Council Reference: ROL 2966/2018
Our Reference: Q184103 L003 01

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12 April 2019

The Chief Executive Officer
Douglas Shire Council
PO Box 723
MOSSMAN QLD 4873

Attention: Jenny Elphinstone

Delivered via email: enquiries@douglas.qld.gov.au
Jenny.Elphinstone@douglas.qld.gov.au

Dear Jenny,

RESPONSE TO INFORMATION REQUEST – PART 3 OF THE *DEVELOPMENT ASSESSMENT RULES* RELATING TO DEVELOPMENT APPLICATION FOR RECONFIGURING A LOT (ONE (1) LOT INTO 32 LOTS PLUS NEW ROAD, BALANCE LOT, DRAINAGE LOT AND PARK) AT CAPTAIN COOK HIGHWAY, CRAIGLIE (LOT 2 ON SR431)

COUNCIL REFERENCE: 2966/2018

I refer to Douglas Shire Council's ('Council') correspondence dated 6 February 2019 requesting further information in relation to the above development application ('the Information Request').

On behalf of *Port Douglas Land Developments Pty Ltd* ('the Applicant'), a written response to the items raised in the Information Request is provided below.

The following response to the Information Request extracts Council's request in bold italicised text and provides corresponding response below. The response includes the following documentation:

- **Attachment A** – Master Plan;
- **Attachment B** – Flood Impact Assessment;
- **Attachment C** – Existing Contour Plan; and
- **Attachment D** – Wabul Street Culvert Crossing.

This response package represents a the Applicant's full response to the information requested as per Part 3 (Information Request) of the *Development Assessment Rules* ('the DA Rules'). Accordingly, it is respectfully requested that Council proceed with the assessment of the application.

Information Request Item

Council has identified that the following information is required in order to complete an assessment of the proposal:

Overall Development

1. ***Please provide a masterplan for the whole of the land including an indicative lot layout, stages, road network, park and drainage lots. Proposed infrastructure should also be indicated and further comments should be included in response to A08 and P08 of the Reconfiguring of a Lot Code.***

   Please provide detail of the number of lots intended to be developed prior to the construction and opening of the linking connector road to Andreassen Road and the intended timing of the upgrade to the Captain Cook Highway / Andreassen Road intersection. Please provide details as to when the buffer to the State-controlled road will be developed for the proposed and balance areas.

Response:

The following responds to the Information Request Item 1, first paragraph.

The proposed Master Plan generally details the overall proposed development of the site beyond the current Development Application for Stage 1A and 1B and is attached for reference at Attachment A. Due to time constraints and need to commence construction and delivery of Stage 1A and 1B it was opted to apply for an initial stage only, to avoid delays addressing issues beyond this initial stage.

Once construction is underway on Stage 1A and 1B it is expected that the applicant will look to apply for a Development Permit over the balance of the site rather than applying for a Preliminary Approval.

The Master Plan has been developed having regard to the underlying zoning of the land and intention to maintain the low density residential character and amenity of the area. It is estimated that the estate will yield up to 300 residential lots. Whilst precincts have been identified, the lot configurations have not been identified at this stage.

Flood Modelling undertaken across site informs the location of residential footprint and land reserved for road, drainage and park purposes.

It is the intention that the estate will be progressively developed from north to south along the corridor to the western side of the Wabul Street extension. The area east of the Wabul Street extension will be developed in the final stages.

It is demonstrated that the proposed Development Application for Stage 1A and 1B is appropriately designed having regard to the zoning of the land and site constraints including drainage. It is demonstrated how these initial stages integrate with the overall intended development of the estate and adjoining undeveloped land.

The following responds to the Information Request Item 1, second paragraph.

It is intended that the precinct on the western side of the Wabul Street extension will be developed initially from north to south. It is estimated that this precinct will accommodated up to 210 residential lots. Connection through to the Captain Cook Highway will be established during the development of the western precinct however the timing is not confirmed at this stage. The buffer to the Captain Cook Highway will be progressively developed respective to the stage of development which backs onto the highway.

The precinct on the eastern side of the Wabul Street extension will be developed as the final stages and is estimated to yield up to 90 residential lots.

The Master Plan presents an alternative new road alignment and drainage reserve between the Wabul Street extension in the south to the Captain Cook Highway, rather than utilising the Andreassen Road reserve. This option was identified primarily in order to establish a drainage reserve with sufficient capacity to carry stormwater. Timing for construction of the connection with the Captain Cook Highway has not been determined at this stage. It is expected that this will form and be further detailed in a subsequent Development Application for Reconfiguring a Lot.

Road Network

2. ***Please provide a road connectivity masterplan to demonstrate how the prosed road network provides a safe and efficient road alignment and geometry providing connectivity to Andreassen Road.***

Response:

Please refer to comments above and the road hierarchy detailed within the Master Plan attached at Attachment A.

In addition, it is submitted that the ultimate road network illustrated under the Master Plan provides for a high level of connectivity and safety. The road layout provides limited use of cul-de-sacs with the majority of roads being designed as through roads. Intersections are provided at locations supporting appropriate sightlines given the role and function of each road.

Water Supply

3. ***The approved development of Stage 5 of the neighbouring residential estate is to the order of some 40 additional lots to connect to the existing system and within this development there is also a need for pressure for fire fighting through the reticulated system. Given this situation please provide advice substantiating there is sufficient water supply capacity within the current network (and existing approved development).***

   Please provide details for the increased demand, resulting from this stage and the development of the balance area. Please provide details of any upgrades necessary to Council's water supply system to meet these increased demand needs.

Response:

Cardno completed the engineering design of the Port Pacific Estate and is familiar with the water supply constraints and at this stage we believe there is sufficient capacity for stage 5 of the Port Pacific Estate as well as stage 1 of this application.

This will be verified with water modelling engineering work in the immediate future, however should there not be sufficient capacity Cardno advises there are alternative acceptable engineering solutions that can be designed at operational works phase once the ROL has been approved, including for example extension of the water main along the Captain Cook Highway to the subject site.

Wastewater Infrastructure

4. ***Provide details as to the capacity of the Council's current infrastructure to meet the proposed demands for this stage and for the development of the balance of the land. Consideration is to be given to the demand and available***

capacity for the completion of the approved Stage 5 of the neighbouring development.

Pump Station PP1 and downstream rising main are known to have existing operational issues, (Cardno report and advices to Council are referenced). Section 4.2.3 of the planning report advises that a new sewerage pump station is required to service the proposed development, which is expected to connect with existing infrastructure in Bear Street. Please provide master plan that shows where the new pump station will be located, access to the pump station and how it integrates with the ultimate development. Please also provide advice on the impact of the new pump station on the existing infrastructure, noting particularly the system deficiencies previously advised by Cardno.

Response:

Cardno advises that there will be approximately 900m of rising main to be constructed to service the whole of the subject development. The rising main will extend from Beor Street along the Captain Cook Highway to the subject site and will be a 100mm diameter main.

The pump station will service the entire estate and is proposed to be located to the east of the Wabul Street extension generally as indicated in Figure 1 below.

Figure 1: Preliminary Rising Main and Pump Station

Flood and storm tide inundation

5. ***Please provide a site plan detailing contours and expected finish levels having regard to impacts of sea level rise. Please provide a copy of the flood study and flood modelling for the site, referred to on page 41 of your report. The flood study must include updated modelling to confirm, hydraulic implications and confirm that no further widening of the drain is required to mitigate hydraulic impact of the development.***

Response:

A copy of the Flood Impact Assessment is attached for reference at Attachment B.

Whilst the finished levels of lots have not been detailed at this stage, a Contour Plan is included at Attachment C which illustrates retention of the existing Drainage Reserve.

Further details in terms of finished ground levels will be presented to Council within the Development Application for Operational Works. The development will be designed to achieve Q100 flood immunity for residential lots.

Use of Milman Drive for Access

6. ***Please provide advice on the adequacy of this access in higher order rainfall events, including the 10% AEP and 1% AEP events (Q10 and Q100 flows respectively).***

Response:

The suitability of Milman Drive for vehicle access has been assessed by Cardno's engineers. It is demonstrated that vehicle access is achieved during a 1% AEP flood event (flooding depth less than 300mm). It is recognised under the Douglas Shire Planning Scheme that a flood depth up to 300mm allows for sedan egress.

Refer to the Flood Impact Assessment attached for reference at Attachment B.

7. ***Please also provide advice on traffic impacts and/or road safety considerations on the existing road network including Downing Road, Beor Street, and the operation of the intersection with the Captain Cook Highway.***

Response:

The Transport Network Overlay Map identifies that both Downing Road and Beor Street are Collector Roads. Under the FNQROC Development manual, due to the width of the carriageway, these roads are considered minor collector roads which caters for up to 300 dwellings. No infrastructure upgrades are identified under the Local Government Infrastructure Plan therefore it is reasonable to assume these roads are designed to their ultimate form. It is noted that there are fewer than 300 dwellings in the existing catchment and the proposed development seeks to introduce an additional 32 lots only. It is considered there is sufficient capacity in this network to serve the proposed development.

It is acknowledge though that there will be a point where a Traffic Assessment is required to identify the timing for the extension of Wabul Street to Andreassen Road and the Captain Cook Highway. It is proposed that this assessment will be provided with the Development Application for Reconfiguring a Lot Stage 2.

Minimum Lot Size

8. ***Please provide further details is required to support the conflict with the benchmark P06 of the Low Density Residential Zone Code.***

Response:

The purpose of the Low Density Residential Zone is to provide for a range of housing opportunities on a range of lot sizes. The intention for the 450m^2 lots was to provide a range of lot sizes and housing affordability.

The applicant is amenable to amending the design however would seek Council accept a minimum lot size of 550m^2. An amendment to design condition would be acceptable.

Culvert Crossing

9. ***Please provide further details of the proposed bridge /crossing over the existing drain including proposed height, form and attributes (pedestrian pathway, road pavement width) and connectivity to the existing residential development to the north. Clarification is required as to the indicative costs of the proposed works given Council's LGIP requirements indicative timing and payment schedule.***

Response:

The culvert crossing design included within the Flood Impact Assessment attached at Attachment B is superseded by the crossing design attached at Attachment D. The design does include a 2m wide footpath in accordance with the FNQROC Development Manual.

Initial costing estimates are currently being calculated and will be presented to Council within the Development Application for Operational Works.

The program includes commencement of construction of Stage 1A and 1B and associated infrastructure by the end of July 2019, subject to Council approvals and weather conditions. Timing, costs and payment schedules will need to be further detailed and agreed within an Infrastructure Agreement subject to separate negotiations.

10. ***Impact of sea level rise on clearance height and waterway area needs to be included in considerations and this may not have been previously considered in the development of the current LGIP. In addition, the updated calculations must confirm the catchments contributing to the different reaches of the drain and to the road crossing.***

Response:

Climate Change is factored in the Flood Impact Assessment included at Attachment B.

Proposed Park

11. ***Provide reasons for the proposed park location and size and confirm the park is suitable for the proposed lots and the master planning of the area. Please advise of any intention to provide facilities or infrastructure in the park area, such as landscaping; playground equipment, picnic shelter, water tap etc. In respect to landscaping please advise whether there is a proposed particular landscaping theme for the road areas and park.***

Response:

The Master Plan attached at Attachment A details the position of parks throughout the estate. Two smaller dedicated parks are proposed, one in the north 3,933m^2 and one in the south 5,929m^2. The northern park is proposed to soften and activate the entry to the estate and to encourage use by residents within the existing estate to the north.

A larger dual purpose park and drainage reserve of 5.2ha is proposed on the eastern side of the Wabul Street extension and adjacent the eastern boundary of the state. This is a larger park area which will likely include a network of footpaths and open areas for recreation activities.

The proposed parks will be embellished with landscaping, play equipment, furniture and footpaths to the satisfaction of Council. An appropriately qualified and experienced local Landscape Architect will be engaged to develop an overall Landscape Master Plan for the estate as well as a detailed Landscape Plan for the park included in the subject Development Application.

Review of the Local Government Infrastructure Plan identifies the location of two new Local Parks (PPLC064 of 1ha) and (PPLC065 of 0.5ha). It is submitted that the master plan achieves the provision of park area required for the development.

It would be reasonable to apply a condition which requires the Landscape Master Plan for the overall estate and a detailed Landscape Plan to be submitted to Council with the Development Application for Operational Works.

Other Infrastructure Servicing

12. ***Please provide advice on the applicant's intentions for the considerations of other infrastructure such as the location of padmount electricity substations, telecommunications and NBN infrastructure.***

Response:

It is acknowledged that other infrastructure will be required to service the development including that described above. Details of which will be confirmed at the time of making a Development Application for Operational Works. If Council has any specific requirements it is anticipated that these will be conditioned.

Buffer to Agricultural Use

13. ***Please provide advice on the applicant's intentions for the provision of a suitable buffer to the proposed ongoing agricultural use on the balance land. Supporting information must demonstrate that the buffer provided will alleviate impacts on the new residential use.***

Response:

The land is presently leased and the balance land will continue to be used for agricultural purposes until such time as the area of land is developed for residential purposes or it is not viable to continue cultivation.

Throughout the Douglas Shire it is common for residential development to back onto agricultural land eg. Daintree Horizons, Shepherd Valley Estate. It is therefore proposed to provide a 5m wide headland/buffer to facilitate drainage and farm machinery access.

Conclusion

The above represents a full response to the information requested under Part 3 (Information Request) of the DA Rules. Council is therefore respectfully requested to proceed with the assessment of this application.

If you have any further queries, please contact the undersigned on (07) 4034 0500.

Yours faithfully,

Daniel Favier
Senior Planner
For Cardno

Attachment A – Master Plan

north

MASTER PLAN

PORT DOUGLAS ESTATE
CAPTAIN COOK HIGHWAY
CRAIGLIE

Cardno®

Tel: (07) 4034 0500

PRELIMINARY ONLY

Date: 5th April 2019 | Scale: 1 : 1500 @ A1 | Drawn: MC | Job No.: Q184103 | Plan No.: Q184103-MP01B

Attachment B – Flood Impact Assessment

Technical Memorandum

Title	**Port Douglas Estate – Stage 1A and 1B – Flood Assessment Technical Memorandum**		
Client	Port Douglas Land Developments	**Project No**	Q181403
Date	4/04/2019	**Status**	Final
Author	Geordi Paxton	**Discipline**	Water & Environment
Reviewer	Daniel Wood	**Office**	Brisbane

Introduction

Cardno was commissioned by Port Douglas Land Developments to undertake a Flood Impact Assessment (FIA) of the proposed Port Douglas Estate residential development located on Lot 2 of Plan SR431 off the Captain Cook Highway, Craiglie, QLD. Figure 1 below displays the locality of the proposed development.

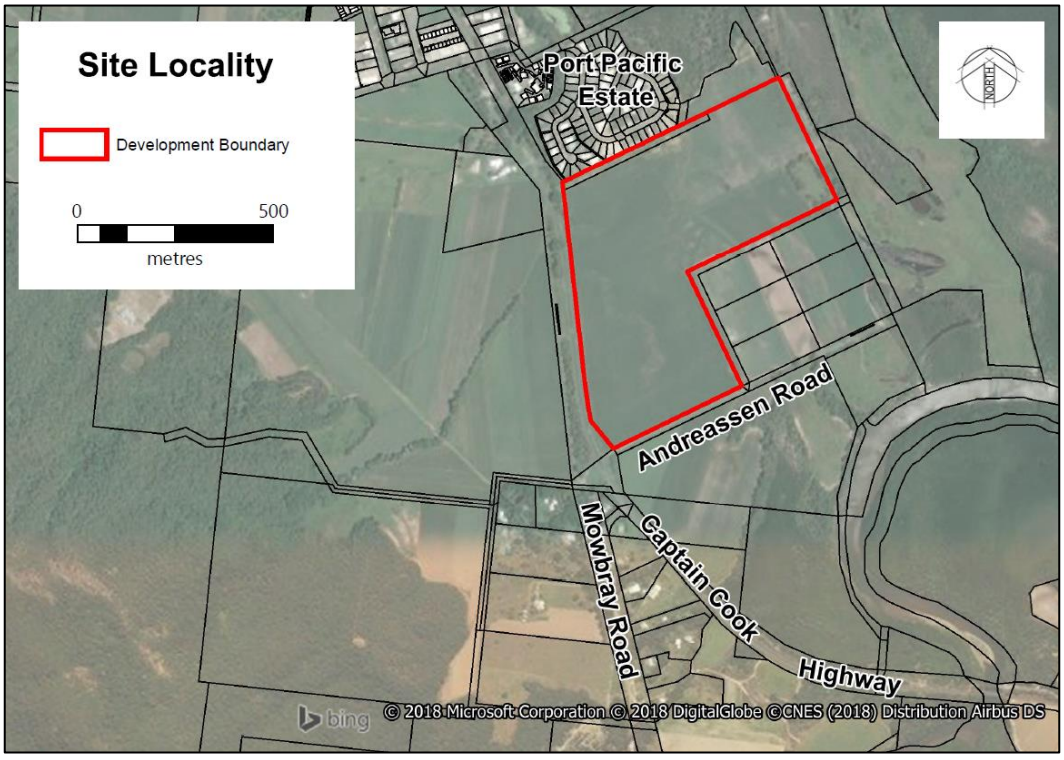

Figure 1 Site Locality – Port Douglas Estate

The aim of this FIA is to support a Development Application (DA) for Lot 2 on SR431 in regards to the reconfiguration of the lot into 32 lots plus a new road, balance lot, drainage lot and park. This DA will facilitate the first stage of the residential development, defined as Stage 1A and 1B. Figure 2 displays the Proposed Plan of Reconfiguration.

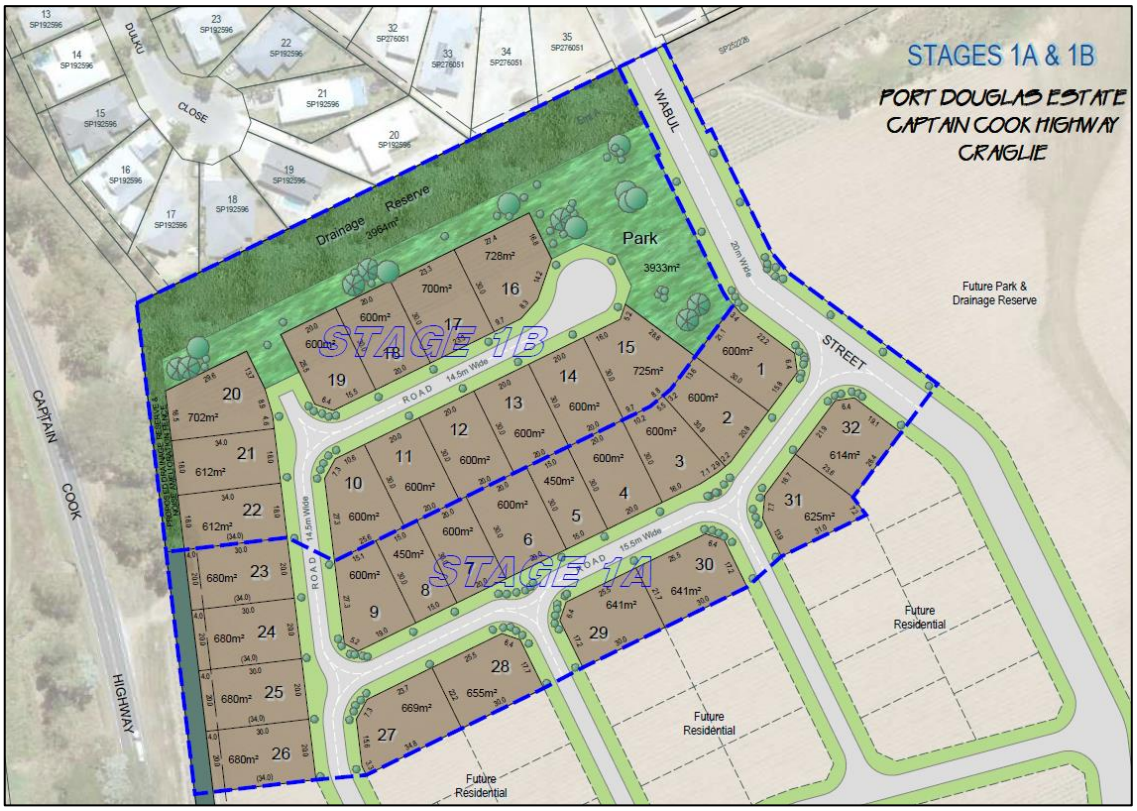

Figure 2 Proposed Plan of Reconfiguration

Stage 1A and 1B are located outside of the Storm Tide, 100 Year ARI flood extent and the Floodplain Assessment Overlay as prescribed in Councils Flood and Storm Tide Inundation Overlay Map (*ref. Sheet – FST-020*). However, as the future development area falls within all of these overlay areas, the following document has been completed to demonstrate the proposed Stage 1A and 1B are in compliance with the Douglas Shire Planning Scheme - Flood and Storm Tide Hazard Overlay Code.

The allotment fill levels in Stage 1A and 1B of the Port Douglas Estate development will be designed to account for the impacts of Climate Change on the Craiglie Creek flood levels. Due consideration will be provided in regards to increases in rainfall intensities and increases in tidal tail water levels.

Access to Stage 1A and 1B is to be provided via Wabul Street across a multi-culvert bridge spanning the overland drainage reserve to the north. Additional future access to Stage 1A and 1B is to be provided with a connection through to Andreassen Road to the south. The site as a whole, is generally bounded by the Captain Cook Highway to the west, Port Pacific Estate to the north and farming land to the south.

Existing ground levels onsite range from approximately 8.2 mAHD in the south west corner grading down to 2.2 mAHD in the north east corner. There is a drainage gully traversing north across the site in which a majority of the onsite runoff is discharged north into the drainage corridor through the Port Pacific Estate. The site is currently utilised as crop farming land.

The Wabul Street bridge requires widening of the existing drainage reserve at the crossing location to accommodate the proposed culvert structures and ensure the smooth transition of flow into the culverts. Reference Drawing Q184103-005-SK-01 (attached to this document), provides an indication of the channel widening required and details the proposed culvert structures.

The park area, identified in Figure 2 above, is to be used as flood storage to mitigate any volume lost through the filling of Stage 1A and 1B. For the purpose of this initial assessment, all residential lots and roads are to be filled above the 1% AEP flood level and the park area at the 20% AEP flood level in accordance with the *Douglas Shire Planning Scheme - Flood and Storm Tide Hazard Overlay Code*.

It is noted that recent development has commenced within the Port Pacific Estate site to the north of the drainage reserve and as such, it is vital that the proposed Port Douglas Estate does not adversely impact on the set freeboards of the southernmost lots. It was deemed necessary that all future development area

discharging into the northern drainage reserve be adequately represented within the Stage 1A and 1B hydraulic modelling to ensure appropriate freeboard for neighbouring lots could be maintained.

Existing Modelling

Cardno has previously undertaken a flood study with regards to the Port Pacific Estate, located to the north of the proposed Port Douglas Estate. The purpose of this flood study was to investigate hydraulic conditions within the Port Pacific site and recommend mitigation options to alleviate adverse flooding within the surrounding catchment. The assessment was detailed within the report "*Port Pacific Estate, Port Douglas – Flood Study (dated 11 August 2009)*". The construction of Port Pacific Estate was divided into five development stages and to date, only stages one to four have been constructed.

The flood study consisted of a detailed hydrological Watershed Bounded Network Model (WBNM) that assessed peak design flows from the local upstream catchment. A two-dimensional hydraulic TULOW model was also created to assess flooding conditions within the Port Pacific Estate and surrounding catchment.

Due to the close proximity of the Port Douglas Estate development, it is proposed to adopt the modelling created within the Port Pacific Estate flood study to assess flooding conditions within the subject site and determine flooding impacts resulting from the proposed development.

Limitations of Existing Modelling

A review of the existing modelling data identified a number of key limitations that needed to be addressed before assessing flooding conditions within the Port Douglas Estate site. The identified limitations are as follows:

Catchment Delineation — The upstream local catchments assessed within the existing WBNM modelling were delineated based on rough contour data. Since this time, newer, 2010 LiDAR data has become available and thus the catchment boundaries were redrawn based on the more recent dataset.

Model Extent — It was identified that the existing hydrologic and hydraulic models did not extend far enough to the south to fully capture the Port Douglas Estate development and its associated catchment. As such, both the hydrologic and hydraulic model were extended to fully encapsulate this area.

Hydrologic Analysis

As discussed above, the existing Cardno WBNM model for the area was adopted to assess peak design discharges from the local upstream catchment. Figure 3 summarises the revised catchment delineation and WBNM model layout. Catchment X discharges directly into the drainage reserve to the north of the Stage 1A and 1B development and Catchment V discharges to the south of the site boundary.

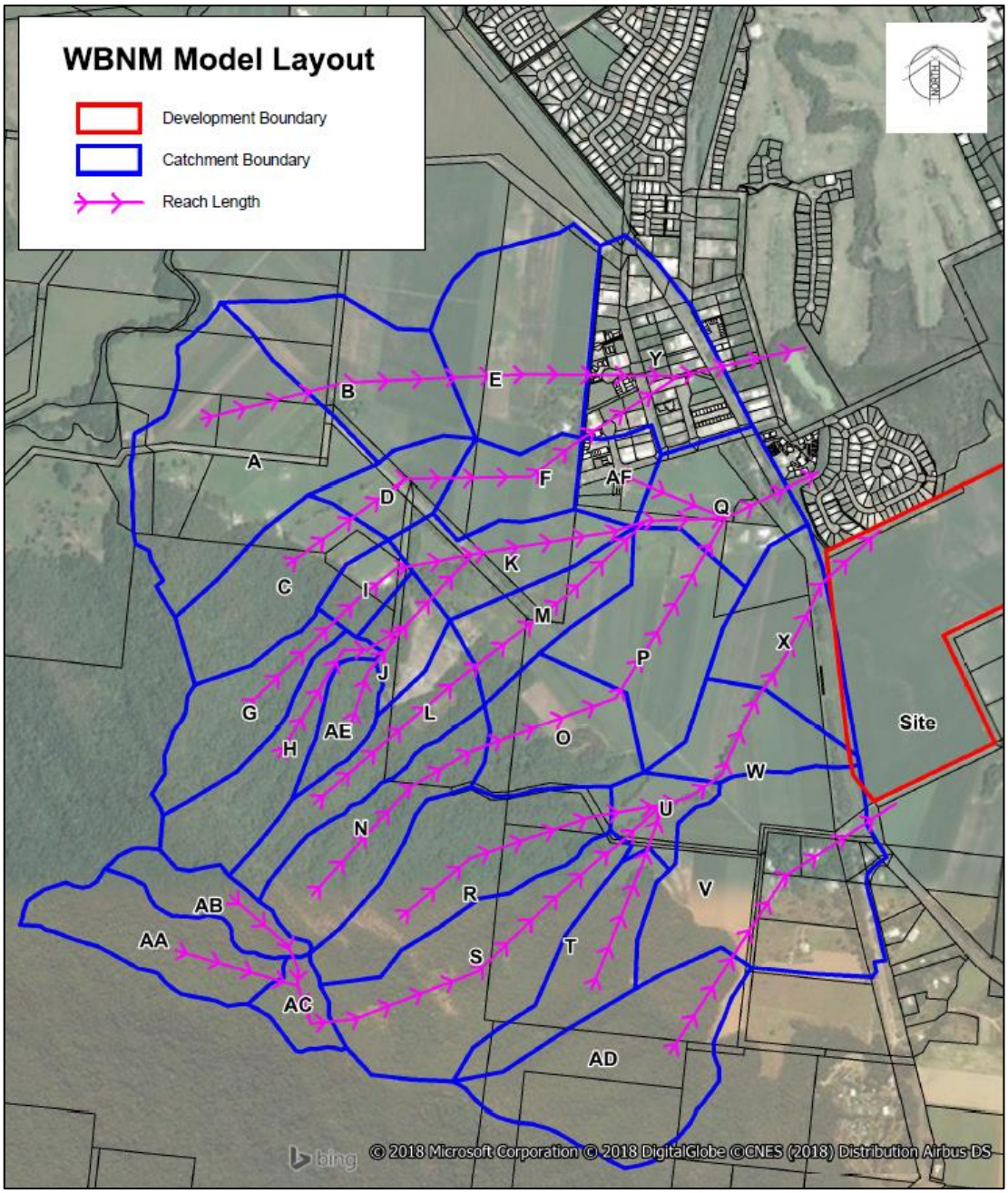

Figure 3 WBNM Model Layout

Table 1 below summarises the catchment areas adopted within the WBNM model.

Table 1 WBNM Catchment Areas

Catchment ID	Area (ha)	Catchment ID	Area (ha)
A	27.80	N	13.21
B	15.72	O	12.44
E	20.35	P	16.87
C	13.36	Q	10.91
D	5.99	R	19.25
F	7.30	AA	11.83
AF	4.46	AB	6.16
Y	16.38	AC	3.59
G	10.36	S	22.83
I	3.38	T	10.89
H	10.76	U	4.49
AE	4.25	W	8.74
J	4.56	X	12.60
K	10.00	AD	22.34
L	11.11	V	29.33
M	8.56		

In accordance with the existing flood study for the area, design rainfall data for the catchment was determined in accordance with Australian Rainfall & Runoff (ARR1987). The information used is as follows:

- 2 Year ARI, 1 hour Intensity 60 mm/h
- 2 Year ARI, 12 hour Intensity 13 mm/h
- 2 Year ARI, 72 hour Intensity 5.0 mm/h
- 50 Year ARI, 1 hour Intensity 100 mm/h
- 50 Year ARI, 12 hour Intensity 27.5 mm/h
- 50 Year ARI, 72 hour Intensity 9.5 mm/h
- Regional Skewness 0.15
- Geographical Factor F2 3.86
- Geographical Factor F50 17.1

The design rainfall losses adopted for the analysis were:

Pervious Area	Initial Loss = 0 mm
	Continuing Loss = 2.5 mm/h
Impervious Area	Initial Loss = 0 mm
	Continuing Loss = 0 mm/h

A Lag Parameter of 1.50 was used in the WBNM model. Studies carried out using WBNM have found that the average value of the Lag Parameter across a wide range of catchments is between 1.30 and 1.80 (ref. WBNM User Manual). Thus, the adopted value of 1.50 is within the accepted bounds. A non-linearity exponent of 0.77 was also used and each catchment was assumed completely pervious.

The WBNM model was run for a range of storm durations, from 25 minutes to 3 hours, with the 1.5 hour event producing the peak discharge from each catchment. The peak 100 year discharges calculated by the WBNM model are:

Catchment Y - 29.7 m^3/s Catchment Q - 38.6 m^3/s

Catchment X - 29.6 m^3/s Catchment V - 14.9 m^3/s

A Rational Method calculation was completed to verify that the WBNM peak discharges were of the correct order of magnitude. The time of concentration was calculated and verified using two different methodologies, as described in the Queensland Urban Drainage Manual (QUDM). Table 2 below summarises the Rational Method parameters adopted in the calculation. A C_{10} value of 0.7 was adopted in accordance with Section 4 of QUDM.

Table 2 Rational Method Parameters

Catchment ID	Area (ha)	Reach Length (m)	Equal Area Slope (%)	Time of Concentration (min)
Catchment Y	107.30	1800	2.34	56
Catchment Q	121.30	2060	4.92	50
Catchment X	100.70	2810	9.97	57
Catchment V	52.17	1630	5.76	45

Table 3 summarises the peak 1% AEP rational discharges and the peak 1% AEP WBNM discharges at each of the catchments outlets.

