BEFORE THE HEARING PANEL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of Proposed Plan Change 17 to the Waipā District Plan – Hautapu Industrial Zones

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STATEMENT OF EVIDENCE OF MICHAEL GEORGE CHAPMAN

(STORMWATER)

Dated 13 March 2023

LACHLAN MULDOWNEY
BARRISTER

P +64 7 834 4336 **M** +64 21 471 490
Office Panama Square, 14 Garden Place, Hamilton
Postal PO Box 9169, Waikato Mail Centre, Hamilton 3240

www.lachlanmuldowney.co.nz

INTRODUCTION

Qualifications and experience

1. My name is Michael George Chapman. I have 24 years' experience as a flood and stormwater engineer in New Zealand, India, and the UK. My career to date has focused on stormwater design and flood risk management in both urban and natural environments. I have worked for the private, public and NGO sectors.

2. I have a Bachelor of Science and Master of Science Degree (Honours) in Hydrology and Freshwater Management from the University of Waikato (1998). I am a Member of Engineering New Zealand (MEngNZ 1032906), and the New Zealand Hydrological Society and Water New Zealand.

3. I currently hold the position of Director – Stormwater Engineer with Te Miro Water Consultants Ltd in Hamilton. I have held this position Since 2019. Between 2010 and 2018 I held the position of Principal Engineer at Harrison Grierson Consultants Ltd in Auckland. I have been the lead author and designer for a wide range of stormwater management plans to support plan variations, resource consents and detailed design for land development projects.

4. I have prepared numerous catchment scale flood models, detailed stormwater pipe models and integrated catchment management plans for private sector clients as well as for district and regional councils. I was the lead author of the Waipā District Council district wide catchment management plan to support renewal of the comprehensive stormwater discharge consent in 2022.

Involvement in the project

5. In early 2022 Te Miro Water was engaged by the Kama Trust to be the lead author and designer of the Stormwater Management Plan to support the Kama Trust land at 98-108 Hautapu Road & 326-342 Peake Road being

incorporated into a potential extension of the existing industrial zone at Hautapu. I led the technical design work undertaken by Te Miro Water.

6. The preparation of the Stormwater Management Plan was intended to support a comprehensive plan change to the existing Hautapu Industrial Zone. That plan change eventually became Plan Change 17 to the Waipā Operative District Plan (**PC 17**).

7. The Kama Trust land sits within the area referred to as "Area 6" in the s32 report and supporting documentation to PC 17. Area 6 is proposed to be rezoned from Rural to Industrial; with the inclusion of "Area 6" in the C9 growth cell.

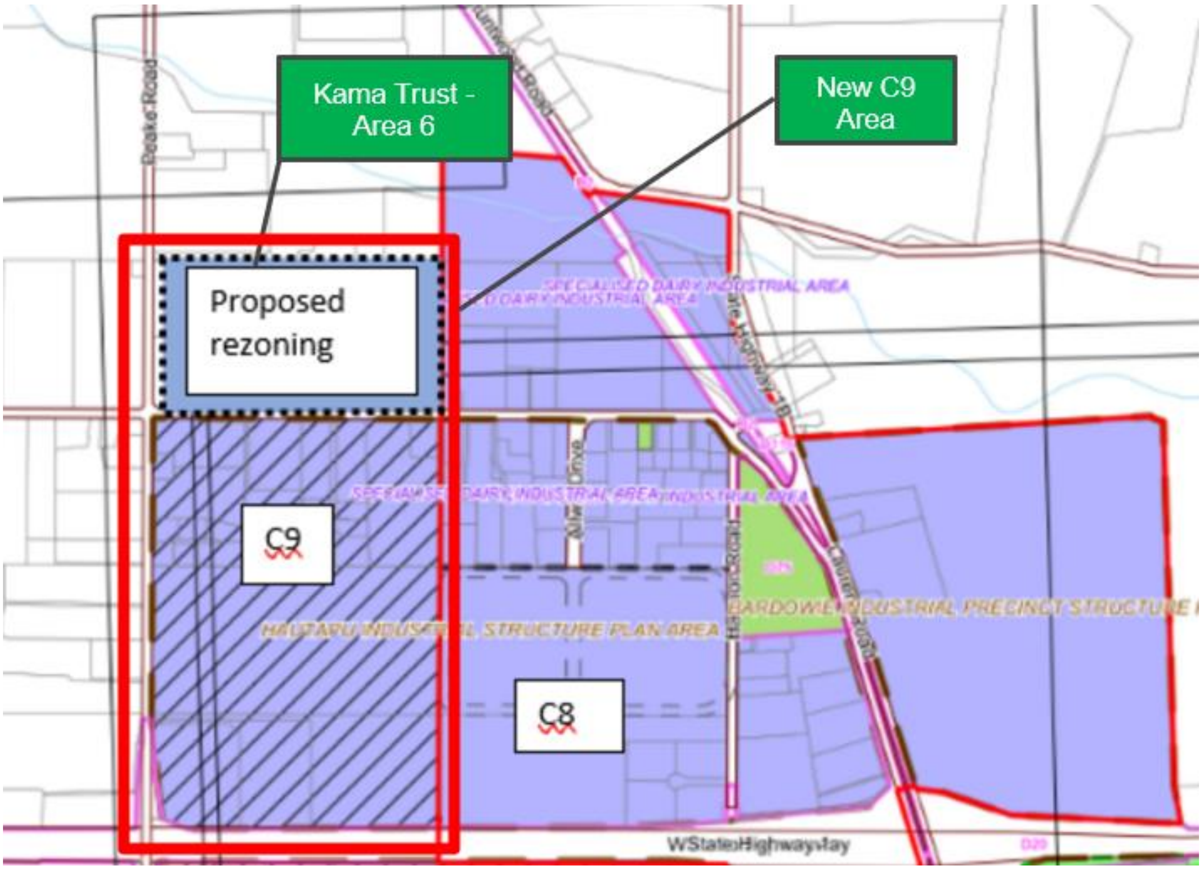


Figure 1: Kama Trust Property "Area 6" Proposed Rezoning

CODE OF CONDUCT

8. I am familiar with the Code of Conduct for Expert Witnesses (Environment Court Practice Note 2023) and although I note this a Council hearing, I agree to comply with this code. The evidence I will present is within my area of expertise, except where I state that I am relying on information provided by another party. I have not knowingly omitted facts or information that might alter or detract from opinions I express.

PURPOSE OF EVIDENCE

9. The purpose of my evidence is to address matters relevant to stormwater management. My evidence specifically addresses the following matters:

    a) Existing site constraints and opportunities for stormwater management;

    b) Outline the stormwater solution for the Kama Trust Property;

    c) Alignment with the wider C8-C9 structure plan stormwater technical documents;

    d) Basin 4 relocation from the south side of Hautapu Road in C8-C9 (Area 5) to the north side of Hautapu Road in the Kama Trust property (Area 6);

    e) Comments on the s42A officers' reports;

    f) Conclusions; and

    g) Comments on submissions.

SUMMARY OF EVIDENCE

10. In accordance with the existing Hautapu Structure Plan, stormwater flows from any industrial development within the area are currently managed within each development site itself. This is normally achieved by, in the first instance, soakage of stormwater to ground and if the soil conditions do not allow for it, retention/detention/storage of stormwater on site and slow release back into the natural watercourses. The management plan requires that development should not increase peak stormwater discharge rates to the receiving environment.

11. Through PC 17, there is an opportunity to present a more integrated stormwater management system for the Hautapu industrial area.

12. Once Area 6 is established as part of the industrial zone, it will become an industrial subdivision that manages its own site runoff from lots and roads, as well as performing the wider function of receiving and discharging the culvert discharge from Area 4 and 5, and from Hautapu Road.

13. The best practical stormwater solution for Area 6 is a communal soakage basin and swale. The solution is aligned to the current Waipā District Council masterplan and with the Waikato Regional Infrastructure Technical Specification and the Waikato Regional Council (**WRC**) Stormwater guidance.

14. Basin 4 does not preclude additional on lot soakage measures from being adopted to reduce pressure and size of the communal basins once the built form is confirmed.

15. Basin 4 will fully contain (and soak away) all runoff up to the 10 year (cc), with spill from the basin above the 10 year up to the 100 year (cc) at existing peak flow rates to existing overland paths (remnant channels).

16. The size of Basin 4 is likely to reduce from the indicative designs following on site soakage testing and inclusion in the wider catchment hydraulic model.

17. The concerns about the effects of the proposed Basin 4 which are set out at paragraph 4.3 of the submission by the Hautapu Landowners Group (**HLG**) are misplaced. The basin will not produce adverse effects of the nature set out in that submission. I am confident that the stormwater solution proposed will have none of the adverse effects on groundwater or odour effects identified by that submitter.

18. The technical reports which I have prepared, and which support my evidence are set out in the appendices. At **Attachment A** is the Stormwater Management Plan Report dated 14 June 2022. At **Attachment B** is the subsequent Basin 4 Relocation and Design Report dated 2 August 2022.

ANALYSIS

Existing Site

19. The Area 6 site (**site**) encompasses approximately 20ha hectares and is located approximately 4km north of the Cambridge town centre and falls just outside the Hautapu Structure Plan (**HSP**) Area.

20. The existing land use is a mix of consented warehousing and industrial activities, and horticulture. The site is predominantly flat with a slight gradient northwards falling towards the Mangaone Stream from RLm62 to RLm60 in the Northwest and Northeast corners.

21. The site has three existing discharge points located in the southwest, northwest and northeast corners. Most rain events will pond and soak away on site. Flood modelling shows the outlets are only triggered as overland flow paths during extreme events up to the 1% AEP.

22. There are no watercourses within the site or bordering the site.

23. The master plan promotes soakage to ground within the C8-C9 structure plan. Soakage testing was undertaken by Te Miro Water at two locations in the northeast and northwest corners. Infiltration rates varied between 50mm/hr in the NW to over 450mm/hr in the NE reflecting the varying lithology of the Hinuera surface deposits with alternating layers of silt, sand, and gravels. An average design rate of 200mm/hr was adopted for design of the soakage basins.

24. No groundwater was encountered down to 2.2m depth, with poor permeability observed on the Northwest test location while very high permeability was identified at the Northeast test location. Groundwater movement generally moved to the northwest following the topography.

25. The flood modelling shows no existing permanent flow connection to the Mangaone Stream which is consistent with the existing Waipā District Council master plan. Onsite management up to the 100 year + climate change (cc) event is therefore considered an appropriate solution for Kama Trust.

26. Through our analysis Te Miro Water has demonstrated that the stormwater can be disposed up the 10-year (cc) on site via soakage and managed safely via spill points to adjacent property (existing overland flow paths) and Peake Road at no more than existing peak flow rates up to the 100-year (cc) design events.

Stormwater Solution

27. The key objective for Te Miro Water was to develop a stormwater management solution to treat water quality, manage erosion and potential flood impacts within the site with discharge to ground via soakage systems.

28. The Te Miro Water stormwater report demonstrates the proposed soakage basin within the land owned by Kama Trust can accommodate runoff (based on 90% impervious area) from the site up to the 100-year (cc) storm event with peak flows limited to the existing discharge from site. The proposed basin is referred to as Basin 4 in the revised WDC Stormwater Masterplan.

29. In accordance with the Hautapu Structure Plan, stormwater flows from any industrial development will need to be managed within the development site itself. This is normally achieved by, in the first instance, soakage of stormwater to ground and if the soil conditions do not allow for it, retention/detention/storage of stormwater on site and slow release back into the natural watercourses. Development should not increase peak stormwater discharge rates to the receiving environment.

30. The stormwater assessment demonstrates that the Kama Trust site can fully contain the 10-year storm runoff by soakage within a communal soakage basin approximately 2-3m deep.

31. During a 100-year event, the basin will fill and then spill via a controlled weir outlet to limit discharges to existing peak flows. Spill during extreme events will be into existing overland flow paths (remnant stream channels). The existing peak flows from the site during a 1% AEP storm event are determined from detailed hydraulic modelling as shown on the flood extent map in Figure 3 contained within my evidence.

32. Soakage will result in a low mounding risk (rise in local water table) due to the depth of groundwater and ability of flows to disperse laterally. This is confirmed in the hydrogeological mounding assessment (WGA, Mounding Assessment, Kama Trust, 17 June 2022).

33. Basin 4 will not only cater for site runoff within Area 6 but also runoff from Areas 4, 5 and Hautapu Road. The stormwater report (which was reviewed

by Waipā District Council) shows less than minor effects in line with Council requirements.

34. The final dimensions and shape of Basin 4 in Area 6 including inlet and outlet structures and conveyance from south of Hautapu Road will be confirmed at subdivision/detailed design once further soakage tests are undertaken and site earthworks levels are confirmed.

35. There are also options to reduce basin size using on lot soakage (ie. from individual roof and driveway areas) once the final built form is confirmed.

Alignment of Area 6 with C8-C9 Stormwater Masterplan and Structure Plan

36. The Kama Trust property is zoned rural and is not included as industrial land within the existing C8-C9 Master Plan. PC 17 proposes to rezone the Kama Trust land, and all other land within Area 6 from Rural to Industrial.

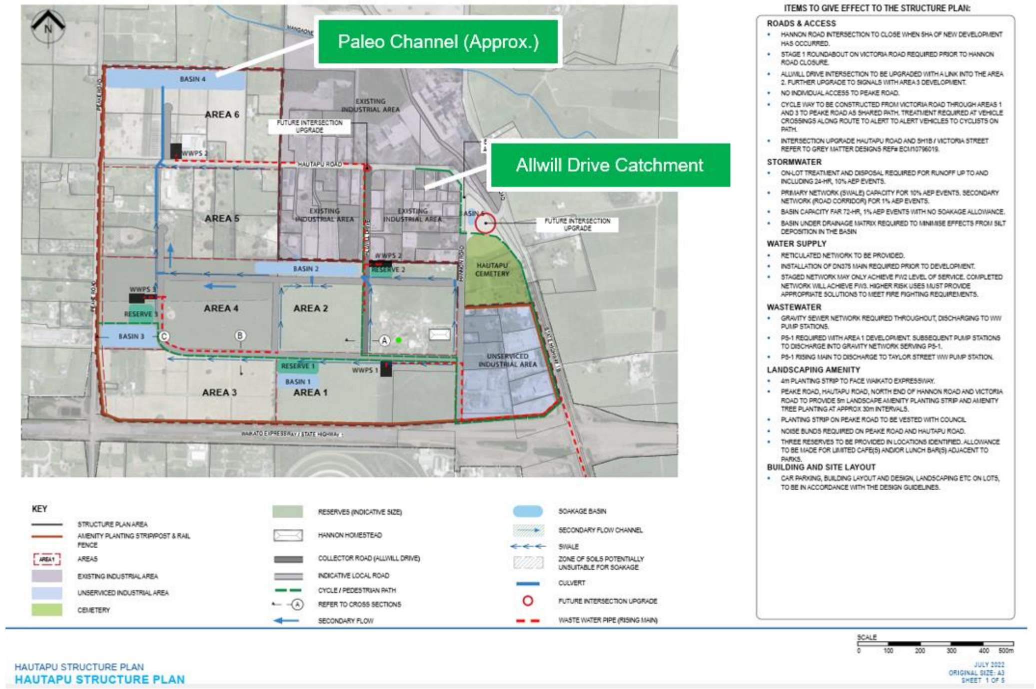
37. The overarching stormwater solution for C8-C9 is outlined in the Cambridge C8/C9 Master Plan (HG, 2020). This master plan supersedes the Structure Plan in the Operative Waipā District Plan. The means of compliance for stormwater is for all new development to discharge to ground via soakage (whether on lot or via communal basins).

38. Further hydraulic modelling was undertaken by Te Miro Water in 2021 to assess the feasibility of relocating Basin 4 to the north side of Hautapu Road. I refer to the C8- C9 Stormwater Options and Update Summary prepared by Te Miro Water in 2021 (TMW, 2021).

39. Figure 2 shows the C8-C9 Structure Plan stormwater layout as notified in PC 17, including the stormwater amendments and provision for Basin 4 within the Kama Trust property.

40. The location of the stormwater basin 4 is indicative only. The current rectangular design can be re-shaped with adjustments to outlet configuration and depths at detailed design following further on-site

soakage testing.



ITEMS TO GIVE EFFECT TO THE STRUCTURE PLAN:

ROADS & ACCESS

- HANNON ROAD INTERSECTION TO CLOSE WHEN 5HA OF NEW DEVELOPMENT HAS OCCURRED.
- STAGE 1 ROUNDABOUT ON VICTORIA ROAD REQUIRED PRIOR TO HANNON ROAD CLOSURE.
- ALLWILL DRIVE INTERSECTION TO BE UPGRADED WITH A LINK INTO THE AREA 2. FURTHER UPGRADE TO SIGNALS WITH AREA 3 DEVELOPMENT.
- NO INDIVIDUAL ACCESS TO PEAKE ROAD.
- CYCLE WAY TO BE CONSTRUCTED FROM VICTORIA ROAD THROUGH AREAS 1 AND 3 TO PEAKE ROAD AS SHARED PATH. TREATMENT REQUIRED AT VEHICLE CROSSINGS ALONG ROUTE TO ALERT TO ALERT VEHICLES TO CYCLISTS ON PATH.
- INTERSECTION UPGRADE HAUTAPU ROAD AND SH1B / VICTORIA STREET REFER TO GREY MATTER DESIGNS REF# ECM10796019.

STORMWATER

- ON-LOT TREATMENT AND DISPOSAL REQUIRED FOR RUNOFF UP TO AND INCLUDING 24-HR, 10% AEP EVENTS.
- PRIMARY NETWORK (SWALE) CAPACITY FOR 10% AEP EVENTS. SECONDARY NETWORK (ROAD CORRIDOR) FOR 1% AEP EVENTS.
- BASIN CAPACITY FAR 72-HR, 1% AEP EVENTS WITH NO SOAKAGE ALLOWANCE.
- BASIN UNDER DRAINAGE MATRIX REQUIRED TO MINIMISE EFFECTS FROM SILT DEPOSITION IN THE BASIN

WATER SUPPLY

- RETICULATED NETWORK TO BE PROVIDED.
- INSTALLATION OF DN375 MAIN REQUIRED PRIOR TO DEVELOPMENT.
- STAGED NETWORK MAY ONLY ACHIEVE FW2 LEVEL OF SERVICE. COMPLETED NETWORK WILL ACHIEVE FW3. HIGHER RISK USES MUST PROVIDE APPROPRIATE SOLUTIONS TO MEET FIRE FIGHTING REQUIREMENTS.

WASTEWATER

- GRAVITY SEWER NETWORK REQUIRED THROUGHOUT, DISCHARGING TO WW PUMP STATIONS.
- PS-1 REQUIRED WITH AREA 1 DEVELOPMENT. SUBSEQUENT PUMP STATIONS TO DISCHARGE INTO GRAVITY NETWORK SERVING PS-1.
- PS-1 RISING MAIN TO DISCHARGE TO TAYLOR STREET WW PUMP STATION.

LANDSCAPING AMENITY

- 4m PLANTING STRIP TO FACE WAIKATO EXPRESSWAY.
- PEAKE ROAD, HAUTAPU ROAD, NORTH END OF HANNON ROAD AND VICTORIA ROAD TO PROVIDE 5m LANDSCAPE AMENITY PLANTING STRIP AND AMENITY TREE PLANTING AT APPROX 30m INTERVALS.
- PLANTING STRIP ON PEAKE ROAD TO BE VESTED WITH COUNCIL.
- NOISE BUNDS REQUIRED ON PEAKE ROAD AND HAUTAPU ROAD.
- THREE RESERVES TO BE PROVIDED IN LOCATIONS IDENTIFIED. ALLOWANCE TO BE MADE FOR LIMITED CAFE(S) AND/OR LUNCH BAR(S) ADJACENT TO PARKS.

BUILDING AND SITE LAYOUT

- CAR PARKING, BUILDING LAYOUT AND DESIGN, LANDSCAPING ETC ON LOTS, TO BE IN ACCORDANCE WITH THE DESIGN GUIDELINES.

Figure 2 The WDC structure plan stormwater layout for PC17

Inclusion of Basin 4

41. The current Master Plan provides indicative sizing for Basin 4 using a conservative 30mm/hr soakage rate based on initial site investigations.

42. The proposed twin culverts under Hautapu Road convey approximately 8m^3/s because Basin 4 no longer provides an attenuation function south of the road.

43. Further catchment scale hydraulic modelling will be required (encapsulating the entire C8-C9 zone and wider catchment) to support subdivision/detailed design of development within the plan change area. The model will include runoff from Kama Trust and Basin 4 so that the area conveys flow effectively and safely - the hydraulics are complex in this area with flat grades and tailwater impacts.

