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Our Ref: L.S20352.000.docx

23 May 2018

Orica Australia Pty Ltd
Head Office
1 Nicholson Street
MELBOURNE VIC 3000

RE: LOT 9, 28 McPHERSON STREET, BANKSMEADOW 2019 - FLOOD ASSESSMENT REPORT

This letter report outlines the flood assessment undertaken for the commercial property at Lot 9, 28 McPherson Street, Banksmeadow. BMT has prepared this Flood Assessment Report to address the following items:

1. Existing flood behaviour affecting the development; and
2. Potential impacts due to proposed design plan involving timber piling.

BMT previously developed the Springvale Drain and Floodvale Drain Flood Study (January 2014) on behalf of Botany Bay Council (now Bayside Council). The flood study is the current hydraulic model of the Springvale Drain and Floodvale Drain catchment and provides comprehensive flood risk information for mainstream and overland flow sources.

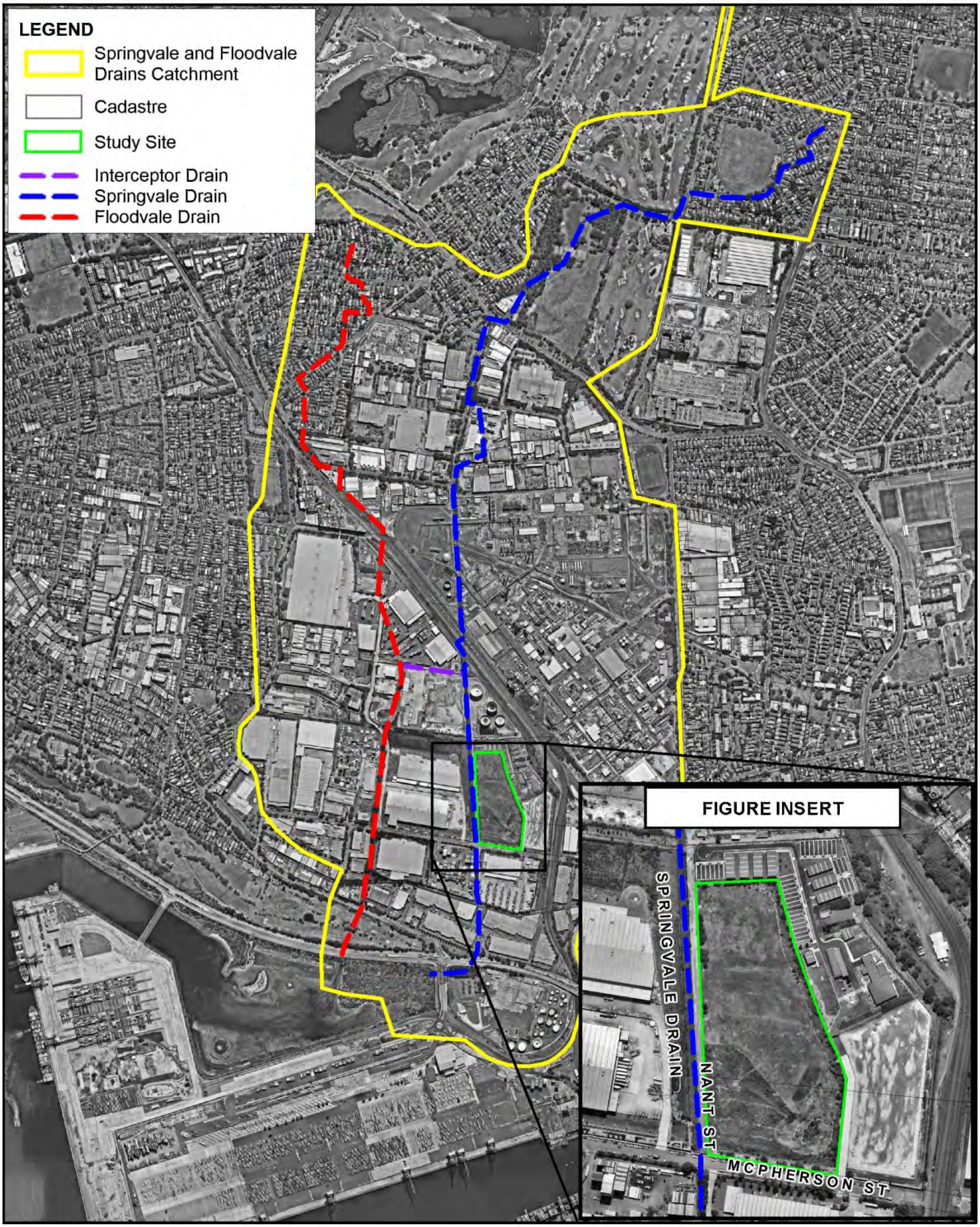
This flood assessment has been undertaken using the TUFLOW hydraulic model developed as part of the Springvale Drain and Floodvale Drain Flood Study (BMT WBM, 2014), provided by Bayside Council.

In order to assess the provisional flood hazards and flood impacts, the following TUFLOW models have been utilised and developed:

- Current scenario model. This scenario utilises the TUFLOW model developed as part of the Springvale Drain and Floodvale Drain Flood Study (BMT WBM, 2014); and
- Proposed scenario model. This scenario revises the land uses and topography within the TUFLOW model at the proposed development site to replicate the proposed development.

The study site is situated within industrial land at the lower end of the Springvale and Floodvale Drains catchment. The site is bound by Nant Street on its western boundary, McPherson Street on its southern boundary, and a dog housing/training facility on its northern and eastern boundaries. 'Springvale Drain' runs along the western side of Nant Street, adjacent to the western lot boundary.

Figure 1 shows the study site in relation to the Springvale and Floodvale Drains catchment.



Title:

Study Site
LOT 9, 28 McPherson Street, Banksmeadow

Figure: 1

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Approx. Scale

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1 Existing Flood Behaviour

1.1 Flood Model Development (Current Scenario)

1.1.1 Introduction

This section provides information on the development of the 'current scenario' model which was used to re-establish design flood conditions for the site, and provide information regarding appropriate flood planning levels and provisional flood hazard.

TUFLOW, a fully 2D hydraulic modelling software package, was selected for the Springvale Drain and Floodvale Drain Flood Study and has been used to undertake this flood assessment. Information on the development of the TUFLOW flood study model is reported in the Springvale Drain and Floodvale Drain Final Report (BMT WBM, 2014).

A review and update of the model was undertaken to include recent survey information. The following sections document the updates to the Springvale Drain and Floodvale Drain TUFLOW model as part of the 'current scenario' model.

1.1.2 Ground Surface Elevation Grid

The ground surface elevation grid is used to represent the topography of the channels and floodplain in the TUFLOW model. The ability of the hydraulic model to provide an accurate representation of the flow distribution on the floodplain ultimately depends upon the quality of the underlying topographic model.

1.1.2.1 Elevation Data – Lot 102, 26 McPherson Street Banksmeadow

Elevation data for the adjacent lot, Lot 102, 26 McPherson Street Banksmeadow, were included into the TUFLOW model. Elevation data was inclusive of ground level survey and as-built ground levels following construction of the Southlands Industrial Estate. These sources of data provided a change in finished floor levels (FFLs), revised platform levels and revised drainage areas in the northern and western portion of the site. Details of the ground surface elevation have been provided by Aurecon with the following file references:

- 10240B FINISHED SURFACE LEVELS REV 2.dwg
- 150608 TRIANGLE FILE-ModelACAD2K.dwg
- Design-3D-934906.dwg

The three sources of elevation data above were used to inform the TUFLOW model elevations for Lot 102, 26 McPherson Street, Banksmeadow.

1.1.2.2 Elevation Data – Lot 9, 28 McPherson Street Banksmeadow, Lot 100 28A McPherson Street Banksmeadow and Lot 101 28B McPherson Street Banksmeadow

Ground elevation data for 28, 28A and 28B McPherson Street were included in the TUFLOW model. Details of the ground surface elevation have been provided by DBL Property Pty Limited with the following file references:

- YN210094_Soutlands_Supertin ascon survey rev02_20150506.12da

- 10240 stage 2 levels 2.dwg

The two sources of elevation data above were used to inform the TUFLOW model elevations for 28, 28A and 28B McPherson Street, Banksmeadow.