Table 3 Peak Discharge Comparison

Catchment ID	Rational Method Peak Discharge (m^3/s)	WBNM Peak Discharge (m^3/s)	Difference (m^3/s)
Catchment Y	30.58	29.72	-0.86
Catchment Q	37.17	38.59	1.42
Catchment X	28.34	29.55	1.22
Catchment V	16.92	14.95	-1.97

The results show that the peak flows calculated by the WBNM model agree well with those from the Rational Method. Thus, it was considered that the WBNM model could be used to calculate the discharge hydrographs from the upstream catchment.

Hydraulics

As previously discussed, the existing Cardno two dimensional TUFLOW hydraulic model for the areas was adapted to model flooding conditions within the Port Douglas Estate development. It was identified that the existing hydraulic model did not extend far enough to the south to fully capture the site and as such, the hydraulic model was extended to fully encapsulate this area. Figure 4 displays the TUFLOW model extent and setup.

The following section discusses the TUFLOW model setup:

Model Extent

The hydraulic model extent was setup to adequately represent the local catchment flooding from the upstream catchment system. Model inflows and boundaries were set a sufficient distance from the development extent to allow for the accurate representation of flow paths and to avoid instabilities. Figure 4 displays the TUFLOW model extent.

Topographic Data, Grid Cell Size and Time Step

A digital terrain model (DTM) of the study area was set up based on the following data:

- 2010 LiDAR survey (*acquired from the Department of Natural Resources and Mines (DNRM)*)

To provide an appropriate level of detail and achieve reasonable run times, the study area was represented by a 5 metre grid. A time step of 2.5 seconds was adopted to maintain stability and appropriate run times. Figure 4 displays the topography surface utilised in the TUFLOW model.

Model Inflows

Inflow into the hydraulic TUFLOW model was achieved using a split of design storm hydrographs from the WBNM model and rainfall on grid. The upstream inflows were represented as point inflows, inserted to the west of the Captain Cook Highway an appropriate distance upstream of the site. Inflows within and downstream of the site were represented using a rainfall on grid modelling approach. Refer to Figure 4 for detail regarding the location of the upstream WBNM inflows and the area represented using rainfall on grid techniques.

In the developed scenario, inflows within the site were concentrated as SA_RF polygons, discharging the rainfall volume directly to the respective discharge locations of the development. Figure 5 highlights the discharge locations and concentrated areas.

1D Links

Culverts were input into the TUFLOW model as 1-dimensional flow links. Inlet and outlet loss coefficients of 0.5 and 1.0 respectively were used for all structures. The TUFLOW model checks the operation of culverts under both inlet and outlet flow control, for Class 1 (free water surface) and Class 2 (submerged entrance) conditions. The existing open channel to the north west of the site was also modelled as a series of 1- dimensional flow links. Cross sections of the open channel were extracted from field survey, and used in the TUFLOW model to define the flow area. Figure 5 displays the culverts adopted within the TUFLOW modelling.

Floodplain Roughness

The Manning's n roughness values applicable to the study area were determined from site inspections and aerial photography. The values used are summarised in Table 4.

Table 4 Manning's n Values

Location	Manning's n
Road Reserves	0.02
Golf Course	0.035
Heavily Grassed or Vegetated Areas	0.08
Densely Treed/Mangrove Areas	0.15
Commercial Precincts	0.20

Downstream Boundary Condition

The downstream boundary of the TUFLOW model is located at the outfall of Craiglie Creek to the Pacific Ocean, near Port Douglas. Relevant ocean levels are as follows.

- The Highest Astronomical Tide (HAT) level at Port Douglas is 1.78 mAHD (ref. Queensland Tide Tables 2012, Queensland Government).
- The 100 year storm tide level in the vicinity of Port Douglas (i.e. at Oak Beach) is 1.9 mAHD (ref. Queensland Climate Change and Community Vulnerability to Tropical Cyclones – Ocean Hazards Assessment Stage 3, Queensland Government, July 2004). An allowance of 300 mm was added to this level, to account for wave setup at the coastline.

Based on these levels, a 100 year storm tide level of 2.2 mAHD was adopted for the existing 100 year event, and a Highest Astronomical Tide level of 1.78 mAHD was adopted for the smaller events.

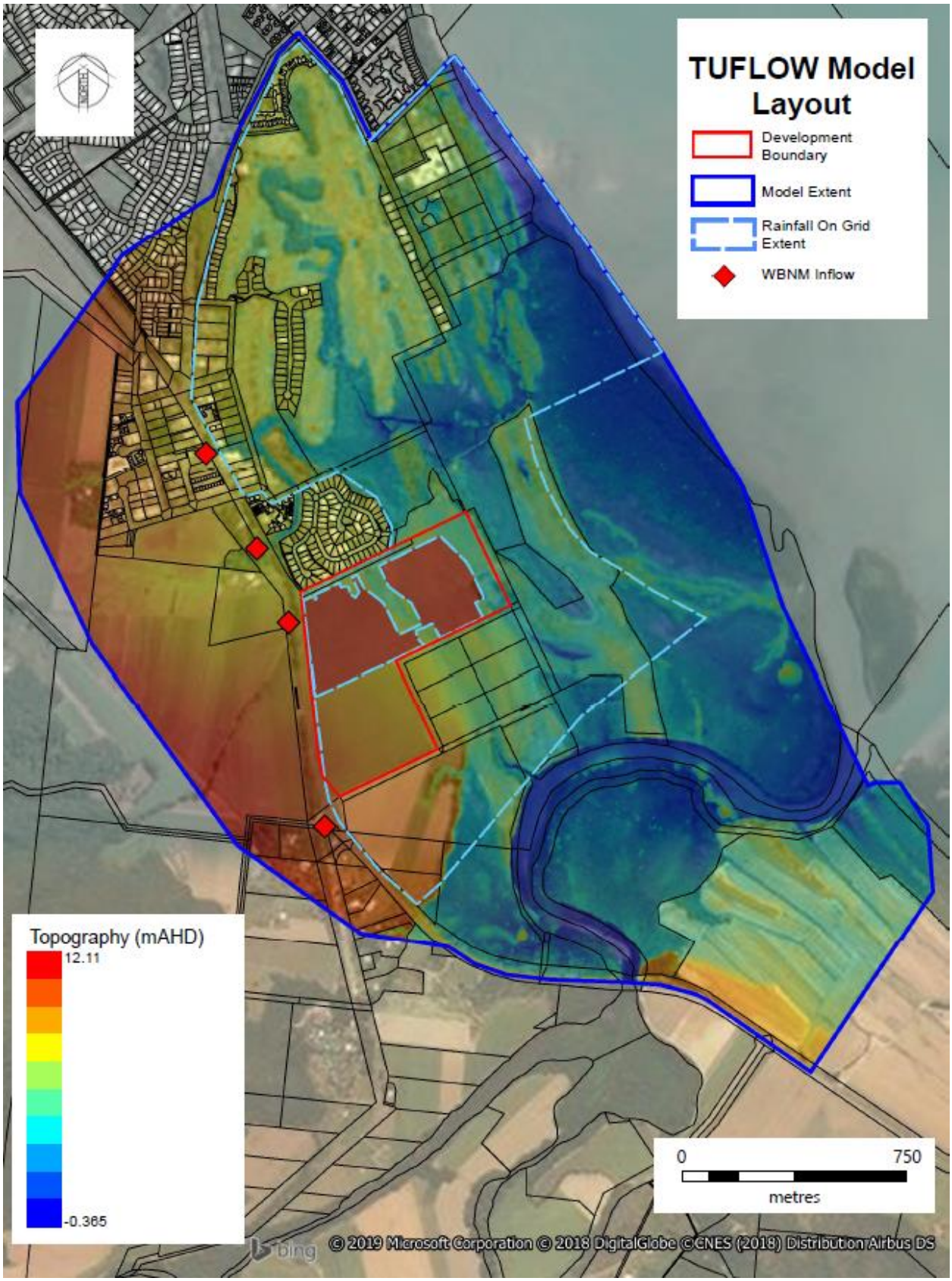

Figure 4 TUFLOW Model Layout

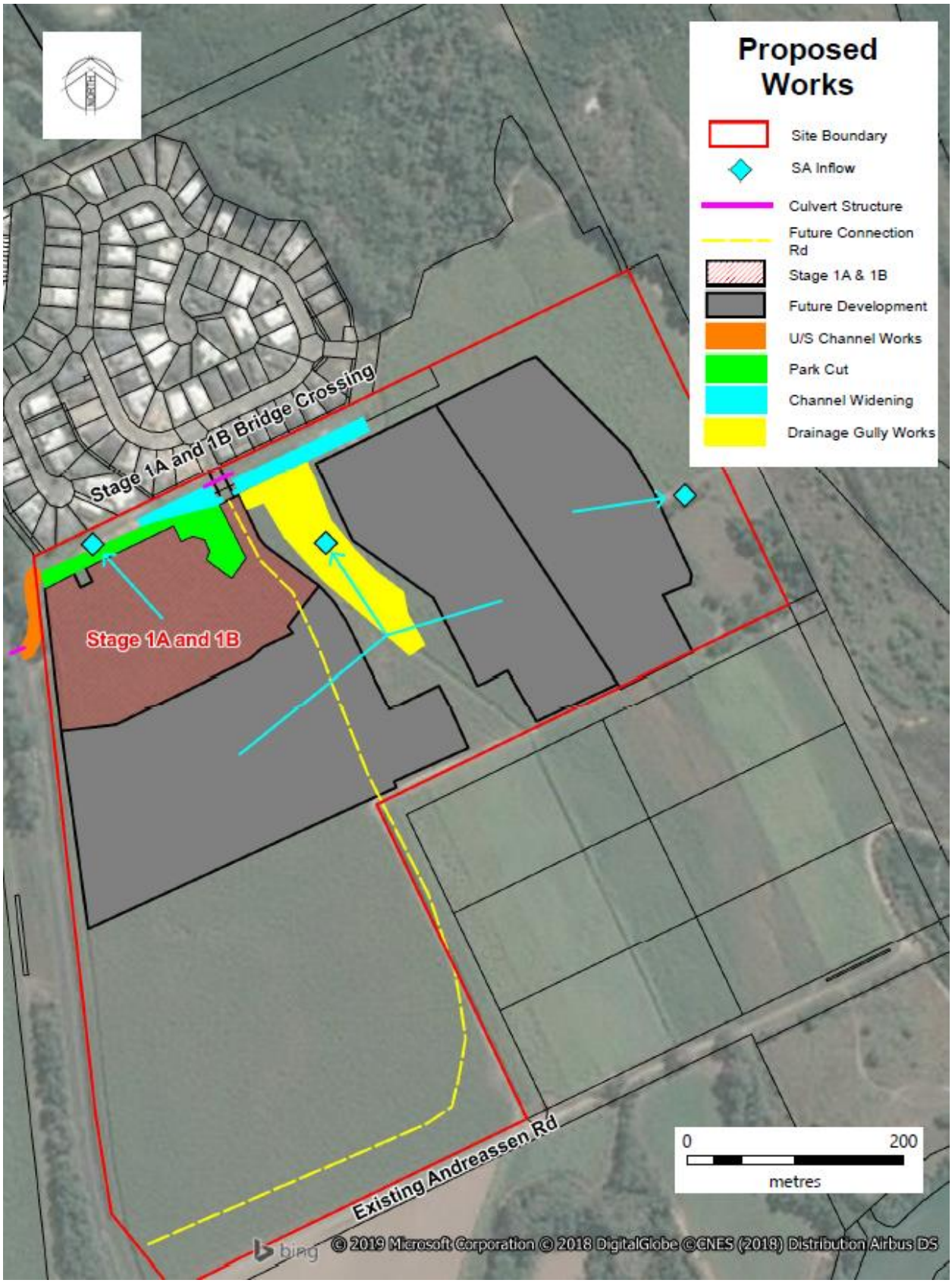

Figure 5 TUFLOW Model Detail

Climate Change

The allotment fill levels in the Port Douglas Estate development will be designed to account for the impacts of Climate Change on the Craiglie Creek flood levels.

Recent climate change investigations (ref. Increasing Queensland's resilience to inland flooding in a changing climate: Final Scientific Advisory Group report – Derivation of a rainfall intensity figure to inform an effective interim policy approach to managing inland flooding risks in a changing climate, Department of Environment and Resource Management, 2010) recommend that an allowance for a 20% increase in design rainfall intensities should be adopted for climate change.

The current projection for sea level rise by the International Panel on Climate Change (IPCC, 2007) is 800 mm by the Year 2100.

An analysis was therefore carried out for the 100 year ARI event, incorporating the following elements of climate change:

- increase in rainfall intensity of 20%; and
- sea level rise of 800 mm (i.e. giving a tailwater level = 3.0 mAHD).

Modelling Scenarios

To assess flooding impacts resulting from the proposed Stage 1A and 1B of the Port Douglas Estate, the following modelling scenarios were assessed:

Existing Case - An existing case model simulation representing current hydraulic conditions. This scenario adopts the existing modelling created for the neighbouring Port Pacific development with minor revisions to the model extent and hydrologic inflows.

Developed Case - A developed case model simulation representing the filling of Stage 1A and 1B of the Port Douglas Estate. For the purpose of this assessment, the Stage 1A and 1B area was filled to a level greater than the 1% AEP + Climate Change event. The park area was set to an elevation of 3.65 mAHD to mitigate losses in flood storage and achieve flood immunity in the 20% AEP storm event (refer figure 5).

The proposed bridge crossing on Wabul Street, providing access to Stage 1A and 1B was also detailed within the hydraulic model. The crossing was represented with five Reinforced Concreate Box Culverts (RCBC's) of varying size and invert level. Refer to Reference Drawing Q184103-005-SK-01 (attached to this document) for design detail regarding the culvert sizing and layout. Earthworks to widen the drainage channel both upstream and downstream of the crossing structure to accommodate the proposed culverts and allow for the smooth transition of flow was required. The road level across the structure was interpolated from 4.95 mAHD at the southern side to 3.5 mAHD at the northern side.

Rough fill was included for the future development area that will likely drain to the north of the site. It was deemed necessary to represent all future runoff into the drainage reserve when assessing Stage 1A and 1B development to ensure adequate freeboard of the adjacent residential properties was maintained.

It was noted that the drainage channel profile immediately upstream of the site was not adequately represented in the LiDAR surface. This was likely due to the heavy vegetation in the drainage reserve at this location. As such, the channel was artificially detailed in this area (refer Figure 5) to ensure adequate conveyance into the northern drainage channel.

Earthworks within the drainage gully immediately east of Wabul Street were required to allow for the free drainage and attenuation of the future development areas. The base of the gully was set to an elevation of 2.4 mAHD for the purposes of this assessment however it is noted that optimization of the earthworks required will be undertaken during the design of the future development areas (refer Figure 5)

The hydraulic model was then simulated for the 2 year to 100 year event for the 60, 90 and 120 minute critical storm durations. The 100 year + climate change event was also assessed.

Model Results

Detailed mapping of peak flood level, depth and velocity has been provided for both existing and developed scenarios in Appendix A and B of this report. Detailed impact mapping has been provided in Appendix C.

Existing Scenario - Model Results

The existing modelling results show minor inundation of the Stage 1A and 1B development area in the design 1% AEP flood event. A majority of the inundation observed can be attributed to pockets present in the topographic surface due the existing cropping land use. The deeper body of flooding present in the north west corner of the Stage 1B area has been identified as storage offset from the adjacent drainage reserve. It is acknowledged that additional flood storage will need to be provided elsewhere within the Stage 1B area to offset any losses resulting from the filling of this storage volume. For the purpose of this assessment, the park area within Stage 1B has been utilised to mitigate any losses in flood storage for events greater than the 20% AEP.

The area of proposed fill within Stage 1A and 1B do not coincide with any existing overland conveyance paths through the site. The existing modelling shows all conveyance flows to be contained within the drainage reserve to the north and as such, the filling of the Stage 1A and 1B area should result in minimal impact to existing flooding conditions within the drainage reserve.

Peak velocities within the drainage reserve varying from 2 m/s at the north west corner of the site down to 1 m/s at the proposed Wabul Street bridge crossing were evident in the 1% AEP event. Extreme velocities greater than 2 m/s could be seen external to the site within the drainage reserve at the bend. It is recommended that detailed survey be undertaken within the drainage reserve at this location.

Developed Scenario - Model Results

The flood impact mapping provided in Appendix C demonstrates the proposed Stage 1A and 1B works do not result in actionable nuisance flooding external to the site. The design achieves flood level reductions within the drainage reserve to the north of Stage 1B hence maintaining the freeboard of adjacent properties. Slight increases flood level can be seen within the drainage reserve to the north west of the site however this are minor in nature and are contained within the existing channel.

Minor increases in flood level (10-20mm) are also apparent on Lot 120 on SP276038 to the north east and on the existing crop plantation to the south in the design 1% AEP event. It must be noted that these impacts are likely resulting from the concentration of post development flow from the future development areas. The concentration of discharge from the future development areas was incorporated into the Stage 1A and 1B modelling to represent a realistic tail water level in the northern drainage reserve, ensuring the Wabul Street culverts were adequately sized. The flooding afflux observed occurs in currently undeveloped areas due to potential future development not proposed in this stage. The impact is minor in nature and future stages of development will ensure these impacts are minimised.

Peak velocities less than 1.5 m/s are maintained within the drainage reserve in the 1% AEP design event. A velocity of approximately 1 m/s can be seen at the upstream and downstream face of the Wabul Street culvert structures. Minor increases in channel velocity are apparent within the drainage reserve at the north east corner of the site and it is recommended that scour protection be assessed at this location during the detailed design stage of this assessment.

The flood depth mapping indicates the park area remains flood free in all events up to and including the 20% AEP storm event and is only partially inundated by the design 1% AEP event.

Vehicle access across the Wabul Street crossing is achieved in the 1% AEP flood event (flooding depth less than 300mm). Flood level reductions can be observed on Milman Drive to the north of the Wabul Street crossing. As such, access into the site via Milman Drive is not impacted by the proposed Port Douglas Estate design.

Conclusion

Cardno was commissioned by Port Douglas Land Developments to undertake a Flood Impact Assessment (FIA) of the proposed Stage 1A and 1B of the Port Douglas Estate residential development located on Lot 2 of Plan SR431 off the Captain Cook Highway, Craiglie, QLD.

Cardno has undertaken detailed flood modelling in the catchment during the design of the neighbouring Port Pacific Estate and it was proposed to adopt the existing modelling for use in the Port Douglas Estate assessment. A review of the existing modelling identified a number of key limitations that needed to be addressed before assessing flooding conditions within the Port Douglas Estate including the delineation of upstream catchments and the model extent. The limitations were addressed and the model was simulated for a range of design storm events up to and including the 1% AEP + Climate Change.

The modelling results demonstrate the proposed Stage 1A and 1B development, designed as discussed in the above report, do not result in any actionable nuisance flooding external to the site and are in accordance with the *Douglas Shire Planning Scheme - Flood and Storm Tide Hazard Overlay Code.*

Minor increases in flood level (10-20mm) in the design 1% AEP event are apparent on Lot 120 on SP276038 to the north east and on the existing crop plantation to the south however, it was noted that these impacts are likely resulting from the concentration of post development flow from the future development areas and will be mitigated in the future design stages of development through onsite drainage and detention.

Vehicle access across the Wabul Street crossing is achieved in the 1% AEP flood event (flooding depth less than 300mm). Flood level reductions can be observed on Milman Drive to the north of the Wabul Street crossing. As such, access into the site via Milman Drive is not impacted by the proposed Port Douglas Estate design.

Detailed mapping of peak flood level, depth and velocity has been provided for both existing and developed scenarios in Appendix A and B of this report. Detailed impact mapping has been provided in Appendix C.

Yours sincerely,

Geordi Paxton
Water Engineer
for Cardno
Direct Line: +61 7 3139 2966

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Approved By,

Daniel Wood
Senior Engineer
for Cardno
Direct Line: +61 7 3100 2266

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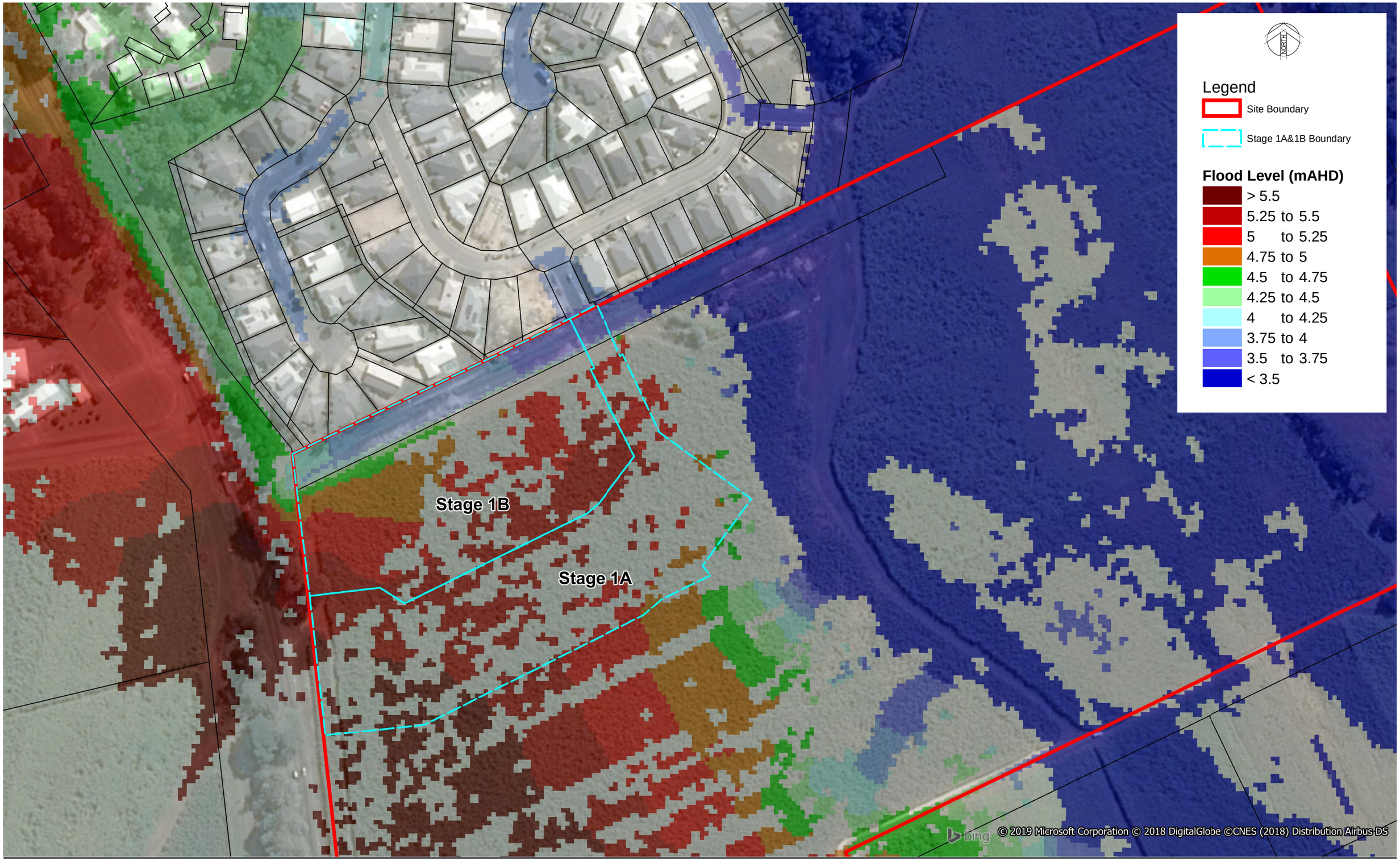
APPENDIX

A

EXISTING FLOODING



Cardno

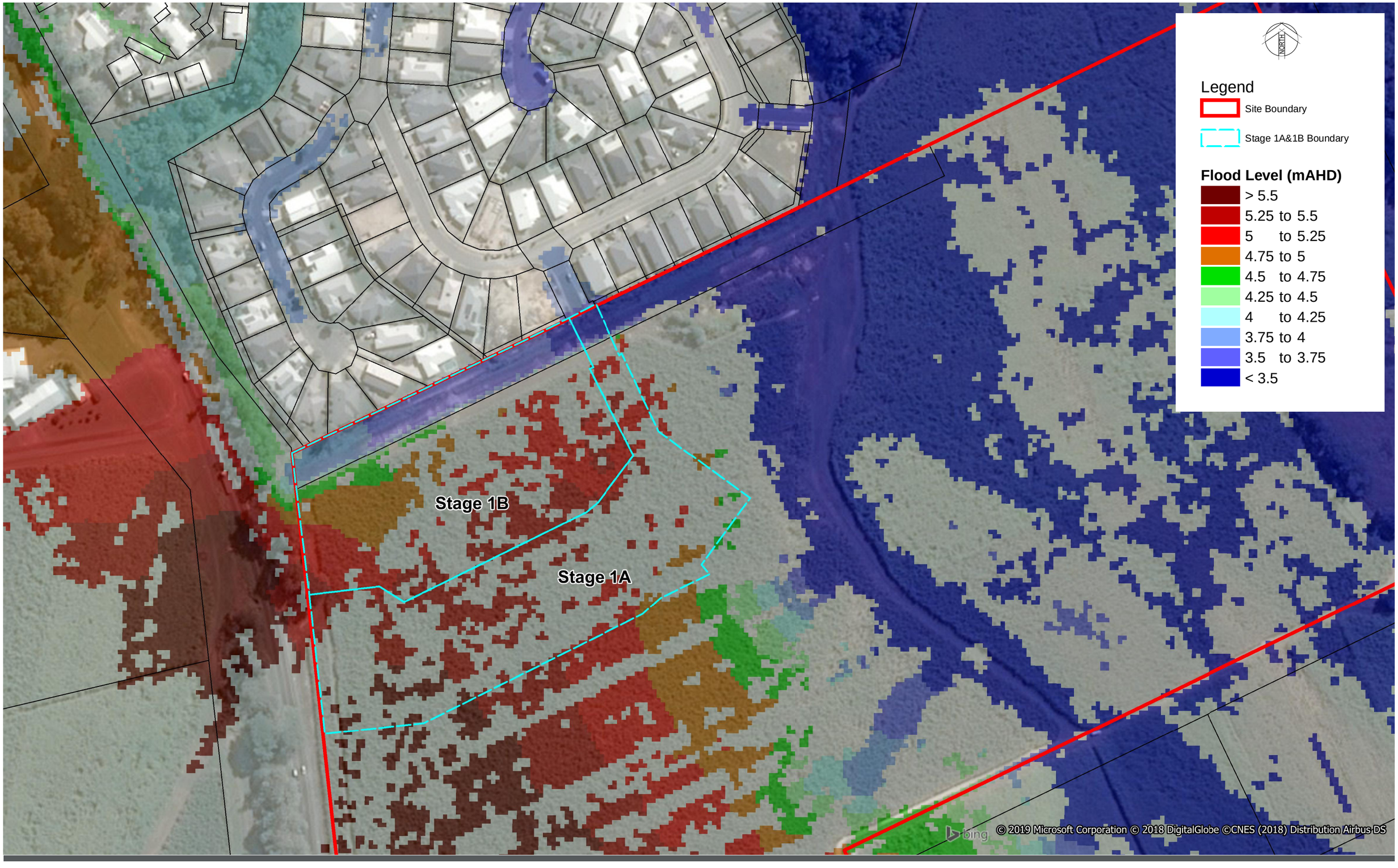
Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
Size
A3
Scale
1:2,000

0 80
metres

APPENDIX A.1.1
EXISTING - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.1_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
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Scale
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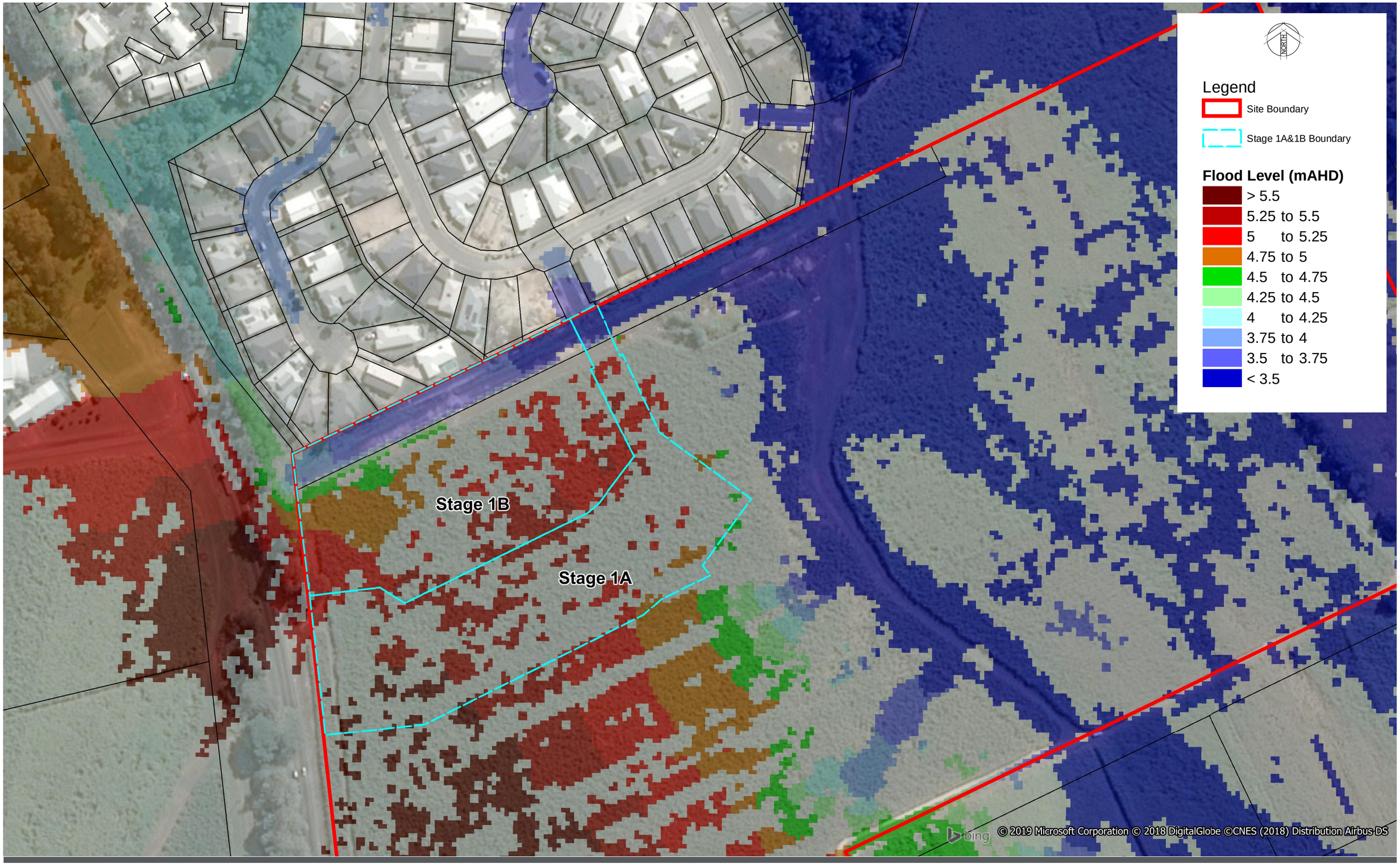
APPENDIX A.1.2
EXISTING - 1% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.2_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
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Tel. 07 3369 9822

