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23 December 2015

Parramatta Park & Western Sydney Parkland Trusts
Attention: Mr George Henien
Level 7
10 Valentine Avenue
PARRAMATTA NSW 2150
George.henien@wspt.nsw.gov.au

Dear Sir

Re: Eastern Creek Business Hub, Rooty Hill Road South, NSW
SSD 5175 Mod 1
Blacktown Council Agency Response Letter

As per your request we have completed a hydraulic analysis and provide commentary regarding flooding and overland flow relating to the above State Significant Development Approval Modification. The analysis has been completed in response to the items raised in Blacktown City Council letter (Ref: MC-12-1769) dated 26 October 2015 and the scope of this letter and analysis were as per discussion held with Blacktown City Council in a meeting on 26 November 2015.

The first of the two items addressed in this letter relate to an assessment of the open channel which conveys stormwater through the site from a 35.4 Ha residential catchment to the north of Rooty Hill. The second item relates to the mainstream flooding of Eastern Creek and its relationship with the development site.

Following the meeting it has been confirmed that the proposed estate access road, associated infrastructure and overland flow path (Channel 01 as shown on drawing **Co12693.00-DA40**) will remain in the ownership of the Western Sydney Parklands Trust (WSPT). The adopted assessment parameters are based on this scenario and may differ from those requested by Council in their letter of 26 October 2015. The outcome and planning requirements remain consistent with council requirements and any differences between adopted parameters and this requested by Council are discussed in the following sections.

Open Channel Assessment

An upstream catchment located on the western side of Rooty Hill Road South is required to be drained through the property. The catchment is approximately 35.4 Ha in area and generally comprises residential/ urban areas. An existing culvert located south of Cable Place along Rooty Hill Road South conveys the majority of the upstream flows into the site. The culvert, running under Rooty Hill Road South, discharge into a channel which conveys flows through the site. The channel runs from west to east towards the existing culvert under the Westlink M7.

Flow from the upstream catchment is to be conveyed through the proposed development to the southern on-site detention (OSD) system but bypasses and water quality measures. XP-Rafts modelling completed by J. Wyndham Prince, as part of the original approved application, calculated the peak 1 in 100 year ARI flow from this catchment as being 12.9m^3/s. 1.3m^3/s will be conveyed across Rooty Hill Road via twin 750mm RCP culverts with the remaining 11.6m^3/s surcharging across Rooty Hill Road.

A 1D HEC-RAS model of the open channel has been completed to confirm the suitability of the proposed channel cross section to convey the 12.9m^3/s design flow. The HEC-RAS assessment is based on the following parameters:

- Design ARI = 1 in 100 year (1% AEP)
- Channel 01 Roughness (base), Manning's n = 0.04;
- Channel 01 Roughness (banks), Manning's n = 0.04;
- Extg. Creek Roughness Manning's n = 0.1 (base), 0.07 (banks);
- Channel bank maximum slope = 1 vertical to 3 horizontal;
- Upstream Boundary Condition: Normal, s = 0.01;
- Downstream Boundary Condition: Known Water Surface Level = RL 39.0m AHD (Basin 1 Q100 ARI W.S.L.); and
- Subcritical, steady flow analysis.

As noted earlier in this letter, some of the parameters differ between Councils letter and those adopted. The Manning's roughness of 0.04 has been adopted which is consistent with the original SSD application however lower than the requested by Council of 0.1 for the channel base and 0.07 for the channel banks. The adopted parameters are consistent with a formed open channel with grassed base and sides. The values requested by Council are consistent with a formed channel with heavily vegetated base and banks with thick reedy vegetation and heavy brush. We understand that Council requested the use of these values as their maintenance regime, if ownership of the channel were to be handed to Council, was lacking and there would be potential issues with channel capacity in the long term. Given Channel 01 will be owned and maintained by WSPT, who have a strict Stormwater Maintenance Schedule, the lower roughness values for a grassed channel are considered appropriate. The banks of Channel 01 also remain at 1v : 1h in geometry which is also consistent with the channel remaining an asset of WSPT. This arrangement has been discussed with council through Mr George Henien of WSPT during the week beginning 21 December 2015. Roughness parameters for the existing creek, between Channel 01 and the detention basin have been modelled with the council roughness parameters which are consistent with the condition of the existing creek bed.

A full set of output from the HEC-RAS analysis has been included in **Enclosure 1**. The assessment shows the following:

- The 1 in 100 year design flow of 12.9m^3/s can be contained in the proposed Channel 01 cross section;
- The 1 in 100 year water surface level, at the upstream end of Pad 1 (adjacent to Rooty Hill Road) is RL 41.85m AHD. The corresponding flood planning level for Pad 1, allowing for 500mm freeboard, is RL 42.35m. We confirm the proposed earthworks level for Pad 1 is RL 43.0m which provides for greater than 1150mm of freeboard to the calculated overland flow water surface level;
- Flow depths in the channel are typically in the order of 1000mm; and
- Velocities typically are consistent at 1.8m/s. Corresponding depth-velocity values of 1.8 will be experienced which are greater than those recommended for pedestrians during a flow event. As such the channel will be required to be fenced to achieve safety requirements for the channel.

Flooding

Council has raised concerns regarding the flood impact from local overland flow and from regional flooding relating to Eastern Creek. The HEC-RAS analysis provided above confirms the local overland flow is able to be conveyed through the site and flood immunity to the building pads is able to be achieved.

Eastern Creek is located downstream of the site some 250-300m to the east of the M7 Motorway. Flood studies undertaken by J. Wyndam Prince, as quoted in Section 6.6 of their Eastern Creek Business Hub Water Cycle Management Strategy Report (included in the original application submission), nominate the 1 in 100 year ARI flood level of Eastern Creek at RL 38.0m AHD. The Section 7.2 of this report also nominates the PMF flood level at RL 39.5m at the southern culvert and RL 38.0m at the northern culvert.

The flood extent is consistent with Blacktown Councils on-line interactive flood mapping tool and can be seen to be clear of the site and stormwater management measures on the site.

The flood levels and extent have been marked on a print out of Councils on-line flood mapping tool for visual confirmation of the above. This sketch has been provided as **Enclosure 2** of this letter.

Further we confirm the minimum proposed pad level of RL 42m AHD is 4m higher than the predicted 1 in 100 year ARI flood level. Also the minimum level of the estate access road is RL 40.3m AHD, 2.3m above the predicted 1 in 100 year ARI flood level.

Conclusion

This letter has been prepared in response to items raised in Blacktown City Council letter (Ref: MC-12-1769) dated 26 October 2015 and meeting regarding the response letter held on 26 November 2015 with Blacktown City Council.
A HEC-RAS analysis has been completed to confirm the overland flow channel will be able to convey the expected 1 in 100 year ARI storm flows from the upstream residential catchments. Parameters are consistent with a grassed open channel which is maintained as part of WSPT operation and maintenance obligations for the development site.
This letter also confirms that the site, development lots are not affected by regional flooding from Eastern Creek and that the development lots have sufficient flood immunity to flooding within Eastern Creek and from the local overland flow path.

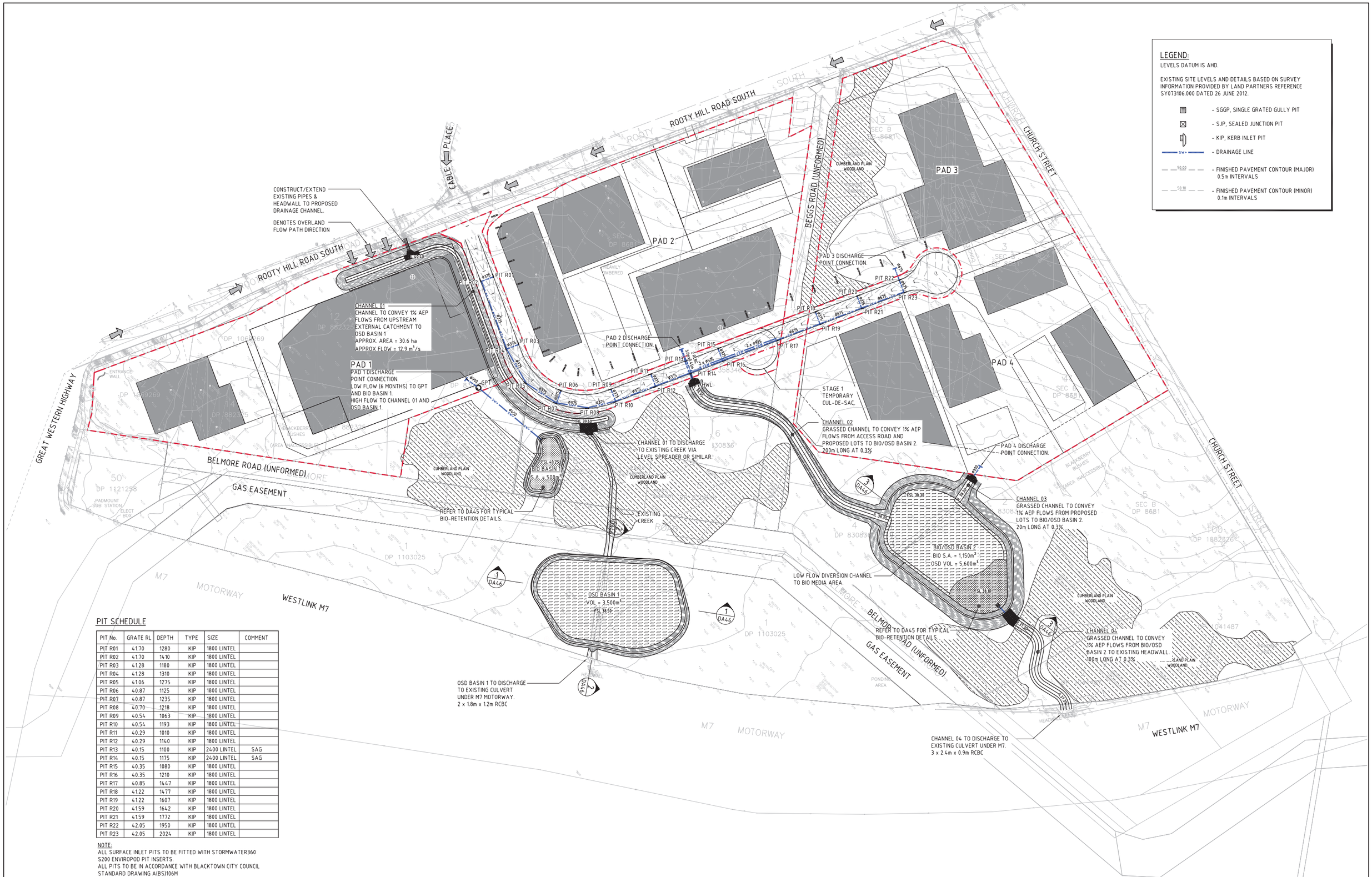
We trust the information contained in this letter meets your current needs. Please do not hesitate to contact the undersigned if further information or clarification is required.

