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Neil Construction Ltd

Whenuapai Business Park Private Plan Change,

Whenuapai, Auckland

Flood and Flood Hazard Risk Assessment Report

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Originating Office

Office	Henderson
Postal Address	PO Box 21355, Henderson 0650
Phone	09 837 0486

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1.0 Introduction

Cato Bolam was engaged by Neil Construction Limited to prepare a flood assessment and flood hazard risk assessment report in support of the plan change application to the Auckland Unitary Plan Operative in Part (AUP). This flood assessment focuses on the flood hazard management within the Plan Change Area (PCA), rezoning from Future Urban Zone to Business-Light Industrial Zone.

The proposed rezoning encompasses the properties at 141, 145, 15, 153, 155-157 and 159 Brigham Creek Road; and at 71, 73, 94, 96A-96 Trig Road. The properties are split into Plan Change Area one (PCA1) to the west and Plan Change Area two (PCA2) to the east of Trig Road as shown in Figure 1. PCA1 covers an area of 36.23ha while PCA2 extends over an area of 11.34ha.

The purpose of this report is to assess the existing flooding effects and flood hazard risk associated with the proposed plan change in relation to future development, and to recommend mitigation measures for the flood management in compliance with Auckland Council requirements where necessary.

There has been extensive liaison with Healthy Waters in the preparation of the report. Responses to Request for Information have been submitted separately on 15 May 2024 and 2 August 2024. The responses discuss additional flood scenarios beyond what is included in this report.

2.0 Site Description

The PCA is split into two distinct site areas being PCA1 and PCA2 as shown in Figure 1. PCA1 comprises 69 to 73 Trig Road, 141 & 145 Brigham Creek Road, 151 to 159 Brigham Creek Road while PCA2 covers 94 Trig Road, 96 & 96A Trig Road in Whenuapai. The entire PCA covers an area of approximately 47.57ha.

PCA1 has a moderate slope with the land falling from RL42m at the southern boundary to RL13m at the north-eastern corner, and to RL15m at the south-eastern corner. The ground slope varies between 2%-6% across the site. An unnamed stream within PCA1, flows from the west to the north-east before discharging to Waiarohia Stream. A gully at the south-eastern corner of the site leads to Waiarohia Stream. Two inline wetlands have been identified within 153 and 155-157 Brigham Creek Road, by the Ecologist.

PCA2 also has a moderate slope falling from RL45m at the south-eastern corner to RL27m at the north-western corner. Minor overland flow paths within PCA2 convey and discharge the flow to the tributaries of Sinton Stream.

There is no public stormwater network in the two areas. The site drains naturally to gullies before discharging to the respective streams as show in Figure 1. The site location is shown in Figure 1 below.

Figure 1: Site Location

3.0 Flood Assessment

3.1 HEC RAS Parameters Assumption

The overland flow paths were assessed using the TP108 graphical method and HEC-RAS 2D software to determine the effects of overland flow on the subject properties and downstream environment. The 24 hours rainfall depths for the 1% AEP, 10% AEP and 50% AEP storm events were calculated from the TP108 rainfall graphs. These rainfall depths account for future climate change based on 3.8°C in accordance with the draft copy of the Auckland Code of Practice Version 4 and the consultation with Healthy Waters. 3.8°C climate change is considered the worst-case scenario that may occur by the year 2100.

The rainfall depths are summarised in Table 1. Therefore, the results based on the conservative 3.8°C climate change are presented in this report with additional information in Appendix D.

Table 1: Rainfall Depths and Climate Change Increase at 3.8°C

Storm Events	Existing TP108 Rainfall Depth (mm)	Climate Change Increase (%)	TP108 Rainfall Depth + CC (mm)
1% AEP	200	32.7	265
10% AEP	135	30.8	177
50% AEP	85	27.4	108

Hydrograph precipitation generated from TP108 using HEC HMS was utilised in HEC RAS rain on grid modelling.

The terrain is based on the on Auckland Council 2016 contours in combination with more accurate survey data taking account of recent development. The levels are in terms of Auckland vertical datum AUK1946.

The meshes were set to 5x5 (refinement region) with 1x1, 2x2 and 2.5x2.5m for break-lines within the proposed plan change and surrounding properties up to SH18; and 50x50m with 2.5x2.5, 5x5m for break-lines and refinement regions in the rest of the catchment. A tailwater level of 3.5m has been used in two model runs as downstream boundary condition to check if the coastal inundation will cause effects on the proposed development.

The impervious areas for the proposed plan change are based on the Maximum Probable Development (MPD) being the proposed future Business Light Industry Zone. The upstream catchment (outside of the PCA) was considered in both its existing state and for MPD to assess the PCA's effects and cumulative effects, respectively. The impervious percentages were estimated at 11.56% for existing and 90% for future development in MPD situations.

Manning's n values ranging from 0.03 to 0.1 were assumed in the flood model as follows:

Light Industrial/Business "n" value of 0.045Residential Properties/Parcels "n" value of 0.1

- Road "n" value of 0.03
- Open Space "n" value of 0.06

The land use values will be determined in more detail during the subdivision design stage.

Existing culverts under the motorway in the upstream catchment are assumed to be 50% blocked. The model allows for existing culverts under SH18 in the upstream catchment to be operating at 100% and 50% capacity in all scenarios.

3.2 Overland Flow-path Catchment

The Auckland Council Geomaps show multiple overland flow paths (OLFP) through the proposed plan change area with other overland flow paths from surrounding area. The overland flow paths within PCA1 merge to form a single overland flow path. The merged overland flow path discharges to an unnamed stream that in turn discharges to Waiarohia Stream.

The overland flow paths within PCA2 convey the flow in separate directions and merge further downstream before discharging to the Sinton Stream. It is noted that the PCA2 area is at the top of the entire Sinton Stream catchment.

A total catchment area of approximately 363.0ha (sub-catchment A1 to A7) as shown in Figure 2 was considered in the HEC RAS model for PCA1. This catchment is enclosed by Trig Road to the west, Royal New Zealand Air Force (RNZAF) Base to the north-west, Hobsonville Road to the east and Waitemata Harbour to the north-east. A catchment area of 361ha was considered in assessing the effects over Brigham Creek Road at the existing 4mx4m box culvert.

Given the small area of PCA2, with no buildings downstream deemed to be negatively impacted, only a total area of 47.10ha was considered in the model. PCA2 itself has an area of 11.34ha.

The above catchments were split into sub-catchments to facilitate in flood modelling and for flood analysis purposes.

Sub-catchments A1, A2, A6 and A7 with a combined area of 283.30ha, have been assumed to generate the overland flow that is likely to be conveyed to the existing 4m box culvert under Brigham Creek Road. Sub-catchment A3 generates the overland flow for the flow path along Brigham Creek Road

which causes flooding near the culvert in all 1% AEP storm scenarios. The flood flow from this sub-catchment crosses Brigham Creek Road (east) and discharges mainly to downstream of the existing box culvert. Note that the split of the sub-catchments is based on the existing situation and may slightly differ from those to be used in the future development within the plan change areas as development occurs. The catchment delineation is presented in Figure 2 and in Appendix E.

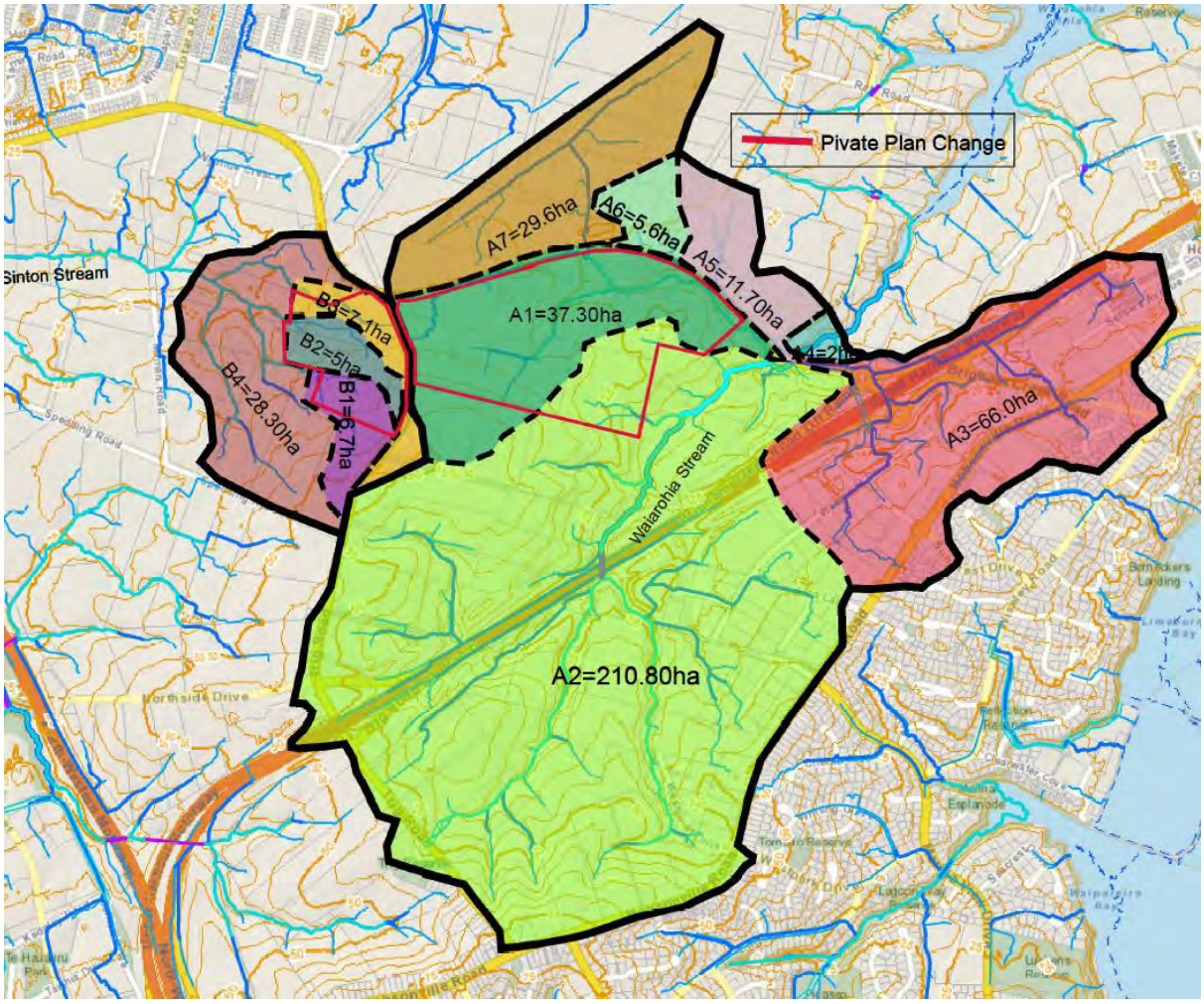

Figure 2: Catchment areas

3.3 Pre-development Flood Analysis

3.3.1 Flooding Within the PCA

The predevelopment flood assessment was carried out using HEC RAS 2D software rain on grid with climate change considered. A climate change allowance of 3.8 degrees has been used in the existing development scenario as in the post-development to assess the effects of the change in impervious area and catchment layout. This assessment focuses on the proposed plan change areas PCA1 and PCA2 on Brigham Creek Road and Trig Road to assess the potential flooding effects on the PCA, on existing roads, over Brigham Creek Road carriageway at the existing box culvert crossing, on surrounding and downstream properties, and on the downstream environment in accordance with Auckland Council requirements.

This report focusses mainly on the future development within PCA. The pre-development flood extent and flood levels within the PCA with 3.8°C climate change are presented in Figures 3a and 3b below. Further details are shown in Appendix D.

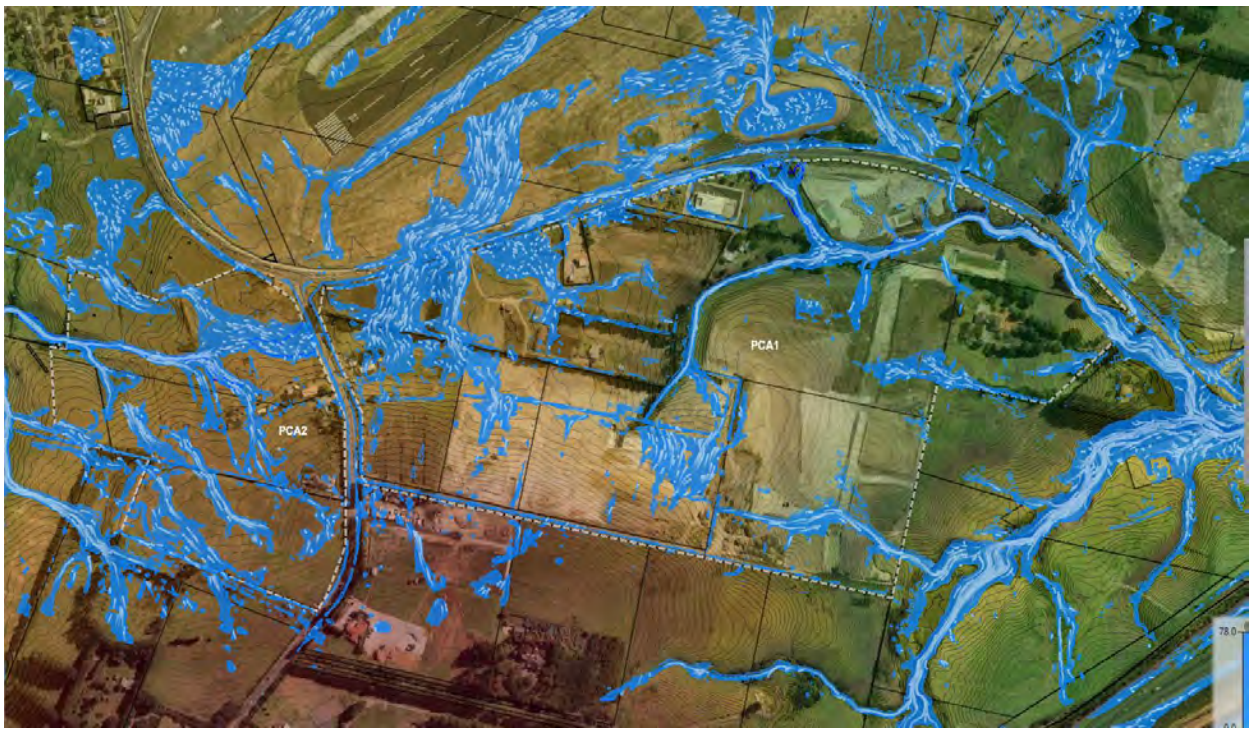

Figure 3a: Pre-Development 1% AEP Flood extent (3.8°C)

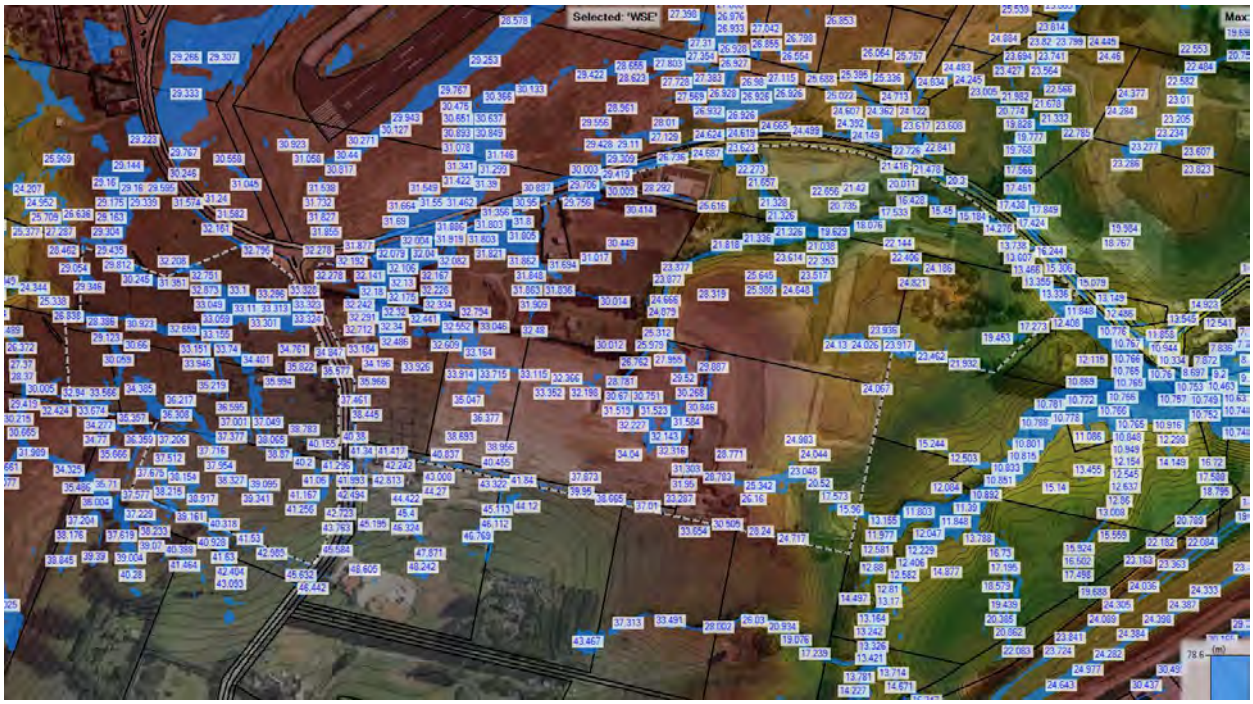

Figure 3b: Pre-development 1% AEP Flood Levels (3.8°C)

HEC RAS results show that the 1% AEP overland flow from neighbouring properties to the south of PCA1 will flow across PCA1 as several small overland flow paths before discharging to the unnamed

stream, Waiarohia Stream and to the Royal New Zealand Air Force property via 141 Brigham Creek Road. The flow that enters the site from neighbouring properties merge with the flow in the unnamed stream within PCA1. The existing Spark Infrastructure buildings within 153 Brigham Creek Road are not affected by flooding in the existing situation and shall remain as such for the future development.

The 1% AEP overland flow within the unnamed stream gradually increase from 4.43m^3/s at the upstream end to 21.97m^3/s at the junction with Waiarohia Stream. The flow of 20.45m^3/s and 3.55m^3/s will exit the PCA1 at the north-eastern and south-eastern boundaries, respectively.

Except for the flow of 1.14m^3/s from 94A Trig Road, the flow affecting the proposed PCA2 is generated by the area within the properties at 94 to 96 Trig Road and that from a portion of the western half of Trig Road. Minor flow of 0.23m^3/s from Trig Road discharges to an existing low-lying area within 96 Trig Road. A combined flow of 5.91m^3/s from PCA2 exits this site and discharges to the tributaries of the Sinton Stream.

As shown in Figure 3b, the existing overland flow in the north-western section of PCA1 and the entire PCA2 flows in an uncontrolled manner which will require flood management solutions. Excluding the unnamed stream, the PCA is only affected by minor flooding which can easily be managed as part of the future earthworks, new roads and building platform formation.

The combined overland flow over the proposed PCA1 will discharge via unnamed stream and Waiarohia Stream to the box culvert inlet where it will be conveyed to Waiarohia Stream Inlet.

3.3.2 Flooding at Brigham Creek Rd Box Culvert Crossing

Two scenarios were considered to assess the effects on Brigham Creek Road at the box culvert crossing and on the existing properties downstream of the culvert. Variation in the capacity of the existing box culvert or the consideration of these options does not create any flooding fluctuation within the proposed PCA1. The following scenarios were considered in the model:

- Box culvert operating at its maximum capacity (unblocked)
- Box culvert operating partially blocked at half its maximum capacity (50% blocked)

Assessing flow with a 50% blockage in the culvert is considered conservative as the size of the 4m box culvert makes it unlikely to block in this catchment, and the Auckland Unitary Plan Operative in Part (Chapter J – Definitions) and the 2011 Auckland Council Flood Modelling Specifications (Section 5.3.2.1) assumes no blockage.

If the existing box culvert is half blocked (50% blockage), it will only convey 32.45m^3/s with 24.17m^3/s overtopping Brigham Creek Road. The flood depth due to overtopping on Brigham Creek Road carriageway is estimated at 0.52m maximum. However, this flood depth is mainly caused by the overland flow discharging along Brigham Creek Road from the roundabout adjacent to the Upper Harbour Motorway (SH18) and shown as Catchment A3 in Figure 2.

When the box culvert is operating without blockage (100% capacity), it would convey 56.62m^3/s without overtopping Brigham Creek Road. The flooding from catchment A3 causes a flood depth of 0.28m along Brigham Creek Road before overtopping the berm to flow towards the stream across 162 Brigham Creek Road. A portion of the flow from Catchment A3 enters the wetland pond to the south of the culvert inlet before discharging to the inlet of the culvert.

The results show that there is preexisting flooding along Brigham Creek Road with overtopping adjacent to the existing box culvert which is unrelated to the operational level of the culvert or its contributing catchment. This is due to Brigham Creek Road acting as a secondary flow path for overland flow coming from the south (Catchment A3).

Two buildings in 162 Brigham Creek Road just downstream of the box culvert outlet are at risk of flood water, even when climate change is not considered. The closest building is a garage and is not deemed a habitable building. This garage is positioned fully within the flood plain with a Finished Floor Level (FFL) of RL8.54m. The second building is a house with an approximate FFL of RL9.13m, which will be encroached by the flood plain in the existing situation (when the flowpath from Catchment A3 flows past the dwelling towards Waiarohia Stream). However, the floor level is positioned above the modelled flood plain level of RL9.03m.

The garage falls within the proposed designation set out in the Notice of Requirement (NOR) relating to the future Brigham Creek Road upgrade and is proposed to be demolished as part of those works. The NOR's boundaries are shown in Figure 4a.

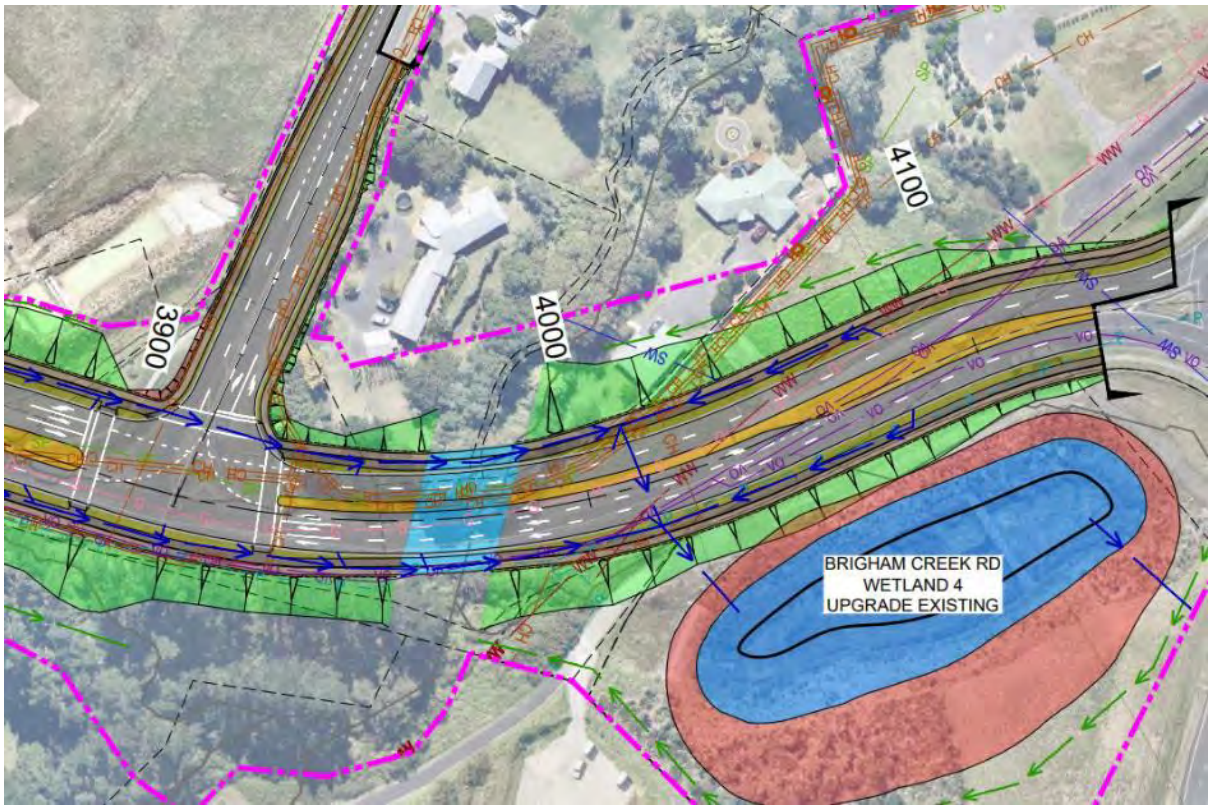

Figure 4a: Auckland Transport Notice of Requirement – Brigham Creek Road

An additional extreme scenario has been considered in consultation with Healthy Waters. This extreme scenario considers the existing box culvert under Brigham Creek Road being at 50% capacity with an allowance of 100% capacity for the culverts under the SH18 in the upstream catchment. This is discussed further at the end of section 3.4.3.

3.4 Post-development Flood Analysis

3.4.1 General Considerations

The post development assessment and analysis focus on demonstrating that the flooding can be managed within PCA without detrimental effects to the neighbouring and downstream properties/environment in support of the plan change application. The assessment allowed for Maximum Probable Development (MPD) for the PCA and considered the upstream catchment with and without MPD in the existing situation.

It has been assumed that portions of Brigham Creek Road and Trig Road will be upgraded as part of the PCA development, and therefore considered in the model. The bulk earthworks carried out or proposed to be carried out under the respective granted land use consents are included in the model.

Indicative earthworks at 94 to 96 Trig Road, 141 and 145 Brigham Creek Road were incorporated in the model to facilitate the flood management within the plan change areas. Existing stormwater water features shall be protected where possible. The terrain within PCA is shown in Figure 4b.

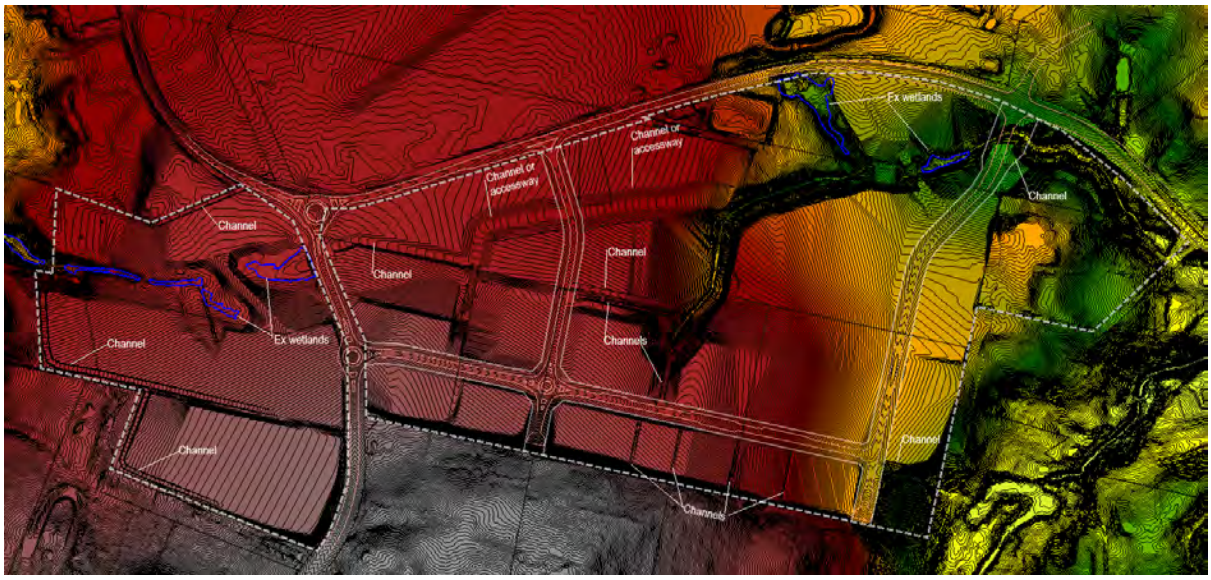

Figure 4b: Terrain of Potential Post-development Earthworks and Channels

3.4.2 Potential Flood Management Solutions Within PCA

The future subdivision design shall consider the options presented in this report in managing the flooding within PCA. The 1% AEP overland flow within the PCA shall be diverted to the nearest stream or their tributaries. Channels, existing and future public roads, and private accessways with overland flow paths protected by easements shall be utilised to convey the overland flow resulting from storm events greater than 10% AEP storm event. The proposed channels used in the flood modelling are indicative and shall be designed at subdivision stage to comply with the Auckland Council Stormwater Code of Practice, Auckland Transport and New Zealand Building Code requirements.

Two bridges and a culvert are proposed within the properties at 151 and 155-159 Brigham Creek Road, and at 96 Trig Road respectively as shown in Figure 5b. The future indicative culvert will convey the flow above the maximum water level in the existing wetland and will discharge to the western side of

the potential indicative accessway to 96 Trig Road. Future upgrades to Brigham Creek Road, Trig Road and proposed roads in the PCA shall be designed to convey a 1% AEP flows.

3.4.3 Flood Results Analysis Within PCA

The post-development scenario was assessed to demonstrate that the 1% AEP overland flow can be managed using a combination of channels, future upgrade of the existing roads and the creation of the future roads with proposed overland flow paths as shown in Figure 4b and Figure 5a.

The 1% AEP storm results based on 3.8°C climate change demonstrate that the flow that was discharging to the Royal New Zealand Air Force from 141 Brigham Creek Road in the pre-development situation will be reduced by an average of 72% as a greater portion will be retained within 141 Brigham Creek Road where it will be conveyed by future channels or accessways and roads for discharge to the unnamed stream within PCA1. The post-development flood results assume that the upgrade of Brigham Creek Road and Trig Road will form part of the PCA work. The flood extent and flood levels for the 1% AEP storm within the PCA are presented in Figures 5a and 5b. Further details are available in Appendix D.

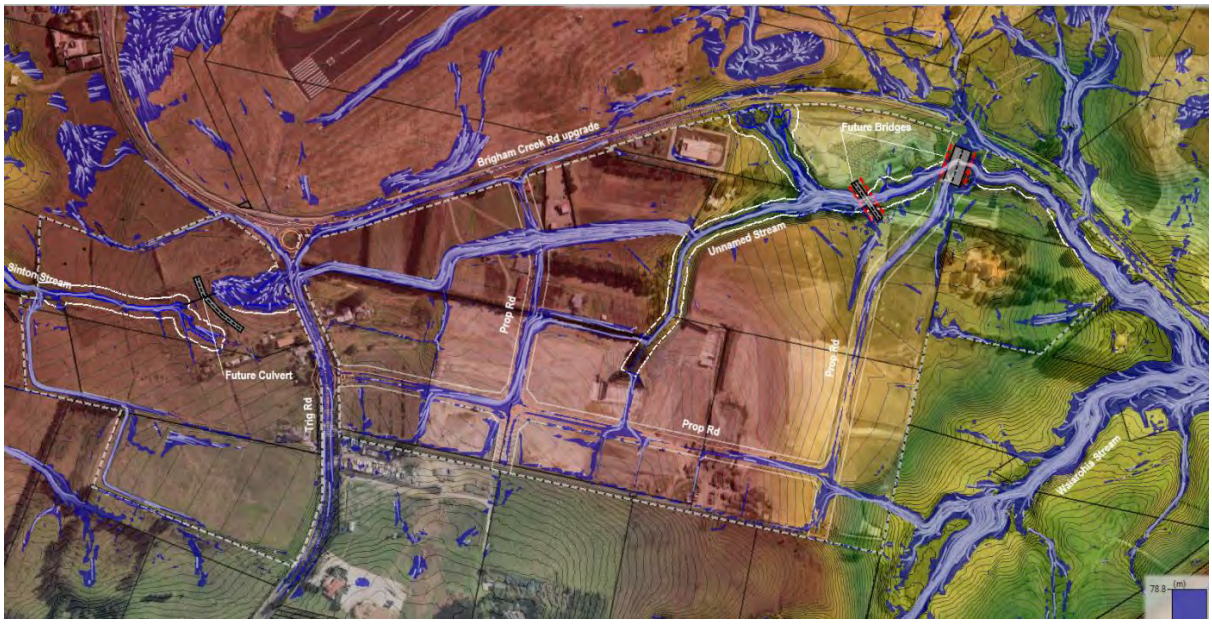

Figure 5a: Post-development Flood extent (3.8°C)

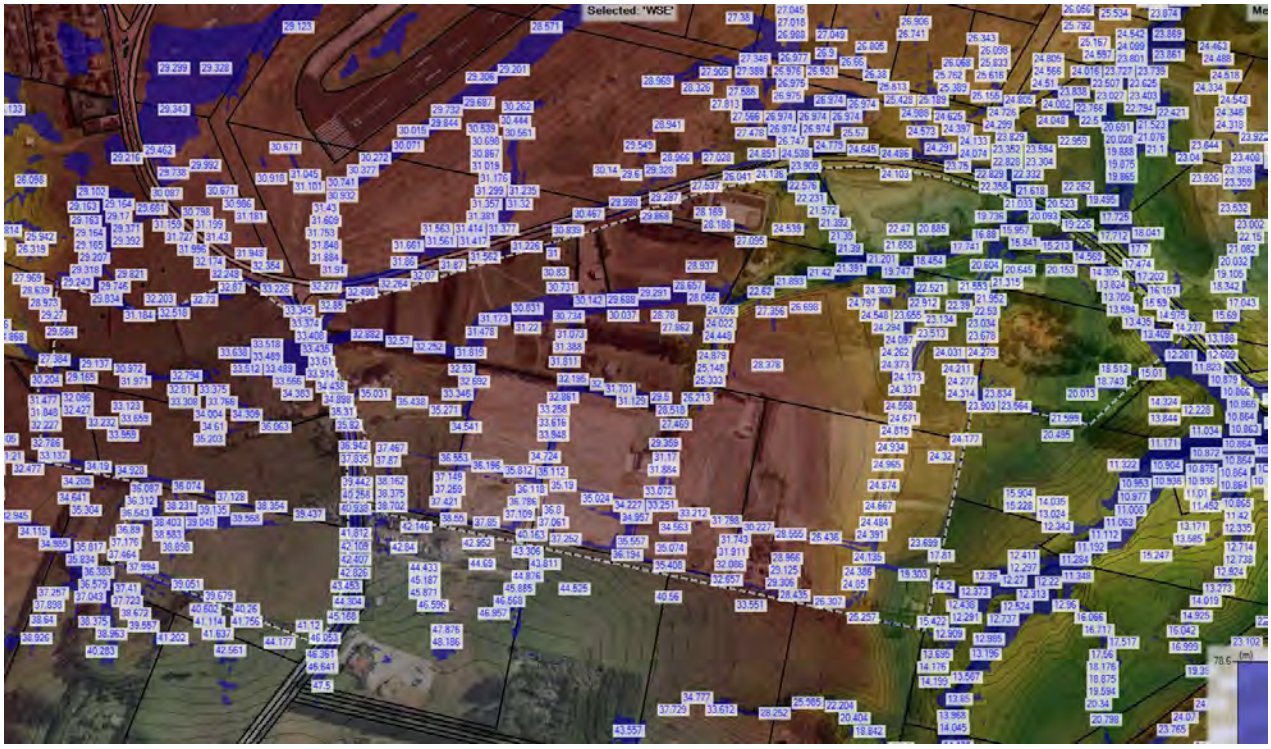

Figure 5b: Post-development Flood Levels (3.8°C)

The results suggest that 1% AEP post-development flow of 2.04m^3/s for the section of Trig Road adjacent to the existing wetland will split into three flow directions, being to the west and east on Brigham Creek Road and towards 73 Trig Road. A flow of 4.93m^3/s from Brigham Creek Road and Trig Road in combination with a portion of the flow generated by 141 Brigham Creek Road, will discharge to the unnamed stream. All flood flows are clear of the Spark Infrastructure buildings at 153 Brigham Creek Road as in the existing situation.

Minor flows from the neighbouring properties to the south will discharge across the southern boundary into PCA1, where the proposed channels will convey it to the adjacent future road, and then discharge to the unnamed stream and to Waiarohia Stream. The future roads shall be designed for a dual role being to convey the traffic and to provide secondary flow paths in accordance with the Auckland Council Code of Practice and Auckland Transport Design Manual. The flow from the properties to the north of PCA1 will continue discharging as in the existing situation.

The 1% AEP post-development overland flow within the unnamed stream will gradually increase from 4.93m^3/s at upstream end to 28.22m^3/s at the junction with Waiarohia Stream.

The 1% AEP flow of 26.16m^3/s and 4.78m^3/s will exit PCA1 at the north-eastern and south-eastern boundaries respectively. The flows of 14.78m^3/s and 17.78m^3/s flow under the proposed accessway bridge and proposed road bridge, respectively.

The flow affecting the proposed PCA2 is mainly generated by an area of the properties in PCA2, and that from the western half area of Trig Road. Minor flow from the western half of Trig Road when upgraded, will discharge to an existing wetland within 96 Trig Road.

A combined flow of 6.03m^3/s from PCA2 with minor flow from the western direction on Brigham Creek Road will exit PCA2 to discharge to the tributaries of Sinton Stream. The existing wetland in 96 Trig

Road, will detain a portion of the flow from Trig Road while discharging to the west via a future indicative culvert. If this culvert is blocked, the flow would overflow to Trig Road. Compared to the flow from PCA2 in the exiting situation, the results suggest that there will be an increase of 0.12m^3/s which will exit this site. This indicates that a portion of the flow is detained within the existing wetland which appears to attenuate the 1% AEP post-development flow.

No habitable building floor levels appears to be affected further downstream of PCA2 as the flow will be contained within the stream channel or riparian margin.

The overland flow over the proposed PCA1 combined with that from the entire upstream catchment of the existing box culvert will discharge at the box culvert inlet where it will be conveyed to Waiarohia Stream Inlet. A portion of the overland flow from upstream of this culvert with that from the roundabout adjacent to Upper Harbour Motorway (SH18), will be temporarily stored in the adjacent pond (south-east of the existing box culvert) as in the existing situation. In general, the flood extent is contained within the riparian margin or flow channel.

The overland flow paths' existing entry and exit points shall not be altered or obstructed. Being located near the bottom of the catchment, the future development in the PCA will not exacerbate the flooding effects at the existing box culvert other than those expected when conservatively allowing for the full development of the catchment as Business Light Industry and allowing for 3.8^{o}C climate change increase. Figures 6 and 7 show 1% AEP predevelopment and post-development (PCA) with the box culvert operating at 100% capacity, with climate change effects with no overtopping of the box culvert.

Figure 6: 1% AEP Pre-Development Flood Depths with Climate Change

Figure 7: 1% AEP Post-Development Flood Depths (PCA) With Climate Change

For the extreme case scenario that Healthy Waters Requestions (see 3.3.2), the results show no increase or decrease in the maximum flood levels/depth when the upstream culverts under SH18 are considered at 100% capacity with the existing box culvert at 50% capacity as shown on the Table 6. As shown in Figures 8 and 9, and in Table 6, the results demonstrate that allowing the full capacity for the culverts under the SH18 upstream, does result in the increase in flow reaching the existing box culvert inlet. The flood extent and levels are shown in Figures 8 and 9 below. Further details with other storms and options are presented in Appendix D.

