LANDMATTERS

14 September 2021

Horizons Regional Council
Private Bag 11025
Manawatū Mail Centre
PALMERSTON NORTH 4442

Attention: Fiona Morton

Dear Fiona

APP-2020203164.01 – Grenadier Limited – Further Information

Further to your letter dated 1 September 2021 regarding the above application, please find below and attached responses to the individual points.

Wastewater

1. Please see attached updated Engineering Report (Revision 2) with updated drawings, including an updated services and infrastructure drawing set (J709-ENG-130 to 134) which reflects the updated design and information provided to GWRC on 17 August 2021.

Groundwater

2. Please see attached letter from project hydrogeologist, Bay Geological Services Limited, which directly responds to this request.
3. Please see attached letter from Bay Geological Services Limited which directly responds to this request.

Earthworks

4. Please see attached information from the Head of Construction for the proposed golf course. This includes information on the management of earthworks to ensure the construction works are phased and managed in a way that will reduce the potential for windblown erosion and will protect the values of the identified and potential natural wetlands.

   Progressive stabilisation of the works will be employed to 'lock down' the desired landforms immediately on completion of the recontouring. This approach is primarily used to secure the landform sought for the golf course but will also ensure the sandy soils are not lost to windblown erosion.

   As stated in the attached information:

   Open areas in the constructed golf corridor can be broadly broken into four categories:
   1. *Areas being stripped and cleaned in preparation for shaping – potentially exposed to erosion (generally <2Ha)*
   2. *Areas with shaping recently completed and being prepared for seeding – potentially exposed to erosion (generally <1/2Ha)*
   3. *Areas with irrigation installed and operational, seeded and hydro mulched and headed to germination – not erodible (generally <1Ha)*
   4. *Areas with grass germinated and heading towards first mow – not erodible (generally <2Ha)*

   No more than ~2ha of the property will be open at any one time.

Ecological matters

5. Please see attached memorandum from project ecologists Boffa Miskell which provides an ecological perspective to this request. The golf course design elements have been addressed by the Course Architect (Darius Oliver) in the attached letter.

   In addition to the ecological perspective attached, it should be noted that the course design has been an iterative and constraints/opportunities led process with significant input from technical experts, including Dr Boffa (for landscape and natural character) and Jim Dahm (from a coastal geomorphological perspective). This has resulted in a number of changes to the course design to date, as shown in the attached Land Matters drawing '*Course Layout Iterations*' (ref. 709-LAYOUT-CH), and described in the table below.

Change	Reason/description
A	Hole and fairway redesigned to avoid a natural wetland identified by Boffa Miskell.
B	Fairway and tee rerouting to avoid removal of stand of kanuka. The course layout and design was amended as a result of input from Jim Dahm and Boffa Miskell.
C	Area C was removed from proposed Fairway 3 and Hole 3 for the same reasons as 'B' above. The hole was also relocated to better provide public access to the coastal margin.
D	The fairways for Fairways 4 and 17 were narrowed at the request of Dr Boffa. His reasons for requesting this were natural character related.
E	The hole and fairway for Hole 14 was amended at the recommendation of Dr Boffa. The hole is now in a location where weed species can be removed.

   As shown, the consideration of alternatives has been at the forefront of the design iteration process throughout and has resulted in a development proposal that has been very cognisant of the valued features on the property, including Schedule F habitat, and has protected those features.

   We note that the Fourth Schedule to the RMA requires an assessment of possible alternative locations for the activities where there will be significant adverse effects. In this case the technical documentation does not conclude there will be significant adverse effects. The various reports conclude the effects on the Schedule F habitats will be less than minor. Boffa Miskell, Darius Oliver and Brendon Allen (in the attached letters) note the positive aspects in comparison.

6. Please see attached letter from Boffa Miskell Limited which directly responds to this request.
7. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
8. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
9. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
10. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
11. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.

12. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request. Although Boffa Miskell note the proposed planting far exceeds a normal 'offsetting' model, we have discussed in the past with Horizons staff (Sara Westcott and Lizzie Daly) the Applicant's willingness to provide detailed planting plans before undertaking the management plan activities on the ground. The Applicant reasserts their willingness for this and would be happy to work with Horizons on a proposed condition of consent to that effect.
13. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
14. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
15. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.
16. As above, please see attached letter from Boffa Miskell Limited which directly responds to this request.

Potential additional consent requirements

17. Whilst the information provided to us by the Head of Construction for the golf course confirms the change in soil types on the property will have no effect on the hydrological regime of any natural wetland on the property (or elsewhere in the vicinity of the property) out of an abundance of caution please accept this letter as confirmation that the Applicant also seeks consent, as a **non-complying activity** under Clause 52(1)(a) of the *Resource Management (National Environmental Standards for Freshwater) Regulations 2020*.

    An assessment of the effects of the proposed activity and against the relevant objectives and policies of the *National Policy Statement for Freshwater Management 2020* (**NPS-FM**) is attached to this letter. As it has been demonstrated that the effects of the proposed activity are less than minor and the proposed activity is not contrary to the objectives and policies of the NPS-FM, the proposed activity can be granted consent in accordance with Section 104D of the RMA.

18. As above, the information provided to us by the Head of Construction for the golf course confirms the rate of irrigation proposed will not exceed the rate of uptake by the golf course vegetation surrounding the irrigation source. The intent here is to conserve water as much as possible so any irrigation will not result in discharge of water beyond the immediate area and will not result in ingress of additional water into any identified or potential wetland. However, as some irrigation activity will occur within 100m of an identified or potential wetland, please accept this letter as confirmation that the Applicant also seeks consent, as a **non-complying activity** under Clause 54(c) of the *Resource Management (National Environmental Standards for Freshwater) Regulations 2020*.

    An assessment of the effects of the proposed activity and against the relevant objectives and policies of the NPS-FM is attached to this letter. As it has been demonstrated that the effects of the proposed activity are less than minor and the proposed activity is not contrary to the objectives and policies of the NPS-FM, the proposed activity can be granted consent in accordance with Section 104D of the RMA.

We trust HRC now has all the necessary information to process and determine this application.

Yours sincerely
LAND MATTERS LIMITED

Tom Bland
Senior Resource Management Consultant
Tel: 021 877 894
Email: tom@landmatters.nz

LANDMATTERS

ENGINEERING REPORT - Resource Consent
765 MUHUNOA WEST ROAD
ŌHAU

CLIENT **GRENADIER LIMITED -** September 2021, Revision 2

www.landmatters.nz

DELIVERING INNOVATIVE PROPERTY, COMMUNITY AND ENVIRONMENTAL SOLUTIONS

ENGINEERING REPORT FOR: Grenadier Limited

Reviewed by:

Bryce Holmes
Principal Planner and Director

Prepared by:

Dan Turner
Senior Civil Engineer, BEng Hons

Date:	03 September 2021
Version:	**FINAL REVISION 2**
Job Ref:	709

Table of Contents

1. Background & Introduction

Grenadier Ltd are applying for a resource consent to construct an 18-hole golf course, Clubhouse, 20 Accommodation Units, Stables, two Maintenance Sheds and a dwelling with a sleep out (Owner's Cottage) at 765 Muhunoa West Road, Ōhau. The resource consent also includes constructing new accesses, a new vehicle crossing, a car park and extracting groundwater for potable water supply and irrigation.

This report considers the engineering feasibility of constructing a golf course and associated infrastructure. The report addresses the following:

- On-site stormwater attenuation and soakage disposal
- On-site sanitary sewer treatment and disposal
- Water supply, storage and treatment
- Building foundations
- Utility supply
- Access and car park design
- Earthworks
- Firefighting water supply

2. The Property

The property at 765 Muhunoa West Road, Ōhau is zoned rural. The property is located just back from the beach and is located on flat to rolling sand dunes. There is one existing dwelling (semi-permanent caravan). The property is mostly covered in pasture with some areas of mature trees.

Figure 1 *– 765 Muhunoa West Road, Ōhau. (outlined in yellow)*

3. The current situation – Base Engineering Information

3.1. Geology and Soils

The soils are mapped as sandy raw and sandy recent. The geology in this area is mapped as aeolian sand dunes. There is a thin topsoil layer on top of the sand supporting pasture.

Refer Appendix C for test pit logs.

3.2. Three Waters

There are no HDC potable water, sanitary sewer or stormwater services available on Muhunoa West Road.

3.3. Utility Services

This section outlines the existing utility services provided on Muhunoa West Road.

3.3.1. Power

Overhead power lines are located on the northern side Muhunoa West Road and terminate outside the entrance to the property. Underground distribution lines extend from the last pole to the Ōhau Sands subdivision at 762 Muhunoa West Road.

3.3.2. Telecommunications

The Chorus telecommunication network extends down the southern side of Muhunoa West Road and terminates just prior to the property.

3.3.3. Gas

There are no existing gas lines at the western end of Muhunoa West Road.

3.4. Vehicle Access

The property is accessed via a farm gate at the north eastern corner of the property. There are two formed accesses through the property. One access follows the eastern property boundary and the other cuts through the centre of the property to the existing dwelling. In the south west corner of the property there is a vehicle access to the Ōhau River mouth.

4. Engineering Assessment

This section describes how the three waters, utilities, roading and earthworks can be implemented for the Golf Course, Clubhouse, Accommodation Units, Stables, Maintenance Sheds and Owner’s Cottage. The objective is to show that a Golf Course and associated infrastructure is feasible at this location.

This report is intended to be referenced in support of a resource consent application. Once the resource consent has been granted a detailed design process will be undertaken for the access, earthworks, three waters and utility connections.

Site investigations were undertaken throughout the property to inform the engineering concept solutions discussed below. The location and type of tests can be found in the engineering drawings in Appendix A.

4.1. Water use assumptions

Refer Figure 2 below for indicative building locations. To calculate the potable water requirement and sanitary sewer disposal the following water use values have been adopted:

- The Clubhouse kitchen will cater for 100 people / day each using 30 liters / day
- The Clubhouse will have 8 staff each using 30 litres per day
- Ten two-bedroom Accommodation Units 40 people / day using 190 litres / day. This is based on an average use of 220 litres / day minus 30 litres / day for the kitchen use, see above
- The Driving Range has two bathrooms. Assume 50 people / day using 10 litres / day

- Owner’s Cottage and sleepout houses 8 people using 145 litres / day
- The stable is assumed to use 100 litres / day (domestic) and 300 litres / day for the wash down facility
- The two Maintenance block buildings near the Stables are assumed to use 2,000 litres / day with a toilet and wash down facilities.

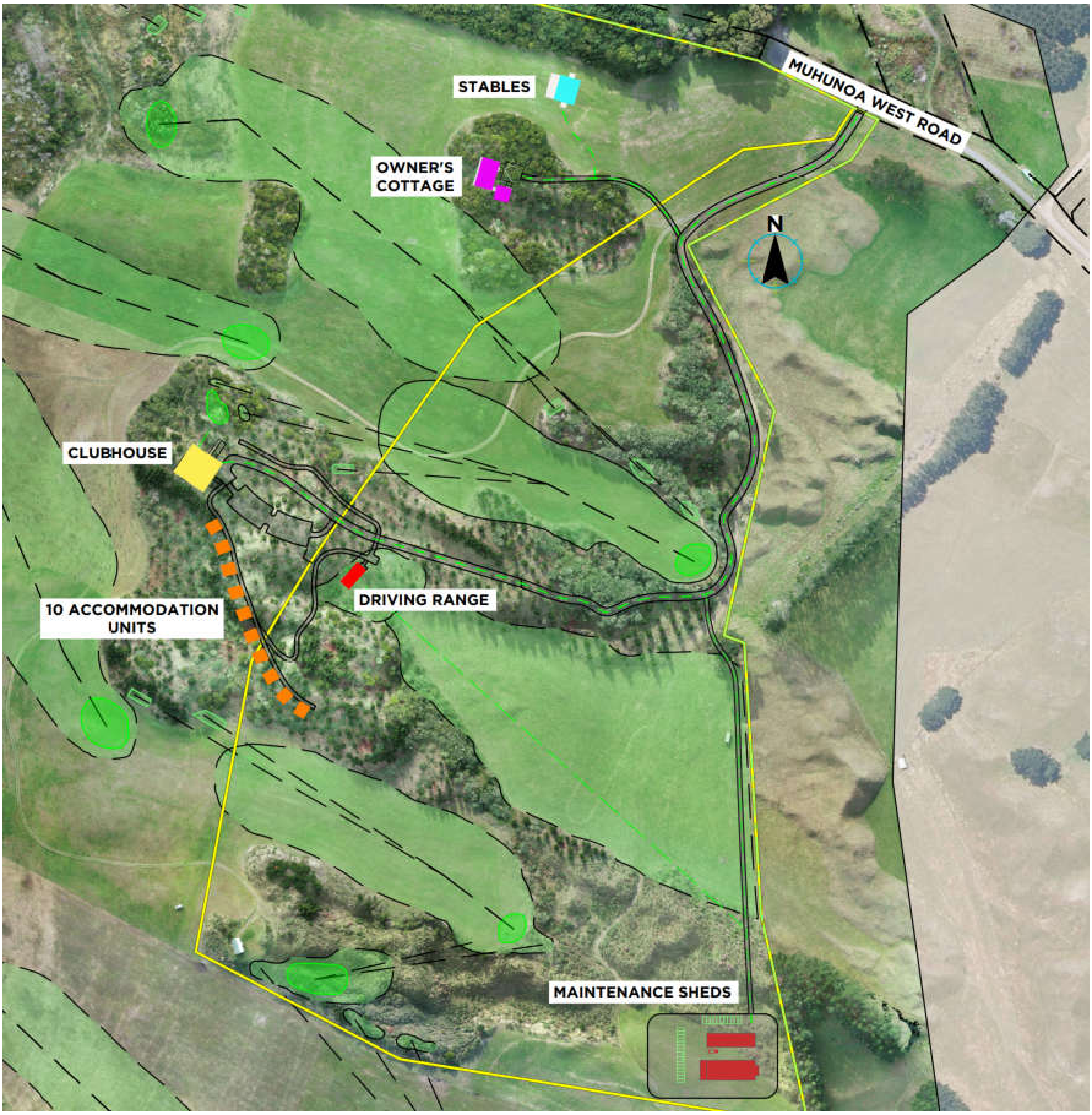


Figure 2 *– Plan showing golf course buildings*

4.2. Potable Water

There is no existing water supply on Muhunoa West Road. Potable water will be provided by bore water and roof collection. This section outlines the potable water supply, quality and storage for the golf course buildings and Owner's Cottage.

4.2.1. Supply

4.2.1.a. Clubhouse, Accommodation and Driving Range

Potable water for the Clubhouse, Accommodation Units and Driving Range will be supplied from a shallow (approximately 10m depth) bore. The bore water will be pumped to a series of potable water storage tanks. Refer accompanying drilling report and hydrogeology reports for further details on bore water supply.

The indicative location of the potable water bore is shown on the drawings in Appendix A. Refer sections below for potable water quality and storage considerations.

4.2.1.b. Owner's Cottage and Stables

The Owner's Cottage potable water supply will be provided from captured roof rainwater. The approximate roof area of the cottage and sleepout is 360m^2 and the average annual rainfall is approximately 1,100mm. The average amount of water captured each year is 322m^3. It is assumed that there will be 8 occupants in the dwelling each using 145 litres / person / day. This water use rate is from Table 3.2 in Horizons Manual for On-site Wastewater Systems Design and Management (MOWSDM). Based on these figures the average yearly water use for the cottage will be 440m^3. As there is a net deficit the potable water tanks will need to be topped up during the year.

The 145 litres / person / day is based on a household with 6/3 flush toilets, aerator faucets, shower flow restrictors, water conserving automatic washing machines and dishwasher and no garbage grinder.

The Stables will capture water from the roof to supply water to the toilets and wash facilities. The expected water use for the Stables is 400 litres / day split between 100 litres / day for domestic supply and 300 litres / day for the horse wash down facility.

The roof has an approximate area of 215m^2. Based on these figures and expected rainfall the yearly volumes of captured rainfall and potable water use are 240m^3 and 183m^3 respectively.

4.2.1.c. Maintenance Sheds

The Maintenance Sheds will also capture water from the roof to supply toilets, wash facilities, office and staff room. The expected water use is 2,000 litres / day. The combined area of the two Maintenance Sheds is 900m^2. Based on these figures and expected rainfall the yearly volumes of captured rainfall and potable water use are 990m^3 and 730m^3 respectively.

Refer sections below for potable water quality and storage considerations. Refer flow routing analysis in Appendix B.

4.2.2. Quality

4.2.2.a. Clubhouse, Accommodation and Driving Range

The shallow water bore will supply potable water to the Clubhouse, Accommodation Units and Driving Range.

The bore water supply is classed as a small water supply under section 69G of the Health Act 1956. To be a compliant small water supplier the golf course owner will need to meet the following requirements from section 10 of the Drinking-Water Standards for New Zealand 2005 (DWSNZ) (revised 2018):

- A drinking-water assessor (DWA) must have approved a water safety plan, and the supplier must be implementing the plan
- Appropriate bacterial, protozoal and chemical treatment, as determined from the catchment assessment in the water safety plan, must be in use
- Water suppliers must monitor water quality and ensure it meets the requirements of section 10.4
- Water suppliers must undertake the remedial actions that have been specified in the water safety plan when a maximum acceptable value (MAV) is exceeded, or treatment process controls are not met.

The potable water will be treated as per DWSNZ guidelines. During detailed design the appropriate treatment will be determined and the appropriate water treatment infrastructure selected. A water safety plan will be submitted outlining the proposed water treatment system to be installed. The plan will also outline how the water quality will be monitored.

4.2.2.b. Owner's Cottage, Stables and Maintenance Sheds

Potable water for the Owner's Cottage, Stables and Maintenance Sheds will be provided from rainwater tanks that capture water from the roof. Each building will have a dedicated rainwater tank. As the potable water supplied to each building is to less than 101 people the water supplier is not considered a small water supplier and does not need to comply with DWSNZ.

However, rainwater supplies are known to contain bacteria, protozoal and particulate matter. DWSNZ section 10.3.2.1 *Rainwater supplies* suggest appropriate treatments for these contaminants. It is recommended that an appropriate treatment system be used for the potable water supply for these buildings.

4.2.3. Storage

4.2.3.a. Clubhouse, Accommodation and Driving Range

Potable water supplied by the shallow bore for the Clubhouse, Accommodation Units and Driving Range building will be stored in multiple tanks located to the east of the Accommodation Units.

The estimated water use for the Clubhouse, Accommodation Units and Driving Range shed is 11.3m^3 per day. For resilience it is recommended to store enough potable water for 4 days if the bore needs servicing. This requires a total storage of 45.36m^3. Two 25,000 litre tanks will be sufficient for the potable water supply for these buildings. Two 25,000 litre firefighting water tanks will sit adjacent to the potable water tanks at this location. This provides the minimum 45,000 of firefighting water storage within 90m of the Clubhouse, Accommodation Units and Driving Range, see firefighting section below for further details.

4.2.3.b. Owner's Cottage, Stables and Maintenance Sheds

Potable water for the Owner's Cottage will be captured from the roof. HDC Subdivision and Development Principles and Requirements 2014 (SDPR), Section 12.4 states that the minimum potable water storage is 25,000 litres. It is recommended that the Owner's Cottage potable water supply be stored in two 25,000 litre rain tanks. Refer section 4.4 for more rain tank details.

It is estimated that the horse Stables will require 400 litres / day. The roof area of the Stables is 216m^2. The yearly rainfall capture and yearly use are 193.2m^3 and 189.9m^3 respectively. It is recommended that a 25,000 litre tank be used to store potable water for the Stables.

Rainfall from the two Maintenance Sheds will be stored in rain tanks, one for each building. The roof area of the Sheds are 360m^2 and 540m^2. It is estimated that the smaller Maintenance shed will use 800 litres / day and the larger shed 1,200 litres / day. The yearly rainfall capture and yearly use for the small shed are 322.0m^3 and 292.0m^3 respectively. The yearly rainfall capture and yearly use for the large shed are 483.0m^3 and 438.0m^3 respectively. It is recommended to have two 25,000 litre tanks for potable water storage for each shed.

4.3. Irrigation

Water supply for green and fairway irrigation will be provided from a deep bore, refer to the drilling and hydrogeology reports. Water will be direct pumped from the well or into storage tanks. A shallow underground pipe network will distribute the water down each fairway and onto the greens. Automatic sprinkler heads will be installed to spray water in the specific locations required.

An irrigation network design will be developed during detailed design. A concept irrigation network is shown on the drawings in Appendix A.

4.4. Stormwater Disposal

4.4.1. Buildings

Stormwater captured from the roofs of the Clubhouse and Accommodation Units will be captured and conveyed to storage tanks. This water will be used for irrigation purposes.

Percolation tests were undertaken in several locations across the site. The percolation rates were high due to the sandy soils. On average a soak rate with a factor of safety of 4 applied was 400mm/hr. The Driving Range building will capture rain from the roof and convey this to a small soak pit.

Stormwater captured from the roofs of the Owner’s Cottage, Stables and two Maintenance Sheds will be captured and attenuated in rain tanks. A small orifice located near the top of the water storage tanks throttles stormwater flow to be lower than predevelopment flows. See potable water calculations for rain tank sizing and see Appendix B for raintank calculations.

The rain tanks for the Stables and Maintenance Sheds attenuate stormwater flows and capture rain for reuse as potable water in the buildings. The raintank for the Owner’s Cottage attenuates stormwater, stores potable water and stores firefighting water supply.

Overflow pipes at the top of the rain tanks allow the release of water in larger stormwater events. This water can be discharged to land or to small soak pits.

During detailed design the rain tanks and soakage pits will be sized.

4.4.2. Accesses

Stormwater from sealed accesses will be captured in swales that will convey the water to soak pits at regular intervals. Sealed car parks will capture water in sumps that will discharge to soak pits. Swale and soak pit sizing will be determined during detailed design.

Unsealed accesses will not require stormwater capture.

