

# THE KILNS RESIDENTIAL DEVELOPMENT

34 & 36 Sandspit Road | Warkworth | Auckland  
TRAFFIC IMPACT ASSESSMENT

**Address** 34 & 36 SANDSPIT ROAD, WARKWORTH  
**Project:** THE KILNS RESIDENTIAL DEVELOPMENT TIA  
**File Path:** Z:\2021\_PROJECTS\21082 - 36 SANDSPIT ROAD\DOCS\RC\THE KILNS PLAN RC TIA.DOCX  
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**Revisions:**

Date	Revision Number	Reviewed By	Initials
11/02/2022	Draft	Amit Arthanari	<i>Amit Arthanari</i>
29/03/2022	Revision 1	Amit Arthanari	<i>Amit Arthanari</i>

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# 1 INTRODUCTION

Team Traffic has been engaged by The Kilns Ltd to undertake a traffic assessment of the proposed residential development at 34 & 36 Sandspit Road.

The site is subject to a private plan change which has been assessed in an Integrated Transport Assessment prepared by Team Traffic. The subject report assumes a Residential Mixed Housing Urban zoning regarding Auckland Unitary Plan assessment criteria.

Vehicle access to the development will be provided via a proposed priority-controlled intersection on Sandspit Road.

The project will involve a single stage development and will comprise of 49 lots and pedestrian connectivity to Warkworth town centre via a shared path/existing public footpath network.

This report considers:

- The existing traffic environment and changes to the receiving environment.
- The staging of the proposed subdivision.
- The internal roads and common access ways (CAW)
- The proposed primary road intersection.
- The proposed shared path connection to Warkworth.
- Parking and access to units;
- Pedestrian access and safety;
- The traffic generated by the development and the capacity of the adjacent roads and intersections.

These and other matters are addressed in the details of this report.

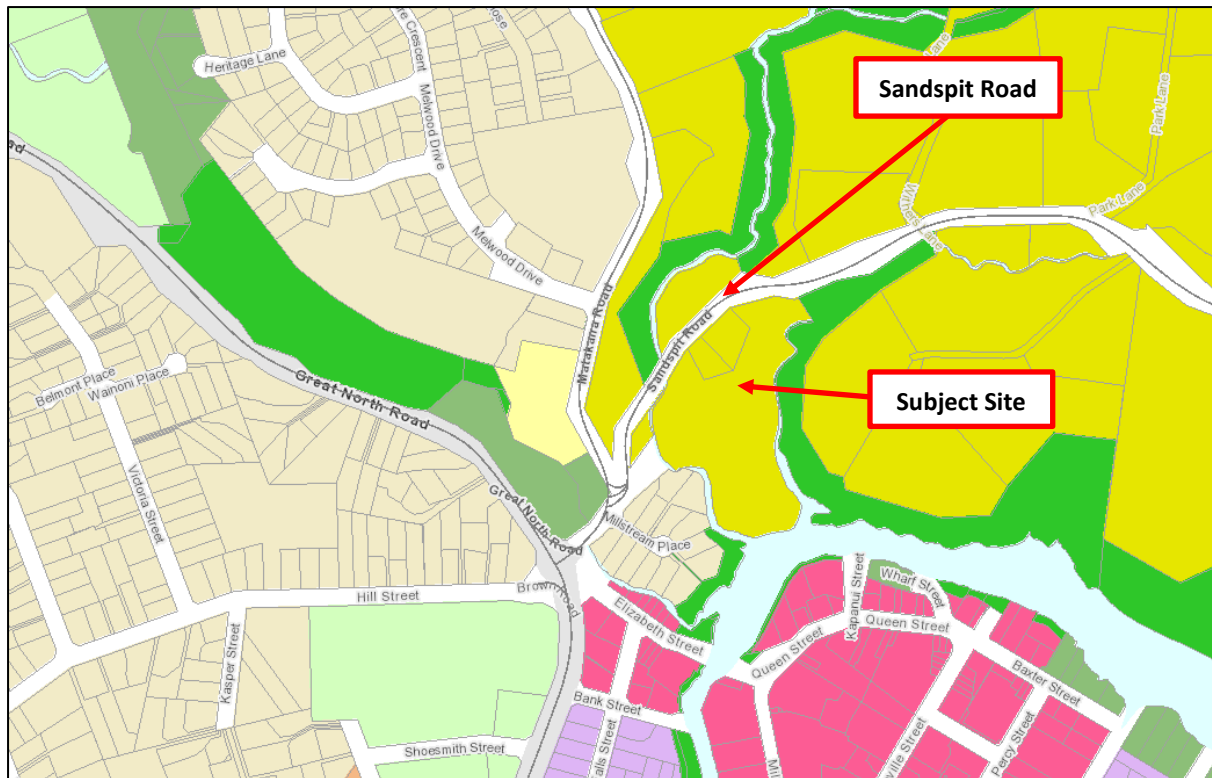
## 2 SITE LOCATION

The location of the subject site in relation to the surrounding road network and properties is shown in the following aerial photographs.



*Figure 1: Surrounding Road and Wider Network*





**Figure 2: Surrounding Road Network**

According to Auckland Unitary Plan Operative in Part (AUP), the subject site is currently zoned as Future Urban Zone. For the purposes of this assessment and pursuant to a private plan change which is being sought in parallel with the subject resource consent, it is assumed that the site will be zoned Mixed Housing Urban (MHU) from a traffic perspective.

Access to and from the site is provided via Sandspit Road.

It is understood that a historic lime kiln site is identified within the subject land and is discussed further in the report.

The subject site has a legal description of Lot 1 DP 66360, Pt Lot 51 DP 703, Pt Lot 51 DP 703 and Lot 1 DP 39534. The site area is approximately 2.9 hectares.

### 3 EXISTING TRANSPORT ENVIRONMENT

The subject site has frontage to Sandspit Road. The following sections provide details of the existing operating environment on Sandspit Road and the immediate intersections.

#### 3.1 Existing Road Network

Sandspit Road provides a key link to and from Warkworth and the Mahurangi Peninsula and is classified as an arterial road. Furthermore, Sandspit Road is considered a holiday highway and has seasonal traffic patterns associated with changes in holiday population.

Sandspit Road in the vicinity of the subject site is typically configured as a single lane in each direction, with an intermittent solid white line and dashed white line to delineate the flow of traffic.

It is noted that there is a bridge located 200 metres southwest of the existing northern vehicle access to 36 Sandspit Road.

Sandspit Road has a 6.5-metre-wide carriageway and there is no footpath provided on either side of the road.

Traffic volumes past the site are in the order of 8,575 vehicles per day (5 day ADT) and commuter peak volumes of 700 vehicles per hour in the AM peak and 750 vehicles per hour in the PM peak based on the traffic count data held by Auckland Transport<sup>1</sup>.

Furthermore, as discussed in the following section on traffic survey data, a turning count survey was undertaken at the intersection of Sandspit Road North and Sandspit Road South. The through volumes for the peak hours surveyed have also been summarised in the following table:

**Table 1: Vehicle Volumes Sandspit Road**

Time	Northbound (Vehicles)	Southbound (Vehicles)
Weekday PM Peak (3 PM – 4 PM)	400	296
Saturday IP (12 PM – 1 PM)	397	281

As can be seen above, the data obtained from the tube count and the surveyed intersection count are relatively similar in nature. It is also noted that Auckland Transport traffic volume data has a 5:00 p.m. peak hour for the through movement. However, the intersection count has a 3:00 p.m. peak hour. Both peaks had very similar quantum of traffic. However, the turning count survey data has been used for the purposes of this report, as it represents the highest opposing traffic in the southbound direction, which would present a worst-case scenario for modelling purposes due to right turn opposing vehicles.

<sup>1</sup> Auckland Transport traffic volume data – count site on Sandspit Road between Hamilton Road and Viponds Culvert, March 2019

### 3.2 Speed Environment

Auckland Transport's Speed Limit Bylaw 2019 and subsequent changes shown on GIS Maps were consulted to provide the existing posted speed limit in the vicinity of the subject site. The following map provides a summary of the findings.



**Figure 3: Posted Speed Limits**

As shown in the above figure, the posted speed limit is 50km/h in the vicinity of the site. It is also noted that Auckland Transport have made changes to the Speed Limits Bylaw to change the speed limit on Sandspit Road north of the subject site from open road to 80km/h (orange section shown in Figure 3 above).

It is noted that these posted speed limit changes have not been signposted nor have the associated supplementary signage, road markings and curve warning signs been updated. This aspect of the receiving environment has been discussed further in section 5.3 with recommendations being made.

### 3.3 Traffic Survey Data

Traffic surveys have been undertaken in order to understand the existing operating environment and traffic volumes in the vicinity of the subject site.

The survey was undertaken on Wednesday 12<sup>th</sup> of May 2021, and Saturday 15<sup>th</sup> of May 2021, with weather condition mostly fine on both days.

The above-mentioned traffic surveys were undertaken at the following key intersections.

#### **Matakana Road/ Millstream Place/ Sandspit Road Intersection**

A traffic distribution survey was undertaken at the intersection of Matakana Road and Sandspit Road, with the traffic movements at Millstream Place also being captured.

The following aerial photograph shows the subject intersection.



*Figure 4: Survey Area (Millstream/Matakana/Sandspit Intersection)*

The survey included Millstream Place in order to determine the directional bias for a residential catchment on Sandspit Road.

On review, the traffic distribution data collected from this survey was not useable, given the small sample size and variability of this data. On this basis, directional bias has been determined using census data as detailed in section 8.1.3 of this report.

Notwithstanding this, the turning movement data for Sandspit Road North has been used to determine the through volumes on Sandspit Road as discussed previously (See section 3.1).



### Melwood Drive/ Matakana Road Intersection

A traffic survey was conducted at the intersection of Melwood Drive/Matakana Road to determine vehicle turning movements during both AM and PM peaks.

This survey was undertaken to determine a specific residential traffic generation rate that would be applicable to the local traffic environment as opposed to generic traffic generation figures.

The Melwood Drive catchment was chosen as it is located just west of the subject site and has a single connection to Matakana Road, which enables the determination of the traffic generation of residential dwellings in the area.

The following aerial photograph shows the subject intersection.



*Figure 5: Survey Area (Melwood Drive residential catchment)*

Given that the traffic movements of the Melwood Drive residential catchment are confined to entry/exit via the subject intersection, the traffic generation rate (trips/dwelling) can be determined by dividing the number of surveyed movements by the number of dwellings (116 dwellings).

It should be noted that the residential catchment on Melwood Drive includes a retirement village. However, to remain conservative, these dwellings have not been considered to determine the trip generation rate for the area.

The following tables summarise the key data from this traffic count.

**Table 2: Wednesday Trip Generation Rates**

<b>Trip Generation – Melwood Drive (Vehicles/Dwelling)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM (7:45 - 8:45)	0.23	0.37	0.60
PM (15:00 - 16:00)	0.39	0.31	0.70
IP (11:45 - 12:45)	0.39	0.28	0.66

**Table 3: Saturday Trip Generation Rates**

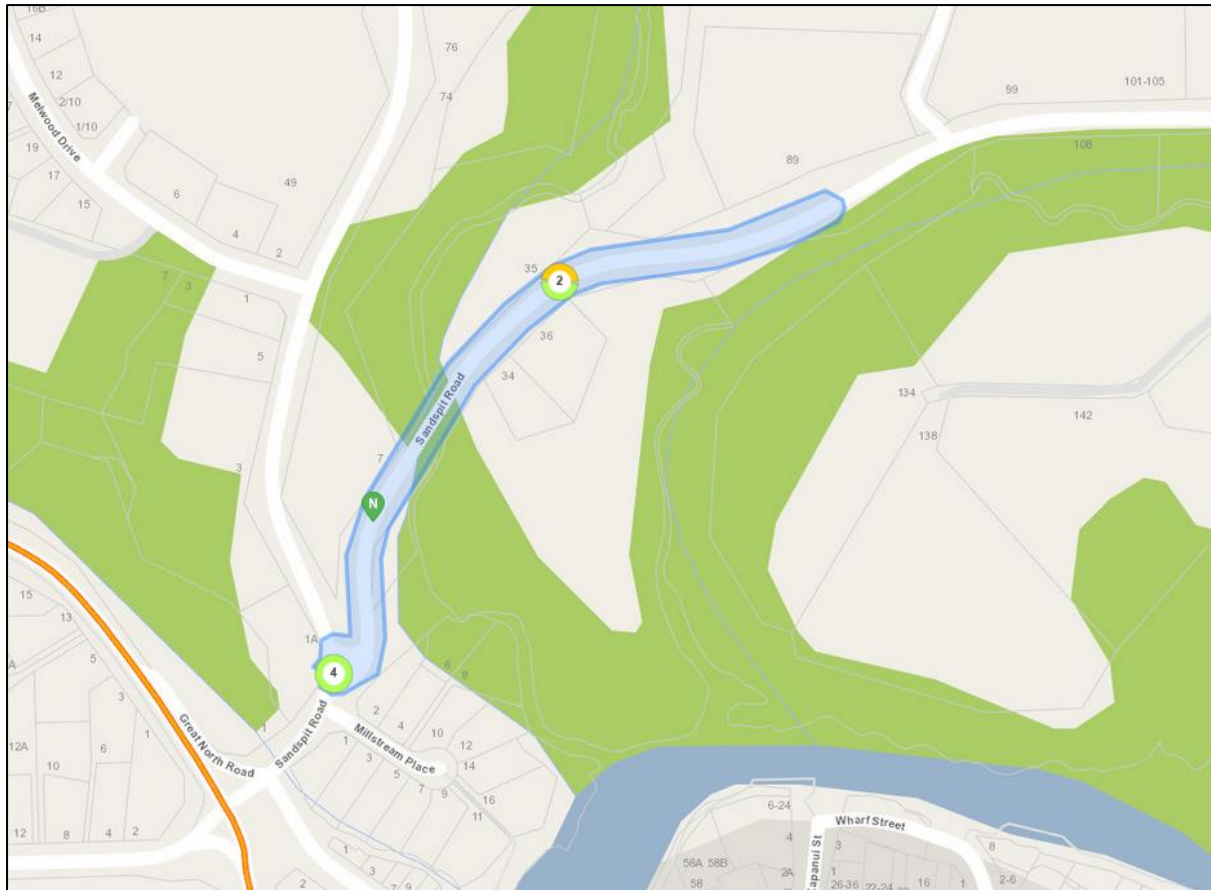
<b>Trip Generation - Melwood Drive (Vehicles/Dwelling)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM (9:00 - 10:00)	0.18	0.28	0.46
PM (15:00 - 16:00)	0.25	0.15	0.40
IP (10:30 - 11:30)	0.26	0.37	0.63

For the purposes of this report, the higher rate associated with the Wednesday PM peak (0.70 vehicles /dwelling) has been selected, and the higher rate associated with the Inter Peak (0.63 vehicles /dwelling) on Saturday has been selected for the purpose of this assessment as this is considered to be conservative.

### 3.4 Crash Analysis

To determine if there are any existing operational issues in the vicinity of the site, a study of the crash record maintained by the NZTA has been undertaken for the 5-year period 2016-2020 inclusive. Crashes that occurred and were reported during 2021 were also included.

The searched area covered a section of Sandspit Road extending 150 metres on either side of the proposed vehicle crossing, as well as the intersection between Sandspit Road and Matakana Drive as shown in the following image:



**Figure 6: CAS Search Area**

In total there were seven crashes reported within the searched area and given timeframe.

The following is a summary of the crashes.

- One crash involved a driver who failed to give way at the Sandspit/Matakana Road intersection and collided with a southbound vehicle on Matakana Road.
- One crash involved a driver who failed to notice a vehicle when merging at the Sandspit Road intersection and collided with a car travelling in the southbound direction.
- One crash involved an inexperienced driver travelling on Sandspit Road veering too far off the road which resulted in a loss of control type crash.
- The remaining four crashes all involved vehicles following other vehicles too closely, resulting in rear end collisions. The locations of these crashes vary, however, they mostly occurred at the Sandspit Road/Matakana Road intersection.

None of these crashes were related to the subject site, nor were they related to property access, pedestrians or cyclists.

Based on the above analysis, the crash history does not highlight any patterns that would indicate that there are any inherent safety or operational issues in the vicinity of the site that could be a cause for concern from a traffic engineering perspective.

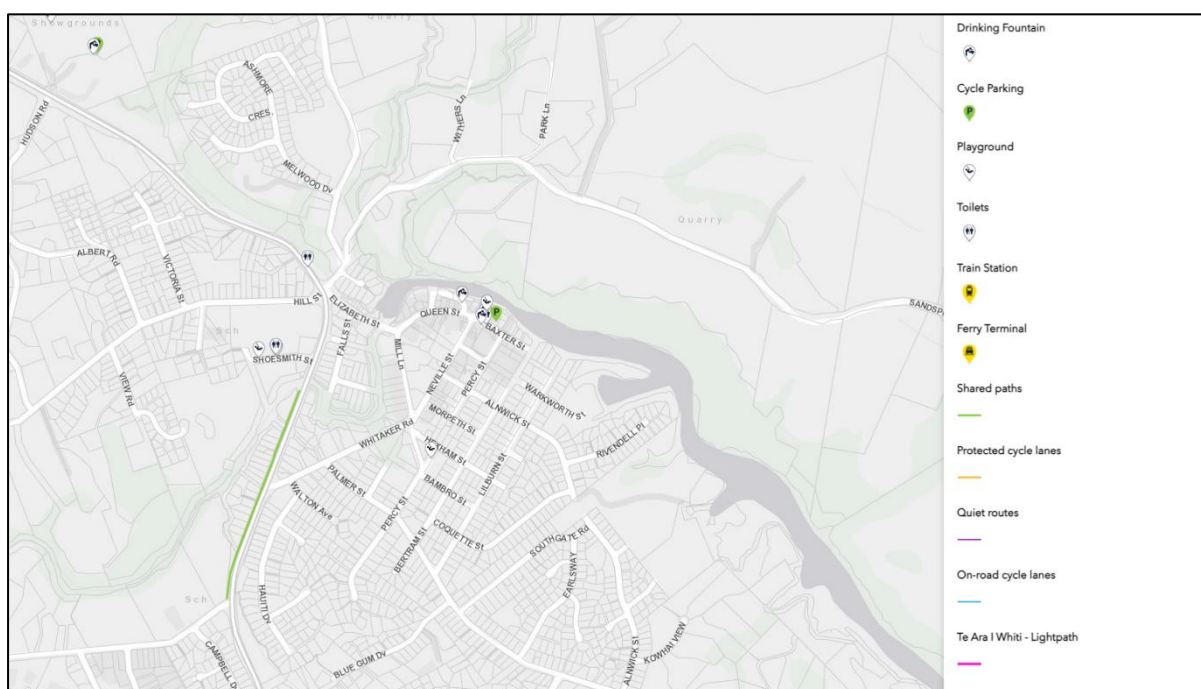


## 4 Public Transport and Pedestrian Amenity

### 4.1 Walking and Cycling Network

Provision for pedestrians and cyclists is limited in the vicinity of the subject site. It is understood that there is no footpath provided along Sandspit Road and the only dedicated cycle facility in the area is a shared path provided along the western side of State Highway 1.

Figure 7 below presents an excerpt from the Auckland Transport Cycleway Map in the vicinity of the subject site and shows the available dedicated cycle amenities in the area.



**Figure 7: Walking and cycling facilities around the region.**

The walking distance between the subject site and the Warkworth Town Centre is estimated to be approximately 800 metres, which is equivalent to a 10 minute walk.

### 4.2 Public Transport

The subject site is not well located for passenger transport provisions for both local trips and more remote journeys. This is a result of the lack of bus stops provided in the vicinity of the subject site (see Figure 8 below).

However, there are a number of bus stops located approximately 1 km south of the subject site. These bus stops are serviced by bus routes 995, 996, 997, 998, and other school routes, which provide connections to Hibiscus Coast Station, Algies Bay, Omaha and Wellsford. These services operate approximately every 30 minutes to 1 hour, depending on the time of day and the day of the week. The following figure shows the available bus services in the area.





Figure 8: Public transport around the subject site.

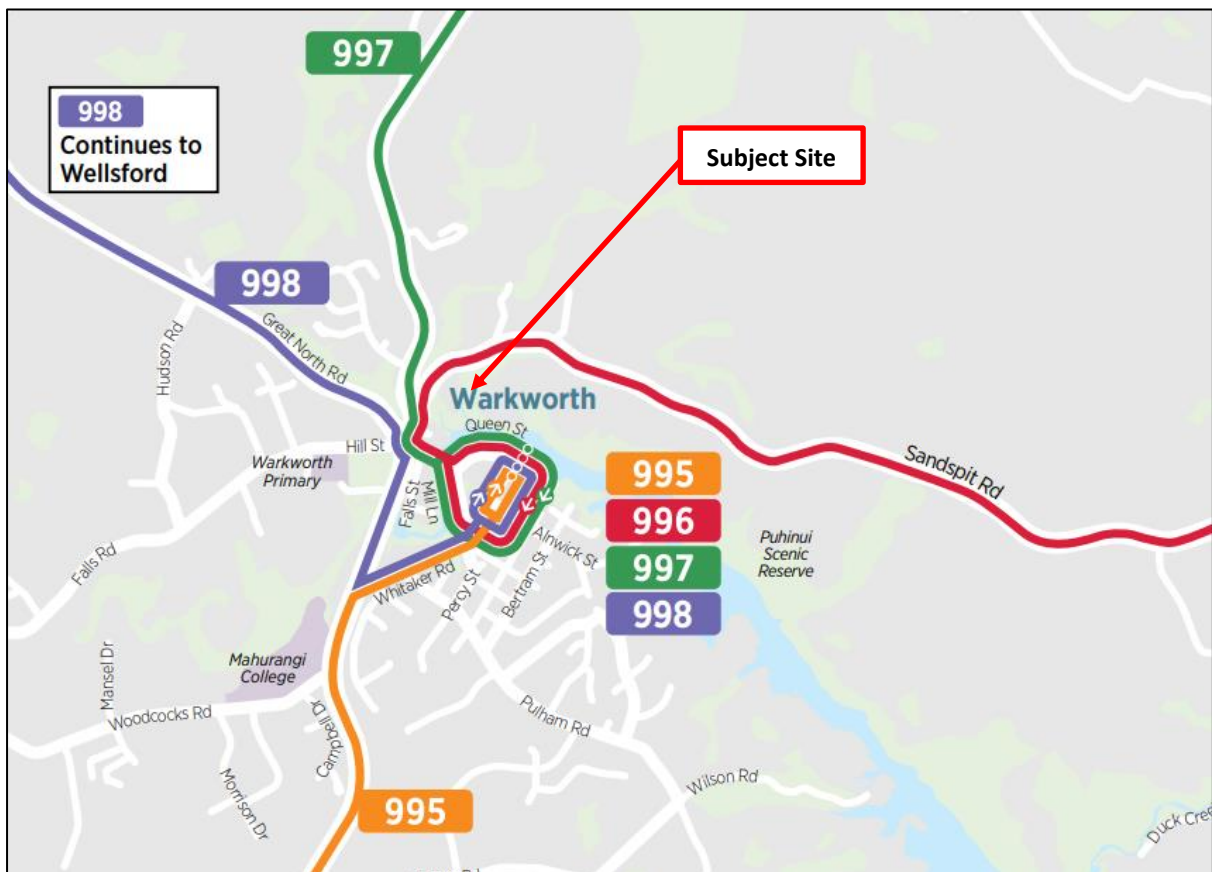


Figure 9: Public Transport around the region.

Given that there are no existing bus stops located within the immediate vicinity of the subject site, existing residents are not likely to use the local public transport given the lack of walking/cycling amenities in the surrounding area.

## 5 PROPOSED FUTURE ENVIRONMENT

### 5.1 Hill Street intersection improvements

Reference has been made to the Hill Street Intersection Improvement ‘Single Stage Business Case’ (Nov 2019) document.

