GRG CONSULTING ENGINEERS

DESIGN • DRAFTING • PROJECT MANAGEMENT

Design of Sedimentation Pond and Drain for Longreach Transit Yards

AAM Investment Group

Level 19, 123 Eagle Street, Brisbane 4000, Queensland

30 July 2021

PREPARED FOR:

AAM Investment Group
Level 19, 123 Eagle Street, Brisbane 4000, Queensland

PREPARED BY:

GRG Consulting Engineers
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Newstead, Qld 4006

REPORT DETAILS:

Filename: 20-3181 R01 Sedimentation and Drain Report
Date: Friday, 30 July 2021

This report has been prepared and collated by:

30/07/2021

Prepared By: Tomasz Cichosz
Position: Senior Structural Engineer

Date

This report has been checked and authorised by:

Gary Gibson

Digitally signed by Gary Gibson
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Date: 2021.07.30 08:57:20 +10'00'

30/07/2021

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Table of Contents

1. Engineering Statement

GRG has completed a design review of stormwater discharge from Transit Yards into proposed pond via an engineered design drain on Longreach Regional Council land on Lot 1 SP303323.

GRG has completed the design using the industry standard “National Guidelines for Beef Cattle Feedlots in Australia” 3rd Edition.

The following design assumptions were used in the design process:

- Pond Design to store stormwater from 24 hour Annual Exceedance Probability (AEP) 1:50 Years
- Drain Design for an AEP 1:20 Years

2. Introduction

This Report details design of sedimentation pond and drain dedicated for collection of stormwater from cattle transit yards areas.

The land is owned by Longreach Regional Council and is described as Lot 1 on Survey Plan 303323 is located fronting the Cramsie- Muttaburra Road, Cramsie.

Following site location map and aerial photograph are taken from Aurizon Site based Management Plan.

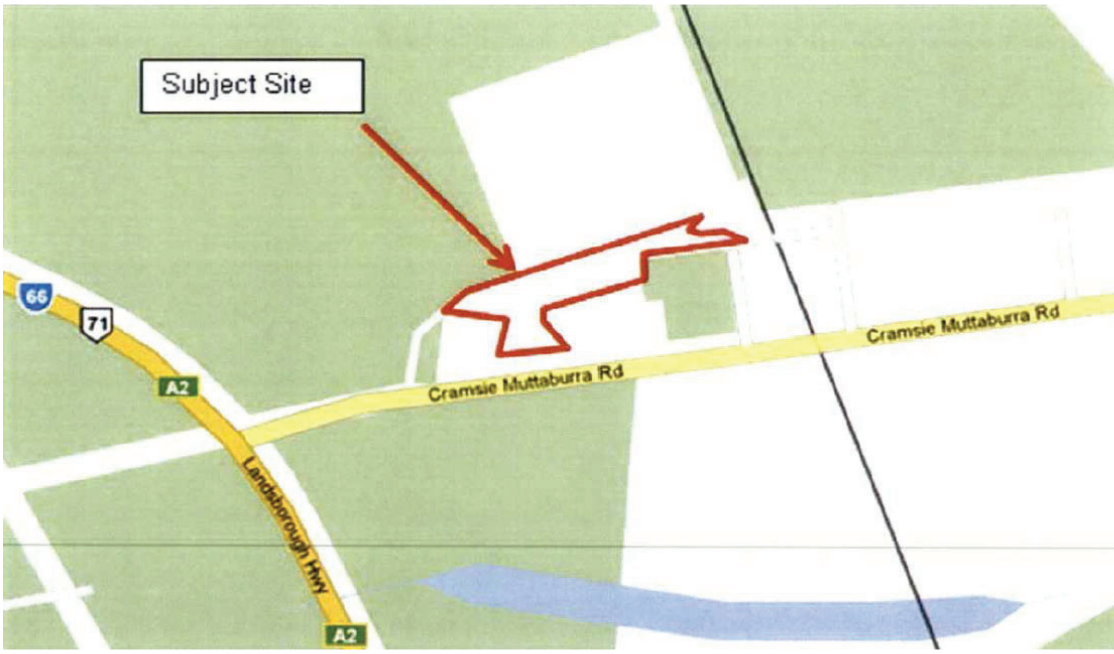


Figure description: site location map.

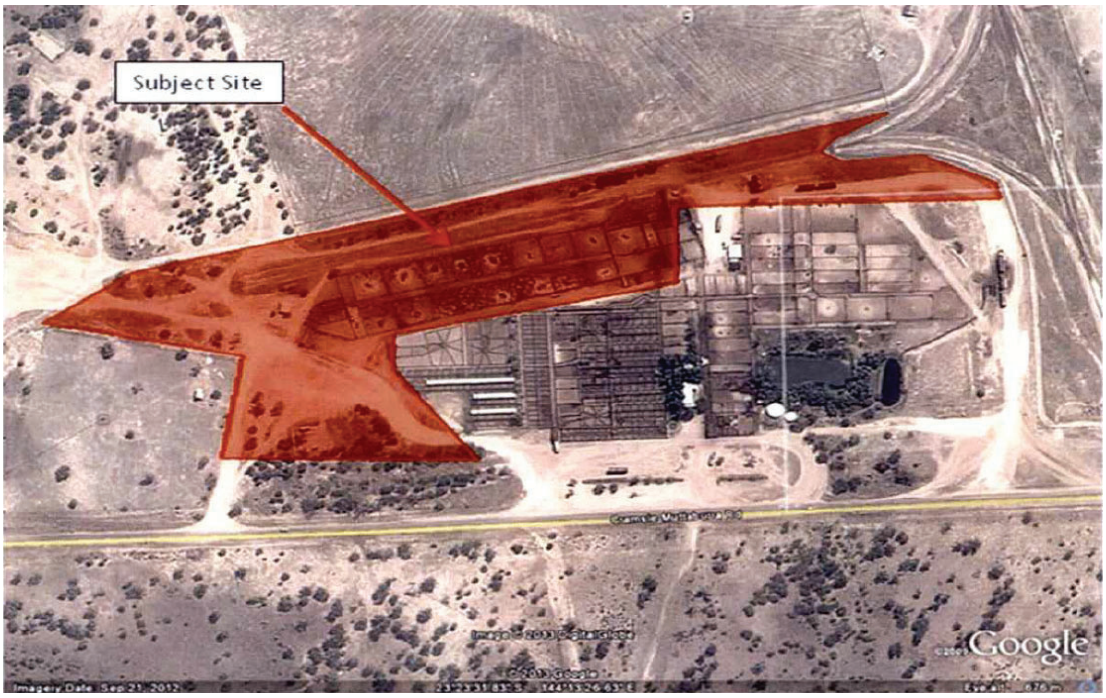


Figure description: aerial photograph of the site.

The stormwater catchment area is limited to fenced zone of the yard with 18 pens. It has area equal to 1.36 ha and it is hatched on following Figure.

