



International Power



CHAPTER 8

Soils, Geology and Groundwater

URS

Soils, Geology and Groundwater – Summary of Key Outcomes

Groundwater at the proposed Parkes Peaking Power Plant Project Site is well below the surface and therefore would be well below any power plant site excavations or excavations associated with the construction of the natural gas pipeline to the site.

The mitigation measures and safeguards implemented would ensure that soils and groundwater are managed using appropriate design, construction and management procedures. Accordingly any impacts on soils and groundwater resulting from the construction and operation of the proposed Parkes Peaking Power Plant Project would be negligible.

8.1 Introduction

This chapter presents an assessment of the soils, geology and groundwater for the proposed Parkes Peaking Power Plant Project. The assessment is based on a field geotechnical investigation undertaken by URS (2006) and supported by laboratory soil testing. The Parkes Shire is located on the western edge of the Great Dividing Range within the Central West Region of NSW. The Central West consists of the Tablelands, and the Slopes and Plains regions. Parkes Shire covers an area of 5,919km² with the town of Parkes being the major urban centre, followed by Orange (to the east), Forbes (to the south) and Peak Hill (to the north). The other major centres are Bogan Gate, Trundle and Tullamore in the west of the Shire

8.2 Existing Environment

8.2.1 Soils and Geology

Topography

The site is currently cleared and cropped, and is adjacent to an existing TransGrid substation which is raised approximately 2m above natural surface level by imported fill materials. The site has a low local relief with the general topography in Parkes Shire being generally described as flat to gently undulating. The area forms part of the catchments for the Bogan and the Lachlan River systems, which are major tributaries of the Murray-Darling Basin System. Most watercourses in the Shire are not permanent, being reduced to a series of waterholes for the majority of the year.

Geology

The Central West of New South Wales lies within a geological structure called the Lachlan Fold Belt formed 350 million years ago when sedimentary rocks were folded and faulted during tectonic activity. The Belt cuts across the east of Australia, running north to south across central New South Wales through to the north-east of Tasmania.

The oldest rocks in the Central West section of the Lachlan Fold Belt are about 480 million years old. They are found between Molong and Wellington and west of Parkes. Younger sandstones and siltstones ranging from 300 to 150 million years in age cover the old rocks of the Lachlan Fold Belt. These sandstones and siltstones form the prominent cliffs and scarps that extend from Lithgow to Ulan and from Dubbo to Dunedoo, and also contain some coal seams.

Also overlying the older rocks are Basalt flows as young as 10-12 million years in age. Mount Canobolas which is approximately 50 km east of Parkes near Orange is one such example.

The Parkes-Narromine Volcanic Belt is one of three main "sub-belts" within the Lachlan Fold Belt. The Parkes-Narromine Volcanic Belt includes the currently operating North Parkes copper mine and the Peak Hill gold mine.

Soils

Between 30 January 2007 and 1 February 2007, site field investigations were conducted at the site for the proposed Parkes Peaking Power Plant Project. Three (3) test bores were drilled between 20.1 m to 20.3 m. Soil samples were collected and laboratory tested. The subsurface conditions encountered generally correlate with the geological map information anticipated. A summary of the materials encountered is provided in **Table 8-1** below.

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Table 8-1 General Subsurface Conditions

Material Type	Typical Depth of Layer (m) Below Ground Level (bgl)	Description
Eluvium	Observed from ground level to between 5.0m bgl (BH03) and 8.0m bgl (BH01 and BH02)	Clayey SILT: brown to orange brown, medium to high plasticity, dry, with some sand, fine to medium grained and with gravel content increasing with depth. Very stiff to hard except for the upper 0.3-0.4m, which has been disturbed by cultivation.
Residual	Extending to limit of drilling at 20m bgl.	Clayey SILT: light brown with some white, medium to high plasticity, dry, becoming moist with depth, hard, with a trace of sand, fine to coarse grained, with some remnant feldspar and gravel observed

The subsurface material excavated in the test pits was consistent with that observed within the boreholes. The material was similarly found to have a very stiff to hard consistency with the exception of the upper 300mm which was observed to have been ploughed or disturbed.

There is no free water and no evidence of salinity. It is also noted that sheet erosion in the area is only minor in nature.

