Watercare Northern Interceptor Project

Phase 1: Hobsonville to Rosedale

Construction Traffic Assessment

May 2015

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Construction Traffic Assessment

Quality Assurance Statement

Prepared by:

Alasdair McGeachie

Project Transportation Engineer

Reviewed by:

Don McKenzie

Senior Associate Technical Director / Branch Manager

Approved for Issue by:

Don McKenzie

Technical Director / Branch Manager

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PO Box 2592, Shortland Street, Auckland 1140
New Zealand

P: +64 9 531 5006

www.tdg.co.nz

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1. Summary of Abbreviations

Abbreviation	Definition
AEE	Assessment of Effects on the Environment
AT	Auckland Transport
CoPTTM	Code of Practice for Temporary Traffic Management
Council	Auckland Council
CTMP	Construction Traffic Management Plan
DN	Nominal Diameter
EED	Engineering Exception Decision
HDD	Horizontal Directional Drill
LOS	Level of Service
MTC	Manual Traffic Controller
NSGC	North Shore Golf Club
NSMP	North Shore Memorial Park
NZTA	New Zealand Transport Agency
PS	Pump Station
PT	Public Transport
RCA	Road Controlling Authority
RTS6	Road and Traffic Standards Part 6: Guidelines to Visibility at Driveway
SH18	State Highway 18
SIDRA	Signalised and unsignalised Intersection Design Research Aid
TMP	Traffic Management Plan
vpd	Vehicles per day
vph	Vehicles per hour
Watercare	Watercare Services Limited
WWTP	Wastewater Treatment Plant

2. Executive Summary

Traffic Design Group Ltd (TDG) has been commissioned by Watercare Services Limited (Watercare) to investigate the traffic engineering and safety implications of a proposal to construct an underground wastewater network through the northern suburbs of Auckland from the existing Hobsonville pump station to the Rosedale Wastewater Treatment Plant (WWTP), in order to meet future growth. This project is known as Northern Interceptor Phase 1 – or "the project" for short.

The proposed route of the new network is as follows:

- North out of the Hobsonville Pump Station;
- Under State Highway 18 (SH18);
- East alongside SH18;
- Across a new reclamation area under the upper Waitemata Harbour;
- Rahui Road, Greenhithe; and
- Along Traffic Road, Rame Road and Greenhithe Road to Wainoni Park.
- Northwards through Wainoni Park and across Te Wharau Creek to North Shore Memorial Park (NSMP);
- Across Schnapper Rock Road, and along a land corridor that includes Witton Place;
- Through the North Shore Golf Club and along Appleby Road;
- Along Albany Highway to No14 John Glenn Avenue;
- Along John Glenn Avenue to William Pickering Drive;
- Along William Pickering Drive to Piermark Drive;
- Along Piermark Drive to Bush Road, and
- Across Bush Road, into Rosedale Park and then to the Rosedale Wastewater Treatment Plant.

The main construction methodology will be open trenching. However, micro-tunnelling will be used to cross beneath the SH18, and horizontal directional drilling (HDD) or marine trenching for the Upper Harbour and Te Wharau Creek crossing.

The traffic safety and traffic engineering implications of this construction work has been assessed.

The primary traffic effects are from the works required in the work corridor rather than from traffic associated with the transport of materials and staff to and from the site. These effects will require careful management. Sections 6 and 8 of this report provide mitigation measures for specific construction areas. That said, the following general principles should apply throughout:

- The length of active construction should be controlled to prevent traffic delays of more than 5 minutes;
- When side roads or intersections must be crossed, construction should be staged to prevent their full closure, particularly where the affected road has only one connection to the road network; and
- The option of working outside of normal construction hours (i.e. night time) to take advantage of lower traffic volumes on the roads in business / industrial areas should be considered to reduce the impact on business and traffic operations.

The concepts and assumptions in this report are based on the information available at the time of writing regarding earthworks and construction methodology. We cannot guarantee that the specific methodologies described here will be employed at the time of construction.

The construction works will involve the operation of heavy machinery, open excavations and the storage of plant and works materials in close proximity to the public road corridor. Appropriate measures, including fencing and barriers, should be employed to provide adequate separation between members of the public and the work site. An examination of the crash record for the pipeline route has not identified any specific road safety concerns and it is considered that subject to the use of appropriate mitigation and management measures existing levels of road safety can be maintained.

A Construction Traffic Management Plan (CTMP) for the project will be submitted to the, Auckland Transport (AT) and the New Zealand Transport Agency (NZTA), for approval, prior to the commencement of works, and this CTMP should incorporate any amendments to the construction methodology.

3. Introduction

Watercare Services Limited (Watercare) is proposing to build new wastewater pipelines and associated infrastructure to convey wastewater from north-western parts of Auckland to the Rosedale Wastewater Treatment Plant (WWTP) in Albany. This project is known as the "Northern Interceptor". Construction of the Northern Interceptor is intended to be staged, with the timing of various stages depending on the rate of population growth.

TDG has been commissioned by Watercare to assess the potential traffic engineering and safety effects related to the construction, operation and maintenance of the proposed Northern Interceptor Phase 1 (the Project).

The proposed work requires various resource consents under the Resource Management Act 1991. This technical report provides specialist input for the *Northern Interceptor Phase 1 – Assessment of Effects on the Environment* report (the main AEE) prepared by MWH New Zealand Limited, which supports the resource consent application.

This report provides:

- A brief overview of the proposed works (Section 4);
- A description of the traffic environment on the roads surrounding the construction route that are potentially affected by the project;
- A summary of investigations undertaken to assess the existing traffic environment and identify potential traffic effects;
- A description of the potential traffic effects of the proposed construction;
- An assessment of the potential effects on the transport environment during construction, considering temporary traffic management requirements, the specific location within the road network any other environmental factors considered relevant;
- An assessment of potential operation effects, including the construction and operation of a new vehicle crossing at the new Hobsonville Pump Station; and
- Recommended mitigation measures.

The concepts and assumptions in this report are based on information available at the time of writing in respect of matters to do with earthworks and construction methodology. All figures for report are included in Appendix 1.

All temporary traffic management measures for the proposed construction works should meet the requirements in the NZTA Code of Practice for Temporary Traffic Management (CoPTTM). Work sites, particularly those close to public roads and parks, should be adequately isolated from the general public during construction to ensure public safety.

A further detailed CTMP for the project will also be submitted to the relevant Road Controlling Authorities, (AT and NZTA), for approval, prior to the commencement of works, and this CTMP should incorporate any amendments to the construction methodology.

4. Proposed Works

4.1 Project

The proposed Northern Interceptor Phase 1 will transfer existing flows from the Hobsonville Pump Station to the Rosedale WWTP. The proposed route is from the existing Hobsonville Pump Station, under the State Highway 18 motorway, along the northern causeway, and then under the Upper Waitemata Harbour, through Greenhithe and then the commercial area of Rosedale.

Figure 1 shows the proposed route and indicates the areas of HDD construction and open trenching.

Key elements of the project include:

- Upgrading of the existing Hobsonville Pump Station;
- Installation of a pipe under SH18;
- Installation of pipelines in a widened section of the existing causeway;
- Installation of dual pipelines across the Upper Waitemata Harbour to Greenhithe via marine trenching or HDD;
- Installation of pipelines under Te Wharau Creek via HDD;
- Construction of a pipe bridge between Witton Place and North Shore Golf Course;
- Installation of dual pipelines under Alexandra Stream via HDD; and
- Trenched construction for pipeline installation in roads, open space and other land; and installation of associated infrastructure including minor above ground structures.

With the exception noted below, the proposed works are described in detail in the main AEE. All figures referenced in this report showing the proposed works and construction methodology are in Appendix A of this report. The works described in the main AEE and shown on the appended drawings are assessed in this report.

Watercare is proposing some widening along the Upper Harbour Highway near Hobsonville to allow for proposed water and wastewater infrastructure, including a section of the project pipeline. That work forms part of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway project. That project is part of a separate resource consent package, and is described in a report titled Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment, prepared by AECOM New Zealand.

5. Construction Methodology

Construction will use three main methodologies. Open trenching will be used for most of the construction length apart from the Upper Harbour and Te Wharau Creek crossings (where horizontal directional drilling or marine trenching will be used) and for crossing beneath SH18, where micro-tunnelling will be used.

5.1 Open Trenching

5.1.1 Installation

Open trenching will involve excavation of a trench wider and deeper than the proposed pipeline.

Depending on the available working area and other site constraints, sections of pipe could be welded at ground level and lowered into the trench, or even welded together in the trench itself. The former method requires long lengths of open trench and sufficient working room for multiple excavators / cranes to lift and lower the pipe string into position. Welding in-trench requires 15m of open trench length (12m for the pipe and 3m working area).

Shorter lengths of pipe may also be used at road crossings, for example, where long trench lengths are not possible. This will increase the number of welds needed, which may increase construction time. It is understood that each weld will take about two hours.

5.1.2 Excavation and Operation

It is understood that an excavation of 3-6m^3 per lineal metre of pipe will be required. The open trench will typically be 1.2-1.5m wide with a minimum 15m of open length required at any one time. The trench depth will depend on location – in some places more depth will be needed to maintain the required gradient profile or to pass under other subsurface infrastructure.

In addition to the 1.5m trench, a further working area of 3.5-5m to the side will be required. Safety zones will be needed between the edge of the working area (or trench if no working area exists) and public areas such as footpaths or traffic lanes - see **Figure 2** for details. Safety and taper zones will also be required at either end of the work site, which will increase the effective length of the construction area.

The following roads along the pipeline route have carriageways around 10m wide:

- Greenhithe Road;
- Schnapper Rock Road;
- Appleby Road;
- Albany Highway (although it is noted that Albany Highway is currently being upgraded, and on completion of that upgrade will have a carriageway width in excess of 10m);

- John Glenn Avenue;
- Piermark Drive; and
- Bush Road.

The carriageway occupation shown in Figure 2 would require a one lane, two-way traffic control operation around the worksite. Four roads have carriageway widths considerably less than 10m:

- Rahui Road;
- Traffic Road;
- Witton Place; and
- Newbury Place.

Traffic diversions and / or additional working and traffic control processes will be required when works are in progress along these roads.

CoPTTM sets minimum standards for lane width based on the speed limit (temporary or permanent) where works are occurring. The minimum permitted lane width is 2.75m (at a speed of 40km/h or less); therefore, two way flow would require 5.5m of road width. If the existing centreline cannot be used, then the opposing traffic flows would need to be divided by a device such as traffic cones or a temporary centre-line. Depending on the method employed, more width may be required.

Traffic flows within the one lane area will be controlled by either Manual Traffic Control or temporary portable traffic signals.

CoPTTM suggests that 500 vehicles per hour (vph) is the typical threshold at which delays of more than five minutes may be expected when a lane closure is within 200m of an intersection. Beyond 200m, the threshold volume is considered to be 800-1000vph.

A key factor influencing the traffic flow volume needed to exceed an acceptable delay threshold is the length of the one-lane section. That means a balance must be struck between efficiency of construction and acceptable traffic capacity.

Limitations on the operation of one-lane sections are discussed in Section 6 of this report.

5.1.3 Construction Traffic Generation

It is understood that the pipe lengths will be delivered 10 per truck on a semi-trailer unit. No more than two deliveries of pipe per week (i.e. four truck trips; two in, two back) are expected per operating section of excavation. The excavation operation itself is expected to generate around 24-36 truck movements per day, based on a daily excavation rate of 90-120m^3 (6.5-7.5m^3 per truck).

5.2 Horizontal Directional Drilling

5.2.1 Location

Horizontal Directional drilling will be employed for the marine crossing of Te Wharau Creek from Wainoni Park to the North Shore Memorial Park and potentially for the Upper Waitemata Harbour from Hobsonville to Greenhithe. The option to cross the Waitemata Harbour by marine trenching is discussed in Section 5.3 of this report.

5.2.2 Construction Methodology and Installation

A drill rig will be installed at one end of the crossing and used to drill and ream a bore hole. This process will continue until the hole is large enough for the pipe to be installed. The pipe will then be pulled through the previously drilled hole. The pipe string will be welded together prior to thrusting.

Working areas will need to be set up to install the drill units, for the drilling operation itself, and to hold equipment and storage containers for the mud that gets drilled. It is understood these working areas would be operational for 4-6 months.

5.2.3 Traffic Generation

The drilling operation is expected to generate about 20 truck movements a day (to remove spoil from the drill hole and deliver drilling mud). Additional truck movements will occur during the establishment and disestablishment of each drilling site. The traffic effects of these movements are discussed in Section 7.

5.3 Marine Trenching

5.3.1 Location

Marine trenching will potentially be employed for the Upper Waitemata Harbour from Hobsonville to Greenhithe.

5.3.2 Construction Methodology and Installation

In the shallower intertidal zone it is understood the trenching works, pipe installation and spoil removal will be done with land based equipment.

Across the deeper sections of the harbour marine trenching will be undertaken from a floating dredge, with the materials hauled to and from the works zone via tug and barge. Pipe strings for this section of the route will be welded together on the causeway towed to their installation location and sunk to the sea floor. Excavation under the pipe will then occur to bury the pipe into the seabed. The installation area will be kept clear of other marine traffic by buoys.

5.3.3 Traffic Generation

The immediate land-based effects of marine trenching are expected to be less than those of directional drilling as less excavated material will be removed by truck. Where land based equipment is used (i.e. in the shallower zones at the start and end of the crossing) the excavated materials will be removed by truck and daily volumes will be similar to those a for HDD operation.

5.4 Micro tunnelling

5.4.1 Location

Micro-tunnelling will be used to install the pipeline underneath SH18. The strategic importance and high speed environment of this road make other construction methods such as open-trenching, inappropriate.

5.4.2 Construction and Installation

A micro-tunnel boring machine will be used to create a concrete-lined tunnel beneath SH18 from an installation shaft on the southern side of the highway to a receiving shaft on the northern side. The pipe will then be drawn through the tunnel by a winch on the southern side. The pipe string will be welded together on the northern side before installation. This work is estimated to take about 3-5 months.

5.4.3 Traffic Generation

Approximately 800-1000m^3 of spoil will be excavated during tunnel construction beneath SH18. Excavated material will be hauled off-site in semi-trailer trucks (approximately 12.5m^3 per load), which equates to about 160 truck trips. A further 30-40 trips are expected for delivery of plant, pipes and other materials.

Truck volumes are expected to be approximately 10 trips per day.

6. General Traffic Considerations for the Construction Route

6.1 Pipeline Route

As shown in Figure 1, the project wastewater line will proceed:

- North out of the Hobsonville Pump Station;
- Under SH18;
- East alongside SH18;
- Across a new reclamation area;
- Under the upper Waitemata Harbour;
- Across Rahui Road, Greenhithe;
- Along Traffic Road, Rame Road and Greenhithe Road to Wainoni Park;
- Northwards through Wainoni Park and across Lucas Creek to North Shore Memorial Park;
- Across Schnapper Rock Road, and along a land corridor that includes Witton Place;
- Through the North Shore Golf Club and along Appleby Road;
- Along Albany Highway to No14 John Glenn Avenue ;
- Along John Glenn Avenue to William Pickering Drive;
- Along William Pickering Drive to Piermark Drive;
- Along Piermark Drive to Bush Road; and
- Across Bush Road, into Rosedale Park and then to the Rosedale WWTP.

6.2 Traffic Environment and Volumes

Table 1 summarises the main characteristics of the route roads. Further detail, including construction effects on particular sections of the route, is provided in Section 7.

CoPTTM categorises roads by traffic volumes, speed limit and number of lanes to determine appropriate standards for temporary management equipment and the dimensions of safety areas. In principle, the greater the speed and traffic volume, the higher the safety requirements expected. Road categories range from Level LV (low-volume) to Level 3 (high-speed, multi-lane roads). **Figure 3** shows the hierarchy of the road network surrounding the route.

Road	Section	Effect	District Plan Classification	Number of lanes	Average Annual Daily Traffic (vpd)	CoPTTM Road Level
Buckley Road	n/a	Work site	Local Road	2	5,476	1
Upper Harbour Highway	North of Squadron Drive	Crossing	National Route	6	33,047	3
Rahui Road	At foreshore reserve	Crossing	Local Road	1	120*	LV
Traffic Road	All	Corridor	Local Road	1	85*	LV
Tauhinu Road	Traffic Rd to Greenhithe Road	Crossing	Local Road	2	3,437	1
Greenhithe Road	Tauhinu Rd to Wainoni Pk	Corridor	Local Road	2	6,116	1
North Shore Memorial Park Road Network	Along main access road	Work site & Corridor		1-2	n/a	LV
Schnapper Rock Road	Between Aberley Drive Nth and Aberley Drive Sth	Crossing	Local Road	2	1,399	1
Witton Place	All	Corridor	Local Road	2	n/a	LV
Newbury Place	@ Witton Place	Crossing	Local Road	2	n/a	1
Appleby Road	All	Corridor	Local Road	2	3,000*	1
North Shore Golf Club	Along main driveway	Corridor	Private Road	2	n/a	LV
Albany Highway	Between Appleby Road and No 14 John Glenn Ave	Corridor & Crossing	Primary Arterial	2	18,090	2
John Glenn Avenue	All	Corridor	Local Road	2	1,300*	1
William Pickering Drive	Between John Glenn Avenue and Piermark Drive	Corridor & Crossing	Secondary Arterial	2	11,881	2
Piermark Drive	All	Corridor	Collector Road	2	4,167	1
Bush Road	@ Piermark Road	Crossing	Secondary Arterial	2	10,806	2

Table 1: Route Road Characteristics

*Daily traffic volume estimated from peak hour surveys

In Table 1 “crossing” refers to a pipeline crossing from one side of a road to the other; “corridor” refers to a pipeline route that runs along the road carriageway or berm.

Unless indicated otherwise, all roads in this report have a speed limit of 50km/h.

Surveys to identify existing traffic volumes along many roads and intersections along the project route were undertaken in November 2014 with additional surveys at the William Pickering Drive / John Glenn Avenue undertaken in May 2015.

The results of the intersection surveys are shown in **Figures 4 to 6** (Greenhithe area) and **7 to 9** (Albany area). Data from the mid-block traffic counts is quoted in Table 1 above and referenced in relevant sections of the report which follows.

6.3 Road Safety

The NZTA Crash Analysis System database was interrogated to identify the location and cause of all injury and non-injury accidents along the pipeline route for the latest full five year period 2010-2014 inclusive. The search area encompassed a 10m corridor on either side of the roads except for SH18 (for which the pipeline will make no surface disturbance).

Table 2 summarises the results from the accident search:

Area	Total Crashes	Injury Crashes	Predominant Crash Types	Heavy Vehicle Crashes	Crashes involving pedestrians	Comment
Buckley Road	0	0	-	0	0	-
Squadron Drive	0	0	-	0	0	
Rahui Road	0	0	-	0	0	-
Traffic Road	0	0	-	0	0	-
Marare Road	0	0	-	0	0	
Tauhinu Road	5	0	Loss of control (3)	0	2	Loss of control crashes were distributed along length of Tauhinu Road
Greenhithe Road	6	3	-	0	2	(includes Rame Road between Traffic Rd and Rahui Rd
Schnapper Rock Road	2	0	Hit Parked Car (failure to apply handbrake) (2)	0	0	Crashes resulted from different vehicles
Newbury Place	0	0	-	0	0	
Witton Place	0	0	-	0	0	
Albany Highway	6	1	Rear end (5)	0	0	(includes Appleby Road) All rear end crashes occurred due to northbound traffic failing to stop in time before hitting queue
John Glenn Avenue	2	1	-	1	1	The injury accident involved a pedestrian being struck by a car while crossing the road
William Pickering Drive	7	3	Lost Control (4)	0	0	2 loss of control crashes occurred at the intersection with John Glen Avenue.
Piermark Drive	5	0	Hit parked car (2), failure to give way (2)	1	0	
Bush Road	0	0	-	-	-	
Total	**33**	**8**	**-**	**2**	**5**	

Table 2: Reported Crashes within Study Area

Only 33 accidents have occurred in the search area within the last five years. Of these, only eight resulted in injuries (all minor). Two accidents involved a heavy vehicle.

No single crash type predominated across the whole study area. Five nose-to-tail crashes occurred at the intersection between Albany Highway and Appleby Road, all as a result of a vehicle failing to stop for the queue in front. As such, no existing road safety issues have been identified.

A decreased speed limit during the works programme will reduce the risk of crashes and the severity of any crashes that do occur.

6.4 Public Transport

The project route cuts across or follows the public transport (PT) network at a number of locations. A summary of the roads affected is provided below:

Road	Routes	Services	Comment
Albany Highway	10	62	8 routes are school bus services. 2 routes are public bus services and account for 56 of the total bus services
Appleby Road	9	9	All bus services on Appleby Road are school related.
Greenhithe Road	6	60	4 routes are school bus services. 2 routes are public bus services and account for 52 of the total bus services
Schnapper Rock Road	2		All bus services on Schnapper Rock Road are school related
William Pickering Drive	2	114	Services provide links to the Northern Busway

Table 3: Public Transport Services on Route Corridor

7. Specific Construction Traffic Effects

7.1 Overview

The following section of the report divides the construction of the project into sectors of shared attributes (based on location, construction method or construction effects) and examines traffic environment, potential traffic effects and possible mitigation / management options.

7.2 Hobsonville Pump Station

7.2.1 Construction Works

The Hobsonville Pump Station (PS) is to be upgraded. The main works include:

- Installation of new pumping machinery;
- Improvements to site access and site roads;
- Construction of a new vehicle crossing;
- Construction of a chemical storage and dosing facility; and
- Construction of a new 710mm ND main connecting to the new pumps.

Photograph 1 shows the existing pump station site. **Figure 10** shows the works area for the PS and the SH18 crossing.

Photograph 1: Hobsonville Pump Station

7.2.2 Traffic Environment

The Hobsonville Pump Station is on Buckley Avenue, defined in the District Plan as a Local Road. In the vicinity of the pump station, Buckley Road has one traffic lane in each direction and is typically 6.2m wide. At the entrance to the Pump Station, Buckley Avenue lacks any kerb and channel or footpaths; features that are found to the east and west, where the road is being progressively upgraded to reflect increasing residential development.

Photographs 2 and 3 show the current traffic environment and available sight distance at the Pump Station driveway.

Photograph 2: Hobsonville Pump Station: Sight Distance to West

Photograph 3: Hobsonville Pump Station: Sight Distance to East

A week-long traffic count in November 2014 indicates weekday traffic volumes of 5,476 vpd with peak flows of 470 vph.

Buckley Avenue enjoys good connectivity to the Strategic Road network, linking to Upper Harbour Highway via the Squadron Drive and Brigham Creek interchanges.

7.2.3 Site Access

The proposed site access driveway can be seen in Photographs 2 and 3 above.

Sight distance is the distance at which a vehicle exiting a driveway can see an approaching vehicle on the through road. The appropriate standard for driveway sight distance used in this report is that given by NZTA Road and Traffic Standards Guide Part 6 (RTS6). Minimum sight distance requirements depend on the operating speed of the through road, the function of the intersecting through road, and the volume of traffic using the site driveway.

Sight distance from this driveway is over 350m to the east and approximately 250m to the west. In both directions, sight distance is limited by a vertical crest in the road. Operating speed for Buckley Avenue, measured as part of the November 2014 traffic count, is 63km/h eastbound and 62km/h westbound. Based on operating speed, and allowing for the gradient of the road (on both approaches there is a downgrade to the site) the sight distance is acceptable in both directions.

The site access to the existing Hobsonville pump station is approximately 80m to the east of the proposed access. This separation distance given operating speed and traffic environment of the Buckley Avenue is considered more than sufficient separation distance, particularly when the low site traffic volumes are taken into account.

The site access should be constructed to the appropriate Auckland Transport code of practise guideline bearing in mind the intended initial usage by heavy vehicles.

7.2.4 Traffic Effects (Construction Works)

Construction volumes and intensities at the Hobsonville PS site will vary depending on the stage of the construction programme. The southern site of the tunnelling works under SH18 will be within the Hobsonville PS area, and will add to construction traffic volumes at this location.

Table 4 below summarises the anticipated construction traffic volumes at various stages of the upgrade works.

Construction Stage	General Works	Duration	Typical Daily Traffic Volume
Site Preparation	Fencing, construction of new temporary access, tree felling, installation of site offices etc.	2-6 weeks	+10-12 vehicles for construction staff
Excavation	Excavation of a working platform	4-8 weeks	40 trucks + staff
Pump Installation	Installation of pumps and ancillary equipment	12-20 weeks	20-30 trucks + staff
Upgrade of switch room	Installation of new wiring, panelling etc.	10-16 weeks	20-30 trucks + staff
Construction of Chemical Storage and dosing facility		12-16 weeks	20-30 trucks + staff
Pipework	Installation of various pipes and ducts	TBA	20-30 trucks + staff
Landscaping / finishing works	Landscaping and construction of permanent site fencing and hard stand areas	6-12 weeks	20-30 trucks + staff
Testing and Commissioning		12-20 weeks	3-4 vans
SH18 Crossing	Boring of a tunnel beneath the SH18 to carry the project wastewater pipeline	10-12 weeks	10 trucks + staff

Table 4: Pump Station Construction Traffic Volumes

* Some works may occur concurrently

Typical traffic volumes will be about 30-40 truck trips and 12 other vehicle trips a day, peaking at four truck trips and two light vehicle trips an hour. The total length of these works including the tunnelling works beneath SH18 is understood to be approximately 8-10 months.

It has been assumed that the micro-tunnelling works for the crossing underneath SH18 will take place at the same time as the PS works and, based on the supplied methodology, it is expected that all excavated material from the southern tunnel portal will be trucked out through the PS site access.

Pipe insertion will occur from the northern side of the tunnel. Accordingly, only the truck and staff traffic volumes related to excavation (approximately eight truck trips per day or one trip per hour) have been added to PS traffic.

The effect of construction traffic volumes, including during morning and afternoon peak hours, has been assessed using the intersection analysis software SIDRA. Results are summarised in Tables 5 and 6 and further detail (as for all the SIDRA modelling) is provided in Appendix B.

Construction of the project pipeline is expected to occur between 2017-2018. The Hobsonville area is currently experiencing rapid development and as such it is probable that traffic volumes on the Hobsonville Road network will have increased in the period when traffic data was collected and when construction will occur.

To this end, a linear annual growth rate of 4% was applied to the surveyed 2014 traffic data so as to enable an extrapolation through to the 2018 year construction year to obtain the traffic volumes used in the intersection modelling. Where the surrounding land is more fully developed lower growth rates have been employed. For the Albany and Greenhithe areas linear growth rate of 1% per annum has been applied.

Tables 5 and 6 show anticipated intersection performance during morning and afternoon peak hours, respectively, while construction is taking place. The parameters are average delay, 95th percentile queue length, and Level of Service (LOS)[1]. For the overall intersection summary, the average delay and LOS is for all vehicles passing through the intersection in the modelled period, although an average Level of Service is not calculated by SIDRA for priority intersections, and the 95th percentile queue is the longest of that reported for an individual leg.

Approach		Construction		
		Average Delay (s)	LOS	95th% Queue (m)
Buckley Avenue	Through	0.0	A	0
	Left	5.2	A	0
Buckley Avenue	Through	1.7	A	5
	Right	6.2	A	5
Hobsonville Pump Station	Left	16.4	C	0
	Right	15.8	C	0
All vehicles		**0.7**	**-**	**5**

Table 5: Model Results for Pump Station / Buckley Avenue intersection – AM Network Peak Hour

Approach		Construction		
		Average Delay (s)	LOS	95th% Queue (m)
Buckley Avenue	Through	0.0	A	0
	Left	5.0	A	0
Buckley Avenue	Through	1.0	A	9
	Right	5.5	A	9
Hobsonville Pump Station	Left	14.6	B	1
	Right	15.0	B	1
All vehicles		**0.7**	**-**	**9**

Table 6: Model Results for Pump Station / Buckley Avenue intersection – PM Network Peak Hour

[1] LOS for the intersection has been calculated by the Highway Capacity Manual method, as a function of delay; according to the Sidra Output Guide, LOS a and B are very good and indicate free-flow conditions; C is good; D is acceptable; and E and F indicate congestion.

As the tables show, the effect of construction traffic on Buckley Avenue is minor: some queuing and minor delays (~16s) for vehicles leaving the pump station, but no effect on through volumes. Given the number of exiting vehicles, it is considered the effects on site can be managed appropriately through the CTMP.

7.2.5 Traffic Effects (Operation)

Once the Northern Interceptor pipeline is installed and commissioned the ongoing operation of the PS will create a small but regular traffic generation. It is understood that the generated traffic will be in the region of 8-10 vehicle trips per week. Two of these trips would be generated by a tanker vehicle delivering supplies to the chemical dosing facility on site. Maximum daily trip generation would thus be ten vehicle trips per day, under the conservative assumption that all service operations occurred on a single day of the week. Tables 5 and 6 above have indicated that only very minor effects on the road network occur under the higher trip generation from the site during construction and hence the effects from the ongoing PS operations will be negligible.

7.3 SH18 Crossing

7.3.1 Overview

The pipeline will be installed beneath SH18 via micro-tunnelling. The strategic importance and high speed environment of this road make other construction methods such as open-trenching inappropriate.

Photograph 4 shows the section of SH18 beneath which the project will pass.

Photograph 4: State Highway 18 at the project Crossing Point

7.3.2 Construction and Installation

The southern work site will be within the Hobsonville PS and the northern work site within the motorway corridor. A micro-tunnel boring machine will be used to create a concrete-lined tunnel beneath SH18 from an installation shaft on the southern side of the motorway to a receiving shaft on the northern side. The pipe will then be drawn through the concrete conduit by winch on the southern side. The pipe string will be welded together on the northern side prior to installation.

7.3.3 Traffic Environment

Access to and from the southern work site will be via the Hobsonville PS on Buckley Avenue. The traffic environment surrounding this site has been discussed and assessed in Section 7.2.2 above. The north worksite will be accessed via a new road off the northern end of Squadron Drive at the roundabout.

7.3.4 Traffic Effects

Tunnel construction and pipe fitting works at the southern work site may occur concurrently with works for the Hobsonville PS upgrade. The traffic effects of these combined operations, as a worst case scenario, have been assessed in Section 7.2.4.

Works relating to the northern site will produce additional traffic at the northern roundabout of the Squadron Drive / Upper Harbour Highway interchange and as shown in Tables 7 and 8.

As with the models for Buckley Avenue the surveyed 2014 traffic volumes have been scaled to the anticipated 2018 traffic flows.

Approach		Existing			Future		
		Average Delay (s)	LOS	95th % Queue (m)	Average Delay (s)	LOS	95th % Queue (m)
Squadron Drive (south approach)	Left	2.8	A	10	3.1	A	12
	Through	6.6	A	10	6.6	A	12
	Right	8.3	A	10	8.3	A	12
Squadron Drive (private road)	Left	4.6	A	1	5.0	A	1
	Through	4.4	A	1	4.8	A	1
	Right	8.1	A	1	8.5	A	1
Stub road	Left	3.9	A	0	4.7	A	0
	Through	7.8	A	0	9.0	A	0
	Right	8.7	A	0	9.5	A	0
All vehicles		**7.9**	**A**	**10**	**8.0**	**A**	**12**

Table 7: Model Results for the Squadron Drive roundabout intersection –AM Network Peak Hour

Approach		Existing			Future		
		Average Delay (s)	LOS	95th % Queue (m)	Average Delay (s)	LOS	95th % Queue (m)
Squadron Drive (south approach)	Left	2.9	A	7	3.2	A	8
	Through	6.7	A	7	6.7	A	8
	Right	8.3	A	7	8.3	A	7
Squadron Drive (private road)	Left	4.0	A	1	4.3	A	1
	Through	3.8	A	1	4.0	A	1
	Right	7.5	A	1	7.8	A	1
Stub Road	Left	3.5	A	0	3.9	A	0
	Through	7.4	A	0	8.1	A	0
	Right	8.3	A	0	8.7	A	0
All vehicles		**7.8**	**A**	**7**	**7.8**	**A**	**8**

Table 8: Model Results for Squadron Drive roundabout intersection –PM Network Peak Hour

The tables above show that this additional traffic can be easily accommodated on the roundabout without any negative effects on the network traffic performance.

