MT FYANS
WIND FARM

APPENDIX W

HYDROGEOLOGICAL ASSESSMENT

ENTURA

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Hydrogeological Assessment

Mt Fyans Wind Farm

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1. Introduction

1.1 Background

Woolnorth Wind Farms Holding Pty Ltd (Woolnorth) has proposed the development of the Mt Fyans wind farm. The location of the site is 5 km north of Mortlake at the centre of Victoria's western plains, which has elevated fields to the north of the proposed development site which would deliver inflows to the site. The proposed site covers several catchments, including Salt Creek - a clearly defined water channel to the west of the site; and Blind Creek - a watercourse through the middle of the site where some ridges suggest possible inflows.

Entura has been appointed by Hydro Tasmania acting on behalf of Woolnorth to undertake preliminary environmental assessments to understand the potential risk to the environment of construction and operation of the proposed Mt Fyans wind farm. The outcomes of the assessments will be used to support the referrals and future planning permit applications under the Policy and Planning Guidelines for the Development of Wind Energy Facilities in Victoria, January 2016.

1.2 Purpose of assessment

The purpose of the assessment provided in this report is to identify potential impacts to local or regional groundwater resulting from construction or operation of the project; and/or development constraints that may be posed by groundwater.

1.3 Project information

Construction and operation information pertinent to the proposed wind farm as provided by Woolnorth Wind is summarised in Table 1.1. Specific to groundwater, the following construction and operation elements are important:

- Foundations for the wind turbines will reach to a maximum of 4 m Below Natural Surface (mBNS) and will have a circular footprint of ~20 m diameter,
- Trenching for the internal (power) collector network would be ~1 mBNS,
- Depth to the watertable and,
- Groundwater quality.

Table 1.1: Mt Fyans Wind Farm Project information provide by Woolnorth (October 2017)

Parameter	Details
Location	5km north of Mortlake at the centre of Victoria's western plains
Client and Proponent	Woolnorth Farms Holding Pty Ltd
Wind turbine foundations	Likely gravity foundations, 3-4 m depth
Local government area	Moyne
Catchment management authority	Glenelg Hopkins - Corangamite
Land-use	Pasture, Agriculture
Proposed electricity connection point	Mortlake Substation

2. Site setting

This chapter provides an overview of the local geology and hydrogeology.

2.1 Geology and Lithology

The Surface Geology of Australia 1:1,000,000 scale dataset (Data Hub of Victoria 2017) is a seamless national coverage of outcrop and surficial geology. In south west Victoria the surficial geology of the Otways-Torquay aquifer basin consists of a variety of geological units.

There are two predominant geological units at the project site - Qbn, and Qt (Figure 2.1)

- Qbn consists of cinder cones, scoria, minor ash and agglutinates, along with lava flows, tholeiitic to minor alkaline and basanitic lavas.
- Qt includes lake and swamp deposits formed of mud, silt, evaporites, limestone, minor sands and peats.

In terms of lithology, the project area (Figure 2.2) is located in basalt, tuff and scoria units. The overhead transmission corridor is located in a sand and gravel unit. The Otway Basin can be divided into structural embayments, named the Gambier, Tyrrendarra and Port Campbell Embayments, which are separated by zones of the uplifted basement (SKM and GHD, 2009). The Torquay Basin mainly occurs off-shore but has expressions on-shore in the Anglesea/Torquay region.

The project area lies within the Otways basin where the volcanic rocks are part of a formation named the Western District Province. These rocks have high heterogeneity, encompassing basalt, scoria and ash deposits, depending on the type of volcano from which the rocks originated (SKM and GHD, 2009). Generally, the basalt and scoria deposits form good fractured rock aquifers. The ash, or tuff, deposits have good primary porosity and hence allow deep drainage and can also host important groundwater resources.

According to Rosengren (2014), two areas of younger volcanic activity included in, or adjacent to, the proposed wind farm preserve original volcanic attributes of high geoscience significance. In the northeast the proposed wind farm encloses 2,300 ha of younger lava flows from Mount Fyans volcano although the eruption point is some distance north of this area. No absolute date has been determined for this eruption but comparison of the landscape with other dated lavas, e.g. Mount Rouse at Penshurst, suggests a time of eruption approximately 300,000 years ago. Here, no independent additional assessment has been done to examine the provided abovementioned information.

According to Rosengren (2014), the lava field includes very clear examples of primary lava flow surfaces including elongate mounds and ridges that have been little modified by weathering and erosion; and several large, complex depressions containing intermittent lakes fed by groundwater. These lava features are part of a broader complex (including Mount Hamilton and other nearby eruption centres) that is of State Significance. The Mondilibi eruption centre, a cone of scoria and lava 11 km north of Mortlake, lies within the proposed wind farm footprint and is a feature of high geoscience significance. The Mount Shadwell eruptive complex immediately north of Mortlake and adjacent to the southern margin of the proposed wind farm is also of high geoscience significance. Here, no independent additional assessment has been done to examine the provided abovementioned information.