Based on the soil conditions encountered, the soil is considered to be non-aggressive to both concrete and steel.

8.2.2 Groundwater

The quality of the groundwater in the Parkes Shire ranges between that which is suitable for livestock containing salt of 1,000 - 3,000 mg/L and some domestic and limited industrial uses, to poor quality with salt concentrations greater than 14,000 mg/L. There are 19 licensed bores in the vicinity of Parkes to depths ranging from 7 to 85 meters. Studies conducted in the vicinity of North Parkes Mine (located approximately 20 km north west of the site) indicate the groundwater level is >25m. Peak Hill Gold Mine (approximately 50 km north of Parkes) has found only small inflows at depths below 90 metres and Australian Topmaking Services in west Parkes found groundwater at 45 m with no evidence of perched water tables in the clay subsoils or alluvium.

No free groundwater was encountered in the boreholes to the depth limit of the investigation (20m). The materials encountered at this depth were dry to moist indicating that the groundwater table was well below this depth.

During field investigations associated with the preparation of this Environmental Assessment, a drilling contractor operating in the vicinity of the eastern end of the proposed natural gas pipeline (i.e. approximately 10km east of the power plant site) advised that he had encountered groundwater at a depth of 50m and it is understood the water table dips deeper as one moves west from the Parkes township.

On this basis it is predicted that groundwater at the site for the proposed Parkes Peaking Power Plant Project is well below the surface and would be well below any site excavations or excavations associated with the construction of the natural gas pipeline to the power plant site.

Chapter 8**Soils, Geology and Groundwater****8.3 Assessment of Potential Impacts****8.3.1 Construction Phase Impacts*****Erosion of Disturbed Areas***

During the construction period, the majority of the power plant site would be disturbed to construct the plant & ancillary plant foundations, to construct access roads, to install buried pipelines, drains and conduits etc, and landscape the perimeter buffer zone. Rainfall on the disturbed sites during construction may cause soil erosion and runoff may contain high levels of sediments which could then enter the natural drainage system. The soils at the site are likely to have a high percentage of fines, and may be dispersible. Given the relatively flat slopes for most of the areas which would be disturbed, most of the disturbed sites are likely to present minimal erosion hazard.

Groundwater

Based on the field investigation, it is predicted that the water table under the power plant site would be at a depth well below the proposed depth of excavation. The presence of groundwater would be confirmed prior to commencement of construction and, if necessary, management procedures prepared in relation to construction implemented.

Moisture Reactivity

Shrink/swell potential is the relative change in volume to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. The design of buried services and structures on shallow footings needs to take into account the moisture reactivity of the near-surface soils.

Of the two samples tested from the site, one inferred a **low/medium**, and the other a **high**, shrink/swell potential. Additional sampling and testing may be required to better define the moisture reactivity of the site.

Liquedaction Potential

Liquefaction can occur in soils below the water table when an increase in pore pressure (typically related to an earthquake) results in a decrease in the effective stress (strength) within a soil. When the pore pressure is equal to the effective stress, the material loses its strength and liquefies. This phenomena is typical of sands, especially loosely compacted ones.

As no groundwater was encountered during the field investigation, and given the high density and significant clay and silt content of the soils, it is considered that there is negligible likelihood of liquefaction at the site.

Soil Contamination

Given the undeveloped nature of the site, with the exception of the TransGrid substation adjacent to the north, it is unlikely that soil has been significantly impacted by pastoral/cropping activities to date. As a result, it is unlikely that any soil contamination is present on the power plant site.

Construction Sediment Ponds

The in-situ material or site-won fill would be structurally adequate for construction of sedimentation ponds (if required) receiving general site runoff during construction.

Foundations

It is not anticipated that the bearing pressures exerted by the gas turbine subfoundations will exceed 100kPa, and the insitu material can be expected to accommodate such loadings with satisfactory settlement performance.

8.3.2 Operational Phase Impacts

Normal engineering practice is to implement regular inspection and maintenance of all operation areas to ensure proper performance of the facilities in accordance with their engineering design.

There is potential for contamination at the site during operation from spills of fuel, oil or chemicals.