7.4 SH18 Crossing to Hobsonville Causeway

7.4.1 Overview

It is proposed that the pipeline will be established on the northern side of the motorway, then around the north end of the Squadron Drive roundabout, and along the access road to a new causeway along the shoreline of the Upper Waitemata Harbour. The pipeline will be trenched along the widened causeway to the start of the harbour crossing.

This section of the route is approximately 1200m long and is estimated to require 2-5 months' work.

Photograph 5 shows the route from SH18 to the approximate location of the new causeway tab. The access road to the causeway can be seen just to the left of centre in Photograph 5. The section of the route from the crossing of Upper Harbour Highway to Squadron Drive can be seen in Photograph 4 in Section 7.3.1.

Photograph 5: The Project Route from SH18 to Causeway Tab

7.4.2 Traffic Environment

Traffic volumes at the Squadron Drive roundabout are summarised in Table 9 below.

As shown in Table 9, thanks to limited completed development within Hobsonville, traffic volumes at this intersection are still relatively low.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Squadron Drive (from Hobsonville)	2014	2,400	326	236
Squadron Drive (private road)	2014	320	50	32
Stub Road	2014	10	1	1
SH18 On-Ramp	2013/14	1,937	279	234

Table 9: Traffic Flow Data: Squadron Drive roundabout

While traffic volumes will increase from their current levels as the Hobsonville development continues to grow the SIDRA modelling in Section 7.3.4 indicates that even at peak times in 2018 there is still more than sufficient spare capacity in the road network to accommodate the relatively low traffic volumes expected as a result of the project pipeline construction.

7.4.3 Construction Effects

Traffic volumes for the open trenching works are forecast to be low: approximately 8-10 truck movements per day (1 per hour). The Squadron Drive roundabout and associated interchange, which provide direct access to SH18, have ample spare capacity to accommodate such volumes.

7.4.4 Construction Traffic Mitigation

To minimise driver distraction, the construction area alongside SH18 should be securely fenced by barriers and sight screens located at an appropriate distance from the motorway to maintain required run-off areas for this high speed environment.

The work area from the SH18 crossing point to the Squadron Drive roundabout will run alongside SH18. As noted in Section 7.4.2, SH18 is a high-speed, multi-lane motorway route that is unsuitable for site access or egress. Instead, access should be solely arranged via a site road off the Squadron Drive roundabout.

From Squadron Drive to the start of the Tab on the causeway, the pipeline route will run alongside the access road and then within the new causeway itself. Because the existing causeway is used by cyclists and pedestrians, fencing and barriers should be installed along the access road and causeway as a safety measure.

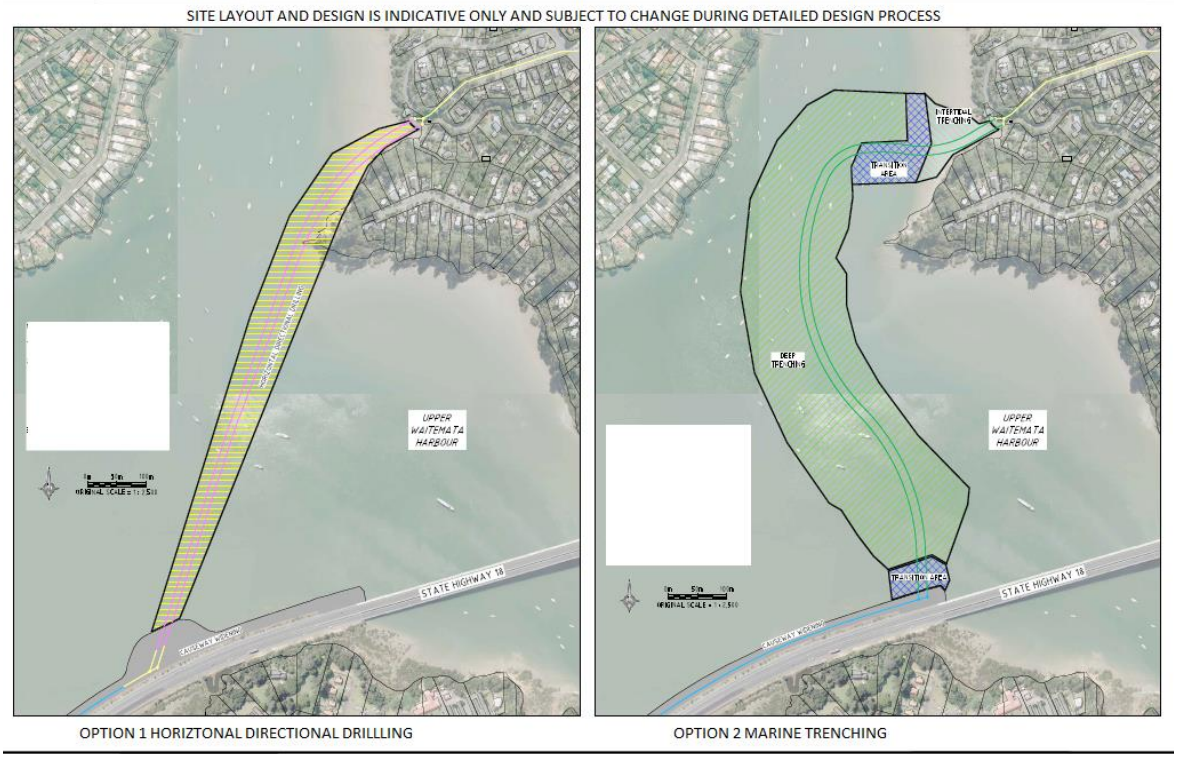
If trucks are required to travel over exposed ground before reaching Squadron Drive, truck washing facilities should be installed to prevent excavated materials being deposited onto Squadron Drive and, more importantly, SH18.

7.5 Upper Waitemata Harbour Crossing

7.5.1 Overview

The Upper Harbour crossing will occur via either directional drilling or marine trenching. A decision on which construction methodology to use will be made later in the planning process. The traffic effects of both options have been considered in this report.

Photograph 6 shows the area and approximate route for the harbour crossing with further detail provided in **Figure 11**.



Photograph 6: Upper Harbour Crossing Options from Hobsonville

7.5.2 Horizontal Directional Drilling

The pilot boring, pipe installation, drilling mud delivery will be run from the causeway widening across to the foreshore reserve on Rahui Road. Spoil removal will occur from the Rahui Road Reserve.

7.5.2.1 Traffic Environment

Access to and from the causeway work site will be via the causeway access road. The access road will connect with the road network at a private section of Squadron Drive which connects to the public road network at the Squadron Drive motorway interchange. Squadron Drive Interchange connects to SH18, affording good access to the road network to both the east and west. Buckley Avenue and Hobsonville Road allow access to the Brigham Creek Road motorway interchange for access to the south and west.

7.5.2.2 Traffic Effects

Potential traffic control measures with this area are shown in Figure 11. The access road should be wide enough to accommodate the expected heavy vehicle types, which will include semi-trailer vehicles.

A SIDRA analysis of the Squadron Drive Roundabout indicates that the additional construction traffic volumes can be easily accommodated.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Squadron Drive (south approach)	Left	2.8	A	10	2.8	A	12
	Through	6.6	A	10	6.6	A	12
	Right	8.3	A	10	8.3	A	12
Squadron Drive (private road)	Left	4.6	A	1	5.1	A	1
	Through	4.4	A	1	4.8	A	1
	Right	8.1	A	1	8.5	A	1
Stub Road	Left	3.9	A	0	4.2	A	0
	Through	7.8	A	0	8.1	A	0
	Right	8.7	A	0	9.0	A	0
All vehicles		**7.9**	**A**	**10**	**7.9**	**A**	**12**

Table 10: Model Results for the Squadron Drive Roundabout Intersection – AM Network Peak Hour

Approach		Existing			Construction2.8		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Squadron Drive (south approach)	Left	2.9	A	7	2.9	A	7
	Through	6.7	A	7	6.7	A	8
	Right	8.3	A	7	8.3	A	8
Squadron Drive (private road)	Left	4.0	A	1	4.6	A	1
	Through	3.8	A	1	4.1	A	1
	Right	7.5	A	1	7.8	A	1
Stub Road	Left	3.5	A	0	3.7	A	0
	Through	7.4	A	0	6	A	0
	Right	8.3	A	0	8.5	A	0
All vehicles		**7.8**	**A**	**7**	**7.8**	**A**	**8**

Table 11: Model Results for the Squadron Drive Roundabout Intersection – PM Network Peak Hour

7.5.3 Marine Trenching

Marine trenching will be undertaken from a floating dredge, with the materials hauled to and from the works zone via tug and barge. In the shallower intertidal zone it is assumed that some of the trenching works / spoil removal will be done with land based equipment.

7.5.3.1 Traffic Environment

The land-based traffic environment is as discussed in Sections 7.5.2.1 and 7.6.3.

7.5.3.2 Traffic Effects

The immediate land-based effects of marine trenching are expected to be less than those of directional drilling as less excavated material will be removed by truck.

The section of the upper Waitemata Harbour to be crossed provides water access to Greenhithe, Riverhead and other areas of the Upper Harbour. Communication with the Harbour Masters office about the project, the proposed harbour crossing route and proposed mitigation measures is ongoing. The dredging operation will be restricted in its ability to manoeuvre and hence other harbour users will need to be advised to keep clear of the working area.

7.6 Rahui Road to Greenhithe Road

7.6.1 Proposed Site Location

It is proposed that the pipelines would land in the small reserve area adjacent to the Tauhinu Sea Scout Hall. The twin pipelines would then be linked into a single larger diameter pipe and the pipeline will proceed to the north-west along Traffic Road to Tauhinu Road and then into Greenhithe Road. All on-shore works would be via open trenching.

The reserve area is accessed via Rahui Road. Photograph 7 shows the reserve. In addition to the Sea Scout Hall, the reserve contains a small toilet block, boat ramp (tidal access only) and parking for four vehicles.

Photograph 7: Rahui Road Reserve where the Pipe Will Land

7.6.2 Traffic Volumes

Auckland Transport traffic volume data for Tauhinu Road indicates a weekday volume of 3,437 vpd. Daily traffic volume data is not available; however peak period counts undertaken by TDG are shown in Table 12 below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Tauhinu Road	2012	3,437	341	330
Rahui Road	2014	120*	6	18
Traffic Road	2014	85*	10	7

Table 12: Traffic Flow Data: Tauhinu, Rahui and Traffic Roads

*estimated from Peak Hour data

According to CoPTTM classifications, both Rahui Road and Traffic Road would be considered low volume (Level LV) roads and Tauhinu Road a Level 1 road.

7.6.3 Traffic Environment

Rahui Road has a winding alignment and a steep gradient profile rising from near sea-level by the reserve up to Tauhinu Road (35m above sea level). In addition, the carriageway is narrow with a limited road shoulder and no separate provision for pedestrians. This creates areas of limited forward visibility (down to 25-30m, in some places as can be seen in Photographs 8 and 9).

Photograph 8: Rahui Road North of the Reserve

Photograph 9: Rahui Road South of the Reserve

Rahui Road connects to the wider road network at Rame Road and Marae Road. The intersection with the Rame Road is a priority T- intersection, with Rame Road traffic having priority. The intersection is approximately 50m north of the Rame Road / Greenhithe Road / Tauhinu Road intersection. At its southern end Rahui Road intersects with Marae Road at a four leg crossroads intersection, the four leg being Austin Road. This intersection is an uncontrolled intersection. Marae Road connects to Tauhinu Road.

Traffic Road is a short, residential cul-de-sac approximately 150m in length. It connects to Rame Road approximately 20m to the north-east of the Rame Road / Greenhithe Road / Tauhinu Road intersection. Traffic Road has a narrow carriageway (typically 5-5.5m wide) which, though not divided by lane markings, does provide sufficient width for two-way traffic flow.

There are no footpaths or other formalised pedestrian provision along Traffic Road, although the southern edge of the carriageway is defined by kerb and channel. There is limited roadside parking on Traffic Road, serving the adjacent residential properties. Where parking is available, the road effectively becomes single lane. A small turning head (6m radius) is provided at the cul-de-sac end of the road.

Photographs 10 and 11 show the existing constructed section of Traffic Road.

Photograph 10: Traffic Road from cul-de-sac

Photograph 11: Traffic Road from Tauhinu Road

There is an unformed paper road extension of Traffic Road from its cul-de-sac end to Rahui Road. After landing in the reserve on Rahui Road, the pipeline would cross Rahui Road, and follow the paper road corridor to Traffic Road and continue along Traffic Road to Tauhinu Road. Photographs 12 and 13 show the paper road end and the gradient which must be climbed from the harbour foreshore.

Photograph 12: Traffic Road; Paper Section Looking South-West to Rahui Road Reserve

Photograph 13: Traffic Road; Paper Road Section Looking North-East

The intersection of Traffic Road, Tauhinu Road, Rame Road and Greenhithe Road is an offset crossroads intersection with the stagger between the centres of Greenhithe Road and Traffic Road approximately 15m. Greenhithe Road meets Tauhinu / Rame Road as a priority intersection, with Tauhinu Road / Rame Road having priority and Greenhithe Road subject to a Give-Way control. The Rame Road / Tauhinu Road / Traffic Road component of the intersection is uncontrolled, but as the through road, Rame Road / Tauhinu Road would have priority over Traffic Road. The principal movements are the right turn from Tauhinu Road into Greenhithe Road and the left turn from Greenhithe Road in Tauhinu Road.

Photograph 14 shows the current intersection configuration.

Photograph 14: Traffic Road / Rame Road / Tauhinu Road / Greenhithe Road Intersection Looking to the South-east

7.6.4 Construction Operation Effects and Mitigation (Rahui Road)

While works will only be conducted within a very limited portion of Rahui Road (crossing from the reserve to the end of Traffic Road), site traffic will need access along Rahui Road to service the works, remove and replace the drilling rig. While drilling will not occur from the Rahui Road reserve, the rig will be used to draw the pipelines through from the Hobsonville causeway, and enable other site operations.

As it is a crescent road with two connections to the road network, consideration should be given to operating Rahui Road as a one-way circuit during construction. This would prevent works vehicles crossing in opposing directions. Alternatively, and to minimise disruption to residents, one-way routing could be limited to construction vehicles only. Such a methodology would depend on the work vehicles in operation.

Vehicle tracking for a variety of heavy vehicles routing along Rahui Road have been tested and are shown in Appendix C. The vehicle tracking indicates that the movement of larger vehicles particularly semi-trailer vehicles and larger 11m rigid trucks will restrict the ability of other vehicles to manoeuvre in opposing directions. To this end, it is recommended that during the haulage operations to remove the drilling and stabilising mud from the tunnel works, smaller rather than larger heavy vehicles should be employed.

No footpath is provided along Rahui Road and any pedestrians would thus be walking within the carriageway. As such, it is recommended that haulage operations are suspended for 30 minutes prior to the start and after the end of the school day to avoid potential conflict with school children who may be walking along the road.

Movement of the drilling rig will likely require the use of low-loader semi-trailer or similar vehicles. Such vehicles would require the use of a special escort vehicle to and from the site along Rahui Road and the movement of these vehicles should be timed for quiet traffic periods of the day and advised to residents in advance. The use of a barge to transport the drilling rig from the causeway to Rahui Reserve should also be investigated for feasibility.

To cross from the Sea Scout reserve to the southern (paper) end of Traffic Road will require the open trenching of Rahui Road. As Rahui Road is a crescent, this will not cut off residents' access, but will result in two-way truck flow and additional traffic management may be required during these operations.

Efforts should be made to control truck movements so that two site trucks are not travelling on Rahui Road at the same time.

The minor increases in traffic volumes from construction will have a minimal effect on the operation of the Rahui Road and its intersections with Rame Road and Marae Road. More significant than the potential traffic delays is the interaction of heavy vehicles with each other and with other traffic on the narrow sections of the route and at these intersections, as discussed. The Rahui Road / Marae Road intersection is uncontrolled and the drivers of construction vehicles should be specifically advised to halt at this intersection to check the road is clear before proceeding through and turning onto Marae Road.

7.6.5 Construction Mitigation Summary (Rahui Road)

- Haulage vehicles should be chosen for manoeuvrability and compatibility with the constrained road network rather than outright capacity.
- Haulage operations to cease in the period 30 minutes before and after the start and end of the school day.
- Construction traffic movements through the Rahui Road / Rame Road, Rahui Road / Marae Road and Marae Road / Tauhinu Road intersections should be limited at peak traffic periods.
- Traffic Control and site staff should be on hand during working hours to assist with / enable access for residents at all times.
- Signage should be erected at the Rahui Road / Rame Road, Rahui Road / Marae Road and Marae Road / Tauhinu Road intersections to alter motorists and pedestrians to the potential for heavy vehicle movements.
- Movement of the drilling rig only to occur with advance notification to residents.

7.6.6 Construction Operation Effects (Traffic Road)

As previously noted, Traffic Road has a narrow carriageway (~5.5m). Therefore, the working area needed to install the pipeline along the northern grass berm will effectively take up the entire carriageway, restricting residents' access. Where driveway access must be affected (temporarily) by construction, residents should be given sufficient advance warning, and every effort made to minimise the duration of such disruptions.

The narrow width and restricted turning circle at the western end of Traffic Road (see **Figure 12**) prevents the efficient turning of most heavy vehicles, which will need to reverse into or out of the street. It is recommended that the preferred solution is for trucks to reverse in and drive forwards out, which not only avoids the need to reverse up the slope to leave Traffic Road, but also enables trucks to drive forward out of Traffic Road in the event of difficulties during entry or unloading.

The pipe route directly crosses through and along the driveway providing access to 11 Traffic Road. Direct communication with the affected property owners and / or occupiers will be required to advise of the potential vehicle access restrictions to their houses and pedestrian access should be maintained at all times.

7.6.7 Construction Effects (Tauhinu Road / Rame Road / Traffic Road / Greenhithe Road Intersection)

From the eastern end of Traffic Road the pipeline will cross Rame Road / Tauhinu Road and enter Greenhithe Road. This is one of the key intersections in Greenhithe, providing access to Greenhithe Road and Greenhithe town centre.

Figures 4 and 5, previously discussed, show current peak hour traffic volumes through this intersection. However, the main effects will occur when the road crossing from Traffic Road into Greenhithe Road takes place, necessitating lane closures and active traffic control via Manual Traffic Controllers (MTC's) or portable traffic signals. Given the short distance of the crossing and the need to provide work access within the intersection, it is considered that the more practical option is use MTC's.

SIDRA models of the intersection under its current control scheme and under an active control system show that while some reduction in intersection capacity is inevitable (see Tables 15 and 16), the intersection will continue to operate at an acceptable level of performance – especially given the short duration of the works.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Tauhinu Road (northbound)	Left	4.8	A	3	35.7	D	33
	Through	0.2	A	3	31.7	C	33
	Right	4.8	A	3	37.5	D	33
Rame Road (southbound)	Left	4.6	A	2	39.6	D	20
	Through	0.0	A	2	35.6	D	20
	Right	4.6	A	2	37.8	D	20
Greenhithe Road (westbound)	Left	4.9	A	3	41.4	C	38
	Through	3.4	A	3	29.8	C	38
	Right	5.0	A	3	35.7	D	38
Traffic Road (eastbound)	Left	5.6	A	0	37.3	D	2
	Through	4.2	A	0	33.3	C	2
	Right	5.6	A	0	39.1	D	2
All vehicles		**4.4**	**-**	**3**	**36.1**	**D**	**38**

Table 15: Model Results for Tauhinu Road / Rame Road / Greenhithe Road / Traffic Road Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Tauhinu Road (northbound)	Left	4.7	A	3	35.3	D	44
	Through	0.2	A	3	33.3	C	44
	Right	4.8	A	3	35.6	D	44
Rame Road (southbound)	Left	4.7	A	1	36.9	D	14
	Through	0.1	A	1	35.0	C	14
	Right	4.6	A	1	37.2	D	14
Greenhithe Road (westbound)	Left	5.0	A	7	34.0	C	54
	Through	3.6	A	7	32.0	C	54
	Right	5.0	A	7	34.3	C	54
Traffic Road (eastbound)	Left	5.4	A	0	34.9	C	2
	Through	4.0	A	0	32.9	C	2
	Right	5.4	A	0	35.2	D	2
All vehicles		**4.4**	**-**	**7**	**34.8**	**D**	**54**

Table 16: Model Results for Tauhinu Road / Rame Road / Greenhithe Road / Traffic Road Intersections – PM Network Peak Hour

7.6.8 Construction Mitigation Summary

As noted, the Tauhinu Road / Rame Road / Greenhithe Road / Traffic Road intersection is one of the key intersections in Greenhithe, providing access to Greenhithe Road and Greenhithe town centre

Access through this intersection must therefore be maintained at all times. Each leg of the intersection (i.e. Rame Road and Greenhithe Road) should be crossed one lane at a time to allow alternating two-way access. Consideration should be given to having steel plates or similar materials on hand to temporarily cover excavation trenches and allow more traffic to pass through the intersection during peak periods.

Tauhinu Road and Greenhithe Road are key bus routes servicing Greenhithe, with about 50 buses a day passing through the intersection. Any restrictions to lane widths and turning paths should maintain sufficient space and manoeuvre area for bus movements. Further discussion on the bus route effects in Greenhithe is provided under Section 7.7 below.

The Rame Road leg of the intersection is only 30m from the Rame Road / Rahui Road intersection. Manual traffic control of the intersection may be required to manage traffic movements onto Rame Road.

In order to mitigate the effects on residents it is recommended that site traffic is restricted during peak traffic periods and where safe and practical the maximum road / intersection area is made available for general traffic use.

7.7 Greenhithe Road to Wainoni Park South

7.7.1 Overview

The route is approximately 1,150m long and passes through or near the Greenhithe town centre, Greenhithe Fire Station, Greenhithe School and four intersections.

Construction will be by open trenching with the pipeline approximately following the centreline of the road.

7.7.2 Traffic Volumes

Average weekday traffic volumes on Greenhithe Road are around 5,400 vpd near Tauhinu Road, rising to 6,100 vpd near Wainoni Park (see Table 17 below).

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Greenhithe Road (north of Tauhinu Road)	2014	5,373	406(average) 465 (peak)	497 (average) 565 (peak)
Greenhithe Road (between Isobel Road and Sunnyview Road)	2014	6,116	537 (average) 561 (peak)	536 (645 peak)

Table 17: Traffic Flow Data: Greenhithe Road

Traffic counts were undertaken at the intersections of Greenhithe Road / Tauhinu Road / Rame Road / Traffic Road; at Greenhithe Road / Roland Road; and at Greenhithe Road / Churchouse Road / Isobel Road for the morning, afternoon and Saturday peak hour periods in November 2014. This data is shown in Figures 4 to 6.

7.7.3 Traffic Environment

Greenhithe Road provides one lane in each direction and is categorised in the District Plan as a Collector Road. Along the section where the pipe line will pass, Greenhithe Road has a typical carriageway width of 10.5m. Footpaths and green berms are provided on both sides of the road and kerbside parking is generally permitted. There is a pedestrian zebra crossing of Greenhithe Road 160m north-east of the intersection with Tauhinu Road and 50m south of the roundabout onto Churchouse Road. At either end of the school day this crossing is operated by a school crossing patrol.

Along the pipeline route Greenhithe Road has five intersections:

- Tauhinu / Rame Road (previously discussed);
- Roland Road;
- Sunnyview Road;
- a four-leg roundabout intersection with Churchouse Road and Isobel Road; and
- Wainoni Heights.

Roland Road and Sunnyview Road are priority intersections with priority afforded to Greenhithe Road.

Photographs 15 and 16 show the intersections with Roland Road and Sunnyview Road, respectively.

Photograph 15: Greenhithe Road / Roland Road Intersection

Photograph 16: Greenhithe Road / Sunnyview Road Intersection

Photograph 15 shows the roundabout intersection of Greenhithe Road with Churchouse Road and Isobel Road.

Photograph 17: Greenhithe Road / Churchouse Road / Isobel Road Intersection. View from Churchouse Road

Greenhithe Road forms the main bus route through Greenhithe and is used by over 50 buses per day. It has four bus stops (two eastbound and two westbound) within the works area. Bus Stops should be maintained in an operative condition for as long as practicable during construction, and liaison should occur with AT prior to any closure.

Alternative temporary bus stopping locations should be established when permanent stops are closed.

7.7.4 Construction Operation Traffic Effects

This section of pipeline will be constructed via open trenching in the road carriageway. Works-related traffic is likely to be about 36-40 trucks trips per day, or 4-6 trips per hour – equivalent to 1-2% of the typical traffic flow along Greenhithe Road. The main impact of the works will thus be to reduce the available carriageway space.

The carriageway is typically 10.5m wide. As discussed in Section 4.1.2, Greenhithe Road may therefore need to be reduced to one lane wide around the works area, but still allow for alternating two-way flow. Control of the one-lane section will be via either manual traffic control or temporary traffic signals. Delays and / or significant queuing are possible near intersections where traffic flows exceed 500 vph.

Photographs 18-22 show the typical carriageway of Greenhithe Road at various locations along the construction route.

Photograph 18: Greenhithe Road near Tauhinu Road Looking South

Photograph 19: Greenhithe Road near Roland Road Looking South

Photograph 20: Greenhithe Road between Roland Road and Sunnyview Road Looking Towards Sunnyview Road

Photograph 21: Greenhithe Road near Churchouse Road Looking South

Photograph 22: Greenhithe Road near Wainoni Park

From Table 17 it is apparent that peak hour traffic volumes on Greenhithe Road are in the region of 600-700 vph, above the critical 500 vph, where significant delays can occur for one-lane operations near intersections for significant periods of the day.

These traffic volumes are likely thus to impose some limitations on the effective operation of a one lane system.

There is limited potential to efficiently divert traffic in the section of Greenhithe Road between Tauhinu Road and Sunnyview Road, so while some reduction in traffic flow could be achieved by a community consultation plan. Any traffic control scheme will need to allow for two way traffic. Between Isobel Road and Sunnyview Road a detour of Greenhithe Road via Isobel Road, Outlook Road and Sunnyview Road could be implemented.

Therefore efforts should be made to reduce the width and length of the construction corridor so the length of any one lane section is reduced and where possible the need for a one lane section is avoided.

Such steps will be particularly critical around the intersections with Roland Road, Sunnyview Road and Churchouse Road / Isobel Road.

7.7.5 Traffic / Access Critical Locations

Greenhithe Fire Station (Photograph 25) is on the southern side of Greenhithe Road 60m to the north-east of the intersection with Rame Road. It is critical that access to and from the station is maintained at all times.

Photograph 23: Greenhithe Fire Station

Access to and from Greenhithe town centre (Photograph 24) is solely via Greenhithe Road. The construction team will need to co-ordinate with local retailers to ensure that sufficient access is maintained during the works.

Photograph 24: Greenhithe Town Centre facing south

Photograph 25: Greenhithe Bus Facilities, Greenhithe Road, facing North

Greenhithe School is located adjacent to the Greenhithe Road / Churchouse Road / Isobel Road roundabout. This school is a primary school with students from 10 years old down to 5 years old. Easy and safe access to the school should be maintained at all during the school term and it is critically important the site area and excavations are securely barriered from public access. When the construction zone reaches the vicinity of the school site traffic movements should be halted during the start and end of the school day and consideration given to timing works in this area for the school holiday period. Timing construction thus would have the twofold advantage of mitigating the presence of schoolchildren in the vicinity of the work site and reducing traffic volumes on Greenhithe Road through the absence of school-related traffic.

Photograph 26: Greenhithe School

There are three pedestrian crossing facilities on Greenhithe Road in the construction corridor. A pedestrian zebra crossing of Greenhithe Road some 160m to the north-east of the intersection with Tauhinu Road, another zebra crossing 50m to the south of the roundabout intersection with Churchouse Road (adjacent to Greenhithe School) and a pedestrian refuge island some 40m on Greenhithe Road to the east of the intersection with Wainoni Heights to facilitate pedestrians crossing to Wainoni Park. The pedestrian zebra crossing should be keep operational as long as safe and practical and when they need to be closed for construction although crossing points provided. The use of the pedestrian refuge island for crossing should be monitored and if necessary a temporary facility provided in this area when required by the construction activities

7.7.6 Traffic Assessment: Greenhithe Road / Roland Road Intersection

The intersection of Greenhithe Road and Roland Road (Photograph 15) is a priority controlled Y-intersection. Greenhithe Road is the major road; consequently, the following traffic movements are all give-way:

- Through northbound traffic from Greenhithe Road into Roland Road;
- Right turning traffic from Greenhithe Road into Roland Road; and
- All traffic out of Roland Road.

SIDRA models for the morning and afternoon peak hour periods under its current control scheme and under an active control system (manual traffic control or temporary traffic signals) are summarised in Tables 18 and 19. They show that while some reduction in intersection capacity will be created by lane closures, the intersection will continue to operate at an acceptable level, given the relatively short duration of the works.

Roland Road connects to the wider road network via Greenhithe Road only. Therefore, construction works across the intersection must be staged to permit ongoing access to Roland Road.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Greenhithe Road (northbound)	Through	0.2	A	1	18.8	B	2
	Right	3.4	A	0	22.9	C	37
Greenhithe Road (southbound)	Through	4.1	A	0	25.7	C	38
	Right	6.0	A	1	23.2	C	4
Roland Road	Left	6.3	A	2	26.7	C	16
	Right	6.8	A	1	22.4	C	4
All vehicles		**4.3**	**-**	**2**	**24.4**	**C**	**38**

Table 18: Model Results for Greenhithe Road / Roland Road Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Greenhithe Road (northbound)	Through	0.6	A	1	22.6	C	5
	Right	3.4	A	0	27.7	C	33
Greenhithe Road (southbound)	Through	4.1	A	0	23.4	C	51
	Right	6.0	A	2	21.1	C	14
Roland Road	Left	6.0	A	1	25.6	C	7
	Right	8.9	A	3	23.1	C	9
All vehicles		**4.5**	**-**	**3**	**24.2**	**C**	**51**

Table 19: Model Results for Greenhithe Road / Roland Road Intersection – PM Network Peak Hour
Traffic Effects Greenhithe Road / Isobel Road / Churchouse Road

7.7.7 Traffic Assessment: Greenhithe Road / Isobel Road / Churchouse Road

The intersection of Greenhithe Road, Isobel Road and Churchouse Road is a four leg roundabout. Greenhithe Road on the southern approach rises to the intersection on a steep upgrade from Sunnyview Road, which reduces the approach sight distance to the intersection (Photograph 23). Any traffic management measures should allow for this.

SIDRA models of the intersection under its current control scheme and under an active control system during lane closures at peak hours show some reduction in intersection capacity during works (Tables 20 and 21). However, the intersection continues to operate at an acceptable level of performance given the relatively short duration of the works.

