

FLOOD HAZARD ASSESSMENT  
42-44 Ponds Drive  
Lara

Project Number W.TRA-002-15  
13 March 2015

Prepared by: Travis Greening *B. Eng (Civil) Hons, M.I.E. Aust*

\_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_\_

PM Design Group  
2/223 Koroit Street Warrnambool 3280  
Telephone (03) 55646888

Rev	Description	Sig	Date
1	Submitted to CMA and CoGG for approval	T.G	16.03.15
2	Includes HGL analysis of existing drainage Network	T.G	29.07.15

## 1.0 Introduction

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On behalf of Tract Consultants Pty Ltd a flood hazard assessment has been prepared to assess the impacts of urban flooding arising from overland flows associated with urban infrastructure exceeding design capacity. The purpose of this report is to determine if minimum flood hazard guidelines are achieved which will allow the subject site at 42-44 Ponds Drive to be rezoned from UFZ (Urban Flood Zone) to RZ1 (Residential Zone 1). If a rezoning of this land is possible then the owner will make application for planning approval to subdivide the subject land.

## 2.0 Existing Site Conditions

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The Subject Site is currently occupied with an existing house and there are plans to subdivide the land into as many as three lots in the future. The site is directly abutting the Hovells Creek and is currently protected from flooding of this creek by an existing levee bank. The levee bank was constructed in 1986 after houses in Ponds Drive and surrounding streets were damaged during flooding in 1973. This levee bank was damaged and flooding occurred again in 1988 after a major flood event which is believed to be the worst in recorded history for this area. The levee bank was repaired and extended in height by 600mm after the 1988 floods. Modelling suggests the levee bank is currently above the 1%AEP flood level however as part of the conditions of rezoning the subject site, the owner is required to conduct remediation works to this levee bank to ensure that it provides 600mm of freeboard above the 1%AEP flood level. Plans for these works have been prepared by PM Design Group and are currently awaiting approval for CoGG<sup>1</sup> and Corangamite CMA. These works would involve increasing the levee bank by up to 330mm above its current height and providing an engineering assessment of the levees structural capacity.

The site is currently designated as UFZ and flood mapping provided by CoGG shows the site to be subject to flooding during events greater than 5%AEP. However the extent of flooding identified on this map has been disputed as it does not appear to take into consideration the protection provided to the site by the levee bank and is based on observed flooding rather than modelled.

The Subject Site is also one of the higher Lots in Ponds Drive with an average level across the block of approximately RL8.80. The Low point in Ponds Drive is located approximately 220m to the east and has an RL of 7.90.

Under normal conditions access from the Subject Site to Flinders Avenue is provided by travelling along Lime Crescent. There is also an "Emergency Access" route via an unmade road reserve between Ponds Drive and Hailar Lane. This Emergency Access route has a gate and is currently designated by the CFA as an emergency exit during fire events. Local residents have informed that keys to this gate are possessed by emergency services and some local residents.

The contours of the surrounding area indicates that any overland flow generated from the 1%AEP flood event would be conveyed along the existing roadway to two(2) low spots in Ponds Drive and Lime Crescent. Analysis of the flow depth and velocity has been undertaken as these roadways are located on the Normal Access route.

<sup>1</sup> CoGG = City of Greater Geelong



**In front of Subject Site (Facing West)**



**Ponds Drive from Subject Site (Facing East)**



**Emergency Access Route (Hailar Lane)**



**Low Point B in Lime Crescent (Facing West)**

### 3.0 Assessment

The area inside the Levee bank has been referred to as the Localised Catchment. As the levee bank will be modified to provide 600mm freeboard above 1%AEP flood levels the Localised Catchment will be protected from floodwaters in the Hovells Creek. There still needs to be consideration for the Subject Site and access routes potential to be subject to flooding by the following means.

- 1. Overland flows from within the Localised Catchment area**
- 2. Backing up of the existing Drainage Network**

Any flooding that is identified should be evaluated against the following flood hazard guidelines to determine if there is an acceptable level of risk to people and property as a result of this flooding event.

The flood hazard guidelines specified in Australian Rainfall and Runoff (AR&R) are as follows:

<b>Appropriate Safety Criteria for People on site during 1%AEP Flood Events</b>
Depth of flow must be no greater than or equal to 0.5m; and
Velocity must be no greater than or equal to 3.0m/s; and
The product of depth multiplied by velocity must be no greater than or equal to $0.4\text{m}^3$

<b>Vehicles Egressing from Site during 1%AEP Flood Events</b>
Depth of flow must be no greater than or equal to 0.3m; and
Velocity must be no greater than or equal to 3.0m/s; and
The product of depth multiplied by velocity must be no greater than or equal to $0.3\text{m}^3$

It should be noted that there is a Normal Access route through Lime Crescent. There is also an Emergency Access route through Hailar Lane that requires a gate to be opened to gain vehicle access.

These access routes have been identified in **Figure 1.0**

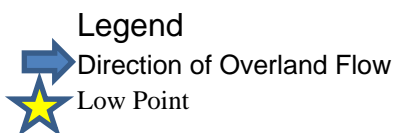


**Figure 1.0 Access Routes**

## Overland flows from within the Localised Catchment area



Figure 2.0 Existing Localised Catchment and flow paths



The Localised Catchment contains two low spots. These low spots are shown in Figure 2 and have been referred to as Low Point A and Low Point B. They have a catchment area of 4.53Ha and 8.95Ha respectively. Low Point B is located on the Normal Access route and vehicles would need to pass through this low point to exit the site unless the Emergency Access route was used. Low Point A is not located on any access routes and rainfall within its catchment would not have an effect on the subject site or the access route.

A catchment plan of the Low Point B has been produced in **Appendix A**. Catchment areas have been broken up into sub catchments located along the Normal Access route.

Rational method calculations in accordance with the Infrastructure Design Manual (Vers 4.2) were completed for Sub-Catchments A through to F for the existing site conditions. Time of concentration was calculated using the Kinematic Wave Equation.

Existing topography was modelled using 3D software and calibrated to produce cross sectional analysis of the Normal Access route and the Subject Site with an inundation area quantified using Manning's formula. Using areas defined by the Localized Catchment boundary illustrated in Attachment A. 1%AEP runoff calculations were prepared in accordance with the IDM and the results have been shown in Table 4.1

Catchment	Area (Ha)	Cumulative Area (Ha)	Average Slope (%)	Time of Concentration (minutes)	Intensity* (mm/hr)	1%AEP Discharge (m <sup>3</sup> /sec)
A	3.32	3.32	1.64	23	82.1	0.54
B	2.51	2.51	2.22	16.5	99.4	0.49
C	0.36	2.87	2.5	16.6	99.5	0.57
D	0.87	3.74	2.4	17	97.7	0.73
E	1.89	1.89	1.7	21	86.6	0.32
F	0.88	0.88	2.4	7	153	0.22

\*Rainfall data for Lara for 1%AEP- sourced from BOM website

**Table 4.1**

The velocity and depth of overland flow along the Normal Access route was analysed extensively. **Appendix B** shows the cross section A to E through the Normal Access route at the lower end of each sub-catchment and Cross section F through the centre of the Subject Site. The cross sectional area of flow has also been plotted on these cross sections. A summary of the overland flow analysis have been shown in Table 4.2

Cross Section	Cross sectional Area (m <sup>2</sup> )	Wetted perimeter (m)	Slope (m/m)	Velocity (m/sec)	Maximum depth of flow (m)	Product of depth and Velocity
A	0.91	10.3	0.023	0.59	0.145	0.085
B	0.866	10.25	0.025	0.60	0.128	0.077
C	0.98	11.5	0.025	0.60	0.140	0.084
D	0.88	9.17	0.048	0.90	0.148	0.133
E	0.58	8.65	0.082	0.93	0.116	0.108
F	0.84	12.27	0.078	0.29	0.120	0.035

**Table 4.2**

From the results shown in Table 4.2 it can be observed that the flood hazard guidelines as shown in Section 3 of this report has not been exceeded.

