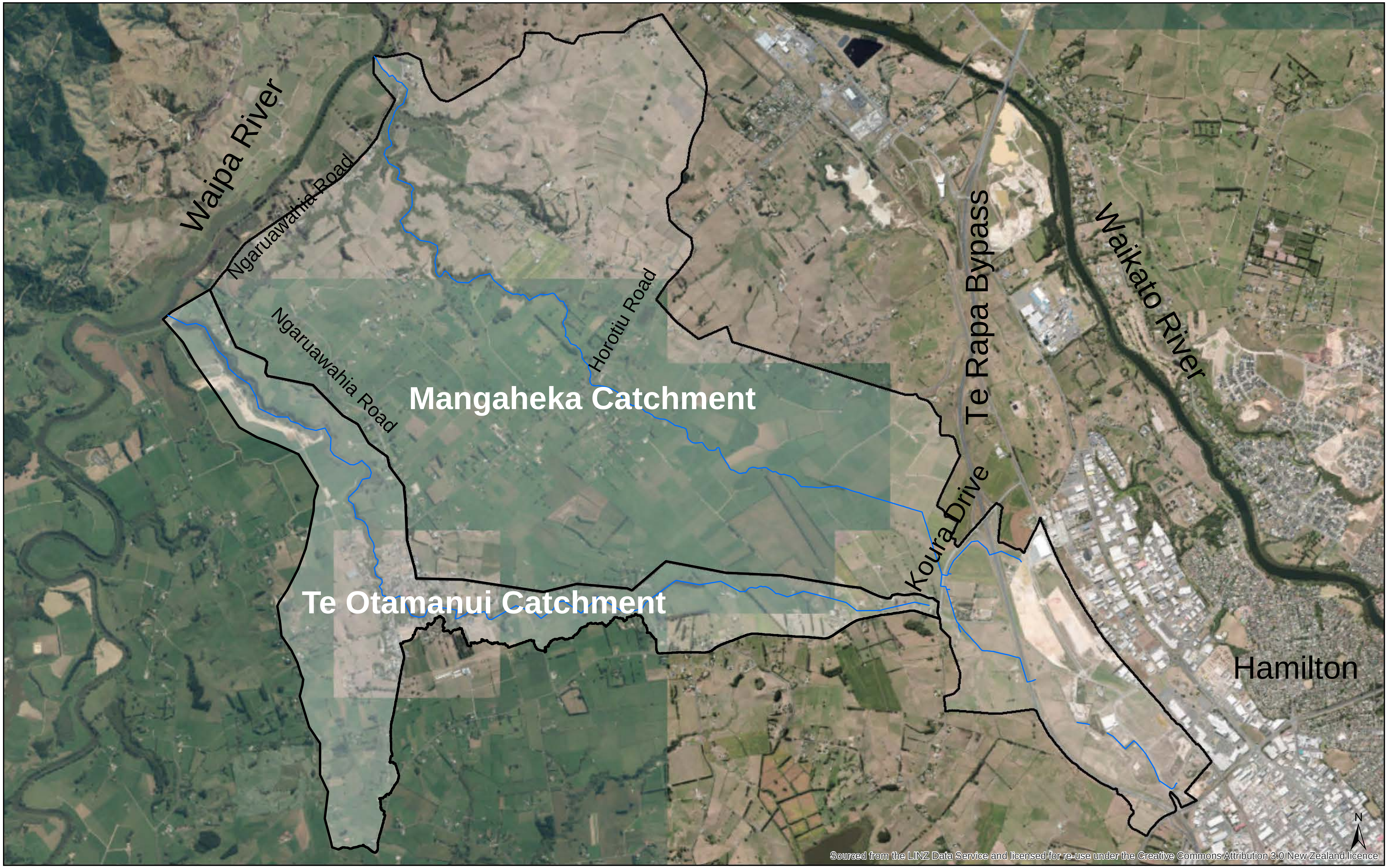
Appendix A

# Catchment Overview Plan





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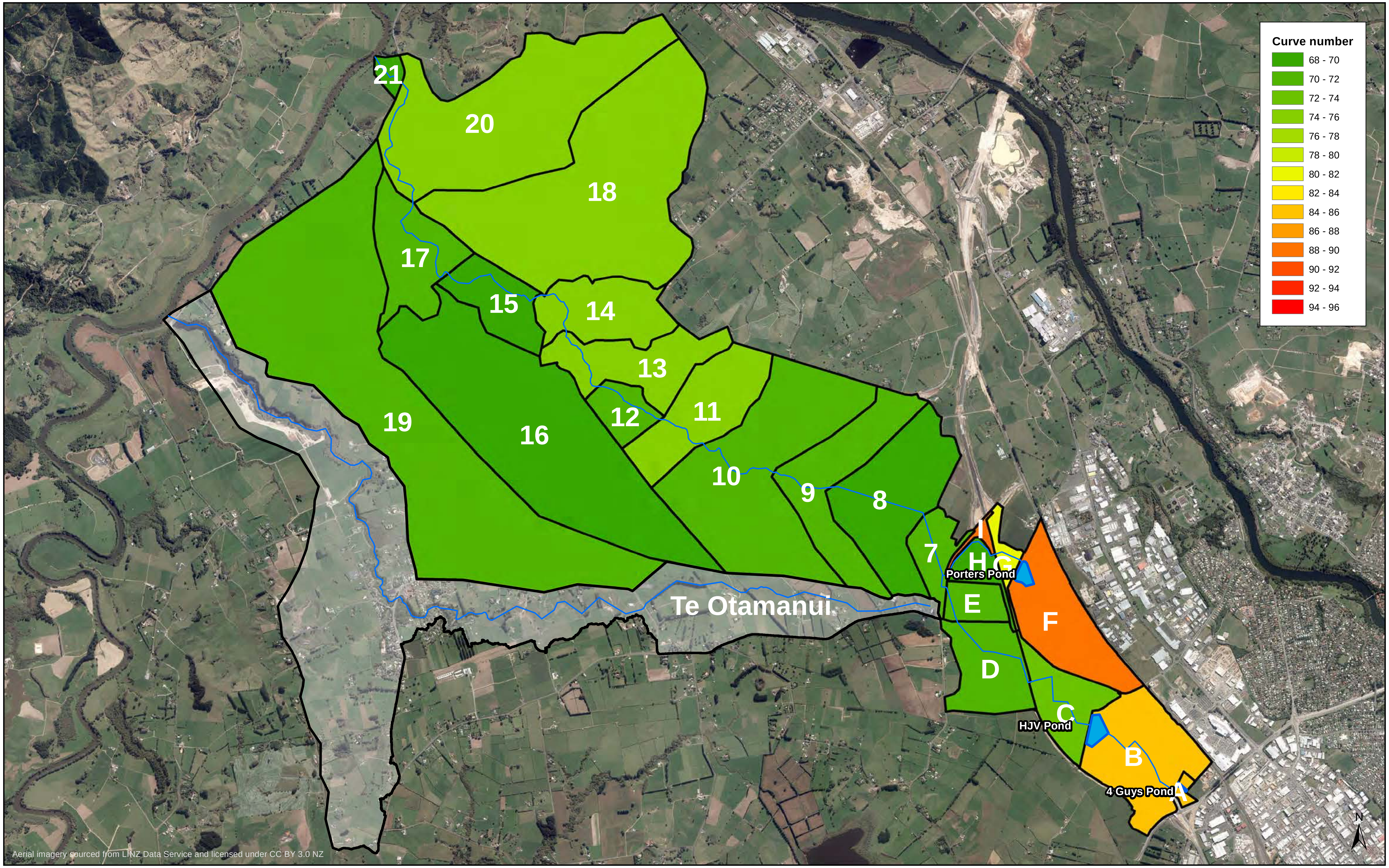
Appendix B

# Catchment and Device Plans

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# MANGAHEKA EXISTING* DEVELOPMENT CATCHMENT BOUNDARIES

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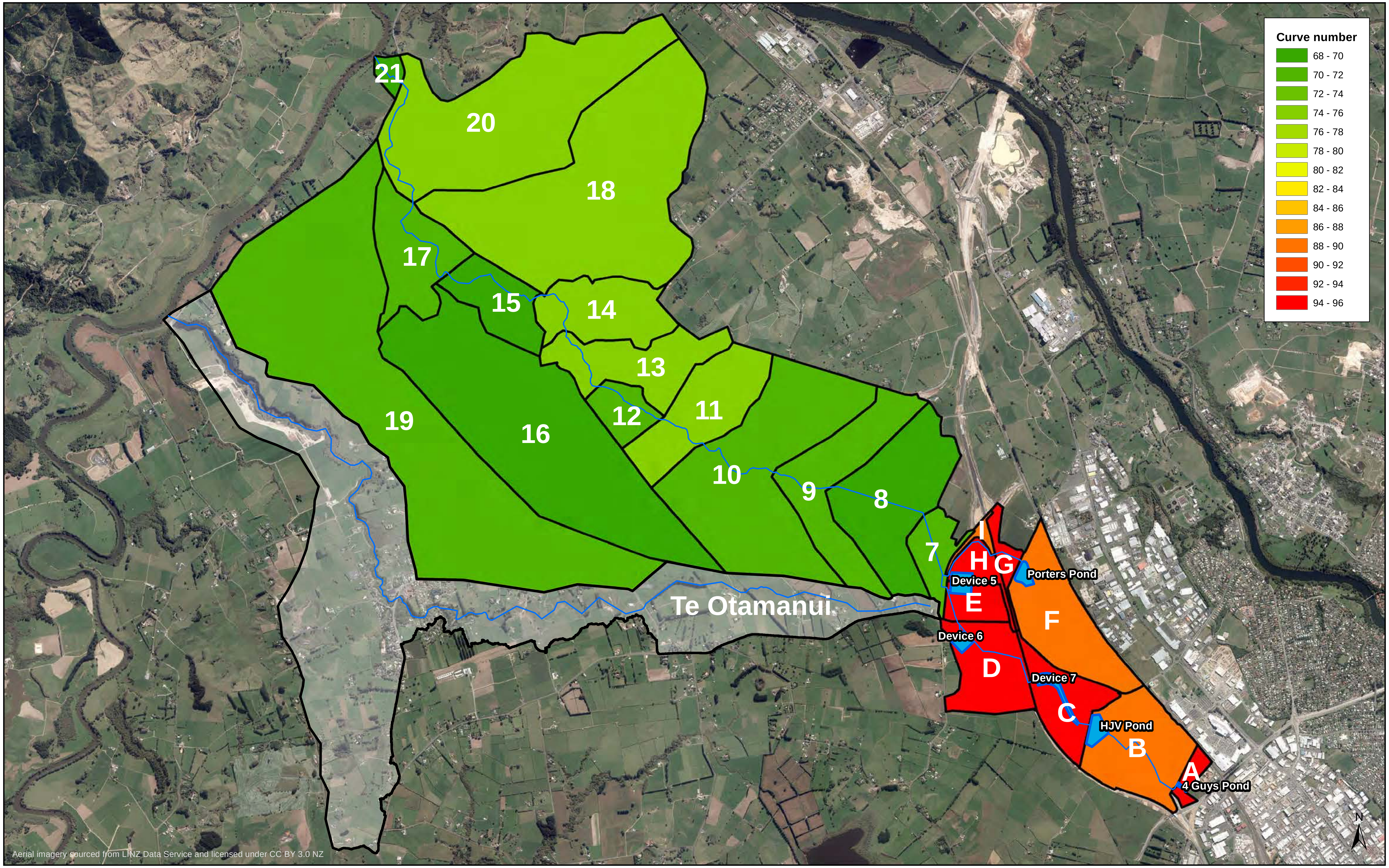


