22-000135_FIA_01C

FLOOD INVESTGATION REPORT

CABOOLTURE WEST NDP1 (PHASE 2) & NDP2

Prepared for **Stockland**

December 2024

Approved Subject to Conditions of Decision Notice DA/2024/2263 28/4/2025

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1 INTRODUCTION

Egis Consulting Pty Ltd (formerly Calibre Professional Services) have been engaged by Stockland to undertake flood investigations and analysis to support planning for the development located within the Caboolture West development area identified as Neighbourhood Development Plan 1 (NDP1) Phase 2 and Neighbourhood Development Plan 2 (NDP2).

The development is located west of the initial NDP1 Phase 1 development area, for which Calibre Professional Services prepared the *Stormwater Management Plan – Caboolture West NDP1* (Report No. 16-0001367-SWMP-01D dated March 2023).

The initial Flood Investigation Report (Issue B) was prepared to document the methodology and results of hydrological and hydraulic analysis undertaken to confirm the Stockland development with proposed flood management strategies will not result in any adverse or actionable flood impacts adjacent to or downstream. The report was also prepared in response to requests for additional information (Development Application No. DA/41766/2020/V23P).

This report (Issue C) has been prepared in response to feedback received from CMB in the two emails titled RE: Updated Flood Investigation - NDP1 (Phase 2) & NDP2*, the first containing initial comments (dated 5 July 2024) and the second containing comments from an external reviewer (dated 11 September 2024).*

Updates made from the previous (Issue B) report have been highlighted as indented italicised text. Where changes have been made to figures or tables, they have been identified in the figure caption or table notes.

1.1 Objectives & Scope

The objectives of this report are to:

- Document the locations where runoff discharges from the study area under existing and future (developed) conditions.
- Demonstrate that the increase in runoff generated by the proposed development, with the provision of mitigation devices where required, will not cause an adverse impact adjacent to or downstream properties.
- Identify drainage infrastructure required to provide mitigation of development flows and convey runoff from properties under the control of multiple entities (i.e., properties under separate ownership) to the study area discharge locations.

The scope of works to prepare this report involved hydrological and hydraulic modelling to determine the potential changes to runoff, peak flow and flood levels associated with the development. For this investigation the hydrological and hydraulic models associated with the *Stormwater Management Plan – Caboolture West NDP1* (2023) were utilised.

1.2 Previous Documentation

Egis have been involved with planning of Neighbourhood Development Plan 1 and 2 of Caboolture West. Under Calibre Professional Services the following documentation has previously been prepared:

- *Stormwater Management Plan – Caboolture West NDP1* (Report No. 16-0001367-SWMP-01D dated March 2023). This report, herein referred to as the *NDP1 SWMP*, documented the investigations and analysis undertaken to address the management of flooding, stormwater quality and quantity and conveyance of runoff from the NDP1 Phase 1 study area. The report provided strategies in accordance with relevant Local and State Government standards and identifies trunk infrastructure relating to the proposed strategies and enable development to discharge lawfully.
- *NDP1 (Phase 2) & NDP2 - Flood Investigation* Technical Memorandum (22-000135_TM01A.MS dated 17 June 2022). This technical memorandum summarised the methodology and results of the initial hydrological and hydraulic analysis undertaken to confirm the discharge of runoff from the Stockland development to adjacent and internal watercourses (and the Caboolture River) would not result in any adverse or actionable flood impacts adjacent to or downstream of the site.

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- *Stockland Caboolture West, NDP1 Phase 2, Precinct 1- Flood Investigation* Technical Memorandum (22-000135_TM02B dated 21 December 2022). This technical memorandum was prepared to support the approval for the initial Precinct 1 of the Stockland NDP2 development, providing a summary of the methodology and results of hydrological and hydraulic analysis that confirmed Precinct 1 can be developed without any adverse or actionable impact to adjacent properties.

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2 NDP1 PHASE 2 & NDP2 LOCATION & CHARACTERISTICS

The location and characteristics of the area under investigation is discussed in the following section.

2.1 Location

Phase 2 of NDP1 and NDP2 are located approximately 6.5km west of the Bruce Highway, in the suburbs of Wagtail Grove and Lilywood, within the City of Moreton Bay (CMB) local government area. Phase 2 of NDP1 is bound by the Caboolture River to the West and Hausmann Lane to the east, while NDP2 is located west of the Caboolture River. **Figure 2-1** below shows the extent of NDP1 Phase 2, NDP2 and properties under the control of Stockland.

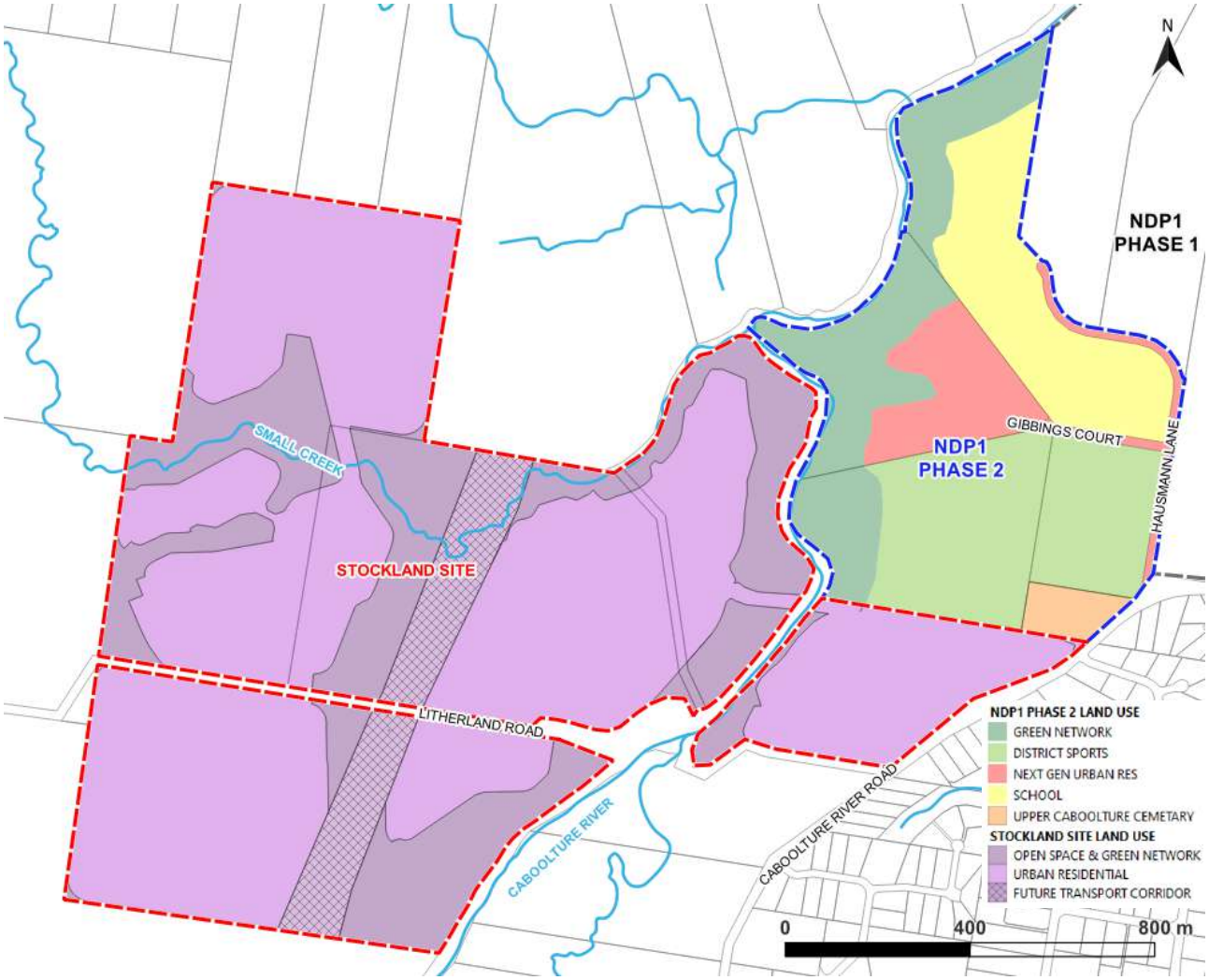


FIGURE 2-1 NDP1 PHASE 2 & NDP1 INVESTIGATION AREA

Three existing roads are located within or adjacent to the investigation area, being:

- Hausmann Lane on the eastern boundary of NDP1 Phase 2.
- Gibbings Court, within NDP1 Phase 2 off Hausmann Lane.
- Caboolture River Road to the south of NDP1 Phase 2.
- Litherland Road running through the Stockland development area and across the Caboolture River.

A future transport corridor approximately 100-metres wide has been incorporated into the proposed Stockland development. This corridor is for a potential Bruce Highway Western Alternative (BHWA) alignment, which allows for a two-lane dual carriageway that is planned for 40 to 60 years from now (refer **Section 3.4** and **Appendix A** for details).

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2.2 Topography & Drainage

The topography over the investigation area is presented in **Figure 2-2** below and is characterised by the following features:

- Well defined riparian corridors of the Caboolture River and Small Creek.
- Gullies extending into the NDP1 Phase 2 area and Stockland site and from the Caboolture River and Small Creek.
- Relatively flat terrain within NDP1 Phase 2 area above on the eastern side of the Caboolture River above the riparian corridor.
- Rolling terrain within the Stockland site (at elevation above the eastern side of the Caboolture River) adjacent to the Small Creek riparian corridor and associated gullies.

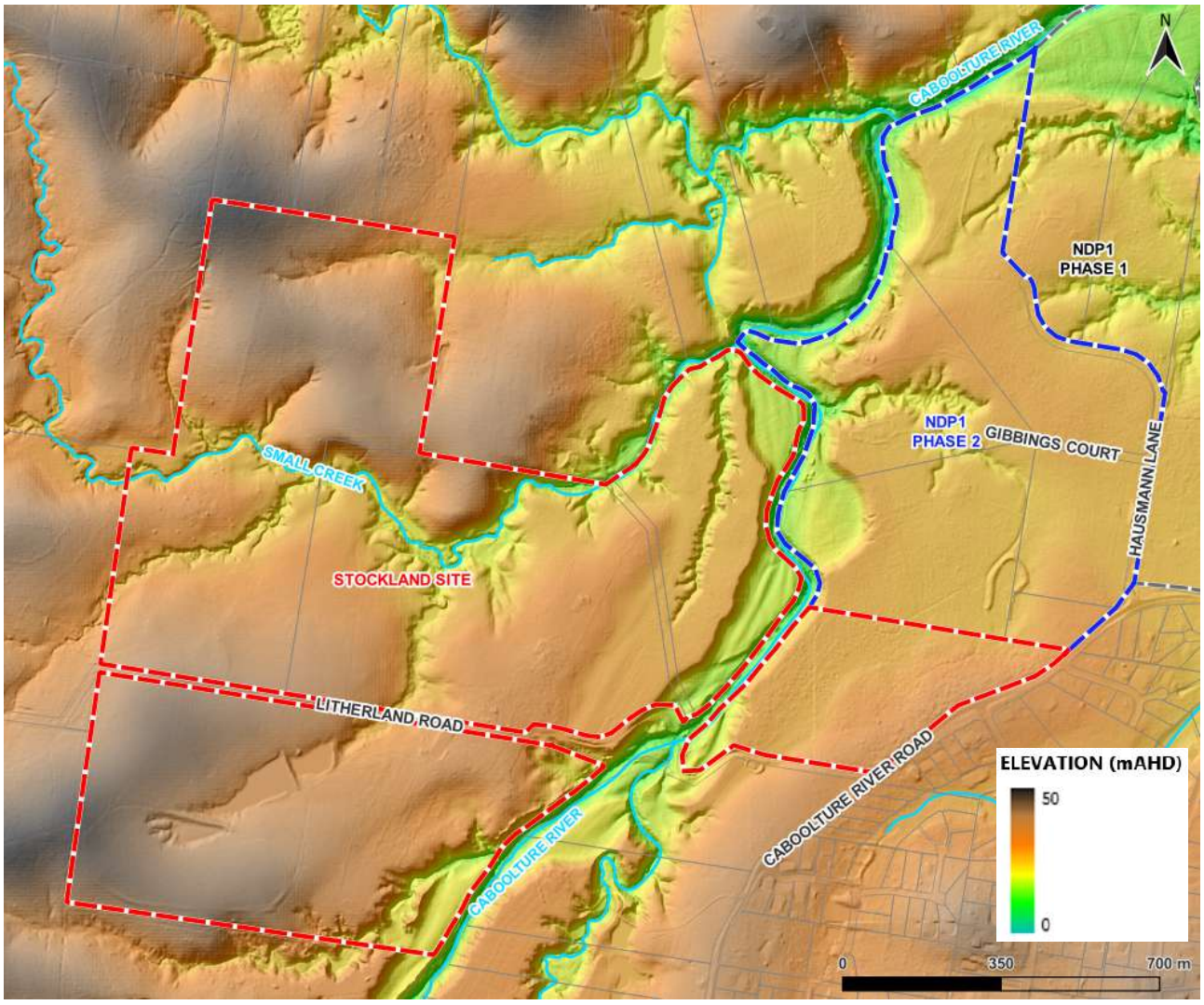


FIGURE 2-2 EXISTING TOPOGRAPHY & DRAINAGE

2.3 Discharge Locations

The investigation area is located within the Caboolture River catchment. As indicated in **Figure 2-3** below, under existing conditions runoff from the Stockland Site west of the Caboolture River effectively discharges into the river via either:

- A minor tributary at the norther eastern corner of the development.
- Small Creek running through the site.
- Directly into the Caboolture River.

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On the eastern side of the river the majority of the Stockland Site (Precinct 1) discharges runoff north into CMB's District Sports Precinct (DSP). This runoff, combined with that from the majority of the NPD1 Phase 2 area north of Caboolture River Road flows into the river.

The remainder of NDP1 Phase 2 flows east into the NDP1 Phase 1 area.

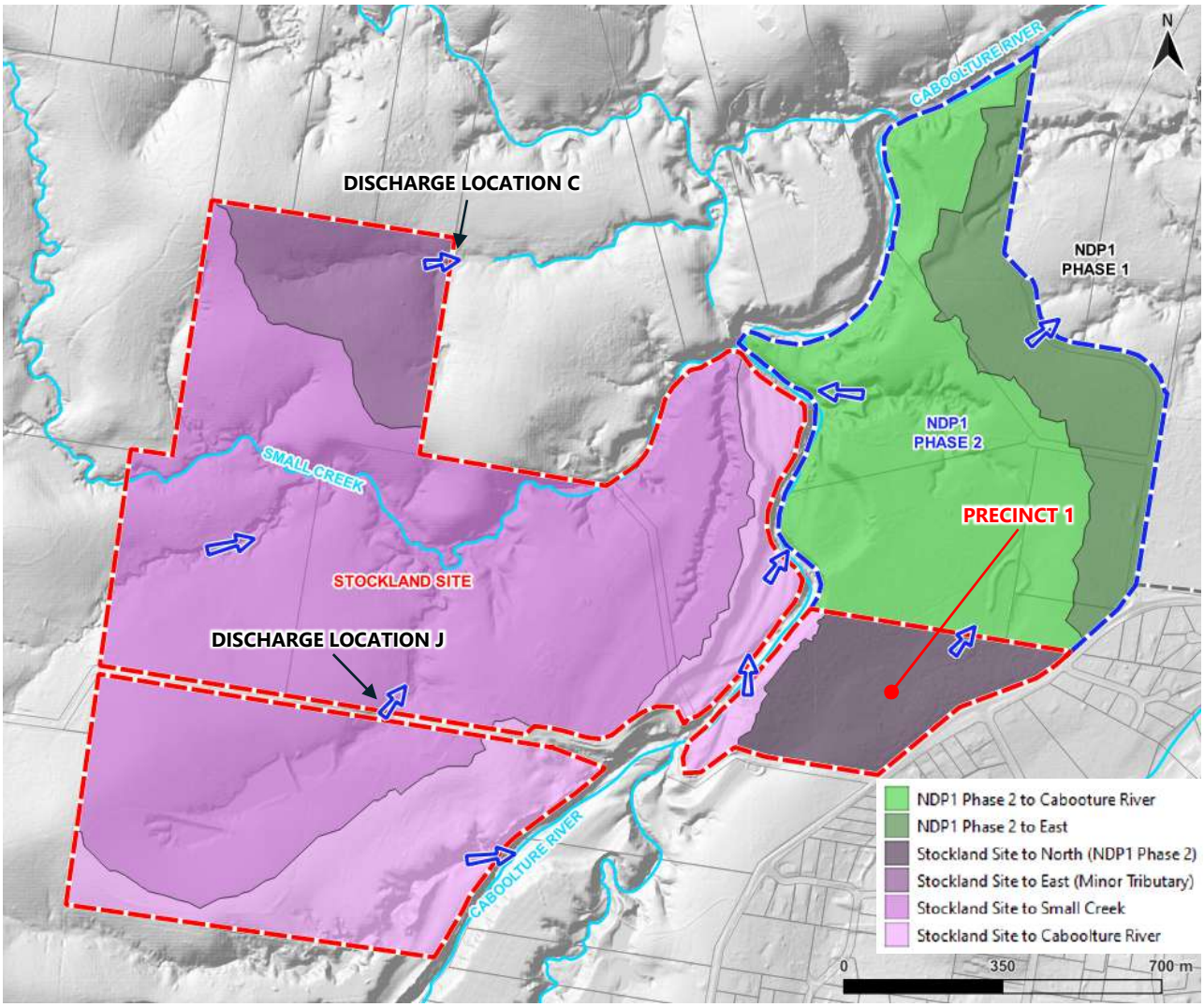


FIGURE 2-3 INVESTIGATION AREA EXISTING DISCHARGE LOCATIONS

Under post development conditions runoff from the Stockland Precinct 1 area and eastern part of NDP1 Phase 2 is to discharge to the Caboolture River south of the proposed bridge crossing.

2.4 Existing Flood Conditions

*As indicated in **Figure 2-4** below parts of the Stockland Site and NDP1 Phase 2 area are within the mapped high and medium category areas of CMB's Flood Hazard Overlay.*

It is noted that flood hazard mapping incorporating development of the Stockland site and NDP1 Phase 2 area was previously prepared by Calibre Professional Services (now Egis) and submitted to CMB for approval. The areas of medium and high flood hazard removed by development are identified in yellow in **Figure 2-4** below.

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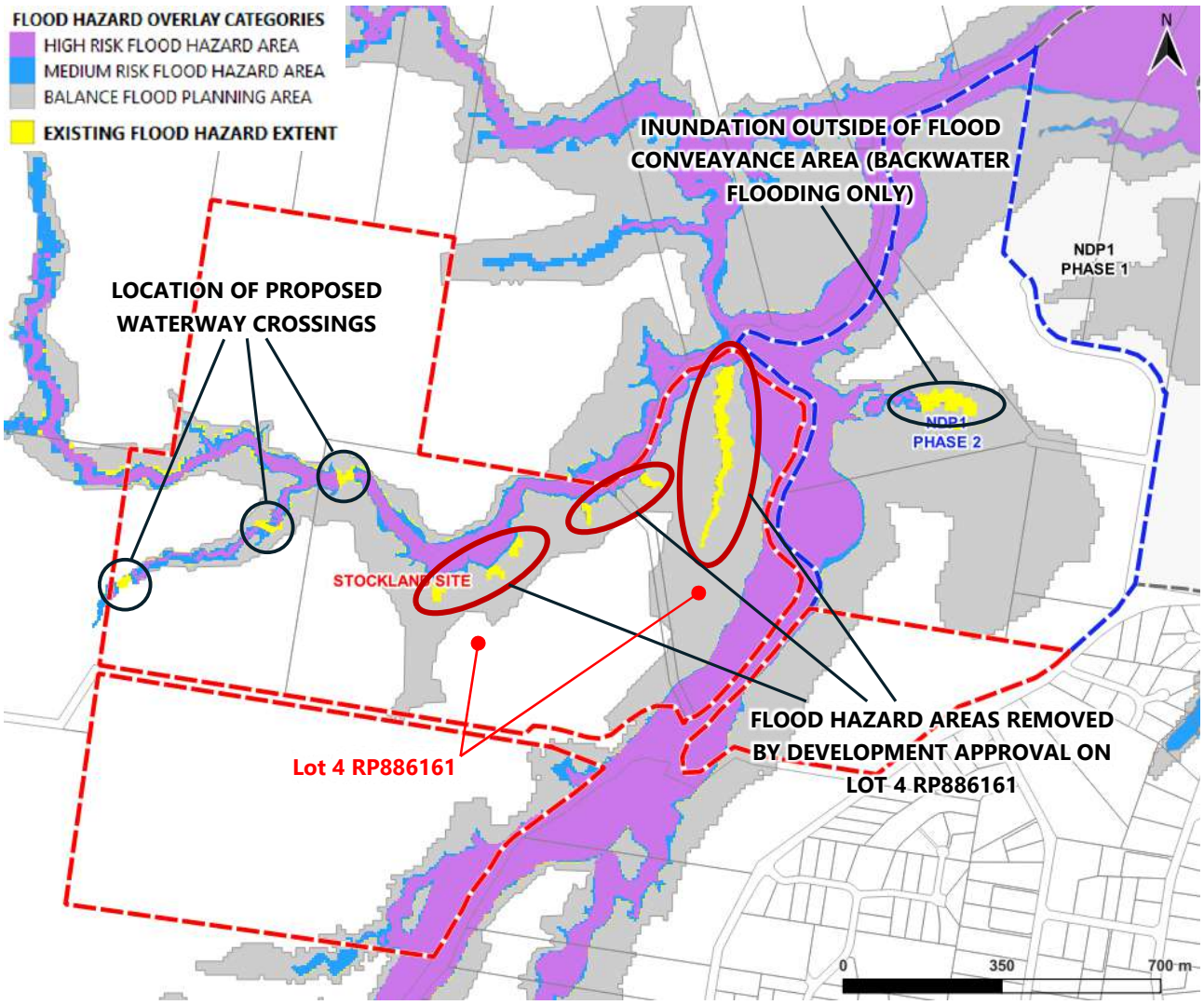


FIGURE 2-4 FLOOD HAZARD OVERLAY MAPPING[1]

The six yellow areas circled in red in **Figure 2-4** were subsequently included in CMB's Amended Flood Hazard Overlay Map (Reference No. 22-000135-D3-COMB-X, Issue B provided in **Appendix E**), which was approved on 22 June 2023 and now supersedes Flood Hazard Overlay Map OM-31 FH in Schedule 2.5 Overlay Maps of the MBRC Planning Scheme specific only to Lot 4 RP886161, as per the CMB Variation Approval (Ref: DA/41766/2020/V23P).

The investigation area is also constrained by local flooding. **Figure 2-5** below identifies area affected by local overland flow inundation as per the CMB Overland Flow Overlay mapping.

[1] *Source CMB & Calibre Professional Services*

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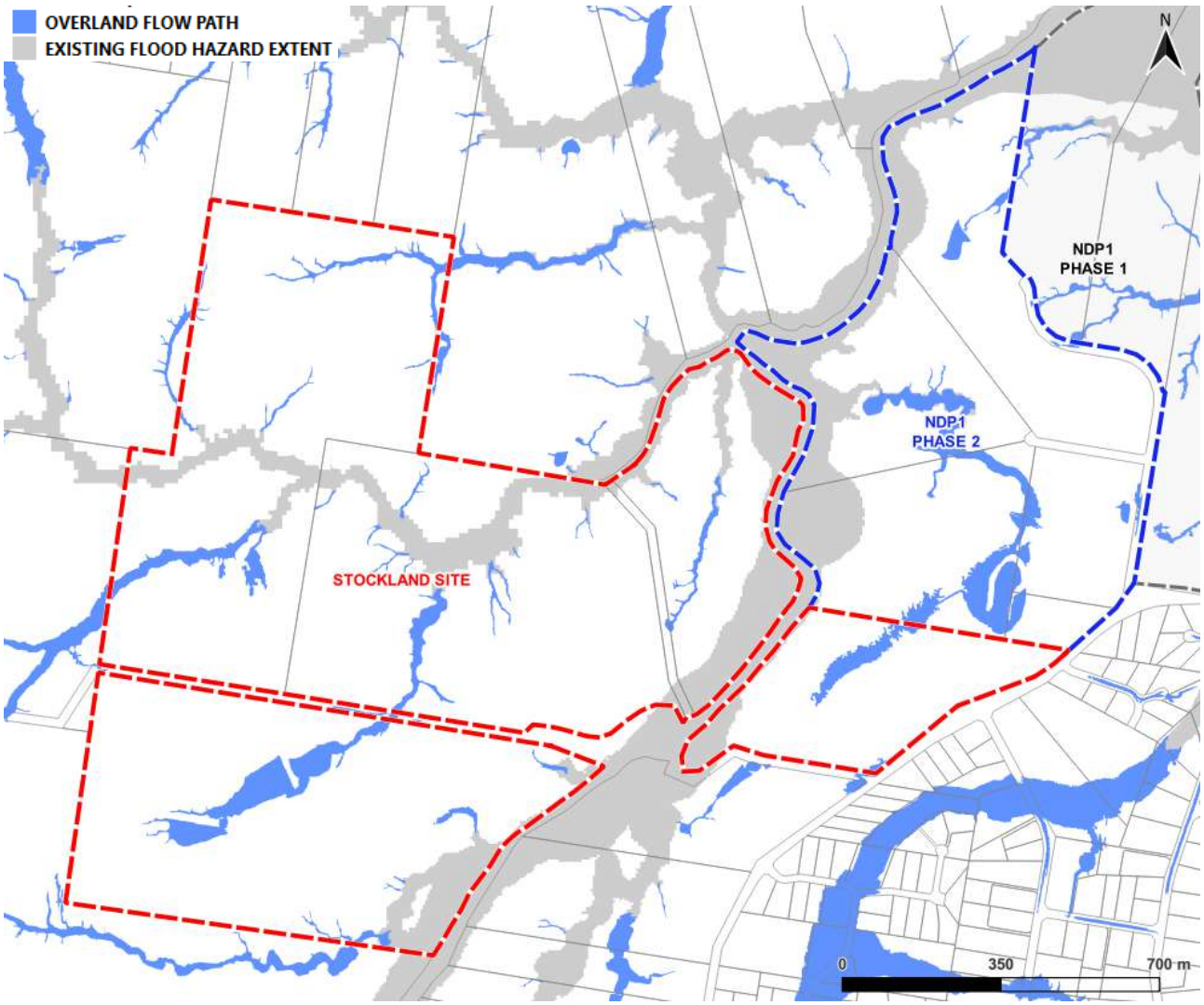


FIGURE 2-5 OVERLAND FLOW OVERLAY MAPPING[2]

Generally, the management of overland flows will be addressed through the provision of an underground drainage network, together with designed overland flow paths (i.e., roads, engineered channels and drainage reserves). The drainage infrastructure provided as part of the development will convey local runoff to an appropriate discharge location.

[2] *Source CMB.*

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3 PROPOSED MANAGEMENT STRATEGIES

3.1 Flood Management

Flood management investigations and analysis have been undertaken to determine the impact the development will have on the magnitude and timing of peak flows to the Caboolture River and Small Creek.

Hydrological and hydraulic investigations have determined that the timing of post development peak flows to the Caboolture River (including those from development within NDP1 Phase 1) do not coincide with, or increase, the peak flow from the larger upstream river catchment. Based on these results, peak flow mitigation (detention) for the investigation area discharging runoff directly to the Caboolture River is considered unnecessary.

Initial analysis has also identified that development discharging to Small Creek will increase peak flow and flood levels along this watercourse, however changed flood conditions will be limited to within the Stockland Site.

If left unmitigated the development will increase peak flows from the north eastern corner of the Stockland Site at Discharge Location C (refer to **Figure 4-4** below for site discharge locations). To meet lawful discharge requirements peak flows from the development will need to be reduced to or below existing conditions. The use of a detention storage (basin) and outlet configured to detain and reduce outflows to the downstream property was previously proposed for this discharge location, as discussed within the *NDP1 (Phase 2) & NDP2 - Flood Investigation* technical memorandum. It is now proposed to design the earthworks and drainage within the northern portion of the site so that the developed catchment is smaller so that discharge to the downstream property is no greater than existing conditions.

It is noted that no on-line detention is proposed along Small Creek as part of the flood management strategy. Preliminary culvert configurations for crossings over Small Creek have been sized to convey 1% AEP flows without reducing flows downstream.

Changes to flood conditions within the Caboolture River are expected from the construction of the river crossing. Modelling of the 1% AEP indicates that increases in flood level (and velocity) will occur, however the change to flood conditions do not alter existing access to affected properties or result in a significant increase to flood extents.

3.2 Flood Storage

The extent of the development (and associated works) is generally located outside of the Medium Risk (blue) and High Risk (purple) Flood Hazard areas of the MBRC Flood Hazard Overlay as indicated on **Figure 2-4** above. Where earthworks are expected within these areas, the works are primarily associated with infrastructure required to service the development (such as trunk sewer mains and stormwater devices). Where filling is required to provide appropriate flood immunity for roads and allotments, the works are located outside of flood conveyance areas (i.e. within areas of backwater inundation). Loss in floodplain storage resulting from filling below the 1% AEP flood level (excluding filling required for waterway crossings and trunk infrastructure) may be compensated for by excavation in areas outside of the development extent where appropriate.

*Flood storage calculations have been undertaken, demonstrating zero loss in flood storage. Refer to **Appendix G** for details.*

3.3 Waterway Crossings

Four waterway crossings are proposed as part of the Stockland development, three across Small Creek and one across the Caboolture River. The proposed Small Creek road crossings within the Stockland development are to incorporate culverts, while a bridge crossing proposed across the river. All crossings will be designed to provide 1% AEP flood immunity.

Each crossing will also be designed to incorporate elements (appropriate to the identified waterway classification) to confirm with the Department of Agriculture and Fisheries *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (2018). Refer to **Section 6** for details.

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3.4 Future Transport Corridor – Bruce Highway Western Alternative

A transport corridor approximately 100-metres wide has been incorporated into the proposed Stockland development. This corridor is for a potential Bruce Highway Western Alternative (BHWA) alignment, which allows for a two-lane dual carriageway that is planned for 40 to 60 years from now.

The previous (Issue B) report identified a strategy and provided details of analysis demonstrating how development runoff could be conveyed within the BHWA, however as there is no certainty around the BHWA (at the time this report was being prepared) the flood management strategy for the development is now presented without the BHWA.

As future approval of development that adjoins the BHWA requires written advice from SARA/TMR confirming requirements of the SARA Response (Ref: 2104-21885 SRA), the previously identified strategy incorporating the BWHA (and supporting analysis) is now provided in ***Appendix A***.

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4 HYDROLOGICAL ANALYSIS

The Watershed Bounded Network Model (WBNM) associated with the *NDP1 SWMP* (endorsed by CMB as part of the NDP1 structure planning process) has been utilised for this investigation.

This WBNM was initially associated with the CMB Caboolture River Flood Modelling Database (002c, 2014) and underwent a comprehensive verification process during its initial development (by SKM). Additional comparisons of peak flow between the WBNM and those determined by preliminary methods were undertaken as part of the *NDP1 SWMP* for a selection of local sub-catchments either within or near the NDP1 study area.

In response to Item 3 and 13 of the CMB Initial Comments (5 July 2024) email, it is noted that the existing scenario WBNM has been configured with areas and fraction impervious values representing NDP1 Phase 1 as undeveloped, while the developed scenario WBNM has been configured with catchment areas and fraction impervious values representing NDP1 Phase 1 as developed. Therefore, the hydrological analysis undertaken accounts for potential changes to flood conditions within the Caboolture River from both NDP1 Phase 1 and NDP1 Phase 2 & NDP2 flows coinciding.

4.1 Model Verification

An extract of the *NDP1 SWMP* discussing the model verification previous undertaken is presented in **Appendix D**. Based on the model verification already undertaken, and proximity of NDP2 and NDP1 Phase 2 to the NDP1 study area, the WBNM previously utilised is considered an appropriate base model for this investigation.

4.2 Catchment Delineation

For the hydrological analysis the WBNM sub-catchments in the vicinity of the proposed Stockland NDP2 and NDP1 Phase 2 area were further refined in order to produce peak results and hydrographs at the desired locations. The refined delineation for the existing scenario is presented below in **Figure 4-1**.

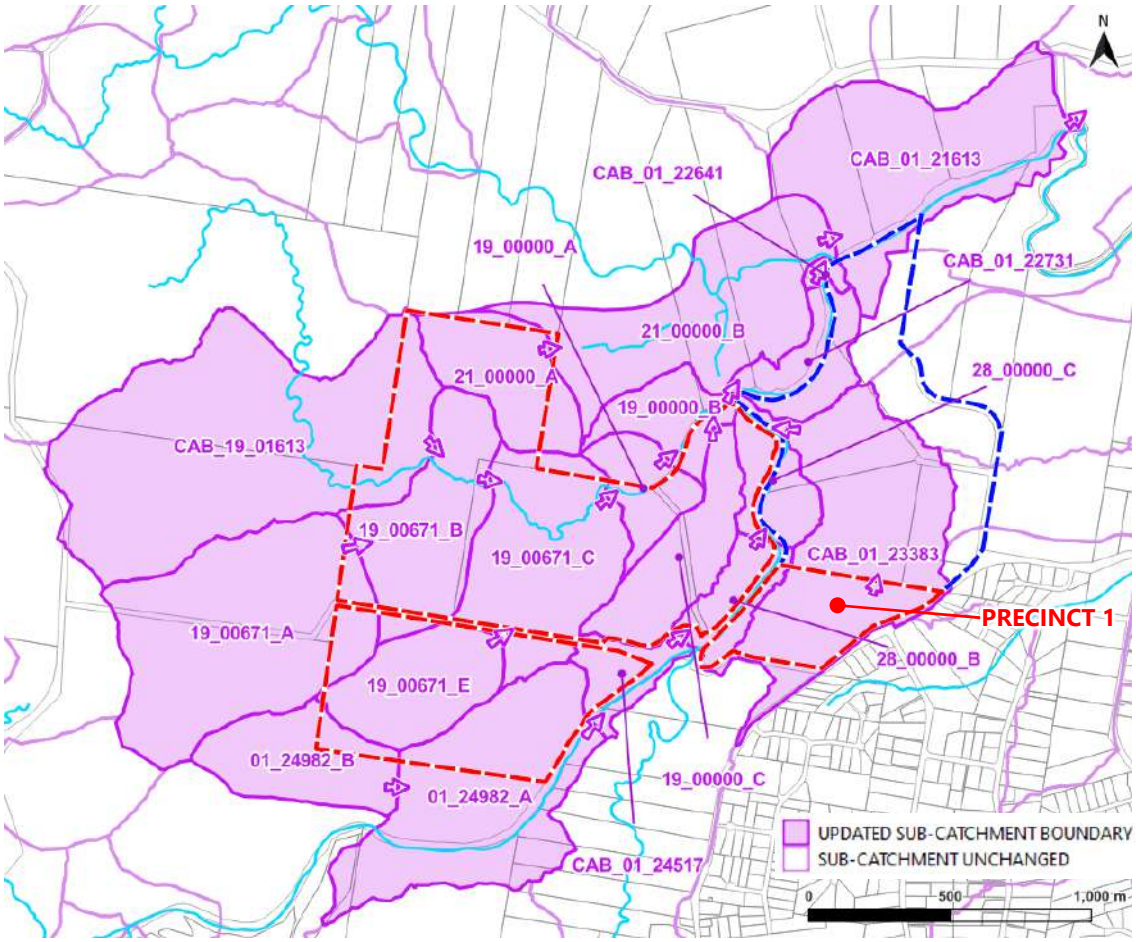


FIGURE 4-1 EXISTING SCENARIO WBNM CATCHMENT DELINEATION

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Fraction impervious values previously assigned to existing sub-catchments were adopted for the updated existing sub-catchment delineation.

For the developed scenario the fraction impervious values for each new sub-catchment were recalculated based on the land uses presented in **Figure 2-1** and fraction impervious values provided in **Table 4-1** below.

TABLE 4-1 ADOPTED DEVELOPED SCENARIO FRACTION IMPERVIOUS FOR LAND USES

LAND USE	IMPERVIOUS (%)
Green Network Areas	0
District Sports (NDP1 Phase 2)	20
Next Generation Urban Residential (NDP1 Phase 2)*	*85*
School (NDP1 Phase 2)	50
Upper Caboolture Cemetery (NDP1 Phase 2)	5
Urban Residential (Stockland Development)*	*85*
Open Space & Green Network Areas (Stockland Development)	0

* - *Fraction* Impervious value have been updated from 0.7 to 0.85 to address Item10 of the CMB Issued Raised email (dated 5 July *2024*).

It is noted that the Future BHWA corridor catchments (19_00671_C5, 19_00671_E3 & 01_24982_A2) retained existing scenario fraction impervious values for the developed scenario WBNM.

Sub-catchment delineation for the developed scenario is presented below in **Figure 4-2**. As indicated Stockland Precinct 1 runoff will be conveyed directly to the Caboolture River under the developed scenario, instead of being conveyed north (as per the exiting scenario).

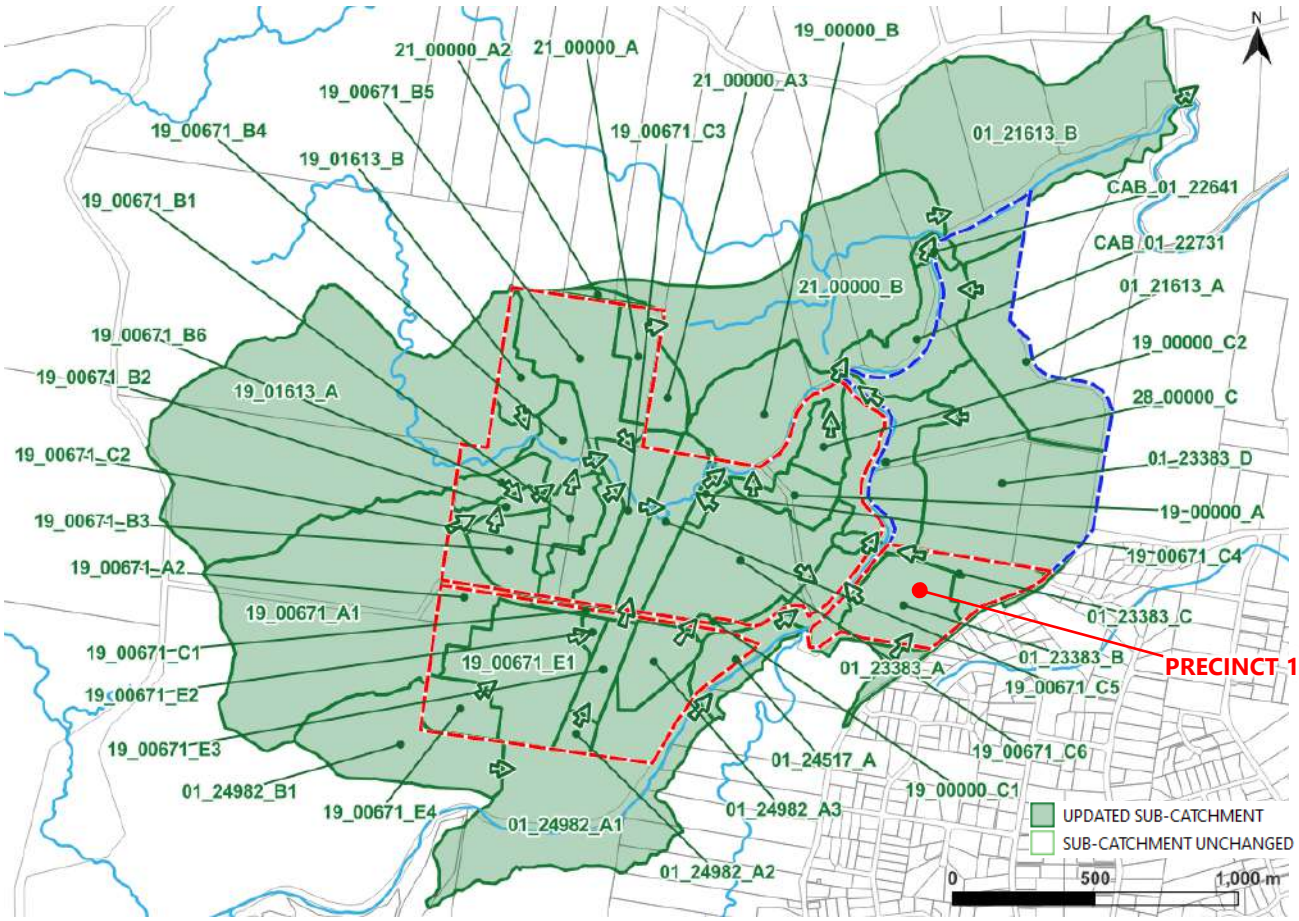


FIGURE 4-2 DEVELOPED SCENARIO WBNM CATCHMENT DELINEATION

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To address Items 9 and 12 of the CMB Initial Comments (5 July 2024) email the previous delineation of Catchment 21_00000_A has been updated to account for the upstream external catchment to the north of the site and external catchment to the east. The updated catchment delineation across the northern part of the site it presented in ***Figure 4-3*** *below.*

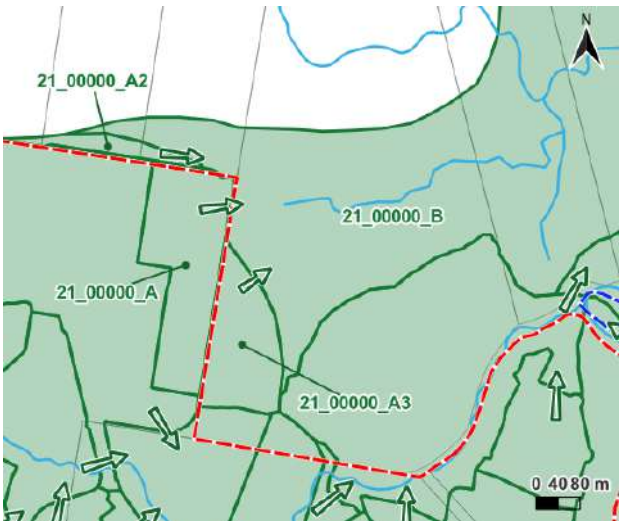


FIGURE 4-3 UPDATED CATCHMENT 21_00000_A DELINEATION

4.3 WBNM Configuration

4.3.1 Design Rainfall

WBNM models were run with following design rainfall.