It should also be noted that the overland flow plotted in Attachment B is fully contained within the road reserve and will not breach onto abutting properties.

### **Backing up of the existing Drainage Network**

The Localised Catchment is drained via an existing drainage network which is confined between Forrest North Road, Flinders Avenue and Hovells Creek. No stormwater from outside this boundary attributes to this drainage network. A plan of the drainage network has been prepared and included in **Appendix C**. The drainage network is discharged into the Hovells Creek approximately 330m downstream of the Flinders Avenue bridge crossing. The 1% AEP level at the discharge location is RL 7.6

Records of this drainage network showing pipe sizes and invert levels were obtained from CoGG and a full hydraulic analysis of the network during a 1%AEP event was conducted.

The hydraulic grade line was calculated using the 1% AEP flood level at the discharge location (RL7.6) as a starting HGL and pit and friction losses were added to determine if any surcharge occurred at the upstream pits. A report showing the results of this analysis has been included in **Appendix D**.

The report shows that the HGL exceeded pit cover levels and caused a surcharge during a 1%AEP event in 10 Pits.

A summary of the surcharging pits is shown in Table 4.3

Pit Number	Pit Location	Address	HGL	Pit cover Level	Surcharge (mm)
798203	Road Reserve	2 Lime Crescent	8.390	8.006	384
798204	Road Reserve	1 Lime Crescent	8.389	7.997	392
798207	Road Reserve	Lime Crescent/ Neville Street Intersection	8.378	8.127	262
798208	Road Reserve	Lime Crescent/ Neville Street Intersection	8.378	8.188	190
798209	Road Reserve	5 Lime Crescent	8.369	8.119	250
798210	Road Reserve	10 Lime Crescent	8.352	8.124	228
798284	Road Reserve	5 Jan Court	8.030	7.962	62
798283	Road	1 Jan Court	8.023	7.818	205

	Reserve				
798290	Property	13 Ponds Drive	7.944	7.857	87
798194	Road Reserve	43 Flinders Avenue	7.657	7.633	24

The above summary shows that most of the pits that are subject to surcharge are in proximity to Low Point B. The amount of surcharge in Pit 798203 and Pit 798204 was 384mm and 394mm respectively which exceeds the allowable maximum flooding depth set out in the flood hazard guidelines. These pits are located along the Normal Access Route and therefore this would not be an acceptable vehicle route during a 1%AEP event. The extend of flooding caused by HGL surcharge has been shown in **Appendix E**

An assessment of the drainage network within proximity to the Subject Site and the Emergency Access Route show that the HGL does not surcharge above pit cover levels and therefore the western side of the Localised Catchment is not subject to flooding during 1%AEP events.

## 4.0 Future Planning

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If the Subject Site is rezoned and subdivided then minimum floor levels should be set for any new development. There is an existing drainage pipe located on the Subject Site and the HGL at this location is RL8.609. A freeboard of 300mm should be provided therefore and new dwellings constructed on the site should have a minimum floor level of RL8.909. Which is 215mm above the lowest point on the site.

Any future development of the site will require on site detention. The amount of discharge allowed to leave the site should be restricted to current pre-development levels. The method and volume of on-site detention required should be design by a suitably qualified engineer ensuring that the allowable discharge rate is not exceeded. All stormwater from the site for storm events less than 10%AEP should be collected and discharged via underground drainage infrastructure into the existing drainage network.

The rezoning and future development of the Subject site will not cause any loss of flood plain storage or off site hydraulic impacts to adjacent properties.

## 5.0 Conclusions

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The following is a summary of the conclusions in regard to this flood hazard assessment.

### **The Subject Site**

1. The subject site is protected from flooding from the Hovells Creek by an existing levee bank. The levee bank will be increased in height to ensure there is a minimum of 600mm freeboard above the 1%AEP and an engineering assessment will be done to verify its structural capacity
2. The subject site is approximately 950mm higher than the lowest point in the catchment. The low point is 220m to the East of the subject site.
3. The subject site has a very small upstream catchment and would be subjected to very minimal amounts of overland flow during 1%AEP events
4. The existing drainage system abutting the site is not subject to HGL surcharge during 1%AEP events.
5. The above analysis indicates that the Subject Site would not be subject to flooding during a 1%AEP event
6. A minimum floor level of any new Dwellings should be set at RL8.906
7. The amount of stormwater discharged from the site should not exceed current pre-development discharge rates.

### **The Access Routes**

8. There is a vehicle access route along Lime Crescent which is used in normal conditions. There is also an emergency vehicle access route through Hailar Lane which is also used for fire escape
9. The existing road network provides defined flow paths for overland flow generated from major storm events. Analysis of overland flow within these road networks along the Normal Access route shows the maximum velocity of 0.93m/s and maximum flow depth of 148mm
10. Some pits in the existing drainage network are subject to surcharge during 1%AEP events. These pits are mostly located around Low Point B which is on the Normal Access route the maximum amount of surcharge above pit cover level is 394mm. This does not comply with AR&R safety criteria.
11. The Emergency Access route would not be subject to flooding during a 1%AEP event and therefore this route should be used if the Normal Access route becomes flooded

## 6.0 Recommendations

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The results of this flood hazard assessment indicates that the Subject site is located at a high enough level in the catchment that it is not subject to flooding during 1%AEP events via stream flow, overland flow from within the Localised Catchment or drainage network surcharge.

HGL analysis of the existing drainage network indicates that there would be a surcharge of stormwater up to 392mm above pit cover level at Low Point B during a 1%AEP event. This means that vehicles could not safely leave the site using the Normal Access route. There is an existing Emergency Access route which the Subject Site has direct access to and could use in Major flooding events. This is the current designated fire escape route.

The City of Greater Geelong should also consider upgrades to the existing drainage system to ensure the height of surcharge at Low Point B does not exceed the maximum depth of flow as set out in the flood hazard guidelines. There are currently 63 properties (approx.) that use Lime Crescent as an access route and their safety should be considered.