1.1.3 Buildings

The influence of buildings and other obstacles to the passage of flow in urban floodplains is an important issue in the context of urban floodplain management (Engineers Australia, 2012). In a typical urban floodplain, some buildings will be elevated on fill and totally obstruct the passage of floodwater, others may be inundated with floodwater ponding inside the building, whilst others may be elevated on piers allowing flow under the building.

For this assessment, the buildings in the adjacent lots were modelled as impermeable structures 0.2 m above the surveyed floor levels. They were assigned a high Manning's 'n' value (refer to Section 1.1.4) above their FFL to represent the energy dissipation of water flowing through and around the buildings. This approach was favoured over blocking out buildings as it includes the storage effects of the building being inundated.

1.1.4 Hydraulic Roughness (Manning's n)

As part of the current scenario model, the roughness zones (Manning's "n") have been updated to reflect the building layout as discussed in Section 1.1.3. The value of the roughness coefficient for buildings (n = 1.0), is based on industry standards (e.g. Chow, 1959).

The Manning's n values from the Springvale Drain and Floodvale Drain Flood Study are listed below in Table 1-1.

Table 1-1 Adopted Manning's "n" values

Surface	Manning's "n"
Urban block	0.070
Grass (maintained)	0.030
Parkland	0.040
Dense vegetation	0.090
Railway corridor	0.080
Roads / Concrete	0.020
Buildings	1.000
Industrial	0.050
Harbour, dams, waterbodies etc	0.022
Tidal / Estuary	0.031

Figure 1-1 shows the updates to the existing flood model documented above to establish the 'current scenario' flood conditions.

Title:
2D Flood Model Updates

Figure: 1-1

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1.2 Model Results

1.2.1 Introduction

Design model results are presented for the current scenario model. The following results are presented in this section:

- Design flood conditions for the current scenario (peak flood levels and peak flood velocities);
- Flood Planning Level for the current scenario; and
- Preliminary Hydraulic Categorisation for the current scenario.

The key focus has been to determine and report on the extent and degree of flooding for the current scenario.

1.2.2 Design Flood Conditions

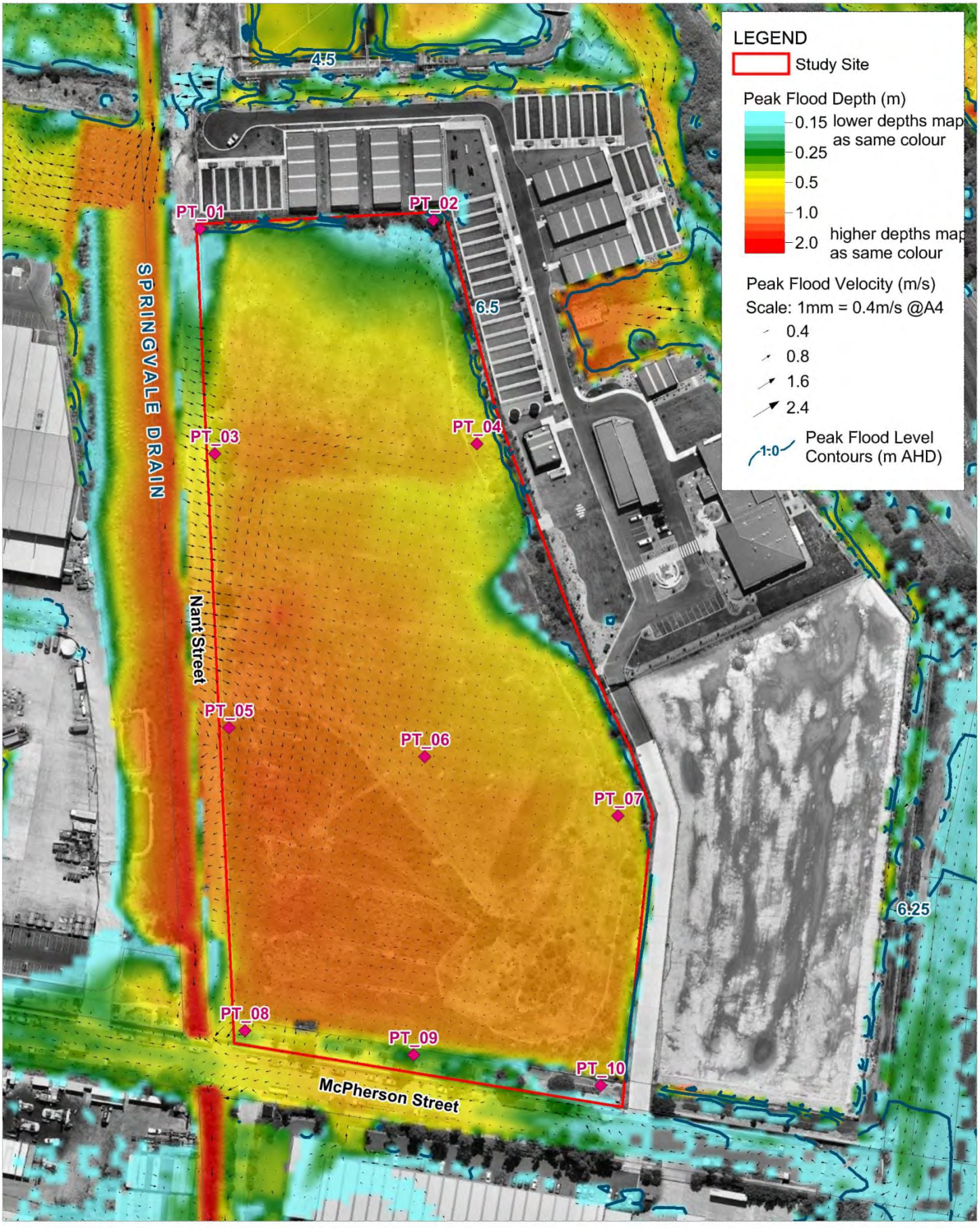
Design flood simulations were undertaken for the 5% AEP, 1% AEP and PMF design events. Peak flood levels, depths and velocities have been mapped and are presented in Appendix A (Figures A-1 to A-3).

Figure 1-2 shows the peak flood condition for the current scenario 1% AEP design event. Selected locations labelled P01 to P04 on Figure 1-2 show the peak water level and velocity as listed in Table 1-2 and Table 1-3 respectively.

Table 1-2 Peak Water Levels at Selected Locations for 5% AEP, 1% AEP and PMF Events

Location (Refer to Figure 1-2)	Peak Water Levels (m AHD) for 5% AEP Event	Peak Water Levels (m AHD) for 1% AEP Event	Peak Water Levels (m AHD) for PMF Event
PT_01	n/a	n/a	4.81
PT_02	n/a	n/a	4.83
PT_03	3.95	4.11	4.74
PT_04	3.95	4.11	4.82
PT_05	3.95	4.11	4.78
PT_06	3.95	4.11	4.81
PT_07	3.95	4.11	4.79
PT_08	3.95	4.11	4.79
PT_09	3.95	4.11	4.80
PT_10	n/a	n/a	4.79
PT_01	n/a	n/a	4.81

n/a: no flooding indicated



Title:

Peak Flood Depth - Existing Scenario 1% AEP

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1-2	-

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Table 1-3 Peak Velocities at Selected Locations for 5% AEP, 1% AEP and PMF Events

Location (Refer to Figure 1-2)	Peak Velocity (m/s) for 5% AEP Event	Peak Velocity (m/s) for 1% AEP Event	Peak Velocity (m/s) for PMF Event
PT_01	n/a	n/a	1.12
PT_02	n/a	n/a	0.38
PT_03	0.52	0.74	1.74
PT_04	0.05	0.10	0.34
PT_05	0.37	0.42	0.63
PT_06	0.12	0.13	0.44
PT_07	0.04	0.02	0.14
PT_08	0.22	0.36	0.87
PT_09	0.07	0.11	0.32
PT_10	n/a	n/a	0.20

n/a: no flooding indicated

1.3 Preliminary Hydraulic Categorisation

Hydraulic categorisation is one of the tools used to identify flood behaviour and risk. Outcomes of the categorisation are primarily used to inform future land use planning. The categorisation is typically not used to assess individual developments, but rather to give a catchment-scale overview of which areas may be appropriate for various types of land use. However, for the purposes of this study, the hydraulic categorisation can act to show where filling may be possible within the floodplain without significant increase in flood levels or redistribution of flows.

