BEFORE HEARING COMMISSIONERS APPOINTED BY CANTERBURY REGIONAL COUNCIL AND WAIMAKARIRI DISTRICT COUNCIL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	Applications CRC204106, CRC204107, CRC204143 and RC205104 – to establish, operate and rehabilitate an aggregate quarry at 309 West Belt, Rangiora

---

STATEMENT OF EVIDENCE OF BENJAMIN THROSSELL FOR TAGGART EARTHMOVING LIMITED

19 APRIL 2021

---

1. INTRODUCTION

Qualifications and Experience

1.1 My name is Benjamin Throssell. I hold a Bachelor of Engineering (Hons) (Natural Resources Engineering) from the University of Canterbury. I have 10 years of experience specialising in water resources.

1.2 I am a Water Resources Engineer with Pattle Delamore Partners Limited (PDP).

1.3 I have particular experience assessing flood hazard and constructing 2D hydraulic models. I was the lead hydraulic modeller for the nearby Silverstream Estates (West Kaiapoi) development and provided advice relating to the mitigation of flood hazard.

2. INVOLVEMENT IN THE PROPOSAL

2.1 I have been involved with the Taggart proposal since the application was lodged in 2018. To date, I have been primarily involved with ascertaining the effects of the proposed acoustic bund on flooding. I have determined these effects using a 2D hydraulic model which incorporates the latest Environment Canterbury flood breakout hydrographs for the Ashley River and recent topographic information.

2.2 I have visited the site and surrounding area. During my visit, I focused particularly on the topography at the Ashley River breakout location and the topography surrounding the proposed quarry site.

3. EXPERT WITNESS CODE OF CONDUCT

3.1 I acknowledge that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2014. My qualifications as an expert are set out above. Other than where I state that I am relying on the advice of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

4. PURPOSE AND SCOPE OF EVIDENCE

4.1 My evidence describes the flood modelling work undertaken to assess the impact of the proposed acoustic bund on flood waters and flood hazard.

4.2 Specifically, my evidence:

4.2.1. Describes the background to the modelling that has been completed;

4.2.2. Describes the modelling methodology;

4.2.3. Presents the results of the latest modelling and the conclusions I have drawn based on this modelling;

4.2.4. Addresses submissions on the proposal; and

4.2.5. Comments on the s42A report and consent conditions.

5. SUMMARY

5.1 PDP prepared a 1D/2D flood model using the modelling software Tuflow as part of the assessment of effects for the proposed Taggart quarry.

5.2 The flood model has been used to predict the effects on flood waters and flood hazard as a result of constructing a 3 m high acoustic earth bund on the eastern and western site boundaries of the racecourse.

5.3 A 0.5 m deep and 5 m wide excavation was modelled to convey flow around the southern tip of the western bund and along the pre-existing flow path. This helps to mitigate any effects of the proposed acoustic bund.

5.4 Various acoustic bund designs were considered and assessed to ensure any secondary effects associated with flooding were acceptable. My evidence does not traverse those potential designs but only addresses the selected final design.

5.5 Based on the results of the modelling undertaken, I consider that there will be no flood depth or flood hazard effects on existing dwellings as a result of the proposed development for either of the 100YR, 200YR or 500YR Average Recurrence Interval (ARI) events.

5.6 Outside the racecourse site, there is a small increase in the flood hazard for a <50 m stretch of River Road. This stretch of River Road does not form part of an evacuation route.

5.7 The model also predicts a small (<50 mm) increase in water levels for properties 331, 335 and 336 West Belt but this increase does not extend as far as the dwellings. Flood levels west to the site and east of the site would be decreased in all events modelled.

5.8 The conveyance channel proposed will increase the capacity of the existing flow path and will reduce water levels to the east and west of the site should a flood occur. This includes all properties along Lehmans Road, including the Holiday Park.

5.9 I note that the probability of an event occurring at least once within the consented 15 year timeframe is 14% for a 100YR event, 7% for a 200YR event and 3% for a 500YR event.

5.10 Overall, I consider any potential effects of the proposed acoustic bund and conveyance channel on flood depth and flood hazard, particularly given the 15 year duration of the consents sought, as less than minor.

6. BACKGROUND

6.1 On 4 October 2018, after the applications were initially lodged, a request for information was made by Council under Section 88 of the Resource Management Act 1991 (RMA). With respect to flood modelling, there was a request for a detailed assessment against any potential flooding effects, including on the overland flow paths.

