Environment Canada's Written Submission
to the
JRP EIS Conference, June 29, 2005
Concerns Regarding Future Climate Variability

The TOR states that the MGP will be planned, designed, operated and decommissioned in a manner that takes due account of climate variability and climate change over the projected lifespan of the project. Upon review, it was felt that the EIS failed to adequately address critical climate change/variability aspects and as a result, several government departments (NRCan, INAC, EC) submitted IRs pertaining to the impacts of future climate variability and change on the pipeline. For example, in IR EC_R2.07 Environment Canada (EC) stated that "The EIS ignored potential thresholds in changes, which when exceeded, could result in a significant increase in impacts of further change". EC further stated that "Future climate variability was not adequately accounted for in the EIS". The proponent's response to EC's concerns raised in EC_R2.07was that "The modelling and design of the pipeline and structures have accounted for future climate change over the lifetime of the Mackenzie Gas Project, as discussed in EIS Volume 5, Part F, Section 11: Climate Change. Consideration was given in the geothermal modelling to a range of regional climate warming trends, and of how they might affect potential thaw settlement and slope stability along the pipeline. In all cases, the integrity of the pipeline was maintained, supporting the design basis chosen for the project. If the pipeline or structures were affected by large climate variability or by an extreme weather event, the pipeline integrity management plan monitoring methods and the weather-induced events monitoring method will detect the event in a timely fashion. The proponents will undertake risk-assessed mitigative action to stabilize, repair and remediate the affected area. Adaptive management (continuous improvement) practices will be used in implementing the integrity management program. Planned monitoring and environmental management will be sufficient to respond to issues that might be related to climate change or climate variability."

As well, information request NRCan R2_IR-09 stated that "The proponent has not considered climate variability and extremes under present and future climates in the analysis of impacts. The impact of extreme warm years (especially if several occur in succession) should be considered in determining the impact of climate change on thaw depth. Thaw penetration in the Mackenzie Delta region during the extreme warm year of 1998 was greater (more than 10 cm in some cases) than previous years and this was accompanied by settlement of the ground surface. The length of the thaw season during 1998 was also longer with freezing of the ground occurring later in the fall. This variability should be considered in determining the period over which the ground is sufficiently frozen and the impact on scheduling of right of way preparation and construction activities as well as maintenance activities during pipeline operation. Extreme precipitation events should also be considered in determining the potential for erosion and slope stability. Consideration of climate variability and extremes under present and future climates as well as the overall change in temperature and precipitation should be considered to adequately assess the impact of the environment on the project and the impacts of climate change. The proponent should show how climate variability

was considered in the impact analysis in order to adequately assess the conclusions made by the proponent in the EIS." The proponent's response to NRCAN R2_IR_09 as follows:
"Climate variability was accounted for in the EIS analytical results through the following approaches:

> A. Model Conservatism – in addition to conservative values used in the analyses, and a variety of possible future warming trends, conservative assumptions and threshold criteria were also used during the application of the geothermal modelling results to potentially affected landform units within the project areas.
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> B. Construction effects are much larger than possible climate change effects – the analyses completed indicate that the effects of climate change and variability are relatively small in comparison to the disturbances expected from construction. Climate warming is a relatively small consideration in the pipeline design aspects.
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> C. Ongoing monitoring and mitigation – through design and operations, appropriate monitoring and mitigation will address the potential effects to landforms (i.e., erosion, drainage disruption and mass movement) and will address the issues that include climate variability and change as possible initiating causes.
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> The basic input parameters for EIS climate change analyses included surface warming rates that were outlined in the EIS climate change scenarios (EIS Volume 5, Part F, Section 11.2.1.1). The results of the geothermal analyses were included in the assessment of thaw depths, slope stability, pond formation (drainage effects) and erosion potential."

It therefore appears that in response to these IRs, the proponent indicated that they have thoroughly accounted for climate change effects on the pipeline and other facilities, via assessment of climate trends and variability and geothermal modelling of a range of climate warming trends and their anticipated effects on potential thaw settlement and slope stability. The proponent concluded that structural integrity of the pipeline is more than adequate for this environmental hazard, and that pipeline monitoring and adaptive management approach will detect and adequately address any potential hazards or damage from large climate change, variability, or weather-induced events affecting project facilities in time for risk-assessed mitigative action to stabilize, repair and remediate affected areas.

