



**Lot 5 & Lot 6 LP7319
Cyril Beechey Lane,
Cranbourne**

Stormwater Strategy

Maclaw No 10 Pty Ltd

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1 Introduction

Maclaw No 10 Pty Ltd has engaged Incitus to undertake a Stormwater Strategy for the subdivision and development of Lot 5 and Lot 6 LP7319, Cyril Beechey Lane, Cranbourne.

The 8 ha parcels of land are located approximately 43 km south-east of Melbourne in Cranbourne. The site is bounded by existing residential development to the west and north, Cemetery Road to the east.

Lot 5 is located on the east and Lot 6 on the west of Cyril Beechey Lane, immediately south of Stevensons Road, approximately 450 m south of Sladen Street. Lot 6 is bounded to the south by the former Brookland Green landfill site, which is now capped and envisaged to be public open space in the future. Lot 5 is bounded to the south by the obsolete City of Casey landfill site and transfer station. The redundant site is also envisaged to become public open space in the future.

The site is located within Melbourne Water's Monahans Road Development Services Scheme and is located in the City of Casey's Cranbourne Local Area Plan. The site is illustrated in **Figure 1.1** below.

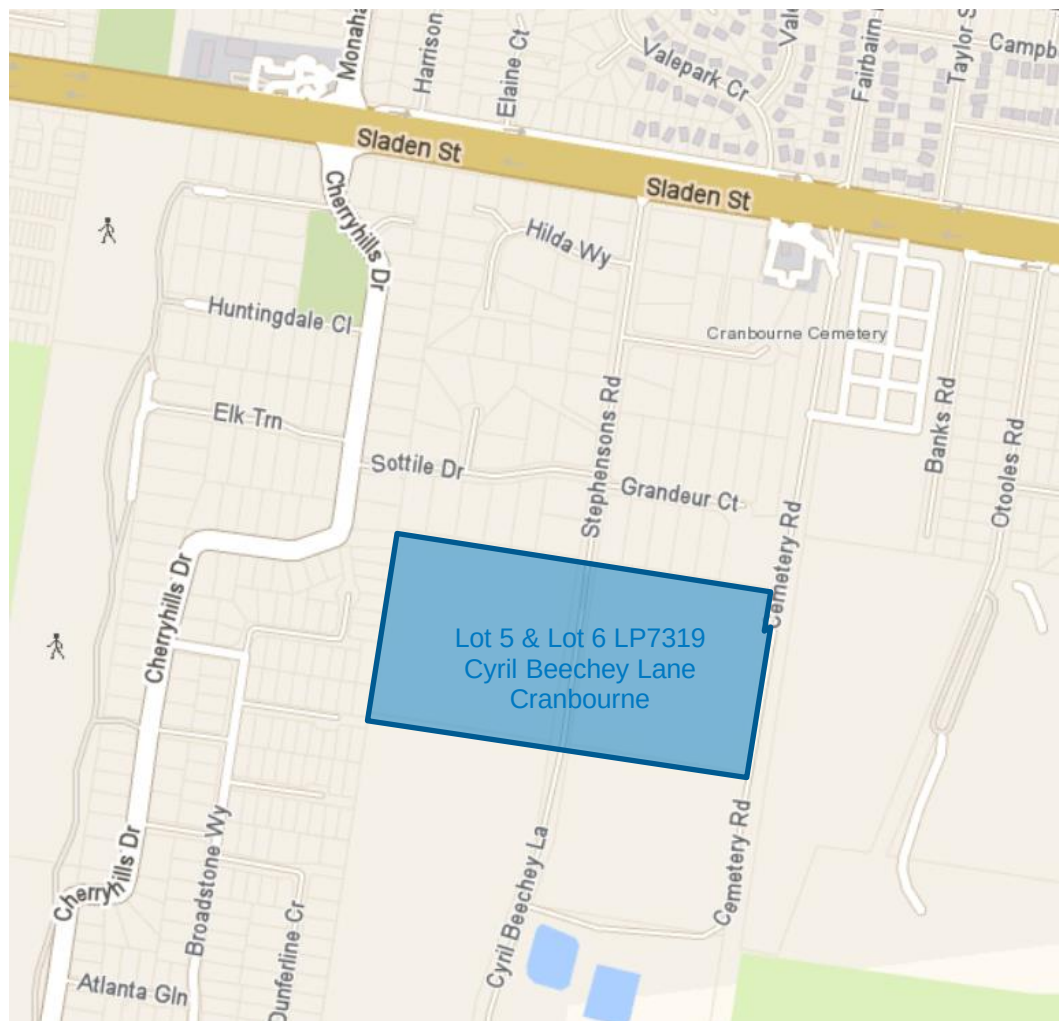


Figure 1.1 Lot 5 & Lot 6 LP7319, Cyril Beechey Lane, Cranbourne

Urbanisation leads to an increase in stormwater runoff and a subsequent increase in pollutant wash-off. It also has detrimental effects on the receiving waterways. In determining the urban structure, it is critical that assets required for drainage purposes are determined early so that the impacts from the increase of stormwater runoff due to urbanisation can be mitigated and all new development can proceed without the risk of flooding, of flooding neighbouring properties and without impacting on the natural environment, receiving waterways and ultimately, Port Phillip Bay.

Undertaking a drainage assessment of the catchment that identifies the quantity of runoff, the conveyance of this runoff, the need to retard the runoff and the treatment and / or reuse of the runoff will assist in determining the assets and / or land-take required for the stormwater management of this catchment. It will also identify the location of all stormwater assets.

Liveability and resilience should be incorporated into all new developments. With respect to stormwater management, this involves utilising the stormwater as an asset for the community whilst ensuring fundamentals such as flood protection, safety with respect to flow management and water supply security are maintained. This can be achieved through incorporation of best planning practices for stormwater management during the development of the urban structure.

This Stormwater Strategy for the development of the site at Lot 5 and Lot 6 of LP7319, Cyril Beechey Lane, Cranbourne outlines a management plan for the stormwater that is generated from the urbanisation of the land. It identifies the assets required to manage the increased surface water runoff from urbanisation and sets a framework to achieve the intent of the stormwater assets. The surface water management for the site has been optimised and designed to achieve multiple benefits for the community and the environment.

2 Catchment Characteristics

The site straddles Cyril Beechey Lane, approximately 450 m south of Sladen Street, and is 8 ha in size. The average annual rainfall for the region is approximately 780 mm. The site is currently used for agricultural purposes and has had significant modification to the pre-European catchment form.

The site generally drains from east to west. The topography is relatively flat ranging from approximately RL 71 m AHD at the high point on the northern boundary approximately 80 m from the eastern boundary to RL 64 m AHD at the low point of the existing drainage reserve located in the north-west corner. Surface grades are generally in the range of 0.1% to 5%.

Figure 2.1 depicts the general site characteristics.

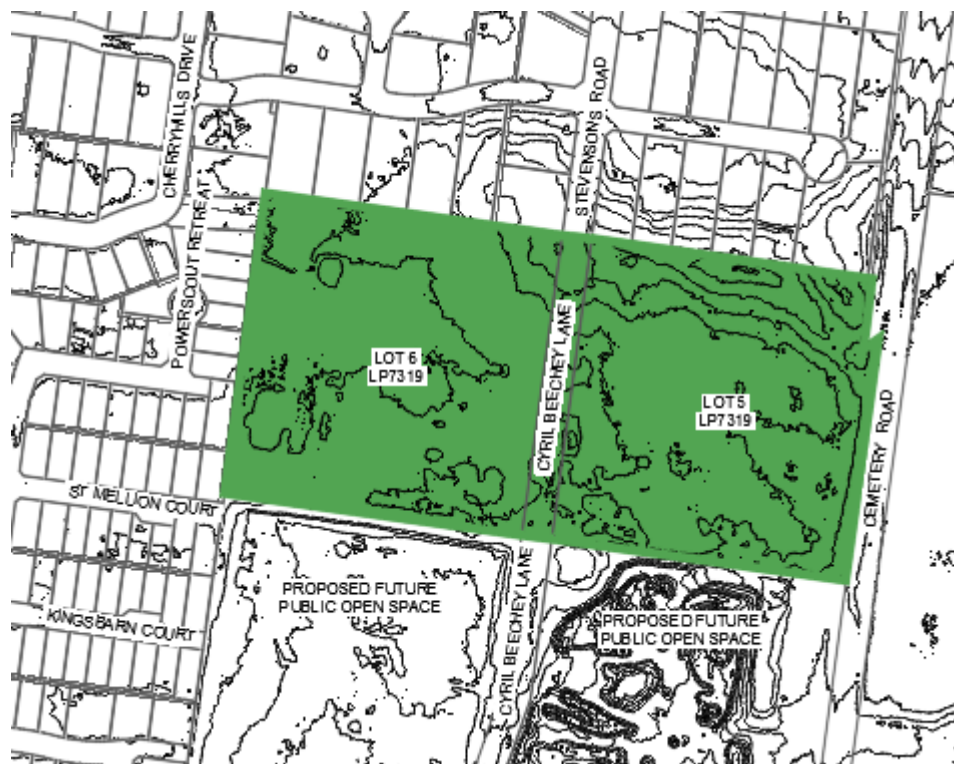


Figure 2.1 Catchment Characteristics Lot 5 & Lot 6, LP7319, Cyril Beechey Lane, Cranbourne

3 Development Services Scheme Works

The site is located within Melbourne Water's Monahans Road Development Services Scheme (DSS). A scheme map sourced from Melbourne Water's website and advice from Melbourne Water indicates that no scheme assets are required in the development. The scheme map encompassing the site is shown in **Figure 3.1**. The site is represented as properties 9 and 12 in the Monahans Road DSS.