4.5. Sanitary Sewer Disposal

There is no existing sanitary sewer network on Muhunoa West Road. It is recommended that wastewater be treated and disposed on site as discussed below. Once treated the wastewater will be discharged to ground via a pressure compensating drip irrigation (PCDI) system. A PCDI requires a minimum secondary treated effluent of BOD_5 and TSS better than 20mg / litre and 30 mg / litre respectively.

The soil logs excavated around the site showed a thin layer of topsoil over the top of sand. A soil category of 1 as per Table 7.3, Appendix B, Onsite Wastewater Management in the Auckland Region has been adopted for this resource consent. Due to the fast drainage characteristics of sand, nutrient leaching may occur and contamination of groundwater may occur. Additional treatment or special design of the land application system will be required during the detailed design stage. A minimum 150mm topsoil is required for these systems in category 1 soils. The location of disposal fields have been selected to ensure adequate clearance from the Ōhau River.

We are also mindful that iwi are interested in the disposal of wastewater and therefore the disposal fields will be in areas away from the river and integrated with ecological design.

The loading rate for a soil category 1 using a PCDI is 5mm / day as per Table 6.2 in Horizons Regional Council Manual for On-Site Wastewater Systems Design and Management (OSWSDM).

Refer Appendix F for wastewater calculations.

4.5.1. Clubhouse, Accommodation and Driving Range

The grey and black water from the Clubhouse, Accommodation Units and Driving Range building will all be gravity piped to one sewage treatment plant. It is expected that the combined flow rate from these buildings is 11,000 litres / day. Secondary treatment is required for a pressure compensating drip irrigation (PCDI) system. A Hynds Oxyfix FIXEUC90 accepts up to 14,850 litres / day. The purification performance of this treatment plant is 20mg / litre for BOD_5 and 30 mg / litre for TSS, which is compliant with OSWSDM. It is recommended to use a treatment plant like this for these buildings. Refer Appendix E for the Hynds Oxyfix information sheet.

The Clubhouse will have a commercial kitchen. Grease traps should be installed to remove grease from the sanitary sewer water from the kitchen.

Based on an areal loading rate of 5mm / day for category 1 soils and an output of 11,000 litres / day the drip field would need to be 2,200m^2 with a reserve area of 1,100m^2, as per OSWSDM Table 2.3. The drip field is shown on the drawings in Appendix A.

4.5.2. Owner's Cottage, Sleepout and Stables

The Owner's Cottage, Sleepout and Stables domestic wastewater will have a secondary treatment sewer system with a PCDI. Based on an areal loading of 5mm/ day and a daily output of 1,260 litres / day the drip field would need to be 260m^2 with a reserve area of 130m^2.

The wastewater from the horse wash down facility will be treated separately. Wastewater from horse wash down facilities typically contain hair, urine, sweat, manure, dirt, wood waste and straw. Of particular concern is the horsehair, which can clog up the wastewater treatment system if not removed. The wastewater can be conveyed through a grit interceptor before being treated in a wastewater system. The wastewater system will be confirmed at detailed design stage.

4.5.3. Maintenance Sheds

Sanitary sewer from the Maintenance Sheds will be piped into a secondary treatment system. The expected sanitary sewer output from the Maintenance Sheds is 2,000 litres / day. Based on the inflow rate of 2,000 litres / day and an areal loading of 5 mm /day the drip field would need to be 400m^2 with a reserve area of 200m^2.

4.6. Firefighting Supply

The firefighting water supply must comply with New Zealand Fire Service Firefighting Water Supplies Code of Practice, SNZ PAS 4509:2008. It is recommended that all buildings at the golf course have a sprinkler system installed as the site is more than 10 minutes from the nearest fire station and is rural.

Firefighting connection kits will be required at the base of all firefighting water storage tanks and an appropriate access and hard stand area required as per SNZ PAS 4509:2008.

4.6.1. Clubhouse, Accommodation and Driving Range

If the Clubhouse, Accommodation Units and Driving Range building have sprinklers installed these buildings will have a water supply classification of FW2. For a non-reticulated water supply a dedicated firefighting water storage facility holding 45m^3 is required within 90m of these buildings. The requirement for firefighting water storage can be removed if the water bore can provide a flow rate of 12.5 litres / sec within a distance of 135m from the building for a minimum firefighting time of 30 minutes.

Two 25,000 litre tanks will be located adjacent to the potable water tanks for the Clubhouse, Accommodation Units and Driving Range. This location is within 90m of all buildings.

If the Clubhouse does not have a sprinkler system installed the water supply classification changes to FW3 and the required firefighting storage capacity increases from 45,000 litres to 180,000 litres.

4.6.2. Owner's Cottage, Sleepout and Stables

A sprinklered single family home has a water supply classification of FW1. The required firefighting water storage is 7,000 litres. If the home does not have a sprinkler system the water supply classification increases to FW2 and the storage requirement increases to 45,000 litres.

If the Stables has a sprinkler system installed the water supply classification is FW2. The minimum water storage required within 90m of the Stables is 45,000 litres. It is recommended to have one 45,000 litre firefighting storage source for both the Owner's Cottage and Stables as these buildings are within 90m of each other.

Note, if the Stables does not have sprinklers installed then the water supply classification changes to FW3 and the water storage requirement increases to 60,000 litres within 90m.

4.6.3. Maintenance Sheds

If the Maintenance Sheds have sprinkler systems installed the water supply classification is FW2. The minimum water storage required within 90m of the Maintenance Sheds is 45,000 litres.

Note if the Maintenance Sheds do not have sprinklers installed then the water supply classification changes to FW7 and a special assessment is required to calculate the water storage requirements. The FW7 classification is due to the likely bulk storage of fuels.

4.7. Utilities

4.7.1. Power

Overhead power lines are located on the northern side Muhunoa West Road and terminate outside the entrance to the property. The buildings can be supplied from these existing overhead lines.

4.7.2. Telecommunications

The Chorus telecommunication network extends down the southern side of Muhunoa West Road and terminates just prior to the property. This existing network could be used to service the new golf course buildings. Satellite internet is available country wide and would provide faster internet speeds.

4.7.3. Gas

There is no existing gas supply at this end of Muhunoa West Road. No gas connections are proposed for the Gold Course.

4.8. Roading & Transportation

4.8.1. Vehicle Crossing to Muhunoa West Road

Tim Kelly Transportation Planning Limited has assessed the external transportation aspects. This report covers internal layout matters only. There is an existing vehicle crossing to Muhunoa West Road in the north east corner of the property. This access will be retained and used as the main access to the Golf Course. The vehicle access will comply with HDC Engineering Appendix One, Vehicle Crossings, Drawing 6 Rural Crossings.

4.8.2. Access

4.8.2.a. Clubhouse, Accommodation Units and Driving Range

The access to the Clubhouse, Accommodation Units and Driving Range will be formed with a minimum carriageway width of 5.5 to 5.7m, with 0.5m sealed shoulders on both sides as per NZS 4404 Table 3.2, rural access to trade. The total formed width will be 6.5-6.7m. Table 3.2 requires a pedestrian width of 1.5m on each side of the road. However, this is not considered necessary as it is unlikely that pedestrians will be accessing the golf course from Muhunoa West Road.

Stormwater runoff from the access will be captured in stormwater swales on both sides. The swales will discharge into soak pits at regular intervals along the access.

The access will be two-way from Muhunoa West Road to the Clubhouse. A car park is provided to the south east of the Clubhouse and provides an alternative route to exit the Clubhouse.

Refer Appendix D for access scala results and a concept pavement design for the Clubhouse access.

4.8.2.b. Owner's Cottage, Stables and Maintenance Sheds

The access to the Maintenance Sheds will be formed with a minimum carriageway width of 5.5 to 5.7m, with 0.5m formed shoulders on both sides as per NZS 4404 Table 3.2, rural access to trade. Swales on the side of the access will capture runoff to discharge into soak pits at regular intervals.

The access to the Owner's Cottage and Stables will have a carriageway width of 3.0m inclusive of shoulders as per NZS4404 Table 3.2, rural live and play and will be unsealed. Swales on the side of the access will capture access runoff to discharge into soak pits at regular intervals.

4.8.3. Car Park

The Clubhouse car park has been designed in accordance with AS/NZS 2890.1 and has a one-way aisle. The car park and proposed access to the Clubhouse form a "roundabout" circulating in an anti-clockwise direction. Where the car park exits onto the access, signs and road marking will be provided to indicate that exiting vehicles must give way to vehicles on the access.

The car park provides 61 car parks. All car parks are at 90 degrees. The aisle widths allow for one-way movement. There is one dedicated entry point to the car park and one dedicated exit point from the car park.

The 61 car parks will allow for the following.

- Two car parks for each accommodation unit (20 total)
- 8 staff car parks
- 3 disability car parks as per NZS4121, Table 1
- 25 car parks for the Clubhouse
- 5 car parks for the Driving Range.

The Maintenance Sheds will have staff parking around the outside of the buildings. These will be design in accordance with AS/NZS 2890.1.

4.8.4. Sight Distance

At the location of the vehicle crossing, Muhunoa West Road is straight and flat. The access is located at the end of a no exit road. There is one existing access to the west on the north side of the road to Ōhau Sands subdivision. Sightlines to the west and east along Muhunoa West Road are good and compliant with HDC District Plan Rule 21, Table 21-1.

4.9. Earthworks

Earthworks are required to construct the accesses and car parks. The sand dune that the Clubhouse and Accommodation Units are located will be shaped to provide a flat building platform. The Clubhouse will sit at approximate RL 22.0m and the Accommodation Units will sit at RL 21.0m. The material cut from the dune for the building platforms will be used to fill in areas on the dune. Refer to architectural drawings for plan cut and fill zones and earthworks cross sections.

Some earthworks will be required to shape the fairways and greens, however, the golf course has largely been designed to follow the existing shape of the land.

The total indicative volumes of cut and fill are 118,000m^3 and 83,000m^3 respectively. The total area of earthworks is 114,000m^2. All earthwork volumes are bulk volumes. Refer Appendix A for earthwork plans.

4.9.1. Erosion and Sediment Controls

During construction erosion and sediment control devices will be installed in accordance with Greater Wellington Regional Council's Erosion and Sediment Control Guidelines. It will be important to stabilize exposed sand faces to prevent wind blown sediment blowing into adjacent properties. Refer Appendix A for the earthworks management plan.

4.10. Venue Foundations

All the proposed buildings within the property will have an importance level of 2 as per NZS3604. Ground investigations as prescribed in NZS3604 Section 3 were undertaken. Based on these investigations and the scala penetrometer results the soil conditions are not classed as good ground. Specific engineering design will be required for all building foundations.

5. Conclusions & Recommendations

Based on the discussions in this report a Golf Course, Clubhouse, Accommodation Units, a Driving Range, a Residential Dwelling, Stables and Maintenance Sheds at 765 Muhunoa West Road is achievable. This report is a preliminary design only and further detailed design will be required.

Overall, we recommend:

1. Potable water for the Clubhouse, Accommodation Units and Driving Range will be sourced from a bore.
2. Potable water for the Owner's Cottage, Stables and Maintenance Sheds will be captured from the roof of each building and stored in rain tanks.
3. Stormwater neutrality is achieved for the Owner's Cottage, Stables and Maintenance Sheds by attenuating the peak discharge in a 10-year, 10-minute duration event by capturing the water from the roof in rain tanks and releasing it slowly through a small orifice.
4. Stormwater from the Clubhouse and Accommodation Units will be piped to storage tanks to be used for irrigation on the golf course.
5. Stormwater from the Driving Range building will be disposed via soakage.
6. Stormwater from accesses will be captured in swales and disposed of in soak pits located at regular intervals.
7. Wastewater from the Clubhouse, Accommodation Units, and Driving Range building will be treated in an on-site secondary treatment plant. The treated effluent will be disposed using a PCDI system.
8. Domestic wastewater from the Owner's Cottage, Sleepout and Stables will be treated in a residential secondary treatment tank and disposed using a PCDI system.
9. Wastewater from the Stables' horse washdown facility will be treated separately from the Stables' domestic wastewater.
10. Wastewater from the Maintenance Sheds will be treated in a secondary treatment plant and disposed of via a PCDI system.
11. Power will be provided by connecting to existing infrastructure on Muhunoa West Road.
12. Telecommunications will be provided by connecting to the existing network on Muhunoa West Road or connecting to satellite internet.
13. The existing access to Muhunoa West Road will be upgraded to a rural vehicle crossing standard.
14. The access to the Clubhouse and the car park will be formed in accordance with NZS4404. The access to the Maintenance Sheds will be formed in all-weather formation. The access to the

Owner's Cottage and Stables will be unsealed.

15. Erosion and sediment controls will be installed in accordance with Greater Wellington Regional Council's Erosion and Sediment Control Guidelines during all land disturbance activities and these will remain in place until all cut faces are stabilized.
16. A dedicated firefighting water source will be required for each building and will be designed in accordance with SNZ PAS 4509:2008. It is recommended that all buildings have sprinklers installed.

APPENDIX A – Drawings

LEGEND:

△	SCALA TEST LOCATION
☐	PERCOLATION TEST LOCATION
○	SOIL LOG
—	IRRIGATION NETWORK
▫	COMPOSTING TOILET

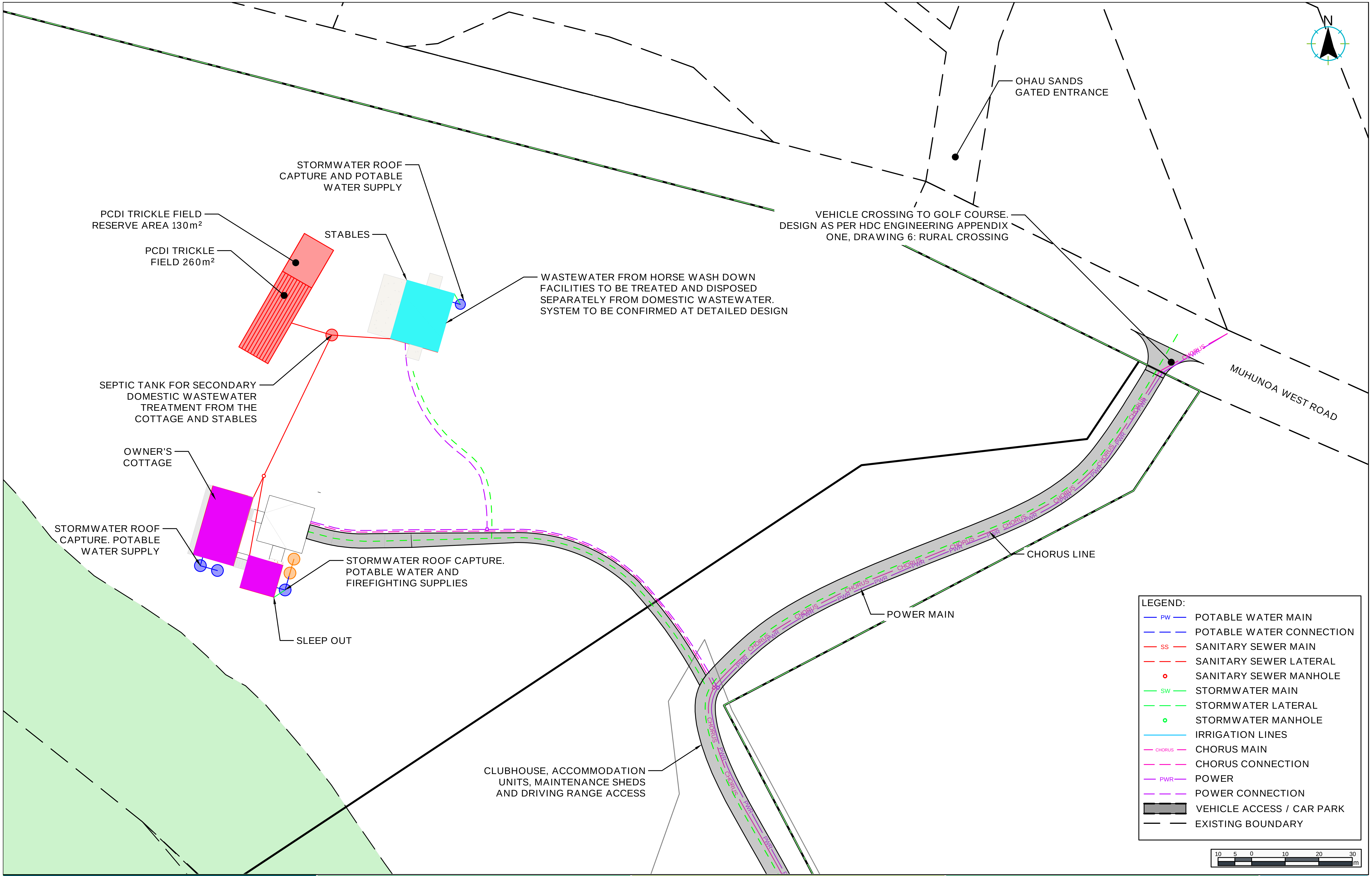
PREPARED BY

LANDMATTERS

CLIENT	PROJECT	DRAWING TITLE
GRENADIER LIMITED	DOUGLAS LINKS - OHAU	OVERALL ENGINEERING PLAN

DATE 02/09/2021
PROJECT NO. 709
SCALE 1:2000 @ A1
1:4000@ A3
DRAWING NO. J709-ENG-130
REV B

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_786\10 Plans, Aerials, CAD\Plans\ENG For RC - 2021-09-02.dwg, Plotted by Dan Turner at 3/09/2021 10:10:08 am



PREPARED BY

LANDMATTERS

CLIENT

GRENADIER LIMITED

PROJECT

DOUGLAS LINKS - OHAU

DRAWING TITLE

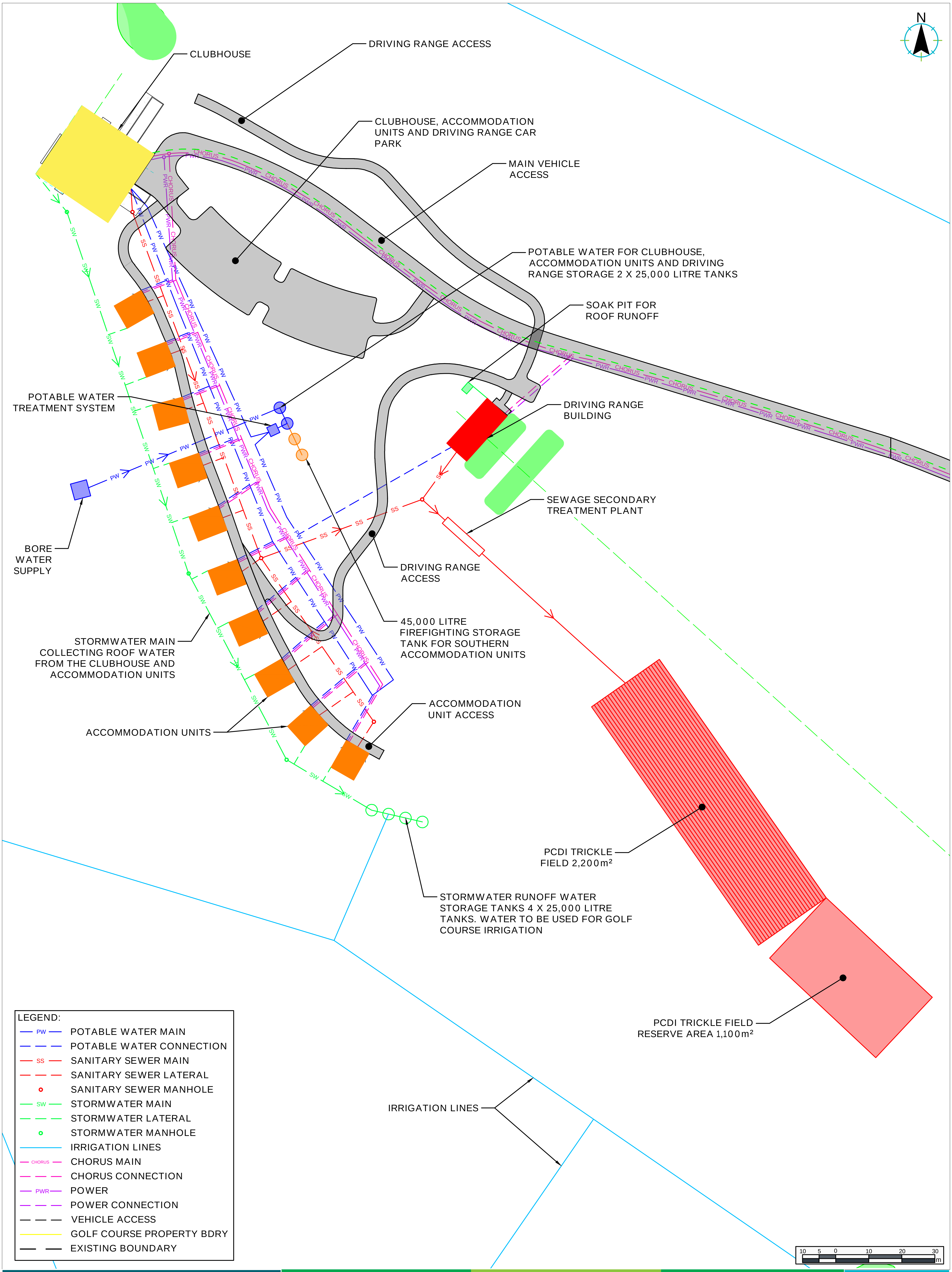
ENGINEERING PLAN
STABLES AND OWNER'S COTTAGE

DATE	PROJECT NO.
02/09/2021	709

SCALE
1:500 @ A1
1:1,000 @ A3

DRAWING NO.	REV
J709-ENG-131	B

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_78610 Plans, Aerials, CAD\Plans\ENG For RC - 2021-09-02.dwg, Plotted by Dan Turner at 3/09/2021 10:10:15 am