For the SIDRA modelling it has been conservatively assumed that during the works through and adjacent to this intersection traffic movements will be possible only on a single leg of the intersection at an only time. Depending on the staging and progress of works at any particular time, it may of course be possible that traffic movements could occur on more than one leg simultaneously in which case the forecast operation of the intersection would improve.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Greenhithe Road (Wainoni Park Approach)	Left	4.0	A	11	51.7	D	116
	Through	4.1	A	11	44.9	D	116
	Right	7.3	A	11	53.5	D	116
Greenhithe Road (Town Centre Approach)	Left	4.6	A	13	51.2	D	116
	Through	4.7	A	13	44.3	D	116
	Right	7.9	A	13	53.0	D	116
Isobel Road	Left	5.3	A	4	52.3	D	35
	Through	5.4	A	4	45.4	D	35
	Right	8.7	A	4	54.0	D	35
Churchouse Road	Left	6.0	A	4	50.0	D	30
	Through	6.0	A	4	43.1	D	30
	Right	9.3	A	4	51.8	D	30
All vehicles		**5.5**	**A**	**13**	**47.4**	**D**	**116**

Table 20: Model Results for Greenhithe Road / Isobel Road / Churchouse Road Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Greenhithe Road (Wainoni Park Approach)	Left	3.8	A	14	42.7	D	135
	Through	3.8	A	14	35.8	D	135
	Right	7.1	A	14	44.4	D	135
Greenhithe Road (Town Centre Approach)	Left	4.2	A	10	49.2	D	99
	Through	4.3	A	10	42.3	D	99
	Right	7.5	A	10	50.9	D	99
Isobel Road	Left	5.7	A	3	55.3	E	28
	Through	5.8	A	3	48.4	D	28
	Right	9.1	A	3	57.0	E	28
Churchouse Road	Left	5.3	A	2	53.2	D	14
	Through	5.3	A	2	46.3	D	14
	Right	8.7	A	2	55.0	D	14
All vehicles		**4.7**	**A**	**14**	**42.0**	**D**	**135**

Table 21: Model Results for Greenhithe Road / Isobel Road / Churchouse Road Intersection – PM Network Peak Hour

As identified previously, consideration should be given to staging the works in this area to coincide with a school holiday period, when traffic volumes on the adjacent roads will likely be reduced and the numbers of young pedestrians in the area also will be less.

Churchouse Road connects to the wider road network solely via Greenhithe Road therefore construction works across the intersection must be completed in stages which permit access to Churchouse Road to be maintained.

7.7.8 Mitigation Summary

The following traffic management policies and practises should be employed to minimise the effects of construction on the road network.

- Access to the Greenhithe Fire Station maintained at all times.
- Access to the Greenhithe town centre should be maintained during business hours.
- Access to cul-de-sac roads (Roland Road and Wainoni Heights) should be maintained.
- The pedestrian crossings of Greenhithe Road should remain open as far as practicable and if closed, an alternative temporary crossing should be established.
- All work sites, particularly those around Greenhithe School should be securely fenced / barriered to prevent public access.
- Works in the vicinity of Greenhithe School should be halted at the start and end of the school day.
- Consideration should be given to staging the works around Greenhithe School to occur during a school holiday period.

7.8 Wainoni Park (South and North)

7.8.1 Overview

It proposed to install the 710mm DN sewer main through Wainoni Park by open trenching. In addition to the pipeline it is intended to install airvalves and two scour valves in this section of the pipeline. There are two small streams which must be crossed as part of the route and it is intended that these crossings would be via pipe bridges. The pipeline route is shown in Figure 22, along with the locations of the air valves, scour valves and pipe bridges. The total length of this section is approximately 1,200m. Photographs 28 and 29 show Wainoni Park.

7.8.2 Traffic Environment

Wainoni Park is an open recreational space of some 40 hectares which includes sports playing fields, playground and walking / recreation areas. The reserve is bounded by Churchouse Road on its western boundary and Greenhithe Road to the south. To the north and east Wainoni Park runs into the harbour. There are parking areas on both Churchouse Road and Greenhithe Road.

Photograph 27: Wainoni Park from Greenhithe Road

Photograph 28: Wainoni Park

7.8.3 Traffic Volumes

There are no trafficked roads within the park itself and hence with the exception of occasional servicing by parks maintenance vehicles, no vehicle movements. Traffic volumes on the frontage roads are summarised in Table 22 below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Churchouse Road	2014	1,300	161	103
Greenhithe Road (east of Churchouse Rd)	2014	7,100	722	702

Table 22: Traffic Flow Data: Greenhithe Road

*estimated from peak hour flows

7.8.4 Construction Operation Traffic Effects

As with the majority of the pipeline route, the construction method for works in Wainoni Park will be open trenching. Unlike most of the areas to be constructed via the open trenching method within Wainoni Park, there will be no conflicting vehicle traffic movements to be managed. However there is also no existing roading infrastructure to be utilised. The first step in construction will thus be to construct access roads within the park. Where these access roads connect to the existing road network, wheelwashes and / or other truck cleaning facilities should be installed.

Given the use of the park by a wide age range of the public all construction areas should be securely fenced off to prevent access. Similarly, access routes within the park should be clearly marked and managed so as to prevent access by non-works vehicles.

Construction traffic volumes during the works in Wainoni Park will be similar to those estimated for the other open trenching works however these truck volumes will be arriving and departing from a single access point over the duration of the works in the park (estimated to be 10-16 weeks) instead of being spread along a road as construction advances.

Access to Wainoni Park is possible via Greenhithe Road, Churchouse Road or Orwell Road. As a vehicle access on Greenhithe Road will need to be created to permit the entry of the construction train, it is recommended that site access for the construction works in Wainoni Park occur via Greenhithe Road. As a local road with conservatively assessed operating speed of 60km/h, a minimum sight distance of 55m in each direction would need to be achieved. Given the on-site topography, it is considered that this is achievable.

Tables 23 and 24 show the results of the SIDRA Modelling undertaken to determine the traffic effects at the site access intersection. It has been assumed that a single site access will be provided with heavy vehicles entering and exiting via a left or right turn movement. Any right turn exit movements which are required should only occur under the direction of a traffic controller.

Tables 23 and 24 show the results of the SIDRA Modelling to determine traffic effects at the site access intersection. It has been assumed that a single site access will be provided with heavy vehicles entering and exiting via a left or right turn. Any right turn exit should only occur under the direction of a traffic controller.

Approach		Construction		
		Average Delay (s)	**LOS**	**95th% Queue (m)**
Greenhithe Road (westbound)	Through	3.6	A	15
	Right	8.6	A	15
Greenhithe Road (eastbound)	Through	0.0	A	0
	Right	4.6	A	0
Wainoni Park Site Access	Left	13.5	B	0
	Right	11.0	B	0
All vehicles		**1.6**	**-**	**14**

Table 23: Model Results for Greenhithe Road / Wainoni Park Site Access Intersection – AM Network Peak Hour

Approach		Construction		
		Average Delay (s)	**LOS**	**95th% Queue (m)**
Greenhithe Road (westbound)	Through	4.0	A	22
	Right	9.0	A	22
Greenhithe Road (eastbound)	Through	0.0	A	0
	Right	4.6	A	0
Wainoni Park Site Access	Left	13.1	B	0
	Right	10.7	B	0
All vehicles		**2.3**	**-**	**21**

Table 24: Model Results for Greenhithe Road / Wainoni Park Site Access Intersection – PM Network Peak Hour

The SIDRA modelling indicates that at the forecast levels of traffic generation the site access can operate efficiently with no significant negative effect to the operation of Greenhithe Road.

At its connection to Greenhithe Road, the site access should be of sufficient width that a heavy vehicle can enter without waiting for a departing heavy vehicle to exit. If it is impractical to provide such width, then heavy traffic movements must be regulated so that entering and exiting trucks will not pass one another at the site access entrance. A wheelwash and / or other truck cleaning facilities should be provided near the site exit to clean any trucks which have travelled over exposed ground prior to their departure. If the site access it to be secured by a gate then any such gate should either be kept open during the working day or be located at a sufficient distance into the site so than an entering truck can turn into the site and stop without the rear of the truck extending into the road.

Upon reaching the shoreline a works and staging area will be created for the crossing of the Te Wharau Creek tidal inlet, these works are described in the following section of the report.

7.8.5 Mitigation Summary

- The site access should be designed to accommodate the simultaneous entry and exit of heavy vehicles, or if this is not practical truck movements should be managed so that waiting is not required at the entry driveway.
- The site entry should be clearly signposted so that it is identifiable to construction vehicles and inadvertent access by the public is avoided.
- A wheelwash or other suitable truck cleaning facilities should be provided at the site access to prevent the deposition of spoil from the works on to the road network.

7.9 Te Wharau Creek Crossing

7.9.1 Overview

It is intended to cross the tidal inlet between Wainoni Park and the North Shore Memorial Park (NSMP) by directional drilling. To undertake these works, staging areas will be constructed at both ends of the crossing. These staging areas will provide working room for the drill rig and its ancillary equipment (NSMP) and pipe string welding (Wainoni Park). The directional drilling will start with a pilot bore drilled from the NSMP end of the crossing. Once the hole is of sufficient diameter, the sewer pipe will be thrust through from Wainoni Park. For redundancy and operational efficiency, it is understood that the inlet crossing will consist of two 550mm DN polyethylene pipes rather than the single 710mm DN pipe.

The length of the crossing from Wainoni Park to the North Shore Memorial Park is approximately 600m. A section of private lane at the north-western end of the Kerema Way will be crossed by the pipeline

7.9.2 Traffic Environment

The traffic environment at Wainoni Park has been previously discussed under Section 7.8.2 of this report.

7.9.3 Construction Operation Traffic Effects

Drilling at the Wainoni Park site for the Te Wharau Creek crossing is expected to generate about 20 truck movements per day, for the removal of spoil from the drill hole and delivery of drilling mud. Additional truck movements will occur during the establishment and disestablishment of the drilling site and to deliver pipe for welding and installation.

The traffic effect of pipe deliveries and excavation at Wainoni Park has been assessed under the previous section of this report and determined to be of minimal effect.

7.10 North Shore Memorial Park

7.10.1 Overview

NSMP is a Council owned and operated crematorium and cemetery. It has road access solely from Schnapper Rock Road.

The twin pipelines will come ashore at the western edge of the North Shore Memorial Park as indicated in Figure 23. Here the two pipelines will be linked into the single 710mm DN pipeline and proceed east along a future internal road corridor within the Memorial Park, before linked to the existing internal road network and continuing to Schnapper Rock Road.

All works in Memorial Park will be undertaken via the open trenching method.

7.10.2 Traffic Environment

Schnapper Rock Road, classified in the District Plan as a local road, runs for a distance of 2.7km from Albany Highway to Te Wharau Creek. Side roads provide access to adjacent residential subdivisions. In the vicinity of NSMP, Schnapper Rock Road has one traffic lane in each direction, divided by a painted centreline. The carriageway is typically 8m wide and kerbside parking is permitted only in sections. Photographs 29 and 30 show the general arrangement of Schnapper Rock Road.

Photograph 29: Schnapper Rock Road facing north, the entrance to the Memorial Park can be seen in the centre of the photograph.

Photograph 30: Schnapper Rock Road facing south

7.10.3 Traffic Volumes

Auckland Transport traffic data for Schnapper Rock Road and from a 7-day machine traffic count near the NSMP entrance is summarised in the table below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Schnapper Rock Road (between Kyle Rd & Albany Hwy)	2014	7,486	631	669
Schnapper Rock Road (between Memorial Park & Aberley Road (S))	2014	1,399	111	128

Table 25: Traffic Flow Data: Schnapper Rock Road.

These results show that traffic volumes on Schnapper Rock Road near the work site are significantly less than those on the road nearer to Albany Highway. Both count locations report a typical heavy vehicle volume of approximately 4% of daily flows. This would be equivalent to 50-60 heavy vehicles a day near Memorial Park and nearly 300 heavy vehicles a day near Albany Highway. The proposed additional heavy vehicle volumes (20 truck movements per day) are thus equivalent to one-third of the current daily truck volumes near Memorial Park and 7% near Albany Highway. While the additional truck movements will be notable to other road users near Memorial Park, as discussed in the following section of this report, it is not considered that there will be an undue effect due to these heavy vehicle movements.

Under the CoPTTM guidelines Schnapper Rock Road is a Level 1 Road.

7.10.4 Construction Operation Traffic Effects and Mitigation

Drilling at the NSMP landing site is expected to generate about 20 truck movements per day, for the removal of spoil from the drill hole and delivery of drilling mud. Additional truck movements will occur during the establishment and disestablishment of the drilling site.

Site access will be via the main driveway to the Memorial Park from Schnapper Rock Road.

Given the location of the main road network it is assumed that site traffic will enter via a left turn movement and exit via a right turn.

Traffic within the NSMP is minimal and the effects of the construction on that traffic will therefore be minor. However, given the sensitive nature of the Memorial Park, all reasonable efforts should be made to minimise construction noise at all times, and to liaise with Memorial Park management to ensure no disruption to services and events held at the Memorial Park. Works may need to be temporarily suspended on occasion to avoid disruption to services.

A high proportion of NSMP visitors may be unfamiliar with the general park layout and the road network within the NSMP. Clear signage will therefore be required on the internal road network of NSMP to direct visitors safely and efficiently around the working area. In addition to the signage, work staff should be on hand to direct and assist visitors as required. The ring road within the park should be used to effect these diversions and additional traffic control staff should be available to direct traffic if required.

It is noted that one of the parking areas within NSMP gains access solely from the section of the ring road on which works will occur. Works should be staged so that access to this car park is maintained as far as is practical.

When works approach the main entrance to NSMP and this entrance is closed to public use additional signage will be required to direct visitors to the secondary northern entrance.

Specific details of the traffic control and management measures should be set out in the CTMP for this stage of the project

7.11 North Shore Memorial Park to North Shore Golf Club

7.11.1 Overview

On reaching Schnapper Rock Road the pipeline will be turned to the north and proceed along Schnapper Rock Road for approximately 80m before crossing the southbound carriageway and proceeding along a reserve corridor between 30 and 32 Newbury Place to Witton Place. The pipeline will continue along Witton Place, across a gully and along the northern end of Laurel Oaks Drive, and into the North Shore Golf Club grounds.

All of the above works will be via open trenching with the exception of a pipe bridge proposed to cross the stream gully at the end of Witton Place.

Photograph 31 shows the reserve corridor which the pipeline will traverse between Schnapper Rock Road and Newbury Place while photographs 32 and 33 show the sections of Witton Place along which the pipeline will pass.

Photograph 31: Pipeline corridor between 30 and 32 Witton Place

Photograph 32: Witton Place (south section)

Photograph 33: Witton Place (North Section)

7.11.2 Traffic Environment

Schnapper Rock Road has been previously described. Witton Place is a short residential street that intersects with Aberley Road and Newbury Place. It is typically 6.5m wide from kerb to kerb, although wider in some sections where indented parking bays have been installed.

Witton Place caters for two way traffic flow, however except near intersections it is not divided by a centre line.

Newbury Place is similarly a narrow residential street with two-way traffic flow.

7.11.3 Construction Operation Traffic Effects and Mitigation

Construction along Schnapper Rock Road will require the use of the full northbound carriageway, and potentially areas of the berm and / or southbound carriageway. From a transport effects minimisation perspective, the goal should be to maintain at least one open traffic lane to provide for alternating two-way flow. Hence, any additional working space should be sought from the berm as opposed to southbound carriageway. The winding alignment of Schnapper Rock Road in this section means that traffic lane width should be greater than the minimum normally required.

With traffic volumes on this section of Schnapper Rock Road less than 1,400 vpd and hourly volumes in the region of 100-130 vph, it is not considered that operating a one-way system in this area will create undue traffic delays.

Aberley Road which runs parallel to Schnapper Rock Road and connects with Schnapper Rock Road on either side of the works area would provide an appropriate detour route when works are crossing Schnapper Rock Road. However, access to and from properties within the diversion area would need to be maintained.

Through-access on Newbury Place will be interrupted whilst the works cross this road. However access for the residents in the eastern section of this street can be maintained via Witton Place or the southern intersection of Newbury Place with Aberley Road.

Between Newbury Place and Aberley Road only one property gains direct access to Witton Place. Given its limited width (~6.5m) it is recommended that this section of Witton Place is closed during the estimated 3-4 days needed for this section of works, while providing alternative access for the residents of this one property (52 Aberley Road). The owner and residents of this property should be contacted directly to advise them of the scope, duration and effects of the proposed works.

North of Aberley Road the pipe route directly crosses a driveway providing access to four residential properties (9, 11, 13 and 15 Witton Place). Direct communication with the affected property owners and / or occupiers will be required to advise of the potential vehicle access restrictions to their houses and pedestrian access should be maintained at all times.

A gully to the north of these properties will be crossed by a pipe bridge linking between Witton Place and a property at 84 Laurel Oaks Drive. From 84 Laurel Oaks Drive the pipeline will continue north and enter the North Shore Golf Club by open trenching. The right of way to 84 Laurel Oaks Drive also provides access to 80 and 82 Laurel Oaks Drive. The sites at 82 and 84 Laurel Oaks Drive are currently vacant, but there is a residential dwelling at 80 Laurel Oaks Drive. As with works in the Witton Place right-of-way there will be some disruption to the access during these works. However, as no open trenching is required along the right of way, only vehicle access, it is considered that the scope of this disruption will be less significant. Nonetheless direct communication with the affected property owners and / or occupiers will be required to advise of the potential vehicle access restrictions to their houses and pedestrian access should be maintained at all times.

It is understood that the majority of the pipe bridge works will be conducted from the Laurel Oaks Drive work site with all crane lifts and the principal construction performed form this area. These works area estimated to take between 3-4 months to complete. Works at the Witton Place work site will be limited to trenching operations and the construction of wing walls for the western end of the pipe bridge. These works will take approximately 1 month to compete.

A temporary haul road will be constructed from the North Shore Golf Club (which is immediately to the north of the property 84 Laurel Oaks Drive) to provide access for the cranes, excavators and construction materials. The traffic effect of this haul road will be discussed in the following section of this report.

7.11.4 Mitigation Summary

The road network on this section of the project route enables effective detour options. The following operational criteria and staging should be implemented to ensure effective use of the road network.

- One lane of Schnapper Rock Road (as a minimum) should remain open as far as practical during the works. When it is necessary to cross both lanes of Schnapper Rock Road, a diversion via Aberley Road should be instituted.

- Works in Newbury Place and Witton Place should be staged so that as a minimum, works in one lane of Newbury Place will have been completed and that lane reopened before the works in Witton Place commence.
- Direct communication with the property owners and occupiers at 52 Aberley Road, 9, 11, 13, and 15 Witton Place and 80 (and 82 if constructed) Laurel Oaks Drive will be required to advise of the potential vehicle access restrictions to their houses and pedestrian access should be maintained at all times. Efforts should be made to minimise the extent of this disruption.

7.12 North Shore Golf Club

7.12.1 Overview

The North Shore Golf Club (NSGC) is located on 41.5ha of land and offers 27 holes, a club house and attached restaurant. Sole road access is via Appleby Road.

The pipeline will be installed by open cut through the golf club site by open trenching, entering from the north-western end of Laurel Oak Drive, running through the golf club car park and then exiting along the route of the golf course driveway.

7.12.2 Traffic Environment

The golf course has vehicle access via a single driveway to Appleby Road. This access road is in the region of 5-6m in width, and connects to the golf course car park with space for over 200 vehicles. This car park is the only parking facility on the golf course.

Weekday traffic volumes for the golf course are low although it is noted that restaurant on site does attract groups. Such groups may arrive individually or collectively in larger vehicles such as tour buses.

7.12.3 Construction Operation Traffic Effects

The key traffic effects within the North Shore Golf Club will occur when the pipeline proceeds across the carpark, and then along the access road.

The alignment through the Golf Club property was reached through discussion with the North Shore Golf Club and it is based on the understanding that this section of works would be undertaken during the annual weekly maintenance shutdown of the Golf Club. Hence the effect on the golf club operations during to the reduction / closure of car parking will be minimal.

Weekday traffic volumes for the golf course are low and it is considered that the addition of construction traffic to the volumes on the access road will not create significant adverse traffic delays, particularly as it is intended to undertake the main part of the works within the Golf Club during the Club's annual shutdown.

However as this is the only vehicle access route to the golf club and has a relatively narrow carriageway (5-6m), where possible construction equipment operation and all materials storage should occur off the access road.

Adequate carriageway width should be maintained on the access road to allow the movement of vehicles which may be required to access the golf course for the Golf Club's maintenance works during the shutdown period and, if works occur outside of this period, to allow access for tour buses and other vehicles which may be bringing groups and individuals to the golf club or restaurant.

Construction traffic volumes during the weekends when the golf course (if open) will be busiest, should be minimised and liaison with the golf club should occur to ensure that access and parking for and tournaments or events is adequately accommodated.

In addition to the open trenching works to route the pipeline through the Golf Club property, a haul road will be constructed to transport plant and materials to the work site at 84 Laurel Oaks Drive to enable the construction of a pipe bridge.

The movement of this heavy equipment will be additional to the truck traffic required for excavation and pipe materials; however it is considered that movement of this traffic will only occur during site establishment and disestablishment and hence not contribute significantly to the overall construction traffic total. As mentioned above, construction traffic volumes during the weekends when the golf course will busiest should be minimised.

7.12.4 Mitigation summary

- Liaison with the Golf Club should occur to ensure that additional access, and adequate parking resources are provided and disruption during tournaments or events is minimised.
- The main works in the Golf Course (e.g. within the car park and along the access road) should be scheduled to coincide with the Golf Club's annual shutdown periods.
- Appropriate access to the golf club should be maintained at all times.
- A wheelwash or truck cleaning equipment should be installed prior to construction traffic entering the golf club roading.
- All work areas should be barriered / fenced.
- Construction traffic volumes during the weekends when the golf course will busiest should be minimised.
- A pre-works video survey of the access road and parking area should be undertaken so that any damage due to construction or construction vehicles is identified. All such damage should be repaired.
- Where possible construction equipment operation and all materials storage should occur off the access road.

7.13 North Shore Golf Club to Albany Highway

7.13.1 Overview

On exiting the golf club grounds, the pipe will follow Appleby Road towards Albany Highway. Works will be undertaken via the open trenching method.

The pipeline route will then turn left out of Appleby Road and head north along the centreline of Albany Highway for a distance of approximately 100m.

7.13.2 Traffic Environment

Appleby Road is a short cul-de-sac some 350 m long primarily providing access to the North Shore Golf Club and Albany Junior High School. At its western end Appleby Road merges into a private driveway to the North Shore Golf Club.

In the District Plan Appleby Road is defined as a local road and has a typical carriageway width of 10m. This width provides for one traffic lane in each direction and kerbside parking on both sides of the road. Photographs 33 and 34 show the carriageway and surrounds of Appleby Road.

Photograph 33: Appleby Road, looking towards Albany Highway

Photograph 34: Appleby Road, looking to the west.

Albany Junior High School is a middle school catering for approximately 1,000 students in Year 7 to 10 (typically 12-16 years in age). While the school has frontage to both Albany Highway and Appleby Road, vehicle access is via Appleby Road only.

Albany Highway is defined in the District Plan as a Primary (Regional) Arterial. On the section for construction it currently has one through traffic lane in each direction, and a flush central median / right turn bay. However works are currently in progress to upgrade Albany Highway. When completed, this section of Albany Highway will include bus lanes, a and improved central median given an increased overall carriageway width. Photographs 35 and 36 show the Appleby Road / Albany Highway intersection.

Photograph 35: Appleby Road / Albany Highway Intersection (from Albany Highway)

Photograph 36: Appleby Road / Albany Highway Intersection (from Appleby Road)

7.13.3 Traffic Volumes

Traffic volume data for Appleby Road was not available from Auckland Transport but based on peak hour flow data from surveys undertaken by TDG, it is estimated that daily traffic volumes on Appleby Road are in the region of 3,500 vpd. Appleby Road is thus a CoPTTM Level 1 Road.

Auckland Transport data for Albany Highway indicates a typical weekday traffic volume in the region of 18,000 vpd. It is thus a CoPTTM Level 2 Road.

Table 26 summarises the traffic volume data.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Appleby Road	2014	3,500	442	308
Albany Highway (btwn Schnapper Rock and Amcor)	2013	18,090	1,551	1,632
Albany Highway (btwn Rosedale and Bass)	2013	17,022	1,463	1,718

Table 1: Traffic Flow Data: Appleby Road and Albany Highway

7.13.4 Construction Operation Traffic Effects: Appleby Road

It is intended to install the pipeline along Appleby Road and along / across Albany Highway via the open trenching method with the pipeline located near the road centreline.

Given the 10.5m carriageway width on Appleby Road, the installation will thus take approximately 50-70% of the total carriageway width.

To allow effective use of the carriageway by both the construction team and other road users, kerbside parking will need to be temporarily prohibited around the active construction area during the course of the construction progress.

The crossing of Fearnley Grove, a short cul-de-sac connecting to Appleby Road will need to be staged so as not to restrict vehicle access to this road.

A one lane operation around the active construction area on Appleby Road, likely to be ~100-150m in length including safety zones, will be required if the road space available to other road users is less than 5.9m (as previously discussed, the 5.9m road width allows for two 2.75m wide traffic lanes separated by 400mm wide traffic cones).

The surveys undertaken by TDG indicate that typical traffic volumes on Appleby Road should not reach levels at which one-lane operation becomes problematic, however it is noted that traffic movements into and out of Appleby Road spike up considerably at the start and end of the school day, and the traffic control measures would need to be allow for this traffic pulse. The ability to manage the school traffic "pulse" will be particularly important when the works approach Albany Highway as there is the potential for vehicles wishing to enter Appleby Road, but delayed by an outgoing traffic stream (in the event of one-way operations) to queue across Albany Highway increasing the traffic effects. As such, it is recommended that the works on Appleby Road are timetabled to occur for a school holiday period.

7.13.5 <u>Construction Operation Traffic Effects: Appleby Road / Albany Highway Intersection and Albany Highway No14 John Glenn Avenue</u>

The pipeline section on Albany Highway between Appleby Road and No14 John Glenn Avenue is approximately 100m in and the works to complete the pipeline installation in this area should have a duration of 6—10 working days. Albany Highway is currently being upgraded to provide bus lanes, traffic lanes and a central median. This will have the effect of increasing the potential traffic diversion space during the works programme.

Albany Highway is a busy arterial road with daily traffic volumes in the region of 18,000 vpd. Unless in exceptional circumstances construction processes which reduce Albany Highway to only one operating traffic lane during the daytime hours should not be employed as vehicle volumes are 1000vph or more between 7am and 7pm.

As the construction corridor runs down the centre of Albany Highway, the construction methodology / process may need to be adjusted so that a traffic lane can operate on either side of the construction area. This may require the temporary use of the bus lanes and / or road shoulder areas as traffic lane.

When the crossing of Albany Highway is required (that is to reach the road centre from Appleby Road, and then to reach No14 John Glenn Avenue from the road centre) and the closure of all traffic lanes in one direction is required, then the option to undertake works at night (e.g. 8pm – 5am) when traffic volumes are lower, will need to be investigated.

Undertaking the works at night would allow for one or both traffic lanes to be closed and diversions established to redirect through traffic while the works are undertake with less disruption to the road network.

7.13.6 Traffic Assessment: Albany Highway / Appleby Road

The potential effect of the works on the Albany Highway / Appleby Road intersection (when the construction works on Appleby Road reach Albany Highway) has been modelling using the SIDRA intersection analysis programme and are summarised in Tables 27 and 28 below.

While the intersection currently operates under priority control with a give-way control for movements on Appleby Road, it is assumed that when works at or in the immediate vicinity of the intersection, the requirement for lane space for excavation and working would necessitate the closure of some lanes and the reallocation of space within the remaining lanes.

In the model (the results of which are presented below) it has been assumed that the northbound lane and Albany Highway north of Appleby has been blocked for construction and northbound flow occurs via the central median and a section of the southbound carriageway, southbound traffic and traffic turning right into Appleby Road share the same single lane formed from the balance of the Albany Highway southbound carriageway. The eastbound (exit) lane of Appleby Road is assumed to be closed due to the works and hence entry and exit movements share (alternately) the westbound (entry) lane. Hence manual or temporary signal control is required to be imposed at the intersection to regular movements into and out of Appleby Road.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Albany Highway (northbound)	Through	0.1	A	0	169.0	F	959
	Left	4.7	A	0	167.0	F	959
Albany Highway (southbound)	Through	0.0	A	0	223.0	F	869
	Right	17.2	C	18	225.3	F	869
Appleby Road	Left	10.2	B	3	131.5	F	63
	Right	26.7.	D	3	131.8	F	63
All vehicles		**3.2**	**-**	**18**	**191.0**	**F**	**959**

Table 27: Model Results for Albany Highway / Appleby Road Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Albany Highway (northbound)	Through	0.1	A	0	Not modelled see discussion below		
	Right	4.6	A	0			
Albany Highway (southbound)	Through	0.0	A	0			
	Right	10.5	B	0			
Appleby Road	Left	9.7	A	2			
	Right	50.9	F	15			
All vehicles		**4.1**	**-**	**15**			

Table 28: Model Results for Albany Highway / Appleby Road Intersection – PM Network Peak Hour

The tables show that operating the intersection under restricted lane allocation (with right turns from Albany Highway into Appleby Road from a single southbound through lane) creates severe delays and unacceptable performance during peak periods.

An alternative is to ban right turns from Albany Highway into Appleby Road, and detour this traffic so that it approaches the intersection from the south (for a left turn into Appleby Road). This allows north- and southbound traffic on Albany Highway to flow simultaneously (except when the temporary traffic lights are allowing traffic to exit Appleby Road).

The results of SIDRA modelling for this scenario are shown in Table 29 and 30 below.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Albany Highway (northbound)	Through	0.1	A	0	26.7	C	372
	Left	4.7	A	0	19.8	B	372
Albany Highway (southbound)	Through	0.0	A	0	5.2	A	86
	Right	15.2	C	15	n/a	n/a	n/a
Appleby Road	Left	9.7	A	3	56.6	E	30
	Right	36.2	E	4	60.0	E	30
All vehicles		**2.9**	**-**	**15**	**17.9**	**B**	**372**

Table 29: Model Results for Albany Highway / Appleby Road Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Albany Highway (northbound)	Through	0.1	A	0	16.0	B	163
	Left	4.6	A	0	9.1	A	163
Albany Highway (southbound)	Through	0.1	A	0	14.1	C	223
	Right	10.0	A	0	n/a	n/a	n/a
Appleby Road	Left	9.2	A	2	46.3	D	34
	Right	99.3	F	23	49.7	D	34
All vehicles		**4.1**	**-**	**23**	**14.2**	**B**	**223**

Table 30: Model Results for Albany Highway / Appleby Road Intersection – PM Network Peak Hour

As can be seen in the above results, while delay and queuing increases notably from the current state, the overall performance of the intersection is more in line with what could be considered acceptable for a short term works programme.

Detoured traffic totals some 200 vehicles in the morning peak hour. Assuming that most of this traffic approaches from north of the Albany Highway / Rosedale Road intersection, it is suggested that the traffic can be detoured via Rosedale Road, William Pickering Drive, and Bush Roads and then into Albany Highway. This detour is approximately 3.5km in length, at an average speed of 40km/h (taking the 50km/h speed limit and assuming some delays for stoppages at intersections) the full detour would add approximately 4 minute travel time to the current route between Albany Highway / Rosedale Road and Appleby Road. All of the turn movements required to achieve this detour occur at roundabouts or a signalised intersection. No uncontrolled right turns are required which will help to manage the effects of the detour.

7.13.7 Mitigation Summary

As with the works in the vicinity of Greenhithe School it is recommended that if practical the construction along the Albany Junior High School frontage of Appleby and across Albany Highway should occur during a school holiday period when traffic to and from the school will be substantially reduced (i.e. the right turn in volume), and typically traffic volumes on the wider road network are also reduced.

Such scheduling would considerably assist with the mitigation of the construction effects.

During construction on Albany Highway the construction methodology / process should allow for one traffic lane to operate on either side of the construction area.

Bus lanes and / or road shoulder areas could be temporary used traffic lanes.

For works which require the crossing of Albany the option to undertake works at night (e.g. 8pm – 5am) should be investigated.

7.14 Albany Highway to William Pickering Drive

7.14.1 Overview

The pipeline will proceed from Albany Highway to William Pickering Drive via No14 John Glenn Avenue, and along John Glenn Avenue to the intersection with William Pickering Drive. All works will be via an open trenching. The pipeline meets William Pickering Drive at the four-leg roundabout intersection of William Pickering Drive, John Glenn Avenue and Douglas Alexander Parade. The pipeline will then proceed north along William Pickering Drive to the intersection with Piermark Drive.

Photograph 37 shows the proposed pipeline route along John Glenn Avenue.