Date
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Size
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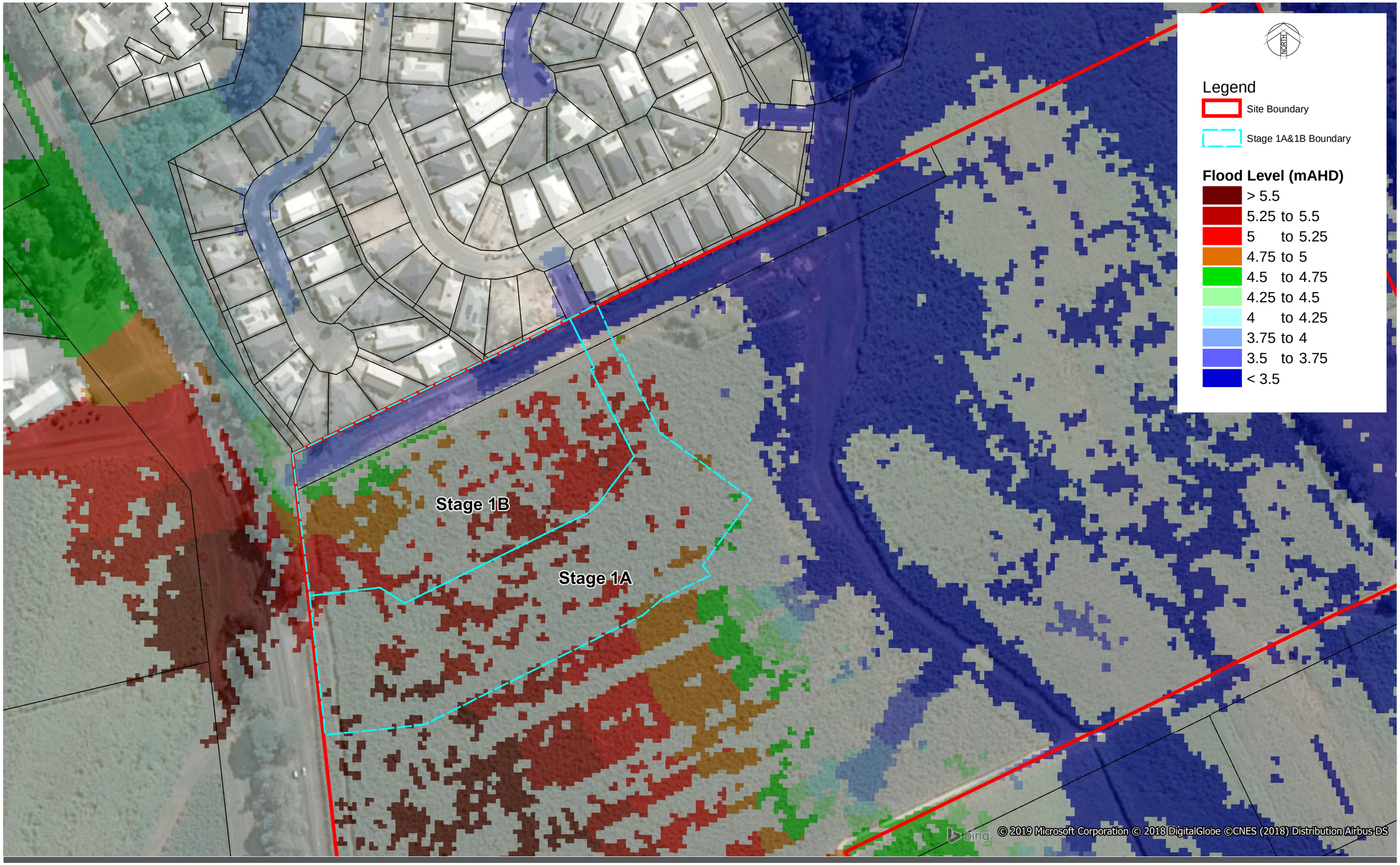
APPENDIX A.1.3
EXISTING - 2% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.3_PortDouglas



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Tel. 07 3369 9822

Date
16/01/2019
Size
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Scale
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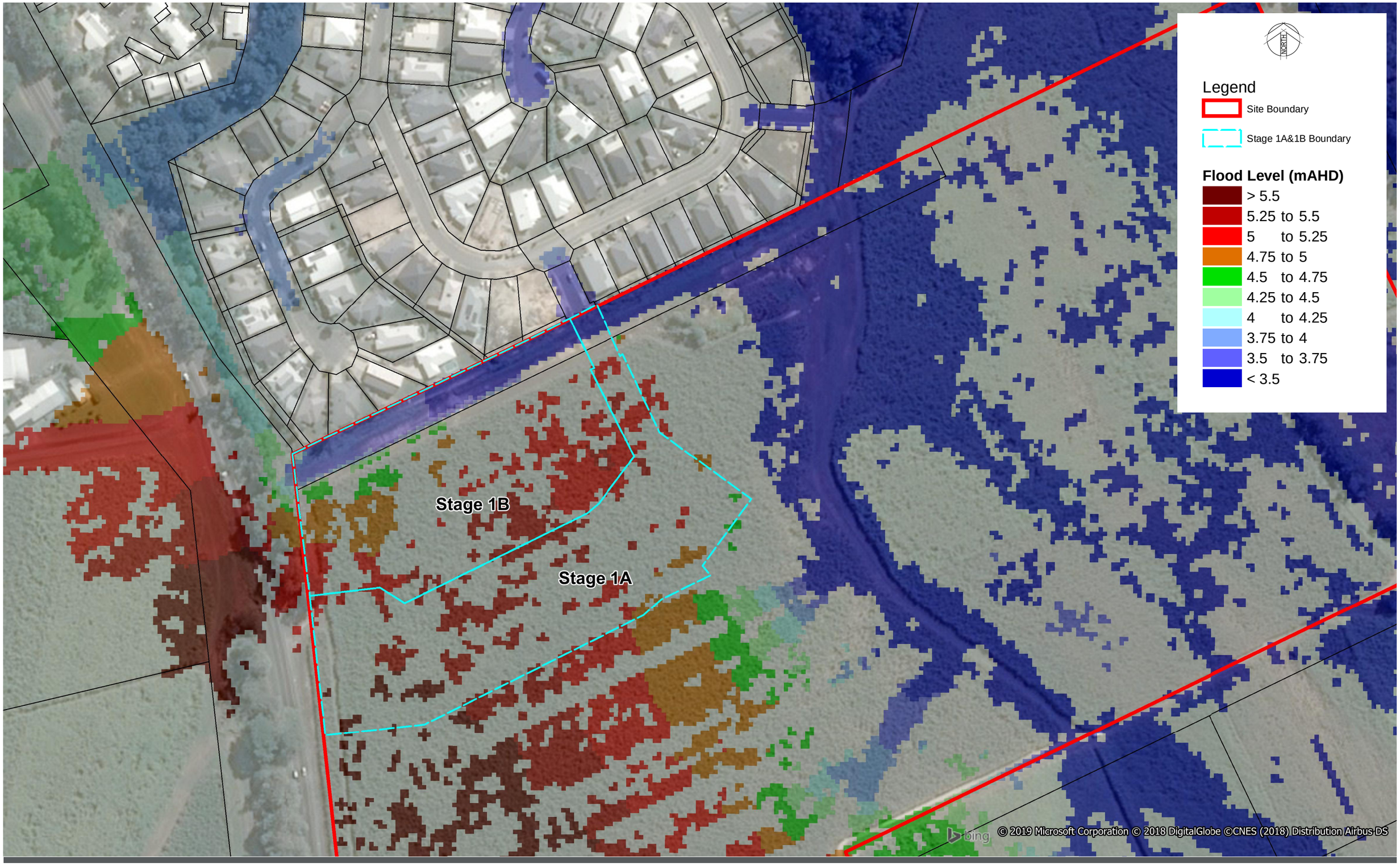
metres

APPENDIX A.1.4
EXISTING - 5% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.4_PortDouglas



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Tel. 07 3369 9822

Date
16/01/2019
Size
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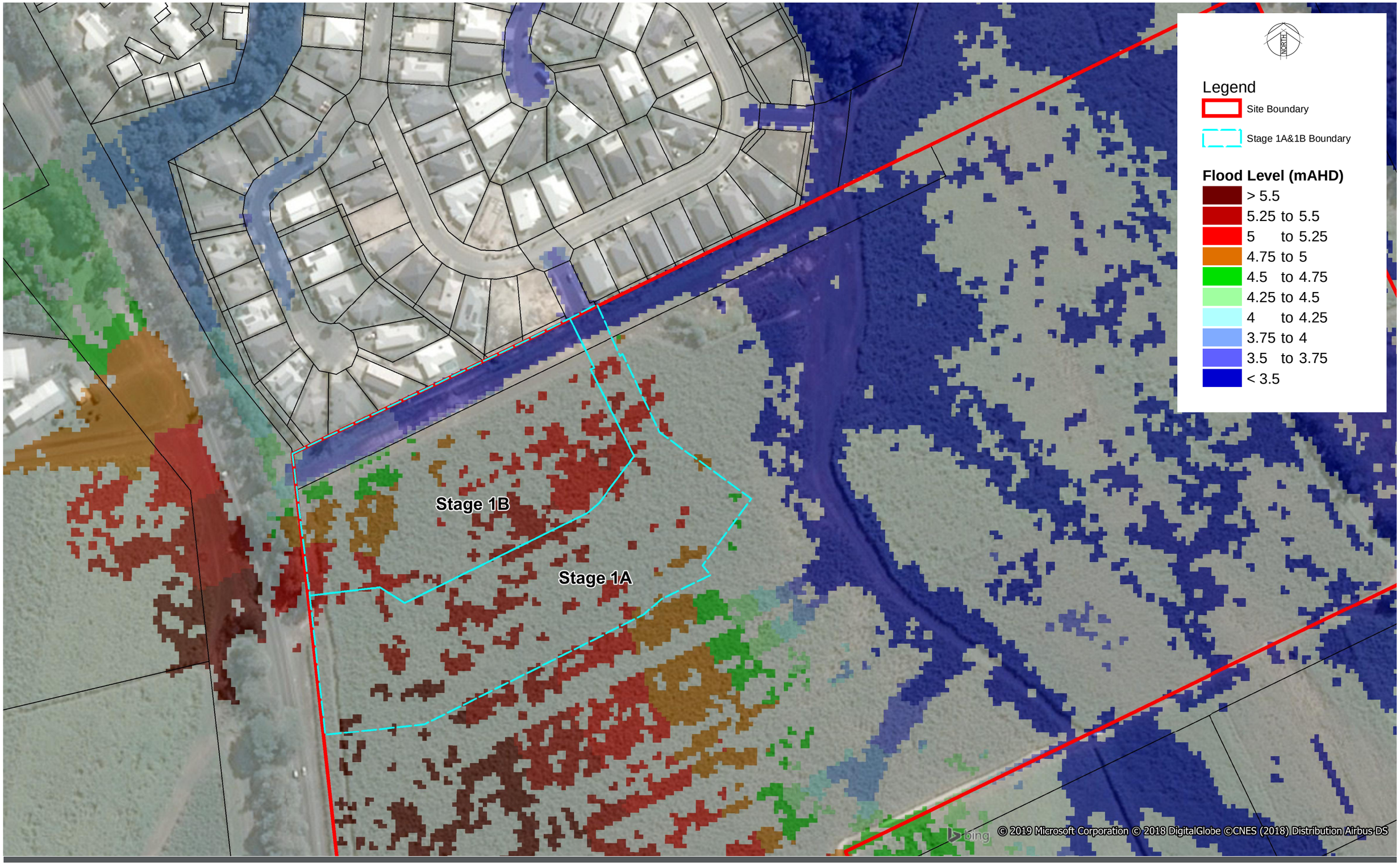
metres

APPENDIX A.1.5
EXISTING - 10% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.4_PortDouglas



Cardno

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Tel. 07 3369 9822

Date
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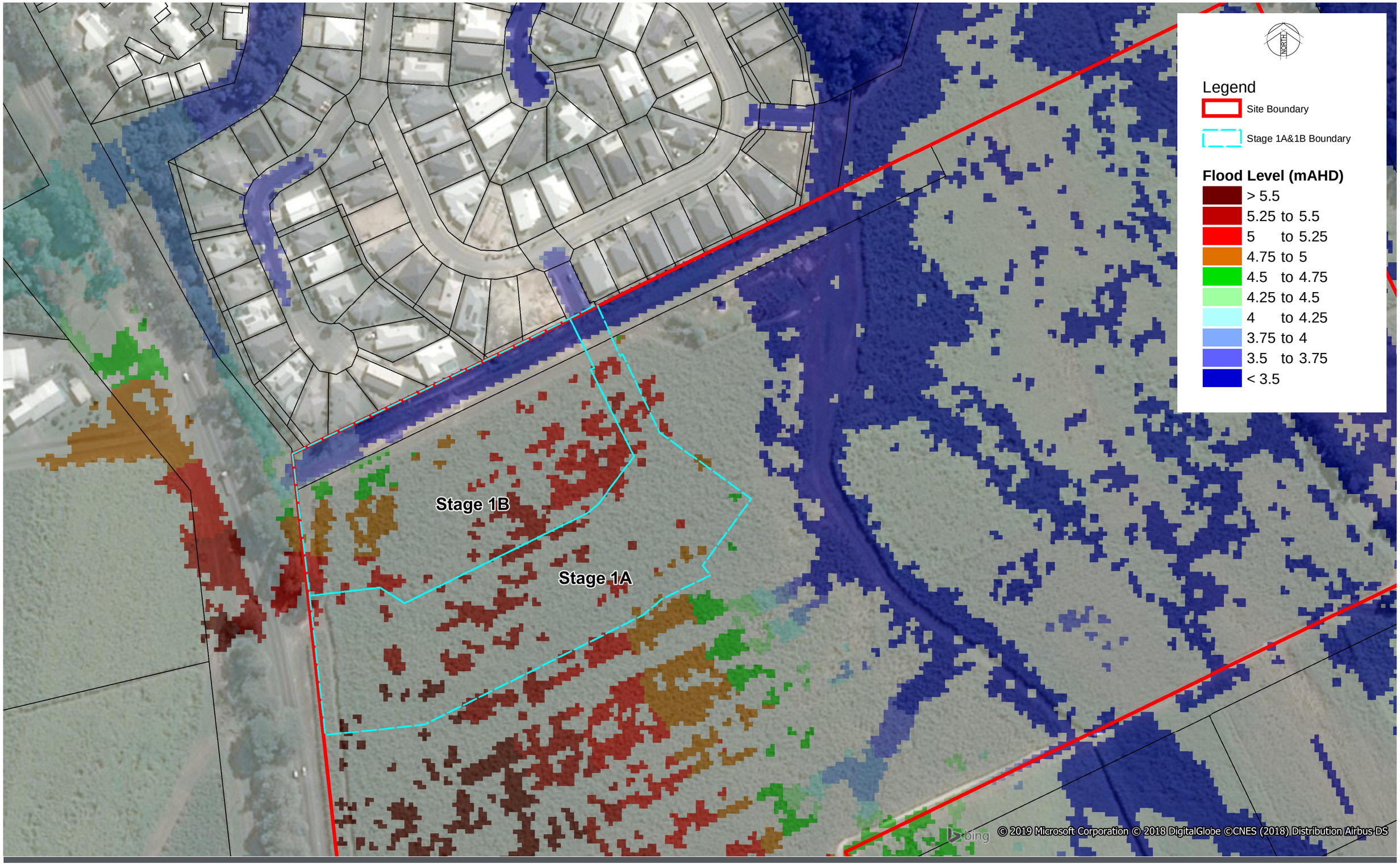
APPENDIX A.1.6
EXISTING - 20% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.6_PortDouglas



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Level 11, North Tower, 515 St Pauls Terrace
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Tel. 07 3369 9822

Date
16/01/2019
Size
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Scale
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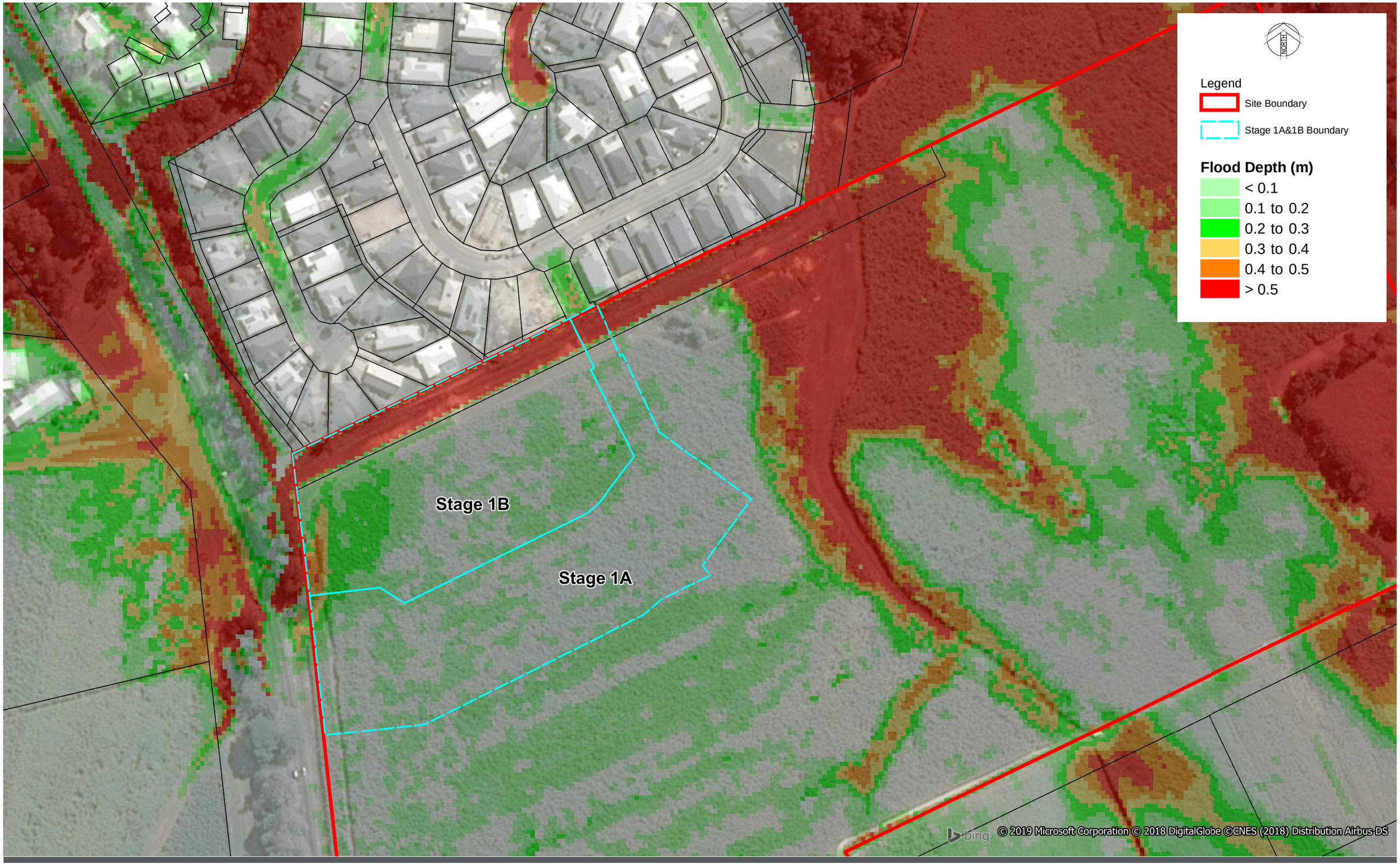
metres

APPENDIX A.1.7
EXISTING - 50% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppA.7_PortDouglas



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Tel. 07 3369 9822

Date
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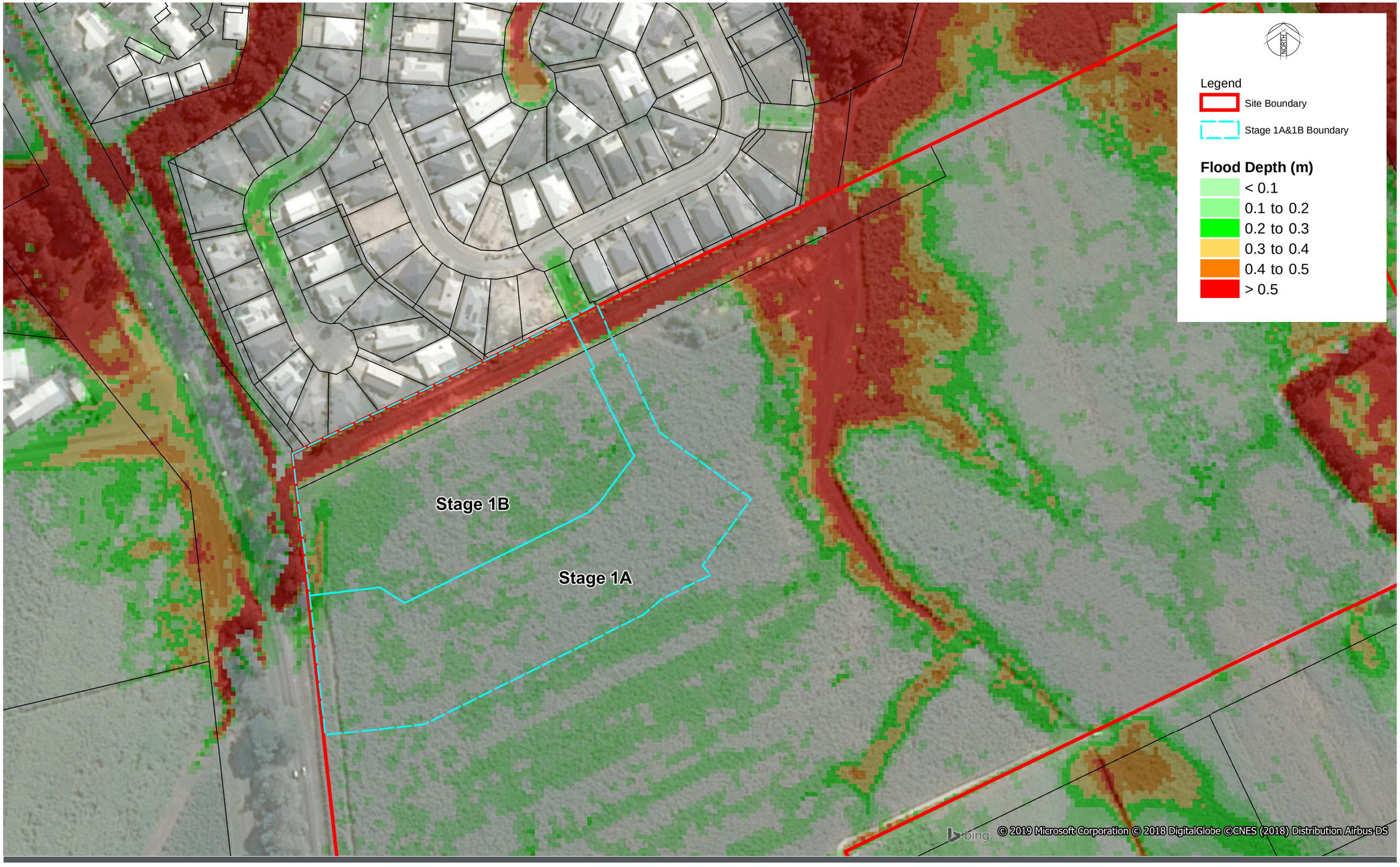
APPENDIX A.2.1
EXISTING - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.1_PortDouglas



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Tel. 07 3369 9822

Date
16/01/2019
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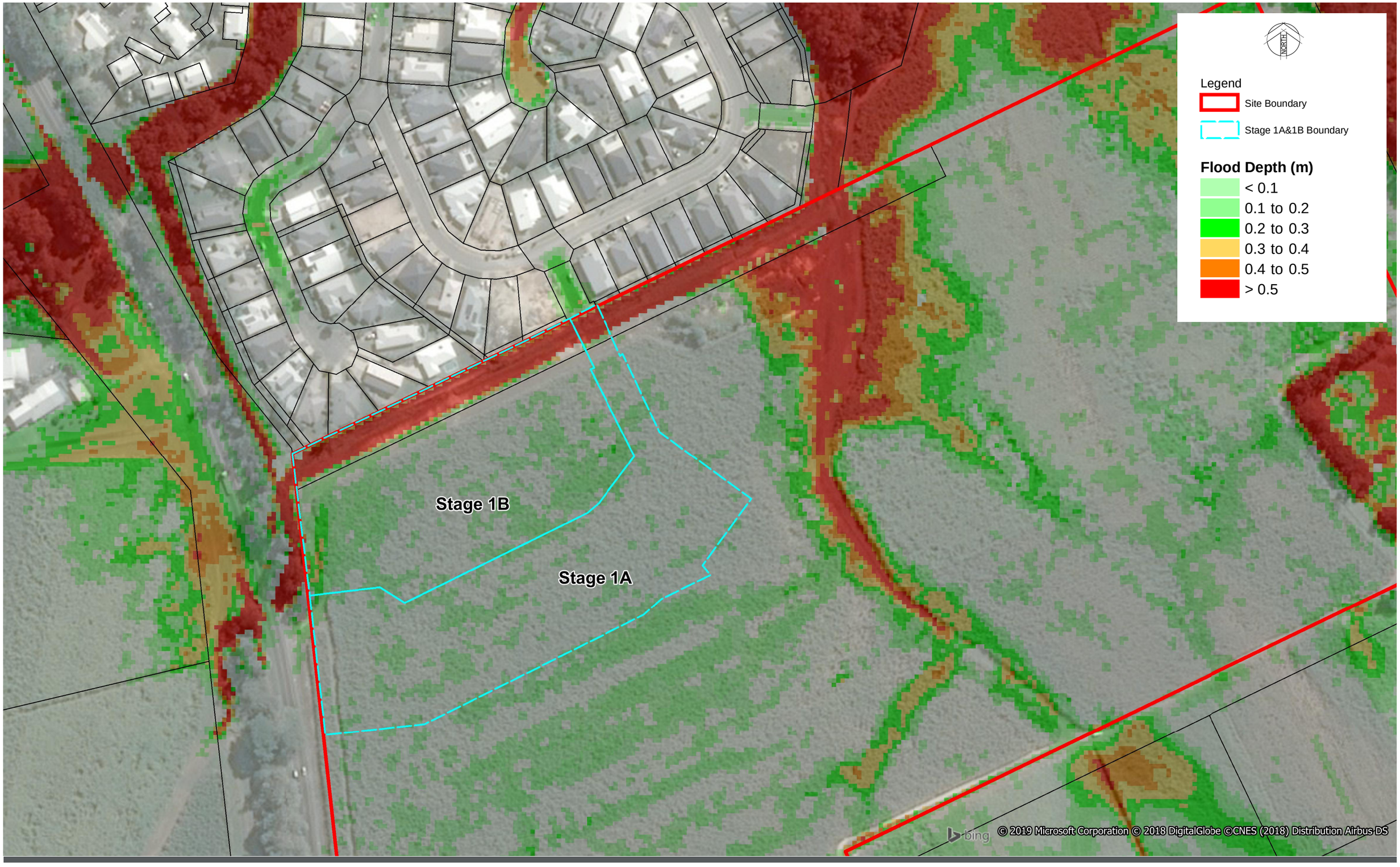
APPENDIX A.2.2
EXISTING - 1% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.2_PortDouglas



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Tel. 07 3369 9822

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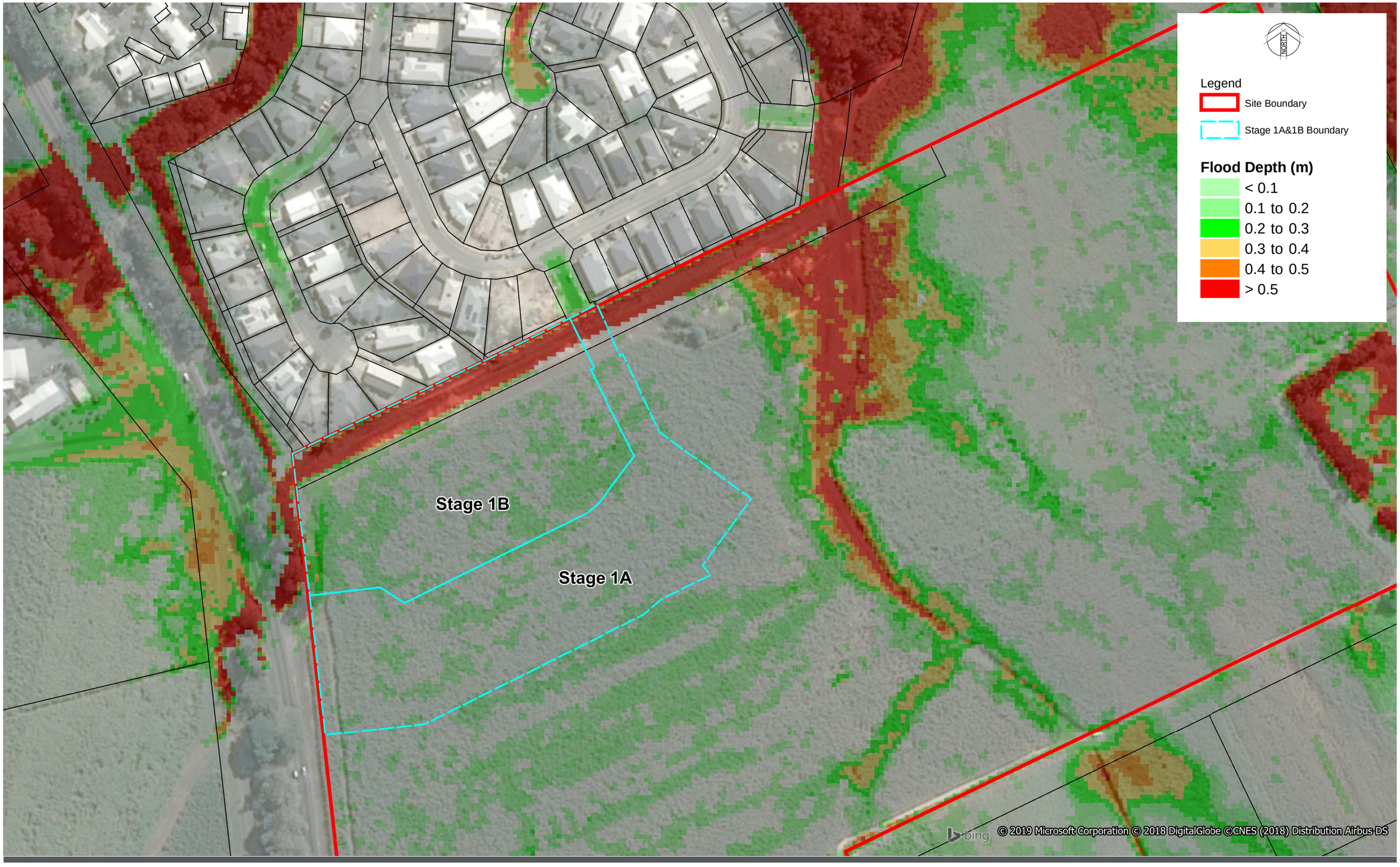
APPENDIX A.2.3
EXISTING - 2% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.3_PortDouglas