Yours faithfully
COSTIN ROE CONSULTING PTY LTD

MARK WILSON MIEAust CPEng NER
Associate Director – Civil Engineering

Encl. HEC-RAS Model Output
Flood Mapping and flood level sketch

ENCLOSURE 1
HEC-RAS MODEL OUTPUT



PIT SCHEDULE

PIT No.	GRATE RL	DEPTH	TYPE	SIZE	COMMENT
PIT R01	41.70	1280	KIP	1800 LINTEL	
PIT R02	41.70	1410	KIP	1800 LINTEL	
PIT R03	41.28	1180	KIP	1800 LINTEL	
PIT R04	41.28	1310	KIP	1800 LINTEL	
PIT R05	41.06	1275	KIP	1800 LINTEL	
PIT R06	40.87	1125	KIP	1800 LINTEL	
PIT R07	40.87	1235	KIP	1800 LINTEL	
PIT R08	40.70	1218	KIP	1800 LINTEL	
PIT R09	40.54	1063	KIP	1800 LINTEL	
PIT R10	40.54	1193	KIP	1800 LINTEL	
PIT R11	40.29	1010	KIP	1800 LINTEL	
PIT R12	40.29	1140	KIP	1800 LINTEL	
PIT R13	40.15	1100	KIP	2400 LINTEL	SAG
PIT R14	40.15	1175	KIP	2400 LINTEL	SAG
PIT R15	40.35	1080	KIP	1800 LINTEL	
PIT R16	40.35	1210	KIP	1800 LINTEL	
PIT R17	40.85	1447	KIP	1800 LINTEL	
PIT R18	41.22	1477	KIP	1800 LINTEL	
PIT R19	41.22	1607	KIP	1800 LINTEL	
PIT R20	41.59	1642	KIP	1800 LINTEL	
PIT R21	41.59	1772	KIP	1800 LINTEL	
PIT R22	42.05	1950	KIP	1800 LINTEL	
PIT R23	42.05	2024	KIP	1800 LINTEL	

NOTE:
ALL SURFACE INLET PITS TO BE FITTED WITH STORMWATER360 S200 ENVIROPOD PIT INSERTS.
ALL PITS TO BE IN ACCORDANCE WITH BLACKTOWN CITY COUNCIL STANDARD DRAWING A(BS)106M

STORMWATER DRAINAGE PLAN
SCALE 1:1000

10m 0 10 20 30 40 50 60 70 80 90 100m
SCALE 1:1000 AT A0 SIZE SHEET

FOR SECTION 96

AMENDMENTS	DATE	ISSUE
ISSUED FOR SECTION 96	21.07.15	C
FOR INFORMATION ONLY	30.03.15	B
FOR INFORMATION ONLY	19.03.15	A

ARCHITECT

CLIENT
Western Sydney Parklands Trust
WESTERN SYDNEY PARKLANDS TRUST
LEVEL 7, 10 VALENTINE AVE
PARRAMATTA NSW 2150

PROJECT
EASTERN CREEK BUSINESS HUB
WESTERN SYDNEY PARKLANDS

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
M.W.	X.C.	MAR 2015		A0		12693.00-DA40

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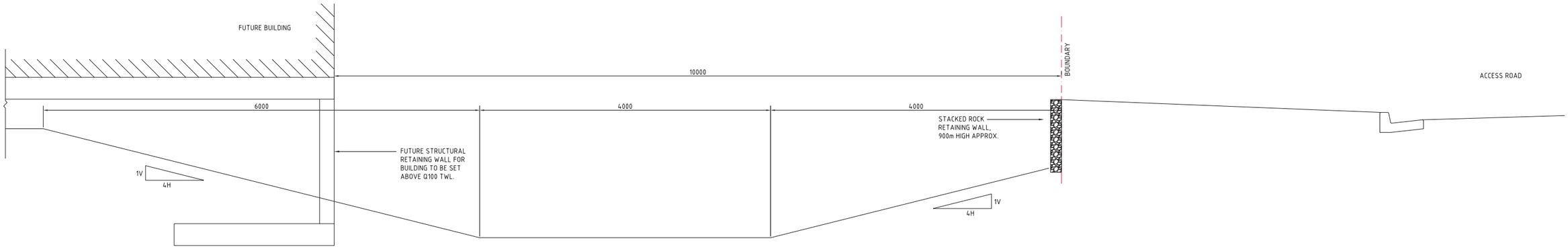
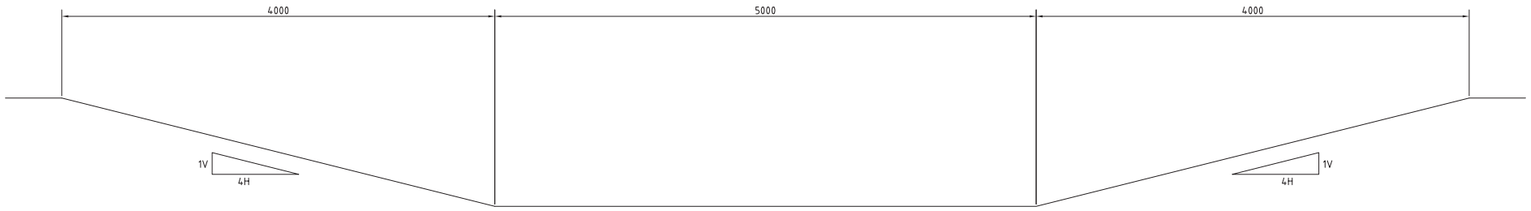
DRAWING TITLE
STORMWATER DRAINAGE PLAN

DRAWING No C012693.00-DA40 ISSUE C



TYPICAL CHANNEL 01 SECTION

SCALE 1:20



TYPICAL CHANNEL 02 & 03 SECTION

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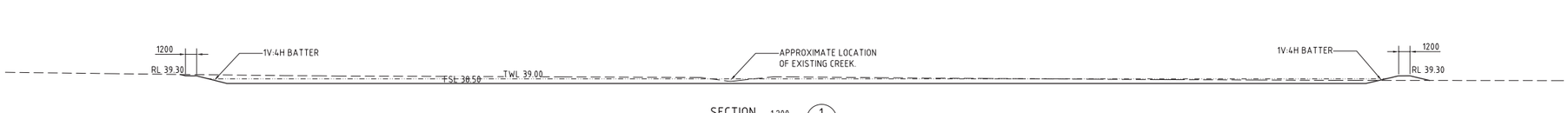

SECTION 1:200 1 / DA40

TYPICAL THRU OSD 1

SECTION 1:200 2 / DA40

TYPICAL THRU OSD 1

SECTION 1:200 3 / DA40

TYPICAL THRU OSD2

2m 0 5 10 15 20m

SCALE 1:200 AT A0 SIZE SHEET

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A0 SIZE SHEET

FOR SECTION 96

AMENDMENTS	DATE	ISSUE
ISSUED FOR SECTION 96	21.07.15	B
FOR INFORMATION ONLY	30.03.15	A

ARCHITECT

CLIENT
Western Sydney Parklands Trust
WESTERN SYDNEY PARKLANDS TRUST
LEVEL 7, 10 VALENTINE AVE
PARRAMATTA NSW 2150

PROJECT
EASTERN CREEK BUSINESS HUB
WESTERN SYDNEY PARKLANDS

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
M.W.	X.C.	MAR 2015		A0	AS SHOWN	12693.00-DA46

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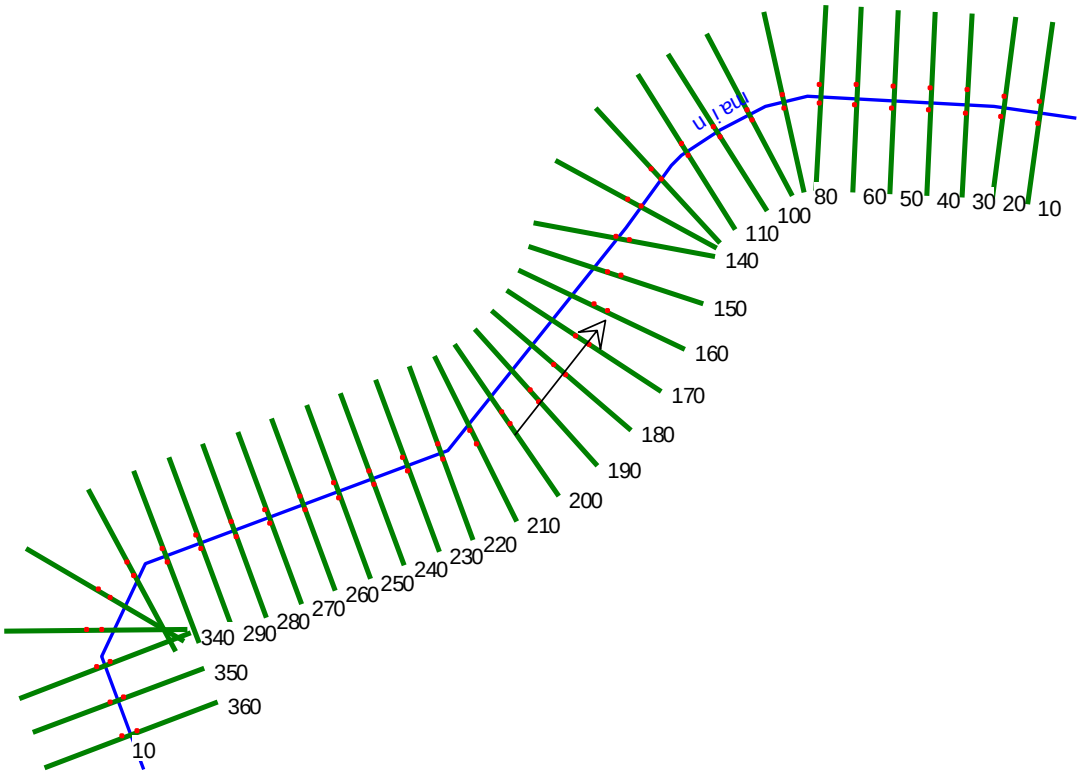
DRAWING TITLE
STORMWATER DRAINAGE DETAILS - SHEET 2

