The geology of the site was described by the 1:250 000 Department of Mineral Resources State wide Geological Map of NSW (2004). Figure 5.3 shows the general geology of the project area. The mineral resource potential of the locality has been demonstrated by the former Woodlawn Mine operations. The Woodlawn Mine has closed down but lesser scale operations are still possible. There is no evident conflict between the wind farm proposal and the potential future mining activities.

In summary, the general subsurface soil profile is shown in Table 5.2 below. Many locations on the ridge where the turbine sites are located have only shallow soils and exposed rock is common. However, intervening areas show evidence of erosion of weaker or more deeply eroded rock strata.

Table 5.2 – General subsurface profile (URS, 2004)

Approximate depth range (m)	Generalised soil
0 to 0.1	top soil: dry, hard brown silt with rootlets
0.1 to 0.9	extremely to highly weathered metasediments: dry extremely low to very low strength, silt(stone) to sand(stone)
0.9 to 1.6	highly weathered metasediments: dry, low to medium strength, undifferentiated metasediments

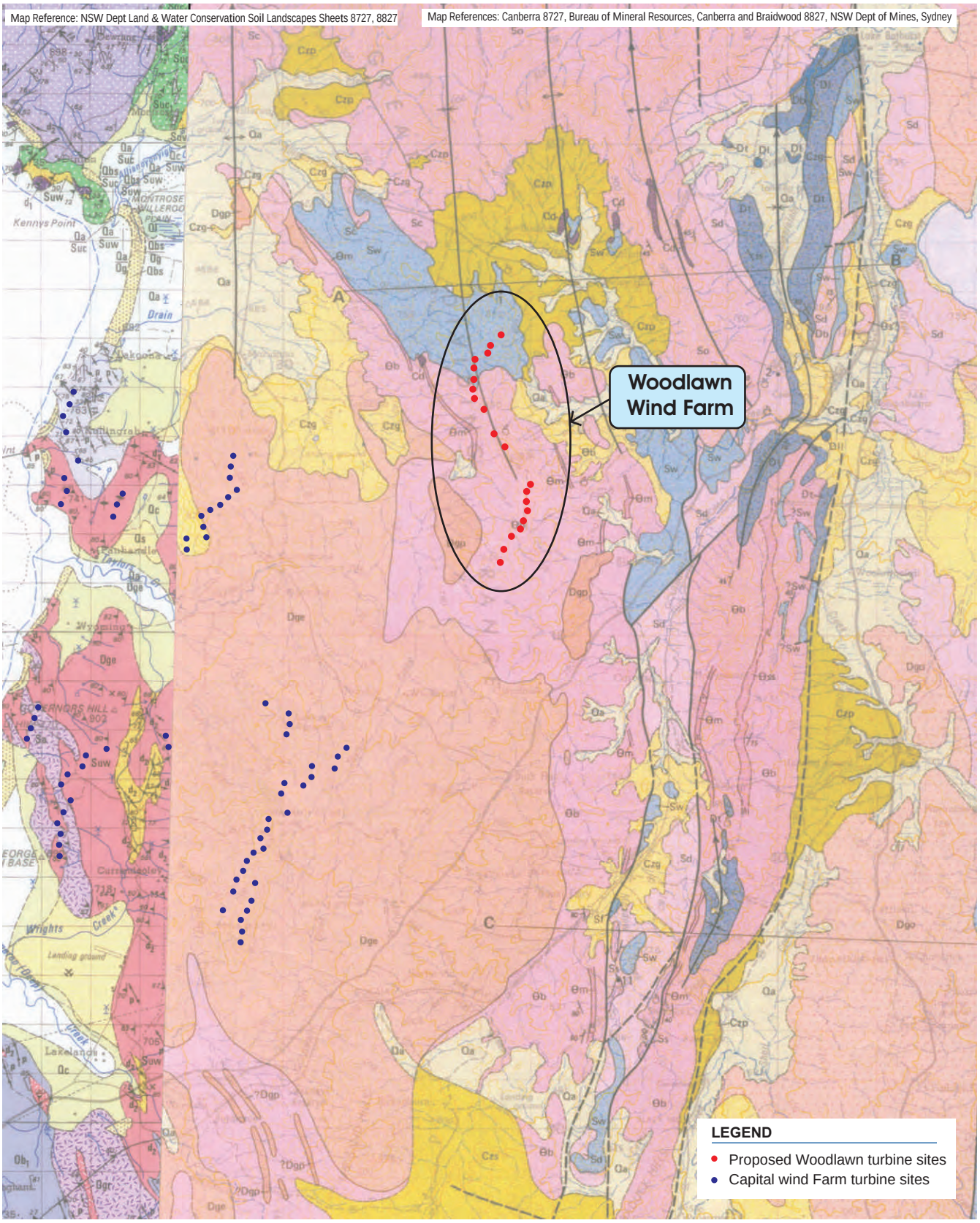
The soil landscapes of the site were described on the Department of Land and Water Conservation Braidwood 1:100 000 Soil Landscape Series Sheet 8827. Figure 5.4 provides a summary of the soil landscapes for the area of Woodlawn Wind Farm and the associated 33 kV transmission line route.