Photograph 37: John Glenn Avenue view towards No14 John Glenn Avenue

7.14.2 Traffic Environment

Between Albany Highway and John Glenn Avenue the pipeline will cross a private property (No14 John Glenn Avenue) and then then re-enter the public road corridor to travel along John Glenn Avenue to William Pickering Drive. John Glenn Avenue is a local road with a single traffic lane in each direction and a typical carriageway width of 10.5m. Kerbside parking is generally permitted on both sides of the road. As shown in Photograph 38 this kerbside parking is heavily utilised during daytime working hours. Footpaths are provided on both sides of John Glenn Avenue.

Some land fronting John Glenn Avenue (including the property via which the pipeline will cross from Albany Highway) is undeveloped, but the developed land in the vicinity is generally occupied by warehousing and commercial activities.

John Glenn Avenue is a cul-de-sac, and only connects to the wider road network via its intersection with William Pickering Drive. One side road, Unity Drive North, leads off John Glenn Avenue, and is also a cul-de sac.

Photograph 38 shows the general layout of the John Glenn Drive / Unity Road North intersection.

Photograph 38: John Glenn Drive / Unity Drive North Intersection

The intersection of William Pickering Drive, John Glenn Avenue and Douglas Alexander Parade is a four-leg roundabout. The roundabout has a single circulating lane and the central island had a diameter of 15m.

Photograph 39 shows this intersection.

Photograph 39: William Pickering Drive / John Glenn Avenue / Douglas Alexander Parade Intersection

William Pickering Drive has a carriageway width of 12.5m and provides one traffic lane in each direction separated by a painted flush median. Kerbside parking is not permitted in the vicinity of the intersection but is otherwise permitted on both sides of the road in marked parking lanes.

Photograph 40 shows the typical carriageway of William Pickering Drive between John Glenn Avenue and Piermark Drive.

Photograph 40: William Pickering Drive (view north)

In the District Plan, William Pickering Drive is classified as a Secondary Arterial Road.

Bus services run along William Pickering Drive, and there are two bus stops (one northbound, one southbound) on the section along which the pipeline will run between John Glenn Avenue and Piermark Drive. These bus stops are approximately 70m south of the intersection with John Glenn Avenue and are served by three routes, each with a 30 minute frequency.

The intersection of William Pickering Drive and Piermark Drive is a priority "T" intersection with priority given to traffic on William Pickering Drive. At the intersection with Piermark Drive the flush median is used as a turning bay for vehicles making the right turn into Piermark Drive.

In the District Plan Piermark Drive is classified as a Collector Road. William Pickering Drive carries approximately 2.5 to 3 times the traffic volume of Piermark Drive (see Section 7.14.3).

Piermark Drive is approximately 11.5m wide between kerbs and has one lane of traffic in each direction. Kerbside parking is generally permitted on both sides of the road.

Both William Pickering Drive and Piermark Drive have footpaths and grass berms on each side of the road.

The intersection is shown in Photograph 41 below.

Photograph 41: William Pickering Drive / Piermark Drive Intersection

7.14.3 Traffic Volumes

The intersection of John Glenn Avenue and Unity Drive North was surveyed on Wednesday 19 November 2014 and Saturday 22 November 2014 for the weekday morning, afternoon and Saturday lunchtime peak periods. The results of this survey are shown in Figures 7 to 9 and summarised in Table 31 below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
John Glenn Avenue	2014	1,100	105	115
Unity Drive North	2014	300	33	27

Table 31: Traffic Flow Data: Unity Drive North and John Glenn Avenue

A traffic survey was undertaken at the intersection of William Pickering Drive and Piermark Drive on Wednesday 19 November 2014 and Saturday 22 November 2014 for the weekday morning, afternoon and Saturday lunchtime peak periods. The results of this survey are shown in Figures 7 to 9.

Traffic volume data for William Pickering Drive and Piermark Drive has been sourced from Auckland Council and is summarised in Table 32 below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
William Pickering Drive	2014	12,833	1,533	1,413
Piermark Drive	2014	3,535	418	325

Table 32: Traffic Flow Data: William Pickering Drive and Piermark Drive

Approximately 90% of the traffic volume on Piermark Drive is recorded during the daytime period of 7am-7pm, suggesting that traffic volumes overnight are extremely low and night works may be the most effective working opportunity for construction in this area. Similarly traffic volume data and observations for William Pickering Drive and John Glenn Avenue suggest that traffic volumes during the night-time hours are low.

Following a revision to the proposed pipeline route, a traffic survey was undertaken at the intersection of William Pickering Drive, John Glenn Avenue and Douglas Alexander Parade on Thursday May 14 2015 for the weekday morning and afternoon peak periods. The results of this survey are shown in Figures 7 to 8.

7.14.4 <u>Construction Operation Traffic Effects</u>

It is intended to install the pipeline along John Glenn Avenue, near the southern edge of the carriageway, via open trenching. The installation corridor will take up approximately 50-70% of the total carriageway width of 10.5m. To accommodate this and other road users, kerbside parking will need to be prohibited around the construction area.

Along William Pickering Drive the pipeline will be installed along the northbound carriageway before crossing William Pickering Drive at the intersection with Piermark Drive and along Piermark Drive.

Figure27 shows the construction corridor.

A ~100-150m long one lane operation around the construction area (including safety zones) will be required if the space available to other road users is less than 5.9m (this width allows for two 2.75m wide traffic lanes separated by 400mm wide traffic cones).

Peak hour traffic volumes on John Glenn Avenue are around 130 vph (two-way), this is a sufficiently low volume as to allow daytime one lane traffic operations, however when works in the immediate vicinity of the intersection with William Pickering Drive are undertaken, the potential for delays and congestion will be increased and this could potentially effect traffic flows on William Pickering Drive, therefore some works should be conducted overnight when traffic volumes on both John Glenn Avenue and William Pickering Drive are lower.

Daytime two-way traffic volumes on William Pickering Drive can be up to 1,500 vph and are consistently over 500 vph between 7am and 7pm. At these traffic volumes long-term, the operation of a one-lane traffic system (e.g. over full course of a working day for a number of days) would not be sustainable.

Tables 33 and 34 show the effect of the construction works on the William Pickering Drive / John Glenn Avenue / Douglas Alexander Parade intersection assuming temporary active control of the and a change in operation from a roundabout to a cross-roads intersection.

It has been assumed that careful staging and management of the works will allow two lane, two way flow under a reduced traffic speed on William Pickering Drive. Where it is impractical to maintain two lane, two way flow on William Pickering Drive such works should not occur during peak times unless essential, and serious consideration should be given to undertaking these works at night.

No allowance has been made for drivers who may choose to divert around the works area in order to avoid potential delays.

The modelling indicated that if all movements were maintained at the intersection queuing of up to 350m in length may occur on the northbound approach of William Pickering Drive during the morning peak hour. Such queuing would extend past the upstream intersection will Piermark Drive and towards Rothwell Avenue.

If the right turn into Douglas Alexander Parade was banned and these vehicles diverted via Rosedale Road, a significant reduction in queue length is anticipated, down to 235m (approximately the distance between the intersections with John Glenn Avenue and Piermark Drive). It is noted that these are results for peak time operations, and during interpeak and non-peak periods when traffic volumes are lower, queuing would also be lower. Additional peak time controls could be imposed on traffic movements out of Douglas Alexander Parade to further improve intersection performance if required.

In the construction scenario reported in Table 33 it has been assumed that only the right turn ban from William Pickering into Douglas Alexander Parade is operating.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
William Pickering Drive (Southbound)	Left	4.9	A	20	22.4	C	81
	Through	4.8	A	20	17.8	B	81
	Right (into JG)	8.9	A	20	22.4	C	81
William Pickering Drive (Northbound)	Left (into JG)	5.7	A	73	25.6	C	235
	Through	5.8	A	73	21.0	C	235
	Right	9.7	A	73	n/a	n/a	n/a
John Glenn Avenue	Left	9.4	A	3	38.8	D	8
	Through	9.4	A	3	34.2	D	8
	Right	13.7	B	3	38.8	D	8
Douglas Alexander Parade	Left	5.4	A	8	45.2	D	47
	Through	5.5	A	8	40.6	C	47
	Right	9.4	A	8	45.2	D	47
All vehicles		**6.3**	**A**	**73**	**23.1**	**C**	**235**

Table 33: Model Results for William Pickering Drive / John Glenn Avenue / Douglas Alexander Parade Intersection – AM Network Peak Hour

The afternoon peak hour modelling indicates that if all movements were maintained at the intersection queuing of up to 190m in length may occur on the northbound approach of William Pickering Drive. Volumes undertaking the right turn into Douglas Alexander Parade are low, so there would be limited benefit in removing the right turn option. However there would be advantages to limiting or restricting the right turn volumes out of John Glenn Avenue and Douglas Alexander Parade in order to allow the movements from this leg to occur simultaneously and reduce the overall delay to traffic movements on William Pickering Avenue.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
William Pickering Drive (Southbound)	Left	4.8	A	14	13.7	B	55
	Through	4.8	A	14	11.7	B	55
	Right (into JG)	9.3	A	14	13.9	B	55
William Pickering Drive (Northbound)	Left (into JG)	3.4	A	26	27.7	C	192
	Through	3.4	A	26	25.7	C	192
	Right	7.3	A	26	27.9	C	192
John Glenn Avenue	Left	7.8	A	6	46.9	D	35
	Through	7.4	A	6	45.0	D	35
	Right	11.4	B	6	47.1	D	35
Douglas Alexander Parade	Left	5.5	A	12	45.5	D	84
	Through	5.5	A	12	43.5	D	84
	Right	9.4	A	12	45.7	D	84
All vehicles		**5.2**	**A**	**26**	**28.1**	**C**	**192**

Table 34: Model Results for William Pickering Drive / John Glenn Avenue / Douglas Alexander Parade Intersection – PM Network Peak Hour

The increases in average vehicle delay predicted by the modelling are not excessive given the short term nature of the works, instead the controls discussed above are proposed in order to manage queuing and hence maintain the efficiency of the road network.

In order to maintain two way traffic flows on William Pickering Drive kerbside parking should be banned during the construction works and the central median utilised as a traffic lane.

Overnight traffic volumes (7pm-7am) on William Pickering Avenue are markedly lower than those during the daytime hours. As an example the 7-8pm traffic volume is 270 vph. If it is not possible to maintain two-way traffic flows it is recommended that construction activities occur overnight where practical.

Crossing the intersection of William Pickering Drive / Piermark Drive via open trenching will require the staged closure of traffic lanes as the works move across the road. As indicated in Table 32 and Figures 7 and 8, the intersection is heavily trafficked at peak times. Additionally, the crossing into Piermark Drive will affect all three legs of the intersection (two directly by construction and the third due to construction on the other two).

To create additional traffic lane space it is recommended that kerbside parking be temporarily prohibited for an extended distance on either side of the intersection.

As construction proceeds across the intersection, the northbound traffic lane will be closed and traffic likely diverted into the central median and / or southbound carriageway. The morning peak hour sees relatively high vehicle numbers turning right into Piermark Drive.

To allow the intersection to operate efficiently under temporary traffic control, it is recommended that right turns be prohibited during the works. Detours are available via Bush Road. Figure 28 provides some indication of potential construction staging in this location.

Tables 35 and 36 show the effect of the construction works assuming temporary active control of the intersection and a right turn ban in place. It has been assumed that careful staging of the works will allow two lane, two way flow under a reduced traffic speed limit on William Pickering Drive.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
William Pickering Drive (Southbound)	Through	4.6	A	0	8.6	A	60
	Left	0.0	A	0	12.6	B	60
William Pickering Drive (Northbound)	Through	0.1	A	0	13.8	B	129
	Right	7.1	A	7	n/a	n/a	n/a
Piermark Drive	Left	6.6	A	4	33.0	C	37
	Right	22.4	C	2	34.8	C	37
All vehicles		**2.0**	**-**	**7**	**13.5**	**B**	**129**

Table 35: Model Results for William Pickering Drive / Piermark Drive Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
William Pickering Drive (Southbound)	Through	0.0	A	0	10.6	B	59
	Left	4.6	A	0	14.6	B	59
William Pickering Drive (Northbound)	Through	0.0	A	0	10.3	B	58
	Right	7.1	A	4	n/a	n/a	n/a
Piermark Drive	Left	6.9	A	5	16.9	B	21
	Right	15.4	B	4	18.8	B	20
All vehicles		**2.0**	**-**	**5**	**11.6**	**B**	**59**

Table 36: Model Results for William Pickering Drive / Piermark Drive intersection – PM Network Peak Hour

Construction may also require the temporary closure of the western footpath on William Pickering Drive. Any temporary traffic management measures will thus be required to provide for a pedestrian diversion via a temporary footpath and / or accommodate pedestrians diverted across the road as a result of the footpath closure.

7.14.5 Mitigation

- A wheelwash or truck cleaning equipment should be installed prior to construction traffic entering public road network.
- All work areas should be barriered / fenced.
- The intersection of William Pickering Drive / John Glenn Avenue / Douglas Alexander Parade should be crossed in stages in order to keep one traffic lane in each direction on William Pickering open, and to maintain access to John Glenn Avenue. This may require temporary changes in the method of intersection control.
- Kerbside parking on John Glenn Avenue should be banned during the construction works to allow for construction, and to increase the available carriageway space.
- Kerbside parking on William Pickering Drive should be banned during the construction to allow for construction, and to increase the available carriageway space.
- Two-way traffic flow should be maintained on William Pickering Drive, potentially via the use of central flush median as a temporary traffic lane. If the maintenance of two-way flow is not possible, then works should occur overnight when traffic volumes are lower.
- Bus Services and accessibility along William Pickering Drive should be maintained. This may require the operation of temporary / relocated bus stops on occasion. Liaison with the Public Transport Operations team of Auckland Transport should occur to ensure that bus stop closures / relocations are suitably advertised and co-ordinated.
- Temporary footpaths and / or other interim pedestrian infrastructure should be installed as required to accommodate pedestrians if it is necessary to close the western footpath of William Pickering Drive.
- The intersection of William Pickering Drive / Piermark Drive should be crossed in stages in order to keep one traffic lane in each direction on William Pickering Drive open.
- Temporary restrictions in the availability of the right turn into Piermark Drive may be required to maintain traffic flow.
- The option of working at night to cross the intersections of John Glenn Avenue / William Pickering Drive / Douglas Alexander Parade and William Pickering Drive / Piermark Drive should be considered.
- Public notices and a publicity campaign should be prepared in advance of the works to adverse businesses, the public and motorists of the works and the potential for the delay. The campaign could have the bonus of encouraging the diversion, delay or otherwise in reduction in trip volumes during the works period which would assist with the management of traffic delay and congestion.

7.15 Piermark Drive to Bush Road

7.15.1 Overview

Piermark Drive is a link road connecting William Pickering Drive with Bush Road. The adjacent properties are largely commercial or light industrial. The road has steady traffic flows during business hours and is heavily parked on both sides.

It is intended to install the pipeline along Piermark Drive, close to the centreline, via open trenching.

On reaching Bush Road the pipeline will turn right and proceed 30m south along the northbound carriageway before crossing the southbound carriageway and entering a right of way through to Rosedale Park.

It intended that the works at the Piermark Drive / Bush Road intersection and along and across Bush Road will be by open trenching.

7.15.2 Traffic Environment

Piermark Drive is approximately 500m long and has a typical carriageway width of 10.5m. One traffic lane in each direction is provided and kerbside parking is permitted along most of both sides of the road. Piermark Drive is not a bus route. In the District Plan Piermark Drive is defined as a Collector Road.

Photograph 42: Typical Cross section of Piermark Drive

The intersection of Bush Road and Piermark Drive is a priority "T" intersection with priority given to traffic on Bush Road. In the District Plan Bush Road is classified as a Secondary Arterial Road.

Bush Road has a carriageway width of 12.5m and provides one traffic lane in each direction separated by a painted flush median. At the intersection with Piermark Drive is a marked turn bay for southbound vehicles making the right turn into Piermark Drive. Kerbside parking is not permitted in the vicinity of the intersection with Piermark Drive but is otherwise generally permitted on both sides of Bush Road.

Footpaths and grass berms are provided on each side of Bush Road. The intersection is shown in photograph 43 below.

Photograph 43: Intersection of Piermark Drive / Bush Road

7.15.3 Traffic Volumes

Recent traffic count data provided by Auckland Transport indicates average weekday traffic on Piermark Drive of 3,535 vpd. In keeping with its commercial nature, heavy vehicles make up a relatively high proportion (~12%) of this volume. As previously noted, approximately 90% of the traffic volume on Piermark Drive is recorded during the daytime period of 7am-7pm; suggesting that traffic volumes overnight are extremely low and night works may be the most effective working opportunity for construction in this area.

A traffic survey was undertaken at the intersection of Bush Road and Piermark Drive on Wednesday 19 November and Saturday 22 November for the weekday morning, afternoon and Saturday lunchtime peak periods. Results are shown in Figures 7 to 9.

Data for daily traffic volumes on Bush Road has been sourced from Auckland Transport and is summarised in Table 37 below.

Road	Traffic Count Date	Daily Traffic Volume (veh)	AM Peak Hour Volume (veh)	PM Peak Hour Volume (veh)
Bush Road	2014	10,806	1,067	907

Table 37: Traffic Flow Data: Bush Road

The data indicates that Bush Road is a Level 2 Road under the CoPTTM classification system, with volumes in excess of 10,00vpd and peak hour volumes around 1,000vph.

7.15.4 Construction Operation Traffic Effects: Traffic Management

It is intended to install the pipeline along Piermark Drive, near the centreline, via open trenching. The installation corridor will take up approximately 50-70% of the total carriageway width of 10.5m. To accommodate this and other road users, kerbside parking will need to be prohibited around the construction area.

Figure29 shows the construction corridor.

A ~100-150m long one lane operation around the construction area (including safety zones) will be required if the space available to other road users is less than 5.9m (this width allows for two 2.75m wide traffic lanes separated by 400mm wide traffic cones).

Peak hour traffic volumes on Piermark Drive are around 500 vph (two-way) with typical daytime interpeak volumes around 300-350 vph. 500vph is the threshold volume at which, according to CoPTTM, delays of more than 5 minutes can be expected if a lane closure is within 200m of an intersection. With a length of 500m, most of Piermark Drive is within 200m of an intersection. Some volume will be through traffic, which could be reduced by restricting access only to vehicles with business in Piermark Drive. However, enforcing this restriction would be difficult

By contrast, typical hourly traffic volumes between 7pm and 7am are substantially less than 100vph. It is therefore recommended that construction occur overnight. Piermark Drive is primarily a commercial area and hence any disruption to residential property would be minimal.

Crossing the intersection of Bush Road / Piermark Drive via open trenching will require the staged closure of traffic lanes as works move across the road due to the intersection being heavily trafficked at peak times. Figure 30 outlines a potential staging scenario.

To create additional traffic lane space it is recommended that kerbside parking is prohibited for an extended distance on either side of the intersection.

As construction proceeds eastward across the intersection, the northbound traffic lane will be closed and traffic likely diverted into the central median and / or southbound carriageway. In the morning peak hour a relatively high number of vehicles turn right into Piermark Drive; it is recommended that the right turn be prohibited during construction. Detour options are available via William Pickering Drive. To minimise disruption, work at this site and similar works at the William Pickering Drive / Piermark Drive intersection should be done at different times.

Tables 38 and 39 show the effect of construction, assuming temporary active control of the intersection and the right turn ban discussed above. It has been assumed that careful staging of the works allows two lane, two way flow under a reduced traffic speed on Bush Road.

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Bush Road (northbound)	Through	0.1	A	0	16.7	B	240
	Left	4.7	A	0	23.6	C	240
Bush Road (southbound)	Through	0.1	A	0	17.0	B	244
	Right	13.4	B	13	n/a	n/a	n/a
Piermark Drive	Left	10.7	B	6	48.2	D	44
	Right	29.8	D	3	42.8	D	4
All vehicles		**2.4**	**-**	**13**	**33.9**	**B**	**244**

Table 38: Model Results for Bush Road / Piermark Drive Intersection – AM Network Peak Hour

Approach		Existing			Construction		
		Average Delay (s)	LOS	95th% Queue (m)	Average Delay (s)	LOS	95th% Queue (m)
Bush Road (northbound)	Through	0.1	A	0	13.5	B	121
	Left	4.7	A	0	20.5	C	121
Bush Road (southbound)	Through	0.1	A	0	18.9	B	156
	Right	8.7	A	4	n/a	n/a	n/a
Piermark Drive	Left	8.5	A	9	27.4	C	38
	Right	20.7	C	6	26.6	C	8
All vehicles		**2.3**	**-**	**9**	**18.3**	**B**	**156**

Table 39: Model Results for Bush Road / Piermark Drive Intersection – PM Network Peak Hour

Construction will also require the temporary closure of the western footpath on Bush Road. Any temporary traffic management measures at the intersection will need to accommodate pedestrians diverted across the road by that closure.

7.15.5 Construction Operation Traffic Effects: Property Access

As construction proceeds along Piermark Drive it will cut across access for the adjacent properties. While some have two driveways, thus allowing construction to be staged so that only one is blocked at a time, many will have only one driveway. Additionally, most properties are serviced by medium to large commercial vehicles which require a wide turning space.

Again, options to reduce the width of the construction corridor should be investigated along with the possibility of undertaking works in the evening or overnight. Communication should occur with all property owners and tenants along Piermark Drive prior to construction and their individual access requirements discussed.

7.15.6 Mitigation Summary

- Communication should occur with all property owners and tenants along Piermark Drive prior to construction and their individual access requirements discussed.
- Access to the adjacent properties should be maintained as far as practical.
- The option of night works should be investigated.
- Works at the Piermark Drive / Bush Road intersection will need to be staged to maintain traffic capacity through the intersection. Works at this intersection should not occur at the same times as works at the William Pickering Drive / Piermark Drive intersection.

7.16 Rosedale Park

7.16.1 Overview

Construction along the Kea Campervans driveway to the gully which divides this property from Rosedale Park will be via open trenching.

For the gully crossing into Rosedale Park the single 710mm nominal diameter pipe will be replaced by twin 450mm nominal diameter pipes installed by directional drilling. Drilling will occur from Rosedale Park towards the Kea Campervans site, and the pipeline thrust through in the opposite direction.

Inside Rosedale Park, construction will be via open trenching. The single 710mm nominal diameter pipeline will be reinstated and continue through to the Rosedale WWTP.

7.16.2 Construction Operation Traffic Effects

The Kea Campervans driveway is currently limited to left-turn exits only, and it is recommended that construction vehicles adhere to this. Additionally, given the proximity of the driveway to the Bush Road / Piermark Drive intersection, it is recommended that only left turn entry is permitted.

8. General Principles for Construction Works

8.1 General Operating Principles for Access to Work Sites

It is proposed that the following principles are employed for all site access locations:

- Wherever practical heavy vehicle movements to or from a live (non-closed) lane of the road network should only occur in a forward direction (i.e. limit reverse manoeuvring).
- Site areas are properly fenced or equipped with barriers to prevent unauthorised pedestrian access, and the worksite staffed and supervised so that pedestrians do not inadvertently enter the site.
- Signage (to CoPTTM specifications) is erected to alert both pedestrians and other road users and truck drivers of the presence of heavy vehicles and pedestrians.
- For heavy vehicle movements to and from individual sites, a traffic controller is on hand to co-ordinate all truck movements.

These measures will promote safe access to and from each site.

8.2 General Operating Principles for Operations around Private Properties / Dwellings and Community Facilities

- Property owners and tenants along the project route should receive initial contact from the project team at least one month prior to the commencement of works, with additional contacts at two weeks and one week in advance of works. Any delay or advancement of the work schedule should be communicated to affected property owners and tenants as soon as practical.
- Where works have the potential for a significant impact on access, (e.g.: along Traffic Road, and the properties on the right of way in Witton Place) more detailed and personal communication may be required.
- Where works are to occur along busy arterial or collector level roads (e.g. Albany Highway or William Pickering Drive) there should be a public awareness campaign to alert drivers and other road users to the potential for delays and to suggest route and / or journey timing changes.
- Access to private properties should be maintained at all times wherever practical. Where vehicle access must be temporarily interrupted (e.g. trenching across a driveway connection) the duration of such interruptions should be minimised.
- Works across cul-de-sacs or roads with limited alternative access routes should be staged so that access to multiple properties is not simultaneously blocked.
- Working areas around schools and other community facilities e.g.: parks should be securely fenced to prevent public access (particularly access by children).

8.3 Traffic Environmental Impact Considerations

The following operational and environmental measures are recommended:

- Equipment and facilities for truck cleaning prior to departure should be provided where there is exposed ground on the site that is traversed by site vehicles.
- All excavated material will be covered prior to being transported off- site to prevent aerial dispersal onto the road network.
- Where appropriate, a bund should be installed around the site to prevent the run-off of exposed material and vehicle oil or fuel from the site roads and parking areas into the stormwater system.
- Truck drivers should be instructed to minimise traffic noise and disruption along the urban / residential portions of their route. Noise reduction measures should include avoiding engine braking where safely possible, avoiding heavy acceleration and not leaving engines idling unnecessarily.

8.4 Truck Waiting

Trucks waiting on surrounding roads should be minimised and avoided if practicable. Where waiting does occur, trucks will be expected to use a designated waiting area.

8.5 Road Signs

All traffic and warning signs to be erected should conform to the standards specified in CoPTTM. All on-road signs associated with the works should be covered at the end of each work day.

9. Mitigation of Traffic Effects Due to Construction

9.1 Overview

Most of the project pipeline will be constructed by open trenching, with tunnelling or directional drilling used elsewhere. Thanks to its progressive nature, the direct effects on traffic from open trenching are limited. A more significant factor is the use of the road carriageway as a construction corridor.

The following general principles should be observed:

- All temporary traffic management measures should meet or exceed the requirements in (CoPTTM).
- Where the physical or operational constraints of a site area make compliance with CoPTTM impractical or inappropriate, and a solution outside of the standard scope is proposed, such solution should not reduce safety levels (for employees and road users). Moreover, any such solution shall be approved via an Engineering Exception Decision (EED) submitted with the relevant TMP.
- A further detailed Construction Traffic Management Plan (CTMP) for the project should also be submitted to the local Road Controlling Authority (Auckland Transport) for approval prior to the commencement of works, and this CTMP should incorporate any amendments to the construction methodology.

Various mitigation measures to minimise the effects on the local road network of both the construction corridor and associated traffic are listed in previous section of this report.

9.2 Mitigation Summary

- All works areas should be barriered / fenced off from public access;
- All site access location should achieve minimum sight distance standards;
- Access to private properties should be maintained at all times, and vehicle access maintained where practical in order to minimise the effects on local residents and businesses. Where vehicle access must be temporarily interrupted alternative access methods such as steel plate ramps should be considered;
- Where footpaths and pedestrian crossing points are to be closed by the works temporary alternatives or diversions should be provided;
- Access to the Greenhithe Fire Station should be maintained at all times;
- Works at intersections should be staged to maintain acceptable minimum traffic capacities;
- Where bus-stops are to be temporarily closed during works alternative bus stop locations should be established. Liaison with AT will be required prior to this process;
- On Greenhithe Road, works in the vicinity of the Greenhithe Road / Churchouse Road / Isobel Road intersection (near Greenhithe School) should be conducted during a school holiday;

- Access to Greenhithe School should be maintained at all times during the school term;
- All side roads along the construction route which connect to the wider road network via a single intersection should not have that intersection fully closed to vehicle access at any time. Where a side road has more than one connection to the road network, at least one of these connections should be open and unaffected by works at any time;
- Works in the North Shore Golf Course car park should be scheduled so as to coincide with annual maintenance shutdown;
- On Appleby Road, works should be conducted during a school holiday to minimise the impact on the adjacent Albany Junior High School and, additionally, to take advantage of reduced traffic volumes on Appleby Road, and
- The option of night works in the Albany / Rosedale commercial area to minimise traffic and business disruption should be investigated.

10. Conclusion

TDG has been commissioned by Watercare to investigate the traffic engineering and safety implications of a proposal to construct an underground wastewater network through the northern suburbs of Auckland from an existing pump station in Hobsonville to the existing Rosedale WWTP, in order to ease the existing and future pressure on the network.

Construction will use three main methodologies. Open trenching will be used for most of the construction length apart from the Upper Harbour and Te Wharau crossings, where marine trenching and / or horizontal directional drilling will be used; and for crossing beneath SH18, where micro tunnelling will be used.

The traffic safety and engineering implications of this project have been assessed with regard to the potential effects on the adjacent road network and adjoining properties.

The primary traffic effects are from the works themselves, rather than from the transport of materials and staff to and from each site. As the project route is primarily within road carriageways the reduction of available lane width will create delays, particularly during peak times. These effects require careful and active management to ensure that the external effects of such activities are acceptable.

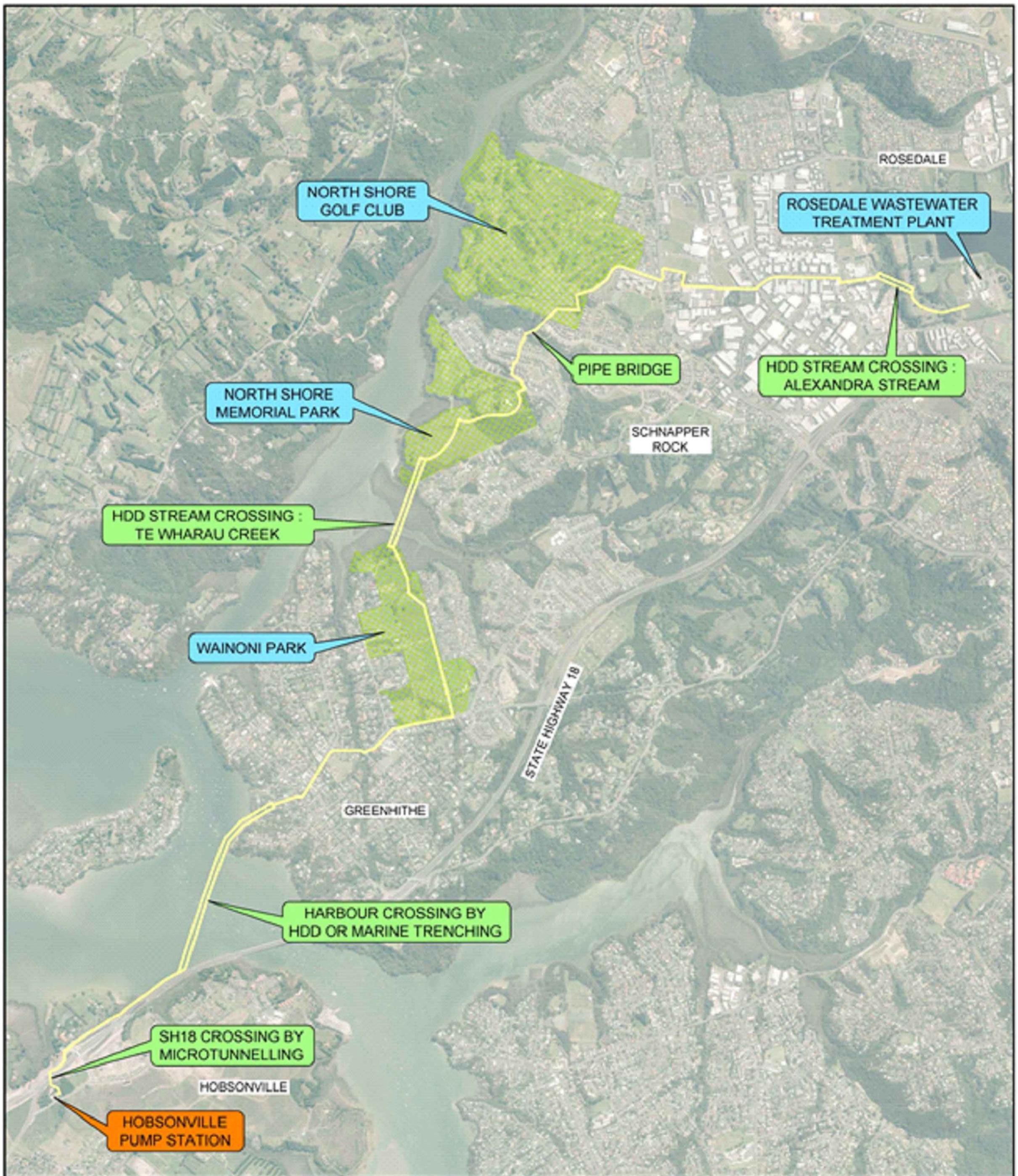
Sections 7 and 9 of this report provide mitigation measures for specific areas of the construction route. Subject to the implementation of these mitigation measures and the operating principles set out in Section 8 it is considered that the construction of the project can proceed with traffic effects that will be manageable and with the relatively short time frame of construction in any one particular area of the route acceptable.

