REPORT

Tonkin+Taylor

Mt Munro Wind Farm

Civil Engineering Report

Prepared for
Meridian Energy Limited
Prepared by
Tonkin & Taylor Ltd
Date
May 2023
Job Number
1016884.1000 v6

Together we create and sustain a better world
www.tonkintaylor.co.nz

Document control

Title: Mt Munro Wind Farm					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
17/05/2022	1	Draft report for client comments and inputs	Maurice Mills Nick Peters	Janine Sziklasi Hayden Sander	
21/10/2022	2	Draft with updates and incorporating MEL comments – Title amended to match contracted scope.	Maurice Mills	Nick Peters	
20/03/2023	3	Updated draft with MEL comments and new stream crossing	Maurice Mills	Nick Peters	
24/03/2023	4	Updated, responding to MEL comments	Maurice Mills	Nick Peters	
05/04/2023	5	Updated, responding to MEL comments	Maurice Mills	Nick Peters	
8/05/2023	6	Updating figures, responding to MEL comments	Maurice Mills	Nick Peters	

Distribution:

Meridian Energy Limited	1 PDF copy
Tonkin & Taylor Ltd (FILE)	1 PDF copy

Table of contents

1 Introduction

Meridian Energy Limited (Meridian) is proposing a new wind farm project (Mt Munro) in the Lower North Island, approximately 5 km south of Eketāhuna. The site is situated within the Tararua and Masterton Districts and the Horizons and Greater Wellington Regions.

Meridian commenced a resource consent process for a wind farm on the site in 2011, although the application was withdrawn. Tonkin & Taylor Ltd (T+T) have been engaged to re-assess and update the assessment of the civil engineering works associated with Mt Munro.

The first part of this task was to identify which areas of the site were likely to be suitable for the civils works and then to carry out a comparative assessment of the technical viability of constructing the civil works within these areas.

This Report contains a summary of the geotechnical inputs to the design, the preliminary civil design philosophies and criteria assumed, a preliminary roading design and description of the civil construction activities required for this project. This Report also provides a preliminary layout for the 20 turbines.

This report is supplemented by preliminary foundation design, aggregate, and water usage studies carried out by other consultants.

A separate Construction Water Management Plan and Effects Assessment has also been prepared by Graeme Ridley of Ridley Dunphy Environmental along with a Traffic and Transportation Effects Assessment prepared by Tonkin & Taylor. Both reports are attached to the AEE and should be read in conjunction with this report.

2 Proposed development

2.1 Project Location

The proposed development of up to 20 wind turbines is situated approximately 5 km south of Eketāhuna, as indicated in Appendix B "Site Location Plan" and Figure 2.1 below.

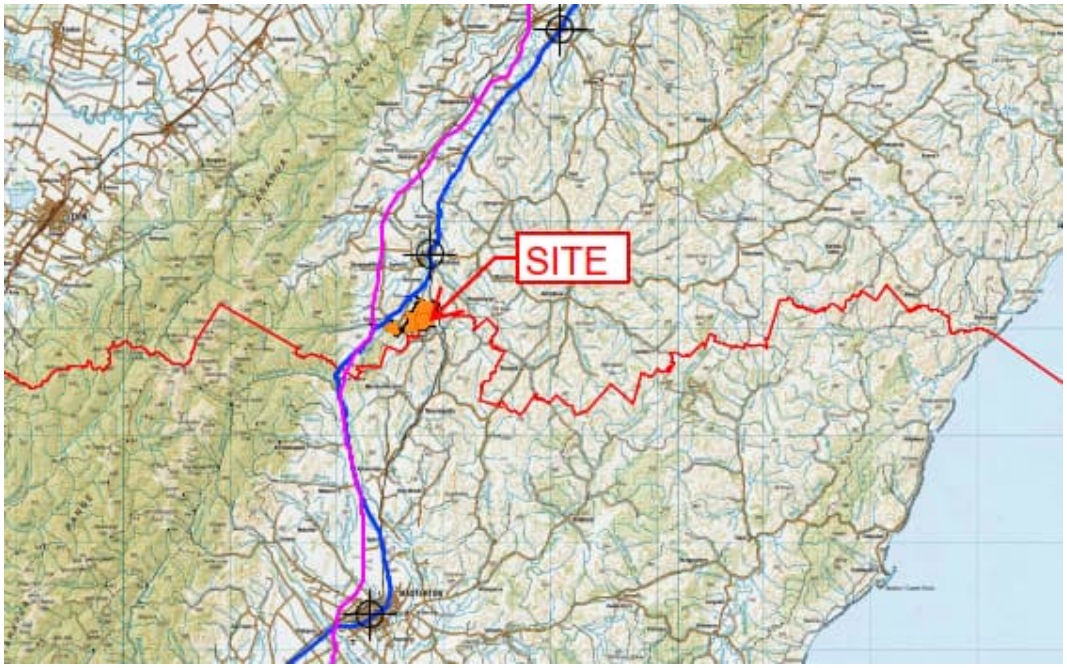


Figure 2.1: Location plan

The site is located on farming land, spread across five properties as shown in Appendix B "Full Site Property Plan", and in Figure 2.2 below.

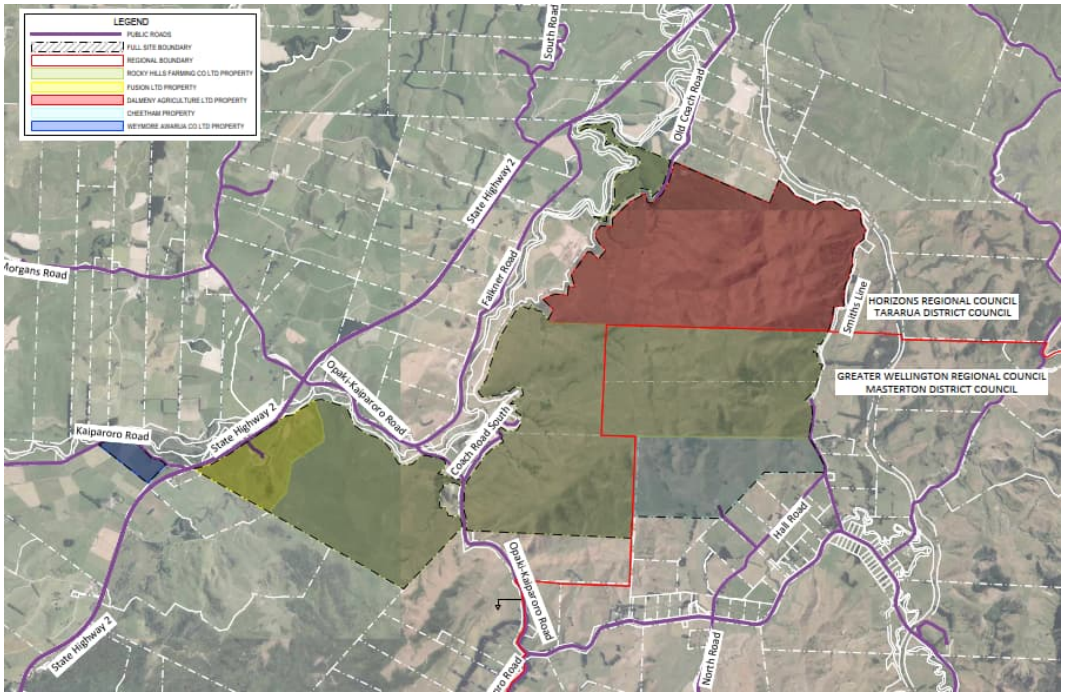


Figure 2.2: Landowner and council boundaries

2.2 Site details

The site comprises of a main ridge running approximately south-west to north-east, and two small ridges running parallel, as indicated in Appendix B “Core Wind Site Ridges” and Figure 2.3 below.

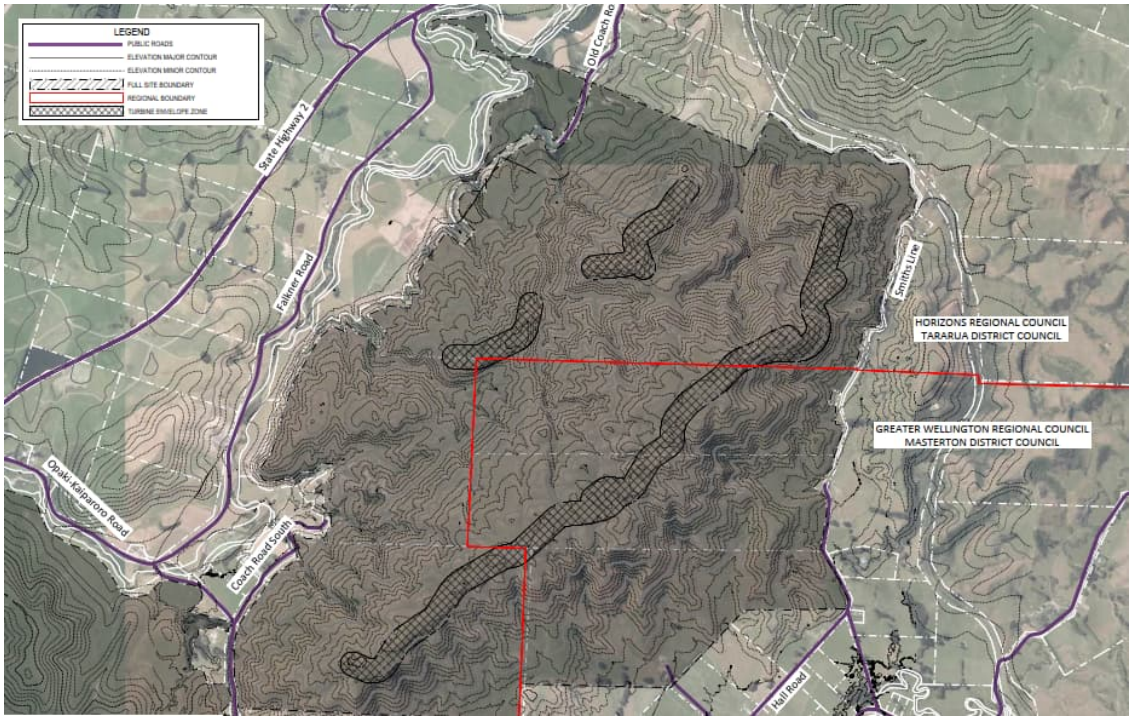


Figure 2.3: Core wind site ridges

The main access to the wind farm site is from the northern end, off Old Coach Road which is off SH2 as indicated in Appendix B “Site Entrance Plan”, and in Figure 2.4 below.

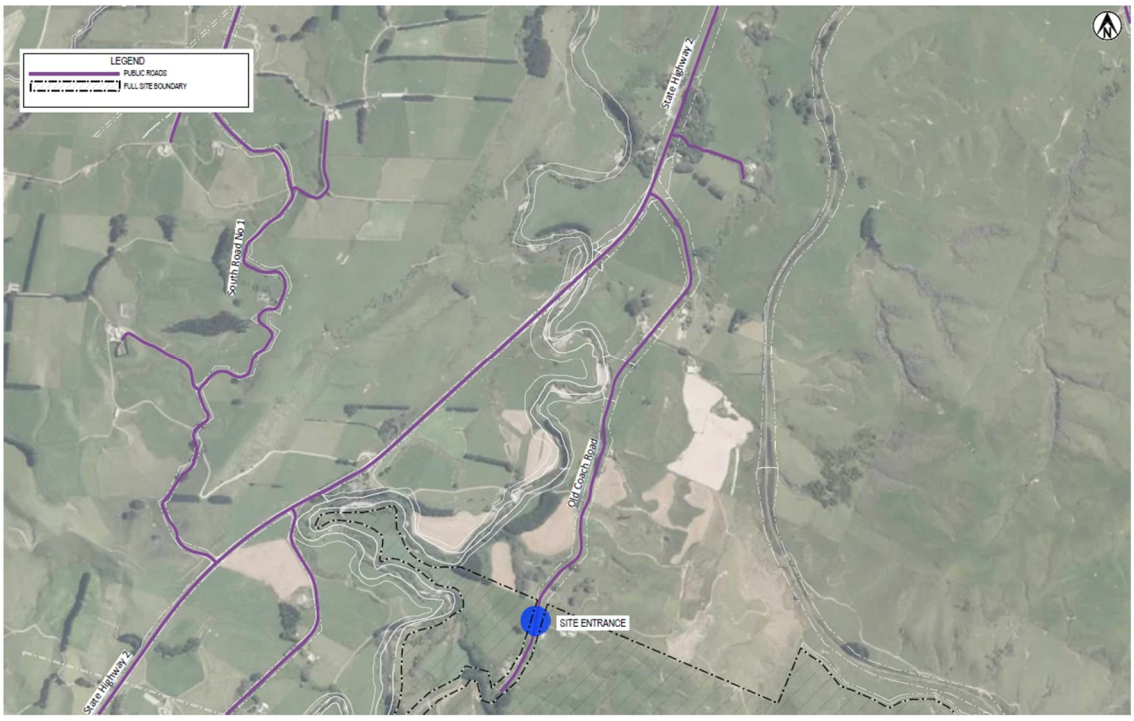


Figure 2.4: Site entrance

The principal objectives in determining the Site Entrance location were to minimise disruption to other road users on the public roads, select a location where a safe and efficient intersection can be constructed on to the public road; and minimise haul distances within the wind farm site.

2.3 Development components

The construction of Mt Munro will require the establishment of the following permanent components:

- Wind Turbines – Including, the tower, nacelle and rotor & hub, as well as the foundation and hardstand area.
- Internal Access Roads - Required from the Site Entrance to the Ridge lines, and inter-connecting the wind turbines. The access roads are through privately owned farms and typically follow / upgrade existing farm tracks where gradients and alignments permit.
- Electrical Infrastructure – Including but not limited to a 33 kV underground cable network, an onsite substation, a 33kV or 110 kV overhead transmission line on pylons, and a terminal substation connecting to the 110 KV network on Transpower's network including associated buildings.
- Operation & Maintenance buildings.
- Meteorological (met) Masts for recording wind data (covered in AEE)
- Security fencing and gates

Construction of these components will require the following activities:

- Construction of Laydown Areas.
- Erection of Temporary site office buildings
- Erection of Concrete batching plant(s).
- Investigation works, including Geotechnical.
- Earthworks.
- Construction of Internal site roads
- Establishment of Fill disposal areas.
- Establishment of a water supply reservoir for construction activities.
- Environmental control measures.

3 Geological and geotechnical assessment

Geological and geotechnical information to support the civil scope effects assessment is included in Appendix A. The main geological and geotechnical considerations are summarised below.

The site topography is governed by the underlying geology. Based on a desk top review, site walkovers and test pitting investigations, the wind farm site is generally underlain by old volcaniclastic greywacke, sandstones and mudstones rocks. These rocks are more resilient to erosion and weathering and have formed the steep and high hill slopes across the area.

The lower lying hillslopes to the east of the windfarm site are underlain by much younger, weaker rock that erodes much quicker and doesn't form the heights of the older greywacke rocks. The river terrace and flat lying land adjacent to State Highway 2 and below the windfarm to the west comprises much younger alluvial (water borne) deposits.

The geology creates geotechnical hazards that need to be considered in the windfarm design. The geotechnical hazards need to be managed in the design of slope batter angles, earthworks and foundations etc.

No deep instability has been observed within the area of proposed windfarm infrastructure. Shallow slope instability is observed onsite and is to be expected from natural and cut slopes during windfarm construction and operations. Slope instability from cut and natural slopes will typically be less than 1-2m deep and 10m wide but larger failures may occur depending upon the characteristics of the rock and thickness of soil cover at any location. Cut slope instability can be managed through appropriate batter angle design, localised stabilisation works, or clearing material that mobilises from the slope.

For the basis of developing a preliminary civil design to assess environmental effects and to provide an indicative earthworks volume, we provide the following slope angles. The slope angles provided are the maximum slope angle however the batter slope angles in cuts may vary during construction (i.e. they may be shallower than the angles given below) depending on the strength, weathering and type of soil or rock encountered and any whether local stabilisation measures are to be constructed.

Slope type	Maximum slope angles used to determine earthworks volumes
Competent greywacke rock or low height slopes (under 5 m high)	75°
Greywacke rock cuts, 5-15 m high	60°
Batters Greywacke rock cuts, exceeding 15 high	55°
Tertiary rock cuts	55°
Surficial deposit cuts	45°

Table 3.1: Recommended maximum cut batter slope angles

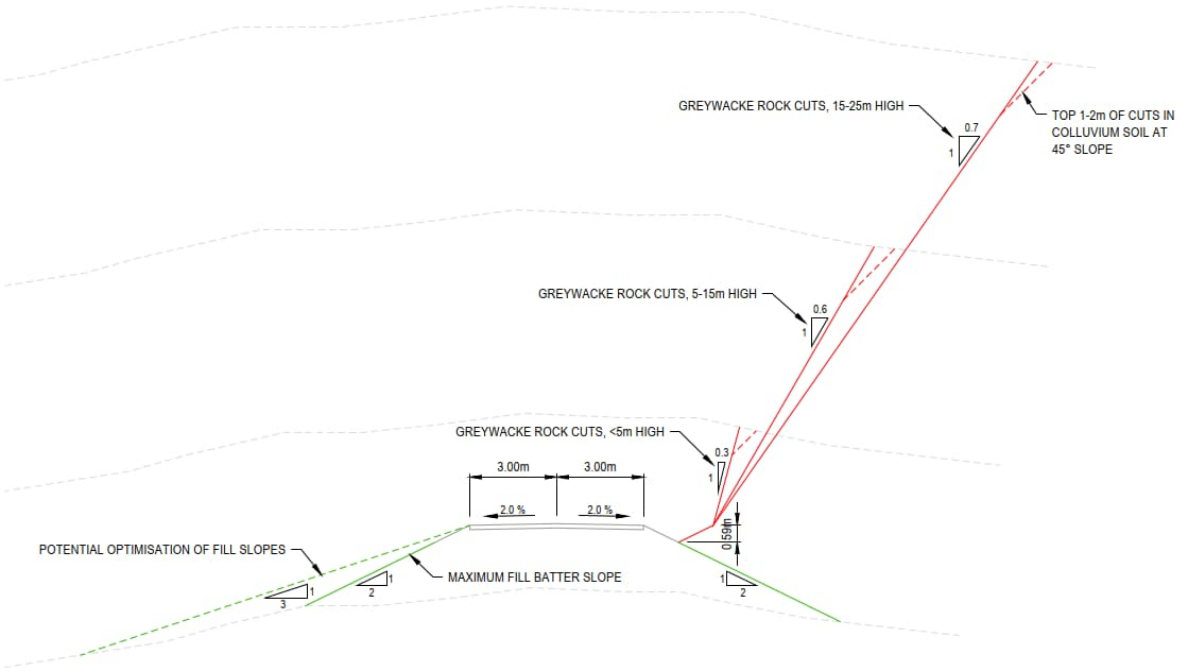


Figure 3.2: Indicative cut and fill slopes

A preliminary design fill batter maximum slope of 1(V):2(H), or 26° has been used to calculate earthworks volumes and could be adopted for fill sites at Mount Munro. However, slopes this steep require extra effort (and cost) to construct and the preliminary design indicates a likelihood of generating excess cut. As part of further design development, optimisation of fill slopes to 1(V):3(H) or flatter could be considered and adopted. Cut soils will either go to fill disposal areas or road embankment fills. Utilising 1(V):3(H) fill slopes may reduce haulage distances to fill disposal sites in some cases.

There are no active faults within the site area but active faults are present in the region and close by. The nearest identified major fault is the Wairarapa Fault. This is 4 km away from the site. Seismic considerations associated with the rupture of these active faults (i.e. earthquake shaking and liquefaction) need to be allowed for in windfarm design. An inactive fault splay is inferred to pass through the site between roads R02 and R10, however as inactive faults are not inferred to have ruptured within the last 125,000 years, the fault is not considered to pose a geotechnical hazard to the windfarm infrastructure.

4 Wind Farm road geometry – preliminary design parameters

Internal wind farm roads generally have lower design standards than public roads due to the low traffic volumes once the relatively short construction period is complete. This section of the report outlines the horizontal and vertical alignment design parameters assumed to model the internal wind farm roads in this preliminary design.

Traffic using the internal site roads will comprise:

- Road legal vehicles such as trucks, utilities and cars/SUVs.
- Over-dimensioned vehicles such as tractor/trailer combinations for transporting the tower and nacelle units (over-width and over-weight) and blades (over-length).
- Construction vehicles such as dump trucks, cable laying equipment and excavators.
- Tracked crane used for tower assembly.
- Concrete Trucks not subject to legal road limits (due to an on-site batching plant).

The selection of design parameters for preliminary horizontal and vertical alignments has been based on discussions with Meridian and experience from other wind farms constructed in New Zealand. The driving factors in the road width parameter are the tracking requirements of the main crane moving between turbines, the wind turbine components being transported to each site and the numbers of strings of cables which are to be buried under the road.

The road carriageway width has typically been modelled at 8 m for access roads leading up to the ridge line(s), and 11 m wide for the ridge-line road where multiple strings of cable are buried under the road. The typical road cross section also allows for a 0.6 m deep table drain when in cut. Upon completion of the wind farm construction, the road will remain in place to allow for access to the wind turbines for maintenance.

The carriageway width will allow for two-way traffic for standard construction and operational traffic. Activities should be programmed such that two over dimensioned vehicles will not pass each other at any given time.

The minimum horizontal centreline radius has been set at 50m and the minimum vertical radius has been set at 250 m. The maximum desirable longitudinal road gradient has been set at 16% for the purposes of modelled volumes, although slightly steeper sections of road may be possible depending on turbine manufacturer specifications.

A summary of the selected roading parameters for the preliminary design is presented in Table 4.1 below.

Criteria	Proposed Dimension	Comment
Carriageway width	8m typically plus a 0.6 m deep table drain in cut (R05 and R06 modelled at 11 m plus table drain where applicable)	Recommended minimum carriageway width of 6 m.
Horizontal curvature	Minimum horizontal curve centreline radius of 50 m	Additional curve widening may be required in detailed design, on a case-by-case basis, for minimum radii curves in embankment situations to accommodate tracked paths of over dimension vehicles and loads
Vertical curvature	Minimum vertical curve radius of 250 m	To be reviewed in detailed design dependant on turbine blade lengths and transporter configuration

Criteria	Proposed Dimension	Comment
Longitudinal grade	Absolute maximum 16%	For grades over 12.5%, additional hauling capability and/or pavement improvements such as sealing may be required in detailed design.
Crossfall	Maximum crossfall of 2%	
Wind turbine platform	Flat area of approximately 125 m at its longest point, and 60 m at it widest	Wind turbine platform sizing and arrangement will depend on final wind turbine selection

Table 4.1: Wind farm road preliminary design parameters

5 Wind Turbines and Related Infrastructure

5.1 General

Multiple turbine models are being considered for this site, based on their IEC 61400 Class, the site conditions, and the design life of the turbine (expected to be 30 years). Meridian has opted for an envelope approach and preliminary design for a maximum turbine size, based on the dimensions of the turbines in Table 5.1 and 5.2 below.

Turbine Manufacture	Turbine Model	Nameplate Capacity	Blade Diameter	Hub Height	Tip Height
Siemens Gamesa	SWT DD120	4.3 MW	120 m	85 m	145 m
Siemens Gamesa	SWT DD130	4.3 MW	130 m	85 m	150 m
Vestas	V136	4.2 MW	136 m	92 m	160 m

Table 5.1: Indicative Wind Turbine Models

For the purposes of hardstand and foundation design, and for transportation, a turbine blade diameter of up to 136 m, and tip height of up to 160 m has been used for this preliminary design.

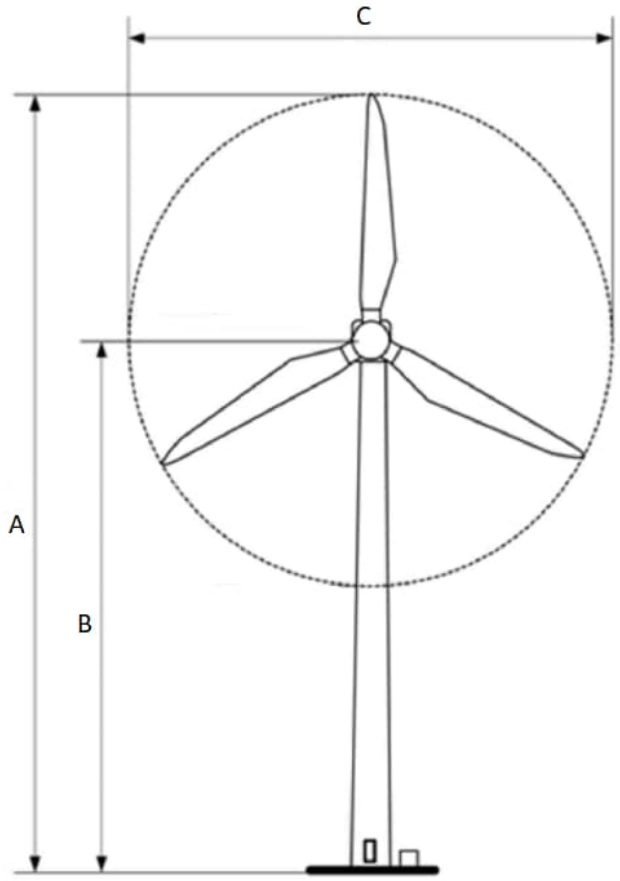


Figure 5.2: Indicative Wind Turbine Dimensions (A = Tip Height, B = Hub Height, C = Blade Diameter)

5.2 Turbine Locations

Indicative turbine locations were developed by the Meridian Wind Development Engineering Team as shown on Appendix B "Indicative Turbine Layout" and Figure 5.3 below. The basis for the turbine locations is provided by Meridian in their Resource Consent Application, section 2.4.

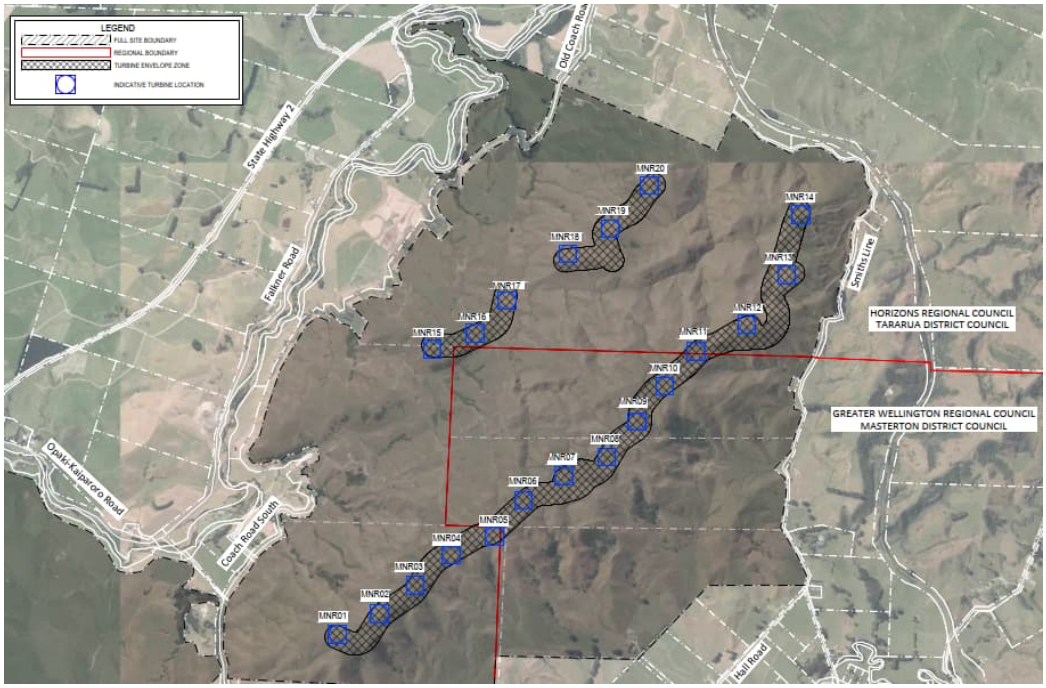


Figure 5.3: Indicative wind turbine locations

5.3 Road Access to Turbines

Access to each turbine is either directly off the wind farm central road or from a spur road. Spur roads are required when a turbine location can't easily be accessed by the central wind farm road. Figure 5.4 below illustrates the difference between the two. The project will use a mixture of spur roads and through roads.

Figure 5.4: Typical turbine access via central wind farm road or spur road.