It is expected that the completion of the Puhoi to Warkworth motorway and Matakana Link Road will reduce traffic flows at this pinch point. The planned growth in Warkworth, however, will see increased movements through the intersection.

The Hill Street business case provides a recommended option for improving the intersection.

The recommended option is for the signalised intersection at Hill Street be turned into a five-arm roundabout, with a three-arm roundabout constructed at the Sandspit Road and Matakana Road intersection. Cycling and walking facilities have been included in preliminary designs.

Construction of the project will not start until the Puhoi to Warkworth motorway, and the Matakana Link Road are completed. By this time, the Hill Street upgrade project will be ‘construction ready’.

The following figure shows the indicative intersection layout:

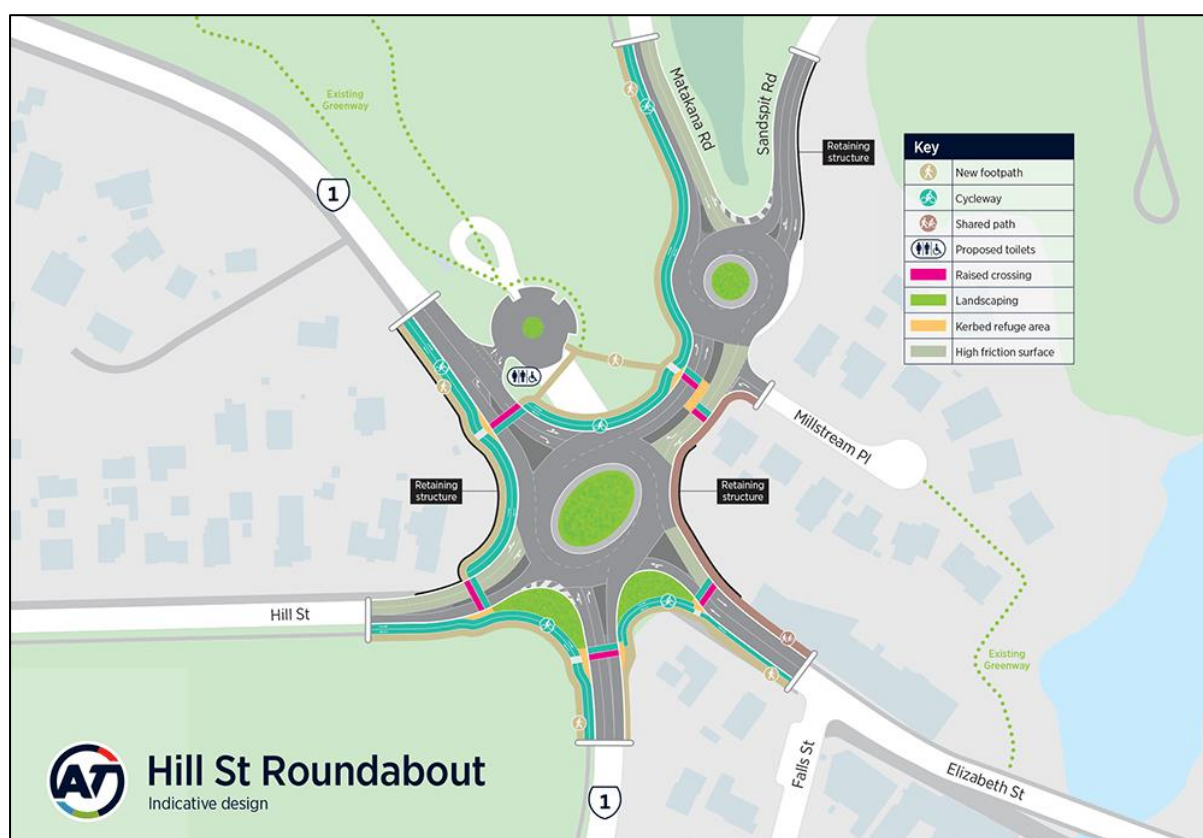


Figure 10: Hill Street Roundabout Plan

## Benefits

- New cycling and walking facilities
- Five-arm roundabout will improve traffic flow through State Highway 1
- Three-arm roundabout will improve traffic flow through the Sandspit Road and Matakana Road intersection.

## 5.2 Sandspit Link Road

The proposed Sandspit Link Road (Not Committed) will enable better accessibility for vehicles travelling between Sandspit, Snells Beach and Algies Bay, and from Ara Tūhono –Pūhoi to Warkworth, by avoiding the need to pass through the SH1/ Hill Street intersection. Essentially, these vehicles can bypass the intersection by following a route along the Sandspit Link Road, Matakana Link Road and SH1 (north of Hudson Road). The project has been prioritised for funding for delivery over the next ten to thirty years.

The effect of this would be to reduce volumes in the section of Sandspit Road between the Hill Street Intersection and the Sandspit Link Road Intersection as indicated in the following figure:

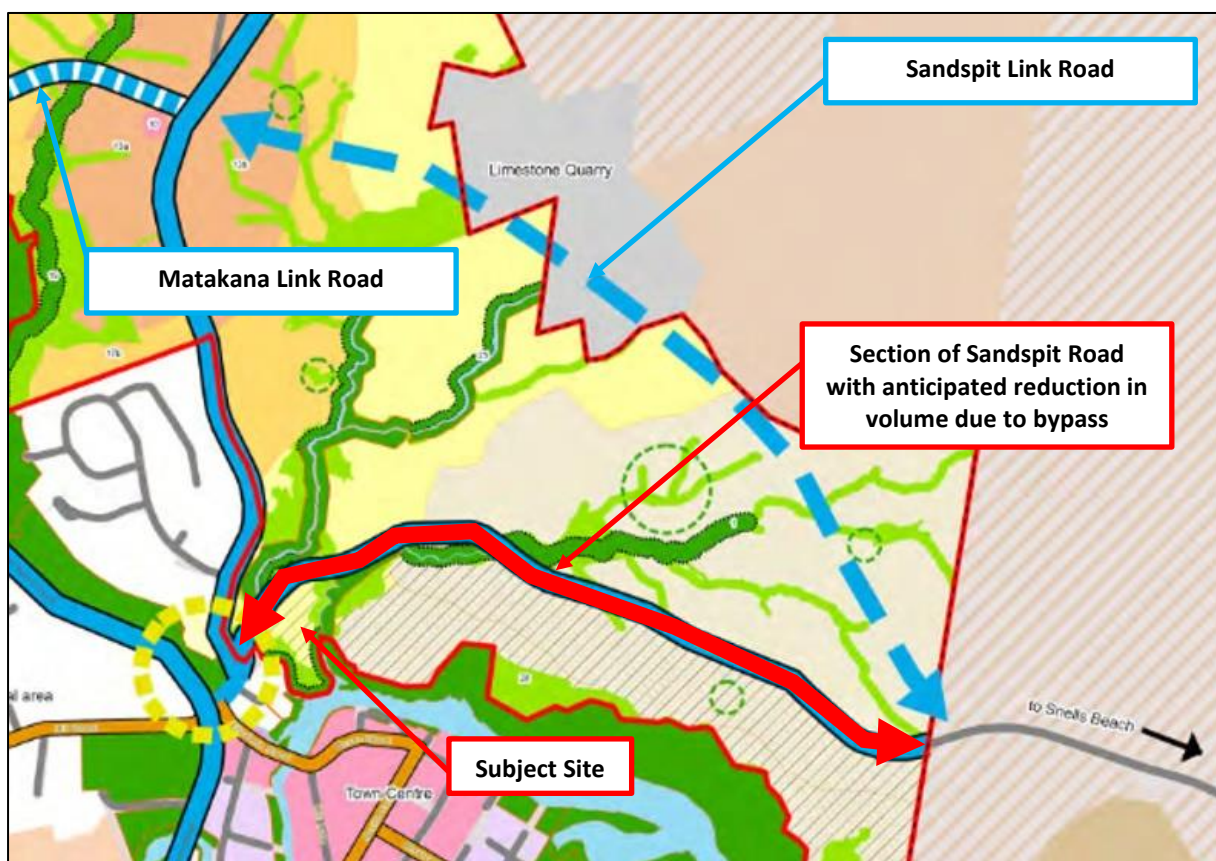


Figure 11: Sandspit Road Anticipated Volume Reduction

### 5.3 Future Speed Environment

No changes to the existing posted speed limits are proposed or planned. It is noted that the existing speed limit was reduced in 2020, however these changes have not been implemented on the road.

However, it is noted that the aspirational Sandspit Link Road as discussed previously gives yield to a scenario in which volumes along Sandspit Road in the vicinity of the subject site are reduced.

This in conjunction with the Warkworth East area being identified as a future growth area in the Structure Plan, leads to the likelihood that the area will become more residential in nature.

On this basis, the posted speed limits along Sandspit Road in this area would likely reduce to support safe neighbourhood design outcomes, particularly as there would likely be pedestrian/cycle paths interacting with the road environment, which currently does not exist.

Overall, in the long term, speeds in this area are anticipated to reduce to 50 km/h between the Hill Street intersection and the future Sandspit Link Road.

It is also noted that some vehicles are exceeding the 50 km/h speed limit in the vicinity of the subject site. This is due to the changes to the posted speed limit not having been implemented on the road. As the appropriate signage, road markings and supplementary signs are installed and the area becomes more urbanised, speeds are anticipated to reduce. The proposed 60 km/h design speed is therefore considered to be conservative for the long-term safety outcomes for the area.

It is not clear why the legal speed limit<sup>2</sup> has not been implemented on Sandspit Road in the vicinity of the subject site.

It is recommended as a part of this proposal that repeater signage and additional road markings be proposed to reinforce the lower speed limit. The location of these signs and markings can be determined at a detailed design stage or by Auckland Transport when they implement the changes on this road.

### 5.4 Rodney Greenways Plan

The Rodney Greenways Plan is a proposed greenways network to provide better connection for active modes (walking and cycling) and to enable ecological regeneration across this area of Auckland. The plan shows several routes located in and around the township of Warkworth, that link to popular destinations such as Matakana and Omaha. The proposed greenways network is shown in the following figure:

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<sup>2</sup> As prescribed in the Auckland Transport Speed Limits Bylaw (2019).





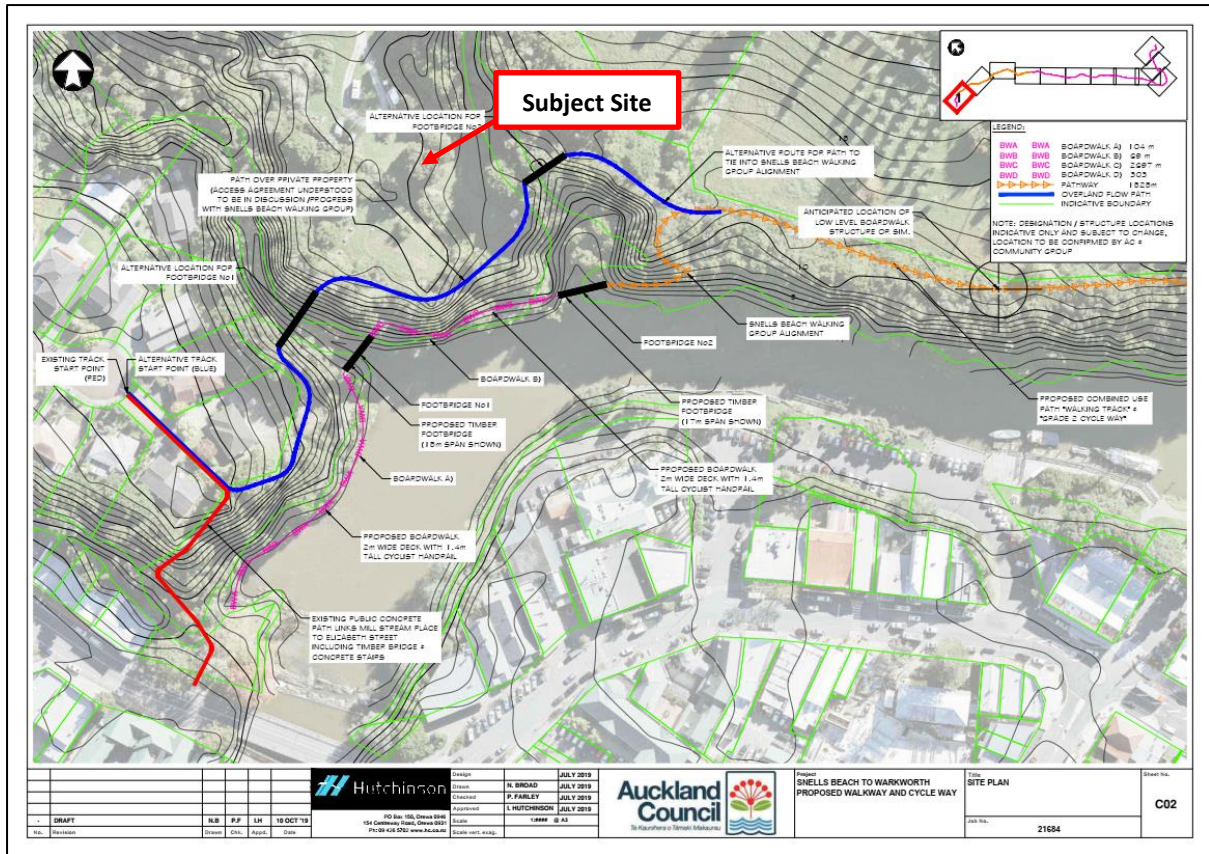


Figure 13: Council Proposed Walkway Concept Scheme

As the intended timeframe for this project is not known, potential integration has not been explored as a part of the subject Resource Consent application, and efforts have been made to provide a robust alternative shared path connection to Millstream Place as discussed in this report. It should however be noted that provisions have been made to accommodate future integration with the Mahurangi cycle trail when the time comes.

### 5.6 Public Transport

The AT Indicative Strategic Transport Network and Warkworth Structure Plan describe the passenger transport projects that are planned for the region. These plans identify the services that are integral to the network to support Auckland’s future urban growth, and Warkworth’s role as a satellite.

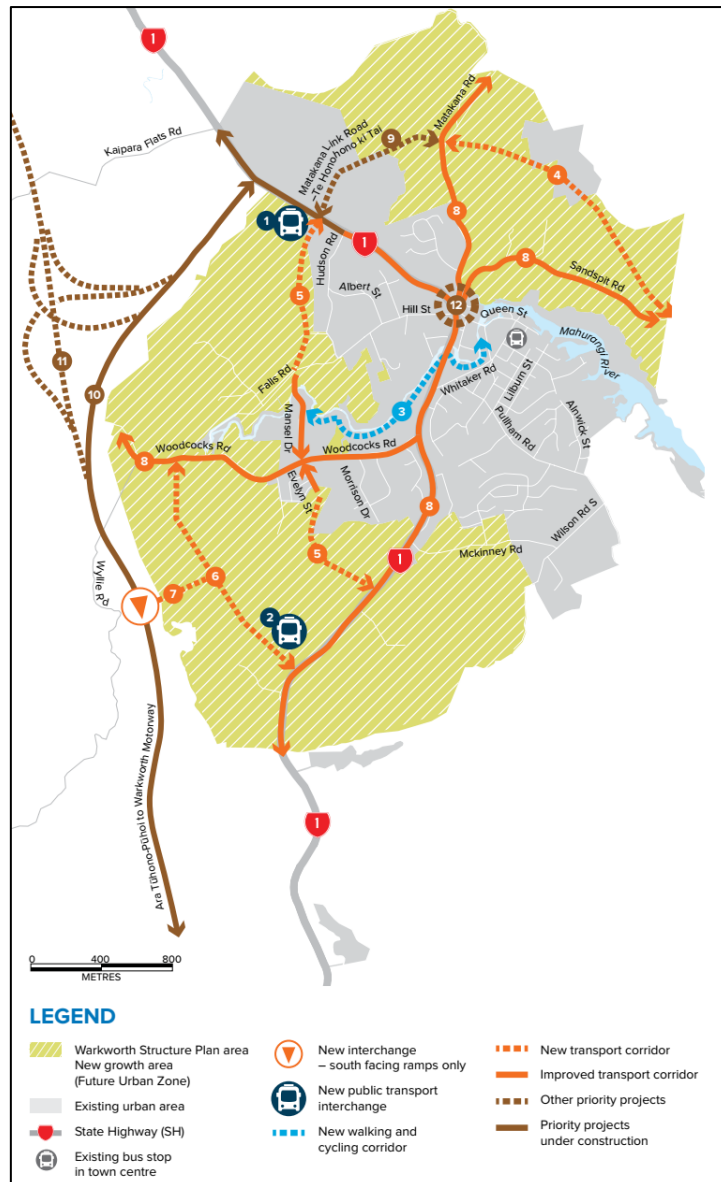


Figure 14: Warkworth Indicative Strategic Network

As can be seen in the above plan, there are two new public transport interchanges proposed in this plan. Interchange 1 will also include a park and ride facility and due to the proximity to the SH1 bypass, this would likely serve as the primary commuter link to Auckland.

### 5.7 Over Dimensional (OD) Vehicle Route

It is noted that Sandspit Road is an over-dimensional vehicle route and the completion of Ara Tūhono (SH1 bypass) is not expected to change this classification. On this basis, the design of any proposed intersection along this route will need to take this into consideration.



## 6 THE PROPOSAL

The proposal involves the subdivision and development of approximately 2.9 hectares of land situated at 34 and 36 Sandspit Road in Warkworth (Subject Site) into 49 lots/units.

Subject to consent, these lots will contain predominantly residential activities, as enabled by the Private Plan Change application which is being considered by Council presently.

The existing farmland and structures contained within the site will be removed as a part of the proposal to facilitate earthworks necessary for the development of the land.

Vehicular connection to the adjacent road network will be provided via Sandspit Road and pedestrian/cycle connections are proposed via a shared path connection close to Millstream Place.

The following plan provides an overview of the proposal:



**Figure 15: Proposed Site Plan**

### 6.1 Development Details

The proposal results in 18 blocks with a combination of typologies. These are predominantly made up of 3-bedroom terraced houses, but also include 2-bedroom units and 3–4-bedroom standalone units.

The following table provides a breakdown of the proposed units by typology:

**Table 4: Development Details**

Typology	TOTAL(REGULAR)
2-bedroom units	8
3-bedroom units	37
3/4-bedroom units	4
<b>TOTAL</b>	<b>49 Residential Units</b>



### 6.1.1 Subdivision Staging

Although the subject report considers the traffic effects of the entire site, the proposed subdivision may be developed in stages. The following figure shows the indicative staging of the subdivision:

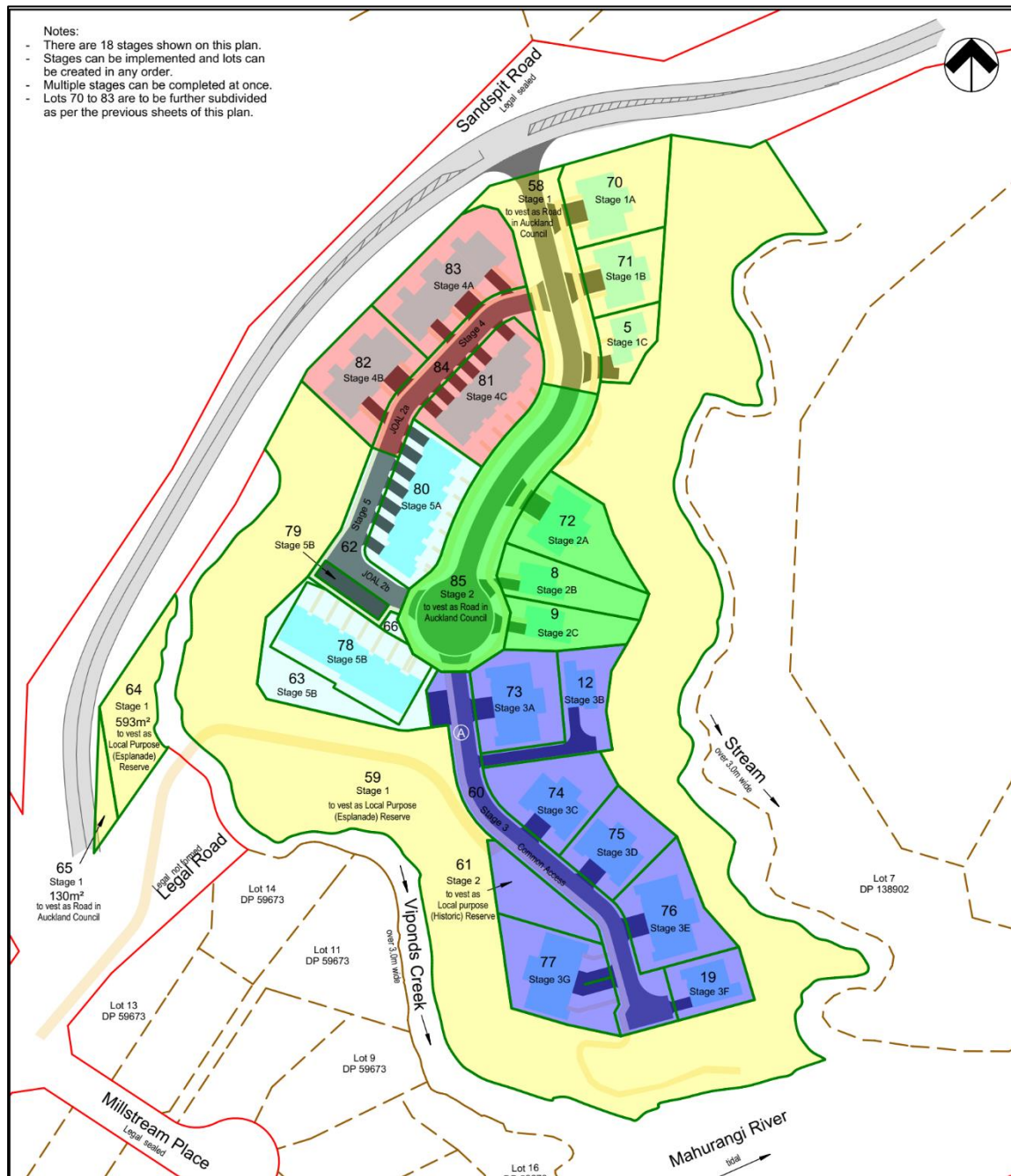


Figure 16: Potential Staging plan

As shown in the figure above, there are five stages proposed each with potential sub staging options.

Consent will be sought on the basis that the development may be staged, and if it is staged, that all relevant conditions for each stage will be fulfilled in order to obtain the s224 (c) for that stage.

It is envisaged that staging may be undertaken in any order so long as all required conditions for each stage are met.

To avoid any access issues due to staging, it is recommended that temporary turning heads (Y-shaped), compliant with AT TDM standards be established in the interim periods to enable servicing of the road. In the case where the stub road terminates close to an adjacent internal intersection, the intersection could be used to turn around. If the cul-de-sac is built in stage one, then no temporary turning areas would be required.

## 6.2 Internal Road Layout

### 6.2.1 Road 1

Road 1 forms the primary link to the development and provides vehicle access to all units via Sandspit Road.

Road 1 has been designed as a Local Road in accordance with Auckland Transport TDM guidelines for movement/place function.

Road 1 terminates at a cul-de-sac or circular turning head.