PREPARED BY
LANDMATTERS

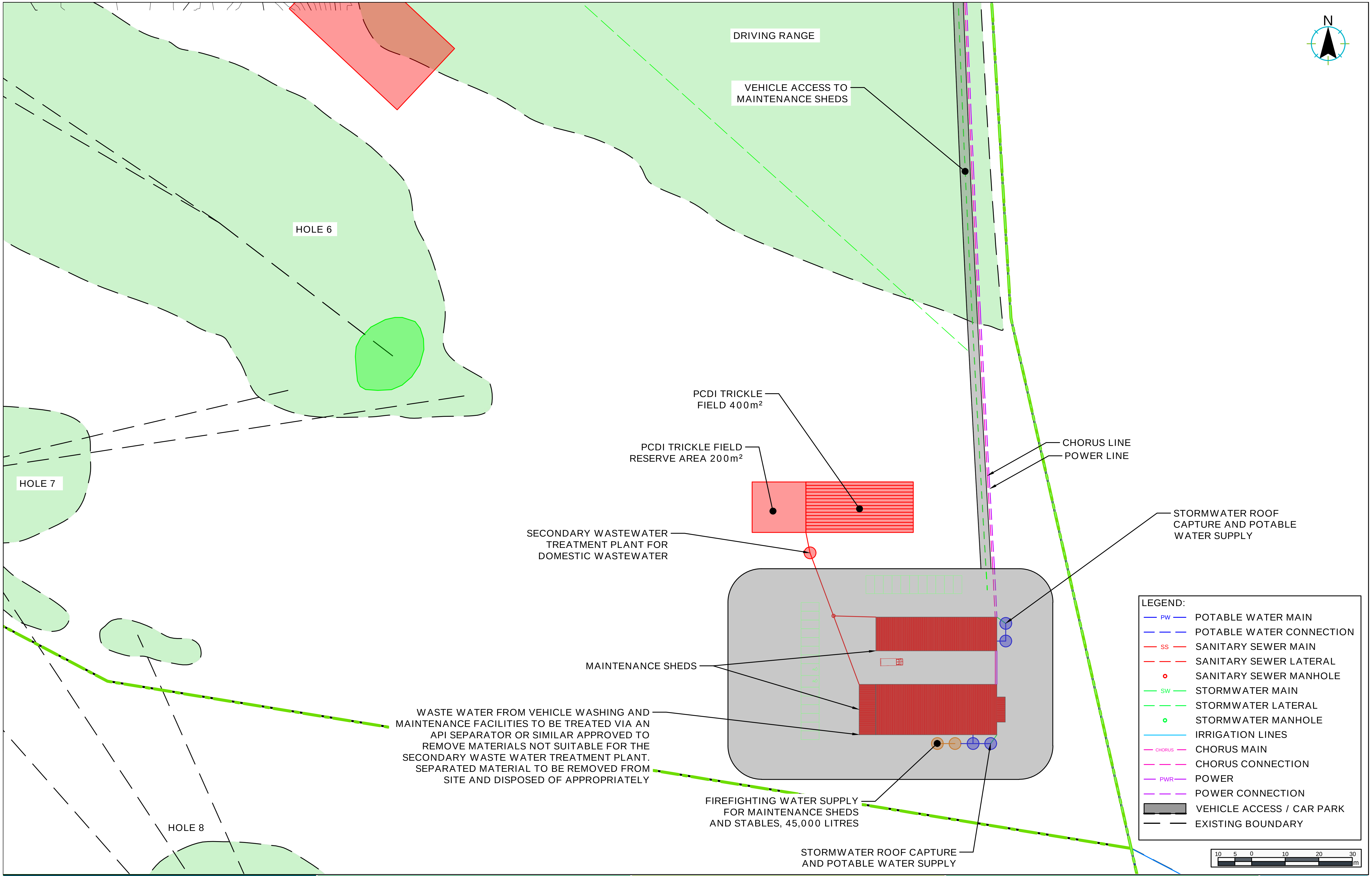
CLIENT
GRENADIER LIMITED

PROJECT
DOUGLAS LINKS - OHAU

DRAWING TITLE
ENGINEERING PLAN
CLUBHOUSE,
ACCOMMODATION UNITS
AND DRIVING RANGE

DATE	PROJECT NO.
21/12/20	709
SCALE	1:500 @ A1 1:1000@ A3
DRAWING NO.	REV
J709-ENG-132	A

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_786\10 Plans, Aerials, CAD\Plans\ENG For RC - 2021-09-02.dwg, Plotted by Dan Turner at 3/09/2021 10:10:20 am



LEGEND:

— PW —	POTABLE WATER MAIN
— — —	POTABLE WATER CONNECTION
— SS —	SANITARY SEWER MAIN
— — —	SANITARY SEWER LATERAL
○	SANITARY SEWER MANHOLE
— SW —	STORMWATER MAIN
— — —	STORMWATER LATERAL
○	STORMWATER MANHOLE
——	IRRIGATION LINES
— CHORUS —	CHORUS MAIN
— — —	CHORUS CONNECTION
— PWR —	POWER
— — —	POWER CONNECTION
▬	VEHICLE ACCESS / CAR PARK
— —	EXISTING BOUNDARY

PREPARED BY

LANDMATTERS

CLIENT

GRENADIER LIMITED

PROJECT

DOUGLAS LINKS - OHAU

DRAWING TITLE

ENGINEERING PLAN
MAINTENANCE SHEDS

DATE 02/09/2021
PROJECT NO. 709
SCALE 1:500 @ A1
1:1,000 @ A3
DRAWING NO. J709-ENG-133
REV A

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_786\10 Plans, Aerials, CAD\Plans\ENG For RC - 2021-09-02.dwg, Plotted by Dan Turner at 3/09/2021 10:10:25 am

APPENDIX B – Flow Routing Calculations

Rain tank - Flow routing analysis for Owner's Cottage

Determine Temporary Storage Zone Requirements

(A) Site Data

Soil type: sand			
Areas:			C Value
Roof and impervious	250	m^2	0.9
Pervious area	250	m^2	0.4

(B) Tank details

Orifice diameter calculation

$Q=3.47 \times C_d \times d^2 \times h^{0.5}$

Tank radius	1.75	m
Number of tanks	2	ea
Combined tank area	19.2	m^2
Depth to overflow	2.50	
Depth to outlet	2.30	
Max head height	0.20	m
Tank volume	3.85	m^3
Orifice diam (max), d	0.03	m
Orifice diam sqared, d^2	0.0009	m^2
Orficie discharge coef	0.69	Cd
Orfice area	0.0007	m^2
Peak flow	1.0	l/s

(c) Hydrology - by rational method

Tc	10	min	
Storm duration	10	min	
Rainfall I (10% AEP)	89.44	mm/hr	
	C value	Peak discharge	
Pre development	0.4	2.5	l/s
Post development	0.9	5.6	l/s

		Tank inflow	Tank		Adjusted	Tank		Net device	Site runoff cals	
Time	Tank inflow	volume	Storage	Tank WL	Av WL	Outflow	Outflow vol	Storage	R-o-S	Total
mins	l/s	m^3	m^3	m	m	l/s	m^3	m^3	l/s	l/s
t	A	$B=A_{av}*t$	$C=G_{t-1}+B$	E=C/Area		F	$F*t$	$G=C-F*t$	H	I=F+H
0	0.00	0.00	0	0	0	0	0	0	0.0	0.0
2.5	1.40	0.10	0.105	0.005	0.003	0.112	0.017	0.088	0.0	0.1
5	2.79	0.31	0.402	0.021	0.013	0.247	0.074	0.328	0.0	0.2
7.5	4.19	0.52	0.852	0.044	0.033	0.389	0.175	0.677	0.0	0.4
10	5.59	0.73	1.411	0.073	0.059	0.523	0.314	1.097	0.0	0.5
12.5	4.19	0.73	1.831	0.095	0.084	0.625	0.469	1.362	0.0	0.6
15	2.79	0.52	1.886	0.098	0.097	0.670	0.603	1.283	0.0	0.7
17.5	1.40	0.31	1.598	0.083	0.091	0.648	0.681	0.917	0.0	0.6
20	0.00	0.10	1.022	0.053	0.068	0.562	0.675	0.347	0.0	0.6
22.5	0	0.00	0.347							

Result:

Tank area	19.2	m^2
Max water level	0.10	m
Orifice diameter	0.03	m
Temp storage req'd, V	1.9	m^3
Temp storage provided	3.8	m^3

Determine Potable Water Storage Zone Requirements

Inputs

Roof area	360	m^2
No. of people	8	
Per capita use	145	l/p/d
Non summer	1160	l/d
Summer	116	l/d
Total summer	1276	l/d
Target % demand from tank	100	%
Rainfall loss factor	0.8	SDPR

	Ave rainfall	**Inflow**	Days in	Outflow	**Difference**	**Net storage**
	NIWA	**Total**		dwelling		
	(mm)	**m^3**	month	m^3	**m^3**	**m^3**
						8.2
January	76	**21.9**	31	39.6	**-17.7**	**-9.5**
February	77	**22.2**	28	35.7	**-13.6**	**-23.0**
March	93	**26.8**	31	39.6	**-12.8**	**-35.8**
April	96	**27.6**	30	34.8	**-7.2**	**-42.9**
May	112	**32.3**	31	36.0	**-3.7**	**-46.6**
June	106	**30.5**	30	34.8	**-4.3**	**-50.9**
July	98	**28.2**	31	36.0	**-7.7**	**-58.7**
August	100	**28.8**	31	36.0	**-7.2**	**-65.8**
September	93	**26.8**	30	34.8	**-8.0**	**-73.8**
October	99	**28.5**	31	36.0	**-7.4**	**-81.3**
November	90	**25.9**	30	34.8	**-8.9**	**-90.2**
December	78	**22.5**	31	39.6	**-17.1**	**-107.3**
Total	1118	**322.0**	365	437.436		**-9.5**
	Minimum permanent storage required					**-17.7**

Tank sizing

Total storage required, T:		
Temporary storage (attenuation), V	3.8	m^3
Potable water invert height	0.8	m
Permanent storage required, S	-9.5	m^3
Permanent storage provided, S	28.9	m^3
Firefighting outlet invert height	0.1	m
Firefighting storage	13.5	m^3
Dead storage, D	1.9	m^3
Total tank capacity	48.1	m^3

Top overflow pipe diameter, F		
Design discharge, Q = 0.00028 x A x I_2		
A, roof area	250	m^2
I_2, 2% AEP rainfall for 10min storm	125.28	mm/hr
Design discharge, Q	8.8	l/s
Q = 3470 x C_d x X d^2 x $h^{0.5}$		
C_d	0.65	
Head h equals pipe diameter	0.11	m
Solve for d =SQRT (Q /(3470 xC_dx$h^{0.5}$))	0.11	m
Difference	0.00	m

Recommend using 2 x 25,000 litre rain tanks			
Devan 25,000 litre rain tank (or similar) design parameters			
Number of tanks	2	no.	
Tank diameter	3.5	m	
Radius	1.75	m	
Base area (total)	19.2	m^2	
Overflow pipe height	2.50	m	
Overflow pipe diam (min.)	0.11	m	
Orifice diameter (max.)	0.030	m	
Orifice height (temp. storage)	2.30	m	
Temporary storage provided	3.8	m^3	
Outlet height (potable water)	0.8	m	
Permanent storage provided	28.9	m^3	25,000 litres minimum water storage requirement as per HDC SDPR, Section 12.4
Fire fighting outlet pipe height	0.1	m	
Firefighting storage	13.5	m^3	7,000 litres for a dwelling with a sprinkler system, 45,000 litres if no sprinkler system
Dead storage at base of tanks	1.9	m^3	
Total of four volumes	48.1	m^3	
Total tank storage	48.1	m^3	

Rain tank - Flow routing analysis for Stables

Determine Temporary Storage Zone Requirements

(A) Site Data				
Soil type: sand				
Areas:			C Value	
Roof and impervious	216	m^2	0.9	
Pervious area	216	m^2	0.4	
(B) Tank details				
Orifice diameter calculation				
$Q=3.47 \times C_d \times d^2 \times h^{0.5}$				
Tank radius	1.75	m		
Number of tanks	1	ea		
Combined tank area	9.6	m^2		
Depth to overflow	2.50			
Depth to outlet	2.30			
Max head height	0.20	m		
Tank volume	1.92	m^3		
Orifice diam (max), d	0.03	m		
Orifice diam sqared, d^2	0.0009	m^2		
Orficie discharge coef	0.69	Cd		
Orfice area	0.0007	m^2		
Peak flow	1.0	l/s		
(c) Hydrology - by rational method				
Tc	10	min		
Storm duration	10	min		
Rainfall I (10% AEP)	89.44	mm/hr		
	C value	Peak discharge		
Pre development	0.4		2.1	l/s
Post development	0.9		4.8	l/s

		Tank inflow	Tank		Adjusted	Tank		Net device	Site runoff cals	
Time	Tank inflow	volume	Storage	Tank WL	Av WL	Outflow	Outflow vol	Storage	R-o-S	Total
mins	l/s	m^3	m^3	m	m	l/s	m^3	m^3	l/s	l/s
t	A	$B=A_{av}*t$	$C=G_{t-1}+B$	E=C/Area		F	$F*t$	$G=C-F*t$	H	I=F+H
0	0.00	0.00	0	0	0	0	0	0	0.0	0.0
2.5	1.21	0.09	0.091	0.009	0.005	0.148	0.022	0.068	0.0	0.1
5	2.41	0.27	0.340	0.035	0.022	0.322	0.097	0.243	0.0	0.3
7.5	3.62	0.45	0.696	0.072	0.054	0.500	0.225	0.471	0.0	0.5
10	4.83	0.63	1.105	0.115	0.094	0.659	0.396	0.709	0.0	0.7
12.5	3.62	0.63	1.343	0.140	0.127	0.769	0.576	0.767	0.0	0.8
15	2.41	0.45	1.220	0.127	0.133	0.786	0.708	0.512	0.0	0.8
17.5	1.21	0.27	0.783	0.081	0.104	0.695	0.730	0.053	0.0	0.7
20	0.00	0.09	0.144	0.015	0.048	0.473	0.568	-0.424	0.0	0.5
22.5	0	0.00	-0.424							

Result:		
Tank area	9.6	m^2
Max water level	0.14	m
Orifice diameter	0.03	m
Temp storage req'd, V	1.3	m^3
Temp storage provided	1.9	m^3

Determine Potable Water Storage Zone Requirements

Inputs		
Roof area	216	m^2
Water use	400	l/d
Target % demand from tank	100	%
Rainfall loss factor	0.8	SDPR

	Ave rainfall	**Inflow**	Days in	Outflow	**Difference**	**Net storage**
	NIWA	**Total**		stables		
	(mm)	**m^3**	month	m^3	**m^3**	**m^3**
	NIWA					**0.0**
January	76	**13.1**	31	12.4	**0.7**	**0.7**
February	77	**13.3**	28	11.2	**2.1**	**2.8**
March	93	**16.1**	31	12.4	**3.7**	**6.5**
April	96	**16.6**	30	12.0	**4.6**	**11.1**
May	112	**19.4**	31	12.4	**7.0**	**18.1**
June	106	**18.3**	30	12.0	**6.3**	**24.4**
July	98	**16.9**	31	12.4	**4.5**	**28.9**
August	100	**17.3**	31	12.4	**4.9**	**33.8**
September	93	**16.1**	30	12.0	**4.1**	**37.9**
October	99	**17.1**	31	12.4	**4.7**	**42.6**
November	90	**15.6**	30	12.0	**3.6**	**46.1**
December	78	**13.5**	31	12.4	**1.1**	**47.2**
Total	1118	**193.2**	365	146		**0.7**
		Minimum permanent storage required				**0.7**

Tank sizing

Total storage required, T:		
Temporary storage, V	1.9	m^3
Permanent storage required, S	0.7	m^3
Permanent storage provided, S	21.2	m^3
Dead storage, D	1.0	m^3
Total tank storage	24.1	m^3

Top overflow pipe diameter, F		
Design discharge, $Q = 0.00028 \times A \times I_2$		
A, roof area	216	m^2
I_2, 2% AEP rainfall for 10min storm	125.28	mm/hr
Design discharge, Q	7.6	l/s
$Q = 3470 \times C_d \times X\ d^2 \times h^{0.5}$		
C_d	0.65	
Head h equals pipe diameter	0.10	m
Solve for d =SQRT $(Q/(3470\ xC_dxh^{0.5}))$	0.10	m
Difference	0.00	m

Recommend using 3 x 25,000 litre rain tanks		
Devan 25,000 litre rain tank (or similar) design parameters		
Number of tanks	1	no.
Tank diameter	3.5	m
Radius	1.75	m
Base area (total)	9.6	m^2
Overflow pipe height	2.50	m
Overflow pipe diam (min.)	0.10	m
Orifice diameter (max.)	0.030	m
Orifice height (temp. storage)	2.30	m
Temporary storage provided	1.9	m^3
Outlet height (potable water)	0.1	m
Permanent storage provided	21.2	m^3
Dead storage at base of tanks	1.0	m^3
Total of three volumes	24.1	m^3
Total tank storage	24.1	m^3

Rain tank - Flow routing analysis for the Small Maintenance Shed

Determine Temporary Storage Zone Requirements

(A) Site Data

Soil type: sand

Areas:			C Value	
Roof and impervious	360	m^2	0.9	
Pervious area	360	m^2	0.4	

(B) Tank details

Orifice diameter calculation

$Q=3.47 \times C_d \times d^2 \times h^{0.5}$

Tank radius	1.75	m
Number of tanks	2	ea
Combined tank area	19.2	m^2
Depth to overflow	2.50	
Depth to outlet	2.20	
Max head height	0.30	m
Tank volume	5.77	m^3
Orifice diam (max), d	0.03	m
Orifice diam sqared, d^2	0.0009	m^2
Orficie discharge coef	0.69	Cd
Orfice area	0.0007	m^2
Peak flow	1.2	l/s

(c) Hydrology - by rational method

Tc	10	min	
Storm duration	10	min	
Rainfall I (10% AEP)	89.44	mm/hr	
	C value	Peak discharge	
Pre development	0.4	3.6	l/s
Post development	0.9	8.0	l/s

		Tank inflow	Tank		Adjusted	Tank		Net device	Site runoff cals	
Time	Tank inflow	volume	Storage	Tank WL	Av WL	Outflow	Outflow vol	Storage	R-o-S	Total
mins	l/s	m^3	m^3	m	m	l/s	m^3	m^3	l/s	l/s
t	A	$B=A_{av}*t$	$C=G_{t-1}+B$	E=C/Area		F	$F*t$	$G=C-F*t$	H	I=F+H
0	0.00	0.00	0	0	0	0	0	0	0.0	0.0
2.5	2.01	0.15	0.151	0.008	0.004	0.135	0.020	0.131	0.0	0.1
5	4.02	0.45	0.583	0.030	0.019	0.298	0.089	0.494	0.0	0.3
7.5	6.04	0.75	1.249	0.065	0.048	0.470	0.212	1.037	0.0	0.5
10	8.05	1.06	2.094	0.109	0.087	0.635	0.381	1.713	0.0	0.6
12.5	6.04	1.06	2.769	0.144	0.126	0.766	0.574	2.195	0.0	0.8
15	4.02	0.75	2.949	0.153	0.149	0.831	0.748	2.202	0.0	0.8
17.5	2.01	0.45	2.654	0.138	0.146	0.822	0.863	1.791	0.0	0.8
20	0.00	0.15	1.942	0.101	0.119	0.745	0.894	1.048	0.0	0.7
22.5	0	0.00	1.048							

Result:

Tank area	19.2	m^2
Max water level	0.15	m
Orifice diameter	0.03	m
Temp storage req'd, V	2.9	m^3
Temp storage provided	5.8	m^3

Determine Potable Water Storage Zone Requirements

Inputs

Roof area	360	m^2
Water use	800	l/d
Target % demand from tank	100	%
Rainfall loss factor	0.8	SDPR

	Ave rainfall	**Inflow**	Days in	Outflow	**Difference**	**Net storage**
	NIWA	**Total**		main shed		
	(mm)	**m^3**	month	m^3	**m^3**	**m^3**
	NIWA					**0.0**
January	76	**21.9**	31	24.8	**-2.9**	**-2.9**
February	77	**22.2**	28	22.4	**-0.2**	**-3.1**
March	93	**26.8**	31	24.8	**2.0**	**-1.2**
April	96	**27.6**	30	24.0	**3.6**	**2.5**
May	112	**32.3**	31	24.8	**7.5**	**10.0**
June	106	**30.5**	30	24.0	**6.5**	**16.5**
July	98	**28.2**	31	24.8	**3.4**	**19.9**
August	100	**28.8**	31	24.8	**4.0**	**23.9**
September	93	**26.8**	30	24.0	**2.8**	**26.7**
October	99	**28.5**	31	24.8	**3.7**	**30.4**
November	90	**25.9**	30	24.0	**1.9**	**32.3**
December	78	**22.5**	31	24.8	**-2.3**	**30.0**
Total	1118	**322.0**	365	292.0		**32.3**
		Minimum permanent storage required				**32.3**

Tank sizing

Total storage required, T:		
Temporary storage, V	5.8	m^3
Permanent storage required, S	32.3	m^3
Permanent storage provided, S	40.4	m^3
Dead storage, D	1.9	m^3
Total tank storage	48.1	m^3

Top overflow pipe diameter, F		
Design discharge, $Q = 0.00028 \times A \times I_2$		
A, roof area	360	m^2
I_2, 2% AEP rainfall for 10min storm	125.28	mm/hr
Design discharge, Q	12.6	l/s
$Q = 3470 \times C_d \times X\ d^2 \times h^{0.5}$		
C_d	0.65	
Head h equals pipe diameter	0.13	m
Solve for d =SQRT $(Q / (3470\ xC_d xh^{0.5}))$	0.13	m
Difference	0.00	m

Recommend using 3 x 25,000 litre rain tanks		
Devan 25,000 litre rain tank (or similar) design parameters		
Number of tanks	2	no.
Tank diameter	3.5	m
Radius	1.75	m
Base area (total)	19.2	m^2
Overflow pipe height	2.50	m
Overflow pipe diam (min.)	0.13	m
Orifice diameter (max.)	0.030	m
Orifice height (temp. storage)	2.20	m
Temporary storage provided	5.8	m^3
Outlet height (potable water)	0.1	m
Permanent storage provided	40.4	m^3
Dead storage at base of tanks	1.9	m^3
Total of three volumes	48.1	m^3
Total tank storage	48.1	m^3

