10 GROUNDWATER

10.1 INTRODUCTION

This chapter provides groundwater related information in response to various submissions on the EIS and refinements/modifications to the Project. The information presented builds on the EIS Volume 1, Chapter 10 Groundwater and should be read in conjunction with the EIS chapter. This chapter provides further information on selected items, including geological strata, community bores, and impacts and mitigation measures.

10.2 METHODOLOGY OF ASSESSMENT

Relevant policy, legislation and guidelines

The Environmental Protection Regulation 2008, section 64 may apply to the Project, due to the potential for indirect release of contaminants to groundwater, due to in-pit fine rejects (tailings) disposal to mined-out pit voids. Chapter 6 Project Operations, section 6.4.4 and section 10.8 below provide further information regarding indirect release of contaminants to groundwater.

10.3 EXISTING ENVIRONMENT

10.3.2 HYDROLOGY

Middle to Upper Jurassic Injune Creek Group Strata, particularly the Juandah Coal Measures

This section provides information and clarification on the Middle to Upper Jurassic Injune Creek Group strata, particularly the Juandah Coal Measures, additional to that provided in the EIS Volume 1, Chapter 10 Groundwater, section 10.3.2. The group strata geological unit comprises interbedded mudstone, sandstone, and siltstone, with minor calcareous rocks, and coal. These sediments, when altered (deeply weathered, fractured, or faulted) have the potential to provide limited sustainable groundwater supplies.

WJV exploration boreholes within the Project area are targeting the upper seams in the Walloon Subgroup, which ranges in depth from 15 to 200 m. The Walloon Subgroup is a unit of the Injune Creek Group, and contain two distinct coal-bearing formations namely the lower Taroom Coal Measures and the upper Juandah Coal Measures. The Tangalooma Sandstone separates the Taroom Coal Measures from the Juandah Coal Measures. These two coal sequences contain the substantial, potential thermal coal resources of the Surat Basin.

The Wandoan Coal Project will target the Kogan, Macalister (Upper and Lower), and Wambo coal seams within the Juandah Coal Measures. Typically, the seam groups are continuous over most of the deposit, even if individual seams are highly attenuated in part. These coal seams can act as coal seam aquifers, as groundwater occurs predominantly within the coal cleats. The coal seams of the Juandah Coal Measures are relatively flat lying with a regional dip of no more than two degrees to the south-west. Local increases in dip to three degrees do occur, probably as a result of differential compaction around sandstone bodies. Two of the deposits have defined faulting that could enhance groundwater potential. No igneous intrusions have been detected within the coal measures sequence. Groundwater occurs predominantly within the coal cleats and water make depths are highly variable (based on exploration drilling data). The interbedded sandstone, siltstone and mudstone act as semi-confining layers and separate the water bearing zones within the coal seams.

A regional groundwater contour map has not yet been compiled as the current groundwater levels were recorded in open monitoring boreholes, with the exception of the new monitoring boreholes. The current open boreholes used for groundwater level recording intersect different aquifers which, if intersecting confining layers without installing bentonite seals, will provide combined piezometric groundwater levels for the area. As additional correctly constructed monitoring bores are installed across the MLA areas, the recorded groundwater levels will allow for groundwater contour maps to be compiled for each of the underlying aquifers.

Water level data from R9096 and R9098 both shallow and deep piezometers, suggest that within the Project area, the water bearing zones within the coal seams are hydraulically connected, that is water levels in shallow and deep piezometers are at the same level.

Cross sections showing the stratigraphic profile of the coal seams across the Project area are shown in EIS Vol 1 Chapter 10 Groundwater, technical report TR10-1-V1.5, Attachment G. These sections were derived using the Vulcan model with lithology logs obtained from the WJV exploration drilling program, with the geological model used for assessment extending to 80 m depth. Included in these sections are the preliminary location and depth of the mine pits, and details regarding logged observations of water make in the exploration boreholes. Together the information provides a graphical view of the potential depth and number of pits that may make water. It should be acknowledged however, that unless specifically hydrogeologically logged, the notation of water make in an exploration borehole should be considered indicative only, rather than a definitive indication of the depth and amount of water make.

The yields from bores across the MLA areas are highly variable, both vertically and spatially. Limited groundwater volumes have been intersected in boreholes with depths between 25 and 35 m. Deeper bores have intersected more marked water bearing horizons (below 50 m) in the Wambo coal seams.

