

6 November 2009

Mr Paul Robilliard
Department of Planning - Strategies & Land Release
Level 5, 10 Valentine Avenue
Parramatta
NSW 2150

Our ref: 21/18870/154583
Your ref: A-60-10-F1

Dear Paul

Open Space Strategy – Engineering Design Hydraulic Assessment of Sports Field Locations

GHD was commissioned by the Department of Planning (DoP) – Strategies & Land Release to assess the suitability (from a flooding perspective) of two sites in the North West Growth Centres area, for the future placement of sports fields. This assessment follows the Sports Fields Locations Opportunities Study, July 2009 undertaken by the Department.

1 Background

The two sites are designated Site 4 and Site 6 in the Departments report “*Sports Fields Location Opportunities Study, July 2009*”. Figure 1 below shows the location of the two sites. Site 4 is located on the eastern bank of Eastern Creek, south of Garfield Road West and west of the railway line. Site 6 is also located on the eastern bank of Eastern Creek, north of the M7 Motorway and the University of Western Sydney Campus.

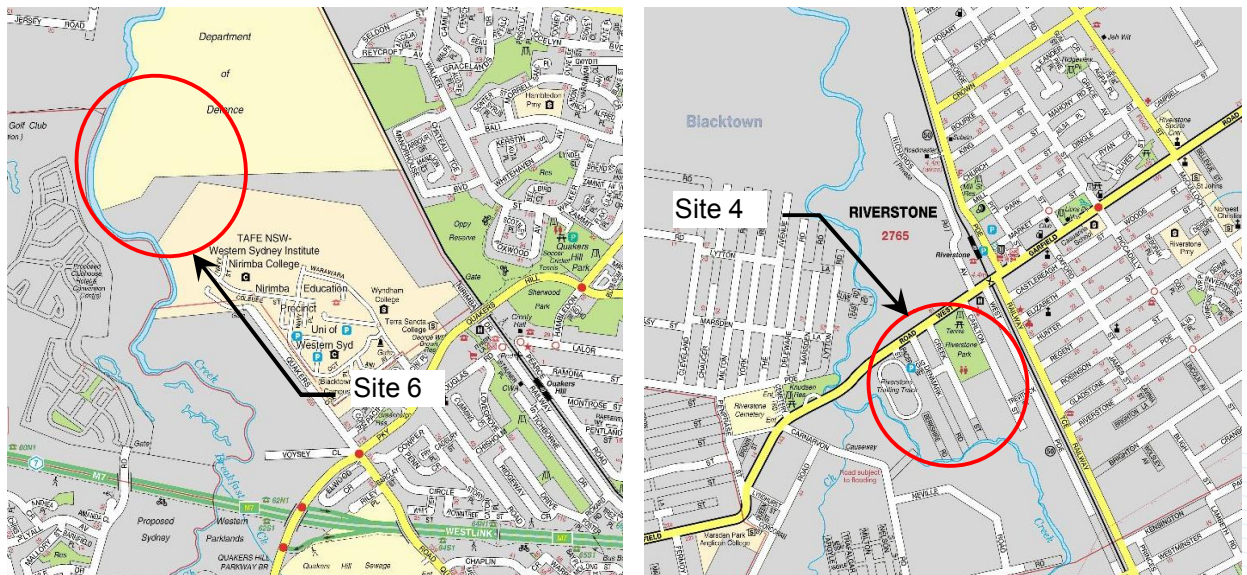


Figure 1: Site 4 and Site 6 Location Plan



2 Study Objectives

This study addresses the following objectives for Site 4 and 6:

- ▶ Define the incremental land availability between the 100-year ARI event and the 5, 10, 20 and 50-year ARI events;
- ▶ Concept design double sports field footprints within the available area defined above, which balances as best as possible cut and fill for the sports field construction;
- ▶ Assess flood impacts of constructing the sports fields within the 100-year ARI event by configuring typical cross-sections which include the sports field; and
- ▶ Iterate the sports field cross-sections to reduce the incremental increase in flood levels to within 20 mm (criteria nominated by Council) of existing conditions. This target has been agreed in discussion with Blacktown City Council as it is considered a manageable afflux in future design work, recognises the 1D approach of this study and allows for the possibility that the impacts could be localised.

3 Methodology

To achieve these objectives we used the following methodology:

- ▶ We sourced the RAFTS and HEC-RAS models held by Council for Eastern Creek and established these in-house, to undertake further simulations. We undertook a cursory assessment of the models to identify any issues with the use of the models for this study. It was concluded that we require additional cross sections within the two study reaches to enhance the flood mapping. These cross sections were then extracted from the ALS data provided by DoP and included in the HEC-RAS model;
- ▶ We then simulated the RAFTS model for the 5, 10, 20, 50 and 100-year ARI storm events and extracted the peak flows relevant to Sites 4 and 6;
- ▶ The HEC-RAS model was updated with the flood peaks simulated. This allowed for the determination of flood levels and flooding extents to be simulated for the 5, 10, 20, 50 and 100-year ARI storm events. The 100-year ARI storm event was also simulated with a 17.3m Nepean River 100-year ARI tailwater condition;
- ▶ The results of the HEC-RAS modelling was imported into the DTM package 12D, to determine the incremental land availability between the 100-year ARI event and the more frequent events listed above. We then compiled a curve of "Available Land versus ARI" graph, which resulted in Site 6 being found unsuitable in terms of flood inundation for the placement of sports fields (See Section 6);
- ▶ Using the DTM package 12D, we then configured 5 double fields on Site 4. This was achieved using terrain modelling which allows cut and fill balancing, in recognition of Council's current soil disposal constraints;
- ▶ The sports field topography was then configured back into the HEC RAS model. This was achieved by cutting new cross sections from the design DTM created in 12D which includes the sports field platforms. The HEC RAS model was then re-simulated, to determine any increases in flood levels and changes in flow velocities. Since HEC-RAS is a one dimensional model, we only reported the impacts across an entire cross-section in the model representing average values;
- ▶ Concept plan sketches of landform levels and layout of the fields that met the afflux criteria, as well as flood maps for the existing and proposed design condition were produced.



4 Hydrological Modelling

4.1 RAFTS

4.1.1 Eastern Creek tributary and Eastern Creek)

A RAFTS hydrological model was developed for the Eastern Creek catchment to model flows at the two sites. The catchment area draining to Site 6 is 85.2 km² whilst the catchment area draining to Site 4 is 99.2 km².

The peak flows for the 5, 10, 20, 50 and 100-year ARI events for the two sites are presented in Table 1.

