STORMWATER MANAGEMENT PLAN

Commercial Development

38-50 MacArthur Street, Sale 3850

Job Reference: 254029

Prepared for: Thexton Smith

ATTENTION:

[redacted]

Date: 13-08-2025

APPROVED DEVELOPMENT PLAN
PLANNING AND ENVIRONMENT ACT 1987
WELLINGTON PLANNING SCHEME
Clause 43.04 Schedule 1

DP NAME: Sale CBD

DATE: 21/01/2026
SIGNED: Barry Hearsey
OFFICER TITLE: Manager Planning and Building

(Page: 1 of 35)

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Document Control

Version	Date	Author	Checker
V001	31-07-2025	[redacted]	
V002	13-08-2025		

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1 Introduction

BCE Design has been engaged by Thexton Smith to provide a stormwater management plan (SMP) for the proposed commercial development at 38-50 MacArthur Street, Sale, VIC, 3850.

This report addresses the Stormwater Management response for the proposed development works. The proposed stormwater management strategy addresses the following building elements:

- New two (2) story commercial area with basement parking and a loading dock.

The report is also intended to satisfy the Stormwater Management Policy (Water Sensitive Urban Design) Clause 22.18-4, and clause 53.18 Stormwater Management in Urban Development.

The purpose of this report is to demonstrate:

- The hydrological and hydraulic analysis supporting the strategy.
- The indicative drainage conditions of the developed site.
- Compliance with stormwater retardation and stormwater treatment requirements.
- Compliance with town planning criteria.
- Provide stormwater management initiatives for the project during the construction phase of the development.

This report further identifies specific requirements for the stormwater drainage system as required by the Infrastructure Design Manual dated 23rd June 2025. The specific requirements include:

- Identification and evaluation of the existing drainage network on the site.
- Propose a Legal Point of Discharge (LPOD).
- Present measures to improve the stormwater discharge quality from the site in accordance with '*Melbourne Water*' WSUD Guidelines which may include:
    - Re-use tanks.
    - Onsite detention.
    - Onsite treatment.
- Assess the major drainage network catering for the 1 in 100-year (1% Annual Exceedance Probability) storm event to pass through the development site without causing damage or nuisance to the adjoining lots.
- Assess the minor drainage network catering for the 1 in 10-year (10% AEP) storm event to pass through the development site without causing damage or nuisance to the adjoining lots.
- All areas of the development are being drained by means of an underground drainage system to retain a post-development 1 in 10 Year (10% AEP) storm event for the critical

storm duration. Discharge from the site must be limited to an equivalent pre-development flow based on a 1 in 1 Year (63.2% AEP) storm event for the critical storm duration and be connected to the existing council drainage system.

1.1 Project Site

The project site is bound by MacArthur Street in the North, Pearson Street to the West and New Railway Road to the South. It is bound by a Desailly Street and a car park in the East.

Figure 1.0: Existing Site – 38-50 MacArthur Street, Sale VIC

1.2 Site Description

The proposed development is situated within the Wellington Shire Council area, bounded by Macarthur Street to the north, Desailly Street to the east, Pearson Street to the west, and New Railway Road to the south. The site is currently occupied by a Bunnings warehouse, with associated vehicular parking distributed around the perimeter. Stormwater drainage infrastructure is present along all four boundary roads, facilitating the discharge of stormwater from the site.

Assessment of Existing Drainage Conditions

The site's stormwater management system has been evaluated based on the following key sources of information:

- **Topographic Survey Data** – A detailed survey was provided by Beveridge Williams (Survey Reference No. 2402360, dated 26/09/2024), which includes site levels, existing drainage infrastructure, and surrounding road profiles. Refer to Appendix E for survey information.

- **Council Drainage Records** – Wellington Shire Council has supplied asset information pertaining to the existing stormwater network external to the site, including pipe sizes

and pit locations (Refer to Appendix F for full details). We importantly note, pipe gradients, and invert levels have not been supplied.

- **Site Inspection Findings** – A visual assessment was conducted by BCE Design on 08/08/2025 to verify the condition and functionality of both internal and external drainage networks, with supporting sketches provided in Appendix G (Sketch SK004).

Summary of Existing Stormwater Infrastructure

1. **Internal Drainage System for Bunnings warehouse:**
   - Stormwater runoff from the warehouse roof is collected via downpipes and directed into grated surface pits and trench drains across the site.
   - These pits are interconnected via an underground pipe network, which conveys stormwater to an external discharge point located within the footpath along New Railway Road.
   - The external outlet pit located on New Railway Road has an approximate depth of 1.4 metres and connects to a 525mm diameter council stormwater drain.

2. **External Drainage Network**

   New Railway Road (Southern Boundary)

   - The existing stormwater drainage aligns in an east-west direction and connects into a junction pit that caters to flows from the upstream catchment.
   - A gentle longitudinal fall along the road ensures overland flows are directed towards a side entry pit *(This side entry pit shall be used as one of the proposed legal point of discharge for the new and proposed development, pending further approval from the council)*.

   Desailly Street & Pearson Street (Eastern and Western Boundaries)

   - Side entry pits on both streets are positioned to capture overland flows generated from both the road reserve and adjacent properties.
   - The drainage network splits flow in two directions:
   - **North-South:** Stormwater is conveyed towards New Railway Road, where it integrates with council's underground drainage network.
   - **South-North:** Flows are directed into the underground drainage network on Macarthur Street.

   Macarthur Street (Northern Boundary)

   - The drainage system receives stormwater from the northern sections of both Pearson Street and Desailly Street, with pipes designed to manage stormwater flows.

Preliminary assessment of existing drainage infrastructure

The existing stormwater infrastructure demonstrates sufficient capacity to manage current runoff conditions, with appropriate road cross-falls and pit placements ensuring effective flow capture.

The proposed development will need to integrate with these systems while ensuring compliance with Wellington Shire Council's stormwater management requirements.

Further analysis will be undertaken to confirm system adequacy for future conditions.

1.3 Development Summary

Address:	38-50 MacArthur Street, Sale VIC 3850
Development Type:	Commercial development.
Total Area:	8,235 m^2 approx.
Pervious Area:	385 m^2 (Landscaping and permeable pavement)
Impervious Area:	7,850 m^2 (Roofs, balconies and pavements)
Buildings:	1 Retail building.

- Total Roof area 7,492 m^2

Importantly noting the above areas are approximates only and subject to change.

1.4 Proposed Developed Site

The proposed development site is shown in figure 1.1 below. The development has approximately 7,929 m^2 (96.3%) impermeable surfaces and 305 m^2 (3.7%) permeable surfaces (landscape, nature strip, etc.).

The development will comprise of one (1) commercial building.

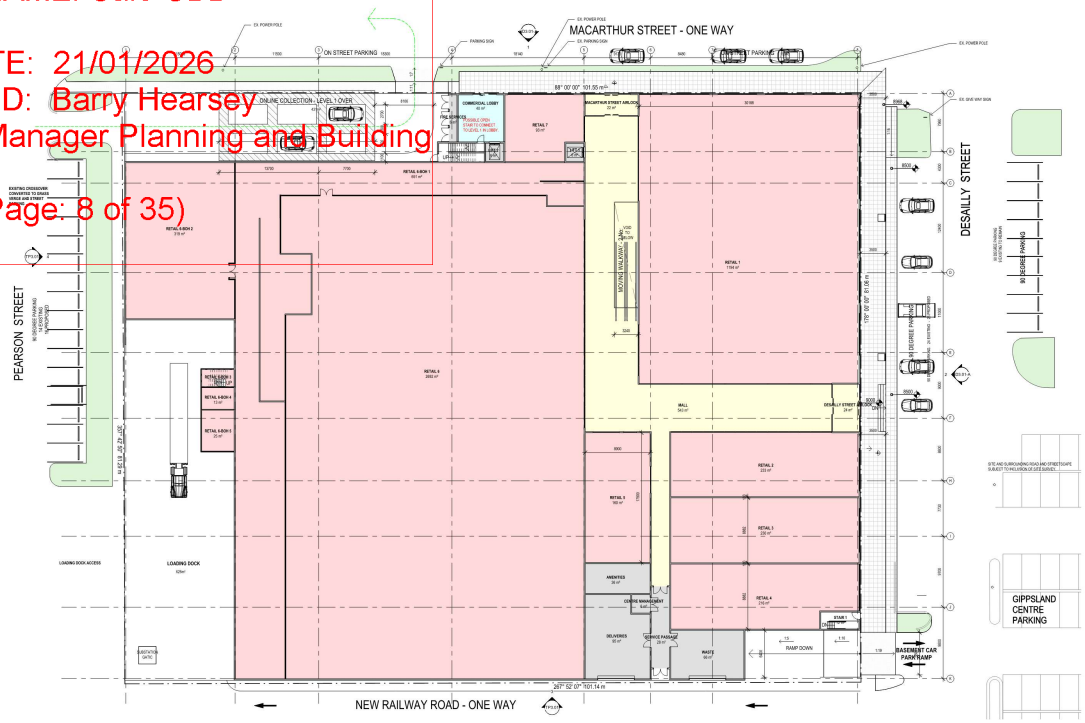

Figure 1.1: Proposed Site – 38-50 MacArthur Street, Sale VIC

Due to the existing condition of the site consisting predominantly of a level building, there are no significant falls within the proposed development. It is proposed that the developed site will be slightly built up and graded towards the roadways from the building to achieve sufficient stormwater overland flow path.