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# MANGAHEKA MAXIMUM PROBABLE DEVELOPMENT CATCHMENT BOUNDARIES

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Appendix C

# Catchment Characteristics

# ED Catchment Characteristics

| Catchment | Area ($km^2$) | Weighted SCS Curve Number | Percent Impervious | Time of Concentration |
|---|---|---|---|---|
| A | 0.0325 | 87.4 | 63.3% | 13 |
| A0 | 0.0377 | 69.0 | 0.0% | 41 |
| B | 0.7499 | 85.7 | 57.7% | 87 |
| C | 0.3835 | 73.4 | 15.0% | 61 |
| D | 0.4936 | 71.4 | 5.0% | 61 |
| E | 0.1730 | 71.9 | 10.0% | 48 |
| F | 0.6990 | 89.6 | 70.9% | 67 |
| G | 0.0951 | 80.6 | 40.0% | 34 |
| H | 0.1391 | 70.5 | 5.0% | 65 |
| I | 0.0411 | 89.3 | 70.0% | 25 |
| 7 | 0.2349 | 70.5 | 5.0% | 98 |
| 8 | 0.9553 | 71.4 | 5.0% | 92 |
| 9 | 0.7650 | 72.2 | 5.0% | 90 |
| 10 | 1.7631 | 72.5 | 5.0% | 80 |
| 11 | 0.6866 | 76.5 | 5.0% | 64 |
| 12 | 0.2195 | 71.1 | 5.0% | 99 |
| 13 | 0.6087 | 75.4 | 5.0% | 74 |
| 14 | 0.5629 | 75.6 | 5.0% | 61 |
| 15 | 0.4046 | 70.5 | 5.0% | 142 |
| 16 | 2.5500 | 70.7 | 5.0% | 136 |
| 17 | 0.5928 | 71.6 | 5.0% | 66 |
| 18 | 2.6593 | 76.4 | 5.0% | 160 |
| 19 | 4.0947 | 70.9 | 5.0% | 278 |
| 20 | 2.0190 | 77.0 | 5.0% | 90 |
| 21 | 0.0672 | 70.5 | 5.0% | 53 |

# MPD Catchment Characteristics

| Catchment | Area ($km^2$) | Weighted Curve Number | Percent Impervious | Time of Concentration |
|---|---|---|---|---|
| A | 0.0702 | 95.1 | 90.0% | 22 |
| B | 0.6674 | 88.6 | 67.6% | 81 |
| C | 0.3836 | 95.4 | 91.0% | 53 |
| D | 0.4936 | 95.5 | 91.0% | 47 |
| E | 0.1730 | 95.4 | 91.0% | 36 |
| F | 0.6990 | 89.6 | 70.9% | 67 |
| G | 0.0951 | 95.4 | 91.0% | 34 |
| H | 0.1391 | 95.4 | 91.0% | 49 |
| I | 0.0411 | 89.3 | 70.0% | 25 |
| 7 | 0.2349 | 70.5 | 5.0% | 98 |
| 8 | 0.9553 | 71.4 | 5.0% | 92 |
| 9 | 0.7650 | 72.2 | 5.0% | 90 |
| 10 | 1.7631 | 72.5 | 5.0% | 80 |
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| 15 | 0.4046 | 70.5 | 5.0% | 142 |
| 16 | 2.5500 | 70.7 | 5.0% | 136 |
| 17 | 0.5928 | 71.6 | 5.0% | 66 |
| 18 | 2.6593 | 76.4 | 5.0% | 160 |
| 19 | 4.0947 | 70.9 | 5.0% | 278 |
| 20 | 2.0190 | 77.0 | 5.0% | 90 |
| 21 | 0.0672 | 70.5 | 5.0% | 53 |

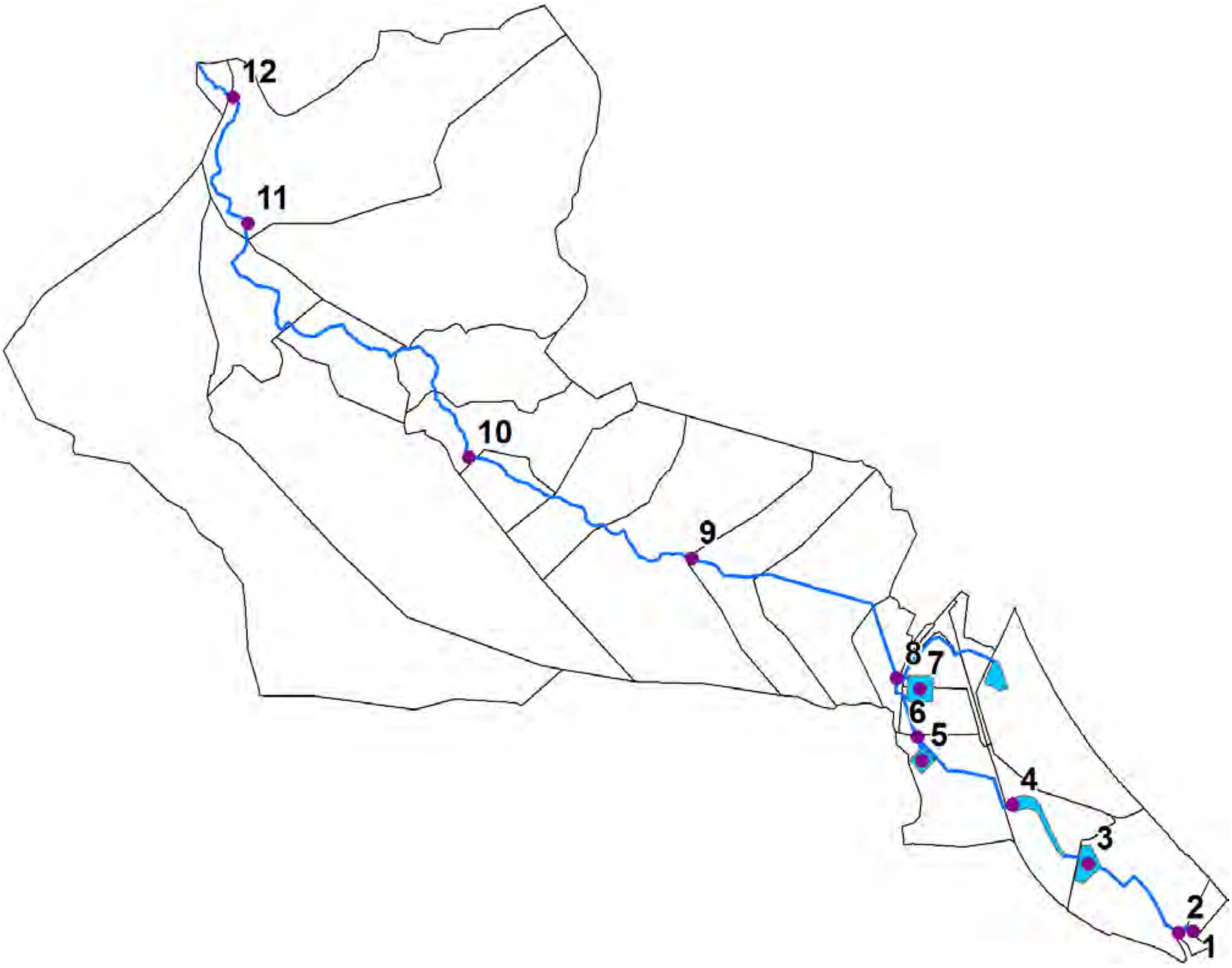
Appendix D

# Reporting Locations

# Reporting location descriptions

| Location Label | Channel | Chainage | Description |
|---|---|---|---|
| 1 | n/a | n/a | 4 Guys Pond (stage or outflow rate) |
| 2 | HJV Drain | 11764 | Immediately upstream of culvert under Arthur Porter Drive |
| 3 | n/a | n/a | HJV Pond (stage or outflow rate) |
| 4 | Mangaheka Stream | 9963.79 | Immediately downstream of Device 7 bund, but upstream of culvert under Waikato Expressway |
| 5 | n/a | n/a | Device 6 (stage or outflow rate) |
| 6 | Mangaheka Stream | 9026.23 | Immediately downstream of Device 6 outflow but upstream of culvert under Te Kowhai Road |
| 7 | n/a | n/a | Device 5 (stage or outflow rate) |
| 8 | Mangaheka Stream | 8584 | Immediately downstream of junction between Mangaheka Stream and Porters Drain |
| 9 | Mangaheka Stream | 6662.78 | Downstream end of catchment 9 |
| 10 | Mangaheka Stream | 4695.33 | Immediately upstream of culvert under Horotiu Road |
| 11 | Mangaheka Stream | 1524.27 | Downstream of catchment 18 inflow hydrograph |
| 12 | Mangaheka Stream | 373.54 | Immediately upstream of culvert under Ngaruawahia Road |

# Reporting Locations

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**MANGAHEKA MAXIMUM PROBABLE DEVELOPMENT CATCHMENT BOUNDARIES CLOSE UP**

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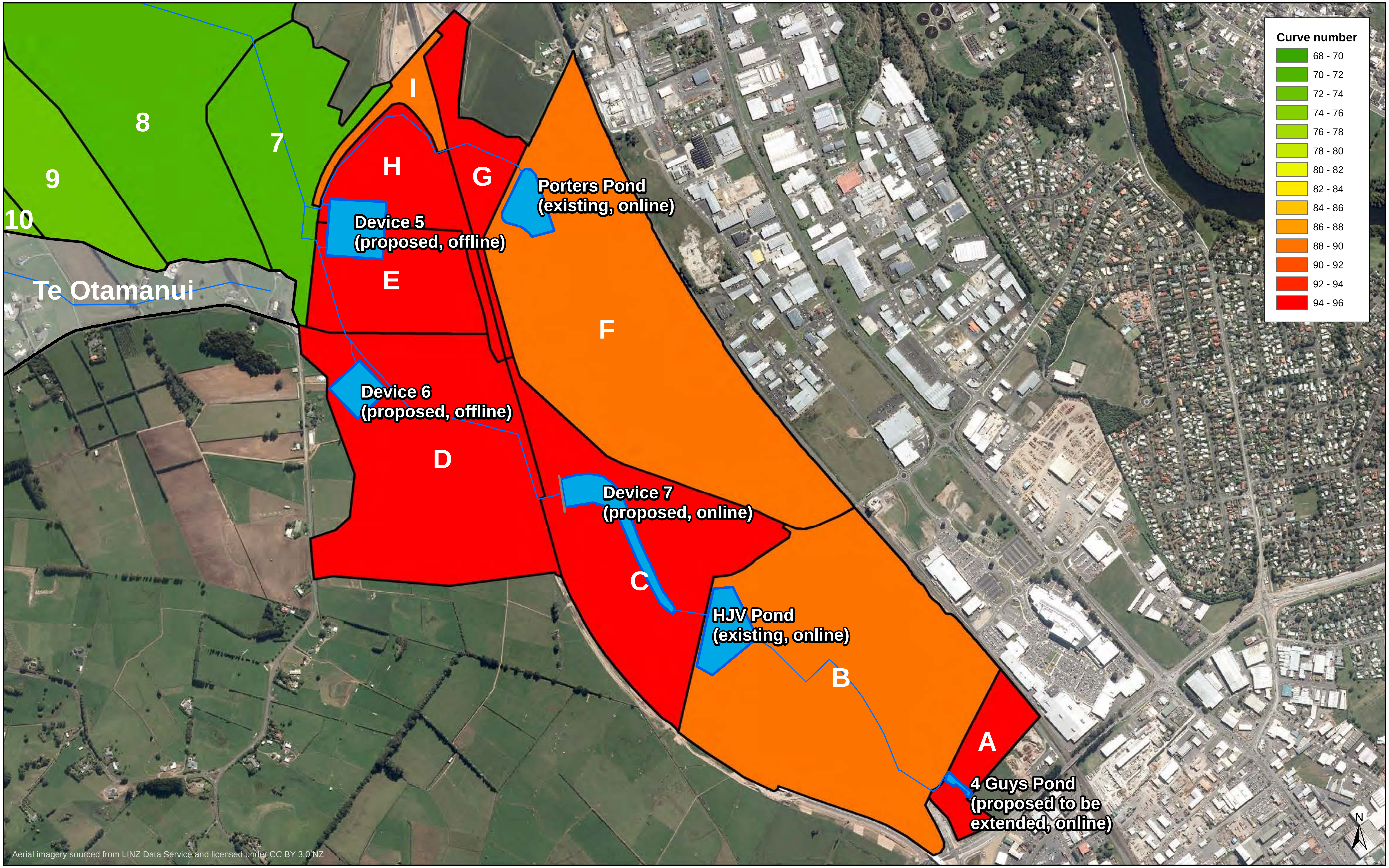
Appendix E