6.2 A flood assessment was then undertaken to determine the effects on flood hazard and flood depth as a result of a proposed acoustic bund and flood conveyance channel (as described in the acoustic evidence of Mr Jon Farren (from Marshall Day Acoustics)). PDP prepared a report titled Acoustic Flood Assessment dated 19 February 2020.

6.3 On 22 December 2020, a s92 request for further information was issued by Council. The request identified nine properties for which an assessment of the change in freeboard was requested. PDP provided a response by letter dated 27 January 2021 and then a further letter of correction dated 25 February 2021.

7. FLOOD MODEL

7.1 The flood model was built using Tuflow. Tuflow is an industry standard hydraulic modelling software package with 1D and 2D capabilities to numerically model free surface flows. It has been widely used throughout New Zealand and is a tool fit for the purposes of this assessment.

7.2 The model incorporates the Rangiora 2014 LiDAR survey obtained from the Land Information New Zealand (LINZ) Data Service. A fixed grid resolution of 5 m was used.

7.3 The flood scenarios considered were the Ashley River break out for the 100YR, 200YR and 500YR Average Recurrence Interval (ARI) flood flows. A 100YR ARI represents the flood event that will, on average, be exceeded once every 100 years.

7.4 Hydrographs for the three breakout flows were provided by Environment Canterbury. The location of these breakouts are identified in the Environment Canterbury Ashley River Floodplain investigation 2016. The relevant breakout flow location (from the Environment Canterbury investigation) is reproduced in Figure 1 attached to my evidence. The breakout flows were introduced to the PDP model to assess the effects of the acoustic bund.

7.5 Roughness values for the model were obtained from reviewing aerial imagery. The land surface between the breakout location and the racecourse is predominantly rural farmland. East of the racecourse is more densely populated residential suburbs. A default manning's n value of 0.04 was used for all areas. Roads and building footprints were obtained from the LINZ Data service. A manning's roughness of 0.016 and 10 were used for the two layers respectively. The manning's roughness values were obtained from the Christchurch City Council Waterways, Wetlands and Drainage Guide.

7.6 To model the development of the acoustic bund (post development), the elevation of the bund footprint was increased by 3 m.

7.7 To mitigate the displacement of flood waters to the west of the bund, a conveyance channel was added to the model. This was represented by a 0.5 m deep, 5 m wide excavation

and was positioned on the southwestern portion of the acoustic bund.

7.8 No gravel pit excavations were modelled. I consider that any removal of material from the site will mitigate the effects of flooding by providing additional storage for floodwaters which will decrease flood depths and velocities. Therefore I consider this approach conservative.

Further Model Development

7.9 In early 2020, a 2018-2019 LiDAR survey of the Ashley River was published by LINZ. A review of the difference between this dataset and that employed by the model indicated that there was no major difference between the two within the model domain. The extent of the new dataset does not encompass the full model extent and therefore the new dataset was not incorporated into the model.

7.10 As the purpose of the model is to estimate the relative difference between flood levels and not quantify flood depths, the 2014 LiDAR survey was considered most suitable for the model purpose.

7.11 On 21 September 2020, Environment Canterbury provided revised flows at the Ashley River breakout location. The model was rerun with the updated revised flows.

7.12 On 6 October 2020, with the revised consent application, the following changes were incorporated within the model:

7.12.1. A revised acoustic bund position; and

7.12.2. The conveyance excavation along the western bund was converted into 1D to better represent the flow through the excavation within the model resolution.

7.13 On 22 December 2020, a s92 request for further information was issued by Council. The request identified nine properties where an assessment on the change in freeboard was requested.

7.14 A field visit on 14 January 2021 was undertaken to measure the floor levels of the identified dwellings. The floor at the dwellings and structures at the sites were measured relative to the ground level at the location.

7.15 The measured floor depths were converted to levels using the LiDAR at available at each site. The floor levels were used to assess the change in freeboard by comparing the change in depth predicted by the model.

7.16 In early 2021 an inconsistency was discovered in the model which affected the reported and presented results in the September 2020 application.

7.17 A misclassification of the manning's n value resulted in two sections of road being incorrectly identified. The impact of this classification was that flood waters were partially deflected and did not follow the preferred flow paths.

7.18 Corrected flood maps were produced and provided to Council with the updated manning's n parameter.

8. RESULTS

8.1 The hydraulic modelling undertaken has evaluated the potential effects on flood levels and flood hazard as a result of constructing the proposed acoustic bund and conveyance channel.

