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Our Ref: 110432-03-Overland Flow Assessment.docx
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12 Oct 2021

The Bathla Group

PO Box 270
Wentworthville, NSW, 2145

Attn: Divya Verma

Subject: 264 Mount Vernon Road, Mount Vernon – Overland Flow Assessment

Dear Divya,

J. Wyndham Prince has been engaged by The Bathla Group to prepare an overland flow assessment to assist in the approval of the proposed development at 264 Mount Vernon Road, Mount Vernon. To support the lodgement of the development application (DA) to Penrith City Council (PCC), the overland flow assessment has addressed PCC's pre-DA advice, dated 23 July 2021.

This assessment has included the following tasks:

- Undertake a hydrological analysis using XP-RAFTS to determine the pre and post-development flows for the 20%, 10% and 1% AEP flood events.
- Prepare a hydraulic impact assessment using HEC-RAS to determine the pre and post-development flood extents for the 20%, 10% and 1% AEP flood events.
- Determine the flood impact from the 1% AEP flood event on the tennis court, tennis pavilion, staff quarters and vehicular access to the site.

1. BACKGROUND

The site is approximately 5.1ha in area and is located in Mount Vernon which is part of the PCC LGA. The site consists of an existing residential dwelling which is surrounded by dense vegetation. The existing dwelling is situated on the high point of the site which can accessed via an existing driveway that extends along the western boundary to Mount Vernon Road. An existing dam also resides at the low point of the site and is within the current overland flow path. The dam currently drains via a culvert under the existing driveway to a neighbouring dam further downstream. The locality of the site is indicated in Plate 1.1 below.

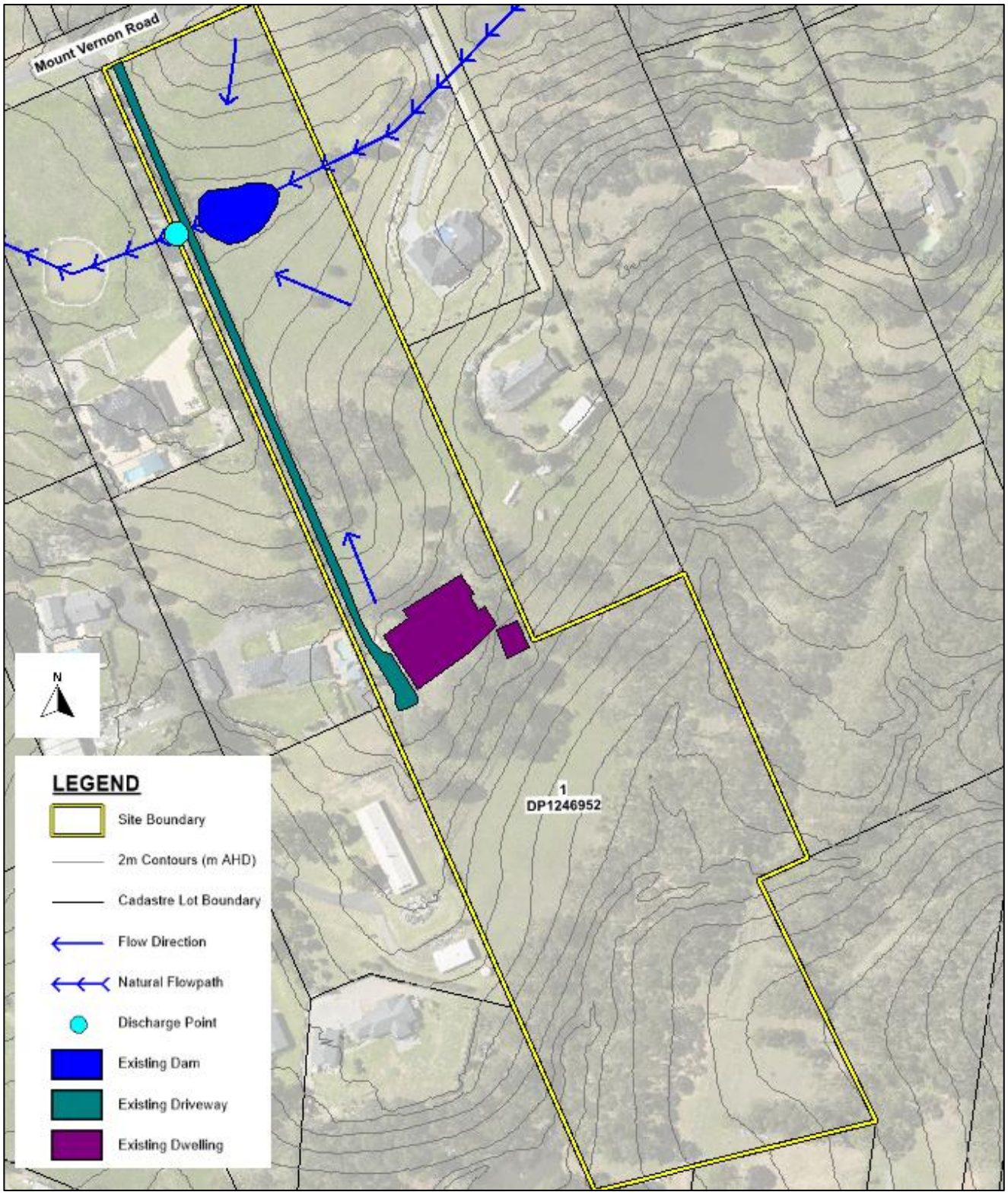


Plate 1.1 – Subject Site

2. PROPOSED DEVELOPMENT

The proposed development consists of a secondary dwelling, tennis court, tennis pavilion, ancillary works and structures. The secondary dwelling will have access via the existing driveway that extends from Mount Vernon Road. The development will also provide improved stormwater management for the site.

Refer to Plate 2.1 below for an illustration of the proposed development.

