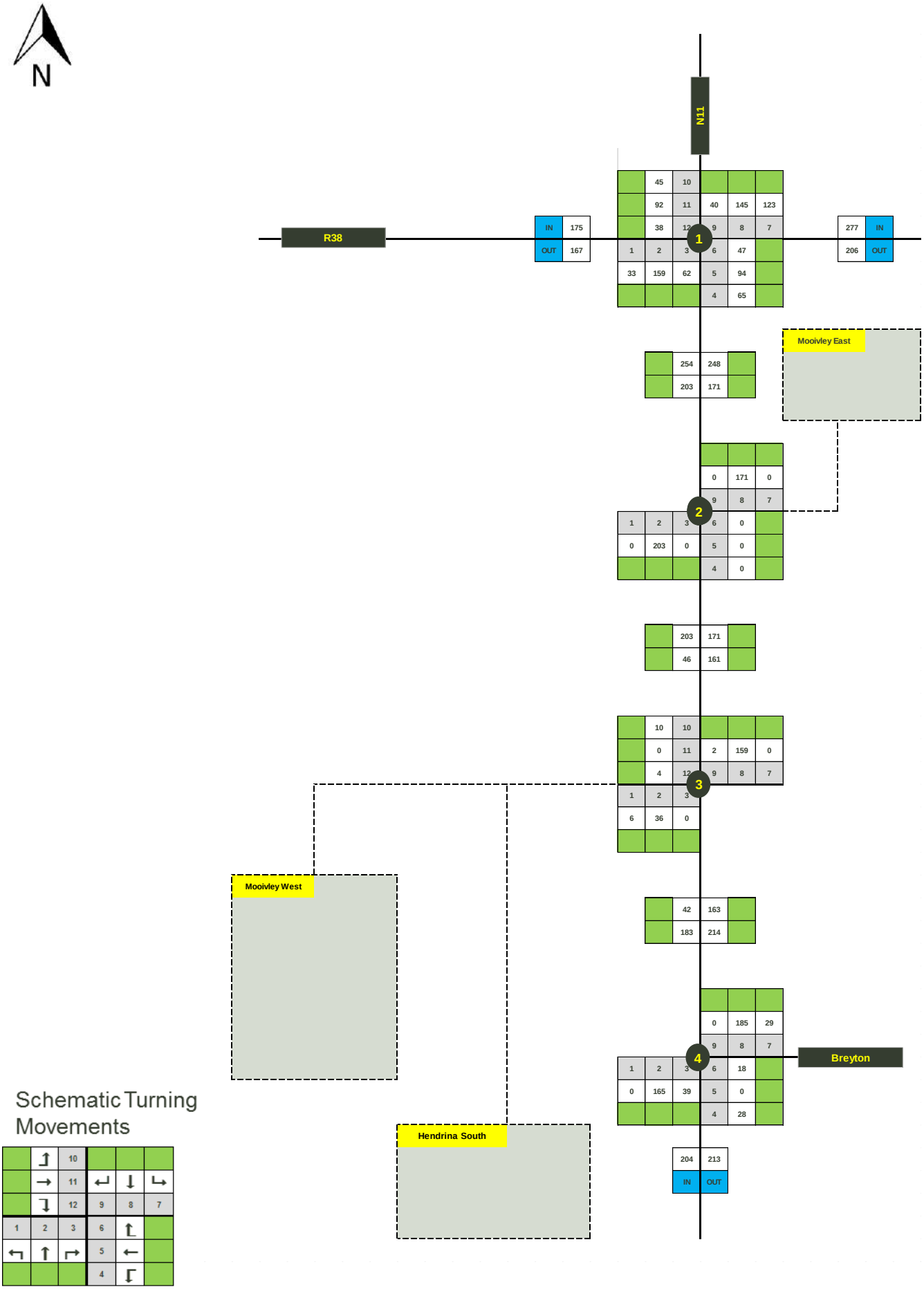


aurecon	Project: Hendrina Reserve TIA	Traffic Distribution Directional Split PM Assignments	Figure: 6

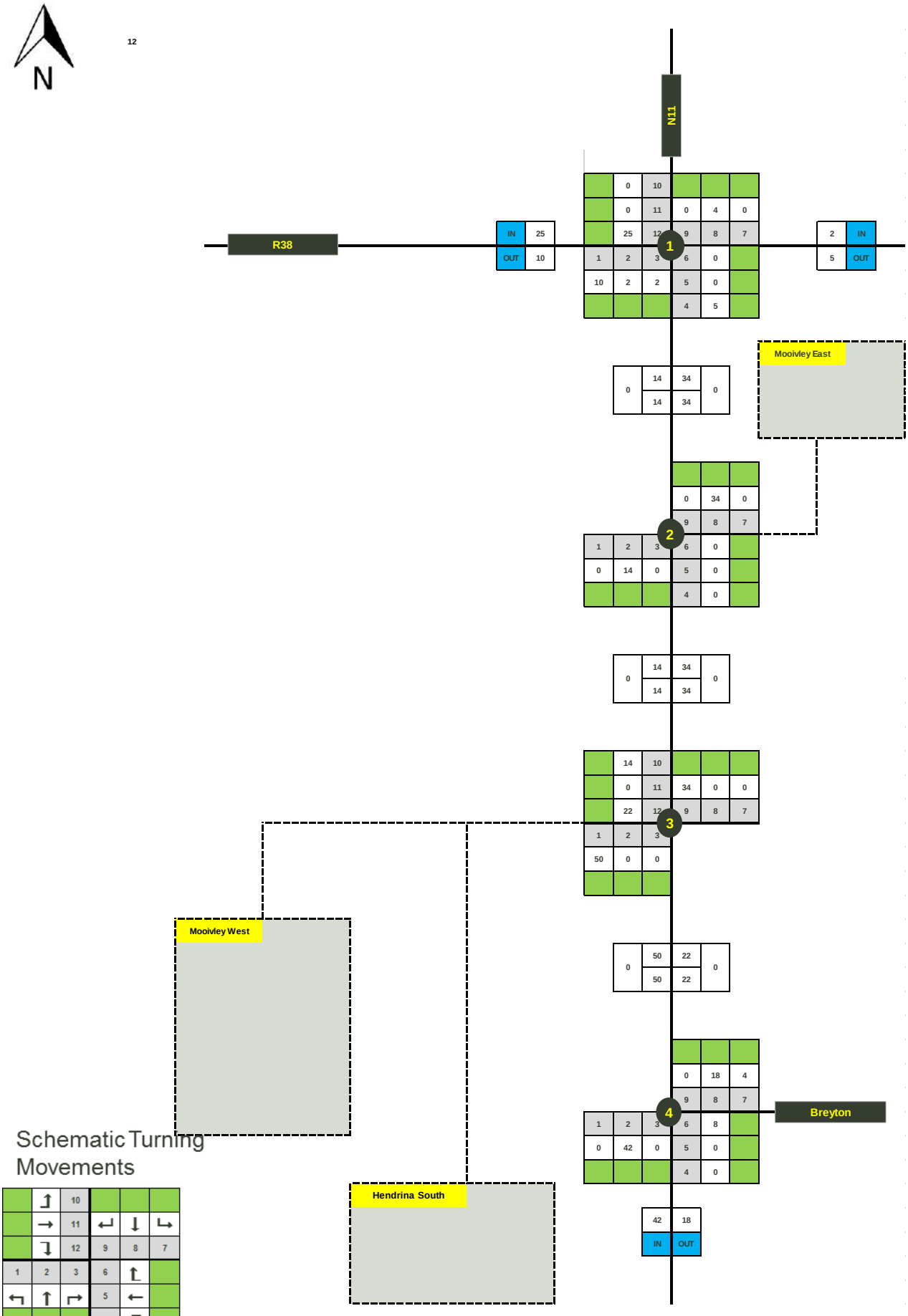


aurecon	Project: Hendrina Reserve TIA	Base year (2016) Weekday Morning (AM) Peak Hour Traffic Volumes

