

Bayview Subdivision – Stage 11 - Lot A, B & C

Site Services Report

Dover Investments Pty

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Ltd



byrne.

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Definitions

Abbreviation	Definition
AAPA	Aboriginal Areas Protection Authority
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
CCTV	Closed Circuit Television
CICL	Cast Iron Cement Lined
COD	City of Darwin
CPTED	Crime Prevention Through Environmental Design
DBYD	Dial Before You Dig
DCDB	Digital Cadastral Data Base
DDA	Disability and Discrimination Act
DICL	Ductile Iron Cement Lined
DN	Nominal Diameter
EP	Equivalent Population
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning System
HV	High Voltage
IECA	International Erosion Control Association
LED	Light Emitting Diode
LIDAR	Light Detection and Ranging
LV	Light Voltage
MH	Manhole
MMDD	Maximum Modified Dry Density
NBNCO	National Broadband Network Company
NT	Northern Territory
NTG	Northern Territory Government
PUP	Public Utility Plant
PVC	Poly Vinyl Chloride
PWC	Power and Water Corporation
RCD	Residual Current Device
RCP	Reinforced Concrete Pipe

Abbreviation	Definition
RHS	Rectangular Hollow Section
RL	Reduced Level
SID	Safety in Design
RODP	Road Owner Distribution Pillar
TBC	To Be Confirmed
TCSD	Transport and Civil Services Department
VC	Vertical Curve
VIAC	Vehicle Impact Absorbing Column
WSAA	Water Services Association of Australia
XLPE	Cross Linked Polyethylene

1 Introduction

Byrne Consultants has been commissioned by the Dover Investments Pty Ltd to develop a Site Services Report for the proposed Bayview Subdivision development, including the proposed subdivisions of Lot A, B and C forming Stage 11 of the development.

This report has been prepared to support the lodgement of the subdivision development application for Bayview Subdivision.

The objective of this Site Services Report is to provide preliminary engineering design and review of:

- The existing site conditions.
- Lot configurations and layouts.
- Proposed access roads and footpaths.
- Bulk earthworks requirements.
- Stormwater drainage reticulation.
- Water reticulation.
- Sewer reticulation.
- Electrical (LV), Street Lighting and Communications (NBN) reticulation; and
- Landscaping strategy.
- Traffic impact assessment.

2 Site Conditions

2.1 Site Description

Dover Investments Pty Ltd is progressing the development of Bayview subdivision to create a contemporary low to medium density residential development. The Site is located in Bayview NT, and consists of three (3) proposed development sites identified as Lot's A, B & C.

Lot's A and B is proposed to be zoned as low density residential (LR) and Lot C is zoned as low to medium density residential (LMR) under the NT Planning Scheme.

The lot areas are 10,600 m², 800 m² and 11,200 m² for Lot's A, B & C respectively.

See Figure 2.1 below for site location summary.

A Site Locality Plan is contained within Appendix A of this report.

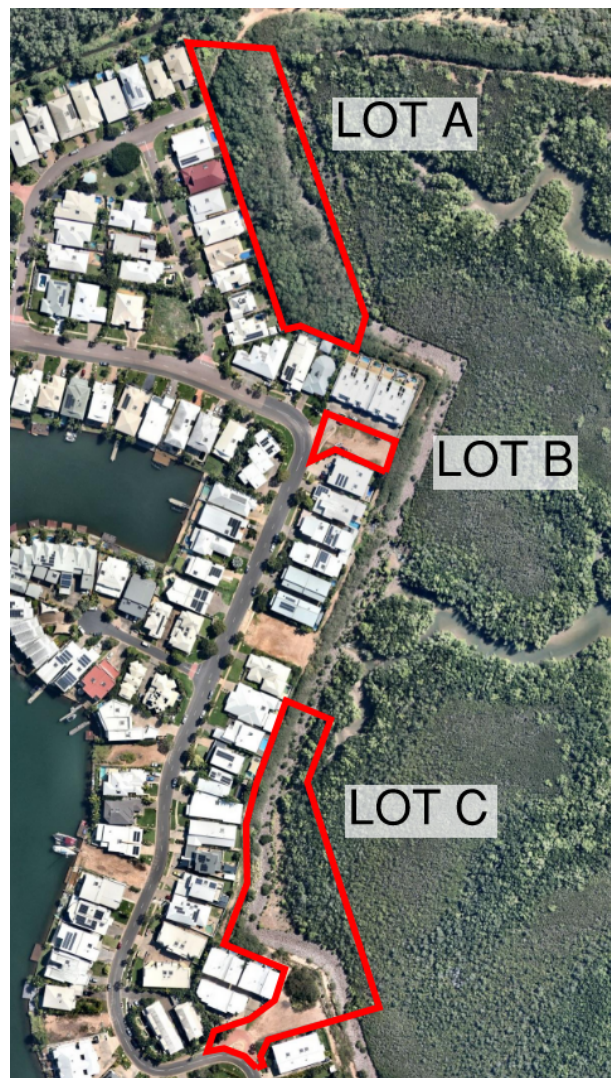


Figure 2.1 – Bayview Subdivision Project Area

The proposed development consists of three (3) proposed subdivisions and two (2) proposed road reserves as well as supporting roads and infrastructure detailed in Figure 2.2, 2.3 and 2.4. The intended use of the lots is as follows:

- Lot A – 14 residential lots (LR).
- Lot B – 2 residential lots (LR).
- Lot C – 3 residential lots (LR).
- Lot C – 2 residential lots (LMR, approx. 9 dwellings)

A Lot Layout Plan is contained within Appendix B of this report.



Figure 2.2 – Lot A Bayview Subdivision Development Intent

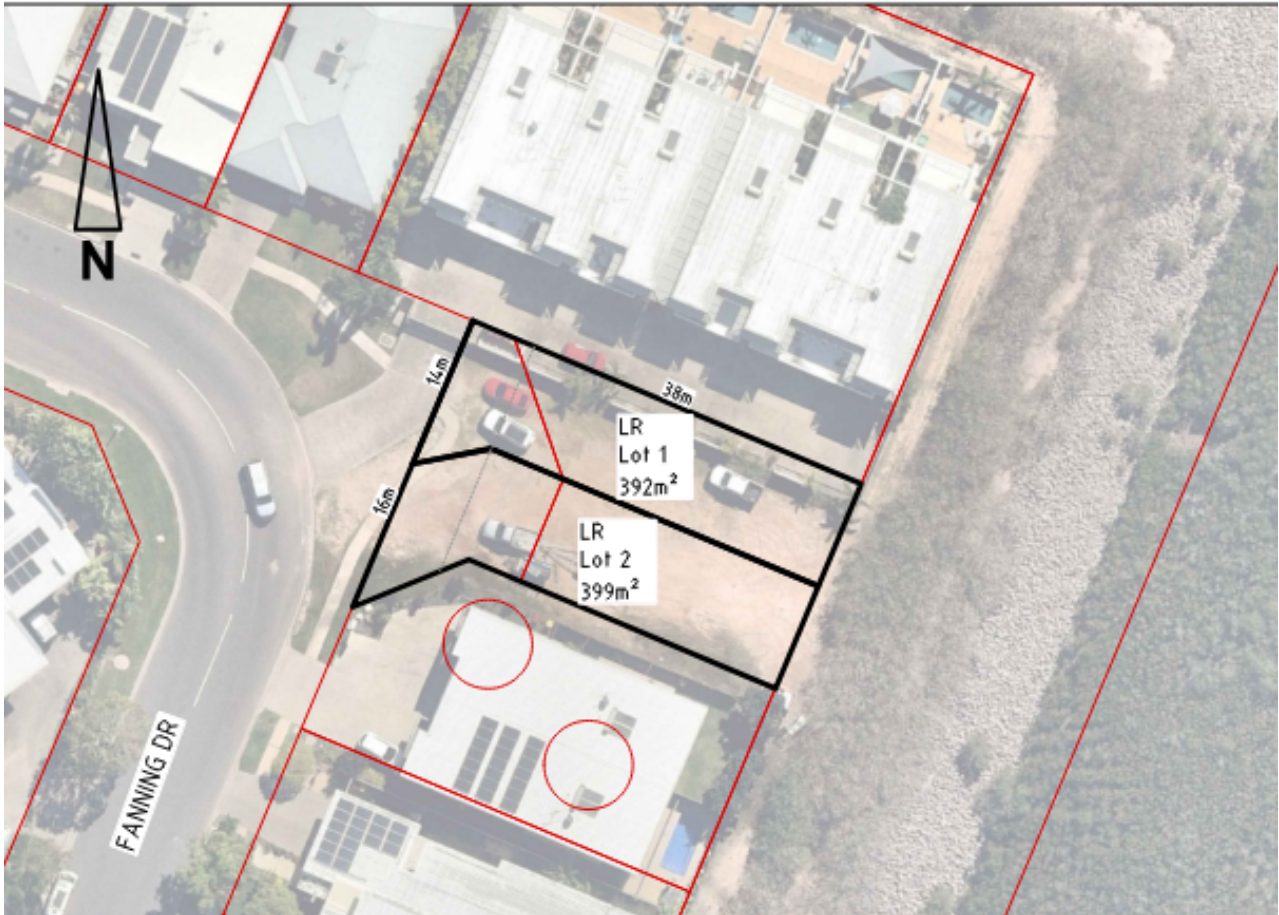


Figure 2.3 – Lot B Bayview Subdivision Development Intent

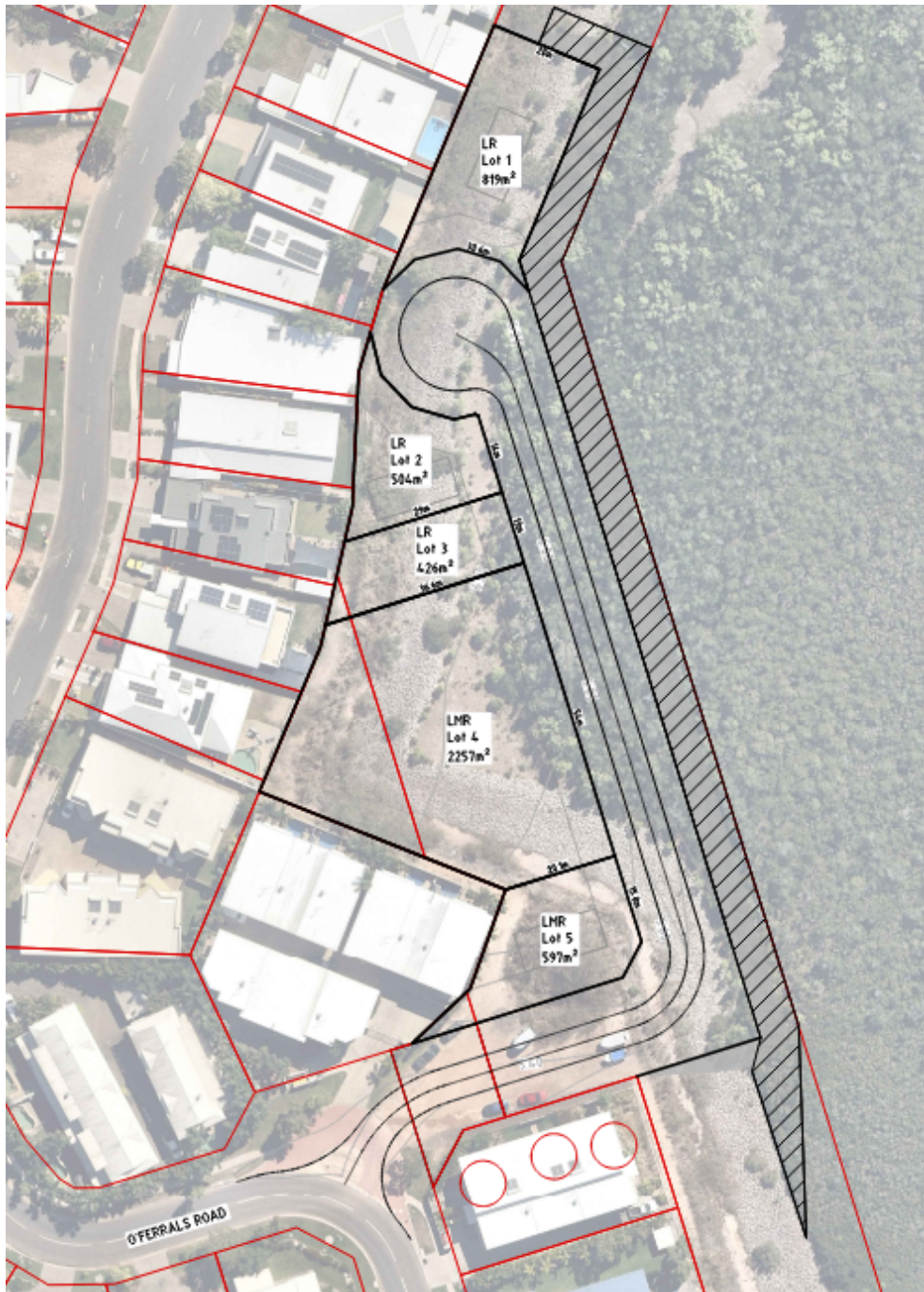


Figure 2.4 – Lot C Bayview Subdivision Development Intent

2.2 Engineering Survey

No detailed engineering survey has been undertaken as part of this study.