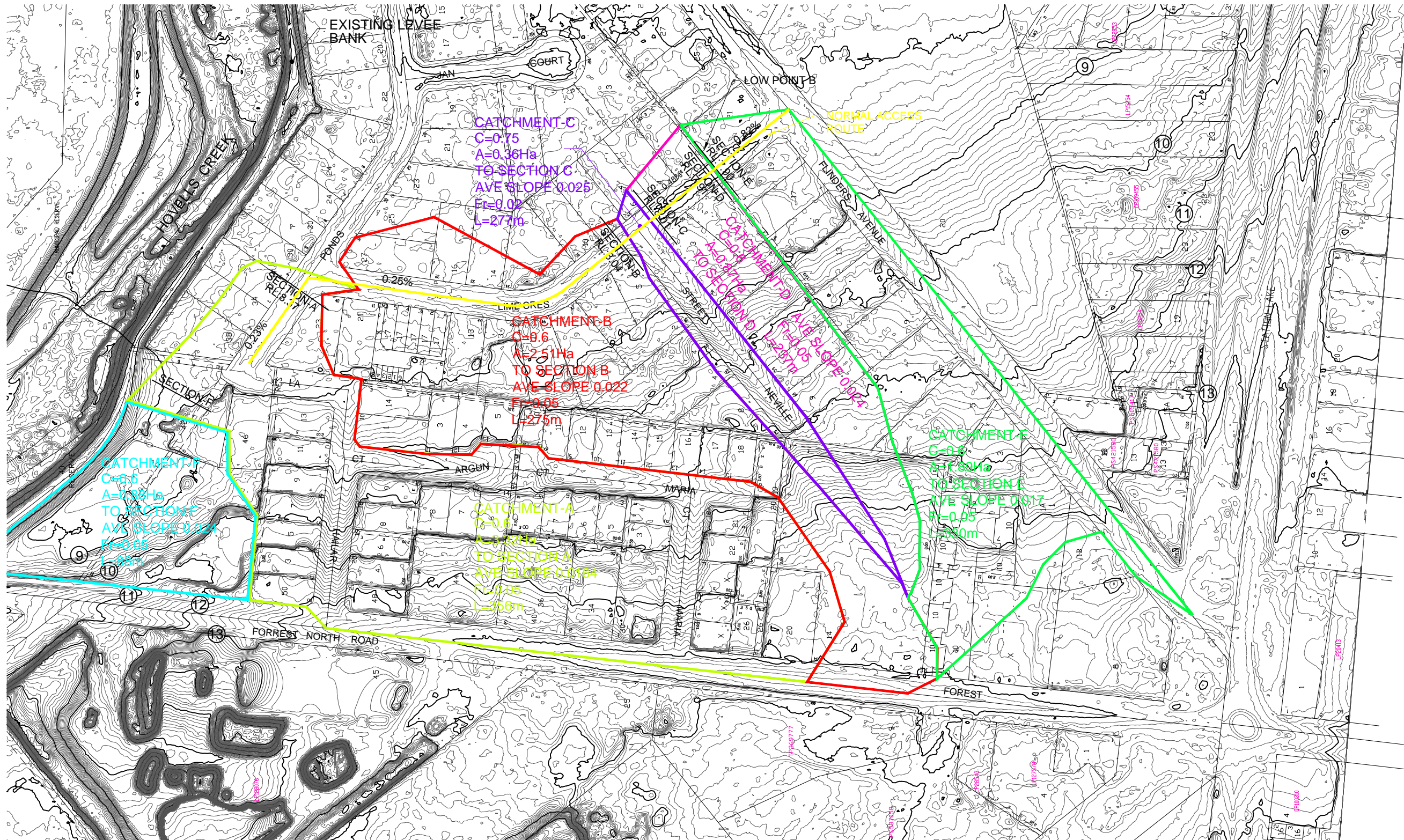
## 7.0 Attachments

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Attachment A	Catchment Plan
Attachment B	Overland Flow Path cross sections
Attachment C	Existing Drainage Network
Attachment D	Hydraulic Grade Line Analysis



Appendix A  
**Catchment Plan**



# CATCHMENT PLAN

NOTES	0	XXXX	RH	TG	L.M	ISSUED FOR CONSTRUCTION	ENGINEER	T. GREENING	17.03.15	<b>PM DESIGN GROUP</b> Engineering Solutions MULTI DISCIPLINE CONSULTING ENGINEERS 2/223 KOROIT ST, WARRNAMBOOL. VIC. 3280 PHONE: (03) 5564 6888 FAX: (03) 5561 1850 WEB: www.pmdesign.com.au	PROJECT: PONDS DRIVE LARA PM PROJECT No.: W.TRA-002-15 CLIENT: TRACT CONSULTANTS	DWG No. :	REV 0
	REV	DATE	DR	CHK	APP	REVISION DESCRIPTION	CHECKED	T. GREENING	XXXX			TITLE: FLOOD HAZARD ASSESSMENT	



Appendix B  
**Overland Flow Path Cross Sections**









Station	NATURAL	DATUM RL:5.0
0+000	8.19	
0+000.26	8.20	
0+000.41	8.20	
0+001.04	8.19	
0+001.54	8.21	
0+002.01	8.21	
0+002.46	8.20	
0+002.82	8.22	
0+003.17	8.22	
0+003.60	8.23	
0+003.88	8.22	
0+004.11	8.23	
0+004.59	8.24	
0+005.20	8.22	
0+005.39	8.21	
0+006.17	8.20	
0+006.67	8.19	
0+006.79	8.19	
0+007.44	8.18	
0+007.95	8.17	
0+008.15	8.17	
0+008.39	8.16	
0+008.86	8.14	
0+009.24	8.14	
0+009.57	8.15	
0+009.99	8.14	
0+010.28	8.14	
0+010.52	8.14	
0+010.99	8.14	
0+011.58	8.13	
0+011.80	8.13	
0+012.42	8.14	
0+013.09	8.09	
0+013.13	8.09	
0+013.18	8.08	
0+013.84	8.00	
0+014.37	7.94	
0+014.55	7.92	
0+014.78	7.92	
0+015.26	7.93	
0+015.65	7.94	
0+015.97	7.95	
0+016.37	7.96	
0+016.68	7.96	
0+016.93	7.97	
0+017.40	7.98	
0+017.97	7.97	
0+018.22	7.97	
0+019.23	7.94	
0+019.50	7.93	
0+019.53	7.93	
0+019.57	7.93	
0+020.78	7.90	
0+020.95	7.90	
0+021.16	7.92	
0+021.66	7.96	
0+022.07	7.99	
0+022.76	8.05	
0+023.09	8.06	
0+023.35	8.06	
0+023.80	8.08	
0+024.36	8.15	
0+024.51	8.17	
0+024.63	8.18	
0+025.22	8.21	
0+025.91	8.27	
0+025.95	8.27	
0+027.20	8.32	
0+027.55	8.31	
0+028.06	8.32	
0+028.48	8.33	
0+028.78	8.33	
0+029.14	8.35	
0+029.49	8.36	
0+029.76	8.35	
0+030.20	8.34	
0+030.74	8.31	
0+031.05	8.29	
0+031.62	8.26	
0+032.33	8.22	
0+032.34	8.22	
0+033.04	8.18	
0+033.61	8.15	
0+033.76	8.14	
0+033.93	8.14	
0+034.47	8.16	
0+034.89	8.19	
0+035.18	8.20	
0+035.25	8.20	

Scale Horizontal 1:100 Vertical 1:50



# CROSS SECTION E

REV	DATE	DR	CHK	APP	REVISION DESCRIPTION	APPROVED	DATE
0	XXXX	RH	TG	LM	ISSUED FOR CONSTRUCTION	L.MCGRATH	XXXX

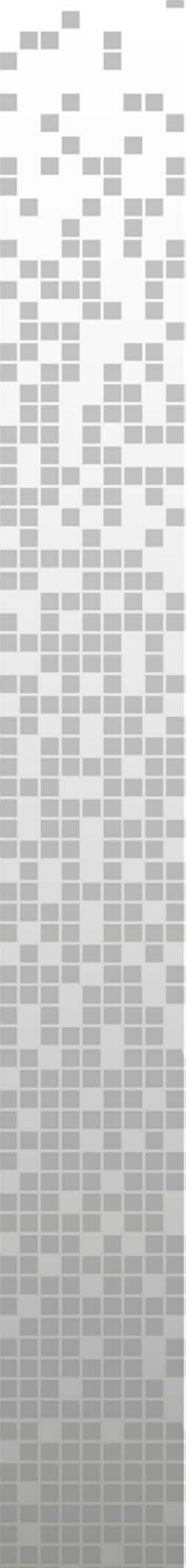
  

ENGINEER	T. GREENING	DATE	17.03.15
DESIGNER	PM DESIGN		
DRAWN	RH		17.03.15
CHECKED	T. GREENING		XXXXX
APPROVED	L.MCGRATH		XXXXX

