

**PRELIMINARY ENGINEERING DESIGN REPORT FOR 3
RESIDENTIAL UNITS AT 4 THOMAS STREET,
TOOWOOMBA CITY, QLD**

Prepared for Zhongyu Liu & Yang Zhou

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1. INTRODUCTION

Vosloo Consulting Engineers Pty Ltd (VCE) was appointed by Zhongyu Liu and Yang Zhou to prepare the preliminary stormwater and earthworks design, as well as a conceptual Stormwater Management Plan (SWMP) for 3 residential units on Lots 23 and 24 on RP16681, at 4 Thomas Street, Toowoomba City. The preliminary designs and SWMP are documented in this Preliminary Engineering Design (PED) Report, which was prepared to accompany the Development Application (DA) to Toowoomba Regional Council (TRC).

1.1. Purpose of the report

The purpose of the report is to document the design criteria and standards adopted for the preliminary engineering designs, report results of preliminary designs, document the proposed SWMP and provide an assessment of the site's suitability for the proposed development, with the intent of obtaining an agreement from TRC that the proposed development can occur in accordance with TRC Planning Scheme Policies (PSP) and standards.

1.2. Scope of services

VCE's scope of professional engineering services are limited to undertaking preliminary earthworks and stormwater designs, the preparation of a conceptual stormwater management plan and this PED Report.

1.3. Site description

The subject site is located at 4 Thomas Street in Toowoomba City (Lots 23 and 24 on RP16681) and is 910m² in area. The fall of the land is predominately from north-east to south-west with an average slope of 3%.

An old timber house is currently located within the front half of the site with a lawn, garden beds and a few trees in the back yard. The site is located within the Low-Medium Density Residential land zone in the TRC Planning Scheme.

The site is bounded on the southern boundary by several industrial and commercial buildings close to the rear property boundary. Adjacent to the western side of the site is a relatively new office complex that was developed on 6 Thomas Street (Lots 25 and 26 on RP16681).

The site location is indicated by a flag on the locality map in Figure 1 on page 2.