A new pump station will be constructed in Hobsonville and operations / traffic at this location will continue post the construction of the Northern Interceptor Pipeline. Site investigations have confirmed that the vehicles crossing can be located to achieve acceptable sight distance, and the minimal traffic flows relating to the day to day operation of the Hobsonville PS will have a negligible effect on the surrounding road network.

TDG

Appendix A

Figures 1 to 31



NORTHERN INTERCEPTOR PHASE 1 PLAN

NOTE : THIS DRAWING IS FOR INFORMATION PURPOSES ONLY. FINAL ALIGNMENT SUBJECT TO CHANGE DURING DETAILED DESIGN.

0m 500m 1000m
NOT TO SCALE

LEGEND

Phase 1 Pipeline : Hobsonville Pump Station to Rosedale WWTP

PLACE / LOCATION

PUMP STATION

HARBOUR OR STREAM CROSSING

HDD Horizontal Directional Drilling

Wednesday, 20 May 2015 0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

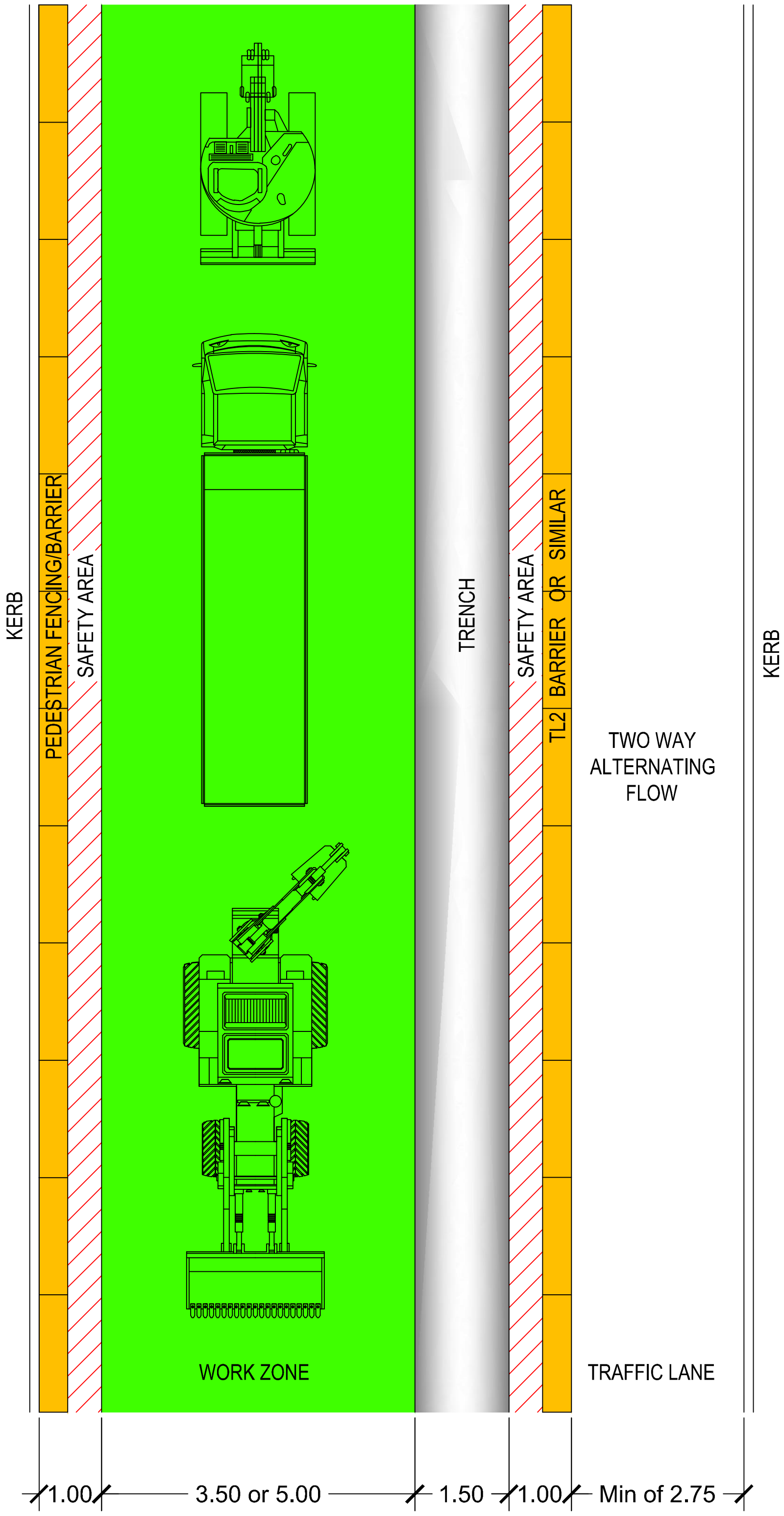
PROPOSED ROUTE

TDG

1

SCALE: N.T.S

TRAFFIC CONTROL TO BE ACHIEVED VIA MANUAL
TRAFFIC CONTROL OR TEMPORARY TRAFFIC SIGNALS



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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONCEPT OPEN TRENCHING OPERATION

TDG

2

SCALE: N.T.S

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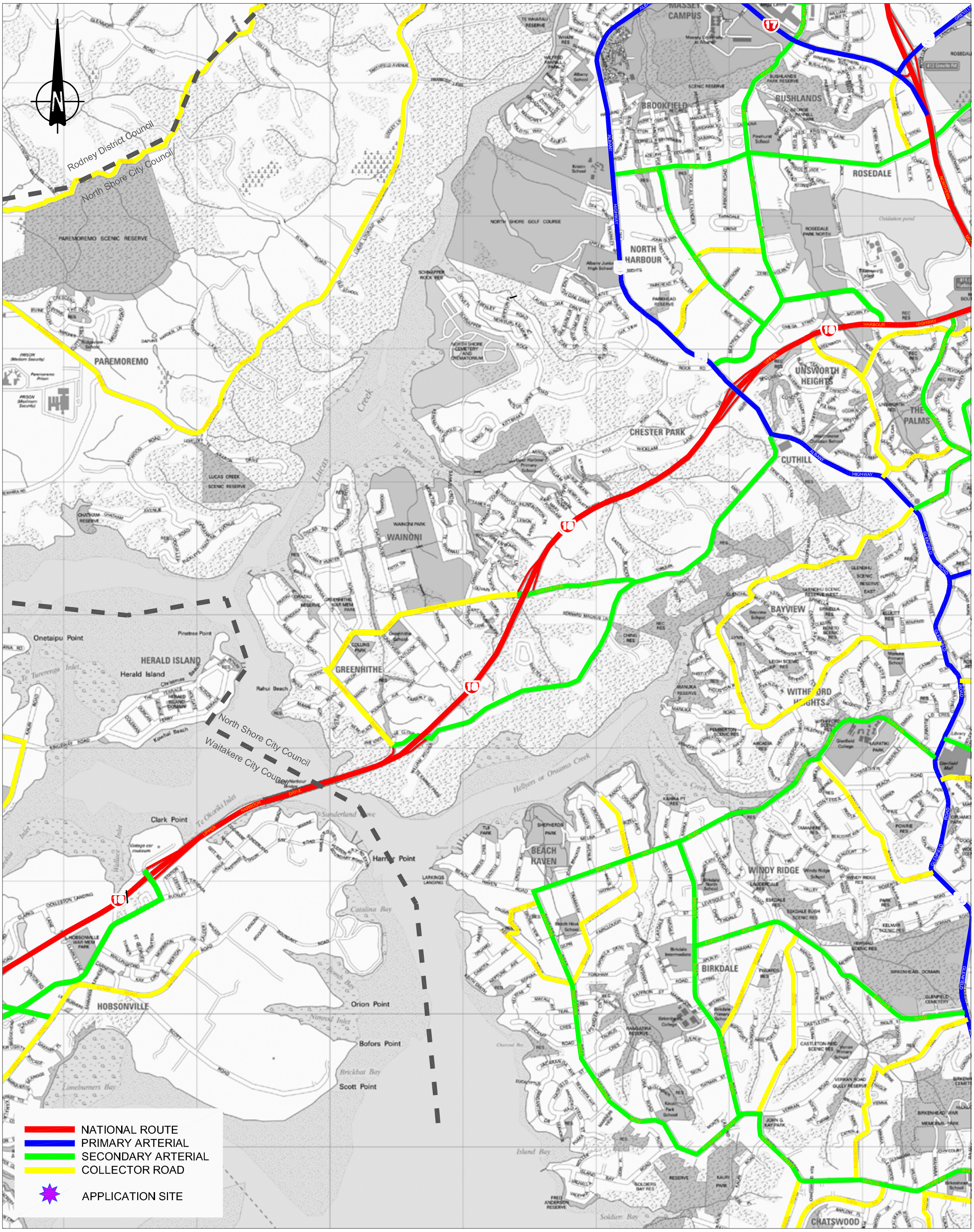

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

ROAD HIERARCHY

TDG

3

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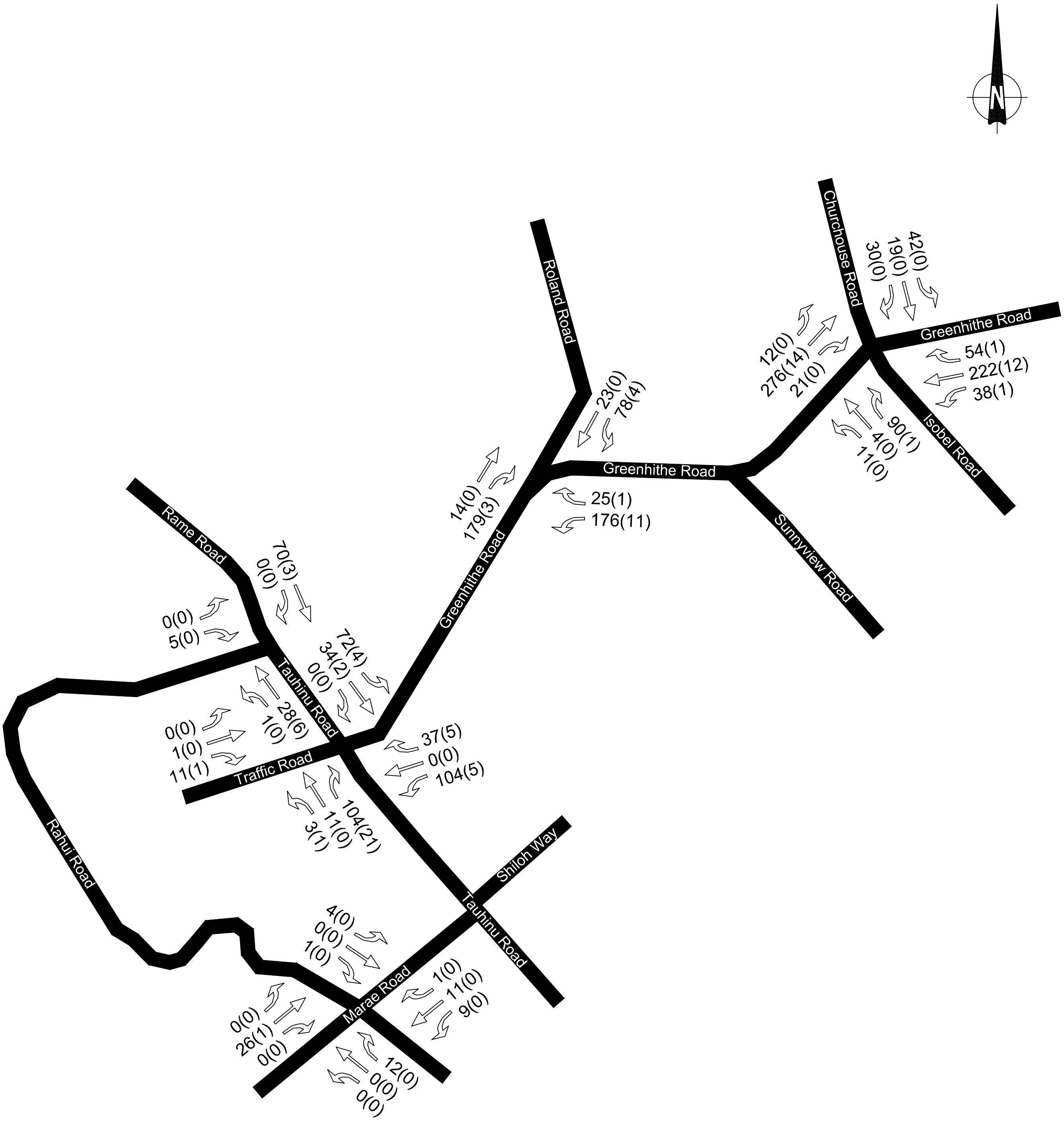

Wednesday, 20 May 2015 0 20mm

WEDNESDAY 19th NOVEMBER 2014
MORNING PEAK HOUR
8:00am - 9:00am

XX = Light Vehicles
(XX) = Heavy Vehicles

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

GREENHITHE AREA TRAFFIC COUNTS

4

SCALE: N.T.S

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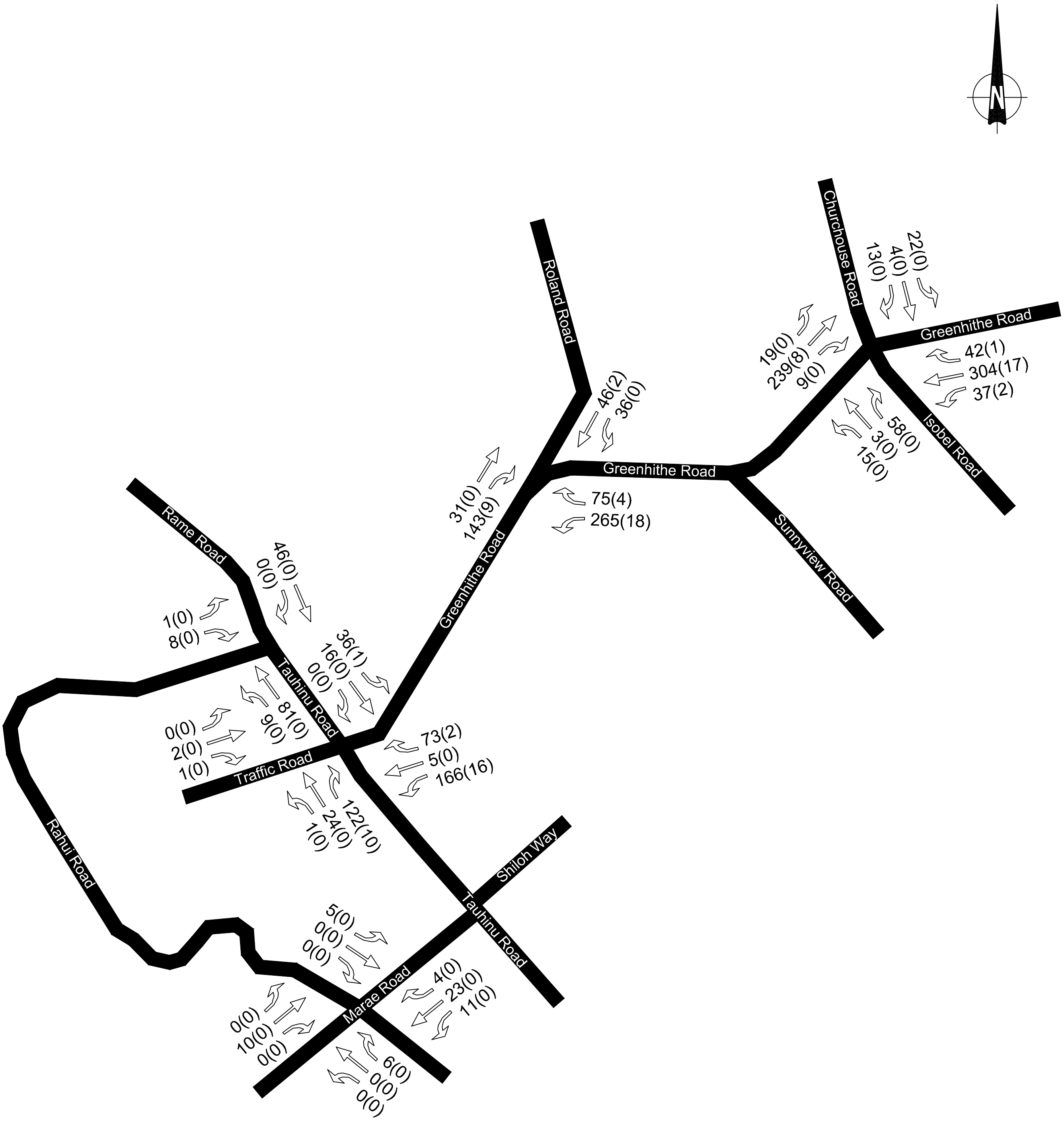

WEDNESDAY 19th NOVEMBER 2014
AFTERNOON PEAK HOUR
3:00pm - 4:00pm

XX = Light Vehicles
(XX) = Heavy Vehicles

Wednesday, 20 May 2015 0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

GREENHITHE AREA TRAFFIC COUNTS

TDG

5

SCALE: N.T.S

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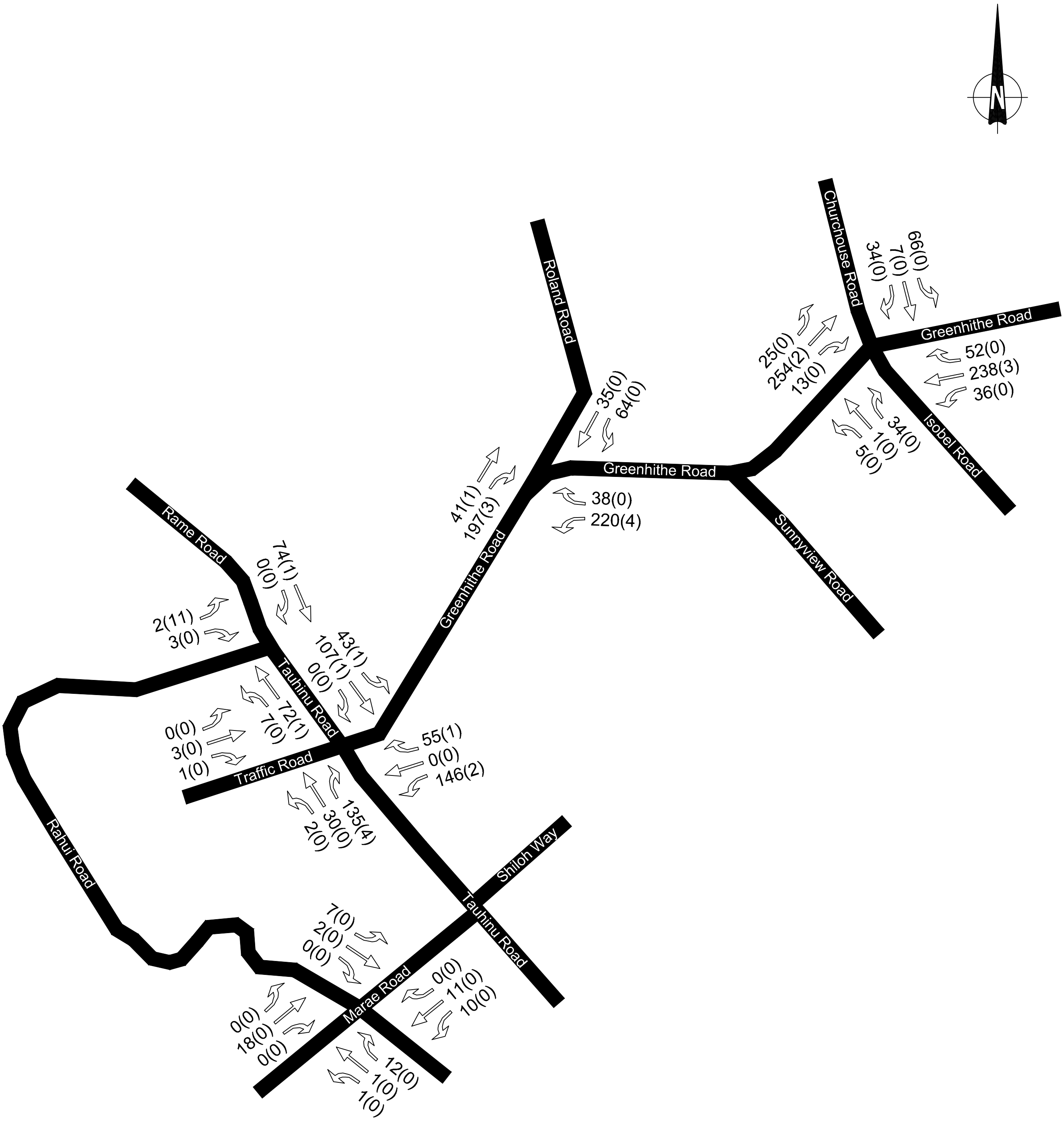

SATURDAY 22nd NOVEMBER 2014
PEAK HOUR
11:30am - 12:30pm

XX = Light Vehicles
(XX) = Heavy Vehicles

Wednesday, 20 May 2015 0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

GREENHITHE AREA TRAFFIC COUNTS

TDG

6

SCALE: N.T.S

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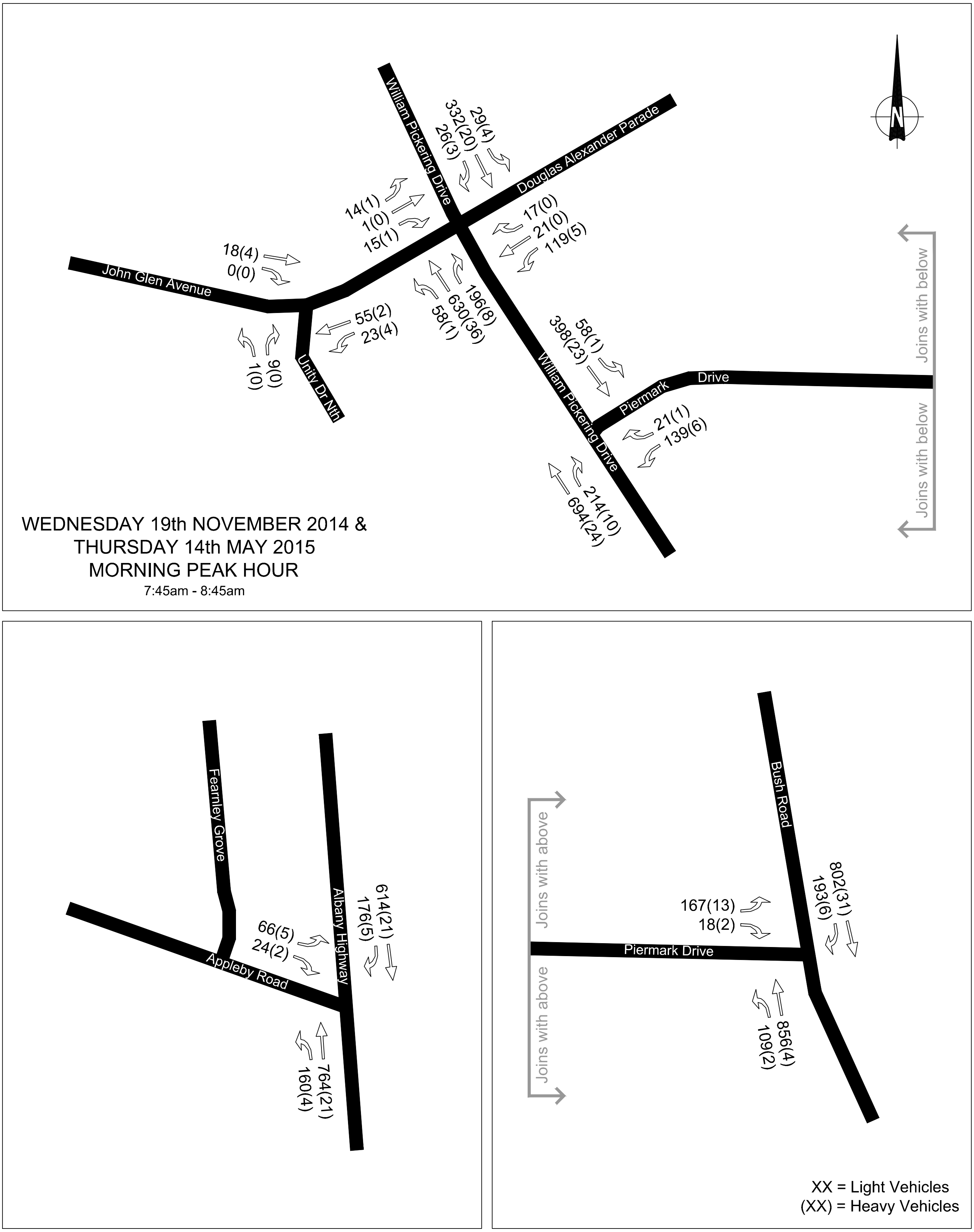

Wednesday, 20 May 2015 0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

ALBANY AREA TRAFFIC COUNTS

TDG

7

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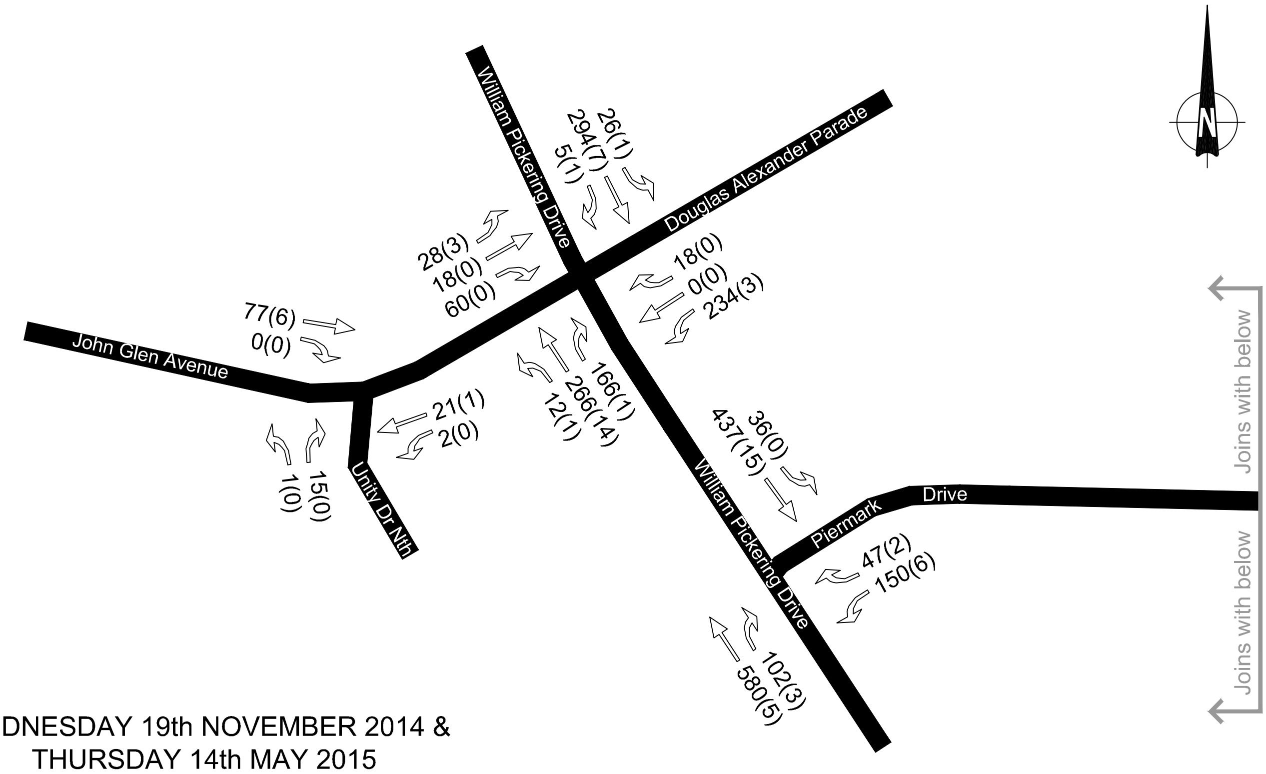
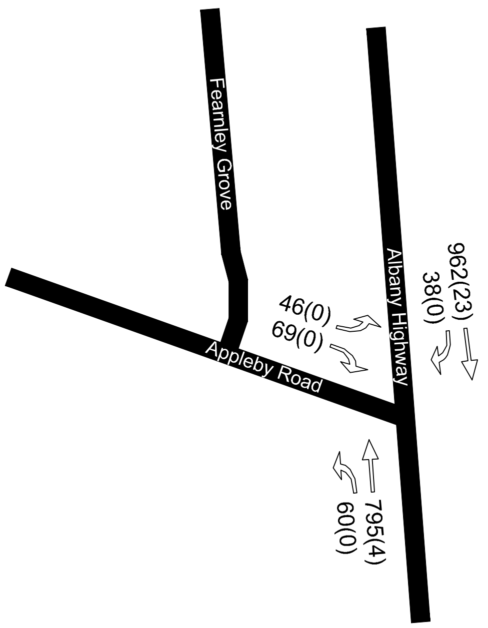
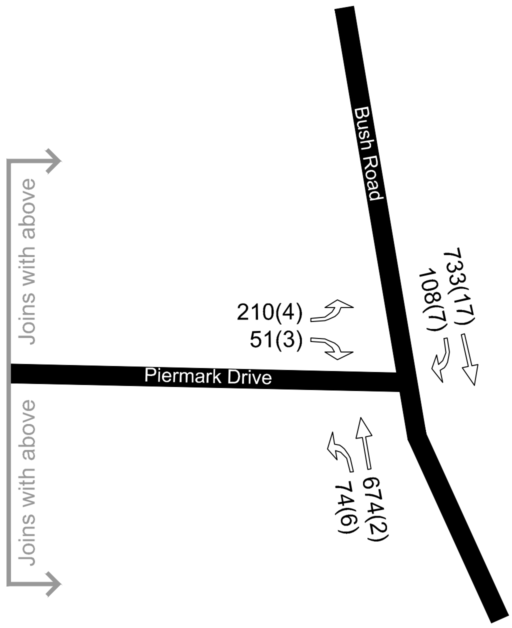