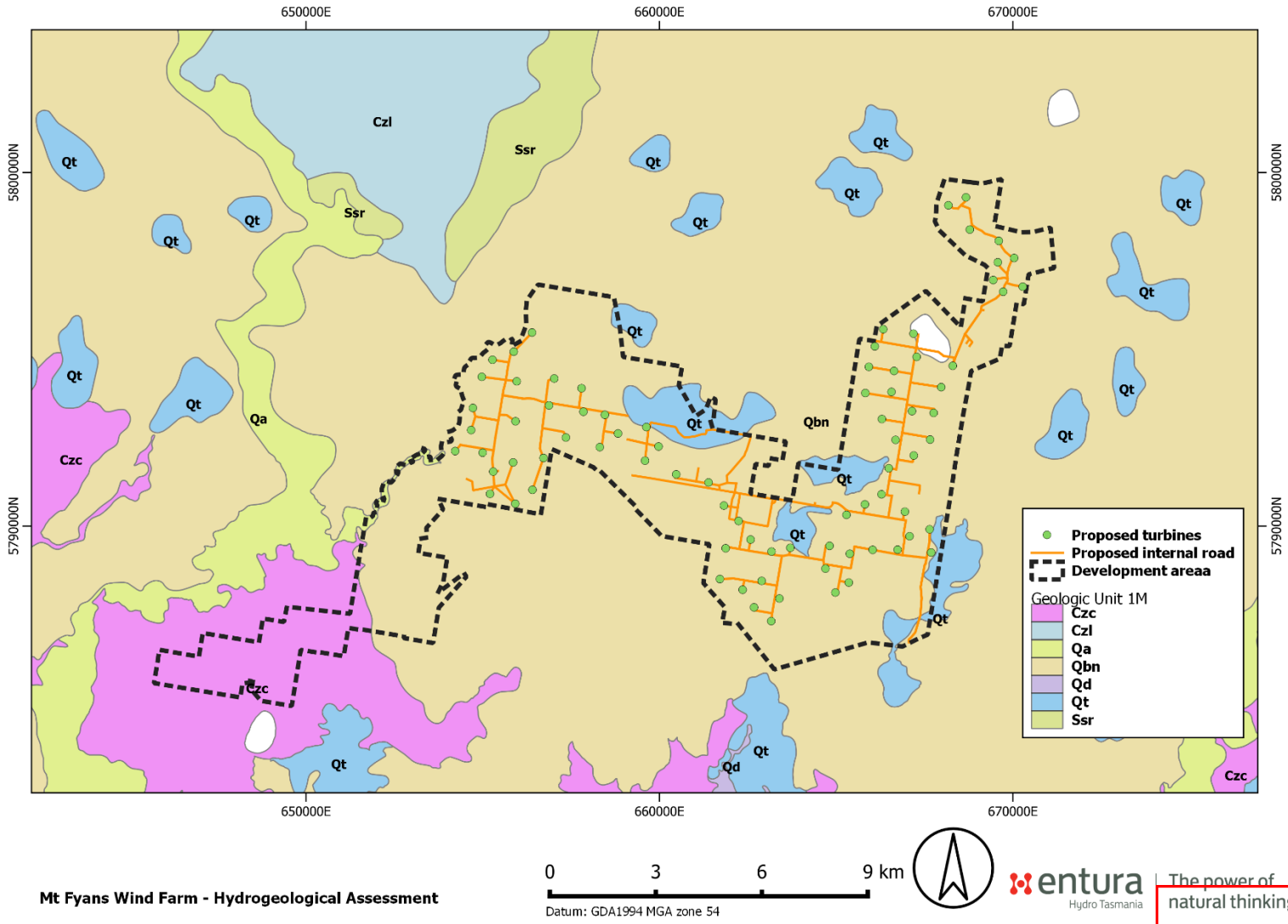

Figure 2.1: Surface geology (1:1,000,000 scale) in the development area (Data Hub of Victoria 2017).