At each wind turbine location, a foundation and hardstand area is needed (refer to WSP Turbine Design Report for foundation details). The foundation supports the erected wind turbine, and the hardstand area provides a crane-pad for cranes to assemble and lift the large heavy components, and an area for storing these components prior to assembly.

The hardstand platforms vary in configuration depending on the component sizes, topography of the surrounding area, and whether the access is on the central road or a spur road. Figure 5.5 below shows an example of a foundation, crane pad, and storage area, for a V136 wind turbine, where the access is on the central road. This example is non-uniform in size and approximately 125 m at its longest point, and 60 m at it widest. The hardstand needs to be level and sound so to provide a stable working platform for the cranes.

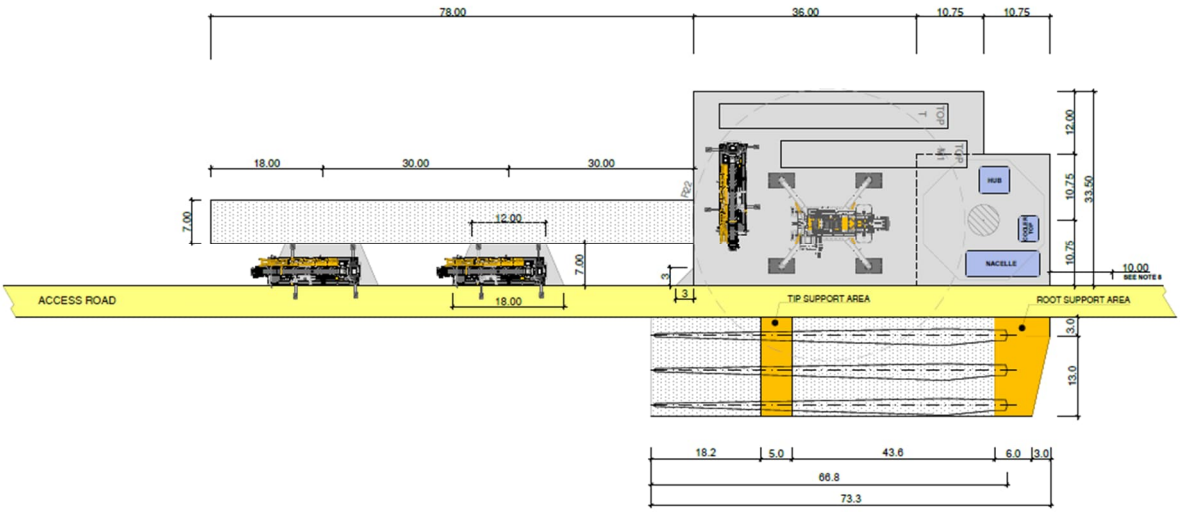


Figure 5.5: Typical hardstand layout

Photograph 5.6: Photo of a hardstand area, foundation and integrated crane pad and blade assembly area, with access via a spur road.

6 Wind Farm internal roading

6.1 Access Road Suitability and Envelope Zones

The development of the preliminary internal roading layout has been an iterative process. As well as the civil design considerations covered in the previous sections, input from landscape, ecology, the site entrance location, turbine locations, existing farm tracks and previous civil design work, were all considered by Meridian when selecting the general layout geometry.

The output of this iterative process was defined corridors (typically 120m wide) on which all roads and infrastructure could be located, as indicated Appendix A7 "Core Site Envelope" and Figure 6.1 below.

All turbines will be located within the zone marked "Turbine Envelope Zone" and will be excluded from the zone marked "Turbine Exclusion Zone". All other infrastructure will be located within either zone. Internal transmission lines will be separate to these zones and are covered in Section 9 of this report.

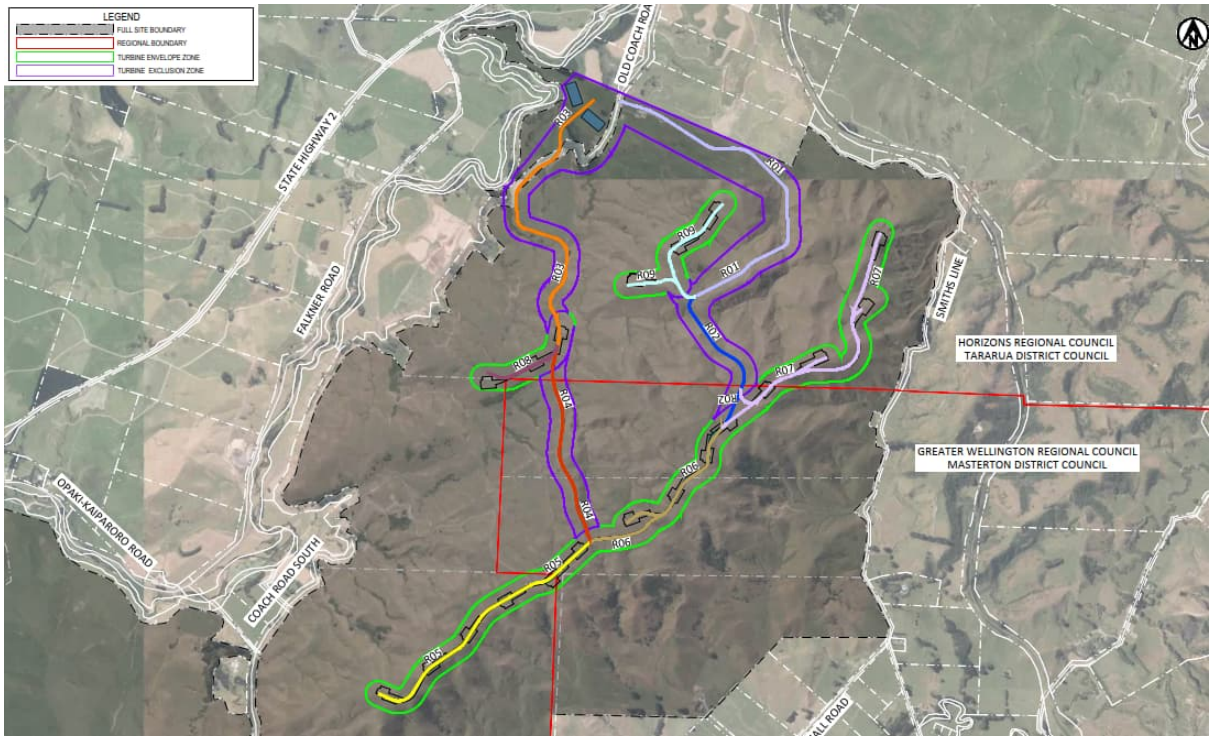


Figure 6.1: Internal roads and associated envelope zones

6.2 Access Road Example

To estimate the approximate earthworks required for this project, a preliminary roading alignment was provided by Meridian. During the alignment development several options were assessed as an initial design optimisation and to reduce the earthworks extents, volumes and associated adverse environmental effects within practical limits.

The overall design philosophy for the internal wind farm access roads has been to follow existing farm tracks and tops of ridges wherever possible. Locating roads along the ridgeline generally minimises the volume of excavation and extent of cuts and fills.

The preliminary road alignment is shown in Appendix A8 "Internal Roading Plan" and summarised in Figure 6.2 below. Note that the iterative process of this design, also fed back into the envelope zones, such that the roads are centred on these zones.

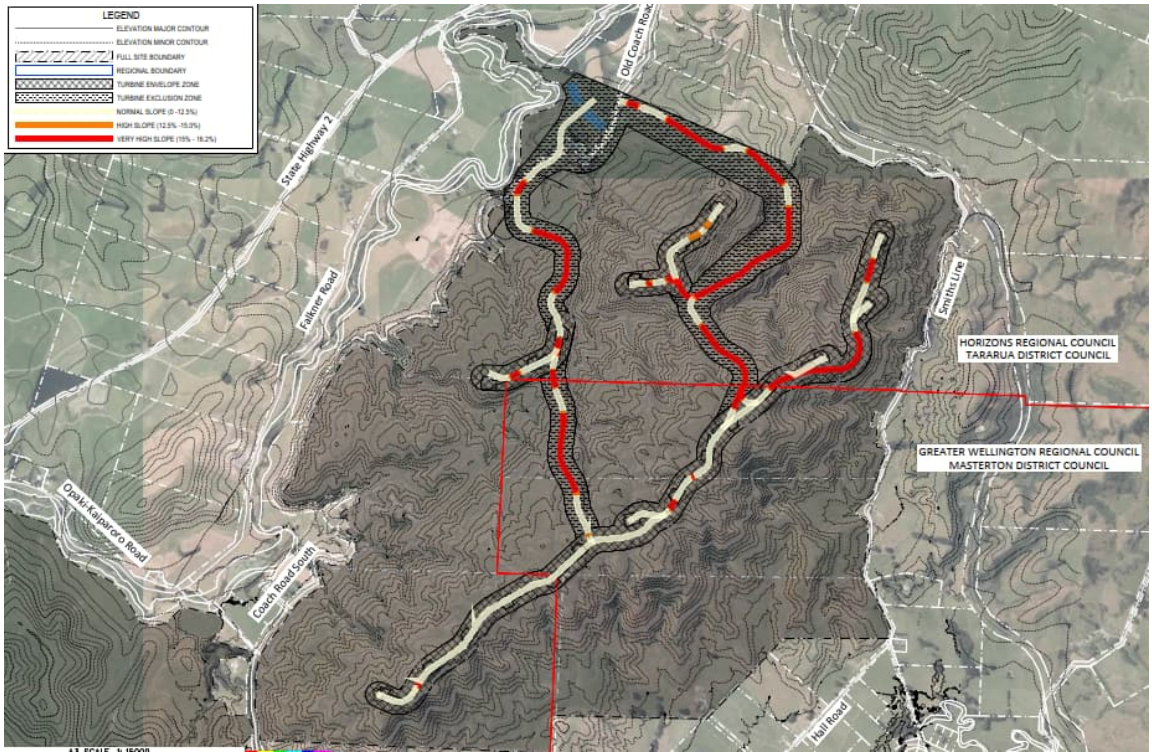


Figure 6.2: Wind farm roading layout

The earthworks volumes associated with this preliminary roading alignment, along with earthworks from other infrastructure components, are presented in section 10.

6.3 Passing Bays

Located strategically along the access roads will be passing bays that will enable heavy traffic to pass each other, and as temporary holding points for traffic transporting components and materials up onto the main ridges. The location and length of the passing bays will be determined as part of the detailed design process, to suit the Contractor's plant and construction methodology.

7 Laydown and site administration areas

Laydown areas are required to service the wind farm site during construction and long-term operations.

During construction the main storage laydown area will be used to store turbine components transported in by road prior to being taken to the turbine pad. It will also be used as a Meridian and contractor's establishment / administration area.

Post construction some or all this storage laydown area will be retained for spare parts storage, and workshop buildings will be established for the servicing of the turbines and as a base for the operations and maintenance teams.

The preferred option for the main storage laydown area, is 1.4 hectares on the western side of Old Coach Road, opposite the wind farm Site Entrance as indicated on Appendix B "Laydown Location Plan" and in Figure 7.1 below.

Figure 7.1: Laydown location

This area is relatively flat and will require minimal earthworks to establish. The yard formation will be constructed by stripping topsoil from the full extent of the laydown area and stockpiling on site. A granular hardfill layer will be placed to provide a sound working surface. The size of the laydown area required will depend on the project construction schedule, the number of turbines, the actual turbines selected, turbine servicing, crane availability, the requirements for any pre-erection activities such as preliminary work on the nacelles and the Contractor's site office location and layout.

Water supply for the site offices will be by rainwater collection from the site establishment building roofs into storage tanks, supplemented by water tanker top-ups as and when required.

There is no proposal for on-site wastewater disposal to service the contractors' administration area, with all wastewater being directed to an on-site holding tank which will be periodically emptied on an as required basis. In addition to the wastewater facilities proposed in the contractor's

administration area, “Portaloos” will be placed around the site where works are currently taking place and will be serviced on an as required basis.

All facilities no longer required will be removed and the area will be rehabilitated back to its original state.

Smaller short term laydown areas typically 130 m x 30 m will be required closer to the turbines, typically onsite alongside hardstands or roads for the temporary storage of components. Construction staff facilities in the form of a “Portacom” and “Portaloos”, will be located on one of these smaller laydown areas.

8 Concrete batching plant

It is proposed to establish a temporary concrete batching plant or plants at the wind farm site. The proposed location of the concrete batching plant is either within the main storage Laydown area, or at a relatively sheltered and flat location within the Turbine Envelope or Turbine Exclusion Zones. A batching plant(s) will occupy an area of approximately 100m x 60m and will be located such that it/they requires minimal earthworks for establishment. The final location of the batching plant is subject to the Contractors construction methodology and will be determined as part of future developed design work.

The concrete batching plant yard will be constructed by stripping topsoil and stockpiling on site and placing a granular hardfill layer to provide a sound working surface. Upon completion of the wind farm construction and at the discretion of the landowner, the hardfill can be removed, the stockpiled topsoil reinstated, and the area re-sown with grass.

The batching plant(s) will be self-contained including all aggregate, cement and water storage. The batching plant will require a number of small temporary buildings for staff facilities, administration and equipment storage. These buildings are likely to be small “Portacom” type structures.

There is no proposal for on-site wastewater disposal, with all wastewater being directed to an on-site holding tank which will be periodically emptied on an as required basis.

An on-site diesel fuel storage facility of approximately 3,000 litres may also be required to service the batching plant. This will be self-bunded to contain any spilled fuel.

Photograph 8.1: Typical mobile concrete batching plant

There is a requirement for limited washing of concrete trucks at the concrete batching plant. The chutes of the concrete trucks will be pre-washed at the foundation sites following the delivery of each load of concrete. At the end of a concrete pour the bowls of the concrete truck will require

washing. The washing will be undertaken on a metalled pad. The runoff will be directed to a decanting pond before discharging to ground.

Stormwater runoff from within the concrete batching plant area will be collected on the perimeter of the site using bunds and cut-off drains and directed to a settlement pond. The outlet of the pond will be controlled by a valve. The purpose of the valve is so water can be retained in the pond in the event that there is a spillage with high cement content in the yard.

9 Substations, Internal Transmission lines and underground cable

9.1 Substations

The Terminal Substation (the Substation connecting directly into Transpower's existing 110 kV transmission line) for the wind farm will be located at the bottom of the hill, on the western side of the corner of Kaiparoro Road and SH2 as indicated in Appendix B "Terminal Substation Location Plan", and Figure 9.1 below.

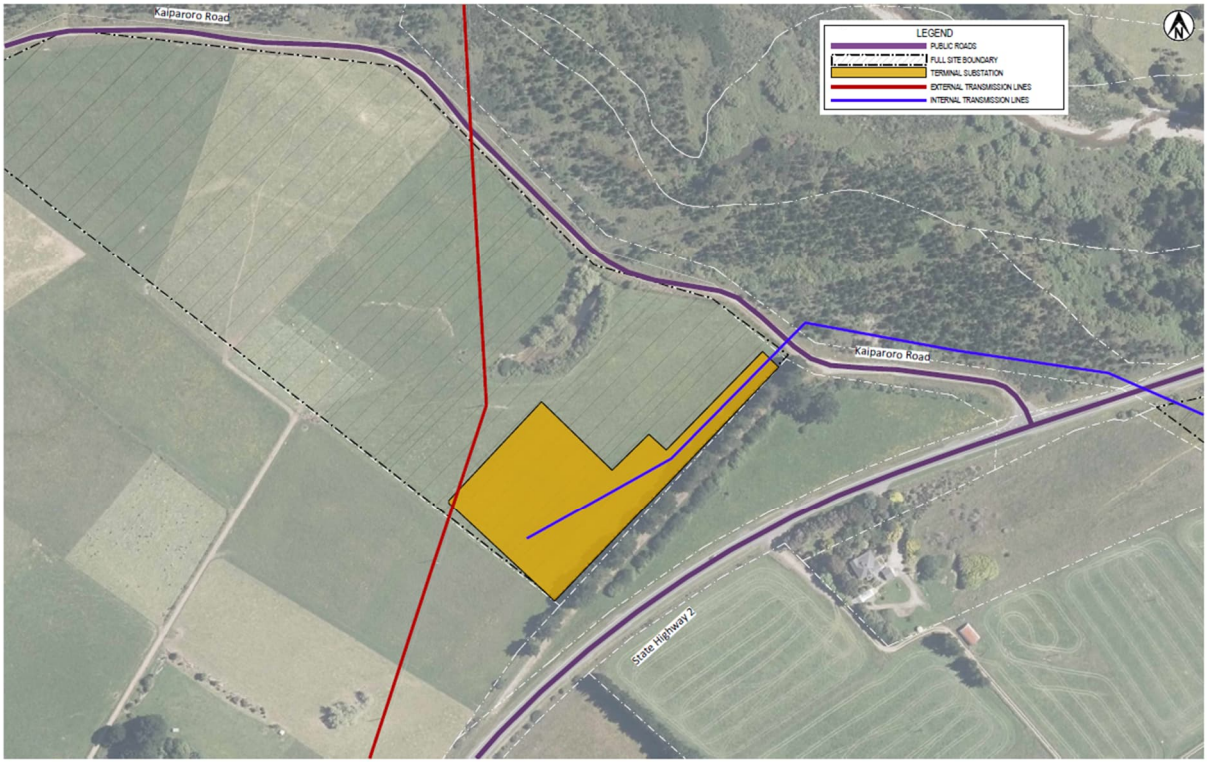


Figure 9.1 Terminal substation location

The Terminal Substation will take power from the Internal Transmission Line from the windfarm Site Substation and connect into the National Grid via Transpower's 110 kV transmission lines. The terminal substation will house all the necessary electrical and protecting equipment, including buildings for both Meridian and Transpower.

The main transformer (33 kV to 110 kV) will be housed either here or at the Site Substation, and correspondingly, the Internal Transmission Line will either be 110 kV or dual circuit 33 kV. Further details of the Internal Transmission Line are in section 9.2.

The Terminal Substation site will consist of a switchyard and up to two control buildings (one approximately 20m x 10m, the other 10m x 6m) over a footprint of approximately 100 m x 125 m. The external perimeter of the compound will be enclosed with a lockable security fence and the surfacing will generally consist of a granular hardstand with concrete plinths to support heavy items of plant such as transformers. All equipment containing oil within the compound will be bunded to contain any spillage.

A permanent control building approximately 30 m x 25 m may be included within the substation compound, together with a water storage tank, on-site wastewater treatment, storage facilities and car parking. A second building for servicing the windfarm (O&M building) may also be housed on Meridian's half of this Substation (the alternative location being at the Site Entrance).

The Site Substation will be located on the hill, at the western edge of the Turbine Envelope Zone. Refer to Figure 9.2 for location.

The Site Substation will have a total footprint of approximately 70 m x 90 m and will consist of a switchyard and potentially a small control building. The external perimeter of the compound will be fenced, and the surfacing will generally consist of a granular hardstand with concrete plinths to support heavy items of plant such as transformers. All equipment containing oil within the compound will be bunded to contain any spillage.

The Site Substation will take power from the underground cables from the wind turbines and connect to the Internal Transmission Line. The main transformer (33 kV to 110 kV) will be housed here (or at the Terminal Substation), as well various switches and electrical protection devices.

9.2 Internal Transmission Line

Connecting the Terminal Substation to the Site Substation, will be an Internal Transmission Line. This will be an overhead line. Depending on the location of the transformer, this line will be either dual circuit 33 kV or single circuit 110 kV. The approximate location of the line is indicated in Appendix B "Internal Transmission Line Location" and Figure 9.2 below.

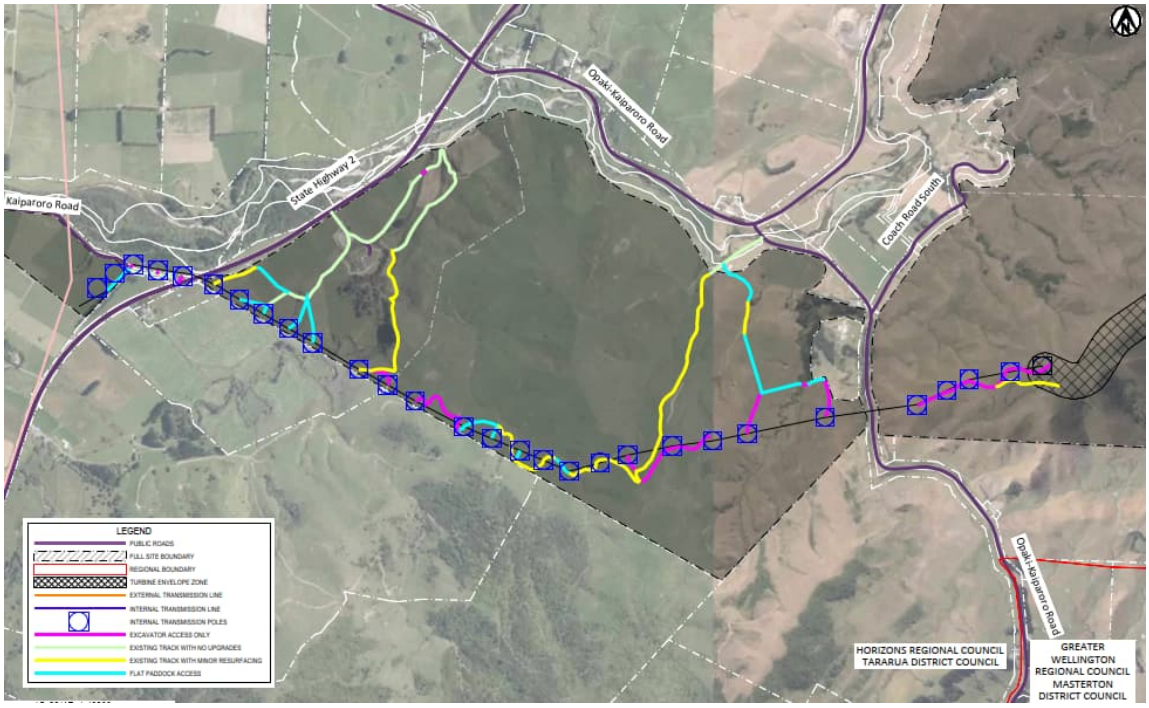


Figure 9.2 Internal transmission line location (indicated in blue)

9.3 Access Roads for Transmission Lines

Access is required to the transmission line for construction and erection of the towers, and for ongoing maintenance. Preliminary designs for this road are shown in Figure 9.2 above.

The strategy for these Access Roads is to largely follow existing farm access tracks and routes, to minimise earthworks. This will be achieved by:

- The use of existing tracks that require no upgrades (light green lines).
- The use of existing tracks where minor resurfacing is required (yellow lines).
- Crossing of flat paddocks when weather and surface conditions permit (light blue lines).
- Some pole locations will only be access by Excavator or suitable vehicles (purple lines).

- Existing culverts and crossings will be used where possible, but may need replaced if in poor condition.

9.4 Transmission Line Poles

The pole design for the project, will depend on whether the Internal Transmission Line is dual circuit 33 kV or 110 kV. The poles will between up to 20 m high.

10 Earthworks

The total estimated earthworks for the project are summarised in Table 10.1 below. In calculating these volumes, we have assumed a topsoil thickness of 250mm, cut slopes of between 0.3V: 1H and 0.7V: 1H (depending on cut height) and fill slopes of 1V: 2H.

Earthworks source	Earthworks volumes (m^3)		
	Topsoil stripping	Cut	Fill
Internal wind farm roads	47,000	935,100	335,700
Cabling	0*	13,200	12,700
Turbine platforms	36,900	716,600	120,300
Turbine foundation excavations	Incl. above	42,000 (2,100 per Wind turbine)	21,000 (Backfill, 1,050 per Wind turbine)
Concrete batching plants and water storage ponds (2 No.) ***	2,500	30,000	30,000
Construction compound/laydown areas ***	500	5,000	5,000
Sub Station ***	1,000	15,000	15,000
Total (m^3)	87,900	1,756900	539,700

*** Volumes are estimated based on assumed plan areas.

Table 10.1: Estimate of total earthworks volumes

The majority of earthworks is on the access roads, in particular, the roads from the Site Entrance to the ridge lines. Figure 10.2 provides a breakdown of the different road areas, and Table 10.3 provides the cut and fill volumes from each of the labelled areas.

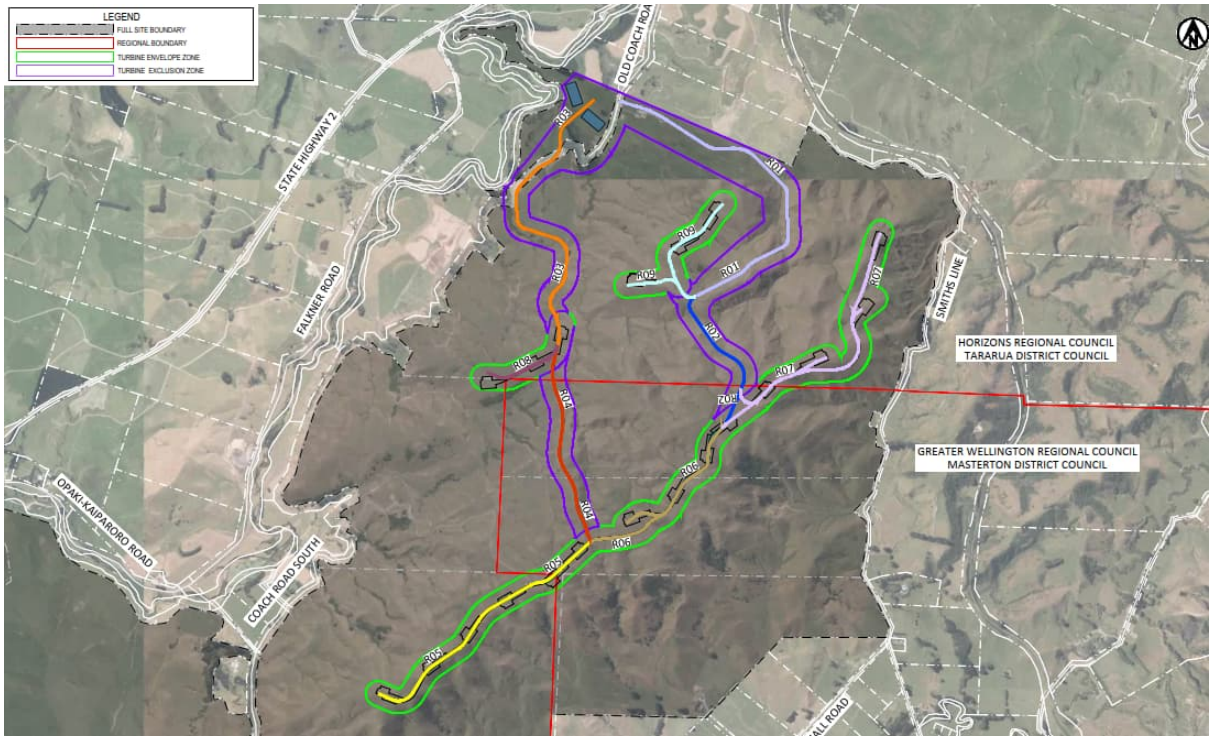


Figure 10.2: Preliminary Internal Road layout

Road Section	Topsoil stripping	Cut (m3)	Fill (m3)
R01	13,800	200,200	209,000
R02	6,300	106,600	47,200
R03	6,100	123,500	10,300
R04	4,200	63,000	14,100
R05	1,600	52,100	3,600
R06	1,500	30,100	5,100
R07	9,800	205,400	45,800
R08	1,700	89,700	
R09	2,000	64,500	600
Total	47,000	935,100	335,700

Table 10.3: Approximate earthworks volumes by road section

11 Fill sites and disposal areas

The earthworks from the windfarm construction will likely result in excess fill. This fill will be disposed with the Turbine Envelope, and Turbine Exclusion Zones. The fill locations should meet the following criteria:

- An inspection by a suitability qualified engineer or geologist to approve the fill site location and the proposed batter slope profiles.
- Fill disposal areas should be chosen in areas that are visibly free of groundwater seepages and instability.
- All topsoil and soft or loose surficial soils to be removed prior to fill placement where needed to ensure fill slope stability.
- Bench in the base of the fill disposal area into stiff or medium dense soil, or rock.
- Engineer to determine under drainage details. This would include layout and centres, additional drains and capacity to be installed over potential seepage zones.
- Fills should be placed and compacted in layer thicknesses and to compaction standards defined during detailed design.
- Fill placement should be inspected by a suitably qualified engineer or geologist.
- Further considerations from respective experts in Ecology, Sediment Control and Visual & Landscape should also be taken into account, e.g.:
  - Avoid wetlands and streams.
  - Avoid vegetation.
  - Visually acceptable
  - Catchment areas above fill sites are minimised and, where these exist, are diverted around the fill area.