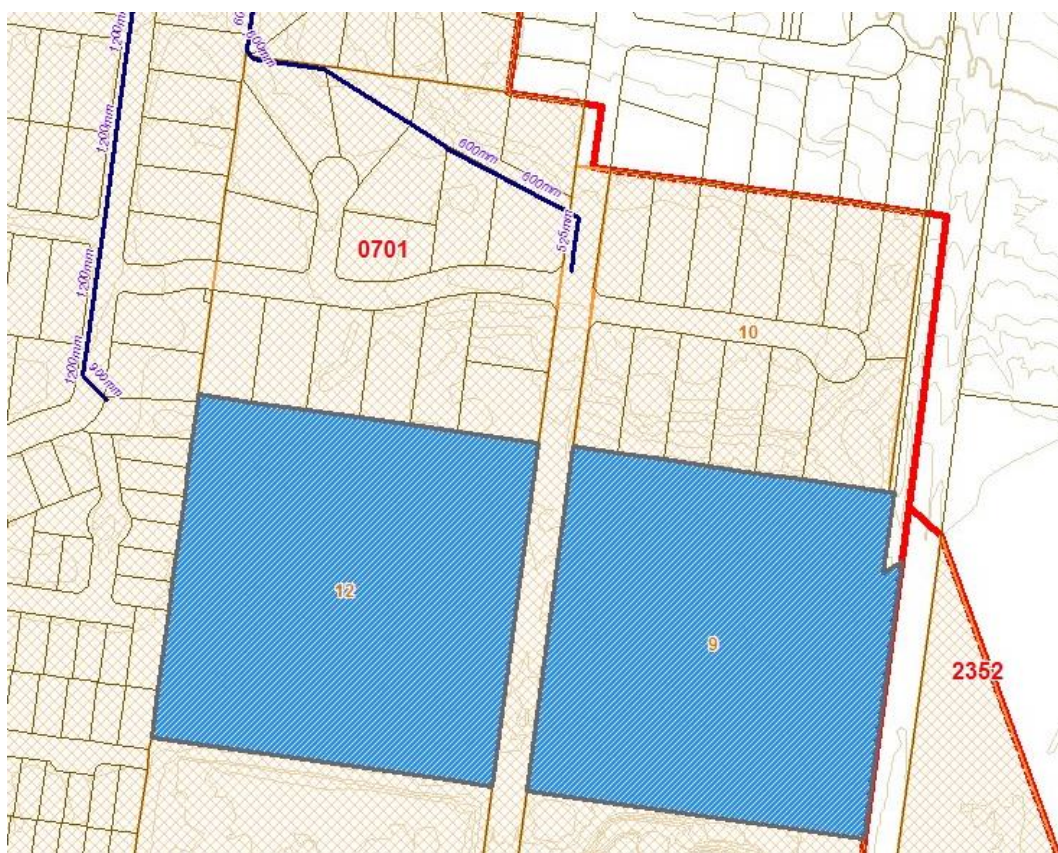


Figure 3.1 Monahans Road Development Services Scheme

4 Stormwater Quantity

The drainage system for the development of Lot 5 and Lot 6, LP7319, Cyril Beechey Lane Cranbourne will be designed to prevent property flooding occurring in a 1% Annual Exceedance Probability (AEP) storm event and the stormwater runoff can be safely conveyed through the development. To achieve this, the development will adopt a minor / major drainage system philosophy.

4.1 Minor Drainage System

The minor drainage system will consist of a subsurface pipe network designed to capture and convey all stormwater runoff generated from the catchment for rainfall events up to and including the 1 in 5 year AEP design storm for residential catchments.

As the localised catchments have an area less than 60 ha, the system will be designed in accordance with the Victorian Planning Authority's Engineering Design and Construction Manual.

4.2 Major Drainage System

The primary objective of the major drainage system is to provide flood protection for the allotments based on the 1% AEP storm event and to ensure the overland flow can be safely conveyed through the development. This will be via overland flow paths contained within road reserves.

The development is located within Melbourne Water's Monahans Road Development Services Scheme (DSS). The DSS provide for catchment scale retardation, none of which is included within this development as per the previous section. A check is required to ensure the downstream system has capacity to convey the flows without the provision of any on-site retardation due to the density of the development.

The development of site will be designed so that all allotments will be set a minimum of 150 mm above the overland flow conveyed through the road reserves, or 300 mm above the hydraulic grade line associated with the Melbourne Water main drain, whichever is greater.

Figure 4.1 illustrates the internal major catchments for the development.



Figure 4.1 Lot 5 and Lot 5 LP7319, Cyril Beechey Lane, Cranbourne Major Catchments

Catchment A

Catchment A is an external catchment located to the south and abutting Cemetery Road. The area of Catchment A is approximately 6 ha. The peak 1% AEP design flow for the catchment is approximately 0.3 m³/s. It is estimated that approximately 0.2 m³/s of this flow will be conveyed overland. The flow will be conveyed through the future open space and development to the north via the road reserves toward the drainage reserve in the north-west corner.

Catchment B

Catchment B is an external catchment located to the north of Catchment A and abutting Cemetery Road. The area of Catchment B is approximately 4 ha. Catchment B will convey the runoff generated from Catchment A. The peak 1% AEP design flow for the combined catchment is approximately 1.0 m³/s. It is estimated that approximately 0.6 m³/s of this flow will be conveyed overland. The flow will be conveyed through the future open space and development to the north via the road reserves toward the drainage reserve in the north-west corner.

Catchment C

Catchment C is an internal catchment located to the north of Catchment B and abutting Cemetery Road. The area of Catchment C is approximately 3.5 ha. The peak 1% AEP design flow for the catchment is approximately 0.8 m³/s. It is estimated that approximately 0.5 m³/s of this flow will be conveyed overland. The flow will be conveyed through the future open space and development to the north via the road reserves toward the drainage reserve in the north-west corner.

Catchment D

Catchment D is an internal catchment located to the north of Catchment B and east of Catchment C. The area of Catchment D is approximately 0.8 ha. Catchment D will convey the runoff generated from Catchment B and Catchment C. The peak 1% AEP design flow for the combined catchment is approximately 1.7 m³/s. It is estimated that approximately 1.0 m³/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves toward the drainage reserve in the north-west corner.

Catchment E

Catchment E is an internal catchment located in the north-east corner and west of Catchment D. The area of Catchment E is approximately 2 ha. The peak 1% AEP design flow for the catchment is approximately 0.5 m³/s. It is estimated that approximately 0.3 m³/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves toward the drainage reserve in the north-west corner.

Catchment F

Catchment F is an external catchment located to the south. The area of Catchment F is approximately 5.4 ha. The peak 1% AEP design flow for the catchment is approximately 0.3 m³/s. It is estimated that approximately 0.3 m³/s of this flow will be conveyed overland until it reaches the development where the minor system will capture the regular flows.

Catchment G

Catchment G is an internal catchment located to the north of Catchment F, west of Catchment D and south of Catchment E. The area of Catchment G is approximately 2 ha. Catchment G will convey the runoff generated from Catchment D and Catchment F. The peak 1% AEP design flow for the combined catchment is approximately 1.9 m³/s. It is estimated that approximately 1.1 m³/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves toward the drainage reserve in the north-west corner.

Peak Outflow at Legal Point of Discharge

The flows from Catchment E and Catchment G combine at the proposed public open space reserve in the north-west corner. The peak 1% AEP design flow for the combined catchment is approximately 2.2 m³/s. It is estimated that approximately 1.3 m³/s of this flow will be conveyed overland.

4.3 Overland Flow Safety

It is imperative that the development conveys the overland flows safely along road reserves. This requires ensuring the overland flow along major flow paths complies with Melbourne Water's floodway safety requirements. The recommended safety limits for residential streets are as follows:

For continuously grading streets:

- $V_{av.dav} \leq 0.35 \text{ m}^2/\text{s}$
- $dav \leq 0.30 \text{ m}$

For undulating streets with a saw-tooth grade:

- Crests $V_{av.dav} \leq 0.35 \text{ m}^2/\text{s}$
- Dips $V_{av.dav} \leq 0.30 \text{ m}^2/\text{s}$
- Crests $dav \leq 0.30 \text{ m}$
- Dips $dav \leq 0.60 \text{ m}$

For the minimum road grades to comply with the engineering standards, the maximum overland flow which can be conveyed along a typical 12 m road reserve is $4 \text{ m}^3/\text{s}$. This is applicable to a v-shaped road profile or a w-shaped road profile for a 12m road reserve.

These figures have been based on 1 dimensional steady state hydraulic modelling using the software program HEC-RAS. The maximum overland flow for the development is estimated to be $1.1 \text{ m}^3/\text{s}$, which will be contained within the road reserves.