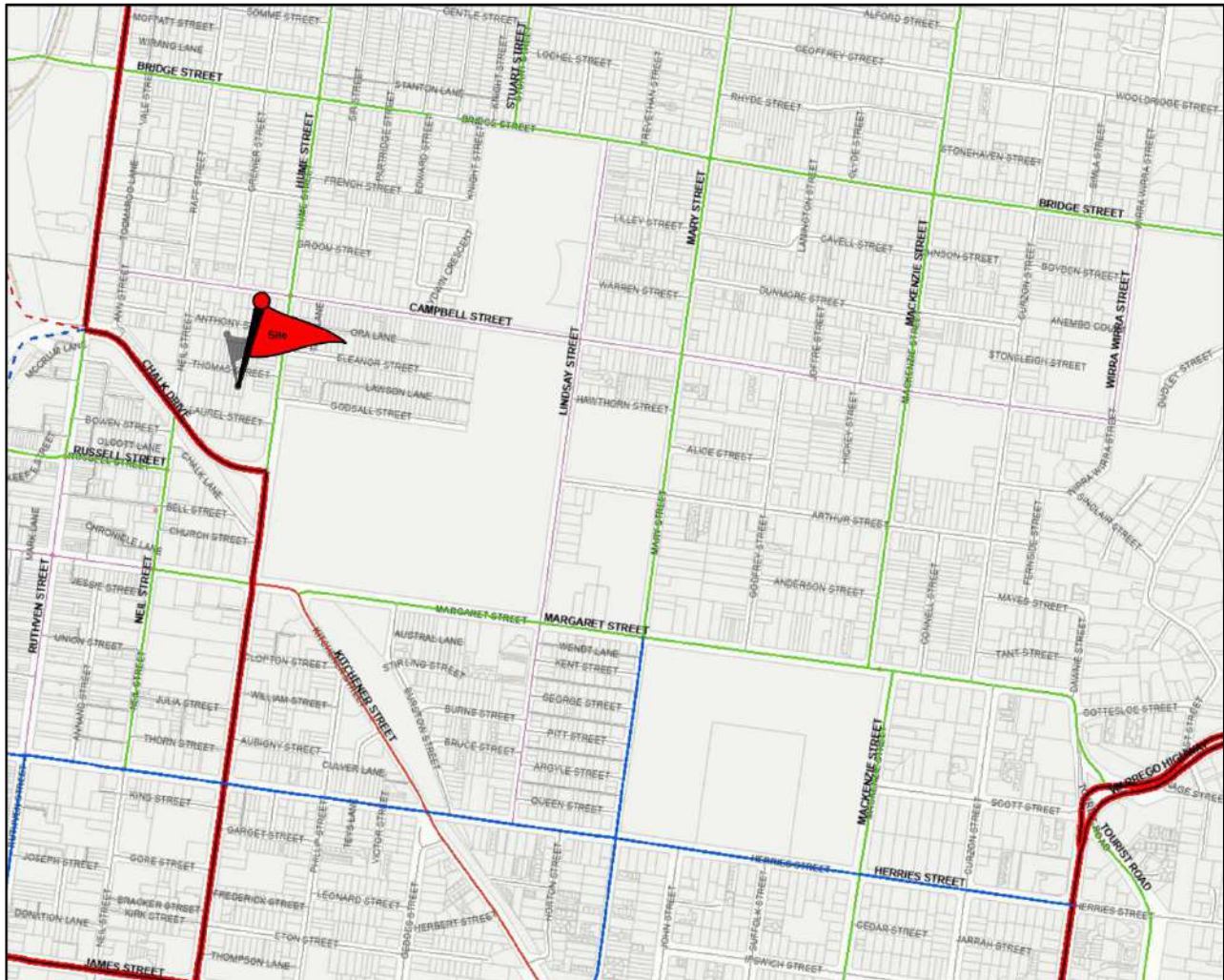


Figure 1: Site locality map

1.4. Proposed development

The proposed development is three (3) residential units to be registered as a Community Title Scheme, with a Body Corporate to manage common property and services. Unit 1 will be a single storey dwelling with 3 bedrooms and 1 garage. Units 2 and 3 will be a double-storey-attached dwelling, each with 3 bedrooms and a double carport. Vehicle access is proposed by two (2) new driveway crossovers from Thomas Street.

It is proposed to clear the site and to remove the existing dwelling and outbuildings to make way for the proposed new dwellings. The site will require earthworks fill to a level that allow stormwater surface flows around the units to discharge to Thomas Street. The proposed building plans designed by Duke Building Design are attached in Appendix A.

1.5. Detail level and feature survey

A detail level and feature survey (contour and detail survey) of the site was completed by Wilson Survey and Design Pty Ltd in June 2025. The contour and detail survey plan is attached in Appendix B.

2. WATER SUPPLY

The site currently has a water service connection to a DN100 UPVC water reticulation in the northern verge of Thomas Street. The existing DN100 water main, which includes a fire hydrant directly opposite the site, is ring-fed from the DN100 water mains in Hume Street and Neil Street.

The additional water demand from the two additional dwellings on the site is unlikely to have a noticeable effect on the current water supply capability. It is therefore proposed that TRC impose appropriate conditions for each of the dwellings to be supplied with a separate water service in accordance with *AS 3500.1 Plumbing and drainage Part 1: Water services* and TRC's *Water Infrastructure Policy 2.03 Sub metering Guidelines and Specifications*.

3. SEWERAGE

A DN150 VC gravity sewer is traversing the centre of the site in an east to west direction. The gravity sewer starts at Hume Street and has an approximate slope of 3.60% (grade of 1 in 27.85) for the section that are located through the site.

TRC's online mapping shows the existing dwelling's sewer property connection is one of four residential dwellings that are connected to the end-of-line sewer. The sewage load from the two additional dwellings will assist in achieving self-cleansing velocities in the sewer, the additional flow from six (6) equivalent persons (EP) is insignificant and the DN150 sewer constructed at 3.6% has ample capacity to convey the additional flows.

The sewer currently has approximately 1.61m of cover near the eastern site boundary and 1.76m near the western boundary. It is proposed that the site's finished surface be raised with earthworks fill to a level that allow stormwater surface flows to drain to the Thomas Street kerb and channel. The additional fill over the sewer will increase the sewer cover to approximately 2.16m near the eastern boundary and 2.82m near the western boundary. The sewer alignment is under the proposed concrete driveway in front of the carports for units 2 and 3. The closest carports support pier are located approximately 1.4m from the sewer, as shown on the Site Plan prepared by Duke Building Design, attached in Appendix A. The proposed carport and retaining wall footing designs will be undertaken in accordance with Queensland Development Code (QDC) *MP 1.4 – Building over or near relevant infrastructure (QDC MP 1.4)* requirements to ensure footings or support piers do not impose additional loads on the sewer that could adversely affect its structure. Retaining wall and footing designs will be undertaken during the detailed design stage of the project.

The site layout has been designed for the closest structure (which is the carport roof) to achieve the required clear zone along the sewer for maintenance purposes, in compliance with QDC MP 1.4 requirements.

It is proposed that TRC impose appropriate conditions for each of the dwellings to be connected to the existing DN150 VC sewer in accordance with *AS 3500.2 Plumbing and drainage Part 2: Sanitary plumbing and drainage* and TRC's *Wastewater Infrastructure Policy 2.04*.

4. VEHICLE ACCESS AND PARKING

The proposed vehicle access to the site is from Thomas Street via two new concrete driveway crossovers to be constructed in accordance with TRC standards. The access driveways and on-site manoeuvring areas have been designed in accordance with TRC's *PSP, AS 2890.1 Parking facilities Part 1: Off-street car parking* and QDC's *NMP 1.1 – Driveways*.

Each dwelling is provided with two (2) car parking spaces and the site layout makes provision for one (1) visitor parking space.

A Traffic Impact Assessment (TIA) report for the proposed development was prepared by Jaiden Patel Traffic Consulting and is attached in Appendix C. The TIA confirms the proposed development has negligible impact on the operation and safety of the road network.

5. SITE EARTHWORKS

VCE completed a preliminary site earthworks design to determine the required building platform levels and finished floor levels (FFL) for the units to comply with the National Construction Code (NCC) requirements for site surface drainage. It is proposed that the site be filled for the finished surfaces around the buildings to be graded to fall from the rear of the site towards Thomas Street. The site grading design aims to direct all stormwater from roof and surface areas to the proposed lawful point of discharge, which is the Thomas Street kerb and channel. Refer to section 6 of this report for a detailed explanation about the proposed stormwater management plan for the proposed development.