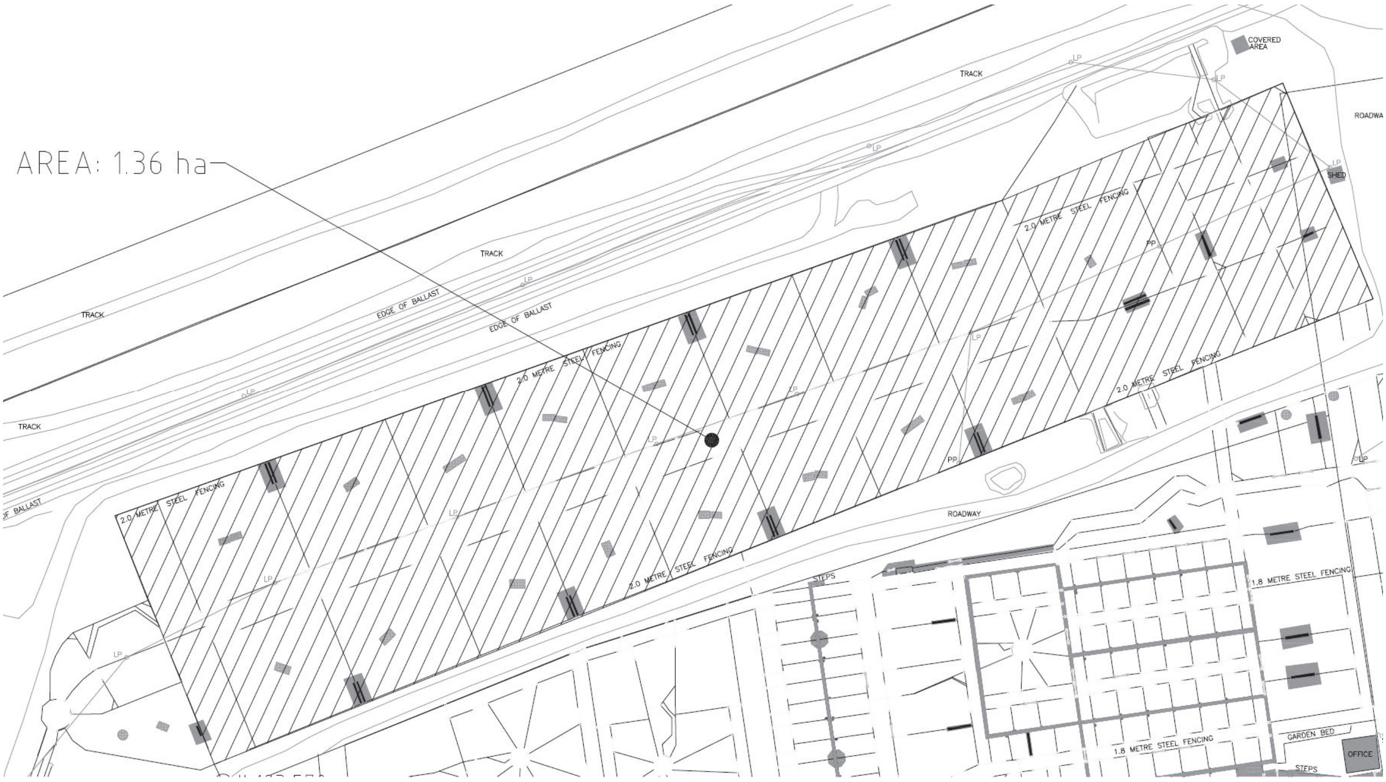


Figure description: hatched part indicates stormwater catchment area considered in calculations.

Reference Drawings include:

Drawing 20-3181-010 Rev 6 Surface Water Management – General Arrangement

Drawing 20-3181-011 Rev 5 Surface Water Management – Details View

Drawing 20-3181-012 Rev 6 Surface Water Management – Section View

3. Sedimentation Pond Volume Design Guidance

Reference was made to “National Guidelines for Beef Cattle Feedlots in Australia” published by Meat & Livestock Australia Limited.

According to the guidance:

An acceptable design method

The required volumetric design capacity of the sedimentation system can be determined using the following formula:

$$V_p = Q_p \times L/W \times \frac{\lambda}{v}$$

where:

- Vp = required sedimentation system volumes (m^3)
- Qp = peak flow rate (m^3/s) for a 20-year ARI design storm[6]
- L/W = length to width or aspect ratio of the system (refer Table A.4)
- λ = a scaling factor (refer Table A.4)
- v = design flow velocity (m/s)
  = 0.005 m/s or less

Table A.4 Typical values for the aspect ratio and scaling factors for various types of sedimentation systems

Sedimentation system	L/W	λ
Terrace	8–10	1.0
Basin	2–3	2.5
Pond	2–3	6.0

Table description: Extract from “National Guidelines for Beef Cattle Feedlots in Australia” by MLA

4. Rainfall Data

Data related to local rainfall depth and statistics was collected from Australian Government Bureau of Meteorology online Design Rainfall Data System.

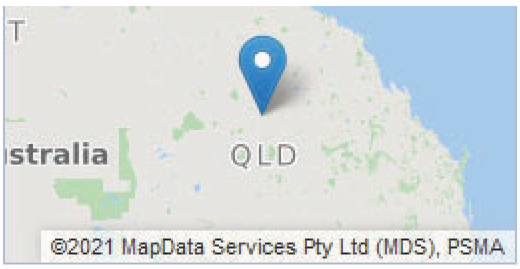
Following page contains relevant data for the specified location:

Location

Label: Not provided

Latitude: -23.3922 [Nearest grid cell: 23.3875 (S)]

Longitude: 144.224 [Nearest grid cell: 144.2125 (E)]



IFD Design Rainfall Depth (mm)

Issued: 12 July 2(

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP)

FAQ for New ARR probability terminology

Table | Chart

Unit: mm

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.93	2.25	3.23	3.87	4.48	5.26	5.84
2 min	3.27	3.82	5.52	6.63	7.69	8.96	9.85
3 min	4.61	5.39	7.76	9.31	10.8	12.6	13.9
4 min	5.86	6.84	9.83	11.8	13.6	15.9	17.6
5 min	7.01	8.18	11.7	14.1	16.3	19.0	21.1
10 min	11.5	13.4	19.2	23.0	26.6	31.3	34.8
15 min	14.7	17.1	24.5	29.4	34.0	40.0	44.6
20 min	17.1	19.9	28.5	34.2	39.6	46.6	51.9
25 min	19.0	22.1	31.7	38.1	44.1	51.9	57.8
30 min	20.5	24.0	34.4	41.3	47.8	56.3	62.6
45 min	24.0	28.0	40.3	48.4	56.2	66.1	73.5
1 hour	26.4	30.9	44.5	53.5	62.1	73.1	81.2
1.5 hour	29.9	35.0	50.5	60.7	70.5	83.0	92.3
2 hour	32.4	37.9	54.8	65.9	76.6	90.3	100
3 hour	36.1	42.2	61.1	73.6	85.6	101	113
4.5 hour	40.2	46.9	67.9	82.0	95.5	113	127
6 hour	43.4	50.6	73.3	88.6	103	123	139
9 hour	48.3	56.4	81.8	99.2	116	140	158
12 hour	52.3	60.9	88.6	108	127	153	174
18 hour	58.3	68.0	99.3	122	145	175	200
24 hour	63.0	73.4	108	133	159	193	221
30 hour	66.7	77.7	115	142	171	209	239
36 hour	69.8	81.3	121	150	181	222	254
48 hour	74.6	87.1	130	163	199	243	279
72 hour	80.9	94.7	143	181	222	272	312
96 hour	84.9	99.5	151	192	236	290	331
120 hour	87.4	103	156	198	244	299	342
144 hour	89.1	105	159	202	248	303	347
168 hour	90.3	106	161	203	249	304	348