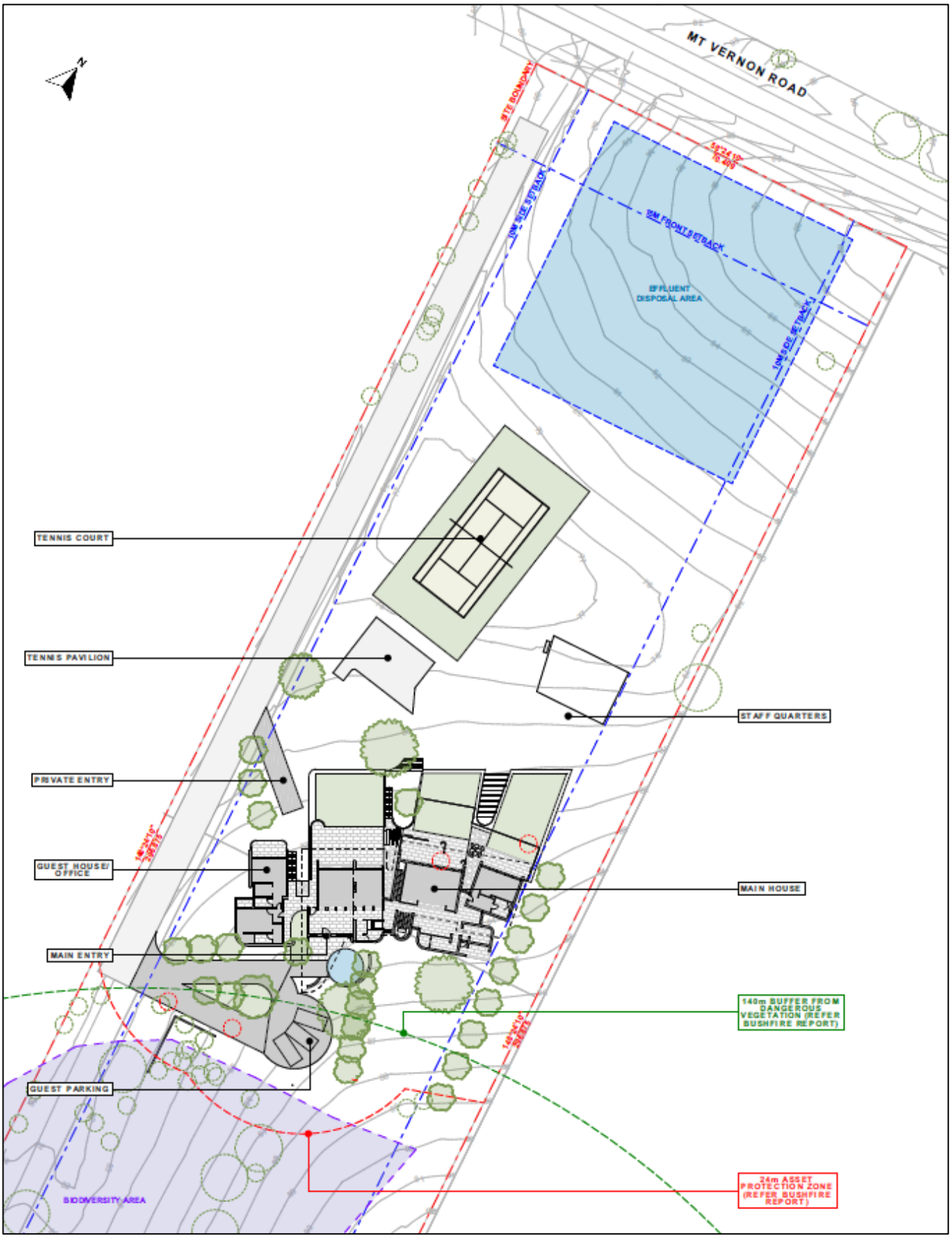


Plate 2.1 – Proposed Development (Source: PopovBass, dated 2 September 2021)

3. HYDROLOGIC ASSESSMENT

An XP-Rafts model has been prepared to determine the peak flows for the pre and post-development scenarios in the 20%, 10% and 1% AEP flood events.

3.1. Pre-Development Conditions

For the pre-development model, the existing dam currently provides approximately 1,170m^3 of storage from the static water level to the level where it overtops the existing 400mm diameter pipe culvert and the existing driveway. In the 1% AEP flood event the overflows currently pond across the existing driveway up to approximately 300mm, to provide a total storage volume of approximately 2,000m^3.

The pre-development catchments and parameters used in XP-RAFTS modelling are provided in Plate 3.1 and Table 3.1.