Surface water from the site that may potentially be contaminated could include:

- rainfall runoff from operational areas of the site; and
- accumulated water within bunds.

In addition where flows are concentrated soil erosion may occur. The impacts of surface water flows are addressed in **Chapter 14**.

Evaporation Ponds

The in-situ materials or site-won fill would be structurally adequate for construction of evaporation ponds. However, the integrity of these materials as a low-permeability lining cannot be relied upon and consequently there would be a risk that the process wastewater could escape unless mitigation measures were implemented.

8.4 Mitigation Measures

8.4.1 Construction

Excavation and foundations

For structures founded on engineered fill, or on natural material close to existing surface levels, an allowable bearing pressure of 150 – 200 kPa would be readily achievable, and these areas can be expected to behave typically as a “Class M” site as defined in the Residential Slabs and Footings code AS2870.

It is anticipated that the gas turbine-generator sets would be founded on reinforced concrete rafts extending to about 1.5 m below the prepared site platform. This would be confirmed in detailed design.

Where fill is proposed to be beneath structures, it is anticipated that the fill would be compacted to 98% (Standard) dry density ratio at a moisture content in the range (Optimum Moisture Content $\pm 2\%$). In areas where fill is not planned to be used as a permanent structural foundation, compaction to 95% standard would be suitable.

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A Construction Soil and Water Management Plan would be developed and implemented for the construction works to ensure effective management of potential soil erosion issues. Construction would be planned to minimise the time that disturbed land is exposed. Disturbed sites would be quickly revegetated or covered with a non-erodible surface following construction. During the construction period water may be required for dust suppression.

Construction Sediment Pond

The insitu material or site-won fill would be structurally adequate for construction of sedimentation ponds (if required) receiving general site runoff and consequently the provision of a synthetic liner would not be necessary.

8.4.2 Operation

Management of surface water flows from the power plant site are described in detail in **Chapter 14**. The outlet of the power plant site stormwater system would be designed to maximize the dispersion of these high flows and thereby minimise their potential to cause soil erosion downstream.

Appropriately bunded areas would be included for storage of fuels, oils and chemicals.

Operational areas within the plant area would be appropriately drained so that surface runoff would be prevented from infiltrating directly into the ground and reaching the groundwater.

Evaporation Pond

Provision of an impermeable liner for the evaporation pond would be necessary to minimise the risk of the high salinity blow-down escaping into the deep natural groundwater system.

8.4.3 Summary

The mitigation measures and safeguards would ensure that soils and groundwater are satisfactorily managed using suitable design, construction and management. Accordingly any impacts on soils resulting from the construction and operation of the proposed Parkes Peaking Power Plant Project will be negligible.

Table 8-2 presents the mitigation measures proposed to address the soil and geological issues for the Parkes Peaking Power Plant Project.

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Table 8-2 Summary of Mitigation Measures

Mitigation Measures	Implementation of mitigation measures		
	Design	Construction	Operation
A nominal cross-falls shall be applied to the platform to provide adequate site surface drainage.	✓	✓	
Assess need for groundwater control and collection system.	✓		
Where practicable, material excavated from the site (except for say 150 mm of topsoil and root-affected material) would be suitable for use as engineered fill in any cut/fill operations.	✓	✓	
Where fill is proposed to be beneath structures, it is anticipated that fill would be compacted to 98% (Standard) dry density ratio at a moisture content in the range (Optimum Moisture Content $\pm 2\%$). In areas where fill is not planned to be used as a permanent structural foundation, compaction to 95% standard would be suitable.	✓	✓	
A Construction Soil and Water Management Plan would be developed and implemented for the construction works to ensure effective management of potential soil erosion issues.		✓	
Construction would be planned to minimise the time that disturbed land is exposed.		✓	
Disturbed sites would be quickly revegetated or covered with a non-erodible surface following construction.		✓	
During the construction period water may be required for dust suppression.		✓	
Provision of an impermeable liner for the evaporation ponds.	✓	✓	
Appropriately bunded areas would be included for storage of fuels, oils and chemicals.		✓	✓
Areas within the operational plant area would be appropriately drained so that surface runoff would be prevented from infiltrating directly onto the ground and from reaching the groundwater.			✓