Figure 47: EB3R design case 100-year flood depth difference

6.2.4 Overland Flow Assessment

The pipe network has had pipe blockages added in accordance with the Stormwater Code of Practice (see Section 4.3.1) to assess overland flow capacity to ensure it has been maintained or replaced by pipes with sufficient capacity when pipe blockages are applied. The 10 and 100-year ARI event overland flow and flooding depths are shown in Figure 48. Again, the 10-year and 100-year flood extents are similar, although the flood extents are more substantial as would be expected when most of the stormwater network capacity is removed via pipe blockages. The 10 and 100-year ARI event depths are shown in Figure 49 and Figure 50 respectively. As would be expected given the pipe capacity has been significantly reduced the flood depths are greater than for the scenario without blockages (see Section 6.2.3). However, flood depths on Ti Rakau Drive and other areas are less than the base case (with pipe blockages applied).

The difference between the base case (with blockages applied to pipes) and the design case (with blockages applied to pipes), is shown in Figure 51 and Figure 52 for the 10 and 100-year ARI events respectively. The results show that adding the pipe blockages does not result in widespread increases in flooding as a result of the EB3R works. This is because the overland flow path capacity hasn't been reduced in most cases or has been supplemented with network drainage capacity even after pipe blockages are applied (i.e. by larger pipes between 600 and 1050 mm that only lose 50% of their capacity or pipes greater than 1050 mm that loss 10% of their capacity).

As shown in Figure 51 there are areas of increased overland flow and flooding depths as a result of the Project during the 10-year event. The private properties impacted by these increases are highlighted on Figure 53 for the 10-year event (see private properties with blue boundaries). It is noted that private properties with increased flood depths shown on Figure 53 includes private properties that previously had overland flow and/or flooding within the property in the base case. Properties purchased by the Project (see properties with red boundaries) are not considered to be impacted. The private properties, not purchased by the Project, with increased overland flow and flooding depths when pipe blockages are applied are:

- 5, 1/6, 2/6, 7, and 33 Edgewater Drive
- 170, 172, 174, 177 and 219 Ti Rakau Drive
- 30 and 32 Te Anau Place
- 3, 5, 7 Fremantle Place.

As shown in Figure 52 there are areas of increased overland flow and flooding depths as a result of the Project during the 100-year event. The private properties impacted by these increases are highlighted on Figure 54 for the 100--year event (see private properties with blue boundaries). It is noted that private properties with increase flood depths shown on Figure 54 includes private properties that previously had overland flow and/or flooding within the property in the base case. Properties purchased by the Project (see properties with red boundaries) are not considered to be impacted. The private properties, not purchased by the Project, with increased overland flow and flooding depths when pipe blockages are applied are:

- 1, 5, 1/6, 2/6, 7, and 33 Edgewater Drive
- 170, 172, 174, 177, 177A and 219 Ti Rakau Drive
- 30 and 32 Te Anau Place
- 3, 5, 7 Fremantle Place
- 176 Gossamer Drive.

The mitigation that is recommended to be included in the final detailed design to address these effects is outlined in Section 7.2.

Figure 48: EB3R design case 10 and 100-year flood extents (pipe blockage)

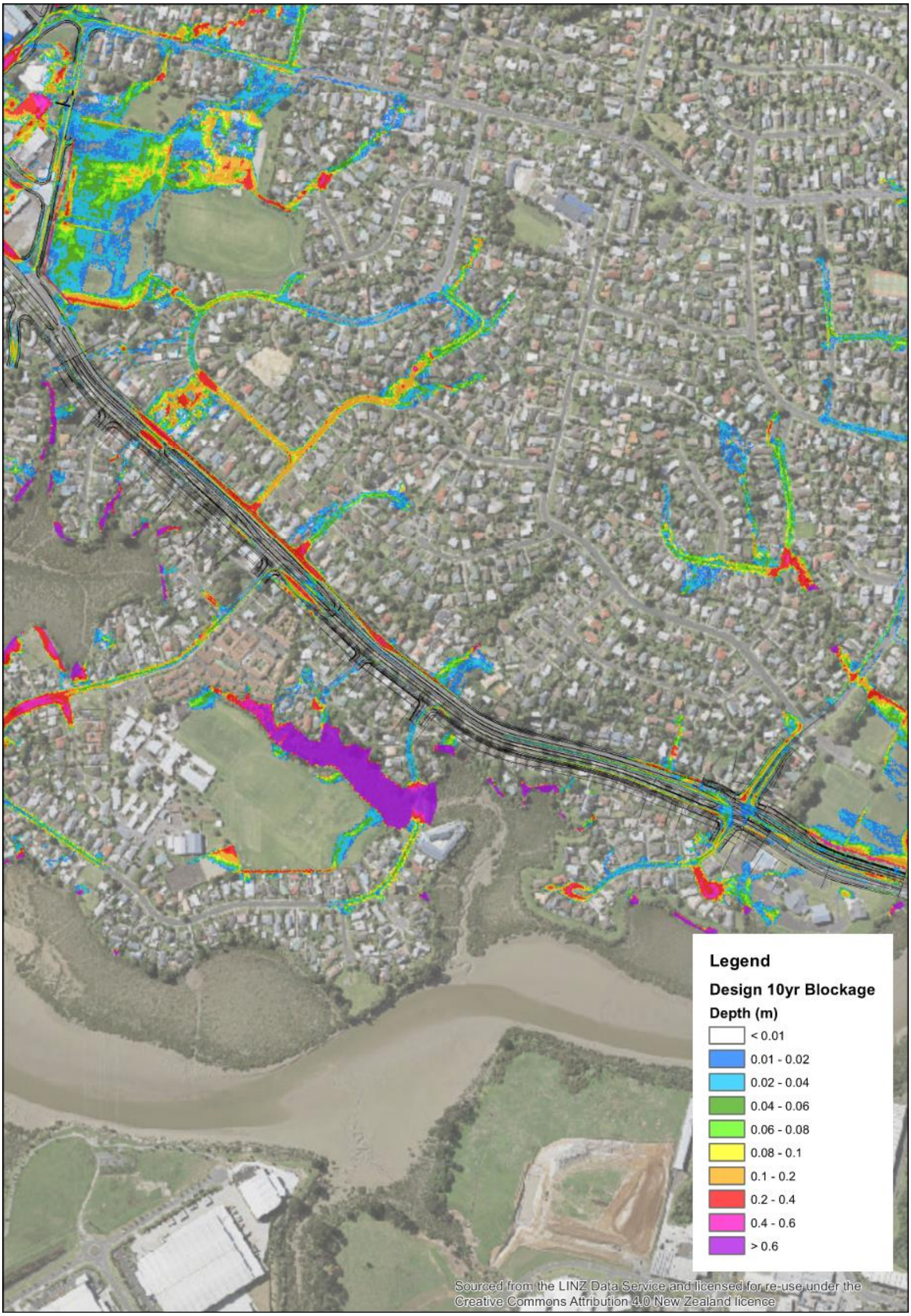

Figure 49: EB3R design case 10-year flood depths (pipe blockage)

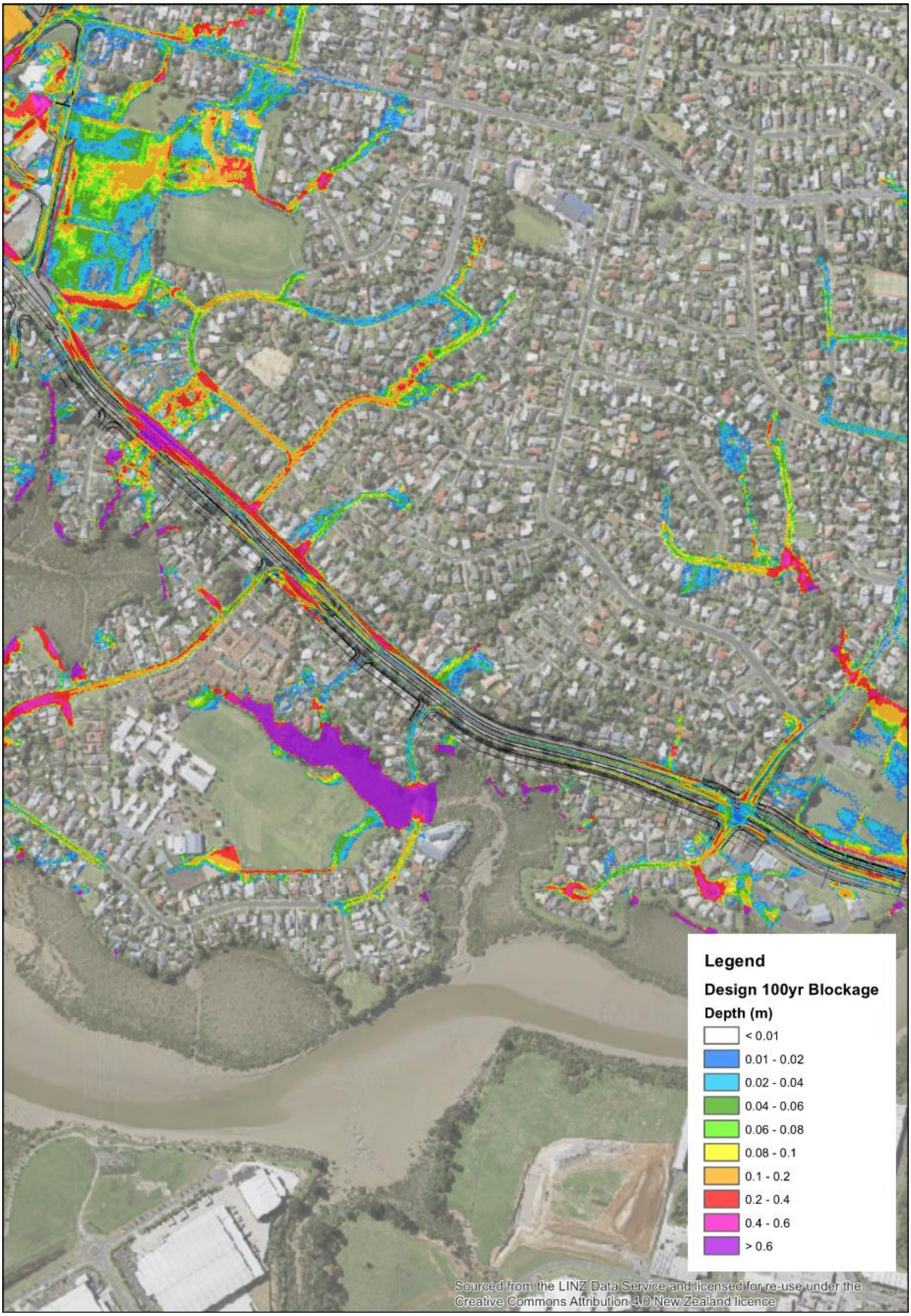

Figure 50: EB3R design case 100-year flood depths (pipe blockage)