Table 1 Peak Flow into Site Areas

Location	Peak Flow (m ³ /s)				
	5 yr ARI	10 yr ARI	20 yr ARI	50 yr ARI	100 yr ARI
Site 6	261.2	301.9	354.5	411.6	462.9
Site 4	280.3	326.0	385.1	453.6	513.1
Eastern & Bells Creek confluence	324.7	378.5	448.1	531.9	602.5

5 Hydraulic Modelling

5.1 HEC-RAS

The Blacktown City Council's existing HEC-RAS model for Eastern Creek was amended to increase the flood mapping accuracy in the vicinity of the two sites. Amendments were in the form of additional cross sections, in the vicinity of the two proposed sites using the ALS data provided by the Department of Planning. No other changes were made to the existing model.

The model was used to simulate the 5, 10, 20, 50 and 100-year ARI events, and also the 100-year ARI event with a 17.3m tailwater condition for the Nepean River 100-year ARI flood.

Results from the simulation runs are provided in the following sections.

5.2 Flood Levels – Existing Condition

Flood levels for the various ARI flood events simulated are tabulated below. The associated flood maps for the two sites are provided in Appendix A, Figure A3. Please note, that the levels shown are at the cross-sections as indicated on Figure A1 & A2, Appendix A.

Table 2 Flood Levels at Sites 4 & 6

Location	Event	Cross Section No.	Flood Level	
Site 4	5 year ARI	Cross Section 4295.30	12.78	mAHD
		Cross Section 4007.64	12.53	mAHD
		Cross Section 3597.45	11.98	mAHD



Location	Event	Cross Section No.	Flood Level	
	10 year ARI	Cross Section 4295.30	12.91	mAHD
		Cross Section 4007.64	12.66	mAHD
		Cross Section 3597.45	12.10	mAHD
	20 year ARI	Cross Section 4295.30	13.06	mAHD
		Cross Section 4007.64	12.81	mAHD
		Cross Section 3597.45	12.24	mAHD
	50 year ARI	Cross Section 4295.30	13.22	mAHD
		Cross Section 4007.64	12.98	mAHD
		Cross Section 3597.45	12.42	mAHD
	100 year ARI	Cross Section 4295.30	13.35	mAHD
		Cross Section 4007.64	13.10	mAHD
		Cross Section 3597.45	12.58	mAHD
	100 year ARI + TWL	Cross Section 4295.30	17.31	mAHD
		Cross Section 4007.64	17.31	mAHD
		Cross Section 3597.45	17.31	mAHD
Site 6	5 year ARI	Cross Section 10019.85	20.44	mAHD
		Cross Section 9397.34	19.45	mAHD
		Cross Section 9059.49	18.40	mAHD
	10 year ARI	Cross Section 10019.85	20.55	mAHD
		Cross Section 9397.34	19.55	mAHD
		Cross Section 9059.49	18.52	mAHD
	20 year ARI	Cross Section 10019.85	20.67	mAHD
		Cross Section 9397.34	19.62	mAHD
		Cross Section 9059.49	18.66	mAHD
	50 year ARI	Cross Section 10019.85	20.81	mAHD
		Cross Section 9397.34	19.71	mAHD
		Cross Section 9059.49	18.79	mAHD
	100 year ARI	Cross Section 10019.85	20.91	mAHD
		Cross Section 9397.34	19.80	mAHD
		Cross Section 9059.49	18.89	mAHD
	100 year ARI + TWL	Cross Section 10019.85	20.91	mAHD
		Cross Section 9397.34	19.80	mAHD
		Cross Section 9059.49	18.90	mAHD

6 Incremental Land Availability

After determining the flood levels at each site, the incremental land availability for each site was established. Figure B1 in Appendix B shows the incremental land availability between the 100-year ARI event and the 5, 10, 20 and 50-year ARI event.



From these plots it was clear that Site 6 will not be suitable for the placement of sports fields, as the majority of the site will be inundated in the 5-year ARI event. To this end, in consultation with DoP, Site 6 was not investigated further.

Site 4 has a substantial area available for the placement of sports fields between the 100-year ARI event flood level and the 100-year ARI event flood level with 17.3m Nepean River tailwater level. Site 4 was thus assessed further.

7 Sports Fields Layout Configuration

A concept design for the placement of 5 double sports fields at Site 4 was undertaken. The following design criteria were adopted for the placement of the fields:

- ▶ Fields to located be outside the 100 year ARI flood extent,
- ▶ Cut and fill volumes must be balanced,
- ▶ Embankments to have 1 in 6 batter slopes,
- ▶ Fields to have a north-south orientation, with a 30 degree maximum deviation from north,
- ▶ Minimum clearance adopted between fields is 10m,
- ▶ Sufficient clearance to be maintained from railway track, and
- ▶ Existing sports field south of Garfield Road to be maintained.

Figure C1, Appendix C shows the resultant layout configuration of the proposed sports fields which satisfies to the above listed criteria.

8 Future Sports Fields Flood Impact Assessment

The impact of the proposed sports fields on the 100-year ARI event flood levels were assessed by including the sports field platforms at Site 4 in the HEC-RAS model. The 100-year ARI event with and without the Nepean River 100-year ARI event tailwater condition were modelled. Table 3 below shows the resultant water levels at the site with and without the proposed sports fields.

Modelling indicates that the sports fields will negligible increases in flood level, in the 100-year ARI and 100-year ARI with Nepean River 100-year ARI tail water condition events. This can be attributed to the care taken during the DTM design to balance the cut and fill volumes for the sports field platforms. There was also no noteworthy change / increase in velocities.

The proposed sports field placement thus complies with Blacktown City Council's afflux criteria of 20 mm maximum increase from the existing condition.

Table 3 Existing and Future Flood Levels and Velocities at Site 4

Storm Event	Cross Section #	Flood Levels (mAHD)		Velocities (m/s)	
		Existing	With Proposed Fields	Existing	With Proposed Fields
5 year ARI	Section 4295.30	12.78	12.78	0.99	0.99
	Section 4007.64	12.53	12.53	0.87	0.87
	Section 3597.45	11.98	11.98	1.52	1.52



Storm Event	Cross Section #	Flood Levels (mAHD)		Velocities (m/s)	
		Existing	With Proposed Fields	Existing	With Proposed Fields
10 year ARI	Section 4295.30	12.91	12.91	1.05	1.05
	Section 4007.64	12.66	12.66	0.90	0.90
	Section 3597.45	12.10	12.10	1.60	1.60
20 year ARI	Section 4295.30	13.06	13.06	1.10	1.10
	Section 4007.64	12.81	12.81	0.94	0.94
	Section 3597.45	12.24	12.24	1.67	1.67
50 year ARI	Section 4295.30	13.22	13.22	1.15	1.15
	Section 4007.64	12.98	12.98	0.97	0.97
	Section 3597.45	12.42	12.42	1.70	1.70
100 year ARI	Section 4295.30	13.35	13.35	1.19	1.19
	Section 4007.64	13.10	13.10	1.00	1.00
	Section 3597.45	12.58	12.58	1.57	1.57
100 year ARI + TWL	Section 4295.30	17.31	17.31	0.19	0.19
	Section 4007.64	17.31	17.31	0.15	0.15
	Section 3597.45	17.31	17.31	0.11	0.11