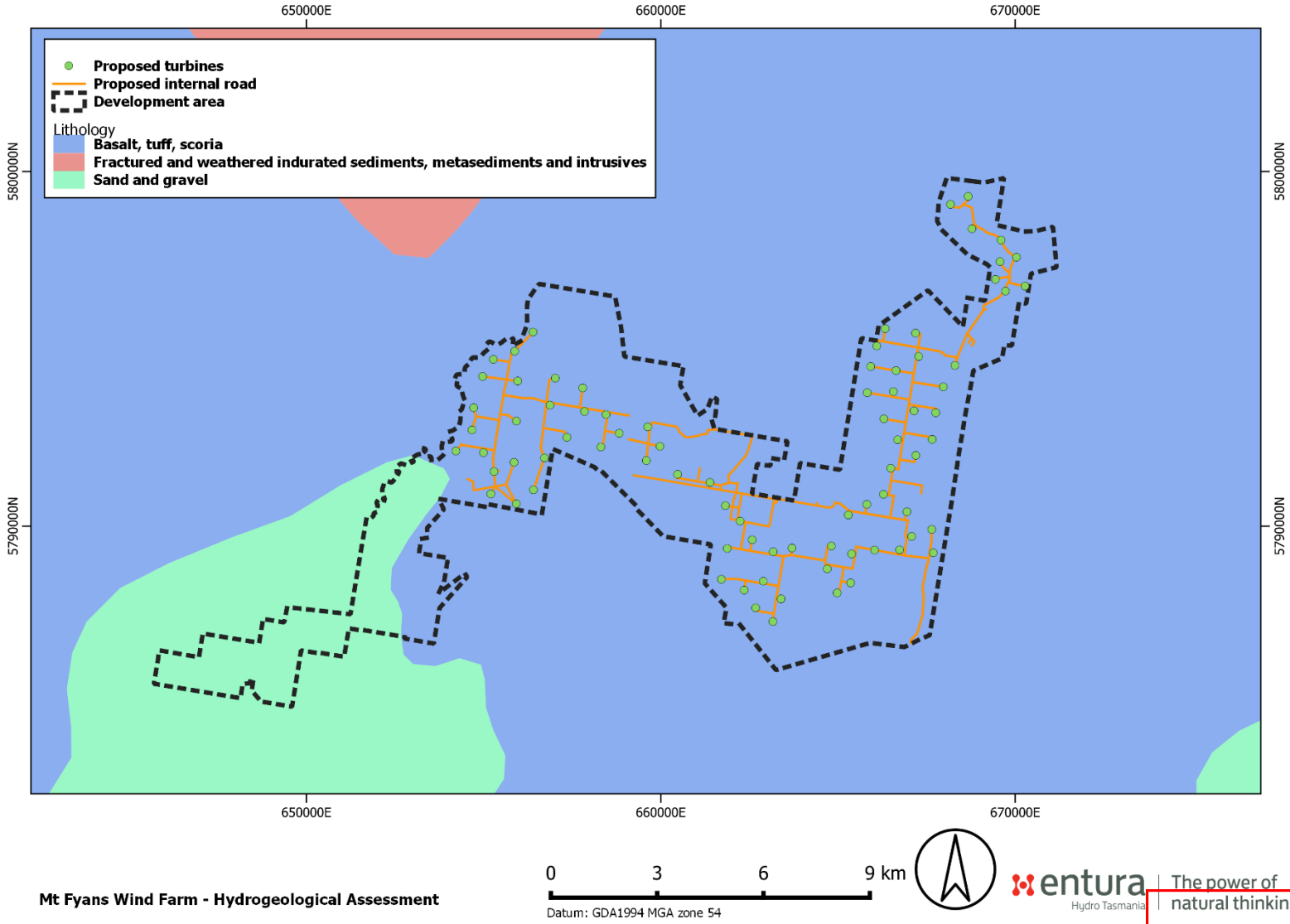

Figure 2.2: Lithological classifications in the development area (Data Hub of Victoria 2017).

2.2 Hydrogeology

2.2.1 Aquifer properties

The hydrogeology of the site mainly includes fractured or fissured, extensive aquifers of low to moderate productivity. The characteristics of these aquifers were extracted from the Groundwater Hub of Southern Vitoria (2017). Groundwater yields from upper aquifer are illustrated in Figure 2.3:

(a) Upper Aquifer (<50 m thickness, mostly 10-50 l/s water yield): Hanson Plain sand or equivalents along with newer volcanics,

(b) Middle Aquifer (<50 m thickness, no water yield): Gellibrand Marl,

(c) Lower Aquifer: No Aquifer.

Figure 2.3: Water yield from upper aquifer across the development area (Visualising Victoria's Groundwater 2017).

Subject to the allocation of groundwater extraction permits, this data indicates there would be sufficient groundwater resources for the construction stage of the wind farm development.

2.2.2 Groundwater

Groundwater flow directions are predominately southwards towards the ocean.

Water Level and groundwater consumption

Water level data was captured from the DELWP website. This data is a combination of point observations at various times and interpolated data that makes it difficult to quantify the absolute accuracy of the depth to water table.

The maximum depth of turbine foundations is likely to be limited to 4 m. To provide a conservative assessment of the risk of encountering the water table during excavation, the depth to water table less than 5 mBNS was mapped along with all active bores (Figure 2.4).

Figure 2.4 shows that the depth to water table across the area is mostly limited to 5-10 mBNS. In some scattered locations in north-west of the development area depths exceed 10 mBNS. Southern and central areas of the site experience water table less than ~5 mBNS.