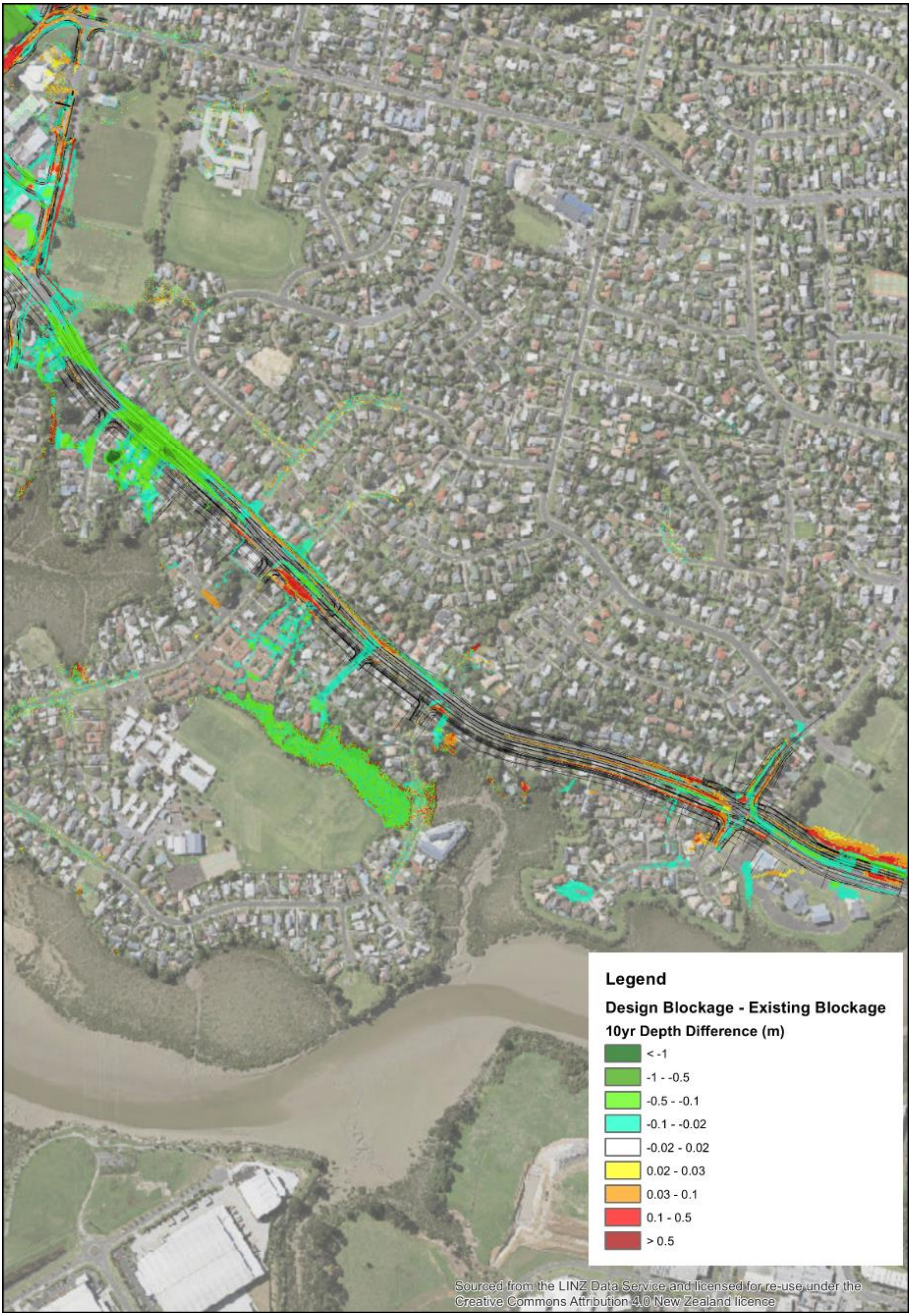

Figure 51: EB3R design case 10-year flood depth difference (pipe blockage)

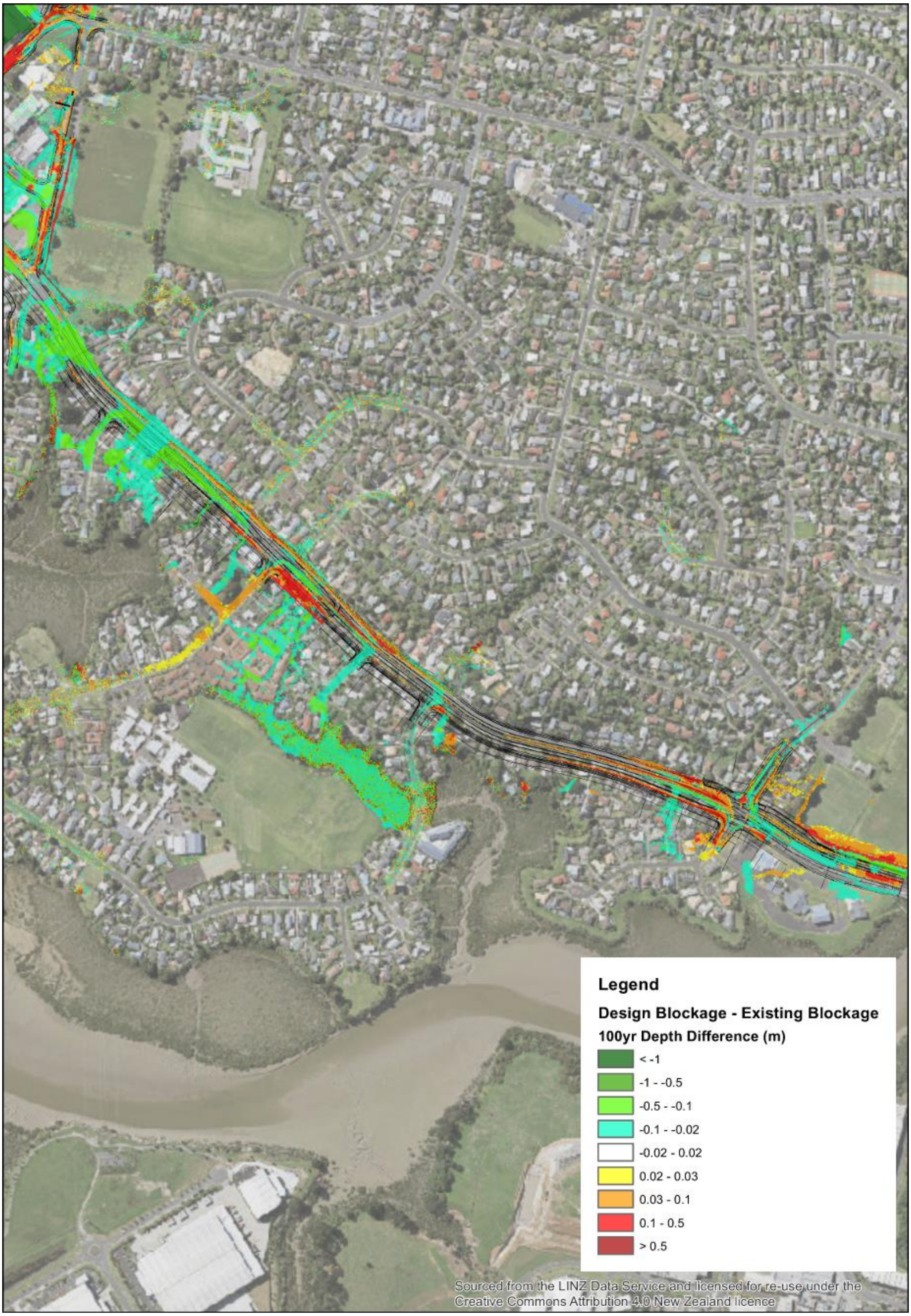

Figure 52: EB3R design case 100-year flood depth difference (pipe blockage)

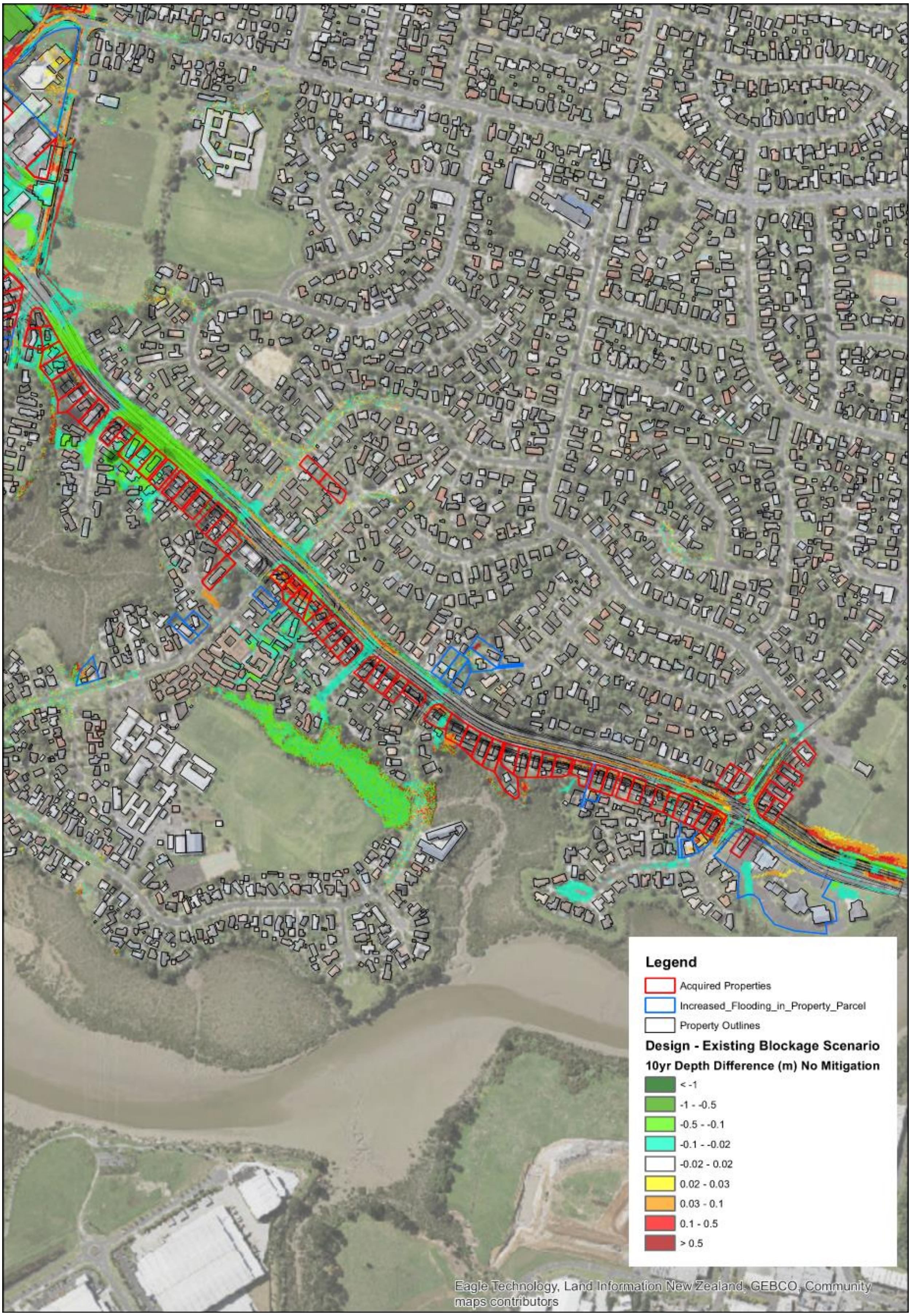

Figure 53: EB3R private properties impacted during 10-year event (pipe blockage)