4.4 Capacity of the Downstream Infrastructure

A dial-before-you-dig enquiry has indicated that the legal point of discharge for the development is a drainage reserve located adjacent to the north-west corner of the site. The drainage reserve contains a 900 mm diameter pipe drain and is shaped to discharge overland flow towards Cherryhills Drive.

The drain connects to a Melbourne Water main drain at Cherryhills Drive. The main drain maintains the 900 mm diameter for the crossing of the road reserve and then increases to a 1200 mm diameter to capture flows from an additional catchment.

The flow is conveyed through the drainage network and road reserve network to a Melbourne Water retarding basin located adjacent to Cranbourne-Frankston Road and west of Augusta Close. **Figure 4.2** illustrates the pipe drainage network to which this catchment is connecting.

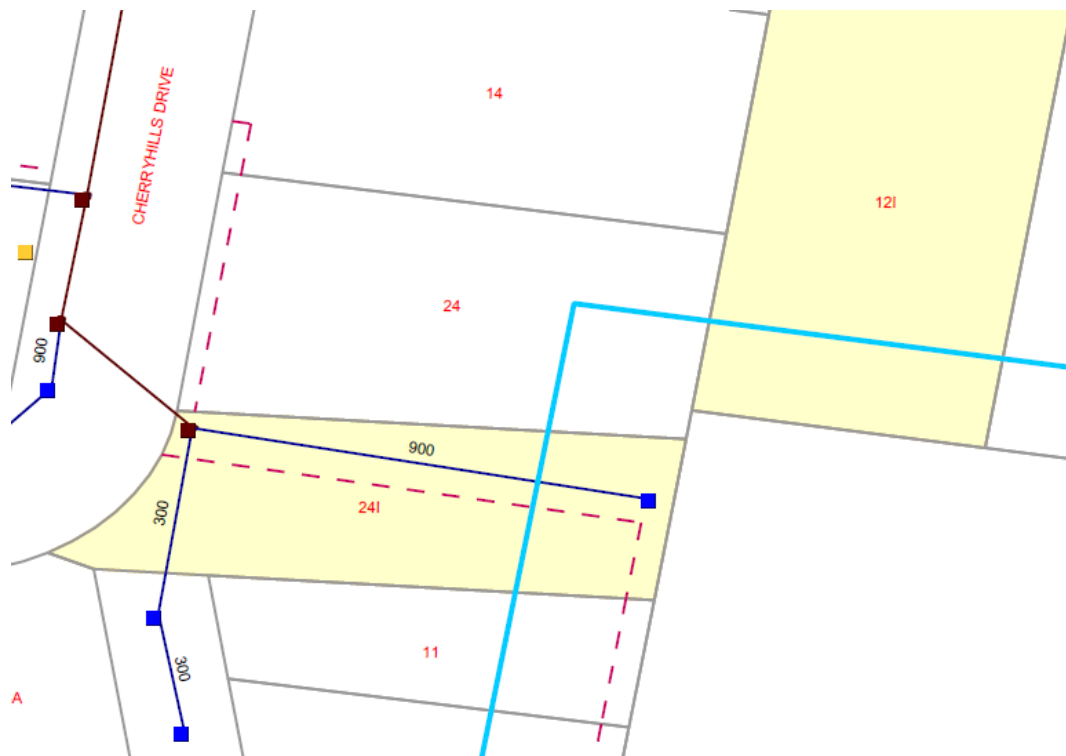


Figure 4.2 Existing Council and Melbourne Water Drainage Network

Melbourne Water has provided layout plans and longitudinal sections of the main drain located in Cherryhills Drive. Assessment of this drain indicates that the 900 mm diameter section has the capacity to convey $1.38 \text{ m}^3/\text{s}$ (based on Colebrook White equation, in accordance with Melbourne Water guidelines). It is estimated that the peak pipe flow discharging from the site is $1.1 \text{ m}^3/\text{s}$, thus the downstream pipe system has capacity to convey the flow.

An additional check has been undertaken on the pipe network where the diameter increases to 1200 mm and an additional catchment contributes from the south. It is estimated that the additional catchment is approximately 26.6 ha. The peak 1 in 5 AEP design flow at the 1200 mm diameter pipe leg is estimated to be $2.84 \text{ m}^3/\text{s}$. The capacity of the pipe at this section is $2.86 \text{ m}^3/\text{s}$. Therefore, the downstream drainage network has capacity to convey the developed stormwater runoff in the drainage network without retardation.

A check is also required on the safe conveyance of the gap flows through the road reserves to ensure no on-site retardation is required. Cherryhills Drive is a 22 m wide road reserve. It is assumed the average grade of this road reserve is 0.5%. It is estimated that the peak gap flow is less than $3 \text{ m}^3/\text{s}$, which can be safely conveyed along the road reserve.

It has been demonstrated that the downstream system has the capacity to convey the peak stormwater flows generated from the development for both the minor and major drainage systems and no on-site retardation is required.

5 Stormwater Quality Treatment

The State Environment Protection Policy (Waters of Victoria) defines the required water quality conditions for urban waterways. The aim of stormwater quality treatment is to reduce typical pollutant loads from urban areas to Best Management Practices as defined in the following targets:

Table 5.1 Best Practice Pollutant Reduction Targets

Pollutant	Performance Objective
Total Suspended Solids (TSS)	80% reduction from typical urban load
Total Phosphorous (TP)	45% reduction from typical urban load
Total Nitrogen (TN)	45% reduction from typical urban load
Gross Pollutants (GP)	70% reduction from typical urban load

Source: *Urban Stormwater: Best Practice Environmental Management Guidelines – Victorian Stormwater Committee, 1999.*

The development is located within Melbourne Water's Monahans Road Development Services Scheme. This DSS is relatively old and does not include any catchment scale treatment. However, it is still possible to make a stormwater quality treatment offset contribution to Melbourne Water to contribute to the funding of treatment assets located elsewhere in the catchment.

An alternative to the financial contribution is the inclusion of at-source treatment. This is usually in the form of the inclusion of rainwater tanks on allotments or rain gardens within the streetscapes.

The inclusion of rainwater tanks works best if the subdivision is undertaken by a builder / developer, whom intends to construct houses as well as undertaking the subdivision and development. Whilst there is a good possibility numerous houses will include a rainwater tank to comply with the building codes, it is difficult to measure and hence will not be included in the overall stormwater quality treatment strategy for the development.

The inclusion of rain gardens in streetscapes only has the possibility of treating the runoff from the road reserves as Metropolitan Planning Authority Engineering Design and Construction Manual discourages allotments from direct connections to the road reserve. The 12 m width of the road reserve makes it difficult to safely provide rain gardens within the road reserve. The surrounding development is also void of at-source treatment, therefore inclusion of streetscape treatment within this development will contrast to the surrounding neighbourhood creating an ad-hoc feeling to the urban design of the area.

The alternative to at-source treatment is end of pipe treatment. The topography indicates that there is drop in levels of approximately 1 m in the north-west proposed open space reserve. This would facilitate the ability to daylight the pipe outlet to achieve treatment of the regular flows generated from the development.

The contributing catchment is too small to justify wetland treatment as an end-of-pipe solution. The alternative effective end-of-pipe solution would be a rain garden. Analysis of the catchment using the industry accepted software MUSIC indicates that a rain garden with a footprint of 50 m² would achieve best practice pollutant reduction targets for the site. It is proposed to include a gross pollutant trap upstream of the rain garden. **Table 5.2** lists the parameters adopted for the rain garden.

Table 5.2 Proposed On-Site Rain Garden for Stormwater Quality Treatment

Parameter	Value
Footprint of Filter Media	50 m ²
Hydraulic conductivity of Filter Media	200 mm / hr
Filter Media Depth	500 mm
Extended Detention Depth	150 mm

Table 5.3 outlines the treatment performance of the rain garden based on a load reduction. This method has been applied as the asset will have an external catchment contributing for which the development is not required to provide stormwater quality treatment.

Table 5.3 Treatment Performance of Proposed On-site Rain Garden

Pollutant	Source Load	Residual Load	Load Removed	Target Load Removal to achieve BPT
Total Suspended Solids (kg/yr)	12,300	2,650	9,650	5,968
Total Phosphorous (kg/yr)	27.8	20.7	7.1	7.0
Total Nitrogen (kg/yr)	217	164	53	50
Gross Pollutants (kg/yr)	2,570	0	2,570	1,148

The rain garden would be transferred to the City of Casey upon completion. If Council would prefer to keep the 0.1 ha reserve free from an encumbrance, the development could undertake some treatment works in the Melbourne Water retarding basin downstream. This would combine the treatment encumbrance with the retarding encumbrance.

The retarding basin appears to have formed an ephemeral wetland in its base, providing the catchment with a level of treatment. The development could expand on this ephemeral wetland, however in doing so it may increase the footprint of the retarding basin. The development would need to seek approval from Melbourne Water and the City of Casey to undertake this option.

The development has 3 possible solutions available for pollutant reduction treatment of the runoff generated from the site:

- Payment of a stormwater quality offset contribution to Melbourne Water
- Construction of a rain garden in the public open space reserve located in the north-west corner of the site
- Augmenting the Melbourne Water retarding basin located downstream with additional ephemeral wetland

The treatment adopted will need to be agreed to Council and Melbourne Water.

6 Outfall Arrangement

The legal point of discharge for the site is the north-west corner. The immediate downstream road and drainage infrastructure has the capacity to convey the stormwater runoff generated from the development of the site and no on-site retardation is required.