Figure: 7

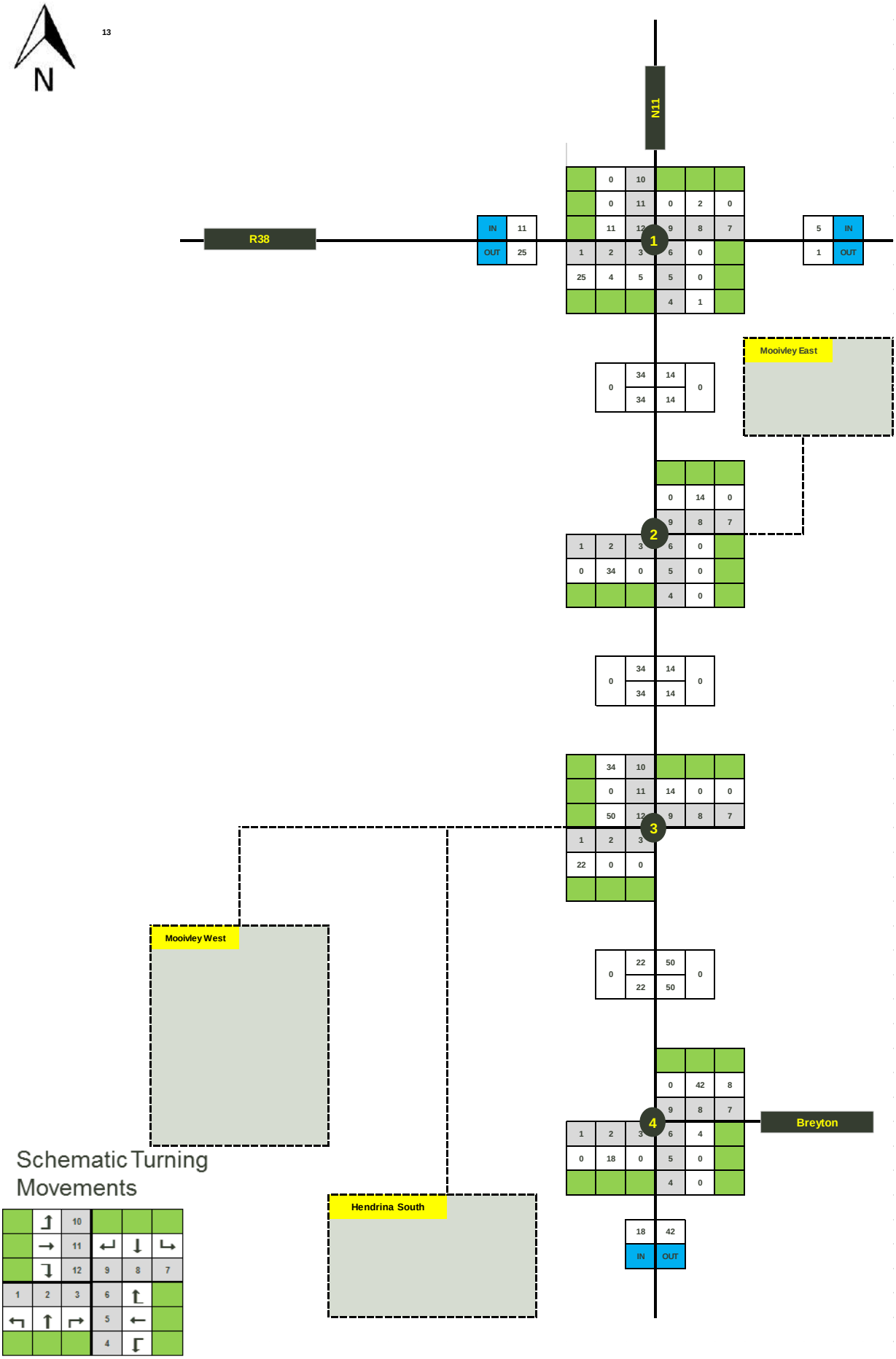


aurecon	Project: Hendrina Reserve TIA	Base year (2016) Weekday Afternoon (PM) Peak Hour Traffic Volumes	Figure: 8

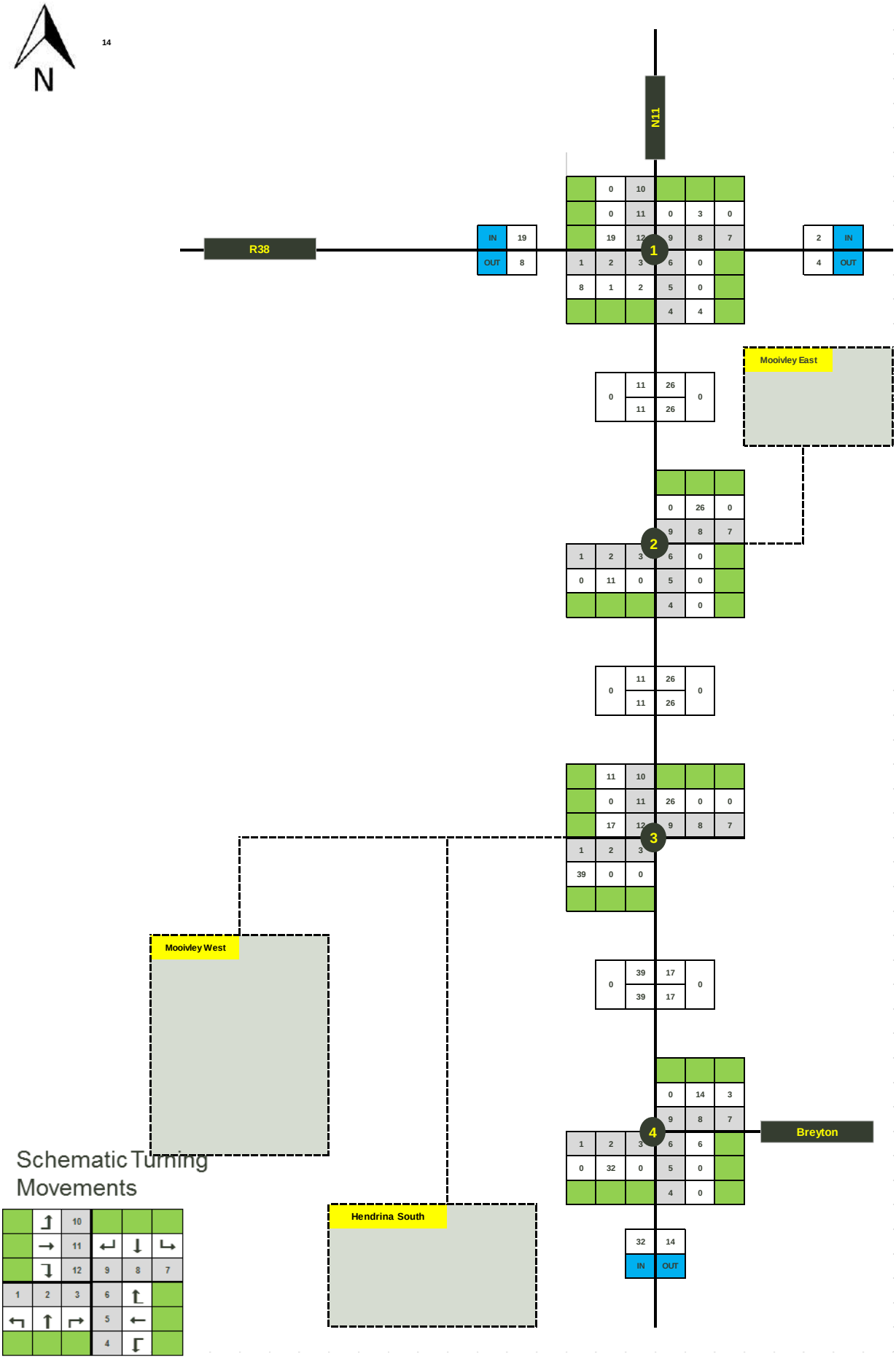


aurecon	Project: Hendrina Reserve TIA	Planned Construction Morning (AM) Peak Hour Assignment