The proposed earthworks design is shown on the Bulk Earthworks Volumes Plan drawing number 2507-04-BE001 Revision A and Bulk Earthworks Sections drawing number 2507-04-BE002 Revision A, attached in Appendix D.

Retaining walls are required on the side and rear site boundaries to retain the fill material. The maximum retaining wall height is in the order of 1.39m in the south-western corner of the site. On the south-eastern corner the retaining wall will be 0.77m high as shown on the site design contour plan on drawing number 2507-04-BE001. The retaining wall heights gradually reduce towards the road frontage and finishes at the same level as the existing surface level at the front site boundary. Detailed design of the retaining walls will achieve compliance with TRC's *PSP, AS4678 Earth-retaining structures*, NCC requirements, QDC's *NMP 1.7 – Retaining walls and Excavation and Filling*, QDC MP 1.4 and good engineering practice.

The bulk earthworks depth plan on drawing number 2507-04-BE001 provide a visual indication of the earthwork depths in the form of depth range colour bands in 100mm intervals. The bulk earthwork depths are also shown below in Figure 2.

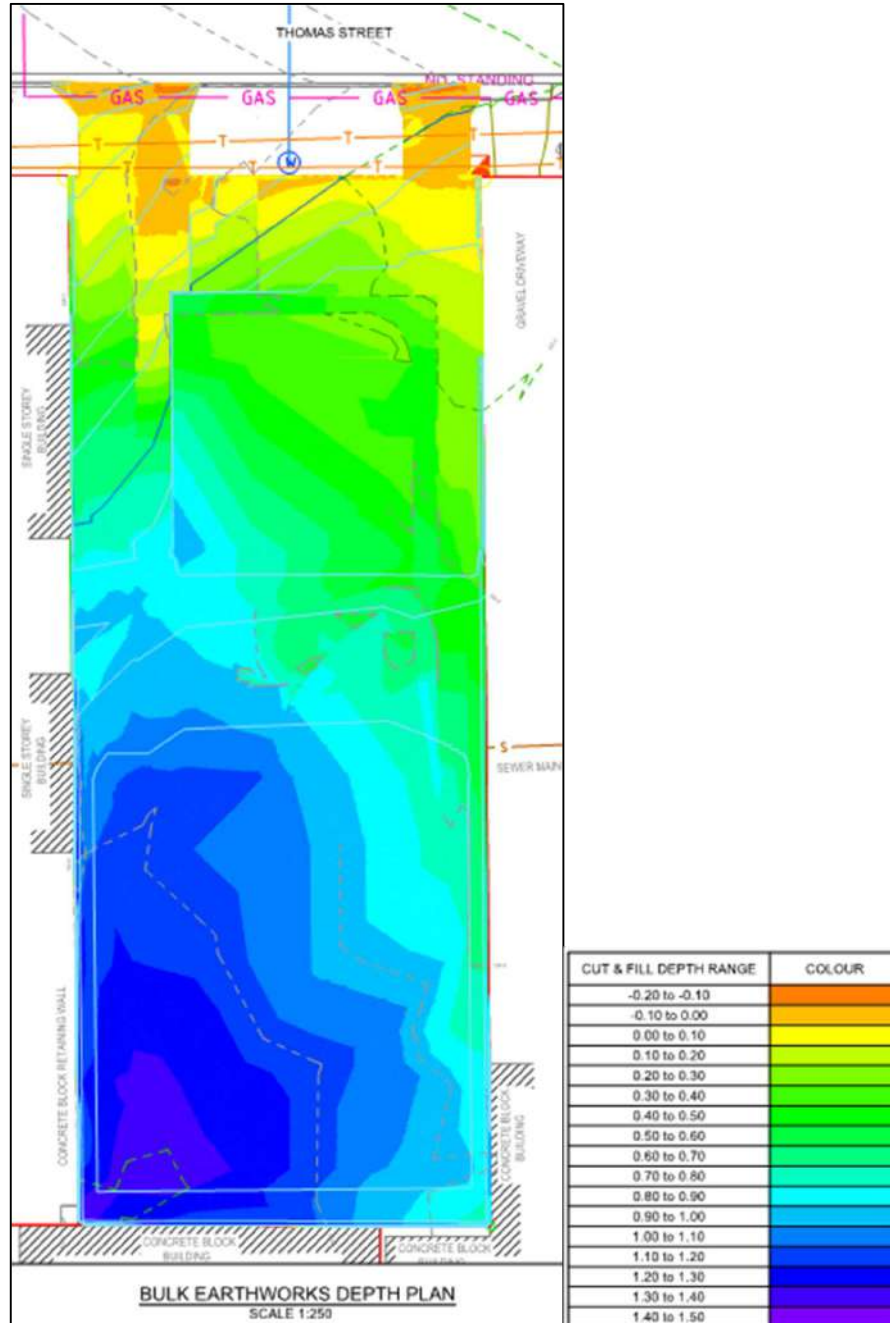


Figure 2: Bulk earthwork depths

Approximately 692m³ of fill will be imported, placed and compaction in accordance with TRC's PSP requirements and AS 3798 Guidelines on earthworks for commercial and residential developments. An earthworks detailed design will be submitted to TRC as part of an Operational

Works (OW) application and Level 1 inspection and testing will be conducted during the construction stage.

