NORTHERN CONSULTING engineers

CIVIL & STRUCTURAL ENGINEERS

ENGINEERING REPORT

COMMERCIAL DEVELOPMENT AT
10-32 LIONEL TURNER DRIVE BUSHLAND BEACH

FOR
Swanland Group

JOB No: IPA0002C

Doc Ref: IPA0002C_Eng

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A	Irem Guney	Derek Saw	Derek Saw (RPEQ 7363)		22/05/2025	Swanland Group	Draft
B	Irem Guney	Derek Saw	Derek Saw (RPEQ 7363)		28/06/2025	Swanland Group	Updates related to revised layout
C	Irem Guney	Derek Saw	Derek Saw (RPEQ 7363)		8/10/2025	Swanland Group	Final (Revised layout)

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICIES

APPENDIX A

CPO ARCHITECTS – Site Plan Proposed Option A Drawings

APPENDIX B

Earlier Development Engineering Report (BELO0001)

APPENDIX C

Water and Sewer Network Assessment Report by DPM Waters

APPENDIX D

Traffic Impact Assessment (TIA) by NCE

1.0 INTRODUCTION

1.1 Background

Northern Consulting Engineers (NCE) have been commissioned to prepare an engineering report for a proposed commercial development at 10-32 Lionel Turner Drive, Bushland Beach. The proposed works are on land described as Lot 2 on SP218628. Figure 1-1 shows the location of the site in context to the surrounding properties, road reserves and easements, courtesy of Queensland Globe's online mapping tool.

The following report has been produced to support a development application for Material Change of Use (MCU). The purpose of this report is to demonstrate how the proposed development can be achieved by addressing:

- Stormwater management, both quantity and quality;
- Existing and future services network assessment; including water and sewer network assessment;
- Traffic Impact Assessment (TIA);

The information provided in this report is based on the following layout plan and documents which are provided as appendices to this report;

- CPO ARCHITECTS – Site Plan Proposed Option A Drawings (Appendix A)
- Earlier Development Engineering Report (BELO0002) (Appendix B)
- Water and Sewer Network Assessment Report by DPM Waters (Appendix C).
- Traffic Impact Assessment (TIA) by NCE (Appendix D)

Figure 1-1 Locality (Queensland Globe online 2025)

1.2 Existing Development

The development site is located to the east of Bushland Beach Plaza and to the north of Bushland Beach Park. The land is currently zoned as 'Low Density Residential' in the Townsville City Plan, and it is currently bare ground, vacant block. The site generally falls towards north - northeast with an average minor slope of ~0.8%. This is based upon the finished surface of the previously approved Bulk Earthworks OPW.

An existing open channel and underground stormwater system is located in the vicinity of the site. The open channel along the northern boundary is also designated as a drainage reserve/easement, which conveys flows eastward into Stony Creek, then into the Bohle River, and ultimately discharges into the ocean to the north. The underground stormwater network is located along Lionel Turner Drive, collecting runoff from the road corridor and conveying it southward into the open drain at Bushland Beach Park, which similarly directs flows northward to the ocean.

Existing sewer manholes are located at the western and eastern ends of the overall development site and connected to an existing gravity sewer network via 300 dia PVC pipe. The site can be connected to TCC's water infrastructure via an existing water network located along the southern boundary of the development. Further discussions on the existing infrastructure in the vicinity of the development site are provided in Section 0 and 0.

1.3 Proposed Development

The proposed commercial development forms the southwest corner of the land parcel, Lot 2 on SP218628. The proposal for the site is a commercial development compromising food outlet, café/retail, gym tenancy, carparks and landscaping which is illustrated in Figure 1-2 with the original drawing provided in Appendix A.

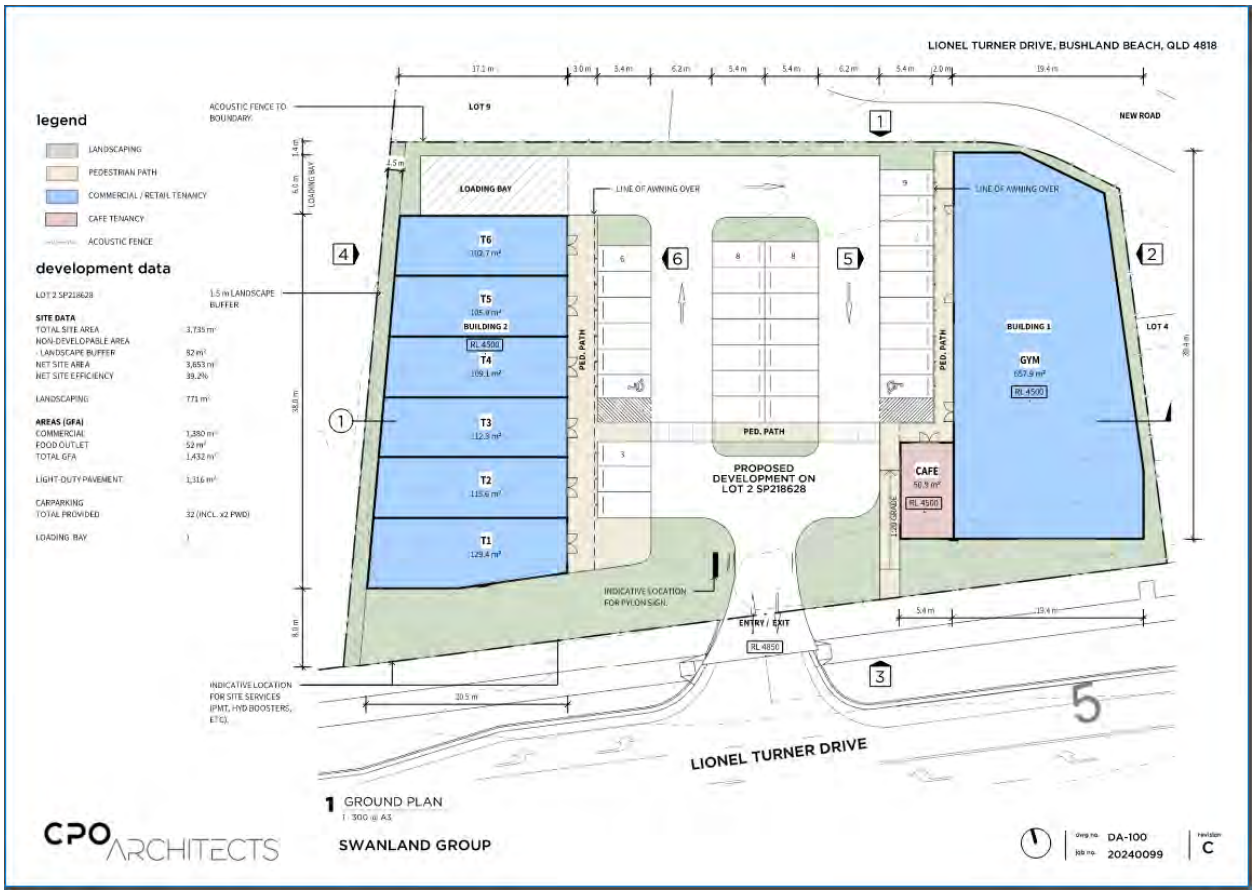


Figure 1-2 Proposed Development

An assessment of the change in impervious area, to determine if there will be an increase in run-off, has been carried out. Best practical solutions to run-off treatment are proposed. Further discussions on these elements are provided in Section 2.0.

Assessment of the water network is undertaken in Section 0 and sewer network is undertaken in Section 0, which provides review of existing infrastructure and commentary on potential alterations.

Traffic Impact Assessment (TIA) is undertaken by NCE. Further discussions are provided in Section 5.0.

2.0 STORMWATER DRAINAGE

In accordance with the Queensland Urban Drainage Manual (QUDM) test in determining the lawful point of discharge (LPOD), the LPOD for the development has been defined as:

- The drainage easement to the north (open channel)

The stormwater currently sheet flow across the site generally towards the north & northeast into the LPOD at an average of ~0.8% grade. The proposed development is anticipated to mimic the existing overland sheet

flow by maintaining the fall northward into the LPOD for the major event flows. Similarly, roof runoff from the buildings and the carpark will be captured by an underground stormwater network which will convey flows towards the LPOD for the minor event flows. The detailed design of the stormwater network will be undertaken during the subsequent design phase.

The requirement for mitigation storage will be assessed in the following sections along with the best practice measures to ensure adequate stormwater quality treatment and compliance with relevant guidelines.

2.1 Quantity

An investigation of both TCC's current and previous flood studies for the development catchment revealed that the site has been modelled as 0% imperviousness and rough Manning's values for low density vegetation. However, NCE has previously undertaken a Flood Impact Assessment (FIA) in relation to earlier operational works on the development site, including bulk earthworks, as documented in NCE Report Reference BELO0001-Eng_RevA and TCC Reference OP13/0053, both included in Appendix B. The FIA indicates that the site was filled, and the overall imperviousness was increased to 90% to accommodate the developed conditions. The assessment concluded that the development is flood immune resulting in no actionable afflux, indicating no adverse off-site impacts.

Overall, the proposed development will not exceed 90% imperviousness and therefore no further quantity mitigation assessment is considered necessary.

2.2 Quality

The design intent for the stormwater system is to meet the current State Planning Policy (SPP) water quality targets. Table B (Post construction phase – stormwater management design objectives) of the SPP identifies the application.

In accordance with the SPP, water treatment applies to the proposed development since the proposal includes a material change of use (MCU) for an urban purpose that involves greater than 2500 m² in size.

All stormwater treatment trains have been modelled with the aid of MUSIC version 6.4.0 and utilises various treatment devices. The development site is within the Townsville Aero meteorological catchment for MUSIC modelling purposes, and it have been modelled in accordance with the following:

- MUSIC Modelling Guidelines, November 2018, by Water by Design
- Townsville Aero, 6-minute time step from 03/03/1953 to 31/03/2021;
- Water by Design MUSIC Modelling Guidelines Source Nodes (Split Catchment) utilising modified percent impervious area & pollutant concentration;
- Water by Design MUSIC Modelling Guidelines Rainfall Runoff Parameters for SEQ;
- No drainage routing between nodes;

2.2.1 Stormwater Quality Objectives

The design intent for the system is to meet the current TCC City Plan water quality targets, namely:

- 80% reduction in total suspended solids (TSS) load
- 65% reduction in total phosphorus (TP) load
- 40% reduction on total nitrogen (TN) load
- 90% reduction in gross pollutant (GP) load

2.2.2 MUSIC Modelling

Pollutant loads for the development have been modelled primarily using "split catchment" and references the MUSIC Modelling Guidelines for the pollutant export parameters for commercial land use. The pollutant generation parameters adopted are shown in Figure 2-1 with Figure 2-2 depicting the rainfall-run-off parameters.

TABLE 3.9 POLLUTANT EXPORT PARAMETERS FOR SPLIT CATCHMENT LAND USE (LOG^{10} VALUES)

FLOW TYPE	SURFACE TYPE	TSS LOG^{10} VALUES		TP LOG^{10} VALUES		TN LOG^{10} VALUES	
		MEAN	ST. DEV	MEAN	ST. DEV	MEAN	ST. DEV
URBAN RESIDENTIAL							
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	1.00	0.34	-0.97	0.31	0.20	0.20
	Ground level	1.00	0.34	-0.97	0.31	0.20	0.20
Stormflow parameters	Roof	1.30	0.39	-0.89	0.31	0.26	0.23
	Roads	2.43	0.39	-0.30	0.31	0.26	0.23
	Ground level	2.18	0.39	-0.47	0.31	0.26	0.23
INDUSTRIAL							
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	0.78	0.45	-1.11	0.48	0.14	0.20
	Ground level	0.78	0.45	-1.11	0.48	0.14	0.20
Stormflow parameters	Roof	1.30	0.44	-0.89	0.36	0.25	0.32
	Roads	2.43	0.44	-0.30	0.36	0.25	0.32
	Ground level	1.92	0.44	-0.59	0.36	0.25	0.32
COMMERCIAL							
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	0.78	0.39	-0.60	0.50	0.32	0.30
	Ground level	0.78	0.39	-0.60	0.50	0.32	0.30
Stormflow parameters	Roof	1.30	0.38	-0.89	0.34	0.37	0.34
	Roads	2.43	0.38	-0.30	0.34	0.37	0.34
	Ground level	2.16	0.38	-0.39	0.34	0.37	0.34

Figure 2-1 MUSIC "split" pollutant export parameters

TABLE A1.2 RECOMMENDED MUSIC RAINFALL-RUNOFF PARAMETERS SEQ

PARAMETER	LAND USE			
	URBAN RESIDENTIAL	COMMERCIAL AND INDUSTRIAL	RURAL RESIDENTIAL	FORESTED
RAINFALL THRESHOLD (MM)	1	1	1	1
SOIL STORAGE CAPACITY (MM)	500*	18	98	120
INITIAL STORAGE (% CAPACITY)	10	10	10	10
FIELD CAPACITY (MM)	200	80	80	80
INFILTRATION CAPACITY COEFFICIENT A	211	243	84	200
INFILTRATION CAPACITY COEFFICIENT B	5.0	0.6	3.3	1.0
INITIAL DEPTH (MM)	50	50	50	50
DAILY RECHARGE RATE (%)	28	0	100	25
DAILY BASEFLOW RATE (%)	27	31	22	3
DAILY DEEP SEEPAGE RATE (%)	0	0	0	0

Figure 2-2 Water by Design MUSIC Modelling Guidelines rainfall run-off parameters SEQ

Below is the modelling concept adopted:

- The modelling has been assessed for post-development.
- The assessment of development has been identified as one catchment area being the development site. The catchment includes pollutant nodes for the roof, ground area (inclusive of landscaping, buffer and footpath) and the roads (inclusive of the pavement and driveway).
- The assessment has been conducted solely on the developed area, utilising a "split" catchment methodology under commercial zone. Table 2-1 shows the MUSIC source nodes.
- Generally, runoff from the catchment will drain into the underground cartridge system at the downstream of the development site. This system will then connect into the an underground stormwater system that discharges into the open drain to the north of development.
- The roof area per lot is calculated as approximately 1000 m² incorporates the commercial buildings of the food outlet, gym tenancy and café/retail. Roof runoff will be managed either by direct discharge onto splash pads or collected through an underground pit and pipe system. In both cases, the water will be conveyed to an underground cartridge treatment system. Similarly, runoff from carparks, driveways, and ground surfaces will also be captured through a pit and pipe system and directed into the same treatment system. The propose underground cartridge treatment system parameters as input into MUSIC are given in Table 2-2.
- Evaporation rate has been set to 0 to ensure no losses occur within the system.

Table 2-1 MUSIC source nodes

Catchments	Node Name	Zoning/Surface Type	Surface Area (ha)	Impervious (%)	Buffer (%)

Development Site	Buildings	Commercial / Roof	0.130	100	0
	Ground (Landscape and Footpath)	Commercial / Ground	0.119	30	0
	Carparks / Driveway	Commercial / Roads	0.125	100	0

Table 2-2 MUSIC treatment input parameters

Node Name	Item
Underground Stormwater Cartridge Treatment System	• 4 x OceanGuard** per catchment (installed in the stormwater inlet pits) • 15 x 460mm Stormfilter Cartridges (PSORB)** • 9.5 m² Stormfilter Chamber** **(or approved similar) to be confirmed by supplier during detailed design phase

The MUSIC model setups described above, and the proposed indicative treatment train layout is depicted in Figure 2-3.

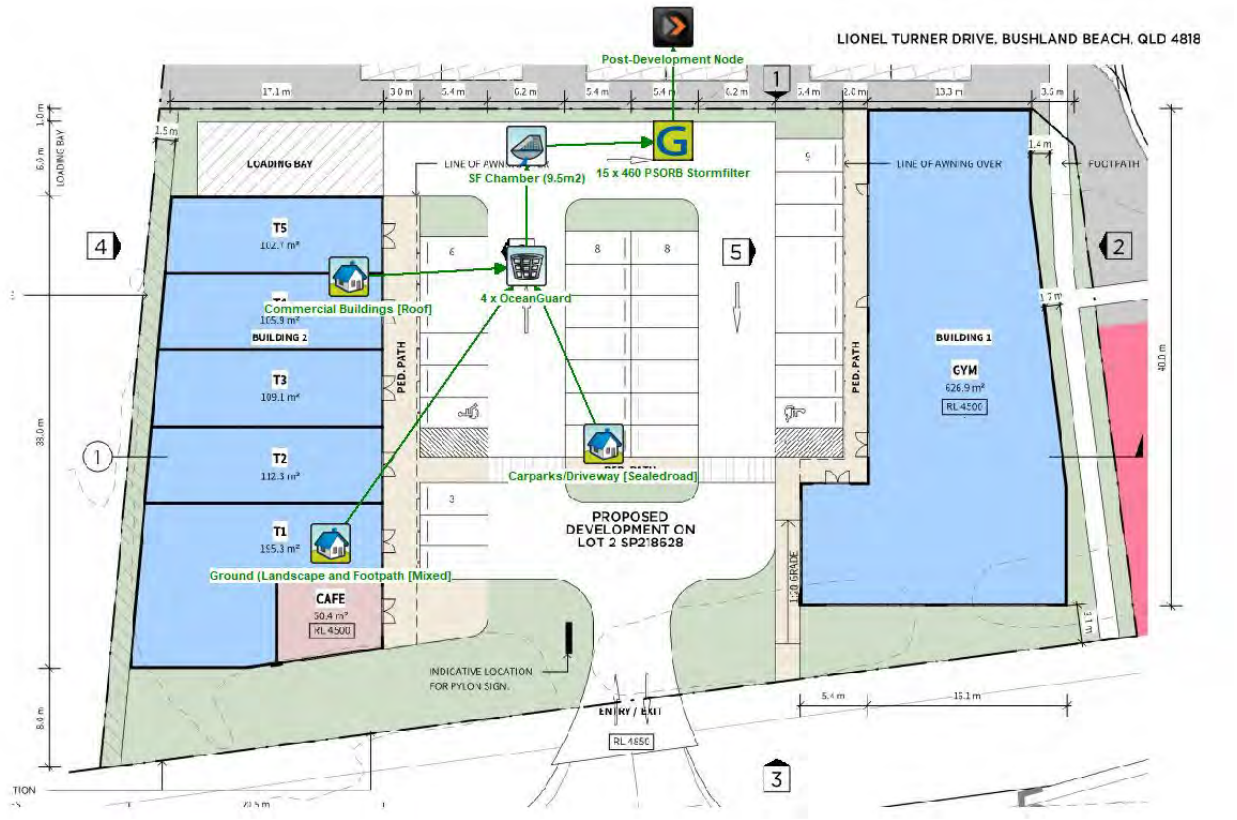


Figure 2-3 MUSIC treatment train layout (Layout shown diagramtically)

Table 2-3 summarises the results of the assessment. It is evident that the water quality leaving the site post development meets the quality objectives set by TCC. Therefore, compliance with stormwater quality requirements is achieved with the proposed stormwater treatment train of underground cartridge treatment system.

Table 2-3 MUSIC treatment train effectiveness

Description	Sources	Residual Load	% Reduction	TCC Treatment %
Flow (ML/yr)	3.35	3.35	0	
Total Suspended Solids (kg/yr)	701	67.5	90	80
Total Phosphorus (kg/yr)	1.53	5.04E-01	67	65
Total Nitrogen (kg/yr)	10.7	5.56	48	40
Gross Pollutants (kg/yr)	59.4	0.00E+00	100	90

3.0 WATER NETWORK

NCE engaged a specialist water engineer (DPM Water) to provide advice in relation to potable water supply and fire flow for the proposed development. The full water assessment is contained within the supplementary report attached in Appendix C. A summary of the proposed water strategy is outlined below:

The water network modelling for the development has been performed using the WaterGEMS network model. The WaterGEMS network model includes the existing water infrastructure along with the existing water demands for all the Bushland Beach, Northshore, Sanctum and Mt Low areas that are located on the northern side of the Bruce Hwy.

The WaterGems network model has been updated to include the water demands for the commercial development on the northern side of Lionel Turner Drv. The trunk water infrastructure that services this development area consists of:

- The Mt Low Reservoirs. There are 2 x 6 ML reservoirs located on the western Mt Low hill with these reservoirs having a bottom water level of 54.5 mAHD and a top water level of 65.5 m AHD. The reservoirs are filled from a DN375 DICL water main along Mt Low Parkway from the Mt Spec pipeline.

- Water is directed out of the reservoirs via existing parallel DN450 DICL and DN375 DICL mains to Mt Low Parkway. A DN450 DICL main then extends to the north along Mt Low Parkway (on its eastern side) to the intersection with Lionel Turner Drv. A DN375 DICL main also extends to the north along Mt Low Parkway (on its western side) to the intersection with Lionel Turner Drv.

- At the Lionel Turner Drv/Mt Low Parkway intersection the above water mains are interconnected with pipelines then extending to the north along Mt Low Parkway, west along Lynwood Ave and east along Lionel Turner Drv.

- A DN300 DICL main extends to the east along Lionel Turner Drv (on the northern side, being the frontage of the commercial development site). This main reduced to be a DN250 DICL main part way along and continues to the east along Lionel Turner Drv.

- A water service offtake and water meter will be connected to the existing DN250 DICL main to service the proposed commercial development.

The WaterGEMS network modelling for the commercial development site has also included the future proposed 80 lot residential development on the balance area of the vacant land parcel. This is to ensure the water network has sufficient capacity for the proposed commercial development and concurrent residential subdivision. The water & sewer assessment for the adjacent proposed 80 lot residential subdivision is detailed in a separate report.

4.0 SEWER NETWORK

NCE engaged a specialist water engineer (DPM Water) to provide advice in relation to sewer infrastructure for the proposed development. The full sewerage assessment is contained within the supplementary report attached in Appendix C. A summary of the proposed sewer strategy is outlined below:

The SewerGEMS network model was run with the inclusion of the above additional equivalent populations and associated sewage flows (for both the proposed commercial development and residential subdivision). The modelling results are provided in Appendix C and show:

- The existing DN300 eastern sewer line from MH 4/WB7F to MH 2/WB7F flows up to 35% full.
- The existing DN300 sewer line from MH 2/WB7F8 to MH 2/WB7F flows up to 63% full.
- The existing DN375/DN450 sewer from MH 2/WB7F to major PS WB7 flows up to 37.5% full.
- All sewers flow less than 75% full and therefore meet the CTM code standards.

The above assessment illustrates the existing gravity sewer system is able to service the additional sewage flows from the proposed commercial development on the northern side of Lionel Turner Drv.

5.0 TRAFFIC IMPACT ASSESMENT

NCE have undertaken a traffic study for the proposed commercial development, at 10-32 Lionel Turner Drive, Bushland Beach as referenced in Attachment D. The findings of this assessment are summarised below:

- Private Access impact assessment and mitigation
    - Development Generated Traffic associated with the use of the proposed commercial development has been assessed and requires the installation of an All-movements intersection inclusive of a CHR(s) and AUL(s) to safety and efficiently move traffic in and out of the development.
    - Sufficient separation distance exists between the adjacent existing roundabout between Lionel Turner Drive and the Access to the nearby chopping centre to allow the construction of the proposed intersection with the recommended AUL(s).
    - Provision of connecting Shared pedestrian / bicycle facilities between the proposed development and existing shared facilities at the above-mentioned roundabout are recommended to facilitate the safe and efficient movement of Pedestrians and cyclists.
    - Utilisation of the existing pedestrian crossing facilities east and west of the development are recommended to limit the number of conflict points along Lionel Turner Drive.
    - An assessment of the on-site parking provisions against AS2890 concluded the proposed facility as detailed is compliant with all design aspects

6.0 CONCLUSION

NCE have undertaken engineering assessment in order to provide support associated with the commercial development at 10-32 Lionel Turner Drive, Bushland Beach. The findings of this assessment are summarised below:

- Local runoff will be conveyed to the lawful point of discharge (LPOD) via a nominated drainage easement (open channel) located to the north. This will occur through a combination of overland sheet flow for major storm events and a pit and pipe system for minor storm events.

- Mitigation of post-development flows is not required, as the change in impervious area associated with the earlier development bulk earthworks has been demonstrated no adverse flooding impacts.

- The stormwater quality assessment, conducted via MUSIC, confirms compliance with quality objectives for all parameters using underground cartridge treatment devices.

- The existing water infrastructure currently servicing the site is anticipated to have sufficient capacity to service the proposed development.

- The existing sewer infrastructure currently servicing the site has sufficient capacity to service the proposed development.

- The TIA conclude that appropriate intersection upgrades, pedestrian and cyclist connectivity, and compliant on-site parking provisions are necessary to ensure safe and efficient access and traffic flow.

APPENDIX A

CPO ARCHITECTS – Site Plan Proposed Option A Drawings

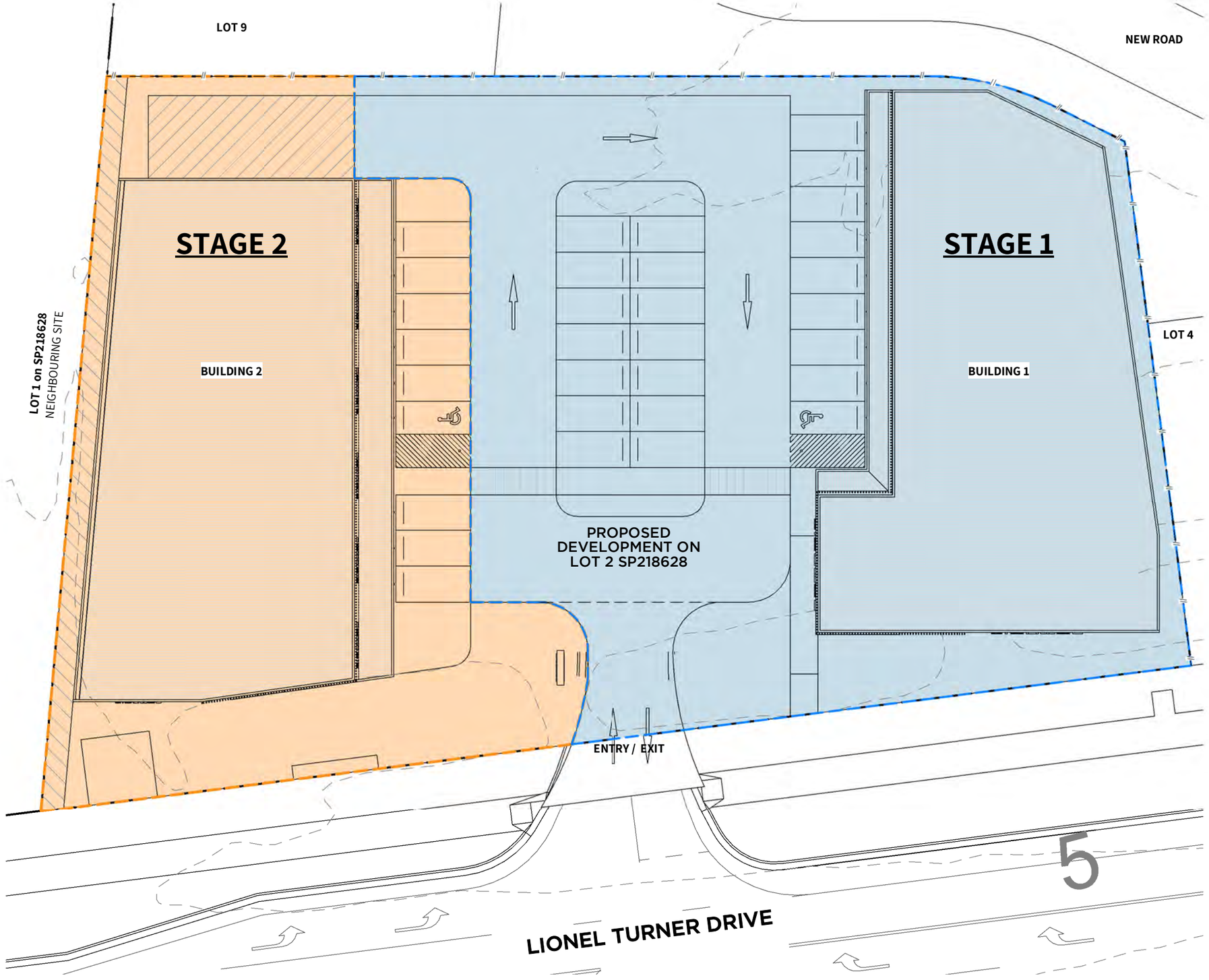
LIONEL TURNER DRIVE

BUSHLAND BEACH

CPO ARCHITECTS

legend

- STAGE 1
- STAGE 2



1 SITE PLAN
1 : 300 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-080
job no. 20240099

revision A

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY
- ACOUSTIC FENCE

development data

LOT 2 SP218628

SITE DATA

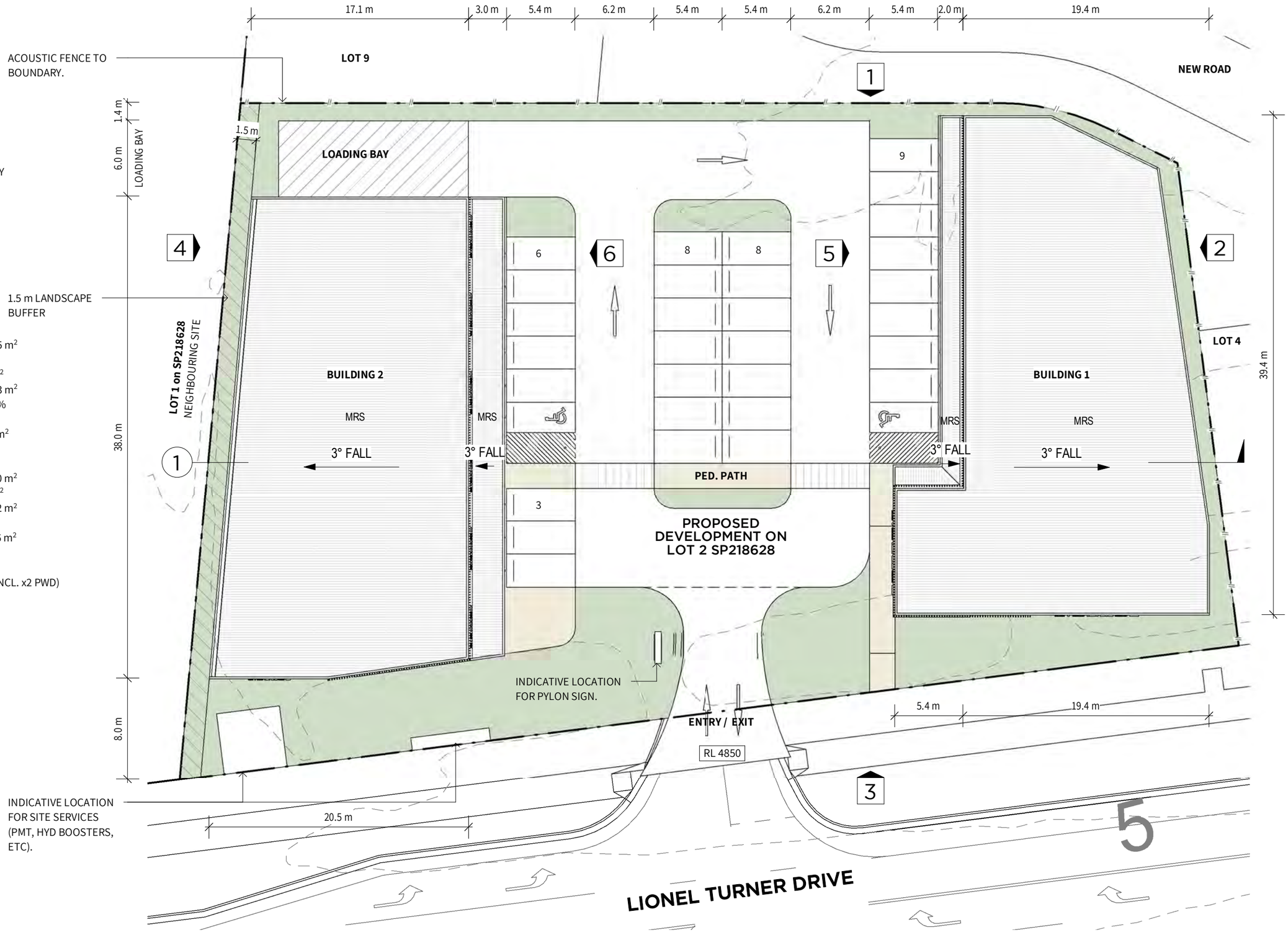
TOTAL SITE AREA	3,735 m²
NON-DEVELOPABLE AREA	
- LANDSCAPE BUFFER	82 m²
NET SITE AREA	3,653 m²
NET SITE EFFICIENCY	39.2%
LANDSCAPING	771 m²

AREAS (GFA)