Within MLA 50230 and 50231, in areas between Woleebee and Frank Creeks, the strata is relatively dry, likely due to topographic elevation and low potential for recharge to the underlying stratigraphy. The creeks have formed along paths of least resistance that could suggest structural zones or where changes in the geology composition occur, enhancing the pathways for vertical groundwater movement from the surface. The possibility of surface/groundwater interaction in these areas is being investigated to ascertain if surface water recharges the groundwater in these discrete areas.

Water quality data for the Juandah Coal Measures suggest that groundwater from the coal seams are saline, decreasing in salinity with depth. Salinity is sodium-chloride dominant. Recorded values of Electrical Conductivity (EC – a measure of salinity) of up to 26,000 µS/cm have been observed in the shallow water bearing seams (up to 50 m depth – i.e. the Kogan seams). EC values are typically between 8,000 to 18,000 µS/cm for the deeper seams (50 to 100 m depth – i.e. the Macalister and Wambo seams). pH increases with depth, typically neutral in the shallower water bearing zones to slightly alkaline (up to pH 9) in the deeper zones.

Low levels of nitrate and phosphorous have been detected in some of the new monitoring bores, these nutrients are not typically associated with the country geology rocks, thus these data need to be compared with other bore samples in the area to obtain a better understanding of potential contaminant recharge sources (such as creek flow). There are trace levels of Arsenic in some groundwater samples, although all observations are still within the Australian drinking water standards of 0.007 mg/L As.

Early Jurassic Great Artesian Basin, particularly Hutton Sandstone

This section provides information and clarification on the Early Jurassic Great Artesian Basin (GAB), particularly Hutton Sandstone, additional to that provided in the EIS, Volume 1, Chapter 10 Groundwater, section 10.3.2.

The Hutton Sandstone is located at depth (> 400 m) below the base of the mine. This major GAB aquifer unit is the targeted aquifer by local community bores due to its highly transmissive nature. The groundwater resources within the Juandah Coal Measures are related to semi-confined coal seam aquifers, which are interbedded with sandstone, siltstone and mudstone.

Currently, there is no evidence to suggest that a hydraulic link (conduits either man-made such as poorly sealed deep exploration bores or natural, faults or fractures) exists between the coal seam aquifers below or within the proposed mine pits, and the Hutton Sandstone aquifer. The vertical hydraulic transmissivity of the interbedded sediments (aquifers and aquitards) between the Juandah Coal Measures and the Hutton sandstone, some 400 m, is very low. Thus the potential for induced flow due to the dewatering of the coal seam aquifers on the GAB aquifers is negligible.

Deep bores (600 to 1,200 m) extracting groundwater from the Hutton and Precipice Sandstones will not be impacted due to the significant depth of separation. Table 10-1 presents the lithostratigraphy of the area, including thickness data, to illustrate the aquifers and confining units between the surface mining and the GAB aquifers.

Table 10-1: Lithostratigraphy

Age	Group	Formation		Lithology	Average thickness (range)	Aquifer characteristics
Quaternary				Alluvium: unconsolidated sand, gravel, and clay	< 20 m	Discontinuous unconfined aquifer with limited effective storage
				Alluvium: sand, gravel, and soil cover		
Unconformity						
Middle to Upper Jurassic	Injune Creek	Westbourne		Grey carbonaceous micaceous siltstone grading to mudstone, very fine quartzose to sublabile sandstone	110 m (60 – 200)	Aquitard with low yielding bores (< 3 L/s)
		Springbok Sandstone		Fine to coarse labile sandstone, in part calcareous; siltstone, mudstone; minor coal	71.5 m	Confined aquifer
		Juandah Coal Measures	Walloon Subgroup	Medium to coarse grained lithic sandstone, siltstone, mudstone and coal seams	170 m	Confined coal seam aquifers
		Tangalooma Sandstone		Sandstone and minor coal	40 to 80 m	Confined aquifer
		Taroom Coal Measures		Sub-labile medium grained sandstone, interbedded sandstone, siltstone, mudstone and coal	100 m	Confined coal seam aquifers
		Eurombah		Cross-bedded thickly bedded fine to coarse clayey labile sandstone, polymictic conglomerate, siltstone, mudstone	50 m (20 – 80)	Low yielding aquitard
Lower to Middle Jurassic	Bundamba	Hutton Sandstone		Argillaceous sublabile and quartzose sandstone, minor mudstone, rare pebble conglomerate beds	150 m (100 – 350)	Major GAB aquifer

Age	Group	Formation	Lithology	Average thickness (range)	Aquifer characteristics
Lower Jurassic		Evergreen	Interbedded sandstone, mudstone, shale, siltstone	105 m (10 – 260)	Confining bed
		Precipice Sandstone	Bedded quartzose sandstone, sublabile lithic sandstone, siltstone	100 m (20 – 140)	Major GAB aquifer

1. The Walloons Subgroup has an average thickness of 227 m (range 100 to 460 m)

The Walloon Subgroup coal seams are targeted for coal production by the WJV where it occurs close to surface. It is understood that coal seam gas (CSG) producers have made applications or propose to make applications for approval to carry out CSG production activities in and around the MLA areas. The CSG producers will typically target the Walloon Subgroup at depth (> 500 m) to ensure sufficient pressures required for CSG to be present.

