GSWA HARVEY 1

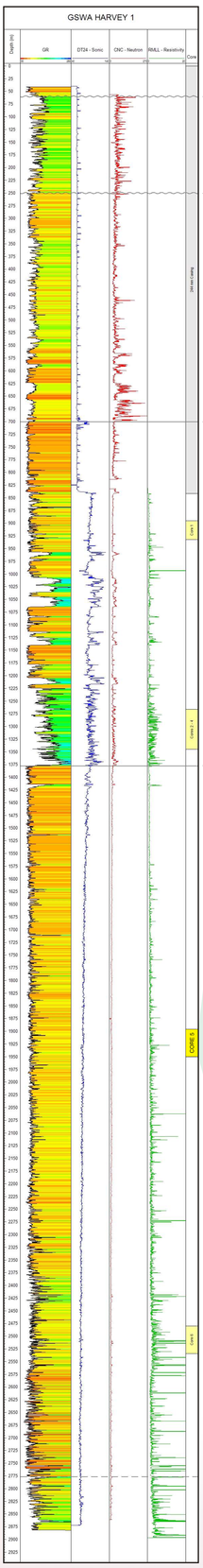


Figure 3. GSWA Harvey 1 coloured natural gamma log plus sonic, neutron and resistivity traces. Casing depth and the location of the 100 mm cored intervals are shown along with the main stratigraphic units.

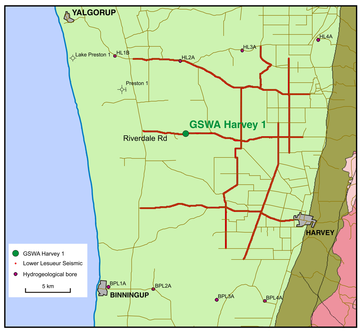


Figure 1. Location of the Lower Lesueur Seismic Survey and GSWA Harvey 1

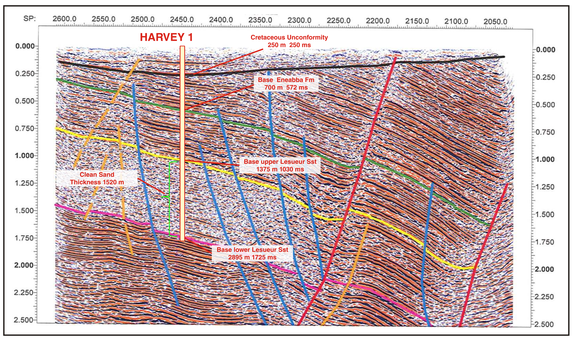
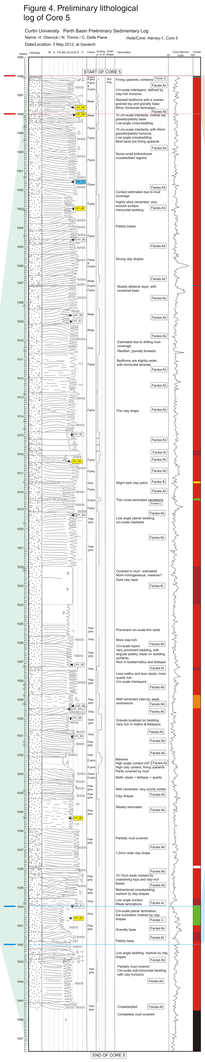


Figure 2. Line 2 of the seismic survey located along Riverdale Road showing the interpreted stratigraphy and the position of GSWA Harvey 1



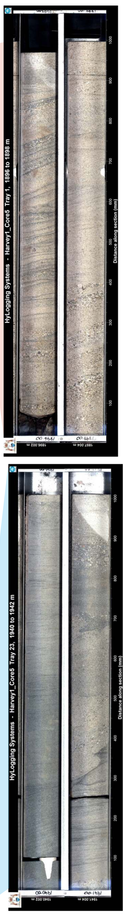


Figure 5. Detailed photographs from Core 5 captured by the GSWA HyLogger unit. Upper photograph interval 1896 – 1898 m and lower from 1940 – 1942 m (see Fig. 4)

The structural unit know as the Harvey Ridge was identified in regional studies as having potential for CO_2 storage. The area was interpreted to contain a significant thickness of saline aquifer to act as a reservoir (lower Lesueur Sandstone), overlain by potential baffle and seal units (upper Lesueur Sandstone and overlying Eneabba Formation). Importantly, the area did not contain the Yarragadee Formation, a significant fresh groundwater aquifer in the Perth Basin. These studies highlighted the lack of conclusive evidence of a regional seal, noted the generally poor seismic and well coverage in the area, and the paucity of modern petrophysical data to determine the reservoir characteristics of the Lesueur Sandstone.