DRAWING No C012693.00-DA46 ISSUE B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10
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60
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230
240
250
260
270
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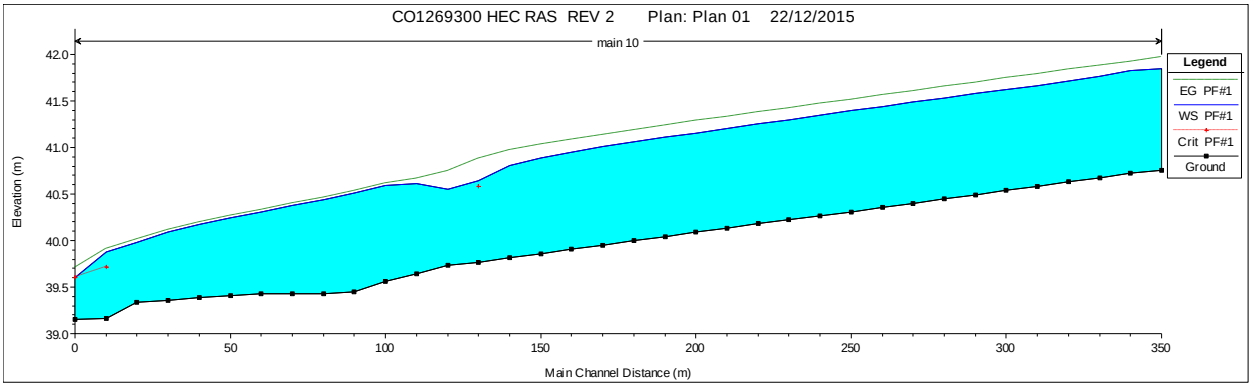
290
340
350
360


CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
main 10
Legend
EG PF#1
WS PF#1
Crit PF#1
Ground
Elevation (m)
Main Channel Distance (m)
42.0
41.5
41.0
40.5
40.0
39.5
39.0
0
50
100
150
200
250
300
350

River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
360	12.9	40.76	41.85		41.97	0.004473	1.77	9.11	13.71	0.54
350	12.9	40.72	41.83		41.92	0.00367	1.62	10.71	23	0.49
340	12.9	40.67	41.76		41.88	0.004456	1.77	9.12	12.72	0.54
330	12.9	40.63	41.71		41.84	0.004547	1.78	9.05	12.68	0.54
320	12.9	40.58	41.67		41.79	0.004527	1.78	9.05	12.66	0.54
310	12.9	40.54	41.62		41.74	0.00453	1.77	9	12.28	0.54
300	12.9	40.49	41.58		41.7	0.00446	1.76	8.98	12.02	0.54
290	12.9	40.45	41.53		41.65	0.004524	1.77	8.94	12.01	0.54
280	12.9	40.4	41.49		41.61	0.004487	1.77	8.96	12.02	0.54
270	12.9	40.36	41.44		41.56	0.004558	1.78	8.92	12.02	0.55
260	12.9	40.31	41.39		41.51	0.004488	1.77	8.96	12.02	0.54
250	12.9	40.27	41.35		41.47	0.0046	1.78	8.89	12.01	0.55
240	12.9	40.22	41.3		41.42	0.004536	1.77	8.93	12.02	0.54
230	12.9	40.18	41.25		41.38	0.004672	1.79	8.85	12.01	0.55
220	12.9	40.13	41.21		41.33	0.004655	1.79	8.85	12.19	0.55
210	12.9	40.09	41.16		41.28	0.00475	1.8	8.8	12.33	0.56
200	12.9	40.04	41.11		41.23	0.004741	1.8	8.8	12.4	0.56
190	12.9	40	41.06		41.19	0.00494	1.82	8.68	12.48	0.57
180	12.9	39.95	41.01		41.14	0.005017	1.84	8.63	12.56	0.57
170	12.9	39.91	40.95		41.09	0.005356	1.88	8.44	12.4	0.59
160	12.9	39.86	40.89		41.03	0.00567	1.92	8.27	12.21	0.6
150	12.9	39.82	40.81		40.97	0.006603	2.01	7.84	11.61	0.65
140	12.9	39.77	40.64	40.58	40.87	0.011015	2.4	6.54	10.97	0.82
130	12.9	39.73	40.55		40.75	0.011449	2.12	6.75	11.85	0.8
120	12.9	39.64	40.61		40.66	0.002187	1.14	13.54	19.86	0.37
110	12.9	39.56	40.59		40.62	0.008676	0.73	17.83	46.68	0.27
100	12.9	39.45	40.51		40.54	0.007397	0.67	19.62	50	0.25
90	12.9	39.43	40.44		40.46	0.007064	0.63	19.95	50	0.24
80	12.9	39.43	40.38		40.4	0.006658	0.59	20.65	50	0.23
70	12.9	39.43	40.31		40.33	0.007144	0.6	20.39	50	0.24
60	12.9	39.41	40.24		40.26	0.005923	0.52	21.63	50	0.22
50	12.9	39.39	40.17		40.19	0.007989	0.6	19.85	50	0.26
40	12.9	39.36	40.09		40.11	0.00843	0.61	19.53	50	0.26
30	12.9	39.34	39.98		40.01	0.011736	0.66	17.61	50	0.3
20	12.9	39.16	39.88	39.71	39.91	0.009097	0.58	18.54	50	0.27
10	12.9	39.15	39.61	39.61	39.71	0.061299	1.08	10.06	50	0.64

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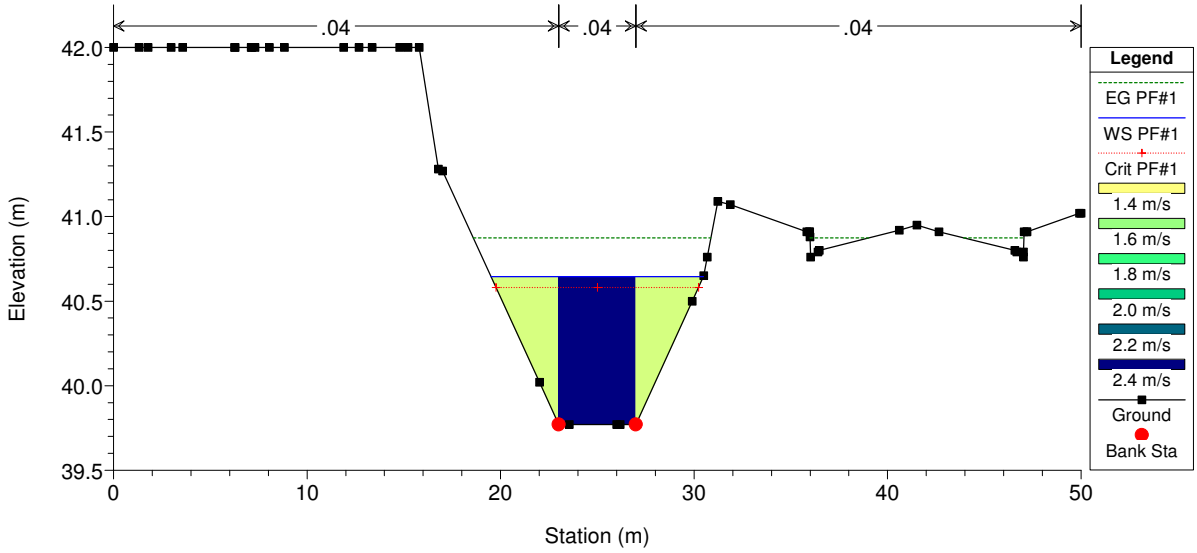

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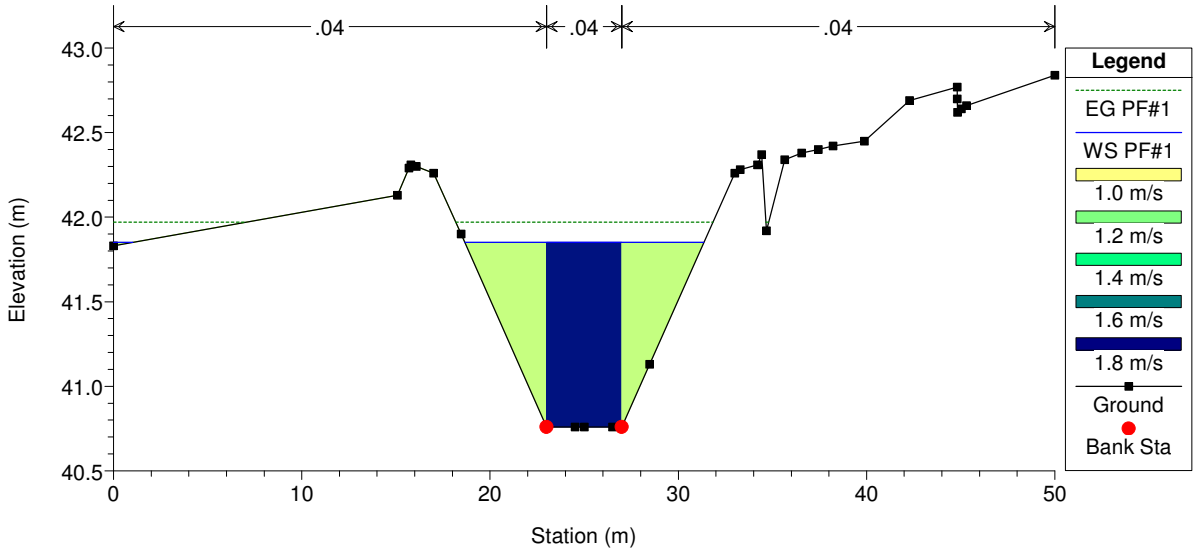