COMMERCIAL	1,380 m²
FOOD OUTLET	52 m²
TOTAL GFA	1,432 m²
LIGHT-DUTY PAVEMENT	1,316 m²

CARPARKING

TOTAL PROVIDED	32 (INCL. x2 PWD)
LOADING BAY	1



1 SITE PLAN
1 : 300 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-090
job no. 20240099

revision C

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY
- ACOUSTIC FENCE

development data

LOT 2 SP218628

SITE DATA

TOTAL SITE AREA	3,735 m²
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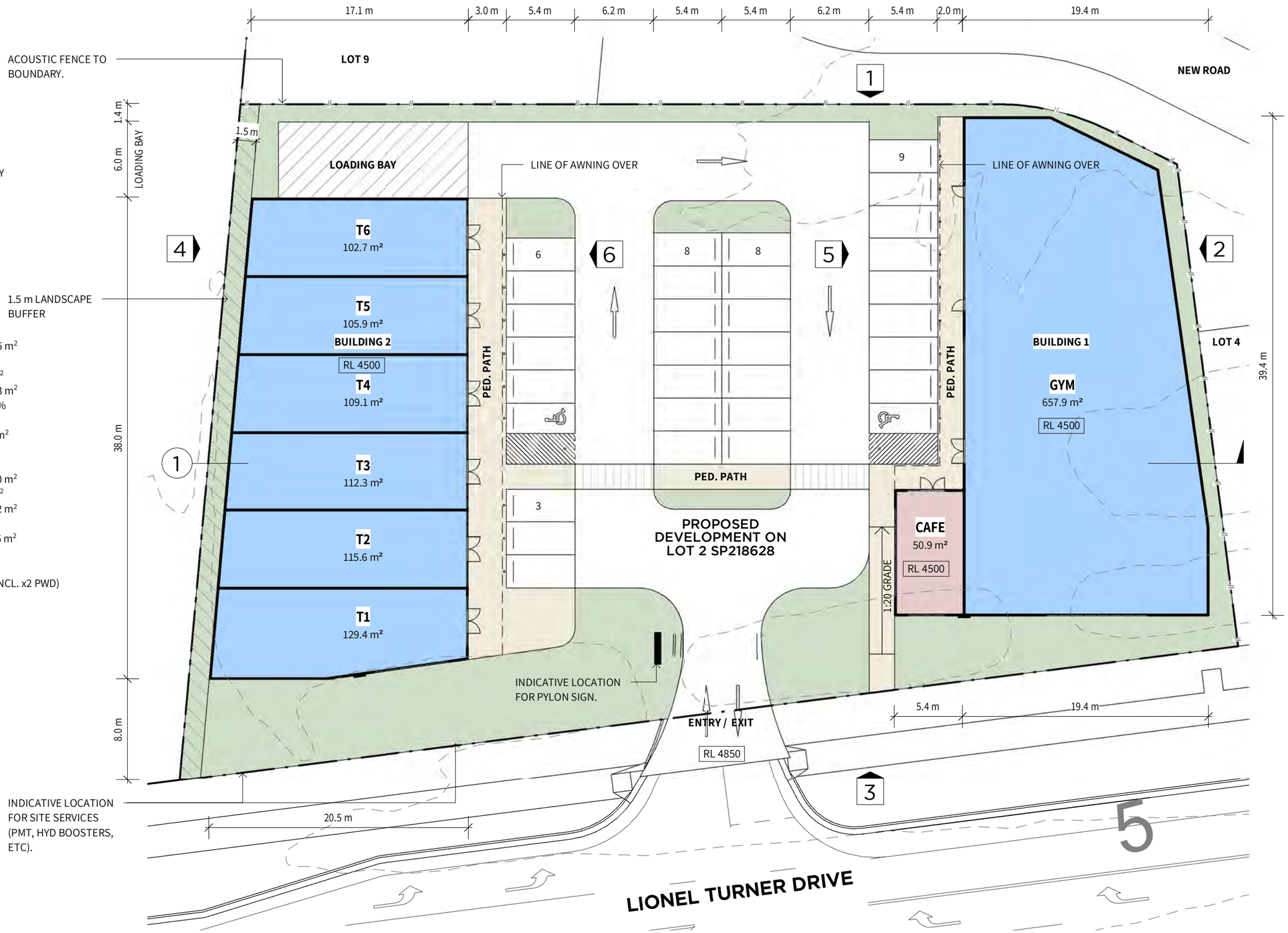

1 GROUND PLAN

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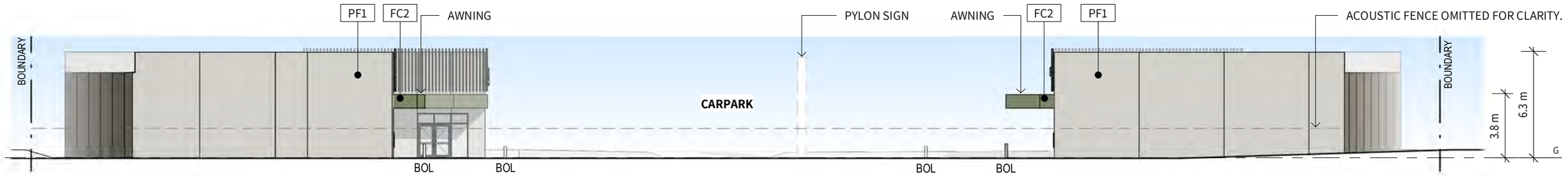
CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-100

job no. 20240099

revision C



1 SITE ELEVATION A

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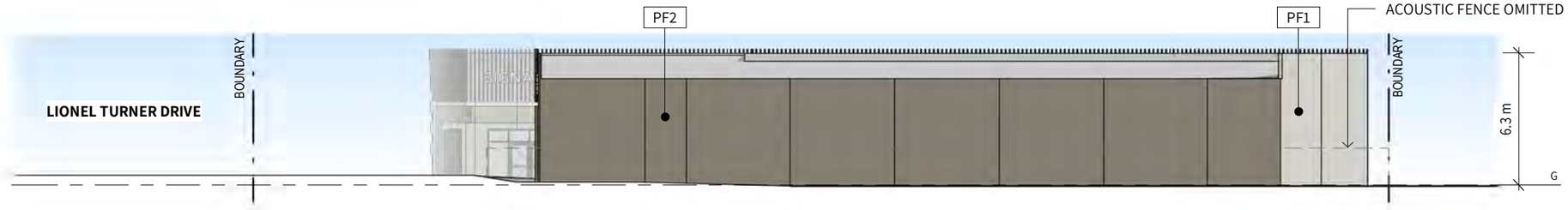

2 SITE ELEVATION B

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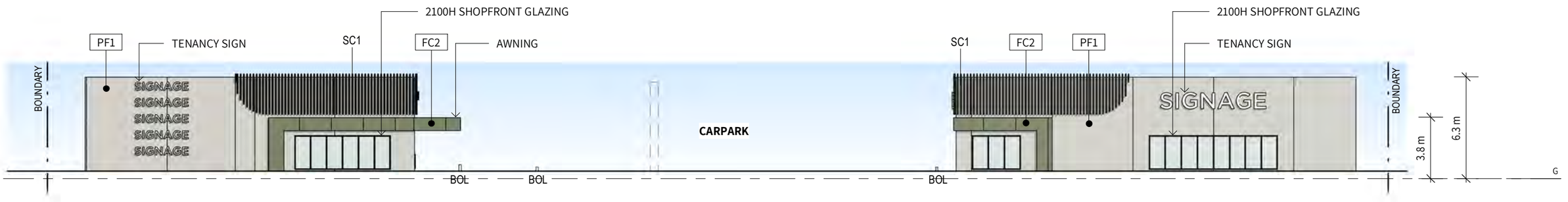

3 SITE ELEVATION C

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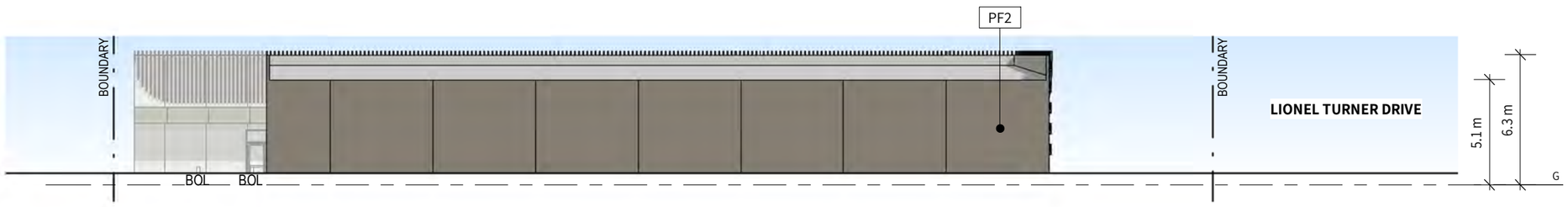


4 SITE ELEVATION D

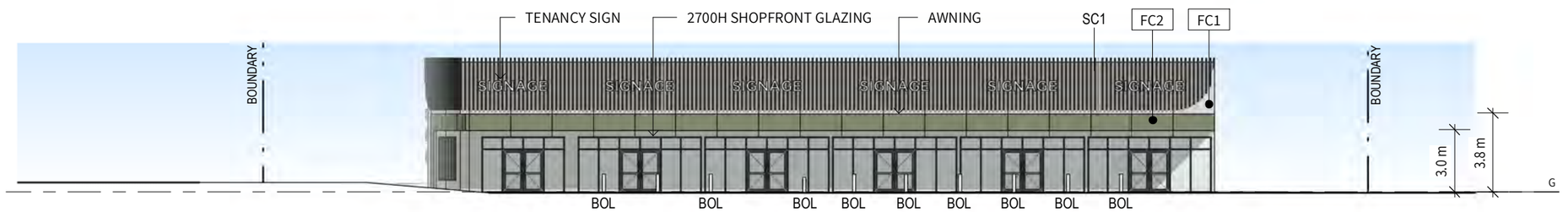
1 : 250 @ A3

legend

FC1	FEATURE CLADDING - TYPE 1
FC2	FEATURE CLADDING - TYPE 2
PF1	CONCRETE TILT PANEL - PAINT FINISH TYPE 1
PF2	CONCRETE TILT PANEL - PAINT FINISH TYPE 2
MRS	METAL ROOF SHEETING
SC1	VERTICAL SCREEN BATTEN

5 INTERNAL SITE ELEVATION A

1 : 250 @ A3

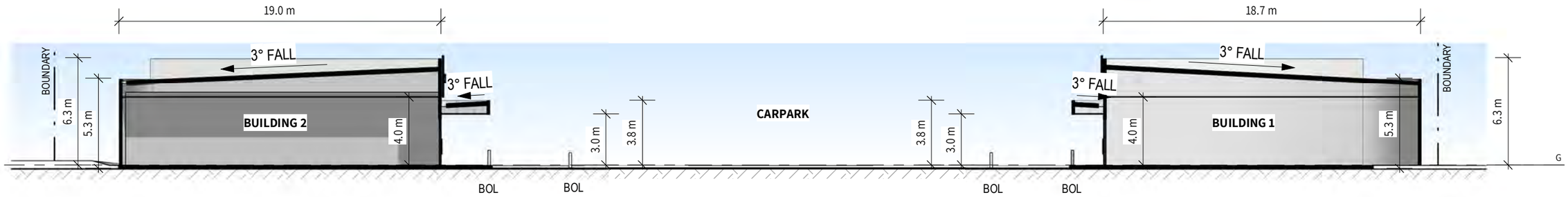


6 INTERNAL SITE ELEVATION B

1 : 250 @ A3

legend

FC1	FEATURE CLADDING - TYPE 1
FC2	FEATURE CLADDING - TYPE 2
PF1	CONCRETE TILT PANEL - PAINT FINISH TYPE 1
PF2	CONCRETE TILT PANEL - PAINT FINISH TYPE 2
MRS	METAL ROOF SHEETING
SC1	VERTICAL SCREEN BATTEN



1 SECTION A

1 : 250 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-400
job no. 20240099

revision C

VIEW FROM LIONEL TURNER DRIVE

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-450
job no. 20240099

revision C

VIEW FROM LIONEL TURNER DRIVE

VIEW FROM LIONEL TURNER DRIVE

CPO ARCHITECTS

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dwg no. DA-452
job no. 20240099

revision C

VIEW TOWARDS CAFE AND RETAIL

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-453
job no. 20240099

revision C

VIEW TOWARDS GYM

CPO ARCHITECTS

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dwg no. DA-454
job no. 20240099

revision C

GYM FRONT ELEVATION

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-455
job no. 20240099

revision C

CAFE AND RETAIL FRONT ELEVATION

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-456
job no. 20240099

revision B

APPENDIX B

Earlier Development Engineering Report (BELO0001)

NORTHERN CONSULTING engineers

CIVIL & STRUCTURAL ENGINEERS

ENGINEERING REPORT

PROPOSED MANUFACTURED HOME PARK
10-32 LIONEL TURNER DRIVE, BUSHLAND BEACH

FOR
Commercial Road Trust

JOB No: BELO0001

Doc Ref: BELO0001-ENG

Phone: 07 4725 5550
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NORTHERN CONSULTING engineers

DOCUMENT CONTROL

Rev	Author	Reviewed	Approved		Date	Issued To:	Purpose
A	Derek Saw	John Single	Derek Saw (RPEQ 7363)		25/08/2022	Client	Draft for review & comment

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICIES

APPENDIX A

VARCHITECTURE Conceptual Plans – SK220714.01 & .02 (dated 14/07/2022)

APPENDIX B

DPM Water – Water Supply Planning and Sewer Report (dated 12 August 2022 - Rev 1)

APPENDIX C

Townsville City Council – Development Permit – operational Works (OP13/0053) Bulk Earthworks

APPENDIX D

SPA Consulting – Planning Report Electrical Supply and Telecommunication

1.0 INTRODUCTION

1.1 Background

Northern Consulting Engineers (NCE) have been commissioned by Commercial Road Trust via Belo Developments to prepare a due diligence assessment on the proposed development at 10-32 & 34-50 Lionel Turner Drive, Bushland Beach. The works proposed are on land described as Lot 2 & 3 on SP218628.

The assessment will review the following aspects:

- Flooding
- Stormwater management details
- Water and sewer infrastructure
- Electrical and Telecommunications
- Traffic

The information provided in this report is based on the following layout plans which are provided as appendices to this report;

- Conceptual Scheme dated 4/07/2022, reference SK220714.01 and .02 (Appendix A).

NCE is an established consulting firm providing services in the land development and infrastructure sector and has been involved in the strategic planning of various developments within the Townsville region.

1.2 Proposed Development

The development proposed for the site is a Manufactured Home Park containing (171) allotments. Figure 1-1 shows the location of the dwellings/lots in context to the surrounding properties.

Lot 2 on SP218628 maintains an Operational works permit for Bulk Earthworks that will see surface elevations be lifted to above the TCC flood event over the site. Therefore, this portion of the site is considered to have flood immunity once the operational works have been completed.

Lot 3 on SP218628 lies below the defined flood event level and will require filling before it becomes flood immune. It is considered this portion of the site is flood impacted where further discussion on the potential impacts associated with filling this area is provided in Section 2.0.

As a result of the change in impervious area, increase in run-off is anticipated which has been considered in the major flood event, however will require further consideration (in particular, the minor events) during the design phase. Best practical solutions to run-off treatment are proposed. Further discussions on these elements are provided in Section 3.0.

The development is to be connected to the Townsville City Council's (TCC) water and sewerage network. Connection to the sewer network will be via the exiting reticulated system that passes the northern boundary of the site. Connection to the water network will via an existing water main passing the southern boundary of the site. Further details are discussed in Section 4.0 and 5.0.

The development is expected to generate additional traffic in the area, details of which are discussed Section 6.0.

Figure 1-1 Location of development in context to the surrounding properties

2.0 FLOODING

Figure 2-1 is an extract from the TownsvilleMaps Flooding Web Map Service that shows the existing flooding conditions, levels and depths. The site is located within the Lower Bohle Flood Study (LBFS) which currently information Councils planning scheme. Significant flooding is observed over both lots (Lot 2 & 3 on SP218628) with flood levels varying from 4.12 m AHD at the western boundary of Lot 2 to 3.44 m AHD at the eastern corner of Lot 3. Council's records show the flood depth to typically be between 300 mm to 500 mm over the site. As a result, the site is constrained by medium flood hazard overlay mapping (OM-6.1) as well as storm tide inundation and erosion areas from sea level rise (OM-3.1).

There is currently a valid bulk earthworks application over Lot 2 on SP218628, therefore assessment against the flood hazard code is not required as at the completion of these works, this portion of the site will be 1% AEP flood immune (minimum lot level is 4.3 m AHD). Subsequently, the succeeding discussion relates to Lot 3 on SP218628 and demonstrating compliance with the coastal environment and flood hazard overlay codes.

In order to achieve the Performance Outcomes (PO) of the overlay codes, filling of the site will be required and as such require a flood impact assessment (FIA) to demonstrate that the filling works can proceed without causing an actionable nuisance on the existing flooding characteristics. Subsequently, NCE have undertaken a preliminary FIA which is summarised in the following sections.

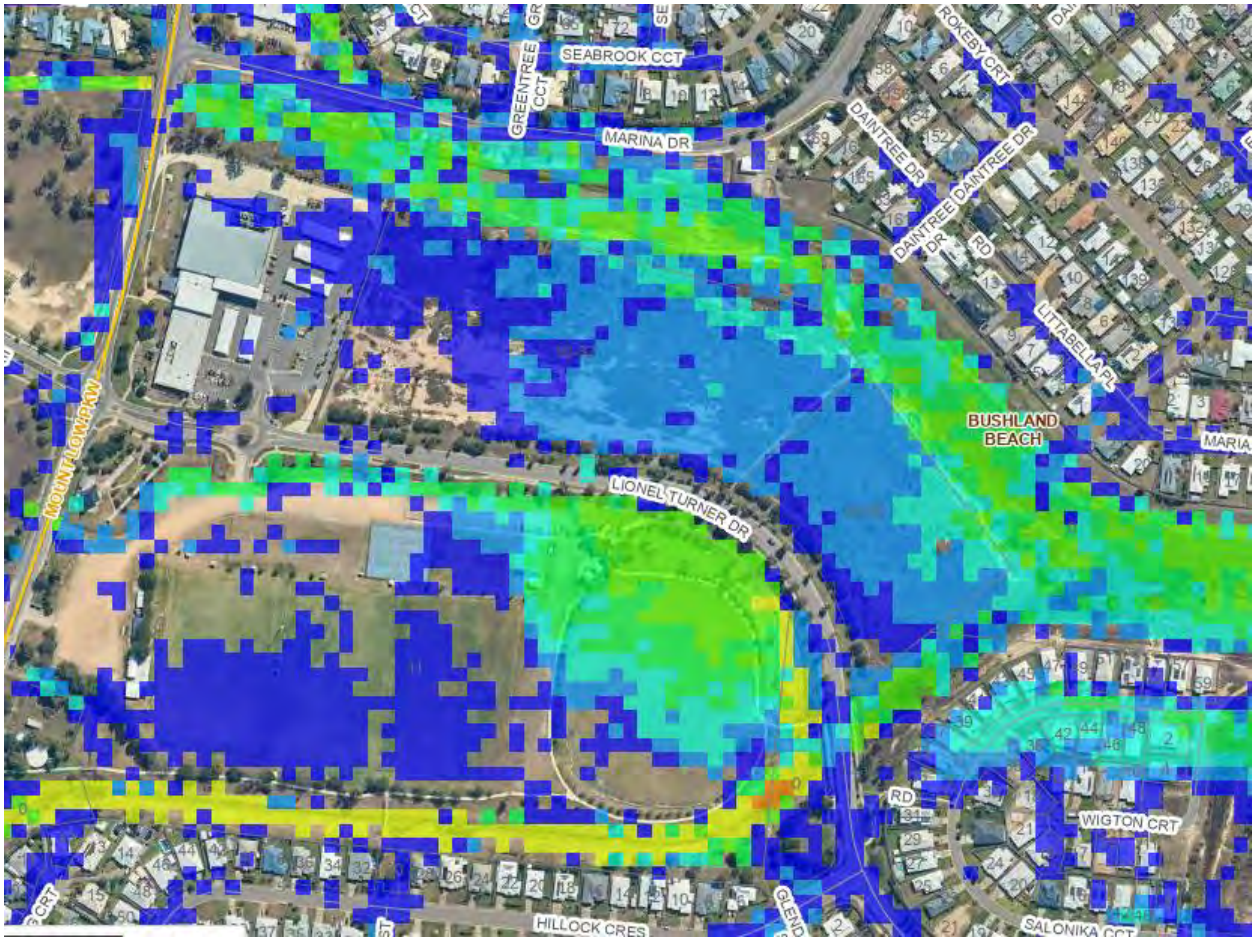


Figure 2-1 TownsvilleMaps Flooding Web Map Service extract and flood levels

2.1 Preliminary Flood Impact Assessment (FIA)

A preliminary FIA has been carried out for the 1% AEP flood event which included the development of a hydrological (XPRAFTS) and hydraulic (TUFLOW) model.

2.1.1 Methodology

- A Digital Elevation Model (DEM) based on LiDAR survey data over the entire hydraulic model extent was captured as part of the Townsville City Council 2019 LiDAR project and sourced from the Open Data portal. This information as well as NCE's background knowledge of the Bushland Beach drainage network was used to define the upper bounds of the catchment contributing to the site and form the basis for the 2D hydraulic model.

- Review the Lower Bohle Flood Study to understanding the flooding characteristics and the likely critical duration of the 1% AEP flood event at the site.

- Develop an XPRAFTS (hydrologic) model and use Storm Injector to simulate the model to derive run-off hydrographs in accordance with Australian Rainfall & Run-off 2019 (ARR2019). A critical duration and ensemble assessment was carried out with Storm Injector in order to identify the median ensemble pattern that is simulated through the hydraulic model to confirm the critical duration. This approach is in-line with ARR2019.

- Develop a fine scale 1D/2D TUFLOW (hydraulic) model, inclusive of rain-on-grid (ROG) hydrology to supplement the upstream run-off hydrographs, derived from the XPRAFTS model, that are

incorporated into the TUFLOW model as source-area inflows. Incorporate significant culvert structures.

- Modify the base DEM to include the filling works associated with Lot 2 and simulate the 1% AEP event for various durations and carry out a critical duration assessment.

- Verify and validate the TUFLOW model via simulating the baseline 1% AEP critical duration event with varying boundary conditions until correlation between the results of the TUFLOW model and Council's records are observed.

- Simulate the developed scenario by modifying the land use / impervious area of Lot 2 and 3 (from 0% to 90%) and adopt an iterative approach to determine the likely maximum fill extent on Lot 3, based on the 1% AEP event. Confirmation of fill extent occurs when there in no actionable or nuisance afflux on adjacent properties.

2.1.2 Model Parameters

Table 2-1 and Table 2-2 detail the parameters adopted in the XPRAFTS and TUFLOW models respectively. A fixed tailwater level (TWL) was adopted for the TUFLOW downstream boundary, over 600 m downstream of the site. The level of 3.32m AHD was adopted which was sourced from Council's records.

Culvert details were included in the model as per Council's online mapping records.

Drying and flooding depths of 0.0002 m were adopted. These values were selected in order to mitigate the risk of mass errors, and are compliant with TUFLOW modelling guidelines.

Table 2-1 XPRAFTS Parameters

ID	Total Area (ha)	Manning's 'n'		% Impervious	Init/Cont Loss	Vectored Slope
		Pervious	Impervious			
W1.0	20.9	0.06	0.02	55%	25I_2.5C	5.8%
W4.0	2.7	0.06	0.02	30%	25I_2.5C	1.5%
W2.0	2.3	0.06	0.02	65%	25I_2.5C	2.0%
W3.0	8	0.06	0.02	65%	25I_2.5C	1.7%
W5.0	3.4	0.06	0.02	65%	25I_2.5C	2.4%
W6.0	6.9	0.06	0.02	60%	25I_2.5C	2.8%
W6.1	1.9	0.06	0.02	5%	25I_2.5C	12.3%
W7.0	3.9	0.06	0.02	45%	25I_2.5C	5.8%
S1.0	8.6	0.06	0.02	60%	25I_2.5C	3.2%
S1.1	4.8	0.06	0.02	5%	25I_2.5C	11.2%
S2.0	9.5	0.06	0.02	65%	25I_2.5C	2.3%
S2.1	5.8	0.06	0.02	5%	25I_2.5C	13.4%
S3.0	6	0.06	0.02	65%	25I_2.5C	3.2%
S3.1	2.6	0.06	0.02	5%	25I_2.5C	8.8%
S6.0	8.5	0.06	0.02	5%	25I_2.5C	3.9%
S4.0	3.9	0.06	0.02	50%	25I_2.5C	2.7%
S5.0	11.3	0.06	0.02	5%	25I_2.5C	9.1%

Table 2-2 TUFLOW Parameters

Land Use	Depth Varying Manning's n	% Impervious
Sealed Roads	0.025	100%
Urban	0.03,0.1,0.1,0.07	60%
Buildings / commercial complex	0.03,0.02,0.1,0.15	90%
Verge	0.03,0.1,0.1,0.05	50%
Ponds and other water	0.025	100%
Concrete Channels	0.025	100%
Vegetation (light)	0.03,0.1,0.1,0.05	0%
Vegetation (medium)	0.03,0.15,0.1,0.07	0%
Vegetation (dense)	0.03,0.15,0.1,0.1	0%
Waterways (natural)	0.03,0.025,0.1,0.07	0%
Road corridors	0.025	60%
Parks	0.03,0.15,0.1,0.07	10%

2.1.3 Results

The critical duration within the TUFLOW model domain was found to be the 1-hour 8696 ensemble. This aligns with the critical duration observed in the Lower Bohle Flood Study within the vicinity of the site.

Initially the entire extent of Lot 3 was fill, however this resulted in significant afflux in within the drain to the south of Lot 3 which extended back through the culvert under Lionel Turner Drive (LTD) and into Peggy Banfield Park (PBP). An increase of 20 mm was observed within the eastern portion of PBP and it is unclear as to whether Council would be accepting of this increase, subsequently the fill extent was reduced to that shown in Figure 2-2, i.e. entire lot can be filled to within 15 m of the south-eastern boundary and battered to existing. A 20 m wide area to the south-east of the fill extent has been excavated to levels of 2.8 m AHD at the drain to the north and 3.5 m AHD near LTD in order to reduce the magnitude of the impact observed in the drainage corridor adjacent to Lot 3.

In reference to Figure 2-2, an increase in water surface levels (WSL) up to 120 mm is observed in the drainage corridor to the south of Lot 3. This increase is a direct result of reducing the flow area in the zone by filling Lot 3. While the increase in notable, it is isolated to the drainage channel and does not impact on adjoining residential properties or LTD. For this reason, the afflux observed in this location is categorised as non-actionable and of no consequence in this situation.

Afflux, up to 40 mm, is also observed in the table drain of LTD as a result of cutting of the existing flow path from LTD across Lot 3 and into the drainage corridor to the north. The increase in levels is contained within the table and do not impact the functionality of LTD, subsequently this afflux is categorised as non-actionable and of no consequence in this situation.

Overall the preliminary FIA has identified that all but a 15 m wide strip on along the south-eastern boundary of Lot 3 can be filled to provide 1% AEP flood immunity and reduce the risk to people or property from coastal hazard impacts by raising the site to a minimum level of 4.2 m AHD.

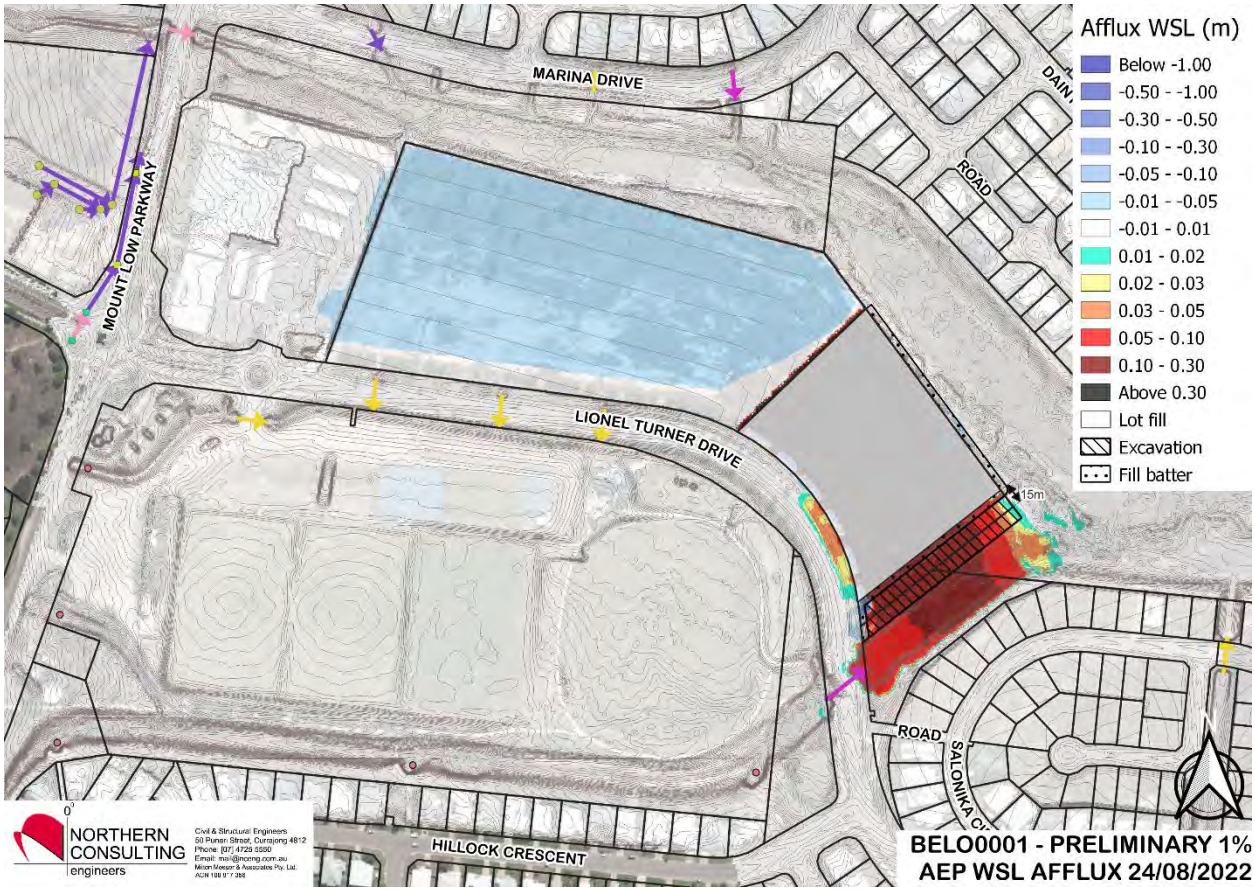


Figure 2-2 Preliminary 1% AEP WSL afflux

3.0 STORMWATER DRAINAGE

The legal points of discharge for the development are the frontage road (Lionel Turner Drive) and the existing open drainage corridors immediately adjacent the northern and south-eastern boundaries. Run-off is expected to be conveyed to these points via a combination of underground system (roof drainage and potential minor pit and pipe network) and overland sheet flow.

Water quality management will be required for the site in order to protect downstream water courses and comply with TCC planning scheme and State policies. This is expected to occur via various treatment devices that are discussed below.

3.1 Quantity

It is expected that the minor system will be designed for a 0.5EY (formerly referred to as 2-year ARI) event, while the major system will be designed for the 1% AEP event.

As mentioned in Section 2.0, NCE has undertaken a preliminary FIA which included an allowance for the change in impervious area as well as the grades and flow paths of the preliminary design finish surface. The site was graded to fall from LTD toward the open drainage corridors at ~0.4% or 1V:250H. The FIA identified that the increase in impervious area and filling of the site (to within 15 of the Lot 3 south-eastern boundary) resulted in afflux categorised as non-actionable and of no consequence within an isolated portion of the open drainage corridor to the south-east of Lot 3.

The results of the preliminary FIA show that mitigation of developed flows are not required in the 1% AEP event, however confirmation of mitigation requirements should be undertaken during the detailed design phase for the minor event.

3.2 Quality

The design intent for the system is to meet the current TCC Planning Scheme water quality targets, namely:

- 80% TSS Reduction
- 65% TP Reduction
- 40% TN Reduction
- 90% Gross Pollutants Reduction

All stormwater treatment trains have been modelled with the aid of MUSIC version 6.3.0. The catchments have been modelled in accordance with the following:

- "MUSIC Modeling Guidelines Version 1.0 - 2010", Water By Design (2010);
- Townsville Aero, 6 Minute Time Step From 3/03/1953 To 31/03/2010;
- Water By Design MUSIC Modeling Guidelines Source Nodes utilising modified percent impervious area, rainfall threshold, soil properties & pollutant concentration;
- No drainage routing between nodes.

3.2.1 MUSIC Modelling

For the purpose of developing the anticipated pollutant loads, the development has been modelled based on 'Urban Residential' land use type spilt notes;

- Roof (100% impervious);

The remaining land is considered to be natural grass which isn't anticipated to generate pollutants and has therefore been omitted from the MUSIC model. Figure 3-1 and illustrate the MUSIC model setup and the treatment train concept respectively.

A summary of the potential treatment train includes:

- Adoption of 100m^2 of roofed area per allotment which includes the manufactured home and a substantial shed to house caravans and or RV's

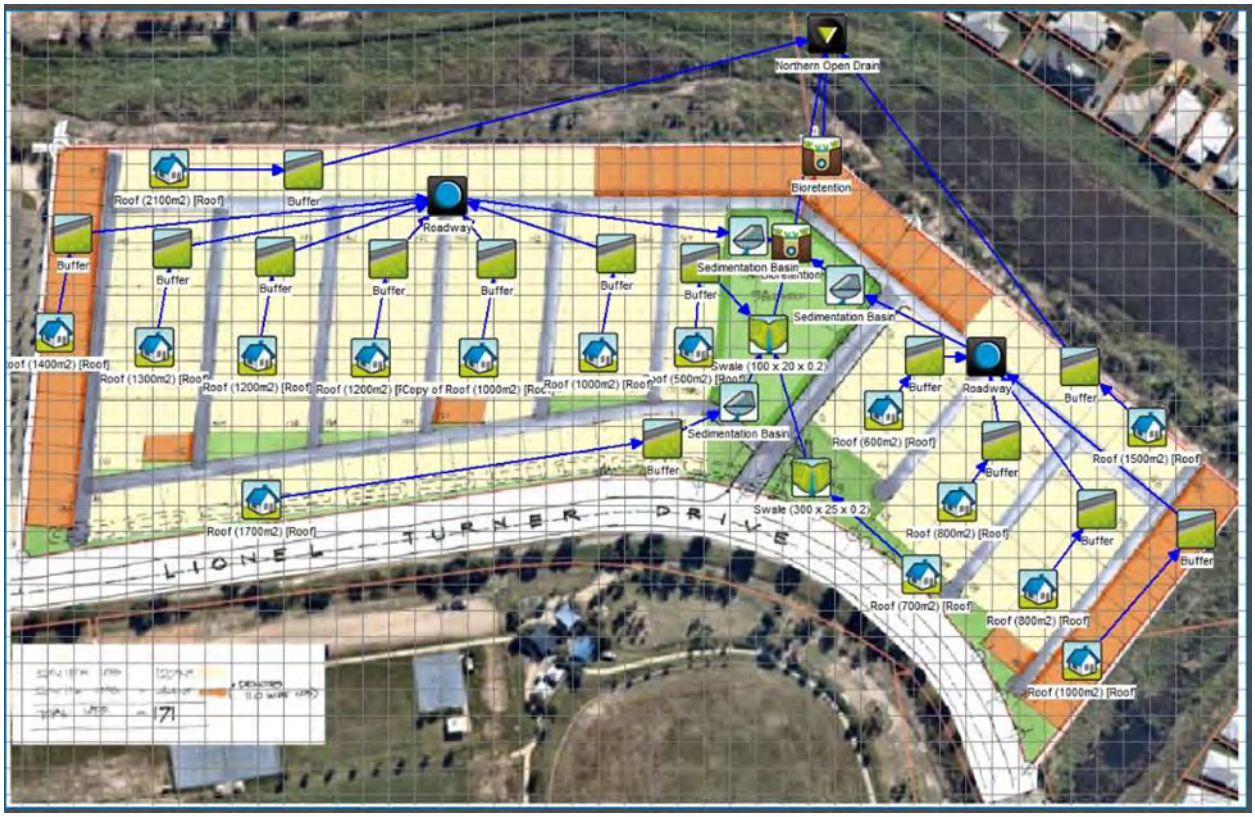


Figure 3-1 MUSIC model setup

MUSIC Modelling Guidelines Version 1.0 – 2010 pollutant and rainfall parameters are shown below in Figure 3-2 and Figure 3-3.