Alternatively, Elevation Information Systems (ELVIS) LIDAR and DCDB cadastral boundary data sourced from NT Atlas Spatial Directory has been utilised for preliminary investigation purposes for this study.

2.3 Location of Existing Services

A preliminary services investigation was undertaken for this study including a DBYD assessment and review of PWC's and City of Darwin utility GIS mapping. Existing services within the project limits were identified and labelled on the site layout plans.

No physical potholing or ground penetrating radar locating of the existing services has been undertaken as part of this study.

2.4 Site Interfaces

The following existing residential lots and roads interface with the proposed development works in Figure 2.5:

Lot A:

- Latrobe Street – Proposed connection road to Lot A
- Lot 7374 – Single Residential Dwelling on Latrobe Street
- Lot 7375 – Single Residential Dwelling on Perth Street
- Lot 7376 – Single Residential Dwelling on Perth Street
- Lot 7377 – Single Residential Dwelling on Perth Street
- Lot 7378 – Single Residential Dwelling on Perth Street
- Lot 7379 – Single Residential Dwelling on Perth Street
- Lot 7380 – Single Residential Dwelling on Perth Street
- Lot 7381 – Single Residential Dwelling on Perth Street
- Lot 7382 – Single Residential Dwelling on Perth Street
- Lot 7486 – Single Residential Dwelling on O'Ferrals Road
- Lot 7497 – Single Residential Dwelling on O'Ferrals Road
- Lot 7498 – Single Residential Dwelling on O'Ferrals Road
- Lot 7499 – Multi Residential Dwellings on O'Ferrals Road

Lot B:

- O'Ferrals Road – Existing Road fronting Lot B
- Lot 7499 – Multi Residential Dwellings on O'Ferrals Road
- Lot 10315 – Duplex Residential Dwelling on O'Ferrals Road

Lot C:

- O'Ferrals Road - Proposed connection road to Lot C
- Lot 7506 – Single Residential Dwelling on O'Ferrals Road
- Lot 7507 – Single Residential Dwelling on O'Ferrals Road
- Lot 7508 – Single Residential Dwelling on O'Ferrals Road

- Lot 7509 – Single Residential Dwelling on O’Ferrals Road
- Lot 7510 – Single Residential Dwelling on O’Ferrals Road
- Lot 7511 – Single Residential Dwelling on O’Ferrals Road
- Lot 7512 – Single Residential Dwelling on O’Ferrals Road
- Lot 7513 – Single Residential Dwelling on O’Ferrals Road
- Lot 7514 – Single Residential Dwelling on O’Ferrals Road
- Lot 7515 – Multi Residential Dwellings on O’Ferrals Road
- Lot 8169 – Multi Residential Dwellings on O’Ferrals Road

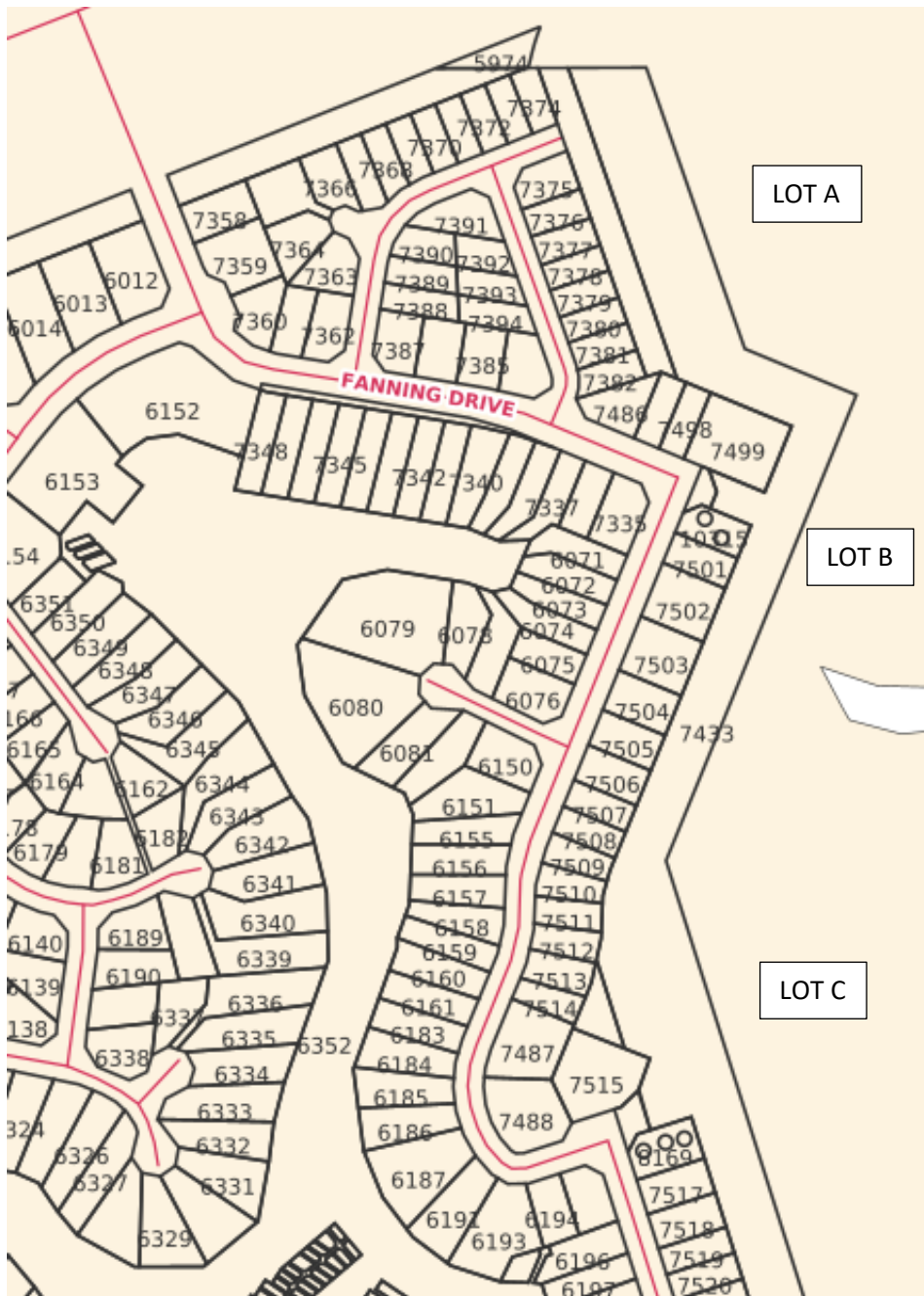


Figure 2.5 – Surrounding Properties

2.5 Geotechnical Investigations and Site Earthworks

For this study, no site-specific geotechnical investigations have been undertaken. Future geotechnical testing activities plan to be undertaken once DA approval is attained and prior to the project progressing into the detailed design phase.

Historical geotechnical site investigations have been completed as part of the previous Bayview Subdivision Stage 10 works. These geotechnical reports were completed by Douglas and Partners and is referenced below:

“Report on Geotechnical Investigation, Stage 10 Area, Bayview, NT”, prepared for Bayview Joint Venture, DP Project 26718, March 2004.

For this the Stage 11 works Douglas and Partners have completed *“Geotechnical Assessment of Proposed Site Filling and Seawalls - Stage 11 – Lot’s A & C” Bayview, NT.*

The above assessment report is contained in Appendix J of this report and references much of the previous geotechnical work carried out by Douglas and Partners within the Bayview Subdivision to date.

The below is a summary of the commentary provided by Douglas and Partners for the *“Geotechnical Assessment of Proposed Site Filling and Seawalls - Stage 11 – Lot’s A & C” Bayview, NT.*

2.5.1 Site Geology

Reference to the Darwin 1:100 000 Geological Map Series sheet indicates the site is underlain by recent marine sediments (mangrove mud) then Quaternary age sediments comprising ferruginous gravelly clayey sand and pisolitic mottled laterite, ferricrete (locally referred to as coffee rock) overlying bedrock comprising low to medium strength metasiltstone (phyllite) of the Burrell Creek Formation.

2.5.2 Surface and Subsurface Conditions

The present surface conditions on Lot’s A and C are shown in the attached site photographs, Plates 1 and 2, taken in early May 2012. There are no mature mangroves within the lease boundary at either of the sites, and all vegetation on the earth and rockfill slopes is regrowth since the slopes were constructed.



Plate 1: View of existing embankment and site surface at Lot A



Plate 2: View of existing embankment and site surface at Lot C

The locations of mud depth probes from Ref 3 are shown on Drawing 4 (See Douglas and Partners Report in Appendix J), and the depths of soft mud penetrated at each probe location are listed in Table 1.

TABLE 1
MUD PROBE RESULTS

PROBE No	SECTION No	OFFSET (m)*	SURF RL (m)	MUD DEPTH (m)	BASE OF MUD RL (m)
24	5	0	2.8	2.0	0.8
25	5	30	2.6	3.2	-0.6
26	5	60	2.4	3.0	-0.6
33	6	0	3.0	2.0	1.0
34	6	30	2.5	2.4	0.1
47	10	0	2.5	2.6	-0.1
48	10	30	2.5	2.8	-0.3
49	10	60	2.0	2.2	-0.2
51	11	0	2.5	2.4	0.1
52	11	30	2.5	1.2	1.3
53	11	60	1.5	1.8	-0.3
54	12	30	2.3	1.8	0.5
55	12	60	2.0	2.0	0.0
56	12	90	2.2	1.6	0.6
58	13	0	2.7	0.0	2.7
59	13	30	2.5	1.8	0.7
60	13	60	2.3	2.2	0.1

Based on these results, average mud depth along the lease boundary at Lot A is about 2m and the average mud depth along the lease boundary at Lot C is about 2.5 m. The soft mud is underlain by a layer of stiff marine clay which averages about 1m thick at Lot A and about 0.7 m thick at Lot C.

2.5.3 Proposed Construction Methodology

It is understood that the proposed construction to develop each of the two lots will be as follows:

Lot A: Clear and reshape the sloping ground, then construct a building platform at a final level at about RL5.5m AHD by filling over the prepared site surface. Surcharge the lot for a period of up to 5 months with about 2m of filling to reduce post construction settlements, then remove the surcharge and construct a seawall to RL6.5 m AHD.

Lot C: Remove and stockpile the rock armour from the current seawall, reshape the sloping fill batter, then construct a building platform at a final level at about RL RL5.5 m AHD by filling over the prepared site surface. Surcharge the lot for a period of up to 8 months with about 2m of filling to reduce post construction settlements, then remove the surcharge and construct a seawall to RL6.5 m AHD.

The above methodology is illustrated in Figures 2.6 and 2.7 below.