5. Calculations

Design pond to store rainfall water from 24 hour rainfall with Annual Exceedance Probability equal to 1 in 50 years. This corresponds to AEP 2%.

Design Rainfall Depth is equal to 193mm.

As mentioned earlier formula for sedimentation system volume:

$$V_p = Q_p \times L/W \times \frac{\lambda}{v}$$

Q_P = 193mm x 1.36ha x 0.8 / (24 x 60 x 60 seconds)

Q_P = 0.0243 m3/s

Assume Pond L/W = 3 (conservatively)

This gives lambda, λ = 6

V=0.005m/s

Required pond volume:

V_P = 0.0243m3/s x 3 x 6 / (0.005m/s)

V_P = 87.5m3

Assume 50% of the required volume is reserved to sediment storage volume

43.75m3 sediment storage volume

Total pond volume: 87.50m3 + 43.75m3 = 131.25m3

6. Pond Construction Requirements

Requirements from MLA guidance:

- The holding pond should have a weir and bywash capable of discharging the peak flow from the controlled drainage area from a 50-year ARI design storm.
- A minimum freeboard of at least 0.9 m should be provided between the crest of the discharge weir and the crest of the holding pond embankment.
- The holding pond should be underlain by a minimum of 300 mm clay or other suitable compactable soil, or by a synthetic liner able to provide a design permeability of <1 x 10^{-9} m/s (~0.1 mm/d).

Other considerations include the following:

Detail design of the sedimentation ponds have taken into account the following:

- A minimum freeboard of 0.9 m should be provided at the pond discharge point.
- A material testing of pond base should determine suitability for use, otherwise a low permeability pond liner such as 300 mm clay.
- A sump pit should be allowed for at the base of the stormwater pond if pumping of water is required, for example for dust suppression or to de-water;
- A first flush pond to allow ease of management for concentrated sediment
- A sediment storage zone marker and measuring stick may be useful for regular monitoring and confirmation of sediment depth;
- Off-site stormwater flow has been diverted around the effluent drains to minimise the loading on the pond.
- Operation management plan shall be adopted for maintenance purposes.
- Pumping water from the pond periodically to allow for maximum capacity in the event of a storm. The pumped water may be reused on site, for example tree irrigation

7. Drain Concept

The proposed location of drain linking transit yard catchment area and sediment pond was based on constraints related to site setting out.

Due to a roadway being located in the middle of proposed truck path approximately 12m long part of the drain was proposed to be constructed of concrete.

The remaining part is Earthen (bare) drain.

Total length of drain is 79m and the difference in levels:

184.65m – 183.6m = 1.05m

This gives average slope 1.05 / 79m = 0.0133

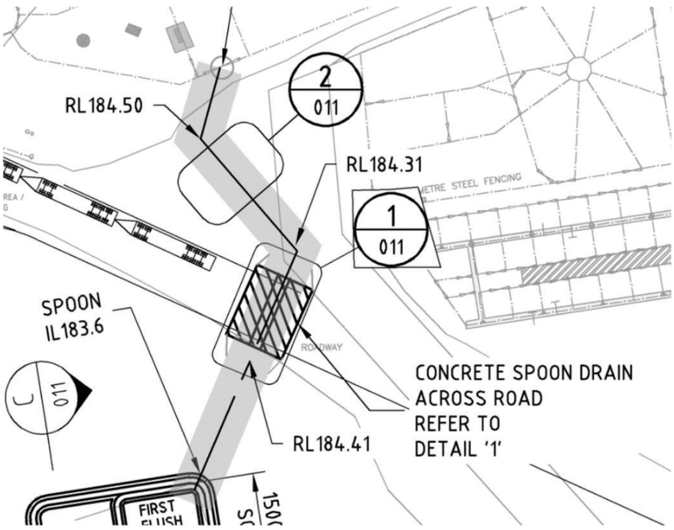


Figure description: Solid hatch area indicated proposed location of drain. Line hatch indicates proposed concrete part of the drain.

8. Drain Calculations

Similar to the pond design, drain calculations were based on guidance from "National Guidelines for Beef Cattle Feedlots in Australia" published by Meat & Livestock Australia Limited.

The calculations were divided on following stages:

1) Check time of concentration of catchment
2) Check peak flow assuming rainfall intensity of 20 year ARI in time of concentration of catchment calculated in point 1
3) Define size of drain
4) Check mean flow velocity as per defined drain dimensions and compare it with values from table A3 in "National Guidelines for Beef Cattle Feedlots in Australia"
5) Check flow rate of flow in designed drain in m^3/s and compare it with peak flow calculated in point 2. It should be bigger than calculated in point 2 to ensure water is contained inside of drain.

- **Time of concentration of catchment**

As per guidance from "National Guidelines for Beef Cattle Feedlots in Australia" published by Meat & Livestock Australia Limited:

One of the more widely accepted methods of estimating time of concentration uses the Bransby Williams Formula, which is given by:

$$t_c = \frac{58 \times L}{A^{0.1} \times S_e^{0.2}}$$

where:

t_c = time of concentration (min)
L = mainstream length (km)
A = area of catchment (km^2)
S_e = equal area slope[5] (m/km)

Having established the time of concentration of the catchment, it is then possible to determine the intensity of a 20-year ARI design storm at the development site. This design storm would have a duration equivalent to the time of concentration of the catchment.

Area of catchment A = 1.36 ha = $0.0136km^2$

Mainstream length L = 0.256km

Difference in levels for equal area slope calculations 0.35m

Equal area slope S_e = 0.35m/0.256km = 1.367m/km

Time of concentration t_c = 21.4minutes

- **Peak flow**

Refer to point 3 of this report, Rainfall data.

From table with Design Rainfall Depth using interpolation for 21.4 minutes I = 41mm for 20 year ARI.