4.3.1.1 ARR 1987

Australian Rainfall and Runoff (ARR) 1987 design rainfall events have been run within the WBNM for standard durations ranging from 30mins to 24hrs for the 1%, 5%, 63.2% and 1% plus climate change events. The 0.1% AEP event has been run with the recorded rainfall events consistent with those associated with the CMB Caboolture River Flood Modelling Database. ARR 1987 IFD data has been run in WBNM 2012 model software to for input into TULFOW modelling to analyse the impacts of development on flood conditions (levels and velocity) within the minor watercourses adjacent to and within the site, and along the Caboolture River.

4.3.1.2 ARR 2019

ARR 2019 storms were run in the Developed Scenario WBNM with durations ranging from 30 minutes to 36 hours for 1% AEP plus climate change event and 0.05% AEP event. Events were generated using the Storm Injector software developed by Catchment Simulation Solutions, utilising ARR Data Hub (txt) information, BOM 2016 IFD's and run using the WBNM 2023 engine.

Since the total catchment area is exceed 75km^2, both Point Temporal Patterns (PTP) from 30 minutes to 36 hours and Areal Temporal Patterns (ATP) from 12 to 36 hours were applied to produce storms for flood condition analysis for the proposed Cab_Bridge_01 design and NDP2 developments. The WBNM models were run for the design rainfall events listed in ***Table 4-2****.*

The ARR 2019 storms have been run for the following:

- *To undertake sensitivity analysis that uses the latest Australian Rainfall and Runoff guidance with respect to design hydrology. This is to address Item 1 of the CMB External Reviewers Comments (11 September 2024) email.*
- *To provide inflow for hydraulic modelling and design of the Caboolture River Bridge.*

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TABLE 4-2 ARR 2019 STORM EVENTS MODELLED IN WBNM				
DURATION (MIN)	1% AEP+CC WITH PTP	1% AEP+CC WITH ATP	0.05% AEP+CC WITH PTP	0.05% AEP+CC WITH ATP
30	✓		✓	
45	✓		✓	
60	✓		✓	
90	✓		✓	
120	✓		✓	
180	✓		✓	
270	✓		✓	
360	✓		✓	
540	✓		✓	
720	✓	✓	✓	✓
1080	✓	✓	✓	✓
1440	✓	✓	✓	✓
1800			✓	✓
2160			✓	✓

4.3.2 Sub Catchment Configuration

Sub-catchment properties input into the WBNM for the existing scenario are summarised in **Table 4-3**.

TABLE 4-3 EXISTING SCENARIO SUB-CATCHMENT PROPERTIES					
SUB-CATCHMENT	AREA (HA)	IMPERVIOUS (%)	SUB-CATCHMENT	AREA (HA)	IMPERVIOUS (%)
01_24982_A	46.366	2.1	**21_00000_B**	40.947	0.2
01_24982_B	19.01	2.1	**28_00000_B**	9.622	0
19_00000_A	10.005	0.7	**28_00000_C**	10.87	0
19_00000_B	10.579	0.7	**CAB_01_21613**	47.652	2.9
19_00000_C	17.373	0.7	**CAB_01_22641**	1.282	4.6
19_00671_A	56.418	1.6	**CAB_01_22731**	11.95	1.9
19_00671_B	26.452	1.6	**CAB_01_23383**	47.507	4.2
19_00671_C	34.213	1.6	**CAB_01_24517**	7.922	9.7
19_00671_E	19.056	1.6	**CAB_19_01613**	83.769	0.1
21_00000_A	18.3	0.2			

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Sub-catchment properties input into the WBNM for the developed scenario are summarised in **Table 4-4**.

TABLE 4-4 DEVELOPED SCENARIO SUB-CATCHMENT PROPERTIES

SUB-CATCHMENT	AREA (HA)	IMPERVIOUS (%)	SUB-CATCHMENT	AREA (HA)	IMPERVIOUS (%)
01_21613_A	16.059	53	**19_00671_B6**	3.518	85
01_21613_B	47.352	2.9	**19_00671_C1**	1.193	57
01_23383_A	2.298	4.2	**19_00671_C2**	4.638	85
01_23383_B	10.360	55	**19_00671_C3**	9.873	1.6
01_23383_C	6.366	85	**19_00671_C4**	1.283	1.6
01_23383_D	31.852	35	**19_00671_C5**	7.178	1.6
01_24517_A	6.420	9.7	**19_00671_C6**	20.096	85
01_24982_A1	37.355	2.1	**19_00671_E1**	16.531	85
01_24982_A2	1.610	30	**19_00671_E2**	0.808	2.1
01_24982_A3	5.818	85	**19_00671_E3**	3.811	30
01_24982_B1	16.906	2.1	**19_00671_E4**	4.719	85
19_00000_A	4.533	85	**19_01613_A**	77.965	0.1
19_00000_B	16.516	0.7	**19_01613_B**	4.587	85
19_00000_C1	2.0490	85	**21_00000_A**	4.700	85
19_00000_C2	3.357	85	**21_00000_A2**	0.797	0.2
19_00671_A1	50.763	1.6	**21_00000_A3**	3.202	0.2
19_00671_A2	7.147	85	**21_00000_B**	40.730	0.2
19_00671_B1	4.641	85	**28_00000_B**	6.382	0
19_00671_B2	2.074	1.6	**28_00000_C**	15.117	0
19_00671_B3	5.964	85	**CAB_01_22641**	1.282	4.6
19_00671_B4	5.172	0.1	**CAB_01_22731**	11.990	1.9
19_00671_B5	14.380	85			

Note: Catchment delineation incorporates updates to account for changes to earthworks design and refinement of Catchment 21_00000_A. Fraction impervious values have also been updated for higher Next Generation Urban Residential (NDP1 Phase 2) and Urban Residential (Stockland Development) values as per Table 4-1.

The developed catchment delineation and fractions impervious values are based on the development layout and earthworks strategy prepared at the time this report was prepared. Catchment delineation and fraction impervious value are to be reviewed as part of future precinct design works and updated if necessary.

4.3.3 Critical Storms

*Critical ARR 1987 storm durations for the NDP2 development have been identified at the reporting point locations (A to J) as shown in **Figure 4-4** below.*

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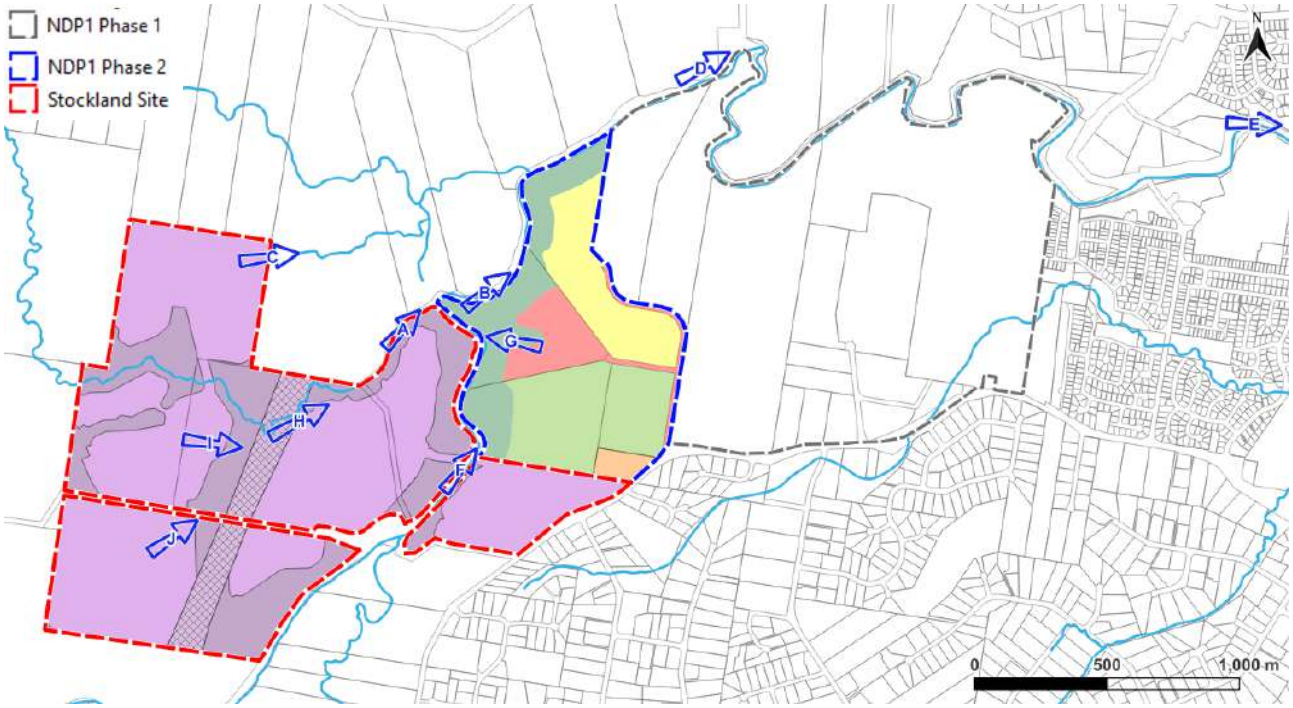


FIGURE 4-4 WBNM REPORTING POINT LOCATIONS

4.3.3.1 ARR 1987

ARR 1987 critical storms have been identified and are listed in the **Table 4-5** *below.*

TABLE 4-5 ARR 1987 CRITICAL STORMS

LOCATION	SUB CATCHMENT ID	0.1% AEP *	1% AEP	5% AEP	63% AEP	1%AEP+CC
A	19_00000_B	180min	90min	120min	120min	90min
B	CAB_01_22731	300min	360min	360min	360min	360min
C	21-00000_B (Top)	180min	30min	60min	60min	60min
D	01_21613_B	300min	360min	360min	360min	360min
E	CAB_01_17864	300min	360min	360min	360min	360min
F	28_00000_B	300min	360min	360min	360min	270min
G	01_23383_D	180min	60min	60min	60min	60min
H	19_00671_C5	180min	90min	90min	120min	90min
I	19_00671_B4	180min	90min	90min	120min	90min
J	19_00671_E2	180min	60min	60min	60min	60min

** 0.1% AEP events are based on historical rainfall events rather than ARR IFD data.*

4.3.3.2 ARR 2019

The critical storms of ARR 2019, using the WBNM 2023 engine for the reporting points, were identified through the Storm Injector and Box Whisker analysis of the 1% AEP plus climate change event. Refer to ***Table 4-6*** *for the critical duration and TP below.*

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TABLE 4-6 ARR 2019 CRITICAL STORMS		
LOCATION	SUB CATCHMENT ID	1%AEP+CC
A	19_00000_B	12hr_TP9
B	CAB_01_22731	6hr_TP10
C	21-00000_B (Top)	45min_TP5
D	01_21613_B	6hr_TP10
E	CAB_01_17864	6hr_TP10
F	28_00000_B (CAB BRIDGE)	6hr_TP10
G	01_23383_D	12hr_TP9
H	19_00671_C5	12hr_TP9
I	19_00671_B4	12hr_TP9

*Refer to **Appendix F** for more detailed Box Whisker analysis of each reporting locations.*

The critical storms of ARR 2019, using the WBNM 2023 engine for the proposed Caboolture Bridge at sub-catchment of 28_00000_B were identified using Storm Injector to produce the Box and Whisker Plot statistical analysis of the 1% AEP plus climate change event (adopted as the Serviceability Limit State (SLS) event for the bridge design) and 0.05% AEP event (adopted as the Ultimate (Failure) Limit State (ULS) event for the bridge design). **Figure 4-3** and **Figure 4-4** show the Box and Whisker Plots for the flows at the proposed Caboolture River bridge for the SLS and ULS design flood events, respectively.

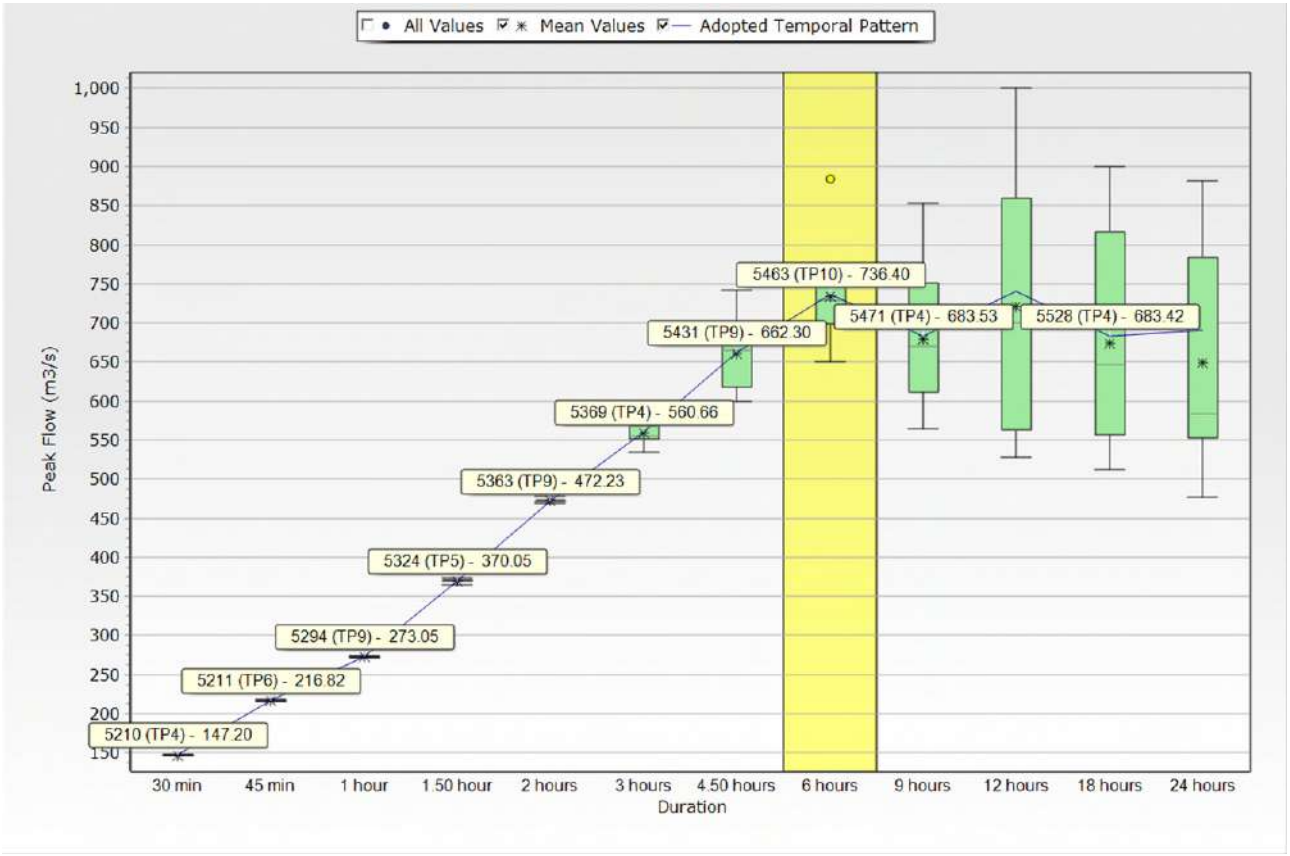


FIGURE 4-5 BOX WHISKER OF 1%AEP PLUS CLIMATE CHANGE STORM EVENT (SLS) FOR PROPOSED BRIDGE

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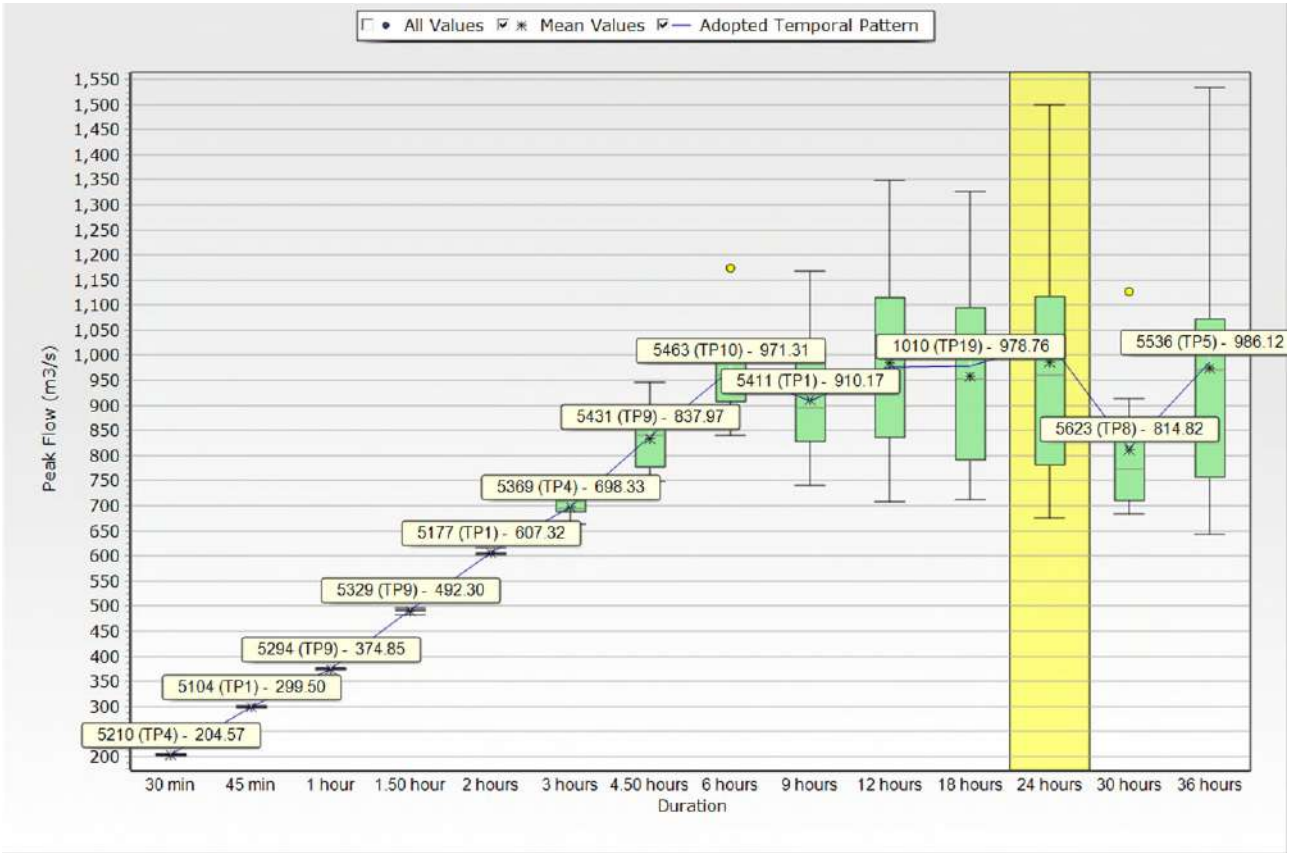


FIGURE 4-6 BOX WHISKER OF 0.05%AEP STORM EVENT (ULS) FOR PROPOSED BRIDGE

According to the Box Whisker Plots, the 6-hour duration with Point TP10 is identified as the critical storm for the 1% AEP plus climate change event, while the 24-hour duration with Areal TP19 is the critical storm for the 0.05% AEP event for the proposed bridge.

The hydrographs of these critical storms have been applied as inflow boundary conditions to hydraulic TUFLOW model to analysis the flood conditions at the proposed bridge both for SLS and ULS design flood events under post-development catchment conditions.

4.4 WBNM Results

*Flow hydrographs for the existing and developed scenarios (adopting ARR 1987 rainfall) are compared at ten locations (A to J) as indicated in **Figure 4-4** above to assess how the change in land use impacts flows within Small Creek / NDP2 Site and the Caboolture River.*

To address Items 9 and 12 of the CMB Initial Comments (5 July 2024) email the short duration events (up to 360 minutes) have been run with shorter timesteps to remove the angularity from the model results.

4.4.1 Small Creek / NDP2 Site

Flow hydrograph comparisons are presented in **Figure 4-7** below for the two discharge locations from the Stockland site west of the Caboolture River (NDP2 site), being:

- Location A - Where Small Creek discharges into the Caboolture River.
- Location C – North eastern site corner.

*The results indicate that, for the event critical to Small Creek, peak flows to the Caboolture River will increase by 17%. The interaction of flows from Small Creek with backwater from the Caboolture River is further discussed in **Section 5**.*

Although the fraction impervious value adopted for the residential land use has increased from 70% to 85%, the comparison for Location C demonstrates that the proposed strategy to limit runoff from the

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developed catchment to the northeastern corner of the site remains effective in reducing peak flows to below existing conditions.

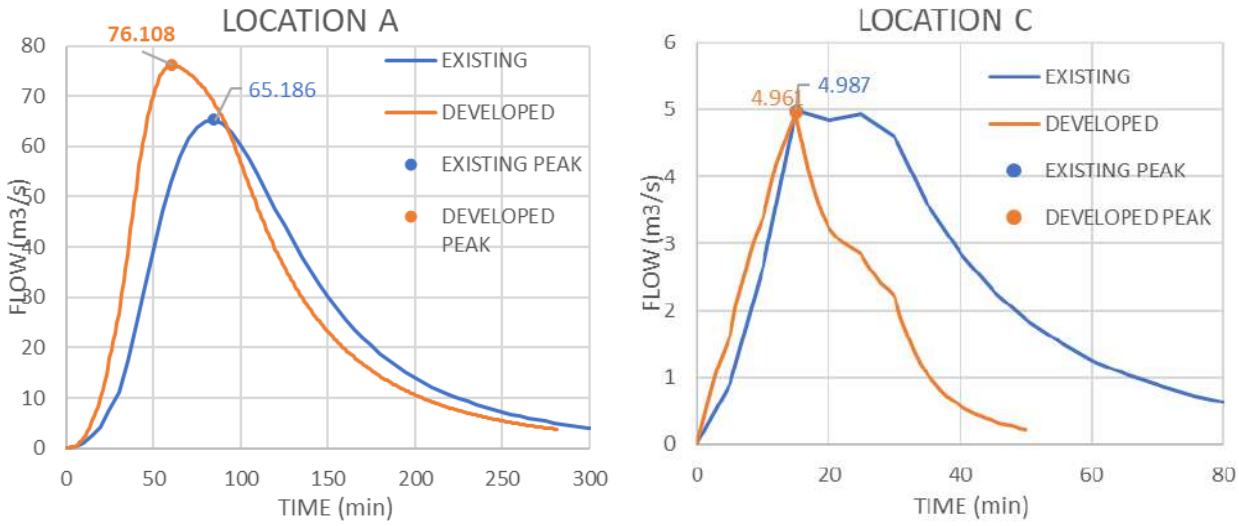


FIGURE 4-7 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATIONS A & C

Flow hydrograph comparisons are presented in **Figure 4-8** and **Figure 4-9** below for the three internal discharge locations within the Stockland development, being:

- Location H –Small Creek, downstream of the future transport corridor.
- Location I – Flow within Small Creek discharging to the Energex Easement and future transport corridor.
- Location J – Development south of Litherland Road discharging to the Energex Easement and future transport corridor.

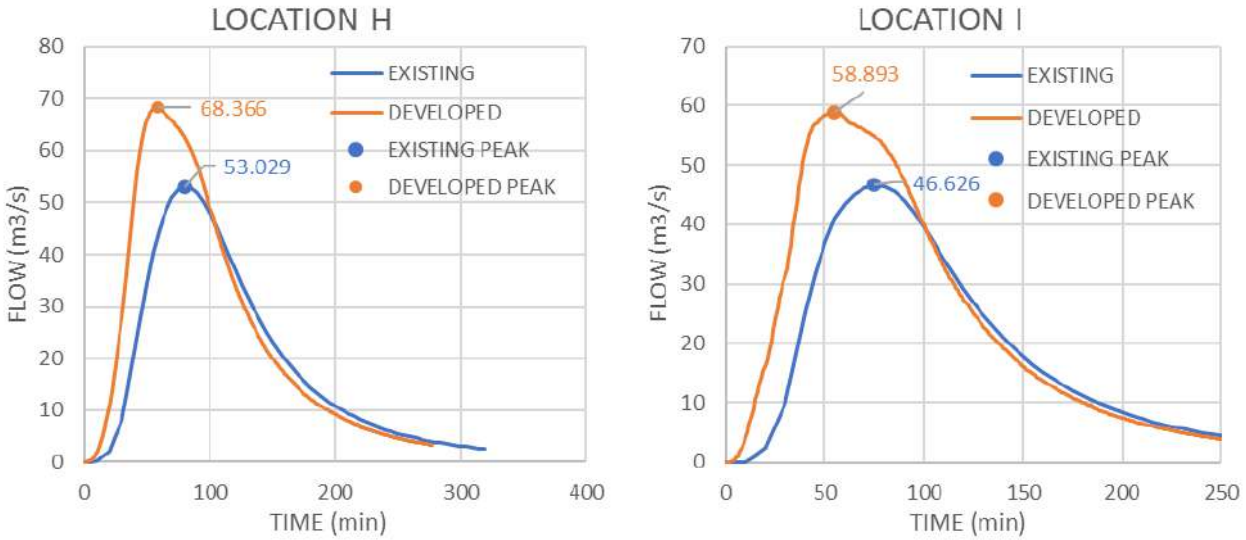


FIGURE 4-8 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATIONS H & I

The comparisons at Discharge Locations H and I indicate that peak flows within Small Creek will increase as a result of the development.

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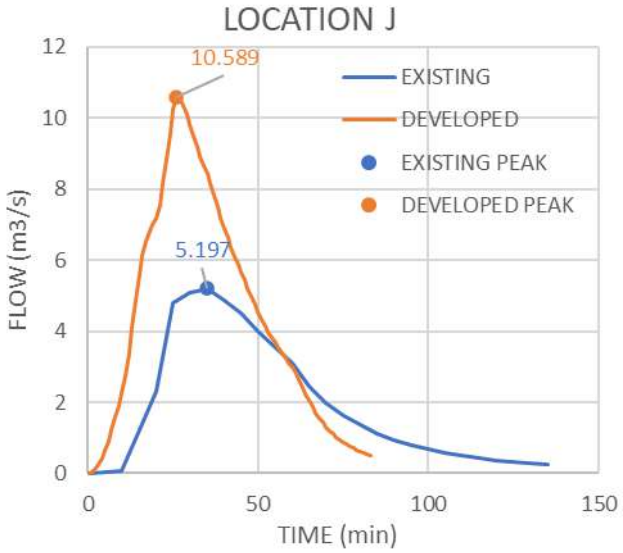


FIGURE 4-9 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATION J

Runoff from development on the southern side of Litherland Road (Discharge Location J) will increase from development.

*Discussion on future considerations regarding drainage infrastructure associated with future transport corridor is provided in **Appendix A**.*

4.4.2 Caboolture River

Flow hydrograph comparisons are presented in **Figure 4-10** below for the four discharge locations along the Caboolture River being:

- Location B – Downstream of the confluence with Small Creek.
- Location F – Downstream of the river crossing.
- Location D – Downstream of NDP1 Phase 2 development extent.
- Location E – Downstream of the NDP1 Phase 1 development extent.

The results indicate that, irrespective of the increase in runoff from development, there is only a negligible increase (less than 0.2%) in peak flow for the event critical to the Caboolture River downstream of the river crossing and at the downstream extents of the NDP1 Phase 1 and NDP1 Phase 2. The results also indicate a negligible reduction in peak flow (less than 0.1%) downstream of the confluence with Small Creek.

A five-minute reduction in the time to peak flow occurs for all four Discharge Locations. This negligible change in timing is equivalent to a single timestep of the WBNM.

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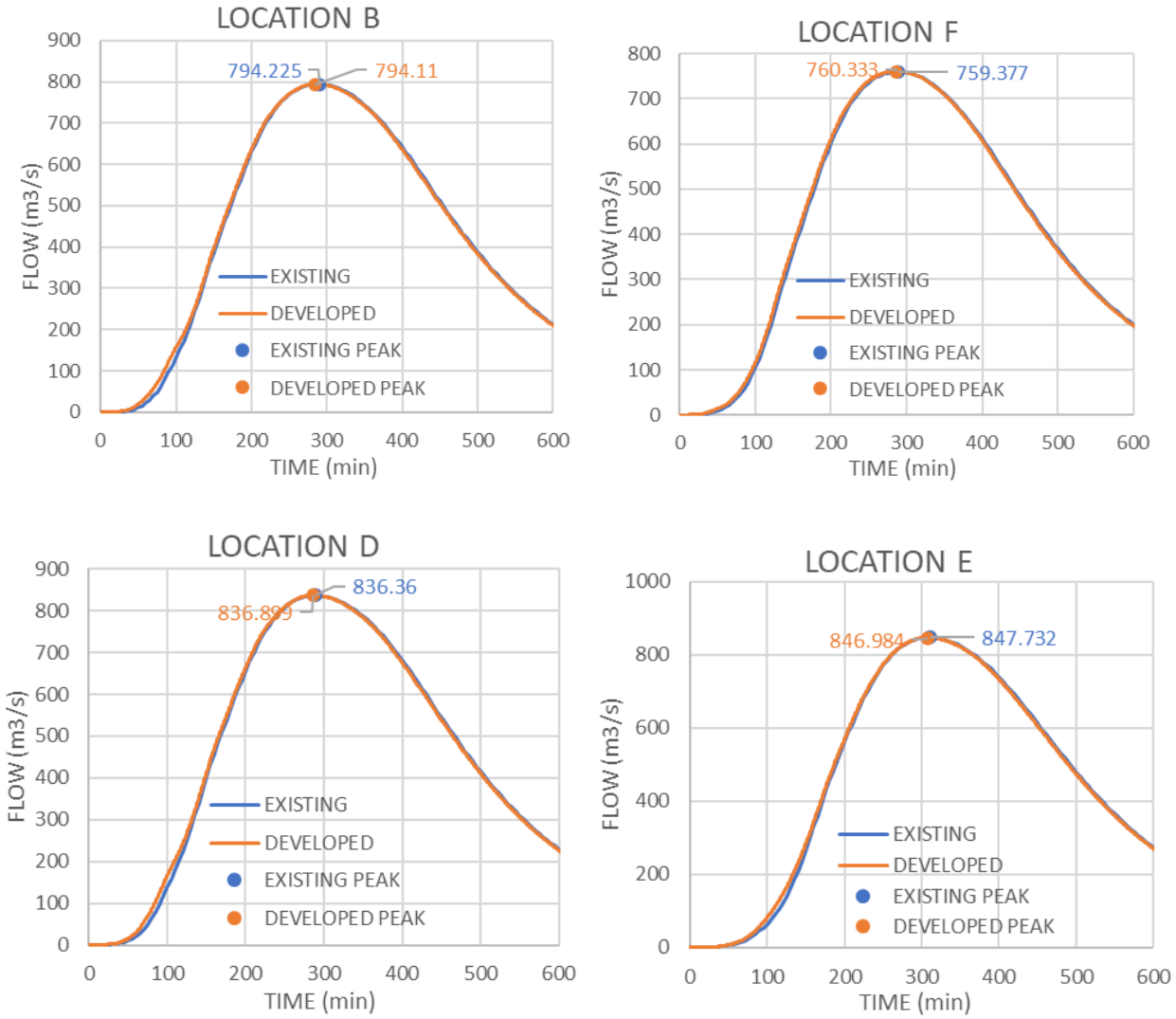


FIGURE 4-10 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATIONS B, F, D & E

The flow hydrograph comparison for Discharge Location G in **Figure 4-11** below shows the change in peak flow and runoff from the development of NDP1 Phase 2 north of the Stockland Precinct development.

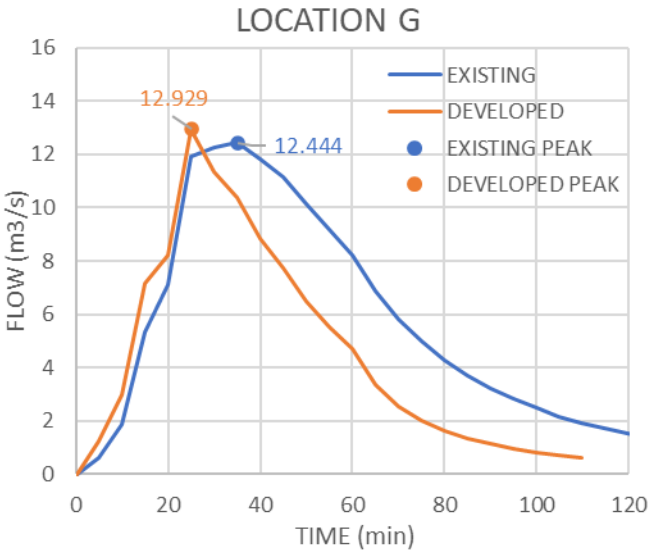


FIGURE 4-11 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATION G

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The results indicate that a slight increase in peak flow (4%) will occur from NDP1 Phase 2 as a result of development. It is noted that the discharge of Stockland Precinct 1 development runoff to the Caboolture River (instead of into the NDP1 Phase 2 area) is evident in the both the peak flow and reduced volume of runoff.

4.4.3 Comparison Summary of WBNM results

Peak flow results for the existing and developed scenarios compared at the seven locations (Discharge Locations A to J are depicted on **Figure 4-4**) discussed above are summarised in **Table 4-7** to assess how the change in land use impacts flows within the Small Creek / NDP2 Site and the Caboolture River.

TABLE 4-7 WBNM PEAK FLOW COMPARISON SUMMARY

REPORTING LOCATION	SCENARIO	0.1% AEP FLOW (M^3/S)	1% AEP FLOW (M^3/S)	5% AEP FLOW (M^3/S)	63.2% AEP FLOW (M^3/S)
A	Existing	97.966	65.186	40.145	12.41
	Developed	103.346 (+5.38)	76.108 (+10.922)	47.272 (+7.127)	15.065 (+2.655)
B	Existing	1408.89	794.225	509.091	147.622
	Developed	1393.499 (-15.391)	794.114 (-0.111)	508.541 (-0.55)	147.559 (-0.063)
C	Existing	5.384	4.987	3.515	1.036
	Developed	2.758 (-2.626)	4.961 (-0.026)	2.955 (-0.56)	1.053 (+0.017)
D	Existing	1482.795	836.36	535.74	155.219
	Developed	1467.874 (-14.921)	836.899 (+0.539)	535.649 (-0.091)	155.332 (+0.113)
E	Existing	1499.335	847.732	541.329	155.476
	Developed	1481.682 (-17.653)	846.984 (-0.748)	540.619 (-0.71)	155.8 (+0.324)
F	Existing	1346.775	759.377	487.281	141.699
	Developed	1335.867 (-10.908)	760.333 (+0.956)	487.974 (+0.693)	141.977 (+0.278)
G	Existing	13.302	12.444	6.025	2.154
	Developed	9.489 (-3.813)	12.929 (+0.485)	8.801 (+2.776)	3.271 (+1.117)
H	Existing	89.309	53.029	37.371	11.471
	Developed	92.228 (+2.919)	68.366 (+15.337)	42.086 (+4.715)	13.173 (+1.702)
I	Existing	76.807	46.626	32.717	9.962
	Developed	80.358 (+3.551)	58.893 (+12.267)	35.923 (+3.206)	11.198 (+1.236)
J	Existing	5.63	5.197	3.64	1.072
	Developed	7.017 (+1.387)	10.589 (+5.392)	8.08 (+4.44)	3.516 (+2.444)

4.4.4 Hydrograph Inputs for the Hydraulic Analysis

Flow hydrographs for the range of ARR 1897 durations for each AEP discussed in **Section 4.3.3** have been extracted from the WBNM for input into the TUFLOW model for the hydraulic analysis; not just the event durations identified as being critical for the respective AEP event. However, for the hydraulic analysis of the ARR 2019 ensembles of design storms, hydrographs for only the one duration and temporal pattern identified as being critical for the respective AEP event were extracted from the WBNM for input into the TUFLOW model.

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5 HYDRAULIC ANALYSIS

The 2D TUFLOW modelling previously undertaken for the *NDP1 SWMP* was updated to analyse the impacts of development on flood conditions (levels and velocity) within the minor watercourses adjacent to and within the site, and along the Caboolture River.

The TUFLOW model configured for the *NDP1 SWMP* was initially sourced for the CMB *Caboolture River Flood Modelling Database* (002c, 2014) and underwent a comprehensive verification process during its initial development (by SKM). As part of the *NDP1 SWMP* investigations a more recent version of the TUFLOW software (Build 2020-10-AB-iSP-w64) was utilised that enabled significantly shorter model run times. Maximum flood level results from the original model using software adopted by CMB was compared with results from the same flood model data adopting more recent Build 2020-10-AB software, which demonstrated the latter were appropriate for the hydraulic analysis.

For this investigation the 5%, 1% and 0.1% AEP flood events have been analysed for the range of storm durations discussed in **Section 4.3.3**. The results presented below represent the maximum flood envelope for the range of modelled durations.

5.1 Modelled Scenarios

Based on the critical storm durations identified at the reporting points in the hydrological analysis, TUFLOW model simulations were initially run for the select design rainfall events.

In response to Items 3 and 4 of the CMB External Reviewers Comments (11 September 2024) email, TUFLOW model simulations have now been run for the following events utilising ARR 1987 rainfall:

- *The 63%, 5% and 1% AEP for all standard durations from 30 minutes to 1440 minutes*
- *The 0.1% AEP for recorded based rainfall events consistent with those associated with the CMB Caboolture River Flood Modelling Database.*
- *The 1% with Climate Change has been run for both zero blockage (0BL) and design blockage (DES_BL) for all standard durations from 30 minutes to 1440 minutes.*

Further, in response to Item 1 of the CMB External Reviewers Comments (11 September 2024) email, TUFLOW model simulations have also been run for the listed identified critical events for the 1% AEP plus Climate Change Event utilising ARR 2019 temporal patterns and rainfall:

- *45 minute TP05*
- *360 minute TP10*
- *720 minute TP09*

5.1.1 Existing Scenario

The updates to the existing scenario model as part of this Revision C investigation relate to the updated catchment delineation and hydrological model inputs (including shorter WBNM timesteps). New sub-area SA Polygons were created (including realigning of current SA Polygons where required) to input the inflow hydrographs from the updated WBNM.

Existing scenario flood plans depicting maximum results for flood levels, flood extent, peak depth and peak velocity are provided in **Appendix B**.

5.1.2 Developed Scenarios

The updates to the developed scenario model as part of this Revision C investigation relate to the updated Caboolture River bridge crossing and bulk earthworks model and the corresponding catchment delineation, Manning's roughness and hydrological model inputs (including shorter WBNM timesteps). New sub-area SA Polygons were created (including realigning of current SA Polygons where required) to input the inflow hydrographs from the updated WBNM.

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Developed scenario flood plans depicting maximum results for flood levels, flood extent, peak depth, peak velocity and flood difference (afflux) are provided in **Appendix C**. The model changes and results of the flood analysis of developed conditions are discussed in the following sections.

5.1.2.1 Development Hydrology & Changes to Landform

The developed scenario TUFLOW model was configured to include the updated developed scenario hydrological model results. This was done by creating new sub-catchment SA Polygons (and realigning current SA Polygons where required) to input flow hydrographs from the updated WBNM.