The existing drain provides the development with a free draining outfall.

7 Conclusion

The development of Lot 5 and Lot 6 LP7319 Cyril Beechey Lane, Cranbourne is located within Melbourne Water's Monahans Road Development Services Scheme and is required to meet the drainage standards specified by the City of Casey, Victorian Planning Authority and Melbourne Water.

The development will provide pipe drainage infrastructure to convey the 1 in 5 AEP design flows and minimise nuisance flooding occurrences in regular rainfall events. The gap flows, i.e. the difference between the 1% AEP design flows and the pipe flows, will be safely conveyed through the development along road reserve corridors.

Ultimate development of the overall catchment will include provision for conveyance of flows from urbanised catchments and flows will be retarded regionally within assets that form part of the Melbourne Water DSS.

Allotments will achieve relevant freeboard from the 1% AEP flood levels associated the overland flows in road reserves or the Melbourne Water main drain, whichever is greater.

The development has provided several possible options for meeting its obligation to stormwater quality treatment. The preferred option will be agreed by the catchment management authorities and adopted for the development.

The outlet for the development is existing and free draining. The downstream infrastructure has the capacity to convey the stormwater runoff generated from the urbanisation of the site without the provision of on-site retardation.

8 References

CSIRO, 2006, Urban Stormwater: Best Practice Environmental Management Guidelines
Engineers Australia, 1987, Australian Rainfall and Runoff
Growth Areas Authority, April 2011, Engineering Design and Construction Manual
Melbourne Water, 2017, Planning and Building website page
Melbourne Water, 2016, Guidelines for the Use of MUSIC
Melbourne Water, 2005, WSUD Engineering Procedures: Stormwater
South East Water, 2017, Learn about Water website page

Appendix A – Intensity Frequency Duration Data

Cranbourne Intensity Frequency Duration Polynomial Coefficients

ARI	Polynomial Coefficients						
	a	b	c	d	e	f	g
1	2.5745347	-5.97E-01	-2.94E-02	8.46E-03	2.48E-05	-3.13E-04	1.15E-05
2	2.8425822	-6.02E-01	-2.63E-02	8.13E-03	-1.83E-04	-2.60E-04	8.25E-06
5	3.1095955	-6.16E-01	-1.91E-02	8.09E-03	-7.39E-04	-1.90E-04	1.14E-05
10	3.2531788	-6.24E-01	-1.48E-02	7.83E-03	-1.07E-03	-1.26E-04	1.02E-05
20	3.4196789	-6.30E-01	-1.11E-02	7.30E-03	-1.31E-03	-3.17E-05	1.74E-06
50	3.6153522	-6.38E-01	-7.17E-03	7.12E-03	-1.56E-03	2.49E-05	-1.16E-06
100	3.7511528	-6.44E-01	-4.35E-03	6.84E-03	-1.73E-03	8.14E-05	-7.01E-06

Cranbourne Intensity Frequency Duration Table

Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
5 mins	43.81	58.59	80.77	96.16	116.64	146.34	171.30
6	40.96	54.74	75.33	89.63	108.71	136.27	159.44
7	38.60	51.54	70.77	84.09	101.91	127.56	149.12
8	36.61	48.82	66.86	79.33	96.02	120.01	140.15
9	34.88	46.46	63.46	75.19	90.89	113.42	132.30
10	33.36	44.39	60.48	71.55	86.37	107.62	125.40
11	32.01	42.55	57.83	68.32	82.36	102.47	119.28
12	30.80	40.89	55.46	65.42	78.77	97.88	113.82
13	29.70	39.40	53.32	62.82	75.55	93.75	108.92
14	28.71	38.04	51.37	60.46	72.63	90.02	104.50
15	27.79	36.80	49.60	58.31	69.97	86.63	100.48
16	26.95	35.66	47.98	56.34	67.54	83.54	96.82
17	26.17	34.60	46.48	54.52	65.31	80.70	93.46
18	25.45	33.62	45.09	52.85	63.25	78.08	90.37

Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
19	24.78	32.71	43.81	51.30	61.34	75.67	87.52
20	24.15	31.86	42.61	49.86	59.57	73.42	84.88
21	23.56	31.07	41.49	48.51	57.93	71.34	82.43
22	23.00	30.32	40.45	47.25	56.39	69.39	80.14
23	22.48	29.62	39.46	46.07	54.95	67.58	78.00
24	21.99	28.96	38.54	44.96	53.59	65.87	76.00
25	21.52	28.33	37.66	43.92	52.32	64.27	74.12
26	21.08	27.74	36.84	42.93	51.12	62.75	72.35
27	20.66	27.18	36.06	42.00	49.98	61.33	70.68
28	20.26	26.64	35.32	41.11	48.91	59.98	69.10
29	19.88	26.13	34.62	40.28	47.89	58.70	67.60
30	19.52	25.65	33.95	39.48	46.92	57.49	66.19
35	17.93	23.53	31.03	36.01	42.73	52.25	60.07
40	16.63	21.80	28.67	33.22	39.37	48.06	55.20
45	15.54	20.36	26.71	30.92	36.59	44.62	51.20
50	14.62	19.13	25.06	28.97	34.27	41.74	47.86
55	13.82	18.08	23.64	27.31	32.28	39.28	45.02
60	13.13	17.16	22.41	25.87	30.56	37.16	42.57
75	11.47	14.98	19.52	22.49	26.54	32.22	36.87
90	10.26	13.39	17.41	20.05	23.64	28.67	32.78
2 hrs	8.58	11.19	14.52	16.71	19.68	23.84	27.24
3	6.65	8.67	11.23	12.92	15.20	18.40	21.02
4.5	5.14	6.70	8.69	9.99	11.76	14.23	16.25
6	4.28	5.58	7.24	8.33	9.80	11.87	13.56
9	3.31	4.32	5.60	6.45	7.59	9.19	10.50
12	2.76	3.59	4.67	5.37	6.33	7.66	8.76
18	2.12	2.77	3.60	4.14	4.88	5.92	6.76

Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
24	1.76	2.29	2.98	3.43	4.04	4.90	5.61
36	1.34	1.74	2.27	2.61	3.08	3.74	4.27
48	1.09	1.42	1.85	2.13	2.51	3.05	3.49
72	0.80	1.04	1.36	1.57	1.86	2.26	2.58

Appendix C – Flow Computations

Catchment	T _c (mins)	Area (ha)	C	A _e (ha)	ΣA _e (ha)	I ₁₀₀ (mm/hr)	Q ₁₀₀ (m³/s)
A	20	6.04	0.214	1.29	1.29	85.740	0.31
B	24	4.04	0.788	3.18	4.48	76.651	0.95
C	16	3.54	0.797	2.82	2.82	96.817	0.76
D	24	0.78	0.844	0.65	7.95	75.105	1.66
E	13	2.08	0.844	1.75	1.75	110.820	0.54
F	18	5.37	0.185	0.99	0.99	91.885	0.25
G	30	1.98	0.703	1.39	10.33	65.913	1.89
Outlet	30			12.09	12.09	65.913	2.21

Appendix C – Existing Monahans Road Drainage Scheme Stage 3 Drain Plans

BEWARE OF EXISTING SERVICES. SERVICES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE LOCATION OF ALL SERVICES PRIOR TO THE COMMENCEMENT OF ANY EXCAVATION, AND SHALL PROTECT THESE AT ALL TIMES.

SERVICES OFFSET TABLE

STREET	GAS		WATER		TELSTRA		ELECTRICITY		LIGHTING COLUMN
	SIDE	OFFSET	SIDE	OFFSET	SIDE	OFFSET	SIDE	OFFSET	
CHERRYHILLS DRIVE	EAST	2.10	EAST	2.60	WEST	1.75	WEST	2.05	3.90
AUGUSTA CLOSE	SOUTH	2.10	SOUTH	2.60	NORTH	1.75	NORTH	2.05	3.05
CONCORD PLACE	NORTH	2.10	NORTH	2.60	SOUTH	1.75	SOUTH	2.05	3.05
HUNTINGDALE CLOSE	SOUTH	2.10	SOUTH	2.60	NORTH	1.75	NORTH	2.05	3.05
ELK TURN	SOUTH	2.10	SOUTH	2.60	NORTH	1.75	NORTH	2.05	3.05
SOTTILE DRIVE	NORTH	2.20	NORTH	2.80	SOUTH	1.80	SOUTH	3.35	3.90

* ELECTRICAL POLE OFFSET TO BE REDUCED TO 3.95 BETWEEN CHAINAGES 90 AND 88.

NOTE:
THIS PLAN SHOWS DETAILS OF WORKS AFFECTING THE NATURAL SURFACE OF THE LAND WITHIN THE SUBDIVISION WHICH HAVE BEEN CARRIED OUT OR ARE PROPOSED TO BE CARRIED OUT PRIOR TO REGISTRATION OF THE PLAN OF SUBDIVISION, BEING FILL PLACED ON THE LAND TO THE EXTENT AND DEPTH SHOWN ON THIS PLAN.