The formula for the rational method is given by:

$$Q = \frac{C \times I \times A}{360}$$

where:

Q = peak flow rate (m³/s)
C = runoff coefficient
I = rainfall intensity of 20-year ARI design storm (mm/hr)
A = catchment area (ha)

C = 0.8 for ponds

Substituting 360 with number of seconds in time of concentration 21.4 x 60 = 1284 seconds

Q = 0.35m^3/s

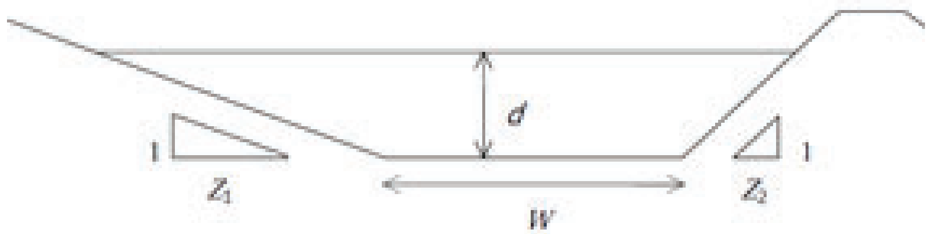
- **Define drain size and calculate relevant flow rate and mean velocity.**

Drain size should allow flow not smaller than 0.35m^3/s calculated above.

Adopt drain dimensions.

Note: use different drain sizes for earthen bare drain and for concrete drain where depth of the drain should be smaller.

Trapezoidal cross-section



The hydraulic radius (R) of the flow in a drain is given by:

$$R = \frac{A}{P}$$

The cross-sectional area (A) of the flow in a drain can be determined using the equation given by:

$$A = W \times d + d^2 \times \frac{(z_1 + z_2)}{2}$$

Similarly, the wetted perimeter (P) can be determined using an equation given by:

$$P = W + d \times \left[(1 + z_1^{2})^{0.5} + (1 + z_2^{2})^{0.5}\right]$$

		Earthen (Bare)	Concrete (Smooth)	
	d =	0.125	0.088	m
	w =	4.79	6.076	m
	Z1 =	5	14	
	Z2 =	5	14	
	A =	0.677	0.643	m2
	P =	6.06	8.55	m
Manning roughness	n =	0.025	0.015	earthen bare
drain bed slope	S =	0.004	0.008	m/m
	R =	0.112	0.075	
mean flow velocity	**U =**	**0.617**	**1.063**	**m/s**
flow rate	**Q =**	**0.418**	**0.683**	**m3/s**

Calculated flow rate for the defined drain size is bigger than required 0.35m^3/s therefore sufficient to hold peak flow from catchment area.

Mean flow velocity is also smaller than maximum recommended velocities listed in Table A.3 of guidelines shown below:

National Guidelines for Beef Cattle Feedlots in Australia

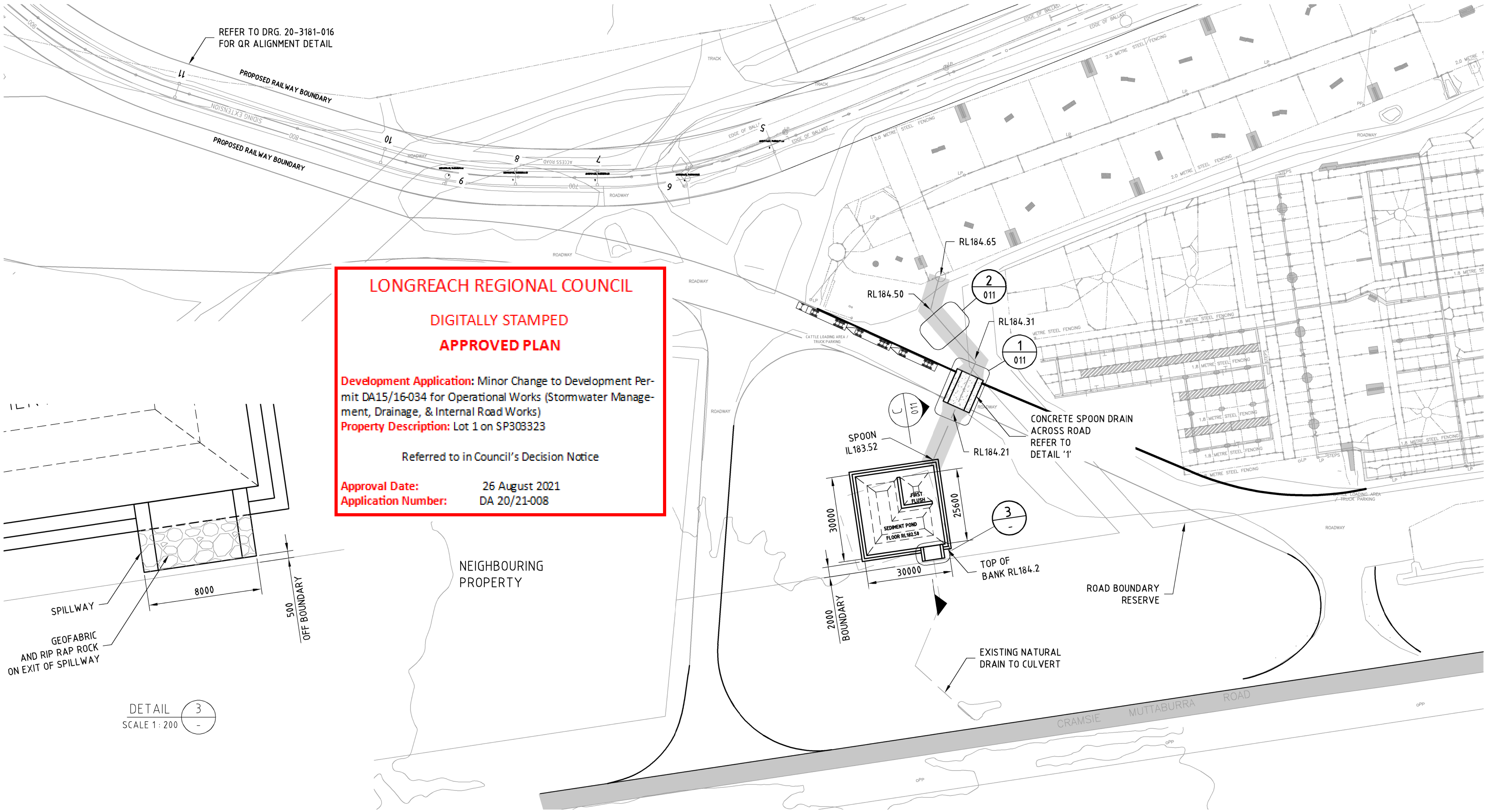
Table A.3 Recommended maximum flow velocities in earthen channels