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Tel. 07 3369 9822

Date
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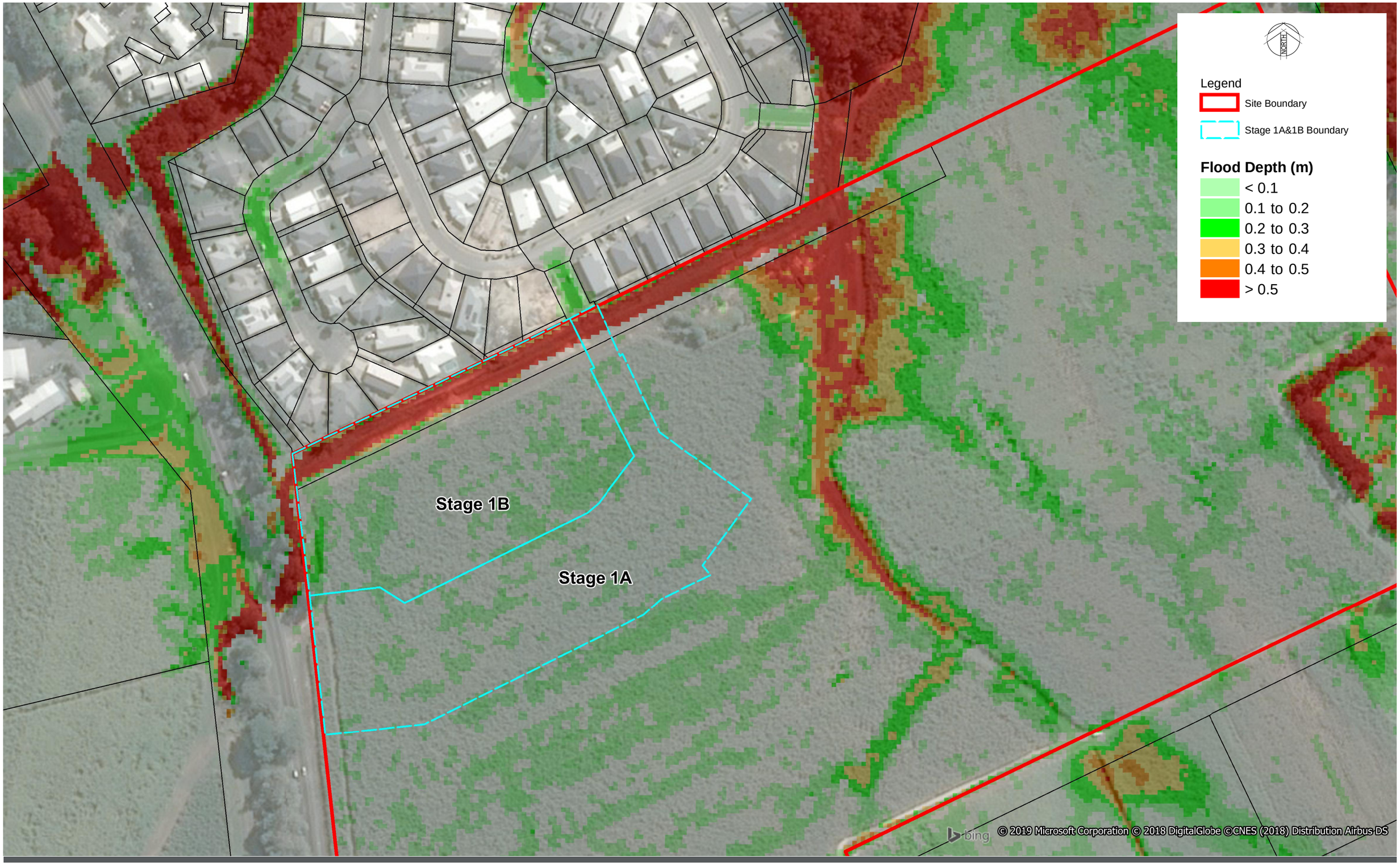
APPENDIX A.2.4
EXISTING - 5% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.4_PortDouglas



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Tel. 07 3369 9822

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APPENDIX A.2.5
EXISTING - 10% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.4_PortDouglas

Cardno

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Tel. 07 3369 9822

Date
16/01/2019
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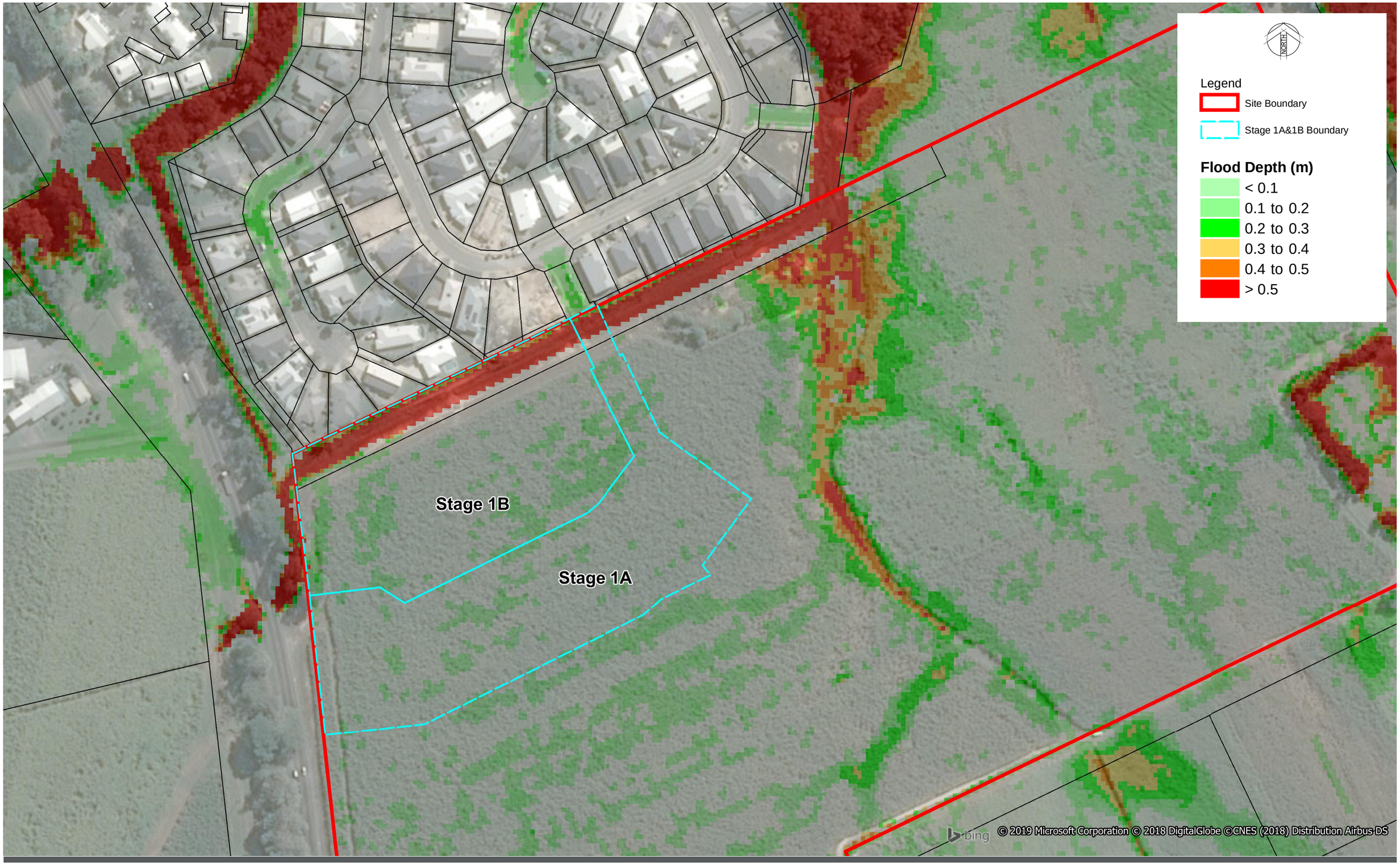
APPENDIX A.2.6
EXISTING - 20% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.6_PortDouglas



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Tel. 07 3369 9822

Date
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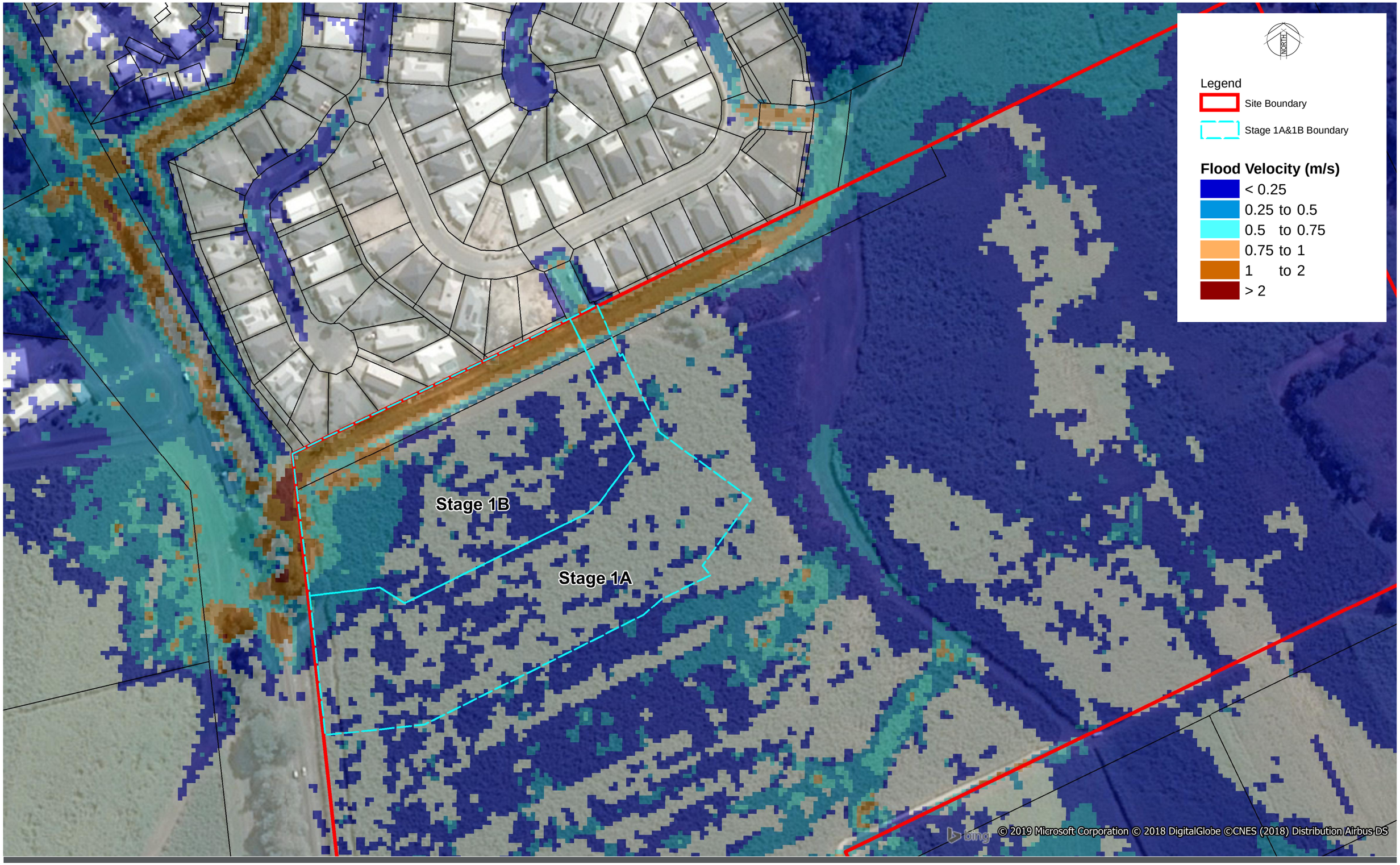
APPENDIX A.2.7
EXISTING - 50% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppA.7_PortDouglas



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Date
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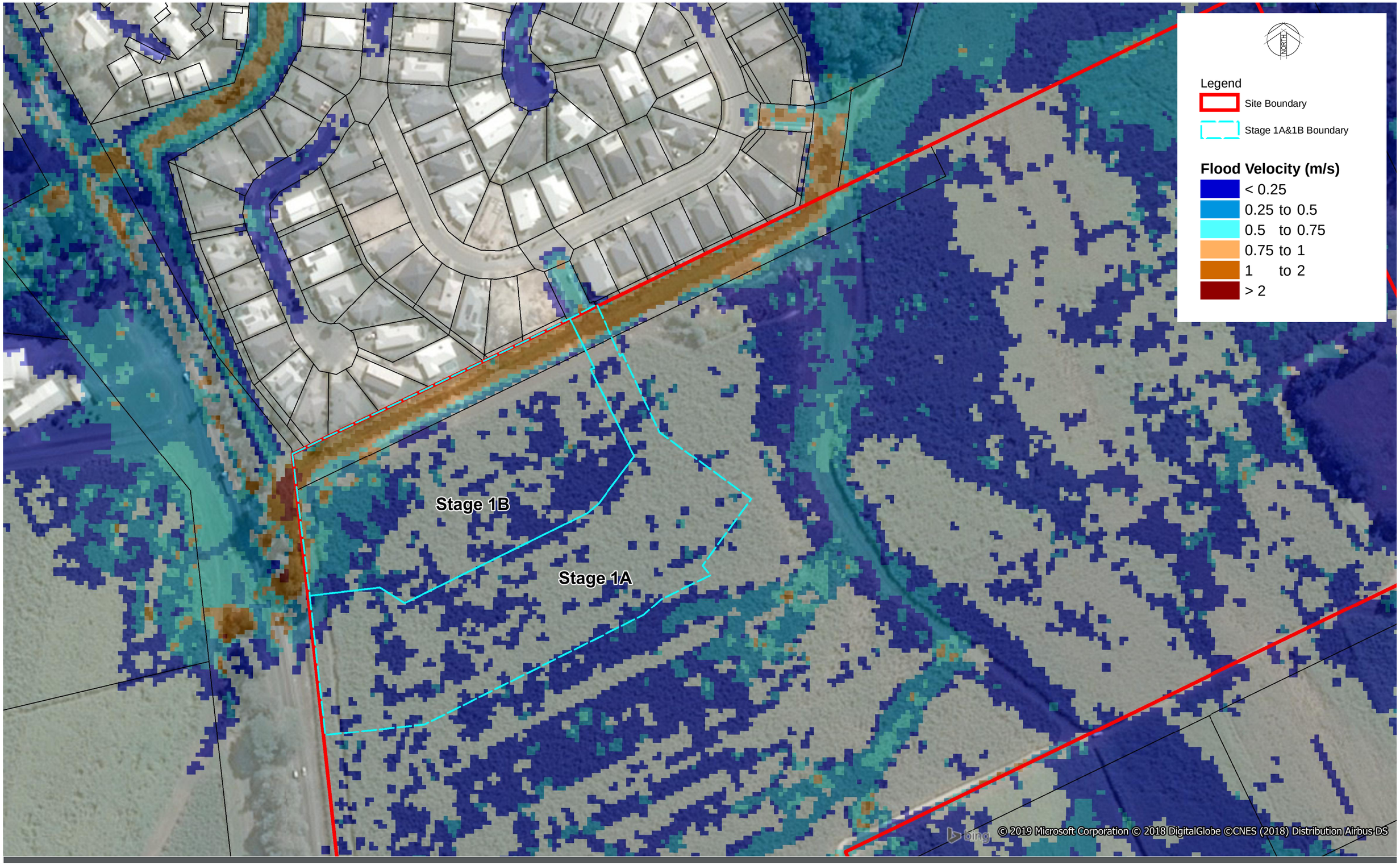
APPENDIX A.3.1
EXISTING - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppA.1_PortDouglas



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Date
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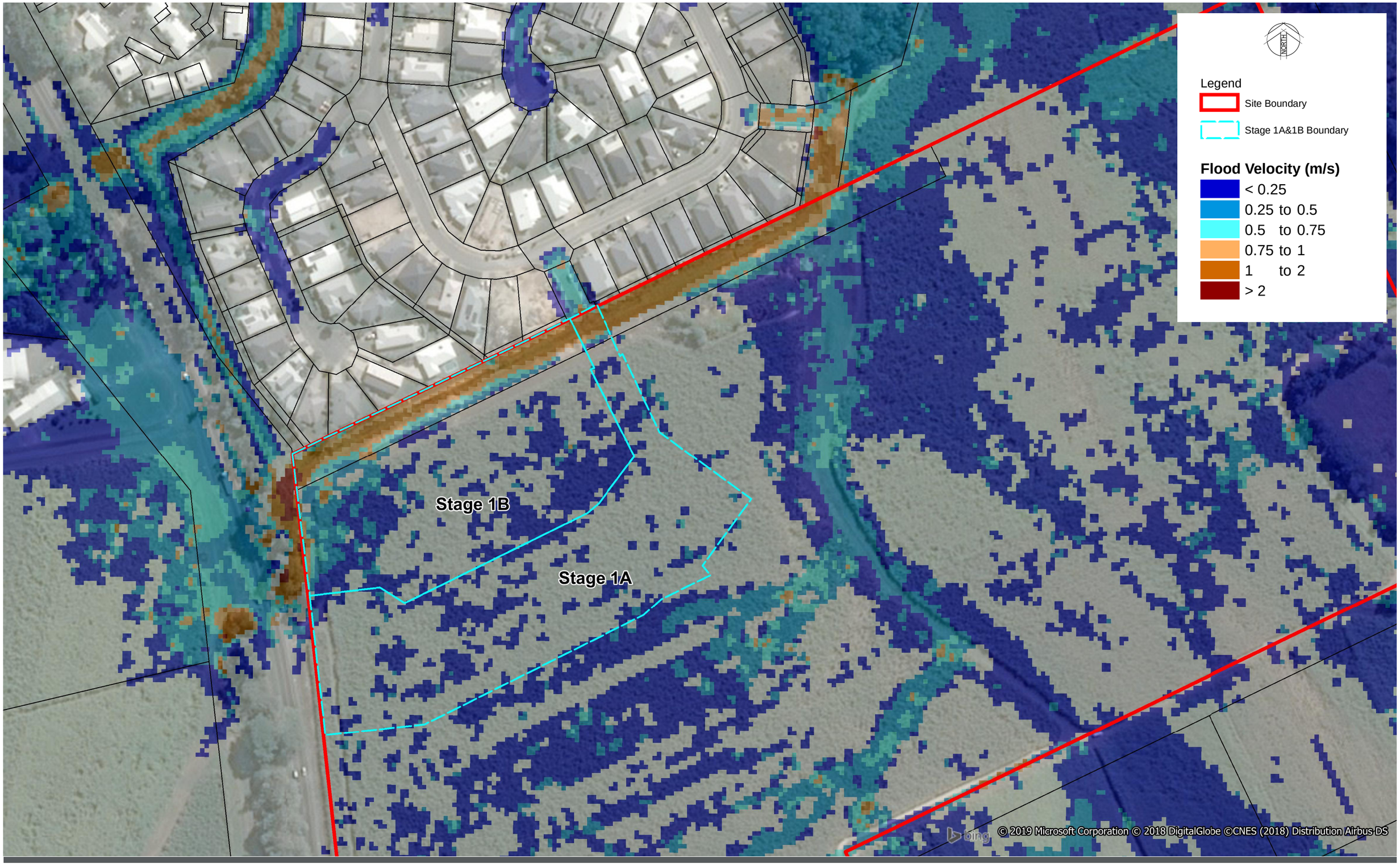
APPENDIX A.3.2
EXISTING - 1% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppA.2_PortDouglas



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Level 11, North Tower, 515 St Pauls Terrace
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Date
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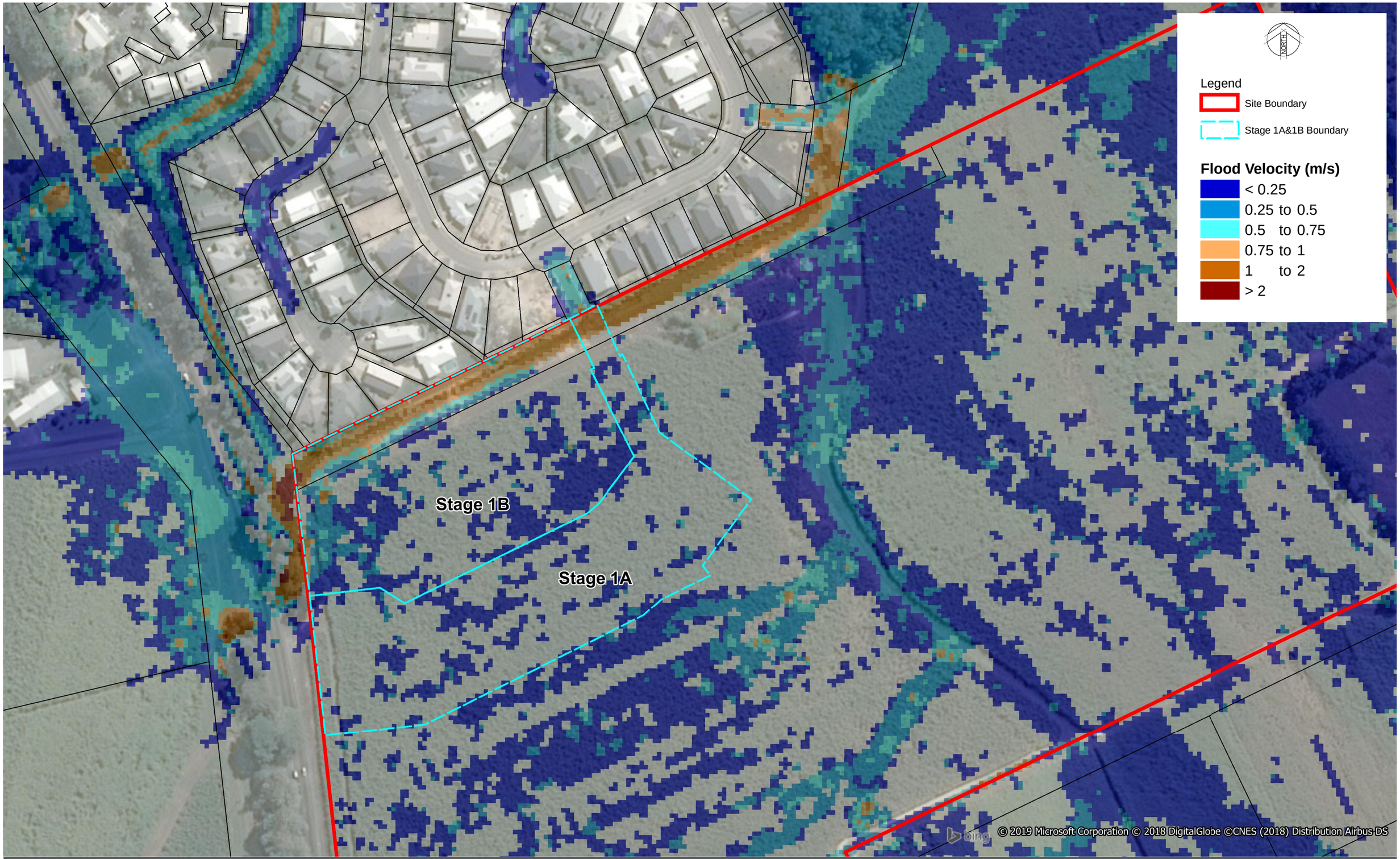
APPENDIX A.3.3
EXISTING - 2% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppA.3_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
Size
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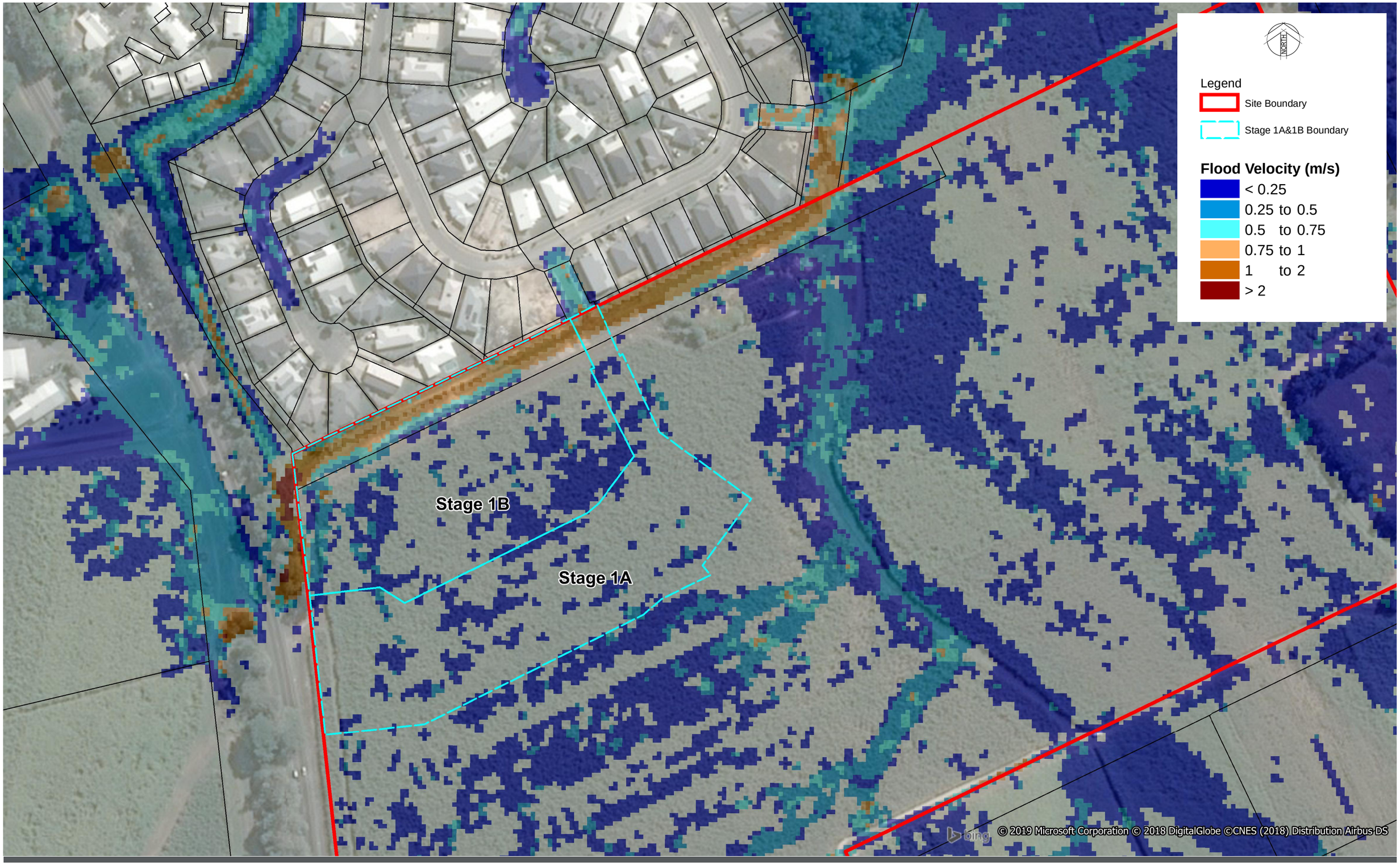
APPENDIX A.3.4
EXISTING - 5% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppA.4_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
Size
A3
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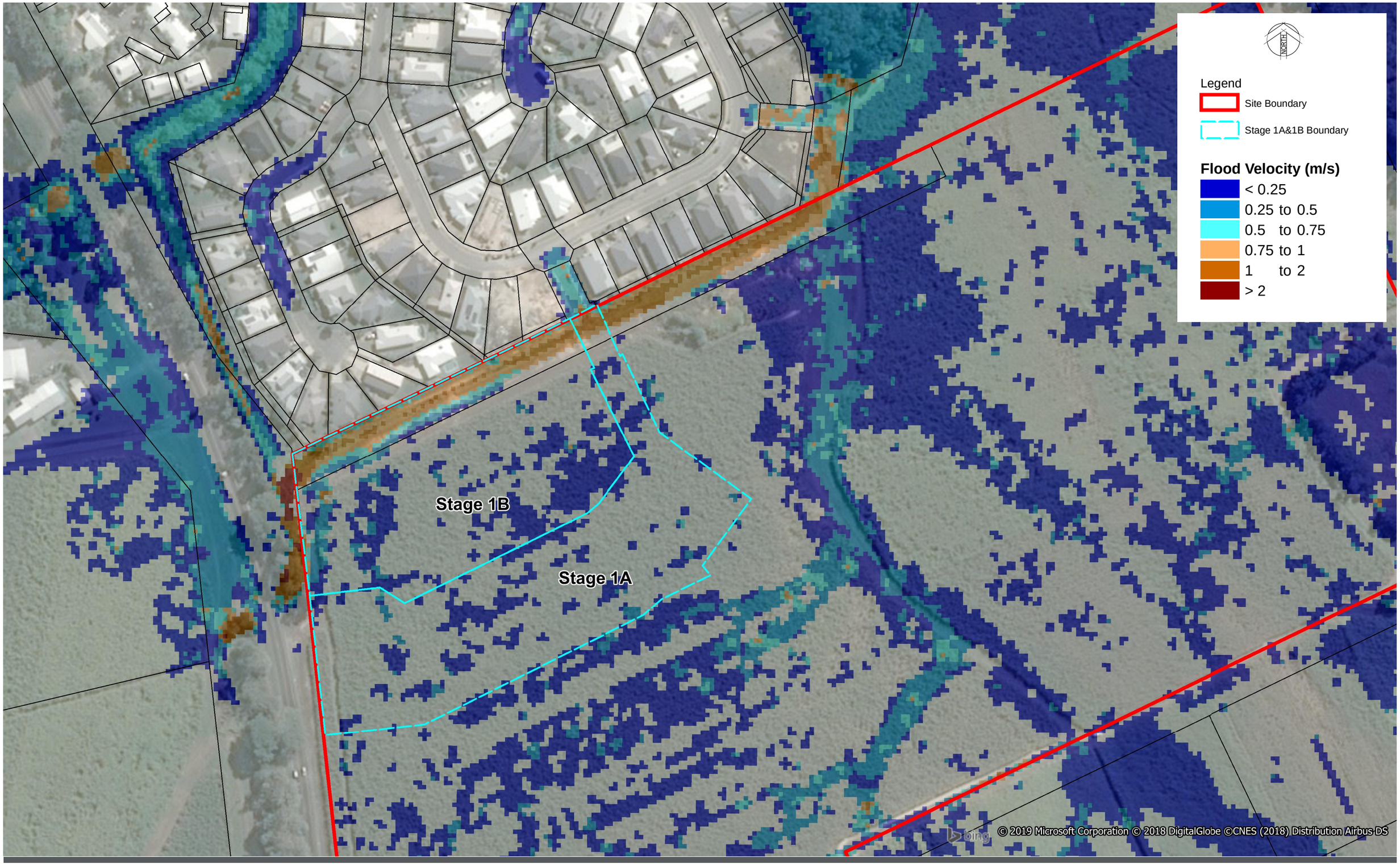
APPENDIX A.3.5
EXISTING - 10% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppA.4_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
Size
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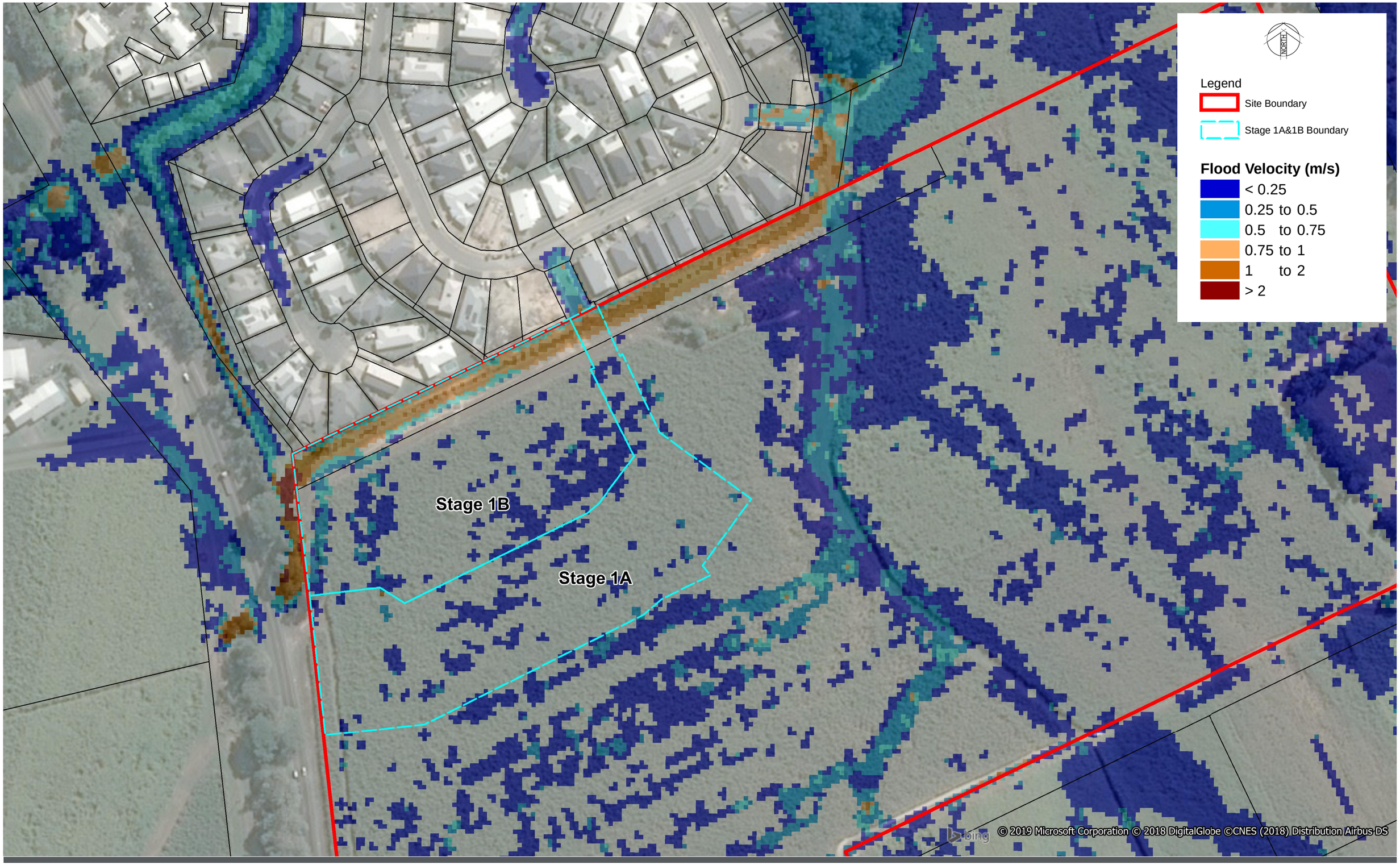
APPENDIX A.3.6
EXISTING - 20% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment
Port Douglas Estate
AppA.6_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
16/01/2019
Size
A3
Scale
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APPENDIX A.3.7
EXISTING - 50% AEP EVENT - PEAK FLOOD VELOCITY