Table 3.8 Pollutant export parameters for split catchment land use (log^{10} values)

FLOW TYPE	SURFACE TYPE	TSS log^{10} values		TP log^{10} values		TN log^{10} values	
		Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
	Urban residential						
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	1.00	0.34	-0.97	0.31	0.20	0.20
	Ground level	1.00	0.34	-0.97	0.31	0.20	0.20
Stormflow parameters	Roof	1.30	0.39	-0.89	0.31	0.26	0.23
	Roads	2.43	0.39	-0.30	0.31	0.26	0.23
	Ground level	2.18	0.39	-0.47	0.31	0.26	0.23
	Industrial						
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	0.78	0.45	-1.11	0.48	0.14	0.20
	Ground level	0.78	0.45	-1.11	0.48	0.14	0.20
Stormflow parameters	Roof	1.30	0.44	-0.89	0.36	0.25	0.32
	Roads	2.43	0.44	-0.30	0.36	0.25	0.32
	Ground level	1.92	0.44	-0.59	0.36	0.25	0.32
	Commercial						
Baseflow parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
	Roads	0.78	0.39	-0.60	0.50	0.32	0.30
	Ground level	0.78	0.39	-0.60	0.50	0.32	0.30
Stormflow parameters	Roof	1.30	0.38	-0.89	0.34	0.37	0.34
	Roads	2.43	0.38	-0.30	0.34	0.37	0.34
	Ground level	2.16	0.38	-0.39	0.34	0.37	0.34

Figure 3-2 MUSIC "split" pollutant standard deviation parameters extracted from MUSIC Modelling Guidelines Version 1.0 – 2010

Table 3.7 Recommended MUSIC rainfall-runoff parameters[9]

PARAMETER	LAND USE			
	URBAN RESIDENTIAL	COMMERCIAL AND INDUSTRIAL	RURAL RESIDENTIAL	FORESTED
Rainfall threshold (mm)	1	1	1	1
Soil storage capacity (mm)	500[10]	18	98	120
Initial storage (% capacity)	10	10	10	10
Field capacity (mm)	200	80	80	80
Infiltration capacity coefficient a	211	243	84	200
Infiltration capacity exponent b	5.0	0.6	3.3	1.0
Initial depth (mm)	50	50	50	50
Daily recharge rate (%)	28	0	100	25
Daily baseflow rate (%)	27	31	22	3
Daily deep seepage rate (%)	0	0	0	0

Figure 3-3 MUSIC rainfall-runoff parameters extracted from MUSIC Modelling Guidelines Version 1.0 – 2010

3.2.2 Results

Figure 3-4 provides the results of the potential treatment train effectiveness. It is evident from the results that TSS, TN and GP's targets can be achieved, whilst TP target is just short of the target reduction percentage. Although the potential treatment train does not meet all targets, it is considered to be a best practical option (BPO) that doesn't require ongoing assessment and maintenance.

Northern Consulting Engineers
10-50 Lionel Turner Drive - Manufactured Home Park
Job Number -BELO0001
MUSIC Modelling Resultsk

Table 1 - Treatment Train Effectiveness

Description	Sources	Residual Load	% Reduction	(TCC 4-Aug-2021)
Flow (ML/yr)	29.9	14.9	50.2	
Total Suspended Solids (kg/yr)	8.74E+02	1.50E+02	82.8	80
Total Phosphorus (kg/yr)	5.19	1.89	63.5	65
Total Nitrogen (kg/yr)	95.5	23	75.9	40
Gross Pollutants (kg/yr)	5.77E+02	32.6	94.4	90

(2) Design objectives for stormwater management
The adopted design objectives for the coastal dry tropics
(a) >= 80% reduction in total suspended solids load
(b) >= 65% reduction in total phosphorus load
(c) >= 40% reduction on total nitrogen load
(d) >= 90% reduction in gross pollutant load.

Figure 3-4 Potential treatment train results

4.0 WATER NETWORK

NCE engaged a specialist water engineer (DPM Water) to provide advice in relation to potable water supply for the proposed development. A summary of the findings relating to the Water supply are listed below:

- The existing DN250 DICL water main on the Lionel Turner Drv frontage of the development site is sufficiently sized to service the 200 lot MHP development with both peak hour and fire flows.

- As the development will be a gated community, a single water service connection off the existing DN250 DICL main will be provided to service the development. The internal water mains will be privately owned. A water network layout has been modelled to show the preliminary sizing of the internal development water network.

For additional information relating to the investigation and assessment please refer to the DPM Water Report within the appendices.

5.0 SEWERAGE NETWORK

NCE engaged a specialist sewer engineer (DPM Water) to provide advice in relation to reticulated sewerage network for the proposed development. A summary of the findings relating to the Sewerage network is listed below:

- The development site has existing gravity sewers along its western (DN150) and northern (DN225/300) boundaries. A sewer (DN300) also traverses the site at the boundary of the two land parcels that form the development. The existing gravity sewer system extends to the north, under the open stormwater drainage reserve to discharge into major PS WB7 (Marina Drv). The existing sewer system has capacity

For additional information relating to the investigation and assessment please refer to the DPM Water Report within the appendices.

6.0 TRAFFIC ASSESSMENT

Northern Consulting Engineers have recently completed Traffic Impact Assessments (TIA) in the Bushland Beach area for separate commercial development, namely the 7Eleven Service Station and (115) place child care centre, both adjacent the roundabout at Lynwood Avenue / Mt Low Parkway / Lionel Turner Drive.

Background traffic for these assessments was based upon the AIMSUN projected traffic volumes for the year of commencement 2021 and the design horizon 2031. Combined with development traffic it was considered the above-mentioned roundabout would be operating at or above capacity from the year 2026 onward.

TCC plan to extend/connect Lionel Turner Drive to North Shore Boulevarde and this connection is expected to relieve the capacity constraint at the previously mentioned node.

A new all movement priority-controlled intersection onto Lionel Turner Drive will be required to be established as part of the development. The geometric form of this intersection will be assessed during subsequent design phases and may take the form of a AUL/CHR intersection based upon traffic warrants at the time.

7.0 ELECTRICAL & TELECOMMUNICATIONS

Details to be provided.

8.0 CONCLUSION

NCE have undertaken a due diligence investigation associated with the development of a ~200 lot Manufactured Home Park child care centre at 10-32 & 34-50 Lionel Turner Drive, Bushland Beach. The findings of this assessment summarised below:

- A flood assessment has demonstrated that the proposed development footprint can comply with the intent of the flood hazard overlay code.
- Local run-off will be conveyed to legal points of discharge via overland flow and a minor underground pit and pipe network. Mitigation of post-development flows are not required for the 1% AEP event as it has been demonstrated that there is non-worsening on the existing infrastructure.
- A best practical option to water treatment has been detailed, however changes to the proposed treatment train devices may occur during detailed design phase.
- Existing water infrastructure surrounding the site has capacity to service the development for peak demands and fire flows. A single DN150 connection to the existing DN250 DICL main in Lionel Turner Drive will be sufficient to service the development.
- The existing sewer mains that adjoin and traverse the site have adequate capacity to service the development.
- Previous traffic Impact Assessments in the area indicate the existing roundabout at Lynwood Avenue/Mt Low Parkway/Lionel Turner Drive will reach or exceed it's capacity during the design horizon for the development. TCC have plans to connect Lionel Turner Drive to North Shore Boulevarde and this connection is expected to relieve the capacity constraint at the previously mentioned node. A new all movement intersection with Lionel Turner Drive will need to be established to service the development.

APPENDIX C

Water and Sewer Network Assessment Report by DPM Waters

BUSHLAND BEACH COMMERCIAL DEVELOPMENT (LIONEL TURNER DRIVE)

WATER SUPPLY PLANNING & SEWER REPORT

Date: 27 August 2025 (Rev 2)

TABLE OF CONTENTS

APPENDICES

REPORT AUTHORISATION				
Revision	**Revision Date**	**Details**	**Prepared by**	**Signature**
1	01/05/2025	Initial Report	Desmond Moseley	
2	27/08/2025	Updated Report (Adjusted commercial layout)	Desmond Moseley	

1 INTRODUCTION

A proposed commercial development is planned on the northern side of Lionel Turner Drv and to the east of the existing Coles shopping centre near the intersection with Mt Low Parkway. The site is currently a vacant land parcel. The commercial development is proposed on the southwest corner of the larger 4.8ha vacant land parcel. The remainder of the land parcel is proposed to be developed into an 80 lot residential development (separate application).

The commercial development is proposed to consist of two buildings. The proposed commercial building on the eastern side of the site is proposed to be a gym while the building on the western side will have six smaller tenancies including a café. The concept plan is provided below with a larger version provided in Appendix A. The development is to be provided with a reticulated water and sewer system.

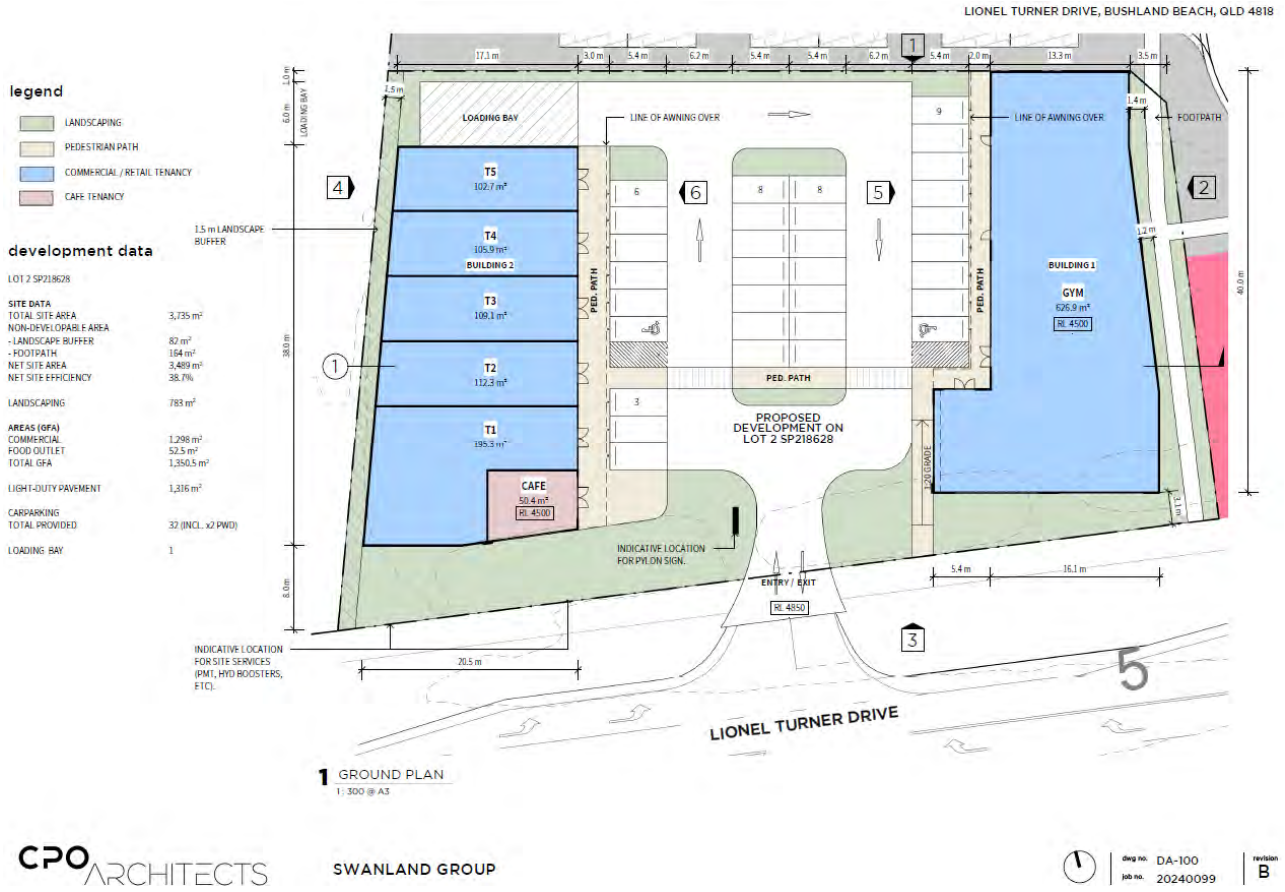


Figure 1.2 – Commercial Site Layout Plan

The following sections of this report provide a summary of the water & sewer capacity assessment for commercial development with this showing:

- The existing DN300 DICL water main on the Lionel Turner Drv frontage of the development site is sufficiently sized to service the commercial development with both peak hour and fire flows.
- As the development is commercial, a single water service connection off the existing DN300 DICL main will be provided to service it. The sizing of the water service offtake and water meter will be confirmed as part of the building hydraulic services design by others.
- The site has existing gravity sewers along its western (DN150) and northern (DN300) boundaries. A sewer (DN300) also runs along the eastern boundary of the large undeveloped land parcel. A new DN150 sewer is proposed to extend from the commercial development site to the east. This sewer will traverse the balance area of the undeveloped land parcel that is to

become a residential subdivision and connect to existing MH 4/WB7F that is located on the existing DN300 trunk sewer.

- The existing DN300 sewer from MH 4/WB7F through to existing major PS WB7 (Marina Drv) has sufficient capacity to service the proposed commercial development.

The location of the site is illustrated on the Townsville City Council GIS extract below.

Figure 1.2 – Commercial Site Location

2 POPULATION ASSESSMENT

The following table provides the population assessment for the proposed development. The equivalent population assessment has been developed based on the unit rates detailed in "Table 8.1 – Infrastructure Demand Unit Rates" of the Local Government Infrastructure Plan – DSS, Definitions & Demands (April 2017) that is extrinsic referenced material to the Townsville CityPlan.

The GFA's for the commercial uses for this development are detailed on the figure in Appendix A with the following table providing a summary of the uses, GFA's and loading rates.

Table 2.1 – Water Equivalent Population Assessment

	Area	Loading Rate	EP
Café/Retail (Retail)	50.4 m^2 GFA	2.11 EP/100m^2	1.1 EP
General Retail (Retail)	625.3 m^2 GFA	2.11 EP/100m^2	13.2 EP
Gym (Services)	626.9 m^2 GFA	1.35 EP/100m^2	8.5 EP
Totals			**22.8 EP**

Table 2.2 – Sewage Equivalent Population Assessment

	Area	Rate	EP
Café/Retail (Retail)	50.4 m^2 GFA	2.74 EP/100m^2	1.4 EP
General Retail (Retail)	625.3 m^2 GFA	2.74 EP/100m^2	17.1 EP
Gym (Services)	626.9 m^2 GFA	1.88 EP/100m^2	11.8 EP
Totals			**30.3 EP**

An alternative method to determine the equivalent population for the development is to apply the generic commercial loading rates from the TCC planning Scheme. The proposed development could be considered a "Local Centre" in the planning scheme which is what the adjacent Coles shopping centre is zoned. The loading rates from "Table SC3.1.6a - Planned demand generation rate for a trunk infrastructure network" in the TCC planning scheme and the equivalent water & sewer population is provided in Table 2.3 & Table 2.4 below.

Table 2.3 – Water Equivalent Population Assessment

	Area	Loading Rate	EP
Commercial Development (Local Centre)	3,735 m^2 (Gross Site Area)	81.6 EP/ha	**30.5 EP**

Table 2.4 – Sewage Equivalent Population Assessment

	Area	Rate	EP
Commercial Development (Local Centre)	3,735 m^2 (Gross Site Area)	103.5 EP/ha	**38.7 EP**

The higher estimated equivalent populations from Table 2.3 and Table 2.4 have been used in the water and sewer capacity assessment for the site.

3 WATER SUPPLY PLANNING

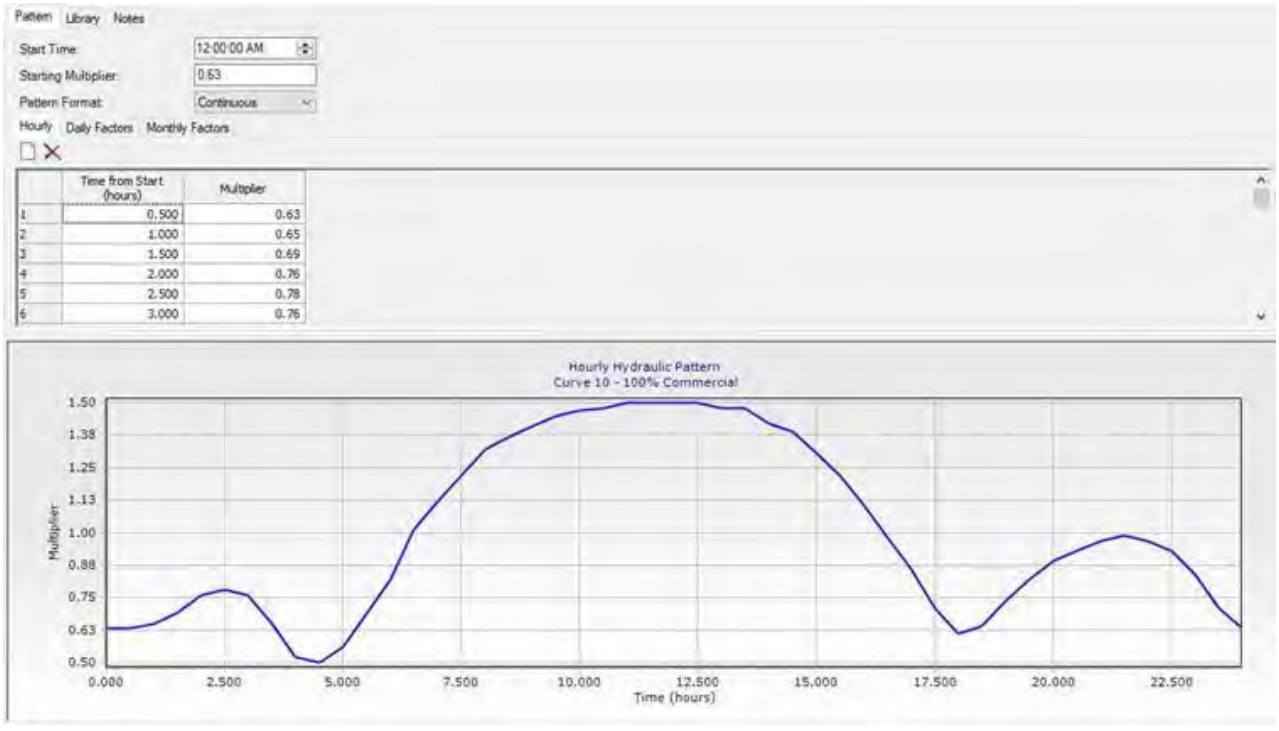
3.1 Water Demand

Water demands have been calculated in accordance with Townsville City Council planning scheme and associated CTM Code. The following table provides the "residential" water demand parameters from the Townsville Planning Scheme for each equivalent person (EP).

Table SC6.4.3.21.2 Water supply unit demand parameters

Parameter	Unit Demand	Peaking Factor
Average Day (AD)	600 L/day/EP	
Mean Day Max Month (MDMM)	900 L/day/EP	1.5 AD
Peak Day (PD)	1125 L/day/EP	1.25 MDMM
Peak Hour (PH)	0.0333 L/s/EP	2.56 PD

Townsville Water also have diurnal water demand patterns that are applied to the various water uses. The commercial demand diurnal pattern will be applied. The commercial demand diurnal pattern has a peaking factor of 1.5, instead of the 2.56 peaking factor provided in the above table for residential water demands. The commercial diurnal pattern is illustrated below.



Based on an equivalent population of 30.5 EP, for commercial development the peak water demand for the development is:

= 30.5 EP x 1125 L/day/EP x 1.5 (commercial peaking factor)

= 30.5 x (1125 / (24*3600)) x 1.5

= 0.60 l/s

In addition to the above, as the development is commercial a 30 l/s fire flow is required in accordance with Council's design standards. The standards allow for the fire flow to be provided from up to three hydrants. The water network modelling results for commercial development is detailed in the following report sections.

3.2 Water Supply Assessment

The water network modelling for the development has been performed using the WaterGEMS network model. The WaterGEMS network model includes the existing water infrastructure along with the existing water demands for all the Bushland Beach, Northshore, Sanctum and Mt Low areas that are located on the northern side of the Bruce Hwy.

The WaterGems network model has been updated to include the water demands for the commercial development on the northern side of Lionel Turner Drv. The trunk water infrastructure that services this development area consists of:

- The Mt Low Reservoirs. There are 2 x 6 ML reservoirs located on the western Mt Low hill with these reservoirs having a bottom water level of 54.5 mAHD and a top water level of 65.5 mAHD. The reservoirs are filled from a DN375 DICL water main along Mt Low Parkway from the Mt Spec pipeline.
- Water is directed out of the reservoirs via existing parallel DN450 DICL and DN375 DICL mains to Mt Low Parkway. A DN450 DICL main then extends to the north along Mt Low Parkway (on its eastern side) to the intersection with Lionel Turner Drv. A DN375 DICL main also extends to the north along Mt Low Parkway (on its western side) to the intersection with Lionel Turner Drv.
- At the Lionel Turner Drv/Mt Low Parkway intersection the above water mains are interconnected with pipelines then extending to the north along Mt Low Parkway, west along Lynwood Ave and east along Lionel Turner Drv.
- A DN300 DICL main extends to the east along Lionel Turner Drv (on the northern side, being the frontage of the commercial development site). This main reduced to be a DN250 DICL main part way along and continues to the east along Lionel Turner Drv.
- A water service offtake and water meter will be connected to the existing DN250 DICL main to service the proposed commercial development.

The following Figure 3.1 from the WaterGEMS model illustrates the existing water infrastructure along with the preliminary location for the water meter offtake for the commercial development.

The WaterGEMS network modelling for the commercial development site has also included the future proposed 80 lot residential development on the balance area of the vacant land parcel. This is to ensure the water network has sufficient capacity for the proposed commercial development and concurrent residential subdivision. The water & sewer assessment for the adjacent proposed 80 lot residential subdivision is detailed in a separate report.

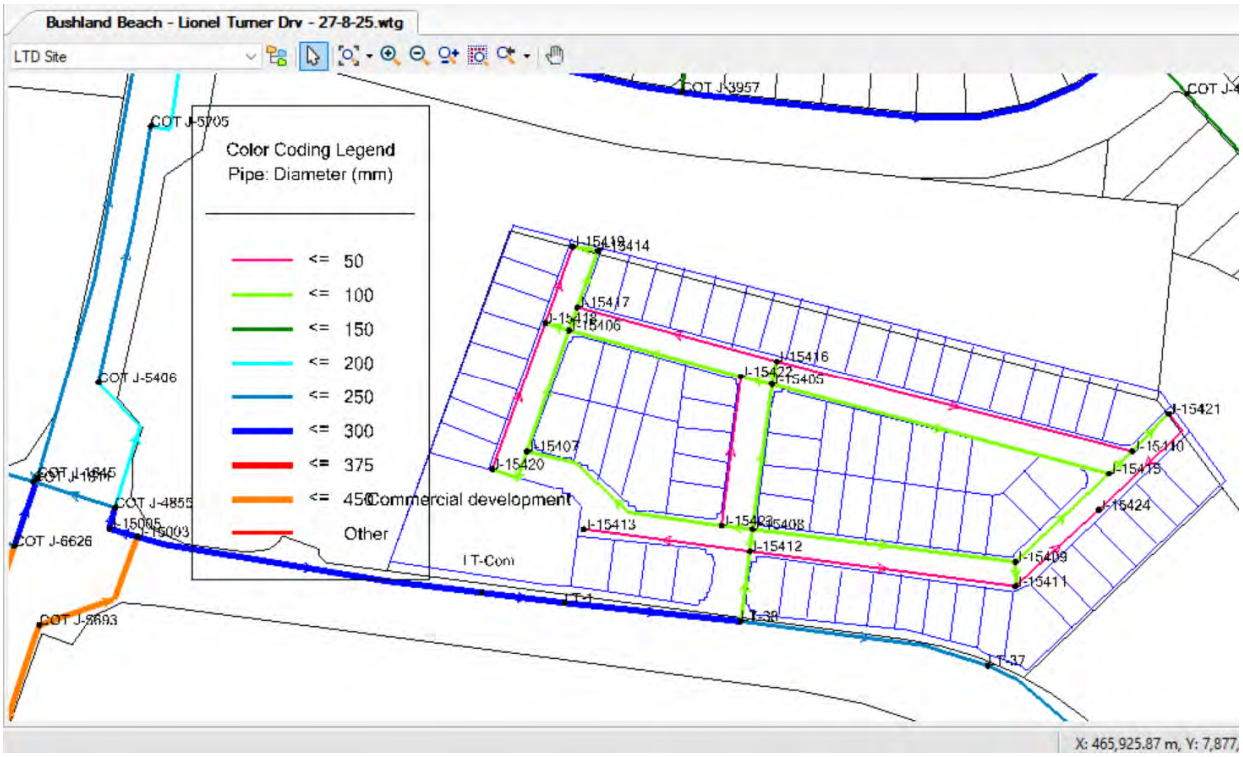


Figure 3.1 – Commercial Site WaterGEMS Model

With the inclusion of the water demands for the commercial development off the existing DN300 DICL water main, the water network performance is summarised below:

- The existing trunk water mains in Bushland Beach (as noted above) are adequately sized to service the commercial development.
- The water pressure at the offtake to the commercial development site (on the existing DN300 DICL water main on Lionel Turner Drv) with the inclusion of the peak hour flows for the development are reduced to a minimum of 566 kPa at 12 noon which is the peak commercial demand period.
- The water pressure at the offtake to the commercial development site (on the existing DN300 DICL water main on Lionel Turner Drv) with the inclusion of the peak hour flows for the development are reduced to a minimum of 521 kPa at 6:30pm which is the peak residential demand period. The lower water pressure at 6:30pm is due to the high amount of residential development in the Bushland Beach area. The water pressure curve for the water offtake location is provided on Figure 3.2 below.
- The velocity and headloss gradients for the existing DN300 and DN250 water main on Lionel Turner Drv is up to 0.43 m/s and 0.002 m/m respectively and are in accordance with Council standards.
- With the inclusion of the 30 l/s commercial fire flows on the existing DN300 main on Lionel Turner Drv the water pressure is 559 kPa at 12 noon and 504 kPa at 6:30pm. This water pressure is above the minimum allowable 120 kPa pressure.
- The velocity along the existing DN300 and DN250 DICL main on Lionel Turner Drv with the inclusion of the 30 l/s fire flow is up to 0.83 m/s which is below the 4.0 m/s maximum value in Council standards.

A Figure of the WaterGems model is provided in Appendix B along with the water network modelling results for peak hour and fire flows.

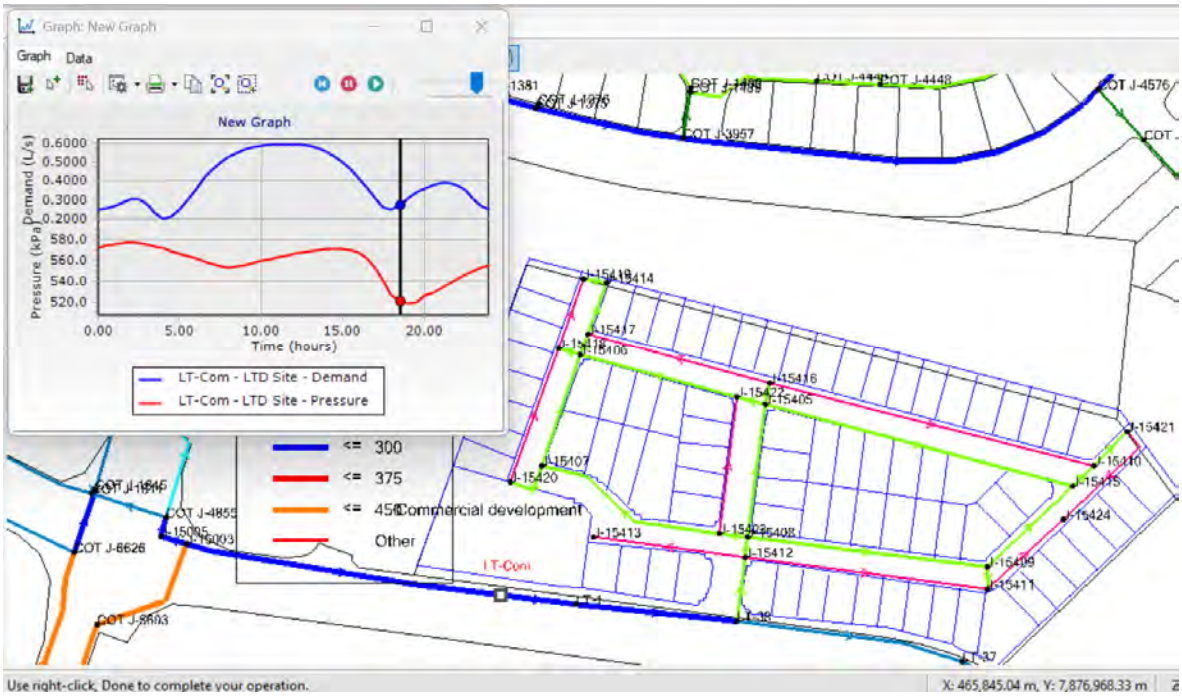


Figure 3.2 – Commercial Site WaterGEMS Model Peak Hour Pressures

The water network modelling shows the existing water network in Bushland Beach is adequately sized to service the commercial development.

4 SEWER SYSTEM PLANNING

The proposed commercial development will be serviced with a reticulated sewer system. The development will be serviced as follows:

- The commercial development will be connected to the existing DN300 sewer that traverses the eastern boundary of the site from MH 1/WB7F to MH 4/WB7F.
- There will be a DN150 sewer constructed from the commercial development site to the east through the planned residential development to existing MH 4/WB7F.
- The above DN300 sewer line extends to the north from MH 1/WB7F, under the open stormwater drain and on to major PS WB7 (Marina Drv) that services all of Bushland Beach. PS WB7 pumps sewage through to the Mt St John STP for treatment.

The following extract from the Council GIS illustrates the existing gravity sewer lines that will service the proposed commercial development site through to major PS WB7 (Marina Drv).

The sewer network modelling for the commercial development site has also included the equivalent population and sewage flows from the proposed 80 lot residential development on the balance of the vacant land parcel on the northern side of Lionel Turner Drv. This is to ensure the existing gravity sewer system is adequately sized to cater for both the proposed commercial development and adjacent residential subdivision. A separate water & sewer report will be developed for the adjacent 80 lot residential development.

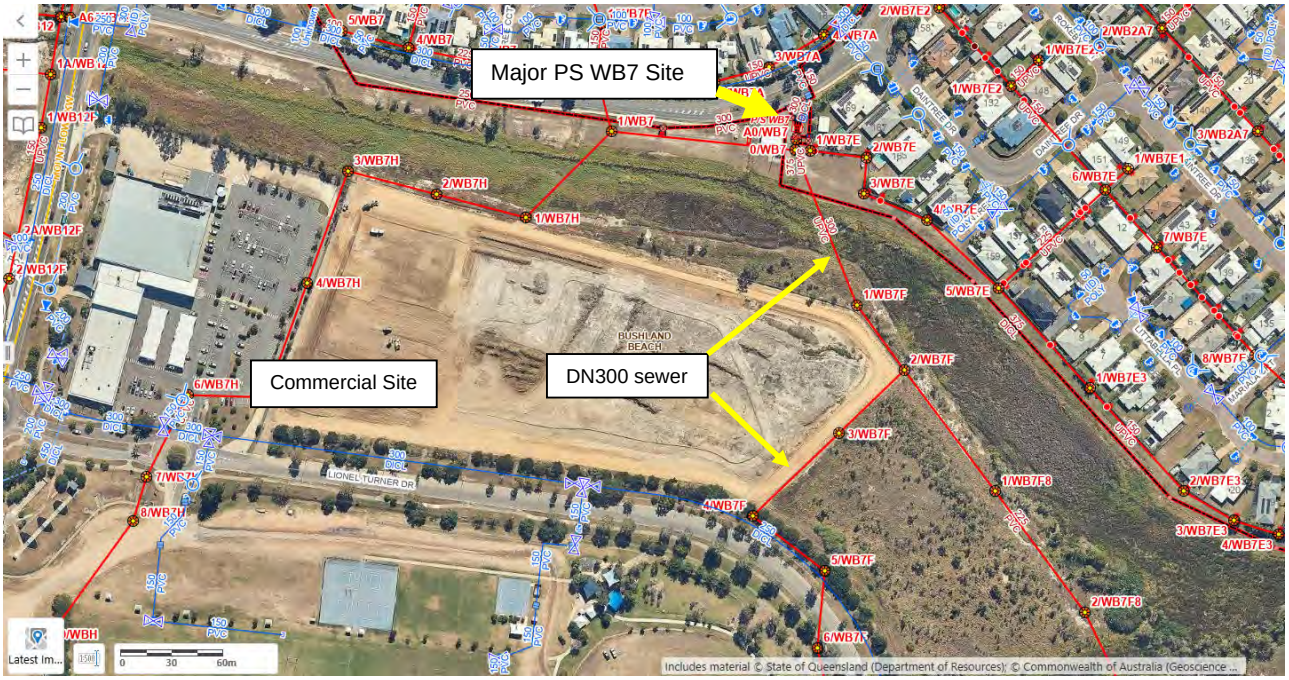


Figure 4.1 – Existing Sewer System

4.1 Sewage Infrastructure Capacity

The existing sewer system that services the eastern portion of Bushland Beach and the proposed commercial development on the northern side of Lionel Turner Drv has been modelled using the SewerGEMS model for Bushland Beach. The SewerGEMS model figure is provided as Figure 4.2 below.