# Proposed Mitigation Device Locations

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PROJECT TITLE
# MANGAHEKA MAXIMUM PROBABLE DEVELOPMENT PROPOSED MITIGATION DEVICES

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Appendix F

# Holdpoint email summarising pond configurations

## Angela Pratt

**From:** Angela Pratt
**Sent:** Thursday, 6 October 2016 9:26 p.m.
**To:** 'Emily Reeves'
**Cc:** Reuben Ferguson; Melissa Slatter; Andrea Phillips; Cameron Oliver; Elliot Tuck
**Subject:** FW: Mangaheka 1D Modelling - MPD Holdpoint
**Attachments:** 10.2015.8149 - Engineering Design Plans & Reports - Z Energy - 77 Tasman... 21.pdf; Mangaheka revised catchment MPD.pdf; Device Locations MPD.pdf

Hi Emily,

We are hoping to get into the MPD modelling shortly, therefore in accordance with our IFS, below is the details of the proposed MPD modelling that requires your approval before we proceed. Are you able to confirm you are happy with this information? I am happy to discuss any of the details. I am out of the office tomorrow, but feel free to ring Cameron Oliver or Elliot Tuck if you have any questions (03 3663521).

**Assumptions**

- The Sharkfin area has been modelled in the Existing Development scenarios but this will discharge to the Rotokauri catchment when the area is developed. This has been discussed and agreed with Andrea Phillips.
- Catchment D has been included in ED modelling and will continue to in the MPD modelling however some of this area may discharge to Rotokauri when it is developed. We have included this area in our model to be conservative.

**Runoff Characteristics (Imperviousness)**

Catchment Summary

| | Existing Development | | | Maximum Probable Development | | |
|---|---|---|---|---|---|---|
| Catchment | Area | Imperviousness | Curve Number | Area | Imperviousness | Curve Number |
| | ha | | | ha | | |
| A | 3.3 | 63% | 87.4 | 7.0 | 90% | 95.1 |
| B | 78.8 | 55% | 84.9 | 66.7 | 68% | 88.6 |
| C | 38.4 | 15% | 73.4 | 38.4 | 91% | 95.4 |
| D | 49.4 | 2% | 70.5 | 49.4 | 91% | 95.5 |
| E | 17.3 | 10% | 71.9 | 17.3 | 91% | 95.4 |
| F | 69.9 | 71% | 89.6 | 69.9 | 71% | 89.6 |
| G | 9.5 | 40% | 80.6 | 9.5 | 91% | 95.4 |
| H | 13.9 | 3% | 69.9 | 13.9 | 91% | 95.4 |
| I | 4.1 | 70% | 89.3 | 4.1 | 70% | 89.3 |
| 7 | 23.5 | 5% | 70.5 | 23.5 | 5% | 70.5 |
| 8 | 95.5 | 0% | 70.0 | 95.5 | 0% | 70.0 |
| 9 | 76.5 | 0% | 70.8 | 76.5 | 0% | 70.8 |
| 10 | 176.3 | 0% | 71.2 | 176.3 | 0% | 71.2 |
| 11 | 68.7 | 0% | 75.3 | 68.7 | 0% | 75.3 |
| 12 | 22.0 | 3% | 70.6 | 22.0 | 3% | 70.6 |
| 13 | 60.9 | 2% | 74.7 | 60.9 | 2% | 74.7 |
| 14 | 56.3 | 0% | 74.4 | 56.3 | 0% | 74.4 |
| 15 | 40.5 | 0% | 69.0 | 40.5 | 0% | 69.0 |
| 16 | 255.0 | 1% | 69.5 | 255.0 | 1% | 69.5 |
| 17 | 59.3 | 0% | 70.2 | 59.3 | 0% | 70.2 |
| 18 | 265.9 | 1% | 75.5 | 265.9 | 1% | 75.5 |
| 19 | 409.5 | 3% | 70.3 | 409.5 | 3% | 70.3 |
| 20 | 201.9 | 0% | 75.9 | 201.9 | 0% | 75.9 |
| 21 | 6.7 | 0% | 69.0 | 6.7 | 0% | 69.0 |
| Total | 2102.8 | | | 2094.6 | | |

- In terms of the main catchments to be developed at MPD (C,D,E,G, and H), we have used 91% Impervious. This assumes that 10% of the catchment is roads (95% Impervious)and 90% is Industrial (90% Impervious). As an average this is 90.5% Impervious (91% used).
- Note that catchment A and B are already partly developed so I have taken an average of the ED % impervious and the percentages stated above for the portion to be developed.

## Catchment Boundaries

Attached is a plan with the MPD catchment boundaries. Of particular note is:

-the Giles block (north-east of 4 guys) is now in catchment A (rather than B)

-the sharkfin has been removed (as above)

-the area at the south end of Arthur Porter Drive goes into another system according the HCC GIS. The catchment boundary here has been changed for both MPD and ED.

## Proposed Device Locations (See attached plan)

I have discussed this with Andrea, and subject to the MPD (without mitigation) modelling proving that mitigation is required, we propose to model the following attenuation systems: (Note that generally treatment would need to be onsite/at source and is not dealt with at all in this modelling)

**Device 5 (Catchment E, H and possibly G)** – This land has multiple owners. They would likely need to work together to build an attenuation system.

For the purposes of modelling, we propose one large offline attenuation pond just upstream of the two Koura Drive culverts. This would serve the three catchments but the triangle of land west of the stream (next to Koura Drive roundabout) and catchment G would not discharge into it ie it would over-attenuate catchments E and H.

**Device 6 (Catchment D)** - As this whole area of land is owned by a single owner, there are a few options for developing the site:

- An attenuation system on either side of the stream
- A combined attenuation system on one side only (SW) that attenuates the whole catchment i.e. larger to attenuate whole catchment but with only part of the catchment (SW part) draining to it. Plus, there would need to be separate treatment on both sides of the stream
- Move the stream north so that the whole catchment can be treated and attenuated in one system.

For the purposes of modelling, we have sized one large attenuation basin which serves the land on both sides of the stream.

**Device 7 (Catchment C) –** The area of land that this serves is owned by a variety of landowners. They would likely need to work together to build an attenuation system. It is also logical here to realign/naturalise the stream given the angular drain/stream alignment and create a low flow channel and higher/wider flood plain.

For the purposes of modelling, we will size one large online attenuation basin which serves the land on both sides of the stream. We will also test whether the existing culvert is enough of a throttle or if a formal outlet pipe/weir arrangement is required.

**Device 8 (Catchment A) -** This has already been sized to provide attenuation for the 4 Guys car yard, the Z energy petrol station and the piece of land north of the pond (Total area 3.5ha- See attached plan). This pond could be made larger to manage the Giles (ex Hooker) land to the north.

For the purposes of modelling, we will increase the size of the existing pond to manage the Giles land to the north. This area will therefore also shift from catchment B to catchment A.

## Deviations from Modelling Specification

No new deviations from those approved for the ED modelling.

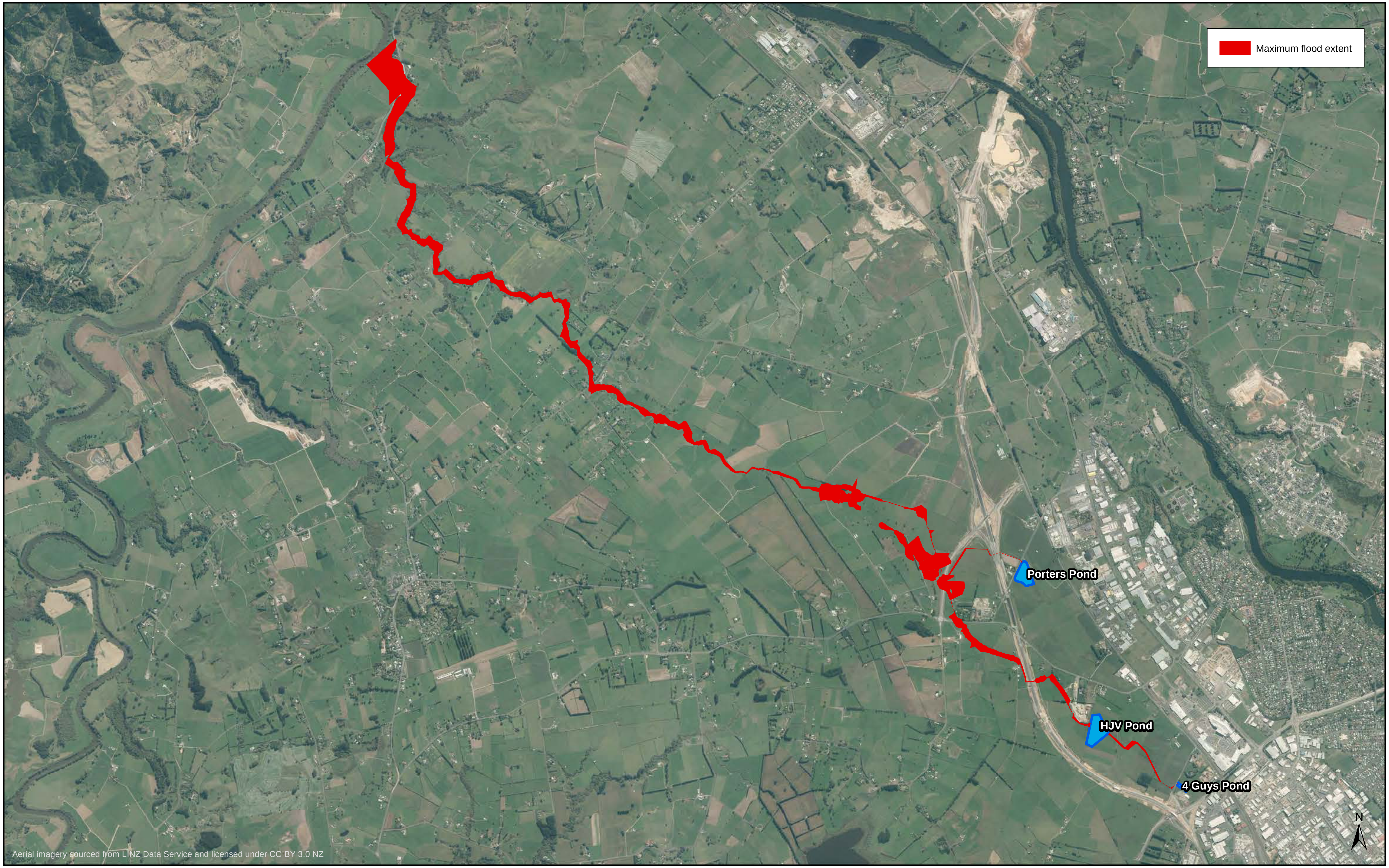
**Angela Pratt**
Senior Environmental Engineer
Beca

DDI +64 3 374 3197
angela.pratt@beca.com
www.beca.com

Note: My working hours are Monday, Wednesday and Friday 8.30am until 4pm.