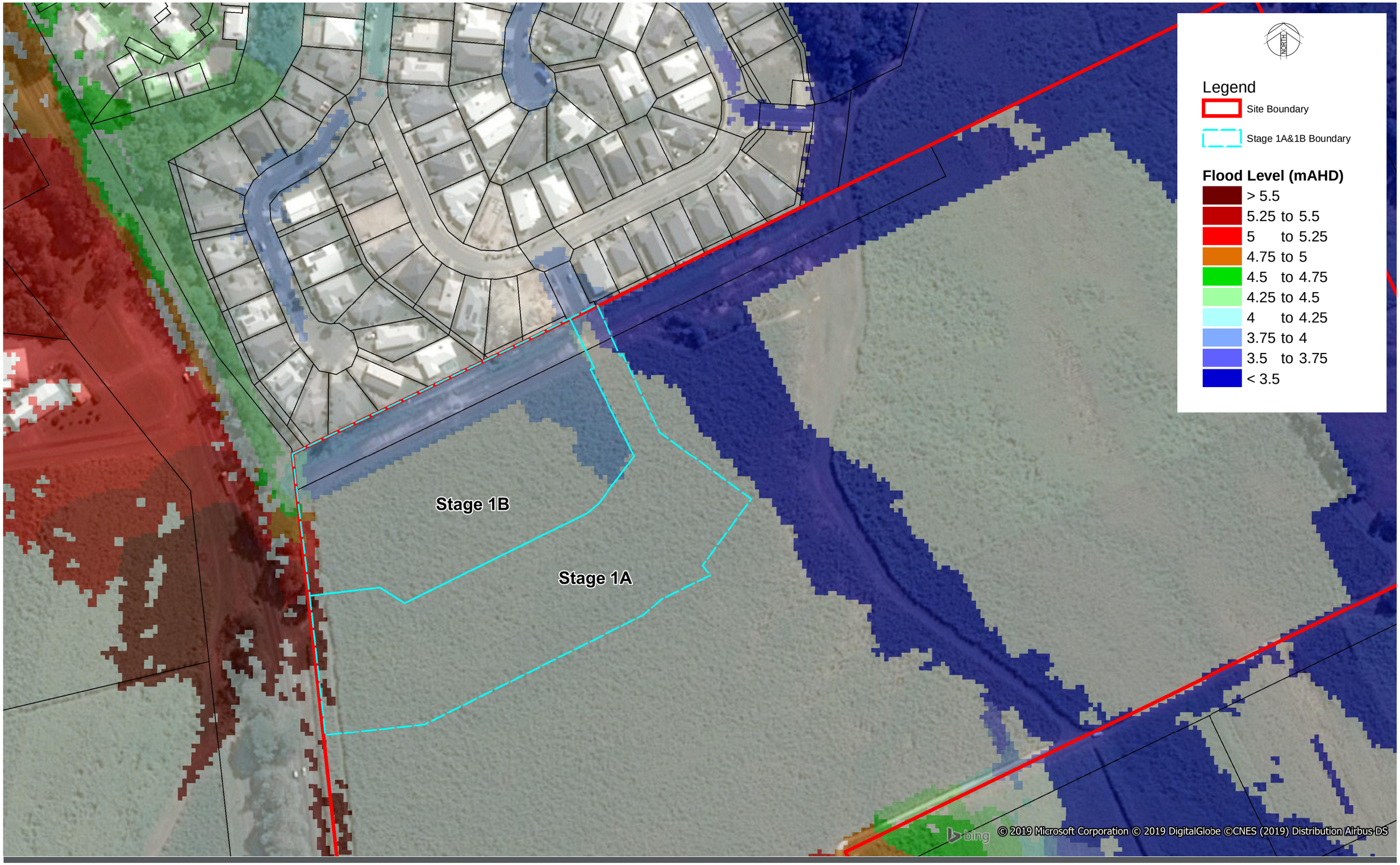
Flood Impact Assessment

Port Douglas Estate

AppA.7_PortDouglas

APPENDIX B

DEVELOPED FLOODING



Cardno

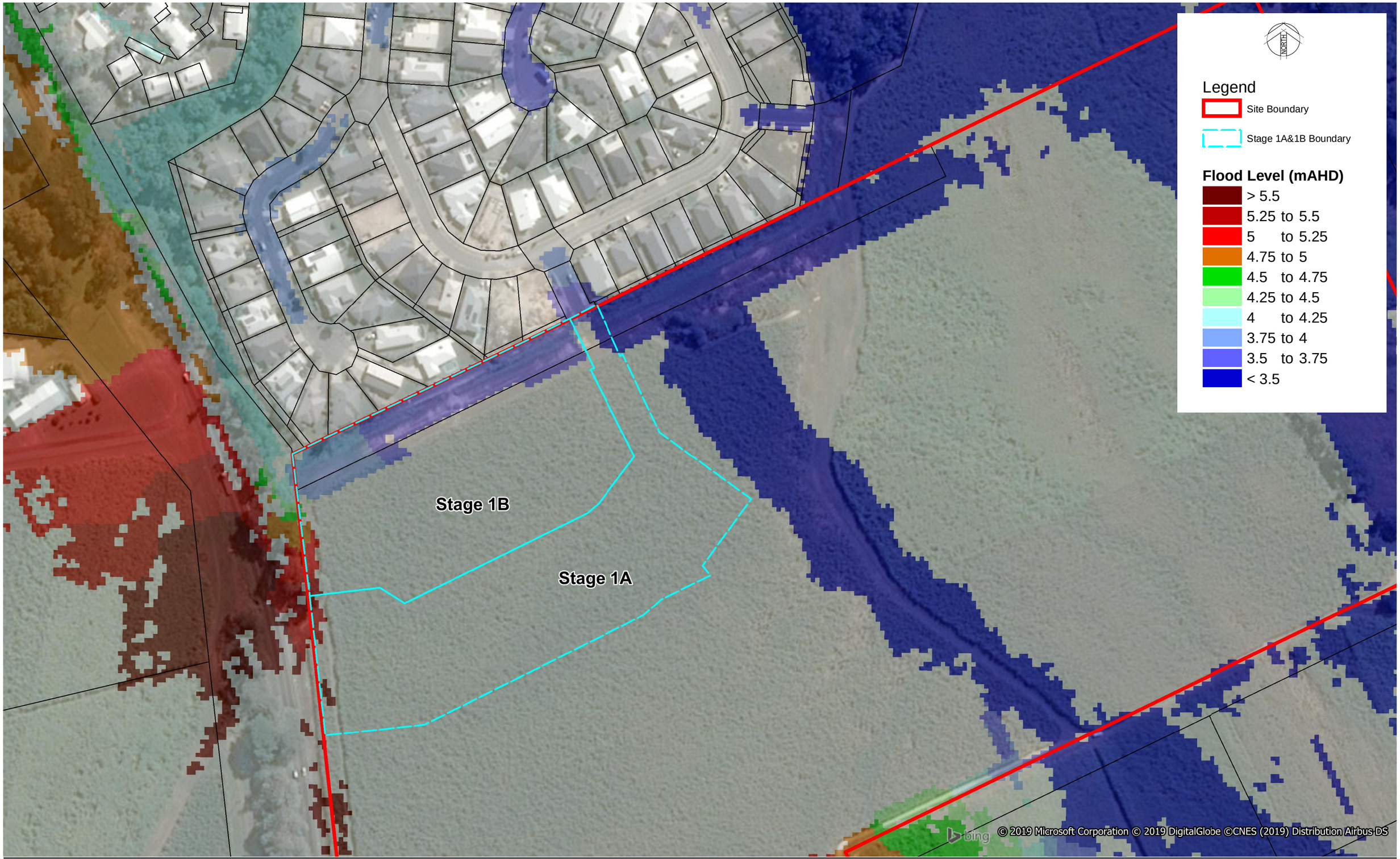
Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
1:2,000

0 80
metres

APPENDIX B.1.1
DEVELOPED - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.1_PortDouglas



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Tel. 07 3369 9822

Date
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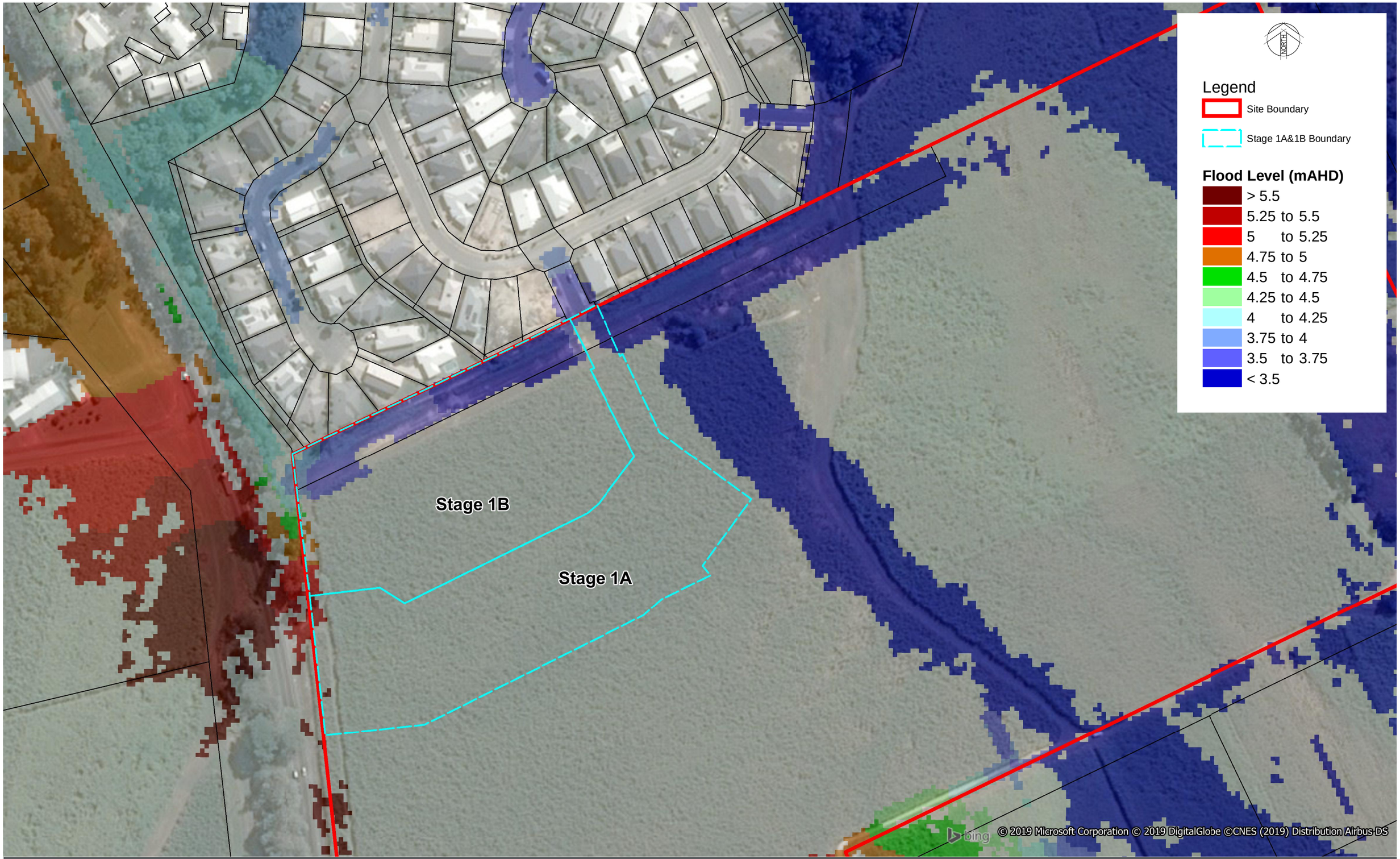
APPENDIX B.1.2
DEVELOPED - 1% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.2_PortDouglas



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Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
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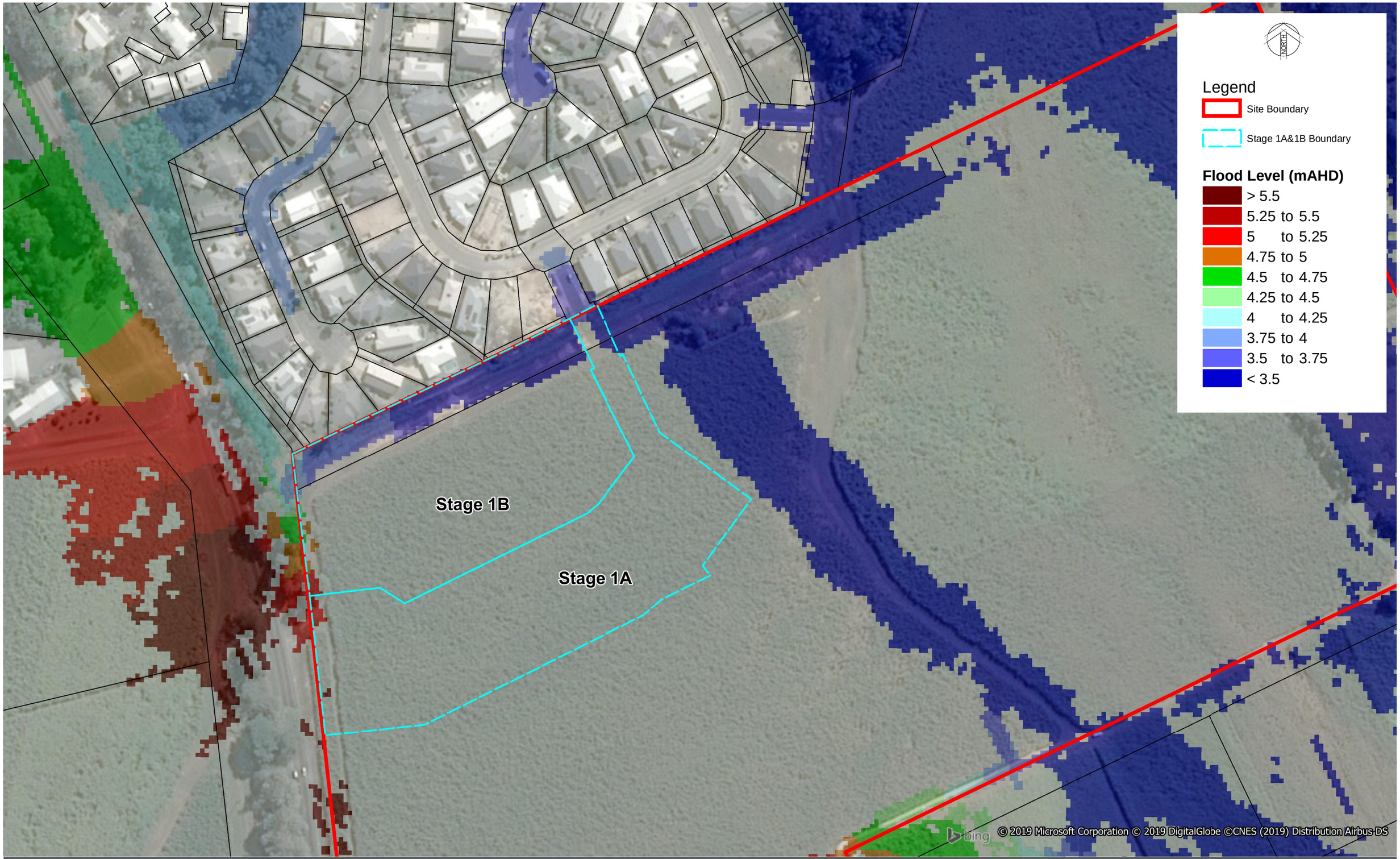
metres

APPENDIX B.1.3
DEVELOPED - 2% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.3_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
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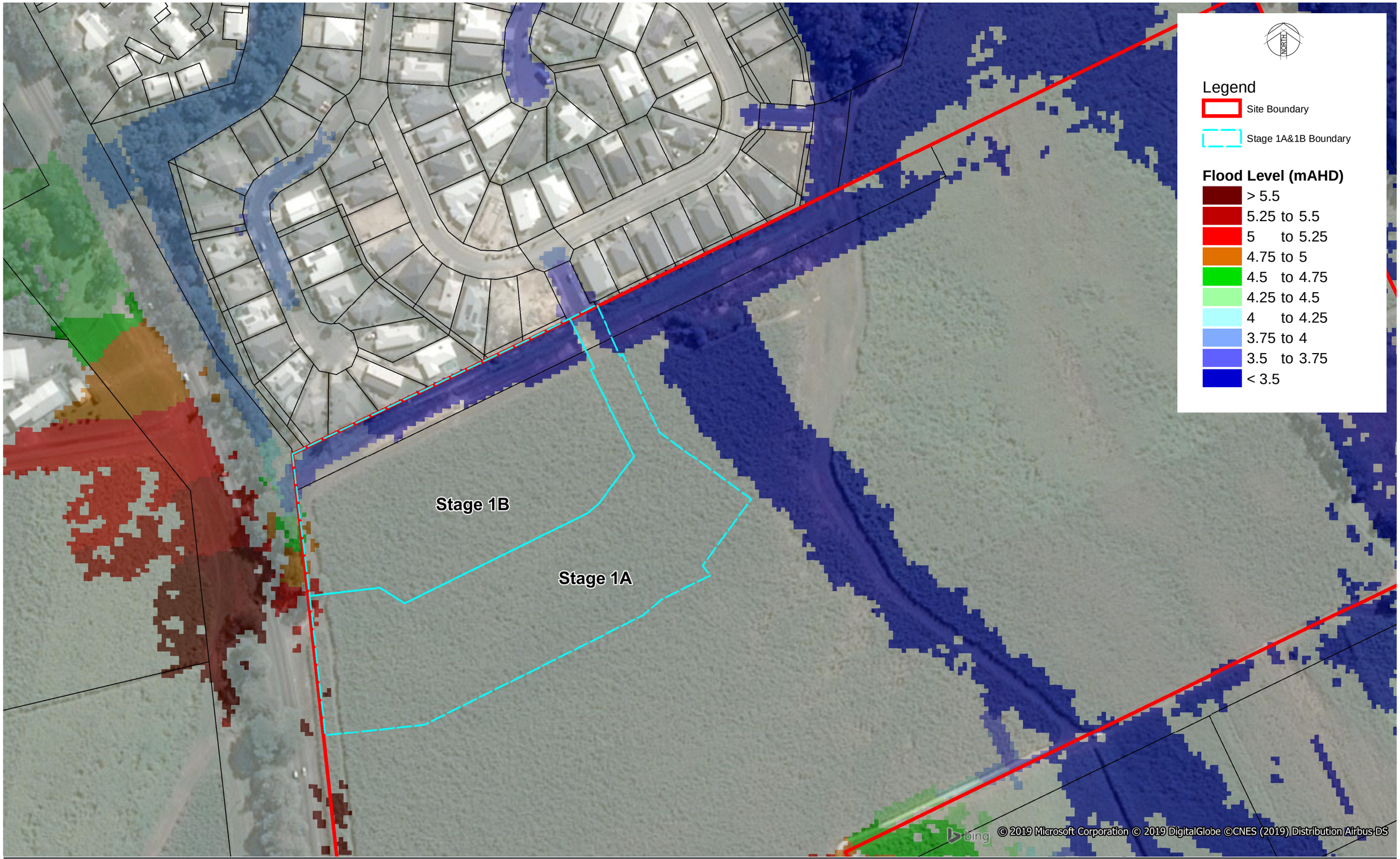
metres

APPENDIX B.1.4
DEVELOPED - 5% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.4_PortDouglas



Cardno

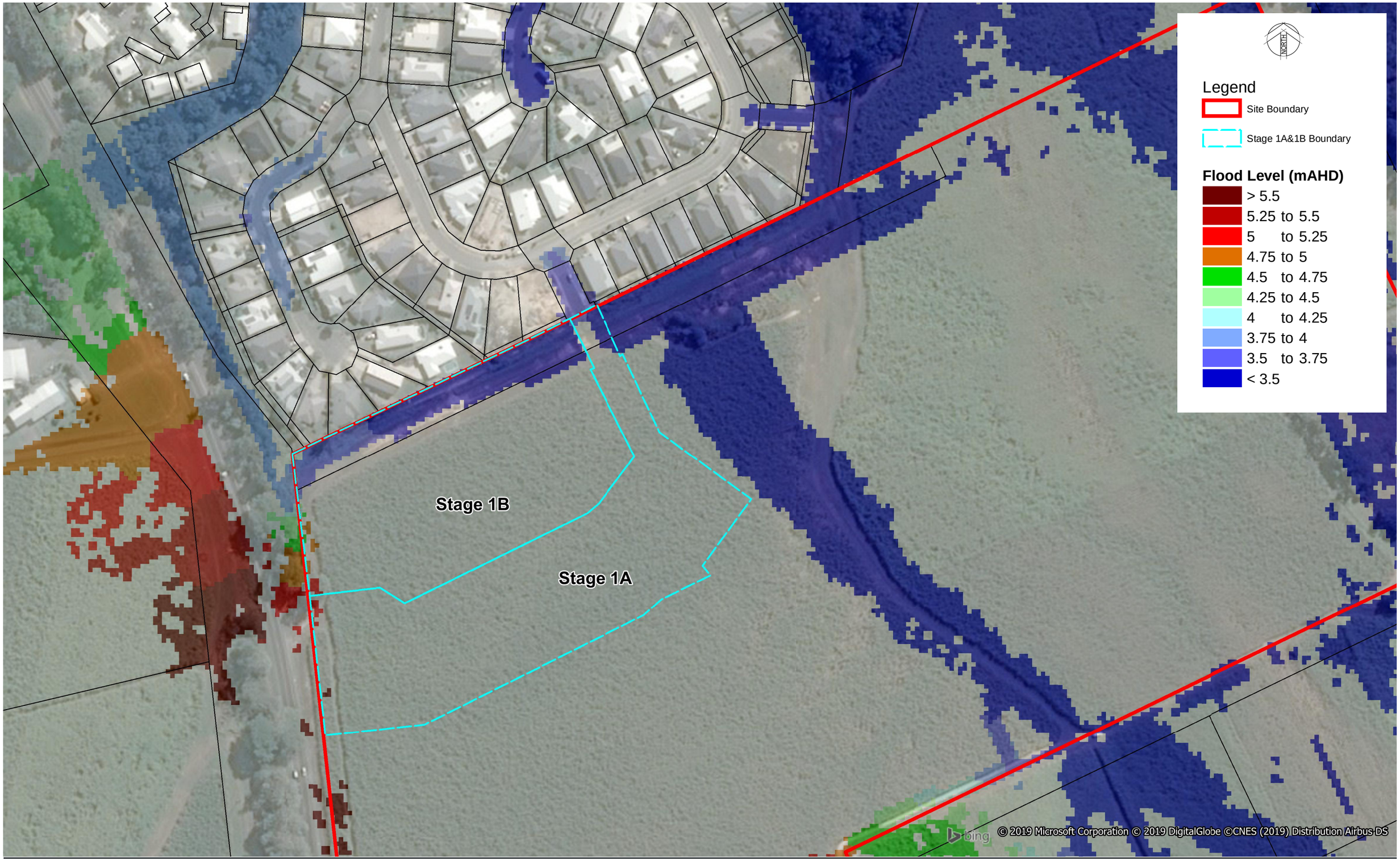
Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
1:2,000

0 80
metres

APPENDIX B.1.5
DEVELOPED - 10% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.4_PortDouglas



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Date
26/02/2019
Size
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Scale
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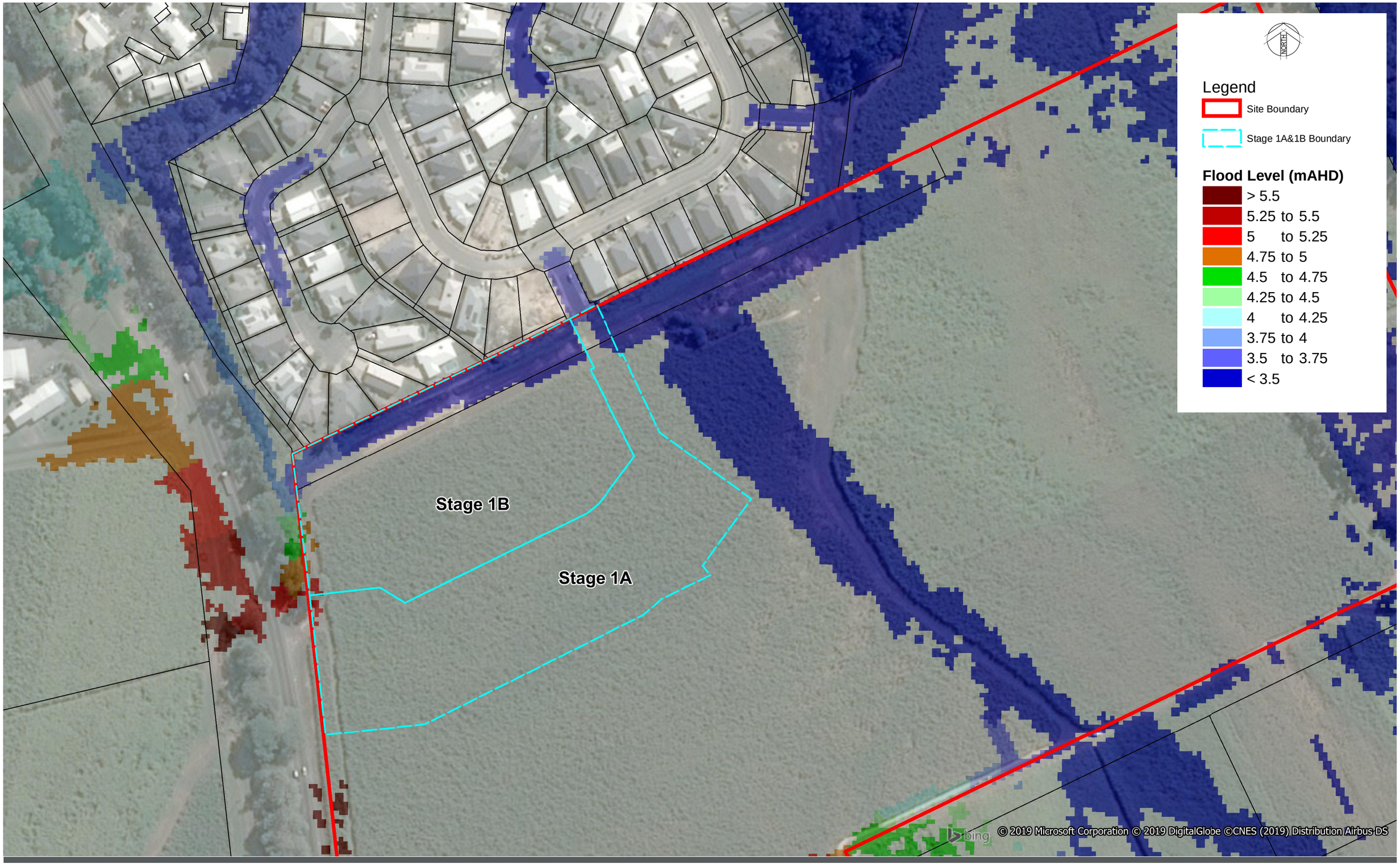
metres

APPENDIX B.1.6
DEVELOPED - 20% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.6_PortDouglas



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Tel. 07 3369 9822

Date
26/02/2019
Size
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Scale
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metres

APPENDIX B.1.7
DEVELOPED - 50% AEP EVENT - PEAK FLOOD LEVEL

Flood Impact Assessment
Port Douglas Estate
AppB.7_PortDouglas

Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
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Scale
1:2,000

0 80
metres

APPENDIX B.2.1
DEVELOPED - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.1_PortDouglas

Cardno

Level 11, North Tower, 515 St Pauls Terrace
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Date
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Size
A3
Scale
1:2,000

0 80
metres

APPENDIX B.2.2
DEVELOPED - 1% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.2_PortDouglas

Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
1:2,000

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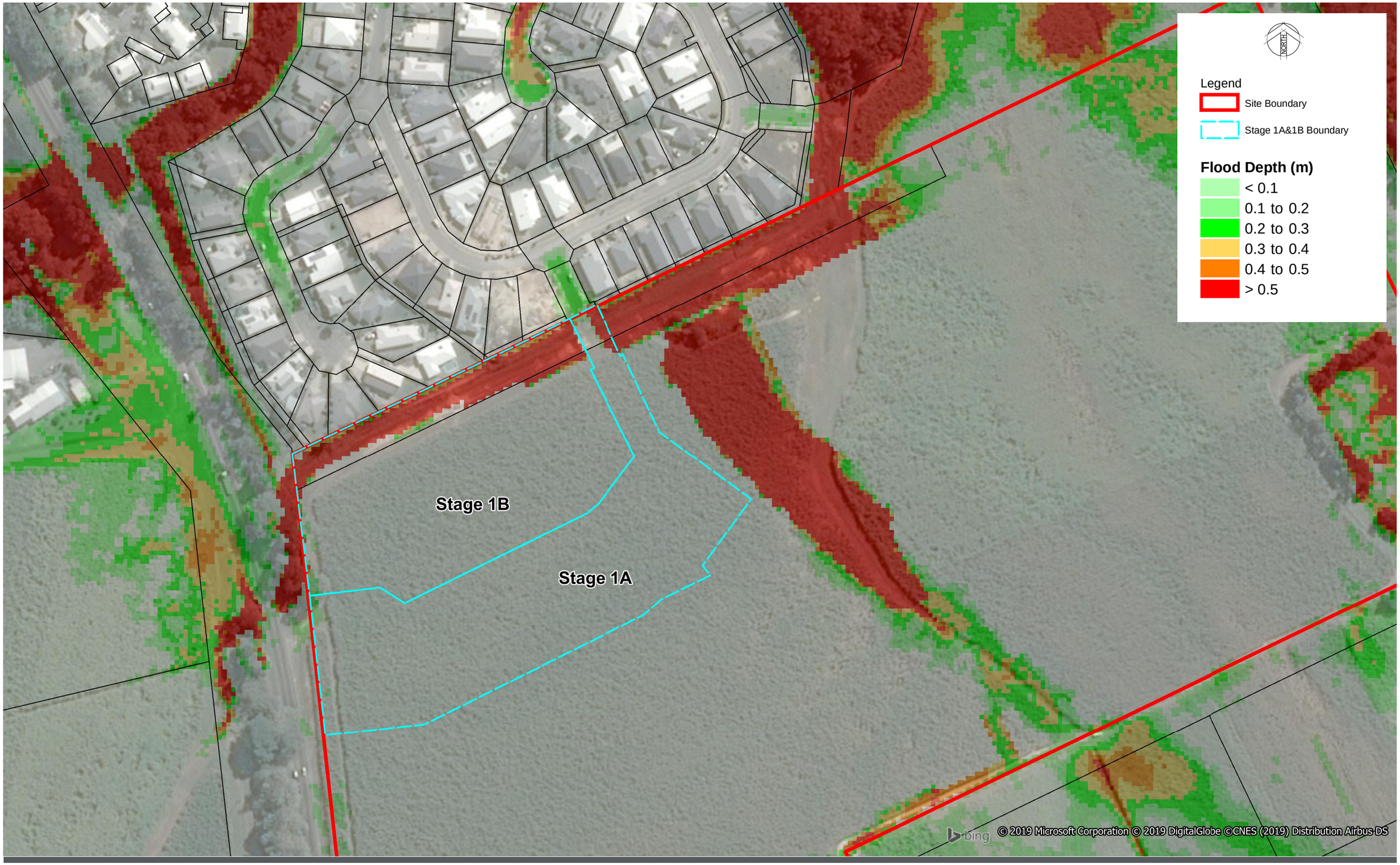
metres

APPENDIX B.2.3
DEVELOPED - 2% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.3_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
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Scale
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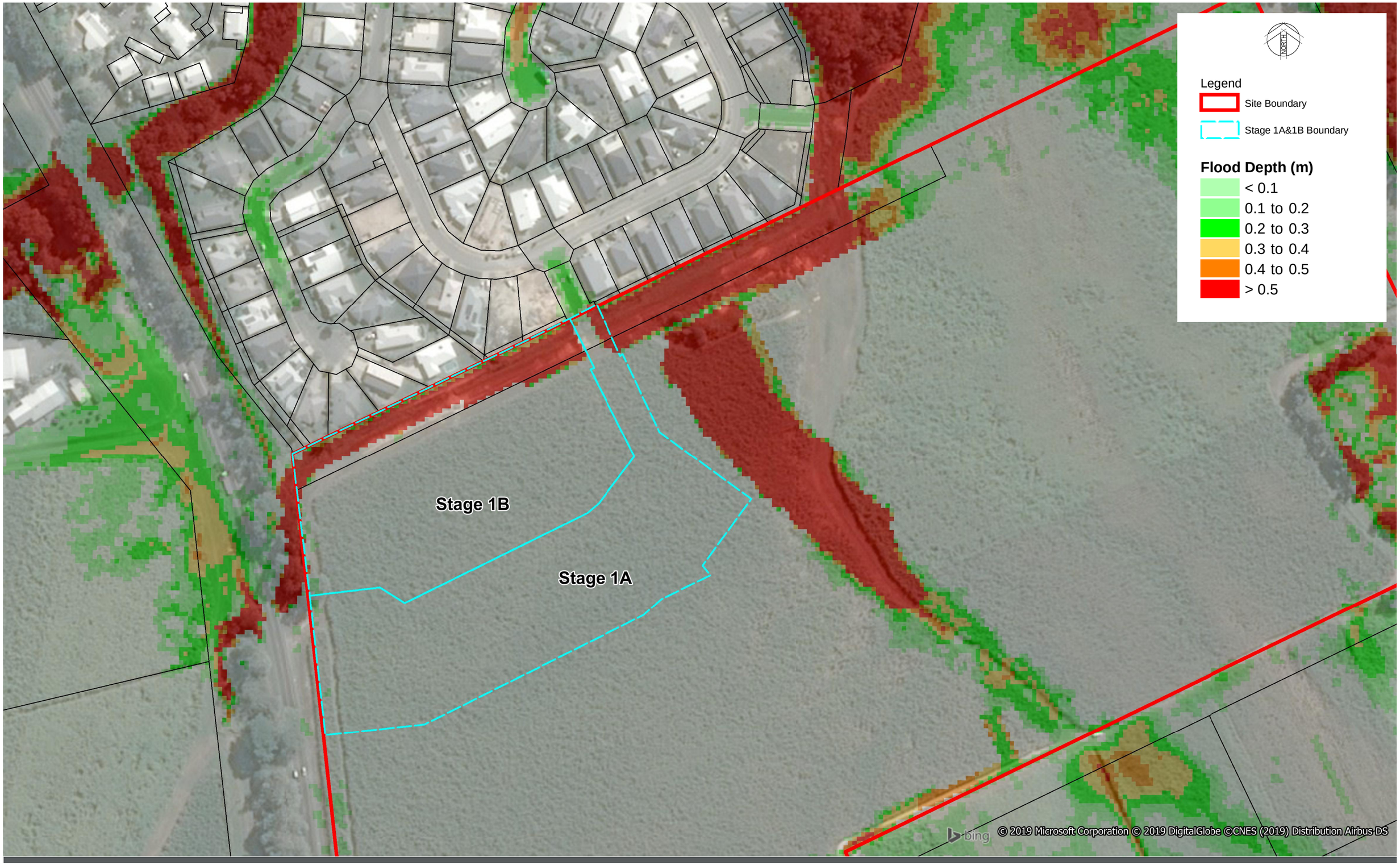
metres

APPENDIX B.2.4
DEVELOPED - 5% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.4_PortDouglas



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Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
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Scale
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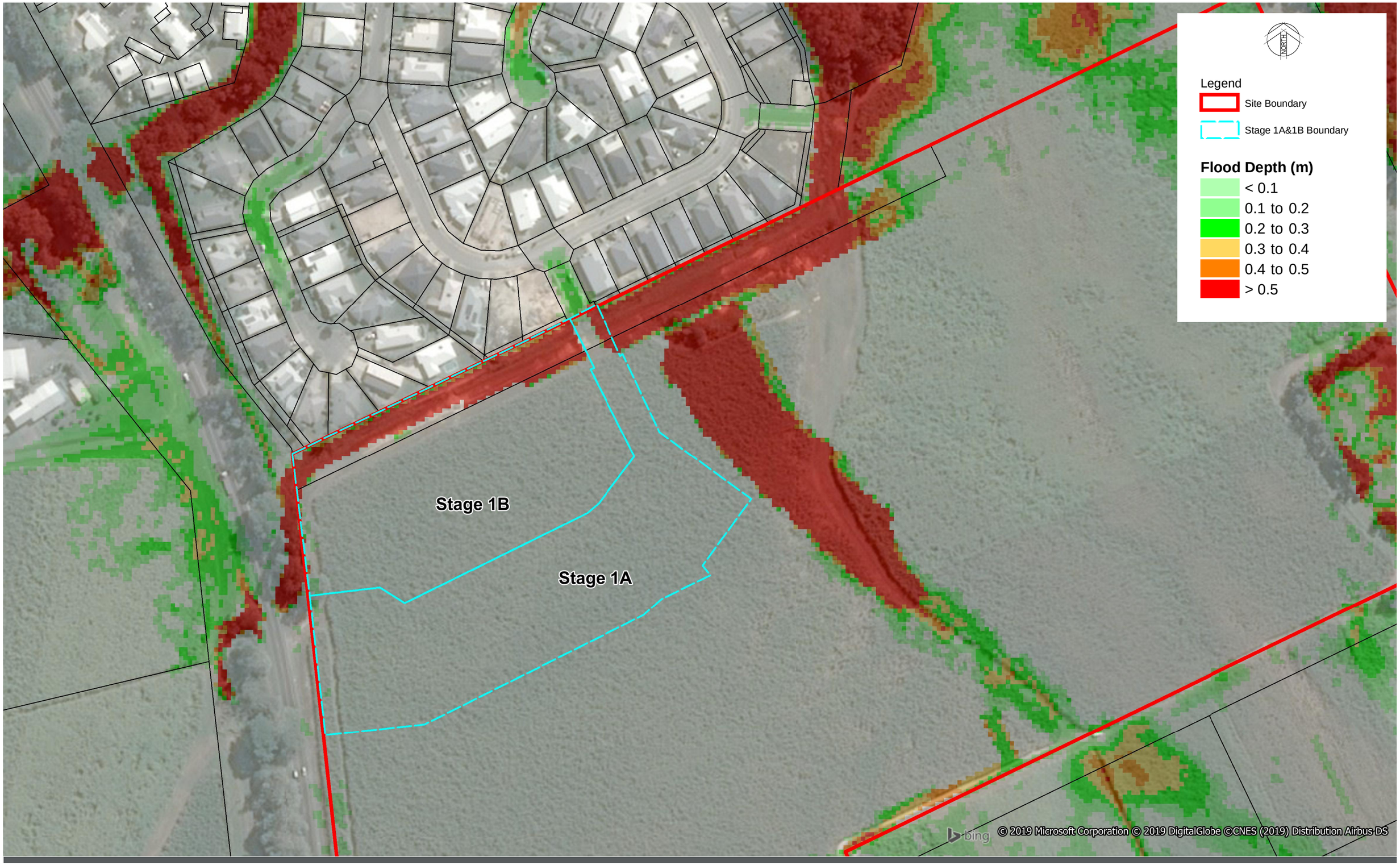
metres

APPENDIX B.2.5
DEVELOPED - 10% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.4_PortDouglas



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Date
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Size
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Scale
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metres

APPENDIX B.2.6
DEVELOPED - 20% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.6_PortDouglas

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Date
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Size
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Scale
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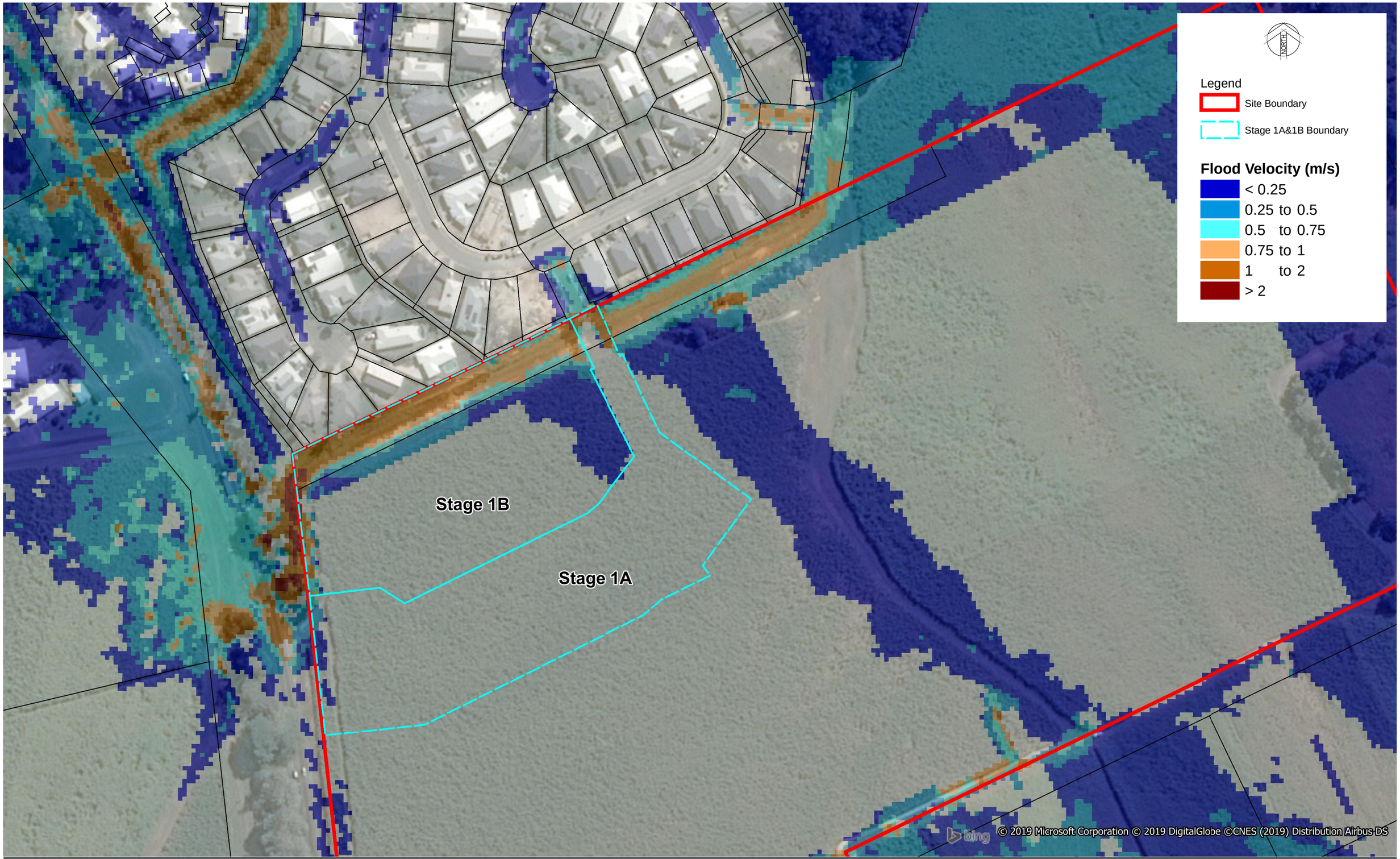
APPENDIX B.2.7
DEVELOPED - 50% AEP EVENT - PEAK FLOOD DEPTH

Flood Impact Assessment
Port Douglas Estate
AppB.7_PortDouglas



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26/02/2019
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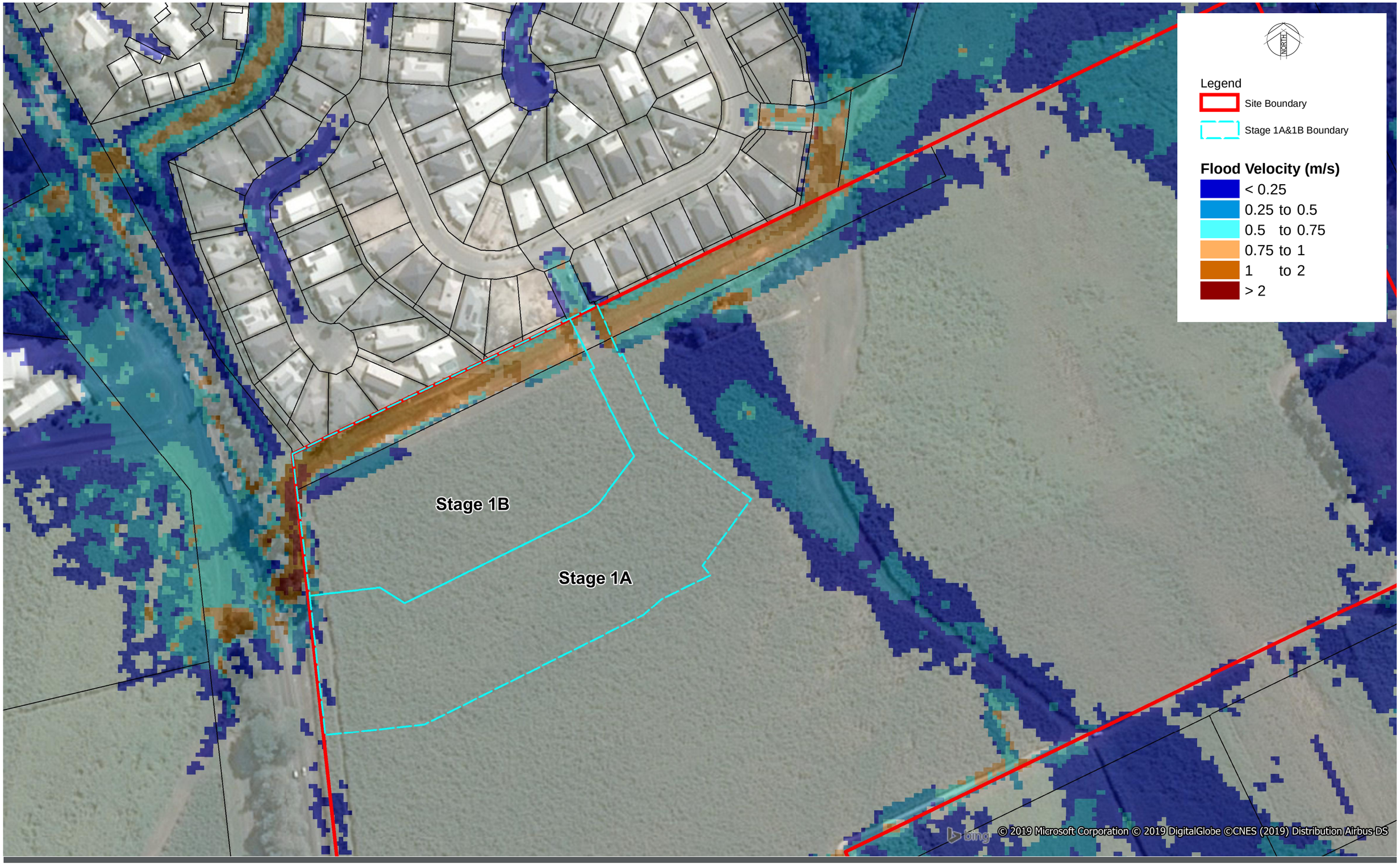
APPENDIX B.3.1
DEVELOPED - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppB.1_PortDouglas



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Date
26/02/2019
Size
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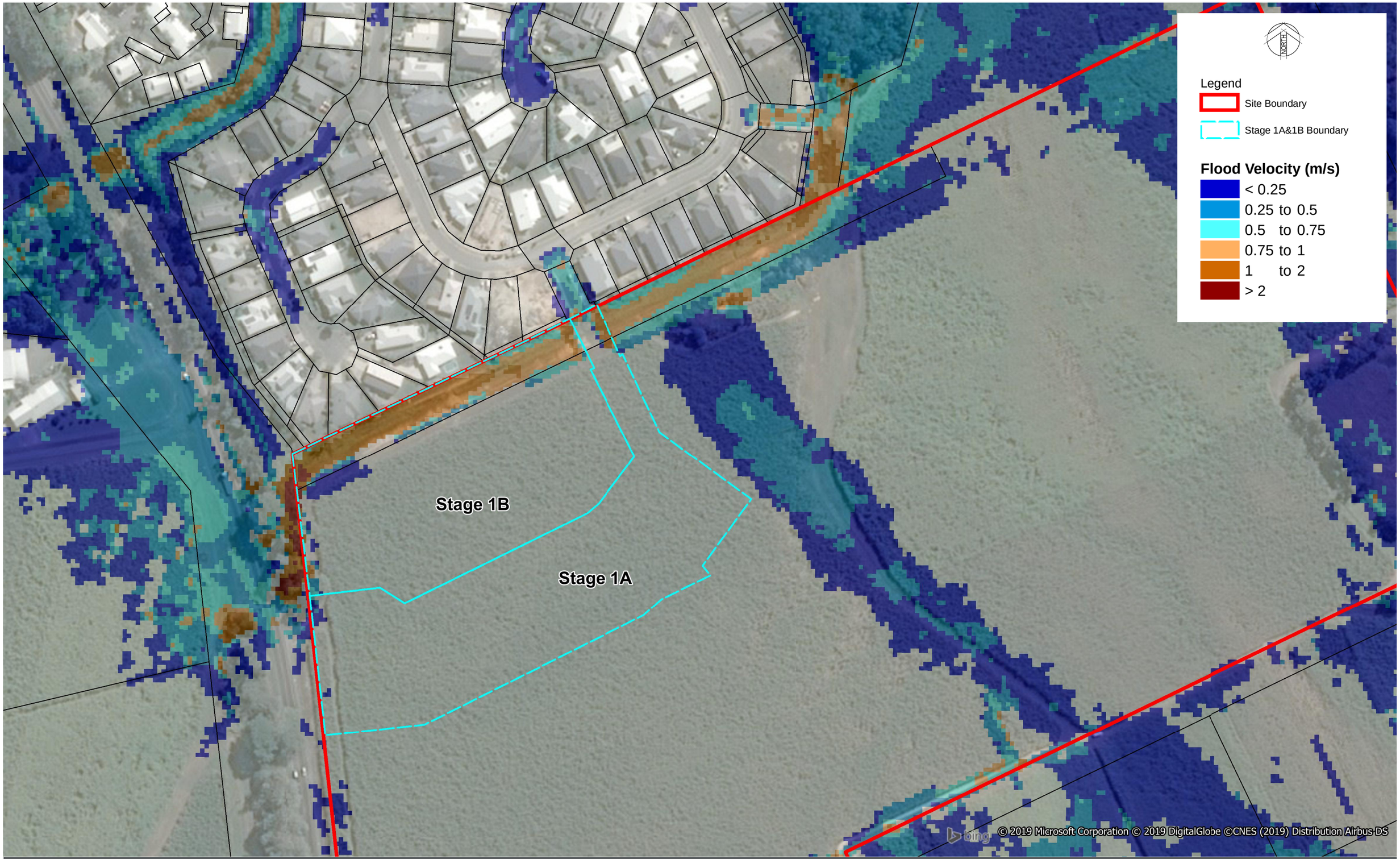
APPENDIX B.3.2
DEVELOPED - 1% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppB.2_PortDouglas



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Date
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Size
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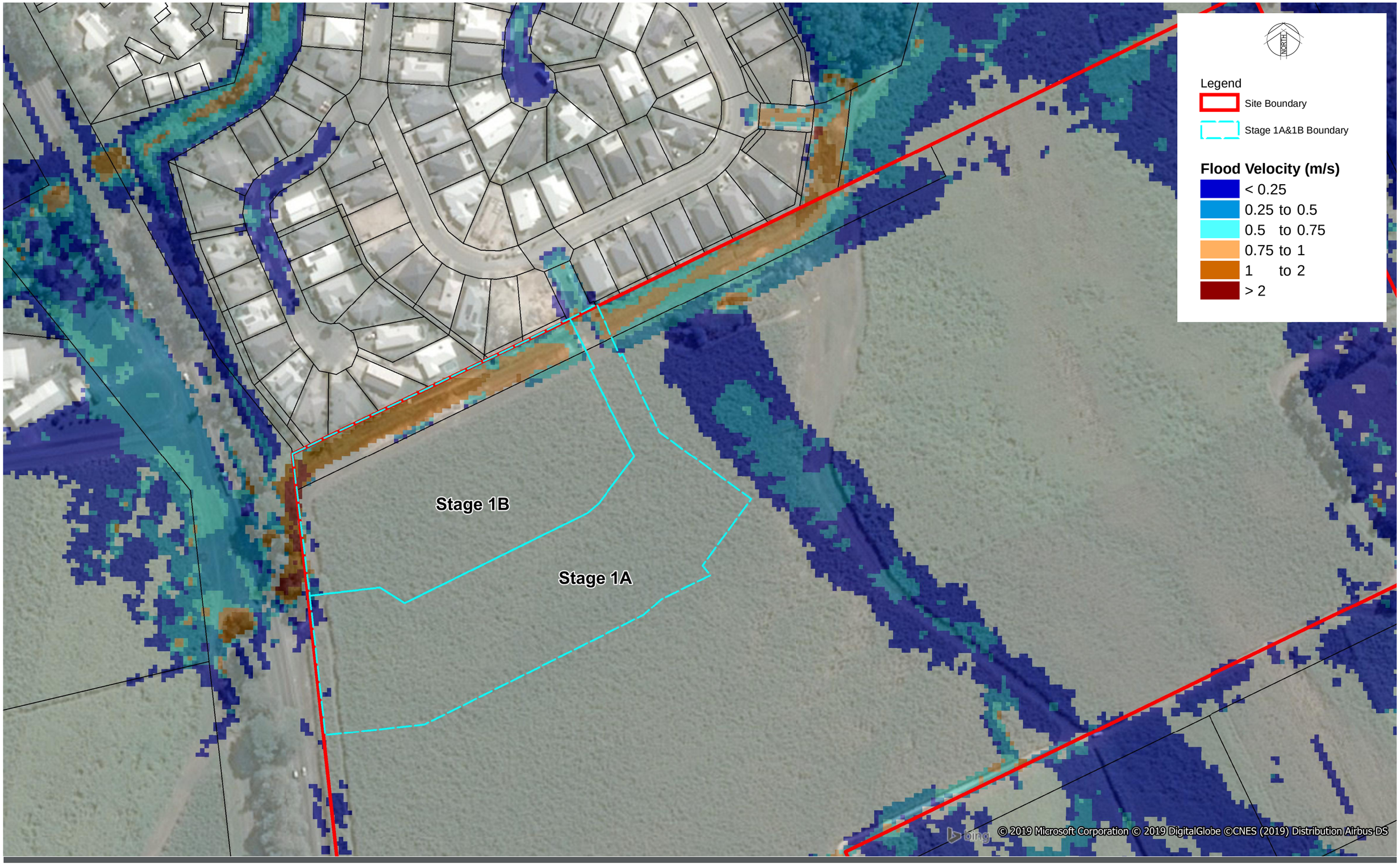
APPENDIX B.3.3
DEVELOPED - 2% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment
Port Douglas Estate
AppB.3_PortDouglas



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Tel. 07 3369 9822

Date
26/02/2019
Size
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Scale
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APPENDIX B.3.4
DEVELOPED - 5% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment
Port Douglas Estate
AppB.4_PortDouglas

Cardno

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Date
26/02/2019
Size
A3
Scale
1:2,000

APPENDIX B.3.5
DEVELOPED - 10% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppB.4_PortDouglas

Cardno

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Tel. 07 3369 9822

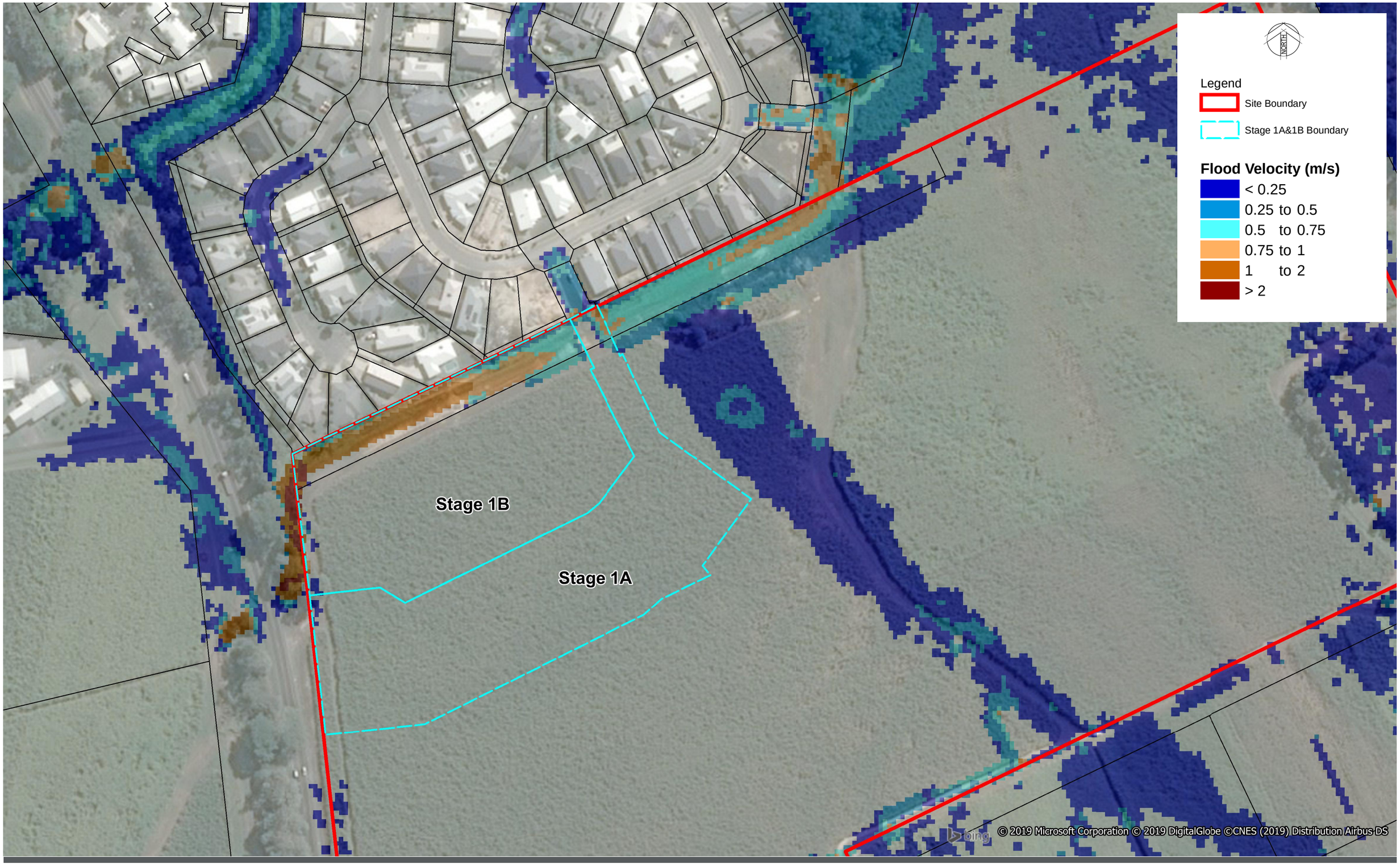
Date
26/02/2019
Size
A3
Scale
1:2,000

APPENDIX B.3.6
DEVELOPED - 20% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment