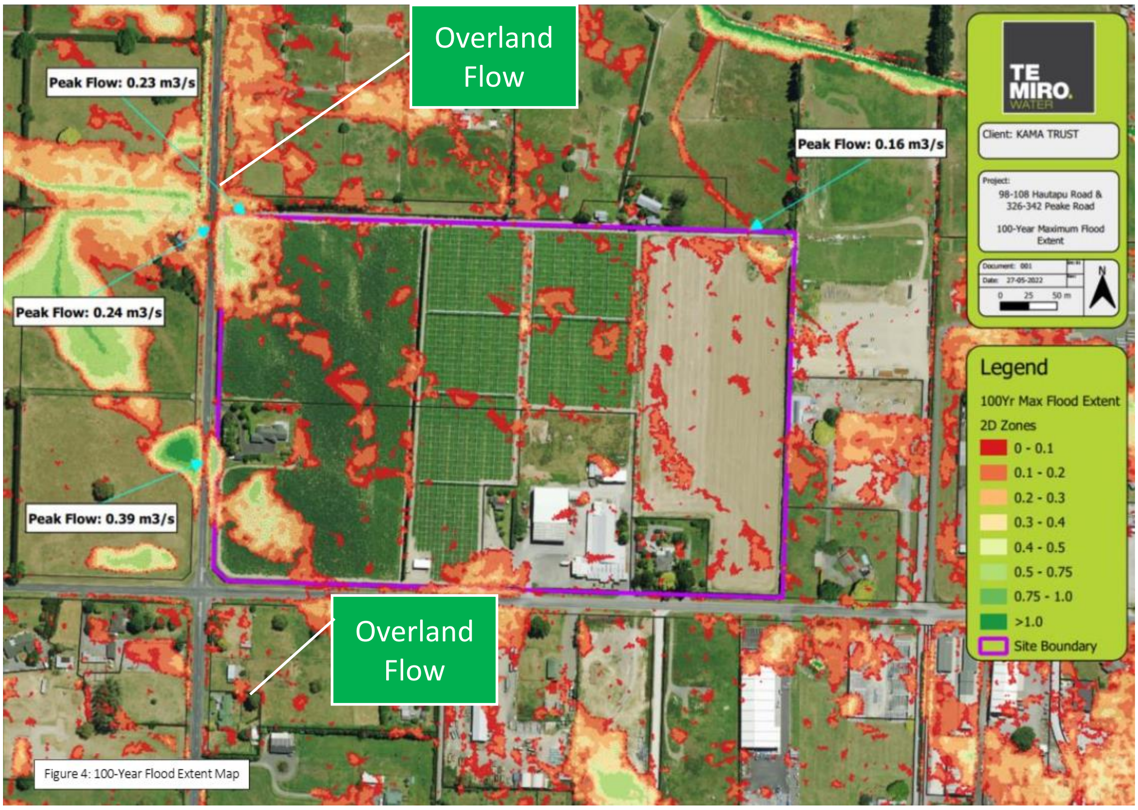


Figure 3. 100-year ARI (CC) existing discharge outlets at 3 corners of Area 6.

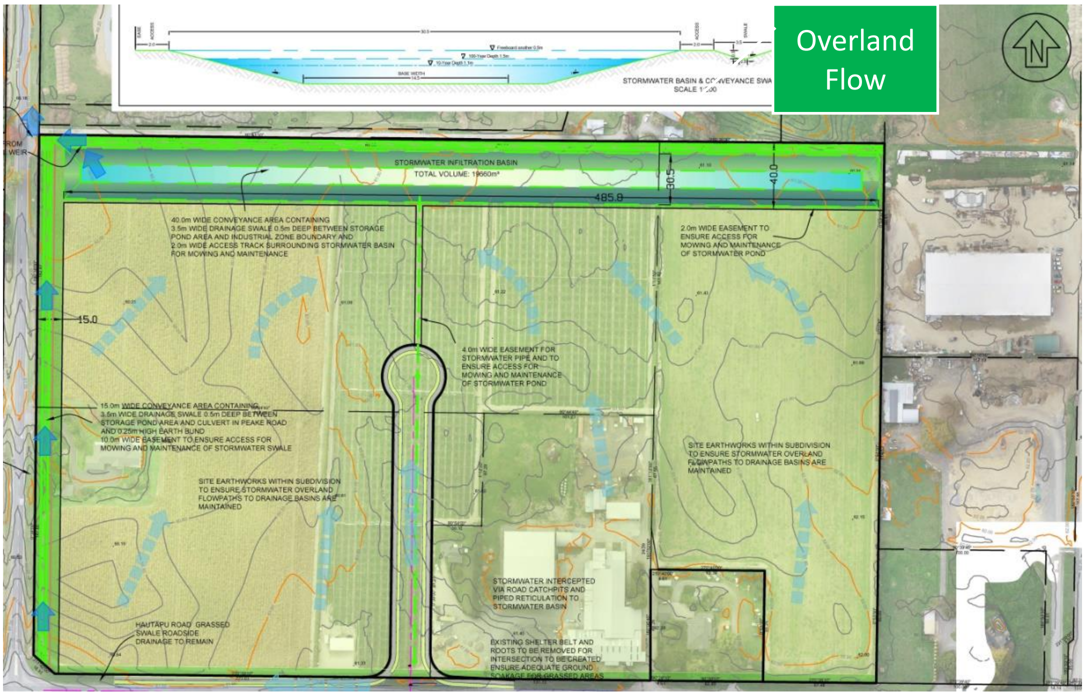


Figure 4. Location of proposed Basin 4 in Kama Trust Property (Nicklin CE, 2022).

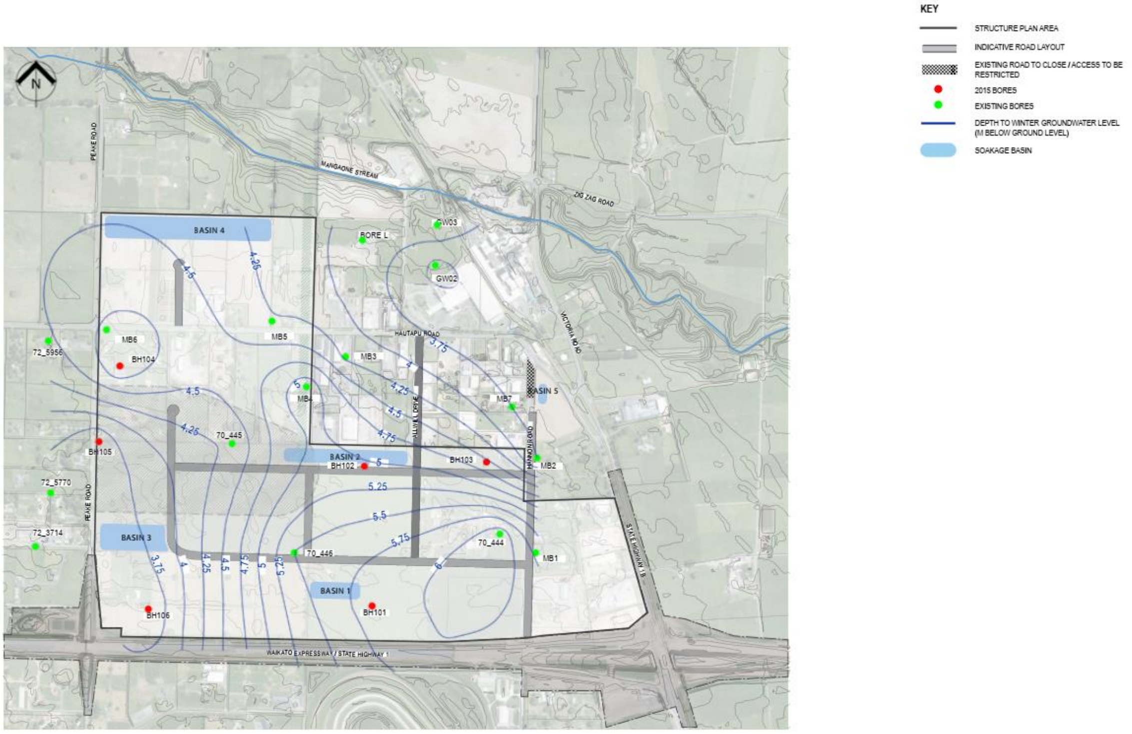


Figure 2. Depth to Groundwater Table (BECA Hautapu Structure Plan).

CONCLUSION

44. Through PC 17, Area 6 will become an industrial subdivision that manages its own site runoff from lots and roads, as well as the culvert discharge from Area 4 and 5, and from Hautapu Road.

45. The best practical stormwater solution for Area 6 is a communal soakage basin and swale. The solution is aligned to the current Waipā District Council masterplan and with the Waikato Regional Infrastructure Technical Specification and the WRC Stormwater guidance.

46. Basin 4 does not preclude additional on lot soakage measures from being adopted to reduce pressure and size of the communal basins once the built form is confirmed.

47. Basin 4 will fully contain (and soak away) all runoff up to the 10 year (cc), with spill from the basin above the 10 year up to the 100 year (cc) at existing peak flow rates to existing overland paths (remnant channels).

48. In accordance with the C8/C9 master plan, and to align with Waikato Regional Council requirements there will be no additional/surplus discharge direct to the Mangaone Stream.

49. Spill points at each Basin 4 outlet to existing overland flow paths will need further detailed design once the final built form is confirmed.

50. Basin 4 is designed to accommodate runoff from

    a) Direct runoff within the Kama trust SW corner;

    b) Area 6;

    c) Area 5 in C9; and

    d) Hautapu Road upgrade.

51. The size of Basin 4 is likely to reduce following on site soakage testing and inclusion in the wider catchment hydraulic model. The current soakage rate is 30mm/hr which is considered conservative and less than the Te Miro Water average rate of 200mm/hr which is adopted for basin sizing from Area 6 only - prior to the inclusion of Basin 4.

52. Overflows from Basin 4 (up to the 100-year event) will not change the flow regimes in the neighbouring overland flow paths. There is a potential impact from allowing more frequent rain events to flow into the flow path from new impervious areas. The impact is related to more frequent wetting of surface soils which could change the vegetation types in these areas. This is not an expected outcome for Area 6 because most rain events will disperse back to ground on site via soakage.

53. In my opinion the development of the Kama Trust property and the rest of Area 6 will not adversely affect the ability of others in the growth area to manage their own stormwater independently of Kama Trust. This is indeed a key advantage of managing runoff close to source within soakage systems –sites can be developed independently of each other with no reliance on cross boundary landowner agreements to implement - for example - large catchment scale basins.

SUBMISSIONS

54. I make the following comments in response to Huatapu Landowner Group (**HLG**) concerns as set out in submission 4.3 (*italics* below):

> The Hautapu Landowners Group is concerned about the manner in which stormwater is proposed to be managed (including as part of the wider Hautapu industrial area whereby stormwater from land to the south of Hautapu Road is conveyed to a large stormwater detention pond) which could have adverse effects on the land owned by the Hautapu Landowners Group. This includes concerns about the potential for groundwater mounding, contamination of groundwater and bores used for domestic and stock drinking purposes, overland flow of stormwater, and odour associated with the proposal to construct a large stormwater detention pond along the northern boundary of the land to be rezoned Industrial Zone. The proposed detention pond is proposed to be located along the boundary of the relevant Hautapu Landowners Group land.

55. Terminology - Basin 4 will perform a soakage function with temporary storage of water. In this sense it not a detention pond with permanent water. It is essentially a dry detention basin whereby the full 10-year runoff (design volume) is infiltrated into the ground rather than being released slowly through an extended detention outlet.

56. Groundwater mounding has been assessed by Wallbridge Gilbert Aztec (17 June 2022). The effects of mounding down gradient of the basins are within the natural fluctuation of the groundwater levels in the area and are less than minor. It is noted the mounding assessment has to date not considered the additional runoff from inclusion of Basin 4.

57. A further mounding assessment will be undertaken once the final Basin 4 configuration (base area and shape) is confirmed taking into consideration runoff from South of Hautapu Road.

58. Contamination - Risk of groundwater contamination for drinking is considered low. Because the runoff will undergo pre-treatment within planted forebays/swales prior to discharge across the wider basin area. Pre-treated flows will then undergo further treatment within the natural topsoil and sand/silt layers. Depth to groundwater is estimated at >3.5mbgl. Basin 4 will be no more than 2.5m deep providing a minimum 1m separation between basin floor and winter high groundwater.

59. Table 8-13 in the WRC stormwater guidance states that the invert of infiltration practices shall be at least one metre above the seasonal high groundwater level (which is generally in late spring / early summer). We achieve this separation by limiting basin depth to maximum of 2.5m.

60. It is recommended that any industrial land uses with potential for chemical spill or high contaminant generating activities include additional on-site pre-treatment and spill containment systems.

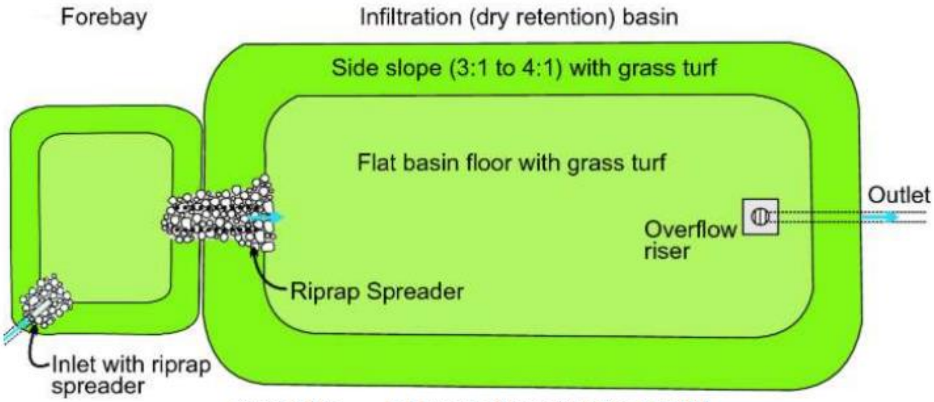


Figure 8-16: **Schematic of an infiltration basin**[114]

Figure 6. Infiltration basin from WRC SW Guidance showing forebay.

61. Odour from the soakage basin is unlikely given the temporary storage of water. Water will not be retained for any longer than it will take to soak away, and the basin will not contain water every time it rains. On occasion

during heavy rainfall, water may accumulate in the basin. This is when the inflow will exceed the infiltration rate. Once inflows decrease to below the infiltration rate, the basin will gradually empty.

62. Overland flow - When Basin 4 capacity is exceeded (likely when the stormwater system's capacity is exceeded), stormwater will flow away at existing peak flow rates into existing ponding areas/overland flow paths. This is much the same as what happens now on site during an extreme 100-year event as shown by the modelling.

Michael George Chapman

13 March 2023

ATTACHMENT A

98-108 HAUTAPU ROAD &
326-342 PEAKE ROAD

STORMWATER MANAGEMENT PLAN

Prepared by

TE MIRO WATER
CONSULTANTS LTD

Version Control

Version	Date	Author	Reviewer	Change Description
1	14/06/2022	Arun Gopi	Mike Chapman mike@temirowater.co.nz	1st Draft
2		Arun Gopi	Mike Chapman mike@temirowater.co.nz	Final Draft

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CONTENTS

1. INTRODUCTION

Te Miro Water Consultants Limited has been engaged by Kama Trust to undertake stormwater design for **98-108 Hautapu Road & 326-342 Peake Road** adjacent to the emerging Hautapu Industrial Node. This stormwater management plan aligns with the Barker & Associate's Conceptual Masterplan Option 3. The purpose of the assessment is to support the plan change for inclusion of the site to accommodate future development.

The intention is to provide confirmation that the site can be serviced appropriately with a stormwater management framework that meets regulatory requirements and integrates with the proposed urban development. The stormwater design philosophy proposed in this report meets the Waipa District Council requirements and the requirements set out in the Hautapu Structure Plan.

The key objective is to develop a stormwater management solution to treat water quality and to manage erosion and potential flood impacts within the receiving environment. A site scale HEC HMS model has been developed to demonstrate the proposed soakage basins can accommodate runoff from the site up to 100-year ARI storm event and match the existing discharge from site.

This report addresses the following design elements:

a. Typical sizing of Soakage Basins required for managing 10-year and 100-year flows
b. Swale sizing for conveyance of overflow from soakage basin

2. SITE DESCRIPTION

The site encompasses 16.2 hectares and is located approximately 4km north-northwest of the Cambridge town centre. It is located just outside the northern boundaries of Cambridge, within the Tamahere area and also falls just outside the Hautapu Structure Plan (HSP) Area.

'*The site is located immediately north of the Deferred Industrial Zone and west of the established Industrial Zone within Hautapu. It is understood that the neighbouring site at 84 Hautapu Road has also been consented for industrial uses. The majority of surrounding land is zoned for rural uses with the equine industry and dairy farms being predominate uses of this land. There are also a number of established rural residential developments in the immediate vicinity.*' – B & A Site Assessment and Conceptual Masterplan.

The existing land use is mostly agricultural and there is a small pocket of rural residential living. The site is predominantly flat with a slight gradient falling towards the Mangaone Stream from RL 62 in the middle of the south side of the site to RL 60 in the Northwest and Northeast corners. The site has 3 main discharge points, and they are located on the western boundary, northwest corner and northeast boundary. The catchment in general is drained to the north by the Mangaone Stream.