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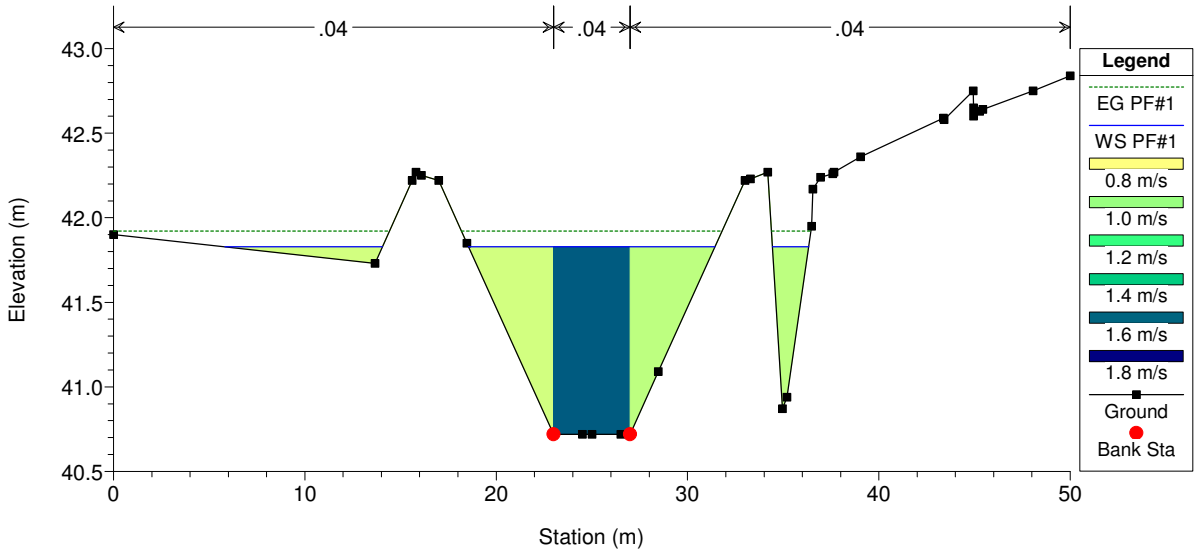

