Appendix 6: Flood Assessment – River Edge Consulting

Memorandum

RIVER EDGE CONSULTING

To: Mark Cooney, Spencer Holmes Ltd

Cc: Alex Gifford, Tonkin + Taylor

From: Philip Wallace, River Edge Consulting

Date: 1 November 2022

Re: Benmore Crescent – Alternative culvert option

1. Introduction

In June 2022 I prepared a flood assessment report for the site and proposed Te Rangihaeata development at 30 Benmore Crescent. I subsequently carried out an assessment of a proposal for an alternative culvert arrangement and reported the findings in a memo dated 27 July.

I have now carried out a flood assessment of further refinements to the proposed layout of the developed site. The current assessment has also incorporated additional stream bed survey data collected by Spencer Holmes in September 2022, immediately downstream of the last culvert crossing within the site.

2. Modified proposal for site

2.1 Fill Platform and earthworks

The previous assessments of the proposal were based on a fill platform prepared by Tonkin + Taylor. Spencer Holmes has prepared a revised fill platform, the latest being dated 26 October 2022. That revised platform is shown in Figure 1.

The design leaves the existing stream channel untouched. A flood channel of at least 20 m width is also provided.

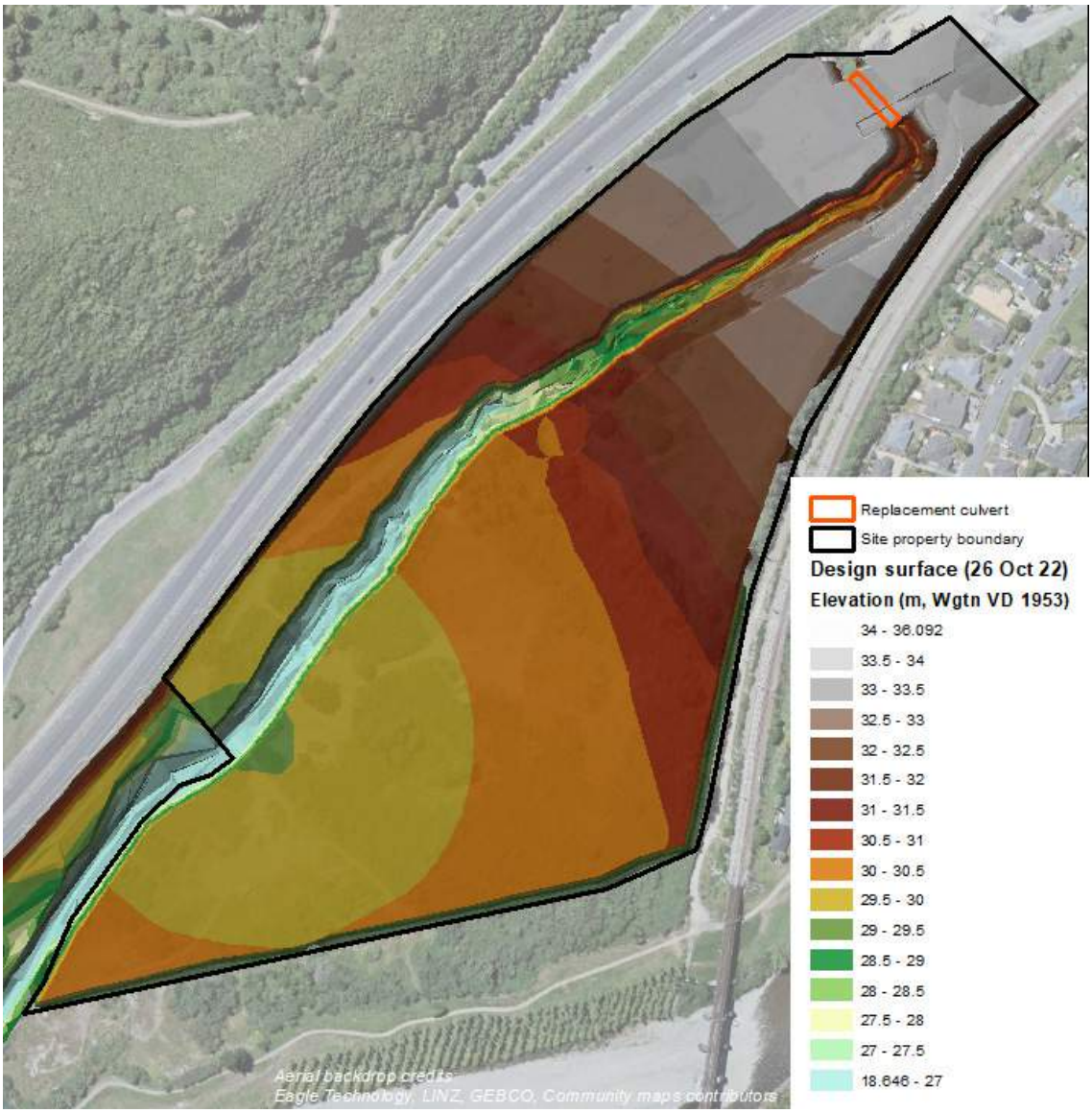

Figure 1 Design platform surface, 26 October 2022

2.2 Culverts

As with the option assessed in July, the proposal under consideration involves removal of all of the Dry Creek culverts within the site and replacement of only culvert 1. Figure 2 shows the location of the culverts.