The developed site will consist of the following drainage components:

- An internal drainage network capable of accommodating 10% AEP (1 in 10 Year ARI) peak flow in the form of grated pits, floor wastes and pipe networks.
- A detention system capable of restricting the post development flows to predevelopment flow levels. (Predevelopment flow rates of 1 in 1 year (63.2% AEP), and post development storage rates of 1 in 10 year (10% AEP).
- A major overland flow drainage system conveying the 1 % AEP (1 in 100 Year ARI) peak flow event.

Additionally, 'Water Sensitive Urban Design' initiatives will be incorporated to treat the stormwater associated with the building works to the satisfaction of the Wellington Shire Council.

'Water Sensitive Urban Design' (WSUD) initiatives may include:

- On-site retention.
- On-site detention.
- Gross pollutant traps or rain gardens.

We additionally note the following:

- Proposed measures to enhance stormwater discharge quality from the site in accordance with Melbourne Water WSUD guidelines are utilised in the design.
- A major drainage network catering for the 1% AEP storm event to pass through the development without causing damage or nuisance to adjacent lots.
- It is anticipated that stormwater runoff from the proposed development will be directed to two Legal Points of Discharge (LPOD) locations. One via a connection to the council's side entry pit on McArthur Street (north-west corner of the site), and the other via a connection to the side entry pit on New Railway Road (south-west corner). These discharge points are provisional and will require formal approval from the relevant Council authority. Refer to Appendix D for detailed drainage strategy and these connection points.

1.5 Hydrologic and Hydraulic Analysis – Flow Calculations

BCE has utilised the Rational Method to undertake flow calculations to estimate preliminary sizing of the internal trunk drainage network.

The following parameters have been used in the assessment of the proposed development site:

- Tc = 10, Tcs = 7.5, 1 in 1-year storm (63.2% AEP), Id = 40.6mm/hr
- Tc = 10, Tcs = 7.5, 1 in 10-year storm (10% AEP), Id = 86.6mm/hr

We note, the internal underground drainage network is to be designed to support a 10% AEP peak flow event.

We additionally note, the above and below values are consistent with information generally provided by Wellington Shire Council. Any flows that exceed this will be via overland flow mechanisms.

Table 1: Tributary Calculation Summary

	Total Site
Catchment Size	8,235 m^2
Impervious Fraction	0.963
Peak Flow 63.2% AEP	0.0894m^3/s
Peak Flow 10% AEP	0.1908m^3/s

Based on the above assessment, on-site detention will be required to ensure pre-development flows are maintained.

1.6 Minor Drainage Assessment

Approximately 7,107m^2 of the proposed development is roof area and 743m^2 is impervious surfaces and pavements.

Flow from roof surfaces will be conveyed via downpipes to underground reuse tanks. Overflows from these tanks will be directed towards the on-site detention system. The impermeable surfaces and pavements will combine and flow into the same on-site detention system. These flows will then discharge to the proposed Legal Points of Discharge (LPOD) via the internal drainage systems associated with the site.

1.7 Major Drainage Assessment

Flows that exceed the 1% AEP storm event will be provided for via overland flow. This typically occurs when roof drainage, downpipe capacity is exceeded in major storm events with overflowing of the subsurface and aerial drainage networks potentially occurring.

The overland flow paths are to be graded from the building line to the external road network, mimicking the existing condition as closely as possible where the majority of the flow enters New Railway Road.

Major event flow paths and discharge points from the site are shown in figure 1.2 below.

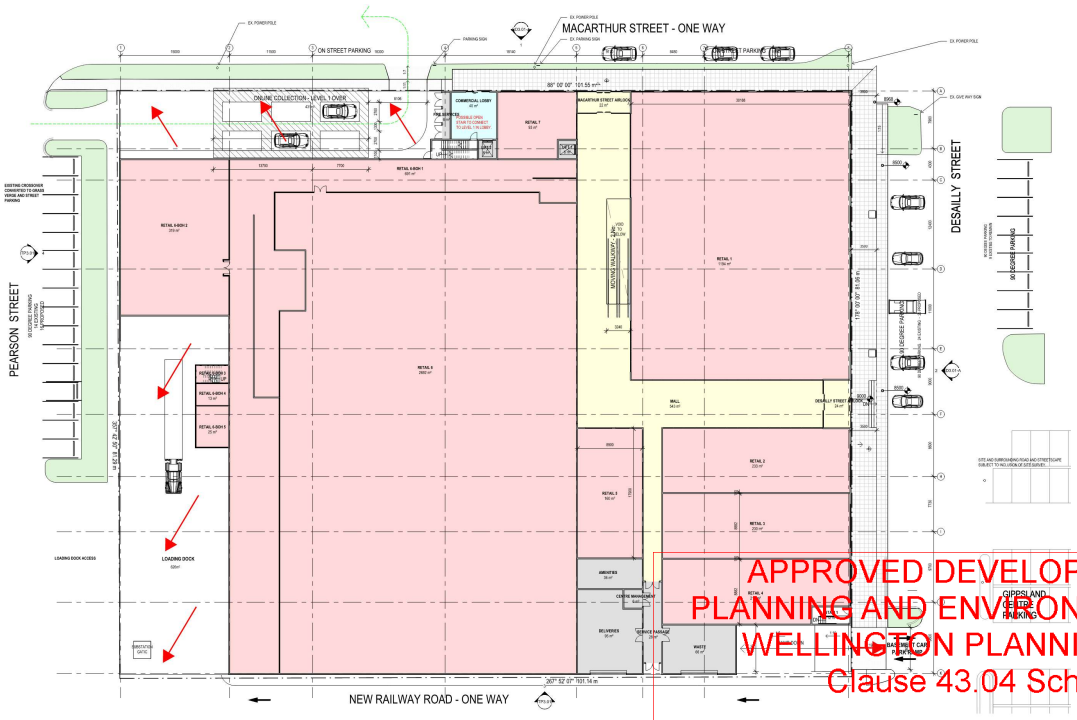

Figure 1.2: Major overland flow paths.

1.8 Stormwater Quality Summary

The improvement of stormwater quality as required by *Melbourne Water WSUD guidelines* Water Sensitive Urban Design (WSUD) treatment initiatives are proposed to reduce pollutants such as suspended solids, gross pollutants, phosphorus, and nitrogen within the project's stormwater network.

Given the nature of the proposed building, it is assumed a minimum occupancy of based on:

- Occupancy has been based on the BESS occupancy rate for the shop spaces, at 5 square meters per person. We assumed that 25% of the total occupants in each building will use the toilets during their shopping

Potential treatment initiatives include:

- Rainwater harvesting and re-use tank (20kL minimum).
- OceanProtect StormFilter PSORB 460mm x 1 unit.
- OceanProtect JellyFish JF-1500-4-1 (460).

Currently, these water quality performance objectives are (applicable to the proposed impervious areas):

a. Total Suspended Solids - >80% reduction in total suspended solids load.

b. Total Phosphorus - >45% reduction in total phosphorus load.

c. Total Nitrogen - >45% reduction on total nitrogen load.

d. Gross Pollutant - >70% reduction in gross pollutant load.

Based on the assessment of the proposed allotments the following treatment initiatives are proposed for each of the allotments to achieve satisfactory stormwater treatment targets as per below:

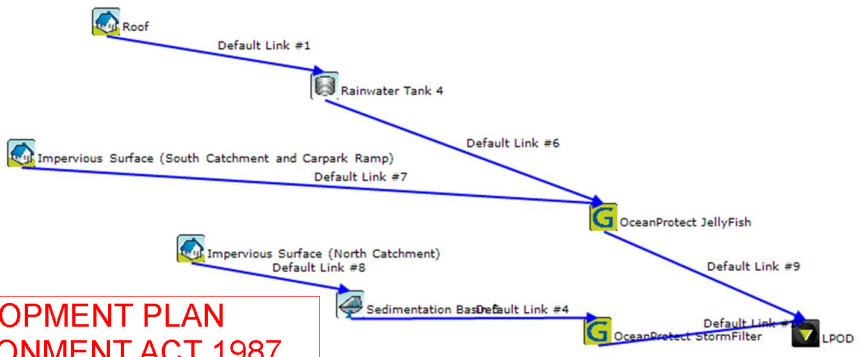

Figure 3: MUSIC Layout

Table 3: Stormwater Treatment Summary

Item	No / Volume
Rainwater Tank	25 kL
OceanProtect StormFilter PSorb 690	6 units

Table 3b: Stormwater Treatment Results

	Sources	Residual Load	% Reduction	Target %
Flow (ML/yr)	4.57	3.56	22.12	
Total Suspended Solids (kg/yr)	339.56	61.86	81.78	80
Total Phosphorus (kg/yr)	1.00	0.41	59.40	45
Total Nitrogen (kg/yr)	10.22	4.77	53.35	45
Gross Pollutants (kg/yr)	150.66	0.98	99.35	70

The following assumptions has been made for water reuse, in accordance with Melbourne Water MUSIC design guidelines (2024):

- 20L/person/day for the development.
- 1 person attending the centre per 20m^2.

As the site's basement extent covers the title boundary, it is likely that raingardens will not be feasible, and the use of proprietary products is recommended.

1.9 On site detention requirements (OSD)

As per typical Wellington Shire Council requirements to mitigate post development flows to the 63.2% AEP (1 in 1 year) pre-development rate, with connections to the Wellington Shire Council stormwater infrastructure being limited to 10% AEP (1 in 10 year) storm event. Note that these design parameters are indicative only and subject to confirmation by the Wellington Shire Council due to the development size.