The project area is dominated by Vestigal landscapes (Moura Creek) and Colluvial landscapes (Fairy Group). Both landscapes are typically non-saline and are regarded as relatively infertile. Minor sheet erosion within the soils was evident on some slopes and some gully erosion was evident along drainage lines (URS, November 2004). Compared to the Capital Wind Farm site that contained deeply weathered granites and highly erodible soils some of the geology at the Woodlawn Wind Farm site will provide more stable ground but erodibility of disturbed areas will be quite variable and controls will need to be adjusted to the conditions encountered. Table 5.3 provides a summary of the soil landscape characteristics for the project area. Examples of erosion are shown in Plates 5.13 and 5.14.

The 2004 EIS indicated that no groundwater was encountered during excavation of test pits and it was not expected that groundwater would be an issue during construction of turbine footings due to the elevated locations of the wind turbine sites along the ridgeline and the relatively shallow depths required for the footings.

Plate 5.13 – Existing erosion between Turbine 11 and Turbine 12

Plate 5.14 – Existing track erosion near Turbine 1



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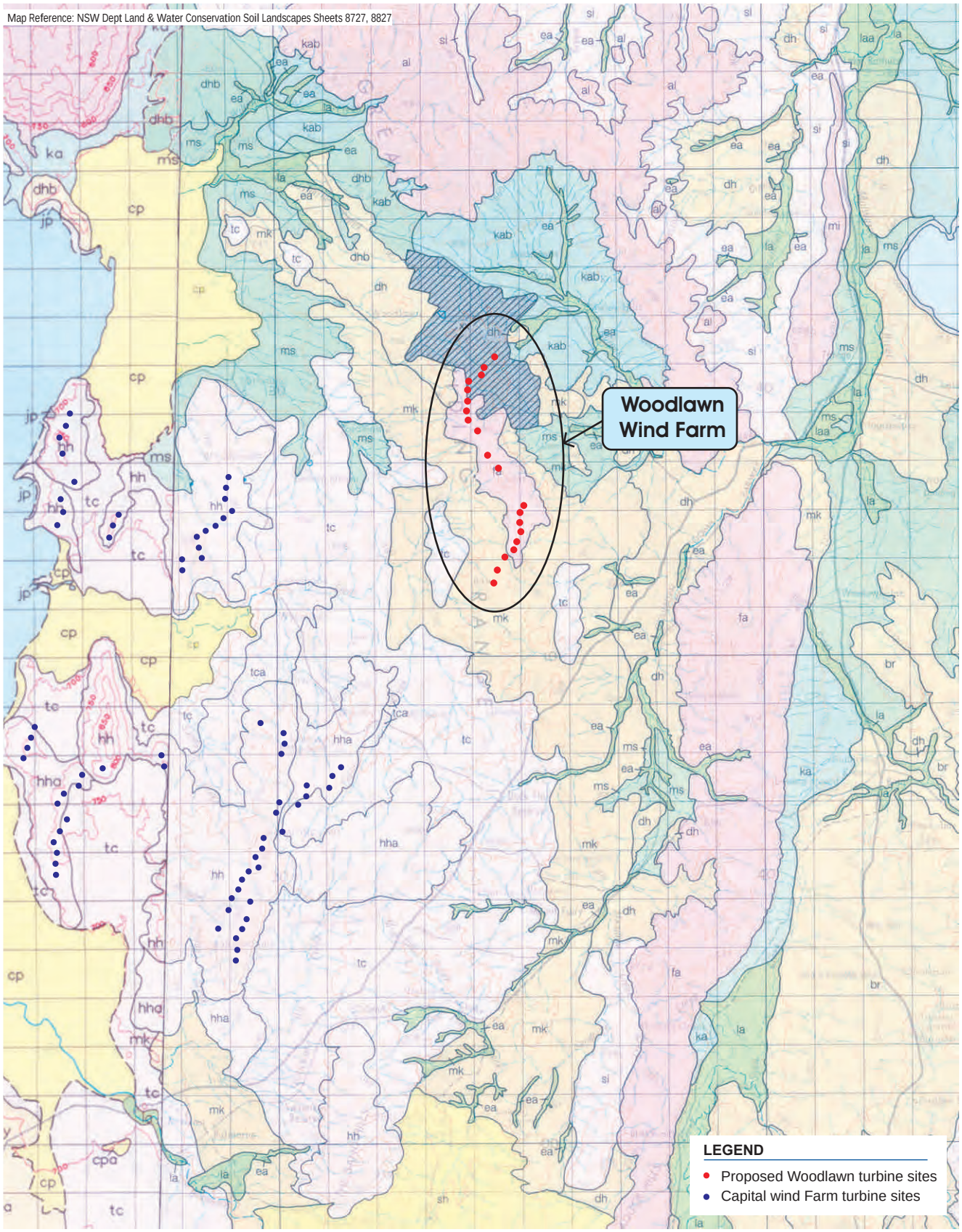