Appendix G

# Flood Maps – 100 year

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# MANGAHEKA FLOOD EXTENT EXISTING DEVELOPMENT 100 YEAR ARI

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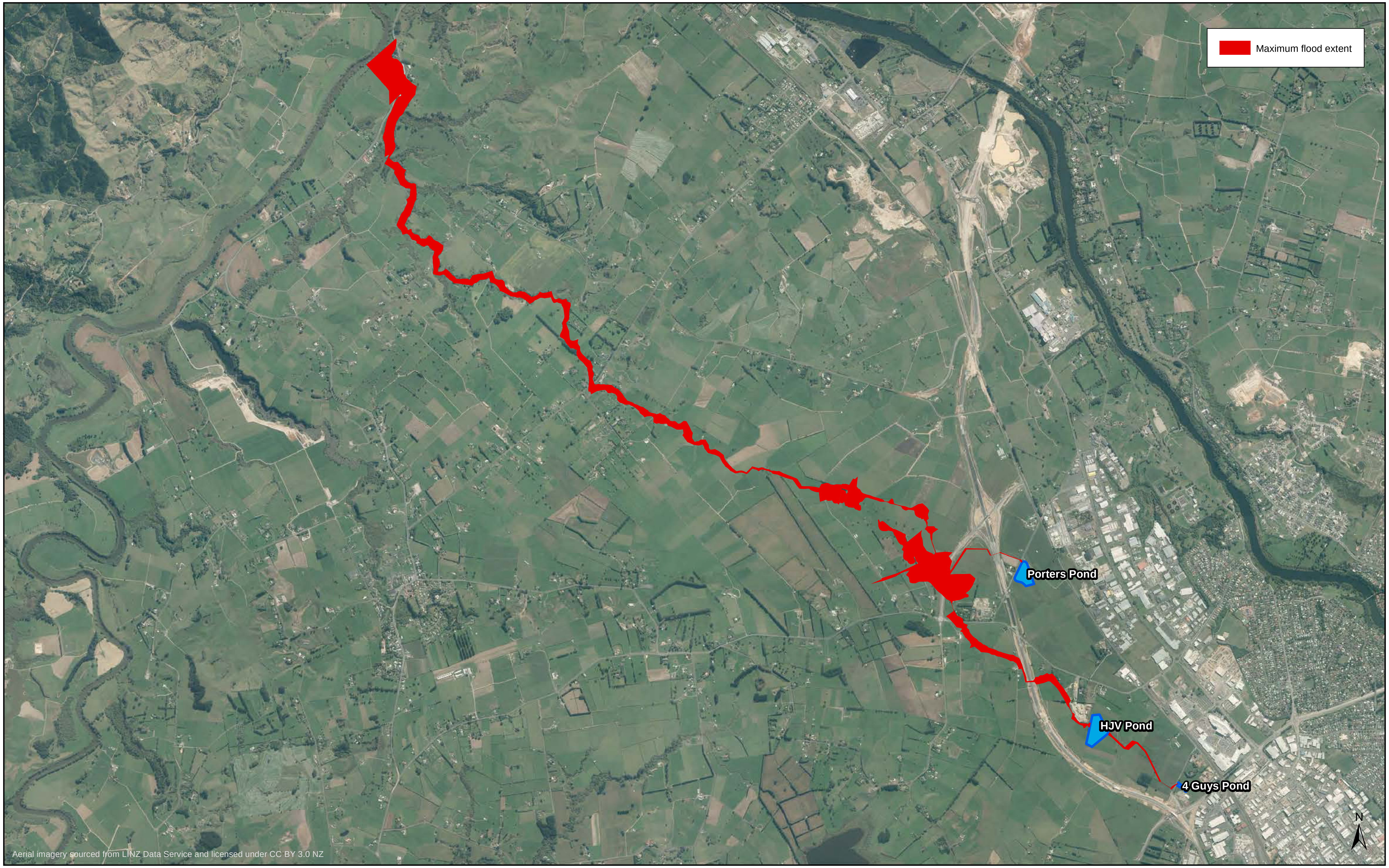


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# MANGAHEKA FLOOD EXTENT EXISTING DEVELOPMENT 100 YEAR ARI CLIMATE CHANGE

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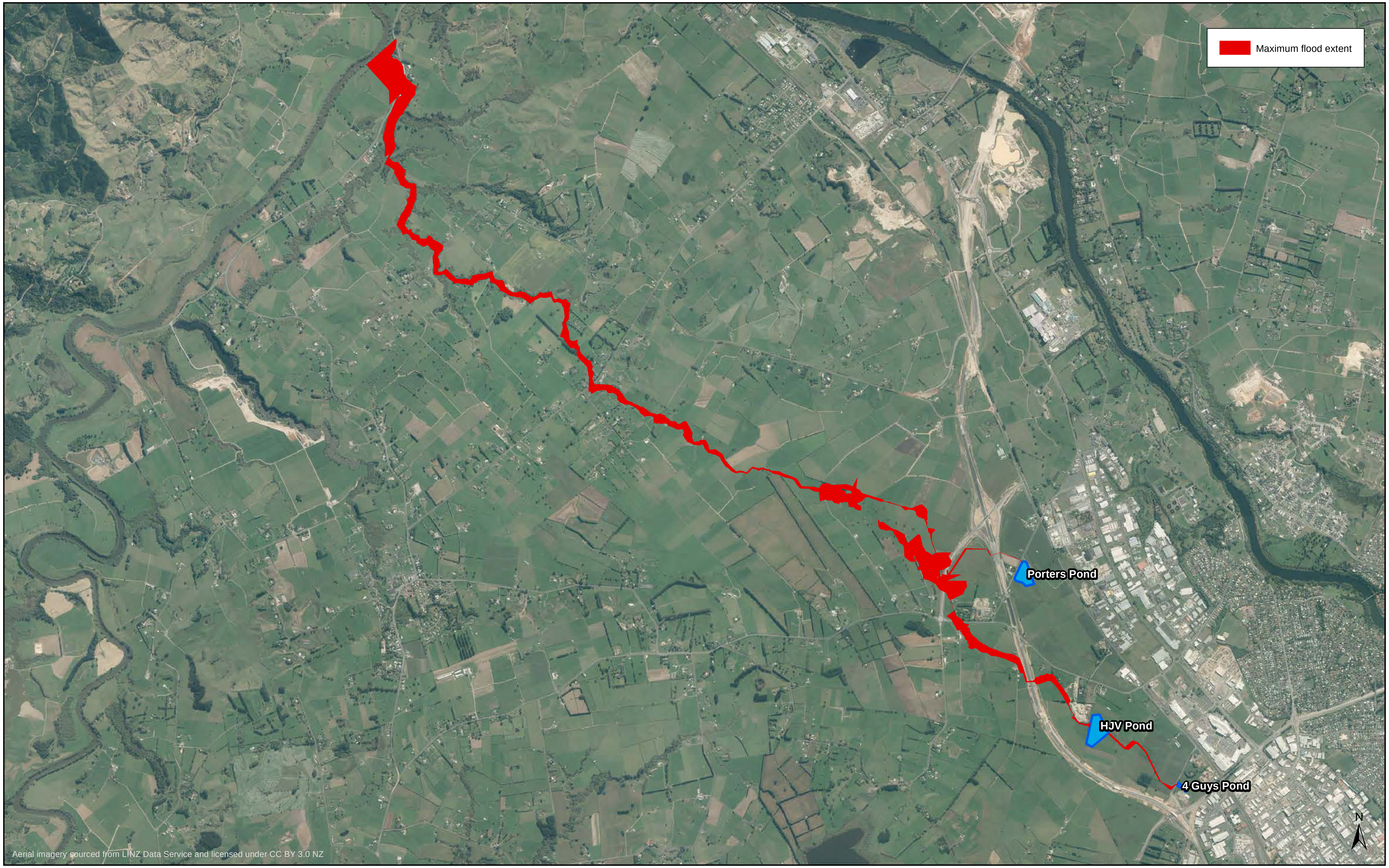


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# MANGAHEKA FLOOD EXTENT MAXIMUM PROBABLE DEVELOPMENT 100 YEAR ARI

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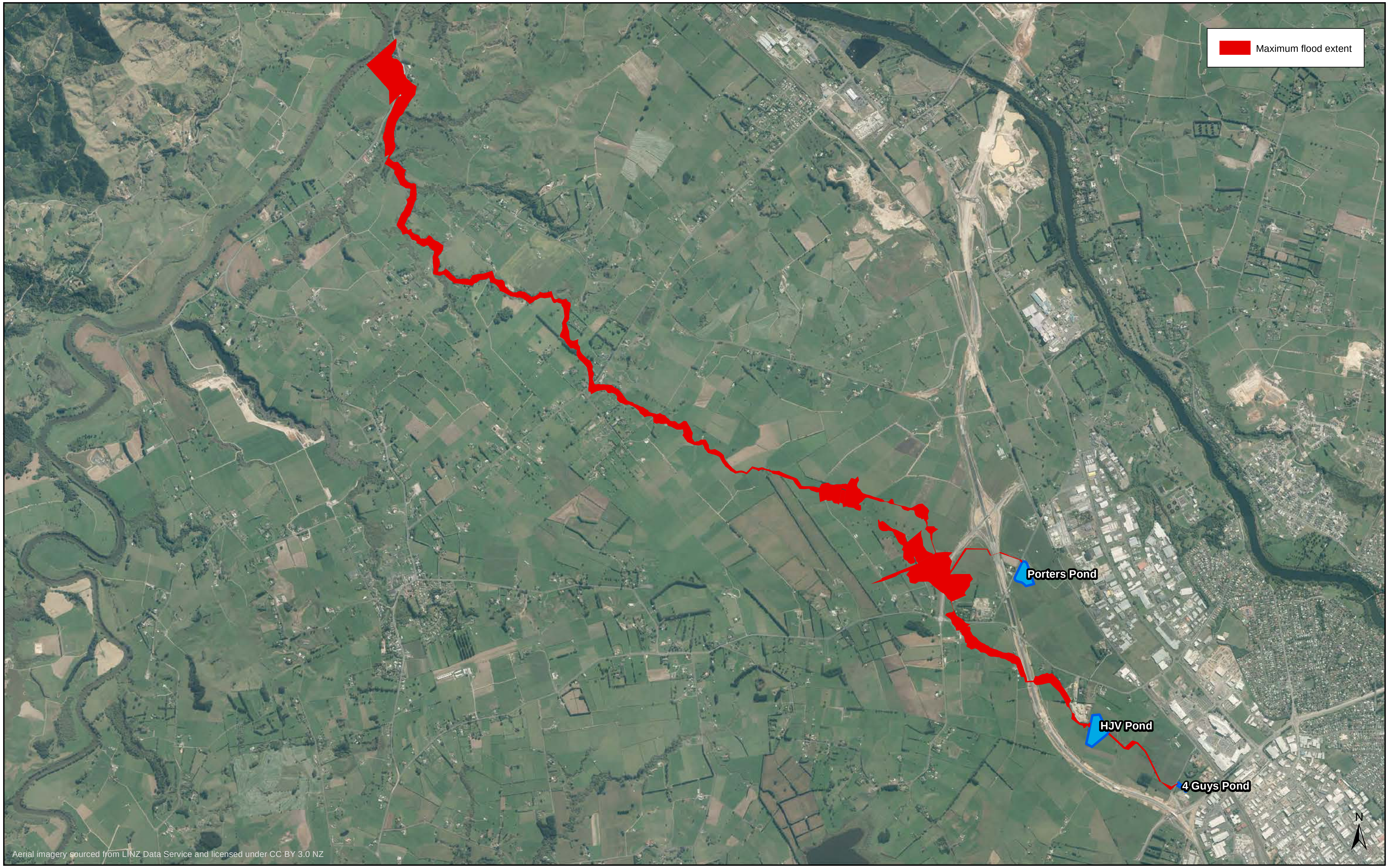


