CASE STUDY
BUCKLEBOO STATION - SA, AUSTRALIA

ADVANCED METHODS IN GROUNDWATER EXPLORATION
LOCATING PREVIOUSLY UNDETECTED WATER SOURCES FOR DROUGHT PRONE REGIONS

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INTRODUCTION

The Eyre Peninsula is a triangular peninsula located in South Australia. Although Dryland Agriculture dominates the Eyre Peninsula in terms of coverage area (>50%), mining and mineral exploration are important economic drivers in the region and have significant consequences for the water resource management practices (Berens et al 2011, Munday et al 2015).

Climatically, the peninsula is generally temperate with hot, dry summers and cool, wet winters, receiving about 300mL of annual rainfall (Berens et al 2011). Though surrounded by sea, the area is still prone to drought, especially the inland and northern regions. Since mid 2018 the area has been experiencing a drought, facing serious rainfall deficiencies and well below average soil moisture (BOM 2019).

BUCKLEBOO STATION, SA

Buckleboo Station is a pastoral station, situated on the northern Eyre Peninsula in South Australia. The property sits south of Lake Gairdner National Park and west of Gawler Ranges National Park. It's approximately 986 km^2 and holds over two dozen pastoral properties ranging in size from 0.4-99.2 km^2.

Bores of modest production had been drilled on Buckleboo and surrounding stations, but even those that yielded water had extremely high salinity levels, often over 5,000 ppm.

In 2018 the property manager of Buckleboo Station was caught in the current drought, with 33 out of 35 dams dry. Having no other options, he needed to resort to the expensive and inefficient process of carting water throughout the property for domestic and stock uses.

He wanted a solution that would not only make the property more drought resilient but would allow for better distribution of watering points throughout the station. Such a change would enable the implementation of more sustainable grazing practices. Having heard of previous successes, he reached out to a senior member of the GISA Company Group* for assistance in locating groundwater on the property.

Figure 1. Location map of Buckleboo Station, SA

*GISA Company Group founded by The Lawrence Anthony Earth Organization consists of entities operating in Australia, USA, Middle East and South Africa with a mission to implement effective water security solutions

ROLE OF GIS ANALYTICS (GISA) COMPANY GROUP

GISA's objective is to reduce the negative economic impacts of drought through mitigating the risks associated with groundwater exploration.

This is accomplished via specialized, proprietary techniques to detect previously unknown sources of groundwater. Through the identification and proper management of these resources, GISA strives to strengthen drought resilience.

METHODS

Figure 2. Process model of groundwater detection methodology

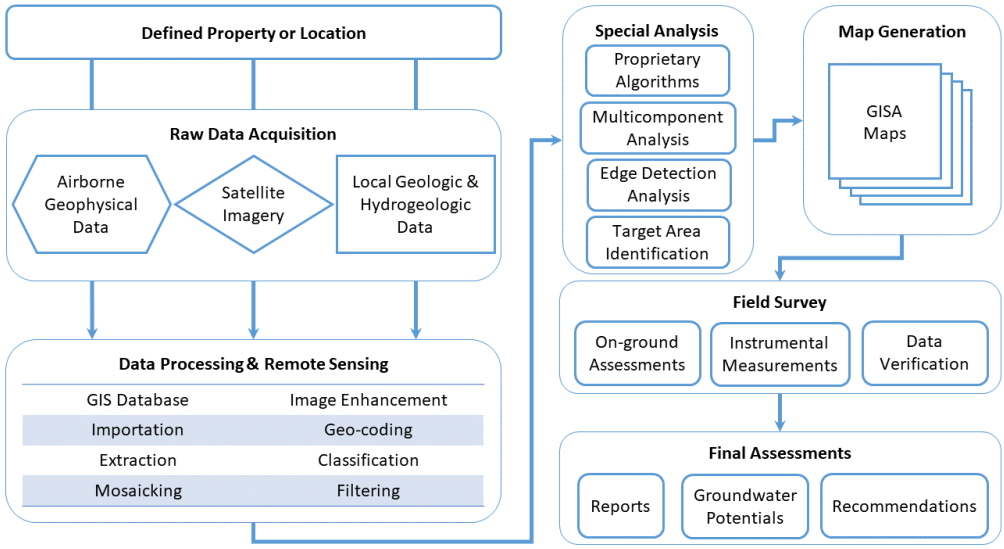
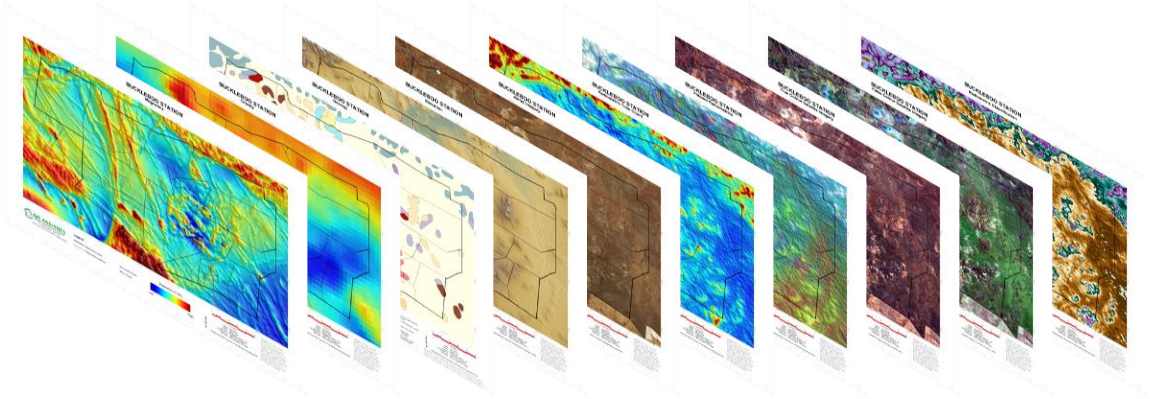