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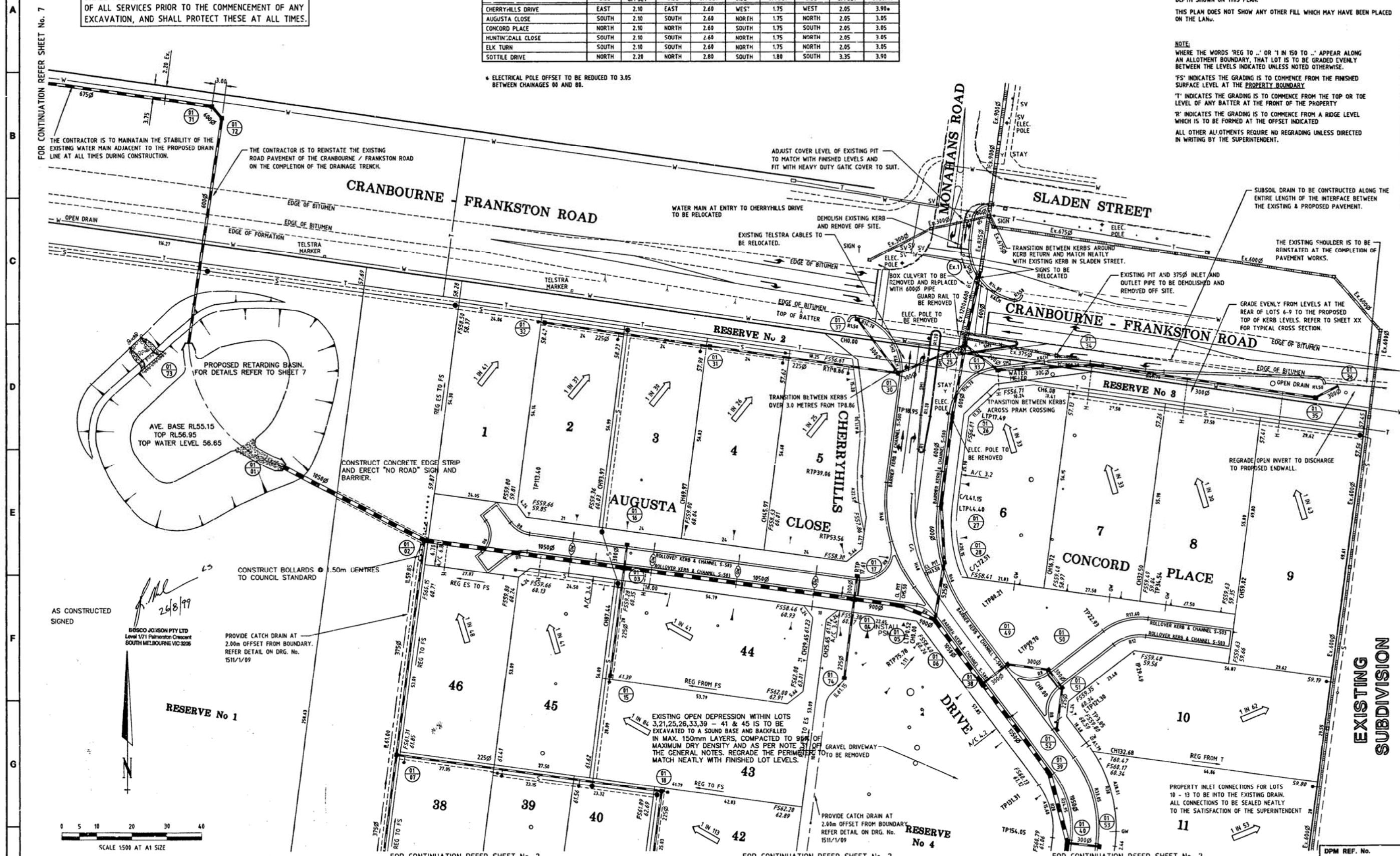
NOTE:
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'R' INDICATES THE GRADING IS TO COMMENCE FROM A RIDGE LEVEL WHICH IS TO BE FORMED AT THE OFFSET INDICATED.

ALL OTHER ALLOTMENTS REQUIRE NO REGRADING UNLESS DIRECTED IN WRITING BY THE SUPERINTENDENT.



SYMBOLS AND GENERAL NOTES				DESIGNED J. Papadimitriou		PLAN REFERENCE		DPM		MELBOURNE WATER CORPORATION		CITY OF CASEY		SCALE: 1500	
SEWERS — S — WATER MAINS — W — TELEPHONE CABLES — T —				CHECKED D. Bellon		MELWAY REFERENCE 133.66		DENNIS, PRICE & MILLER PTY. LTD.		MONAHANS ROAD DRAINAGE SCHEME		SHEET 1 OF 8		DRAWING NO.	
GAS MAINS — G — ELEC. CABLES — E — MANHOLES — M.H. —				AUTHORISED BY M. Price		MELBOURNE WATER OFFER FILE No. 46191		CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS		STAGE 33		0701/33/1			
REGARDING ACCURACY OF POSITIONS OF UNDERGROUND AND OVERHEAD STRUCTURES AND SERVICES SEE SPECIFICATION 92.A.014 ALL CONCRETE SHALL CONFORM WITH SPECIFICATION 92.A.017 ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (A.H.C.—METRES ABOVE MEAN SEA LEVEL)								207 Waverley Road East Melbourne 3145		LAYOUT PLAN - SHEET 1 OF 3					
								Telephone: (03) 9573 1255, Facsimile: (03) 9573 1280							

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RESERVE No 1

CONSTRUCT CONCRETE EDGE STRIP AND ERECT 'NO ROAD' SIGN AND BARRIER.

CONSTRUCT BOLLARDS 0.50m CENTRES TO COUNCIL STANDARD

PROVIDE CATCH DRAIN AT 2.00m OFFSET FROM BOUNDARY. REFER DETAIL ON DRG. No. 1511/1/09

AS CONSTRUCTED
SIGNED *me* 26/8/99

BOSCO JOHNSON PTY LTD
Level 17/171 Palmerston Crescent
SOUTH MELBOURNE VIC 3205



0 5 10 20 30 40
SCALE 1:500 AT A1 SIZE

FUTURE STAGE

SYMBOLS AND GENERAL NOTES

SEWERS — S — WATER MAINS — W — PHONE CABLES — T —
GAS MAINS — G — ELEC. CABLES — E — MANHOLES — M.H. — OR — M.H.

REGARDING ACCURACY OF POSITIONS OF UNDERGROUND AND OVERHEAD STRUCTURES AND SERVICES SEE SPECIFICATION 92.A.014
ALL CONCRETE SHALL CONFORM WITH SPECIFICATION 92.A.017
ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (A.H.D.)—METRES ABOVE MEAN SEA LEVEL

DESIGNED A. Papadimitriou
CHECKED D. Bellan
AUTHORISED BY M. Price

PLAN REFERENCE 133, E6
MELWAY REFERENCE 46191
MELBOURNE WATER OFFER FILE No.

DPM
DENNIS, PRICE & MILLER PTY. LTD.
A.C.N. 006 550 803
CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS
207 Waverley Road East Melbourne 3145
Telephone: (03) 9573 1255, Facsimile: (03) 9573 1280

MELBOURNE WATER CORPORATION
CITY OF CASEY
MONAHANS ROAD DRAINAGE SCHEME
STAGE 33
LAYOUT PLAN - SHEET 2 OF 3

DPM REF. No. 1511/1
SCALE: 500
SHEET 2 OF 8
DRAWING NO. 0701/33/2

EXISTING SUBDIVISION

EXISTING SUBDIVISION

BEWARE OF EXISTING SERVICES. SERVICES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE LOCATION OF ALL SERVICES PRIOR TO THE COMMENCEMENT OF ANY EXCAVATION, AND SHALL PROTECT THESE AT ALL TIMES.

SEC
RESERVE No 1

FUTURE
STAGE

FUTURE
STAGE

FUTURE
STAGE

EXISTING
SUBDIVISION

SOTTILE
DRIVE

MUNICIPAL
RESERVE

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SYMBOLS AND GENERAL NOTES

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REGARDING ACCURACY OF POSITIONS OF UNDERGROUND AND
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ALL CONCRETE SHALL CONFORM WITH SPECIFICATION 92.A.017
ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (A.H.D.)—METRES ABOVE MEAN SEA LEVEL)

DESIGNED J. Papadakis
CHECKED D. Ballin
AUTHORISED BY M. Price
PLAN
REFERENCE
MELWAY
REFERENCE
MELBOURNE
WATER
OFFER FILE No.