WEDNESDAY 19th NOVEMBER 2014 &
THURSDAY 14th MAY 2015
AFTERNOON PEAK HOUR





XX = Light Vehicles
(XX) = Heavy Vehicles

Wednesday, 20 May 2015 0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

ALBANY AREA TRAFFIC COUNTS

TDG

8

SCALE: N.T.S

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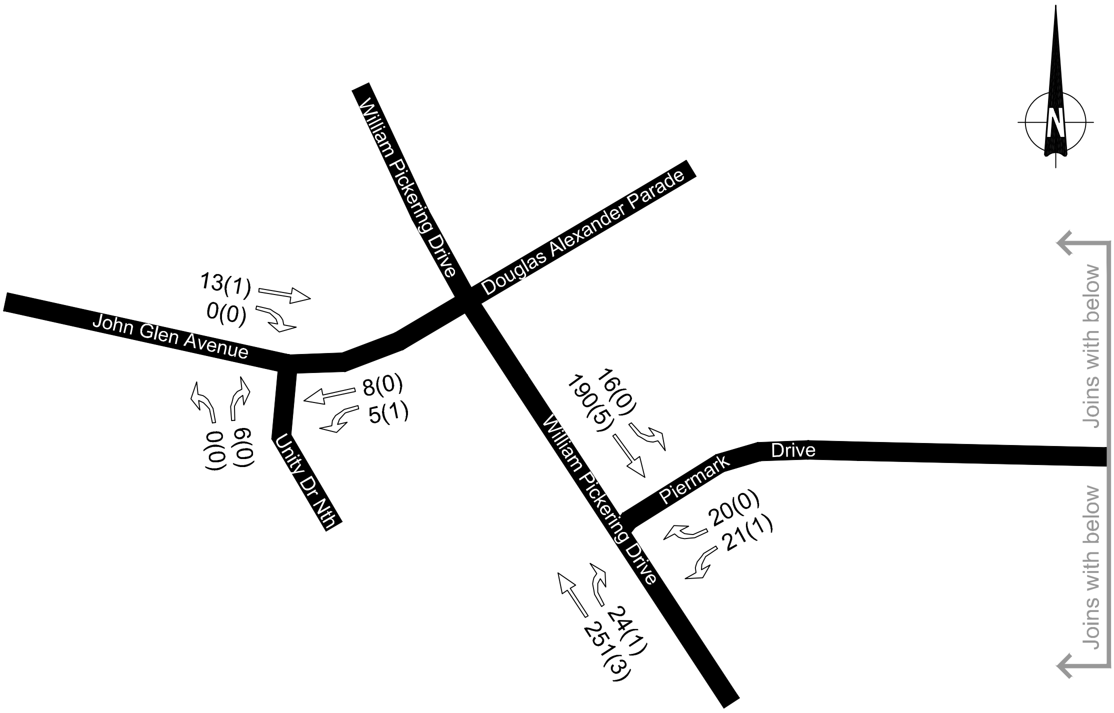
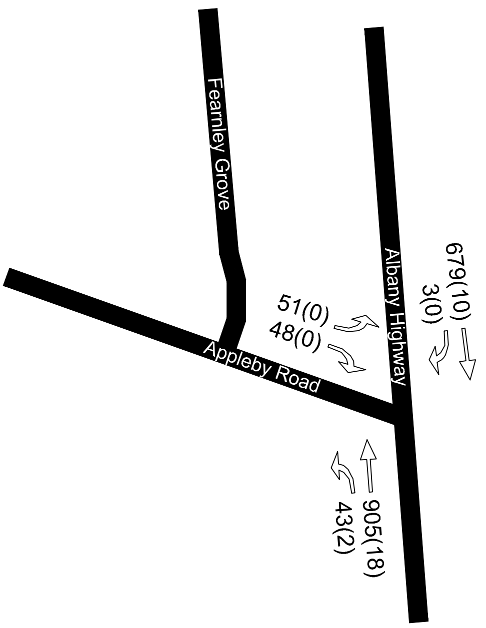
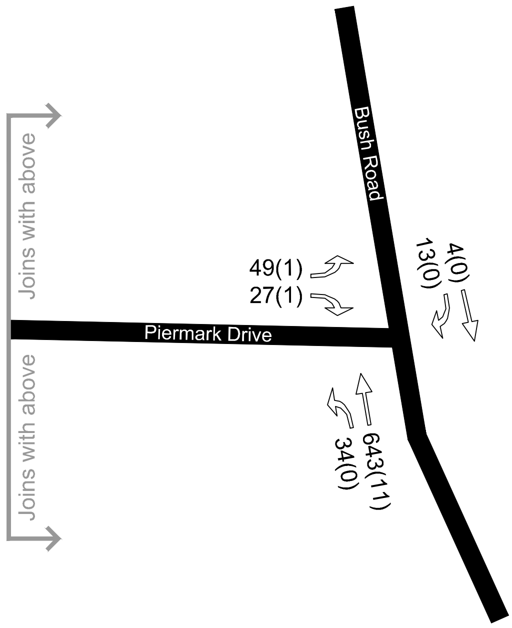


SATURDAY 22nd NOVEMBER 2014
PEAK HOUR
11:45am - 12:45pm





XX = Light Vehicles
(XX) = Heavy Vehicles

Friday, 13 March 2015

0 20mm

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

ALBANY AREA TRAFFIC COUNTS

TDG

9

SCALE: N.T.S

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

HOBSONVILLE PUMP STATION TO SH18

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---

DATE: 20.05.15 STATUS: ---

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DWG NO:12923A3B

TDG

10

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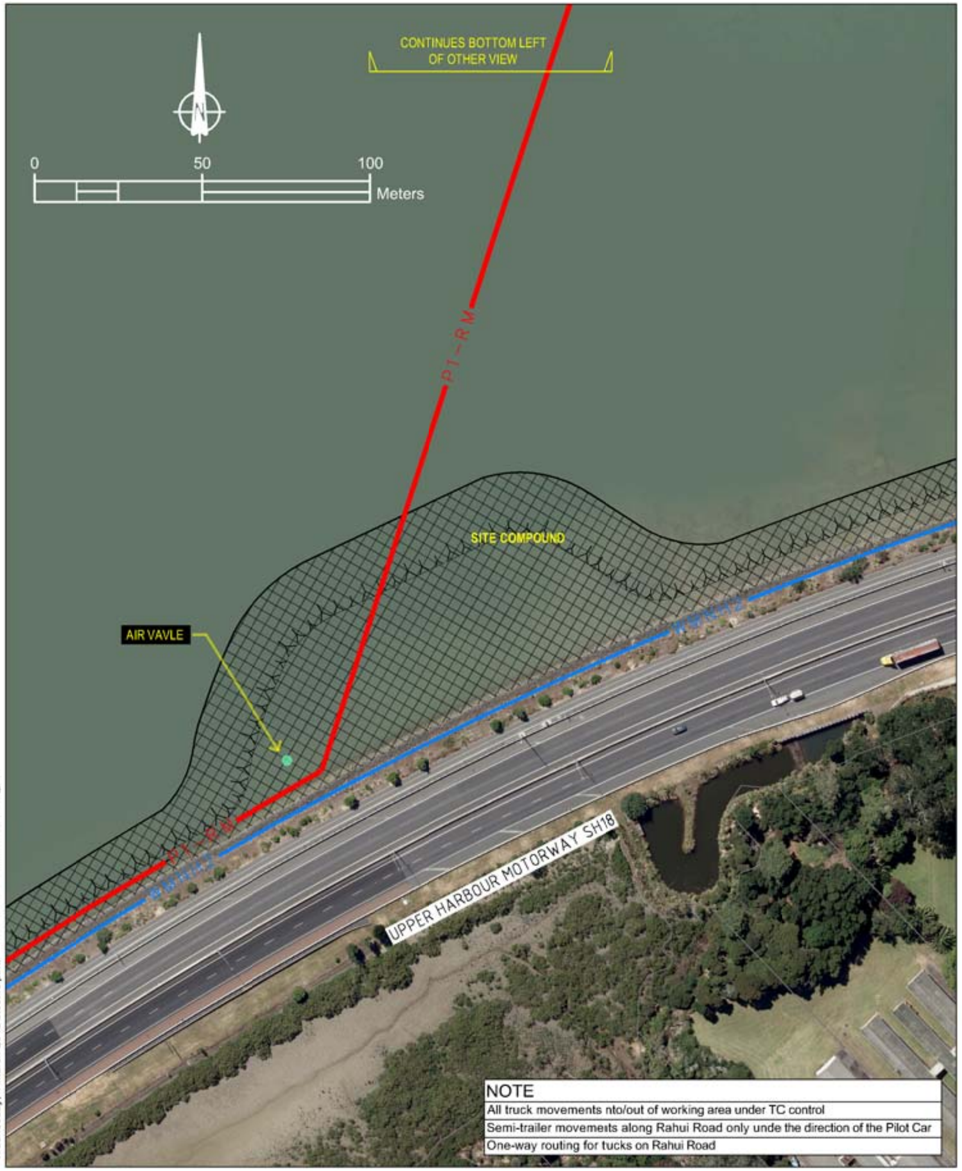

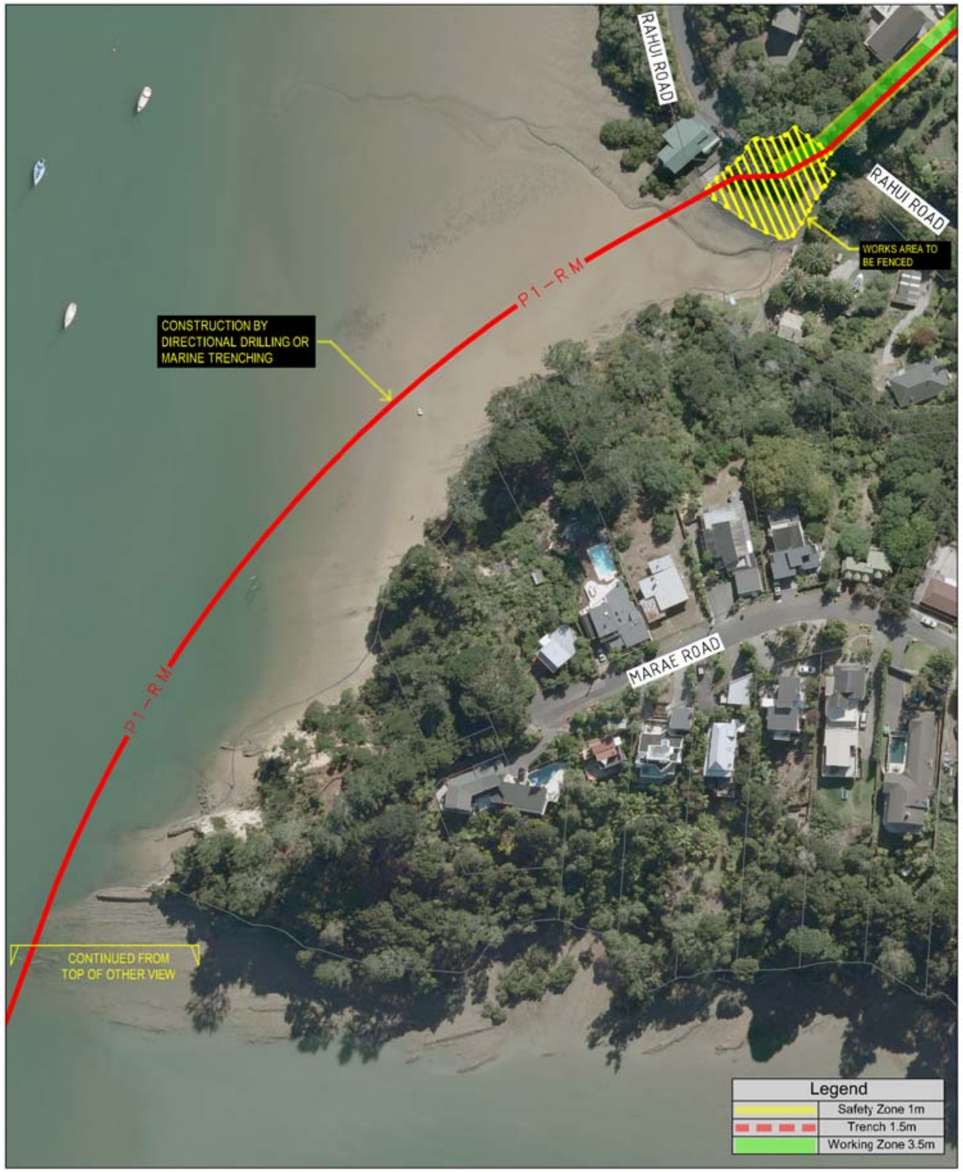

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CONSTRUCTION TRAFFIC ASSESSMENT
UPPER HARBOUR CROSSING

MWH

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TDG

11

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
RAHUI ROAD RESERVE LANDING AREA

MWH
BUILDING A BETTER WORLD

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TDG

12

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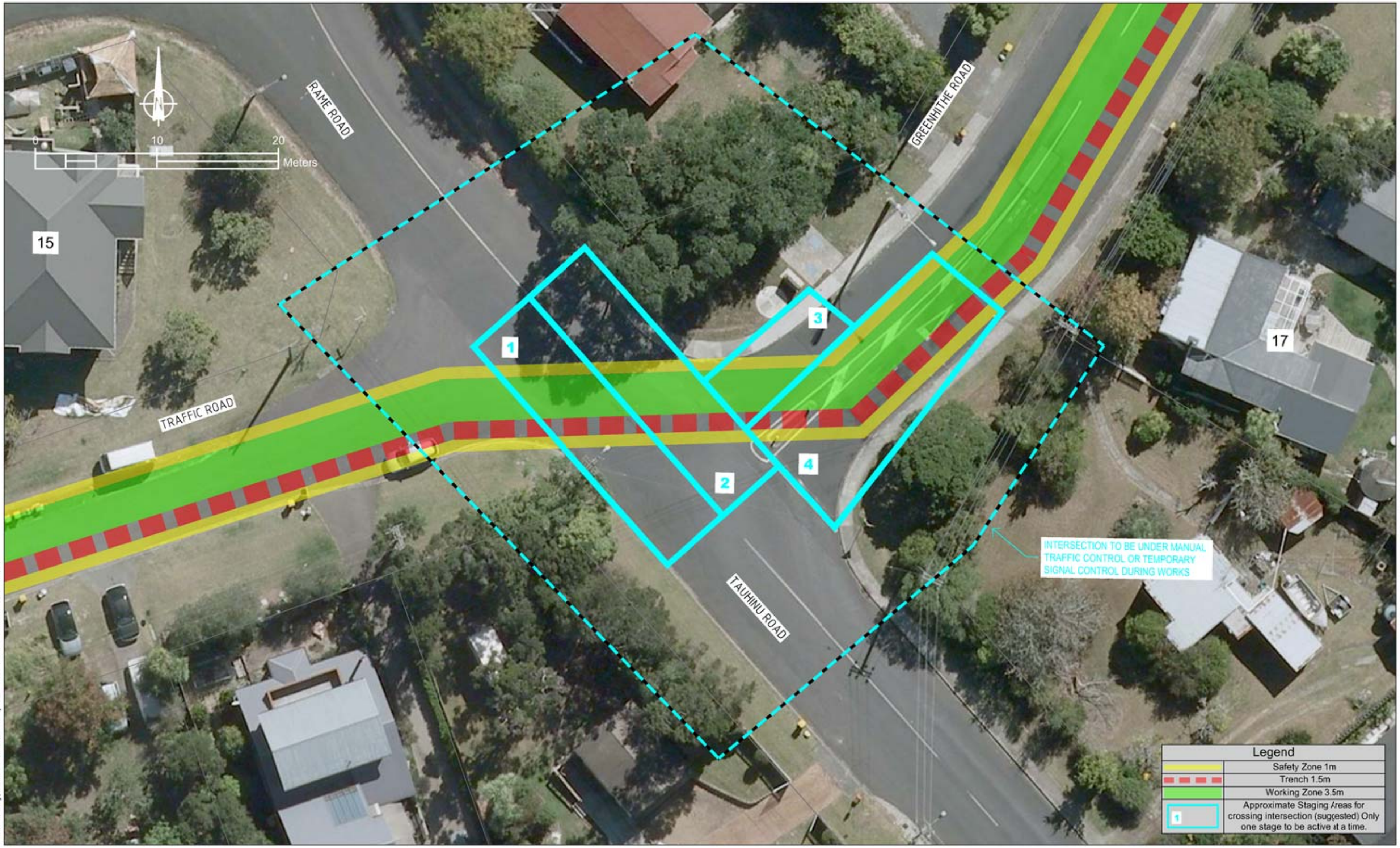

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

TRAFFIC ROAD/ROME ROAD/GREENHITHE ROAD/TAUHINU ROAD

MWH BUILDING A BETTER WORLD

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13

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD 1

MWH BUILDING A BETTER WORLD

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14

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

GREENHITHE ROAD 2

MWH
BUILDING A BETTER WORLD

DRAWN: SP --- ---
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TDG

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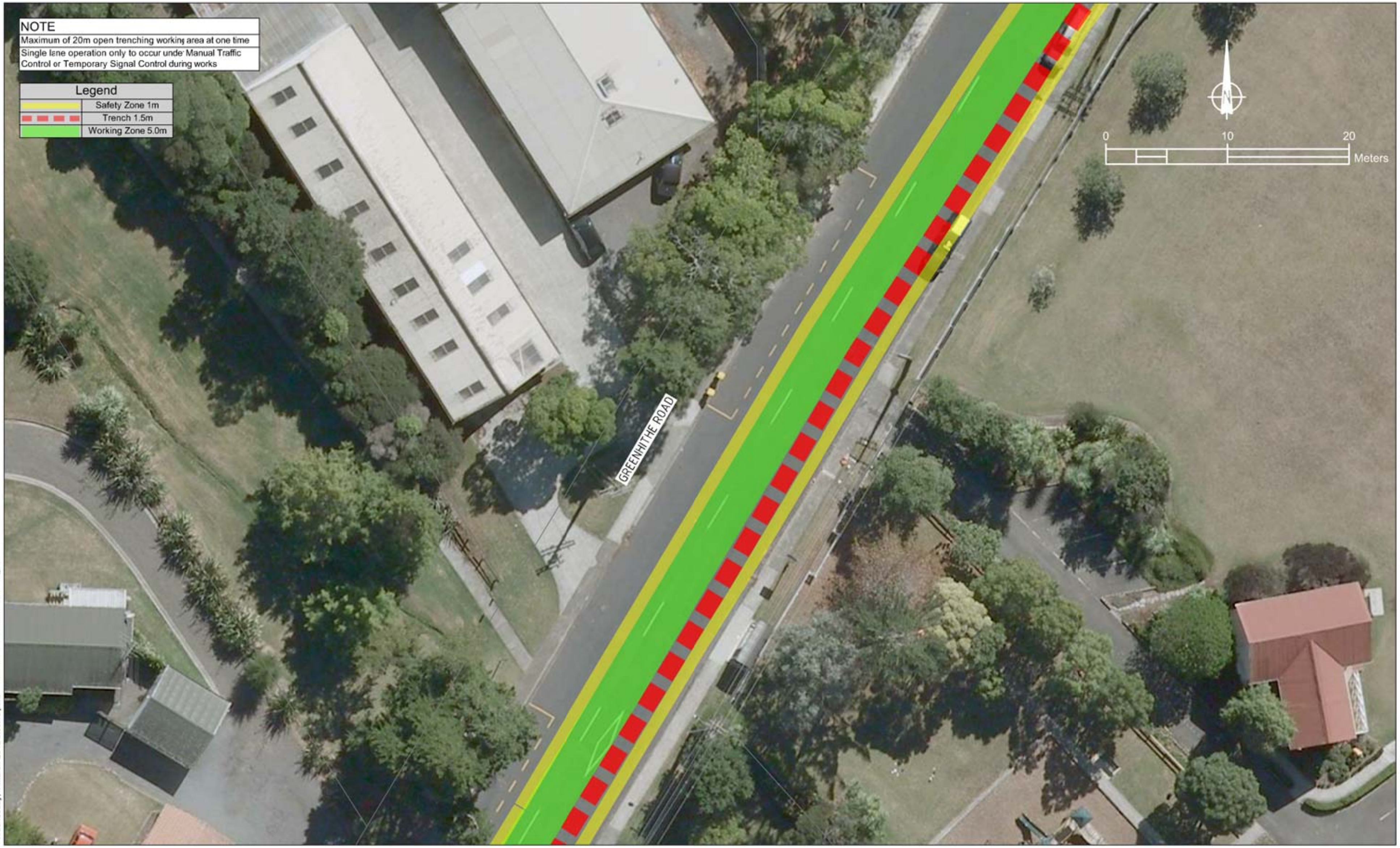

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD 3

MWH BUILDING A BETTER WORLD

DRAWN: SP	--- ---
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TDG

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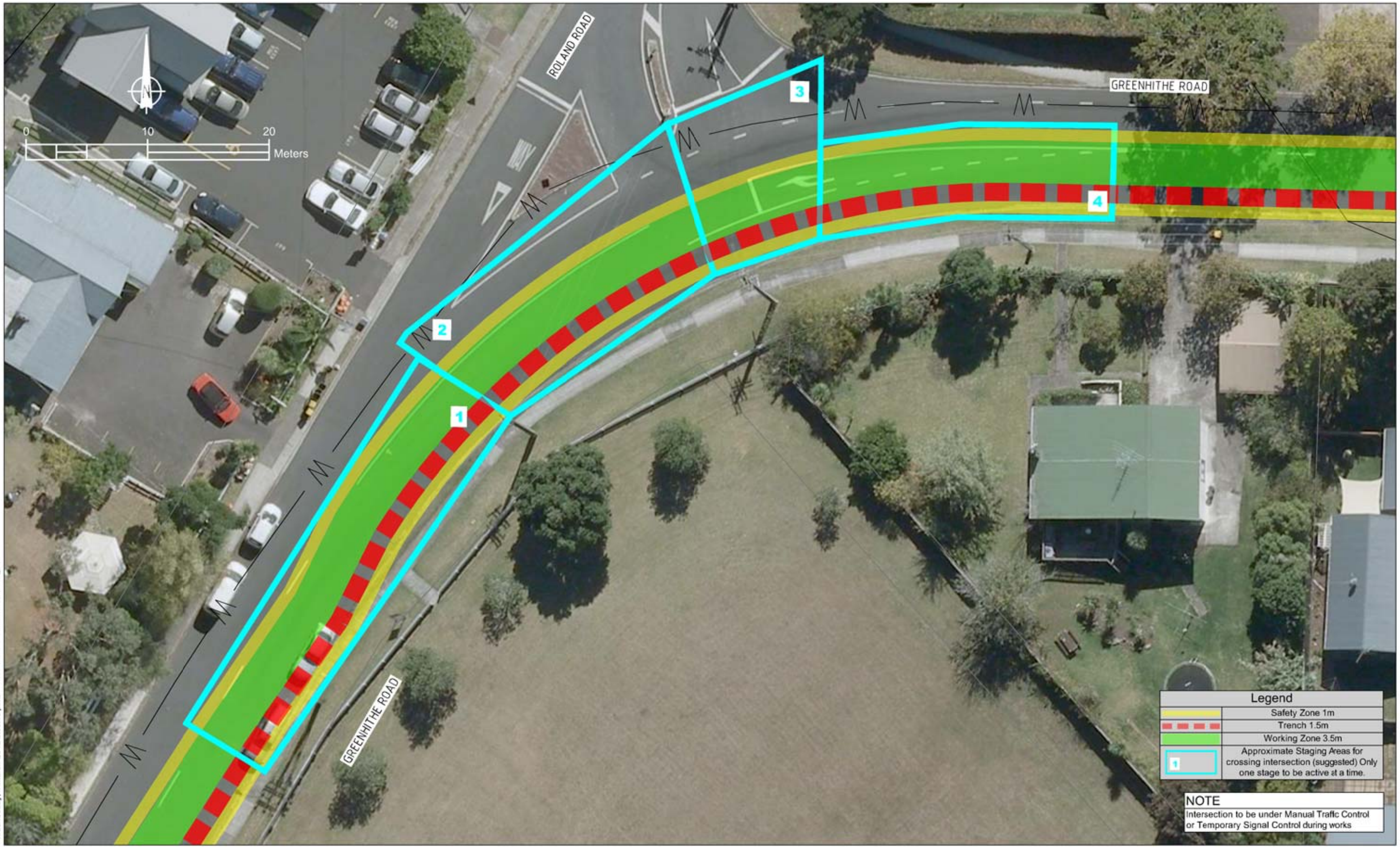

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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD/ROLAND ROAD INTERSECTION

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
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DWG NO:12923A2B

TDG

17

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REV	DATE	DRN	CHK	DESCRIPTION
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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD BETWEEN ROLAND ROAD & SUNNYVIEW ROAD

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:300@A3 (1:450@A4)
DWG NO:12923A2B

TDG

18

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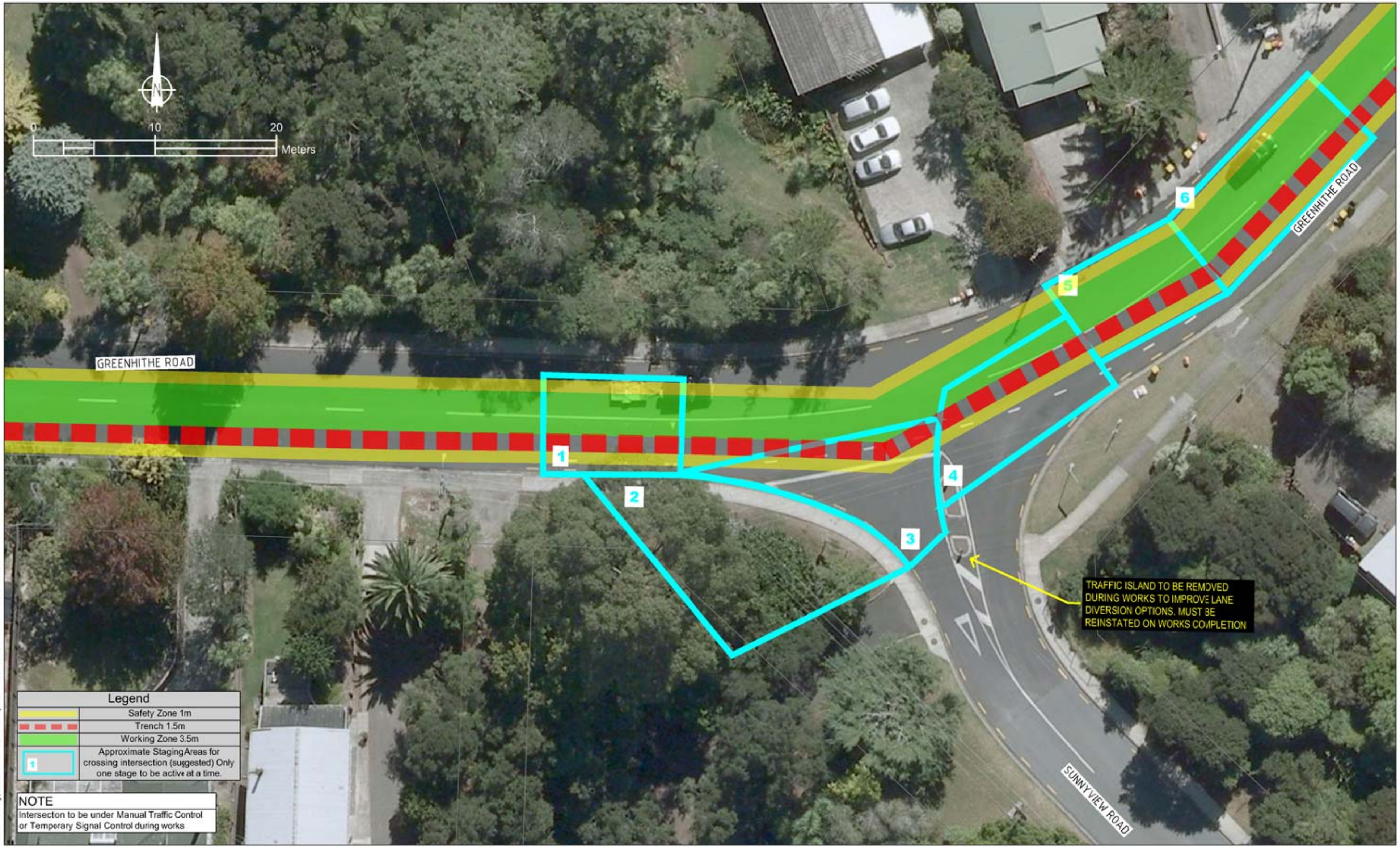


REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD & SUNNYVIEW ROAD INTERSECTION

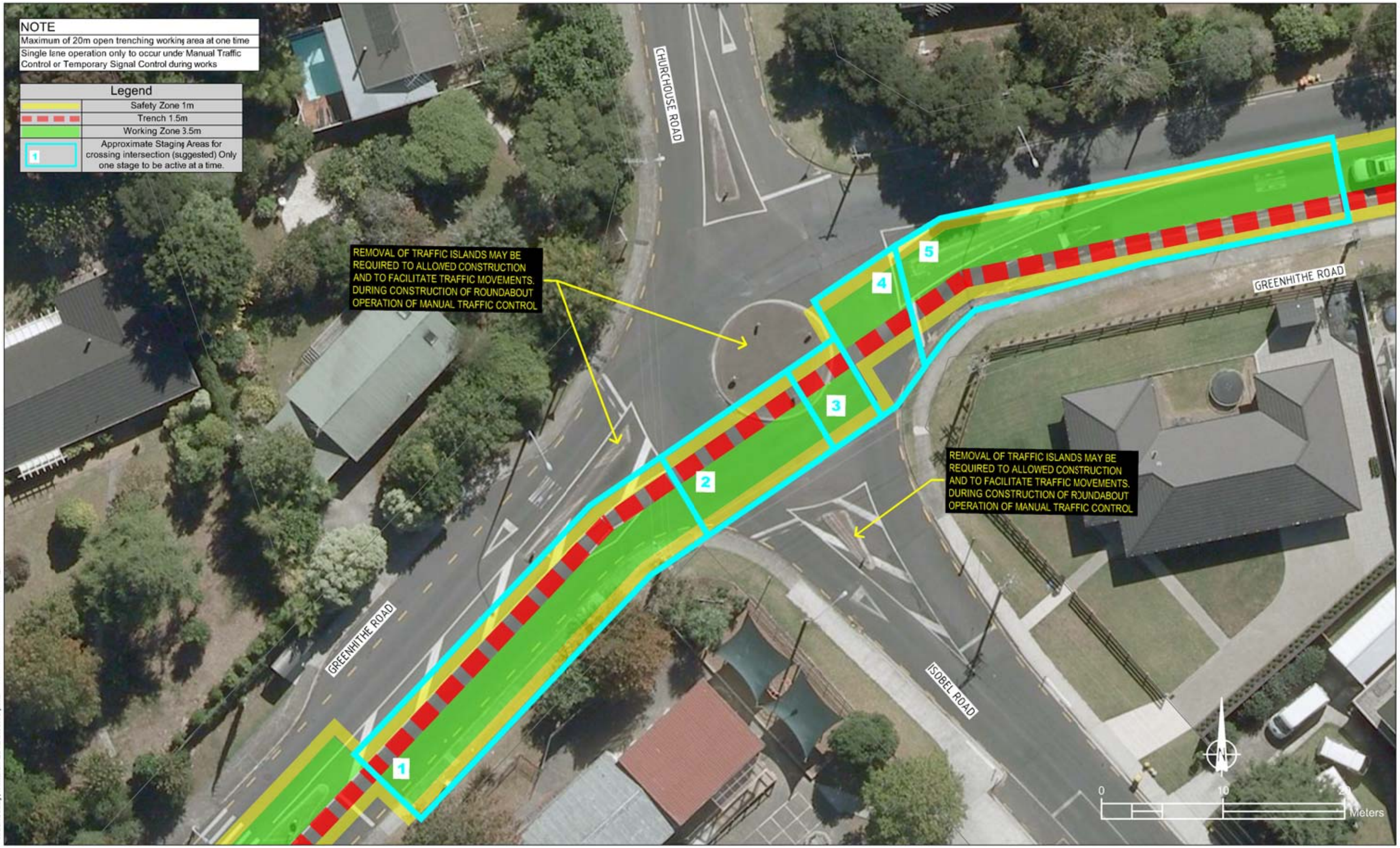
MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:300@A3 (1:450@A4)
DWG NO:12923A2B

TDG

19

J:\12900-49\12923\drawings\12923A2b.dwg



REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
GREENHITHE ROAD, CHURCHOUSE ROAD & ISOBEL ROAD INTERSECTION

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:300@A3 (1:450@A4)
DWG NO:12923A2B

TDG

20

J:\12900-49\12923\drawings\12923A2b.dwg

Wednesday, 4 March 2015 3:09:45 p.m.

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
WAINONI PARK

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,000@A3 (1:3,000@A4)
DWG NO:12923A2B

TDG

21

J:\12900-49\12923\drawings\12923A2b.dwg

Wednesday, 4 March 2015 3:09:45 p.m.