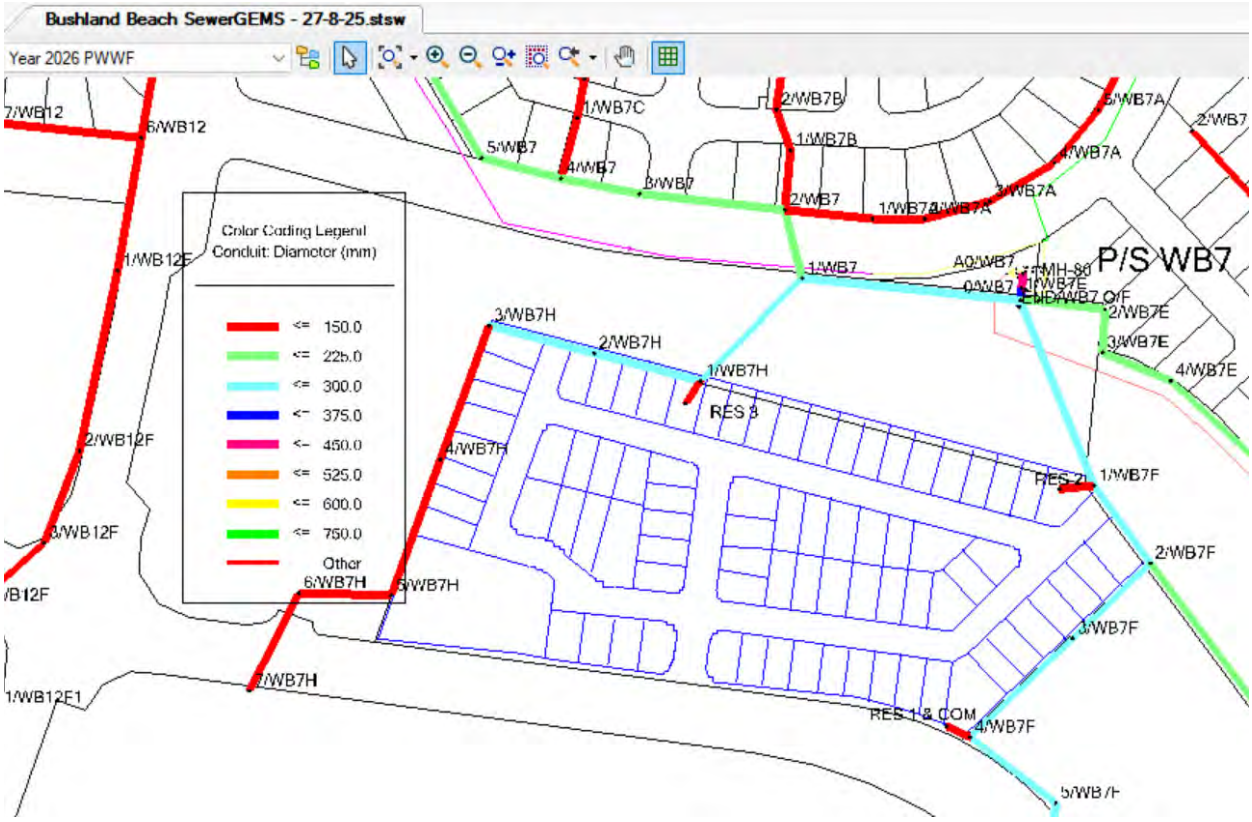


Figure 4.2 – SewerGEMS Model Figure

The SewerGEMS network model was run with the inclusion of the above additional equivalent populations and associated sewage flows (for both the proposed commercial development and residential subdivision). The modelling results are provided in Appendix C and show:

- The existing DN300 eastern sewer line from MH 4/WB7F to MH 2/WB7F flows up to 35% full.
- The existing DN300 sewer line from MH 2/WB7F8 to MH 2/WB7F flows up to 63% full.
- The existing DN375/DN450 sewer from MH 2/WB7F to major PS WB7 flows up to 37.5% full.
- All sewers flow less than 75% full and therefore meet the CTM code standards.

The above assessment illustrates the existing gravity sewer system is able to service the additional sewage flows from the proposed commercial development on the northern side of Lionel Turner Drv.

APPENDIX A
COMMERCIAL DEVELOPMENT LAYOUT PLAN

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY

development data

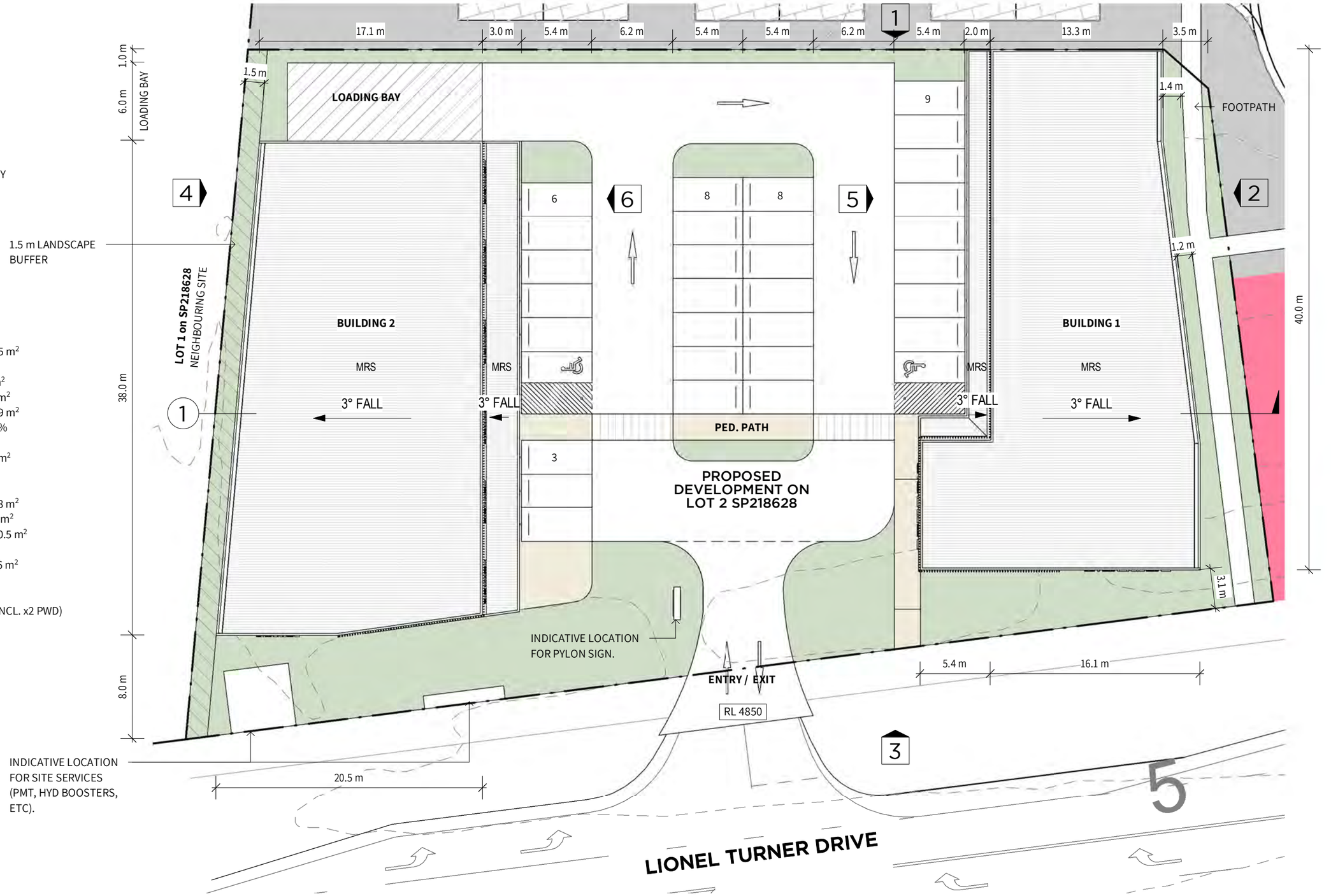
LOT 2 SP218628

SITE DATA

TOTAL SITE AREA	3,735 m²
NON-DEVELOPABLE AREA	
- LANDSCAPE BUFFER	82 m²
- FOOTPATH	164 m²
NET SITE AREA	3,489 m²
NET SITE EFFICIENCY	38.7%
LANDSCAPING	783 m²

AREAS (GFA)

COMMERCIAL	1,298 m²
FOOD OUTLET	52.5 m²
TOTAL GFA	1,350.5 m²
LIGHT-DUTY PAVEMENT	1,316 m²
CARPARKING	
TOTAL PROVIDED	32 (INCL. x2 PWD)
LOADING BAY	1



1 SITE PLAN
1 : 300 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-090
job no. 20240099
revision B

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY

development data

LOT 2 SP218628

SITE DATA	
TOTAL SITE AREA	3,735 m²
NON-DEVELOPABLE AREA	
- LANDSCAPE BUFFER	82 m²
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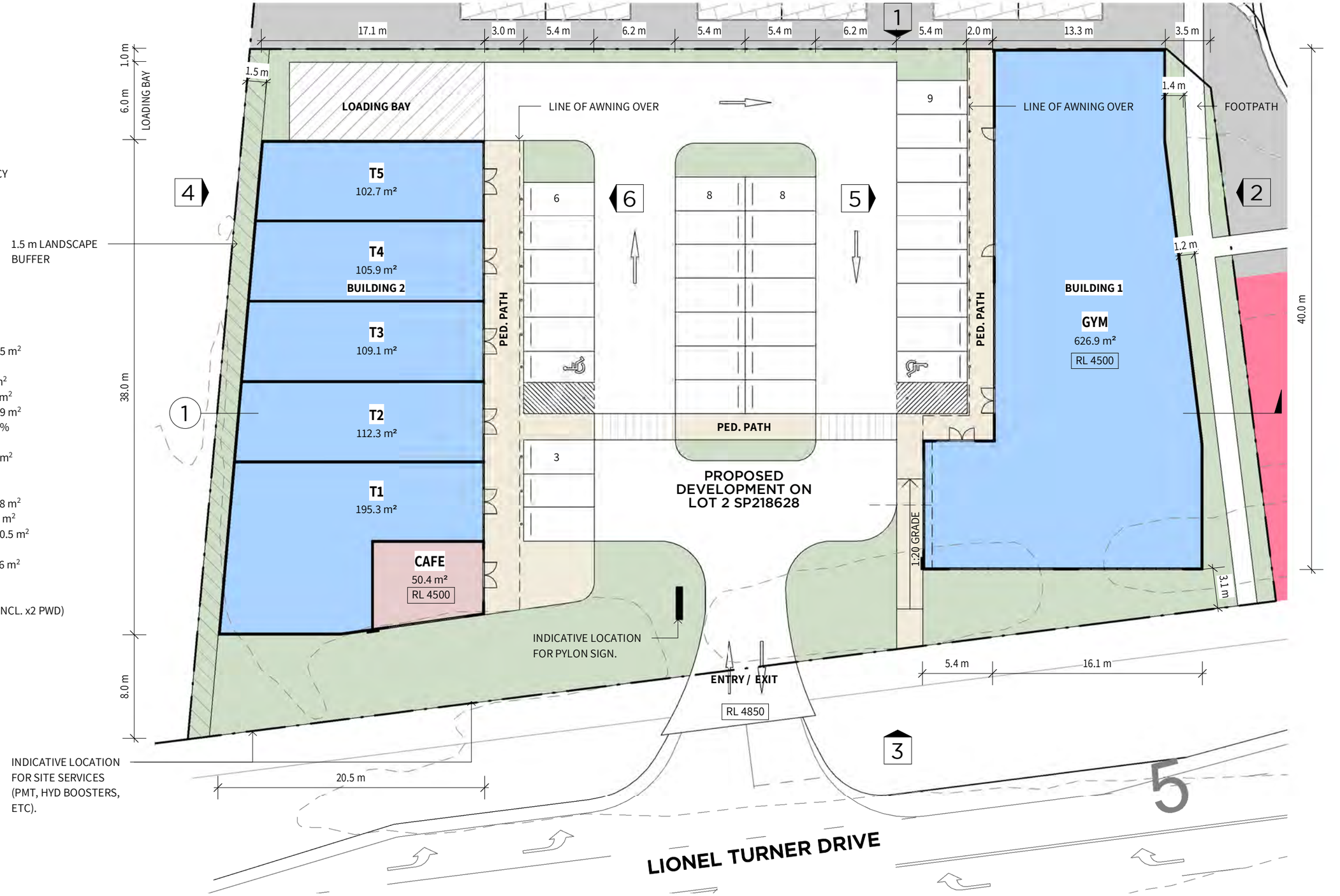
CARPARKING	
TOTAL PROVIDED	32 (INCL. x2 PWD)
LOADING BAY	1