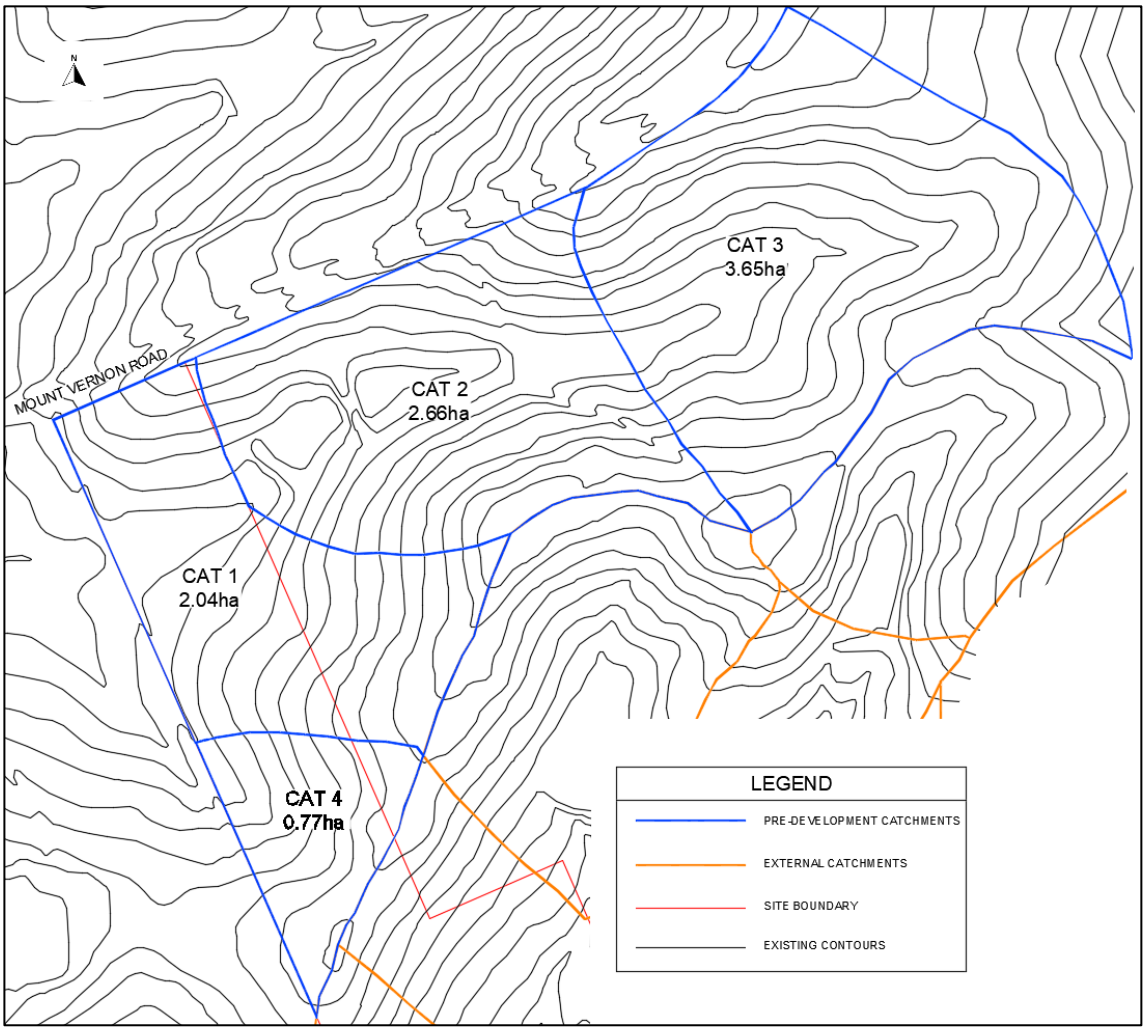


Plate 3.1 – XP-RAFTS Pre-Development Catchments

The pre-development catchment percentage impervious and slope parameters that are outlined in Table 3.1 below have been determined through the current available aerial imagery and ALS data.

Table 3.1 – Summary Of Pre-Development XP-RAFTS Parameters

Catchment	Catchment Area (ha)	Pern (n) Value (Pervious)	Pern (n) Value (Impervious)	Percentage Impervious (%)	Slope (%)
1	2.04	0.04	0.015	14	10.2
2	2.66	0.04	0.015	13	4.9
3	3.65	0.04	0.015	10	5.9
4	0.77	0.04	0.015	24	11.7

3.2. Post-Development Conditions

For the post-development model, 2x750mm diameter pipe culverts have been proposed to manage the overland flow from the upstream catchments. The combination of these proposed pipes, the upgrade to the existing driveway and the existing drainage to 3x750mm diameter pipes will improve the management of the existing upstream flows in this locality.

The post-development catchments and parameters used in XP-RAFTS are provided below in Plate 3.2 and Table 3.2.

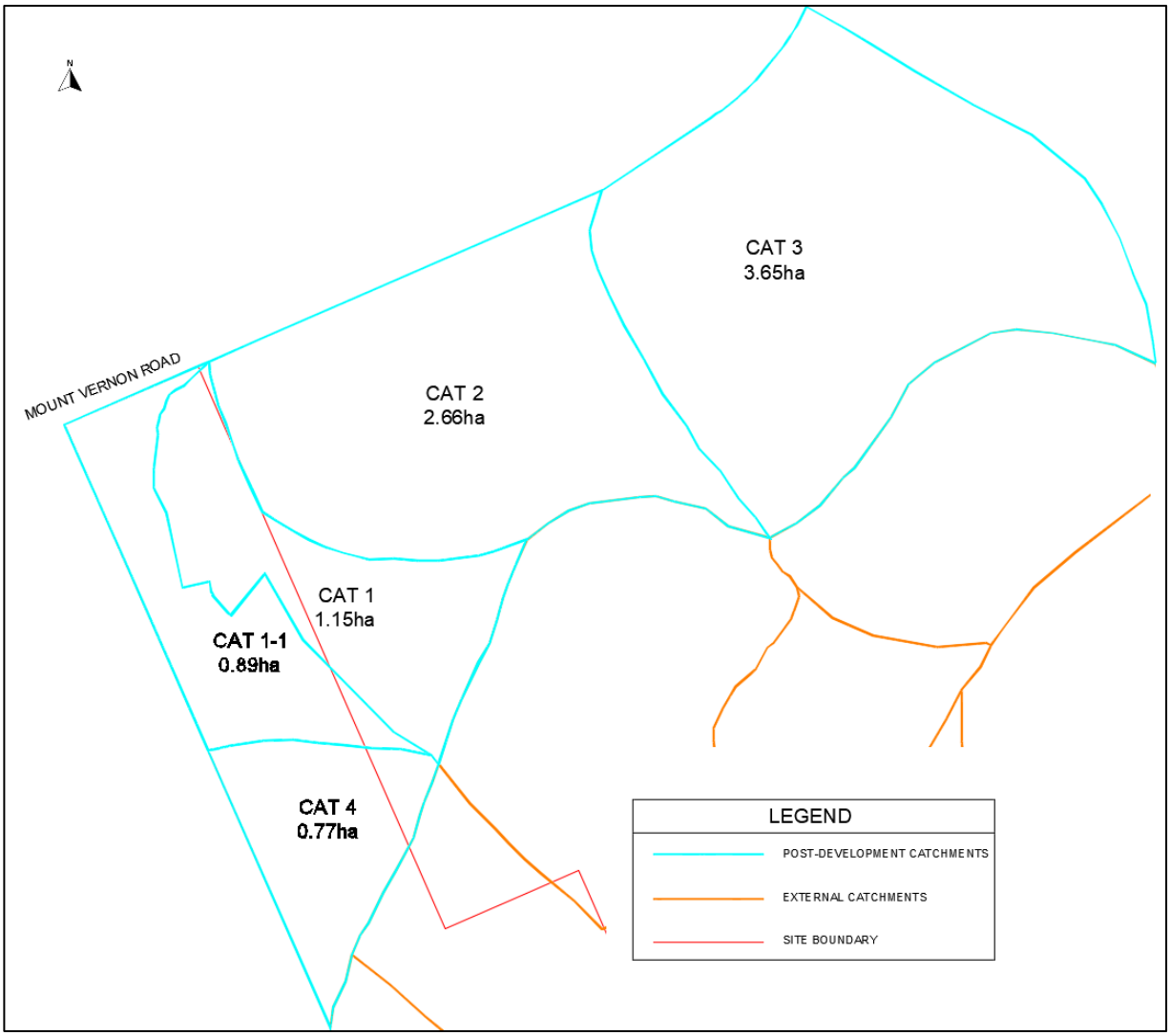


Plate 3.2 – XP-RAFTS Post-Development Catchments

The post-development catchment percentage impervious and slope parameters that are outlined in Table 3.2 below have been determined through the current available aerial imagery, ALS data and the new design surface information.

Table 3.2 – Summary Of Post-Development XP-RAFTS Parameters

Catchment	Catchment Area (ha)	Pern (n) Value (Pervious)	Pern (n) Value (Impervious)	Percentage Impervious	Slope (%)
1	1.15	0.04	0.015	24	9.1
1-1	0.89	0.04	0.015	46	9.1
2	2.66	0.04	0.015	13	4.9
3	3.65	0.04	0.015	10	5.9
4	0.77	0.04	0.015	24	11.7

A summary of the peak flows at the downstream site boundary for a range of flood events are shown in Table 3.3.