There are no prescriptive methods for determining what parts of the floodplain constitute floodways, flood storages and flood fringes. Descriptions of these terms within the *Floodplain Development Manual* (DIPNR, 2005) are essentially qualitative in nature. Of particular difficulty is the fact that a definition of flood behaviour and associated impacts is likely to vary from one floodplain to another depending on the circumstances and nature of flooding within the catchment.

The hydraulic categories as defined in the *Floodplain Development Manual* are:

Floodway. Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.

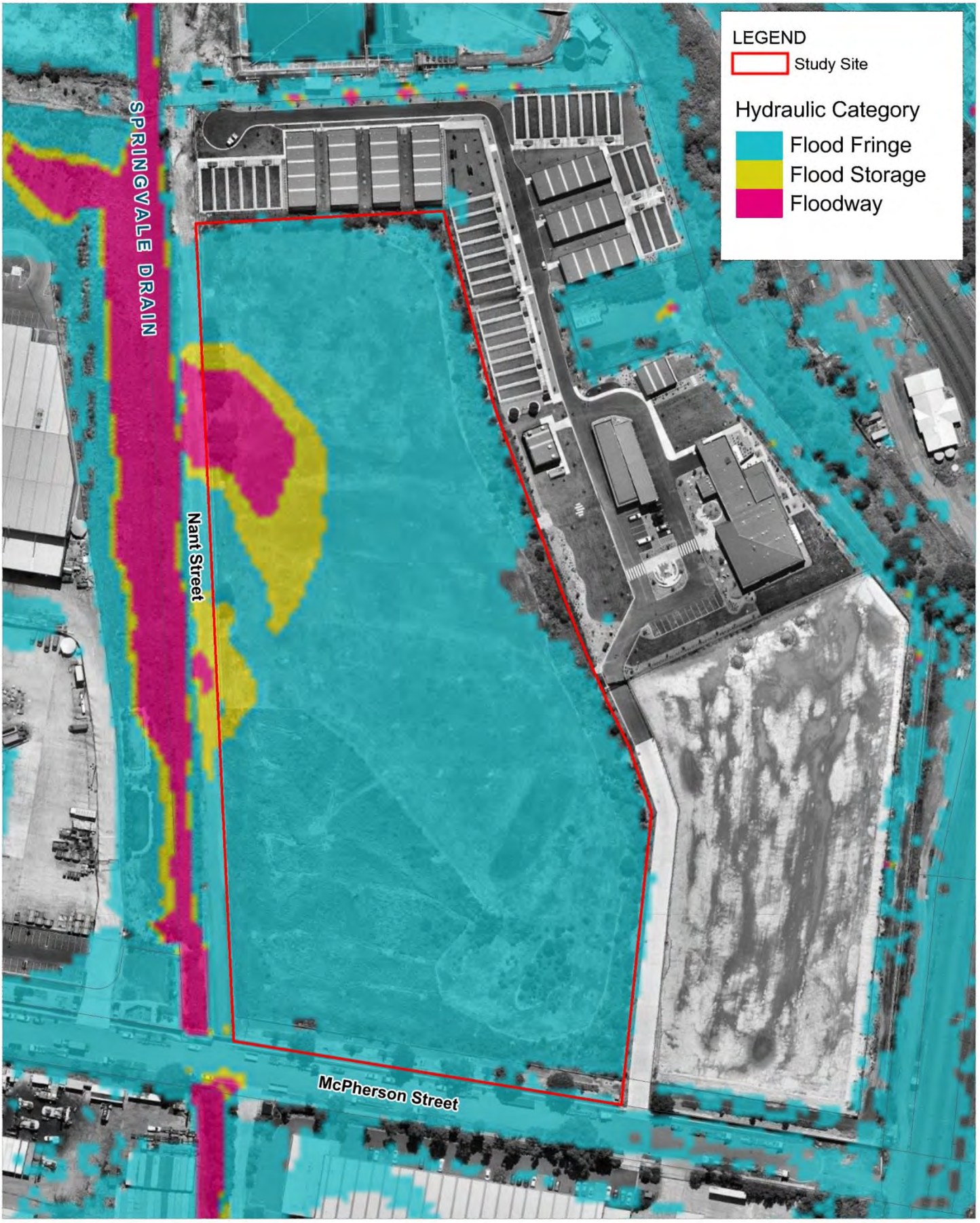
Flood Storage. Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.

Flood Fringe. Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.

The definition of hydraulic categorisation that was considered to best fit the purposes of modelling the on-site constraints was based on a combination of velocity*depth, velocity and depth parameters, as follows:

- Floodway is defined as areas where:
    - Velocity x depth greater than 0.25 m^2/s and velocity greater than 0.25 m/s; or
    - Velocity greater than 1 m/s.
- Flood storage areas were identified as those areas which do not operate as floodways but where the depth of inundation exceeded 1 m.
- Flood fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined.

Provisional hydraulic categorisation for the 1% AEP design event for the study area under current flood conditions is shown in Figure 1-3.



Title:

Preliminary Hydraulic Categorisation
1% AEP (100 yr ARI)

Figure: **1-3**

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2 Flood Impact Assessment

2.1 Introduction

A preliminary assessment of potential site configuration has been undertaken utilising the TUFLOW hydraulic model developed as part of Section 1.

The proposed site configuration involves an elevated 'ground floor' slab supported by a grid of timber piles to allow flood conveyance beneath the slab. Details of the timber piling grid have been supplied by Costin Roe Consulting Pty Ltd.

2.1.1 Flood Model Development (Proposed Scenario)

The following changes were made to the TUFLOW model to reflect the initial site concept, referred to herein as the 'proposed development scenario'.

2.1.1.1 Suspended Slab

The proposed development constitutes an elevated ground flood slab, supported by timber/concrete piers. Details of the timber piling grid was provided by Costin Roe Consulting Pty Ltd (drawing reference: CO9349.11-S01-P-3.pdf). The elevated slab has been represented in the model using a layered flow constriction layer and a storage reduction layer to model the hydraulic losses associated with flow around the building piers, in addition to modelling the impacts of the piers in relation to reduced storage. Blockage between the building piers has not been considered for this assessment.

To account for the proposed piers, the layered flow constriction shape was modelled with a blockage of 0.5% in accordance with relevant design drawings, and using the following assumptions regarding pier size and spacing:

1) 800 mm diameter pier columns; and
2) 10m pier centres.

The underside of the building slab (i.e. soffit) has been modelled at the 1% AEP plus freeboard (0.5m) level, 4.6 m AHD. The slab deck has been modelled at a thickness of 0.25 m. No obstructions have been modelled above the deck height of 4.85 m AHD.

2.1.1.2 Topographic modifications

Consideration has been given to structures which may become an impediment to flood flows or have the potential to remove flood storage from the floodplain. The proposed access ramps connecting Nant Street and McPherson Street with the elevated ground slab have therefore been modelled as impervious to flood waters.

The proposed access ramps have been modelled using an increased elevation (20m AHD), thereby rendering their footprints flood free and removing potential storage from the floodplain. The depiction of access ramps within the hydraulic model was based on the development layout provided by Costin Roe Consulting Pty Ltd (drawing reference: CO9349.11-S01-P-3.pdf).

Figure 2-1 illustrates the changes to the 'current scenario' model as discussed above, representing the elevated slab and associated ramp access structures.

Title:

Proposed Development
Lot 9 28 McPherson Street

Figure: 2-1

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BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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2.2 Model Results

Design flood simulations were undertaken for the 5% AEP, 1% AEP and PMF design events. Peak flood levels, depths and velocities have been mapped and are presented in Appendix B (Figures B-1 to B-3).

2.2.1 Flood Impacts

Peak flood impacts for the proposed development have been mapped and are presented in Appendix C (Figures C-1 to C-3).