1 GROUND PLAN

1 : 300 @ A3

CPO ARCHITECTS

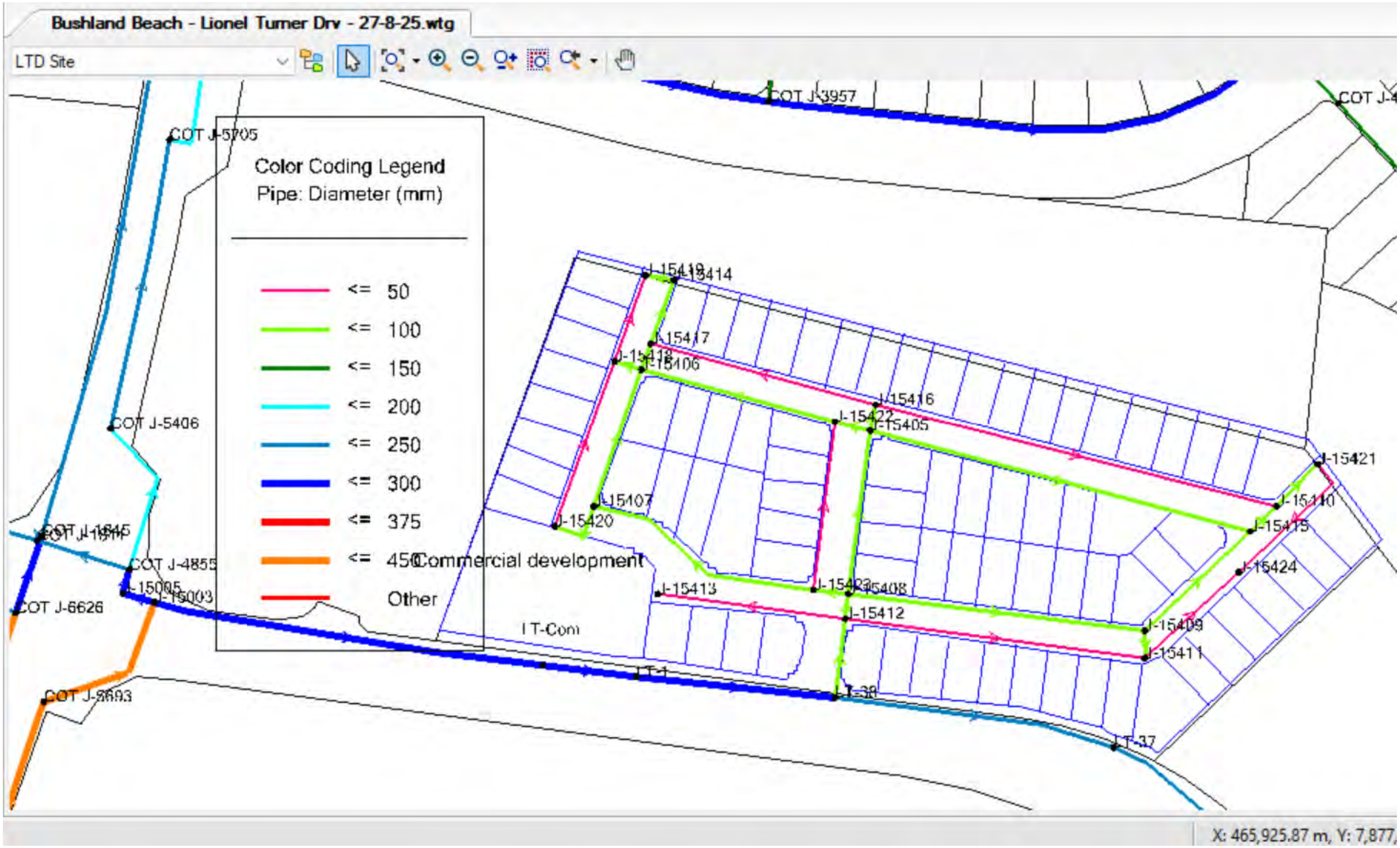
SWANLAND GROUP

dwg no. DA-100

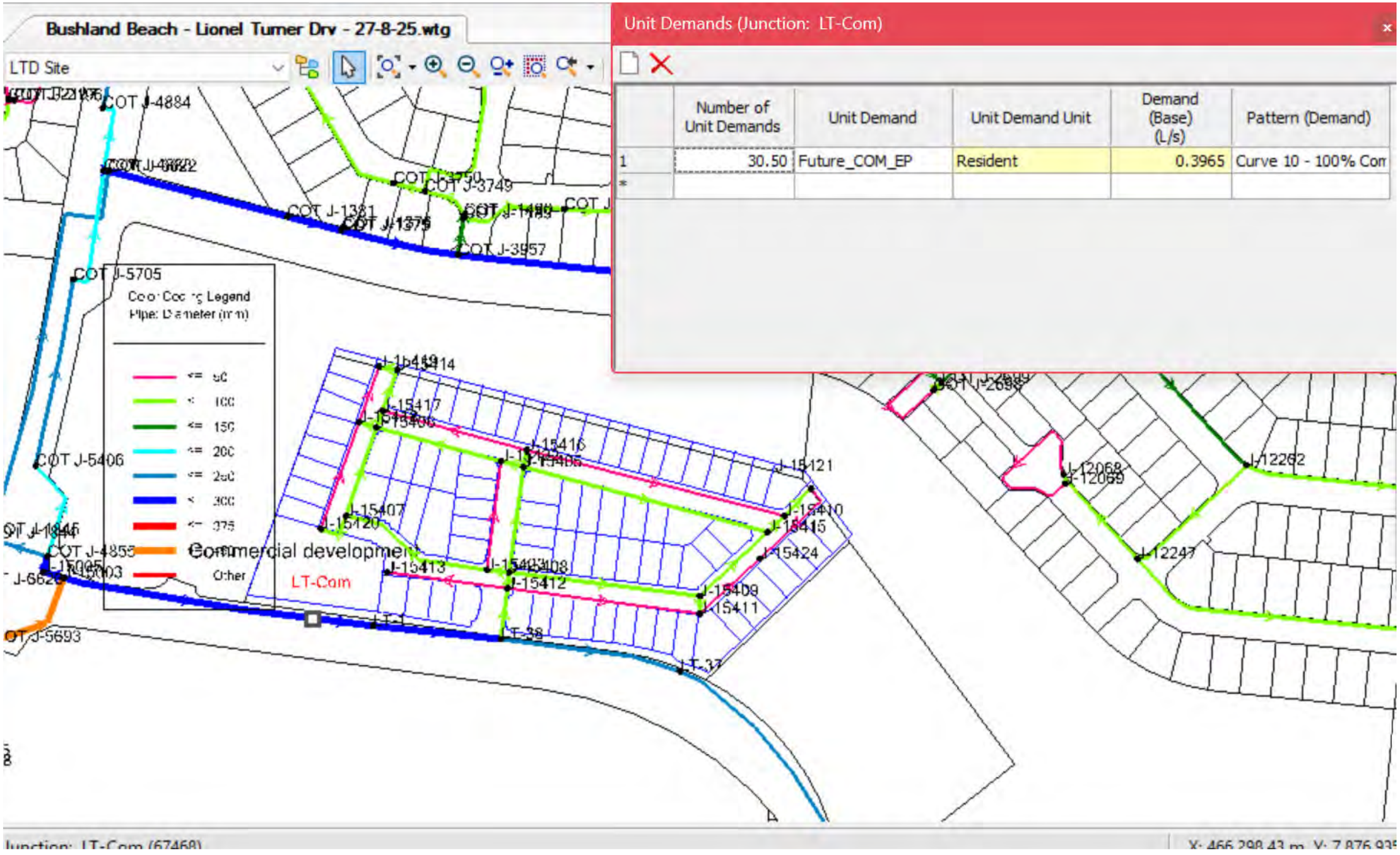
job no. 20240099

revision B

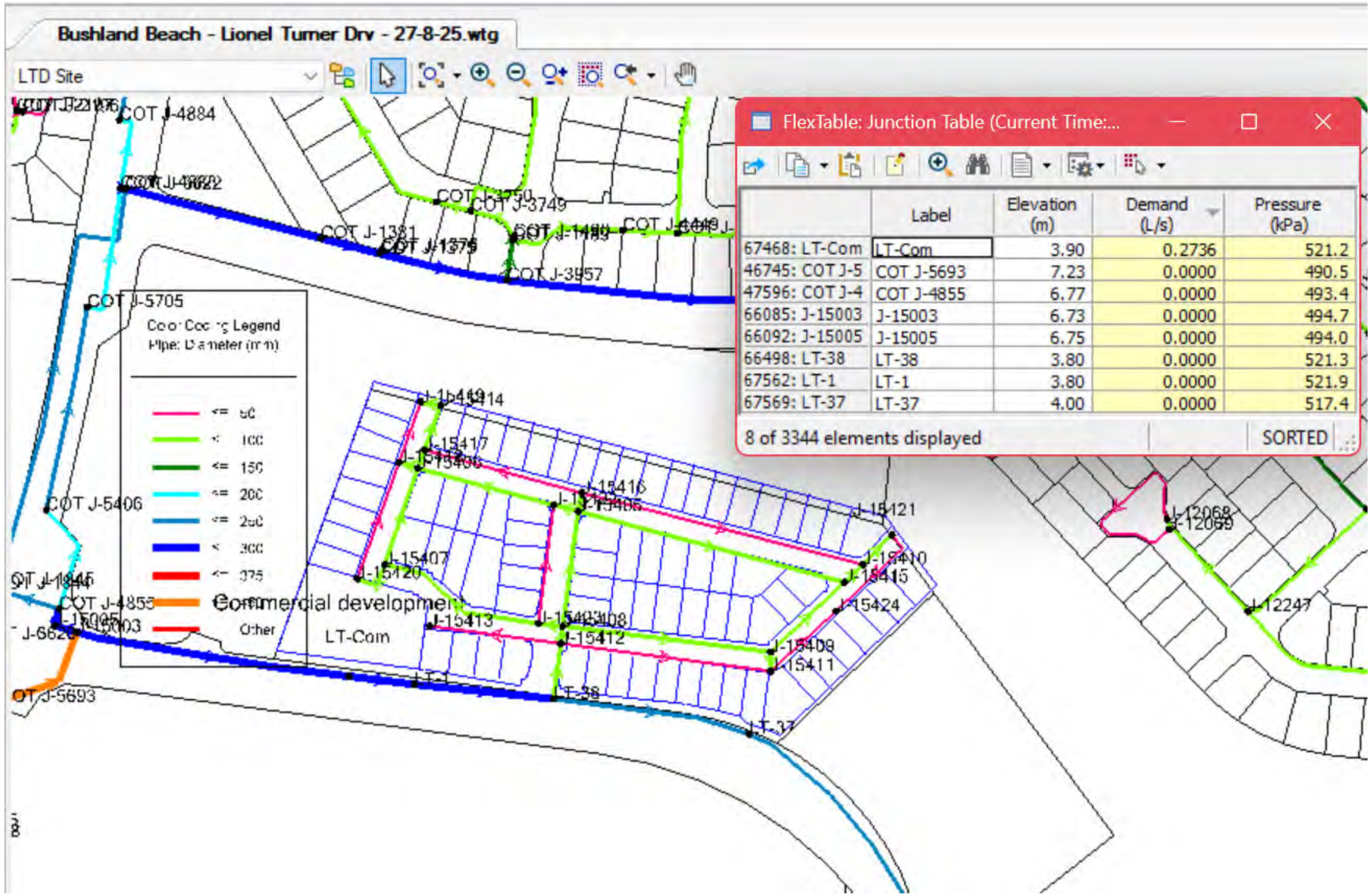
APPENDIX B
WATER MODELLING FIGURE & RESULTS



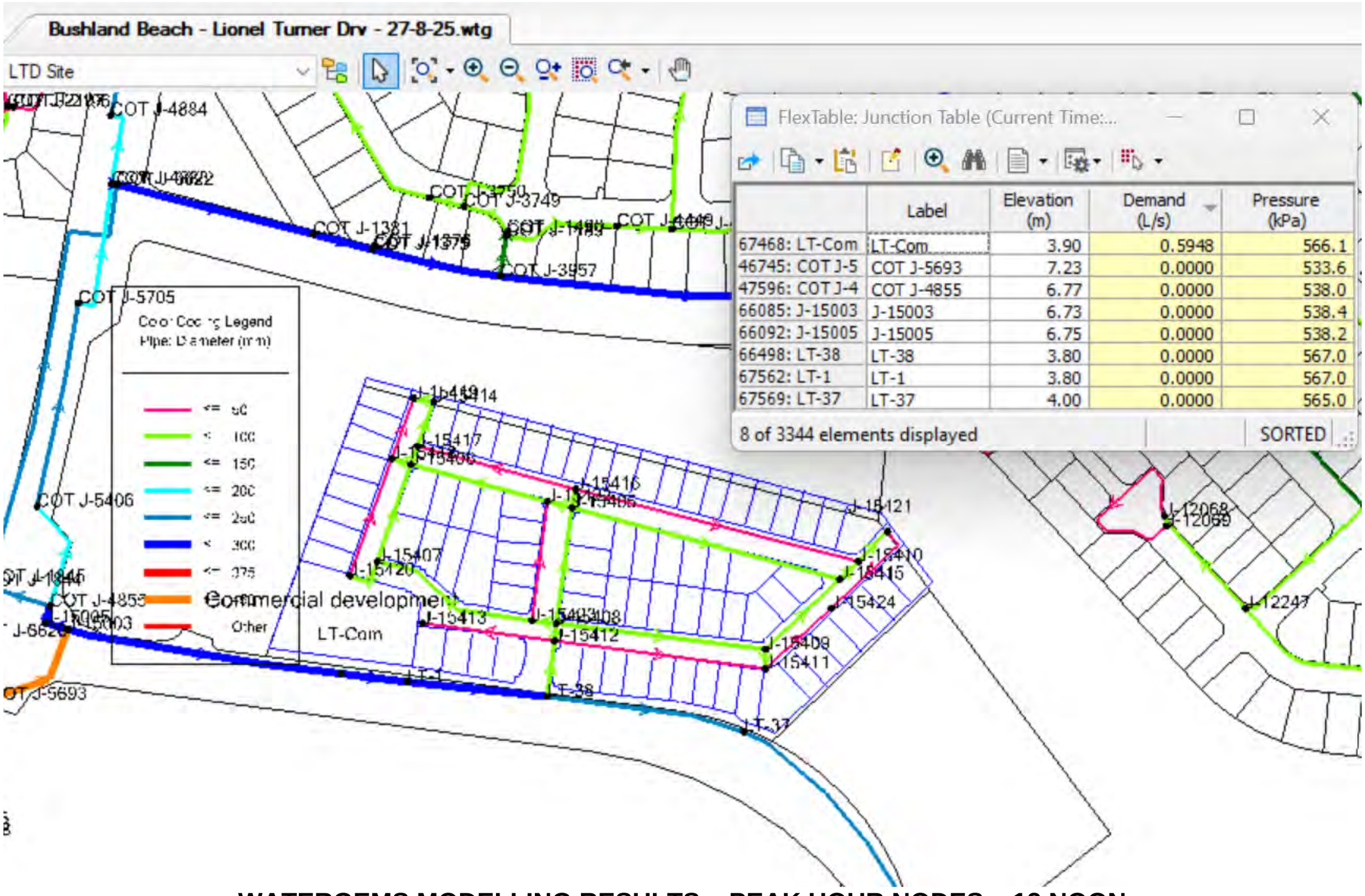
COMMERCIAL DEVELOPMENT SITE – WATERGEMS MODELLING FIGURE



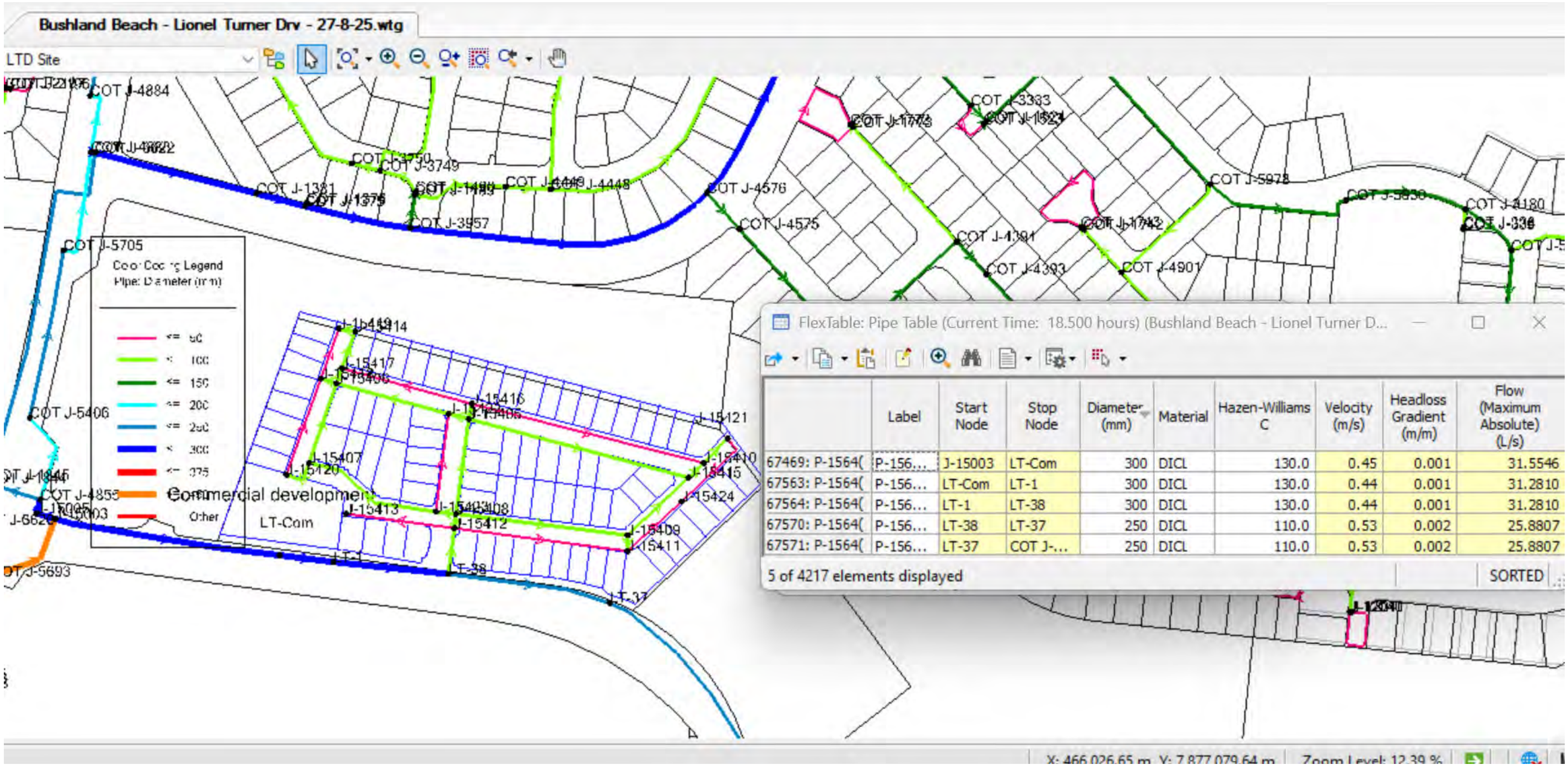
COMMERCIAL DEVELOPMENT SITE – WATERGEMS MODELLING DEMANDS



WATERGEMS MODELLING RESULTS – PEAK HOUR NODES – 6:30pm

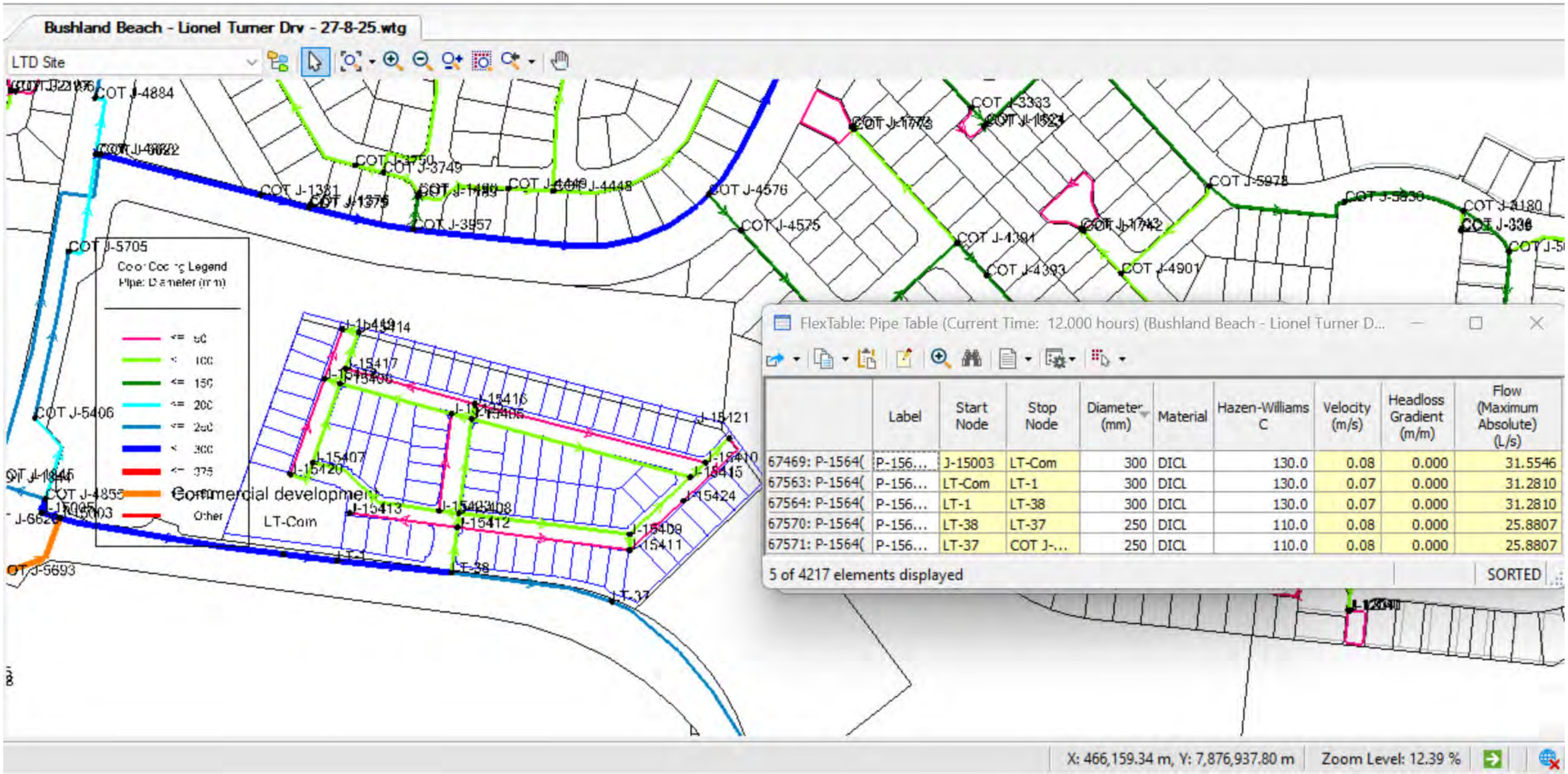


WATERGEMS MODELLING RESULTS – PEAK HOUR NODES – 12 NOON



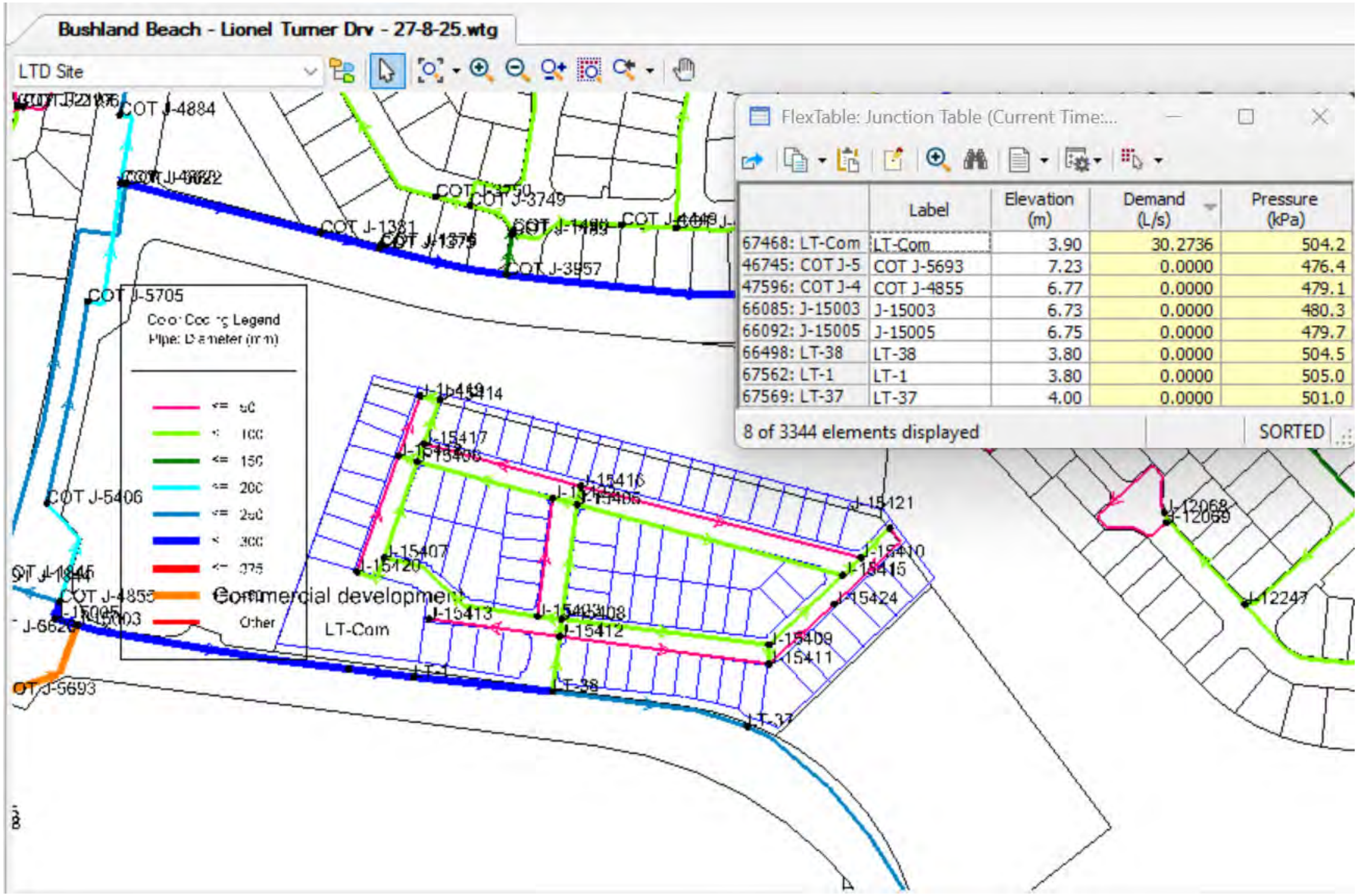
	Label	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Velocity (m/s)	Headloss Gradient (m/m)	Flow (Maximum Absolute) (L/s)
67469: P-1564(	P-156...	J-15003	LT-Com	300	DICL	130.0	0.45	0.001	31.5546
67563: P-1564(	P-156...	LT-Com	LT-1	300	DICL	130.0	0.44	0.001	31.2810
67564: P-1564(	P-156...	LT-1	LT-38	300	DICL	130.0	0.44	0.001	31.2810
67570: P-1564(	P-156...	LT-38	LT-37	250	DICL	110.0	0.53	0.002	25.8807
67571: P-1564(	P-156...	LT-37	COT J-...	250	DICL	110.0	0.53	0.002	25.8807

WATERGEMS MODELLING RESULTS – PEAK HOUR PIPES – 6:30 PM

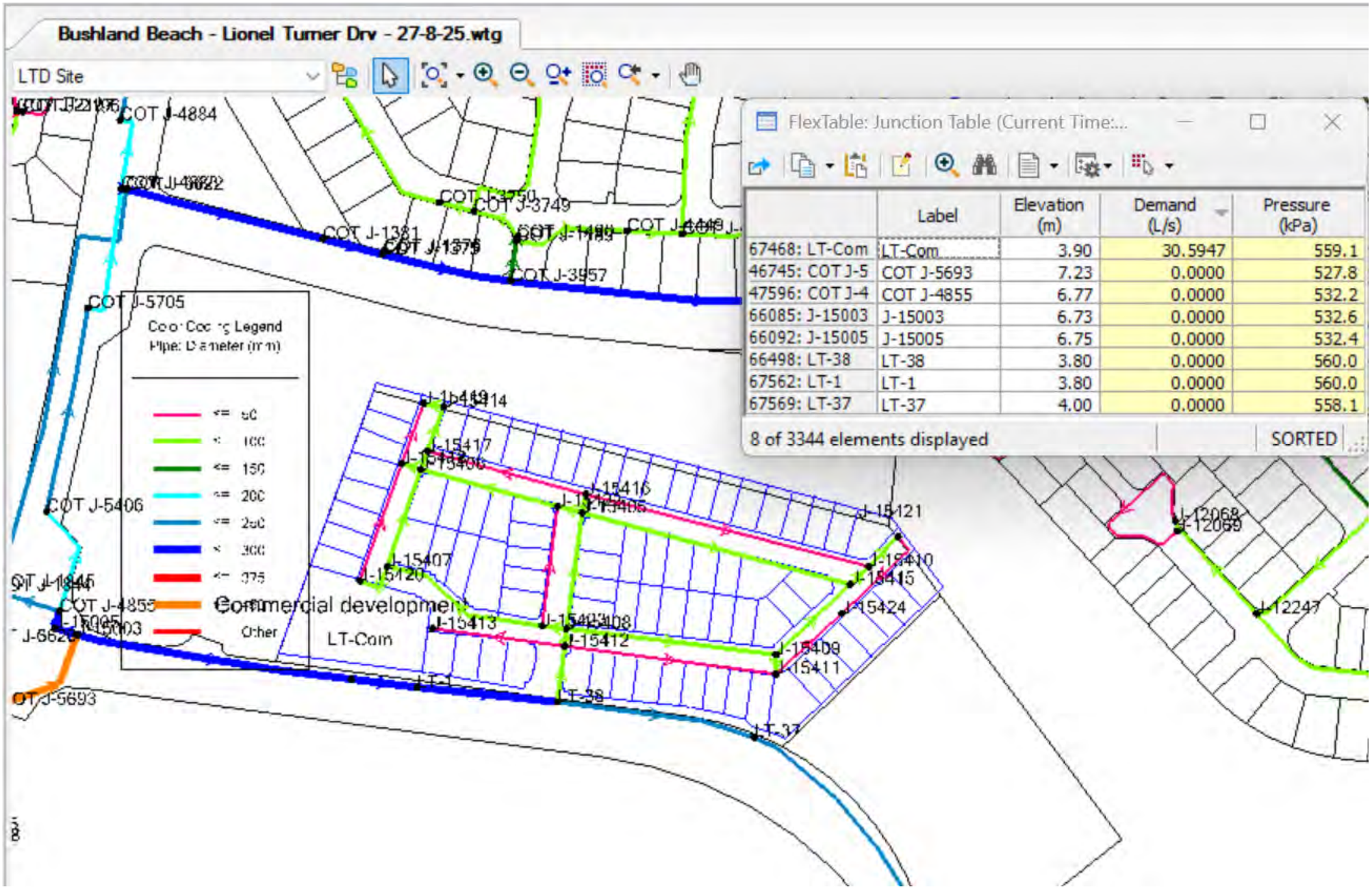


	Label	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Velocity (m/s)	Headloss Gradient (m/m)	Flow (Maximum Absolute) (L/s)
67469: P-1564(	P-156...	J-15003	LT-Com	300	DICL	130.0	0.08	0.000	31.5546
67563: P-1564(	P-156...	LT-Com	LT-1	300	DICL	130.0	0.07	0.000	31.2810
67564: P-1564(	P-156...	LT-1	LT-38	300	DICL	130.0	0.07	0.000	31.2810
67570: P-1564(	P-156...	LT-38	LT-37	250	DICL	110.0	0.08	0.000	25.8807
67571: P-1564(	P-156...	LT-37	COT J-...	250	DICL	110.0	0.08	0.000	25.8807

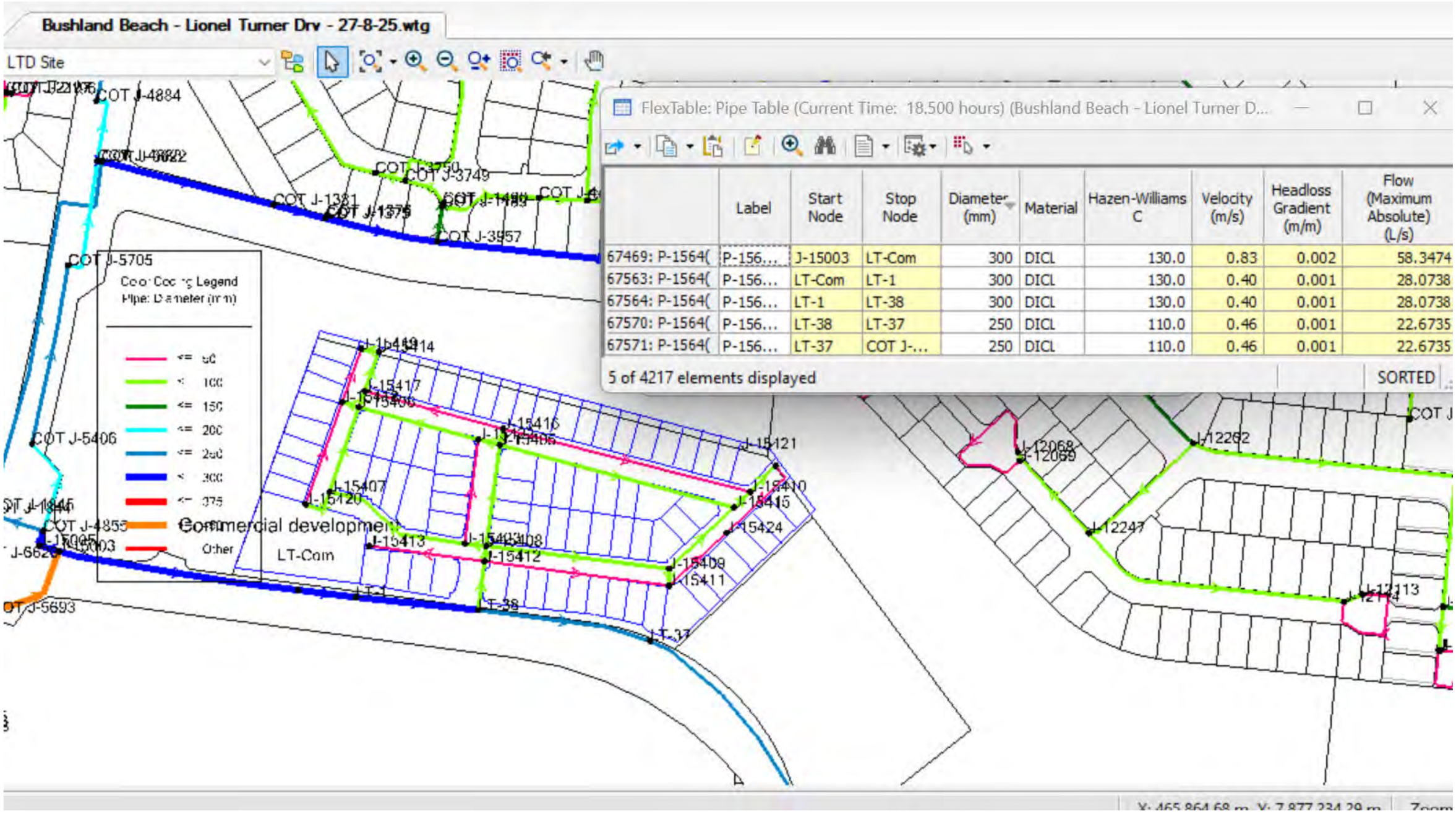
WATERGEMS MODELLING RESULTS – PEAK HOUR PIPES – 12 NOON



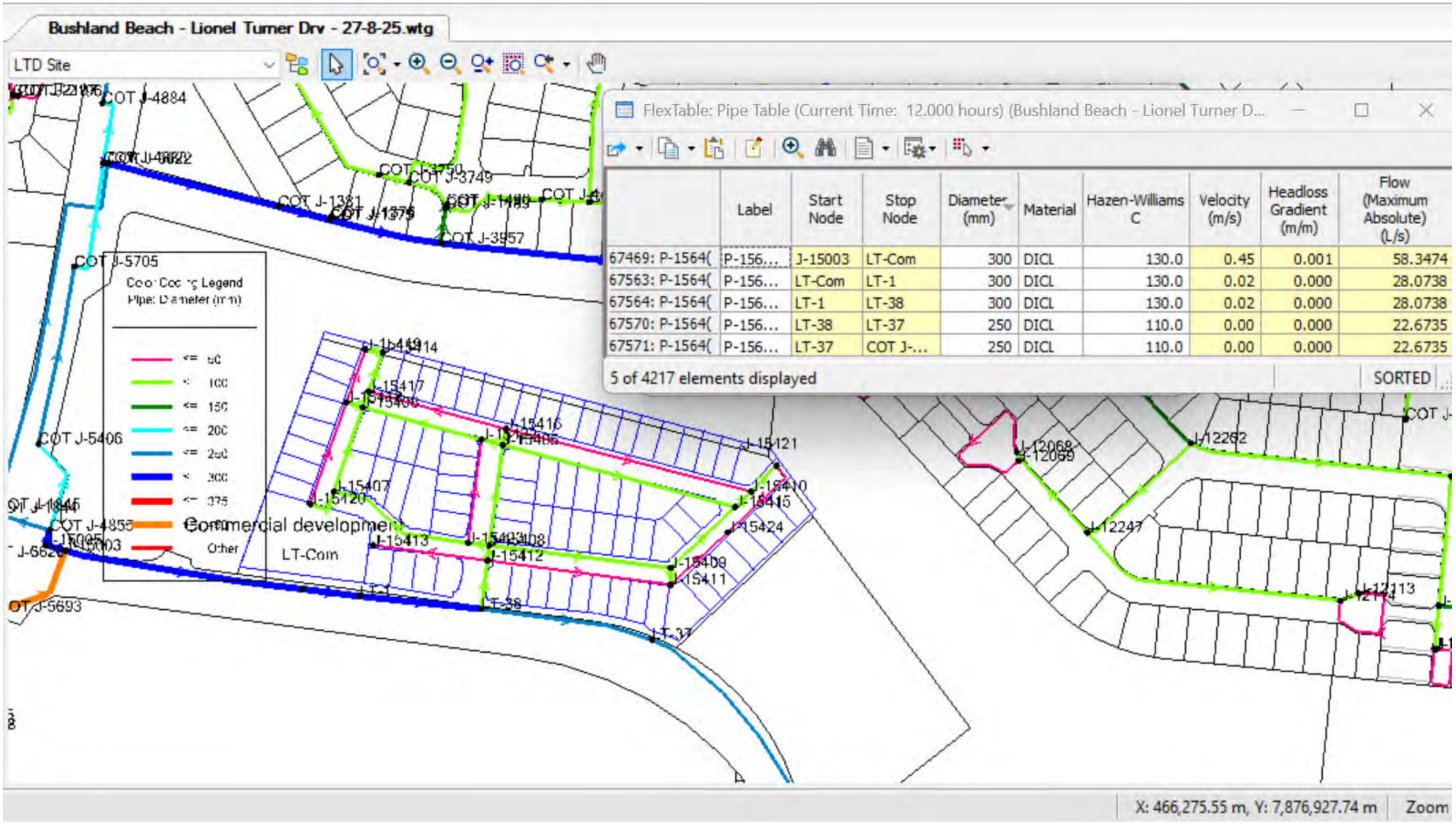
WATERGEMS MODELLING RESULTS – FIRE FLOW NODES – 6:30 PM



WATERGEMS MODELLING RESULTS – FIRE FLOW NODES – 12 NOON

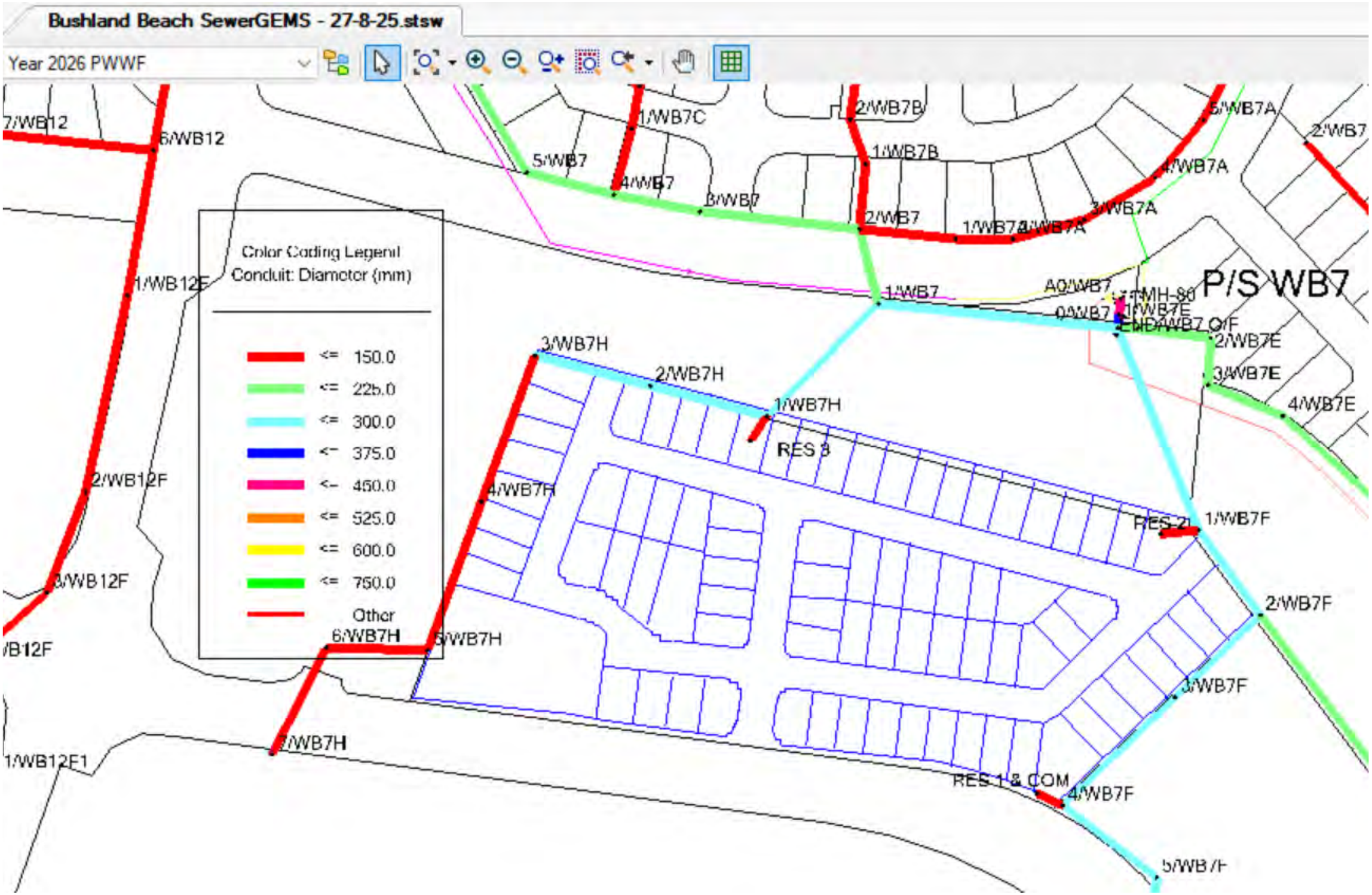


WATERGEMS MODELLING RESULTS – FIRE FLOW PIPES – 6:30 PM

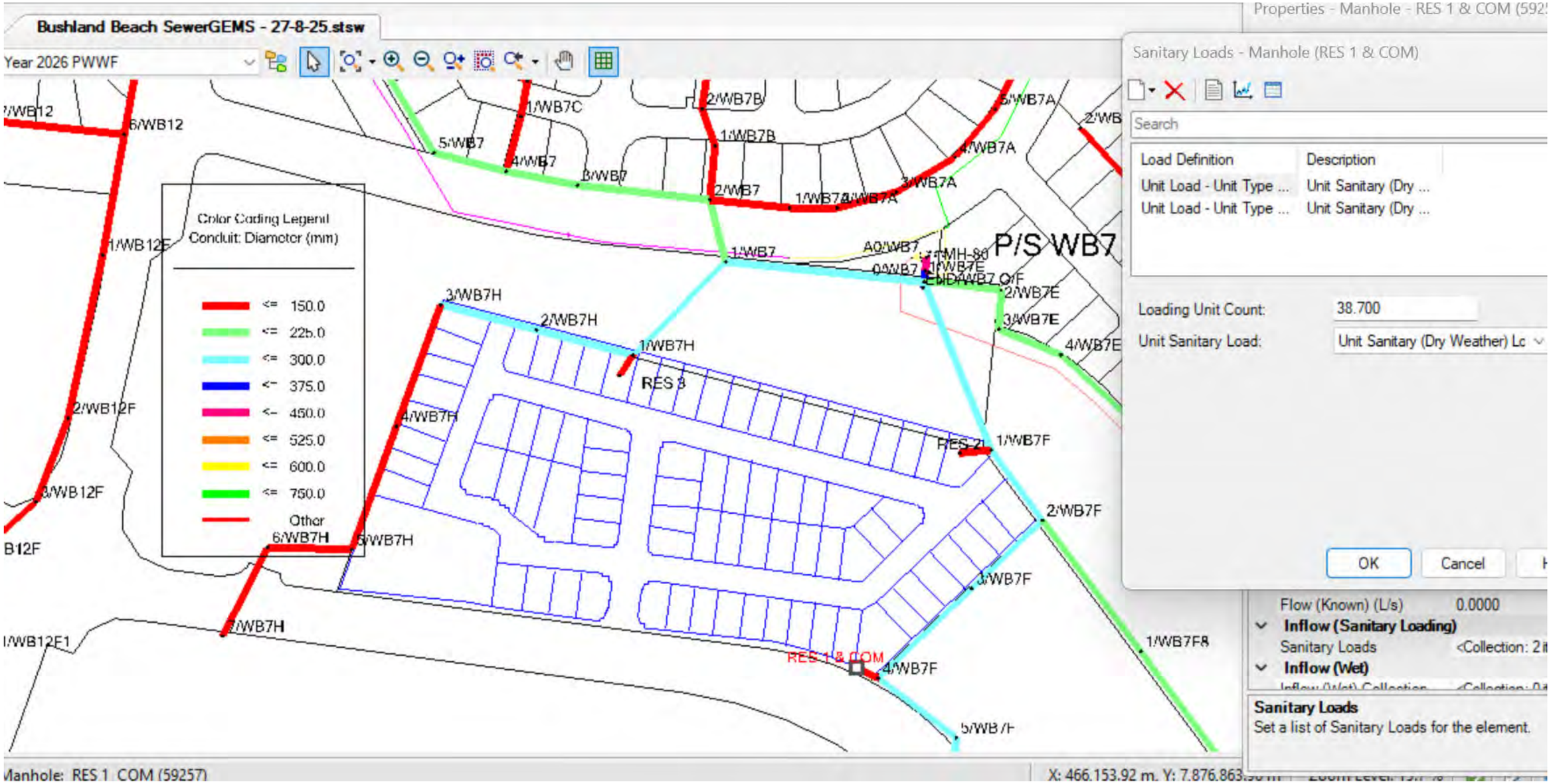


WATERGEMS MODELLING RESULTS – FIRE FLOW PIPES – 12 NOON

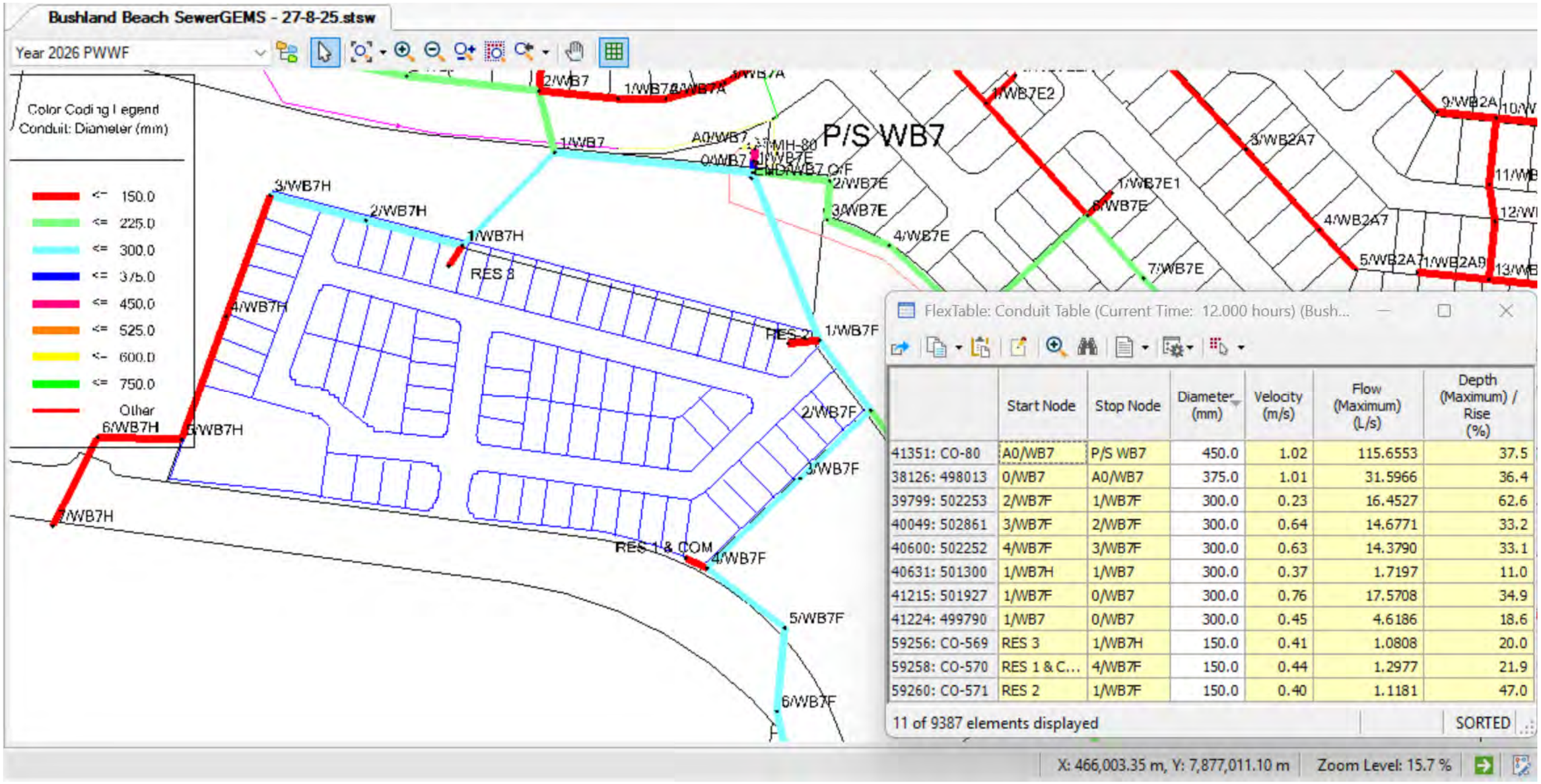
APPENDIX C
SEWER MODELLING FIGURE & RESULTS



COMMERCIAL DEVELOPMENT SITE – SEWERGEMS MODELLING FIGURE



COMMERCIAL DEVELOPMENT SITE – SEWERGEMS MODELLING – EP LOADING



	Start Node	Stop Node	Diameter (mm)	Velocity (m/s)	Flow (Maximum) (L/s)	Depth (Maximum) / Rise (%)
41351: CO-80	A0/WB7	P/S WB7	450.0	1.02	115.6553	37.5
38126: 498013	0/WB7	A0/WB7	375.0	1.01	31.5966	36.4
39799: 502253	2/WB7F	1/WB7F	300.0	0.23	16.4527	62.6
40049: 502861	3/WB7F	2/WB7F	300.0	0.64	14.6771	33.2
40600: 502252	4/WB7F	3/WB7F	300.0	0.63	14.3790	33.1
40631: 501300	1/WB7H	1/WB7	300.0	0.37	1.7197	11.0
41215: 501927	1/WB7F	0/WB7	300.0	0.76	17.5708	34.9
41224: 499790	1/WB7	0/WB7	300.0	0.45	4.6186	18.6
59256: CO-569	RES 3	1/WB7H	150.0	0.41	1.0808	20.0
59258: CO-570	RES 1 & C...	4/WB7F	150.0	0.44	1.2977	21.9
59260: CO-571	RES 2	1/WB7F	150.0	0.40	1.1181	47.0

COMMERCIAL DEVELOPMENT SITE – SEWERGEMS MODELLING RESULTS

APPENDIX D

Traffic Impact Assessment (TIA) by NCE

NORTHERN CONSULTING engineers

CIVIL & STRUCTURAL ENGINEERS

TRAFFIC IMPACT ASSESSMENT

10-32 LIONEL TURNER DRIVE – COMMERCIAL DEVELOPMENT

FOR
Swanland Group P/L

JOB No: IPA0002C

Doc Ref: IPA0002C-TIA

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ACN 100 817 356 ABN 34 100 817 356

DOCUMENT CONTROL

Rev	Author	Reviewed	Approved		Date	Issued To:	Purpose
A	Derek Saw	Derek Saw	Derek Saw (RPEQ 7363)		24/04/2025	Client	Draft
B	Derek Saw	Brendan Blair	Derek Saw (RPEQ 7363)		21/05/2025	Client	For Client Review
C	Derek Saw	Brendan Blair	Derek Saw (RPEQ 7363)		07/08/2025	Client	For Client Review
D	Derek Saw	Brendan Blair	Derek Saw (RPEQ 7363)		26/08/2025	Client	For DA Approval
E	Derek Saw	Brendan Blair	Derek Saw (RPEQ 7363)		08/10/2025	Client	For DA Approval (Revised Site Plan)

TABLE OF CONTENTS

APPENDICES

APPENDIX A

CPO ARCHITECTS – Site Plan Option - A Drawings

APPENDIX B

Northern Consulting Engineers – Traffic Drawings

APPENDIX C

Northern Consulting Engineers – Miscellaneous Figures

APPENDIX D

Northern Consulting Engineers – Existing Road Safety Audit Spreadsheets

APPENDIX E

Certification Statement and Authorisation

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Northern Consulting Engineers (NCE) have been commissioned by Swanland Group P/L to undertake an engineering investigation relating to the proposed commercial development, at 10-32 Lionel Turner Drive, Bushland Beach on land described as Lot 2 on SP218628.

This report summarises the analysis and results of the traffic study associated with the proposed development, including the likely impacts and mitigation measures required to ensure the development can proceed whilst maintaining an acceptable level of service within the local government road network.

- Commercial Development – Lionel Turner Drive, Bushland Beach.
    - Development Generated Traffic associated with the use of the proposed commercial development has been assessed and requires the installation of an All-movements intersection inclusive of a CHR(s) and AUL(s) to safety and efficiently move traffic in and out of the development.
    - Sufficient separation distance exists between the adjacent existing roundabout between Lionel Turner Drive and the Access to the nearby shopping centre to allow the construction of the proposed intersection with the recommended AUL(s).
    - Provision of connecting Shared pedestrian / bicycle facilities between the proposed development and existing shared facilities at the above-mentioned roundabout are recommended to facilitate the safe and efficient movement of Pedestrians and cyclists.
    - Utilisation of the existing pedestrian crossing facilities east and west of the development are recommended to limit the number of conflict points along Lionel Turner Drive.
    - An assessment of the on-site parking provisions against AS2890 concluded the proposed facility as detailed is compliant with all design aspects.

1.0 INTRODUCTION

1.1 Background

Northern Consulting Engineers (NCE) have been commissioned by Swanland Group P/L to undertake an engineering investigation relating to the proposed commercial development, at 10-32 Lionel Turner Drive, Bushland Beach on land described as Lot 2 on SP218628.

Specifically, this phase of the engagement is focused on a traffic study for the full operation of the facility. This study will be utilised to support development applications associated with the development.

1.2 Previous work

NCE are not aware of any previous traffic studies relating to the site.

