NGAWHA INNOVATION & ENTERPRISE PARK
Ultimate Development - Site and Infrastructure Suitability Report

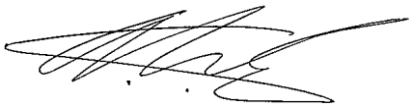
5435 State Highway 12, Ngawha

For Far North Holdings Ltd

14 September 2019
Revision: 1
CCL Project Number: 14190

COOK COSTELLO
DOCUMENT CONTROL RECORD

Client:	Far North Holdings Ltd
Address:	5435 State Highway 12, Ngawha
CCL Reference:	14190
Project description:	Ngawha Innovation & Enterprise Park
Document Name:	14190 – Overview Site Suitability Report
Date of issue:	Sunday, 15 September 2019
Status:	For Resource Consent and Master Planning Use

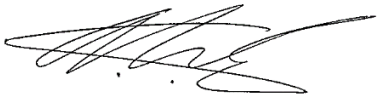


Originator: **Adrian Tonks, Engineer**

BE(ESc), MEngNZ, MACENZ

Reviewed: **Philip Cook, Engineer**

BE(hons), Dip Ag, CPEng, CMEngNZ, IntPE(NZ), MACENZ, MInstD



Approved for issue: **Adrian Tonks, Engineer**

BE(ESc), MEngNZ, MACENZ

Office of origin:	Whangarei
Telephone:	09 438 9529
Contact email:	ccl@coco.co.nz

Version	Date	Comment	
0.0	25/06/2019	Draft issue to project team	Adrian Tonks
1.0	14/09/2019	RC and PPC issue	Adrian Tonks

EXECUTIVE SUMMARY

It is proposed to develop an Innovation and Enterprise Park in Ngawha (NIEP). The Park will comprise of a Horticulture Hub and an Innovation & Enterprise Hub.

The Horticulture Hub contains a 9ha glass house with associated processing buildings and a 63,000m³ water storage reservoir for the retention of roof rainfall runoff. The rainfall capture provides a largely self sufficient water supply for the horticultural needs. A potential future development within the Horticulture Hub would add an anaerobic digester Bio Fuel plant that would convert organic waste to electricity and supply heat and carbon dioxide to the glass house in addition to producing soil conditioners, stock feed and a range of other products. Initial access to the Horticulture Hub is from Wallis Road. A second access to State Highway 12 may be considered in the future should the biofuel proposal progress.

The Innovation & Enterprise Hub is an aspirational suite of related but distinct areas set within an environment that is discrete and sympathetic to the surrounding landscape and character. Lighter activities, particularly those with a visitor aspect (Manuka honey, oil and tea extraction, processing, and retail) are located in the south nearest the entrance, progressing to business and education, with the heavier production activities (processing of graphite, prefabricated building manufacture, along with other future tenant options) located in the north. The proposed entrance from State Highway 12 passes through a mature stand of native trees, predominately Puriri, which have been preserved to provide screening and amenity to the Park.

The Park will provide locally and regionally significant new job growth with a fully developed Park having a projected staffing of 145 at the Horticulture Hub and 299 at Innovation & Enterprise Hub, along with an additional 99 student positions.

The site has excellent development potential with the areas for development within the 204ha property being generally elevated land on flat to mildly undulating topography that is clear of flood hazards, and is not subject to land instability issues. The proposed primary works involve an intersection upgrade at Wallis Road, a new intersection on State Highway 12 opposite Ngawha Springs Road, and bulk earthworks across both Hubs. Earthworks cut to fill volumes total 220,000m³ and occurs across an area totalling 35ha. As would be expected in a rural property with an agricultural and horticultural history, limited areas of contaminated ground have been identified through NES Detailed Site Investigations. Contaminated soil will be managed on site with an estimated volume of 3300m³, although of this only 8m³ exceed threshold values for the Commercial/Industrial land use.

Water Sensitive Urban Design is an underpinning principal to the Parks development and shall maintain the hydrological balance and runoff flow mitigation, in addition to creating habitat and providing landscape aesthetic. The proposed mitigation measures are demonstrated to mitigate peak flow and runoff volume to pre development levels across a full range of events.

The Park is located within the area of benefit for municipal potable and wastewater services, however initial investigations indicate the Public infrastructure is capacity constrained and is unable to service the Park. In light of this a self-contained approach has been taken. The Park is well appointed with raw water sources, with the most likely option being groundwater. The Park is located over a low allocated (<25% allocation) aquifer and deep bore data from the area indicates 100m³/day yield. As a result the Parks total human contact need of 41m³/day could be supplied for onsite treatment and distribution from a single bore. It is proposed to reticulate primary treated effluent from each site by low pressure sewer to a communal secondary treatment facility and communal land disposal field. The required 1.2ha disposal field area is smaller than the nominated field location which totals 4ha.

An integrated traffic assessment has been undertaken for the proposed intersections and concludes that the transport planning effects of the Park can be accommodated on the State Highway 12 transport network without compromise to its function, capacity or safety. Additionally the ITA projects that the Park at ultimate development consumes 15% and 75% of the available capacity at the Wallis Road and Innovation & Enterprise SH12 intersections respectively, and therefore both have capacity to support growth well beyond the projected ultimate demand. Internal to the Park, the design operating speed is 30km/hr and the internal road geometry has been designed to comply with FNDC Engineering Standard Type B Rural Roads.

A feasibility analysis on utilisation of the geothermal resource has been undertaken. It is considered likely that a greater number of direct heat users than are presently proposed would be needed to reach critical mass for the financial viability of a geothermal scheme. Utilisation of the geothermal resource is not proposed at this time.

Existing power and communication services are located adjacent to and within both Hubs and can be readily extend to meet the Parks requirements.

The site is suitable for the proposed Ngawha Innovation and Enterprise Park development and is unconstrained in all aspects for the projected ultimate development, and is unconstrained for further growth beyond that should this occur.

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1. INTRODUCTION

Cook Costello have been engaged by Far North Holdings Ltd to provide a Site and Infrastructure Suitability Report for use in support of a Plan Change and to inform Resource Consent applications to the Far North District Council and Northland Regional Council.

It is proposed to develop an Innovation and Enterprise Park in Ngawha (NIEP). The property is presently in use as a dairy farm which incorporates multiple titles and totals 204ha. The property is located on the northern side of State Highway 12 and has frontage on the State Highway in three locations with neighbouring blocks between these locations resulting in three southern fingers to the property. Finger 1, the western finger, is referred to as the Horticulture Hub. The Horticulture Hub also has frontage to Wallis Road which will be the primary access point, with the State Highway 12 frontage not proposed as an access point in the initial stages. Finger 2, the central finger, is located opposite Ngawha Springs Road and shall contain multiple precincts of the Innovation & Enterprise Hub. The eastern finger, Finger 3, is largely set aside for ecological enhancement, with potentially a Training & Support Accommodation facility proposed in the long timeframe with access provided from Finger 2. In the centre of the property, north of the fingers, the land is of lower elevations with streams flowing east west, with the topography north of this rising on the southern flanks of a scoria cone to its summit.

This report considers:

- Geotechnical suitability of the proposed building platforms for the construction of new buildings. This includes consideration of the existing stability of the site and effects of the proposed development on stability.
- Earthworks
- Stormwater & Flood Assessment
- Potable Water & Fire Fighting
- Wastewater
- Internal roads and service access

Additionally separate reports by others consider:

- Traffic and Access Assessment
- NES Contaminated Land Preliminary & Detailed Site Investigation
- Geothermal Resource Assessment
- Landscaping and Urban Design
- Lighting, Signage
- Noise and Acoustics
- Ecology, Biodiversity and Natural Character
- Solid Waste Management

1.1. Proposed development

It is proposed to develop:

- A new Horticulture Hub comprising of a 9ha glasshouse with associated service buildings and infrastructure including a 63,000m³ storage reservoir. Also in the future, it is possible that a biofuel anaerobic digester will be established in this hub. Initial access to the Horticulture Hub is from Wallis Road. A second access to State Highway 12 may be considered in the future should the biofuel proposal progress.
- A new Innovation & Enterprise Hub comprising of distinctive areas, including processing of graphite, prefabricated building manufacture, along with other future tenant options, an innovation and education support centre, a business centre, and a food production area (Manuka honey, oil and tea extraction and processing). It is proposed to provide for education and training facilities within the innovation and education centre, until such time as there is sufficient demand to establish a dedicated precinct at the northern end of Finger 3.
- In the future, it is intended that a small education facility and associated student accommodation will be established at the northern end of Finger 3.

The development is also to involve:

- Earthworks to create a level building platforms
- Construction of an intersection with State Highway 12 and an upgrade of the existing State Highway 12 and Wallis Road intersection
- Construction of internal roads, driveways, yards and car parks
- Construction of stormwater management infrastructure following Water Sensitive Urban Design principals
- Construction of a new effluent treatment and disposal system
- Construction of potable water treatment and supply
- Construction of fire fighting water storage reservoirs

1.2. Scheme Amendments

The Civils preliminary design enclosed in this report was undertaken in May and June 2019 for scheme Revision 5. Following that time further amendments have evolved the scheme which is presently at Revision 7. The changes between the accessed scheme and Revision 7 are:

- Horticulture Hub – removal of the south eastern fire fighting pond to be replaced with a fire fighting booster pump and ring main with supply from the main horticulture reservoir.
- Innovation & Enterprise Hub – 180° rotation of the Carbonscape building, removal of the secondary yard access from the north, and minor realignment of the internal road centreline westward by <5m.
- Innovation & Enterprise Hub – Spindle building has changed locations with the adjacent Kiln, with Spindle moving south and the Kiln moving north.

- Innovation & Enterprise Hub – addition of the hydroponics glasshouse.

The effect of these changes has been assessed in the various study models for constructability and effect with particular attention given to the current cohort of resource applications. The changes are minor and do not alter from the findings of the scheme Revision 5 study. Discussion within this report has been updated to reflect the latest scheme changes. Update to the surface modelling, stormwater modelling and drawing set have not been made as the expense and impact on the project timeframe is not warranted given the level of change. Scheme Revision 5 approach, findings and quantum remain relevant and correct.

1.3. Relevant Documentation

- AS/NZS 1547:2012 – On-site wastewater
- AS 2870: 2011 – Construction of residential slabs and footings
- Auckland Council technical publications GD01, GD05 and GD06
- Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements. Technical Report 2013/035 (2013)
- ARC TP 10, Stormwater Management Devices – Design Guidelines Manual (2003)
- ARC TP 108, Stormwater Runoff Modelling in the Auckland Region (1999)
- ARC TP 124, Low Impact Design Manual (2000)
- ARC TR 2009/083 – Landscape and Ecology Values within Stormwater Management
- Dept. Lands and Surveys: 1980 – NZMS290 Sheet P04/05 Whangaroa - Kaikohe (SOILS)
- Department of Civil and Environmental Engineering, The University of Auckland: New Strategies for Low Impact Design – Rain Gardens. Course notes December 2010
- Far North District Council: 2016 – GIS Maps
- Far North District Council – District Plan
- Far North District Council: 2009 – Engineering Standards and Guidelines
- Land Information New Zealand – Aerial imagery
- NIWA – The Climate and Weather of Northland, 3rd Edition
- NRC: 2016 – GIS Maps
- NRC: 2004 – Regional Water and Soil Plan
- NRC: 2019 – Proposed Regional Plan
- NZS 4402:1986 – Methods of testing soils for civil engineering purposes
- NZS 4404:2010 Land Development and Subdivision Infrastructure
- New Zealand Building Code: Clause E1 – Surface Water
- New Zealand Building Code: Clause G1 - Personal Hygiene – Second Edition
- NZTA Stormwater Treatment Standard for State Highway Infrastructure (2010)
- NZ Building Code: B1/VM4:

  "Good Ground – means any soil or rock capable of permanently withstanding an ultimate bearing pressure of 300kPa (i.e. an allowable bearing of 100kPa using a factor of safety of 3.0) but excludes:

  a. *Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids,*

  b. *Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS4402 Test 2.2 and a linear shrinkage of more than 15% when tested from the liquid limit in accordance with NZS 4402 Test 2.6 and,*

  c. *Any ground which could foreseeably experience movement of 25mm or greater for any reason including one or a combination of the following: land instability, ground*

creep, subsidence, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots."

- SNZ PAS 4509-2008 – New Zealand Fire Service Firefighting Water Supplies Code of Practice
- United States Department of Agriculture: Urban Hydrology for Small Watersheds. Technical Release 55 (1986)

2. SITE DESCRIPTION

2.1. Site Location

The site is located approximately 3.5 kilometres east of Kaikohe, near Ngawha Springs Road, adjacent to State Highway 12. The southern boundary has frontage at three points to State Highway 12 and the western boundary has frontage to Wallis Road. The legal description of the property is made up of the following titles; Section 15S Te Pua Settlement, Lot 2 DP 196311, Lot 1 DP 172355, Lot 1 DP 190387, Reiwhatia B1 Block, Lot 1 DP 196319, Lot 1 DP 196320, Oraruwharo 5B1A Block, Oraruwharo 5B2C Block. The total area is approximately 204 hectares. Figure 1 below shows the layout of the different blocks, with the overall property outlined in purple.

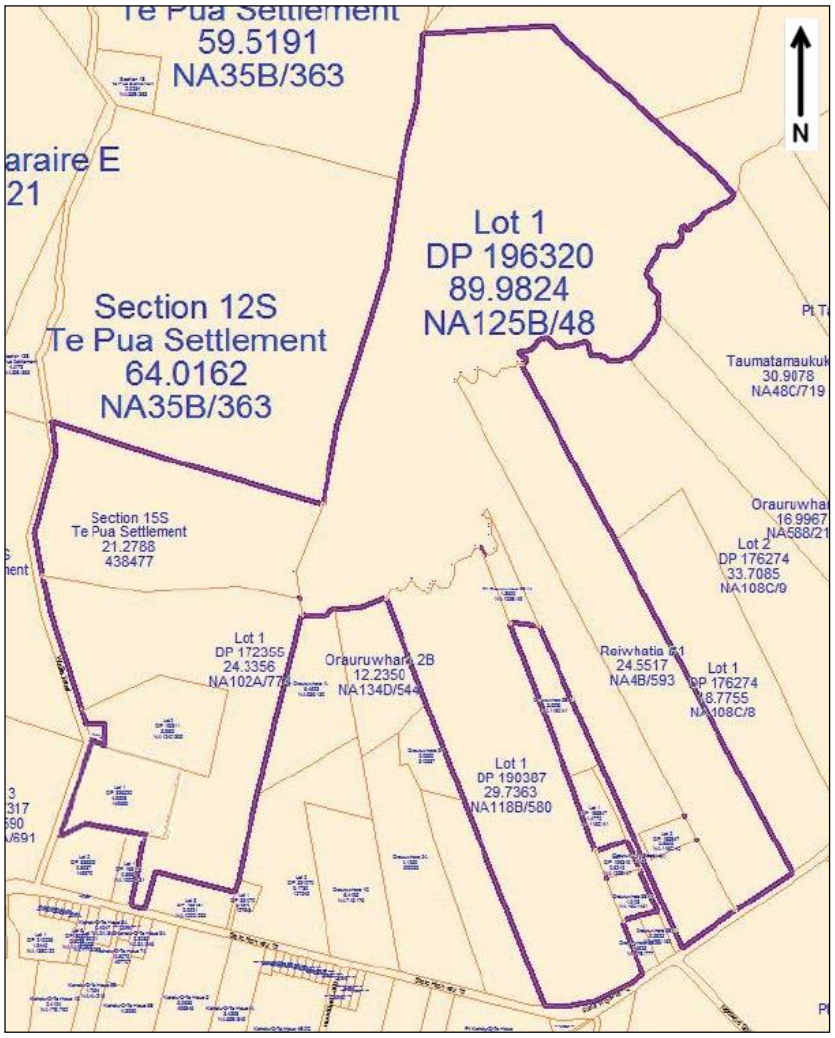


Figure 1. Site legal descriptions with overall property outlined in purple

2.2. Current Land Use

The site is currently being used as a dairy farm, with much of the site developed to support pastoral production (i.e. agriculture) and dairy farming activities. It is intended that the balance of the farm property not utilised within the Innovation and Enterprise Park, will remain in pastoral

farming or primary production. Figure 2 below shows the general layout of the site. Some points of interest are the two water springs at the northern end of the site, the geothermal activity towards the western corner near Wallis Road, the cow milking shed and associated effluent ponds located relatively central on the site and the pond and wetland area located opposite to and providing irrigation water for the Kaikohe Golf Course to the south.

Located in proximity to the site are the Ngawha Springs Thermal Pools, the Ngawha Geothermal Power Station, the Ngawha Regional Correction Facility, and Kaikohe township, with each providing present and future synergies associated with tourism, electricity and heat, and training and education.

2.3. District and Regional Council Maps

A review of the Far North District Council and Northland Regional Council online GIS Maps website shows a number of different map overlays. The following maps were considered relevant:

2.3.1. General Topography

The contour overlay map (Figure 3) indicates that the site is relatively flat with some rolling hills which steepen towards the northern end of the property. The contours also indicate that the site is relatively elevated with the elevations ranging from approximately 215m to 270m above sea level. The blue lines also indicate permanent or ephemeral waterways.

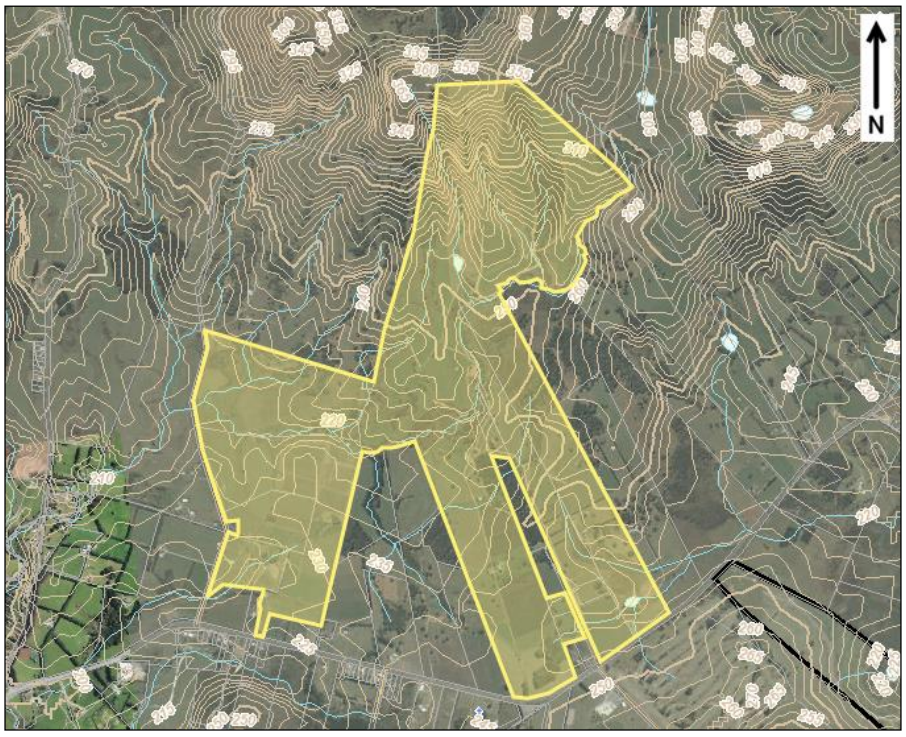


Figure 2. Aerial view of contours of property with waterways shown in blue, from the Far north District Council

2.3.2. Flood Levels

A review of the floodplains maps indicate that the site is not mapped within a flood zone. The site straddles two headwater catchments that ultimately discharge to both the East and West Coast. Areas of development are confined to elevated ground away from the water courses, with much of the wetlands and streams set aside with additional proposed buffer margins.

