

**CNRL Undertaking 4
(Revised)
July 6, 2005**

Undertaking 4 (Revised). Regarding Wabiskaw B Valley fill Wt% bitumen: What weight % does CNRL believe more accurately accounts for 50% bitumen saturation for the Wabiskaw B Valley Fill? (Transcript Reference: Line 00661 – 23)

Response:

One of the major controls of SAGD economics is SOR. This can be simplified to be roughly a measure of how much bitumen will be produced per volume of reservoir heated. In order for a bitumen cutoff to be meaningful, it should reflect this fact. As a result, CNRL believes that the saturation calculation used to define potentially recoverable bitumen must be carried out on porosity values without the use of a shale correction. The use of a shale correction essentially discounts the shaley portion of the reservoir, and only looks at the remaining sand. The end result is that a reservoir containing 50% shale will appear to equal one with 0% shale. In reality, both must be heated to produce the bitumen. Thus the shaley sand will require the same heat as clean sand, but will produce substantially less oil. It is for this same reason that weight percent tar is commonly used, as it contains no shale correction. Similarly, calculated saturations presented in typical core analysis contain no shale correction. For these reasons, no shale correction is applied in the following calculations.

Weight Percent Bitumen (WTAR) is calculated as follows:

$$WTAR = \frac{(PHI * SO * RHOHY)}{((1 - PHI) * RHOMA + PHI * (SO * RHOHY + SW * RHOF))}$$

Where:

- SO - Oil Saturation
- SW - Water Saturation
- PHI - Porosity
- RHOMA - Matrix Density
- RHOHY - Hydrocarbon Density
- RHOF - Fluid Density

Kirby Wabiskaw B Valley Fill Parameters (Core Porosity)

- SO = 0.5
- SW = 0.5
- PHI = 0.34 (Median value from core analysis)
- RHOMA = 2650 kg/m³
- RHOHY = 1000 kg/m³
- RHOF = 1000 kg/m³

- WT TAR Frac = 0.081

Although the PHIE of 34% is statistically robust due to the large sample involved, it suffers from the problem that core derived porosity are potentially higher than in situ. Observed porosity values from a more limited suite of logs range from 27 to 35%, with estimated average of approximately 31%. Substituting this value in the calculations:

Kirby Wabiskaw B Valley Fill (Log Porosity)
WT TAR Frac =0.072

Based on these observations CNRL believes that 50% saturation in the Wabiskaw B Valley fill would be equivalent to a Wt Tar of approximately 7.2%. CNRL also notes that using these same calculations, the RGS cutoff of 6 Wt % Tar equates to a bitumen saturation of approximately 35%. This is likely to be part of the overestimation of pay documented by CNRL.