Fill stability is strongly governed by effective under drainage and surface water control. Under drainage details could comprise a central drain under the fill disposal area where groundwater inflows are relatively low. Where there is a larger / broader groundwater inflow, a more detailed under drainage detail could be undertaken with additional drains extending out of the main spine drain to tap localised groundwater seepages or outflows.

Based on our investigations and inspections to date, we consider that suitable and sufficient fill disposal sites are likely to be feasible subject to detailed design and site characteristics.

12 Stormwater culverts and stream crossings

12.1 Catchment overview

Mt. Munro topography can generally be categorised as farm pasture on relatively steep hillside. Generally, the proposed access track alignment follows the ridgeline of these hills but also crosses a number of smaller catchments and one or two more significant catchments when rising up from the lower reaches in the northeast. The access track is quite steep and rises from approximately RL270m to RL490m over 2.5 km. To enable the access track, a number of culverts will be required crossing what appear to be ephemeral streams, and smaller watersheds and overland flow paths. Where the road alignment crosses over minor ephemeral flow paths, the road levels shall be designed to accommodate sheet flow over the road.

The existing alignment crosses a significant overland flow path in two locations in catchment 2 and one location in catchment 4 (see Figure 12.1, 12.2 and 12.3). These culverts have been sized using the rational method with results provided in Table 12.4.

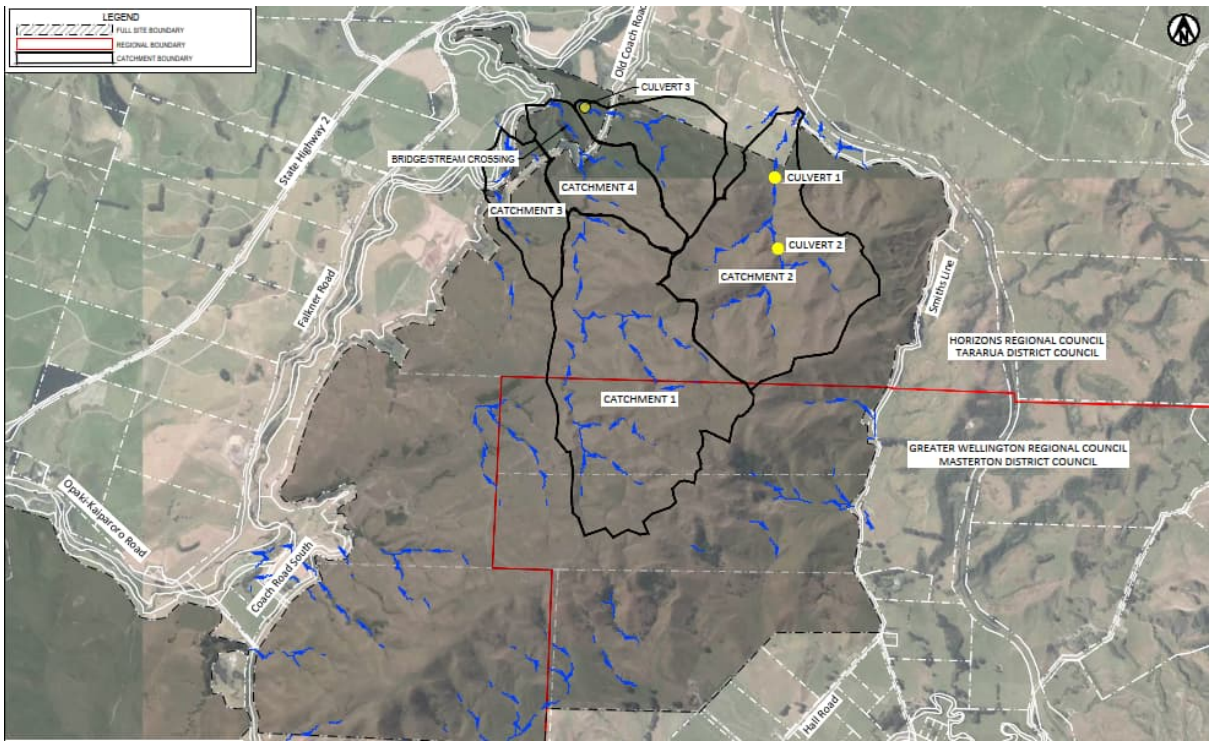


Figure 12.1: Catchment plan

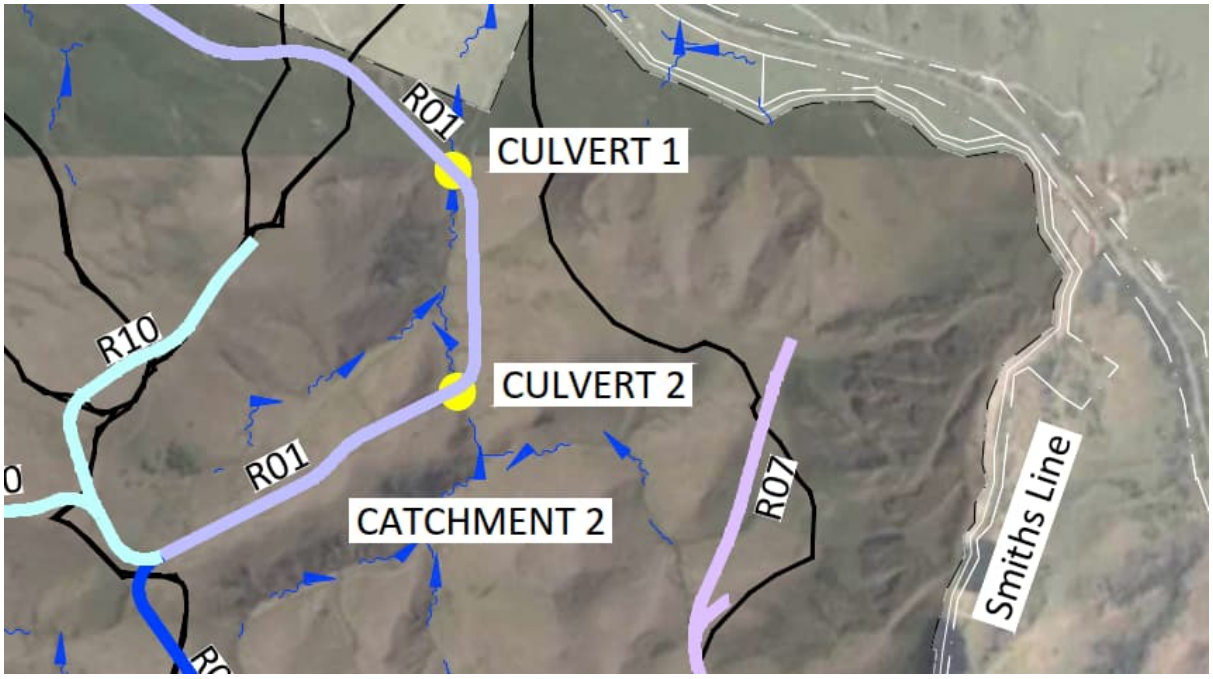


Figure 12.2: Location of culverts 1 and 2

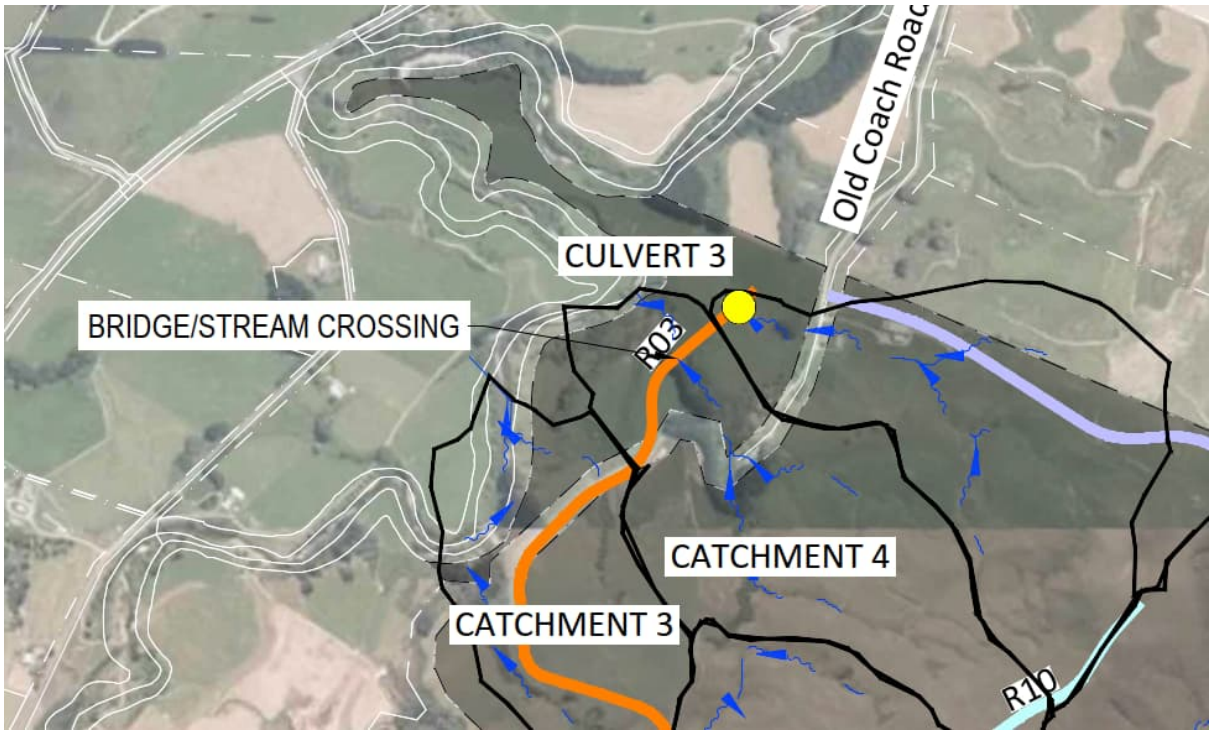


Figure 12.3: Location of culvert 3 and bridge crossing

12.2 Culverts

Initial indications are that these pipes will need to be in the range of 1050-1200 mm in diameter to service the 10% annual exceedance probability (AEP) design storm. During the detailed design phase, the design storm adopted will be reviewed to assess any benefit in increasing the culvert sizes to reduce maintenance costs.

Culvert	Estimated Size	Estimated length	10% AEP+CC Peak Flow	Scour Protection	Fish Passage
Culvert 1	1200 mm dia.	110m	3.2 m^3/s	Yes	Yes
Culvert 2	1050 mm dia.	100m	2.5 m^3/s	Yes	Yes
Culvert 3	900 mm dia.	30m	1.6 m^3/s	Yes	Yes

Table 12.4: Stormwater culvert crossings

12.3 Bridge crossing

A permanent bridge crossing is proposed on an un-named tributary of the Makahahi River to provide access from the laydown area to the western part of the site.

The proposed bridge is likely to consist of driven steel piles, steel girders and a concrete deck. Concrete abutments will be placed well back from the stream bank so that no excavation will take place within the waterway. If retaining is required around the abutments this will be undertaken using rock gabions or similar type construction. No earthworks or retaining will be undertaken within the waterway.

The level of the underside of the bridge will be set at 1.0m above the 2% AEP, (1 in 50 year) flood level. An allowance for climate change has been included when assessing the 2% AEP flood level. During the detailed design phase, the design flood level adopted will be reviewed to assess any benefit in increasing the bridge level to reduce maintenance costs.

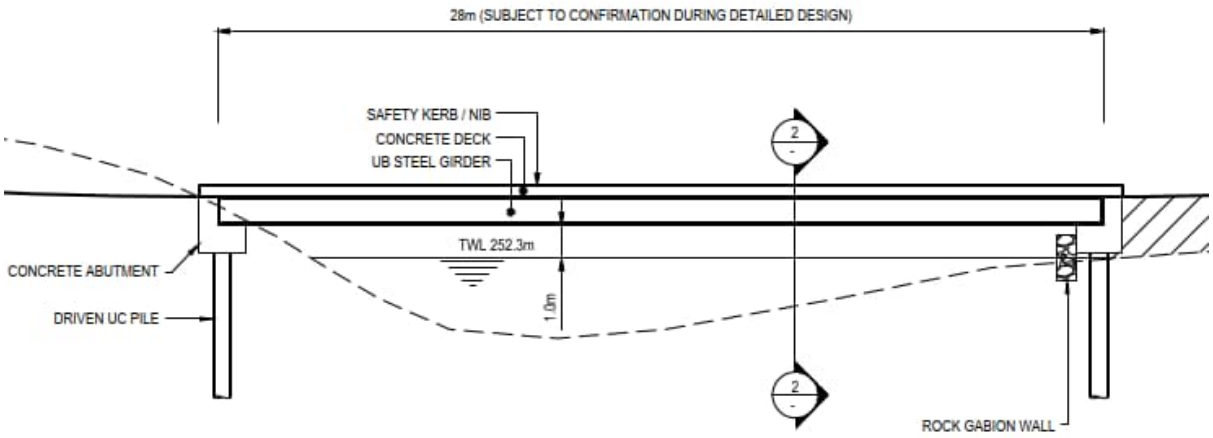


Figure 12.5: Typical bridge elevation

13 Pavements

Pavements are the granular layers that form the base course and running surface of roads.

Pavement depths will vary across the site depending on traffic loading, grade of the route and on the stiffness of the subgrade (foundation) material actually encountered. An unsealed granular pavement is proposed across the site. Different geological materials have different stiffness characteristics. The geology along a given section of road will therefore influence the likely pavement layering and thickness.

Greywacke sandstone and siltstone are expected to provide good subgrade performance requiring thinner thicknesses of the granular pavement than will the overlying soils or any Tertiary rocks encountered. However, investigations undertaken to date suggest that the greywacke rock is typically weak to moderately strong and is unlikely to be suitable for use as roading aggregate. Therefore, basecourse aggregate material will likely be sourced from local quarries outside of the site.

An assessment on the available aggregates for pavement construction was undertaken by WSP in September 2022. This concluded that suitable aggregate materials can be supplied from reputable quarries in either Masterton or Pahiatua.

14 Applicability

This report has been prepared for the exclusive use of our client Meridian Energy Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Masterton District Council, Tararua District Council, Greater Wellington Regional Council and Horizons Regional Council as the consenting authorities will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Maurice Mills Senior Civil Engineer	Bruce Symmans Project Director

Maurice Mills
t:\christchurch\tt projects\1016884\1016884.1000\workingmaterial\civil design report\mtmr_civilreport_v02-06_ttfinal.docx

Appendix A Geological and geotechnical assessment

- Report 1016884.1000 v2 – Geological and geotechnical information to support civil engineering report dated May 2023

REPORT

Tonkin+Taylor

Mount Munro Windfarm

Geological and geotechnical information to support civil engineering report

Prepared for
Meridian Energy Limited
Prepared by
Tonkin & Taylor Ltd
Date
May 2023
Job Number
1016884.1000 v2

Together we create and sustain a better world
www.tonkintaylor.co.nz

Document control

Title: Mount Munro Windfarm					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
19/10/2022	1	DRAFT for review	Nick Peters	Maurice Mills	Bruce Symmans
09/05/2023	2	FINAL	Nick Peters	Maurice Mills	Bruce Symmans

Distribution:

Meridian Energy Limited	1 PDF copy
Tonkin & Taylor Ltd (FILE)	1 PDF copy

Table of contents

1 Introduction

Meridian Energy Limited (Meridian) is proposing a new wind farm project (Mt Munro) in the Lower North Island, approximately 5 km south of Eketāhuna. The site is situated within the Tararua and Masterton Districts and the Horizons and Greater Wellington Regions.

This report provides geological and geotechnical information to support the Civil Engineering Report. This information focuses primarily on the proposed road alignments, turbine locations, and infrastructure locations. It provides, based on a desktop review of existing data, site walkovers and a test pit investigation only, an overview of ground conditions, expected geology, geotechnical hazards and basis for geotechnical parameters assumed for the civil construction such as cut and fill batter slopes for the roads and platforms.

2 Project location and site description

Mt Munro windfarm site is located on hill tops approximately halfway between Mauriceville and Eketāhuna in the northern Wairarapa. The site area is approximately 2 km southeast of State Highway 2 and straddles the regional boundary between the Wellington and Manawatū-Whanganui Regions.

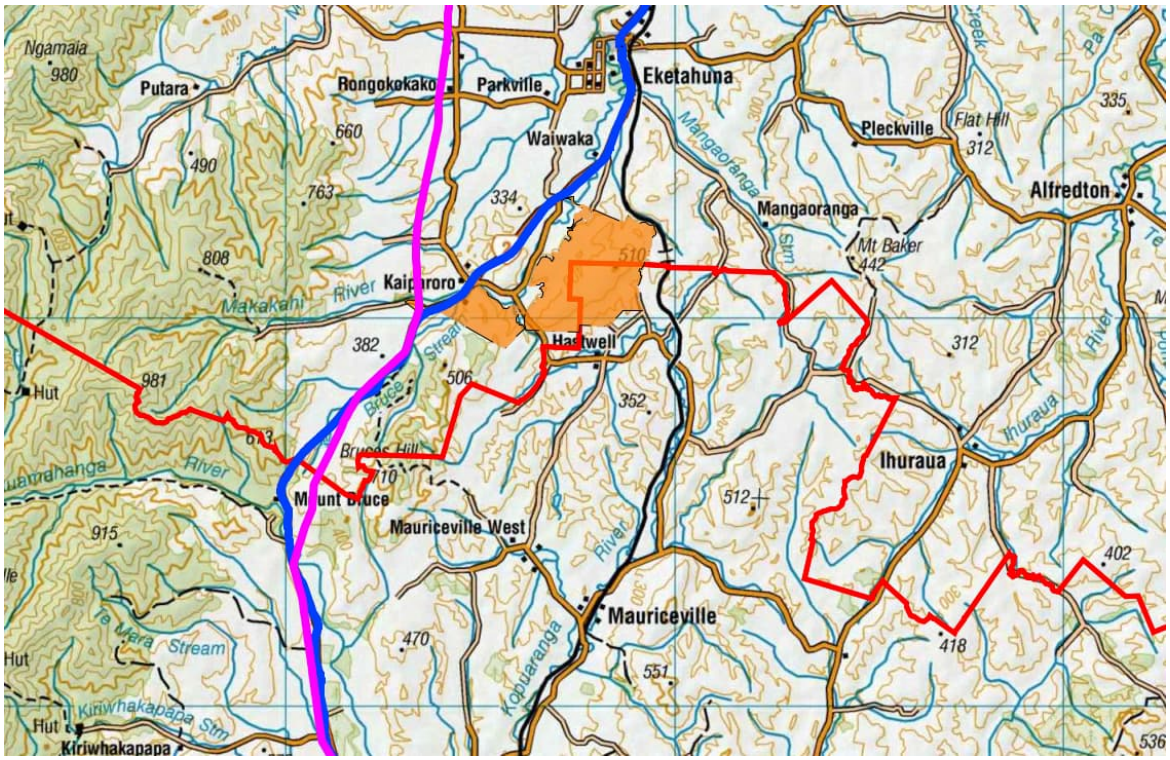


Figure 2.1: Site Location Plan (site is highlighted orange, blue line is SH2, pink line is the existing transmission line and regional council boundaries in red)

The site is characterised by steep hills and relatively flat plateau areas on top. The hills have a prominent ridge and gulley structure. The hillslopes are generally quite steep and high within the project area, with more gentle lower hillslopes to the east. The site is located on active farmland, which is used primarily for sheep grazing.

Photograph 2.2: Steep hillslopes typical of the windfarm area

3 Geotechnical assessment

This section provides a summary of the geotechnical investigations that have been completed to help inform the Civil Engineering Report.

3.1 Desktop review

To undertake our geotechnical assessment, we have reviewed the following documents:

- Geotechnical Factual Report, T+T reference 1016884.1000 v1, February 2022.
- Preliminary Geotechnical Assessment, Opus reference GER 2011/02, July 2011.
- Lee, J.M., Begg, J.G. (compilers) 2002. Geology of the Wairarapa area. Institute of Geological and Nuclear Sciences 1:250000 geological map 11. 1 sheet + 66 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.
- Aerial imagery including the 2021 Drone survey undertaken by Meridian Energy Ltd.

3.2 Site walkovers

Three reconnaissance and geological walkovers have been completed across the site on 3 May 2021, 25 November 2021 and 17 March 2022. The site visits have progressively built the knowledge and understanding of the geological conditions. The site visits included:

- Inspection of potential road alignments and potential turbine locations.
- Inspection of outcrops around the site, particularly on farm tracks and stream cuttings.
- Surface identification of geological materials and the location of any geotechnical hazards and constraints.

3.3 Subsurface Geotechnical Investigations

A test pitting investigation was completed at the site in December 2021. Details of the investigations are provided in the T+T Geotechnical Factual Report of February 2022 (GFR) attached in Appendix A. The primary purpose of those investigations was to provide an indicative preliminary assessment of the likely ground conditions in the vicinity of proposed wind turbines and along the transmission line.

The investigations were mainly completed on hilltops near to expected positions of wind turbine locations, as well as at one location near to the proposed alignment for the electrical transmission line. These investigations provided descriptions of the principal geological materials as well as confirmation of the depth to rockhead below ground level at each investigated location. Those investigations helped inform the Civil Engineering Assessment.

4 Engineering Geology

4.1 Published Site Geology

The published geological map of the area[1] indicates that the wind farm is generally underlain by strong volcaniclastic greywacke sandstones and mudstones of the Waioeka Terrane. The river terrace adjacent to State Highway 2 comprises Quaternary-age alluvial deposits whilst the lower lying hillslopes to the east are underlain by much younger, weaker Miocene-age conglomerates and Pleistocene-mudstones. The location of the site in the context of the regional geology is presented on Figure 4.1 below and on the Annotated Geological Plan in Appendix B.

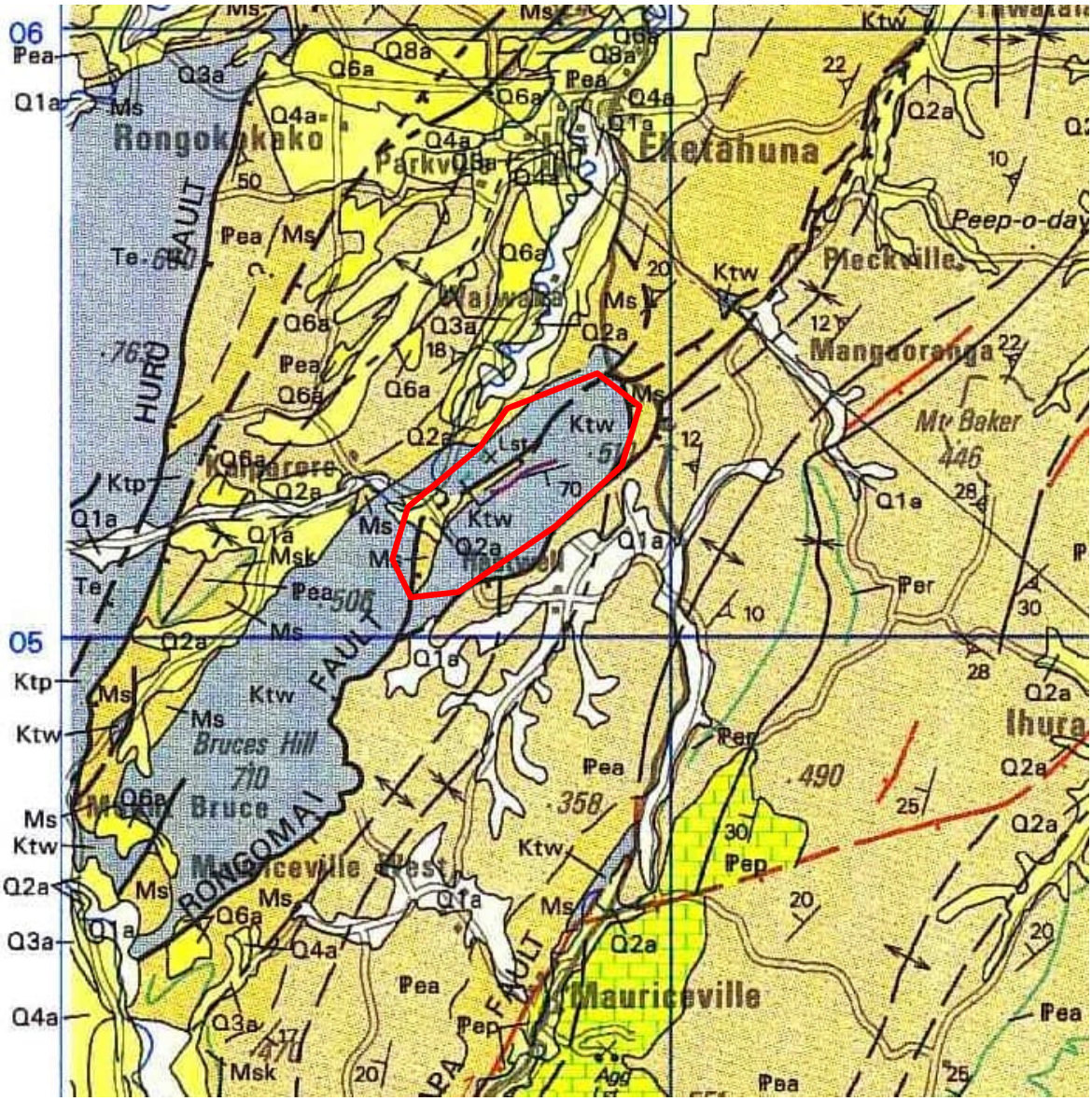


Figure 4.1: Geological map of the site[1] and the surrounding area. The site area is approximately outlined in red. Older Greywacke rock is shown in dark grey. Younger Tertiary aged rock is beige and bricked yellow (around Mauriceville), and recent alluvium deposits are shown in yellow and white.

[1] Lee, J.M., Begg, J.G. (compilers) 2002. Geology of the Wairarapa area. Institute of Geological and Nuclear Sciences 1:250000 geological map 11. 1 sheet + 66 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

4.2 Observed Geology

The geology observed at Mount Munro is consistent with the published geological map. It is dominated by older stronger greywacke rock with younger Tertiary rocks dominating to the east and north of the site and deposits of recent alluvium on the lower lying river terraces to the north and south. High level geological and geomorphological observations made around the windfarm site are shown on the Simplified Geological Observations Plan in Appendix B.

4.3 Geological materials

A Summary of the main geological materials expected to be encountered at this site is as follows:

4.3.1 Loess

Loess is a windblown deposit that mantles the colluvium or rock. It comprises variations of fine-grained soils such as silts, sandy silts, silty sands and fine sands. Its thickness varies but it is typically less than 1m. Although loess was not recorded during the investigations it may be locally present across the site, especially on the ridge top.

4.3.2 Colluvium

Colluvium materials are slope wash and shallow landslide deposits. These deposits typically comprise a mixture of soil types from clayey silt to silty sands and gravels. Colluvium can also comprise a reworking of loess soils. Colluvium can also have similar characteristics to residual soils (i.e. rock that has weathered to a soil) as it can be dominated by fine grained soils that also include gravel clasts.

Photograph 4.1: Gravel and silt dominated colluvium soils mantling the slopes

4.3.3 Alluvium

Two types of alluvium were observed on the site:

- Recent (Holocene) alluvium from streams accumulating in gullies and on the valley floors.
- Older (Pleistocene) alluvial deposits on the flat river terrace where the transmission line is to be located.

Holocene alluvial deposits were observed during the site walkovers in gullies. They are relatively thin deposits (typically less than 2m thick) and comprise grey and brown silts and silty sands.

Photograph 4.2: Holocene alluvium on valley floor and covered with vegetation

Pleistocene age alluvial deposits were observed in exposures on the river terrace and in Test Pit TP16. The material is described as a Sandy SILT with some gravel.

Photograph 4.3: Pleistocene alluvium on the lower terrace at the laydown area.

4.3.4 Greywacke rock

The basement rock at Mount Munro is “greywacke”. The rock exposures typically comprise highly and moderately weathered, interbedded sandstone with lesser mudstone and siltstone (argillite). The test pits indicate that the greywacke rock is typically weak to moderately strong.

Locally there are exposures of slightly weathered (SW) greywacke although, compared to the moderately (MW) and highly weathered (HW) rock, these exposures are relatively infrequent. In some areas, the surficial exposure of the greywacke is extremely or completely weathered (CW) and / or has characteristics of a residual soil. The ridge tops are likely to comprise a mantle of residual soils or completely weathered greywacke and although the test pit investigations on the ridge tops recorded in places colluvium overlying greywacke rock, this colluvium deposit could also be residual soil.