9 Conclusions

- ▶ Hydraulic 1D modelling concluded that Site 6 is not suitable for the placement of sports fields as the majority of the site is inundated in the 5 year ARI flood event;
- ▶ Site 4 is suitable for the future placement of sports fields, with a large enough area available above the 100-year ARI flood extent for the placement of five double sports fields;
- ▶ A concept design of five double sports fields were prepared and provided in Appendix C;
- ▶ Hydraulic 1D modelling indicates that the sports fields will cause no afflux in the 100-year ARI event with and without the Nepean River 100-year ARI event tailwater condition of 17.3m; and
- ▶ The proposed sports field placement as presented in Appendix C thus complies with Blacktown City Council's afflux criteria of 20 mm maximum increase from the existing condition.

We trust the information supplied in this letter is sufficient for your purposes. Please do not hesitate to contact either the undersigned if you have any questions or comments.

Yours sincerely

GHD Pty Ltd

Rainer Berg

Service Group Manager: Hydrology and Civil Services
02-9239 2747



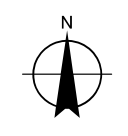
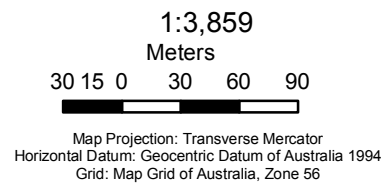
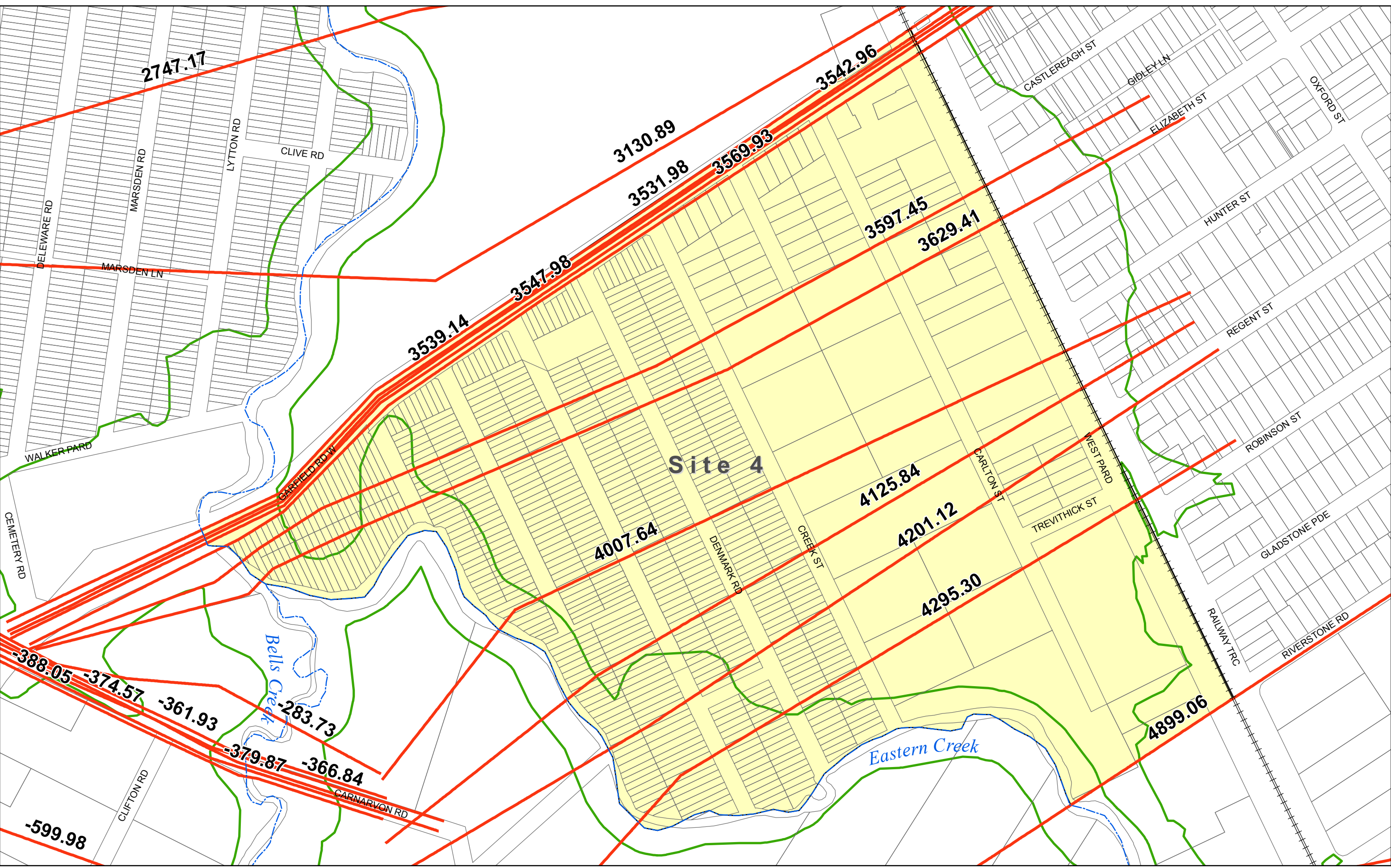
Appendix A