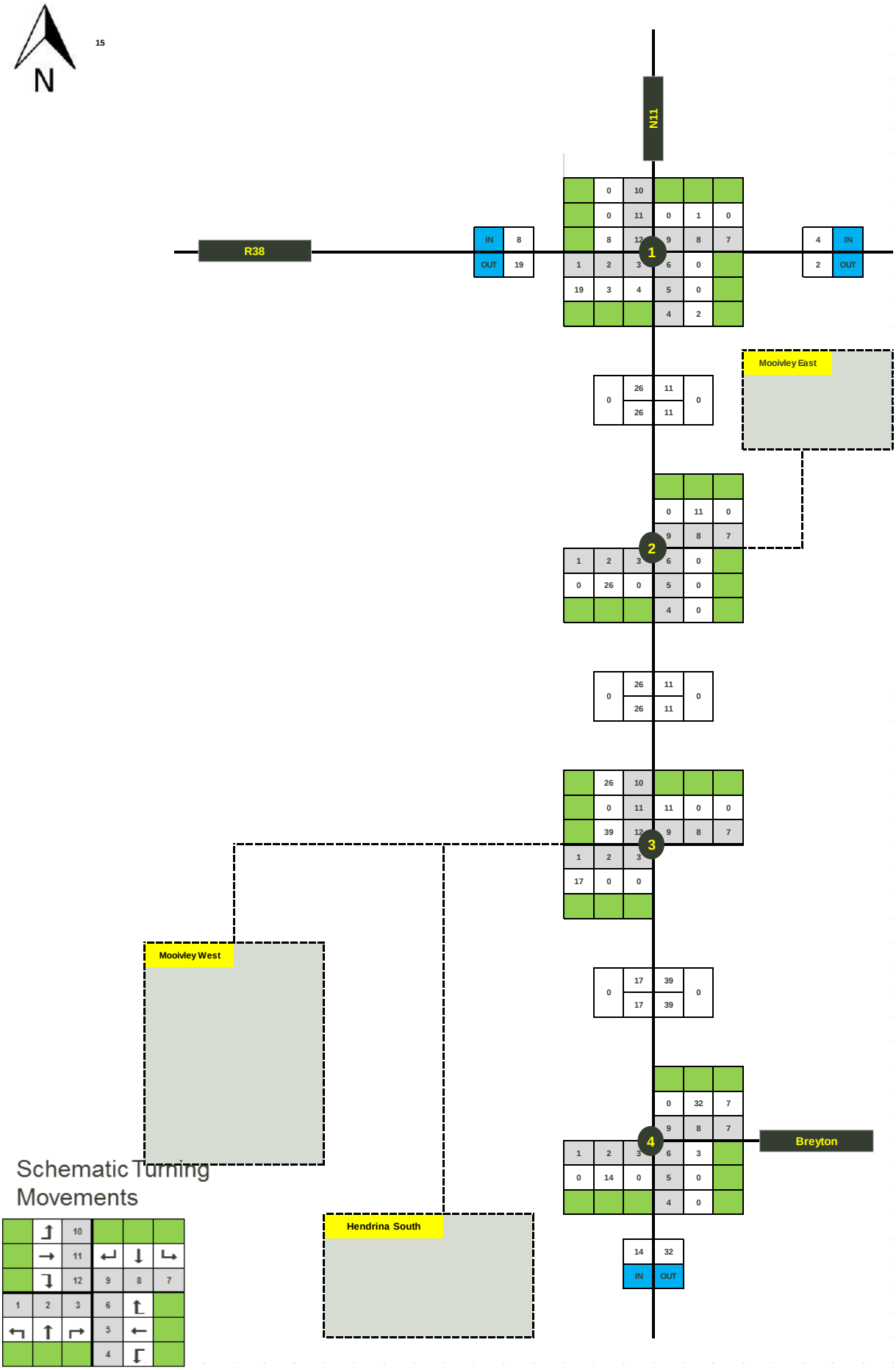
Figure: 9



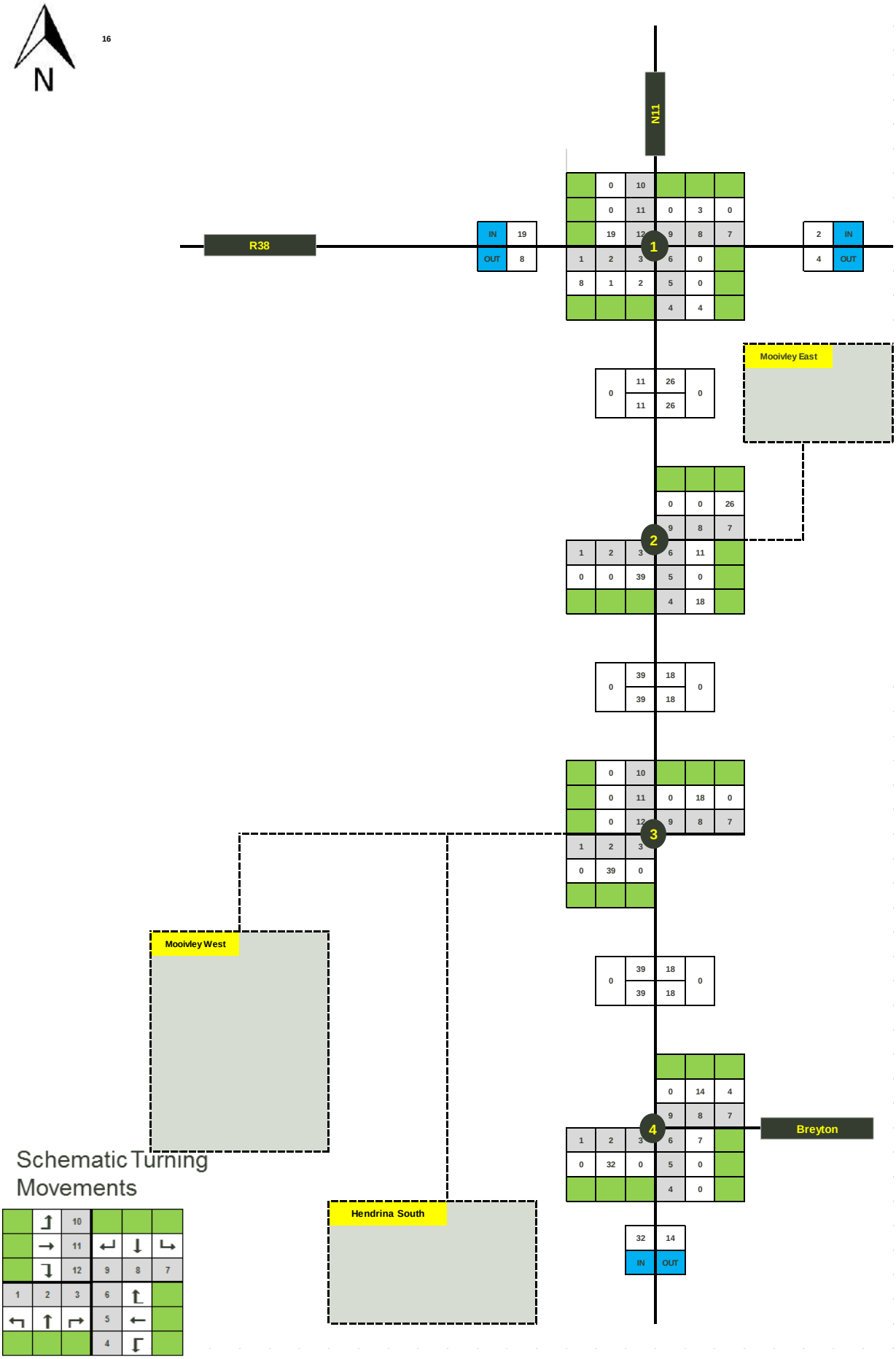
aurecon	Project: Hendrina Reserve TIA	Planned Construction Afternoon (PM) Peak Hour Assignment	Figure: 10



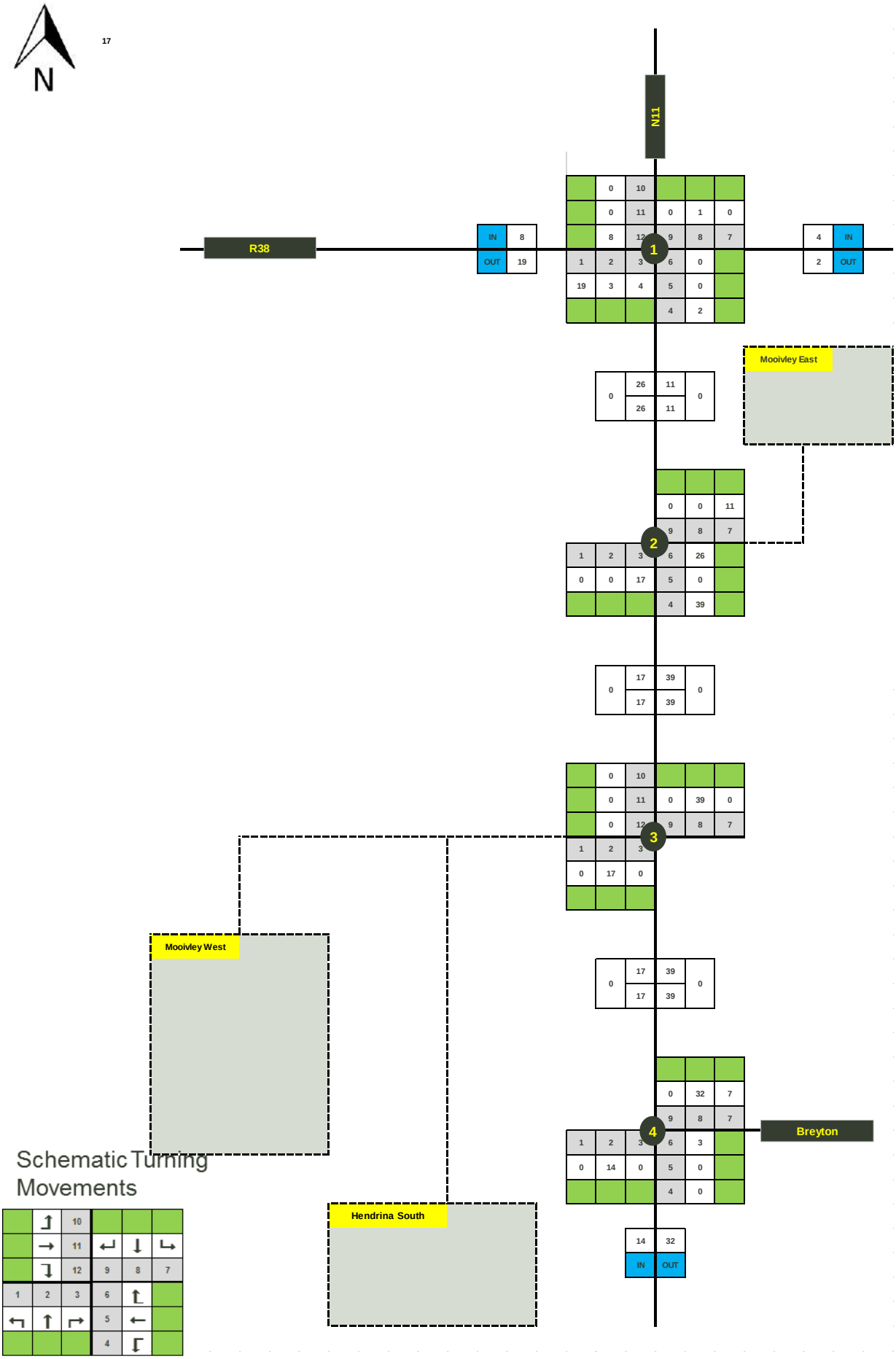
aurecon	Project: Hendrina Reserve TIA	Planned Operations Morning (AM) Peak Hour Assignment	Figure: 11