Figure 2.5 illustrates the locations of (>200) active bores across the development area and adjacent regions, Most of bores are for stock and domestic water supply (>170 bores). Figure 2.6 presents the time series of reduced water level (mAHD) and depth to water table (mBNS) for two monitoring bores (55506, 75635: see locations in Figure 2.5) inside and adjacent to the development area. In general, there is a drop in groundwater depth over the area likely due rainfall deficits and groundwater consumption.

Figure 2.7 illustrates the likely groundwater dependent terrestrial ecosystems and potential interactions between groundwater and surface water. Besides the two main watercourses located along the eastern and western sides of the development area; there are spots (mostly lakes) that appear to be highly dependent on groundwater interactions.

Groundwater quality

The regional salinity of the Newer Volcanics is generally higher than 2000 mg/L TDS (Total Dissolved Salts).

The Victorian Aquifer Framework (VAF) 2014 dataset (http://www.vvg.org.au/) was used to derive a groundwater salinity classification map (Figure 2.8). The development area is dominated by groundwater quality with 3000-7000 mg/L TDS which is considered unsuitable for poultry or pigs. Areas where salinity lays in the range 5000-7000 mg/L TDS would also not be appropriate for lambs, calves and/or weaner stock.

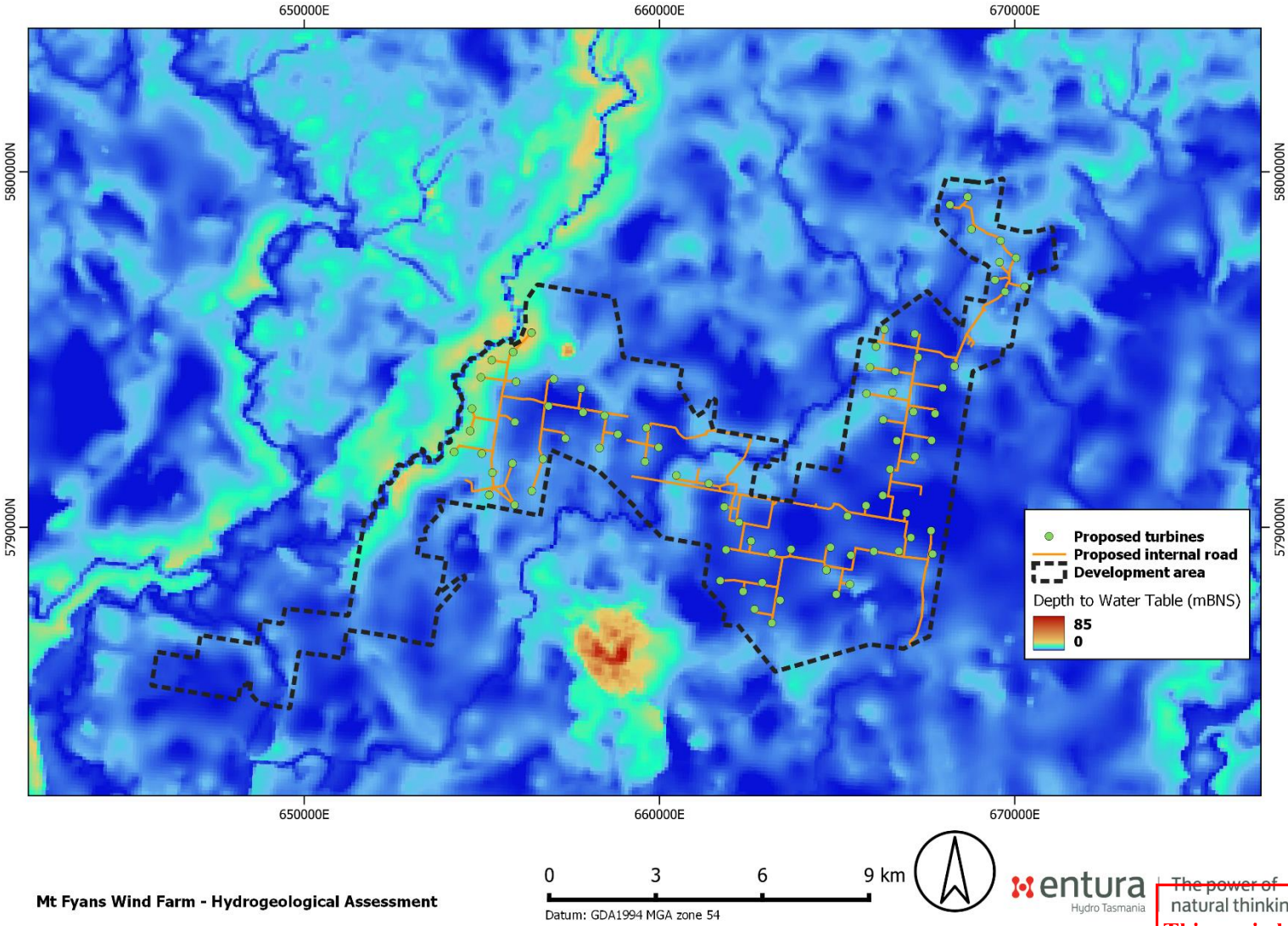

Figure 2.4: Depth to groundwater table (mBNS) across the development site (Data Hub of Victoria 2017).