The following figure shows the general layout of Road 1 including the proposed turning head:

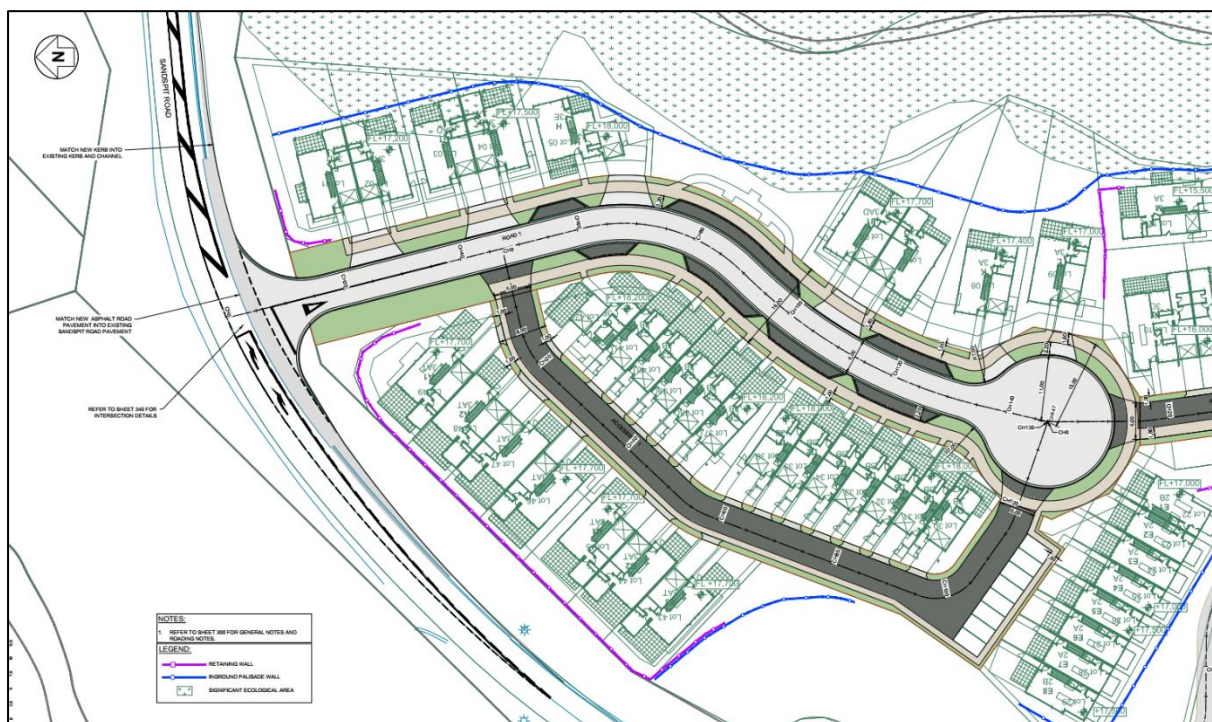
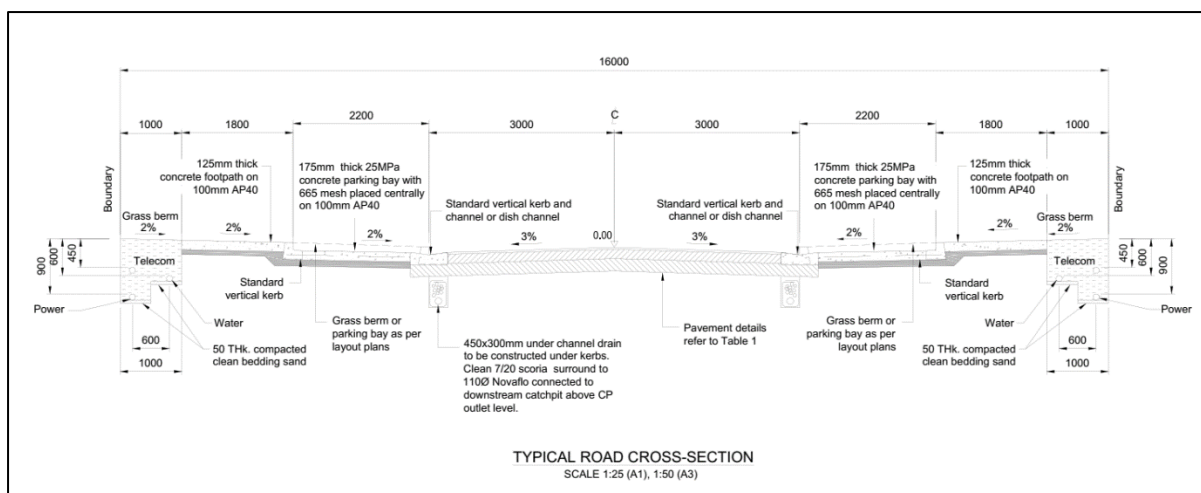


Figure 17: General Layout Road 1

Road 1 will be 16 metres wide between boundaries and will have a 6-metre-wide carriageway. This width would be able to facilitate 3-metre-wide lanes in each direction, with the ability to provide recessed parking proposed as to not affect two-way movement. The design also includes 1.8-metre-wide footpaths on both sides of the road and includes front and rear berms to accommodate services.

These details are shown on the following cross section of the road.



**Figure 18: Road 1 Cross Section**

On street recessed parking spaces are a minimum of six metres long by 2.2 metres wide per space with 45-degree entry and egress tapers at the start and end of each recessed bay. I.e., a 2-space recessed parking bay would have dimensions in the order of 12 metres long at the kerbside and 16.4 metres wide at the roadside.

Due to the adverse gradients and physical constraints on Sandspit Road, no public footpath network currently exists in the vicinity of the subject site. On this basis, footpaths on Road 1 terminate within Road 1 and have been designed to integrate with the proposed shared path connection via JOAL 2, which provides a connection to the proposed footpath network near Millstream Place/Sandspit Road, in the vicinity of the proposed roundabout intersection upgrade.

Road 1 also features an 11-metre radius<sup>3</sup> circular turning head / cul-de-sac. The dimensions of which are compliant with Auckland Transport TDM requirements. Furthermore, the ability for a 10.3-metre-long Council rubbish truck to circulate the cul-de-sac has been checked with vehicle tracking analysis; the output of which is shown in the following diagram and in Appendix B of this report:

<sup>3</sup> Includes front berm dimension.







## 6.2.2 Common Accessway 1

Common Access Way (CAW) 1 provides pedestrian and vehicular access to blocks A-E and is configured as a crescent which links to Road 1

CAW 1 will be 8 metres wide between boundaries and will have a 6-metre-wide carriageway. This width would be able to facilitate 3-metre-wide lanes in each direction. The design also includes a 1.0-metre-wide pedestrian strip within the access on the northern side of the CAW.

These details are shown on the following cross section of the road.

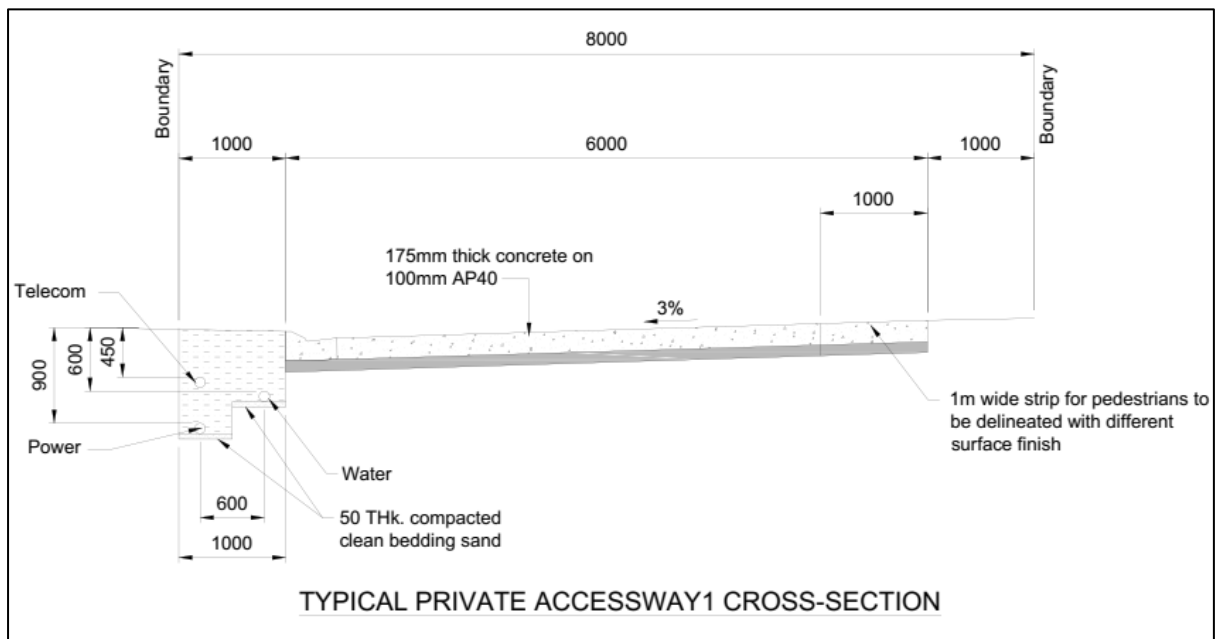


Figure 20: CAW 1 Cross Section

This configuration is consistent with NZS 4404 and Auckland Transport's TDM guidelines and is considered to be suitable for the proposed subdivision.

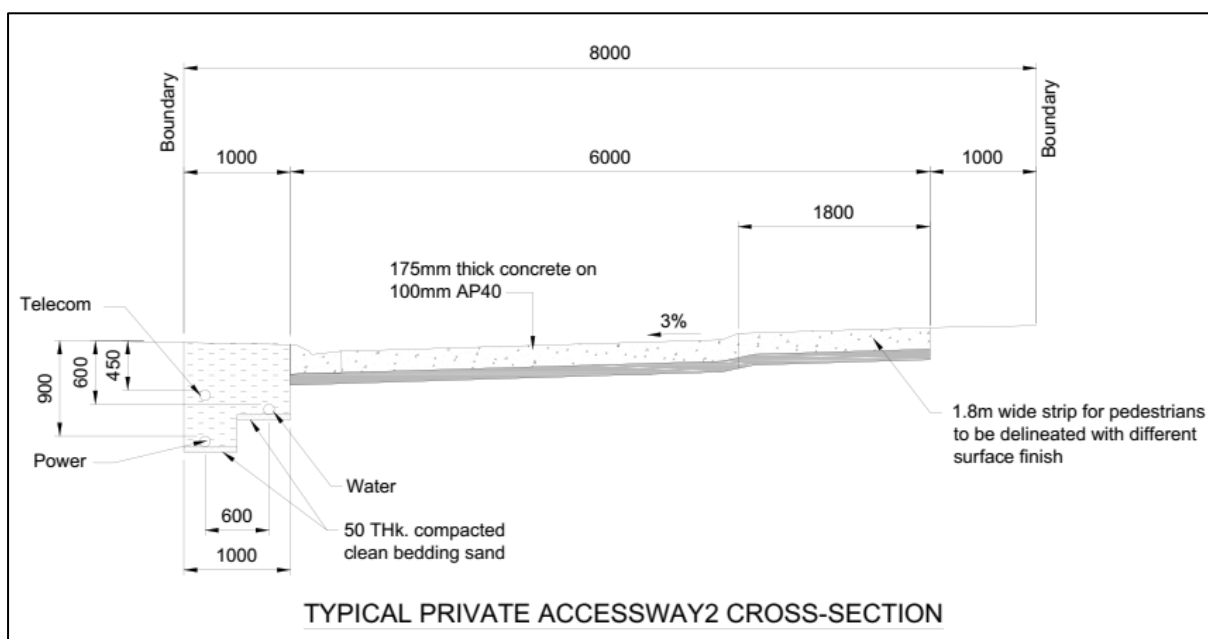
### 6.2.3 Common Accessway 2

Common Access Way (CAW) 2 provides pedestrian and vehicular access to blocks M-S as well as providing public access to the Historic Kilns Site and pedestrian connection to Warkworth town centre via the proposed shared path (discussed further in section 6.4 of this report).

CAW 2 will be 8 metres wide between boundaries and will have a 6-metre-wide shared-space carriageway. This width would be able to facilitate 3-metre-wide lanes in each direction. The design also includes a 1.8-metre-wide pedestrian strip within the access on the western side of the CAW.

The 1.8-metre-wide pedestrian strip within the carriageway will be delineated with texture or colour and would likely be separated by a dish channel or similar with pedestrian banding across the driveway as a suitable shared space treatment. This pedestrian strip will provide public access to the Historic Kilns Site and may well serve as a connection to the Mahurangi cycle trail in the future.

These details are shown on the following cross section of the road.



*Figure 21: CAW 2 Cross Section*

This configuration is consistent with NZS 4404 and Auckland Transport's TDM guidelines and is considered to be suitable for the proposed subdivision.

### 6.3 Sandspit Road/ Road 1 Intersection

Access to the triangular-shaped site is significantly constrained by the presence of a tributary river of the Mahurangi Harbour on its southern side, and deep vegetated cuttings with streams on its western and eastern sides.

Although a paper road exists through to the western side of the property, it is very poorly located, stops at the western stream, and has challenging topography to establish vehicular access. The following figure shows the existing access and site context:



Figure 22: Access Context Plan

Collectively, these constraints result in the subject site being in the form of a 'peninsula' that is 'land-locked' on its eastern, western and southern sides.

For these reasons, vehicle access can realistically only be taken from Sandspit Road, which in itself has significant alignment and topographical constraints.

These constraints include:

- a complex combination of horizontal and vertical alignments,
- a two-lane bi-directional bridge,







Figure 24: Indicative Works for Access

### 6.3.1 Intersection Visibility

It is commonly accepted that the operating speed is typically 15% above the posted speed limit. The posted speed limit in the vicinity of the subject site is 50km/hr. On this basis, the operating speed is anticipated to be in the order of 57.5km/h.

The assessment of the speed has conservatively assumed an 85<sup>th</sup> percentile speed of 60km/h in each direction for the purposes of this assessment.

This is considered to be appropriate given that as the site is developed and as the surrounding environment becomes more residential in nature, that speeds will reduce to meet safe neighbourhood speeds (as discussed in section 5.3). It is also recommended as a part of this proposal that repeater signage and additional speed limit road markings be proposed to reinforce the lower speed limit. The location of these signs and markings can be determined at a detailed design stage.

At this more appropriate speed, the Austroads design guideline<sup>4</sup> states that the SISD visibility requirement for normal reaction times is 123 metres.

This distance has been provided with the two sight lines and long sections shown in the following figures and in the Civil Engineering Drawings prepared by Aireys.

<sup>4</sup> AUSTRROADS Guide to Road Design Part 4A





### 6.3.2 Right Turn Facility

In determining the design details in this area, thought was given to the need for the right turn facility. Having considered the nature of the traffic environment, it is considered that there are significant benefits in providing a right turn facility for both road safety and also operational reasons.

Specifically, the availability of the right turn bay and outbound merge taper will avoid the capacity constraints and increased risk of rear end collisions occurring if vehicles had otherwise been required to stand in the live lane if delayed by oncoming traffic - a situation that would have occurred due to the limited, to non-existent, shoulder widening present in the area.

The following figure provides details of the proposed right turn bay and merge taper:



Figure 27: Intersection Plans

The right turn bay has been designed in accordance with MOTSAM Part 2 and Austroads GDR Part 4. Due to the physical constraint imposed by the presence of the bridge to the west, the development length of the diverge taper into the right turn bay would be limited by the physical distance to the bridge. On this basis, as prescribed by MOTSAM, the Urban Area Alternative design has been selected.

Applying the appropriate calculations for the proposed 60km/hr design speed to the proposed design results in a technical requirement of 75 metres. Given that the proposal results in a 70-metre-long taper there is a technical shortfall of five metres or one car length. This minor technical shortfall is not expected to result in any operational or safety issues, particularly when considering the uphill direction in which the diverge will occur and that this difference would be marginal (relates to an additional 0.29 seconds<sup>5</sup> at the decision point).

<sup>5</sup> Calculated based on an operating speed of 60km/hr over five metres.

Furthermore, horizontal geometry has been tested in accordance with TDM Urban and Rural Roadway Design documentation, which specifies the appropriate design/check vehicles and tracking typology for various scenarios. These tracking checks have been supplied in Appendix B of this report.

Overall, the proposed right turn facility is considered to be appropriate for the intended use. Furthermore, as an additional benefit, the proposed right turn facility is expected to reduce speeds in the vicinity of the site by providing visual narrowing of the lanes in the immediate area.

## 6.4 Shared Path Connection to Warkworth

Due to the uncertainty around the timeframes for the completion of the Mahurangi River Trail, consideration has been given to alternate pedestrian connection routes into Warkworth Township, assuming that further integration with the Mahurangi River Trail could easily be achieved via the proposed walkway to the historic Kilns site.

Although a paper road exists through to the western side of the property, as previously discussed, it is poorly located to provide vehicular access to the site, however, a pedestrian/cycle linkage has been explored in this location.

The general layout of the proposed path is shown in the following figure:

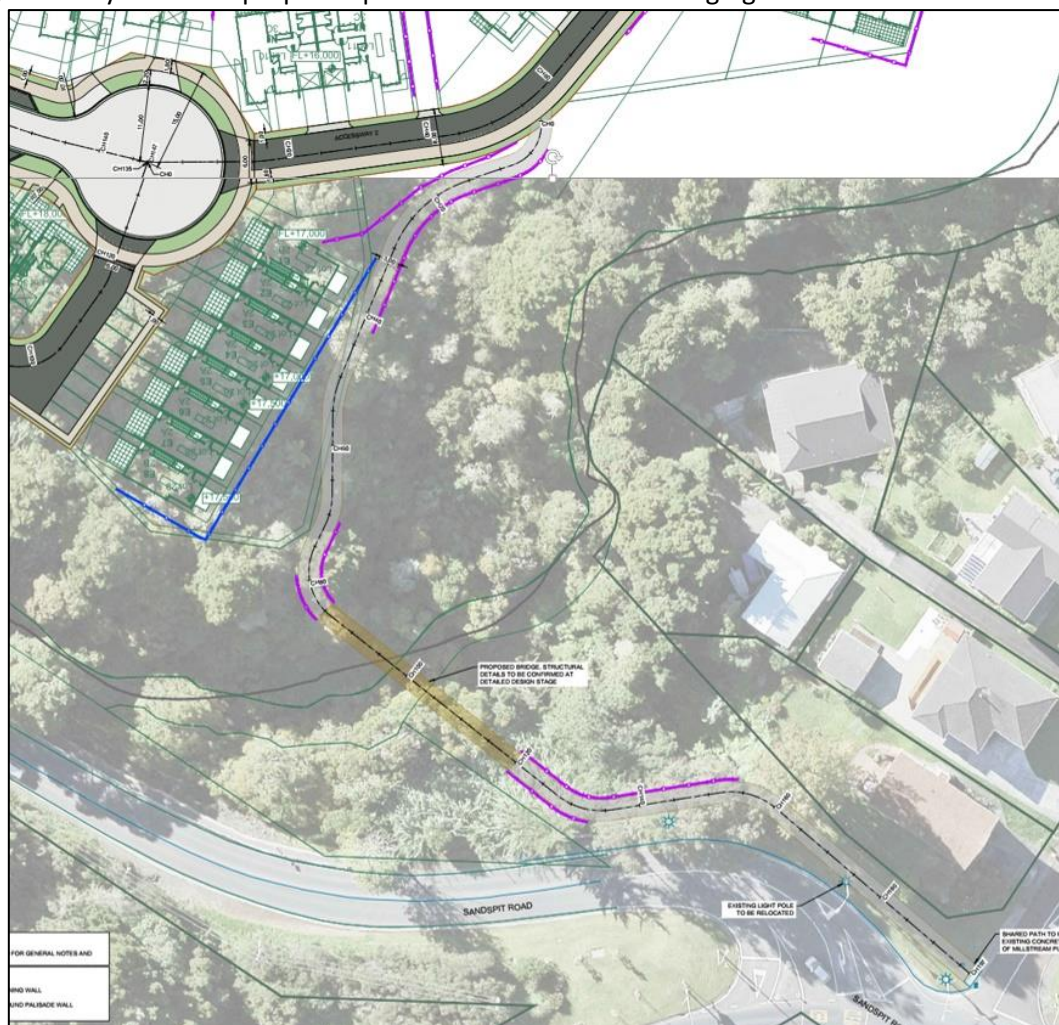
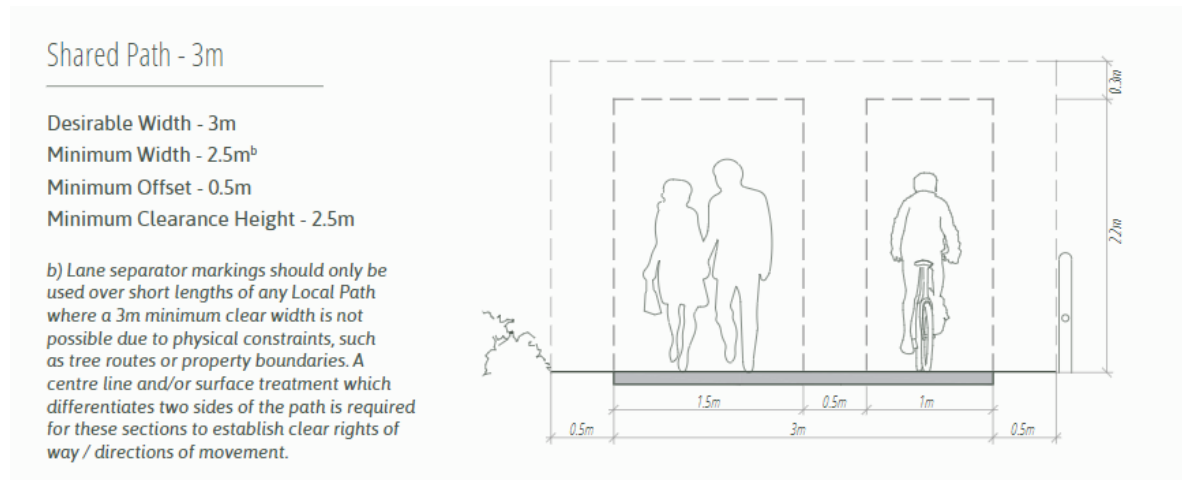


Figure 28: Shared Path Route



The shared path has been designed in general accordance with Auckland Transport's Local Path Design Guide document.

The guide sets out the following layout for a 3-metre-wide shared path:



**Figure 29: Shared Path Configuration as per the Local Path Design Guide**

The exact details of the formation of the path including pavement markings, signage, safety rails and Street/Path furniture are not known at this stage and will be confirmed at a detailed design stage. However, it is understood that there is sufficient width to accommodate a suitable path in accordance with these guidelines.

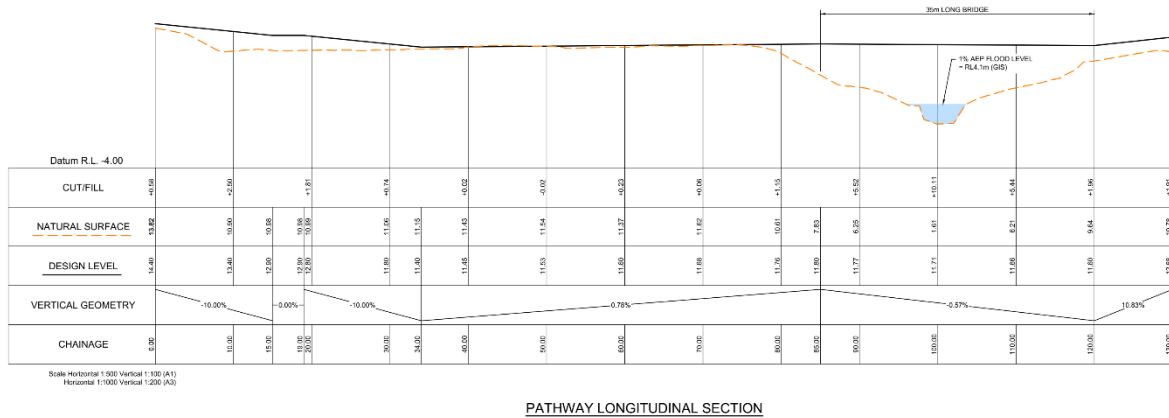
### Gradients

The longitudinal gradients of this shared path will be varying given the topography of the hill making it difficult to achieve ideal accessible grades for mobility impaired users. On this basis, the path has been designed to try and accommodate general users, however, some mobility impaired users or elderly would also be able to use the path given the many level landings that have been proposed to break up the sections with slightly steeper grades.