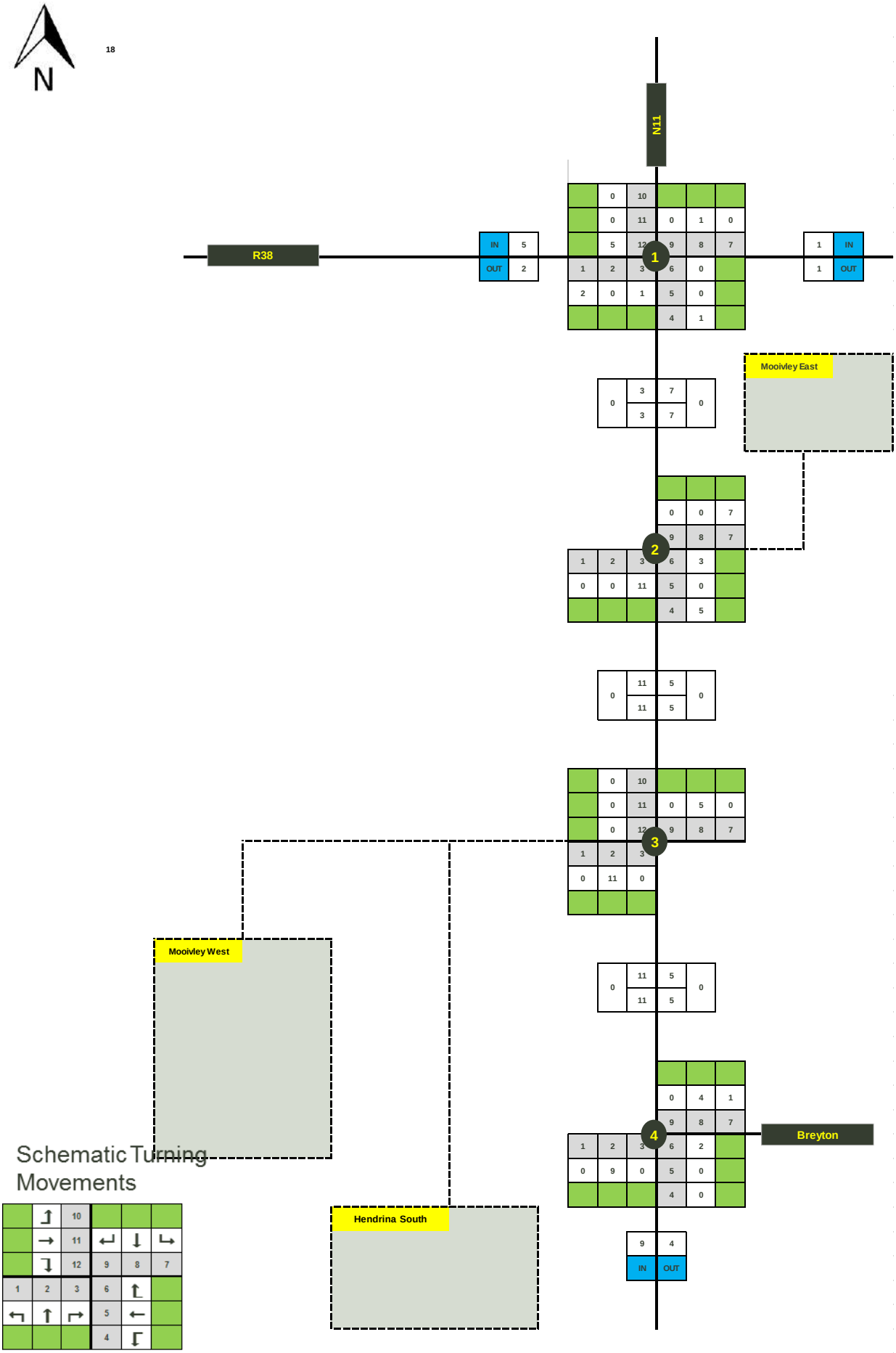
aurecon	Project: Hendrina Reserve TIA	Planned Operations Afternoon (PM) Peak Hour Assignment	Figure: 12



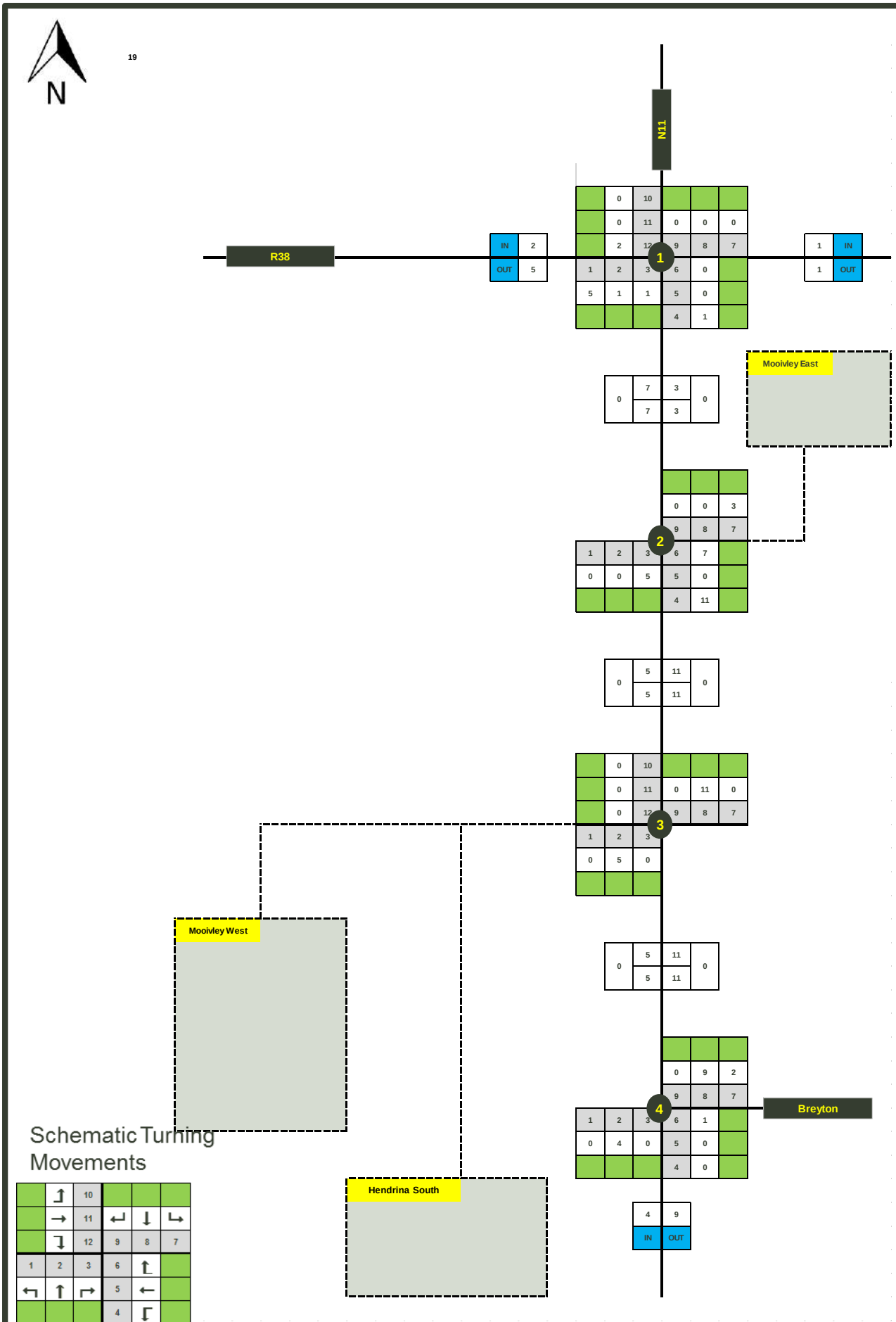
aurecon	Project: Hendrina Reserve TIA	Planned Operations Phase 2 Morning (AM) Peak Hour Assignment	Figure: 13



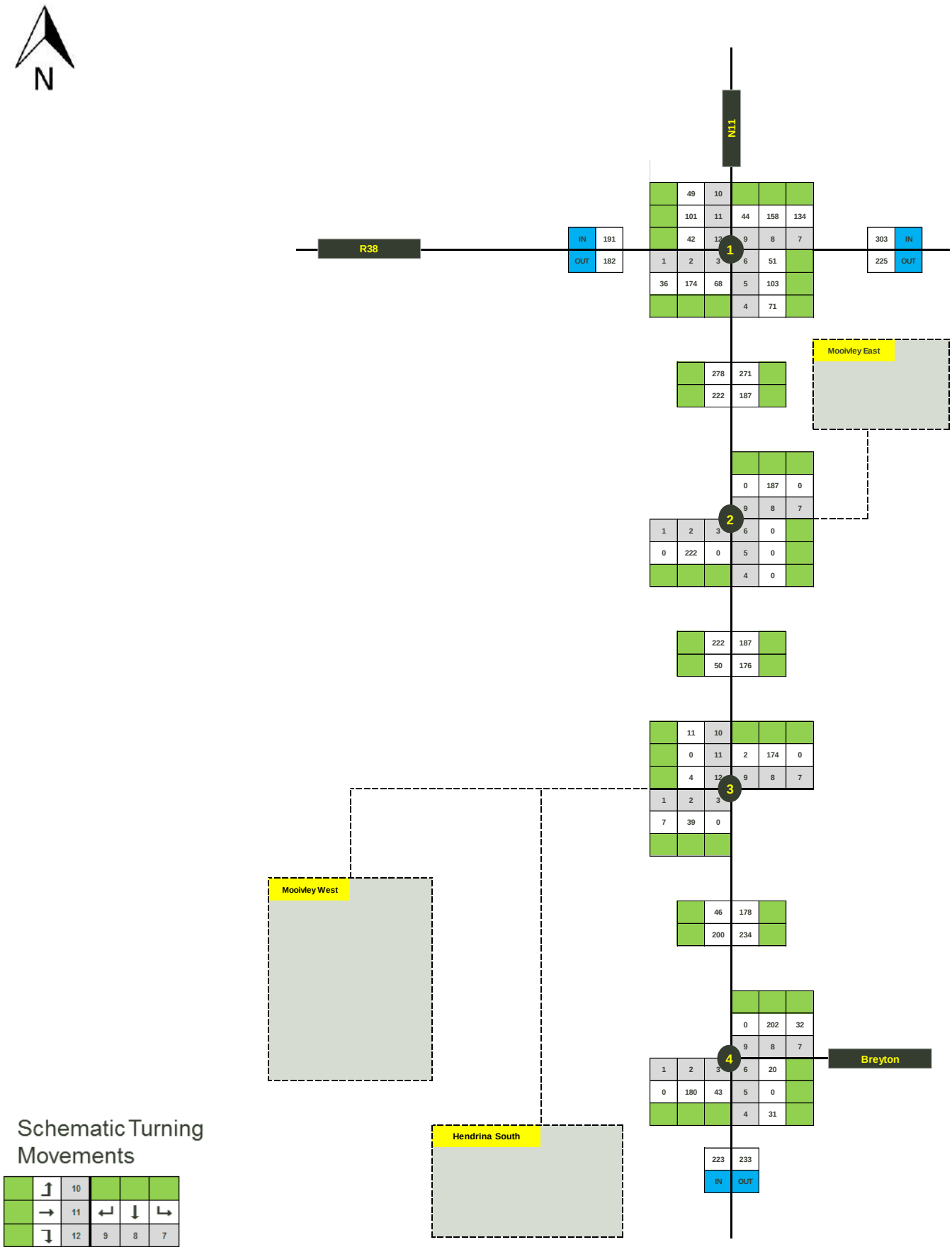
aurecon	Project: Hendrina Reserve TIA	Planned Operations Phase 2 Afternoon (PM) Peak Hour Assignment	Figure: 14