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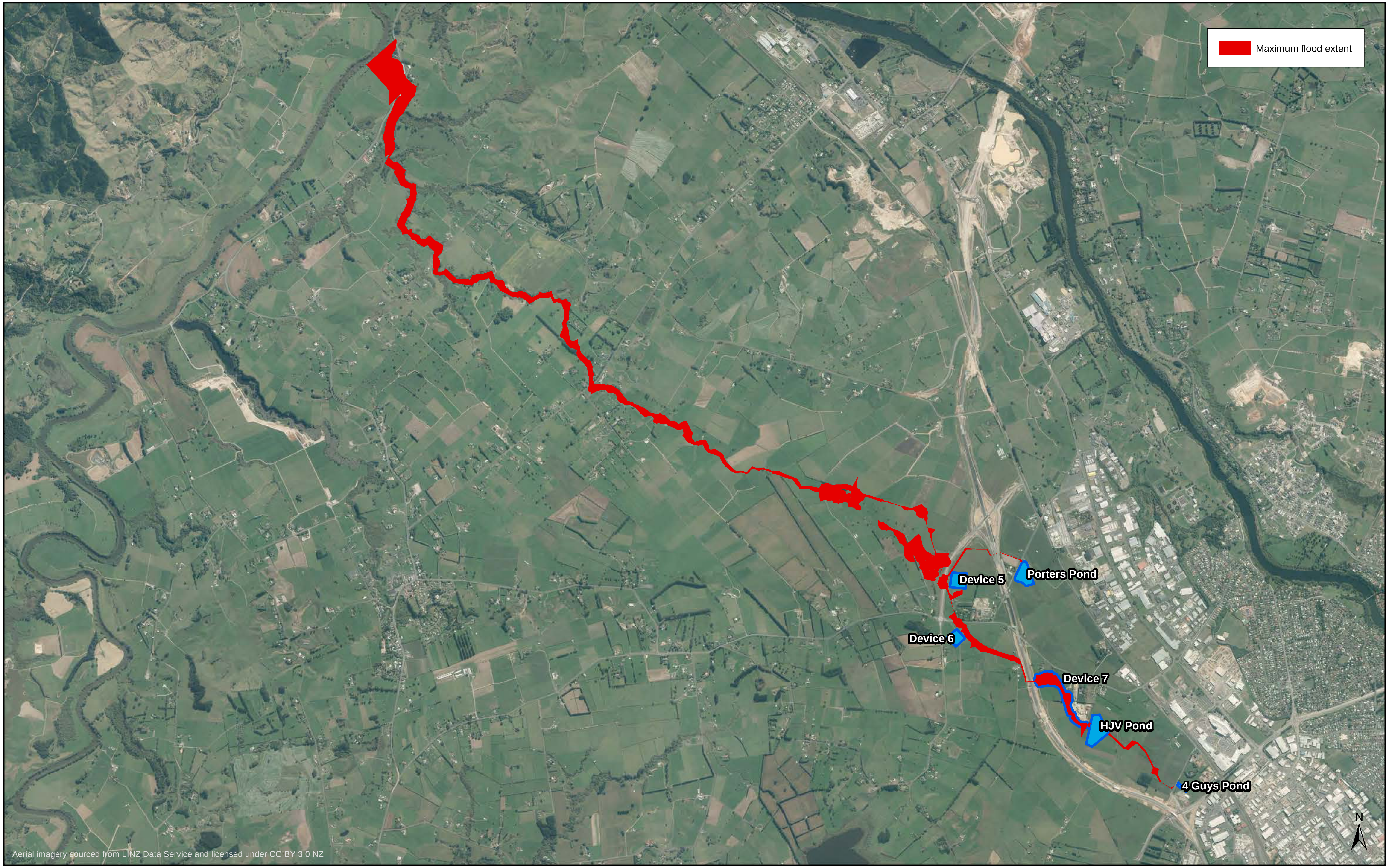


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# MANGAHEKA FLOOD EXTENT MPD 100 YEAR ARI CLIMATE CHANGE WITH PROPOSED MITIGATION

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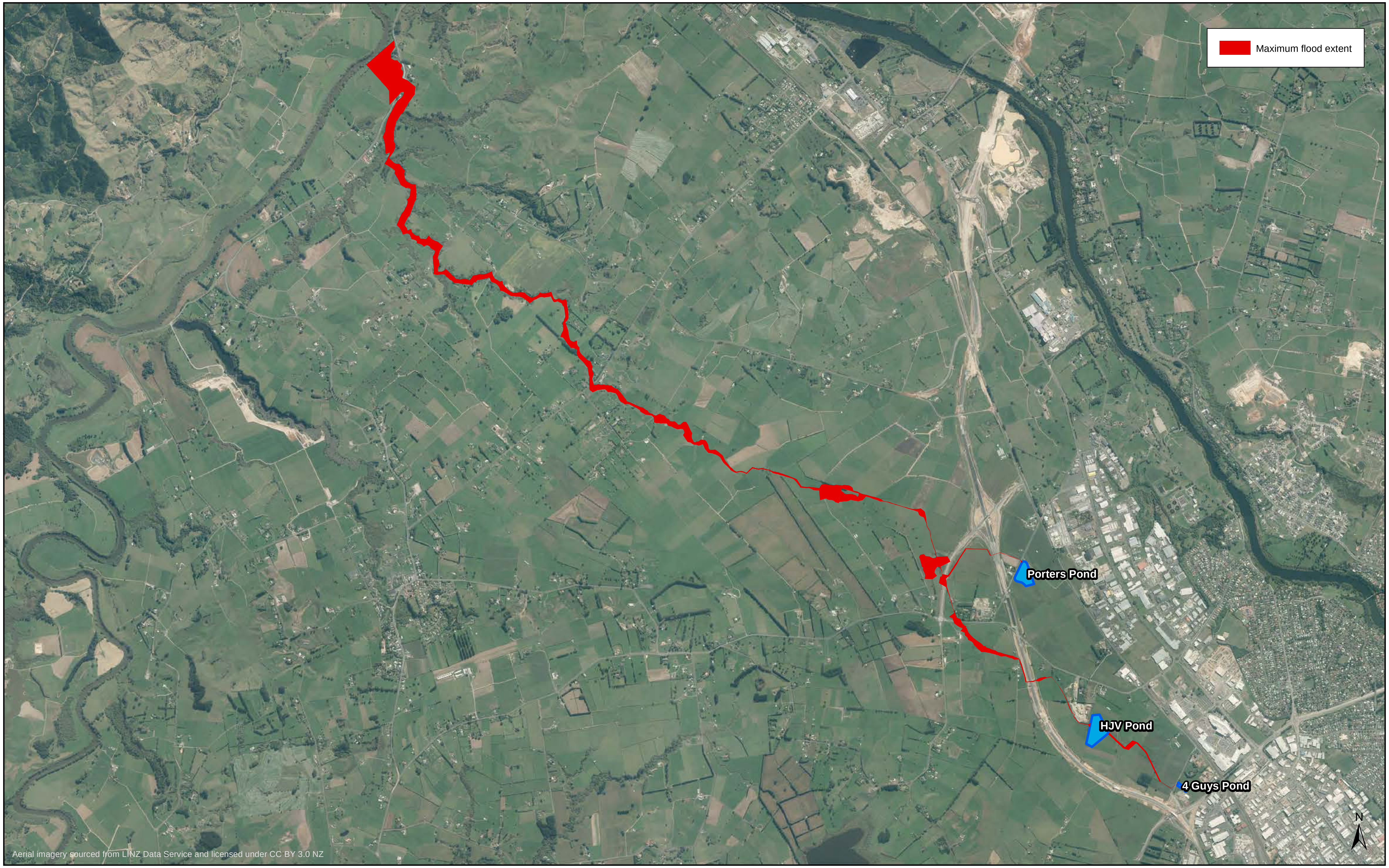
Appendix H