8.2 Pre and post development scenarios were run for 100, 200 and 500 year ARI events. The figures attached to my evidence illustrate the water level difference and flood hazard effects as a result of building the proposed acoustic bund. Some water level increases are predicted for properties along West Belt (331 to 336), however it is noted that these increases are limited to the landscaped areas of the properties. No increase in flood level is predicted for any dwellings, including those at 331, 335 and 336 West Belt.

8.3 The acoustic bund is modelled as a 3 m barrier along the east and west boundary of the site. A 5 m wide and 0.5 m deep, excavation (conveyance channel) along the western bund conveys flood waters along the existing flow path. The channel will in fact increase the capacity of the existing flow path and will reduce water levels to the east and west of the site should a flood occur.

Flood Overview

8.4 Flood waters break out of the Ashley River at location A, opposite the confluence of the Ashley and Okuku Rivers. The breakout location is shown in Figure 1 attached to my evidence. The peak flow of the respective 100YR, 200YR and

500YR ARI events is 450 m^3/s, 580 m^3/s, and 850 m^3/s. The breakout flow follows the contour of the land (sloping towards the south east) and only a small portion of the breakout flow reaches the racecourse area. The model predicts the breakout peak flows (at the racecourse) to be: 12.6 m^3/s, 13.7 m^3/s, and 18.4 m^3/s for the respective 100YR, 200YR, and 500YR ARI events.

8.5 Floodwaters are predicted to pool on the eastern side of the racecourse due to the eastern bund. The major flow path out of the racecourse site is on the north east with some minor flow paths along the eastern boundary.

8.6 A similar trend is predicted for all three modelled events. There is a decrease in water level predicted west of the racecourse. More flow is predicted to be conveyed through the excavated channel, resulting in an increase in depth in the flow paths south of the track and within the racecourse.

8.7 The eastern bund impedes the pre-existing flow paths and results in an increase in flood depth along the eastern edge of the eastern bund. The model predicts that flood waters leave the site to the east via River Road. The maximum increase in depth on the inside of the eastern bund is approximately 0.8 m.

8.8 The floor levels assessed as part of the s92 request in 2021 are no longer predicted to be flooded. This is because the model inconsistency identified in early 2021 has been rectified. As such, there is no predicted reduction in freeboard for the identified properties.

Predicted Changes to Flood Level

8.9 Figures 2, 3 and 4 attached to my evidence illustrate the predicted change to the flood level for the 100YR, 200YR and 500YR ARI events respectively.

8.10 The change in flood level is obtained by subtracting the water level of the pre-developed (no acoustic bund) event from the post-developed (with acoustic bund) event. Positive numbers represent a predicted increase in the elevation of the water level as a result of constructing the acoustic bund and negative numbers represent a predicted decrease in the elevation of the water level as a result of constructing the acoustic bund.

8.11 The effects are typically the same for all three events. To the west of the racecourse, adjacent to Lehmans Road, decreases in the water level are predicted. Within the racecourse boundaries, water level increases of up to 300 mm are predicted. The greatest water level increases (more than 350 mm) are predicted for the upgradient side of the eastern bund. Increases of up to 150 mm are predicted for a 50 m length of River Road (and surrounding land) adjacent to the eastern bund.

8.12 For all three flood events, no flood level increases are predicted for any existing dwellings (as defined by the LINZ buildings layer).

Predicted Changes to Flood Hazard

8.13 Policy 11.3.1 of the Canterbury Regional Policy Statement (CRPS) specifies that development in high hazard areas should be avoided. The CRPS provides a definition for flood hazard:

> *"flood hazard areas subject to inundation events where the water depth (metres) x velocity (metres per second) is greater than or equal to 1, or where depths are greater than 1 metre, in a 0.2% AEP flood event;"*

The 0.2% AEP flood event is equivalent to the 500YR ARI event.

8.14 The Waimakariri District Plan also provides guidance on assessing the potential impacts of flooding. Policy 8.2.1.3 seeks to avoid floodwaters entering residential, commercial, and industrial buildings and Policy 8.2.1.4 seeks to avoid, remedy, or mitigate the adverse effects of activities that impede or redirect the movement of floodwater on a site, and/or exacerbate flood risk.

8.15 Figure 5 attached to my evidence shows the difference in flood hazard classification for the 500YR event. The difference in flood hazard is obtained by comparing the flood hazard classification (as defined by the CRPS) for the pre development (no acoustic bund) and post development (with acoustic bund) scenarios. The post development scenario also includes the open channel installed around the southern tip of the western bund which helps to mitigate the effects of the bund.