Given these responses, it is still the opinion of the EC climate change review team that there are still important uncertainties regarding the technical basis for concluding that there will be insignificant potential effects of climate variability/climate change on the integrity of the pipeline and associated anchor field facilities during all phases of the project (ie all phases over the next 30-40 years). Additional technical discussions would assist EC and other intervenors to reliably recommend to the Panel specific suggestions for inclusion in the adaptive management program proposed by the proponent and identify specific clauses on follow-up, monitoring and continuous improvement of environmental performance in recommendations to assist the JRP in its deliberations and for consideration in determining potential terms and conditions for approvals to be passed on to project Regulators. As outlined previously, the proponent indicated that they have

thoroughly accounted for these effects on the pipeline and other facilities, via assessment of climate trends and variability and geothermal modeling of a range of climate warming trends (e.g., the low, medium, and high climate change scenarios provided in EIS Volume 5, Part F, Section 11) and their anticipated effects on potential thaw settlement and slope stability. However, their assessment assumed a gradual change in annual air temperature distributed evenly throughout the proposed duration of the pipeline. Even though this analysis has given some indication toward the potential impacts of an average temperature change as projected by Global Climate Models, it fails to adequately address the potential impacts of future climate variability and extremes. Figure 1 shows future temperature distributions given: a) an increase in the mean temperature, b) an increase in temperature variance with the mean remaining constant, and c) an increase in both the mean and the variance. With regard to high temperature extremes, all three scenarios show an increased occurrence with the most dramatic being associated with increases to both the mean and the variance. Even if future variability remains the same, Figure 1a reveals that extreme high temperatures will become more frequent due to an increase in mean temperature. This is further exemplified in Figure 2 which shows annual mean temperature anomalies (relative to the 1961-90 period) for the Inuvik climate station from 1958-2003. Time series for the projected low (+1.3°C), medium (+1.6°C), and high (+2.5°C) changes are also provided by simply adding the changes to the observed time series (which assumes that future variability does not change). The figure clearly shows that future (2010-2039) temperatures are much warmer than observed with 27 out of 30 years containing above normal temperatures for the low projection, and all 30 years above normal for the high temperature projection. In addition, there are several extreme high temperature years in all projected future time series. It should be noted that this may even be a conservative estimate since variability is assumed to remain constant, and this example incorporates annual mean temperatures. Individual seasons or individual temperature events (e.g., warm spells) could show even more drastic changes. As can be seen from Figures 1 and 2, climate change is not just a number; it's the impact that this number will have on future climate including trends, variability, and extremes.

It should also be pointed out that for certain hydrologic analyses, the proponent has calculated the design floods on the major stream crossings using available historic data. We have reason to believe, that while certainly traditionally defensible, this approach does not account for future hydrologic regimes that will likely be impacted by climate change and variability since it assumes that the past is representative of the future.

As a result of this evidence, the EC climate change review team remains concerned about the potential hazard from the interactions between climate change, variability and extreme events on project components over the lifespan of the project and we may choose to continue making this point in the hearing process. As stated above, there are still important uncertainties regarding the technical basis for concluding that there will be insignificant potential effects of climate variability/climate change on the integrity of the pipeline and associated anchor field facilities during all phases of the project (ie all phases over the next 30-40 years). Additional technical discussions would assist EC and other intervenors to reliably recommend to the Panel specific suggestions for inclusion in the adaptive management program proposed by the proponent and identify specific

clauses on follow-up, monitoring and continuous improvement of environmental performance in recommendations to assist the JRP in its deliberations and in determining potential terms and conditions for approvals to be passed on to project Regulators. EC suggests that the preferred option for resolving current uncertainties would be a multi-party meeting such as a technical session . Trying to resolve technical concerns of this nature at formal hearings may prove to be unnecessarily burdensome on the process in terms of the technical intensity of potential debate and the time required to accommodate the level and detail of technical discussions.