6. STORMWATER MANAGEMENT PLAN

6.1. Objective of the SWMP

The objectives of the SWMP are to address TRC's development engineering requirements, assess the potential impact of the proposed development on the surrounding environment and existing stormwater infrastructure, provide stormwater management measures to mitigate the potential impacts, and undertake hydrological and hydraulic modelling and design of the proposed management measures.

The SWMP has been undertaken in accordance with the following guidelines:

- Current TRC Planning Scheme Policies (PSP);
- Queensland Urban Drainage Manual (QUDM), 4th edition 2016;
- AS 3500.3 Plumbing and Drainage: Stormwater Drainage;
- Queensland State Planning Policy (SPP), July 2017;
- National Construction Code (NCC)
- Australian Rainfall and Runoff, A Guide to Flood Estimation (ARR 2019)
- Queensland Development Code (QDC) NMP 1.8 – Stormwater drainage

6.2. Drainage philosophy and design criteria

The proposed stormwater drainage philosophy is to collect runoff from roof and surface areas within the allotment and convey by means of a combination of underground stormwater pipe systems and overland flow to the Thomas Street kerb and channel as the proposed lawful point of discharge (discharge point 2). Runoff from the upstream catchment that flow into the site will be collected in an inter-allotment drainage pipe and conveyed to a different lawful point of discharge (discharge point 1).

The Rational Method was used to estimate the peak flows from various drainage areas for the pre-development and post-development scenarios. The Intensity Frequency Duration (IFD) and Design Rainfall Depth Tables for the site were obtained from the Bureau of Meteorology (BOM) website and are attached in Appendix E. The time of concentration was calculated based on the methods recommended in QUDM and AS 3500.3. Stormwater runoff was estimated for the design storms shown in Table 1.

The design intent is for roof water resulting from up to a 20-year ARI (5% AEP) design storm event to be captured within the gutters and downpipes and discharged to the underground drainage pipes on site, in accordance with guidelines in AS 3500.3. Stormwater flows above the 5% AEP design storm bypasses the system and discharges to the surrounding finished surface which has been designed with a slope to convey stormwater runoff to the proposed grated trench drains and grated inlet pits within the allotment.

Table 1: Design storms

Average Recurrence Intervals (ARI) in years	Annual Exceedance Probabilities (AEP) in % Or Exceedances per Year (EY)
1-year ARI	63.20% AEP
2-year ARI	39.35% AEP or 0.5 EY
5-year ARI	18.13% AEP or 0.2 EY
10-year ARI	10% AEP
20-year ARI	5% AEP
50-year ARI	2% AEP
100-year ARI	1% AEP

The effect of surcharge and overland flow was assessed as potentially significant with ponding against adjoining buildings and flows entering buildings being possible if not designed appropriately. The on-site surface drainage system was therefore designed for a 5% AEP storm event. However, the proposed system was also checked for compliance with overland flow criteria from events up to a 1% AEP storm.

The proposed stormwater quantity management measures are based on the design criteria as outlined in the TRC *PSP No 2 – Engineering Standards – Roads and Drainage Infrastructure*, QUDM and AS3500.3. A summary of the adopted design ARI or AEP, and other design criteria are provided in Table 2.

Table 2: Stormwater design criteria

Parameter	Design criteria	Reference
Street minor drainage system	Minimum 2-year ARI (0.5 EY)	TRC PSP No 2 – Table SC6.2.7
Site minor drainage system	5% AEP	AS3500.3 Table 5.4.3
Major drainage system	Minimum 1% AEP (less piped flow)	TRC PSP No 2 – Table SC6.2.7
Minor road kerb & channel flow	Minimum 0.5 EY	TRC PSP No 2 – Table SC6.2.7
Roof drainage	5% AEP	AS3500.3 Table 3.3.4
Min. time of concentration	5 minutes	QUDM Sec. 4.6.2 & AS3500.3
Level of roof & allotment drainage	Level II	QUDM Sec. 7.13.4 & TRC SC6.2.4.4.5
Fractions impervious	Calculated	QUDM Sec. 4.5

6.3. Pre-development hydrology

A stormwater catchment plan was prepared based on contours from a detail survey of the site, LiDAR contours on TRC's online mapping system, aerial images and observations during a site inspection. The sub-catchments that were used to calculate the pre-development stormwater runoffs indicated on the stormwater catchment plan drawing number 2507-04-D001, attached in Appendix D. The Rational Method calculations are attached in Appendix F. Figure 3 is an extract from drawing number 2507-04-D001 and shows the sub-catchment numbers, boundaries and flow direction for each.