Rain tank - Flow routing analysis for the Large Maintenance Shed

Determine Temporary Storage Zone Requirements

(A) Site Data			
Soil type:	sand		
Areas:			C Value
Roof and impervious	540	m^2	0.9
Pervious area	540	m^2	0.4

(B) Tank details		
Orifice diameter calculation		
$Q=3.47 \times C_d \times d^2 \times h^{0.5}$		
Tank radius	1.75	m
Number of tanks	2	ea
Combined tank area	19.2	m^2
Depth to overflow	2.50	
Depth to outlet	2.20	
Max head height	0.30	m
Tank volume	5.77	m^3
Orifice diam (max), d	0.03	m
Orifice diam sqared, d^2	0.0009	m^2
Orficie discharge coef	0.69	Cd
Orfice area	0.0007	m^2
Peak flow	1.2	l/s

(c) Hydrology - by rational method			
Tc	10	min	
Storm duration	10	min	
Rainfall I (10% AEP)	89.44	mm/hr	
	C value	Peak discharge	
Pre development	0.4	5.4	l/s
Post development	0.9	12.1	l/s

		Tank inflow	Tank		Adjusted	Tank		Net device	Site runoff cals	
Time	Tank inflow	volume	Storage	Tank WL	Av WL	Outflow	Outflow vol	Storage	R-o-S	Total
mins	l/s	m^3	m^3	m	m	l/s	m^3	m^3	l/s	l/s
t	A	$B=A_{av}*t$	$C=G_{t-1}+B$	E=C/Area		F	$F*t$	$G=C-F*t$	H	I=F+H
0	0.00	0.00	0	0	0	0	0	0	0.0	0.0
2.5	3.02	0.23	0.226	0.012	0.006	0.165	0.025	0.202	0.0	0.2
5	6.04	0.68	0.881	0.046	0.029	0.365	0.110	0.771	0.0	0.4
7.5	9.06	1.13	1.903	0.099	0.072	0.580	0.261	1.642	0.0	0.6
10	12.07	1.58	3.227	0.168	0.133	0.787	0.472	2.755	0.0	0.8
12.5	9.06	1.58	4.340	0.226	0.197	0.955	0.717	3.623	0.0	1.0
15	6.04	1.13	4.755	0.247	0.236	1.048	0.943	3.812	0.0	1.0
17.5	3.02	0.68	4.491	0.233	0.240	1.056	1.109	3.382	0.0	1.1
20	0.00	0.23	3.609	0.188	0.210	0.989	1.186	2.422	0.0	1.0
22.5	0	0.00	2.422							

Result:		
Tank area	19.2	m^2
Max water level	0.25	m
Orifice diameter	0.03	m
Temp storage req'd, V	4.8	m^3
Temp storage provided	5.8	m^3

Determine Potable Water Storage Zone Requirements

Inputs		
Roof area	540	m^2
Water use	1200	l/d
Target % demand from tank	100	%
Rainfall loss factor	0.8	SDPR

	Ave rainfall	**Inflow**	Days in	Outflow	**Difference**	**Net storage**
	NIWA	**Total**		main shed		
	(mm)	**m^3**	month	m^3	**m^3**	**m^3**
	NIWA					**0.0**
January	76	**32.8**	31	37.2	**-4.4**	**-4.4**
February	77	**33.3**	28	33.6	**-0.3**	**-4.7**
March	93	**40.2**	31	37.2	**3.0**	**-1.7**
April	96	**41.5**	30	36.0	**5.5**	**3.7**
May	112	**48.4**	31	37.2	**11.2**	**14.9**
June	106	**45.8**	30	36.0	**9.8**	**24.7**
July	98	**42.3**	31	37.2	**5.1**	**29.9**
August	100	**43.2**	31	37.2	**6.0**	**35.9**
September	93	**40.2**	30	36.0	**4.2**	**40.0**
October	99	**42.8**	31	37.2	**5.6**	**45.6**
November	90	**38.9**	30	36.0	**2.9**	**48.5**
December	78	**33.7**	31	37.2	**-3.5**	**45.0**
Total	1118	**483.0**	365	438.0		**48.5**
		Minimum permanent storage required				**48.5**

Tank sizing

Total storage required, T:			
Temporary storage, V	5.8	m^3	
Permanent storage required, S	48.5	m^3	Some water will be released to ground during the wetter months.
Permanent storage provided, S	40.4	m^3	
Dead storage, D	1.9	m^3	
Total tank storage	48.1	m^3	

Top overflow pipe diameter, F		
Design discharge, $Q = 0.00028 \times A \times I_2$		
A, roof area	540	m^2
I_2, 2% AEP rainfall for 10min storm	125.28	mm/hr
Design discharge, Q	18.9	l/s
$Q = 3470 \times C_d \times X\ d^2 \times h^{0.5}$		
C_d	0.65	
Head h equals pipe diameter	0.15	m
Solve for d =SQRT $(Q/(3470\ xC_d xh^{0.5}))$	0.15	m
Difference	0.00	m

Recommend using 3 x 25,000 litre rain tanks		
Devan 25,000 litre rain tank (or similar) design parameters		
Number of tanks	2	no.
Tank diameter	3.5	m
Radius	1.75	m
Base area (total)	19.2	m^2
Overflow pipe height	2.50	m
Overflow pipe diam (min.)	0.15	m
Orifice diameter (max.)	0.030	m
Orifice height (temp. storage)	2.20	m
Temporary storage provided	5.8	m^3
Outlet height (potable water)	0.1	m
Permanent storage provided	40.4	m^3
Dead storage at base of tanks	1.9	m^3
Total of three volumes	48.1	m^3
Total tank storage	48.1	m^3

APPENDIX C – Test Pit Logs

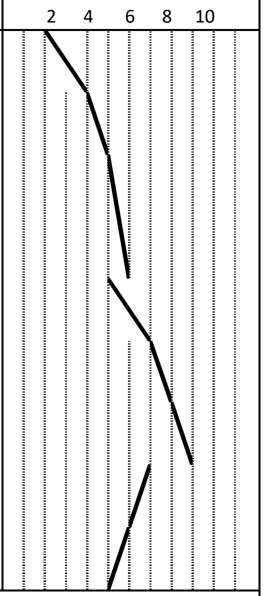
LANDMATTERS

LOG OF TEST PIT TP01
Existing access near gate to Muhunoa West Road
Geotechnical investigations

765 Muhunoa West Road, Ohau

Client: Grenadier Developments
Date: 24/11/2020
Digger type / size: N/A
Location: Near entrance

Logged by: DT SN
Auger size: 100mm
Existing ground level: 8.0m RL
Max test pit depth: 0.9m

Depth (m)	Material	Excavatability (Relative scale) Easier … Harder	USCS Symbol	Description	Graphic symbol	Water Level	Moisture Cond.	Consistency / Density Index	Scala Penetrometer Blows per 100mm
0.25 0.5 0.75	Sand	Easier	SP	Grey Sand		Not encountered	Slightly Moist	Loose	

Required depth reached

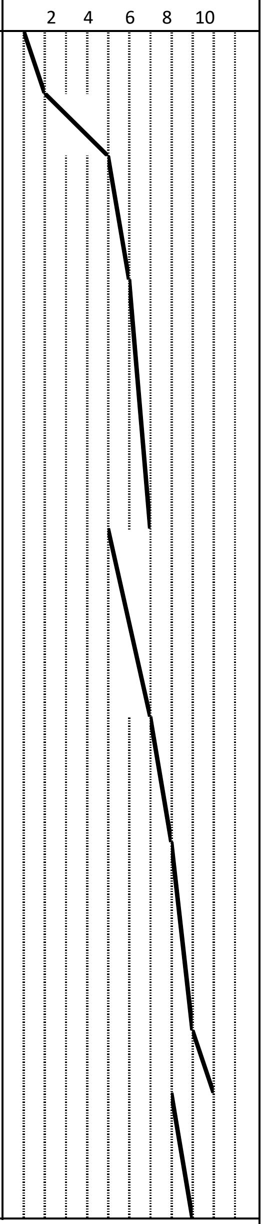
1.0
1.25
1.5
1.75

LANDMATTERS

LOG OF TEST PIT TP02
Maintenance Sheds
Geotechnical investigations

765 Muhunoa West Road, Ohau

Client: Grenadier Developments
Date: 24/11/2020
Digger type / size: N/A
Location: Maintenance sheds
Logged by: DT SN
Auger size: 0.1m
Existing ground level: 11.0m RL
Max test pit depth: 0.875m

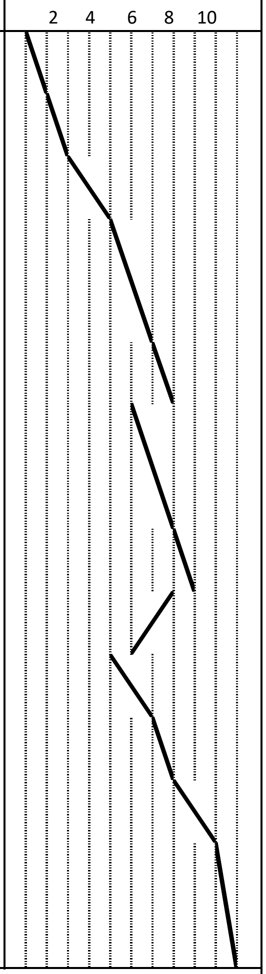
Depth (m)	Material	Excavatability (Relative scale) Easier Harder	USCS Symbol	Description	Graphic symbol	Water Level	Moisture Cond.	Consistency / Density Index	Scala Penetrometer Blows per 100mm
0.25 0.5 0.75 1.0 1.25 1.5 1.75 1.9	Sand	▨	SP	Grey Sand	▨	Not encountered	Dry Slightly Moist	Loose	

Required depth reached

LOG OF TEST PIT TP03
Owner's Cottage
Geotechnical investigations

765 Muhunoa West Road, Ohau

Client: Grenadier Developments
Date: 24/11/2020
Digger type / size: N/A
Location: Owner's Cottage
Logged by: DT SN
Auger size: 0.1m
Existing ground level: 20.0m RL
Max test pit depth: 1.5m

Depth (m)	Material	Excavatability (Relative scale) Easier … Harder	USCS Symbol	Description	Graphic symbol	Water Level	Moisture Cond.	Consistency / Density Index	Scala Penetrometer Blows per 100mm
0.25 0.5 0.75 1.0 1.25 1.5	Sand	▨	SP	Grey Brown Sand	▨	Not encountered	Dry Slightly Moist	Loose	

Required depth reached

LANDMATTERS

LOG OF TEST PIT TP05
Driving range and trickle field
Geotechnical investigations

119 Rangiuru Road,
Otaki Beach

Client: Grenadier Developments
Date: 24/11/2020
Digger type / size: N/A
Location: Driving range
Logged by: DT and SN
Auger size: 0.1m diam
Existing ground level: 7.0m RL
Max test pit depth: 0.9m

Depth (m)	Material	Excavatability (Relative scale) Easier … Harder	USCS Symbol	Description	Graphic symbol	Water Level	Moisture Cond.	Consistency / Density Index	Scala Penetrometer Blows per 100mm 2 4 6 8 10
	TS	▨	OL	TOPSOIL, dry, dark brown, rootlets to 50mm	▨	Not encountered	Slightly Moist	Loose	No scalas undertaken
0.25 0.5	Sand	▨	SP	Dark brown sand	▨				
0.75		▨		Grey sand	▨				
		▨		Orange Sand	▨				
1.0		▨		Grey sand	▨				
1.25 1.5				Target depth reached					
1.75									

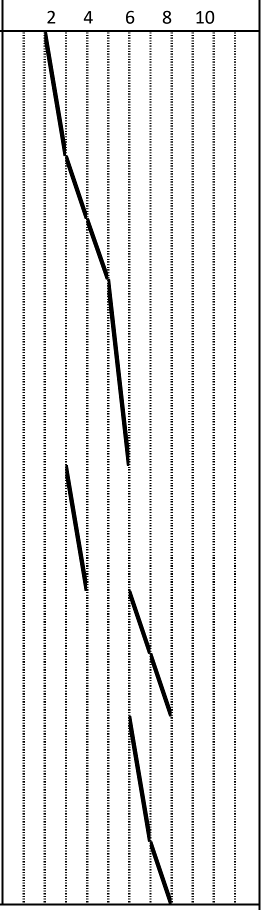
LOG OF TEST PIT TP06
Existing dwelling
Geotechnical investigations

765 Muhunoa West Road, Ohau

Client: Grenadier Developments
Date: 24/11/2020
Digger type / size: N/A
Location: Existing dwelling

Logged by: DT SN
Auger size: 0.1m
Existing ground level: 21.0m RL
Max test pit depth: 1.4m

Depth (m)	Material	Excavatability (Relative scale) Easier … Harder	USCS Symbol	Description	Graphic symbol	Water Level	Moisture Cond.	Consistency / Density Index	Scala Penetrometer Blows per 100mm
	Sand	▨ Easier	SP	Orange sands with trace of gravels	🟫	Not encountered	Dry	Loose	
0.25 0.5 0.75 1.0 1.25 1.4				Grey Sand	▨		Slightly Moist		



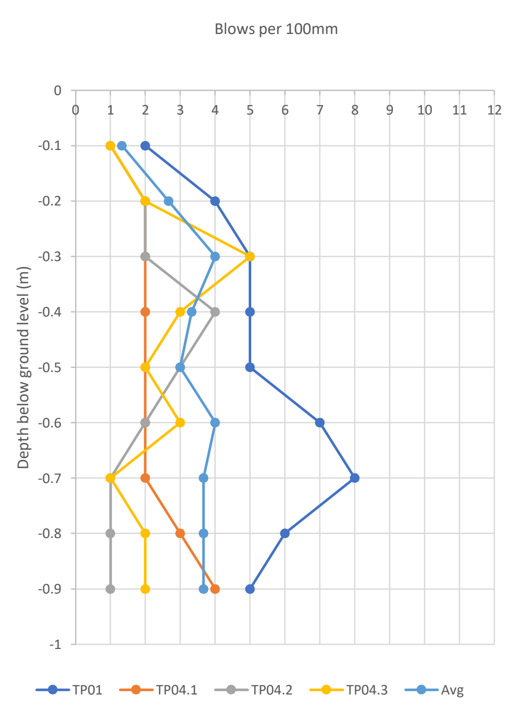
Required depth reached and no change

APPENDIX D – Scala Test Results

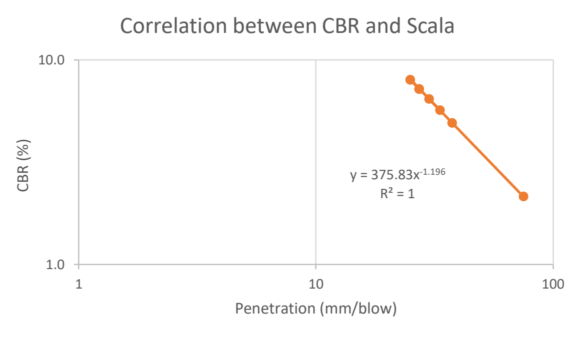
LANDMATTERS

Scala Penetrometer Test Results and Concept Pavement Design for the Clubhouse Access at TP01 and TP04

Client: Grenadier Developments
Logged by: DT SN
Date: 24/11/2020
Existing ground level: 9.0m RL (approx.)
Location: 765 Muhunoa West Road, Ohau
Max test pit depth: 0.9m

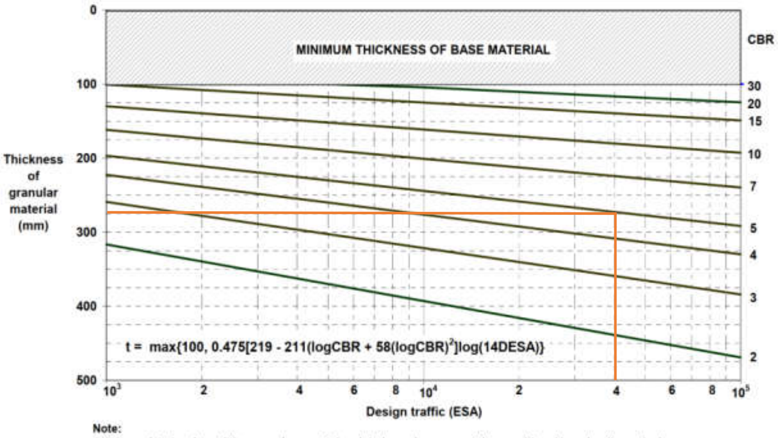


Depth (m)	Blows per 100mm (number)					mm/ blow	CBR
	TP01	TP04.1	TP04.2	TP04.3	Ave.		
0	0	0	0	0	0.0		
-0.1	2	1	1	1	1.3	75	2.1
-0.2	4	2	2	2	2.7	38	4.9
-0.3	5	2	2	5	4.0	25	8.0
-0.4	5	2	4	3	3.3	30	6.4
-0.5	5	2	3	2	3.0	33	5.7
-0.6	7	2	2	3	4.0	25	8.0
-0.7	8	2	1	1	3.7	27	7.2
-0.8	6	3	1	2	3.7	27	7.2
-0.9	5	4	1	2	3.7	27	7.2



In accordance to Austroads:Pavement Design for Light Traffic

5 %	CBR
Steet type:	Local access with no buses
400 v/day	AADT
4 %	Heavy vehicles
8	AADHV (single lane)
20 years	Design period
1 %	Annual growth rate
22	Cumulative growth factor
2.1 no.	Axle groups per heavy vehicle
128,480	Cumulative HVAG
0.3	ESA/HVAG
4 x 10^4 ESA	Indicative design traffic, Pavement Design for Light Traffic, Table 7.9
40,000 ESA	Indicative design traffic
275 mm	Thickness of granular material required, Figure 8.5



Note:
1. Appropriate local conditions, environmental and drainage issues must be considered in using these design curves.
2. Thin asphalt surfacings may be included in total granular thickness. However, the minimum thickness of the granular base is 100 mm.

Figure 8.5: Light traffic design chart for granular pavements with thin bituminous surfacings

APPENDIX E – Wastewater Treatment Plant Example

Product : Sewage treatment plant

Type :	Oxyfix® FIXEUC90
Model :	14.85 m³/day - C-90 CB 99 PE (3) Tri 3x400V + N
Process :	Submerged Aerated Fixed Film (SAFF) Technology

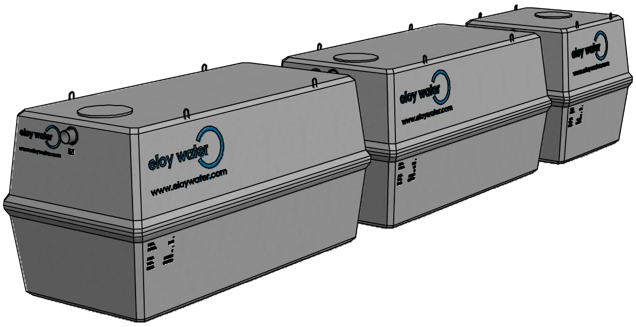
PERFORMANCE

Assumed Influent Values

Application :	Wastewater Treatment*	
Pollutant load BOD_5 :	400	mg/L
Pollutant load TSS :	600	mg/L
Pollutant load Ntot :	80	mg/L
Pollutant load Ptot :	13	mg/L

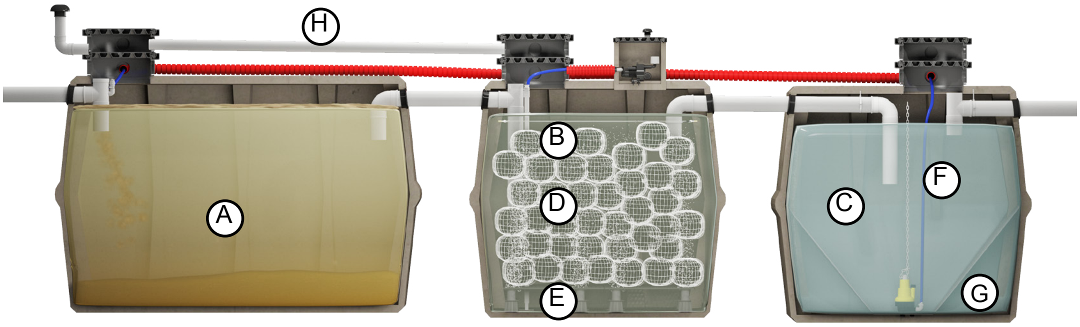
Purification performance

BOD_5 :	20	mg/L
TSS :	30	mg/L



* We recommend placing a grease trap for treating waste water generated by a restaurant, kitchens used for commercial purposes, etc.

FEATURES



ELECTROMECHANICAL COMPONENTS

Blower

Quantity :	1	pc(s)
Type :	side channel air blower	
Installed power :	1.50	kW
Power consumption :	1.05	kW
SPL (Sound Performance Lab) :	61	dB(A)
On / Off :	32/28	min.
Voltage :	3x400V	

Air Diffusers

Quantity :	15	pc(s)
Type :	fine bubbles	

Sludge recirculation

Type :	submerged pump	
Installed power :	0.85	kW
Power consumption :	0.85	kW
On / Off :	14/46	min.