In addition to input of the developed scenario hydrology the model was updated to incorporate changes to proposed landform. This involved the following inputs:

- A Digital Elevation Model (DEM) of the proposed earthworks associated with the Stockland development (created from information provided by KN Group[3]).

  It is noted that the updated earthworks DEM as provided by KN Group was incorporated into the TUFLOW model for this report Issue C update.

- Elevation shapes to increase and replicate development levels in NDP1 Phase 1 & 2 areas outside of the Green Network area.
- Preliminary culvert configurations within the Stockland development (i.e., watercourse crossings).

Preliminary calculations (using peak flow results from the developed scenario WBNM) were undertaken to determine culvert configurations for watercourse crossings within the Stockland development. The configurations are preliminary only, for the purpose of incorporating culverts and allowing for the conveyance of flows under crossing within the TUFLOW model.

> *In response to Item 16 of CMB Initial Comments (5 July 2024) and Item 8 of the CMB External Reviewers Comments (11 September 2024) zero blockage has been adopted for all proposed culverts for impact analysis while 25% blockage (and limiting outlet velocity to a maximum of 2.5 m/s) has been adopted for all proposed culverts to assess development levels, in accordance with CMB's Regional Flood Database: Floodplain Parametrisation Report (SKM 2012).*

The culvert design has also considered the current (2023) fish passage classifications and respective design requirements as per the Department of Agriculture and Fisheries *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (2018), specifically minimum aperture widths, skew angles and culvert bed levels. Culvert configurations will be refined as part of future design works.

It is noted that Manning's roughness values were updated for development areas only. For areas where changes to surface levels occur for urban use (i.e., roads and allotments) a roughness value of 0.15 has been adopted. Existing values have been retained outside of development extents. This is consistent with the modelling previously undertaken for the *NDP1 SWMP*.

5.1.2.2 Proposed River Crossing

The developed scenario model configuration included the proposed Caboolture River Road crossing, which incorporated the following inputs from KN Group (civil and earthworks design) and Red Fox Advisory (structural and geotechnical engineering design of the Caboolture River Bridge):

- Earthworks associated with the proposed bridge abutment, incorporated into the flood model as a digital elevation model.
- The proposed bridge, incorporated into the model as a layered flow constriction shape detailed below in **TABLE 5-1**.

[3] *DEM created from Triangulated Irregular Network (TIN) of high-level Caboolture West finished surface design prepared in 2024 (received from KN Group October 2024).*

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TABLE 5-1 TUFLOW BRIDGE LAYER (2D_LFCSH) ATTRIBUTES

STRUCTURE ID	SHAPE WIDTH (m)	L1 OBVERT (m AHD)	L1 BLOCKAGE (%)	L1 FLC	L2 DEPTH (m)	L2 BLOCKAGE (%)	L2 FLC	L3 DEPTH (m)	L3 BLOCKAGE (%)	L3 FLC
Cab_ Bridge_01	14.860	Point Varying (Pier 2 = 23.201)	4.65	0.1	3.277	100	1.6	0.979	30	0

Details of the required drainage infrastructure identified by the hydraulic analysis are presented in **Section 6**.

5.1.2.3 Form Loss Coefficient Validation

In response to Item 6 of the CMB External Reviewers Comments (11 September 2024) email, the 1D HECRAS model was developed to validate the Form Loss Coefficient (FLC) adopted for the bridge sub-structure (Layer 1) within the TUFLOW model 2D Layered Flow Constriction in accordance with Section 7.3.8 of the TUFLOW User Manual 2023-03.

This Layer 1 bridge sub-structure is comprised of spill-through abutments and three (3) piers comprising of two (2) 1200 mm diameter Cast-In-Place (CIP) piles spaced at 10-metre centres. The bridge is not expected to overtop, and there is approximately 1.6 metres of freeboard to the lowest soffit level at Abutment B in the 0.05% AEP flood event. Given the proposed bridge spans a total length of 137-metres from high bank to high bank with a relatively hydraulicly efficient sub-structure, the overall flow constriction applied by the bridge is minimal.

Based on the HECRAS results yielding an average head loss of only 30mm resulting from the proposed bridge, the TUFLOW model Layer 1 FLC was iteratively adjusted between a range of 0.001 to 1 until a close correlation with the HEC-RAS results was observed when adopting a L1_FLC value of 0.1. Hence, a Layer 1 FLC of 0.1 was adopted for the TUFLOW model 2D Layered Flow Constriction.

The configuration and results of the HEC-RAS model and the FLC validation is detailed further in **Appendix H.**

5.2 TUFLOW Model Results

Peak water level, depth and velocity results were extracted for each storm duration and combined to create 'max of max' raster files for each set of peak flood results for the extent of the TUFLOW model. Flood difference (or afflux) plans for water level and velocity were produced by comparing the developed scenario results against those for the existing scenario.

Existing scenario flood plan results (flood levels, depths and velocity plans) are provided in **Appendix B** and developed scenario flood plan results (flood levels, depths, velocity and flood difference plans) are provided in **Appendix C**.

5.2.1 Flood Impact

In response to Item 16 of CMB Initial Comments (5 July 2024) and Item 8 of the CMB External Reviewers Comments (11 September 2024) zero blockage has been adopted for all proposed culverts for impact analysis while 25% blockage (and limiting outlet velocity to a maximum of 2.5 m/s) has been adopted for all proposed culverts to assess development levels, in accordance with CMB's Regional Flood Database: Floodplain Parametrisation Report (SKM 2012).

This section presents TUFLOW model results with zero blockage for all proposed culverts in the developed scenario for the purpose of impact assessment against the existing scenario results.

Figure 5-1 below presents the 1% AEP flood level difference between the existing and developed scenarios.

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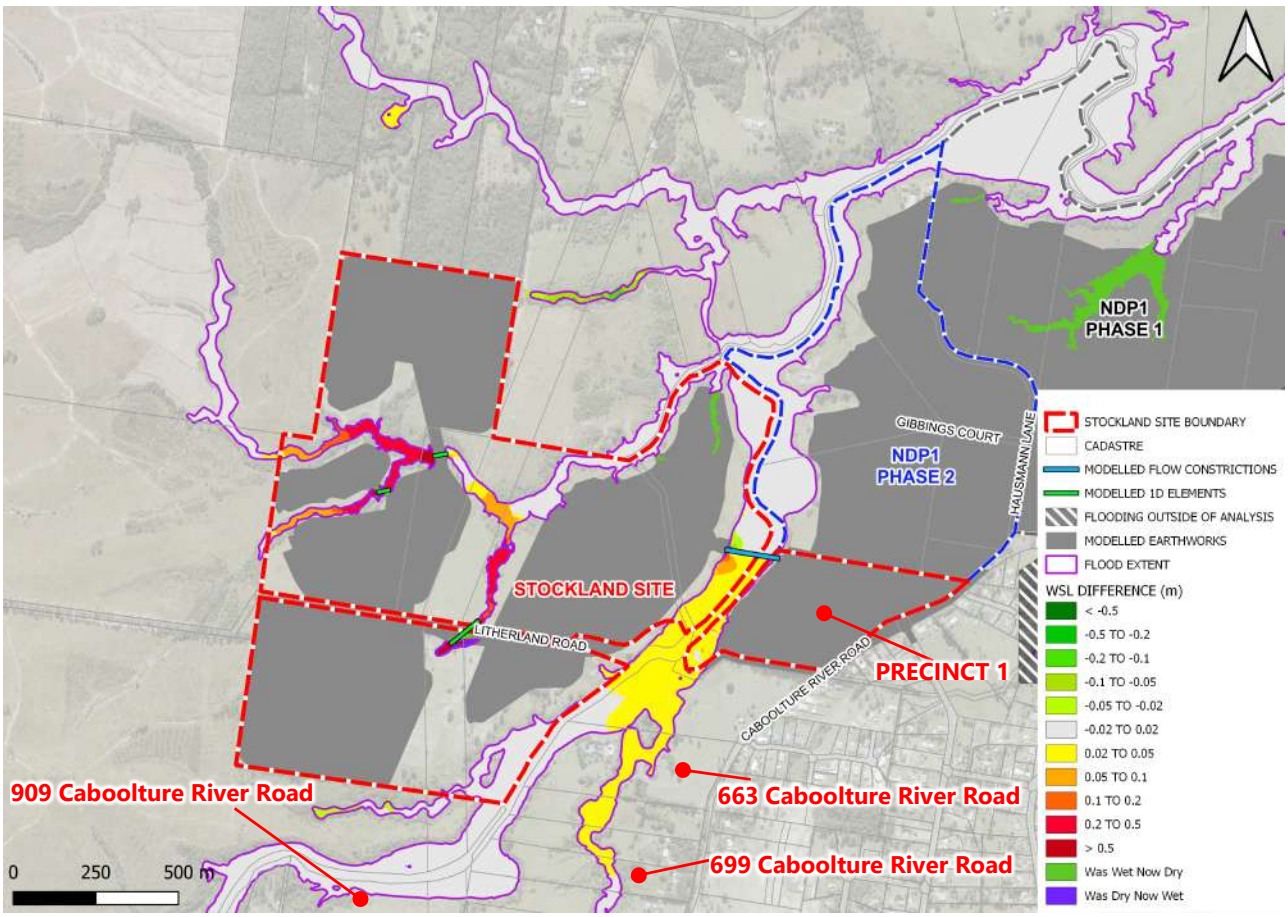


FIGURE 5-1 1% AEP FLOOD LEVEL DIFFERENCE OVERALL

5.2.1.1 Caboolture River

The 1% AEP flood level difference results indicate a flood impact greater than 20mm within the Caboolture River extending less than 1km upstream of the proposed river crossing to the property at 663 Caboolture River Road. This flood impact greater than 20mm also propagates upstream within a nearby tributary of the river to the property at 699 Caboolture River Road.

A maximum flood level increase of 0.22m occurs immediately upstream of the western bridge abutment and overbank area as depicted in **Figure 5-2**. The maximum 1% AEP flood level increase within the main channel of the river is approximately 0.05m, which occurs immediately upstream of the proposed bridge structure as depicted in **Figure 5-2**.

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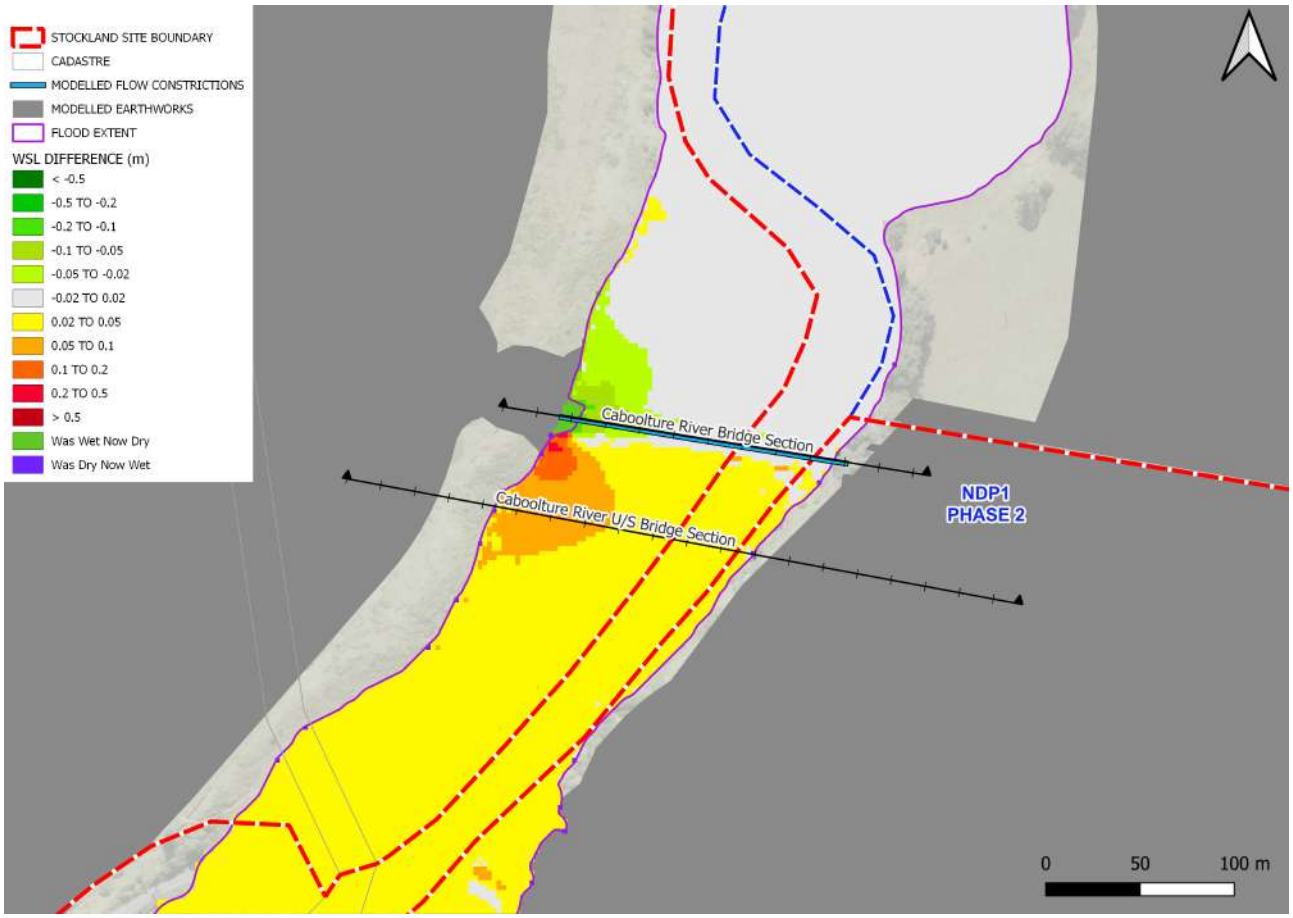


FIGURE 5-2 CROSS SECTION LOCATIONS AT RIVER CROSSING WITH 1% AEP WSL DIFFERENCE

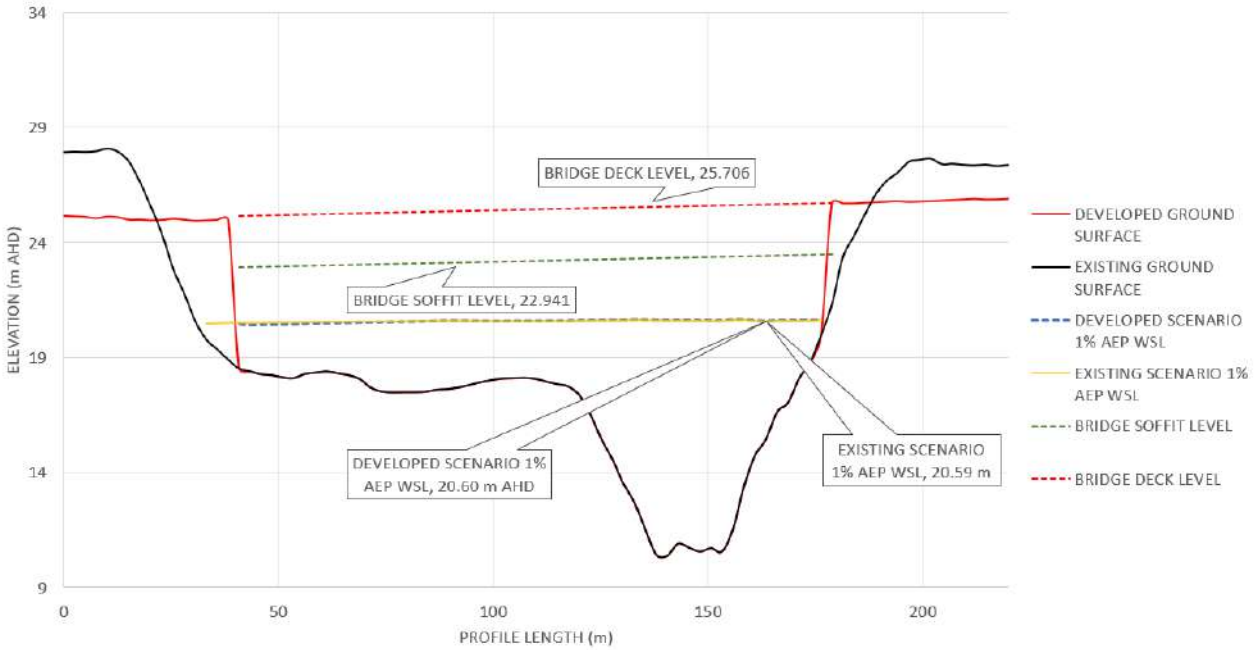


FIGURE 5-3 1% AEP FLOOD LEVELS AT THE CABOOLTURE RIVER BRIDGE SECTION

Current modelled Stockland development earthworks levels shown in the cross section provided in **Figure 5-4** indicate that there will be over 5.0m of freeboard to the 1% AEP developed scenario flood level in the vicinity of the bridge where the greatest flood afflux was simulated. Based on the lowest soffit level of the proposed

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bridge at Abutment B at a design level of 22.941 m AHD, there will be over 2.3 m of freeboard to the 1% AEP developed scenario flood level in the main channel of the river.

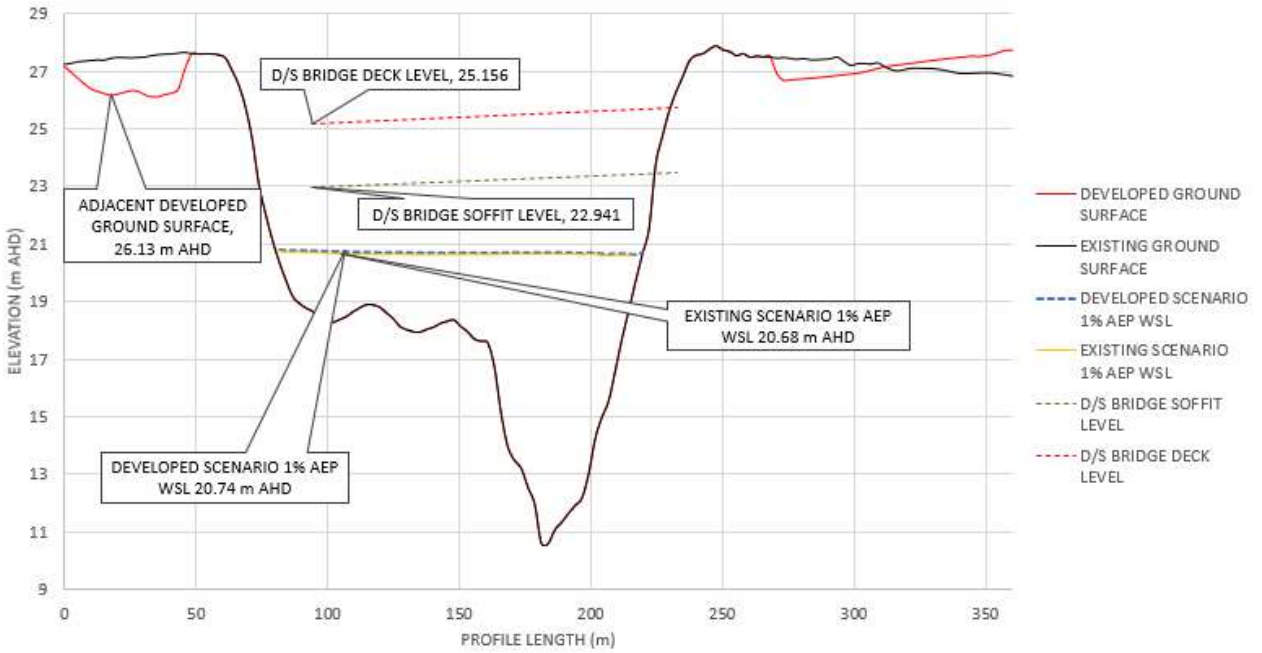


FIGURE 5-4 1% AEP FLOOD LEVELS ~70M UPSTREAM OF THE PROPOSED RIVER CROSSING

1% AEP flood level increases greater than 20 mm extend south from the proposed river crossing approximately 1 km upstream along an unnamed tributary of the Caboolture River which traverse properties from 663 to 699 Caboolture River Road. An analysis of flood results on the upstream property at 663 Caboolture River Road (Lot 1on RP13771) was undertaken to identify how the change in flood conditions will impact the access to the existing residence from Caboolture River Road (that traverses High Risk Flood Hazard Area within the MBRC Flood Hazard Overlay).

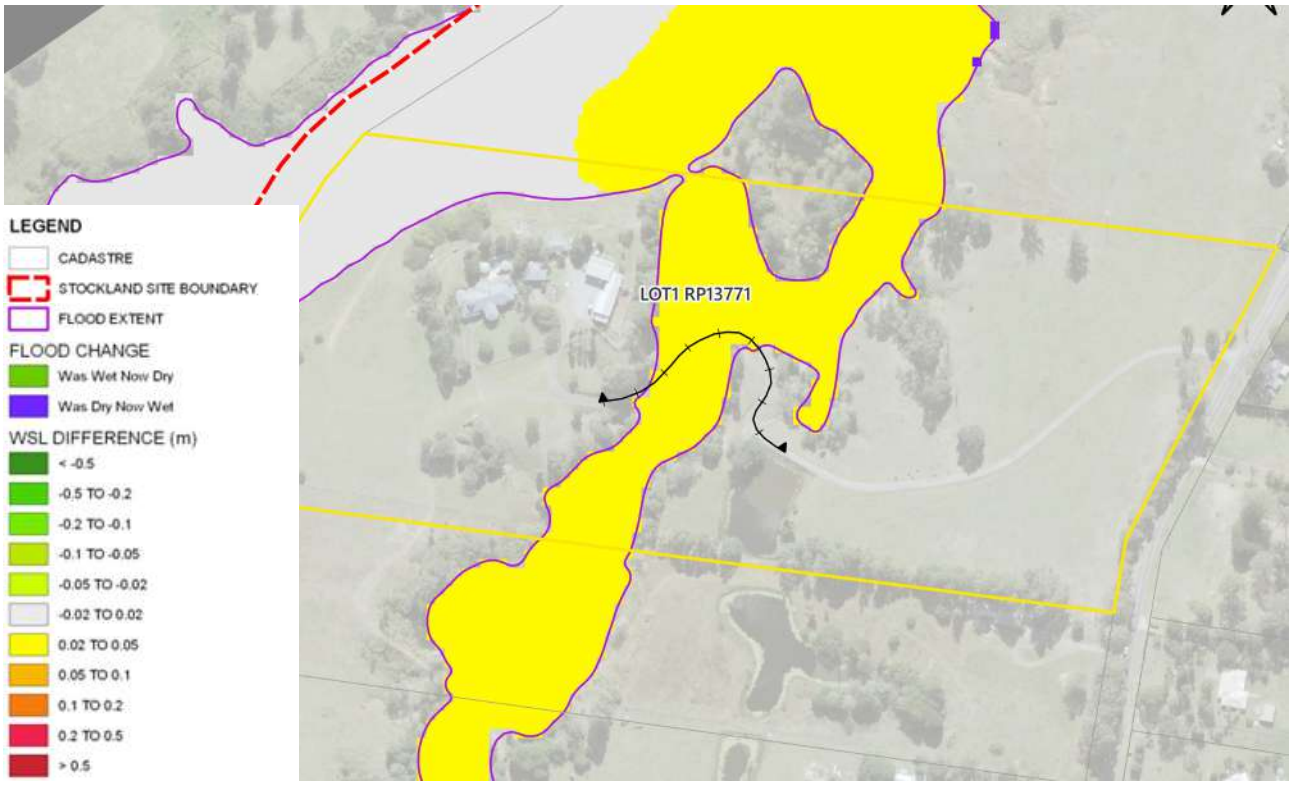


FIGURE 5-5 1% AEP FLOOD LEVEL DIFFERENCE AT 663 CABOOLTURE RIVER ROAD (LOT 1 ON RP13771)

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Figure 5-5 indicates the flood level change across the upstream property at 663 Caboolture River Road (Lot 1on RP13771). The results presented in the profile section taken along the property access in **Figure 5-6** indicate that developed 1% AEP flood levels across the property access to the existing residence will increase by 0.02 m to 21.22 m AHD.[4] However, under existing conditions the driveway is already inundated by approximately 3.22m (assuming minimum access crossing level at 17.98 m AHD, based on available LIDAR). Flood velocity results (presented in **Appendix C**) indicate there is no change in flood velocity across the access crossing. Furthermore, the extent of inundation on the property for developed conditions is negligible compared with existing conditions.

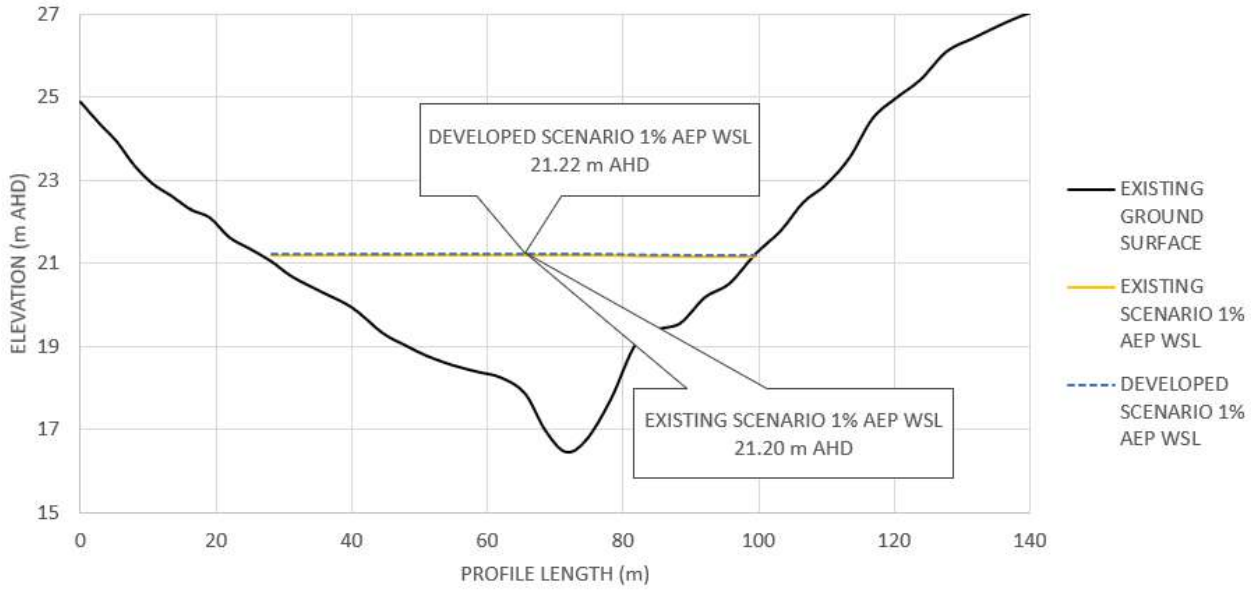


FIGURE 5-6 1% AEP FLOOD LEVELS OVER 663 CABOOLTURE RIVER ROAD ACCESS CROSSING

While an increase in flood levels will result from the proposed Caboolture River crossing the existing flood conditions preclude the use of the access crossing for Lot 1on RP13771 in this flood event. Therefore, the increase in flood level resulting from the proposed bridge crossing does not change the useability of this access in a flood event.

5.2.1.2 Internal Creeks and Watercourses

The culvert configurations for watercourse crossings within the Stockland NDP2 development allow for the conveyance of flows under crossing within the TUFLOW model with provision for 25% culvert design blockage (DES_BL), however for the purposes of flood impact assessment the results presented below are with zero culvert blockage (0BL) to present the worst-case peak velocity within the watercourse. The preliminary road culvert design hydraulic objectives were to achieve greater than 600mm freeboard to road levels and to limit outlet velocities to a maximum of 2.5 m/s during the 1% AEP event to allow scour protection measures to be implemented with minimal impact to the existing watercourse.

*Discussion of freeboard to development levels within the waterway and at waterway crossings with 25% culvert design blockage (DES_BL) is further discussed within **Section 5.2.2** below and addresses Item 16 of CMB Initial Comments (5 July 2024) and Item 8 of the CMB External Reviewers Comments (11 Sept. 2024).*

The developed scenario flood plan results (flood levels, depths, velocity and flood difference plans) provided in **Appendix C** indicate changes in flood level and velocity occur along the watercourse running through the site. Flood level increases are limited to parts of the watercourse within the site only as indicated in **Figure 5-7** below.

[4] *This developed 1% AEP WSL of 21.22 m AHD is 0.35m less than the 21.57 m AHD flood level previously reported in Issue B of this report and Calibre's (now Egis) NDP1 (Phase 2) & NDP2 - Flood Investigation Technical Memorandum (22-000135_TM01A.MS) dated 17 June 2022. These reductions are due to a significantly wider and more hydraulically efficient bridge redesign.*

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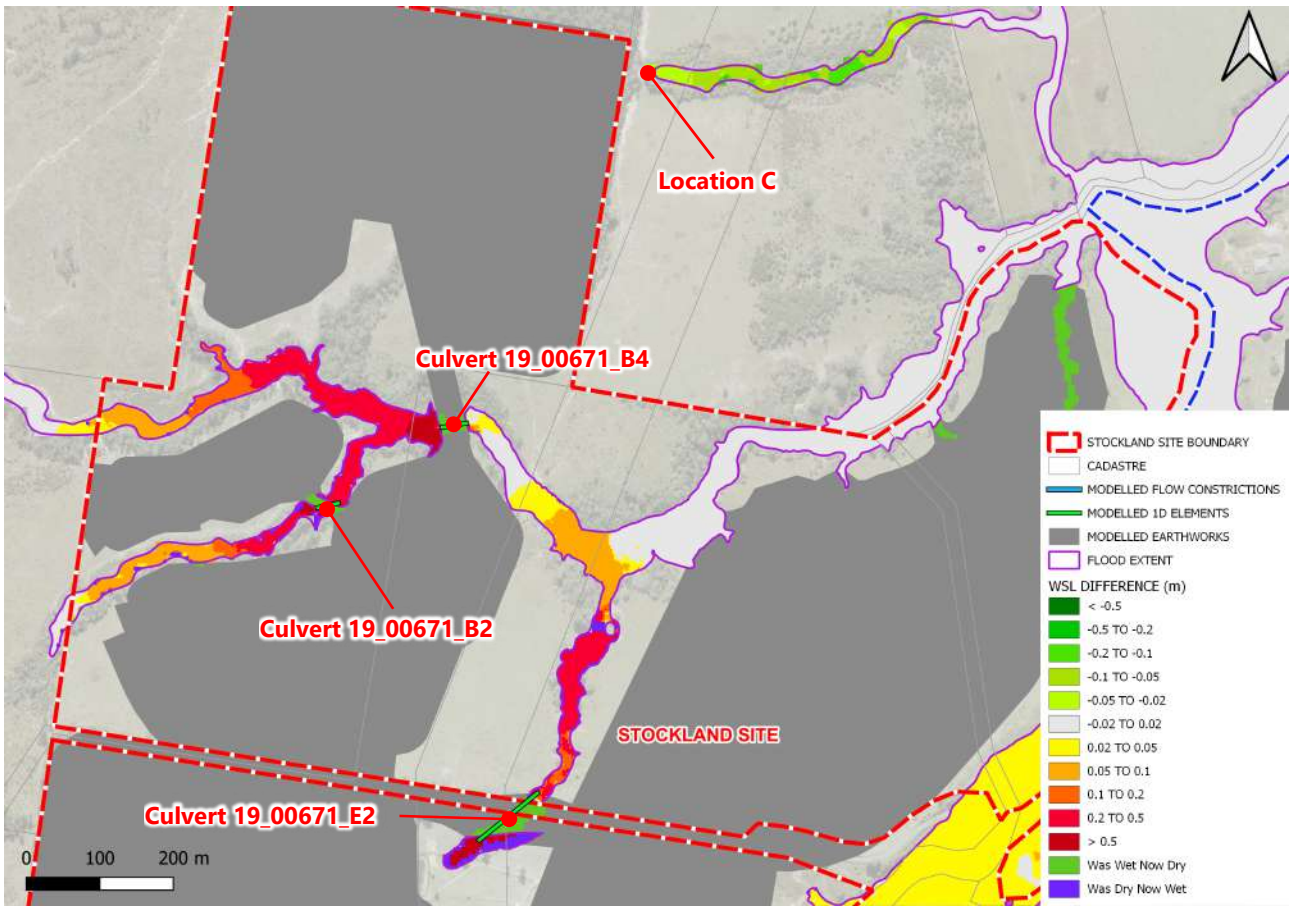


FIGURE 5-7 1% AEP FLOOD LEVEL DIFFERENCE AT INTERNAL WATERCOURSES

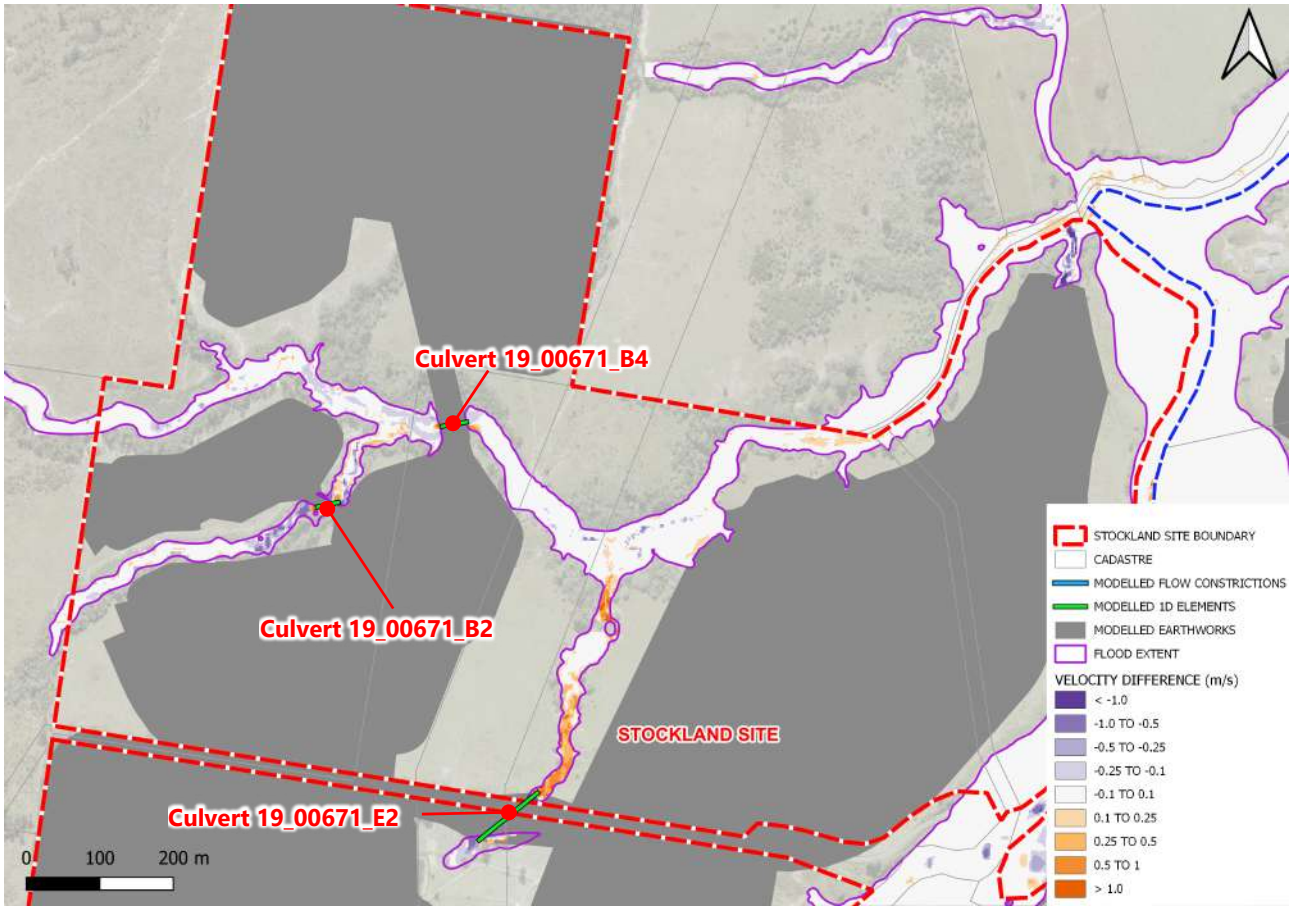


FIGURE 5-8 1% AEP FLOOD VELOCITY DIFFERENCE AT INTERNAL WATERCOURSES

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As indicated in **Figure 5-7** and **Figure 5-8** above, there are reductions in flood level and velocity within the watercourse downstream of the northern corner of the site (location C). This confirms that the proposed strategy to limit the developed catchment discharging to the north eastern corner of site is effective in reducing flood level and velocity to below existing conditions within this watercourse.

Figure 5-8 above indicates that 1% AEP velocity changes are in the order of -0.03m/s, +0.09m/s and +0.50m/s at Culvert 19_00671_B4, Culvert 19_00671_B2 and Culvert 19_00671_E2, respectively. **Figure 5-9** below demonstrate that the proposed preliminary culvert sizing has limited outlet velocities to a maximum of 2.5 m/s, with maximum 1% AEP outlet velocities of 1.24m/s, 1.05m/s and 1.90m/s at Culvert 19_00671_B4, Culvert 19_00671_B2 and Culvert 19_00671_E2, respectively.

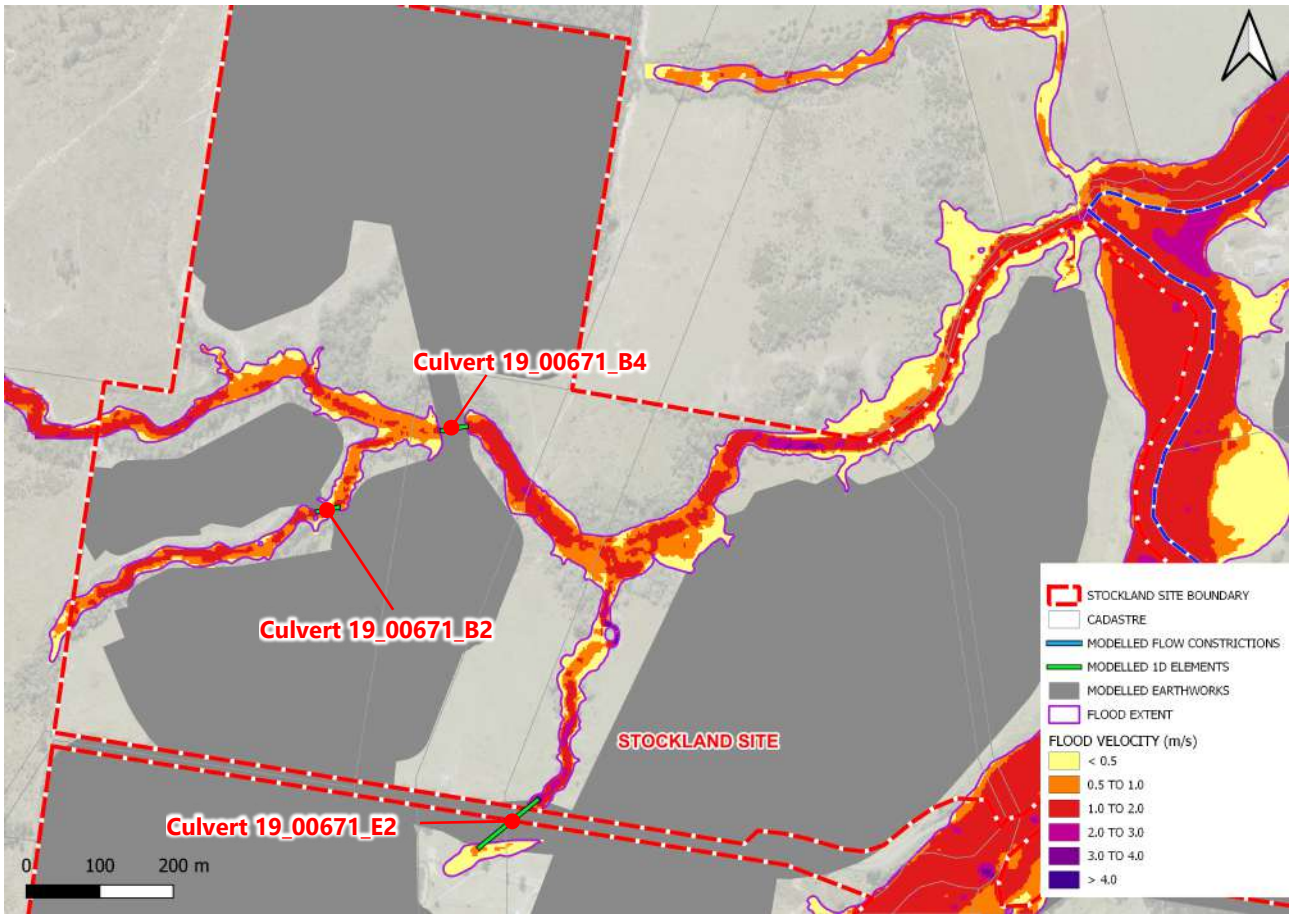


FIGURE 5-9 1% AEP FLOOD VELOCITY AT INTERNAL WATERCOURSES (0% BLOCKAGE SCENARIO)

In response to Item 15 of CMB Initial Comments (5 July 2024), the increases in velocity at each culvert crossing is expected and will be managed through providing appropriate inlet and outlet dissipation of energy and scour protection in accordance with QUDM (2017) and the recommended outlet treatments outlined in Section 1.11.12 of the CMB Planning Scheme Policy - Integrated Design, Appendix C: Stormwater Management. During detailed design to support Operational Works approval, all culverts and stormwater outlets will be designed with headwalls, concrete aprons with cut-off walls and stone pitched rock protection. Dumped rock is not accepted by CMB as an alternative to stone pitching.