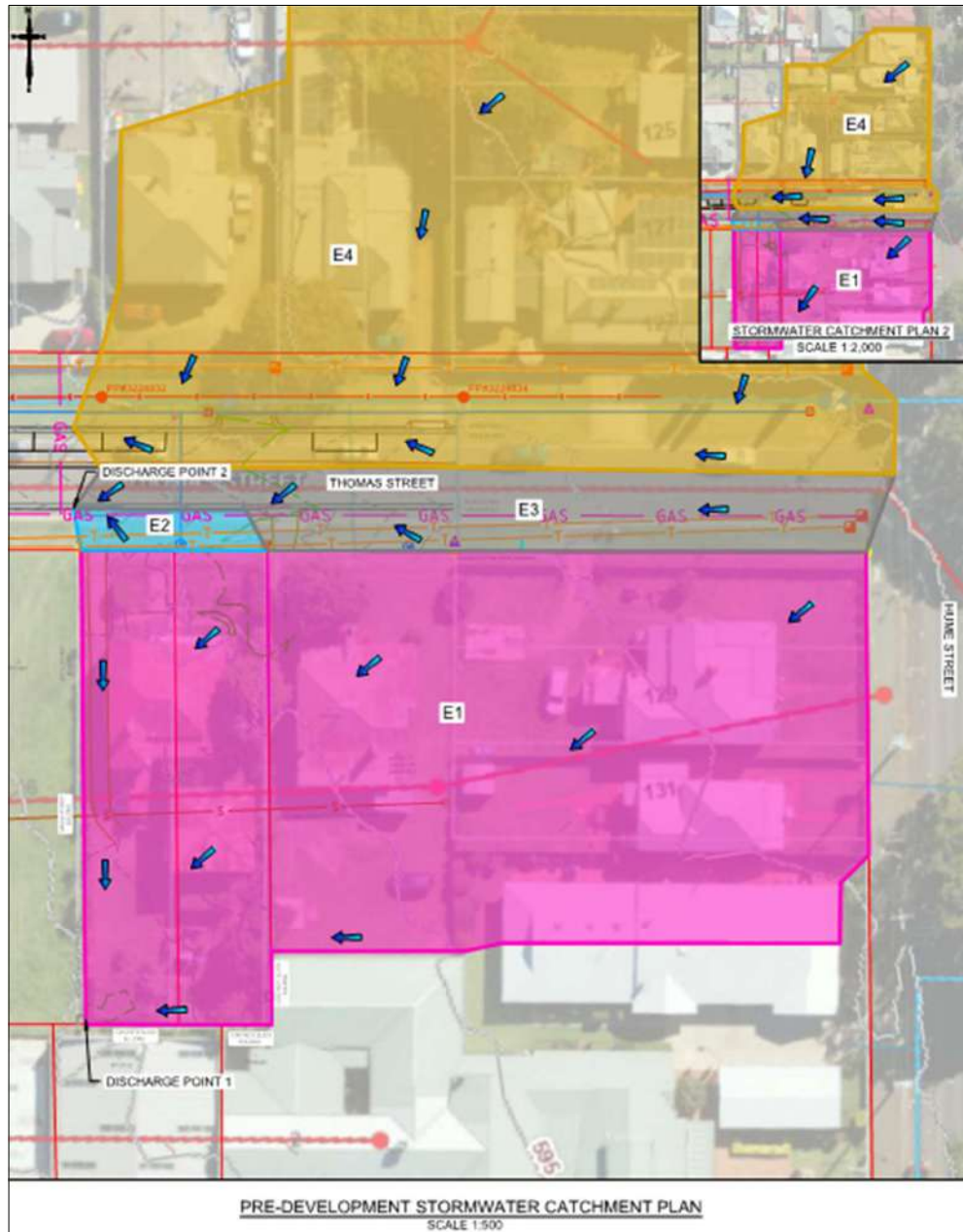


Figure 3: Pre-development sub-catchment boundaries

Stormwater sub-catchment areas, fraction impervious (f_i), time of concentration (t_c) and 10-year discharge coefficient (C_{10}) for each sub-catchment is shown in Table 3. Aerial imagery and measurements in CAD was used to determine the fraction impervious for sub-catchments.

Table 3: Pre-development sub-catchment data

Sub-catchment no.	Area (m ²)	f_i	t_c (min.)	C_{10}
E1	3,340	0.39	15	0.64
E2	75	0.19	5	0.55
E3	601	0.58	5	0.71
E4	4,590	0.85	15	0.84

Two (2) discharge points have been identified to compare the pre-development and post-development runoff scenarios. The discharge points are indicated on the stormwater catchment plan and are described below.

- Discharge point 1 is a DN150 PVC pipe that was installed below the carpark on number 6 Thomas Street (Lot 25 and 26 on RP16681) when the site was redeveloped as professional offices. The pipe is located along the rear boundary of 6 Thomas Street and was designed by Reid Consulting Engineers to convey stormwater from sub-catchment E1 to the lower part of the catchment where it discharges onto number 8 Thomas Street (Lot 27 on RP73716).
- Discharge point 2 is the Thomas Street kerb and channel on the western side of the development site, which is the proposed lawful point of discharge for post-development stormwater runoff.

Stormwater from pre-development sub-catchment E1 mostly flows as sheet flow with some concentrated overland flows from upstream adjoining residential allotments through the development site before reaching the DN150 PVC pipe under the carpark within 6 Thomas Street. An opening in the retaining wall on the shared boundary between 4 and 6 Thomas Streets allows the stormwater to enter the DN150 pipe. The professional offices at 6 Thomas Street were developed on earthwork fill to raise the finished surface and building pad for stormwater to be conveyed to the Thomas Street kerb and channel under gravity head.