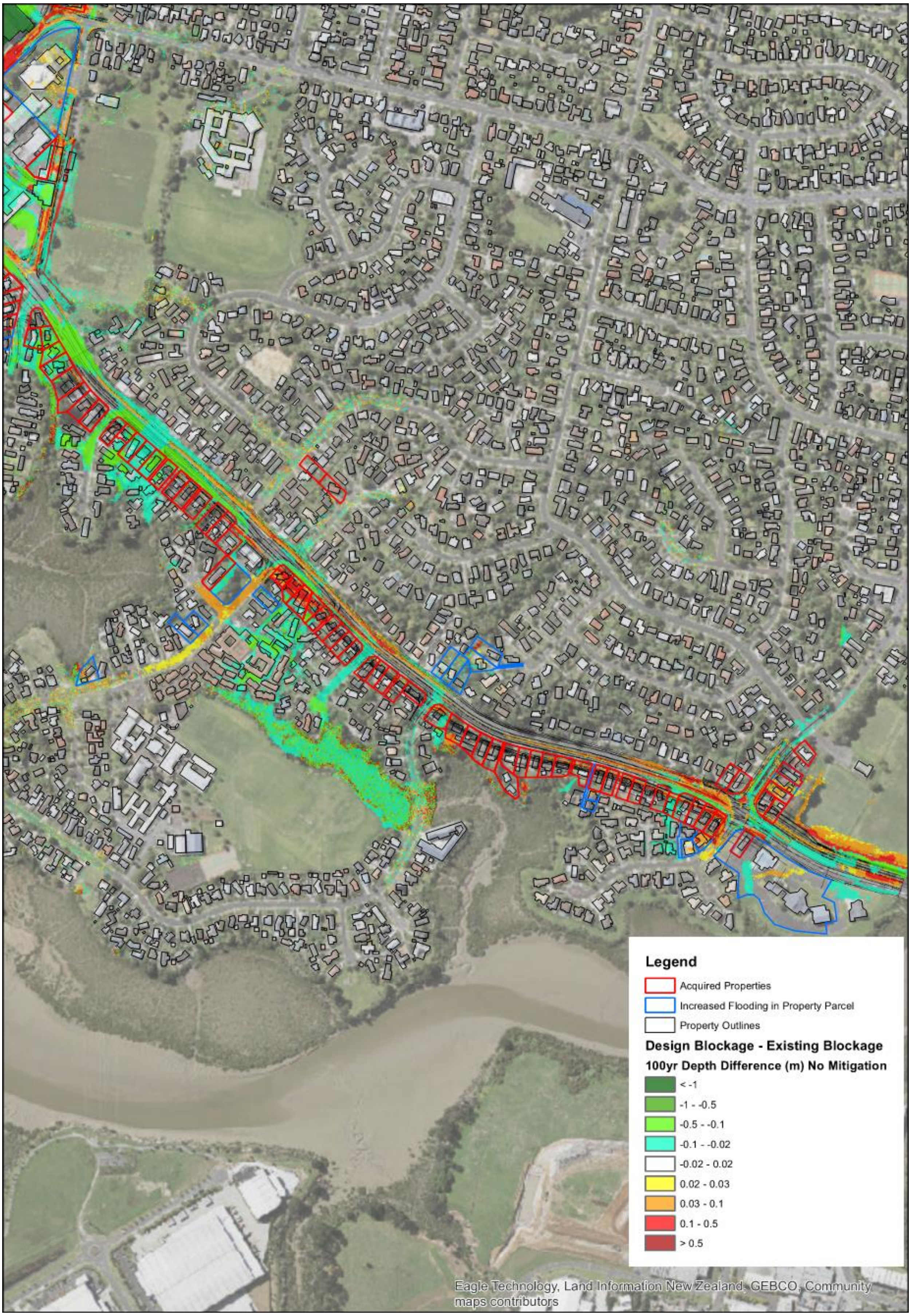

Figure 54: EB3R private properties impacted during 100-year event (pipe blockage)

Mitigation for EB3R is proposed for all the properties identified as affected for the 10 and 100-year events. The mitigation consists of upgrading pipe diameters to avoid potential impacts from changes to overland flow path capacity. The proposed pipe size upgrades and flood modelling results demonstrate the potential impacts have been fully mitigated and are outlined in Section 7.2. The proposed mitigation measure or alternative measures that achieve the same outcomes (such as changes to the road geometric design) will be incorporated into the final detailed design which will be verified during the NDC connection approval process via the EPA process once the design is completed.

6.3 Cumulative Effects

6.3.1 Discharge of Stormwater

Cumulative water quality effects have been considered by assessing changes in annual contaminant loads at each of the outfalls that the Project interacts with across the entire Project extents. The results are summarised for each zone and a total for the Project are provided in Table 9.

It is noted that EB3C is still awaiting outcomes of public consultation and EB4 is still awaiting the outcome of multicriteria analysis of additional options requested by property owners. As such, EB3C and EB4 are still subject to change and are only indicative at this stage. The CLM will be updated as design progresses through detailed design (and included in consent packages for EB3 Commercial and EB4). This will track changes, allow adaptive responses (i.e. where new constraints prevent the use of a device at a particular location, its impact can be assessed, and other locations and options can be considered) and identify the final reductions achieved at the time of issuing the final design for EPA and connection approval under the NDC.

The current results (see Table 9) show the Project can achieve a reduction of the existing contaminants from roads discharging to the receiving environments on an overall Project basis. Although the contaminant loads calculated are only from road sources, the results do represent an improvement on the existing situation. Although not accounted for in the contaminant load model, where discretionary treatment targets high use roads outside the Project area by installing a GPT (design to remove 50% of TSS on an annual average basis) over an existing network pipe some commercial and residential land is also treated. Based on the results, the Project is predicted to have a positive impact on annual contaminant loads discharging to the receiving environments and cumulative impacts is not an issue.

Table 9: Summary of EB2 & EB3R overall predicted change in contaminant loads

Outfall	TSS	Zinc	Copper	TPH
EB2	-39%	-14%	-18%	-23%
EB3R	-59%	-43%	-48%	-53%
EB3C (interim)	-32%	-14%	-20%	-21%
EB4 (interim)	-5.4%	-14%	-15%	-18%
Total EBA	-41%	-21%	-26%	-29%

Cumulative quantity impacts have not been assessed as all outfalls discharge directly to the CMA or immediately adjacent to the CMA and stream channel erosion and changes in hydrological regimes are not relevant for coastal discharges. See Section 6.3.2 for the assessment of cumulative flooding impacts and Section 6.3.3 for cumulative assessment of overland flow path capacity impacts.

6.3.2 Flooding Assessment

Cumulative flooding effects have been considered by using comprehensive flood modelling, with EB2 and EB3R covered by the same flood model, noting that it includes all outfall catchments within these zones. This approach allows assessment of changes to geometric and drainage design (or other disciplines) in one zone on potential flooding impacts in the other zone. As discussed for EB2 in Section 6.1.3, it can be seen in Figure 13 and Figure 23 that the existing 10 and 100-year flood extents in EB2 and EB3R overlap in the respective zones and interact. This is because the Project zone boundaries between EB2 and EB3 do not match the boundaries of the Tāmaki River – Pakuranga Catchment and the Pakuranga Creek Catchment. EB3C and EB4 are in the Pakuranga Creek Catchment and are hydraulically independent from EB2 and EB3R due to separation by the Pakuranga Creek and are therefore modelled in a separate EB3C and EB4 flood model.

The design achieves flood management outcomes that avoid new flood extents or increasing existing flood depths on private property for the 10-year ARI event (see Figure 34 and Figure 46) and 100-year ARI event (see Figure 35 and Figure 47) with large areas with reduced extents and depths in the order of 20 mm through to 500 mm. All areas of increased flood depths are contained within the road reserve or parks.

6.3.3 Overland Flow Assessment

As for the assessment of cumulative effects for flooding, cumulative effects on overland flow path capacities and associated flooding impacts have been considered by use of comprehensive flood modelling and included EB2 and EB3R in the same flood model while applying pipe blockage and capacity reductions in accordance with the Stormwater Code of Practice. As discussed in Section 6.3.2, the Project zone boundaries for EB2 and EB3R do not match the boundaries of the Tāmaki River – Pakuranga Catchment and the Pakuranga Creek Catchment. The combined EB2 and EB3R flood model is able to assess the interaction between the zones and assess the impacts of design changes in one zone on overland flow path capacity (i.e. the overland flow path in one zone may receive additional flow from another overland flow path in the other zone). EB3C and EB4 are in the Pakuranga Creek Catchment and are hydraulically independent from EB2 and EB3R due to separation by the Pakuranga Creek and are therefore modelled in a separate EB3C and EB4 flood model.

The design achieves overland flow path outcomes that avoid new flood extents or increasing existing flood depths on the majority of private property for the 10-year ARI event (see Figure 39 and Figure 51) and 100-year ARI event (see Figure 40 and Figure 52). Whilst there are locations where flood depths have increased (see Sections 6.1.4 and 6.2.4) it has been demonstrated these impacts can be mitigated by further drainage upgrades (see Sections 7.1.3 and 7.2.3), or potentially by geometric changes during detailed design, with large areas with reduced extents and depths in the order of 20 mm through to 500 mm. All areas of increased flood depths are contained within the road reserve or parks.

7 Mitigation

Chapter Summary
EB2 Summary of key points/ findings • *No mitigation is required for water quality as the proposed EB2 design is predicted to improve the total overall (i.e. all the outfalls combined) contaminant loads discharged from roads when compared to existing contaminant loads discharged from roads. All individual outfalls have improved contaminant loads except small increases in zinc, copper and TPH for Outfall MCC_108633* • *No mitigation is required for water quantity as EB2 is not located within an AUP(OP) SMAF area and does not discharge to streams. All discharges are to the CMA or immediately adjacent to the CMA and pipe capacities match design flows* • *No mitigation is required for flooding as no additional impacts to private property have been identified in EB2 by the flood modelling* • *Mitigation is required to avoid impacts on a number of properties in EB2 where an assessment of overland flow path capacity (i.e. pipe blockages applied in accordance with the Stormwater Code of Practice) has identified the Project has reduced overland flow path capacity slightly in several locations and stormwater network pipes have not sufficiently replaced the loss of capacity. The mitigation involves relatively minor pipe size upgrades at a few locations and some minor localised geometric design changes to the ground surface levels. There were also some areas identified as model noise rather than being an actual impact.* *EB3R Summary of key points/ findings* • *No mitigation is required for water quality as the proposed EB3R design is predicted to improve the total overall (i.e. all the outfalls combined) contaminant loads discharged when compared to the existing contaminant loads discharged from roads. All individual outfalls have improved contaminant loads except for Outfall MCC_108707. The increases at this outfall are caused by diversion of stormwater from Outfall MCC_108713 which does not have sufficient capacity. It is not feasible to upgrade the network downstream of the Project to the outfall as it runs under and immediately adjacent to several properties. The mitigation outcome for this outfall is a difficult balance of water quality and flood management outcomes and in this case flood management has been the main driver for the design with an overall total contaminant load improvement across EB3R* • *No mitigation is required for water quantity as EB3R is not located within an AUP(OP) SMAF area and does not discharge to streams. All discharges are to the CMA or immediately adjacent to the CMA and the pipe capacity match design flows* • *No flood mitigation is required as no impacts have been identified by the flood modelling* • *Mitigation is required to avoid impacts on a number of EB3R properties where an assessment of overland flow path capacity (i.e. pipe blockages applied in accordance with the Stormwater Code of Practice) has identified the Project has reduced overland flow path capacity and stormwater network pipes have not sufficiently replaced the loss of capacity. The mitigation involves relatively minor pipe upgrades at several locations and some geometric design changes to the ground surface levels.*

7.1 EB2

7.1.1 Mitigation of Stormwater Discharge Effects

No mitigation is required for the discharge of stormwater to EB2 outfalls with the CLM predicting reductions in the total (i.e. all outfalls combined) existing annual contaminant loads from roads as a result of the Project's stormwater treatment approach in the design as discussed in Section 6.1.2.

No water quantity mitigation is required for EB2 discharges as they are directly to the CMA or immediately adjacent to the CMA. The EB2 zone is not within any SMAF zone.

7.1.2 Mitigation of Flooding Effects

As discussed in Section 6.2.3 , there are no flood impacts on private property within EB2. The area of increased flooding within Ti Rakau Park is contained within an overland flow path conveyance channel that has been agreed with Auckland Council Parks as part of the mitigation plan for the park. No mitigation is required based on the proposed design for EB2.