The greywacke typically has closely and very closely spaced fractures. Locally there are areas where a high frequency of shearing is encountered. As the rocks have been subject to extensive burial, deformation and uplift in their past, they are slightly metamorphosed (i.e. they have been changed by heat and pressure when they were buried). As such, in many places, silica within these rocks has been remobilised during burial and these fluids have solidified in fractures to form veins of quartz.

Photograph 4.4: Jointed moderately weathered greywacke rock typical of the windfarm site

Locally, the greywacke also contains areas of a fine siliceous rich material called chert and are slightly weathered and strong to very strong. The spatial extent of this rock is limited but forms prominent ridge top rock outcrops around the site.

There are two small quarrys and a small borrow area off Faulkner Road and Coach Road (South) that expose greywacke rock. Although the quarrys were not accessible, the Greywacke rock was observed from a distance to be characteristic of the Greywacke rock observed around the windfarm site.

Photograph 4.5: Example of highly and completely weathered greywacke on the windfarm site

Photograph 4.6: Example of strong chert outcrops around the windfarm site

Photograph 4.7: Borrow area in Greywacke Rock off Coach Road (South)

4.4 Groundwater

Groundwater seepages / springs are typically observed in gullies or on lower slopes.

A number of gullies along the proposed access roads exhibited seepages or a steady water flow. Soils in these gullies were soft, and the ground was locally wet and boggy. Seepages sometimes coincided with localised shallow translational landslides and earthflows.

Some gullies where seepages and semi-permanent water flows occur have been dammed by farmers to form stock ponds.

The seepages often occur at low points in the topography and will often coincide with minor permeability variations within the greywacke rock (i.e. between variably fractured sandstone and siltstones), or along more defined fracture planes.

During the test pit investigations, all except two test pits recorded groundwater seepages. Groundwater seepage in the test pits ranged from slow seepage to rapid inflow through the colluvium or rock defects.

Photograph 4.8a&b: (a) Groundwater seeps from gullies resulting in shallow landslides and (b) in test pits along the soil / rock interface

4.5 Faulting

There are no recorded active faults within the site area.

According to the GNS active fault database there are five active faults within 10km of the site boundary. The nearest active fault is the Mangaoranga Fault which has a characteristic magnitude event of 6.1. The greatest seismic hazard to the windfarm is likely to be from the Wairarapa Fault, which is approximately 4 km from the site, although this fault has a recurrence interval of 1160-1880 years (according to GNS) and last ruptured in 1855.

Based on the published geological map, inactive faults are present in the immediate area and within the site area. The Rongomai Fault is shown on the published geological map to pass to the south of the windfarm site with a splay (offshoot) of the fault extending through the site north of road R10. However due to the small scale of the geological map and site observations of geomorphology (i.e. a linear valley), the fault splay is inferred to cross the site in a SW-NE direction between roads R02 and R10. Refer the Geological Observations Plan in Appendix B for the inferred position of the fault splay based on the surface topography and geomorphology.

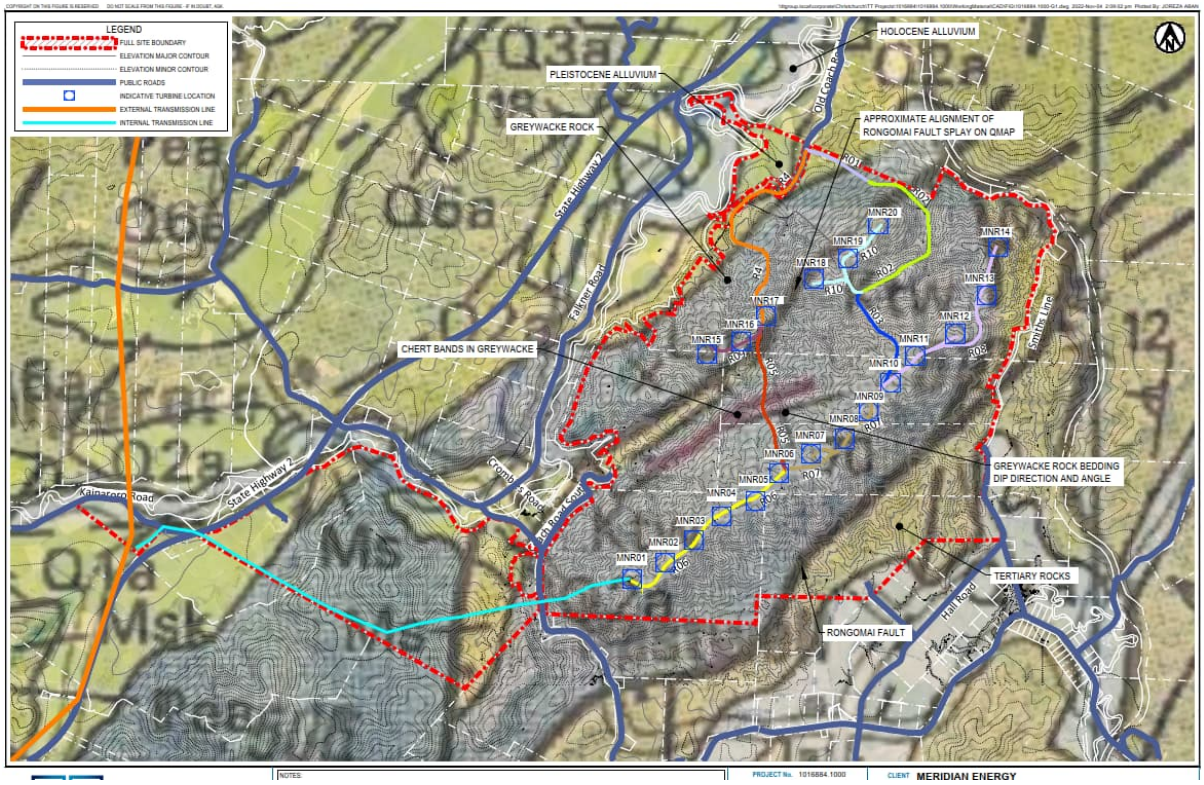


Figure 4.2: Annotated geological plan (refer Appendix B).

Photograph 4.9: Indicative line of inactive Rongomai Fault splay through the windfarm site based on geomorphology / topography. The proposed access road R02 runs from the bottom of the valley in the middle of the picture and up the hillside to the right of the inferred fault splay line

Blue and grey gravely clay was observed in a limited exposure on the valley floor close to the line of the Rongomai Fault splay which is inferred to be alluvium but could also be near fault crushed greywacke argillite.

Photograph 4.10: Blue grey gravely clay on valley floor where road R02 crosses stream

Within the fault zones, broken and crushed greywacke rock should be expected and batter slopes should be reviewed during construction in the event that disturbed rock is present. This may require local shallowing of batter angles or localised stabilisation or protection works.

5 Slope instability

Based on our inspections within the project area we expect that the landslip risk to the proposed project is low. We have not identified any existing large scale or deep-seated instability close to the proposed earthworks, road alignments, wind turbines or other project infrastructure. Large areas of superficial soil erosion were also not observed during our site walkovers. However minor, localised areas of erosion during extreme rainfall events on unstabilised (not yet vegetated) cut and fill batters should be expected.

Existing small scale shallow slope instability has been identified within the site area, and there is a risk of isolated, localised shallow instability on cut and fill batters during the construction and operational phases. For example, shallow soil slides are expected to occur off the slopes above road R02 where the road sidles up the slope to the top of the ridge through an area exhibiting soil creep.

Examples of minor slope instability observed on site, and to be expected during the construction works and life of the project are as follows:

5.1 Soil creep

Soil creep can occur in the near surface soils (typically less than 0.5 m thickness) on slopes typically steeper than 30-35°. It is usually caused by the cyclic shrink- swell due to wetting and drying cycles of more silty soils (i.e. the loess or colluvium). This creep creates small linear features called terracettes. These are slow developing features and as they are constrained to the surface soils will not have any stability impact on platforms or formed roads.

5.2 Shallow translational slides and earthflows

Some shallow translational slides and resulting debris earthflows were observed onsite.

These landslips occur when the soils on steep slopes become saturated through heavy or prolonged rainfall. They are typically only a few metres wide and less than 1 m deep.

The effects of shallow earthflows from above are considered to be minor (i.e. localised debris inundation of an access road). Where fills are placed over gullies to form the roads, translational slides below (forming under slips) could cause road edge undermining only.

Photograph 4.11: Example translational landslide and shallow creep forming terracettes (refer Geological Observations Plan in Appendix B for approximate location)

5.3 Shallow rockfalls and rockslides

Shallow rockfalls and rockslides are expected to occur on rock cut batters and could range from 1-2 m wide to possibly tens of metres wide. These rockfalls will occur where adversely orientated or clay filled discontinuities in the rockmass dip out of the cut slope face at a shallower angle than the cut slope. Small rockfalls and rockslides are likely to be common along cut slopes but they can be easily managed byby clearing debris that may accumulate on the sides of the roads.

Larger rockfalls and rockslides can also be managed but will be more disruptive, potentially blocking roads for a few hours to days. As rock cuts are excavated they should be inspected by a suitability qualified engineer or geologist and then locally retained or stabilised (for example by soil nails, rock anchors and meshing), reduced batter slope angles or areas accepting that additional maintenance and material clearance would be required.

5.4 Mitigation of instability on slopes above roads

During construction, a suitability qualified engineer or geologist should inspect the natural and cut slopes above the roads, and if adverse rock defects, existing shallow soil slides or remnant colluvial gullies are observed, then recommendations on appropriate mitigation measures can be provided if

they are required. This may include allowance for material clearance, slope batter reprofiling, localised drainage controls or localised slope stabilisation measures.

5.5 Mitigation of instability on existing slopes below roads

Shallow slides and rockfalls may exist or occur on the downslope side of proposed roads. The best ways to remediate slope instability of existing slopes below proposed roads is to:

- Excavate and replace unstable soils. This would comprise benching in soils below instability and replacing with compacted backfill, with geogrid reinforcement.
- Install specifically designed subsurface drainage.

Assets such as roads and cables should be positioned so that they are sufficiently offset from the top of the slope to avoid higher risk areas of slope instability. Cables should be installed on the upslope / inside half of the road where practical, rather than the outside.

In isolated cases where the roads cannot avoid areas of potential soil creep, the formation should be excavated through this surface layer and the outside shoulder of the road stabilised (preferably with an anchored and tensioned geogrid) to minimise deflection of the outer edge.

A geotechnical engineer or engineering geologist should inspect the roads during construction and make recommendations on slope instability mitigation measures where required.

5.1 Fill slopes

Existing fill slopes around the windfarm site are small in height and have been formed during the construction of farm tracks across gullies or to create small ponds. Instability in existing fill slopes was not observed during our walkovers and any instability that may be present is expected to be small in nature.

Engineered fill batters are expected to perform well provided that they have good surface water control and under drainage and are constructed with engineered fill soils.

6 Seismic considerations

6.1 Earthquake shaking

The nearest identified major fault is the Wairarapa Fault. This is 4 km away from the site. This major fault is likely to subject this site to near fault amplification effects.

6.2 Site subsoil class

New Zealand Standard NZS 1170.5:2004 defines the site subsoil class. Assessments of the subsoil class are based on observations and investigations across the site.

Where the wind turbines are expected to be founded on greywacke rock. A subsoil class B can be assumed for turbines founding on greywacke rock. Turbine founding conditions are to be confirmed during construction.

For laydown areas off Old Coach Road a site subsoil class C should be assumed. This assumes that there is greater than 3 m depth to rock greater than 1MPa compressive strength. Founding conditions for the laydown areas should be confirmed prior to construction to determine if subsoil class B or C is to be assumed.

For the design of earthworks and infrastructure across the site the subsoil class is likely to be site subsoil class B or C. Assessment of the site subsoil class will need to be made by the designer at each location and confirmed during construction. Where less than 3 m to >1MPa rock can be confirmed, site subsoil class B can be assumed. Elsewhere, site subsoil class C should be assumed.

6.3 Liquefaction

The in-situ greywacke rock presents no liquefaction hazard. The liquefaction risk to the proposed turbines, infrastructure and the majority of the road network is very low.

Liquefaction susceptible soils are typically:

- Saturated
- Non plastic
- Non-cohesive silt, sand or gravel
- In a very loose to medium dense state

The investigations indicate that the existing surficial silt and sand soils could fall within the liquefaction susceptibility criteria with respect to particle size distribution and density.

However, liquefaction is only a risk where the materials are also saturated. This is likely to occur only in localised low lying areas and gullies containing alluvium. The liquefaction risk to infrastructure or earthworks can be mitigated by locally undercutting these materials first and replacing with non-liquefiable material. Soils away from gullies are typically not saturated and therefore present a low risk of liquefaction.

7 Site topography and Site suitability

This section provides a summary of the suitability of the site for a wind farm from a geological and geotechnical viewpoint based on the desktop review and site walkovers.

7.1 Site Topography

The site topography is governed by the underlying geology described in the sections above. The wind farm site is generally underlain by the older, stronger volcaniclastic greywacke, sandstones and mudstones. These strong greywacke rocks are more resilient to erosion and weathering and have formed the steep and high hill slopes across the area. These stronger rocks erode and weather at different rates depending upon the rock types (sandstones are typically more resilient than the siltstones and mudstones) and also the rock can erode and weather a lot quicker if they are more heavily sheared and fractured. These local variations result in the changes in topography (i.e. ridges and gullies) within the main windfarm site.

The lower lying hillslopes to the east of the windfarm site are underlain by much younger, weaker rock that erodes much quicker and doesn't form the heights of the older greywacke rocks. The river terrace and flat lying land adjacent to State Highway 2 and below the windfarm to the west comprises much younger alluvial (water borne) deposits.

Photograph 7.1: Photo looking south west along the main ridge of the site

The hills below the main ridges vary in steepness. Appendix A6 "Hill Slope Plan" and Figure 7.2 below show the areas that are steeper than 28°. Slopes at or steeper than this angle are almost exclusively in Greywacke rock.

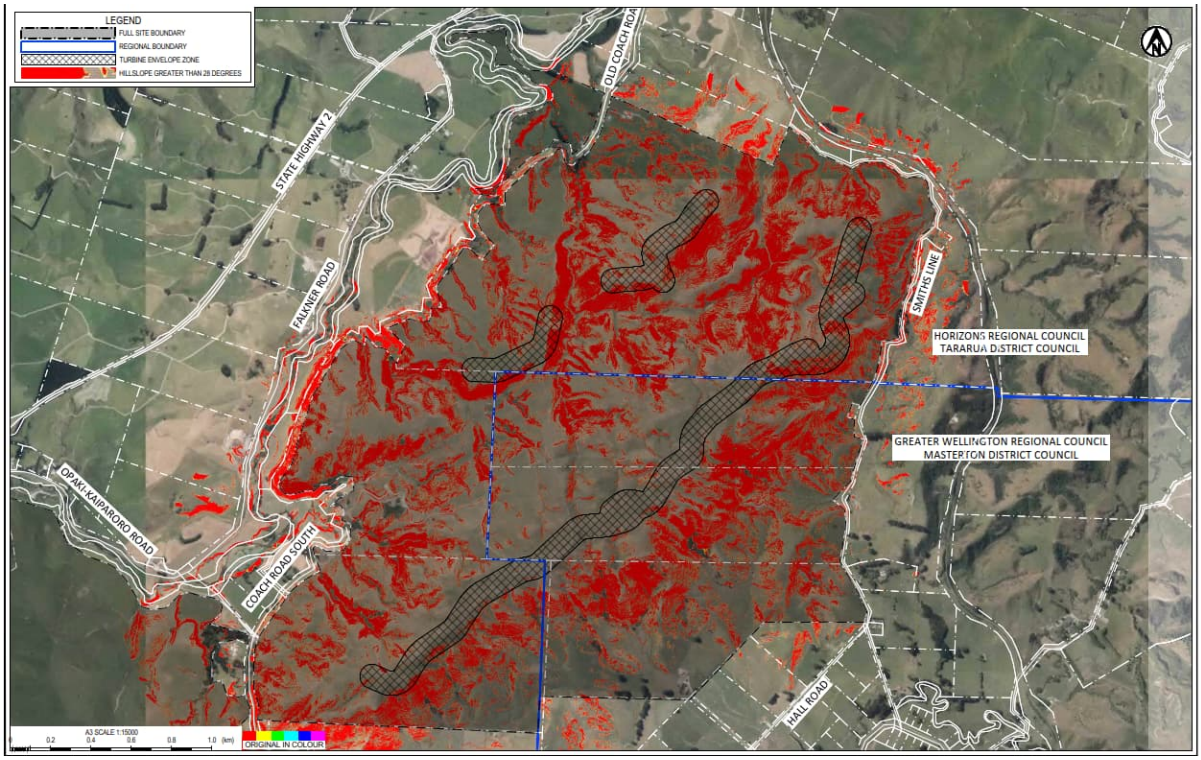


Figure 7.1: Plan of the Core Site, showing areas in red that are above 28° in steepness. The main ridges with the turbine envelope area is hatched in grey.

7.2 Site suitability

The wide ridges assist to provide room for roading, turbines, general infrastructure, and any environmental control measures.

Based on analysis of geological and geotechnical factors in the previous sections, as well as the topography, the ridgeline is well suited to a wind farm from a civil engineering viewpoint.

The suitability of the site for access roads is dependent on further design parameters which are covered in Sections 8, 9 and 10.

8 Material characteristics & design recommendations

This section provides recommendations and commentary on engineering parameters for this resource consent stage of the civil preliminary design. Likely engineering characteristics of geological materials have been assessed on the basis of:

- Site specific investigations.
- Observation of existing slopes and stability on site.
- Our experience and knowledge of these materials from other sites.

It must be appreciated that the nature and continuity of these materials away from the test sites and observed exposures is inferred and will vary.

8.1 Performance of existing cut & fill slopes

To assess the likely performance of proposed cut and fill slopes we have:

- Observed existing cut and fill slopes around the site during walkovers and test pit investigation works.
- Inspected existing cut and fill slopes at Mill Creek and Westwind Windfarms which have been constructed in similar greywacke rock terrain as is proposed for Mount Munro.
- Observed numerous cut and fill slopes in greywacke rock around the Wellington region of similar geology.

The following observations are considered relevant to this assessment.

8.1.1 Cut slopes

Cut slopes in greywacke and the overlying soils generally perform well but instability can occur where:

- Adversely orientated jointing and defects dip out of the slope at a slightly shallower angle than the cut profile.
- Shear zones or fault zones (inactive or active) in the rock results in highly sheared rock failing back at angles shallower than the cuts.
- Sliding of surface soils over the top of the underlying rock during heavy rainfall events because the soils become saturated and effectively reduce in strength as water pressures in the soils rise.

8.2 Indicative slope angles for preliminary (consent level) earthworks design

The greywacke derived materials are likely to perform relatively well in both cut and fill applications providing that, during construction, location specific guidance is provided to manage groundwater, rock and soil conditions.

8.2.1 Indicative preliminary design cut slope profiles

The final cut batter profiles will be best decided on site at the time of excavation as stability will vary at each specific location. The maximum stable cut batter angles in greywacke rock depend upon:

- weathering grade / rock material strength.
- orientation of defects (bedding, joints and faults) relative to the cut batter.
- Characteristics of defects (spacing, aperture, persistence, surface condition and dilation).

- Groundwater conditions.

Generally, as the rock becomes less weathered the strength of material on joint surfaces increases and the thickness and continuity of infill material between the defect's surfaces reduces. This results in an overall increase in the rock mass strength parameters.

For the basis of developing a preliminary civil design to assess environmental effects and to provide an indicative earthworks volume, we provide the following slope angles. The slope angles provided are the maximum slope angle however the batter slope angles in cuts may vary during construction (i.e. they may be shallower than the angles given below) depending on the strength, weathering and type of soil or rock encountered and any whether local stabilisation measures are to be constructed:

Table 8.1: Maximum cut batter slope angles used to obtain earthworks volumes

Slope type	Maximum slope angles used to determine earthworks volumes
Competent greywacke rock or low height slopes (under 5 m high)	75°
Greywacke rock cuts, 5-15 m high	60°
Batters Greywacke rock cuts, exceeding 15 high	55°
Tertiary rock cuts	55°
Surficial deposit cuts	45°

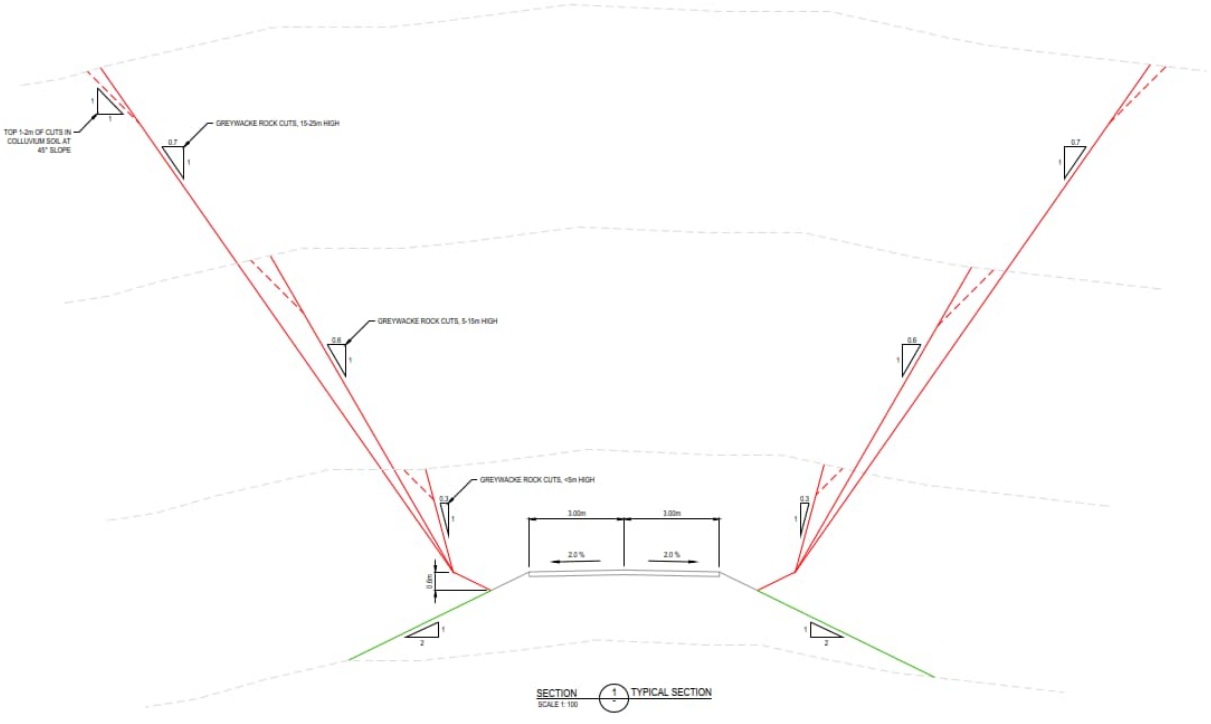
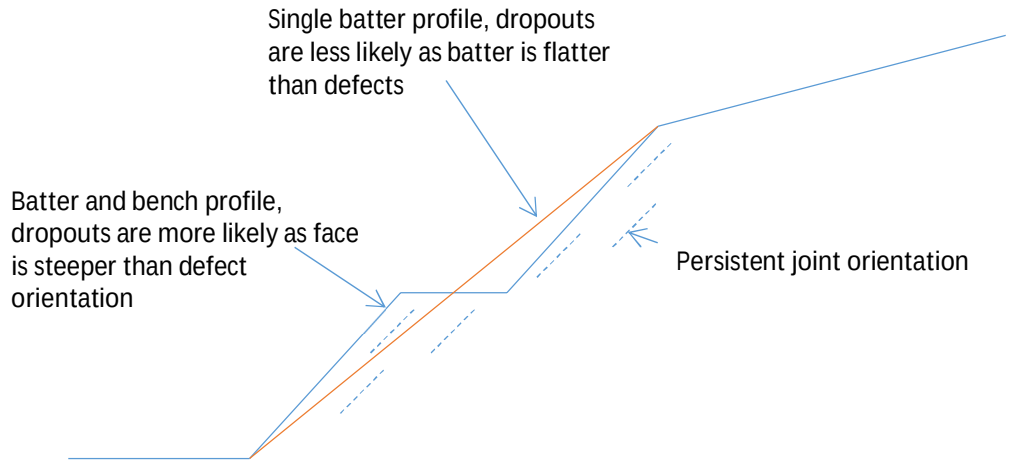


Figure 8.1: Maximum batter angle profile used to determine earthworks volumes

During construction, a suitably qualified engineer or geologist should assess the road cuts and confirm the appropriate batter angle if for example thick surficial deposits, groundwater seepages, adversely orientated prominent discontinuities in the rock or inactive fault zones are exposed. Where instability may be expected then this can be managed through measures described in Section 5.5 and 5.6.

8.2.2 Cut benches

Benches are not proposed for the project cut batters. This is because, with rock cuts in greywacke, the batter slope stability is heavily influenced by the face batter slope. Flatter (and therefore more stable) batter slopes are achieved without benches compared to multiple steeper faces and benches. Although the preference is not to have benches on slopes, there may be some situations where the rock and soil profile in the cut slope means that benches are a suitable option.



Sketch 1 –Single Batter compared to benched slope profile.

8.2.3 Cut slope instability management

If a sufficiently wide open drain is allowed for between the bottom of the slope and the road edge, then the effects of intermittent instability by small landslips on access or operation are likely to be relatively minor.

If slope instability does occur during construction or operation, then a number of different low cost mitigation measures can be immediately implemented, such as:

- Debris clearance.
- Slope trimming or regrading to a shallower angle.
- Hydroseeding.
- Bunding at the bottom of the slope.
- Face drainage (PVC bored drains or geotextile lined gravel filled trench drains with slotted pipe at the base).

8.2.4 Maximum fill batter slope

A preliminary design fill batter maximum slope of 1(V):2(H), or 26° has been used to calculate earthworks volumes and could be adopted for fill sites at Mount Munro. However, slopes this steep require extra effort (and cost) to construct and the preliminary design indicates a likelihood of generating excess cut. As part of further design development, optimisation of fill slopes to 1(V):3(H) or flatter could be considered and adopted. Cut soils will either go to fill disposal areas or road embankment fills. Utilising 1(V):3(H) fill slopes may reduce haulage distances to fill disposal sites in some cases.

Fill slopes could be steepened significantly, if required, with the use of specifically designed geotextile / geogrid reinforcement. Slopes of 1V:1H could be achieved with geogrid placed at nominal intervals of depth within the fill. We consider this unlikely to be cost effective on this site.

In selecting the final fill batter slopes for specific sites, consideration should also be given to visual objectives and the likely pastoral or end use of fill areas. Fill batter slopes should ideally be 1(V):3(H) or flatter where it is desired that effective pasture will be established and maintained.

8.2.5 Excavatability

The soils and highly or extremely weathered greywacke are easily excavatable. Earthworks can be undertaken with standard construction plant. A large majority of the moderately weathered greywacke can still be excavated with standard construction plant. Localised areas of slightly weathered greywacke or chert may require ripping with a tooth or with a rock pick on a 50 tonne excavator.

9 Applicability

This report has been prepared for the exclusive use of our client Meridian Energy Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Masterton District Council, Tararua District Council, Greater Wellington Regional Council and Horizons Regional Council as the consenting authorities will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Nick Peters Senior Engineering Geologist	Bruce Symmans Senior Geotechnical Engineer

Civil considerations review by Maurice Mills, Senior Civil Engineer

NCP
\\ttgroup.local\corporate\christchurch\tt projects\1016884\1016884.1000\workingmaterial\geotechnical\ncp_mt_munro_geological_geotechnical_report.docx

Appendix A Geotechnical Factual Report (GFR)

- 1016884.1000.v1 Geotechnical Factual Report dated February 2022

REPORT

Tonkin+Taylor

Mount Munro Windfarm

Geotechnical Factual Report

Prepared for
Meridian Energy Ltd
Prepared by
Tonkin & Taylor Ltd
Date
May 2023
Job Number
1016884.1000 v2

Together we create and sustain a better world
www.tonkintaylor.co.nz

Document control

Title: Mount Munro Windfarm					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
14/02/2022	V1	Factual report of geotechnical investigations at Mt Munro Windfarm	DAHE	NCP	BSS
11/05/2023	V2	Figures updated	MGM	NCP	BSS

Distribution:

Meridian Energy Ltd	1 PDF copy
Tonkin & Taylor Ltd (FILE)	1 PDF copy

Table of contents

1 Introduction

Tonkin & Taylor Ltd (T+T) have been engaged by Meridian Energy Ltd (MEL) to conduct geotechnical investigations at the proposed Mt Munro windfarm site. The primary purpose of the investigations has been to assess the ground conditions in the vicinity of proposed wind turbines and the transmission line. The investigations were mainly completed on hilltops near to proposed wind turbine locations, as well as at one location near to the proposed alignment for the electrical transmission line. These investigations have included providing descriptions of the geological materials as well as confirmation of the depth to rockhead below ground level at each location. The investigations will help inform geotechnical design of the wind turbine tower and transmission line foundations during future stages of the project.