Table 3.3 – Summary Of Peak Flows

Flood Event (AEP)	Pre-Development Flow (m^3/s)	Post-Development Flow (m^3/s)
20%	1.55	1.48
10%	1.87	1.77
1%	3.03	2.80

4. HYDRAULIC ASSESSMENT

A HEC-RAS model has been prepared to determine the pre and post-development flood extents for the 20%, 10% and 1% AEP flood event. The peak flows from the XP-RAFTS model for all assessed AEPs has been adopted in this assessment, refer to Table 3.3 above for details. The 1% AEP flood extents for the pre and post-development conditions are illustrated in Plate 4.1 below. It is worth noting that the HEC-RAS cross sections that pass through the proposed tennis court (i.e. at chainages 25-40m), are not part of the post-development conditions modelling.

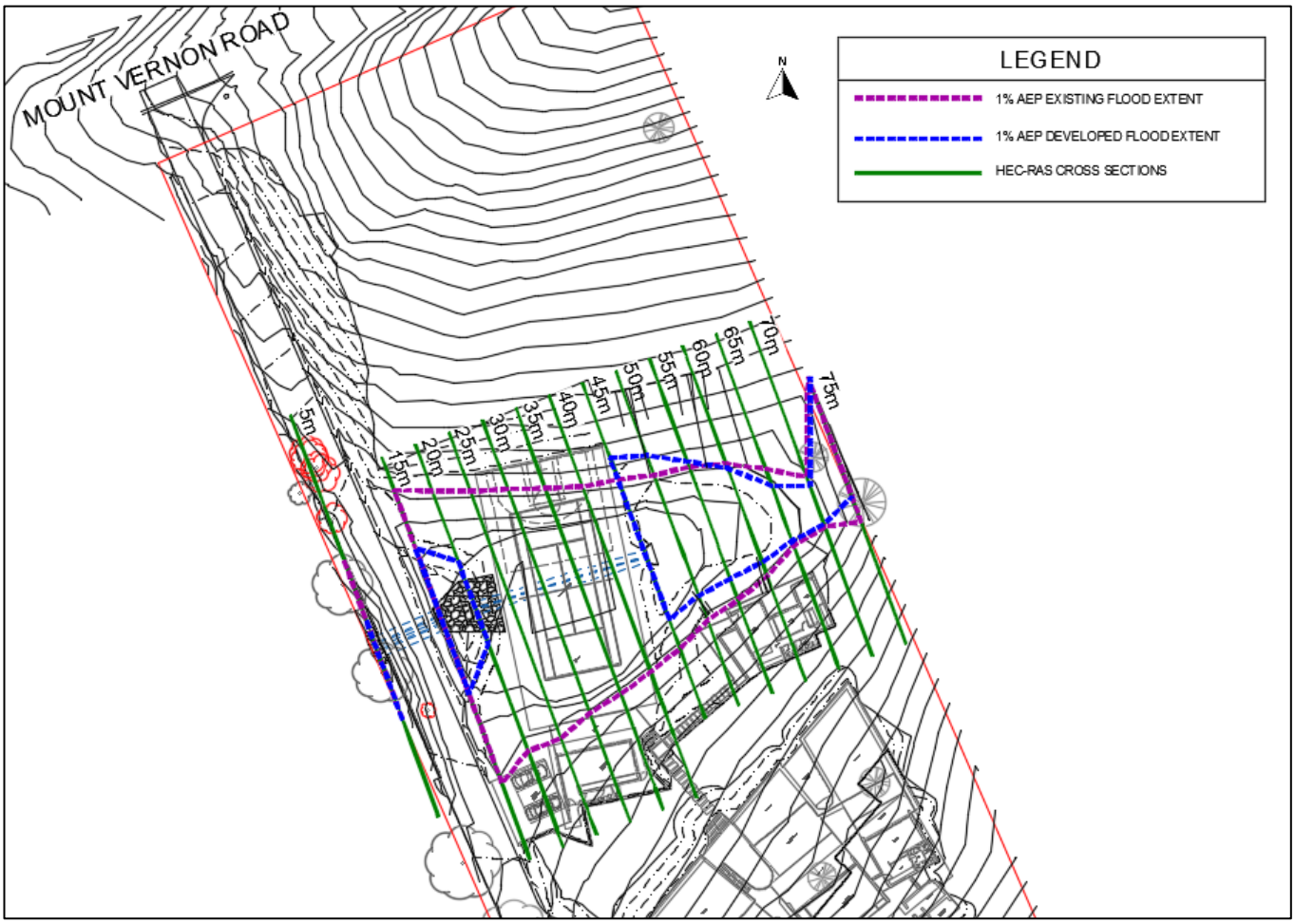


Plate 4.1 – 1% AEP Flood Extents

4.1. Pre-Development Conditions

The pre-development 1% AEP flood extent was found to consistently increase in water surface level, this is particularly evident at the downstream location of the existing pipe culvert. This is due to the low capacity of the existing 400mm diameter pipe culvert causing a backwater effect and increasing the extent of affectation upstream. In the 20% and 10% AEP flood events, the flood water overtops the existing driveway by approximately 200mm and 250mm respectively. In the 1% AEP flood event, approximately 300mm of flood water will overtop the driveway.

The pre-development HEC-RAS modelling parameters can be seen in Table 4.1.

Table 4.1 – Summary Of Pre-Development HEC-RAS Parameters

	Manning's Value (n)		
Chainage (m)	**Left Bank**	**Main Channel**	**Right Bank**
5	0.05	0.05	0.05
15 - 50	0.05	0.02	0.05
55 - 75	0.05	0.05	0.05

4.2. Post-Development Conditions

The pre-development conditions HEC-RAS cross sections have been updated based on the new design surface information. The post-development HEC-RAS modelling parameters are shown in Table 4.2.

Table 4.2 – Summary Of Post-Development HEC-RAS Parameters

	Manning's Value (n)		
Chainage (m)	**Left Bank**	**Main Channel**	**Right Bank**
5 - 20	0.05	0.05	0.05
45 - 75	0.035	0.035	0.035

The proposed 3x750mm diameter pipe captures all flows in all of the modelled flood events without overtopping on to the driveway. This ensures the safe passage across the driveway for vehicles and pedestrians during the 1% AEP flood event.

The proposed tennis court (RL 77.9m), tennis pavilion (RL 77.9m) and staff quarters (RL 78.81m) all have proposed surface levels above the 1% AEP flood levels. The staff quarters proposed finished floor level complies with the freeboard requirement outlined in PCC's pre-DA advice letter, dated 23 July 2021. i.e. habitable floor levels are to be minimum 0.5m above the 1% AEP flood level.