Figure 3. Specialized maps generated and analyzed for Buckleboo Property



DRILLING RESULTS

Based on GISA's analysis, the client pursued the two most highly recommended bore sites. As of July 2020, both bores are still under development, but have yielded excellent preliminary results. Hard rock encountered at both sites necessitated proper planning and real-time modifications by the drillers in order to succeed.

Site 1. Buckleboo Springs

Site 1 is near the homestead and is intended to be utilized for human consumption, if the water quality is satisfactory. A significant water bearing zone was found at approximately 260 metres. Due to structural ground conditions, the driller recommended ceasing at that depth.

Initially, the water was extremely salty, measuring at 22,000 ppm, and a desalination unit was under consideration. However, GISA delivered a report on the various potential sources of salinity in the area, with recommendations for how to proceed.

Based on these recommendations, preliminary pumping was conducted to determine more about the nature of the salinity. After the preliminary pumping, the salinity decreased to 95 ppm, extremely fresh and described as "beautiful to drink" by the property manager.

Site 3. Six Mile Dam

Site 3 is near an existing dam (Six Mile Dam) and is intended to be utilized mainly for stock, if the water quality is satisfactory. Most stock animals require salinity at levels of ≤ 4,000 ppm.

Figure 4. Drilling at Site 3, January 2020.

Significant water bearing zones were encountered at 243 and 320 metres. The flow rate at 243 metres was observed to be approx. 20,000 litres per hour with a standing water level at 24 metres. However, salinity levels of about 5,000 ppm were observed. Following the same recommendations from GISA, preliminary pumping was conducted at the site. Salinity levels decreased to 43ppm, well within the standards for stock and human consumption.

Table 1. Data on drilled bores as of July 2, 2020

Site	Drill Depth (metres)	Flow Rate (L/hr)	Salinity Level (ppm)	Standing Water Level (metres)
1. Buckleboo Springs	268	25,000*	95	18
3. 6 Mile Dam	324	20,000*	043	24

*Estimated values, awaiting final driller report.

Standing Water Level: Flow rates at 268 meters depth of 25,000 lph and at 324 meters depth of 20,000 lph produced significantly high standing water levels (or, piezometric surface) of 18 and 24 meters below the surface, respectively.

A piezometer (from 'piezo' - pressure) measures the height to which a column of liquid rises against gravity. A high piezometric level above the source aquifer strongly implies that it might be a previously untapped, new source (that is, there is nothing else drawing it down.)

REFERENCES

1. Berenes V., Alcoe D., and Watt E. Non-prescribed Groundwater Resources Assessment: Alinytjara Wilurara Natural Resources Management Region: Phase 1- Literature and Data Review. Science, Monitoring and Information Division, Department for Water, 2011. **2.** Bureau of Meteorology, Commonwealth of Australia (BOM). "Drought Rainfall Deficiencies and Water Availability." *Monthly Drought Statement*, Australian Government - Bureau of Meteorology (2019), www.bom.gov.au/climate/drought/#tabs2=Rainfall-deficiencies. **3.** Munday, T., et al. "The role of airborne geophysics in facilitating long-term outback water solutions to support mining in South Australia." *Water: Journal of the Australian Water Association* 42.2 (2015): 138. **4.** Gilfedder, Mat & Munday, Tim & Bestland, Erick & Cahill, Kevin & Davies, Phil & Davis, Aaron & Heinson, Graham & Ibrahimi, Tania & Lamontagne, Sébastien & Ley-Cooper, Alan & Love, Andrew & Olifent, Vanessa & Pichler, Markus & Robinson, Neville & Smith, Stan & Sorensen, Camilla & Suckow, Axel & Taylor, Andrew & Thompson, Jessica & Annetts, David. (2015). Facilitating Long-term Outback Water Solutions (G-FLOWS Stage-2) Final Report.