Cross Section Location & Existing Condition Flood Mapping

Figure A1 – Cross Section Locations Site 4

Figure A2 – Cross Section Locations Site 6

Figure A3 – Existing Condition Flood Mapping Site 4 & 6



LEGEND

- Eastern Creek
- HEC-RAS Cross Sections_plz

- DoP Riparian Buffer
- Site 4 Site Extents

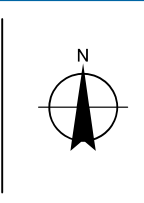
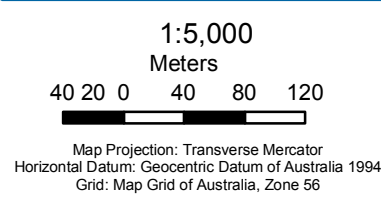
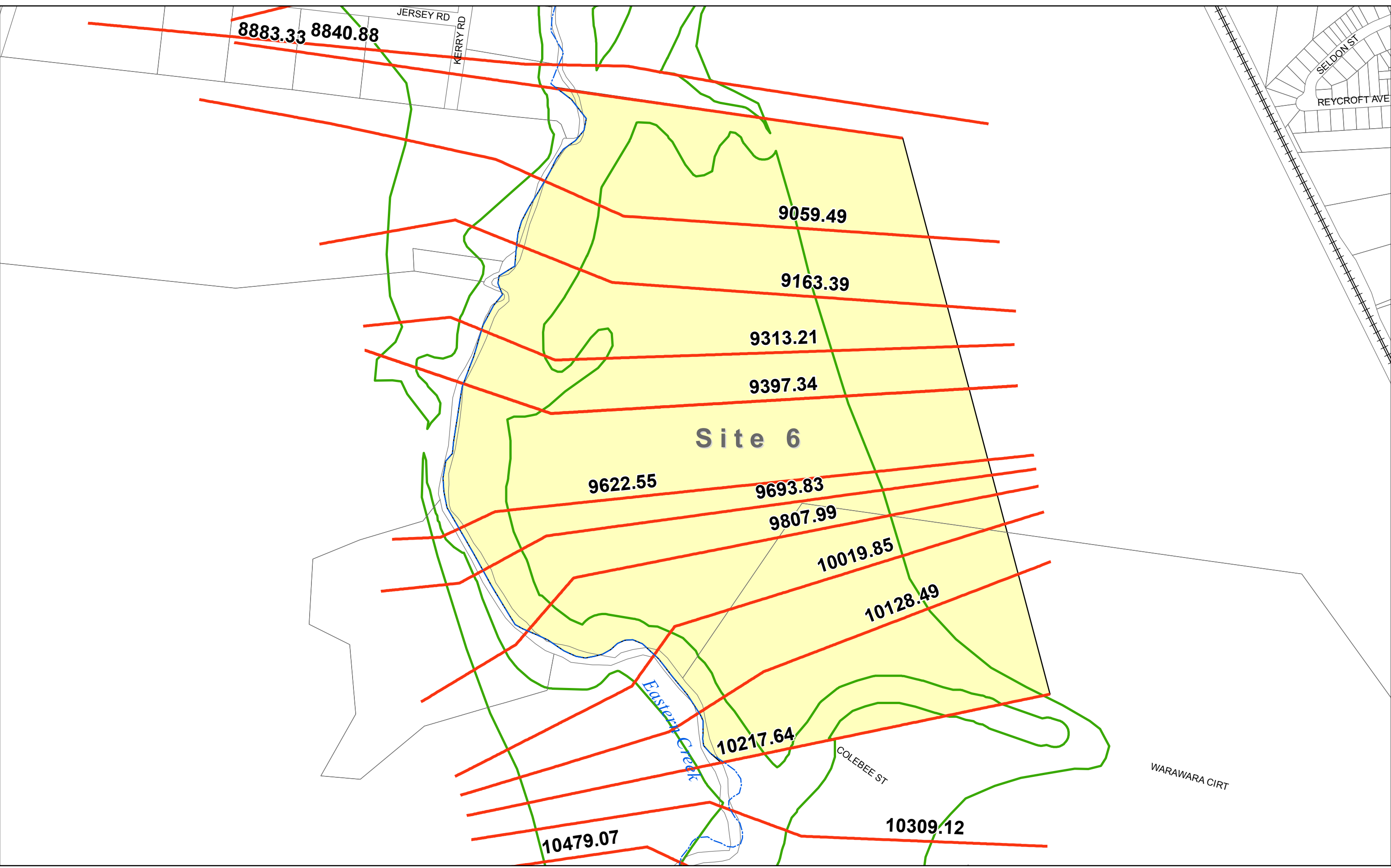


Department of Planning
North Western Growth Centre - Sportsfield Location Study
Site 4
HEC-RAS Cross Section Locations