Culvert 1 is proposed to be 35 m long (Figure 3). While the July assessment assumed culvert 1 would consists of twin 2.5 m wide x 2 m high box concrete culverts, the current assessment now assumes twin 3 m wide x 2 m high box concrete culverts. These would be embedded by around 500 mm, to provide a natural gravel bed and meet fish passage guidelines. Thus the effective height of the twin culverts would be 1.5 m.

An alternative of twin 3.5 m wide x 2 m high culverts has also been tested.

The new culvert is proposed to be laid a gradient (2.3%) reflecting the general gradient of the stream bed in the vicinity, although it is expected that stream gradient will adjust itself in light of

the much larger culvert opening proposed (compared to the existing culvert opening). Having an initial embedment of 500 mm will provide some leeway for the bed to adjust itself. Figure 4 shows the existing stream bed gradient and the culvert invert levels. The dotted red line shows the level at which the culvert invert would be laid while the solid red line, 500 mm higher, shows the bed level assumed through the culvert.

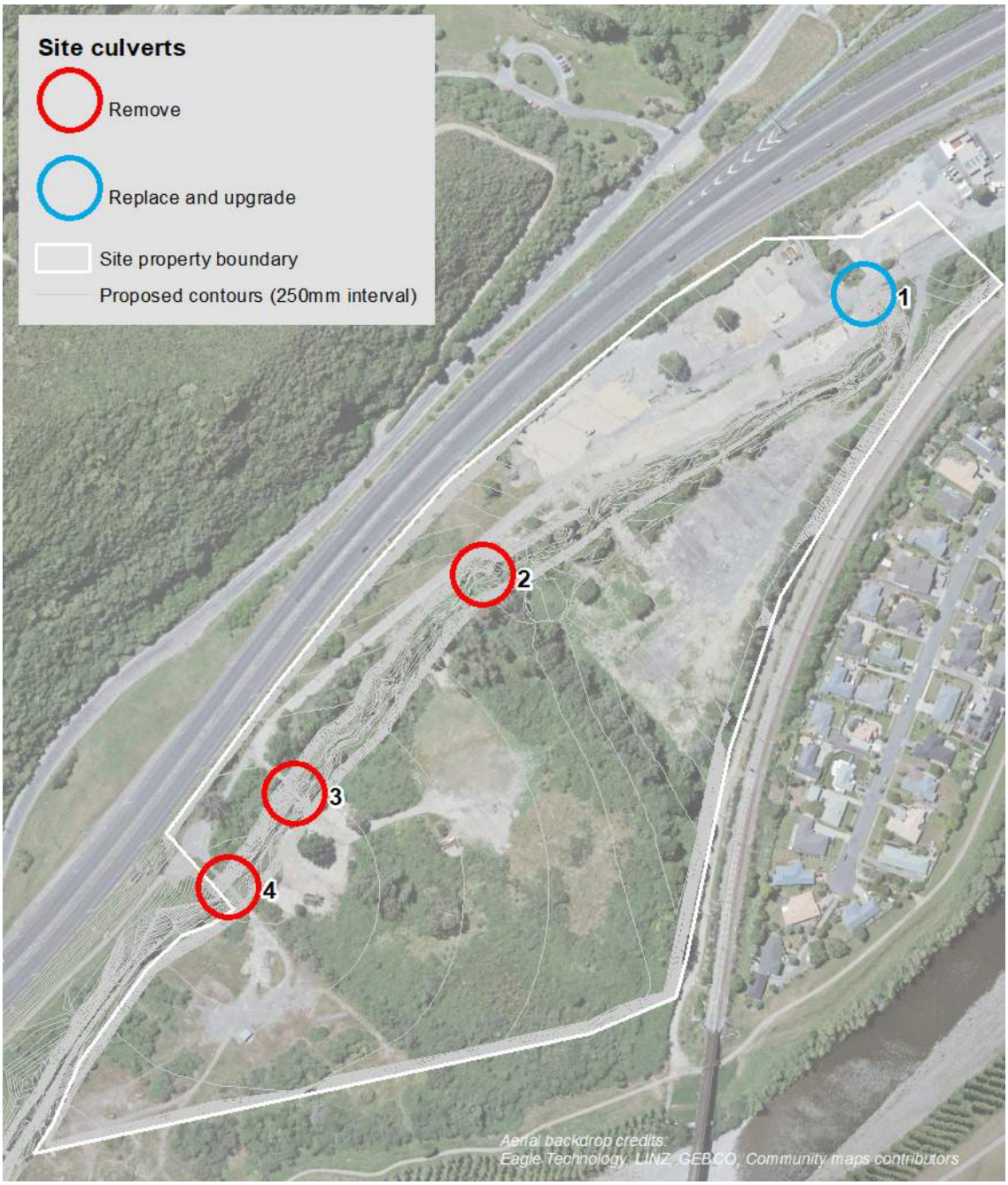

Figure 2 Culvert option, October 2022: removal and replacement

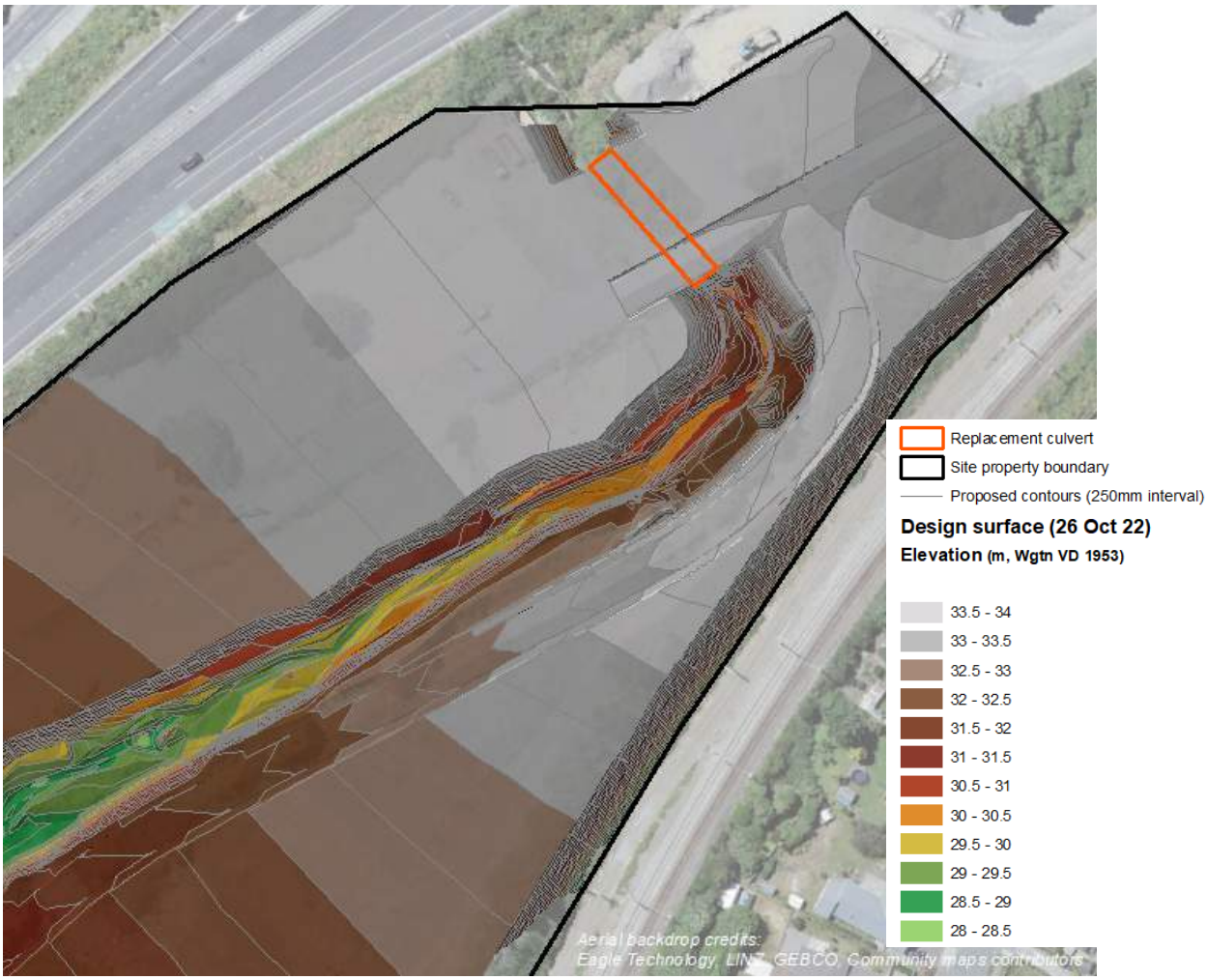

Figure 3 Alternative culvert option, October 2022: culvert 1 replacement

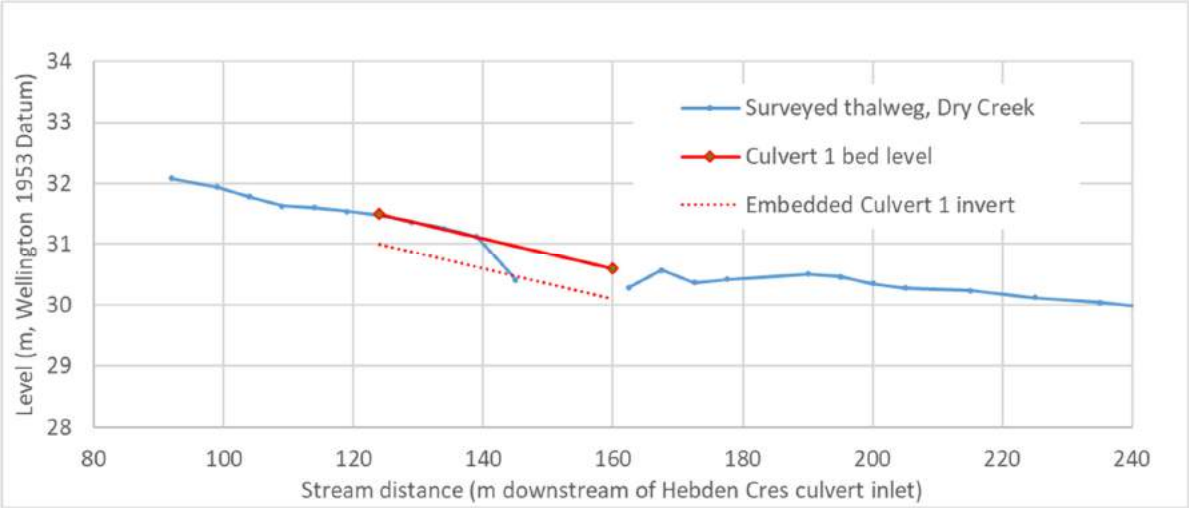

Figure 4 Alternative culvert option, October 2022: culvert 1 bed and invert levels

3. Model results

3.1 Existing situation

Flood depths for the existing situation are shown in Figure 5. Results have been reported previously, in the June 2022 report and the incorporation of the additional survey data made very little difference for the existing situation.