LEGEND - SOIL

al	ALLIANOYONYIGA	cp	COOPERS	dhb	DUCKFIELD HUT (basaltic, fertile)	hh	HAMMONDS HILL	ka	KALBILI	laa	LARBERT (less frequently flooded)	ms	MORASS	tc	TAYLORS CREEK
br	LOWER BORO	cpa	COOPERS (heavier textured)	ea	EASTFIELDS CREEK	hha	HAMMONDS HILL (lower local relief, gentler slopes)	kab	KALBILI (coarser grained)	mi	MISERY MOUNTAIN	sh	SAND HILLS	tca	TAYLORS CREEK (greater incidence of rock outcrop)
by	BYWONG	dh	DUCKFIELD HUT	fa	FAIRY	jp	JAMES POINT	la	LARBERT	mk	MOURA CREEK	si	SIGHT HILL		DISTURBED TERRAIN

SCALE
0 2 4km

Table 5.3 – Summary of soil landscape characteristics for the Woodlawn Wind Farm project area

Soil Landscape	Main Rock Types	Soil Landscape – Main characteristics	Erodibility			K Factors	USCS Code
			Concentrated flow	Non-concentrated flow	Wind		
Fairy (Colluvial) (fa)	Meta-sediments	Steep hills on metasediments and few angular outcrops. Lithosols on crests, yellow earth on side slopes and yellow Podzolic soils on lower slopes. Foundation hazard. Low wet bearing strength.	very low to high	moderate to very high	Very low to very high	fa1 – 0.010 fa2 – 0.034 fa3 – 0.028 fa4 – 0.041 fa5 – 0.052 fa6 – 0.038	SM-ML ML CL SM, ML CL
Moura Creek (Vestigial) (mk)	Meta-sediments	Rolling low hills with short steeper slopes above drainage lines. Alluvial soils on drainage lines. Lithosols and Yellow Podzolics on crests and upper slopes, Red Podzolics, Solodics. Localised flood hazard, low wet bearing strength.	high to very high	high to very high	moderate to high	mk1 – 0.054 mk2 – 0.073 mk3 – 0.028 mk4 – 0.058 mk5 – 0.050	ML ML CL ML ML-CL
Taylors Creek (Erosional) (tc)	Granite (Adamellite)	Undulating low hills. Shallow Lithosols and earthy sands near crests. Red earths and Podzolics on upper/mid slopes. Gully and sheet erosion risk and low wet bearing strength	high to very high	high to very high	very low to moderate	tc1 – 0.049 tc2 – 0.055 tc3 – 0.035 tc4 – 0.058 tc5 – 0.023	SM-ML SM-ML CL SM CL
Hammonds Hill (Erosional) (hh)	Granite (Adamellite)	Rolling to steep to low hills with tors common. Lithosols at crests and near rock outcrops and various Podzolic Soils at lower to upper slopes. Strongly acidic with risk of sheet erosion. Shallow soils of low wet bearing strength.	high to very high	moderate to high	low	hh1 – 0.052 hh1 – 0.042 hh1 – 0.060	ML CL ML-CL
Hammonds Hill (hha)	Granite (Adamellite)	Lower local relief and gentler slopes than (hh). Highly erodible, strongly acid, infertile and shallow soils; engineering hazard; rock outcrop localised.	high to very high	moderate to high	low		