Soil cover	Flow velocity (m/s)
Couch and similar low-growing stoloniferous grasses	1.5
Mid-height, mat-forming grasses	1.4
Native and other culmiferous grasses	1.2
Lucerne	1.2
Annual weeds	0.8
Coarse gravel	1.3–1.8
Bare, consolidated, stiff sandy clay	1.3–1.5
Bare, consolidated, coarse sand	0.5–0.7
Bare, consolidated, fine sand	0.2–0.5

One of the recommendations from the guidelines on drain size says “velocity values of less than 0.5 m/s are likely to result in excessive sedimentation in feedlot catch and main drains”

Calculated velocities are above 0.5m/s and below maximum recommended for Bare, consolidated, stiff sandy clay (1.3-1.5 m/s)

IF IN DOUBT – PLEASE ASK



LONGREACH REGIONAL COUNCIL

DIGITALLY STAMPED

APPROVED PLAN

Development Application: Minor Change to Development Permit DA15/16-034 for Operational Works (Stormwater Management, Drainage, & Internal Road Works)
Property Description: Lot 1 on SP303323

Referred to in Council's Decision Notice

Approval Date: 26 August 2021
Application Number: DA 20/21-008

LONGREACH TRANSIT YARDS
SCALE 1 : 1000

NOTE:
1. ALL DIMENSIONS ARE NOMINAL AND SHOULD BE SITE CHECKED PRIOR TO WORK COMMENCING.
2. FOR QR RAIL EXTENSION, REFER TO DRG. 20-3181-016

CONSTRUCTION ISSUE

REVISIONS

REV.	BY	DATE	DESCRIPTION	CHK'D	APPD
6	PB	27/07/21	SPILLWAY ADDED, CONSTRUCTION ISSUE	GRG	GRG
5	PB	20/07/21	CHANGES TO FIRST FLUSH AND SEDIMENT POND	GRG	--
4	PB	04/06/21	CHANGES MADE TO DRAIN PATH	JL	--
3	PB	22/02/21	DRAIN PATH CHANGED	JL	--
2	PB	03/02/21	SECTIONS CHANGED, DETAIL VEWS & EVAPORATION POND ADDED	GRG	--
1	PB	28/10/20	CLIENT REVIEW	AJH	--

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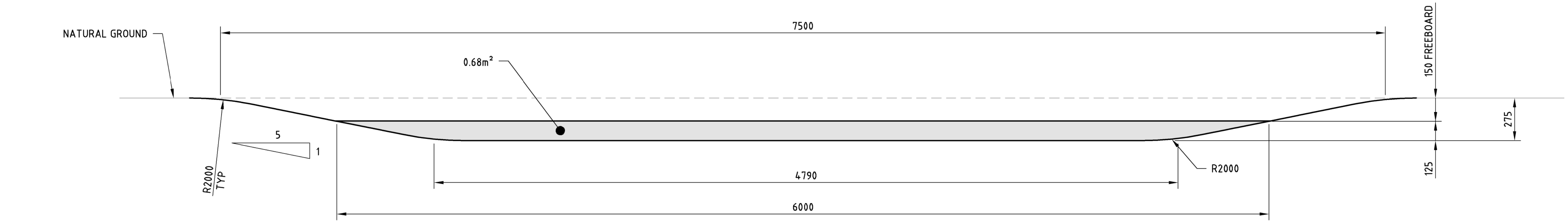
DWG. CHECKED:	A. HARTLEY	28/10/20
PROJ. CHECKED:	N. MURPHY	28/07/2021
APPROVED:	G. GIBSON	29/07/2021
SCALE:	1:1000	DO NOT SCALE
ALL DIMENSIONS IN mm.		

CLIENT: AAM INVESTMENT GROUP
PROJECT: LONGREACH TRANSIT YARDS

SURFACE WATER MANAGEMENT GENERAL ARRANGEMENT

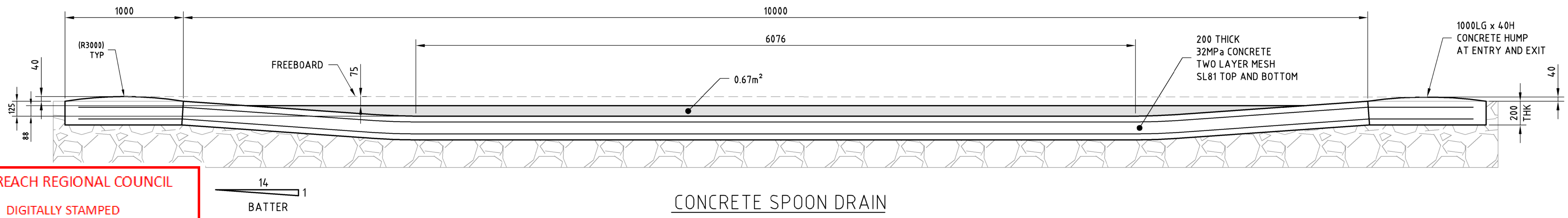
DRAWING NUMBER
20-3181-010
REVISION 6
THIRD ANGLE PROJECTION A2

IF IN DOUBT – PLEASE ASK



EARTH SPOON DRAIN

SECTION A 011
SCALE 1 : 20



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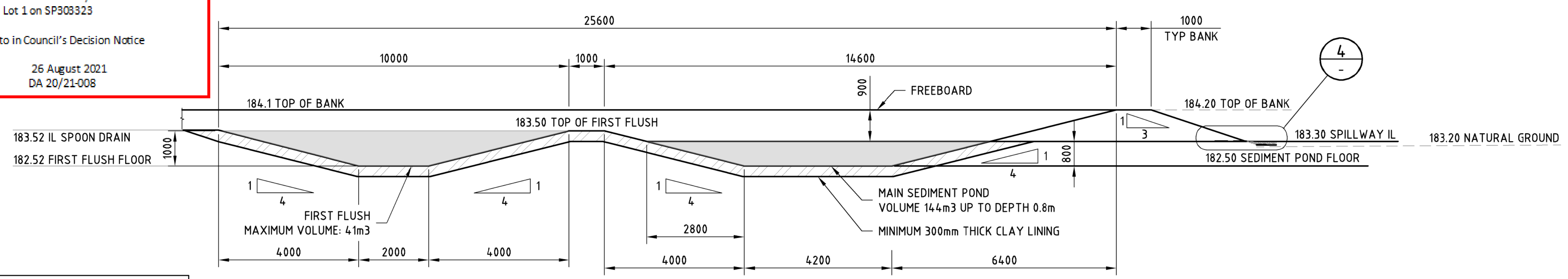
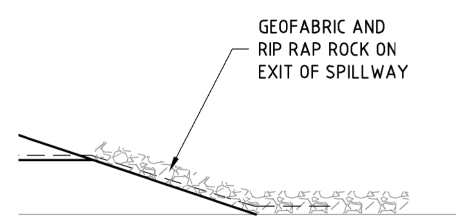
CONCRETE SPOON DRAIN

SECTION B 011
SCALE 1 : 25





DETAIL 4 -
SCALE 1 : 20

SECTION C 011
SCALE 1 : 100

NOTE:
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CONSTRUCTION ISSUE

REVISIONS

REV.	BY	DATE	DESCRIPTION	CHK'D	APPD
6	PB	27/07/21	SPILLWAY ADDED, CONCRETE INCREASED, CONSTRUCTION ISSUE	GRG	GRG
5	PB	21/07/21	CHANGES TO CONCRETE SPOON DRAIN MADE	GRG	--
4	PB	04/06/21	CHANGES MADE TO DRAINAGE PATH	JL	--
3	PB	22/02/21	CONCRETE SPOON DRAIN CHANGED, FIRST FLUSH ADDED	JL	--
2	PB	03/02/21	SECTION VIEWS CHANGED	GRG	--
1	PB	28/10/20	CLIENT REVIEW	AJH	--

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APPROVED:	G. GIBSON	29/07/2021
SCALE:	1:100	DO NOT SCALE
ALL DIMENSIONS IN mm.		