<b>PM DESIGN GROUP</b> Engineering Solutions www.pmdesign.com.au		PROJECT: PONDS DRIVE LARA
MULTI DISCIPLINE CONSULTING ENGINEERS 2/223 KORROIT ST, WARRIMARRBOOL, VIC. 3280 PHONE: (03) 5564 6888 FAX: (03) 5561 1850 WEB: www.pmdesign.com.au		PM PROJECT No.: W/TRA-002-15 CLIENT: TRACT CONSULTANTS
DWG No. :		TITLE: CROSS SECTION -E 1% AEP OVERLAND FLOW
SCALE: AS NOTED @ A3		REV 0

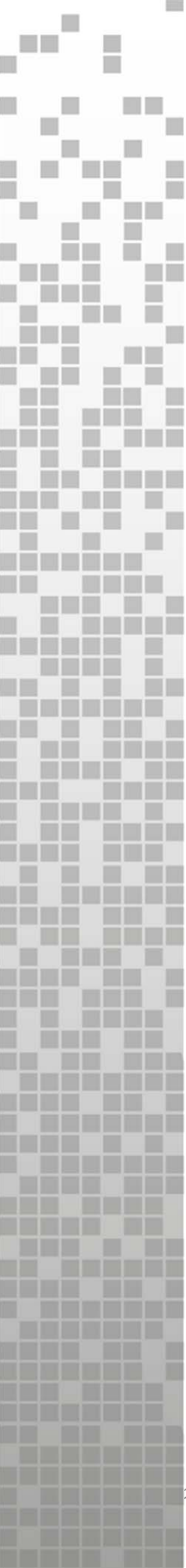




Appendix C  
**Existing Drainage Network**



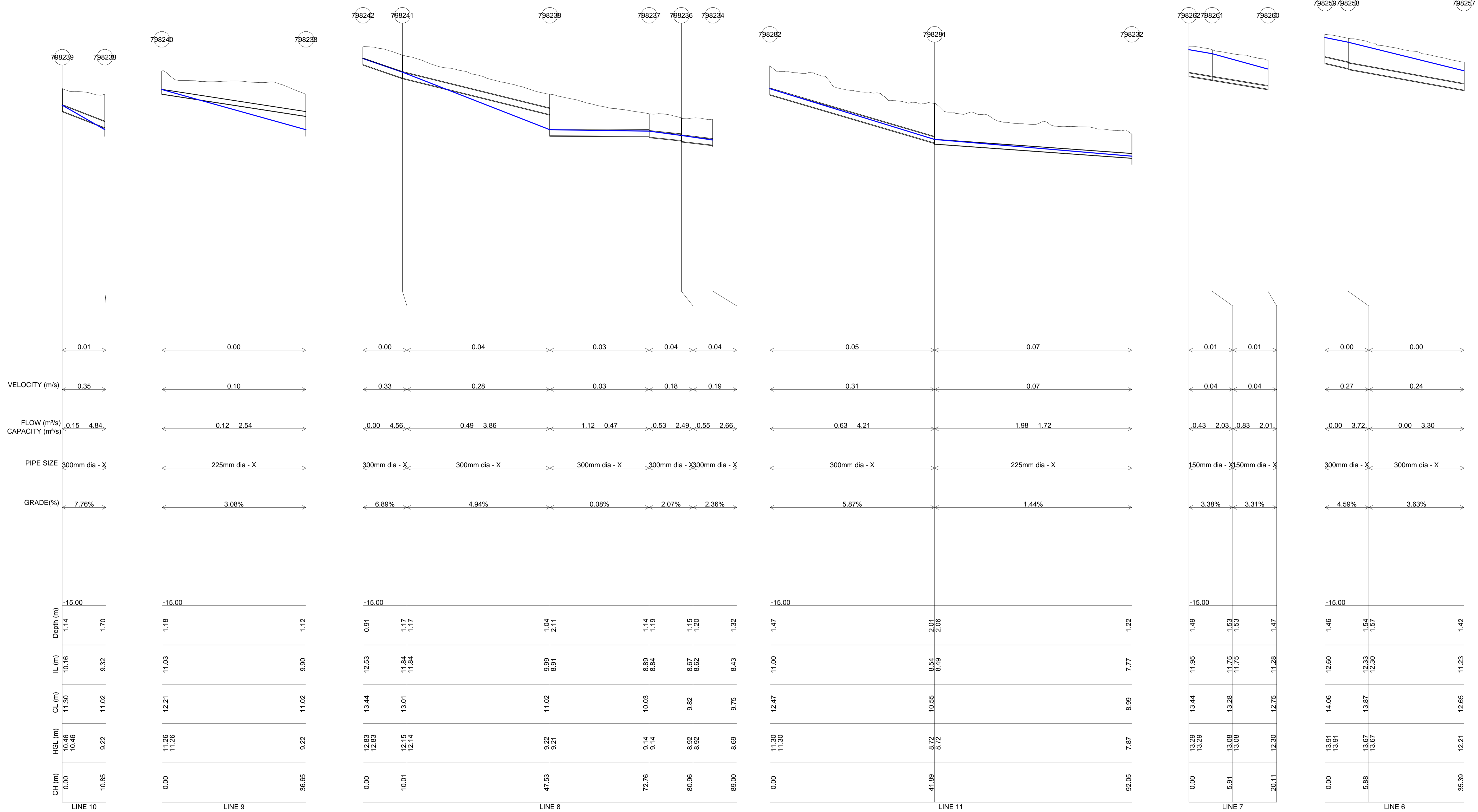




Appendix D  
**Hydraulic Gradeline Analysis**

DRAINAGE CALCULATION SHEET

P/T	ARI	Sub-catchment				Inlet design										Total catchment										Design										Head Loss & Partial Flow										Remarks	Hydraulic check				
		Time of conc.	Area	Intensity	C/Area	Overland Flow	Total gutter	Eff gutter	Width	Depth	Velocity	Total inflow	Flow into Pit	Bypass	Bypass Pit	Time of conc	Intensity	Sum C A	Cumulative Flow	Num. Pipes	Pipe Class	Norm Diam	Pipe Length	Pipe Grade	HGL Grade	Manning's n	Roughness	Surcharge	HGL grade (Backwater)	D/A	K factor	Pipe vel (Colebrook & White)	Part depth (Colebrook & White)	Capacity (Colebrook & White)	Pipe vel (Mannings)	Part depth (Mannings)	D/S HGL BW.	Pit loss	Pipe loss	Total loss	US HGL	Gutter level (NS)									
798243	100	5.00	0.158	176	0.090	44	44	44	1.182	85	0.941	44	44	0	798235	5.00	176	0.090	44	1	X	300	67.4	0.64	0.1	0.013	0.300	0.0	0.066	5.00	1.374	0.160	100	0.657	0.045						8.866	0.001	0.001	0.002	9.285	10.226					
798235	100	5.00	0.097	176	0.073	36	36	36	1.084	80	0.898	36	36	0	798234	5.96	164	0.162	74	1	X	300	9.5	0.84	0.4	0.013	0.300	0.0	0.124	2.10	1.571	0.205	114	0.857	0.058						8.689	0.002	0.001	0.002	8.868	9.725					
798242	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	798241	5.00	176	0.000	0	1	X	300	10.0	6.89	0.0	0.013	0.300	0.0	0.000	0.00	4.559	0.000	331	0.000	0.000						12.145	0.000	0.000	0.000	12.834	13.436						
798241	100	5.00	0.139	176	0.073	36	36	36	1.086	80	0.897	36	36	0	798238	5.00	176	0.073	36	1	X	300	37.5	4.94	0.1	0.013	0.300	0.0	0.053	10.00	3.856	0.082	280	1.269	0.025						9.216	0.001	0.001	0.002	12.145	13.009					
798240	100	5.00	0.020	176	0.010	5	5	5	0.442	39	0.576	5	5	0	798236	5.00	176	0.010	5	1	X	225	36.6	3.08	0.0	0.013	0.300	0.0	0.009	1.00	2.535	0.037	104	0.000	0.000						9.216	0.000	0.000	0.000	11.258	12.212					
798239	100	5.00	0.029	176	0.022	11	11	11	0.640	52	0.688	11	11	0	798238	5.00	176	0.022	11	1	X	300	10.8	7.76	0.0	0.013	0.300	0.0	0.010	10.00	4.838	0.040	351	0.678	0.007						9.216	0.000	0.000	0.000	10.464	11.304					
798238	100	5.00	0.120	176	0.069	34	34	34	1.063	79	0.896	34	34	0	798237	6.63	168	0.174	81	1	X	300	25.2	0.08	0.4	0.013	0.300	0.0	0.131	20.00	0.466	0.304	34	0.392	0.109						9.145	0.002	0.002	0.004	9.216	11.021					
798237	100	5.00	0.020	176	0.015	7	7	7	0.537	45	0.633	7	7	0	798236	6.05	163	0.189	86	1	X	300	8.2	2.07	0.1	0.013	0.300	0.0	0.145	0.50	2.487	0.106	180	1.269	0.050						8.925	0.001	0.001	0.001	9.145	10.028					
798236	100	5.00	0.006	176	0.005	2	2	2	0.333	29	0.477	2	2	0	798234	6.18	161	0.194	87	1	X	300	8.0	2.36	0.1	0.013	0.300	0.0	0.150	0.50	2.658	0.105	193	1.360	0.049						8.689	0.001	0.001	0.001	8.925	9.816					
798234	100	5.00	0.108	176	0.039	19	19	19	0.832	64	0.779	19	19	0	798233	6.12	162	0.396	178	1	X	300	25.2	2.22	1.1	0.013	0.300	0.0	0.304	1.10	2.675	0.220	187	1.559	0.073						8.082	0.005	0.009	0.014	8.689	9.754					