2.3.3. Hazard Maps

A review of the hazard maps indicates that the site has not been mapped within any extreme flood risk zones, coastal erosion hazards, coastal landslide instability hazards or coastal flood hazards and this expected within inland, elevated location.

2.3.4. Resource Maps

The resource maps (Figure 3) indicate that the northern part of the site is within an area of "Outstanding Natural Feature". It is unclear exactly what this feature is on the Far North District Council website. On the Northland Regional Council website, it appears this may be "Waimimiti Scoria Mounds". This feature is considered further by other technical experts. Refer to the Landscape Assessment (S. Cooker).

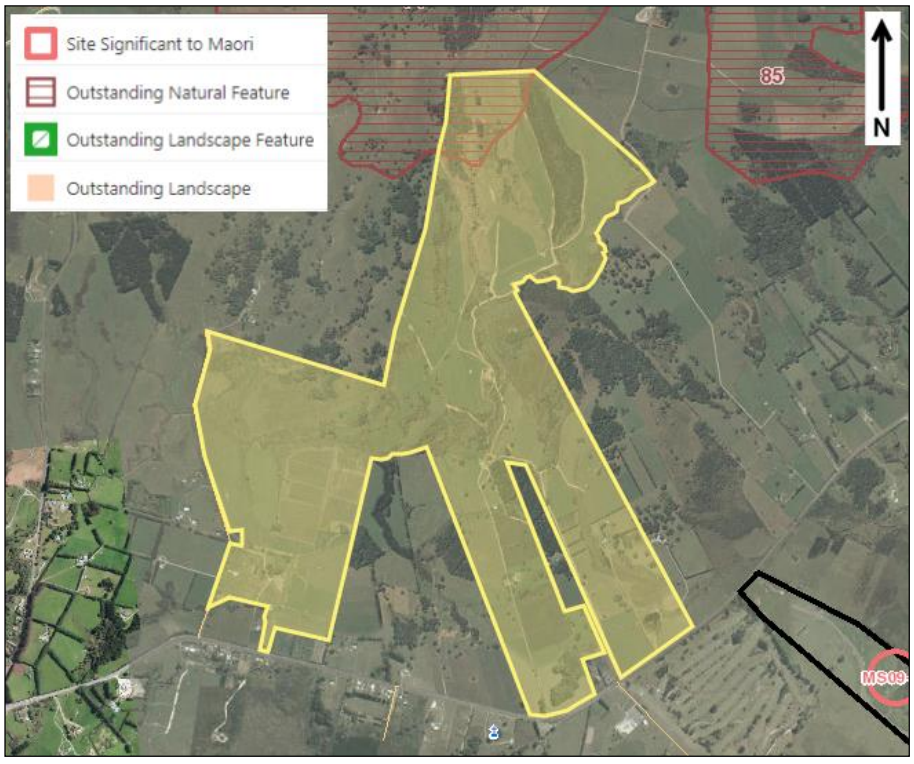


Figure 3. Aerial plan showing area of "Outstanding Natural Feature", from the Far North District Council

2.3.5. Land and Water Resources

The on-site waste water modelling map (Figure 4) indicates that most of the site is within an area mapped as "medium" with an area towards the south-eastern corner mapped as "high".

This is an indicative wastewater potential zoning map. A site specific assessment is discussed within the Wastewater section below.

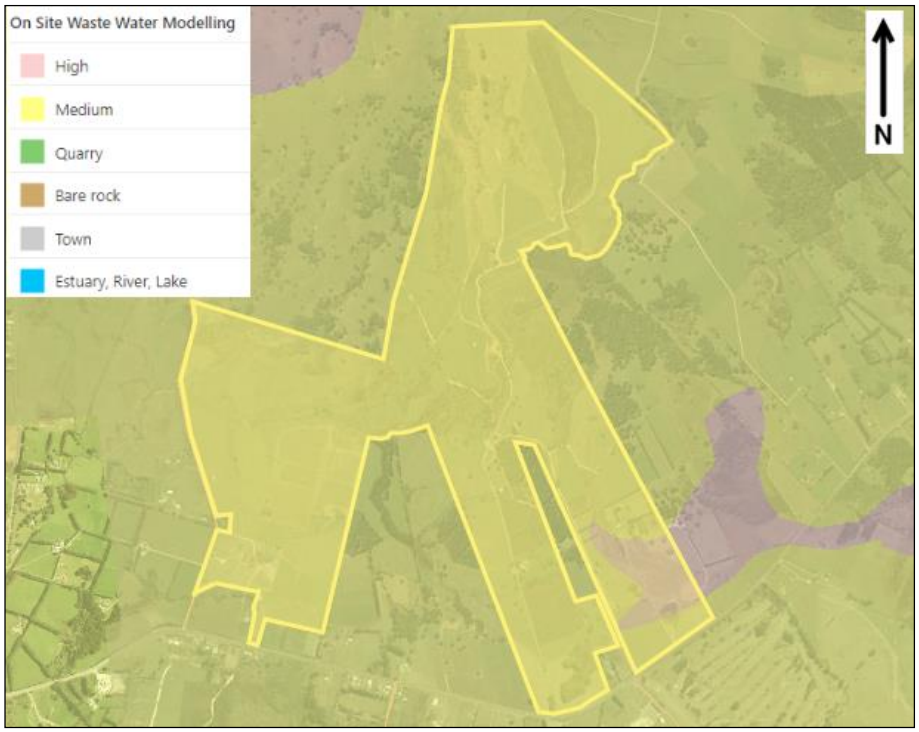


Figure 4. Onsite waste water modelling map from the Far North District Council

2.3.6. Services

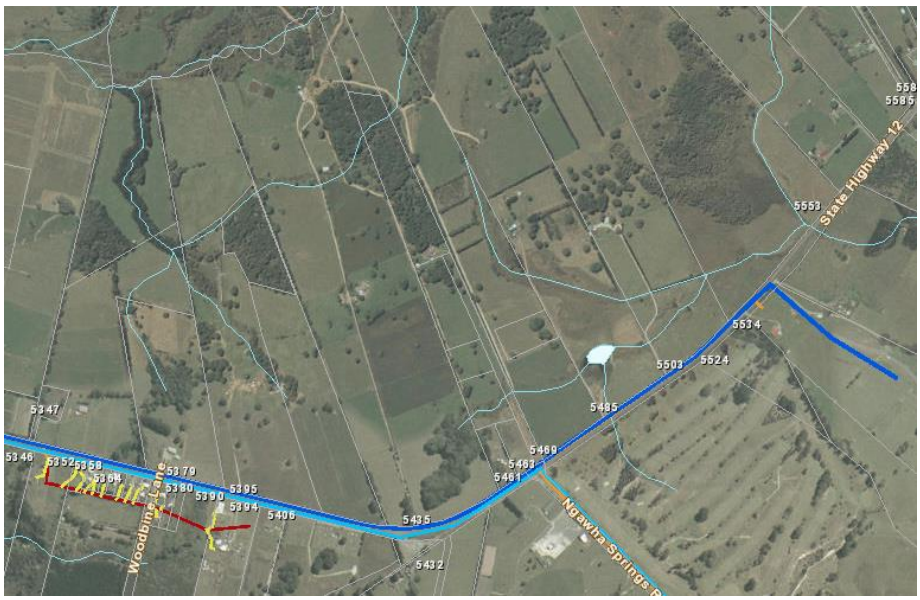


Figure 5. Aerial Imagery & services (FNDC GIS Maps)

Municipal supply of potable and waste water run along the property frontage. Preliminary discussions with Far North District Council Infrastructure Department engineers have however indicated these services are capacity constrained, such that, while this property is within the area of benefit the existing municipal schemes are unable service the Park.

2.3.7. Zoning and Land Use

The District Plan (Figure 7) indicates that the site is zoned “Rural Production”. It is anticipated that zoning will be changed through a Proposed Private Plan Change.

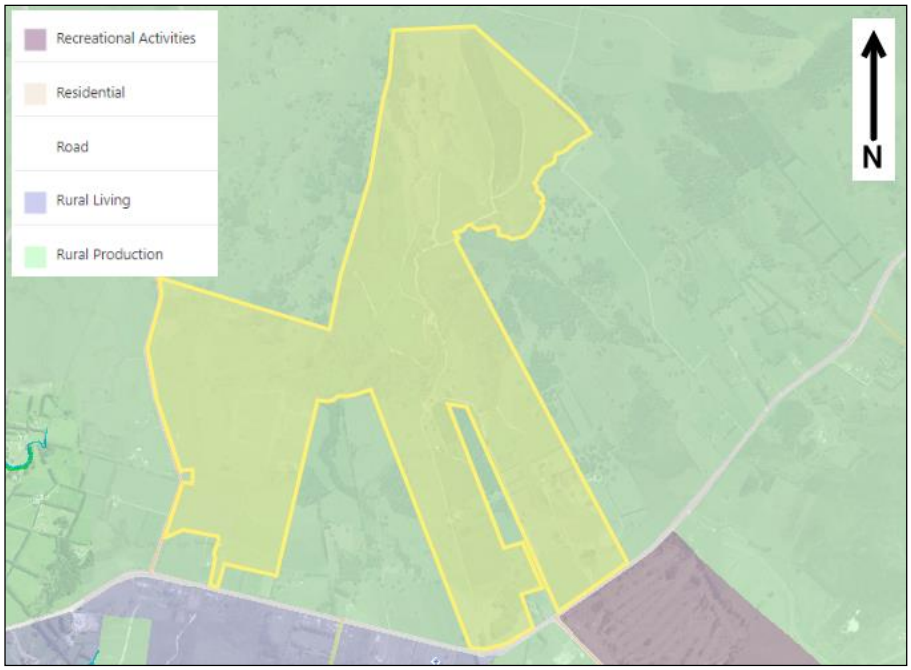


Figure 6. Current zoning of the site and surrounding area from the Far North District Council

2.3.8. Historical Imagery

A review of historical imagery on Google Earth going as far back as December 2004 reveals that the site has been used as a dairy farm throughout this time and no significant features of the site have changed in recent years.

2.3.9. Power and Telecommunication Services

Power and telecommunication services are located adjacent to the site within the State Highway 12 corridor and within the property. Existing Top Energy power lines pass through the central finger and various other locations within the property. The existing lines within the proposed Innovation & Enterprise Hub are to be moved to a new easement along the western boundary of that finger during the initial construction phase of the Parks development.

2.4. Proposed Development

The proposed development is concentrated within the southern portion of the property on the western and central fingers, with centralised utility services for waste water (WWTP) and potable water treatment (WTP) located centrally in the property in vicinity of the existing milking shed. Wastewater disposal is to land on a plateau to the north east of the WWTP and a treated water reservoir providing gravity supply to the Innovation & Enterprise Hub is located to the north of the WTP. The Park will develop over time and treatment, storage and disposal

infrastructure will expand in a modular fashion as uptake dictates. Early stages of the Park development will potentially utilise 'at demand' localised solutions, in particular for water supply.

The property is presently well serviced with internal races and metalled tracks. These will be retained outside of the primary development areas to provide service access and will be incorporated into pedestrian routes. The two development fingers, being the Horticulture Hub on the western finger and the Innovation & Enterprise Hub on the central finger, by in large operate independently of each other and have no proposed formed internal road connection.

The Horticulture Hub contains a 9ha glass house with associated processing buildings and a 63,000m³ water storage reservoir for retention of the roof rainfall runoff providing for a largely self sufficient supply. Traffic movements are relatively low in relation to the size of the development with a projected 110 employees and approximately two truck movements per day. The Horticulture Hub has frontage to both Wallis Road, a metal road which is accessed from State Highway 12, and with State Highway 12 itself. It is proposed to access the Horticulture Hub from Wallis Road. A potential future development within the Horticulture Hub would add an anaerobic digester Bio Fuel plant that would convert organic waste to electricity and supply heat and carbon dioxide to the glass house in addition to producing soil conditioners, stock feed and a range of other products. This future development will likely necessitate an intersection on to State Highway 12 to accommodate the increased traffic movements and to provide a circulating route between Wallis Road and the highway.

The Innovation & Enterprise Hub on the central finger is an aspirational suite of related but distinct precincts set within a built environment that is discrete and sympathetic to the surrounding landscape and character. Lighter activities, particularly those with a visitor aspect are located in the south nearest the entrance, progressing to business and education, with the heavier manufacturing activities located in the north. The precincts are the Honey Manuka, Business, Innovation & Incubator, and Production Precincts. The existing farm access from State Highway 12 is to be retired and a new intersection is proposed to the east of the present crossing location. The proposed entrance passes through a mature stand of native trees, predominately Puriri, which have been preserved and provide screening and amenity to the park.

2.5. Activity and Occupancy

		Area (m²)	Floor Sub Area (m²)				
Hub	Building	Total Roof	Office	Education	Retail	Factory	Accommodation
Hort	Glasshouse	93840	0	0	0	93840	0
Hort	Glasshouse - Plant, Packing & Staff	5000	0	0	0	5000	0
Hort	Glasshouse - MPI	800	0	0	0	800	0
Hort	Glasshouse - Wood store	300	0	0	0	300	0
Hort	Bio fuel	16310	0	0	0	16310	0
I&E	WH1 (Carbonscape)	9633	251	0	0	9382	0
I&E	WH2 (Spindle)	3717	277	0	0	3440	0
I&E	WH2 (Spindle) Expansion	2000	0	0	0	2000	0
I&E	WH3	2300	300	0	0	2000	0
I&E	WH4	2300	300	0	0	2000	0
I&E	WH5	2300	300	0	0	2000	0
I&E	Kiln	600	0	0	0	600	0
I&E	Innovation & Education	1458	1008	450	0	0	0
I&E	Incubator	1733	0	0	0	1733	0
I&E	Honey Manuka	3171	0	0	0	3171	0
I&E	Honey Manuka Expansion	1588	0	0	0	1588	0
I&E	Retail / Café	585	0	0	585	0	0
I&E	Office Hub	1500	150	0	0	1350	0
I&E	Security & Maintenance	0	0	0	0	0	0
I&E+	Hydroponic Glasshouse	5694	200	0	0	5494	0
I&E+	Training + Support Accom	2400	0	0	0	0	2400

Table 1: Building Area (scheme Rev7)

		Total	Stage 1	Stage 2		Stage 3	Stage 4
Hub	Building	Peak	Office / Factory / Students	Office / Factory / Students	Café Patrons	Office / Factory / Students	Accommodation
Hort	Glasshouse	110	110	0	0	0	0
Hort	Bio fuel	35	0	35	0	0	0
I&E	WH1 (Carbonscape)	28	28	0	0	0	0
I&E	WH2 (prefab)	84	52	32	0	0	0
I&E	WH3	8	0	8	0	0	0
I&E	WH4	8	0	8	0	0	0
I&E	WH5	8	0	8	0	0	0
I&E	Kiln	2	2	0	0	0	0
I&E	Innovation & Education Hub	81	81	0	0	0	0
I&E	Incubator Hub	28	0	28	0	0	0
I&E	Honey Manuka Hub	41	41	0	0	0	0
I&E	Retail/Café	9	0	9	210	0	0
I&E	Office Hub	40	0	20	0	20	0
I&E	Security & Maintenance	6	6	0	0	0	0
I&E+	Hydroponic Glasshouse	55	0	55	0	0	0
I&E+	Training + Support Accom	0	0	0	0	0	60

Table 2: Building Occupancy (scheme Rev7)

Occupancy figures are based on prospective occupant surveys and the business case study. The Park development spans multiple stages with Stage 1 associated with a number of individual resource consent applications lodged under the existing land zoning. Parallel to Stage 1 consenting and construction a proposed Private Plan Change shall be applied for and the subsequent stages shall be lodged under the new zone.

Stage 1 results in a 346 peak occupancy including part time students.

Stage 2 expands on Stage 1 adding 177 additional occupants, raising the total peak occupancy to 523 excluding café patrons. In Stage 2 a retail space and café associated with the Honey

Manuka Hub is proposed. The café is expected to occupy approximately half of the proposed 585m² floor and based on a NZBC G1 gross floor area approach of 1.25 patron/m² is anticipated to cater for 210 patrons a day, although a proportion are expected to be internal park occupants.

Stage 3 projects the continued update of office space adding 20 additional occupants raising the total peak occupancy to 543.

Stage 4 is the proposed long timeframe future addition of accommodation to house students on site. The proposed future Training & Support Accommodation is 10 x 2 bedroom units and dormitory of 30 beds, yielding a design occupancy of 60 people. Stage 4 does not alter the total projected occupancy though does lower offsite traffic movements while increasing water and wastewater infrastructure demands.

3. GEOTECHNICAL SITE INVESTIGATION

3.1. Geology

The GNS Science online geology map (Figure 8) defines the underlying geology of the site predominantly as “Basalt lava flows” (Qvb) with the northern area consisting of “basaltic andesite lava” (Pva). The area towards the western corner of the site is defined as “Poorly to moderately consolidated mud, sand, gravel and peat or lignite of alluvial, swamp and estuarine origin” (eQa). It should be noted that an area of the Whangai Formation (Kkw) is located to the south of the site. This consists of Thin-bedded siliceous mudstone, locally with thin glauconitic sandstone interbeds, minor calcareous mudstone and micritic limestone.