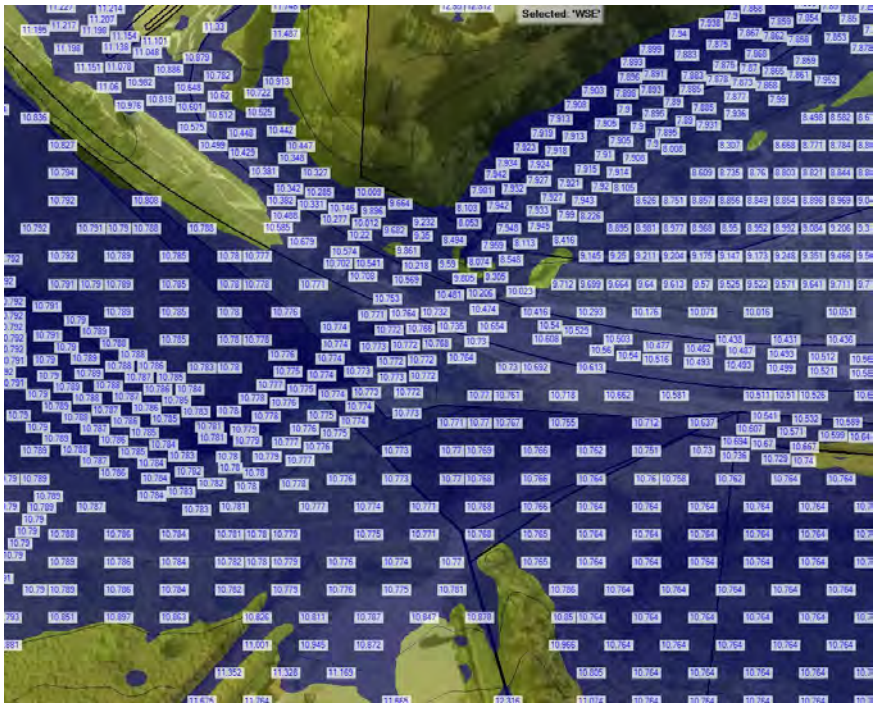

Figure 8: 1% AEP Post-Development Flood Depths with Climate Change and 50% Capacity Box Culvert with Culverts under SH18 at 100% Capacity

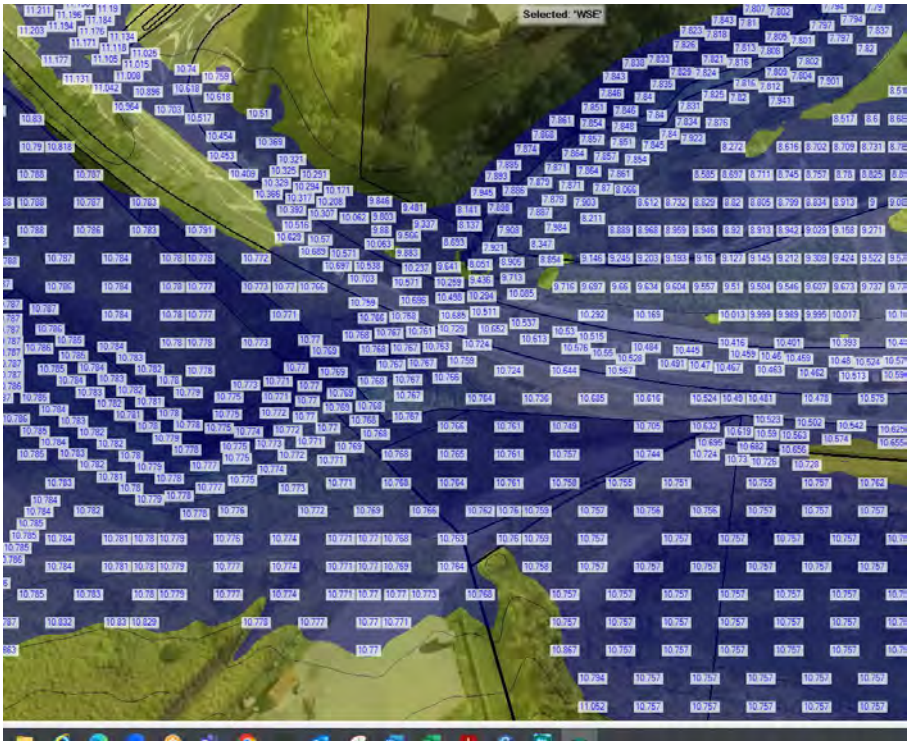

Figure 9: 1% AEP Post-Development Flood Depths (PCA) With Climate Change with all Culverts at 50% Capacity

3.5 Flood Effects Analysis on Land and Structures Outside the PCA

The impact of the proposed change of land use on land and structures downstream of the PCA was assessed for the 2-year, 10-year and 100-year rainfall events with and without climate change. The results demonstrate that no downstream habitable floors are affected by the development of PCA in any of the modelled scenarios. The properties considered include:

- The 4m box culvert at Brigham Creek Road (adjacent to the Kauri Road intersection)
- Buildings at 162 Brigham Creek Road
- Land at 131-137, and 139 Brigham Creek Road
- Land and structure at 161 and 163 Brigham Creek Road
- The Watercare pump station at 161 Brigham Creek Road

3.5.1 Flood Analysis at Box Culvert When PCA Only Developed

Flood analysis was carried out at the existing Brigham Creek Road box culvert crossing considering the future development in the PCA (MPD) with the remainder of the entire upstream catchment being in the existing situation (i.e. with the same impervious surface coverage as assumed in the pre-development scenario). The PCA results have been compared to the existing situation, to determine the effects caused by PCA1 when the box culvert is at 100% capacity and 50% (50% blockage) capacity scenarios. The flood results demonstrate that the 1% AEP flow and flood depth will increase by 3.09m^3/s compared to the existing situation as shown in Table 2. The culvert has sufficient capacity to convey this increased flow when unblocked and the increased flow has a less than minor effect

downstream as the flow is contained in the stream channel and riparian, and the increased flow does not affect any habitable floors of the existing dwellings.

Table 2: PCA1 Flood compared to Existing situation at Box Culvert at 3.8°C			
Scenarios	**Flow through Culvert (m^3/s)**	**Flow Overtopping (m^3/s)**	**Max Depth Over BHC Rd (m)**
100% Capacity existing	56.62	NA	NA
50% Blockage Existing	32.45	24.17	0.52
100% Capacity PCA1 Only Fully Developed	59.71	NA	NA
50% Blockage PCA1 Only Fully Developed	32.56	27.17	0.54

The effect of the increase in flood depth is considered less than minor.

The proposed development in PCA will not worsen the existing flood risk to the existing garage and house at 162 Brigham Creek Road. This property is subject to flooding from Catchment A3 shown in Figure 2 above, which is unaffected by the PCA. The PCA does not contribute to the flood water affecting the existing dwelling in either the pre-development or post-development scenarios. The existing garage which does not contain a habitable room, is located within the flood extent while the house is encroached by the flood extent (within the flowpath from Catchment A3) with its FFL 9.13m being just above the estimated flood level of RL9.08m as in the existing situation as summarised in Table 3.

Table 3: Flooding at Existing House at 162 BHC Rd (3.8°C Climate Change)				
Scenarios	**House Flood Levels (m)**	**Garage Flood Levels (m)**	**House Current FFL (m)**	**Garage Current FFL (m)**
100% Culvert Capacity existing	9.08	8.9	9.13	8.54
50% Culvert Blockage Existing	9.08	9.0	9.13	8.54
100% Culvert Capacity PCA Only Fully Developed	9.08	8.9	9.13	8.54
50% Culvert Blockage PCA Only Fully Developed	9.08	9.0	9.13	8.54

Anecdotal evidence gathered from residents and the selling agent for 162 Brigham Creek Road suggest that the culvert did not block, and the neither the garage nor the dwelling at 162 Brigham Creek Road were affected by flood water or sustained flood damage during the flood event on 27 January 2023 (229mm rain depth was recorded on the Whenuapai Rain Gauge).

Figure 10 and Figure 11 below show the flood levels in the pre-development and post-development scenarios when the culvert is 100% operational, allowing for climate change. They are also included in Appendix D.

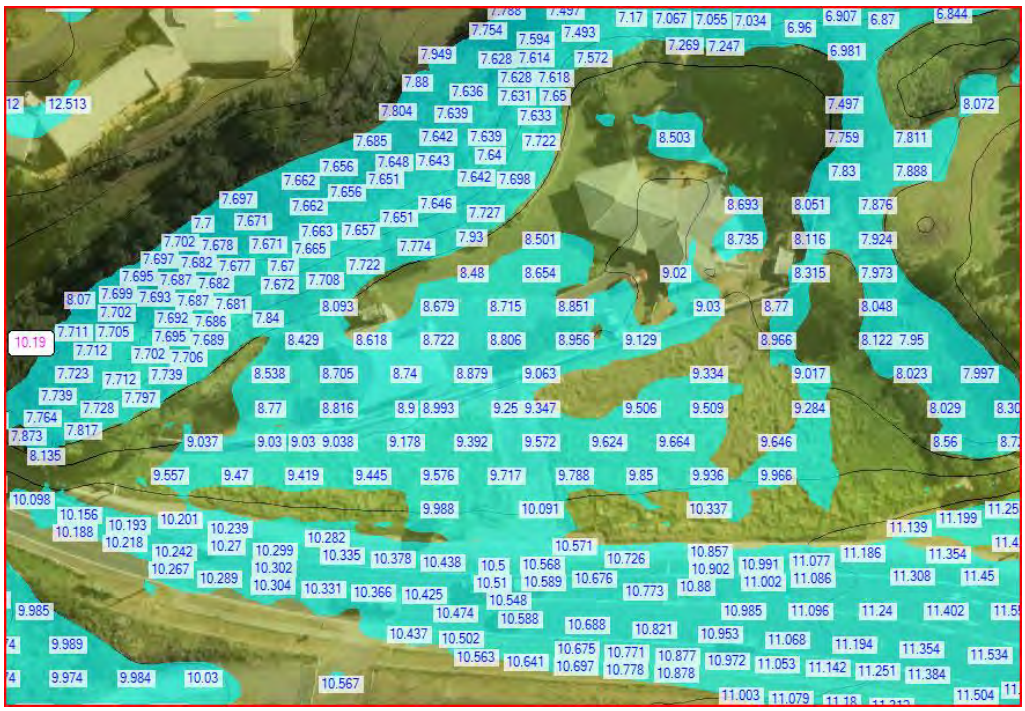

Figure 10: Pre-Development Flood Depths

Figure 11: Post-Development Flood Depths

3.5.2 Properties at 131-137, and 139 Brigham Creek Road

The properties at 131-137 and 139 Brigham Creek Road are at the upstream end of the catchment. The flood assessment carried out for the 50% AEP (2year), 10% AEP (10year) and 1% AEP (100year) storm events demonstrates that the flooding effects over 131-137 Brigham Creek Road will be considerably improved as the post-development flow (0.08m3/s) discharging to this site will be reduced by 0.50m3/s compared to the flow (0.58m3/s) in the pre-development scenario for a 1% AEP storm without climate change.

The flow that will discharge to 139 Brigham Creek Road will increase from predevelopment flow of 2.94m3/s to 3.50m3/s. The flow increases by 0.56m3/s compared to the predevelopment. However, the 1% AEP flow increase will be contained within the flow channel. No habitable floor is expected to be affected by the 1% AEP post development flow. The effect on this property is less than minor.

3.5.3 Properties at 161 and 163 Brigham Creek Road

The modelled flow generally remains in the stream channel or riparian margin, except for at the driveway stream crossings to 161 and 163 Brigham Creek Road where the existing culverts are under capacity and the driveways are overtopped.

The results indicate that the driveways at 161 and 163 Brigham Creek Road will not be accessible for a period of time in both pre-development and post-development scenarios during the 1% AEP storm event (with or without climate change). Mitigation options include:

- Flood warning signage could be provided along the driveways to warn traffic and pedestrians of the flood depth if present. Residents and visitors shall avoid accessing this location until the water has receded. It is noted that the affected areas are largely part of land designated for road upgrades and subject to Notice of Requirement.
- The existing culverts are shown to be under capacity in pre-development assessments. Upgrading the culverts subject to property owner approval to convey the additional flow resulting from development in the PCA, would reduce the risk of access being limited due to flood water. Installing 1800mm diameter culverts would convey the additional flow up to the 100year storm which includes an additional 20% capacity to allow for partial blockage.

The current flood scenario excluding climate change was assessed to enable a better understanding of the impact of the development of the PCA on downstream structures (as opposed to the impact of climate change on existing structures). The results indicate that the post-development flood depth over the 161 Brigham Creek Road driveway will increase by 130mm depth in 2-year event, 60mm depth in 10year event, and 50mm depth in 100year storm event. At the property 163 Brigham Creek Rd Driveway, the post-development flood depth will increase by 30mm depth in 2year event, 20mm depth in 10year events and 30mm depth in 100year event. The detailed results are listed in following Tables 4, 5 and 6.

Table 4: Assessment of Impact/effect on Land and Structures for 2year ARI PCA Only Excluding Climate Change										
Location	Flood flows (m^3/s)		Maximum Flood Depth D (m)		Average Flood Velocity V (m/s)		Product of D & V (m^2/s)		Flood Duration above 200mm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
161 BC Rd Driveway/ 1050 Culvert	0.31/1.48	1.88/1.71	0.12	0.25	0.62	0.86	0.07	0.22	0min	17min
163 BC Rd Driveway	1.88	3.74	0.19	0.22	0.83	1.45	0.16	0.32	0min	13min

Table 5: Assessment of Impact/effect on Land and Structures for 10year ARI PCA Only Excluding Climate Change										
Location	Flood flows (m^3/s)		Maximum Flood Depth D (m)		Average Flood Velocity V (m/s)		Product of D & V (m^2/s)		Flood Duration above 200mm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
161 BC Rd Driveway/1050 Culvert	4.10/1.85	6.03/1.93	0.35	0.41	1.05	1.15	0.37	0.47	32min	43min
163 BC Rd Driveway	6.69	8.67	0.30	0.32	1.66	1.99	0.50	0.64	49min	44min

Table 6: Assessment of Impact/effect on Land and Structures for 100year ARI PCA Only Excluding Climate Change										
Location	Flood flows (m^3/s)		Maximum Flood Depth D (m)		Average Flood Velocity V (m/s)		Product of D & V (m^2/s)		Flood Duration above 200mm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
161 BC Rd Driveway/1050 Culvert	11.50	13.95	0.36	0.41	1.15	3.26	1.0	1.27	1h31min	1h38min
163 BC Rd Driveway	12.47	15.27	0.37	0.40	2.27	2.42	0.83	0.97	1h30	1h29min

The flood depth increases are as shown on the attached drawing 47712-DR-C-8700-8701, drawing 47712-DR-C-8702-8703, and drawing 47712-DR-C-8704-8705 in Appendix A. The flow remains in the channel except for at the stream crossings where the existing culverts are under capacity.

3.5.4 Watercare Pump Station

The current flood scenario (i.e. excluding climate change) was assessed to enable a better understanding of the impact of the development of the PCA on the Watercare pump station as opposed to the impact of climate change on the pump station.

The pump station is located within an existing flood plain in 161 Brigham Creek Road and within an identified flood prone area. The flood levels in the flood prone area appear to be set by Brigham Creek Road if the 4m box culvert is blocked. The development has a less than minor effect on the flood water adjacent to the pump station.

Attached drawings 47712-8708-8709 in Appendix A demonstrate that if the existing culvert is fully operational, the 1% AEP water level increases 10mm at pump station post-development. This effect is considered less than minor.

Attached drawings 47712-DR-8706-8707 in Appendix A demonstrate the water level increases 30mm at the pump station between the pre-development and post-development in the 1% AEP storm event excluding climate change when the existing culvert is 50% blocked. This effect is considered less than minor.

3.5.6 Summary of Flood Effects

The flood effects on downstream properties is summarised below:

Property	Pre-Development Flood Depth	Flooding Effect	Mitigation Measures	Flooding Effect Post-Mitigation
159 Brigham Creek Road	590mm	An increase in maximum flood depth of 50mm. Access restricted in the 100-year storm for an additional 2 hours (from 14 hours to 16 hours).	A new access point will be available from proposed Road 1.	Improved safe access during storm events
161 Brigham Creek Road	360mm	Access restricted in the 100-year storm for an additional 7 minutes and the maximum flood depth increases by 50mm.	A new access point will be available from proposed Road 1.	Improved safe access during storm events

163 Brigham Creek Road	370mm	Access is restricted for the same amount of time as pre-development. The maximum flood depth increases by 30mm	It is recommended to upgrade the driveway culvert to convey the 10-year storm, and to limit the flood depth overtopping the drive to less than 200mm.	Improved safe access during storm events
162 Brigham Creek Road	NA	No effect on the flood levels at the existing buildings or causing access restrictions.	None	N/A
Watercare Pump Station	400mm	The flood depth adjacent to the pump station is modelled to increase by 10mm.	None	The impact of a 10mm increase in flood level in an existing flood plain is considered insignificant.

4.0 Flood Hazard Risk Assessment

4.1 Brigham Creek Road at Existing Box Culvert Crossing

The effect on the existing flood risk at the existing 4m Brigham Creek box culvert resulting from the development of the PCA was assessed based on two scenarios for the 1% AEP storm event at 3.8°C climate change. These scenarios have been applied to any upstream culvert greater than 1500mm in diameter:

- Full capacity culvert operational,
- 50% culvert blockage or capacity

Table 7 below summarises the HEC RAS results, showing the calculated flow through the culvert, and the flow overtopping Brigham Creek Road for the various scenarios. The table includes calculations for the flood hazard as specified by Auckland Transport.

When the culvert is fully operational, it is shown to have capacity for the additional flow resulting from the development of the PCA, allowing for climate change. This means that flow within Waiarohia Stream passes through the culvert without overtopping Brigham Creek Road. Development of the PCA therefore has no measurable impact on the existing flood risk on Brigham Creek Road adjacent to the existing box culvert.

The HEC RAS results demonstrate that there is an existing flood risk on Brigham Creek Road when the culvert is assumed 50% blocked (which is considered the wort case scenario and unlikely to occur) with a flood depth of approximately 520mm overtopping Brigham Creek Road. This depth of water is considered impassable to both vehicles and pedestrians.

Allowing for the full development of PCA1 (and 50% blockage in the culvert), the flood depth overtopping Brigham Creek Road is calculated to increase by 20mm to a depth of 540m. When assessing flooding effects, a change in flood level of less than 50mm is considered less than minor, and a change of 0.05m to 0.15m is considered minor. The increase in flood depth over the road because of the development of the PCA (if the culvert is 50% blocked) is therefore considered to be less than minor. Allowing for full MPD flow (and 50% blockage in the culvert), the depth of flow overtopping the road is calculated to increase by 0.15m to a depth of 0.65m. The effect of this increase is considered minor. The MPD flow does not allow for any level of mitigation in the upstream catchments.

Table 7: Flood Hazard Risk Assessment on Brigham Creek Road at Existing Box Culvert only (3.8°C)

Box Culvert Capacity Scenarios	Flood flows at Box Culvert (m^3/s)	Maximum Flood Depth D (m)	Average Flood Velocities V (m/s)	Product of D & V (m^2/s)	Flood Duration above 200mm
Pre-development					
Full Capacity unblocked	56.62	NA	NA	NA	NA
50% Blockage	32.45 (24.17 over weir)	0.52	3.51	1.82	34min
Post-development (PCA1 Fully Developed)					
Full Capacity unblocked	59.71	NA	NA	NA	NA
50% Blockage	32.56 (27.15 over weir)	0.54	3.60	1.94	37min
Post-development (Full catchment MPD)					
Full Capacity with all culverts unblocked	65.10 (1.48 over weir)	0.30	1.6	0.48	34mins
50% Blockage in culverts	33.18 (58.28 over weir)	0.61	1.0	1.0	53min

Table 7: Flood Hazard Risk Assessment on Brigham Creek Road at Existing Box Culvert only (3.8°C)					
Box Culvert Capacity Scenarios	**Flood flows at Box Culvert (m^3/s)**	**Maximum Flood Depth D (m)**	**Average Flood Velocities V (m/s)**	**Product of D & V (m^2/s)**	**Flood Duration above 200mm**
50% Blocked 4m box culvert with 100% capacity for culverts under SH18 in upstream	32.62 (44.15 over weir)	0.54	1.64	0.89	60min

The 0.30m maximum flood depth in the above table, is caused by the flow ($5.63m^3/s$) from the roundabout (Catchment A3) rather than the overtopping from the box culvert inlet. The flood depth caused by the overtopping flow ($1.48m^3/s$) from the culvert inlet is only 0.17m.

Flooding over Brigham Creek Road (if the culvert is 50% blocked) will last for a maximum duration of 34minutes for the predevelopment scenario, 37minutes when allowing for the development of the PCA, and 53minutes above 200mm flood depth for the post development (full MPD) when the box culvert is half blocked. The flood duration when the culvert is operating at full capacity post-development (full MPD) will last 12 minutes only, which is caused by the flood flow from the roundabout adjacent to SW18 (Catchment A3), which is not affected by the PCA. Further details are presented in Table 7.

4.2 Sections of Brigham Creek Road and Trig Road Along PCA

The post-development flood depths on the above roads beyond the box culvert are less than 200mm except for isolated points where two lanes merge into a single lane towards Brigham Creek Road and Trig Road future roundabout intersection. The velocities are slightly greater with than those in the existing situation. However, the future final design to upgrade these roads shall not exacerbate the existing flood risk. They should be designed in compliance with Auckland Transport requirements.

4.3 PCA1 Post-development Flow in Relation to MPD Flow

Given the above and the location of the proposed development in the greater catchment, the risk caused by the 1% AEP flow from the proposed plan change will be less than minor to minor. Consideration could be given to providing 1% AEP level mitigation, however, as this site is at the lower end of the catchment, mitigation may worsen the flood risk effects by aligning peak flows with that of the upstream catchment. It is best practice that with catchments of this size, mitigation not to be provided in the lower half of the catchment. Section B1.7.1.3 of the Auckland Design Manual (GD01) states that Detention of 10% AEP and 1% AEP rainfall events is not required for developments that are located within the lower half of the catchment.

Therefore, mitigation for 1% AEP flow from the proposed development is not recommended. Development of properties upstream will be required to assess their effect on the downstream environment, and it is anticipated that developments south of the State Highway 18 motorway would likely be required to provide mitigation for the 1% AEP storm.

However, depth markers and vehicle warning signage are recommended to be installed on Brigham Creek Road where flood risk occurs and assist in safely managing traffic and pedestrians in the area.

5.0 Mitigation Options for Flood Effects

The development of the PCA does not have adverse effect on flood levels in relation to habitable dwellings within or downstream of the development.

The development of the PCA does not cause any significant flood hazard risk on existing or proposed roads, however, the development of the PCA will increase the flood depth over the existing driveways at 161 and 163 Brigham Creek Road.

To assist drivers and pedestrians in identifying hazards posed by flood water if overtopping occurs at the two driveways, it is recommended that flood depth markers be installed along the driveways, or for the culverts (which are under capacity in the existing situation) to be replaced with appropriately sized culverts. Both mitigation options would require agreement from the relevant property owners.

The 1% AEP overland flow within the PCA shall be diverted to the nearest stream. Channels, existing and future public roads, and private accessways with overland flow paths protected by easements shall be utilised to convey the overland flow resulting from greater than 10% AEP storm events.

6.0 Request for Further Information (RFI)

RFI's were submitted to address questions from Healthy Waters relating to the flood modelling and flood hazard assessment. Four responses dated 2 May 2024, 31 July 2024, 2 September 2024 and 12 September 2024 were submitted to Healthy Waters. This report has been updated to include the pertinent information from those responses, however, the responses include information additional to this report.

7.0 Conclusion and Recommendations

The flooding and flood hazard risk have been assessed in relation to the proposed plan change areas being PCA1 and PCA2 to Business Light Industry Zone.

The two plan change areas are located to the eastern and western of Brigham Creek Road and Trig Road respectively. The flood results in this report are not to be used to set up the finished floor levels of the future buildings but shall serve as guidance for the future flood modelling during the subdivision and roads upgrade design. It is to demonstrate that the flooding within the PCA can be managed in accordance with the Auckland Council requirements.

The flood results demonstrate that the future and existing roads, future accessways and multiple channels could be utilised to convey the 1% AEP overland flow for discharge to the unnamed stream within PCA1, Waiarohia Stream to the east and to the tributaries of Sinton Stream. The roads, the channels and building platforms will necessitate earthworks, especially at 141 Brigham Creek Road and 96A to 96 Trig Road.

A proposed public and a private bridge at the unnamed stream crossings within PCA1 shall be designed and constructed for access to the future lots. A proposed culvert shall be designed and constructed to convey the water above the maximum water level in the existing wetland within 96 Trig Road to facilitate access to the northern section of this property. The proposed plan change will not create

further flood risk or exacerbate the existing flood risk on neighbouring properties and downstream environment.

The flood risk assessment at Brigham Creek Road box culvert crossing suggested that there are no flood effects from the PCA if the culvert is fully operational during a 1% AEP storm event. When a 50% blockage is considered, the flood depth will reach maximum levels of 0.52m and 0.54m in the predevelopment and post-development (PCA fully developed) scenarios, respectively. It is calculated that the flood depth overtopping Brigham Creek Road when the culvert is considered 50% blocked will increase by 0.02m. The effect of this increase is less than minor.

Auckland Unitary Plan Operative in Part (Chapter J – Definitions) and the 2011 Auckland Council Flood Modelling Specifications (Section 5.3.2.1) assumes no blockage.

Anecdotal evidence from residents and the selling agent for 162 Brigham Creek Road suggests that the culvert did not block, and the neither the garage nor the dwelling at 162 Brigham Creek Road were affected by flood water or sustained any flood damage during the flood event on 27 January 2023 (229mm rain depth was recorded on the Whenuapai Rain Gauge).

It is recommended that flood depth markers be installed adjacent to the driveways at 161 and 163 Brigham Creek Road to assist drivers and pedestrians in identifying existing flood risk in the event flood water overtops the driveways.

Due to having less than minor impact on the flood risk on Brigham Creek Road, the location of PCA in relation to the entire upstream catchment and no impact on downstream habitable floor levels, mitigation of additional 1% AEP flow is not recommended.

8.0 Limitations

This report has been prepared for the applicant, Neil Construction Limited - Whenuapai Business Park Plan Change, in relation to the plan change application at Brigham Creek Road and Trig Road, from Auckland Council.

The comments within this report are limited to the purpose stated. Cato Bolam accept no liability for the use of this report by any other person that that stated above, or use for any other purpose, and any such person who relies upon any matter contained in this report does so entirely at their own risk.

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Whenuapai Business Park Private Plan Change, Whenuapai, Auckland

Flooding and Flood Hazard Risk Report

Appendix A: Plans

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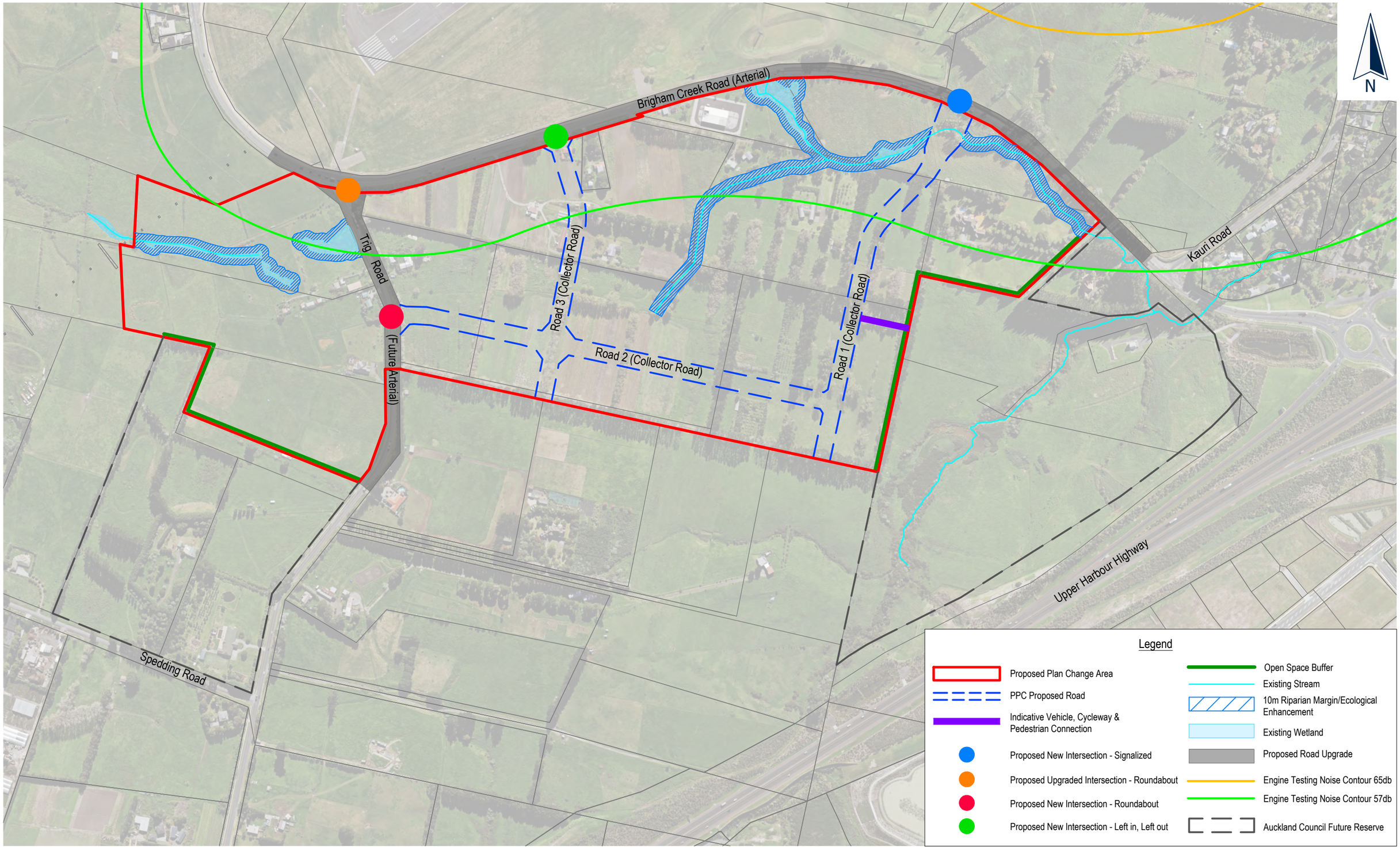

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Precinct Plan

No.	REVISION (DESCRIPTIONS)	NAME	DATE
K	Pedestrian and cycle links removed	M.Chen	15/03/2024
L	Minor changes	M.Chen	10/04/2024
M	Minor changes	M.Chen	18/04/2024
H	Riparian margins updated	T.Morris	25/10/2023
I	Legend amended	T.Morris	08/11/2023
J	Legend amended	T.Morris	16.11/2023

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	M.Chen	18/08/2023
DRAWN	M.Chen	18/08/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
02/10/2023	1:5000	A3

DRAWING NO.	REVISION
47712-DR-C-8003	M

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Proposed Contours

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	P.Kleynhans	19/10/2023

FOR INFORMATION

	NAME	DATE
SURVEYED	-	-
DESIGNED	-	-
DRAWN	T.Morris	19/10/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
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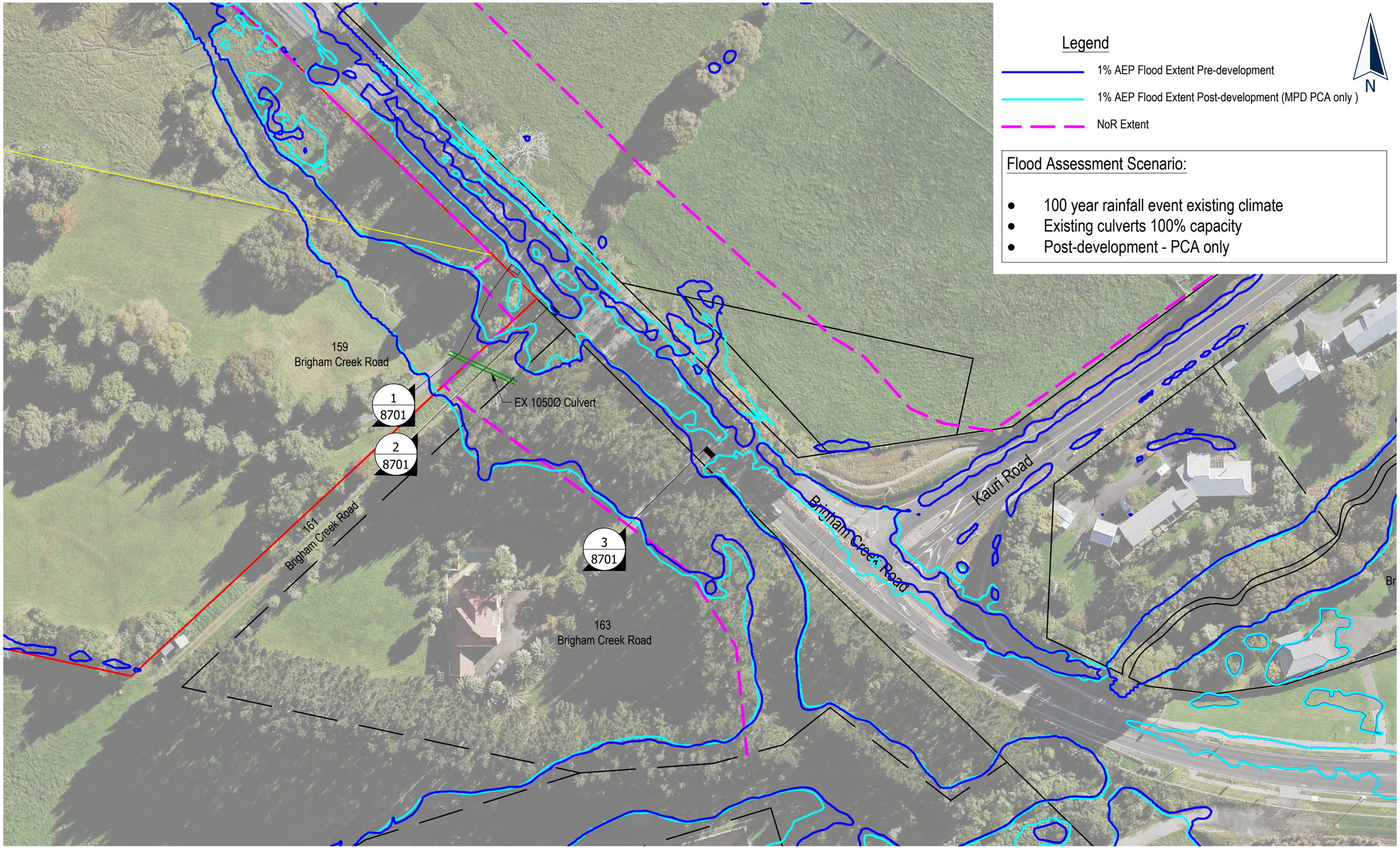
DRAWING NO.	REVISION
47712-DR-C-8300	A



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1% AEP Flood Extents
EX Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

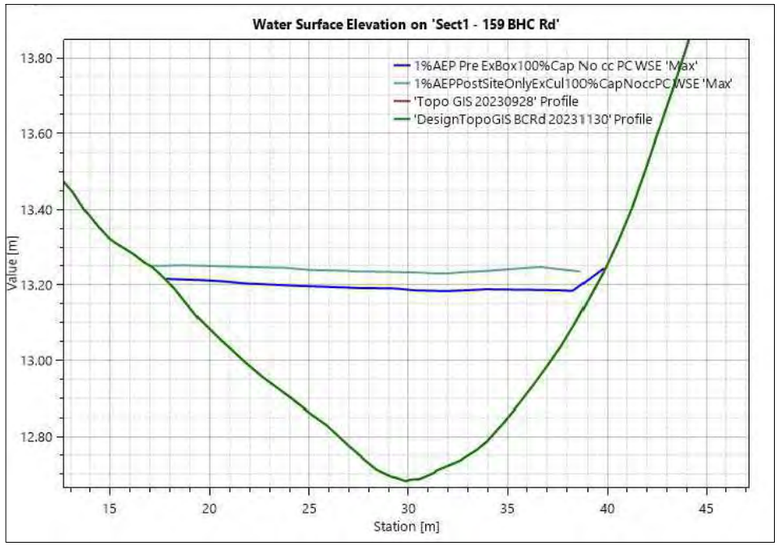
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	26/03/2024
B	Issued For Information	A.Manirambona	04/04/2024

FOR INFORMATION

		NAME	DATE
SURVEYED			
DESIGNED		A.Manirambona	26/03/2024
DRAWN		M.Chen	26/03/2024
DATE 26/03/2024	ORIGINAL SCALE 1:1000	ORIGINAL SIZE A3	
DRAWING NO. 47712-DR-C-8700		REVISION B	

Flood Assessment Scenario:

- 100 year rainfall event existing climate
- Existing culverts 100% capacity
- Post-development - PCA only



1 / 8700 Section 1-159 Brigham Creek Road Driveway

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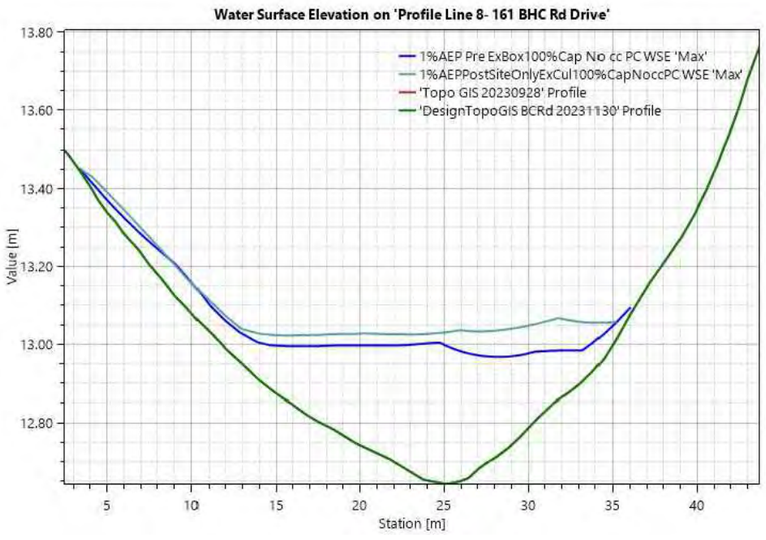

2 / 8700 Section 2- 161 Brigham Creek Road Driveway

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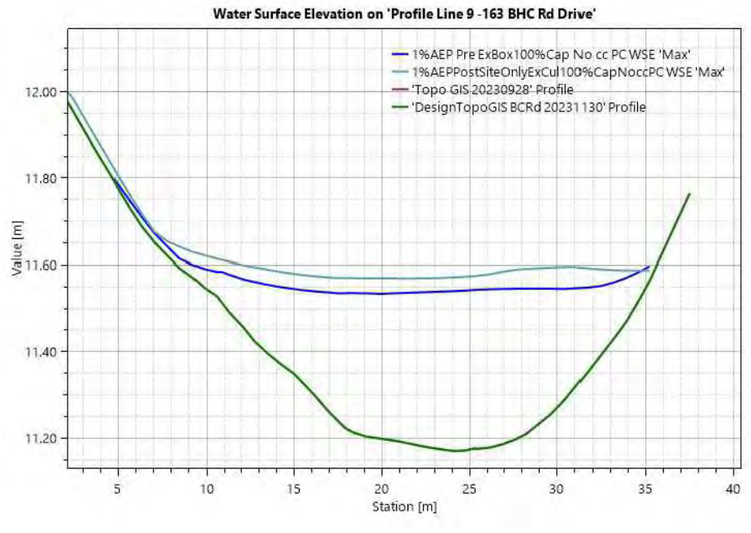

3 / 8700 Section 3- 163 Brigham Creek Road Driveway

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1% AEP Water Levels
Existing Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	26/03/2024
B	Issued For Information	A.Manirambona	04/04/2024
C	159 BC Cross section added	A.Manirambona	22/04/2024

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	26/03/2024
DRAWN	M.Chen	26/03/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
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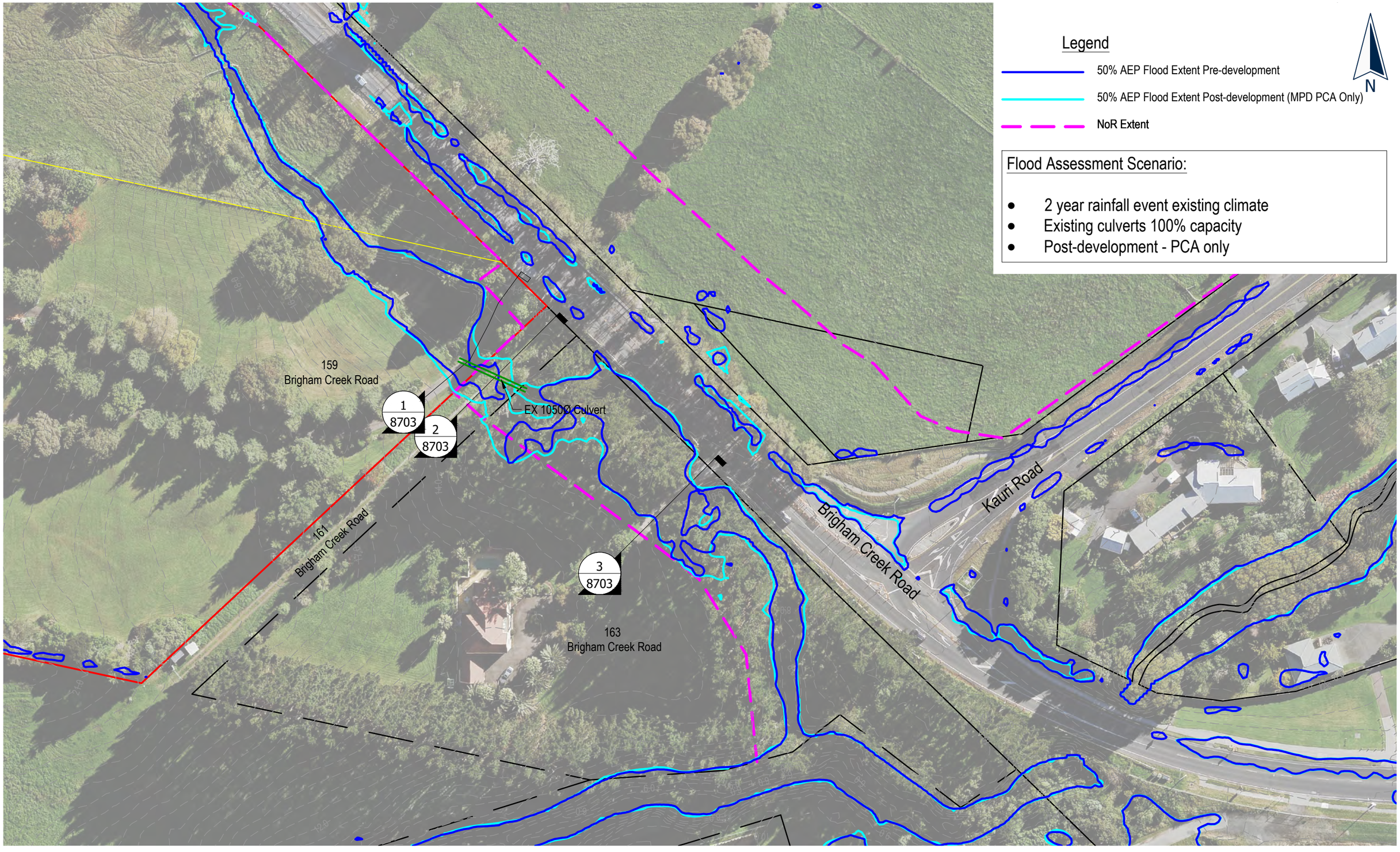
DRAWING NO.	REVISION
47712-DR-C-8701	C