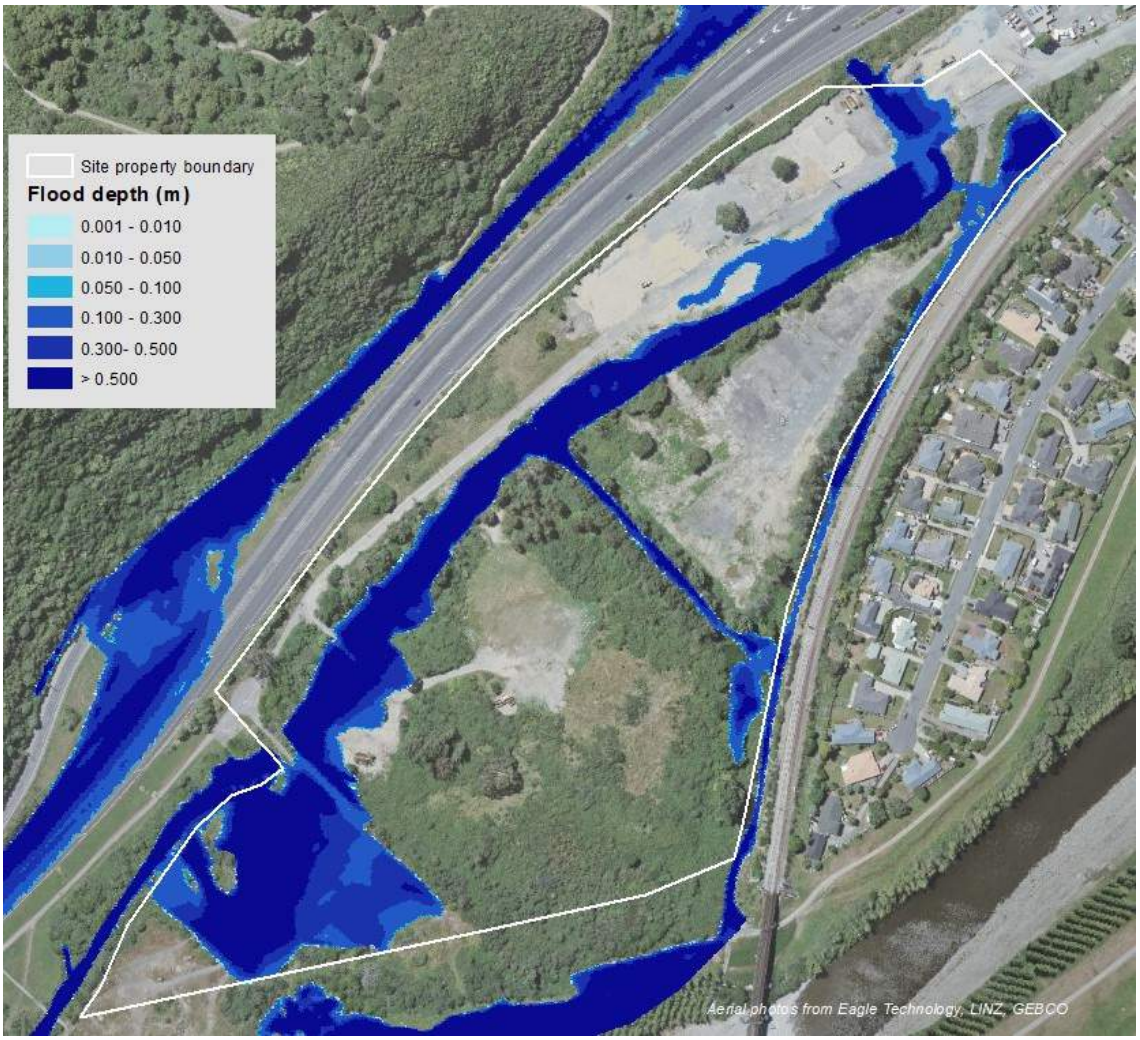

Figure 5 Predicted flood depths, existing situation

3.2 Proposed development situation - twin 3m wide replacement culverts under Benmore Ave

Flood depths for the proposed situation are shown in Figure 6. Floodwaters are contained within the wider stream corridor within the site.

Model results predict that the peak flow through culvert 1 would be 14.4 m3/s, with a velocity of 1.65 m/s.

Figure 7 shows the impact of the proposed development platform on flood levels. Increases of less than 300 mm are predicted in the incised stream channel downstream of where the existing culvert 4 is, which would pose no additional risk to people or assets. There is also a trivial

amount of additional flooding in the stream channel between the upstream end of the site and SH2 (Figure 8).

Otherwise, all increases in depth are contained within the site. Floodwaters are cut off along the KiwiRail access track alongside the railway, hence a small decrease in depth along the track is shown in Figure 7.