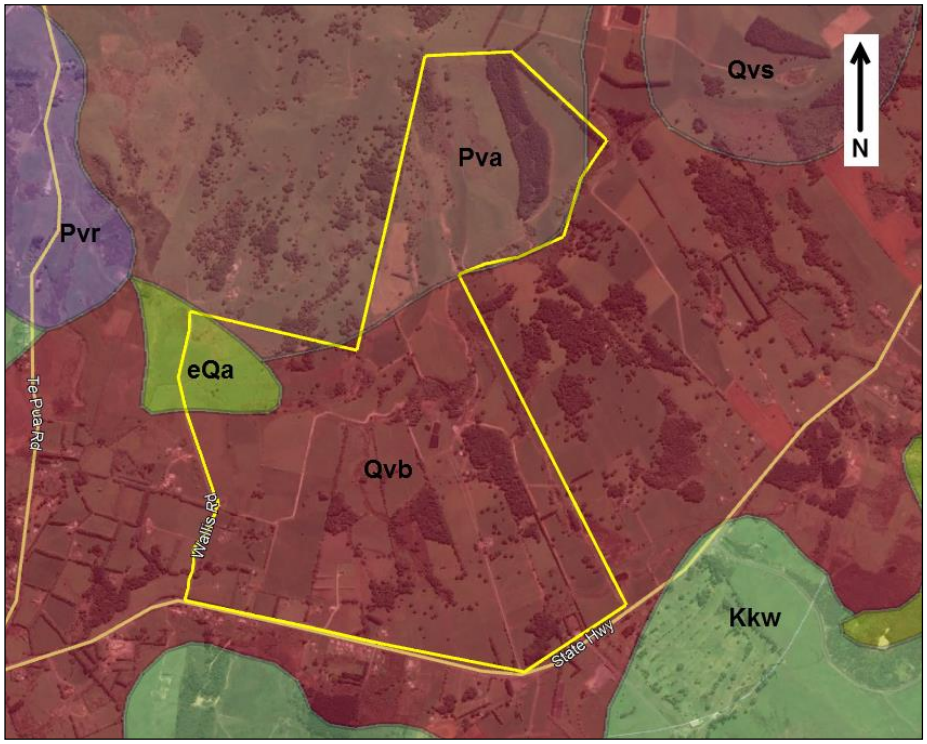


Figure 7. Extract from GNS Science 1:250 000 scale online geology map with geological unit symbols added and approximate site location outlined in yellow

3.2. Soil Types

The NZMS 290 Sheet P04/05 (Figure 9) defines the overlying soil types for the Whangaroa-Kaikohe area. The site is mapped as being underlain by Waiotu friable clay towards the northern side of the site, Whakapai friable clay loam to the south, Ruatangata friable clay towards the west and likely Otaha clay further to the west of the site.

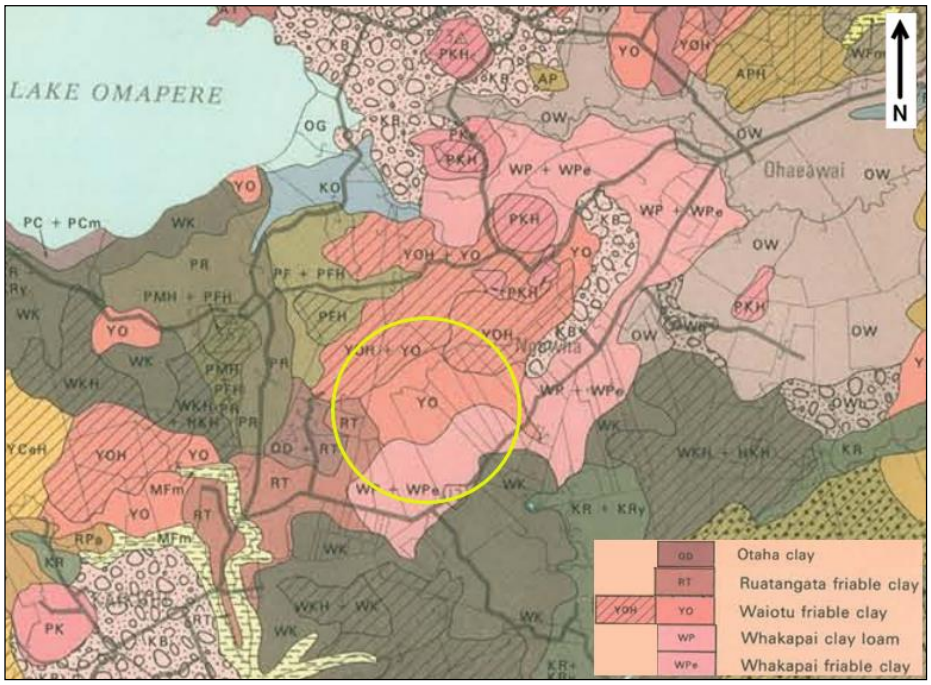


Figure 8. New Zealand Land Inventory NZMS 290 Sheet P04/05 with approximate location circled in yellow

3.3. Site Walkover

A site walkover was undertaken on the 9th January 2019. The purpose of the site visit was to confirm the findings from the desktop study, undertake some limited onsite testing and assess an appropriate area for onsite water storage. The following was noted:

- Much of the site is undulating and contains pasture used for grazing stock and areas of vegetation. Much of these undulations are due to ephemeral water courses and low-lying wetland areas.
- The northern end of the site is relatively steep. There are two ephemeral gullies between ridgelines in this area that could potentially be used for water catchment. Maps supplied by the client indicate that there are two water springs within these gullies.
- The area at the northern end of the site that has been mapped as an outstanding “natural feature” from the desktop study. This is likely to be the “Waimimiti Scoria Mounds”, however, there was no obvious evidence of this observed during the site visit. (Refer to S. Cocker, Landscape Assessment Report, for further discussion).
- Some natural formation of terracettes, indicative of shallow soil creep, are present on the steeper slopes at the northern end of the property.
- The area of geothermal activity to the west of the site was relatively inactive at the time of the site visit with the ground being relatively dry. However there was evidence of previous activity with the ground containing yellow deposits and the smell of sulphur present.
- Over the northern property boundary on the western side of the site, there were many boulders present within the wetlands area.

- At the time of the site visit, Top Energy was conducting some machine augered boreholes as part of their investigation for erecting power pylons through the site, to relocate lines as per their recently obtained easement. A visual observation of one borehole towards the western side of the site revealed Clays down to a depth of approximately 2.5mbgl where upon the volcanic basalt bedrock was encountered.
- It should be noted that not every area of the site was able to be viewed due to access and time constraints.

Three hand auger and Scala penetrometer investigations were carried out at the time of the site visit. These were conducted at the northern end of the site, western corner and south-eastern corner of the site to confirm the three different mapped geological formations within the site. The test locations are shown on the site investigation plan attached as Appendix 1 and test results are attached as Appendix 2.

Test ID	Depth (mBGL)[1]	GWL[2] (mBGL)	Test Results	
			(mBGL)	Soil Type
BH1	3.0 (target depth)	Not encountered	0.0 – 0.7	Clayey SILT with minor rootlets; dark orangey brown; friable; dry (TOPSOIL)
			0.7 – 1.3	Slightly sandy CLAY with rootlets; light brown; sand is fine to medium; stiff; dry; high plasticity
			1.3 – 1.8	Slightly silty and slightly sandy CLAY; orangey light brown; sand is fine-coarse; sand is very weak; dry; medium plasticity. Becomes lighter brown with grey mottling @1.5m
			1.8 – 3.0	CLAY with trace of gravel; very light brown; dry; low plasticity. Becomes damp and high plasticity @2.2m
BH2	3.0 (target depth)	2.8	0.0 – 0.5	Silty TOPSOIL with minor rootlets; dark brown; dry. Contains minor friable clay @0.3m
			0.5 – 0.8	CLAY; dark brown with white mottling; dry; low plasticity
			0.8 – 2.8	CLAY; grey with dark brown mottling; very mouldable; dry; high plasticity Moist @1.6m Wet @ 2.5m Very dense; strong smell of sulphur @2.6m
			2.8 – 3.0	Slightly sandy CLAY; grey with dark brown mottling; sand is medium-coarse; very mouldable; saturated
BH3	1.5 (refusal)	Not encountered	0.0 – 0.4	Silty TOPSOIL with minor rootlets; dark brown; friable; dry. Orangey brown @0.2m
			0.4 – 1.5	CLAY; orangey brown; stiff; friable; dry; low plasticity. Becomes light orangey brown; hard @1.0m

[1] mBGL: metre Below Ground Level [2] GWL: Ground Water Level

Table 3. Summary of borehole results

The boreholes undertaken across the site typically identified CLAY soils beneath the layer of topsoil. This is relatively consistent with the mapped geology across the site. However, the western area of the site was mapped as being alluvial deposits which were not encountered.

Test ID	Depth (mBGL) [1]	Scala Penetrometer (mm/Blow)	Inferred Ultimate Bearing Capacity (kPa)
SP1	0.1	<50mm/blow	>200
	0.4	<28mm/blow	>300
SP2	0.1	<50mm/blow	>200
	0.1	<28mm/blow	>300

[1] mBGL: metre Below Ground Level

Table 4. Summary of Scala penetrometer results

Scala penetrometer results show that an ultimate bearing capacity (UBC) in excess of 300kPa (100kPa) is available from approximately 0.4mbgl. It should be noted that a third Scala penetrometer was unable to be conducted at the location of BH2.

Uncorrected bearing capacities derived from Scala penetrometer tests were estimated using the procedure presented by M.J. Stockwell in the paper 'Determination of allowable bearing pressure under small structures (June 1977)'.

3.4. Conclusion

The findings from the desktop study indicate that majority of the site is relatively suitable for building development. The underlying geology of the site is predominantly volcanic basalt which is likely to have good strength parameters. This material is also considered to be relatively free draining.

3.5. Foundation Considerations

The overlying soil is a combination of different clay types. This is confirmed by the hand augured boreholes carried out onsite. Based on our experience of nearby properties, and the observations from the boreholes, our preliminary assessment is that these clays are likely to be Class M – moderately expansive. This will need to be confirmed by lab sample testing. Due to these moderately expansive clays, NZS3604 foundations will not be suitable and will require specific engineering design.

If it is desired to develop the northern end of the property, it is likely that a slope stability analysis will need to be carried out to determine how suitable this area is for development and if this slope can resist the additional loads from construction. The terracing that was observed in this area indicates that there is likely some soil creep present, however this is outside of the Parks development area.

More intensive geotechnical investigations will be required near the north western corner towards Wallis Road if it is desired to build on this area. This is due to the geothermal activity

in this area and the typically weak nature of alluvial deposits. Although we did not encounter alluvial deposits during the site visit in this area, it is still considered likely that these soils are present due to the site observations and drainage channels in the area. It is unlikely that NZS 3604 foundations will be suitable in this area and therefore specific engineering design will likely be required. As noted earlier, presently this locality is outside of the proposed development area.

All cut and fill operations at the proposed building platforms should be undertaken with care and in accordance with proper engineering practices. All fill within 2m of the building footprint, or with thickness greater than 0.6m, or on slopes greater than 15° shall be specifically considered by a Geotechnical Engineer prior to construction.

3.6. Seismicity

Seismicity parameters may be determined by the risk based method using the earthquake hazard presented in the NZS1170.5. Based on the geotechnical interpretation a classification of 'Class C – shallow soil' is expected. Geophysics would be the best method to confirm and is recommended.

4. CONSTRUCTION MANAGEMENT – CIVIL WORKS

4.1. Onsite Effects:

The main onsite effects is the mitigation of erosion and sediment and dust caused by bulk earthworks operations. Erosion and Sediment Control shall be in accordance with Auckland Council GD05 (supersedes TP90).

An earthworks consent will be applied for to the Northland Regional Council which will include an Erosion & Sediment Control Plan and a Dust Control Plan. Water carts will be available on site for dust suppression. Water supply for dust suppression will be sourced from the existing water bore on site and stored in water tanks, temporary storage pond, and/or sediment retention ponds. A dust suppression volume equivalent to 5mm/m²/day (50m³/ha/day) will be made available onsite.

The development area is predominantly of gentle grade and set back from water bodies and it is expected to be relatively straight forward to comply with the guidance requirements. The primary constraint is the large areas of works, particularly in the Horticulture Hub, and this will be addressed either by restricting the area open at any one time or by increasing the number of sediment retention ponds and dust suppression water storage.

The Wallis Road intersection and new State Highway 12 intersection involve widening works and will be managed with localised erosion and sediment devices and controls.

	Horticulture Hub	Wallis Road & Existing SH12 Intersection	Innovation & Enterprise Hub	Innovation & Enterprise Reservoir Pad	Innovation & Enterprise SH12 Intersection
Cut (m³)	164,320	2250	46,150	1,990	1800
Fill (m³)	139,820	-	42,290	920	-
Bulk (m³)	24,500	2250	(3,860)	1,070	1800
Area of EW (m²)	223,070	2500	120,550	2290	2500
Volume of Topsoil (m³)	33,460	375	18,423	343	280
Contaminated (m³)	600	-	2700	-	-
Max Depth of Cut (m)	6	<1	4.1	3	<1
Max Depth of Fill (m)	4.5	<1	4.1	2.2	<1

Table 5: Summary of Earthwork Volumes and Extent

The bulk earthworks result in all building platforms within the Horticulture and Innovation & Enterprise Hub (excluding the proposed Hydroponic Glasshouse and the future Training & Accommodation Centre). Platforms not developed in Stage 1 will be topsoil spread and re-established in grass. No earthworks or contaminated land will be taken off site. A cut / fill balance will be achieved during detailed design. Topsoil volumes stated in the table above are an assumed 150mm thickness and are included in the cut volumes. Excess topsoil shall be used in the buffer planting areas, and will also potentially be respreads in the effluent disposal field area. All proposed filling is located away from existing watercourse and overland flow paths.

4.2. Estimated construction duration:

The construction of the civil works will be carried out in four areas with the construction duration estimated separately for each area.

Area of Works	Description	Duration	Notes
Horticulture Hub	Bulk Earthworks Civil Works	5-6 Months 7-9 Months	Summer Works (Bulk EW)
Wallis Road Widening & SH12 Intersection	All works	3-4 Months	Some enabling works may be required for utilities
Manufacturing Hub	Bulk Earthworks Civil Works	2-3 Months 7-9 Months	Summer Works (Bulk EW)
Manufacturing Hub SH12 Intersection	All works	3-4 Months	Some enabling works may be required for utilities

Table 6: Estimated construction duration

4.3. Hours of Work:

Construction works will be carried out between 7am – 6pm Monday to Saturday. Construction works outside these hours may be required for a limited duration for special works on the SH12 upgrade/widening to ensure normal traffic operation is not interrupted. Approval for these works will be applied for to the FNDC and the NZTA if required.

4.4. Offsite Effects:

The main offsite effects is the truck movements to and from each site, mainly for imported metal and material supplies to site. All metals imported will need to be sourced from a suitable quarry to meet the required project specification for the application of that metal. There will be no additional movements offsite generated from the bulk earthworks, as the bulk earthworks will be kept at a balance on site for the Horticulture and Innovation & Enterprise Hubs. Any disposal generated from the bulk earthworks for the two intersections will be carted and disposed of on their respective hub and no allowance for truck movements has been allowed for, as this will be minimal. There will also be no additional movements offsite generated from the contaminated land, as these will be dealt with on their respective hubs. The contractor will prepare, obtain approval and follow all necessary traffic management plans and corridor access requests required for all four sites. See table below for estimated truck movements. Note that no day to day workers movements have been allowed for as these are less than the operational workers traffic movements.

Area of Works	Description	Truck Movements	Notes
Horticulture Hub	Establishment Supply Deliveries Roading Metals	20 Trucks 50 Trucks 100 Trucks	Delivery of plant and site office. Mulch not allowed for. 18m³ Truck & Trailer (1.2x bulking factor).
Wallis Road Widening & SH12 Intersection	Establishment Supply Deliveries Roading Metals	10 Trucks 20 Trucks 75 Trucks	Delivery of plant and site office. Mulch not allowed for. 18m³ Truck & Trailer (1.2x bulking factor).
Manufacturing Hub	Establishment Supply Deliveries Roading Metals	20 Trucks 70 Trucks 170 Trucks	Delivery of plant and site office. Mulch not allowed for. 18m³ Truck & Trailer (1.2x bulking factor).
Manufacturing Hub SH12 Intersection	Establishment Supply Deliveries Roading Metals	10 Trucks 20 Trucks 70 Trucks	Delivery of plant and site office. Mulch not allowed for. 18m³ Truck & Trailer (1.2x bulking factor).

Table 7: Estimated Civil construction movements

5. WASTEWATER MANAGEMENT

It is proposed to manage wastewater treatment and disposal in a communal facility servicing the Park in its entirety. This facility will be located in the vicinity of the existing milking shed which is centrally located and has power supply. Disposal is to land and is proposed on an elevated plateau which is located near to the treatment facility. Prospective tenants have been canvased and no trade waste of note, either in volume or constituents, is proposed with the effluent load by in large being human sourced.

	Load l/p
Office	40
Factory/Manufacturing	40
Café	15
Motel	160 (200-40)

Table 8: Design effluent load/person. Sources NZBC G1, AC GD06, ARC TP58, NZS 1547

The future proposed accommodation will house students already located in the Park and as a result the 'Motel' load figure has been adjusted to remove the portion of flow already accounted for in the day activity load.

	WW m³/day (Cumulative total at each Stage)			
Building	Stg 1	Stg 2	Stg 3	Stg 4
Glasshouse	4.4	4.4	4.4	4.4
Bio fuel	0	1.4	1.4	1.4
WH1 (Carbonscape)	1.12	1.12	1.12	1.12
WH2 (prefab)	2.08	3.36	3.36	3.36
WH3	0	0.32	0.32	0.32
WH4	0	0.32	0.32	0.32
WH5	0	0.32	0.32	0.32
Kiln	0.08	0.08	0.08	0.08
Innovation & Education Hub	3.24	3.24	3.24	3.24
Incubator Hub	0	1.12	1.12	1.12
Honey Manuka Hub	1.64	1.64	1.64	1.64
Retail	0	3.51	3.51	3.51
Office Hub	0	0.8	1.6	1.6
Security & Maintenance	0.24	0.24	0.24	0.24
Hydroponic Glasshouse	0	2.2	2.2	2.2
Training + Support Accom	0	0	0	9.6
Total	12.8	24.07	24.87	34.47
Increase At Stage	12.8	11.27	0.8	9.6

Table 9: Design effluent / stage (m³/day).

5.1. Wastewater Load, Reticulation and Treatment

The fully developed wastewater load is projected to total 35m³/day and it is proposed to treat this to a secondary treatment standard.

Conveyance from source is by low pressure sewer (LPS), an approach that is becoming increasingly common in Northland as it avoids gravity reticulation and the topographic constraints that faces, as well as avoiding stormwater infiltration.

LPS has two main variants, either grinder or effluent pump. The grinder pump approach involves a small wet well located at each occupant site or cluster, with a macerating pump

discharging to a common backbone reticulation. The effluent pump is similar however this approach has a primary septic tank in place of the grinder wet well and instead discharges primary treated effluent to the backbone.

LPS effluent pump is indicated to have a lower total lifecycle cost, lower unplanned maintenance requirements, inherently buffers the communal reticulation and treatment system from problematic discharges such as excessive fats, oils and grease, and does not have the minimum flushing velocity requirements of the grinder systems. With these advantages the LPS effluent is likely to be the selected approach.

A communal treatment plant, such as a recirculating packed bed filter, will raise the effluent quality from primary to secondary treatment quality. It is proposed to modularly increase the communal treatment capacity by installing multiple smaller units in parallel as uptake dictates with 15m³/day at Stage 1, 10m³/day at Stage 2, and a final 10m³/day at Stage 4.

5.2. Wastewater Disposal Land Application

An elevated plateau with grades of <10%, totaling 4ha in area and located well in excess of the minimum horizontal setbacks from water bodies is the proposed wastewater disposal location. Allowing for a 30% reserve disposal area the available field size is 2.8ha for secondary treated effluent disposal. The observed soils are basalt derived clay loams and are expected to perform as NZS1547 soil category 4, however as the wider area has a mapped qualitative permeability of medium over slow the lower soil category 5 loading rates have been selected for design purposes.