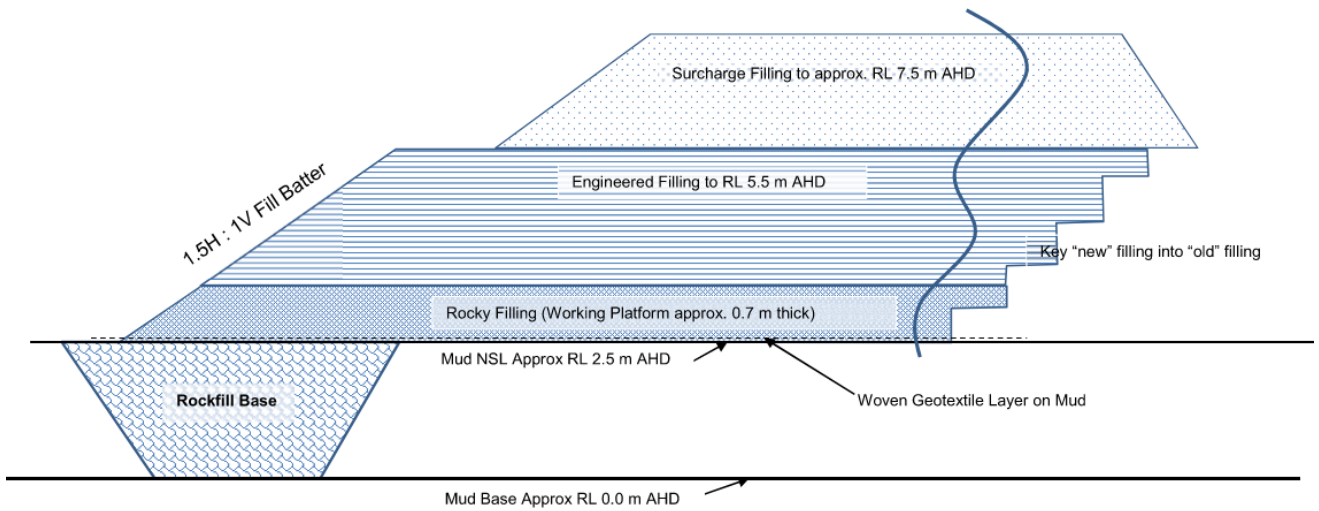


Figure 2.6 – Proposed Filling and Pre-loading design of Lot's A and C

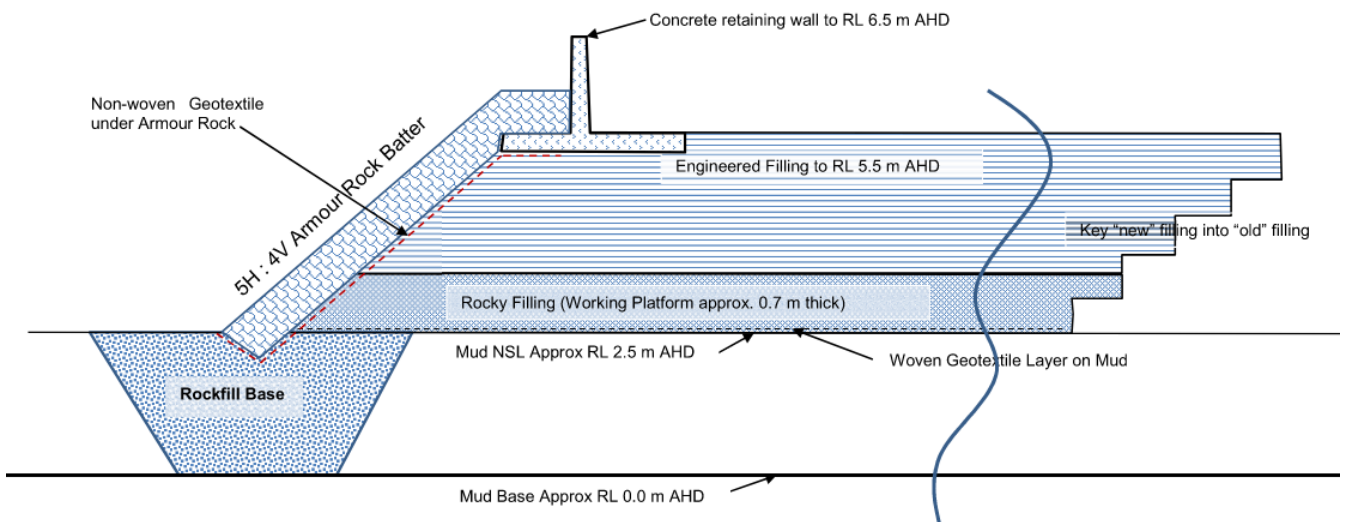


Figure 2.7 – Proposed Final Earthworks Design – Lot's A and C

2.5.4 Suitability for Residential Construction

The attached Drawing 4 (*See Douglas and Partners Report in Appendix J*) shows the locations of the proposed Stage 11 – Lot's A and C which confirms that the information on mud depths and surcharge calculations contained in previous DP geotechnical reports will adequately cover the proposed Stage 11 lot areas. In addition, the information on Drawings 6 and 7 (*See Douglas and Partners Report in Appendix J*) indicate that previous calculations of surcharge heights and surcharge times could be revised to adequately address the proposed construction schedule of the Stage 11 lots.

The proposed composite wall profile with a rockfill base will be stable, will enable development of the lots for their intended purposes, and with a crest level of RL6.5 m AHD will mitigate risk and damage as a result of any storm surge event.

Providing construction is carried out in accordance with a strategy developed during the detailed design phase of the project, it is considered that the construction strategy and monitoring proposed above will produce filling platforms for Lots A and C that are suitable for residential construction of single (SU) or multiple (MU) residential buildings up to two storeys high. The geotechnical risk of damage as a result of a storm surge event is considered to be minimal.

2.6 Site Contamination

Site contamination has not been assessed as part of this study. If the proposed seawall section shown on Figure 2.6 above is adopted for construction, some additional geo environmental sampling, testing and reporting will be required to assess the potential for acid sulphate soils (PASS) and to address the issues of handling and disposal of PASS. The management of PASS has been addressed for previous stages of Bayview and the same management plans would apply to this additional development.

2.7 Cultural and Heritage Approvals

A Cultural and Heritage assessment on the proposed land use has not been undertaken at this stage.

A preliminary review of The Northern Territory Heritage Register did not identify any declared heritage places or objects within proximity of the proposed area of development.

2.8 Noise

A noise assessment has not been conducted as part of this study.

3 Stormwater Drainage

3.1 General

A stormwater management plan was developed for this study and is contained in Appendix E of this report.

The stormwater drainage for each development site was designed in accordance with the City of Darwin Development Standards and the Northern Territory Subdivision Development Guidelines.

The extracts below provide a summary of the investigations undertaken and included in the Stormwater Management Plan contained in Appendix E.

3.1 Design Criteria

Table 3.1 – Design Criteria

Parameter	Criteria Value	Comments
Design Storms	Minor Storm: Q2 Major Storm: Q100	As per NT SDG Table 19
Flow Widths	≤ 2.5 metres from kerb invert	As per NT SDG Table 21
Flow Depths	Minor Storm: Flows must not overtop kerb Major Storm: Flow contained within the road reserve boundaries	As per NT SDG Table 21 & 22
Freeboard	Min 300mm freeboard to allotment boundaries	As per NT SDG Table 22

3.2 Existing Topography and Drainage Patterns

3.2.1 Lot A

The site generally falls from west to east from an existing urban residential environment to a vegetated mangrove creek. From google imagery and CoD Stormwater Network Mapping, the existing site indicates that stormwater is collected in a series of stormwater pits located along Latrobe Street. The existing underground stormwater pipe system discharges into the mangroves at the end of Latrobe Street through a 525mm diameter RCP.

3.2.2 Lot B

The project area consists of a vacant lot which drains towards O’Ferrals Road reserve at an approximate grade of 1%. Stormwater discharge from the lot is collected by the existing stormwater network (pit and pipes) which is directed via the trunk underground drainage network to via a drainage easement through Lot 7502 before discharging into the adjacent mangroves area. No upgrades to the existing drainage system are proposed to service Lot B.

3.2.3 Lot C

The site generally falls from west to east from an existing urban residential environment to a vegetated mangrove creek. From google imagery and CoD Stormwater Network Mapping, stormwater is collected via the truck stormwater network located within O’Ferrals Road reserve. The trunk drainage network then discharges stormwater into the mangrove creek via a 1200mm diameter RCP which runs through Lot PT8169. Do designated easement through PT8169 was identified, so the pipe alignment would need to be confirmed.

3.3 Upstream Network Catchment Assessment

For the purposes of preliminary investigations, a high-level upstream catchment assessment has been conducted. Existing pit and pipe networks have been modelled and catchment boundaries defined for the purpose of preliminary hydrology and hydraulics calculations. It is anticipated that the proposed stormwater design will cause no worsening effects of upstream conditions.

3.4 Flooding Assessment

Department of Environment and Natural Resources storm surge map indicates that the Site is subject to flooding via Extreme Storm Surge (10,000-year ARI) as shown in Figure 3.1.

Flood mitigation has been considered during the design process of the development and involves the implementation of raised embankments and revetment walls to RL to 6.5m in line with the current immunity of existing Bayview development. No further flood analysis has been conducted as part of this study.

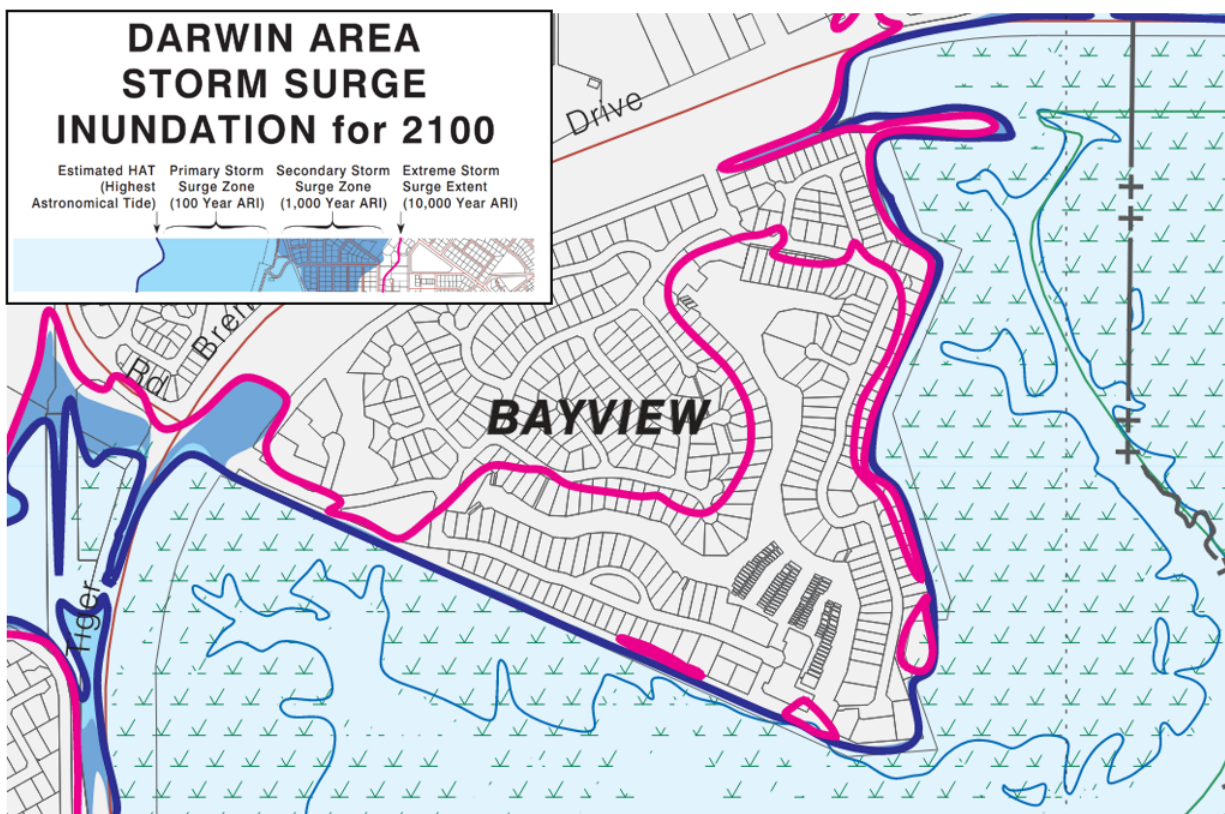


Figure 3.8 – Storm Surge Excerpt

3.5 Catchment Assessment

A catchment and hydrology assessment were carried out to determine the design stormwater flows contributing to the proposed stormwater networks within the development.

Catchment flows were calculated for Q2 and Q100 storm events using the rational method and available LIDAR data. Upstream stormwater networks and their associated discharge effects on the proposed stormwater networks were also considered with the existing networks modelled to flow full where connections to the new network are required. This is a conservative approach to ensure the downstream stormwater networks is sized sufficiently for the existing upstream flow.

3.6 Pre and Post Development Assessment

3.6.1 Pre-Development Peak Flow Calculations

Pre-development flows were not assessed as part of this study as there is no impact on the downstream stormwater network. The proposed stormwater design for the new development areas is effectively connecting to the downstream end of the existing stormwater network and therefore not adding any additional stormwater flows to the upstream stormwater network.

For this purpose, predevelopment flows are not relevant and therefore excluded in this study.

3.6.2 Post Development Peak Flow Calculations

All stormwater management infrastructure for the proposed development is designed generally in accordance with *Northern Territory Subdivision Development Guidelines (2020)*.

3.7 Internal Stormwater Strategy

The intent of the internal development stormwater strategy is to direct all stormwater flows from the proposed lots toward the road reserve where it will be collected via kerb and channel along the roadway and captured via stormwater inlet pits into the proposed stormwater pipe network.

The sites shall discharge stormwater into the existing mangrove creek in accordance with the current stormwater management philosophy for the development.