Pre-development sub-catchments E2 and E3 are the verge and street pavement surfaces upstream of discharge point 2 and were included in the analysis to determine the Thomas Street kerb and channel stormwater carrying capacity. Sub-catchment E4 is the residential land on the northern side of Thomas Street and the road reserve (half road) which was also included in the analysis to determine road carrying capacity.

A summary of the pre-development design storm flowrates is provided in Table 4.

Table 4: Pre-development runoff flowrates

Discharge point	0.5 EY (L/s)	0.2 EY (L/s)	10% AEP (L/s)	5% AEP (L/s)	1% AEP (L/s)
Discharge point 1	40.28	56.62	69.63	84.26	126.04
Discharge point 2	8.92	12.54	15.42	18.66	27.92

6.4. Post-development hydrology and hydraulics

The post-development sub-catchments areas are also indicated on the stormwater catchment plan, attached in Appendix D. Figure 4 is an extract from drawing number 2507-04-D001 and shows the post-development sub-catchment numbers, boundaries and flow direction for each.

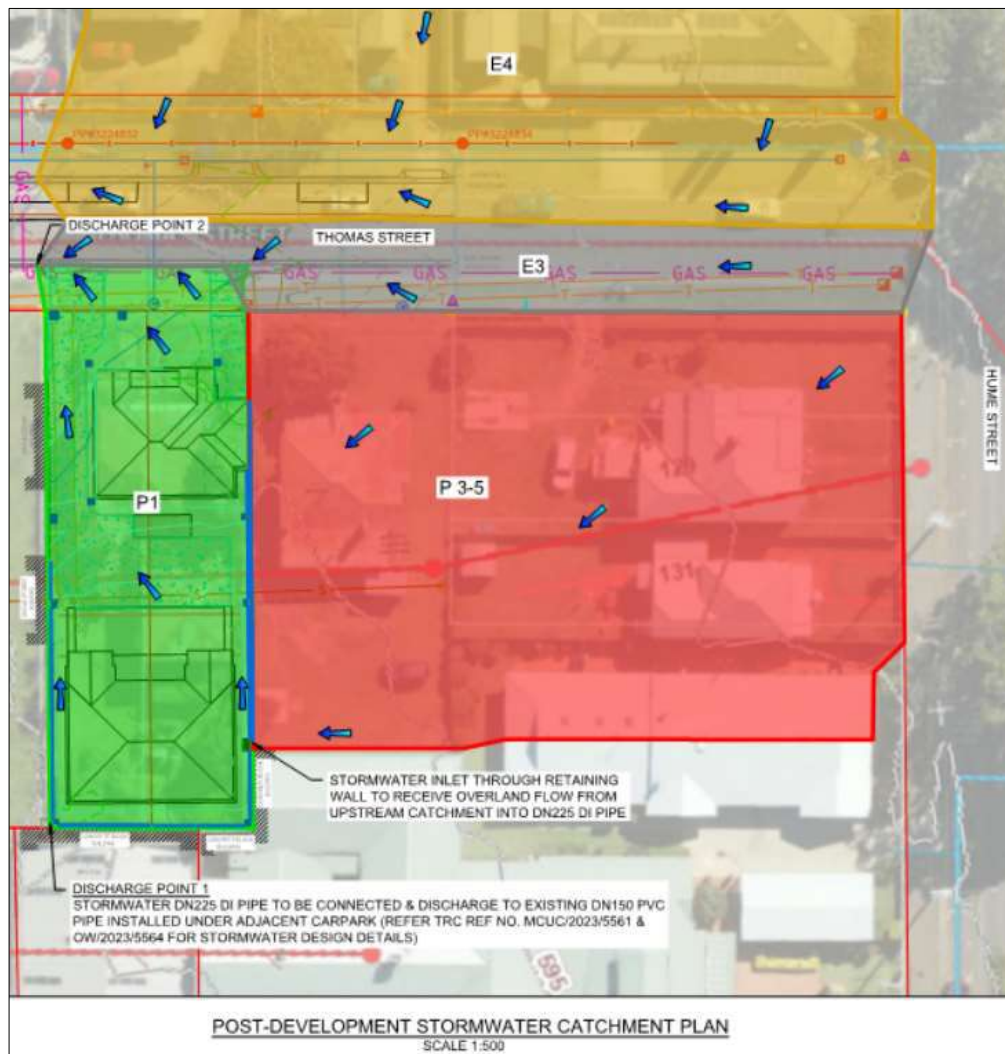


Figure 4: Post-development sub-catchment boundaries

Stormwater sub-catchment parameters used in the Rational Method calculations for the post-development scenario are shown in Table 5.

Table 5: Post-development sub-catchment data

Sub-catchment no.	Area (m ²)	f _i	t _c (min.)	C ₁₀
P 3-5	2,420	0.39	15	0.64
P1	993	0.75	5	0.79
E3	601	0.58	5	0.71
E4	4,590	0.85	15	0.84

A summary of the post-development design storm flowrates is provided in Table 6.

Table 6: Post-development runoff flowrates

Discharge point	0.5 EY (L/s)	0.2 EY (L/s)	10% AEP (L/s)	5% AEP (L/s)	1% AEP (L/s)
Discharge point 1	29.36	41.28	50.77	61.44	91.90
Discharge point 2	33.96	48.24	59.25	71.81	108.88

The preliminary design for the proposed stormwater design for the development site is shown on the stormwater layout plan drawing number 2507-04-D002, attached in Appendix D. Figure 5 is an extract from drawing number 2507-04-D002 that shows the proposed stormwater design.