aurecon	Project: Hendrina Reserve TIA	Planned Decommissioning Morning (AM) Peak Hour Assignment	Figure: 15



aurecon	Project: Hendrina Reserve TIA	Planned Decommissioning Afternoon (PM) Peak Hour Assignment	Figure: 16



Schematic Turning Movements

		10			
		11			
		12	9	8	7
1	2	3	6		
			5		
			4		

	49	10			
	101	11	44	158	134
	42	12	9	8	7
1	2	3	6	51	
36	174	68	5	103	
			4	71	

	278	271			
	222	187			

			0	187	0
			9	8	7
1	2	3	6	0	
0	222	0	5	0	
			4	0	

	222	187			
	50	176			

	11	10			
	0	11	2	174	0
	4	12	9	8	7
1	2	3			
7	39	0			

	46	178			
	200	234			

			0	202	32
			9	8	7
1	2	3	6	20	
0	180	43	5	0	
			4	31	

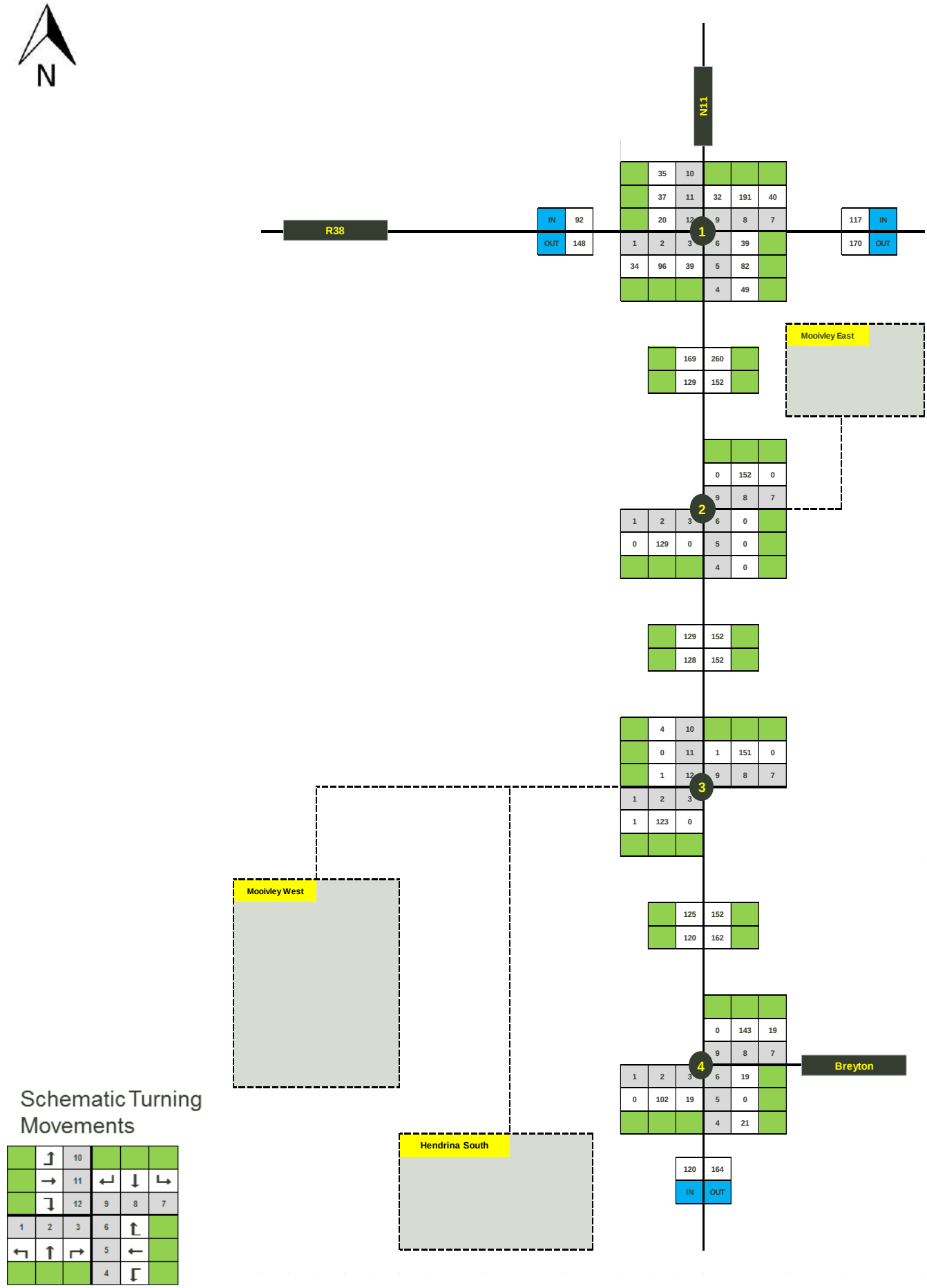
223	233
IN	OUT

			303	IN	
			225	OUT	

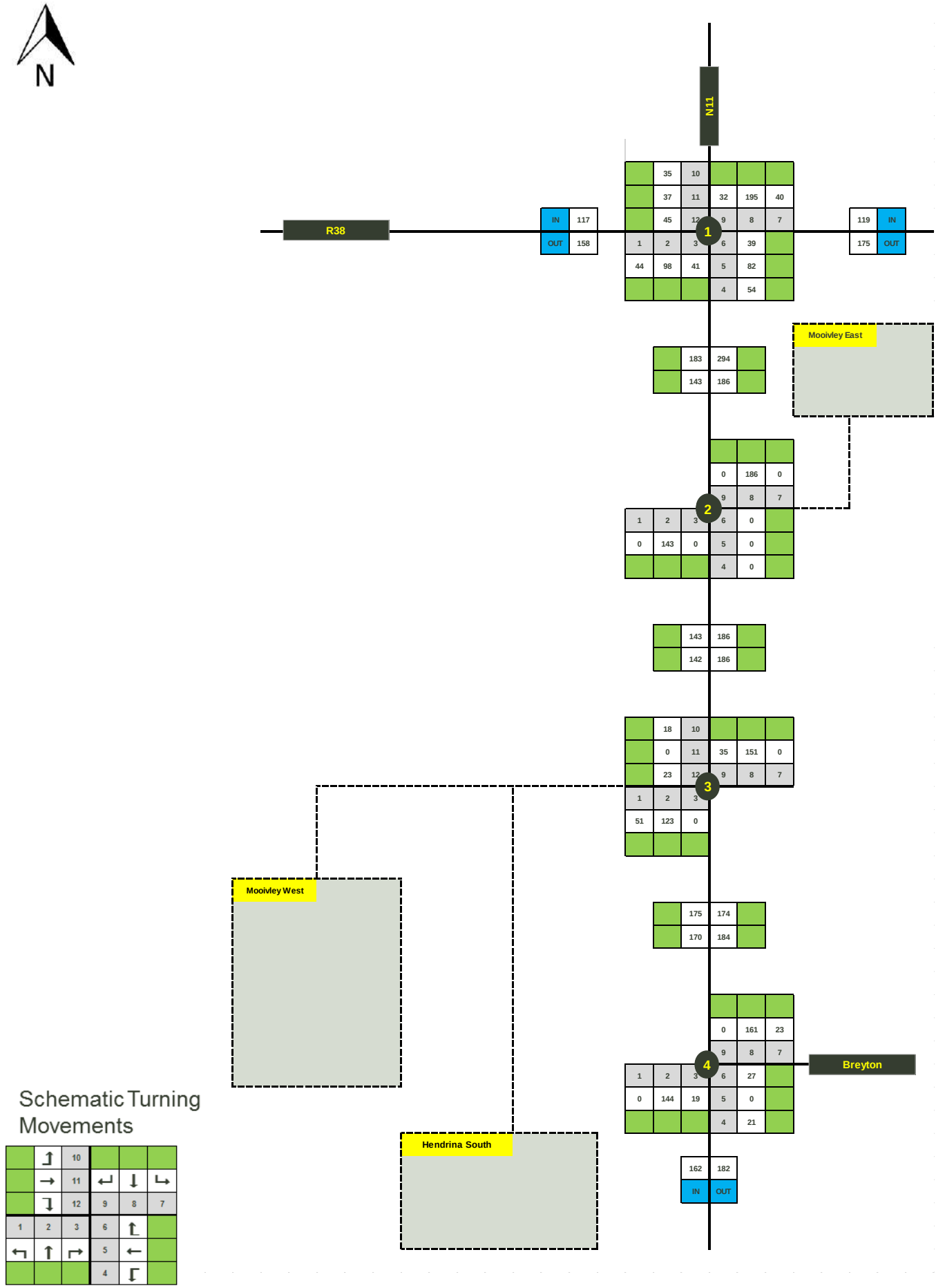
IN	191				
OUT	182				

aurecon	Project: Hendrina Reserve TIA	2019 Background Traffic Weekday Morning (PM) Peak Hour Traffic Volumes