3.7.1 Lot A

The proposed lawful point of discharge for the development of Lot A is into the mangroves and creek area east of Latrobe Street. An existing 525mm diameter RCP which discharges to the area shall be extended and upsized to account for the additional development catchment area of Lot A.

3.7.2 Lot B

All stormwater from Lot B is collected by the existing stormwater network (pit and pipes) on O’Ferrals Road which is directed via the trunk underground drainage network to a drainage easement through Lot 7502 before discharging into the adjacent mangroves area. No upgrades to the existing drainage system are proposed to service Lot B.

3.7.3 Lot C

The proposed lawful point of discharge for the development of Lot C shall be via the existing underground stormwater network and 1200mm diameter RCP outlet which discharges to the mangroves area through Lot PT8169.

The existing 1200mm RCP discharge pipe shall be extended and upsized to account for the additional development catchment area of Lot C.

A Master Services Plan illustrating the above is contained in Appendix C of this report.

3.8 External Stormwater Strategy

It is anticipated that the proposed internal stormwater strategy design will cause no worsening effects of existing upstream conditions due to the proposed stormwater network being sized sufficiently to convey the upstream inflows. No worsening of the downstream flows is expected due to discharge into the existing tidal mangrove creek.

3.9 Stormwater Quality

3.9.1 Design Basis

The NT SDG require that gross pollutant traps are considered as part of the drainage design.

3.9.2 Assessment

Given the existing stormwater system within the development and associated discharge points do not have a gross pollutant trap installed on the outlets. It is not proposed to provide GPT's as part of this stormwater design. The intention is to connect or extend the proposed stormwater system to the existing discharge outlets and to discharge stormwater under the current site conditions into the mangrove creek.

3.9.3 Erosion and Sediment Control

During construction it is proposed to implement sediment and erosion control measures in accordance with the Erosion and Sediment Control Plan contained in Appendix F of this report.

This will ensure all erosion and sediment control measures are in place to minimise impact on the neighbouring environment due to sediment loss during construction.

It is expected that a similar environmental management plan used in Bayview previous stages will be adopted for the Stage 11 works.

3.10 Overland Flow Constraints

For Lot A there is no overland flow path outlet as the flow path to the creek will be blocked by the construction of the retaining wall. The proposed retaining wall within Lot A will prevent all overland flow towards the mangroves therefore the underground stormwater system will need to be designed for the 1% AEP (Q100 flow event). The design of Lot B and C allows the Q100 overflow to run down and be contained within the existing road reserve.

4 Access Roads and Footpaths

4.1 General

All roads in the Bayview subdivision development have been designed to generally comply with City of Darwin Subdivision and Development Guidelines (2005) and the NT Subdivision Guidelines.

4.2 Road Hierarchy for Development

The development of proposed Lot's A and C shall adopt the minor street / cul-de-sac road hierarchy as stated in Table 6 – Street Hierarchy Design Criteria – Category A – Set 1 of the NT Subdivision Guidelines.

The developed land shall be zoned as low to medium residential.

4.3 Access Road Cross-section

The proposed road cross-section for the minor street / cul-de-sac shall conform to the following road cross-section requirements.

Road Reserve Width	15.0m
Carriageway Width	2 x 3.0m traffic lanes
Central Median Width	None
Verge Width	2 x 4.5m wide verges
Formalised Parking	None
Footpath	1 x 1.5m (one side of road only)
Lot Access	Direct Access

4.4 Access Road Connections

Lot A shall be accessed via a proposed road extension of Latrobe Street. Latrobe Street comprises of a standard urban cross-section with a 6.0m carriageway width and kerb and gutter.

Lot B shall be accessed via O'Ferrals Road. No road access is proposed to be upgraded as part of the Lot B works. A new driveway shall extend from O'Ferrals Road to service Lot B.

Lot C shall be accessed via a proposed road extension and minor intersection off O'Ferrals Road.

The general arrangement has been designed based on the following constraints:

- Existing topography
- Lot A Road to tie into Latrobe Street.
- Lot C Road to tie into O'Ferrals Road.
- Lot A and C to have a cul-de-sac for vehicle U-turns.

4.5 Footpaths

Footpaths shall be concrete and a minimum 1.5m wide. It is proposed to have a footpath on one (1) side of the road only in line with the NT Subdivision Guidelines.

5 Traffic Impact Assessment

A Traffic Impact Assessment (TIA) was completed as part of this study and assessed four (4) intersections potentially impacted by the proposed Stage 11 Bayview development.

The purpose of the TIA report was to support the Development Application (DA) submission and identify any traffic generation impacts caused by the proposed development to existing intersections.

Comparison between the existing traffic conditions and stage 11 developed traffic conditions was undertaken with the assessment scope including the following:

1. Review of background traffic information and previous reporting
2. Carry out peak hour (AM / PM) traffic count surveys at the following intersections
 - i. Stoddard Dr / Tiger Brennan Dr / Woolner Rd
 - ii. Stoddard Dr / Tiger Brennan Dr
 - iii. Stoddard Dr / Fanning Dr
 - iv. Stoddard Dr / Bayview Blvd
3. Calculate future development traffic potential and its impacts to the existing intersections (if any)
4. Calculate peak hour traffic trip generation by the proposed development and directional splits at the existing intersections.
5. Calculate traffic growth rates for the AM/PM peak hour movements at the intersections.
6. Undertake SIDRA intersection analysis for existing case (2022) and development cases (2027 and 2032) cases for the AM /PM peak hours.
7. Identify any upgrade requirements to intersections as a direct result of the development traffic generated by the proposed development (if any).

The Traffic Impact Assessment Report is contained within Appendix K of this report.

The following commentary generally summarises the report findings.

5.1 Study Area

The Bayview residential and development area is connected to Tiger Brennan Drive via Stoddard Drive, as per 5.1, in which the four (4) highlighted intersections was the focus of this study including:

1. Stoddard Dr / Tiger Brennan Dr / Woolner Rd Intersection
2. Stoddard Dr / Tiger Brennan Dr Intersection
3. Stoddard Dr / Fanning Dr Intersection
4. Stoddard Dr / Bayview Blvd Intersection

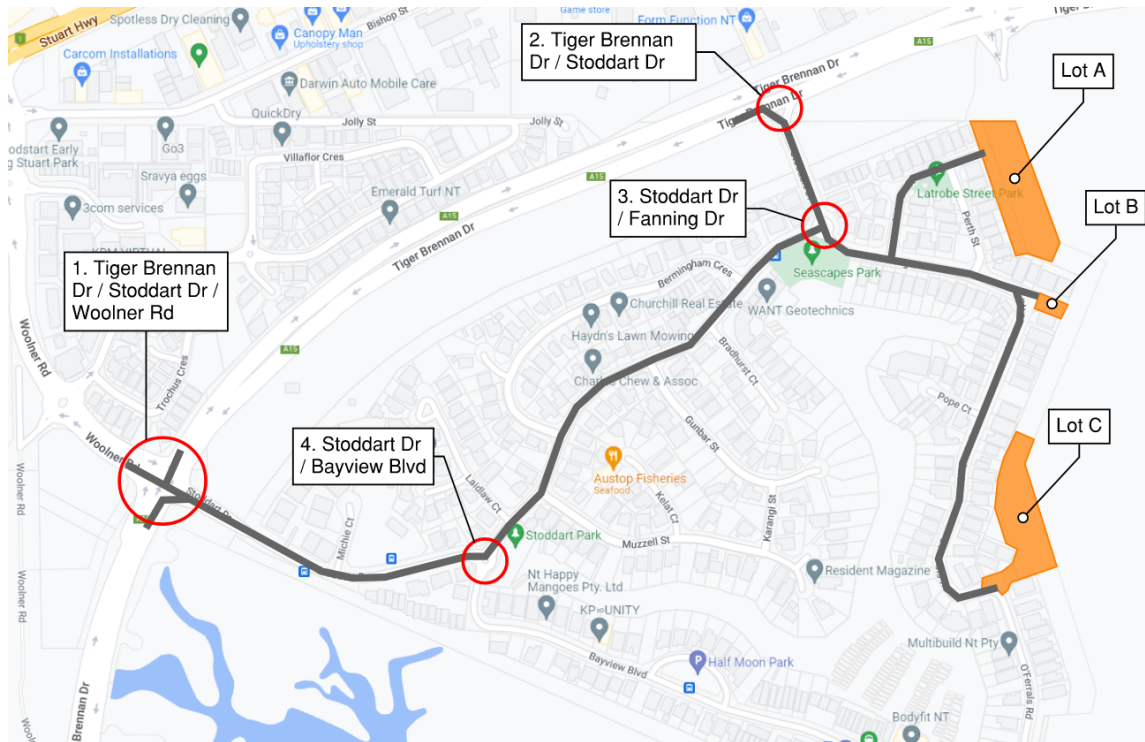


Figure 5.9 – Site Overview (source: Google)

5.2 Traffic Survey Information

Byrne Consultants conducted intersection traffic surveys for the peak hour traffic volumes (AM and PM) at each of the four (4) key intersections. These counts were undertaken on 1 day for each site, over a 2-hour AM/PM peak period and included counts of heavy vehicles and identified pedestrians / cyclists.

The AM peak hour period surveyed was between 7:00AM – 9:00AM and the PM period between 4:00PM – 6:00PM. These volumes for each site are summarised in Figure 5.2 below with the heavy vehicle counts summarised in Figure 5.3.

For the full traffic count survey information, refer to Appendix K of this report.