7.1.3 Mitigation of Overland Flow Path Capacity Effects

For the overland flow path capacity assessment with pipe blockages applied, several design changes were made in the flood model to achieve mitigation for the private properties that were identified in Section 6.1.4 as being potentially impacted. The required mitigation removes all the impacts to private property, and this is demonstrated in Figure 55 and Figure 56 for the 10 and 100-year events respectively. Alternatively, the final detailed design could include geometric design solutions that could either replace the pipe upgrades or reduce the amount and diameter of the pipe upgrades. The proposed mitigation for EB2 (see locations (1) to (7) on Figure 57) consists of the following:

- Location (1) impacts are to be mitigated by increasing the existing pipe to 900 mm diameter to avoid 100% blockage requirement which when combined with location (2) measures removes impacts to properties north of the SEART (see Figure 58)
- Location (2) increase each of the three culvert barrels to 750 mm diameter to avoid the 100% blockage requirement and increase an existing pipeline to 750 mm which when combined with location (1) measures remove impacts on private properties north of SEART (see Figure 59)
- Location (3) increase the Pakuranga Road pipeline to 1350 mm diameter and numerous Ti Rakau Drive pipes to 750 mm to avoid the 100% blockage requirement which removes impacts to private properties to the west of Ti Rakau Drive (see Figure 60)
- Location (4) increase Pakuranga Road pipeline to a 1350mm and provide connection to the existing 675 mm pipe which reduces flow towards WRR which when combined with the measures for locations (5) and (6) removes impacts on private properties along Reeves Road (see Figure 61)
- Location (5) increase the pipeline into WRR (North) to a 750 mm pipeline to avoid the 100% pipe blockage requirement and when combined with measures for locations (4) and (6) removes impacts on private properties along Reeves Road (see Figure 62)
- Location (6) increase the WRR pipeline along the western kerb to 750 mm diameter to avoid 100% blockage requirement which when combined with the measures for locations (4) and (5) removes impacts on private properties along Reeves Road (see Figure 63)
- Location (7) the bund along the overland flow path in Ti Rakau Park is shortened to end closer to WWR. When combined with the other measures proposed for Reeves Road property impacts (locations 4 to 6), private property impacts are avoided along Mattson Road (see Figure 64)

The predicted increases in flooding on properties on Pakuranga Road and some on Latham Avenue were in fact model noise. Using the alternative ‘clip meshing’ method provided by the model developer, as opposed to the previous ‘classic’ method, shows no increases were predicted for these properties and therefore no mitigation is required.

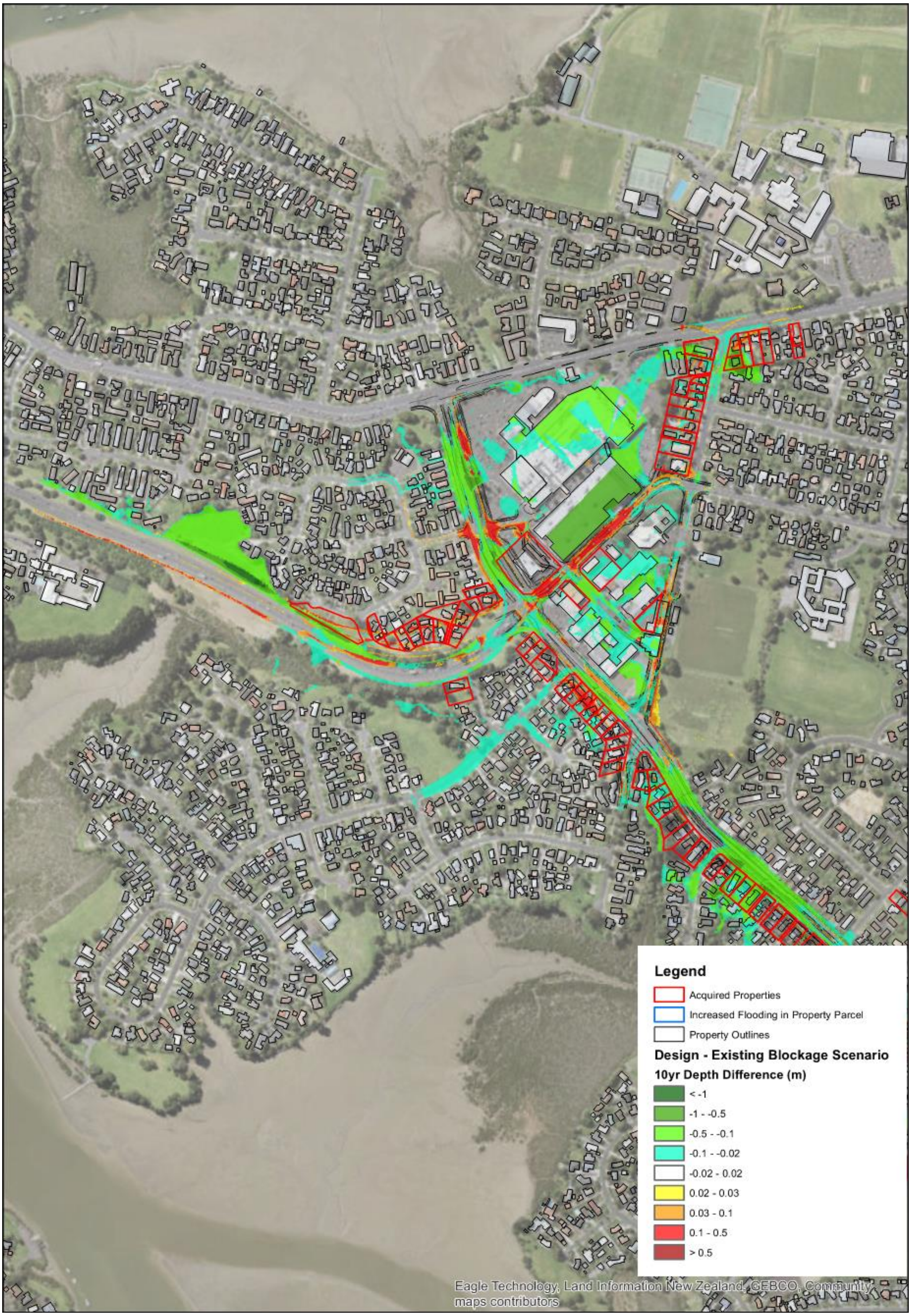

Figure 55: EB2 private properties impacted during 10-year event (pipe blockage with mitigation)

Figure 56: EB2 private properties impacted during 100-year event (pipe blockage with mitigation)

Figure 57: Locations of Proposed Overland Flow Path Capacity Mitigation for EB2 and EB3R.