Figure 2-2 shows a flood impact map comparing the peak water levels for the proposed development scenario against the current scenario peak water levels for the 1% AEP. The maps identify areas where:

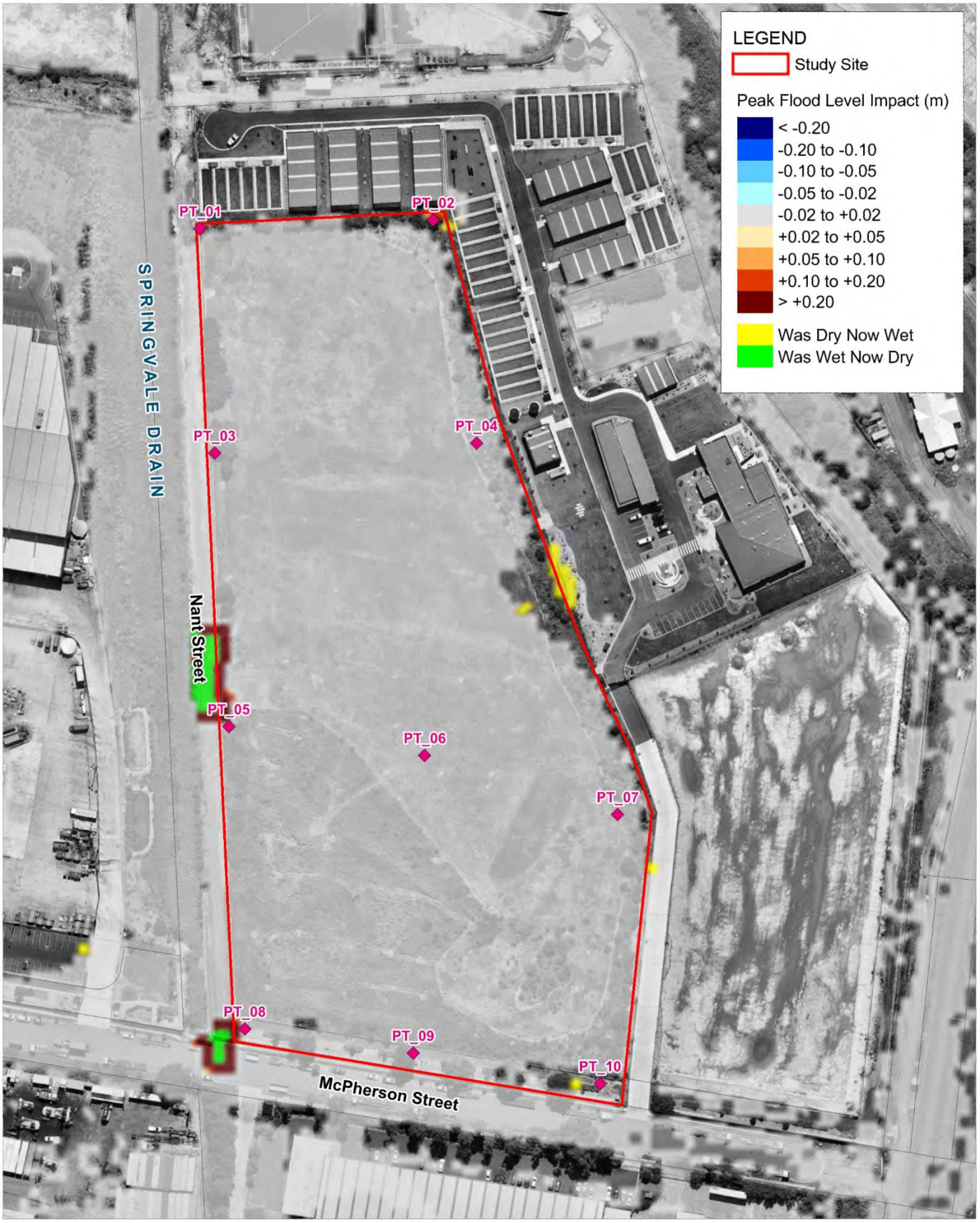
- Flooding previously occurred in the current scenario model but no longer occurs in the proposed scenario model (referenced “was wet now dry”);
- Flooding now occurs in the proposed scenario model which was previously not flooded in the current scenario model (referenced “was dry now wet”); and
- Extent and degree of change in the peak water levels.

The degree of change in peak flood levels has been identified at a number of locations within the vicinity of the proposed development site. The points are labelled Pt01 to Pt04 on Figure 2-2 and correspond with the locations listed in Table 2-1.

Table 2-1 Comparison of peak water levels at selected locations between the proposed development scenario and current scenario for 1% AEP Events

Location (Refer to Figure 2-2)	Peak water levels (m AHD)		Difference in levels (m) between proposed development scenario and current scenario	FPL (m AHD) Proposed Development Scenario + 0.5 m
	Current Scenario	Proposed Development Scenario		
PT_01	n/a	n/a	n/a	4.61
PT_02	n/a	n/a	n/a	4.61
PT_03	4.11	4.11	0.00	4.61
PT_04	4.11	4.12	0.01	4.62
PT_05	4.11	4.11	0.00	4.61
PT_06	4.11	4.11	0.00	4.61
PT_07	4.11	4.11	0.00	4.61
PT_08	4.11	4.11	0.00	4.61
PT_09	4.11	4.11	0.00	4.61
PT_10	n/a	n/a	n/a	4.61

n/a: no flooding indicated



Title:

Peak Flood Level Impacts
1% AEP

Figure: 2-2

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Figure 2-2 shows that in the 1% AEP, the proposed development scenario causes no discernible changes to peak flood level, in the order of ±0.02m. There are localised increases in flood level around the elevated structures representing the ramps up to the elevated deck structure, however these changes in flood level are largely due to the modelling methodology (rainfall-on-grid), and not as a result of the loss of storage, or reduction in conveyance area caused by the elevated deck.

In the PMF event (refer Appendix C), there are off-site impacts in the order of 0.02 m to 0.05 m, which constitute only minor differences in flood level. Increased flood levels at the PMF are not typically considered as a development constraint unless it results in a notable difference in flood risk, which is not the case for this development.

A summary of the flood impacts due to the proposed development scenario are provided below:

- No discernible flood impacts for events less than or equal to the 1% AEP;
- Minor changes in flood level for the PMF event, in the order of +-0.05 m; and
- Localised increases in peak flood level along Nant Street and McPherson Street, in all modelled design events due to the rainfall-on-grid modelling methodology.

3 Conclusion

The property at Lot 9, 28 McPherson Street, Banksmeadow is affected by flooding. This report has analysed the flood characteristics in events ranging from the 5% AEP to the PMF. Preliminary hydraulic categorisation has identified areas of the site which are floodways, flood storages and flood fringes.

A preliminary flood impact assessment was undertaken on the initial site concept to determine impacts associated with the proposed elevated ground slab and piling grid configuration. With the exception of the PMF, no off-site impacts were evident based on the supplied piling grid, applying a 0.5% blockage.

I trust that our report adequately addresses your requirements. Please do not hesitate to contact me should you wish to discuss any of the above or require additional information.