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50% AEP Flood Extents
Existing Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	M.Chen	15/03/2024

FOR INFORMATION

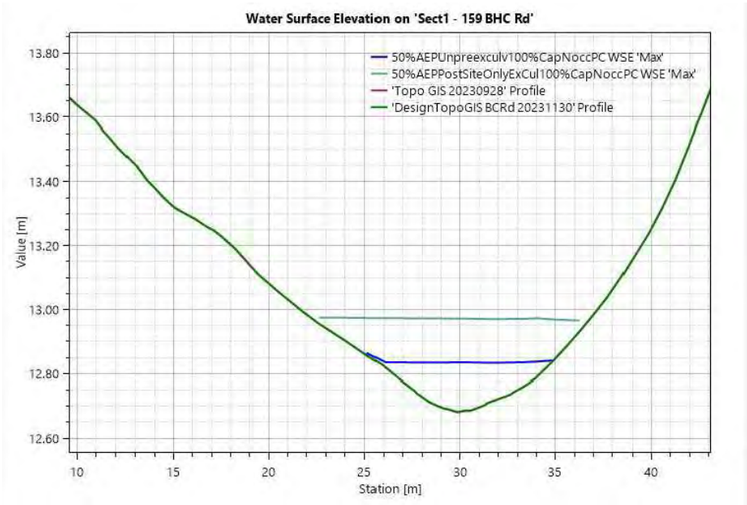
	NAME	DATE
SURVEYED		
DESIGNED	-	15/03/2024
DRAWN	M.Chen	15/03/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/03/2024	1:1000	A3

DRAWING NO.	REVISION
47712-DR-C-8702	A

Flood Assessment Scenario:

- 2 year rainfall event existing climate
- Existing culverts 100% capacity
- Post-development - PCA only



1 / 8702 Section 1-159 Brigham Creek Road Driveway

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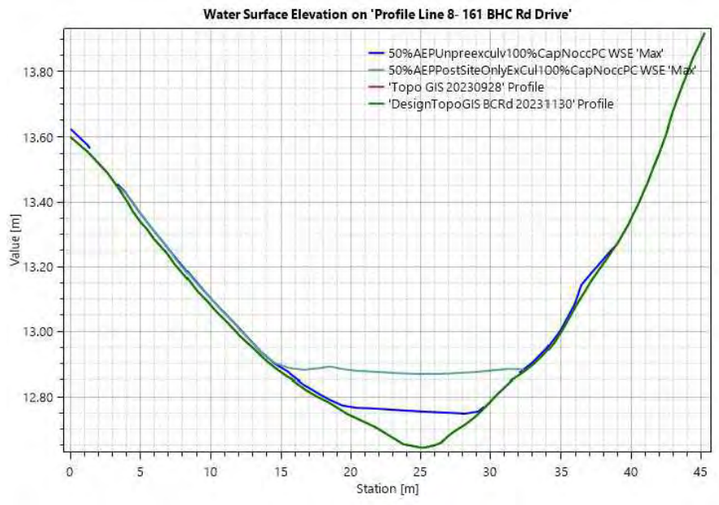

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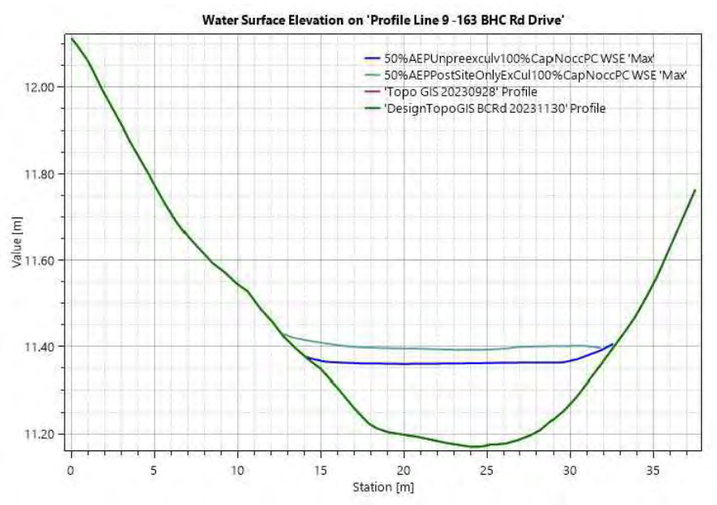

3 / 8702 Section 3- 163 Brigham Creek Road Driveway

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50% AEP Water Levels
Existing Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	M.Chen	15/03/2024
B	159 BC Cross section added	M.Chen	22/04/2024

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	15/03/2024
DRAWN	M.Chen	15/03/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
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DRAWING NO.	REVISION
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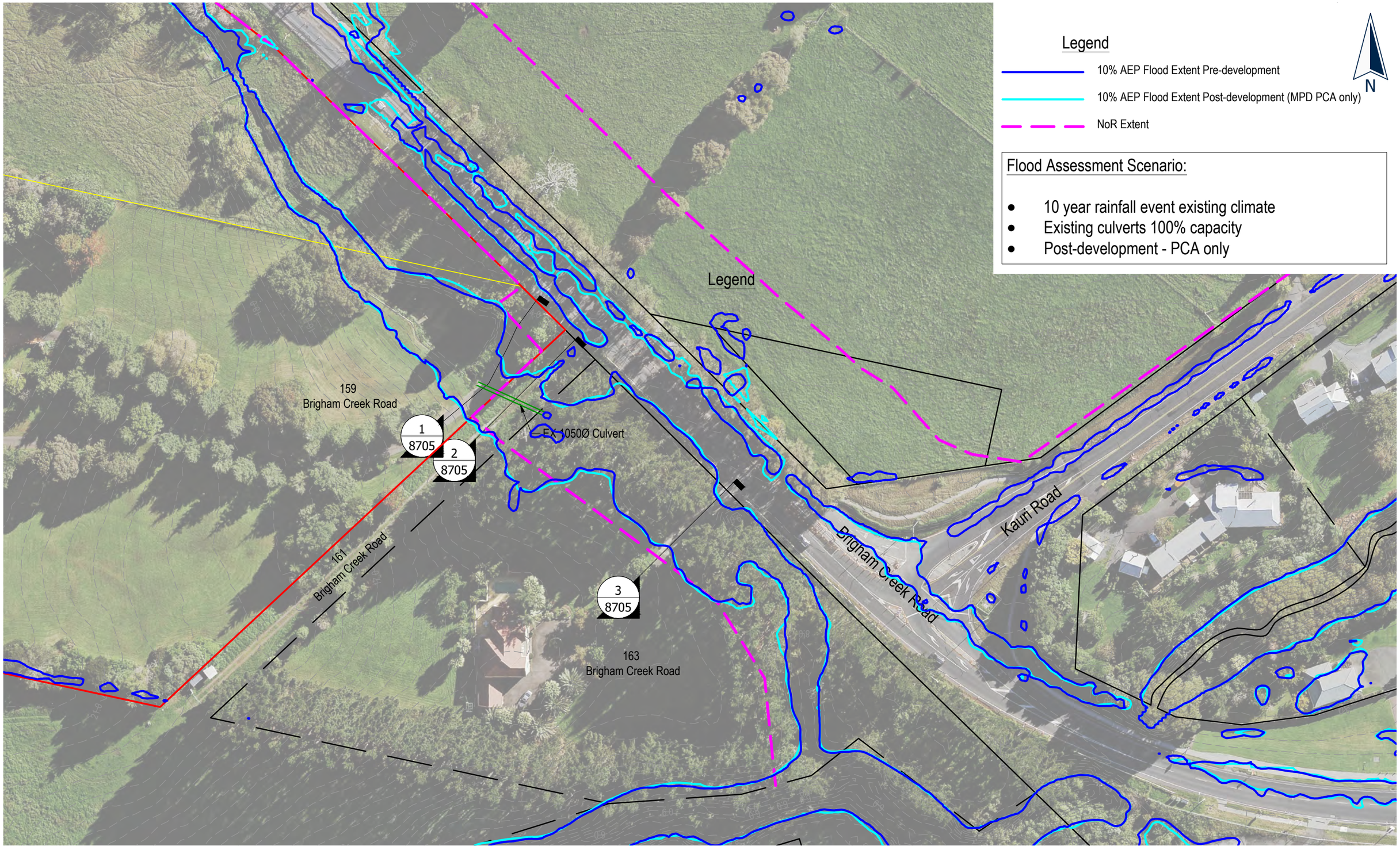

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Whenuapai

10% AEP Flood Extents
EX Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

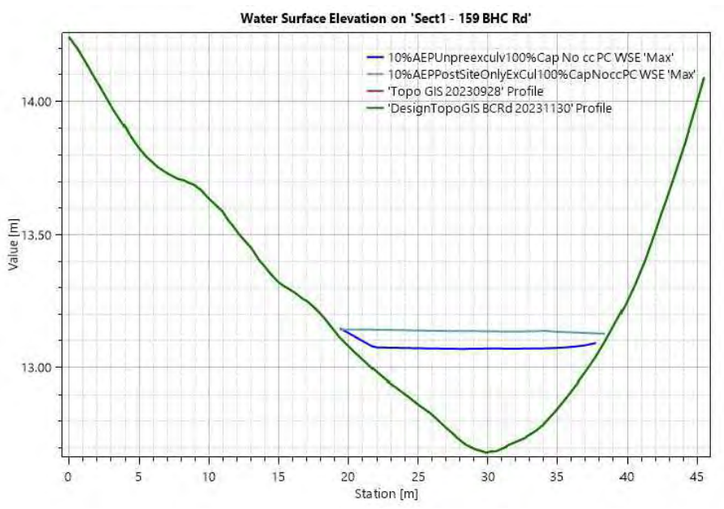
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	M.Chen	02/07/2024

FOR INFORMATION

		NAME	DATE
SURVEYED			
DESIGNED		-	02/07/2024
DRAWN		M.Chen	02/07/2024
DATE	ORIGINAL SCALE	ORIGINAL SIZE	
02/07/2024	1:1000	A3	
DRAWING NO.		REVISION	
47712-DR-C-8704		A	

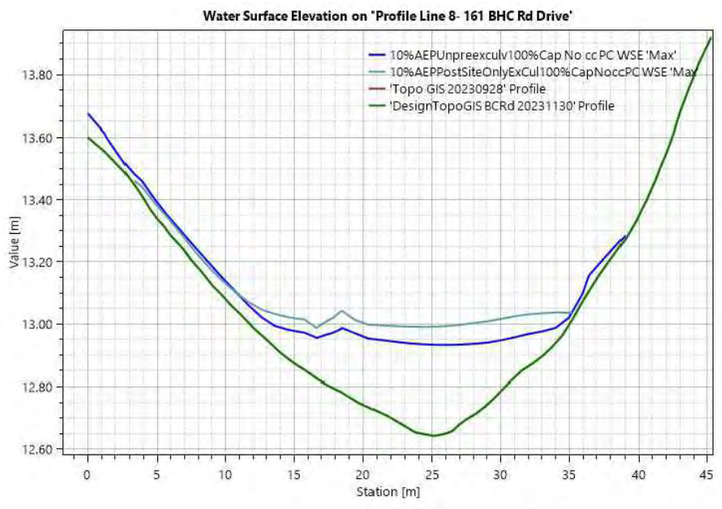
Flood Assessment Scenario:

- 10 year rainfall event existing climate
- Existing culverts 100% capacity
- Post-development - PCA only



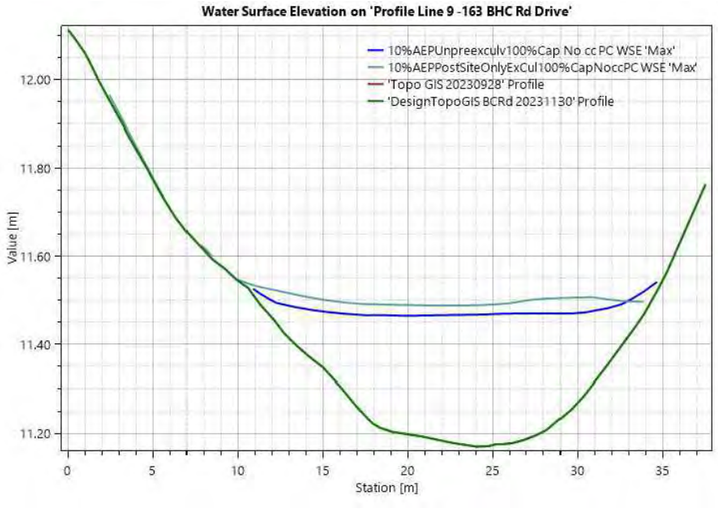
1 / 8704 Section 1-159 Brigham Creek Road Driveway

Scale: NTS



2 / 8704 Section 2- 161 Brigham Creek Road Driveway

Scale: NTS



3 / 8704 Section 3- 163 Brigham Creek Road Driveway

Scale: NTS

C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Whenuapai Business park Plan Change_65094\Technical\Drawings\47712-DR-C-8704-Flood extent 10yr

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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

10% AEP Water Levels
Existing Culverts 100% Capacity
Without Climate Change
159-163 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	M.Chen	02/07/2024

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	02/07/2024
DRAWN	M.Chen	02/07/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
02/07/2024	NTS	A3

DRAWING NO.	REVISION
47712-DR-C-8705	A

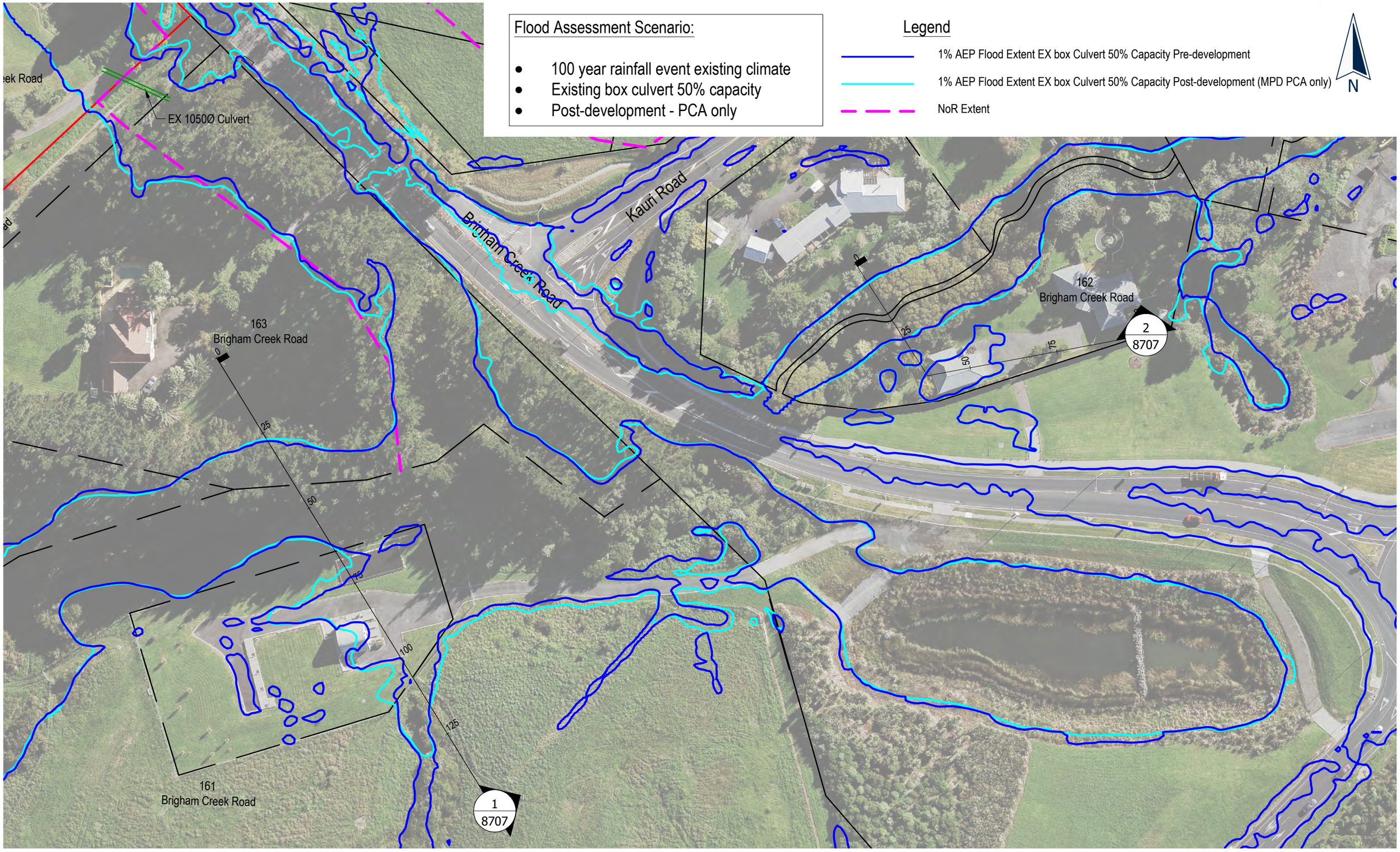
Flood Assessment Scenario:

- 100 year rainfall event existing climate
- Existing box culvert 50% capacity
- Post-development - PCA only

Legend

- 1% AEP Flood Extent EX box Culvert 50% Capacity Pre-development
- 1% AEP Flood Extent EX box Culvert 50% Capacity Post-development (MPD PCA only)
- NoR Extent

N



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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

1% AEP Flood Extents
Ex Box culvert 50% Capacity
Without Climate Change
Pumpstation & 162 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	07/08/2024

FOR INFORMATION

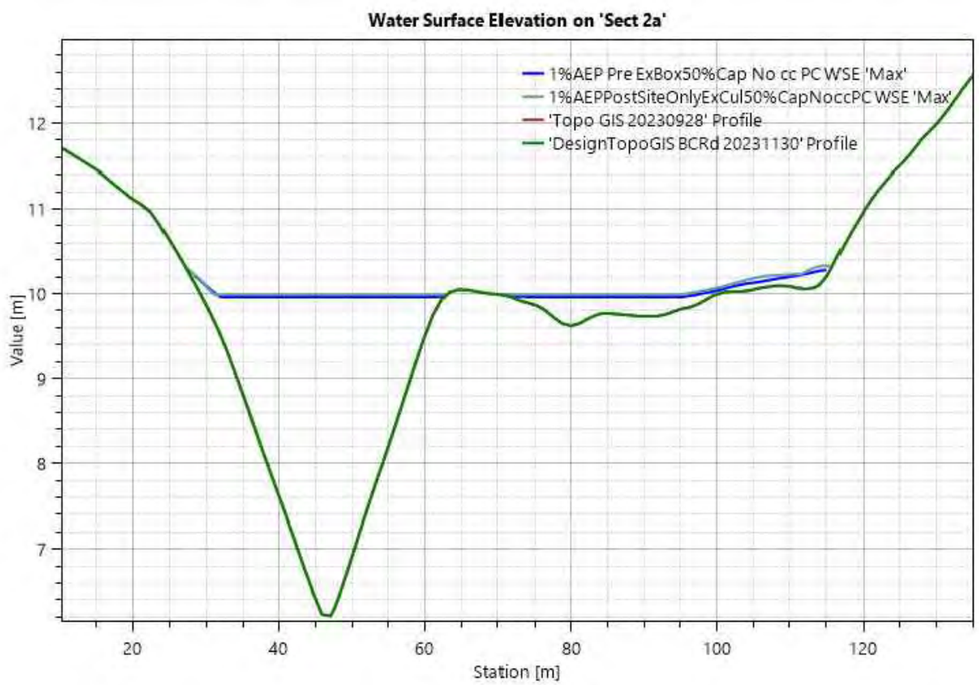
	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	07/08/2024
DRAWN	M.Chen	07/08/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
07/08/2024	1:1000	A3

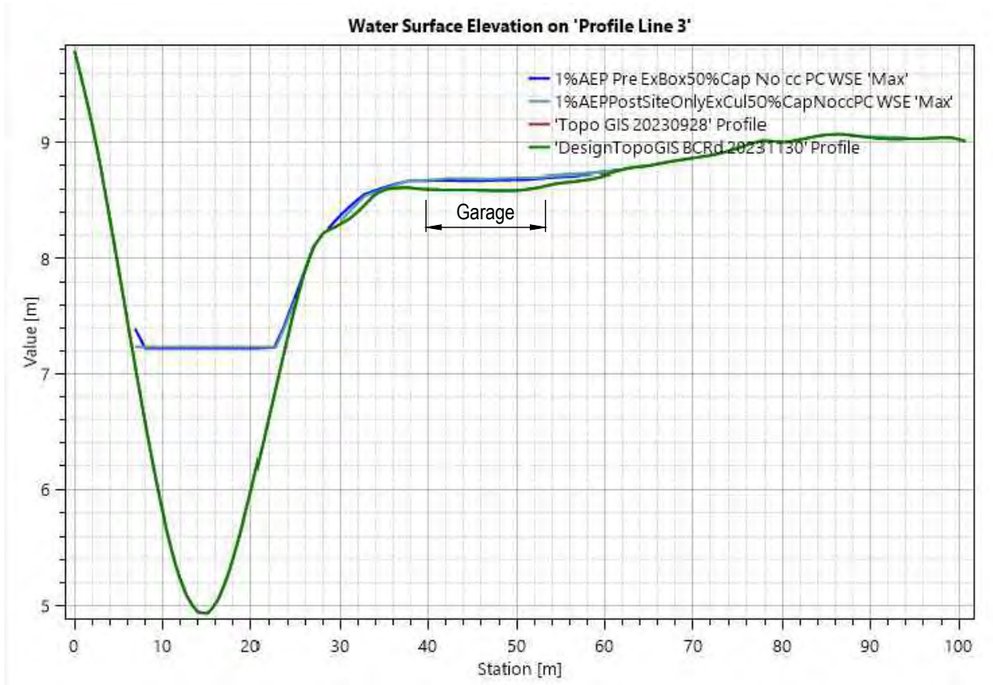
DRAWING NO.	REVISION
47712-DR-C-8706	A

Flood Assessment Scenario:

- 100 year rainfall event existing climate
- Existing box culvert 50% capacity
- Post-development - PCA only



1 / 8706 Section 1 (Pump Station)
Scale: NTS



2 / 8706 Section 2 (162 BCR)
Scale: NTS

C:\12dSynergy\Workspace\data\CATOAPP\47712-Neil Construction Limited - Whenuapai Business park Plan Change_65094\Technical\Drawings\47712-DR-C-8706-Flood extent 1%AEP 50%CulCAP 162 BCR

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Brigham Creek Road and Trig Road
Whenuapai

1% AEP Water Levels
Ex Box Culvert 50% Capacity
Without Climate Change
Pumpstation &162 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	07/08/2024

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	07/08/2024
DRAWN	M.Chen	07/08/2024

DATE	ORIGINAL SCALE	ORIGINAL SIZE
07/08/2024	1:1000	A3

DRAWING NO. 47712-DR-C-8707
REVISION A

Flood Assessment Scenario:

- 100 year rainfall event existing climate
- Existing culverts 100% capacity
- Post-development - PCA only

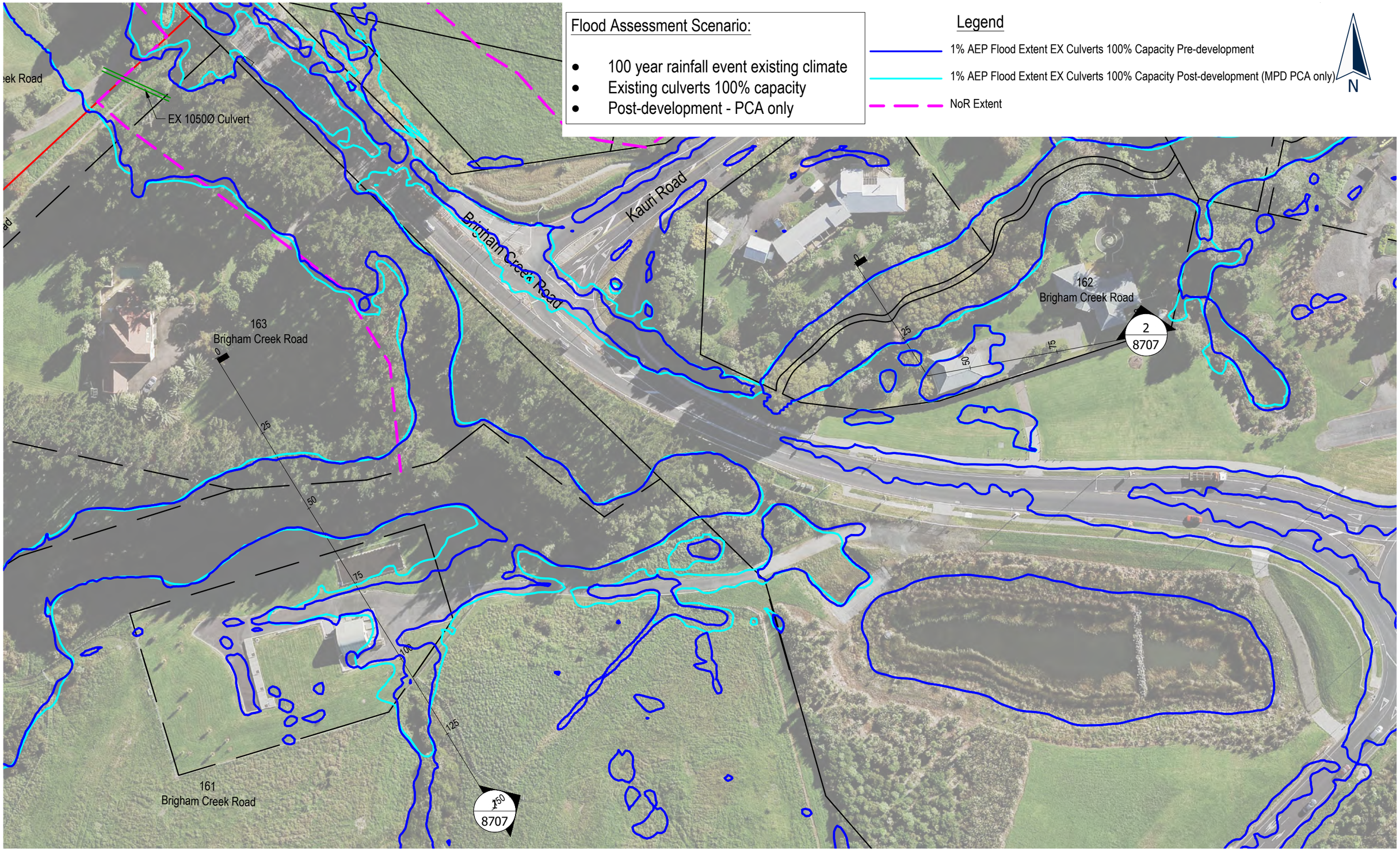
Legend

1% AEP Flood Extent EX Culverts 100% Capacity Pre-development

1% AEP Flood Extent EX Culverts 100% Capacity Post-development (MPD PCA only)

NoR Extent

N



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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

1% AEP Flood Extents
Ex culverts 100% Capacity
Without Climate Change
Pumpstation &162 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	07/08/2024

FOR INFORMATION

	NAME	DATE
SURVEYED		
DESIGNED	A.Manirambona	07/08/2024
DRAWN	M.Chen	07/08/2024

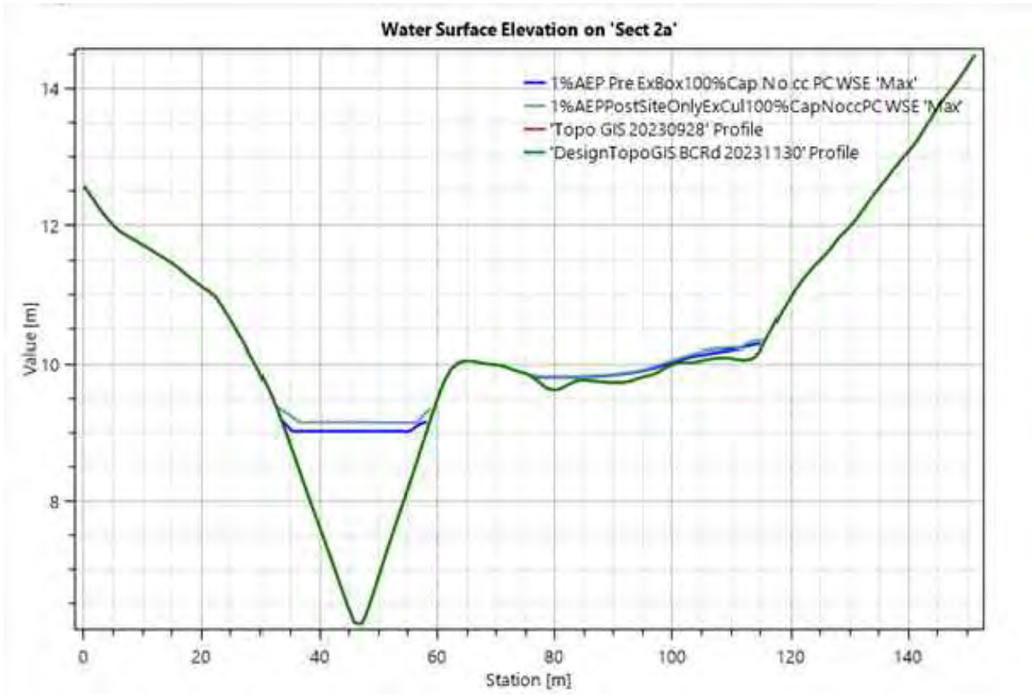
DATE	ORIGINAL SCALE	ORIGINAL SIZE
07/08/2024	1:1000	A3

DRAWING NO. 47712-DR-C-8708

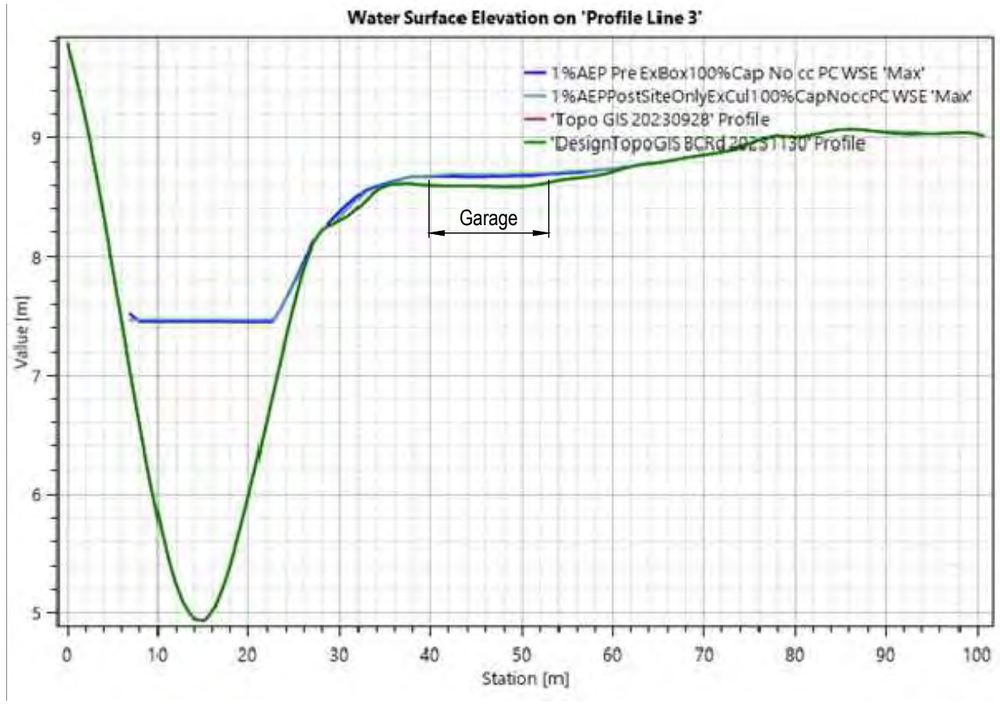
REVISION A

Flood Assessment Scenario:

- 100 year rainfall event existing climate
- Existing culverts 100% capacity
- Post-development - PCA only



1 - Section 1 (Sec 2a Pump Station)
Scale: NTS



2 - Section 2 (Profile Line 3 162 BCR)
Scale: NTS

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Neil Construction Limited
Brigham Creek Road and Trig Road
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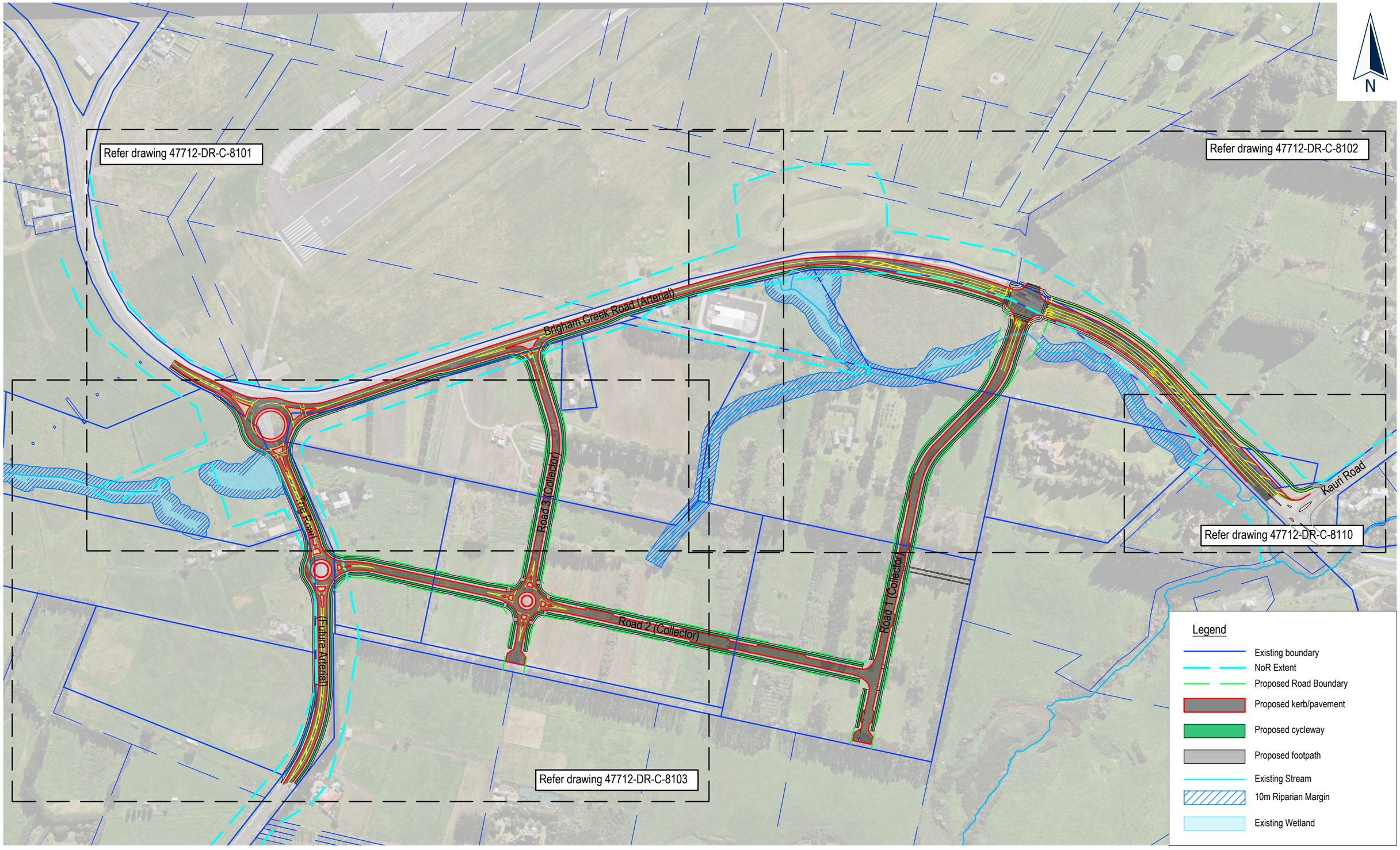
1% AEP Water Levels
Ex culvert 100% Capacity
Without Climate Change
Pumpstation & 162 Brigham Creek Road

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	A.Manirambona	07/08/2024

FOR INFORMATION

		NAME	DATE
SURVEYED			
DESIGNED		A.Manirambona	07/08/2024
DRAWN		M.Chen	07/08/2024
DATE	ORIGINAL SCALE	ORIGINAL SIZE	
07/08/2024	1:1000	A3	
DRAWING NO.		REVISION	
47712-DR-C-8709		A	



C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Whenuapai Business park Plan Change_65094\Technical\Drawings\47712-DR-C-8100-8103-BCR TR upgrading

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Whenuapai Business Park
Whenuapai

Private Plan Change
Road Upgrading
Overview

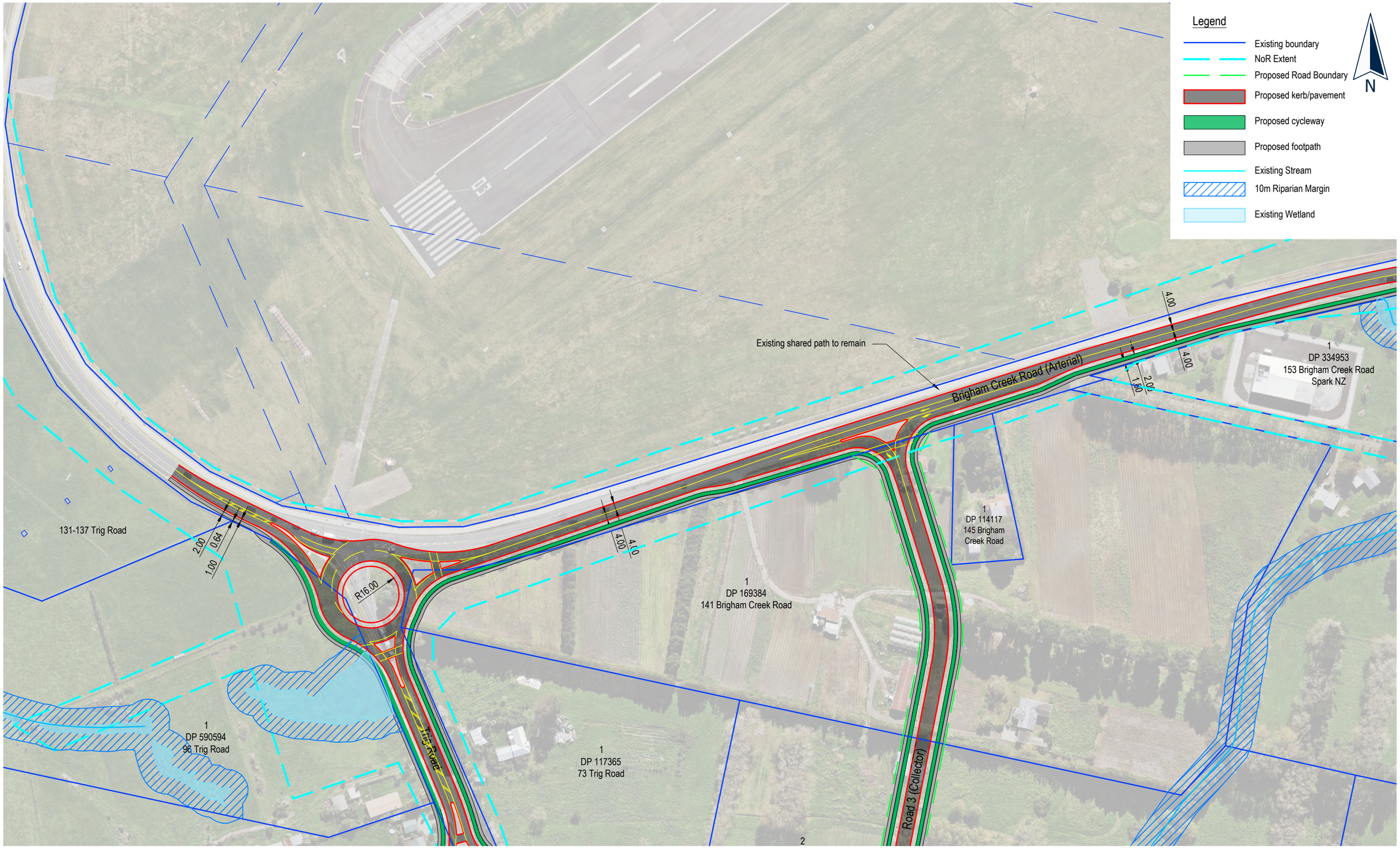
No.	REVISION (DESCRIPTIONS)	NAME	DATE
G	Issued For Information	M.Chen	20/11/2023
H	Issued For Information	M.Chen	05/04/2024
I	Issued For Information	M.Chen	12/04/2024
J	Issued For Information	M.Chen	22/07/2024
E	Issued For Information	-	15/11/2023
F	Issued For Information	-	17/11/2023