8.16 Yellow shading on Figure 5 represents no change to the flood hazard classification. Red shading represents an increase to the flood hazard classification (from low to high) and green shading represents a decrease to the flood hazard classification (from high to low). Figure 5 illustrates some very small increases to the flood hazard around the edges of the proposed bund. No increase to the flood hazard is predicted for any existing dwellings (as defined by the Land Information New Zealand (LINZ) buildings layer).

8.17 Figure 5 shows that the model predicts an increase in flood hazard for the small (<50m stretch) of River Road located directly to the north of the proposed eastern acoustic bund. This stretch of River Road does not provide an evacuation route for any houses and therefore I consider the effect as less than minor.

8.18 For existing dwellings, there is no increase to the flood hazard as a result of the proposed bund with the open channel mitigation, therefore I consider the effects to be less than minor.

9. SUBMISSIONS

9.1 I note that a small number of some submitters raised concerns in relation to the potential effects associated with the diversion of floodwater arising due to the construction of the acoustic bunds. The revised modelling undertaken confirms that any effects associated with diversion of floodwater will be negligible and no dwellings would be affected in a Q100, Q200 or Q500 event.

9.2 One submitter also raised concerns that the proposal will damage infrastructure and increase flood risk. The flood model predicts that there will be no increased flood risk to habitable dwellings. Some small increase in flood depths, (up to 50 mm), are predicted for the landscaped areas at 331, 335 and 336 West Belt for all events. The negligible increase in flood risk contributed by this project will not result in additional damage to infrastructure.

10. RESPONSE TO S42A OFFICERS REPORT AND CONSENT CONDITIONS

10.1 I have reviewed the s42A report on the proposal as it relates to flooding matters, and the evidence of Kalley Simpson, the

3 Waters Manager for Waimakariri District Council (Appendix 7 to the s42A report, Part 2 – Flood Risk).

10.2 In paragraph 53 of his report, Mr Simpson states that the modelling topography does not include the two stock piling areas. I agree with Mr Simpson's assessment that stockpiling at the locations shown on the site plan may decrease the predicted water level increases for the properties at 331, 335 and 336 West Belt.

10.3 In paragraph 54 of his report, Mr Simpson recommends that stockpiling should be limited to the locations identified on the site plan. I agree that a condition should be imposed which limits stockpiles to the locations proposed.

10.4 In paragraph 56 of his report, Mr Simpson states that based on the latest modelling, the duration of flooding will not significantly change. I agree with this conclusion.

10.5 In paragraph 57 of his report, Mr Simpson recommends that the conditions are modified to require the construction of the western channel and also to ensure that the bunds do not extend beyond the footprint shown on the site plan. I support these requirements being reflected in proposed consent conditions.

11. CONCLUSION

11.1 The flood model predicts increases in flood depths for the north east area of the racecourse for all events. Floodwaters would leave the site onto River Road with a post-development increase in flood depth of approximately 0.4 m directly north of the eastern bund. The difference in pre and post flood levels decreases to less than 0.1 m within 30 m of the bund.

11.2 For all events (100YR, 200YR and 500YR), there are no increases in flood depths predicted for existing dwellings. There are some minor water level increases (up to 50 mm) predicted for the landscaped areas at 331, 335 and 336 West Belt for all events but the increases do not extend to the household structures.

11.3 The only areas where an increase in flood hazard is predicted are:

11.3.1. Within the excavation along the western bund; and

11.3.2. Where flood waters exit the site north of the eastern bund along River Road.

11.4 Therefore, I consider any potential effects of the proposed acoustic bund and conveyance channel on flood depth and flood hazard as less than minor.