798233	100	5.00	0.033	176	0.025	12	12	12	0.676	54	0.704	12	12	0	798232	6.54	157	0.420	184	1	X	300	37.4	0.64	1.2	0.013	0.300	0.0	0.329	1.50	1.372	0.304	100	1.088	0.104						7.870	0.008	0.015	0.023	8.082	9.009					
798282	100	5.00	0.180	176	0.084	46	46	46	1.202	87	0.950	46	46	0	798281	5.00	176	0.094	46	1	X	300	41.9	5.87	0.1	0.013	0.300	0.0	0.044	1.00	4.206	0.089	305	1.253	0.021						8.718	0.000	0.000	0.001	11.304	12.469					
798281	100	5.00	0.155	176	0.081	40	40	40	1.132	83	0.918	40	40	0	798232	5.70	167	0.174	81	1	X	225	60.2	1.44	1.9	0.013	0.300	0.0	0.159	0.00	1.720	0.228	70	1.010	0.047						7.870	0.000	0.000	0.008	8.718	10.549					
798232	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798230	7.16	151	0.694	249	1	X	375	14.3	0.66	0.5	0.013	0.300	0.0	0.303	2.00	1.472	0.381	168	1.124	0.119						7.704	0.009	0.004	0.013	7.870	8.993					
798273	100	5.00	0.233	176	0.121	58	58	58	1.334	96	1.008	58	58	0	798272	5.00	176	0.121	58	1	X	225	38.6	0.49	1.0	0.013	0.300	0.0	0.191	1.00	0.996	0.228	41	0.597	0.048						12.798	0.001	0.003	0.003	13.039	13.753					
798272	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798271	5.64	168	0.121	56	1	X	225	6.3	1.75	0.4	0.013	0.300	0.0	0.110	0.00	1.903	0.129	78	0.966	0.037						12.638	0.000	0.000	0.000	12.798	13.784					
798271	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798268	5.75	166	0.121	56	1	X	225	25.0	0.48	0.4	0.013	0.300	0.0	0.110	0.00	0.983	0.228	40	0.607	0.050						12.470	0.000	0.002	0.002	12.638	13.678					
798268	100	5.00	0.117	176	0.061	30	30	30	1.006	75	0.860	30	30	0	798269	6.17	162	0.182	82	1	X	225	35.0	2.09	1.2	0.013	0.300	0.0	0.175	1.30	2.080	0.174	85	1.180	0.045						11.814	0.002	0.005	0.008	12.470	13.405					
798269	100	5.00	0.557	176	0.290	142	142	142	1.881	130	1.240	142	142	0	798270	6.75	155	0.471	203	2	X	300	29.3	6.22	0.6	0.013	0.300	0.0	0.135	0.00	4.328	0.128	314	1.855	0.037						10.072	0.000	0.002	0.002	11.814	12.063					
798270	100	5.00	0.319	176	0.168	81	81	81	1.511	107	1.085	81	81	0	798245	7.24	150	0.637	206	2	X	375	135.7	0.95	0.3	0.013	0.300	0.0	0.121	1.30	1.931	0.233	220	1.039	0.066						8.934	0.001	0.006	0.007	10.072	11.309					
798266	100	5.00	0.077	176	0.040	20	20	20	0.841	65	0.784	20	20	0	798264	5.00	176	0.040	20	1	X	150	15.8	3.36	1.0	0.013	0.300	0.0	0.019	5.00	2.027	0.091	36	0.485	0.019						12.839	0.000	0.000	0.000	13.047	13.197					
798264	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798263	6.26	173	0.040	19	1	X	150	3.1	1.94	1.0	0.013	0.300	0.0	0.019	1.50	1.535	0.109	27	1.010	0.012						12.533	0.000	0.000	0.000	12.839	13.128					
798263	100	5.00	0.033	176	0.017	8	8	8	0.569	47	0.650	8	8	0	798260	5.31	172	0.057	27	1	X	150	18.0	1.00	2.0	0.013	0.300	0.0	0.028	1.80	1.095	0.150	19	0.571	0.025						12.303	0.000	0.000	0.000	12.533	12.733					
798262	100	5.00	0.030	176	0.015	8	8	8	0.543	46	0.636	8	8	0	798261	5.00	176	0.015	8	1	X	150	4.9	3.38	0.2	0.013	0.300	0.0	0.007	5.00	2.035	0.052	36	0.235	0.003						13.084	0.000	0.000	0.000	13.289	13.439					
798261	100	5.00	0.028	176	0.015	7	7	7	0.528	45	0.628	7	7	0	798260	5.10	175	0.030	15	1	X	150	14.2	3.31	0.6	0.013	0.300	0.0	0.014	0.00	2.012	0.076	36	0.649	0.012						12.303	0.000	0.000	0.000	13.084	13.284					
798260	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798257	5.61	168	0.087	41	1	X	150	4.0	1.26	2.8	0.013	0.300	0.0	0.044	0.50	1.232	0.150	22	0.679	0.032						12.214	0.000	0.000	0.000	12.303	12.747					
798259	100	5.00	0.000	176	0.000	0	0	0	0.000	0	0.000	0	0	0	798258	5.00	176	0.000	0	1	X	300	5.9	4.59	0.0	0.013	0.300	0.0	0.000	0.00	3.717	0.000	270	0																	