10.3.3 GROUNDWATER USE

Community bores

EIS Volume 1, Chapter 10, section 10.2.1 incorrectly reports that multiple landholders are serviced by community bores via bore drains. Following submissions on the EIS, landowners have indicated that they obtain water via bore pipelines from the community bores.

There are twelve community bores that have been identified within the study area that have the potential to supply water to more than one property. These bores and their property associations have been identified through extensive community consultation and a thorough review of available documentation.

Available records indicate that these bores are extracting groundwater from either the Hutton Sandstone or Precipice Sandstone aquifers from depths ranging between 600 and 1,200 m. Both of these aquifers typically provide a reliable and good quality supply in comparison the shallow coal seam aquifers in the area. The details of the community bores inspected during the hydrocensus are also included in EIS Vol 1, technical report 10-1-V1.5, Table 3-11 with additional and updated details is provided in Table 10-2 below.

Table 10-2: Summary of community bores

Registered number	Community/ reference	Aquifer	Allocation per water year (ML/a)	Purpose
58133	Juandah	Hutton Sandstone/Evergreen Formation	75	Stock, Stock intensive
-	Hinchley	No information	No information	Domestic and stock
58484	Grosmont	Lower Evergreen Formation and Precipice Sandstone	100	Group domestic, stock
58850	Yabba	Precipice Sandstone	Not specified	Domestic and stock
102714	Culgowie	N/a	80	Group domestic, Stock
400405	Bimbadeen	Precipice Sandstone	Not specified	Domestic and stock
58377	Playfair	Hutton Sandstone	50	Group domestic, stock
-	Burunga	No information	No information	No information
Unidentified	Cherwondah	Reported depth of 670.5 m suggests Hutton Sandstone	No information	Stock
-	Trelinga	Hutton Sandstone	No information	Domestic and stock
-	Peakes	No information	No information	No information
22117	Pecos Valley	Hutton Sandstone	No information	Stock

There are no community bores within MLA 50230, but five bores are associated with supplying water to properties within the southern portion of MLAs 50230 and 50231 (Pecos Valley, Trelinga, Peakes, Cherwondah and Burunga). In addition, Playfair Bore is located just northeast of MLA 50230 and supplies water to properties in this region. On and around MLA 50229, there are four community bores (Grosmount, Yabba, Hinchley and Juandah). Culgowie and Bimbadeen are the other two known bores which have multiple properties associated with these bores, and in comparison to the other bores, are further away from the MLAs. The updated location of community bores is shown in Figure 10-6-SV1.3.

Water licence records for all community bores were not available at the time of preparing the Supplementary EIS. However, Table 10-2 above provides a summary of the current available information for the registered community bores. Licence details typically stipulate the parcel of land to which the licence is attached, that is the parcel on which the bore is situated, as well as any attached parcels of land, being the land on which the water can be used/distributed. Furthermore the details of the licensee indicate whether a community group/organisation or a number of landholders is authorised to take water.

The GAB Water Resource Plan and Resource Operations Plan provide the mechanisms for the protection of existing users' entitlements and environmental flows associated with springs and baseflow.

10.4 DESCRIPTION OF PROPOSED DEVELOPMENT

10.5 POTENTIAL IMPACTS

10.5.1 POTENTIAL IMPACTS DURING CONSTRUCTION AND OPERATION

Impacts to the GAB

The shallow mining is envisaged to impact on shallow alluvium, weathered, and coal seam aquifers. No impacts on the deep Hutton or Precipice GAB aquifers are envisaged from the mining activities due to the thick layers of sediments between the mining and the GAB aquifers and the vertical separation being in the order of 400 m and absence of conduits.

Additional discussions regarding the use of water from the Precipice Sandstone aquifer for construction purposes is discussed in Chapter 11 Water Supply and Management.