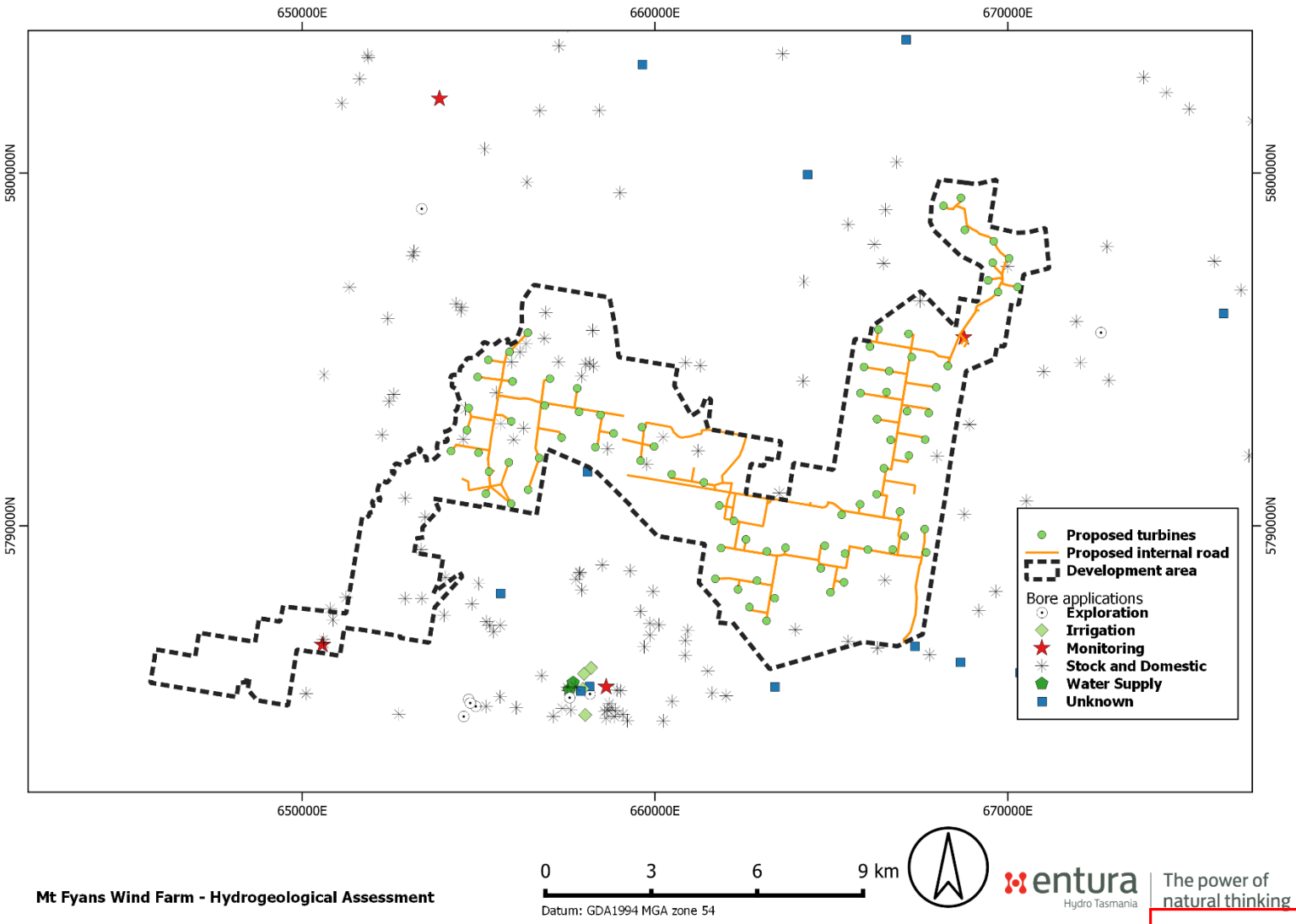

Figure 2.5: The locations of all active bores across the development site (Data Hub of Victoria 2017).