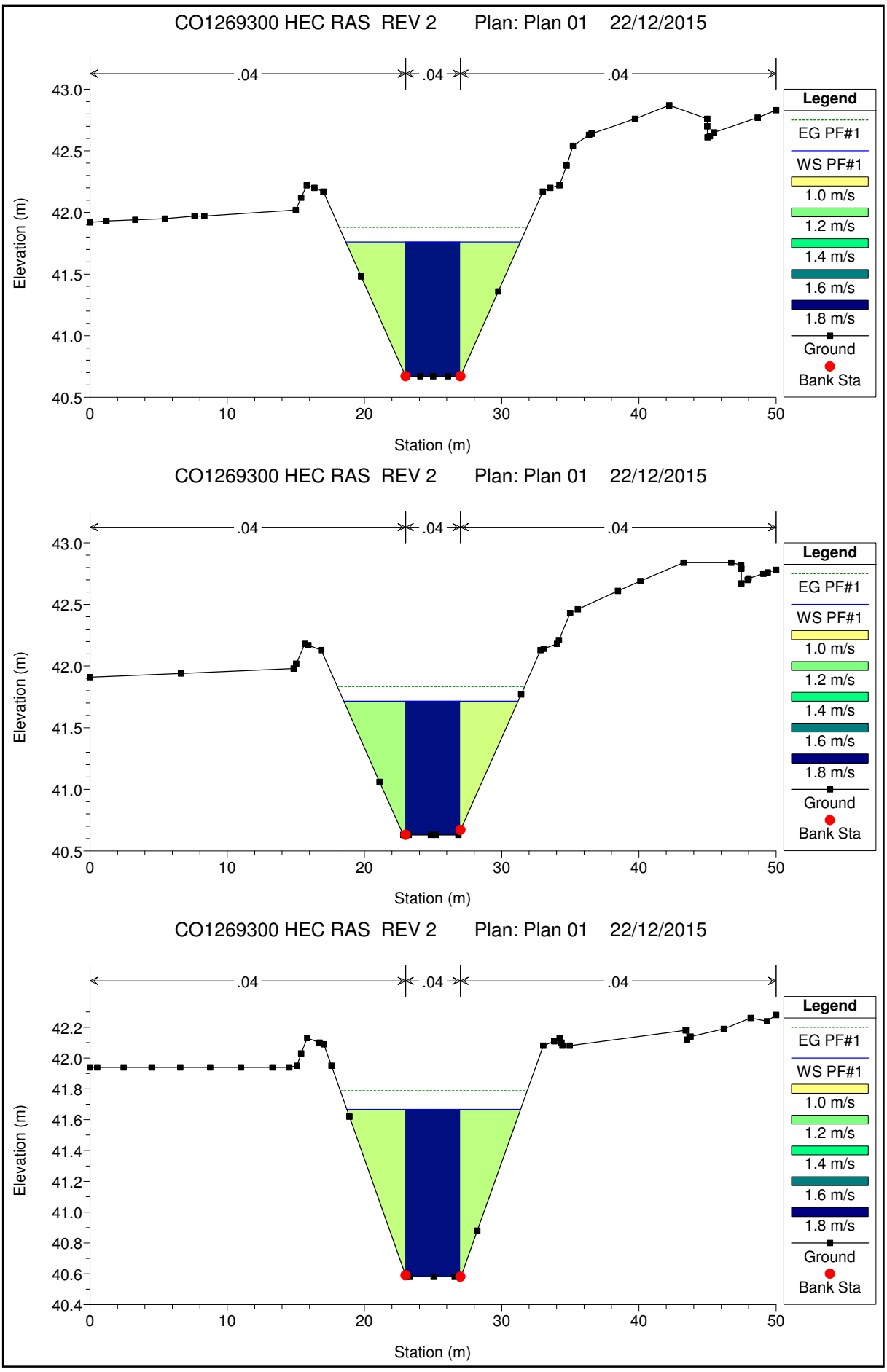
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Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
1.0 m/s
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1.8 m/s
Ground
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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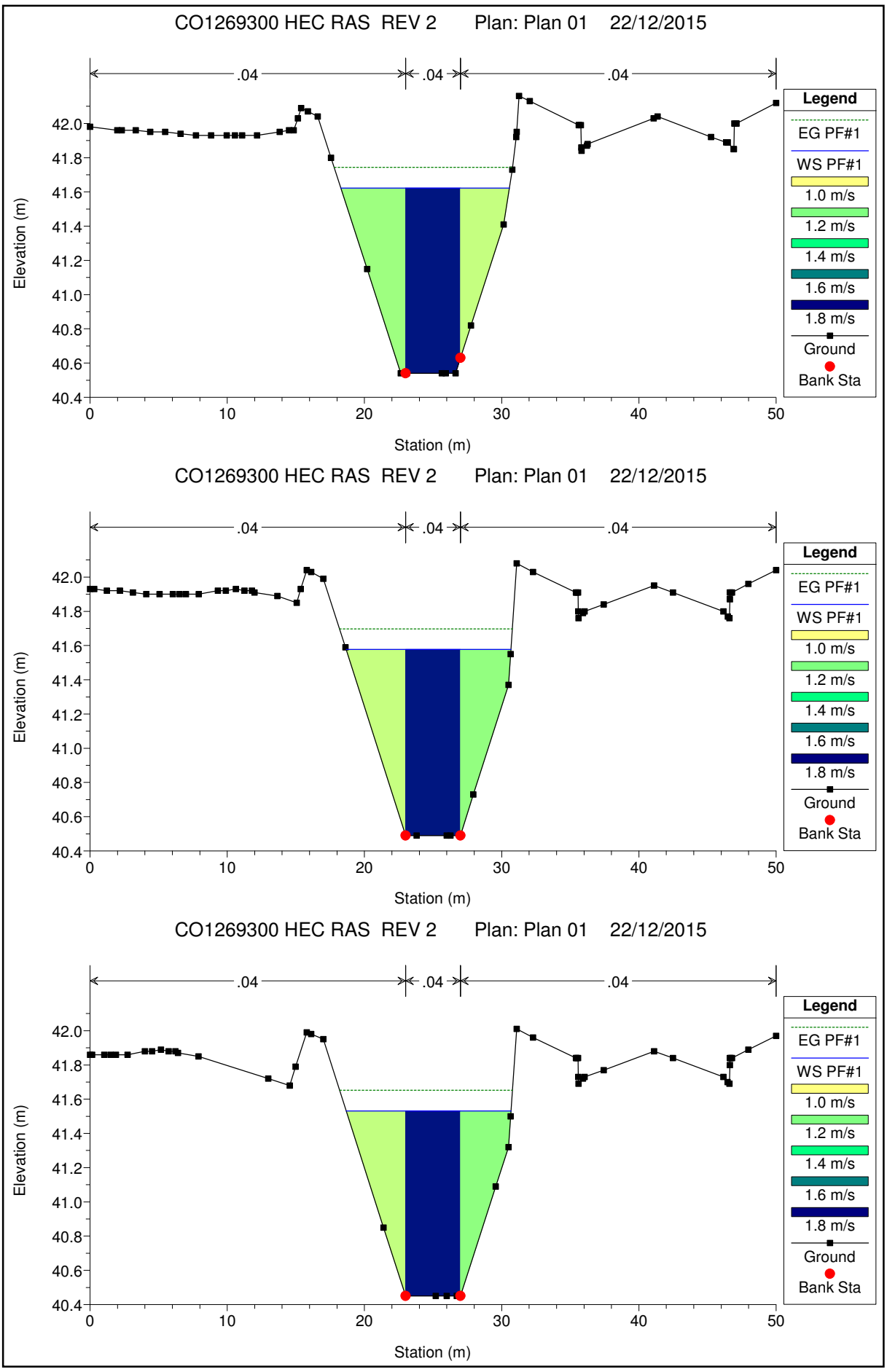
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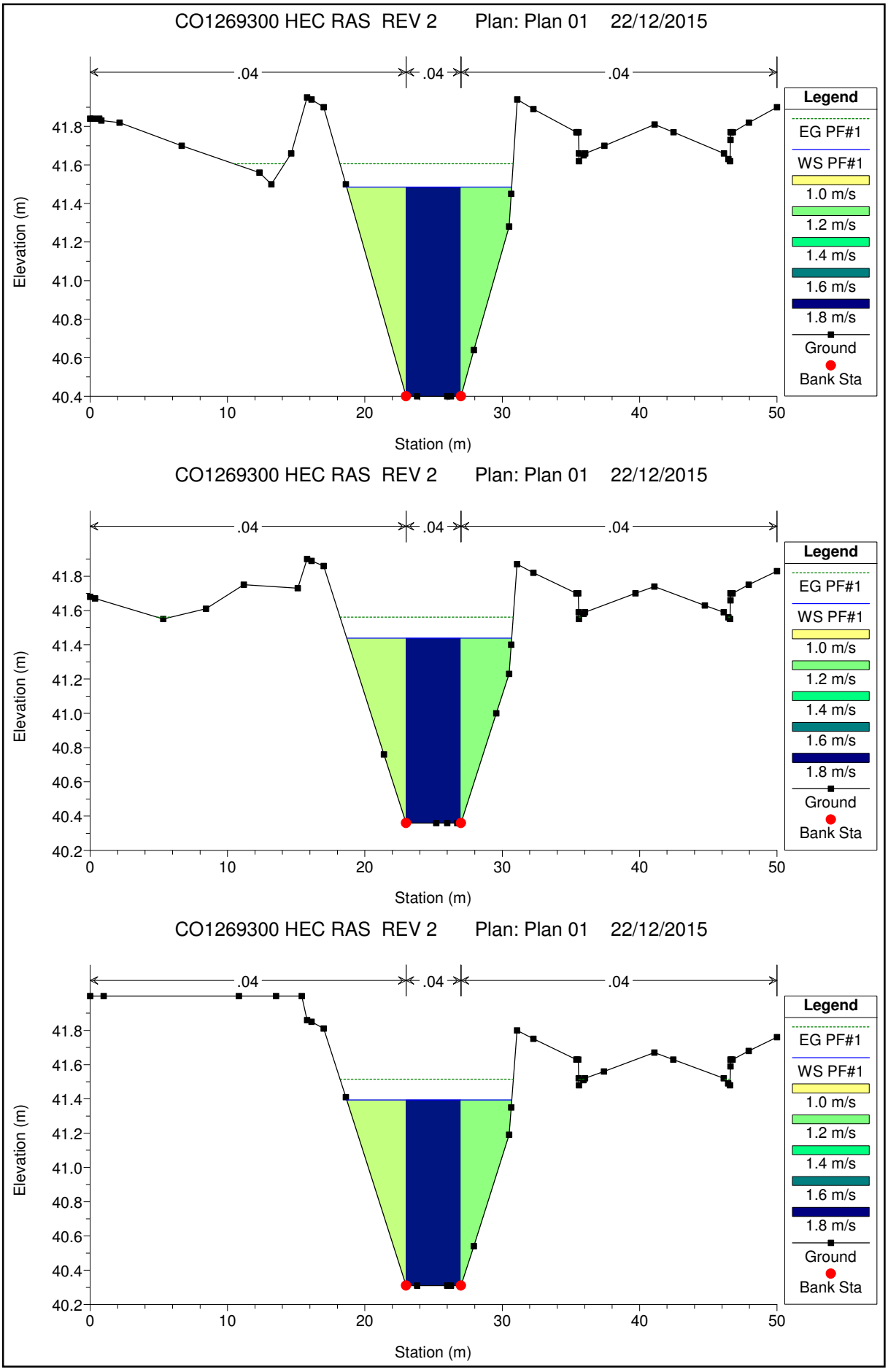
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Elevation (m)
Station (m)
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Station (m)
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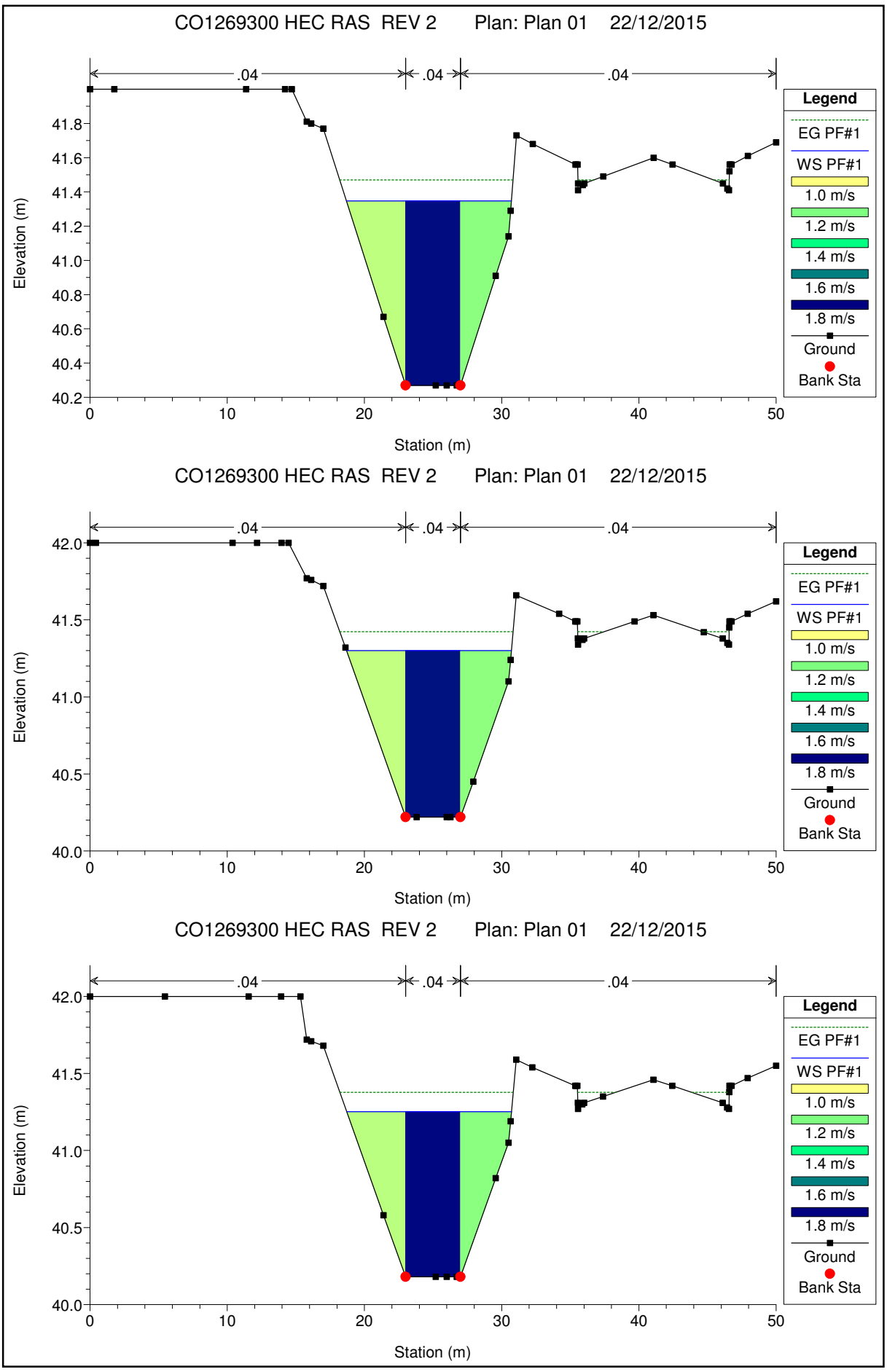
Ground
Bank Sta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Station (m)
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WS PF#1
1.0 m/s
1.2 m/s
1.4 m/s
1.6 m/s
1.8 m/s
Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Elevation (m)
Station (m)
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1.0 m/s
1.2 m/s
1.4 m/s
1.6 m/s
1.8 m/s
Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Elevation (m)
Station (m)
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WS PF#1
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1.6 m/s
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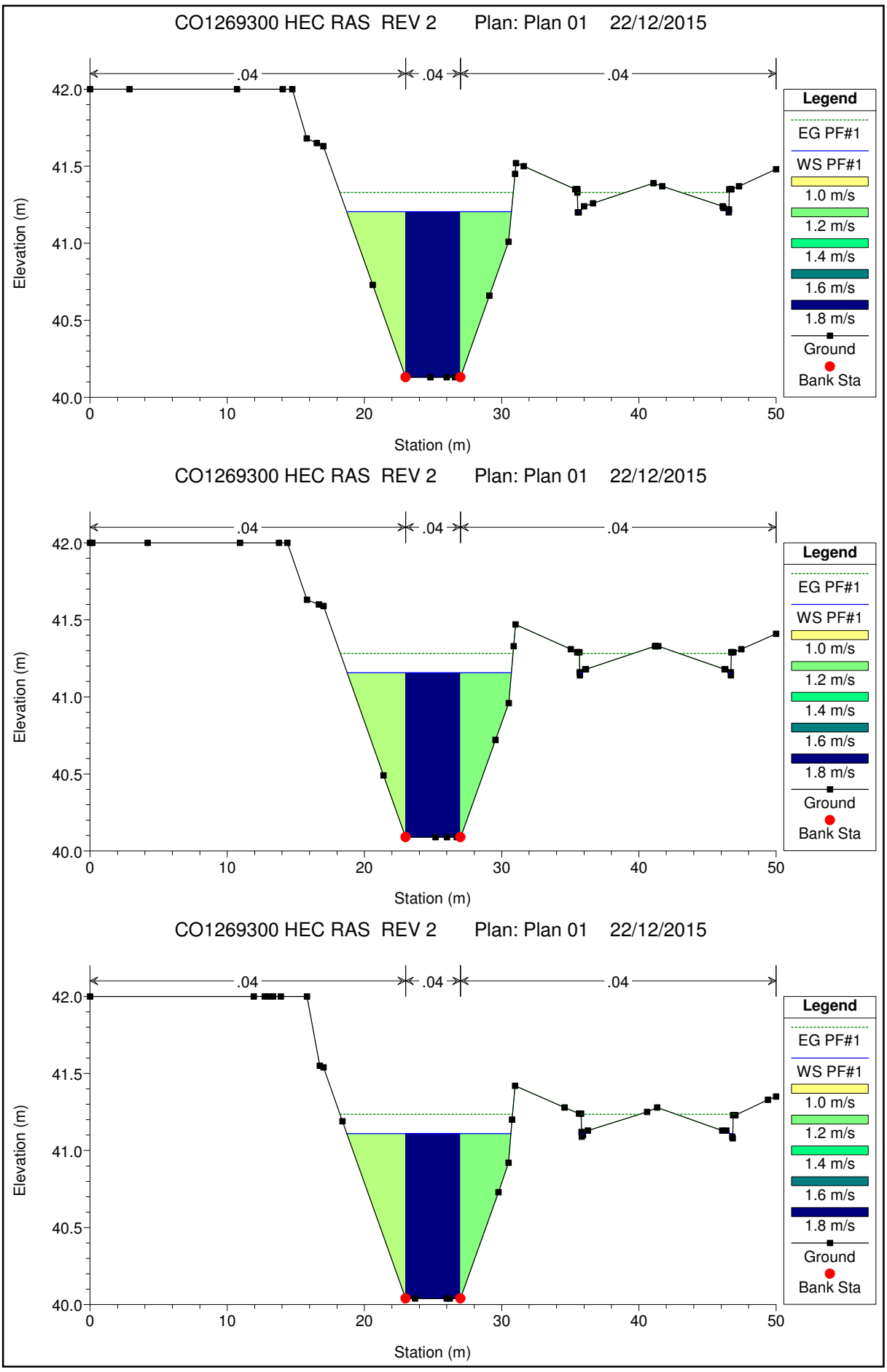
Ground
Bank Sta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42.0