Port Douglas Estate

AppB.6_PortDouglas



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Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
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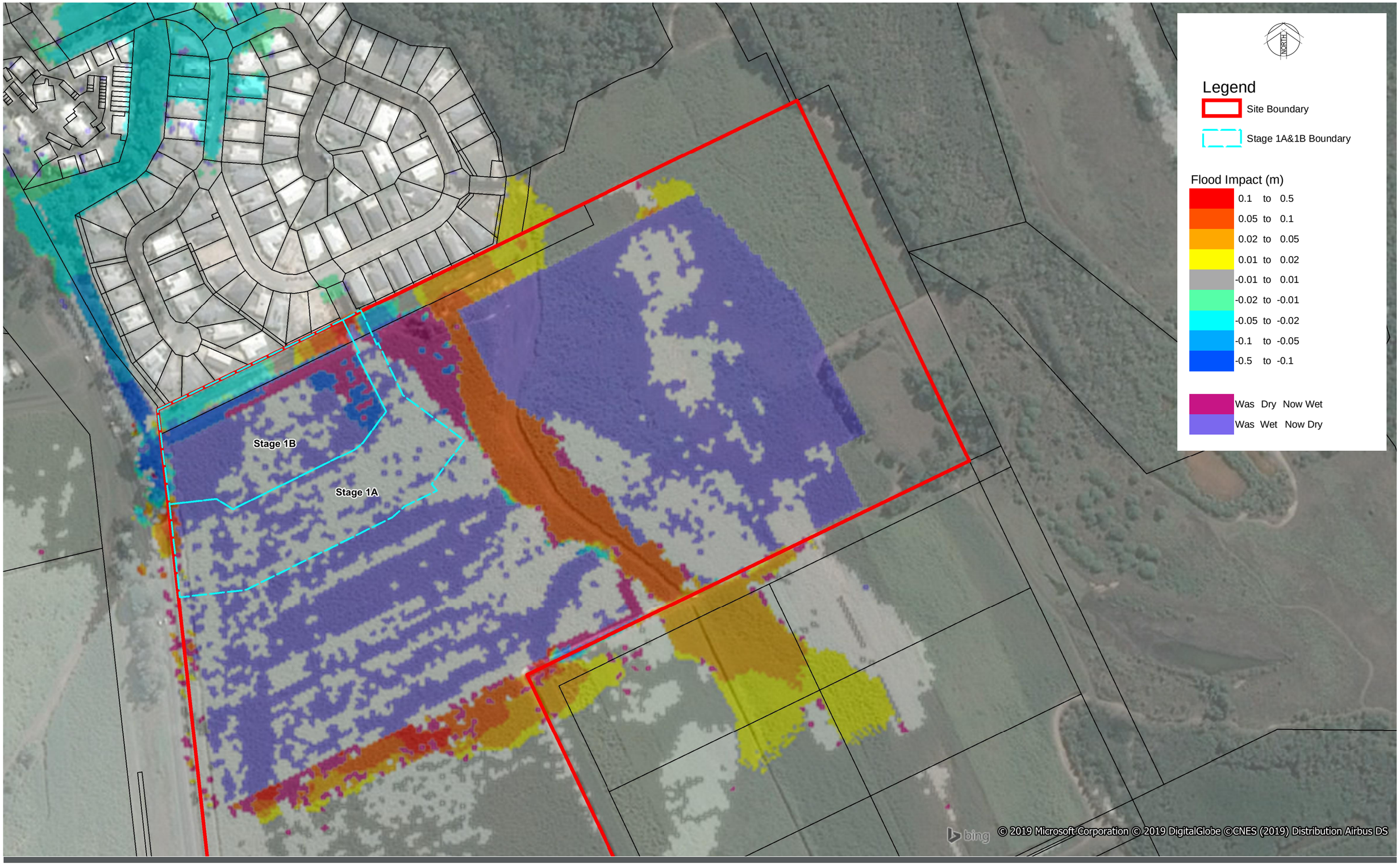
Scale
1:2,000

APPENDIX B.3.7
DEVELOPED - 50% AEP EVENT - PEAK FLOOD VELOCITY

Flood Impact Assessment
Port Douglas Estate
AppB.7_PortDouglas

APPENDIX C

FLOODING IMPACT



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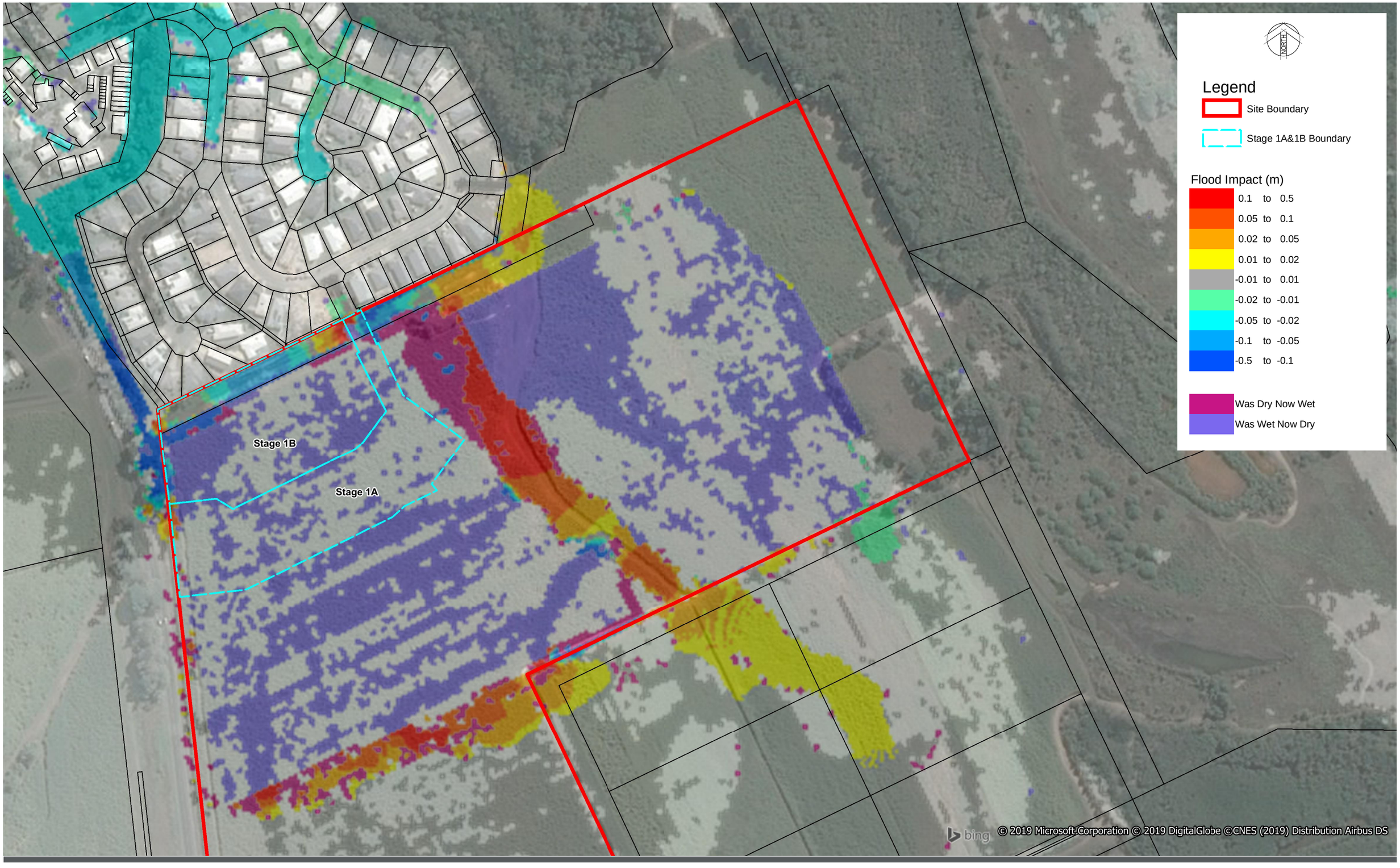
Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
1:3,000

0 120
metres

APPENDIX C.1
DEVELOPED - 1% AEP CLIMATE CHANGE EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



Cardno

Level 11, North Tower, 515 St Pauls Terrace
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Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
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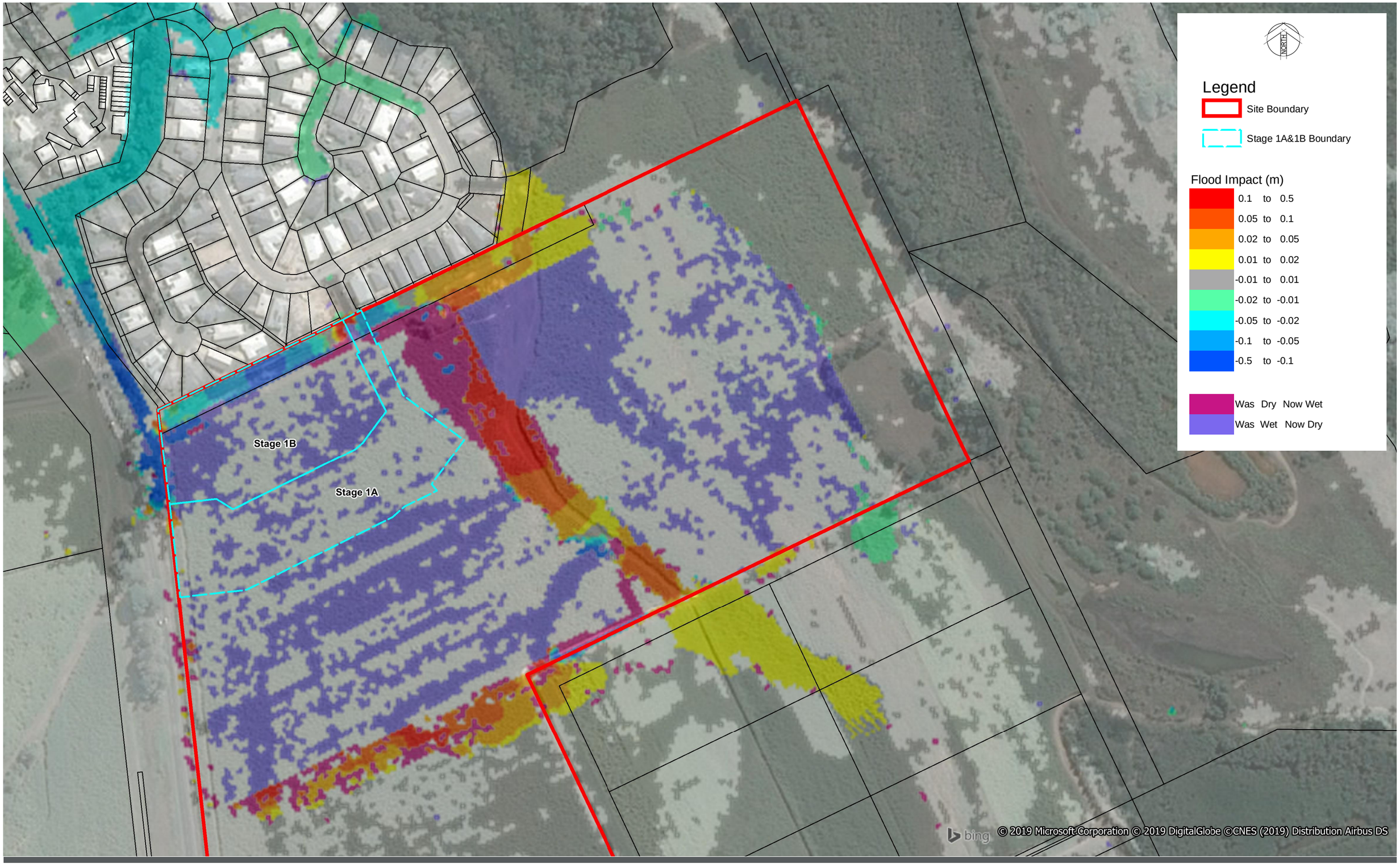
0 120
metres

APPENDIX C.2
DEVELOPED - 1% AEP EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



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Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
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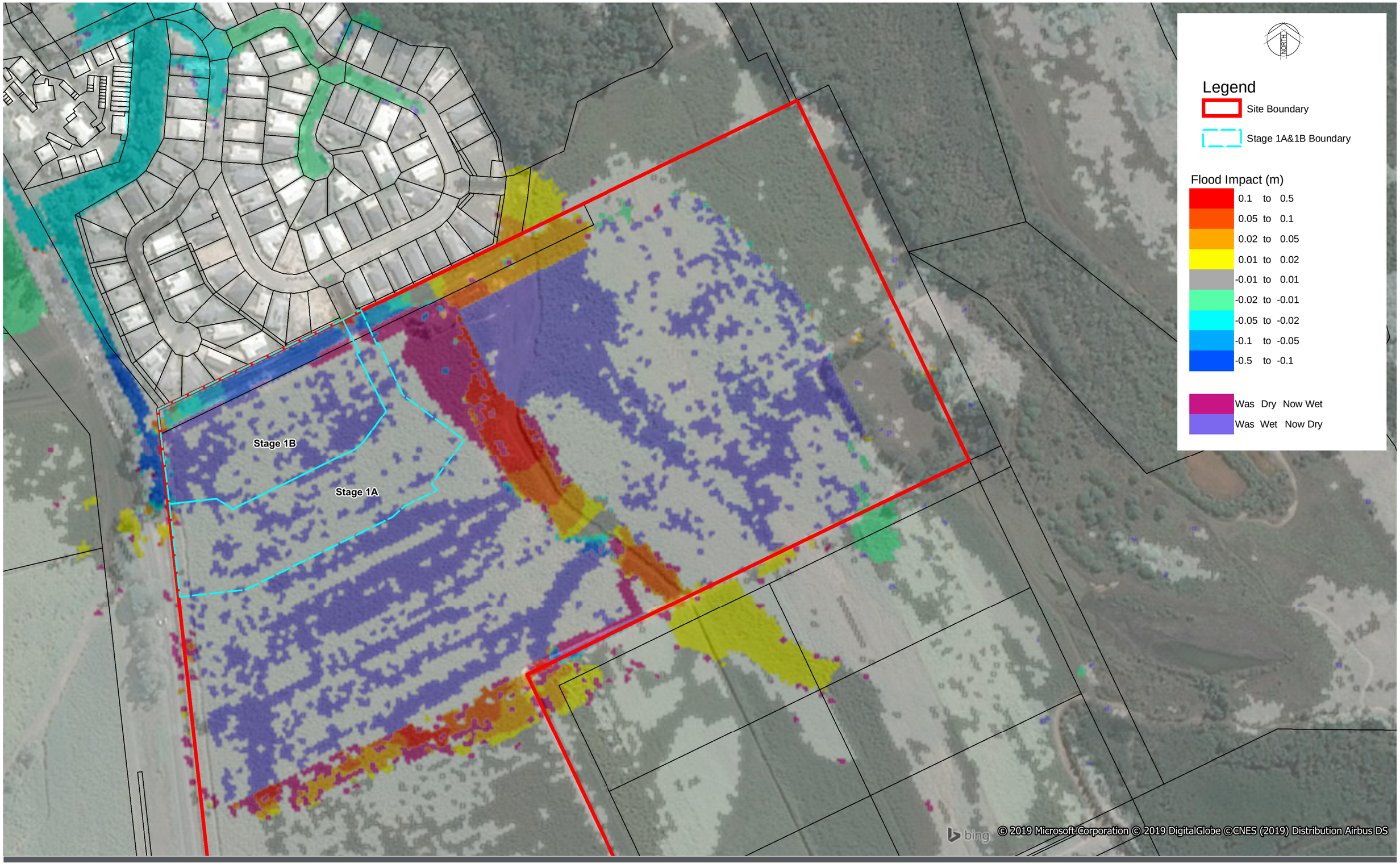
0 120
metres

APPENDIX C.3
DEVELOPED - 2% AEP EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



Cardno

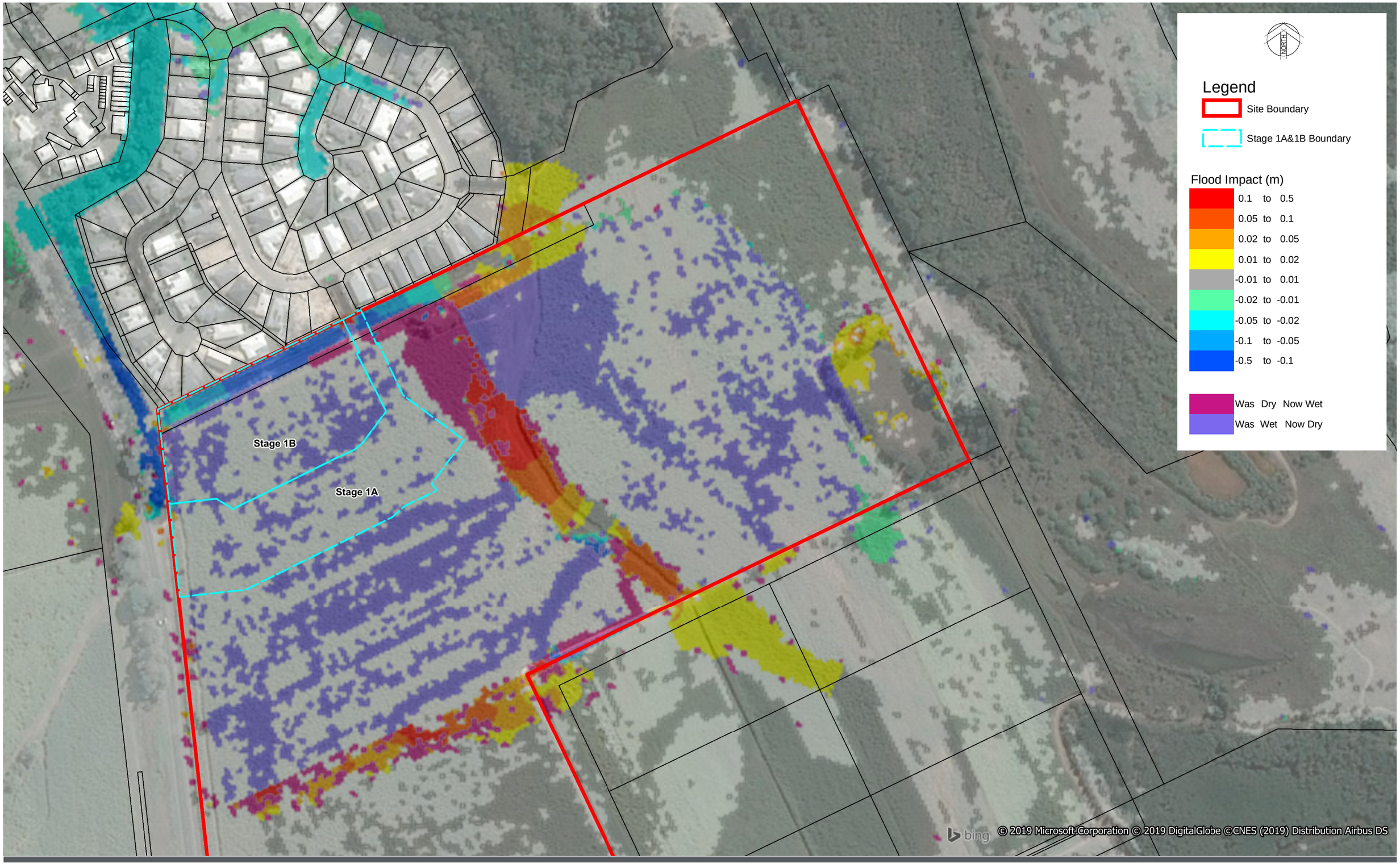
Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
1:3,000

0 120
metres

APPENDIX C.4
DEVELOPED - 5% AEP EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



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Level 11, North Tower, 515 St Pauls Terrace
Fortitude Valley QLD 4006
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Date
26/02/2019
Size
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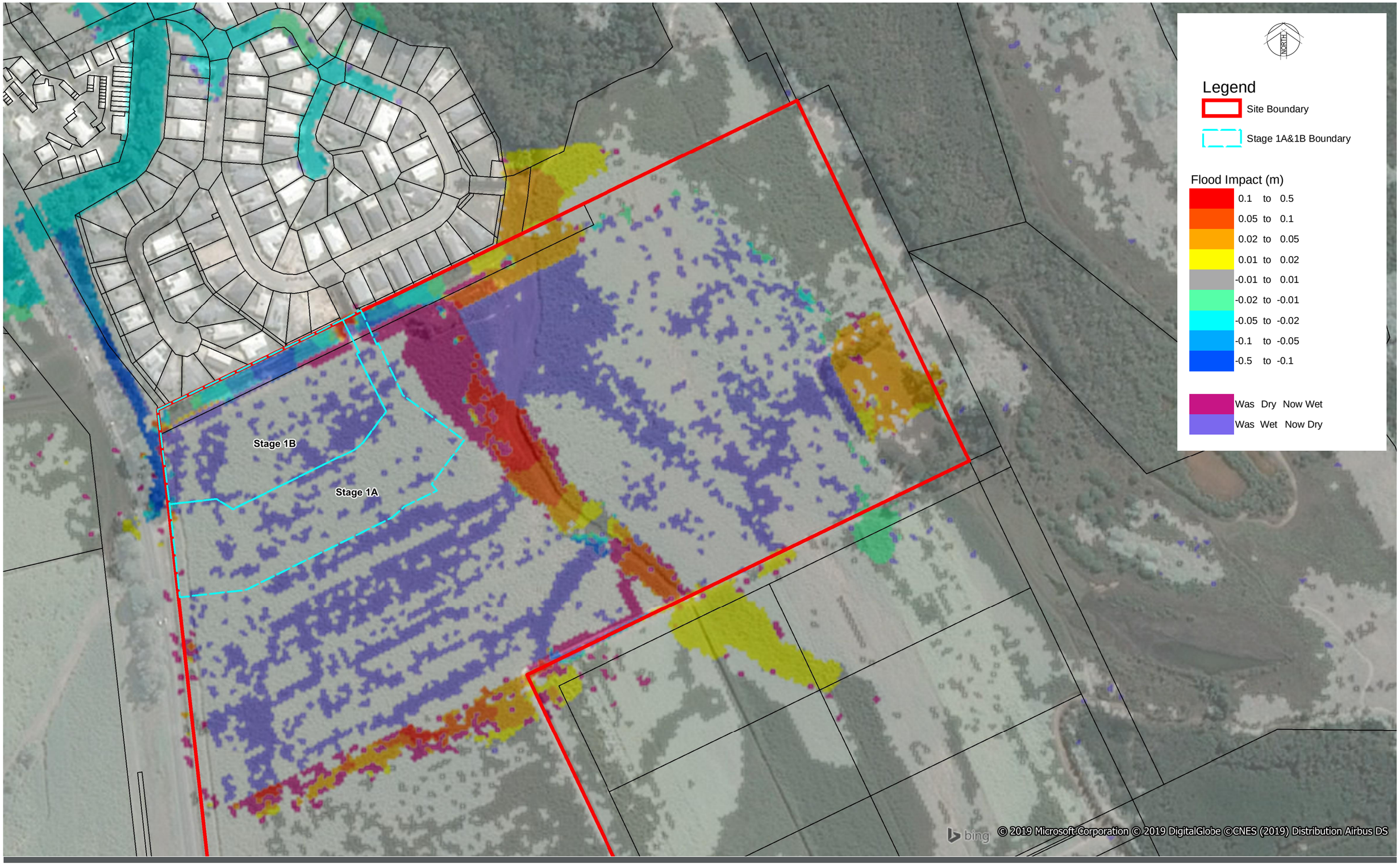
Scale
1:3,000

0 120
metres

APPENDIX C.5
DEVELOPED - 10% AEP EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



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Tel. 07 3369 9822

Date
26/02/2019
Size
A3
Scale
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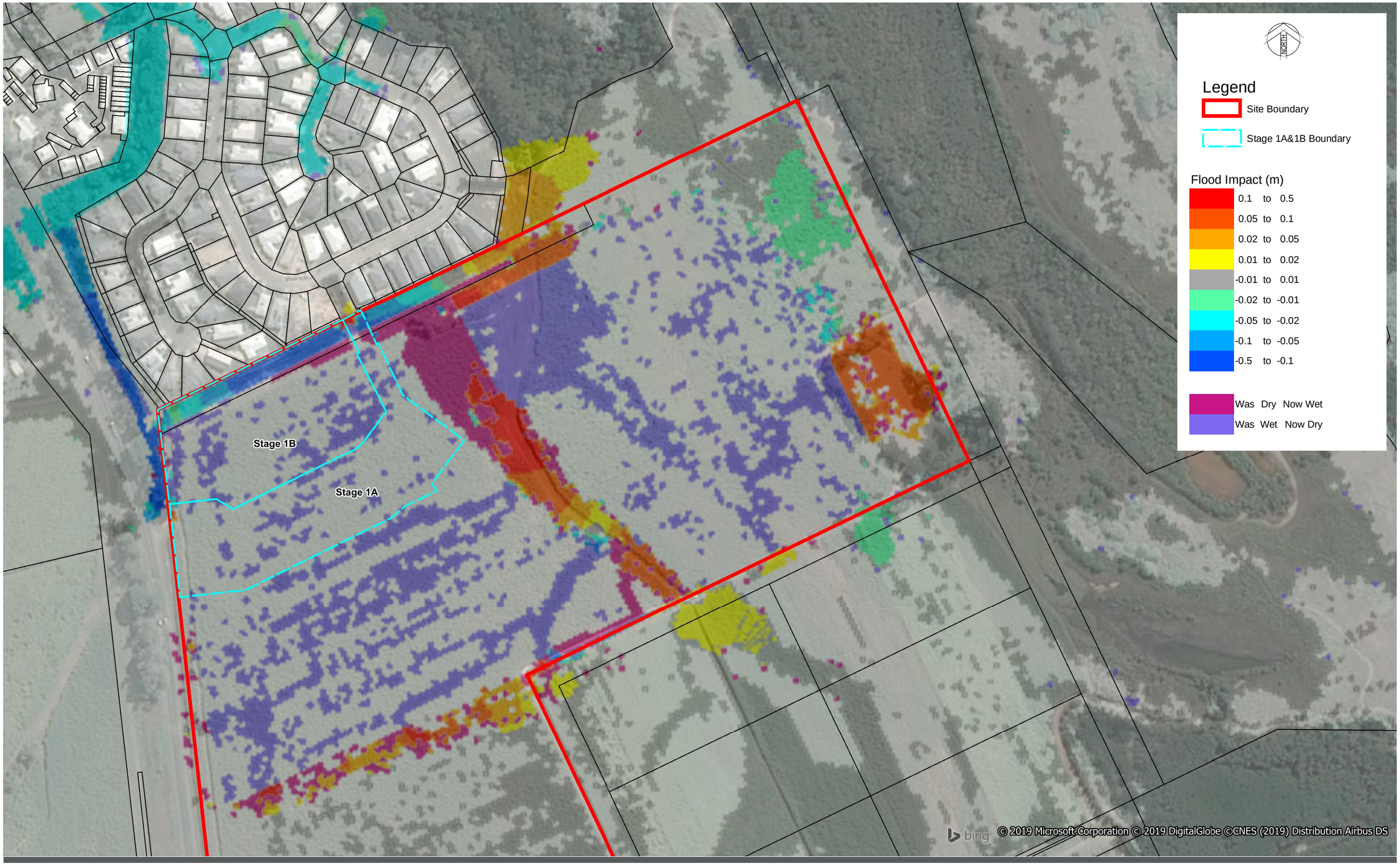
0 120
metres

APPENDIX C.6
DEVELOPED - 20% AEP EVENT - PEAK FLOOD IMPACT

Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas



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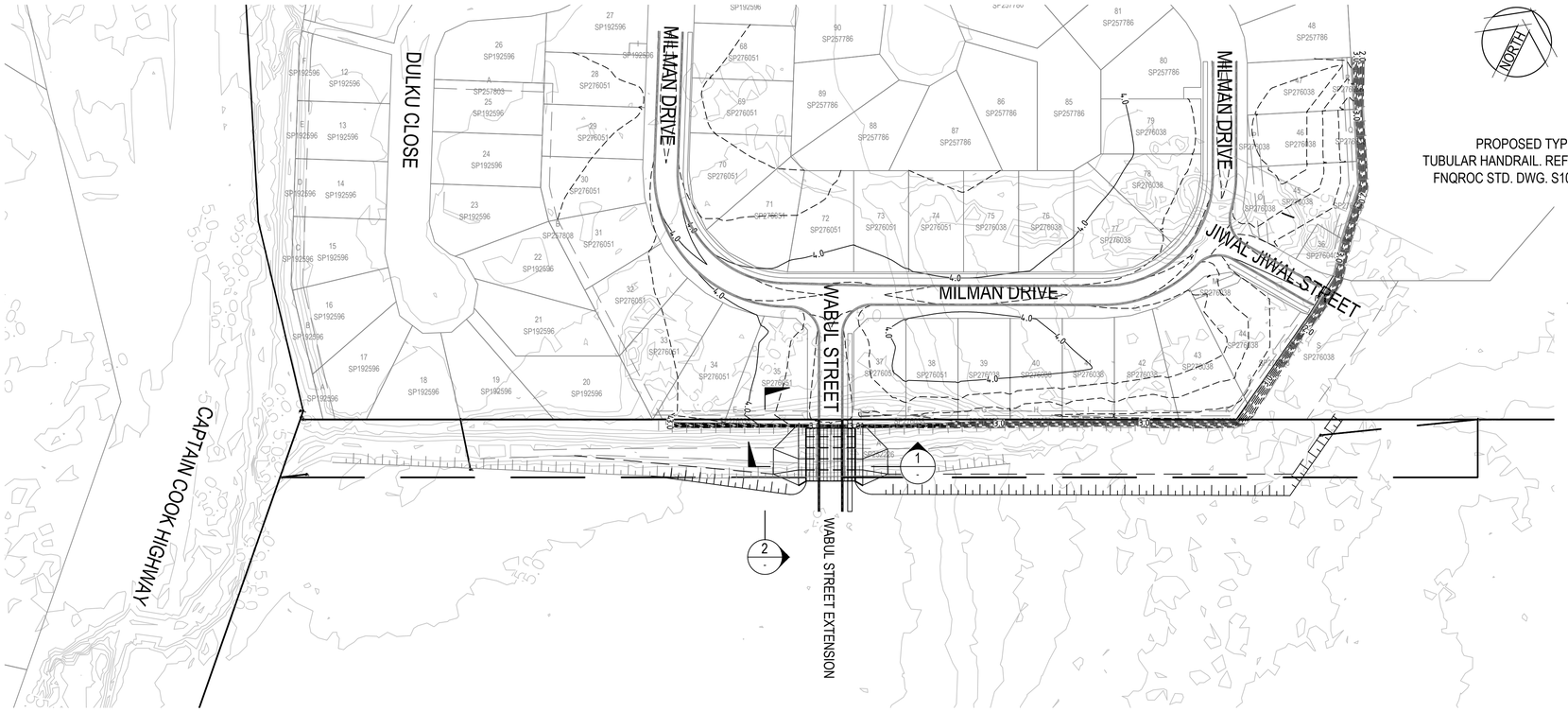
Date
26/02/2019
Size
A3
Scale
1:3,000

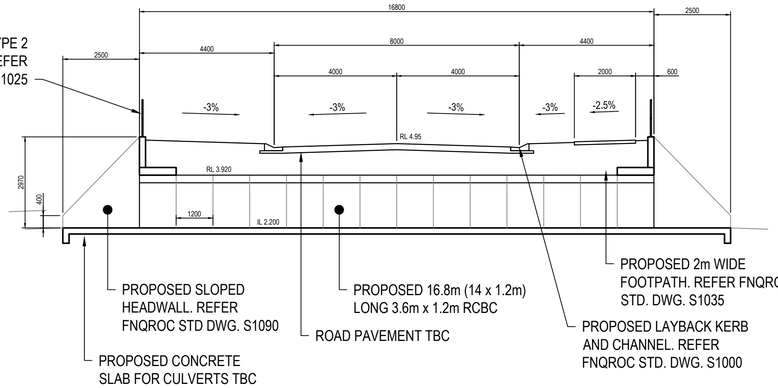
0 120
metres

APPENDIX C.7
DEVELOPED - 50% AEP EVENT - PEAK FLOOD IMPACT

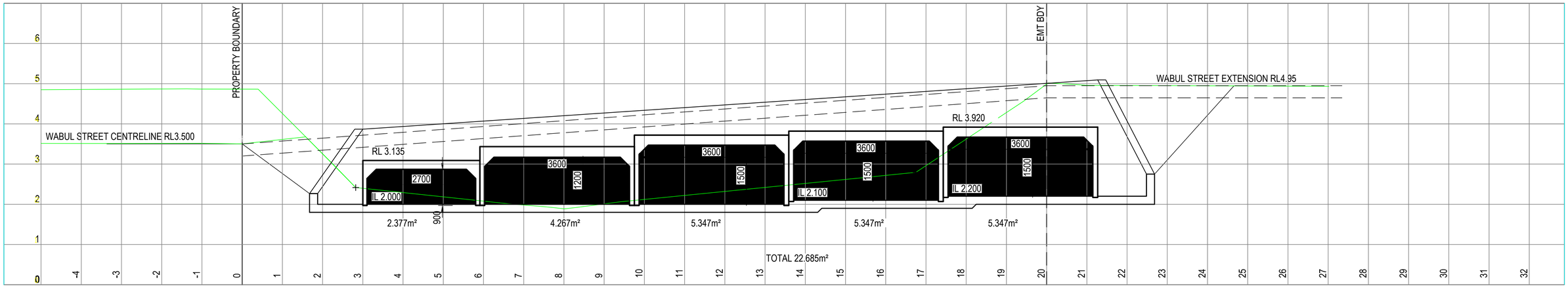
Flood Impact Assessment
Port Douglas Estate
AppC_PortDouglas

Reference Drawings





TYPICAL CROSS SECTION - WABUL STREET EXTENSION WITH CULVERT (1)
SCALE 1:100



ELEVATION - WABUL STREET EXTENSION WITH CULVERT (2)
SCALE 1:50

Cardno®
Cairns Tel: 07 4034 0500

This plan is conceptual and for discussion purposes only. All areas, dimensions and land uses are preliminary, subject to investigation, survey, engineering and Local Authority and Agency approvals.