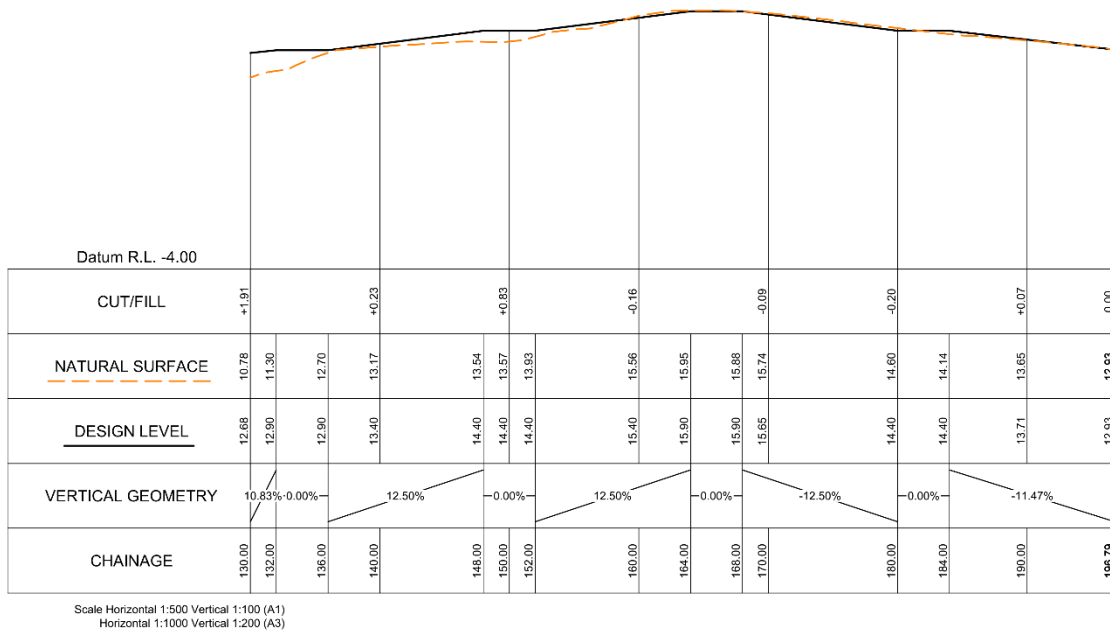
The local path design guide specifies the following design parameters for shared routes on grades steeper than 1:20:

- 1:10 slope is acceptable up to 50m in length where pathway is straight.
- 1:6 slope is acceptable for lengths up to 50m where the horizontal path is curved and/or changes alignment.
- For every 1500mm rise - a level landing equal or greater than the width of the ramp is to be provided.
- For cycling purposes - paths that exceed these parameters are considered extremely hazardous.
- Accessible ramps should not exceed 1:12 gradients.

The following figures show the longitudinal sections of the shared path:



**Figure 30: Shared Path Long-section chainage (0-130) – Millstream Ln**



**PATHWAY LONGITUDINAL SECTION (CONTINUED)**

**Figure 31: Shared Path Long-section chainage (130-197) – The Kilns**

As shown in the figures above, short sections of 12.5 % grade are required as a part of the proposed design. On this basis, the requirements of this guideline are slightly exceeded (250mm over 10 metres) in limited sections.

However, this minor technical non-compliance is not considered to be an issue, as several intermittent flat landings have been provided to mitigate this. On balance, the proposal is considered to be a better alternative to providing longer sections of compliant grades with larger distances between landings.

The proposal will therefore provide a comfortable path for most users and represents a significant improvement over the existing stairway connection to the south.

The local path design guide specifies acceptable crossfall as:

- The preferred cross fall is 1:50 (2%)
- The maximum cross fall is 1:8 (12.5%)
- For impermeable surfaces, gradients of 2%-4% are adequate for drainage
- For permeable surfaces, a gradient of 5% is recommended for drainage.

It is understood that the proposed pathway will meet the above requirements.

The shared path will integrate into the existing pedestrian footpath network at Millstream Place as shown in the following figure:



Overall, the proposed shared path is expected to be an excellent pedestrian amenity for the site, providing connectivity to Warkworth Township.

## 6.5 Traffic Generation & Distribution

### 6.5.1 Methodology & Assumptions

Traffic generation, distribution and an assessment of effects has been undertaken to demonstrate that the traffic volumes generated by the proposed development at the intersection with Sandspit Road will not result in any significant operational/capacity effects on Sandspit Road.

Trip generation for the proposed development has been based on a conservative assumption of the scale and intensity of the development with emphasis being placed on the operation of the priority-controlled intersection of the Access Road/Sandspit Road.

#### Development Traffic Generation and Distribution:

In order to estimate the traffic generating potential of the proposed development, several assumptions have been made about development details, directional biases etc.

The assumptions and the reasoning for these assumptions are detailed below:

- Trip generation rates are sourced from the surveyed data for the Melwood Drive residential catchment as detailed in the section titled 'Traffic Survey Data'<sup>6</sup>.
- A peak hour rate of 0.70 trips/dwelling was obtained from analysis of this data for the weekday.
- AM/PM/IP inbound outbound splits were determined from the Melwood Drive turning movement survey.
- A directional bias of 11%/89% has been assumed to determine the East/West bias for the subject intersection. These rates are based on the Commuter Waka data derived from the 2018 Census Data.

### 6.5.2 Traffic Generation

As discussed in the methodology section above, the residential trip generation rates have been sourced from survey data for the Melwood Drive residential catchment.

The likely development peak hour is expected to be between 5:00 p.m. to 6:00 p.m., in line with the commuter peak hour. It should be noted that the surveyed residential peak hour was 3:00 p.m. to 4:00 p.m., however, to remain conservative it has been assumed that the development peak hour will overlap with the school peak as detailed in the survey data.

The proposal will result in 49 units being established, each typically with two parking spaces.

As detailed in the 'Traffic Survey Data' section of this report, the following trip generation rates would apply:

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<sup>6</sup> The reasoning for the use of the Melwood Drive data has been detailed in the PPC ITA and subsequent RFI responses that have been prepared for this site, and are considered to be appropriate.



**Table 5: Wednesday Trip Generation Rates**

<b>Trip Generation – Melwood Drive (Trips/Dwelling)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM (7:45 - 8:45)	0.23	0.37	0.60
PM (15:00 - 16:00)	0.39	0.31	0.70
IP (11:45 - 12:45)	0.39	0.28	0.66

**Table 6: Saturday Trip Generation Rates**

<b>Trip Generation - Melwood Drive (Trips/Dwelling)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM (9:00 - 10:00)	0.18	0.28	0.46
PM (15:00 - 16:00)	0.25	0.15	0.40
IP (10:30 - 11:30)	0.26	0.37	0.63

Applying this rate to the proposed development (49 units) results in the following peak hour traffic generation:

**Table 7: Traffic Generation Weekday**

<b>Residential Traffic Generation (Trips/hour)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM Peak	11	18	30
PM Peak	19	15	34
IP Peak	19	14	33

**Table 8: Traffic Generation Saturday**

<b>Residential Traffic Generation (Trips/hour)</b>			
	<b>Inbound</b>	<b>Outbound</b>	<b>Total</b>
AM Peak	9	14	22
PM Peak	12	7	19
IP Peak	13	18	31

### 6.5.3 Traffic Distribution

In order to understand how the abovementioned trips could be distributed at the subject site's intersection with Sandspit Road, reference has been made to census commuter (work and school) data<sup>7</sup>.

The following figures show a heat map of where people from Warkworth East<sup>8</sup> commute to for work and school, and what mode of transport they used.

<sup>7</sup> The Commuter View dataset is used for the map & bubble visualisations, while the NZ Stat repository is used for the modes of travel, and resident population.

<sup>8</sup> The subject site is located within this Warkworth East Census Catchment.

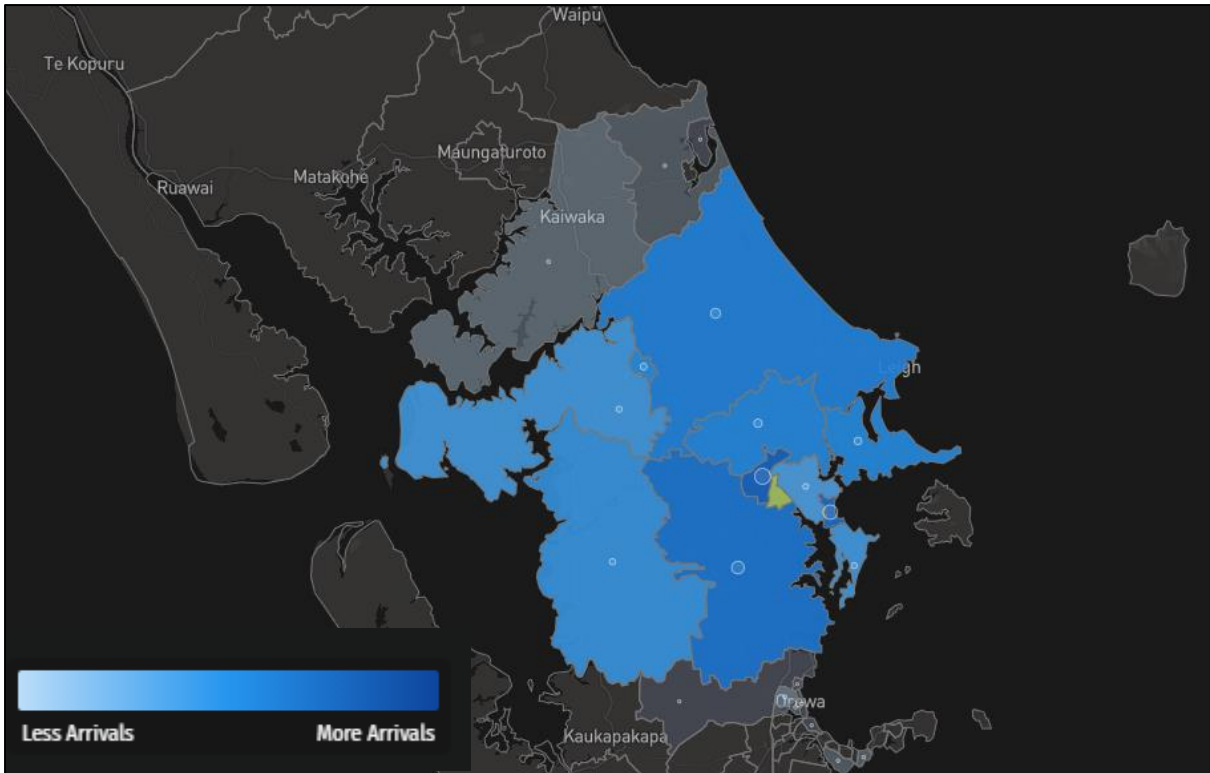


Figure 32: Commuter Heat Map (Warkworth East)

### Arrivals

993 people travel to Warkworth East for work or school (65%), while 537 people (35%) also live in Warkworth East. People arrive from 22 different areas, the largest share being Warkworth West (171 people—11% of arrivals). The most common way to arrive to for work or school is to drive a private car, truck or van (62%).

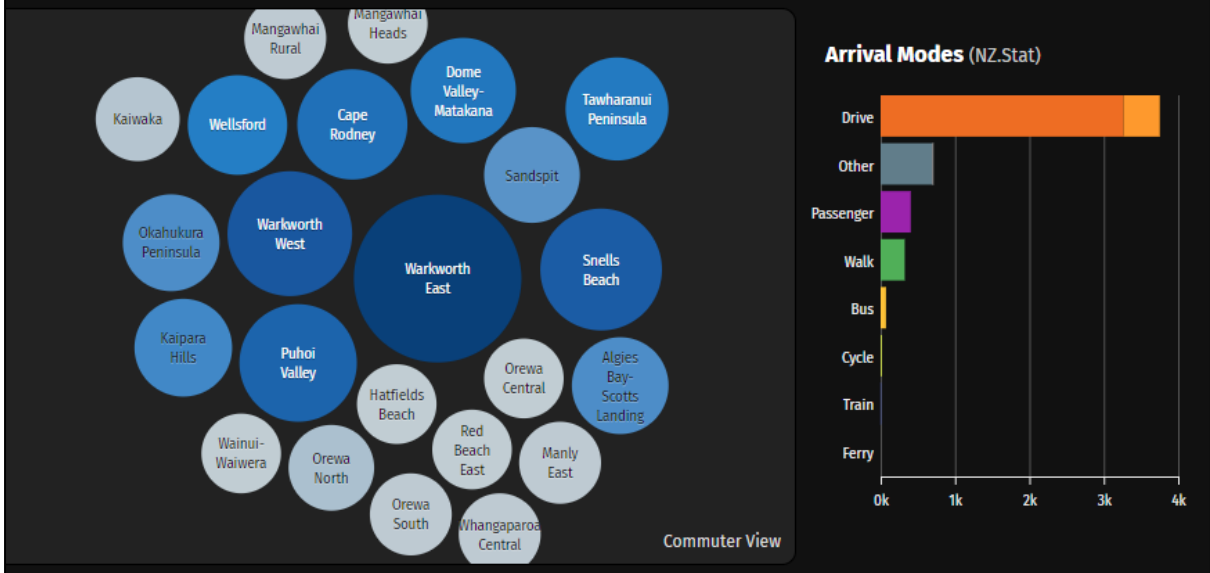


Figure 33: Commuter Data Summary Including Mode Split

The following table provides a summary of the key findings of the above data set in relation to the subject site:

Trip Distribution – Work/School			
Location	Direction	West (percentage)	East (percentage)
Warkworth West	W	53%	-
Puhoi Valley	W	7%	-
Silverdale Central	W	3%	-
Wairau Valley	W	2%	-
Orewa Central	W	2%	-
Takapuna West	W	2%	-
Quay Street-Customs Street	W	2%	-
Albany Central	W	3%	-
Wellsford	W	2%	-
Maungaturoto	W	2%	-
North Harbour	W	5%	-
Cape Rodney	W	2%	-
Dome Valley-Matakana	W/E	3%	3%
Tawharanui Peninsula	W/E	1%	1%
Sandspit	E	-	2%
Snells Beach	E	-	4%
Algies Bay-Scotts Landing	E	-	1%
<b>Total</b>		<b>89%</b>	<b>11%</b>

Based on the above distribution information, the following turning movements could be anticipated at the envisaged primary intersection to the subject site:

**Table 9: Traffic Distribution Weekday**

Sandspit Road/Access Road Intersection (Vehicles/hour)					
	Inbound		Outbound		Total
	Left In	Right In	Left Out	Right Out	
AM	1	10	16	2	29
PM	2	17	13	2	34
IP	2	17	12	2	33

**Table 10: Traffic Distribution Saturday**

Sandspit Road/Access Road Intersection (Vehicles/hour)					
	Inbound		Outbound		Total
	Left In	Right In	Left Out	Right Out	
AM	1	8	12	2	23
PM	1	11	6	1	19
IP	1	12	16	2	31

As can be seen from the above tables:

#### **Weekday**

- The weekday PM peak hour results in the most trips (34 trips/hour).
- The dominant movement would be the left turn towards Hill Street in the morning and right turn in during the evening.
- A maximum of 30 trips or 15 vehicles/hour on average travelling to/from the Hill Street intersection.

#### **Saturday**

- The Saturday IP hour results in the highest weekend trips (31 trips/hour).
- The dominant movement would be the left turn towards Hill Street in the morning and right turn into the development during the evening.
- A maximum of 28 trips or 14 vehicles/hour on average travelling to/from the Hill Street intersection.

This level of traffic is minimal and is not expected to result in operational issues within the site or on the adjacent road network.

Based on the census data obtained, the following non-motorised trips could also be extrapolated for a typical weekday commuter peak hour:

- 4 walking trips to/from the site during the peak hour.
- 1 cycle trip to/from the site during the peak hour.
- 1 bus trip.

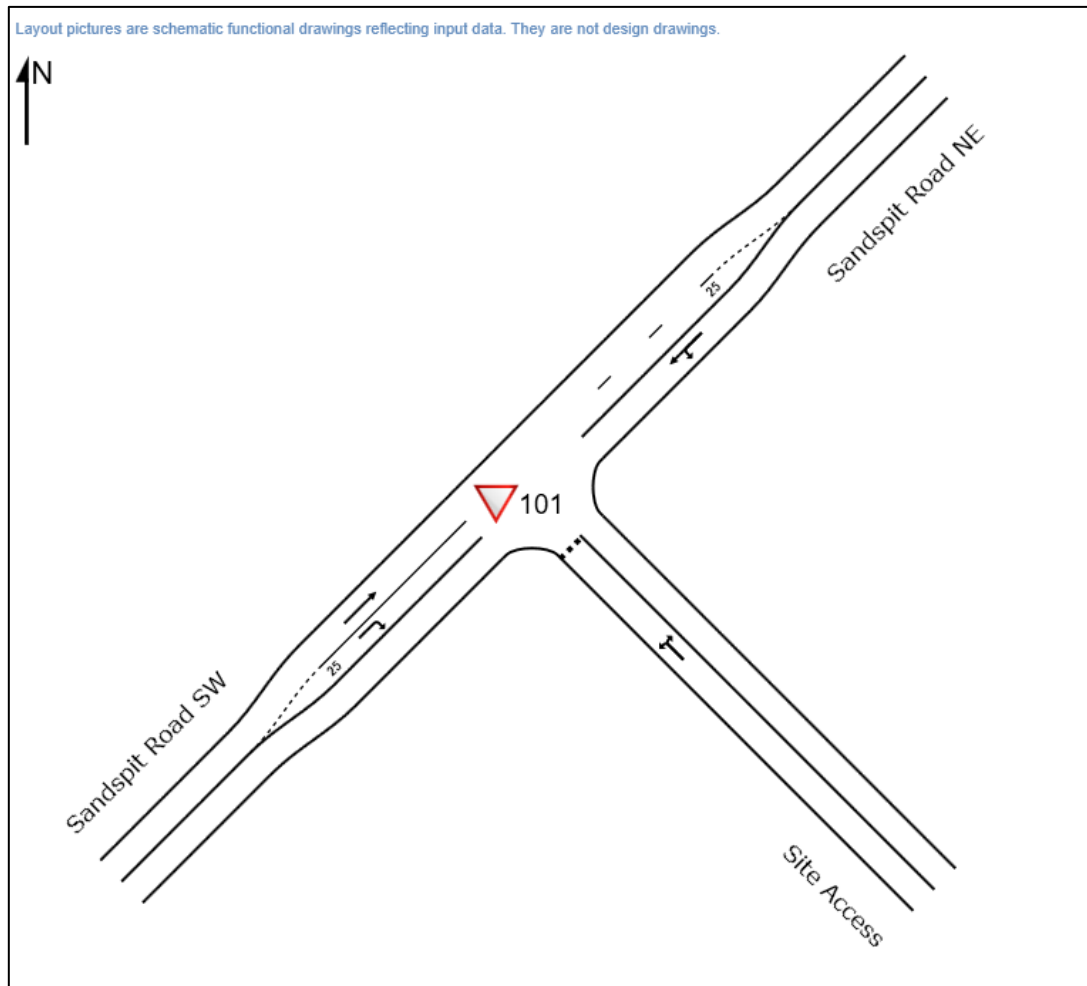
It should be noted that the above scenario is conservative as it is taking a view based on the existing census data for which the mode split is severely limited by the lack of pedestrian/cycle/ PT options at present.



### 6.5.4 Capacity Analysis

In order to understand the potential traffic effects of the development on the adjacent road, SIDRA intersection modelling has been undertaken for the weekday and weekend peak scenarios.

A give-way sign-controlled intersection with the following configuration has been assumed for the purpose of this assessment:



The following points relate to the modelling that has been undertaken:

- The worst surveyed peak for the weekday (PM) and weekend (IP) have been modelled.
- Base scenario background volumes for Sandspit Road have been sourced from the 2021 surveyed data as discussed in section 3.3 of this report.
- Future (2036) background volumes from Sandspit Road have been sourced from Appendix E of the Hill Street intersection improvement single stage business case - November 2019 (2018 forecast) document with the Hill Street intersection upgrade being completed.

It should be noted that these volumes do not account for the completion of the Sandspit Link Road (which would essentially divert traffic from this area). Should the SLR eventuate, the anticipated future volumes (even with expected residential growth in the vicinity) would likely be significantly less than what has been used here. On this basis, the proposed future scenario volumes are considered to be conservative.

A summary of the modelling outputs is provided below:

## Weekday PM

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total	HV ]	[ Total	HV ]				[ Veh.	Dist ]				
		veh/h	veh/h	veh/h	%	v/c	sec		veh	m				km/h
SouthEast: Site Access														
4	L2	13	0	14	0.0	0.015	5.6	LOS A	0.1	0.4	0.40	0.56	0.40	45.7
6	R2	2	0	2	0.0	0.015	10.1	LOS B	0.1	0.4	0.40	0.56	0.40	45.3
Approach		15	0	16	0.0	0.015	6.2	LOS A	0.1	0.4	0.40	0.56	0.40	45.6
NorthEast: Sandspit Road NE														
7	L2	2	0	2	0.0	0.170	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	49.4
8	T1	296	26	312	8.8	0.170	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		298	26	314	8.7	0.170	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.9
SouthWest: Sandspit Road SW														
2	T1	400	25	421	6.3	0.227	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
3	R2	17	0	18	0.0	0.014	5.6	LOS A	0.0	0.3	0.29	0.56	0.29	45.6
Approach		417	25	439	6.0	0.227	0.3	NA	0.0	0.3	0.01	0.02	0.01	49.7
All Vehicles		730	51	768	7.0	0.227	0.3	NA	0.1	0.4	0.02	0.03	0.02	49.7

## Weekday PM Future

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total	HV ]	[ Total	HV ]				[ Veh.	Dist ]				
		veh/h	veh/h	veh/h	%	v/c	sec		veh	m				km/h
SouthEast: Site Access														
4	L2	13	0	14	0.0	0.021	6.3	LOS A	0.1	0.5	0.52	0.64	0.52	44.8
6	R2	2	0	2	0.0	0.021	17.8	LOS C	0.1	0.5	0.52	0.64	0.52	44.4
Approach		15	0	16	0.0	0.021	7.8	LOS A	0.1	0.5	0.52	0.64	0.52	44.7
NorthEast: Sandspit Road NE														
7	L2	2	0	2	0.0	0.248	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	49.4
8	T1	440	26	463	5.9	0.248	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		442	26	465	5.9	0.248	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.9
SouthWest: Sandspit Road SW														
2	T1	660	25	695	3.8	0.368	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
3	R2	17	0	18	0.0	0.016	6.3	LOS A	0.1	0.4	0.39	0.60	0.39	45.2
Approach		677	25	713	3.7	0.368	0.3	NA	0.1	0.4	0.01	0.02	0.01	49.7
All Vehicles		1134	51	1194	4.5	0.368	0.3	NA	0.1	0.5	0.01	0.02	0.01	49.7

## Saturday IP

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total	HV ]	[ Total	HV ]				[ Veh.	Dist ]				
		veh/h	veh/h	veh/h	%	v/c	sec		veh	m				km/h
SouthEast: Site Access														
4	L2	16	0	17	0.0	0.018	5.5	LOS A	0.1	0.5	0.38	0.56	0.38	45.7
6	R2	2	0	2	0.0	0.018	9.7	LOS A	0.1	0.5	0.38	0.56	0.38	45.3
Approach		18	0	19	0.0	0.018	6.0	LOS A	0.1	0.5	0.38	0.56	0.38	45.7
NorthEast: Sandspit Road NE														
7	L2	1	0	1	0.0	0.157	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	49.4
8	T1	281	13	296	4.6	0.157	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		282	13	297	4.6	0.157	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.9
SouthWest: Sandspit Road SW														
2	T1	397	12	418	3.0	0.220	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
3	R2	12	0	13	0.0	0.009	5.5	LOS A	0.0	0.2	0.28	0.55	0.28	45.6
Approach		409	12	431	2.9	0.220	0.2	NA	0.0	0.2	0.01	0.02	0.01	49.8
All Vehicles		709	25	746	3.5	0.220	0.3	NA	0.1	0.5	0.01	0.02	0.01	49.7

## Saturday IP Future

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total	HV ]	[ Total	HV ]				[ Veh.	Dist ]				
		veh/h	veh/h	veh/h	%	v/c	sec		veh	m				km/h
SouthEast: Site Access														
4	L2	16	0	17	0.0	0.025	6.5	LOS A	0.1	0.6	0.53	0.65	0.53	44.8
6	R2	2	0	2	0.0	0.025	17.5	LOS C	0.1	0.6	0.53	0.65	0.53	44.4
Approach		18	0	19	0.0	0.025	7.7	LOS A	0.1	0.6	0.53	0.65	0.53	44.8
NorthEast: Sandspit Road NE														
7	L2	1	0	1	0.0	0.264	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	49.4
8	T1	480	13	505	2.7	0.264	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		481	13	506	2.7	0.264	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.9
SouthWest: Sandspit Road SW														
2	T1	630	12	663	1.9	0.347	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
3	R2	12	0	13	0.0	0.012	6.5	LOS A	0.0	0.3	0.41	0.60	0.41	45.1
Approach		642	12	676	1.9	0.347	0.2	NA	0.0	0.3	0.01	0.01	0.01	49.7
All Vehicles		1141	25	1201	2.2	0.347	0.3	NA	0.1	0.6	0.01	0.02	0.01	49.7

As can be seen in the above modelling outputs, the intersection would likely perform well even with the characteristically higher background volumes that have been modelled for the future scenario, with only minimal increases in delay to right turners from the site.

