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Subject: MGP Impacts of Subsidence at Niglintgak and Taglu Anchor Fields – Review of Proponent's March 2006 letters to NRCan

Dear Mr. Pawluk and Mr. Davies,

Please find attached NRCan's response to the subsidence/submergence components of the letters NRCan received from Shell and IORVL in March 2006. NRCan's response is provided in two parts, one for each of the Niglintgak and Taglu anchor fields.

If you have any questions, or require any clarifications, do not hesitate to contact me.

Sincerely,

(O*riginal signed by*)

Livain Michaud
Senior Environmental Assessment Officer

c.c. Paula Pacholek, Panel Manager, Mackenzie Gas Project Joint Review Panel

attach.

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NRCan Comments on the Proponents' responses to the NRCan letter of 13 January 2006 and the follow-up meeting (Proponent, NRCan and EC) held on 10 February 2006 with respect to questions concerning the impacts of subsidence from hydrocarbon extraction

The proponents responded to the NRCan letter of 13 January 2006 and the follow-up meeting held on 10 February 2006 on subsidence issues with cover letters, dated 15 and 16 March 2006, and attachments. The proponents treated questions about the two anchor fields in the delta (Taglu and Niglintgak) separately and NRCan has done the same.

1. Niglintgak Anchor Field – Attachment 1, Shell letter of 16 March 2006. (J-SCL-00012) (J-SCL-00013) (J-SCL-00014)

Section 1 – Analysis of water levels

NRCan concurs with the methodology used by the proponents and the values chosen for water levels to evaluate impacts of subsidence. We note also that in this response they use the water level as derived from LIDAR by NRCan to help corroborate the observed water level from their water level gauge (in the Taglu field response, the proponent uses a different approach to WL estimation using LiDAR).

NRCan notes that the proponents continue to use CGVD28 as their datum and to transform ellipsoidal heights to orthometric heights using HT2. They also choose to equate CGVD28 values derived using HT2 to mean sea level (MSL). In previous IRs we have pointed out some of the problems with CGVD28 and HT2 in the Delta, and the proponents are aware of those issues. However, we strongly suggest that MSL not be used as a shorthand notation for the CGDV28HT2 since we are not sure how the 2 datums are related in the area and MSL gives the false impression that we do.

NRCan also concurs with methodology used in the analysis of potentially inundated area as shown in Figure 2 of attachment 1. It would be useful to provide a quantitative estimate of the area that may be inundated as well as the graphic display.

Section 2 - Morphological Processes

In general, NRCan agrees with the proponent's assertion that the area is dynamic and prone to sediment deposition. The proponent cites an analysis of evolution of sandbars and mudflats as corroborating evidence for this assertion, but there is no reference. If this is a report, it should be tabled for the JRP.

The proponent cites Carson et al (1998) as evidence that the spring freshet is responsible for most of the sediment deposition on the delta. NRCan does not necessarily agree that is the case for the outer delta islands. Deposition from storm surges may play a significant role in locations that are close to the coast (Jenner, K. A. and Hill, P.R. 1998. *Recent Arctic deltaic sedimentation, Olivier, Islands, Mackenzie Delta, Northwest Territories,* Canada. Sedimentology, v. 45, 987-1004; Hill, P.R., Lewis, C.P., Desmarais, S., Kauppaymuthoo, V. and Rais, H. 2001. *The Mackenzie Delta: sedimentary processes and facies of a high-latitude, fine-grained delta*. Sedimentology, v.48: 1047-1078). Based on the data presented by the proponent, the suggestion that sediment deposition on exposed mudflats could keep up with subsidence is not unreasonable. The single season post-freshet sedimentation rates measured by the proponents however are highly unlikely to be indicative of long-term sedimentation rates throughout the potentially impacted area. Efforts should be made to ascertain the long-term net sedimentation rates in potentially inundated locations, especially at those locations farther away from channels.

The video images of the shoreline provided by the proponent are useful as indicators of the water level at the time of the LIDAR survey. Noting the position of the images on a map would have made them easier to use. The imagery on the tapes could be very useful in establishing baselines for monitoring.

2. Taglu Anchor Field – Attachment 2 of IORVL letter of 15 March 2006 (J-IORVL-00469)

Topographic map study

The proponents provided a copy of a previously compiled map showing predicted subsidence using contour lines (Map JRP 1.25-1). This did not provide any new information.

Criteria used to discern water levels from LIDAR

This remains a small point of disagreement between the proponent and NRCan. The proponent's consultants (Colt Geomatics) provided a description of their method which they describe as reliable and tested, however, they do not provide a reference. The mean water level at the time of the LIDAR survey was 0.32 m (±0.11m) calculated using this method. NRCan calculated the water level using an alternative method, as described in the appendix to its written submission for the March 20-22 JRP technical hearings, and obtained a water level of 0.41 m (±0.06m). Neither result is definitive nor do we know how this instantaneous mid-open water season water level corresponds to the long term mean or to water levels during nesting season (June-July). Given the lack of any other data, we agree that using a range from 0.2 m to 0.4 m is reasonable for estimation of inundation during that time of year. However,

we think that additional information will be required in order to assess the degree to which that range of values may represent the water level during that time period.

Estimation of inundation

The proponent defines the term inundation to describe a landscape that is permanently submerged. This definition was ascribed to the Feb. 10, 2006 meeting. There may be issues with this definition based on Canadian Wildlife's concerns about inundated land during the nesting season (June-July). NRCan agrees with the results of the estimation of inundation as defined above and as shown in Attachment 2 Table 1 and Figure 1. However, the proponent contends that these changes are not expected to be distinguishable from natural variability such as flooding. We do not believe that the proponent has provided sufficient information to demonstrate that is the case. While it may not be possible to differentiate between subsidence-induced and natural affects on a year to year basis, initial results of the NRCan-EC investigation of natural changes in the size of Big Lake suggests that over the lifetime of the project, the reduction in the elevation of the land surface may result in expansion of the lake in excess of historical rates. We also believe that it may be possible to use a combination of remotely sensed satellite imagery (optical and synthetic aperture radar), water level monitoring and ground surveys to gain a better understanding of historical water levels and extent of Big Lake as a means of evaluating the impacts of changes due to subsidence. Given the concerns expressed by the regulators (Canadian Wildlife Service) about the potential impacts on bird habitat, they may require additional consideration of this issue.

Assessed topography along the eastern shoreline of Big Lake

NRCan appreciates the efforts made by the proponents to assess the elevation of areas which are not covered by LIDAR, but are potentially impacted by extraction-induced flooding. The regulators may still require quantification of the potential impacts in that area. That could be accomplished by additional LIDAR surveys, conventional or GPS ground-based surveys. It may also be possible to use radar obtained when the area is flooded and extract the elevation of the flood water level where it intersects existing LIDAR.