0 20 40 60 80 100m
SCALE 1:1000 @A1

0 1 2 3 4 5m
SCALE 1:50 @A1

0 1 2 4 6 8 10m
SCALE 1:100 @A1

PORT DOUGLAS LAND DEVELOPMENTS PTY LTD
PORT PACIFIC ESTATE
LOT 2 ON SR431

CONCEPT STORMWATER CULVERT DETAILS

Date	Scale	Size
19/023/2019	AS SHOWN	A1

Q184103-005-SK-01 (Drawing Number) 02 (Revision)

Attachment C – Existing Contour Plan

north

CONTOUR PLAN
STAGES 1A & 1B

PORT DOUGLAS ESTATE
CAPTAIN COOK HIGHWAY
CRAIGLIE

STAGE 1B

STAGE 1A

DULKU CLOSE

WABUL STREET

CAPTAIN COOK HIGHWAY

ROAD 14.5m Wide

ROAD 15.5m Wide

20m Wide

PROPOSED DRAINAGE RESERVE & NOISE AMELIORATION FENCE

Drainage Reserve 3964m²

Park 3933m²

Future Park & Drainage Reserve

Future Residential

Future Residential

Future Residential

Cardno

Tel: (07) 4034 0500

Date: 11th April 2019 | Scale: 1 : 1000 @ A3 | Drawn: MC | Job No.: Q184103 | Plan No.: Q184103-PP01A

Attachment D – Wabul Street Culvert Crossing

GENERAL

G1 THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL AND OTHER DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT.

G2 THE INFORMATION CONTAINED ON THESE DRAWINGS IS FOR STRUCTURAL ENGINEERING PURPOSES ONLY. ALL DISCREPANCIES THAT COULD RESULT IN CHANGES TO THE STRUCTURAL DETAILS SHALL BE REFERRED TO THE ENGINEER PRIOR TO PROCEEDING WITH CONSTRUCTION.
IF IN DOUBT - ASK.

G3 CONSTRUCTION FROM THESE DRAWINGS AND ASSOCIATED CONSULTANTS' DRAWINGS SHALL NOT COMMENCE UNTIL APPROVED BY THE LOCAL AUTHORITIES.

G4 ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE RELEVANT AND CURRENT AUSTRALIAN STANDARDS AND WITH THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE PROJECT SPECIFICATION.

G5 ALL DIMENSIONS SHOWN SHALL BE VERIFIED BY THE BUILDER ON SITE. ENGINEERS' DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS.

G6 DURING CONSTRUCTION THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED. TEMPORARY BRACING SHALL BE PROVIDED BY THE BUILDER TO KEEP WORKS AND EXCAVATIONS STABLE AT ALL TIMES.

G7 THE BUILDER SHALL GIVE 48 HOURS NOTICE FOR ALL ENGINEERING INSPECTIONS.

G8 UNLESS NOTED OTHERWISE ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES.

G9 THE STRUCTURAL COMPONENTS DETAILED ON THESE DRAWINGS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS AND LOCAL GOVERNMENT ORDINANCES FOR THE FOLLOWING LOADINGS :

DESIGN LOADS		
AREA	LIVE LOAD kPa	SUPERIMPOSED DEADLOAD kPa
GENERAL	?	NIL

SAFETY IN DESIGN AND CONSTRUCTION

D1 CONSTRUCTION WORK UNDERTAKEN BY THE BUILDER/CONTRACTOR IS TO COMPLY WITH THE REQUIREMENTS OF THE WORK PLACE HEALTH AND SAFETY ACT.

D2 CONSTRUCTION ACTIVITY CAN BE HAZARDOUS. POTENTIAL SAFETY HAZARDS CONSIDERED BY THE DESIGNERS TO HAVE A HIGHER RISK THAN NORMAL CONSTRUCTION ACTIVITY ARE IDENTIFIED WITH APPROPRIATE NOTES ON THESE DRAWINGS. IT SHOULD BE NOTED THAT DESIGNERS HAVE A LOWER LEVEL OF UNDERSTANDING OF THE RISKS INVOLVED IN CONSTRUCTION COMPARED TO THAT OF A COMPETENT CONTRACTOR. IT IS THEREFORE ESSENTIAL THAT AN ADEQUATE SAFETY PLAN IS PREPARED BY THE CONTRACTOR FOR THE WORKS. SAFETY PLANS ARE TO BE PREPARED IN COMPLIANCE WITH THE STATUTORY REQUIREMENTS. THE DESIGNERS MAY NOT BE AWARE OF ALL SAFETY RISKS AND HAZARDS INVOLVED IN THIS PROJECT AND THE ABSENCE OF COMMENT DOES NOT IMPLY THAT THERE ARE ONLY LOW LEVEL RISKS OR HAZARDS INVOLVED IN THIS PROJECT. APPROPRIATE WORK METHOD STATEMENTS ARE TO BE PREPARED FOR ANY HIGH RISK ACTIVITY BY THE CONTRACTOR. THE DESIGNERS ARE AVAILABLE TO BE CONSULTED WHEN REQUIRED CONCERNING THEIR AREA OF CONTROL WITH REGARD TO SAFETY PLANS.

D3 PRIOR TO FABRICATION OF STEELWORK THE CONTRACTOR SHALL AGREE WITH THE ENGINEER ON AREAS OF RISK WHICH HAVE BEEN ADDRESSED BY THE DESIGN WHERE POSSIBLE AND AGREE ON SUITABLE CONSTRUCTION PROCEDURES WHERE AREAS OF RISK STILL EXIST.

D4 PRIOR TO ANY FABRICATION THE CONTRACTOR SHALL HAVE COMPLETED A RISK ASSESSMENT OF ALL CONSTRUCTION PROCEDURES AND ENSURED THAT WHERE POSSIBLE, ALL RISKS HAVE BEEN ELIMINATED AND WHERE NOT POSSIBLE THEIR SAFETY PLAN HAS ADDRESSED THOSE ISSUES AND IT HAS BEEN FORMULATED AND DOCUMENTED FOR STRICT ADHERENCE DURING THE CONSTRUCTION WORKS.

D5 PRIOR TO THE USE OF THE PROJECT AS DESIGNED, THE OWNER SHALL HAVE COMPLETED A RISK ASSESSMENT OF ALL WORK PRACTICES AND ENSURED THAT WHERE POSSIBLE ALL RISKS HAVE BEEN ELIMINATED AND WHERE NOT POSSIBLE THEIR SAFETY PLAN HAS ADDRESSED THOSE ISSUES AND IT HAS BEEN FORMULATED AND DOCUMENTED FOR STRICT ADHERENCE AFTER COMMISSIONING.

FORMWORK

CF1 THE DESIGN, CONSTRUCTION AND PERFORMANCE OF THE FORMWORK AND FALSEWORK IS THE RESPONSIBILITY OF THE BUILDER. INSTALLATION OF STEEL FORMWORK SHALL BE STRICTLY IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

CF2 DESIGN AND CONSTRUCTION AND STRIPPING TIMES SHALL COMPLY WITH AS 3610 AND AS 3600 UNLESS OTHERWISE APPROVED BY THE ENGINEER.

CF3 DURING CONSTRUCTION, SUPPORT PROPPING SHALL BE PROVIDED WHERE LOADS FROM STACKED MATERIALS, FORMWORK AND OTHER SUPPORTED SLABS INDUCE LOADS IN A SLAB OR BEAM WHICH EXCEED THE DESIGN LOAD FOR STRENGTH OR SERVICEABILITY AT THAT AGE ONCE THE NOMINATED 28 DAY STRENGTH HAS BEEN ATTAINED, THESE LOADS SHALL NOT EXCEED THE DESIGN SUPERIMPOSED LOADS SET OUT IN THE GENERAL NOTES.

CF4 THE FORMWORK SHALL BE DESIGNED TO RELY ON NO RESTRAINT OR SUPPORT FROM THE PERMANENT STRUCTURE WITHOUT PRIOR APPROVAL FROM THE PROJECT DESIGN ENGINEER.

CF5 WHERE NECESSARY SPECIAL REQUIREMENTS FOR SEQUENCE OF CONCRETE PLACEMENT AND STRIPPING ARE SET OUT ON DRAWINGS.

CF6 DESIGN INFORMATION CONCERNING THE FOUNDATION FORMWORK SHALL BE DETERMINED FROM THE CONDITIONS EXISTING ON SITE AT THE TIME OF CONSTRUCTION. REFER ALSO TO THE GEOTECHNICAL REPORT WHERE AVAILABLE.

CF7 UNLESS NOTED OTHERWISE PROVIDE UPWARD CAMBER TO FORMWORK OF CANTILEVERS OF L/120, WHERE L IS THE SHORTEST PROJECTION BEYOND COLUMN OR WALL FACE, AND TO FORMWORK OF SLABS WHERE NOTED ON PLAN. MAINTAIN THE SLAB AND BEAM DEPTHS SHOWN.

REINFORCEMENT

R1 ALL REINFORCING BARS SHALL BE GRADE D500N TO AS 4671 UNLESS NOTED OTHERWISE. IT SHALL BE CUT AND BENT IN ACCORDANCE WITH AS3600. ACCEPTABLE MANUFACTURERS AND PROCESSORS OF STEEL REINFORCEMENT MUST HOLD A VALID CERTIFICATE OF APPROVAL, ISSUED BY THE AUSTRALIAN CERTIFICATION AUTHORITY FOR REINFORCING STEELS (ACRS), OR TO SUCH AN EQUIVALENT CERTIFICATION SYSTEM AS MAY BE APPROVED IN WRITING BY THE SPECIFIER. EVIDENCE OF COMPLIANCE WITH THIS CLAUSE MUST BE OBTAINED WHEN CONTRACT BIDS ARE RECEIVED. ALL MESH SHALL BE GRADE 500L TO AS4671 AND SHALL BE SUPPLIED IN FLAT SHEETS.
REINFORCEMENT NOTATION SHALL BE AS FOLLOWS IN THE FOLLOWING

THE FIGURES FOLLOWING THE FABRIC SYMBOLS RL, SL, L ,TM IS THE REFERENCE NUMBER FOR FABRIC TO AS 4671.

R2 REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.

R3 SPLICES IN REINFORCEMENT SHALL BE MADE ONLY IN POSITIONS SHOWN OR OTHERWISE APPROVED IN WRITING BY THE ENGINEER. LAPS SHALL BE IN ACCORDANCE WITH AS 3600 AND NOT LESS THAN THE DEVELOPMENT LENGTH FOR EACH BAR, AS SHOWN IN THE TABLE BELOW.

BAR LAPS (mm) FOR BEAMS & SLABS		
BAR SIZE	TOP BAR	BOTTOM BAR
N12	500	500
N16	600	600
N20	800	800
N24	1200	1000
N28	1500	1200
N32	1900	1500
N36	2300	1800

MINIMUM LAP FOR ALL REINFORCING FABRIC SHALL BE ONE MESH SQUARE PLUS 30mm.

R4 WELDING OF REINFORCEMENT SHALL NOT BE PERMITTED UNLESS SHOWN ON THE STRUCTURAL DRAWINGS OR APPROVED BY THE ENGINEER. WHERE APPROVED, WELDING MUST COMPLY WITH AS1554.3 STANDARD STEEL WELDING, PART 3 : WELDING OF REINFORCING STEEL. NO WELDING IS ALLOWED WITHIN 120mm OF BENDS.

R5 FABRIC SHALL BE LAPPED TWO TRANSVERSE WIRES PLUS 25mm. BUNDLED BARS SHALL BE TIED TOGETHER AT 30 BAR DIAMETER CENTRES WITH 3 WRAPS OF THE WIRE.

R6 WHERE TRANSVERSE TIE BARS ARE NOT SHOWN PROVIDE N12-300 SPLICED WHERE NECESSARY AND LAP WITH MAIN BARS 400 mm UNLESS NOTED.

R7 JOGGLES TO BARS SHALL COMPRISE A LENGTH OF 12 BAR DIAMETERS BETWEEN BEGINNING AND END OF AN OFFSET OF 1 BAR DIAMETER.

R8 ALL REINFORCEMENT SHALL BE FIRMLY SUPPORTED ON MILD STEEL PLASTIC TIPPED CHAIRS, PLASTIC CHAIRS OR CONCRETE CHAIRS AT NOT GREATER THAN 1 METRE CENTRES BOTH WAYS, AND 800 EACH WAY FOR FABRIC. WHEN POURED ON GROUND AS FORMWORK PROVIDE PLATES UNDER ALL BAR CHAIRS. PLASTIC TIPPED STEEL CHAIRS SHALL NOT BE USED ON EXPOSED FACES IN EXPOSURE CLASSIFICATION B1, B2 AND C ONLY PLASTIC OR CONCRETE CHAIRS.

R8 SITE BENDING OF REINFORCEMENT SHALL BE AVOIDED IF POSSIBLE. WHERE SITE BENDING IS UNAVOIDABLE IT SHALL BE CARRIED OUT COLD, WITHOUT THE APPLICATION OF HEAT, AND IN ACCORDANCE WITH THE PRACTICE NOTE RPN1 OF THE STEEL REINFORCEMENT INSTITUTE OF AUSTRALIA. REINFORCEMENT SHALL NOT BE REBENT WITHOUT APPROVAL OF THE SUPERINTENDENT.

R9 THE STRUCTURAL ENGINEER SHALL BE GIVEN 48 HOURS NOTICE FOR REINFORCEMENT INSPECTION AND CONCRETE SHALL NOT BE DELIVERED UNTIL FINAL APPROVAL HAS BEEN OBTAINED FROM THE STRUCTURAL ENGINEER.

CONCRETE

C1 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600, AS 1379 & AS 3610 CURRENT EDITIONS WITH AMENDMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

TABLE 1 - CONCRETE QUALITY			
ELEMENT	STRENGTH GRADE	SLUMP (mm)	MAXIMUM AGGREGATE SIZE (mm)
BASE SLAB	N25	80±15	20
WING WALLS	N25	80±15	20
RETAINING WALL FTG	N20	230±15	10
RETAIINING WALL	S32	80±15	20
EXPOSURE CLASSIFICATION			
INTERNAL	A1		
EXTERNAL	B1		

TABLE 2 - CLEAR COVER TO REINFORCEMENT (UNO)			
ELEMENT	TOP (mm)	BTM (mm)	SIDE (mm)
BASE SLAB	50	50	50
WING WALL / HEAD WALL	25	40	40
RETAINING WALL FOOTING	40	40	40
RETAINING WALL	40	40	40

PROJECT ASSESSMENT SHALL BE CARRIED OUT IN ACCORDANCE WITH AS 1379, EXCEPT THAT SAMPLING FREQUENCY SHALL BE AS FOLLOWS. ONE SAMPLE SHALL CONSIST OF 3 CYLINDERS.

NUMBER OF TRUCKS	NUMBER OF SAMPLES
1	1
2 - 10	2
11 - 20	3
FOR EACH ADDITIONAL 10 TRUCKS	1 EACH

C2 NO ADMIXTURES OTHER THAN LOW RANGE WRA SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING.

C3 CLEAR CONCRETE COVER TO ALL REINFORCEMENT SHALL BE AS SHOWN ON PLANS.

C4 CONCRETE SIZES SHOWN DO NOT INCLUDE THICKNESS OF APPLIED FINISHES. NO FINISH WHICH DECREASES COVER IS ALLOWED WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER.

C5 NO HOLES, CHASES, BLOCKOUTS, DUCTS OR EMBEDMENT OF PIPES OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.

C6 CONSTRUCTION JOINTS WHERE NOT SHOWN SHALL BE LOCATED TO THE APPROVAL OF THE ENGINEER.

C7 THE FINISHED CONCRETE SHALL BE MECHANICALLY VIBRATED TO ACHIEVE A DENSE HOMOGENEOUS MASS, COMPLETELY FILLING THE FORMWORK THOROUGHLY EMBEDDING THE REINFORCEMENT AND FREE OF STONE POCKETS. ALL CONCRETE INCLUDING SLABS ON GROUND AND FOOTINGS SHALL BE COMPACTED WITH MECHANICAL VIBRATORS.

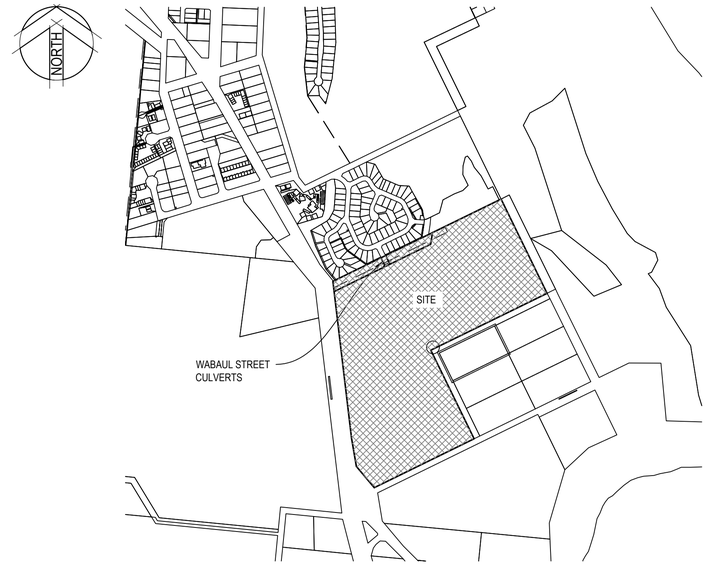
C8 USE EVAPORATIVE RETARDANT DURING CONCRETE PLACING AND IMMEDIATELY AFTER BULL FLOATING.

C9 CURING OF ALL CONCRETE IS TO BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF THREE DAYS, AND THE PREVENTION OF LOSS OF MOISTURE FOR A TOTAL OF 7 DAYS FOLLOWED BY A GRADUAL DRYING OUT. APPROVED SPRAYED ON CURING COMPOUNDS THAT COMPLY WITH AS 3799 MAY BE USED WHERE FLOOR FINISHES WILL NOT BE AFFECTED (REFER MANUFACTURERS SPECIFICATIONS). POLYTHENE SHEETING OR WET HESSIAN MAY BE USED IF PROTECTED FROM WIND AND TRAFFIC.

C10 CONSTRUCTION SUPPORT PROPPING IS TO BE LEFT IN PLACE WHERE NEEDED TO AVOID OVERSTRESSING THE STRUCTURE DUE TO CONSTRUCTION LOADING.

C11 REPAIRS TO CONCRETE SHALL NOT BE ATTEMPTED WITHOUT THE PERMISSION OF THE ENGINEER.

C12 CAST-IN FIXINGS, BOLTS ETC. SHALL NOT BE ALTERED WITHOUT THE PERMISSION OF THE ENGINEER.



LOCALITY PLAN
NTS

Rev.	Date	Description	Des.	Verif.	Appd.
1	11/04/2019	PRELIMINARY ISSUE	ML	MS	

Cardno (QLD) Pty Ltd | ABN 57 051 074 992
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Drawn	NB	Date 26/02/2019
Checked	ML	Date 10/04/2019
Designed	ML	Date 20/02/2019
Verified	MS	Date
Approved		

Client: PORT DOUGLAS LAND DEVELOPMENTS PTY LTD

Project: PORT DOUGLAS ESTATE
LOT 2 ON SR431
WABAUL STREET CULVERTS

Title: GENERAL CULVERT CONSTRUCTION NOTES

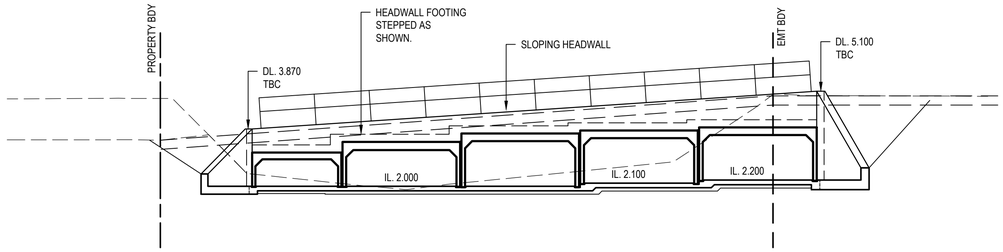
Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Scale:

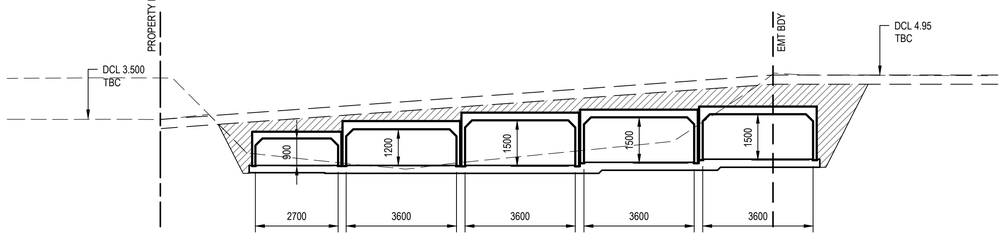
Size: A1

Drawing Number: Q184103-005-CI-001

Revision: 1



UPSTREAM ELEVATION
1:100



SECTION 1
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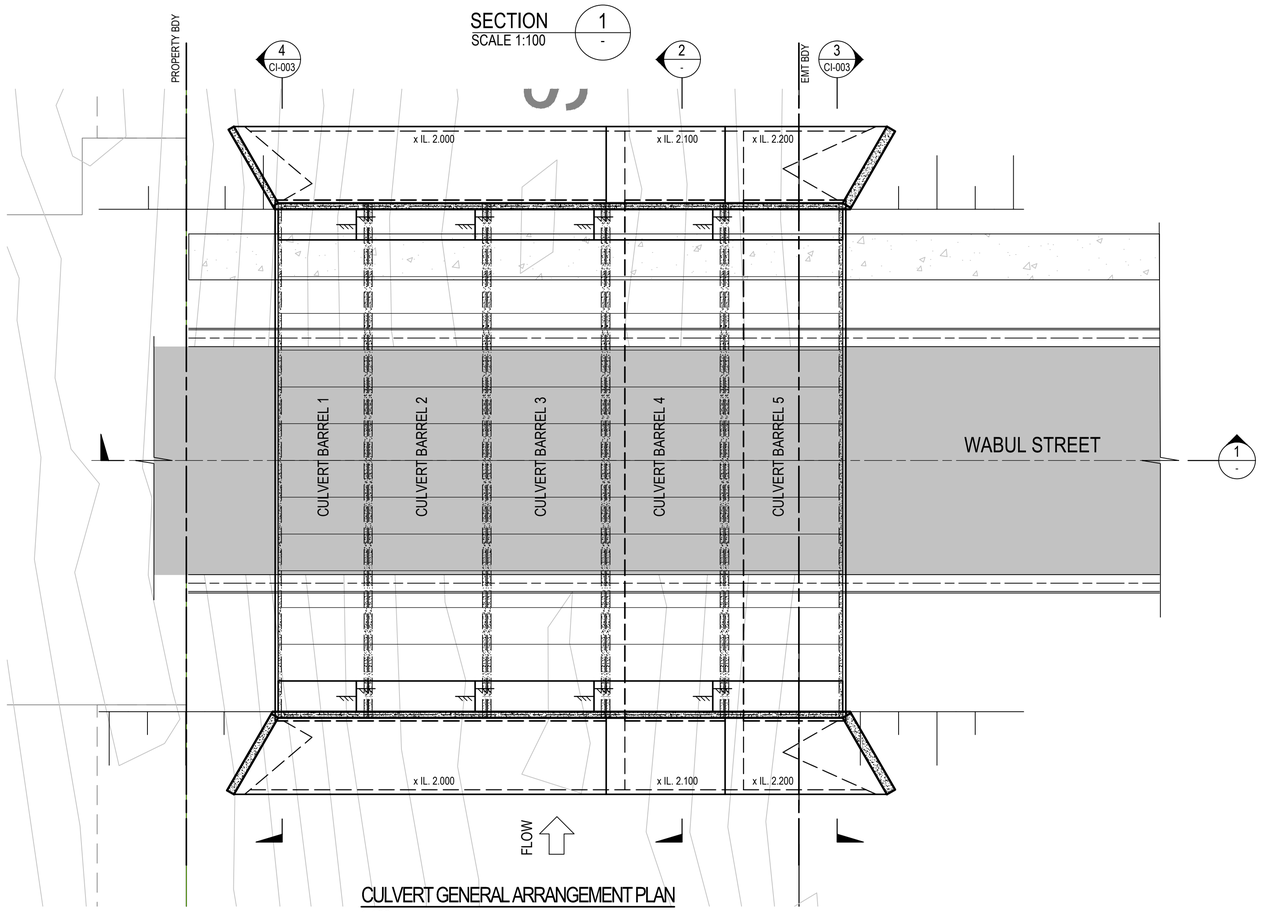
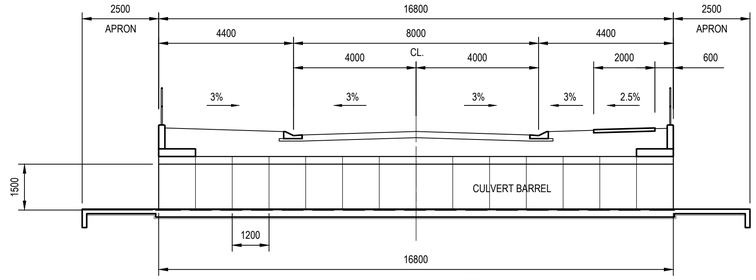


CULVERT GENERAL ARRANGEMENT PLAN
1:100

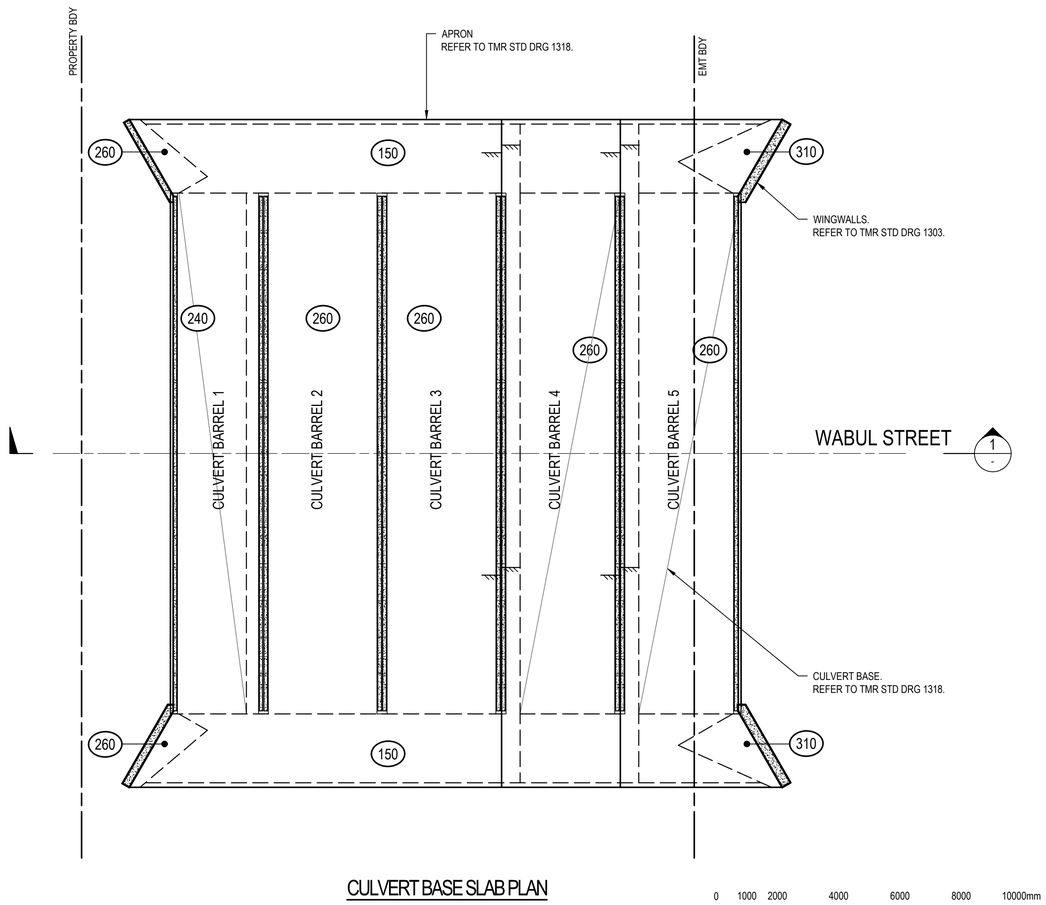


SECTION 2
SCALE 1:100

SLAB LEGEND

200 ..... DENOTES CONCRETE SLAB THICKNESS

..... DENOTES STEP TOP OF SLAB



CULVERT BASE SLAB PLAN
1:100

0 1000 2000 4000 6000 8000 10000mm

SCALE 1:100 @A1

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Client: PORT DOUGLAS LAND DEVELOPMENTS PTY LTD

Project: PORT PACIFIC ESTATE
LOT 2 ON SR431
WABAUL STREET CULVERTS

Title: PLAN AND SECTIONS

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Scale:

Size: A1

Drawing Number: Q184103-005-CI-002

Revision: 1

XREFs: Q184103-005 CULVERT XSEC; Q184103-005 Wabul culvert General; Q184103-005 Wabul culvert CL; Q184103-005 Wabul culvert Upstream; Q184103-005 Wabul culvert Slab; Q184103-005 Wabul culvert Sect 02; Q184103-005 Wabul culvert Sect 03; Q184103-005 Wabul culvert Sect 04; Q184103-005-SK-02; Q184103-005-BDY's; Q184103 Ident; Q184103-005-Ex Conts; Q184103-005-Stg 3+4 Conts; Q184103-005 CULVERT LONGSEC
DATE PLOTTED: 11 April 2019 10:47 AM BY: NEIL BROWNING
CAD File: H:\2019\Q184103 - Port Douglas Estate\005 - Civil Engineering\Design_CAD & Models_Acad\Q184103-005-CI-001-002-003.dwg