On this basis, it is considered that a priority-controlled intersection of the site access road and Sandspit Road would likely function without any operational issues.

### 6.5.5 Traffic Impact Assessment

Overall, the anticipated traffic generated by the site is minimal given the limited number of units being proposed.

The traffic generated by the development has been applied to a conservative model of the sign-controlled intersection with Sandspit Road.

This analysis shows minimal operational issues both for present day volumes and future volume projections for Sandpit Road in the vicinity of the subject site.

On this basis, the formation, capacity, and safety of the intersection has been assessed and is found to be acceptable from a traffic engineering perspective.

Overall, the traffic generated by the potential development has been assessed and is not expected to result in any operational issues on the internal roads and intersections, or on the wider road network.

### 6.6 Access & Parking Arrangements

For ease of understanding, the proposed residential development has been divided into three separate zones, and each zone has been assessed separately regarding the access and parking arrangements. Each zone has a variety of different dwelling typologies, parking configurations, and access arrangements. The three zones are highlighted in the following image:

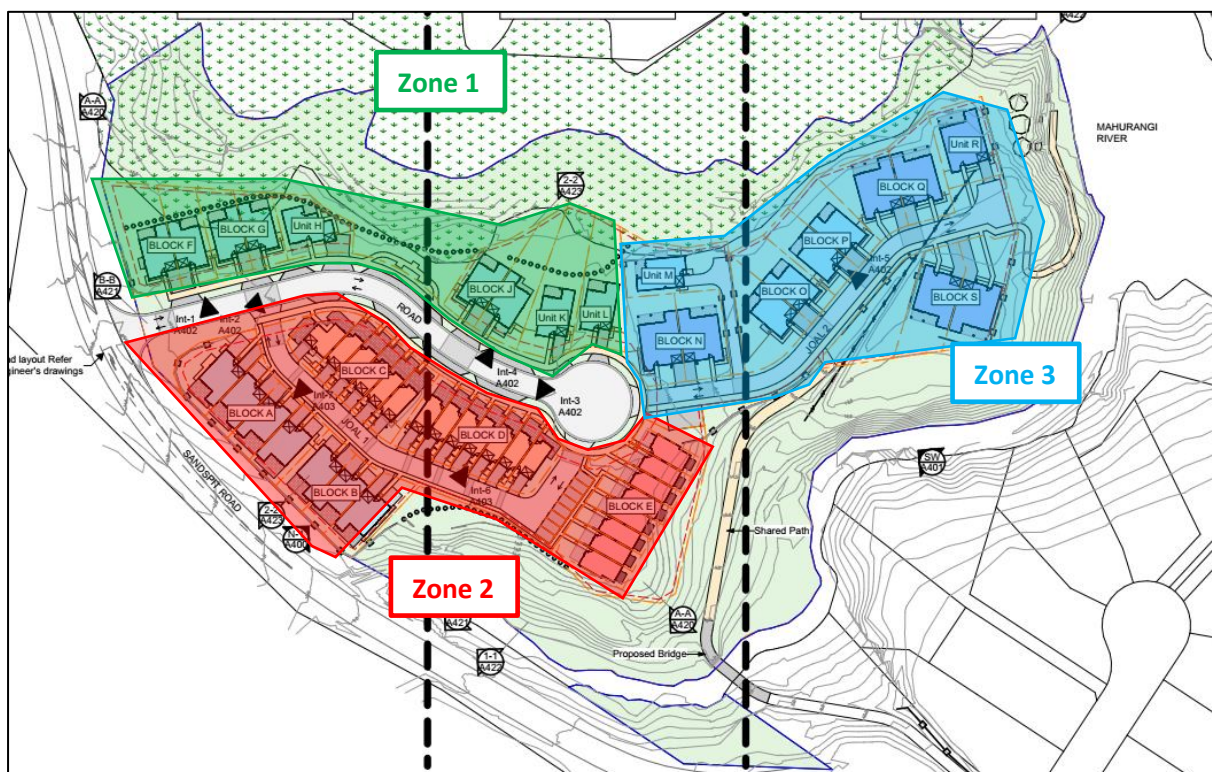


Figure 34: Breakdown of overall site by zone.

The access and parking arrangements for the proposed dwellings located within each zone are detailed in the following sections.



### 6.6.1 Zone 1 (Road 1)

Zone 1 includes the nine dwellings located with direct access to/from the proposed new cul-de-sac road and is shown in the following figure:

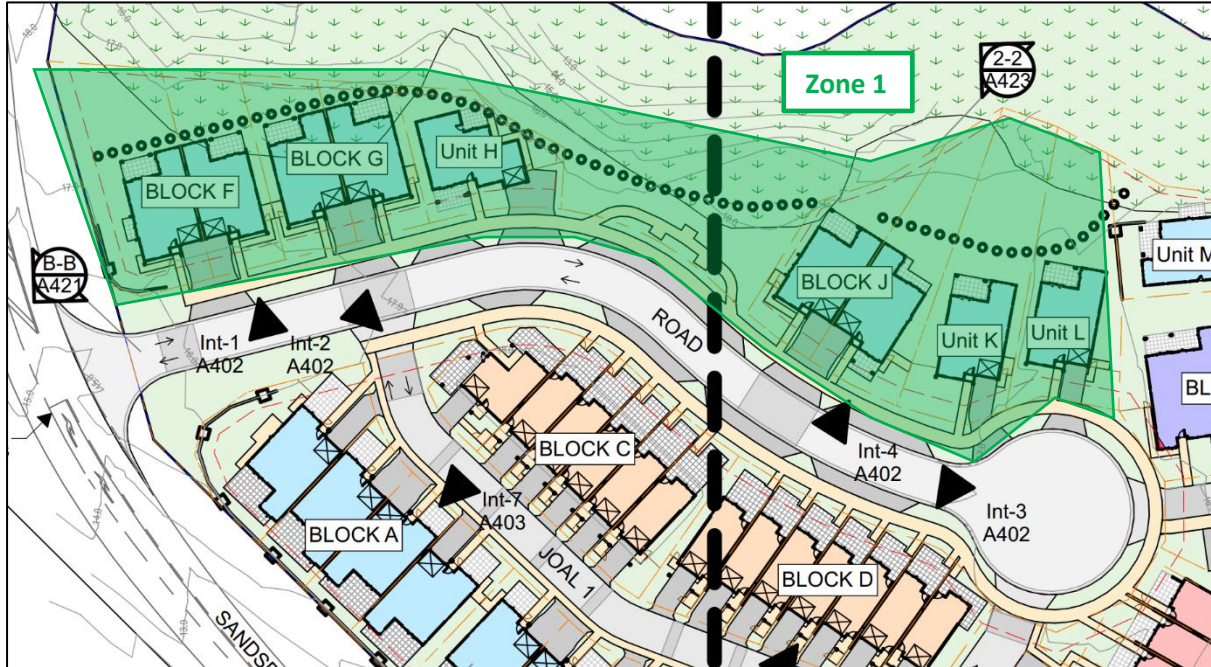


Figure 35: Zone 1 Overview

#### **Parking**

Each of the dwellings located within Zone 1 have a single garage parking space as well as an uncovered parking space. For eight of the nine dwellings the uncovered parking space is located directly in front of the garage, however for unit H, the outdoor parking space is located adjacent to the garage.

Each of the units, with the exception of unit H, have garages with a 2.7 metre wide door, 3.3 metre wide internal width, and 6.4 metre depth. The garage for unit H has a 2.7 metre wide door, 3.3 metre wide internal width, and 5.7 metre depth. All garage parking spaces have a manoeuvring distance exceeding 10 metres.

Additionally, the external parking spaces for all units have a minimum width of 3.0 metres, a minimum available depth of 5.0 metres, and a manoeuvring distance in excess of 10 metres.

The Unitary Plan defines the minimum dimensions for parking spaces under Table E27.6.3.1.1 ‘Minimum car parking space and manoeuvring dimensions’. The relevant requirements have been summarised in the following table.

Table 11: Auckland Unitary Plan requirements for parking dimensions

Car Parking Angle	Width	Depth	Manoeuvring
90 degrees (regular users)	2.7 metres	5.0 metres	5.9 metres

As can be seen from the above table, all the proposed parking spaces located within Zone 1 exceed the minimum required dimensions, are therefore compliant with the Unitary Plan requirements, and are considered to be appropriate for the intended use.

Vehicle tracking curves for the dwellings within Zone 1 are provided within Appendix B attached to this report.

It is understood that visitor/ resident cycle parking would occur within each unit's garage or storage areas and are therefore compliant with the AUP requirements in this regard and considered appropriate for the intended use.

### **Vehicle Access**

Each of the proposed dwellings within Zone 1 typically have a 3.0-metre-wide vehicle crossing/formed access. The exception to this is unit H which has a vehicle crossing width of 6.0 metres.

The units arranged in a duplex configuration have a shared vehicle crossing that combines each of the 3.0-metre-wide crossings to a total width of 6.0 metres.

The dimensional requirements for vehicle crossing and access widths are defined in Table E27.6.4.3.2 of the AUP. These requirements are summarised in the following table.

**Table 12: Auckland Unitary Plan requirements for vehicle crossing and access widths**

Item	Number of parking spaces served	Minimum width of crossing at site boundary	Maximum width of crossing at site boundary	Minimum formed access width
(T149)	Serves 1 or 2 parking spaces	2.75m	3.0m	2.5m provided it is contained within a corridor clear of buildings or parts of a building with a minimum width of 3.0m

As can be seen from the above table, the vehicle crossing and access arrangements for all units, except unit H, comply with the requirements of the Unitary Plan.

Unit H exceeds the maximum crossing width requirement due to the arrangement of the external parking space being located adjacent to the garage. This extra wide crossing is necessary because the external parking space is intended to accommodate a trailer for a boat or caravan parking.

Vehicle tracking curves are provided in Appendix B that demonstrate the manoeuvring required for a 20-foot boat trailer to access the parking space.

The extra width of the vehicle crossing is necessary to accommodate the manoeuvring of the boat trailer.

Given the low number of vehicle movements that will use this access, as well as the low anticipated pedestrian volumes on the new road, it is considered that the wider crossing will have negligible effect on the pedestrian amenity in the area.

On this basis, the technical non-compliance of the vehicle crossing width for unit H is considered to be appropriate and acceptable from a traffic engineering perspective.

The Unitary Plan requirements related to vehicle crossing separation distances are provided in the following table.

**Table 13: Vehicle crossing separation requirements**

Location	Maximum number of vehicle crossings per road frontage of the site	Minimum separation from crossings serving adjacent sites	Minimum separation between crossings serving same site
(T146) All other sites	1 per 25m of frontage or part thereof	2m. Where two crossings on adjacent sites can be combined and where the combined crossings do not exceed a total width of 6m at the property boundary, no minimum separation distance will apply	6m

Given that all dwellings have a single vehicle crossing per lot, and that all of the neighbouring vehicle crossings are separated by more than 2.0 metres or have been amalgamated to 6.0 metres, the vehicle crossing separation distance requirements of the Unitary Plan are satisfied for the dwellings located within Zone 1.

The Vehicle crossing to Lot 01 has been offset sufficiently from the intersection with Sandspit Road by some 17 metres or (11 metres from the site boundary). On this basis, no vehicle access restriction would be triggered by the proposal in relation to the AUP requirements.

### **Pedestrian Access**

Each of the dwellings located within Zone 1 will gain pedestrian access directly via the Council footpath on the cul-de-sac road.

The footpath provided on the new road will be 1.8 metres wide and form an excellent connection to the surrounding area.

Overall, the pedestrian access arrangements are considered to be suitable for the intended use and acceptable from a traffic engineering perspective.

### **Visibility**

It is considered that there will be excellent visibility available along the new cul-de-sac road, from each of the proposed vehicle crossings serving the dwellings that are located within Zone 1. It is understood that there will be no vertical obstructions located within the road reserve that might limit visibility between vehicles exiting their property and vehicles on the road.

It is expected that the 85<sup>th</sup> percentile speed of vehicles using the new road will not exceed 50 km/h at any point along the road and will likely be less than this (anticipated design speed in the order of 30km/h in line with *AT's Roads and Streets Framework - P1/M1*).

As an indication, the NZTA document 'Guidelines for Visibility at Driveways RTS 6' requires 30 metres of sight distance from a low use driveway (under 200 movements per day) onto a Local Road in an area where the vehicle speed is 40 km/h.



The proposed vehicle crossings will all have in excess of 30 metres with most exceeding 40 metres of sight distance.

On this basis, it is considered that all dwellings with vehicle access provided directly onto the new road will have available visibility that exceeds the minimum requirements for the relevant operating speeds.

Overall, the available visibility for each of the proposed dwellings within Zone 1 is considered to be acceptable from a traffic engineering perspective.

### 6.6.2 Zone 2 (CAW 1)

Zone 2 includes the 28 dwellings located with parking and access provided directly to/from the proposed Combined Access Way 1, which is formed like a crescent with two connections to the new cul-de-sac road.

The 28 proposed dwellings within Zone 2 are arranged in several different configurations. There is a group of seven dwellings on the northern side of CAW 1, a group of 13 dwellings located between CAW 1 and the cul-de-sac road, and a group of eight dwellings located at the southern end of CAW 1 near the cul-de-sac head.

For the purposes of clarity, each of these groups within Zone 2 have been summarised in the following table and image:

**Table 14: Breakdown of Zone 2 into subgroups.**

Zone	Units	Number of Units
2.1	A1 – A4, B1 – B3	7 units
2.2	C1 – C6, D1 – D7	13 units
2.3	E1 – E8	8 units

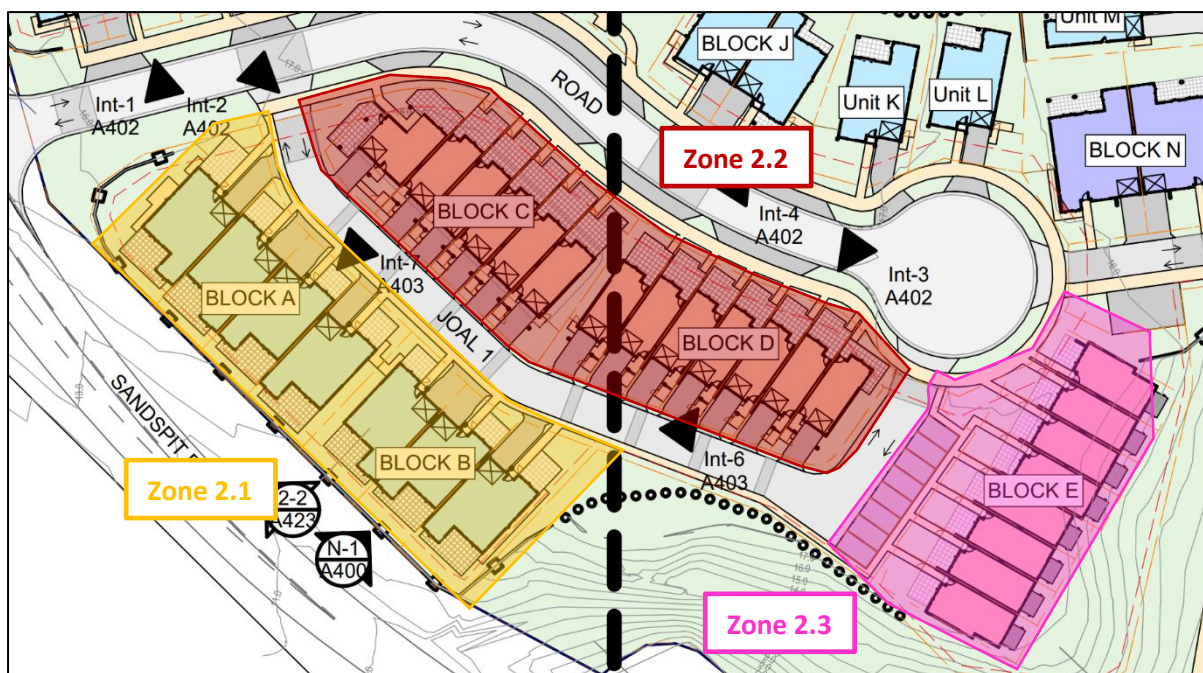


Figure 36: Breakdown of Zone 2 into subgroups.

**Parking**

Each of the dwellings within Zones 2.1 and 2.2 have a single garage parking space as well as an uncovered outdoor parking space. The units within Zone 2.3 have a single outdoor parking space.

For the units within Zones 2.1 and 2.2, the uncovered parking space is located directly in front of the garage.

The minimum dimensions provided for garage parking spaces within each subzone are summarised in the following table:

Table 15: Minimum proposed garage dimensions within Zone 2

Zone	Minimum Door Width	Minimum Internal Width	Minimum Depth	Minimum Manoeuvring
2.1	2.7 metres	3.3 metres	6.4 metres	12.0 metres
2.2	2.7 metres	3.3 metres	5.7 metres	11.5 metres
2.3	N/A	N/A	N/A	N/A

Note, the units within Zone 2.3 do not have a garage, hence why there are not dimensions provided in the table above.

The minimum dimensions provided for outdoor parking spaces within each subzone are summarised in the following table:

**Table 16: Minimum proposed outdoor parking space dimensions within Zone 2**

Zone	Minimum Width	Minimum Depth	Minimum Manoeuvring
2.1	3.0 metres	5.0 metres	7.0 metres
2.2	3.0 metres	5.0 metres	7.0 metres
2.3	2.7 metres	5.0 metres	6.0 metres

The Unitary Plan defines the minimum dimensions for parking spaces under Table E27.6.3.1.1 'Minimum car parking space and manoeuvring dimensions'. The relevant requirements have been summarised in the following table.

**Table 17: Auckland Unitary Plan minimum requirements for parking dimensions**

Car Parking Angle	Width	Depth	Manoeuvring
90 degrees (regular users)	2.7 metres	5.0 metres	5.9 metres

As can be seen from the above tables, all of the proposed parking spaces located within Zone 2 exceed the minimum required dimensions, are therefore compliant with the Unitary Plan requirements, and are considered to be suitable for the intended use.

Vehicle tracking curves for indicative dwellings within Zone 2 are provided within Appendix B attached to this report.

It is understood that visitor/ resident cycle parking would occur within each unit's garage or storage areas and are therefore compliant with the AUP requirements in this regard and considered appropriate for the intended use.

### **Vehicle Access**

Vehicle access to the parking spaces for each of the dwellings located within Zone 2 will be provided via CAW 1, which is a two-way private lane and has a crescent style configuration with two formed connections to the new cul-de-sac road.

The first connection to the new cul-de-sac road is located approximately 35 metres south of the intersection with Sandspit Road. The second connection is located on the western side of the cul-de-sac head.

Both access locations are 6.0 metres wide at the boundary and flare out to the kerb.

CAW 1 is located within a boundary-to-boundary corridor of 8.0 metres, which includes a 6.0-metre-wide formed vehicle access as well as a 1.0 metre wide pedestrian walk strip.

The dimensional requirements for vehicle crossing and access widths are defined in Table E27.6.4.3.2 of the AUP. These requirements are summarised in the following table.

**Table 18: Auckland Unitary Plan requirements for vehicle crossing and access widths**

Item	Number of parking spaces served	Minimum width of crossing at site boundary	Maximum width of crossing at site boundary	Minimum formed access width
(T149)	Serves 10 or more parking spaces	5.5 metres (two-way)	6.0 metres (two-way)	5.5m (providing for two-way movements). The formed width is permitted to be narrowed to 2.75m if there are clear sight lines along the entire access and passing bays at 50m intervals are provided. 1.0m pedestrian access for rear sites which may be located within the formed driveway.

As can be seen from the above table, the proposed vehicle crossing connections between CAW 1 and the cul-de-sac road comply with the requirements of the Unitary Plan. Additionally, the width of CAW 1 complies with the minimum requirements for formed accesses.

The Unitary Plan requirements related to vehicle crossing separation distances are provided in the table below.

**Table 19: Vehicle crossing separation requirements**

Location	Maximum number of vehicle crossings per road frontage of the site	Minimum separation from crossings serving adjacent sites	Minimum separation between crossings serving same site
(T146) All other sites	1 per 25m of frontage or part thereof	2m. Where two crossings on adjacent sites can be combined and where the combined crossings do not exceed a total width of 6m at the property boundary, no minimum separation distance will apply	6m

The proposed vehicle crossing connections from CAW 1 to the cul-de-sac road exceed the minimum separation requirements and satisfy the requirements related to the number of crossings per road frontage.

On this basis, the proposed vehicle access arrangements are considered to be suitable for the intended use and acceptable from a traffic engineering perspective.

### **Pedestrian Access**

Each of the dwellings located within Zone 2 have pedestrian access provided via the 1.0-metre-wide walk strip located within the vehicle access. This pedestrian walk strip connects with the footpath on the cul-de-sac road and provides an excellent connection to the surrounding area.



This arrangement where vehicles and pedestrians share the access is common for residential developments of this type and is not considered to be a cause for concern from a traffic engineering perspective.

Overall, the pedestrian access arrangements are considered to be suitable for the intended use and acceptable from a traffic engineering perspective.

### **Visibility**

It is considered that there is excellent visibility available along the new cul-de-sac road, from the location of the two vehicle crossing connections to CAW 1.

Given that one connection is located approximately 40 metres from the intersection with Sandspit Road, and the second connection is located within the cul-de-sac head, it is considered that vehicle speeds in the vicinity of these connections will be less than 40 km/h.