The identified drainage related infrastructure, including road crossings of internal creeks and major river crossings is detailed in **Section 6** below.

5.2.2 Freeboard

In response to Item 16 of CMB Initial Comments (5 July 2024) and Item 8 and 12 of the CMB External Reviewers Comments (11 September 2024), two sensitivity events have been modelled to check the freeboard throughout the proposed development meets the requirements of the MBRC Planning Scheme (Version 7) Section 8.2.2 Flood hazard overlay code, Table 8.2.2.3 Flood planning level for a habitable floor

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(residential development) and a non-habitable floor (non-residential development) and levels for hazardous chemicals. The sensitivity events are as follows:

- *The 1% AEP with Climate Change has been run with design blockage (DES_BL) for all standard durations from 30 minutes to 1440 minutes utilising ARR 1987 design rainfall.*
- *The 1% AEP with Climate Change has been run with design blockage (DES_BL) for the listed identified critical events for the 1% AEP plus Climate Change Event utilising ARR 2019 temporal patterns and rainfall.*

For the purposes of setting Flood Planning Levels for the proposed development, the Defined Flood Event (DFE) will adopt the larger of the two sensitivity events. The 1% AEP plus Climate Change Event utilising ARR 2019 temporal patterns and rainfall yielded much lower flood levels compared with the 1% AEP plus Climate Change Event utilising ARR 1987 design rainfall. As such, the event adopted for the DFE is the maximum flood envelope of all standard durations from 30 minutes to 1440 minutes utilising ARR 1987 design rainfall for the 1% with Climate Change and 25% culvert design blockage (DES_BL).

As per Table 8.2.2.3 of the *MBRC Planning Scheme (Version 7) Section 8.2.2 Flood hazard overlay code* the adopted 'Defined Freeboard' is 750mm for areas west of the Bruce Highway. Hence, the **Flood Planning Levels for the development are the DFE + 750 mm**.

The maximum flood depth and peak flood level contours for the adopted DFE are presented in **Figure 5-10**.

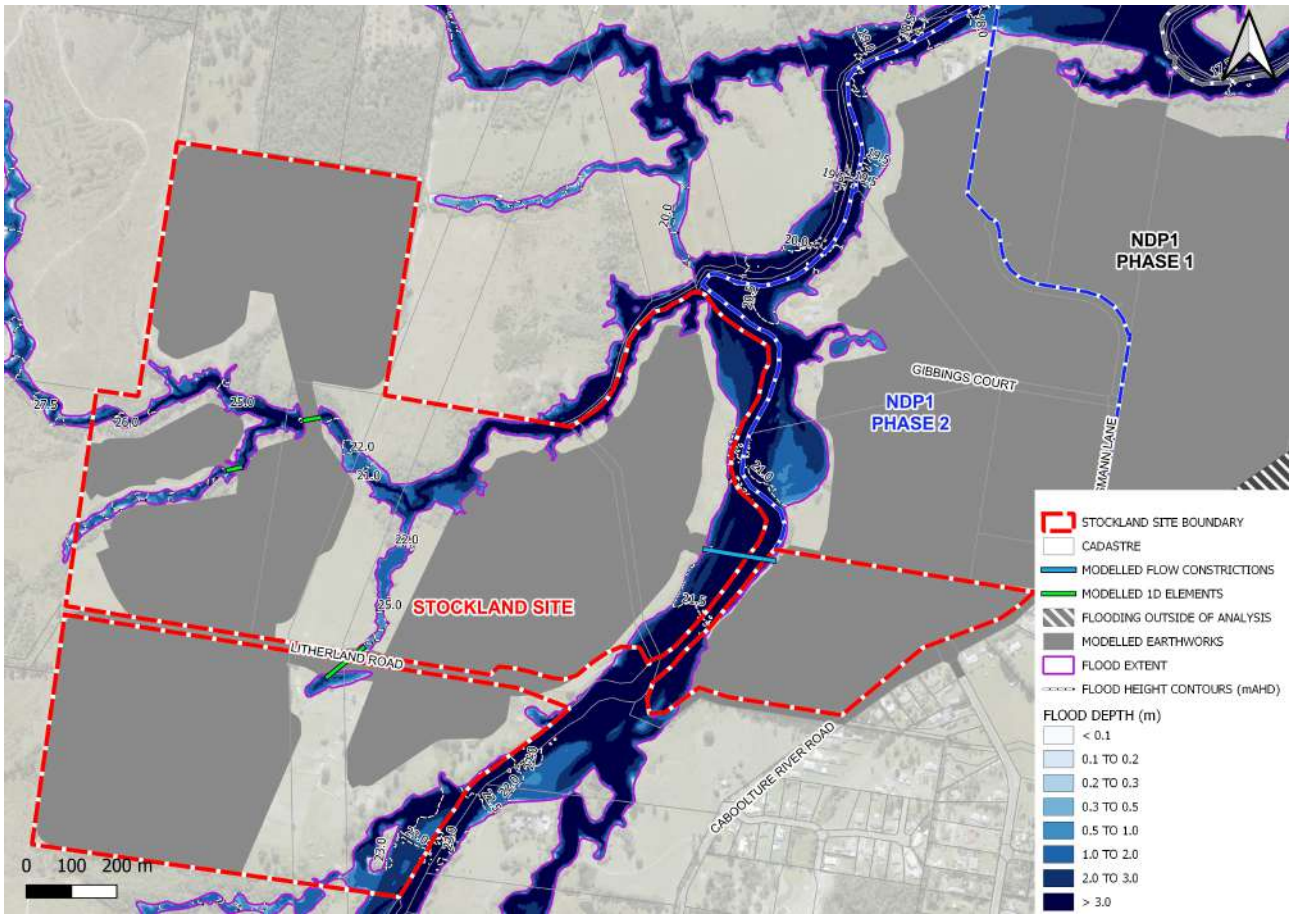


FIGURE 5-10 ARR1987 FLOOD DEPTH FOR 1% AEP WITH CLIMATE CHANGE AND DESIGN BLOCKAGE EVENT (ADOPTED DFE)

The results presented in **Figure 5-10** were interrogated within the flood model and the minimum 750mm freeboard criteria has been achieved. Generally, more than 2 metres of freeboard is achieved to all development levels throughout the development, with the lowest freeboard levels occurring upstream of the Litherland Road culvert crossing where a freeboard of approximately 1.4 metres is achieved between the DFE and the minimum road crest level.

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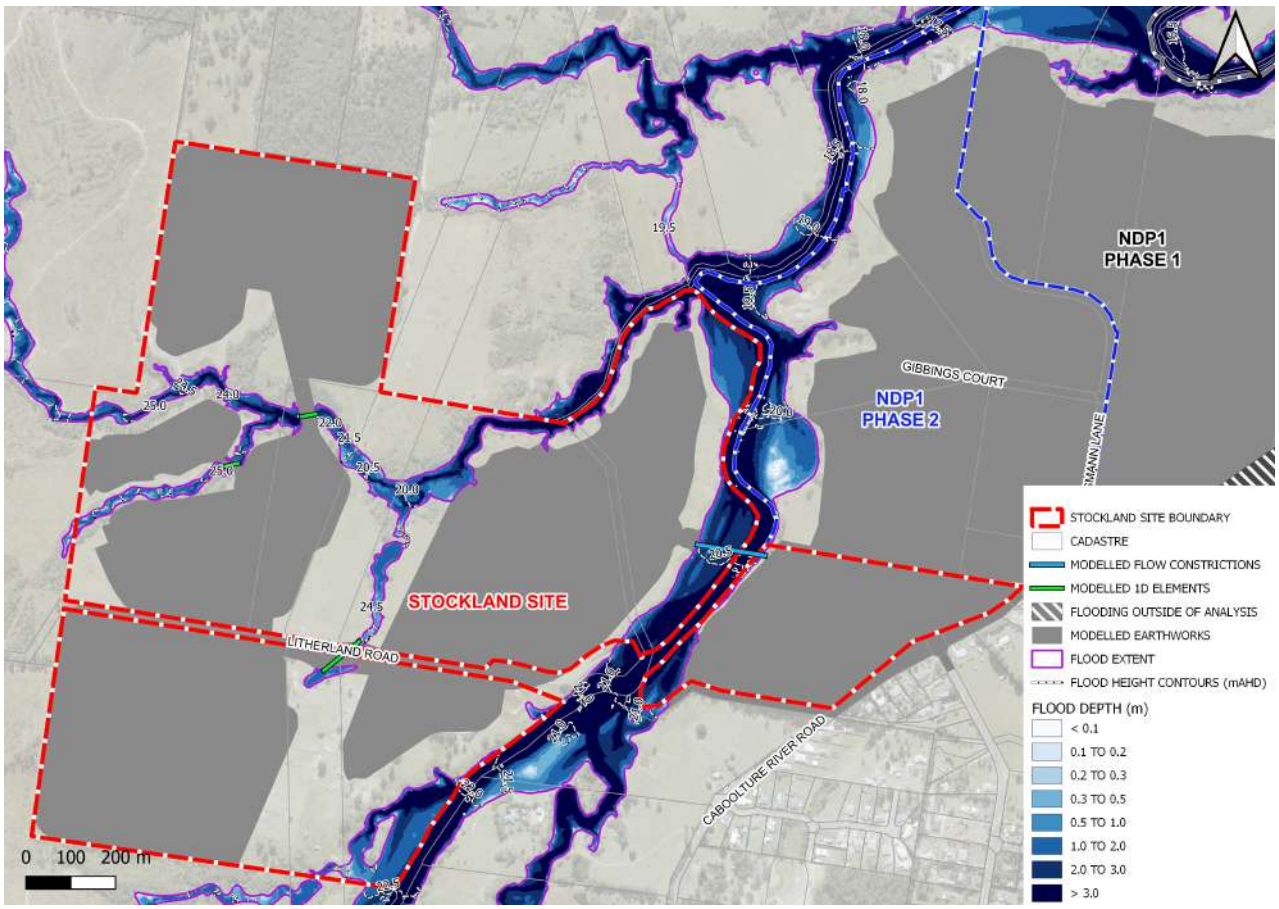


FIGURE 5-11 ARR2019 FLOOD DEPTH FOR 1% AEP WITH CLIMATE CHANGE AND DESIGN BLOCKAGE EVENT

The maximum flood depth and peak flood level contours for the 1% AEP plus Climate Change Event utilising ARR 2019 temporal patterns and rainfall has been provided in **Figure 5-11** above for comparison.

5.2.3 Waterway Stability

Item 11 of the CMB External Reviewers Comments (11 September 2024) identifies the requirement for the management of waterway stability to be addressed in accordance with the CMB Planning Scheme and the State Planning Policy (SPP 2017). It is the intent of these instruments to protect waterways from the potential impacts of increased runoff to the receiving waterways through management of frequent flows (i.e., 63.2% AEP).

As indicated in **Figure 5-12** below, there are changes in 63% AEP peak velocity within the watercourses downstream of the three proposed road culvert crossings within the development. **Figure 5-12** indicates that 63% AEP velocity changes are in the order of -0.02m/s, -0.15m/s and +0.30m/s at Culvert 19_00671_B4, Culvert 19_00671_B2 and Culvert 19_00671_E2, respectively. Reductions in 63% AEP velocity within the waterway in the vicinity of proposed culvert outlets at Culvert 19_00671_B4 and Culvert 19_00671_B2 demonstrate that the waterway already sustains high stream velocities and the waterway stability management in this area will not be problematic.

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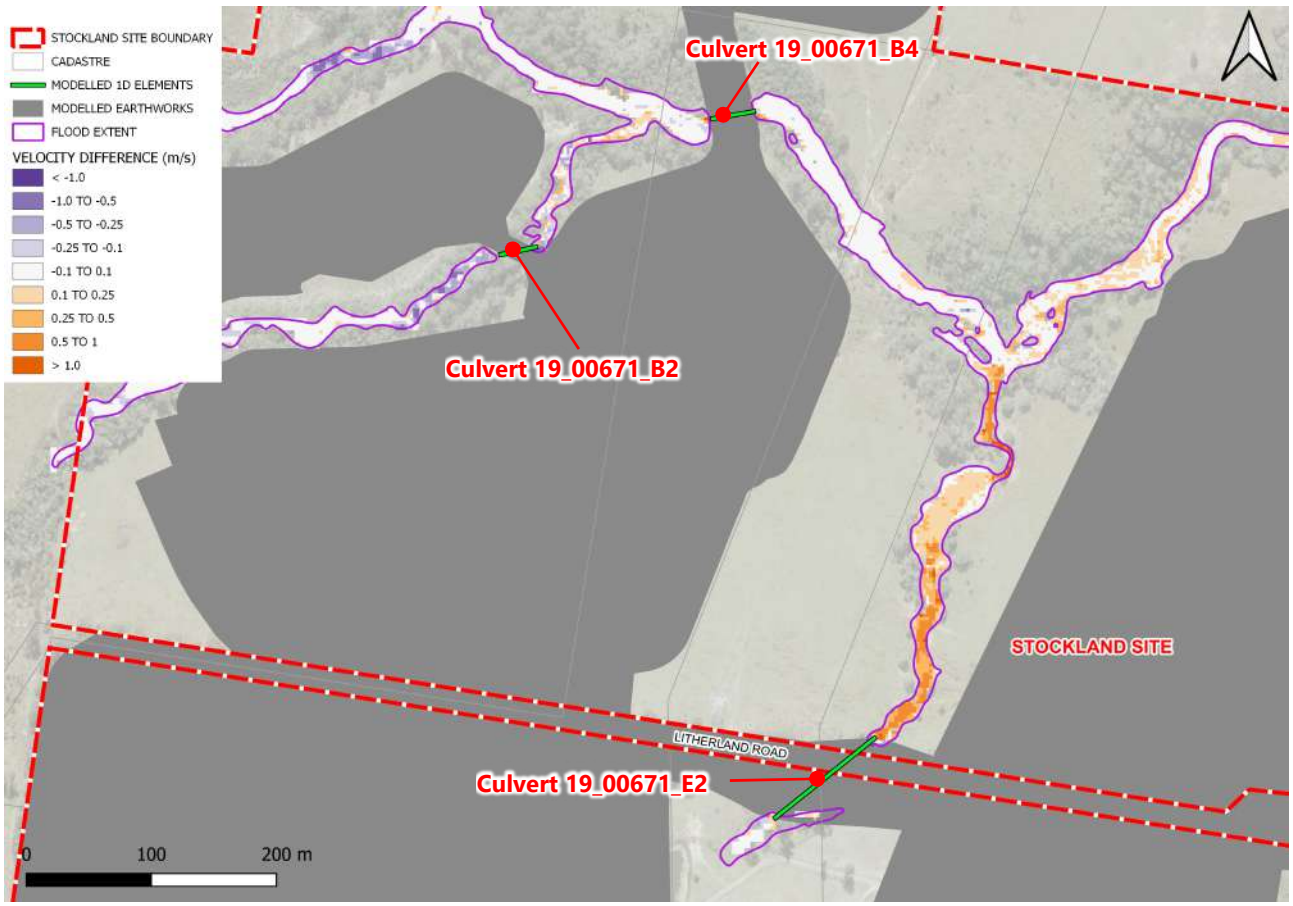


FIGURE 5-12 63% AEP FLOOD VELOCITY DIFFERENCE AT INTERNAL WATERCOURSES

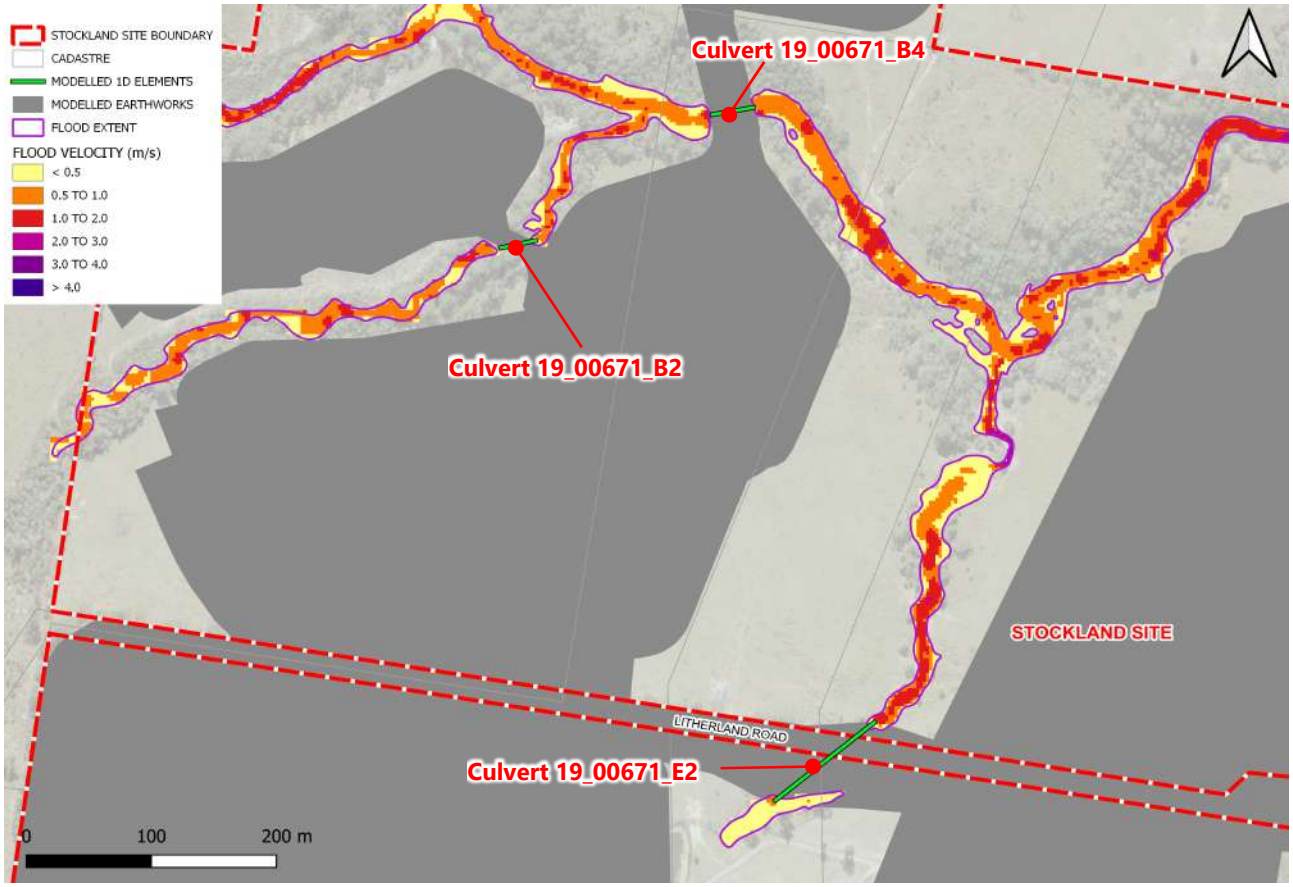


FIGURE 5-13 63% AEP FLOOD VELOCITY AT INTERNAL WATERCOURSES (0% BLOCKAGE SCENARIO)

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Figure 5-13 above demonstrates that the proposed preliminary culvert sizing has limited 63% AEP outlet velocities to a maximum of 0.72m/s, 1.01m/s and 1.16m/s at Culvert 19_00671_B4, Culvert 19_00671_B2 and Culvert 19_00671_E2, respectively. Any increases in velocity at each culvert crossing is expected and will be managed through providing appropriate inlet and outlet dissipation of energy and scour protection in accordance with QUDM (2017) and the recommended outlet treatments outlined in Section 1.11.12 of the *CMB Planning Scheme Policy - Integrated Design, Appendix C: Stormwater Management*. During detailed design to support Operational Works approval, all culverts and stormwater outlets will be designed with headwalls, concrete aprons with cut-off walls and stone pitched rock protection. Dumped rock is not accepted by CMB as an alternative to stone pitching.

In addition to headwalls, apron cut-off walls and stone pitching, outlet structures discharging directly to existing naturalised waterways will be further rehabilitated to ensure the existing flow path is stabilised from increased runoff impacts. These locations include naturalised areas where downstream flow paths will convey the ultimate discharges from the site, such that there will be no risk to waterway stability in these rehabilitated sections. In particular, the channel within the Energex Easement downstream of Culvert 19_00671_E2 crossing Litherland Road where velocity increases are observed (refer **Figure 5-12** above). Therefore, no mitigation of 63.2% flows will be required at all discharge locations.

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6 IDENTIFIED INFRASTRUCTURE

The following section discusses drainage related infrastructure (trunk and non-trunk) associated with the Stockland development.

6.1 Drainage Reserve

As previously discussed in **Section 2.4**, the management of overland flows will be addressed through the provision of an underground drainage network, together with designed overland flow paths (i.e., roads, engineered channels and drainage reserves). The drainage infrastructure provided as part of the development will convey local runoff to an appropriate discharge location to be determined during future approval phases.

6.2 River Crossing

The Caboolture River crossing incorporates a four (4) span Super-T girder bridge spanning a total length of 137-metres from high bank to high bank of the river. Three (3) piers comprising of two (2) 1200 mm diameter Cast-In-Place (CIP) piles spaced at 10-metre centres are proposed for the bridge sub-structure. This bridge will provide access across the river for future development of Caboolture West beyond NDP2 the crossing, classifying it as trunk infrastructure. **Figure 6-1** below identifies the bridge and culvert locations for the river crossing.

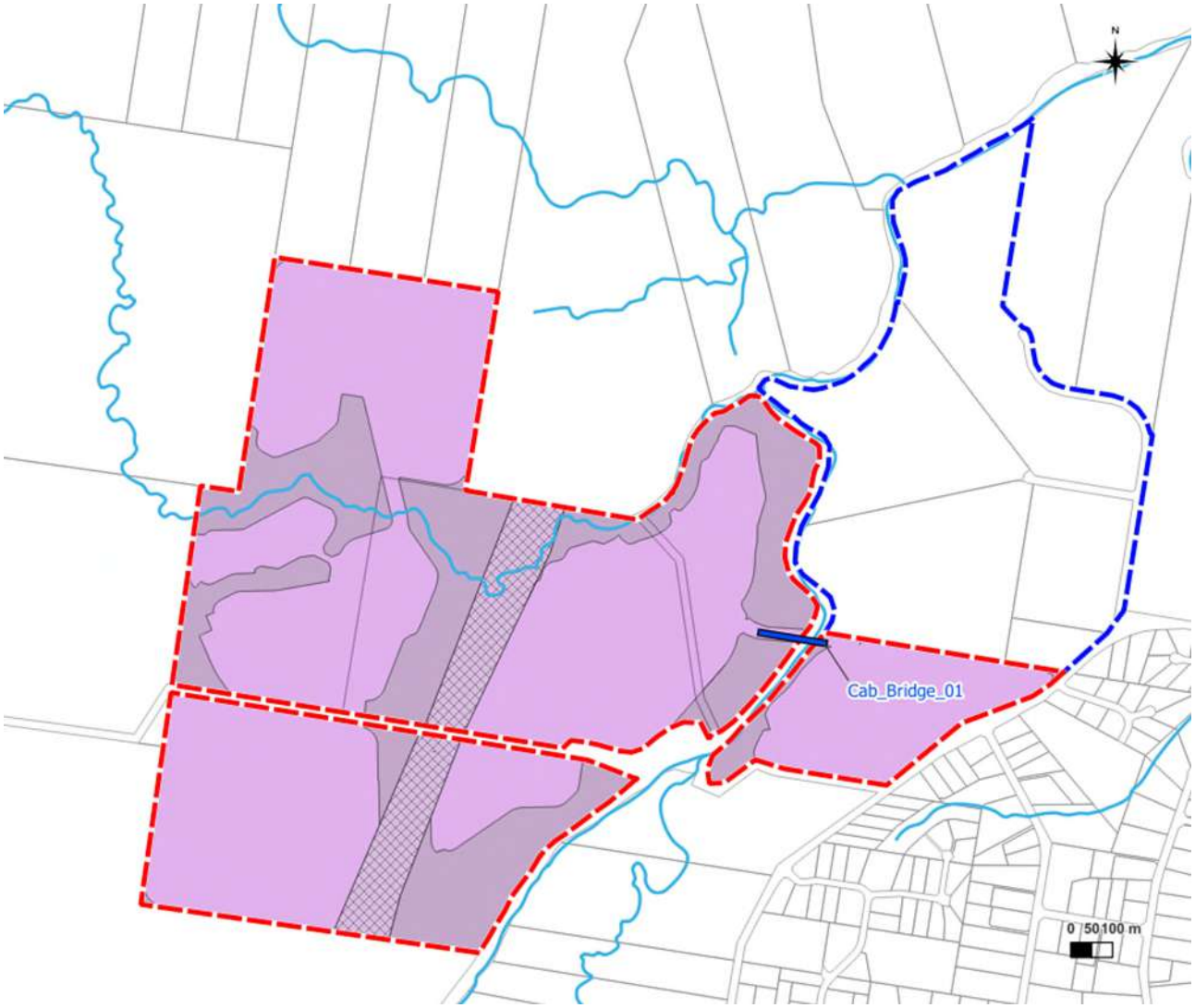


FIGURE 6-1 RIVER CROSSING LOCATIONS

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Table 6-1 below summarises the configuration of Caboolture River crossing element as configured from the bridge design information received from Red Fox Advisory[5].

TABLE 6-1 RIVER CROSSING DETAILS

ID	NAME	CONFIGURATION	NOTES
Cab_Bridge_01	Caboolture River Bridge	4 Span with 137m total length, 1850 mm Super-T girder truss, 1200 mm CIP piles, and spillthrough abutments.	Major impact (purple) DAF waterway designation

The Caboolture River crossing is required to unlock development west of the river and following development or Precinct 1.

6.3 Internal Creek / Watercourse Crossings

Three creek / watercourse crossings to convey runoff under internal roads have been identified. **Figure 6-2** below identifies the location of each internal crossing.

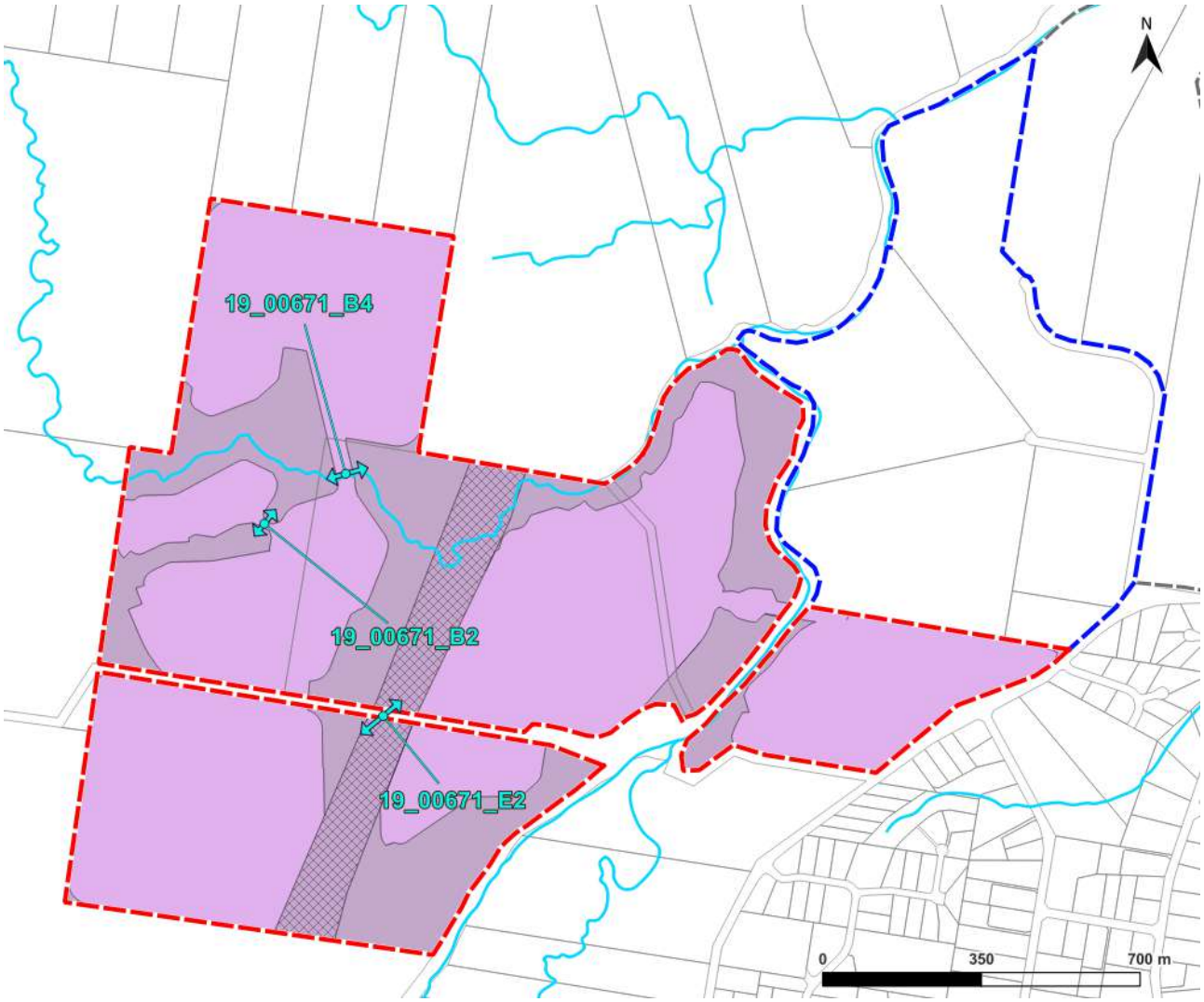


FIGURE 6-2 INTERNAL CREEK / WATERCOURSE CROSSING LOCATIONS

[5] *Bridge General Arrangement Plan, Drawing No. 01099-RFA-BR01-DRG-GA_01, Revision 2A, preliminary design issued for internal review, received from Red Fox Advisory on 2nd October 2024.*

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The following design allowances have been considered in the configuration of each crossing, adopting the 1% AEP as the design storm event:

- Greater than 600mm freeboard to road sag crest levels.
- Limit outlet velocities to a maximum of 2.5 m/s to allow scour protection measures to be implemented with minimal impact to the existing watercourse.
- 25% blockage factor.

The design has also considered the current (2023) fish passage classifications and respective design requirements as per the Department of Agriculture and Fisheries *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (2018).

Table 6-2 below summarises the configuration of each internal creek / watercourse element as configured from the concept design and bulk earthworks information received from KN Group[6].

TABLE 6-2 INTERNAL CREEK / WATERCOURSE CROSSING DETAILS

ID	NAME	CONFIGURATION	NOTES
19_00671_B4	Small Creek Crossing	4 x 3000 x 2700 RCBC – 40m Long	Moderate impact (amber) DAF waterway designation
19_00671_B2	Minor Watercourse Crossing	3 x 3600 x 1200 RCBC – 18m Long	Low impact (green) DAF waterway designation
19_00671_E2	Litherland Road Crossing	2 x 1800 x 1500 RCBC – 100m Long	Low impact (green) DAF waterway designation

The order of construction for the above infrastructure is expected to follow development as it progresses west from the Caboolture River, with the Litherland Road crossing to commence first, followed by the Minor Watercourse crossing then Small Creek crossing.

[6] *DEM created from Triangulated Irregular Network (TIN) of high-level Caboolture West finished surface design (received from KN Group 9 November 2023).*

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7 CONCLUSION

Egis Consulting Pty Ltd has prepared this Flood Investigation Report to support planning for the development located with the Caboolture West development area identified as Neighbourhood Development Plan 1 (NDP1) Phase 2 and Neighbourhood Development Plan 2 (NDP2) proposed by Stockland.

This report investigates and addresses the management of flooding, stormwater quantity and conveyance of runoff from the proposed Stockland development area. Through the implementation of appropriate management strategies and provision of both trunk and non-trunk drainage infrastructure, sequenced development of Phase 2 of NDP1 and NDP2 can occur without resulting in adverse or actionable impacts to adjacent or downstream properties.

The investigations and analysis undertaken has identified the following.

7.1 Hydrologic Analysis (WBNM)

The WBNM results indicate that, irrespective of the increase in runoff from development, there is only a negligible increase (less than 0.2%) in peak flow for the event critical to the Caboolture River downstream of the river crossing and at the downstream extents of the NDP1 Phase 1 and NDP1 Phase 2. The results also indicate a negligible reduction in peak flow (less than 0.1%) downstream of the confluence with Small Creek. Furthermore, the comparison for Location C demonstrates the proposed strategy to limit the developed catchment discharging to the north eastern corner of site is effective in reducing peak flows to below existing conditions. On this basis peak flow mitigation (i.e., detention) is not required for the proposed Stockland development.

7.2 Hydraulic Analysis (TUFLOW)

The TUFLOW model results reveal a flood impact greater than 20mm within the Caboolture River, extending approximately 2.03km upstream of the proposed river crossing. Notably, a maximum flood level increase of 0.6m occurs immediately upstream of the proposed fauna culvert at the western bridge abutment and overbank area, with the main channel experiencing a maximum increase of approximately 0.3m upstream of the proposed bridge structure. These maximum increases are located primarily within reaches of the Caboolture River adjacent to the proposed Stockland development, which proposes earthworks levels that maintain significant freeboard (over 4.0m) to 1% AEP developed scenario flood levels upstream of the proposed river crossing.

The analysis extends beyond the immediate river crossing, revealing 1% AEP flood level increases greater than 20mm along an unnamed tributary of the Caboolture River, impacting properties from 663 to 699 Caboolture River Road. Specifically, an increase of approximately 0.37m in 1% AEP flood levels was modelled across the property access to an existing residence at 663 Caboolture River Road (Lot 1 on RP13771). Despite this increase, it's noteworthy that the driveway is already inundated by approximately 3.22m under existing conditions, and the analysis concludes that while the proposed Caboolture River crossing will lead to an increase in flood levels, the existing flood conditions already impede the use of the access crossing for Lot 1 on RP13771 during a 1% AEP flood event. Consequently, the anticipated increase in flood levels resulting from the proposed bridge crossing does not significantly alter the usability of this access in flood conditions.

The developed scenario flood plan results (flood levels, depths, velocity and flood difference plans) provided in **Appendix C** indicate changes in flood level and velocity occur along the watercourses through NDP2, including within Small Creek, however, flood level increases are limited to parts of the watercourse within the site only and significant freeboard to proposed development levels are maintained. The culvert configurations for watercourse crossings within the Stockland NDP2 development allow for 25% culvert blockage and achieve greater than 600mm freeboard to road crossing sag levels while limiting outlet velocities to a maximum of 2.5 m/s during the 1% AEP event.

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8 RECOMMENDATIONS

It is recommended that the strategies identified with this Flood Investigation Report be adopted as part of the Caboolture West NDP1 Phase 2 and NDP2 master plan, and future planning associated with each separate development application incorporate and where appropriate refine the strategies presented.

9 REFERENCES

- Calibre Professional Services (2021), *Stormwater Management Plan – Caboolture West NDP1* (Report No. 16-0001367-SWMP-01D);
- Calibre Professional Services (2022), *NDP1 (Phase 2) & NDP2 - Flood Investigation* Technical Memorandum (22-000135_TM01A.MS);
- Calibre Professional Services (2022), *Stockland Caboolture West, NDP1 Phase 2, Precinct 1- Flood Investigation* Technical Memorandum (22-000135_TM02B);
- Department of Agriculture and Fisheries (2018), *Accepted development requirements for operational work that is constructing or raising waterway barrier works*;
- Moreton Bay Regional Council (2014), *Caboolture River Regional Flood Modelling Database* (002c);
- SKM (2012); *MBRC Regional Floodplain Database: Floodplain Parameterisation Report*;
- Moreton Bay Regional Council (2015), *Integrated Design Planning Scheme Policy – Appendix C Stormwater Management*;
- Moreton Bay Regional Council (2015), *Planning Scheme Policy – Flood Hazard, Coastal Hazard and Overland Flow*.

10 DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Stockland and is subject to and issued in accordance with the agreement between Egis Consulting Pty Ltd.

Our investigation and analysis have been specifically catered for the particular requirements of Stockland and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from Egis Consulting Pty Ltd.

Egis Consulting Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon this report by any third party.

The investigation and analysis undertaken has relied on information provided by others. Egis Consulting Pty Ltd accept no responsibility for accuracy of material supplied by others. The accuracy of the investigation, analysis and report is dependent upon the accuracy of this information.

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APPENDIX A: TREATMENT STRATEGY FOR BHWA THROUGH DTMR CORRIDOR

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Future Transport Corridor – Bruce Highway Western Alternative (BHWA)

A transport corridor approximately 100-metres wide has been incorporated into the proposed Stockland development. This corridor is for a potential Bruce Highway Western Alternative (BHWA) alignment, which allows for a two-lane dual carriageway that is planned for 40 to 60 years from now.

Runoff from the Stockland development north of Litherland Road will be conveyed to Small Creek via an existing overland flow path within the transport corridor. Due to the expected timing of the future road corridor works the mitigation of peak flow increases to the corridor are not considered necessary as part of the proposed Stockland development (as detailed in the **BHWA Hydrologic Analysis** below), however a strategy to convey development flows along the future transport corridor has been investigated by Stockland in consultation with KN Group. This proposed strategy considers the cross-drainage configuration for Litherland Road at Discharge Location J for the current developed scenario (i.e., without the BHWA) and ultimate scenario (i.e., with the BHWA). Refer to **Figure 4-4** in **Section 4.3** of the main report above for site discharge locations.

The developed scenario cross drainage configuration for Litherland Road (culvert '19_00671_E2') proposed by KN Group is a 2/1800x1500 RCBC (approximately 100m long) located within the invert of the watercourse within the future transport corridor.

The ultimate scenario cross drainage configuration proposed by KN Group is approximately 380m long culvert located outside of the future transport corridor, straddling the eastern boundary of the existing electrical easement, which runs adjacent to the transport corridor. This future culvert design is subject to future design iteration. Preliminary culvert sizing has been undertaken adopting the WBNM flows reporting to Discharge Location J.

BHWA Hydrologic Analysis

A strategy to convey development flows along the future transport corridor has been investigated by Stockland in consultation with KN Group (refer to *KN Group Drawing no. 16-151-SK202 and SK203* below for details). *KN Group Drawing no. 16-151-SK202* considers the cross-drainage configuration for Litherland Road at Discharge Location J for the current developed scenario (i.e., without the BHWA) and *KN Group Drawing no. 16-151-SK203* considers the ultimate scenario (i.e., with the BHWA). The ultimate scenario is anticipated to increase the fraction impervious within the 100m-wide corridor by approximately 30% to allowing for a two-lane dual carriageway. As such, an ultimate scenario WBNM was configured from the developed scenario WBNM, which increases the fraction impervious for the Future BHWA corridor catchments (19_00671_C5, 19_00671_E3 & 01_24982_A2) to 30%, as specified in **TABLE 4-1** in **Section 4.2** of the main report above. A flow hydrograph comparison is presented in **Figure A-1** for Discharge Location H at Small Creek, downstream of the future transport corridor. Refer to **Figure 4-4** in **Section 4.3** of the main report above for site discharge locations.

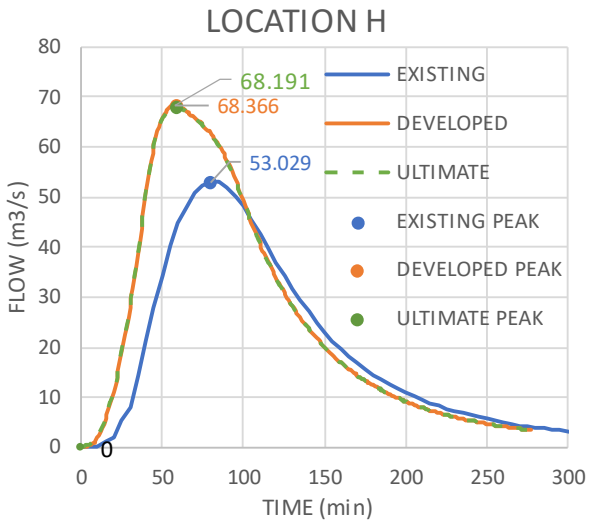


FIGURE A-1 1% AEP HYDROGRAPH COMPARISON – DISCHARGE LOCATION H WITH ULTIMATE SCENARIO

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The comparisons at Discharge Location H indicates that peak flows within Small Creek will increase as a result of the development. However, the increased impervious fraction within the future transport corridor associated with the BHWA has resulted in reduction in the magnitude of ultimate scenario peak flows due to the change in the timing of coincident peaks between the upper sub-catchment areas and the future transport corridor sub-catchments reporting to Discharge Location H. Due to the expected timing of the future road corridor works (~40 years) the mitigation of peak flow increases to the corridor are not considered necessary as part of the proposed Stockland development.