DPM
DENNIS, PRICE & MILLER PTY. LTD.
A.C.N. 006 050 803
CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS
207 Waverley Road East Malvern 3145
Telephone: (03) 9573 1255, Facsimile: (03) 9573 1280

CITY OF CASEY
MONAHANS ROAD DRAINAGE SCHEME
STAGE 33
LAYOUT PLAN - SHEET 3 OF 3

DPM REF. No.
1511/1
SCALE: 1500
SHEET 3 OF 8
DRAWING NO.
0701/33/3

NOTE:
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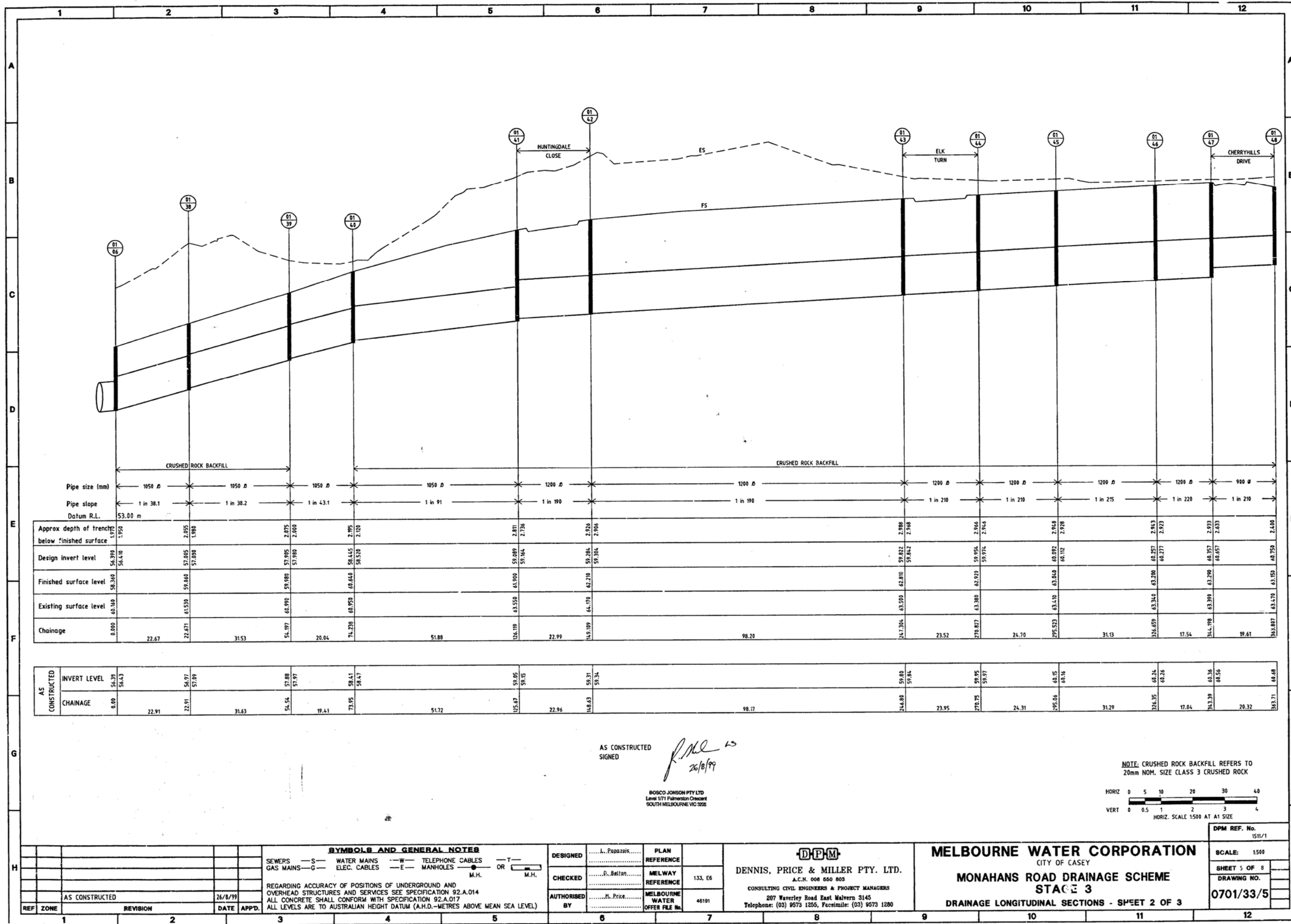
ALL OTHER ALLOTMENTS REQUIRE NO REGRADING UNLESS DIRECTED
IN WRITING BY THE SUPERINTENDENT.

AS CONSTRUCTED
SIGNED

26/8/99

BOSSCO JOHNSON PTY LTD
Level 17/1 Palmerston Crescent
SOUTH MELBOURNE VIC 3205

0 5 10 20 30 40
SCALE 1500 AT A1 SIZE



	CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL			CRUSHED ROCK BACKFILL		
Pipe size (mm)	1050 $\varnothing$	1050 $\varnothing$	1050 $\varnothing$	1050 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	1200 $\varnothing$	900 $\varnothing$									
Pipe slope	1 in 38.1	1 in 38.2	1 in 43.1	1 in 91	1 in 190	1 in 190	1 in 190	1 in 190	1 in 210	1 in 210	1 in 210	1 in 210	1 in 215	1 in 220	1 in 210									
Datum R.L.	53.00 m																							
Approx depth of trench below finished surface	1.950	2.055	2.075	2.095	2.811	2.736	2.926	2.906	2.988	2.968	2.966	2.966	2.948	2.933	2.933	2.933	2.933	2.933	2.933	2.933	2.933	2.933	2.400	
Design invert level	56.390	57.005	57.005	58.445	59.089	59.164	59.284	59.304	59.822	59.842	59.954	59.974	60.092	60.257	60.277	60.357	60.657	60.657	60.657	60.657	60.657	60.657	60.657	
Finished surface level	58.340	59.060	59.080	60.440	61.900	62.210	62.210	62.210	62.810	62.810	62.923	62.923	63.040	63.200	63.200	63.290	63.290	63.290	63.290	63.290	63.290	63.290	63.150	
Existing surface level	60.340	61.530	61.990	62.950	63.550	64.770	64.770	64.770	65.590	65.590	66.380	66.380	66.410	66.410	66.340	66.390	66.390	66.390	66.390	66.390	66.390	66.390	66.390	
Chainage	0.000	22.67	31.53	54.97	74.238	126.119	149.189	169.189	247.304	270.827	295.523	311.112	326.659	344.198	363.807	383.416	403.025	422.634	442.243	461.852	481.461	501.070		

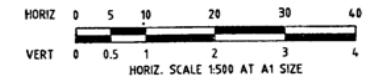
AS CONSTRUCTED	INVERT LEVEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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AS CONSTRUCTED
SIGNED