Yours Faithfully
BMT WBM

Sebastian Froude
Engineer – Water and Environment

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
000	22/05/2018	JDE			

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
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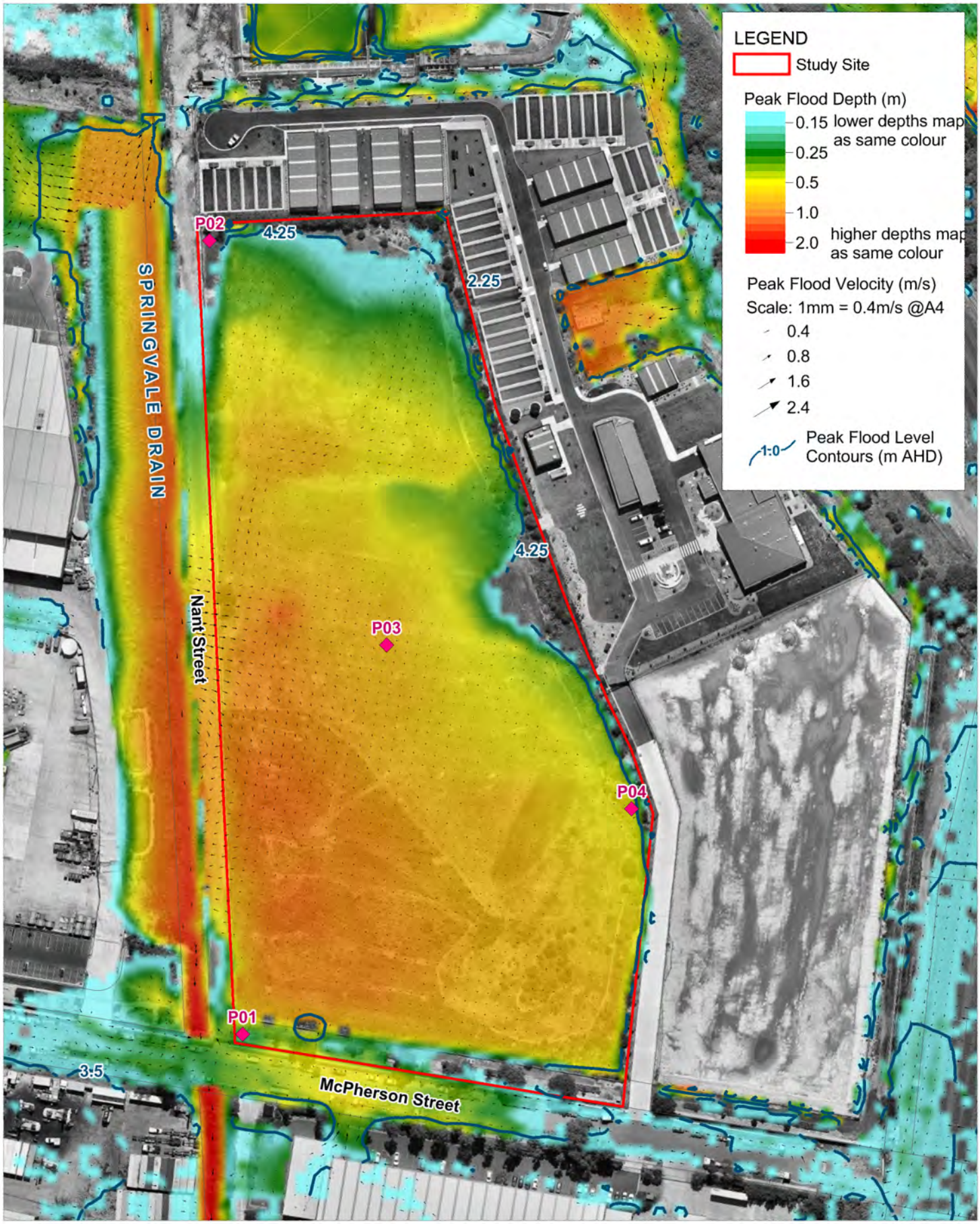
Appendix A – Current Scenario Design Flood Conditions



Title:

Peak Flood Depth - Existing Scenario 5% AEP

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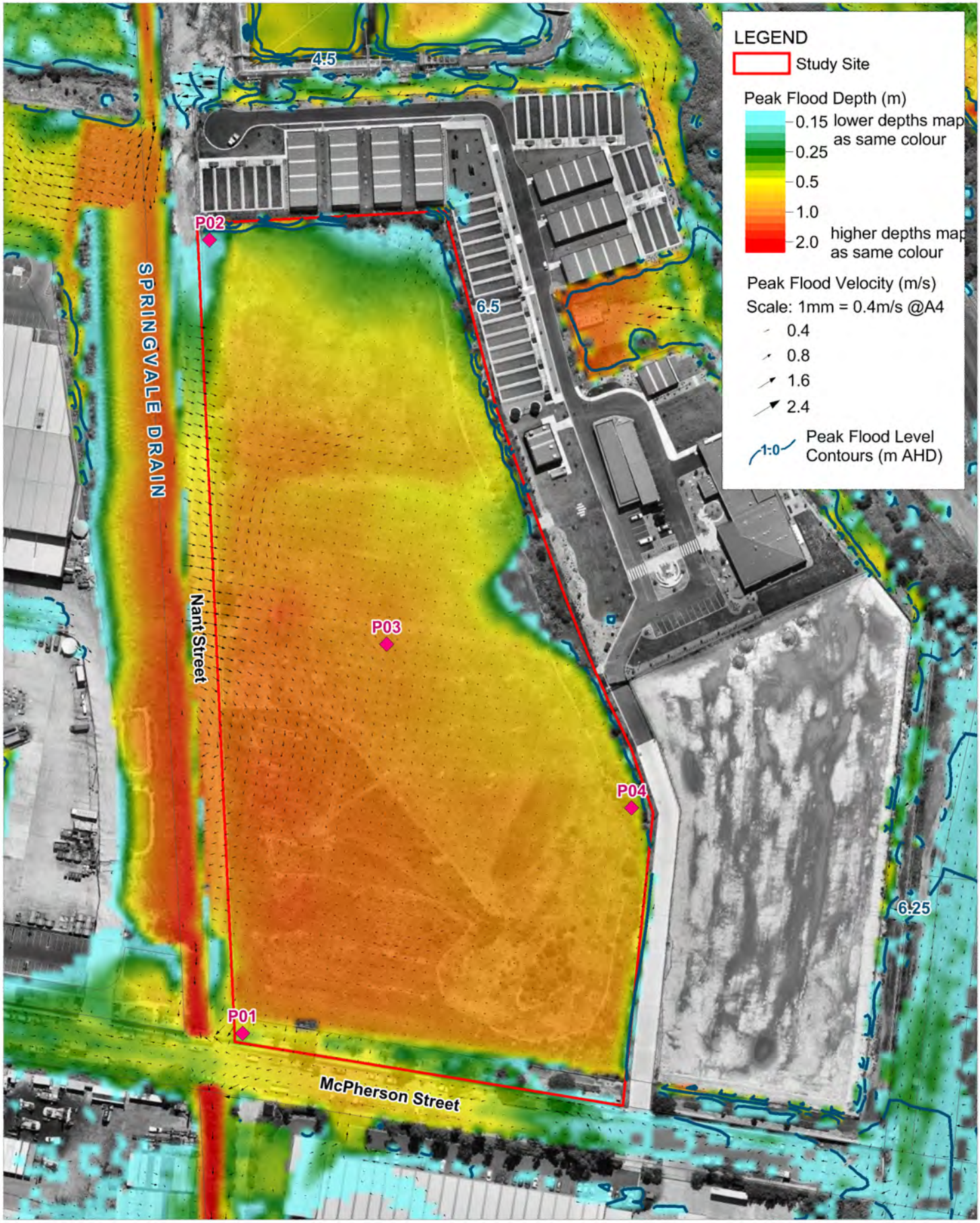

Title:

Peak Flood Depth - Existing Scenario 1% AEP

Figure: A-2

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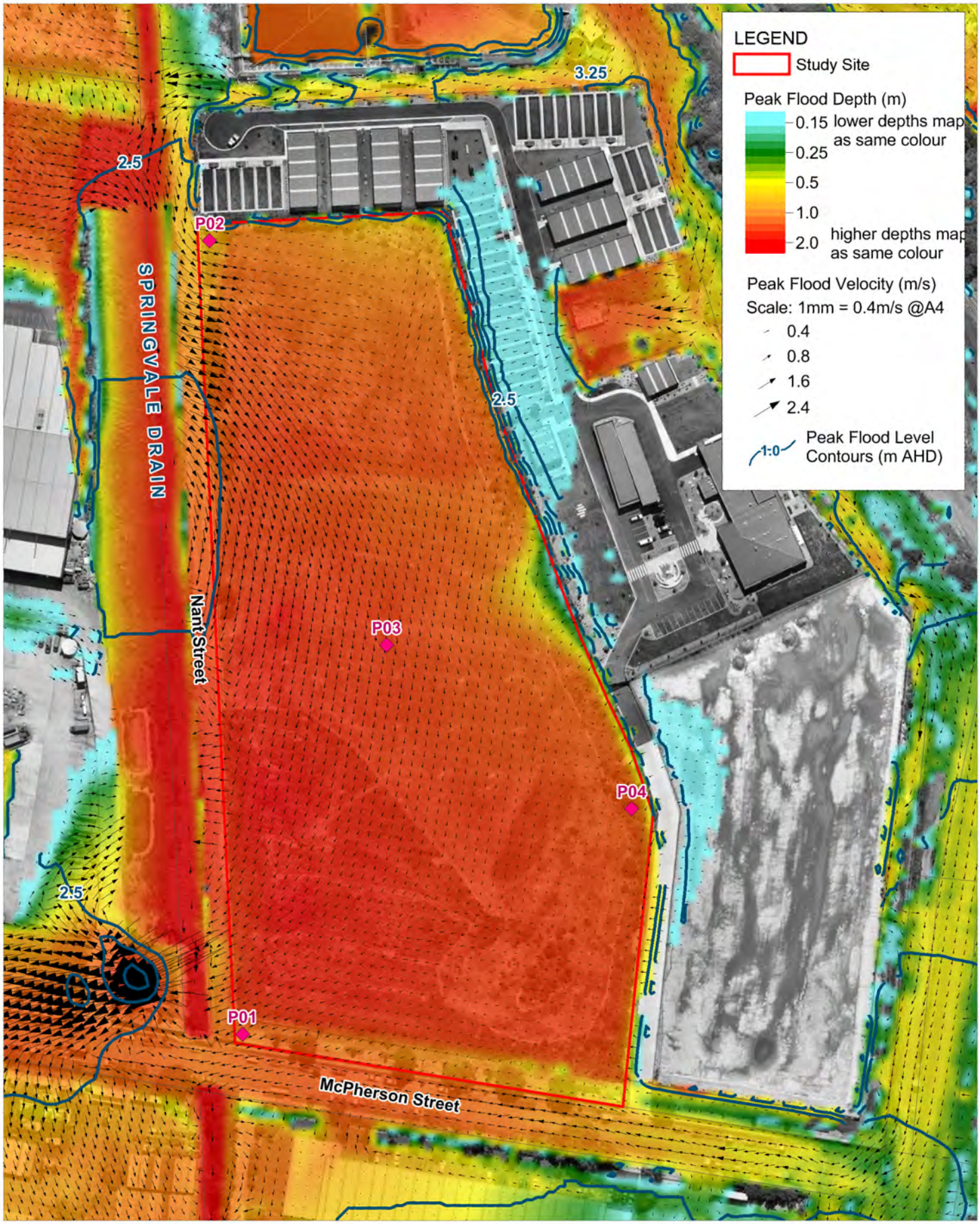