# Flood Maps – 10 year

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# MANGAHEKA FLOOD EXTENT EXISTING DEVELOPMENT 10 YEAR ARI

DRAWING TITLE

**FOR INFORMATION ONLY**

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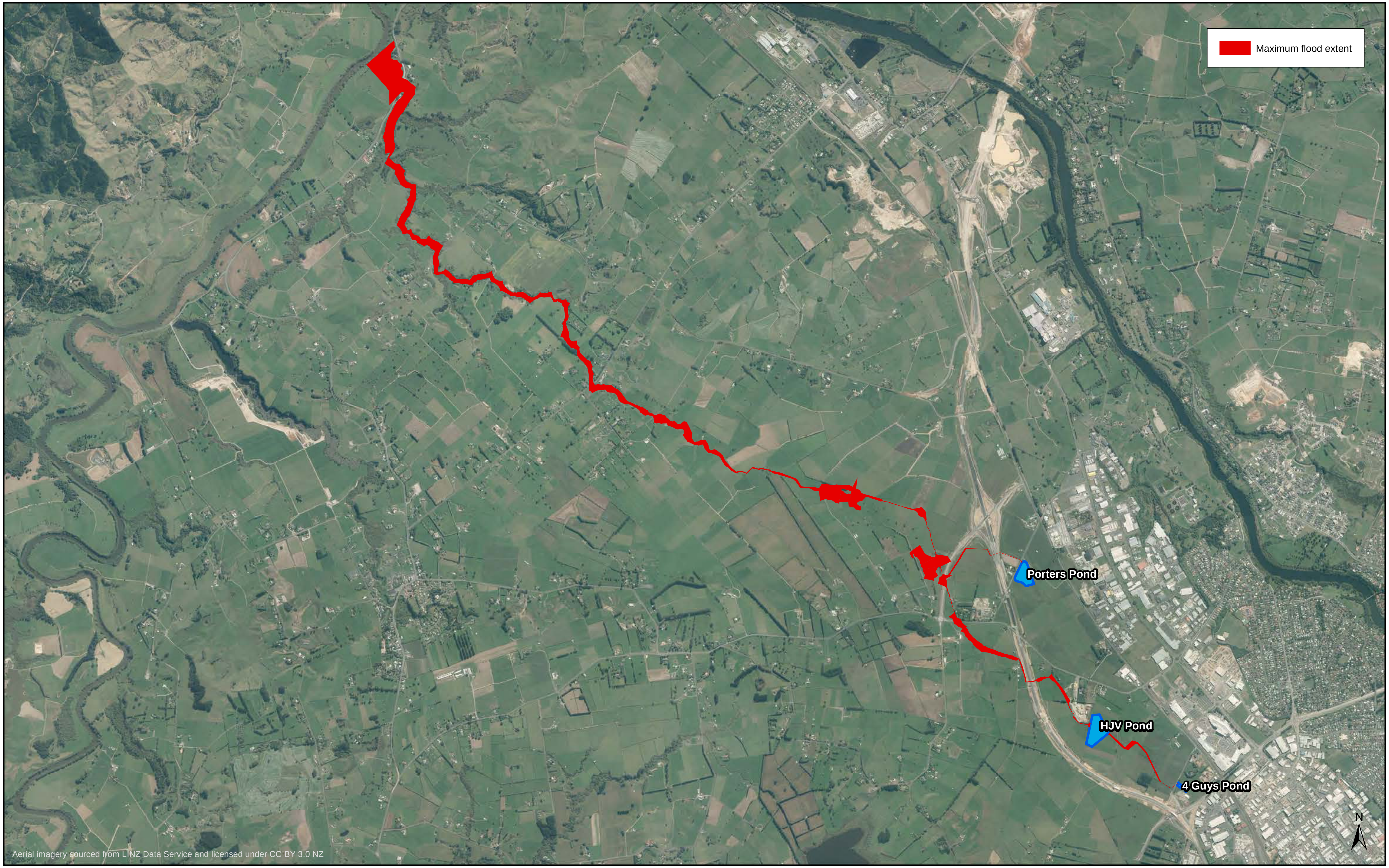



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PROJECT TITLE

# MANGAHEKA FLOOD EXTENT EXISTING DEVELOPMENT 10 YEAR ARI CLIMATE CHANGE

DRAWING TITLE

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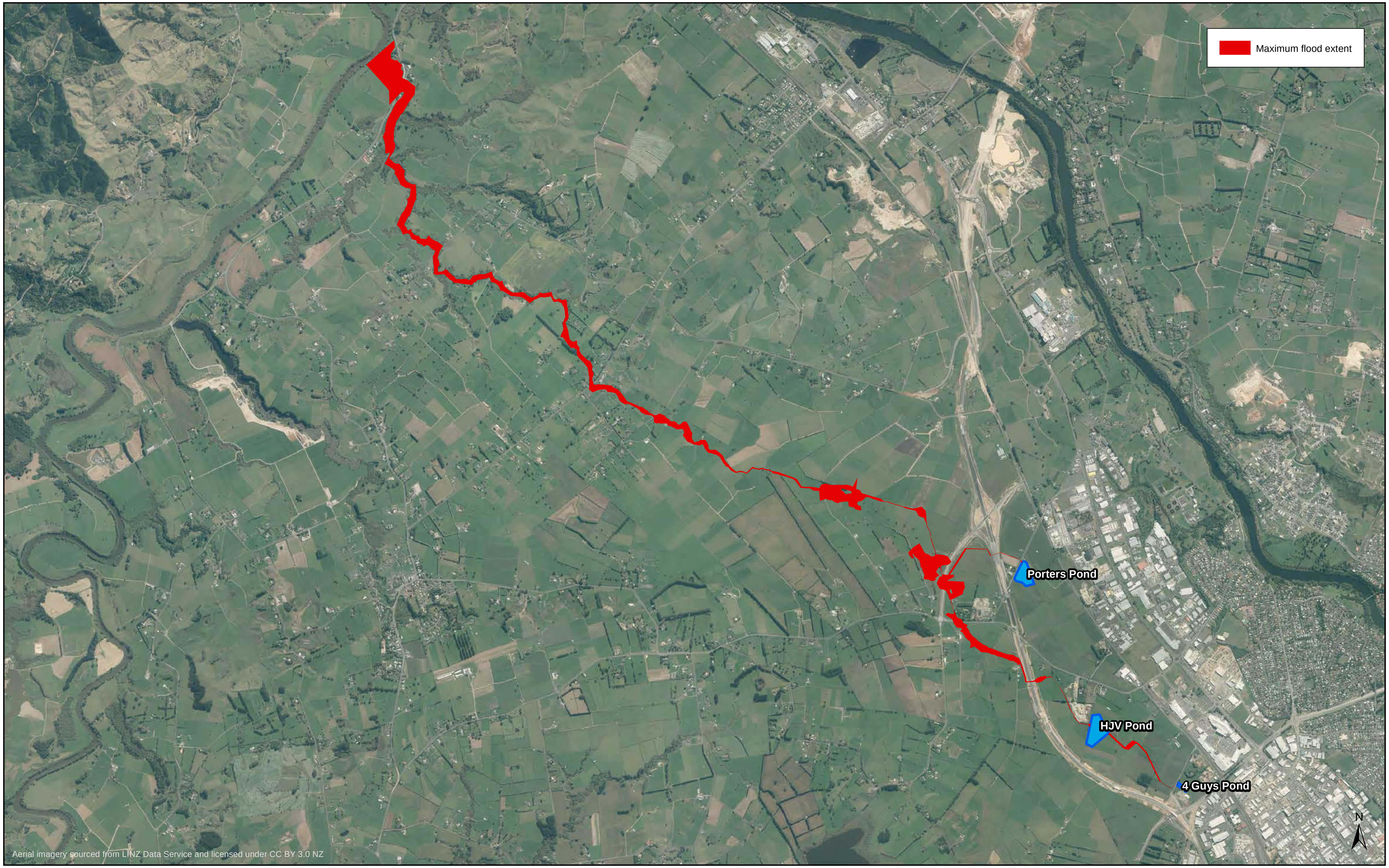


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PROJECT TITLE

# MANGAHEKA FLOOD EXTENT MAXIMUM PROBABLE DEVELOPMENT 10 YEAR ARI

DRAWING TITLE

**FOR INFORMATION ONLY**

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ORIGINAL SHEET SIZE: A3

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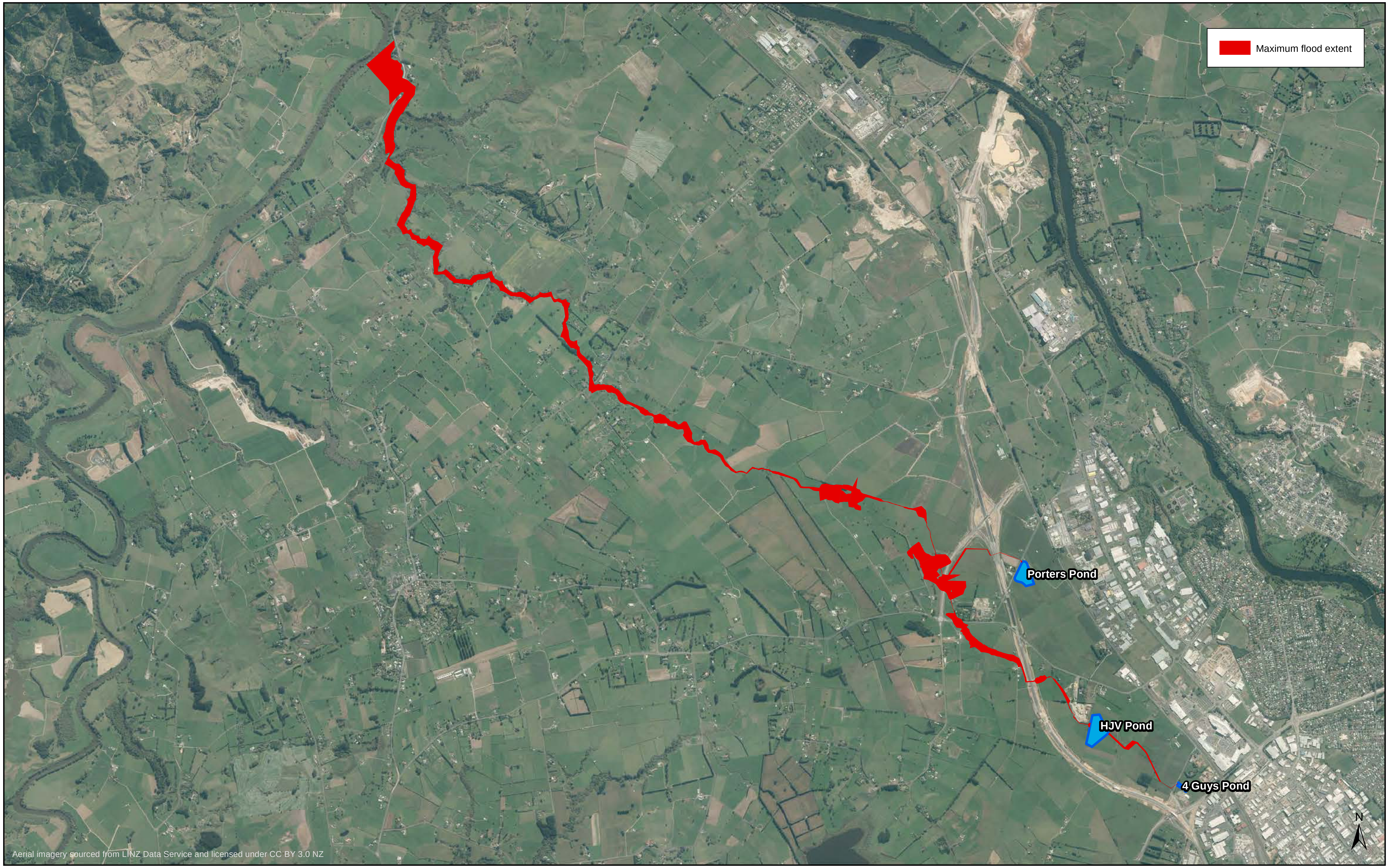


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# MANGAHEKA FLOOD EXTENT MAXIMUM PROBABLE DEVELOPMENT 10 YEAR ARI CLIMATE CHANGE