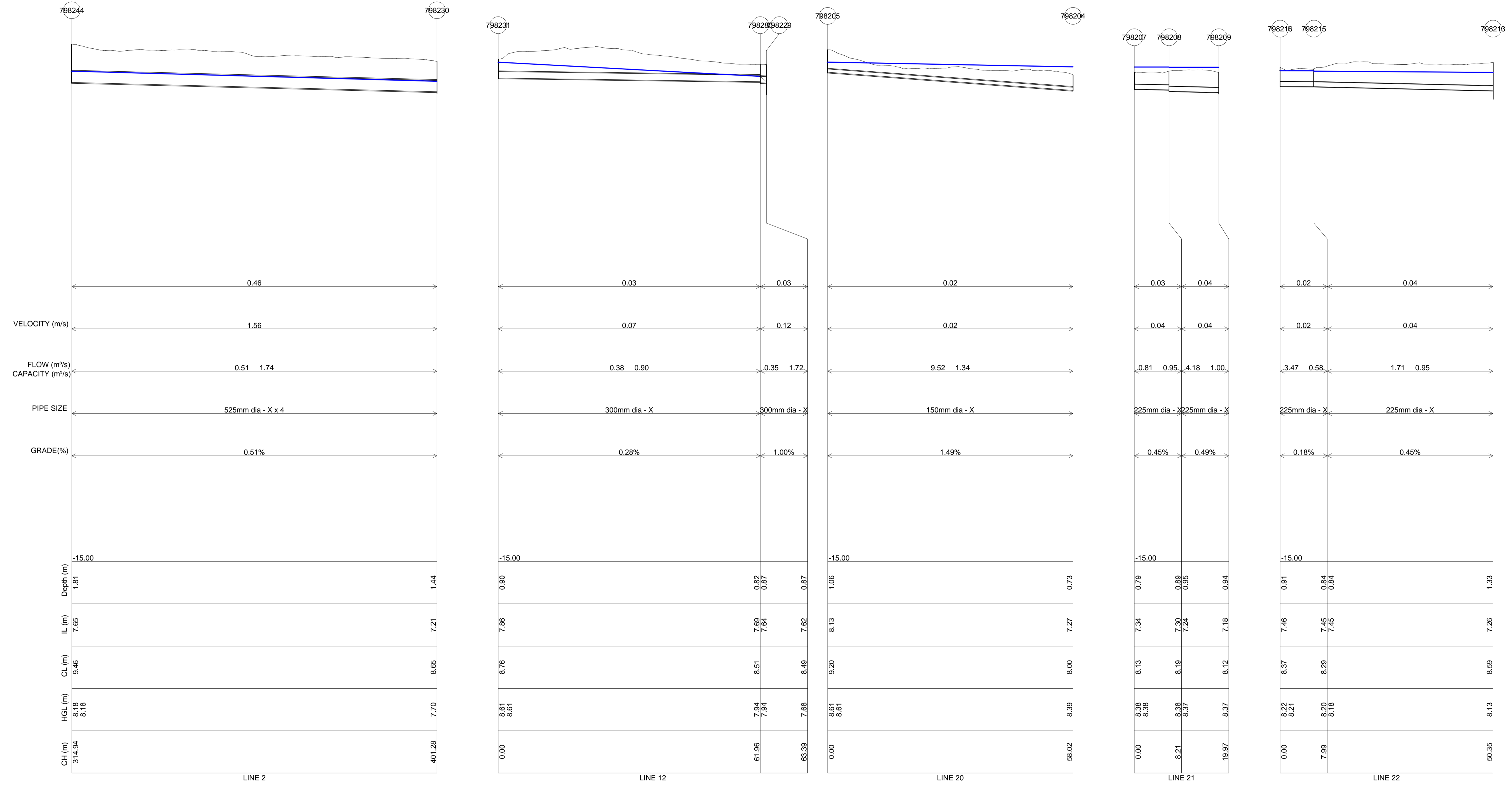


PIPE LONG SECTIONS  
 SCALE VERTICAL - 1:100  
 HORIZONTAL - 1:500

NOTE:1									ENGINEER	T.GREENING	29.07.15	<b>PM DESIGN GROUP</b> Engineering Solutions www.pmdesign.com.au MULTI DISCIPLINE CONSULTING ENGINEERS 223 KOROIT ST, WARRNAMBOOL VIC. 3280 PHONE: (03) 5564 6888 FAX: (03) 5561 1850 WEB: www.pmdesign.com.au	PROJECT: PONDS DRIVE LARA DWG No.: <b>C03</b> TITLE: FLOOD HAZARD ASSESSMENT PIPE LONG SECTIONS PM PROJECT No.: <b>W.TRA-002</b> CLIENT: <b>TRACT CONSULTANTS</b>	SCALE: VER 1:100 HOR 1:500 @ A1	REV <b>0</b>
								DESIGNER	T.GREENING	29.07.15					
								DRAWN	KB	29.07.15					
								CHECKED	T.GREENING						
								APPROVED							
NOTES	REV	DATE	DR	CHK	APP	REVISION DESCRIPTION	APPROVED								