The proposed disposal method is pressure compensating dripper irrigation. Disposing the fully developed daily load of 35,000l/day, with a design irrigation rate of 3mm/day, and line spacing at 1m, produces a field size of 1.2ha. It is proposed to sequence dose load the disposal field and the field will be developed progressively as the communal treatment facility is incrementally expanded.

An opportunity may exist to use the disposal field for cropping. To achieve this the disposal field would be overspread with topsoil sourced from the Parks developed areas so that the disposal dripper lines are effectively deeper than they would normally be installed. It is likely that tertiary treatment of the effluent water by UV would be needed if this option were to progress.

6. WATER RESOURCES

The property is well appointed with raw water resources.

6.1. Groundwater

The dairy farm is currently using two groundwater springs which are located at elevated positions on the northern slopes. These are accessed by simple surface takes which gravity feed to tank storage, and in turn gravity supply the farm. Both springs flow at ground surface at their take locations for much of the year. Also currently in use by the dairy farm is a shallow 18m bore located in the southern portion of the proposed Horticulture Hub. This shallow bore is within 20m of a deep 84m bore located on the neighbouring property. Bore logs from the deep bore indicate that it yields 100m³/day and is accessing an aquifer formed within a lens of volcanic ash present beneath the overlying basalt flow in that locality. The deep bore is presently unused. No bore log or yield data is available for the shallow bore, it is inferred that this bore is accessing groundwater flow from fissures within the basalt rock. An historic bore is also present within the southern portion of the proposed Innovation & Enterprise Hub. Regionally there are a limited number of bores within 3km of the site with depths varying from 30 to 84m, with those stated for irrigation purposes generally accessing the deeper unit. The site overlies a mapped aquifer with low existing allocation (<25% allocated).

Anecdotally the bore water available is of good quality free from iron and other constituents that would require more involved treatment. An early stage task for the development is to prove this is the case and confirm yields through bore condition assessments of the existing bores and laboratory testing of samples to confirm quality. Geophysics is recommended to assist in identifying shallow groundwater resource accessible to the Innovation & Enterprise Hub.

6.1. Rainwater Harvesting

Mean annual rainfall depth for Kaikohe is 1532mm and rainwater harvesting is a viable option subject to the space for storage being available within tanks or reservoirs.

6.2. Surface Water Takes

Several permanently flowing water courses are present within the property. The catchment is ungauged although a theoretical seasonal estimate indicates yields between 424 and 3574 m³/day. The yield figures have been estimated by scaling down the gauged Punakitere at Taheke flow and applying the Proposed Regional Plan Rules C5.1.8, D.4.16, D.4.14 as well as an assumed maximum practical extraction no greater than the mean flow. Nevertheless achieving this level of take is likely impractical, and given the availability of other options, seeking to take from existing surface water bodies is unlikely to be perused in the foreseeable future.

6.3. Top Energy Consented Surface Water Take

Further afield a Top Energy consented water take is surplus to their requirements and is potentially able to be made available to NIEP. The reticulation distance is approximately 5km and given the availability of other options it is unlikely to be cost favourable to access this source.

6.4. Municipal Supply

In addition to raw water the site is located within the zone of benefit for the municipal water supply of Kaikohe. Initial discussions with Far North District Council indicate that this scheme is capacity constrained and is unable to supply NIEP however further investigation into this statement is warranted.

7. POTABLE WATER SUPPLY

The potable water demand is extrapolated from the waste water load, which is assumed to account for 85% of the water usage. The fully developed human contact demand of 6.8 and 33.7m³/day is projected for the Horticulture and Innovation & Enterprise Hubs respectively, though these figures contain the future demand of the Biofuel (1.6m³/day) and an education facility with student accommodation (11.3m³/day).

The municipal reticulated scheme runs past the property (along SH12 between Kaikohe and Ngawha village), and subject to availability of the supply is a viable option, particularly during the early development stages.

Were the Park to be self-sufficient in human contact supply the most practical approach is for the Hubs to operate as separate schemes or alternatively for each occupant to operate their own scheme. While raw water supply by rainwater harvesting alone is practical, despite the large roof area relative to the occupant density rainwater harvesting requires a large storage volume to buffer dry periods for supply from this source alone. For instance for the Innovation & Enterprise Hub, including Accommodation, to have sufficient storage for secure supply of rain water would require 28 x 50m³ water tanks, or a 1385m³ storage reservoir. Given the availability of groundwater it is proposed that raw water supply is from that source.

7.1. Innovation & Enterprise Hub Reservoir Scheme

For the Innovation & Enterprise Hub the lowest total lifecycle cost is most likely a communal bore and communal treatment scheme, with the storage of processed water within a reservoir located on the northern slopes and gravity supply back to the park. A suitable location of moderate topography exists outside of the are noted as having Outstanding Natural Feature(s) and is elevated approximately 40m above the developed area. Surface modelling demonstrates a cut bench can be masked behind an 3m earth batter totalling 2000m³ earthworks and would yield sufficient area to locate up to 1400m³ of storage within 2 x Ø15x4m tanks or 750m³ in 15 x Ø4.6x3m 50m³ tanks, both of which is vastly greater than NIEP requires and the area could either be scaled down or be utilised to assist the Kaikohe water supply as part of the broader municipal scheme.

Setting aside firefighting flows and supply to the wider area, peak flow (peak factor = 5) to the Innovation & Enterprise Hub is 1.95l/s. The southernmost point in the Innovation & Enterprise Hub is approximately 2km from the reservoir site and peak flow could be supplied in a DN80 pipe with 7.5m friction head loss, leaving a residual head around 33.5m. Alternatively 50l/s firefighting flows could be supplied by DN250 with an 11m friction head loss, leaving a residual head around 29m. Raw water supply for a single deep bore at 100m³/day, or potentially a shallow bore depending on the yield, is more than enough for the needs of the Innovation & Enterprise Hub. Supply to the wider area within the municipal scheme would likely require more than one deep bore with 100m³/day sufficient to supply around 200 residences.

7.2. Innovation & Enterprise Hub Occupant Scheme

Despite the lower total lifecycle cost and breadth of options expected from the reservoir scheme it is possible that the initial capital cost is beyond the means of the development to sustain at its initial stage. The alternative is for occupants to supply their own water. The likely implementation is a communal bore supplying individual occupant tanks with a volume equivalent to 2 - 3 days of their water needs, and individual filter & UV treatment with pump supply. These small tanks are needed to buffer peak flow demands that exceed the bore capacity and would also allow the supply reticulation from bore to tank to be a small DN50 pipe. Raw water supply by rainwater harvesting is also an option but as discussed above requires significant storage.

7.3. Horticulture Hub Scheme

Individual occupants within the Horticulture Hub have relatively low human contact water demands. If municipal supply is not made available, an individual occupant scheme similar to the one discussed for the Innovation & Enterprise Hub is the likely best option. An existing groundwater bore is already present and in use within the area of this Hub.

7.4. Treatment

Drinking Water Standards for New Zealand 2005 (rev 2008) categorises the supply as a small supply in its initial stages (<500 people), and as such, has minimum treatment requirements for rainwater harvesting of prefiltration or selective abstraction (first flush, floating top draw down and alike) followed by chlorine disinfection or by UV disinfection. Treatment for groundwater is similar unless it is demonstrated that the source is a confined aquifer. At its ultimate development the Innovation & Enterprise Hub is unlikely to exceed the small supply definition.

8. HORTICULTURAL WATER SUPPLY

The principal occupant at the Horticulture Hub is a 9ha glass house. Irrigation rates range from 278 to 542m³/day, with 80% taken up by plants and the remaining 20% being collected and recycled. It is proposed to source irrigation water through rainwater harvesting with storage in an 97,256m³ reservoir, with 63,094m³ dedicated to raw water storage and the remainder allocated to peak flow mitigation during storm events (18,421m³) and freeboard (0.3m spillway flow depth + 0.3m freeboard).

The overall area of the reservoir totals 2.94ha and evaporation loss is projected to range between 24 to 120m³/day. There is a degree of uncertainty in these figures as evaporation rates for stored water bodies have been difficult to source and instead the monthly soil moisture balance evapotranspiration rates for the Kaikohe area, seasonally ranging from 0.92 to 4.10mm/d, have been used.

To size the storage requirements and assess security of supply a long time series simulation using the Kerikeri AWS daily rainfall data between July 2004 and March 2019 has been conducted with daily water demand and evaporation loss based on the monthly daily projection to reflect the seasonal variability both in demand and in supply. The rainfall catchment area is all significant roves within the Horticulture Hub as well as the reservoir surface itself. For the glass house occupant alone the catchment area totals 12.69ha, and with the addition of the future biofuel plant increases to a total of 14.33ha.

	Glass House	+ Biofuel
Total Days in Simulation	5363	5363
Simulation Days With Rain >1mm	2056	2056
Max Storage Capacity Utilised	63094	63094
Days Exceeding Storage Capacity	407	550
% of rain events exceeding storage	20%	27%
Average Exceedance Day Overflow m³	1940	2130
Days empty storage	0	0
Days less 10% storage	2	0
Days less 20% storage	93	6
Days of top up	0	0
Minimum volume in storage m³	5860	11330

Table 10: Horticulture irrigation raw water supply, storage and demand simulation – key results

The simulation demonstrates the glass house irrigation requirements can be met though rainwater harvesting alone. Additionally significant firefighting water supply is permanently available from this reservoir.

In scheme Revision 7 a hydroponic glasshouse has been added to the northern extent of the Innovation & Enterprise Hub. At the time of writing little is known of this facilities requirements however assuming these are similar to the main Horticulture Hub glasshouse this hydroponic glasshouse would be self-sufficient in water supply from the proposed roof area and a 4000m³ storage reservoir. The proposed location is in vicinity of existing dairy effluent ponds, which calculated from observation approach this storage volume. The scheme Revision 7 of the

hydroponics glass house clashes in part with these existing ponds and a minor adjustment in the scheme layout would be needed if these ponds are to be retained.

9. FIREFIGHTING WATER SUPPLY

Firefighting water supply is by storage reservoir.

9.1. Innovation & Enterprise Hub

Storage reservoirs have been located within the southern three ponding areas, which themselves have been positioned to provide firefighting supply within 90m of all occupants. It is proposed locate 1000m³ in each of these reservoirs. Due to their position within landscaped ponding areas, it is proposed to locate accessible wet wells adjacent to the firefighting implement hard stands, to aid access. Some roof catchments will discharge stormwater to the wet wells to ensure the firefighting volume remains replenished.

The large fire cells at Carbonscape and at the Prefabricated buildings manufacturing sites will require investigation when the fuel loads and fire cell sizes are determined. The fourth northern pond, which is located beyond and below the elevation of the developed area, is also an option of additional firefighting storage.

9.2. Horticulture Hub

The irrigation storage reservoir simulation projects a minimum stored volume of 5800m³ being permanently available for firefighting. This reservoir is located on the north west side of the glass house. To service the further extents of the building a fire fighting ring main with booster pump supply is proposed.

10. STORMWATER MANAGEMENT

10.1. Stormwater Quantity Mitigation

Far North District Plan 'Rural Production' Permitted Activity rule 8.6.5.1.3 Stormwater Management sets an impervious surface threshold at 15% of the gross site area. The projected fully developed impervious area including the buildings, driveways, roads, car parks, yards and lined reservoir is 25.08ha, 12.3% of the gross 204ha area, and is therefore within the permitted activity threshold when considered as a whole site. FNDC have noted that the permitted activity status does not preclude the use of mitigation measures to improve the overall environmental outcomes. As such provision has been made within the design to accommodate attenuation requirements for the increased runoff as a result of the development along with water quality treatment. Despite the Permitted Activity status the Control Activity rules give design direction. Item 8.6.5.2.1.(b) gives consideration to the extent Low Impact Design principles has been used. Item 8.6.5.2.1.(h) gives consideration the availability of land for the disposal of effluent and stormwater on the site without adverse effects on the water quantity and water quality of water bodies (including groundwater and aquifers) or on adjacent sites; and 8.7.5.2.2.(h) gives consideration to the extent to which landscaping and vegetation may reduce adverse effects. The proposed stormwater practice is highly consistent with these objectives, in addition to achieving the peak flow mitigation requirements.

The Regional Water and Soil Plan section 21.1.1 allows as a permitted activity for the diversion and discharge of stormwater where the collection system is connected to a stormwater system for which a resource consent exists. Section 21.1.2 provides a list of permitted activity rules where not otherwise permitted by 21.1.1. In relation to stormwater quantity Rule 21.1.2.a requires the design to minimize change to stormwater flows after development for the 5 year ARI storm event. 21.1.2.d requires the primary flow capacity for the 5 year ARI flows, and secondary flows by stabilized overland flow path for the 50 year ARI event. 21.1.2.f requires discharge to not cause scour or erosion of the beds or banks of the receiving water body. 21.1.2.i requires the diversion and/or discharge does not cause flooding of adjacent properties.

The Far North District Council Engineering Standards 4.3.2.5.1 Design Storms requires mitigation of the 10 year ARI plus climate change. In recent times Councils processing officers have expanded this requirement to include a range of events up to the 10 year ARI plus climate change, plus consideration of the 100 year ARI +cc event in some circumstances. In this assessment two different rainfall shapes have been considered, the USDA Type 1A and the nested Chicago. The Type 1A, specified in the Whangarei District Council Engineering Standards, represents normal rainfall, and in the high order events represent cyclonic weather with high total rainfall and low peak intensity. The nested Chicago hyetograph, first specified in New Zealand within ARC TP108, represents a high intensity low total rainfall convective thunderstorm event. The design objective has been to mitigate peak flow to pre-development levels for the 2yr present (Type 1A), 5yr+cc (Chicago), 10yr+cc (Chicago), and the 100yr+cc

(Type 1A). Runoff volume change has also been considered for the 1/3 2yr present climate event, which is roughly equivalent to the 95th percentile event. Hydrological models have been built using the SCS Generalised Method as described in "Technical Publication 108, Guidelines for Stormwater Runoff Modelling in the Auckland Region". Rainfall depth and intensity data is sourced from NIWA HIRDS4 with the future climate utilizing the RCP8.5 for the period 2081-2100. The 24 hour rainfall depths for the 2yr, 5yr+cc, 10yr+cc, and 100yr+cc are 118, 185, 219, and 337mm respectively. Peak 10 minute intensities for these events and the applied hyetograph are 5.5, 18.5, 21.9, and 15.7mm respectively. Predevelopment Time of Concentration has been calculated using the "New Zealand Building Code E1 Surface Water" approach.

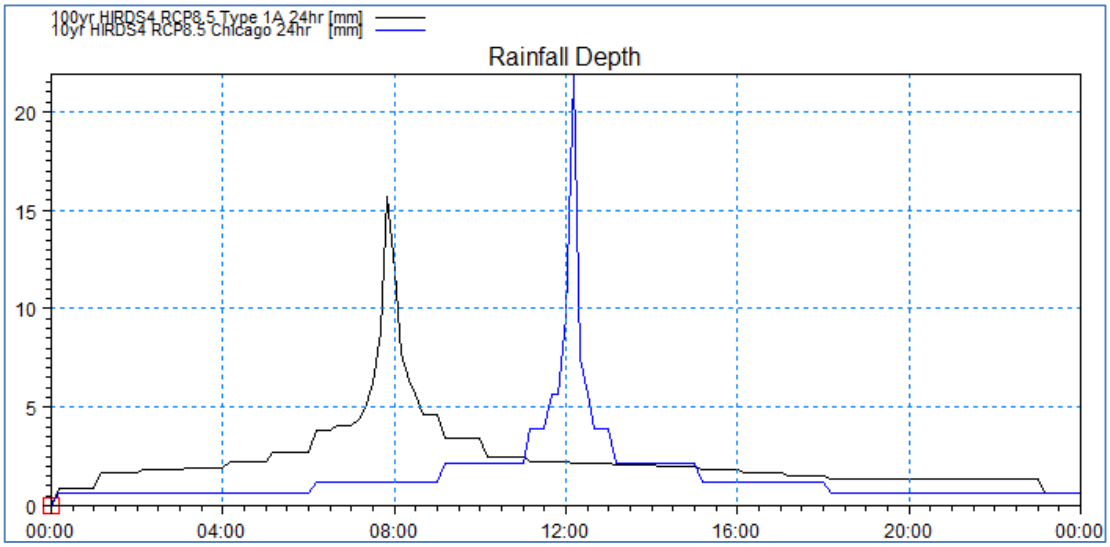


Figure 9: Design rainfall hyetographs

To assess the stormwater runoff change and mitigation requirements a hydrological and hydraulic model has been built using Mike Urban by DHI.

10.1.1. Innovation & Enterprise Hub

The existing topography within the proposed Innovation & Enterprise Hub straddles two catchments. The southern portion discharges to the east in Ngawha Stream, ultimately discharging to the East Coast via the Waitangi River. The northern portion discharges west to the Kopenui Stream, ultimately discharging to the West Coast via the Waima River. One of the design objectives has been to keep the post development catchments similar to the predevelopment case, and has been achieved through the finished surface design.

In keeping with Water Sensitive Urban Design (WSUD) and its predecessor Low Impact Design (LID) primary and secondary flow conveyance is within planted roadside swale drains. Peak flow mitigation has been achieved within four ponding areas with inverts similar to the swale invert in the southern two ponding areas where the topography is flattest. In the southern catchment is one ponding area, in the northern there are three in series. Firefighting water

storage is located in the ponding area and through planting creates a landscaped area with a pond with a planted margin in part of its footprint. Excess roof runoff is discharged directly to the firefighting storage to replenish and refresh that volume with surface runoff discharging to the surrounding ponding area. The firefighting volume is dead storage and is excluded from the stormwater mitigation calculations. The Stage 4 Training & Support Accommodation and the Hydroponic Glass House added at scheme Revision 7 are excluded from the scheme Revision 5 model. Similar mitigation principals will be applied at these areas.