1.3 Scope and study area

The proposed development is located within the Townsville City Council (TCC) Commercial area of Bushland Beach, 4818. The site is over (1) land parcel described as Lot 2 on SP218628 with the land zoned as Low Density Residential under the Townsville City Plan, refer Figure 2-1 Townsville City Council planning zones.

The site plan can be seen in Figure 1-1 below.

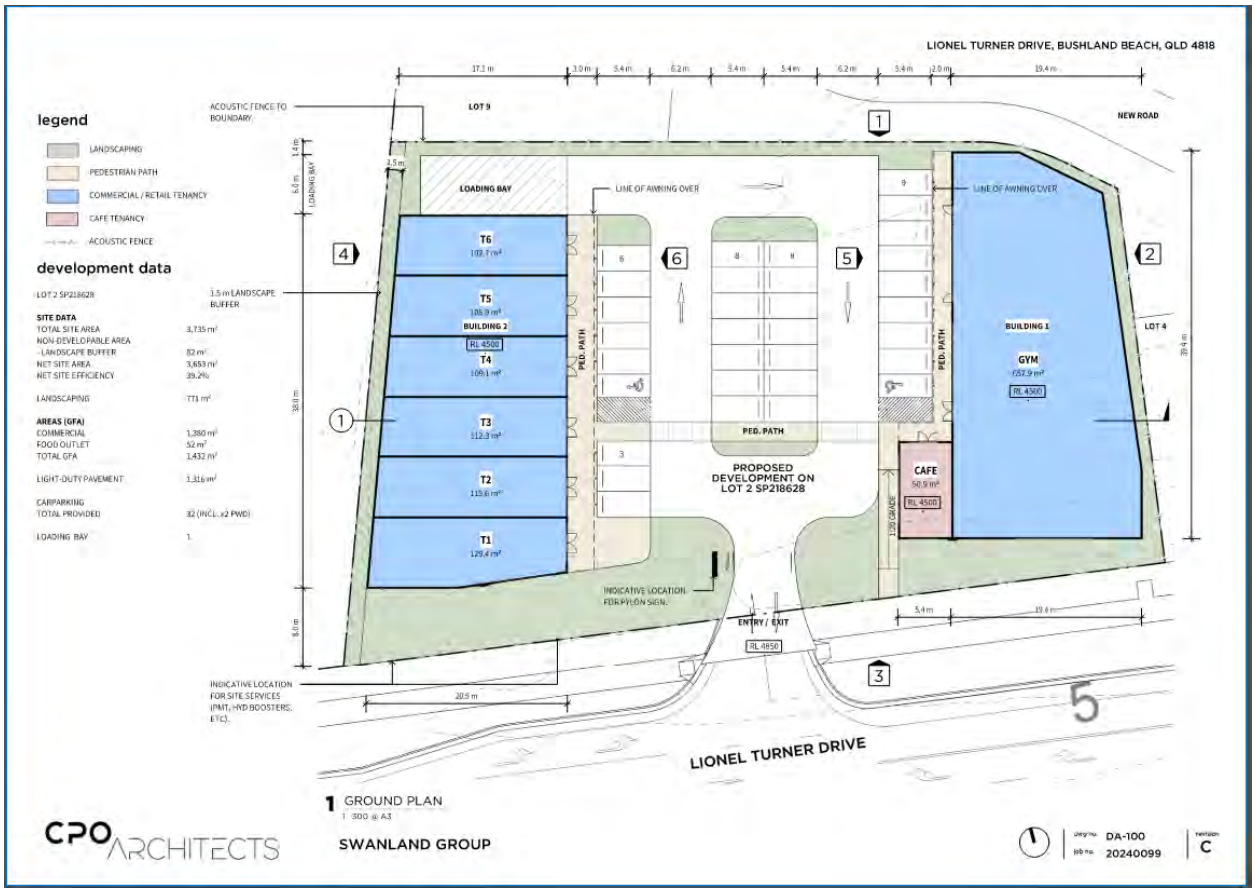


Figure 1-1 Site plan

2.0 EXISTING CONDITIONS

2.1 Land use and zoning

The proposed development is on land zoned as Low Density Residential under the Townsville City Plan as per the Townsville City Plan (2014) mapping available on the TownsvilleMAPS Web Map Service.

Figure 2-1 Townsville City Council planning zones

2.2 Adjacent land uses / approvals

Adjacent land parcels within the immediate area are zoned Local Centre to the west, Low density Residential to the east and Recreation and Open Space to the south.

2.3 Surrounding road network details

The adjacent road network falls under the jurisdiction of the local government. Connections with the State Controlled Road network occur significantly further southward of the development.

2.3.1 Local authority roadways

The impacted local road network consists of Lionel Turner Drive, running parallel with the southern boundary of the proposed development. Lionel Turner Dive is depicted as a Sub-arterial Road in both the current and future mapping.

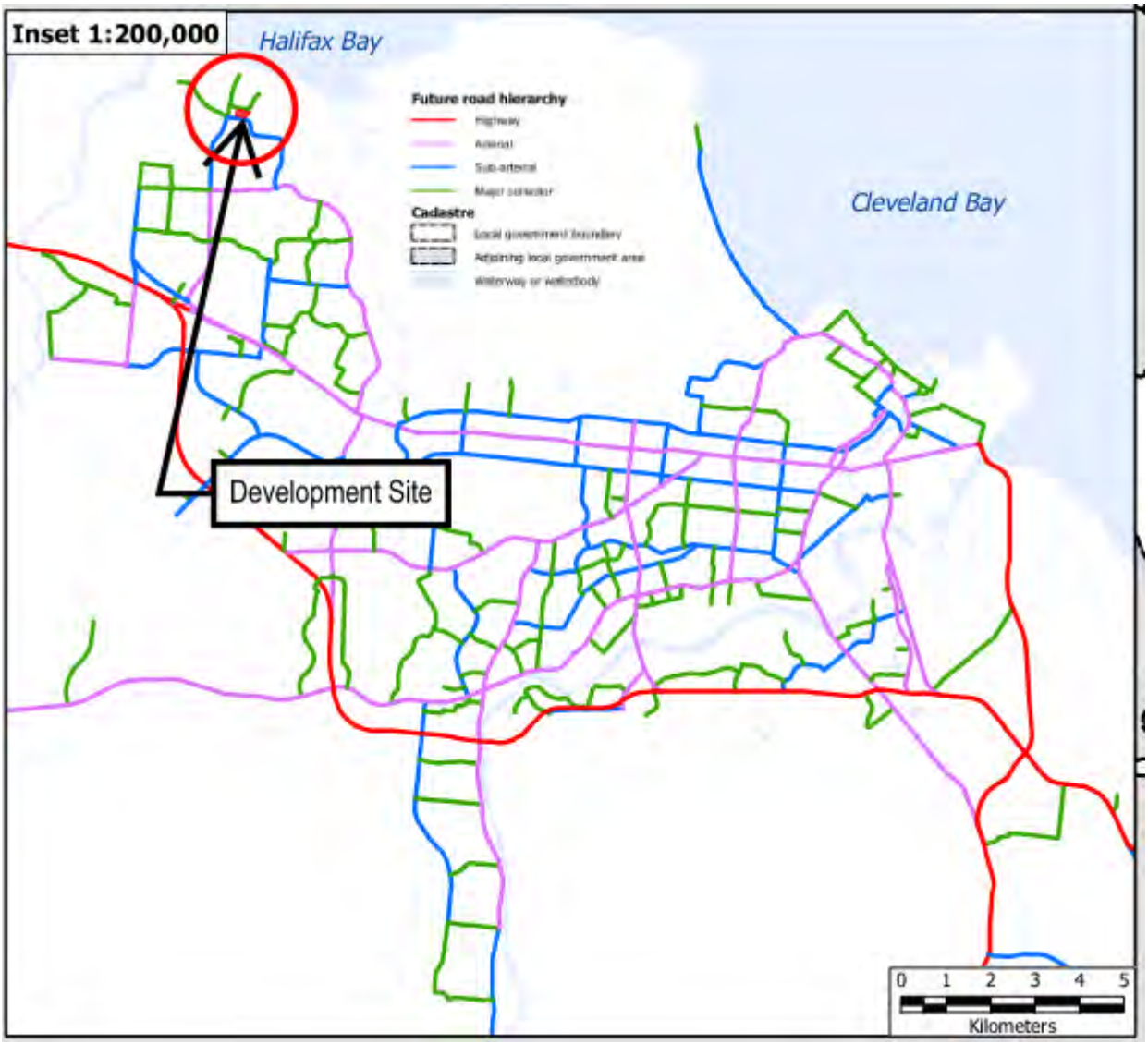


Figure 2-2 TCC Planning Road Hierarchy Map (Future Insert)

2.4 Background traffic volumes

Background traffic volumes utilised within the analysis were derived from the current TCC AIMSUN traffic model

2.4.1 Townsville City Council – AIMSUN volumes

Interrogation of the AIMSUN model via TCC mapping results in the following traffic volumes for the current year 2026 and the design horizon 2036

Figure 2-3 TCC AIMSUN Traffic Model 2026

Figure 2-4 TCC AIMSUN Traffic Model 2026

Figure 2-5 TCC AIMSUN Traffic Model 2036

Figure 2-6 TCC AIMSUN Traffic Model 2036

Townsville AIMSUN Integrated Model 2026 / 2036.

- Lionel Turner Drive 2026:
  - Eastbound:
    - AADT: 1074
    - Peak AM: 191
    - Peak PM: 153
    - %HV: 8.57%
  - Westbound:
    - AADT: 1627
    - Peak AM: 51
    - Peak PM: 288
    - %HV: 7.81%
- Lionel Turner Drive 2036:
  - Eastbound:
    - AADT: 1194
    - Peak AM: 222
    - Peak PM: 156
    - %HV: 8.21%
  - Westbound:
    - AADT: 1790
    - Peak AM: 59
    - Peak PM: 305
    - %HV: 7.6%

2.5 Road safety issues

2.5.1 Crash data

Crash data was obtained for the area via the Queensland Globe. Specifically, adjacent to the proposed site and indicates (2) accidents have occurred between 2013 and 2021.

In both cases the vehicle has left the carriageway and hit an object. From the information obtained it is unclear if driver error contributed to each crash, however given they are both single vehicle accidents, it is more likely that driver error contributed to the accidents.

Table 2-1 QLD Globe – Crash Data

Location	Date and Time	Occupancy	Nature of Crash
Lionel Turner Drive	July 2013, Thursday at 12:00 PM	(2) Hospitalisation	Single Vehicle, Hit object, Off Path-Straight: Left Off Cway Hit Obj
Lionel Turner Drive	September 2021, Monday at 8:00 AM	(1) Hospitalisation	Single Vehicle, Hit object, Off Path-Curve: Off Cway Lt Bend Hit Obj

2.6 Public Transport

There are currently several bus stops located along Mount Low Parkway nearby the site. The Queensland Government TransLink website indicates the stops are currently serviced via route 233, refer Figure 2-7 Translink Townsville Bus Routes

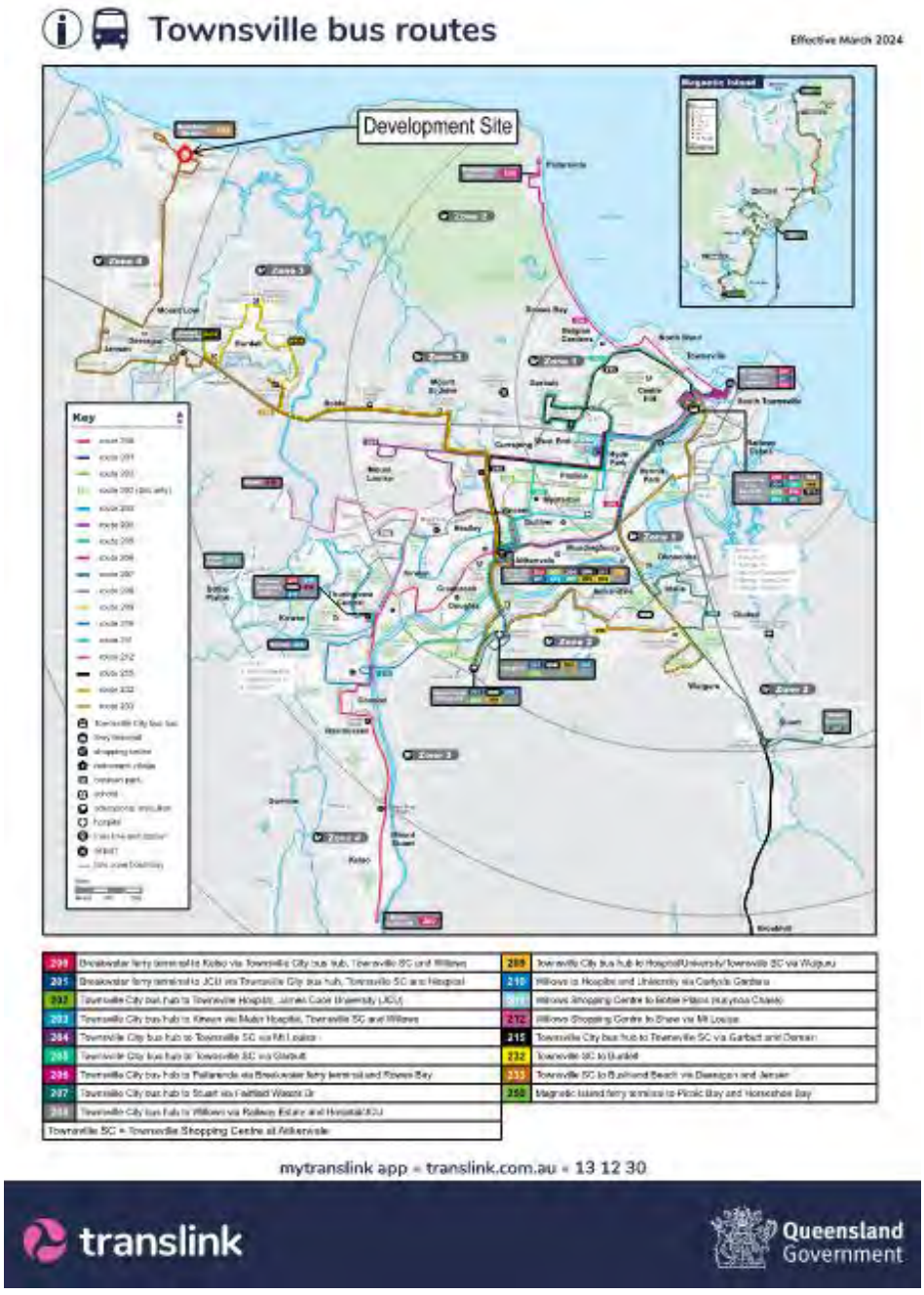


Figure 2-7 Translink Townsville Bus Routes

3.0 PROPOSED DEVELOPMENT DETAILS

3.1 Development site plan

The development proposed is for an commercial development, associated amenities, and parking facilities.

The total expected developed area of the site encompasses approximately (0.3735ha) of the englobo 4.790ha site, and will consist of the following components:

- Driveway and carparks
- Food and Drink Outlet (52.5m^2)
- Gym Tenancy (626.9m^2)
- Commercial Retail (1298m^2)

3.2 Operational details

The development site once amalgamated will include the operation of:

- Food and Drink Outlet (6:00am to 10:00pm)
- Gym Tenancy (24-hour operation)
- Commercial Retail (9:00am to 5:00pm)

Each use is expected to operate at different times during the day as nominated above.

3.3 Proposed access and parking

Access to the site will be via a new driveway off Lionel Turner Drive. Proposed car parking will be designed and constructed to AS2890 guidelines.

4.0 DEVELOPMENT TRAFFIC

4.1 Traffic generation

In accordance with the Department of Transport and Main Roads Guide to Traffic Impact Assessment (GTIA) December 2018, traffic demand was sourced from the following data bases:

- QLD Government - Open Data Portal – Traffic Generation Data 2006-2019
- NSW – Guide to Transport Impact Assessment – TS 00085 / Version 1.1

4.1.1 Traffic generation calculations

Table 4-1 identifies the current uses within the development site in addition to the proposed development generations for each use and calculated traffic volumes expected to be generated.

Utilising the GLFA provided, NCE have assigned likely traffic generation rates from the data sources discussed previously and determined a weekday peak traffic volume of 229 veh/hr.

Table 4-1 Trip calculations

Northern Consulting Engineers Project Number	IPA0002C	
Project Description	10-32 Lionel Turner Drive	
Traffic Survey or Construction Commencement Year	2036	
Commencement of Use Year	2026	
Projected 10 year design horizon	2036	
Figure 2.27 (Left Approach)	Lionel Turner Drive	
Figure 2.27 (Right Approach)	Lionel Turner Drive	
Figure 2.27 (Bottom Approach)	Development Access	
Background Growth Factor	0%	
Peak Hour Factor (12% Urban / 16% Rural)	12%	
Site Information		
Food and Drink Outlet	**GLFA**	
10-32 Lionel Turner Drive	52.5	
Gym Tenancy	**GFLA**	
10-32 Lionel Turner Drive	627	
Commercial retail	**GFLA**	
10-32 Lionel Turner Drive	671	
QLD Open Portal (Fast Food with Driveway)	**Vehicle Trips / GLFA**	**Predicted Traffic Volumes**
Average Weekday	5.92	**311**
Average Weekend	3.39	**178**
Weekday Peak hour	0.63	**33**
Weekend Peak hour	0.63	**33**
NSW 2024 - Guide to Transport Impact Assessment TS 00085 V1.1 (Fitness Centre - 2014)	**Vehicle Trips / per 100m^2 GLFA**	**Predicted Traffic Volumes**
Evening Peak (Weekday)	3.6	**23**
Evening Peak (Weekend)	2.9	**18**
Daily trips	16.9	**106**
NSW 2024 - Guide to Transport Impact Assessment TS 00085 V1.1 (Small Shopping Centre - 2018)	**Vehicle Trips / per m^2 GLFA**	**Predicted Traffic Volumes**
AM Peak (Weekday)	0.192	**129**
PM Peak (Weekday)	0.259	**174**
Daily trips (Weekday)	2.022	**1357**
Peak (Weekend)	0.283	**190**
PM Peak (Weekend)		**0**
Daily trips (Weekend)	1.894	**1271**
(Development Traffic)	**Approach Traffic (Peak Hour)**	Public Transport Factor (100%)
Total Weekday peak hour	**229**	100%
Total Weekend peak hour	**241**	100%

Appendix D includes spreadsheets for the calculation of generated traffic.

4.1.2 Traffic composition

The composition of generated traffic is expected to be largely passenger vehicles. A smaller percentage of vehicle will be medium heavy vehicles (8.8m) servicing the operations such as delivery vehicles and waste management vehicles.

4.1.3 Heavy vehicle payloads

Heavy vehicle payloads have been assumed to be the legal payload limits for each vehicle type, i.e. 12.5 tonnes for class 3-5 Medium Heavy Rigid.

4.2 Trip distribution

Trip distribution scenarios documented are based upon (50% In / 50% Out) split scenario with 50% of traffic choosing to utilise the Lionel Turner Extension to North Shore Boulevard in the 2036 design year. Sensitivity assessments utilising alternate in/out splits and network distributions have been completed and confirm the access intersection proposed is suitable for a range of scenarios. It is assumed that the site can and will operate at any given hour of any given day regardless of weekday or weekend.

5.0 LOCAL AUTHORITY: TRAFFIC IMPACT ASSESSMENT AND MITIGATION

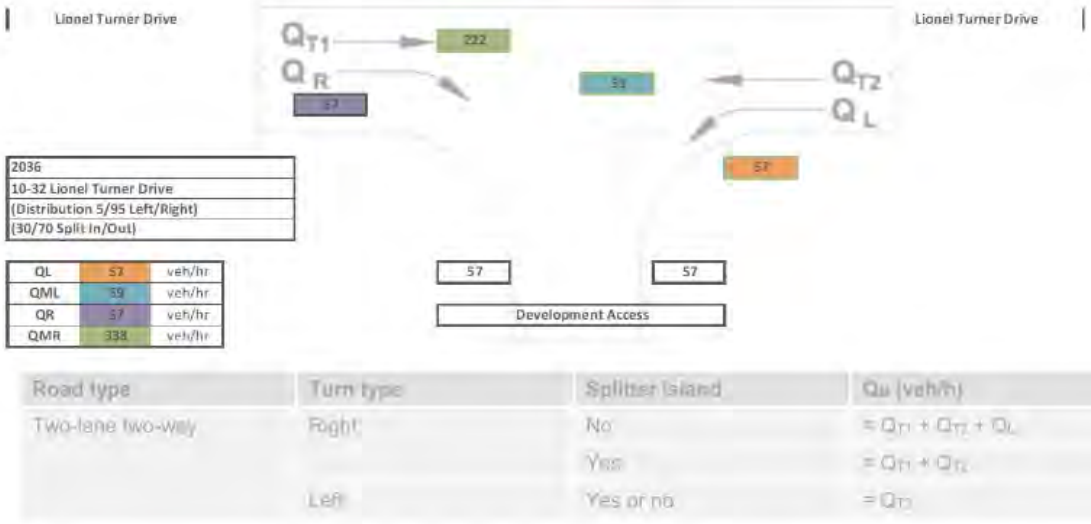
5.1 Development traffic volumes on the network

5.1.1 Intersection warrant assessment

The Development Access / Lionel Turner Drive intersection has been assessed using the intersection warrant method outlined by the TMR Supplement to Austroads Guide to Road Design Part 4A for Unsignalised and Signalised intersections.

The intersection has been assessed for the peak background traffic predicted for 2026 and 2036. Figure 5-1 shows the warrant for the AM peak in 2036 while Figure 5-2 shows the warrant for the PM peak in 2036 which represent the Design Horizon year peak periods for the assessment. As can be deduced from the figures, the PM scenario for 2036 requires a CHR(s) / AUL(s) intersection treatment to safely convey right turning traffic from Lionel Turner Drive into the development. The full intersection warrant assessment spreadsheet is contained within Appendices.

Figure 2.27: Calculation of the major road traffic volume Q_M



Road type	Turn type	Splitter Island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$

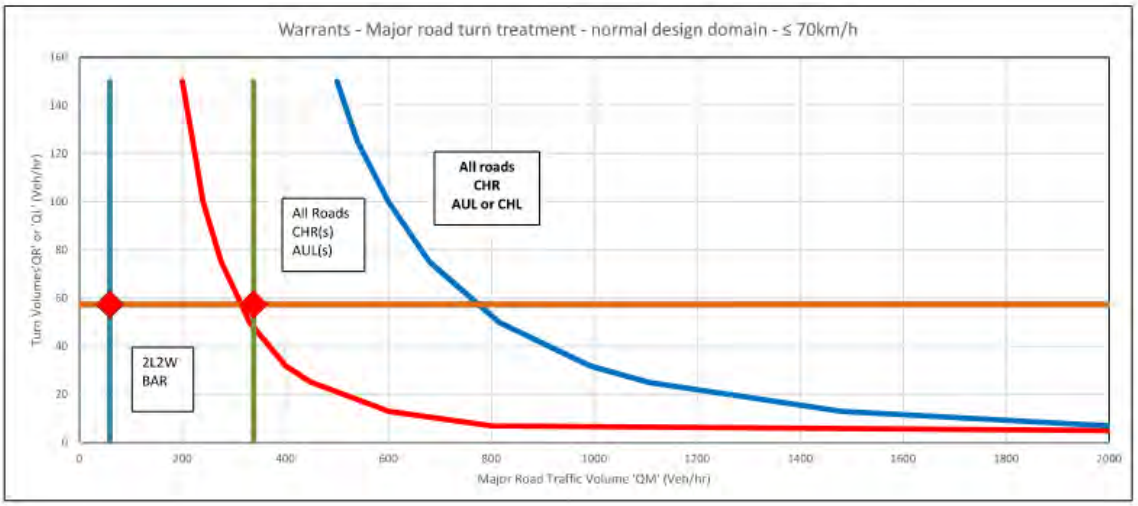
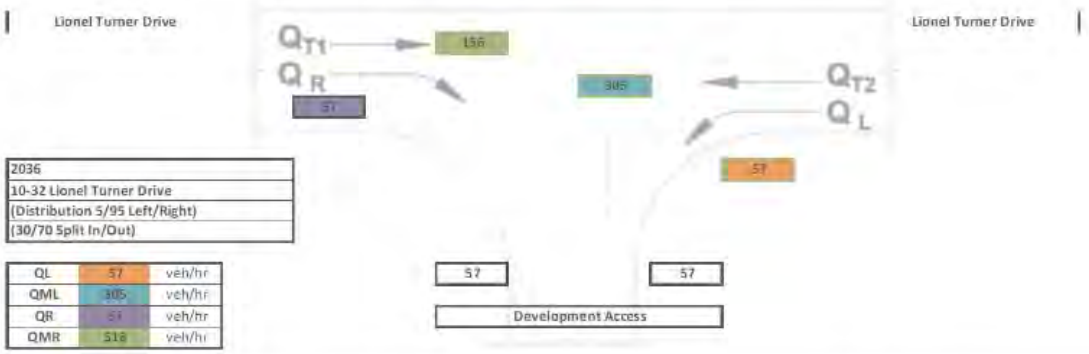


Figure 5-1 2036 AM Peak hr Assessment

Figure 2.27: Calculation of the major road traffic volume Q_M



Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$

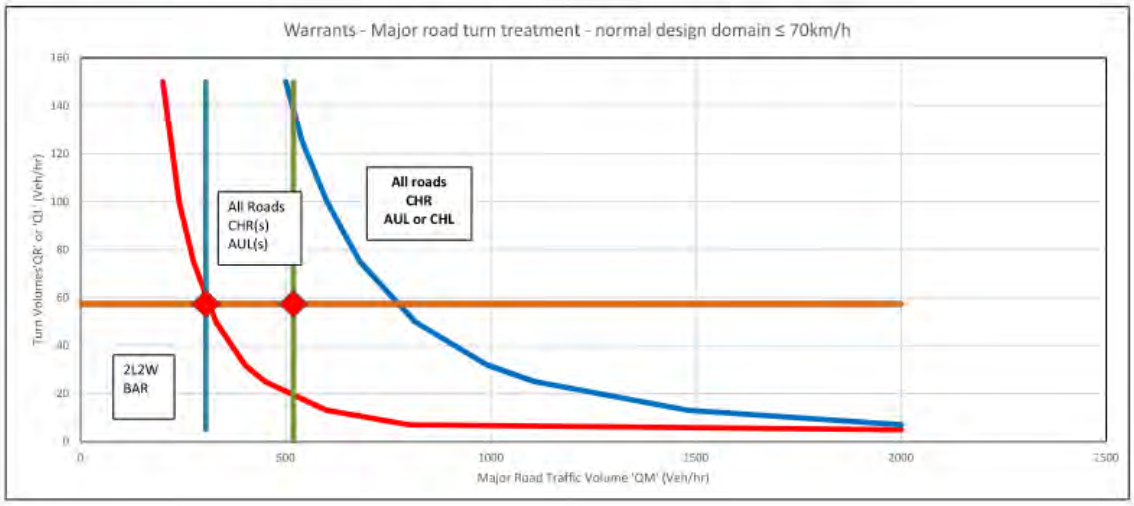


Figure 5-2 2036 PM Peak hr Assessment

5.1.2 Operation of Private Access and interface with parking facilities

The proposed layout provides good opportunity for vehicles wishing to access the site opportunity to exit Lionel Turner Drive and exit the site without restriction.

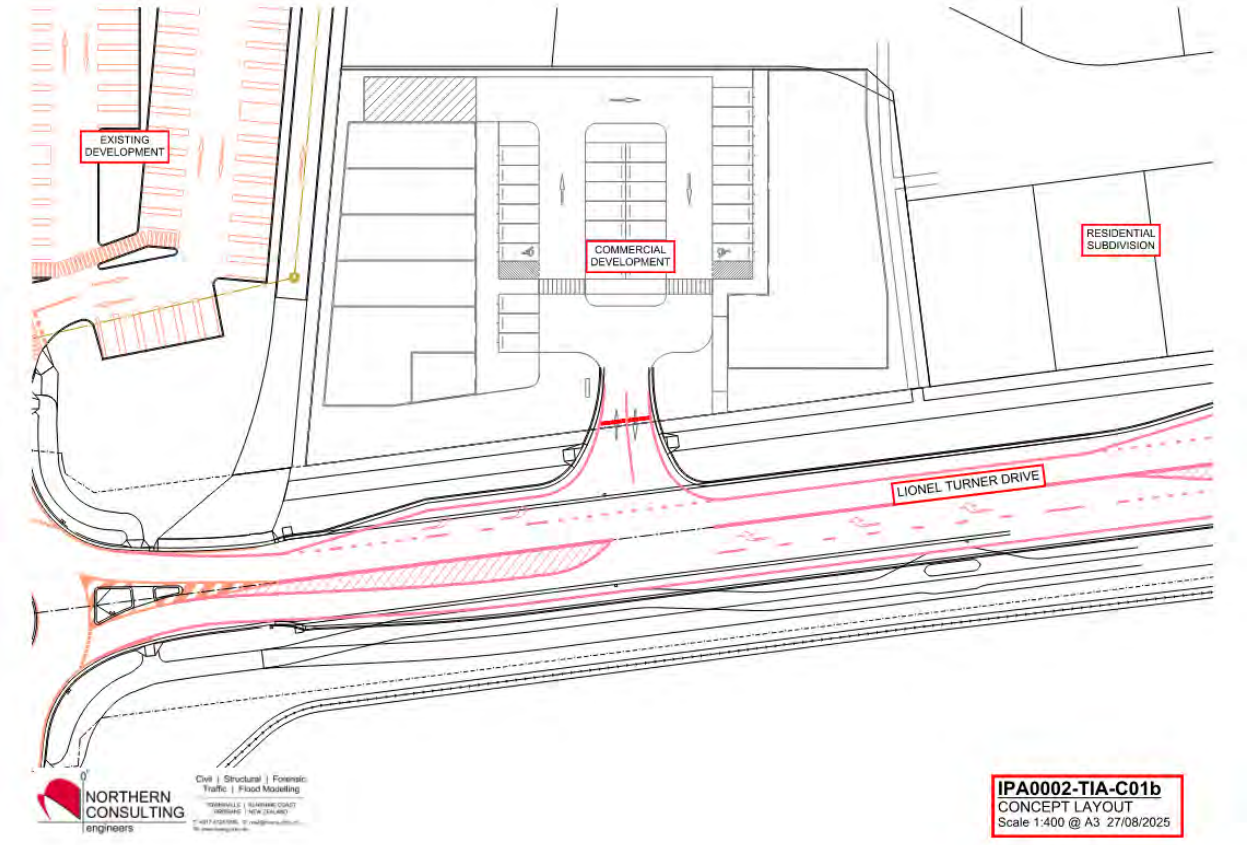


Figure 5-3 Development Site – Concept Layout

5.2 Off-Street Car Parking Facility (Compliance assessment against AS2890.1)

5.2.1 Compliance criteria assessed

- Clause 1.4 Classification of Off-Road car parking facilities
  - User Class 3A
- Clause 2.4 Design Parking Modules 90-degree Angled Parking
  - Angle parking space - 2.6m wide (compliant)
    - 5.4m long (compliant)
    - 6.2m aisle (compliant)
- Clause 2.4.5 Physical controls
  - 2.4.5.4 Wheel stops (compliant)
- Clause 2.5 Design of Circulation Roadways and ramps
  - Two-way roadways – 6.2m wide (compliant)

5.3 Off-Street Car Parking Facility for People with Disabilities (Compliance assessment against AS2890.6)

5.3.1 Compliance criteria assessed

- Clause 2.5 Parking spaces - Dimensions
  - Angle parking space - 2.4m wide (compliant)

- 5.4m long (compliant)
- 6.2m aisle (compliant)

- Shared area - 2.4m wide (compliant)
- 5.4m long (compliant)

5.4 Off-Street Commercial Vehicle Facilities (Compliance assessment against AS2890.2)

5.4.1 Compliance criteria assessed

- Clause 2.2 Description and Dimensions
  - (b) Medium rigid vehicle (MRV)
- Clause 3.3 Circulation Roadway – Table 3.1
  - Single lane - 6.2m wide (compliant)
  - Two-way lane – 6.9m wide (compliant)
- Clause 4.2 Dimensions of Service Bays – Table 4.1
  - MRV bay width – 6.0m wide (compliant)
  - MRV bay length – 15.0m long (compliant)

5.5 Road safety impact assessment (Prelim Design Phase)

5.5.1 Road safety audit – Outcomes

Lionel Turner Drive

- 2.1.2. Drainage
  - *The proposed widening of the carriageway may impact the slope of batters to table drains.*
  - *Recommendation to extend urban verge profile from Coles to Residential access intersection.*
  - *Review table slopes in other areas.*

- 2.5.2. Pedestrians
  - *Increase in pedestrian movements between the development and Peggy Banfield Park will be via footpath connections within the frontage of the development to the existing pedestrian crossing facilities within Lionel Turner Drive.*
  - *Limit pedestrian conflict locations to the safe existing locations.*

- 2.5.3. Cyclists
  - *Any increase in cycle activity will be managed through existing/new infrastructure (2.5m wide shared footpath on the northern and southern sides of Lionel Turner Drive.*

- 2.4 Intersections
  - *Inclusion of an All-movements intersection CHR(s) & AUL(s) to permit access to the development site off Lionel Tuner Drive has been accessed and adequate and suitable.*

5.5.2 Road Safety Risk Assessment Matrix

Table 5-1 Road Safety Risk Assessment

	Job Name: Job No:	Gallerria - Comercial Development			IPA0002C	Designer:			Northern Consulting Engineers		Client:	Swanland	Date:			19/05/2025
	Hazard	Project Life Cycle Stage	Risk	Control Hierarchy	Current Control Measures	Current Risk Rating			Potential Control Hierarchy	Proposed Control Measures	Who is Responsible?	By When	Residual Risk Rating			Are risks eliminated or reduced
						Consequence	Likelihood	Risk Rating					Consequence	Likelihood	Risk Rating	
1	Changes in the Infrastructure Network															
1.1	Existing table drain infrastructure within road frontage	Operations	Errant vehicle unable to regain control	Engineering	Batter grades, edge lines	Property Only	Unlikely	L	Eliminate	Remove table drain and modify verge to urban	Design team	Operational Works	Property Only	Very Unlikely (Rare)	L	Yes, removal of the hazard within development frontage.
1.2	Introduction of Commercial access to proposed development.	Operations	Risk of rear end collision due to slowing vehicles	Engineering	Nil	Medical Treatment	Likely	M	Engineering	All movements Intersection [CHR(s) and AUL(s)]	Design team	Operational Works	Medical Treatment	Very Unlikely (Rare)	L	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
1.3	ExistingPower Pole near carsigeway.	Operations	Risk of vehicle impact including injury to persons and property damage	Engineering	Clearance from through traffic	Hospitalisation	Possible	M	Maintain	Relocate Power Pole adequate clearanc distance from through traffic.	Design Team	Operational Works	Hospitalisation	Possible	M	Risk level Maintained
2	Introduction or changes to pedestrian or cyclist desire liners															
2.1	Potential for additional pedestrian traffic across Lionel Turner Drive.	Operations	Conflict between pedestrians and vehicles	engineering	Designated pedestrian crossing at roundabout.	Hospitalisation	Unlikely	M	Maintain	Designated pedestrian crossing at roundabout.	Design Team	Operational Works	Hospitalisation	Unlikely	M	Risk level increased slightly due to increase in probability (volume of pedestrians) potentially using the crossing.
4	Changes in site operations that may have an external influence															
4.1	Increased traffic through creation of a commercial development Increased conflicting movements	Operations	Vehicle collisions	Engineering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection [CHR(s) and AUL(s)]	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
6	Increase in traffic volumes, including additional turn movements															
6.1	Increased traffic through Lionel Turner Drive accessing the Development	Operations	Vehicle collisions through congestion	Engineering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection [CHR(s) and AUL(s)]	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
7	Introducing an Access off an existing Roadway															
7.1	Increase of vehicle to vehicle collisions form vehicles completing turn movements of Lionel Turner Drive.	Operations	Vehicle collisions	Engineering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection [CHR(s) and AUL(s)]	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
10	Introduction of hours of operation outside daylight hours (including safetuy risk for pedestrians and cyclists)															
10.1	Introduction of vehicle movements during dark/night times.	Operations	Vehicle collisions	Engineering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection [CHR(s) and AUL(s) With V Category lighting.	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision. Improve visibility at night through inclusion of V Category lighting.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of impacts and mitigation measures proposed

NCE have undertaken a traffic study for the proposed commercial development, at 10-32 Lionel Turner Drive, Bushland Beach. The findings of this assessment are summarised below:

- Private Access impact assessment and mitigation
    - Development Generated Traffic associated with the use of the proposed commercial development has been assessed and requires the installation of an All-movements intersection inclusive of a CHR(s) and AUL(s) to safety and efficiently move traffic in and out of the development.
    - Sufficient separation distance exists between the adjacent existing roundabout between Lionel Turner Drive and the Access to the nearby shopping centre to allow the construction of the proposed intersection with the recommended AUL(s).
    - Provision of connecting Shared pedestrian / bicycle facilities between the proposed development and existing shared facilities at the above-mentioned roundabout are recommended to facilitate the safe and efficient movement of Pedestrians and cyclists.
    - Utilisation of the existing pedestrian crossing facilities east and west of the development are recommended to limit the number of conflict points along Lionel Turner Drive.
    - An assessment of the on-site parking provisions against AS2890 concluded the proposed facility as detailed is compliant with all design aspects.