FOR INFORMATION

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	11/09/2023
DRAWN	M.Chen	11/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
11/09/2023	1:4000	A3

DRAWING NO.	REVISION
47712-DR-C-8100	J



C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Whenuapai Business park Plan Change_65094\Technical\Drawings\47712-DR-C-8100-8103-BCR TR upgrading

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ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Whenuapai Business Park
Whenuapai

Private Plan Change
Brigham Creek Road Upgrading
Blow Up Sheet 1

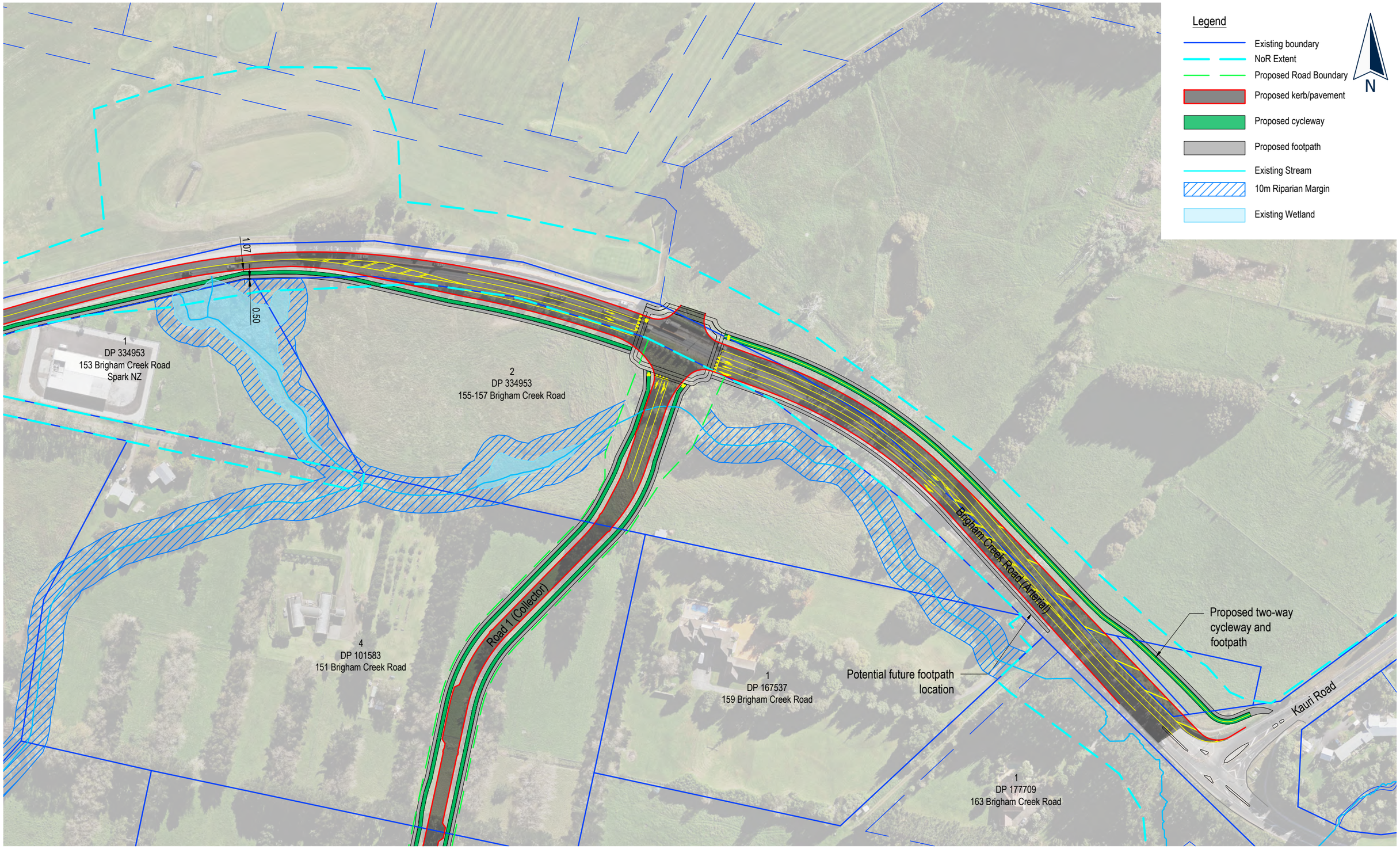
No.	REVISION (DESCRIPTIONS)	NAME	DATE
G	Issued For Information	M.Chen	20/11/2023
H	Issued For Information	M.Chen	05/04/2024
I	Issued For Information	M.Chen	12/04/2024
J	Issued For Information	M.Chen	22/07/2024
E	Issued For Information	-	15/11/2023
F	Issued For Information	-	17/11/2023

FOR INFORMATION

	NAME	DATE
SURVEYED	-	11/09/2023
DESIGNED	M.Chen	11/09/2023
DRAWN	M.Chen	11/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
11/09/2023	1:2000	A3

DRAWING NO. 47712-DR-C-8101
REVISION J



C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Whenuapai Business park Plan Change_65094\Technical\Drawings\47712-DR-C-8100-8103-BCR TR upgrading

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ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Whenuapai Business Park
Whenuapai

Private Plan Change
Brigham Creek Road Upgrading
Blow Up Sheet 2

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	-	11/09/2023
B	Issued For Information	-	18/09/2023
C	Issued For Information	M.Chen	26/09/2023
D	Issued For Information	M.Chen	20/11/2023
E	Issued For Information	M.Chen	05/04/2024
F	Issued For Information	M.Chen	12/04/2024

FOR INFORMATION

	NAME	DATE
SURVEYED	-	11/09/2023
DESIGNED	M.Chen	11/09/2023
DRAWN	M.Chen	11/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
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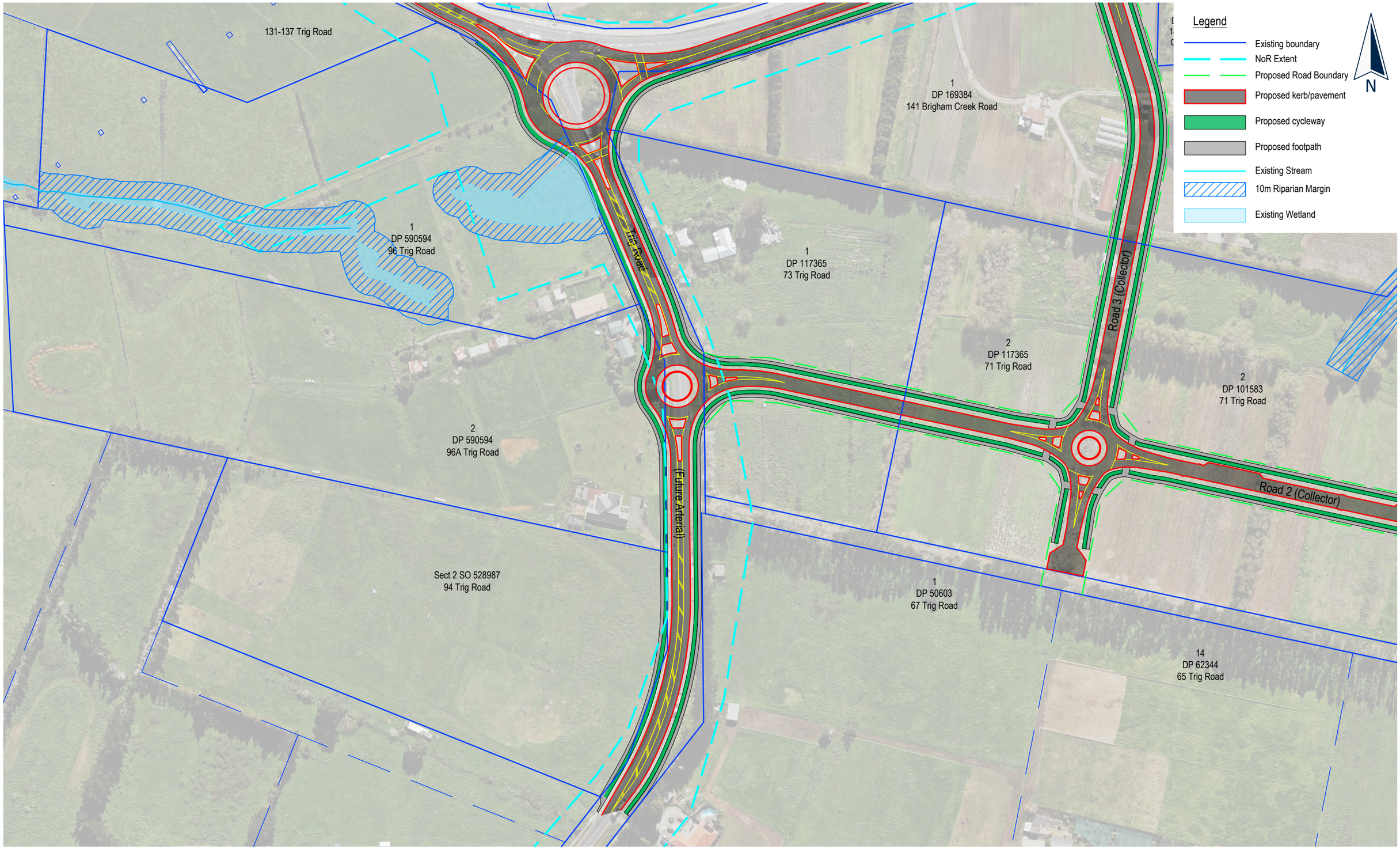
DRAWING NO. 47712-DR-C-8102

REVISION F



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Whenuapai

Private Plan Change
Trig Road Upgrading
Blow up Sheet 3

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	-	18/09/2023
B	Issued For Information	M.Chen	18/09/2023
C	Issued For Information	M.Chen	20/11/2023
D	Issued For Information	M.Chen	05/04/2024
E	Issued For Information	M.Chen	12/04/2024
F	Issued For Information	M.Chen	22/07/2024

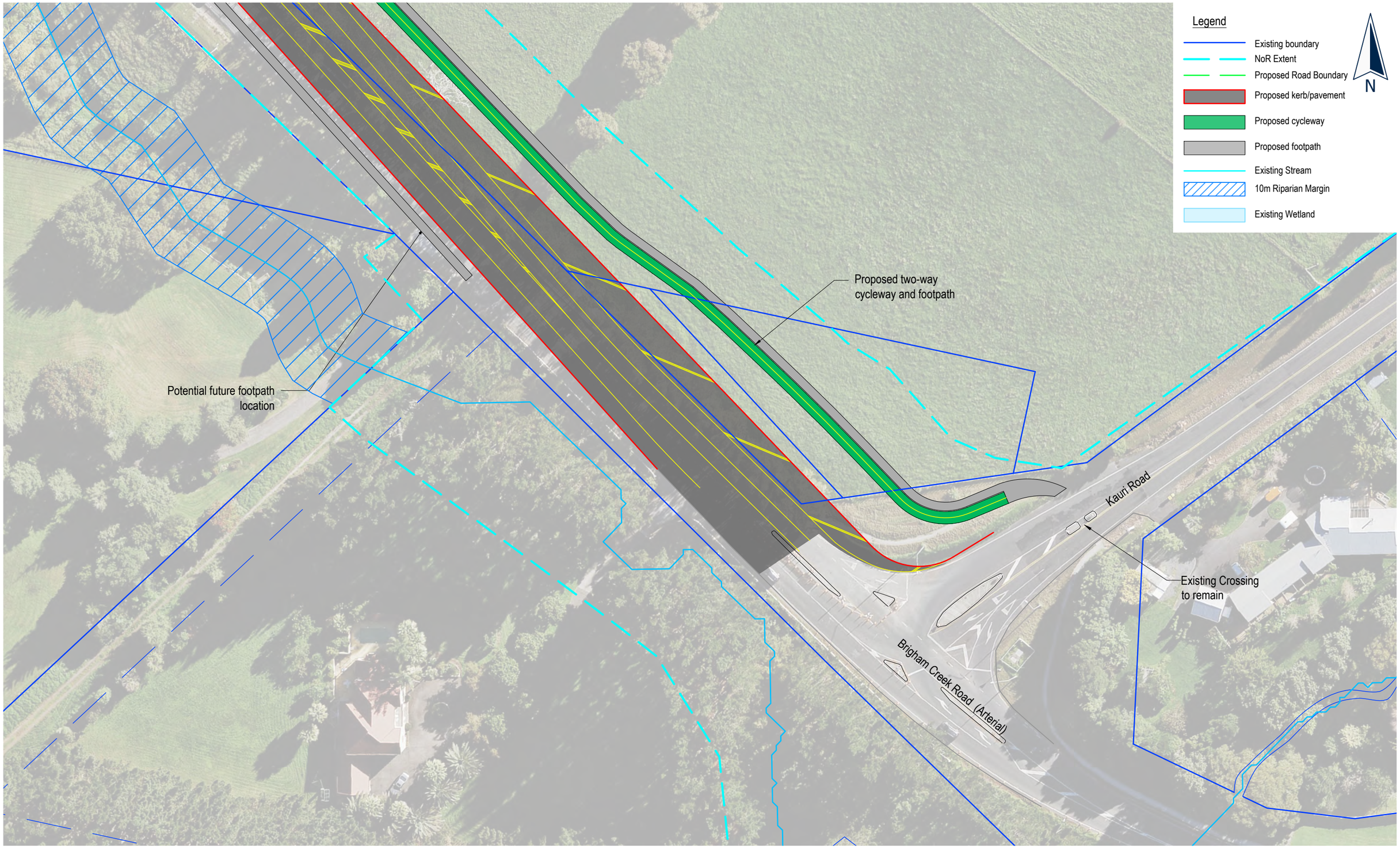
FOR INFORMATION

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	11/09/2023
DRAWN	M.Chen	11/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
18/09/2023	1:2000	A3

DRAWING NO. 47712-DR-C-8103

REVISION F



C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Brigham Creek Road_65094\Technical\Drawings\47712-DR-C-8100-8103-BCR TR upgrading

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Neil Construction Limited
Whenuapai Business Park
Whenuapai

Private Plan Change
BCR Upgrading Near Kauri Road
Blow up Sheet 4

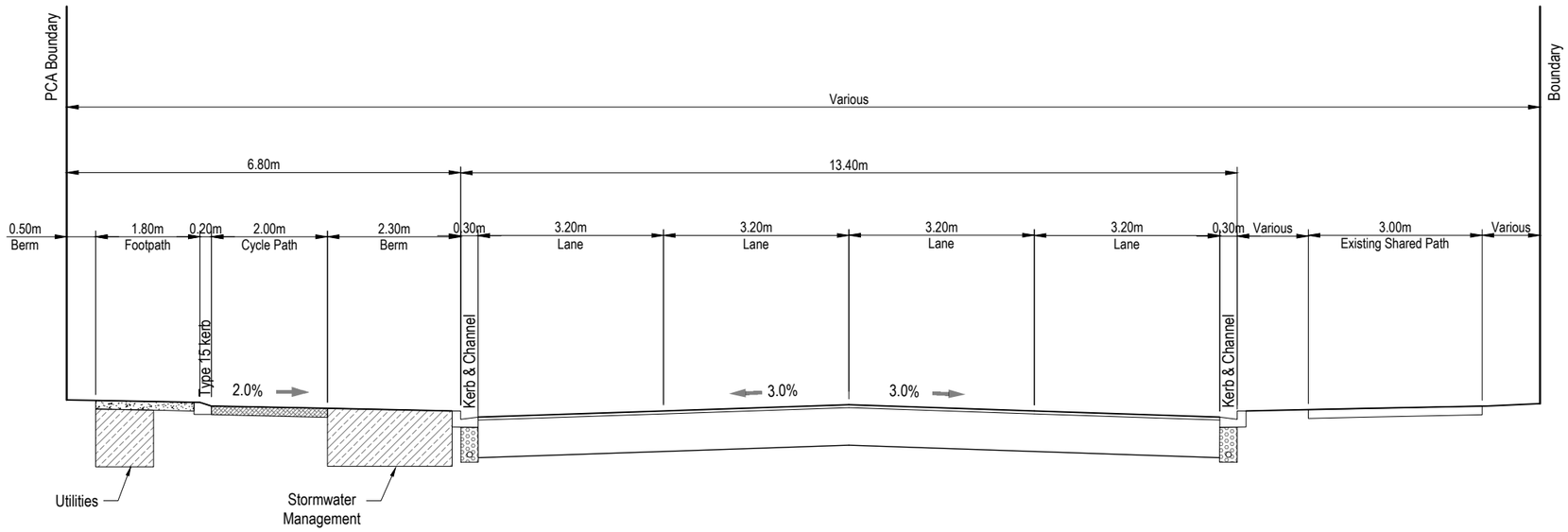
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	M.Chen	20/11/2023
B	FP at BCR southernside added	M.Chen	07/03/2024
C	Drawing title amended	M.Chen	12/04/2024

FOR INFORMATION

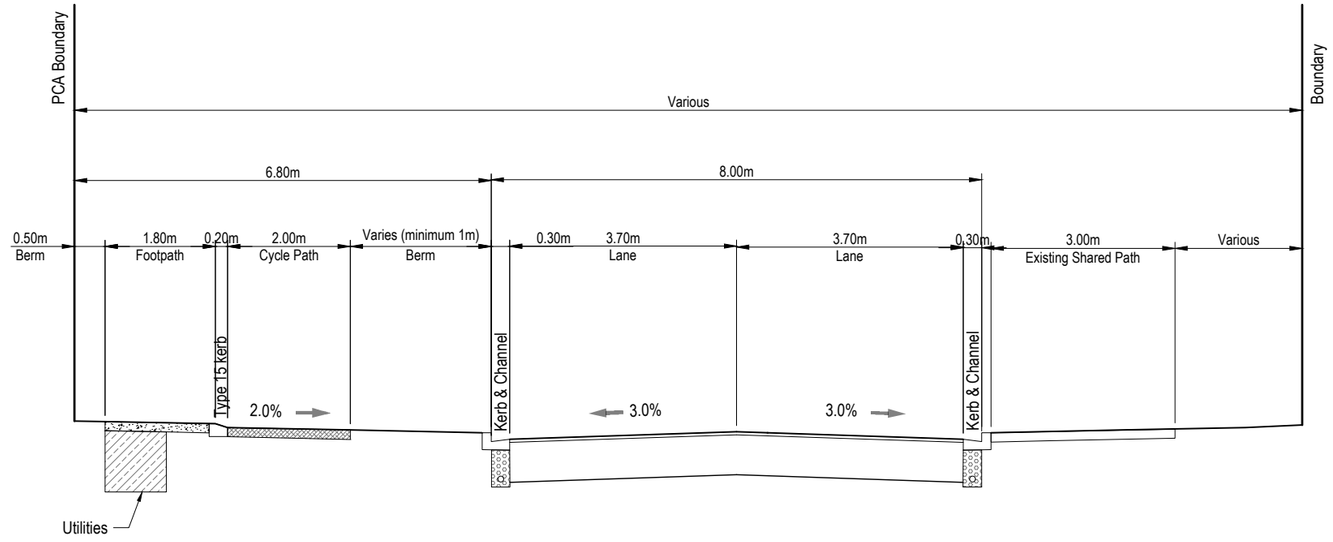
	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	20/11/2023
DRAWN	M.Chen	20/11/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
20/11/2023	1:750	A3

DRAWING NO. 47712-DR-C-8110
REVISION C



Brigham Creek Road Upgrading - Typical Section



Brigham Creek Road Upgrading - Typical Section
In Front of Spark NZ Site

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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

Typical Road Cross Sections
Sheet 1

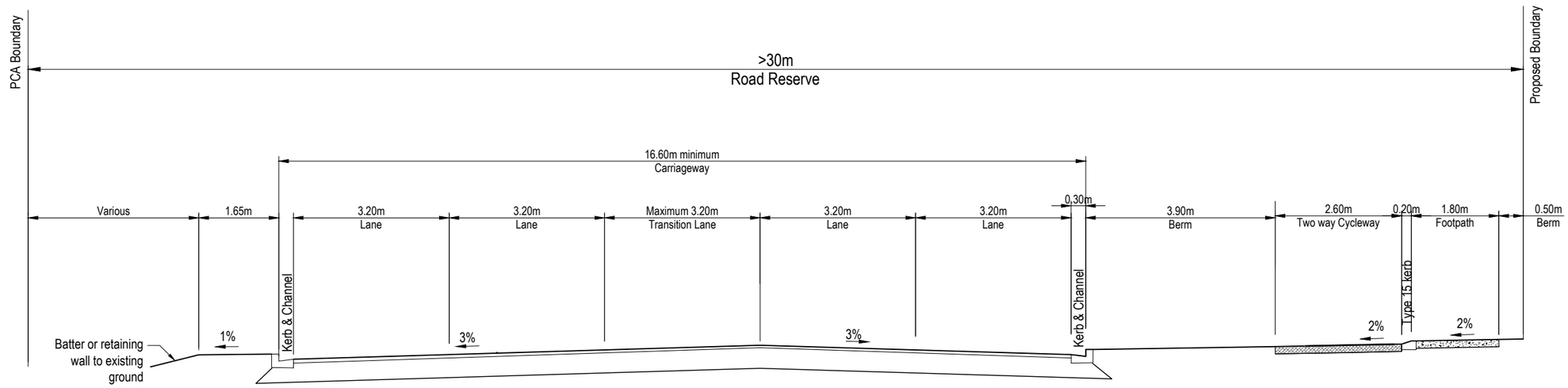
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	-	05/09/2023
B	Issued For Information	M.Chen	09/10/2023
C	Issued For Information	M.Chen	20/11/2023

FOR INFORMATION

	NAME	DATE
SURVEYED	-	05/09/2023
DESIGNED	-	05/09/2023
DRAWN	-	05/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
05/09/2023	1:100	A3

DRAWING NO.	REVISION
47712-DR-C-8007	C



Brigham Creek Road Upgrading - Typical Cross Section
(Eastern side of the proposed new signalized intersection)

C:\12dSynergy\Workspace\data\CATOAPP1\47712-Neil Construction Limited - Brigham Creek Road_65094\Technical\Drawings\47712-DR-C-8007-8009 Typical Road Xsec

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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

Typical Road Cross Sections
Sheet 2

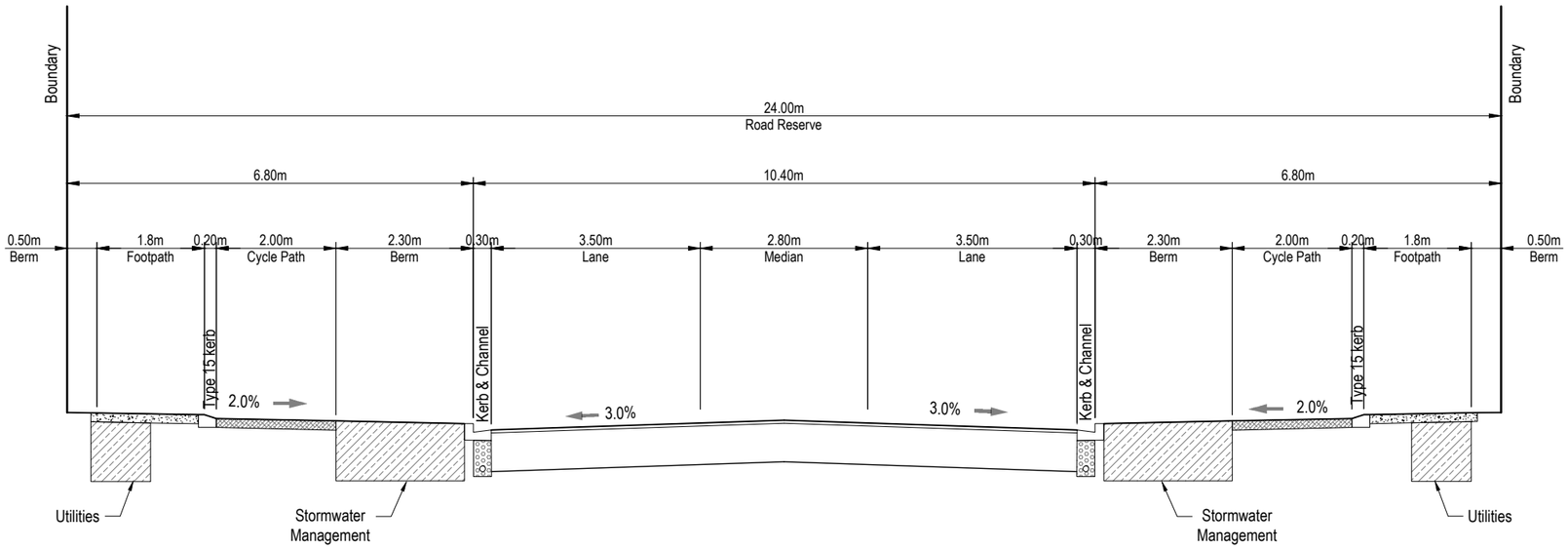
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	-	05/09/2023
B	Issued For Information	M.Chen	09/10/2023

FOR INFORMATION

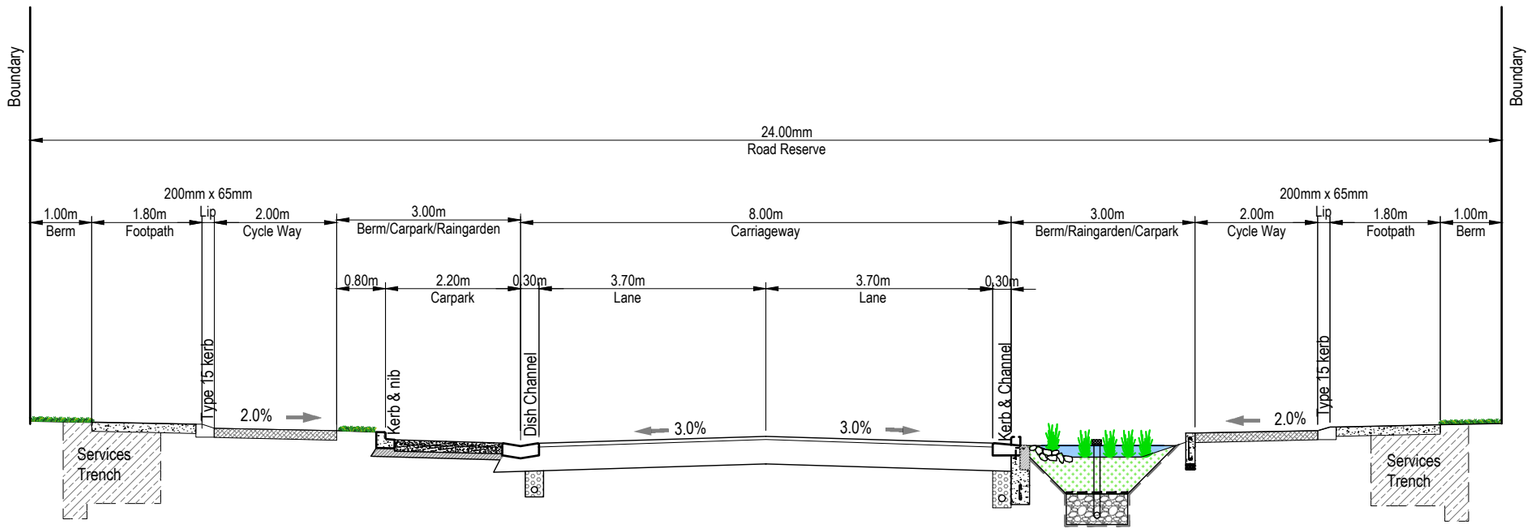
	NAME	DATE
SURVEYED	-	05/09/2023
DESIGNED	-	05/09/2023
DRAWN	-	05/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
05/09/2023	1:100	A3

DRAWING NO.	REVISION
47712-DR-C-8008	B



Trig Road Upgrading - Typical Section



Proposed Collector Road- Typical Section

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Neil Construction Limited
Brigham Creek Road and Trig Road
Whenuapai

Typical Road Cross Sections
Sheet 2

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Information	-	05/09/2023
B	Issued For Information	M.Chen	09/10/2023

FOR INFORMATION

	NAME	DATE
SURVEYED	-	-
DESIGNED	-	05/09/2023
DRAWN	-	05/09/2023

DATE	ORIGINAL SCALE	ORIGINAL SIZE
05/09/2023	1:100	A3

DRAWING NO. 47712-DR-C-8009
REVISION B

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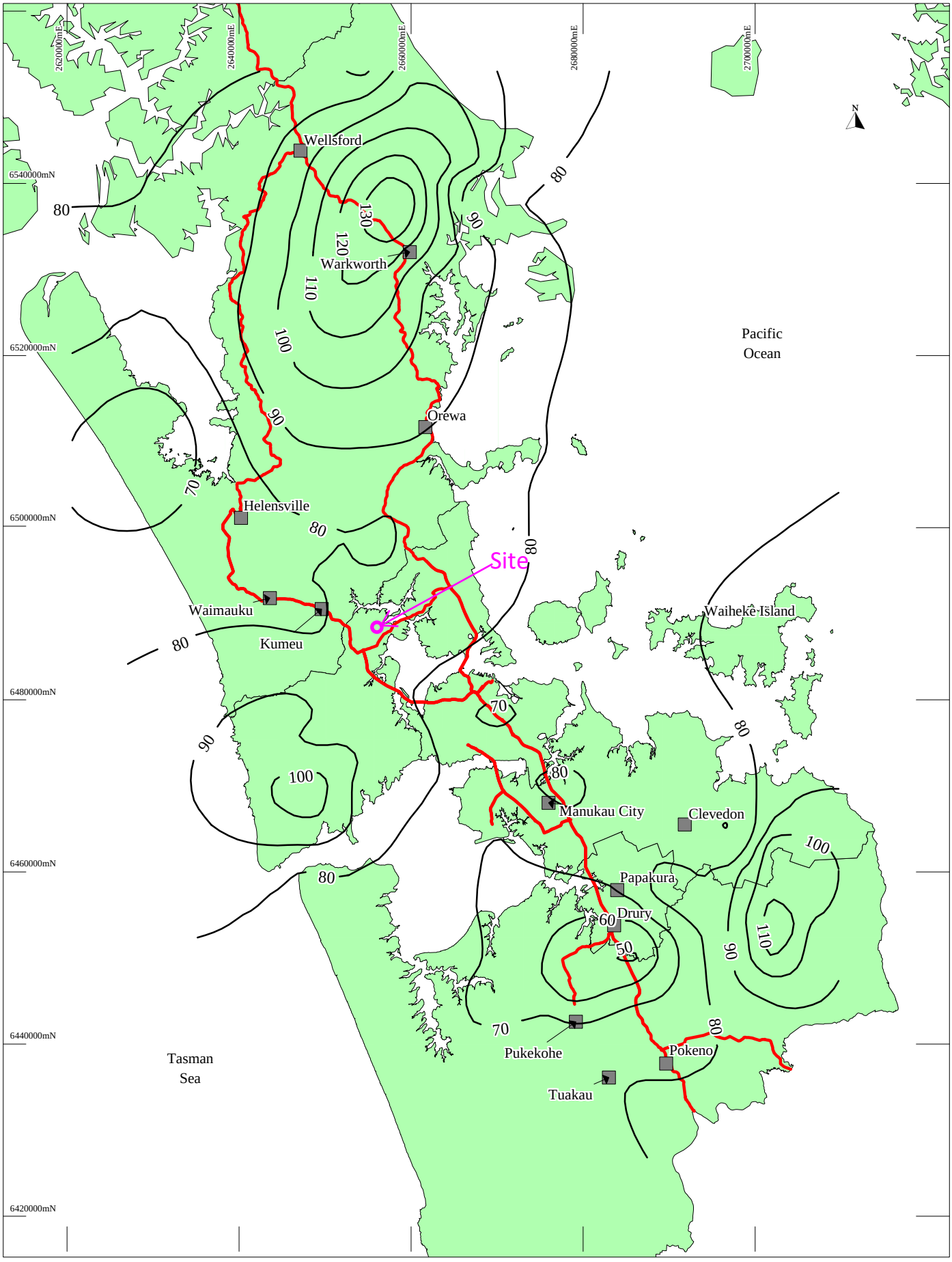
Whenuapai Business Park Private Plan Change, Whenuapai, Auckland

Flooding and Flood Hazard Risk Report

Appendix B: Rainfall Depth Map

PLANNERS
SURVEYORS
ENGINEERS
ARCHITECTS
ENVIRONMENTAL



A

Legend: — 70 — Rainfall Contour (mm)

State Highways

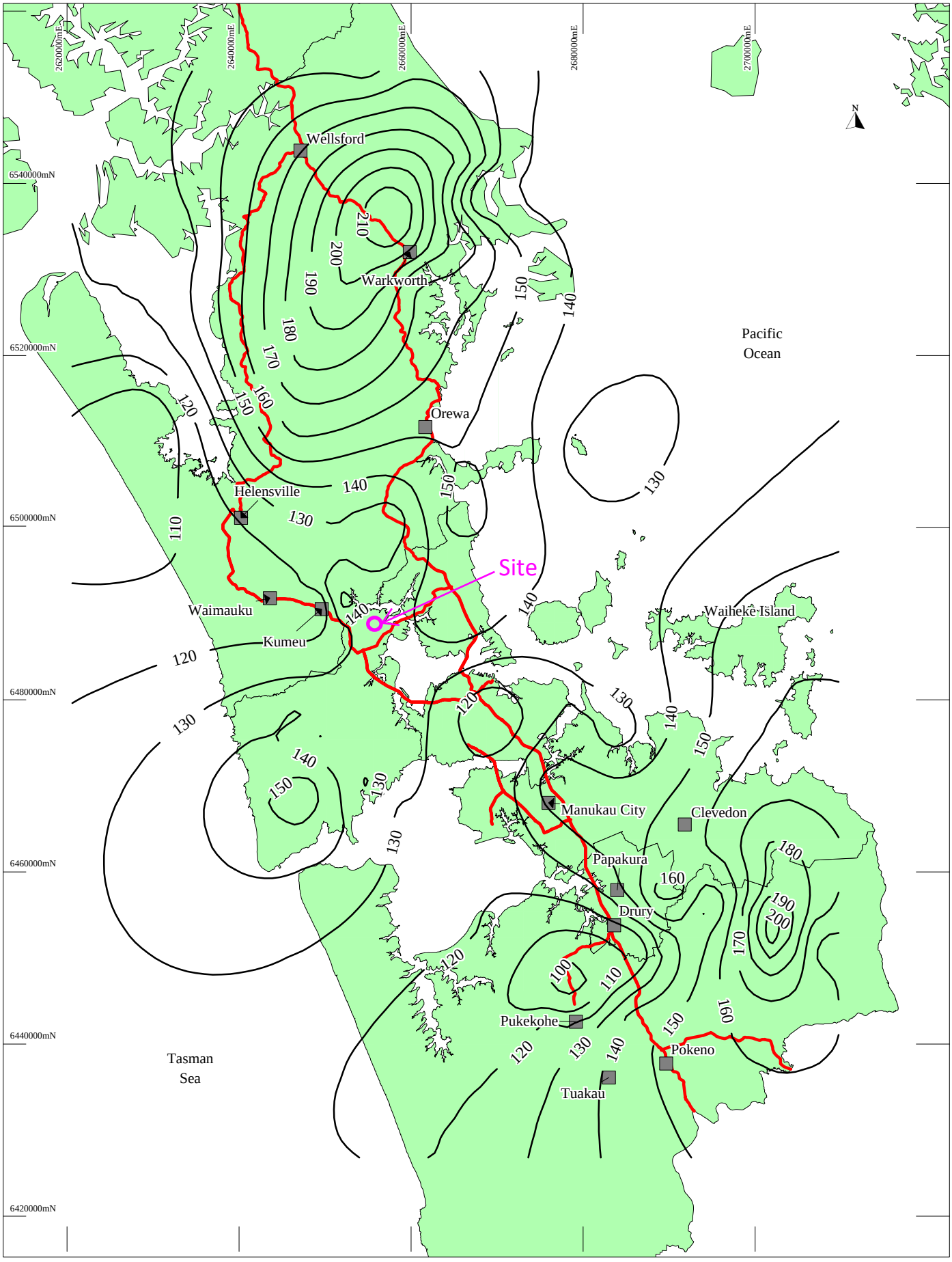
Auckland Regional Council

Figure A.1
2 Year ARI
Daily Rainfall Depth

Scale: 1:600,000 (at A4)

(Revised 25/08/1999)

Workspace: N:(civil)\25\2507757\gis\mapinfo\wor\2yrari.wor Date: 25/08/1999



A

Legend: — 90 — Rainfall Contour (mm)

State Highways

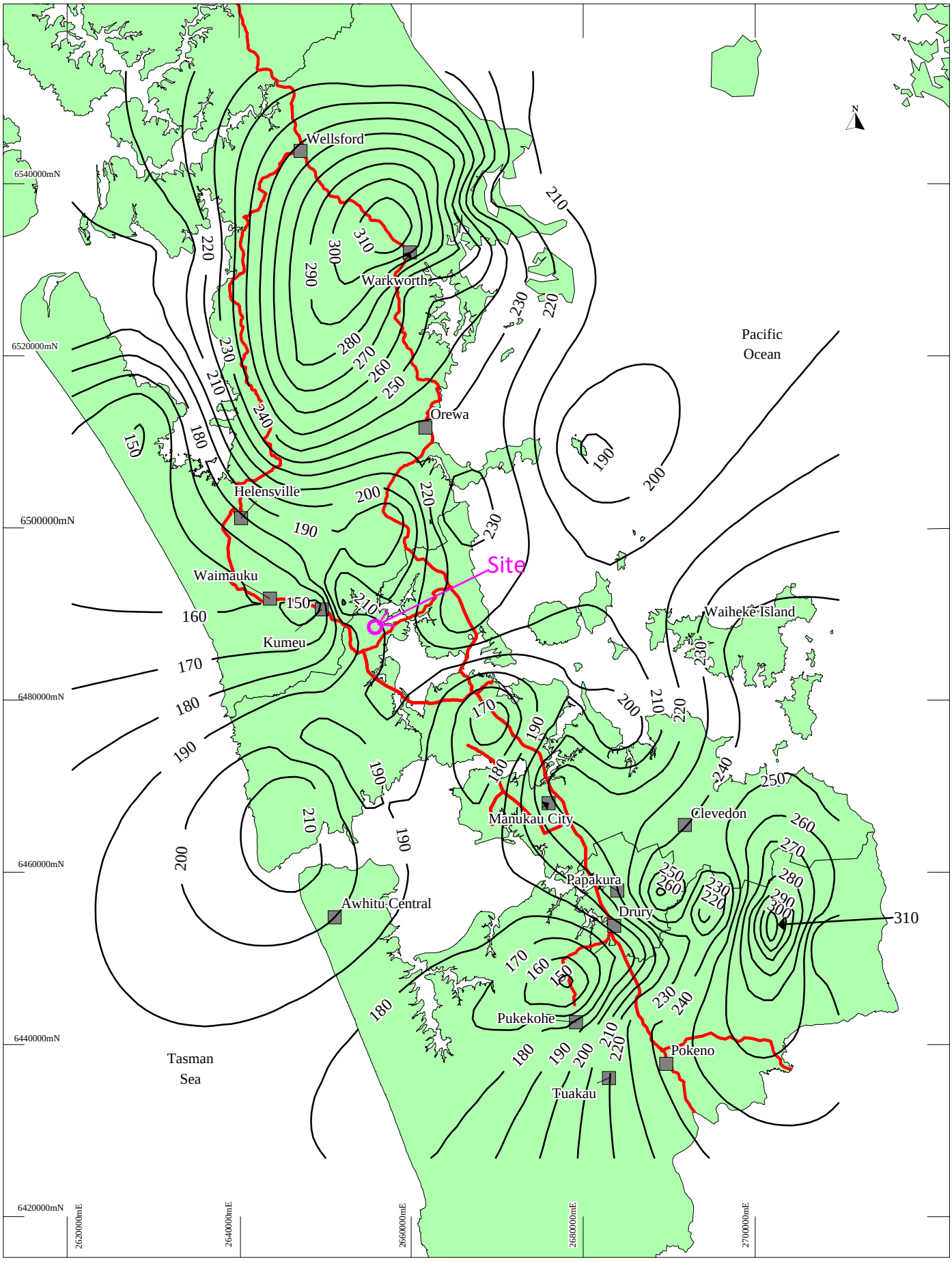
Auckland Regional Council

Figure A.3
10 Year ARI
Daily Rainfall Depth

Scale: 1:600,000 (at A4)