The ultimate scenario cross drainage configuration proposed by KN Group is approximately 380m long culvert running adjacent to the transport corridor (refer to *KN Group Drawing no. 16-151-SK203* below for details). The ultimate scenario was not considered in the Hydraulic Analysis presented in **Section 5** of the main report, however preliminary culvert sizing has been undertaken using the HY-8 culvert modelling software (Version 7.70.1.0, June 2021) developed by the US Federal Highways Administration adopting the developed scenario WBNM flows reporting to Discharge Location J. The preliminary culvert sizing for the ultimate scenario cross drainage configuration at Litherland Road is presented in **TABLE A-1**.

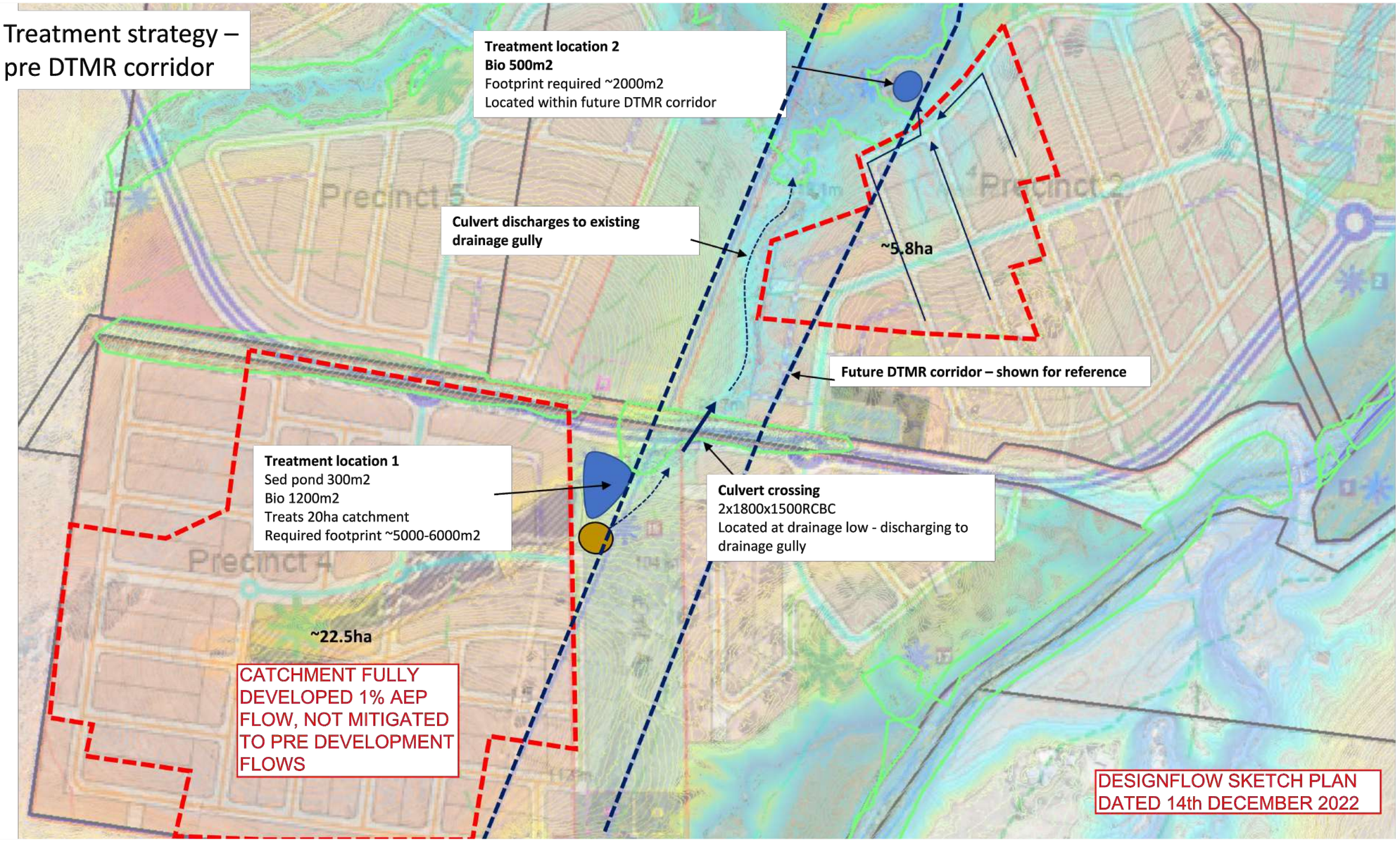
TABLE A-1 ULTIMATE SCENARIO CROSS DRAINAGE CONFIGURATION AT LITHERLAND ROAD

STRUCTURE ID	SIZE /TYPE	UPSTREAM/ DOWNSTREAM INVERT (M AHD)	DESIGN BLOCKAGE (%)	LENGTH (M)	ROAD CREST LEVEL (M AHD)	5% AEP HEADWATER (*FREEBOARD*) LEVEL (M AHD)	1% AEP HEADWATER (*FREEBOARD*) LEVEL (M AHD)	1% AEP OUTLET VELOCITY (M/S)
19_00671 _E2_ Future	2/120 0 RCP	28.56 / 22.00	25%	380	37.70	31.65 (*6.05 m)*	35.10 (*2.60 m*)	5.36

The preliminary culvert design is subject to further design iteration as the BHWA planning and design development progresses over the next 40-years. Refer to **Section 5** of the main report for the current developed scenario drainage infrastructure proposed for the Litherland Road crossing at Discharge Location J.

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Treatment strategy – pre DTMR corridor



DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN

REVISIONS

No	Description	Date	By
A	FOR INFORMATION	16.12.22	RW

Client

Stockland

Project

CABOOLTURE WEST
BRUCE HIGHWAY
WESTERN ALTERNATIVE
(BHWA)

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved Director - RPEQ 17544

Drawing Title

BHWA
TREATMENT STRATEGY
PRE DTMR CORRIDOR

Drawn	Designed	Checked	Date
RW	MS	MS	DEC' 22

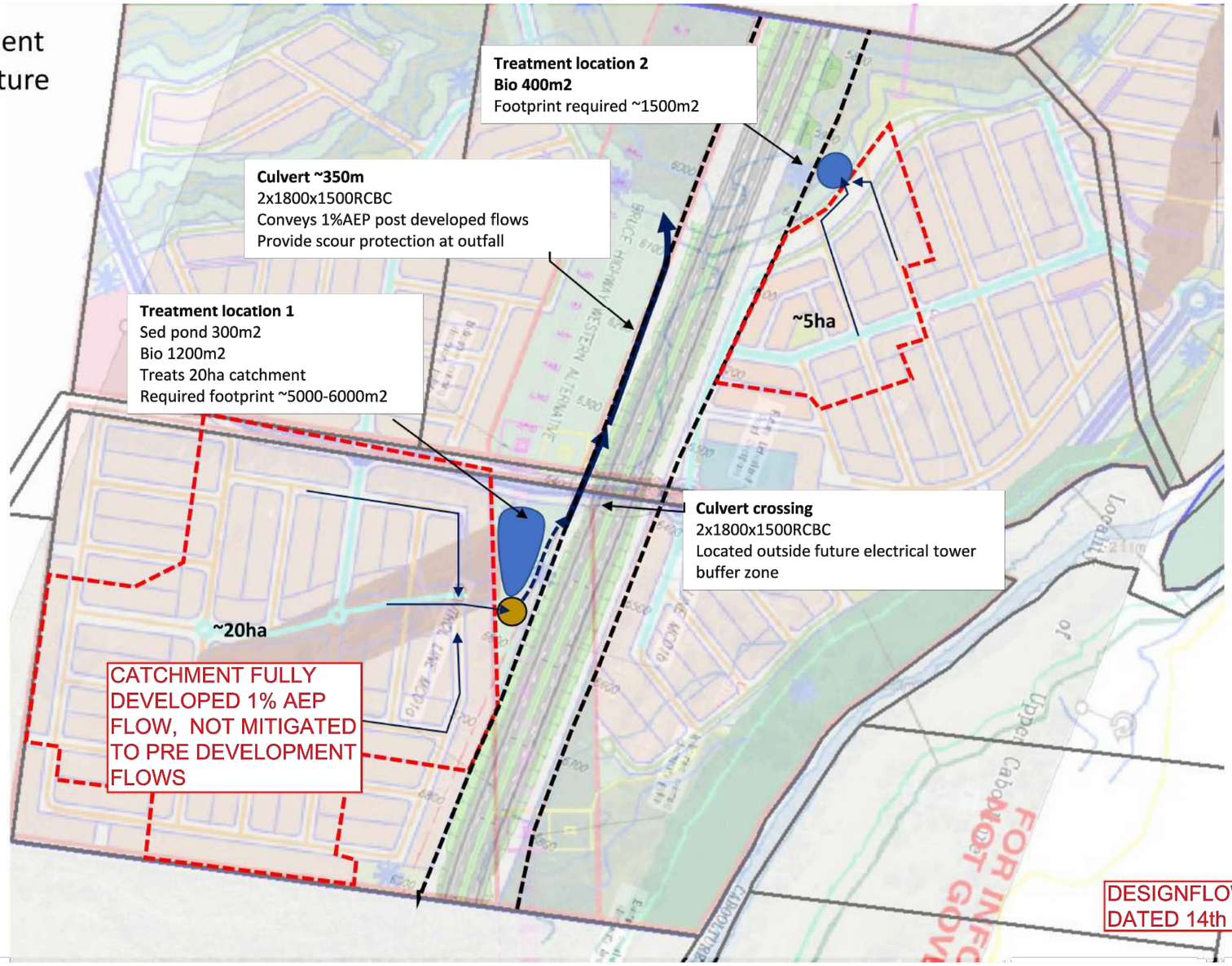
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AS SHOWN	3 of X

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28/4/2025

Updated treatment strategy with future DTMR Road



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NORTH

LOCALITY PLAN

REVISIONS

No	Description	Date	By
A	FOR INFORMATION	16.12.22	RW

Client

Stockland

Project

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BRUCE HIGHWAY
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(BHWA)

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved Director - RPEQ 17544

Drawing Title

BHWA
UPDATED TREATMENT STRATEGY
WITH FUTURE DTMR CORRIDOR

Drawn	Designed	Checked	Date
RW	MS	MS	DEC' 22

Scale	Sheet
AS SHOWN	4 of X

	Drawing No	Revision
A1	16-151-SK203	A

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APPENDIX B: EXISTING SCENARIO FLOOD PLANS

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

STOCKLAND SITE

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



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PLAN TITLE

EXISTING SCENARIO
0.1% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-E-1000-A	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
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B	27.11.24	AM	DY	REVISED ISSUE
C				
D				
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F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

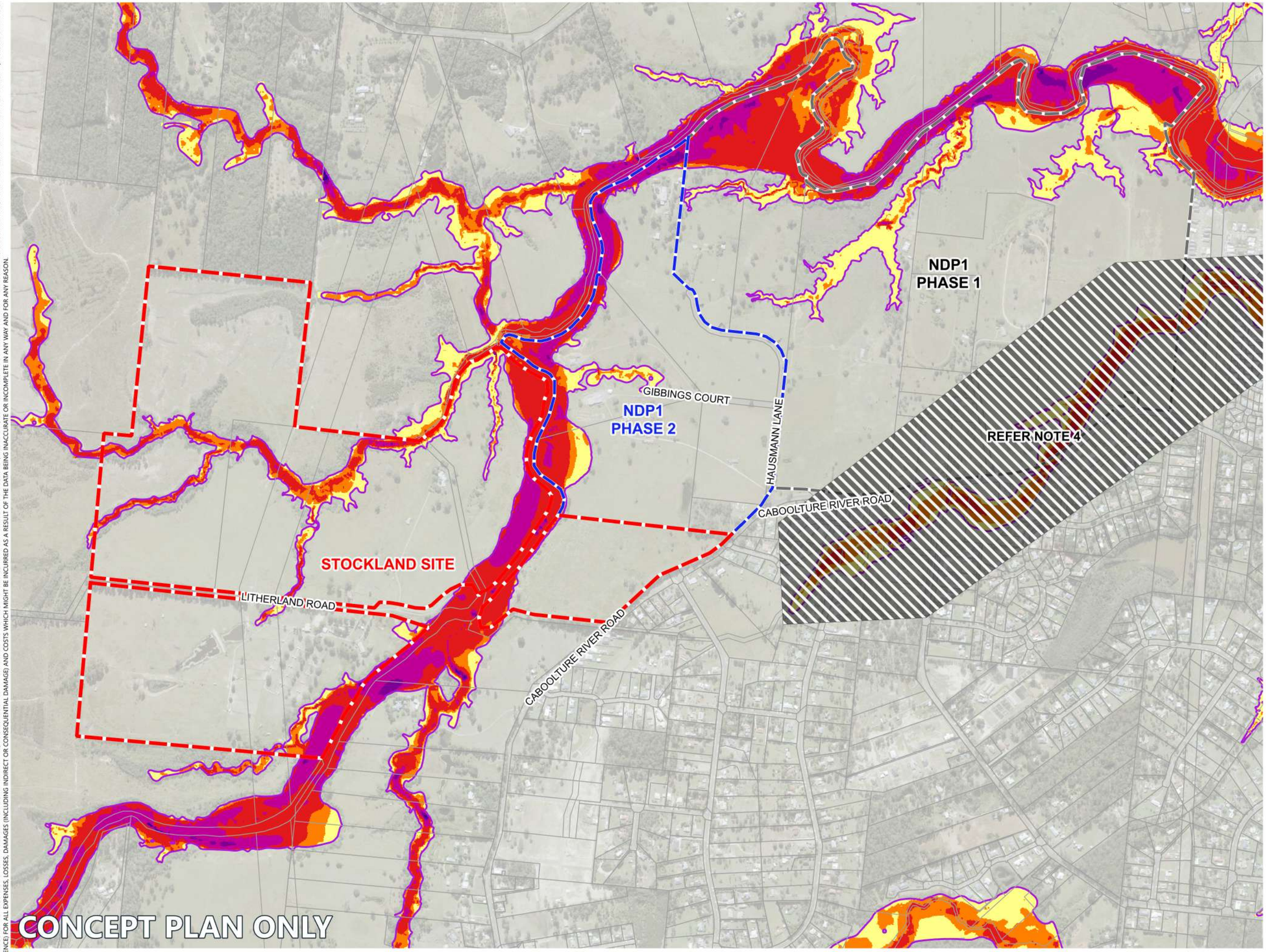
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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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EXISTING SCENARIO
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MAXIMUM FLOOD VELOCITY

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PROJECT
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HEIGHT DATUM: GDA1994

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

INDEX MAP



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PLAN TITLE

EXISTING SCENARIO
0.1% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-E-1000-C	B

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
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PLAN TITLE

EXISTING SCENARIO
1% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-E-100-A	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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LITHERLAND ROAD

CABOOLTURE RIVER ROAD

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EXISTING SCENARIO
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MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
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CLIENT
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NDP1 PHASE 1

NDP1 PHASE 2

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CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
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PLAN TITLE

EXISTING SCENARIO
1% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

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22-000135-E-100-C	B

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ISSUE				
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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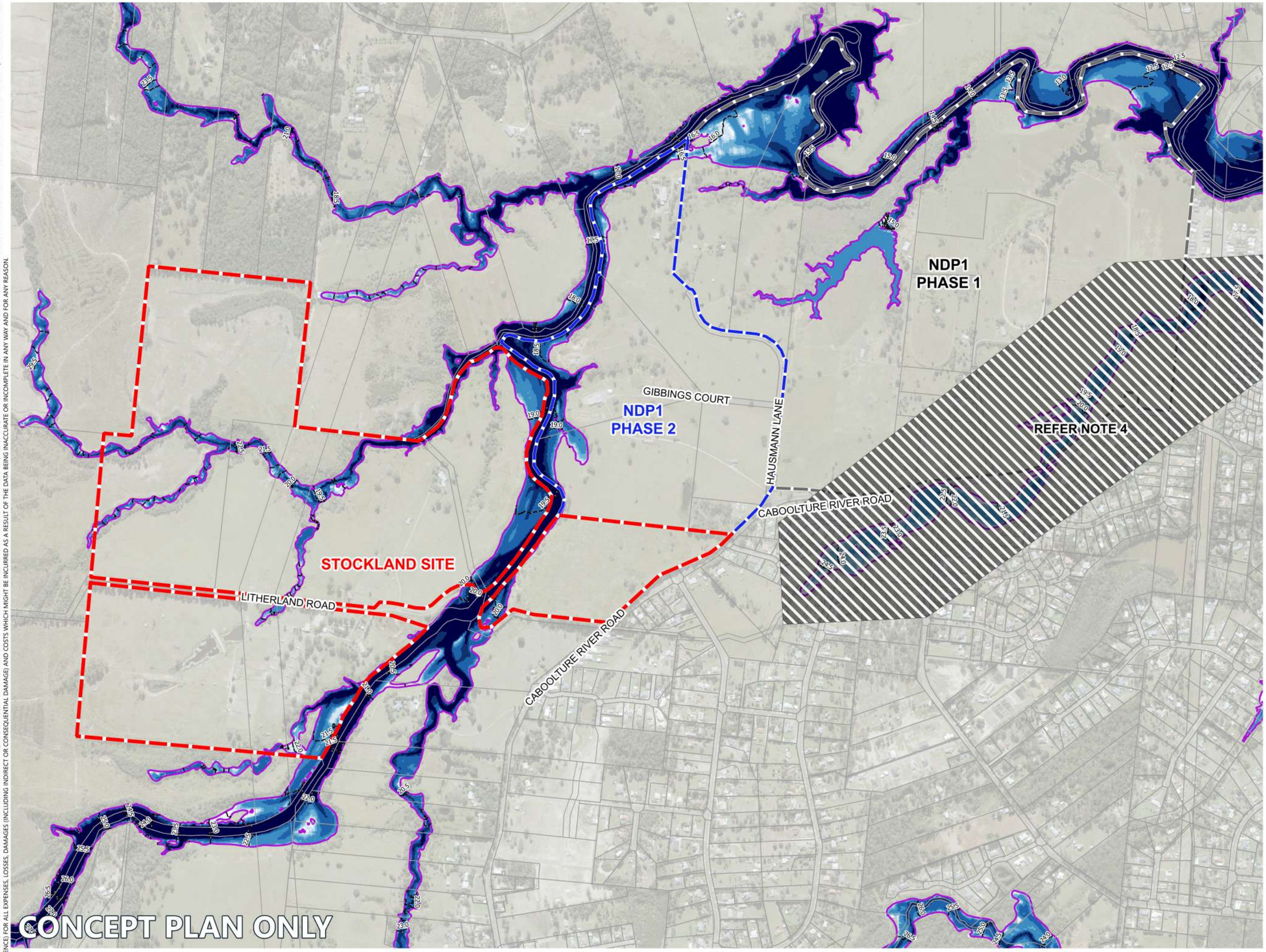
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- FLOOD HEIGHT CONTOURS (mAHD)
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FLOOD DEPTH (m)

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PLAN TITLE

EXISTING SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-E-020-A	B

INITIAL	DATE	BY	CHK	
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



NOTES

1. REFER TO EGIS REPORT No. 22-000135_FIA_01C DATED NOVEMBER 2024.
2. RESULTS PRESENTED ARE THE MAXIMUM OF STANDARD DURATIONS FOR THE AEP EVENT PRESENTED.
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4. ANALYSIS OF SOUTH EAST WATERCOURSE WITHIN NDP1 PHASE UNDETAKEN AS PART OF THE STORMWATER MANAGEMENT PLAN - CABOOLTURE WEST NDP1 (MARCH 2023)

PLAN TITLE

EXISTING SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-E-020-B	B

INITIAL	DATE	BY	CHK	
ISSUE				
A	16.06.22	DY	MS	ISSUE DETAILS
B	19.12.23	AM	DY	REVISED ISSUE
C	27.11.24	AM	DY	REVISED ISSUE
D				
E				
F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

H:\22\000135 - Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_Oct2024IRR_Var_03\QGIS_PLANS\22-000135_FLOOD_PLANS.qgz

egis

Stockland

0 200 400 600 m

1:12000 (A3)

COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

Approved Subject to Conditions of Decision Notice DA/2024/2263

28/4/2025

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

INDEX MAP



NOTES

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PLAN TITLE

EXISTING SCENARIO
5% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-E-020-C	B

INITIAL	DATE	BY	CHK	
ISSUE				
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

H:\22\000135 - Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_Oct2024IRR_Var_03\QGIS_PLANS\22-000135_FLOOD_PLANS.qgz

egis

Stockland

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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

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NDP1 PHASE 1

NDP1 PHASE 2

GIBBINGS COURT

HAUSMANN LANE

REFER NOTE 4

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



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PLAN TITLE

EXISTING SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-E-001-A	B

INITIAL	DATE	BY	CHK	
ISSUE				
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

0 200 400 600 m

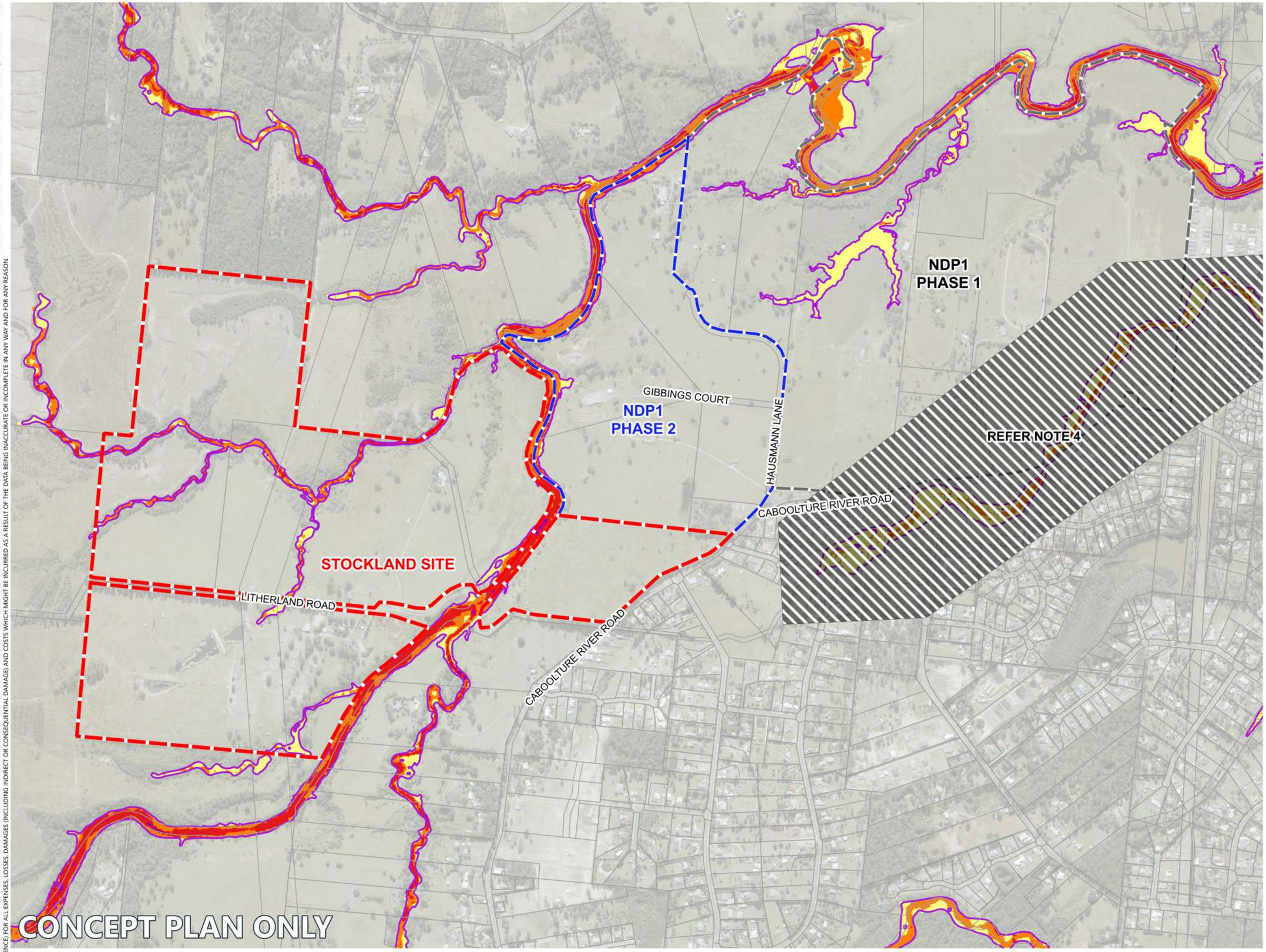
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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

EXISTING SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-E-001-B	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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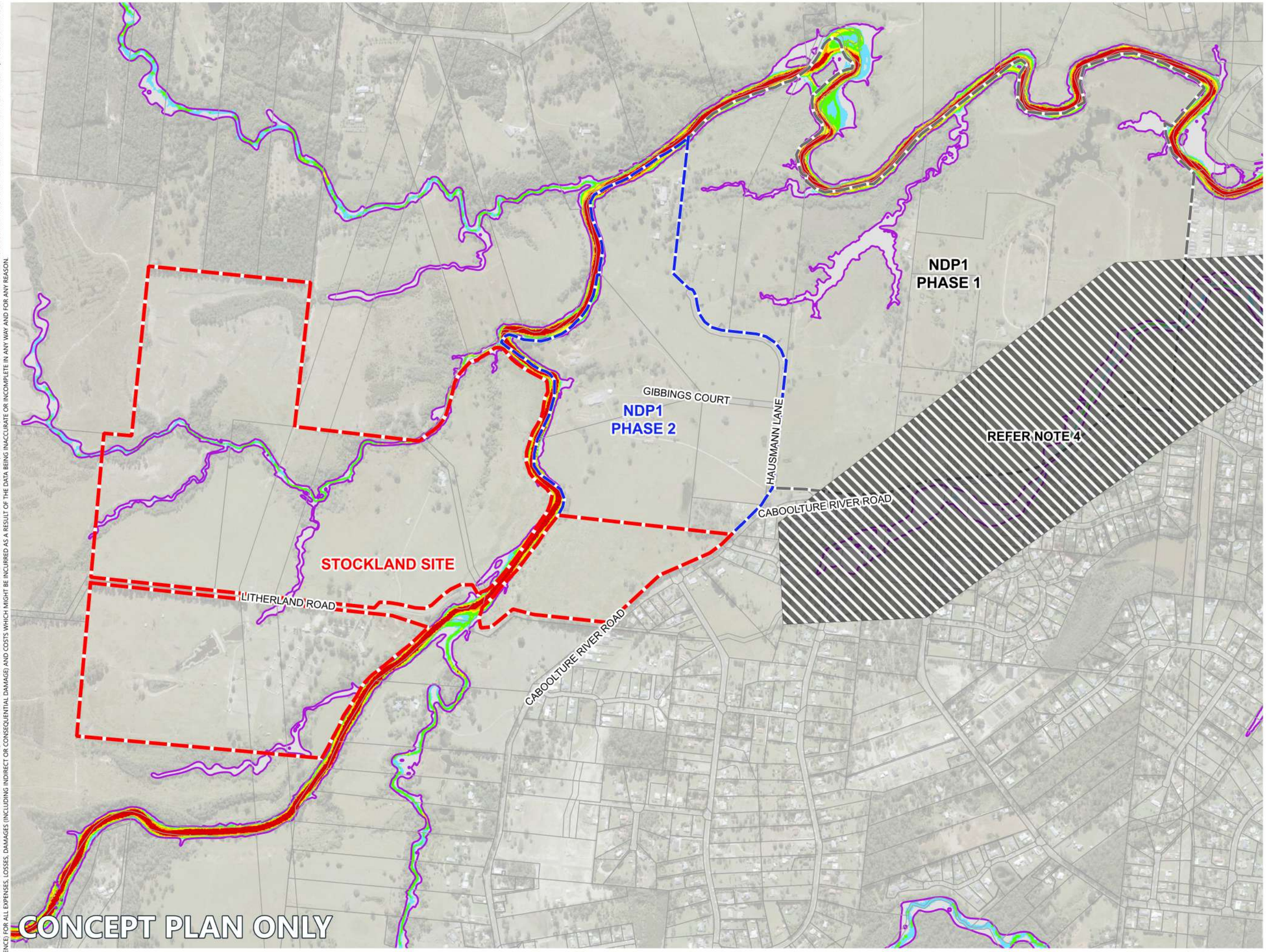
Stockland

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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

Approved Subject to Conditions of Decision Notice DA/2024/2263

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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- FLOODING OUTSIDE OF ANALYSIS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

INDEX MAP



NOTES

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PLAN TITLE

EXISTING SCENARIO
63% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-E-001-C	B

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C				
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

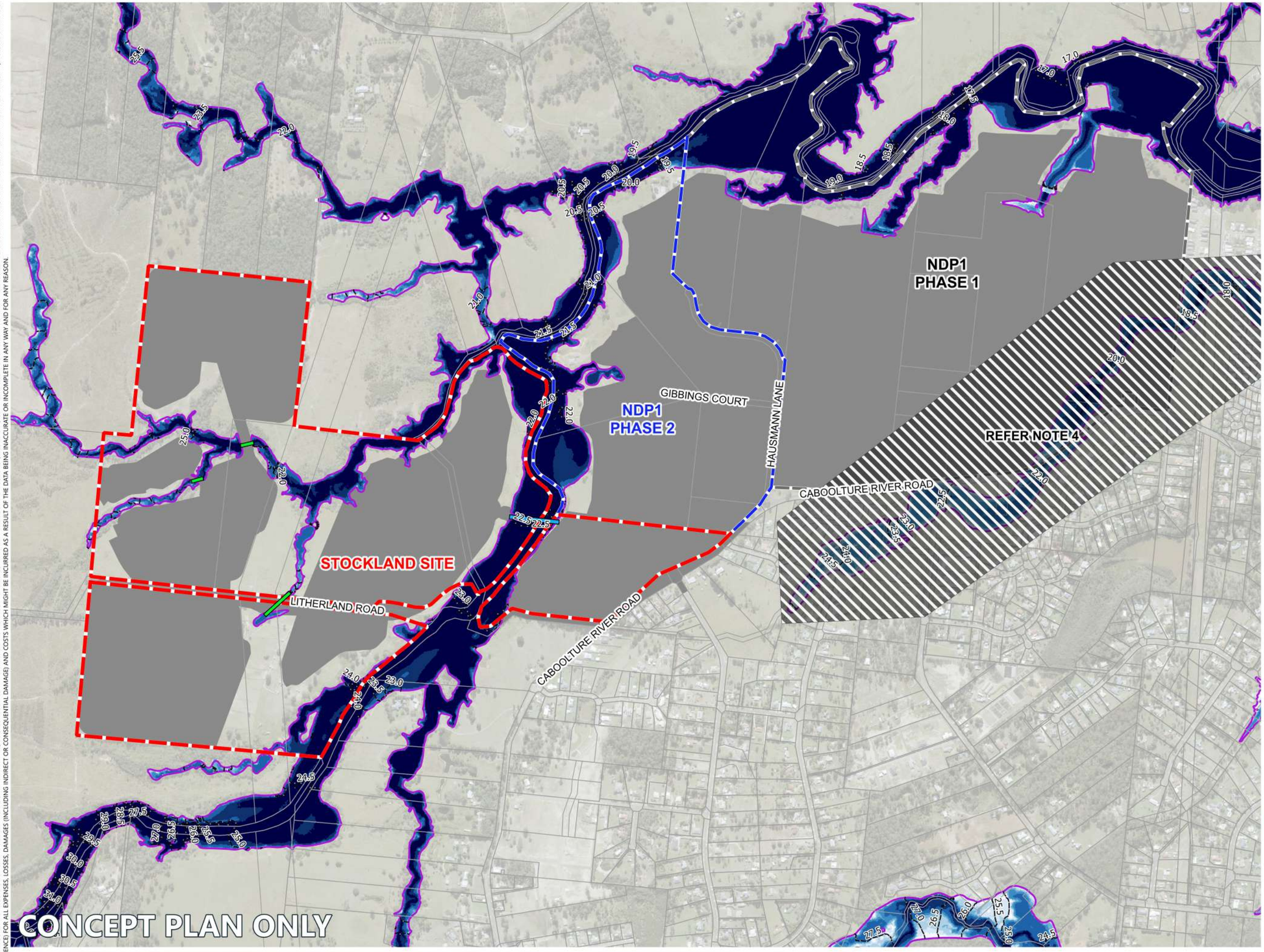
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28/4/2025

APPENDIX C: DEVELOPED SCENARIO FLOOD PLANS (INCLUDING AFFLUX)

Approved Subject to Conditions of Decision Notice DA/2024/2263 28/4/2025

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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



NOTES

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PLAN TITLE

DEVELOPED SCENARIO
0.1% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-D-1000-A	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
B	27.11.24	AM	DY	REVISED ISSUE
C				
D				
E				
F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

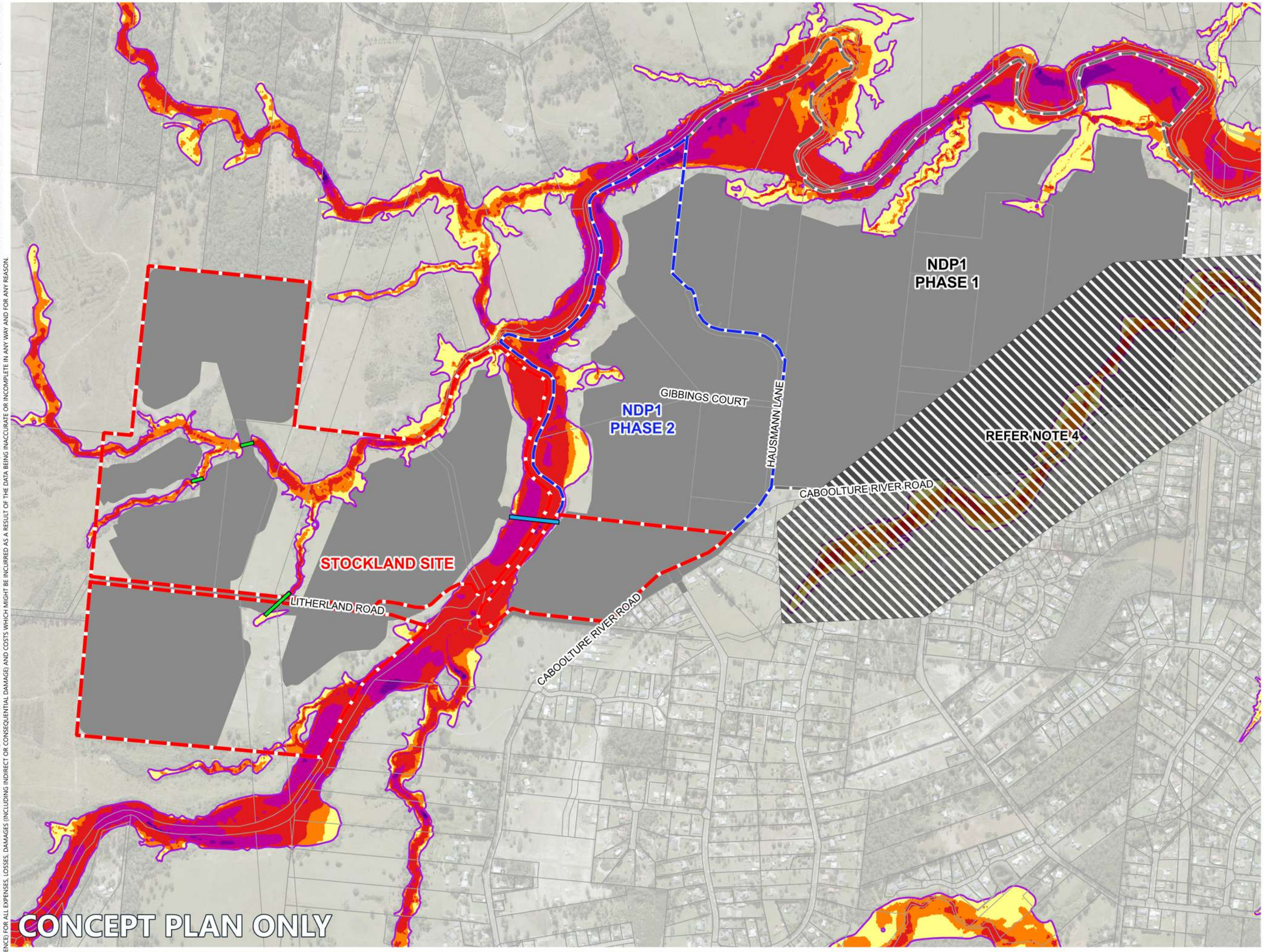
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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
0.1% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

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22-000135-D-1000-B	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

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PLAN TITLE

DEVELOPED SCENARIO
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MAXIMUM DEPTH-VELOCITY

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

0 200 400 600 m

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

WSL DIFFERENCE (m)

- < -0.5
- -0.5 TO -0.2
- -0.2 TO -0.1
- -0.1 TO -0.05
- -0.05 TO -0.02
- -0.02 TO 0.02
- 0.02 TO 0.05
- 0.05 TO 0.1
- 0.1 TO 0.2
- 0.2 TO 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
0.1% AEP STORM EVENT
MAXIMUM FLOOD LEVEL
DIFFERENCE

PLAN NUMBER	REV
22-000135-D-1000-E	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

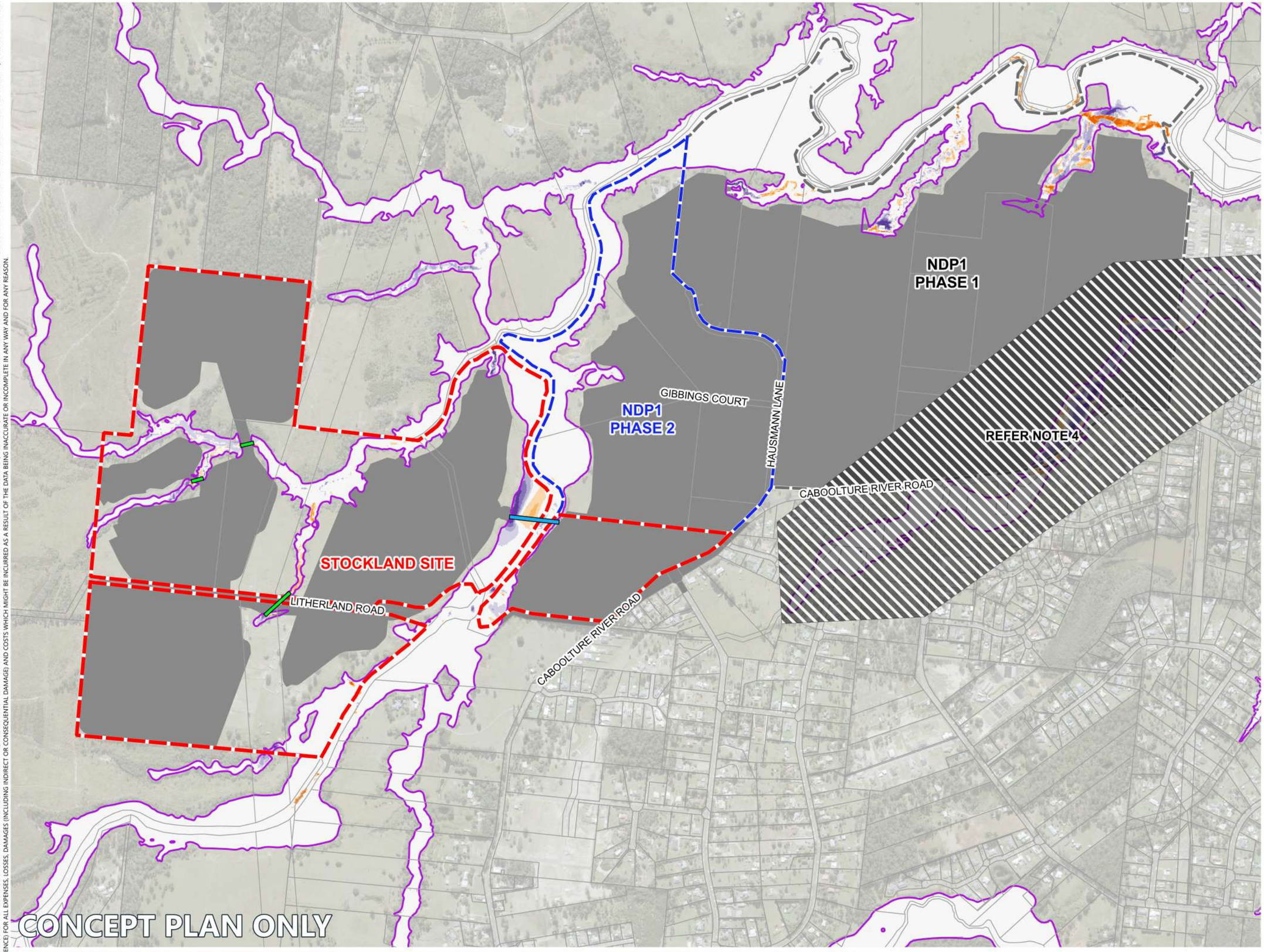
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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