Ben Throssell

19 April 2021

Figure 3-5: 100 year ARI (1% AEP) - Breakout A maximum modelled water depths

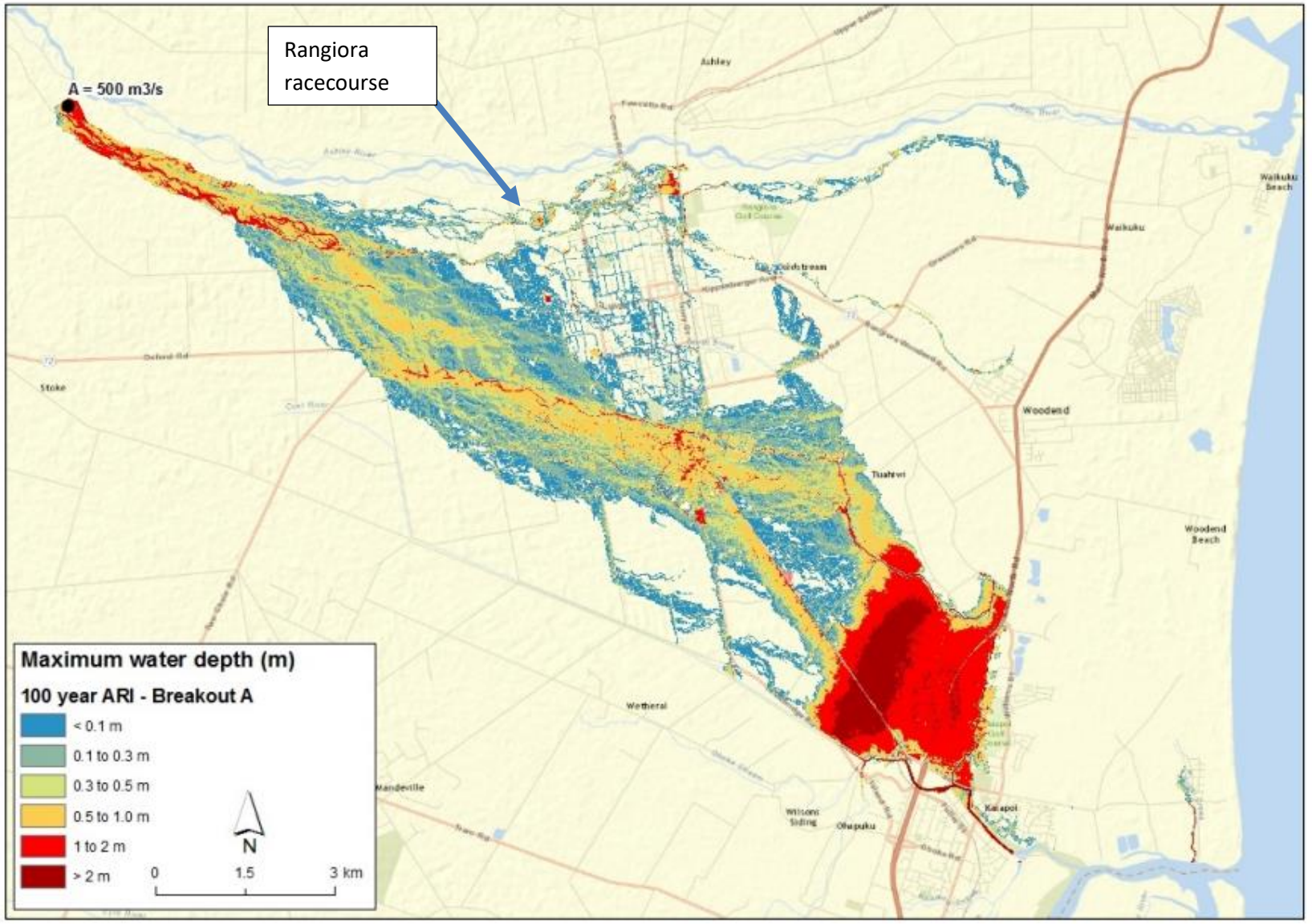


FIGURE 1: REPRODUCED FROM FIGURE 3-5 OF ENVIRONMENT CANTERBURY ASHLEY RIVER FLOODPLAIN INVESTIGATION 2016.

SOURCE:
1. AERIAL IMAGERY (FLOWN 2015-2016) SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/layer/53452-waimakariri-0075m-urban-aerial-photos-2015-2016/ AND LICENCED BY WAIMAKARIRI DISTRICT COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

WATER LEVEL DIFFERENCE MAP Q100 (POST - PRE)

SCALE : 1:10,000 (A4)