	Area (m²)					Sub Catchment			
Building	Total Roof	Yard	Car Park	Drive	Total	Roof	Yard	Car Park	Drive
Business Hub	1500	0	2570	0	4070	1	0	1	0
WH1 (Carbonscape)	8280	4338	680	270	13568	3	3	3	4
WH2 (prefab)	3690	2400	800	750	7640	4	4	4	4
WH2 Expansion	2000	0	0	0	2000	4	0	0	0
WH3	2300	1470	500	120	4390	1	2	1	2
WH4	2300	1470	500	120	4390	2	2	2	2
WH5	2300	1470	500	120	4390	2	3	2	3
Kiln	600	1000	25	165	1790	4	4	4	4
Innovation Incubator Hub	3150	5390	3005	1074	12619	2	2	2	3
Honey Manuka Hub	5130	3710	982	1020	10842	1	1	1	1
Retail	525	0	0	0	525	1	0	0	0
Road catchment 1	0	0	0	1410	1410	0	0	0	1
Road catchment 2	0	0	0	810	810	0	0	0	2
Road catchment 3	0	0	0	810	810	0	0	0	3

Table 11: Innovation & Enterprise Hub (scheme Rev5) – post development sub catchment component areas

	Surface	Area (m²)	Hydrologic Soil Group	CN	Ia (mm)	ToC (min)
South	Predevelopment	19647	C	70	5	39.9
	Post Pond 1	19647		98	0	10
North	Predevelopment	51597	C	70	5	31.4
	Post Pond 2	21135		98	0	10
	Post Pond 3	16772		98	0	10
	Post Pond 4	13690		98	0	10

Table 12: Innovation & Enterprise Hub (scheme Rev5) - catchment and hydrological model parameters

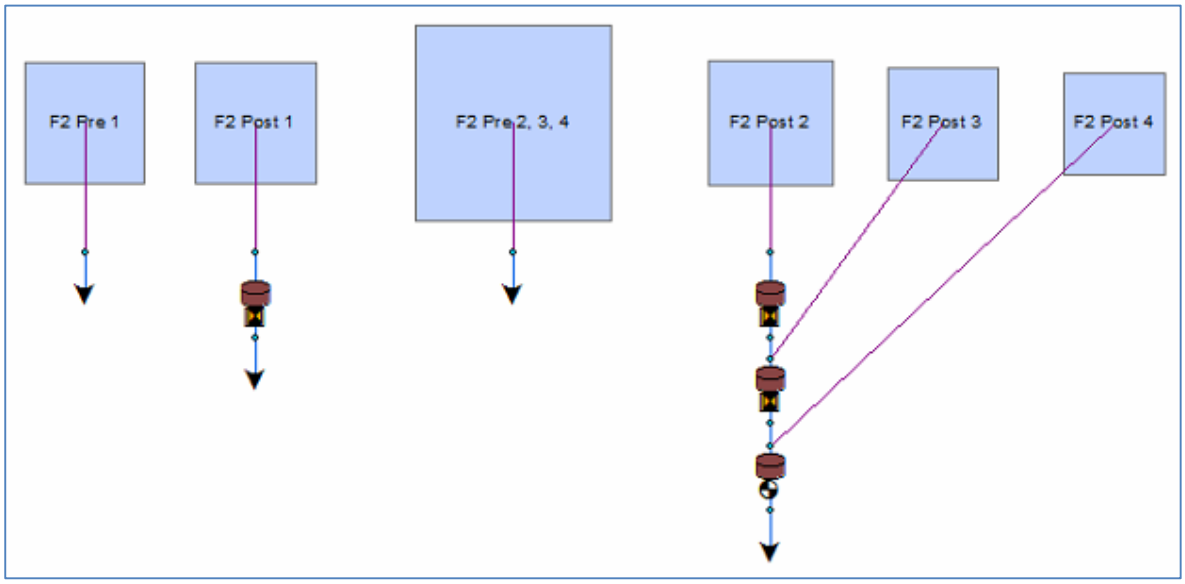


Figure 10: Innovation & Enterprise Hub (scheme Rev5) - hydrological and hydraulic model

	Sub Catch	Pond Geometry (m²)	Outlet Weir	Orifice Ø (mm)	Event (ARI)	Pre Peak (m³/s)	Atten Peak (m³/s)	Atten WL (m)	Atten Vol (m³)	Post to Pre (%)
South	1	IL 2074 1m 2587	V notch 1H:2V		2yr	0.1088	0.0990	0.304	1150	91
					5yr+cc	0.2276	0.2082	0.468	1770	91
					10yr+cc	0.285	0.2570	0.511	1933	90
					100yr+cc	0.281	0.2639	0.517	1955	94
North	2	IL 2000 1m 2504	V notch 3H:1V		2yr			0.348	784	
					5yr+cc			0.404	910	
					10yr+cc			0.427	961	
					100yr+cc			0.409	921	
	3	IL 741 1m 1049	V notch 1H:2V		2yr			0.572	512	
					5yr+cc			0.753	674	
					10yr+cc			0.818	730	
					100yr+cc			0.780	698	
	4	IL 300 2m 782	Rectangle RL 0.98m Width 0.1m	Ø0.395m RL 0m	2yr	0.3276	0.3192	0.939	508	97
					5yr+cc	0.6858	0.5715	1.774	960	83
					10yr+cc	0.8576	0.7025	2.074	1140	82
					100yr+cc	0.8116	0.7243	2.116	1230	89

Table 13: Innovation & Enterprise Hub (scheme Rev5) - hydrological and hydraulic model output

	Pre (m³)	Post (m³)	Diff (m³)	Soil Surface Available (m²)	Soil Storage Volume (m³)	Residual (m³)	Ponding (mm)
South	185	682	497	3104	248	249	80
North	490	1801	1311	4072	326	985	242

Table 14: Innovation & Enterprise Hub (scheme Rev5) – 1/3 2yr (39mm 24hr) runoff volume change

In Table 13 a range of moderate to high order design events are investigated and it is demonstrated peak discharge is mitigated back to or below predevelopment discharge. Table 14 investigates change in runoff volume from high frequency low order events. Literature review indicates change in hydrology for these low order events are principally involved in stream erosion due to their frequency. Table 14 nominally assume a soil depth of 0.4m within the swale inverts and ponding areas with a 20% void ratio and ignores run-over soil depth within the swale batters and exfiltration to the surrounding ground, which will be significant in relation to the small events. The residual volume is then applied to the ponding area to determine the ponding depth requirement, with that water soaking away over 24 – 48 hours. Table 14 shows the runoff volume from low order events can be mitigated back to their predevelopment levels and will be considered further during detailed design.

10.1.2. Horticulture Hub

The Horticulture Hub is located across two catchments of the Kopenui Stream, with the northern portion discharging directly to the stream and the larger southern catchment discharging to a minor tributary whose confluence with the stream is approximately 1km south west of the site on the southern side of State Highway 12. The primary source of irrigation water to the glass house is from collection of roof runoff and the storage of this is within a large reservoir. The diversion of runoff from 14.3ha of roof and reservoir surface alters the catchment boundaries with a net increase to the north catchment of 9.9ha. The design approach is to mitigate within the reservoir live storage such that the peak flows do not exceed the predevelopment catchment

flows. Change in impervious areas in the southern catchment are offset by the reduced catchment size.

Catchment	Subcatchment	Mitigated	m²
North	Hort Glasshouse roof	yes	93835
	Hort Processing roof	yes	3350
	Hort Woodstore roof	yes	400
	Hort Reservoir	yes	29365
	Biofuel Roof	yes	16300
	Hort Process Water	no	11280
	Hort ring road	no	2575
South	Access road, yards, car parks, minor buildings	no	26474
	Fire reservoir	no	1700

Table 15: Horticulture Hub (scheme Rev5) – post development sub catchment component areas

Catchment Change	Area (m²)	Comment
North m² gain from south	101382	Biofuel roof, 80% of glass house, processing roof
North m² loss to south	2462	Wood yard, small portion of access
North m² net increase	98920	

Table 16: Horticulture Hub (scheme Rev5) – sub catchment area change

Catchment	Surface	Area (m²)	Hydrologic Soil Group	CN	Ia (mm)	ToC (min)
North	Predevelopment	58185	C	70	5	24.2
	Post Mitigated	143250		98	0	10
	Post Unmitigated	13855		98	0	10
South	Predevelopment	127094	C	70	5	33.4
	Post Unmitigated	28174		98	0	10

Table 17: Horticulture Hub (scheme Rev5) - catchment and hydrological model parameters

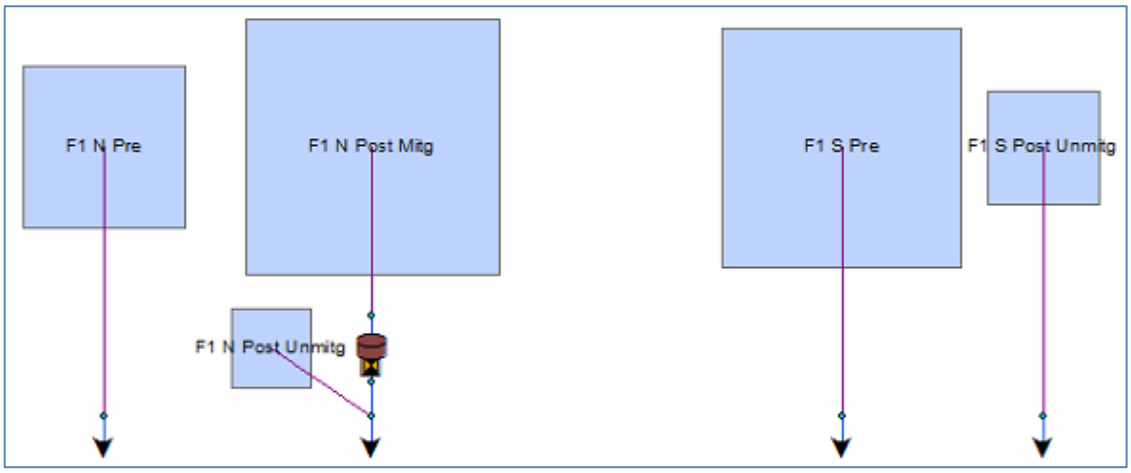


Figure 11: Proposed Horticulture Hub hydrological and hydraulic model

The predevelopment area of the north catchment is the scheme area of improved ground within the predevelopment catchment. The post development is the total scheme improved area draining north. The predevelopment area of the south is the area of improved ground within the predevelopment catchment plus the area of post development improved land gained by the north. The post development is the total improved area draining south.

The primary checks for the north catchment is mitigation of high order events back to their pre development levels. The primary check for the south catchment is runoff volume and discharge of the low order events.

	Live Storage Geometry (m^2)	Outlet Weir	Event (ARI)	Pre Peak (m^3/s)	Atten Peak (m^3/s)	Atten WL (m)	Atten Vol (m^3)	Post to Pre (%)
North	IL 25906 0.75m 27804	V notch 2H:3V	2yr	0.4055	0.3119	0.397	10650	77
			5yr+cc	0.8477	0.6415	0.564	15150	76
			10yr+cc	1.0608	0.8336	0.644	17300	79
			100yr+cc	0.9646	0.9273	0.723	19400	96
South	n/a	n/a	2yr	0.764	0.346			45
			5yr+cc	1.5997	0.7526			47
			10yr+cc	1.9997	0.8927			45
			100yr+cc	1.9248	0.6715			35

Table 18: Horticulture Hub (scheme Rev5) - hydrological and hydraulic model output

	Pre (m^3)	Post (m^3)
South	1199	977

Table 19: Horticulture Hub (scheme Rev5) – 1/3 2yr (39mm 24hr) runoff volume change

Runoff volume change in low order events for the south catchment is lower than the predevelopment case and therefore the unmitigated discharge from the new improved areas is not detrimental to the stream bank stability. Peak flow for the range of high order events is mitigated back to the predevelopment levels for the predevelopment catchment area and as a result there will be no worsening of the flood frequency in either water course.

10.1.3. Hydraulic structures

In both the Innovation & Enterprise and Horticulture Hubs discharge control by V notched weir is preferred as these tend to best match the discharge response over a range of events, both design and their intermediaries. The opportunity will be taken during detailed design to tune these to better match pre to post across the range of events in order to optimize the live storage volume, though the likely gains are expected to be within 10 – 20% of the preliminary volume sizing.

Unmitigated peak Q10 (convective) and Q100 (cyclonic) flow into the Horticulture Hub reservoir is 4.55 and 3.42m^3/s. Assuming a fully blocked outlet the emergency overflow spillway, operating as a broad crested weir with 0.3m flow depth, requires a width of 16m. Above this level is 0.3m freeboard. The live storage operating depth is 0.75m, which combined with the freeboard and spillway flow depth places the dead storage RL 1.35m below the reservoir bund crest.

Within the Horticulture Hub proposed glass house footprint is an existing farm drain that is to be diverted around the building. The catchment of 26ha to the downstream extent of the building is assumed with the Rational Method giving a Q100+cc flow of 3.5m^3/s which can be accommodated within a 0.8m flow depth at 0.5% grade in a channel with 1m base width and

2:1 H:V sides. The selected Manning's 'n' is 0.025 for straight and clean earth lined channel and the resulting Q100+cc velocity is 1.7m/s.

10.2. Stormwater Quality Mitigation

Stormwater quality mitigation shall occur in the swales, ponding areas, and ponds. The swales are generally low gradient and suit check dams to create ponding volumes equivalent to linked rain gardens. The following assessment confirms the proposed measure are sufficient in area to provide the level of treatment required. During detailed design further options and opportunities, such as a constructed wetland in northern Innovation & Enterprise Hub pond and at source treatment will be investigated to further enhance the proposed treatment train.

10.2.1. Innovation & Enterprise Hub – South Catchment

Water Quality Volume calc (TP10 manual method)						
Rainfall	25	mm	90th% Storm Depth. Source NZTA standards pg 221			
Area	39272	m²				
		CN	S (mm)	Ia (mm)	Runoff (mm)	V (m³)
Impervious	19647	98	5.18	0	20.71	406.8
Pervious	19625	70	108.9	5	3.10	60.92
						467.7

Table 20: Innovation & Enterprise Hub – South Catchment Water Quality Volume

Rain Garden Design Elements (TP10)		
Design Parameter	Criteria	Value
Water Quality Volume (m³)		467.7
Planting Soil Depth	recommended 0.85	0.5
Coefficient of permeability (m/day)	recommended 0.75	0.75
Average height (m) 1/2 max depth	max 0.15	0.15
Time to pass WQV through soil bed (days)	recommended 1.5	1.5
Live storage surface area requirement (m²)		623.7
Soil storage surface area requirement (m²)		706.8
Surface area of rain garden (m²)		706.8
Proposed (m²) swales + ponding area less ff pond		2114

Table 21: Rain garden size for water quality treatment

10.2.2. Innovation & Enterprise Hub – North Catchment

Water Quality Volume calc (TP10 manual method)						
Rainfall	25	mm	90th% Storm Depth. Source NZTA standards pg 221			
Area	97135	m²				
		CN	S (mm)	Ia (mm)	Runoff (mm)	V (m³)
Impervious	51597	98	5.18	0	20.71	1068.4
Pervious	45538	70	108.9	5	3.10	141.7
						1209.8

Table 22: Innovation & Enterprise Hub – North Catchment Water Quality Volume

Rain Garden Design Elements (TP10)		
Design Parameter	Criteria	Value
Water Quality Volume (m³)		1209.8
Planting Soil Depth	recommended 0.85	0.5
Coefficient of permeability (m/day)	recommended 0.75	0.75
Average height (m) 1/2 max depth	max 0.15	0.15
Time to pass WQV through soil bed (days)	recommended 1.5	1.5
Live storage surface area requirement (m²)		1613.0
Soil storage surface area requirement (m²)		1828.1
Surface area of rain garden (m²)		1828.1
Proposed (m²) swales + ponding area less wet pond		2032

Table 23: Rain garden size for water quality treatment

10.2.3. Horticulture Hub

Water Quality Volume calc (TP10 manual method)						
Rainfall	25	mm	90th% Storm Depth. Source NZTA standards pg 221			
Area	74874	m²				
		CN	S (mm)	Ia (mm)	Runoff (mm)	V (m³)
Impervious	26474	98	5.18	0	20.71	548.2
Pervious	48400	70	108.9	5	3.10	150.2
						698.4

Table 24: Innovation & Enterprise Hub – South Catchment Water Quality Volume

Rain Garden Design Elements (TP10)		
Design Parameter	Criteria	Value
Water Quality Volume (m³)		698.4
Planting Soil Depth	recommended 0.85	0.4
Coefficient of permeability (m/day)	recommended 0.75	0.75
Average height (m) 1/2 max depth	max 0.15	0.1
Time to pass WQV through soil bed (days)	recommended 1.5	1.5
Live storage surface area requirement (m²)		1396.9
Soil storage surface area requirement (m²)		1388.7
Surface area of rain garden (m²)		1396.9
Proposed (m²) swales		1910

Table 25: Rain garden size for water quality treatment

11. INTERNAL ACCESS

Internal roads and relevant crossings are designed to cater for the semi-trailer vehicle, which is also the design vehicle for the main SH12 intersections. Car parking and yards within individual tenant areas are design to accommodate movement of the relevant vehicle required for each site, being either semi-trailer or 8m rigid truck.

The cross section of the internal roads have been designed in accordance with the Far North District Council requirements. As per the Engineering Standard table 3.1A below, a Type B rural road requires a carriageway with of 6.5m of which is complied with. The operating speed environment is 30km/hr and no super-elevation is proposed because of the low design speed. The horizontal curves radius are dictated by vehicle tracking rather than speed. The vertical geometry is less than 1in8 in all locations.

Area	Description of Road	Carriageway (metres)	Formation (metres)	Minimum legal width (metres)	Kerb	Lights to NZS 6701	Footpath and Berm
Rural	Type A: ultimate development 5 to 15 H.E.	6.0	8.5	16.0			
Rural	Type B: ultimate development greater than 15 H.E. All collector roads	6.5	8.5	20.0			
Rural	Type C: all arterial and strategic roads	7.5	9.5	20.0			
Urban	Type A: ultimate development 5 to 15 H.E. All service lanes	6.5	9.0	16.0	Yes	Yes (Minor Road)	Footpath one side, no berm
Urban	Type B: ultimate development greater than 15 H.E. (except service lanes)	8.0	12.5	16.0	Yes	Yes (Minor Road)	One side
Urban	Type C: (see notes)	12.0	18.0	20.0	Yes	Yes (Minor Road)	Both sides
Urban	Type D: roads with cycle paths (see notes)	14.0	20.0	22.0	Yes	Yes (Intermediate Road)	Both sides

Figure 12: FNDC ES Table 3a from section 3.3.2 Road Geometric Design

12. TRAFFIC ASSESSMENT – SUMMARY OF FINDINGS

An Integrated Transport Assessment, '19121 Ngawha NIEP ITA report v1' dated September 2019 has been undertaken by Traffic Planning Consultants Ltd to assess the impact of the proposed development on the State Highway 12 function and considers the interaction from both the Wallis Road and the proposed Innovation & Enterprise Hub SH12 intersections. The ITA excludes the proposed Biofuel facility within the Horticulture Hub which will be assessed at a future point in time when this progresses to a preliminary stage and the facilities requirements and traffic generation are better understood.

The ITA concludes that it is considered that the transport planning effects of the proposed Ngawha Innovation and Enterprise Park can be accommodated on the transport network without compromise to its function, capacity or safety.

The ITA projects that at ultimate development cases consumes 15% and 75% of the available capacity at the Wallis Road and Innovation & Enterprise SH12 intersections respectively, and therefore both have capacity to support growth well beyond the projected ultimate demand.

The ITA also considers the first cohort of individual tenant resource applications and concludes that these sites are expected to be more than adequate to accommodate their respective anticipated peak parking demands.

13. CONTAMINATION – SUMMARY OF FINDINGS

A contaminated land Preliminary Site Investigation (PSI) and two subsequent Detailed Site Investigation (DSI) reports have been completed by NZ Environmental. These reports identify the present and past land use is dairy farming with some cropping and minor sheep grazing. The Preliminary Site Investigation identified a number of areas of interest. The DSI reports investigate those areas within the extent of the Parks development, with the purpose to identify the presence and/or general extent of soil contamination, and to consider the risk posed by any contaminants to human health under the proposed Commercial/Industrial land use.