Geotechnical services were provided in accordance with our proposal dated 15 October 2021[1]. This factual report provides details of the project-specific geotechnical investigation. This investigation involved the digging of test pits using a 13-tonne excavator and the collection of soils samples for future laboratory testing.

[1] Tonkin & Taylor Ltd (15 October 2021), Letter of Engagement – Mount Munro Windfarm – Civils Scope Effects Assessment. Job Ref: 1016884.1000.

2 Site Description

Mt Munro windfarm site is located on hill tops approximately halfway between Mauriceville and Eketāhuna in the northern Wairarapa. The site area is approximately 2 km southeast of State Highway 2 and straddles the regional boundary between the Wellington and Manawatū-Whanganui Regions. It is characterised by steep hills and relatively flat plateau areas ontop. The hills have a prominent ridge and gulley structure. The hillslopes are generally quite steep and high within the project area, with more gentle lower hillslopes to the east. The site is located on an active farm, which is used primarily for sheep and cattle grazing.

2.1 Published geology

The published geological map of the area[2] indicates that the wind farm is generally underlain by older, stronger volcaniclastic greywacke sandstones and mudstones of the Waioeka Terrane. The river terrace adjacent to State Highway 2 comprises Quaternary-age alluvial deposits whilst the lower lying hillslopes to the east are underlain by much younger, weaker Miocene-age conglomerates and Pleistocene-mudstones. The location of the site in the context of the regional geology is presented on Figure 2.1 below.

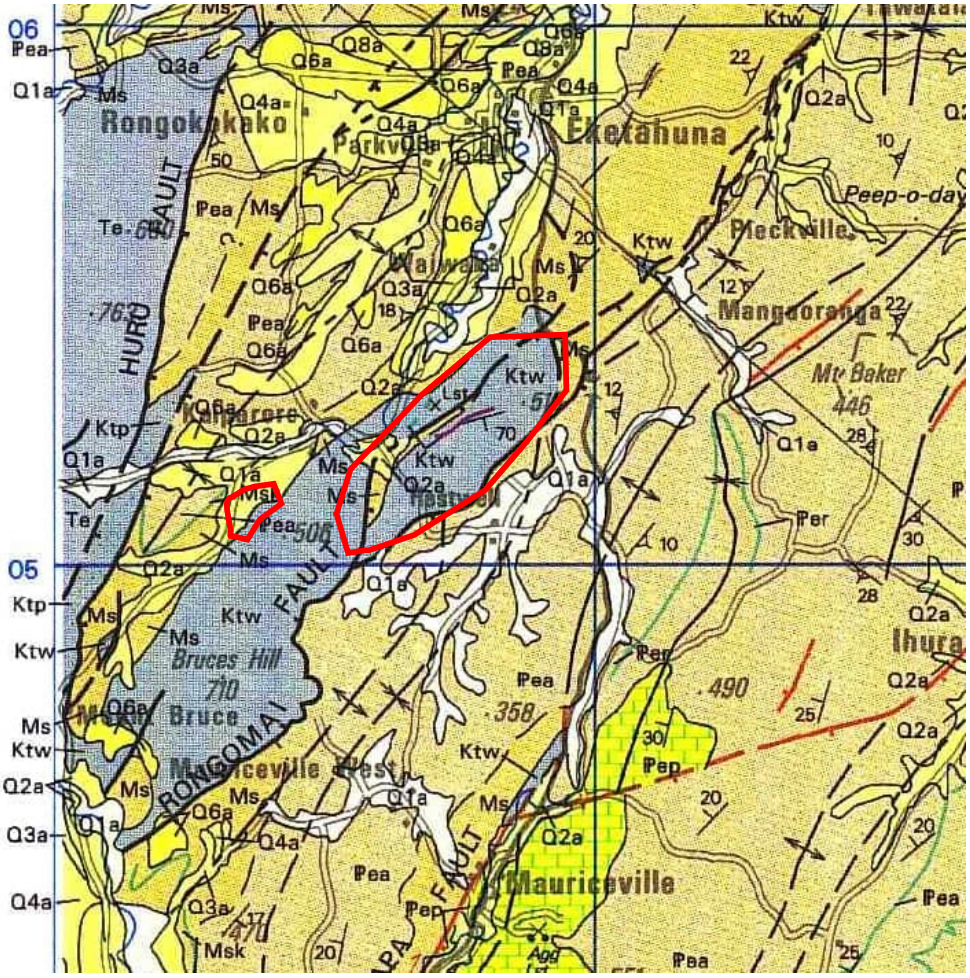


Figure 2.1: Geological map of the site and the surrounding area. The site investigation locations are within the red outlines on the geological map

[2] Lee, J.M., Begg, J.G. (compilers) 2002. Geology of the Wairarapa area. Institute of Geological and Nuclear Sciences 1:250000 geological map 11. 1 sheet + 66 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

3 Site investigations

3.1 Test Pits

Geotechnical investigations were carried out at the project site on 14 and 15 December 2021. The investigations comprised the excavation of sixteen (16) test pits. The test pits were undertaken by Goodman Contractors, under the supervision of an engineering geologist from T+T. In all cases, the test pits were dug until they encountered rock or until instability of the pit walls made it difficult to continue digging. The test pits were logged to NZGS 'Field Description of Soil and Rock' guidelines.

Actual investigation locations were selected by T+T based on access and the presence of overhead and buried services considerations. Observations of the surrounding geomorphology also aided in choosing the exact locations for each test pit.

The locations of the test pit investigations were surveyed by handheld GPS and are presented on Figures 1 to 4 attached in Appendix A. Test pit logs and photographs are presented in Appendix B. Summary details of the test pits are presented in Table 3.1 below.

Table 3.1: Test Pit Summary

Test Pit ID	Location (NZTM)		Ground Surface Elevation RL (m)	Depth (m)	Reason for termination	Approximate location description[1]
	Easting (m)	Northing (m)				
TP01	1827318.44	5490378.48	466.5	1.4	Criteria achieved	On ridgetop, west of topdressing shed
TP02	1827303.27	5490407.84	459.9	1.5	Criteria achieved	On ridgetop, west of topdressing shed
TP03	1827288.27	5490414.96	458.4	1.5	Criteria achieved	On ridgetop, west of topdressing shed
TP04	1826976.14	5490081.14	466.5	1.5	Criteria achieved	On ridgetop, west of topdressing shed
TP05	1827201.42	5490285.38	468.8	1.5	Criteria achieved	On ridgetop, west of topdressing shed
TP06	1827529.04	5490489.82	462.9	2.8	Criteria achieved	In paddock east of topdressing shed
TP07	1827745.29	5490674.32	457.1	3.0	Criteria achieved	Ridgetop east of topdressing shed
TP08	1827773.29	5490686.43	458.8	2.4	Criteria achieved	Ridgetop east of topdressing shed
TP09	1827919.66	5490748.14	473.3	2.4	Criteria achieved	Ridgetop east of topdressing shed
TP10	1827949.46	5490766.48	465.9	3.5	Pit side collapsing	Ridgetop east of topdressing shed
TP11	1828198.09	5490937.47	483.2	3.0	Criteria achieved	Ridgetop east of topdressing shed
TP12	1828402.56	5491196.41	492.6	3.6	Criteria achieved	Near met mast
TP13	1828550.66	5491355.08	491.1	3.6	Criteria achieved	East of met mast, near razorback at property boundary

TP14	1827575.87	5491385.78	375.6	3.4	Criteria achieved	In saddle on track to north side of farm
TP15	1827308.12	5491470.04	381.8	3.8	Criteria achieved	On north side of farm
TP16	1824326.59	5490269.56	282.0	3.5	Pit side collapsing	River flats near transmission line alignment

[1]See site plans in Appendix A for exact locations of each test pit relative to proposed turbine locations.

3.2 Groundwater levels

The groundwater level within each test pit was recorded using a tape measure at the time of excavation. The recorded groundwater levels are presented below in Table 3.2.

Table 3.2: Recorded groundwater levels

Borehole ID	Recorded groundwater level (m bgl)	Test pit depth (m)	Material and inflow characteristics
TP01	Dry	1.4	N/A
TP02	1.1	1.5	Rapid inflow from colluvium and defects in rock
TP03	1.1	1.5	Inflow of water from rock defects
TP04	1.1	1.5	Inflow of water in colluvium and rock defects
TP05	1.0	1.5	Inflow of water through rock defects
TP06	2.3	2.8	Inflow of water through rock defects
TP07	0.4	3.0	Inflow of water in colluvium, high groundwater
TP08	0.7	2.4	Inflow of water through rock defects
TP09	Dry	2.4	N/A
TP10	0.4	3.5	Colluvium – inflow on all sides
TP11	1.6	3.0	Inflow along soil/rock boundary
TP12	1.6	3.6	Seepage through rock defects
TP13	0.4	3.6	Soil/rock boundary, some seepage from defects
TP14	1.2	3.4	Slow seepage through residual soils
TP15	3.7	3.8	Slow inflow from
TP16	3.0	3.5	Rapid inflow from alluvial deposits.

3.3 Geotechnical Laboratory Testing

Twelve (12) disturbed samples were collected from a selection of the test pits. These samples include nine bulk samples and three small, bagged samples. The small samples were taken from the colluvium soil layers beneath the topsoil, whilst the bulk samples were taken from both the colluvium soil and the upper sections of the bedrock. Summary details of these samples are presented in Table 3.3 below.

At the time of this report being published, no geotechnical laboratory testing of these samples has been scheduled. If any geotechnical testing should be performed on the samples, this report will be superseded by a further report that will include details and results of any tests that are conducted.

Table 3.3: Summary of samples collected from test pits

Test Pit No.	TP02	TP03	TP04	TP05	TP06	TP07	TP07	TP09	TP10	TP11	TP11	TP15
Sample Depth (m)	0.3 to 1.2	0.3 to 1.1	0.3 to 1.2	0.3 to 1.5	0.8 to 2.8	0.2 to 1.5	1.5 to 3.0	0.2 to 0.4	0.2 to 3.4	0.2 to 1.8	1.8 to 3.0	0.3 to 2.7
Sample Type	Bulk bag	Small bag	Small bag	Bulk bag	Bulk bag	Small bag	Bulk bag	Bulk bag	Bulk bag	Bulk bag	Bulk bag	Bulk bag

4 Applicability

This report has been prepared for the exclusive use of our client Meridian Energy Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

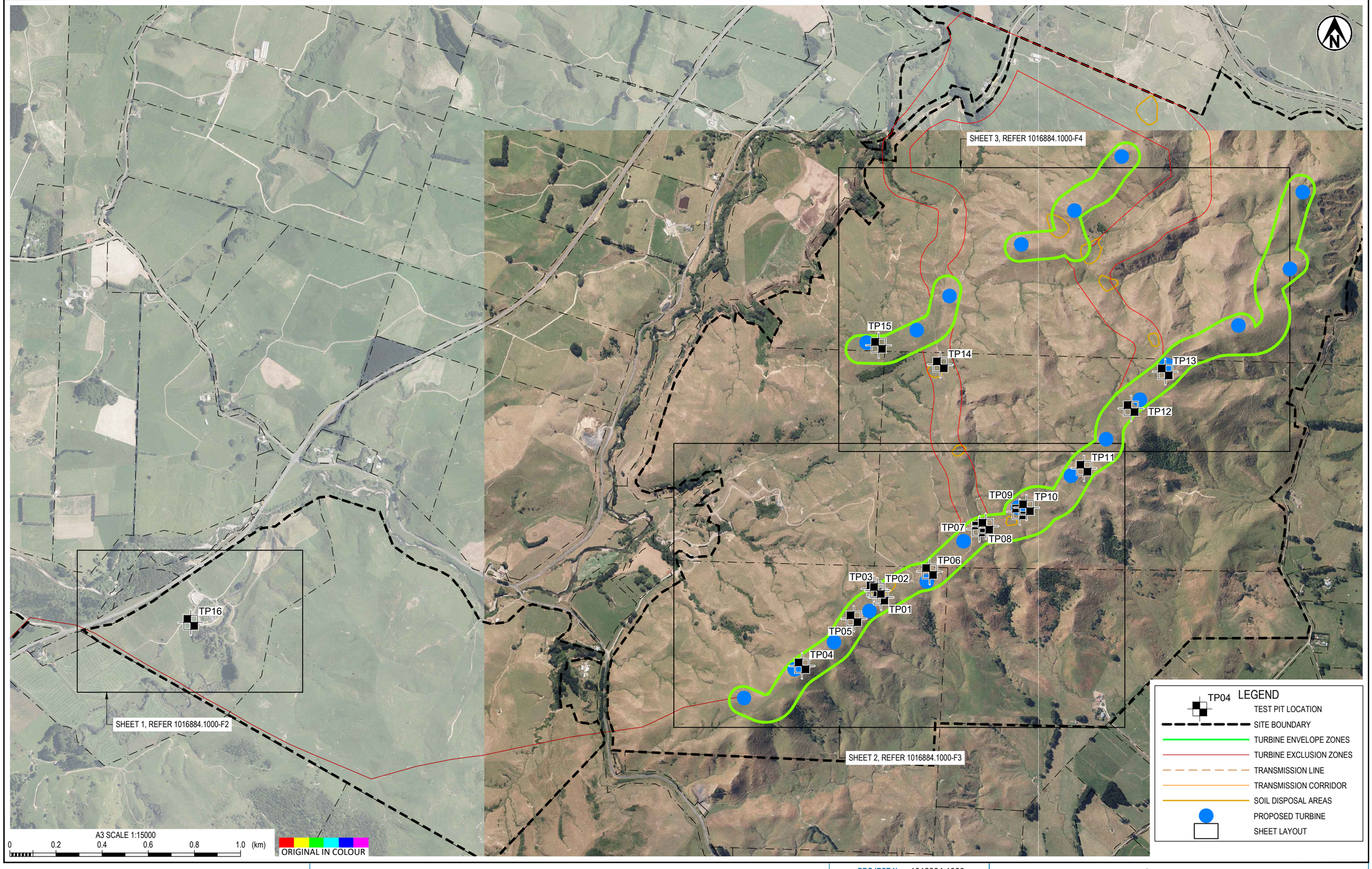
Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Dacre Herlihy	Bruce Symmans
Engineering Geologist	Project Director

IDAHE
t:\christchurch\tt projects\1016884\1016884.1000\workingmaterial\geotechnical\factualreport\mtmunrowindfarm_draftfactualreport_v2.docx

Appendix A Investigation plans

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-F1_F5.dwg 2023-May-11 4:24:07 pm Plotted By: MAURICE MILLS



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

1. AERIAL AND PROPERTY BOUNDARIES SOURCED FROM LINZ DATA SERVICE [https://data.linz.govt.nz] AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.
2. REFER DRAWING 1016884.1000-F1 FOR LEGEND.

PROJECT No.	1016884.1000	
DESIGNED	DAHE	May.23
DRAWN	DFL	May.23
CHECKED	NPC	May 23
APPROVED		DATE

CLIENT **MERIDIAN ENERGY**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE SITE INVESTIGATION LOCATION OVERVIEW PLAN

SCALE (A3) 1:15000 FIG No. 1016884.1000-F1 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-F1_F5.dwg 2023-May-11 4:46:41 pm Plotted By: MAURICE MILLS

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

1. AERIAL AND PROPERTY BOUNDARIES SOURCED FROM LINZ DATA SERVICE [https://data.linz.govt.nz] AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.
2. REFER DRAWING 1016884.1000-F1 FOR LEGEND.

PROJECT No.	1016884.1000	
DESIGNED	DAHE	May.23
DRAWN	DFL	May.23
CHECKED	NPC	May 23
APPROVED		DATE

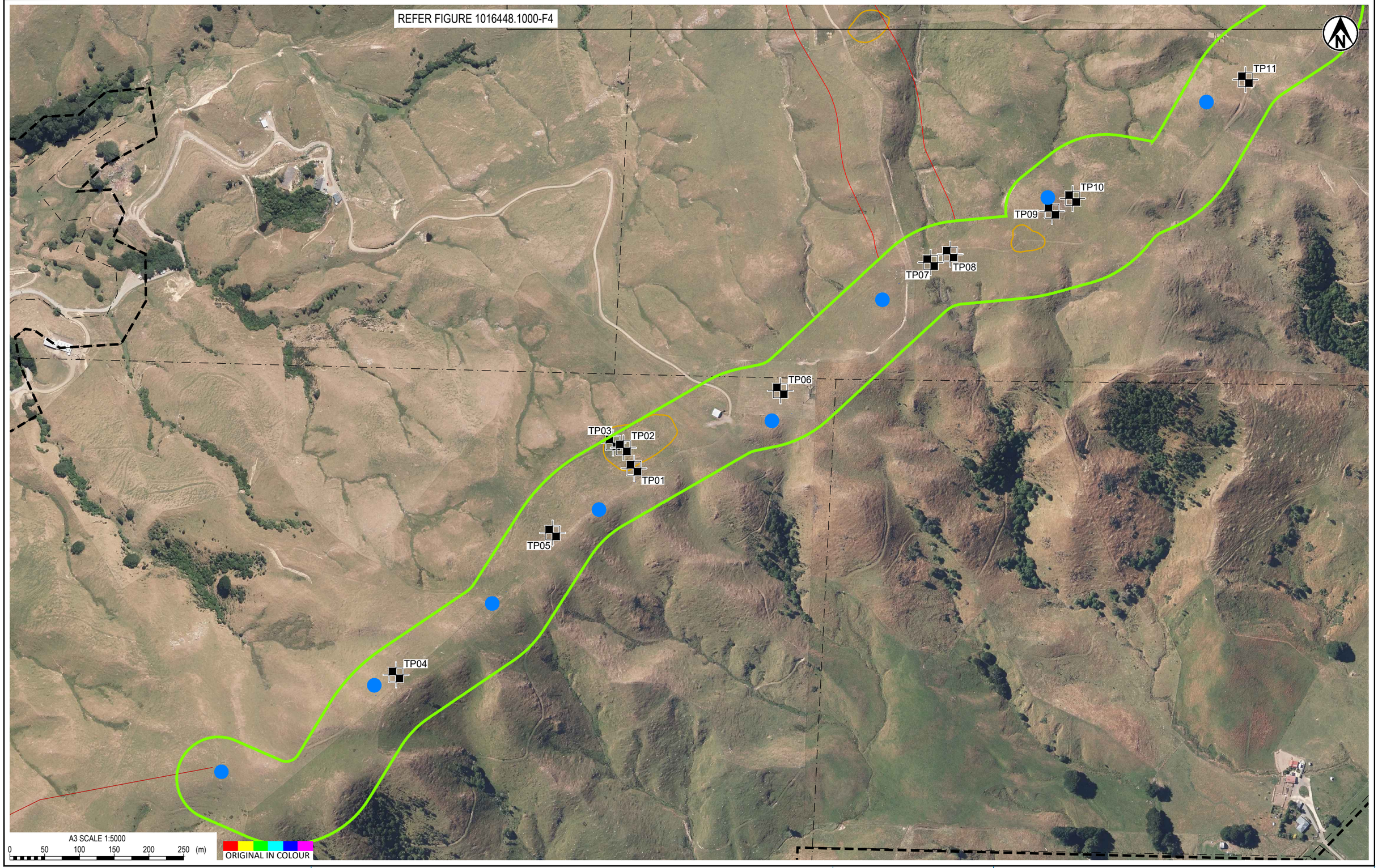
CLIENT **MERIDIAN ENERGY**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE SITE INVESTIGATION LOCATION SITE PLAN
SHEET 1

SCALE (A3) 1:2500 FIG No. 1016884.1000-F2 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-F1_F5.dwg 2023-May-11 4:46:57 pm Plotted By: MAURICE MILLS



NOTES:

1. AERIAL AND PROPERTY BOUNDARIES SOURCED FROM LINZ DATA SERVICE [https://data.linz.govt.nz] AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.
2. REFER DRAWING 1016884.1000-F1 FOR LEGEND.

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1016884.1000	
DESIGNED	DAHE	May.23
DRAWN	DFL	May.23
CHECKED	NPC	May 23
APPROVED		DATE

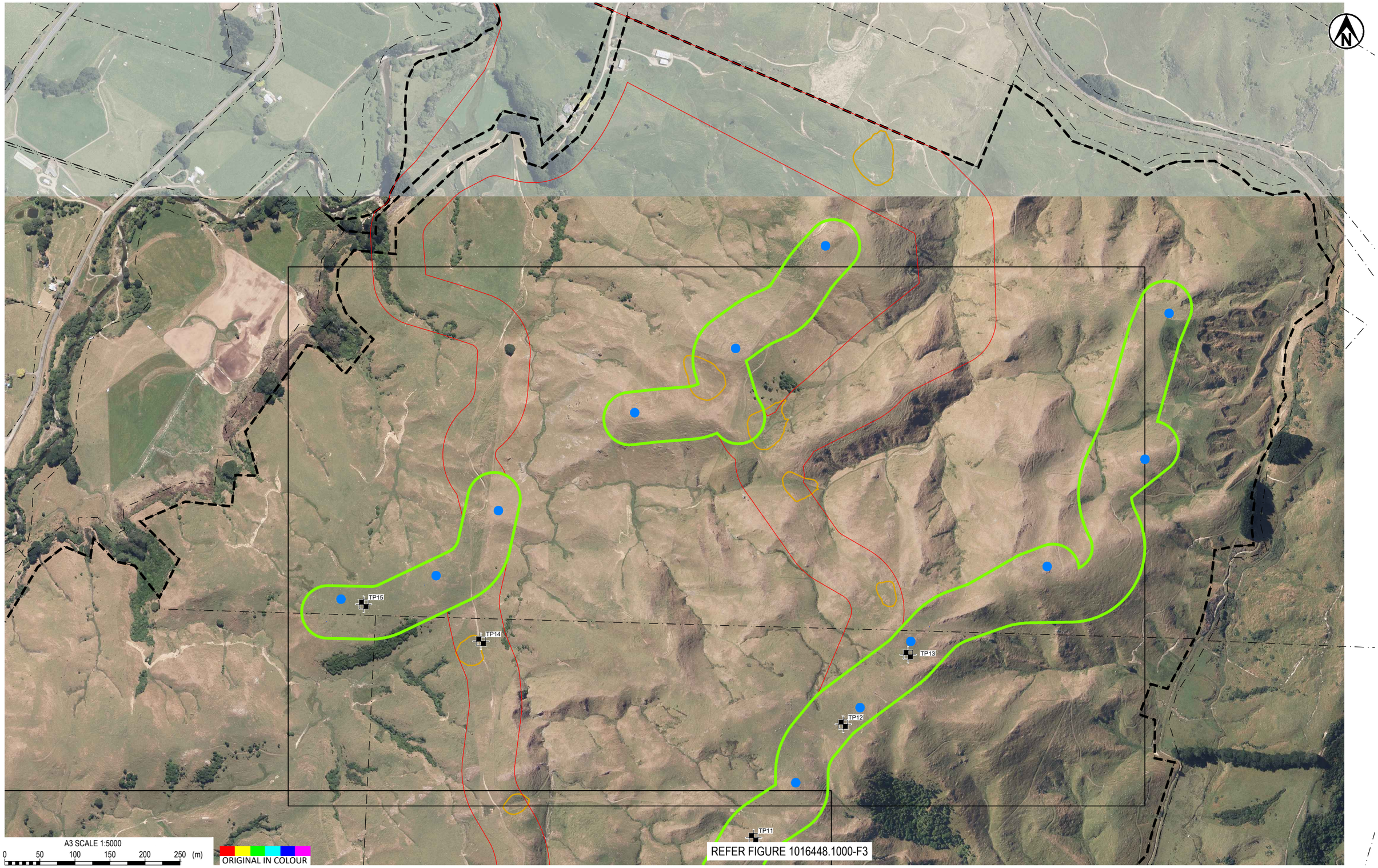
CLIENT **MERIDIAN ENERGY**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE SITE INVESTIGATION LOCATION SITE PLAN
SHEET 2

SCALE (A3) 1:5000 FIG No. 1016884.1000-F3 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-F1_F5.dwg 2023-May-11 4:49:20 pm Plotted By: MAURICE MILLS



NOTES:

1. AERIAL AND PROPERTY BOUNDARIES SOURCED FROM LINZ DATA SERVICE [https://data.linz.govt.nz] AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.
2. REFER DRAWING 1016884.1000-F1 FOR LEGEND.

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1016884.1000	
DESIGNED	DAHE	May.23
DRAWN	DFL	May.23
CHECKED	NPC	May 23
APPROVED		DATE

CLIENT **MERIDIAN ENERGY**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE SITE INVESTIGATION LOCATION SITE PLAN
SHEET 3

SCALE (A3) 1:1000 FIG No. 1016884.1000-F4 REV 2

Appendix B: Test pit logs

EXCAVATION LOG

Excavation Id.: **TP01**

Hole Location: On top of ridgeline, approximately 140 m southwest of topdressing shed on top of ridge.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490378.48 mN 1827318.44 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	466.50m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	2.8m by 2.1m	CHECKED BY:	NCP

EXCAVATION TESTS					ENGINEERING DESCRIPTION					GEOLOGICAL	
PENETRATION -1 -2 -3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa) 10 25 50 100 200	DEFECTS, STRUCTURE, COMMENTS	UNIT
							TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS			Topsoil
	None	DRY 14/12/2021			466	0.5		*0.30m:* Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spacing close to very close (approx. 20mm to 200mm).	MW-HW				Greywacke
						1.0							
					465	1.5		1.4m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Hole dry, no observable flow of water.

Hole Depth 1.4m

Scale 1:17

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP02**

Hole Location: Approximately 145 m west of topdressing shed on top of ridge. Approximately 30 m downslope (northwest) of TP01.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490407.84 mN 1827303.27 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	459.90m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	3m by 2m	CHECKED BY:	NCP

EXCAVATION TESTS					ENGINEERING DESCRIPTION					GEOLOGICAL	
PENETRATION (-1 -2 -3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	DEFECTS, STRUCTURE, COMMENTS	UNIT
	None	14/12/2021 ▼	Bulk bag @ 0.30m		459	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, moist, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, moderately strong, greywacke; sand, fine to coarse; organics, rootlets.	M	VS		Topsoil
						1.0		*0.30m:* SILT, minor clay and minor sand and minor gravel; orange brown with reddish brown mottles. Soft, wet, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke.	W	S		Colluvium
								1.10 - 1.20m: Saturated.	S			
						1.5		*1.20m:* Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spacing close to very close (approx. 20mm to 200mm).	MW-HW			Greywacke
					458			1.5m: Criteria achieved				

ESTIMATED SHEAR STRENGTH (kPa): 10, 25, 50, 100, 200

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Rapid inflow of water below the groundwater level. 4) Water stood at groundwater level. 5) Sample is a general bulk sample from across the colluvium layer.

Hole Depth 1.5m

Scale 1:17

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP03**

Hole Location: Approximately 155 m west of topdressing shed on top of ridge. Approximately 15 m downslope (northwest) of TP02.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490414.96 mN 1827288.27 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	458.40m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	2.2m by 1.2m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	None	14/12/2021	Small bag @ 0.30m		458	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS			Topsoil
								0.30m: SILT, minor clay and minor sand and minor gravel; orange brown with reddish brown mottles. Soft, wet, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke.		S			Colluvium
					457	1.0		*1.10m:* Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spacing close to very close (approx. 20mm to 200mm).	MW-HW				Greywacke
						1.5		1.5m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Inflow of water estimated to be at approximately 1.2 m, however much of the water filling the hole seemed to be due to overland flow. 4) Sample is a general disturbed sample from across the colluvium layer.