Job Number	21-18870
Revision	A
Date	26 October 2009

Figure A1

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LEGEND

- Eastern Creek
- HEC-RAS Cross Sections_plz

- DoP Riparian Buffer
- Site 6 Site Extents

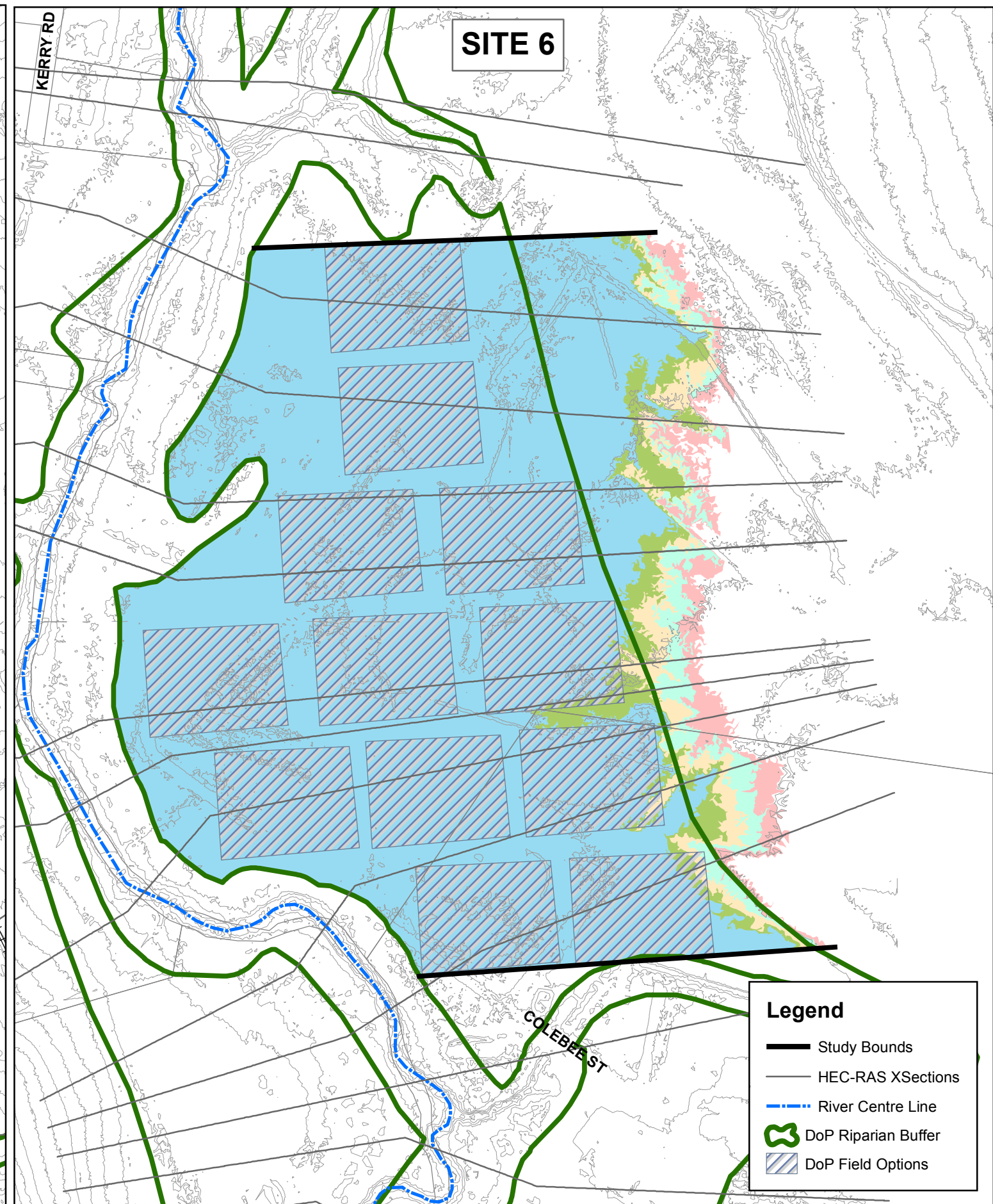
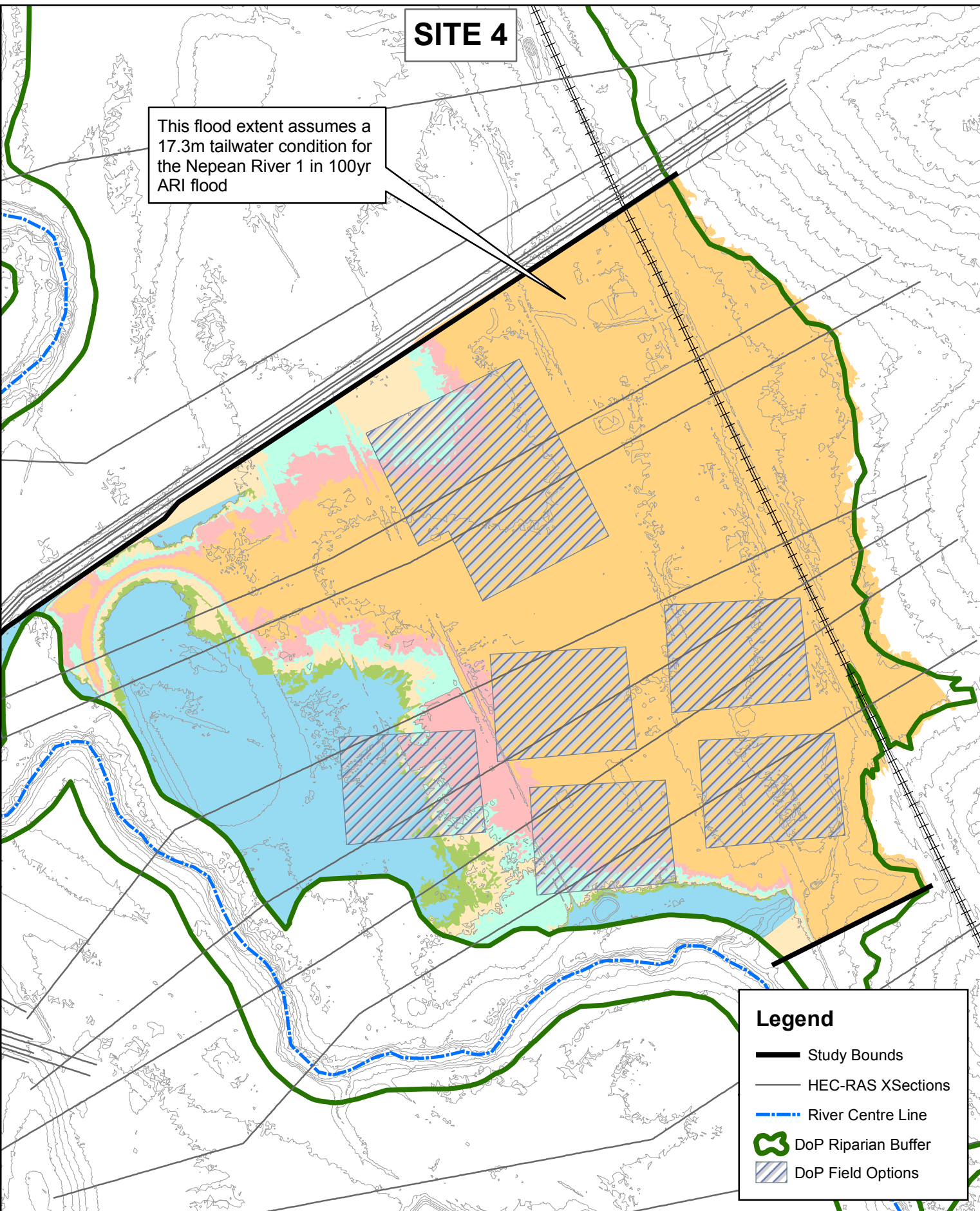


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Site 6
HEC-RAS Cross Section Locations

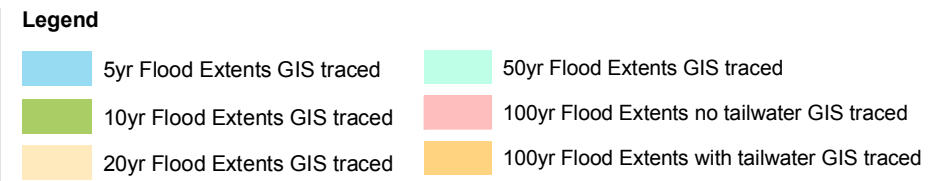
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Date	26 October 2009

Figure A2



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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56



Department of Planning, Strategies & Land Release
North Western Growth Centre - Sportsfield Location Study

Site 4 and 6
Existing Condition Flood Mapping

Job Number	21-18870
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Date	1 September 2009

