Soils, Geology and Groundwater – Summary of Key Outcomes

Groundwater at the proposed Buronga Peaking Power Plant site is well below the surface and therefore would be well below any site excavations.

The mitigation measures and safeguards implemented would ensure that soils and groundwater are adequately protected and managed using suitable design techniques and construction management. Accordingly any impacts on soils and groundwater resulting from the construction and operation of the proposed Buronga Peaking Power Plant Project would be negligible.

Chapter 8 Soils, Geology and Groundwater

8.1 Introduction

This chapter presents an assessment of the soils, geology and groundwater of the site for the proposed Buronga Peaking Power Plant Project. The assessment is based on a field geotechnical investigation undertaken by URS (2008) and supported by laboratory soil testing.

Buronga is within the Wentworth Shire which is located on the Lower Murray in the south west of NSW. The general area of the Lower Murray consists of rivers and creeks, saltbush, acacia, casuarina and mallee and wide flat plains. Wentworth Shire covers an area of some 26,000 km^2 and is the second largest shire in NSW. It is located on the junction of the Murray and Darling Rivers. The southern boundary runs along the Murray River bordering Victoria where the townships of Buronga, Gol Gol, Dareton and Wentworth are located (Wentworth Shire Council, 2007).

8.2 Existing Environment

8.2.1 Soils and Geology

Topography

The proposed peaking power plant site is currently being utilised for the purposes of a pastoral lease, and is adjacent to the TransGrid 220kV Buronga Switching Station. General topography in the vicinity of the site is relatively flat. The terrain within the development site is approximately 47m AHD with slope angles less than 5%. The local catchment drains south west toward Lake Gol Gol and Gol Gol Swamp eventually discharging into the Murray River further south.

Geology

The proposed site lies within the Murray Darling Basin and is part of the Woorinen Formation. The formation of the Darling Basin was from major crustal extension through reactivation of faults in the earliest Devonian with the Murray Basin developing during the Cainozoic era. The Cainozoic history indicates slow rates of subsidence coupled with low rates of sediment supply (Kingham, 1998).

Based on the 1:250,000 Geological Map Series, Mildura Map (St 54-11) Edition 2, May 1997, the site is underlain by the Woorinen Formation which consists of Aeolian (deposited by wind) sediments comprising pale to reddish brown calcareous sandy clays, clayey sands and sands, dominated by quartz or gypsum.

Soils

In January 2008, site field investigations were conducted at the site for the proposed facility. One test bore was drilled to a depth of 20m and one test pit was excavated on the site. Soil samples were collected and laboratory tested. The subsurface conditions encountered generally correlate with the geological map information. A summary of the materials encountered is provided in **Table 8-1**.

Table 8-1 General Subsurface Conditions

Geotechnical Unit	Approximate Depth (mbgl)*		Thickness (m)	Typical Summary Description
	To top	To bottom		
Unit 1A	0	0.2	0.2	**LOOSE SAND:** silty SAND, fine grained sand, red brown, with trace coarse sand sized quartz grains, with trace rootlets, dry, loose (TOPSOIL)
Unit 1B	0.2	0.5	0.3	**LOOSE SAND:** silty SAND, fine grained sand, red brown, dry loose
Unit 2	0.2 – 0.5	>3.0 – 3.9	>2.8 – 3.4	**STIFF CLAY:** silty CLAY, very low PI, red brown, with trace fine grained sand, dry, stiff (ALLUVIAL)
Unit 3	3.9	5.5	1.6	**DENSE SAND:** clayey SAND, medium to coarse grained sand, light grey/white, moist, dense (ALLUVIAL)
Unit 4	5.5	>20	>14.5	**MEDIUM DENSE TO DENSE SAND:** clayey SAND/SAND, medium to coarse grained, light grey/white/red/yellow, sub-rounded to sub-angular , predominantly quartz, dry to wet, medium dense to dense (AEOLIAN)

Note: mbgl = metres below existing ground level

8.2.2 Groundwater

A review of the NSW Department of Water and Energy's (DWE) (previously the NSW Department of Natural Resources (DNR)) NSW Groundwater Works (http://test.nratlas.nsw.gov.au) database revealed that there is one bore located approximately one kilometre from the proposed site. The final depth of the bore extended 14.00 m below ground surface level. There was no data available on water bearing zones.

During the field investigations, the groundwater level at the site was observed at a depth of approximately 14.7m. Groundwater is therefore well below the surface and will be well below any site excavations.

8.2.3 Geotechnical

Based on the preliminary geotechnical investigation results, the site is underlain by a thin layer of sandy top soil measuring approximately 0.2m in thickness, underlain by alluvial deposits comprising loose sands, stiff clays and clayey sands up to 0.3m, 3.4m and 1.6m thick respectively, with underlying Aeolian sands of consistent density.

It is anticipated that this material can be excavated using standard earthmoving equipment. The in situ material would be suitable for reuse on site for landscaping, creation of the stormwater pond, embankments and other ancilliary works as engineering fill.

It is anticipated that the gas turbine and generator reinforced concrete foundations would extend approximately 1.5m below the site prepared platform. This would be confirmed during detailed design. The underside of the foundation blocks would be founded in dense or better granular soil, or stiff or better cohesive soil.

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 ±2%). In areas where fill is not planned to be used as a permanent structural foundation, compaction to 95% standard would be suitable.

Excavated material from the site would be suitable for use as engineered fill, and can provide suitable foundation conditions for the transformers and ancilliary buildings.

8.2.4 Potential Acid Sulphate Soil Materials

Acid sulphate soils are typically found in low lying areas of coastal floodplains such as rivers, creeks, lakes and mangroves in coastal creeks and rivers below 5m AHD. The desk top study and site investigation shows that the proposed site has no known occurrence of potential acid sulphate soil material.