(Revised 25/08/1999)

Workspace: N:(civil)\25\2507757\gis\mapinfo\wor\10yrari.wor Date: 25/08/1999



A

Legend: — 90 — Rainfall Contour (mm)

State Highways

Auckland Regional Council

Figure A.6
100 Year ARI
Daily Rainfall Depth

Scale: 1:600,000 (at A4)

(Revised 25/08/1999)

Workspace: N:(civil)\25\2507757\gis\mapinfo\wor\100yrari.wor Date: 25/08/1999

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Whenuapai Business Park Private Plan Change, Whenuapai, Auckland

Flooding and Flood Hazard Risk Report

Appendix C: TP108 Calculations

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ARCHITECTS
ENVIRONMENTAL

PCA Pre-development OLFP Catchment Summary (3.8CC)				
Catchment	**Impervious (ha)**	**Pervious (ha)**	**Catchment Area (ha)**	**Peak flow (m3/s)**
Catchment 1	0.0105	6.4163	6.4268	2.20
Catchment 2	0.0000	5.5499	5.5499	1.97
Catchment 3	0.2394	3.2356	3.475	1.28
Catchment 4	0.0000	5.9098	5.9098	1.96
Catchment 5	0.0000	1.4167	1.4167	0.51
Catchment 6	0.1290	3.3831	3.5121	1.27
Catchment 7a	0.0979	3.0526	3.1505	1.10
Catchment 7b	0.7362	10.1061	10.8423	3.21
Catchment 7c	3.7293	26.3647	30.094	7.11
Catchment 8	0.4434	5.4923	5.9357	1.91
Catchment 9	0.1344	11.2056	11.34	3.52
Catchment 10	0.1395	3.0623	3.2018	1.11
Catchment 11	0.3285	1.4455	1.774	0.63
Trig Road	0.2436	0.4491	0.6927	0.26

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 1

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	6.4163	474.81
			0.00
Total pervious		6.41630	474.81

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.5873	
Time Concentration	0.2036	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data			
Catchment	0.0642	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.2035707		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	89.24		

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0105	1.03
			0.00
			0.00
			0.00
Total impervious		0.0105	1.03

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.9608	
Time Concentration	0.0932	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data			
Catchment (km²)	0.0001	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.17		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	5.18		

Check of Areas	
Input	6.4268
Site (ha)	6.4268
Check	

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	Post-dev Pervious					Post-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)										
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.095	0.115	0.129		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0849	0.6606	1.3057	2.1993	(m3/s)	0.0006	0.0019	0.0032	0.0049	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	484	3,555	7,242	12,443	(m3)	3	11	18	27	(m3)

Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.086**	**0.663**	**1.309**	**2.204**	Pre-dev	**487.48**	**3566.31**	**7260.23**	**12470.80**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 2

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	5.5499	410.69
			0.00
Total pervious		5.54990	410.69

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.241	km
Catchment slope	0.05	m/m
Runoff factor	0.5873	
Time Concentration	0.1802	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0555	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.180175	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Pervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.039	0.099	0.120	0.134	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0764	0.5928	1.1721	1.9747	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	419	3,075	6,264	10,763	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0000	0.00
			0.00
			0.00
			0.00
Total impervious		0.0000	0.00

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.241	km
Catchment slope	0.05	m/m
Runoff factor	0.9608	
Time Concentration	0.0825	Hrs

Check of Areas	
Input	5.5499
Site (ha)	5.5499
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0000	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Pre-dev Impervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0000	0.0000	0.0000	0.0000	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	0	0	0	0	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.076**	**0.593**	**1.172**	**1.975**	Pre-dev	**418.89**	**3075.37**	**6264.31**	**10763.24**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 3

Based on ARC TP 108, April 1999 | **Soil name and classification:** | Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.2356	239.44
			0.00
Total pervious		3.23562	239.44

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.142	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.1481	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0324	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.17		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	89.24		

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.2394	23.46
			0.00
			0.00
			0.00
Total impervious		0.2394	23.46

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.142	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.0678	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0024	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.17		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	5.18		

Check of Areas	
Input	3.4750
Site (ha)	3.4750
Check	

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	Pre-dev Pervious					Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)										
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.040	0.100	0.122	0.136		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0453	0.3516	0.6952	1.1713	(m3/s)	0.0132	0.0442	0.0732	0.1109	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	244	1,793	3,652	6,275	(m3)	73	247	411	623	(m3)

Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.059**	**0.396**	**0.768**	**1.282**	Pre-dev	**317.19**	**2040.33**	**4062.76**	**6898.15**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 4

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	5.9098	437.33
			0.00
Total pervious		5.90980	437.33

CN (weighted)	74.00
Ia (weighted)	5

1.2 Time of Concentration

Channelisation C	1	
Catchment length	0.224	km
Catchment slope	0.02	m/m
Runoff factor	0.5873	
Time Concentration	0.2260	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0591	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2260003	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.037	0.092	0.112	0.125	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0756	0.5890	1.1637	1.9598	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	446	3,275	6,671	11,461	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0000	0.00
			0.00
			0.00
			0.00
Total impervious		0.0000	0.00

CN (weighted)	98
Ia (weighted)	0

1.2 Time of Concentration

Channelisation C	0.6	
Catchment length	0.224	km
Catchment slope	0.02	m/m
Runoff factor	0.9608	
Time Concentration	0.1034	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0000	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0000	0.0000	0.0000	0.0000	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	0	0	0	0	(m3)

Check of Areas	
Input	5.9098
Site (ha)	5.9098
Check	

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.076**	**0.589**	**1.164**	**1.960**	Pre-dev	**446.05**	**3274.80**	**6670.54**	**11461.21**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 5

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	1.4167	104.84
			0.00
Total pervious		1.41670	104.84

CN (weighted)	74.00
Ia (weighted)	5

1.2 Time of Concentration

Channelisation C	1	
Catchment length	0.15	km
Catchment slope	0.05	m/m
Runoff factor	0.5873	
Time Concentration	0.1318	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0142	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.17		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.040	0.100	0.122	0.136	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0198	0.1539	0.3044	0.5128	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	107	785	1,599	2,747	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0000	0.00
			0.00
			0.00
			0.00
Total impervious		0.0000	0.00

CN (weighted)	98
Ia (weighted)	0

1.2 Time of Concentration

Channelisation C	0.6	
Catchment length	0.15	km
Catchment slope	0.05	m/m
Runoff factor	0.9608	
Time Concentration	0.0603	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0000	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.17		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0000	0.0000	0.0000	0.0000	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	0	0	0	0	(m3)

Check of Areas	
Input	1.4167
Site (ha)	1.4167
Check	

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.020**	**0.154**	**0.304**	**0.513**	Pre-dev	**106.93**	**785.04**	**1599.08**	**2747.51**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 6

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.3831	250.35
			0.00
Total pervious		3.38310	250.35

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.213	km
Catchment slope	0.04	m/m
Runoff factor	0.5873	
Time Concentration	0.1776	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0338	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.1775689	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.1290	12.64
			0.00
			0.00
			0.00
Total impervious		0.1290	12.64

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.213	km
Catchment slope	0.04	m/m
Runoff factor	0.9608	
Time Concentration	0.0813	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0013	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Check of Areas	
Input	3.5121
Site (ha)	3.5121
Check	

Legend

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	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.039	0.099	0.120	0.135		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0468	0.3629	0.7176	1.2090	(m3/s)	0.0071	0.0238	0.0394	0.0598	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	255	1,875	3,819	6,561	(m3)	39	133	221	336	(m3)

Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.054**	**0.387**	**0.757**	**1.269**	Pre-dev	**294.67**	**2007.99**	**4039.87**	**6896.83**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7a

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.0526	225.89
			0.00
Total pervious		3.05260	225.89

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.219	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.1972	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0305	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.1971565	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0979	9.59
			0.00
			0.00
			0.00
Total impervious		0.0979	9.59

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.219	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.0902	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0010	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Check of Areas	
Input	3.1505
Site (ha)	3.1505
Check	

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	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.096	0.116	0.130		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0408	0.3174	0.6274	1.0568	(m3/s)	0.0054	0.0181	0.0299	0.0454	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	230	1,692	3,446	5,920	(m3)	30	101	168	255	(m3)

Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.046**	**0.335**	**0.657**	**1.102**	Pre-dev	**260.24**	**1792.71**	**3613.48**	**6174.92**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7b

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	10.1061	747.85
			0.00
Total pervious		10.10610	747.85

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.646	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.4026	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.1011	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.4025979	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.7362	72.15
			0.00
			0.00
			0.00
Total impervious		0.7362	72.15

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.646	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1843	Hrs

Check of Areas	
Input	10.8423
Site (ha)	10.8423
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0074	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.184268934	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.030	0.075	0.091	0.107		0.153	0.166	0.169	0.170	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.1047	0.8261	1.6287	2.8740	(m3/s)	0.0396	0.1326	0.2196	0.3329	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	763	5,600	11,407	19,599	(m3)	224	761	1,263	1,916	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.144**	**0.959**	**1.848**	**3.207**	Pre-dev	**987.20**	**6360.89**	**12669.89**	**21515.74**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7c

Based on ARC TP 108, April 1999 | **Soil name and classification:** | Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	26.3647	1,950.99
			0.00
Total pervious		26.36470	1950.99

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.787	km
Catchment slope	0.01	m/m
Runoff factor	0.5873	
Time Concentration	0.6377	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.2636	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.6376725	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.024	0.058	0.071	0.080	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.2252	1.6596	3.3121	5.6061	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	1,990	14,609	29,758	51,130	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	3.7293	365.47
			0.00
			0.00
			0.00
Total impervious		3.7293	365.47

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.787	km
Catchment slope	0.01	m/m
Runoff factor	0.9608	
Time Concentration	0.2919	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0373	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.291862543	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.137	0.148	0.150	0.152	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.1790	0.5982	0.9902	1.5004	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	1,137	3,854	6,397	9,708	(m3)

Check of Areas	
Input	30.0940
Site (ha)	30.0940
Check	

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.404**	**2.258**	**4.302**	**7.106**	Pre-dev	**3126.78**	**18463.42**	**36155.82**	**60838.41**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 8

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	5.4923	406.43
			0.00
Total pervious		5.49230	406.43

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.371	km
Catchment slope	0.02	m/m
Runoff factor	0.5873	
Time Concentration	0.3153	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0549	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.315306		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.4434	43.45
			0.00
			0.00
			0.00
Total impervious		0.4434	43.45

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.371	km
Catchment slope	0.02	m/m
Runoff factor	0.9608	
Time Concentration	0.1443	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0044	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.17		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Check of Areas	
Input	5.9357
Site (ha)	5.9357
Check	

	Pre-dev Pervious					Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)										
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.032	0.082	0.100	0.117		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0625	0.4900	0.9671	1.7006	(m3/s)	0.0244	0.0818	0.1355	0.2054	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	415	3,043	6,199	10,652	(m3)	135	458	761	1,154	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.087**	**0.572**	**1.103**	**1.906**	Pre-dev	**549.71**	**3501.67**	**6959.91**	**11805.75**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 9

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	11.2056	829.22
			0.00
Total pervious		11.20564	829.22

CN (weighted) 74.00
Ia (weighted) 5

1.2 Time of Concentration

Channelisation C 1
Catchment length 0.451 km
Catchment slope 0.03 m/m

Runoff factor 0.5873
Time Concentration 0.3176 Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment 0.1121 km2
Runoff CN 74.00
Initial abstraction Ia 5
Time of c 0.3175956 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 89.24

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.032	0.082	0.099	0.116	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.1271	0.9973	1.9682	3.4613	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	846	6,209	12,648	21,732	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.1344	13.17
			0.00
			0.00
			0.00
Total impervious		0.1344	13.17

CN (weighted) 98
Ia (weighted) 0

1.2 Time of Concentration

Channelisation C 0.6
Catchment length 0.451 km
Catchment slope 0.03 m/m

Runoff factor 0.9608
Time Concentration 0.1454 Hrs

Check of Areas	
Input	11.3400
Site (ha)	11.3400
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²) 0.0013 km2
Runoff CN 98
Initial abstraction Ia 0
Time of c 0.17 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 5.18

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0074	0.0248	0.0411	0.0622	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	41	139	230	350	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.134**	**1.022**	**2.009**	**3.523**	Pre-dev	**886.72**	**6348.22**	**12878.54**	**22081.45**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 10

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.0623	226.61
			0.00
Total pervious		3.06230	226.61

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.5873	
Time Concentration	0.2036	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0306	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2035707	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Pervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.095	0.115	0.129	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0405	0.3153	0.6232	1.0497	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	231	1,697	3,456	5,939	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.1395	13.67
			0.00
			0.00
			0.00
Total impervious		0.1395	13.67

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.9608	
Time Concentration	0.0932	Hrs

Check of Areas	
Input	3.2018
Site (ha)	3.2018
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0014	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Pre-dev Impervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0077	0.0257	0.0426	0.0646	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	43	144	239	363	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.048**	**0.341**	**0.666**	**1.114**	Pre-dev	**273.66**	**1841.07**	**3695.79**	**6302.02**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 11

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	1.4455	106.97
			0.00
Total pervious		1.44554	106.97

CN (weighted) 74.00
Ia (weighted) 5

1.2 Time of Concentration

Channelisation C 1
Catchment length 0.34 km
Catchment slope 0.03 m/m

Runoff factor 0.5873
Time Concentration 0.2636 Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment 0.0145 km2
Runoff CN 74.00
Initial abstraction Ia 5
Time of c 0.2635689 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 89.24

	Pre-dev Pervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.035	0.088	0.106	0.124	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0175	0.1371	0.2707	0.4749	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	109	801	1,632	2,803	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.3285	32.19
			0.00
			0.00
			0.00
Total impervious		0.3285	32.19

CN (weighted) 98
Ia (weighted) 0

1.2 Time of Concentration

Channelisation C 0.6
Catchment length 0.34 km
Catchment slope 0.03 m/m

Runoff factor 0.9608
Time Concentration 0.1206 Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²) 0.0033 km2
Runoff CN 98
Initial abstraction Ia 0
Time of c 0.17 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 5.18

	Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0181	0.0606	0.1004	0.1522	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	100	339	563	855	(m3)

Check of Areas	
Input	1.7740
Site (ha)	1.7740
Check	

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.036**	**0.198**	**0.371**	**0.627**	Pre-dev	**209.23**	**1140.46**	**2195.07**	**3658.44**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Trig Road

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.4491	33.23
			0.00
Total pervious		0.44905	33.23

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.27	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.2264	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment	0.0045	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2263696	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.2436	23.88
			0.00
			0.00
			0.00
Total impervious		0.2436	23.88

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.27	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1036	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment (km²)	0.0024	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

Check of Areas	
Input	0.6927
Site (ha)	0.6927
Check	

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	Pre-dev Pervious					Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)										
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.037	0.092	0.111	0.125		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0057	0.0447	0.0884	0.1488	(m3/s)	0.0134	0.0450	0.0745	0.1129	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	34	249	507	871	(m3)	74	252	418	634	(m3)

Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.019**	**0.090**	**0.163**	**0.262**	Pre-dev	**108.17**	**500.63**	**924.82**	**1505.12**

PCA Post-development OLFP Catchment Summary (3.8CC)				
Catchment	**Impervious (ha)**	**Pervious (ha)**	**Catchment Area (ha)**	**Peak flow (m3/s)**
Catchment 1	5.6742	0.7526	6.4268	2.87
Catchment 2	4.8928	0.6571	5.5499	2.48
Catchment 3	2.4956	0.9794	3.4750	1.49
Catchment 4	5.0141	0.8957	5.9098	2.62
Catchment 5	0.8644	0.5523	1.4167	0.60
Catchment 6	0.1290	3.3831	3.5121	1.27
Catchment 7a	0.0979	3.0526	3.1505	1.10
Catchment 7b	9.4296	1.4127	10.8423	4.67
Catchment 7c	3.7293	26.3647	30.0940	7.11
Catchment 8	0.4434	5.4923	5.9357	1.91
Catchment 9	9.0955	2.2445	11.3400	4.91
Catchment 10	0.1395	3.0623	3.2018	1.11
Catchment 11	0.3285	1.4455	1.7740	0.63
Trig Road	0.2436	0.4491	0.6927	0.26

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 1

Based on ARC TP 108, April 1999 | **Soil name and classification:** | Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.7526	55.69
			0.00
Total pervious		0.75260	55.69

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.287	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.2357	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0075	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2356786	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	5.6742	556.07
			0.00
			0.00
			0.00
Total impervious		5.6742	556.07

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.287	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1079	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0567	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Check of Areas	
Input	6.4268
Site (ha)	6.4268
Check	

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	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.036	0.091	0.110	0.123		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0095	0.0740	0.1462	0.2462	(m3/s)	0.3123	1.0470	1.7343	2.6287	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	57	417	849	1,460	(m3)	1,730	5,864	9,734	14,771	(m3)

Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.322**	**1.121**	**1.880**	**2.875**	Post-dev	**1786.58**	**6280.93**	**10583.23**	**16230.39**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 2

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.6571	48.63
			0.00
Total pervious		0.65710	48.63

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.294	km
Catchment slope	0.02	m/m
Runoff factor	0.5873	
Time Concentration	0.2704	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0066	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2704299	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	4.8928	479.49
			0.00
			0.00
			0.00
Total impervious		4.8928	479.49

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.294	km
Catchment slope	0.02	m/m
Runoff factor	0.9608	
Time Concentration	0.1238	Hrs

Check of Areas	
Input	5.5499
Site (ha)	5.5499
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0489	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.034	0.087	0.105	0.123		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0079	0.0618	0.1220	0.2141	(m3/s)	0.2693	0.9028	1.4955	2.2667	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	50	364	742	1,274	(m3)	1,492	5,056	8,393	12,737	(m3)

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Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.277**	**0.965**	**1.617**	**2.481**	Post-dev	**1541.17**	**5420.49**	**9135.00**	**14011.07**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 3

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.9794	72.48
			0.00
Total pervious		0.97940	72.48

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.142	km
Catchment slope	0.01	m/m
Runoff factor	0.5873	
Time Concentration	0.2060	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment	0.0098	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2059514	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	2.4956	244.57
			0.00
			0.00
			0.00
Total impervious		2.4956	244.57

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.142	km
Catchment slope	0.01	m/m
Runoff factor	0.9608	
Time Concentration	0.0943	Hrs

Check of Areas	
Input	3.4750
Site (ha)	3.4750
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment (km²)	0.0250	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.095	0.115	0.129		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0129	0.1005	0.1986	0.3345	(m3/s)	0.1373	0.4605	0.7628	1.1561	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	74	543	1,105	1,899	(m3)	761	2,579	4,281	6,496	(m3)

Legend

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Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.150**	**0.561**	**0.961**	**1.491**	Post-dev	**834.71**	**3121.74**	**5386.53**	**8395.84**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 4

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.8957	66.28
			0.00
Total pervious		0.89570	66.28

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.224	km
Catchment slope	0.02	m/m
Runoff factor	0.5873	
Time Concentration	0.2260	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment	0.0090	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2260003	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	5.0141	491.38
			0.00
			0.00
			0.00
Total impervious		5.0141	491.38

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.224	km
Catchment slope	0.02	m/m
Runoff factor	0.9608	
Time Concentration	0.1034	Hrs

Check of Areas	
Input	5.9098
Site (ha)	5.9098
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data		
Catchment (km²)	0.0501	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.037	0.092	0.112	0.125		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0115	0.0893	0.1764	0.2970	(m3/s)	0.2760	0.9252	1.5325	2.3229	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	68	496	1,011	1,737	(m3)	1,529	5,182	8,601	13,052	(m3)

Legend

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Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.287**	**1.014**	**1.709**	**2.620**	Post-dev	**1596.15**	**5678.06**	**9612.39**	**14789.56**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 5

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.5523	40.87
			0.00
Total pervious		0.55230	40.87

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.15	km
Catchment slope	0.05	m/m
Runoff factor	0.5873	
Time Concentration	0.1318	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0055	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

	Post-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.040	0.100	0.122	0.136	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0077	0.0600	0.1187	0.1999	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	42	306	623	1,071	(m3)

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.8644	84.71
			0.00
			0.00
			0.00
Total impervious		0.8644	84.71

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.15	km
Catchment slope	0.05	m/m
Runoff factor	0.9608	
Time Concentration	0.0603	Hrs

Check of Areas	
Input	1.4167
Site (ha)	1.4167
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0086	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Post-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0476	0.1595	0.2642	0.4005	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	264	893	1,483	2,250	(m3)

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Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.055**	**0.220**	**0.383**	**0.600**	Post-dev	**305.20**	**1199.34**	**2106.22**	**3321.27**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 6

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.3831	250.35
			0.00
Total pervious		3.38310	250.35

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.213	km
Catchment slope	0.04	m/m
Runoff factor	0.5873	
Time Concentration	0.1776	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0338	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.1775689	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.1290	12.64
			0.00
			0.00
			0.00
Total impervious		0.1290	12.64

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.213	km
Catchment slope	0.04	m/m
Runoff factor	0.9608	
Time Concentration	0.0813	Hrs

Check of Areas	
Input	3.5121
Site (ha)	3.5121
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0013	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.039	0.099	0.120	0.135		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0468	0.3629	0.7176	1.2090	(m3/s)	0.0071	0.0238	0.0394	0.0598	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	255	1,875	3,819	6,561	(m3)	39	133	221	336	(m3)

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.054**	**0.387**	**0.757**	**1.269**	Pre-dev	**294.67**	**2007.99**	**4039.87**	**6896.83**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7a

Based on ARC TP 108, April 1999 | **Soil name and classification:** | Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.0526	225.89
			0.00
Total pervious		3.05260	225.89

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.219	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.1972	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0305	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.1971565	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	89.24	

Pre-dev Pervious	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.096	0.116	0.130	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0408	0.3174	0.6274	1.0568	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	230	1,692	3,446	5,920	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.0979	9.59
			0.00
			0.00
			0.00
Total impervious		0.0979	9.59

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.219	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.0902	Hrs

Check of Areas	
Input	3.1505
Site (ha)	3.1505
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0010	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*
2.2 Calculation of Storage		
Storage	5.18	

Pre-dev Impervious	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0054	0.0181	0.0299	0.0454	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	30	101	168	255	(m3)

Legend

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.046**	**0.335**	**0.657**	**1.102**	Pre-dev	**260.24**	**1792.71**	**3613.48**	**6174.92**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7b

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	1.4127	104.54
			0.00
Total pervious		1.41270	104.54

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.646	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.4026	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0141	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.4025979		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	9.4296	924.10
			0.00
			0.00
			0.00
Total impervious		9.4296	924.10

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.646	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1843	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0943	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.184268934		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Check of Areas	
Input	10.8423
Site (ha)	10.8423
Check	

Legend

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	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.030	0.075	0.091	0.107		0.153	0.166	0.169	0.170	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0146	0.1155	0.2277	0.4017	(m3/s)	0.5066	1.6984	2.8131	4.2639	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	107	783	1,595	2,740	(m3)	2,875	9,745	16,176	24,547	(m3)

Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.521**	**1.814**	**3.041**	**4.666**	Post-dev	**2981.24**	**10527.66**	**17770.47**	**27286.45**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 7c

Based on ARC TP 108, April 1999 | **Soil name and classification:** | Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	26.3647	1,950.99
			0.00
Total pervious		26.36470	1950.99

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.787	km
Catchment slope	0.01	m/m
Runoff factor	0.5873	
Time Concentration	0.6377	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data			
Catchment	0.2636	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.6376725		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	89.24		

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.024	0.058	0.071	0.080	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.2252	1.6596	3.3121	5.6061	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	1,990	14,609	29,758	51,130	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	3.7293	365.47
			0.00
			0.00
			0.00
Total impervious		3.7293	365.47

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.787	km
Catchment slope	0.01	m/m
Runoff factor	0.9608	
Time Concentration	0.2919	Hrs

Check of Areas	
Input	30.0940
Site (ha)	30.0940
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data			
Catchment (km²)	0.0373	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.291862543		*minimum 0.17hrs*
2.2 Calculation of Storage			
Storage	5.18		

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.137	0.148	0.150	0.152	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.1790	0.5982	0.9902	1.5004	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	1,137	3,854	6,397	9,708	(m3)

Legend

Titles
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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.404**	**2.258**	**4.302**	**7.106**	Pre-dev	**3126.78**	**18463.42**	**36155.82**	**60838.41**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 8

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	5.4923	406.43
			0.00
Total pervious		5.49230	406.43

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.371	km
Catchment slope	0.02	m/m
Runoff factor	0.5873	
Time Concentration	0.3153	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0549	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.315306	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.4434	43.45
			0.00
			0.00
			0.00
Total impervious		0.4434	43.45

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.371	km
Catchment slope	0.02	m/m
Runoff factor	0.9608	
Time Concentration	0.1443	Hrs

Check of Areas	
Input	5.9357
Site (ha)	5.9357
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0044	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.032	0.082	0.100	0.117		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0625	0.4900	0.9671	1.7006	(m3/s)	0.0244	0.0818	0.1355	0.2054	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	415	3,043	6,199	10,652	(m3)	135	458	761	1,154	(m3)

Legend

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.087**	**0.572**	**1.103**	**1.906**	Pre-dev	**549.71**	**3501.67**	**6959.91**	**11805.75**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 9

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Post-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	2.2445	166.09
			0.00
Total pervious		2.24451	166.09

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.451	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.3176	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0224	km2	
Runoff CN	74.00		
Initial abstraction Ia	5		
Time of c	0.3175956		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Post-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	9.0955	891.36
			0.00
			0.00
			0.00
Total impervious		9.0955	891.36

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.451	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1454	Hrs

Check of Areas	
Input	11.3400
Site (ha)	11.3400
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0910	km2	
Runoff CN	98		
Initial abstraction Ia	0		
Time of c	0.17		*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Post-dev Pervious					Post-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.032	0.082	0.099	0.116		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0255	0.1998	0.3942	0.6933	(m3/s)	0.5006	1.6783	2.7800	4.2137	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	169	1,244	2,533	4,353	(m3)	2,773	9,400	15,603	23,677	(m3)

Legend

Titles
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Post Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Postdev	**0.526**	**1.878**	**3.174**	**4.907**	Post-dev	**2942.17**	**10643.31**	**18136.21**	**28029.88**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 10

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	3.0623	226.61
			0.00
Total pervious		3.06230	226.61

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.5873	
Time Concentration	0.2036	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0306	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2035707	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Pervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.038	0.095	0.115	0.129	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0405	0.3153	0.6232	1.0497	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	231	1,697	3,456	5,939	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.1395	13.67
			0.00
			0.00
			0.00
Total impervious		0.1395	13.67

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.262	km
Catchment slope	0.04	m/m
Runoff factor	0.9608	
Time Concentration	0.0932	Hrs

Check of Areas	
Input	3.2018
Site (ha)	3.2018
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0014	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

Pre-dev Impervious					
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0077	0.0257	0.0426	0.0646	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	43	144	239	363	(m3)

Legend

Titles
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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.048**	**0.341**	**0.666**	**1.114**	Pre-dev	**273.66**	**1841.07**	**3695.79**	**6302.02**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Catchment 11

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	1.4455	106.97
			0.00
Total pervious		1.44554	106.97

CN (weighted) 74.00
Ia (weighted) 5

1.2 Time of Concentration

Channelisation C 1
Catchment length 0.34 km
Catchment slope 0.03 m/m

Runoff factor 0.5873
Time Concentration 0.2636 Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment 0.0145 km2
Runoff CN 74.00
Initial abstraction Ia 5
Time of c 0.2635689 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 89.24

	Pre-dev Pervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59	
2.8 Specific peak flow rate q* (from figure 5.1)	0.035	0.088	0.106	0.124	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0175	0.1371	0.2707	0.4749	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	109	801	1,632	2,803	(m3)

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.3285	32.19
			0.00
			0.00
			0.00
Total impervious		0.3285	32.19

CN (weighted) 98
Ia (weighted) 0

1.2 Time of Concentration

Channelisation C 0.6
Catchment length 0.34 km
Catchment slope 0.03 m/m

Runoff factor 0.9608
Time Concentration 0.1206 Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²) 0.0033 km2
Runoff CN 98
Initial abstraction Ia 0
Time of c 0.17 *minimum 0.17hrs*

2.2 Calculation of Storage

Storage 5.18

	Pre-dev Impervious				
	90th %ile	50% AEP	10% AEP	1% AEP	
2.3 Annual Exceedance Probability (AEP) (%)					
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0181	0.0606	0.1004	0.1522	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	100	339	563	855	(m3)

Check of Areas	
Input	1.7740
Site (ha)	1.7740
Check	

Legend

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.036**	**0.198**	**0.371**	**0.627**	Pre-dev	**209.23**	**1140.46**	**2195.07**	**3658.44**

TP108 - Stormwater Runoff Calculation

development	Neil Construction Whenuapai Business Park
Address	Whenuapai Business Park Private Plan Change

Job Number	47712
Date	11/23/2023

Trig Road

Based on ARC TP 108, April 1999 | **Soil name and classification:** Group C Soil : Mudstone/Sandstone

Pre-dev Pervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Pervious	74	0.4491	33.23
			0.00
Total pervious		0.44905	33.23

CN (weighted)	74.00	
Ia (weighted)	5	
1.2 Time of Concentration		
Channelisation C	1	
Catchment length	0.27	km
Catchment slope	0.03	m/m
Runoff factor	0.5873	
Time Concentration	0.2264	Hrs

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment	0.0045	km2
Runoff CN	74.00	
Initial abstraction Ia	5	
Time of c	0.2263696	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	89.24	

Pre-dev Impervious

Runoff Curve Number (CN) and Initial Abstraction (Ia)

Cover type	Curve No.	Area (Ha)	CN x Area
Impervious	98	0.2436	23.88
			0.00
			0.00
			0.00
Total impervious		0.2436	23.88

CN (weighted)	98	
Ia (weighted)	0	
1.2 Time of Concentration		
Channelisation C	0.6	
Catchment length	0.27	km
Catchment slope	0.03	m/m
Runoff factor	0.9608	
Time Concentration	0.1036	Hrs

Check of Areas	
Input	0.6927
Site (ha)	0.6927
Check	

Section 2 - Graphical Peak Flow Rate

2.1 Data

Catchment (km²)	0.0024	km2
Runoff CN	98	
Initial abstraction Ia	0	
Time of c	0.17	*minimum 0.17hrs*

2.2 Calculation of Storage

Storage	5.18	

	Pre-dev Pervious					Pre-dev Impervious				
2.3 Annual Exceedance Probability (AEP) (%)	90th %ile	50% AEP	10% AEP	1% AEP		90th %ile	50% AEP	10% AEP	1% AEP	
2.4 24hr rainfall depth, P24(mm) (from TP 108)	35	85	135	200	(mm)	35	85	135	200	(mm)
2.5 Rainfall Depth Climate Change %	0	27.4	30.8	32.7	%	0	27.4	30.8	32.7	%
2.6 Adjusted 24hr rainfall depth, P24(mm)	35	108	177	265	(mm)	35	108	177	265	(mm)
2.7 Compute c* = P24-(2 x Ia)/(P24 - 2 x Ia) +2 x S	0.12	0.36	0.48	0.59		0.77	0.91	0.94	0.962	
2.8 Specific peak flow rate q* (from figure 5.1)	0.037	0.092	0.111	0.125		0.157	0.170	0.173	0.175	
2.9 Peak flow rate, qp = q* x A x P24 (m3/s)	0.0057	0.0447	0.0884	0.1488	(m3/s)	0.0134	0.0450	0.0745	0.1129	(m3/s)
2.10 Runoff Depth, Q24 = (P24 - Ia)2/((P24-Ia) + S)	8	55	113	194	(mm)	30	103	172	260	(mm)
2.11 Runoff volume, V24 = 1000 x Q24 x A (m3)	34	249	507	871	(m3)	74	252	418	634	(m3)

Legend

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Pre Development Summary - Flows and Volumes

	Peak Flow by Storm (m³/sec)					Runoff volume by Storm (m³)			
AEP (%)	**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**		**90th %ile**	**50% AEP**	**10% AEP**	**1% AEP**
Pre-dev	**0.019**	**0.090**	**0.163**	**0.262**	Pre-dev	**108.17**	**500.63**	**924.82**	**1505.12**

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Whenuapai Business Park Private Plan Change, Whenuapai, Auckland

Flooding and Flood Hazard Risk Report

Appendix D: HEC RAS Results

PLANNERS
SURVEYORS
ENGINEERS
ARCHITECTS
ENVIRONMENTAL

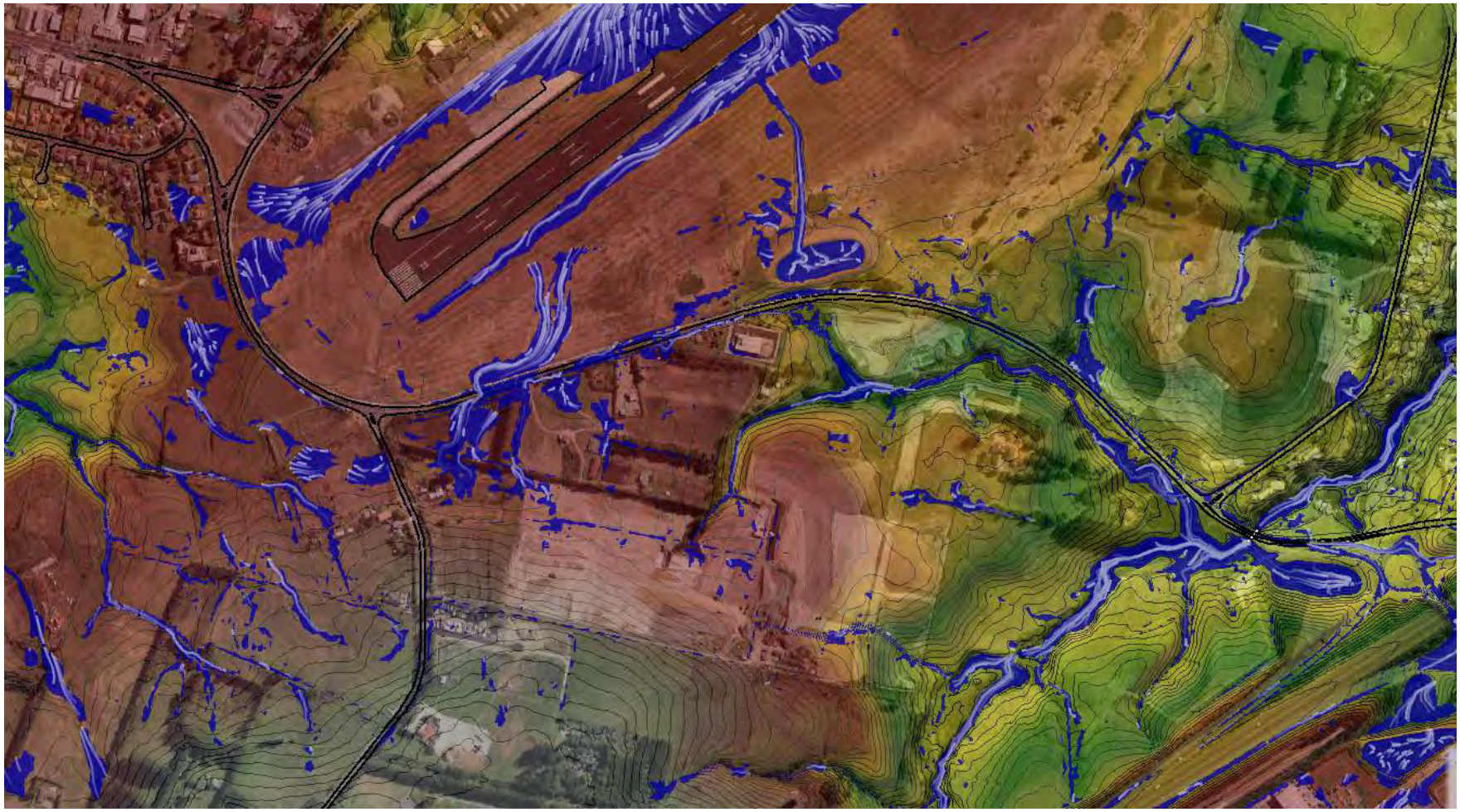
47712 – HEC RAS RESULTS (Flood Depths Limited to 45mm)

Plan Change - 141, 145, 151, 153, 155-157 & 159 Brigham Creek Road - 69-71, 73, 94, 96A & 96 Trig Road