41.5
41.0
40.5
40.0
Elevation (m)
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Station (m)
Legend
EG PF#1
WS PF#1
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1.6 m/s
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Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Elevation (m)
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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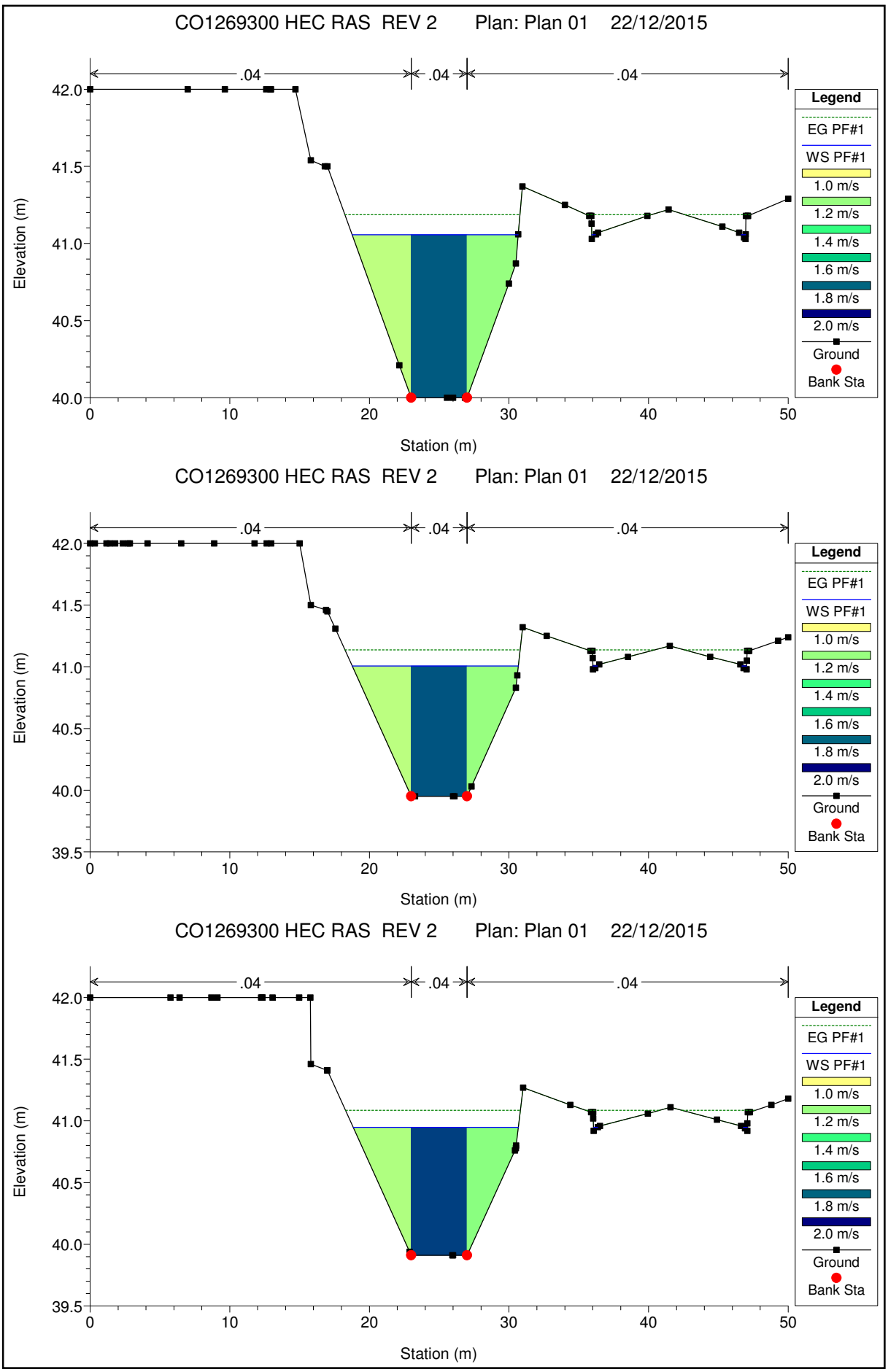
Ground
Bank Sta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Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
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1.4 m/s
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Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Elevation (m)
Station (m)
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EG PF#1
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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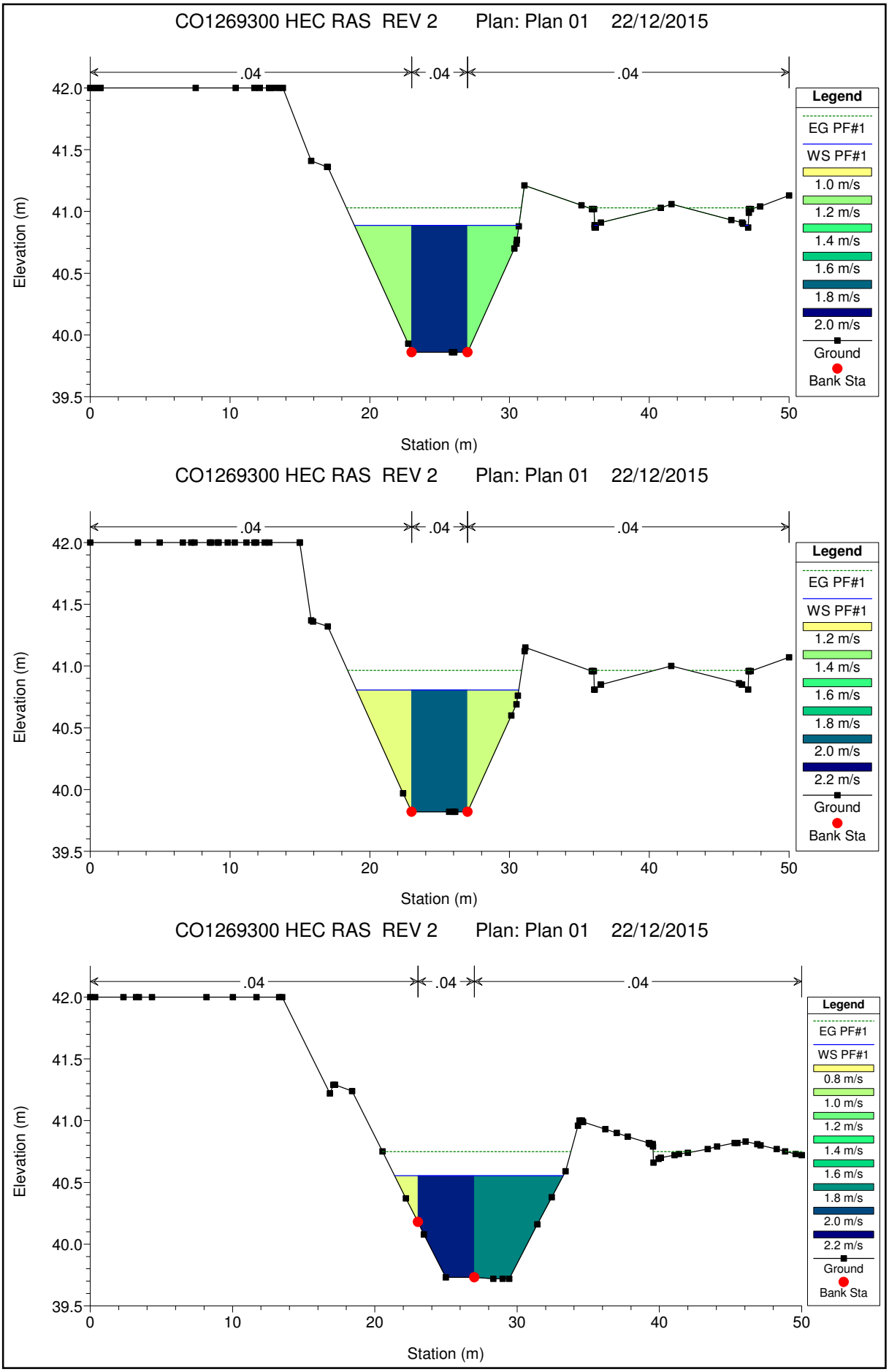
Ground
Bank Sta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Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
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1.4 m/s
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Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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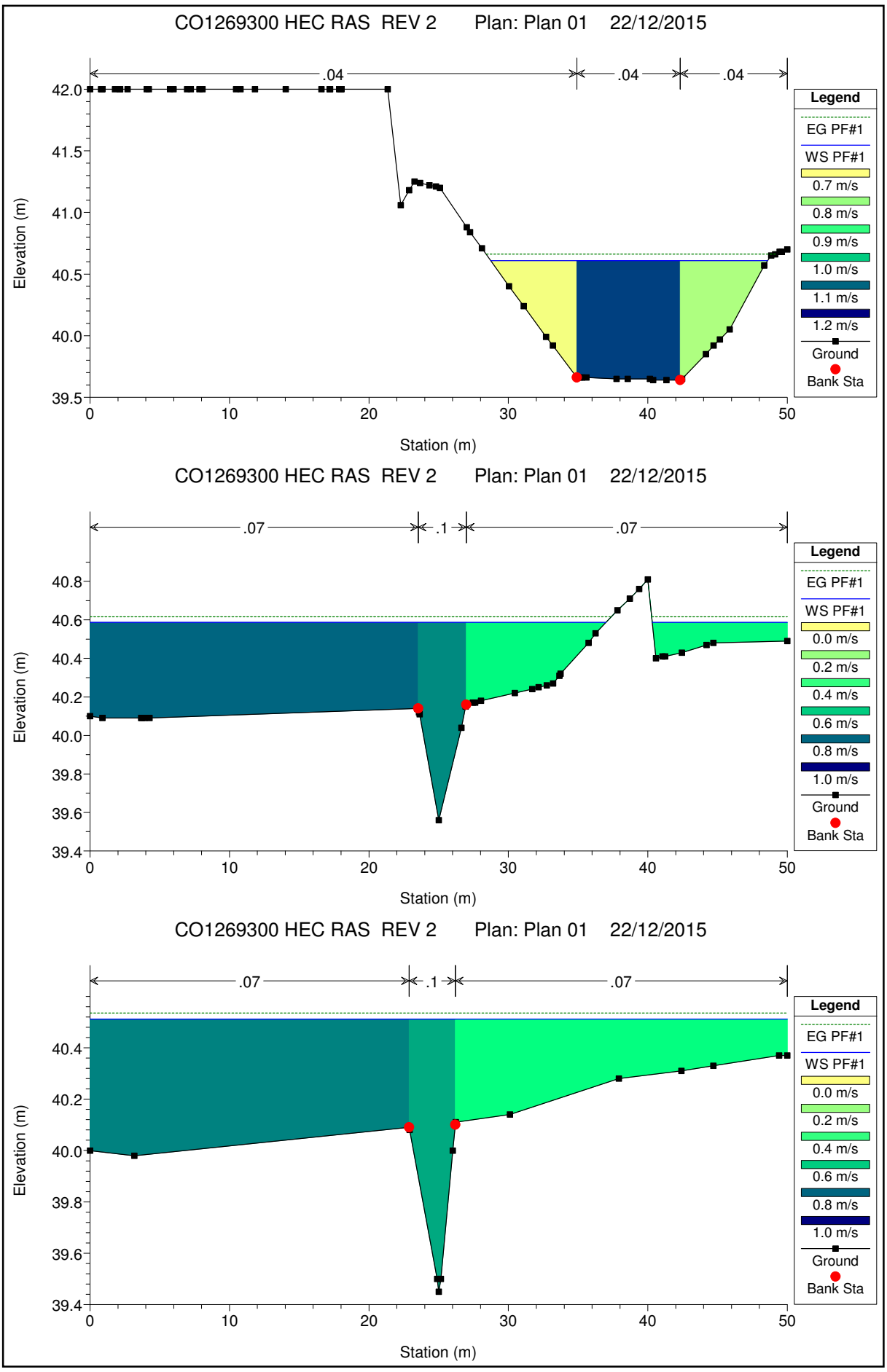
Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