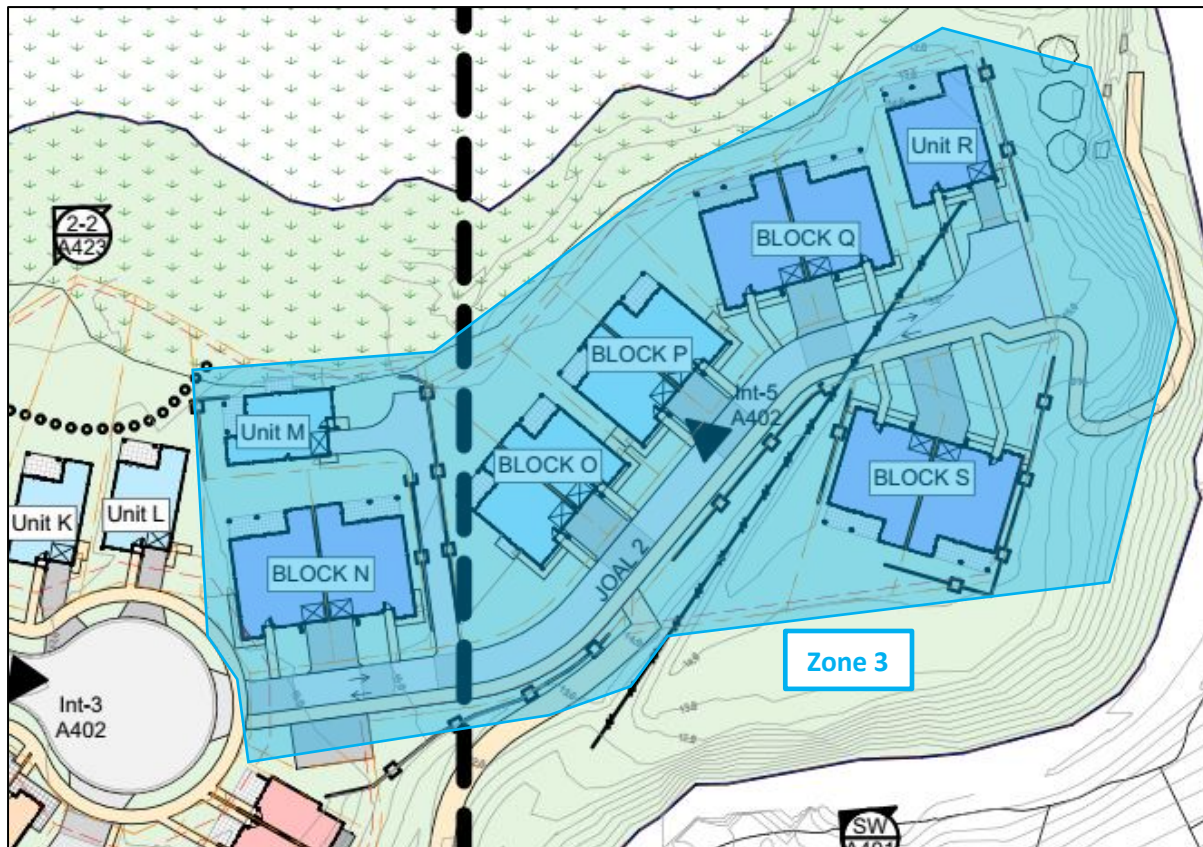
However, if we assume a vehicle speed up to 40 km/h, the NZTA document 'Guidelines for Visibility at Driveways RTS 6' requires 30 metres of sight distance from a high-volume driveway (over 200 movements per day) onto a Local Road.

The available visibility from each of the connections to CAW 1 exceeds 30 metres at both locations. On this basis, the visibility available from the location of the vehicle crossings serving CAW 1 exceed the guideline requirements.

Overall, the available visibility from the location of the proposed vehicle crossings is considered to be acceptable from a traffic engineering perspective.

### **6.6.3 Zone 3 (CAW 2)**

Zone 3 includes the 12 dwellings located with parking and access provided directly to/from the proposed Combined Access Way 2 (CAW 2). CAW 2 is located towards the south of the overall site, is served by a vehicle crossing connection at the southern end of the proposed cul-de-sac and is shown in the following figure:



Of the 12 proposed dwellings within Zone 3, 10 are located on the eastern side of CAW 2 and the remaining two are located on the western side.

The majority of the dwellings are arranged in a duplex style configuration, with the exception of units 12 and 19 (Units M and R) that are standalone dwellings.

**Parking**

Each of the dwellings within Zone 3 have a single garage parking space as well as an uncovered outdoor parking space located directly in front of the garage. Unit 12, being located at the rear of units 10 and 11, allows for an on-site turning area so that vehicles do not have to reverse to/from CAW 2.

The minimum dimensions provided for the proposed parking spaces are summarised in the following table:

*Table 20: Minimum proposed garage dimensions within Zone 3*

Space	Minimum Door Width	Minimum Internal Width	Minimum Depth	Minimum Manoeuvring
Garage	2.7 metres	3.3 metres	6.4 metres	12.0 metres
Outdoor	3.0 metres	N/A	5.0 metres	7.0 metres

The Unitary Plan defines the minimum dimensions for parking spaces under Table E27.6.3.1.1 'Minimum car parking space and manoeuvring dimensions'. The relevant requirements have been summarised in the following table:

**Table 21: Auckland Unitary Plan minimum requirements for parking dimensions**

Car Parking Angle	Width	Depth	Manoeuvring
90 degrees (regular users)	2.7 metres	5.0 metres	5.9 metres

As can be seen from the above tables, all of the proposed parking spaces located within Zone 3 exceed the minimum required dimensions, are therefore compliant with the Unitary Plan requirements, and are considered to be suitable for the intended use.

Vehicle tracking curves for the dwellings within Zone 3 are provided within Appendix B attached to this report.

It is understood that visitor/ resident cycle parking would occur within each unit's garage or storage areas and are therefore compliant with the AUP requirements in this regard and considered appropriate for the intended use.

### **Vehicle Access**

Vehicle access to the parking spaces for each of the dwellings located within Zone 3 will be provided via CAW 2, which is a two-way 'no exit' private lane extending from the cul-de-sac head to the southern end of the site.

CAW 2 has a boundary-to-boundary width of 8.0 metres and includes a 6.0-metre-wide formed carriageway which features a 1.8-metre-wide pedestrian walk strip running the full length of the western side of the access. Approximately midway along the access there is a new connection to a 3.0-metre-wide shared path.

The shared path will create a link between the proposed development and the existing pedestrian/cycle infrastructure in the area, forming a connection with the Warkworth Township (see section 6.4 for further details of this).

The vehicle crossing connection to the cul-de-sac road is 6.0 metres wide at the boundary and flares out to the kerb.

The dimensional requirements for vehicle crossing and access widths are defined in Table E27.6.4.3.2 of the AUP. These requirements are summarised in the following table.

**Table 22: Auckland Unitary Plan requirements for vehicle crossing and access widths**

Item	Number of parking spaces served	Minimum width of crossing at site boundary	Maximum width of crossing at site boundary	Minimum formed access width
(T149)	Serves 10 or more parking spaces	5.5 metres (two-way)	6.0 metres (two-way)	5.5m (providing for two-way movements). The formed width is permitted to be narrowed to 2.75m if there are clear sight lines along

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the entire access and passing bays at 50m intervals are provided.  
1.0m pedestrian access for rear sites which may be located within the formed driveway.

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As can be seen from the above table, the proposed vehicle crossing connection between CAW 2 and the cul-de-sac road comply with the requirements of the Unitary Plan. Additionally, the width of CAW 2 complies with the minimum requirements for formed accesses.

The Unitary Plan requirements related to vehicle crossing separation distances are provided in the table below.



**Table 23: Vehicle crossing separation requirements**

Location	Maximum number of vehicle crossings per road frontage of the site	Minimum separation from crossings serving adjacent sites	Minimum separation between crossings serving same site
(T146) All other sites	1 per 25m of frontage or part thereof	2m. Where two crossings on adjacent sites can be combined and where the combined crossings do not exceed a total width of 6m at the property boundary, no minimum separation distance will apply	6m

The proposed vehicle crossing connection from CAW 2 to the cul-de-sac road far exceeds the minimum separation requirements and satisfies the requirements related to the number of crossings per road frontage.

On this basis, the proposed vehicle access arrangements are considered to be suitable for the intended use and acceptable from a traffic engineering perspective.

### **Pedestrian Access**

Each of the dwellings located within Zone 3 have pedestrian access provided via the 1.8-metre-wide walk strip located within the formed vehicle access. This pedestrian walk strip forms connections with the footpath on the cul-de-sac road as well as the proposed shared path, and provides an excellent connection to the surrounding area. The proposal will also feature shared space treatments including pavement selection and banding to create a pedestrian orientated space, which should achieve safe speed outcomes along this lane. This is considered appropriate given that the lane will provide public pedestrian access to the historic Kilns Site.

This arrangement where vehicles and pedestrians share the access is common for residential developments of this type and is not considered to be a cause for concern from a traffic engineering perspective.

Overall, the pedestrian access arrangements are considered to be suitable for the intended use and acceptable from a traffic engineering perspective.

### **Visibility**

It is considered that there is excellent visibility available along the new cul-de-sac road, from the location of the vehicle crossing connection to CAW 2.

It is considered that excellent visibility is available along the new cul-de-sac road from the location of the proposed vehicle crossing serving CAW 2. Given that this vehicle crossing is located within the cul-de-sac head and at the end of the road, drivers will have a perfect view of all other road users.

Based on the plans provided, the available visibility is expected to be in excess of 80 metres.

The NZTA document 'Guidelines for Visibility at Driveways RTS 6' requires 30.0 metres of sight distance from a low volume driveway (under 200 movements per day) onto a Local Road in an area where the 85<sup>th</sup> percentile vehicle speed is 40 km/h. On this basis, the visibility from the location of the proposed vehicle crossing serving CAW 2 exceeds the guideline requirements.

On this basis, the available visibility from the proposed vehicle crossing location is considered to be acceptable from a traffic engineering perspective.

#### 6.6.4 Gradients

The AUP contains gradient related requirements pertaining to vehicle accesses, parking spaces, and manoeuvring areas. The gradients of the two accessways have been assessed together below.

These relevant gradient related requirements are repeated as follows:

- Vehicle accesses serving residential activities must have a gradient no steeper than 1:5.
- Transition sections must be provided where the access has a change in gradient exceeding 1:8 at a crest or exceeding 1:6.7 at a sag.
- A 4.0-metre-long platform with a gradient no steeper than 1:20 is to be provided at the boundary.
- All parking spaces must have a gradient no steeper than 1:20.
- All manoeuvring areas must have a gradient no steeper than 1:8.

A long section of CAW 1 and CAW 2 has been shown in Sheet 311 and 312 from the Civil Engineering Plans prepared by Aireys.

As can be seen in the long section diagrams, the gradients along each access do not exceed 1:5 and no transition sections are required. Additionally, the requirement to provide a 4.0-metre-long platform with a gradient no steeper than 1:20 is achieved at the vehicle crossings for both accessways.

Furthermore, all manoeuvring areas have gradients at or less than 1:8 and it is understood that all parking spaces will be no steeper than 1:20.

On this basis, the proposed accessways comply with the gradient related requirements of the AUP and are considered to be suitable for the intended use, and acceptable from a traffic engineering perspective.

## 6.7 Fire Appliance Access, Loading & Servicing

The Unitary Plan does not require that loading spaces be provided for residential activities that have a GFA of less than 5000m<sup>2</sup>. As there are no apartments proposed as a part of the subject development, no one building would trigger this requirement.

Loading and unloading by medium sized trucks can occur within the access lanes. These activities are expected to be very infrequent and potentially confined to the delivery of furniture. As CAW 1 is shaped as a crescent, vehicles will simply circulate back to Road 1 from either direction. CAW 2 however is a dead end, and as such, a suitable turning head has been provided to accommodate an 8-metre-long Medium Rigid Truck. This tracking is shown in Appendix B of this report.

Other smaller deliveries, such as those by courier van will also be infrequent and will be able to use the shared access momentarily.

For the residents on Road 1 and CAW1, it is understood that rubbish collection will be undertaken by the kerb-side collection with rubbish/recycling being stored within enclosures adjacent to each unit. It is understood that the proposal will result in a mix of private and Council collections for rubbish and recycling.

For units on CAW2 however, a rubbish/recycling storage pad has been provided at the top of the driveway close to the cul-de-sac. The intention being that a private collection would be employed, with the rubbish truck circulating the cul-de-sac and stopping at the parking pad. The bins/bags would then be transferred to the stopped truck. The ability for a 10.3m rigid truck to undertake this manoeuvre in a safe and efficient manner has been checked using vehicle tracking software, the outputs of which are presented in Appendix B of this report.

The Building Code requires residential developments to provide fire appliance access to a hard-standing area within 75 metres of any point in any unit. As both accessways and Road 1 would accommodate hardstanding, this requirement is expected to be easily met by the proposed development.

The fire access requirements of the Building Code are therefore satisfied from a traffic engineering perspective.

In summary, the proposed loading and servicing arrangements for the site are considered to be acceptable for the intended use and are expected to operate without issue.

## 6.8 Construction Traffic Management Plan

It is standard practice that the applicant is to submit a Construction Traffic Management Plan (CTMP) so that any potential adverse effects of construction traffic will be mitigated. The CTMP is to be approved by Auckland Council and this requirement should be included in the conditions of consent. In this case the CTMP will likely be developed by the contractors as they will have the best information with regards to the staging of the development.

The CTMP needs to address how deliveries would be made to the site, the location of loading areas (such as any temporary use of the on-street traffic lane), how heavy or over dimension vehicles would be brought to and removed from the site, etc.

The CTMP should include details (among other general issues listed in the standard CTMP list) of hours of operation, location of parking for workers or sub-contractors who need to have their vehicles on or close to the site, when vehicles would be able to use the roadway to load or unload (if at all), wheel washing, maintenance of pedestrian access, adequate signage and ensuring that access to neighbouring properties is not compromised.

Overall, the provision of an appropriate CTMP will ensure that details of the construction traffic are carefully considered, and the effects mitigated appropriately.

Given the good site access arrangements available for construction traffic and the good connectivity to the surrounding arterial network, there is not expected to be any issues in this regard.



## 7 CONCLUSIONS

The subject site is currently subject to a private plan change which would enable a Residential Mixed Housing Urban zoning.

The subdivision and development of the site is likely to be staged, with five stages proposed, each with potential sub staging options.

The proposal involves the subdivision and development of approximately 2.9 hectares of land situated at 34 and 36 Sandspit Road in Warkworth (Subject Site) into 49 lots/units.

Each unit will have two parking spaces (one garage unit and one external carpark), except for units in Block E which will have one external carpark allocated to each unit. Access to these spaces and compliance of these spaces against the AUP requirements has been considered and found to be compliant and acceptable from a traffic engineering perspective.

Formal on-street parking spaces have been provided on Road 1, which have been considered against the appropriate AUP/TDM standards and are considered to be suitable for resident/visitor use.

The parking and access arrangements for each of the zones are considered to be suitable for the intended use.

The proposed cycle facilities meet the Unitary Plan requirements and are considered to be suitable for the development.

The proposed accessways have been considered and found to be appropriate for the intended use.

The proposed priority-controlled intersection with Sandspit Road has been assessed in regard to operational, safety and capacity considerations and found to be appropriate for the intended use.

The development is considered to have excellent pedestrian/cycling amenity, and the proposed shared path connection to the public footpath network has been assessed and found to be acceptable from a traffic engineering perspective.

The servicing, loading and fire appliance access arrangements of the proposal have been assessed and are considered acceptable from a traffic engineering perspective.

The traffic generation of the development is not expected to result in any operational issues occurring within the site or on Sandspit Road via the proposed priority-controlled T-intersection and is found to be minimal.

In summary, the proposed residential development is considered to be acceptable from a traffic engineering perspective.

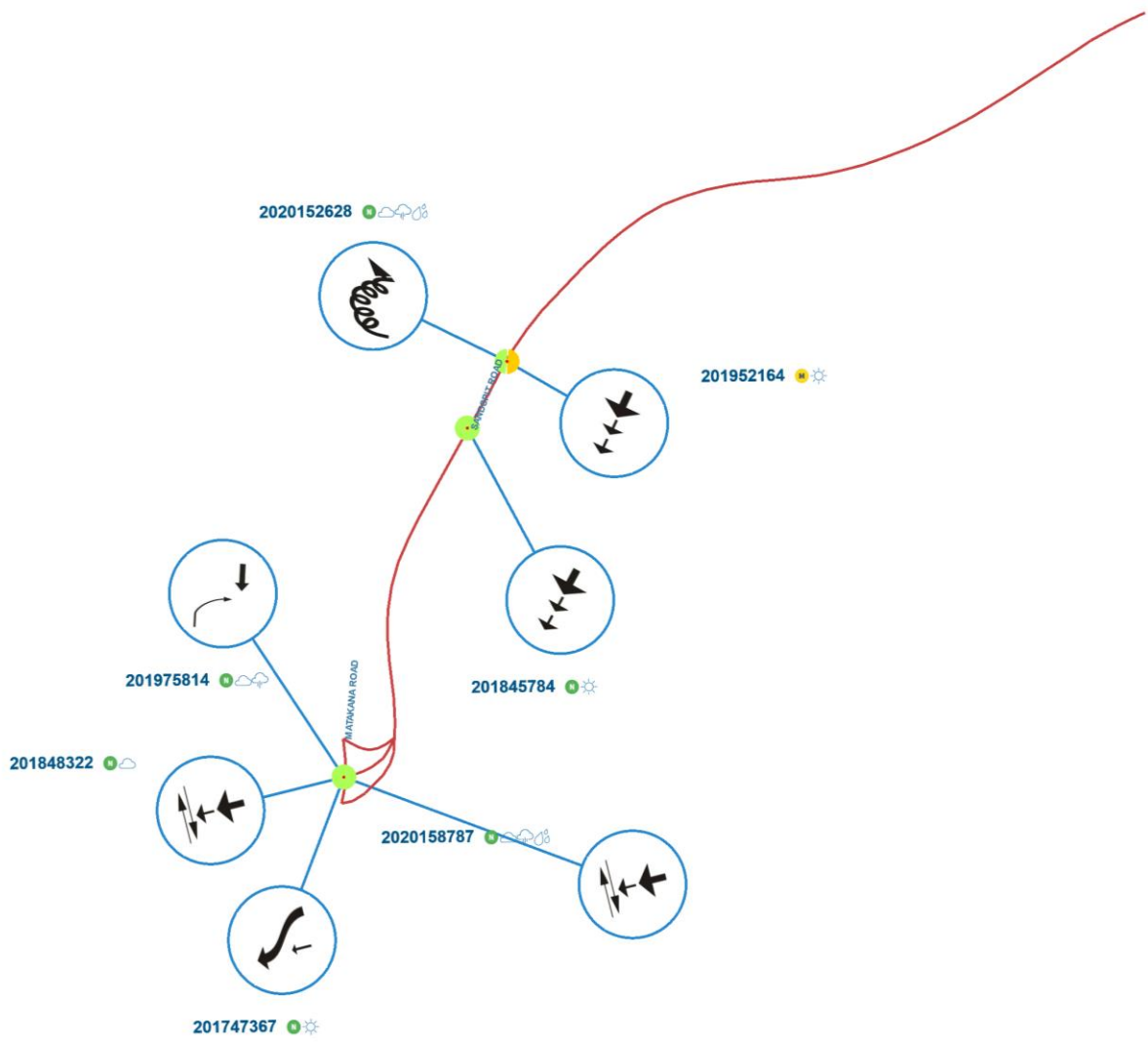
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Auckland



# Appendix A: Crash Analysis

Site/Case/Incident	Crash road	Site road	Failure mode/description	Distance from site	Direction	Reference station	Route position	Easting	Northing	Longitude	Latitude	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Caution count	Caution count	Caution count	Shield cost (\$m)
1748977-5970814	MATAMORA ROAD	SANDSPIT ROAD			I	1748977	5970815	174.667355	-38.360778	202.075254	-38.360778	202.075254	30/07/2018	Tue	13:45	Van turning right in by oncoming truck, SUV on MATAMORA ROAD	Van, alcohol test below limit, failed to give way/turning to non-turning traffic, TRUCK, alcohol test above limit or test refused	Dry	Overcast	Light rain	T Junction	Give way	0	0	0	0.02
1748977-5970814	SANDSPIT ROAD	MATAMORA ROAD		100m	I	1748978	5970815	174.667355	-38.360832	202.074392	-38.360832	202.074392	17/09/2017	Thu	08:30	Car/Wagon 1, SUV on SANDSPIT ROAD, changing lanes to left hit Car/Wagon 2	CAR/WAGON1, other wrong lane or position	Dry	Bright sun	Fine rain	T Junction	Give way	0	0	0	0.02
1748977-5970814	SANDSPIT ROAD	MATAMORA ROAD			I	1748988	5970807	174.661363	-38.362643	202.075277	-38.362643	202.075277	17/07/2020	Fri	13:37	Car/Wagon 1, WB on Sandspit Rd hit rear end of Car/Wagon 2, stop/stop for cross traffic	CAR/WAGON2, alcohol test below limit, CAR/WAGON1, alcohol test (depression, hysterical)	Wet	Overcast	Light rain	T Junction	Give way	0	0	0	0.02
1748977-5970814	SANDSPIT ROAD	MATAMORA ROAD			I	1748978	5970815	174.667355	-38.362632	202.074822	-38.362632	202.074822	18/07/2018	Wed	13:39	Car/Wagon 1, WB on SANDSPIT ROAD, WAGON WITH AU/C/LAND hit rear end of SUV, 2 stop/stop for cross traffic	CAR/WAGON1, alcohol test below limit, wrong pedal/foot slipped SUV2, alcohol test below limit	Dry	Overcast	Fine	T Junction	Give way	0	0	0	0.02
1749034-5970936	SANDSPIT ROAD	MATAMORA ROAD		100m	N	1749003	5970901	174.661514	-38.365504	202.081726	-38.365504	202.081726	25/07/2018	Thu	15:00	Van 1, SUV on Sandspit rd hit rear end of Car/Wagon 2, stop/stop for queue	CAR/WAGON2, alcohol test below limit, VAN1, following too closely	Dry	Bright sun	Fine	NIJ (Default)	Unknown	0	0	0	0.04
1749002-5970883	SANDSPIT RD (SANDSPIT)	WITHERS LANE		247m	W	1749006	5971028	174.662641	-38.364249	202.075256	-38.364249	202.075256	25/07/2018	Mon	16:47	Truck 1, WB on SANDSPIT ROAD, WAGON WITH AU/C/LAND hit rear end of SUV 2, stop/stop for queue	CAR/WAGON1, alcohol test below limit, TRUCK1, alcohol test below limit, failed to notice car slowing, stopping/stationary, speed exceeding, corrective	Dry	Bright sun	Fine	NIJ (Default)	Unknown	0	0	3	0.11
1749002-5970883	SANDSPIT ROAD	WITHERS LANE		239m	W	1749015	5971042	174.662741	-38.364207	202.075228	-38.364207	202.075228	24/07/2020	Sun	09:05	Car/Wagon 1, NB on SANDSPIT ROAD, lost control turning right, went off road to left, Car/Wagon 1 hit embankment (driver over)	CAR/WAGON1, alcohol test below limit, lost control when turning, new driver/under instruction	Wet	Overcast	Light rain	NIJ (Default)	NIJ	0	0	0	0