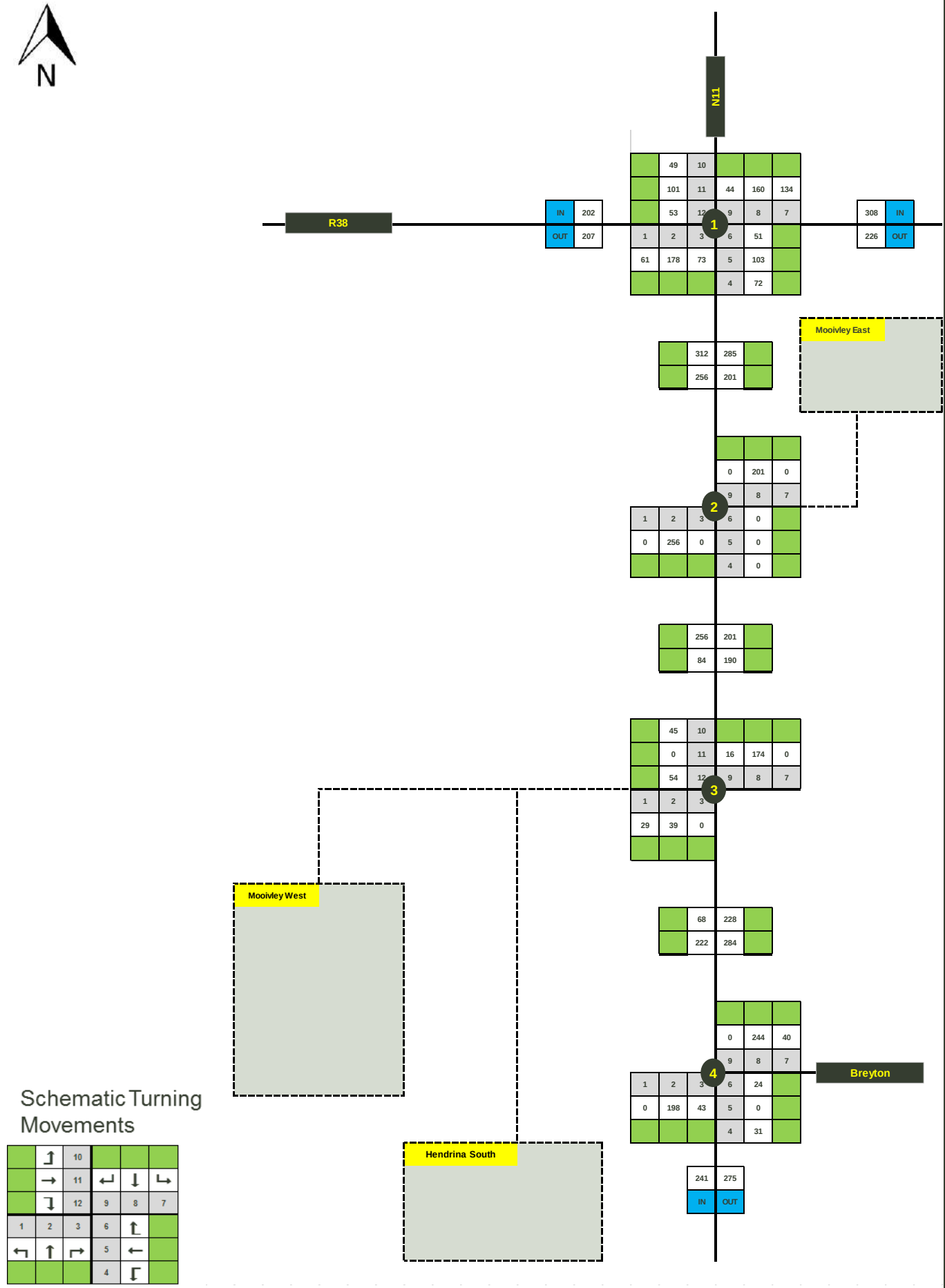
Figure: 17



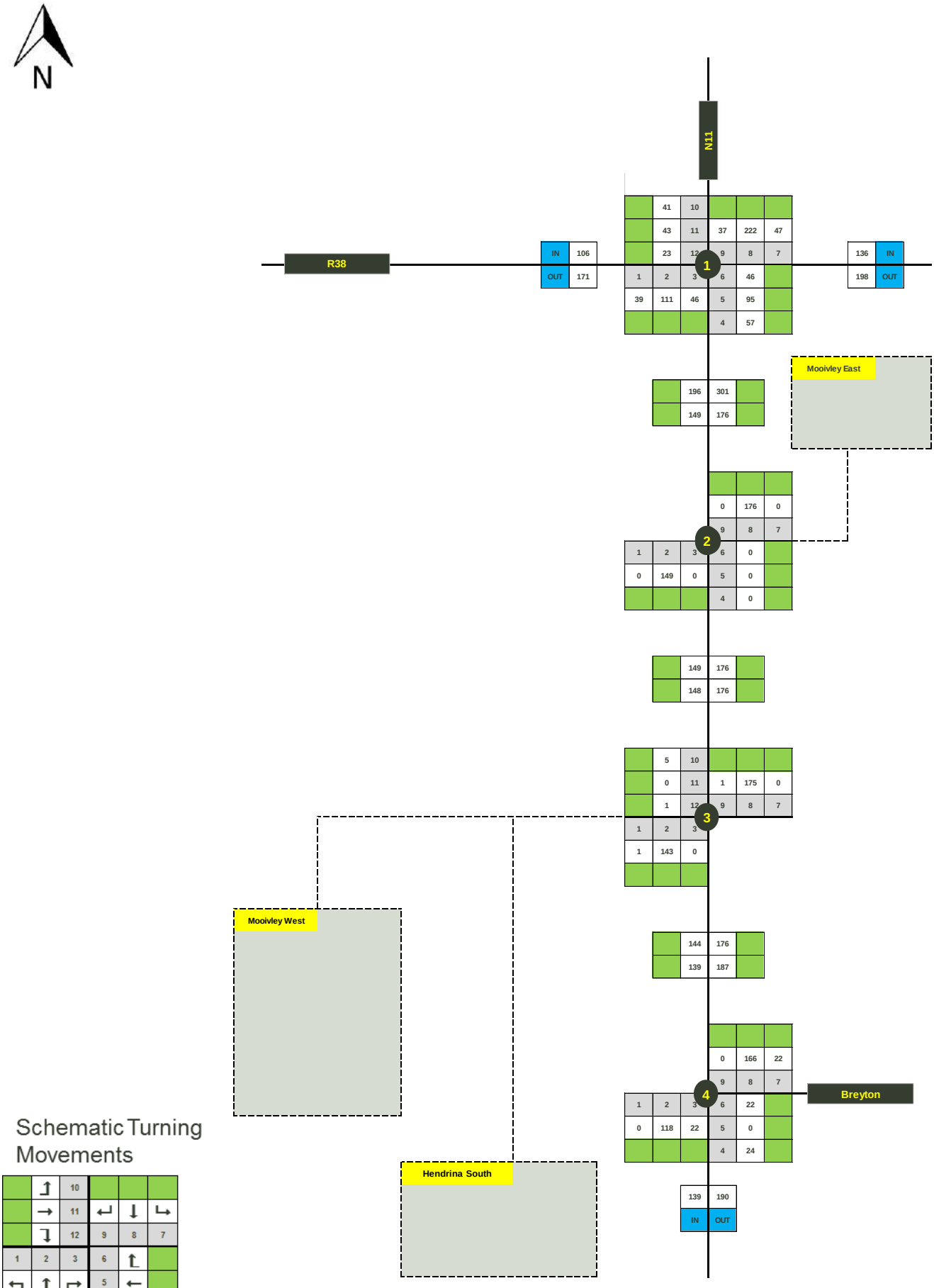
aurecon	Project: Hendrina Reserve TIA	2019 Background Traffic Weekday Morning (PM) Peak Hour Traffic Volumes
		Figure: 18