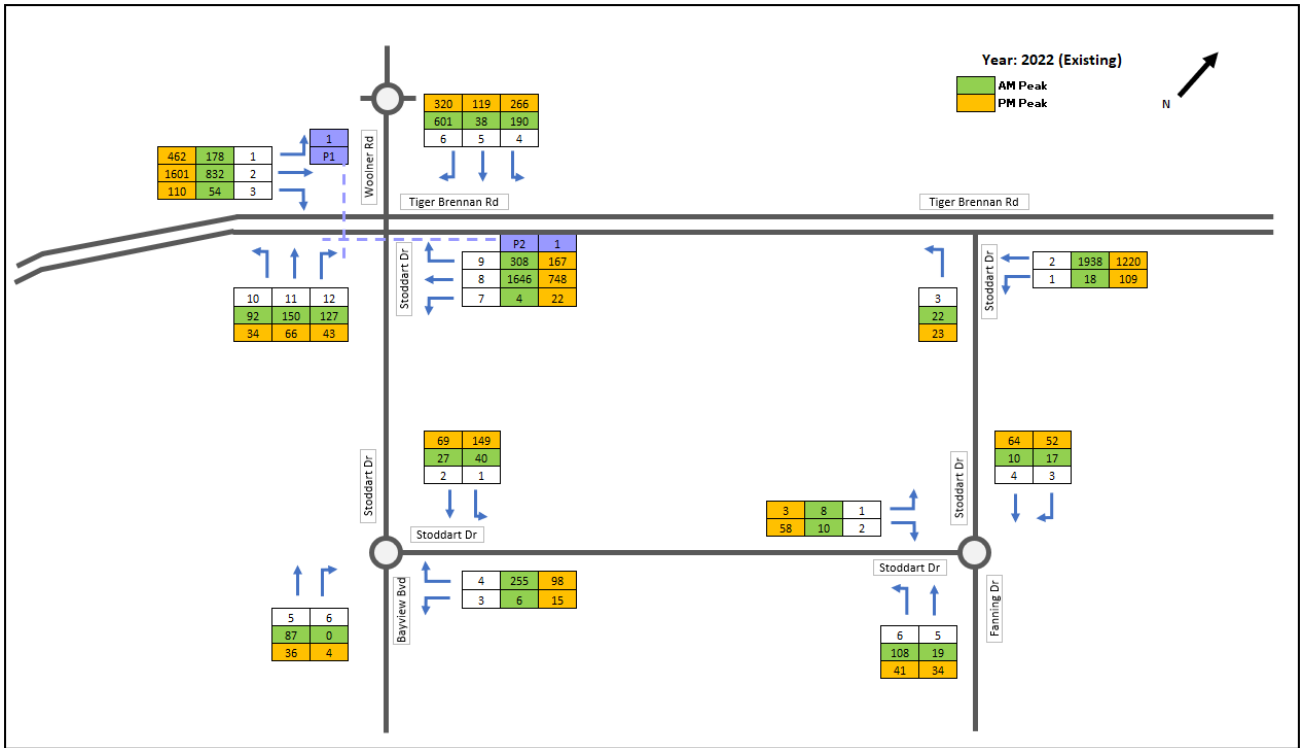


Figure 5.10 – Traffic Count Information Summary

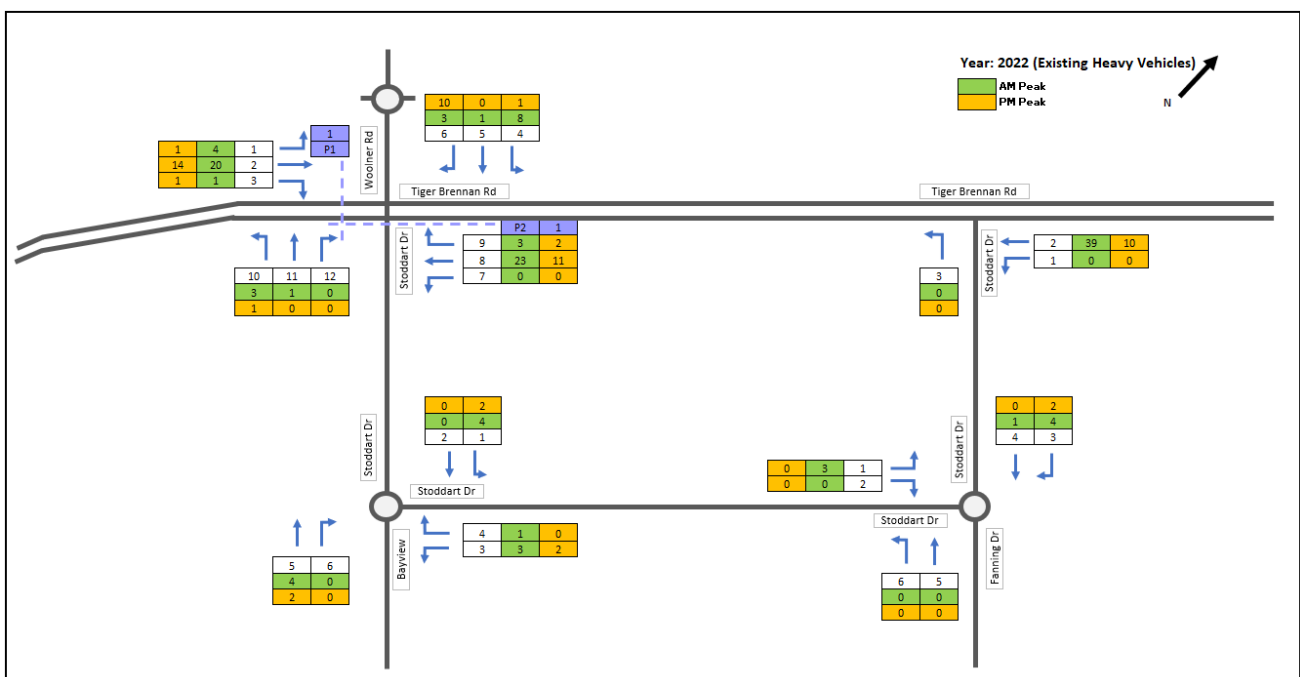


Figure 5.11 – Traffic Count Heavy Vehicle Summary

5.3 Development Traffic

The proposed stage 11 development consists of 19 LR lots and 2 LMR lots. The LMR lots are assumed to account for approximately 8 individual residences, for a total of 28 residences. A trip generation factor of 10.7 was used per residency in accordance with *Austrroads Guide to Traffic Management (AGTM P12, 2020)*,

Appendix D.1 Low Density Sydney). This is similar to the previous study conducted by PB who used a trip generation factor of 10 per residency. Using a nominated 10% AADT for peak hour flows, the total trips calculated during a peak hour period for the proposed development is estimated to be 31 vehicles. This is outlined in Table 5.1.

Table 5.2 – Stage 11 Development Trip Generation

Development	Equivalent LR Lots	Development Daily Trip Generation (veh trips)	Development Peak Hour Trip Generation (10%) (veh trips)
Lot A – 14 x LR lots	14	150	15
Lot B – 2 x LR lots	2	22	3
Lot C – 3 x LR lots. 2 x LMR lots (duplex + 7 townhouses)	12	129	13
TOTAL	28	301	31

With the development traffic generation estimated, these peak hour figures were then applied to the four (4) intersections throughout the road network assessment area. Starting with Intersection 3 (Fanning Drive / Stoddart Drive), the 31 generated trips were distributed using the traffic movement splits identified in the traffic survey. The results are summarised in Figure 5.4.

In addition, Figure 5.5 outlines the percent increase for the generated development traffic for each vehicle movement. All intersections exhibit at least 1 leg with an increase of 5.0% or greater, in which assessment of the intersection is required. The development does not anticipate an increase of heavy vehicle volumes within the subdivision. It is anticipated that an increase in Equivalent Standard Axels (ESA) will be less than 5.0% and as such, no existing pavement assessment has been conducted.

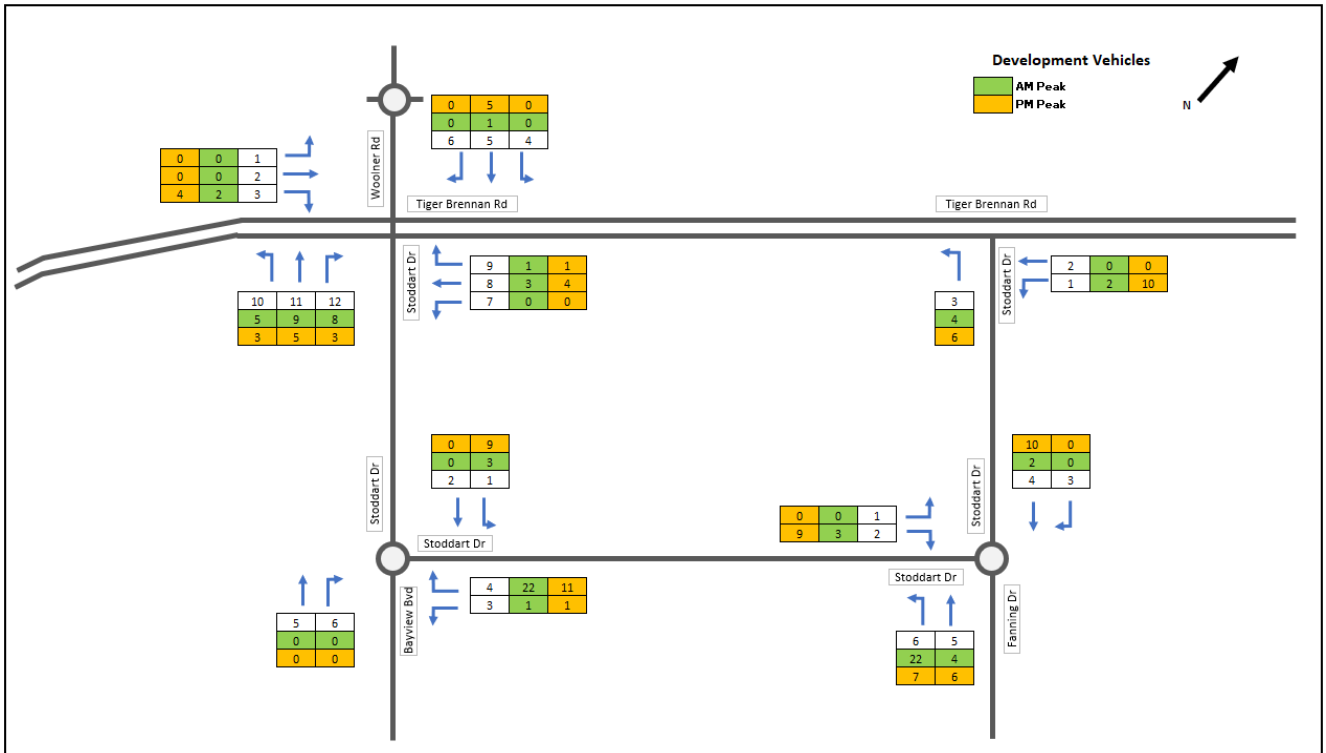


Figure 5.12 – Development Generated Vehicle Movements (2022)

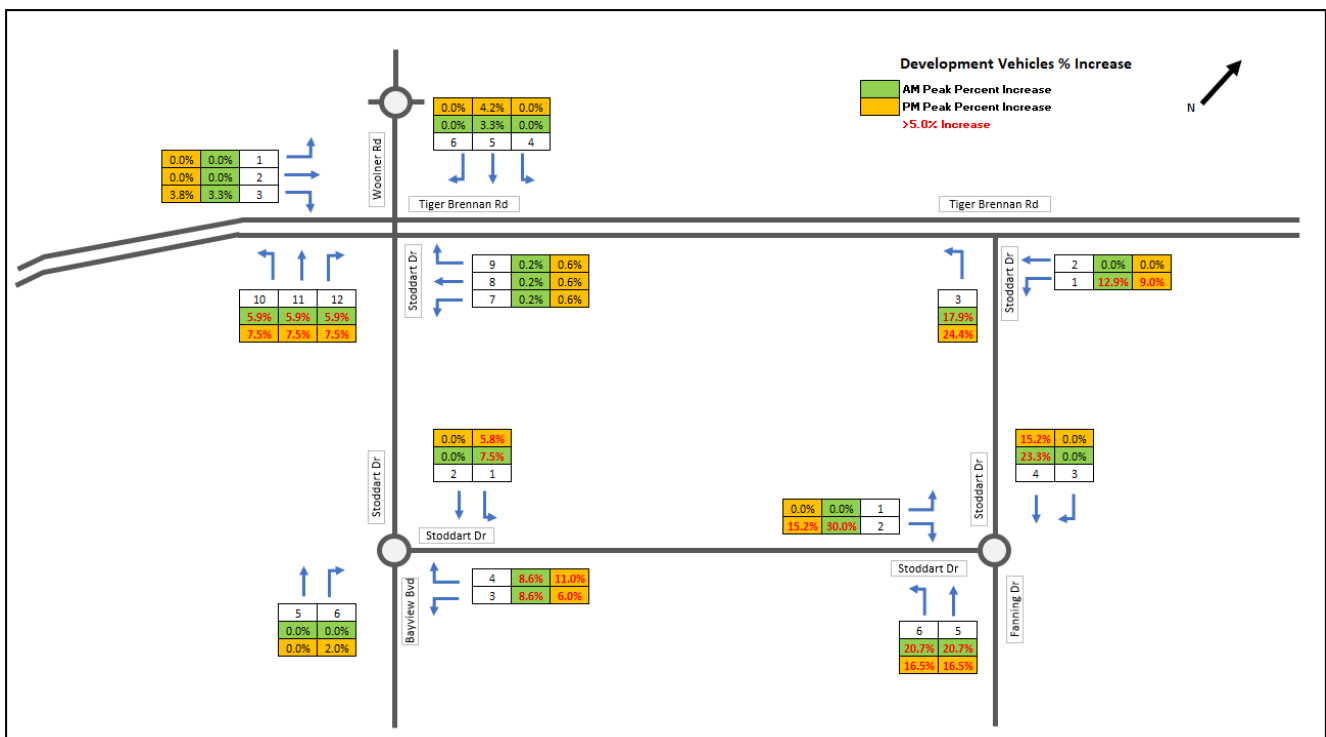


Figure 5.13 – Development Generated Vehicle Movement Percent Increases (2022)

5.4 Traffic Analysis

With the existing traffic counts, selected growth rates and estimated development vehicle generation, the following developed traffic scenarios were analysed using SIDRA Intersection 9.0 software.

- 2022 Background, AM and PM peak, Figure 5.2
- 2022 Background + Development, AM and PM peak, Figure 5.6
- 2027 Background + Development, AM and PM peak, Figure 5.7
- 2032 Background + Development, AM and PM peak, Figure 5.8

The scenarios were then modelled in SIDRA Intersection 9.0 software as separate intersections.