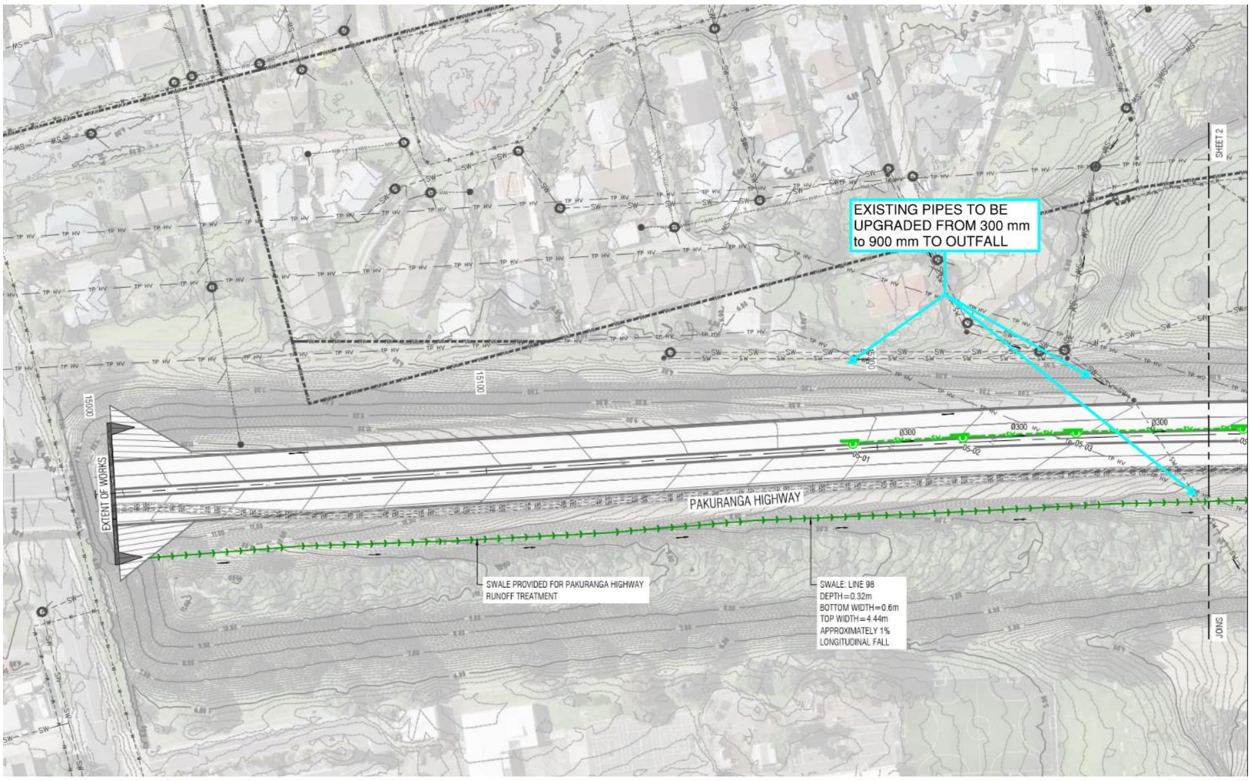

Figure 58: EB2 proposed mitigation for location 1

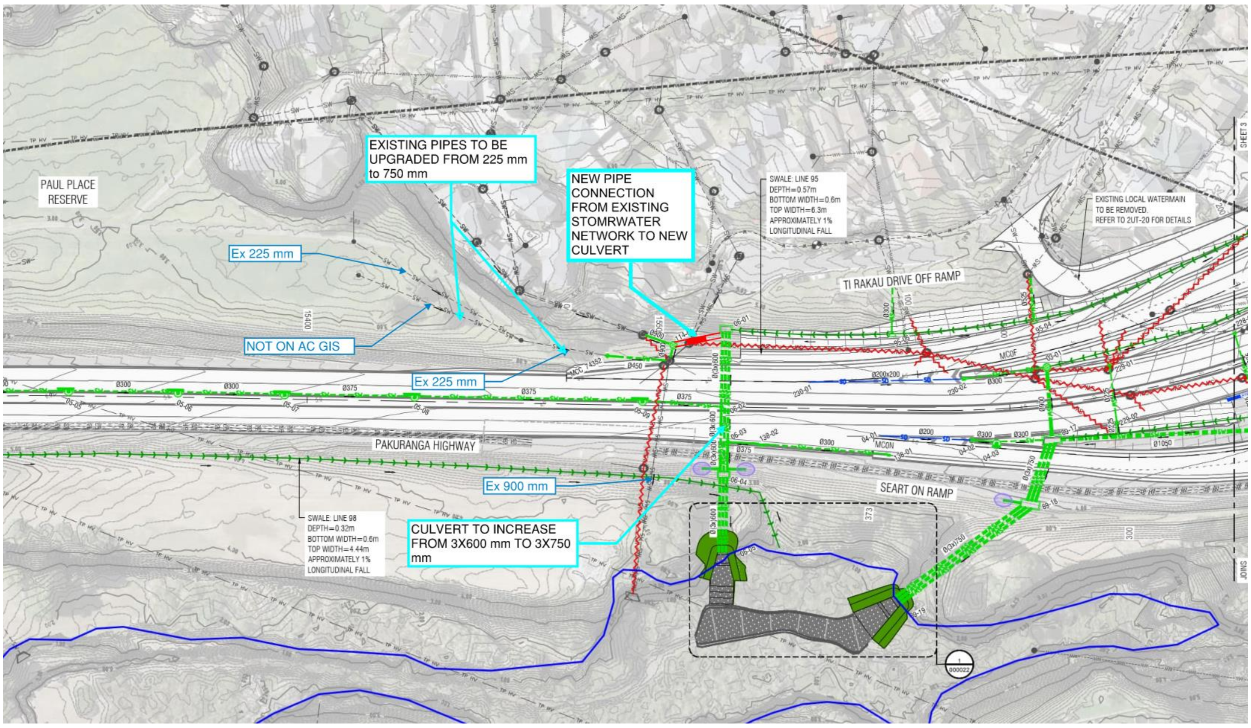

Figure 59: EB2 proposed mitigation for location 2

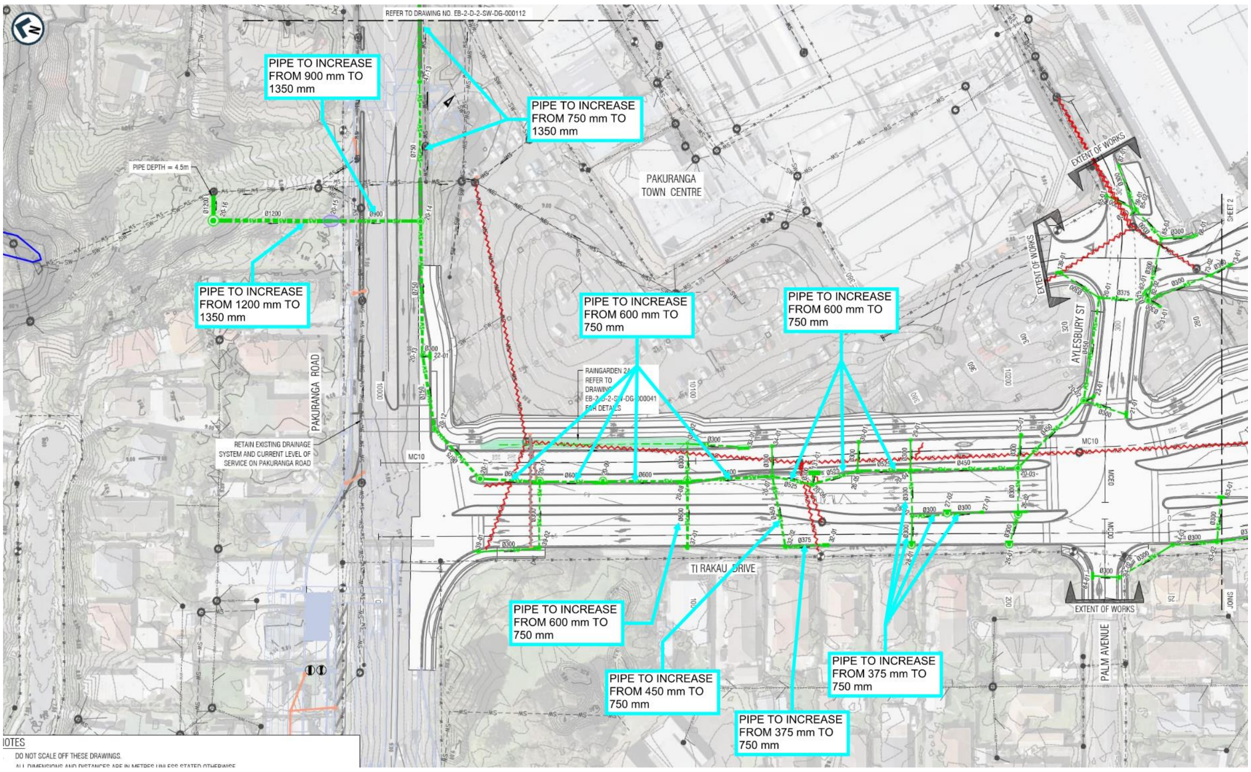

Figure 60: EB2 proposed mitigation for location 3

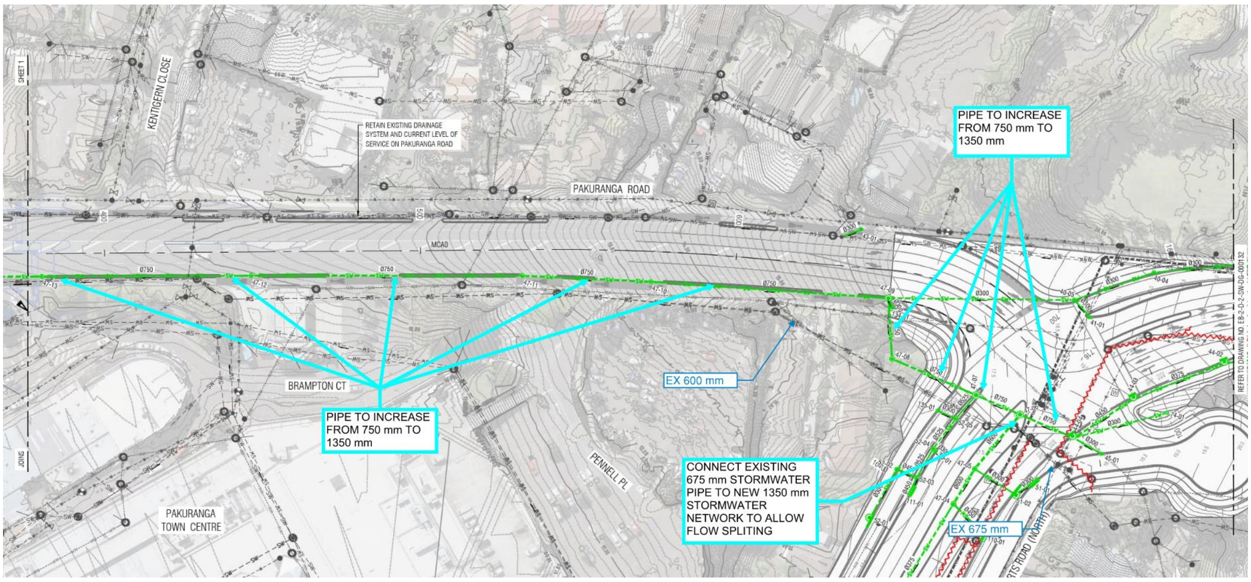

Figure 61: EB2 proposed mitigation for location 4

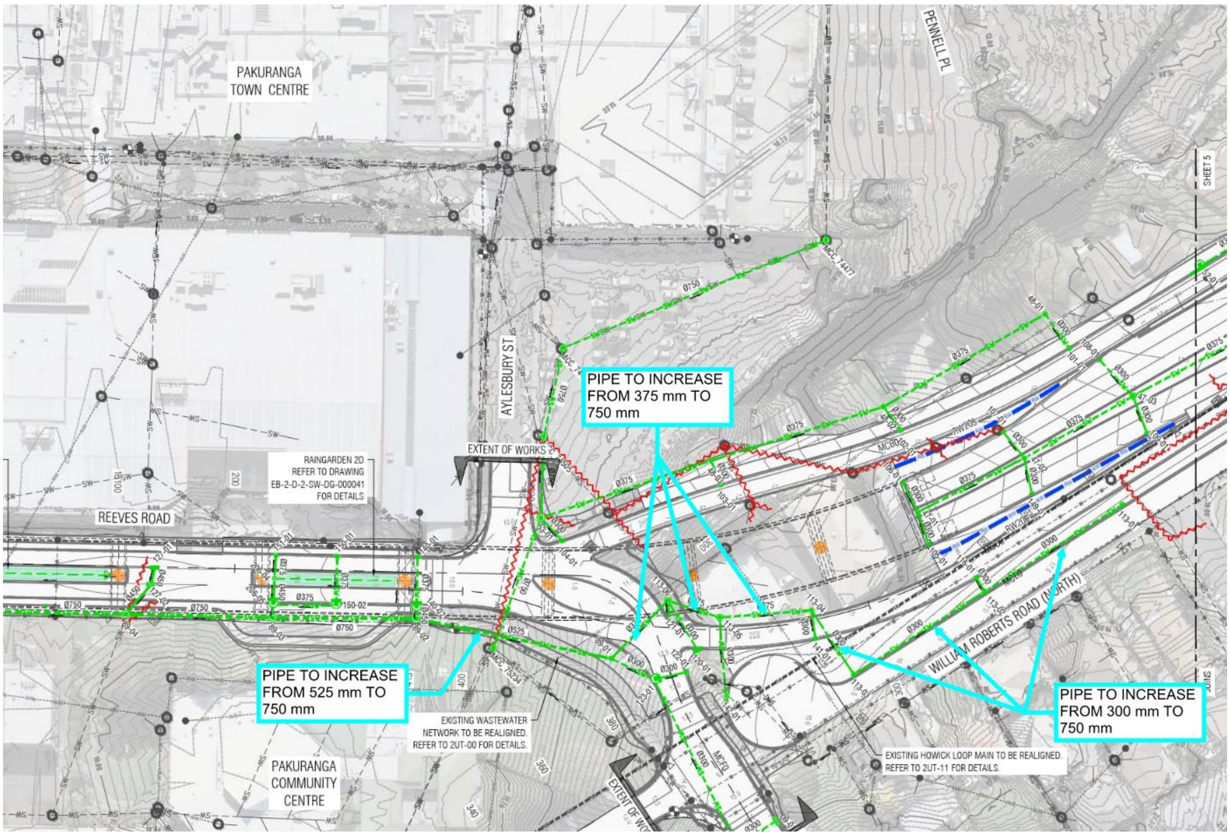

Figure 62: EB2 proposed mitigation for location 5

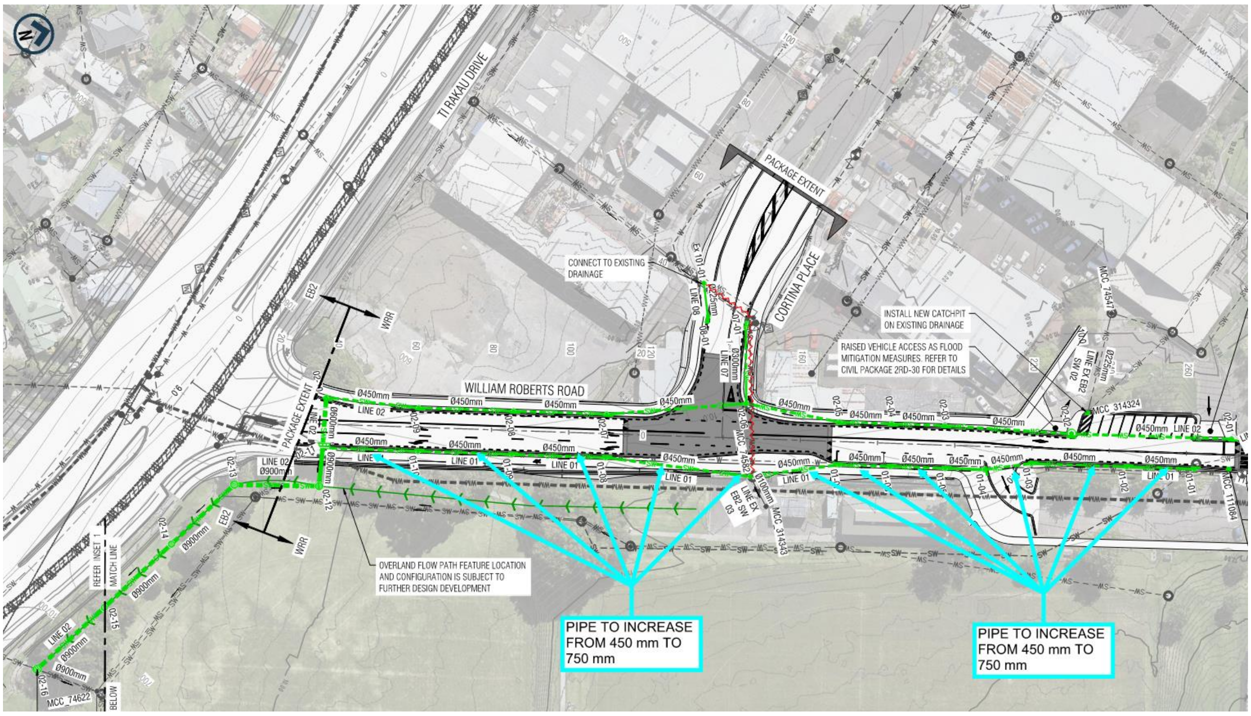

Figure 63: EB2 proposed mitigation for location 6

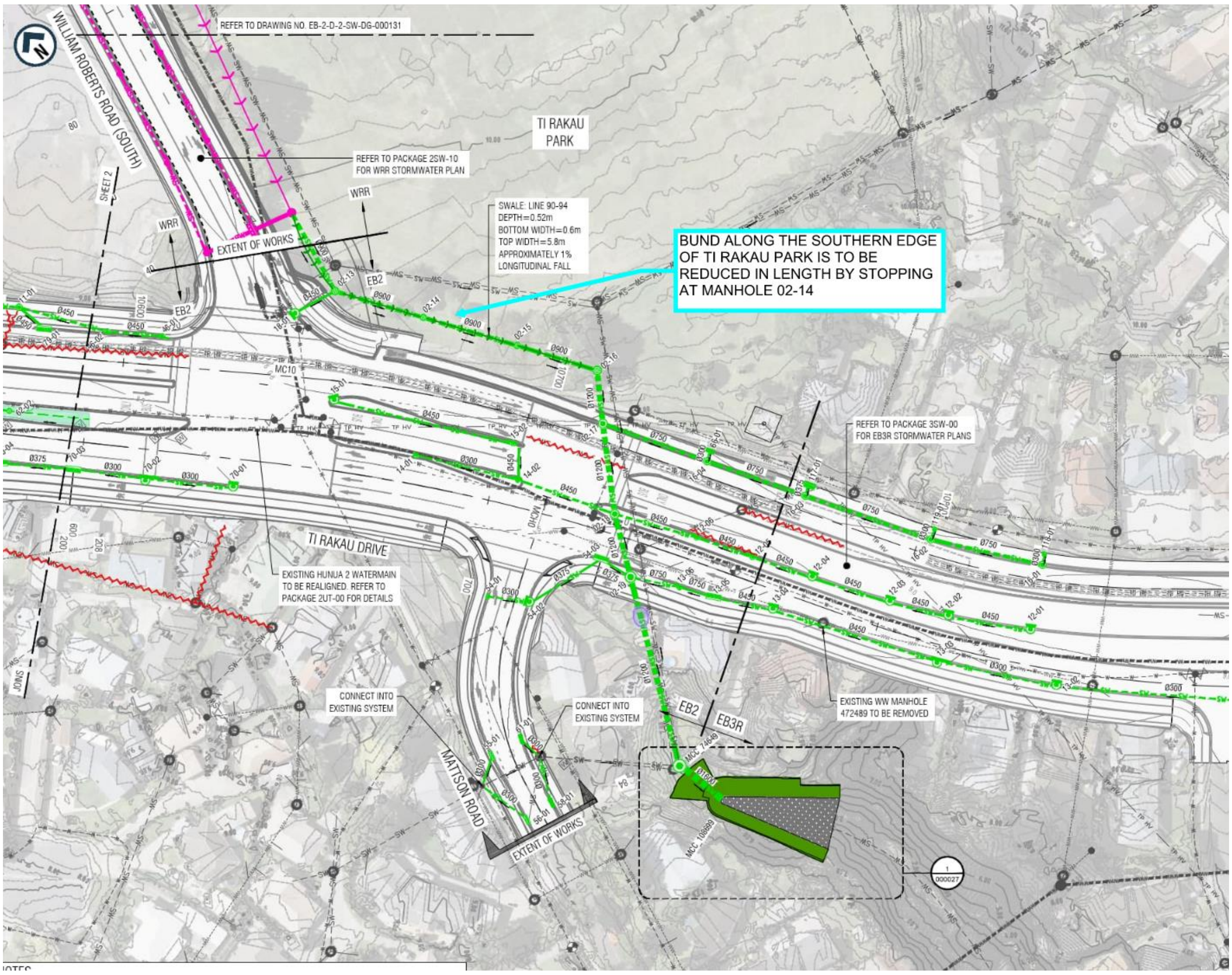

Figure 64: EB2 proposed mitigation for location 7

7.2 EB3R

7.2.1 Mitigation of Stormwater Discharge Effects

No mitigation has been proposed for the discharge of stormwater to EB3R outfalls with the CLM predicting reductions in the total existing annual contaminant loads from roads to all the outfalls combined as a result of the Project's stormwater treatment approach. Outfall MCC_108707 is predicted to have a large increase in contaminant load due to a 100% increase in road catchment area being discharged to this outfall. There are no treatment solutions that would avoid the increase other than avoiding diverting the additional carriageway catchment to the outfall. However, this carriageway catchment was diverted to avoid flooding impacts of private property since its original stormwater network cannot be upgraded easily as the pipeline goes under and immediately adjacent to numerous houses. The increase is offset by an equivariant decrease at outfall MCC_1087703 that originally included the diverted road catchment.

No water quantity mitigation is proposed for EB3R discharges as they are directly to the CMA or immediately adjacent to the CMA. The EB3R area is not within any SMAF zone.

7.2.2 Mitigation of Flooding Effects

As discussed in Section 6.3.2, there are no flood impacts on private property predicted within EB3R. No mitigation is required.