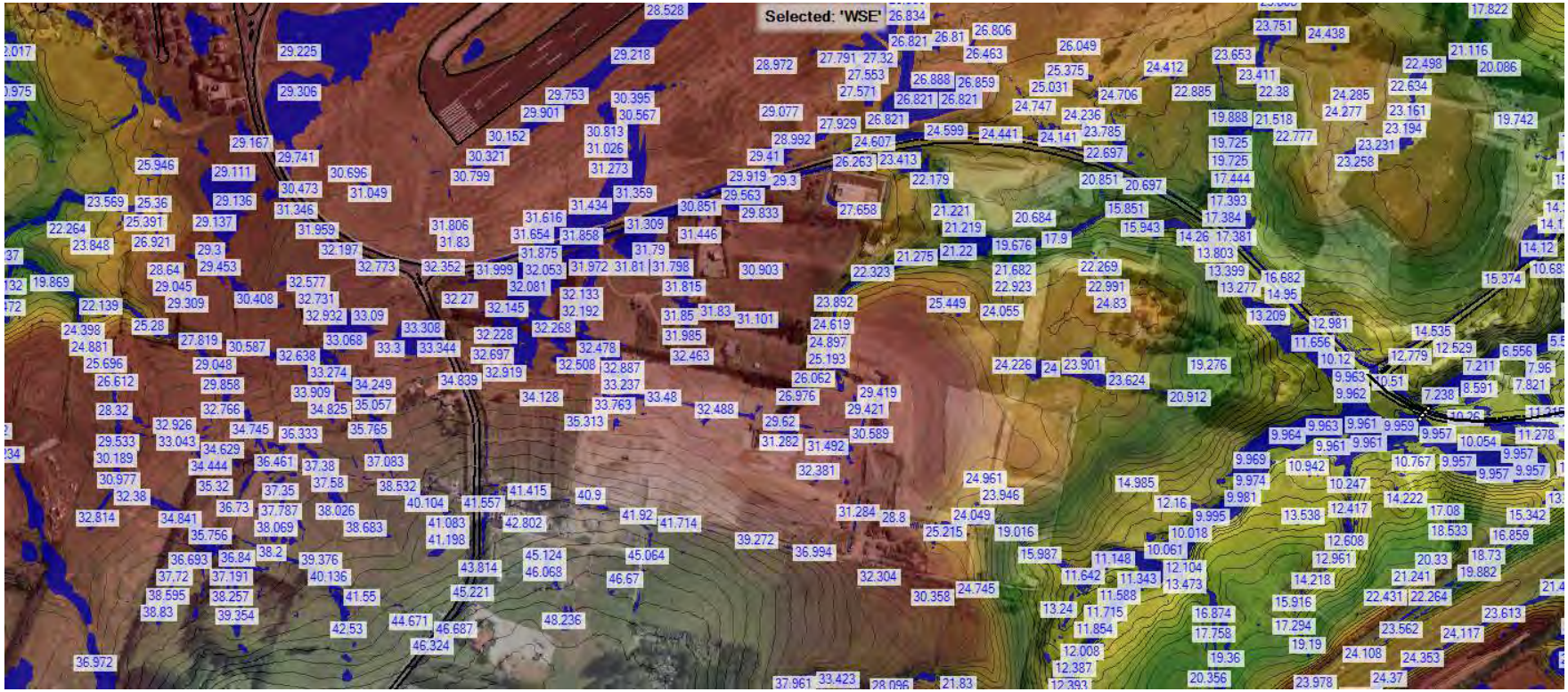
PRE-DEVELOPMENT

1) 1% AEP PRE-DEVELOPMENT– EXISTING BOX CULVERT WORKING AT 50% CAPACITY EXCLUDING CLIMATE CHANGE

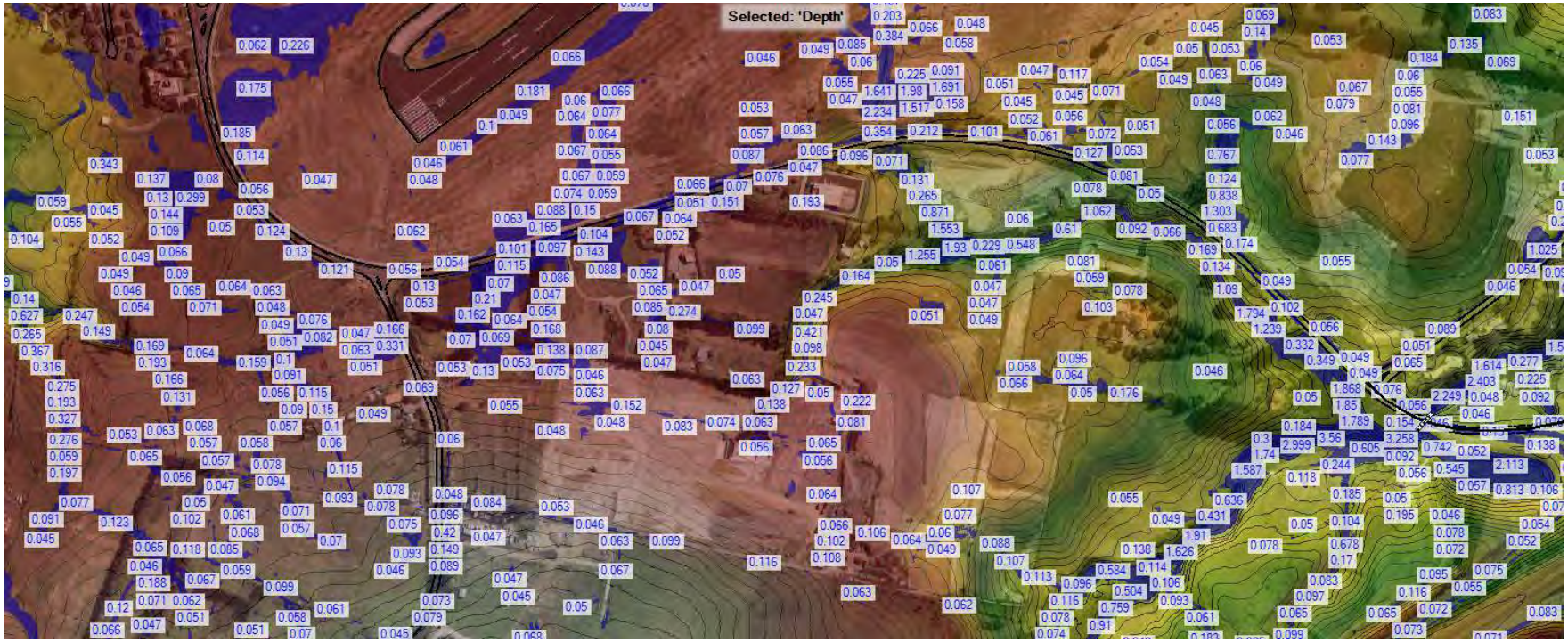
Flood Extent & Flow Direction



Flood Levels

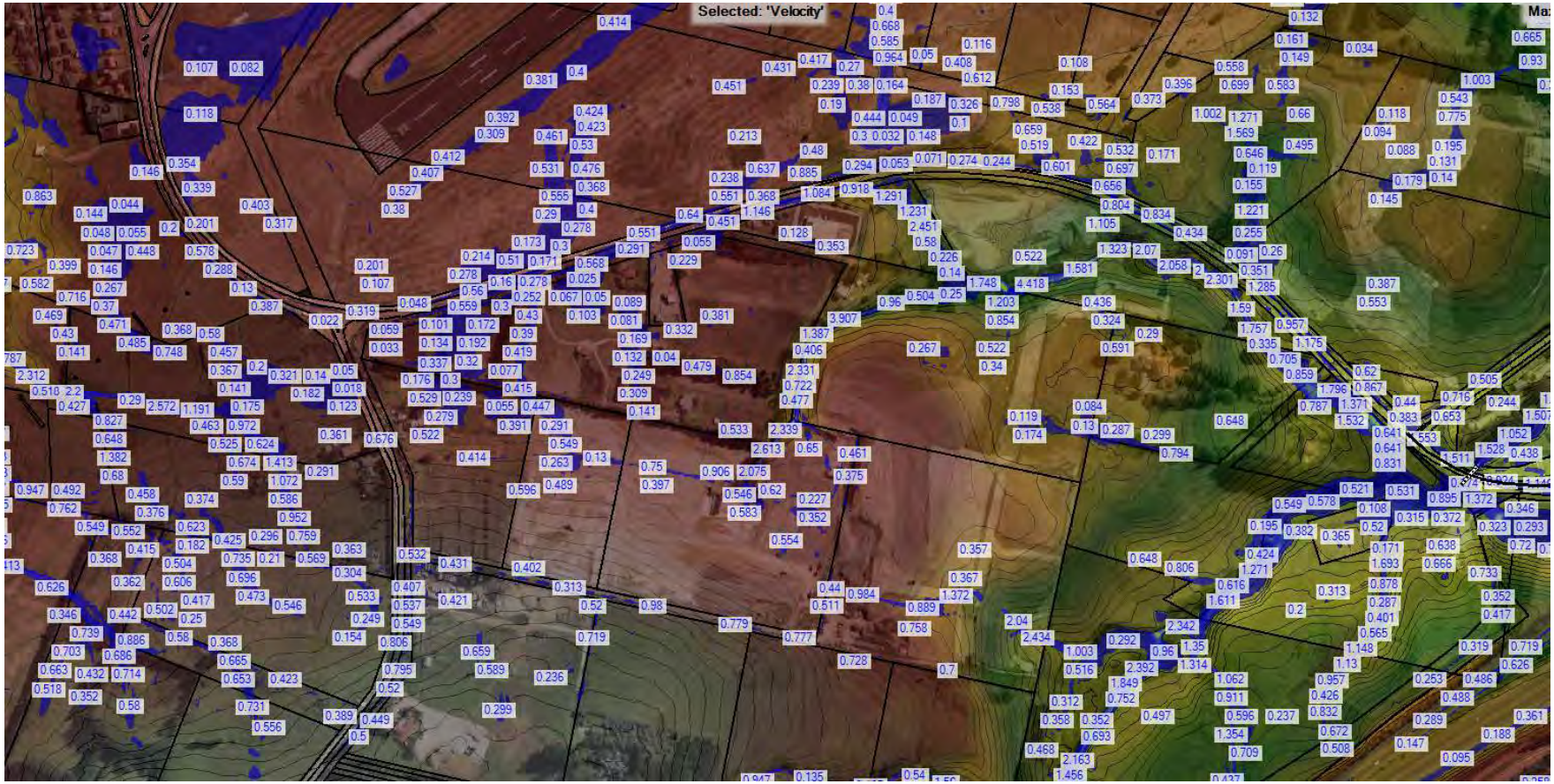


Flood Depths



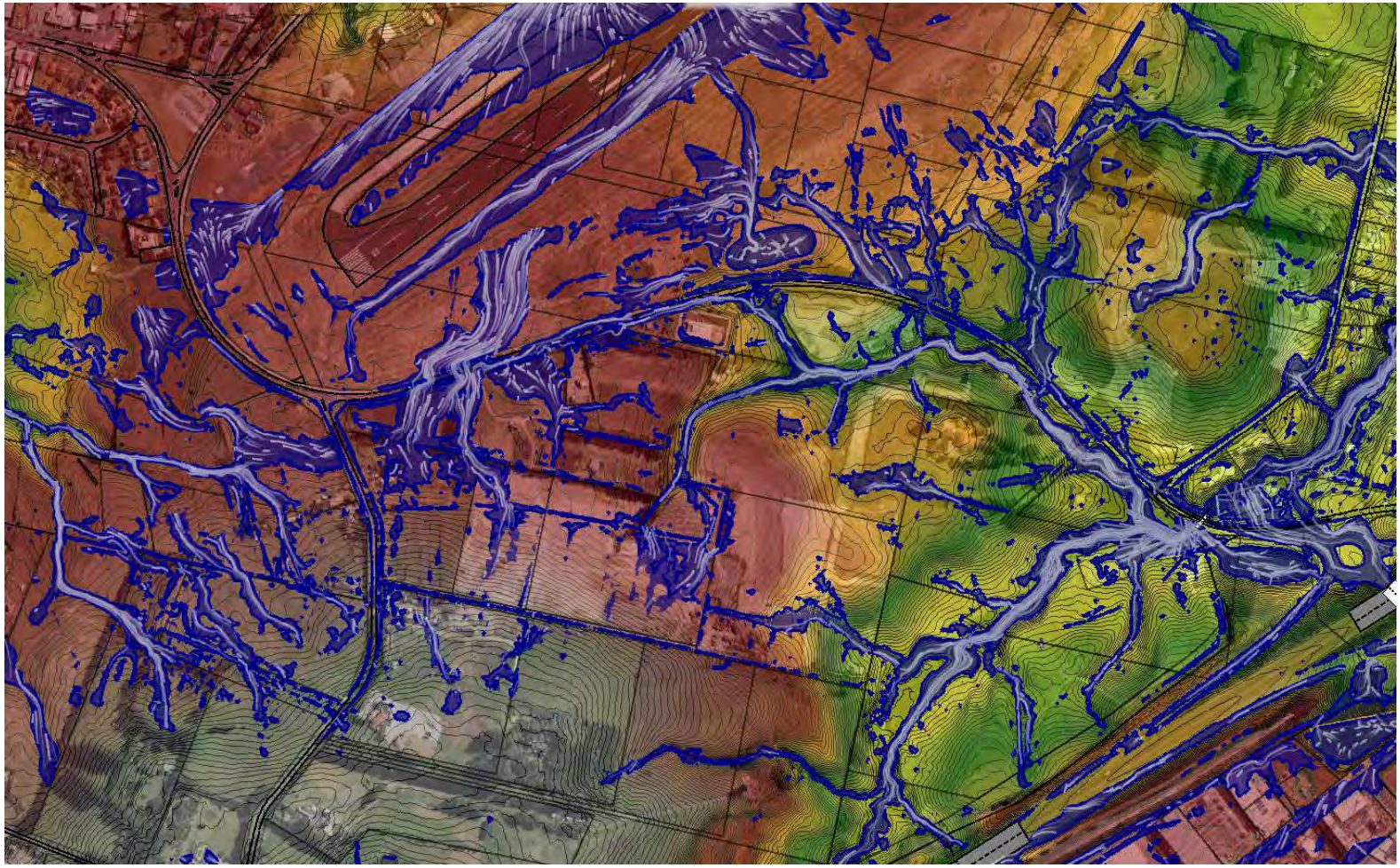
Flood Depths at Existing Box Culvert

Flood Velocities

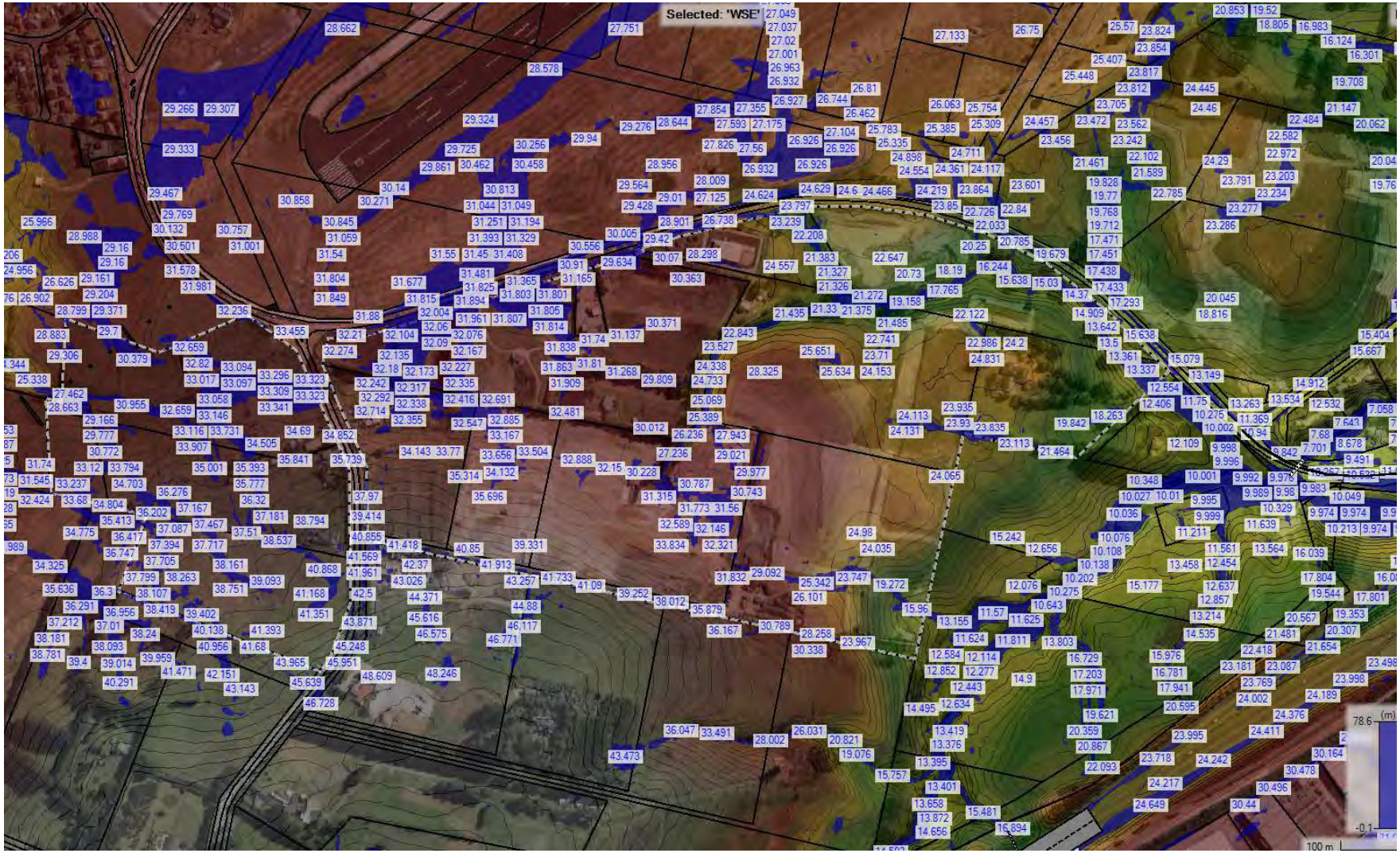


2) 1% AEP PRE-DEVELOPMENT – EXISTING BOX CULVERT WORKING AT 100% CAPACITY 3.8cc

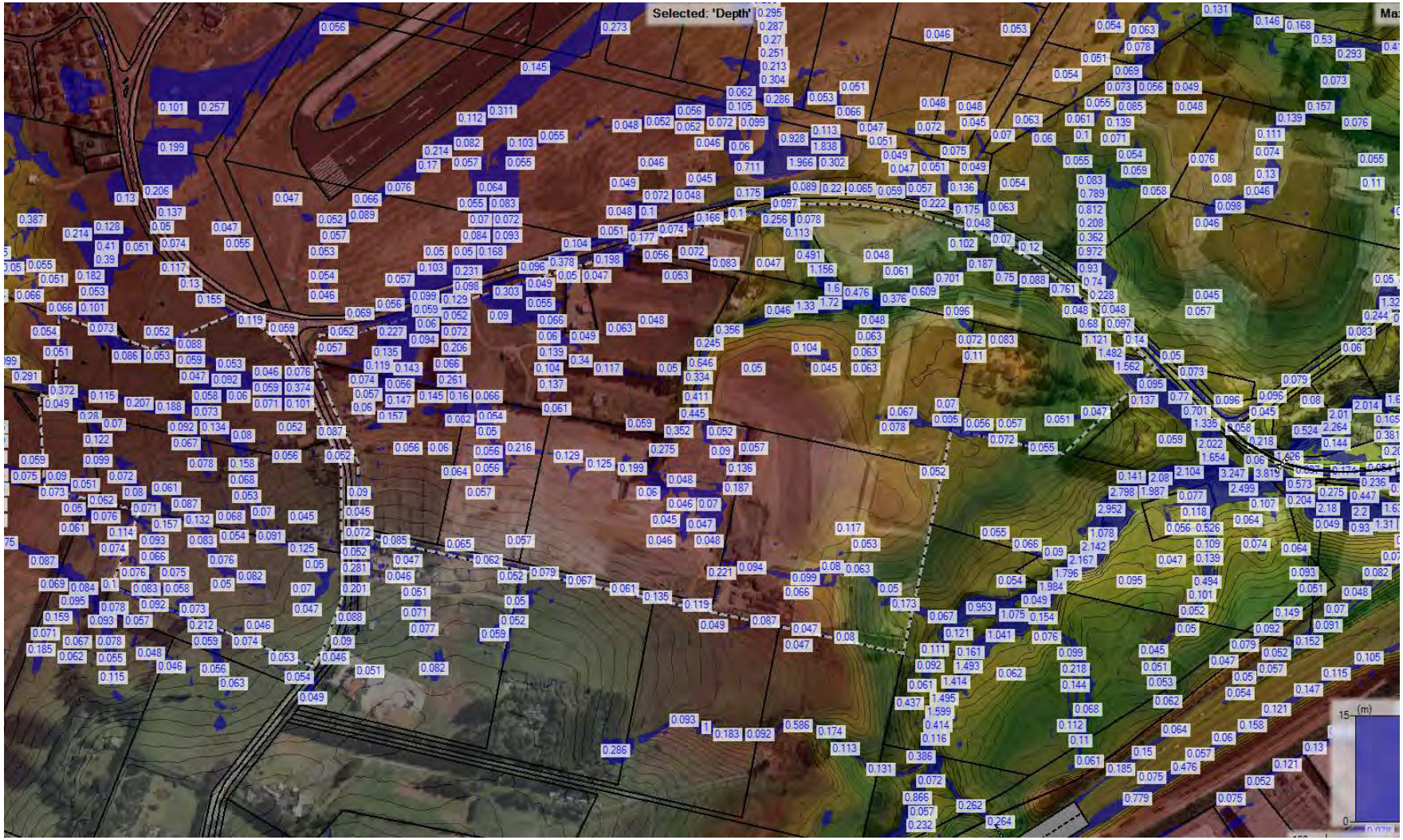
Flood Extent & Flow Direction



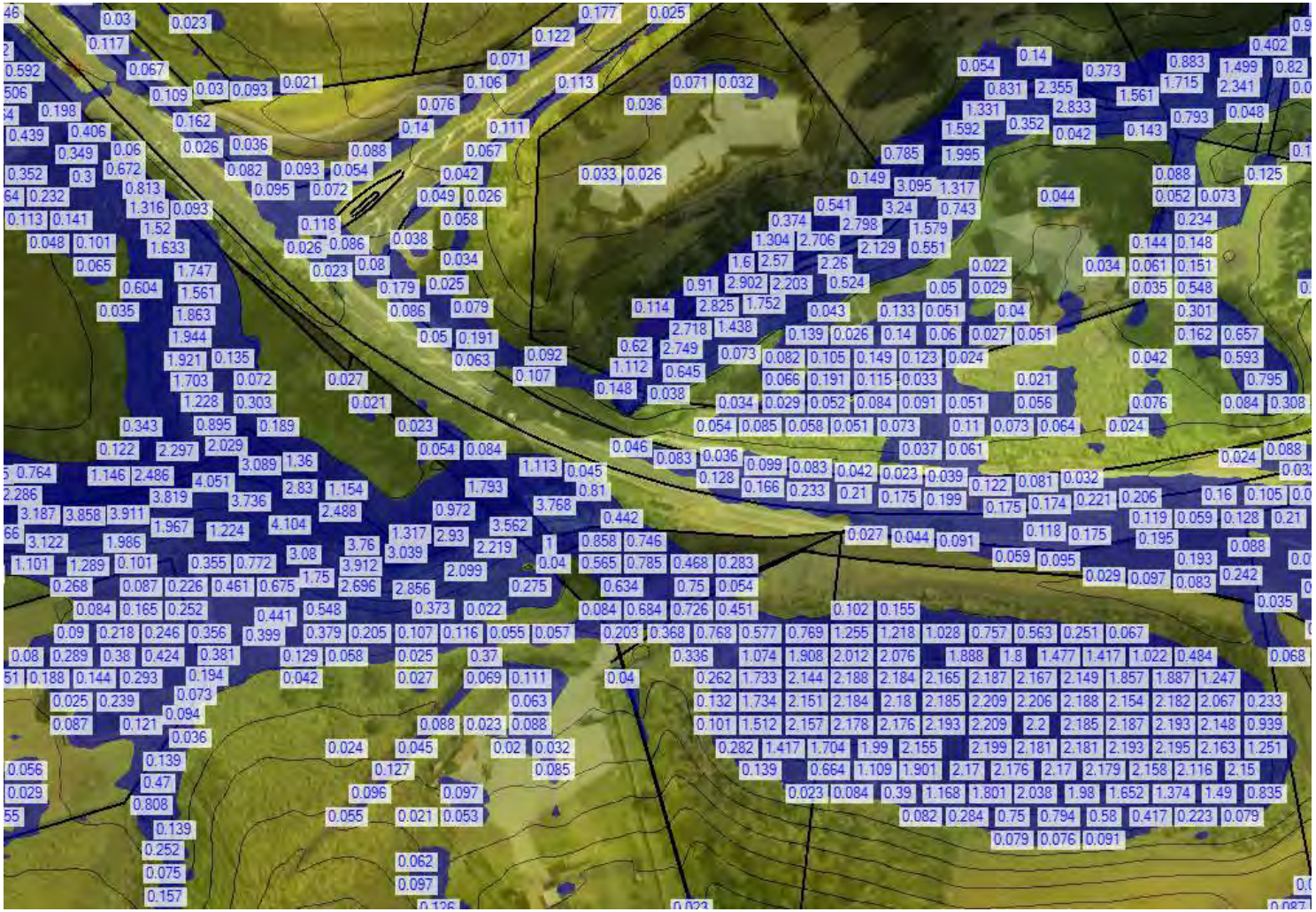
Flood Levels



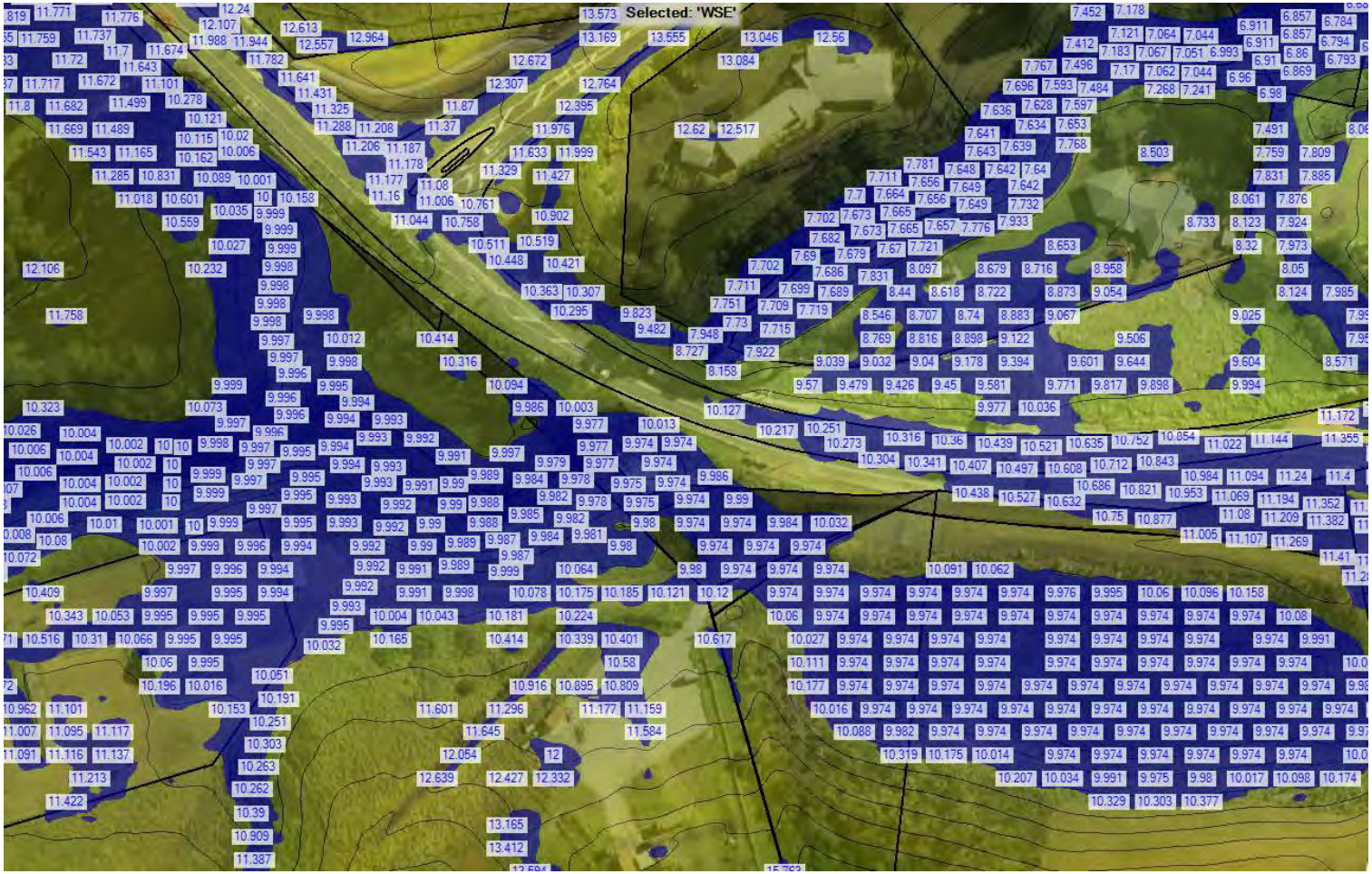
Flood Depths



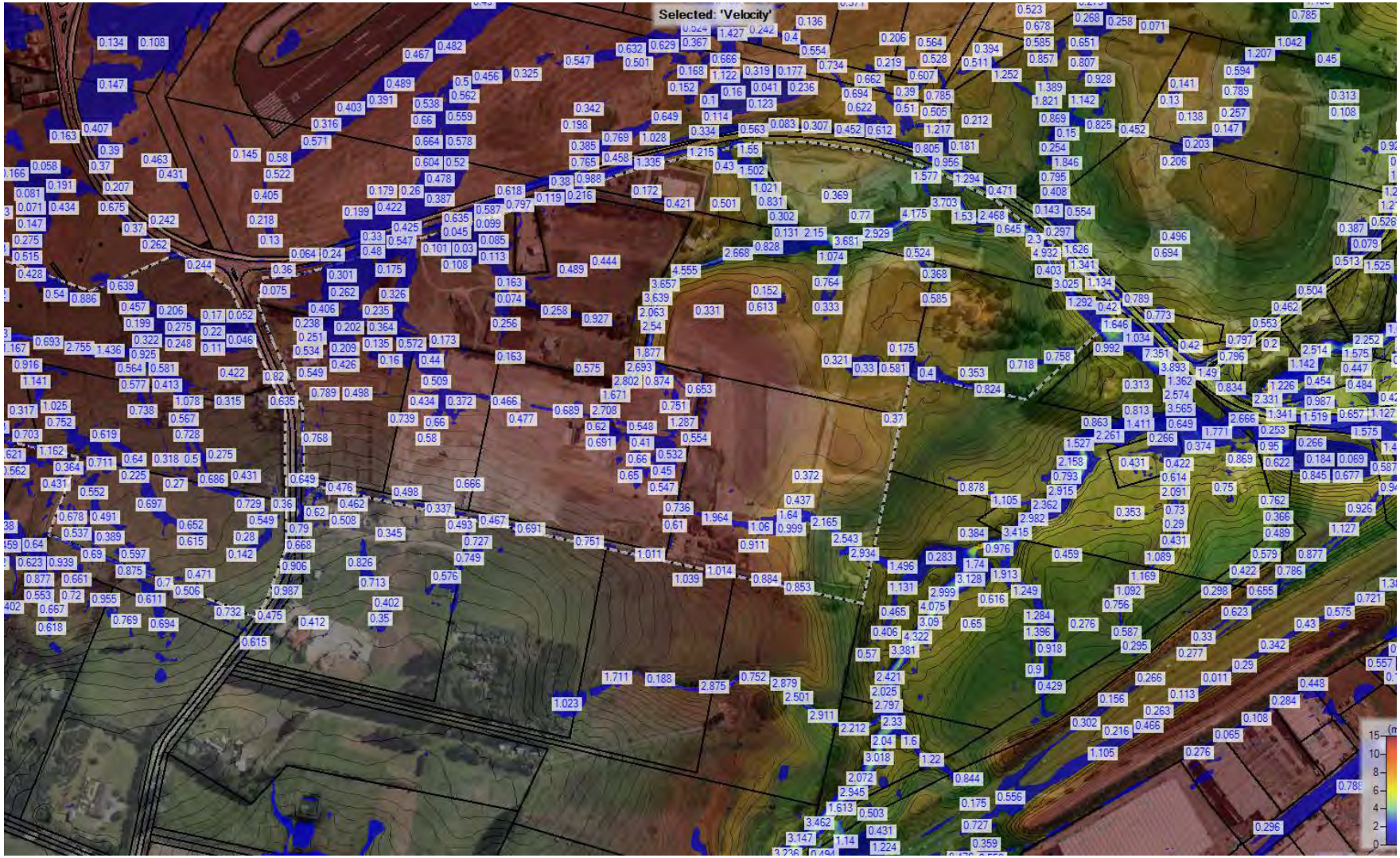
Flood Depths at Box Culvert



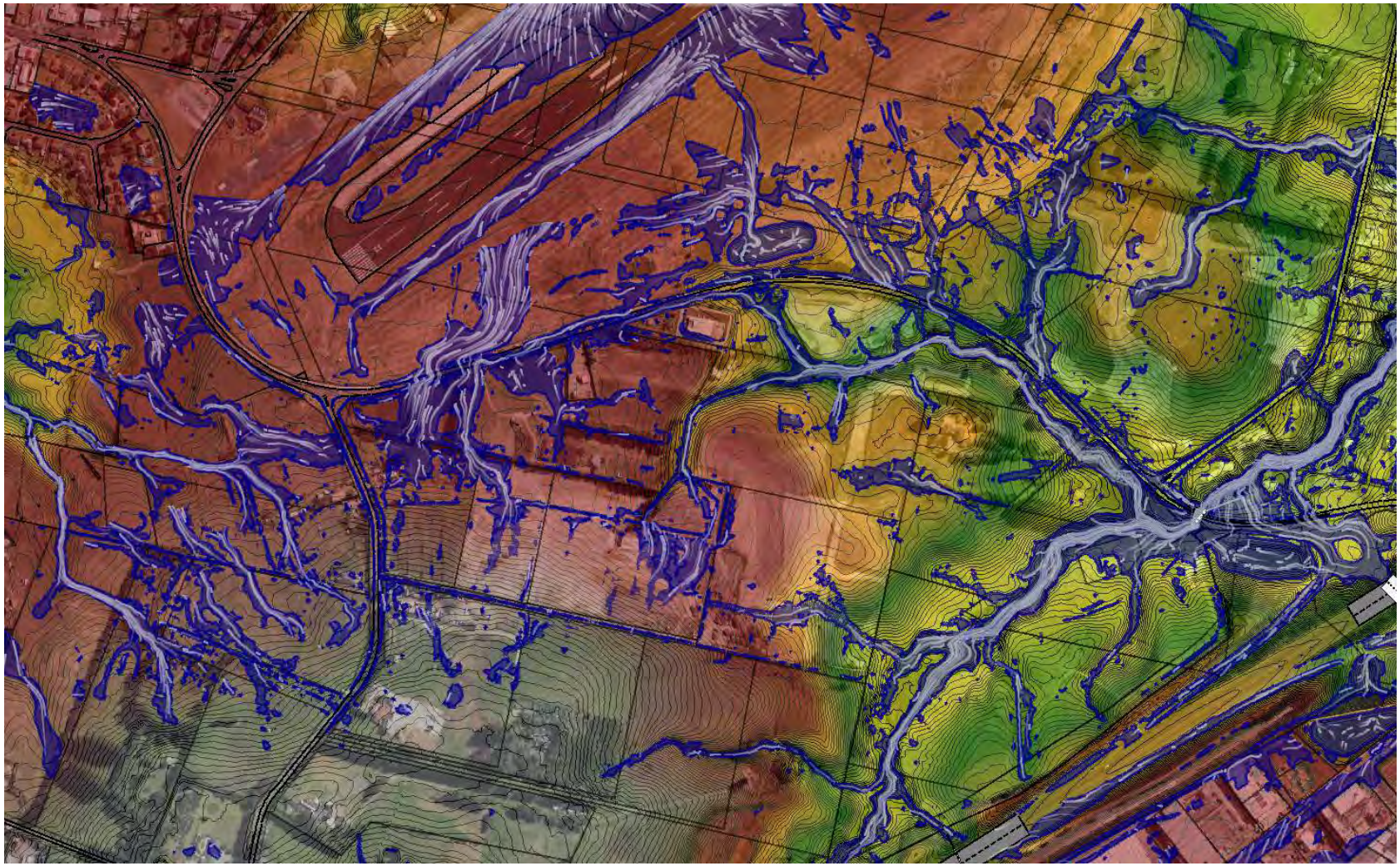
Flood Level Around Box Culvert



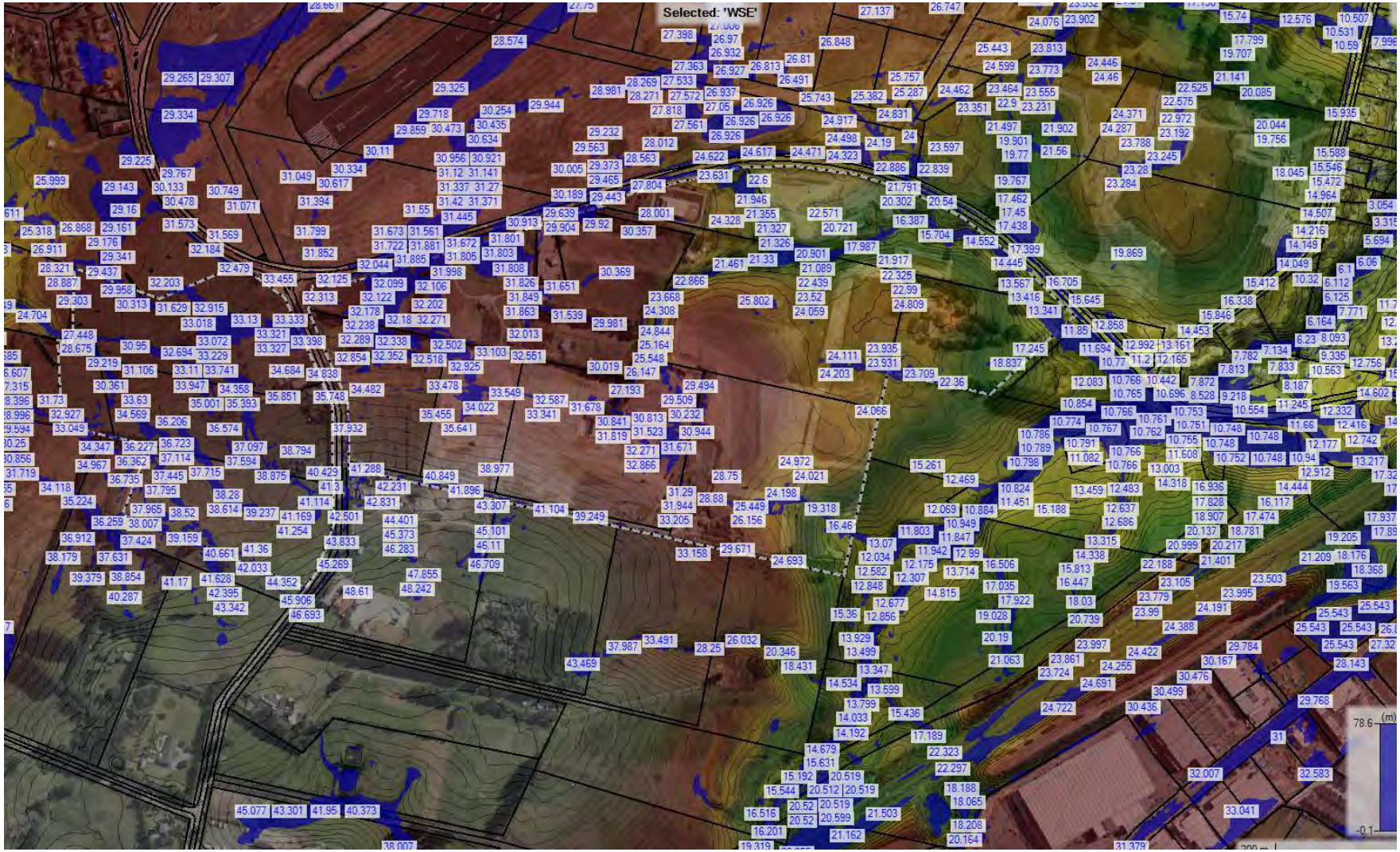
Flood Velocities



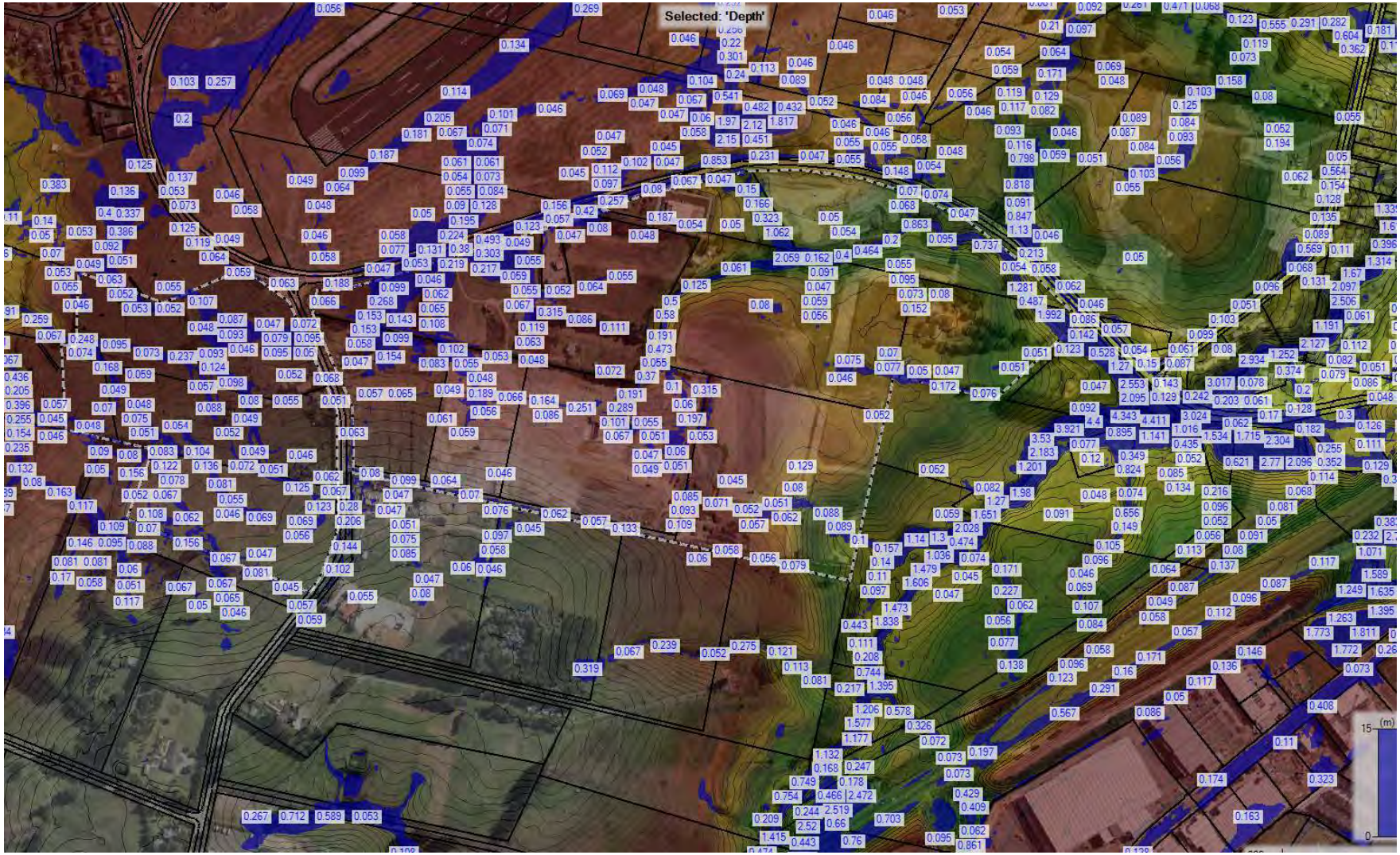
3) 1% AEP PRE-DEVELOPMENT - EXISTING CULVERT WORKING AT 50% CAPACITY with 3.8cc