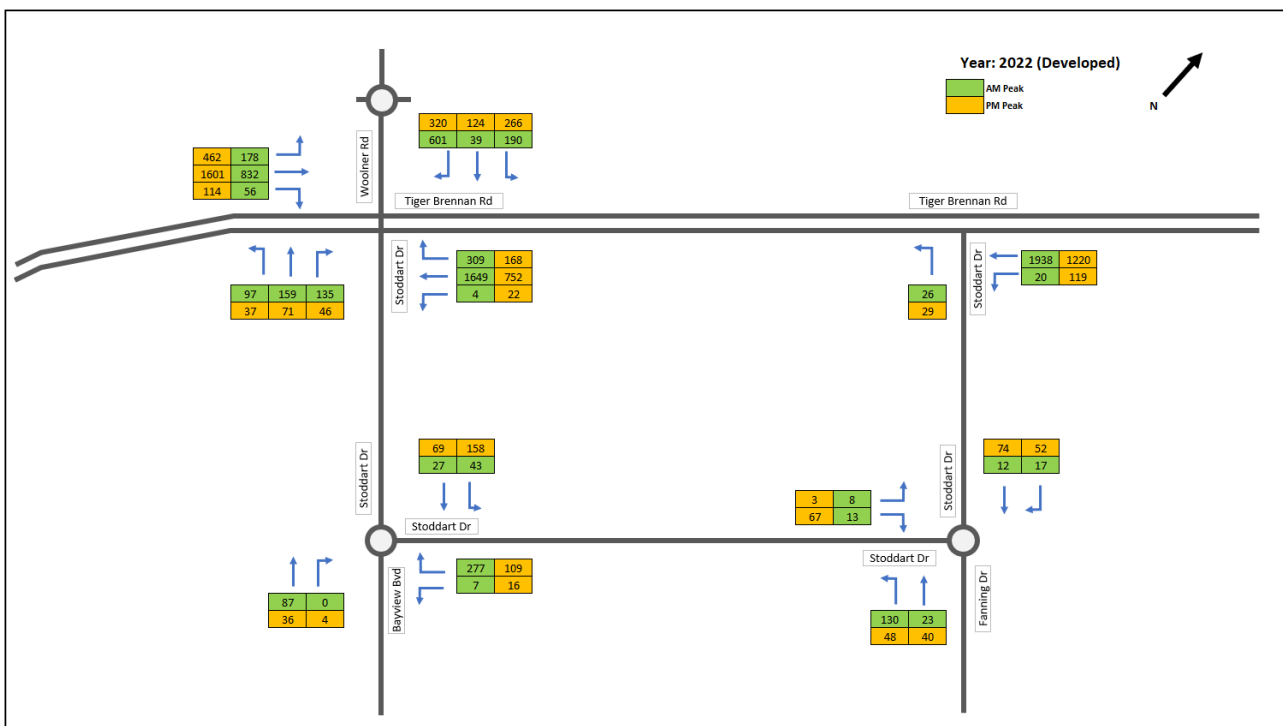


Figure 5.14 – 2022 Background + Development Peak Hours (Base Case)

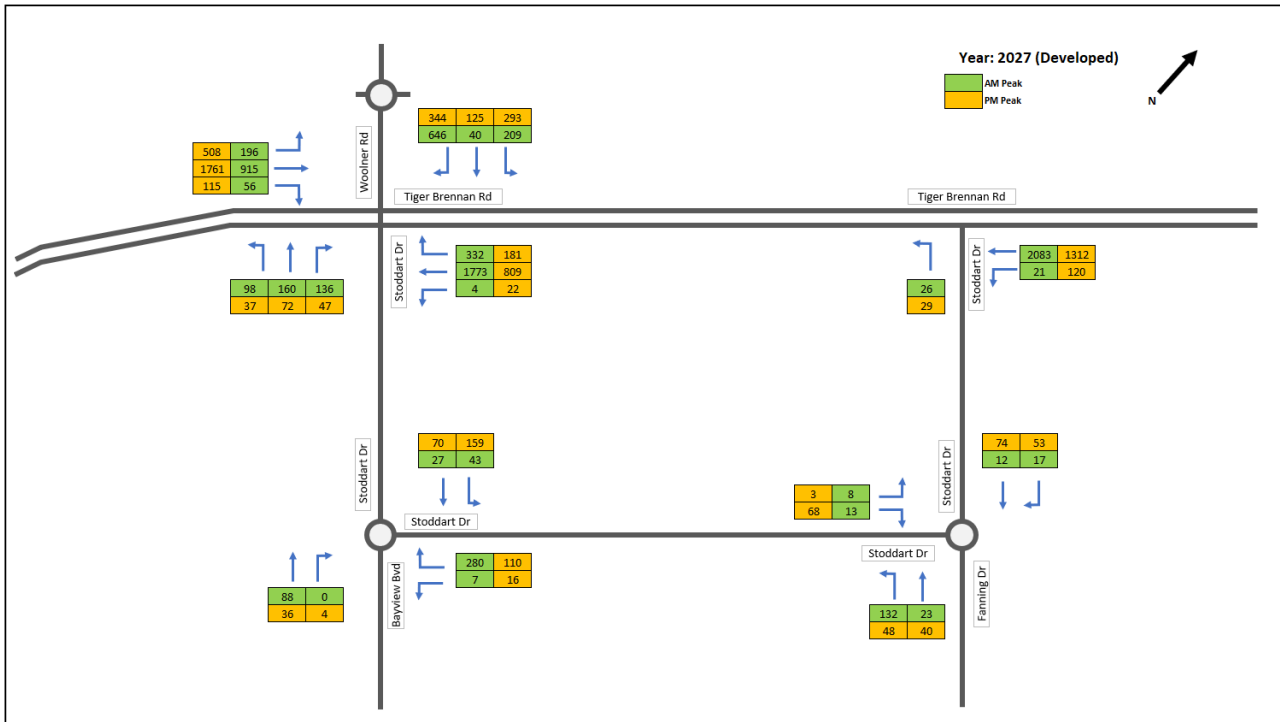


Figure 5.15 – 2027 Background + Development Peak Hours (5-Year Design Horizon)

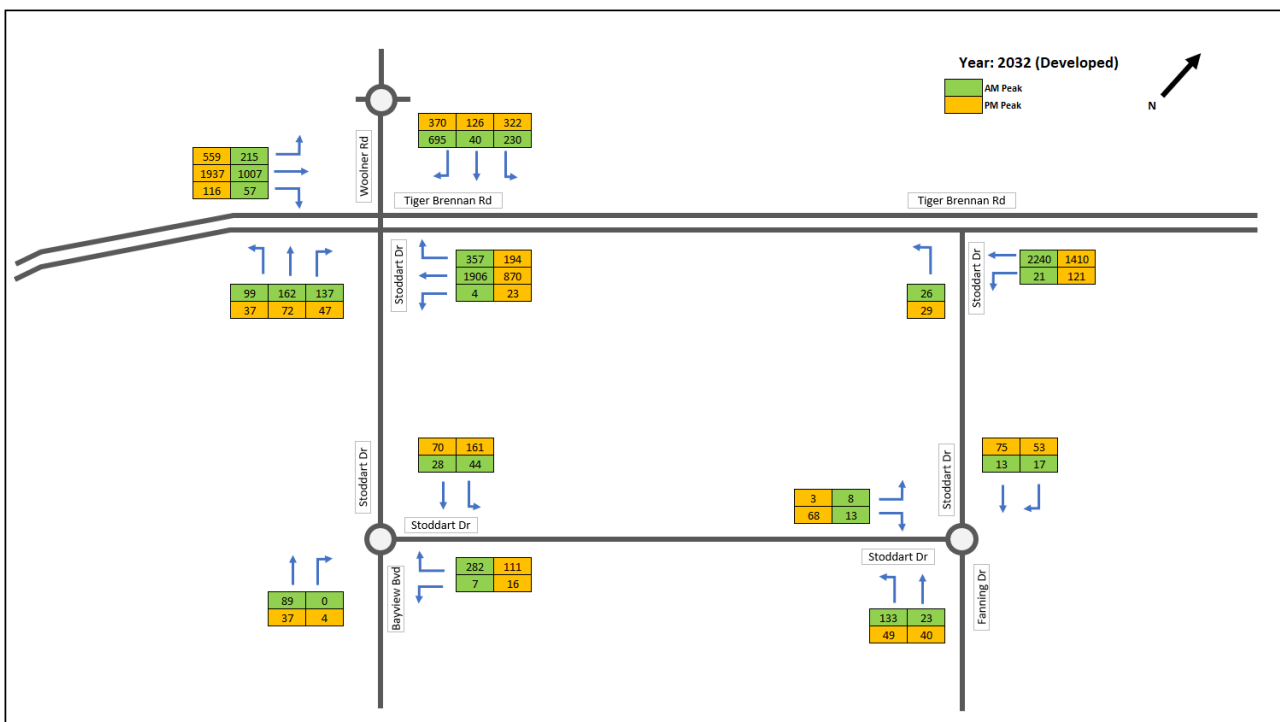


Figure 5.16 – 2032 Background + Development Peak Hours (10-Year Design Horizon)

5.5 Results and Findings

A summary of the Traffic Impact Assessment modelling results was as follows:

- Intersection 1 (Stoddard Dr / Tiger Brennan Dr / Woolner Rd) exhibited minor changes in the intersection performance due to the development traffic generation (no notable change). The intersection performance with respect to degree of saturation, average delay and queue length lowered during the 2027 and 2032 scenarios due to the applied background growth factors on Tiger Brennan Drive and Woolner Road, not the development traffic. It is beyond the scope of this TIA to suggest any upgrades to this intersection and impact by the proposed development is minimal.
- Intersection 2 (Stoddard Dr / Tiger Brennan Dr) exhibited a LoS of B and DoS ≤ 0.6 during the 2032 growth scenario (AM / PM) due to growth rates applied to Tiger Brennan Drive. This intersection performs satisfactorily with the proposed development traffic.
- Intersection 3 (Stoddard Dr / Fanning Dr) and Intersection 4 (Stoddard Dr / Bayview Blvd) exhibited a LoS of A and a DoS ≤ 0.2 for all growth scenarios performing satisfactorily with the proposed development traffic to the 2032 design horizon.
- Overall, no traffic impacts to the existing intersections resulting from the Stage 11 development were identified.

For the full breakdown of the analysis and results refer to the Traffic Impact Assessment Report contained within Appendix K of this report.

6 Water Supply

6.1 General

Water reticulation design and infrastructure for Bayview Stage 11 development shall be designed to Power and Water Corporation (PWC) requirements.

6.2 Available Network Capacity

6.2.1 Lot A

Lot A is currently supplied by a 150 diameter PVC watermain from Latrobe Street, which is fed from Stoddard Drive with a 100mm PVC looped connection on Perth Street.

PWC have reviewed the network capacity requirement for future supply to service Lot A. The results indicate water assessment peak hour scenario requirements of minimum 20m (196.2 kPa) and maximum velocity of 1.4m/s were achieved. Furthermore, the results for fire flow assessment minimum pressure of 10m and velocity of 2.5m/s were reached.

A map of existing PWC water mains for Lot A is shown in Figure 6.1.

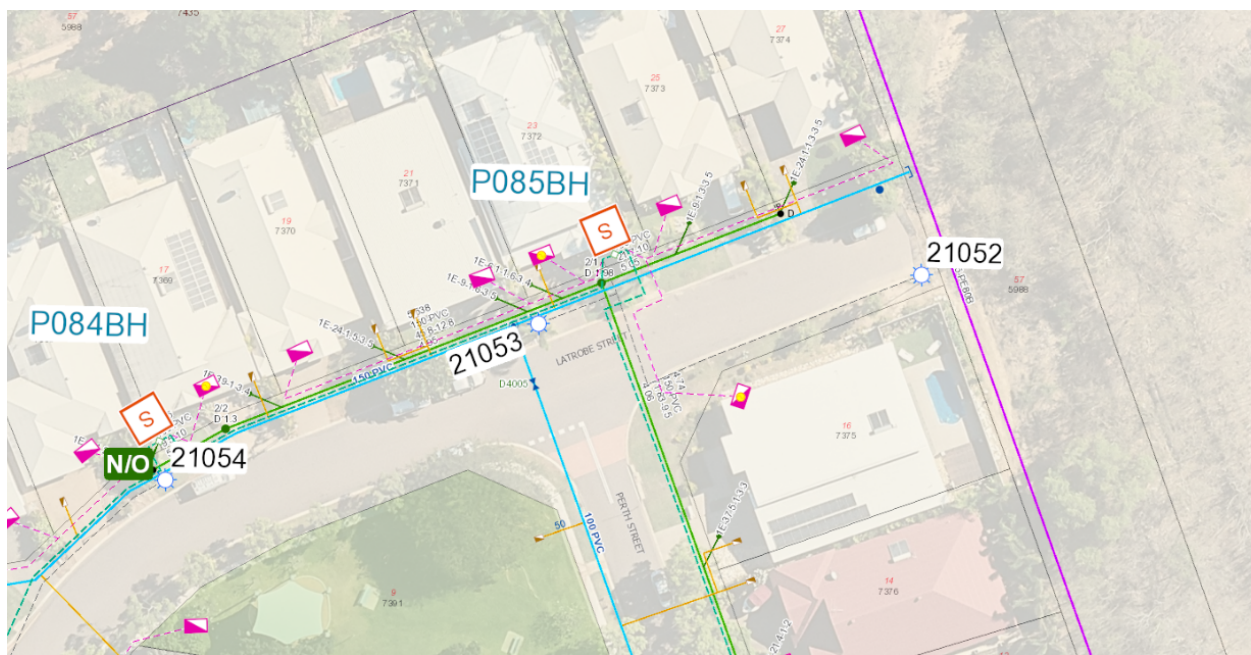


Figure 6.17 – Latrobe Street (Lot A) PWC Water Mains

6.2.2 Lot B and C

Lot B and C is currently supplied by a 150 diameter PVC watermain from O’Ferrals Road, which is fed from Stoddard Drive.