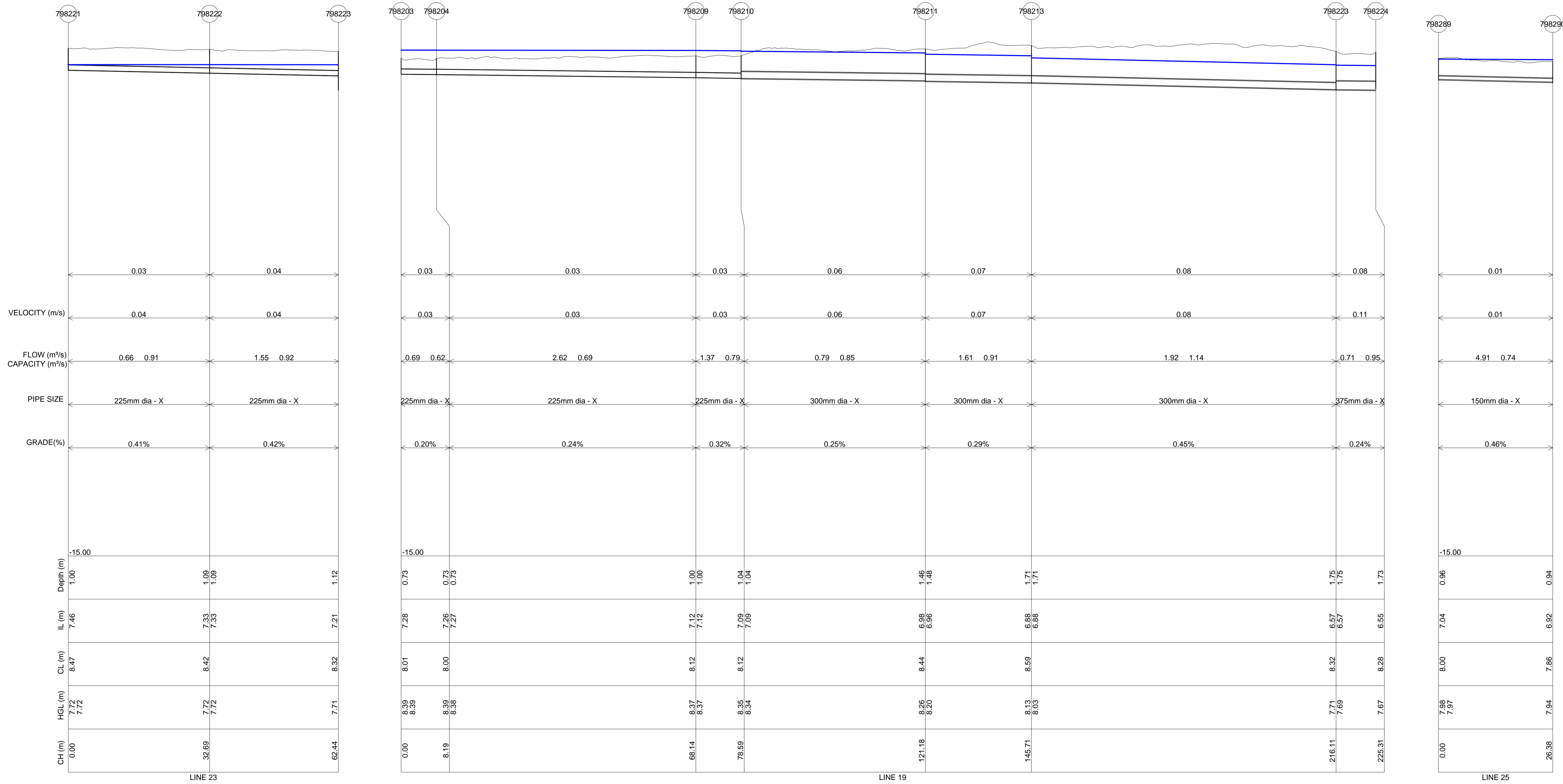






**PIPE LONG SECTIONS**  
 SCALE VERTICAL - 1:100  
 HORIZONTAL - 1:500

NOTE:1									ENGINEER	T.GREENING	DATE	29.07.15					
									DESIGNER	T.GREENING	DATE	29.07.15					
									DRAWN	KB	DATE	29.07.15					
									CHECKED	T.GREENING							
									APPROVED								
NOTES	REV	DATE	DR	CHK	APP	REVISION DESCRIPTION	APPROVED										
<b>PM DESIGN GROUP</b> Engineering Solutions www.pmdesign.com.au MULTI DISCIPLINE CONSULTING ENGINEERS 223 KOROIT ST. WARRNAMBOOL. VIC. 3280 PHONE: (03) 5564 6888 FAX: (03) 5561 1850 WEB: www.pmdesign.com.au										PROJECT:	PONDS DRIVE LARA		DWG No. :	C06			
										PM PROJECT No. :	W.TRA-002		TITLE:		FLOOD HAZARD ASSESSMENT PIPE LONG SECTIONS		
										CLIENT:	TRACT CONSULTANTS		SCALE:	VER 1:100 HOR 1:500	@ A1	REV	0



**PIPE LONG SECTIONS**

SCALE VERTICAL - 1:100  
HORIZONTAL - 1:500

NOTE:1

REV	DATE	DR	CHK	APP	REVISION DESCRIPTION

		DATE
ENGINEER	T.GREENING	29.07.15
DESIGNER	T.GREENING	29.07.15
DRAWN	KB	29.07.15
CHECKED	T.GREENING	
APPROVED		

**PM DESIGN GROUP**  
Engineering Solutions  
www.pmdesign.com.au  
MULTI DISCIPLINE CONSULTING ENGINEERS  
223 KOROIT ST. WARRNAMBOOL. VIC. 3280  
PHONE: (03) 5564 6888  
FAX: (03) 5561 1850  
WEB: www.pmdesign.com.au

PROJECT: PONDS DRIVE LARA

PM PROJECT No.: W.TRA-002

CLIENT: TRACT CONSULTANTS

DWG No.: C07

TITLE:  
FLOOD HAZARD ASSESSMENT  
PIPE LONG SECTIONS

SCALE: VER 1:100  
HOR 1:500

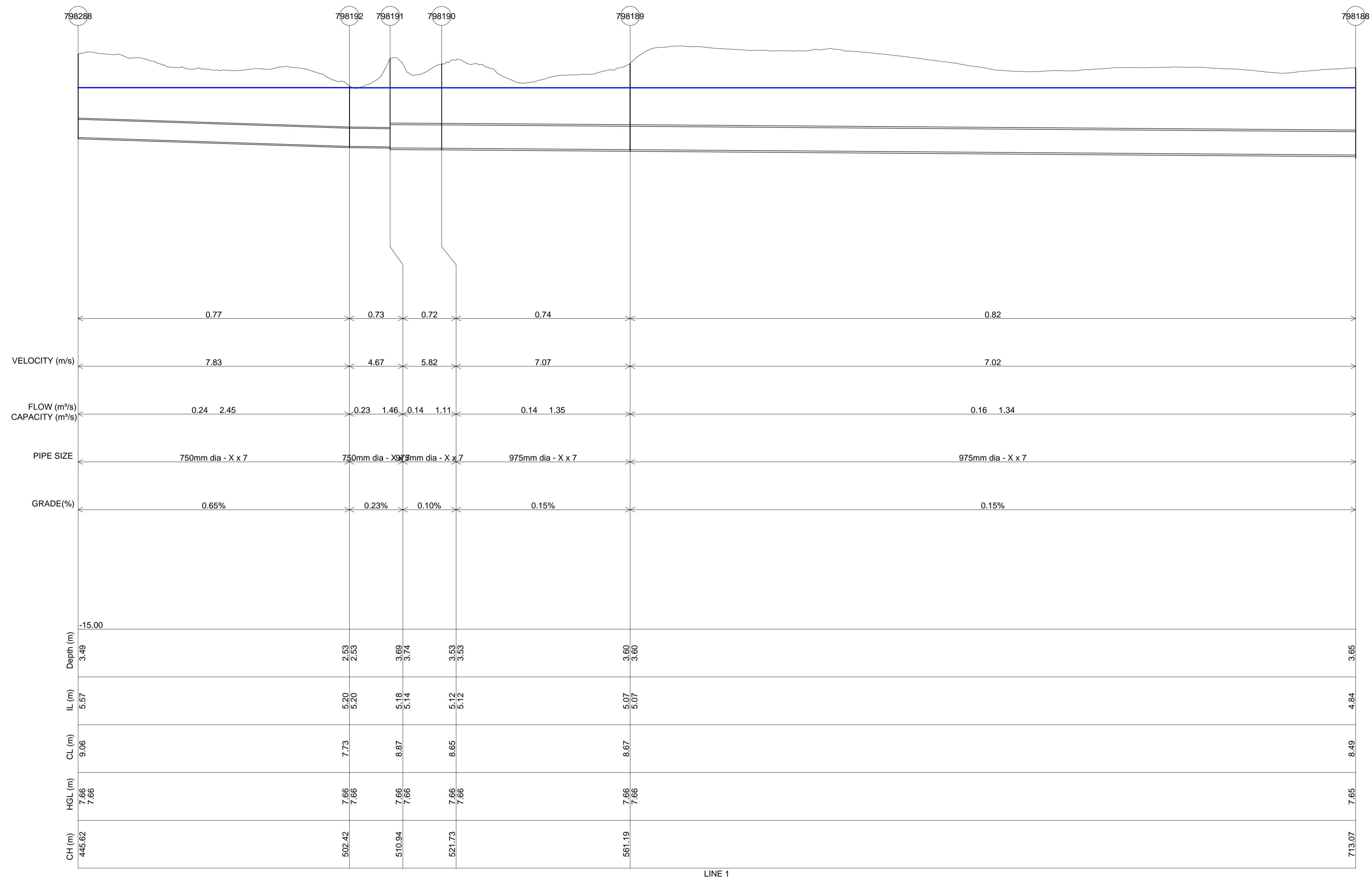
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REV 0