Detention tanks or oversized inground pipes will be located within the development before the nominated stormwater control pits to the LPOD. It is expected that the detention system can be divided into stages to minimise construction cost for each stage.

The required storage was calculated using the Swinburne Method. The estimated pre-development and post-development flows and associated storage are indicated in table 2 below.

Table 2: Detention Calculation Summary

Parameter	Pre-Development	Post-Development	Detention Volume
Site	0.097 m^3/s	0.194 m^3/s	97.29 m^3

Legal points of discharge (LPOD) consent for the site are to be confirmed by Wellington Shire Council. Currently, BCE is assuming that the existing drainage system on New Railway Road and Desailly Street can be used as discharge points.

1.10 Design Summary

The existing stormwater infrastructure demonstrates adequate capacity to manage current runoff conditions, with appropriate road cross-falls and stormwater pits ensuring effective flow capture.

The proposed development will be integrated with the existing drainage infrastructure and will comply with Wellington Shire Council's stormwater management requirements.

Based on the findings of this report, we can conclude that the existing drainage infrastructure has sufficient capacity to cater for stormwater flows generated by the proposed development.

The following summary supports this position:

- All flows up to the 10% AEP event will be catered for via the internal drainage network and discharged to the LPOD at pre-development rate.
- All flows that exceed 10% AEP event will be catered for via overland flows.
- Stormwater discharge from the site will be retarded via onsite detention, A combined minimum detention volume of 97.29m^3 will need to be allowed for. Refer appendix B for detail.
- Flows that exceed the 1% AEP event will be via overland flow and drained naturally to the South of the site.
- Total of 20kL rainwater tanks for collection and re-use. Refer to Appendix B for detail.
- OceanProtect StormFilter PSORB 460mm and OceanProtect JellyFish JF-1500-4-1 (460) will be utilised for water treatment.
- The proposed stormwater drainage for the development is expected to discharge to two separate Legal Points of Discharge (LPOD). One outlet will connect to the council's side entry pit located on McArthur Street at the north-west corner of the site, while the other will connect to the Council's grated pit on New Railway Road at the south-west corner. Final LPOD locations are subject to Council approval.

2 Detailed Response

2.1 Site Layout

Requirement

"To illustrate the position, area draining to treatment measures, and any connection points of the following":

- Harvesting and Reuse Measures, including rainwater tanks.
- Water Quality Treatment Measures may include wetlands, rain gardens and swales.
- Infiltration Measures, including infiltration trenches and porous paving.
- Passive Irrigation Measures, including directing runoff into gardens.

Response

An indicative site layout is provided in the attached appendices.

2.2 Proposed Response (Operation Phase)

Requirement

"To summarise how the Stormwater Management (Water Sensitive Urban Design Policy) requirements are met".

Response

The proposed development makes use of water harvesting and re-use to meet Water-Sensitive Urban Design (WSUD) initiatives.

- All rainfall on new roof areas is directed to rainwater tanks subject to finalized water supply information from plant operators/ suppliers.
- Rain heads and first flush diverters will be installed to ensure any initial sediment flow, into the rainwater tanks is minimized.
- Selected toilets and garden irrigation will be supplements by harvested rainwater for the rainwater tanks.
- The garden beds which are exposed are considered permeable and allow direct ground infiltration.

2.3 Site Management Plan (Construction Phase)

Requirement

"Details specifying measures aimed at preventing sediment, pollution and litter entering stormwater systems. To advise for preparation of the WSUD site management plan".

Response

Principles from the EPA Environmental Guidelines. These principles and measures are intended to reduce runoff to adjacent properties and reduce erosion. Any waste accumulated during construction, including chemicals and food waste is to be disposed of correctly using best practice measures, described below.

Principles:

- Minimise any disturbance of land.
- Minimise time bare earth is exposed.
- Install features such as rock, vegetation, grass, etc as early as possible.
- Minimise stormwater run-off into and within site.
- Divert stormwater from exposed parts of site.
- Devise solutions for possible peak run-off flows.
- Position earth stockpiles away from run-off pathways.
- Ensure stockpiles have mild slopes (max 1:2 height to radius).

Measures:

The following measures will be implemented as required to achieve the principles listed above.

- **Mesh fabric** to minimise sediment flow, placed at porous fences and gates.
- **Silt fences** to prevent large sediment transport by installation at the base, where the site has a slope steeper than 1:20.
- **Drain filters/sediment traps** to cover pits. Any water pumped from the site must be filtered with this method.

- **Temporary down pipes** to facilitate runoff from the roof to LPOD during construction prior to installation of water tanks.
- **Crushed Rock** to stabilise site and prevent access issues on foot due to mud, as well as stabilise areas subject to heavy vehicle use.
- **Removal of mud on the cross-over and roadway** to contain mud to construction site. Maintained by removing mud from vehicles on site on the day the mud is deposited.
- **Vehicle wash down within site** to remove earth gathered from excavation.
- **Erosion control blankets** to control erosion over mounded earth, especially over any steep slopes.
- **Waste bins** to be provided for personnel as appropriate.
- **Proper disposal of paints and solvents**, to allow safe removal and disposal, separate bins will be used as appropriate.
- **Brick cleaning with acid to be avoided**, particularly on-site.

Additionally, the contractor is required to:

- **Identify and document**, where these measures are to be fitted and how erosion and waste will be managed.
- **Fit tarps on waste bins** each night.
- **Avoid overfilling vehicles** and cover soils being taken offsite.
- **Sweep the site** each day works occurs.
- **Ensure sediment and erosion measures** are operating appropriately via weekly checks and maintenance.

Figure A. Temporary downpipes (image credit: Northumberland Handyman Supplies Pty Ltd)

Figure B. Sediment trap (image credit: ERTEC Environmental Systems)

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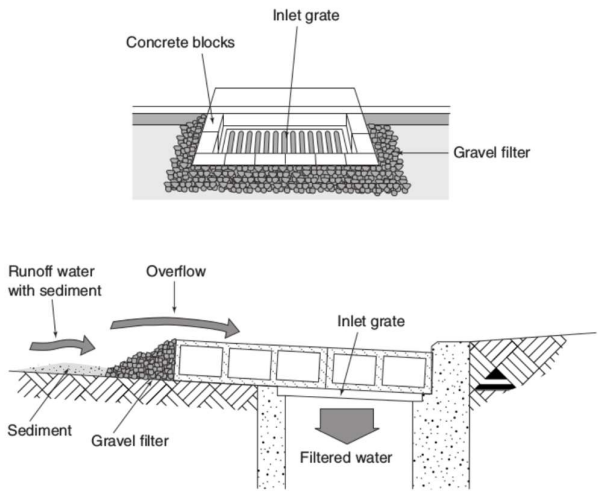

Figure D. Sediment trap (image credit: Delta T Solutions)

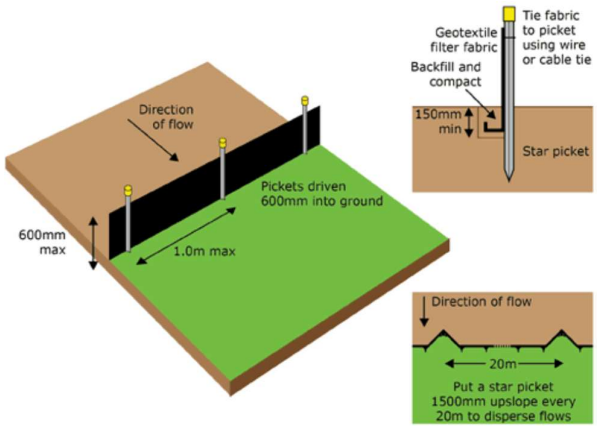

Figure E. Silt fence installation (image credit: Melbourne Water via EPA Victoria 2004, Publication 960 p.30)

Figure F. Silt Fence (image credit: US EPA, 2008)

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2.4 Maintenance Plan (Operation Phase)

Requirement

"An outline of maintenance and operational measures, which are used to ensure the proper operation of all systems".

Response

Rainwater Harvesting System

1. Roofs are to be regularly checked for debris and leaves. Some pruning may be advised.
2. First flush measures are to be checked and cleaned if appropriate every 3-6 months.
3. Screens are to be inspected every 6 months at inlet and overflow points from the tank.
4. Sludge is to be removed when the colour or smell of the tank output is significantly impacted (sludge on the tank walls is part of the purification process). Generally, this may occur when tank water levels are low.
5. Pumping systems should be checked and maintained according to the manufacturer's specifications.
6. Filters are to be checked and maintained according to the manufacturer's specifications.
7. Implementation of the maintenance schedule is the responsibility of the owner.