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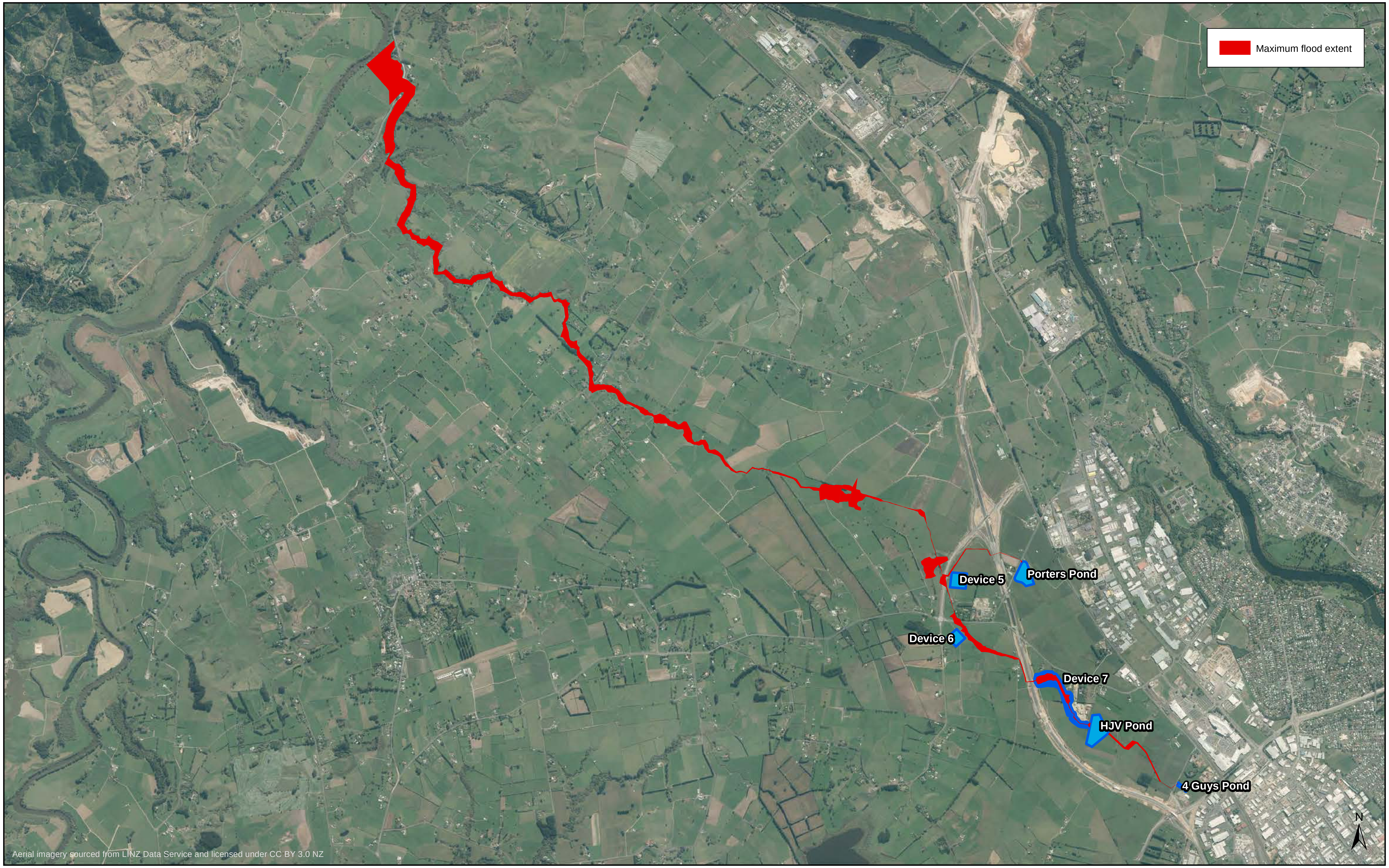


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# MANGAHEKA FLOOD EXTENT MPD 10 YEAR ARI CLIMATE CHANGE WITH PROPOSED MITIGATION

DRAWING TITLE

**FOR INFORMATION ONLY**

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Appendix I

# Peer Review Comments and Responses

| Item | Reference | MEL comment | Beca comment | MEL response | Beca further response |
|---|---|---|---|---|---|
| 1 | General | Some background to the hydrological modelling underpinning the reported work would provide useful context, including specification of software used (understood to be HEC-HMS) and related assumptions. Similarly, further information on e.g. channel roughness values adopted, calculation of time of concentration, etc. would also provide useful context. | We agree that it would be useful to include this information. | | Section 3.1, 3.4 and 3.7 of the report have been added to discuss the use of HEC-HMS and other inputs. |
| 2 | General | Mitigation targets were specified in the initial IFS as 80% of ED peak flows, and in the subsequent IFS as maintaining (i.e. 100%) existing water levels. It appears from Table 7 and Table 12 that the required flow reductions to meet the water level targets are in fact variable (and that water levels rather than peak flow rates are the parameter of interest). Could you please clarify the mitigation targets and reasoning behind them, e.g. why maintaining a particular peak flow does not result in maintaining the corresponding water level? | Section 2 states the overarching objectives of the modelling however more specifically, mitigation targets (provided in Table 7) are of three types: a) maximum pond levels to prevent overtopping, b) maximum 100-yr pond outflow rates equal to 70% of ED peak flows for the catchments being attenuated, and c) maximum water levels downstream of ponds, to ensure that water is no higher than in ED ie no additional flooding (extent or depth). Target b) is achieved for all devices. In general, b) would imply that c) is satisfied, however (with the exception of Device 6) this is not the case in the Mangaheka model. Flat gradients and coincidence of flows mean that achieving b) alone was not enough to mitigate effects. Additional attenuation wass requried to achieve target c). This results in peak flows less than 70% of ED. Therefore c) is the limiting factor for Devices 5 and 7 as well as 4 Guys pond upgrades. For Device 6, achieving target b) also resulting in target c) being met. | | |
| 3 | General | The rationale for making detention devices either online or offline is not stated. While it is understood device positions have previously been agreed with HCC, some justification for the choice of different configurations would be welcome. | The rationale for deciding whether devices were offline or online was primarily based on land ownership. For devices servicing catchments which were generally one or two land owners, it was seen as easier to have one device as the developers could construct such devices themselves. For devices servicing multiple land owners, it was seen as better to have an online device which most lots could easily discharge to and would likely be constructed by Council. Development contributions would be charged to each landowner who develops. The online device ( Device 7) also offers an opportunity to enhance/realign an existing waterway which is quite unnatural in alignment. Although note that for simplicity our modelling only utilises the existing landforms, with a modified ( higher overflow level and smaller culvert size) existing culvert at the downstream end to control flows more appropriately. The alignment of the proposed basin could be modified to suit landowners at the time of development. If the existing landform were utilised, there is sufficient storage available within the existing flood plain, therefore not requiring major earthworks. | | |
| 4 | General | The relative positions of the devices and reporting locations are not very clear on Figure 1. While it is acknowledged that the locations are described in Table 18, a large scale map (similar to Figure 9) would assist with interpreting the mitigation targets in Table 7 by showing the reporting locations in relation to each device. A map showing all the road names and other topographic features referred to in the text would also assist in understanding the modelling. | We agree, we will add a plan showing reporting locations to Appendix C. We will also add a "Catchment Overview" section which describes the catchments, roads and streams. | | Section 3 has been added to include a catchment overview. Appendix A also provides a catchment overview plan showing road and river name labels. Appendix 3 provides a clearer plan of the reporting locations. |
| 5 | General | Do the reporting locations correspond to HEC-RAS cross-section locations or other model elements? | Reporting locations are first described in the first paragraph of Section 5. This paragraph refers to a table of HEC-RAS cross-section chainages in Appendix C. Text revised to make this clearer. | | |
| 6 | Section 3.1 p2 | Factoring in the Te Rapa four-laning was stated as an exclusion if not already present in the Lysaght model. Section 3.1 refers to 'minor adjustments' to account for the Te Rapa Bypass motorway. Does this mean the four-laning? A map to show the position of these roads would be useful to help reconcile report references with structures on the ground. | Yes we are referring to the 4 lane Te Rapa Bypass. The Lysaght Model was carried out pre construction of the motorway but had a catchment boundary along the alignment of the road. Now that this is constructed, we could better define which parts of the motorway discharge where, including the Koura Drive interchange, as part of our model. We have added a catchment plan which has an aerial photograph underneath to better see the alignment of the motorway. | | |
| 7 | Table 1 p3 | The IFS states that 8 scenarios will be modelled but Table 1 lists 10 scenarios, the additional ones being unmitigated MPD with non-CC rainfall for both return periods. While it is acknowledged that this provides additional information, that fact that there is no subsequent reference to the results of these scenarios means they could be omitted for simplicity. | After the IFS was agreed, it was realised that it would be necessary to also to include the additional scenarios for completeness i.e so that it would be possible to separate out the effects of MPD (as compared to ED), climate change, as well as the effect of the proposed mitigation. 'MPD 100 yr' appears in figures 3, 4 and 5, and appears in Table 11. 'MPD 10 yr' appears in Tables 4, 5 and 15 as well as, figures 6, 7 and 8. | Understood. The values are useful for comparison but the comment referred to the fact that there do not appear to be any textual references to them (I think), i.e. no interpretation of their significance or relationship to the values of other scenarios? | Comments added to discuss the significance of the additional scenario's. |
| 8 | Table 7 p7-8 | States "Outflow from Device 6 (Location 5) must be ≤ 0.93 $m^3/s$ … etc.". However, Location 5 has no flow reported in Table 3. If it is instead assumed to be Location 6 (as Catchment D flow), how is 0.93 $m^3/s$ derived? | Table 3 only reports on scenarios that exclude mitigation (Section 6 is entitled "Model Results - Without Mitigation"). Device 6 and its corresponding Location 5 are only present in mitigation scenarios. 0.93m3/s represents 70% of the ED flows from the catchment, which was a conclusion in the Lysaghts model i.e reducing developed flows to 70% of existing will provide sufficient mitigation. This was the starting target for the MPD development, however it was realised that this alone would not mitigate water level increases resulting from MPD (+ CC) | Apologies, I mis-read that and got the tables mixed up. | |
| 9 | Table 7 p7-8 | No reporting location is given for the outflow from Device 7 in Table 7 to check the mitigation result against. Presumably this is Location 4? It is unclear how the stated 5.70 $m^3/s$ target (70% of ED) for Device 7 is related to the peak flow results in Table 10. Similarly for Devices 5 and 6. | Yes, Location 4. This has been added to text. | Still unclear on second part of comment, i.e. 5.70 $m^3/s$ reported as being 70% of ED100y value. That would imply ED100y peak flow of 8.14 $m^3/s$ which is not apparent in any tables. | Table 7 (8 in updated report) states that 5.7 $m^3/s$ is "equivalent to 70% contribution... from catchment C". That is, only the component of the stream flow that originates from catchment C has been factored by 70%. The 5.7 $m^3/s$ value is calculated by summing 100% of the HJV pond outflow rate with 70% of the catchment C runoff rate. Comment in Table 7(8) modified to make this clearer. |

