QGC
A BG Group business

Appendix N
Walloon Coal Measures vertical permeability analysis

FILE NOTE

SUBJECT: QGC WALLOON VERTICAL PERMEABILITY/ HYDRAULIC CONDUCTIVITY ANALYSIS DATABASE ANALYSIS

DATE: APRIL 2012

AUTHOR: STEPHEN HOWELL

PROJECT: GROUNDWATER

Technical Summary

Recent analysis of the Walloon vertical permeability in the Northern, Central and Southern areas has been conducted by QGC. The analysis makes use of lithological log data; core and DST-calibrated log data and porosity log data from QGC wells across three main development areas. The methodology for deriving the vertical permeability is demonstrated.

On the basis of laboratory, DST and core-logging data, the derived vertical permeability ranges for the highly interbedded non-coal facies range from 7.6×10^{-4} mD to 1.9×10^{-6} mD (7.6×10^{-7} m/d to 1.9×10^{-9} m/d) with the coal facies ranging from 1.4×10^{0} mD to 3.5×10^{-6} mD (1.4×10^{-3} m/d to 3.5×10^{-9} m/d).

Introduction

Recent analysis of the Walloon permeability in the Northern, Central and Southern areas has been conducted by QGC. Table 1 summarises the source data with results summary shown within Table 2. The analysis makes use of lithological log data; DST and core-calibrated log data and porosity log data from QGC wells. The methodology for deriving the vertical permeability is shown below.

Source Data

Table 1: Summary of Source Data used for the Analysis of Walloon Permeability

Wells Logged	Area
Kathleen-1	North
Pinelands-4	North
Berwyndale South-10	Central
Codie-1	Central
Jordan-3	South
Jen-1	South
Teviot-2	South

Methodology

The source data used for this analysis is summarised within Table 1.

Performing the methodology at a 1m fine-scale may be summarised by the following steps:

QGC
275 George Street, Brisbane QLD 4000
GPO Box 3107, Brisbane QLD 4001
Tel: (61) 7 3024 9000 Fax: (61) 7 3024 8999
www.qgc.com.au

1) Digitised core facies Log divided into 1m increments.
2) For each 1 metre increment Kv values assigned to each facies based on laboratory or DST data.
3) For each 1 metre increment, the facies flag is assigned to match the “dominant” facies type.
4) Harmonic average is assigned to the logged-facies Kv to calculate the vertical permeability of the 1 metre increment.
5) The calculated Kv is grouped for each facies flag and determine the P10/P50/P90 values of a log normal distribution.

Initially, the five facies are identified for each well using a computer-processed lithological log. A constant vertical permeability per facies is applied, based on QGC’s core-derived permeability data. These values are then used in their correct proportions to create a harmonic average of the vertical permeability per 1m interval. The harmonic average captures the effect of the low permeability facies. Each 1m interval is then designated as belonging to the facies with the greatest volumetric (thickness) proportion. This contributes towards the overall distribution of vertical permeability for that particular facies to allow a P10, P50 and P90 probabilistic distribution to be created. Figure 1summarises the methodology used to approximate the vertical permeability per facies type.

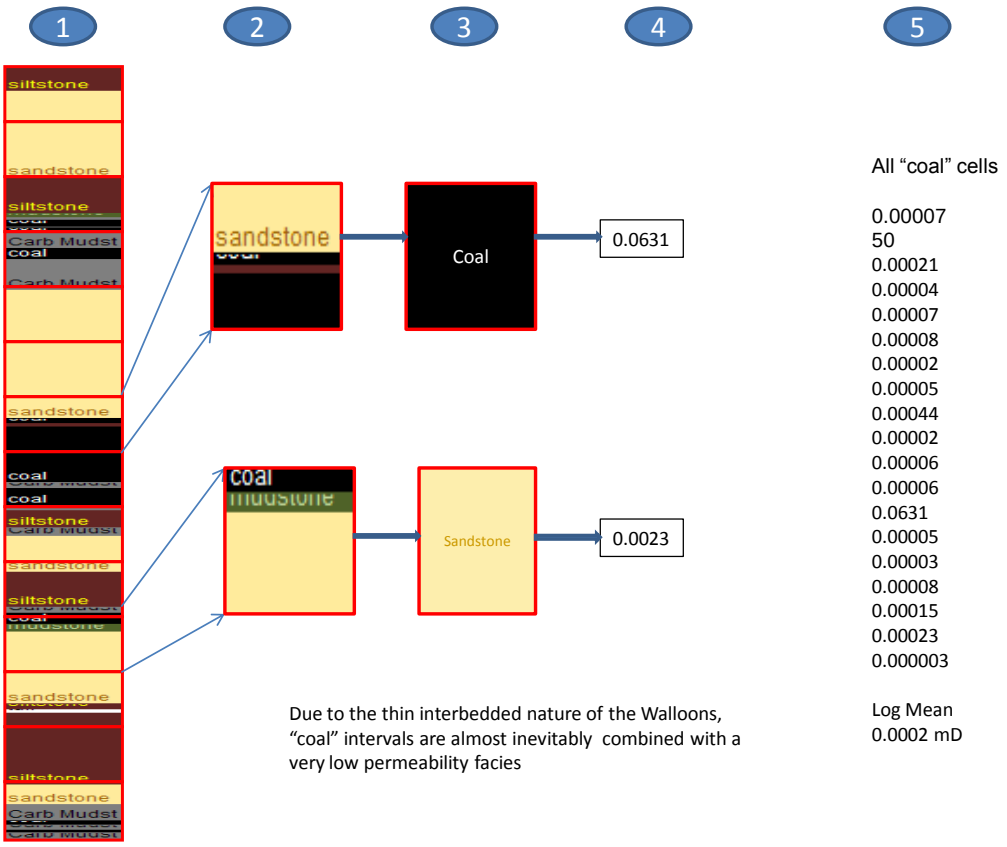

Figure 1: Methodology Used to Approximate the Vertical Permeability for Coal and Non-Coal Lithological Facies

Results

The range of vertical permeability / hydraulic conductivity computed based upon the methodology described in Figure 1 is highlighted within Table 2.

Inter-Walloon Lithology	Vertical Permeability (mD) & Vertical Hydraulic Conductivity (m/d)					
	P10		P50		P90	
	mD	m/d	mD	m/d	mD	m/d
Non-Coal	7.6×10^{-4}	7.6×10^{-7}	3.8×10^{-5}	3.8×10^{-8}	1.9×10^{-6}	1.9×10^{-9}
Coal	1.4×10^{0}	1.4×10^{-3}	2.2×10^{-3}	2.2×10^{-6}	3.5×10^{-6}	3.5×10^{-9}

Table 2: Summary of Vertical Permeability/Hydraulic Conductivity Ranges Observed from Typical Walloons Coal and Non-Coal Facies - Data Acquired via Laboratory, DST and Core-Logging