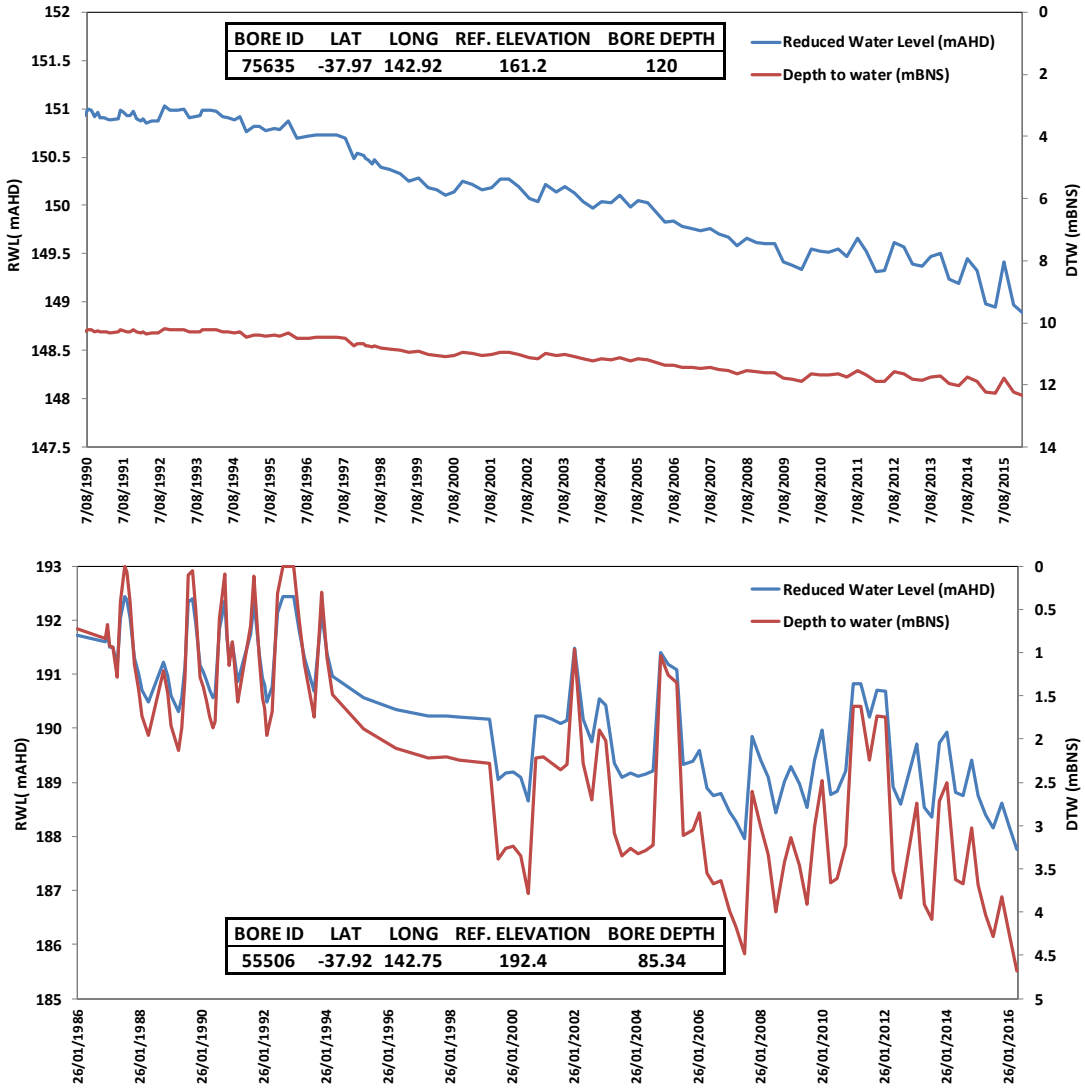

Figure 2.6: Groundwater level time series of monitoring bore 55506 outside the development site, and monitoring bore 75635 located within the development site (Data Hub of Victoria 2017).