6.2 Certification statement and authorisation

A signed Traffic Impact Assessment Certification can be found in the appendices.

APPENDIX A

CPO ARCHITECTS – Site Plan Option - A Drawings

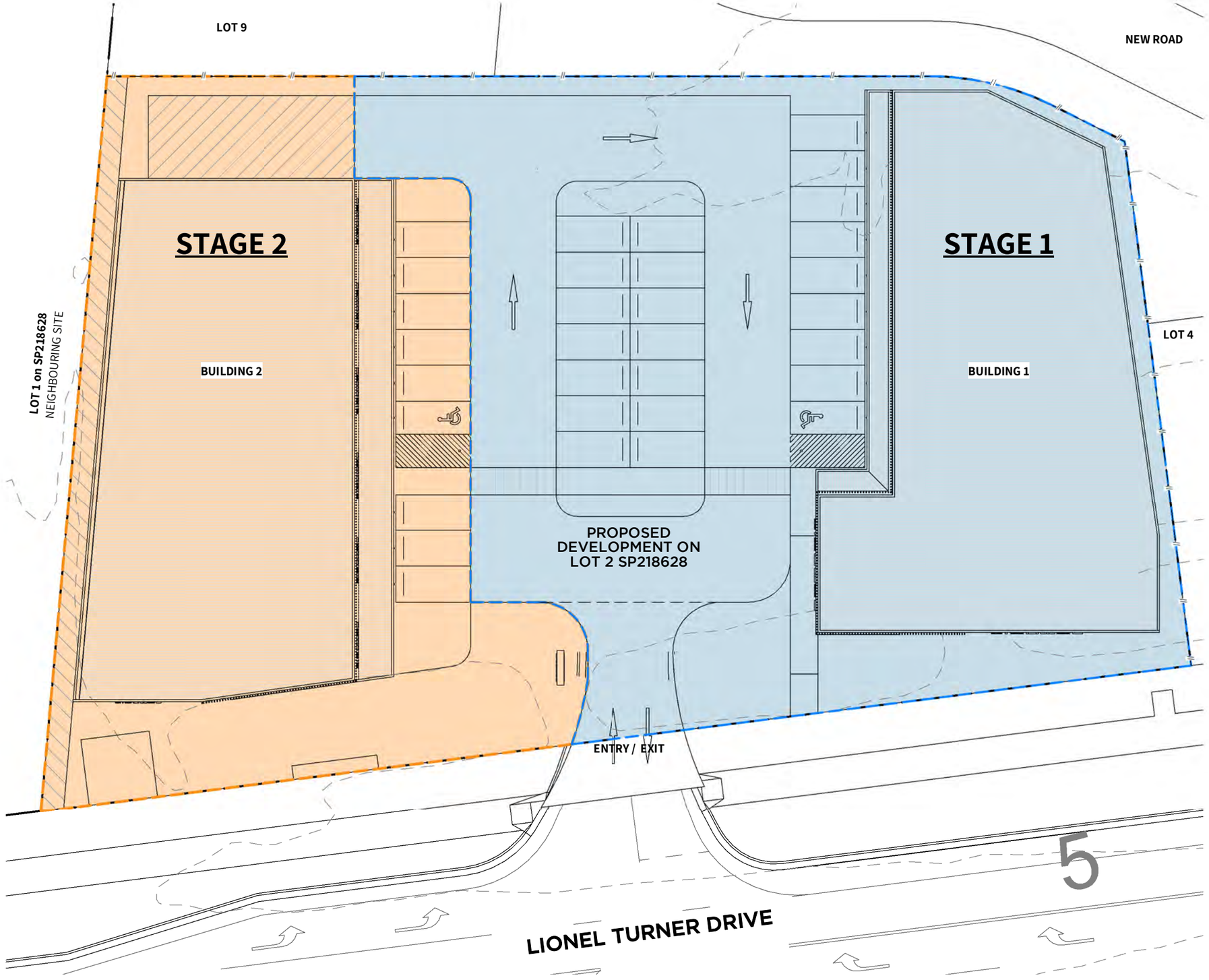
LIONEL TURNER DRIVE

BUSHLAND BEACH

CPO ARCHITECTS

legend

- STAGE 1
- STAGE 2



1 SITE PLAN
1 : 300 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-080
job no. 20240099

revision A

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY
- ACOUSTIC FENCE

development data

LOT 2 SP218628

SITE DATA

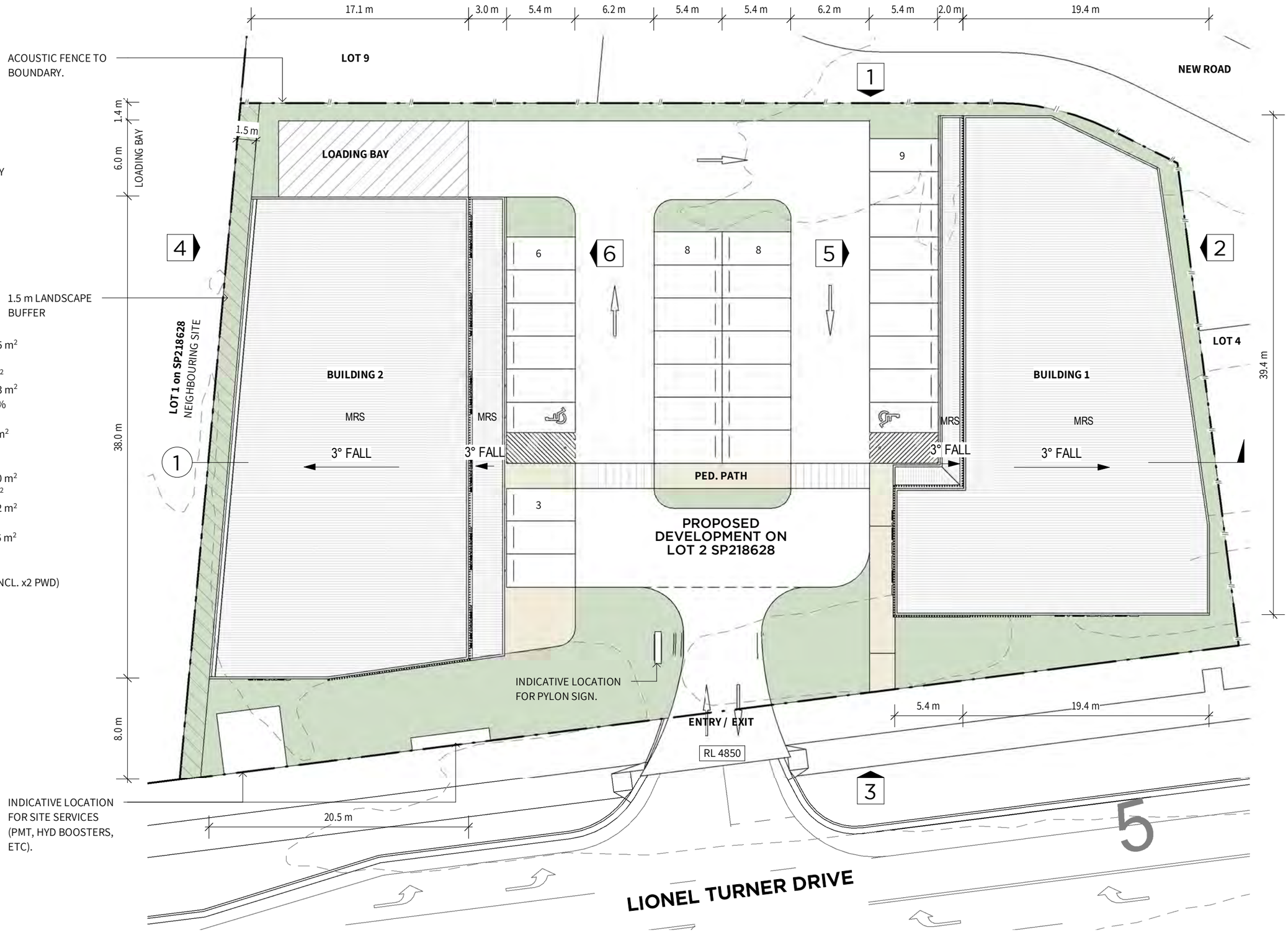
TOTAL SITE AREA	3,735 m²
NON-DEVELOPABLE AREA	
- LANDSCAPE BUFFER	82 m²
NET SITE AREA	3,653 m²
NET SITE EFFICIENCY	39.2%
LANDSCAPING	771 m²

AREAS (GFA)

COMMERCIAL	1,380 m²
FOOD OUTLET	52 m²
TOTAL GFA	1,432 m²
LIGHT-DUTY PAVEMENT	1,316 m²

CARPARKING

TOTAL PROVIDED	32 (INCL. x2 PWD)
LOADING BAY	1



1 SITE PLAN
1 : 300 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-090
job no. 20240099

revision C

legend

- LANDSCAPING
- PEDESTRIAN PATH
- COMMERCIAL / RETAIL TENANCY
- CAFE TENANCY
- ACOUSTIC FENCE

development data

LOT 2 SP218628

SITE DATA

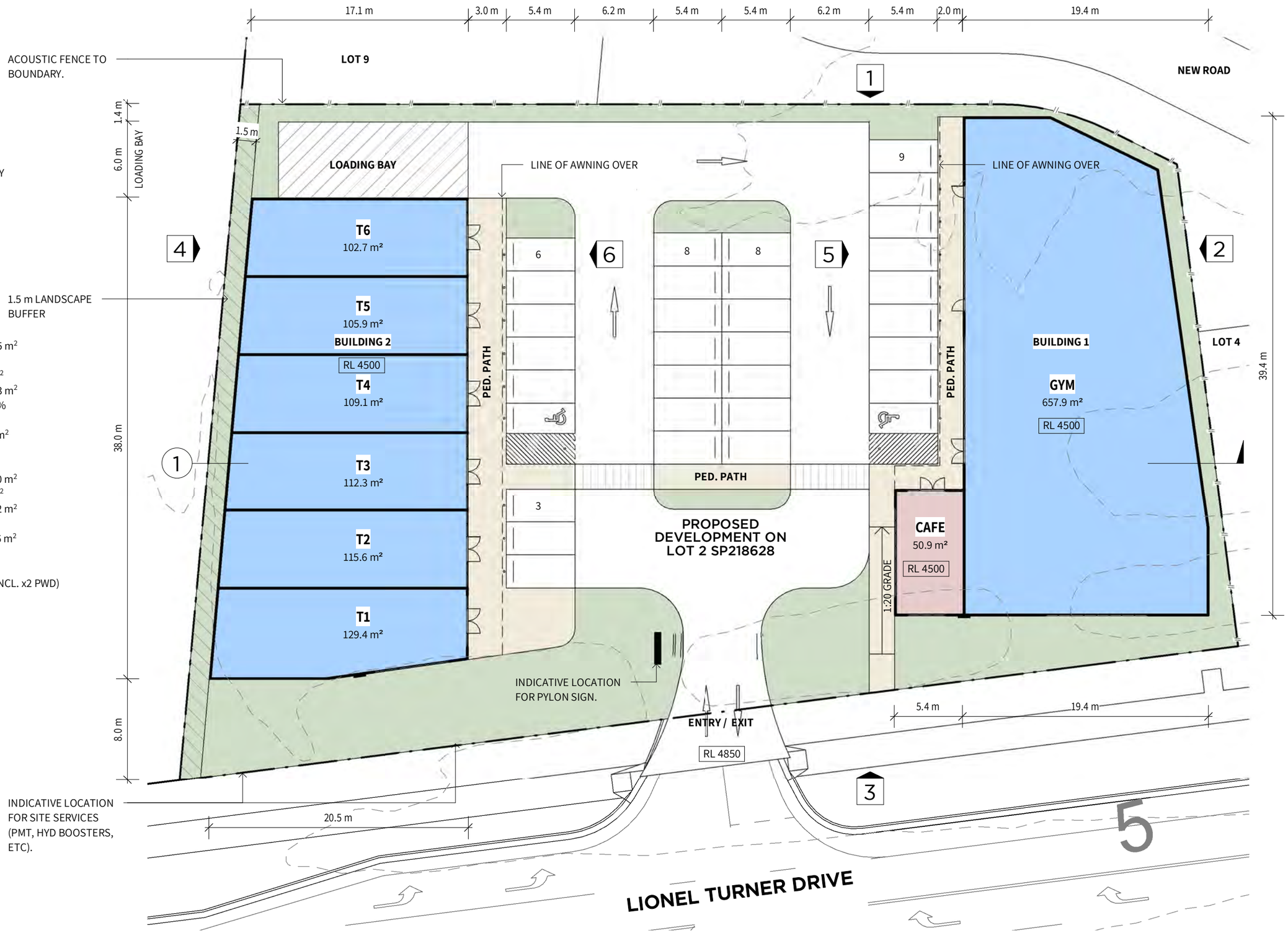
TOTAL SITE AREA	3,735 m²
NON-DEVELOPABLE AREA	
- LANDSCAPE BUFFER	82 m²
NET SITE AREA	3,653 m²
NET SITE EFFICIENCY	39.2%
LANDSCAPING	771 m²

AREAS (GFA)

COMMERCIAL	1,380 m²
FOOD OUTLET	52 m²
TOTAL GFA	1,432 m²
LIGHT-DUTY PAVEMENT	1,316 m²

CARPARKING

TOTAL PROVIDED	32 (INCL. x2 PWD)
LOADING BAY	1



1 GROUND PLAN

1 : 300 @ A3

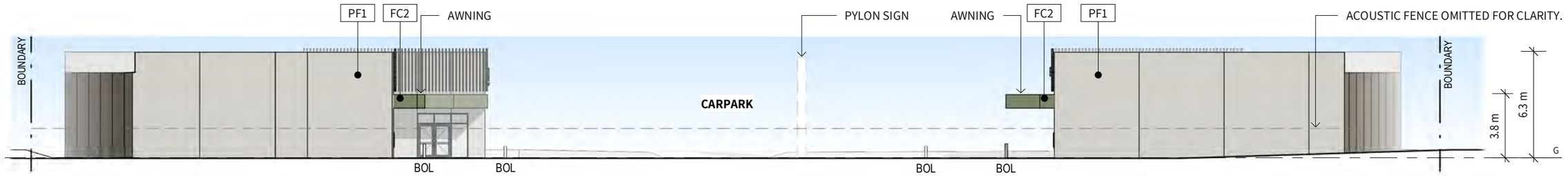
CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-100

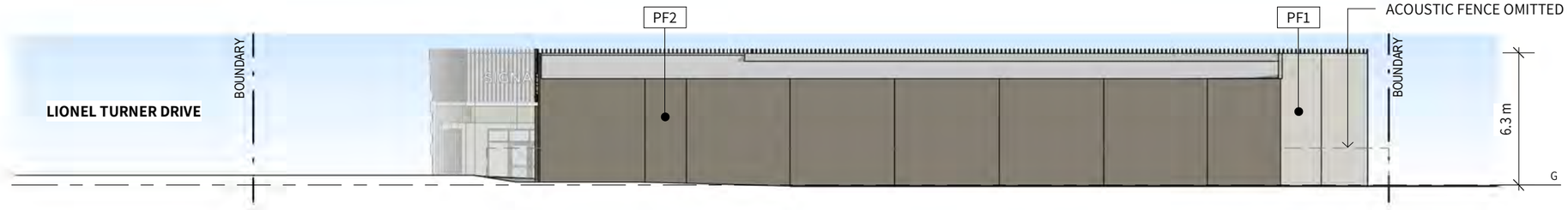
job no. 20240099

revision C



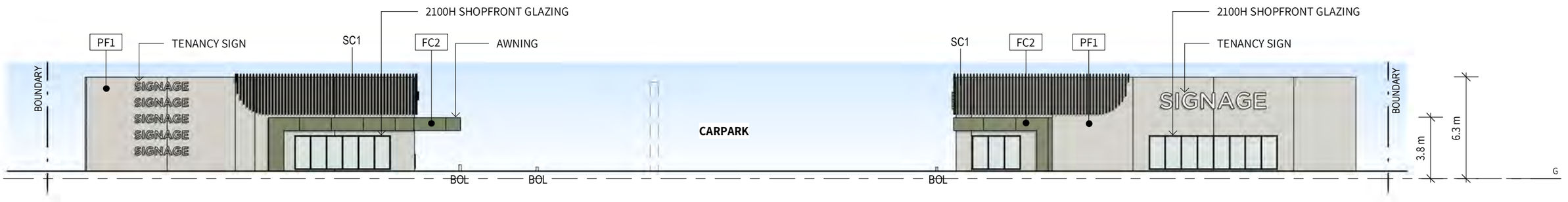
1 SITE ELEVATION A

1 : 250 @ A3



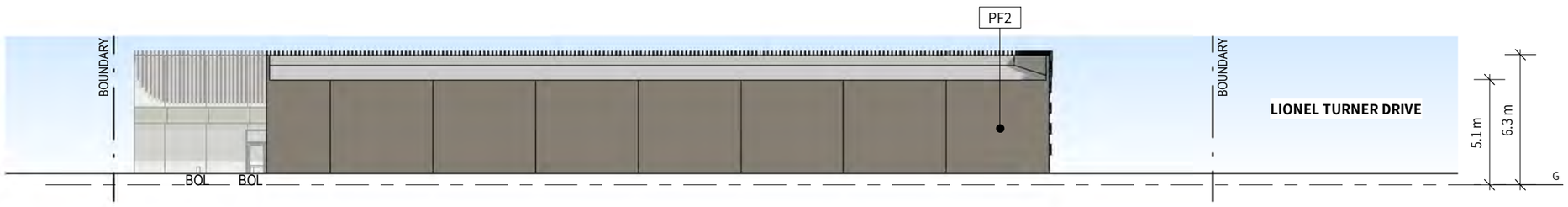
2 SITE ELEVATION B

1 : 250 @ A3



3 SITE ELEVATION C

1 : 250 @ A3



4 SITE ELEVATION D

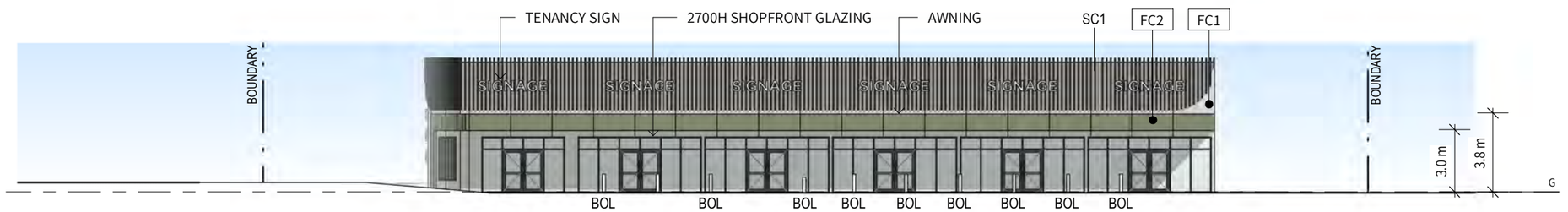
1 : 250 @ A3

legend

FC1	FEATURE CLADDING - TYPE 1
FC2	FEATURE CLADDING - TYPE 2
PF1	CONCRETE TILT PANEL - PAINT FINISH TYPE 1
PF2	CONCRETE TILT PANEL - PAINT FINISH TYPE 2
MRS	METAL ROOF SHEETING
SC1	VERTICAL SCREEN BATTEN

5 INTERNAL SITE ELEVATION A

1 : 250 @ A3

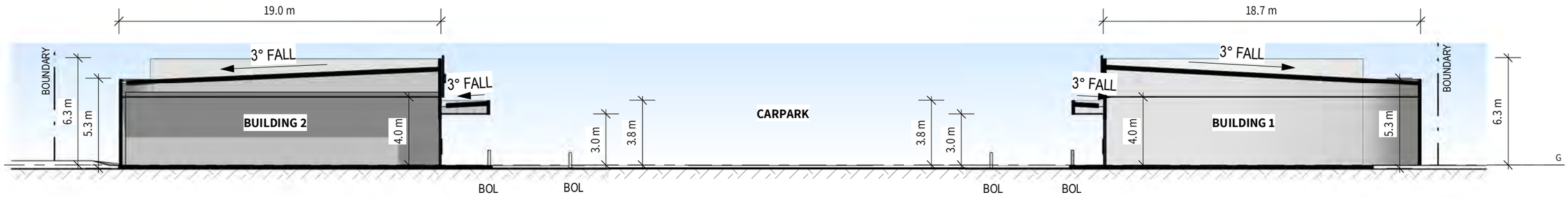


6 INTERNAL SITE ELEVATION B

1 : 250 @ A3

legend

FC1	FEATURE CLADDING - TYPE 1
FC2	FEATURE CLADDING - TYPE 2
PF1	CONCRETE TILT PANEL - PAINT FINISH TYPE 1
PF2	CONCRETE TILT PANEL - PAINT FINISH TYPE 2
MRS	METAL ROOF SHEETING
SC1	VERTICAL SCREEN BATTEN



1 SECTION A

1 : 250 @ A3

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-400
job no. 20240099

revision C

VIEW FROM LIONEL TURNER DRIVE

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-450
job no. 20240099

revision C

VIEW FROM LIONEL TURNER DRIVE

VIEW FROM LIONEL TURNER DRIVE

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-452
job no. 20240099

revision C

VIEW TOWARDS CAFE AND RETAIL

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-453
job no. 20240099

revision C

VIEW TOWARDS GYM

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-454
job no. 20240099

revision C

GYM FRONT ELEVATION

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-455
job no. 20240099

revision C

CAFE AND RETAIL FRONT ELEVATION

CPO ARCHITECTS

SWANLAND GROUP

dwg no. DA-456
job no. 20240099

revision B

APPENDIX B

Northern Consulting Engineers – Traffic Drawings

EXISTING DEVELOPMENT

COMMERCIAL DEVELOPMENT

RESIDENTIAL SUBDIVISION

LIONEL TURNER DRIVE

NORTHERN CONSULTING engineers

Civil | Structural | Forensic
Traffic | Flood Modelling

TOWNSVILLE | SUNSHINE COAST
BRISBANE | NEW ZEALAND

T: +617 4725 5550 E: mail@nceng.com.au
W: www.nceng.com.au

IPA0002-TIA-C01b
CONCEPT LAYOUT
Scale 1:400 @ A3 27/08/2025

EXISTING DEVELOPMENT

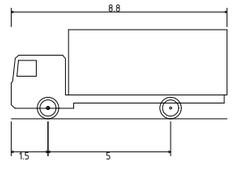
COMMERCIAL DEVELOPMENT

RESIDENTIAL SUBDIVISION

LIONEL TURNER DRIVE

MRV - Medium Rigid Vehicle

MRV - Medium Rigid Vehicle



MRV - Medium Rigid Vehicle	
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock to lock time	4.00s
Kerb to Kerb Turning Radius	10.000m

NORTHERN CONSULTING engineers

Civil | Structural | Forensic
Traffic | Flood Modelling

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IPA0002-TIA-C02b

RETAIL ACCESS
VEHICLE MOVEMENTS
Scale 1:400 @ A3 27/08/2025

EXISTING DEVELOPMENT

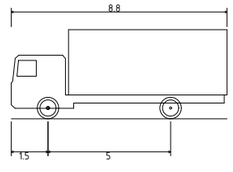
COMMERCIAL DEVELOPMENT

RESIDENTIAL SUBDIVISION

LIONEL TURNER DRIVE

MRV - Medium Rigid Vehicle

MRV - Medium Rigid Vehicle



MRV - Medium Rigid Vehicle	
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock to lock time	4.00s
Kerb to Kerb Turning Radius	10.000m

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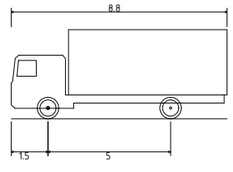
RETAIL ACCESS
VEHICLE MOVEMENTS
Scale 1:400 @ A3 27/08/2025

EXISTING DEVELOPMENT

COMMERCIAL DEVELOPMENT

RESIDENTIAL SUBDIVISION

LIONEL TURNER DRIVE



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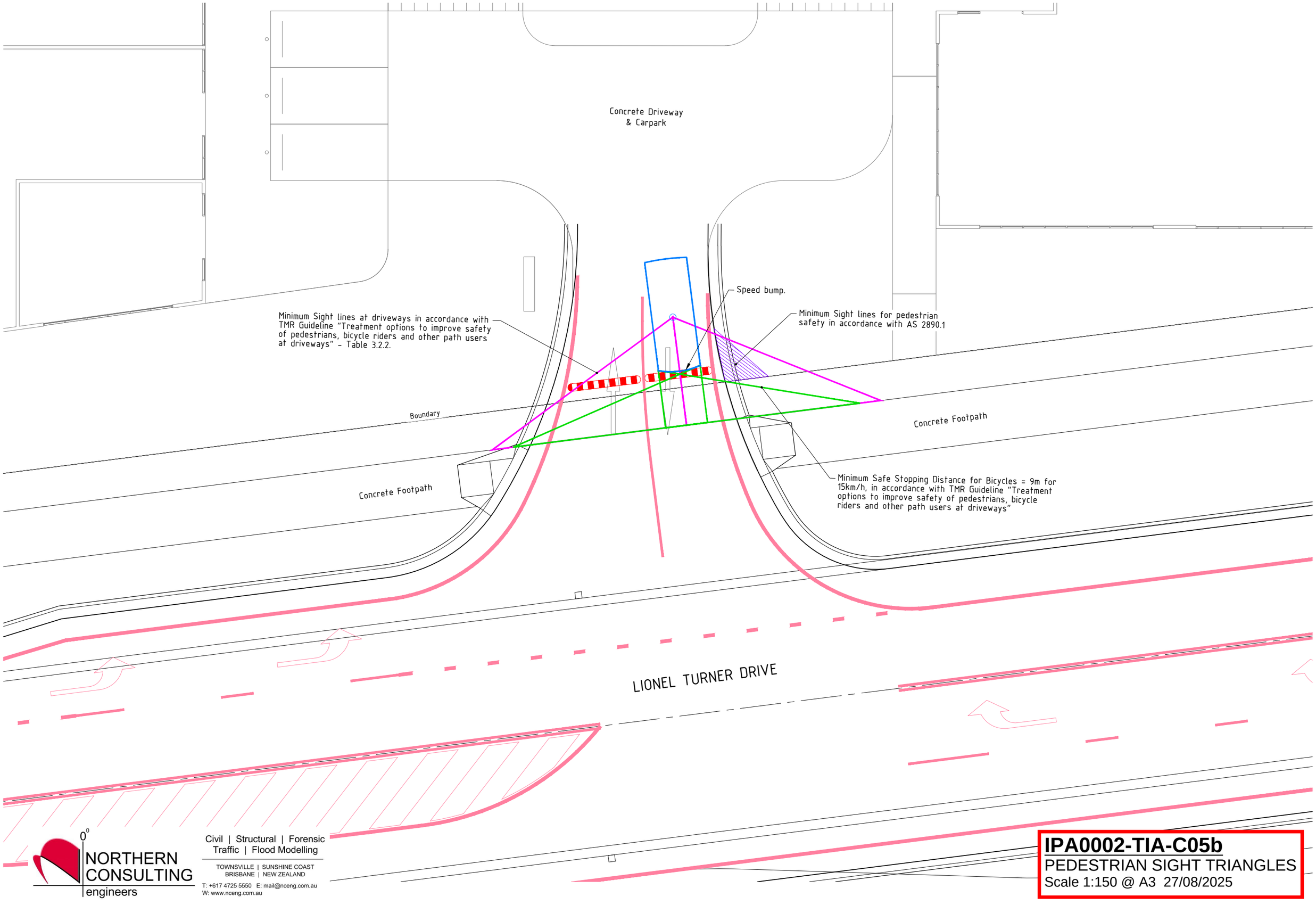
RETAIL ACCESS
VEHICLE MOVEMENTS
Scale 1:400 @ A3 27/08/2025



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PEDESTRIAN SIGHT TRIANGLES

Scale 1:150 @ A3 27/08/2025

EXISTING DEVELOPMENT

COMMERCIAL DEVELOPMENT

RESIDENTIAL SUBDIVISION

LIONEL TURNER DRIVE

Indicates sight distance requirements at access driveways, in accordance with AS2890.1 Minimum SSD 65m @ 60km/h.

Indicates sight distance requirements at access driveways, in accordance with AS2890.1 Minimum SSD 65m @ 60km/h.

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SIGHT DISTANCE AS2890

Scale 1:500 @ A3 27/08/2025

APPENDIX C

Northern Consulting Engineers – Miscellaneous Figures

TCC Zone Map

Legend

EXT_CORE

CORE - Properties

Properties

CORE - Road Corridor Centreline

Secondary Road

Trafficable Road

CORE - Suburbs

Suburbs

EXT_CityPlanningScheme_Current

Zoning

Low density residential

Local centre

Sport and recreation

Open space

0 50 100

m

Scale 1: 5733

City of Townsville

Townsville City Council Planning Scheme Infrastructure

HINCHINBROOK SHIRE COUNCIL

CHARTERS TOWERS REGIONAL COUNCIL

BURDEKIN SHIRE COUNCIL

CORAL SEA

Halifax Bay

Cleveland Bay

Bowling Green Bay

Lake Ross

See Inset

Inset 1:200,000

Halifax Bay

Cleveland Bay

Future road hierarchy
- Highway
- Arterial
- Sub-arterial
- Major collector

Cadastre
- Local government boundary
- Adjoining local government area
- Waterway or waterbody

Development Site

0 1 2 3 4 5
Kilometers

Future road hierarchy
- Highway
- Arterial
- Sub-arterial
- Major collector

Cadastre
- *Local government boundary*
- *Adjoining local government area*
- *Waterway or waterbody*

Road hierarchy data was supplied by the planning and development division of the Townsville city council.
This data is to be used as a guide only for planning purposes.

While every care is taken to ensure the accuracy of this product, Townsville City Council makes no representations or warranties about the accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs you may incur as a result of the product being inaccurate or incomplete in any way or for any reason.