Laboratory testing has been undertaken on soil samples collected in a stratified method using grid and targeted samples. Where samples identified contamination these were by in large below the standard for Commercial/Industrial outdoor worker. Contaminants of concern exceeding Rural Residential/Lifestyle 25% produce land use, but below Commercial/Industrial land use, remain areas of interest and are identified on the Civil earthworks drawing set.

Within both hubs individual areas exceeding Commercial/Industrial guideline values were identified and relates to elevated arsenic. The estimated volume is ~4m³ in each location. The options for this soil is removal from site to an approved landfill, or for the soil to remain onsite. A Remedial Action Plan will be submitted to Council once the preferred option is decided.

The DIS indicate that with the exception of the identified Control Area and Areas of Interest, soils at the property are highly unlikely to pose a risk to human health under the proposed change of land use to Commercial/Industrial.

14. GEOTHERMAL ASSESSMENT – SUMMARY OF FINDINGS

A feasibility analysis on utilisation of the geothermal resource has been undertaken by University of Auckland for the Ngawha Innovations & Enterprise Park. The study investigates the resource potential in relation to utilisation of direct heat and CO_2 from the geothermal field for horticulture and other potential direct-use applications.

The reports main findings are:

- The gas quality of the CO_2 produced in Ngawha is not suitable for agricultural use due to the high H_2S content, which is detrimental to the growth of most market vegetables inside the proposed glass houses.
- The Ngawha geothermal system is a low enthalpy geothermal system with a conductive temperature profile up to depths of 600-1100m and has a high gas content. Drilling deep wells (>1000m) will be at high risk (low success rate) and high cost.
- The application of down-hole heat exchangers (DHE) is not recommended because of the conductive shallow behaviour of Ngawha wells, which will reduce the thermal power output of any DHE and the output fluid temperature.
- An option to provide geothermal power to the project site is to tap into the existing wells on the Top Energy site. Well NG3, which is not currently in use for production, is the nearest (~ 3km) well to the project site and can be used to produce substantial thermal power. However, access to the well and reinjection of the produced geothermal fluid should be addressed first.
- The most likely option to provide geothermal heat to the Park is a heat exchanger on the reinjection water as it is discharged from the Top Energy power station.

It is anticipated that a larger number of direct heat users than is presently proposed would likely be needed for a scheme to reach a critical mass sufficient to achieve financial viability due to the cost of the heat exchanger and long transmission system.

Utilisation of the geothermal resource is not proposed at this time.

15. CONCLUSIONS

The site is suitable for the proposed Ngawha Innovation and Enterprise Park development and is unconstrained in all aspects for the projected ultimate development, and is unconstrained for further growth beyond that should this occur.

Geotechnical

A building platform of sufficient area has been nominated at the proposed building platforms. Based on this geotechnical investigation it is considered to presently be stable and suitable for the proposed development. Development will need to be carried out in accordance with the recommendations of this report and proper engineering practices.

Findings from the desktop study and limited onsite testing indicate that much of the site is relatively suitable for development. The following considerations will need to be made prior to any detailed design commencing:

- Much of the site is underlain by volcanic material which is considered to be relatively free-draining.
- The clay soils present on-site are likely to be Class M – moderately expansive. Lab sample testing will be required to confirm this.
- If it is desired to develop the northern end of the property, a slope stability analysis will likely be required to determine if the slope can handle the additional loads of any development. Current land features indicate that some soil creep is likely taking place.
- More intensive geotechnical investigations will be required near the western corner towards Wallis Road if it is desired to develop this area. This is due to weak alluvial deposits being present and geothermal activity in this area. Presently this area is outside of the proposed development.
- Further onsite testing will be required to assist with the preliminary and detailed design process. Shallow rock is expected to be encountered at varying depths across the development area. A geophysical survey is recommended to inform construction cost estimates, to identify points of interest in relation to the proposed development for intrusive geotechnical ground investigation, and to assist in locating shallow groundwater resources.
- It should be noted that this report should not be used as part of any design or building consent process. It is only intended to provide a preliminary overview of the property to assist with the project direction. Further testing and reporting will be required to assist with preliminary and detailed design phases.

Wastewater

Both the Horticulture and Innovation & Enterprise Hubs are within the area of benefit for municipal reticulated waste water scheme. However initial discussion with Far North District Council indicate this scheme is capacity constrained and is unable to take the Parks flow.

A central scheme receiving inflow from both Hubs by Low Pressure Sewer is proposed. The combined fully developed flow is 35m³/day and will be treated to secondary treated quality and disposed to land by pressure compensating dripper irrigation within dosed loaded field totalling 1.2ha. Treatment and disposal systems will be expanded as the Parks uptake dictates. The nominated field location is significantly greater than the ultimately development requirement, totalling 4ha.

Human Contact Water Supply

A range of options for raw water supply are available with groundwater bore being preferred as it avoids the large storage requirements of a rainwater source. The site is located over a mapped low allocated aquifer and both shallow and deep groundwater resources are present. Proving the groundwater yield and quality is a priority action. Raw water is to be treated to New Zealand Drinking Water Standard. Either a communal gravity water supply scheme or individual occupant treatment and pump supply scheme are viable, with the latter likely having lower initial capital cost to the Park but overall higher total lifecycle cost. The economics of this remain to be tested.

Horticultural Water Supply

Irrigation water for the glass house is to be rainwater harvesting with storage within a large reservoir, which serves the dual purpose of stormwater mitigation and fire fighting supply. Long time series simulation demonstrates the glass house can be entirely self-sufficient in water supply though it is expected a groundwater bore backup supply may also be sought.

Fire Fighting Supply

Fire fighting water supply is by on-site storage within reservoir ranging from 1000 to 5000m³ permanent storage located within 90m of all occupants.

Flooding

The development area at both Hubs are not affected by flooding.

Stormwater Quantity Mitigation

Water Sensitive Urban Design is an underpinning principal to the Parks development and shall maintain the hydrological balance and runoff flow mitigation, in addition to creating habitat and providing landscape aesthetic. The proposed mitigation measures are demonstrated to mitigate peak flow and runoff volume to pre development levels across a full range of events.

Stormwater Quality Mitigation

The proposed linked rain gardens, swales, and ponding areas create a treatment train and have sufficient area to provide stormwater treatment.

Contaminated Land

Limited areas of interest, containing soil that exceeds the 'Rural Residential/Lifestyle 25% produce' land use, but is below 'Commercial/Industrial', have been identified within the development areas of the Horticulture and Innovation & Enterprise Parks. The likely effected volumes are 600m³ and 2700m³ for the hubs respectively. While it is not proposed to remove topsoil from site the soil from these areas would not be suitable and will be managed onsite.

On both hubs there are individual isolated areas totalling approximately 4m³ each that exceed the 'Commercial/Industrial' standard and will be managed onsite.

Traffic Assessment

The Integrated Traffic Assessment concludes that the transport planning effects of the proposed Ngawha Innovation and Enterprise Park can be accommodated on the State Highway 12 transport network without compromise to its function, capacity or safety.

The ITA projects that the Park at ultimate development consumes 15% and 75% of the available capacity at the Wallis Road and Innovation & Enterprise SH12 intersections respectively, and therefore both have capacity to support growth well beyond the projected ultimate demand.

Internal to the Park, the individual tenant sites are expected to be more than adequate to accommodate their respective projected peak parking demands. The design operating speed within the park is 30km/hr and the internal road geometry complies with FNDC Engineering Standard Type B Rural Roads.

Geothermal Assessment

It is likely that a greater number of direct heat users than are presently proposed would be needed to reach a critical mass for the financial viability of a geothermal scheme. Utilisation of the geothermal resource is not proposed at this time.

Power and Communication

Existing services are located adjacent to and within both Hubs.

16. LIMITATIONS

This report has been prepared for the benefit of Far North Holdings Ltd as our client and for Far North District Council and Northland Regional Council as a Site Suitability Report as defined in the brief for the proposed change of land use at 5435 State Highway 12 in Ngawha. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

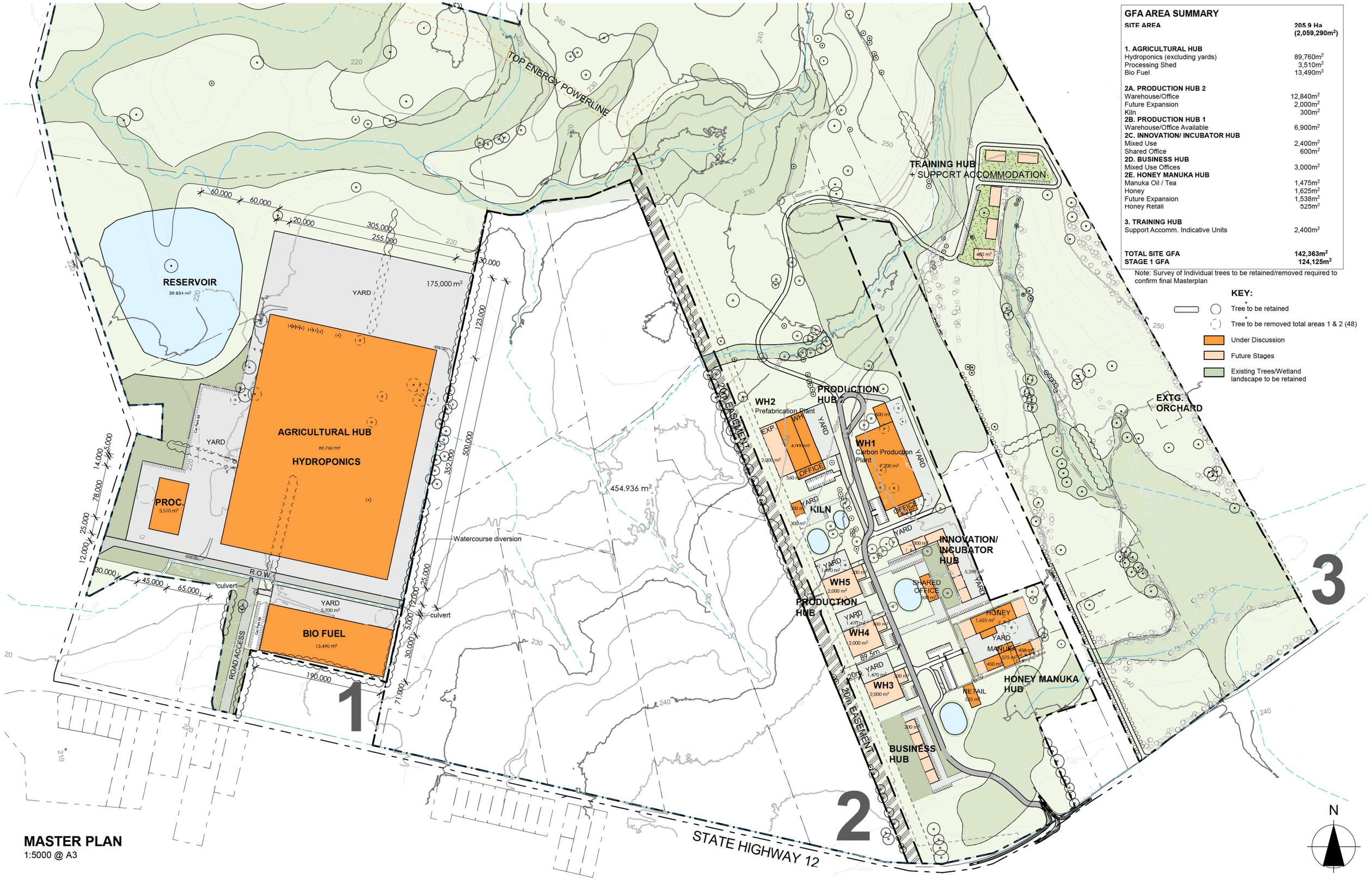
Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgments are to be relied on they should be independently verified with appropriate legal advice. Any recommendations, opinions, or guidance provided by Cook Costello in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Recommendations and opinions in this report are based on data from observations and limited intrusive ground testing undertaken on site. The nature and continuity of subsoil conditions away from test locations are inferred and it must be appreciated that actual ground conditions could vary considerably from the assumed model.

Cook Costello have performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

If there are any queries regarding the content of this report, please do not hesitate to contact the authors.

APPENDIX 1. SCHEME REVISIONS



GFA AREA SUMMARY

SITE AREA	**205.9 Ha (2,059,290m²)**
1. AGRICULTURAL HUB	
Hydroponics (excluding yards)	89,760m²
Processing Shed	3,510m²
Bio Fuel	13,490m²
2A. PRODUCTION HUB 2	
Warehouse/Office	12,840m²
Future Expansion	2,000m²
Kiln	300m²
2B. PRODUCTION HUB 1	
Warehouse/Office Available	6,900m²
2C. INNOVATION/ INCUBATOR HUB	
Mixed Use	2,400m²
Shared Office	600m²
2D. BUSINESS HUB	
Mixed Use Offices	3,000m²
2E. HONEY MANUKA HUB	
Manuka Oil / Tea	1,475m²
Honey	1,625m²
Future Expansion	1,538m²
Honey Retail	525m²
3. TRAINING HUB	
Support Accomm. Indicative Units	2,400m²
TOTAL SITE GFA	**142,363m²**
STAGE 1 GFA	**124,125m²**

Note: Survey of Individual trees to be retained/removed required to confirm final Masterplan

KEY:

- Tree to be retained
- Tree to be removed total areas 1 & 2 (48)
- Under Discussion
- Future Stages
- Existing Trees/Wetland landscape to be retained

MASTER PLAN
1:5000 @ A3

eclipse architecture
Far North Holdings Limited
24 GUNDRY STREET,
NEWTON
PO BOX 7539,
AUCKLAND 1141
p. +64 9 303 4759
www.eclipsearchitecture.co.nz

rev	date	details

job no.	#Pln
cad file	FHH0657 Ngawha MASTERPLAN 01 Ness.pln
design	
drawn	
checked	
date	5/06/2019

job title
NGAWHA INNOVATION & ENTERPRISE PARK
State Highway 12, Kaikohe

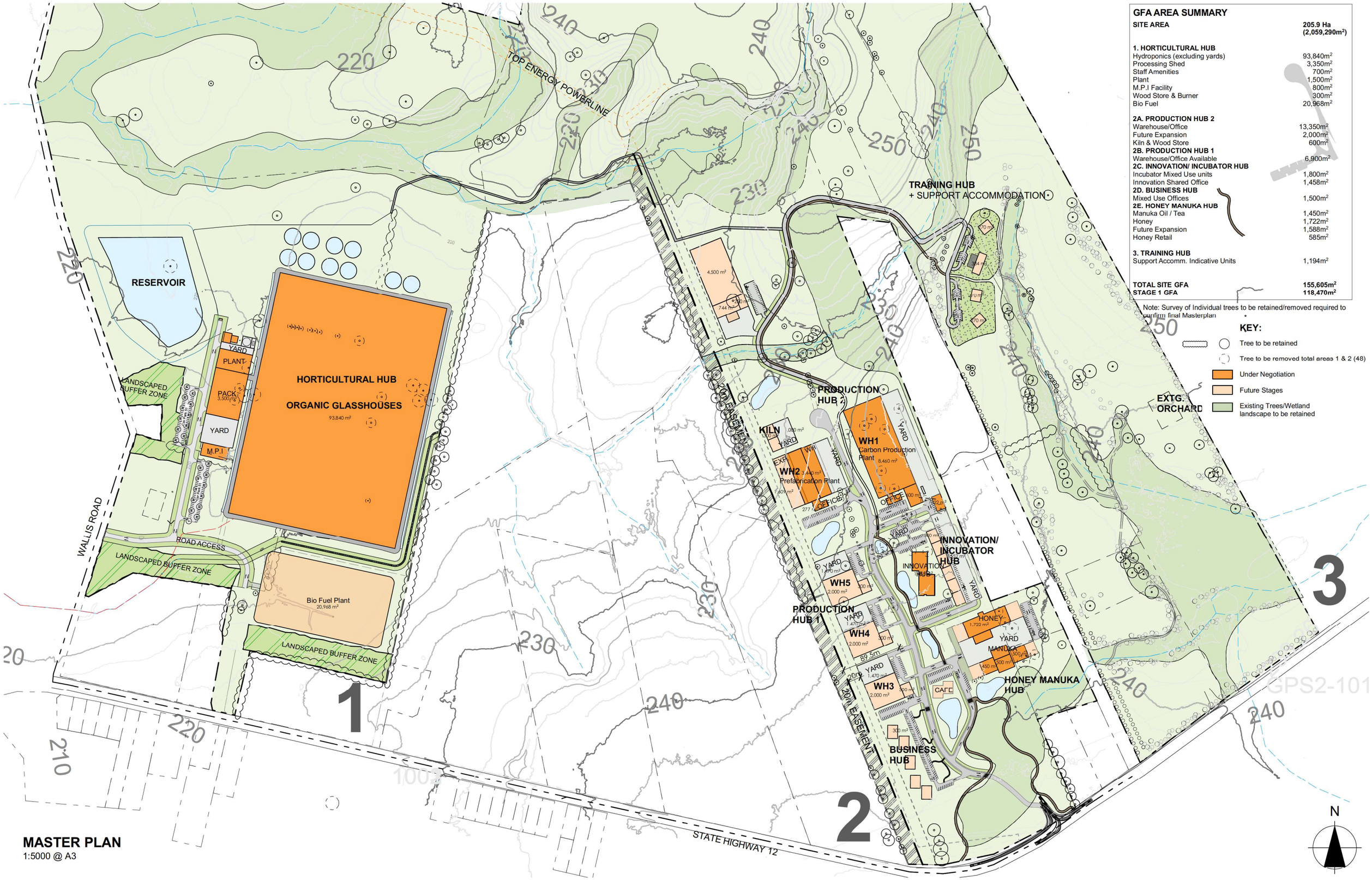
dwg title
MASTER PLAN

status
MASTER PLANNING

scale
AS SHOWN @ A3

rev
5

dwg No



GFA AREA SUMMARY

SITE AREA	**205.9 Ha (2,059,290m²)**
1. HORTICULTURAL HUB	
Hydroponics (excluding yards)	93,840m²
Processing Shed	3,350m²
Staff Amenities	700m²
Plant	1,500m²
M.P.I Facility	800m²
Wood Store & Burner	300m²
Bio Fuel	20,968m²
2A. PRODUCTION HUB 2	
Warehouse/Office	13,350m²
Future Expansion	2,000m²
Kiln & Wood Store	600m²
2B. PRODUCTION HUB 1	
Warehouse/Office Available	6,900m²
2C. INNOVATION/ INCUBATOR HUB	
Incubator Mixed Use units	1,800m²
Innovation Shared Office	1,458m²
2D. BUSINESS HUB	
Mixed Use Offices	1,500m²
2E. HONEY MANUKA HUB	
Manuka Oil / Tea	1,450m²
Honey	1,722m²
Future Expansion	1,588m²
Honey Retail	585m²
3. TRAINING HUB	
Support Accomm. Indicative Units	1,194m²
TOTAL SITE GFA	**155,605m²**
STAGE 1 GFA	**118,470m²**