Control panel

Type :	inside

Legend

A	Primary settling compartment
B	Biological reactor
C	Secondary settling compartment
D	Bacterial support
E	Diffusers
F	Sludge recirculation
G	Settling cone

APPROVALS AND CERTIFICATES

: 2014/04/142/A

DIMENSIONS | VOLUMES | WEIGHTS

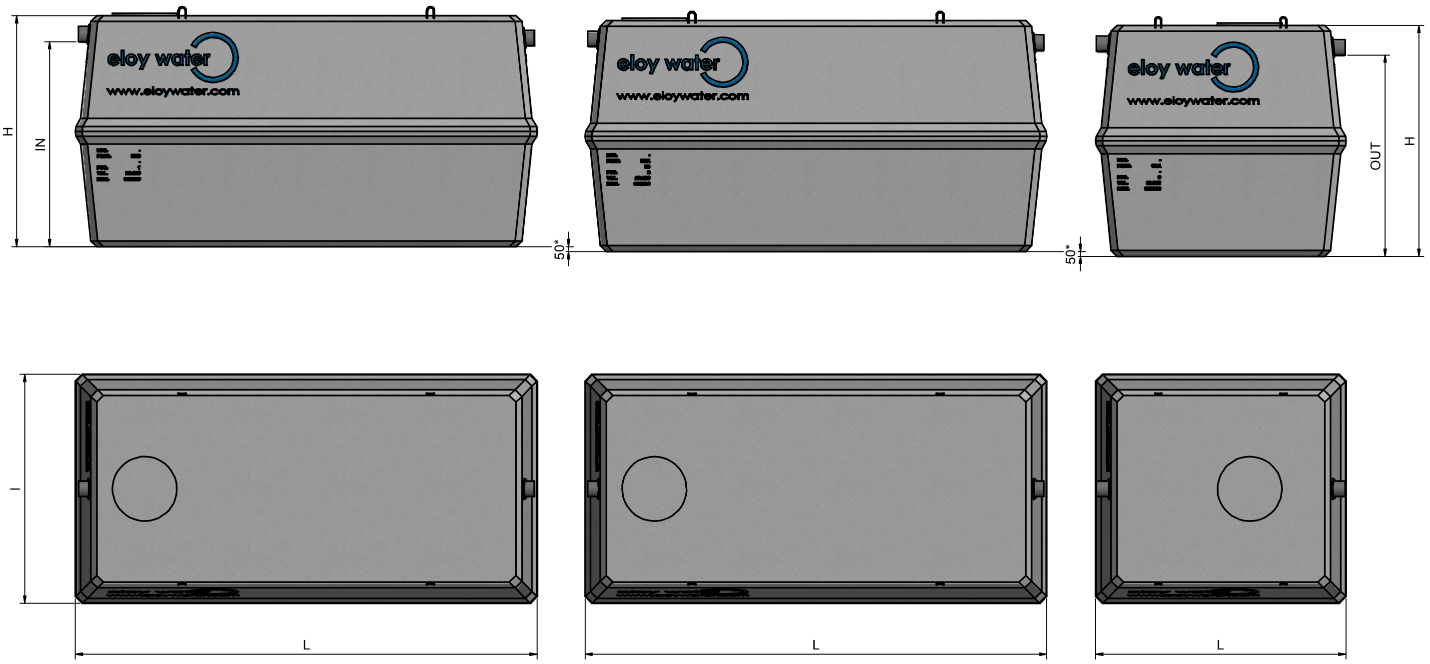
Measure	**Unit**	**Tank 1**	**Tank 2**	**Tank 3**
Total height* :	(cm)	240	240	240
Entry height* :	(cm)	213	213	213
Exit height* :	(cm)	209	209	209
Length :	(cm)	480	480	260
Width :	(cm)	238	238	238
Total volume :	(m^3)	20.00	20.00	10.00
Useful volume :	(m^3)	18.16	18.16	9.19
Weight :	(T)	9.10	9.95	5.82
Weight (w/o shipping cover):	(T)	-	-	-
Manhole(s) :	(cm)	1 x Ø60	1 x Ø60	1 x Ø60
Ø In / Out :	(mm)	160/160	160/160	160/160

* tolerance ± 2 cm

Material

Tank(s):	High performance steel reinforced concrete
Biocarrier:	Recycled PP
Air feed pipes:	PVC PN16

TANK DIMENSIONS



OPERATION

Useful volumes/surfaces

Primary settling compartment:	18.16	m^3
Biological reactor:	18.16	m^3
Clarifier:	4.41	m^2

Operation

Sampling chamber:	integrated	
Theoretical desludging frequency:	every 13 months	
Approximate energy consumption:	6,643	kW
Maintenance frequency :	annually (recommended)	
Admissible load :	80 cm of fill + pedestrian load	

Consumables

Blower filter:	annually
Blower membranes:	-
Air diffusers:	every 8 years

OPTIONS

Wall support for blower	
PE/concrete tank cover riser	3 pces
PE/steel tank cover	3 pces

GUARANTEES

Electromechanical kit :	2 years
Tanks :	10 years
Resistance :	B125

Sheet version: 20150609
Product version: 20140606

APPENDIX F – Wastewater Calculations

Pressure Compensating Dripper Irrigation Design (PCDI) for Club House, Accommodation Units and Driving Range Shed

Daily flow:	11,000 litres/day/person	Guidelines for on-site sewage systems in the Wellington Region; Table 7
Soil category:	1	AS/NZS 1547:2012, Table 5.1
Areal loading rate:	5 litres/m^2/day or mm/day	Auckland Council Guideline GD2018/006, E2.2.2.1
Design land application area:	2200 m^2	
Reserve land application (50%):	1100 m^2	Auckland Council Guideline GD2018/006, E2.2.2.1
Total land area:	3300 m^2	
Land application dimensions:	10m x 37m + (5m x 37m {reserve})	
Line spacing 1m centres	3300 linear metres	

Pressure Compensating Dripper Irrigation Design (PCDI) for Owner's Cottage and Stables (domestic only)

Daily flow:	1,260 litres/day/person	Guidelines for on-site sewage systems in the Wellington Region; Table 7
Soil category:	1	AS/NZS 1547:2012, Table 5.1
Areal loading rate:	5 litres/m^2/day or mm/day	Auckland Council Guideline GD2018/006, E2.2.2.1
Design land application area:	252 m^2	
Reserve land application (50%):	126 m^2	Auckland Council Guideline GD2018/006, E2.2.2.1
Total land area:	378 m^2	
Land application dimensions:	10m x 24m + (5m x 24m {reserve})	
Line spacing 1m centres	378 linear metres	

Pressure Compensating Dripper Irrigation Design (PCDI) for Maintenance Sheds

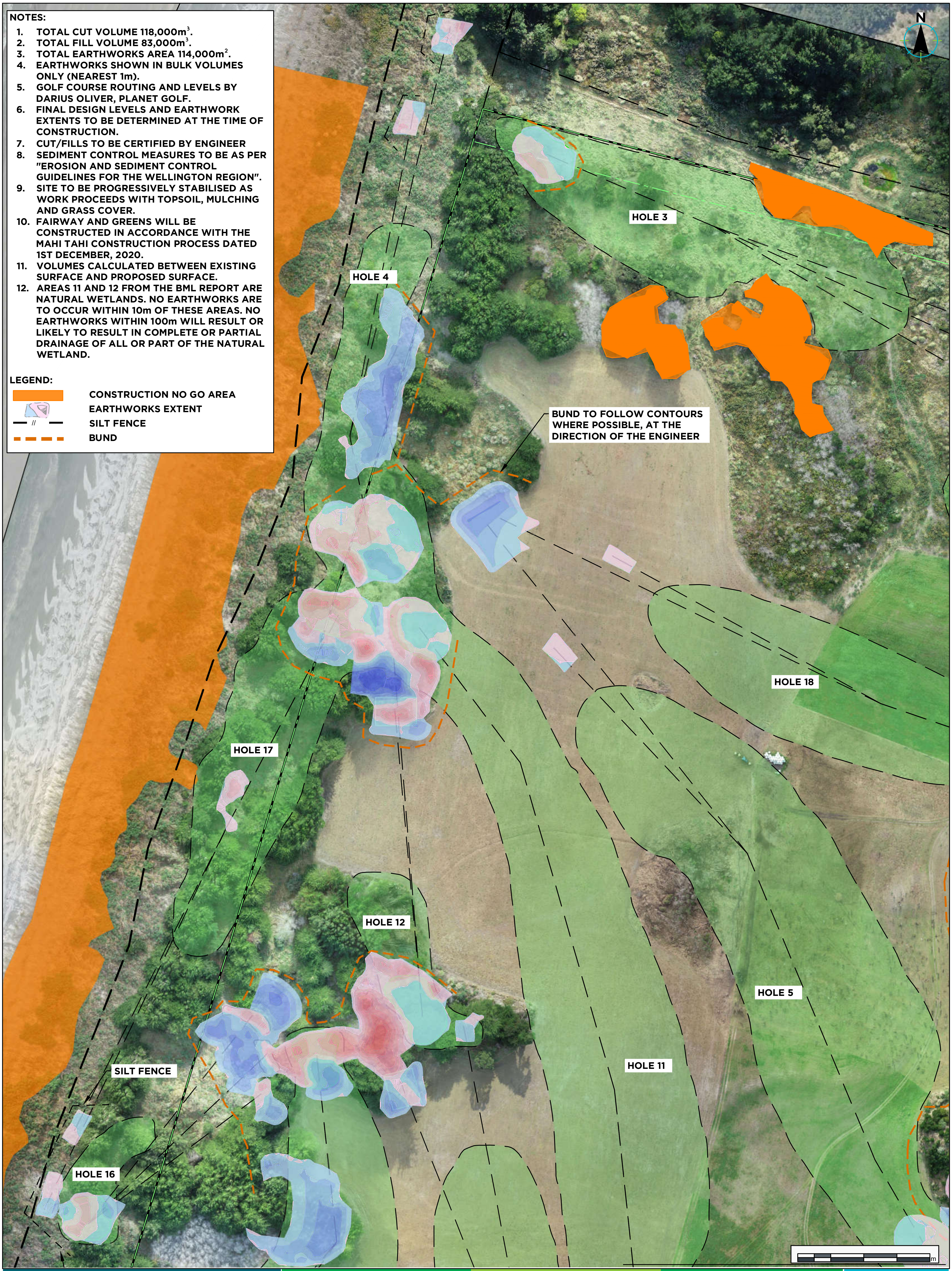
Daily flow:	2,000 litres/day/person	Guidelines for on-site sewage systems in the Wellington Region; Table 7
Soil category:	1	AS/NZS 1547:2012, Table 5.1
Areal loading rate:	5 litres/m^2/day or mm/day	Auckland Council Guideline GD2018/006, E2.2.2.1
Design land application area:	400 m^2	
Reserve land application (50%):	200 m^2	Auckland Council Guideline GD2018/006, E2.2.2.1
Total land area:	600 m^2	
Land application dimensions:	10m x 37m + (5m x 37m {reserve})	
Line spacing 1m centres	600 linear metres	

NOTES:

1. TOTAL CUT VOLUME 118,000m^3.
2. TOTAL FILL VOLUME 83,000m^3.
3. TOTAL EARTHWORKS AREA 114,000m^2.
4. EARTHWORKS SHOWN IN BULK VOLUMES ONLY (NEAREST 1m).
5. GOLF COURSE ROUTING AND LEVELS BY DARIUS OLIVER, PLANET GOLF.
6. FINAL DESIGN LEVELS AND EARTHWORK EXTENTS TO BE DETERMINED AT THE TIME OF CONSTRUCTION.
7. CUT/FILLS TO BE CERTIFIED BY ENGINEER
8. SEDIMENT CONTROL MEASURES TO BE AS PER "EROSION AND SEDIMENT CONTROL GUIDELINES FOR THE WELLINGTON REGION".
9. SITE TO BE PROGRESSIVELY STABILISED AS WORK PROCEEDS WITH TOPSOIL, MULCHING AND GRASS COVER.
10. FAIRWAY AND GREENS WILL BE CONSTRUCTED IN ACCORDANCE WITH THE MAHI TAHI CONSTRUCTION PROCESS DATED 1ST DECEMBER, 2020.
11. VOLUMES CALCULATED BETWEEN EXISTING SURFACE AND PROPOSED SURFACE.
12. AREAS 11 AND 12 FROM THE BML REPORT ARE NATURAL WETLANDS. NO EARTHWORKS ARE TO OCCUR WITHIN 10m OF THESE AREAS. NO EARTHWORKS WITHIN 100m WILL RESULT OR LIKELY TO RESULT IN COMPLETE OR PARTIAL DRAINAGE OF ALL OR PART OF THE NATURAL WETLAND.

LEGEND:

🟧	CONSTRUCTION NO GO AREA
▨	EARTHWORKS EXTENT
— // —	SILT FENCE
- - -	BUND



PREPARED BY	CLIENT	PROJECT	DRAWING TITLE	DATE	PROJECT NO.
LANDMATTERS	GRENADIER LIMITED	DOUGLAS LINKS - OHAU	ESCP PLAN NORTH WEST CORNER	03/09/2021	709

SCALE 1:1000 @ A1
1:2000@ A3

DRAWING NO. J709-ENG-150

REV B

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_786\10 Plans, Aerials, CAD\Plans\ENG For RC - 2021-09-02.dwg, Plotted by Dan Turner at 3/09/2021 1:42:24 pm

NOTES:

1. TOTAL CUT VOLUME 118,000m^3.
2. TOTAL FILL VOLUME 83,000m^3.
3. TOTAL EARTHWORKS AREA 114,000m^2.
4. EARTHWORKS SHOWN IN BULK VOLUMES ONLY (NEAREST 1m).
5. GOLF COURSE ROUTING AND LEVELS BY DARIUS OLIVER, PLANET GOLF.
6. FINAL DESIGN LEVELS AND EARTHWORK EXTENTS TO BE DETERMINED AT THE TIME OF CONSTRUCTION.
7. CUT/FILLS TO BE CERTIFIED BY ENGINEER
8. SEDIMENT CONTROL MEASURES TO BE AS PER "EROSION AND SEDIMENT CONTROL GUIDELINES FOR THE WELLINGTON REGION".
9. SITE TO BE PROGRESSIVELY STABILISED AS WORK PROCEEDS WITH TOPSOIL, MULCHING AND GRASS COVER.
10. FAIRWAY AND GREENS WILL BE CONSTRUCTED IN ACCORDANCE WITH THE MAHI TAHI CONSTRUCTION PROCESS DATED 1ST DECEMBER, 2020.
11. VOLUMES CALCULATED BETWEEN EXISTING SURFACE AND PROPOSED SURFACE.
12. AREAS 11 AND 12 FROM THE BML REPORT ARE NATURAL WETLANDS. NO EARTHWORKS ARE TO OCCUR WITHIN 10m OF THESE AREAS. NO EARTHWORKS WITHIN 100m WILL RESULT OR LIKELY TO RESULT IN COMPLETE OR PARTIAL DRAINAGE OF ALL OR PART OF THE NATURAL WETLAND.

LEGEND:

🟧	CONSTRUCTION NO GO AREA
▨	EARTHWORKS EXTENT
— // —	SILT FENCE
- - -	BUND

PREPARED BY

LANDMATTERS

CLIENT

GRENADIER LIMITED

PROJECT

DOUGLAS LINKS - OHAU

DRAWING TITLE

ESCP PLAN
NORTH EAST CORNER

DATE	PROJECT NO.
03/09-2021	709
SCALE	1:1000 @ A1 1:2000@ A3
DRAWING NO.	REV
J709-ENG-151	B

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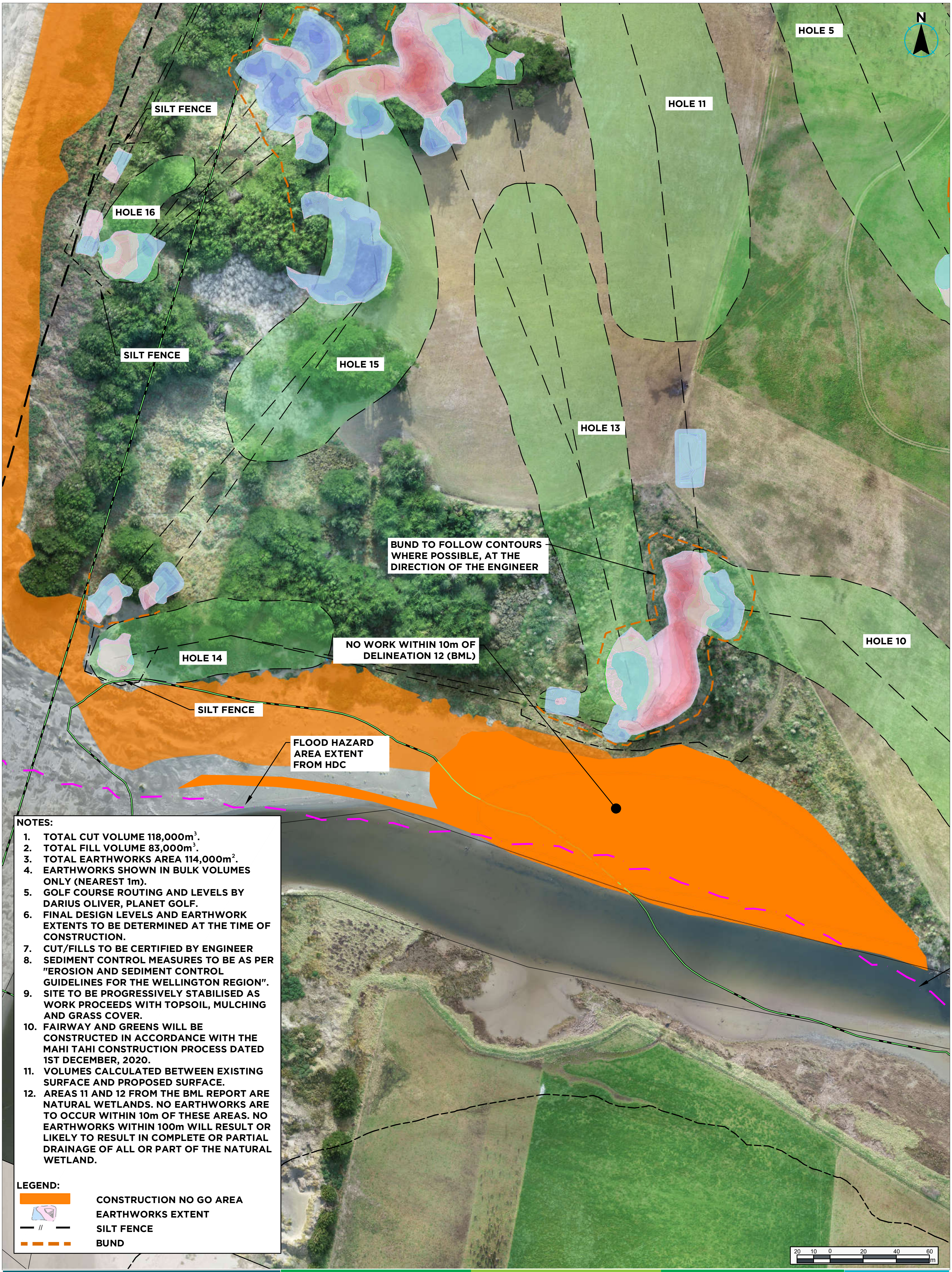

NOTES:

1. TOTAL CUT VOLUME 118,000m^3.
2. TOTAL FILL VOLUME 83,000m^3.
3. TOTAL EARTHWORKS AREA 114,000m^2.
4. EARTHWORKS SHOWN IN BULK VOLUMES ONLY (NEAREST 1m).
5. GOLF COURSE ROUTING AND LEVELS BY DARIUS OLIVER, PLANET GOLF.
6. FINAL DESIGN LEVELS AND EARTHWORK EXTENTS TO BE DETERMINED AT THE TIME OF CONSTRUCTION.
7. CUT/FILLS TO BE CERTIFIED BY ENGINEER
8. SEDIMENT CONTROL MEASURES TO BE AS PER "EROSION AND SEDIMENT CONTROL GUIDELINES FOR THE WELLINGTON REGION".
9. SITE TO BE PROGRESSIVELY STABILISED AS WORK PROCEEDS WITH TOPSOIL, MULCHING AND GRASS COVER.
10. FAIRWAY AND GREENS WILL BE CONSTRUCTED IN ACCORDANCE WITH THE MAHI TAHI CONSTRUCTION PROCESS DATED 1ST DECEMBER, 2020.
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LEGEND:

🟧	CONSTRUCTION NO GO AREA
▨	EARTHWORKS EXTENT
— // —	SILT FENCE
- - - -	BUND

PREPARED BY	CLIENT	PROJECT	DRAWING TITLE	
LANDMATTERS	GRENADIER LIMITED	DOUGLAS LINKS - OHAU	ESCP PLAN SOUTH WEST CORNER	DATE 03/09/2021 PROJECT NO. 709 SCALE 1:1000 @ A1 1:2000@ A3 DRAWING NO. J709-ENG-152 REV B