In March 2011, the Geological Survey of Western Australia (GSWA) in conjunction with Geoscience Australia (GA) completed a 106 km 2D seismic survey along shire roads (Figure 1). The results from the survey were used in planning a stratigraphic well, GSWA Harvey 1 (Figure 2), targetted at filling a number of the identified data gaps *viz:*

- Confirm the predicted stratigraphy was present
- Confirm the presence of a lower "shale unit" in the Eneabba Formation, and evaluate the sealing capacity of that unit
- Collect fresh core samples of both the Eneabba Formation and Lesueur Sandstone for seal capacity, reservoir characterisation and injectivity testing
- Run modern evaluation logs
- Calibrate the new seismic and integrate findings into the 3D model for the area
- Assist in the planning and development of future holes and seismic programs for evaluating the area.

GSWA Harvey 1 was located on private land off Riverdale Road, Cookernup. The well was spudded on the 7th February 2012, reached a total depth of 2945 m on the 9th March and plugged and abandoned on the 23rd March.

Broadly the predicted stratigraphy was intersected, however depths of formation boundaries were higher (shallower) by 120 – 145 m than predicted (Figure 3). The higher than predicted formation tops led to the basal Eneabba Shale being drilled in the open-hole section of the hole at approximately 625 – 705m and therefore not cored. This basal shale was thinner than that intersected in the nearest offset well (Lake Preston 1) and contains a sandstone interbed. Mud logging (chip) samples indicate the unit is oxidized (weathered) at this location.

Approximately 217 m of 100 mm diameter core was collected over four separate intervals to test both seal and reservoir potential and to provide detailed geological information not previously available. The core has undergone initial lithological description, basic porosity and permeability testing and XRD analysis. The preliminary lithological description for Core 5 (1896 – 1950 m) from the lower Lesueur Sandstone is shown in Figure 4. The core has been run through the GSWA HyLogger unit which includes the high resolution photographs from Core 5 shown in Figure 5. End core photographs of sedimentary features present in the upper Lesueur Sandstone are shown in Figure 6. Examples of porosity and permeability data collected from Core 5 are presented in Table 1.

A comprehensive suite of modern down-hole geophysical logs was completed including natural gamma, density, resistivity, sonic, neutron-neutron, magnetic resonance and image logs (Table 2). A single formation test sample was recovered from the upper Lesueur Sandstone. A vertical seismic profile (VSP) survey could only be completed above 1200 m. This will be used along with the down-hole sonic survey to up-date the current 3D model and assist with the planning of a 3D seismic survey.

Detailed research is currently being undertaken using the downhole log data and on core samples from the well by scientists from CSIRO, University of Western Australia, Curtin University and GSWA. Basic data is available from the WAPIMS database via the DMP website.

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Figure 6. End core photographs of core from the basal section of the upper Lesueur Sandstone showing sedimentary features

Plug ID	Depth (m)	Grain Density (g/cc)	Porosity 800 (%)	Permeability 800 (mD)	Porosity 4300 (%)	Permeability 4300 (mD)
45H	1897.66	2.65	15.51	136.82	15.07	128.58
46V	1897.91	2.65	16.05	215.01	15.34	194.35
61V	1940.00	2.72	14.42	1.27	13.65	0.13
62H	1940.58	2.68	15.46	0.34	14.22	0.07

Table 1. Preliminary porosity and permeability data from samples from Core 5

Suite	Log Run	Name	Start Depth	End Depth	Comments
		MWD GR-RES	55	834	12¼" hole
		MWD GR-RES	930	2945	8½" hole
1	1	GR-SL-CN-ZDL-CAL-ORIT-XMAC-RTEX-MLL-TEMP	55	2940	
1	2	GR-STAR-ORIT-CBIL	941.3	2940	STAR failed at 1376 metres
1	3	SP-GR-MRES	55	2940	
1	4	GR-RCI	916	2504	10 pretests. Tool lost in hole
1	5	VSP	24.48	1189	
1	6	GR-RCI	856	856	14 litre water sample taken

Table 2. Downhole logging data summary

AUGUST 2012