The HEC-RAS results also highlights the post-development conditions water surface level for the 1% AEP flood event at a lower level than the pre-development water surface level, resulting in a reduction in the downstream flood extent. The post-development discharge is also lower than the pre-development discharge and this is due to the change in the landform upstream of the proposed tennis court.

A summary of the HEC-RAS results for the pre and post-development cases are shown in Attachment A.

5. CONCLUSION

This overland flow assessment has been completed to support the DA submission and has addressed PCC's pre-DA advice, dated 23 July 2021.

A hydrological model was prepared to determine the pre and post-development flows for the 20%, 10% and 1% AEP flood events. The 2x750mm and 3x750mm diameter pipe culverts have been proposed to manage the overland flow from the upstream catchments. The proposed pipe culverts and landform modification ensures the post-development flow rates are lower than the pre-development flow rates for all of the modelled flood events.

A hydraulic assessment was undertaken to determine the pre and post-development flood extents for the 20%, 10% and 1% AEP flood events. The post-development water surface level for all of the modelled flood events was found to be lower than the pre-development water surface levels, resulting in a reduction in the downstream flood extent. The proposed tennis court, tennis pavilion and the staff quarters finished floor levels are all above the 1% AEP flood extent and adhere to PCC's freeboard requirement outlined in PCC's pre-DA advice letter, dated 23 July 2021.

Should you have any queries regarding this matter please do not hesitate to contact me.