0 20mm@A3

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
WAINONI PARK

MWH BUILDING A BETTER WORLD

DRAWN: SP	--- ---
DATE: 20.05.15	STATUS: ---
SCALE: 1:2,500@A3 (1:3,750@A4)	
DWG NO:12923A2B	

TDG

22

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REV	DATE	DRN	CHK	DESCRIPTION
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WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
NORTH SHORE MEMORIAL PARK

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,500@A3 (1:3,750@A4)
DWG NO:12923A2B

TDG

23

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REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg
---	---	---	---	---
---	---	---	---	---
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---	---	---	---	---

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
NORTH SHORE MEMORIAL PARK TO NORTH SHORE GOLF COURSE

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,500@A3 (1:3,750@A4)
DWG NO:12923A2B

TDG

24

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REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
WITTON PLACE TO APPLEBY ROAD

MWH BUILDING A BETTER WORLD

DRAWN: SP
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,000@A3 (1:3,000@A4)
DWG NO:12923A2B

TDG

25

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Wednesday, 4 March 2015 3:09:45 p.m. 0 20mm@A3

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
APPLEBY ROAD TO ALBANY HIGHWAY

MWH BUILDING A BETTER WORLD

DRAWN: SP
DATE: 20.05.15
STATUS: ---
SCALE: 1:1,000@A3 (1:1,500@A4)
DWG NO:12923A2B

TDG

26

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REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
UNITY DRIVE TO PIERMARK DRIVE

MWH
BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,000@A3 (1:3,000@A4)
DWG NO:12923A2B

TDG

27

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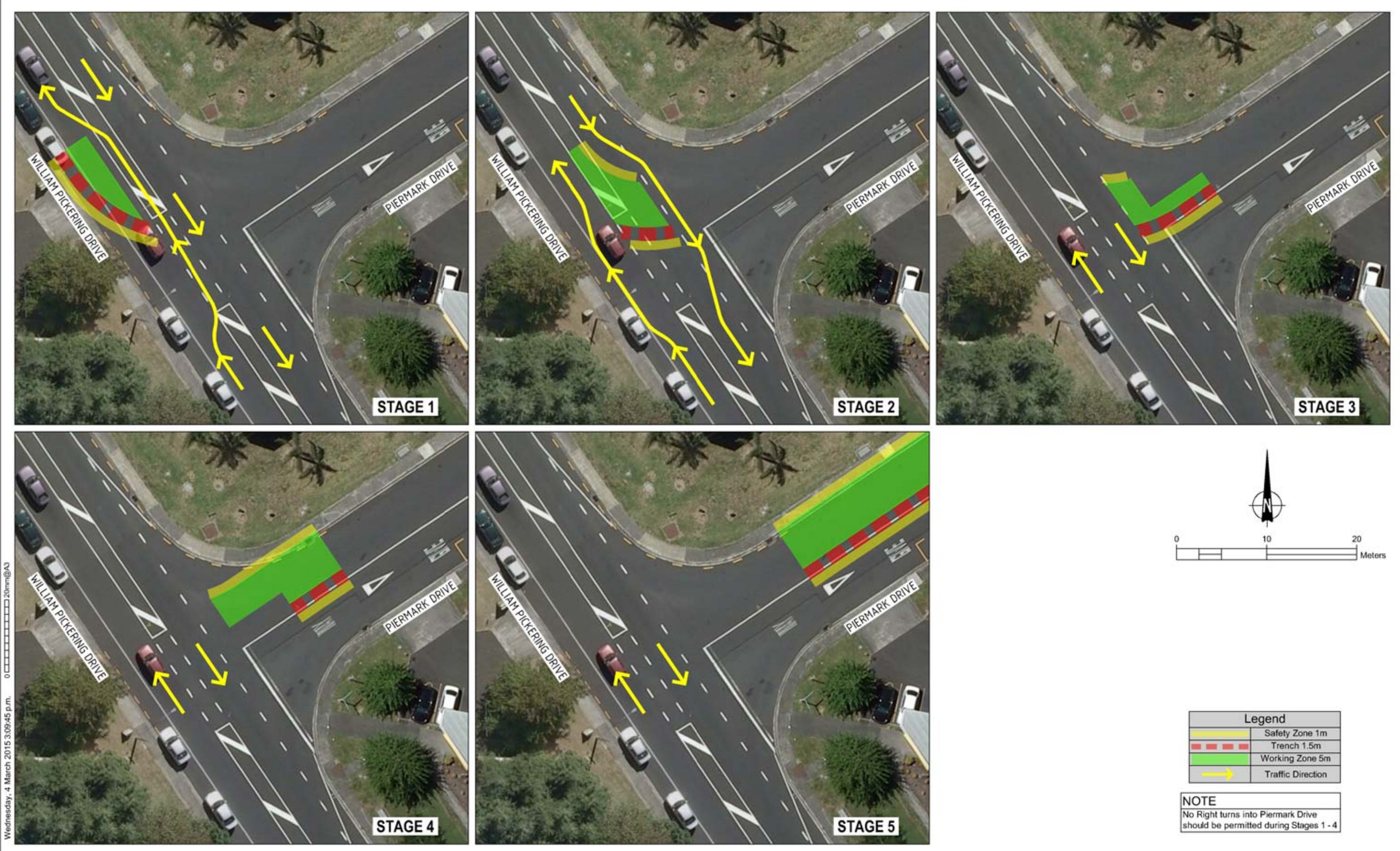

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

WILLIAM PICKERING DRIVE/PIERMARK DRIVE INTERSECTION - STAGING DETAILS

MWH BUILDING A BETTER WORLD

DRAWN: SP | --- ---

DATE: 20.05.15 | STATUS: ---

SCALE: 1:400@A3 (1:600@A4)

DWG NO:12923A2B

TDG

28

J:\12900-49\12923\drawings\12923A2b.dwg

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

PIERMARK DRIVE TO ROSEDALE PARK

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,000@A3 (1:3,000@A4)
DWG NO:12923A2B

TDG

29

J:\12900-49\12923\drawings\12923A2b.dwg

Wednesday, 4 March 2015 3:09:45 p.m.

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
POTENTIAL BUSH ROAD/PIERMARK DRIVE INTERSECTION - STAGING DETAILS

MWH BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:750@A3 (1:1,125@A4)
DWG NO:12923A2B

TDG

30

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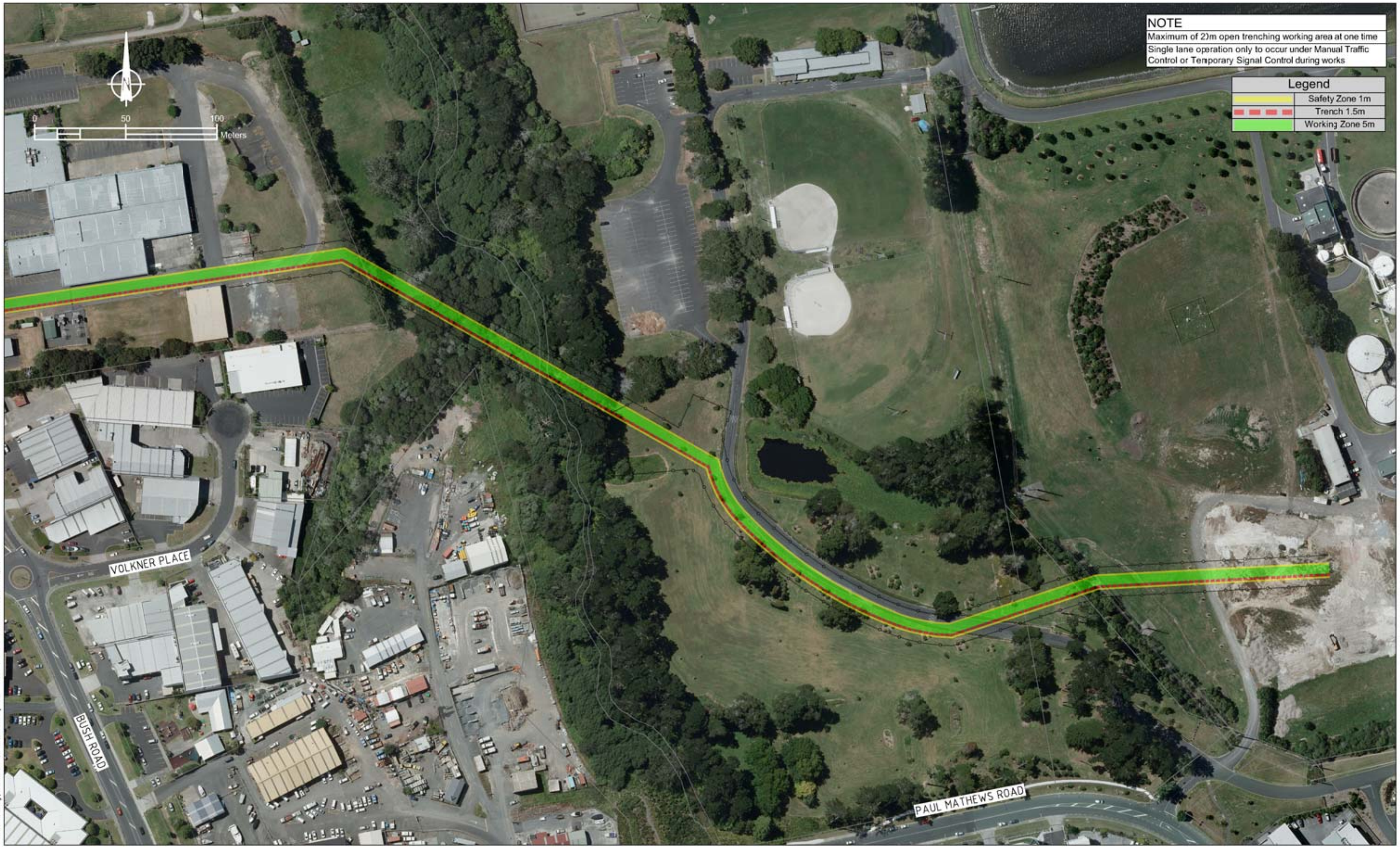

REV	DATE	DRN	CHK	DESCRIPTION
---	28.11.14	---	---	Sourced from MWH - 2011112 - Phase 1, Open Cut Works Plans.dwg

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1
CONSTRUCTION TRAFFIC ASSESSMENT
ROSEDALE PARK

MWH
BUILDING A BETTER WORLD

DRAWN: SP --- ---
DATE: 20.05.15 STATUS: ---
SCALE: 1:2,000@A3 (1:3,000@A4)
DWG NO:12923A2B

TDG

31

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Appendix B

Sidra Results

MOVEMENT SUMMARY

▽ Site: Greenhithe-Tauhinu-Traffic-Rame Existing AM

Existing AM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Tauhinu Road											
1	L2	2	0.0	0.080	4.8	LOS A	0.4	2.8	0.18	0.49	46.4
2	T1	9	22.2	0.080	0.2	LOS A	0.4	2.8	0.18	0.49	46.8
3	R2	121	5.2	0.080	4.8	LOS A	0.4	2.8	0.18	0.49	45.9
Approach		133	6.3	0.080	4.5	NA	0.4	2.8	0.18	0.49	46.0
East: Greenhithe Road											
4	L2	126	5.0	0.111	4.9	LOS A	0.5	3.4	0.07	0.51	46.4
5	T1	1	0.0	0.111	3.4	LOS A	0.5	3.4	0.07	0.51	46.5
6	R2	24	21.7	0.111	5.0	LOS A	0.5	3.4	0.07	0.51	45.7
Approach		152	7.6	0.111	4.9	LOS A	0.5	3.4	0.07	0.51	46.3
North: Rame Road											
7	L2	51	4.2	0.041	4.6	LOS A	0.2	1.4	0.06	0.34	47.3
8	T1	24	0.0	0.041	0.0	LOS A	0.2	1.4	0.06	0.34	47.8
9	R2	1	0.0	0.041	4.6	LOS A	0.2	1.4	0.06	0.34	46.9
Approach		76	2.8	0.041	3.2	NA	0.2	1.4	0.06	0.34	47.5
West: Traffic Road											
10	L2	1	0.0	0.009	5.6	LOS A	0.0	0.2	0.10	0.53	46.2
11	T1	2	0.0	0.009	4.2	LOS A	0.0	0.2	0.10	0.53	46.3
12	R2	5	0.0	0.009	5.6	LOS A	0.0	0.2	0.10	0.53	45.8
Approach		8	0.0	0.009	5.3	LOS A	0.0	0.2	0.10	0.53	46.0
All Vehicles		368	6.0	0.111	4.4	NA	0.5	3.4	0.11	0.47	46.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Tauhinu-Traffic-Rame Existing PM

Existing PM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Tauhinu Road											
1	L2	1	0.0	0.089	4.7	LOS A	0.4	3.2	0.15	0.43	46.8
2	T1	28	3.7	0.089	0.2	LOS A	0.4	3.2	0.15	0.43	47.3
3	R2	120	7.9	0.089	4.8	LOS A	0.4	3.2	0.15	0.43	46.2
Approach		149	7.0	0.089	3.9	NA	0.4	3.2	0.15	0.43	46.4
East: Greenhithe Road											
4	L2	183	10.3	0.200	5.0	LOS A	0.9	6.5	0.06	0.52	46.3
5	T1	3	0.0	0.200	3.6	LOS A	0.9	6.5	0.06	0.52	46.5
6	R2	71	3.0	0.200	5.0	LOS A	0.9	6.5	0.06	0.52	45.9
Approach		257	8.2	0.200	5.0	LOS A	0.9	6.5	0.06	0.52	46.2
North: Rame Road											
7	L2	38	2.8	0.031	4.7	LOS A	0.1	1.1	0.10	0.33	47.2
8	T1	18	0.0	0.031	0.1	LOS A	0.1	1.1	0.10	0.33	47.7
9	R2	1	0.0	0.031	4.6	LOS A	0.1	1.1	0.10	0.33	46.8
Approach		57	1.9	0.031	3.2	NA	0.1	1.1	0.10	0.33	47.4
West: Traffic Road											
10	L2	1	0.0	0.004	5.4	LOS A	0.0	0.1	0.13	0.49	46.5
11	T1	2	0.0	0.004	4.0	LOS A	0.0	0.1	0.13	0.49	46.6
12	R2	1	0.0	0.004	5.4	LOS A	0.0	0.1	0.13	0.49	46.1
Approach		4	0.0	0.004	4.7	LOS A	0.0	0.1	0.13	0.49	46.4
All Vehicles		467	7.0	0.200	4.4	NA	0.9	6.5	0.10	0.47	46.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Tauhinu-Traffic-Rame Future AM Signals

Construction AM Peak Hour
Signal / MTC Operation 30km/h TSL
2018 Volumes
Signals - Fixed Time   Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Tauhinu Road											
1	L2	2	0.0	0.525	35.7	LOS D	4.4	33.2	0.97	0.79	24.0
2	T1	8	25.0	0.525	31.7	LOS C	4.4	33.2	0.97	0.79	23.2
3	R2	121	7.8	0.525	37.5	LOS D	4.4	33.2	0.97	0.79	24.0
Approach		132	8.8	0.525	37.1	LOS D	4.4	33.2	0.97	0.79	23.9
East: Greenhithe Road											
4	L2	129	7.3	0.520	33.8	LOS C	5.1	38.3	0.96	0.79	24.5
5	T1	1	0.0	0.520	29.8	LOS C	5.1	38.3	0.96	0.79	23.6
6	R2	25	16.7	0.520	35.7	LOS D	5.1	38.3	0.96	0.79	24.4
Approach		156	8.8	0.520	34.1	LOS C	5.1	38.3	0.96	0.79	24.5
North: Rame Road											
7	L2	53	4.0	0.492	39.6	LOS D	2.8	19.7	0.99	0.76	23.8
8	T1	24	0.0	0.492	35.6	LOS D	2.8	19.7	0.99	0.76	23.0
9	R2	1	0.0	0.492	41.4	LOS D	2.8	19.7	0.99	0.76	23.8
Approach		78	2.7	0.492	38.4	LOS D	2.8	19.7	0.99	0.76	23.6
West: Traffic Road											
10	L2	1	0.0	0.052	37.2	LOS D	0.3	1.9	0.94	0.65	24.0
11	T1	2	0.0	0.052	33.3	LOS C	0.3	1.9	0.94	0.65	23.1
12	R2	5	0.0	0.052	39.1	LOS D	0.3	1.9	0.94	0.65	23.9
Approach		8	0.0	0.052	37.4	LOS D	0.3	1.9	0.94	0.65	23.7
All Vehicles		374	7.3	0.525	36.1	LOS D	5.1	38.3	0.97	0.78	24.1

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Tauhinu-Traffic-Rame Future PM Signals

Construction PM Peak Hour
Signal / MTC Operation 30km/h TSL
2018 Volumes
Signals - Fixed Time   Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Tauhinu Road											
1	L2	1	0.0	0.657	35.3	LOS D	5.5	44.3	0.99	0.87	23.5
2	T1	28	40.7	0.657	33.3	LOS C	5.5	44.3	0.99	0.87	23.2
3	R2	128	11.5	0.657	35.6	LOS D	5.5	44.3	0.99	0.87	23.3
Approach		158	16.7	0.657	35.2	LOS D	5.5	44.3	0.99	0.87	23.3
East: Greenhithe Road											
4	L2	123	17.9	0.685	34.0	LOS C	7.0	54.0	0.99	0.89	23.7
5	T1	4	0.0	0.685	32.0	LOS C	7.0	54.0	0.99	0.89	23.4
6	R2	74	2.9	0.685	34.3	LOS C	7.0	54.0	0.99	0.89	23.5
Approach		201	12.0	0.685	34.1	LOS C	7.0	54.0	0.99	0.89	23.6
North: Rame Road											
7	L2	38	0.0	0.352	36.9	LOS D	2.0	13.8	0.98	0.74	23.3
8	T1	18	0.0	0.352	35.0	LOS C	2.0	13.8	0.98	0.74	23.1
9	R2	1	0.0	0.352	37.2	LOS D	2.0	13.8	0.98	0.74	23.2
Approach		57	0.0	0.352	36.3	LOS D	2.0	13.8	0.98	0.74	23.3
West: Traffic Road											
10	L2	1	0.0	0.026	34.9	LOS C	0.1	1.0	0.94	0.61	23.7
11	T1	2	0.0	0.026	32.9	LOS C	0.1	1.0	0.94	0.61	23.4
12	R2	1	0.0	0.026	35.2	LOS D	0.1	1.0	0.94	0.61	23.5
Approach		4	0.0	0.026	34.0	LOS C	0.1	1.0	0.94	0.61	23.5
All Vehicles		420	12.0	0.685	34.8	LOS C	7.0	54.0	0.99	0.86	23.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: Greenhithe-Roland Existing AM

Existing AM Peak
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Greenhithe Road											
2	T1	16	0.0	0.016	0.2	LOS A	0.1	0.5	0.12	0.03	49.7
3a	R1	196	6.5	0.107	3.4	LOS A	0.0	0.0	0.00	0.44	47.6
Approach		212	6.0	0.107	3.2	NA	0.1	0.5	0.01	0.41	47.8
NorthEast: Greenhithe Road											
24a	L1	193	6.0	0.105	4.1	LOS A	0.0	0.0	0.00	0.52	46.5
26b	R3	27	0.0	0.023	6.0	LOS A	0.1	0.6	0.30	0.57	45.4
Approach		220	5.3	0.105	4.4	NA	0.1	0.6	0.04	0.53	46.4
North: Roland Road											
7b	L3	86	6.1	0.081	6.3	LOS A	0.3	2.2	0.30	0.58	45.7
8	T1	25	0.0	0.041	6.8	LOS A	0.2	1.1	0.52	0.63	45.4
Approach		112	4.7	0.081	6.4	LOS A	0.3	2.2	0.35	0.59	45.6
All Vehicles		543	5.4	0.107	4.3	NA	0.3	2.2	0.09	0.49	46.8

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: Greenhithe-Roland Existing PM

Existing PM Peak
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Greenhithe Road											
2	T1	34	0.0	0.037	0.6	LOS A	0.2	1.1	0.23	0.10	49.3
3a	R1	157	7.4	0.086	3.4	LOS A	0.0	0.0	0.00	0.44	47.6
Approach		191	6.1	0.086	2.9	NA	0.2	1.1	0.04	0.38	47.9
NorthEast: Greenhithe Road											
24a	L1	268	7.5	0.148	4.1	LOS A	0.0	0.0	0.00	0.52	46.5
26b	R3	82	5.1	0.069	6.0	LOS A	0.3	2.0	0.28	0.58	45.3
Approach		351	6.9	0.148	4.6	NA	0.3	2.0	0.06	0.53	46.2
North: Roland Road											
7b	L3	39	0.0	0.034	6.0	LOS A	0.1	0.8	0.25	0.55	45.9
8	T1	51	8.3	0.103	8.9	LOS A	0.4	3.0	0.60	0.75	44.1
Approach		89	4.7	0.103	7.7	LOS A	0.4	3.0	0.45	0.66	44.9
All Vehicles		631	6.3	0.148	4.5	NA	0.4	3.0	0.11	0.51	46.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Greenhithe-Roland Future AM

Construction AM Peak MTC of temp signal control 30km/h TSL
2018 Volumes
Signals - Fixed Time   Cycle Time = 50 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Greenhithe Road											
2	T1	16	0.0	0.045	18.8	LOS B	0.3	2.3	0.85	0.59	26.0
3a	R1	199	9.5	0.617	22.9	LOS C	4.9	36.8	0.97	0.85	25.6
Approach		215	8.8	0.617	22.6	LOS C	4.9	36.8	0.96	0.83	25.6
NorthEast: Greenhithe Road											
24a	L1	196	8.6	0.679	25.7	LOS C	5.0	37.7	0.99	0.91	24.9
26b	R3	27	0.0	0.105	23.2	LOS C	0.6	4.2	0.88	0.69	25.4
Approach		223	7.5	0.679	25.4	LOS C	5.0	37.7	0.98	0.88	24.9
North: Roland Road											
7b	L3	86	6.1	0.460	26.7	LOS C	2.2	15.9	0.97	0.76	25.0
8	T1	24	0.0	0.103	22.4	LOS C	0.6	3.9	0.92	0.65	25.3
Approach		111	4.8	0.460	25.8	LOS C	2.2	15.9	0.96	0.74	25.1
All Vehicles		548	7.5	0.679	24.4	LOS C	5.0	37.7	0.97	0.83	25.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA
INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Roland Future PM

Construction PM Peak MTC/ temp signal control 30km/h TSL
2018 Volumes
Signals - Fixed Time Cycle Time = 50 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Greenhithe Road											
2	T1	34	0.0	0.144	22.6	LOS C	0.8	5.5	0.93	0.67	25.3
3a	R1	160	10.5	0.749	27.7	LOS C	4.4	33.3	1.00	1.00	24.7
Approach		194	8.7	0.749	26.8	LOS C	4.4	33.3	0.99	0.94	24.8
NorthEast: Greenhithe Road											
24a	L1	272	9.7	0.689	23.4	LOS C	6.7	50.9	0.97	0.90	25.3
26b	R3	86	6.1	0.251	21.1	LOS C	1.8	13.5	0.86	0.73	25.8
Approach		358	8.8	0.689	22.8	LOS C	6.7	50.9	0.95	0.86	25.4
North: Roland Road											
7b	L3	39	0.0	0.200	25.6	LOS C	0.9	6.5	0.93	0.71	25.2
8	T1	51	8.3	0.228	23.1	LOS C	1.2	9.0	0.94	0.70	25.2
Approach		89	4.7	0.228	24.2	LOS C	1.2	9.0	0.94	0.70	25.2
All Vehicles		641	8.2	0.749	24.2	LOS C	6.7	50.9	0.96	0.86	25.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Greenhithe-Isobel-Churchouse Existing AM

2018 Volumes
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Isobel Road											
21	L2	12	0.0	0.117	5.3	LOS A	0.6	4.3	0.48	0.66	44.5
22	T1	4	0.0	0.117	5.4	LOS A	0.6	4.3	0.48	0.66	45.3
23	R2	99	1.1	0.117	8.7	LOS A	0.6	4.3	0.48	0.66	45.1
Approach		115	0.9	0.117	8.2	LOS A	0.6	4.3	0.48	0.66	45.1
NorthEast: Greenhithe Road											
24	L2	35	0.0	0.251	4.0	LOS A	1.6	11.3	0.27	0.47	46.1
25	T1	234	5.4	0.251	4.1	LOS A	1.6	11.3	0.27	0.47	46.9
26	R2	57	1.9	0.251	7.3	LOS A	1.6	11.3	0.27	0.47	46.7
Approach		325	4.2	0.251	4.6	LOS A	1.6	11.3	0.27	0.47	46.8
NorthWest: Churchouse Road											
27	L2	46	2.3	0.111	6.0	LOS A	0.6	4.2	0.55	0.65	45.1
28	T1	21	0.0	0.111	6.0	LOS A	0.6	4.2	0.55	0.65	45.9
29	R2	33	0.0	0.111	9.3	LOS A	0.6	4.2	0.55	0.65	45.7
Approach		100	1.1	0.111	7.1	LOS A	0.6	4.2	0.55	0.65	45.4
SouthWest: Greenhithe Road											
30	L2	13	0.0	0.295	4.6	LOS A	1.8	13.2	0.40	0.50	45.8
31	T1	302	5.2	0.295	4.7	LOS A	1.8	13.2	0.40	0.50	46.6
32	R2	23	0.0	0.295	7.9	LOS A	1.8	13.2	0.40	0.50	46.5
Approach		338	4.7	0.295	4.9	LOS A	1.8	13.2	0.40	0.50	46.6
All Vehicles		878	3.6	0.295	5.5	LOS A	1.8	13.2	0.38	0.53	46.3

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA
INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Isobel-Churchouse Existing PM

Existing PM Peak
2018 Volumes
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Isobel Road											
21	L2	16	0.0	0.086	5.7	LOS A	0.4	3.1	0.51	0.66	44.5
22	T1	3	0.0	0.086	5.8	LOS A	0.4	3.1	0.51	0.66	45.3
23	R2	61	1.7	0.086	9.1	LOS A	0.4	3.1	0.51	0.66	45.1
Approach		80	1.3	0.086	8.3	LOS A	0.4	3.1	0.51	0.66	45.0
NorthEast: Greenhithe Road											
24	L2	41	5.1	0.287	3.8	LOS A	1.9	13.6	0.15	0.43	46.4
25	T1	333	5.7	0.287	3.8	LOS A	1.9	13.6	0.15	0.43	47.3
26	R2	45	2.3	0.287	7.1	LOS A	1.9	13.6	0.15	0.43	47.1
Approach		419	5.3	0.287	4.1	LOS A	1.9	13.6	0.15	0.43	47.2
NorthWest: Churchouse Road											
27	L2	24	0.0	0.045	5.3	LOS A	0.2	1.6	0.47	0.59	45.5
28	T1	4	0.0	0.045	5.3	LOS A	0.2	1.6	0.47	0.59	46.3
29	R2	15	7.1	0.045	8.7	LOS A	0.2	1.6	0.47	0.59	46.0
Approach		43	2.4	0.045	6.4	LOS A	0.2	1.6	0.47	0.59	45.7
SouthWest: Greenhithe Road											
30	L2	21	0.0	0.238	4.2	LOS A	1.4	10.1	0.31	0.46	46.2
31	T1	262	3.2	0.238	4.3	LOS A	1.4	10.1	0.31	0.46	47.0
32	R2	9	0.0	0.238	7.5	LOS A	1.4	10.1	0.31	0.46	46.8
Approach		293	2.9	0.238	4.4	LOS A	1.4	10.1	0.31	0.46	46.9
All Vehicles		835	3.9	0.287	4.7	LOS A	1.9	13.6	0.26	0.47	46.8

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Greenhithe-Isobel-Churchouse Future AM

Construction AM Peak MTC / Temp signal control 30km/h TSL
2018 Volumes
Signals - Fixed Time   Cycle Time = 80 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Isobel Road											
21	L2	12	0.0	0.799	52.3	LOS D	5.0	35.3	1.00	1.01	22.8
22	T1	4	0.0	0.799	45.4	LOS D	5.0	35.3	1.00	1.01	21.3
23	R2	99	1.1	0.799	54.0	LOS D	5.0	35.3	1.00	1.01	22.8
Approach		115	0.9	0.799	53.6	LOS D	5.0	35.3	1.00	1.01	22.7
NorthEast: Greenhithe Road											
24	L2	36	0.0	0.888	51.7	LOS D	15.8	116.0	1.00	1.14	23.6
25	T1	246	7.7	0.888	44.9	LOS D	15.8	116.0	1.00	1.14	22.1
26	R2	59	1.8	0.888	53.5	LOS D	15.8	116.0	1.00	1.14	23.6
Approach		341	5.9	0.888	47.1	LOS D	15.8	116.0	1.00	1.14	22.5
NorthWest: Churchouse Road											
27	L2	46	2.3	0.691	50.0	LOS D	4.2	29.7	1.00	0.89	23.4
28	T1	21	0.0	0.691	43.1	LOS D	4.2	29.7	1.00	0.89	21.9
29	R2	33	0.0	0.691	51.8	LOS D	4.2	29.7	1.00	0.89	23.3
Approach		100	1.1	0.691	49.1	LOS D	4.2	29.7	1.00	0.89	23.0
SouthWest: Greenhithe Road											
30	L2	13	0.0	0.884	51.2	LOS D	15.7	115.7	1.00	1.14	23.9
31	T1	305	7.2	0.884	44.3	LOS D	15.7	115.7	1.00	1.14	22.3
32	R2	23	0.0	0.884	53.0	LOS D	15.7	115.7	1.00	1.14	23.9
Approach		341	6.5	0.884	45.1	LOS D	15.7	115.7	1.00	1.14	22.5
All Vehicles		897	4.9	0.888	47.4	LOS D	15.8	116.0	1.00	1.09	22.6

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Isobel-Churchouse Future PM

Construction PM Peak MTC or temp signals operation 30km/h TSL
2018 Volumes
Signals - Fixed Time Cycle Time = 90 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Isobel Road											
21	L2	17	0.0	0.653	55.3	LOS E	3.9	27.6	1.00	0.85	22.4
22	T1	3	0.0	0.653	48.4	LOS D	3.9	27.6	1.00	0.85	21.0
23	R2	63	1.7	0.653	57.0	LOS E	3.9	27.6	1.00	0.85	22.4
Approach		83	1.3	0.653	56.4	LOS E	3.9	27.6	1.00	0.85	22.3
NorthEast: Greenhithe Road											
24	L2	41	5.1	0.786	42.7	LOS D	18.5	135.0	0.99	0.93	25.1
25	T1	336	5.6	0.786	35.8	LOS D	18.5	135.0	0.99	0.93	23.4
26	R2	45	2.3	0.786	44.4	LOS D	18.5	135.0	0.99	0.93	25.1
Approach		422	5.2	0.786	37.4	LOS D	18.5	135.0	0.99	0.93	23.7
NorthWest: Churchouse Road											
27	L2	24	0.0	0.341	53.2	LOS D	1.9	13.9	0.99	0.73	22.8
28	T1	4	0.0	0.341	46.3	LOS D	1.9	13.9	0.99	0.73	21.4
29	R2	15	7.1	0.341	55.0	LOS D	1.9	13.9	0.99	0.73	22.8
Approach		43	2.4	0.341	53.1	LOS D	1.9	13.9	0.99	0.73	22.7
SouthWest: Greenhithe Road											
30	L2	21	0.0	0.799	49.2	LOS D	13.6	98.6	1.00	0.97	24.2
31	T1	265	4.4	0.799	42.3	LOS D	13.6	98.6	1.00	0.97	22.6
32	R2	9	0.0	0.799	50.9	LOS D	13.6	98.6	1.00	0.97	24.2
Approach		296	3.9	0.799	43.1	LOS D	13.6	98.6	1.00	0.97	22.8
All Vehicles		844	4.2	0.799	42.0	LOS D	18.5	135.0	0.99	0.93	23.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Greenhithe-Wainoni Park Site Access AM