Hole Depth 1.5m

Scale 1:17

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP04**

Hole Location: Approximately 590 m southwest of topdressing shed on hilltop. Located off the fenceline on the north side of the ridge.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490081.14 mN 1826976.14 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	466.50m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	2.5m by 1.2m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION (-1 -2 -3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa) (10 25 50 100 200)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	None	14/12/2021 ▼	2 small bags @ 0.30m		466	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS			Topsoil
								0.30m: SILT, some gravel, minor clay and minor sand, trace rootlets; orange brown. Soft, wet, non-plastic to low plasticity. Gravel, fine to coarse, angular, moderately weathered; sand, fine to coarse.		S			Colluvium
						1.0		*1.10 - 1.20m:* Saturated.	S				
								1.20m: Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spacing close to very close (approx. 20mm to 200mm).	MW-HW				Greywacke
					465	1.5		1.5m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), coursed from LINZ. 3) Inflow of water below 1.1 m. 4) Samples are general disturbed samples from across the colluvium layer.

Hole Depth 1.5m

Scale 1:17

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP05**

Hole Location: Approximately 290 m west of topdressing shed on hilltop. Located off the fenceline on the north side of the ridge.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490285.38 mN 1827201.42 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	468.80m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	2.3m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	None	14/12/2021	Bulk bag @ 0.30m		468	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS			Topsoil
						1.0		*0.30m:* Moderately to highly weathered, SANDSTONE. Weak to moderately strong. Defects are orthogonal, spacing close to very close (approx. 20mm to 200mm).	MW-HW				Greywacke
					467	1.5		1.5m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater below 1 m. 4) Sample is a general bulk sample from across the upper layer of the rock head.

Hole Depth 1.5m

Scale 1:17

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP06**

Hole Location: In paddock immediately east of topdressing shed on hilltop. Approximately 95 m east of topdressing shed.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490489.82 mN 1827529.04 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	462.90m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	4m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	None	14/02/2021	Bulk bag @ 0.80m		462 461 460 459	0.5 1.0 1.5 2.0 2.5 3.0 3.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets. *0.20m:* SILT, minor sand and minor gravel, trace clay; orange brown. Soft, wet, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke. *0.80m:* Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced very close to moderately widely (approx. 50mm to 250mm). 2.8m: Criteria achieved	W MW-HW	VS S	10 25 50 100 200		Topsoil Colluvium Bedrock

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater below 2.3 m. 4) Sample is a general bulk sample from across the upper layer of the rock head.

Hole Depth 2.8m

Scale 1:33

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP07**

Hole Location: Approximately 375 m northeast of topdressing shed on hilltop. Approximately 30 m west of TP08

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm	LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000
CO-ORDINATES: (NZTM2000) 5490674.32 mN 1827745.29 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 14/12/2021	
	EQUIPMENT: 13-Tonne Excavator	EXCAV. FINISHED: 14/12/2021	
R.L.: 457.10m	OPERATOR: Goodmans	LOGGED BY: DAHE	
DATUM: NZVD2016	DIMENSIONS: 4m by 1m	CHECKED BY: NCP	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None	14/12/2021 ▼	2 small bags @ 0.20m		457	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS			Topsoil
								0.20m: SILT, some sand, trace clay and trace gravel; greyish orange brown. Soft, wet, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke.		S			Colluvium
			Bulk bag @ 1.50m		456	1.5		*1.50m:* Moderately weathered, grey with brown staining, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, very closely to closely spaced (approx. 20mm to 200mm).	MW-HW				Greywacke
					455	2.0 2.5 3.0		3m: Criteria achieved					
					454	3.5							

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Rapid inflow of water on all sides of pit below 0.4 m. 4) Samples are two disturbed samples from across the colluvial layer and a general bulk sample from across the upper layer of the rock head.

Hole Depth 3m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP08**

Hole Location: Approximately 410 m northeast of topdressing shed on hilltop. Approximately 30 m east of TP07.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm	LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000
CO-ORDINATES: (NZTM2000) 5490686.43 mN 1827773.29 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 14/12/2021	
	EQUIPMENT: 13-Tonne Excavator	EXCAV. FINISHED: 14/12/2021	
R.L.: 458.80m	OPERATOR: Goodmans	LOGGED BY: DAHE	
DATUM: NZVD2016	DIMENSIONS: 4m by 1m	CHECKED BY: NCP	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None	14/12/2021			458	0.5	TS	*0.00m:* SILT, some organics and some gravel, minor sand; dark brown. Very soft, wet, non-plastic to low plasticity. Gravel, fine to medium, angular, moderately weathered, greywacke; sand, fine to coarse; organics, rootlets.	W	VS	10 25 50 100 200		Topsoil
								0.40m: Moderately weathered, grey with brown staining, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced very close to moderately widely (approx. 50mm to 250mm).	MW-HW				Greywacke
					457	1.0							
						1.5							
						2.0							
					456	2.5		2.4m: Criteria achieved					
						3.0							
						3.5							
					455								

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Inflow of groundwater below 0.7 m.

Hole Depth 2.4m

Scale 1:33

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP09**

Hole Location: On ridge out to NE section of farm. Approx. 565 m NE of topdressing shed on hilltop. Approx. 585 m SW of metmast.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa	JOB No.: 1016884.1000
CO-ORDINATES: (NZTM2000)	5490748.14 mN 1827919.66 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 14/12/2021
		EQUIPMENT: 13-Tonne Excavator	EXCAV. FINISHED: 14/12/2021
R.L.:	473.30m	OPERATOR: Goodmans	LOGGED BY: DAHE
DATUM:	NZVD2016	DIMENSIONS: 4m by 1m	CHECKED BY: NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	None	DRY 14/12/2021	Bulk bag @ 0.20m		473 472 471	0.5 1.0 1.5 2.0	TS TS	*0.00m:* SILT, some organics and some sand and some gravel; dark brown. Very soft, wet, non-plastic. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke; organics, rootlets. *0.20m:* Red. Very soft, wet. Colour may be due to a completely decomposed tree; a long mound crosses the test pit at the point where the red soil is located. *0.40m:* Moderately weathered, grey, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced very close to moderately widely (approx. 50mm to 250mm).	W MW-HW	VS			Topsoil Bedrock
					470	2.5 3.0 3.5		2.4m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Hole located on a high point, no groundwater inflow identified.

Hole Depth 2.4m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP10**

Hole Location: In gully approx. 40 m northeast of TP09. Approx. 610 m NE of topdressing shed on hilltop. Approx. 550 m SW of metmast.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490766.48 mN 1827949.46 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	14/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	14/12/2021
R.L.:	465.90m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	5m by 1.5m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None	14/12/2021 ▼	Bulk bag @ 0.20m		465 464 463 462 461	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	TS	*0.00m:* SILT, some organics and some sand and some gravel; dark brown. Very soft, saturated, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to medium, angular, moderately weathered, greywacke; organics, rootlets. *0.20m:* Clayey SILT, some sand, minor gravel; greyish brown. Very soft to soft, saturated, low to medium plasticity. Sand, fine to coarse; gravel, fine to medium, angular, moderately weathered, greywacke. *3.40m:* Moderately weathered, grey, SANDSTONE. Weak to moderately strong. Defects are orthogonal, spaced closely to moderately widely (approx. 100mm to 250mm). Excavator refusing on rock head. 3.5m: Target depth. Side collapse.	S MW	VS VS-S			Topsoil Colluvium Greywacke

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Rapid inflow of water on all sides of hole. 4) Water pooling at ground-level in the vicinity of the hole, with overland flow identified. 5) Significant collapse of pit walls. 6) Sample is a general bulk sample from across the colluvial layer.

Hole Depth 3.5m

Scale 1:42

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP11**

Hole Location: On ridge in northeast of farm. Approx. 900 m NE of topdressing shed on hilltop. Approximately 280 m SSW of metmast.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490937.47 mN 1828198.09 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	15/12/2021
R.L.:	483.20m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	4.2m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None	15/12/2021 ▼	Bulk bag @ 0.20m		483	0.5	TS	*0.00m:* Organic SILT, trace sand and trace gravel; dark brown. Soft, wet, low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke; organics, rootlets (fresh).	W	S			Topsoil
								0.20m: SILT, minor sand, trace gravel; orange brown. Soft to firm, moist to wet, non-plastic to low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke.	M-W	S-F			Colluvium
					482	1.0							
						1.5		*1.60 - 1.80m:* Saturated.	S				
			Bulk bag @ 1.80m										
					481	2.0		*1.80m:* Moderately weathered, grey and dark brownish orange, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced extremely closely to closely (approx. 10mm to 200mm).	MW				Greywacke
						2.5							
						3.0		3m: Criteria achieved					
					480	3.5							

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Rapid inflow of groundwater below 1.6 m. 4) Samples are general bulk samples, one from across the colluvial layer and the other from across the upper layer of the rock head.

Hole Depth 3m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP12**

Hole Location: On relatively flat ground approximately 120 m east of metmast.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5491196.41 mN 1828402.56 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	15/12/2021
R.L.:	492.60m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	4.5m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	None	15/12/2021			492 491 490 489	0.5 1.0 1.5 2.0 2.5 3.0 3.5	TS	*0.00m:* Organic SILT, trace sand and trace gravel; dark brown. Soft, wet, low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke; organics, rootlets (fresh). *0.20m:* Clayey SILT, minor sand and minor gravel; brownish orange. Soft, wet, medium plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke. *1.20m:* Moderately to highly weathered, grey and dark brownish orange, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced extremely closely to closely (approx. 10mm to 200mm). 3.6m: Criteria achieved	W MW-HW	S	10 25 50 100 200		Topsoil Colluvium Greywacke

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater below 1.6 m.

Hole Depth 3.6m

Scale 1:33

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP13**

Hole Location: Approximately 310 m northeast of metmast. West of razorback.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5491355.08 mN 1828550.66 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	15/12/2021
R.L.:	491.10m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	5m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					491	0	TS	*0.00m:* Organic SILT, trace sand and trace gravel; dark brown. Soft, wet, low plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately weathered, greywacke; organics, rootlets (fresh).	W	S	10 25 50 100 200		Topsoil
	None	15/12/2021 ▼				0.5		*0.40m:* Moderately to highly weathered, brownish orange and dark brown, SANDSTONE. Weak to moderately strong, fine to medium grained. Defects are orthogonal, spaced extremely closely to closely (approx. 10mm to 200mm). Rock strength is predominantly weak.	MW-HW				Greywacke
					490	1.0							
						1.5							
					489	2.0							
						2.5							
					488	3.0							
						3.5		3.6m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater through rock defects below 0.4 m.

Hole Depth 3.6m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP14**

Hole Location: On saddle in track to northern section of farm. Approximately 935 m north-northeast of topdressing shed on hilltop.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5491385.78 mN 1827575.87 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	15/12/2021
R.L.:	375.60m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NZVD2016	DIMENSIONS:	5m by 1m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	None	15/12/2021 ▼			375	0.5	TS	*0.00m:* Organic SILT, trace sand; dark brown. Soft, moist, non-plastic. Sand, fine; organics, rootlets (fresh).	M	S	10 25 50 100 200		Topsoil
								0.20m: Fine to medium SAND, some silt and some gravel and some cobbles; brown. Tightly packed, moist. Gravel, fine to coarse, angular, completely weathered, extremely weak, greywacke; cobbles, angular, completely weathered, extremely weak, greywacke. Cobbles and gravel readily break down to fine to medium sand.		MD			Colluvium
					374	1.0 1.5		*1.20 - 2.40m:* Wet.	W				
					373	2.0 2.5		*2.40m:* Completely weathered, grey, laminated, SANDSTONE. Extremely weak, fine to medium grained. Bedding. Recovered as: Fine to medium SAND, some silt; grey. Moist to wet. Difficult to dig - excavator teeth sliding on surface. Inferred to be dense.	CW				Greywacke
					372	3.0 3.5		3.4m: Criteria achieved					

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater below 1.2 m.

Hole Depth 3.4m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP15**

Hole Location: North face of farm at far end of farm track. Approx. 1 km north of topdressing shed on hilltop. Approx. 285 m NW of TP14.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm	LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000
CO-ORDINATES: (NZTM2000) 5491470.04 mN 1827308.12 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 15/12/2021	
	EQUIPMENT: 13-Tonne Excavator	EXCAV. FINISHED: 15/12/2021	
R.L.: 381.80m	OPERATOR: Goodmans	LOGGED BY: DAHE	
DATUM: NZVD2016	DIMENSIONS: 5m by 1m	CHECKED BY: NCP	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None	15/12/2021	Bulk bag @ 0.30m		381 380 379 378	0.5 1.0 1.5 2.0 2.5 3.0 3.5		*0.00m:* Organic SILT, trace sand; dark brown. Soft, moist, non-plastic. Sand, fine; organics, rootlets (fresh). *0.30m:* Silty fine to medium SAND, some gravel; orange brown. Loosely packed, moist, poorly graded. Gravel, fine to coarse, angular, completely weathered, extremely weak. Gravel breaks down to same material as sand in major fraction. *2.70m:* Moderately to highly weathered, orange brown, SANDSTONE. Weak to moderately strong. Defects in rock are orthogonal, very closely to closely spaced (approximately 50mm to 200mm spacing). 3.8m: Criteria achieved	M MW-HW	S L	10 25 50 100 200		Topsoil Colluvium Greywacke

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from LiDAR 1m DEM of Wellington (2013-2014), sourced from LINZ. 3) Slow inflow of groundwater below 3.7 m. 4) Sample is a general bulk sample from across the residual soil layer.

Hole Depth 3.8m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP16**

Hole Location: Mt Munro - 180 m southeast of SH2, on river terrace, near transmission line alignment.

SHEET: 1 OF 1

PROJECT: Mt Munro Windfarm		LOCATION: Mt Munro, Wairarapa		JOB No.: 1016884.1000	
CO-ORDINATES: (NZTM2000)	5490269.56 mN 1824326.59 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/12/2021
		EQUIPMENT:	13-Tonne Excavator	EXCAV. FINISHED:	15/12/2021
R.L.:	282.00m	OPERATOR:	Goodmans	LOGGED BY:	DAHE
DATUM:	NA	DIMENSIONS:	5m by 2m	CHECKED BY:	NCP

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None	15/12/2021 ▼			281 280 279	0.5 1.0 1.5 2.0 2.5 3.0 3.5		*0.00m:* Organic SILT; dark brown. Very soft, wet. Organics, root fibres less than 2mm diameter. *0.20m:* Sandy SILT, some gravel, minor wood and minor cobbles, trace boulders; dark brown. Soft, moist, non-plastic to low plasticity. Organics, branches (partially decomposed). Gravel, cobbles, and boulders are all rounded, slightly weathered, very strong greywacke sandstone. Cobbles are up to 200mm and boulders are up to 300mm diameter. Branches are up to 1m long and 150 mm in diameter. *3.00 - 3.50m:* Saturated. 3.5m: Collapse	W M S	VS S			Topsoil Alluvial deposits

SKETCH / PHOTO:

COMMENTS: 1) Coordinates are determined from hand-held GPS. 2) Elevation determined from estimation of contours. 3) Rapid inflow of groundwater below 3.0 m. 4) Groundwater stood at the groundwater level of 3.0 m. 5) Significant collapse of pit walls.

Hole Depth 3.5m

Scale 1:33

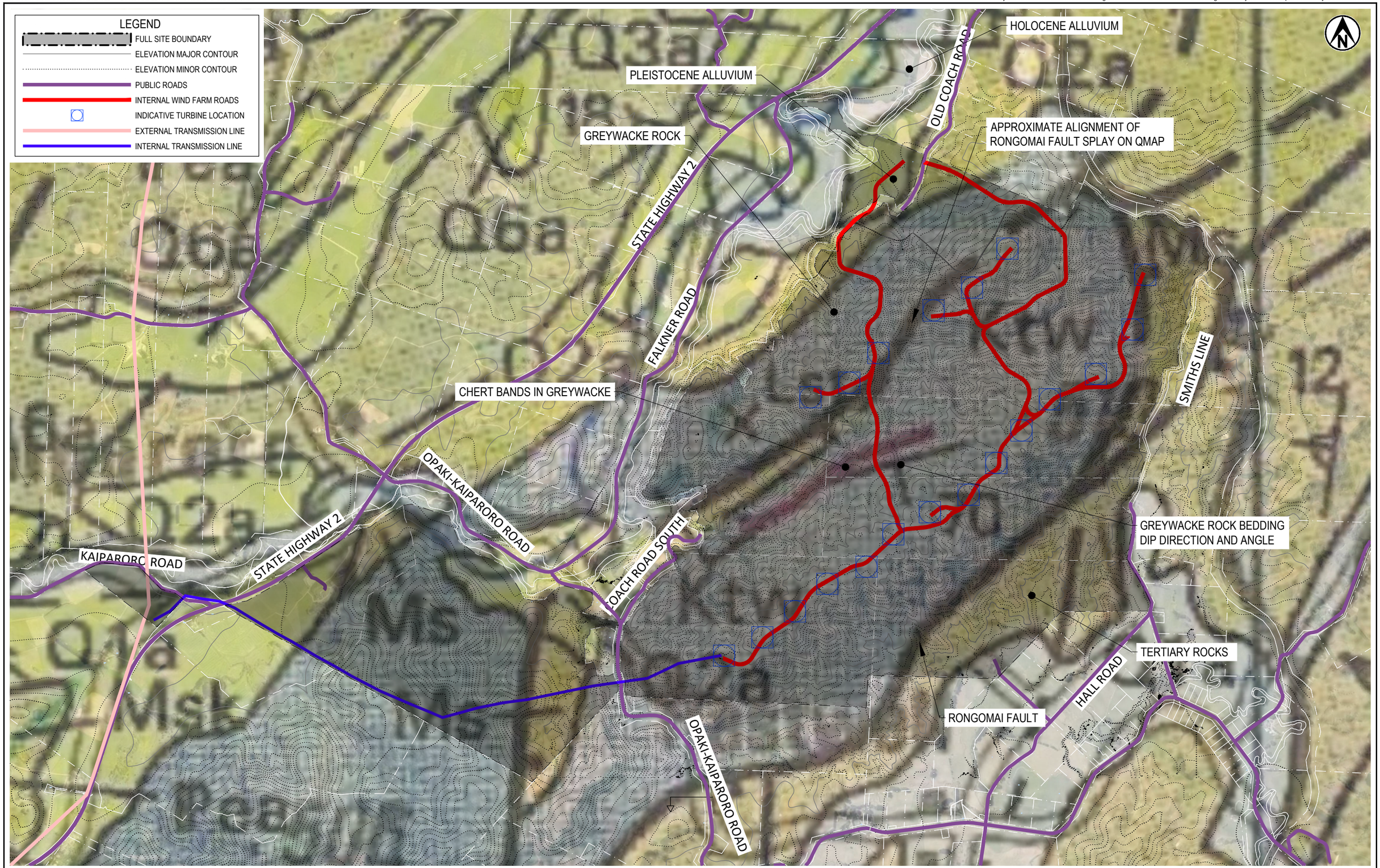
Rev.: A

www.tonkintaylor.co.nz

Appendix B Figures

- Annotated geological plan
- Simplified geological observations plan

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-G1.dwg 2023-May-10 12:14:16 pm Plotted By: MAURICE MILLS



Tonkin+Taylor
www.tonkintaylor.co.nz
Exceptional thinking together

Meridian.

NOTES:
1. BIBLIOGRAPHIC REFERENCE: LEE,J.M. BEGG, J.G. (COMPILERS) 2002. GEOLOGY OF WAIRARAPA AREA. INSTITUTE OF GEOLOGICAL AND NUCLEAR SCIENCES 1: 250 000 GEOLOGICAL MAP 11. 1 SHEET + 66P. LOWER HUTT, NEW ZEALAND: INSTITUTE OF GEOLOGICAL AND NUCLEAR SCIENCES LIMITED.

PROJECT No.	1016884.1000	
DESIGNED	NCP	Oct.22
DRAWN	JOAB	Oct.22
CHECKED		

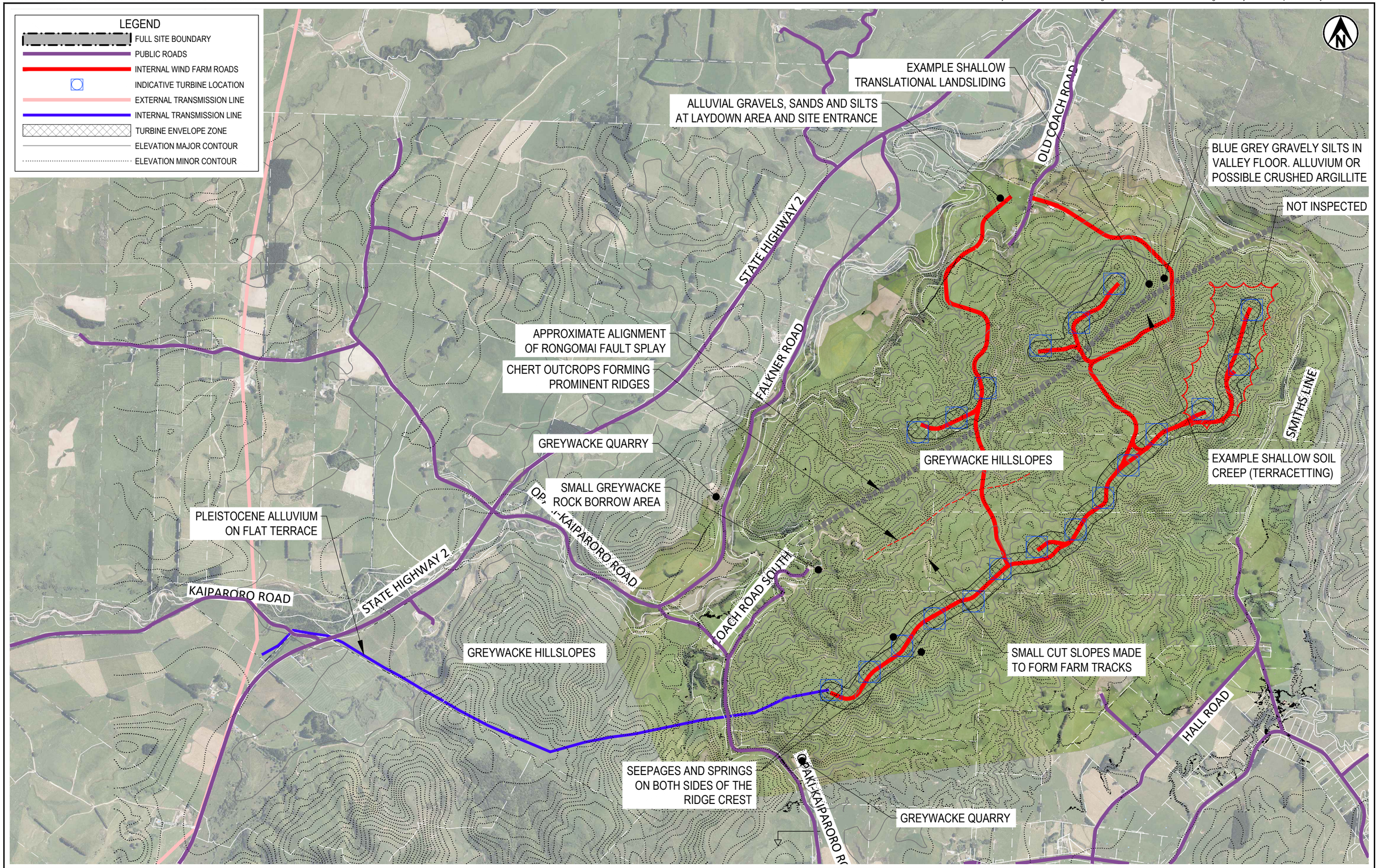
RESOURCE CONSENT ISSUE

APPROVED DATE

CLIENT **MERIDIAN ENERGY**
PROJECT **MOUNT MUNRO WIND FARM**
TITLE ANNOTATED GEOLOGICAL PLAN

SCALE (A3) 1:20000 FIG No. 1016884.1000-G1 REV 1

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\FIG\1016884.1000-G2.dwg 2023-May-10 12:25:09 pm Plotted By: MAURICE MILLS



Tonkin+Taylor
www.tonkintaylor.co.nz
Exceptional thinking together

Meridian.

NOTES:
1. SIMPLIFIED PLAN INDICATING GEOLOGICAL FEATURES OBSERVED ONSITE THAT ARE REFERRED TO IN THE GEOLOGICAL REPORT.

PROJECT No.	1016884.1000	
DESIGNED	NCP	Oct.22
DRAWN	JOAB	Oct.22
CHECKED		
RESOURCE CONSENT ISSUE		
APPROVED	DATE	

CLIENT **MERIDIAN ENERGY**
PROJECT **MOUNT MUNRO WIND FARM**
TITLE SIMPLIFIED GEOLOGICAL OBSERVATIONS PLAN
SCALE (A3) 1:20000 FIG No. 1016884.1000-G2 REV 1

www.tonkintaylor.co.nz

Appendix B Drawings

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-000.dwg 2023-May-10 11:27:05 am Plotted By: HEIDI WHALLEY

MERIDIAN ENERGY LIMITED
MOUNT MUNRO WIND FARM

Resource Consent Issue

DRAWING	Rev	Title
GENERAL		
● 1016884.1000-000	2	DRAWING LIST, LOCATION MAP & GENERAL NOTES
● 1016884.1000-001	2	SITE LOCATION PLAN
PLANS		
● 1016884.1000-002	2	PROPERTY PLAN
● 1016884.1000-003	2	SITE ENTRANCE LOCATION PLAN
● 1016884.1000-004	2	CORE SITE EXISTING CONTOUR PLAN
● 1016884.1000-005	2	CORE SITE HILL SLOPE PLAN
● 1016884.1000-006	2	INDICATIVE TURBINE LAYOUT PLAN
● 1016884.1000-007	2	TURBINE ENVELOPE AND EXCLUSION PLAN
● 1016884.1000-008	2	INDICATIVE INTERNAL ROADING PLAN
● 1016884.1000-009	2	LAYDOWN AREA LOCATION PLAN
● 1016884.1000-010	2	TERMINAL SUBSTATION LOCATION PLAN
● 1016884.1000-011	2	INTERNAL TRANSMISSION LINE, ROAD ACCESS PLAN
● 1016884.1000-012	2	INDICATIVE ROADING SECTION PLAN
● 1016884.1000-013	2	WATER CATCHMENT PLAN
● 1016884.1000-014	2	INDICATIVE STREAM/BRIDGE CROSSING PLAN AND SECTION

NOTES:

1. LOCATION TOPO MAP AND AERIAL IMAGE SOURCED FROM LINZ DATA SERVICE (https://data.linz.govt.nz/).
2. COORDINATE AND LEVEL DATUME ARE IN NEW ZEALAND TRANSVERSE MERCATOR 2000 (NZTM2000).