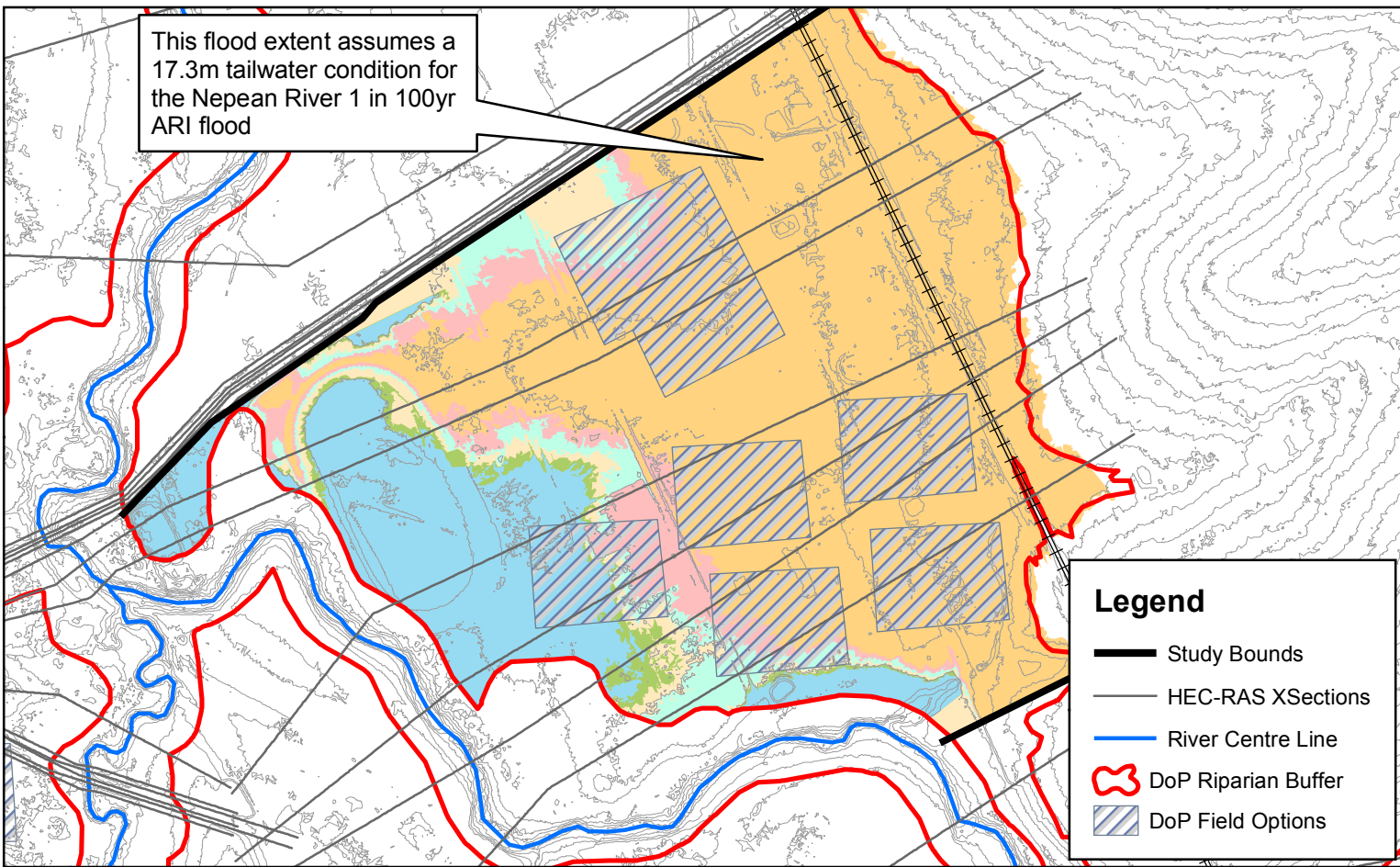
Figure A3

G:\2118870\GIS\Map\21-18870-Figure 1-Incremental Flooded Area.mxd
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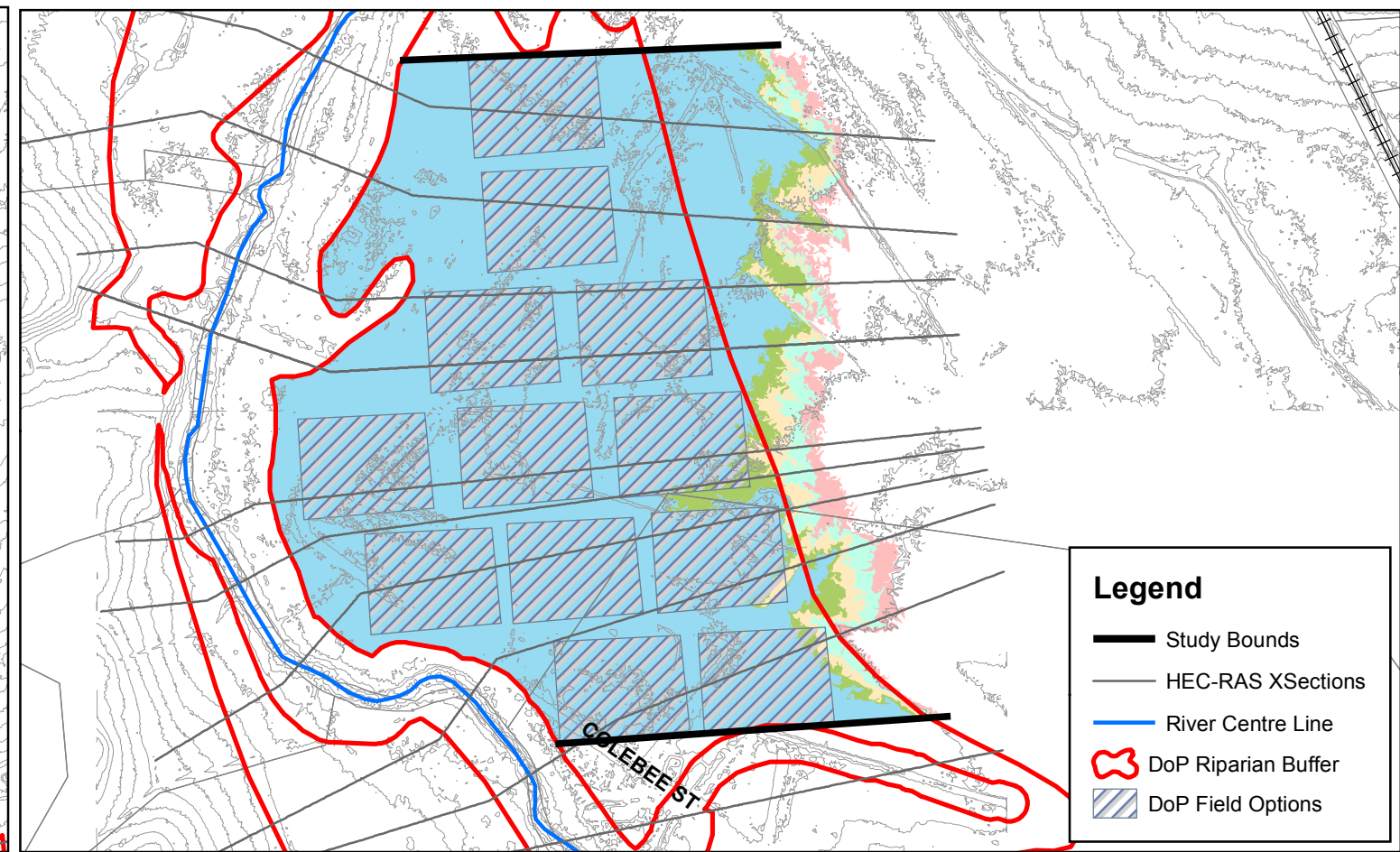
Appendix B
Incremental Land Availability