Note: Survey of Individual trees to be retained/removed required to confirm final Masterplan

KEY:

- Tree to be retained
- Tree to be removed total areas 1 & 2 (48)
- Under Negotiation
- Future Stages
- Existing Trees/Wetland landscape to be retained

N

MASTER PLAN
1:5000 @ A3

eclipse architecture

Far North Holdings Limited

24 GUNDRY STREET,
NEWTON
PO BOX 7539,
AUCKLAND 1141

p. +64 9 303 4759
www.eclipsearchitecture.co.nz

rev	date	details

job no.	#Pln FHH0657 Ngawha Innovation Enterprise Park
cad file	
design	
drawn	
checked	
date	11/09/2019

job title
NGAWHA INNOVATION & ENTERPRISE PARK
State Highway 12, Kaikohe

dwg title
MASTER PLAN

status
MASTER PLANNING

scale
AS SHOWN @ A3

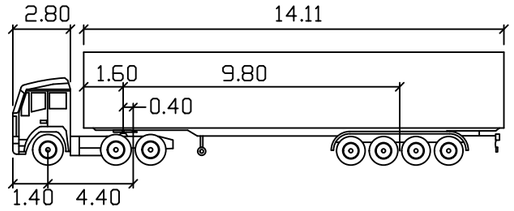
rev
F

dwg No
YET TO BE ISSUED

APPENDIX 2. CIVIL DRAWING SET

APPENDIX 3. STAGE 1 TENANT SITE ACCESS AND PARKING

N



SEMI-TRAILER

Meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0 s
Trailer Width	: 2.50	Steering Angle	: 24.1 deg
Tractor Track	: 2.50	Articulating Angle	: 70.0 deg
Trailer Track	: 2.50		

SCALE 1:1000

0 10 20 30 40 50

SCALE 1:1000

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REV.	REVISION DETAILS	DRAWN APP.
C		
B		
A	1ST ISSUE	11-09-19 BG

PROJECT DETAILS
NGAWHA INNOVATION & ENTERPRISE PARK
STATE HIGHWAY 12, KAIKOHE

TITLE
HORTICULTURE HUB
TRACKING CURVES - SEMI TRAILER

DATE CREATED	DRAWN	DESIGNED	APPROVED
11/09/2019	BG		

CCL REF NO	SCALE	STATUS
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DWG NUMBER	REVISION
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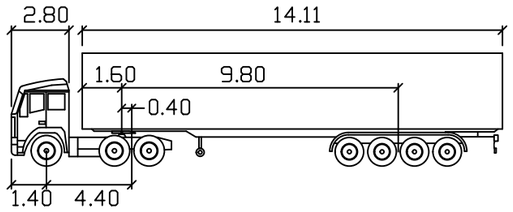
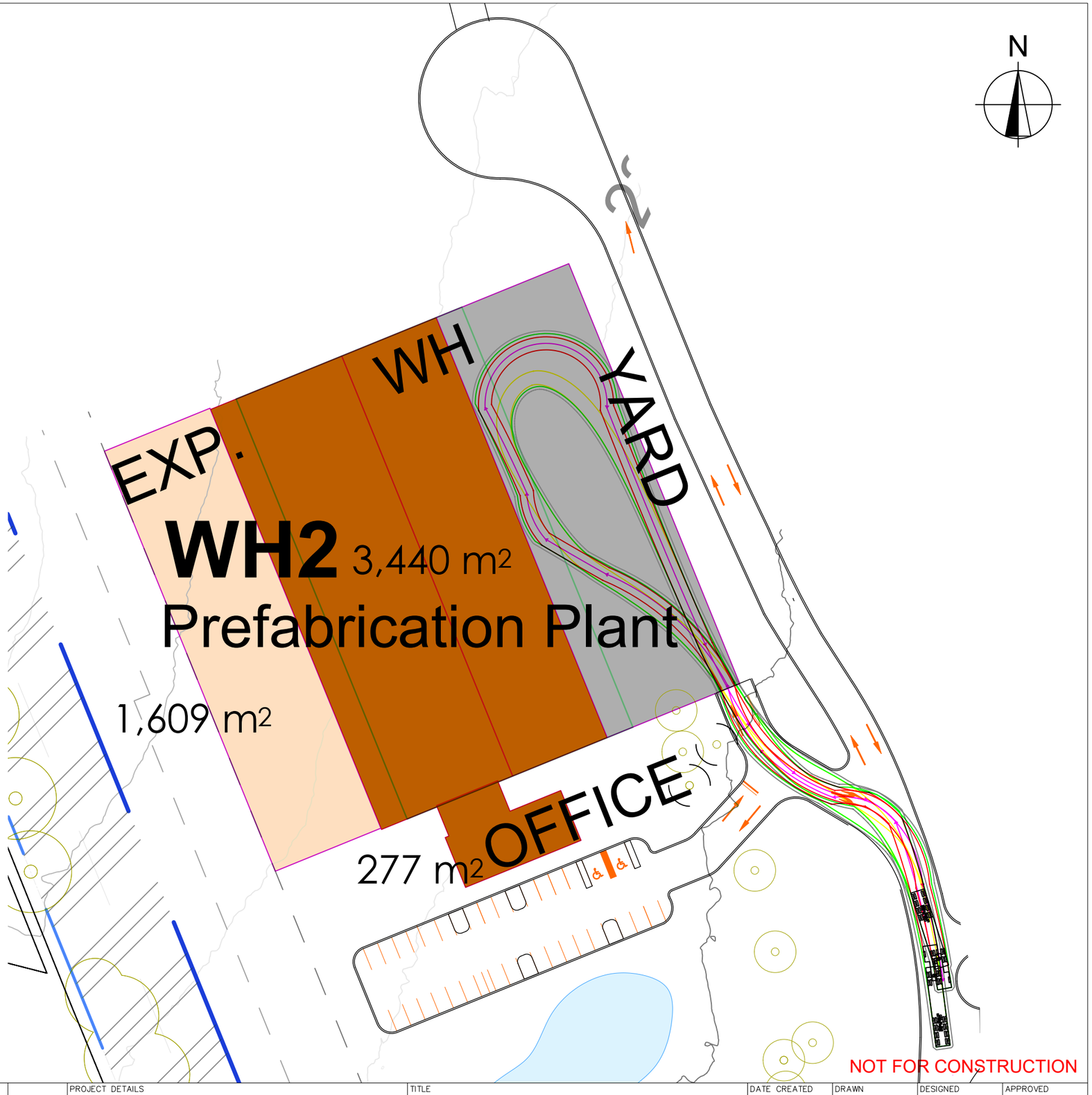


SEMI-TRAILER

Meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0 s
Trailer Width	: 2.50	Steering Angle	: 24.1 deg
Tractor Track	: 2.50	Articulating Angle	: 70.0 deg
Trailer Track	: 2.50		



SCALE 1:750

0 10 20 30

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REV.	REVISION DETAILS	DRAWN APP.
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PROJECT DETAILS
NGAWHA INNOVATION & ENTERPRISE PARK
STATE HIGHWAY 12, KAIKOHE

TITLE
SPINDLE
TRACKING CURVES - SEMI TRAILER

DATE CREATED	DRAWN	DESIGNED	APPROVED
11/09/2019	BG		

CCL REF NO	SCALE	STATUS
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DWG NUMBER	REVISION
TC02	A

SCALE 1:750

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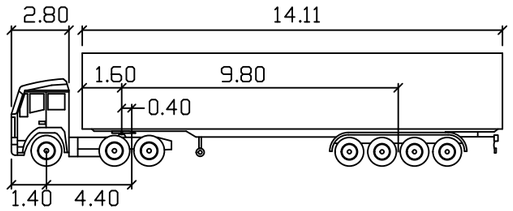
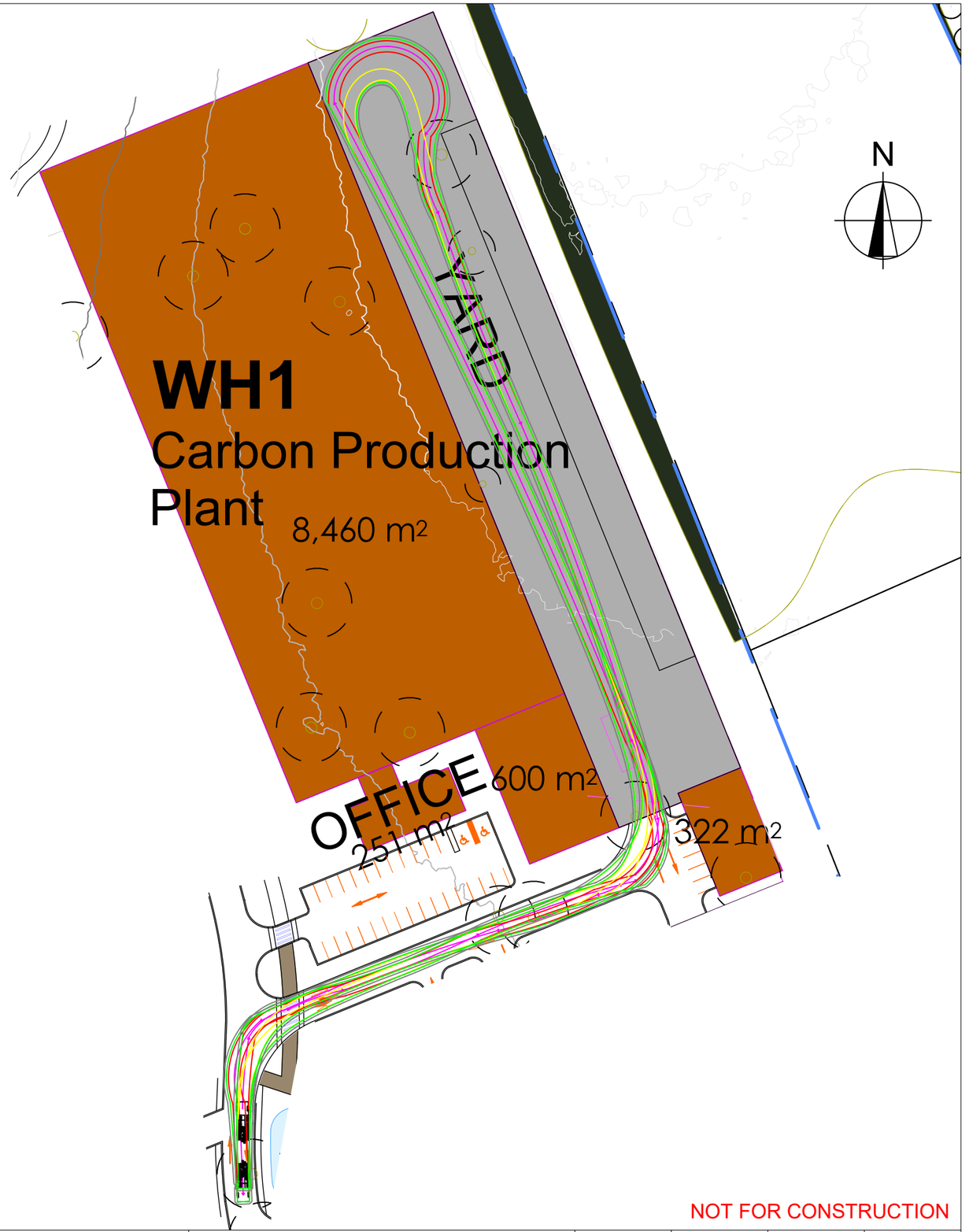


SEMI-TRAILER

Meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0 s
Trailer Width	: 2.50	Steering Angle	: 24.1 deg
Tractor Track	: 2.50	Articulating Angle	: 70.0 deg
Trailer Track	: 2.50		



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SCALE 1:750

0 10 20 30

SCALE 1:750

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PROJECT DETAILS
NGAWHA INNOVATION & ENTERPRISE PARK
STATE HIGHWAY 12, KAIKOHE

TITLE
CARBONSCAPE
TRACKING CURVES - SEMI TRAILER

DATE CREATED	DRAWN	DESIGNED	APPROVED
11/09/2019	BG		

CCL REF NO	SCALE	STATUS
14190	1:750 @ A3	PRELIMINARY

DWG NUMBER	REVISION
TC03	A

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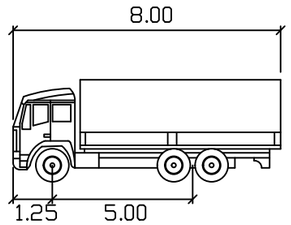
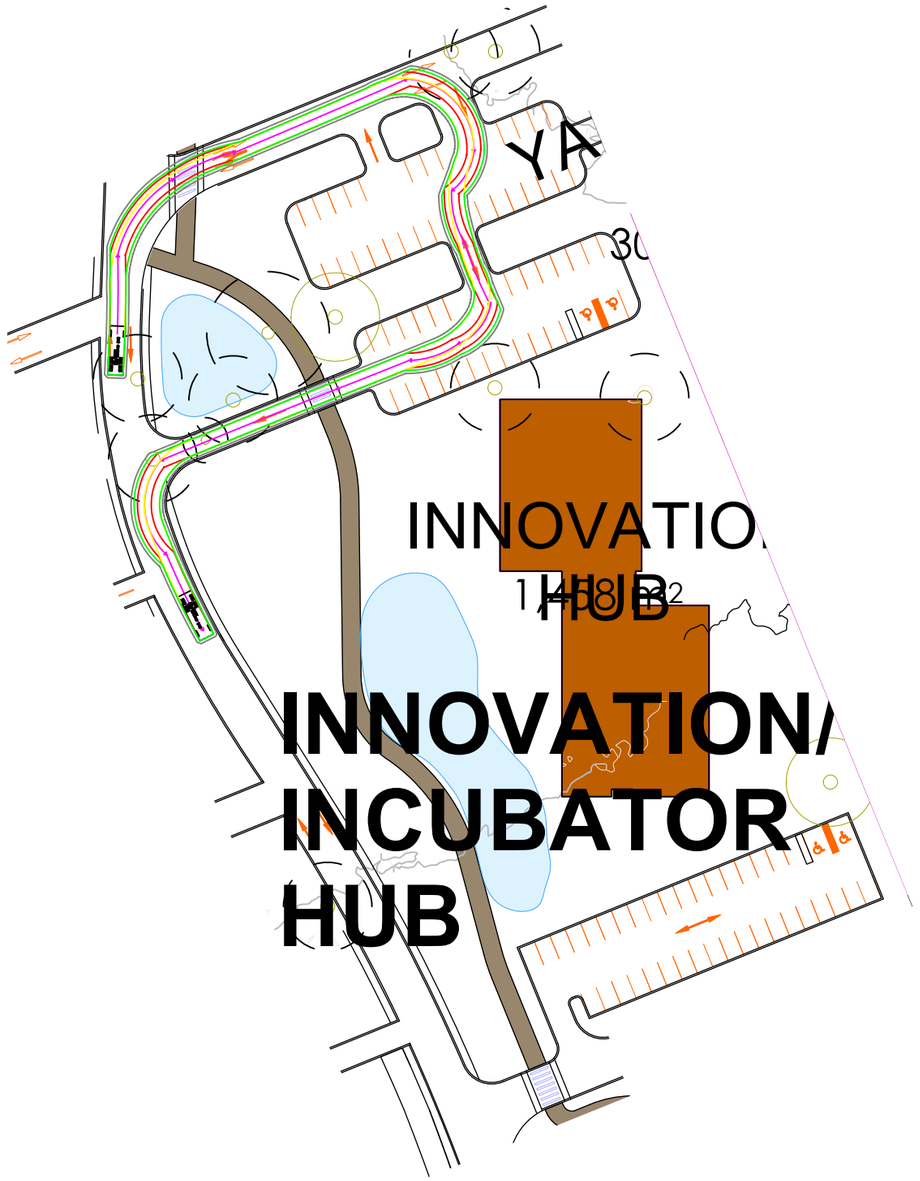


8M-TRUCK

	Meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0 s
Steering Angle	: 37.3 deg



N

SCALE 1:1000

0 10 20 30 40 50

SCALE 1:1000

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REV.	REVISION DETAILS	DRAWN APP.
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B		
A	1ST ISSUE	11-09-19 BG

PROJECT DETAILS
NGAWHA INNOVATION & ENTERPRISE PARK
STATE HIGHWAY 12, KAIKOHE

TITLE
INNOVATION & INCUBATOR HUB
TRACKING CURVES - 8m RIGID TRUCK

DATE CREATED	DRAWN	DESIGNED	APPROVED
11/09/2019	BG		

CCL REF NO	SCALE	STATUS
14190	1:1000 @ A3	PRELIMINARY

DWG NUMBER	REVISION
TC04	A

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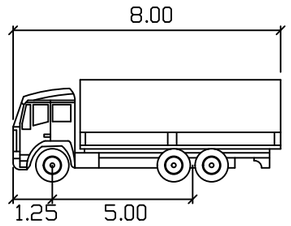
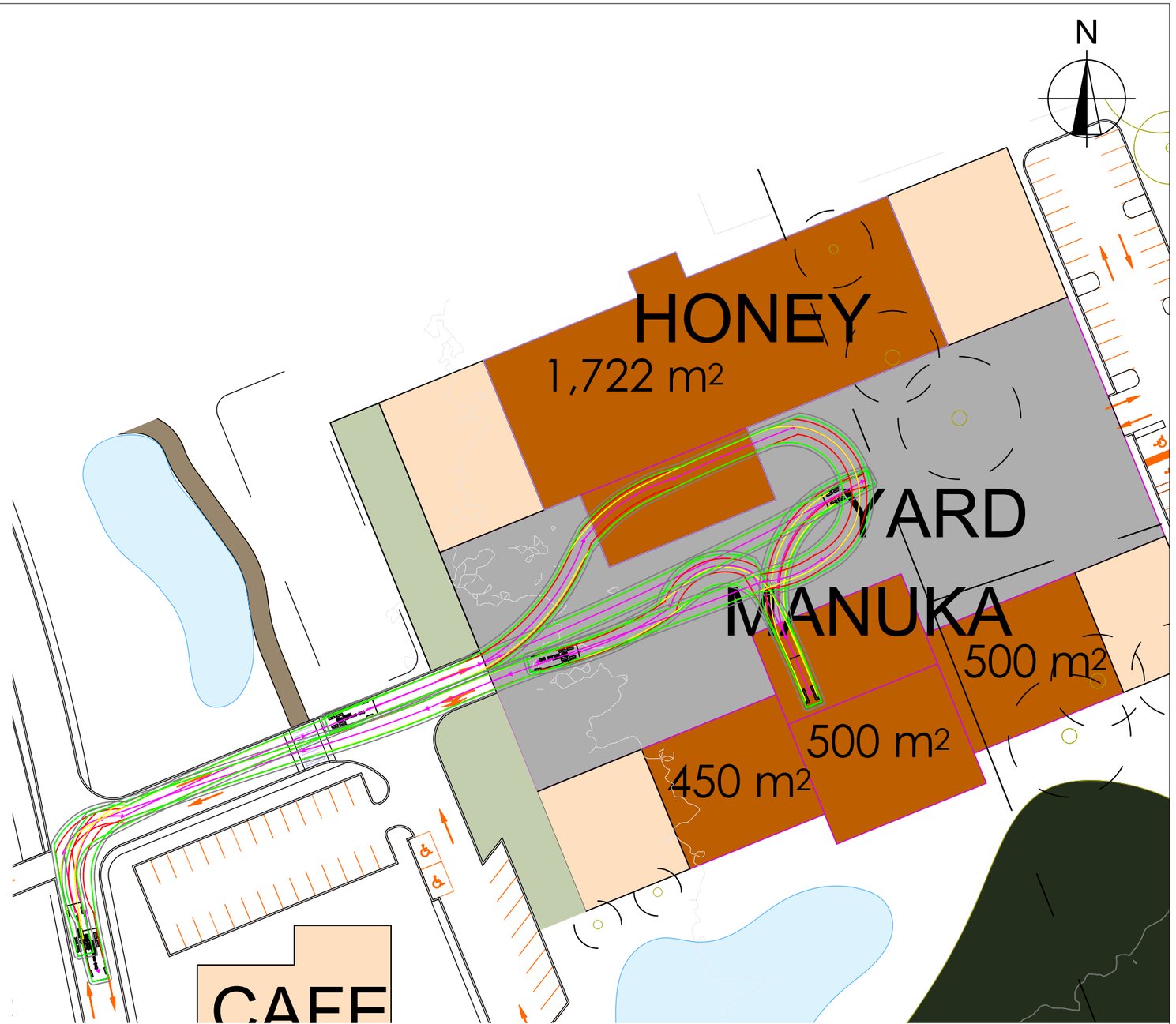