7.2.3 Mitigation of Overland Flow Path Capacity Effects

For the overland flow path capacity assessment with pipe blockages applied, several design changes were made in the flood model to achieve mitigation for the private properties that were identified in Section 6.2.4 as being potentially impacted. The proposed mitigation removes all the impacts to private property, and this is demonstrated in Figure 65 and Figure 66 for the 10 and 100-year events respectively. Alternatively, the final detailed design could include geometric design solutions that could replace the pipe upgrades or reduce the amount and diameter of the pipe upgrades. The proposed mitigation for EB3R (see locations eight to ten on Figure 57) consists of the following:

- Location (8) increase the size of the stormwater pipeline along the Ti Rakau Drive westbound kerb to 750 mm to avoid the 100% blockage requirement which removes the impacts on private properties behind 123 Ti Rakau Drive (see Figure 67)
- Location (9) increase the size of the pipes crossing the busway and westbound lanes to 750 mm diameter which removes the impacts on private properties south of Ti Rakau Drive (see Figure 68)
- Location (10) increase the Gossamer pipeline to 750 mm until the Ti Rakau Drive intersection then 1200 mm until the pipeline along the median between the busway and eastbound traffic which removes the impacts on private properties along Gossamer Drive (see Figure 69)

The predicted impacts on properties on Edgewater Drive, Te Anau, Fremantle Place and several properties on Ti Rakau Drive have been identified as model noise. By using the alternative 'clip meshing' method supplied by the model developer, as opposed to the previous 'classic' method shows no flood increases for these properties. No mitigation is required for these properties.

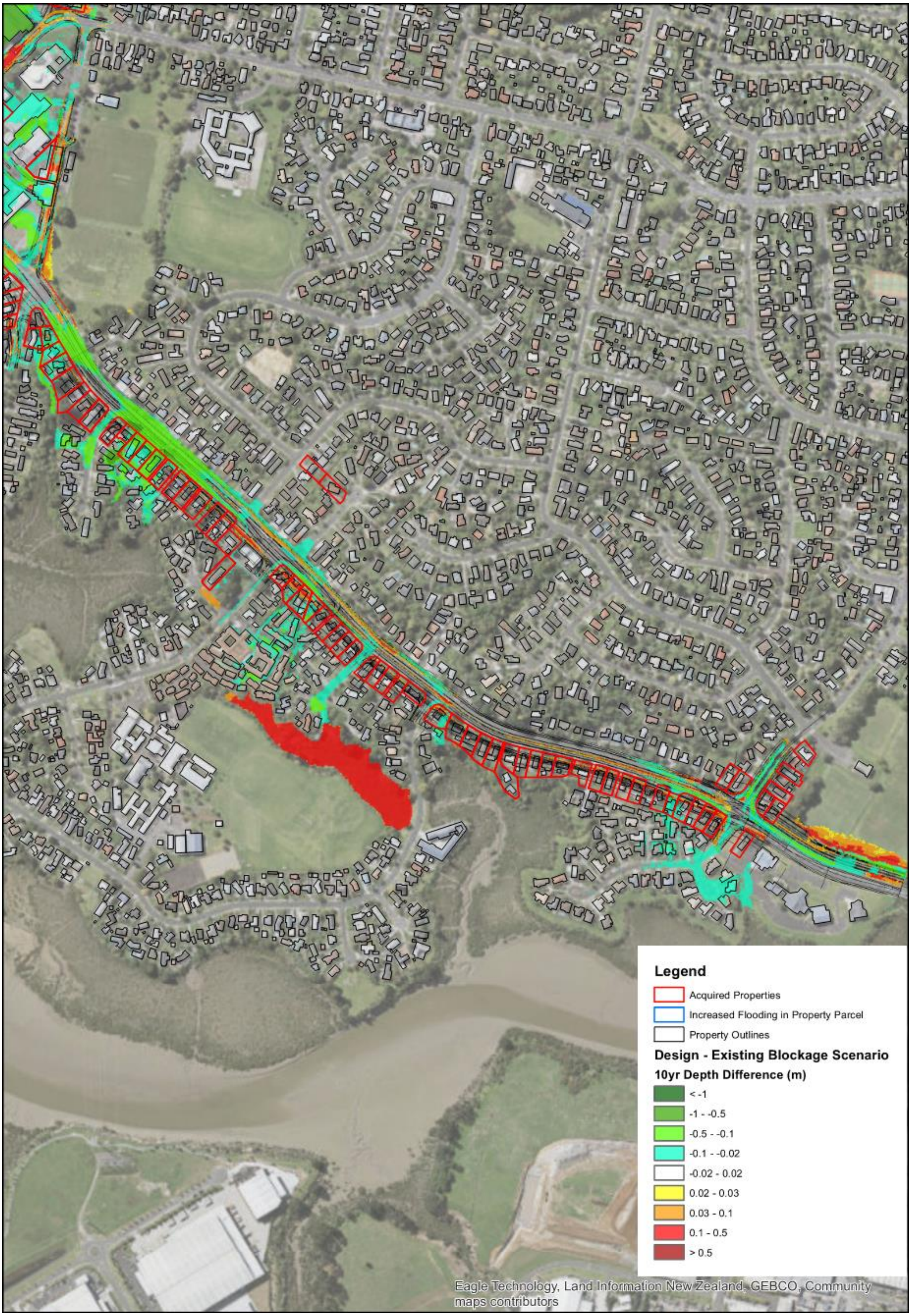

Figure 65: EB3R private properties impacted during 10-year event (pipe blockage with mitigation)