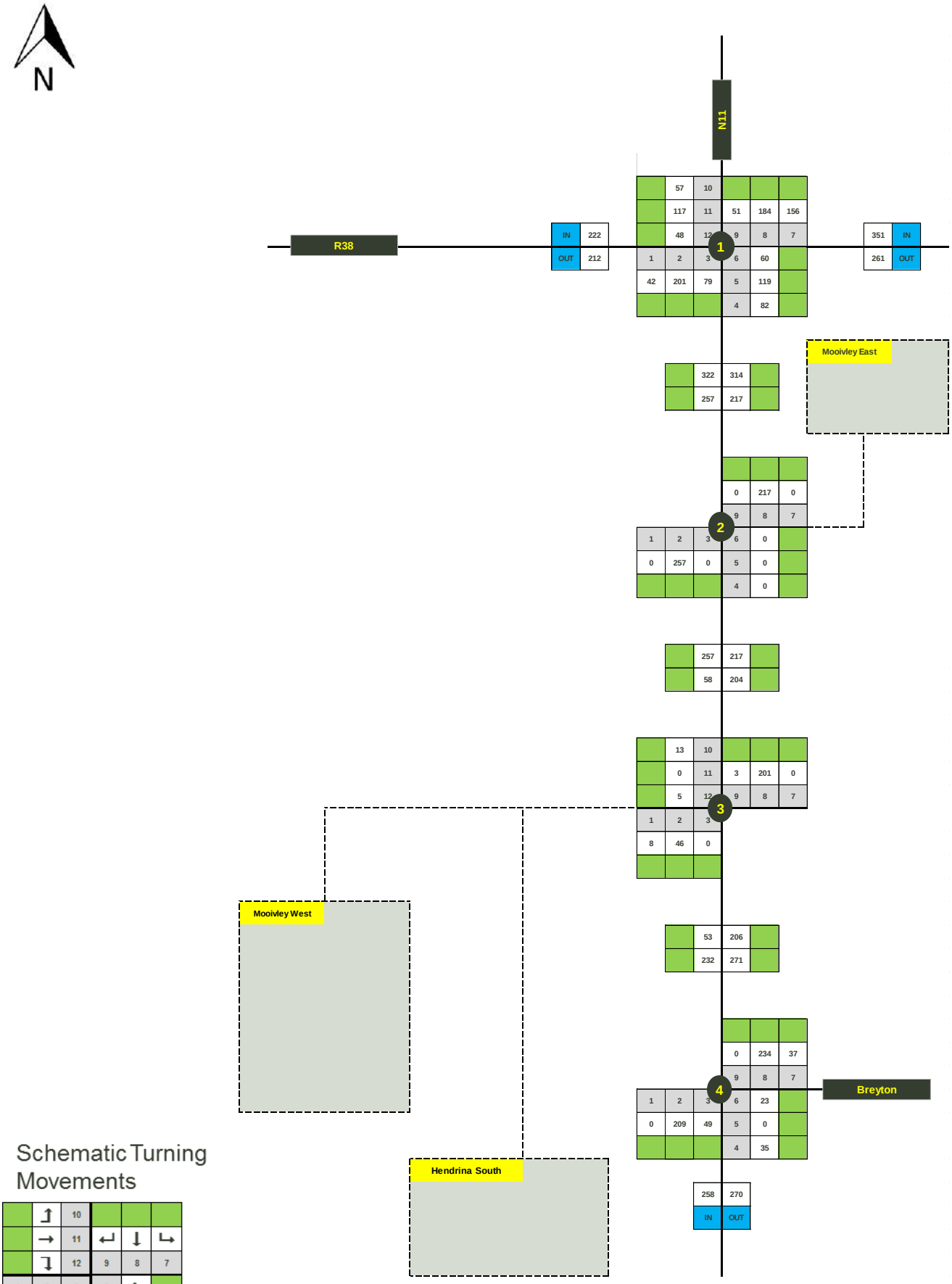
aurecon	Project: Hendrina Reserve TIA	2019 Background Growth with Construction Morning (AM) Peak Hour Traffic Volumes	Figure: 19



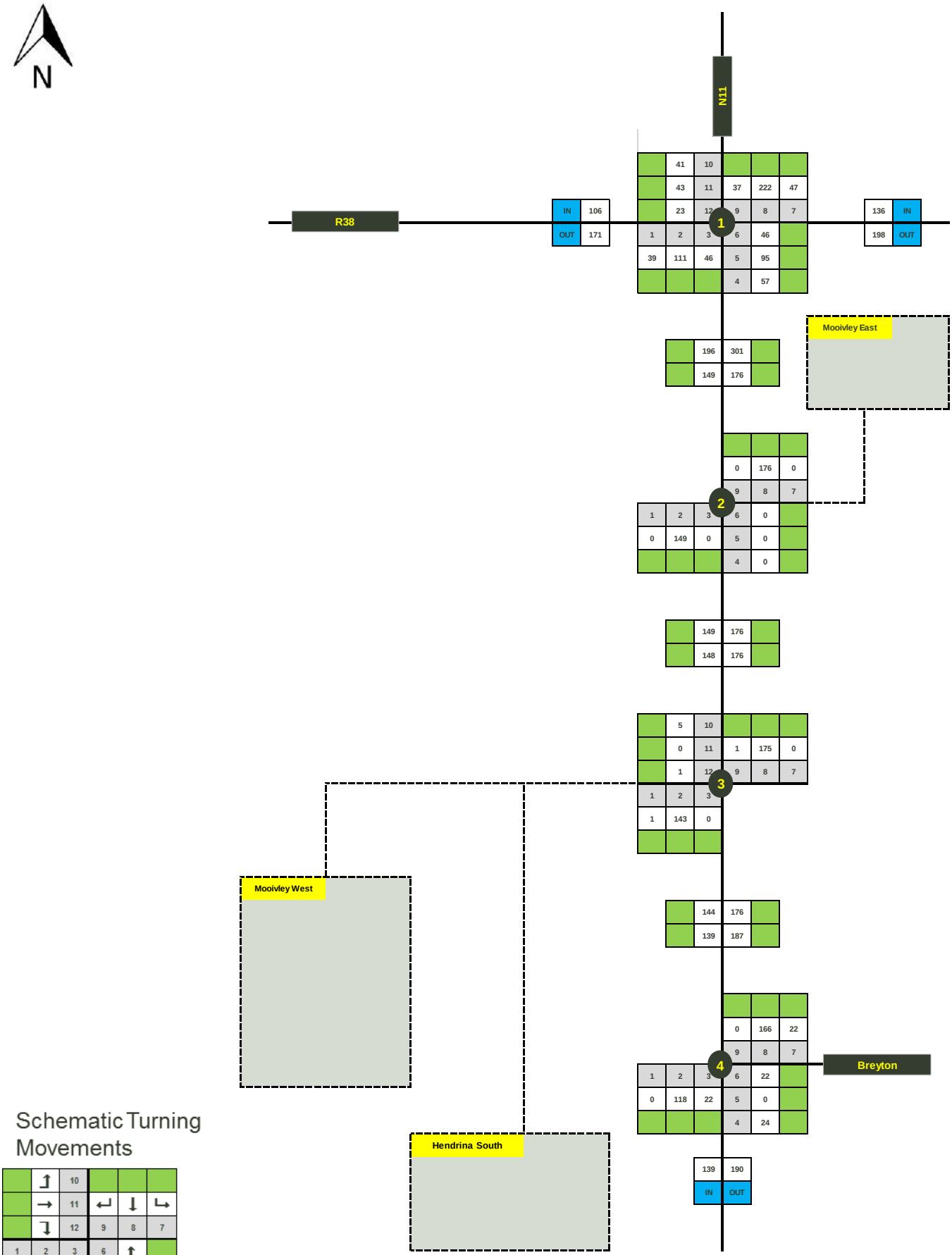
aurecon	Project: Hendrina Reserve TIA	2019 Background Growth with Construction Afternoon (PM) Peak Hour Traffic Volumes	Figure: 20



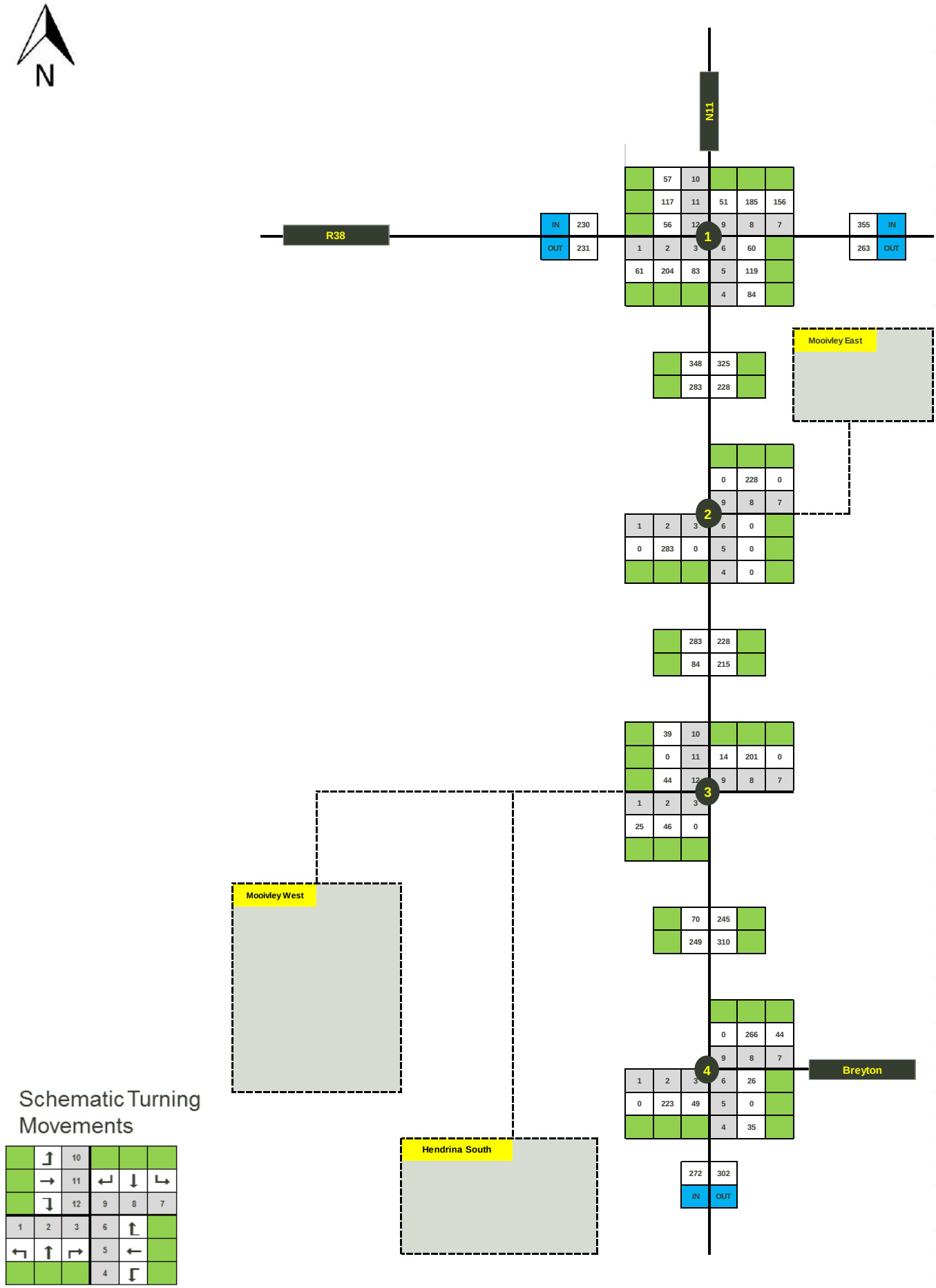
aurecon	Project: Hendrina Reserve TIA	2024 Background Traffic Morning (AM) Peak Hour Traffic Volumes	Figure: 21