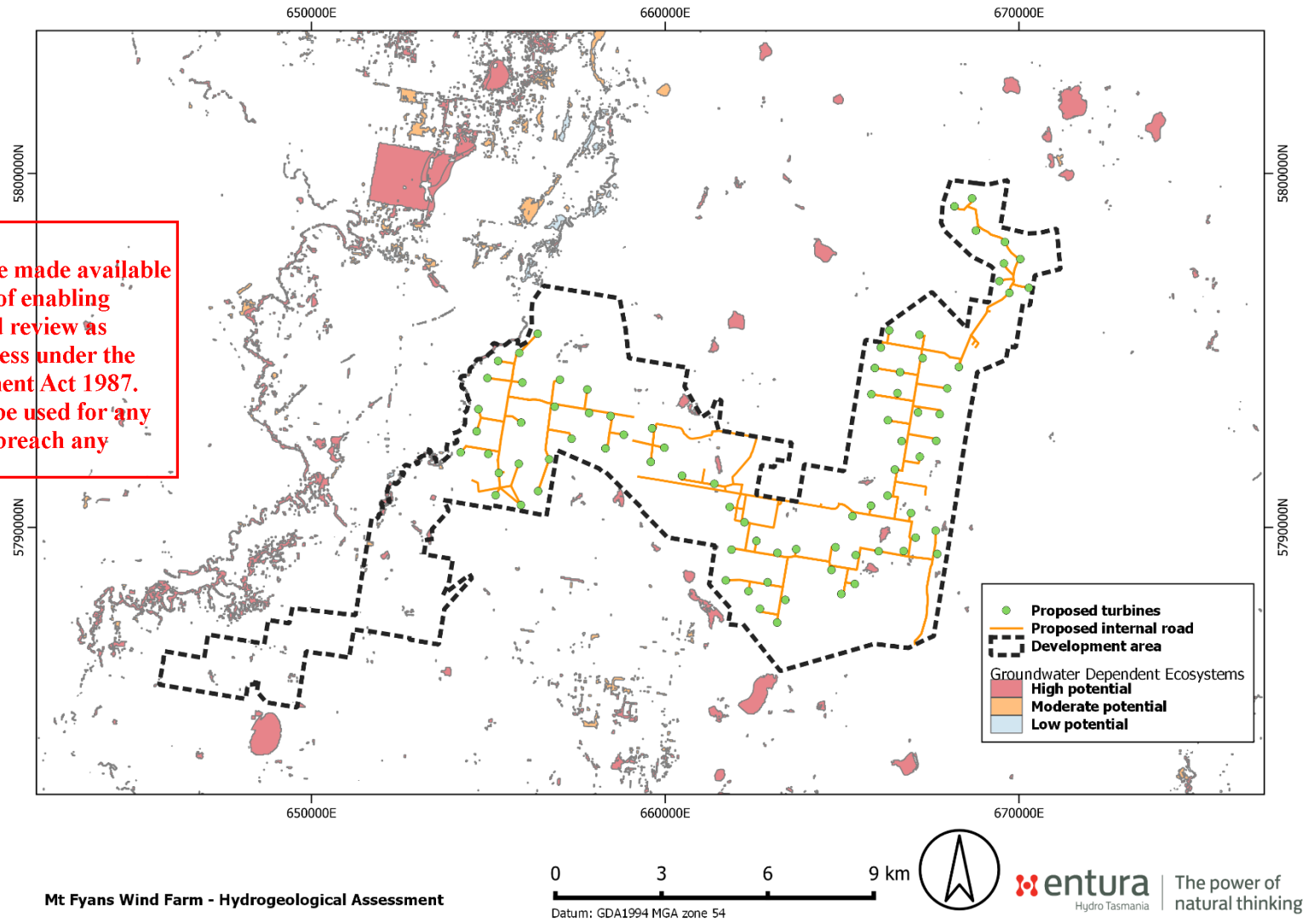

Figure 2.7: Potential groundwater dependent terrestrial ecosystems and areas with potential groundwater-surface water interaction (Data Hub of Victoria 2017).