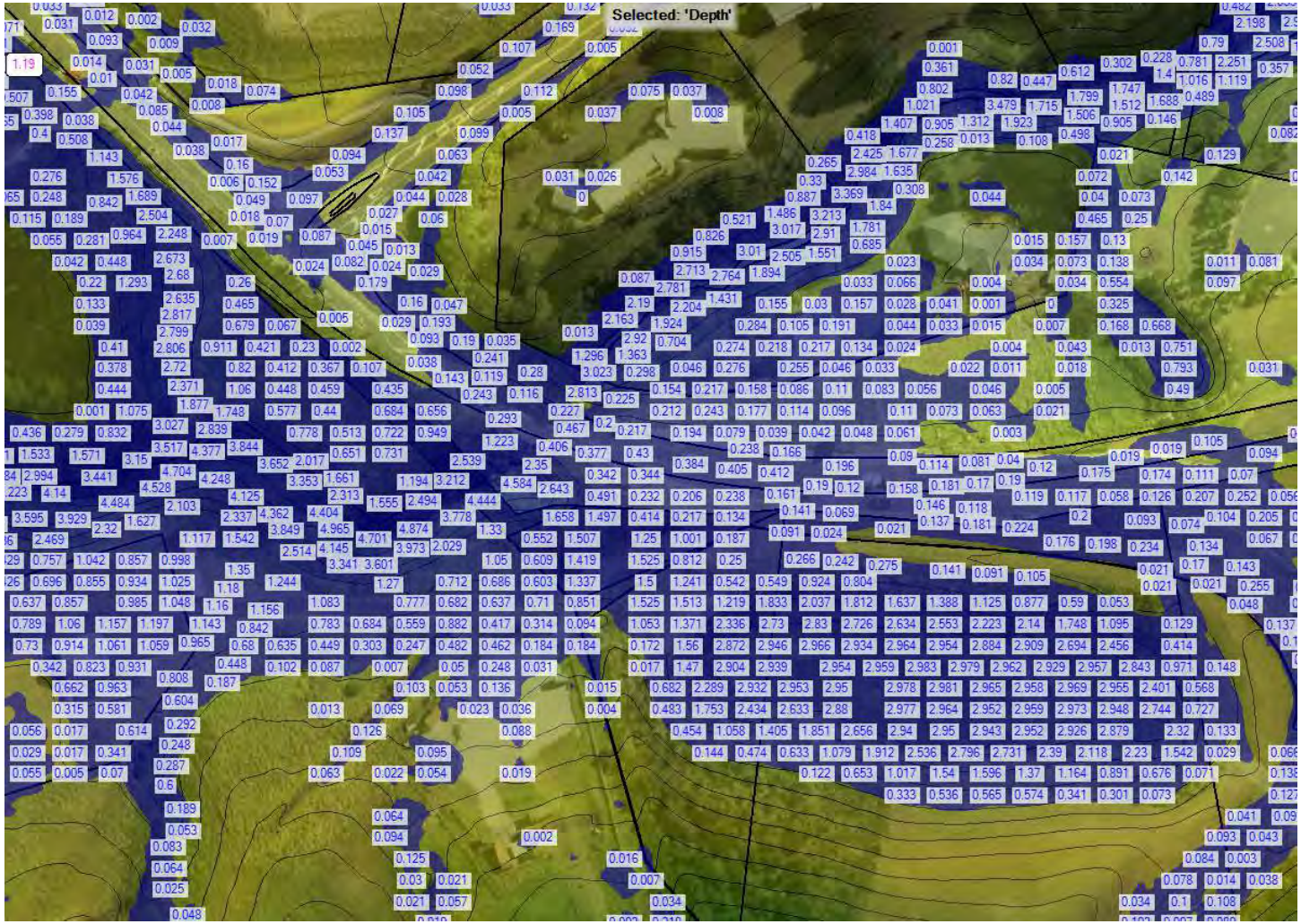
Flood Levels



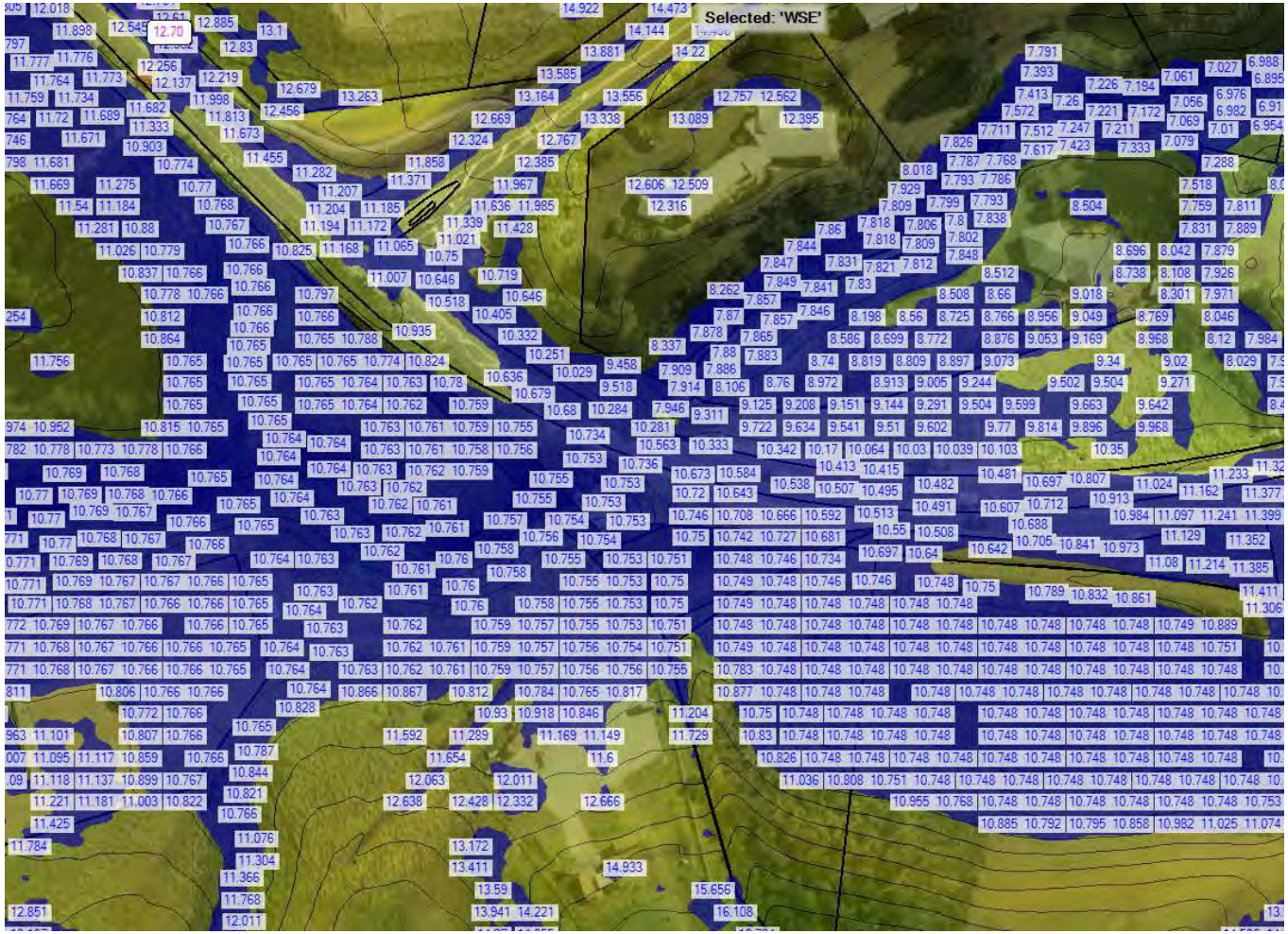
Flood Depths



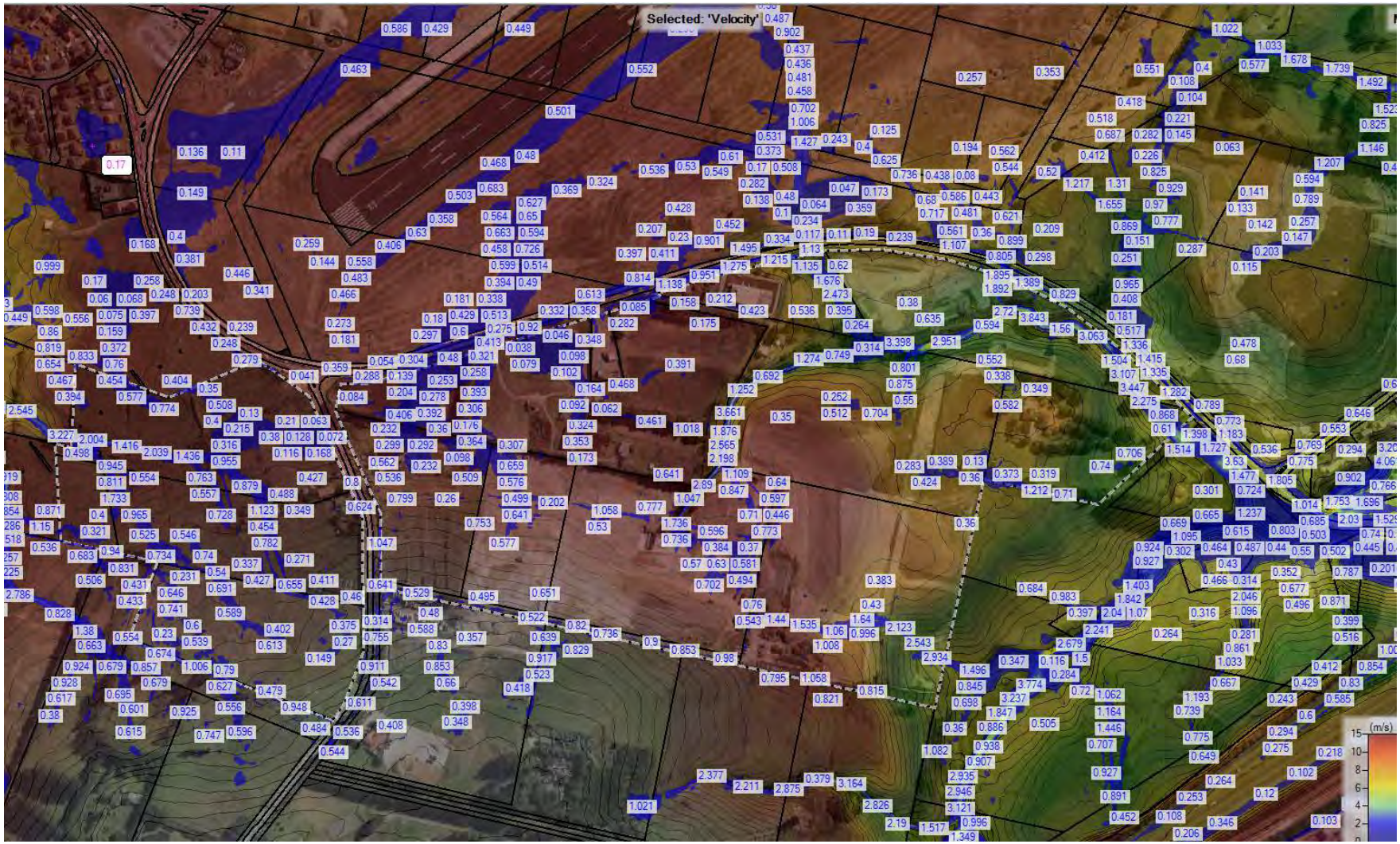
Flood Depth at Box Culvert



Flood Levels Around Box Culvert



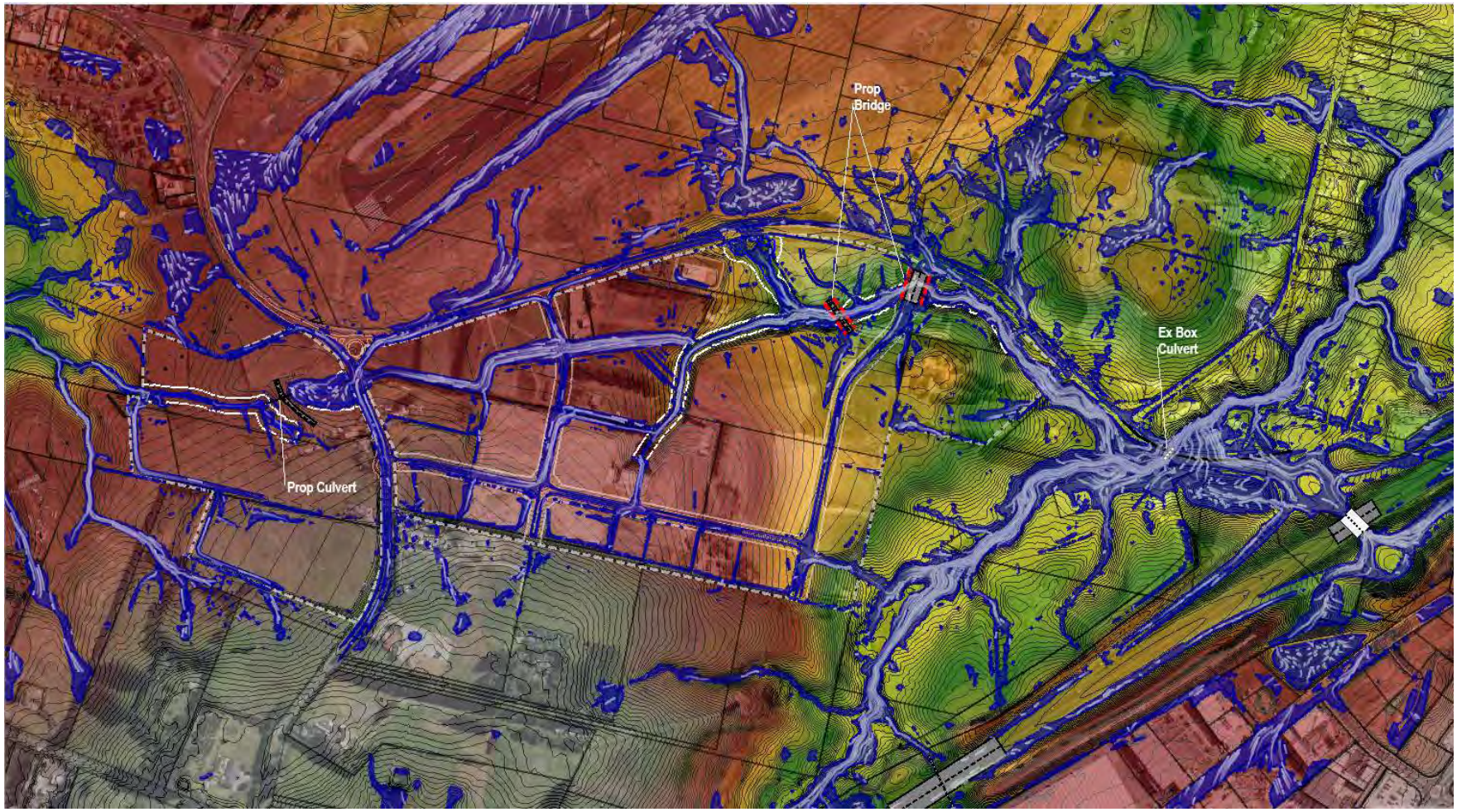
Flood Velocities



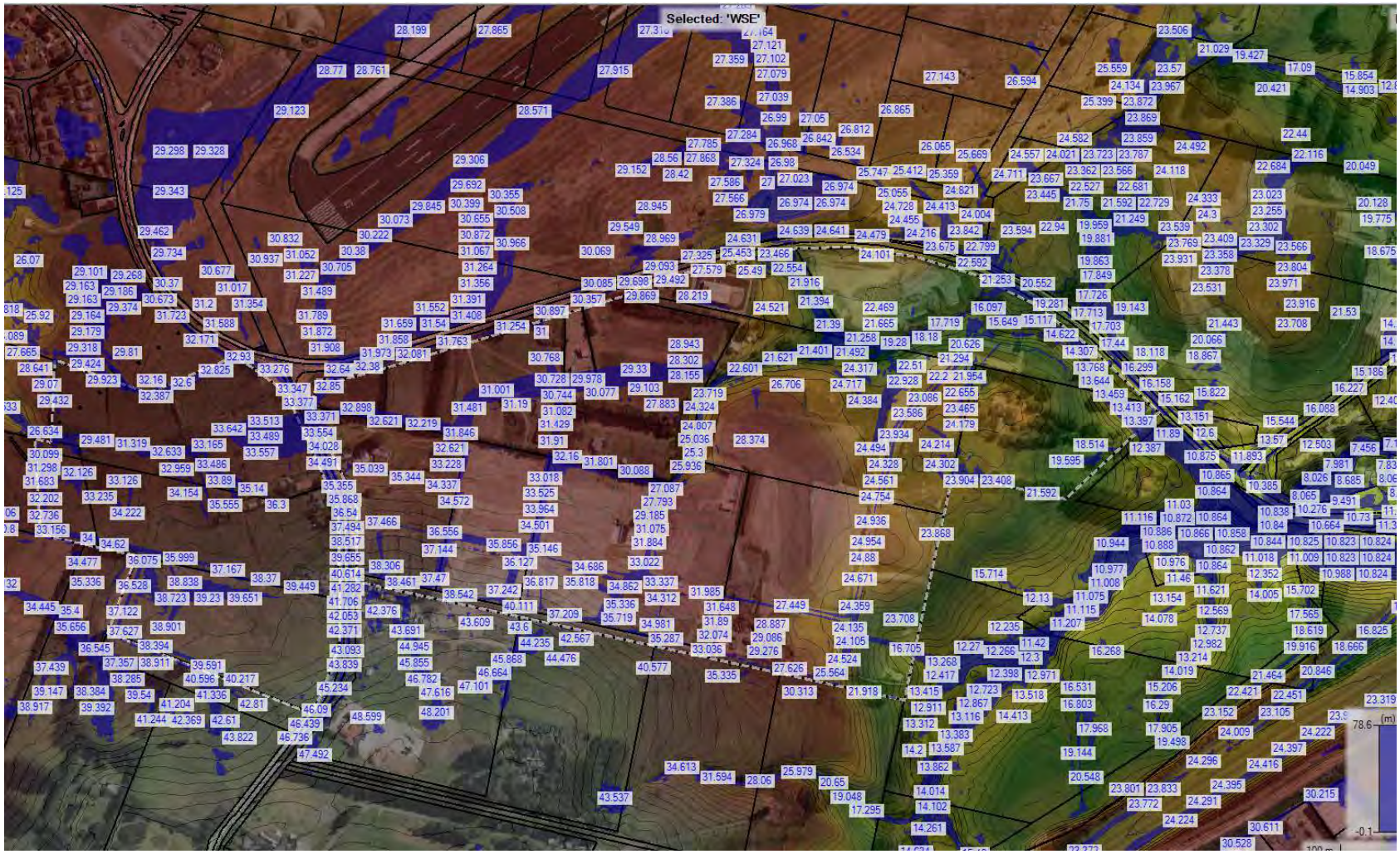
POST-DEVELOPMENT

4) 1% AEP POST-DEVELOPMENT MPD– EXISTING BOX CULVERT WORKING AT 50% CAPACITY with 3.8cc

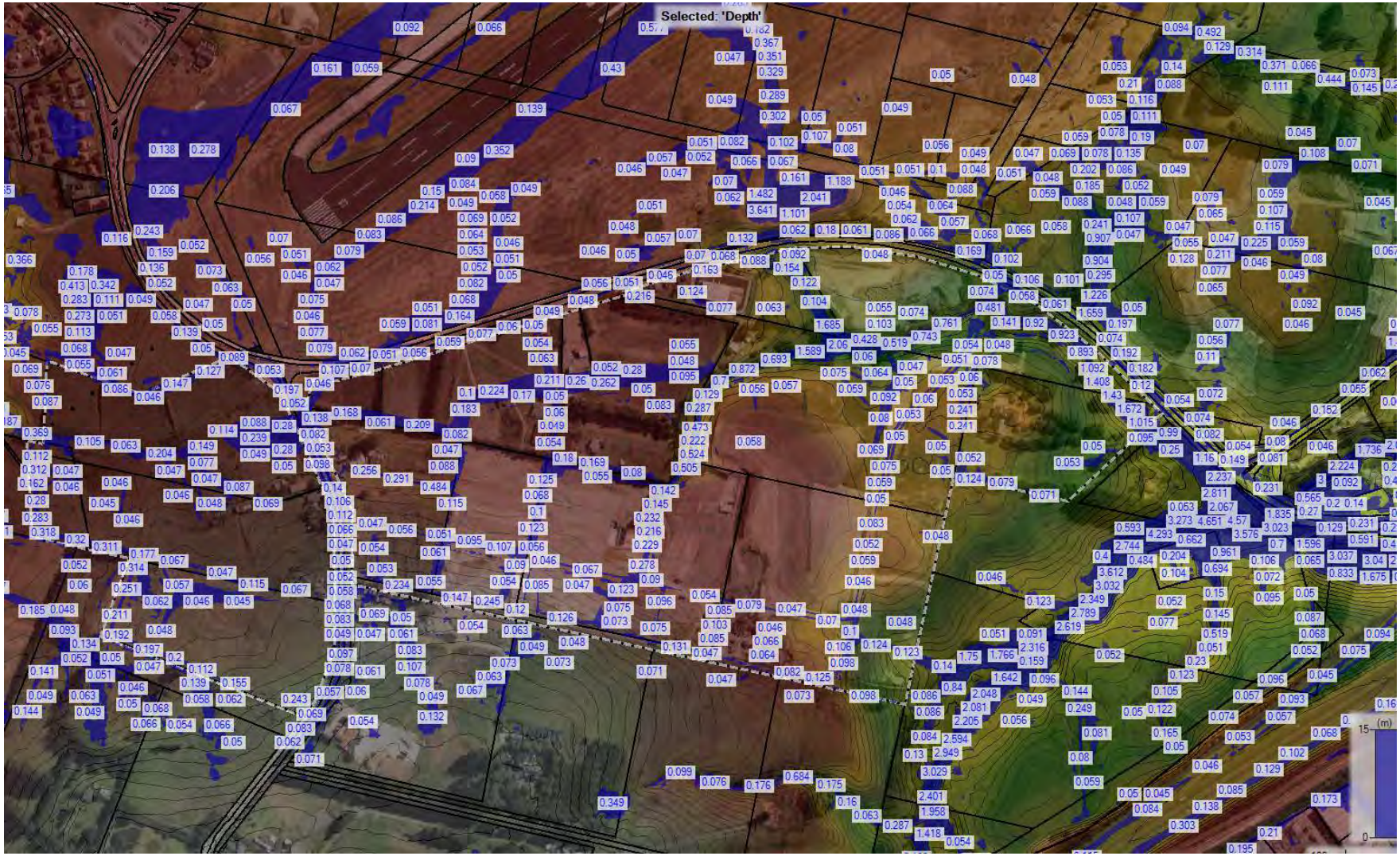
Flood Extent & Flow Direction



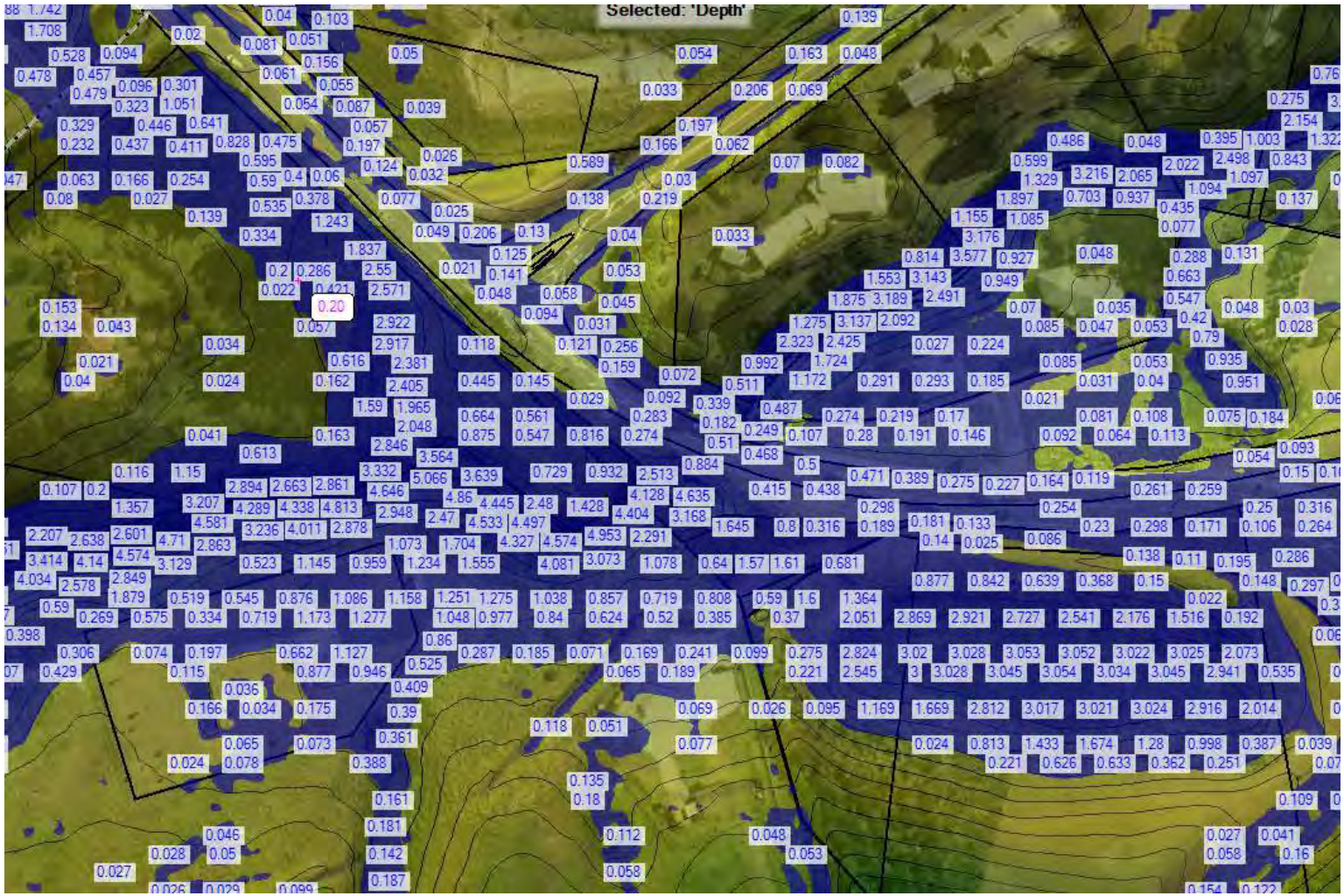
Flood Levels



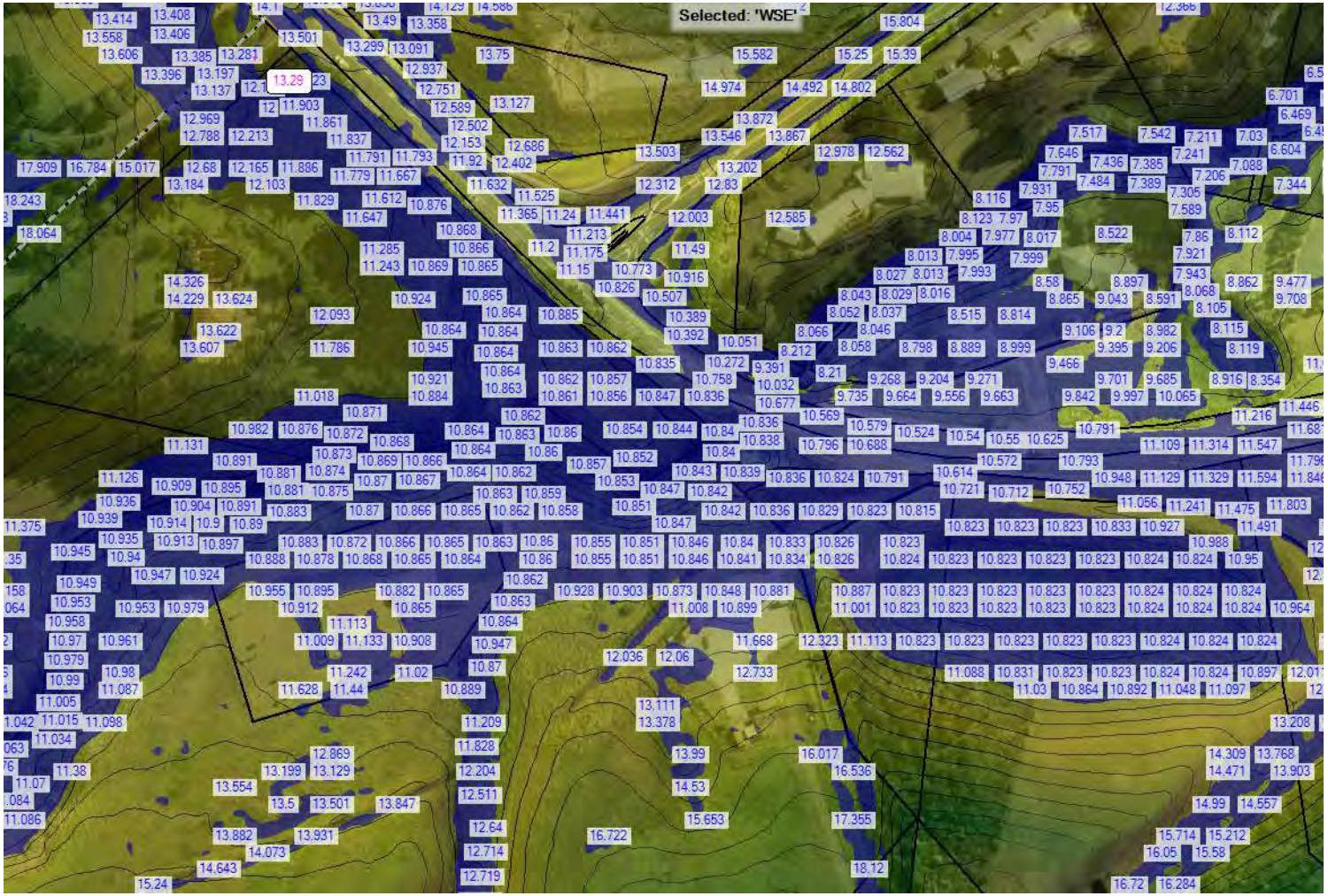
Flood Depths



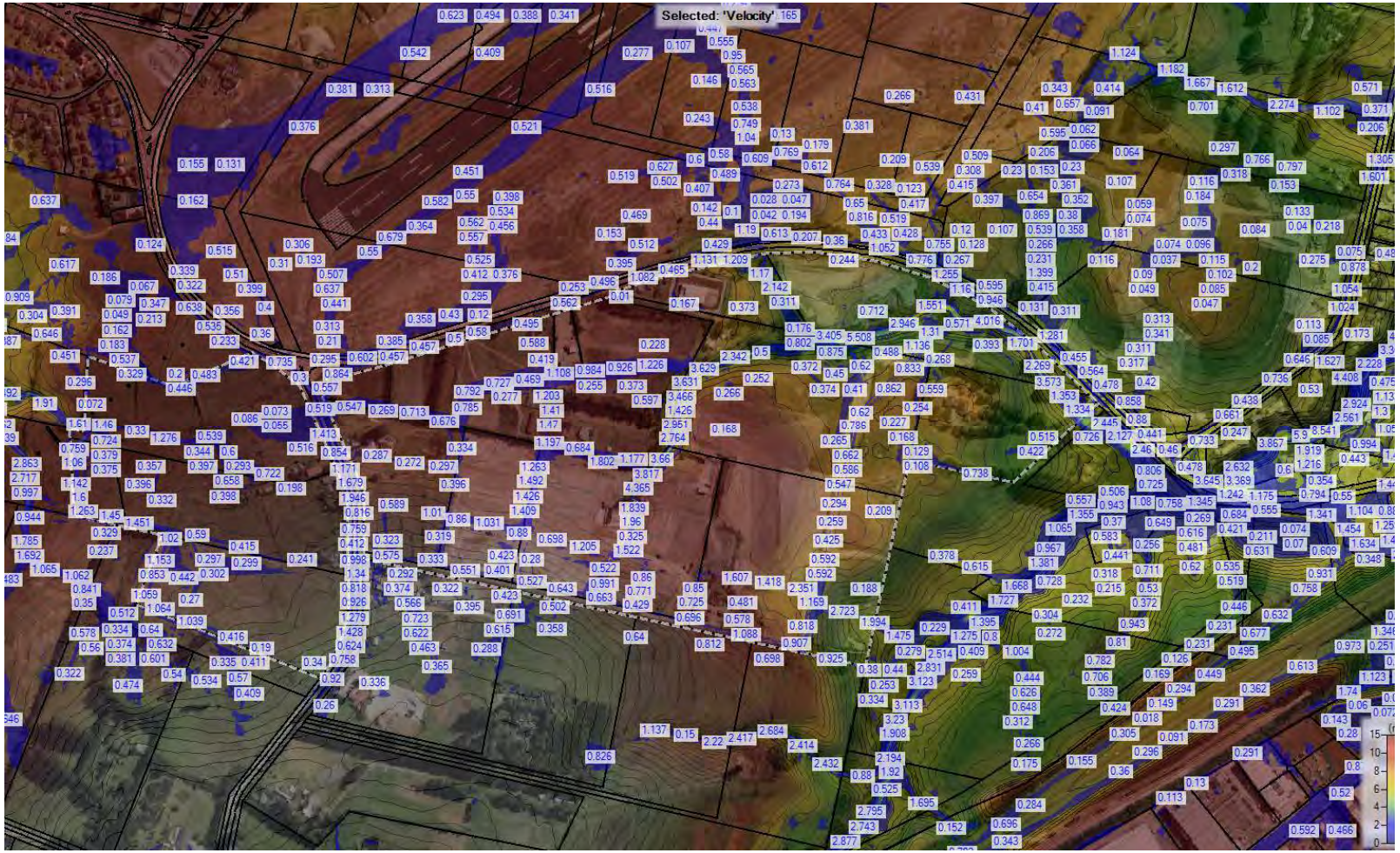
Flood Depths at and Around Existing Box Culvert