Effects of blasting on bore infrastructure

The effects of blasting on bores, including community bore infrastructure is discussed in the EIS Volume 1, Chapter 16 Vibration, section 16.5.2.

Specifically the Juandah community bore and associated pipelines is shown in Figure 10-6-SV1.3, with the pipelines indicatively identified, as the extent of the pipelines requires field verification. The bore construction information received from the DERM (formerly NRW) groundwater database suggests the bore is sleeved with steel casing to the completed depth of 686 m below ground level. The effect of the blasting on the bore will ultimately depend on the current status of the 25 year old steel casing and welded joins. As detailed in EIS Volume 1, Chapter 28, the WJV will undertake, with the co-operation of landowners, condition surveys of buildings and structures within 2 km of blasting activities prior to commencing blasting operations. The current status of the bore casing can be determined using a down-hole camera and bore integrity testing can be considered.

Prediction of groundwater inflows

During operational activities in pits, any water that collects in the pits from groundwater seepage or direct rainfall will be pumped from the pits into environmental dams, as part of the water management system, discussed further in Chapter 11 Water Supply and Management.

Regarding groundwater management associated with fine rejects (tailings), the impact of the disposal of wet material may result in decant and seepage. An assessment of the hydrogeology to determine the surface water and groundwater (Wambo coal seam sub outcrop) interaction will be conducted. Monitoring bores will be constructed in these areas to evaluate the piezometric levels within the area of the proposed tailings disposal facilities Decant potential will be evaluated.

The monitoring bores will be located between the local creek systems and the tailings disposal sites and along strike of the coal seams adjacent to the proposed tailings disposal voids. The bores will be designed and constructed to allow for the measurement of piezometric levels and to obtain

groundwater monitoring data. A minimum of three approximately 60 m deep monitoring bores are to be constructed at each of the proposed tailings disposal sites.

Exploration bores drilled in these areas may be used for multipiezometers constructed within the 125 mm diameter bores. These bores will be used for long term monitoring around the CPP and tailings storages to allow for the verification of geochemical predictions and to assess potential impacts of the CPP and tailings disposal. This network will be incorporated into the detailed design plan for the tailings storage facilities

10.5.2 POTENTIAL IMPACTS POST-MINING

Groundwater resources

In the pit voids that are not used for tailings storage, if higher rainfall periods result in water being held in the pit voids, and if water levels in the pits are higher than the regional water levels next to the pits, recharge to the local aquifers could potentially take place. However, given that surface water catchment size will be minimised where practical, and that groundwater inflows are anticipated to be limited to negligible, and based on the typical climatic conditions in the Wandoan area, the potential for impacts on local aquifers is considered to be low.

The deeper Hutton and Precipice Sandstone aquifers are located approximately 400 m below the mine site and will not be affected due to the negligible risk of induced flow.

Existing groundwater users

10.6 MITIGATION MEASURES

10.6.2 OPERATIONS

Following submissions on the EIS regarding the WJV's commitment to 'make good' mitigation measures where groundwater modelling or monitoring demonstrates that mining activities will have an unacceptable impact on the local shallow bores within the area surrounding the MLA areas, the WJV clarifies that this commitment does not extend to compensation for any loss of productivity as a result of water loss, although the 'make good' measures may include, where appropriate, sinking of new bores, replacement or deepening existing bores, cement grouting to the full depth of the bore, or providing an alternative water supply. The make good commitment would replace the groundwater supply in terms of volumes and quality, which will be either the same or better.

10.7 RESIDUAL IMPACTS

10.8 MONITORING PROGRAM

Additional information will be sought from landholders, within a reasonable buffer of the MLA boundary, as part of the proposed groundwater monitoring augmentation program outlined in EIS Volume 1, Chapter 10 Groundwater, section 10.8. Additional monitoring of bores for baseline quality and quantity across the entire mining lease area, within the alluvium aquifers, and adjacent to the potential contaminant sources (such as the tailings disposal facilities and CPP) is planned. The analysis and interrogation of the additional hydrogeological information will allow for the compilation of a more effective groundwater monitoring program in terms of monitoring points, frequency of monitoring, and monitoring parameters.

The initial groundwater investigation was concentrated within MLA 50230, however, available geological information (from exploration drilling records) indicate that the aquifer hydraulic characteristics in MLAs 50229 and 50231 are expected to be similar. The surrounding groundwater levels reported in the EIS were obtained from three sources:

- data obtained during the hydrocensus (bore census) based on actual groundwater level measurements taken from bores
- if no access into the bore was available due to the pumping equipment, information was supplied by the landowner
- water level data from historic DERM (formerly NRW) bore registration records.