● Denotes drawing this issue: 05/05/2023

LOCATION MAP
NOT TO SCALE

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS: RESOURCE CONSENT
DRAWN	JOAB	SEP.22	
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

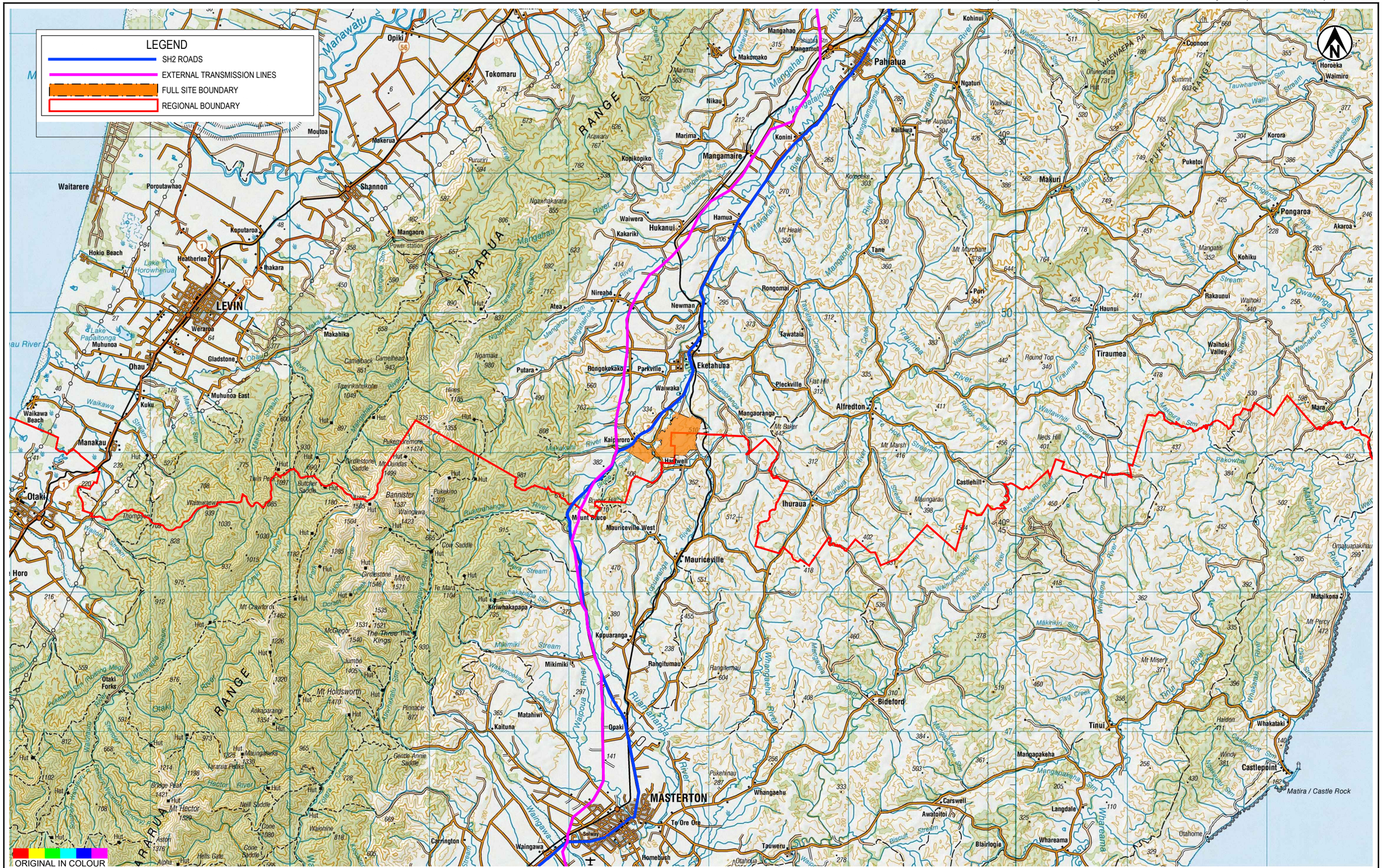
NOT FOR CONSTRUCTION — APPROVED — DATE

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **MERIDIAN ENERGY LIMITED**
PROJECT **MOUNT MUNRO WIND FARM**
TITLE DRAWING LIST, LOCATION MAP & GENERAL NOTES

SCALE (A3) N.T.S DWG No. 1016884.1000-000 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-001.dwg 2023-May-10 11:27:33 am Plotted By: HEIDI WHALLEY



					DESIGNED	MGM	MAR.23
					DRAWN	JOAB	SEP.22
					DESIGN CHECKED	NCP	May.23
					DRAWING CHECKED	EMSO	May.23
1	DRAFT CONSENT ISSUE						
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23	NOT FOR CONSTRUCTION		
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE	

DRAWING STATUS: RESOURCE CONSENT

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

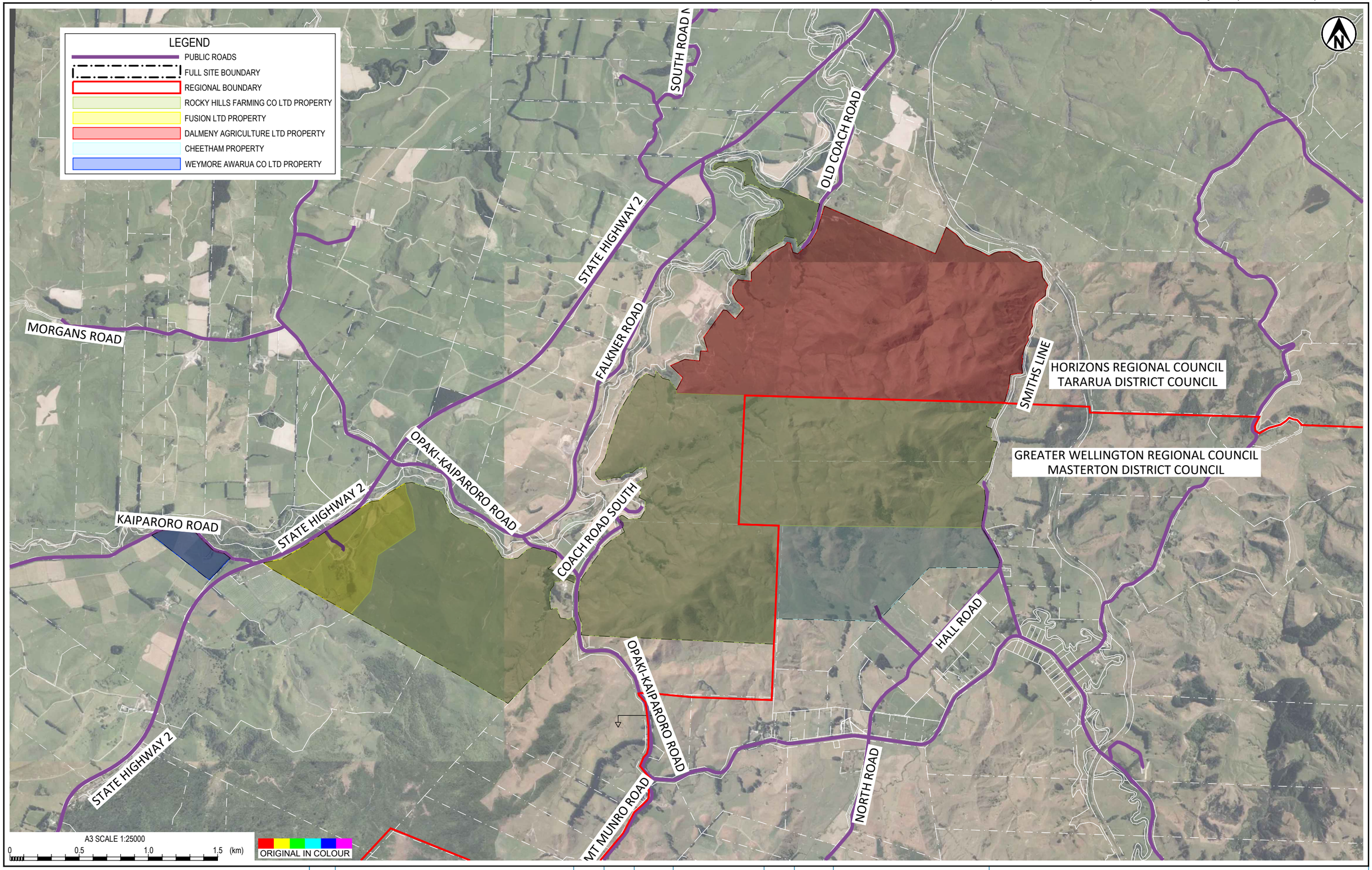
CLIENT: **MERIDIAN ENERGY LIMITED**

PROJECT: **MOUNT MUNRO WIND FARM**

TITLE: SITE LOCATION PLAN

SCALE (A3): 1:250000 DWG No. 1016884.1000-001 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-002.dwg 2023-May-10 11:27:51 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS
DRAWN	JOAB	SEP.22	RESOURCE CONSENT
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

APPROVED DATE

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

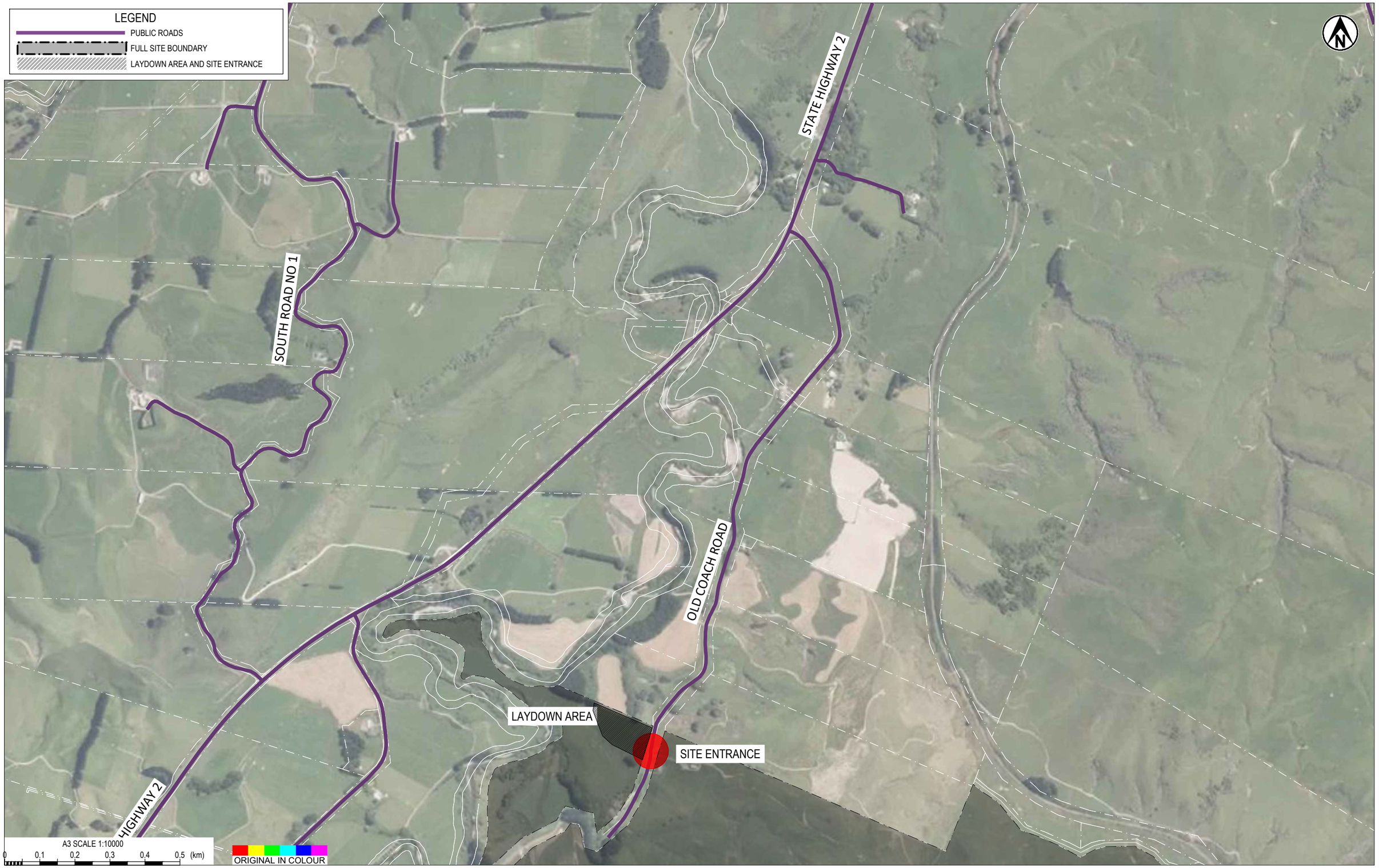
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE PROPERTY PLAN

SCALE (A3) 1:25000 DWG No. 1016884.1000-002 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-003.dwg 2023-May-10 11:28:05 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS
DRAWN	JOAB	SEP.22	RESOURCE CONSENT
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION — APPROVED — DATE

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

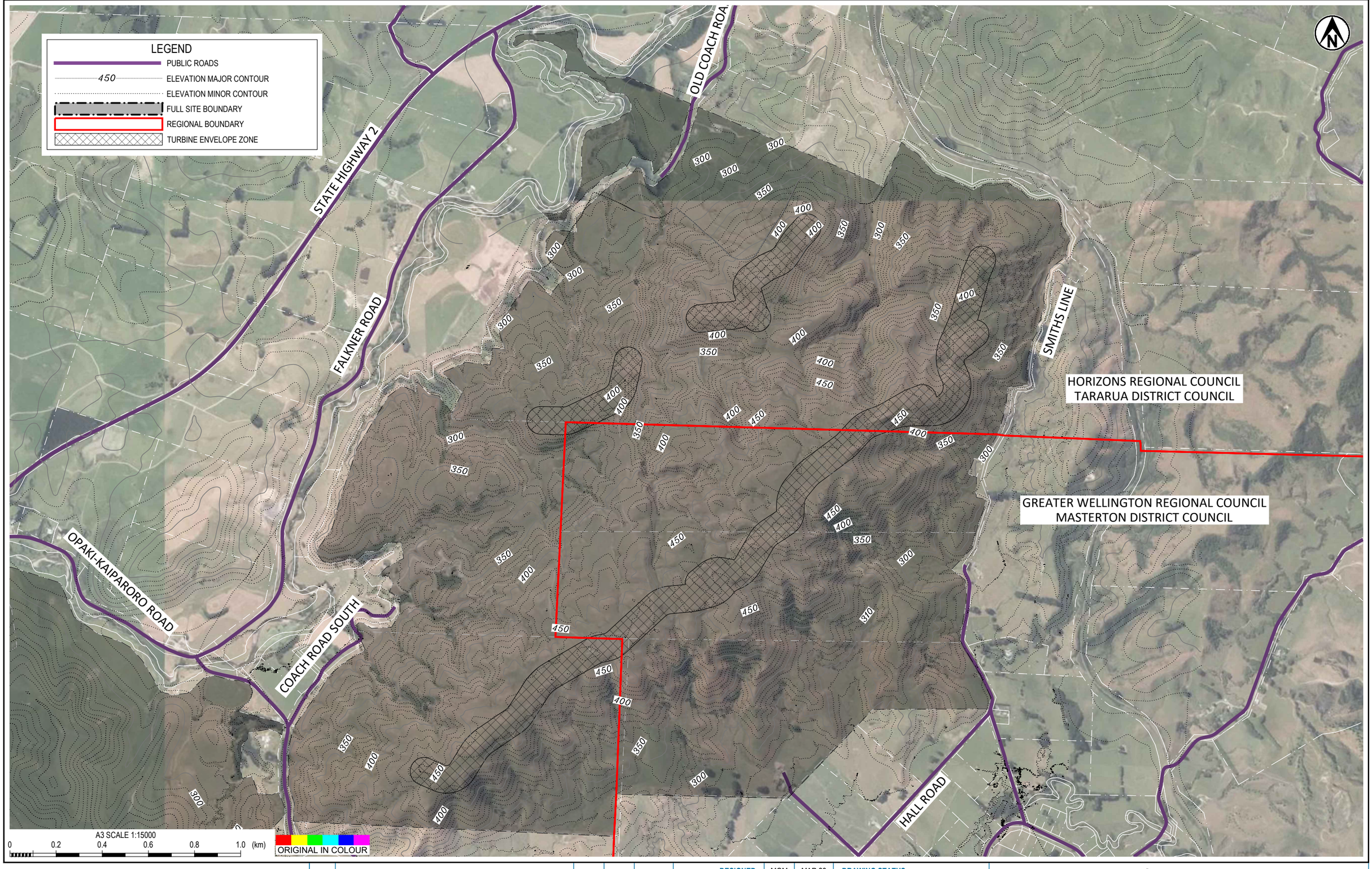
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE SITE ENTRANCE LOCATION PLAN

SCALE (A3) 1:10000 DWG No. 1016884.1000-003 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-004.dwg 2023-May-10 12:50:57 pm Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

DRAWING STATUS: RESOURCE CONSENT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

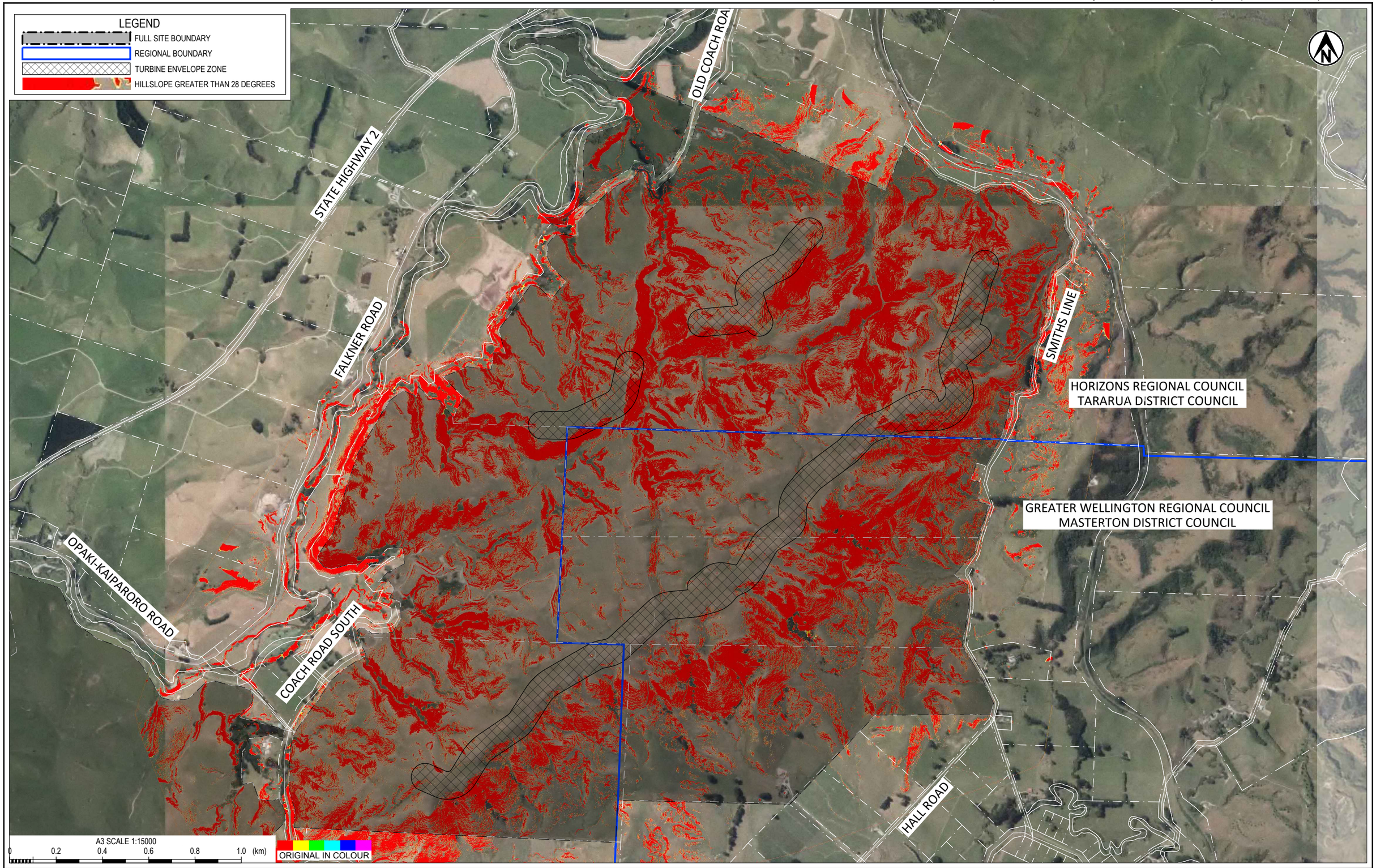
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE CORE SITE EXISTING CONTOUR PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-004 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-005.dwg 2023-May-10 11:29:16 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

DRAWING STATUS: RESOURCE CONSENT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

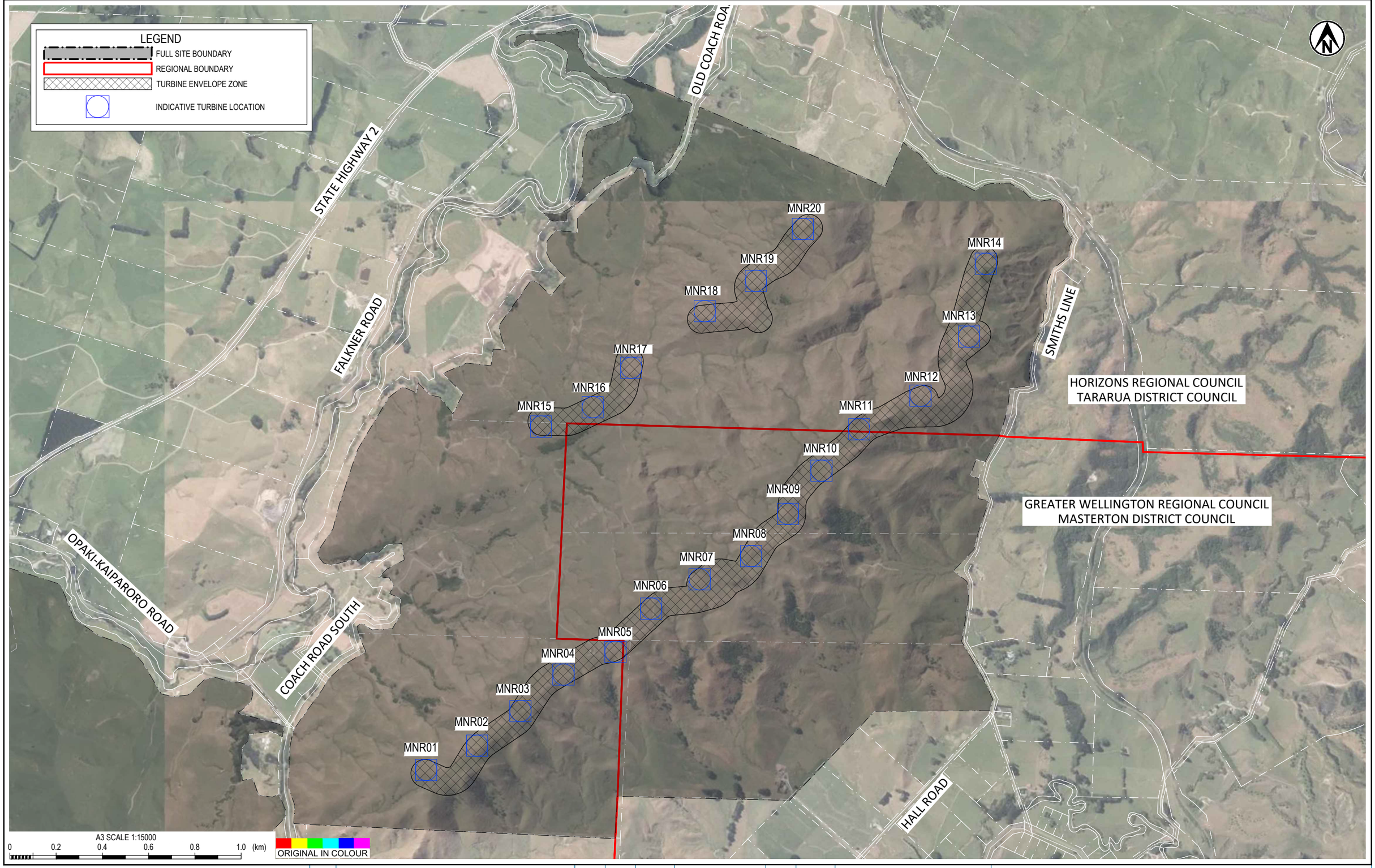
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE CORE SITE HILL SLOPE PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-005 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-006.dwg 2023-May-10 11:29:33 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS: RESOURCE CONSENT
DRAWN	JOAB	SEP.22	
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

APPROVED DATE

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

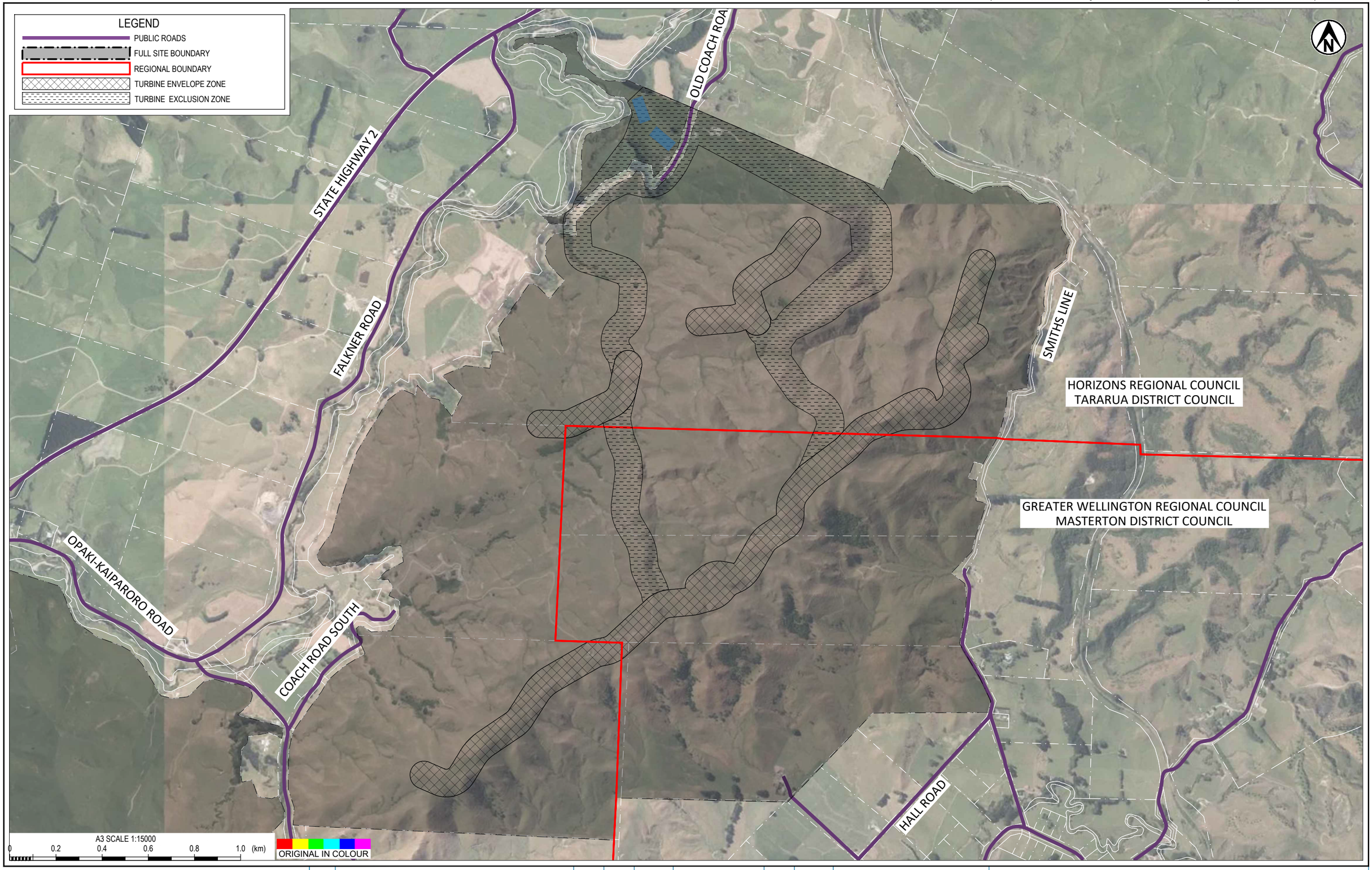
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE INDICATIVE TURBINE LAYOUT PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-006 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-007.dwg 2023-May-10 11:29:50 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

DRAWING STATUS: RESOURCE CONSENT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