Flood Levels at and Around Existing Box Culvert

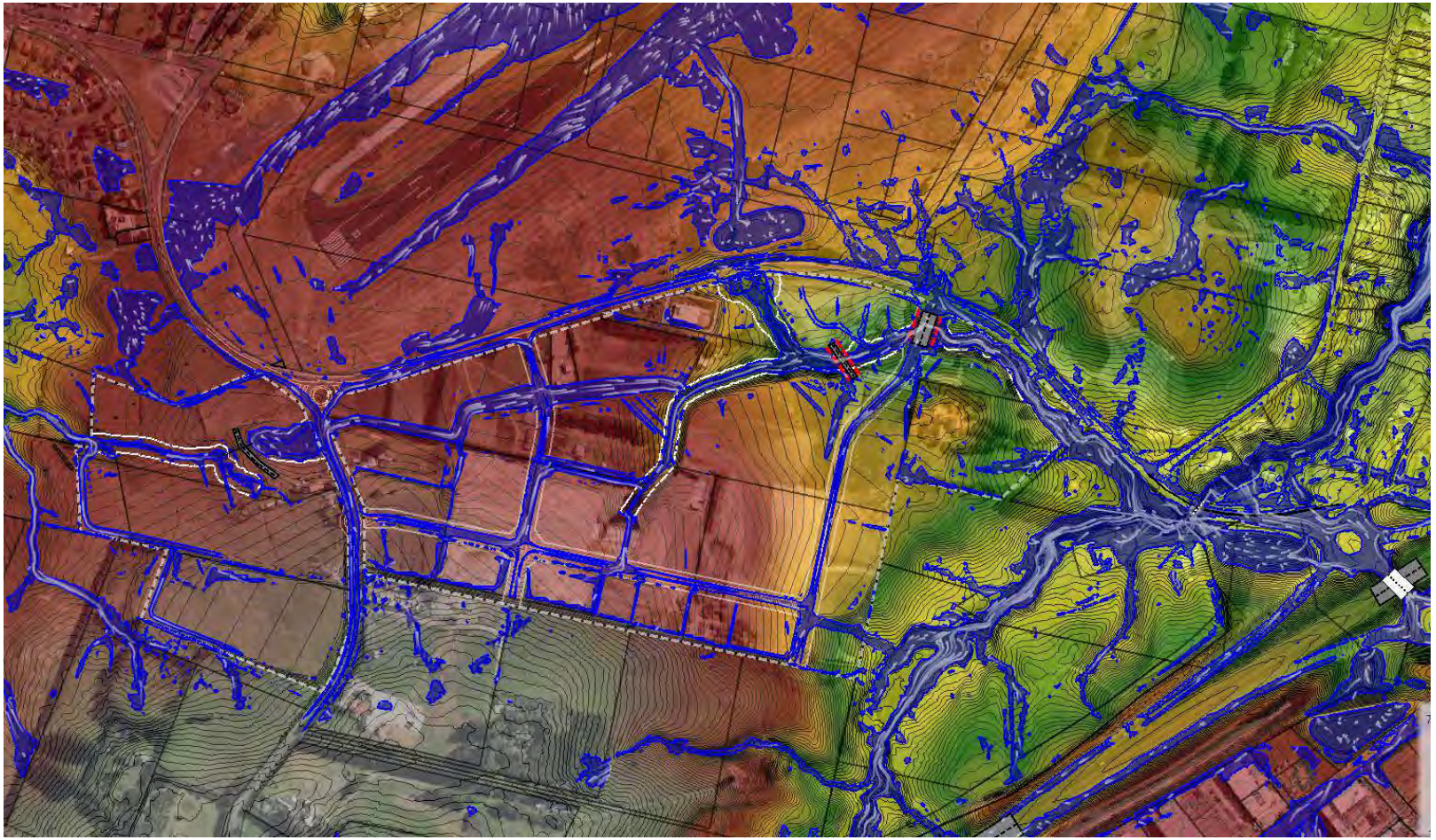


Flood Velocities

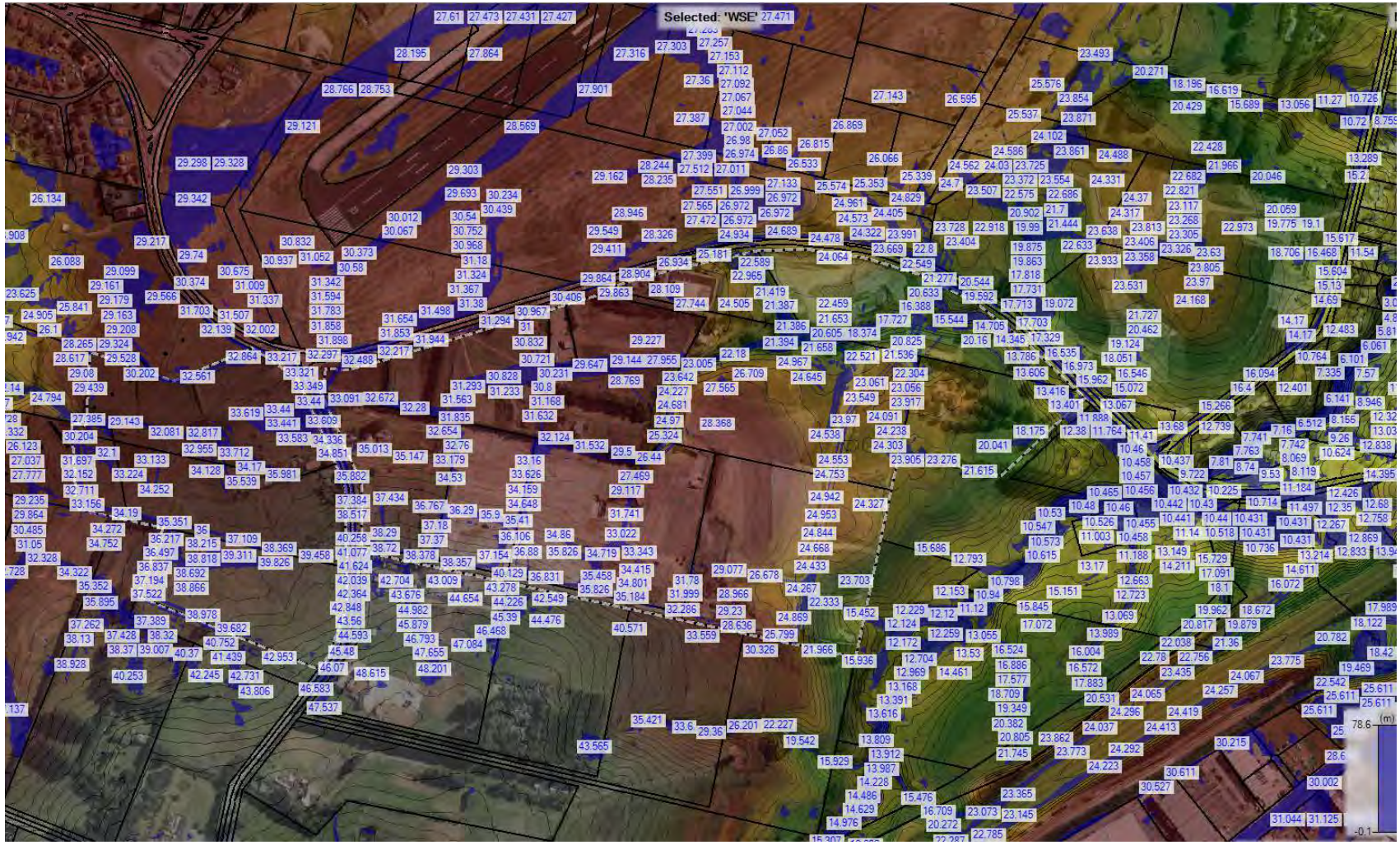


5) 1% AEP POST-DEVELOPMENT MPD- EXISTING CULVERT WORKING AT 100% CAPACITY with 3.8cc

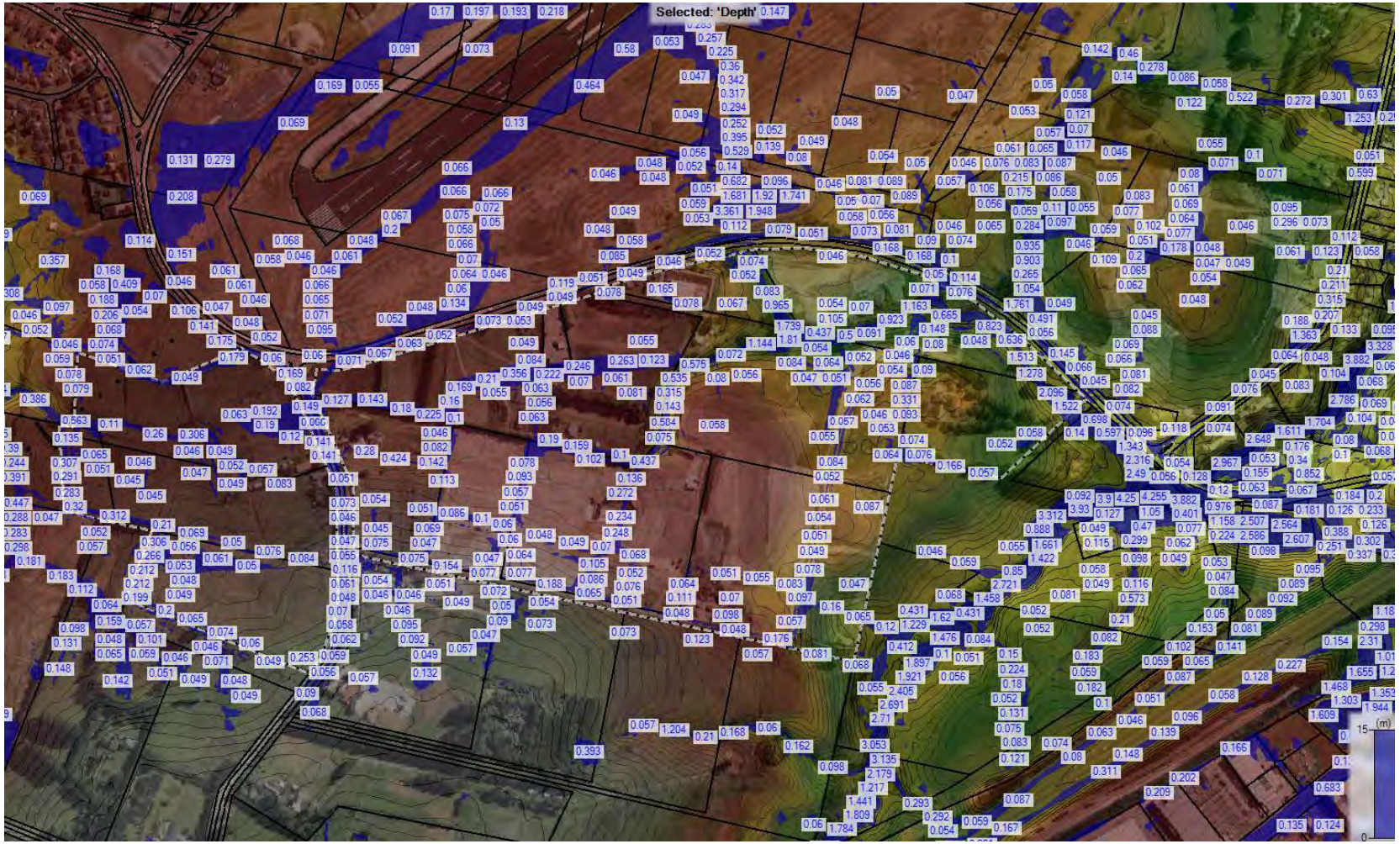
Flood Extent and Flow Direction



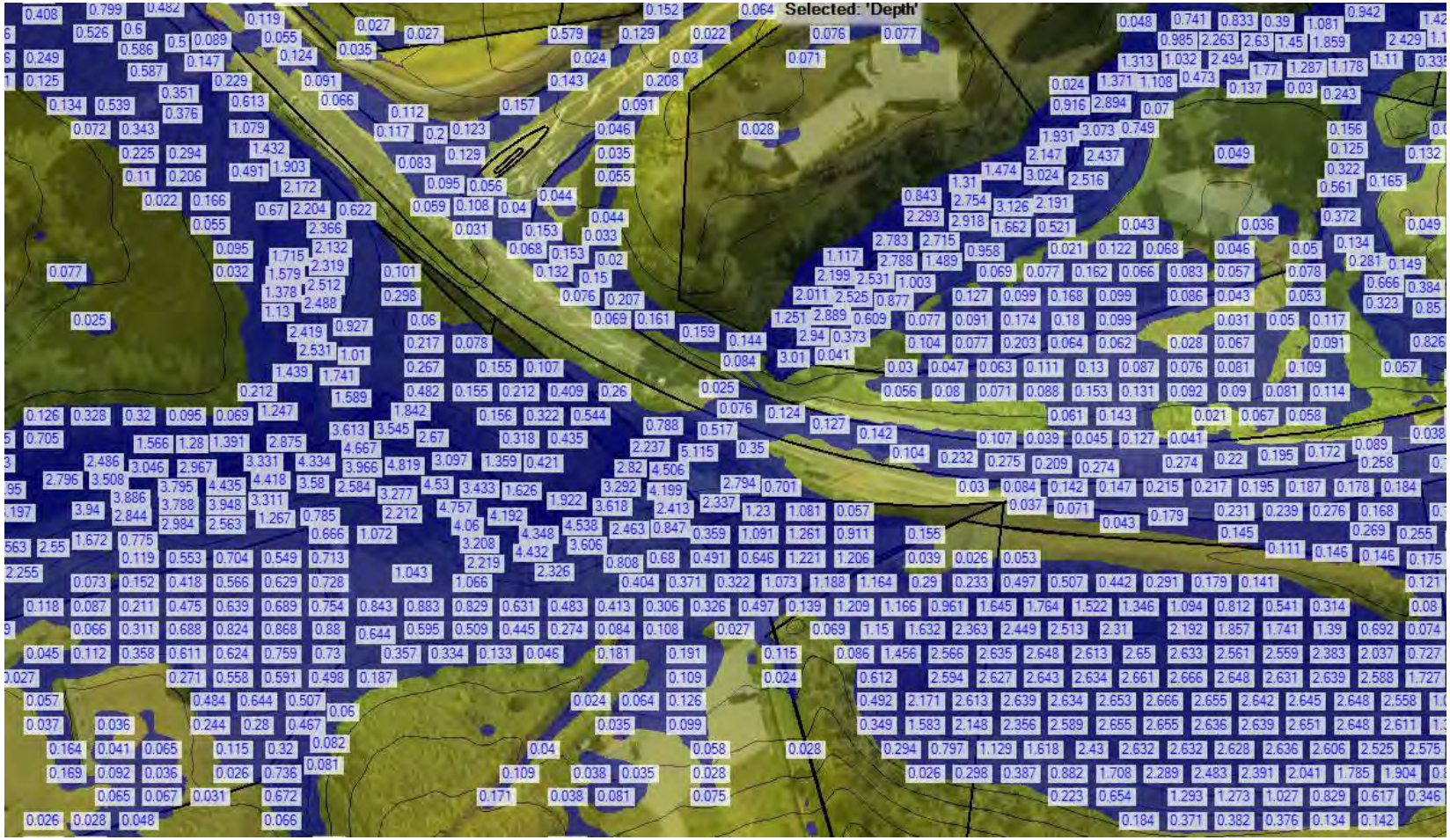
Flood Levels



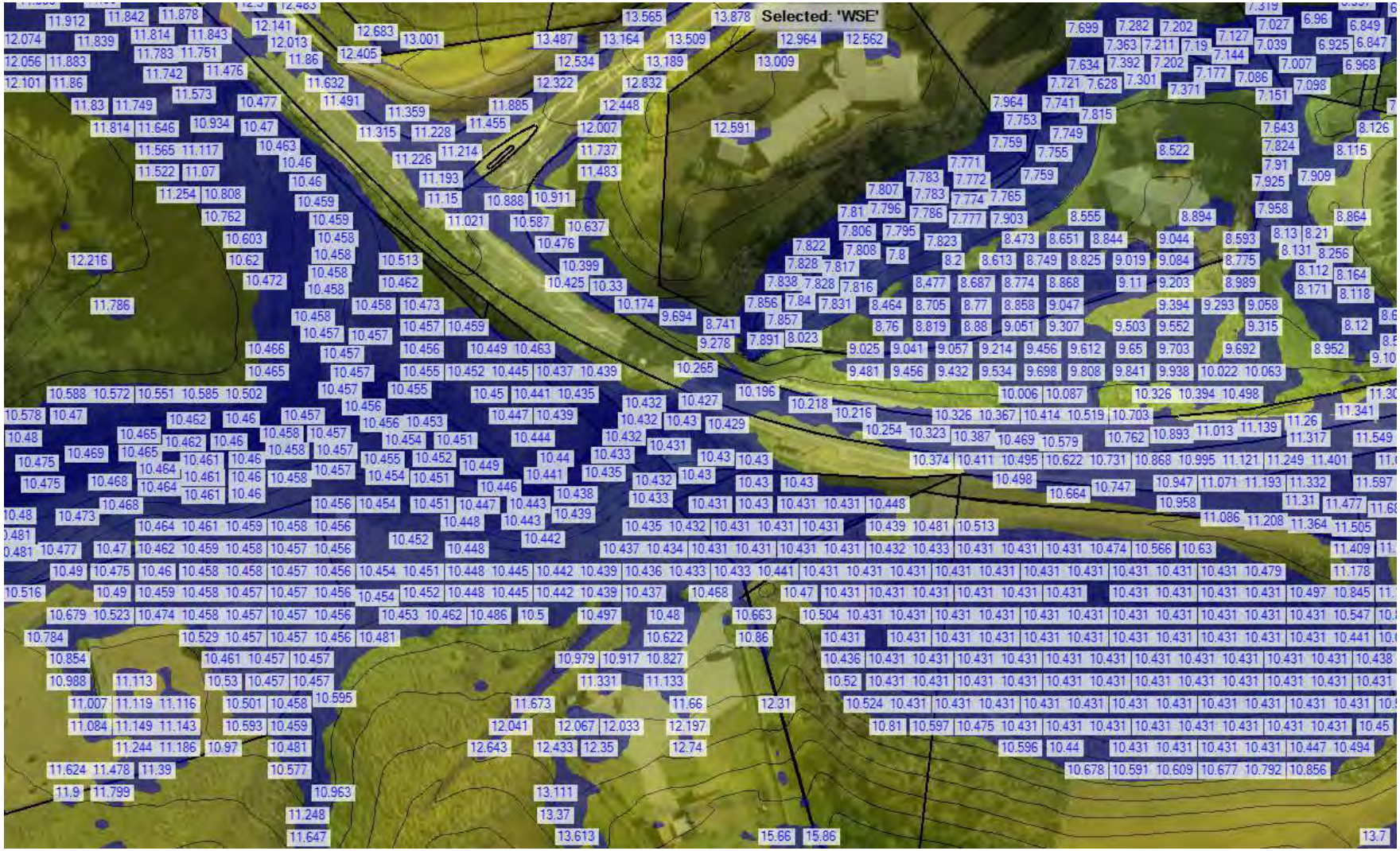
Flood Depths



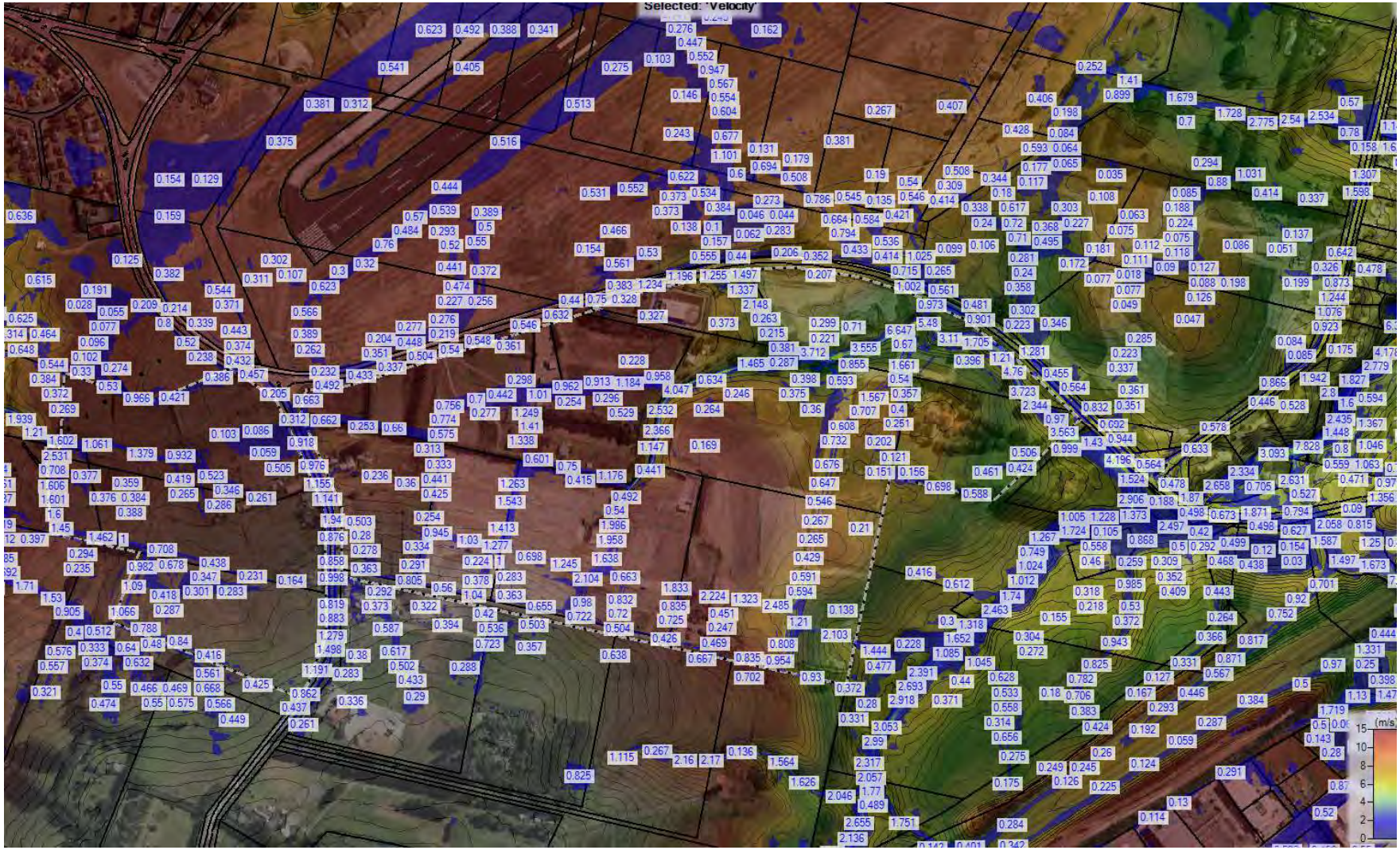
Flood Depths (Existing Box Culvert)



Flood Levels at and Around Existing Box Culvert

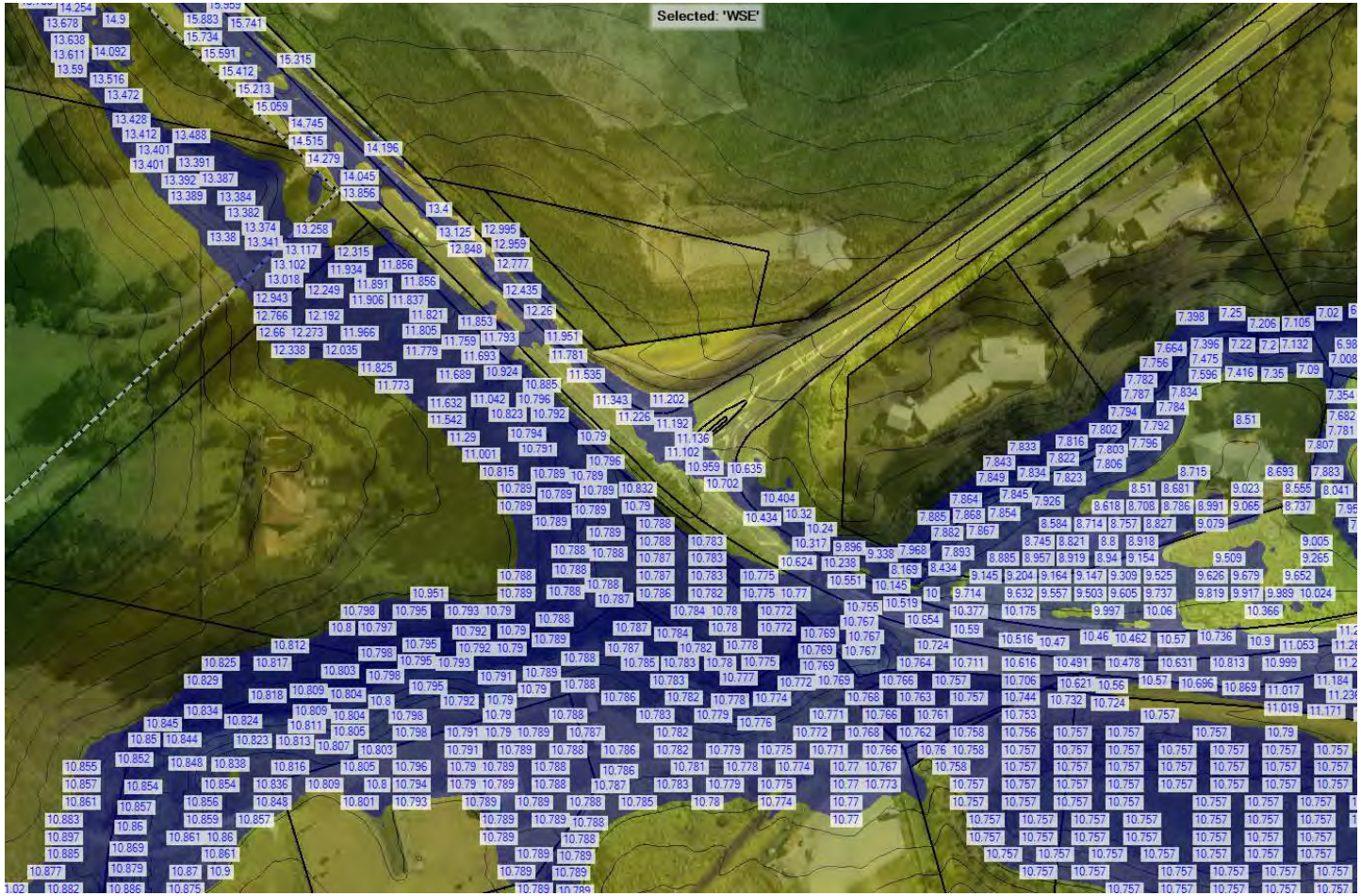


Flood Velocities

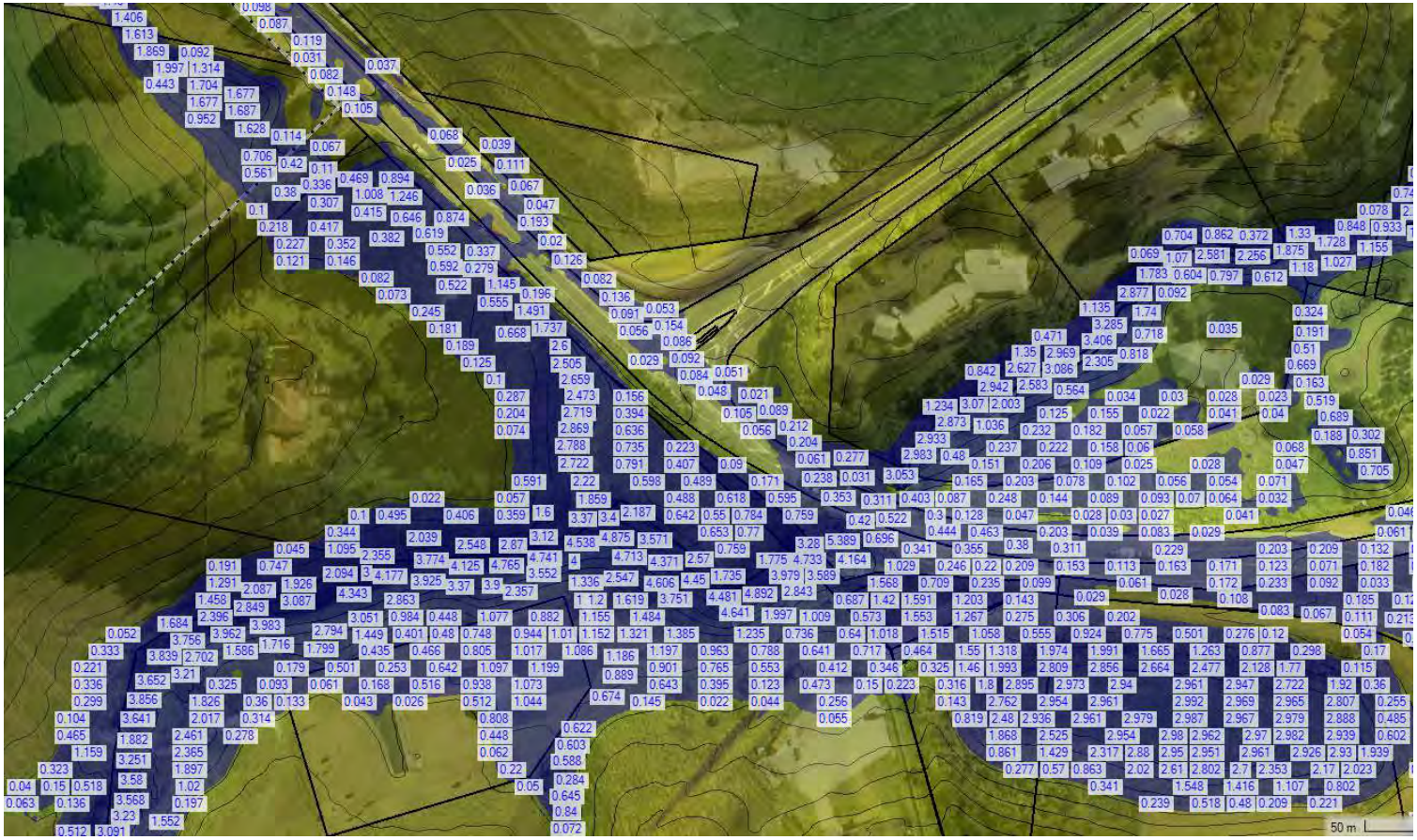


6) 1% AEP POST-DEVELOPMENT <u>PCA ONLY</u> WITH THE <u>REMAINDER OF THE CATCHMENT IN EXISTING SITUATION</u> AT EXISTING BOX CULVERT WORKING AT 50% CAPACITY with 3.8cc

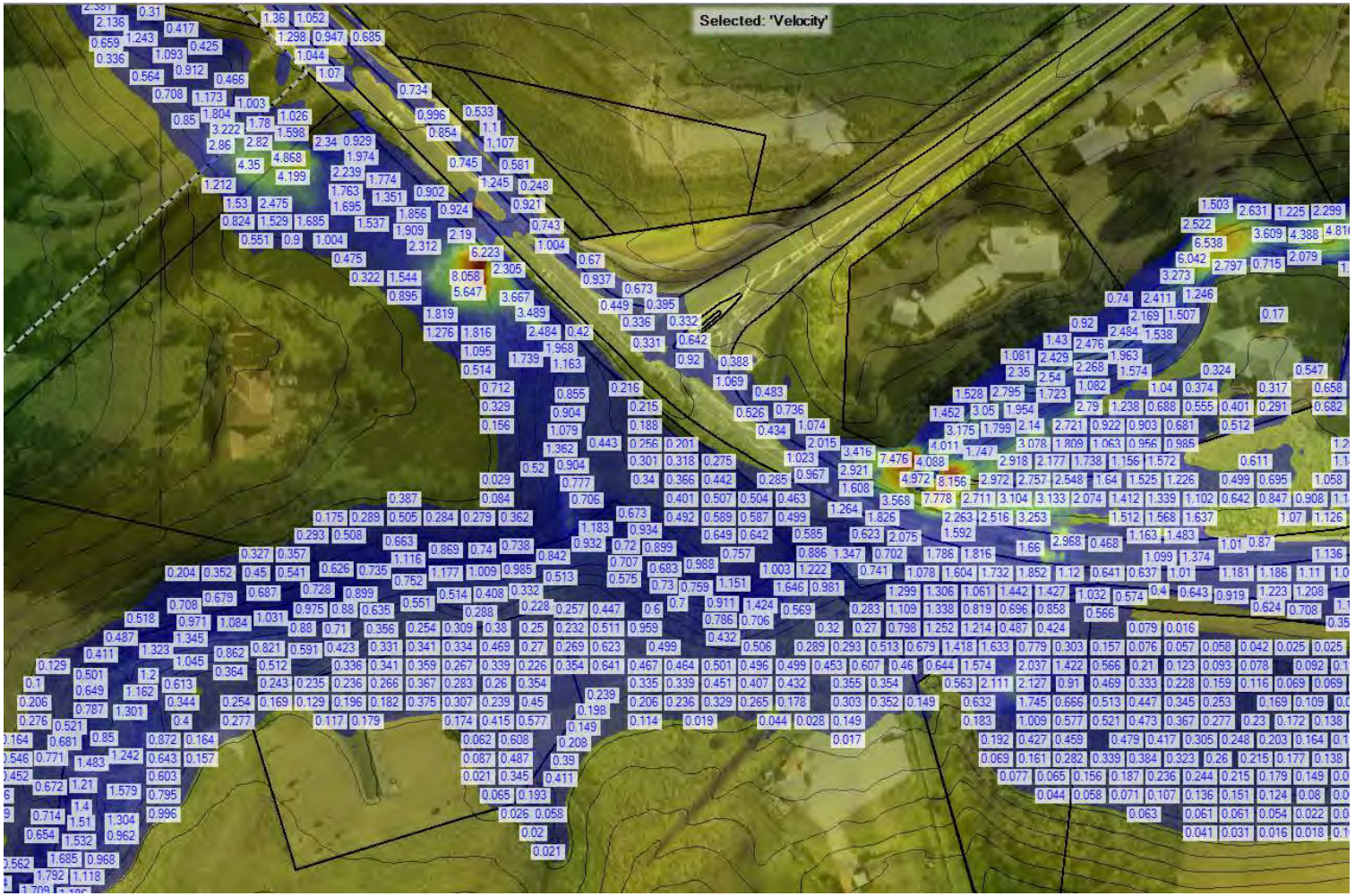
Flood Levels



Flood Depths

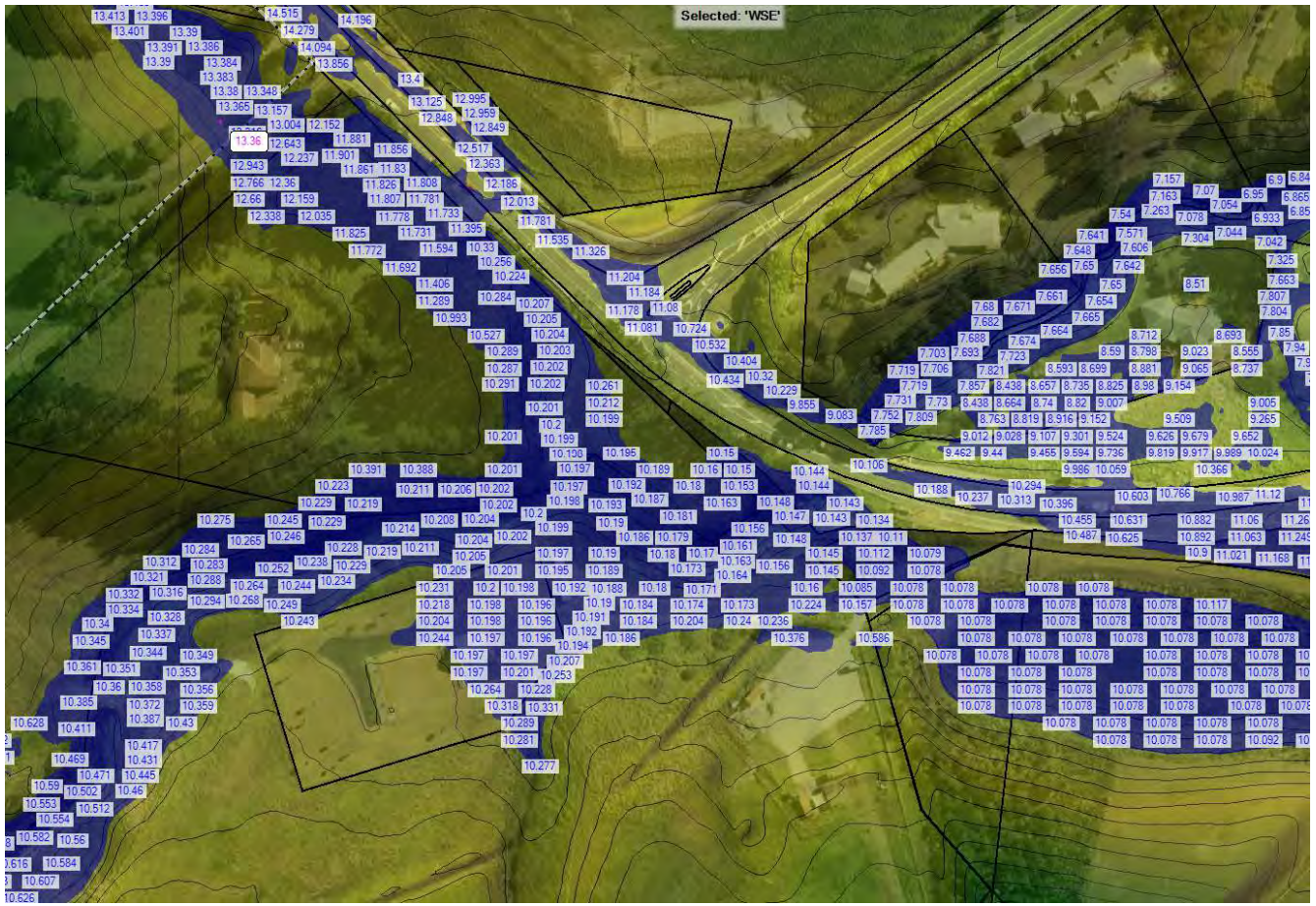


Flood Velocities

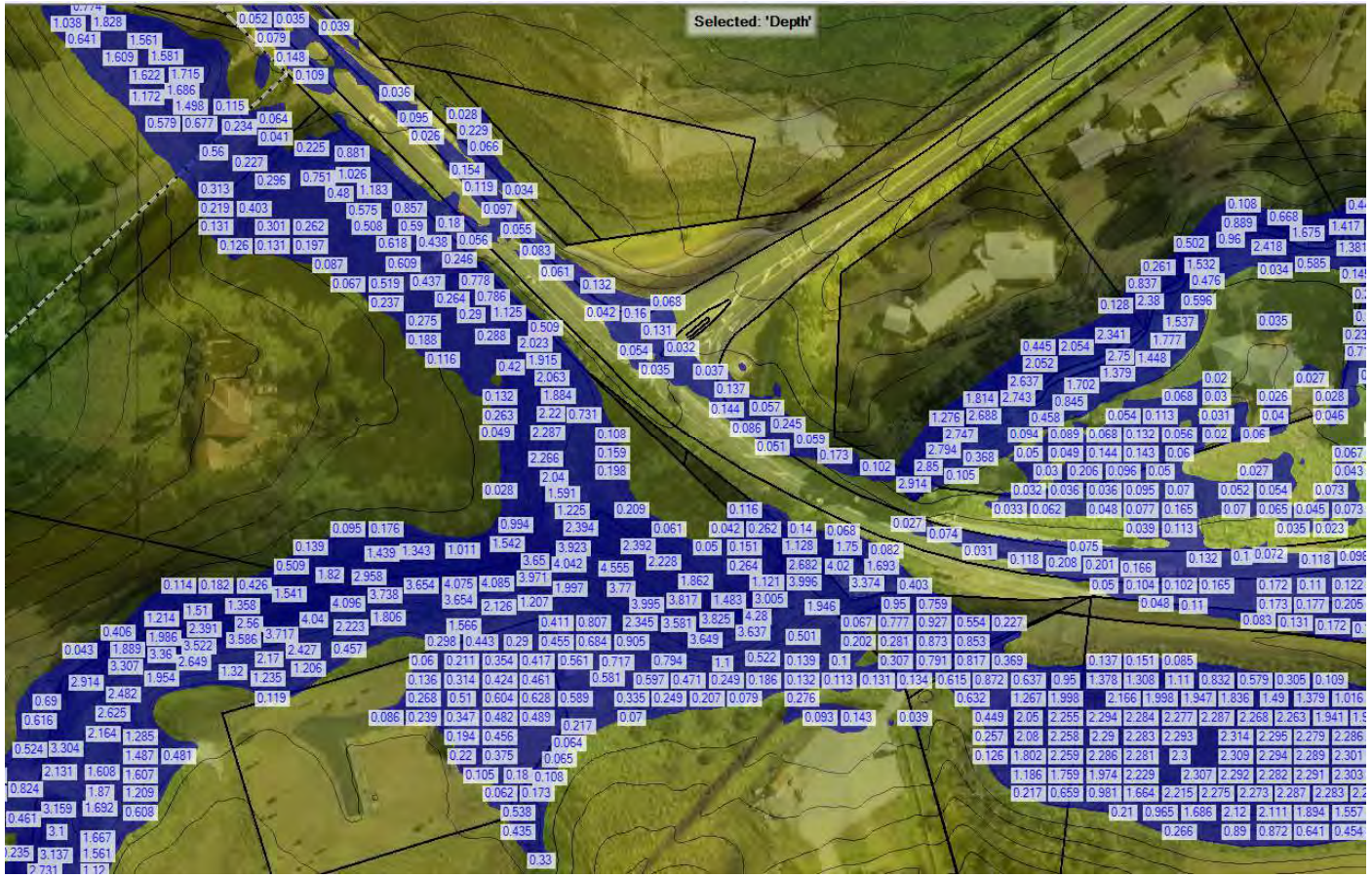


7) 1% AEP POST-DEVELOPMENT <u>PCA ONLY</u> WITH THE <u>REMAINDER OF THE CATCHMENT IN EXISTING SITUATION</u> AT EXISTING BOX CULVERT WORKING AT 100% CAPACITY with 3.8cc

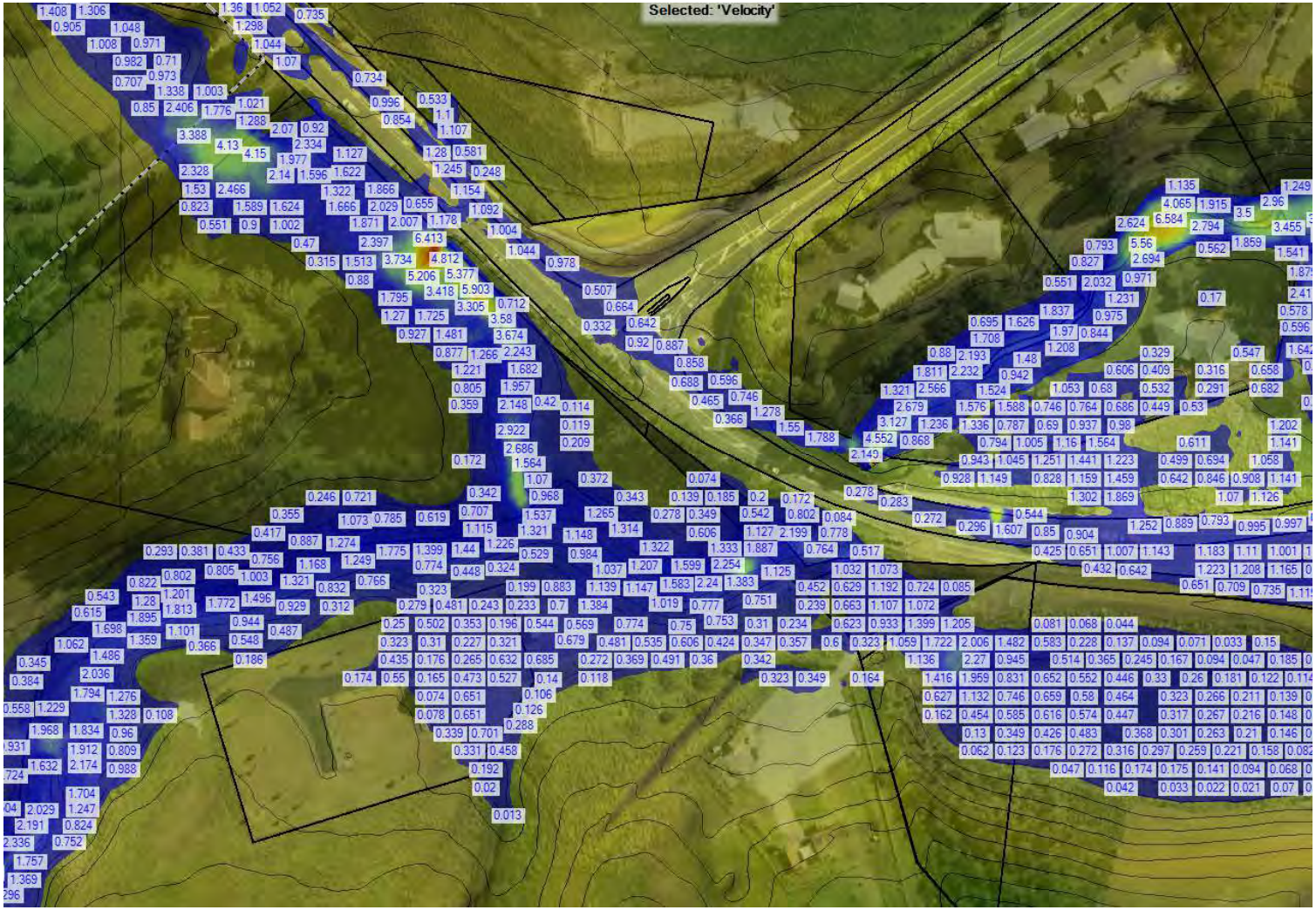
Flood Levels



Flood Depths



Flood Velocities



8) 10% AEP POST-DEVELOPMENT MPD- EXISTING CULVERT WORKING AT 100% CAPACITY with 3.8cc (No pipe Network Considered)