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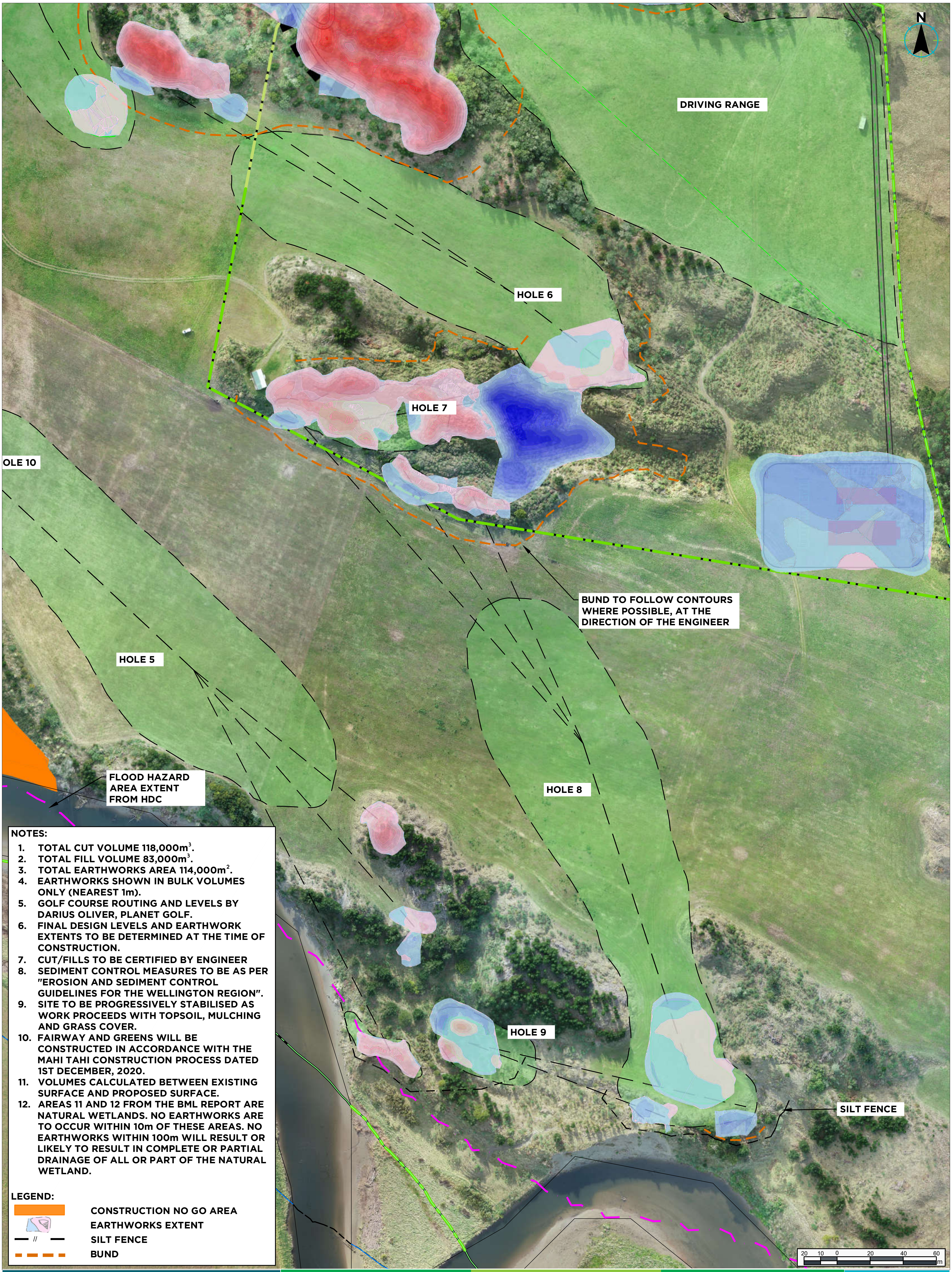

NOTES:

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LEGEND:

🟧	CONSTRUCTION NO GO AREA
▨	EARTHWORKS EXTENT
— // —	SILT FENCE
- - -	BUND

PREPARED BY
LANDMATTERS

CLIENT
GRENADIER LIMITED

PROJECT
DOUGLAS LINKS - OHAU

DRAWING TITLE
ESCP PLAN
SOUTH EAST CORNER

DATE	PROJECT NO.
03/09/2021	709
SCALE	1:1000 @ A1 1:2000@ A3
DRAWING NO.	REV
J709-ENG-153	B

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Bay Geological Services Ltd

Bay Geological Services Ltd
A C Johansen
RD6
Napier 4186

mobile: +64 275 014 984
email: *baygeological@xtra.co.nz*

7 September, 2021 ref: BGS258_02b

Grenadier Limited
c/- Tom Bland/Bryce Holmes
Land Matters Limited
20 Addington Road
RD1
Otaki 5541

Dear Tom and Bryce,

DOUGLAS LINKS APPLICATION FOR GROUNDWATER RESOURCES
765 MUHUNOA WEST ROAD, OHAU

Thank you for the email dated 2 September 2021 attaching the Horizons Regional Council Request for Further Information in relation to our expertise in hydrogeology. I have reviewed the request, and responses to the Horizons S92 points 2 and 3 (provided below), follow in Sections 1 and 2.

> *Groundwater*
>
> 2. *The volumes applied for are considered to be reasonable and efficient, based on the SPASMO estimates present, however based on the information provided it is unlikely that the daily and annual volumes proposed can be achieved by abstraction from the Applicant's bore. It is therefore recommended that the proposed daily and annual volumes are reduced to be consistent with the maximum instantaneous rate; this would equate to a maximum volume of 1,388.45 m^3/day (1,388) and 208,267.5 m^3/day (208,268). Alternatively, further testing could be undertaken on the Applicant's bore to assess whether it can achieve the pumping rates necessary to abstract the proposed daily and annual maximum volumes.*
> 3. *Please provide an assessment of effects on the reduced groundwater discharge to the Ōhau River, saltmarsh and lagoon resulting from this groundwater abstraction.*

1. GROUNDWATER VOLUMES

Following a review of the Douglas Links new well aquifer pump test analysis, the indication from Horizons is that the Application volume should reflect the capacity of the new 150 mm diam. well which was tested at 16.07 l/s for four days. Therefore, using this as the maximum instantaneous rate equates to a maximum daily volume of 1,388.45 m^3 and 208,267.5 m^3/year as recommended by Horizons.

2. GROUNDWATER DISCHARGE TO SURFACE WATER

The Douglas Links new well aquifer pump test report provided by Bay Geological Services Ltd. in June 2021 discusses the potential for groundwater discharge to surface water features within the vicinity of the project area.

In 2019, GNS completed a geochemical and hydrochemical study of the Ohau and Waikawa catchments in the Horowhenua Groundwater Management Zone to understand groundwater dynamics, source, and hydrochemical processes (Morgenstern et al, 2019). The study included stable isotope and gas data analysis which determined that groundwater recharge is dominated by local rainfall, rather than from stream depletion. The determination of stream and river water ages enabled understanding of which strata preferentially allowed infiltration of rainwater into groundwater systems, along with recharge rates, areas of recharge and more importantly, areas of discharge.

Section 9.2 of the Bay Geological Services Ltd. report provides the following discussion:

> *A geochemistry study by GNS in 2019 on the Ohau and Waikawa catchments modelled groundwater interactions with surface water including recharge and discharge, using groundwater age, chemistry, gas, and isotope tracers (Morgenstern et al, 2019). The study revealed high radon concentrations along the lower reaches of the Ohau River and Waikawa Stream, indicative of significant groundwater discharge into the surface waterways just upstream of the confluence, beyond which surface water flows across the Quaternary sands. The sands exhibit low permeability, inhibiting groundwater discharge to the sea, instead, it discharges to surface water bodies once it reaches the coastal end of the transmissive Quaternary gravel beds.*

An investigation into the Kapiti Coast groundwater resource by Gyopari et al (2014), studied the Otaki groundwater zone located approximately 12 km south of the project area. Measurement of stream contribution in the Rangiuru Stream is predominantly from groundwater which drains from the shallow (Q1) gravels which lie behind the lower conductivity sand deposits along the present-day costal margin. This is also the case in the Q1 alluvium adjacent to the Waitohu Stream (Gyopari et al, 2014).

Deeper wells north of Waitohu Stream screened across the Q5 sediments (approximately 30 m depth) exhibit systematic seasonal variation indicative of rainfall recharge as inferred in Figure 1 below from Gyopari et al (2014). Interpretation of the lithology and aquifer parameters of the Applicant’s well, suggest it is screened across the deep Q6 alluvium which is recharged by rainfall. The well is located near the coast and west groundwater discharge zones where shallow Quaternary gravels lie adjacent to low permeability sands further to the east.

Yours sincerely,

Alexandra Johansen
Principal Geologist/Hydrogeologist BSc (Hons)
Bay Geological Services Ltd

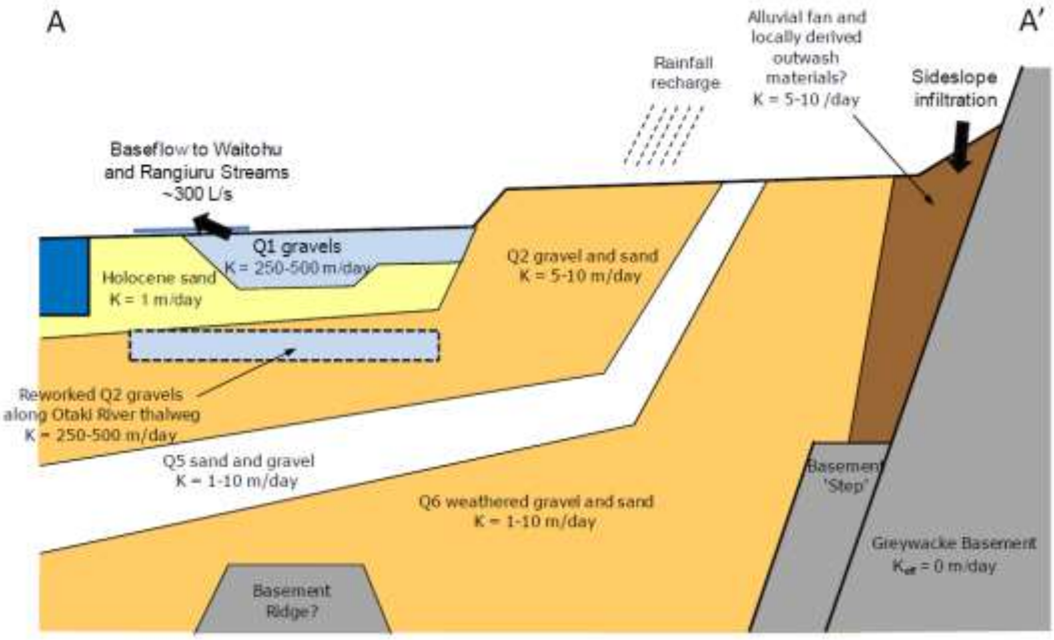


Figure 1: Schematic cross section of the Otaki groundwater zone (from Gyopari et al, 2014).

3. REFERENCES

Horizons Regional Council, 2021: Additional Information Request for Application APP-2020203164.01. Letter from Fiona Morton, Consultant Senior Consent Planner, (Horizons) to Tom Bland (Planner/Senior Resource Management Consultant, Land Matters Limited) on 1 September, 2021.

Morgenstern, U., van der Raaij, R.W., Baisden, W.T., Stewart, M.K., Martindale, H., Matthews, A., Collins, S., 2019: Ohau and Waikawa catchments of the Horowhenua Groundwater Management Zone: groundwater dynamics, source, and hydrochemical processes as inferred from the groundwater tracer data. Lower Hutt, N.Z.: GNS Science. GNS Science report 2018/06. 52 p.

Gyopari, M., Mzila, D., Hughes, B., 2014: Kapiti Coast groundwater resource investigation. Client report No. GW/ESCI-T-14/92 for Greater Wellington Regional Council. Wellington, New Zealand.

Report Limitations

This S92 response is written based on conditions as provided by third party contractors at the time of the desktop study report 'Douglas Links Well Aquifer Pump Test Report and AEE', Report No. BGS258_02 (Bay Geological Services Ltd, 2021). No interpretation is made on potential changes that may occur across the site or incorrectly reporting by third parties. Subsurface conditions may exist across the site that are not able to be detected or revealed by the investigation within the scope of the project, and are therefore not taken into account in this response. Furthermore, statements included within this response are assumptions made for the purposes of providing interpretations of site geology and aquifer pump test analysis.

9th September 2021

Attn: Grenadier Limited C/- Tom Bland/Bryce Holmes

Dear Tom and Bryce

Thank you for the email dated 2 September 2021 containing a request for further information in relation to my expertise in Golf Course Construction and Management.

As discussed previously I am uniquely qualified to discuss these matters having Horticulture and Amenity Turf Management qualifications and 25+ years of practical experience, most at the highest levels of golf in New Zealand. That experience spans multiple regions of New Zealand, almost all soil types, numerous different construction methods, and the full spectrum of grass varieties. I have worked with river sands in Hamilton, alluvial gravels in Canterbury, clays in Auckland, volcanic soils in Tauranga, and glacial silts in Otago.

I am also a former Board member and ex-president of the NZ Golf Course Superintendents Association, a former golf environmental award judge, a regular presenter at golf conferences, a former winner of NZ's premier golf course maintenance award, and a strong advocate for sustainable and environmentally responsible stewardship of the land.

I have reviewed the request, and my comments regarding points 4,11 and 16 are as follows:

4. Earthworks

General comments

The apparent concern around erosion, particularly wind erosion, on a pure sand site in entirely understandable and reasonable. It is also relatively simple to mitigate with correct earthworks staging and progressive stabilisation. Non wind-based erosion could be considered a very minor concern due to the high hydraulic conductivity rates of the sandy soils (tested at 345-413mm/hr), the lack of clear water courses, and the design of the golf course meaning the play corridors avoid the steepest land.

It needs to be highlighted that the natural contours and sand dunes are the reason Grenadier Ltd are so keen on this specific site. To allow them to become eroded or blown away would be counterproductive. While the coastal part of the site is almost perfect for golf, there are also other areas that will need to be carefully constructed by professional golf course shapers. This will come at significant cost to Grenadier Ltd and means erosion control will be front of mind simply to avoid having to repeat these works. The fine detail and subtlety of what seems like tiny contour changes to the uninitiated are what will help take Grenadier's links course to the level of design needed to make it financially viable long term. Golf Course construction staff will be 'locking down' those shapes immediately following completion.

From an agronomic and ongoing maintenance perspective it should be recognized that wind blow influences the size distribution of the sand particles and the uniformity of the soil. Areas where the finest sand particles may aggregate due to wind erosion will be more difficult to grow grass in long term. The finest sand particles will pack tighter, reducing aeration and water infiltration and will likely create areas that increase ongoing maintenance requirements. Again, it is Grenadier's best interests to control any erosion.

Site observations have noted a substantial germination of native Fescue grasses on the site since autumn (Fescues are the grass varieties that have been selected for the proposed golf course). This has some very positive implications as it means significant areas of the site may not need to be exposed to erosion. If the 'native' Fescue population remains high enough, selective removal of undesirable grasses and weeds using targeted spraying, followed by overseeding with extra Fescue seed, will allow Grenadier to create suitable playing surfaces for golf without the need to open or strip the surface.

Onsite observations, along with the sand tests performed for Grenadier Ltd by the New Zealand Sports Turf Institute (NZSTI), indicate that the fine sandy soils pack tight and maintain good moisture levels with relatively low rainfall. This points to a relatively low levels of water being required to keep the soil damp and in place, which is very helpful for erosion control.

Progressive stabilization and open areas

Given the financial and agronomic implications of losing highly desirable existing contours and newly created shapes due to erosion, Grenadier has planned construction processes designed to minimize open ground to the areas its relatively small team can maintain control of. The exact size of the open areas will be partly contingent on the time of year with associated rainfall and germination temperatures, but mostly determined by Grenadier's ability to keep the areas irrigated to a level that quickly germinates and grows fine turfgrass.

The Golf Corridor

Open areas in the constructed golf corridor can be *broadly* broken into four categories:

1. Areas being stripped and cleaned in preparation for shaping – potentially exposed to erosion (generally <2Ha)
2. Areas with shaping recently completed and being prepared for seeding – potentially exposed to erosion (generally <1/2Ha)
3. Areas with irrigation installed and operational, seeded and hydro mulched and headed to germination – not erodible (generally <1Ha)
4. Areas with grass germinated and heading towards first mow – not erodible (generally <2Ha)

Irrigation availability is critical to grass growth, especially on sandy soils. Grenadier's golf course construction team will be working away from the irrigation source. This means installation of a suitable pumping system and pipe network is a precursor to starting to construct the golf corridor. While the existing farm supply and the use of water tankers would suffice for wind erosion control in the preliminary stages, prior to opening larger areas for golf construction a secure and rapidly expandable irrigation pipe network would need to be in place.

Grenadier has planned for the extensive use of Hydromulch and Hydroseeding to minimize erosion, along with the use of durable polymer-based erosion control products (e.g., GRT Envirobinder) should any areas that aren't irrigatable be at risk of erosion.

The Macrocarpa Trees

The Macrocarpa trees cover a relatively small % of the overall site but conceals some of the best contours for golf on the site. Those contours also provide great framing and separation of the golf holes and Grenadier will have no desire to lose those contours.

The size of the macrocarpa trees, and the health and safety of those involved requiring separation of large tree and golf construction works, means slightly different erosion control methods will be required than for the golf corridor. To help minimize erosion the stump and root systems of the macrocarpas outside the golf corridor will be left in the ground to break down over time. Areas between these stumps will be prepared and hydroseeded and irrigated adequately to achieve revegetation and full cover with the RBT site remediation plan. These areas will then be largely left their own devices once established.

Grenadier is proposing to leave much of the associated mulch and debris on the surface as a stabilizer prior to the golf course shapers entering the area to begin golf construction.

Inland Dune Seedling Pines and Scrub

The soil on the steeper inland dunes is to remain as untouched as possible. The steepness of these dunes is a big component of the visual appeal of the site, but they are largely avoided and played around from a golf perspective meaning they don't need to provide the same quality of turfgrass cover as the golf playing corridor. There will be only minimal soil disturbance in most of these areas, associated with the felling of the juvenile pines. To the extent the slopes allow these areas will be mulched with a forestry mulcher with the mulch left on the surface as a stabilizer and to naturally break down.

……………………………

11. Ecological Matters – Hydrological and Nutrient effects

General comments

Based on observation during summer, autumn and winter, it is my view that the wetland on the site is more dependent on the level of the underlying ground water table than any runoff. This has been confirmed by the project ecologists (Boffa Miskell) and by the hydrogeologist. There are no spring fed features.

Any runoff will be minimal due to the sandy soils high infiltration and percolation rate (soil/sand hydraulic conductivity of 345-413mm/hr).

The removal of grazing cattle from the site would be expected to have a positive effect on water and nutrient levels in the wetland, particularly given the reduction in any potential for effluent based nutrient runoff.

The small wetland between Grenadier's proposed 2nd and 3rd holes has been frequented by animals, with evidence of wallowing, and both sign and sighting of Sambar deer. Upon the beginning of construction this will no longer be likely.

The grass varieties to be used are only successful under low nutrient and low soil volumetric water percentages. Excess fertilisation or irrigation has been proven to reduce their competitiveness against weed species resulting in low quality playing surfaces which will be unacceptable to Grenadier's future golfing guests.

Hydrological effects

Grenadier's golf construction team will using the native sandy soils and contours with only minor contouring changes, so there will be no significant change in runoff compared to the current situation.

The Fescue grass varieties chosen for this links golf course thrive under low moisture conditions. This means soil volumetric moisture percentages of less than 25%, which leaves significant room for infiltration rather than runoff. Standard golf course maintenance practices such as coring, spiking, and vertidraining will be regularly used to maintain consistency of water infiltration to maximise turfgrass health.

During the summer low rainfall period Grenadier will be irrigating the turfgrass to keep it healthy and to a standard required to meet high player expectations. However, over irrigation to the point of runoff produces undesirable soft playing surfaces totally incompatible with links golf. It will be in Grenadier's best interests to use their advanced irrigation control software to minimize runoff using such tools as soak times.

Nutrient Effects

Given the characteristics of the sandy soil, the ability to minimise runoff, the likely management practices, and the Fescue grass variety requiring minimal fertilizer inputs to establish and maintain, I would expect the nutrient effect to be minimal.

There would be no need to apply nutrients near any wetland to maintain the Fescue grasses. Modern golf course fertilizer application practices are focused on targeted low rate sprayed on foliar application of nutrients and nutrient rate decisions based on soil test results and minimum sufficient levels. A preliminary site soil test result from the NZ Sports Turf Institute via Hills Laboratories showed sufficient existing levels of Calcium, Magnesium and Potassium to grow Fescue. Should Grenadier need to apply corrective fertiliser, this would take the form of stable granular fertilisers applied immediately prior to seeding and incorporated into the soil surface, making nutrient runoff extremely unlikely.

Excessive nutrient application to fescue grasses has a negative effect by creating an environment better suited to weed competition. Links golf courses tend to be lean and lacking in turfgrass colour. Links grasses are fertilized only to maintain cover. Any excess growth would extra mowing – unlike a farming or cropping situation there is no commercial gain from dry matter production.

Phosphorus is generally considered the nutrient of greatest concern for wetlands. Fescues can be established with negligible levels of Phosphorus and maintained with almost none. It is highly likely that the conversion from farmland to golf course will see a significant reduction in the use of Phosphorus.

Grenadier Ltd will also be using buffer zones of longer grass and native plantings to reduce the likelihood of any nutrient runoff wherever needed. Evidence exists that simple steps such as cutting height changes in turfgrass reduce nutrient runoff.

……………………………………..

16. Ecology – Wetland drainage

The additional information request indicates a potential concern around the potential for drainage of natural wetlands. I believe the possibility of natural wetland drainage as a result of the golf course to be almost nonexistent.

The native sandy soils on the site are very well suited to producing high quality firm and bouncy Fescue playing surfaces, and a key reason Grenadier Ltd is attracted to the site. Links golf courses are meant to be firm and dry. Sandy soils provide the free draining characteristics ideal for the construction of golf courses. Indeed, sand is frequently imported into golf courses to build greens and tees on and to be used as a topdressing medium to firm up surfaces. Grenadier will want to maintain wetland features to enhance the appeal of the wider golf landscape. Unlike the farms in the surrounding area there is no advantage to capturing moisture retentive soils to create 'productive' land.

There will be no topsoil imported to site. Grenadier will be exclusively using the existing sands from the site and from the immediate surrounds of each specific zone. There should be no noticeable or measurable change in moisture retention. There are no upsides to Grenadier moving more moisture retentive soils into the areas meant for golf turf. Again, moisture retaining soils mean softer surfaces which lead to poorer playing conditions, extra growth to mow, and invasion of weed species grasses such as Poa Annua. Lower moisture soils encourage deeper root systems which can access natural rainfall and nutrients at depth better and leads to healthier grass requiring less fungicide and fertiliser.

Grenadier will not be contouring to lead water away from the wetland.

Additionally, the water level in the wetland is likely determined more by the level of the water table rather than runoff or seepage from surrounding soils.

To meet the summer survival and health requirements of the Fescue turfgrass, Grenadier would potentially apply approximately 300mm of irrigation in the summer months when natural rainfall isn't frequent. I suspect that irrigation in the absence of rainfall would be more likely to enhance any wetland than detract from it, although the effect would be small enough to not be able to be measurable.

……………………………

Should you require any further clarification on any of the above, please feel free to contact me.