Figure B1 – Incremental Land Availability Graphs



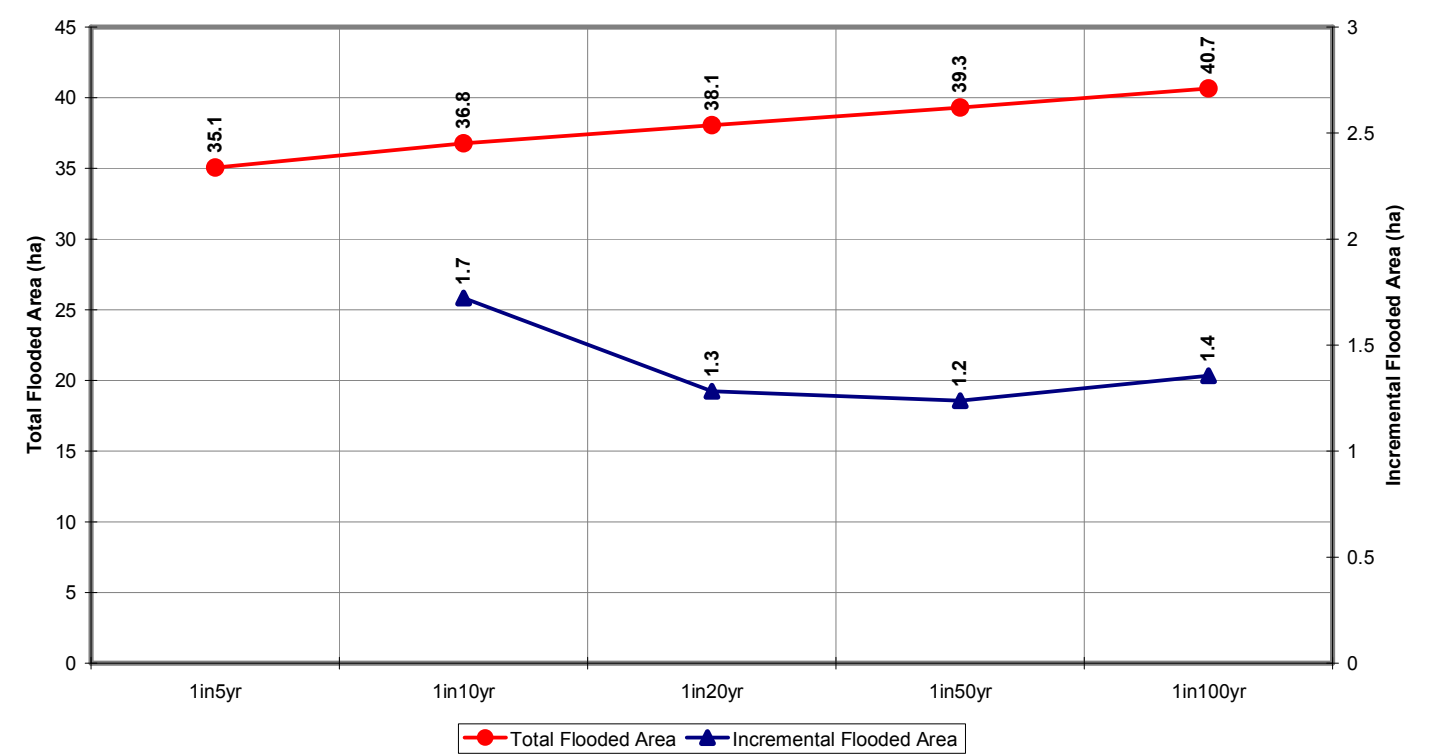
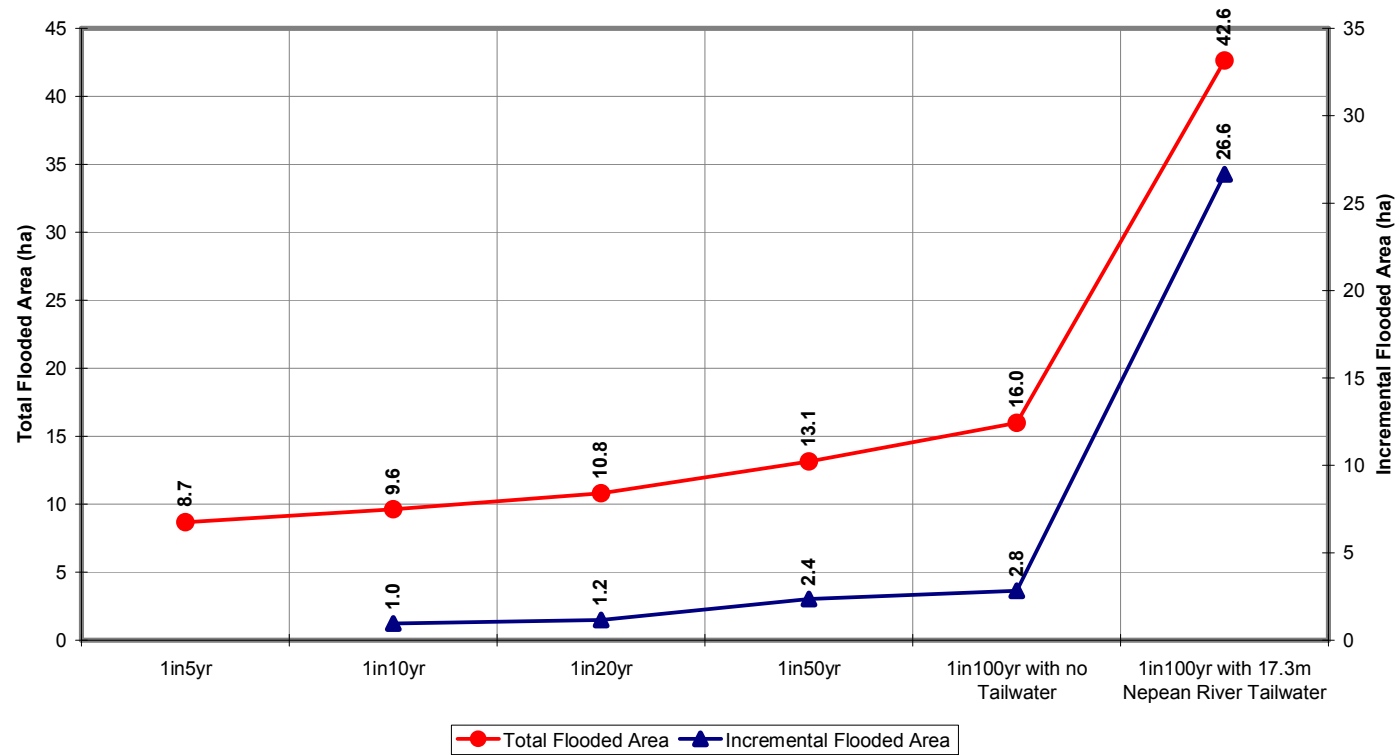
SITE 4