Approved Subject to Conditions of Decision Notice DA/2024/2263

28/4/2025

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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

VELOCITY DIFFERENCE (m/s)

- < -1.0
- -1.0 TO -0.5
- -0.5 TO -0.25
- -0.25 TO -0.1
- -0.1 TO 0.1
- 0.1 TO 0.25
- 0.25 TO 0.5
- 0.5 TO 1
- > 1.0

INDEX MAP



NOTES

1. REFER TO EGIS REPORT No. 22-000135_FIA_01C DATED NOVEMBER 2024.
2. RESULTS PRESENTED ARE THE MAXIMUM OF STANDARD DURATIONS FOR THE AEP EVENT PRESENTED.
3. ALL LEVELS PRESENTED ARE IN METRES FROM AUSTRALIAN HEIGHT DATUM (mAHD).
4. ANALYSIS OF SOUTH EAST WATERCOURSE WITHIN NDP1 PHASE UNDETAKEN AS PART OF THE STORMWATER MANAGEMENT PLAN - CABOOLTURE WEST NDP1 (MARCH 2023)

PLAN TITLE

DEVELOPED SCENARIO
0.1% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY DIFFERENCE

PLAN NUMBER	REV
22-000135-D-1000-F	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
B	27.11.24	AM	DY	REVISED ISSUE
C				
D				
E				
F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

H:\22\000135 - Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_Oct2024IRR_Var_03\QGIS_PLANS\22-000135_FLOOD_PLANS.qgz

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Stockland

0 200 400 600 m
1:12000 (A3)

COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

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NDP1 PHASE 1

NDP1 PHASE 2

GIBBINGS COURT

HAUSMANN LANE

REFER NOTE 4

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
1% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-D-100-A	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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C				
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

0 200 400 600 m
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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
1% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-D-100-B	B

INITIAL	DATE	BY	CHK	
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
1% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-D-100-C	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

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1:12000 (A3)

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

WSL DIFFERENCE (m)

- < -0.5
- -0.5 TO -0.2
- -0.2 TO -0.1
- -0.1 TO -0.05
- -0.05 TO -0.02
- -0.02 TO 0.02
- 0.02 TO 0.05
- 0.05 TO 0.1
- 0.1 TO 0.2
- 0.2 TO 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

INDEX MAP



NOTES

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PLAN TITLE

DEVELOPED SCENARIO
1% AEP STORM EVENT
MAXIMUM FLOOD LEVEL
DIFFERENCE

PLAN NUMBER	REV
22-000135-D-100-E	B

INITIAL	DATE	BY	CHK	ISSUE DETAILS
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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C				
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G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

0 200 400 600 m

1:12000 (A3)

COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

VELOCITY DIFFERENCE (m/s)

- < -1.0
- -1.0 TO -0.5
- -0.5 TO -0.25
- -0.25 TO -0.1
- -0.1 TO 0.1
- 0.1 TO 0.25
- 0.25 TO 0.5
- 0.5 TO 1
- > 1.0

INDEX MAP



NOTES

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PLAN TITLE

DEVELOPED SCENARIO
1% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY DIFFERENCE

PLAN NUMBER	REV
22-000135-D-100-F	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
B	27.11.24	AM	DY	REVISED ISSUE
C				
D				
E				
F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

0 200 400 600 m
1:12000 (A3)

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NDP1 PHASE 1

NDP1 PHASE 2

GIBBINGS COURT

HAUSMANN LANE

REFER NOTE 4

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-D-020-A	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

0 200 400 600 m
1:12000 (A3)
COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-D-020-B	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

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CONCEPT PLAN ONLY

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- STOCKLAND SITE BOUNDARY
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- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

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PLAN TITLE

DEVELOPED SCENARIO
5% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-D-020-C	B

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

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INITIAL	DATE	BY	CHK	
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A	19.12.23	AM	DY	REVISED ISSUE
B	27.11.24	AM	DY	REVISED ISSUE
C				
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G				

Approved Subject to Conditions of Decision Notice DA/2024/2263

28/4/2025

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

WSL DIFFERENCE (m)

- < -0.5
- -0.5 TO -0.2
- -0.2 TO -0.1
- -0.1 TO -0.05
- -0.05 TO -0.02
- -0.02 TO 0.02
- 0.02 TO 0.05
- 0.05 TO 0.1
- 0.1 TO 0.2
- 0.2 TO 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

INDEX MAP

NOTES

1. REFER TO EGIS REPORT No. 22-000135_FIA_01C DATED NOVEMBER 2024.
2. RESULTS PRESENTED ARE THE MAXIMUM OF STANDARD DURATIONS FOR THE AEP EVENT PRESENTED.
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4. ANALYSIS OF SOUTH EAST WATERCOURSE WITHIN NDP1 PHASE UNDETAKEN AS PART OF THE STORMWATER MANAGEMENT PLAN - CABOOLTURE WEST NDP1 (MARCH 2023)

PLAN TITLE

DEVELOPED SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD LEVEL
DIFFERENCE

PLAN NUMBER	REV
22-000135-D-020-E	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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C				
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E				
F				
G				

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

H:\22\000135 - Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_Oct2024IRR_Var_03\QGIS_PLANS\22-000135_FLOOD_PLANS.qgz

egis

Stockland

0 200 400 600 m

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COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
HEIGHT DATUM: GDA1994

Approved Subject to Conditions of Decision Notice DA/2024/2263

28/4/2025

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

VELOCITY DIFFERENCE (m/s)

- < -1.0
- -1.0 TO -0.5
- -0.5 TO -0.25
- -0.25 TO -0.1
- -0.1 TO 0.1
- 0.1 TO 0.25
- 0.25 TO 0.5
- 0.5 TO 1
- > 1.0

INDEX MAP



NOTES

1. REFER TO EGIS REPORT No. 22-000135_FIA_01C DATED NOVEMBER 2024.
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PLAN TITLE

DEVELOPED SCENARIO
5% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY DIFFERENCE

PLAN NUMBER	REV
22-000135-D-020-F	B

PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

H:\22\000135 - Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_Oct2024IRR_Var_03\QGIS_PLANS\22-000135_FLOOD_PLANS.qgz

egis

Stockland

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1:12000 (A3)

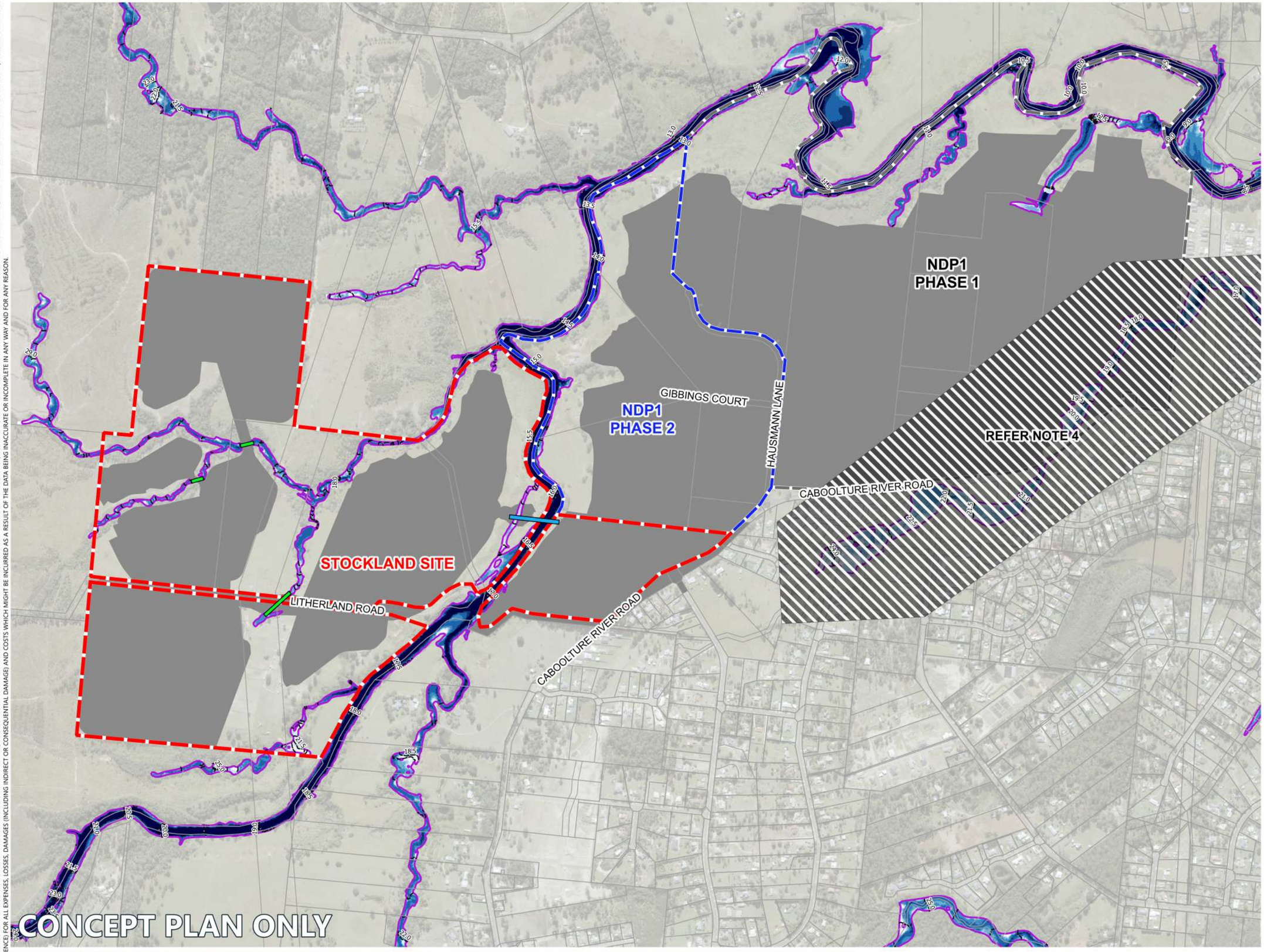
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LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD HEIGHT CONTOURS (mAHD)
- FLOOD EXTENT

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



NOTES

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PLAN TITLE

DEVELOPED SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-D-001-A	B

INITIAL	DATE	BY	CHK	
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

0 200 400 600 m
1:12000 (A3)

COORDINATE REFERENCE: GDA1994 / MGA ZONE 56
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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-D-001-B	B

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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

0 200 400 600 m
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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD DV (m^2/s)

- 0.01 to 0.05
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.4
- 0.4 to 0.6
- 0.6 to 1

INDEX MAP

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PLAN TITLE

DEVELOPED SCENARIO
63% AEP STORM EVENT
MAXIMUM DEPTH-VELOCITY

PLAN NUMBER	REV
22-000135-D-001-C	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

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1:12000 (A3)

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

STOCKLAND SITE

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

WSL DIFFERENCE (m)

- < -0.5
- -0.5 TO -0.2
- -0.2 TO -0.1
- -0.1 TO -0.05
- -0.05 TO -0.02
- -0.02 TO 0.02
- 0.02 TO 0.05
- 0.05 TO 0.1
- 0.1 TO 0.2
- 0.2 TO 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

INDEX MAP

NOTES

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PLAN TITLE

DEVELOPED SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD LEVEL
DIFFERENCE

PLAN NUMBER	REV
22-000135-D-001-E	B

INITIAL	DATE	BY	CHK	
ISSUE	16.06.22	DY	MS	ISSUE DETAILS
A	19.12.23	AM	DY	REVISED ISSUE
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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Stockland

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1:12000 (A3)

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

VELOCITY DIFFERENCE (m/s)

- < -1.0
- -1.0 TO -0.5
- -0.5 TO -0.25
- -0.25 TO -0.1
- -0.1 TO 0.1
- 0.1 TO 0.25
- 0.25 TO 0.5
- 0.5 TO 1
- > 1.0

INDEX MAP

NOTES

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PLAN TITLE

DEVELOPED SCENARIO
63% AEP STORM EVENT
MAXIMUM FLOOD VELOCITY DIFFERENCE

PLAN NUMBER	REV
22-000135-D-001-F	B

INITIAL	DATE	BY	CHK	
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

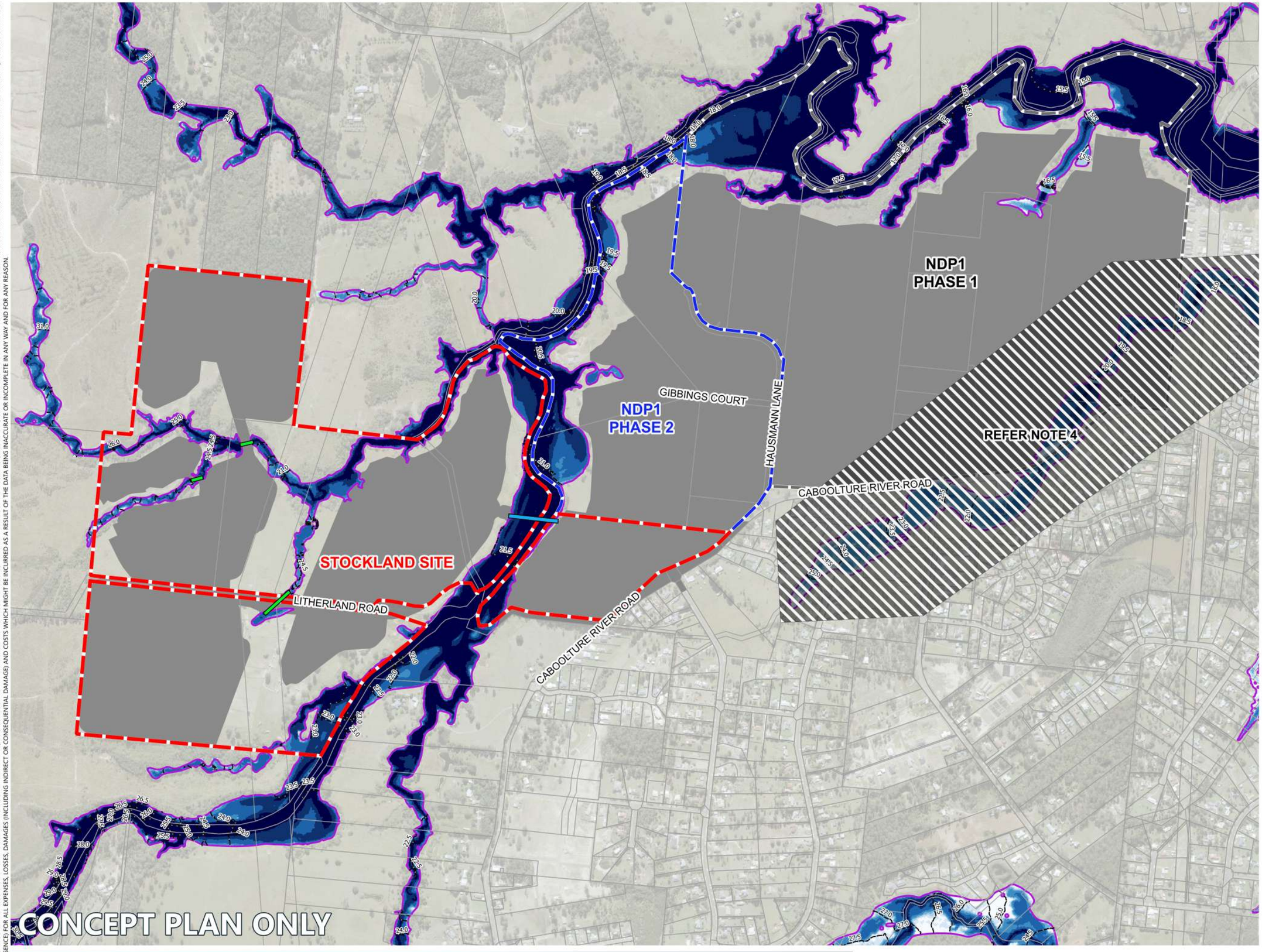
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- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT
- FLOOD HEIGHT CONTOURS (mAHD)

FLOOD DEPTH (m)

- < 0.1
- 0.1 TO 0.2
- 0.2 TO 0.3
- 0.3 TO 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- > 3.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
1% AEP + CC STORM EVENT
MAXIMUM FLOOD DEPTH

PLAN NUMBER	REV
22-000135-D-100CC-A	B

INITIAL	DATE	BY	CHK	
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PROJECT
CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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egis

Stockland

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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

STOCKLAND SITE

GIBBINGS COURT

HAUSMANN LANE

CABOOLTURE RIVER ROAD

LITHERLAND ROAD

CABOOLTURE RIVER ROAD

CONCEPT PLAN ONLY

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE
- MODELLED FLOW CONSTRICTION
- MODELLED 1D ELEMENTS
- FLOODING OUTSIDE OF ANALYSIS
- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD VELOCITY (m/s)

- < 0.5
- 0.5 TO 1.0
- 1.0 TO 2.0
- 2.0 TO 3.0
- 3.0 TO 4.0
- > 4.0

INDEX MAP



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PLAN TITLE

DEVELOPED SCENARIO
1% AEP + CC STORM EVENT
MAXIMUM FLOOD VELOCITY

PLAN NUMBER	REV
22-000135-D-100CC-B	B

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CABOOLTURE WEST NDP1 PHASE 2 & NDP2

CLIENT
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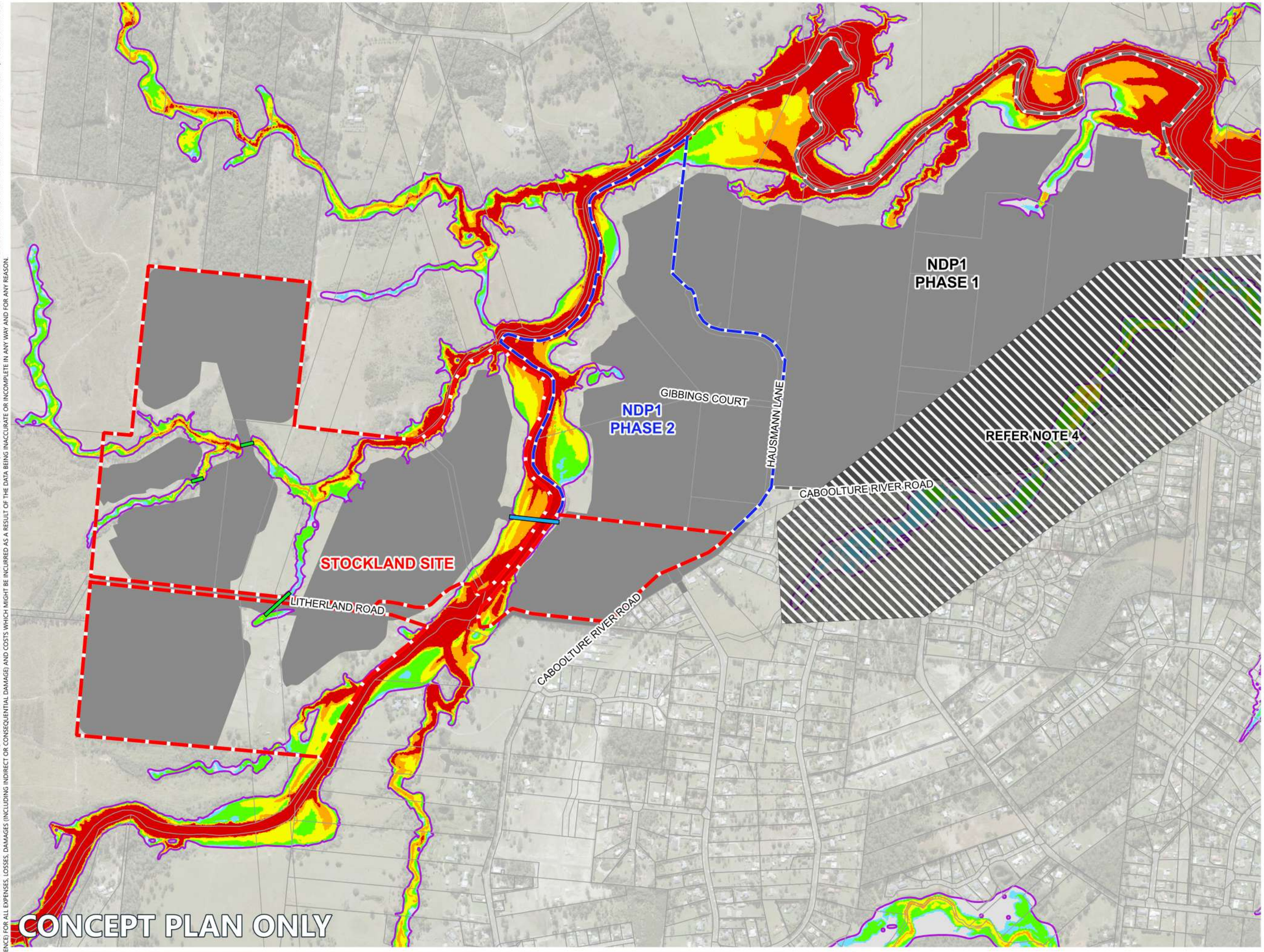
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- MODELLED EARTHWORKS
- FLOOD EXTENT

FLOOD DV (m^2/s)

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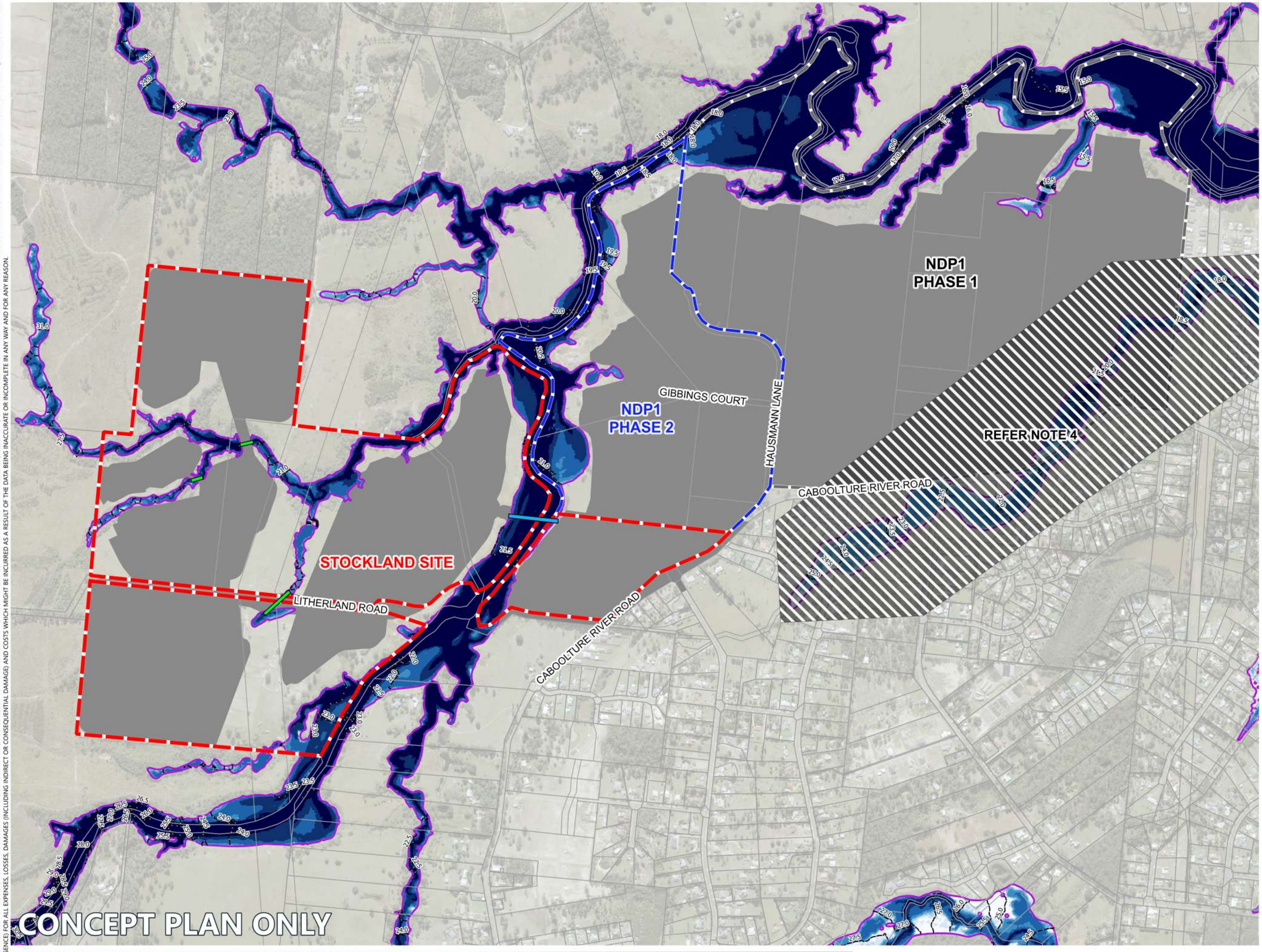
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NDP1 PHASE 1

NDP1 PHASE 2

STOCKLAND SITE

REFER NOTE 4

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CABOOLTURE RIVER ROAD

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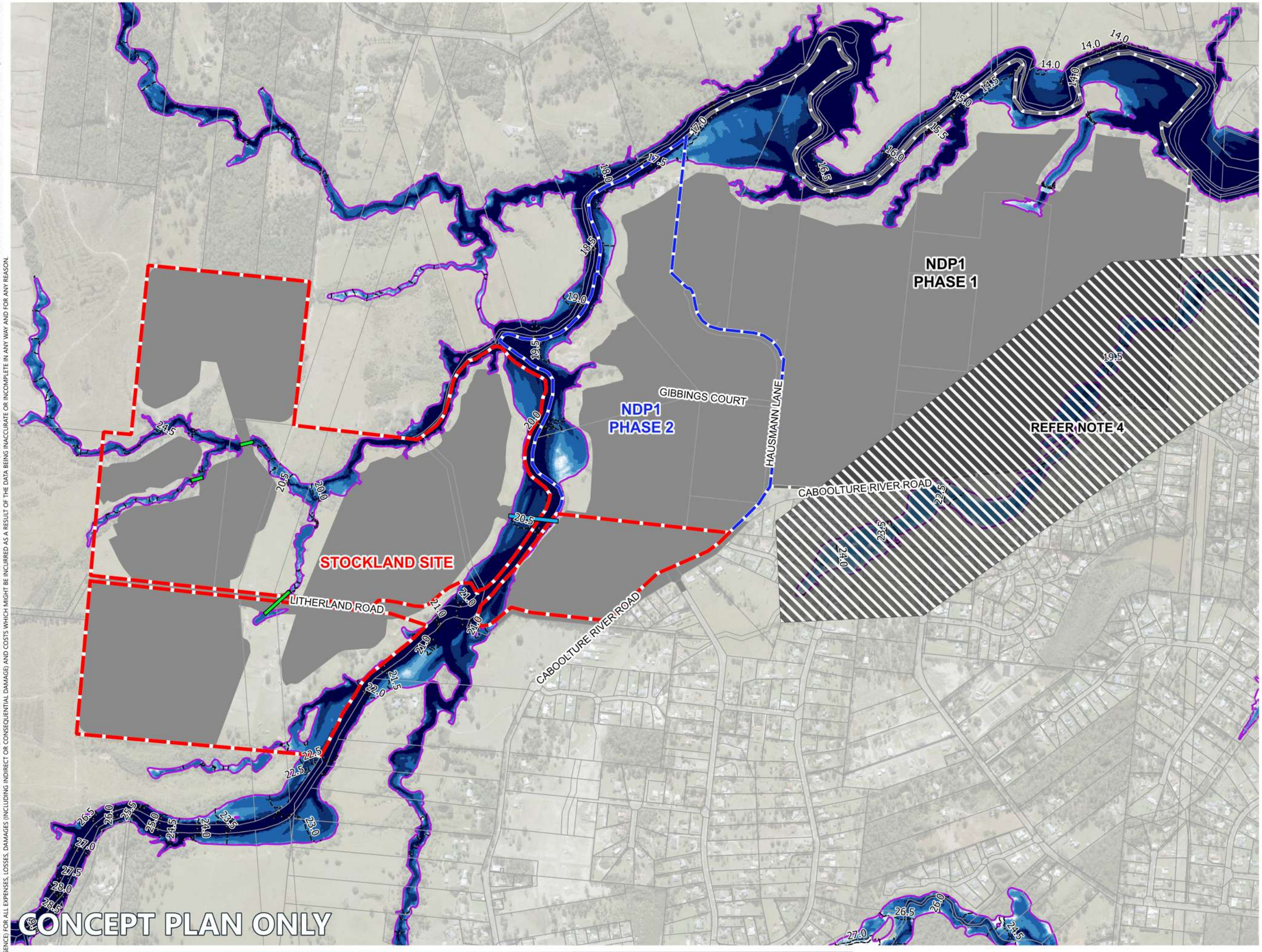
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NDP1 PHASE 1

NDP1 PHASE 2

REFER NOTE 4

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APPENDIX D: MODEL VERIFICATION EXTRACT FROM *NDP1 SWMP* (March 2023)

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The future alignment of Caboolture River Road crosses into the study area at the southern end of the South East Watercourse. Allowance has been made to include the future road embankment in the strategy as these works will reduce the amount of flood storage in the study area once complete. Preliminary levels for the road embankment have taken into consideration the need for Caboolture River Road to be immune to 1% AEP inundation (as requested at Development Control Group meeting held 25 February 2021). Therefore, in order to achieve no impact upstream a conceptual culvert design has been sized to convey the 1% AEP event peak flow. Details of the conceptual configuration of the culvert underneath the future Caboolture River Road is provided on **Figure 4.21** below.

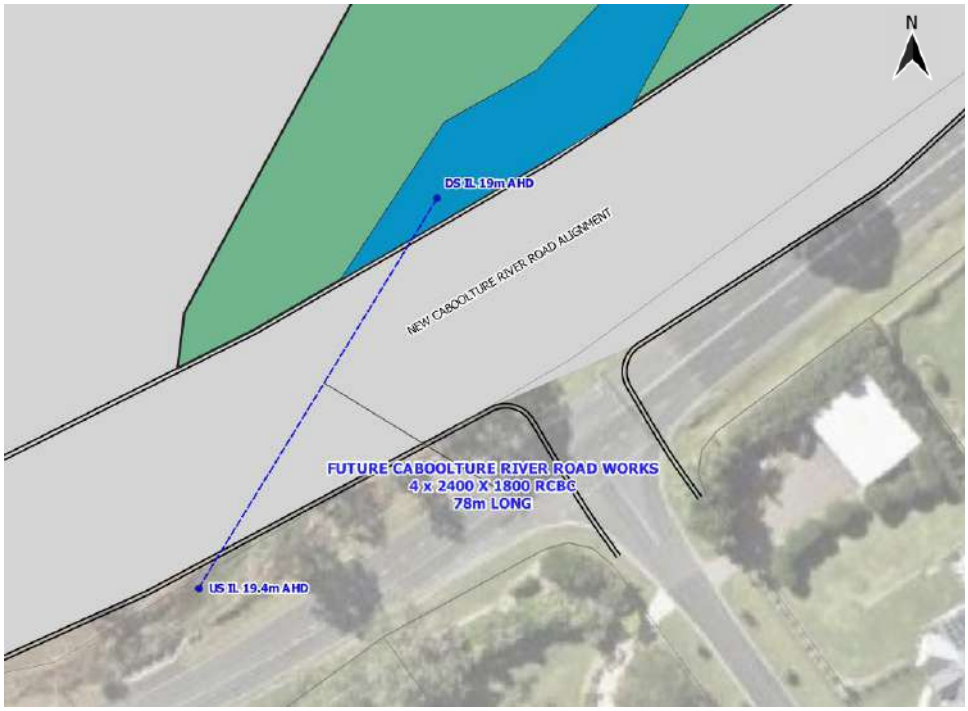


Figure 4.21: Future Caboolture River Road Culvert Configuration

The elements associated with the future Caboolture River Road works includes the following:

- 30m wide road embankment with a minimum crest level of 21.6m AHD.
- Four 2400mm x 1800mm Reinforced Concrete Box Culverts (RCBC's). The invert levels of these conduits have been set to the minimum levels within the South East Watercourse either side of the road embankment.

It is noted that the final configuration of the Caboolture River Road upgrade and culverts is subject to separate investigation, analysis and design. It is assumed that this separate flood investigation, undertaken as part of planning and design of the road upgrade, will also account for potential changes in flood behaviour where the proposed road alignment and Tinney Road intersection works are located within the existing watercourse.

The limitations of the analysis presented in this report (i.e. inclusion of the part of future Caboolture River Road within the Study Area only) was discussed and agreed with MBRC representatives during the Development Control Group meeting (held 25 February 2021).

4.3 Hydraulic Investigations

Hydraulic modelling using TUFLOW has been undertaken to:

- Confirm the results of the hydrological investigation; and
- Demonstrate the development will not adversely change maximum flood conditions on adjacent and downstream properties within the Caboolture River or South East Watercourse, downstream of the study area.

4.3.1 TUFLOW Model Configuration

As discussed in **Section 1.2** the investigations and analysis undertaken has utilised the hydraulic (TUFLOW) modelling previously undertaken as part of the *Caboolture River Flood Modelling Database* (002c, 2014), sourced from MBRC.

TUFLOW modelling was undertaken to confirm the results of the initial hydrological analysis for the Caboolture River. This model was reconfigured to incorporate proposed works associated with development adjacent to the Caboolture River, together with design levels and hydraulic elements associated with the South East Watercourse (as identified in **Section 0**).

The full extent of the Caboolture River model was initially adopted for the analysis as:

- Truncating the model had the potential to cause model instabilities; and

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- By adopting the original model extent eliminated the potential for any change to flood conditions well outside of the study area to go unnoticed.

The original 2D grid cell size of 5 meters was also initially adopted.

Following consultation with MBRC a model with a finer grid cell size of 2.5m was adopted over the critical area of investigation, using a Quadtree mesh. At this cell size it was determined that that run times would be too onerous to run the full extent of the model, therefore a modified model was finally adopted.

Model Version & Comparison

The TUFLOW modelling undertaken has utilised a recent version of the software (Build 2018-03-AE-iSP-w64) enabled with the Heavily Parallelised Compute (HPC) functionality. This allows for a single model to be run across multiple CPU's or GPU, resulting in significantly shorter model run times. The original modelling undertaken as part of the *Caboolture River Flood Modelling Database* (002c, 2014) utilised an older version of TUFLOW (Build 2013-12-AD-iDP-w64). As the two versions compute hydraulic conditions differently a comparison of maximum flood level results was undertaken for the 1% AEP. From the calculated flood level difference raster a histogram representing the frequency of flood level difference values was output. This histogram is presented below in **Figure 4.22**.

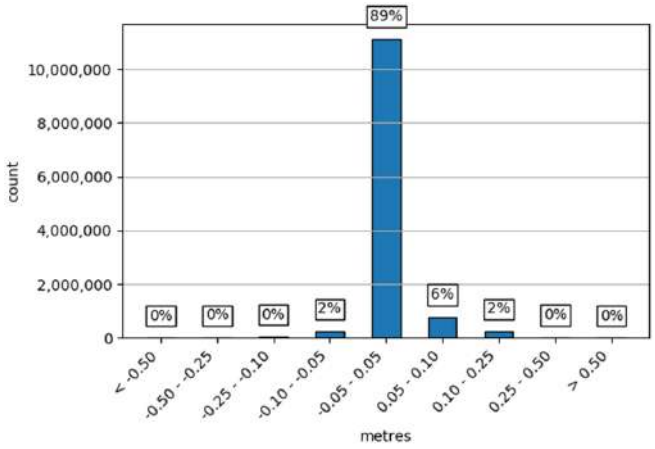


Figure 4.22: Flood Level Difference Histogram – 2013 & 2018 Version Comparison

The results indicate for the extent of the Caboolture River TUFLOW model the majority of flood level values differ by less than 50mm.

Flood level differences between the two model versions in the vicinity of the study area are presented on **Figure 2.1** below. This indicates that along the Caboolture River (adjacent to NDP1) and the upstream portion of the South East Watercourse flood levels between the two versions are generally consistent (less than 100mm difference).

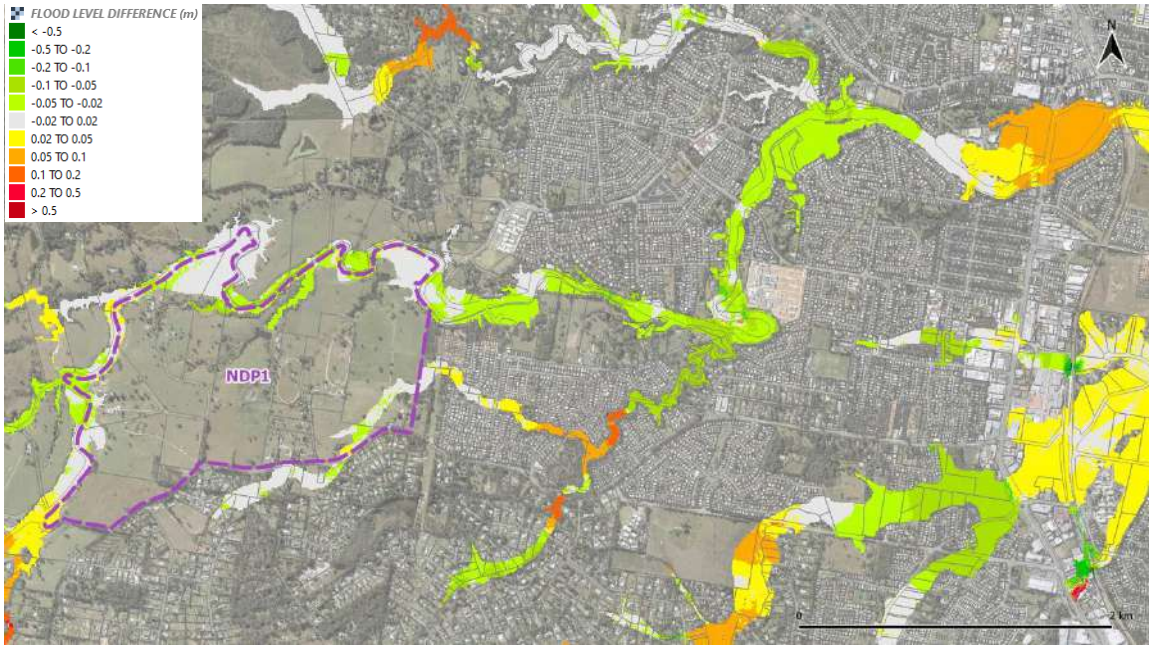


Figure 4.23: 1% AEP Flood Level Difference - 2013 & 2018 Version Comparison

Differences in flood levels are more prevalent within the South East Watercourse downstream of NDP1, particularly upstream and downstream of junction with the minor tributary to the east. Here increases are observed where existing waterway crossings are located, however the increases are less than 200mm and confined to short lengths of the waterway.

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On the basis of the above comparisons the switch in TUFLOW model versions from Build 2013-12-AD-iDP-w64 to Build 2018-03-AE-iSP-w64 is considered appropriate to facilitate the use of the HPC solution scheme (instead of CPU) with GPU hardware (instead of CPU).

In consultation with MBRC the model was initially truncated downstream of where the Caboolture – Sunshine Coast Rail Line crosses the Caboolture River. This location is indicated on **Figure 4.24** below. The downstream model extent was configured with a Head-Flow (HQ) boundary. A rating curve of Head (i.e. WSL) versus flow was configured from flood level and flow results, recorded using string and node time series results measured at location using the original model (i.e. full extent).