PWC have reviewed the network capacity requirement for future supply to service Lot B and C. The results indicate water assessment peak hour scenario requirements of minimum 20m (196.2 kPa) and maximum velocity of 1.4m/s were achieved. Furthermore, the results for fire flow assessment minimum pressure of 10m and velocity of 2.5m/s were reached.

A map of existing PWC water mains for Lot B is shown in Figure 6.2

A map of existing PWC water mains for Lot C is shown in Figure 6.3

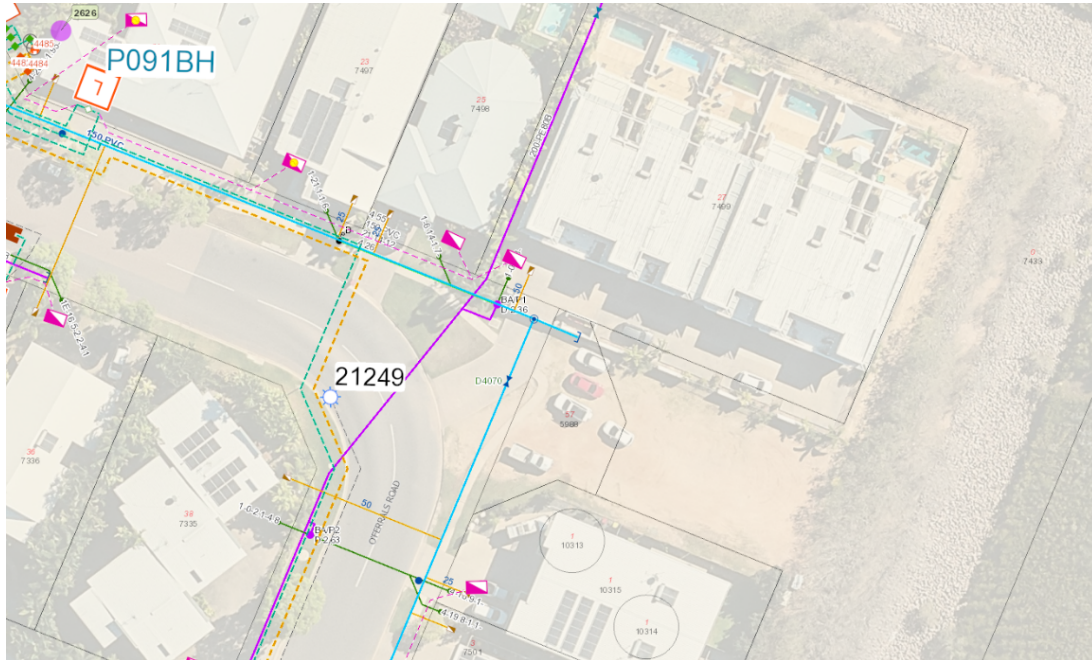


Figure 6.18 – O'Ferrals Road (Lot B) PWC Water Mains

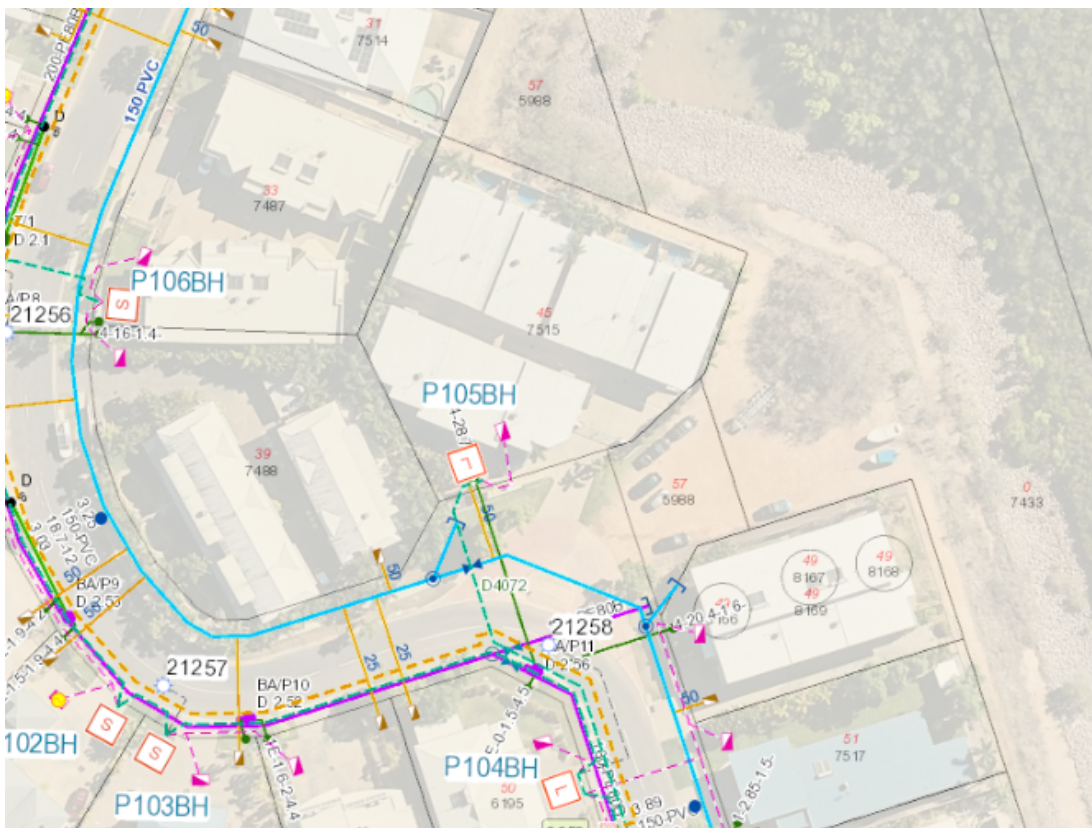


Figure 6.19 – O’Ferrals Road (Lot C) PWC Water Mains

6.3 Hydraulic Demand

Hydraulic demand is based on the PWC supplement to the WSA Water Supply Code of Australia.

6.4 Water Headworks

At this stage no watermain headworks upgrades are proposed to service Lot A, B and C. However, this may change depending on the feedback pending to be received from PWC.

The intention for each development site is to connect to the existing 150mm PVC stubs available at each site.

6.5 Internal Water Mains

The proposed scope of internal water main works for Lot’s A, B and C is:

- Lot A - Connect to the existing 150mm PVC watermain located in Latrobe Street. The proposed watermain to be looped in the cul-de-sac and connect back into the existing DN100 in Perth Street. The water network to be designed to direct flow through cul-de-sac. Therefore, it reduces risk to water quality.
- Lot B – Install 2 x services connection on the existing DN150 water main in O’Ferrals Road.
- Lot C - Connect to the existing 150mm PVC watermain located in O’Ferrals Road. The proposed watermain to be looped in the cul-de-sac and connect back into the existing DN150 in O’Ferrals Road. The water Network to be designed to direct flow through cul-de-sac. Therefore, it reduces risk to water quality.
- Construct new 150mm PVC watermain reticulation to Lot’s A and C in accordance with PWC standard drawings.
- Construct a total of twenty-three (23) new DN50 services to each lot.
- Construct fire hydrants, valves and fittings as required to service Lot A and C.

The proposed development sites are comprised of the following (Total EP 94):

- Lot A – 16 Single Dwelling Lots – 56 EP.
- Lot B – 2 Single Dwelling Lots – 7 EP.
- Lot B – 3 Single Dwelling Lots and 2 Multi Dwelling Lots (x9 Units Total) – 31 EP.
- Lot A peak day demand is: 0.75 L/s and the corresponding peak hour flow demand is: 1.5 L/s.
- Lot B peak day demand is: 0.10 L/s and the corresponding peak hour flow demand is: 0.20 L/s.
- Lot C peak day demand is: 0.40 L/s and the corresponding peak hour flow demand is: 0.8 L/s.

PWC design requirement for firefighting flows in a SD and MD residential development area is: 25 L/s. It should be noted Fire hydrants are proposed to be spaced at a nominal 80 m within Lot A and C.

- Lot A design total peak flow of 26.5 L/s has been adopted, noting that fire fighting flows govern design.
- Lot B design total peak flow of 25.2 L/s has been adopted, noting that fire fighting flows govern design.
- Lot C design total peak flow of 25.8 L/s has been adopted, noting that fire fighting flows govern design.

Refer to Master Services Plan contained in Appendix C of this Report for the proposed water reticulation connections and layout.

7 Sewer

7.1 General

The sewer design and infrastructure Bayview Stage 11 shall be designed to Power and Water Corporation (PWC) requirements. The hydraulic design basis is the WSAA Sewerage Code of Australia and PWC supplement to the Code.

7.2 Existing Sewer

7.2.1 Lot A

Lot A is proposed to be serviced by a DN150 gravity main fronting the proposed lots and connecting to the existing DN150 gravity sewer located on Latrobe Street fronting Lot 7374 as illustrated in Figure 7.1 below.

No investigations have been carried out to date to determine the I.L of the proposed sewer connection point on Latrobe Street.

Should gravity connection not be possible a secondary option is available to connect to the existing DN225 vacuum sewer located to the rear of the existing lots (7375 to 7381) east of Perth Street.

The DN225 vacuum discharges to the north and services much of the existing Bayview Subdivision.

Preliminary discussions with PWC indicate that PWC's preference is to connect via gravity main (if possible) to ensure less ongoing maintenance of the future sewer infrastructure. It is noted from this discussion that a 3.0m easement will be required over the existing vacuum sewer for the proposed Lot A development.

Preliminary capacity checks were undertaken by PWC which identified that The self-cleansing capacity is not achieved in the lines in lot A from Latrobe Street for dry weather flow but given it is an existing line in an established area it is acceptable as it involves low risk.

PWC requested that the sewer connect into existing sewer reticulation main in Latrobe Street via new DN150 sewer reticulation main.

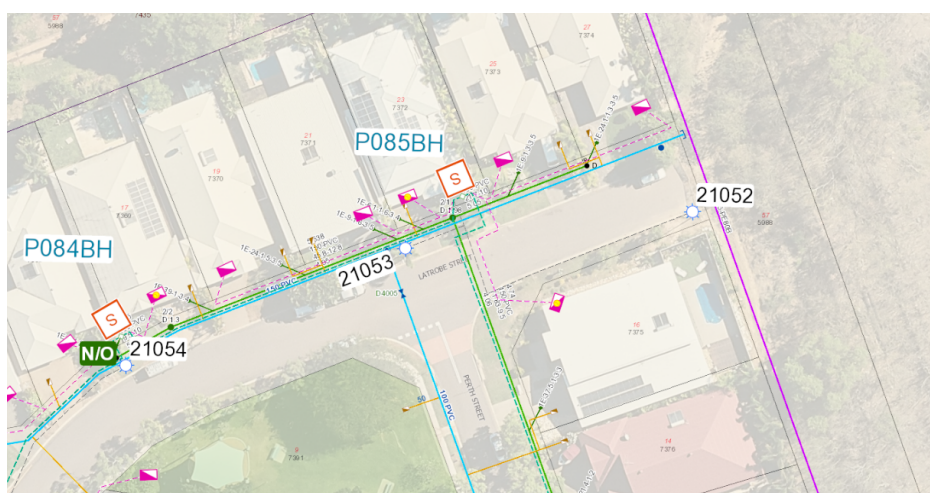


Figure 7.20 – Existing PWC Sewer Mains – Lot A

7.2.2 Lot B

Lot B is proposed to be serviced by a DN150 gravity main fronting the proposed lots and connecting to the existing vacuum sewer pit located fronting Lot 7499 on O’Ferrals Drive. The vacuum pit then discharges into a DN200 vacuum sewer line which runs to the north as illustrated in Figure 7.2 below.

PWC requested the construction of new sewer service connections for both lots and connection into existing vacuum pit BA/P1.