References

1. EPA Environmental Guidelines for Major Construction Sites, Victorian Environmental Protection Authority 1996 http://www.epa.vic.gov.au/~/media/Publications/480.pdf
2. Urban Stormwater: Best Practice Environmental Management Guidelines, CSIRO, 1999, http://www.publish.csiro.au/pid/2190.htm

Appendix A: Detention Calculations

BCE

COMMERCIAL DEVELOPMENT
38-50 MACARTHUR STREET, SALE
Civil Engineer

Page:
Project No.: 254029
Designed: [redacted]
Detention Design SD01

STORMWATER DETENTION V5.05 — BCE Design Pty Ltd

Location: Melbourne, VIC
Site: 8235m² with tc = 10 and tcs = 7.5 mins.
PSD: AEP of 63.2%, Underground rectangular tank PSD = 86.94L/s
Storage: AEP of 10%, Underground rectangular tank volume = 97.29m³

Design Criteria

Location = Melbourne, VIC
Method = E (A)RI 2001,A(E)P 2019

PSD annual exceedance probabiliy (APE) = 63.2 %
Storage annual exceedance probabiliy (APE) = 10 %

Storage method = U (A)bove,(P)ipe,(U)nderground,(C)ustom

Site Geometry

Site area (As) = 8235 m² = 0.8235 Ha
Pre-development coefficient (Cp) = 0.95
Post development coefficient (Cw) = 0.96

Total catchment (tc) = 10 minutes
Upstream catchment to site (tcs) = 7.5 minutes

Coefficient Calculations

Pre-development

Zone	Area (m²)	C	Area * C
Concrete	3157	0.90	2841
Roof	4970	1.00	4970
Gravel	0	0.30	0
Garden	108	0.40	43
Total	8235 m²		7855

Cp = ΣArea*C/Total = 0.954

Post development

Zone	Area (m²)	C	Area * C
Concrete	743	0.90	669
Roof	7107	1.00	7107
Gravel	0	0.30	0
Garden	385	0.40	154
Total	8235 m²		7930

Cw = ΣArea*C/Total = 0.963

Permissible Site Discharge (PSD) (AEP of 63.2%)

PSD Intensity (I) = 44.5 mm/hr — For catchment tc = 10 mins.
Pre-development (Qp = Cp*I*As/0.36) = 97.14 L/s
Peak post development (Qa = 2*Cw*I*As/0.36) = 196.14 L/s — =(4.405 x I) — Eq. 2.24

Storage method = U (A)bove,(P)ipe,(U)nderground,(C)ustom
Permissible site discharge (Qu = PSD) = 86.935 L/s

Above ground - Eq 3.8

$0 = PSD^2 - 2*Qa/tc*(0.667*tc*Qp/Qa + 0.75*tc+0.25*tcs)*PSD + 2*Qa*Qp$

Taking x as = PSD and solving

a = 1.0 b = -497.3 c = 38106.2

$PSD = -b \pm \sqrt{(b^2-4ac)}/(2a)$

PSD = 94.620 L/s

Below ground pipe - Eq 3.3

$Qp = PSD*[1.6*tcs/\{tc*(1-2*PSD/(3*Qa))\}-0.6*tcs^{2.47}/\{tc*(1-2*PSDp/(3*Qa))\}^{2.67}]$

= 97.14

PSD = 99.632 L/s

Below ground rectangular tank - Eq 3.4

t =tcs/(tc*(1-2*PSD/(3*Qa))) = 1.065

Qp = PSD*[0.005-0.455*t+5.228*t²-1.049*t³+2.459*t⁴-1.619*t⁵]

= 97.14

PSD = 86.935 L/s

STORMWATER DETENTION V5.05 BCE Design Pty Ltd

Design Storage Capacity (AEP of 10%)

Above ground (Vs) = $[0.5*Qa*td-[(0.875*PSD*td)(1-0.917*PSD/Qa)+(0.427*td*PSD^2/Qa)]]*60/10^3$ m³ Eq 4.23
Below ground pipe (Vs) = $[(0.5*Qa-0.637*PSD+0.089*PSD^2/Qa)*td]*60/10^3$ m³ Eq 4.8
Below ground rect. tank (Vs) = $[(0.5*Qa-0.572*PSD+0.048*PSD^2/Qa)*td]*60/10^3$ m³ Eq 4.13

td (mins)	I (mm/hr)	Qa (L/s)	Above Vs (m³)	Pipe Vs (m³)	B/G Vs (m³)
5	111.1	489.6			58.74
10	84.3	371.5			82.20
12	77.3	340.3			87.48
15	68.8	303.2			92.75
17	64.3	283.1			94.95
19	60.3	265.7			96.34
22	55.3	243.8			97.25
24	52.5	231.3			97.21
27	48.8	215.1			96.40
29	46.7	205.6			95.44

Table 1 - Storage as function of time for AEP of 10%

Type	td (mins)	I (mm/hr)	Qa (L/s)	Vs (m³)
Above				
Pipe				
B/ground	22.9	54.0	238.0	97.29

Table 2 - Storage requirements for AEP of 10%

Frequency of operation of Above Ground storage

Qop2 = 0.75 Cl 2.4.5.1
Qp2 = Qop2*Qp1 (where Qp1=PSD) = 70.97 L/s at which time above ground storage occurs
I = $360*Qp2/(2*Cw*As*10^3)$ = 16.1 mm/h Eq 4.24

Period of Storage

Time to Fill:

Above ground (tf) = td*(1-0.92*PSD/Qa) Eq 4.27
Below ground pipe (tf) = td*(1-2*PSD/(3*Qa)) Eq 3.2
Below ground rect. tank (tf) = td*(1-2*PSD/(3*Qa)) Eq 3.2

Time to empty:

Above ground (te) = $(Vs+0.33*PSD^2*td/Qa*60/10^3)*(1.14/PSD)*(10^3/60)$ Eq 4.28
Below ground pipe (te) = $1.464/PSD*(Vs+0.333*PSD^2*td/Qa*60/10^3)*(10^3/60)$ Eq 4.32
Below ground rect. tank (te) = $2.653/PSD*(Vs+0.333*PSD^2*td/Qa*60/10^3)*(10^3/60)$ Eq 4.36

Storage period (Ps = tf + te) Eq 4.26

Type	td (mins)	Qa (L/s)	Vs (L/s)	tf (mins)	te (mins)	Ps (mins)
Above						
Pipe						
B/ground	22.9	238.0	97.3	17.3	56.9	74.2

Table 3 - Period of Storage requirements for AEP of 10%

Orifice

Permissible site discharge (Qu=PSD) = 86.94 L/s (Underground storage)
Orifice coefficient (CD) = 0.61 For sharp circular orifice
Gravitational acceration (g) = 9.81 m/s²
Maximum storage depth above orifice (H) = 400 mm
Orifice flow (Q) = CD*Ao*√(2*g*H)

Therefore:
Orifice area (Ao) = 50873 mm²
Orifice diameter (D = √(4*Ao/π)) = 254.5 mm

Appendix B: Technical Measure Explained

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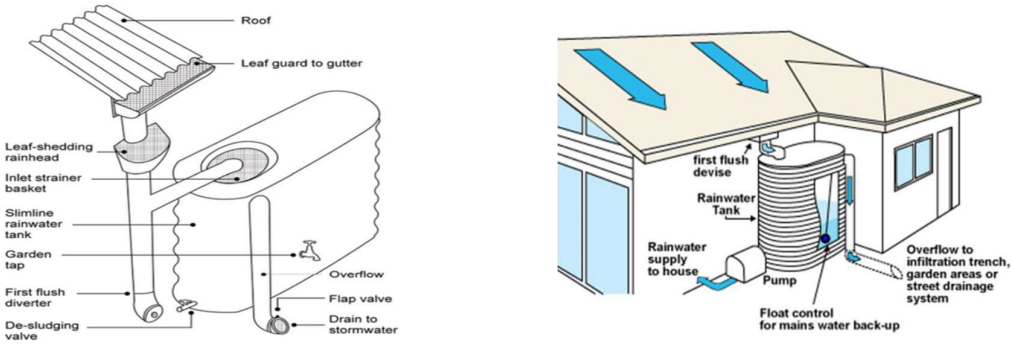
Rainwater Harvesting

Downpipes are used to transport rainwater from the rood to the rainwater tanks. These tanks can be used to provide a flow detention capacity, storage for reuse, and to treat rainwater via particle settlement. Purposes for re-use generally include irrigation, laundry and toilet services and showers.



Components of a rainwater harvesting system. Source: BlueScope Steel

Rainwater Filtration

The requirements of filtration depend on the use for the tank water. Therefore, different treatment measures are required to meet certain uses. These relationships are shown in the tables below.

Required Quality					Filter			
End use	Clear	Odourless	Low in dissolved solids	No human pathogens, toxins. heavy metals	**Fixture/ Use**	Tannin filter if tannin from trees expected	Sediment filter (e.g.: 20 micron)	Sub 1-micron absolute filter
Garden/Lawn irrigation					**Irrigation & outdoor**			
Toilet services	✓	✓			**Hot water system**	✓	✓	
Clothes washing	✓	✓			**Toilet / Washing machine**	✓		
Showering	✓	✓	✓		**Drinking water outlets cold**	✓	✓	✓
Drinking	✓	✓	✓	✓				

General considerations:

- Tank systems can be at several different levels of complexity. The simplest tank system is where downpipes flow directly into the top of a water tank as shown above. If several downpipes from around the building are collecting water for the same tank that is aboveground, a charged pipe system may be required, where water sits in the downpipes to the level of the top of the tank, and the water level stays balanced.

- Rainwater tank systems may be wet (charged) or dry. Charged systems are where the pipes from the gutter run down the wall and underground, then up into the tank. If there are long runs of pipe underground which remain full of water, they are wet systems. If the pipe network runs directly from the gutter into the tank, such that the pipes drain out the water when rainfall stops, they are dry systems.

- Aperture screens of 1mm should be included on all openings to prevent mosquito breeding.