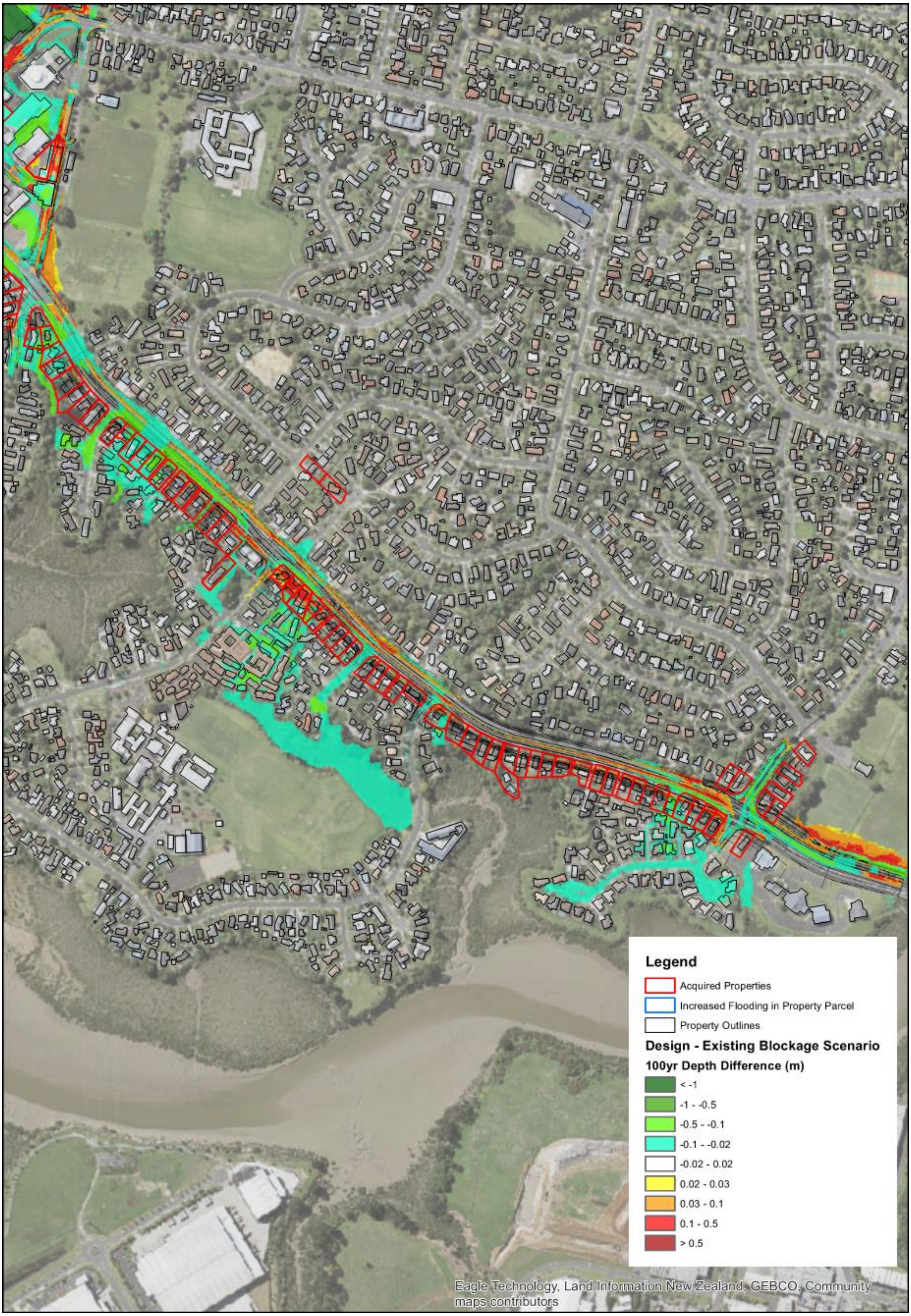

Figure 66: EB3R private properties impacted during 100-year event (pipe blockage with mitigation)