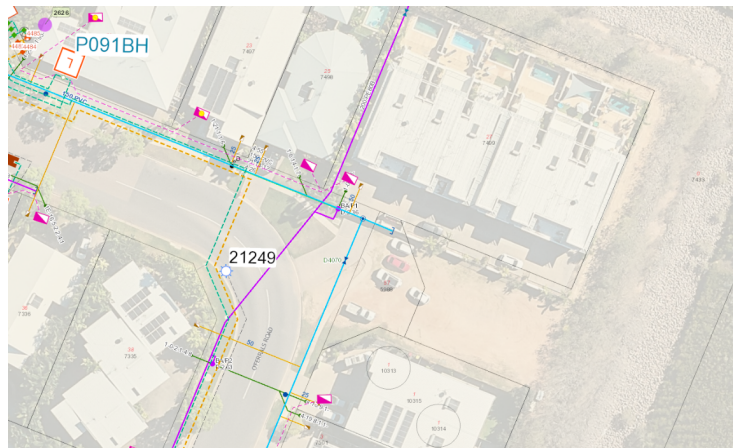


Figure 7.21 – Existing PWC Sewer Mains – Lot B

7.2.3 Lot C

Lot C is proposed to be serviced by a DN150 gravity main fronting the proposed lots and connecting to a new vacuum sewer pit located fronting Lot 8169. The vacuum pit then discharges into the existing DN200 vacuum sewer line which runs to the north along O’Ferrals Road as illustrated in Figure 7.3 below.

PWC requested the construction of a new sewer reticulation main to service the subdivision and connect into existing DN125 vacuum sewer line via a new vacuum pit built as per PWC standard drawing W2-2-10A.

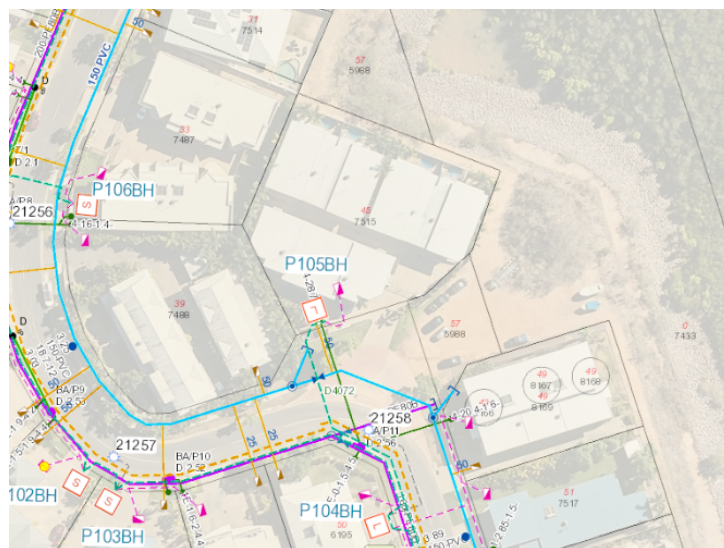


Figure 7.22 – Existing PWC Sewer Mains – Lot C

7.3 Sewer Headworks

At this stage it is not envisaged that there would be sewer headworks within this scope. However, any future upgrades will be a consideration for PWC.

7.4 Internal Sewer

The proposed scope of internal sewer works is:

- Construct new DN150 PVC gravity sewer reticulation for Lot’s A, B and C.
- Connect to existing vacuum sewer pit – Lot B
- Construct new vacuum sewer pit – Lot C
- Construct new property connections to Lot’s A, B and C.

Refer to Master Services Plan contained in Appendix C of this Report for the proposed water reticulation connections and layout.

The proposed Stage 11 development is comprised of the following (Total EP 103):

- Lot A – 16 Single Dwelling Lots – 56 EP.
- Lot B – 2 Single Dwelling Lots – 7 EP.
- Lot B – 3 Single Dwelling Lots and 2 Multi Dwelling Lots (x9 Units Total) – 40 EP.

Sewer loads were based on PWC design guidelines:

- 3.5 EP per single dwelling
- 3.0 EP per unit dwelling
- Load – 300 L/day/EP.

Sewer Pipe Sizing Calculator									
Note: Please enter a value for each of the cells colored green									
green									
		Grade	DN150						
			Flow (L/s)		Equiv. Tenements		Equiv. Population		
			Q _{sc}	Q _f	Min	Max	Min	Max	
k	1.50 mm	1 in 300	0.33%						
d/D	1.00	1 in 250	0.40%	3.41	9.75	55	96	192	337
EP/ET	3.50	1 in 200	0.50%	2.15	10.92	29	111	101	388
ADWF	300 L/d/EP	1 in 175	0.57%	1.66	11.68	20	120	70	422
Ave Lot Area	450 m ²	1 in 150	0.67%	1.26	12.62	14	133	49	465
Net/Gross Lot Area	90%	1 in 140	0.71%	1.11	13.07	12	139	42	485
Sewer below water table	90%	1 in 130	0.77%	0.98	13.56	10	145	35	508
Soil aspect	0.20 = S _{aspect}	1 in 125	0.80%	0.92	13.83	9	149	31	521
Network defects aspect	0.20 = N _{aspect}	1 in 120	0.83%	0.86	14.12	8	153	28	534
Leakage Severity C	0.40 = S _{aspect} + N _{aspect}	1 in 110	0.91%	0.74	14.75	6	161	21	564
Ave Lot Density	20 Lots/ha	1 in 56	1.79%	0.24	20.71	1	246	3	860
I _{1,2}	61.3 mm/hr	1 in 100	1.00%	0.63	15.48	5	171	17	599
ARI	5 years	1 in 90	1.11%	0.53	16.32	4	183	14	640
τ _{ev}	1.40 Pa	1 in 80	1.25%	0.44	17.31	3	197	10	689
g	9.81 m/s ²	1 in 70	1.43%	0.35	18.52	2	214	7	748
ν	1.01E-06 m ² /s	1 in 60	1.67%	0.27	20.01	1	235	3	824
Q _{sc}	= Self cleansing flow L/s	1 in 50	2.00%	0.21	21.93	1	264	3	922
Q _{df}	= Design flow L/s	1 in 40	2.50%	0.14	24.53	0	302	0	1059

8 Electrical, Lighting and Communications

8.1 PWC Electrical Infrastructure

8.1.1 Design Basis

The following design basis applies to all high voltage (HV) and low voltage (LV) infrastructure to be owned by Power and Water Corporation (PWC).

The applied design standards are:

- PWC Standards/Guidelines
- PWC Standard Drawings (Underground Manual).
- Northern Territory Subdivision Development Guidelines

Detailed design criteria are provided in the table below.

Table 8.3 – Electrical PWC HV/LV Design Criteria

Package Substations & Distribution Pillars	
Type	Package Substation – Existing Distribution Pillars – Stripple Fuse type.
Location	Package Substation - Sub 2626 in existing lot 7486 Distribution Pillars - P01 in new lot 12A, P03 in new lot 1A (each lot with 1mx1m PWC Electricity Easement), P02 in new lots 13A/14A, P04 in new lots 2A/3A, P05 in new lots 4A/5A, P06 in new lots 6A/7A, P07 in new lots 8A/9A and P08 in new lots 10A/11A (each lot with 1m x 0.5m PWC electricity easement).
Loads	Loads are allocated as follows: <ul style="list-style-type: none"> • 10kVA for each lot
Underground Reticulation	
Trenching/Cable/Conduit Type	PWC standard – New LV distribution cable within subdivision area is 0.6/1kV 4x1C 240 sqmm Al/XLPE and bare earth cable – direct buried.
Cover	Generally, 900mm except 1200mm at kerb/1500mm at centre of road at road crossings.

Refer to Electrical Reticulation Plan contained in Appendix I of this Report.

8.2 City of Darwin Lighting Infrastructure

The following design basis shall apply to all lighting for streets and public open space. The design standards are:

- AS/NZS 3000 & AS/NZS 3008.1.1.
- AS/NZS 1158.1.1 & AS/NZS 1158.3.1.

- PWC Standard Drawings (Street Lighting and Underground Manuals).
- COD Requirements.
- Northern Territory Subdivision Development Guidelines

Detailed design criteria are provided in the table below.

Table 8.4 – Lighting Design Criteria

Road Lighting Category	
New Road	Category PR4
Street Lighting Luminaires	
New Road	“GE” EVOLVE 18W LED
Street Lighting Poles	
Type	Street Lighting – 6.5m “Rigid” Type.
Location	Street Lighting - Generally 1m behind kerb (offset varies in some areas to avoid clash with other services).
Street Lighting Reticulation	
Trenching/Cable/Conduit/ Cable Pit Type	PWC standard (2x1C 25sqmm Cu/XLPE) except 1x1C 35 sqmm Cu/PVC (insulated) earth enclosed within same 80 HD uPVC conduit as street lighting active/neutral conductors.
Cover	Generally, 750mm except 2.5m either side of cable pits shallower as conduits taper up to bottom of cable pits and 1200mm at kerb/1500mm at centre of road at road crossings.
Control	Road Owner Distribution Pillar (RODP) supplies power to the new streetlights/pathway lights, however, for COD projects, RODP’s no longer incorporate time clock control for street/pathway lighting with each street/pathway light but are individually controlled via “smart” PE switch on each luminaire.
Circuit Protection	AS/NZS 3000 requires RCD protection, however, due to possible nuisance tripping and subsequent loss of power/street lighting turns off, Road Owners were to seek Exemption from NT WorkSafe to exclude RCDs (circuit breakers to be used in lieu) based on AS/NZS 3000. Exemption 5 “Where disconnection of a circuit by an RCD could cause danger greater than earth leakage current” ie: the danger of supply loss resulting in a failure of the road lighting is a greater risk to motorists than the potential earth leakage current. Current advice from COD is that “Risk Assessment” is not being carried out by COD and as such RCD protection is to be provided for this project.

Refer to Street Lighting Plan contained in Appendix G of this Report.

8.3 CCTV

No CCTV cameras are proposed for the Bayview Stage 11 development.

8.4 Communications Infrastructure

The communications pit/pipe infrastructure for Stage 11 Bayview shall be designed to comply with NBN and Vocus standards and requirements.

Refer to NBN Communications Plan contained in Appendix H of this Report.

9 Landscaping

9.1 General

The landscape works to the streets shall generally be in accordance with the City of Darwin standards and subdivision guidelines.

9.2 Pedestrian Pavements and Crossovers

The pedestrian pavements and kerb ramps provide clearly defined movement areas throughout the proposed development.

9.3 Street Furniture

Street furniture has not been considered at this stage of the project. The intention would be to match the existing street furniture strategy within the existing development.

9.4 Streetscaping and Planting

Streetscaping and tree planting has not been considered at this stage of the project. The intention would be to match the existing streetscaping and tree planting strategy within the existing development (see image below).



10 Conclusions

This Engineering Services Report has reviewed the existing site conditions and infrastructure for the proposed redevelopment of Bayview Subdivision. The key observations include:

- Existing Site Conditions – There were no significant challenges raised by a range of high-level investigations including geotechnical, survey and environmental.
- Stormwater – The stormwater drainage is generally designed to meet City of Darwin requirements and pipe 1% AEP flows to the lawful point of discharge.
- Access Roads and Footpaths – Roads and paths are generally designed to meet City of Darwin requirements. The proposed subdivision will have little effect on existing traffic conditions.
- The Traffic Impact Assessment indicates the development will have no effect to the existing intersections surrounding the development during Am and PM peak hours.
- Water Supply – The water supply is generally designed to meet PWC requirements and to provide sufficient capacity for the development. PWC are still yet to supply their final review comments for the development.
- Sewer – The sewer is generally designed to meet PWC requirements and to provide sufficient capacity for the development. There are no sewer headworks within this scope and any future upgrades will be a consideration for PWC. PWC are still yet to supply their final review comments for the development.
- Electrical and Lighting – The electrical and lighting infrastructure are generally designed to meet PWC and City of Darwin requirements.
- Communications – The communication infrastructure is generally designed to meet NBN and/or Vocus requirements.
- Landscaping – The landscaping is generally designed to meet City of Darwin requirements.

Overall, the proposed development can be adequately serviced by the delivery of new and upgraded infrastructure. There were no engineering service issues identified that would prevent the proposed development proceeding.

Appendix A Development Locality Plan

Appendix B Development Lot Layout and Site Plan

Appendix C Master Services Layout Plan

Appendix D Development Cadastral Boundaries

Appendix E Stormwater Management Plan

Appendix F Erosion and Sediment Control Plan

Appendix G Street Lighting

Appendix H NBN

Appendix I Electrical (LV)

Appendix J Geotechnical Assessment (Douglas Partners)

Appendix K Traffic Impact Assessment

Darwin

T8 Ground Floor, Winnellie Point
60 Winnellie Road, Winnellie NT 0820
08 8947 2476

Gold Coast

Building 1, Level 2, Suite 124
34 Glenferrie Drive, Robina QLD 4226
07 5628 2794

Sunshine Coast

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68 Simpson Street, Beerwah QLD 4519
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