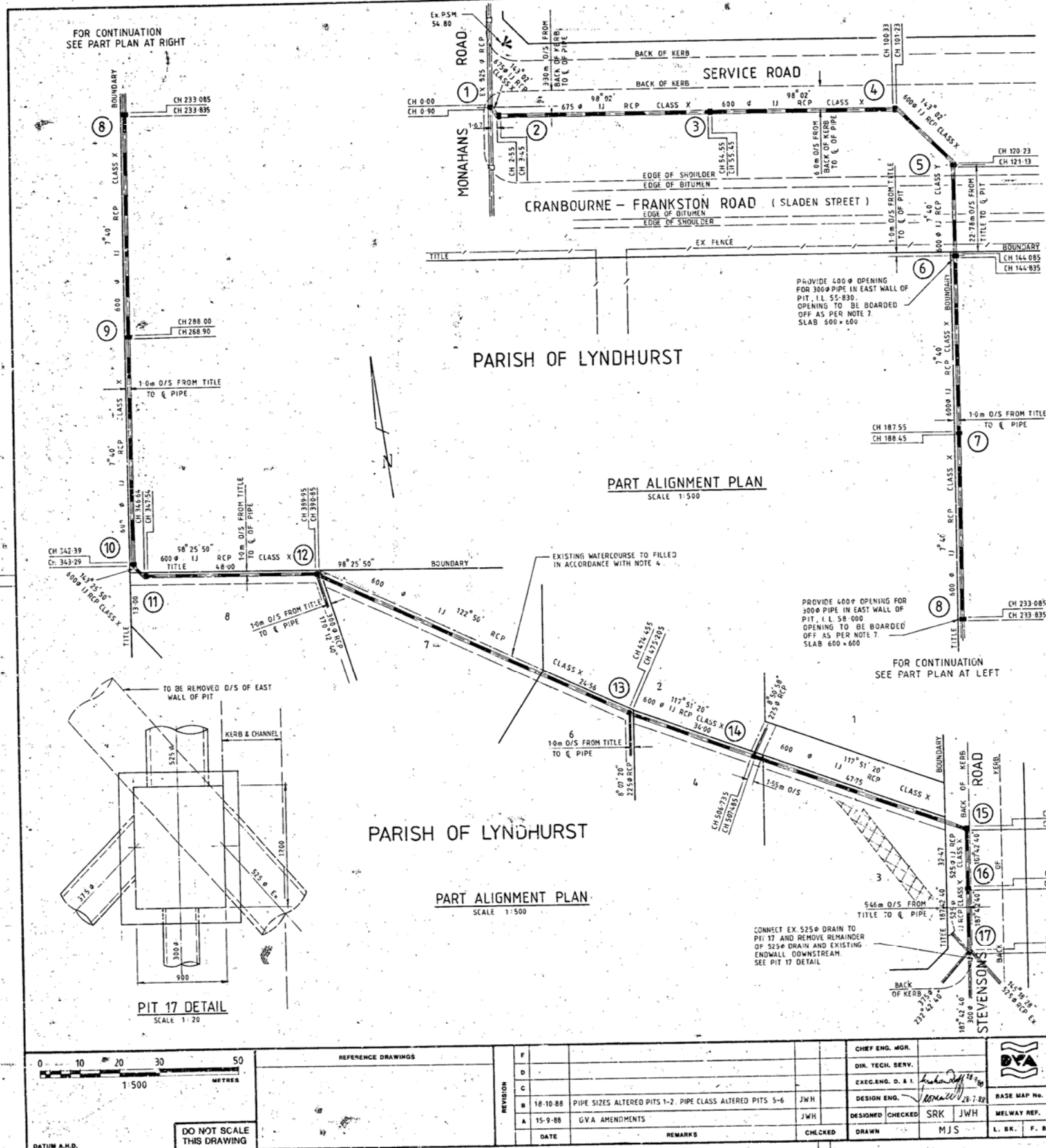
R. M. Price
26/8/99

BOSCO JOHNSON PTY LTD
Level 17/171 Palmerston Crescent
SOUTH MELBOURNE VIC 3206

NOTE: CRUSHED ROCK BACKFILL REFERS TO
20mm NOM. SIZE CLASS 3 CRUSHED ROCK



SYMBOLS AND GENERAL NOTES				DESIGNED A. Papadakis		PLAN REFERENCE		DPM		MELBOURNE WATER CORPORATION	
SEWERS — S — WATER MAINS — W — TELEPHONE CABLES — T —				CHECKED D. Bell		MELWAY REFERENCE 133. E6		DENNIS, PRICE & MILLER PTY. LTD.		CITY OF CASEY	
GAS MAINS — G — ELEC. CABLES — E — MANHOLES — M.H. —				AUTHORISED BY M. Price		MELBOURNE WATER OFFER FILE No. 46191		CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS		MONAHANS ROAD DRAINAGE SCHEME	
REGARDING ACCURACY OF POSITIONS OF UNDERGROUND AND OVERHEAD STRUCTURES AND SERVICES SEE SPECIFICATION 92.A.014								207 Waverley Road East Waverley 3145		STAGE 3	
ALL CONCRETE SHALL CONFORM WITH SPECIFICATION 92.A.017								Telephone: (03) 9573 1255, Facsimile: (03) 9573 1280		DRAINAGE LONGITUDINAL SECTIONS - SHEET 2 OF 3	
ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (A.H.D.)—METRES ABOVE MEAN SEA LEVEL										DRAWING NO. 0701/33/5	
REF	ZONE	REVISION	DATE	APP'D.							
		AS CONSTRUCTED	26/8/99								

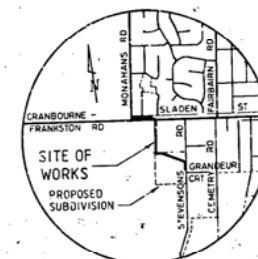


GENERAL NOTES

- All concrete shall contain not less than 320 kg of cement per cubic metre. The maximum slump ordered shall be 60mm.
- All concrete shall contain an approved water reducer and air entrainer to give 4.0% ± 0.5% air content.
- The use of any other additives is not permitted in any concrete.
- All refill material, within properties, to be compacted until the dry density is in excess of 95% of the maximum dry density obtained from the standard compaction test as per A.S.1289.
- All refill material, within road reserve, to be compacted until the dry density is in excess of 98% of the maximum dry density obtained from the standard compaction test as per A.S.1289.
- Backfill within existing and proposed road pavement(s) to be 20mm Class 2A F.C.R. to levels indicated on Drawings.
- All pit openings to be boarded off with concrete slab 75 thick, size to suit opening as shown. Provide 75 x 50 rebate to all outside faces of top of pit risers.
- Provide U shaped S12 splice bars, 600 x 200 x 600, placed at 400 c/s at all construction joints.
- All reinforcement to be centrally placed, unless indicated otherwise.
- All exposed edges of concrete to have 25mm chamfer.
- All exposed steelwork to be hot dipped galvanised, after fabrication.
- Laps to reinforcement to be 400mm unless indicated otherwise.
- All pit risers to be on RH side (looking U/S), unless indicated otherwise.
- Minimum height, from invert level to underside of pit roof, to be 1500mm, where depth of pit will permit.
- Before commencing work on trenches in excess of 1.5m deep notice of such proposal is to be sent to the Secretary of Minerals and Energy in accordance with Clause 202 of the Mines (Trenches) Regulations 1982. All trenches in excess of 1.5m depth shall be constructed in accordance with the Mines (Trenches) Regulations 1982.
- All works to be carried out in accordance with Dandenong Valley Authority standard specifications, except where varied by these notes.
- Top of pits to be boarded off similar to note 7.

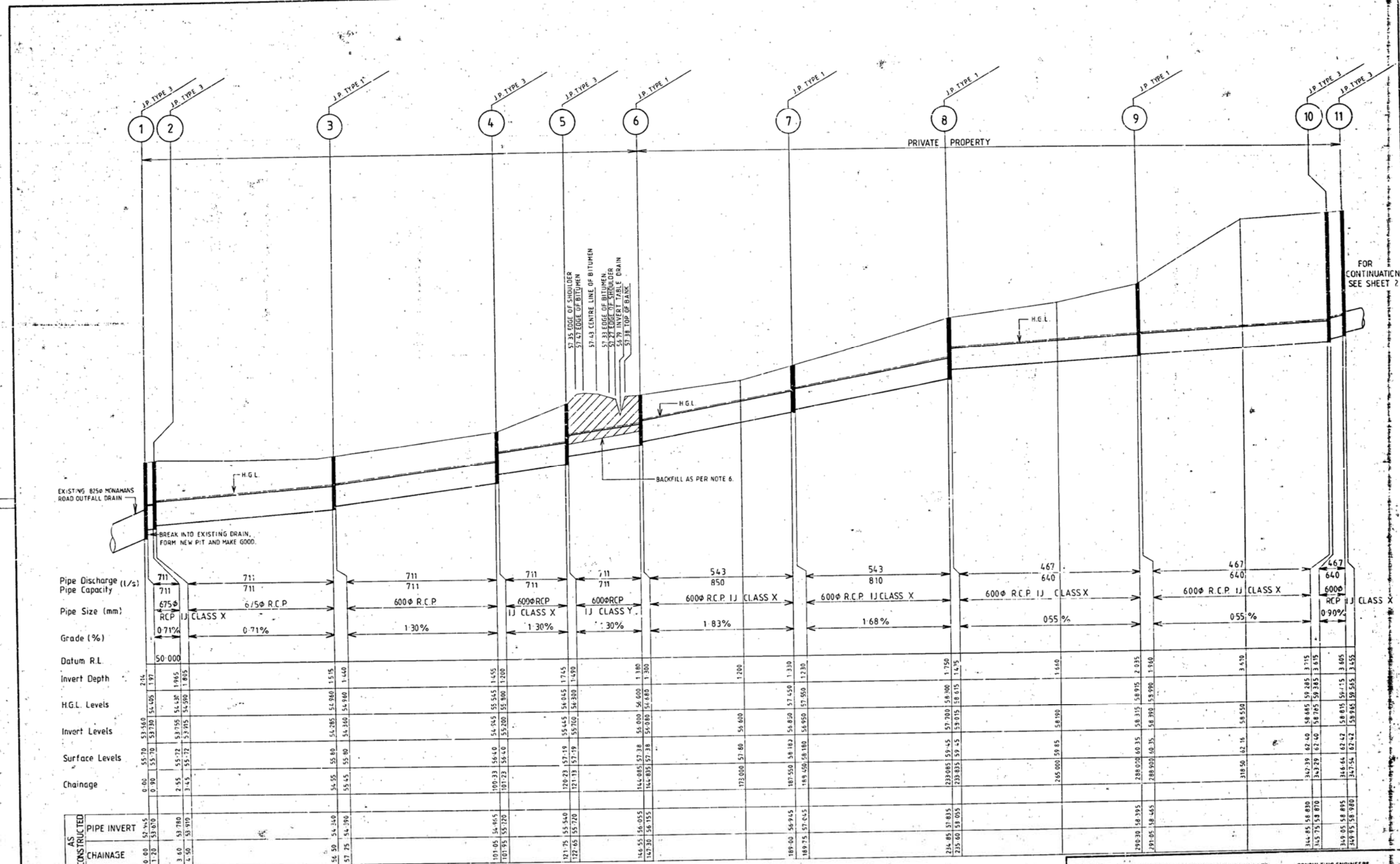
SERVICE NOTES

TELECOM - CONTACT LINES OFFICER Mr. NORM SCHMIDT 48 HOURS PRIOR TO CONSTRUCTION IN VICINITY OF TELECOM ASSETS - Ph. 059-961699
MPDWP - CONTACT Mr. B. HAMMOND (WATER RETICULATION) Ph. 7836677
S.E.C. - CONTACT DISTRICT MANAGER BEACONSFIELD Ph. 7091200
SHIRE OF CRANBOURNE - CONTACT CONSTRUCTION SUPERVISOR (Mr. LES SMITH) Ph. 059-961000



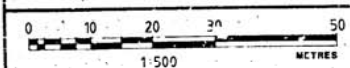
LOCALITY PLAN NTS

271



LONGITUDINAL SECTION

SCALE: HORIZ - 1:500
VERT - 1:50



DATUM A.M.D.

DO NOT SCALE THIS DRAWING

REFERENCE DRAWINGS

REVISION	DATE	REMARKS	CHECKED	DRAWN
E				
D				
C				
B	31-3-89	AS CONSTRUCTED	J.W.H.	
A	15-9-88	D.V.A. AMENDMENTS	J.W.H.	