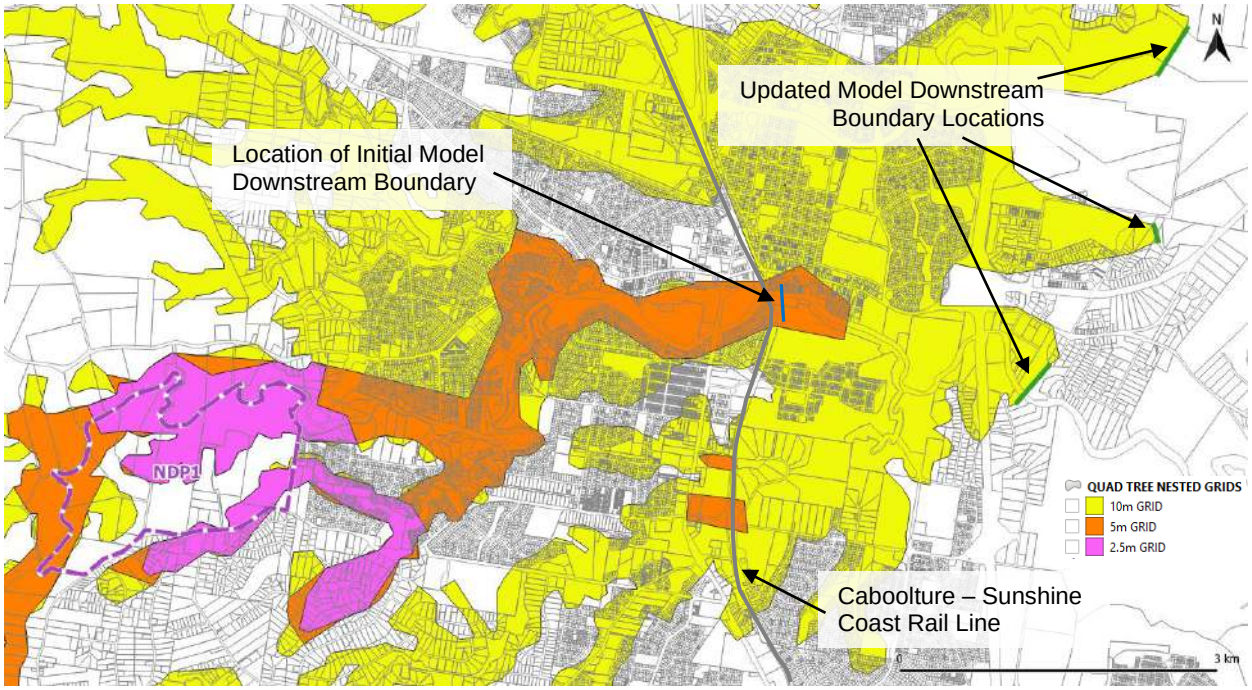


Figure 4.24: Configuration of Truncated TUFLOW Model

On comparing the truncated model results to those from the full model, flood level differences were found to extend upstream to a location on the Caboolture River approximately 2km downstream of the eastern NDP1 boundary. The nearness of the flood level difference to the eastern boundary of NDP1 was considered to be unsatisfactory for the investigation and new locations for the model truncation were chosen further downstream. At these three locations Head versus Flow boundary conditions were derived using known water surface slopes adopted from the original model. The location for the revised downstream boundaries are indicated on **Figure 4.24** above.

As the truncated model became larger it was found that nested grids were required to keep model runs to an acceptable timeframe. These nested grids were configured using the TUFLOW Quad Tree Mesh (QTM) functionality, which required a further change in TUFLOW model version (from Build 2018-03-AE-iSP-w64 to Build 2020-10-AB-iSP-w64). As indicated in **Figure 4.22** above a 2.5m grid (identified as pink) was applied over the extent of the Caboolture River and SEWC adjacent to and downstream of NDP1. A 5m grid (identified as orange) was adopted for the Caboolture River and SEWC downstream to the initially proposed truncated model boundary (i.e. to the downstream side to the Caboolture – Sunshine Coast Rail Line). All other areas within the model outside of the critical area of investigation were modelled at a 10m grid (identified as yellow).

Once the model was configured and run (using TUFLOW Build 2020-10-AB-iSP-w64) the flood level determined for the 1% AEP event were compared to that of the full (un-truncated) model (run in Build 2018-03-AE-iSP-w64). The comparison is presented in **Figure 4.25** below.

The results of the comparison indicate that flood levels are consistent across both models. Flood levels for the truncated model were found to be lower downstream of the rail line, however these differences do not propagate upstream more than 900m from where the model was initially to be truncated. Based on these results the location and configuration of the new downstream boundary are considered appropriate for the intended analysis.

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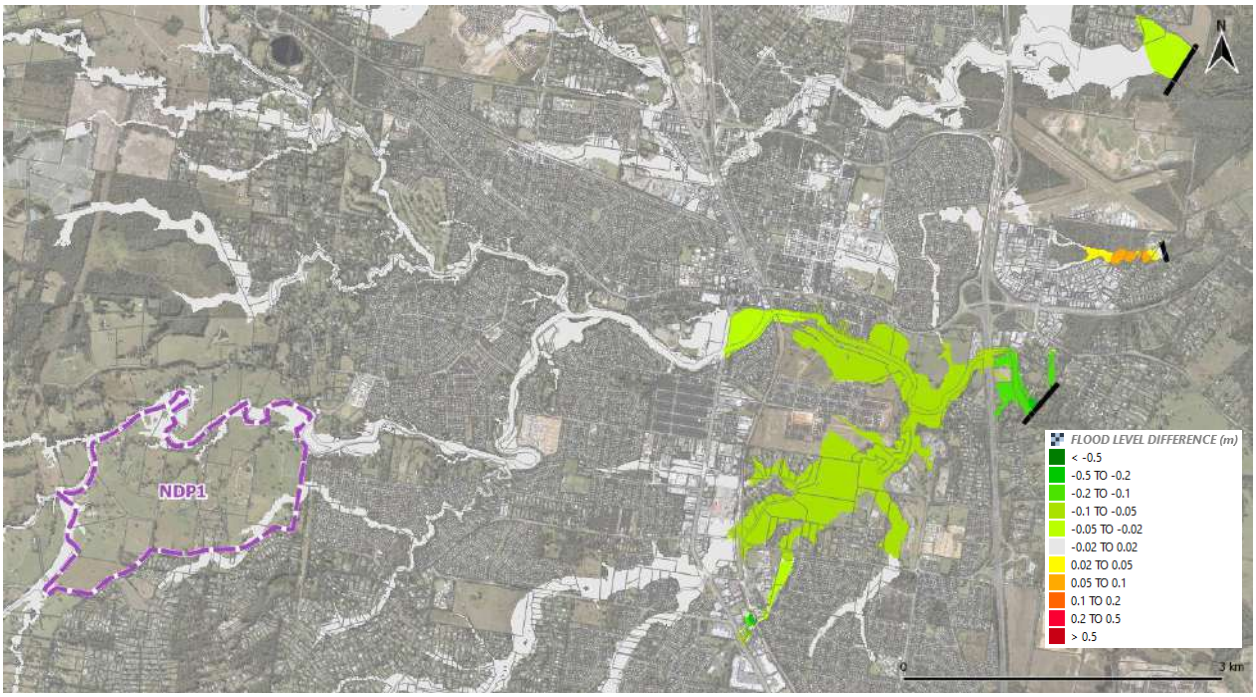


Figure 4.25: 1% AEP Flood Level Difference – Truncated versus Full Model Comparison

Modelled Events

Critical durations for the extent of the model adjacent to and downstream of the study area were initially determined from analysis of existing scenario results. Initially TUFLOW model runs were limited to these durations (120 to 1440 minute) for the 5%, 1% and 0.1% AEP events, however following consultation with MBRC TUFLOW model runs were undertaken for critical durations for all standard AEP events (i.e. 1% to 63%) and the 0.1% AEP event.

Existing Scenario

Before the model was configured to account for the proposed development, the existing scenario model previously utilised for the Caboolture River hydrological investigation was first updated with the catchment SA Polygons and inflow hydrographs adopted for the South East Watercourse hydrological analysis (as discussed in **Section 4.2**). This model was run for the critical durations of the select events before results extracted for comparison to developed scenario model results.

Developed Scenario

The model was next updated to incorporate the following for the developed scenario:

- Proposed design surface levels across the study area using preliminary design surface models (DEMs), or shapefiles with preliminary design elevation data (2d_zshape files).
- The conduits proposed to convey and control flows as part of the South East Watercourse Strategy, located underneath the District Collector Road (as discussed in **Section 0**) were entered into the model using 1D Network (1d_nwk) elements. The 1D network elements were linked to the 2D grid. Allowance was made in the 1D networks configuration to restrict flows through the Secondary Detention Outlet (3 x 1500 RCP's) until water surface level values in the connected 2D grid upstream reached an elevation above the level of the upstream 19m long Weir.
- A 2d_zshape configured to allow for the future Caboolture River Road embankment across the South East Watercourse.
- The concept culvert configuration conceived for the new Caboolture River Road alignment. These culverts were also entered into the model using 1D network elements and linked to the 2D grid.
- Proposed revegetation of the South East Watercourse. The roughness shapefile was updated to incorporate depth-varying roughness values for Medium Dense Vegetation, as per Table 5-10 of the *MBRC Regional Floodplain Database: Floodplain Parameterisation Report* (SKM 2012), along the South East Watercourse within the study area. As stated in **Section 0** the original roughness value at the very downstream end of the South East Watercourse have been retained.
- The SA Polygons and inflow hydrographs allowing for development of the study area catchments discharging runoff to the Caboolture River and South East Watercourse (as configured for the Caboolture River hydrological investigation).

It is noted that:

- The TUFLOW model was not updated to allow for revegetation within the areas designated as the Green Infrastructure Network (GIN) along and within Caboolture River watercourse; and
- The TUFLOW model does not incorporate any allowance for a crossing over the Caboolture River.

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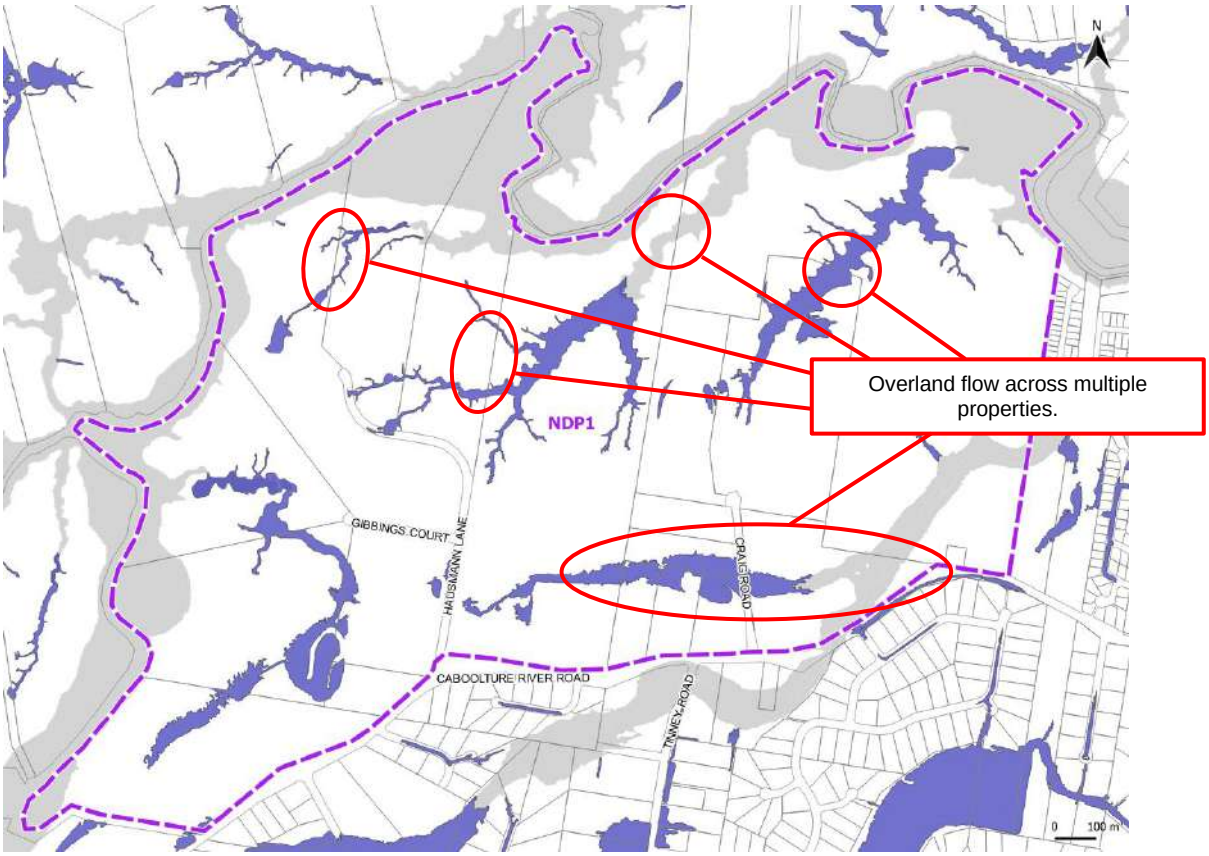


Figure 4.2: Overland Flow Overlay Mapping (Source: MBRC)

Generally, the management of overland flows can be addressed through the provision of an underground drainage network, together with designed overland flow paths (i.e. roads and drainage reserves). For most landowners within Phase 1 the drainage infrastructure provided as part of each separate development will convey local runoff to an appropriate discharge location.

Fragmentation of land ownership in the south east and north east parts of the study area (where significant overland flow paths exist) will however require trunk drainage infrastructure to convey runoff from more than one development to an appropriate discharge location. This is discussed further in **Section 7**.

4.2 Hydrological Investigations

Hydrological analysis and modelling were initially undertaken to develop the flood mitigation strategies for the catchments discharging to the Caboolture River and the South East Watercourse.

4.2.1 Model Verification

The Watershed Bounded Network Model (WBNM) associated with the MBRC *Caboolture River Flood Modelling Database* (002c, 2014) has been utilised for the investigations. It is noted that this model underwent a comprehensive verification during its initial development (by SKM), however a comparison of peak flows against those determined by preliminary methods has been undertaken for a selection of local sub-catchments which are located within or near the study area, and regional catchment downstream.

Peak flows for the local sub-catchment verification have been undertaken using the Rational Method. **Figure 4.3** below indicates the sub-catchments investigated. Due to the variability in how the Time of Concentration (tc) value can be calculated, peak flows been calculated for a range of tc values. Details of the Rational Method calculated peak flows and comparison to those from the WBNM are summarised in **Table 4.1** and **Figure 4.4** below.

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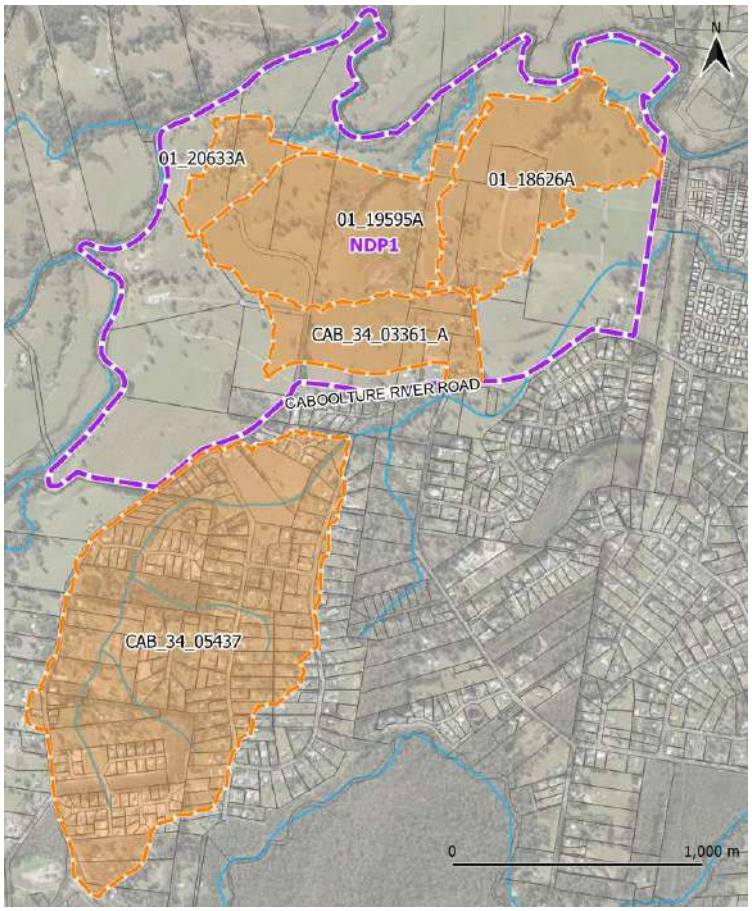


Figure 4.3: Verification Sub-Catchments

With regards to the Rational Method Calculations the following is noted:

- Values of tc were calculated using the following:
  - Overland sheet flow together with an initial estimate of channel flow time (as per Sections 4.6.6 & 4.6.7 of QUDM);
  - Bransby-Williams and Modified Friends Equations (as per Section 4.6.11 of QUDM); and
  - Overland sheet flow together with the Modified Stream Velocity method (as per Sections 4.6.6 & 4.6.11 of QUDM).
- Rainfall intensities sourced from the Bureau of Meteorology Design Rainfall Data System (2016).

Table 4.1: Rational Method Summary & Comparison to WBNM Peak Flow – 1% AEP

Sub-Catchment	Area (ha)	Impervious Percentage (%)	Rational Method Peak Flow (m^3/s)			WBNM Peak Flow (m^3/s)
			Average	Minimum	Maximum	
01_20633A#	10.98	0.8	2.85	2.04	3.76	2.31
01_19595A#	46.05	3.3	10.89	7.66	14.58	12.11
01_18626A	42.2	2.3	8.44	6.46	10.78	11.28
CAB_34_03361_A	23.82	4.4	4.95	3.74	6.75	7.31
CAB_34_05437	136.52	6.3	23.13	19.85	26.57	28.15

Parameterisation of this sub-catchment has undergone minor change in the WBNM model since the model verification was undertaken as part of previous revisions of this report (up to and including Revision C)

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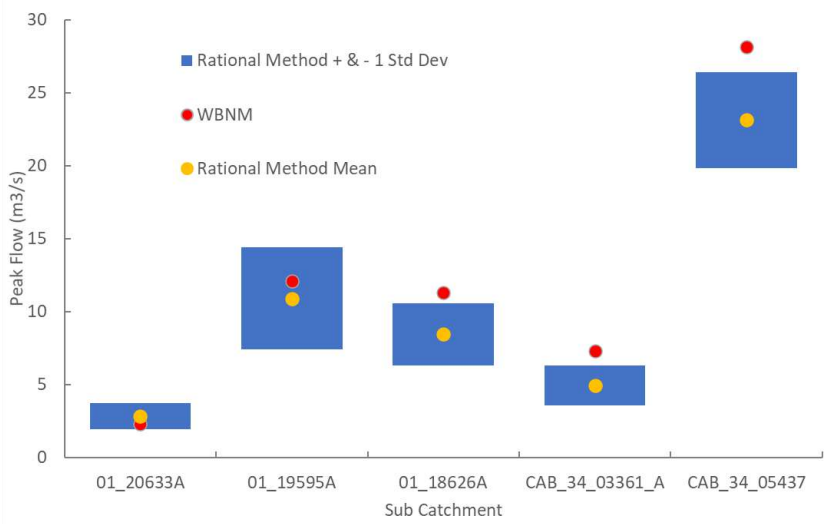


Figure 4.4: Comparison of Rational Method & WBNM Peak Flows – 1% AEP

The above comparisons indicate that peak flows generated by WBNM are either within the range of those determined by the Rational Method, or are slightly higher.

Peak flows for the regional verification have been determined using the Australian Rainfall & Runoff *Regional Flood Frequency Estimation* (RFFE) Model (https://rffe.arr-software.org/). Peak flows were determined using the RFFE model for the Caboolture River catchment above the Caboolture – Sunshine Coast Rail Line (at Sub Catchment CAB_01_11674). A comparison of the WBNM peak flows to those determined by the RFFE model at this location is presented in **Figure 4.5** below.

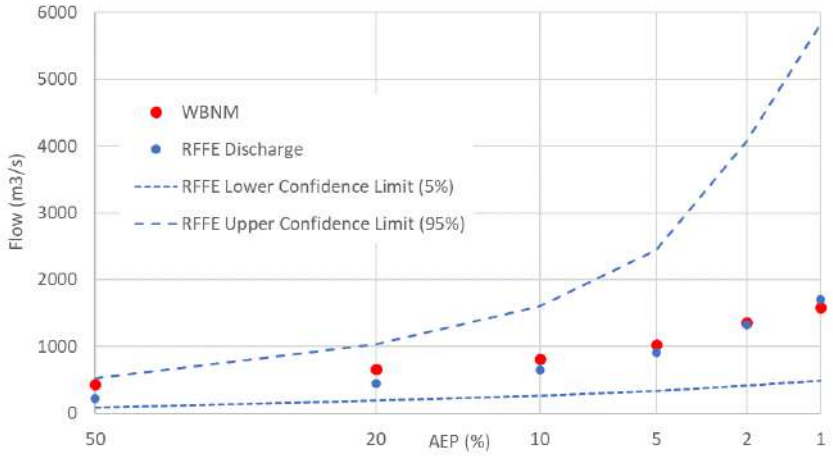


Figure 4.5: Comparison of RFFE & WBNM Peak Flows

The above comparison demonstrates that WBNM peak flows are generally consistent with those determined by the RFFE model. WBNM peak flows are higher than the RFFE Discharge for all events except the 1% AEP, however the difference in the 1% AEP peak flows is less than 7%.

Based on the above comparisons it appears that peak flows determined by WBNM are either consistent with or slightly higher than determined by alternate methods. On the basis of this result the WBNM configuration is considered appropriate for the intended analysis.

4.2.2 Caboolture River

Hydrological modelling of the Caboolture River catchment was initially undertaken by Calibre prior to 2020. This initial investigation identified that the increase in runoff associated with developing the study area catchments discharging runoff directly to the river did not change downstream peak flows, as the timing of peak flows from the study area did not coincide with the much greater peak from the larger upstream catchment as discussed in the Calibre *Technical Memo – NDP1 (Phase 1) Flooding & Stormwater Management Investigations - Caboolture River Flood Impacts* (2020).

Since the initial investigation, changes to the layout and configuration of proposed development within NDP1 have been made. In order to confirm the result of the previous hydrological analysis the following was the WBNM for the Caboolture River catchment was updated to account for the proposed NDP1 development and discharge locations.

The entire NDP1 development discharging runoff to the Caboolture River (including area west of Phase 1) was allowed for in the WBNM update. Sub-catchment areas were re-delineated based on the preliminary grading plans and development layouts where available. These catchments and their properties are indicated on **Figure 4.6** and **Figure 4.7** below.

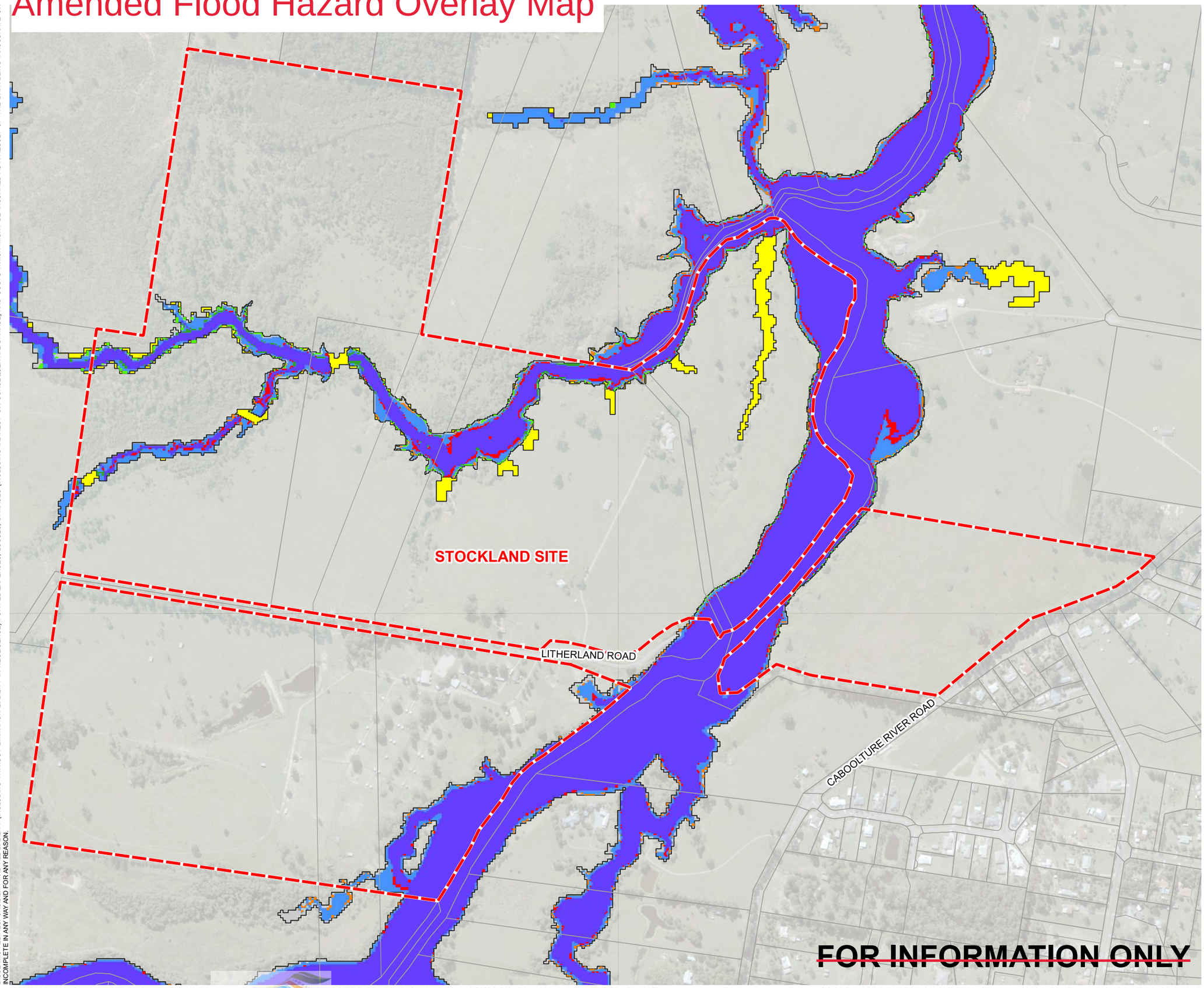
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APPENDIX E: AMENDED FLOOD HAZARD OVERLAY MAP (CMB VARIATION APPROVAL)

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This information is provided by Moreton Bay Regional Council

Amended Flood Hazard Overlay Map



WHILE EVERY CARE IS TAKEN TO ENSURE THE ACCURACY OF DATA SOURCED THROUGH THIRD PARTIES, CALIBRE PROFESSIONAL SERVICES PTY LTD MAKES NO REPRESENTATIONS OR WARRANTIES ABOUT ITS ACCURACY, RELIABILITY, COMPLETENESS OR SUITABILITY FOR ANY PARTICULAR PURPOSE AND DISCLAIMS ALL RESPONSIBILITY AND ALL LIABILITY (INCLUDING WITHOUT LIMITATION LIABILITY IN NEGLIGENCE) FOR ALL EXPENSES, LOSSES, DAMAGES (INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGE) AND COSTS WHICH MIGHT BE INCURRED AS A RESULT OF THE DATA BEING INACCURATE OR INCOMPLETE IN ANY WAY AND FOR ANY REASON.

FOR INFORMATION ONLY

H:\22\000135_Cab West NDP1 Phase 2 & NDP2 - Flood Investigations\6_Model\SF\FS_May2022_Original_Scope\GIS\QGIS_Plans\22-000135_FLOOD_PLANS.qgz

COORDINATE REFERENCE SYSTEM: GDA2020 / MGA ZONE 56 HEIGHT DATUM: GDA 1996

calibre

LEGEND

- STOCKLAND SITE BOUNDARY
- CADASTRE

FLOOD HAZARD OVERLAY

- BALANCE FLOOD PLANNING AREA
- MEDIUM RISK FLOOD HAZARD AREA
- HIGH RISK FLOOD HAZARD AREA
- EXISTING FLOOD HAZARD EXTENT

CHANGE IN FLOOD HAZARD

- FROM HIGH TO MEDIUM
- FROM MEDIUM TO BALANCE
- FROM BALANCE TO MEDIUM
- FROM MEDIUM TO HIGH

NOTES:
1. REFER TO CALIBRE TECHNICAL MEMORANDUM No. 21-000135_TM01A.MS DATED Jun-22.
2. RESULTS PRESENTED ARE THE MAXIMUM OF STANDARD DURATIONS FOR THE FLOODING INFORMATION PRESENTED.
3. ALL LEVELS (IF PRESENTED) ARE IN METRES FROM AUSTRALIAN HEIGHT DATUM (mAHD).
4. EXTENT OF BALANCE FLOOD PLANNING AREA DOES NOT CONSIDER THE EFFECTS OF CLIMATE CHANGE.

0 70 140 210 280 350 m

1:7,000 (A3)

N

PROJECT:
CABOOLTURE WEST NDP1 PHASE 2 & NDP3

CLIENT:
STOCKLAND DEVELOPMENT PTY LTD

DRAWING TITLE:

as amended by Council - 08/03/2023

C
D
E

Document Set ID: 67333086
Version: 1, Version Date: 23/06/2023

Approved Subject to Conditions of Decision Notice DA/2024/2263

Print Date: 23/06/2023 8:16 AM

28/4/2025

APPENDIX F: 1% AEP + CC BOX WHISKER PLOTS AT ALL REPORTING LOCATIONS

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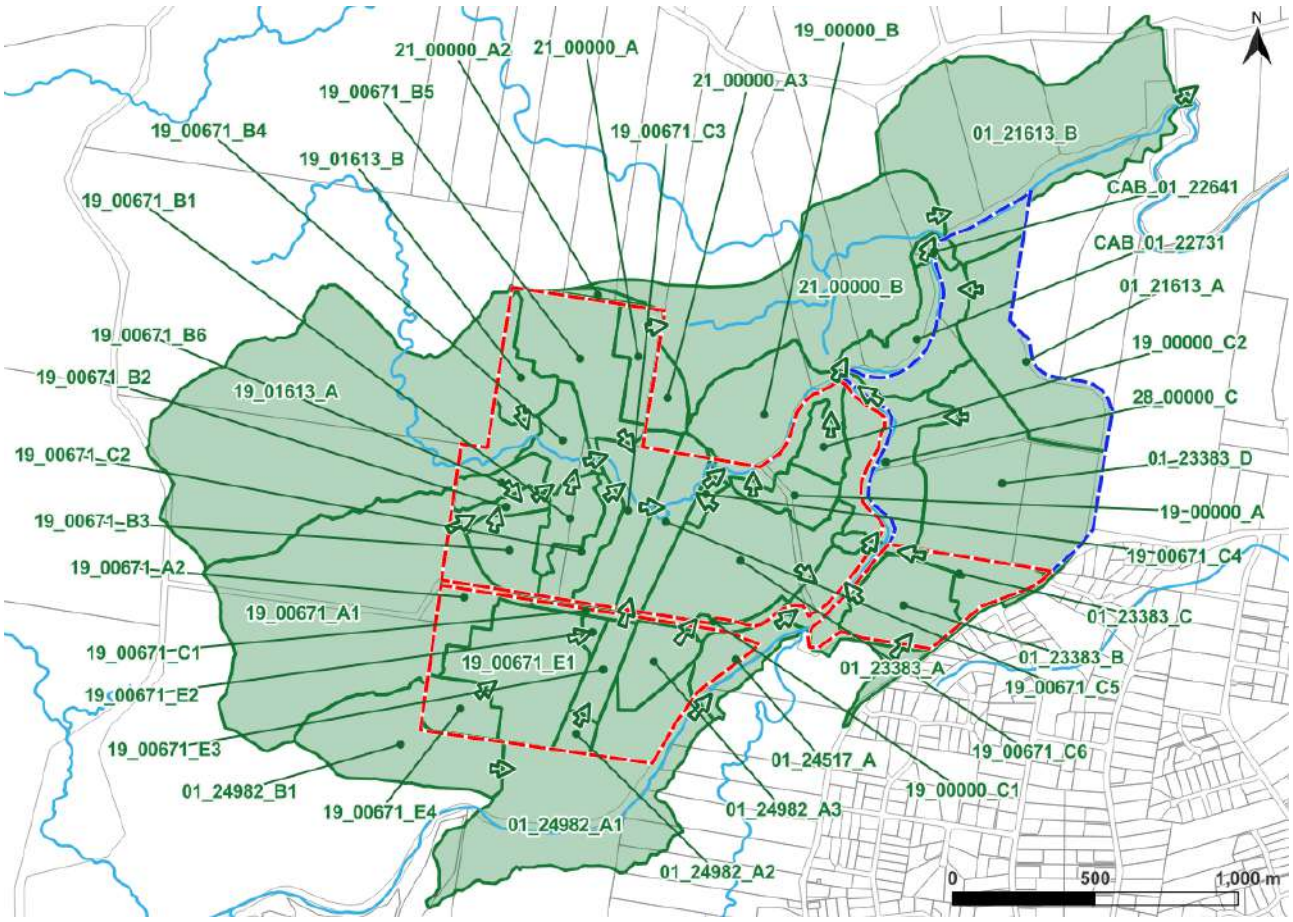


FIGURE F-1 DEVELOPED SCENARIO WBNM CATCHMENT DELINEATION

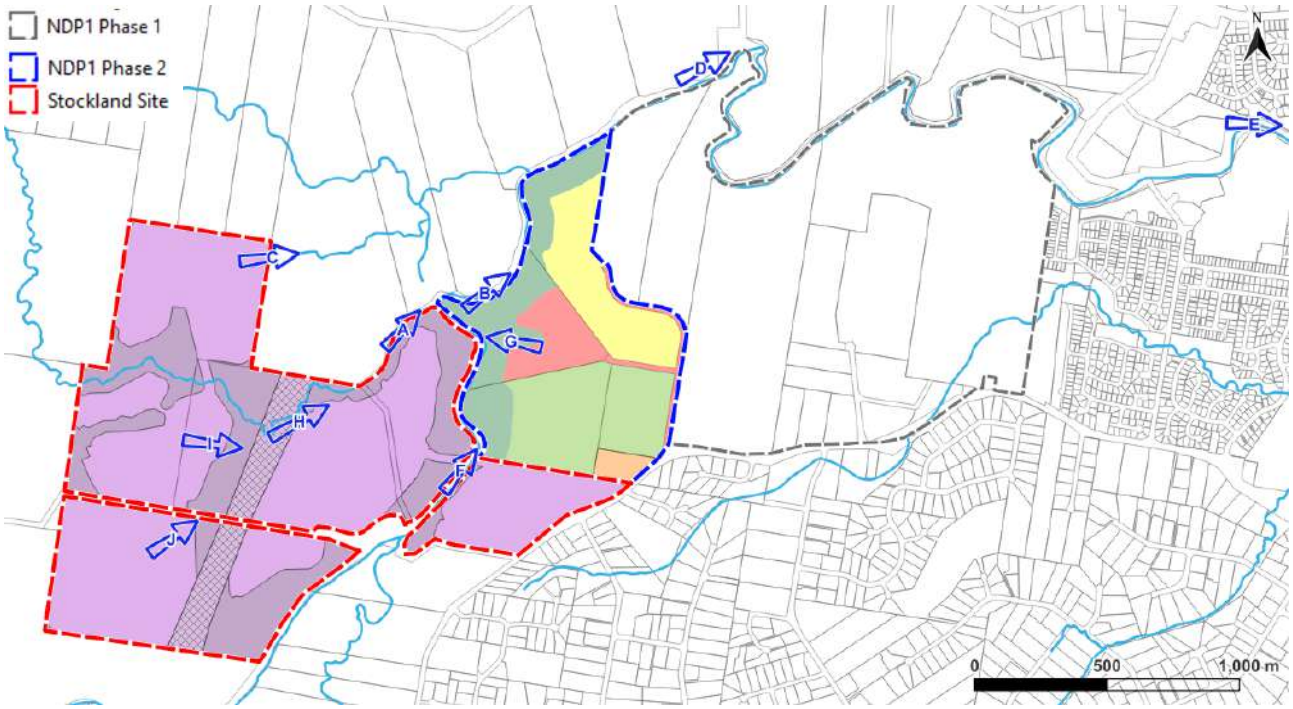


FIGURE F-2 WBNM REPORTING POINT LOCATIONS

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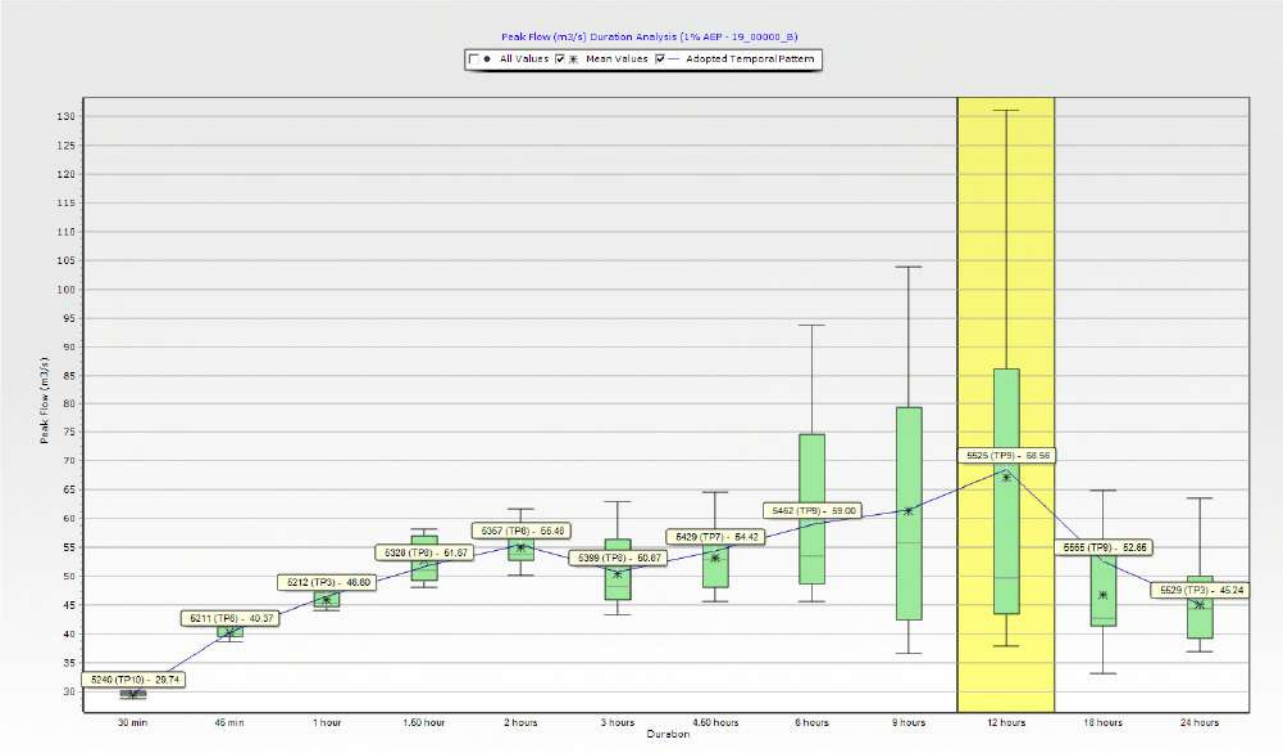


