DEPARTMENT OF MINES AND ENERGY RESOURCES
GEOLOGICAL SURVEY
SOUTH AUSTRALIA

REPORT BOOK 97/43

"THE LINKS" AQUIFER STORAGE AND RECOVERY INVESTIGATION

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JUNE, 1997 DME 95/405

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1. INTRODUCTION

Mines and Energy South Australia were approached by "The Links" development consortium to assess the prospects of an aquifer storage and recovery (ASR) scheme at the development known as The links, Lady Bay, south of Normanville to enhance water supply for irrigation. A total of 100 ML per year is required for irrigation purposes.

At this site it is believed that an ASR scheme may be best implemented by a combination of swales, infiltration trenches, and extraction via shallow wells where required or directly from the planned lakes.

A brief desk top study was carried out, followed by a site inspection on 13/11/95 during which the surface geology was noted.

2. SETTING AND SURFACE GEOLOGY

The area is bounded to the east and south east by a ridge covered by sand and calcrete. The area is mainly covered by small sand ridges which tend to run north - south. These dunes are composed of a thick layer of red - brown aeolian sand underlain by a clean white sand. The dunes are likely to be a source of high recharge resulting in mounding of a perched low salinity watertable beneath them.

The lower lying area of interest which will be utilised for the development, between the ridge and the main road, is covered by sands and calcrete capping which occurs extensively across the site in lenses.

3. INTERPRETED SUB-SURFACE HYDROGEOLOGY

The sub-surface hydrogeology of the area has been interpreted from the surface geology and limited water well information.

3.1 Watertable aquifer

This lower lying area of interest is underlain by a sand aquifer (dunes over beach sand, interpreted to be up to (?)10 m thick) which is exposed in the excavation on the western boundary. The watertable is believed to occur at a depth of ~5 - 10 m and has a salinity of 1,000 - 3,000 mg/L. The average well yield is expected to be 1 L/s, however an occasional yield of several L/s can probably be obtained from an appropriately constructed well.

The field inspection of the proposed lake on the western boundary revealed that a permanent watertable occurs in a white sand, which contains abundant shell remains, at ~4 m below ground and has a salinity of 1,050 mg/L. It is believed that the permeability of this aquifer could be as high as 10 m/day.

During the drilling of an auger hole in the bottom of the major eastern excavation, the sand colour changed significantly from pale brown to off white, with dampness occurring at a depth from 2 - 3 m.

The existence of the calcrete layer at 1 - 2 m below the surface and approximately 1 m thick is likely to impede rainfall recharge to the aquifer, possibly up to 80%. The return of irrigation water to the aquifer will be similarly impeded, and may result in slight surface salinisation via evapotranspiration.

If there are groundwater mounds beneath the coastal dunes it is inferred that the hydraulic gradient is in the north westerly direction with discharge occurring around the mouth of the Normanville River.

3.2 Lower sand aquifer

This moderately low salinity watertable aquifer overlies a potentially saline sand aquifer which may occur between 10 - 30 m depth. This saline aquifer is separated from the overlying fresh aquifer by a thin layer of weathered material.

The lower sand aquifer between 30 and 70 m is believed to consist of mudstone, which may act as a confining bed to the underlying (?)Permian aquifer.

3.3 Permian aquifer

The second significant aquifer is possibly of Permian age, and may occur at depths between 70 - 120 m. This is expected to consist of fine sandstones and minor clays. The salinity is expected to be between 1,500 - 3,000 mg/L, and the yield 1 - 15 L/s.

3.4 Basement aquifer

The underlying basement aquifer, lying at a depth of 120 - 200 m, is composed of Archaean (Barossa Complex) mica - schists, and quartz veins. Groundwater salinity may be as low as 1,300 mg/L, and yield up to 10 L/s.

4. SIROTEM SURVEY

A brief Sirotem survey involving 3 separate lines was conducted on 17/11/95 and indicated homogeneous lithology to a depth of approximately (?)50 m, with a change in salinity occurring between 10 and 15 m - supporting the interpretation above.

5. PRELIMINARY WATER BALANCE OF THE WATERTABLE AQUIFER

A preliminary calculation of the water balance of the area 1.5 square kilometres (1 km by 1.5 km) indicates that recharge on the site is approximately 30% of the average rainfall (520 mm) which calculates at 230 ML per year.

The area is under equilibrium, so that inflow is equal to outflow. The outflow can be calculated at 220 ML per year (using a width of 1,000 m, a saturated thickness of 5 m, a transmissivity 50 m^2/day (K = 10 m/day, b = 5 m) and a hydraulic gradient of 0.0044).

It is expected that surface runoff from the study area is negligible, possibly of the order of 10 ML per year.

The volume of water in storage is equal to 750 ML, using a specific yield of 0.1 and assuming 5 m of saturated material. However, the amount of water above dead storage (that available for extraction before producing any harmful upconing of the underlying saline aquifer) can be estimated between 1/2 - 2/3 of the total volume of water in storage. This is equal to 375 - 500 ML.

The demand of 100 ML for irrigation possibly can be supplied, providing the water balance calculation is accurate. However, developing the site (road building, pavements, housing and covering the area with a blanket of low permeability top soil) will reduce the amount of natural recharge significantly. In addition the establishment of trees will result in increased evapotranspiration.

Therefore, the proposed solution to meet current and future irrigation requirements, relies heavily on developing a successful ASR scheme. An ASR scheme will also result in better water quality which has been demanded for building an international the golf course of this calibre.

6. RECOMMENDED HYDROGEOLOGICAL PRELIMINARY ASSESSMENT

It is recommended that the watertable aquifer is investigated due to its shallow depth (which will involve low cost drilling) and apparent low salinity.

The preliminary assessment of the potential for ASR involves a groundwater investigation which includes drilling, discharge and injection testing.

6.1 Groundwater investigation

The following hydrogeological issues need to be investigated for the watertable aquifer.

- The saturated thickness of the watertable aquifer.
- The sequence beneath the watertable aquifer, importantly definition of the separator between the low salinity watertable aquifer and the underlying saline sand aquifer.
- The salinity profile through the watertable aquifer and underlying saline sand aquifer.
- The potential yield from the lake.
- Aquifer parameters, hydraulic gradient and direction of flow.

The following program of investigation, to be further defined, is recommended for the watertable aquifer:

- Installation of piezometers in the watertable aquifer for monitoring (base, middle, capilliary fringe) to be installed at possibly 6 sites (for use with neutron moisture probe).

- Drilling and discharge/injection testing of at least 2 wells adjacent to the existing western excavation (water immediately available from the excavation). In addition further trenches (NZG proposed construction) may be required to be excavated and filled with appropriate material.

It is not anticipated at this stage that investigation of the potential of deeper aquifers will be required.

This work can be carried out at an estimated cost of between $30,000 to $50,000. Departmental supervision, data analysis and report writing can be provided in kind.

7. PROPOSED ASR INJECTION SCHEME

An ASR scheme may involve the following features in conjunction with the planned lakes:

- Swales to recharge trenches lined with appropriate material, with surface overflow discharging into the lakes.

- The potential to use large diameter (>1 m) injection/extraction wells using the Dutch construction and completion methods.

- Extraction can occur from wells or the planned lakes.

In addition:

- Stormwater could be harvested from roof runoff and allowed to run through grass swales for natural filtering, supplementing natural recharge.

- Treated wastewater could also be used to supplement natural rainfall recharge.