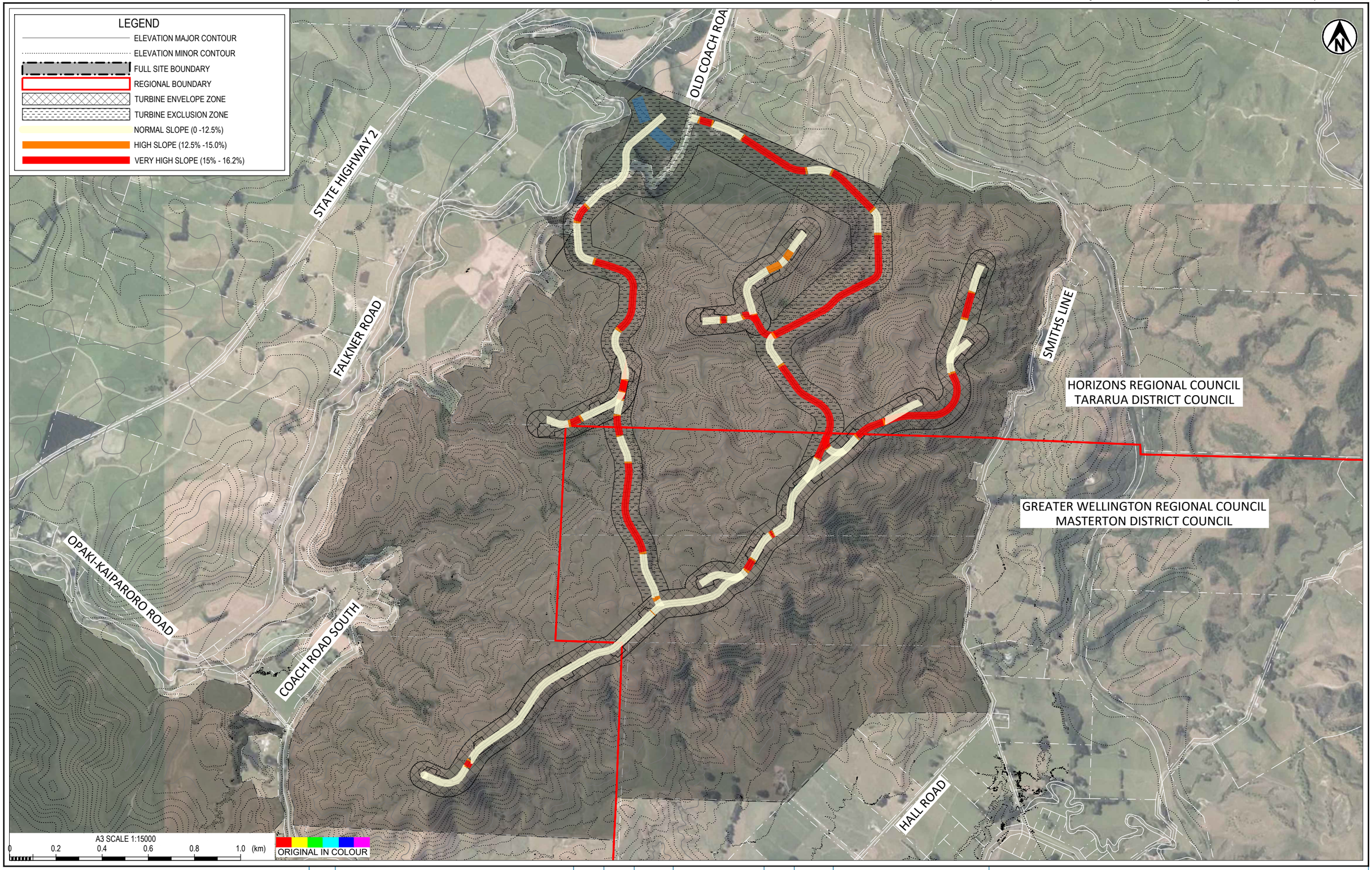
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE TURBINE ENVELOPE AND EXCLUSION PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-007 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-008.dwg 2023-May-10 11:30:12 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

DRAWING STATUS: RESOURCE CONSENT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

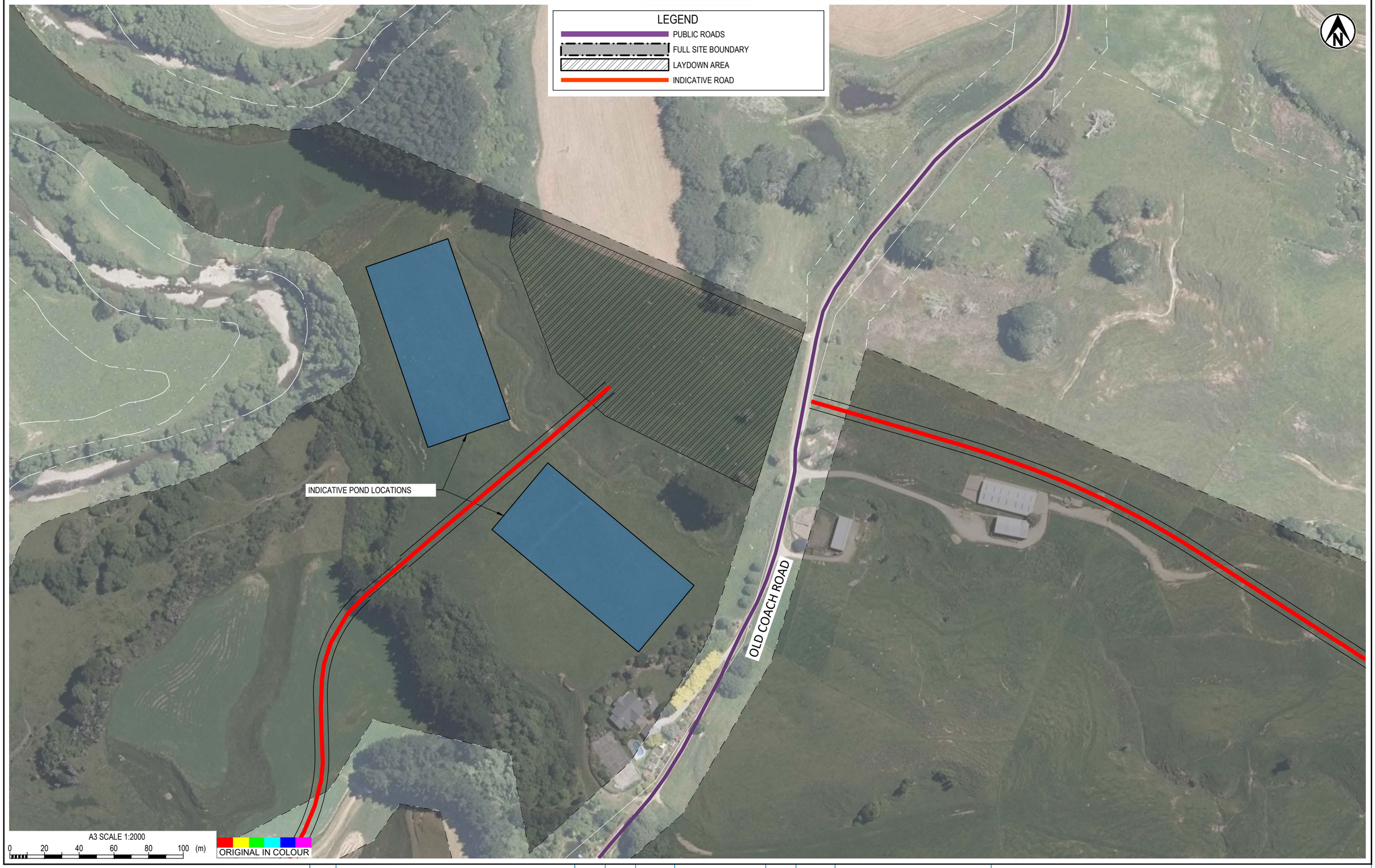
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE INDICATIVE INTERNAL ROADING PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-008 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-009.dwg 2023-May-10 11:30:32 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS: RESOURCE CONSENT
DRAWN	JOAB	SEP.22	
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

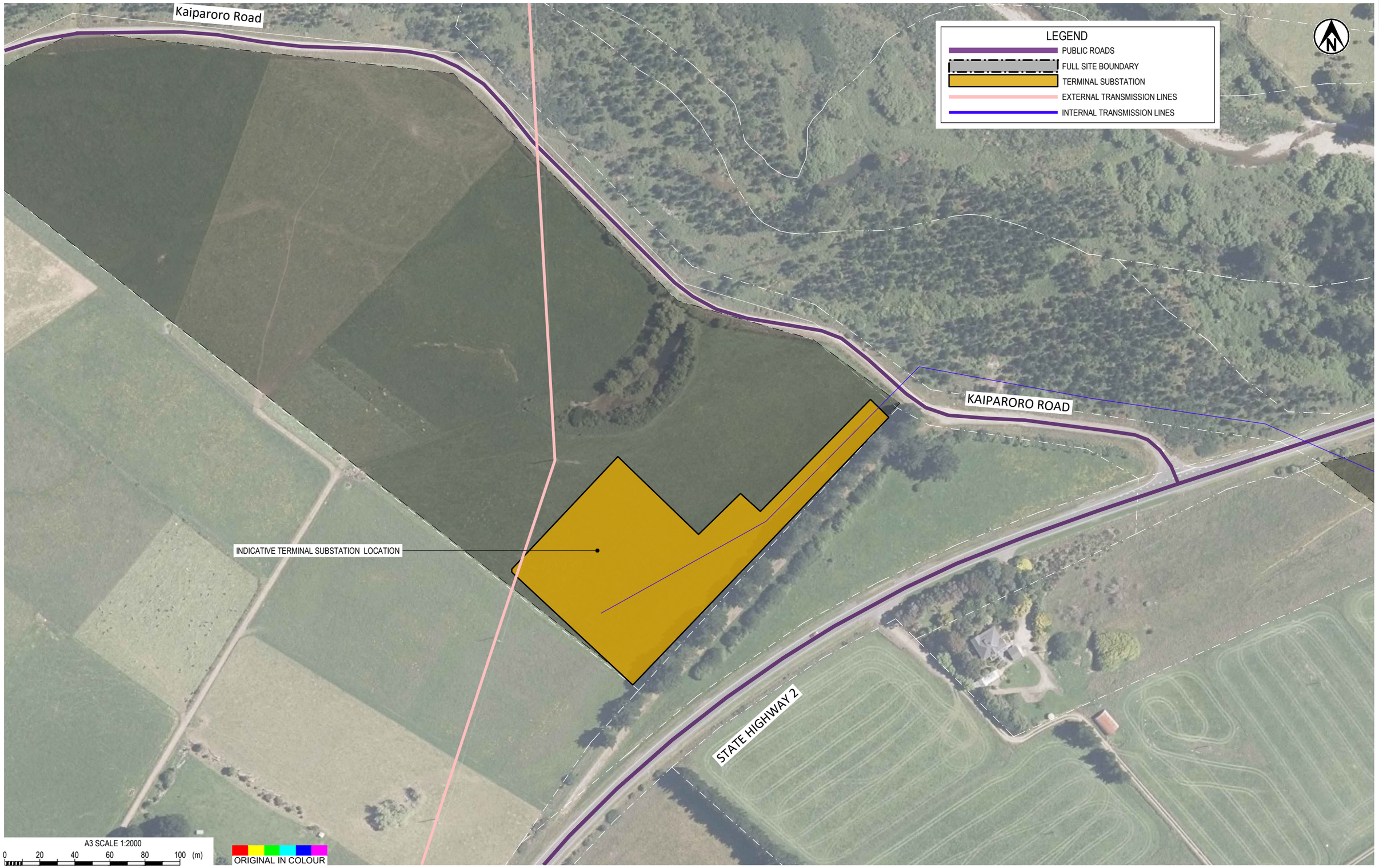
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE LAYDOWN AREA LOCATION PLAN

SCALE (A3) 1:2000 DWG No. 1016884.1000-009 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-010.dwg 2023-May-10 11:30:54 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

APPROVED DATE

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

DRAWING STATUS: RESOURCE CONSENT

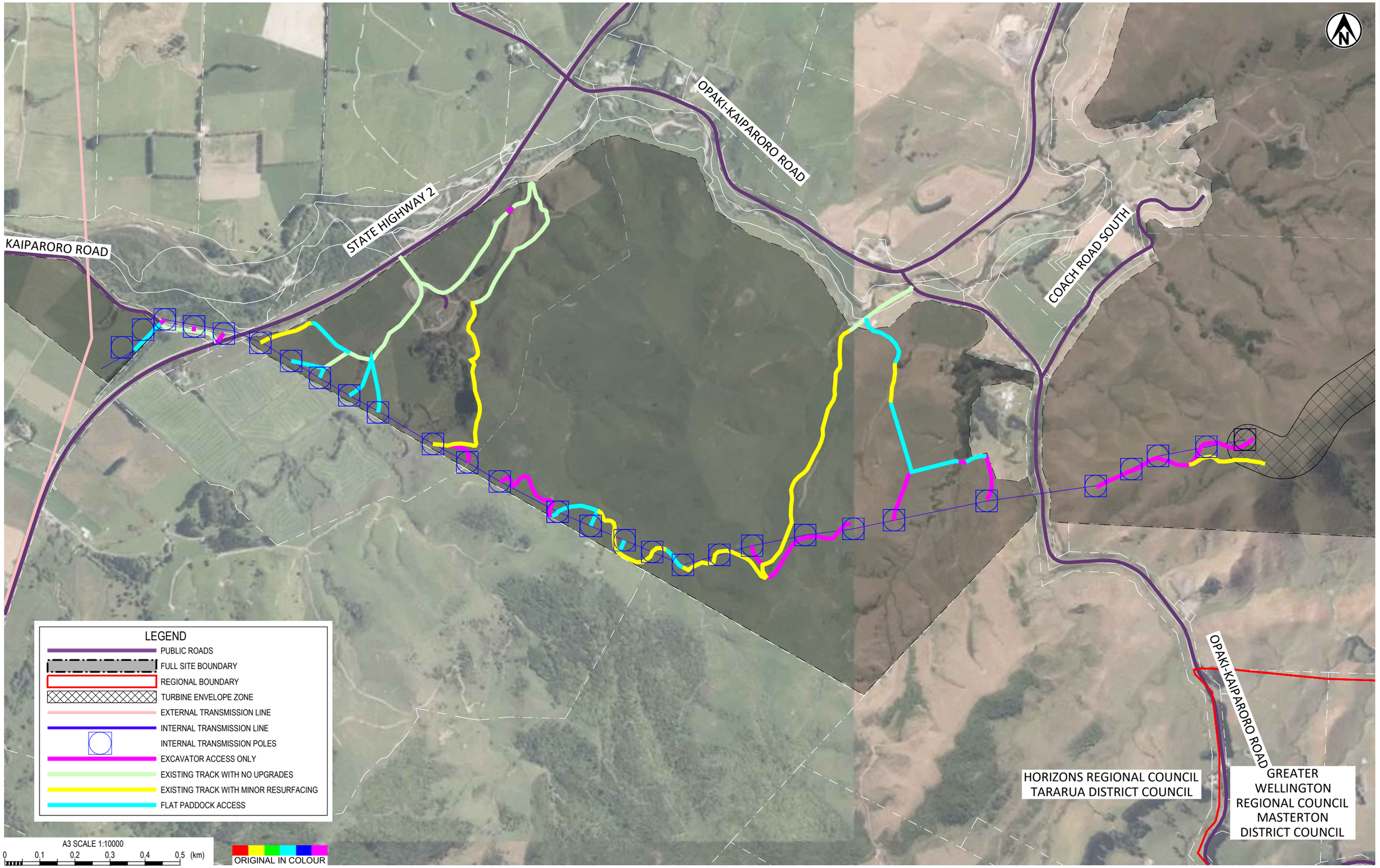
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE TERMINAL SUBSTATION LOCATION PLAN

SCALE (A3) 1:2000 DWG No. 1016884.1000-010 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-011.dwg 2023-May-10 11:31:18 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS
DRAWN	JOAB	SEP.22	RESOURCE CONSENT
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

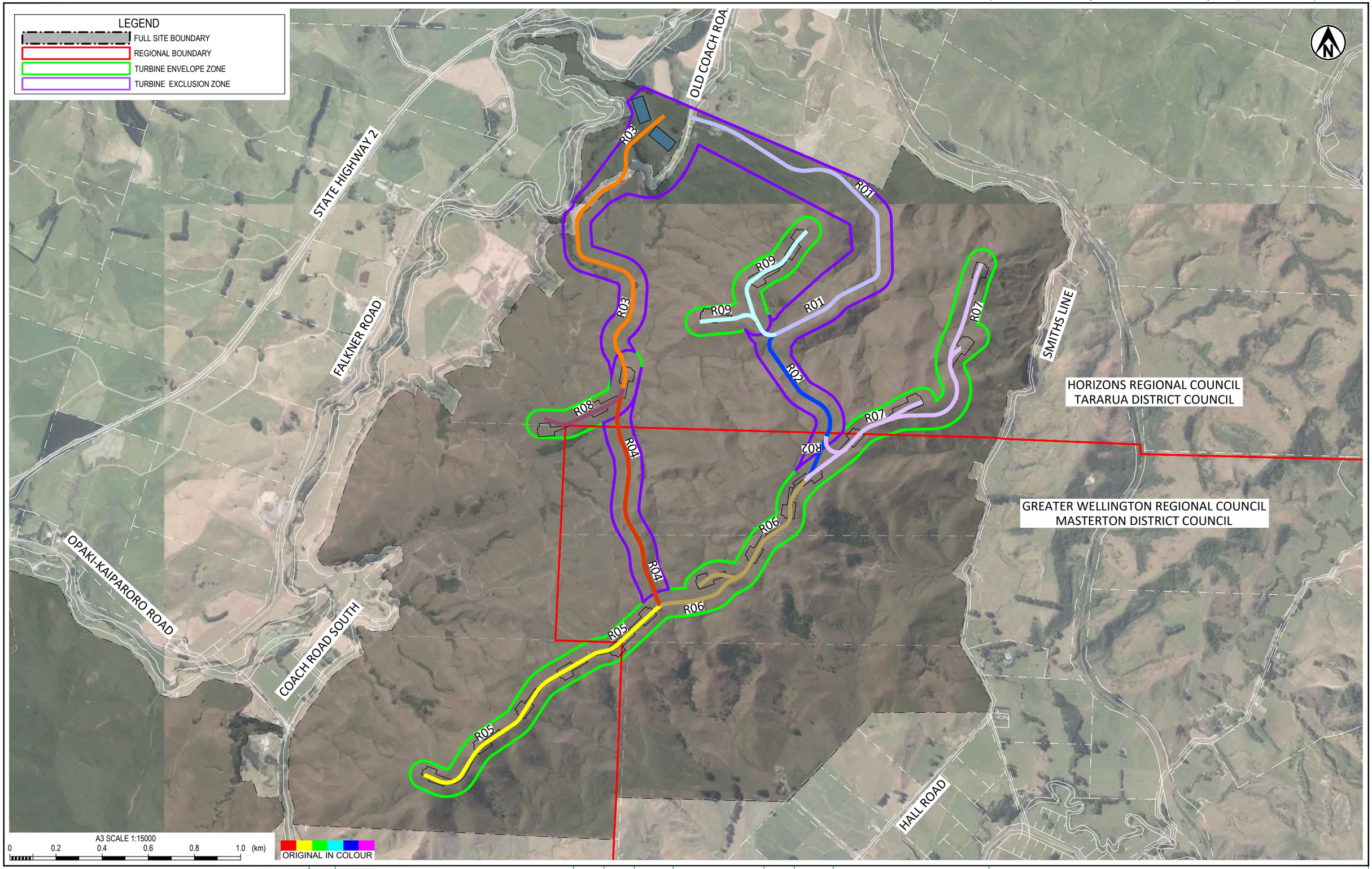
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE INTERNAL TRANSMISSIONLINE, ROAD ACCESS PLAN

SCALE (A3) 1:10000 DWG No. 1016884.1000-011 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-012.dwg 2023-May-10 11:31:36 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23
DRAWN	JOAB	SEP.22
DESIGN CHECKED	NCP	May.23
DRAWING CHECKED	EMSO	May.23

DRAWING STATUS: RESOURCE CONSENT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

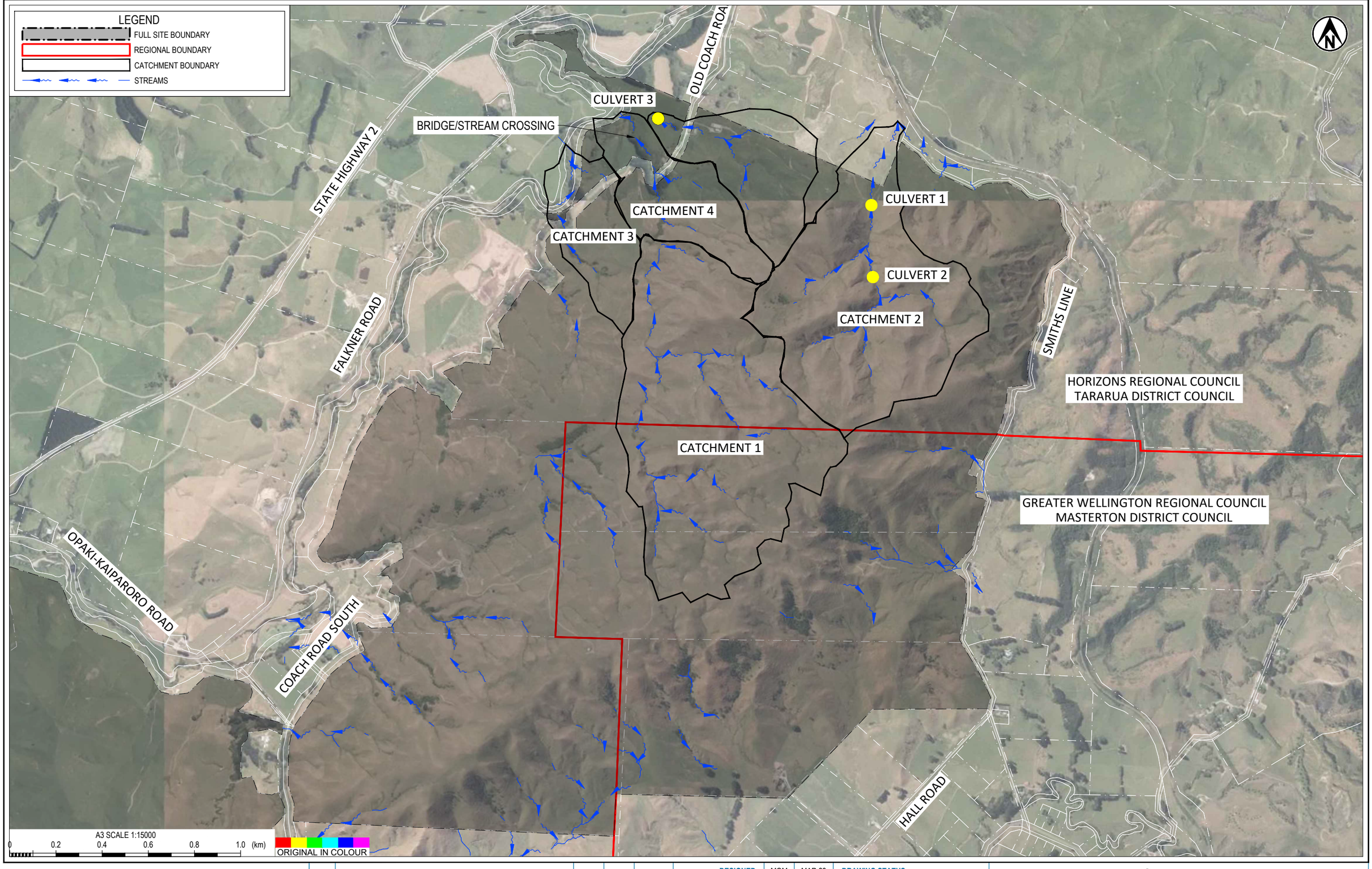
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE INDICATIVE ROADING SECTION PLAN

SCALE (A3) 1:15000 DWG No. 1016884.1000-012 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-013.dwg 2023-May-10 11:31:59 am Plotted By: HEIDI WHALLEY



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	JOAB	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS: RESOURCE CONSENT
DRAWN	JOAB	SEP.22	
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

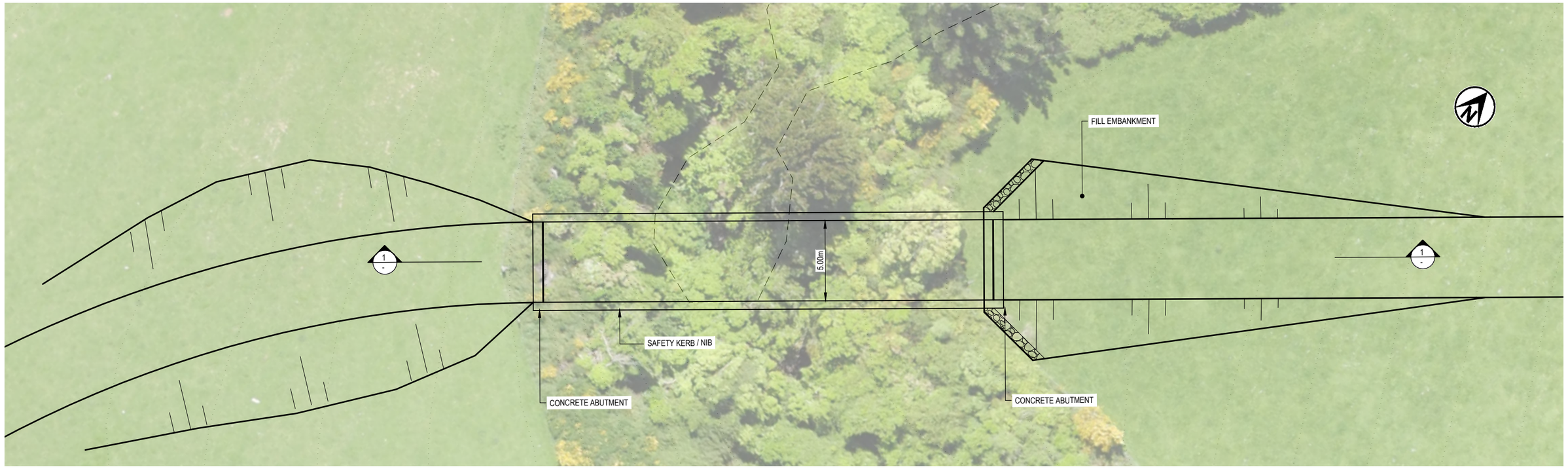
CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE WATER CATCHMENT PLAN

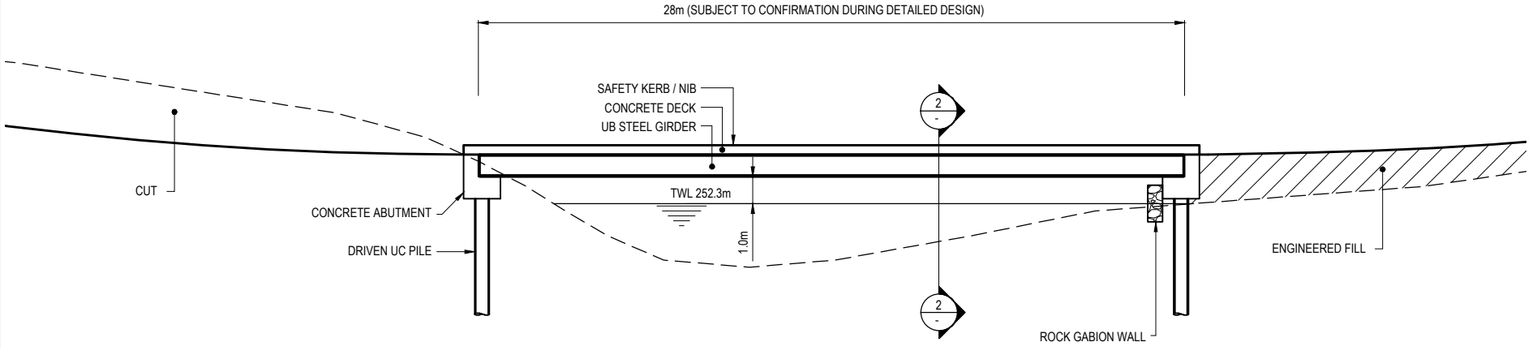
SCALE (A3) 1:15000 DWG No. 1016884.1000-013 REV 2

T:\Christchurch\TT Projects\1016884\1016884.1000\WorkingMaterial\CAD\DWG\1016884.1000-014.dwg 2023-May-10 11:33:10 am Plotted By: HEIDI WHALLEY



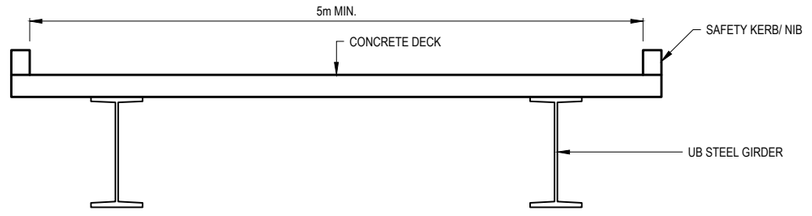
PROPOSED STREAM / BRIDGE CROSSING PLAN

SCALE 1:250



SECTION 1 - PROPOSED STREAM / BRIDGE CROSSING

SCALE 1: 250



SECTION 2 -

SCALE 1: 50

A3 SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 (m)

A3 SCALE 1:250

0 5 10 15 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT ISSUE			
2	RESOURCE CONSENT ISSUE	MGM	EMSO	May.23

DESIGNED	MGM	MAR.23	DRAWING STATUS
DRAWN	MGM	MAR.23	RESOURCE CONSENT
DESIGN CHECKED	NCP	May.23	
DRAWING CHECKED	EMSO	May.23	

NOT FOR CONSTRUCTION

APPROVED DATE

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **MERIDIAN ENERGY LIMITED**

PROJECT **MOUNT MUNRO WIND FARM**

TITLE INDICATIVE STREAM/BRIDGE CROSSING PLAN AND SECTION

SCALE (A3) AS SHOWN DWG No. 1016884.1000-014 REV 2

www.tonkintaylor.co.nz