Figure 1: Site Location

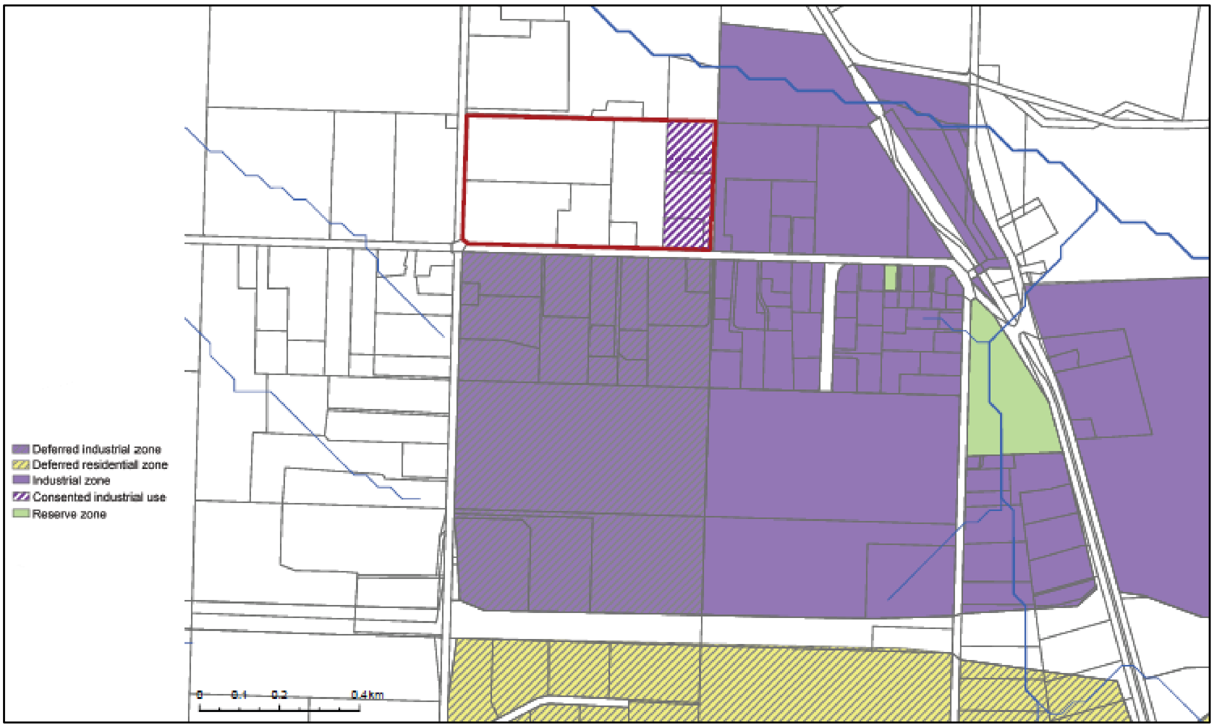


Figure 2: Waipa District Zoning

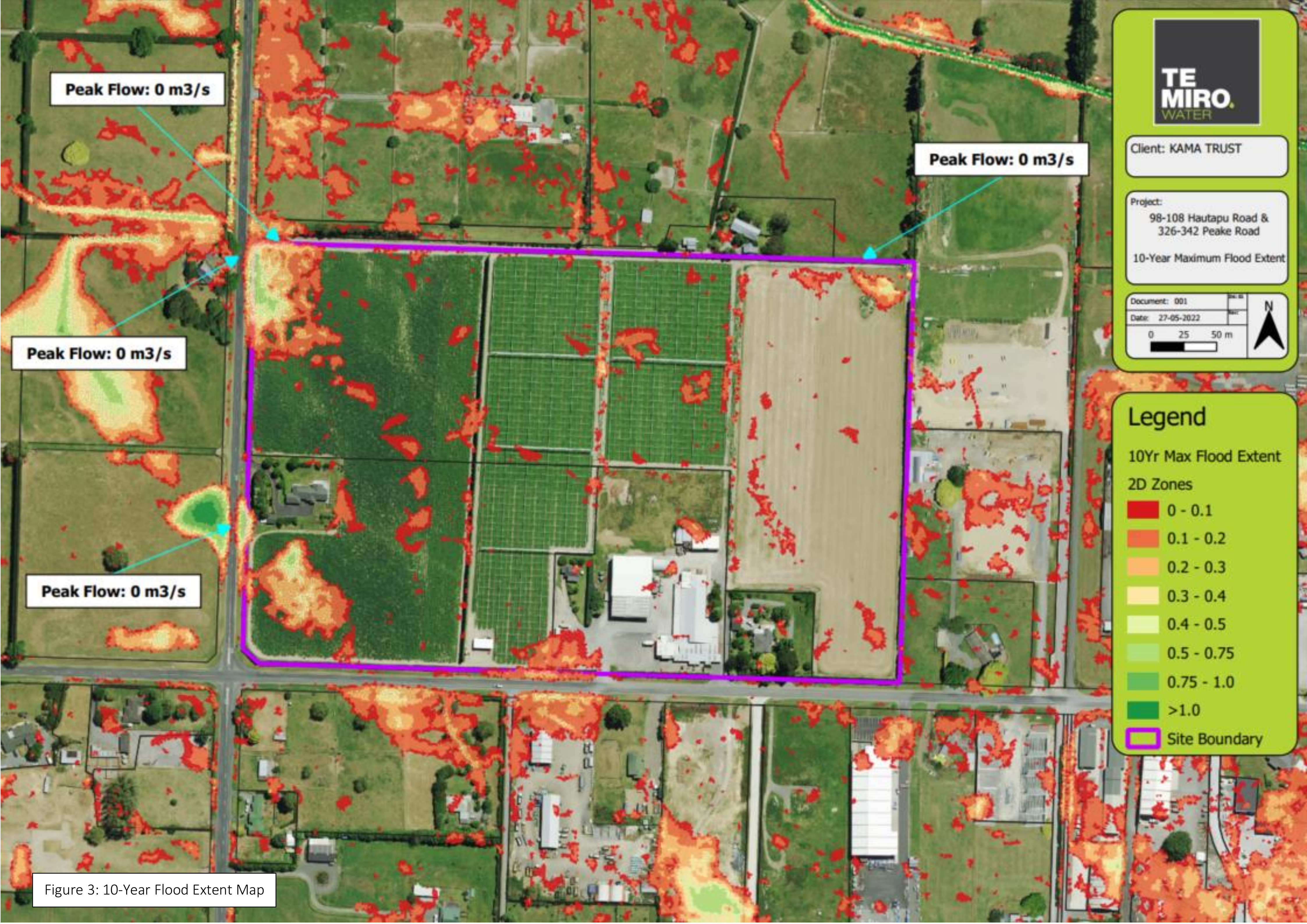


Figure 3: 10-Year Flood Extent Map

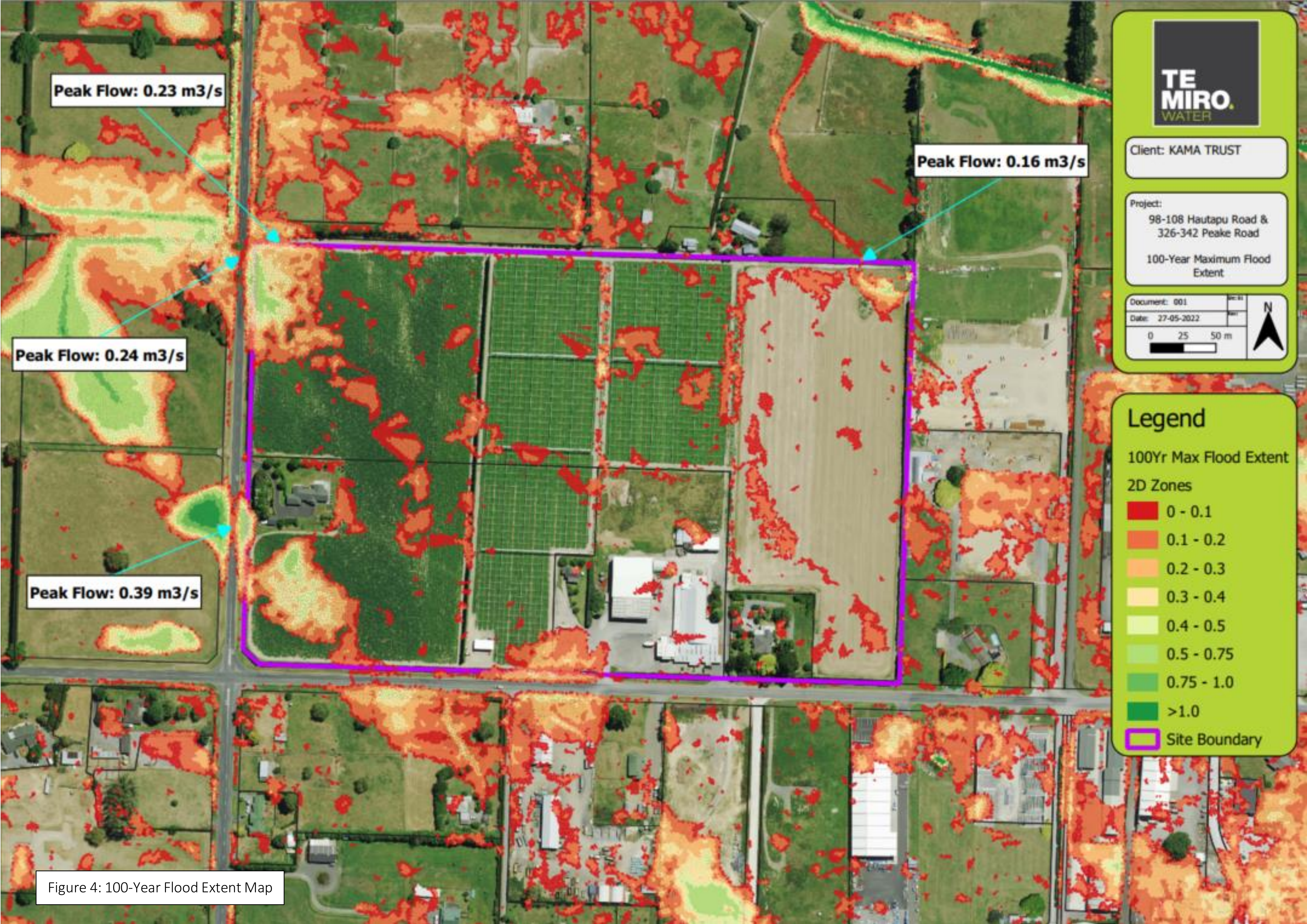


Figure 4: 100-Year Flood Extent Map

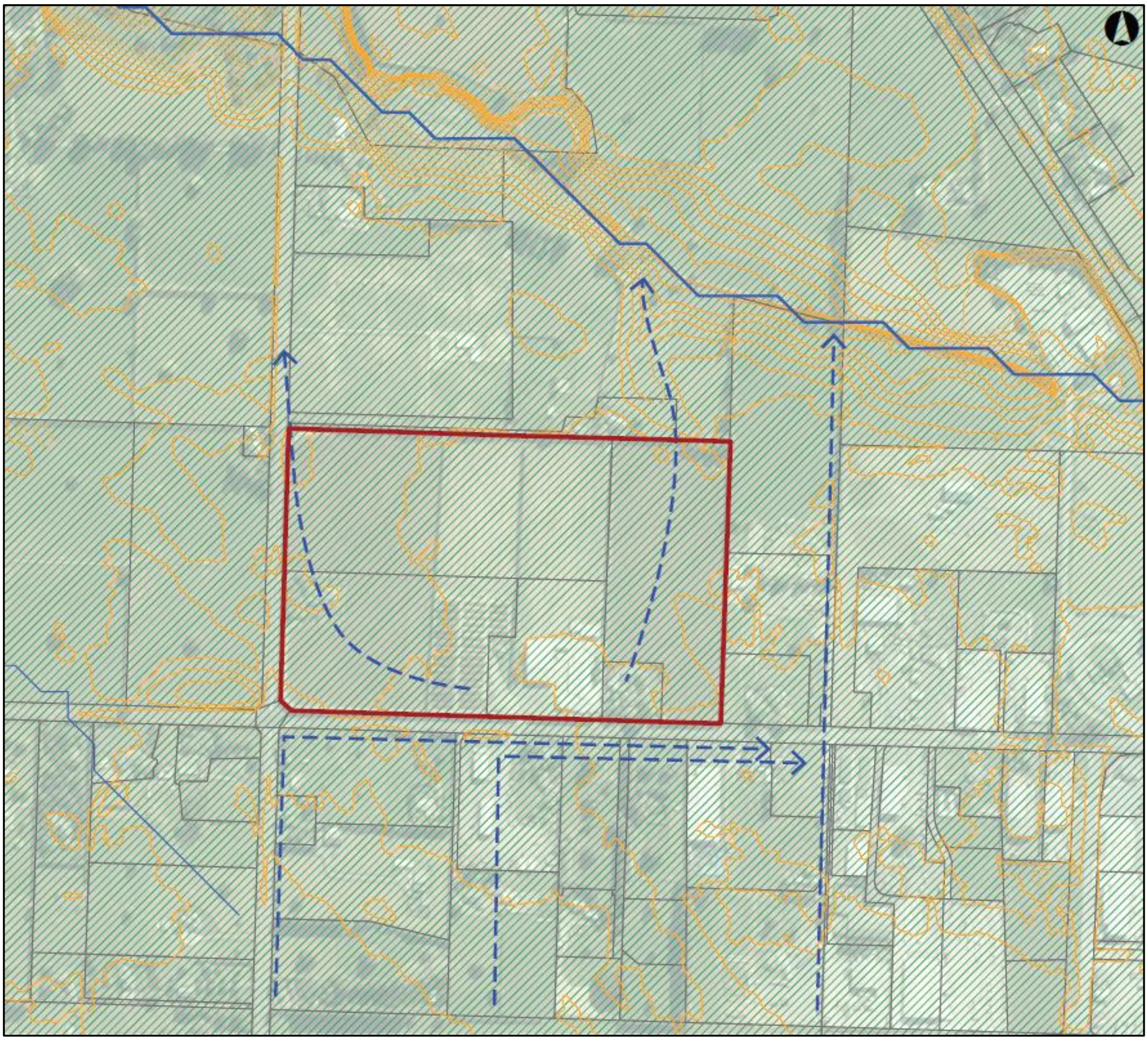


Figure 5: Overland Flow Paths to Mangaone Stream

In accordance with the Hautapu Structure Plan, stormwater flows from any industrial development will need to be managed within the development itself. This is normally achieved by, in the first instance, soakage of stormwater to ground and if the soil conditions do not allow for it, retention/detention/storage of stormwater on site and slow release back into the natural watercourses. Development should not increase peak stormwater discharge rates to receiving environment.

In our case, we are able to fully contain the 10-year ARI storm event runoffs from the site in the two proposed soakage basins and the 100-year event spills and discharges into the receiving environment at a rate less than the existing peak flows.

The existing peak flows from the site during a 100-year ARI storm event are marked up on the flood extent map in Figure 4.

3. SOAKAGE ASSESSMENT

Te Miro Water Consultants completed falling head percolation tests at the Northwest and Northeast corners of the site to assess the soakage rates for the development. The testing was undertaken as per the New Zealand Standard with the calculation procedure followed in general accordance with widely accepted methods. The details of the soakage assessment have been provided in the Appendix.

Test Location	Test Depth	Soakage Rate (mm/hr)
Northwest	2.1m	51 mm/hr
Northeast	2.1m	492 mm/hr

Table 1: Summary of test results

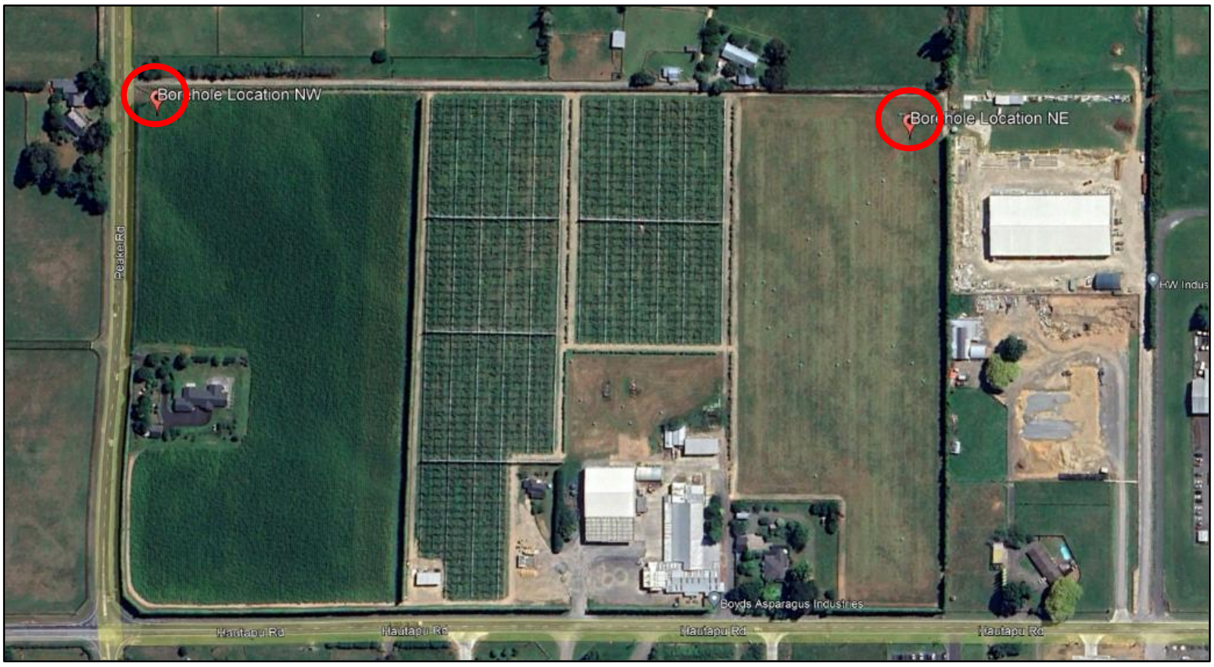


Figure 6: Soakage Test Locations

No groundwater was encountered down to 2.2m depth, and we noticed poor permeability on the Northwest test location but very high permeability for the Northeast test location

4. PROPOSED INFILTRATION BASIN DESIGN

The site has been divided into 3 catchment areas and we are proposing 2 soakage basins to accommodate the runoffs from these catchments up to 100-year storm event based on the modelling assumptions in Table 2.

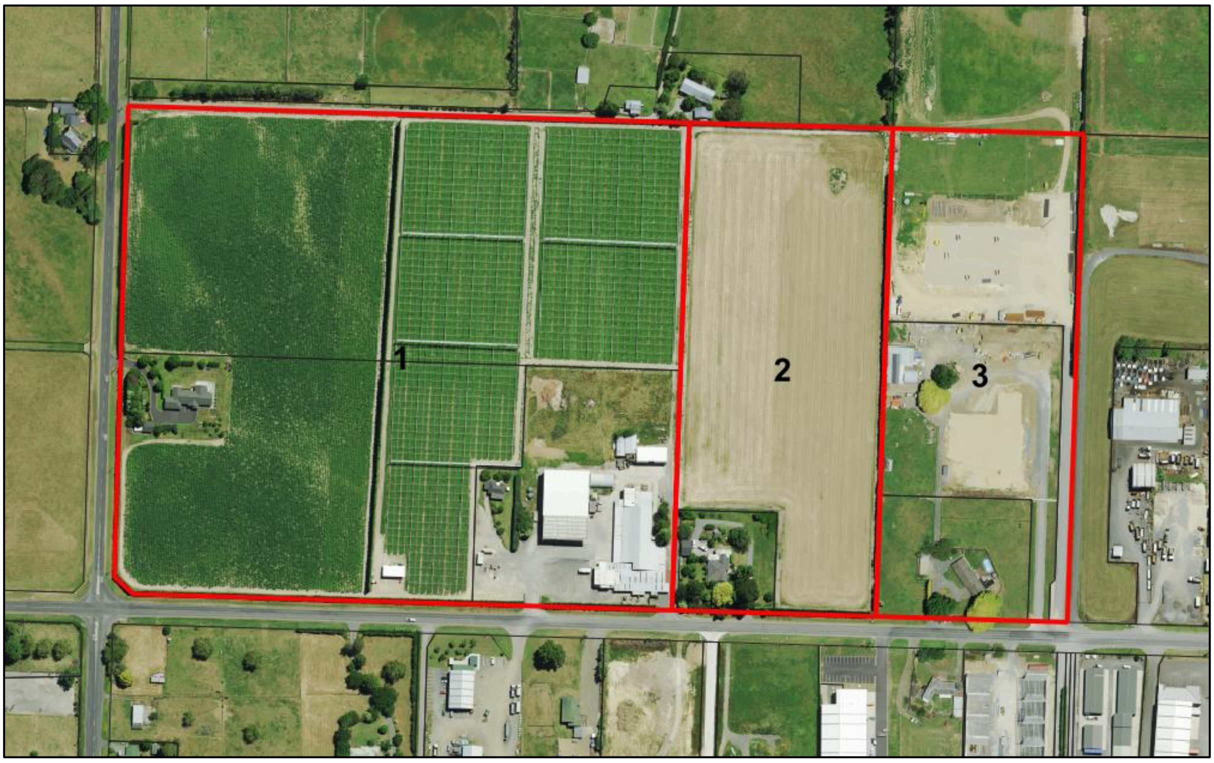


Figure 7: Site divided into 3 catchment areas

Catchment 1 Area	118,619m^2
Catchment 2 Area	43,236m^2
Catchment 3 Area	40,639m^2
Impervious Area (%) for Industrial	90%
Time of Concentration	10 min
Infiltration Rate (From Soakage Assessment Report)	50 – 492 mm/hr
Pre-Developed Runoff Coefficient	0.35
Post Developed Runoff Coefficient	0.9
Rainfall intensity for 10 – year @10min	136 mm/hr (RCP 6)
Rainfall intensity for 100 – year @10min	212 mm/hr (RCP 6)
CN Number for all Impervious Areas	98
CN Number for all Pervious Areas	61

Table 2: Hydrology Design Parameters for the HEC-HMS model

Catchment	CN	Ia	Area (Km²)	Lag Time (min)	Peak Flow (m³/s) 100-year	Peak Flow (m³/s) 10-year
Catchment 1 Pervious	61	8.1	0.0119	6.667	0.220	0.106
Catchment 1 Impervious	98	0.3	0.1068	6.667	3.377	2.147
Catchment 2 Pervious	61	8.1	0.0043	6.667	0.079	0.038
Catchment 2 Impervious	98	0.3	0.0389	6.667	1.230	0.782
Catchment 3 Pervious	61	8.1	0.0041	6.667	0.076	0.036
Catchment 3 Impervious	98	0.3	0.0366	6.667	1.157	0.736

Table 3: Hydrology Peak Flow Results for the HEC-HMS model

The input parameters from Table 2 and Table 3 were assigned to the HEC HMS basin model. Several model iterations were run varying basin length and width, and infiltration area to optimize the basin size. Groundwater depths at >4m were not an issue limiting the size, however increasing depth while keeping side slopes at 1 in 4 reduced the base area for infiltration and we found that 2.5m depth was optimum for this site.

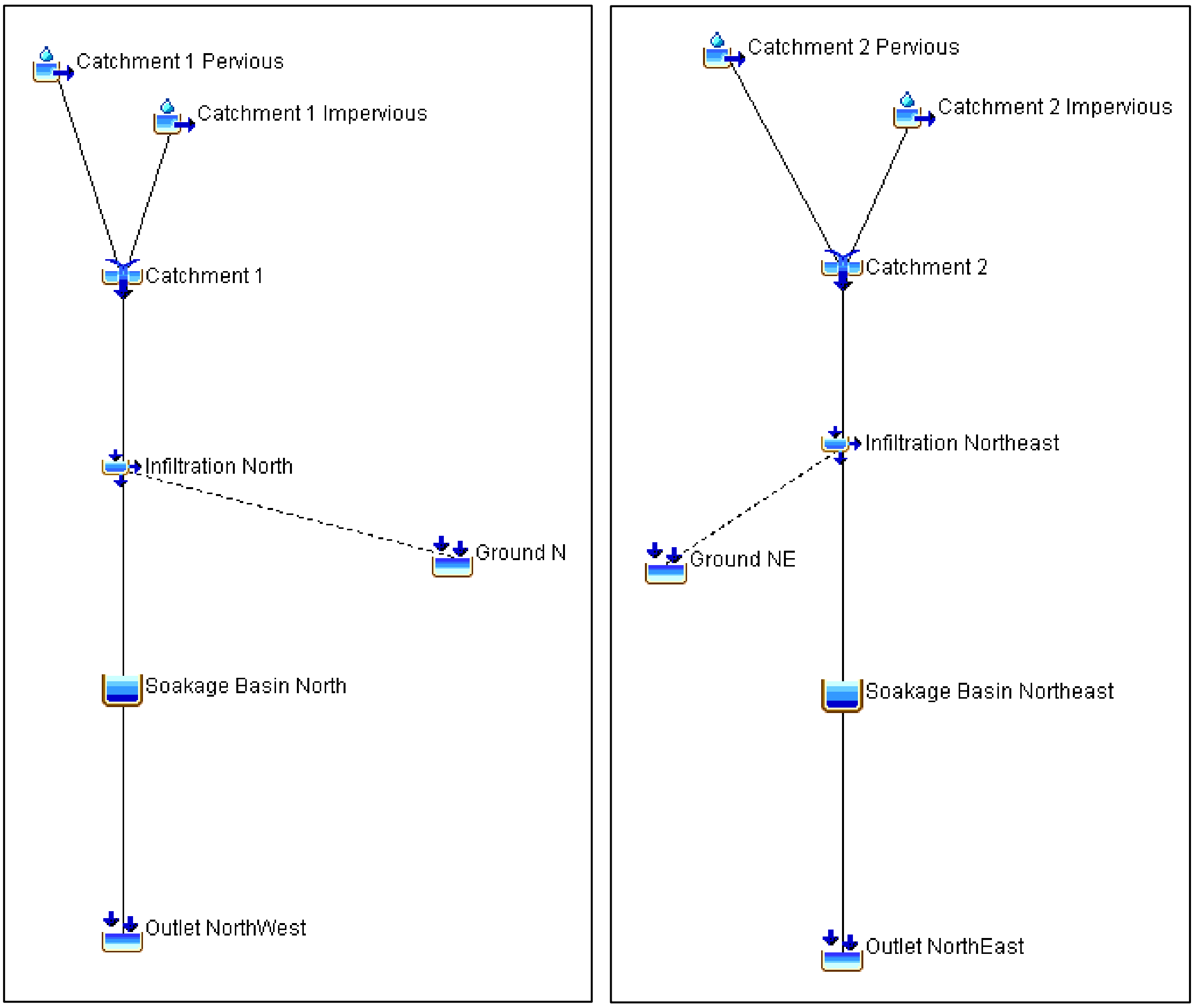


Figure 8: HEC HMS Basin Model Schematics for Soakage Basins without Catchment 3 contributing to the flow

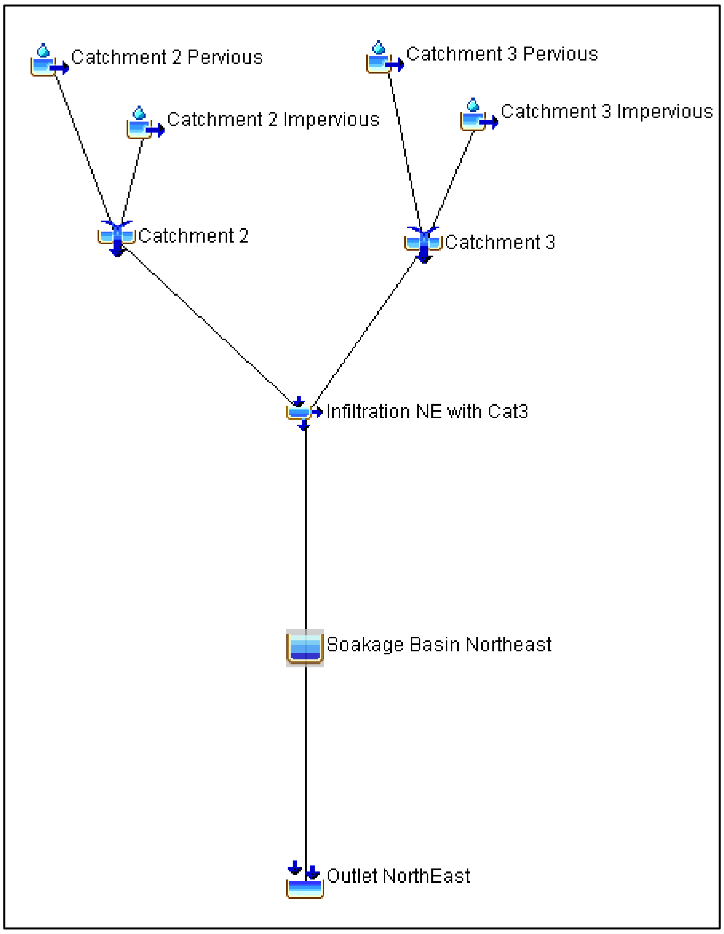


Figure 8: HEC HMS Basin Model Schematic for NE Soakage Basin with Catchment 3 contributing to the flow