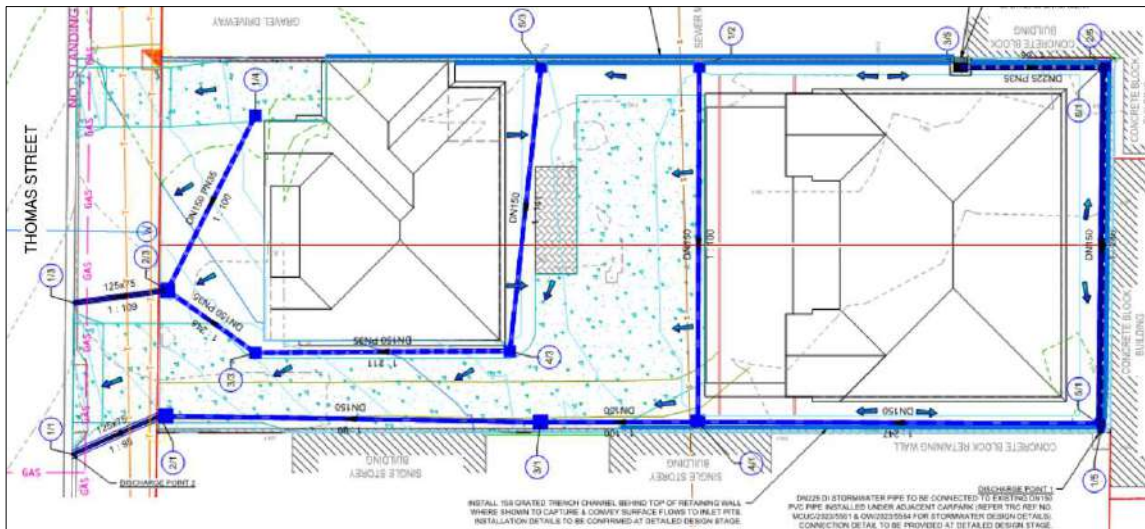


Figure 5: Proposed stormwater design

The proposed allotment drainage system consists of grated pits and channels that collect stormwater and then convey the same to discharge at two locations along the Thomas Street kerb and channel. Discharge to two locations is proposed to spread the flow over the property frontage in order to not exceed TRC's preferred 50 L/s discharge limit per discharge location at the kerb and channel. Each discharge to the kerb and channel will be through a series of hot dipped galvanized RHS steel sections in the street verge. Stormwater infrastructure sizes and grades will be confirmed during detailed design. All runoff from storm events up to the 1% AEP event will be discharged to Thomas Street (discharge point 2) via a combination of piped and surface flows.

Stormwater from the upstream catchment P 3-5 will flow to the same location as per the pre-development scenario, which is the backyard of 8 Thomas Street. This will be achieved by installing a DN225 DI inter-allotment pipe at the rear boundary of the proposed development. The DN225 DI pipe is sized to convey the 1% AEP flowrate from sub-catchment P 3-5 under the site fill and discharge to the existing DN150 inter-allotment drainage pipe through 6 Thomas Street (discharge point 1). A grated trench channel will be installed along the toe of the new retaining wall on the eastern site boundary. The channel will ensure that overland flow from the upstream catchment do not adversely affect the retaining wall. Pipe and pit connection details will be prepared during detailed design and submitted to TRC for OW approval prior to the construction stage.

A comparison of the pre- and post-development flowrates are provided in Table 7.

Table 7: Pre- and post-development runoff flowrate comparison

DP*	Development condition	0.5 EY (L/s)	0.2 EY (L/s)	10% AEP (L/s)	5% AEP (L/s)	1% AEP (L/s)
DP 1	Pre-development	40.28	56.62	69.63	84.26	126.04
	Post-development	29.36	41.28	50.77	61.44	91.90
	Flowrate increase / (decrease) in L/s	(10.92)	(15.34)	(18.86)	(22.82)	(34.14)
	% increase / (decrease)	(27.1%)	(27.1%)	(27.1%)	(27.1%)	(27.1%)
DP 2	Pre-development	8.92	12.54	15.42	18.66	27.92
	Post-development	33.96	48.24	59.25	71.81	108.88
	Flowrate increase / (decrease) in L/s	25.04	35.70	43.83	53.15	80.96
	% increase / (decrease)	281%	285%	284%	285%	290%

*DP denotes discharge point

6.5. Proposed lawful point of discharge

The proposed site fill and allotment stormwater system will result in a 27.1% reduction in stormwater runoff that flows to discharge point 1, which is the DN150 PVC inter-allotment drainage pipe at the rear of 6 Thomas Street. Since the backyard of 8 Thomas Street is not

under the control of TRC and the stormwater overland flow path is blocked by buildings, discharge point 1 is not a suitable lawful point of discharge for the proposed development.

It is proposed that the development's roof and surface drainage system convey stormwater runoff to the Thomas Street kerb and channel as the proposed lawful point of discharge. To demonstrate that this proposed stormwater management measure would not cause a nuisance or a case of actionable damage to properties downstream of the site, an assessment of the Thomas Street capacity to safely convey the additional stormwater flows from the proposed development was undertaken. This was done for the 0.5 EY (2-year ARI) and 1% AEP storm events.