## Appendix B: Vehicle Tracking

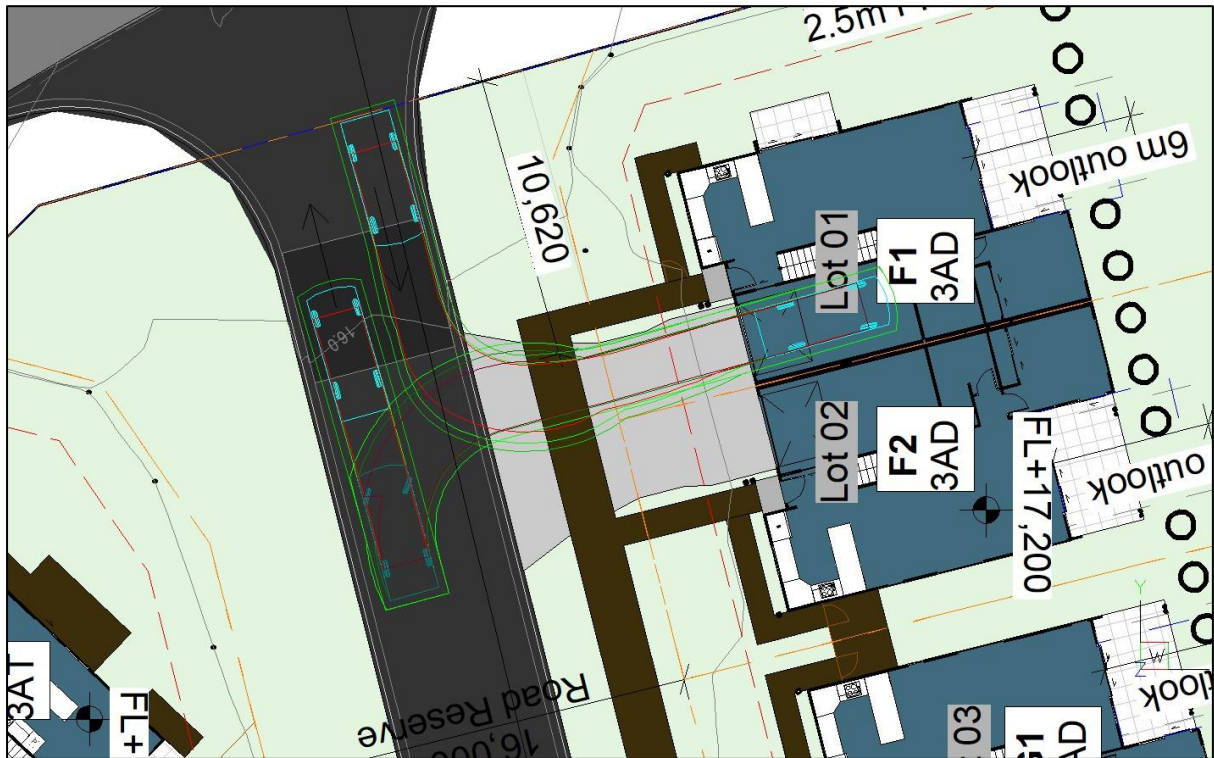


Figure 37: Lot 01 - B85 Vehicle Tracking

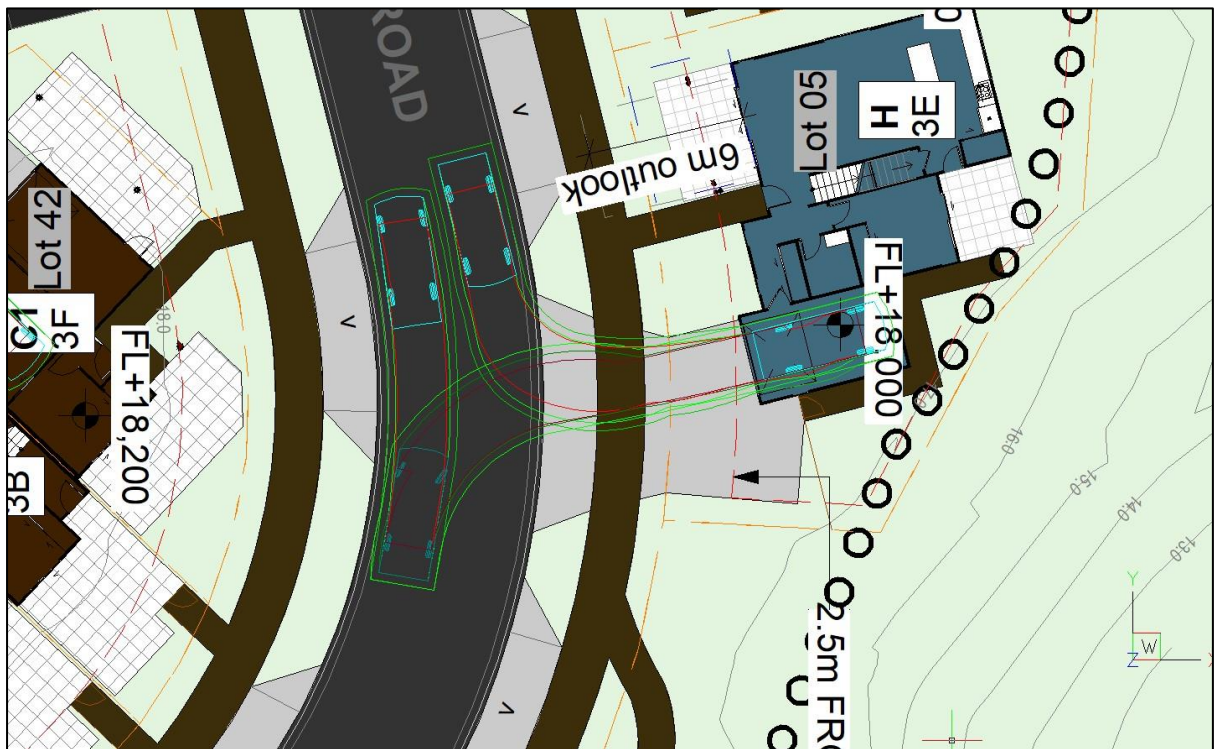


Figure 38: Lot 05 - B85 Vehicle Tracking



Figure 39: Lot 05 – B85 Vehicle with Trailer Tracking

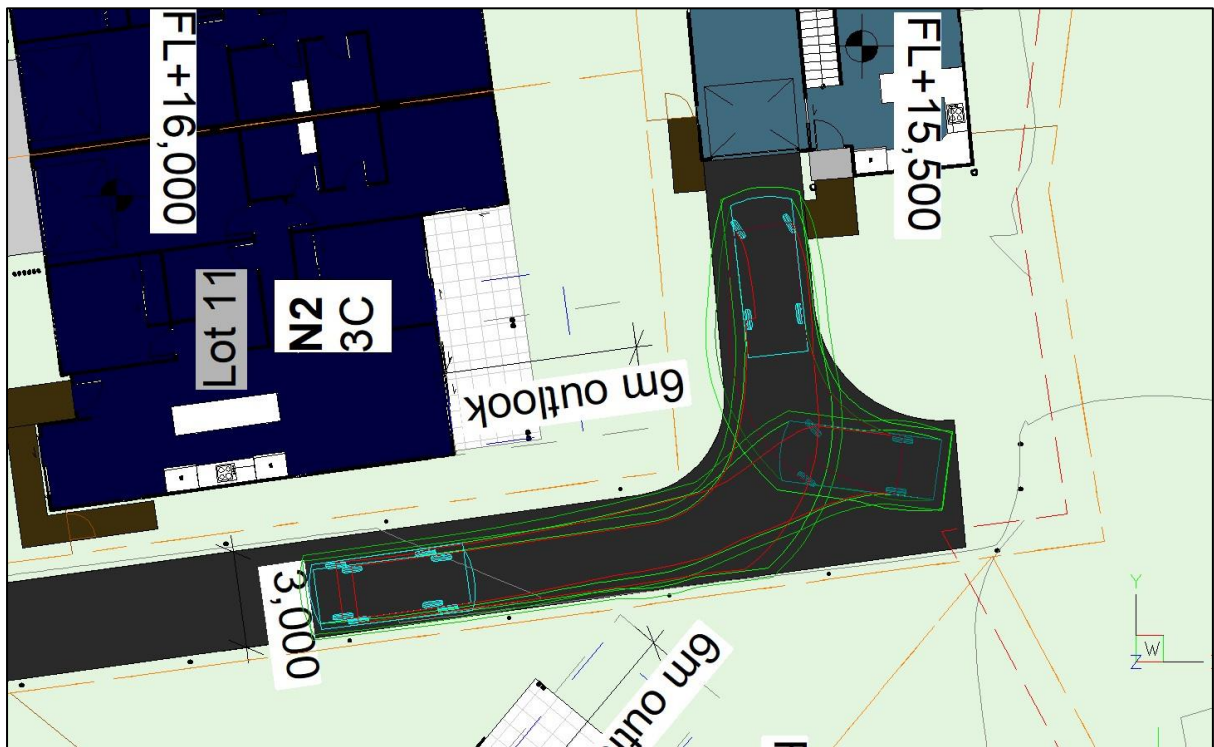


Figure 40: Lot 12 - B85 Vehicle Tracking





Figure 41: Lot 13 - B85 Vehicle Tracking

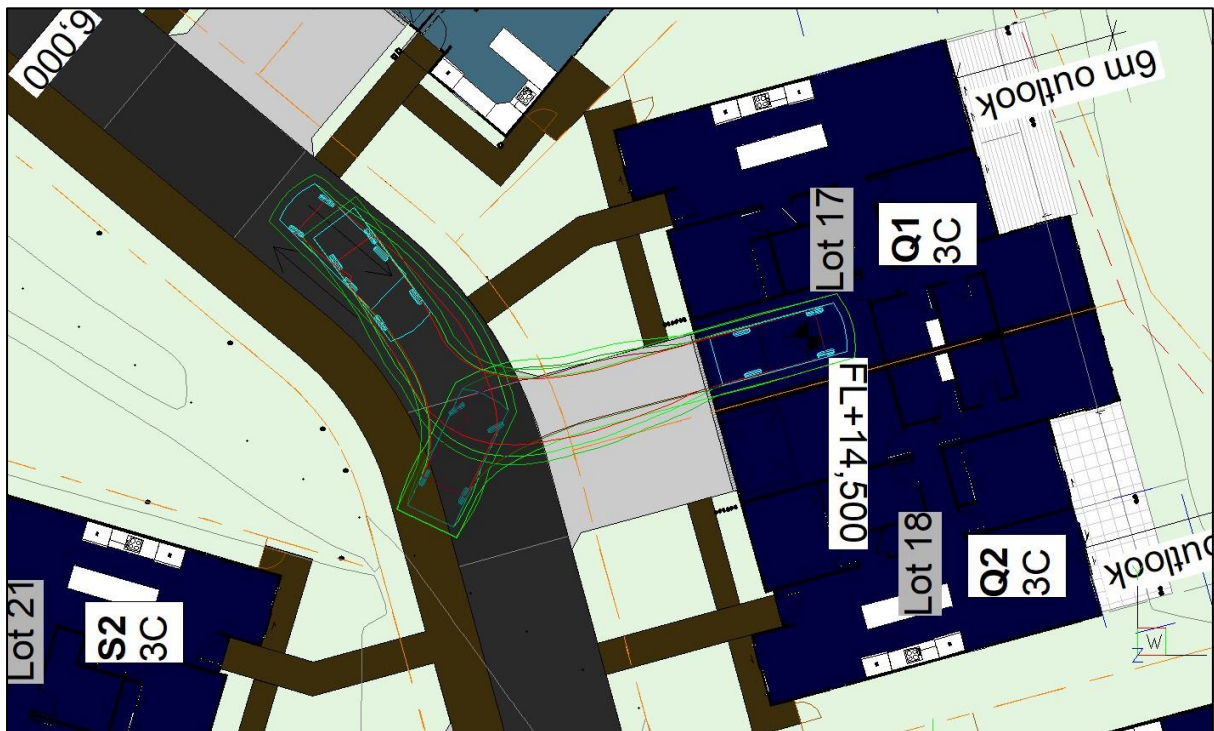


Figure 42: Lot 17 - B85 Vehicle Tracking

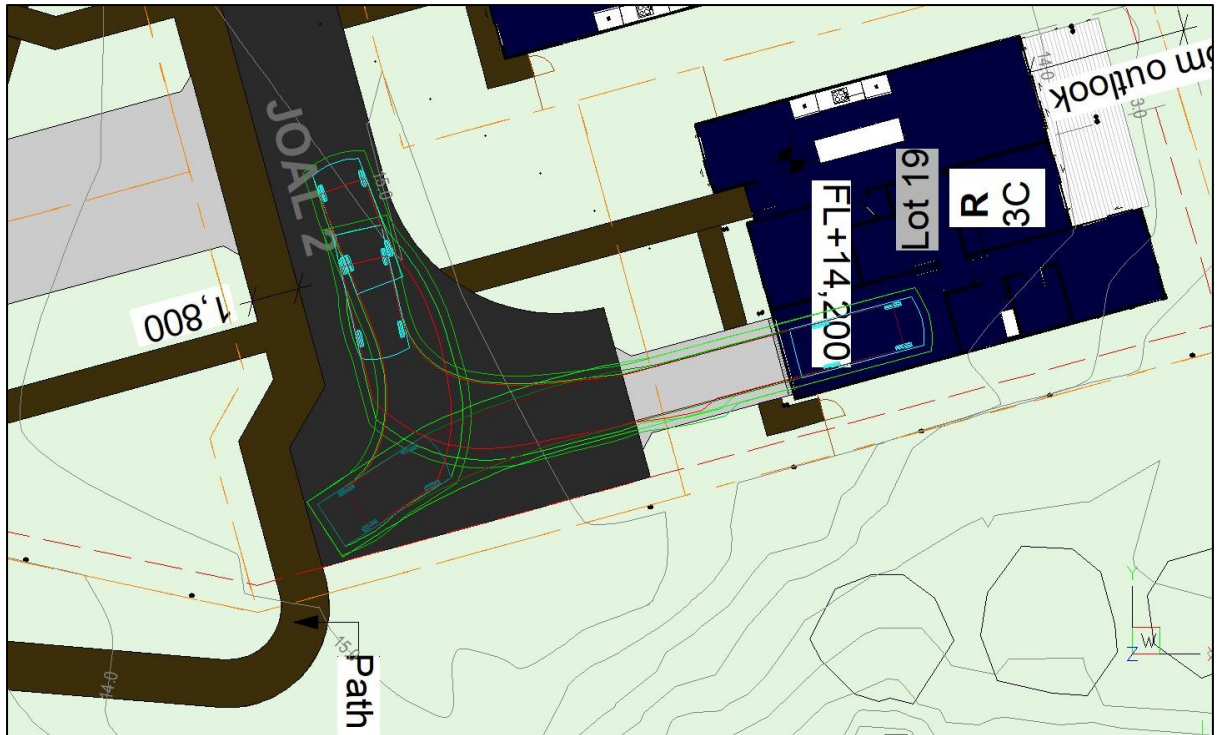


Figure 43: Lot 19 - B85 Vehicle Tracking

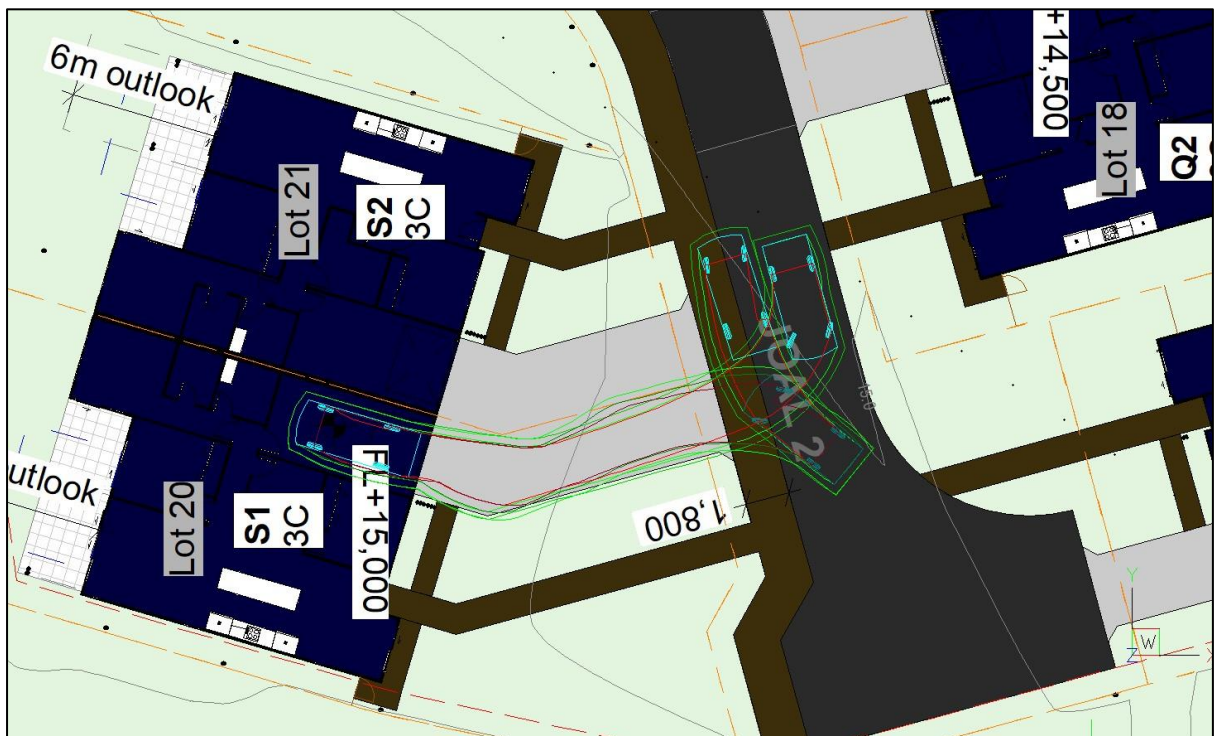


Figure 44: Lot 20 - B85 Vehicle Tracking



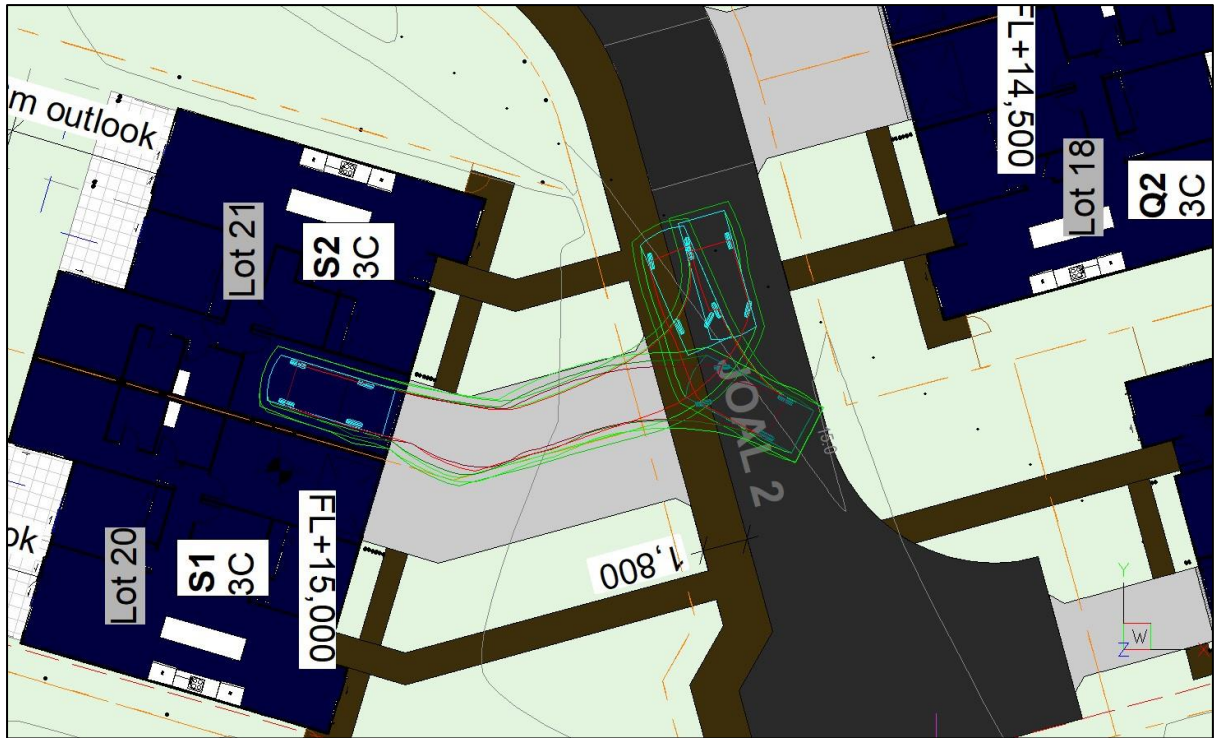


Figure 45: Lot 21 - B85 Vehicle Tracking

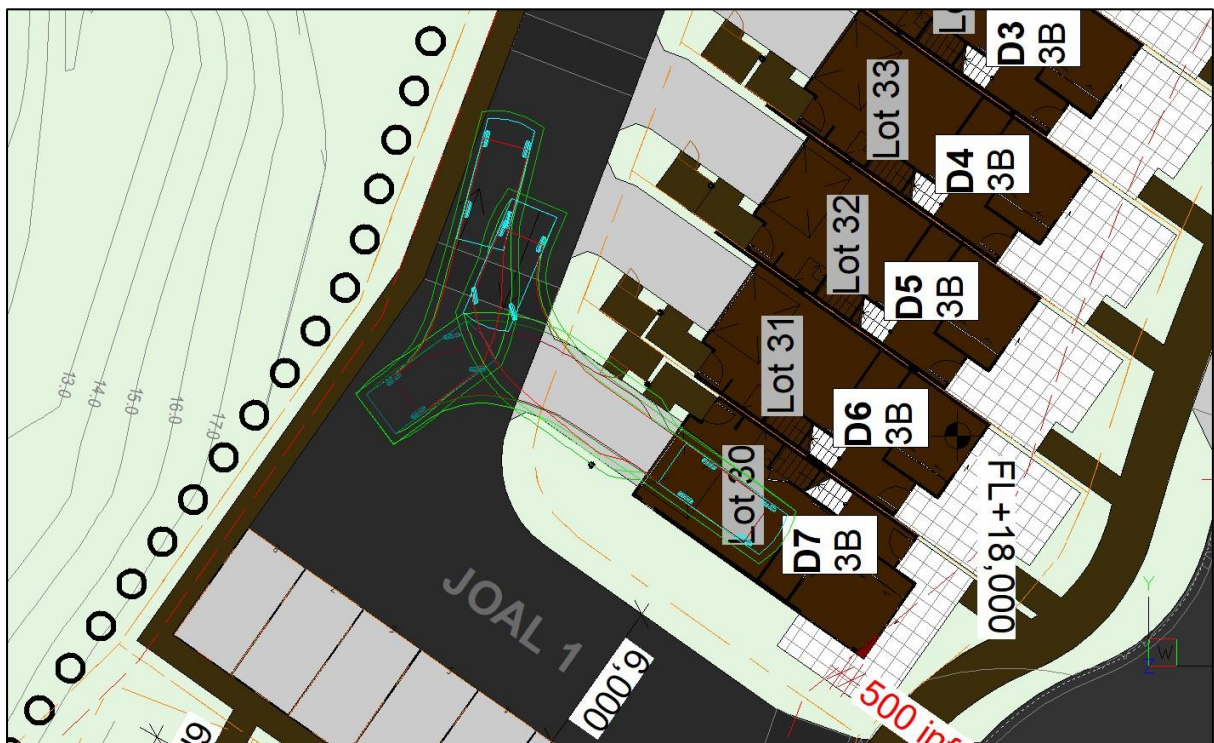


Figure 46: Lot 30 - B85 Vehicle Tracking



Figure 47: Lot 37 - B85 Vehicle Tracking



Figure 48: Lot 42 - B85 Vehicle Tracking





Figure 49: Lot 43 - B85 Vehicle Tracking



Figure 50: Lot 45 - B85 Vehicle Tracking

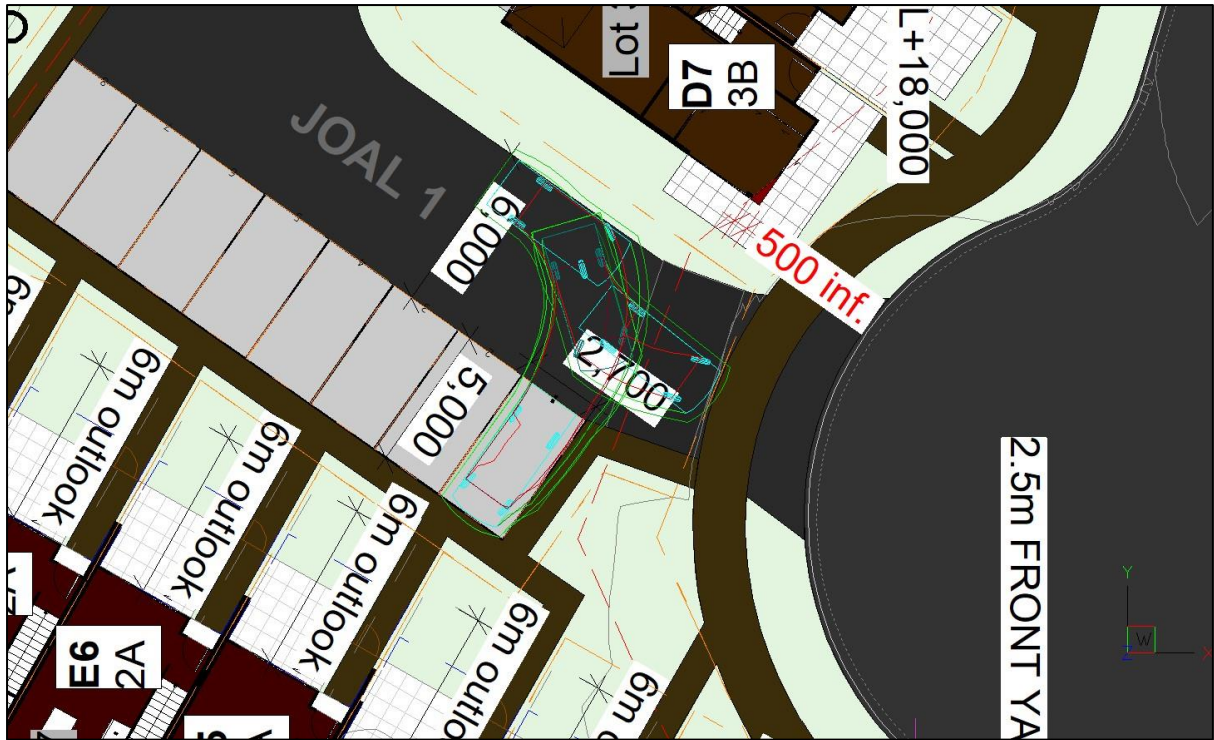