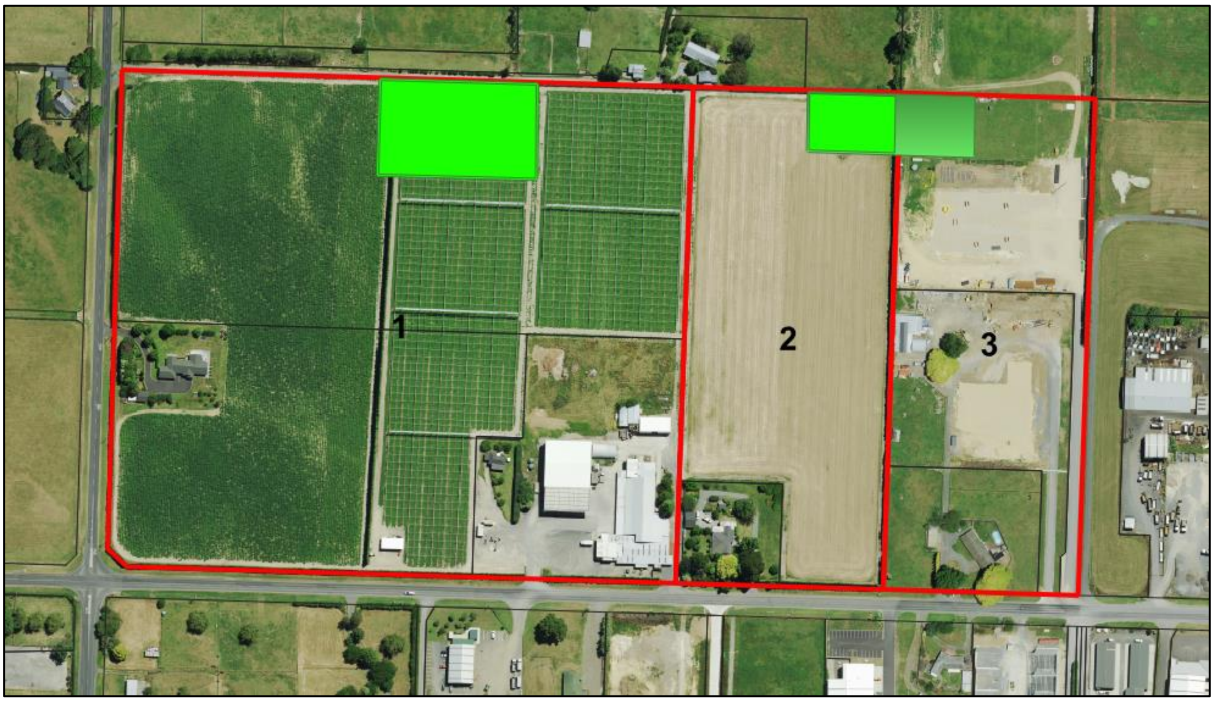


Figure 9: Soakage Basins Layout

The final optimised basin sizes are given below. Nicklin CE will endeavour to incorporate the sizing into their drawing set. Note the sizes are preliminary at this stage for plan change. They could be subject to change at detailed design although overall storage volumes will remain largely similar those in Table 4

Catchment 1 – pervious Area (m²)	11,862
Catchment 1 – impervious area (m²)	106,757
Basin Base Area for soakage (m²)	3,200 (80x40)
Basin Top Area (m²)	6,000 (100x60)
Side Slope Area for soakage (m²)	1,340
Side Slope	1:4
Infiltration rate (m³/s)	0.126
Infiltration rate (mm/hr)	200mm/hr with Factor of Safety 2
100-year Storage Depth (m)	2.5
10-year Storage Depth (m)	1.44
100-year peak storage volume (m³)	11,297
10- year peak storage volume (m³)	6,512
100-year peak discharge (m^3/s)	0.272

Table 4: Basin North design results for 10-year and 100-year ARI including climate change (24-hour storm)

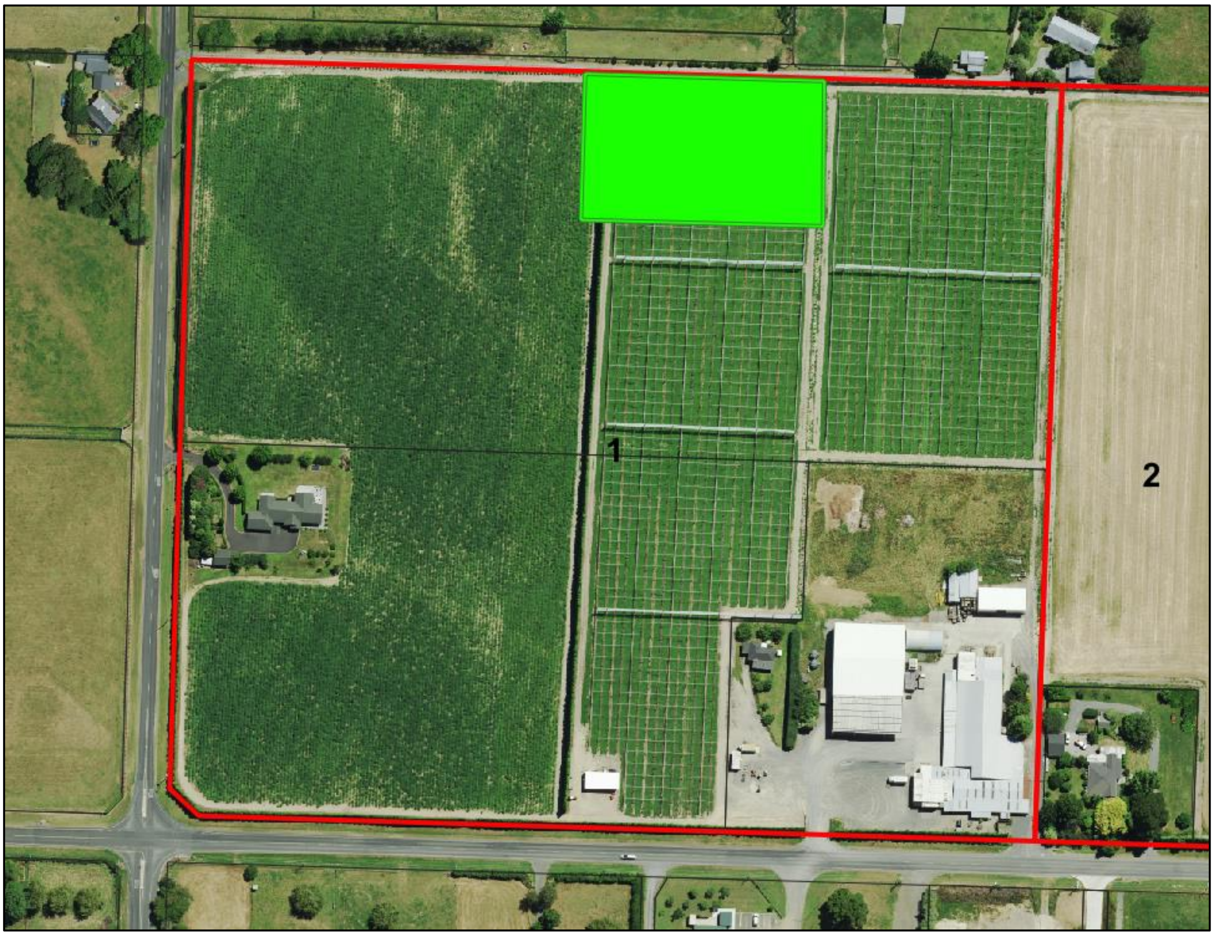


Figure 10: Soakage Basin - North

Catchment 2 – pervious Area (m²)	4,324
Catchment 2 – impervious area (m²)	38,912
Basin Base Area for soakage (m²)	560
Basin Top Area (m²)	1,980
Side Slope Area for soakage (m²)	629
Side Slope	1:4
Infiltration rate on Basin base area (m³/s)	0.081
Infiltration rate on Basin base area (mm/hr)	492mm/hr with Factor of Safety 2
100-year Storage Depth (m)	2.5
10-year Storage Depth (m)	1.42
100-year peak storage volume (m³)	2,993
10- year peak storage volume (m³)	1,700
100-year peak discharge (m³/s)	0.154

Table 5: Basin Northeast (Option 1) design results for 10-year and 100-year ARI including climate change (24-hour storm) – without Catchment 3 contributing to the flow

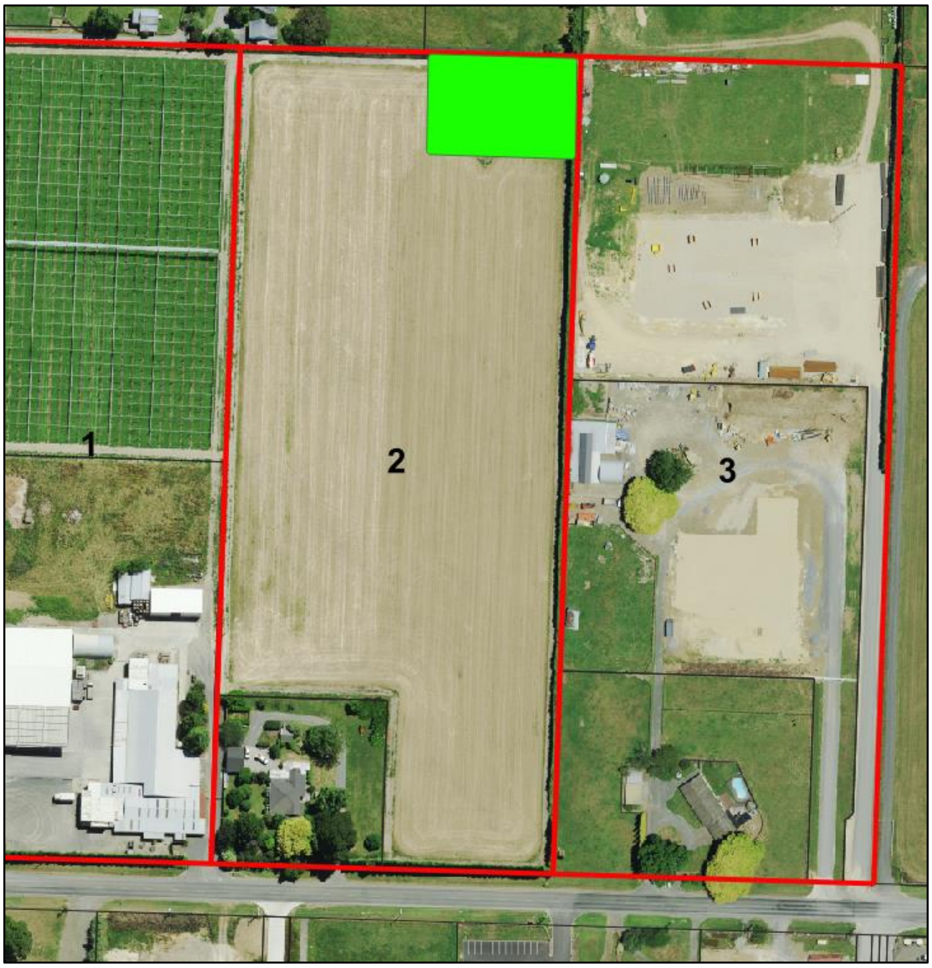


Figure 11: Soakage Basin – Northeast without Catchment 3 contributing to the flow (Option 1)

Catchment 3 – pervious Area (m²)	4,064
Catchment 3 – impervious area (m²)	36,575
Basin Base Area for soakage (m²)	1,360
Basin Top Area (m²)	3,780
Side Slope Area for soakage (m²)	1,144
Side Slope	1:4
Infiltration rate on Basin base area (m³/s)	0.171
Infiltration rate on Basin base area (mm/hr)	492mm/hr with Factor of Safety 2
100-year Storage Depth (m)	2.5
10-year Storage Depth (m)	1.27
100-year peak storage volume (m³)	6,157
10- year peak storage volume (m³)	3,136
100-year peak discharge (m³/s)	0.140

Table 6: Basin Northeast (Option 2) design results for 10-year and 100-year ARI including climate change (24-hour storm) – with Catchment 3 contributing to the flow

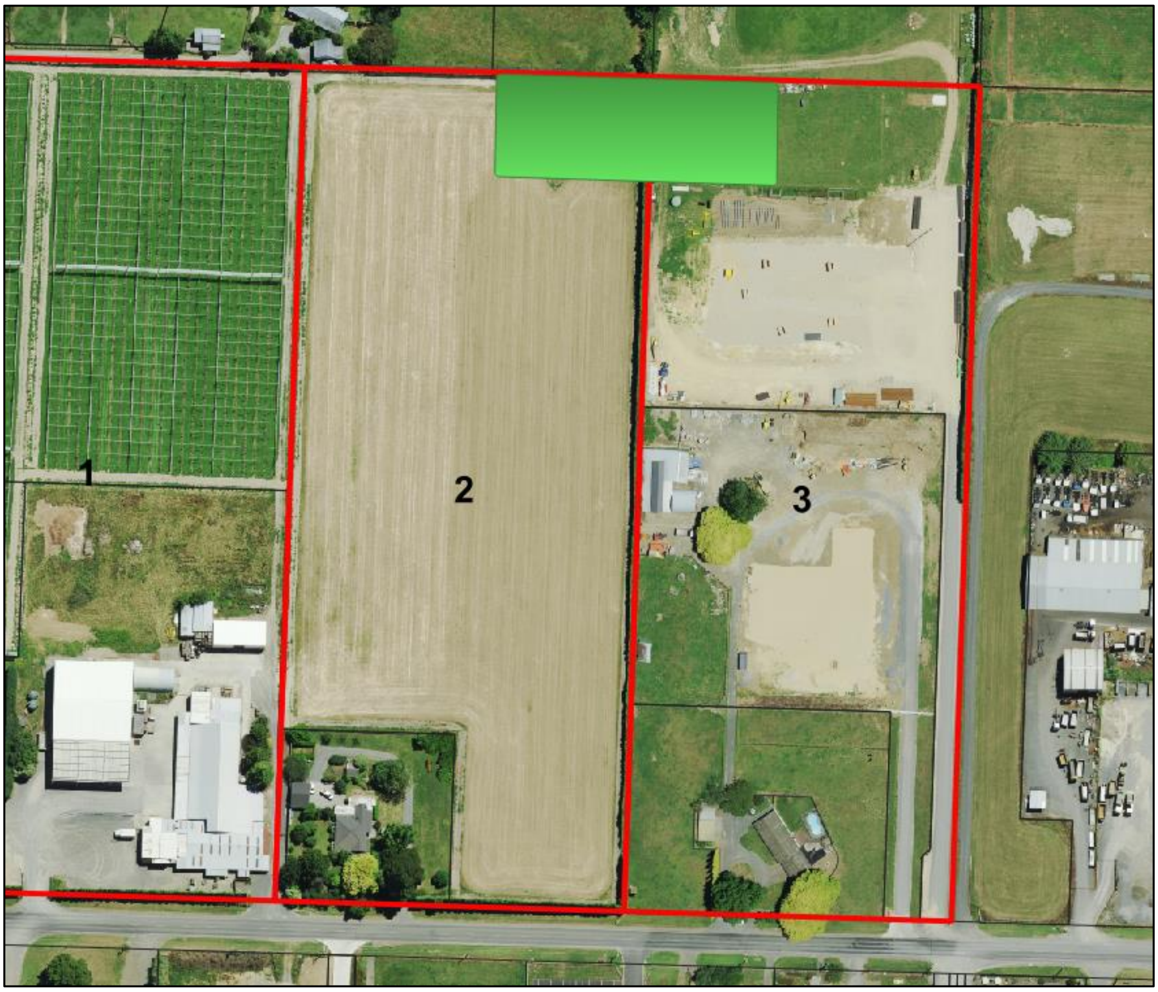


Figure 12: Soakage Basin – Northeast with Catchment 3 contributing to the flow (Option 2)

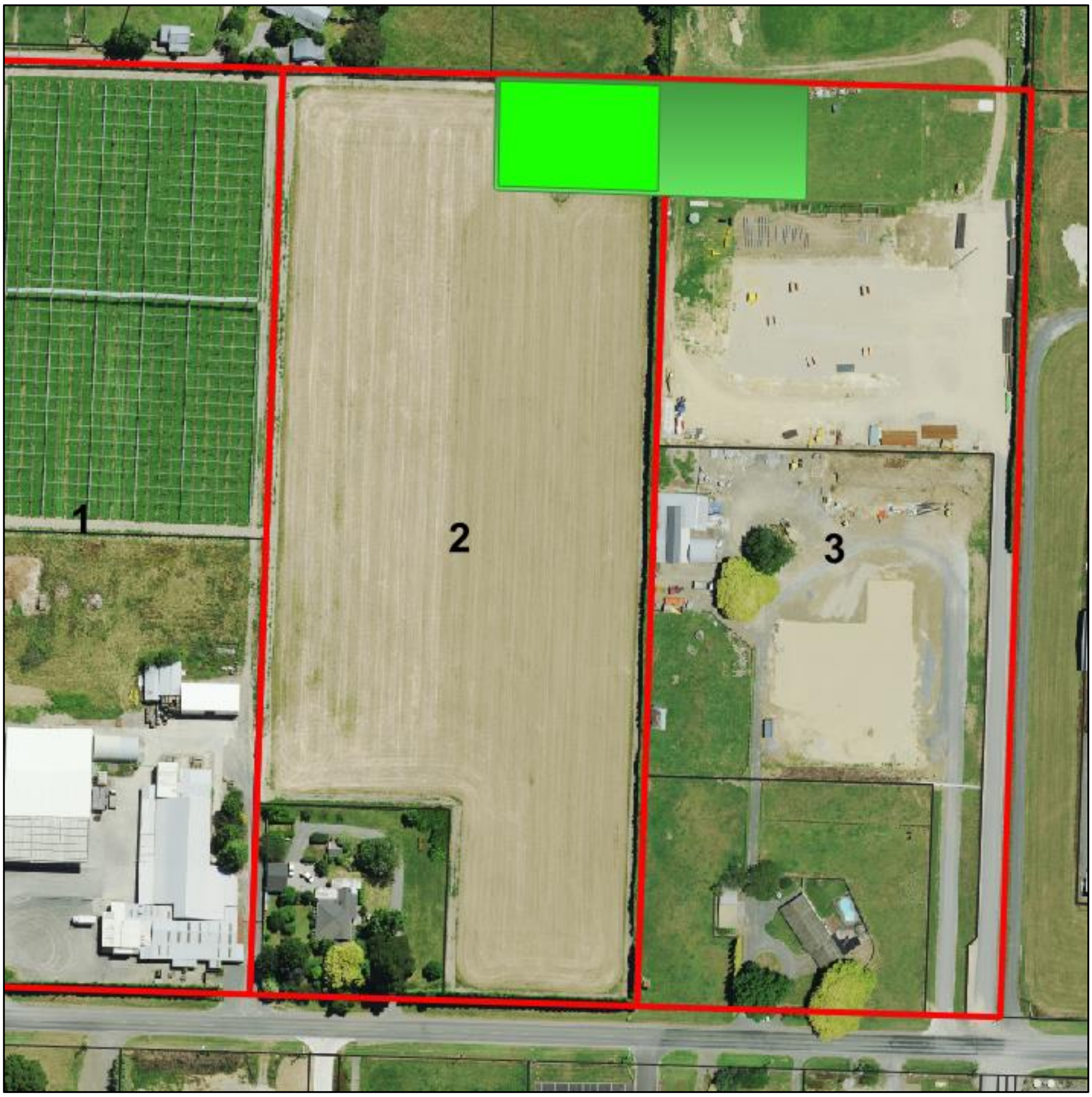


Figure 13: Comparison of the 2 options for Northeast Basin

The catchment 3 site (84 Hautapu Rd) has already got their building consent approval for the industrial building construction. The site plan references 30,000 Litre tanks and overflow to swales for stormwater management. Our option 2 for the Northeast basin allows to capture all the runoff from this site (Catchment 3) but does not allow for any flows from further east to this site (86 and 90 Hautapu Road - outside plan change). The site plan from Structural Steel for HW Industries (84 Hautapu Rd, Tamahere) has been attached in the Appendix.