0 50 100 200 300

METRES

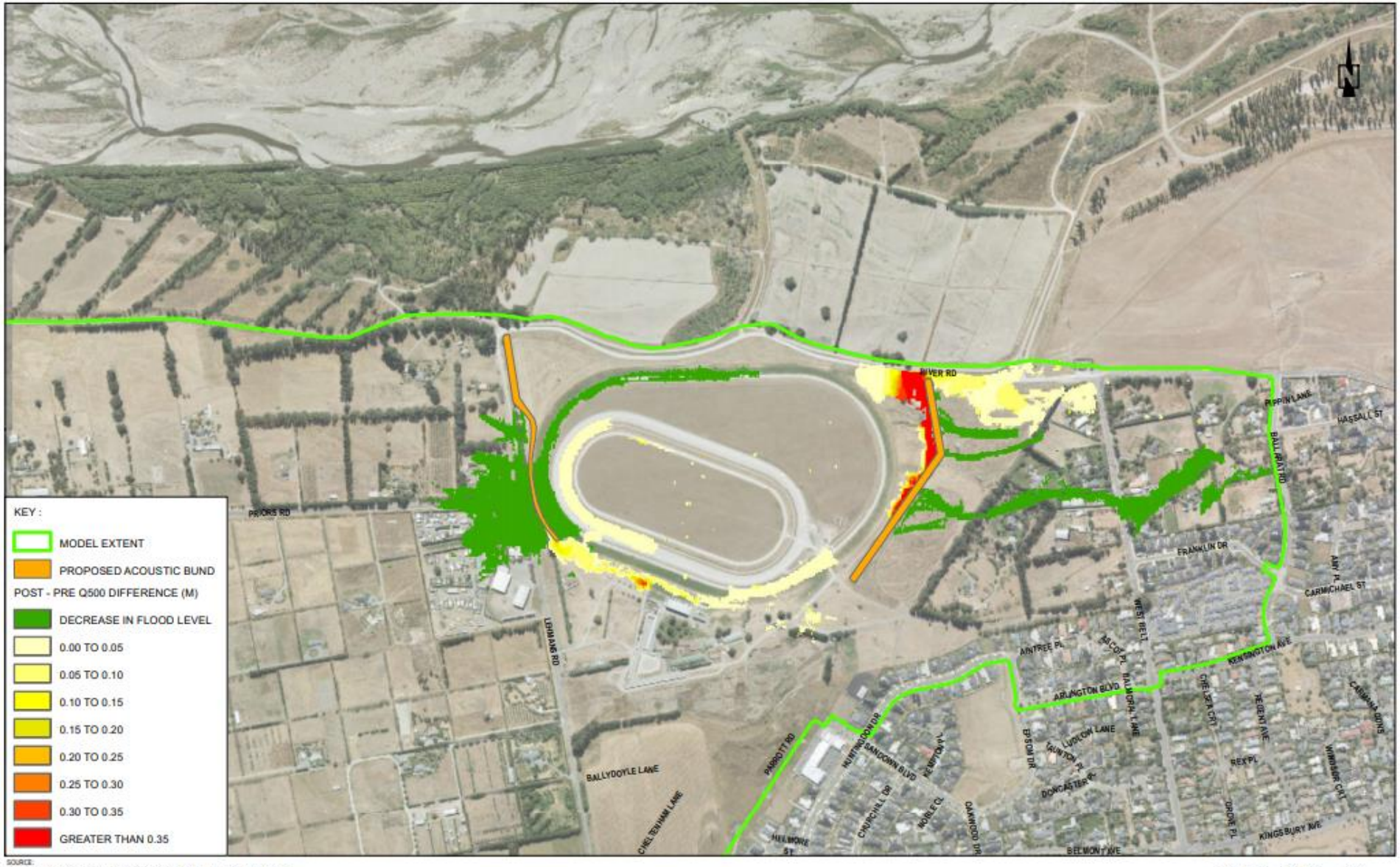
SOURCE:
1. AERIAL IMAGERY (FLOWN 2015-2016) SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/layer/53452-waimakariri-0075m-urban-aerial-photos-2015-2016/ AND LICENCED BY WAIMAKARIRI DISTRICT COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

WATER LEVEL DIFFERENCE MAP Q200 (POST - PRE)

SCALE : 1:10,000 (A4)

0 50 100 200 300

METRES



SOURCE:
1. AERIAL IMAGERY (FLOWN 2015-2016) SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/layer/53452-waimakariri-2075m-urban-aerial-photos-2015-2016/ AND LICENCED BY WAIMAKARIRI DISTRICT COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

WATER LEVEL DIFFERENCE MAP Q500 (POST - PRE)

SCALE : 1:10,000 (A4)

0 50 100 200 300

METRES

SOURCE:
1. AERIAL IMAGERY (FLOWN 2015-2016) SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/layer/53452-waimakariri-0075m-urban-aerial-photos-2015-2016/ AND LICENCED BY WAIMAKARIRI DISTRICT COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

Q500 FLOOD HAZARD DIFFERENCE