Kind regards,

Brendan Allen,

Head of Construction of the Douglas Links,

Grenadier Ltd, Wellington, NZ

e. brendan@douglaslinks.co.nz – m. +64221656729

Douglas Links - Horizons Response Letter

This response has been prepared by Darius Oliver as the lead Golf Course Architect for the Douglas Links.

My involvement in this project dates back to January 2020, when I was first engaged to survey the land at Ohau and determine its suitability for a world-class 'links style' golf course.

I have previous golf course design experience, as the designer of Cape Wickham Links on King Island in Tasmania, which is ranked the #1 public access golf course in Australia, and among the Top 25 golf courses in the World. I also designed the 9-hole Farm course at The Hills Golf Club in Central Otago, and am currently engaged as the designer of The Cliffs golf course on Kangaroo Island in South Australia, and as design consultant on two courses at Thirteenth Beach in Victoria. Aside from The Hills, each of the other golf courses are built on sandy, links-style, sites like at Douglas Links.

Beyond my expertise in golf course design, I am also an author and the publisher of the Planet Golf series of books. For the four Planet Golf volumes I have studied golf courses in 40 countries and been fortunate to visit more than 2,000 golf courses worldwide.

It appears the Regional Council are seeking to ensure the project team have been considerate to the environmental values on the subject land through asking questions around assessment of alternative locations for the golfing aspects of the Douglas Links. An understandable request. I have prepared the following statement to explain those considerations and also describe the reasons for the current layout.

In terms of alternative approaches, I have worked with the project landscape architects and ecologists (including Dr Boffa, Mr Jim Dahm, Boffa Miskell and RBT Design) to amend the layout of the course to respect the environmental values of this area. I understand maps will be produced to demonstrate the iterative process that the project team has been through to ensure the Douglas Links was not the only consideration in design, but rather ensuring the golf course did not override important environmental values.

There are more than 30,000 golf courses in the world, yet only a few hundred that could be accurately described as a '*links*'. Golf was born along Scotland's East Coast more than 500 years ago, its earliest courses known as '*links*' because they were built on undulating, sandy ground with little agricultural value. This ground generally *linked* the sea and beach areas with the more productive farming land, hence the term '*links*'.

In my travels I have been fortunate to play and study all of the world's premier golf courses, including each of the famous ancient 'links' in Britain, Ireland, Europe, Australia, New Zealand and North America. The best golf courses worldwide have a clear character, an emphasis on fun and natural beauty, and a strong sense of place. There are great links courses that occupy softly, rumpled ground and others that weave in and out of larger sand dunes. Some get right beside the beach while others afford more distant coastal views and settings. Each is naturally attractive, easily walkable, publicly accessible and complete with holes that feel like they were 'discovered', rather than 'created'.

The aim is for the Douglas Links to provide a similar world-class '*links*' golf experience, and to stand out as one of New Zealand's premier golf courses, and one of its most natural. While there is room on the privately held land parcel at Ohau to accommodate 18 holes, there would be little interest in a golf course here that did not enjoy the views of the sea, the coastal air, sea breeze and vistas to Kapiti Island and the Ohau River. The design of the Douglas Links allows for those coastal processes to be experienced through just a minor occupation of the dunes areas. Without that enjoyment a golf course in this location would not be a true *links* course, and be unlikely to appeal to the discerning golfer.

Instead, Grenadier seek to create a true modern golf icon; a course so memorable that it is capable of attracting local and overseas golfers to the region for years and decades to come. In order to achieve this goal, Grenadier will need to use both private land as well as a small part of the Esplanade reserve, some of which is classified as a 'Schedule F' area in the planning documents. The reason this coastal land is essential for this project is two-fold. Firstly, it houses three of our most exciting holes (4, 16 and 17). Secondly, it enables the entire golf course to be built with a 'least disturbance' mindset.

The small occupation of part of this degraded ecosystem shall be offset by heavy indigenous planting elsewhere along the coastal margin, and mitigated by ongoing professional land management and the knowledge that these three holes are crucial to the overall appeal and success of the project and will alone attract many golfers to the Horowhenua District.

As highlighted in the Boffa Maskill ecological report, Grenadier's proposal brings significant benefits to the broader development area, including the coastal margin. Not only will non-native trees, weeds and livestock be removed from the site, there will be a heavy revegetation program undertaken, with native species like Sand Daphne planted along unused sections of the esplanade reserve, and elsewhere on the private parcel. There will also be Kanuka plantings on the private land. The entire site will then be professionally managed and maintained in perpetuity, by a team of highly skilled and passionate green keepers whose job will involve not only maintaining playing surfaces for golfers, but ensuring that the surrounding dunes are weed and pest free, and that they continue to properly showcase the beauty and diversity of local plant life.

We believe, that for Douglas Links to appeal to global golfers we need to showcase the stunning landforms of Ohau in the best, and most natural, light possible. The additional planting and ongoing management of these coastal dunes will not only keep the entire area attractive for visiting golfers, it will certainly prove a more sustainable use of the land than at present, and help to preserve the diversity of the region much more sensitively. We hope that through the removal of large introduced trees along the boundary of our property, and a combination of sensitive native plantings and ongoing land management, that we are able to create one of the best restored, and well-maintained, stretches of dune land in New Zealand.

Among the attractions, for golfers, at Ohau are the variety of coastal landforms and the variety of coastal views across the property – be they beach or river, ocean or offshore islands, or even panoramic landscape sight-lines from the elevated riverside bluffs. What excites our team about this project, is not only that the golf experience is sure to be a visual feast from start to finish, but that the natural dunes and natural '*links-like*' landforms are as appealing, for golfers, as these incredible views. This is particularly true of the larger ridges and sand hills nearest the private / esplanade boundary. Golfers love big sand dunes, and we are blessed with some magnificent structures throughout this transition zone.

In order to be able to build the best possible golf course on this land, and to navigate through some of the heavier landforms without major earthworks, we will need to use sections of the esplanade to accommodate holes 4, 16 and 17. Each of these holes has tremendous golf potential. They are also important parts of the overall golf routing, and crucial to the broader development journey.

In many ways these holes are the Douglas Links equivalent of the seaside holes at Royal County Down in Northern Ireland, or Barnbougle Dunes in Australia, both Top 30 in the world standard golf courses. As with these global examples, the dune land at Ohau provides both exceptional golf across rumpled sandy land, whilst helping provide golfers with an interesting and varied assortment of coastal views during their round.

Owing to the somewhat degraded and constricted nature of the private land parcel, without access to a small part of the esplanade and the ability to create these three beautiful holes, we would need to manipulate the boundary dune land to provide sufficient space for playable golf corridors. The additional earthworks would not only increase the cost and difficulty of construction, they would reduce the scale of the natural dune land and, arguably, spoil the very element that we believe will draw golfers to this part of the New Zealand coastline.

The clearest example of how excluding the small part of the esplanade impacts on the overall golf course, and the earthworks needed to complete construction, is the building of a 4th hole somewhere between our 3rd green and 5th tee. The proposed 4th hole tumbles across what are mostly gentle undulations, ideal for golf and with stunning outlooks toward the sea and Kapiti Island. The dunes on the east of the hole tower above the fairway and, though far too large and extreme for golf, they are magnificent in scale and structure. They offset the hole perfectly, and help the golf course feel like it is part of a unique and impressive, ancient setting.

Without access to part of the esplanade for hole 4, Grenadier would need to significantly reshape these dunes and lower them by several metres. Leaving a scar on the landscape would be somewhat inevitable, as would the sense from golfers that they were being denied access to what appears to be a perfect '*links*' hole on the other side of the fence. Neither outcome is going to help this golf course succeed and would result in far greater disturbance on the coastal environment.

We believe the impacts on the natural landscape in such a case would be significant, and also that the subsequent diminishing of the overall golf experience would make development next to impossible. As I'm sure you are aware, Grenadier have no interest in building a golf course simply for the sake of it. This project needs a world-class golf layout, in order to generate attention in the short-term, and to continue to attract the discerning golf traveller *to* the Horowhenua District in the longer term.

Like the world's best ancient links, Grenadier want the Douglas Links to be successful, for the business to endure and for the golf course to be able to draw visitors from all corners of the world for decades to come. This promotional aspect is not to attract large numbers of people at any one time, and in fact the appeal of the course is to allow only a few on the Links during the course of a day so they have a sense of wilderness while enjoying a recreational activity.

Our strong view is that the golf course needs to be world-class for the business to be sustainable, and for the environmental benefits of removing livestock from the area and reintroducing and managing native plant species to be realised in the long-term.

Darius Oliver.

LEGEND :

- Boundary
- Greens
- Maintained Turf Areas
- Original Green / Fairway Outline (August 2020)
- Hole Centreline
- Original Hole Centreline
- A Change Since Original Design

PREPARED BY LANDMATTERS	CLIENT GRENADIER DEVELOPMENTS LIMITED	PROJECT DOUGLAS LINKS - OHAU	DRAWING TITLE COURSE LAYOUT ITERATIONS	DATE 8/9/2021 PROJECT NO. 709 SCALE 1:1600 @ A1 1:3200@ A3 DRAWING NO. 709-LAYOUT-CH REV -

C:\12dS\data\LM-DATA\709 - Grenadier Developments Limited - Douglas Links - Ohau_786\10 Plans, Aerials, CAD\709-Course Layout Iterations.dwg, Plotted by Evan Pinfold at 8/09/2021 13:42:12

Boffa Miskell

Memorandum

☐ **Auckland**
PO Box 91250, 1142
+64 9 358 2526

☐ **Hamilton**
PO Box 1094, 3240
+64 7 960 0006

☐ **Tauranga**
PO Box 13373, 3141
+64 7 571 5511

☑ **Wellington**
Level 4
Huddart Parker Building
1 Post Office Square
PO Box 11340, 6142
+64 4 385 9315

☐ **Christchurch**
PO Box 110, 8140
+64 3 366 8891

☐ **Queenstown**
PO Box 1028, 9348
+64 3 441 1670

☐ **Dunedin**
PO Box 657, 9054
+64 3 470 0460

Attention:	Tom Bland and Bryce Homes
Company:	Grenadier Limited C/- Land Matters Limited
Date:	8.09.2021
From:	Dr Vaughan Keesing
Message Ref:	Douglas Links Golf Course, Ohau - Section 92 responses - Ecology

Dear Sirs

The following are our reposes to the Horizons section 92 – on ecological matters. In the following we repeat verbatim the Section 92 ecological request in red and then supply our responses and additional information. There is one appendix which is the additional vegetation map requested.

Ecological matters raised

5. Please demonstrate/justify why the permanent loss of rare and threatened ecosystems as identified within schedule F of the One Plan cannot be avoided in the first instance.

Response:

This is not an ecological matter for the ecologists to answer, other than to say while there are relatively small areas of golf course technically in Schedule F identified habitat, they are few and related in the main to knobbly club rush modified hind dune and an area of weedy foredune, not ecologically valuable communities in good quality schedule F habitat. In part the schedule F boundary recognised on site initially by Horizons was based on the dominant landform (dune) rather than the vegetation, and the golf course fairways that extend into the zone are largely intruding into exotic vegetation of low value. As Dr Boffa and the Golf Course Architect (Mr Oliver) note, the Douglas Links seeks to retain the majority of the landform to give the course its 'links' character and therefore the integrity of the schedule F values identified in the Horizons assessment will remain. The assessment reflects these intrusions through the condition and values of the actual impact not, on the overarching label.

6. Please undertake a wetland delineation assessment (in line with the NPS FM) to establish the true extent of wetlands including the saltmarsh, the Raupo wetland and within Vegetation Community 2.

Response:

The true extent is as reported and mapped consistent with the intent of the NPS FM. There is no need to undertake the delineation process where it is clear from the rapid assessment method that there is no need for plots to be set down. Delineation using either Clarkson 2018 or MfE 2020 is where there is uncertainty over either the wetland boundary or if a feature could be a natural wetland. The surveys were carried out by very experienced wetland specialists (and botanists) (Mel Brown and Pat Enright) who did not locate any natural wetland in community 2 and as reinforced by the recent MfE (sept 1 2021) discussion document, we note that the NPS-FM does not seek to capture wet pasture.

We assure the Council that there was not, by way of the delineations first step “rapid assessment”, any vegetation or hydrology cue to undertake the natural wetland “delineation” protocol in community 2.

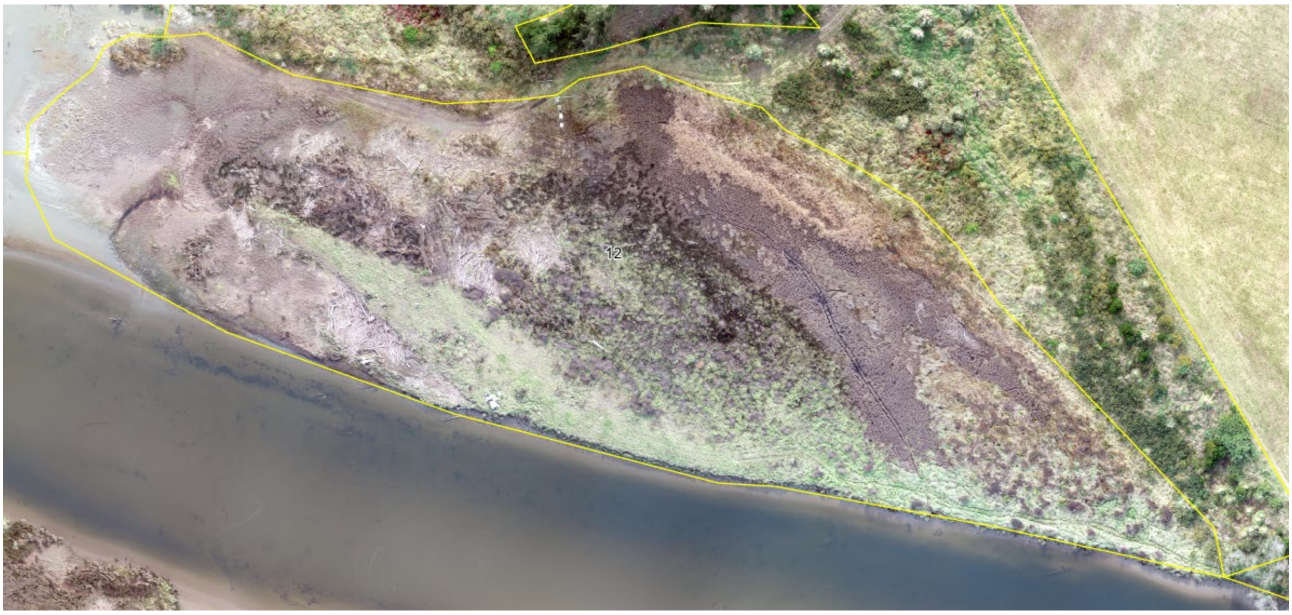
The inland freshwater wetland that was located and identified had very clear and topographic boundaries (raised surrounding lands) and it does not require plot delineation. The unusual circular shape of the feature our team identified could well be ‘constructed’ but it is not worth investigating that further when it can be avoided by the Applicant. Furthermore, the salt marsh boundary was initially fixed by Horizons and our team have expanded that boundary based on our filed work and with a conservative buffer.

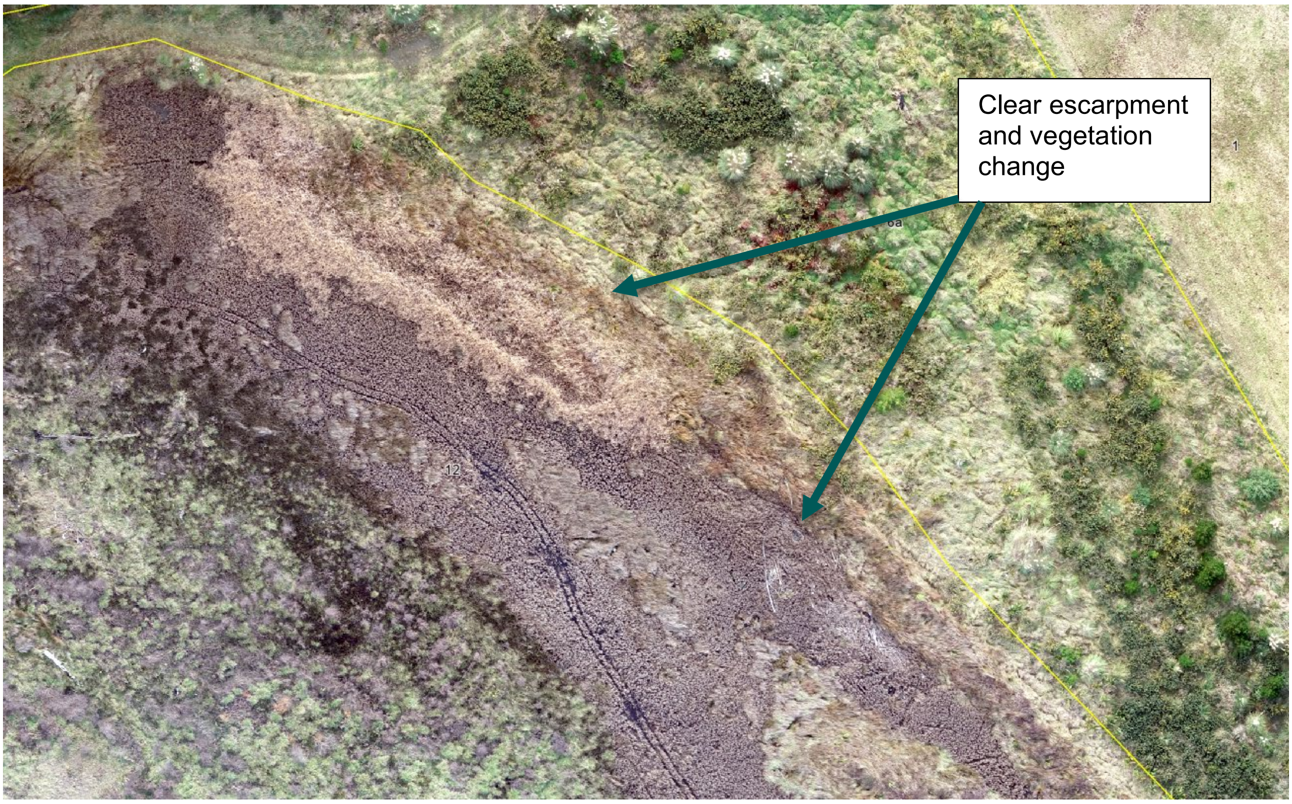
Through the recommendation in our report, the Applicant has sought to avoid the feature from disturbance resulting from construction of the Course. For completeness we do note that the salt marsh is technically not covered by the NPS FM as that policy statement only covers inland *freshwater* wetlands and not *saline* coastal wetlands. Nevertheless, the salt marsh is within the Coastal Environment and therefore covered by the New Zealand Coastal Policy Statement (NZCPS). Our assessment has considered the NZCPS and it is clear that the proposed activities seek to avoid the salt marsh from disturbance but the restoration plan by RBT and Dr Boffa seek to undertake active management and further planting at its margins.

Returning to the identification of the wetland types on and around the Course, we produce two high resolution aerials as evidence of these clear boundaries.


Raised bank and terrestrial vegetation edge is clear

Raupo circular depression wetland.





Clear escarpment and vegetation change

Coastal salt marsh edge identified with a buffer added.

7. Please provide a map that overlays the areas proposed for vegetation clearance/earthworks with areas of rare and threatened ecosystems. It does appear that some of the holes proposed (specifically hole three) appears to remove a portion of a Schedule F area of Kanuka. Please provide a map combining both sets of information

Response:

We apologise and appreciate the question. The required map was produced but it clearly did not get attached as the replacement for Map three in Appendix 1 as was intended. It is attached to this document.

On the matter of kanuka, we understand that while the fairway does show inclusion of areas of the kanuka, we understand, and as evidenced in our AEE, that the main stands of kanuka areas are not being cleared or otherwise impacted and the fairway will operate around those areas.

8. Please provide comment on the differences between the vegetation assessments undertaken by the Regional Council's Ecologist (which identifies a large area of Kanuka forest or tree land within the north of the property) and the mapping undertaken by Boffa Miskill (sic), which shows a significant reduced area of Kanuka forest.

Response.

From the ecological survey perspective we cannot comment on the investigation the Horizons assessor undertook to delineate the actual boundary of the kanuka, but we suspect that they did not field verify the full extent of the type, as one area labelled kanuka (the western most area) is in fact macrocarpa and silver birch. It could simply be a difference in mapping equipment or aerial photography. We mapped and highlighted only that kanuka area that met the schedule F criteria but all kānuka found is mapped (community 8). If this is carefully traced it can be seen that the BML kanuka map reveals kanuka in more areas than the Horizons map. Although not a peer review, we have been provided with a map prepared by the project coastal geomorphologist (Jim Dahm) whom assessed the site before our team did. Mr Dahm's map is consistent with our mapping and is a good corroboration of the area of Kanuka.

In any case we can only comment on what were found and mapped on site and that is reported in the AEE, and that Retrolens (historic aerials) do not show such an extensive area of kanuka either.

9. Please provide an assessment on Katipo Spider, include survey on presence and potential effects

Response.

Katipo were searched for in the survey field investigations (Ms Amanda Healy is our herpetologist and macro-invertebrate field ecologist and has 5 years' experience with BML in undertaking field surveys for lizards and invertebrates). While a difficult species to find without trapping, the surveys by Amanda did not find any sign of katipo. Our experience with similar survey is that if there was an appreciable density of katipo sign would have been found.

The literature (Patrick 2002, Costall and Death 2010[1]) suggests that while there are "strongholds" in Foxton to Himitangi and Makara beach and the Wellington south coast (Te Humenga Point) there is no indication of populations south of Foxton to Makara. This may reflect a lack of survey effort, but it also indicates that the Ohau River outlet area was not identified as a high probability site.

Nevertheless, it may be that katipo are present. If they are they will be present in the foredune amongst the spinifex and drift wood, not in the hind dune amongst the exotic dune vegetation. *Steatoda capensis* (the south African invader) is most likely the dune spider present if any are present in the hind dune - but again these are most likely in the spinifex foredune.