NOTE: **USCS** – Unified Soils Classification Scheme: CL/CH represent Clays; ML Silt dominant, SM Sand dominant

K Factor is a measure of Soil Erodibility

5.3.1 Potential impacts and mitigation measures

Construction activities, including the excavation of footings and earthworks for access tracks and cable trenches have the potential to increase levels of erosion on site. A Soil and Water Management Plan (SWMP), which forms a part of the CEMP, will set out the measures to mitigate potential impacts on the soils at the wind farm site. Details of the SWMP and specific measures will be provided at the pre-construction stage as part of the CEMP

Erosion and sediment control measures will be designed to:

- divert runoff away from areas of earthworks or soil stockpiles
- reduce the energy of surface flows in areas of potential erosion
- prevent sediment laden or contaminated water leaving the construction site
- provide containment for sediment entrained in surface flows
- reduce susceptibility of disturbed areas to erosion and include prompt revegetation of disturbed areas
- ensure control of erosion and sedimentation over the project life

Such measures may include:

- construction of drains and check dams
- construction of diversion banks, perimeter banks and level spreader sills
- use of sediment traps
- sediment fences around stockpiles and areas of earthworks
- stabilisation of temporary batters
- straw bale and geotextile filter fabric sediment traps and filters
- monitoring to identify deficiencies in controls and enable corrective action

All erosion and sediment control devices will be maintained in satisfactory working order until such time as the disturbed areas have been stabilised to the satisfaction of the proponent and the respective landowners.