Yours faithfully

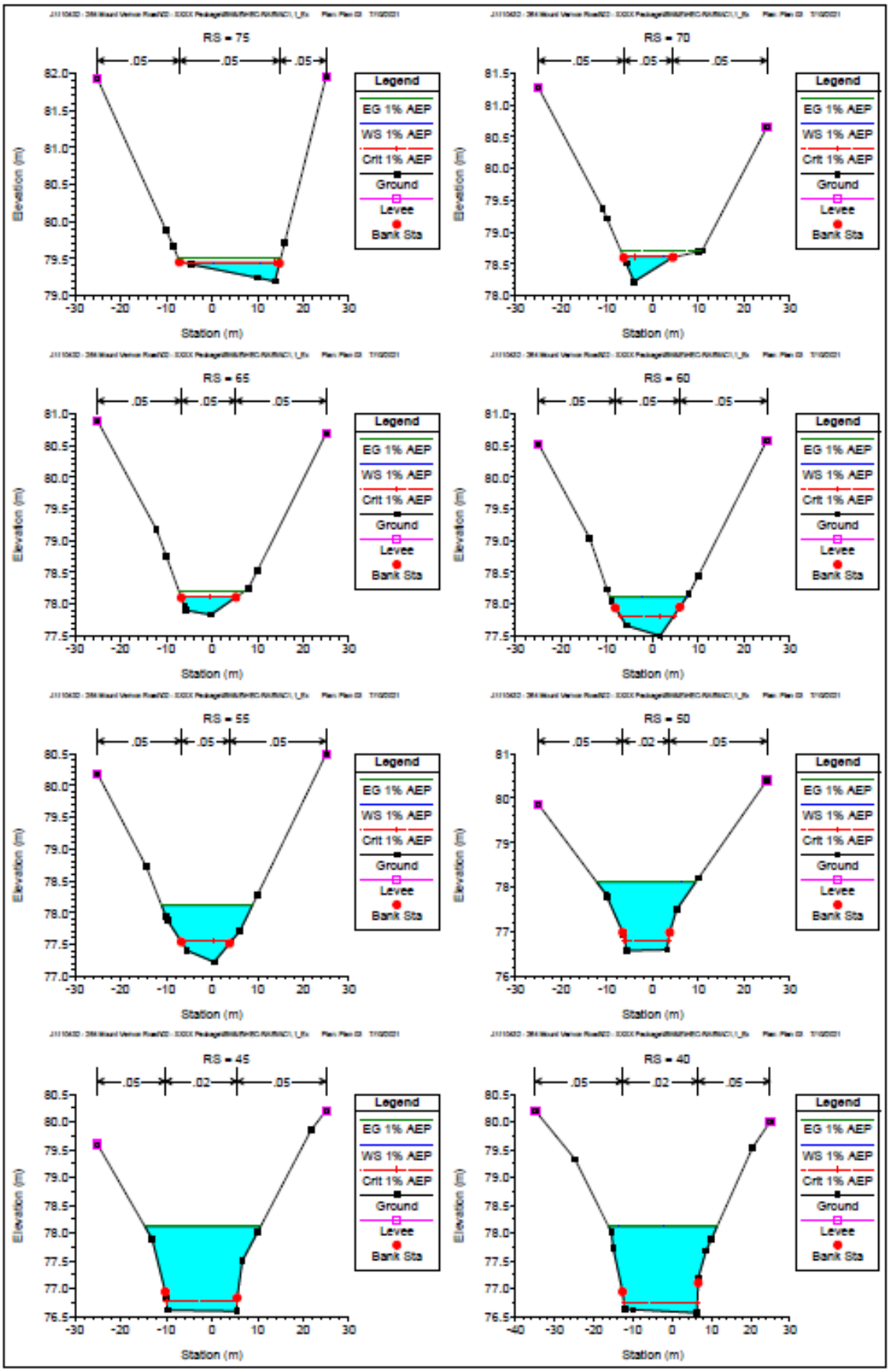
DAVID CROMPTON

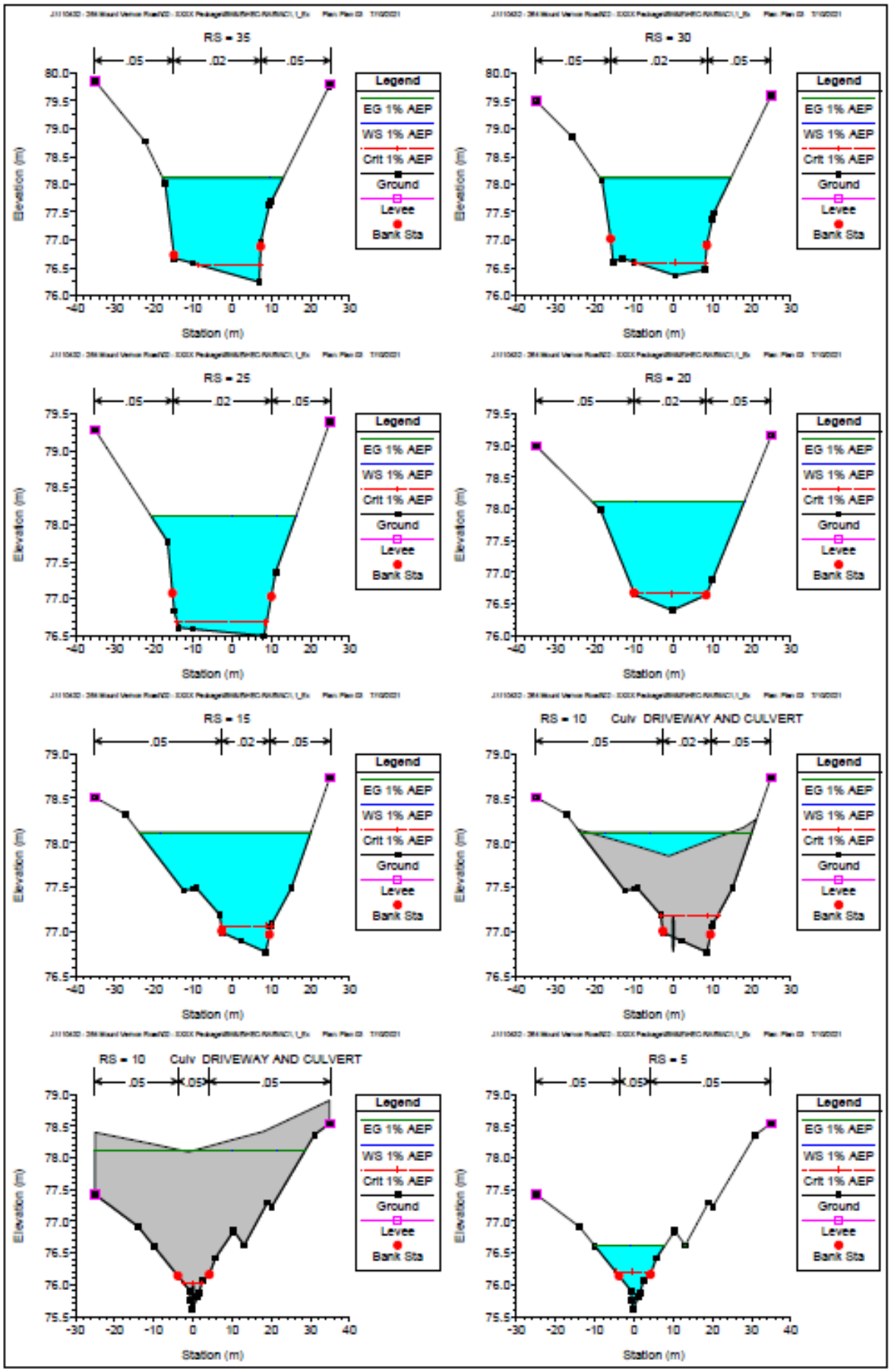
Manager – Stormwater and Environment Group