**PIPE LONG SECTIONS**

SCALE VERTICAL = 1:100  
HORIZONTAL = 1:500

NOTE:1

REV	DATE	DR	CHK	APP	REVISION DESCRIPTION

		DATE
ENGINEER	T.GREENING	29.07.15
DESIGNER	T.GREENING	29.07.15
DRAWN	KB	29.07.15
CHECKED	T.GREENING	
APPROVED		

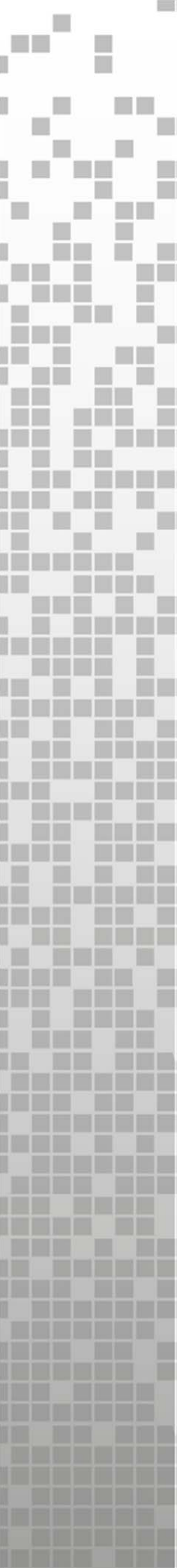
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Engineering Solutions  
www.pmdesign.com.au  
MULTI DISCIPLINE CONSULTING ENGINEERS  
223 KORROIT ST. WARRNAMBOOL VIC. 3280  
PHONE: (03) 5564 6888  
FAX: (03) 5561 1850  
WEB: www.pmdesign.com.au

PROJECT: PONDS DRIVE LARA  
PM PROJECT No.: W.TRA-002  
CLIENT: TRACT CONSULTANTS

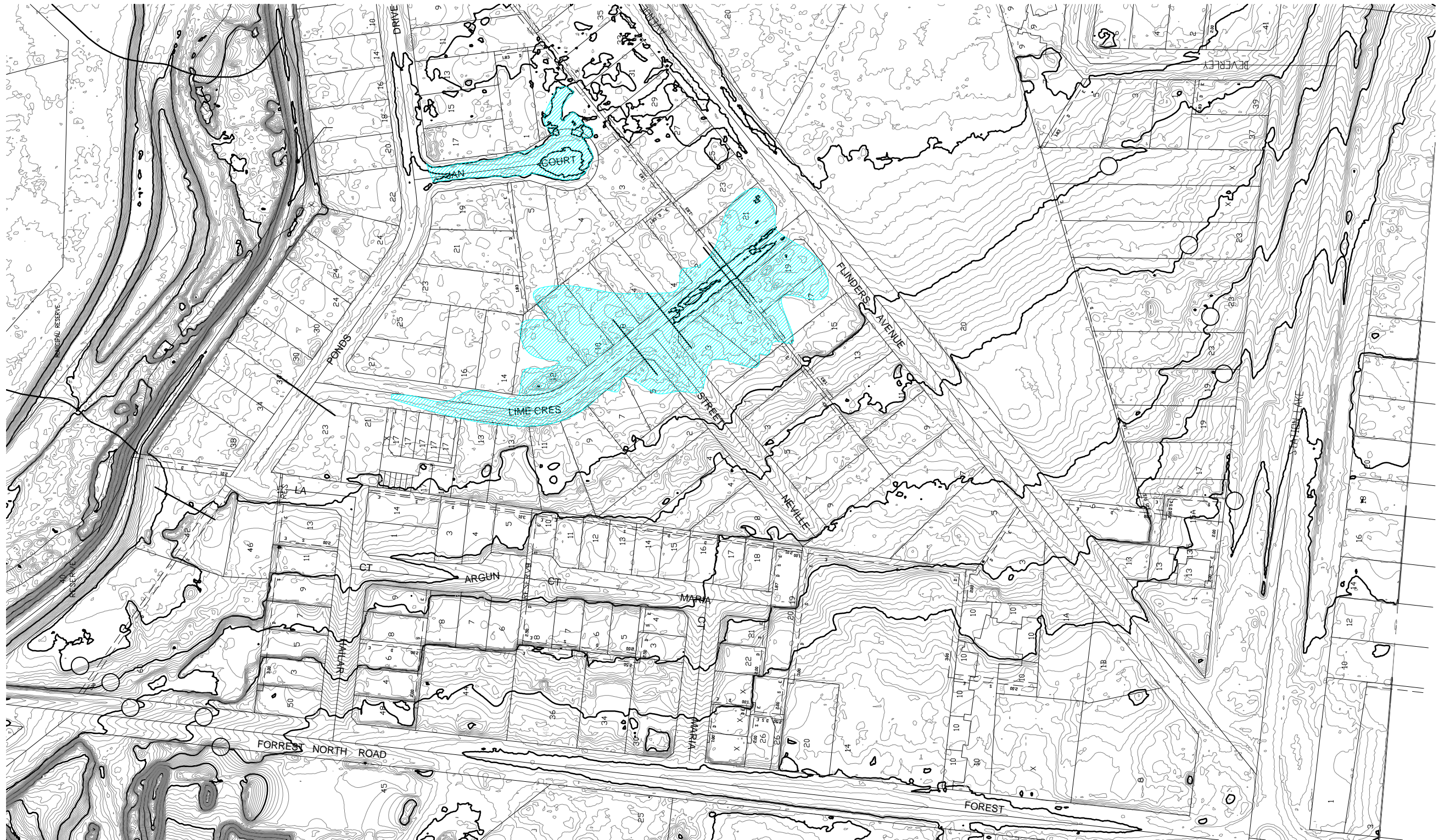
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TITLE: FLOOD HAZARD ASSESSMENT PIPE LONG SECTIONS  
SCALE: VER 1:100 HOR 1:500 @ A1

REV 0





Appendix E  
**Flood Extents from Hydraulic Gradeline Surge**



# FLOOD EXTEND

					ENGINEER	T. GREENING	DATE	17.03.15	<b>PM DESIGN GROUP</b> <small>www.pmdesign.com.au Engineering Solutions</small> MULTI DISCIPLINE CONSULTING ENGINEERS 2/223 KOROIT ST, WARRNAMBOOL. VIC. 3280 PHONE: (03) 5564 6888 FAX: (03) 5561 1850 WEB: www.pmdesign.com.au	PROJECT:	PONDS DRIVE LARA	DWG No. :	
					DESIGNER	PM DESIGN				PM PROJECT No. :	W.TRA-002-15	TITLE:	HYDRAULIC GRADE LINE SURCHARGE
NOTES 0 XXXX RH TG L.M ISSUED FOR CONSTRUCTION REV DATE DR CHK APP REVISION DESCRIPTION					DRAWN	RH	DATE	17.03.15	CLIENT:	TRACT CONSULTANTS	SCALE:	1:2000 @ A3	
					CHECKED	T. GREENING	DATE	5.08.15			REV	0	
					APPROVED	L.McGRATH	DATE	5.08.15					