The proposed golf course intrudes into the hind dunes (near the sand daphne populations) it does not enter into Katipo habitat.

Survey sites for the red katipo (from Patrick 2002) are shown in the following image.

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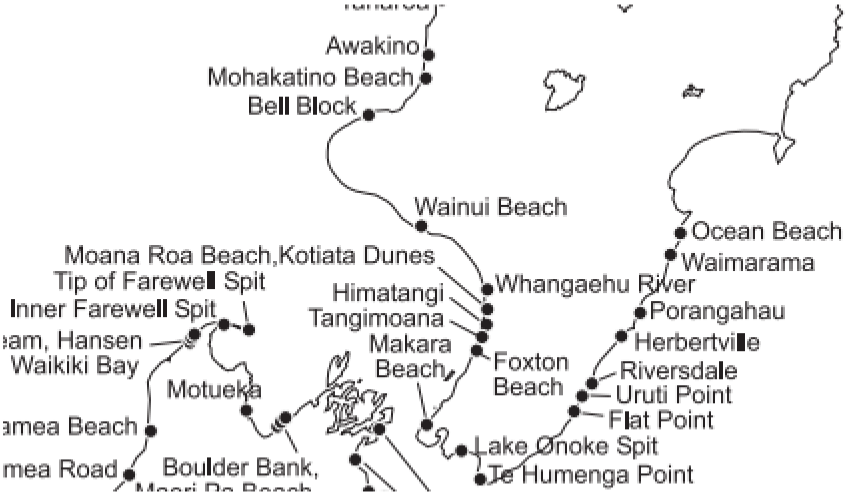
[1] Patrick B 2002. Conservation status of the New Zealand red katipo spider (Latrodectus katipo Powell, 1871). Science for Conservation 194: 33 p.
A Costall & Russell. G Death (2009): Population structure and habitat use by the spider Latrodectus katipo along the Manawatu–Wanganui coastline, New Zealand Journal of Zoology, 36:4, 407-415



10. Please provide further investigations on the impacts on native lizards. Specifically, it is documented within the Department of Conservation's database that the Wellington Green gecko and ornate skink have been recorded within 8 km of the site in similar degraded and isolated vegetation pockets.

Response:

It appears the Wellington green gecko record being referenced is from 1972, and is therefore nearly 50 years old. We consider records this old to be out of date and not representative of current populations, especially for species like the Wellington green gecko which has had a marked decline in the region over recent years, and is "no longer being recorded from many sites known from the 1970s" (Crisp, P., 2020). The site has been isolated from source populations since the arboreal vegetation has regenerated, and it is considered very unlikely that arboreal geckoes are present here.

For ornate skink, there are some more recent (but still fairly old) records in the surrounding areas (early 1990s). However, their populations are known to be very sensitive to high mouse numbers, and so it is considered unlikely that a population would be able to persist at this site given the considerable number of mice observed using the CritterPics, and the lack of appropriate refugia present (e.g. thick leaf litter, rock piles, etc). It is perhaps possible that they are present in very low numbers, but we would not consider that to constitute a stable population.

Furthermore, the survey effort undertaken would only likely detect lizard species if they were in abundantly high numbers and not at moderate to low level populations.

Response:

Our previous trials using CritterPics have shown them to typically be more effective at detecting lizard populations than many of the methods currently in common use. While we agree that they may not detect very low populations of lizards, we do believe that they would have detected moderate or high populations. Additionally, the very high numbers of mice (plus several hedgehogs) detected using the CritterPics, and the numbers of mammalian tracks (stoats, feral cats) seen on the site indicate that any lizard populations would likely be heavily suppressed, if present at all.

Additional the survey effort has largely been focused predominantly in the Active Dune and has ignored over habitat throughout the site.

Response:

The duneland areas were considered to be the most stable habitat present on the site, as the inland areas have been used for pine forestry and farming and were cleared fairly recently (2013 – 2018). And so, we focused our attention on the areas considered most likely to hold a lizard population.

Finally, the Applicant has not proposed how to address adverse effects on the potential native lizard population.

Response.

It remains highly unlikely that there are lizard populations of conservation concern in the areas being affected by the proposal and therefore no management regime has been recommended. We do not consider that normal salvage, even for northern grass skink, will be required at this site. Although we consider it unnecessary, we can discuss proposed conditions to alleviate any residual concern around native lizard management. There are some very practical ways of managing woody vegetation removal that can be employed if Horizons deem a response is necessary with an effect of very low probability.

11. Please provide a more comprehensive assessment on both the hydrological and nutrient effects associated with the running of the golf course within proximity to 2 to 3 natural wetlands. Specifically, a further understanding on if the wetlands can tolerate additional nutrient input expected of a golf course and address the hydrological effects of both altering the soil composition within proximity of a natural wetland and the increased water discharge within the proximity of a natural wetland.

Response:

A section was contained in the AEE. While this is an issue for the golf course management as to how they proposed to manage their turfs, the raupo wetland pocket is best described as a swamp (Johnson and Gerbeaux 2004[2]) and the vegetation components (mostly raupo) are very able to manage high nutrient loading (e.g. Pegman & Ogden 2005[3], Vymazal 2011[4]) Raupo has high decomposition rates (3kg/m^2/year) and high biomass production rates enabling it to utilise high nutrient loading.

We understand that fairway management should not cause additional nutrient leachate. However, we note also that current farm practices in relation to nutrient addition will cease and the inputs related to the raupo wetland may actually balance. We also understand Mr Allan on behalf of Grenadier will be addressing this potential issue.

In respect to the salt marsh wetland, this feature is some distance from any fairway or green (a very small back green of one hole is near) and therefore there will be a substantive non-fertilised area between it and those activities; and in a predominantly sand substrate soils leachate of that distance is highly unlikely. Again, the Applicant is proposing rehabilitation planting at the buffer of this area to remove the past exotic forestry influence and the current agricultural use of the land. From an ecological perspective this is considered a positive resulting from the proposal on the salt marsh. We note the northern margin of the salt marsh has emerging gorse, pampus and rank exotic grass invading the area.

12. Please provide a more quantitative assessment, using a peer reviewed methodology, of offsetting or compensating the permanent loss of rare and threatened ecosystems.

Response:

---

[2] Johnson, P.; Gerbeaux, P. 2004. Wetland types in New Zealand. Department of Conservation. ISBN: 0-478-22604-7.

[3] New Zealand Journal of Botany, 2005, Vol. 43: 779–789

[4] Hydrobiologia (2011) 674:133–156

Does the reviewer refer to those areas identified as Hole 14 foredune, and the three longitudinal dune system holes 17, 4 and 16 within which are the schedule F areas of Knobbly club rushland? We note in terms of Hole three and the kanuka, the significant kanuka is not being affected.

In terms of Hole 14 and being in the foredune, the report points out the issues with the holes intrusion but has sort to ensure that the hole has no impact on the spinifex community and the current layout only removes sands, lupin and gorse. These are not technically the vegetation communities of schedule F, but we did not micro-map out the various small exotic areas. We do not see offset requirement for this effect. Dr Boffa and Mr Dahm have recommended changes in the location of hole 14 (see the Land Matters Plan) that largely avoid the issues referred to (area E on that plan).

In regard to the interspersed Knobbly club rush with weed species in the hind dunes which is shown under some of the golf course; the effect was calculated as 1.7% of the local habitat affected (low) and the 11% of that on site (1.1 ha of clearance). The value of the community was rated as low (where there was no sand Daphne) and the loss of this edge 1.1 ha does not diminish the contextual value of the wider community or its representativeness. Much of the area to be affected is fragmented amongst exotic native weed mix. It is essentially a monoculture of knobby club rush interspersed with weed specifies.

We do not consider it necessary to develop a standard offset model as per (Business and Biodiversity Offsets Programme (BBOP) 2009; Maseyk et al. 2017; 2015) but that a sensible and effects proportionate approach is sufficient.

In this case 1.1 ha of moderate value simple interspersed knobby club rush hind dune is being lost to golf course fairway. Sufficient remains to be functional and self-sustaining. The draft restoration plan proposed by the Applicant and developed by the project landscape experts (Boffa, Oliver and RBT), with ecological input (Dahm and Boffa Miskell), shows substantive area of native coastal assemblage revegetation which replaces the 1.1 ha with 12.6ha. A ratio of 11.5-gain : 1-loss which would be more than a standard offset model. Our report was based on that approach and consistent with the approach promoted by Grenadier which is to fit the course into the important values of the site, and not the other way around.

While we do not consider a standard model is necessary (given the approach of the Applicant), we note that recently at projects in the lower North Island (McKays to Pekapeka and Transmission Gully and summer set retirement village Waikanae) the "offset" ratios for simple and early seral assemblage losses have been in the order of 1:1 and 1.5:1 and 2:1. These were offset modelled out comes. We consider this simple system of modified hind dune should be a 1:1 offset ratio, especially where the offset is more representative hind dune native revegetation (such as is proposed).

13. Please provide further information on the potential for bats occurring within vegetation likely to be removed as a result of the proposed golf course holes.

The Peka Peka to Otaki NZTA Opus report (2011) noted that the long-tailed bat *Chalinolobus tuberculatus* is known to inhabit Kapiti Island and the Tararua Forest Park. It is true that there are records of long tail bat sightings on Kapiti island, but curiously no specimens have ever been collected. DoC has also translocated 20 short tail bat pups to Kapiti Island.

No bat surveys have, to our knowledge, ever been undertaken along the coastal dunelands of the Kapiti and Horowhenua coasts. Duneland's were not historically part of the native (long or short tailed) bats home range (in the absence of forest). They may have flown the riparian vegetation of the Ohau seasonally with emergence of flighted larger insects – but this forest is no longer present. There has been no large forest ecosystems in the coastal lands of the area for over 200 years (only a few small remnants see Foxton PNAP (Ravine 1992[5])) and it is unlikely any remnant bat population remain in the highly modified and predated

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[5] Ravine, D. A. (1992). Foxton Ecological District: Survey report for the Protected Natural Areas Programme (New Zealand Protected Natural Areas Programme No. 19). Wanganui: Department of Conservation.

rural landscape or visit the various coastal macrocarpa trees that are, at most on site, 70 years old as night roosts form the forested hills of the Tararua Forest Park.

The distribution figures in M. J. Daniel 9 1 and G. R. Williams 1984. New Zealand journal of ecology 7: 9-25 shows Kapiti Island and Tararua forest records, no coastal levin - Ohau records.

Despite growing evidence of bats using farmlands and shelter belts in Waikato as more acoustic monitoring is undertaken, it remains highly improbable that the coastal macrocarpa shelterbelts and random trees offer bat roosts on this property in the absence of resources or nearby forest areas suitable to a population.

If there is insistence around this issue, then we recommend that the common practice of pre felling roost detection be undertaken to ensure no roosted bats are in residence at felling.

14. Please provide further information that demonstrates that the location of hole 4 and 17 will not result in the loss of the dominate cluster of sand daphne within the site.

Response:

The maps in the AEE appendix show the sand daphne that were located in the botanic survey. The vegetation map and golf layout overlay attached to this response illustrates this more clearly.

No other clusters or single species were observed in the areas proposed to be golf course as the botanic team searched extensively to ensure all of these taxa were located relevant to the proposed greens, Tees and fairways that intersected the dunes.

15. Please update the ecological assessment to factor in the potential ecological value of all freshwater features and assess the effects against the potential values, as directed by the NPS FM 2020.

Response:

We are unsure what this relates to. The Ecological assessment has undertaken the evaluation all of the freshwater wetland and the salt marsh features on site and provided an assessment and outcome of value. It also addressed the significance of the Ohau River and its values. The effects assessment considers the wetlands (in line with the NPS FM (2020), finding (with the avoidance recommended) an absence of direct effects (and no indirect effects are considered likely – see the nutrient response above and the response under point 16).

We note in the effects assessment that there are no perennial flowing streams in the proposed activity area, and we record that the risk of earthwork related sediment discharge to the Ohau River is unlikely – no effect.

Mr Allen on behalf of Grenadier has assessed the other potential issues as it relates to the Golf Course management especially during construction. We understand the project hydrogeologist has also assessed potential effects on surface water features.

16. Please provide further information that clearly demonstrates the removal and replace of more moisture retentive soils within proximity of all-natural wetland will not result in the partial drainage of the natural wetlands.

Response:

There is only one freshwater wetland, the circular “pit” containing raupo. The feature has no topographic features supplying surface flow or discharge. We are certain it is ground water fed. The base of the feature is between 400 and 500mm deeper set that the surrounding lands. Activity that might impact the top 400m (such as new more moisture hungry turf) are unlikely to influence the ground water level (450mm below the surface) at the base of the wetland.

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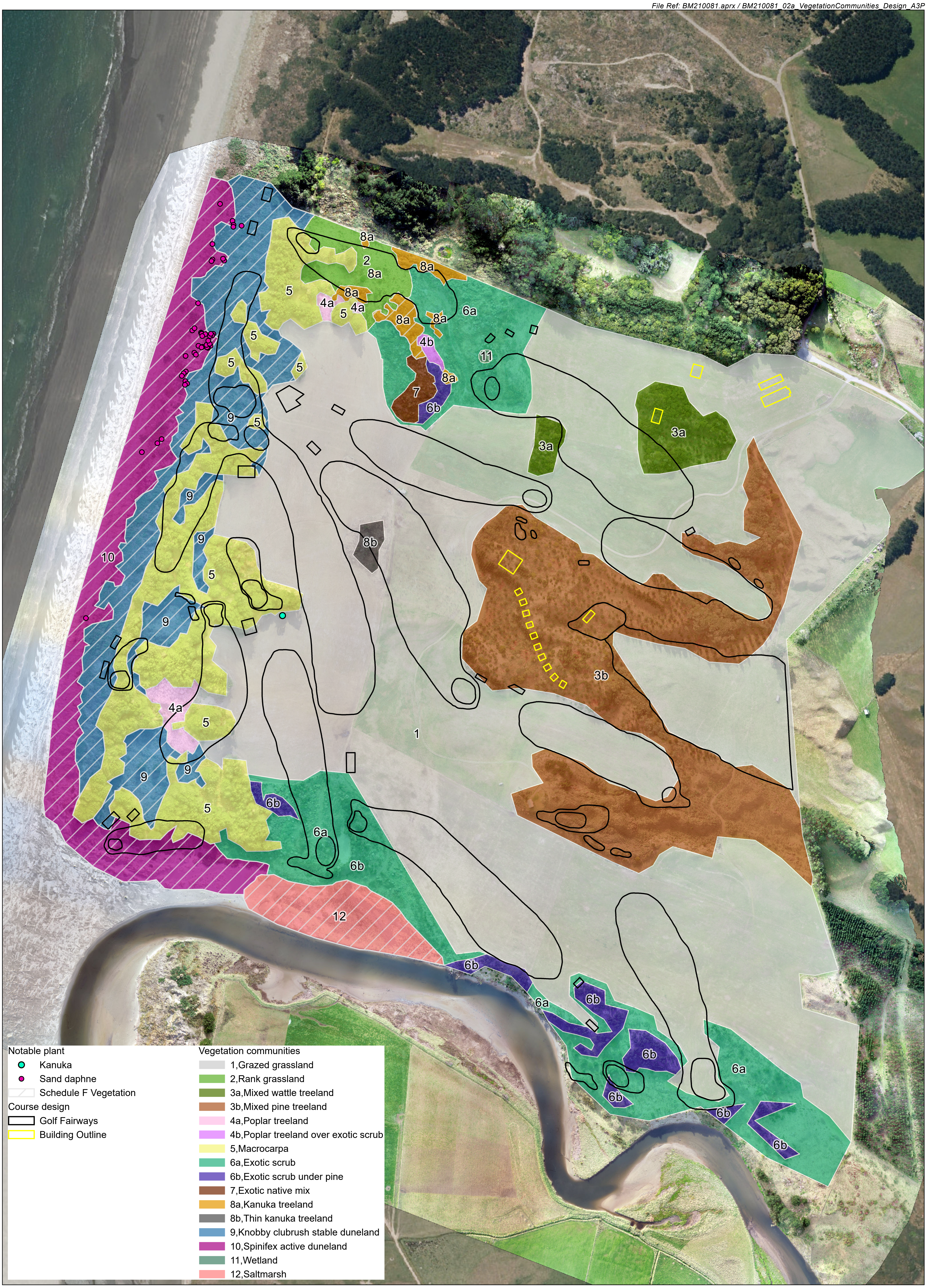

Boffa Miskell

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Data Sources: BML, Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence , Land Matters

Projection: NZGD 2000 Wanganui Circuit

DOUGLAS LINKS OHAU

Schedule F Vegetation and course

Date: 13 September 2021 | Revision: 1

Plan prepared for Landmatters Limited by Boffa Miskell Limited

Project Manager: Vaughan.Keesing@boffamiskell.co.nz | Drawn: MBr | Checked: HHu

Map 2a

Assessment of the proposed earthworks and irrigation activities against the relevant objectives and policies of the National Policy Statement for Freshwater Management 2020

The following assessment of the proposed earthworks and irrigation activities against the relevant objectives and policies of the National Policy Statement for Freshwater Management 2020 is informed by the information provided by the relevant technical experts who have assessed the proposal on behalf of the Applicant.

Objective 1

The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that prioritises:

a. *first, the health and well-being of water bodies and freshwater ecosystems*
b. *second, the health needs of people (such as drinking water)*
c. *(c) third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.*

Policies

Policy 2: *Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for.*

Comments

As part of the development process, the Applicant has consulted with Ngāti Kikopiri who have mana whenua over the land. The Applicant understands from the consultation and the Cultural Values Assessment, conveyed to the Applicant by Ngāti Kikopiri, that there is an inter-related nature between a number of groups in the area and the Applicant intends to continue to consult with, and discuss opportunities for, iwi throughout the development of the proposed activity.

The Memorandum of Understanding (**MoU**) between the Applicant and Ngāti Kikopiri provides for this ongoing consultation.

The Applicant is keen to continue to involve tangata whenua in the development of the land and water in a way that identifies and provides for their values.

Policy 6: *There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.*

Comments

As stated in the information provided by the Head of Construction for the proposed golf course:

> *The additional information request indicates a potential concern around the potential for drainage of natural wetlands. I believe the possibility of natural wetland drainage as a result of the golf course to be almost nonexistent.*
>
> *The native sandy soils on the site are very well suited to producing high quality firm and bouncy Fescue playing surfaces, and a key reason Grenadier Ltd is attracted to the site. Links golf courses are meant to be firm and dry. Sandy soils provide the free draining characteristics ideal for the construction of golf courses. Indeed, sand is frequently imported into golf courses to build greens and tees on and to be used as a topdressing medium to firm up surfaces. Grenadier will want to maintain wetland features to enhance*

> *the appeal of the wider golf landscape. Unlike the farms in the surrounding area there is no advantage to capturing moisture retentive soils to create 'productive' land.*
>
> *There will be no topsoil imported to site. Grenadier will be exclusively using the existing sands from the site and from the immediate surrounds of each specific zone. There should be no noticeable or measurable change in moisture retention. There are no upsides to Grenadier moving more moisture retentive soils into the areas meant for golf turf. Again, moisture retaining soils mean softer surfaces which lead to poorer playing conditions, extra growth to mow, and invasion of weed species grasses such as Poa Annua. Lower moisture soils encourage deeper root systems which can access natural rainfall and nutrients at depth better and leads to healthier grass requiring less fungicide and fertiliser.*
>
> *Grenadier will not be contouring to lead water away from the wetland.*
>
> *Additionally, the water level in the wetland is likely determined more by the level of the water table rather than runoff or seepage from surrounding soils.*
>
> *To meet the summer survival and health requirements of the Fescue turfgrass, Grenadier would potentially apply approximately 300mm of irrigation in the summer months when natural rainfall isn't frequent. I suspect that irrigation in the absence of rainfall would be more likely to enhance any wetland than detract from it, although the effect would be small enough to not be able to be measurable.*

As stated in the information provided by Boffa Miskell in the attached memo:

> *…the raupo wetland pocket is best described as a swamp (Johnson and Gerbeaux 2004[1]) and the vegetation components (mostly raupo) are very able to manage high nutrient loading (e.g. Pegman & Ogden 2005[2], Vymazal 2011[3]) Raupo has high decomposition rates (3kg/m^2/year) and high biomass production rates enabling it to utilise high nutrient loading.*
>
> *We understand that fairway management should not cause additional nutrient leachate. However, we note also that current farm practices in relation to nutrient addition will cease and the inputs related to the raupo wetland may actually balance. We also understand Mr Allan on behalf of Grenadier will be addressing this potential issue.*
>
> *In respect to the salt marsh wetland, this feature is some distance from any fairway or green (a very small back green of one hole is near) and therefore there will be a substantive non-fertilised area between it and those activities; and in a predominantly sand substrate soils leachate of that distance is highly unlikely. Again, the Applicant is proposing rehabilitation planting at the buffer of this area to remove the past exotic forestry influence and the current agricultural use of the land. From an ecological perspective this is considered a positive resulting from the proposal on the salt marsh. We note the northern margin of the salt marsh has emerging gorse, pampus and rank exotic grass invading the area.*

Based on the above, it is our view that the design of the golf course, including iterative design process and the construction and operation procedures designed to protect the natural wetlands on the property, we consider the proposal is consistent with Policy 6.

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[1] Johnson, P.; Gerbeaux, P. 2004. Wetland types in New Zealand. Department of Conservation. ISBN: 0-478-22604-7.

[2] New Zealand Journal of Botany, 2005, Vol. 43: 779–789

[3] Hydrobiologia (2011) 674:133–156

Policy 13: *The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.*

Comments

As part of the on-going golf course management regime, the valued features on the property, including fresh- and salt-water wetlands and other significant habitats on the property, will be monitored and, if required, management changes will be implemented to ensure those features are protected throughout the life of the project.

Policy 15: *Communities are enabled to provide for their social, economic, and cultural well-being in a way that is consistent with this National Policy Statement.*

Comments

The proposed activity has been demonstrated to be consistent with the NPS-FM and will enable the use of the property in a way that provides for the social, economic and cultural well-being of the local and wider communities.