Title:

Peak Flood Depth - Existing Scenario PMF

Figure: A-3

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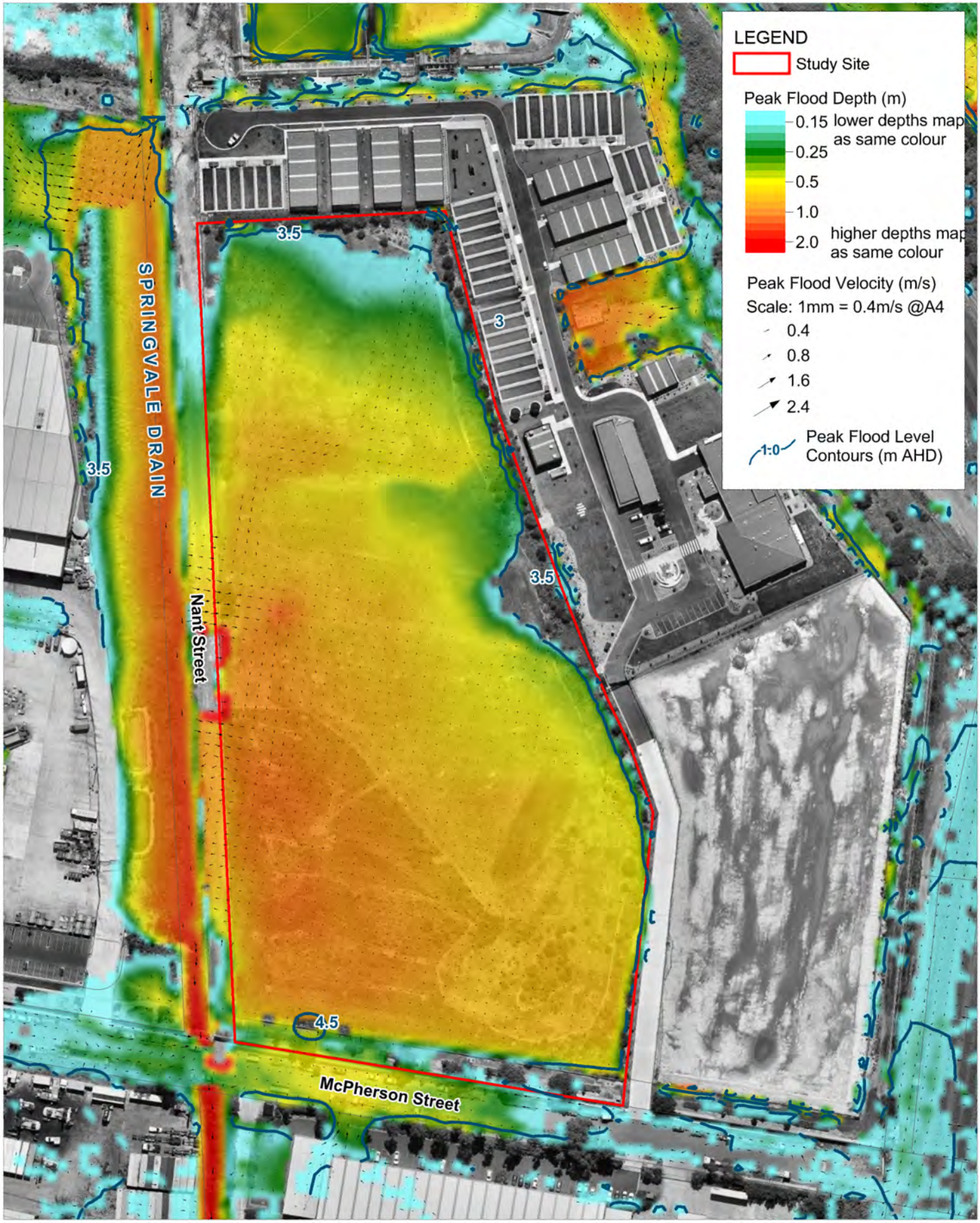
Appendix B – Proposed Scenario Design Flood Conditions



Title:

Peak Flood Depth - Developed Scenario 5% AEP

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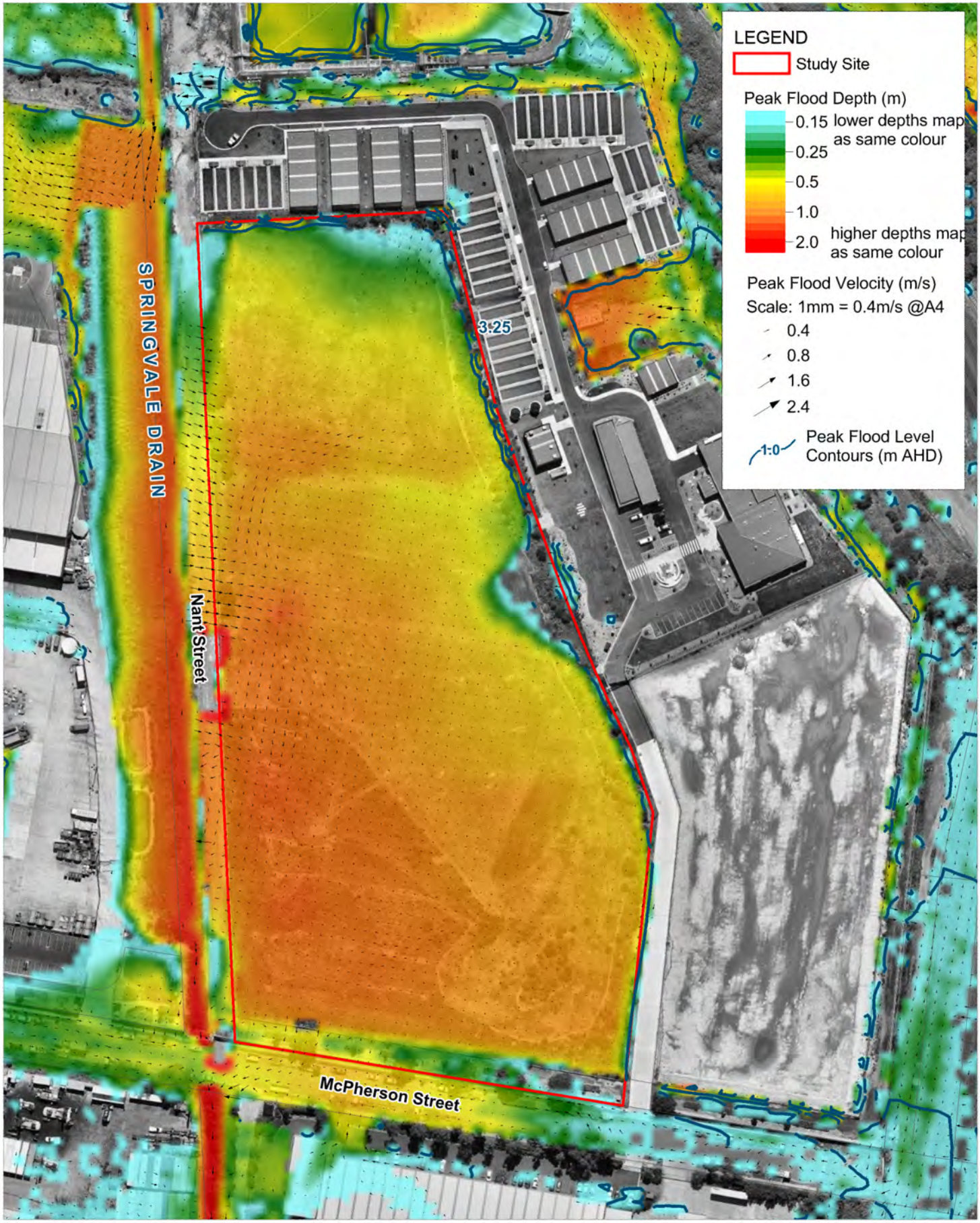