New monitoring bores installed as part of the preparation of the EIS, plus additional monitoring bores following submission of the EIS have been constructed according to the Minimum Construction Requirements for Water Bores in Australia (Queensland Department of Natural Resources, 2003). The monitoring bores have been equipped with groundwater level loggers (pressure transducers) with sub centimetre accuracy. These loggers are currently recording natural fluctuations in groundwater levels across the site prior to any mining influences. These data will be utilised for comparison during mining to assist in evaluating possible mining impacts on groundwater levels, either dewatering or artificial recharge.

The downloading of the logger data (on an initial quarterly basis) will make up part of the groundwater monitoring plan that will include groundwater quality samples. Groundwater samples will be collected and preserved / stabilised according to recognised procedures to ensure accurate repeatable laboratory results. The groundwater samples, collected from the various shallow aquifers (alluvium, coal seam, and weathered Injune Creek sediments) and analysed for major anion and cations, selected metals, and selected nutrients. A groundwater quality database will be compiled prior, during and post mining for interrogation to determine mining impacts on groundwater quality.

As outlined in EIS Volume 1, Chapter 10, section 10.8 and Chapter 28, Table 28-1, the WJV has committed to developing and maintaining an ongoing groundwater monitoring program of the groundwater systems identified as possibly being impacted by the proposed shallow surface mining. The physical extent of the monitoring program will be determined in discussions with DERM (formerly NRW) during the development of the program. Additional groundwater data will be compiled during the construction and testing of the new monitoring bores, as detailed in the EIS commitments, which will allow for a reassessment of the empirical calculations regarding zones of influence (initial dewatering zones are calculated at ~ 2 km around each of the pits). Where shallow neighbouring bores may be impacted by reductions in shallow groundwater levels then there is an option to install a monitoring bore between the proposed pits and neighbouring bores (e.g. bore 15831). These bores will allow for the recording of groundwater level changes with time.

The initial census of groundwater users and usage, including springs and seeps, was carried out as part of the EIS. The bore census was conducted up to 5 km from the MLA boundary and included a review of all bores registered on the DERM groundwater database. Based on the results and aquifer testing of the six (6) original monitoring bores constructed by PB during the EIS compilation an assessment of the zone of influence around each of the proposed mining pits was calculated. These calculations, based on shallow mining (60 m) and poor aquifer parameters (only 1 of the 6 bores had sufficient water to conduct a pump out test), recognised that the dewatering during mining would result in possible reduction in shallow groundwater levels within a ~ 2 km zone from the centre of the pits. It was, therefore, recognised that the 5 km bore census area was sufficient to identify any bores that may potentially be impacted by the mine dewatering.

The bore census and DERM bore records were evaluated to determine only the bores that intersected the shallow aquifers (alluvium, coal seam, and weathered Injune Creek sediments) as these are the only bores which could potentially be impacted by mine dewatering. All deeper bores, screened within GAB aquifers or target units below the base of mining, will not be impacted by mine dewatering.

After sufficient groundwater data has been collected from the current and proposed monitoring bores an additional assessment of the dewatering (based on the revised mine plan plus the revised tailings disposal scheme) will be conducted. A conceptualisation of the hydrogeology, the zones of influence, and the identification of shallow bores within these zones, will be compiled. The groundwater monitoring network will be altered accordingly to monitor groundwater levels within these areas and bores allowing for the verification or alteration of predictions.

For example, where the conceptual groundwater model or uncertainties in the extent of influence on the groundwater system exists, the monitoring program may be expanded to include existing suitable constructed private bores to be incorporated into monitoring network, examining water levels and groundwater quality.

The monitoring program will allow for the collection of sufficient data (spatially and with time) to allow for the development of seasonal changes in groundwater levels and quality (wet and dry seasons). These data will be utilised to propose trigger levels, which will be used to assess actual impacts and allow for the implementation of water replacement plans (as per the make good commitment).

In the event of actual or potential impacts being identified, the WJV will develop site specific management measures to address those impacts, as committed to in the EIS Volume 1, Chapter 28, Table 28-1.