Construction AM Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Greenhithe Road											
5	T1	344	4.3	0.184	3.6	LOS A	2.1	14.9	0.61	0.00	47.6
6	R2	2	50.0	0.184	8.6	LOS A	2.1	14.9	0.61	0.00	45.9
Approach		346	4.6	0.184	3.6	NA	2.1	14.9	0.61	0.00	47.6
North: Site Access Wainoni Park											
7	L2	2	50.0	0.006	13.5	LOS B	0.0	0.2	0.53	0.89	42.8
9	R2	1	0.0	0.006	11.0	LOS B	0.0	0.2	0.53	0.89	43.1
Approach		3	33.3	0.006	12.7	LOS B	0.0	0.2	0.53	0.89	42.9
West: Greenhithe Road											
10	L2	1	0.0	0.236	4.6	LOS A	0.0	0.0	0.00	0.00	49.5
11	T1	447	3.8	0.236	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		448	3.8	0.236	0.0	NA	0.0	0.0	0.00	0.00	50.0
All Vehicles		798	4.2	0.236	1.6	NA	2.1	14.9	0.27	0.01	48.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Greenhithe-Wainoni Park Site Access PM

Construction PM Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Greenhithe Road											
5	T1	420	5.3	0.225	4.0	LOS A	3.0	22.0	0.61	0.00	47.4
6	R2	1	100.0	0.225	9.0	LOS A	3.0	22.0	0.61	0.00	45.7
Approach		421	5.5	0.225	4.0	NA	3.0	22.0	0.61	0.00	47.4
North: Site Access Wainoni Park											
7	L2	2	50.0	0.007	13.1	LOS B	0.0	0.2	0.49	0.90	43.0
9	R2	2	0.0	0.007	10.7	LOS B	0.0	0.2	0.49	0.90	43.2
Approach		4	25.0	0.007	11.9	LOS B	0.0	0.2	0.49	0.90	43.1
West: Greenhithe Road											
10	L2	1	0.0	0.183	4.6	LOS A	0.0	0.0	0.00	0.00	49.5
11	T1	349	2.4	0.183	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		351	2.4	0.183	0.0	NA	0.0	0.0	0.00	0.00	50.0
All Vehicles		776	4.2	0.225	2.3	NA	3.0	22.0	0.33	0.01	48.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Memorial Park AM Existing

AM Existing Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Schanpper Rock Road											
1	L2	4	50.0	0.021	5.0	LOS A	0.0	0.0	0.00	0.06	48.5
2	T1	33	6.5	0.021	0.0	LOS A	0.0	0.0	0.00	0.06	49.8
Approach		37	11.4	0.021	0.6	NA	0.0	0.0	0.00	0.06	49.6
North: Schnapper Rock Road											
8	T1	79	1.3	0.041	0.1	LOS A	0.2	1.5	0.12	0.01	49.6
9	R2	1	0.0	0.041	4.7	LOS A	0.2	1.5	0.12	0.01	48.7
Approach		80	1.3	0.041	0.2	NA	0.2	1.5	0.12	0.01	49.6
West: Memorial Park											
10	L2	1	0.0	0.003	7.9	LOS A	0.0	0.1	0.14	0.96	45.0
12	R2	2	50.0	0.003	9.3	LOS A	0.0	0.1	0.14	0.96	43.8
Approach		3	33.3	0.003	8.8	LOS A	0.0	0.1	0.14	0.96	44.2
All Vehicles		120	5.3	0.041	0.5	NA	0.2	1.5	0.08	0.05	49.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Memorial Park PM Existing

PM Existing Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Schanpper Rock Road											
1	L2	15	7.1	0.039	4.6	LOS A	0.0	0.0	0.00	0.11	48.8
2	T1	59	1.8	0.039	0.0	LOS A	0.0	0.0	0.00	0.11	49.4
Approach		74	2.9	0.039	0.9	NA	0.0	0.0	0.00	0.11	49.3
North: Schnapper Rock Road											
8	T1	44	11.9	0.025	0.2	LOS A	0.1	0.9	0.17	0.01	49.4
9	R2	1	0.0	0.025	4.8	LOS A	0.1	0.9	0.17	0.01	48.5
Approach		45	11.6	0.025	0.3	NA	0.1	0.9	0.17	0.01	49.4
West: Memorial Park											
10	L2	1	0.0	0.012	7.9	LOS A	0.0	0.3	0.19	0.89	45.2
12	R2	12	0.0	0.012	7.4	LOS A	0.0	0.3	0.19	0.89	44.8
Approach		13	0.0	0.012	7.4	LOS A	0.0	0.3	0.19	0.89	44.8
All Vehicles		132	5.6	0.039	1.3	NA	0.1	0.9	0.08	0.15	48.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Memorial Park AM Future

AM Construction Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Schanpper Rock Road											
1	L2	8	62.5	0.024	5.1	LOS A	0.0	0.0	0.00	0.11	48.2
2	T1	33	6.5	0.024	0.0	LOS A	0.0	0.0	0.00	0.11	49.7
Approach		41	17.9	0.024	1.1	NA	0.0	0.0	0.00	0.11	49.4
North: Schnapper Rock Road											
8	T1	79	1.3	0.041	0.1	LOS A	0.2	1.5	0.13	0.01	49.6
9	R2	1	0.0	0.041	4.7	LOS A	0.2	1.5	0.13	0.01	48.6
Approach		80	1.3	0.041	0.2	NA	0.2	1.5	0.13	0.01	49.6
West: Memorial Park											
10	L2	1	0.0	0.006	8.0	LOS A	0.0	0.2	0.16	0.96	45.0
12	R2	4	50.0	0.006	9.4	LOS A	0.0	0.2	0.16	0.96	43.8
Approach		5	40.0	0.006	9.1	LOS A	0.0	0.2	0.16	0.96	44.1
All Vehicles		126	8.3	0.041	0.8	NA	0.2	1.5	0.09	0.08	49.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Memorial Park PM Future

PM Construction Peak Hour
2018 Volumes
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Schanpper Rock Road											
1	L2	17	12.5	0.039	4.7	LOS A	0.0	0.0	0.00	0.12	48.7
2	T1	57	1.9	0.039	0.0	LOS A	0.0	0.0	0.00	0.12	49.3
Approach		74	4.3	0.039	1.1	NA	0.0	0.0	0.00	0.12	49.2
North: Schnapper Rock Road											
8	T1	44	11.9	0.025	0.2	LOS A	0.1	0.9	0.17	0.01	49.4
9	R2	1	0.0	0.025	4.8	LOS A	0.1	0.9	0.17	0.01	48.5
Approach		45	11.6	0.025	0.3	NA	0.1	0.9	0.17	0.01	49.4
West: Memorial Park											
10	L2	1	0.0	0.019	8.0	LOS A	0.1	0.5	0.20	0.92	45.1
12	R2	17	18.8	0.019	8.1	LOS A	0.1	0.5	0.20	0.92	44.4
Approach		18	17.6	0.019	8.1	LOS A	0.1	0.5	0.20	0.92	44.5
All Vehicles		137	8.5	0.039	1.7	NA	0.1	0.9	0.08	0.19	48.6

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

▽ Site: Albany Highway-Appleby Road Existing AM

Existing AM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Albany Highway											
1	L2	180	2.3	0.536	4.7	LOS A	0.0	0.0	0.00	0.10	48.8
2	T1	834	3.7	0.536	0.1	LOS A	0.0	0.0	0.00	0.10	49.3
Approach		1014	3.4	0.536	0.9	NA	0.0	0.0	0.00	0.10	49.2
North: Albany Highway											
8	T1	666	3.9	0.350	0.0	LOS A	0.0	0.0	0.00	0.00	49.9
9	R2	221	2.4	0.514	17.2	LOS C	2.5	17.9	0.87	1.08	40.0
Approach		887	3.6	0.514	4.3	NA	2.5	17.9	0.22	0.27	47.0
West: Appleby Road											
10	L2	60	8.8	0.110	10.2	LOS B	0.4	2.9	0.68	0.85	43.4
12	R2	23	9.1	0.153	26.7	LOS D	0.4	3.2	0.91	0.96	36.0
Approach		83	8.9	0.153	14.8	LOS B	0.4	3.2	0.74	0.88	41.1
All Vehicles		1984	3.7	0.536	3.0	NA	2.5	17.9	0.13	0.21	47.8

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: Albany Highway-Appleby Road Existing PM

Existing PM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Albany Highway											
1	L2	65	0.0	0.481	4.6	LOS A	0.0	0.0	0.00	0.04	49.2
2	T1	866	0.5	0.481	0.1	LOS A	0.0	0.0	0.00	0.04	49.7
Approach		932	0.5	0.481	0.4	NA	0.0	0.0	0.00	0.04	49.6
North: Albany Highway											
8	T1	1054	2.4	0.549	0.1	LOS A	0.0	0.0	0.00	0.00	49.9
9	R2	42	0.0	0.077	10.5	LOS B	0.3	2.0	0.71	0.87	43.2
Approach		1096	2.3	0.549	0.5	NA	0.3	2.0	0.03	0.03	49.6
West: Appleby Road											
10	L2	49	0.0	0.086	9.7	LOS A	0.3	2.1	0.67	0.84	43.8
12	R2	76	0.0	0.638	50.9	LOS F	2.1	14.7	0.97	1.09	29.1
Approach		125	0.0	0.638	34.6	LOS D	2.1	14.7	0.85	1.00	33.5
All Vehicles		2153	1.4	0.638	2.4	NA	2.1	14.7	0.06	0.09	48.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Albany Highway-Appleby Road Future AM All

Construction AM Peak Hour
MTC/ Temp signal control 30km/h TSL
All movements
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Albany Highway											
1	L2	180	2.3	1.102	169.0	LOS F	133.1	959.3	1.00	1.53	12.7
2	T1	834	3.7	1.102	167.0	LOS F	133.1	959.3	1.00	1.53	12.6
Approach		1014	3.4	1.102	167.4	LOS F	133.1	959.3	1.00	1.53	12.6
North: Albany Highway											
8	T1	666	3.9	1.205	223.0	LOS F	120.5	869.1	1.00	1.80	10.5
9	R2	221	2.4	1.205	225.3	LOS F	120.5	869.1	1.00	1.80	10.6
Approach		887	3.6	1.205	223.6	LOS F	120.5	869.1	1.00	1.80	10.5
West: Appleby Road											
10	L2	60	8.8	1.020	131.5	LOS F	8.4	63.3	1.00	1.34	14.5
12	R2	23	9.1	1.020	131.8	LOS F	8.4	63.3	1.00	1.34	14.5
Approach		83	8.9	1.020	131.6	LOS F	8.4	63.3	1.00	1.34	14.5
All Vehicles		1984	3.7	1.205	191.0	LOS F	133.1	959.3	1.00	1.64	11.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

MOVEMENT SUMMARY

Site: Albany Highway-Appleby Road Future AM No RT

Construction AM Peak Hour
MTC or Temp signal control 30km/h TSL
No RT into Appleby
Signals - Fixed Time   Cycle Time = 90 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Albany Highway											
1	L2	401	2.4	0.896	26.7	LOS C	51.7	371.9	0.85	0.92	27.8
2	T1	834	3.7	0.896	19.8	LOS B	51.7	371.9	0.85	0.92	25.7
Approach		1235	3.2	0.896	22.1	LOS C	51.7	371.9	0.85	0.92	26.3
North: Albany Highway											
8	T1	666	3.9	0.478	5.2	LOS A	11.8	85.7	0.44	0.40	28.9
Approach		666	3.9	0.478	5.2	LOS A	11.8	85.7	0.44	0.40	28.9
West: Appleby Road											
10	L2	60	8.8	0.714	56.6	LOS E	4.0	30.0	1.00	0.91	22.3
12	R2	23	9.1	0.714	60.0	LOS E	4.0	30.0	1.00	0.91	22.2
Approach		83	8.9	0.714	57.5	LOS E	4.0	30.0	1.00	0.91	22.3
All Vehicles		1984	3.7	0.896	17.9	LOS B	51.7	371.9	0.72	0.75	26.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA
INTERSECTION 6

MOVEMENT SUMMARY

Site: Albany Highway-Appleby Road Future PM

Construction PM Peak Hour MTC or temp signals control 30 km/h TSL
2018 Volumes
Signals - Fixed Time   Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Albany Highway											
1	L2	107	0.0	0.766	16.0	LOS B	23.2	162.7	0.75	0.71	30.4
2	T1	866	0.5	0.766	9.1	LOS A	23.2	162.7	0.75	0.71	27.9
Approach		974	0.4	0.766	9.9	LOS A	23.2	162.7	0.75	0.71	28.2
North: Albany Highway											
8	T1	1054	2.4	0.835	14.1	LOS B	31.2	223.1	0.82	0.83	27.1
Approach		1054	2.4	0.835	14.1	LOS B	31.2	223.1	0.82	0.83	27.1
West: Appleby Road											
10	L2	49	0.0	0.787	46.3	LOS D	4.8	33.6	1.00	1.01	23.5
12	R2	76	0.0	0.787	49.7	LOS D	4.8	33.6	1.00	1.01	23.4
Approach		125	0.0	0.787	48.3	LOS D	4.8	33.6	1.00	1.01	23.5
All Vehicles		2153	1.4	0.835	14.2	LOS B	31.2	223.1	0.80	0.79	27.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: William Pickering-John Glenn-Douglas Alexander AM Existing

AM Peak Hour
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Avenue S											
1	L2	61	1.7	0.763	5.7	LOS A	10.0	73.0	0.77	0.64	44.9
2	T1	663	5.7	0.763	5.8	LOS A	10.0	73.0	0.77	0.64	45.8
3	R2	206	4.1	0.763	9.7	LOS A	10.0	73.0	0.77	0.64	45.8
Approach		931	5.1	0.763	6.7	LOS A	10.0	73.0	0.77	0.64	45.8
East: Douglas Alexander Parade											
4	L2	22	0.0	0.180	5.4	LOS A	1.0	7.5	0.58	0.62	45.7
5	T1	125	4.2	0.180	5.5	LOS A	1.0	7.5	0.58	0.62	46.6
6	R2	18	0.0	0.180	9.4	LOS A	1.0	7.5	0.58	0.62	46.6
Approach		165	3.2	0.180	5.9	LOS A	1.0	7.5	0.58	0.62	46.4
North: William Pickering Avenue N											
7	L2	31	13.8	0.382	4.9	LOS A	2.7	20.3	0.55	0.55	45.7
8	T1	349	6.0	0.382	4.8	LOS A	2.7	20.3	0.55	0.55	46.7
9	R2	27	11.5	0.382	8.9	LOS A	2.7	20.3	0.55	0.55	46.6
Approach		407	7.0	0.382	5.1	LOS A	2.7	20.3	0.55	0.55	46.6
West: John Glenn Avenue											
10	L2	15	0.0	0.064	9.4	LOS A	0.4	3.1	0.86	0.78	43.1
11	T1	1	0.0	0.064	9.4	LOS A	0.4	3.1	0.86	0.78	43.9
12	R2	16	6.7	0.064	13.7	LOS B	0.4	3.1	0.86	0.78	43.8
Approach		32	3.3	0.064	11.5	LOS B	0.4	3.1	0.86	0.78	43.5
All Vehicles		1535	5.3	0.763	6.3	LOS A	10.0	73.0	0.70	0.62	46.0

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: William Pickering-John Glenn-Douglas Alexander PM Existing

PM Peak Hour Existing
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Avenue S											
1	L2	13	8.3	0.435	3.4	LOS A	3.6	25.7	0.18	0.43	46.5
2	T1	491	3.0	0.435	3.4	LOS A	3.6	25.7	0.18	0.43	47.5
3	R2	175	0.6	0.435	7.3	LOS A	3.6	25.7	0.18	0.43	47.5
Approach		678	2.5	0.435	4.4	LOS A	3.6	25.7	0.18	0.43	47.5
East: Douglas Alexander Parade											
4	L2	246	1.3	0.277	5.5	LOS A	1.7	12.0	0.59	0.65	46.1
5	T1	1	0.0	0.277	5.5	LOS A	1.7	12.0	0.59	0.65	47.1
6	R2	19	0.0	0.277	9.4	LOS A	1.7	12.0	0.59	0.65	47.1
Approach		266	1.2	0.277	5.8	LOS A	1.7	12.0	0.59	0.65	46.2
North: William Pickering Avenue N											
7	L2	27	3.8	0.317	4.8	LOS A	1.9	13.8	0.50	0.54	46.0
8	T1	309	2.4	0.317	4.8	LOS A	1.9	13.8	0.50	0.54	47.0
9	R2	5	20.0	0.317	9.2	LOS A	1.9	13.8	0.50	0.54	46.7
Approach		342	2.8	0.317	4.9	LOS A	1.9	13.8	0.50	0.54	46.9
West: John Glenn Avenue											
10	L2	29	10.7	0.146	7.8	LOS A	0.8	5.9	0.68	0.75	43.9
11	T1	19	0.0	0.146	7.4	LOS A	0.8	5.9	0.68	0.75	44.8
12	R2	63	0.0	0.146	11.4	LOS B	0.8	5.9	0.68	0.75	44.8
Approach		112	2.8	0.146	9.8	LOS A	0.8	5.9	0.68	0.75	44.6
All Vehicles		1398	2.3	0.435	5.2	LOS A	3.6	25.7	0.37	0.52	46.9

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: William Pickering-John Glenn-Douglas Alexander AM Construction

Existing Traffic flows, under Manual/ Portable traffic light control.
No RT into Douglas Alexander
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Avenue S											
1	L2	61	1.7	0.857	25.6	LOS C	32.2	235.3	0.92	0.95	38.4
2	T1	869	5.3	0.857	21.0	LOS C	32.2	235.3	0.92	0.95	38.7
Approach		931	5.1	0.857	21.3	LOS C	32.2	235.3	0.92	0.95	38.7
East: Douglas Alexander Parade											
4	L2	22	0.0	0.845	45.2	LOS D	6.5	46.6	1.00	1.01	31.6
5	T1	125	4.2	0.845	40.6	LOS D	6.5	46.6	1.00	1.01	31.8
6	R2	18	0.0	0.845	45.2	LOS D	6.5	46.6	1.00	1.01	31.5
Approach		165	3.2	0.845	41.7	LOS D	6.5	46.6	1.00	1.01	31.7
North: William Pickering Avenue N											
7	L2	31	13.8	0.563	22.4	LOS C	10.9	81.1	0.83	0.73	39.5
8	T1	349	6.0	0.563	17.8	LOS B	10.9	81.1	0.83	0.73	39.9
9	R2	27	11.5	0.563	22.4	LOS C	10.9	81.1	0.83	0.73	39.3
Approach		407	7.0	0.563	18.4	LOS B	10.9	81.1	0.83	0.73	39.9
West: John Glenn Avenue											
10	L2	15	0.0	0.196	38.8	LOS D	1.1	7.7	0.96	0.71	32.5
11	T1	1	0.0	0.196	34.2	LOS C	1.1	7.7	0.96	0.71	32.7
12	R2	16	6.7	0.196	38.8	LOS D	1.1	7.7	0.96	0.71	32.3
Approach		32	3.3	0.196	38.7	LOS D	1.1	7.7	0.96	0.71	32.4
All Vehicles		1535	5.3	0.857	23.1	LOS C	32.2	235.3	0.90	0.89	37.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: William Pickering-John Glenn-Douglas Alexander PM Construction

Existing Traffic flows under Manual/ Portable traffic light control
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Avenue S											
1	L2	13	8.3	0.841	27.7	LOS C	26.9	192.2	0.93	0.96	24.9
2	T1	491	3.0	0.841	25.7	LOS C	26.9	192.2	0.93	0.96	24.7
3	R2	175	0.6	0.841	27.9	LOS C	26.9	192.2	0.93	0.96	24.8
Approach		678	2.5	0.841	26.3	LOS C	26.9	192.2	0.93	0.96	24.7
East: Douglas Alexander Parade											
4	L2	246	1.3	0.859	45.5	LOS D	11.8	83.8	1.00	1.08	22.0
5	T1	1	0.0	0.859	43.5	LOS D	11.8	83.8	1.00	1.08	21.8
6	R2	19	0.0	0.859	45.7	LOS D	11.8	83.8	1.00	1.08	22.0
Approach		266	1.2	0.859	45.5	LOS D	11.8	83.8	1.00	1.08	22.0
North: William Pickering Avenue N											
7	L2	27	3.8	0.336	13.7	LOS B	7.7	54.9	0.62	0.54	27.6
8	T1	309	2.4	0.336	11.7	LOS B	7.7	54.9	0.62	0.54	27.3
9	R2	5	20.0	0.336	13.9	LOS B	7.7	54.9	0.62	0.54	27.5
Approach		342	2.8	0.336	11.9	LOS B	7.7	54.9	0.62	0.54	27.3
West: John Glenn Avenue											
10	L2	29	10.7	0.782	46.9	LOS D	4.8	34.7	1.00	0.99	21.9
11	T1	19	0.0	0.782	45.0	LOS D	4.8	34.7	1.00	0.99	21.7
12	R2	63	0.0	0.782	47.1	LOS D	4.8	34.7	1.00	0.99	21.8
Approach		112	2.8	0.782	46.7	LOS D	4.8	34.7	1.00	0.99	21.8
All Vehicles		1398	2.3	0.859	28.1	LOS C	26.9	192.2	0.87	0.88	24.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: Wiliam Pickering-Piermark AM Existing

Existing AM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Drive											
2	T1	781	3.5	0.410	0.1	LOS A	0.0	0.0	0.00	0.00	49.9
3	R2	225	5.1	0.220	7.1	LOS A	1.0	7.2	0.56	0.73	44.9
Approach		1006	3.9	0.410	1.6	NA	1.0	7.2	0.13	0.16	48.7
East: Piermark Drive											
4	L2	153	4.8	0.150	6.6	LOS A	0.6	4.4	0.48	0.68	45.4
6	R2	23	9.1	0.130	22.4	LOS C	0.4	2.7	0.86	0.94	37.6
Approach		176	5.4	0.150	8.7	LOS A	0.6	4.4	0.53	0.71	44.2
North: William Pickering Drive											
7	L2	57	1.9	0.266	4.6	LOS A	0.0	0.0	0.00	0.06	49.1
8	T1	439	7.0	0.266	0.0	LOS A	0.0	0.0	0.00	0.06	49.6
Approach		496	6.4	0.266	0.6	NA	0.0	0.0	0.00	0.06	49.5
All Vehicles		1678	4.8	0.410	2.0	NA	1.0	7.2	0.13	0.19	48.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: Wiliam Pickering-Piermark PM Existing

Existing PM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Drive											
2	T1	566	0.7	0.292	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
3	R2	116	3.6	0.121	7.2	LOS A	0.5	3.7	0.56	0.73	44.9
Approach		682	1.2	0.292	1.3	NA	0.5	3.7	0.09	0.12	49.0
East: Piermark Drive											
4	L2	147	3.6	0.157	7.0	LOS A	0.6	4.5	0.52	0.72	45.2
6	R2	51	8.3	0.174	15.4	LOS C	0.5	3.8	0.78	0.91	40.5
Approach		198	4.8	0.174	9.1	LOS A	0.6	4.5	0.59	0.77	43.9
North: William Pickering Drive											
7	L2	43	0.0	0.295	4.6	LOS A	0.0	0.0	0.00	0.04	49.2
8	T1	521	2.8	0.295	0.0	LOS A	0.0	0.0	0.00	0.04	49.7
Approach		564	2.6	0.295	0.4	NA	0.0	0.0	0.00	0.04	49.7
All Vehicles		1444	2.3	0.295	2.0	NA	0.6	4.5	0.12	0.18	48.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA
INTERSECTION 6

MOVEMENT SUMMARY

Site: Wiliam Pickering-Piermark AM Future

Construction AM Peak Hour MTC or Temp signals 30km TSL
Right turn traffic diverted.
2018 Volumes
Signals - Fixed Time Cycle Time = 50 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Drive											
2	T1	781	3.5	0.788	13.8	LOS B	17.8	128.5	0.87	0.88	27.0
Approach		781	3.5	0.788	13.8	LOS B	17.8	128.5	0.87	0.88	27.0
East: Piermark Drive											
4	L2	153	4.8	0.819	33.0	LOS C	5.0	36.7	1.00	1.11	24.6
6	R2	23	9.1	0.819	34.8	LOS C	5.0	36.7	1.00	1.11	24.6
Approach		176	5.4	0.819	33.2	LOS C	5.0	36.7	1.00	1.11	24.6
North: William Pickering Drive											
7	L2	57	1.9	0.512	12.6	LOS B	8.1	59.5	0.70	0.63	29.2
8	T1	439	7.0	0.512	8.6	LOS A	8.1	59.5	0.70	0.63	28.0
Approach		496	6.4	0.512	9.1	LOS A	8.1	59.5	0.70	0.63	28.1
All Vehicles		1453	4.7	0.819	14.5	LOS B	17.8	128.5	0.83	0.82	27.1

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Wiliam Pickering-Piermark PM Future

Construction PM Peak Hour MTC or Temp signal control 30km/h TSL
2018 Volumes
Signals - Fixed Time Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: William Pickering Drive											
2	T1	566	0.7	0.730	10.3	LOS B	8.2	57.7	0.90	0.91	27.7
Approach		566	0.7	0.730	10.3	LOS B	8.2	57.7	0.90	0.91	27.7
East: Piermark Drive											
4	L2	147	3.6	0.551	16.9	LOS B	2.9	21.1	0.94	0.83	27.4
6	R2	51	8.3	0.551	18.8	LOS B	2.9	21.1	0.94	0.83	27.4
Approach		198	4.8	0.551	17.4	LOS B	2.9	21.1	0.94	0.83	27.4
North: William Pickering Drive											
7	L2	43	0.0	0.738	14.6	LOS B	8.3	59.4	0.91	0.93	28.8
8	T1	521	2.8	0.738	10.6	LOS B	8.3	59.4	0.91	0.93	27.6
Approach		564	2.6	0.738	10.9	LOS B	8.3	59.4	0.91	0.93	27.7
All Vehicles		1328	2.1	0.738	11.6	LOS B	8.3	59.4	0.91	0.91	27.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Bush-Piermark AM Existing

Existing AM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Bush Road											
1	L2	109	1.0	0.547	4.7	LOS A	0.0	0.0	0.00	0.06	49.0
2	T1	920	5.1	0.547	0.1	LOS A	0.0	0.0	0.00	0.06	49.5
Approach		1029	4.7	0.547	0.6	NA	0.0	0.0	0.00	0.06	49.5
North: Bush Road											
8	T1	942	3.4	0.494	0.1	LOS A	0.0	0.0	0.00	0.00	49.9
9	R2	215	2.9	0.408	13.4	LOS B	1.8	13.2	0.82	1.01	41.7
Approach		1157	3.3	0.494	2.6	NA	1.8	13.2	0.15	0.19	48.1
West: Piermark Drive											
10	L2	152	5.6	0.262	10.7	LOS B	1.0	7.4	0.73	0.90	43.2
12	R2	18	5.9	0.140	29.8	LOS D	0.4	2.7	0.92	0.97	35.0
Approach		169	5.6	0.262	12.7	LOS B	1.0	7.4	0.75	0.91	42.1
All Vehicles		2356	4.1	0.547	2.4	NA	1.8	13.2	0.13	0.18	48.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

▽ Site: Bush-Piermark PM Existing

Existing PM Peak Hour
2018 Volumes
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Bush Road											
1	L2	79	5.3	0.416	4.7	LOS A	0.0	0.0	0.00	0.05	49.1
2	T1	723	0.4	0.416	0.1	LOS A	0.0	0.0	0.00	0.05	49.6
Approach		802	0.9	0.416	0.5	NA	0.0	0.0	0.00	0.05	49.6
North: Bush Road											
8	T1	826	3.4	0.433	0.1	LOS A	0.0	0.0	0.00	0.00	49.9
9	R2	102	6.2	0.135	8.7	LOS A	0.5	3.9	0.63	0.83	44.1
Approach		928	3.7	0.433	1.0	NA	0.5	3.9	0.07	0.09	49.2
West: Piermark Drive											
10	L2	241	2.6	0.297	8.5	LOS A	1.3	9.3	0.62	0.86	44.4
12	R2	66	4.8	0.291	20.7	LOS C	0.9	6.4	0.88	0.98	38.3
Approach		307	3.1	0.297	11.2	LOS B	1.3	9.3	0.67	0.88	42.9
All Vehicles		2038	2.5	0.433	2.3	NA	1.3	9.3	0.13	0.20	48.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Bush-Piermark AM Future

Construction AM Peak Hour
2018 Volumes
Signals - Fixed Time   Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Bush Road											
1	L2	109	1.0	0.851	23.6	LOS C	32.9	239.9	0.86	0.89	28.7
2	T1	920	5.1	0.851	16.7	LOS B	32.9	239.9	0.86	0.89	26.5
Approach		1029	4.7	0.851	17.4	LOS B	32.9	239.9	0.86	0.89	26.7
North: Bush Road											
8	T1	1049	3.2	0.855	17.0	LOS B	33.9	244.0	0.86	0.89	26.6
Approach		1049	3.2	0.855	17.0	LOS B	33.9	244.0	0.86	0.89	26.6
West: Piermark Drive											
10	L2	152	5.6	0.849	48.2	LOS D	6.0	44.1	1.00	1.13	23.5
12	R2	18	5.9	0.100	42.8	LOS D	0.6	4.3	0.94	0.70	24.2
Approach		169	5.6	0.849	47.6	LOS D	6.0	44.1	0.99	1.09	23.6
All Vehicles		2248	4.1	0.855	19.5	LOS B	33.9	244.0	0.87	0.90	26.4

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Bush-Piermark PM Future

Construction PM Peak Hour
2018 Volumes
Signals - Fixed Time   Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Bush Road											
1	L2	79	5.3	0.821	20.5	LOS C	17.1	120.8	0.90	0.98	29.4
2	T1	753	0.4	0.821	13.6	LOS B	17.1	120.8	0.90	0.98	27.1
Approach		832	0.9	0.821	14.3	LOS B	17.1	120.8	0.90	0.98	27.3
North: Bush Road											
8	T1	878	3.6	0.878	18.9	LOS B	21.6	156.1	0.95	1.15	26.2
Approach		878	3.6	0.878	18.9	LOS B	21.6	156.1	0.95	1.15	26.2
West: Piermark Drive											
10	L2	241	2.6	0.756	27.4	LOS C	5.2	37.5	1.00	1.03	26.8
12	R2	66	4.8	0.211	26.6	LOS C	1.2	8.7	0.89	0.75	26.9
Approach		307	3.1	0.756	27.2	LOS C	5.2	37.5	0.98	0.97	26.8
All Vehicles		2017	2.4	0.878	18.3	LOS B	21.6	156.1	0.93	1.05	26.8

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA INTERSECTION 6

Appendix C

Vehicle Tracking Rahui Road

Wednesday, 4 March 2015 4:09:45 p.m.

0 20mm@A3

REV	DATE	DRN	CHK	DESCRIPTION

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

VEHICLE ACCESS TRAFFIC ROAD & RAHUI ROAD

DRAWN: SP	--- ---
DATE: 13.03.15	STATUS: ---
SCALE: 1:1,250@A3	
DWG NO:12923A2B	

TDG

C1

J:\12900-49\12923\drawings\12923A2b.dwg

Wednesday, 4 March 2015 4:09:45 p.m.

0 20mm@A3

REV	DATE	DRN	CHK	DESCRIPTION

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

VEHICLE ACCESS TRAFFIC ROAD & RAHUI ROAD

DRAWN: SP	--- ---
DATE: 13.03.15	STATUS: ---
SCALE: 1:1,250@A3	
DWG NO:12923A2B	

TDG

C2

J:\12900-49\12923\drawings\12923A2b.dwg

Wednesday, 4 March 2015 4:09:45 p.m.

0 20mm@A3

REV	DATE	DRN	CHK	DESCRIPTION

WATERCARE: NORTHERN INTERCEPTOR, PHASE 1

CONSTRUCTION TRAFFIC ASSESSMENT

VEHICLE ACCESS TRAFFIC ROAD & RAHUI ROAD

DRAWN: SP	--- ---
DATE: 13.03.15	STATUS: ---
SCALE: 1:1,250@A3	
DWG NO:12923A2B	

TDG

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