8M-TRUCK

	Meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0 s
Steering Angle	: 37.3 deg



SCALE 1:750

0 10 20 30

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REV.	REVISION DETAILS	DRAWN APP.
C		
B		
A	1ST ISSUE	11-09-19 BG

PROJECT DETAILS
NGAWHA INNOVATION & ENTERPRISE PARK
STATE HIGHWAY 12, KAIKOHE

TITLE
MANUKA & HONEY
TRACKING CURVES - 8m RIGID TRUCK

DATE CREATED	DRAWN	DESIGNED	APPROVED
11/09/2019	BG		

CCL REF NO	SCALE	STATUS
14190	1:750 @ A3	PRELIMINARY

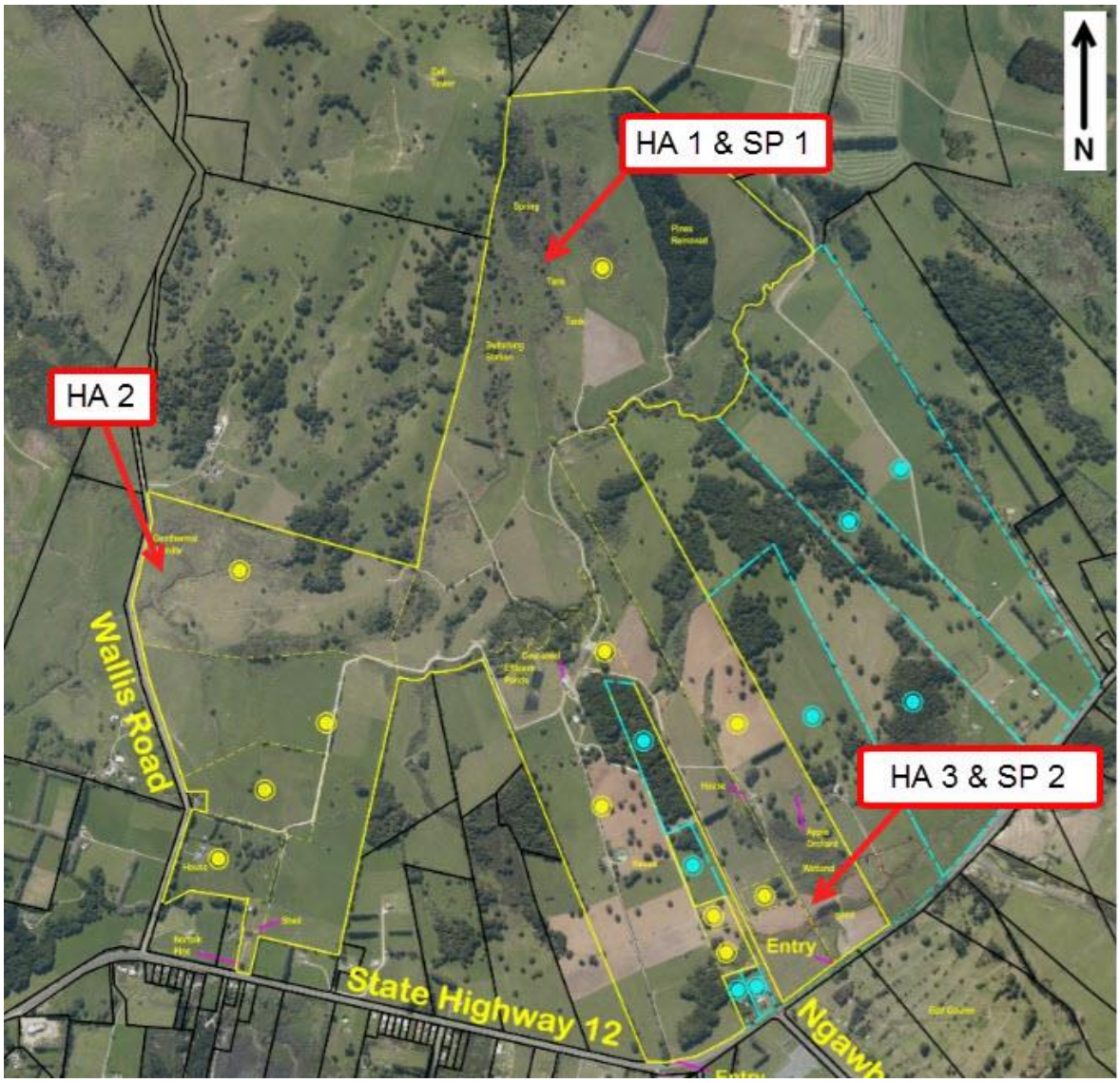
DWG NUMBER	REVISION
TC05	A

SCALE 1:750

DATE PLOTTED: Friday, 13 September 2019 4:15:53 PM FILE PATH: C:\Users\Gill\AppData\Local\Temp\BricsCAD\bp_3\14190 Ngawha-Tracking Curves.dwg

APPENDIX 4. INTRUSIVE GROUND TEST RESULTS

APPENDIX 1: SITE PLAN



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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

Ref.: 14190
Client: Far North Holdings Ltd.
Date: 9/01/2019
Borehole No.: 1
Location: 5435 SH12 Kaikohe
Drilling Method: HA

Page: 1
Tested by: CA & MSP
Logger: CA & MSP
Checked:
Date Checked:

Depth (mbgl)	Legend	Soil Description	Water Level	Vane Shear Strength maximum/ residual corrected (kPa)
0		Clayey SILT with minor rootlets; dark orangey brown, friable, dry. (TOPSOIL)		
0.7		Slightly sandy CLAY with rootlets; light brown; sand is fine to medium; stiff; dry; high plasticity.		
1.3		Slightly silty and slightly sandy CLAY; orangey light brown; sand is fine-coarse; sand is very weak; dry; medium plasticity		
1.5		Becomes lighter brown with grey mottling		
1.8		CLAY with trace of gravel; very light brown; dry; low plasticity		
2.2		Becomes damp; high plasticity		
3		End of BH1 - 3.0m		

Remarks:
Groundwater was not encountered

Topsoil
Fill
Clay
Silt
Sand
Gravel
Peat
Rock

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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

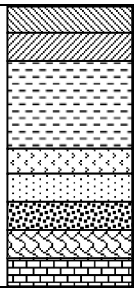
Ref.: 14190
Client: Far North Holdings Ltd.
Date: 9/01/2019
Borehole No.: 2
Location: 5435 SH12 Kaikohe
Drilling Method: HA

Page: 2
Tested by: CA & MSP
Logger: CA & MSP
Checked:
Date Checked:

Depth (mbgl)	Legend	Soil Description	Water Level	Vane Shear Strength maximum/ residual corrected (kPa)
0		Silty TOPSOIL with minor rootlets; Dark brown; dry.		
0.3		Contains minor friable clay		
0.5		CLAY; dark brown with white mottling; dry; low plasticity		
0.8		CLAY; grey with dark brown mottling; very mouldable; dry; high plasticity		
1.6		Becomes moist		
2.5		Becomes wet		
2.6		Becomes very dense; strong smell of sulphur		
2.8		Becomes saturated; slightly sandy; sand is medium-coarse	2.8m	
3		End of BH2 - 3.0m		

Remarks:
Groundwater was encountered @ 2.8mbgl
Test conducted near an area noted as having geothermal activity

Topsoil
Fill
Clay
Silt
Clay
Silt
Sand
Gravel
Peat
Rock



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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

Ref.: 14190
Client: Far North Holdings Ltd.
Date: 9/01/2019
Borehole No.: 3
Location: 5435 SH12 Kaikohe
Drilling Method: HA

Page: 3
Tested by: CA & MSP
Logger: CA & MSP
Checked:
Date Checked:

Depth (mbgl)	Legend	Soil Description	Water Level	Vane Shear Strength maximum/ residual corrected (kPa)
0		Silty TOPSOIL with minor rootlets; Dark brown; friable; dry.		
0.2		Becomes orangey brown		
0.4		CLAY; orangey brown; stiff; friable; dry; low plasticity		
1		Becomes light orangey brown; hard		
1.5		End of BH 3 - Unable to penetrate		

Remarks:
Groundwater not encountered
Terminated in hard, dense material

Topsoil
Fill
Clay
Silt
Clay
Silt
Sand
Gravel
Peat
Rock

Consulting Engineers
cook | costello

Norfolk House
2 Norfolk Street
Whangarei
P 64 9 4389529
F 64 9 4304282
E ccl@coco.co.nz

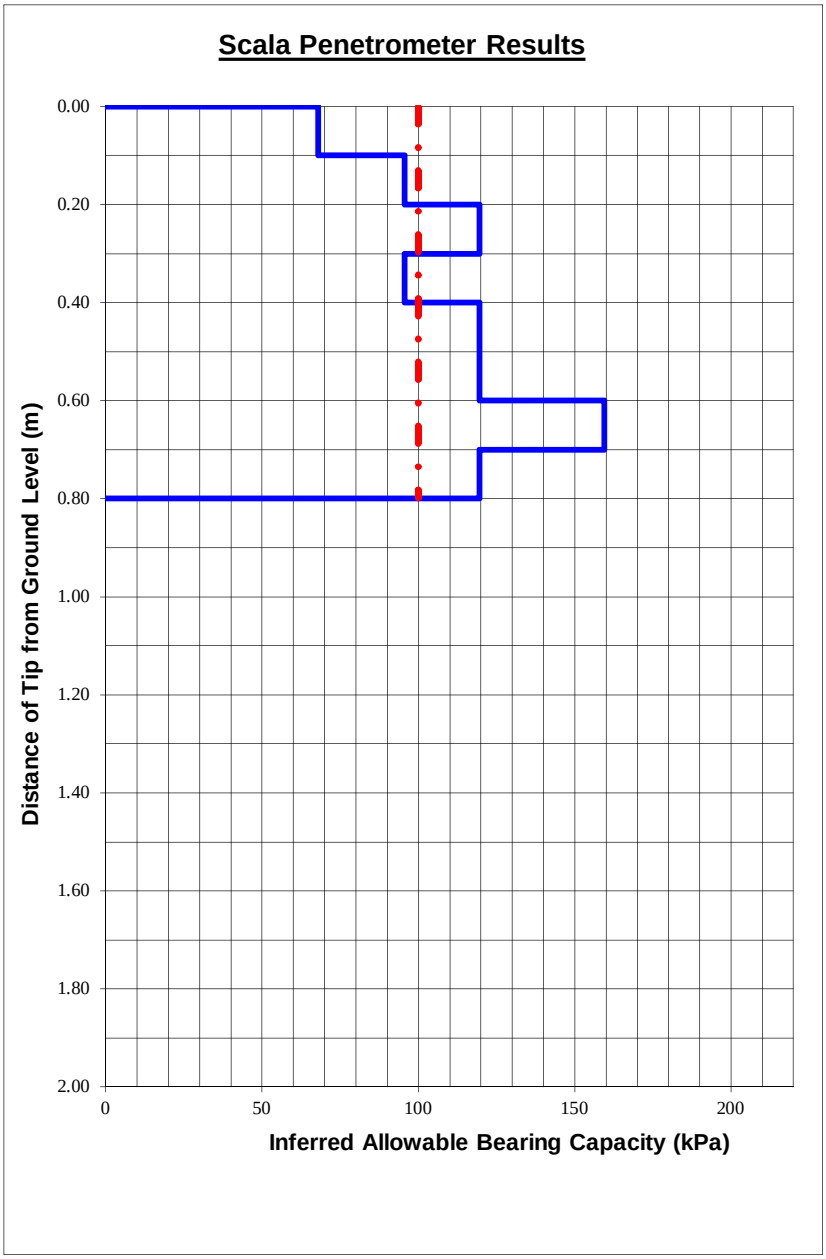
DYNAMIC CONE (SCALA) PENETROMETER

Test 23 / NZS 4402 : 1988 Test 6.5.2

Job: 14190
Client: Far North Holdings Ltd.
Date: 9/01/2019
Location: Farm
Scala No.: 1
Page: 1

Tested by: CA & MSP
Logged by: CA & MSP
Checked:
Date Checked:
Ground Level (m): 0
Required Allowable kPa: 100

No. Blows	Tip to ref (cm)	Total Blows	mm / blow	kPa	depth (m)
0	106.0	0	0	0	0.0
2	96.0	2	50	68	0.10
3	86.0	5	33	95	0.20
4	76.0	9	25	120	0.30
3	66.0	12	33	95	0.40
4	56.0	16	25	120	0.50
4	46.0	20	25	120	0.60
6	36.0	26	17	160	0.70
4	26.0	30	25	120	0.80



Line is the suggested correlation of e (mm/blow) and Bearing Pressure after STOCKWELL REF: NZ ENGINEERING (32,6) 15 June 1977

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cook | costello

Norfolk House
2 Norfolk Street
Whangarei
P 64 9 4389529
F 64 9 4304282
E ccl@coco.co.nz

DYNAMIC CONE (SCALA) PENETROMETER

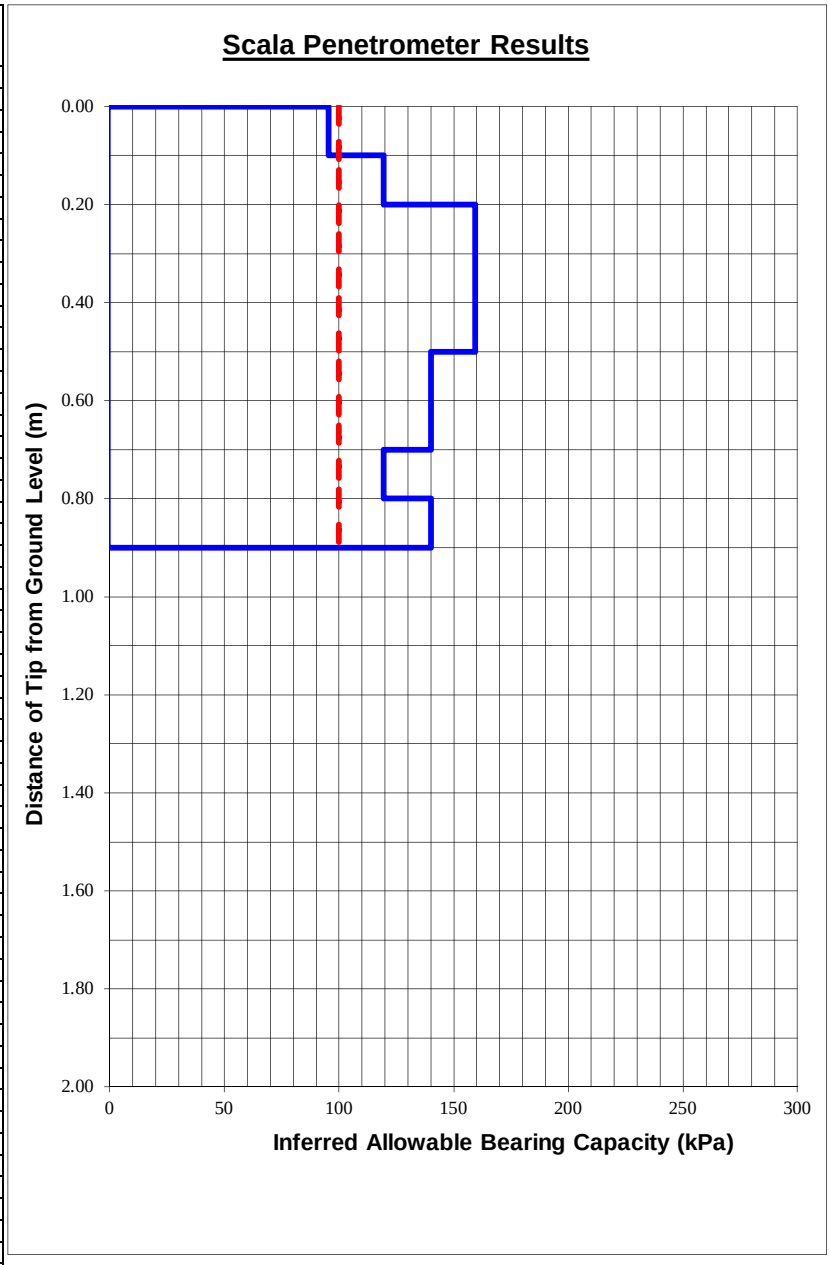
Test 23 / NZS 4402 : 1988 Test 6.5.2

Job: 14190
Client: Far North Holdings Ltd.
Date: 9/01/2019
Location: Farm
Scala No.: 2
Page: 2

Tested by: CA & MSP
Logged by: CA & MSP
Checked:
Date Checked:
Ground Level (m): 0
Required Allowable kPa: 100

9/01/2019

No. Blows	Tip to ref (cm)	Total Blows	mm / blow	kPa	depth (m)
0	105.0	0	0	0	0.0
3	95.0	3	33	95	0.10
4	85.0	7	25	120	0.20
6	75.0	13	17	160	0.30
6	65.0	19	17	160	0.40
6	55.0	25	17	160	0.50
5	45.0	30	20	140	0.60
5	35.0	35	20	140	0.70
4	25.0	39	25	120	0.80
5	15.0	44	20	140	0.90



Line is the suggested correlation of e (mm/blow) and Bearing Pressure after STOCKWELL REF: NZ ENGINEERING (32,6) 15 June 1977