- A first flush device should be installed into the system initially, which will divert the initial 1 or 2 minutes of runoff from the roof to minimize pollutants.

- Connection from the tank to toilets (or other regularly used end-uses) is often done to allow the tanks to be used up regularly. This ensures the tank is able to collect new rainfall water.

- Tank to mains switches, which diverts water supply from water storage tanks to mains must be installed, in the event the water storage tanks are empty. Automated and manual switches is often recommended (to account for the event of automatic switch failure).

a)

b)

c) d)

Types of rainwater tanks a) slime line; b) storage walls; c) underground tanks; d) modular
Sources: www.yourhome.gov.au/water/rainwater www.freshwater.com.au

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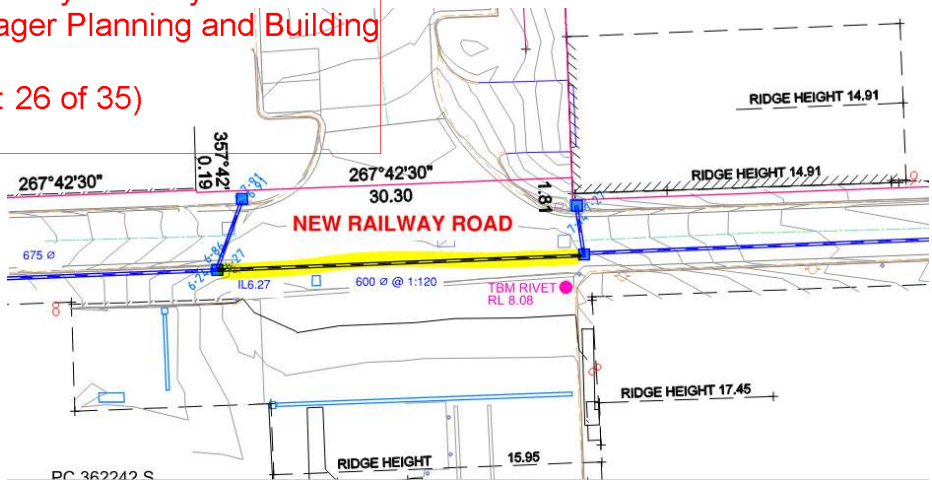
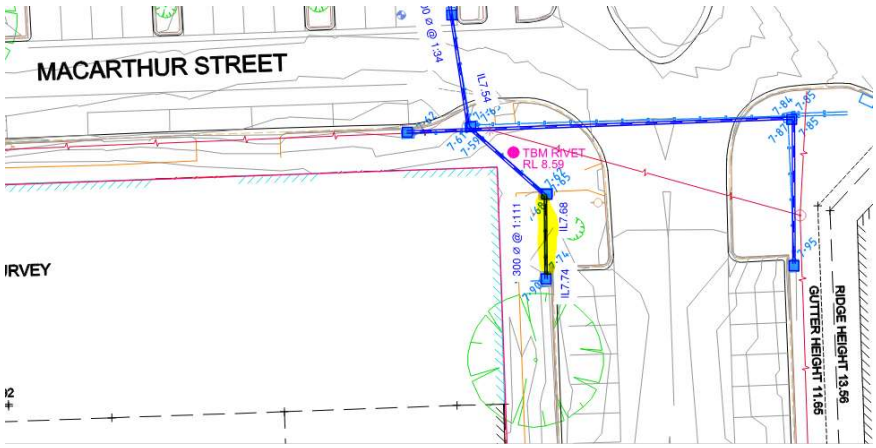
Appendix C: Assessment of the Existing Stormwater System



DIAMETER (mm)	TYPE	FALL	PIPE CAPACITY MANNING		FLOW RATE COLEBROOK-WHITE	
			l/sec	m/sec	l/sec	m/sec
600	RC	120	561	1.98	325.1	1.15



DIAMETER (mm)	TYPE	FALL	PIPE CAPACITY MANNING		FLOW RATE COLEBROOK-WHITE	
			l/sec	m/sec	l/sec	m/sec
300	RC	111	92	1.30	60.8	0.86

Appendix D: Concept Civil Drainage Plans

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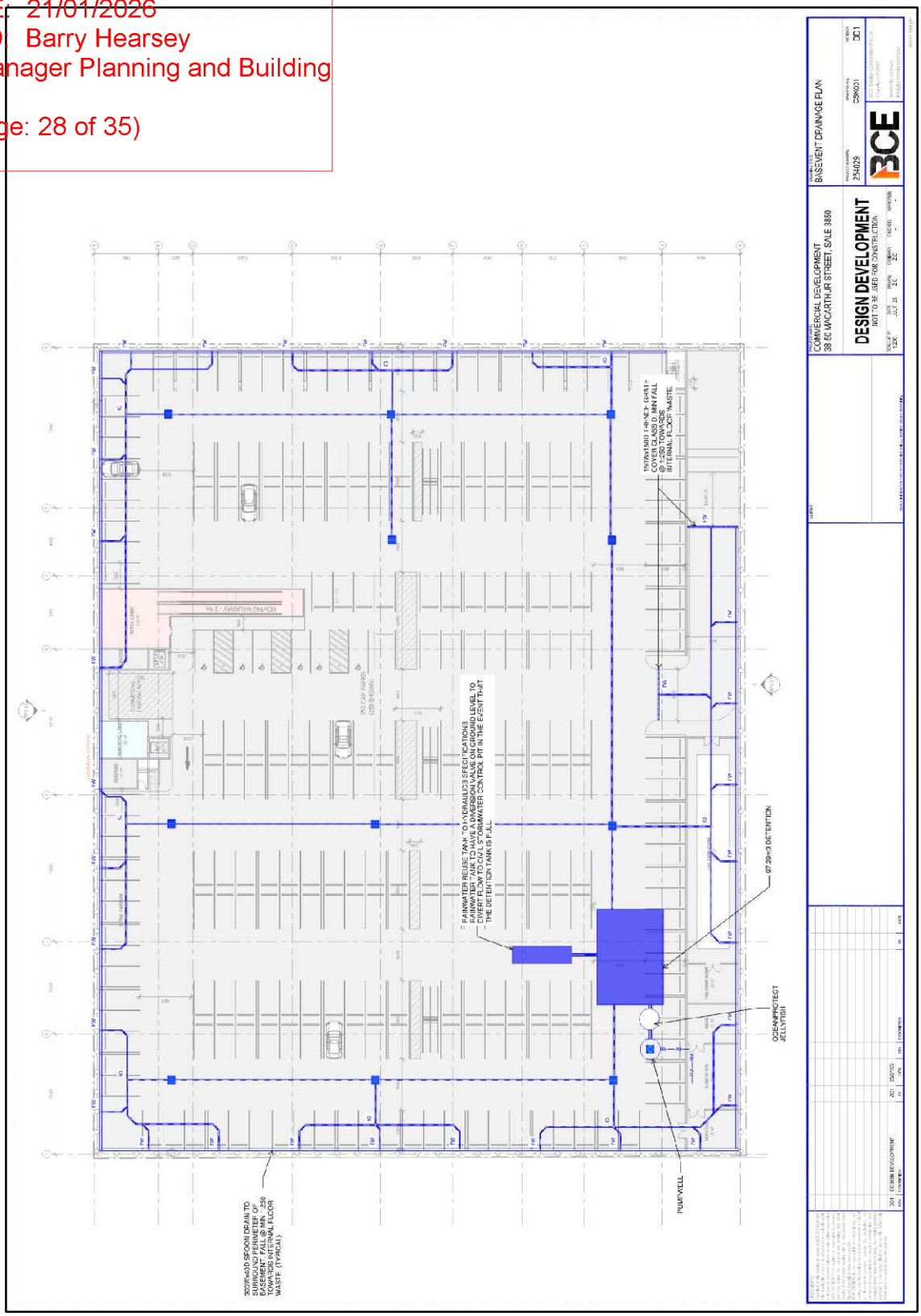