Figure 51: Parking Space 1 - B85 Vehicle Tracking



Figure 52: Parking Space 4 - B85 Vehicle Tracking



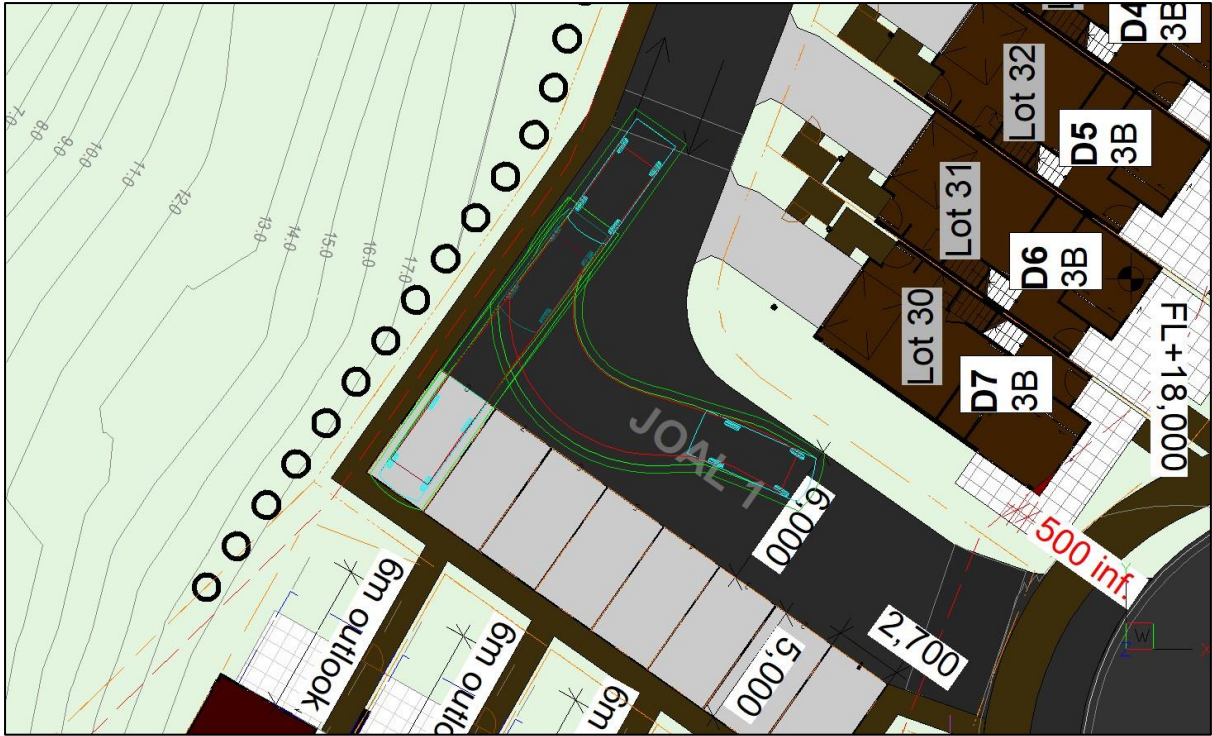


Figure 53: Parking Space 8 - B85 Vehicle Tracking

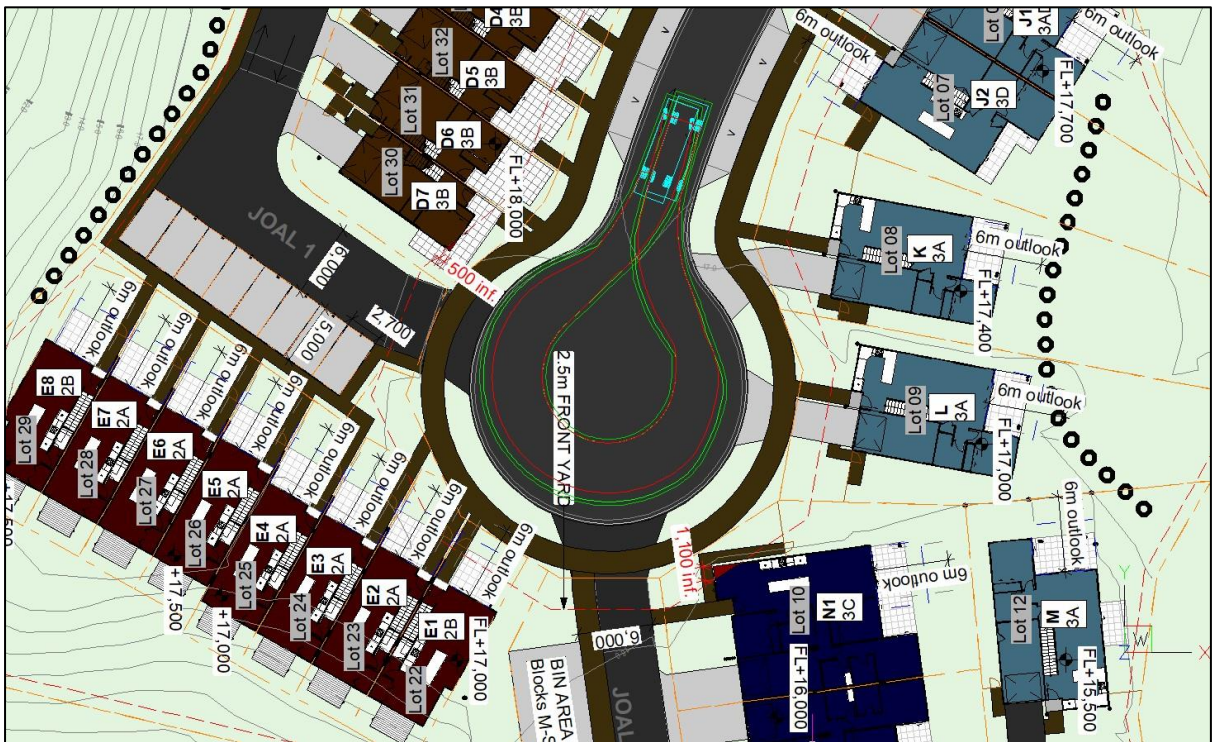


Figure 54: Road 1 cul-de-sac - 8.0 metre Rigid Truck Tracking



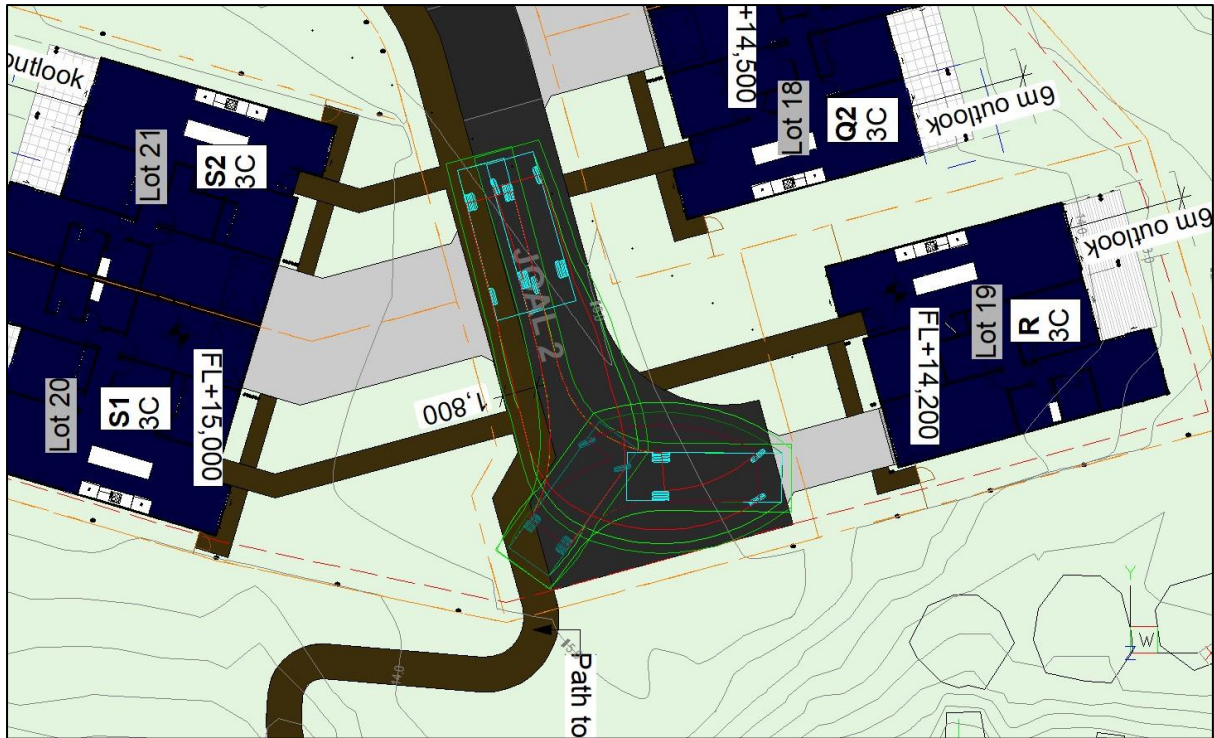


Figure 55: JOAL 2 - 8.0 metre Rigid Truck Tracking

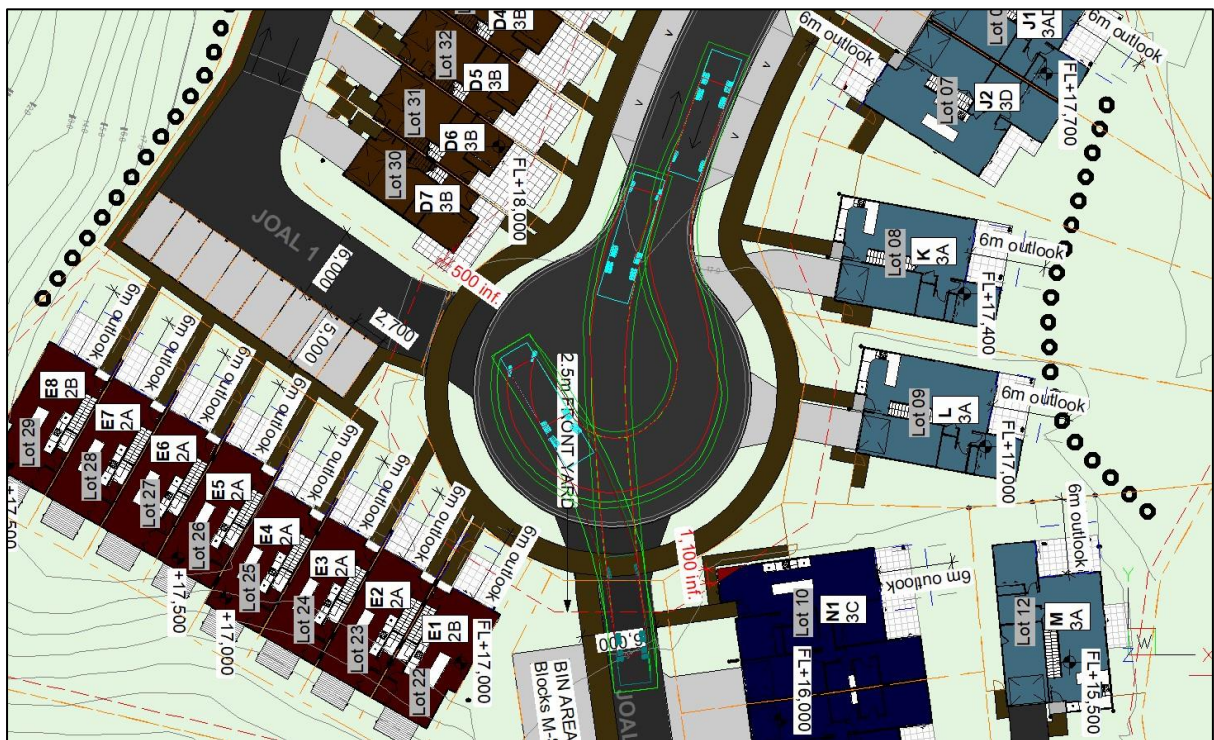


Figure 56: 10.3 metre Rubbish Truck Tracking

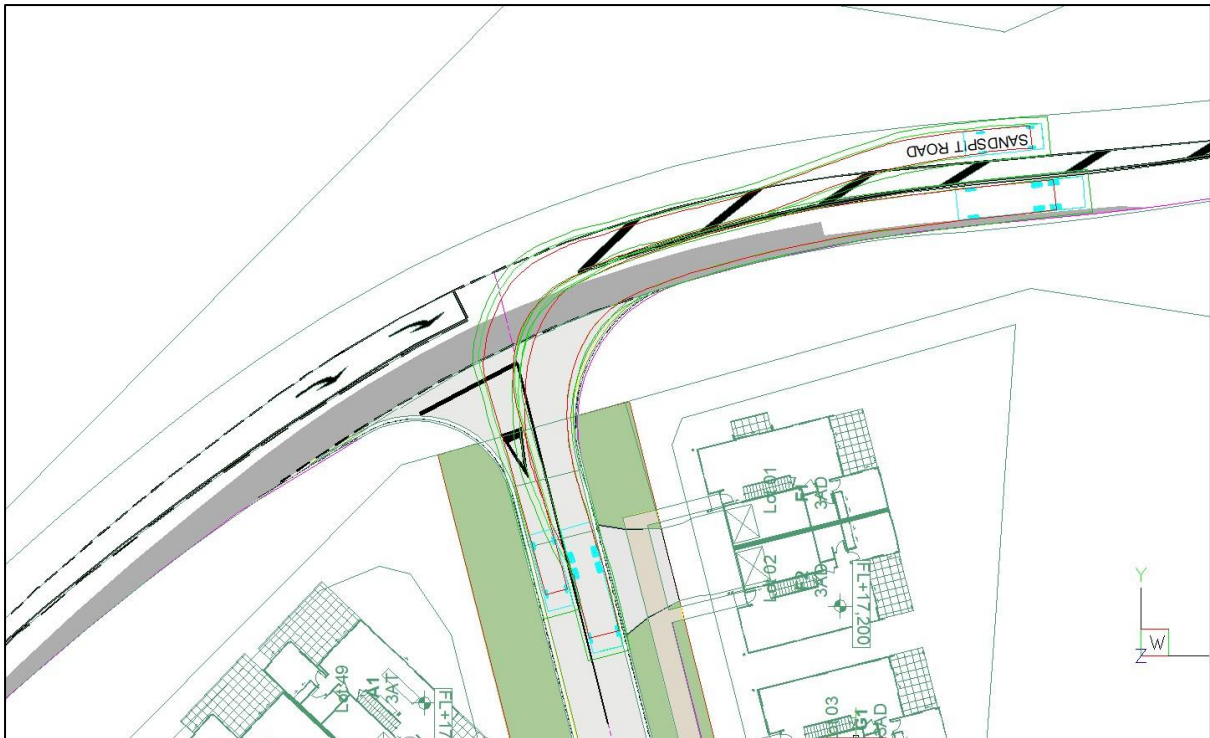


Figure 57: Sandspit Road Intersection - 10.3 metre Truck (Left In) & 6.3 metre Van (Right Out)

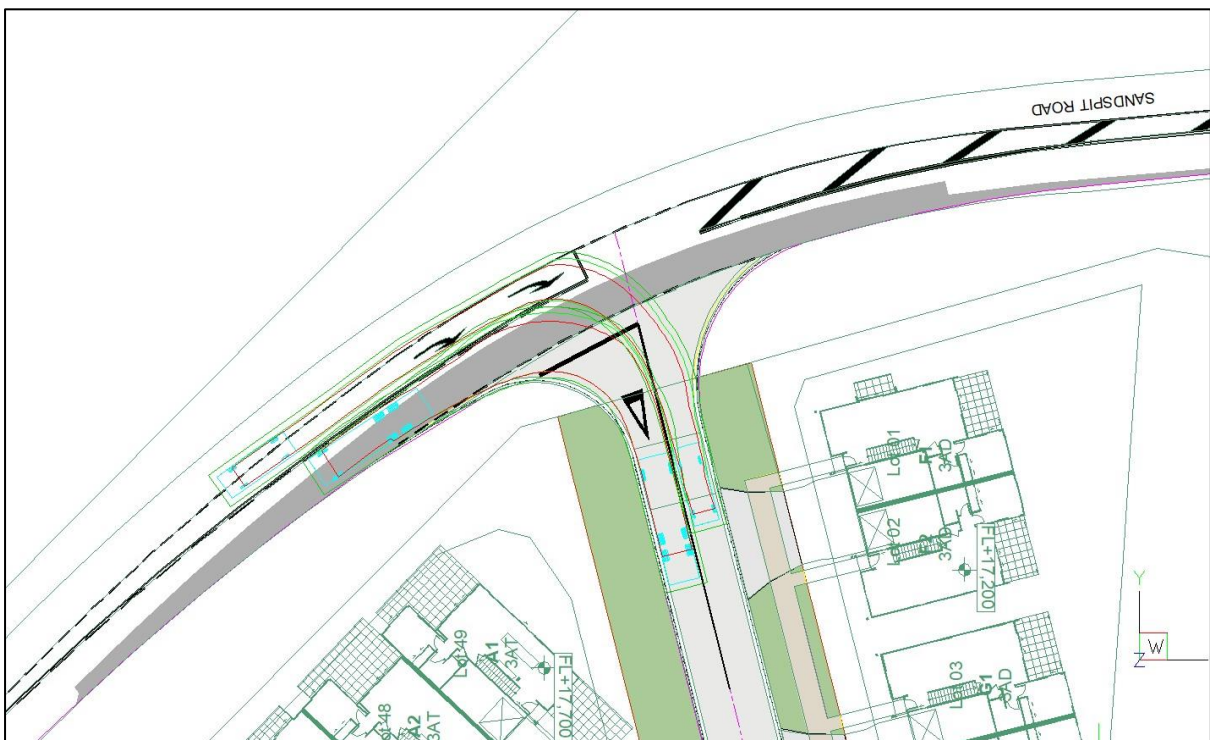
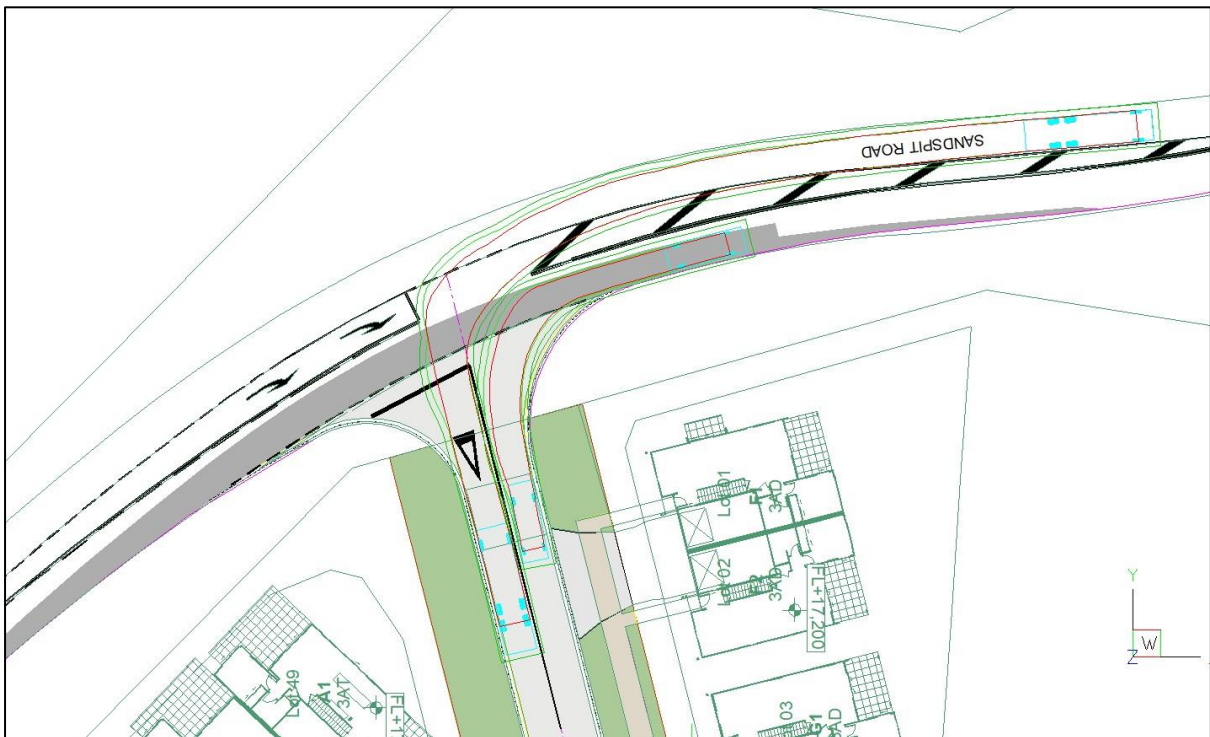


Figure 58: Sandspit Road Intersection - 10.3 metre Truck (Left Out) & 6.3 metre Van (Right In)





**Figure 59: Sandspit Road Intersection - 10.3 metre Truck (Right In) & 6.3 metre Van (Left Out)**



**Figure 60: Sandspit Road Intersection - 10.3 metre Truck (Right Out) & 6.3 metre Van (Left In)**