CLIENT: AAM INVESTMENT GROUP
PROJECT: LONGREACH TRANSIT YARDS

SURFACE WATER MANAGEMANT SECTION VIEW

DRAWING NUMBER **20-3181-012**

REVISION 6

THIRD ANGLE PROJECTION A2

IF IN DOUBT - PLEASE ASK

LONGREACH REGIONAL COUNCIL

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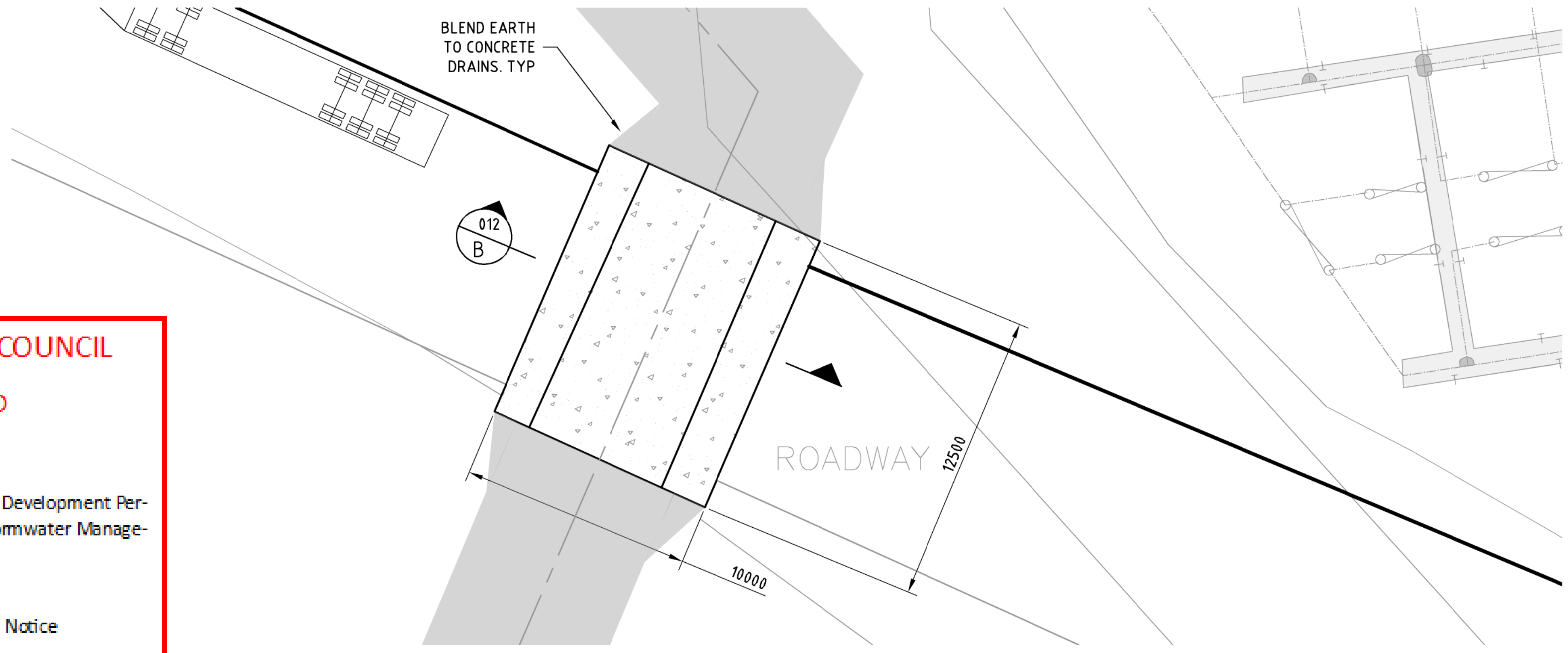
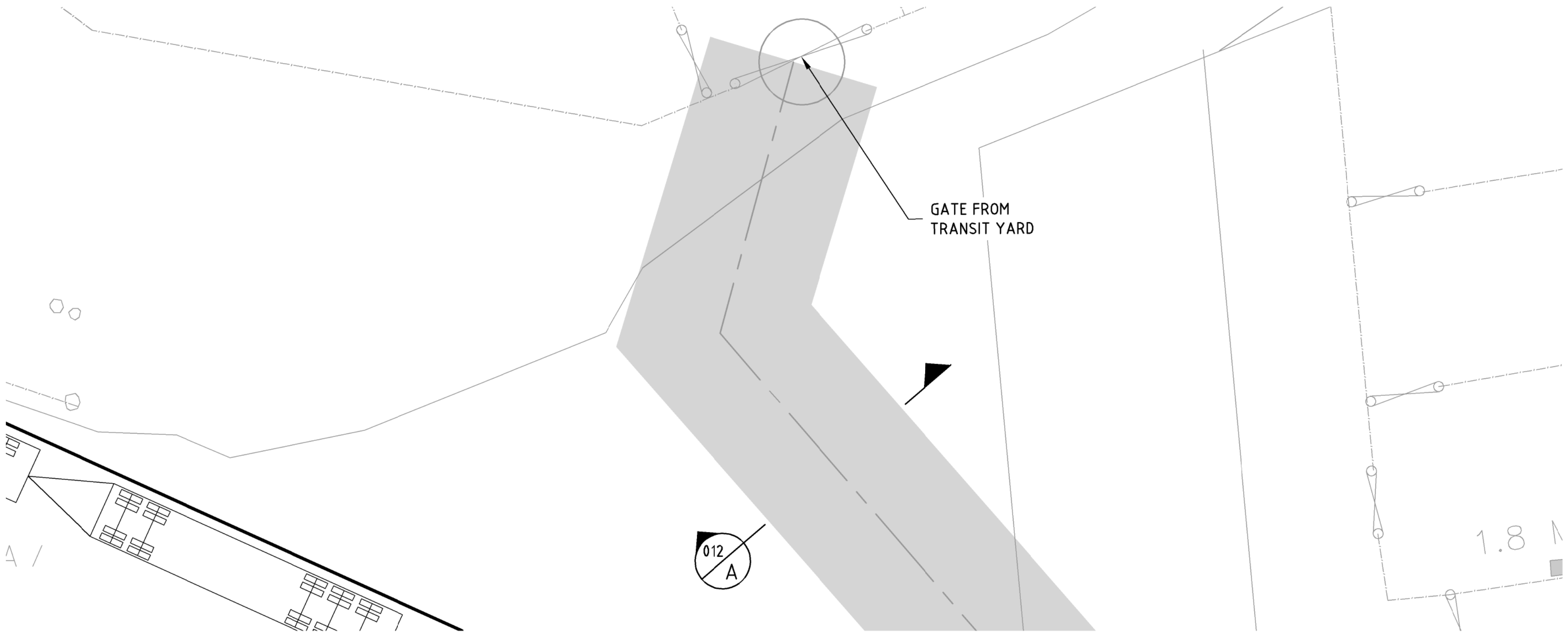