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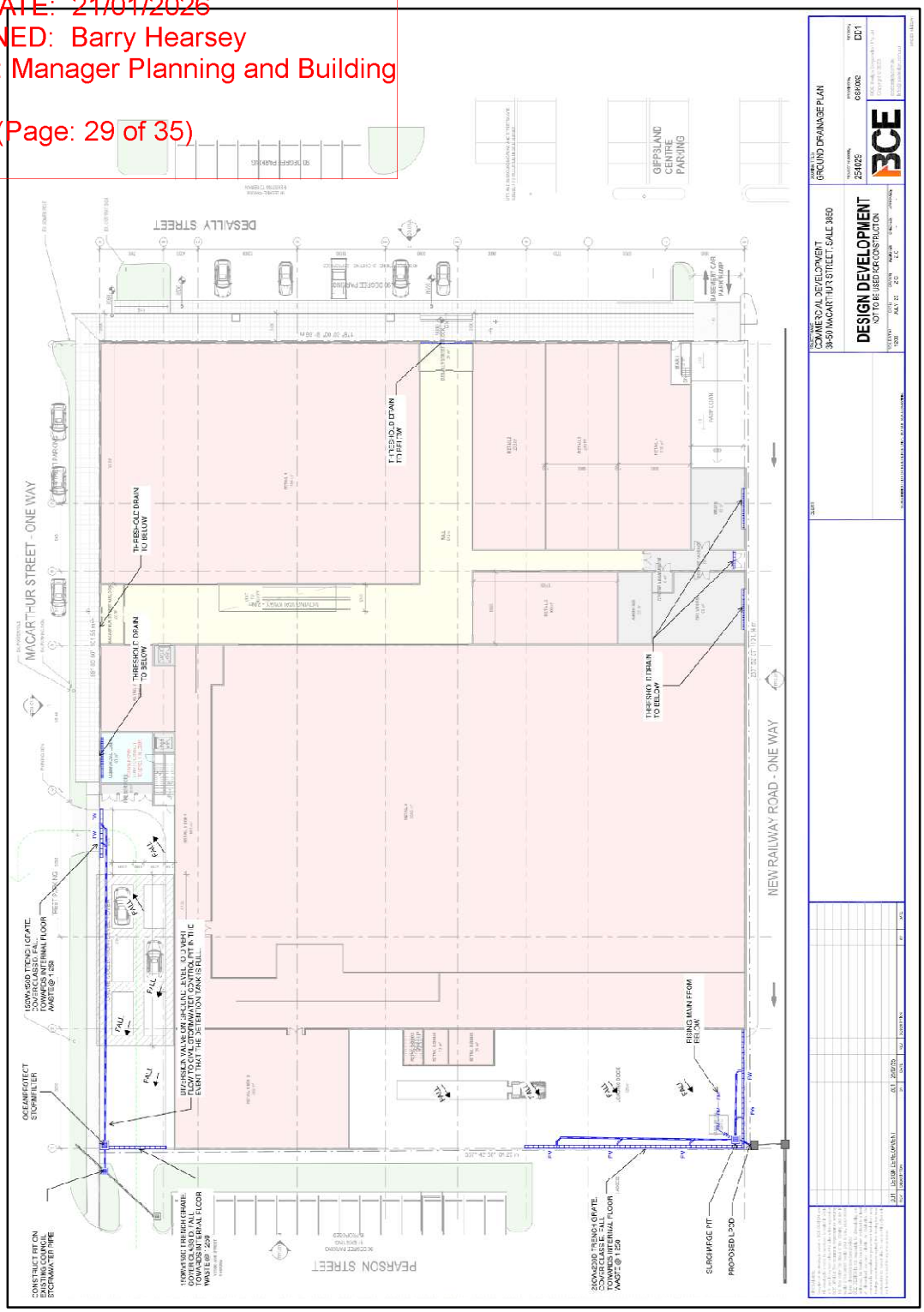

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Appendix E: Survey Information

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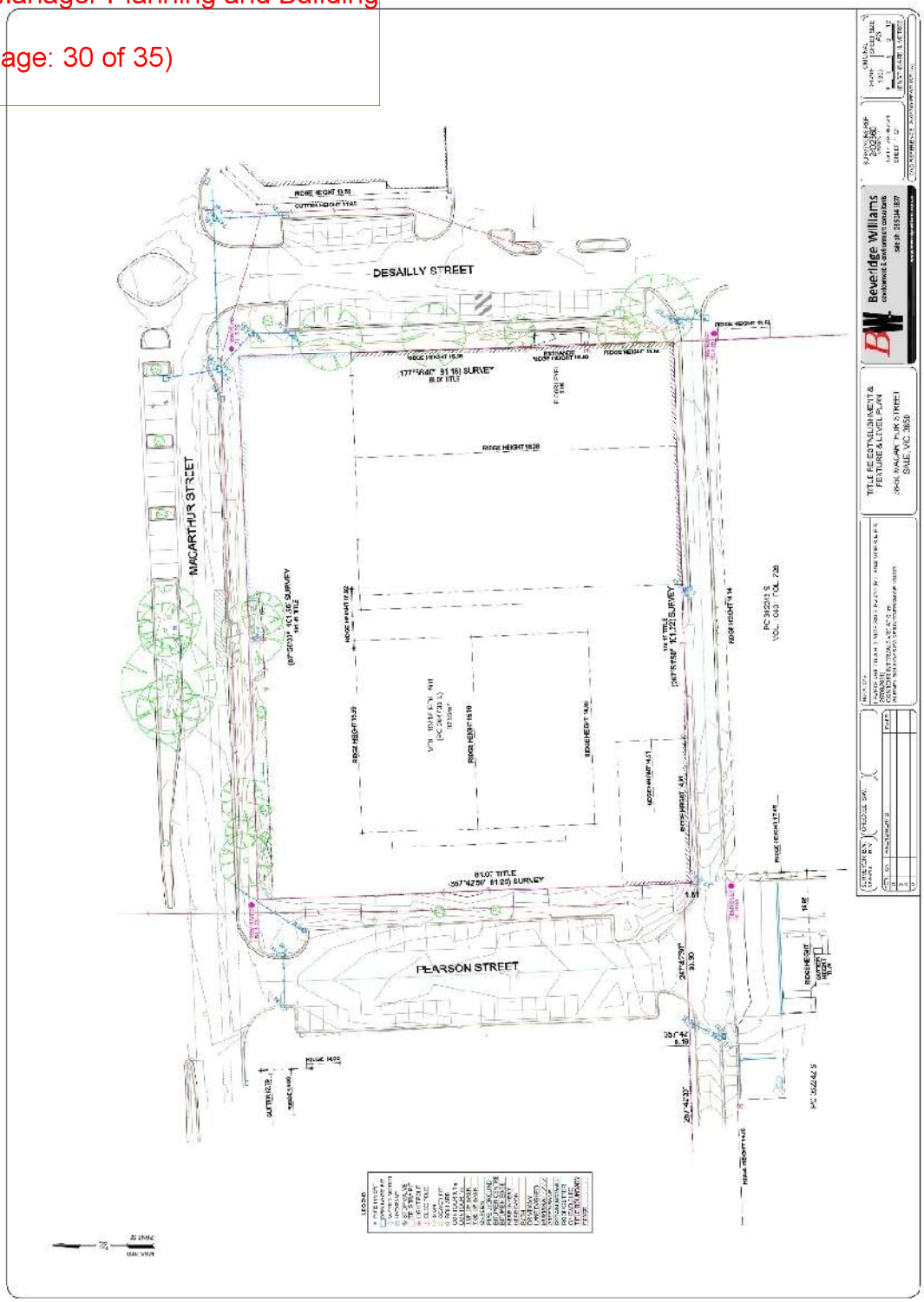
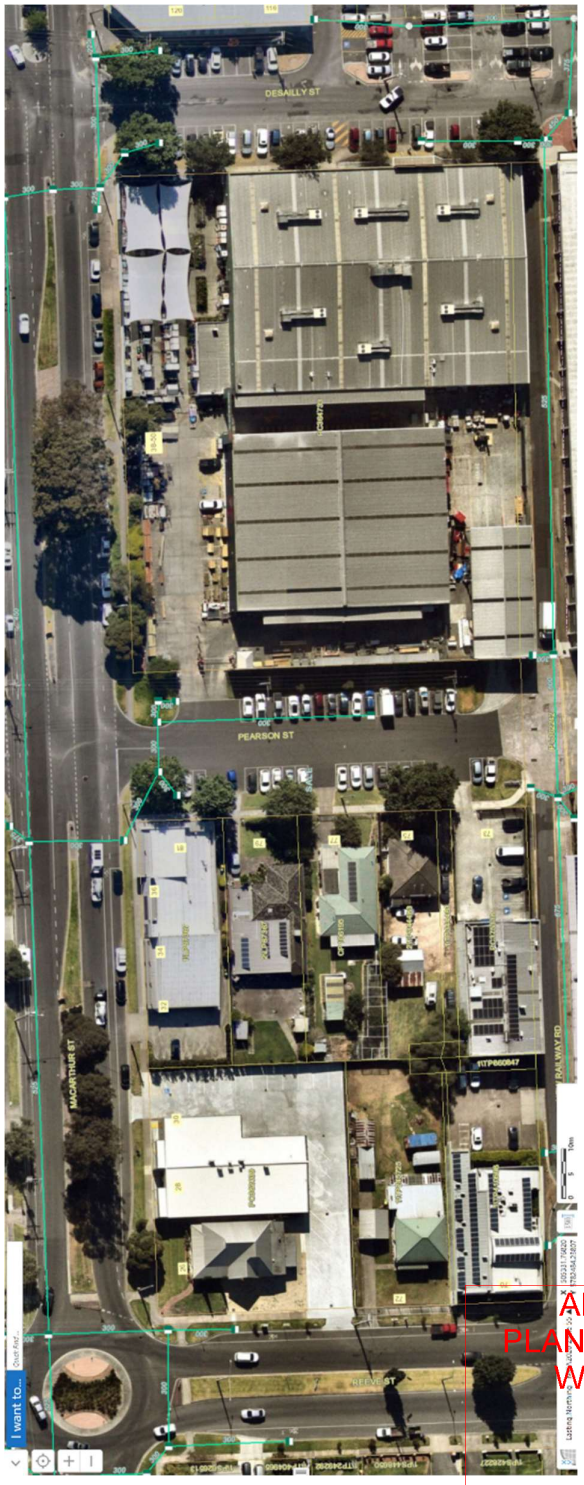


Appendix F: Council's Existing Drainage Information



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Appendix G: SK004 – Site Visit