The Thomas Street capacity to safely convey stormwater flows was calculated based on Izzard's equation for half road flow, as well as the Manning equation for open channels as defined in AS 3500.3 (equation 5.4.9). Izzard's equation gives a more conservative estimate than the Manning equation and was therefore adopted to estimate the street capacity. Thomas Street has a 7.9m wide carriageway (between kerb inverts) with 150mm high barrier kerbs on both sides of the street. It is classified as a local residential access street and has an average longitudinal slope of approximately 3.3% and a 3% two-way crossfall. The street's maximum carrying capacity for a minor storm was estimated based on the top water level being equal to the top of kerb. The capacity for a major storm was taken as the flowrate when the top water level is 50 mm above the top of kerb.

A summary of the calculation results using the Izzard's equation are provided in Table 8.

Table 8: Thomas Street half road flow capacity using Izzard's equation

Flow depth - d_g (mm)	Max. flow rate (L/s)	Flow area (m^2)	Flow width (m)	Velocity (m/s)	$d_g \cdot v_{ave}$ (m^2/s)
150	505.3	0.243	3.99	2.08	0.31
200	791.7	0.473	5.10	1.67	0.33

As shown by the stormwater runoff comparison on the stormwater catchment plan attached in Appendix D and the Rational Method calculations in Appendix F, the post-development flows to the proposed lawful point of discharge (discharge point 2) for a 1% AEP storm is 108.88 L/s, which is well below the Thomas Street half road stormwater carrying capacity. The 1% AEP flows on the northern side of Thomas Street directly opposite discharge point 2 is 226.95 L/s. The Thomas Street kerb and channel therefore have ample capacity to accommodate the additional runoff from the proposed development.

The proposed development is located low in the larger East Creek catchment and is close to the East Creek channel along Chalk Drive. No on-site detention is proposed so that the street drainage system in Thomas and Neil Streets can convey the site's stormwater to the East Creek channel before the upstream catchment peak arrives. If on-site detention were provided, the

site peak discharge would be reduced but discharge would occur over a prolonged period, which could coincide with the upstream peak and cause an increase in flowrates in East Creek.

At the low end of Thomas Street (at the junction with Neil Street) stormwater flows in the kerb and channel is collected by grated kerb inlet structures on both sides of the street before being conveyed to East Creek through pipes over a distance of 116m.

On the basis of the aforementioned calculations and our demonstration that the proposed stormwater system is unlikely to cause an actionable nuisance, it is proposed that TRC accept this proposal for stormwater from the proposed development to discharge to the Thomas Street kerb and channel without on-site detention storage.

6.6. Stormwater quality management

Stormwater quality design objectives outlined in the SPP (July 2017) recommend the following pollutant reduction targets are achieved for residential developments located within the Western Queensland zone:

- 85 % reduction in Total Suspended Solids (TSS);
- 60 % reduction in Total Phosphorus (TP);
- 45 % reduction in Total Nitrogen (TN); and
- 90 % reduction in Gross Pollutants > 5 mm.

The proposed development is exempt from being required to meet the water quality design objectives because the development site is less than 2,500m² in area and the proposed development does not result in six or more dwellings. As such, no stormwater quality modelling was undertaken for the proposed development and no stormwater quality works are proposed.

7. POWER SUPPLY AND TELECOMMUNICATIONS

The site is currently supplied with electricity and the contour survey has identified that a gas main and two telecommunications cables are located in the southern road verge of Thomas Street.

Each of the units will be provided with an electricity supply by the local Electricity Supplier. An online nbn address check shows that a Fibre to the Premises (FTTP) service is available to the site.

8. CONCLUSION

The engineering assessment undertaken demonstrates that the development site can be developed with three (3) residential units in compliance with TRC and industry development engineering standards.

There is an existing DN100 UPVC water reticulation main in the northern verge of Thomas Street and it is proposed that each of the units to be supplied with water service from this main.

A DN150 VC gravity sewer is traversing the centre of the site in an east to west direction with an approximate slope of 3.60% (grade of 1 in 27.85) for the section that are located through the site. The sewer has ample capacity to convey the additional sewage flows from the two additional units.

Vehicle access and on-site parking are proposed to be provided in accordance with TRC and Australian Standards as demonstrated in the TIA report prepared by Jaiden Patel Traffic Consulting.

It is proposed that the site be filled for the finished surfaces around the buildings to be graded from the rear of the site towards Thomas Street. The site grading design was undertaken for all stormwater from roof and surface areas on the development site to be conveyed to Thomas Street.

Each of the units will be provided with an electricity supply and a Fibre to the Premises (FTTP) nbn service is available to the site.

VCE has undertaken pre-development and post-development hydrologic and hydraulic analysis of the proposed stormwater management system and estimated stormwater runoff for the 63.20% AEP (1-year ARI) up to the 1% AEP storm events. Stormwater quantity management measures for runoff from the proposed development site were designed to a level of detail commensurate with TRC's requirements for a conceptual SWMP.

The stormwater design and analysis results indicate that the proposed development do not cause a nuisance and should not result in negative impacts external to the site. The proposed lawful point of discharge for the allotment drainage system is the Thomas Street kerb and channel.