| Item | Reference | MEL comment | Beca comment | MEL response | Beca further response |
|---|---|---|---|---|---|
| 10 | Table 7 p7-8 | For Devices 5 and 6, mitigated maximum water levels are stated as 29.7 m and 31.2 m, respectively. How are these numbers derived (given that there are no ED equivalents)? | Device 6 text has been appended with "minimum ground elevation in nominal basin location".<br><br>29.7 m for device 5 represents a maximum water level of 300 mm lower than ground surface on the eastern side of this pond (as per cross-section elevation data). On the southern side this is 200 mm above immediately adjacent ground surface, but is equivalent to ground surface further upstream (from chainage 8811). This elevation has been chosen to allow for sufficient head difference during flood events. | | |
| | | | | | |
| 11 | Table 7 p7-8 | Mitigation targets are expressed in terms of the proposed devices rather than the sections of channel between devices which are of interest from a flooding perspective. For example, does Location 4 account for the water level in the channel between Devices 4 and 5? | We presume you mean between device 6 and 7. If so, yes location 4 represents the channel between devices 6 and 7. Table 7 provides a water level target within each device, and downstream of each device. . See last bullet point of each row. | Yes, sorry - I did mean between devices 6 and 7. I'd reiterate the value of a single large-scale map that shows the devices and reporting locations relative to each other (even though this information is provided in text form - just takes a bit more interpretation). | Appendix 3 now includes a clearer plan of reporting locations. |
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| 12 | Table 9 p9 | While it is explained why the mitigated 100-year water level at Location 8 slightly exceeds the ED level, no corresponding note accounts for the even greater exceedance at Location 3. Presumably the mitigated level is being compared to ED 100-year with CC in this case (as appears to be the case for the 100-year flows on p16). Please confirm this is the case. | Correct. Text amended to make this clear. | | |
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| 13 | Table 10 p12 | Locations 9-12 show significant increases in peak flow between the ED and mitigated MPD scenarios. This increase is attributed to the effects of climate change (higher rainfall intensity) alone in the undeveloped catchments (as shown in Table 3). It seems rather a large increase - almost 50% in the case of Location 10 - especially given the low catchment imperviousness (much larger percentage differences than for the 10-year event). The corresponding water levels (Table 9) are not substantially higher (are these flows out of the channel?). Can you please confirm that the difference in flow rates between ED 100-year and ED 100-year CC (Table 3) are really that great for Locations 9-12? | For clarity, we have responded to each of the questions/statements separately below. | | |
| 13A | | The corresponding water levels (Table 9) are not substantially higher. | As mentioned in the report, "Water levels at locations 11 and 12 are influenced by the water level boundary condition set at Waipa River of 16.07 for all 100-year ARI scenarios." The presence of this boundary condition and hence wider flooding extent means that an increase in flow at these cross sections does not change water level significantly.<br>Locations 9 and 10 are immediately upstream of surcharged culverts, which have a similar effect to the downstream water level affecting locations 11 and 12. | | |
| 13B | | Are these flows out of the channel? | Yes some of the flows are out of the channel. Note also that where flows in the MPD 100 year with CC and mitigation are out of the channel, they are also out of the channel in ED 100yr. | | |
| 13C | | Can you please confirm that the difference in flow rates between ED 100-year and ED 100-year CC (Table 3) are really that great for Locations 9-12? | Yes these differences are correct and only due to the effect of climate change. The HEC-HMS model has been checked for representative catchment (13) and it was verified that the only variable changed was the selected nested storm. The HEC-RAS model was then checked to see that peak lateral inflows were the same for this catchment. The HEC-RAS peak modelled flows were checked at location 10 (RS 4695.33). The increase in catchment peak flows at MPD + CC are similar to the increase in rainfall depth that climate change produces. Whilst we have not interrogated the model to understand the timing of the peaks from each catchment, we consider that the large increases will likely be a result of coincidence of flows. | | |
| | | | | | |
| 14 | Table 10 p12 | The mitigated MPD peak flow at Location 1 is nearly twice that of ED but it is stated that the water level criterion is satisfied. This implies an increase in velocity which may lead to other issues. Please confirm the flow and water level values for Location 1. | Reported flow and water level are confirmed to be correct. The stream velocity in the MPD 100 yr with CC scenario at this location is almost three times that of ED 100 yr, but both are very small (significantly lower than 0.1 m/s) and therefore unlikely to lead to erosion. Froude number here is also much less than 1. | Okay. Is it worth reporting velocities alongside their corresponding flows in the report also? | Velocities have been added to Table 10 (now 12), as well as additional discussion on velocities. |
| | | | | | |
| 15 | Table 10 p12 | Location 8 also shows a mitigated peak flow in excess of ED but the water level target is stated as being attained. Does this also imply an increase in velocity? | Yes, slightly. Channel velocity at this location is 0.35 m/s for ED 100 yr and 0.41 m/s for MPD 100 yr CC. It is not expected that additional erosion would occur at these velocities. | Okay. Might be worth stating that in the report (as above). | Table 10 is now Table 12. This table now shows that the velocity is lower at MPD after a error was fixed. |
| | | | | | |
| 16 | | It would be useful to have a table that directly compares the mitigated MPD flow rates (or water levels) for each reporting location with the particular ED value they are to be compared to, i.e. ED 100-year or ED 100-year with CC. This would enable easier checking of mitigation targets being achieved so that the reader does not have to refer to different tables. | This information is in Table 10. | Specifically I meant the scenario name (i.e. ED100y or ED100yCC) rather than the actual value. e.g. for Location 3, a glance at Table 10 gives the impression that the target is not met, until you read the note at the bottom that says the target was the ED100yCC value rather than the ED100y value. It was just a thought that occurred to me while initially comparing the various ED and mitigated MPD values and having to flick between tables. | Table 8 modified and Table 13 added to explan the attenuation targets better. |
| | | | | | |
| 17 | Figure 4 p11 | Long-section shows mitigated MPD water level to be above all other scenarios between the HJV pond and the Waikato Expressway. Does this represent the maximum water level in Device 7 (approx. 700 m long)? | Yes this is the location of Device 7 therefore it is expected that the water level will be higher than ED given that attenuation is occurring in this area. This is seen in the long section as the device is online. | | |
| | | | | | |
| 18 | Section 8.1.1 p12 | Porters Drain flows are stated as being mitigated by Device 5. Figure 9 appears to show the Porters Drain flows discharging to the Mangaheka channel downstream of Device 5. Could you please confirm the hydraulic relationships between the channels and device, and that Device 5 receives all flows from Catchments E, G and H. | Yes you are correct, Porters Drain does enter Mangaheka Stream downstream of Device 5. Device 5 over-attenuates flows from catchment E and H ( As stated in Table 6) thus also providing mitigation for catchment G. This was done because the developable area (parts not within the Te Rapa Bypass designation) of catchment G is small and the stream runs through the centre of the developable area. This mean that it would likely be difficult to configure a device in this location. The text has been amended to make this clearer. | | |
| | | | | | |

| Item | Reference | MEL comment | Beca comment | MEL response | Beca further response |
|---|---|---|---|---|---|
| 19 | Section 8.1.3 p12 | "Drain down time" appears to refer to the duration of overbank spilling (but not necessarily draining from the floodplain) rather than emptying of the detention devices following the particular design event. Or does it refer to overtopping of low flow channels within the detention basins? If it does not refer to the emptying of the devices themselves, this would be useful information to have. While perhaps out of scope, the duration of sustained high flow from the device outlets is important from an ecological perspective. | We have defined drain down time as the length of time water is outside of the stream bank and in the floodplain. As mentioned in section 2, Objective 5, it is important to farmers and Waikato Regional Council that farmland is not flooded for longer than 72 hours, hence it was the "farmable" ie floodplain land that we were assessing in terms of length of flooding. That said, a similar definition of drain down time has been used in the upper reaches which are not farmed. We agree that it would be useful to know how long it takes to empty the devices but this was not one of the objectives of the modelling. We have run the models for 72 hours therefore they would need to be rerun the model to assess the device drain down times. | | |
| | | | | | |
| 20 | | There are several mis-referenced tables and comments, e.g. Section 8.2.1, 8.2.2 and 10.0. It would assist with general readability to fix these. | Could you provide more specific information on where in the document these incorrect references are given? Page 7 of the PDF we sent contains a reference to Section 8.2.1, but this is the correct location. We can't find any references to Sections 8.2.2 or 10.0. | Sorry, I meant references *in* those sections, rather than *to* them.<br>8.2.1: says "Table 13 refers to MPD 100 yr with CC … etc." when it in fact refers to MPD 10 yr with CC.<br>8.2.2: says "Table 14 lists maximum flow rates for the MPD 100 yr with CC … etc." when it refers to MPD 10 yr (Table 14 captions also refers to 100 yr).<br>10.0: A reference to Table 16 appears to actually mean Table 17 (device specs).<br>There are also references to "Attachment" when it appears to mean "Appendix". It's obvious enough what's intended but I had initially gone looking for an attachment. References to "Attachment A" (p2) and "Appendix A" (p8) appear to mean the same thing. | Referencing has been fixed. |
| | | | | | |
| 21 | Table 12 p13 | Why difference between catchment outflow and device outflow? | "Peak discharge from catchment" refers to the runoff only from the catchment area that the device was designed to serve ie the outflow from the device.<br>"Peak flow downstream of device" refers to the total flow rate in the channel downstream of the device, and therefore includes the effect of other upstream (and downstream) mitigation devices. | | |
| | | | | | |
| 22 | Table 16 p19 | Please confirm that the last column in Table 16 is the mitigated MPD peak flow, as a percentage of ED, that results in the water levels reported in Table 9. | Correct. | | |
| | | | | | |
| 23 | Figure 9 p20 | The placement of Devices 6 and 7 appear to show that not all parts of the contributing catchments are able to reach the devices, i.e. the devices are not located at the downstream extent of the catchments. Do the devices receive flows from all parts of the catchment attributed to them? Do the runoff calculations assume that all parts of each catchment are contributing flow to the respective devices? Are the devices sized for all flows generated by the catchments or just the portion of catchment upstream of the device as shown? | Device locations are indicative. It is assumed that all parts of the catchment can drain to the device, other than Devices 5 and 6 which over attenuate for parts of catchments or other catchments which will not be able to drain to the device. Runoff calculations reflect this ie runoff from catchment G goes into Porters Drain rather than Device 5. | | |
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| 24 | Section 13.1 p21 | Existing culvert levels and dimensions have been assumed to be correct. Were the culvert inverts defined as part of the surveying in accordance with discussion in earlier correspondence (emails of 13/4/16)? | The survey only included the culverts that were seen as critical to the modelling and information on size and levels were not known or available . The following culverts were modelled: 2x culverts under Koura Drive, culvert under TRB servicing the Shark Fin (south part of catchment B which is only in model in ED scenario) and Porters drain culvert under TRB. Culverts downstream of the developable area were assumed to be correct from the Lysaghts modelling. They were however checked to make sure the levels in the model looked realistic. | | |
| | | | | | |
| 25 | Appendix B p28-29 | In accordance with the recommendations of Hold Point 2, all minimum imperviousness values for rural areas (for ED and MPD) were changed to 5% (from 0%). It is noted that Catchment A0 in ED remains at 0%. While this is unlikely to have any more than a negligible effect on model results, for consistency it would be good to set to 5%. | This was a mistake. Changing catchment A0 to 5% imperviousness would increase the ED 100 year flow from 0.420 m3/s to 0.435 m3/s, i.e. by 3.6%. In ED models catchment A0 is routed into the stream passing 4 Guys pond. Because location 1 flows are measured immediately at the outflow point of 4 Guys pond, peak flow rates at this location would be unaffected by such a change. Given the size of the A0 catchment compared to the total catchment at location 2 or anywhere else in the model, and given the very small increase in flows, we consider that this would not likely make a material difference to the conclusions made. We therefore have not rerun the model to reoutput the results. | | |
| | | | | | |
| 26 | Appendix B p28-29 | The time of concentration for Catchment A is longer for MPD than ED (22 mins vs 13 mins). It is assumed that this has something to do with the way Catchment A has been divided up, given the ED reference to Catchment A0. There is also no Catchment A0 reported in the MPD table or on the maps. Should this be the case? | Yes, ToC differences for catchment A are to do with the way this catchment has been divided up. A0 needed to be separated as in the existing scenario this would likely have drained to the channel alongside 4 Guys pond, however at MPD it has been assumed that it would drain directly into the pond. MPD catchment A = ED catchments A + A0. We have corrected the ED map in Attachment A to plot catchment A0. | | |