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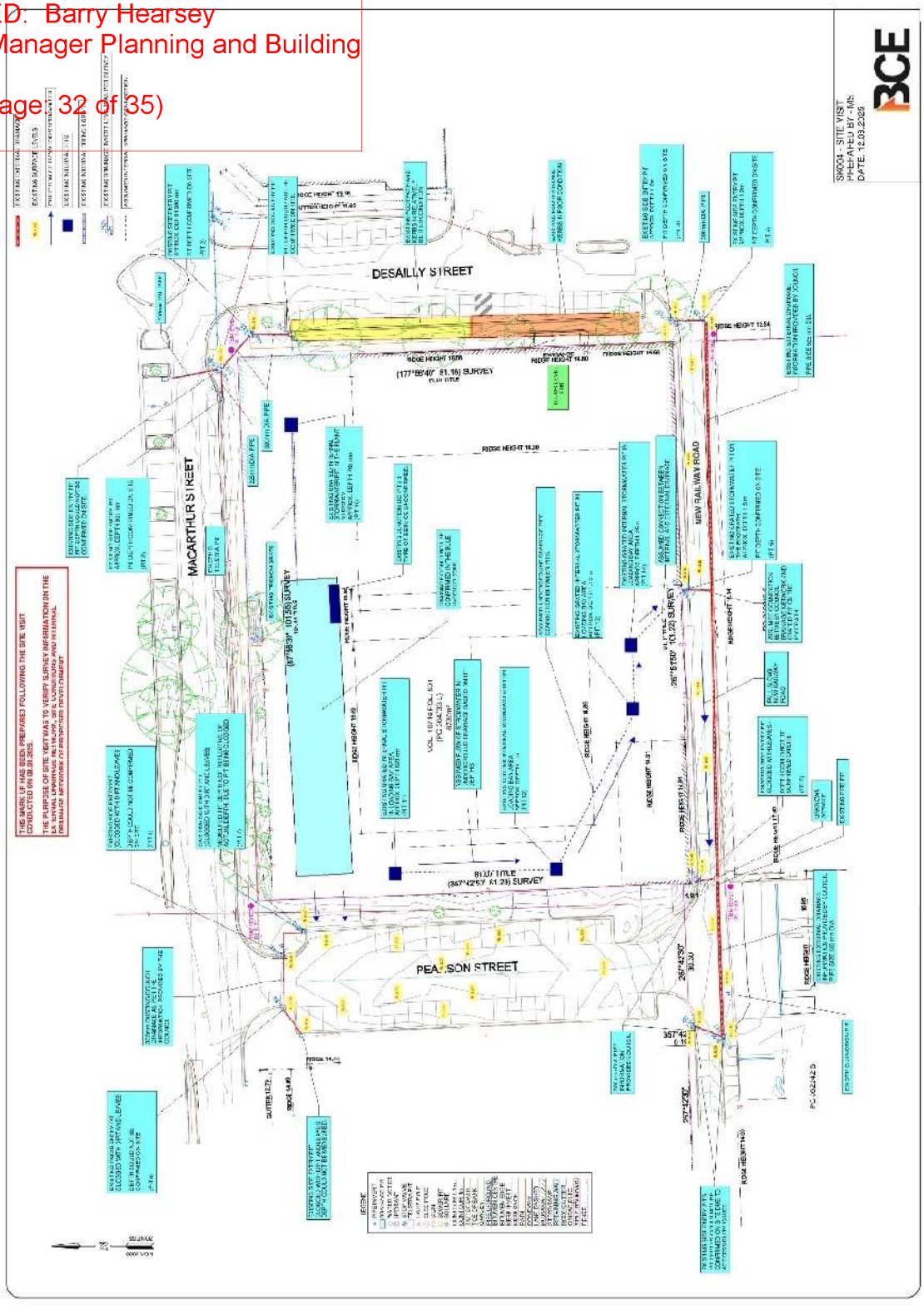

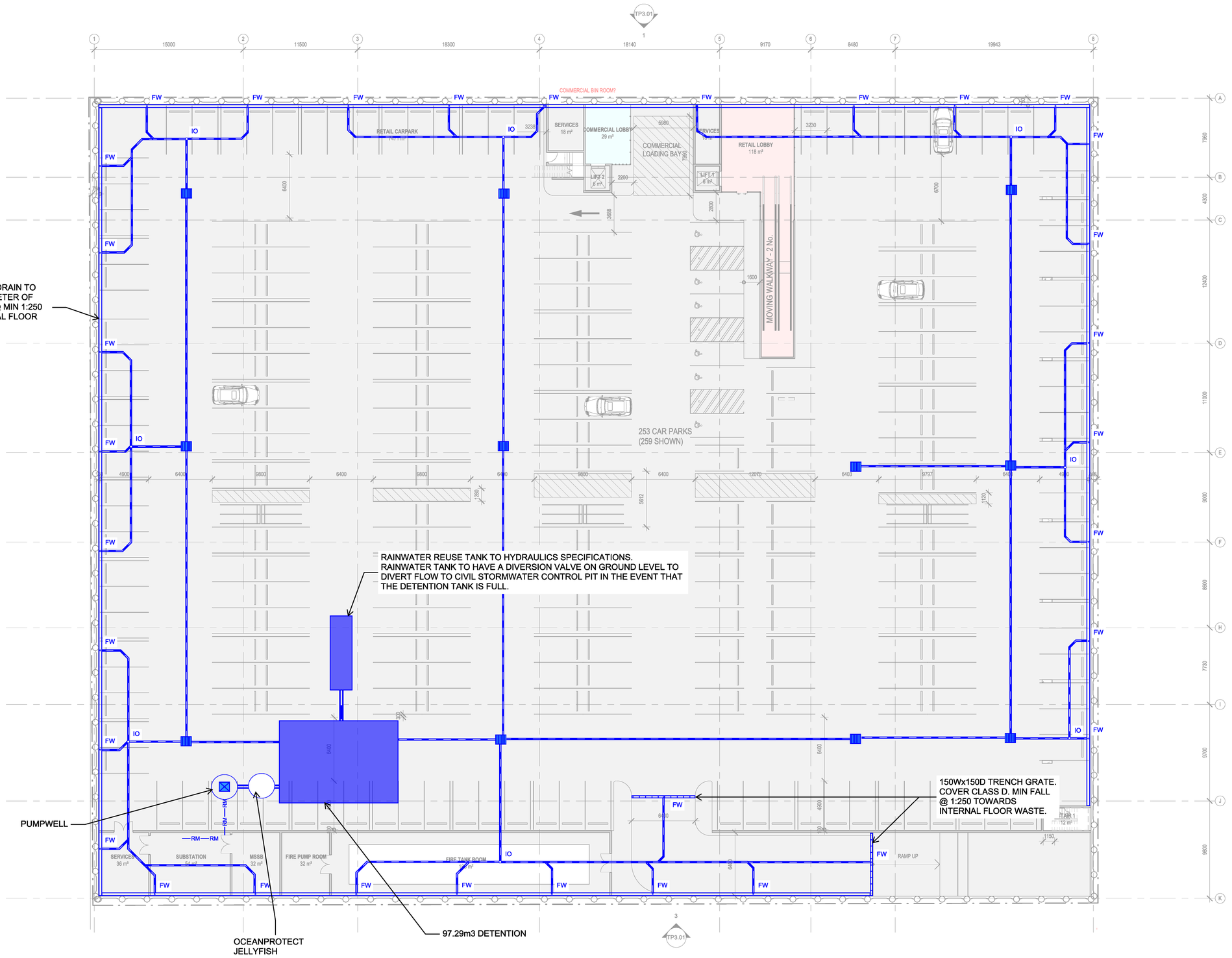

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REV	DESCRIPTION	DATE	REV	DESCRIPTION	BY	DATE
DD1	DESIGN DEVELOPMENT	25/07/25				

CLIENT:

SCALE INDICATED FOR REFERENCE ONLY. DO NOT SCALE DRAWING.