Title:

Peak Flood Depth - Developed Scenario 1% AEP

Figure: **B-5**

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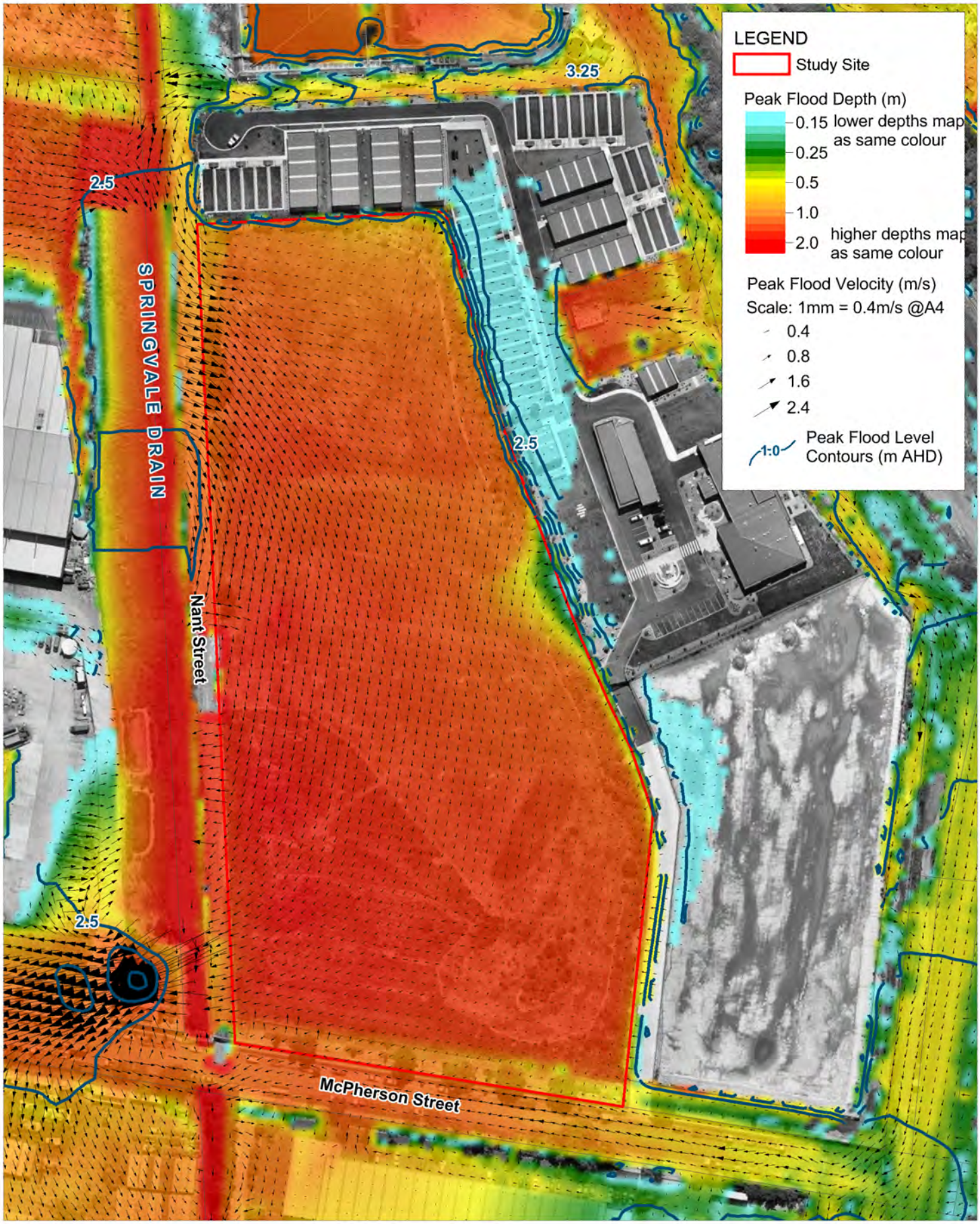

Title:

Peak Flood Depth - Developed Scenario PMF

Figure: B-6

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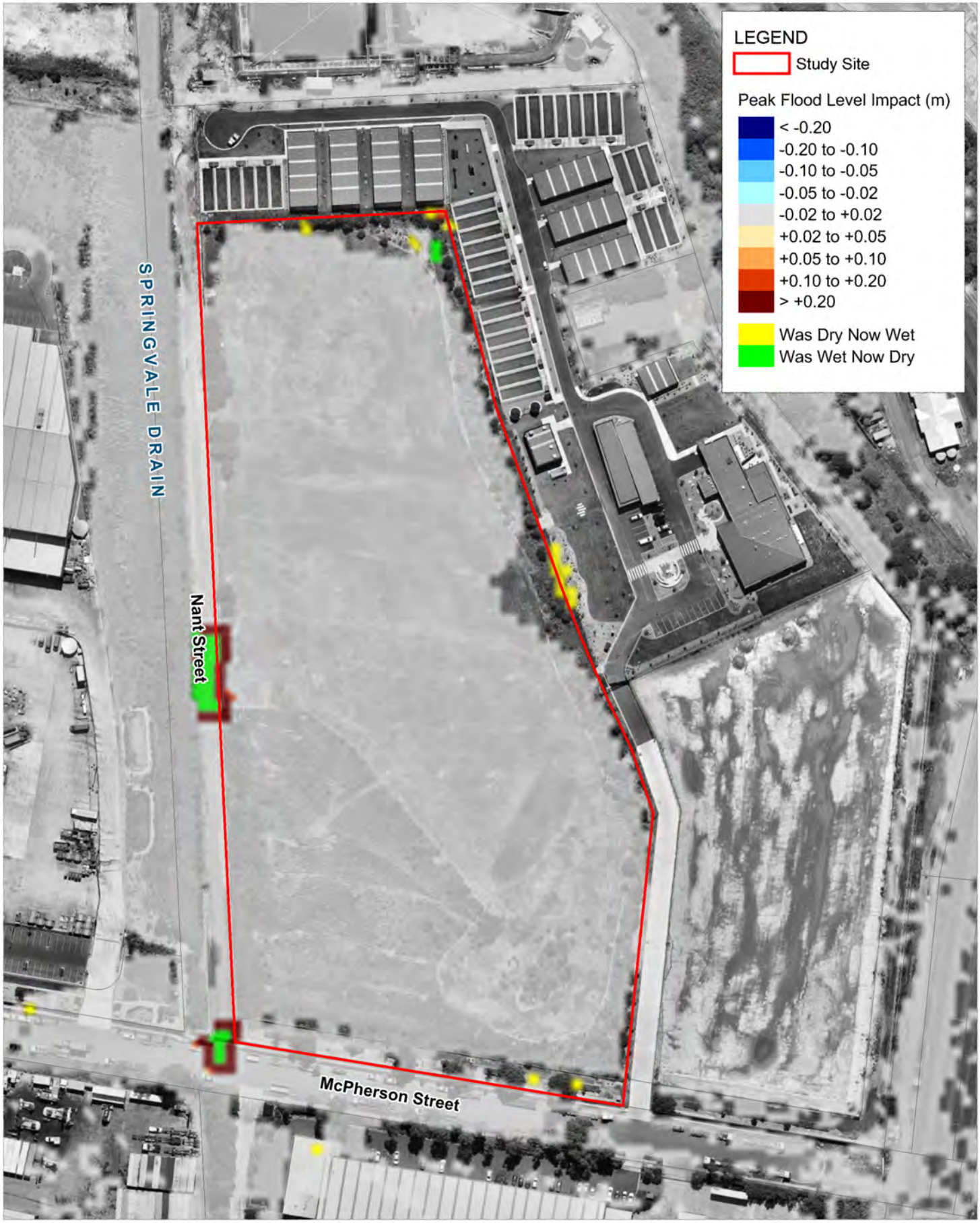
Appendix C – Peak Flood Level Impacts