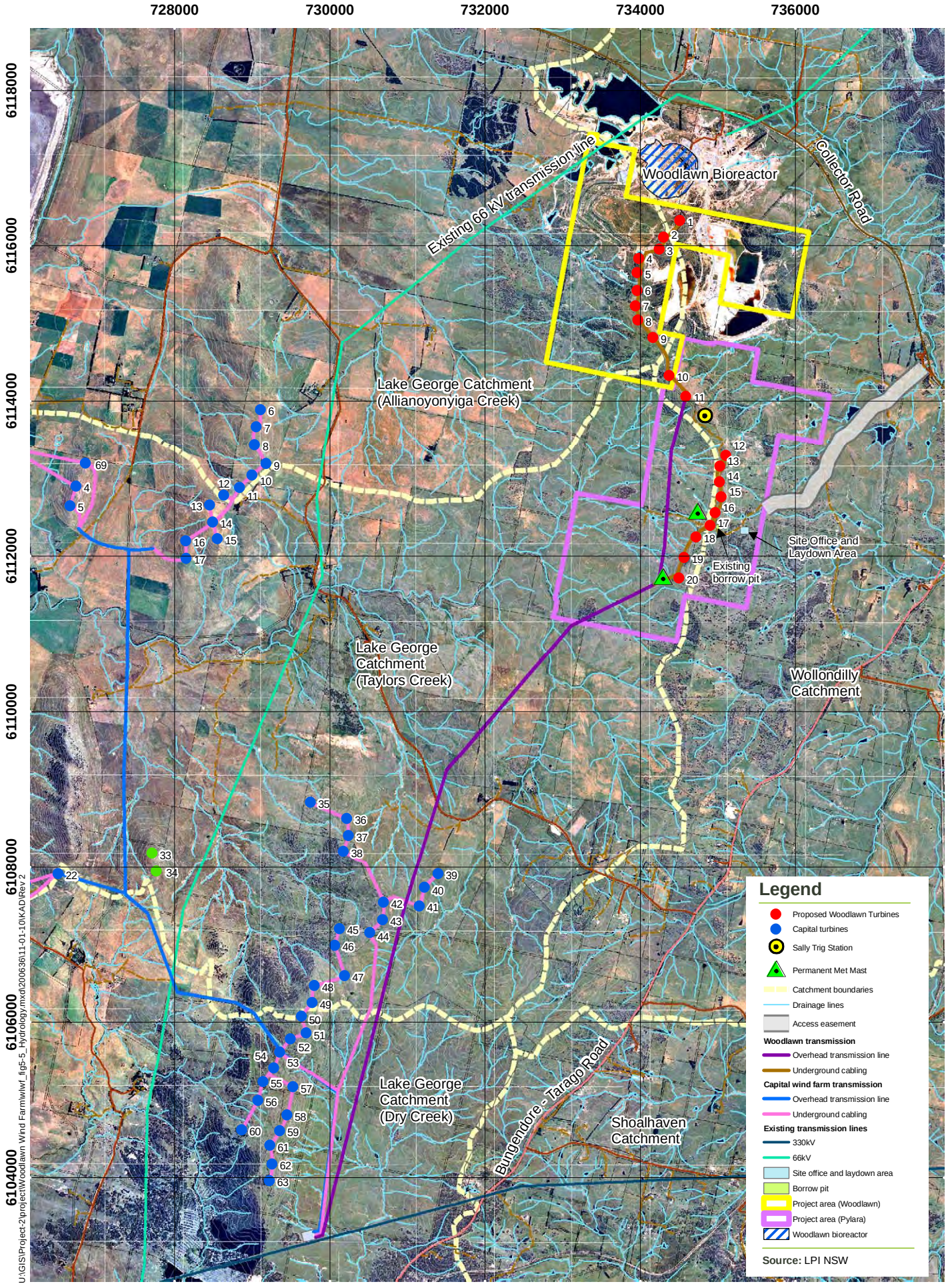
5.4 Water resources and water quality

The 2004 EIS provided an assessment of the significance of the potential impacts resulting from the construction and operation of the proposed Woodlawn Wind Farm. The amended project involves a lesser extent of disturbance at the wind farm site with removal of five wind turbine sites and the 22 kV/66 kV substation at the wind farm location. The installation of the wind farm and the new 33 kV transmission line will be undertaken in accordance with an approved Soil and Water Management Plan. With effective implementation of the identified controls there will be an insignificant impact on local water quality.

5.4.1 Overview

The locality has relatively low annual rainfall, typical of the Southern Tablelands areas away from the coast. Extended dry periods are not uncommon and for much of the time there is little or no surface flow in the upper reaches of the drainage. Winter is generally associated with slightly lower rainfall but due to lower evaporation, soil moisture can be higher during that time. Storms are possible at any time during the year but are more common in summer periods.

The ridgeline on which the wind turbines are to be located forms a catchment divide between the Wollondilly River catchment to the east and Lake George catchment to the west. The ridgeline is also located on the boundary of the Outer Sydney Drinking Water Catchment (See Section 4.4.2) that includes the Wollondilly River catchment (Figure 5.5). Slope gradients vary along the axis of the ridgeline with the steepest slopes near the highest point of the ridge near Mt Sally.



SCALE 1:65,000 @ A4

0 1 2km

Projection: MGA

Woodlawn Wind Farm **Statement of Environmental Effects**

FIGURE 5.5: Site drainage and catchments

The eastern side of the ridge where the wind farm is located drains into Crisps Creek and Mulwaree River that are upper tributaries of the Wollondilly catchment. Three tailings dams associated with the former Woodlawn mine site are located on the north-eastern side of the ridgeline and require comprehensive environmental management. In comparison the proposed wind farm represents a low risk for impacts on water quality and these risks are able to be managed with well known procedures and techniques as outlined in section 5.4.1.

The western side of the ridgeline drains relatively freely into Lake George. The proposed transmission line will be entirely located within the Lake George Catchment. The Capital Wind Farm is also located within the Lake George catchment. The northern half of the proposed 33 kV line route drains to Lake George via Taylors Creek while the southern half of the line route drains to Lake George via Dry Creek.

5.4.2 Potential impacts and mitigation measures

The potential for the project to impact local water courses varies with the stage of the project. The construction works will involve earthworks, storage and handling of equipment, pouring of concrete for footings and use of facilities for the construction workforce over a period of about eight months.

Activities that will need to be managed to avoid impacts on the local drainage system include:

- soil disturbance associated with earthworks, including roads, trenches and foundations
- creation of temporary stockpiles of soil and rock
- works associated with crossings of watercourses
- removal of sewage effluent from construction workforce facilities
- storage and handling of fuels, oils and chemicals

Potential impacts relating to the operational stage of the wind farm include loss of oil from electrical or mechanical equipment (considered a low potential) and the operation of the existing septic system at the facilities building of the Capital Wind Farm substation.

The 20 turbine generator transformers located at each turbine site will contain about 1500 litres of oil with containment built into the design of the transformer footings. Any spillage or leakage of oil for these transformers, should it occur, can be contained at the turbine locality and cleaned up. There is a very low risk of this source of oil significantly impacting water quality at the locality.