PROJECT NAME:
COMMERCIAL DEVELOPMENT
38-50 MACARTHUR STREET, SALE 3850

DESIGN DEVELOPMENT
NOT TO BE USED FOR CONSTRUCTION

SCALE AT A1	DATE:	DRAWN:	DESIGNER:	CHECKED:	APPROVED:
1:200	JULY 25	Z.C	Z.C	-	-

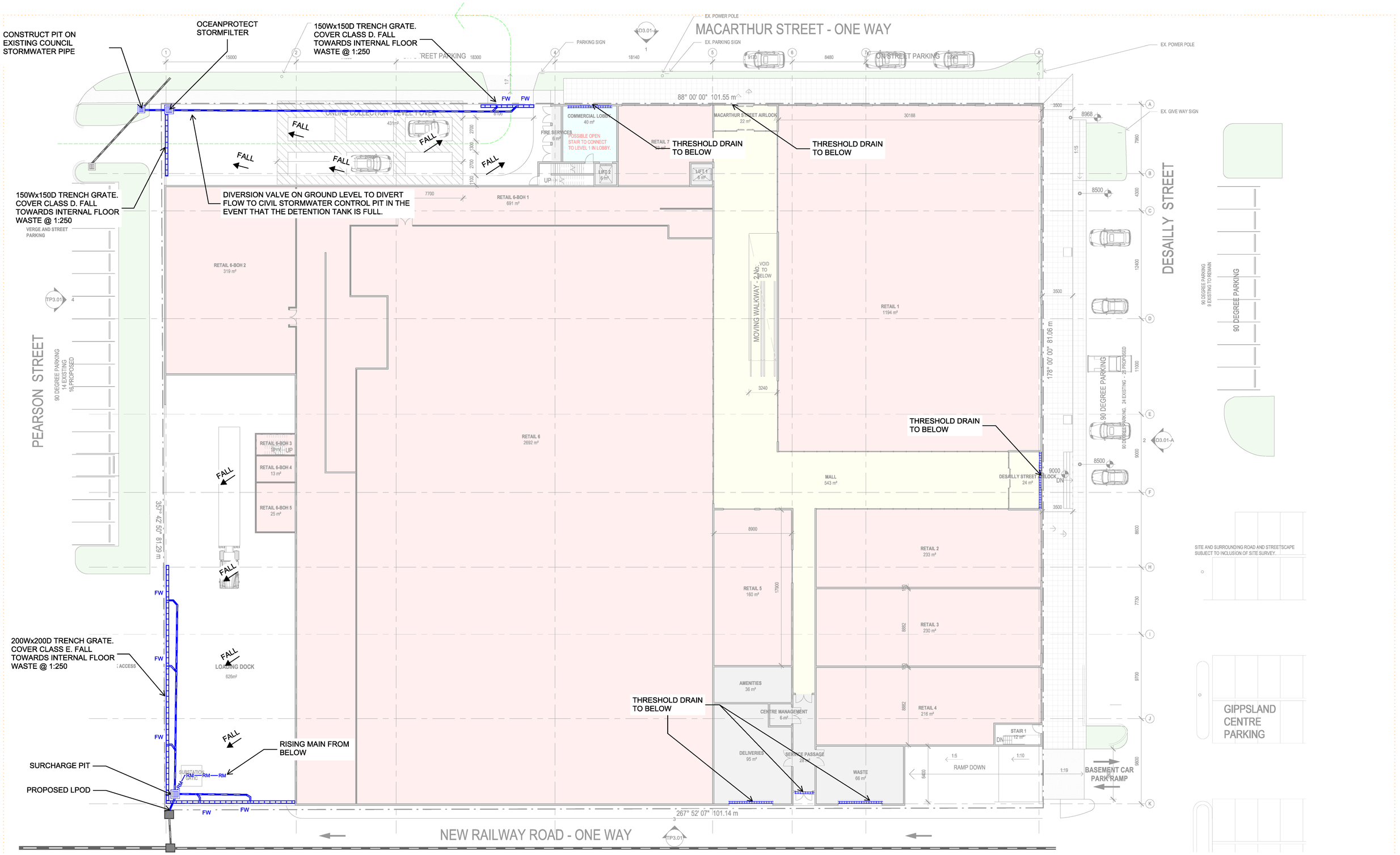
DRAWING TITLE:
BASEMENT DRAINAGE PLAN

PROJECT NUMBER:	DRAWING No:	REVISON:
254029	CSK001	DD1

BCE Design Corporation Pty Ltd

bcedesign.com.au
info@bcedesign.com.au

SHEET SIZE: A1



REV	DESCRIPTION	DATE
DD1	DESIGN DEVELOPMENT	25/07/25

REV	DESCRIPTION	BY	DATE

APPROVED DEVELOPMENT PLAN
PLANNING AND ENVIRONMENT ACT 1987
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DP NAME: Sale CBD

DATE: 21/01/2026
SIGNED: Barry Hearsey
OFFICER TITLE: Manager Planning and Building

CLIENT:

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PROJECT NAME:
COMMERCIAL DEVELOPMENT
38-50 MACARTHUR STREET, SALE 3850

DESIGN DEVELOPMENT
NOT TO BE USED FOR CONSTRUCTION

SCALE AT A1	DATE:	DRAWN:	DESIGNER:	CHECKED:	APPROVED:
1:200	JULY 25	Z.C	Z.C	-	-

DRAWING TITLE:
GROUND DRAINAGE PLAN

PROJECT NUMBER:	DRAWING No:	REVISION:
254029	CSK002	DD1

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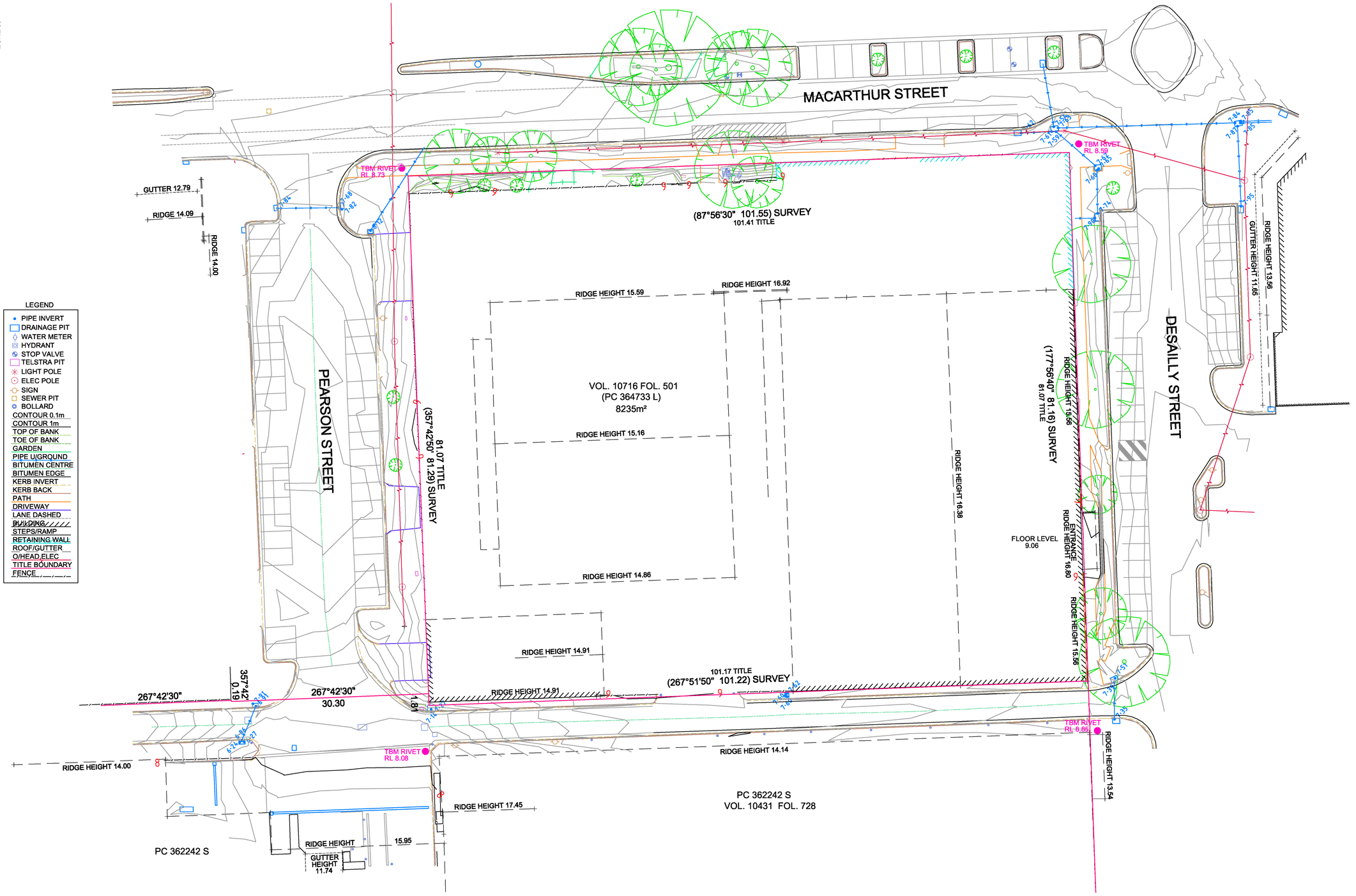
N
MGA 2020
ZONE 55



LEGEND

- PIPE INVERT
- DRAINAGE PIT
- WATER METER
- HYDRANT
- STOP VALVE
- TELSTRA PIT
- LIGHT POLE
- ELEC POLE
- SIGN
- SEWER PIT
- BOLLARD
- CONTOUR 0.1m
- CONTOUR 1m
- TOP OF BANK
- TOE OF BANK
- GARDEN
- PIPE U/GROUND
- BITUMEN CENTRE
- BITUMEN EDGE
- KERB INVERT
- KERB BACK
- PATH
- DRIVEWAY
- LANE DASHED
- BUILDING
- STEPS/RAMP
- RETAINING WALL
- ROOF/GUTTER
- O/HEAD ELEC
- TITLE BOUNDARY
- FENCE

SURVEYOR DRAWN: [redacted] CHECKED: S.W.

VER	BY	AMENDMENTS	DATE
2			
3			
4			
5			

NOTATIONS:
LEVELS ARE TO A.H.D. VIDE SALE PM 410 (R.L. 8.940 VIDE S.M.E.S. 26/09/2024)
CONTOUR INTERVALS ARE AT 0.1m
SURVEY BOUNDARIES DERIVED FROM CP 163573

TITLE RE-ESTABLISHMENT & FEATURE & LEVEL PLAN

38-50 MACARTHUR STREET
SALE, VIC, 3850

Beveridge Williams
development & environment consultants
sale ph : 03 5144 3877
www.beveridgewilliams.com.au

SURVEYORS REF. 2402360
VERSION: 1
DATE: 26/09/2024
SHEET 1 OF 1

ORIGINAL
SCALE 1:300
SHEET SIZE A3
0 3 6 9 12
LENGTHS ARE IN METRES

CAD REFERENCE: 2402360-FEATURE.dwg