8.2.5 Potential Contaminated Areas

A review of past and current landuse activities was undertaken as part of this EA. A search on the NSW Department of Environment and Climate Change (DECC) Contaminated Land Records (www.epa.nsw.gov.au/clm/searchregister.aspx) database revealed no records within the Local Government Area of Wentworth Shire. Land use in the area is identified as being primarily agricultural with the current use of the site being for pastoral purposes. There is an existing TransGrid high voltage switching station adjacent to the site. Existing land use suggests the likelihood of contamination at the site is very low.

8.3 Assessment of Potential Impacts

8.3.1 Construction Phase Impacts

Erosion of Disturbed Areas

During the construction period, the majority of the peaking power plant site would be disturbed to construct the main plant and ancillary plant foundations, to install buried pipelines, drains and conduits, and to landscape the perimeter buffer zone. Rainfall on the disturbed areas during construction has the potential to cause soil erosion and runoff may contain sediments which could then enter the natural drainage system. This would be managed by the implementation of appropriate techniques such as installation of drains to divert runoff around and away from construction areas and stabilisation of banks and stockpiles. However, given the flat topography at the site, most of the disturbed areas are likely to present minimal erosion hazard.

Groundwater

The water table under the proposed peaking power plant site is well below the proposed depth of excavation. The risk of contamination to groundwater should any pollutants infiltrate the overlying soils during construction would be low given that potential pollutants used during the construction phase such as oils and machinery fuel would be stored in bunded areas and managed to ensure any risk of spill is minimised.

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.

Shrink/swell data available for the site is limited. However, the silty clay with some coarse grained sand, underlain by medium dense to dense sand indicates that the site may have a “low-medium” reactivity to seasonal moisture variation. This would be managed in the detailed design phase. Additional sampling and testing may be required to better define the moisture reactivity of the site for detailed design of structures and services.

Liquefaction 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.

Although groundwater was observed within the borehole, the depth of the water strike (14.7mbgl), coupled with the medium dense or dense nature of the sand, indicates that there is little potential for liquefaction at the site.

Soil Contamination

Given the undeveloped nature of the site, it is considered unlikely that the soil has been significantly impacted by the pastoral activities to date. As a result, it is considered unlikely that any soil contamination is present on the 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 anticipated that the in-situ material can be expected to accommodate the loadings from the gas turbines and other associated plant and structures with satisfactory bearing capacity and settlement performance. This would be confirmed during detailed design.

8.3.2 Operation 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.**

Stormwater and Wastewater Storage Ponds

The in-situ materials or site-won fill would be structurally adequate for construction of the stormwater and wastewater storage ponds. However, the integrity of these materials as a low-permeability lining cannot be relied upon and consequently the risk that stored water would escape will be addressed by provision of a low-permeability lining to these ponds.

8.4 Mitigation Measures

8.4.1 Construction

Excavation and Foundations

Excavations expected on the site, typically relating to forming up ponds, landscaping and excavation of shallow foundations and services trenches, would be practicable using conventional earth moving equipment.

For structures founded on engineering fill, or on natural material close to existing surface levels, an allowable bearing pressure of 150 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 and generator reinforced concrete foundations would extend approximately 1.5m below the site prepared platform. The underside of the foundation blocks would be founded in dense or better granular soil, or stiff or better cohesive soil. Founding the gas turbine and generator foundation blocks at this depth below existing general platform level would significantly reduce the potential for it to be affected by shrink/swell movement. If necessary the potential for any residual shrink/swell movement can be eliminated by sub-excavation of any residual silty clay below the foundations to about 2.5m below final adjacent surface level, and replacement to sub-foundation base level with non-reactive fill. This would be confirmed during the detailed design stage.

Excavated material from the site would be suitable for use as engineered fill, and can provide suitable foundation conditions for the transformers and ancilliary buildings.

Service lines buried in the site soils (either in-situ soils or engineered fill) or founded on these soils could be subject to shrink-swell effects resulting in differential movements relative to the main plant foundations and services connections to the gas turbine units would need to be provided with adequate articulation or flexibility to accommodate such movements.

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 ±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 areas would be quickly revegetated or covered with a non-erodable surface following construction. During the construction period water may be required for dust suppression.

8.4.2 Operation

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

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

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

Stormwater and Wastewater Storage Ponds

To mitigate any impact of increased peak flows during flood events, stormwater detention would be provided on site. It would be designed so that flows from 5yr, 20yr, 50yr and 100yr Average Recurrence Interval storms do not exceed existing flows from the site (refer **Chapter 14**).

Provision of an impermeable liner for the storage ponds would be necessary to minimise the risk of the high salinity waste from the water treatment plant escaping.

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 Buronga facility will be negligible.

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

Table 8-2 Summary of Mitigation Measures

Mitigation Measures	Implementation of mitigation measures		
	Design	Construction	Operation
A nominal cross-fall 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 it would be compacted to 98% (Standard) dry density ratio at a moisture content in the range (Optimum Moisture Content ±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 and erosion issues.	√	√	
Construction would be planned to minimise the time that disturbed land is exposed.		√	
Disturbed areas would be quickly revegetated or covered with a non-erodable surface following construction.		√	
During the construction period water may be required for dust suppression.		√	
Provision of an impermeable liner for the stormwater and wastewater storage ponds.	√	√	
Discharge from the stormwater pond would be through an appropriately designed dissipating structure to minimise soil erosion potential.	√		√
Appropriately bunded areas would be included for storage of fuels, oils and chemicals.		√	√
Water falling onto operational areas of the site would be collected and directed through an oil trap, gross pollutant trap and a sedimentation pond before discharge from the peaking power plant site.	√	√	√