The large 33 kV/330 kV transformer to be installed at the Capital Wind Farm substation has a large volume of oil of the order of 20,000 litres. Consequently it will be located within a concrete bund that has sufficient capacity to contain the oil contained within the transformer equipment should its structure be damaged. An additional containment pond is located outside the substation compound to provide a secondary containment measure.

The temporary amenities facilities at the Woodlawn Wind Farm site will involve a temporary pump out facility during the construction stage. Facilities are also available at the existing Capital Wind Farm substation and once Woodlawn Wind Farm is operational the substation will provide the operations centre and the existing facilities buildings for both wind farms with associated amenities shared by the two wind farm projects.

The Soil and Water Management Plan prepared for the project (Section 5.4.1) and the project Environmental Management Plan (EMP) will include the relevant soil and water management measures to address the potential impacts.

5.5 Landuse at the locality

The Woodlawn Wind Farm turbines will be located on parts of the Pylara and Woodlawn properties now owned by Veolia Environmental Services. The proposed 33 kV overhead transmission line traverses a number of other privately owned properties list in Table 2.1.

The area is generally characterised by rural land holdings with scattered rural residential settlement. Other developments at the locality were described in Section 1.4 and include:

- the Woodlawn Bioreactor and associated recycling facilities infrastructure located at the northern end of the wind farm site
- the former mine site features such as a large revegetated out of pit spoil pile and tailings dams and some derelict structures and the indicated future mining activities
- the fully constructed Capital Wind Farm and 33 kV/330 kV substation located to the south and south-west of the site (Figure 1.3)
- parts of the Woodlawn and Pylara properties have been classified as Wildlife Refuges through development of voluntary agreements between the landowners and DECCW.

The extensive area of Lake George to the west of the site is low lying and intermittently flooded and hence is not suitable for residential development. The township of Tarago is located seven kilometres to the east-north-east of the wind farm site but due to intervening ridgeline with elevation of over 800 metres the wind farm is unlikely to be visible from the bulk of Tarago township.

The owners of the lands where the wind farm will be located will lease their lands to Woodlawn Wind Pty Ltd and are therefore beneficiaries of the project. The agreement of Veolia Environmental Services indicates that the proposed activities can be integrated with the existing land use. As indicated in Chapter 2 parts of the land owned by Veolia Environmental Services that will be leased for the wind farm contain two wildlife refuges located on the former Woodlawn and Pylara properties. There will be no substantive impact on the wildlife refuges that were also considered by the 2004 EIS and in the determination of the existing consent. The land associated with the southern part of the Woodlawn 33 kV transmission line is also associated with the Capital Wind Farm.

In general, neighbouring properties are setback from the wind farm site and the project area is regarded as suitable for the wind farm development. While the wind farm is more than 2.7 kilometres from all neighbouring residences it may nevertheless be evident to the neighbours but will not affect the neighbour's landuse.

The development of wind farms is often associated with concerns by neighbours that their land value may be impacted. While it may be reasonable to have that concern, as is common with developments of many types, the available studies indicate that there will be no significant impact on land values.

5.6 Socio-economic aspects

The Woodlawn Wind Farm represents a moderate size wind farm development that will have the capacity to produce 42 MW of electricity from a renewable energy resource. It will contribute to Australia's efforts to increase the proportion of electricity generated from renewable energy sources with the objective of reducing the overall greenhouse gas emissions intensity of electricity generation.

The project will have an estimated cost of about $100 million for which a significant portion will be directed to Australian based businesses. Landowners on which the project is located will benefit through income from leases of their land by the proponent. Additionally, various service businesses in the area surrounding the wind farm site will receive increased income from supplying services directly and indirectly to the project.

Local employment will also be likely to be supported by the project as was the case for Capital Wind Farm construction. Additionally, it has been seen that developments such as Capital Wind Farm and in the future Woodlawn Wind Farm will attract interest including from community and school groups. These activities are seen as an indirect benefit of the project that will improve the wider communities

understanding of the technologies that will enable Australians to diversify electricity supply from traditional fossil fuel sourced generation and integrate sustainable energy generation.

The region has demonstrated its ability to cater for the larger development of the Capital Wind Farm and the Woodlawn Wind Farm is similarly able to be integrated in the socio-economic setting of the region.

A viewing area is to be installed on Collector Road near its intersection with Tarago-Bungendore Road and will provide an additional point of interest for the locality.