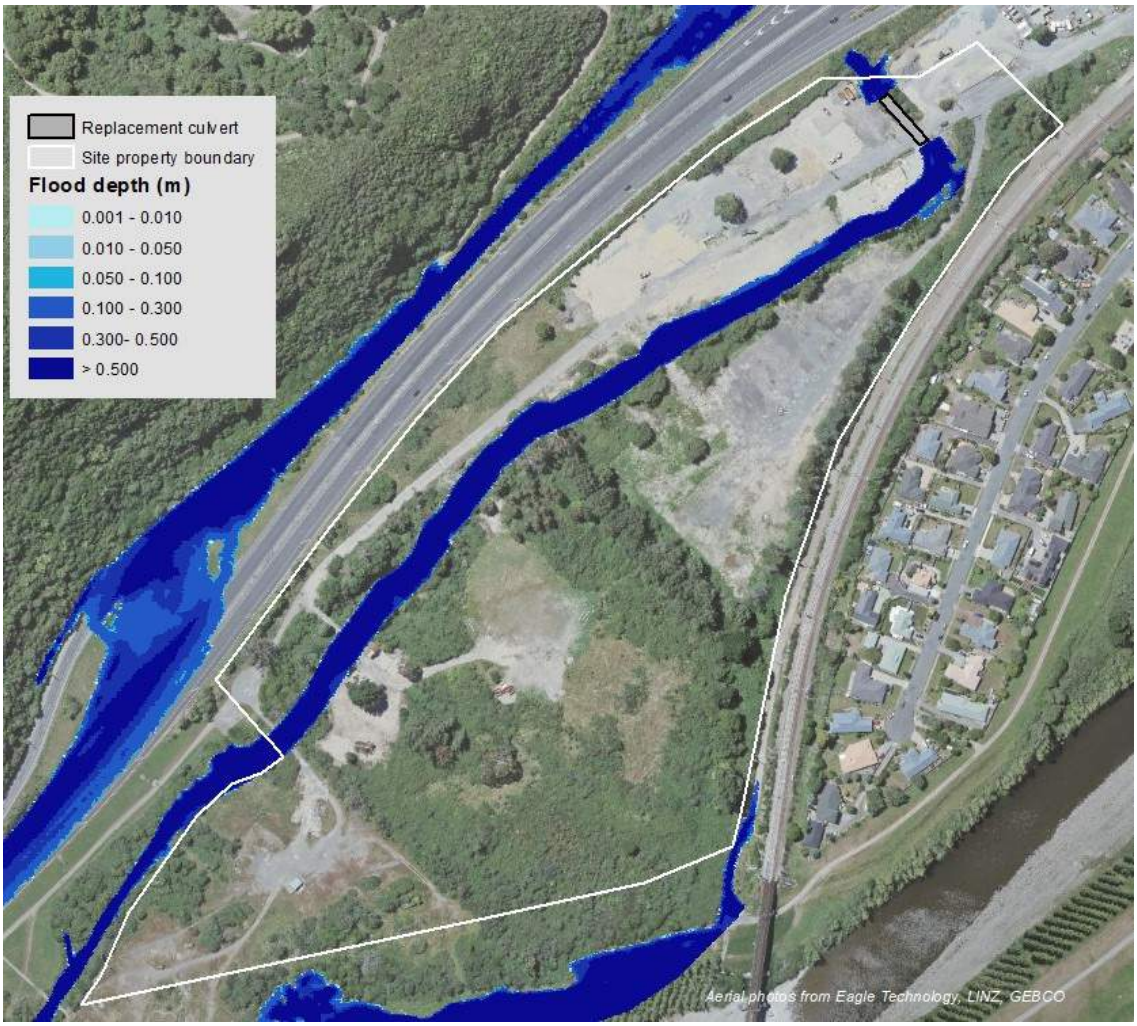

Figure 6 Predicted flood depths, developed situation

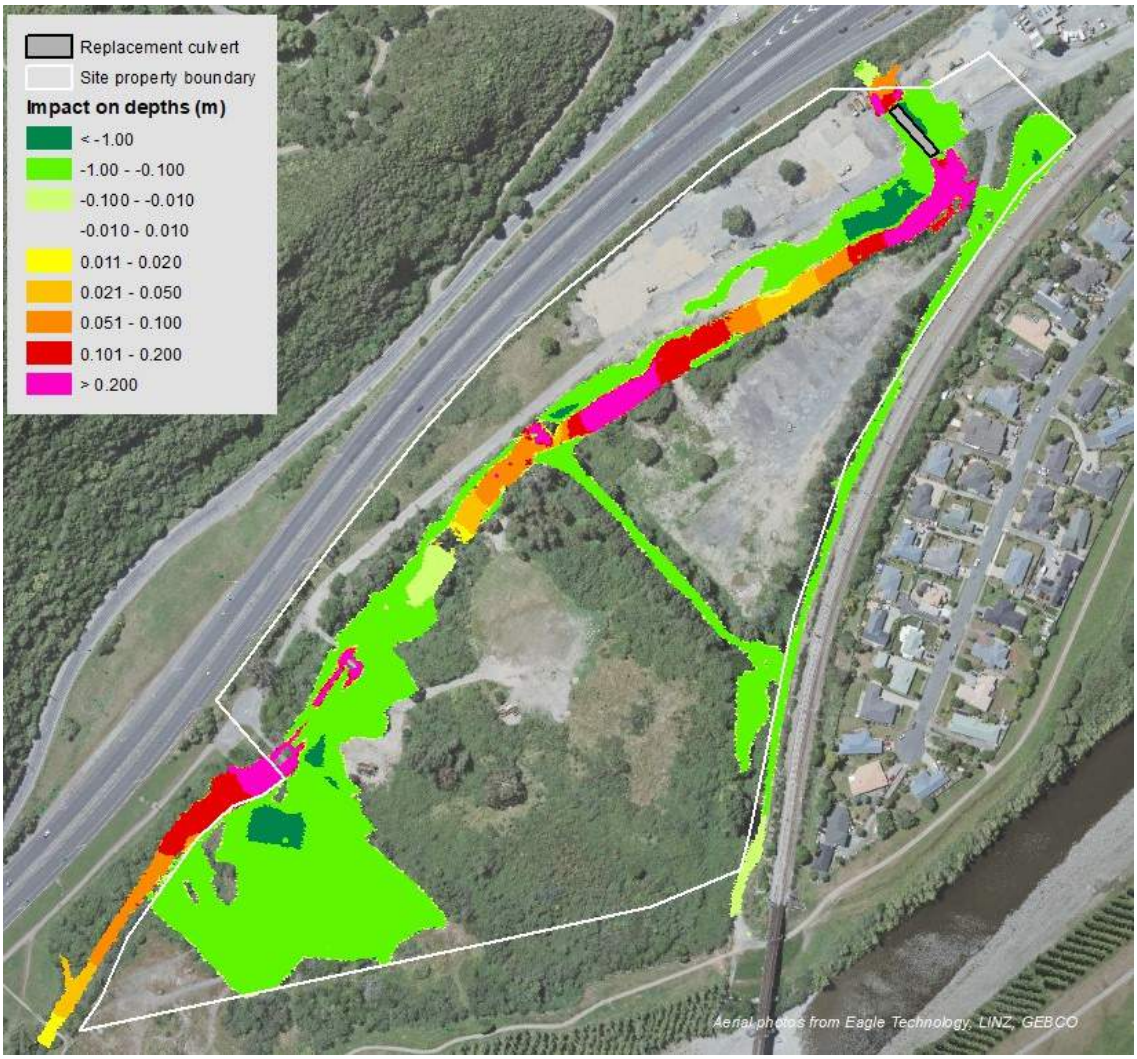

Figure 7 Impact of proposed development on peak flood depths

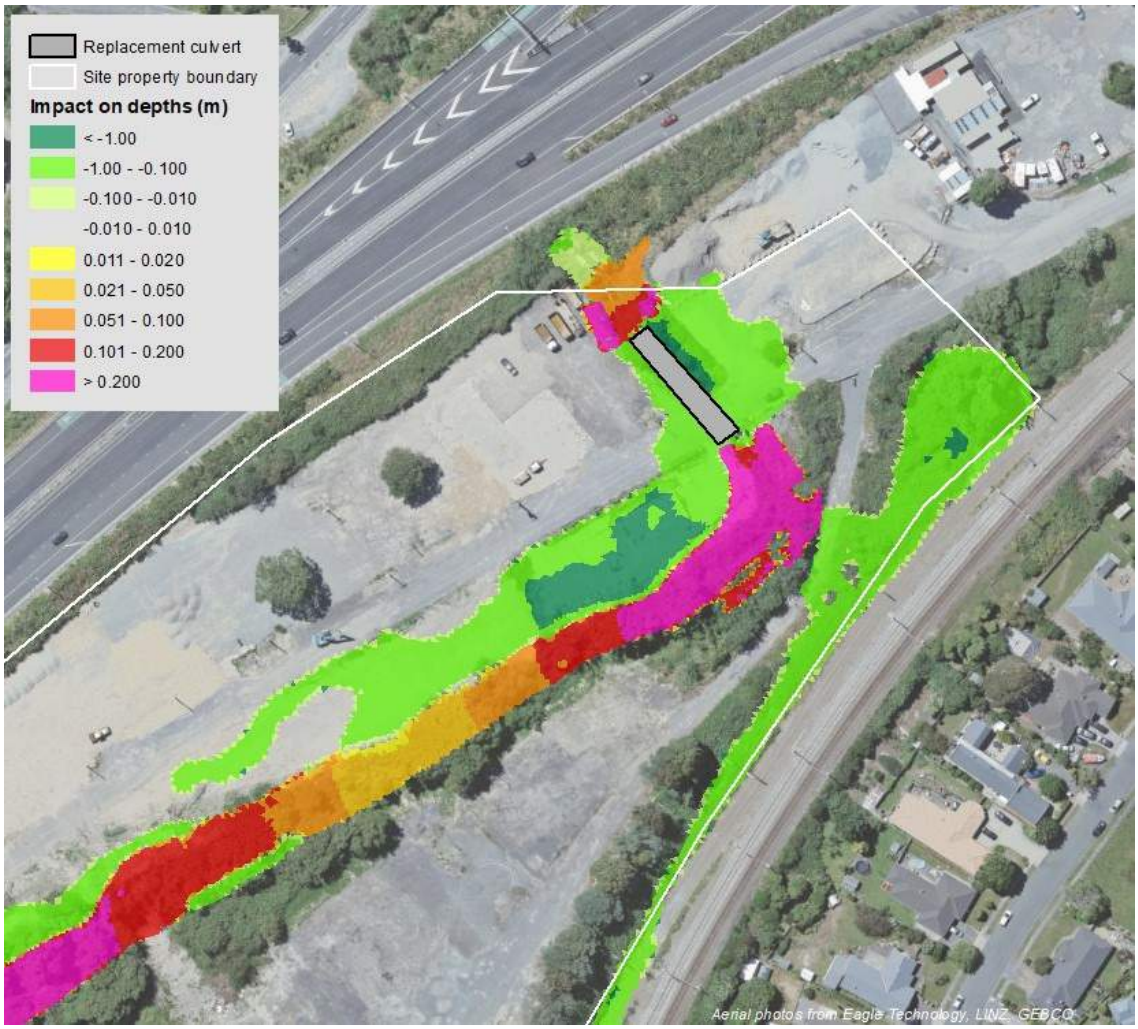

Figure 8 Impact of proposed development on peak flood depths, close-up at northern end of site

3.3 Proposed development situation - twin 3.5 m wide replacement culverts under Benmore Ave

A variation with twin 3.5 m culverts under Benmore Ave was also modelled. This showed a slight reduction of around 50 mm in flood levels upstream of the culvert, with no change to downstream flood levels. The predicted peak velocity through the culvert is 1.55 m/s.