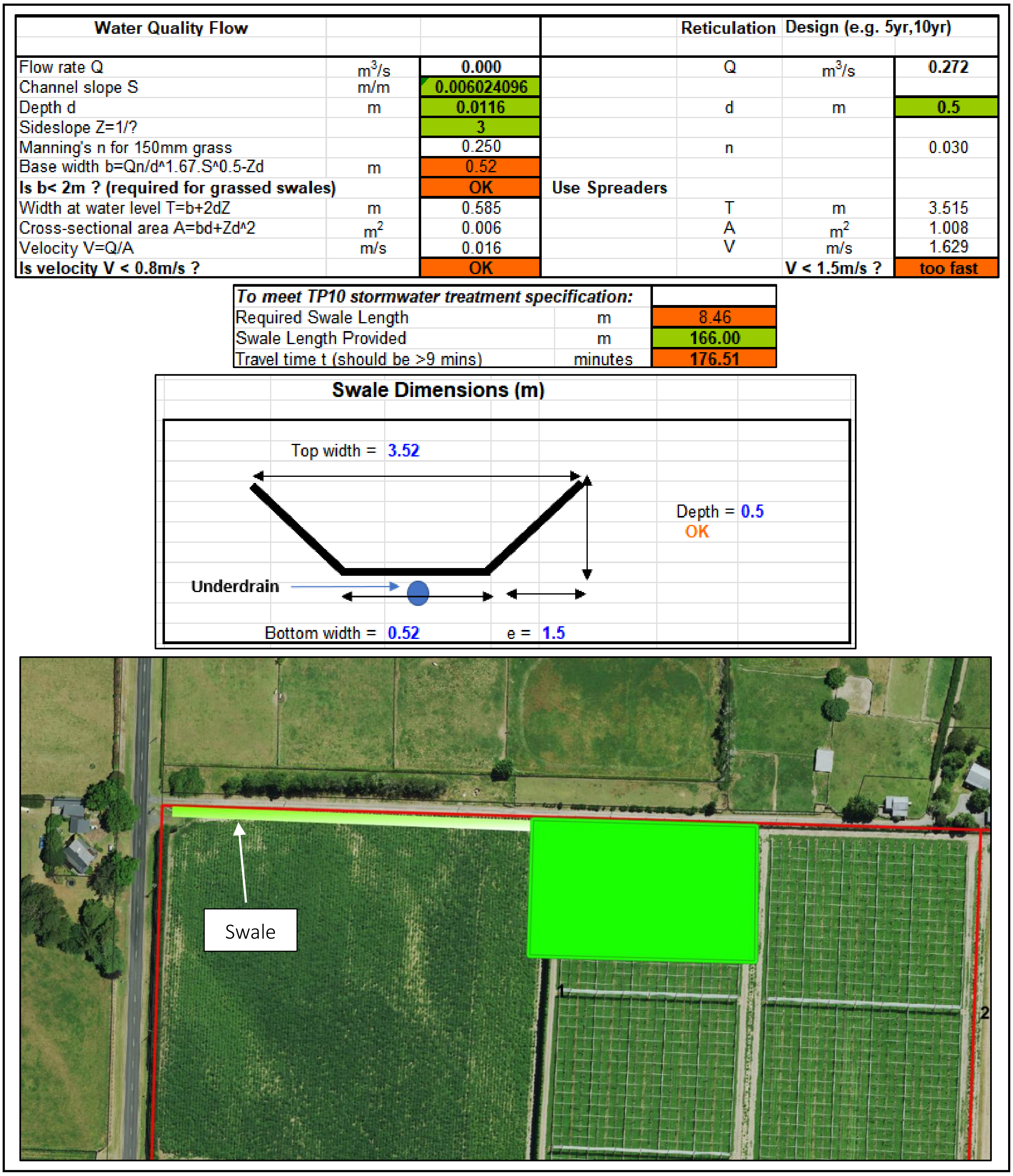
Outflow Location	Peak Flow before Development	Peak Flow after Development
Northwest Outlet	0.47m^3/s (0.86m^3/s total through west)	0.272m^3/s
Northeast Outlet (Option 1)	0.16m^3/s	0.154m^3/s
Northeast Outlet (Option 2)	0.16m^3/s	0.14m^3/s

Table 7: Peak Discharges from site before and after development with and without flow form catchment 3

5. CONVEYANCE SWALE SIZING

A grassed swale is proposed for conveyance of flows from the North Basin westwards to the culvert under Peake Road through the northwest corner of the site. The preliminary swale dimensions are as follows:

166m long, 3.52m top width with side slopes of 1 in 3. An underdrain is recommended as the channel slope is less than 2%.



Water Quality Flow				Reticulation	Design (e.g. 5yr,10yr)	
Flow rate Q	m^3/s	0.000		Q	m^3/s	0.272
Channel slope S	m/m	0.006024096				
Depth d	m	0.0116		d	m	0.5
Sideslope Z=1/?		3				
Manning's n for 150mm grass		0.250		n		0.030
Base width b=Qn/d^1.67.S^0.5-Zd	m	0.52				
Is b< 2m ? (required for grassed swales)		OK	**Use Spreaders**			
Width at water level T=b+2dZ	m	0.585		T	m	3.515
Cross-sectional area A=bd+Zd^2	m^2	0.006		A	m^2	1.008
Velocity V=Q/A	m/s	0.016		V	m/s	1.629
Is velocity V < 0.8m/s ?		OK			**V < 1.5m/s ?**	too fast

To meet TP10 stormwater treatment specification:		
Required Swale Length	m	8.46
Swale Length Provided	m	166.00
Travel time t (should be >9 mins)	minutes	176.51

Figure 14: Conveyance swale from Basin North to outlet on the Northwest corner of the site

6. CONCLUSIONS

a. The B & A Site Assessment and Conceptual Masterplan, 3 Waters Assessment Report by Harrison Grierson and the Beca Hautapu Structure Plan Review (Hydrogeological Investigation) documents have been referenced to achieve an aligned stormwater solution for **98-108 Hautapu Road & 326-342 Peake Road**.

b. The 100-year flood map shows our site is above the flood levels and the existing peak flows from the site have been determined to size the basins accordingly.

c. A HEC HMS hydrology basin model was built to test various basin sizing dimensions to optimise sizing.

d. A key parameter for sizing is the design infiltration rate which have been assessed by Te Miro Water Consultants and provided in the Soakage Assessment Report as 51mm/hr on the Northwest corner to 492mm/hr on the Northeast corner of the site while noting water tables depth >4m bgl. The Matamata Piako Method (among all the different methods) gives an average infiltration rate, and this was selected with a factor of safety for designing the basins. The Basin North location being in between the NW and NE test locations, and the ground level being 1m above the NW test location was assumed to have a conservative infiltration rate of 200mm/hr.

e. A 2.5m deep, 6,000m^2 (top surface) basin in the North excluding freeboard is required to manage flows from Catchment 1. This is required so that all flows up to the 100-year + climate change are safely managed and an acceptable discharge from site matching the existing peak flows is achieved.

f. A 2.5m deep, 1980m^2 (top surface) basin in the Northeast excluding freeboard is required to manage flows from Catchment 2. This is required so that all flows up to the 100-year + climate change are safely managed and an acceptable discharge from site matching the existing peak flows is achieved.

g. A 2.5m deep, 3,780m^2 (top surface) basin in the Northeast excluding freeboard is required to manage flows from Catchments 2 and 3. This is required so that all flows up to the 100-year + climate change are safely managed and an acceptable discharge from site matching the existing peak flows is achieved.

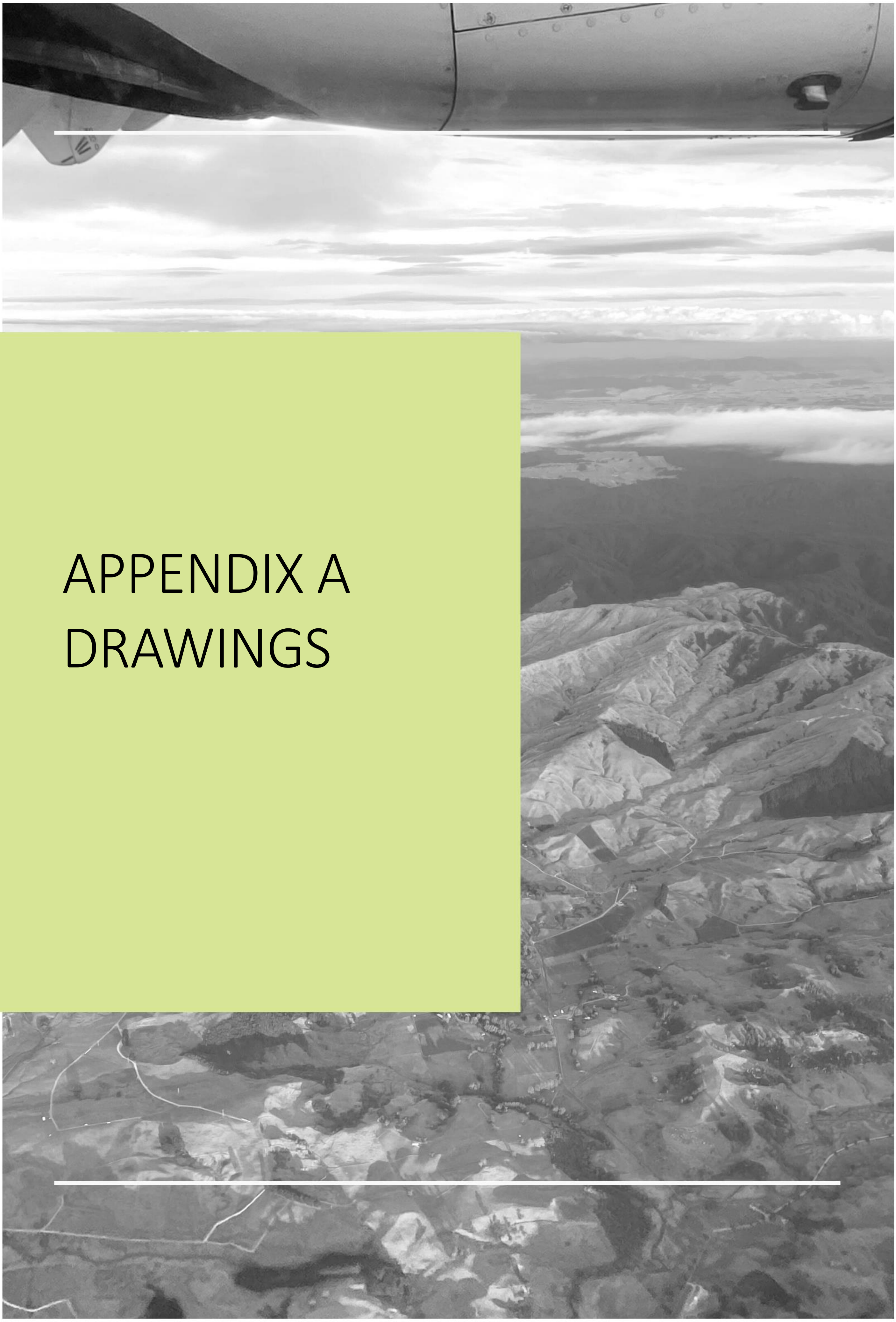
h. The road and industrial areas will be managed via a stormwater reticulated network within the road reserve with kerb, channel, and catchpits. This pipe network collects the runoffs and discharges into the soakage basins.

i. A grassed swale 66m long, 3.52m top width with side slopes of 1 in 3 is proposed for conveyance of flows from the North Basin to the culvert under Peake Road through the northwest corner of the site. An underdrain is recommended as the channel slope is less than 2%.

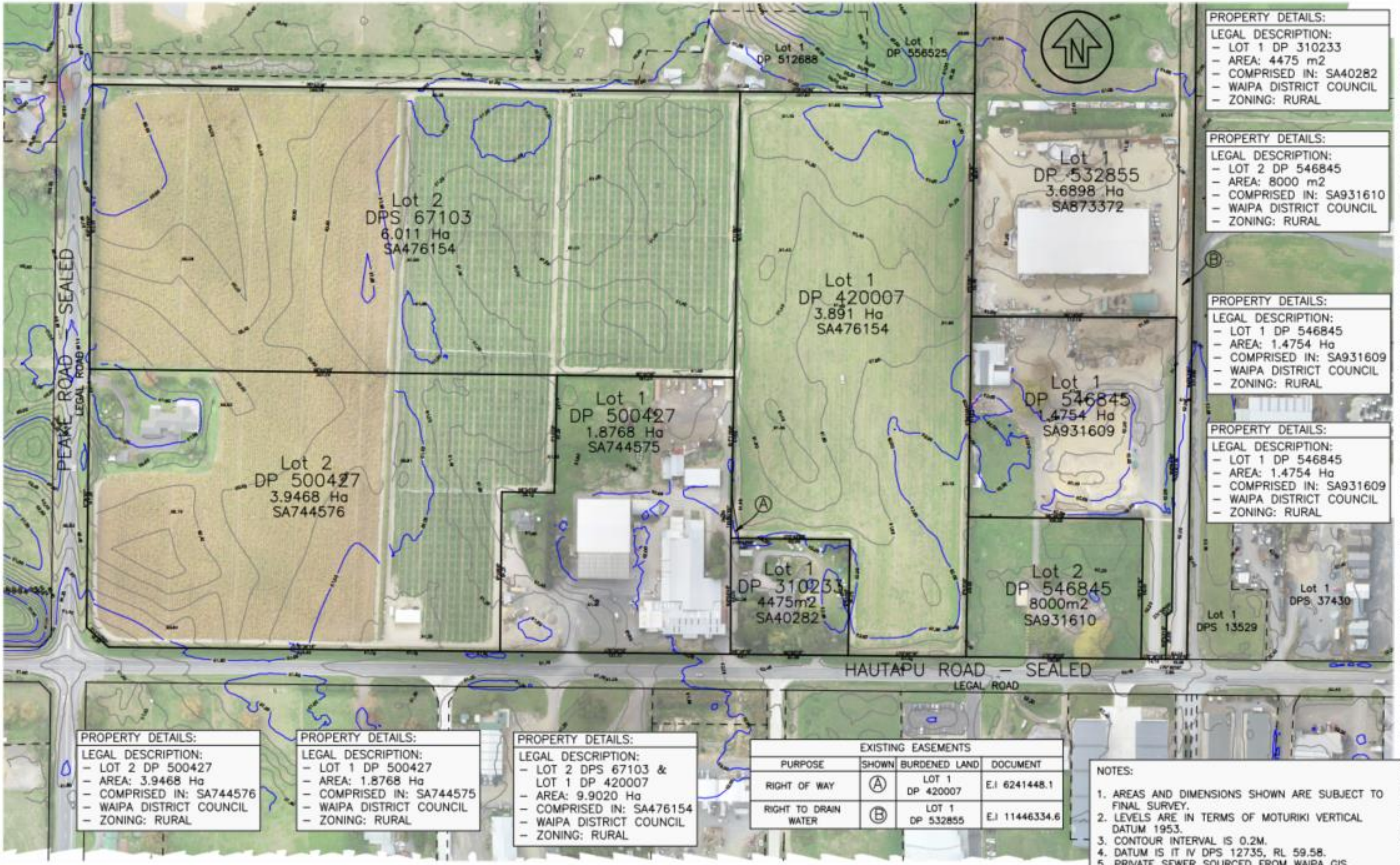
7. LIMITATIONS

This report has been prepared for the project described to us and its extent is limited to the scope of work agreed between the client and Te Miro Water Limited and the data available for the model build.

No responsibility is accepted by Te Miro Water Consultants Limited, or its directors, servants, agents, staff, employees or subcontractors related to the inherent flood model limitations, or the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purpose



APPENDIX A
DRAWINGS



PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 1 DP 310233
- AREA: 4475 m2
- COMPRISED IN: SA40282
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 2 DP 546845
- AREA: 8000 m2
- COMPRISED IN: SA931610
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 1 DP 546845
- AREA: 1.4754 Ha
- COMPRISED IN: SA931609
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 1 DP 546845
- AREA: 1.4754 Ha
- COMPRISED IN: SA931609
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 2 DP 500427
- AREA: 3.9468 Ha
- COMPRISED IN: SA744576
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 1 DP 500427
- AREA: 1.8768 Ha
- COMPRISED IN: SA744575
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

PROPERTY DETAILS:

LEGAL DESCRIPTION:
- LOT 2 DPS 67103 & LOT 1 DP 420007
- AREA: 9.9020 Ha
- COMPRISED IN: SA476154
- WAIPA DISTRICT COUNCIL
- ZONING: RURAL

EXISTING EASEMENTS

PURPOSE	SHOWN	BURDENED LAND	DOCUMENT
RIGHT OF WAY	Ⓐ	LOT 1 DP 420007	E.I 6241448.1
RIGHT TO DRAIN WATER	Ⓑ	LOT 1 DP 532855	E.I 11446334.6

NOTES:

1. AREAS AND DIMENSIONS SHOWN ARE SUBJECT TO FINAL SURVEY.
2. LEVELS ARE IN TERMS OF MOTURIKI VERTICAL DATUM 1953.
3. CONTOUR INTERVAL IS 0.2M.
4. DATUM IS IT IV DPS 12735, RL 59.58.
5. PRIVATE SEWER SOURCED FROM WAIPA GIS.

NICKLIN CE
SURVEYING PLANNING ENGINEERING

Tel: (07)827-4945
www.nicklince.com
info@nicklince.co.nz

6 Wilson Street
P.O. Box 754
Cambridge 3450

PROJECT TITLE

TOPOGRAPHICAL SITE PLAN
OF LOT 2 DPS 67103, LOT 1&2 DP 500427, LOT 1 DP 310233,
LOT 1 DP 420007, LOT 1&2 DP 546845 AND LOT 1 DP 532855
342, 326 PEAKE ROAD, 84, 86, 90, 98, 102 & 108 HAUTAPU ROAD
BOYD ASPARAGUS INDUSTRIES LIMITED

PLAN TITLE

TOPOGRAPHICAL
SITE PLAN

ALTERATION

CAD CA

DATE 06 MAY 2022

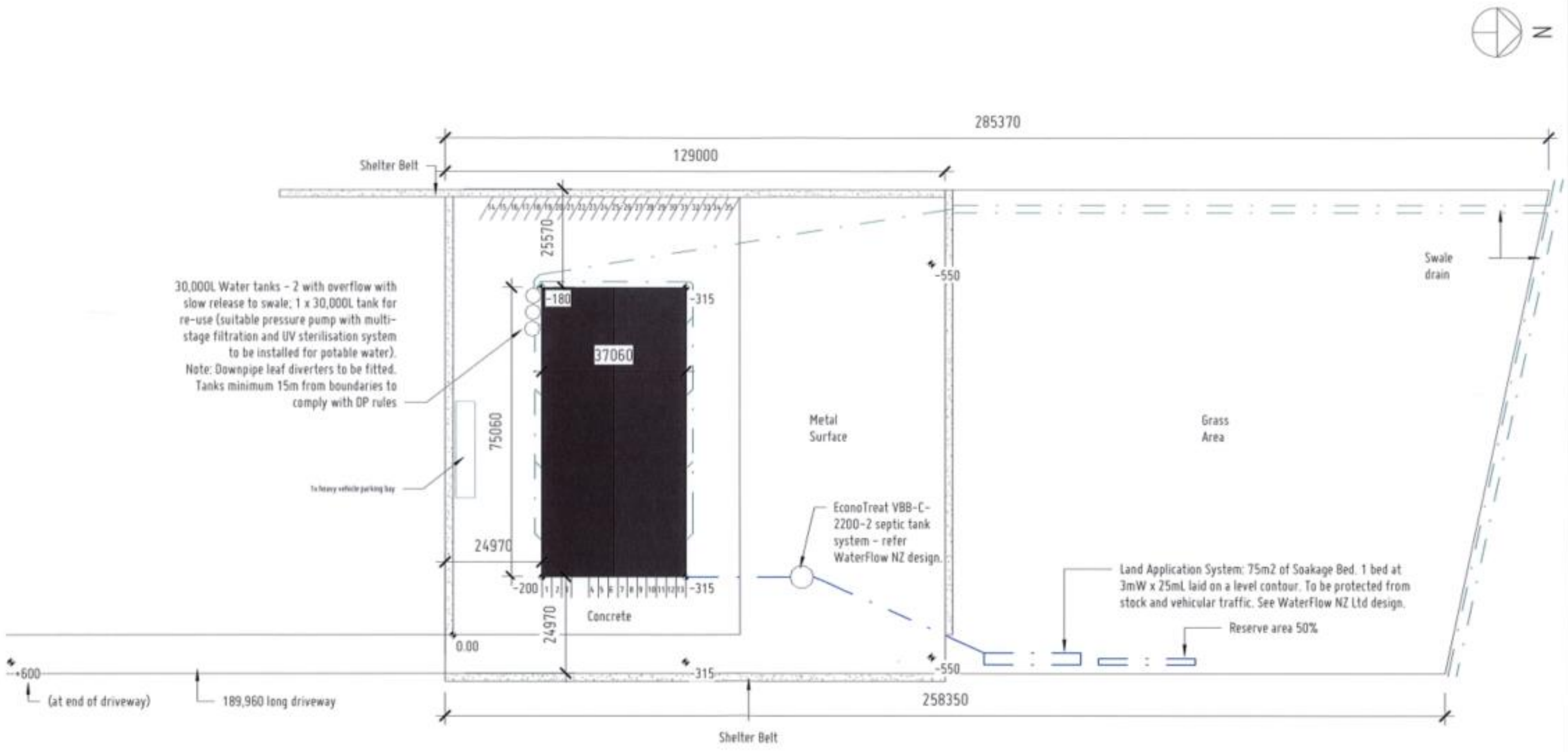
JOB 4771

ORIGINAL SCALE AT A3 1:2000

SHEET 01

ISSUE 1

C:\USERS\SURVEYOR-NICKLINCE\NICKLIN CE\NICKLIN CE TEAM SITE – DOCUMENTS\4771 KAMA TRUST PLAN (98 – 108 HAUTAPU ROAD)\FIELD DATA\FROM FIELD\4771 DRONE CA 29.04.22\4771 TOPO PLAN 29.04.22.DWG



① Site
1 : 1000

Waipa District Council
Approved Amendment
Consent Number: 201263.A1
24 Jun 2021

www.alpinebuildings.co.nz 0800 428 453

STRUCTURAL STEEL a division of Alpine Buildings NZ Ltd

Status: CONSENT

Project: HW Industries

Address: 84 Hautapu Road
Tamahere
Hamilton

Drawing: Site Plan

Drawn Scale: 1 : 1000

Reduced Scale:

Drawn By: TF

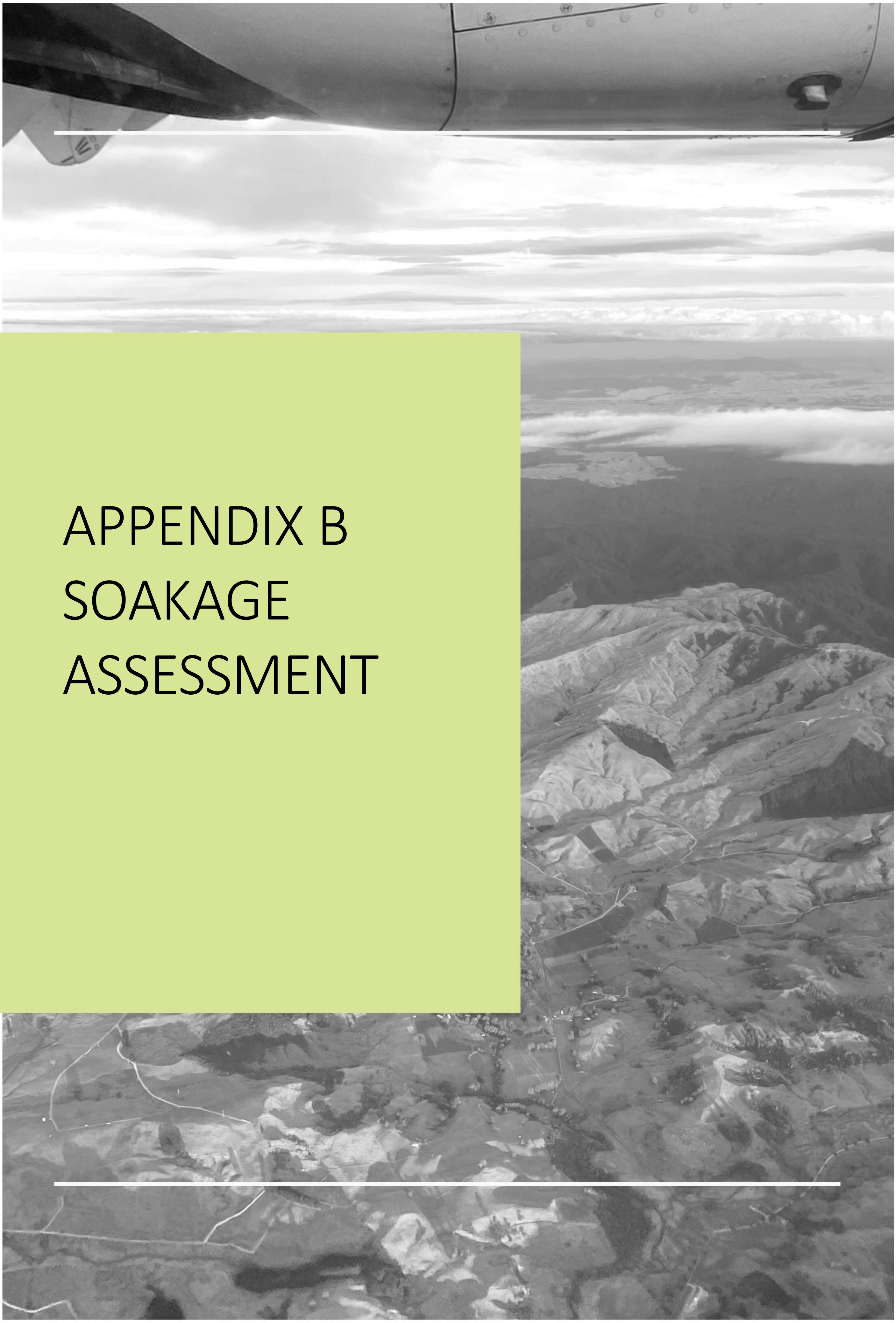
Checked By:

Date: 10/06/2021

Project No. 13940

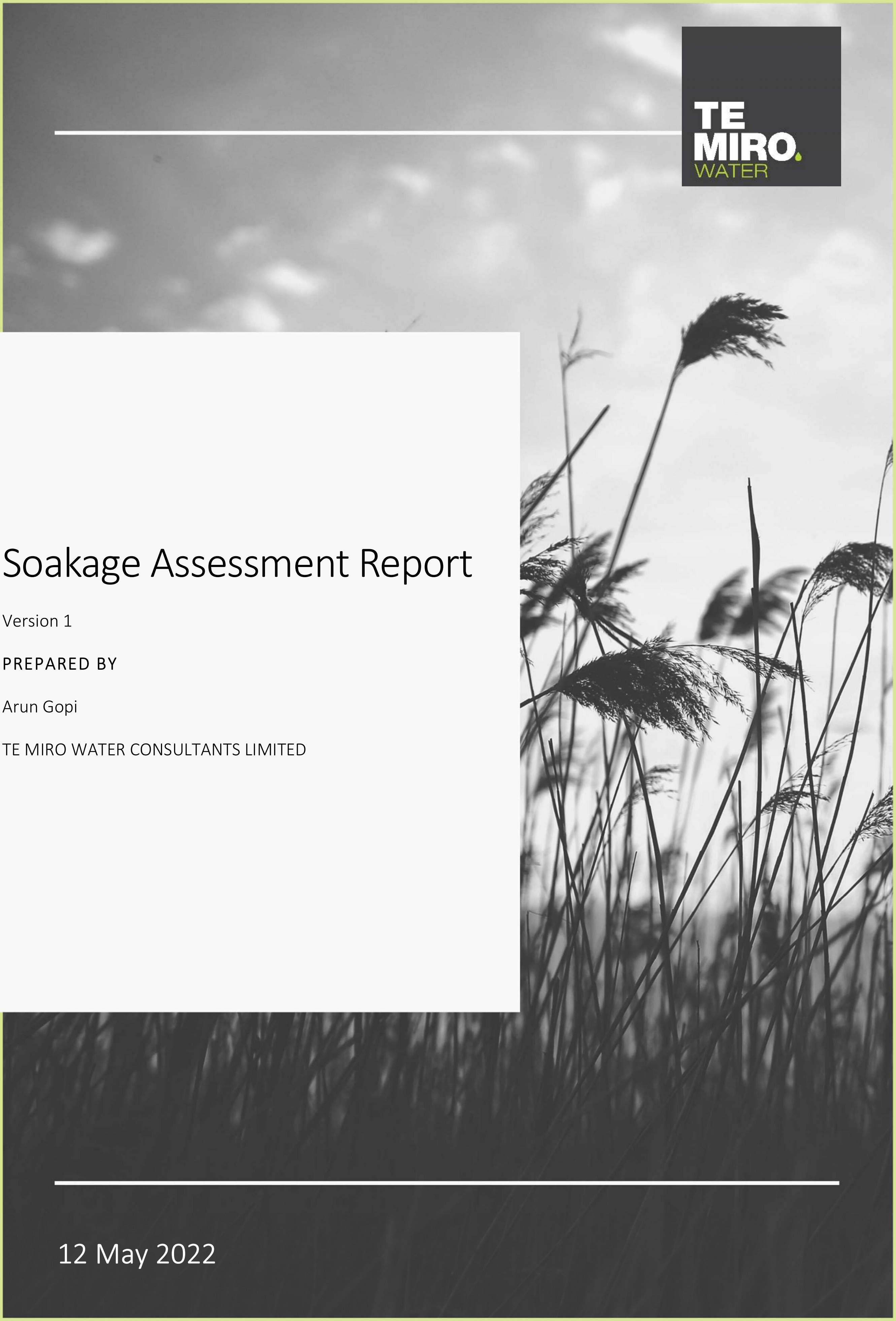
Sheet No: A101

Revision:



APPENDIX B

SOAKAGE ASSESSMENT



Soakage Assessment Report

Version 1

PREPARED BY

Arun Gopi

TE MIRO WATER CONSULTANTS LIMITED

12 May 2022

Table of Contents

Version Control

Version	Date	Author	Reviewer	Change Description
1.1	12/05/22	Arun Gopi arun@temirowater.co.nz	Mike Chapman mike@temirowater.co.nz	FINAL

This report is for the use by Kama Trust (Client) and should not be used or relied upon by any other person or entity or for any other project. No responsibility is accepted by Te Miro Water Limited or its directors for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

1. Introduction

Te Miro Water Ltd was engaged by Kama Trust to complete a falling head percolation test to support the soakage assessment for development of 98-108 Hautapu Road and 326-342 Peake Road.

The locations for the soakage tests were selected at the Northwest and Northeast corners of the property. The site was found to have Allophanic well-structured soils, and no groundwater was encountered up to 2.1m deep.

2. Soakage Procedure

The capacity of the sub surface conditions was determined by conducting an in-situ falling head percolation test using hand augured bore hole. The steps are outlined below:

1. Hand auger bore hole (100mm diameter) down to ~2.1 m depth.
2. The hole was scarified to ensure the hole was not smeared.
3. Pre-soak the test hole by filling and allowing 1 x cycle of water drainage from the test hole.
4. Re-fill the test hole and monitor the rate of water level drop overtime using onset water level logger.

2.1. Test Results

The testing was undertaken as per New Zealand Standard with the calculation procedure followed in general accordance with widely accepted methods following Hvorslev and the Matamata Piako Method. The results represent the theoretical soil hydraulic conductivity or ability of that soil medium to transmit water flows under a simulated water level head. An alternative procedure to determine design soakage rate is presented in the New Zealand Building Code Verification Method E1/VM1 (MBIE, 1992) which involves the selection of a particular gradient on the draw down curve. The limitations of the building code method are discussed further by Trigger MD (2017) as it generally results in less conservative test soakage rates and thus smaller systems could be designed.

The lowest rates were found in the lower lying silty soils in the northwest of the site. The rate recommended for design is taken from Matamata Piako which represents a mid-range point compared to other methods.

Test Location	Test Depth	Soakage Rate (mm/hr)
Northwest	2.1m	51 mm/hr
Northeast	2.1m	492 mm/hr

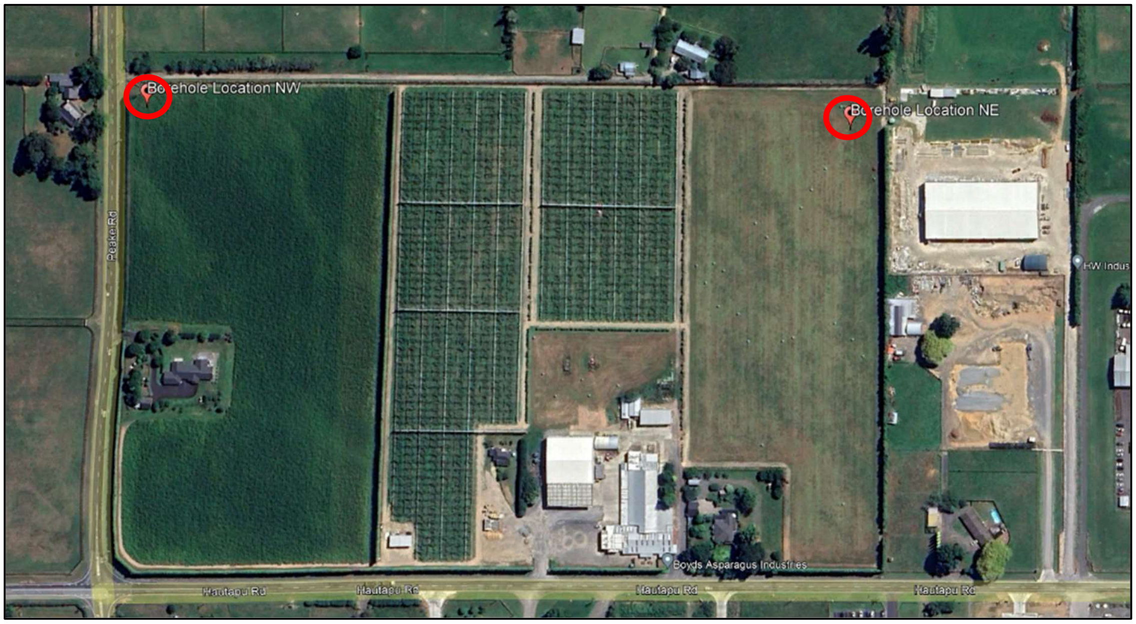


Figure 1: Soakage test locations

Northwest Borehole Location Test Results

Test Method	Test Depth	Soakage Rate (mm/hr)
Matamata Piako	2.1m	51 mm/hr
Horslev – 7	2.1m	30 mm/hr
Horslev – 4	2.1m	65 mm/hr
Building Code E1	2.1m	200 mm/hr
Building Code E1 Modified	2.1m	107 mm/hr

Northeast Borehole Location Test Results

Test Method	Test Depth	Soakage Rate (mm/hr)
Matamata Piako	2.1m	492 mm/hr
Horslev – 7	2.1m	291 mm/hr
Horslev – 4	2.1m	635 mm/hr
Building Code E1	2.1m	982 mm/hr
Building Code E1 Modified	2.1m	593 mm/hr

2.2. Northwest Test Location

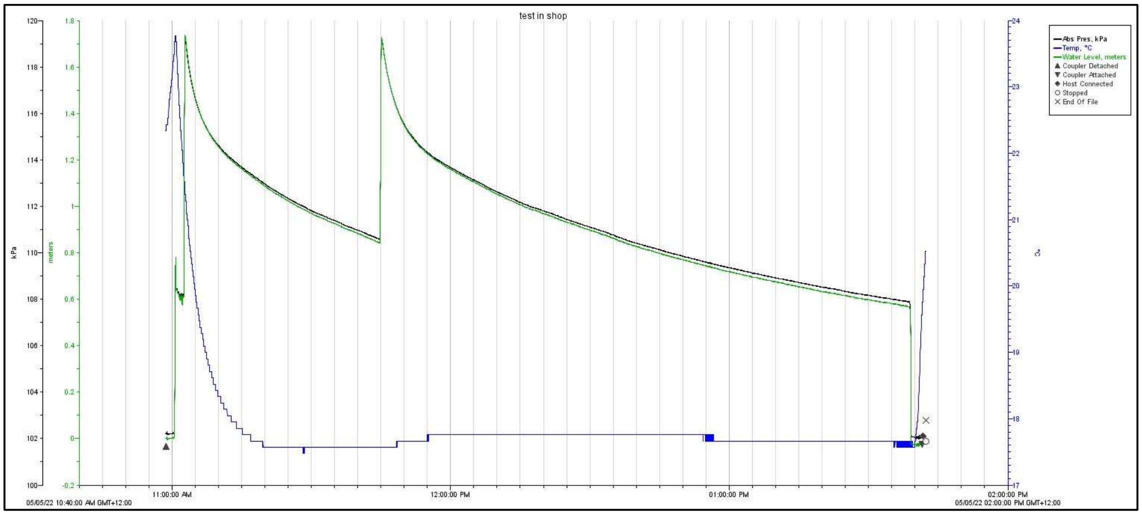


Figure 2: Temp and KPa 'raw data' graphical output from HOBO software (Onset level logger)

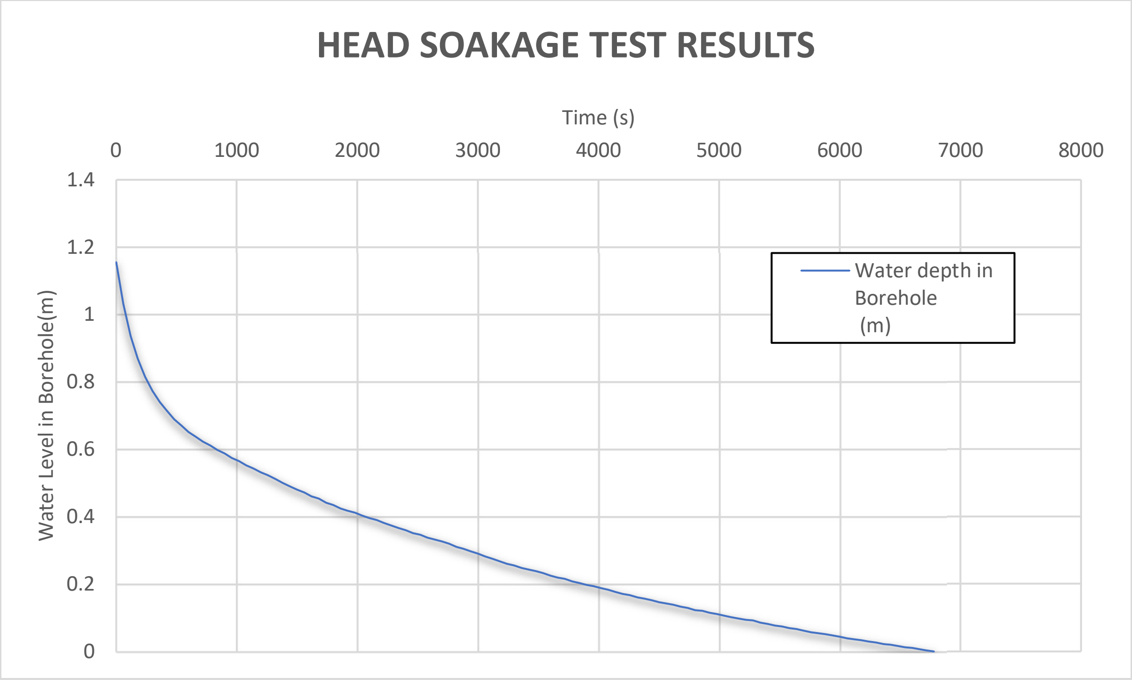


Figure 3: Northwest Test Location - Soakage test result graph

Matamata Piako Method Northwest

L= Soakage (Sand Length(m))	0.2
R= Test Hole Radius (m)	0.05
A= Test Hole Area (m2)	0.008
Deep of borehole (mm)	1.15532
Average Soakage Rate	
0.9	l/min/m^2
51	mm/hr

The test result from the Matamata Piako method is selected as the soakage rate for the Northwest test location, as it is closest to the average of both the Horslev – 7 and Horslev – 4 test results. Also, the test result from the Matamata Piako method is more conservative than both the Building Code and Modified Building Code methods.

2.3. Northeast Test Location

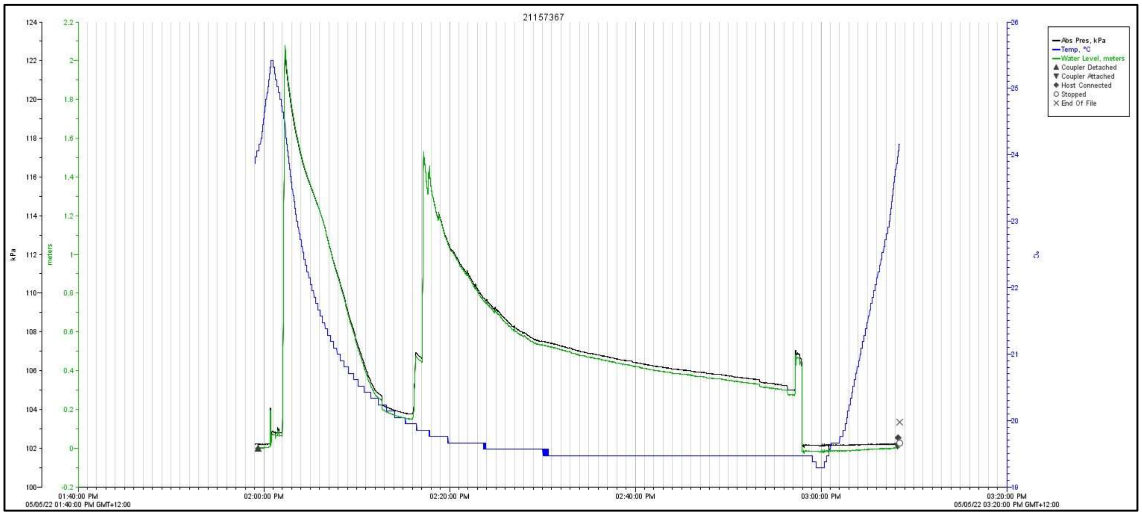


Figure 4: Temp and KPa 'raw data' graphical output from HOBO software (Onset level logger)

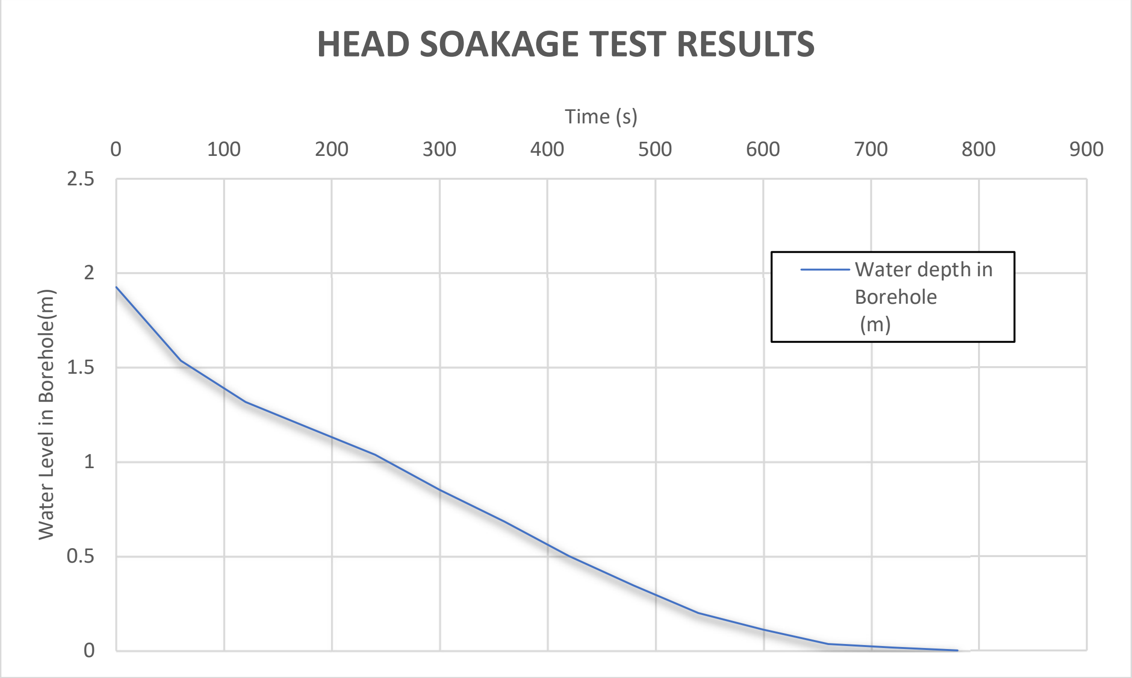


Figure 5: Northeast Test Location - Soakage test result graph

Matamata Piako Method Northeast

L= Soakage (Sand Length(m))	0.2
R= Test Hole Radius (m)	0.05
A= Test Hole Area (m2)	0.008
Deep of borehole (mm)	1.15532
Average Soakage Rate	
8.2	l/min/m^2
492	mm/hr

The test result from the Matamata Piako method is selected as the soakage rate for the Northeast test location, as it is closest to the average of both the Horslev – 7 and Horslev – 4 test results. Also, the test result from the Matamata Piako method is more conservative than both the Building Code and Modified Building Code methods.