Additional groundwater investigations have been carried out since the publication of the EIS. These investigations include drilling of fourteen (14) additional shallow bores into the shallow coal seam measures and the alluvial sediments, adjacent to Mud, Frank, Woleebee, and Juandah creeks across the MLA. The following points summarise the extent of these investigations:

- ten (10) of the 14 geotechnical bores were constructed as monitoring bores to allow for the determination of groundwater and surface water interactions
- eight (8) monitoring bores have been equipped with pressure transducers to collect groundwater level data at 12 hour intervals
- variable head tests were carried out in selected bores in order to obtain site specific aquifer hydraulic parameters for the shallow aquifers and to augment the existing field data
- groundwater sampling (where possible) of the new monitoring bores to obtain additional baseline hydrochemistry for the aquifers targeted.

The additional groundwater investigations are summarised below:

- the exploration program will include the capture of groundwater data, such as water strikes, blow out yields, and alteration. This will add additional groundwater information which will allow for the improvement of the conceptual understanding and the impacts of the mine dewatering on the aquifers
- it is proposed to install monitoring bores in the vicinity of the Coal Processing Plant (CPP) to allow for the monitoring of groundwater parameters to determine potential impacts
- the existing bore hydrocensus will be confirmed, updated and neighbouring bores that could be impacted, based on the revised zone of influence evaluations, will be identified and the hydrogeological data will be captured for later use
- the hydrogeological study is to be extended into MLA 50229 and MLA 50231 with time (as agreed with DERM) after the analysis of the exploration drilling results. The results will assist in identifying locations for groundwater monitoring bores to be constructed
- where possible, constant discharge tests (24 hour) will be carried out to obtain aquifer hydraulic parameters.

Furthermore, it may be possible to use the existing bores for monitoring purposes if bore construction records exist and fall outside the proposed areas directly affected by mine pits and infrastructure. These bores will allow for the evaluation of groundwater trends outside the mining influence.

10.8.1 GREAT ARTESIAN BASIN (GAB) UNITS

CSG production by CSG producers results in the depressurisation of the Walloon Subgroup coal seams and could potentially result in induced groundwater flow, possibly from surrounding GAB aquifers, such as the Hutton Sandstone. Therefore, the Wandoan Coal Project groundwater monitoring program will be increased to distinguish, if possible, between possible potential impacts from shallow surface mining under the Project, and potential impacts from the deeper CSG production projects. Further discussion on this issue is provided in Chapter 26 Cumulative Impacts, section 26.3.4.

Based on the very high costs involved with constructing deep (approximately 675 m) monitoring bores into the deep GAB aquifers (Hutton Sandstone is approximately 600 m deep and Precipice Sandstone is approximately 1,200 m deep), an assessment of available existing bores was conducted to allow for the identification of possible existing bores within the study area, which could be considered for use as GAB aquifer monitoring points by the WJV.

Information obtained from the DERM registered bores database and a bore census conducted during the EIS compilation allowed for the identification of deep bores within and adjacent to the MLA areas. The bore depth data, where available, indicates that the Community bores, as listed in Table 10-2, and the Wandoan Town water supply bores are drilled at depths between 600 and 1,200 m. Based on the stratigraphy shown in Table 10-1, the Hutton Sandstone could be monitored to evaluate possible impacts on the GAB aquifers. It is recognised that the Tangalooma Sandstone unit could be monitored, however, no drilling records, based on DERM data and/or discussions with bore owners during the hydrocensus, are available indicating that this thin unit is not utilised in the study area.

The bore census data, plus the location of the bores in relation to the proposed mine plan, allowed for the identification of deep bores which could be considered for use as monitoring points. These bores include:

- the Jundah Government bore (registration number 58113), which is 676 m deep and intersects the Hutton Sandstone. The groundwater level within this bore is approximately 43 m below surface and is located within MLA 50229
- the Playfair Community bore (registration number 58377), a 675 m deep bore into the Hutton Sandstone. The groundwater level is approximately 55 m below surface, and is located to the east of the MLA areas
- the proposed third Town water supply bore, a new bore to be drilled by the WJV in order to obtain water for the construction phase.

In order to monitor the piezometeric level associated with a specific target unit (Hutton Sandstone) the overlying units (aquifers and confining layers) must be sealed off and the open section of the production well is located only within the target unit. An assessment of the bore logs will need to be conducted to ensure that the bores are only screened across the Hutton Sandstone.

Any of these bores, if suitable, will then be equipped with water level loggers (automatic pressure transducers) in order to monitor the groundwater level at 12 hour intervals. The groundwater levels, either static (no pumping) or dynamic (measured during pumping), will be monitored over time such that long term trends can be established. The trends can identify seasonal variations and the possible impacts of current extraction. The data can be interrogated to determine possible impacts of shallow mining activities, extraction (during construction only), and CSG production through the life of the mine.

10.9 REFERENCES

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