ATTACHMENT A

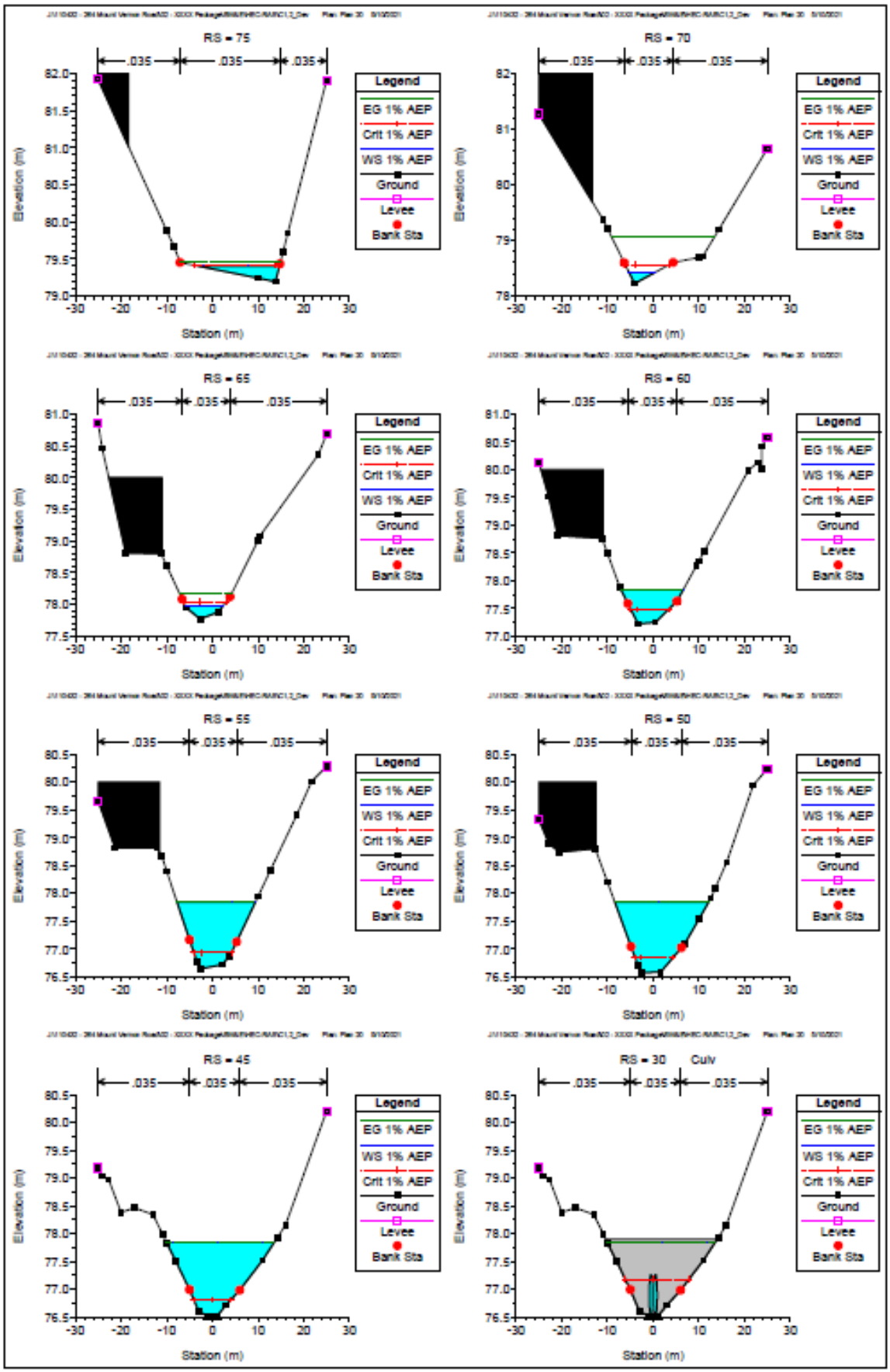
HEC-RAS RESULTS

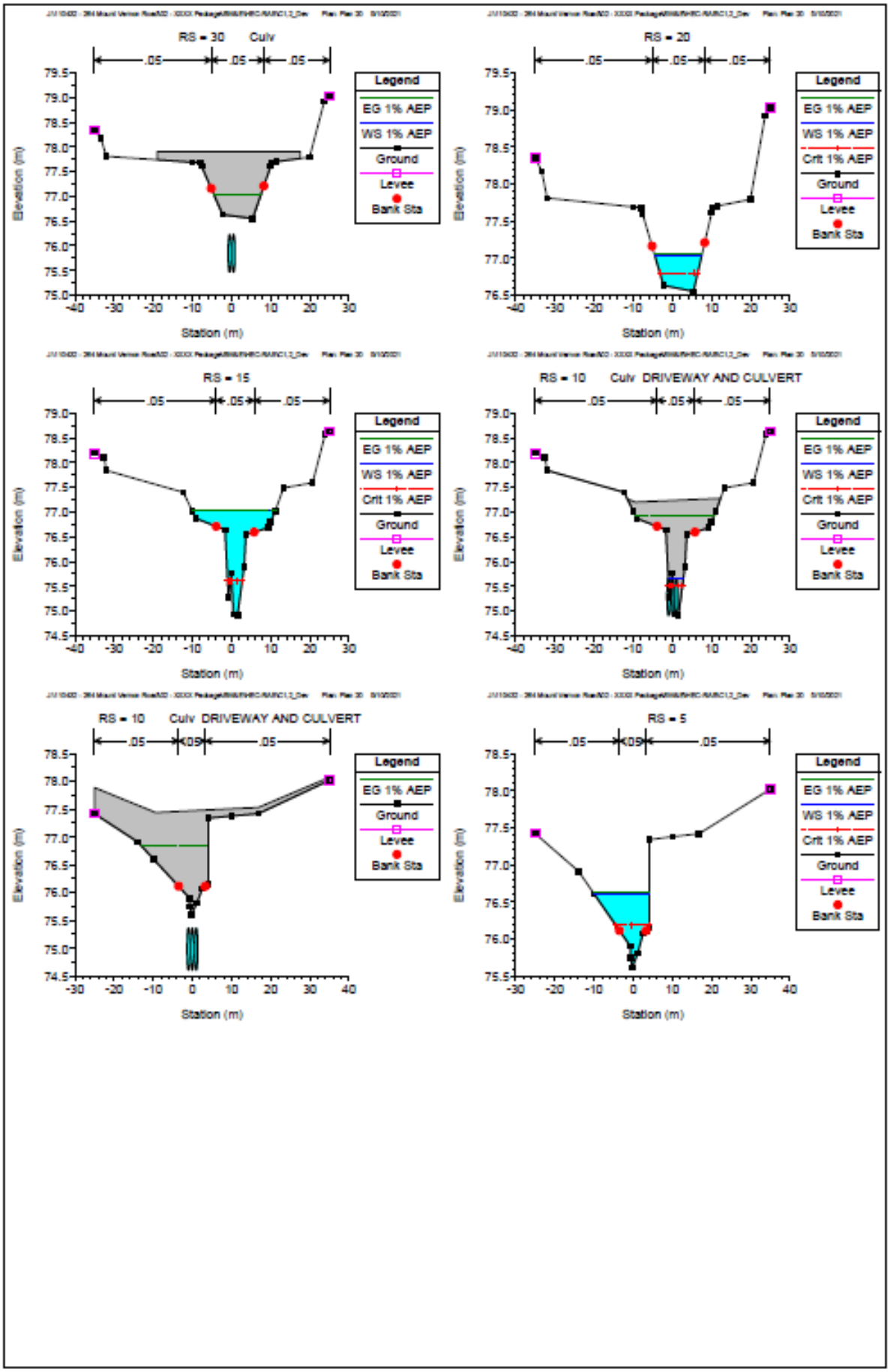
Pre-Development HEC-RAS Cross Section Results