CONCRETE SPOON DRAIN
DETAIL 1/010
SCALE 1 : 200



EARTH SPOON DRAIN
DETAIL 2/010
SCALE 1 : 200

NOTE:
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2. FOR QR RAIL EXTENSION, REFER TO DRG. 20-3181-016

CONSTRUCTION ISSUE

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REV.	BY	DATE	DESCRIPTION	CHK'D	APPD
5	PB	29/07/21	CONSTRUCTION ISSUE	GRG	GRG
4	PB	20/07/21	CHANGES TO DRAINS AND POND MADE	GRG	--
3	PB	04/06/21	DRAINAGE PATH CHANGED	JL	--
2	PB	22/02/21	SECTION VIEWS CHANGED ADDED	JL	--
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SCALE:	1:500 UNO	DO NOT SCALE

ALL DIMENSIONS IN mm.

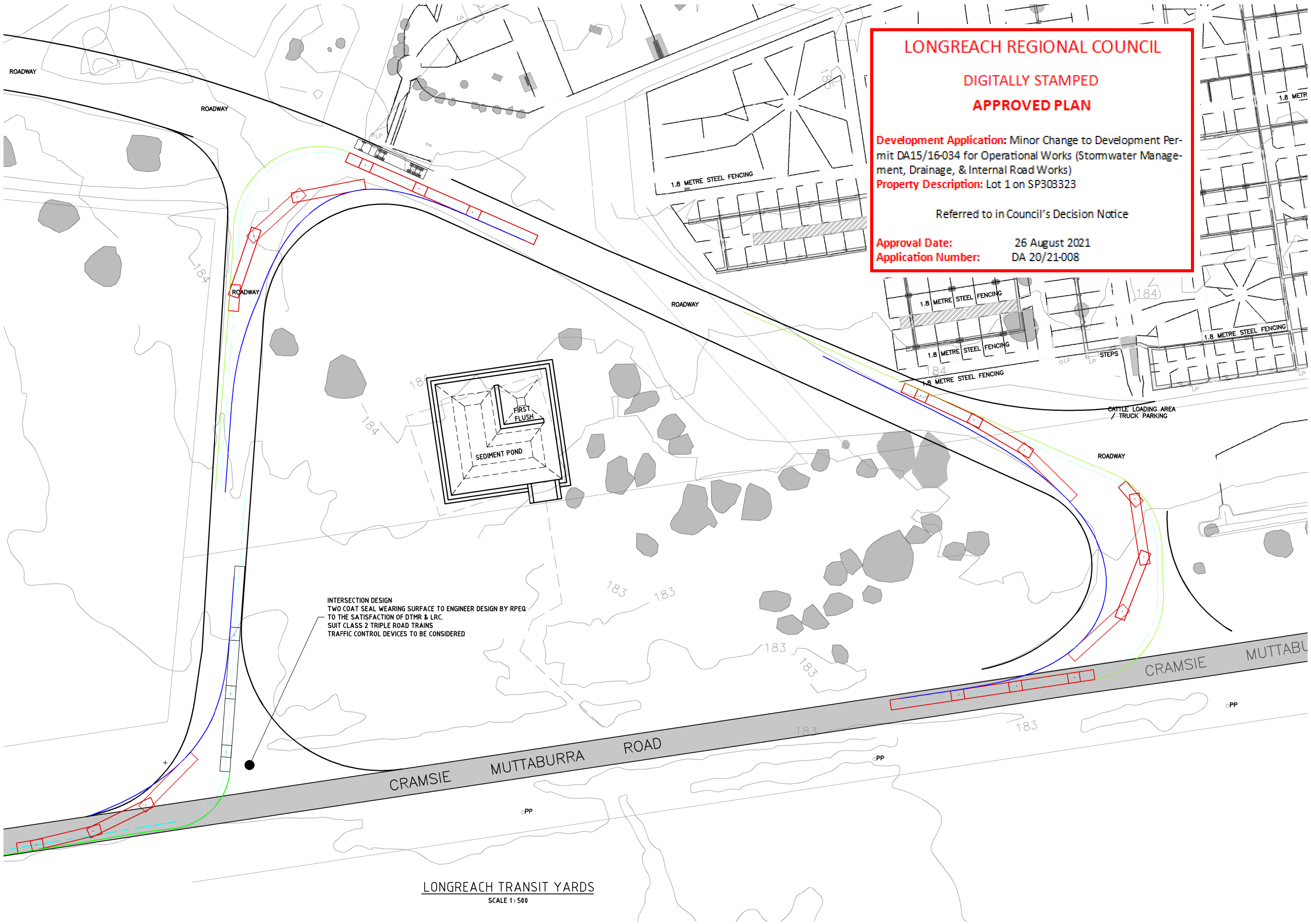
CLIENT: AAM INVESTMENT GROUP
PROJECT: LONGREACH TRANSIT YARDS

SURFACE WATER MANAGEMENT DETAIL VIEWS

DRAWING NUMBER **20-3181-011**
REVISION 5
THIRD ANGLE PROJECTION A2

IF IN DOUBT - PLEASE ASK

WORKSHOP DETAIL DRAWINGS ONLY. NO DESIGN OR CALCULATIONS HAVE BEEN UNDERTAKEN.



LONGREACH TRANSIT YARDS

SCALE 1 : 500

LONGREACH REGIONAL COUNCIL

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3. REFER TO DRG. 20-3181-010 FOR GENERAL ARRANGEMENT

INFORMATION ONLY

NOT TO BE USED FOR CONSTRUCTION PURPOSES

REVISIONS

REV.	BY	DATE	DESCRIPTION	CHK'D	APP
4	PB	03/08/21	INTERSECTION DETAILS CHANGED	GRG	--
3	PB	30/07/2021	TURN DIRECTION CHANGED IN TITLE BLOCK	GRG	--
2	PB	27/07/21	TURNING RADIUS CHANGED, EXIT POINT RE ALIGNED, INFORMATION ONLY	GRG	--
1	PB	12/07/21	CLIENT REVIEW ISSUE	JL	--

REFERENCE DWGS.