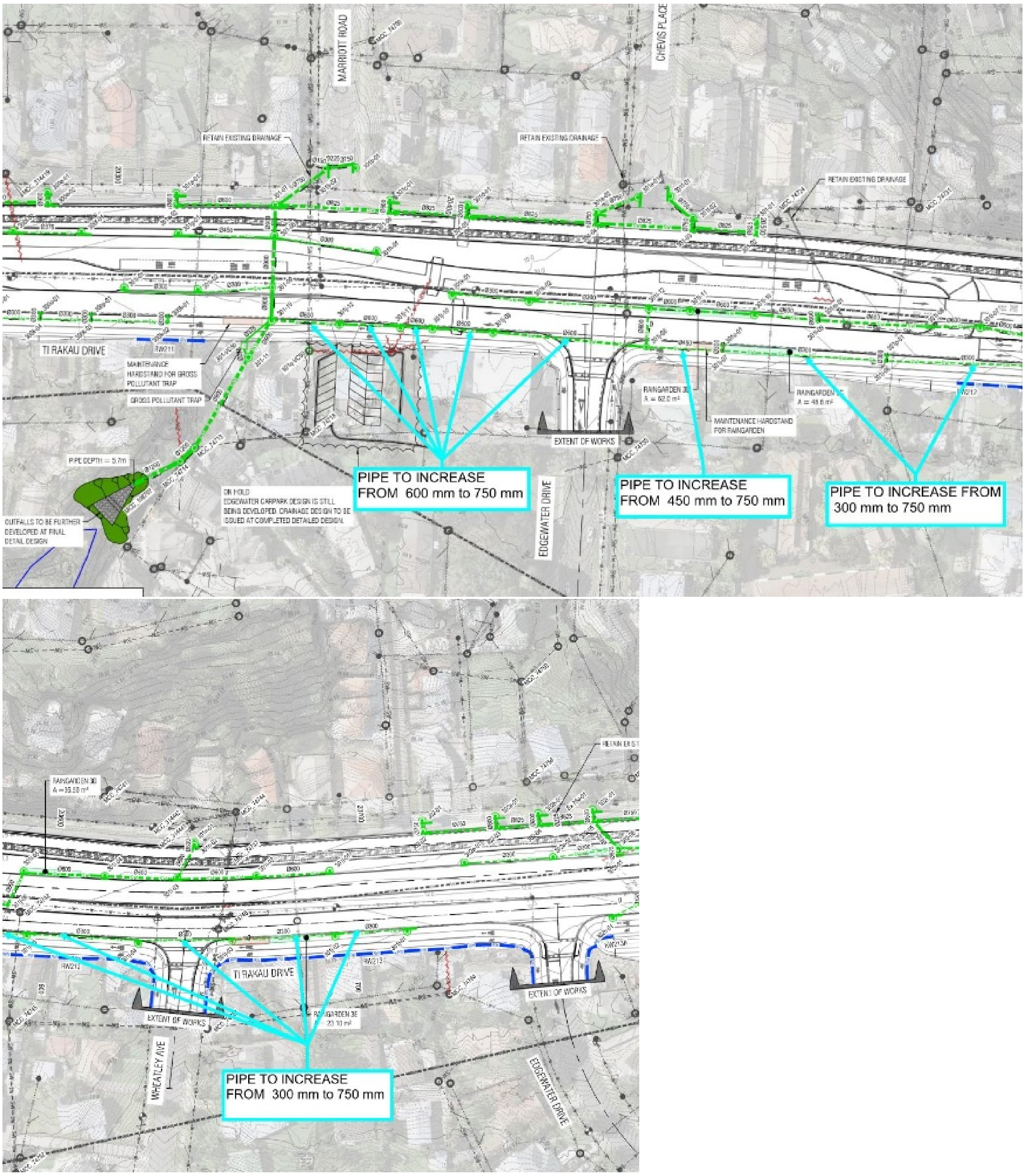

Figure 67: EB3R proposed mitigation for location 8

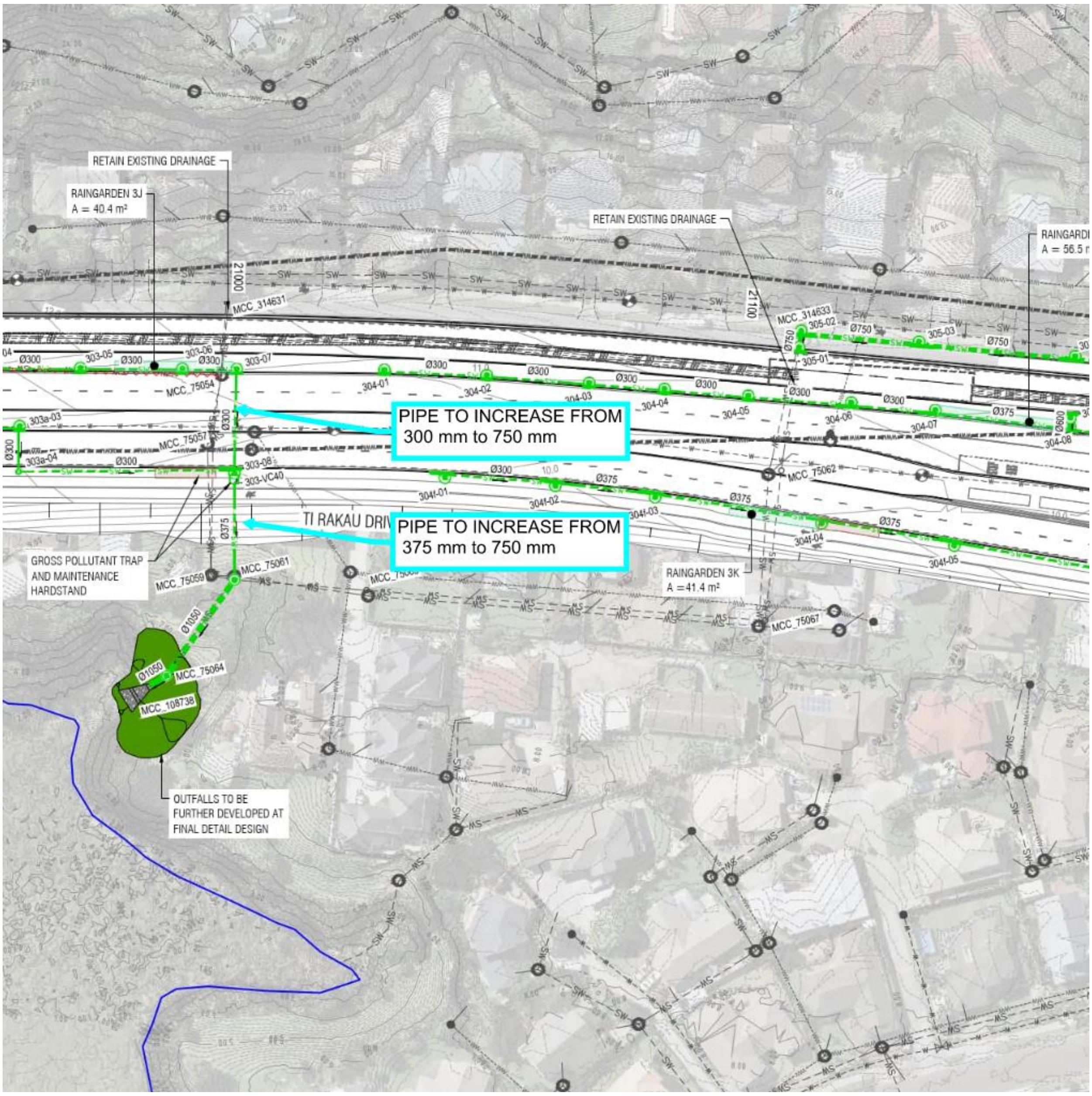

Figure 68: EB3R proposed mitigation for location 9

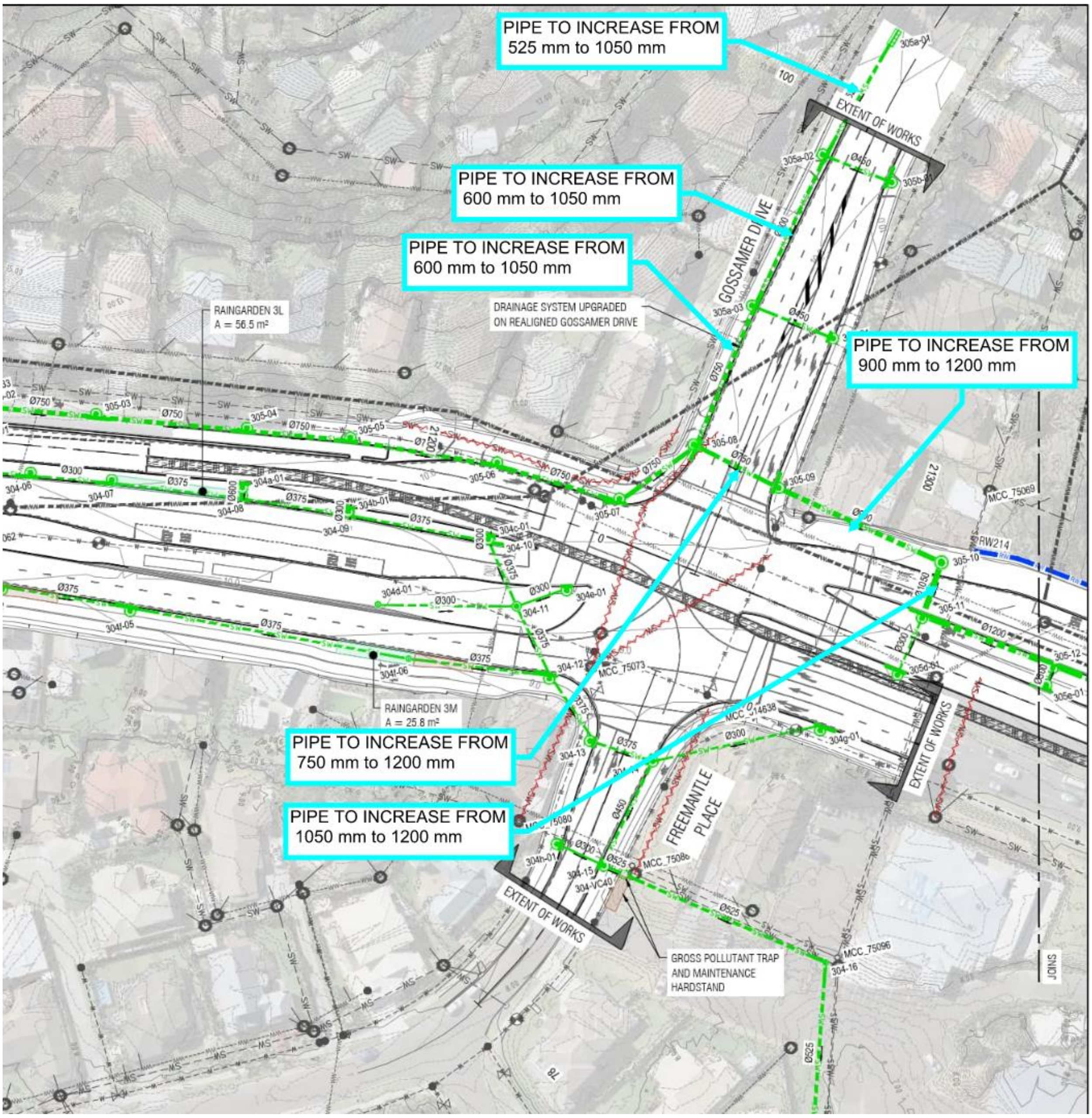

Figure 69: EB3R proposed mitigation for location 10

8 Recommendations and Conclusions

Chapter Summary
EB2 Summary of key points/ findings • *The existing EB2 environment has significant flooding and overland flows as a result of existing stormwater networks being undersized (approximately 2-year ARI event capacity).* • *EB2 stormwater is mostly untreated with parts treated by a GPT* • *The EB2 design achieves an overall improvement in contaminant loads being discharged from roads (within and outside of the Project extents). No mitigation is required for water quality* • *There are no flooding impacts predicted for EB2. Overland flow paths have been slightly reduced and mitigation is proposed by increasing some pipe sizes and via some geometric design changes. This will avoid potential impacts on several private properties* • *EB2 meets the network connection requirements under category 3 from schedule 4 of the NDC* *EB3R Summary of key points/ findings* • *The existing EB3R environment has significant flooding and overland flows as a result of existing stormwater networks being undersized (approximately 2-year ARI event capacity)* • *EB3R stormwater from roads is untreated* • *The EB3R design achieves an overall improvement in contaminant loads being discharged from roads (within and outside of the Project extents). No mitigation is proposed for water quality* • *There are no flooding impacts predicted for EB3R except that overland flow paths have been slightly reduced and mitigation is proposed by increasing some pipe sizes and through some geometric design changes to avoid potential impacts on several private properties* • *EB3R meets the network connection requirements under category 3 from schedule 4 of the NDC*

8.1 EB2

EB2 has several overland flow paths running through its extents which cross roads in the Project footprint in the 10 and 100--year ARI events in particular Ti Rakau Drive. The existing stormwater networks were historically designed for a 5-year event which is equivalent to a capacity of a 2-year event when allowing for climate change (increased rainfall and sea level rise).

There is extensive flooding during the 10 and 100-year ARI events with similar extents due to the under sized networks. Flood depths within the EB2 Project area range from shallow (10-40 mm) to deep (100-600 mm) in the 10-year ARI event and in the 100-year ARI event the areas with deeper flooding increase in extent.

Large parts of the existing outfall catchments, including stormwater from roads, have no stormwater treatment, except for MCC_108633 which has Tetra Traps within some catchpits and an Ecosol unit (GPT 41350) within the Bus Stop Reserve.

There are no flood impacts on private property during the 10 and 100-year events as a result of the EB2 stormwater design and Project works. There are large areas of reduced flooding throughout the wider catchment that EB2 is located within. No mitigation is proposed for flooding.

There are some reduced overland flow path capacities as a result of the EB2 works that the EB2 stormwater network design has not compensated for, based on the secondary flow assessment where pipe blockages are applied to pipes in accordance with the Stormwater Code of Practice. These reduced overland flow path capacities result in predicted small to modest flood impacts on private property during the 10 and 100-year events. Mitigation is proposed for these properties. The mitigation involves relatively minor pipe size upgrades at several locations and some minor localised geometric design changes to the ground surface levels. The model showed some areas as subject to flooding in the 10 and 100-year events. This was identified as model noise rather than an actual impact. All potential impacts have been confirmed by updated flood model results. The mitigation ensures the proposed design meets the network connection requirements of category 3 under schedule 4 of the NDC.

The proposed stormwater treatment in the design reduces the overall contaminant load from all roads discharging to EB2 outfalls. The reductions are 39% for TSS, 14% for zinc, 18% for copper and 23% for TPH. All individual outfalls have reductions in their existing contaminant loads from roads except for Outfall MCC_108633 which will have a larger road catchment as a result of the Project works. Whilst outfall MCC_108633 is predicted to receive a reduced TSS contaminant load of 17%, it is predicted to receive small increases for zinc, copper and TPH. This is a small increase in comparison to the larger overall decreases. No mitigation is required for water quality as overall the Project improves water quality (i.e. reduces the total combined existing contaminant loads discharged from all roads within outfall catchments) in accordance with the BPO and will be further detailed in the SMP. The SMP will be submitted for network connection approval via the EPA process. The quality outcomes meet the connection requirements of category 3 under schedule 4 of the NDC.

8.2 EB3R

EB3R crosses or follows several overland flow paths which cross Ti Rakau Drive in several locations during the 10 and 100-year ARI events. The existing stormwater networks were designed for a 5-year event which is equivalent to a capacity of a 2-year event when allowing for climate change (increased rainfall and sea level rise).

There is extensive flooding during the 10 and 100-year ARI events with similar extents due to the under sized networks. Flood depths within the EB2 Project area ranges from shallow (10-40 mm) to deep (100-600 mm) in the 10-year ARI event and in the 100-year ARI event the areas with deeper flooding increase in extent.

There is no existing treatment of stormwater from roads within EB3R.

There are no flood impacts on private property during the 10 and 100-year events as a result of the EB3R stormwater design and Project works. There are large areas of reduced flooding throughout the wider catchment EB3R is located within. No mitigation is proposed for flooding.

There are some reduced overland flow path capacities as a result of the EB3R works based on the secondary flow assessment where pipe blockages are applied to pipes in accordance with the Stormwater Code of Practice. These reduced overland flow path capacities result in predicted small to modest flood impacts on private property during the 10 and 100-year events. Mitigation is proposed for these properties. The mitigation involves relatively minor pipe upgrades at several locations and some geometric design changes to the ground surface levels. The model showed some areas as subject to flooding in the 10 and 100-year events. This was identified as model noise rather than an actual impact. All potential impacts have been confirmed by updated flood model results. The mitigation ensures the proposed design meets the network connection requirements of category 3 under schedule 4 of the NDC.

The proposed stormwater treatment in the design reduces the existing total contaminant load from all roads discharging to EB3R outfalls. The reductions are 59% for TSS, 43% for zinc, 48% for copper and 53% for TPH. All individual outfalls have their existing contaminant loads from roads reduced except for Outfall MCC_108707 which receives runoff from a larger road catchment as a result of the Project works. Whilst outfall MCC_108707 is predicted to receive a reduced TSS contaminant load of 17%, it is predicted to receive increases of 74% for zinc, 62% for copper and 49% for TPH. This increase is the result of a section of Ti Rakau Drive being diverted from outfall MCC_108713 for flood mitigation reasons since it could not easily be upgraded (it runs under several houses and immediately adjacent to several others). The mitigation ensures the proposed design meets the network connection requirements of category 3 under schedule 4 of the NDC.

No mitigation is required for water quality at this outfall as overall the EB3R Project works improves water quality (i.e. reduces the total combined existing contaminant loads discharged from all roads within outfall catchments) in accordance with the BPO and will be further detailed in the SMP. The SMP will be submitted for network connection approval via the EPA process. The quality outcomes meet the connection requirements of category 3 under schedule 4 of the NDC.

Appendix 1: Design Philosophy Statement

The philosophy for the design of drainage and treatment system for the entire Project (inclusive of William Roberts) has adopted an approach that considers a "maintenance-led" approach, seeking to provide well designed assets which reduce the maintenance and operational expenditure to Auckland Transport and ultimately the ratepayers of Auckland. Life-cycle cost assessments are to be undertaken to support the selected approaches. The design philosophy has been developed to carefully balance Auckland Transport's standards and approaches to stormwater, the aspirations of mana whenua, Healthy Waters requirements under the NDC, and affordability.

The philosophy adopts a BPO approach for water quality treatment which has taken a risk-based approach, providing treatment efficiencies and options commensurate with the contaminant generating risk. The use of a BPO approach is balanced by adopting the key objective of providing a net positive receiving environment benefit for locations where stormwater from the Project works is discharged (i.e a reduction of the existing contaminant contributions from roads following completion of the Project). Green infrastructure-based conveyance and treatment have been considered and provided where feasible. However, compliance with GD01 is not the default position. Cycleways do not receive water quality treatment if separate from the carriageway and the stormwater network. However, runoff controls are provided where necessary to avoid flooding impacts.

Providing discretionary treatment that targets high contaminant generating roads and parking areas outside of the Project works (i.e. from pavements and/or kerb lines not modified by Project works) is a key element of the philosophy. This targeted discretionary treatment will provide more water quality improvement than providing GD01 treatment of the entire busway which is a low contaminant generating road. The daily bus count has been estimated to be well below 1000 bus movements in each direction per day. This is well below the lowest category in the Auckland Council CLM (version 2.0) which has an upper limited of 1,000 vehicle movements per day. Discretionary treatment has been provided wherever possible, particularly adjacent to outfalls to minimise construction works while improving water quality of existing discharges. Auckland Transport have indicated that the BPO approach with targeted discretionary treatment of high contaminant generating roads and parking areas is consistent with mana whenua expectations to date although engagement with mana whenua as a key partner is ongoing.

A key element of the agreed philosophy is to separately collect, reticulate and treat stormwater from all new pavements of the busway and any roads that have small and localised pavement modification and/or changes to the kerbs. The approach provides a new independent stormwater network designed to the Projects 10-year design rainfall event including allowance for climate change and sea level rise in accordance with the Stormwater Code of Practice. Pavements and kerbs with only minor works carried out (i.e. pavement overlays and kerb tie-ins) would continue to enter the existing stormwater networks except where new drainage is required for flood mitigation to avoid potential adverse flood impacts on private property. The key objective of this element of the philosophy is to avoid potential impacts from flooding that could otherwise occur if additional stormwater is collected and discharged into the existing stormwater networks. These existing networks were designed for a 5-year ARI event without climate change (i.e. capacity equal to approximately a 2-year ARI event with climate change) in accordance with the former Manukau City Council's standards. These networks currently surcharge to overland flow paths in the Projects design rainfall event (i.e. 10-year ARI event) for the busway and roadways being substantially modified by the Project.

The philosophy for management of flooding and overland flow paths is predominantly focused on not creating new or increasing existing flood impacts. The current approach to managing these overland flows across the general traffic lanes and therefore the busway is to provide variable messaging systems (VMS) at these locations. The VMS will either impose a reduce speed on the buses or will alert the bus drivers to stop due to impassable overland flow depths. The Project will mitigate any potential impacts from flooding as a result of changes to the road corridor to accommodate the busway. The main approach to minimising flood impacts is by geometric design where possible. The geometric design has attempted to not increase the crest spill height of the road at overland flow paths as well as not shifting low points to avoid moving the overland flow towards properties that were not previously within the overland flow paths. Residual impacts will be mitigated as necessary through further geometric design modification or drainage solutions.