3. Conclusions

The test results indicate:

1. The bore logs display soil profile characteristics with well-structured Allophanic soils, and no groundwater was encountered down to 2.2m depth, poor permeability for the Northwest test location and very high permeability for the Northeast test location based on Hvorslev and Matamata Piako Method of testing.
2. The bore log at the Northwest location displayed moist conditions throughout the profile, and it was noticed to be the low point of the property with the runoffs from the farm running towards this point after a rain event.
3. Soakage test was done in the month of May, but the weather was clear and sunny.

APPENDIX A

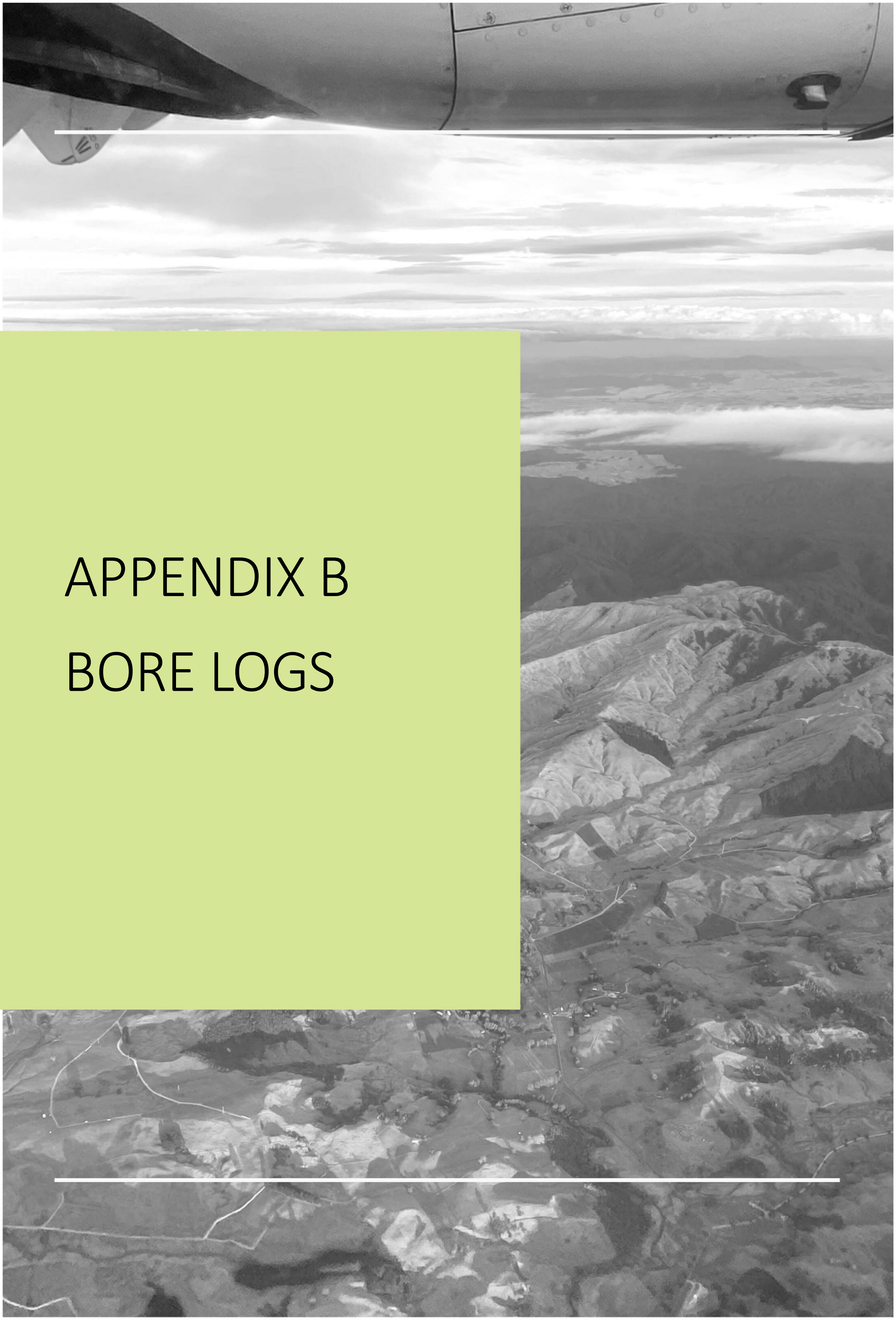
PHOTOS

Test location near the Northwest boundary

Northwest Test location – Looking towards South side of the property

Test location near the Northeast boundary had to be changed as the area near the corner was filled up and not natural ground profile

Test location near the Northeast boundary



APPENDIX B

BORE LOGS

HAND AUGER LOG - Northeast Site

PROJECT NAME Waikato Future Proof Strategy
CLIENT Barker & Associates c/o Kama Trust

ADDRESS 92 - 108 Hautapu Rd, Cambridge
TOTAL DEPTH 2.2 m

DATE 05-05-2022
TIME 12:30 PM

COMMENTS

LOGGED BY SV
CHECKED BY MC

Depth (m)	Graphic Log	Material Description	Borelog Images
0.1	■	TOPSOIL: Light brown in colour with medium gravel (5%)	 
0.2 0.3 0.4	▨	SANDY CLAY LOAM: Medium to coarse sand with 5% fine to medium gravel	
0.5 0.6 0.7 0.8 0.9	▥	CLAY LOAM with fine sand, light orangey brown in colour	
1 1.1 1.2 1.3 1.4	▥	CLAY LOAM: More greyish in colour, with fine sand present	
1.5 1.6 1.7 1.8 1.9 2 2.1	▨	LOAMY SAND: Greyish in colour, Sand is getting coarser as we go deeper, Presence of sand is getting more and clay is getting lesser as we go deeper	
2.2 2.3		Termination Depth at: 2.2 m Groundwater not encountered	

Disclaimer This bore log is intended for soakage assessment not any other geotechnical purposes.

produced by ESlog.ESdat.net on 06 May 2022

TE MIRO WATER

HAND AUGER LOG - Northwest Site

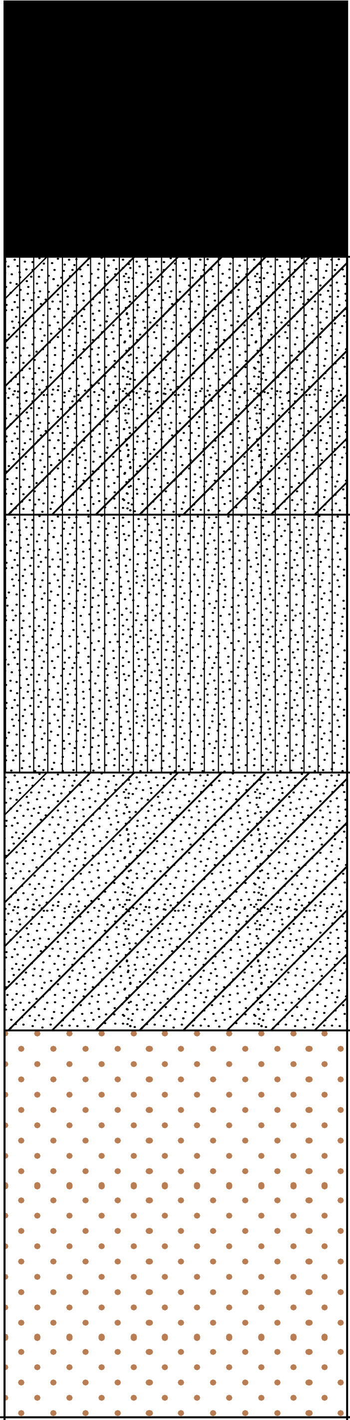
PROJECT NAME Waikato Future Proof Strategy
CLIENT Barker & Associates c/o Kama Trust

ADDRESS 92 - 108 Hautapu Rd, Cambridge
TOTAL DEPTH 2.2 m

DATE 05-05-2022
TIME 9:45 AM

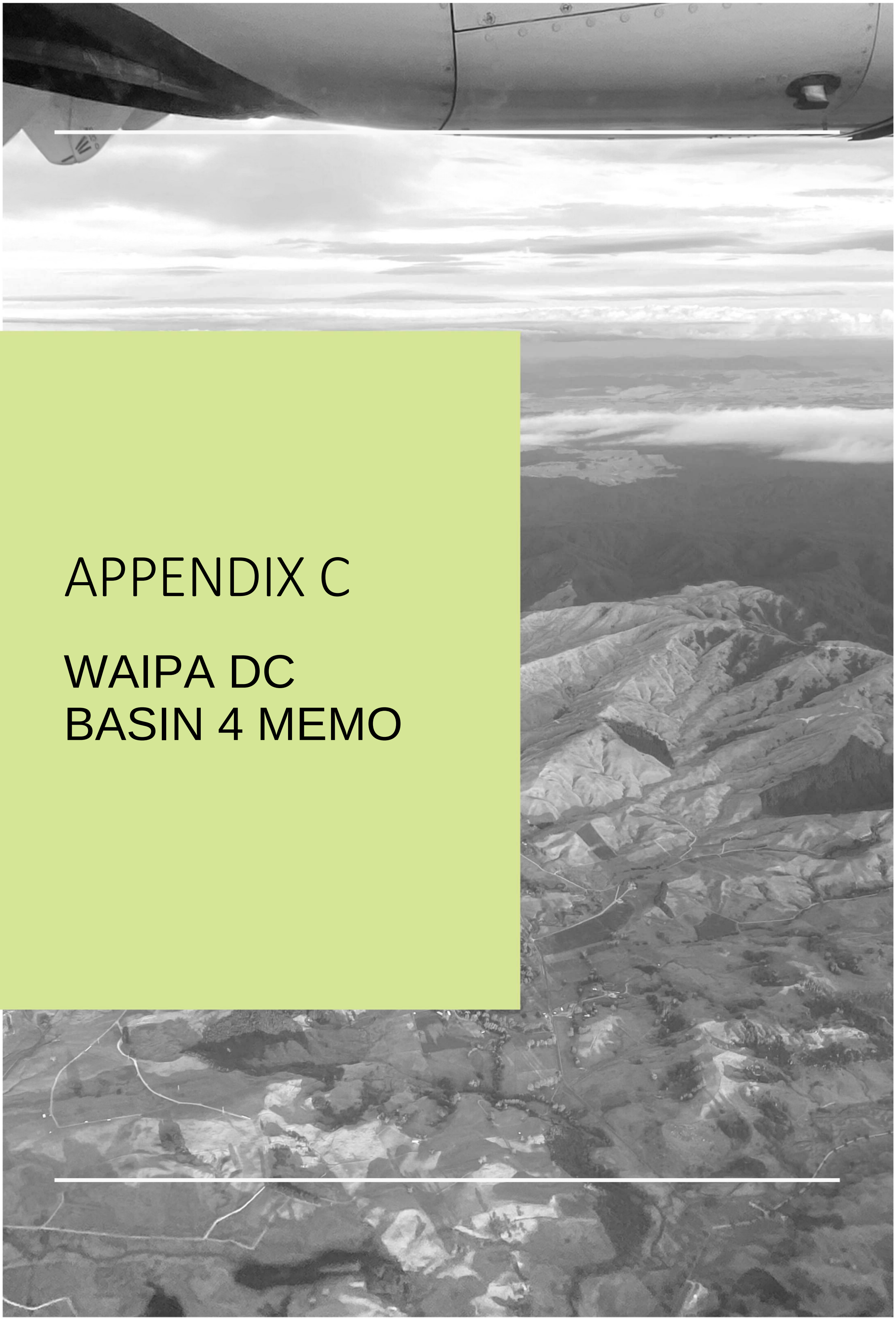
COMMENTS Moist conditions noted throughout the soil profile

LOGGED BY SV
CHECKED BY MC

Depth (m)	**Graphic Log**	**Material Description**	**Borelog Images**
0.1 0.2 0.3		TOPSOIL: Light brown in colour, medium loam	
0.4 0.5 0.6 0.7		SANDY CLAY LOAM: Rich orange in colour, getting heavier in clay as it gets deeper	
0.8 0.9 1 1.1		CLAY LOAM: Greyish in colour	
1.2 1.3 1.4 1.5		LOAMY SAND: Medium gravels present (30%), rich orange fading to brown as it gets deeper	
1.6 1.7 1.8 1.9 2 2.1		COARSE BROWN SAND with medium to coarse gravel (30%)	
2.2 2.3		Termination Depth at: 2.2 m Groundwater not encountered	

Disclaimer This bore log is intended for soakage assessment not any other geotechnical purposes.

produced by ESlog.ESdat.net on 06 May 2022



APPENDIX C

WAIPA DC BASIN 4 MEMO

DATE 02/08/2022

TO: Kama Trust c/o Dave Timms, Nicklin CE

FROM: Te Miro Water Consultants – Mike Chapman (Reviewed Britta Jensen)

SUBJECT: Kama Trust – Relocation and Design Basis for WDC Basin 4 (C8-C9 Structure Plan)

INTRODUCTION

This memo supports the stormwater management plan for Kama Trust (TMW, 14-06-2022). This memo outlines the design basis for Basin 4 from the WDC C8-C9 Master Plan and more recent optioneering and model update in September 2021 by TMW.

Basin 4 is proposed to be relocated from the current position (Figure 1) to within the Kama Trust site. Several options were explored as to the location within the site based on discussions with the client and Nicklin CE.

- Option 1 – Relocate Basin 4 to SW corner and separate from Kama Trust northern basin (Figure 2)
- Option 2 – Combine Basin 4 and Kama basin along the northern boundary (Figure 3)
- Option 3 (Preferred)- Combine Basin 4 and Kama basin and reconfigure the shape as L shape within the site (Figure 4) along west and north boundary to make use of the set back

It is important to note the current Basin 4 size is based on 30mm/hr soakage rate and various other catchment runoff assumptions as explained later in this memo. The size could be considered reasonably conservative as this point.

It is also important to note the Kama Trust basin along the northern boundary as well as Basin 4 will need detail design and integration with the wider C8-C9 flood model. Please also note the current model assumption relating to the invert level of Basin 4 (Figure 5) the level is approximately 58.4mRL. The results of the optioneering are based on this level working within the wider C9 Area 5. It follows that the invert of the relocated basin within Kama Trust will also need to be at or similar level for the system to work as there are backwater hydraulics at play.

The purpose of the conceptual Basin 4 sizing for master planning was to check viability of moving Basin 4 north of Hautapu Road allowing the road frontage to properties within C8/C9 and to assess capacity of Basin 4 to receive flows from upgrading Hautapu Road (10yr pipe reticulation to the basin) as an alternative to the currently proposed soakage trench design for the road.

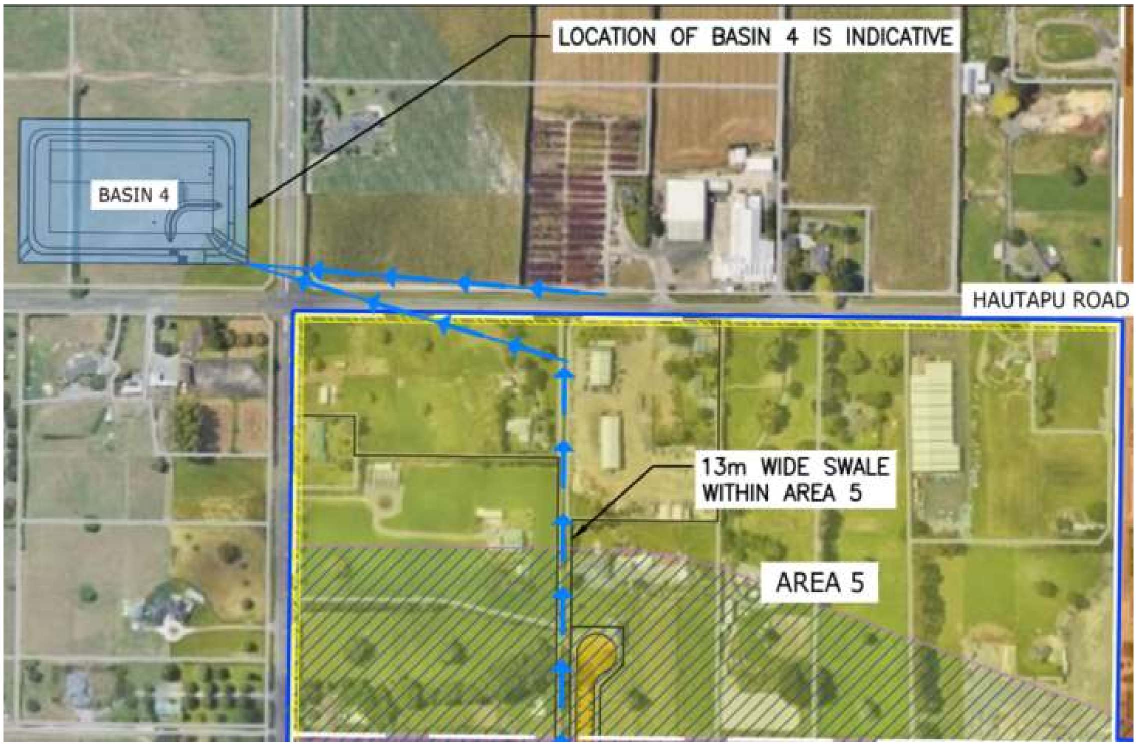


Figure 1: Currently Proposed Location of Basin 4

Figure 2: Option 1 - Proposed Location of Basin 4 – Preliminary Design Only with Basin 4 Separate from Kama Trust Basins

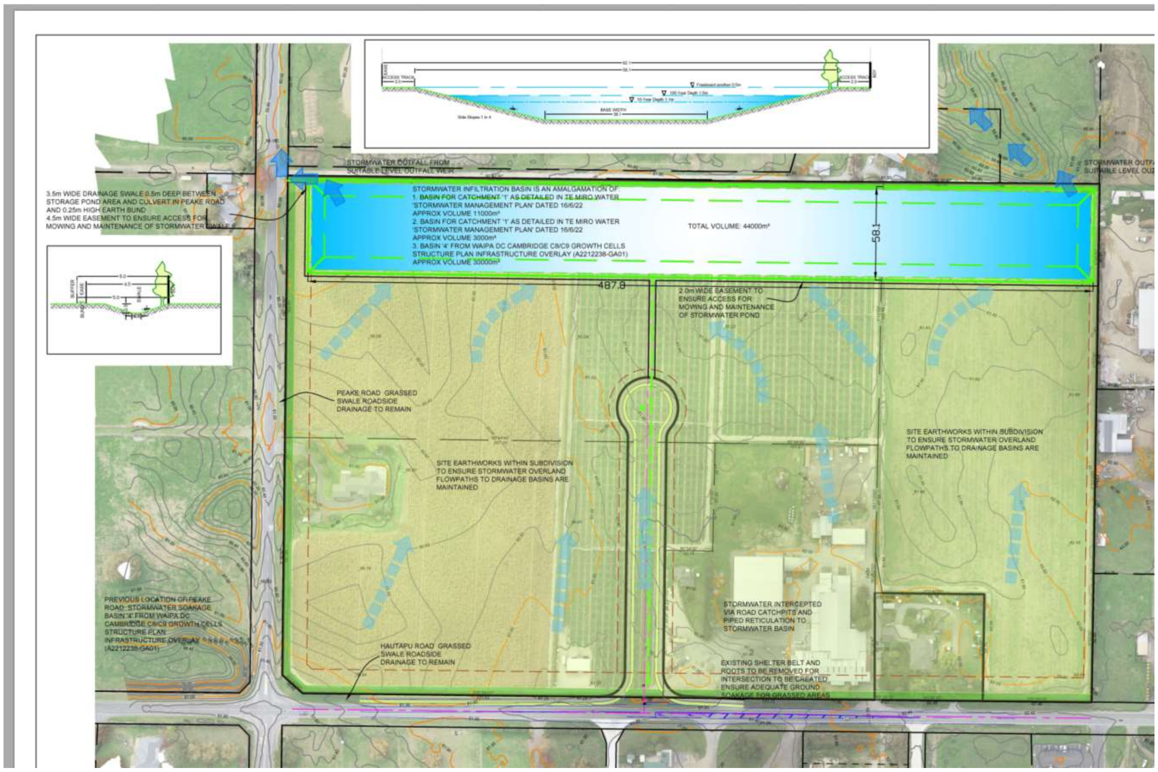


Figure 3: Option 2 – Combined Basin along Northern Kama Boundary

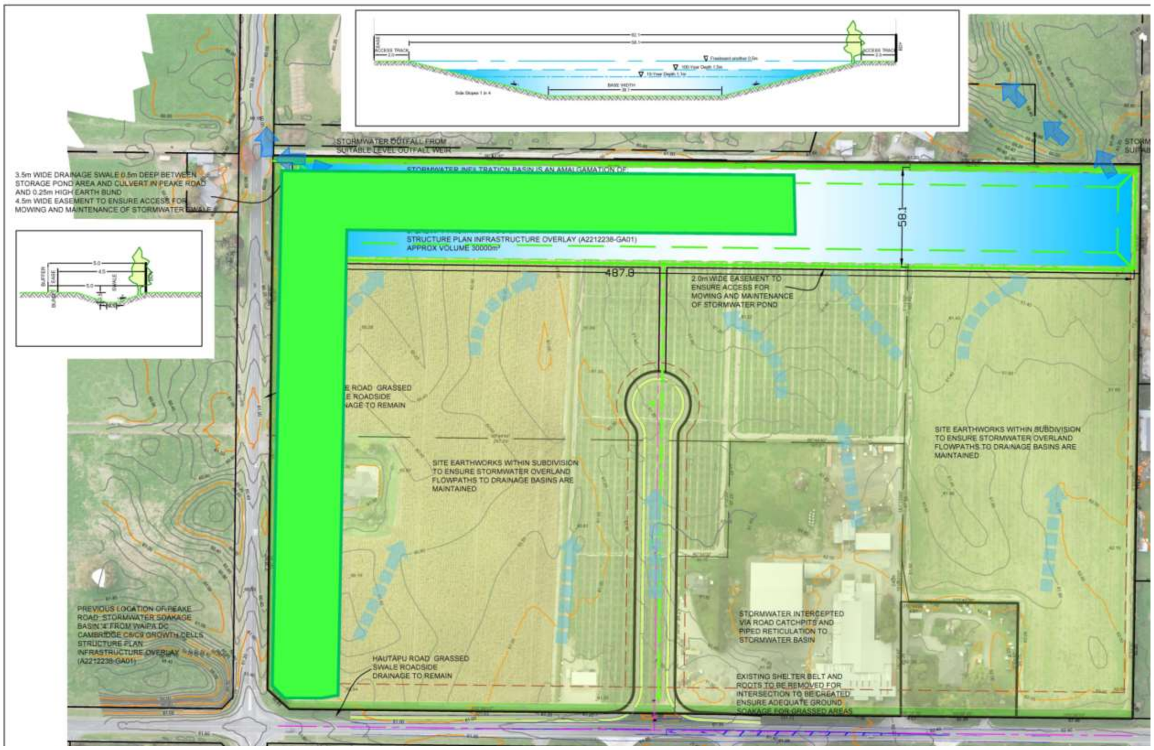


Figure 4: Option 3 – Combined Basin 'L shape' (green indicative sizing)

Basin 4 Design Assumptions (WDC Master Plan)

1. Soakage rates for Basin 4 design are the same as adopted elsewhere in C9 = 30mm/hr. this is allow rate and we recommend testing at Kama trust in the location to confirm actual rates on site. Combined with HIRDSv4 2.1 degree increase for climate change.
2. The flood modelling continues to establish no existing flow connection to the Mangaone Stream. On site management up to the 100yr + cc event was therefore continuing to be an appropriate solution for C8/C9.
3. Movement and enlargement of Soakage Basin 4. The basin area has increased from 2.0 Ha to 2.6 Ha and accounts for additional runoff from Hautapu Road and the local catchment surrounding the basin and Area 5 (see Figure 5 and 6).
4. The incorporation of the Hautapu Road stormwater network from Allwill Drive to the new Basin 4 location. Pipe diameters range from 450 to 1200 mm in diameter (see Figure 6).
5. The extension and incorporation of 2 x 1500 mm diameter culverts under Hautapu Road to convey the Area 5 catchment to Basin 4 (see Figure 6 and Figure 7).
6. Hautapu Road assumed 90% impervious (as for developed C8/C9 developed) – runoff to Basin 4.
7. The twin culverts under Hautapu road convey approximately. 8cumecs. Detailed design will incorporate the Kama runoff into the wider catchment stormwater model for C8/C9 as the hydraulics are complex with flat grades and tailwaters.
8. This flow will also need to be safely conveyed into the new Kama basin accounting for backwater impacts.