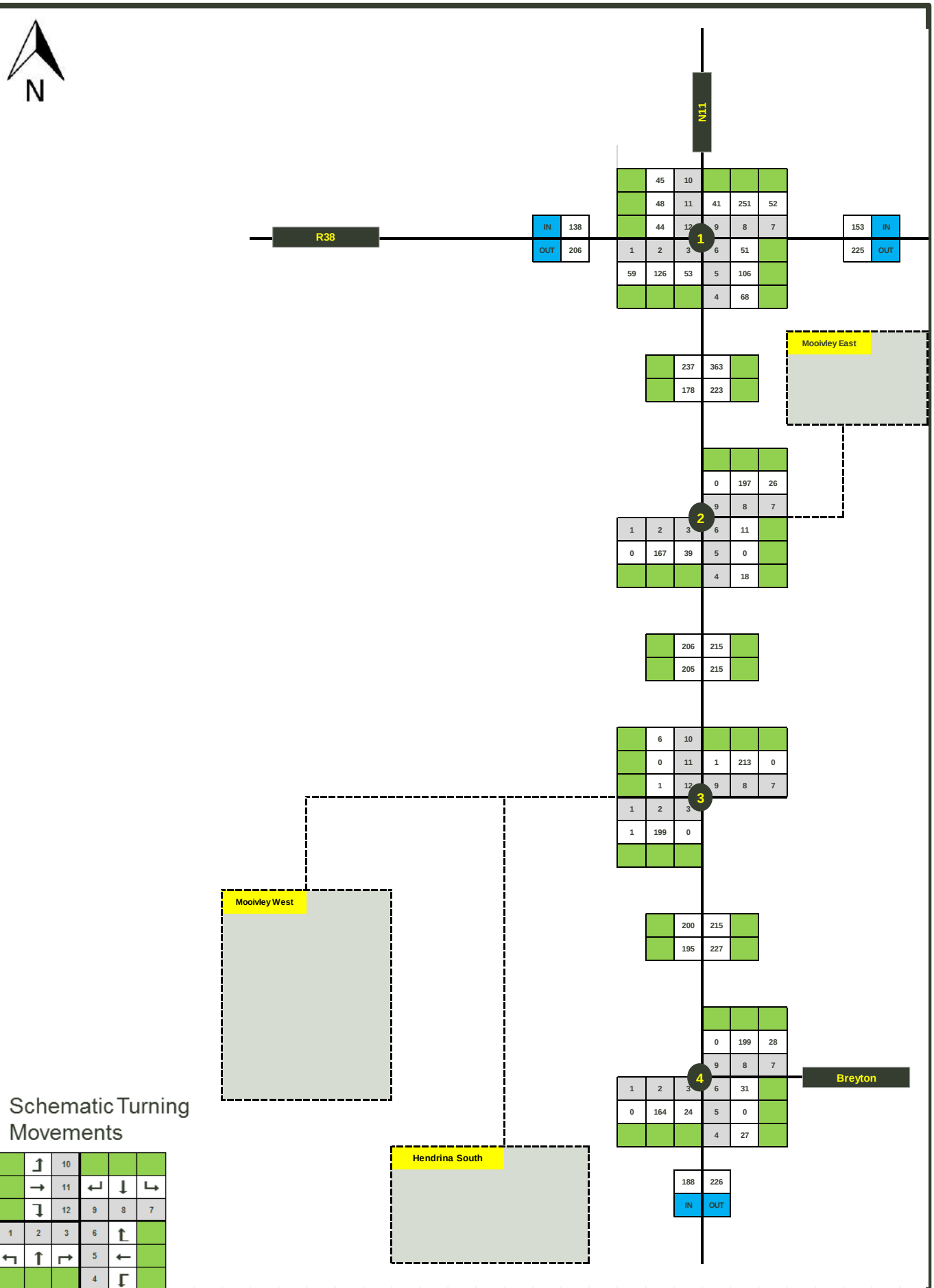
aurecon	Project: Hendrina Reserve TIA	2024 Background Traffic Afternoon (PM) Peak Hour Traffic Volumes	Figure: 22



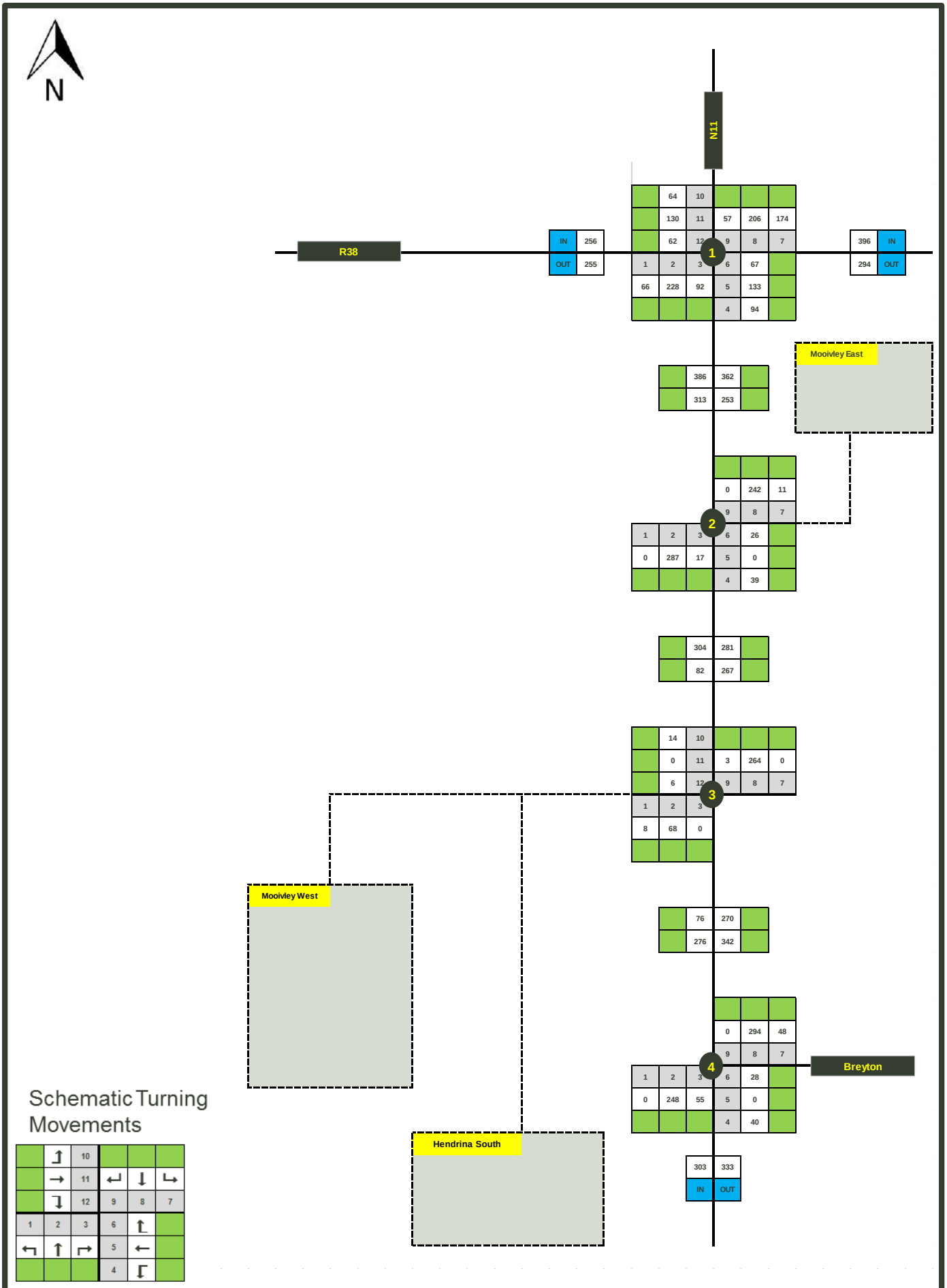
aurecon	Project: Hendrina Reserve TIA	2024 Background Traffic Morning with Phase 1 Operations (AM) Peak Hour Traffic Volumes	Figure: 23



aurecon	Project: Hendrina Reserve TIA	2024 Background Traffic with Phase 1 Operations (PM) Peak Hour Traffic Volumes	Figure: 24



aurecon	Project: Hendrina Reserve TIA	2042 with Phase 2 Operations Morning (AM) Peak Hour Traffic Volumes	Figure: 25



aurecon	Project: Hendrina Reserve TIA	2024 with Phase 2 Operations Phase 1 Afternoon (PM) Peak Hour Traffic Volumes	Figure: 26

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