Gazettal Date: 27/10/2014

Geocentric Datum of Australia 1994 (GDA94)

Approx Scale @ A3 1:350,000

0 2 4 8 12 16 20
Kilometres

CORAL SEA


1677780282
Details
FID
4316
Id
1677780282
% Heavy Vehicles
7.81
AADT (vpd)
1627
AM Peak Hourly Volume (vph)
51
PM Peak Hourly Volume (vph)
288
AM Peak Speed (km/h)
34.898
PM Peak Speed (km/h)
34.277
Shape
N/A
Shape.STLength()
931.1949
Blank
Townsville City Council | TownsvilleCityCouncil


1677780281
Details
FID
4554
Id
1677780281
% Heavy Vehicles
8.21
AADT (vpd)
1194
AM Peak Hourly Volume (vph)
222
PM Peak Hourly Volume (vph)
156
AM Peak Speed (km/h)
34.49
PM Peak Speed (km/h)
34.661
Shape
N/A
Shape.STLength()
931.7865
Blank
Townsville City Council | TownsvilleCityCouncil


1677780282
Details
FID
4555
Id
1677780282
% Heavy Vehicles
7.6
AADT (vpd)
1790
AM Peak Hourly Volume (vph)
59
PM Peak Hourly Volume (vph)
305
AM Peak Speed (km/h)
34.876
PM Peak Speed (km/h)
34.214
Shape
N/A
Shape.STLength()
931.1949
Blank
Townsville City Council | TownsvilleCityCouncil


1677780281
Details
FID
4315
Id
1677780281
% Heavy Vehicles
8.57
AADT (vpd)
1074
AM Peak Hourly Volume (vph)
191
PM Peak Hourly Volume (vph)
153
AM Peak Speed (km/h)
34.575
PM Peak Speed (km/h)
34.661
Shape
N/A
Shape.STLength()
931.7865
Blank
Townsville City Council | TownsvilleCityCouncil

Townsville bus routes

Effective March 2024

200	Breakwater ferry terminal to Kelso via Townsville City bus hub, Townsville SC and Willows
201	Breakwater ferry terminal to JCU via Townsville City bus hub, Townsville SC and Hospital
202	Townsville City bus hub to Townsville Hospital, James Cook University (JCU)
203	Townsville City bus hub to Kirwan via Mater Hospital, Townsville SC and Willows
204	Townsville City bus hub to Townsville SC via Mt Louisa
205	Townsville City bus hub to Townsville SC via Garbutt
206	Townsville City bus hub to Pallarenda via Breakwater ferry terminal and Rowes Bay
207	Townsville City bus hub to Stuart via Fairfield Waters Dr
208	Townsville City bus hub to Willows via Railway Estate and Hospital/JCU
209	Townsville City bus hub to Hospital/University/Townsville SC via Wulguru
210	Willows to Hospital and University via Carlysle Gardens
211	Willows Shopping Centre to Bohle Plains (Kalynda Chase)
212	Willows Shopping Centre to Shaw via Mt Louisa
215	Townsville City bus hub to Townsville SC via Garbutt and Domain
232	Townsville SC to Burdell
233	Townsville SC to Bushland Beach via Deeragun and Jensen
250	Magnetic Island ferry terminal to Picnic Bay and Horseshoe Bay

Townsville SC = Townsville Shopping Centre at Aitkenvale

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Queensland Government

Northern Consulting Engineers Project Number	IPA0002C
Project Description	10-32 Lionel Turner Drive
Traffic Survey or Construction Commencement Year	2036
Commencement of Use Year	2026
Projected 10 year design horizon	2036
Figure 2.27 (Left Approach)	Lionel Turner Drive
Figure 2.27 (Right Approach)	Lionel Turner Drive
Figure 2.27 (Bottom Approach)	Development Access
Background Growth Factor	0%
Peak Hour Factor (12% Urban / 16% Rural)	12%

Site Information	
Food and Drink Outlet	**GLFA**
10-32 Lionel Turner Drive	52.5
Gym Tenancy	**GFLA**
10-32 Lionel Turner Drive	627
Commercial retail	**GFLA**
10-32 Lionel Turner Drive	671

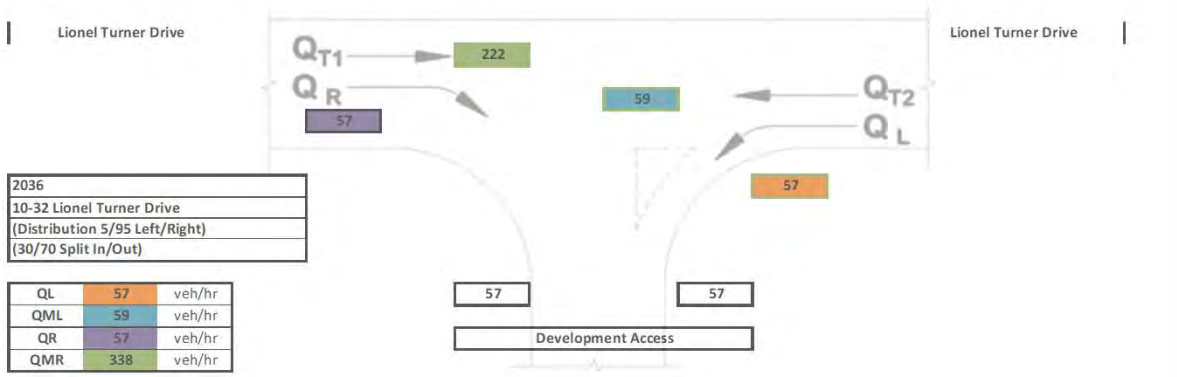
QLD Open Portal (Fast Food with Driveway)	**Vehicle Trips / GLFA**	**Predicted Traffic Volumes**
Average Weekday	5.92	**311**
Average Weekend	3.39	**178**
Weekday Peak hour	0.63	**33**
Weekend Peak hour	0.63	**33**

NSW 2024 - Guide to Transport Impact Assessment TS 00085 V1.1 (Fitness Centre - 2014)	**Vehicle Trips / per 100m^2 GLFA**	**Predicted Traffic Volumes**
Evening Peak (Weekday)	3.6	**23**
Evening Peak (Weekend)	2.9	**18**
Daily trips	16.9	**106**

NSW 2024 - Guide to Transport Impact Assessment TS 00085 V1.1 (Small Shopping Centre - 2018)	**Vehicle Trips / per m^2 GLFA**	**Predicted Traffic Volumes**
AM Peak (Weekday)	0.192	**129**
PM Peak (Weekday)	0.259	**174**
Daily trips (Weekday)	2.022	**1357**
Peak (Weekend)	0.283	**190**
PM Peak (Weekend)		**0**
Daily trips (Weekend)	1.894	**1271**

(Development Traffic)	**Approach Traffic (Peak Hour)**	Public Transport Factor (100%)
Total Weekday peak hour	**229**	100%
Total Weekend peak hour	**241**	100%

Figure 2.27: Calculation of the major road traffic volume Q_M



Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$

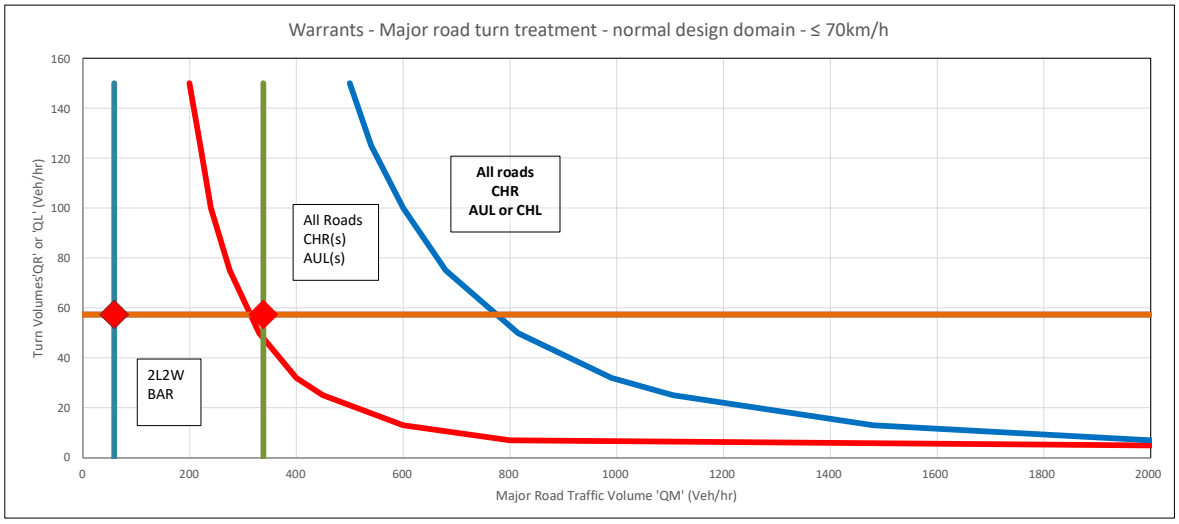
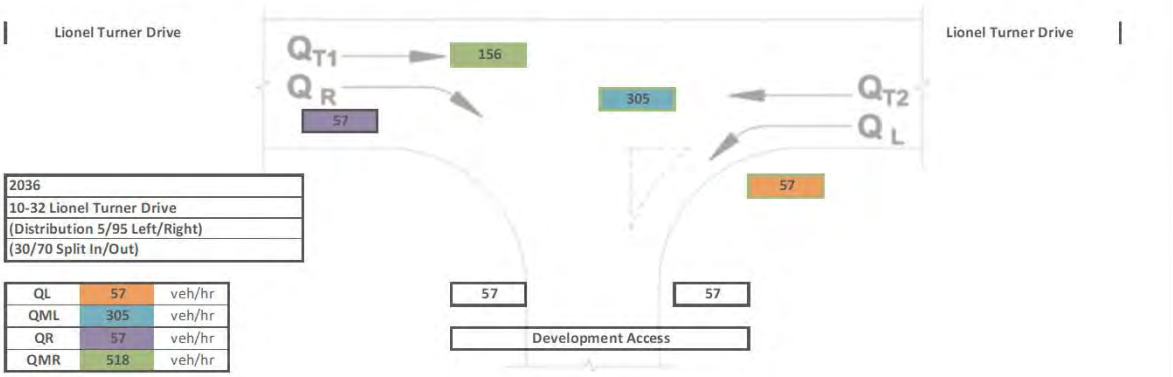
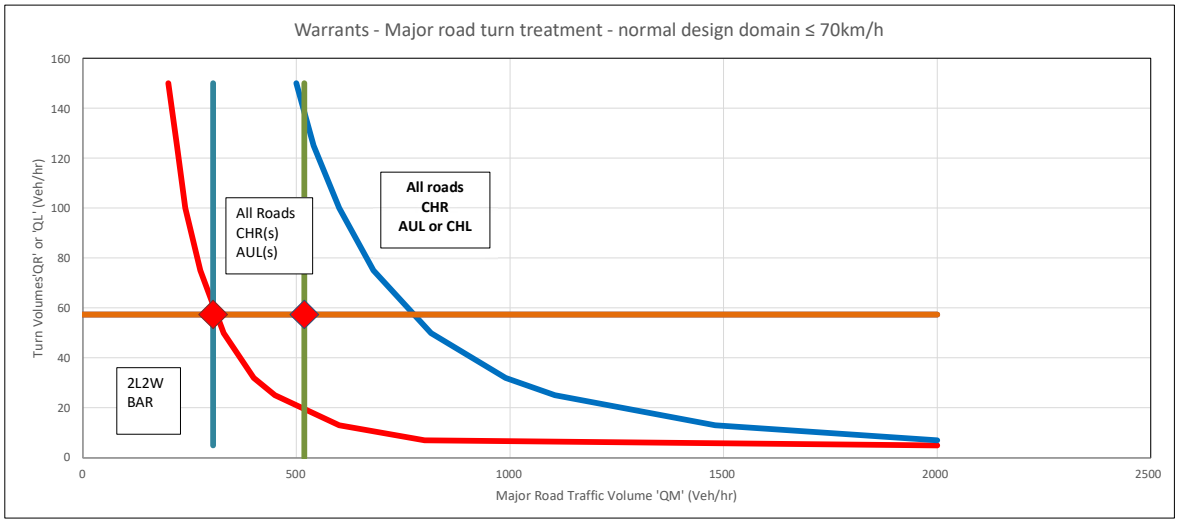


Figure 2.27: Calculation of the major road traffic volume Q_M



Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$



APPENDIX D

Northern Consulting Engineers – Existing Road Safety Audit Spreadsheets

	Job Name: Job No:	Gallerria - Comercial Development			IPA0002C	Designer:			Northern Consulting Engineers		Client:	Swanland	Date:			19/05/2025
	Hazard	Project Life Cycle Stage	Risk	Control Hierarchy	Current Control Measures	Current Risk Rating			Potential Control Hierarchy	Proposed Control Measures	Who is Responsible?	By When	Residual Risk Rating			Are risks eliminated or reduced
						Consequence	Likelihood	Risk Rating					Consequence	Likelihood	Risk Rating	
1	**Changes in the Infrastructure Network**															
1.1	Existing table drain infrastructure within road frontage	Operations	Errant vehicle unable to regain control	Engineering	Batter grades, edge lines	Property Only	Unlikely	L	Eliminate	Remove table drain and modifiy verge to urben	Design team	Operational Works	Property Only	Very Unlikely (Rare)	L	Yes, removal of the hazard within development frontage.
1.2	Introduction of Commercial access to proposed development.	Operations	Risk of rear end collision due to slowing vehicles	Engineering	Nil	Medical Treatment	Likely	M	Engineering	All movements Intersection (CHR(s) and AUL(s)	Design team	Operational Works	Medical Treatment	Very Unlikely (Rare)	L	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
1.3	ExistingPower Pole near carraigeway.	Operations	Risk of vehicle impact including injury to persons and property damage	Engieering	Clearance from through traffic	Hospitalisation	Possible	M	Maintain	Relocate Power Pole adequate clearanc distance from through traffic.	Design Team	Operational Works	Hospitalisation	Possible	M	Risk level Maintained
2	**Introduction or changes to pedestrian or cyclist desire liners**															
2.1	Potential for additional pedestrian traffic across Lionel Tuner Drive.	Operations	Conflict between pedestrians and vehciles	engineering	Desginated pedestrian crossing at roundabout.	Hospitalisation	Unlikely	M	Maintain	Desginated pedestrian crossing at roundabout.	Design Team	Operational Works	Hospitalisation	Unlikely	M	Risk level increased slightly due to increase in probability (volume of pedestrians) potentially using the crossing.
4	**Changes in site operations that may have an external influence**															
4.1	Increased traffic through creation of a commrcial development Increased conflicting movements	Operations	Vehicle collisions	Engineering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection (CHR(s) and AUL(s)	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
6	**Increase in traffic volumes, including additional turn movements**															
6.1	Increased traffic through Lionel Turner Drive accessing the Development	Operations	Vehicle collisions through congestion	Engienering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection (CHR(s) and AUL(s)	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
7	**Introducing an Access off an existing Roadway**															
7.1	Increase of vehicle to vehcile collisions form vehciles completing turn movements of Lionel Turner Drive	Operations	Vehicle collisions	Engienering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection (CHR(s) and AUL(s)	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision.
10	**Introduction of hours of operation outside daylight hours (including safetuy risk for pedestrians and cyclists)**															
10.1	Introduction of vehcile movements during dark/night times.	Operations	Vehicle collisions	Engienering	Nil	Property Only	Very Unlikely (Rare)	L	Engineering	All movements Intersection (CHR(s) and AUL(s) With V Category lighting.	Design team	Prior to OPW Approval	Medical Treatment	Unlikely	M	New hazard introduces into road syste. Limit risk as far as possible by including CHR(s) and AUL(s) to avoid rear end collision. Improve visibility at night through inclusion of V Category lighting.

CHECKLIST 2: PRELIMINARY DESIGN STAGE AUDIT

Issue	Yes	No	Comment
2.1 General topics			
2.1.1 Changes since previous audit			
Do the conditions for which the scheme was originally designed still apply? (for example, no changes to the surrounding network, area activities or traffic mix)	☐	☑	New Development Proposal
Has the general form of the project design remained unchanged since previous audit (if any)?	☐	☑	New development Proposal
2.1.2 Drainage			
Will the scheme drain adequately?	☑	☐	Development to drain northward toward the existing drainage reserve.
Has the possibility of surface flooding been adequately addressed, including overflow from surrounding or intersecting drains and water courses?	☑	☐	Table drain design within Lionel Turner Drive will need to be adjusted to accomdate the proposed access. Table Drain along frontage to be removed changed to urban profile.
2.1.3 Climatic conditions			
Has consideration been given to weather records or local experience that may indicate a particular problem? (for example, snow, ice, wind, fog)	☑	☐	N/A
2.1.4 Landscaping			
If any landscaping proposals are available, are they compatible with safety requirements? (for example, sight lines and hazards in clear zones)	☑	☐	Landscaping to be contained within development footprint.
2.1.5 Services			
Does the design adequately deal with buried and overhead services? (especially in regard to overhead clearances, etc)	☑	☐	
Has the location of fixed objects or furniture associated with services been checked, including the position of poles?	☑	☐	Alterations to existing Ergon Energy Infrastructure will be required as part of the development.
2.1.6 Access to property and developments			
Can all accesses be used safely? (entry and exit/merging)	☑	☐	Establishment of a suitabe intersection configuration.
Is the design free of any downstream or upstream effects from points of access, particularly near intersections?	☐	☑	Nearby roundabout access to Peggy Banfield Park / Coles Supermarket is nearby. Installation of an AUL(s) is acheivable.
Have rest areas and truck parking accesses been checked for adequate sight distance, etc.?	☐	☑	N/A
2.1.7 Adjacent developments			
Does the design handle accesses to major adjacent generators of traffic and developments safely?	☑	☐	Assessment of impacts to adjacent roundabout has been considered. (Beggy Banfield Park / Coles/supermarket)

Issue	Yes	No	Comment
Is the driver's perception of the road ahead free of misleading effects of any lighting or traffic signals on an adjacent road?	☑	☐	
2.1.8 Emergency vehicles and access			
Has provision been made for safe access and movements by emergency vehicles?	☑	☐	
Does the design and positioning of medians and vehicle barriers allow emergency vehicles to stop and turn without unnecessarily disrupting traffic?	☑	☐	
2.1.9 Future widening and/or realignments			

If the scheme is only a stage towards a wider or dual carriageway is the design adequate to impart this message to drivers? (is the reliance on signs minimal/appropriate, rather than excessive?)	☐	☐	N/A
Is the transition between single and dual carriageway (either way) handled safely?	☑	☐	
2.1.10 Staging of the scheme			
If the scheme is to be staged or constructed at different times: are the construction plans and program arranged to ensure maximum safety? do the construction plans and program include specific safety measures, signing; adequate transitional geometry, etc. for any temporary arrangements?	☐ ☐	☐ ☐	N/A
2.1.11 Staging of the works			
If the construction is to be split into several contracts, are they arranged safely?	☐	☐	N/A
2.1.12 Maintenance			
Can maintenance vehicles be safely located?	☑	☐	
2.2 Design issues (general)			
2.2.1 Design standards			
Is the design speed and speed limit appropriate? (for example, consider the terrain, function of the road)	☑	☐	
Has the appropriate design vehicle and check vehicle been used?	☑	☐	MHRV

Issue	Yes	No	Comment
2.2.2 Typical cross-sections			
Are lane widths, shoulders, medians and other crosssection features adequate for the function of the road?	☑	☐	
Is the width of traffic lanes and carriageway suitable in relation to: alignment? traffic volume? vehicle dimensions? the speed environment? combinations of speed and traffic volume?	 ☑ ☑ ☑ ☑ ☑	 ☐ ☐ ☐ ☐ ☐	
Are overtaking/climbing lanes provided if needed?	☐	☐	N/A
Have adequate clear zones been achieved?	☑	☐	
2.2.3 The effect of cross-sectional variation			
Is the design free of undesirable variations in cross-section design?	☐	☐	
Are crossfalls safe? (particularly where sections of existing highway have been used or there have been compromises to accommodate accesses, etc.)	☐	☐	
Does the cross-section avoid unsafe compromises such as narrowings at bridge approaches or past physical features?	☐	☐	
2.2.4 Roadway layout			
Are all traffic management features designed to avoid creating unsafe conditions?	☑	☐	
Is the layout of road markings and reflective materials able to deal satisfactorily with changes in alignment? (particularly where the alignment may be substandard)	☑	☐	
2.2.5 Shoulders and edge treatment			

Are the following safety aspects of shoulder provision satisfactory:	☑	☐	Potential for Urban profile
provision of sealed or unsealed shoulders			
width and treatment on embankments	☑	☐	
crossfalls all of shoulders	☑	☐	
Are the shoulders likely to be safe if used by slow moving vehicles or cyclists?	☐	☑	
Are any rest areas and truck parking areas safely designed?	☐	☐	N/A

Issue	Yes	No	Comment
2.2.6 Effect of departures from standards or guidelines			
Any approved departures from standards or guidelines: is safety maintained?	☐	☐	N/A
Any hitherto undetected departures from standards: is safety maintained?	☐	☐	N/A
2.3 Alignment details			
2.3.1 Geometry of horizontal and vertical alignment			
Do the horizontal and vertical design fit together correctly?	☑	☐	
Is the design free of visual cues that would cause a driver to misread the road characteristics? (for example, visual illusions, subliminal delineation such as lines of trees, poles, etc.)	☑	☐	
Does the alignment provide for speed consistency?	☑	☐	
2.3.2 Visibility; sight distance			
Are horizontal and vertical alignments consistent with the visibility requirements?	☑	☐	
Will the design be free of sight line obstructions due to safety fences or barriers?			
boundary fences?	☑	☐	
street furniture?	☑	☐	
parking facilities?	☑	☐	
signs?	☑	☐	
landscaping?	☑	☐	
bridge abutments?	☑		
parked vehicles in laybys or at the kerb?	☑	☐	
queued traffic?	☑	☐	
Are railway crossings, bridges and other hazards all conspicuous?	☐	☐	N/A
Is the design free of any other local features which may affect visibility?	☑	☐	
2.3.3 New/existing road interface			
Does the interface occur well away from any hazard? (for example, a crest, a bend, a roadside hazard or where poor visibility/distractions may occur)	☐	☑	Nearby roundabout has been assessed and considered safe
If carriageway standards differ, is the change effected safely?	☑	☐	Urban profile adopted to eliminate excessive batter slopes.

Issue	Yes	No	Comment
Is the transition where the road environment changes (for example, urban to rural; restricted to unrestricted; lit to unlit) done safely?	☑	☐	
Has the need for advance warning been considered?	☐	☑	Extenstion of an Urban profile.

2.3.4 Readability of the alignment by drivers			
Will the general layout, function and broad features be recognised by drivers in sufficient time?	☑	☐	
Will approach speeds be suitable and can drivers correctly track through the scheme?	☑	☐	
2.4 Intersections			
2.4.1 Visibility to and at intersections			
Are horizontal and vertical alignments at the intersection or on the approaches to the intersection consistent with the visibility requirements?	☑	☐	
Will drivers be aware of the presence of the intersection? (especially on the minor road approach)	☑	☐	
Will the design be free of sight line obstructions due to:			
safety fences or barriers?	☑	☐	
boundary fences?	☑	☐	
street furniture?	☑		
parking facilities?	☑	☐	
signs?	☑	☐	
landscaping?	☑	☐	
bridge abutments?	☑	☐	
Are railway crossings, bridges and other hazards near intersections conspicuous?	☐	☐	N/A
Will the design be free of any local features which adversely affect visibility?	☑	☐	
Will intersection sight lines be obstructed by permanent or temporary features such as parked vehicles in laybys, or by parked or queued traffic generally?	☐	☑	
2.4.2 Layout, includes its appropriateness			
Is the type of intersection selected (cross roads, T, roundabout, signalised, etc.) appropriate for the function of the two roads?	☑	☐	
Are the proposed controls (Give Way, Stop signals, etc.) appropriate for the particular intersection?	☑	☐	
Are junction sizes appropriate for all vehicle movements?	☑	☐	

Issue	Yes	No	Comment
Are the intersections free of any unusual features which could affect road safety?	☑	☐	
Are the lane widths and swept paths adequate for all vehicles?	☑		
Is the design free of any upstream or downstream geometric features that could affect safety? (for example, merging of lanes)	☑	☐	
Are the approach speeds consistent with the intersection design?			
Where a roundabout is proposed:	☐	☐	N/A
have pedal cycle movements been considered?	☐	☐	
have pedestrian movements been considered?	☐	☐	
are details regarding the circulating carriageway sufficient?			
2.4.3 Readability by drivers			
Will the general type, function and broad features be perceived correctly by drivers?	☑	☐	

Are the approach speeds and likely positions of vehicles as they track through the scheme safe?	☑	☐	
Is the design free of sunrise or sunset problems that may create a hazard for motorists?	☑	☐	
2.5 Special road users			
2.5.1 Adjacent land			
Will the scheme be free of adverse effects from adjacent activity and intensity of land use? (if not, what special measures are needed?)	☐	☐	Peggy Banfield Park (Attractor) limit access through nominated corridors.
2.5.2 Pedestrians	☐	☐	
Have pedestrian needs been satisfactorily considered?	☑	☐	
If footpaths are not specifically provided, is the road layout safe for use by pedestrians? (particularly at blind corners or on bridges)	☐	☑	
Are pedestrian subways or footbridges sited to provide maximum use? (i.e. Is the possibility of pedestrians crossing at grade in their vicinity minimised?)	☐	☐	N/A
Has specific provision been made for pedestrian crossings, school crossings or pedestrian signals?	☑	☐	Linkages to existing cvrossing have been included.
Where present, are these facilities sited to provide maximum use with safety?	☑	☐	

Issue	Yes	No	Comment
Are pedestrian refuges/kerb extensions provided where needed?	☐	☑	
Has specific consideration been given to provision required for special groups? (for example, young, elderly, disabled, deaf or blind)	☐	☑	
2.5.3 Cyclists			
Have the needs of cyclists been satisfactorily considered, especially at intersections?	☑	☐	2.5m wide shared Off Road facilities provided each side of the roasdway.
Are all cycleways of standard or adequate design? Where a need for shared pedestrian/cycle facilities exists, have they been safely treated?	☑	☐	
Where cycleways terminate at intersections or adjacent to the carriageway, has the transition treatment been handled safely?	☑	☐	
Have any needs for special cycle facilities been satisfactorily considered? (for example, cycle signals)	☑	☐	
2.5.4 Motorcyclists			
Has the location of devices or objects that might destabilise a motorcycle been avoided on the road surface?	☑	☐	
Will warning or delineation be adequate for motorcyclists?	☑	☐	
Has barrier kerb been avoided in high-speed areas?	☑	☐	
In areas more likely to have motorcycles run off the road is the roadside forgiving or safely shielded?	☐	☑	
2.5.5 Equestrians and stock			
Have the needs of equestrians been considered, including the use of verges or shoulders and rules regarding the use of the carriageway?	☐	☐	N/A
Can underpass facilities be used by equestrians/stock?			N/A
2.5.6 Freight			
Have the needs of truck drivers been considered, including turning radii and lane widths?	☑	☐	
2.5.7 Public transport			
Has public transport been catered for?	☑	☐	

Have the needs of public transport users been considered?	☑	☐	

Issue	Yes	No	Comment
Have the manoeuvring needs of public transport vehicles been considered?	☑	☐	
Are bus stops well positioned for safety?	☑	☐	
2.5.8 Road maintenance vehicles			
Has provision been made for road maintenance vehicles to be used safely at the site?	☑	☐	
2.6 Signs and lighting			
2.6.1 Lighting			
Is this project to be lit? Will safety be maintained if the project is not lit?	☑	☐	
Is the design free of features that make illuminating sections of the road difficult? (for example, shadow from trees or over bridges)	☑	☐	
Has the question of sighting of lighting poles been considered as part of the general concept of the scheme?	☑	☐	
Are frangible or slip-base poles to be provided?	☑	☐	
Are any special needs created by ambient lighting? Will safety be maintained if special treatments are not provided?	☑	☐	
Have the safety consequences of vehicles striking lighting poles (of any type) been considered?	☑	☐	
2.6.2 Signs			
Are signs appropriate for their location?	☑	☐	
Are signs located where they can be seen and read in adequate time?	☑	☐	
Will signs be readily understood?	☑	☐	
Are signs located so that visibility to and from accesses and intersecting roads is maintained?	☑	☐	
Are signs appropriate to the driver's needs? (for example, destination signs, advisory speed signs, etc.)	☑	☐	
Have the safety consequences of vehicles striking sign posts been considered?	☑	☐	
Are signs located so that drivers' sight distance is maintained?	☑	☐	
Where signs are to be located in the clear zone, are they frangible or adequately shielded by a crash barrier?	☑	☐	

Issue	Yes	No	Comment
2.6.3 Marking and delineation			
Has the appropriate standard of delineation and marking been adopted?	☑	☐	
Are the proposed markings consistent with the works in the adjoining section of the route?	☑	☐	
Are the previous/adjacent markings to be upgraded? If not, will safety be maintained?	☑	☐	
2.7 Traffic management			
2.7.1 Traffic flow and access restrictions			
Can traffic volumes from the proposed scheme be safely accommodated on existing sections of road?	☑	☐	
Have parking provision and parking control been adequately considered?	☑	☐	

Can any turn bans be implemented without causing problems at adjacent intersections?	☑	☐	
Has the effect of access to future developments been considered?	☑	☐	
Is safety maintained for any traffic diverting to other roads? (for example, to avoid a traffic control device)	☑	☐	
2.7.2 Overtaking and merges			N/A
Are overtaking sight distance and stopping distance adequate?	☐	☐	
Have suitable shoulder widths been provided at lane drop merges?	☐	☐	
Have standard signs and markings been provided for any lane drop?	☐	☐	
Has adequate sight distance been provided to any lane drop?	☐	☐	
Are shoulders wide enough opposite access points and intersections?	☐	☐	
2.7.3 Rest areas and stopping zones			N/A
Are there sufficient roadside stopping areas, rest areas and truck parking areas?	☐	☐	
Are any entries and exits to rest areas or truck parking areas safe?	☐	☐	

Issue	Yes	No	Comment
2.7.4 Construction and operation			
If the scheme is to be constructed 'under traffic', can this be done so safely?	☑	☐	
Can the scheme be safely constructed?	☑	☐	
Have the maintenance requirements been adequately considered?	☑	☐	
Is safe access to and from the works available?	☑	☐	
2.8 Additional questions to be considered for development proposals **2.8.1 Horizontal alignment**			
Is visibility adequate for drivers and pedestrians at proposed accesses?	☑	☐	
Is adequate turning space provided for the volume and speed of traffic?	☑	☐	
Are curve radii and forward visibility satisfactory?	☑	☐	
Are sight and stopping distances adequate?	☑	☐	
2.8.2 Vertical alignment			
Are gradients satisfactory?	☑	☐	
Are sight and stopping distances adequate?	☑	☐	
2.8.3 Parking provision			
Is on-site parking adequate to avoid on-street parking and associated risks?	☐	☐	N/A
Are parking areas conveniently located?	☐	☐	N/A
Is adequate space provided in parking areas for circulation and intersection sight distance?	☐	☐	N/A
2.8.4 Servicing facilities			
Are off-street loading/unloading areas adequate?	☑	☐	
Are turning facilities for large vehicles provided in safe locations?	☑	☐	
Is emergency vehicle access adequate?	☑	☐	
2.8.5 Signs and markings			

Have necessary traffic signs and road markings been provided as part of a development?	☑	☐	

Issue	Yes	No	Comment
Is priority clearly defined at all the intersection points within the car park and access routes?	☑	☐	
Will the signs and markings be clear in all conditions, including day/night, rain, fog, etc.?	☑	☐	
2.8.6 Landscaping			
Does landscaping maintain visibility at intersections, bends, accesses and pedestrian locations?	☑	☐	
Has tree planting been avoided where vehicles are likely to run off the road?	☑	☐	
2.8.7 Traffic management			
Have any adverse area-wide effects been addressed?	☑	☐	
Will the design keep travel speeds at the safe level?	☑	☐	
Are the number and location of accesses appropriate?	☑	☐	
Are the facilities for public transport services safely located?	☑	☐	
Are any bicycle facilities safely located in respect to vehicular movements?	☑	☐	
Are pedestrian facilities adequate and safely located?	☑	☐	
2.8.8 Other			
Has appropriate street lighting been provided?	☑	☐	
Are any roadside hazards appropriately dealt with?	☑	☐	
Has safe pedestrian access to the development been provided?	☑	☐	
2.9 Any other matter **2.9.1 Safety aspects not already covered**			
Have all unusual or hazardous conditions associated with special events been considered?	☑	☐	
Is the road able to safely handle oversize vehicles, or large vehicles like trucks, buses, emergency vehicles, road maintenance vehicles?	☑	☐	
If required, can the road be closed for special events in a safe manner?	☑	☐	
If applicable, are special requirements of scenic or tourist routes satisfied?	☐	☐	N/A
Have all other matters which may have a bearing on safety been addressed?	☑	☐	

APPENDIX E

Certification Statement and Authorisation

Appendix B: Traffic impact assessment certification

Certification of Traffic Impact Assessment Report

Registered Professional Engineer Queensland

for

Project title:	10-32 Lionel Turner Drive. Mt Low, 4818 Lot 2 on SP218628 Traffic Impact Assessment (IPA0002C)

As a professional engineer registered by the Board of Professional Engineers of Queensland pursuant to the *Professional Engineers Act 2002* as competent in my areas of nominated expertise, I understand and recognise:

- the significant role of engineering as a profession, and that
- the community has a legitimate expectation that my certification affixed to this engineering work can be trusted, and that
- I am responsible for ensuring its preparation has satisfied all necessary standards, conduct and contemporary practice.

As the responsible RPEQ, I certify:

(i) I am satisfied that all submitted components comprising this traffic impact assessment, listed in the following table, have been completed in accordance with the *Guide to Traffic Impact Assessment* published by the Queensland Department of Transport and Main Roads and using sound engineering principles, and

(ii) where specialised areas of work have not been under my direct supervision, I have reviewed the outcomes of the work and consider the work and its outcomes as suitable for the purposes of this traffic impact assessment, and that

(iii) the outcomes of this traffic impact assessment are a true reflection of results of assessment, and that

(iv) I believe the strategies recommended for mitigating impacts by this traffic impact assessment, embrace contemporary practice initiatives and will deliver the desired outcomes.

Name:	Derek Saw	RPEQ No:	7363
RPEQ competencies:	Civil		
Signature:		Date:	8th October 2025
Postal address:	50 Punari Street, Currajong. 4812		
Email:	derek.saw@nceng.com.au		

Traffic impact assessment components to which this certification applies	✓
1. Introduction	
Background	✓
Scope and study area	✓
Pre-lodgement meeting notes	
2. Existing Conditions	
Land use and zoning	✓
Adjacent land uses / approvals	✓
Surrounding road network details	✓
Traffic volumes	✓
Intersection and network performance	✓
Road safety issues	✓
Site access	✓
Public transport (if applicable)	✓
Active transport (if applicable)	✓
Parking (if applicable)	✓
Pavement (if applicable)	
Transport infrastructure (if applicable)	✓
3. Proposed Development Details	
Development site plan	✓
Operational details (including year of opening of each stage and any relevant catchment / market analysis)	✓
Proposed access and parking	✓
4. Development Traffic	
Traffic generation (by development stage if relevant and considering light and heavy vehicle trips)	✓
Trip distribution	✓
Development traffic volumes on the network	✓
5. Impact Assessment and Mitigation	
With and without development traffic volumes	✓
Construction traffic impact assessment and mitigation (if applicable)	✓
Road safety impact assessment and mitigation	✓
Access and frontage impact assessment and mitigation	✓
Intersection delay impact assessment and mitigation	
Road link capacity assessment and mitigation	✓
Pavement impact assessment and mitigation	
Transport infrastructure impact assessment and mitigation	✓
Other impacts assessment relevant to the specific development type / location (if applicable)	✓

Traffic impact assessment components to which this certification applies	✓
6. Conclusions and Recommendations	
Summary of impacts and mitigation measures proposed	✓
Certification statement and authorisation	✓
[change above and / or insert other component as needed]	