0.8 m/s
1.0 m/s
1.2 m/s
1.4 m/s
1.6 m/s
1.8 m/s
2.0 m/s
2.2 m/s
Ground
Bank Sta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Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
0.7 m/s
0.8 m/s
0.9 m/s
1.0 m/s
1.1 m/s
1.2 m/s
Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
.07
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.07
Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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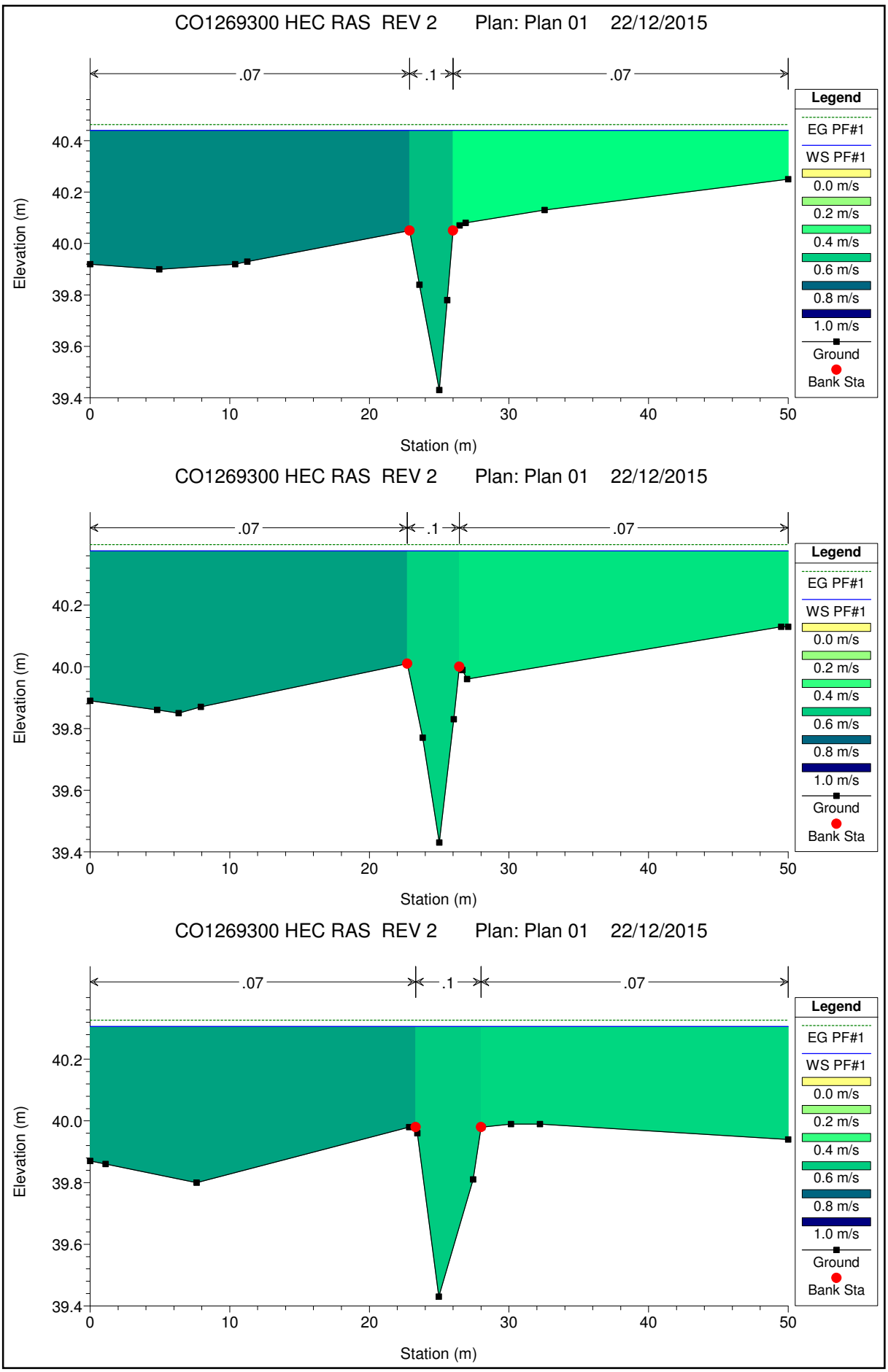
Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta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Legend
EG PF#1
WS PF#1
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Legend
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Ground
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Elevation (m)
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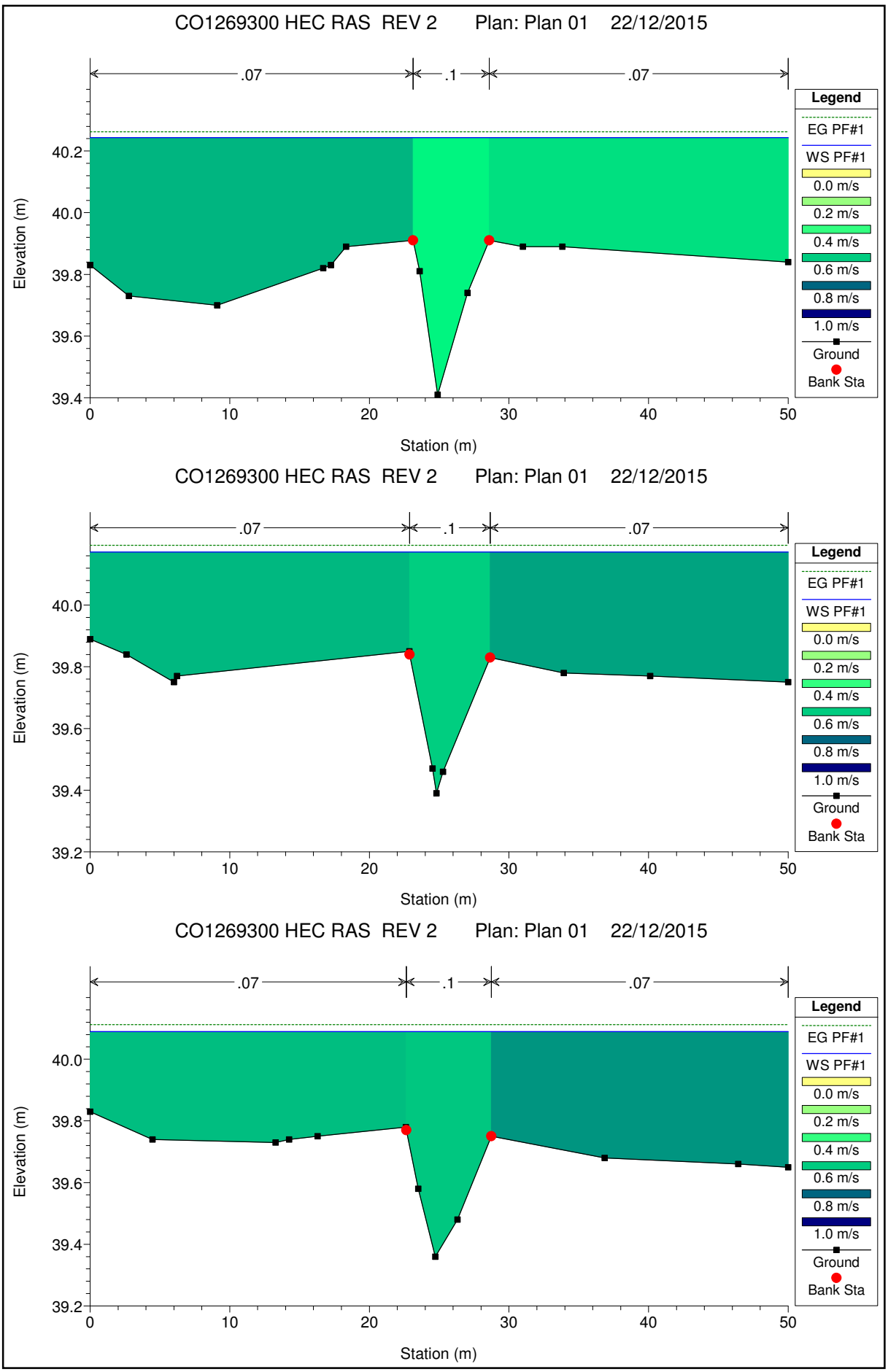
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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EG PF#1
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Ground
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Elevation (m)
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CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Legend
EG PF#1
WS PF#1
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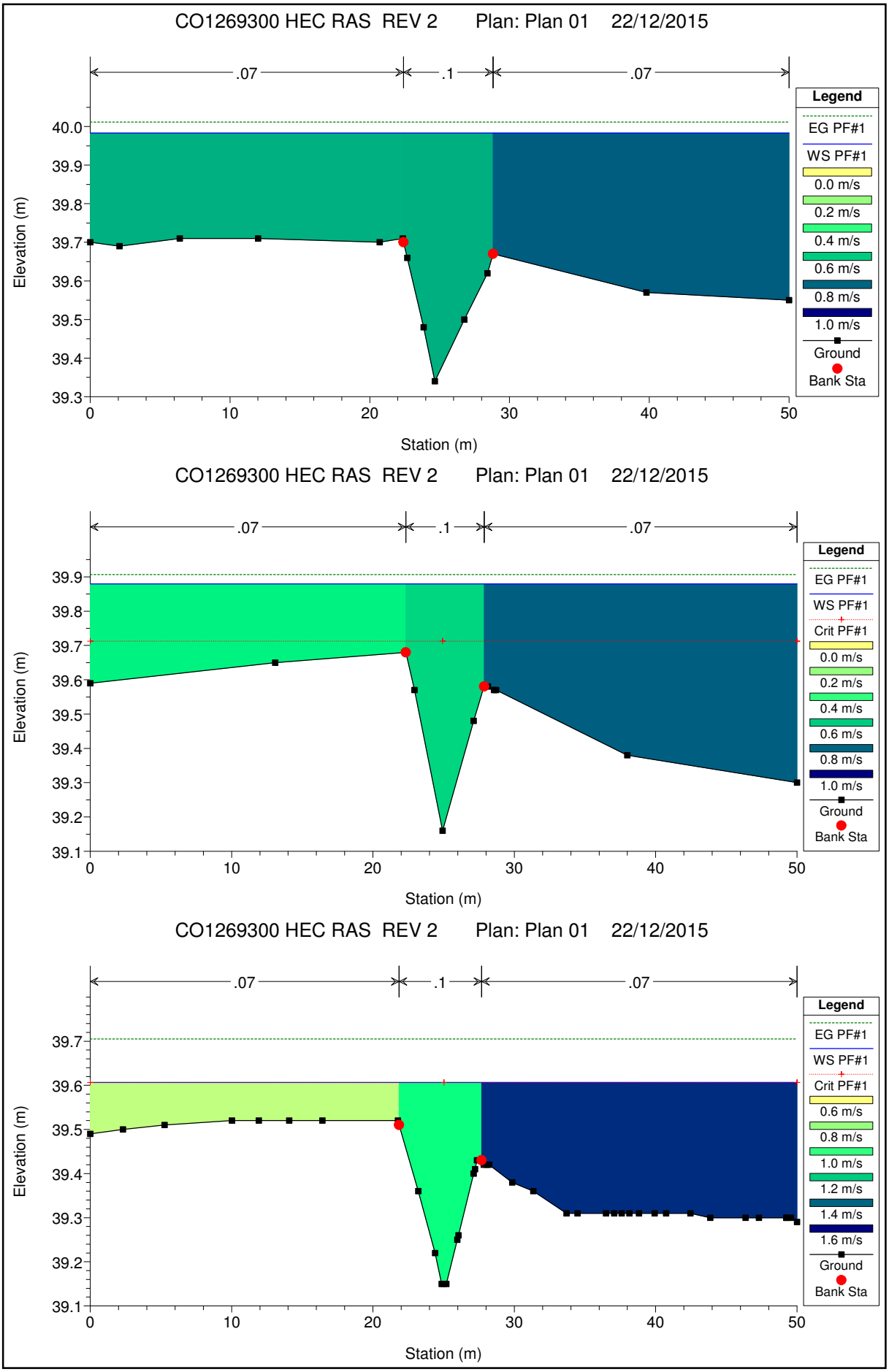
Ground
Bank Sta
Elevation (m)
Station (m)


CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Ground
Bank Sta
Elevation (m)
Station (m)
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Legend
EG PF#1
WS PF#1
Crit PF#1
0.0 m/s
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Ground
Bank Sta
Elevation (m)
Station (m)
CO1269300 HEC RAS REV 2 Plan: Plan 01 22/12/2015
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Legend
EG PF#1
WS PF#1
Crit PF#1
0.6 m/s
0.8 m/s
1.0 m/s
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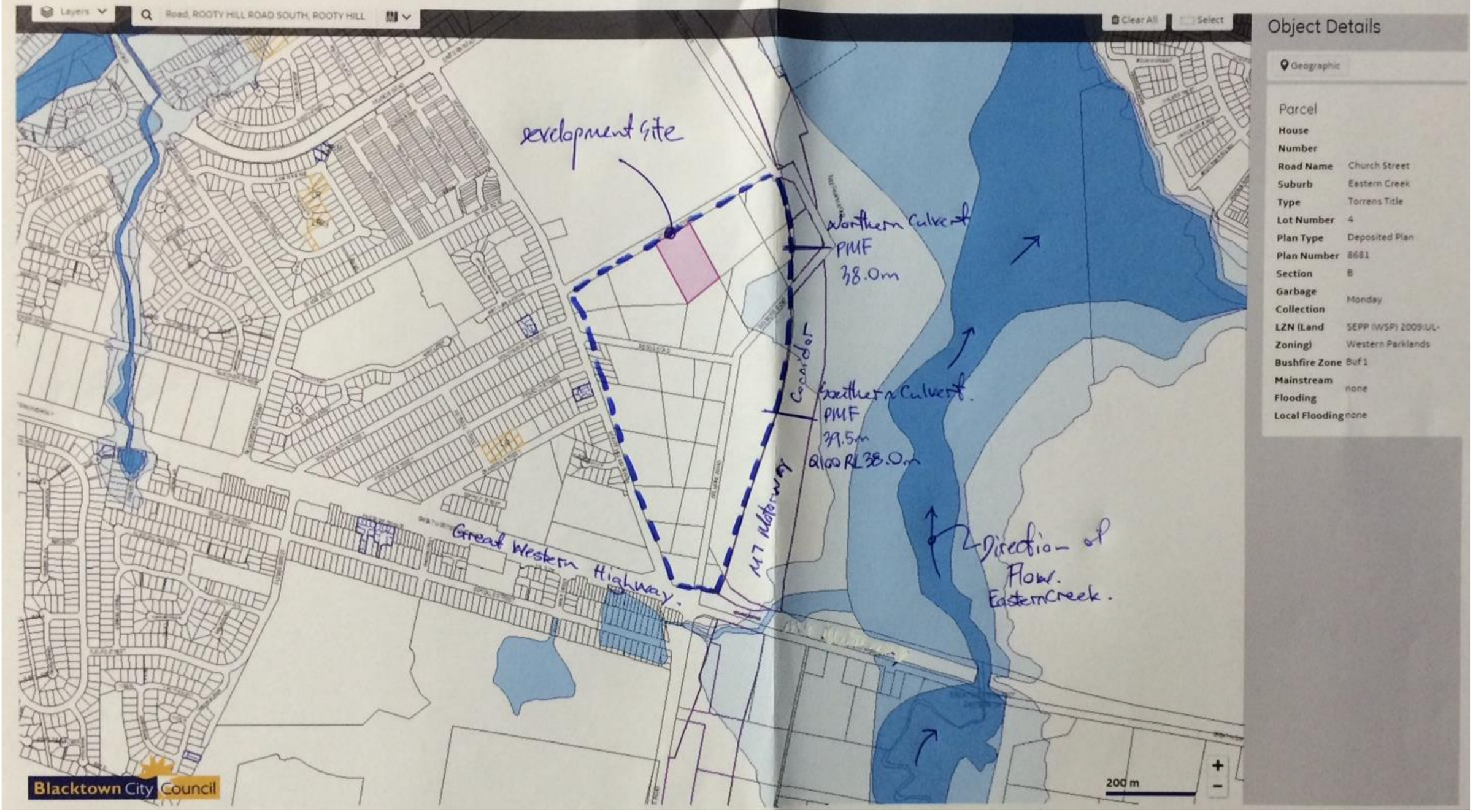
Ground
Bank Sta
Elevation (m)
Station (m)

ENCLOSURE 2
FLOOD EXTENT SKETCH

Enclosure 2


Layers
Road, ROOTY HILL ROAD SOUTH, ROOTY HILL
Clear All
Select
development site
Northern Culvert
PMF
38.0m
Corridor
Southern Culvert.
PMF
39.5m
Q100 RL38.0m
M7 Motorway
Great Western Highway.
Direction of Flow. Eastern Creek.
Object Details
Geographic
Parcel
House Number
Road Name Church Street
Suburb Eastern Creek
Type Torrens Title
Lot Number 4
Plan Type Deposited Plan
Plan Number 8681
Section B
Garbage Collection Monday
LZN (Land Zoning) SEPP (WSP) 2009:UL-Western Parklands
Bushfire Zone Buf 1
Mainstream Flooding none
Local Flooding none
200 m
Blacktown City Council