

ALBERTA ENERGY AND UTILITIES BOARD

COLD LAKE OIL SANDS AREA – CLEARWATER DEPOSIT

Husky Oil Operation Limited's Response to Board Staff Information Requests
Application Nos. 1394112 and 1409180

1)

- a) Figure 1 (attached) is an index map showing the locations of the 14 structural cross sections of annotated logs over the Clearwater Formation (Figures 2 to 15, attached). As requested, the logs are annotated with Formation and facies tops, gas, water and bitumen zones, perf and core intervals, and piezometer locations. Note that cross section GGX-GOB_M (Figure 14) contains wells not in the public domain and cross section GGX-GOB_N (Figure 15) contains only those wells with piezometers.
- b) Regarding a description of the Clearwater depositional environments and internal facies, Husky is currently evaluating these issues, with the intent of submitting a formal pilot project application to the Board by the end of 2006. Our intent is to have the facies work completed for that application. This work will include core and log interpretations, including correlations from our lands onto CNRL acreage. Our intent is to link with CNRL interpreted facies (i.e. blue, yellow sands etc.), but this additional evaluation of cores on CNRL lands, plus integration with Husky data, is required.

Notwithstanding the preceding, we believe that the Blue valley fill sediments of Figure 2.1 (CNRL application, July 4, 2006) continue onto Husky land, and that this represents the major exploitable reservoir. Our proposed pilot project will exploit this reservoir. The net pay map (Figure 16, attached), plus the Clearwater bitumen pay thickness map of the EUB (Figure 2.4, ST98-2006,) both substantiate the presence of bitumen pay up to 28m on Husky lands (T69 R4-5W4). We also concur with the CNRL statement that:

The interpretation of valley sediment fill is not critical to the impact of gas production on bitumen recovery. Rather, it is the cross-cutting relationships between the stratigraphy that control the distribution of sediments such as placing sand on sand and / or truncating non reservoir muds that are relevant. (July 4 Application, page 7)

- c) Husky's Clearwater Bitumen Net Pay map is attached (Figure 16). The following cutoffs were used:
 - Resistivity: not used; accounted for in the Sw calculation
 - Porosity: 20%
 - Sw: 50%
- d) OBIP was calculated using the following parameters:
 - Area: lease area as outlined on Figure 16
 - Porosity cutoff: 20%
 - Sw cutoff: 50%
 - $B_0 = 1.005$

The HPV calculation was completed on a well by well basis, using PRIZM, and individual HPV values posted, gridded and contoured. OBIP calculations were then completed, using the gridded values.

Husky Land	Area (Ha)	OBIP Volume (Barrels)
Initial Development Area	3,957.39	1,088,883,903

- e) A Clearwater Gas Over Water map is attached (Figure 17). Eight wells containing gas over water over bitumen were identified.

	Well ID	Water Thickness
1	00/06-19-069-04W400	3.7
2	00/08-26-069-05W400	3.1
3	00/14-30-069-04W400	2.9
4	00/05-36-069-05W400	2.7
5	00/10-34-069-05W400	1.6
6	00/06-04-070-05W400	1.5
7	00/06-02-070-05W400	1.4
8	00/06-03-070-05W400	1.2

No bottom water exists below the bitumen.

- 2) Geological Study to evaluate Gas oil contact: A structure map was constructed on the top of Clearwater sand (Figure 18, attached). Wells with gas in the Clearwater (identified by neutron-density cross over) were noted, and gas oil contacts identified. It is generally apparent that the gas/oil contact follows the top Clearwater sand contours. Isolated pools have different elevations for the gas/oil contact. However, as the bitumen was already predominately solid at the time of subsequent gas generation and later structural changes, the gas/oil contact does not always conform to a specific elevation. Below is a brief summary of the mechanism for gas over bitumen.

Gas in place is interpreted as:

- Original structure formed a trap
- Oil migrated into structure (20+ API)
- Original gas cap formed from associated gas
- Cap rock slightly porous (some permeability)
- Gas migrated over geologic time out of gas caps
- Oil was now immobile due to degradation
- Water moved through oil and filled the gas cap
- Continued anaerobic degradation of the bitumen form methane which partially filled the earlier gas cap
- Results in gas over water over bitumen

3)

- a) Electronic data is provided in the attached zipped file (Schedule 1).
- b) The piezometers were strapped to the outside of 2 3/8" tubing and cemented in as part of the abandonment of stratigraphic evaluation wells that Husky drilled last winter. Enclosed is the 14-9-69-4W4M as built report (Schedule 2) as prepared by Thurber Engineering as an example of how the instruments were installed and where they are located in the well. Please see Husky's responses to Board Staff Information Request 1(a) for the locations with respect to well logs.
- c) Husky is currently evaluating any hardware or installation problems that could explain these small pressure anomalies at wells 16-7 and 4-6. In addition, these zones may have been inadvertently swabbed during drilling, coring, logging operations or wiper trips.

The enclosed map (Schedule 3) shows that the nearest steaming operations in the Clearwater are from CNRL's operation. It shows that the pad of wells in sections 19, 20, and 21 started steaming in July of 2006. These wells are located over 2 sections or over 3.2 kms away from the nearest Piezometers at 4-6-69-4W4M or 3-4-69-4W4M. No changes were observed at these two locations during July, August or September.

- d) All the latest piezometer pressures were corrected to a common datum. The initial pressure was assumed to be largest pressure when corrected to the common datum. This pressure itself may have declined due to gas cap pressure depletion, however, it is a conservative estimate of the initial pressure. That is, the initial pressure can be higher than this pressure which means the actual pressure drop in the bitumen zone would be greater.
- 4) The enclosed memo (Schedule 4) gives a brief overview of the HSAGD process and repeats the information that was presented to the AEUB on August 23, 2006 as an initial project disclosure to the AEUB.
 - 5) The reference to point 5 of the submission is for GOC's from pools that have current gas production wells; the two closer mapped gas pools do not have any production wells. Consequently, these two pools do not contribute to the observed pressure decline
 - 6) The blue straight lines on Figure 4 show the lease boundaries of Husky's oil sands lease #7188110343. The purple straight lines show the lease boundaries of Husky oil sands lease #718811A344. Other straight lines in the North West corner 68-4-W4M are CNRL's licensed but not yet drilled horizontal wells.