North Western Growth Centre - Sportsfield Location Study
Sportsfield Study - Site 4



SITE 6

North Western Growth Centre - Sportsfield Location Study
Sportsfield Study - Site 6



1:7,500



Legend

- 5yr Flood Extents GIS traced
- 10yr Flood Extents GIS traced
- 20yr Flood Extents GIS traced
- 50yr Flood Extents GIS traced
- 100yr Flood Extents no tailwater GIS traced
- 100yr Flood Extents with tailwater GIS traced



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Incremental Land Availability

Figure B1

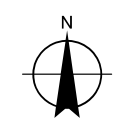
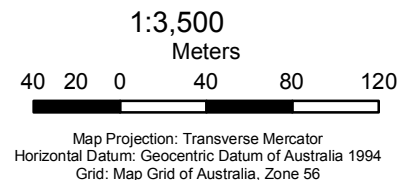
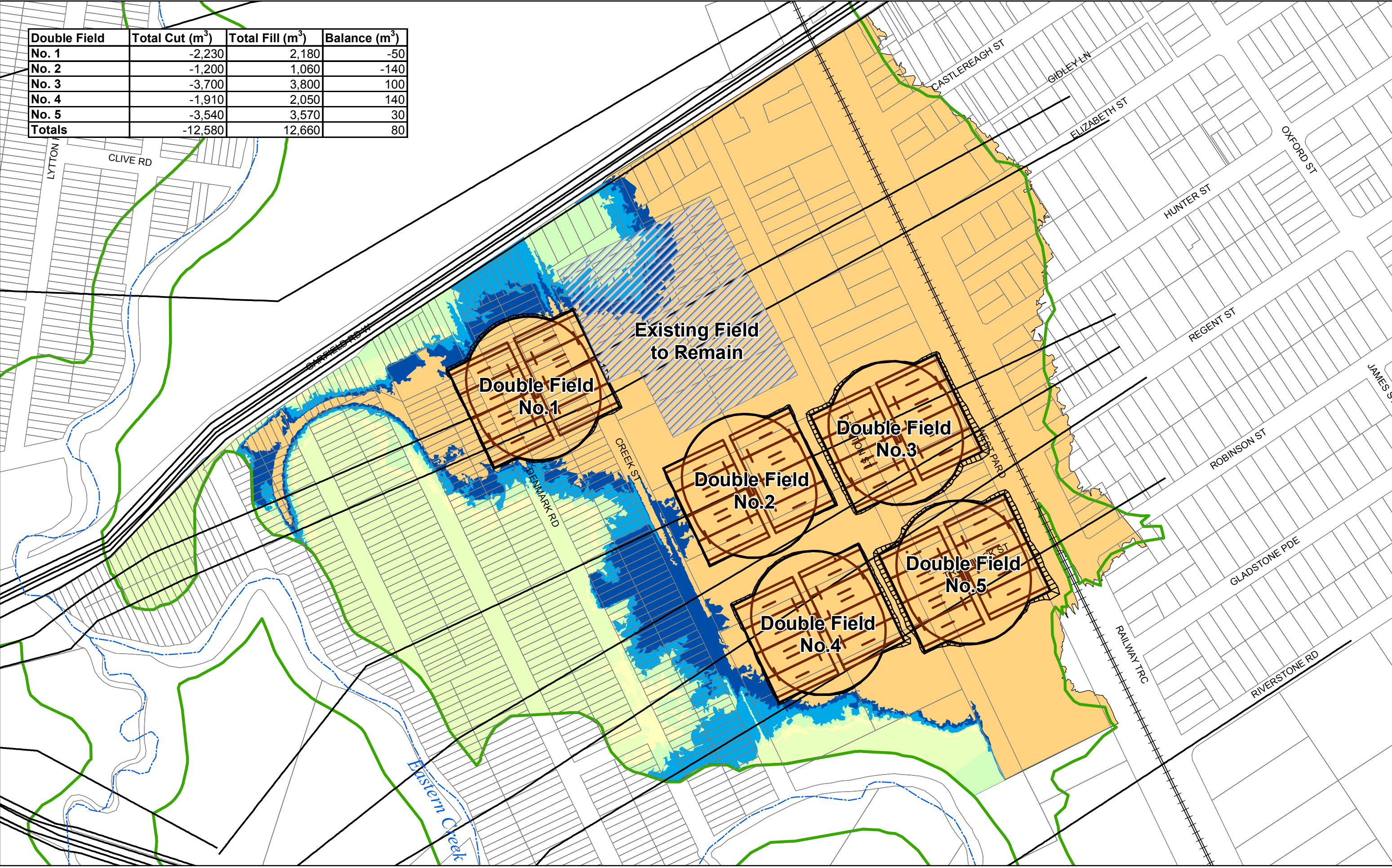


Appendix C

Sports Fields Concept Plans

Figure C1 – Sports Fields Layout Configuration

Double Field	Total Cut (m ³)	Total Fill (m ³)	Balance (m ³)
No. 1	-2,230	2,180	-50
No. 2	-1,200	1,060	-140
No. 3	-3,700	3,800	100
No. 4	-1,910	2,050	140
No. 5	-3,540	3,570	30
Totals	-12,580	12,660	80



LEGEND

- Eastern Creek
- DoP Riparian Buffer
- HEC-RAS Cross Sections
- 5yr Flood Extents GIS traced
- 10yr Flood Extents GIS traced
- 20yr Flood Extents GIS traced
- 50yr Flood Extents GIS traced
- 100yr Flood Extents no tailwater GIS traced
- 100yr Flood Extents with tailwater GIS traced



Department of Planning
 North Western Growth Centre - Sportsfield Location Study
Site 4
Sports Fields Layout Configuration

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Figure C1

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