FIGURE F-3 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION A

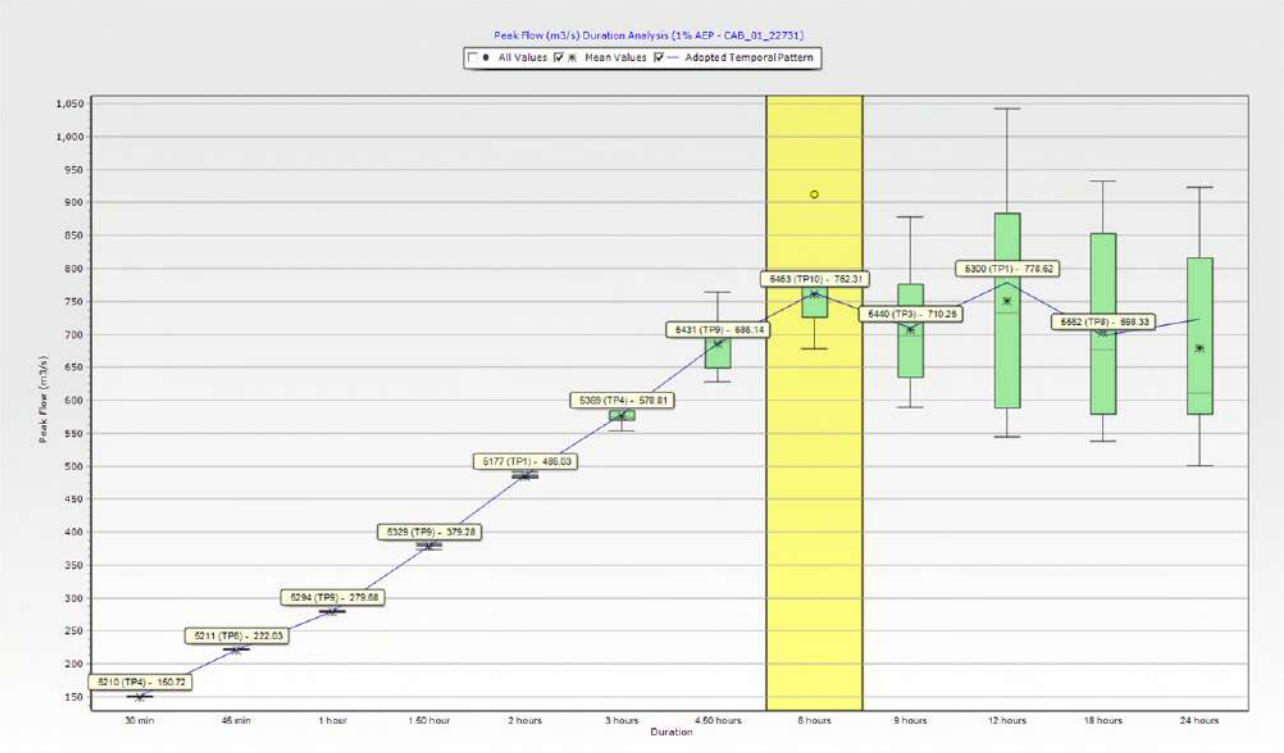


FIGURE F-4 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION B

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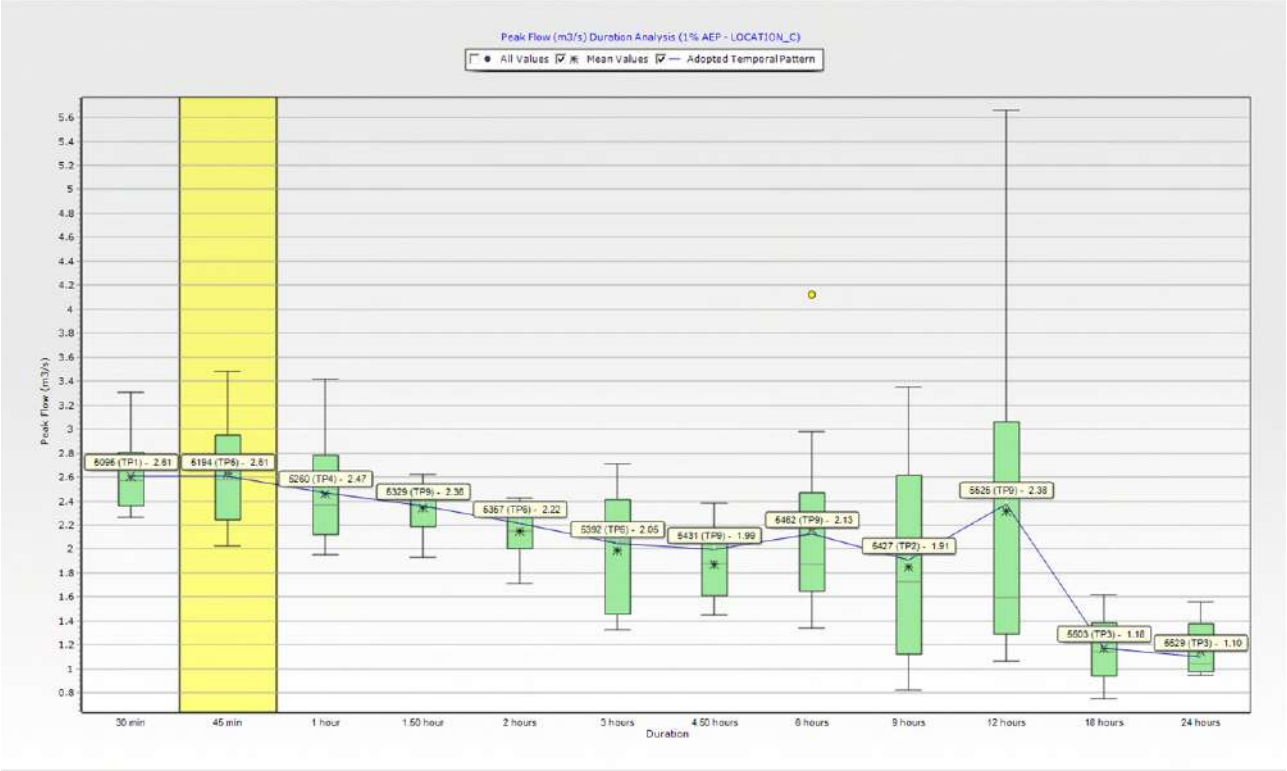


FIGURE F-5 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION C

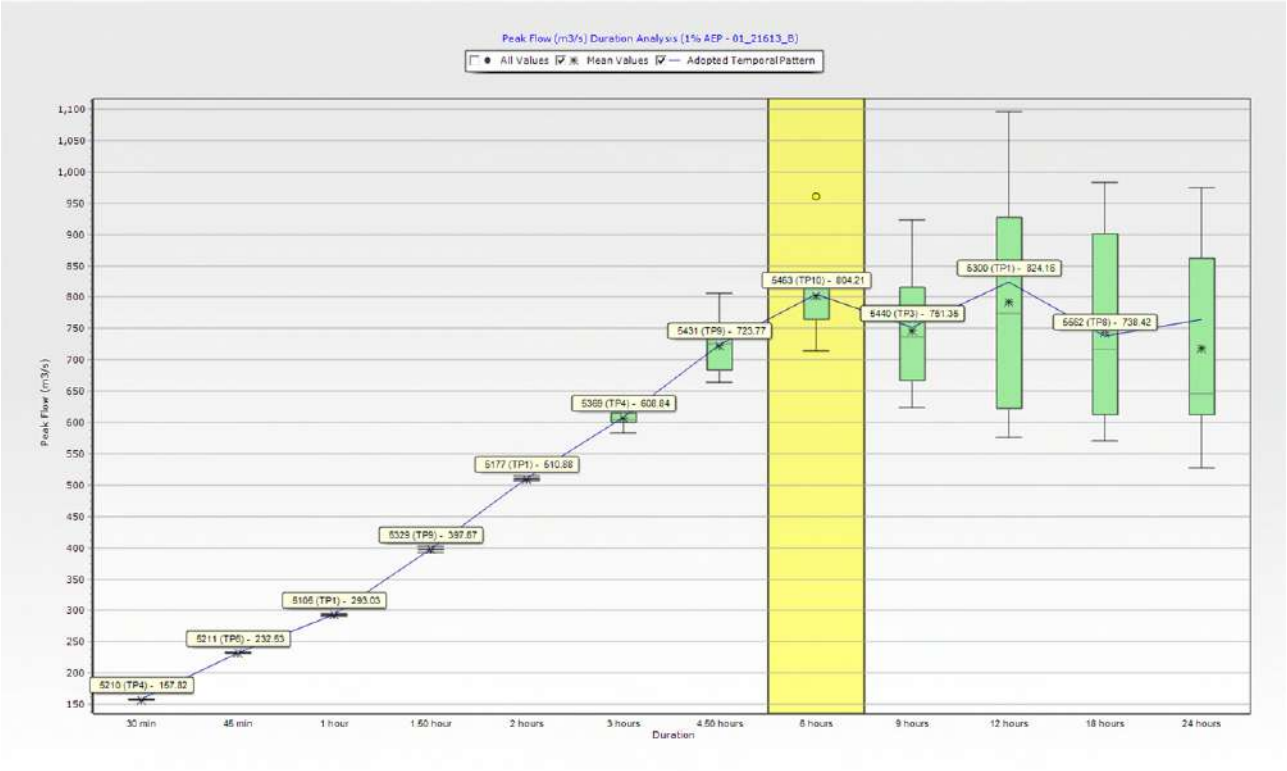


FIGURE F-6 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION D

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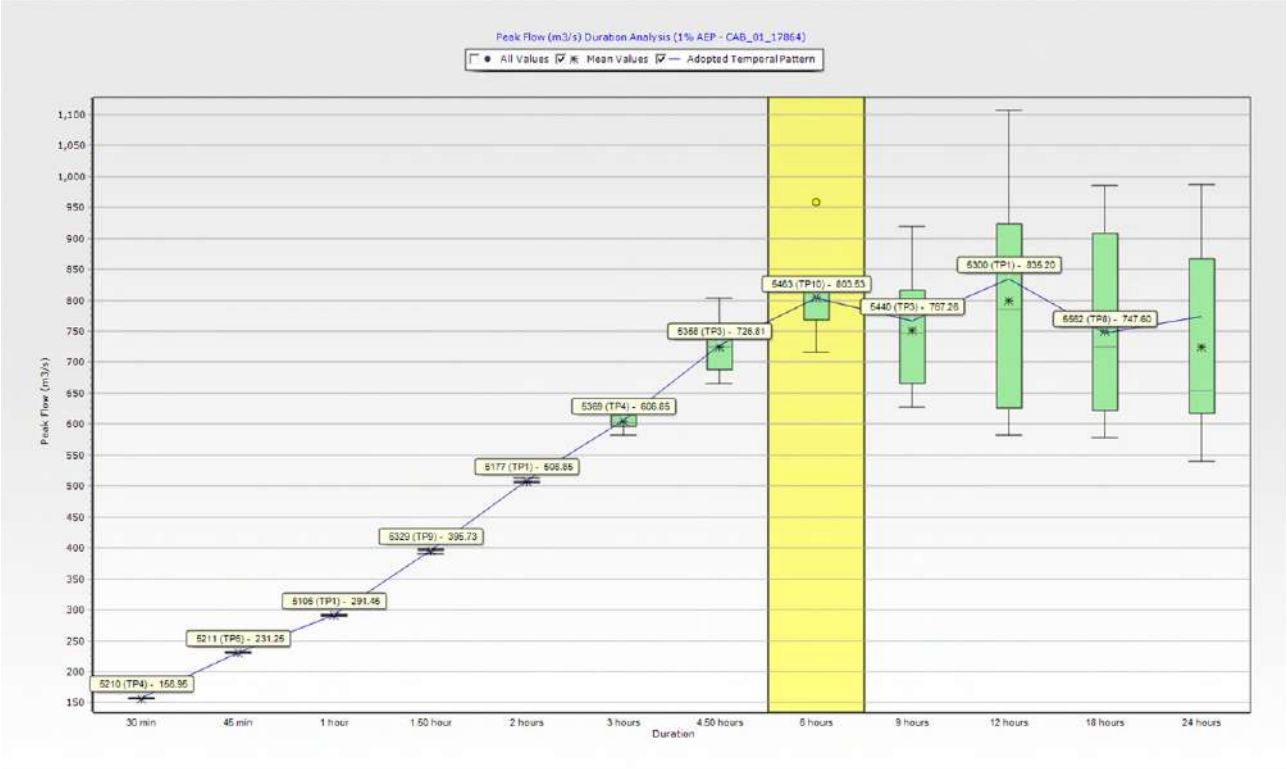


FIGURE F-7 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION E

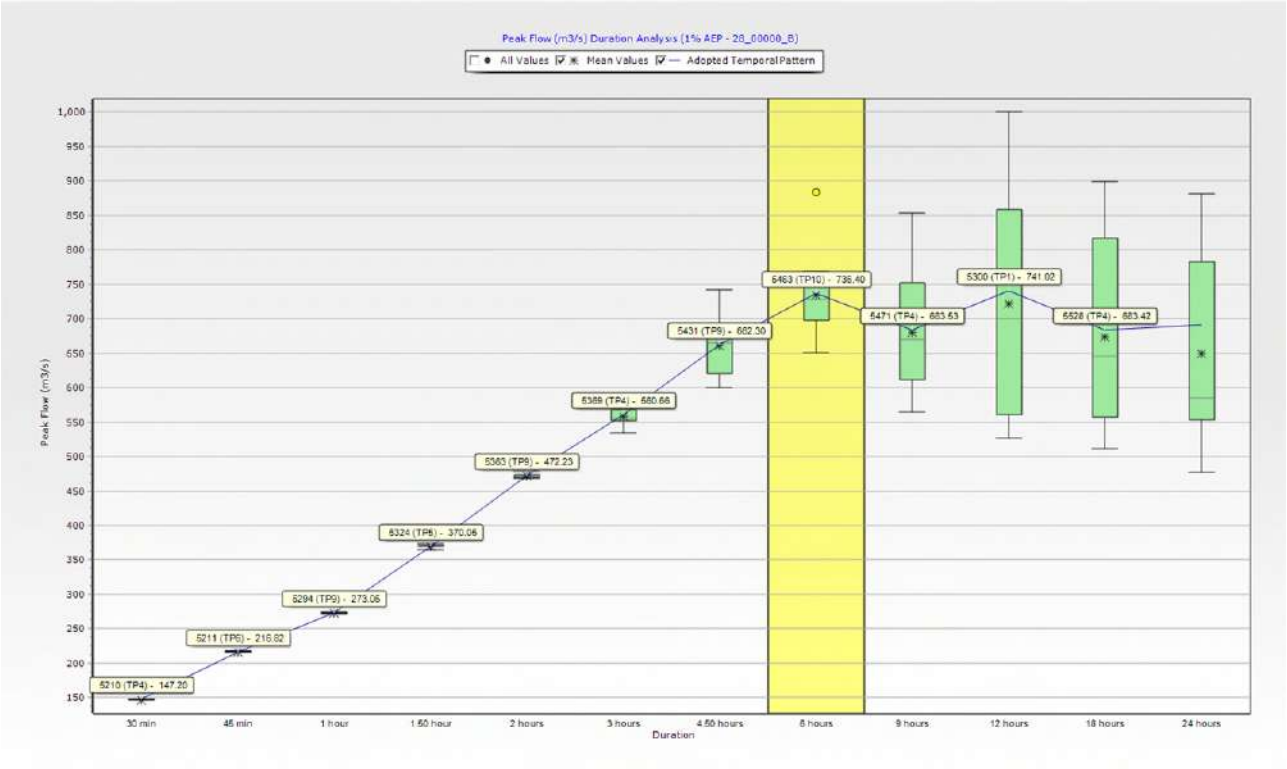


FIGURE F-8 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION F

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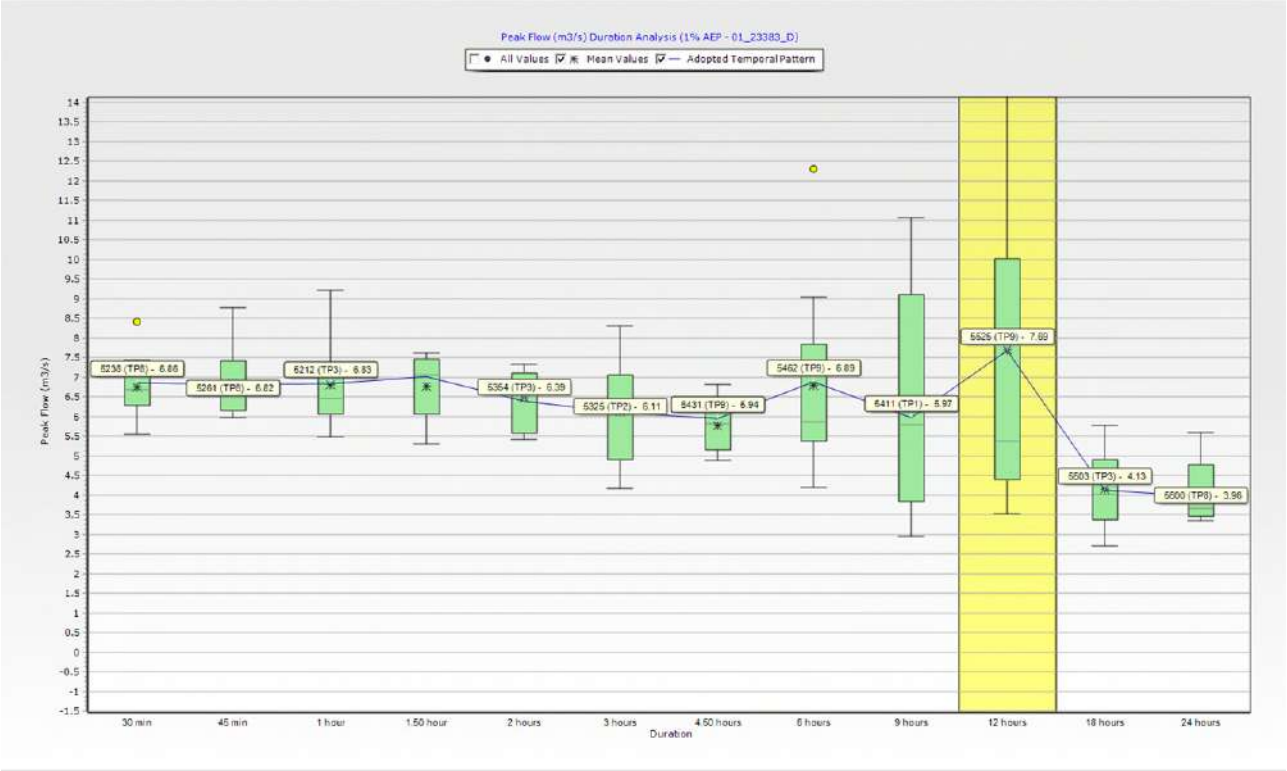


FIGURE F-9 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION G

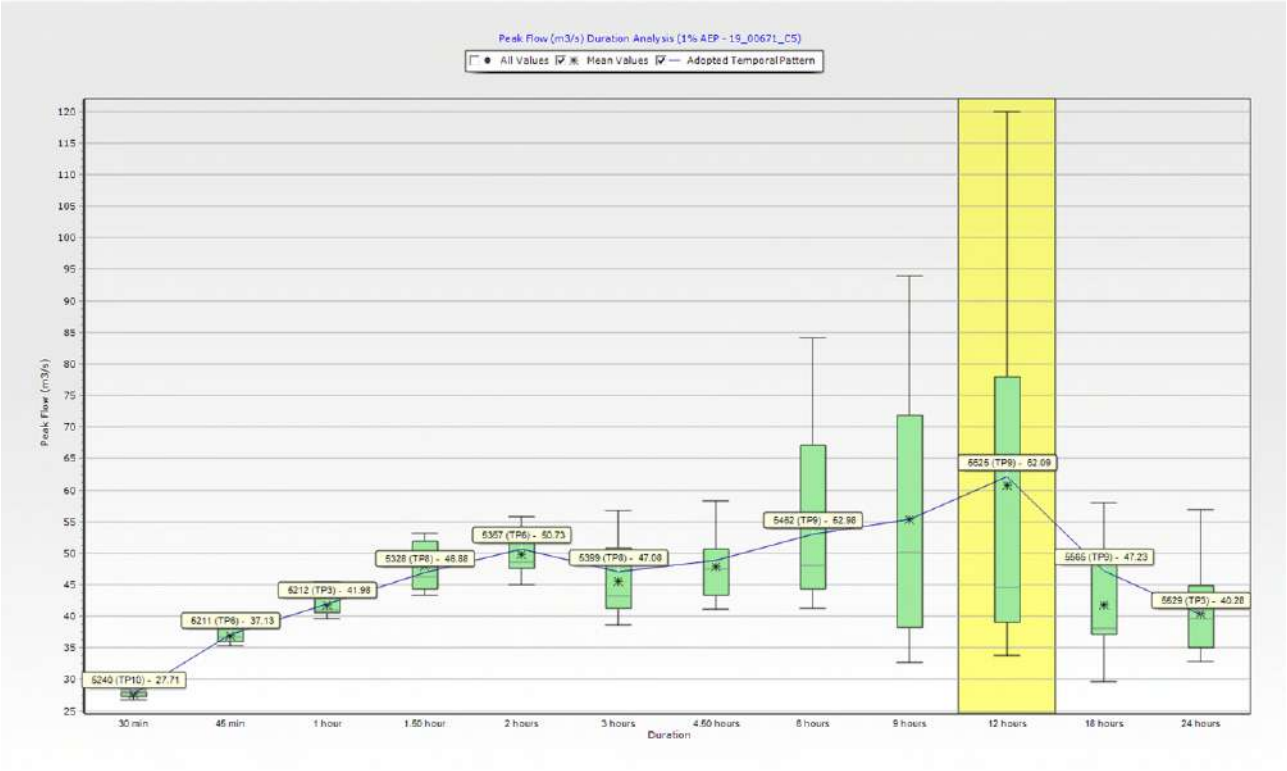


FIGURE F-10 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION H

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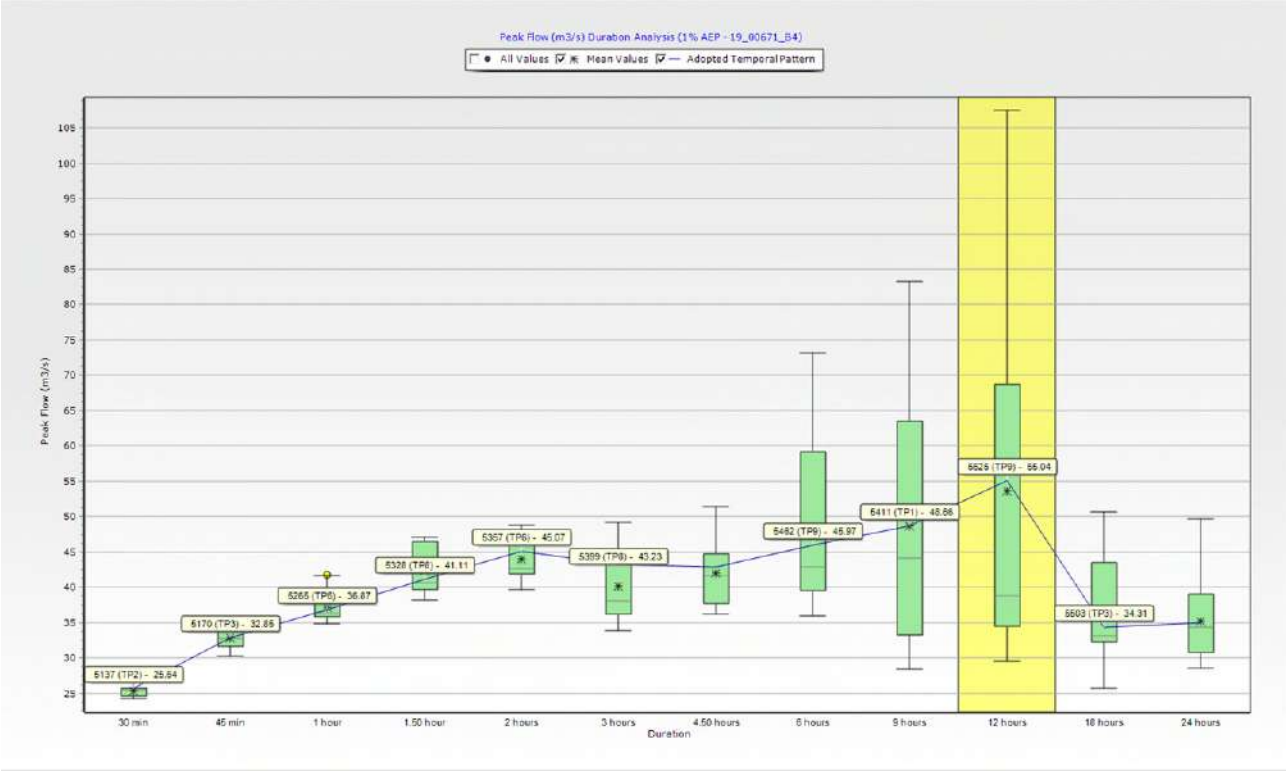


FIGURE F-11 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION I

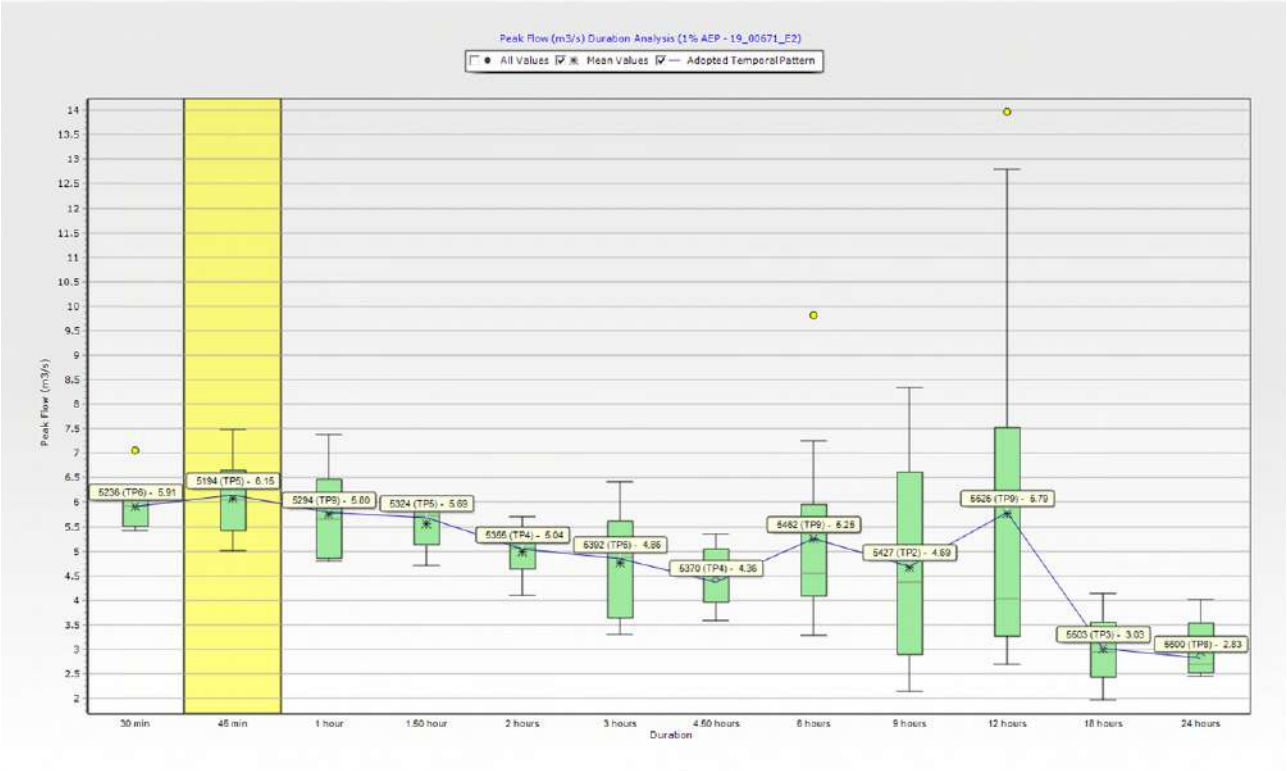


FIGURE F-12 BOX & WHISKER PLOT 1%AEP PLUS CLIMATE CHANGE EVENT AT REPORTING LOCATION J

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APPENDIX G: FLOOD STORAGE CALCULATIONS

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Flood Storage

Raster calculations were carried out to determine the volume of fill below the Existing Scenario 1% AEP flood envelope associated with the proposed development. A total of approximately 60,042 m^3 of fill within existing flood storage was calculated for the overall site, which is further detailed in **Table G-1** below.

TABLE G-1 LOCATIONS OF FILLING WITHIN FLOOD STORAGE

LOCATION	FILL WITHIN FLOOD STORAGE (m^3)	LOCATION DESCRIPTION
Abutment A	503	East bank of the Caboolture River at the proposed bridge
Abutment B	648	West bank of the Caboolture River at the proposed bridge
Culvert 19_00671_B2	2,263	3 x 3600 x 1200 RCBC; 18m long crossing a minor tributary of Small Creek
Culvert 19_00671_B4	8,422	4 x 3000 x 2700 RCBC; 40m long crossing Small Creek
Culvert 19_00671_E2	6,276	2 x 1800 x 1500 RCBC; 100m long crossing a minor tributary of Small Creek at Litherland Road
Location 1	39,275	Backwater inundation from the confluence of Small Creek and the Caboolture River.
Location 2	1,422	Minor filling associated with trunk sewer main in this area.
Location 3	1,233	Minor fill batter encroachment into the flood fringe within a minor tributary of Small Creek
TOTAL	**60,042**	

These locations are identified in **Figure G-1** below.

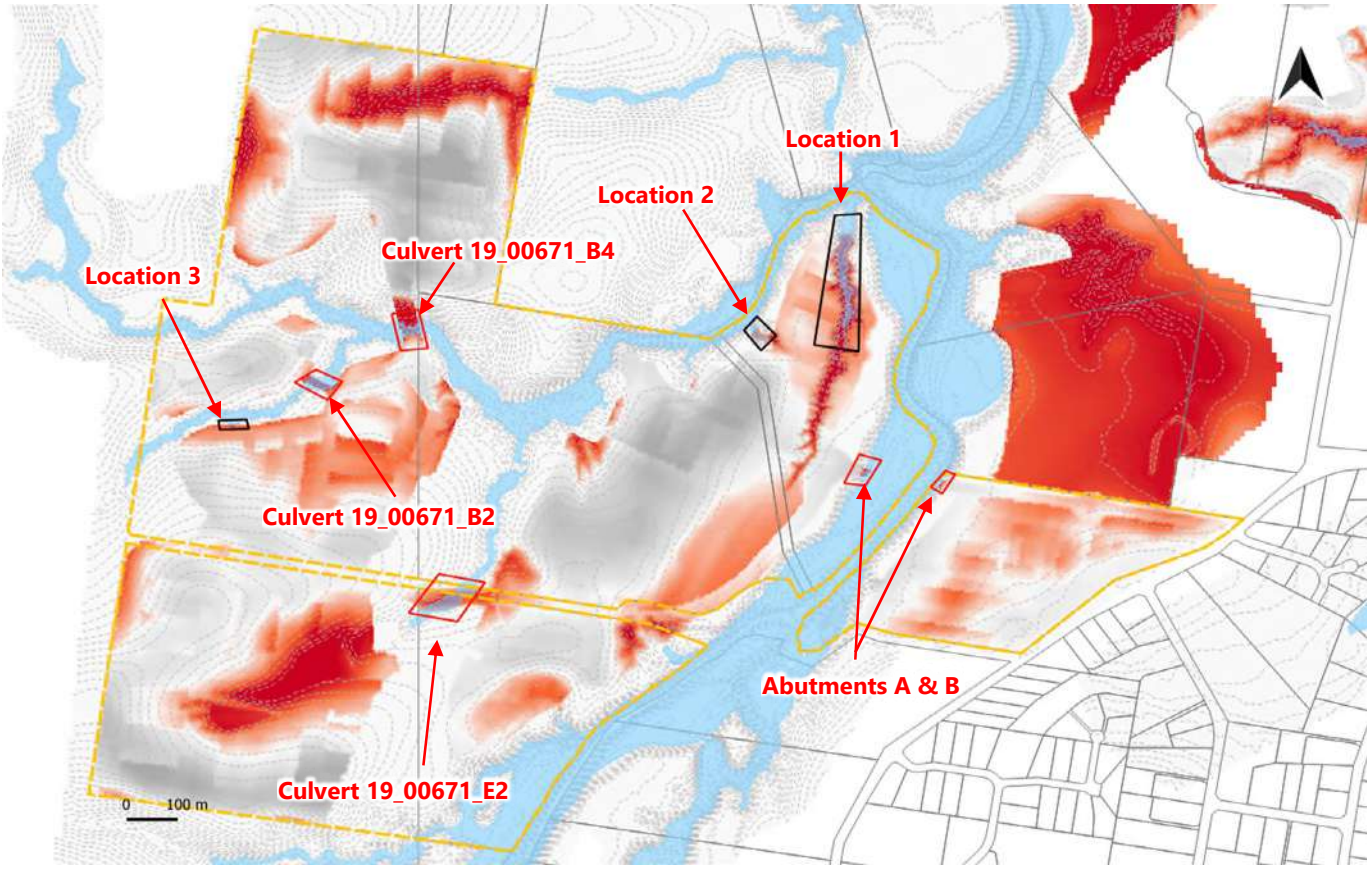


FIGURE G-1 OVERALL SITE CUT/FILL AND EXISTING 1% AEP FLOOD ENVELOPE

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Of the total 60,042 m^3 fill within existing flood storage across the site, there is approximately 17,000 m^3 (28%) associated with the three culvert crossing embankments and approx. 1,151 m^3 (2%) associated with the bridge approaches within the Caboolture River.

Where earthworks are expected within the existing 1% AEP flood envelope, the works are primarily associated with infrastructure required to service the development, such as waterway crossings, trunk sewer mains and stormwater devices. Where filling is required to provide appropriate flood immunity for roads and allotments, the works are located outside of flood conveyance areas (i.e. within areas of backwater inundation). For example, Location 1 is an area of backwater inundation and is not considered to be a flood conveyance area.

Loss in floodplain storage resulting from filling below the 1% AEP flood level (excluding filling required for waterway crossings and trunk infrastructure) may be compensated for by excavation in areas outside of the development extent where appropriate.

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APPENDIX H: HEC-RAS MODEL VALIDATION OF BRIDGE FORM LOSS COEFFICIENT

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Form Loss Coefficient Validation

The 1D HECRAS model was developed to validate the Form Loss Coefficient (FLC) adopted for the bridge sub-structure (Layer 1) within the TUFLOW model 2D Layered Flow Constriction in accordance with Section 7.3.8 of the *TUFLOW User Manual 2023-03*. This Layer 1 bridge sub-structure is comprised of spill-through abutments and three (3) piers comprising of two (2) 1200 mm diameter Cast-In-Place (CIP) piles spaced at 10-metre centres. The bridge is not expected to overtop, and there is approximately 1.6 metres of freeboard to the lowest soffit level at Abutment B in the 0.05% AEP flood event adopted for the Ultimate Limit State (ULS) design. Given the proposed bridge spans a total length of 137-metres from high bank to high bank with a relatively hydraulicly efficient sub-structure, the overall flow constriction applied by the bridge was observed to be minimal.

The configuration of the HEC-RAS model and the FLC validation is detailed further below.

Manning's Roughness

Following Manning 'n' values have been adopted along the channel.

- Manning Value at Channel = 0.06
- Manning Value at Right and Left Bank = 0.035

Boundary Conditions

Following Modelling inputs/assumptions were made during HEC-RAS modelling:

- Maximum Flow rate at Channel (River Station 1129) = 4000m^3/s

  The peak flow for 1%AEP plus climate change is 736.4m^3/s, with 2.6m freeboard from the soffit level of the bridge. However, to determine head loss resulting from the proposed Cab_Bridge_01, the steady inflow was adjusted to 4000m^3/s to ensure the flood level reach the soffit level, yielding the greatest hydraulic impact of the bridge substructure (Layer 1).

- Boundary Conditions= Normal Depth (S = 0.003 for upstream and S = 0.001 for downstream)
- Contraction Coefficient = 0.1
- Expansion Coefficient = 0.3
- Flow Regime = Mixed (both subcritical and supercritical)

Bridge Input

Following structure parameters have been adopted for the bridge in the HEC-RAS modelling.

- Minimum Bridge Deck Elevation (RS 750 Right Side) = 22.913 m AHD
- Maximum Bridge Deck Elevation (RS 750 Left Side) = 23.519 m AHD
- Bridge Width = 14.86m
- Bridge Pier1 Elevation (RS 750) = 23.347 m AHD
- Bridge Pier2 Elevation (RS 750) = 23.201 m AHD
- Bridge Pier3 Elevation (RS 750) = 23.055 m AHD

The model extent has been modified to align with the Caboolture River, extending from approximately 370m upstream of the proposed bridge to 750m downstream of the bridge. The updated longitudinal section of Caboolture River including cross sections and bridge is shown in **Figure H-1**.

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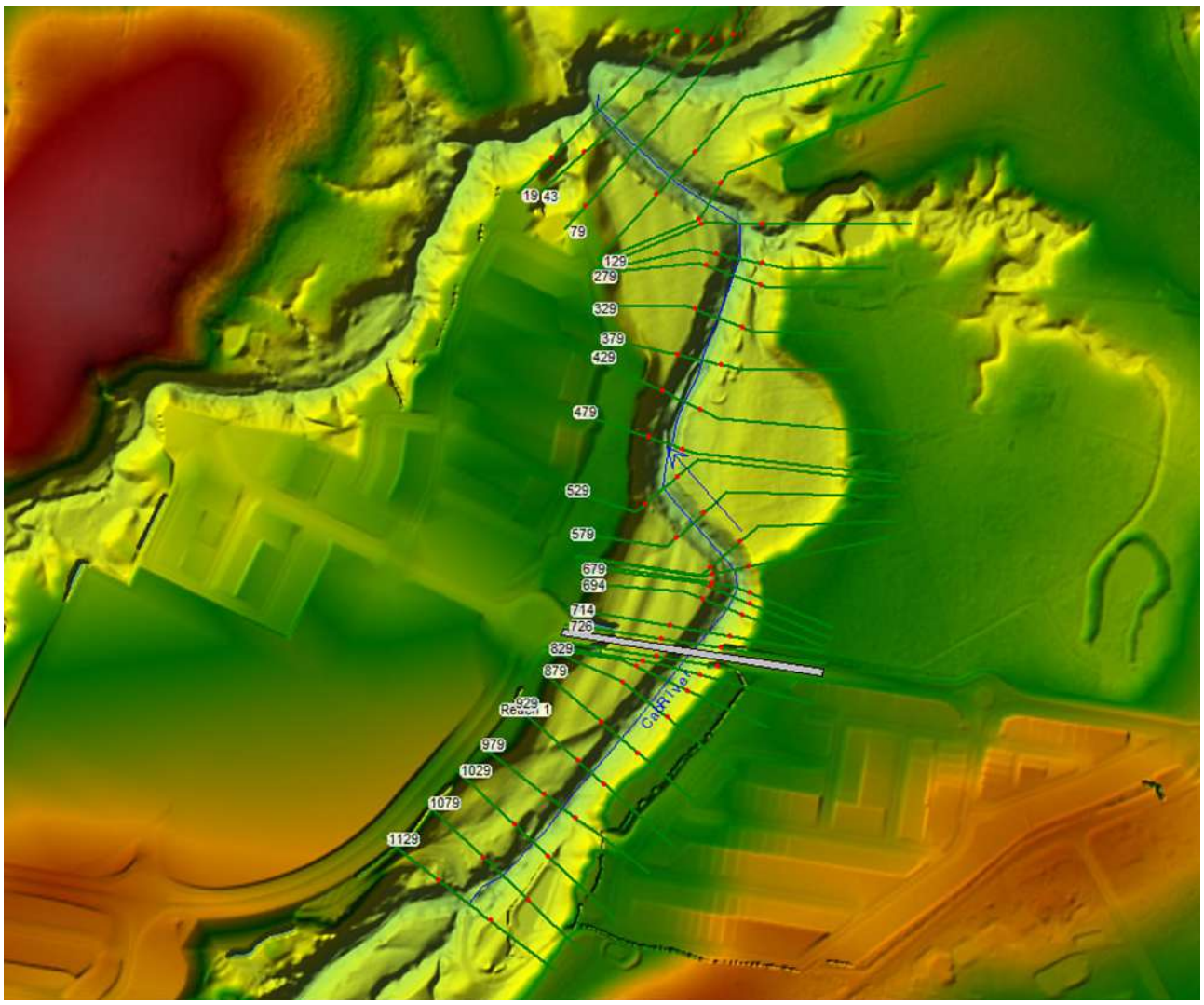


FIGURE H-1 1D HEC RAS CROSS SECTIONS AND CAB BRIDGE 01 AT CABOOLTURE RIVER

HEC-RAS Model Results

Both existing and developed scenario have been run in the HECRAS and the results at upstream CS 1129 and downstream CS 763 are displayed below in **Table H-1**.

TABLE H-1 HECRAS RESULTS

SCENARIO	RIVER STATION	Q TOTAL (M3/S)	MIN CHANNEL ELEVATION (M AHD)	WATER SURFACE ELEVATION (M AHD)	HEAD LOSS FROM BRIDGE (MM)
EXISTING	1129	4000	11.01	25.26	
	763	4000	10.48	23.71	
DEVELOPED	1129	4000	11.01	25.51	250 ~~25~~
	763	4000	10.45	24.03	320 ~~32~~

Amended by CMB

Based on the HECRAS results above, the average head loss of 30mm resulting from the proposed bridge. Based on the HECRAS results yielding an average head loss of only 30mm resulting from the proposed bridge, the TUFLOW model Layer 1 FLC was iteratively adjusted between a range of 0.001 to 1 until a close correlation with the HEC-RAS results was observed when adopting a L1_FLC value of 0.1. Hence, a Layer 1 FLC of 0.1 was adopted for the TUFLOW model 2D Layered Flow Constriction.

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