DWG No.	DESCRIPTION

GRG CONSULTING ENGINEERS
ACN 099 974 239 ABN 11 099 974 239
P.O. BOX 2815 NEW FARM QUEENSLAND 4005
Phone : 07 3085 1000 Email: mail@grgengineers.com.au

DESIGNED:	--	--
DRAWN:	P. BLACKWOOD	12/07/2021
DWG. CHECKED:	J. LU	12/07/2021
PROJ. CHECKED:	N. MURPHY	28/07/2021
APPROVED:		--
SCALE:	1:500	DO NOT SCALE
ALL DIMENSIONS IN mm.		

CLIENT: AAM INVESTMENT GROUP

PROJECT: LONGREACH TRANSIT YARDS

SURFACE WATER TREATMENT
A TRIPLE TRUCK TURNING PATH
RIGHT TURN ON EXIT LAYOUT

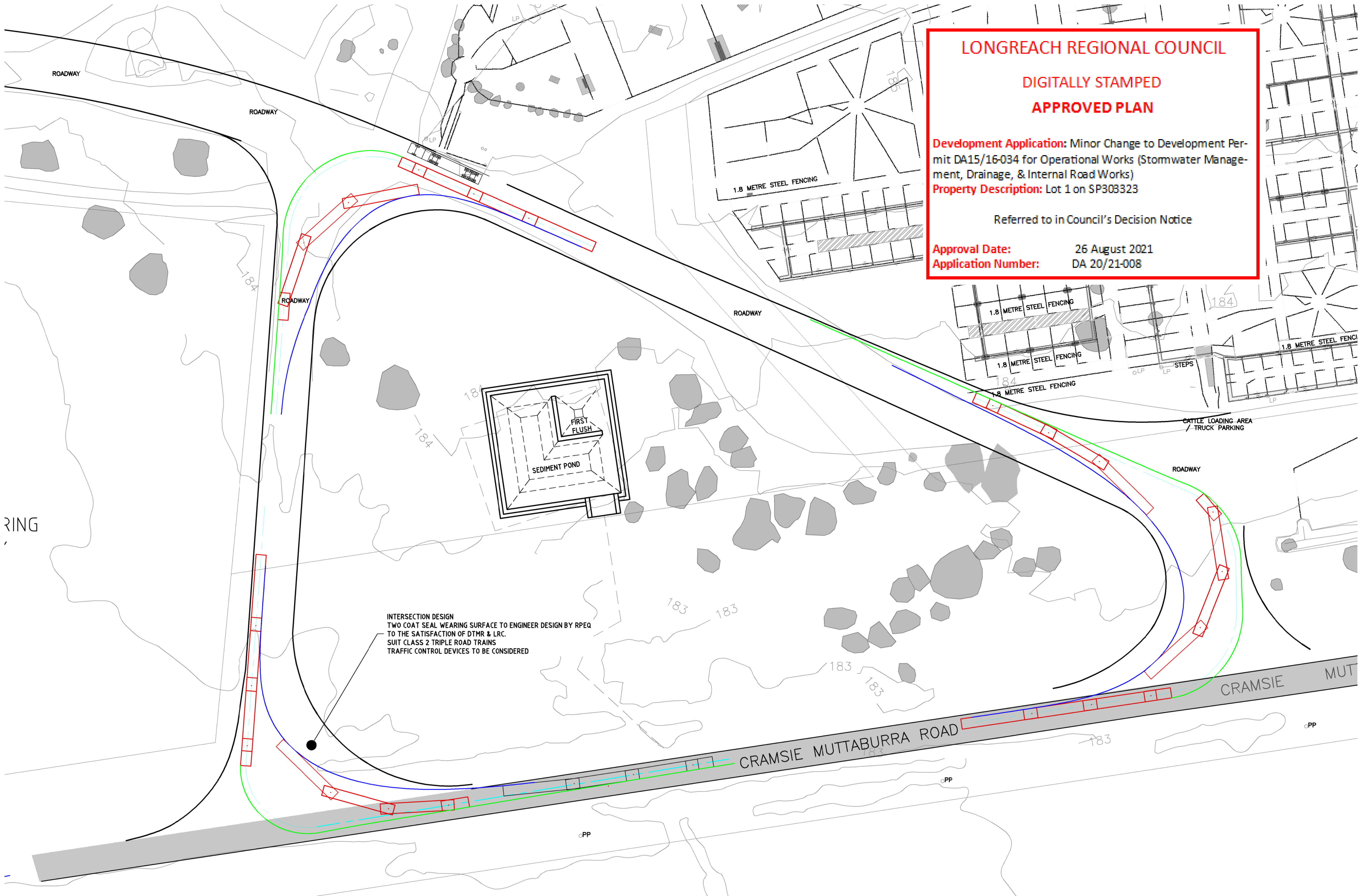
DRAWING NUMBER **20-3181-014**

REVISION 4

THIRD ANGLE PROJECTION A1

IF IN DOUBT - PLEASE ASK

WORKSHOP DETAIL DRAWINGS ONLY. NO DESIGN OR CALCULATIONS HAVE BEEN UNDERTAKEN.



LONGREACH TRANSIT YARDS

SCALE 1 : 500

LONGREACH REGIONAL COUNCIL

DIGITALLY STAMPED

APPROVED PLAN

Development Application: Minor Change to Development Permit DA15/16-034 for Operational Works (Stormwater Management, Drainage, & Internal Road Works)
Property Description: Lot 1 on SP303323

Referred to in Council's Decision Notice

Approval Date: 26 August 2021
Application Number: DA 20/21-008

FRONT LEADING PROJECTOPN
REAR TRAILING EDGE
B TRIPLE
CENTRE LINE

NOTE:
1. ALL DIMENSIONS ARE NOMINAL AND SHOULD BE SITE CHECKED PRIOR TO WORK COMMENCING.
2. NO DESIGN OR CALCULATIONS HAVE BEEN UNDERTAKEN
3. REFER TO DRG. 20-3181-010 FOR GENERAL ARRANGEMENT

INFORMATION ONLY

NOT TO BE USED FOR CONSTRUCTION PURPOSES

REVISIONS

REV.	BY	DATE	DESCRIPTION	CHK'D	APP
4	PB	03/08/21	INTERSECTION DETAILS CHANGED	GRG	--
3	PB	30/07/21	TURN DIRECTION CHANGED IN TITLE BLOCK	GRG	--
2	PB	27/07/21	TURNING RADIUS CHANGED, EXIT POINT RE ALIGNED, INFORMATION ONLY	GRG	--
1	PB	12/07/21	CLIENT REVIEW ISSUE	JL	--

REFERENCE DWGS.

DWG No.	DESCRIPTION

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