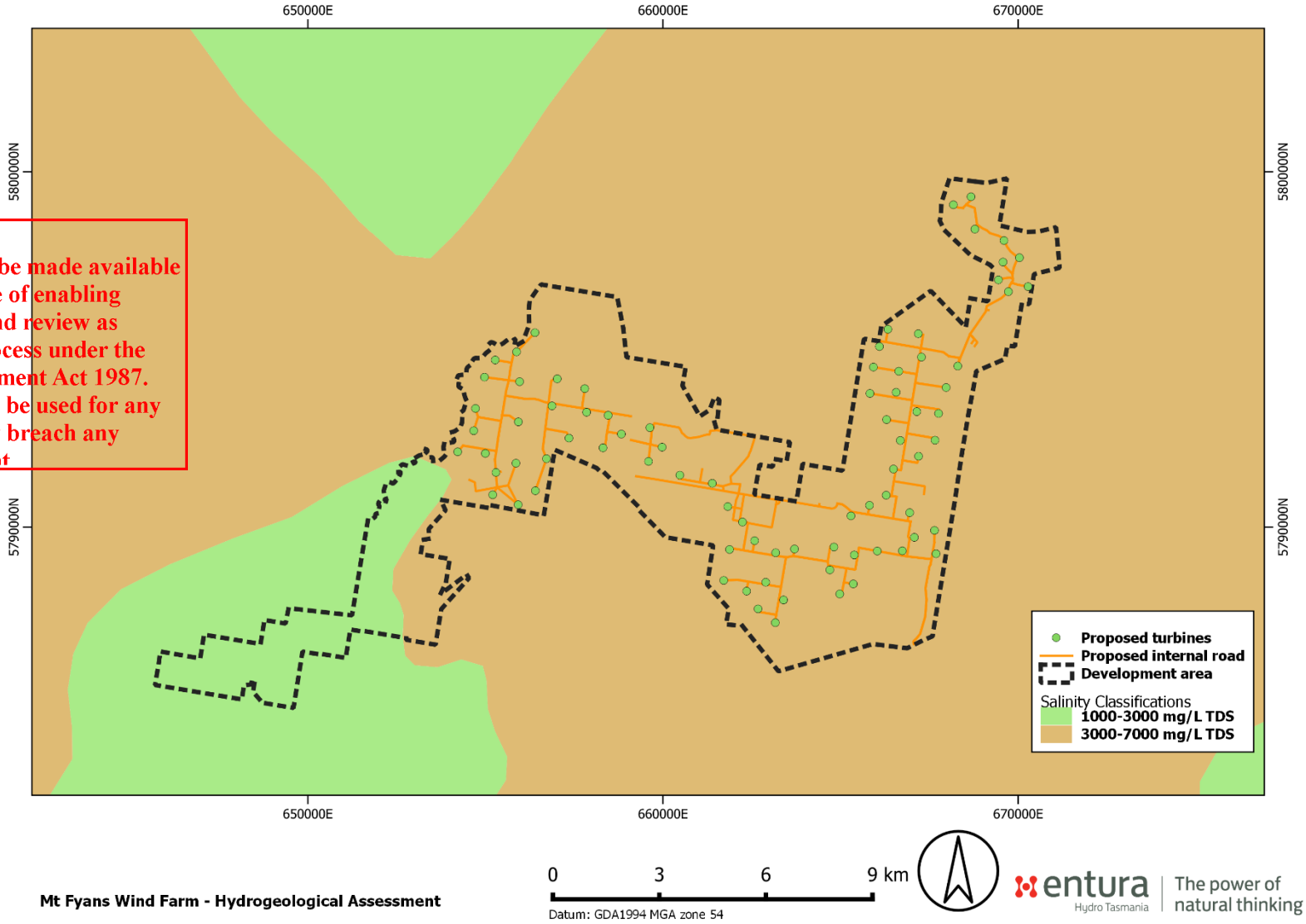

Figure 2.8: Salinity classification across the development area along with active bores (Data Hub of Victoria 2017).

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3. Impact assessment

This chapter considers likely groundwater impacts arising during construction and operation of the proposed wind farm.

3.1 Construction

From the project information provided, it is understood that foundations for the wind turbines will sit at a maximum of 4 mBNS and will have a 20–25 m circular diameter foundation. Available hydrogeological information has indicated the potential for shallow (<5 mBNS) groundwater across much of site. There is therefore some indication that groundwater may be encountered during construction.

Based on the indicated foundation depths and turbine locations it is estimated that there is a potential for groundwater encountered at ~72 turbine locations. Temporary local dewatering would therefore be likely to be required during construction. Construction during summer, when groundwater is typically low, would minimise any dewatering required.

Given the likely duration of any dewatering and the generally shallow nature of any drawdown, the impacts are expected to be localised and minor. As indicated earlier, no areas of high groundwater – surface water connectivity are located within 100 m buffer of wind turbine locations. Therefore no significant impacts on groundwater dependent ecosystems are expected. Further assessment of individual turbine locations may be required as part of final design.

3.2 Design and operation

Groundwater, particularly saline groundwater, can have corrosive or aggressive properties that could affect concrete and steel structures. Since potentially 72 of the wind turbines foundations will intersect groundwater the impact of groundwater quality on construction will need to be assessed and construction materials selected appropriately.

Groundwater inflow to excavations may be higher on scoria cones and as such, siting of final turbine locations should avoid these areas, where practical. Low lying areas and drainage lines should also be avoided where possible.

Given the relatively small scale of the footprints (20-25 m circular diameter), it is considered highly unlikely that the wind farm development would have any regional scale impact on groundwater levels or flow directions.

To confirm the local hydrogeological conditions (and the presence of groundwater) and inform detailed design, a field investigation is recommended.

3.3 Water licences

The local water corporation responsible for groundwater licensing within the Hopkins-Corangamite Groundwater Catchment is Southern Rural Water (SRW). Under section 51 of the *Water Act 1989* a person may apply for a licence to take and use groundwater so long as a proportion of water taken is returned to the water system or water is used for a prescribed purpose. SRW has verbally advised

that there are unlikely to be any capacity constraints to issuing water licences for the development of the wind farm in this area.

4. Conclusions

- The proposed Mt Fyans wind farm development site is predominantly underlain by Newer Volcanics basalt which hosts the watertable.
- Groundwater flow is in a southerly direction towards the Ocean.
- Groundwater salinity is expected to range between 3000-7000 mg/L TDS.
- Shallow depths to groundwater exist across the area - predominantly less than 5 mBNS.
- There is a significant potential that groundwater may be intersected during construction of some wind towers.
- Temporary dewatering of some tower sites is likely to be required during construction.
- The impact of localised dewatering on groundwater flow and groundwater dependent ecosystems is likely to be minimal.
- The impact of groundwater presence and quality on the construction and operation of the wind farm needs to be assessed during detailed design.

5. References

Data Hub of Victoria (2017) https://www.data.vic.gov.au/data/dataset.

Groundwater Hub of Southern Vitoria (2017) http://gwhub.srw.com.au/south-west-region-overview.

Rosengren N (2014) proposed Mount Fyans wind farm, geoheritage assessments.

SKM and GHD (2009) Hydrogeological Mapping of Southern Victoria. Southern Rural Water.

Visualising Victoria's Groundwater (2017) http://maps.cerdi.com.au/vvg.php.

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