As the reduction in water levels, compared to the twin 3 m wide culverts option is small, the flood depth map for the twin 3.5 m culverts option is not presented.

3.4 Freeboard

Results for the design scenario (twin 3 m culverts) have then had freeboard added. NZS 4404 specifies a minimum freeboard of 0.3 m for commercial or industrial buildings, but higher levels are suggested here, to provide greater protection for any high value assets. GWRC uses 0.9 m freeboard for Hutt River design levels, so that has been added to the Hutt River levels in this current study. A lesser amount, 0.5 m, has been applied to the Dry Creek flood levels, in recognition that this is a much smaller stream.

The model has been rerun with the freeboard applied. The resulting depths are as shown in Figure 9; it can be seen that the floodwaters do not reach the site platform and remain within the wider stream channel.

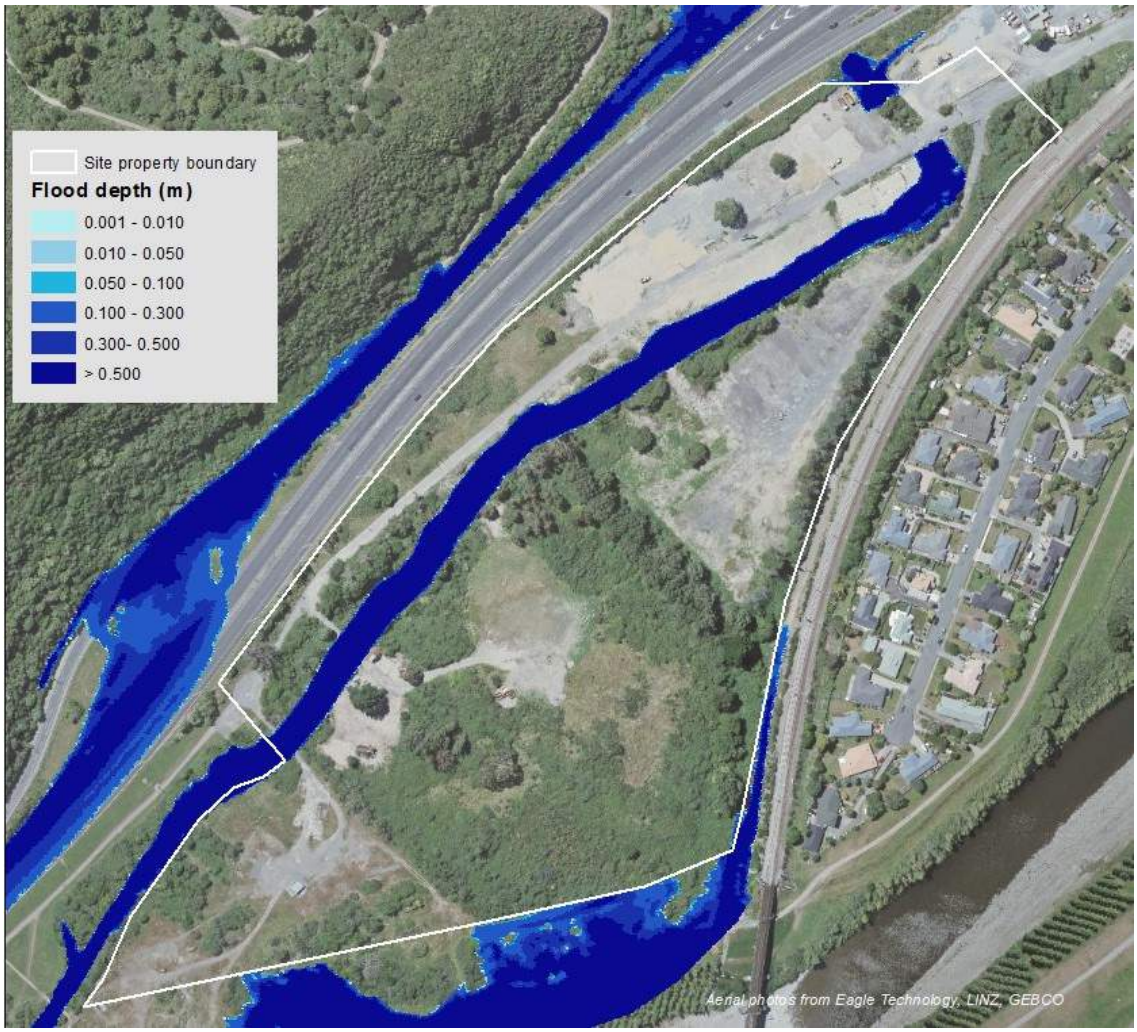

Figure 9 Predicted flood depths, developed situation with freeboard allowance

Figure 10 and Table 1 present a longitudinal profile of flood levels and the platform levels down the stream corridor; these are updates of Figure 7-6 and Table 7-1 in the original report.