Title:

Peak Flood Level Impacts
5% AEP

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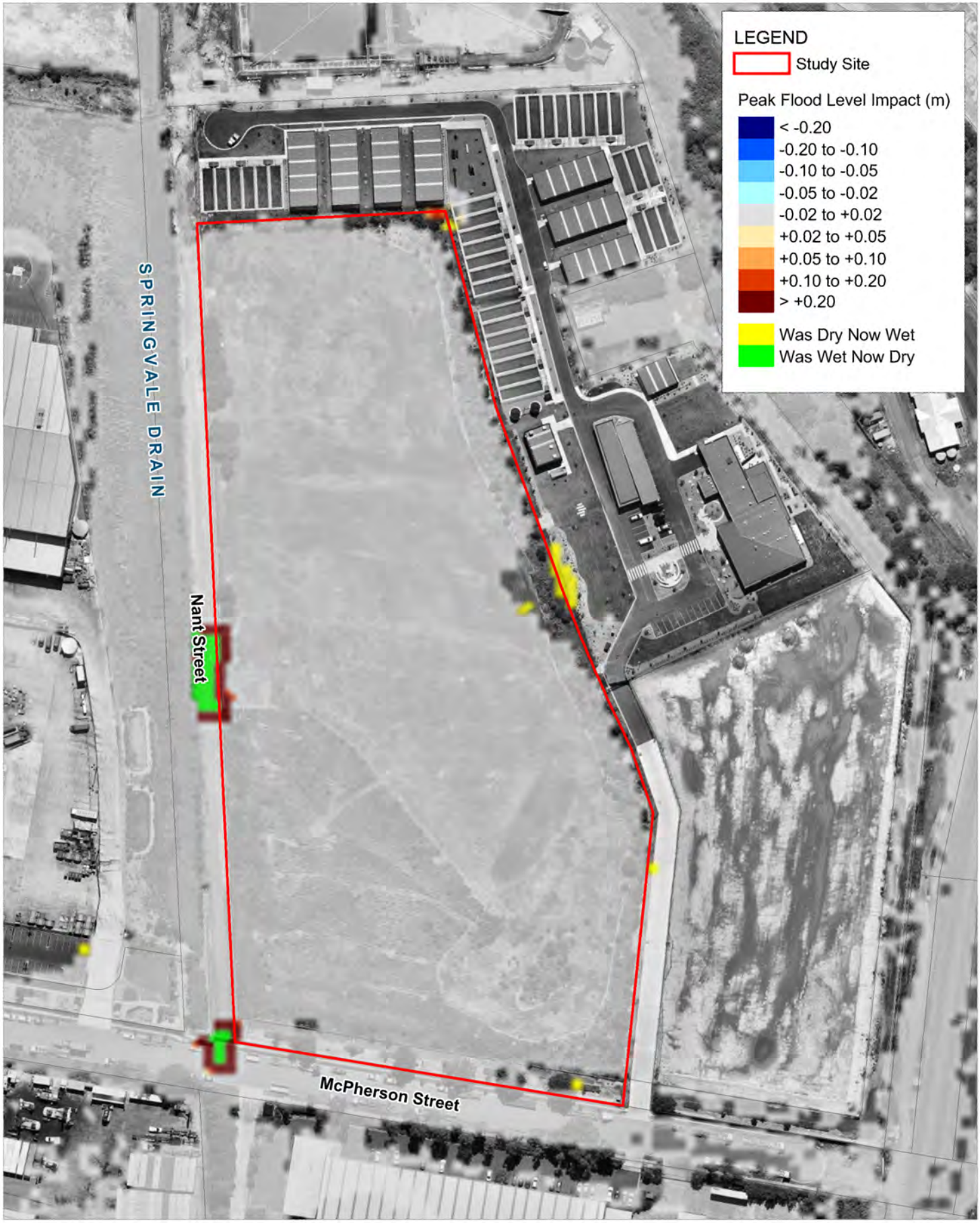

Title:

Peak Flood Level Impacts
1% AEP

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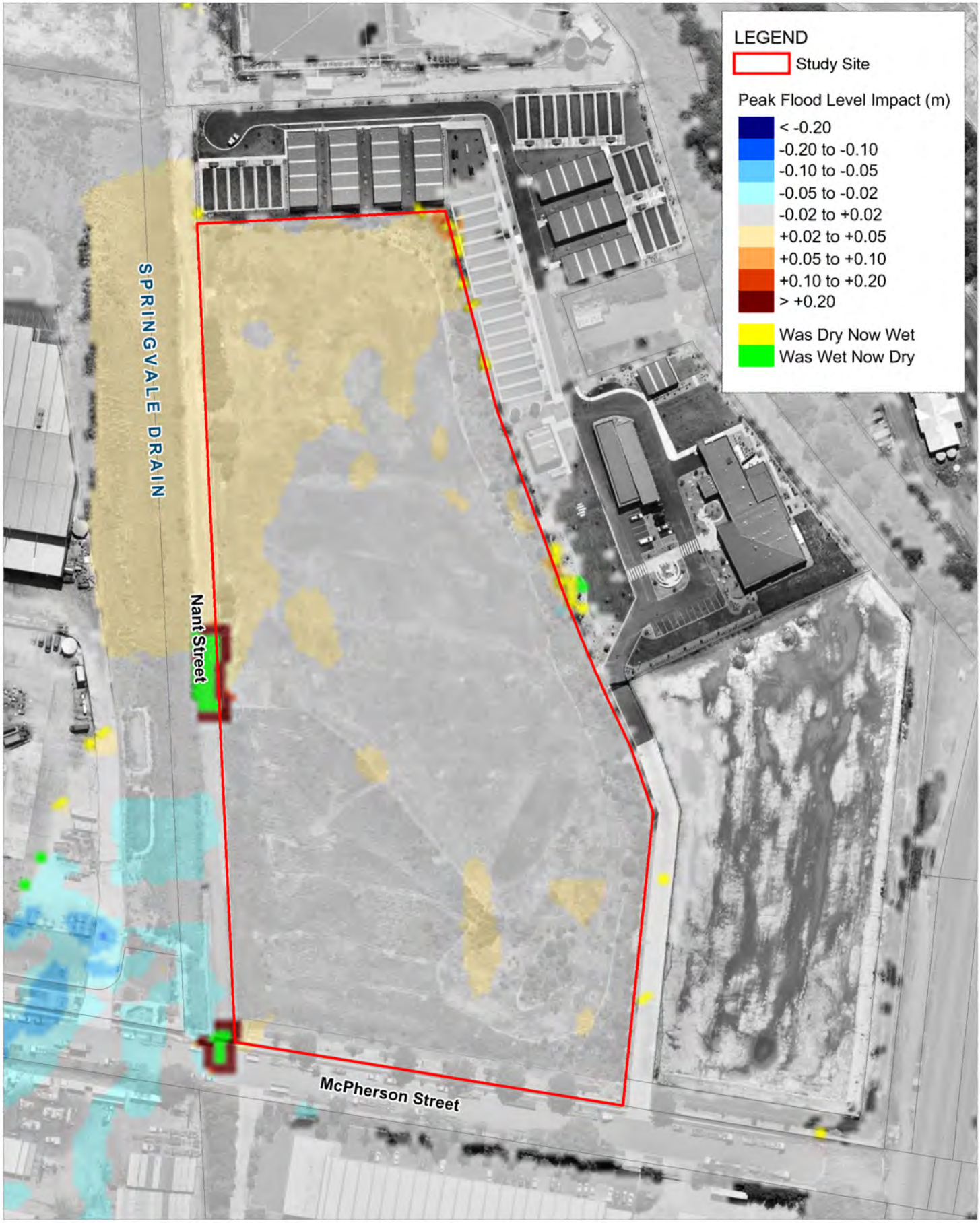

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Peak Flood Level Impacts
PMF

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