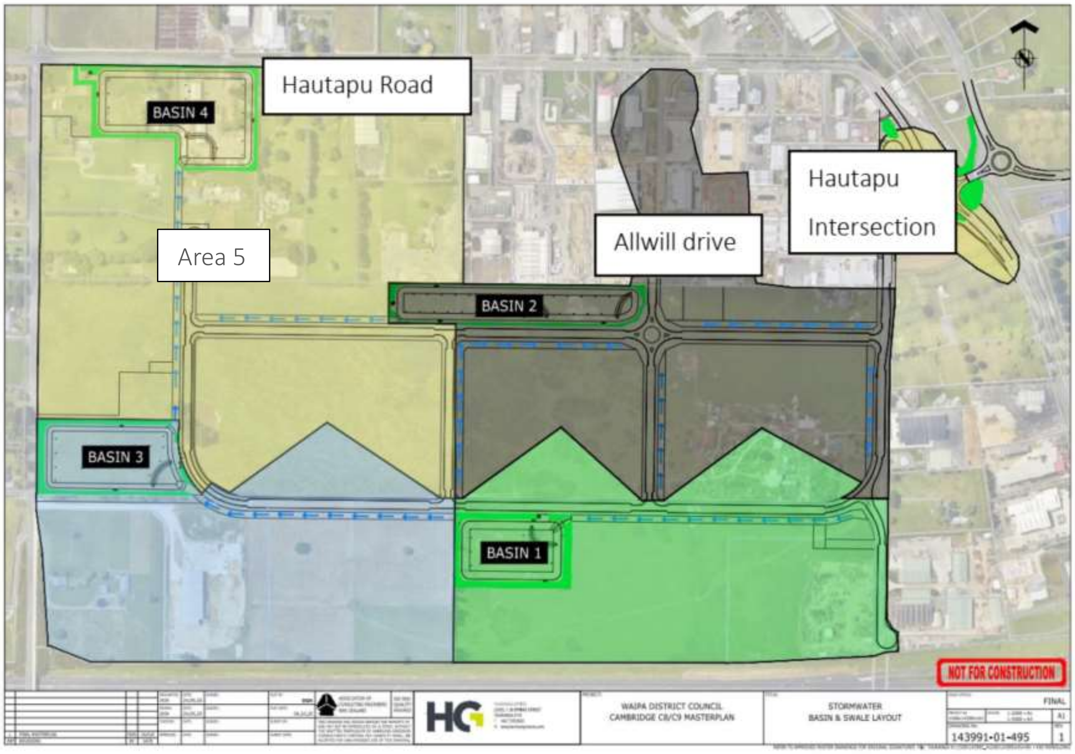
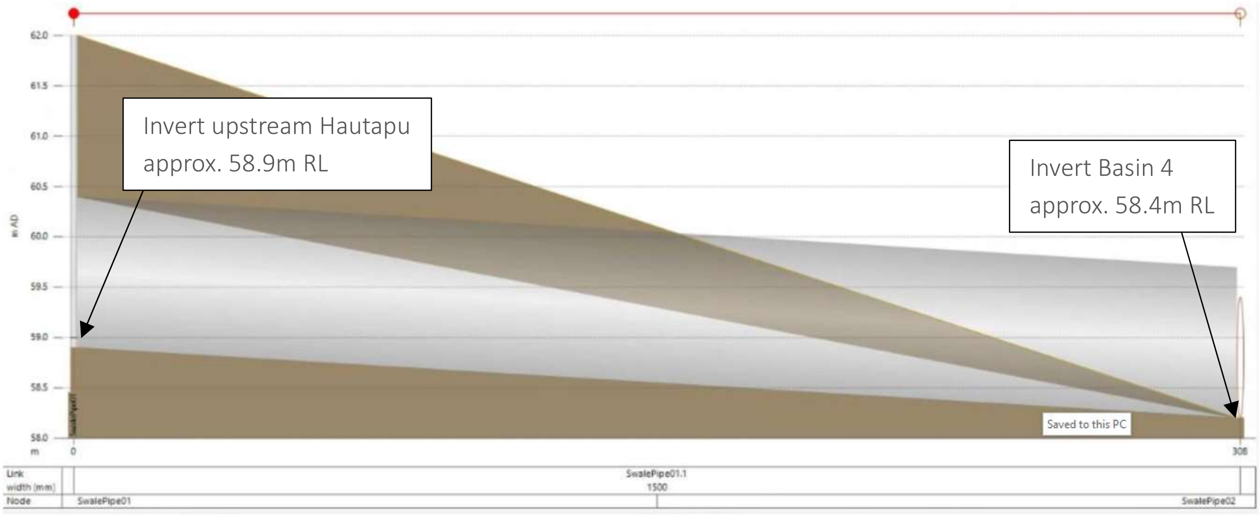


Figure 5: Master Plan Layout – Area 5 Catchment Drains to Basin 4

Figure 6: Proposed Basin, culvert and Allwill Drive network location from 2020 Masterplan.



Invert upstream Hautapu approx. 58.9m RL

Invert Basin 4 approx. 58.4m RL

Figure 7 Culvert under Hautapu Road to Basin 4 with Invert levels of Basin 4

Conclusions and Impact at the Kama Trust Site

1. In accordance with the C8/C9 master plan, no additional/surplus discharge direct to the Mangaone Stream to align with WRC requirements.
2. The 1% AEP can be released to the existing 100-year depression/overland flow paths.
3. Spill point outlet from the proposed L shape basin to existing OLF will need careful design considering landscape bunding and weir design.
4. Noting WRC regional plan rules requiring discharge consent for primary 10yr flow connection direct to a water course. 10yr flows to ground and ‘safe conveyance of secondary flow’ to meet ‘discharge to ground criteria’.
5. Basin 4 size is large relative to the site because it is managing runoff from 3 sources (and low soakage rate 30mm/hr).
    a. Area 5 in C9
    b. Hautapu Road upgrade
    c. Local runoff within Kama trust SW corner
6. The final combined Kama basin could reduce following on site testing and optimisation using catchment model and noting the existing basin invert in the model (58.4mRL).
7. TMW can undertake optimising work following additional soak testing during plan change/resource consent phase using the WDC catchment model.

ATTACHMENT B

DATE 02/08/2022

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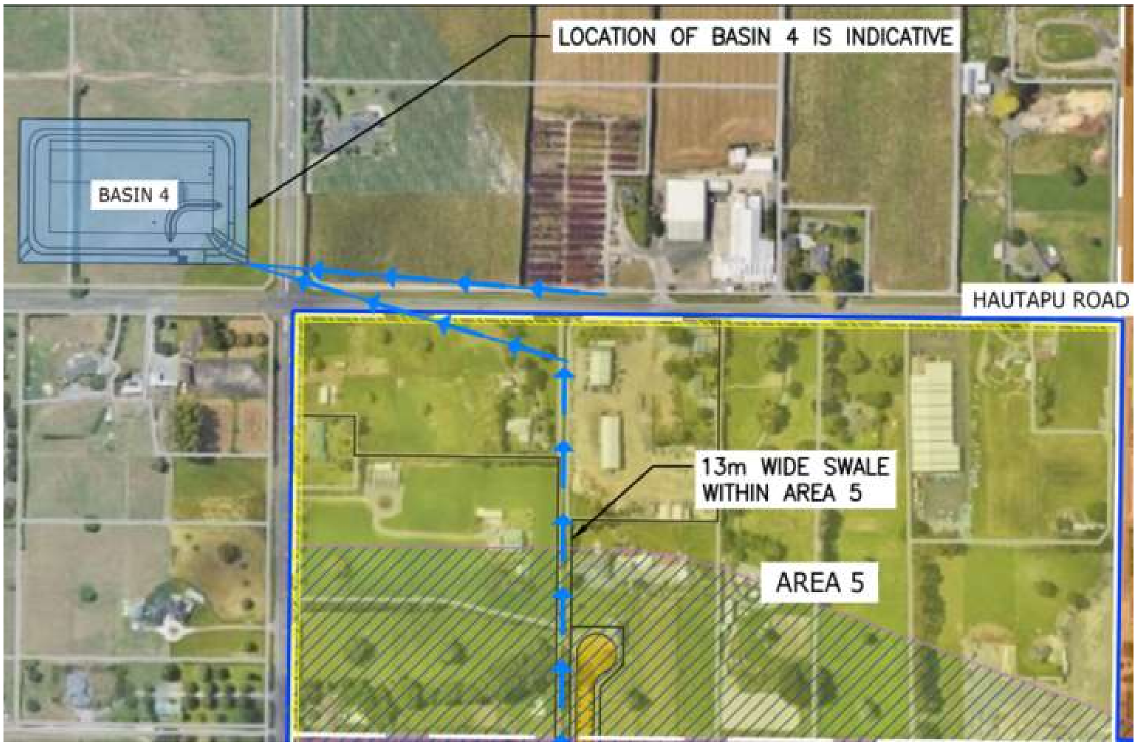

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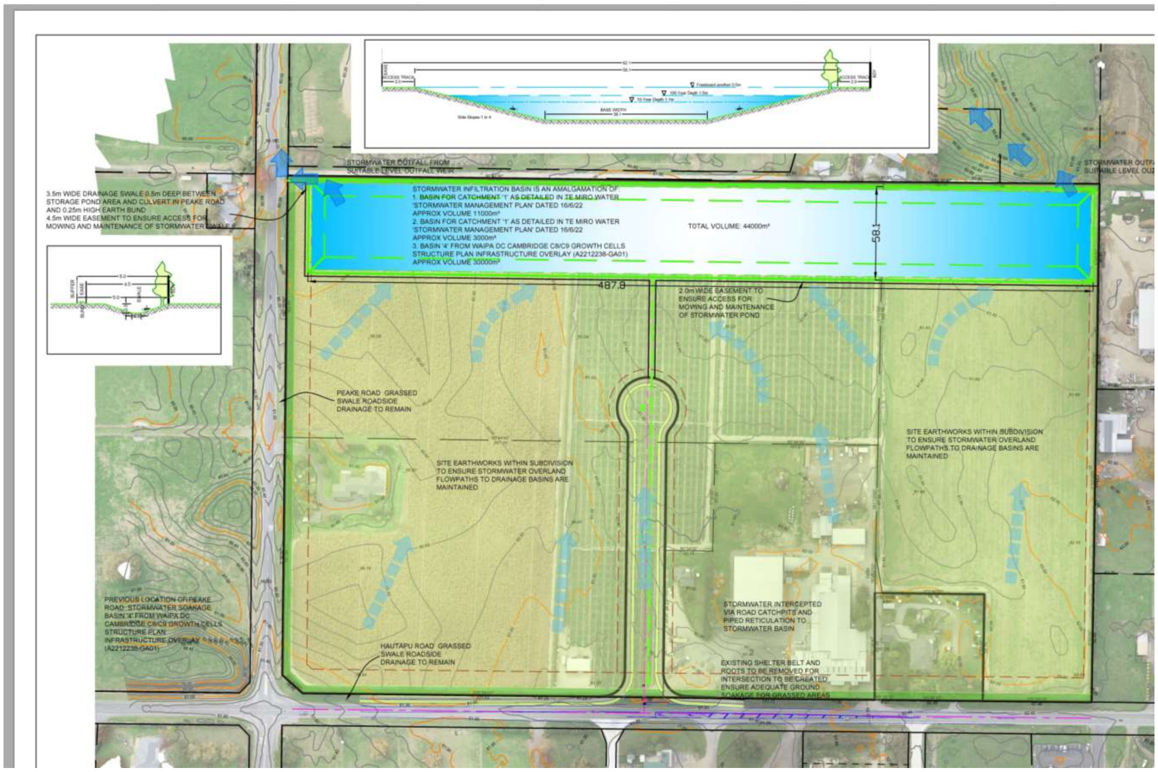

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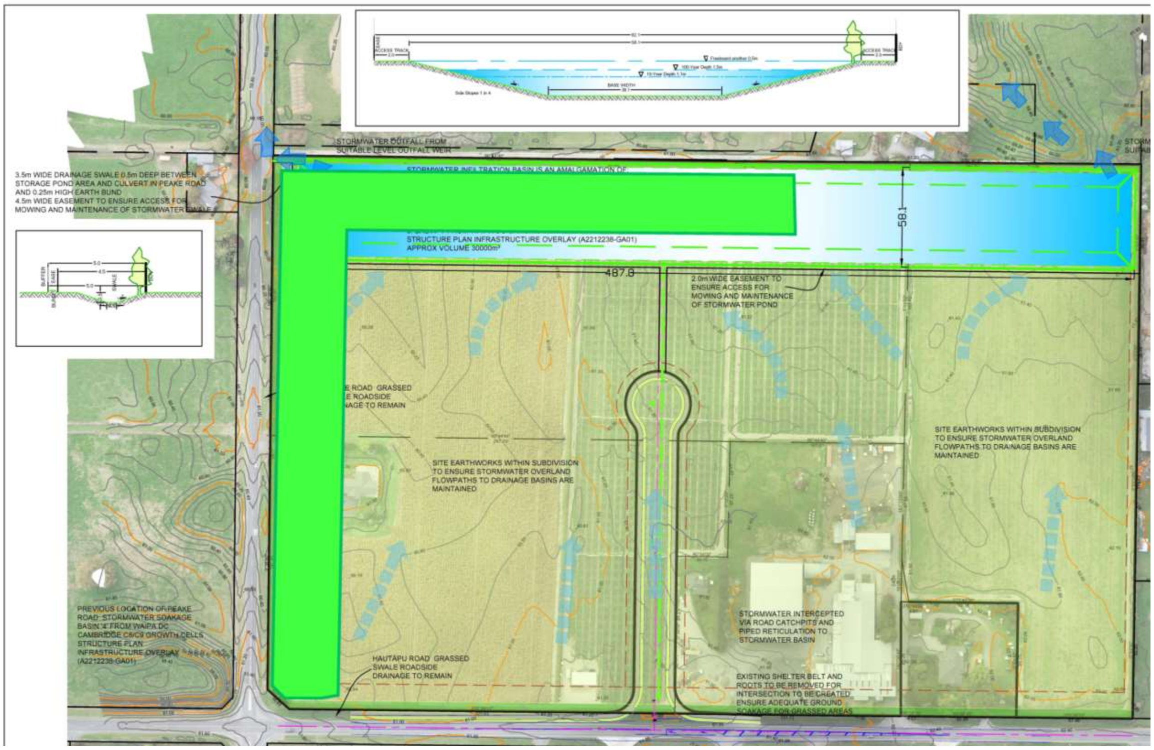

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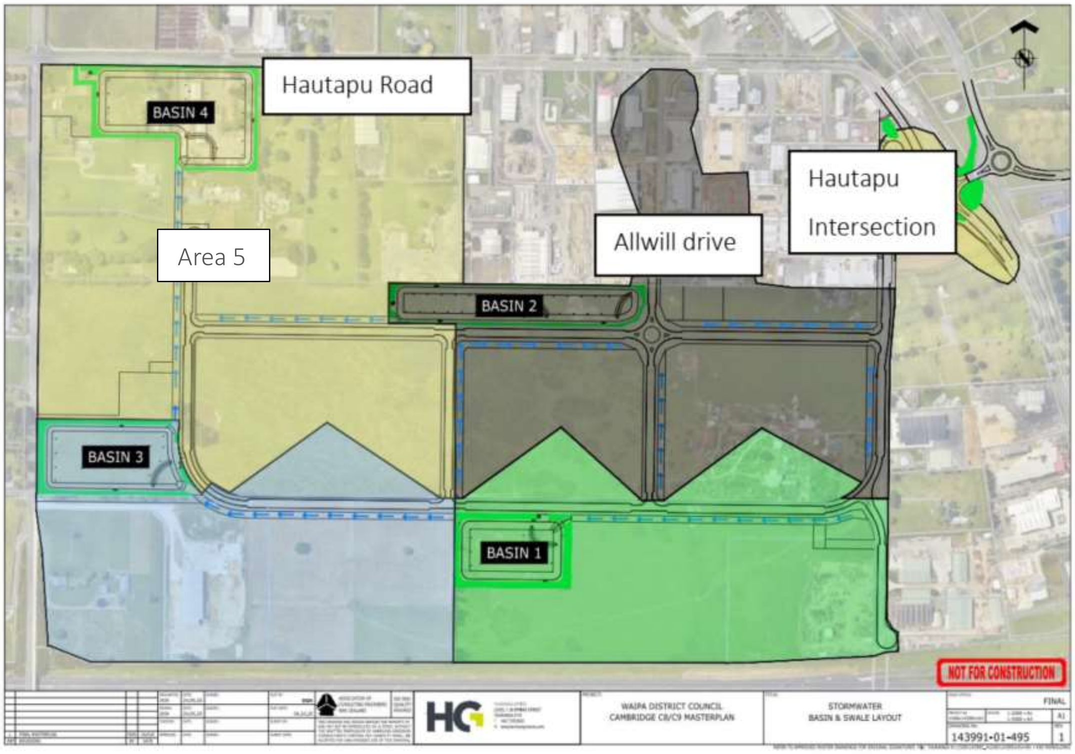

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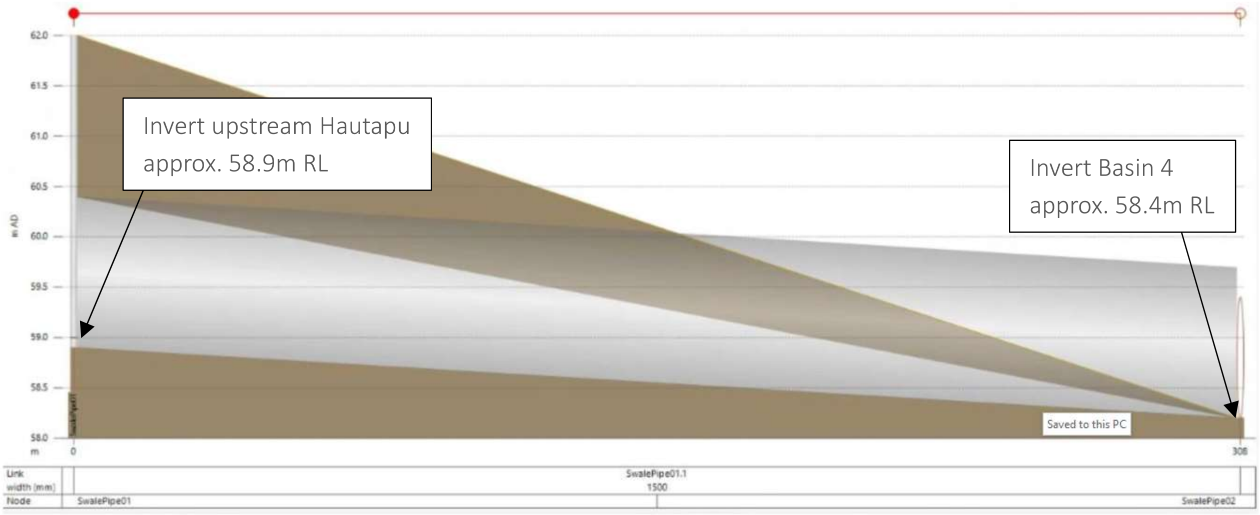

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