Post-Development HEC-RAS Cross Section Results





Pre-Development HEC-RAS Results

River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
75	20% AEP	1.55	79.19	79.38	79.38	79.43	0.056375	0.99	1.56	16.28	1.02
75	10% AEP	1.9	79.19	79.4	79.4	79.45	0.051822	1.01	1.88	17.86	1
75	1% AEP	3.03	79.19	79.45	79.45	79.51	0.047654	1.1	2.75	21.62	0.99
70	20% AEP	1.55	78.22	78.52	78.52	78.6	0.043519	1.19	1.31	8.59	0.97
70	10% AEP	1.9	78.22	78.55	78.55	78.63	0.045062	1.26	1.5	9.21	1
70	1% AEP	3.03	78.22	78.61	78.61	78.71	0.042093	1.41	2.16	11.47	1
65	20% AEP	1.55	77.83	78.03	78.03	78.1	0.047766	1.14	1.36	10.12	1
65	10% AEP	1.9	77.83	78.06	78.06	78.13	0.044621	1.19	1.6	10.7	0.98
65	1% AEP	3.03	77.83	78.11	78.11	78.2	0.041055	1.34	2.27	12.16	0.98
60	20% AEP	1.55	77.5	78.04	77.73	78.05	0.000757	0.29	5.45	15.88	0.15
60	10% AEP	1.9	77.5	78.06	77.75	78.07	0.000965	0.34	5.75	16.15	0.17
60	1% AEP	3.03	77.5	78.11	77.81	78.12	0.001623	0.47	6.59	16.88	0.22
55	20% AEP	1.55	77.22	78.04	77.47	78.04	0.000129	0.18	9.79	19.01	0.07
55	10% AEP	1.9	77.22	78.06	77.49	78.06	0.000175	0.21	10.15	19.25	0.08
55	1% AEP	3.03	77.22	78.11	77.55	78.12	0.00034	0.31	11.16	19.88	0.11
50	20% AEP	1.55	76.57	78.04	76.73	78.04	0.000003	0.1	19.45	20.69	0.03
50	10% AEP	1.9	76.57	78.06	76.75	78.06	0.000004	0.12	19.85	20.96	0.03
50	1% AEP	3.03	76.57	78.11	76.81	78.12	0.000008	0.18	20.97	21.7	0.05
45	20% AEP	1.55	76.59	78.04	76.7	78.04	0.000001	0.07	26.44	24.35	0.02
45	10% AEP	1.9	76.59	78.06	76.72	78.06	0.000002	0.08	26.91	24.61	0.02
45	1% AEP	3.03	76.59	78.11	76.76	78.12	0.000004	0.12	28.23	25.32	0.03
40	20% AEP	1.55	76.56	78.04	76.68	78.04	0.000001	0.05	31.24	26.76	0.01
40	10% AEP	1.9	76.56	78.06	76.7	78.06	0.000001	0.07	31.76	27.02	0.02
40	1% AEP	3.03	76.56	78.12	76.74	78.12	0.000002	0.1	33.21	27.73	0.03
35	20% AEP	1.55	76.24	78.04	76.48	78.04	0	0.04	38.84	29.75	0.01
35	10% AEP	1.9	76.24	78.06	76.5	78.06	0.000001	0.05	39.42	30.02	0.01
35	1% AEP	3.03	76.24	78.12	76.55	78.12	0.000001	0.08	41.02	30.76	0.02
30	20% AEP	1.55	76.36	78.04	76.53	78.04	0	0.04	41.46	32.37	0.01
30	10% AEP	1.9	76.36	78.06	76.55	78.06	0.000001	0.05	42.08	32.56	0.01
30	1% AEP	3.03	76.36	78.12	76.59	78.12	0.000001	0.08	43.83	33.44	0.02
25	20% AEP	1.55	76.5	78.04	76.63	78.04	0	0.04	40.58	35.61	0.01
25	10% AEP	1.9	76.5	78.06	76.65	78.06	0.000001	0.05	41.27	35.98	0.01
25	1% AEP	3.03	76.5	78.12	76.68	78.12	0.000001	0.08	43.2	36.99	0.02
20	20% AEP	1.55	76.4	78.04	76.6	78.04	0.000001	0.05	40.64	37.26	0.01
20	10% AEP	1.9	76.4	78.06	76.62	78.06	0.000001	0.06	41.37	37.7	0.02
20	1% AEP	3.03	76.4	78.12	76.66	78.12	0.000002	0.09	43.39	38.91	0.02
15	20% AEP	1.55	76.77	78.04	77	78.04	0.000003	0.09	29.25	42	0.03
15	10% AEP	1.9	76.77	78.06	77.01	78.06	0.000004	0.11	30.06	42.48	0.03
15	1% AEP	3.03	76.77	78.11	77.06	78.12	0.000008	0.16	32.32	43.81	0.05
10		Culvert									
5	20% AEP	1.55	75.61	76.42	76.09	76.43	0.001001	0.38	4.52	13.33	0.18
5	10% AEP	1.9	75.61	76.48	76.12	76.49	0.001001	0.4	5.26	14.61	0.18
5	1% AEP	3.03	75.61	76.62	76.2	76.63	0.001001	0.47	7.52	17.95	0.19

Post-Development HEC-RAS Results

River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
75	20% AEP	1	79.19	79.35	79.36	79.4	0.030034	0.92	1.09	13.59	1.04
75	10% AEP	1.22	79.19	79.36	79.37	79.41	0.030018	0.97	1.26	14.65	1.05
75	1% AEP	2.01	79.19	79.4	79.41	79.46	0.030058	1.09	1.84	17.68	1.08
70	20% AEP	1	78.22	78.36	78.48	78.95	0.47431	3.4	0.29	4.07	4.04
70	10% AEP	1.22	78.22	78.38	78.49	78.98	0.426663	3.44	0.36	4.48	3.9
70	1% AEP	2.01	78.22	78.42	78.56	79.05	0.325373	3.52	0.57	5.68	3.54
65	20% AEP	1	77.77	77.93	77.97	78.05	0.07402	1.55	0.65	7.24	1.66
65	10% AEP	1.22	77.77	77.94	77.99	78.08	0.076881	1.67	0.73	7.57	1.71
65	1% AEP	2.01	77.77	77.97	78.04	78.18	0.084476	2.03	0.99	8.23	1.86
60	20% AEP	1	77.22	77.34	77.4	77.56	0.138616	2.07	0.48	5.62	2.25
60	10% AEP	1.22	77.22	77.35	77.42	77.59	0.130758	2.16	0.56	5.88	2.23
60	1% AEP	2.01	77.22	77.84	77.48	77.84	0.000487	0.38	5.44	13.6	0.18
55	20% AEP	1.18	76.64	77.23	76.84	77.24	0.00024	0.26	4.63	11.21	0.12
55	10% AEP	1.44	76.64	77.35	76.87	77.35	0.000163	0.25	5.99	12.34	0.11
55	1% AEP	2.38	76.64	77.84	76.93	77.84	0.000046	0.2	13.24	17.16	0.06
50	20% AEP	1.18	76.57	77.23	76.75	77.23	0.00012	0.2	6.04	13.63	0.09
50	10% AEP	1.44	76.57	77.35	76.77	77.35	0.000088	0.2	7.69	14.95	0.08
50	1% AEP	2.38	76.57	77.84	76.84	77.84	0.000028	0.16	16.41	20.55	0.05
45	20% AEP	1.18	76.51	77.23	76.72	77.23	0.000099	0.19	6.51	14.72	0.08
45	10% AEP	1.44	76.51	77.35	76.74	77.35	0.000073	0.19	8.32	16.48	0.07
45	1% AEP	2.38	76.51	77.84	76.81	77.84	0.000024	0.15	18.23	23.58	0.05
30		Culvert									
20	20% AEP	1.18	76.55	76.72	76.72	76.78	0.04806	1.08	1.09	8.9	0.98
20	10% AEP	1.44	76.55	76.74	76.74	76.81	0.044295	1.13	1.27	9.1	0.97
20	1% AEP	2.38	76.55	77.03	76.8	77.05	0.002948	0.55	4.34	11.97	0.29
15	20% AEP	1.48	74.91	76.53	75.41	76.54	0.000235	0.26	5.66	5.26	0.08
15	10% AEP	1.77	74.91	76.63	75.46	76.64	0.000332	0.28	6.37	9.14	0.1
15	1% AEP	2.8	74.91	77.04	75.6	77.04	0.000174	0.24	13.31	21.37	0.08
10		Culvert									
5	20% AEP	1.48	75.61	76.42	76.07	76.42	0.001002	0.39	4.22	11.63	0.18
5	10% AEP	1.77	75.61	76.47	76.11	76.47	0.001	0.41	4.81	12.27	0.18
5	1% AEP	2.8	75.61	76.61	76.19	76.62	0.001	0.48	6.72	14.17	0.19