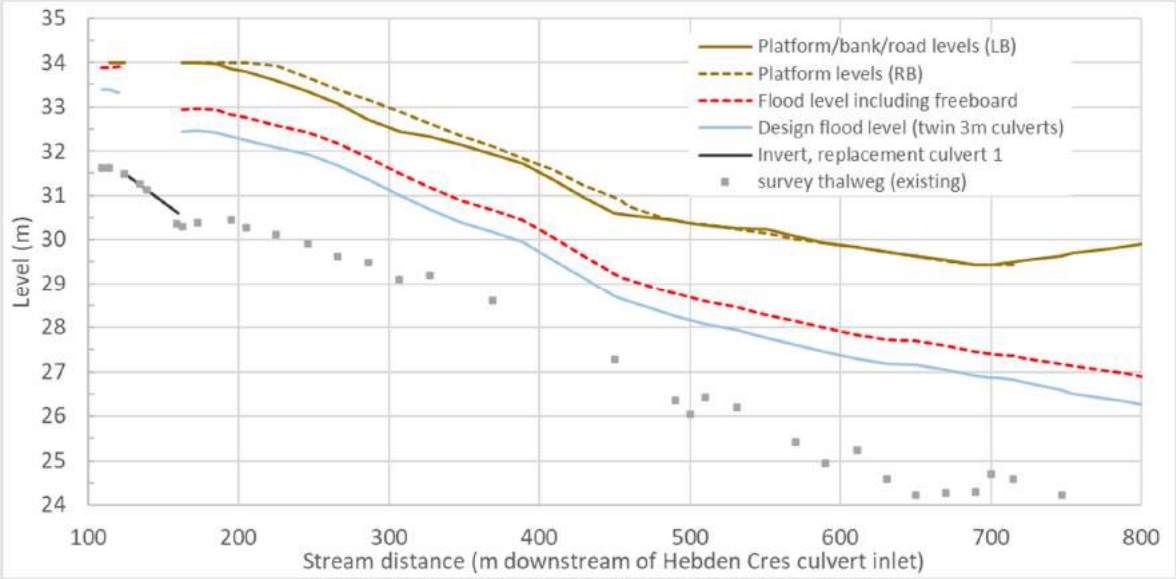

Figure 10 Longitudinal profiles along stream of bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case)

Table 1 Bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case) along stream

Stream chainage	Thalweg (surveyed)	Replacement culvert invert	Platform level		Flood level		
			Left bank	Right bank	Model prediction		incl. freeboard
					Twin 3m	Twin 3.5m	Twin 3m
109	31.63						
114	31.61		34.00	34.00	33.38	33.32	33.88
124	31.48	31.5	34.00	34.00	33.39	33.33	33.89
131							33.93
134	31.26						
139	31.13	culvert 1					
144							
149							
159	30.36	30.6					
163	30.29		34.00	34.00	32.44	32.44	32.94
166			34.00	34.00	32.46	32.46	32.96
173	30.39		34.00	34.00	32.43	32.43	32.93
185			33.96	34.00	32.32	32.32	32.82
195	30.46		33.86	34.00	32.25	32.25	32.75
205	30.28		33.78	34.00	32.07	32.07	32.57
225	30.12		33.59	33.92	31.93	31.93	32.43
246	29.91		33.34	33.65	31.68	31.68	32.18
266	29.62		33.07	33.39	31.37	31.37	31.87
286	29.49		32.71	33.16	31.00	31.00	31.50
307	29.11		32.44	32.89	30.69	30.69	31.19
327	29.19		32.34	32.62	30.39	30.39	30.89
347			32.14	32.36	30.16	30.16	30.66
369	28.61		31.93	32.11	29.95	29.95	30.45
389			31.72	31.84	29.55	29.55	30.05
409			31.37	31.58	29.13	29.13	29.63
429			30.96	31.23	28.72	28.72	29.22
450	27.28		30.60	30.95	28.64	28.64	29.14
455			30.57	30.87	28.33	28.33	28.83
459			30.55	30.76	28.27	28.27	28.77
484			30.46	30.47	28.18	28.18	28.68
485			30.46	30.47	28.09	28.09	28.60
490	26.35		30.43	30.44	27.94	27.94	28.46
500	26.04		30.38	30.38	27.76	27.76	28.28
510	26.42		30.33	30.34	27.60	27.60	28.14
531	26.20		30.26	30.24	27.46	27.46	27.99
551			30.24	30.14	27.29	27.29	27.84
570	25.41		30.07	30.02	27.19	27.19	27.73
590	24.95		29.92	29.93	27.15	27.15	27.69
611	25.23		29.83	29.83	27.05	27.05	27.59
631	24.59		29.73	29.72	26.91	26.91	27.45
650	24.23		29.63	29.63	26.89	26.89	27.43
670	24.28		29.54	29.52	26.87	26.87	27.41
690	24.30		29.44	29.44	26.86	26.86	27.39

Table 1(cont). Bed levels, culvert invert levels, flood levels, conceptual fill platform levels (proposed case) along stream

Stream chainage	Thalweg (surveyed)	Replacement culvert invert	Platform level		Flood level		
			Left bank	Right bank	Model prediction		incl. freeboard
					Twin 3m	Twin 3.5m	Twin 3m
695			29.42	29.43	26.82	26.82	27.35
697			29.42	29.43	26.75	26.75	27.29
700	24.69		29.42	29.42	26.60	26.60	27.19
715	24.58		29.49	29.42	26.50	26.50	27.13
719			29.51		26.38	26.38	27.03
724			29.55		26.33	26.33	26.96
747	24.23		29.64		26.21	26.21	26.84
754			29.69				
777	22.43		29.79				
791			29.85				
795	23.27		29.94				
808	22.89		29.94				