CHIEF ENG. MOR.	
DIR. TECH. SERV.	
EXEC. ENG. D. R. L.	
DESIGN ENG.	
DESIGNED	SRK
CHECKED	JWH
DRAWN	MJS

BASE MAP No.	106
MELWAY REF.	133 ES
L. BK.	
F. BK.	

DANDENONG VALLEY AUTHORITY

DANDENONG VALLEY AUTHORITY

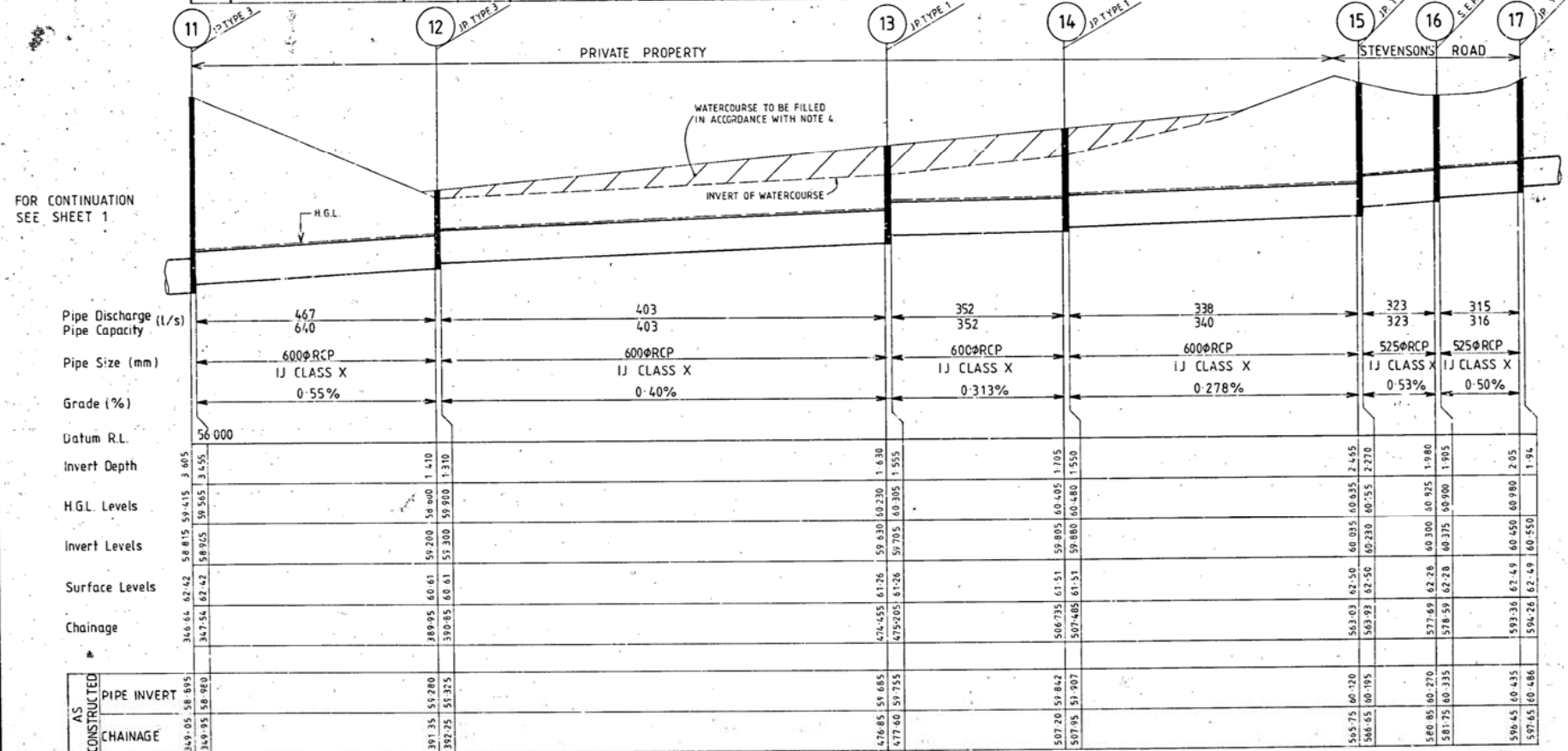
MONAHANS ROAD DRAINAGE SCHEME
STAGE 11.
LONGITUDINAL SECTION - SHEET 1

273

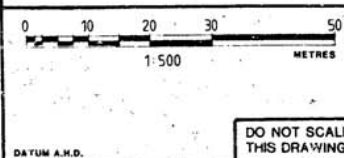
0701/11/2
REVISION
SHEET 2 OF 3
DATE JULY 86

IRWIN, JOHNSTON & PARTNERS ENGINEERS PTY. LTD. CONSULTING ENGINEERS
78 EASTERN ROAD, SOUTH MELBOURNE 3206. TEL. 009 7199
80 SMITH STREET, DAPWIN 5700. TEL. 81 8790
Job No: 14652

STRUCTURE SCHEDULE												AS CONSTRUCTED			
STR. NO.	DESCRIPTION	INTERNAL DIMENSIONS		INLET		OUTLET		BRANCH CONNECTION		TOP OF STR.	DEPTH OF STR.	REMARKS	INLET	OUTLET	TOP OF STR.
		L	W	DIA	LEVEL	DIA	LEVEL	DIA	LEVEL				LEVEL	LEVEL	STR.
1	J.P. TYPE 3	1200	1200	675	53.730	Ex 825	53.560	—	—	55.70	2.140	AS PER ST 102	53.670	52.945	55.56
2	J.P. TYPE 3	900	1200	675	53.915	675	53.755	—	—	55.72	1.965	AS PER ST 102	53.910	53.780	55.71
3	J.P. TYPE 1	750	750	600	54.285	675	54.360	—	—	55.80	1.515	AS PER ST 101	54.390	54.340	56.01
4	J.P. TYPE 3	900	1200	600	55.200	600	54.945	—	—	56.40	1.455	AS PER ST 102	55.220	54.965	56.57
5	J.P. TYPE 3	900	1200	600	55.700	600	55.445	—	—	57.19	1.745	AS PER ST 102	55.725	55.540	57.23
6	J.P. TYPE 1	750	750	600	56.080	600	56.000	300	55.830	56.38	1.380	AS PER ST 101	56.155	56.055	57.42
7	J.P. TYPE 1	750	750	600	56.950	600	56.850	—	—	58.18	1.330	AS PER ST 101	57.045	56.945	58.23
8	J.P. TYPE 1	750	750	600	58.615	600	58.300	300	58.000	59.45	1.750	AS PER ST 101	58.055	57.835	59.68
9	J.P. TYPE 1	750	750	600	58.390	600	58.315	—	—	60.35	2.035	AS PER ST 101	58.465	58.395	60.71
10	J.P. TYPE 3	900	1200	600	58.785	600	58.685	—	—	62.40	3.715	AS PER ST 102	58.870	58.830	62.47
11	J.P. TYPE 3	900	1200	600	58.965	600	58.815	—	—	62.42	3.605	AS PER ST 102	58.980	58.895	62.42
12	J.P. TYPE 3	900	900	600	59.300	600	59.200	300	59.655	60.61	1.410	AS PER ST 102	59.325	59.280	60.89
13	J.P. TYPE 1	750	750	600	59.705	600	59.630	225	60.100	61.26	1.630	AS PER ST 101	59.755	59.685	61.31
14	J.P. TYPE 1	750	750	600	59.880	600	59.805	225	60.260	61.51	1.705	AS PER ST 101	59.907	59.842	60.89
15	J.P. TYPE 3	900	900	525	60.230	600	60.035	—	—	62.50	2.465	AS PER ST 102	60.195	60.120	62.52
16	S. E. P. TYPE 1	900	900	525	60.375	525	60.300	—	—	62.28	1.980	AS PER ST 100	60.335	60.270	62.28
17	J.P. TYPE 3	1200	900	Ex 525	60.550	525	60.450	375 300	60.555 61.270	62.490	2.050	AS PER ST 102	60.485	60.435	62.49



LONGITUDINAL SECTION
SCALE: HORIZ - 1:500
VERT - 1:50



REVISION	DATE	REMARKS	CHECKED	DRAWN
A	15-9-88	D.V.A. AMENDMENTS	J.W.H.	J.W.H.
B	27-10-88	PIT 14 STRUCTURE DEPTH REVISED	J.W.H.	J.W.H.
C	31-3-89	AS CONSTRUCTED	J.W.H.	J.W.H.

CHIEF ENG. MGR.	
DIR. TECH. SERV.	
EXEC. ENG. D. & I.	
DESIGN ENG.	
DESIGNED	CHECKED
SRK	J.W.H.
M.J.S.	

DANDENONG VALLEY AUTHORITY	
BASE MAP No.	496
MELWAY REF.	133 ES
L. BK.	P. BK.

DANDENONG VALLEY AUTHORITY		0701/11/3
MONAHANS ROAD DRAINAGE SCHEME		REVISION C
STAGE 11.		SHEET 3 OF 3
LONGITUDINAL SECTION - SHEET 2 AND STRUCTURE SCHEDULE		DATE JULY 88

27.2

IRWIN, JOHNSTON & PARTNERS ENGINEERS PTY. LTD.
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90 SMITH STREET, DARWIN 5790. TEL. 81 8790



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