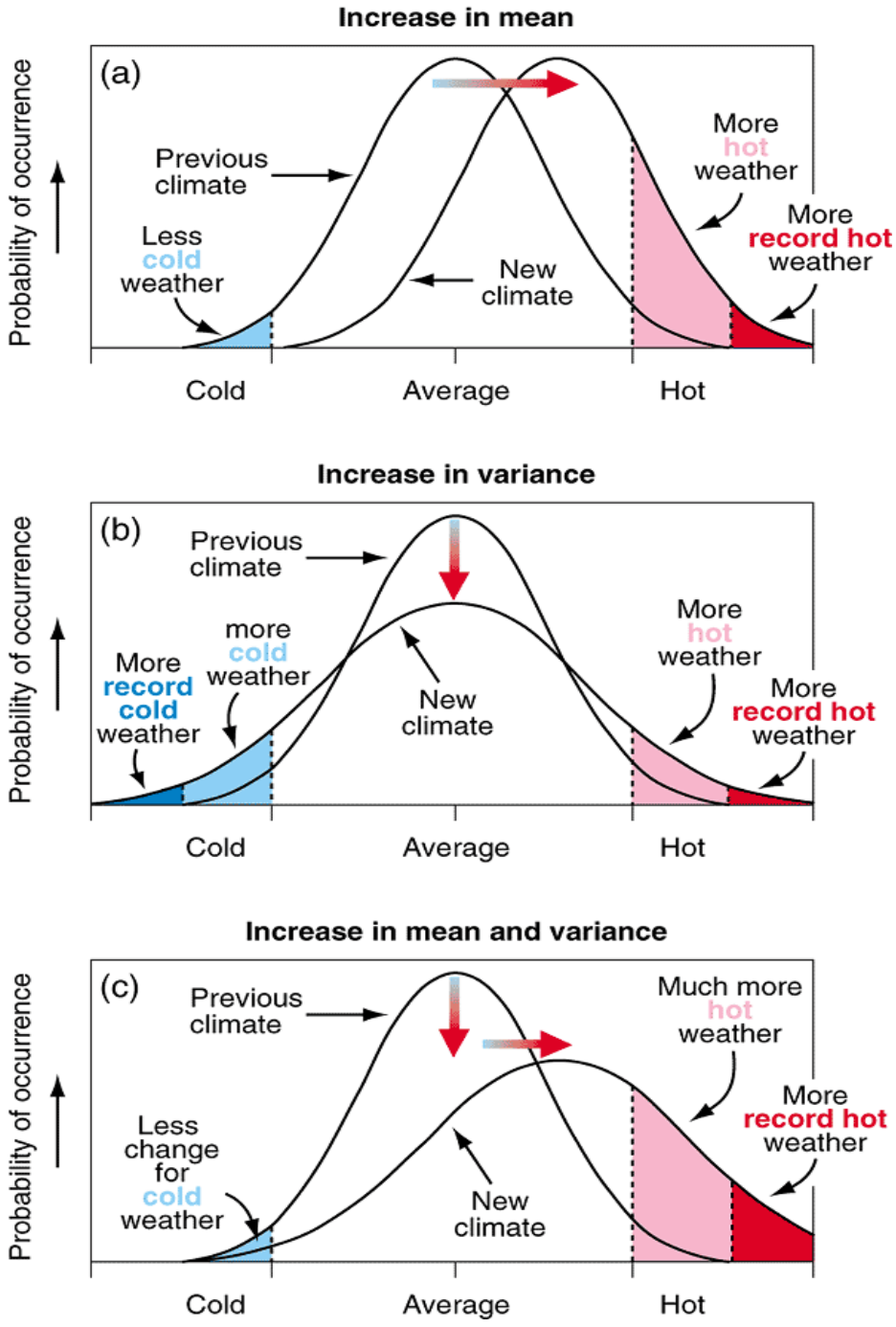

Figure 1: Changes to temperature extremes given a) increases to mean temperature, b) increases to temperature variance, and c) increases to mean and variance in temperature.
Ref: IPCC, 2001

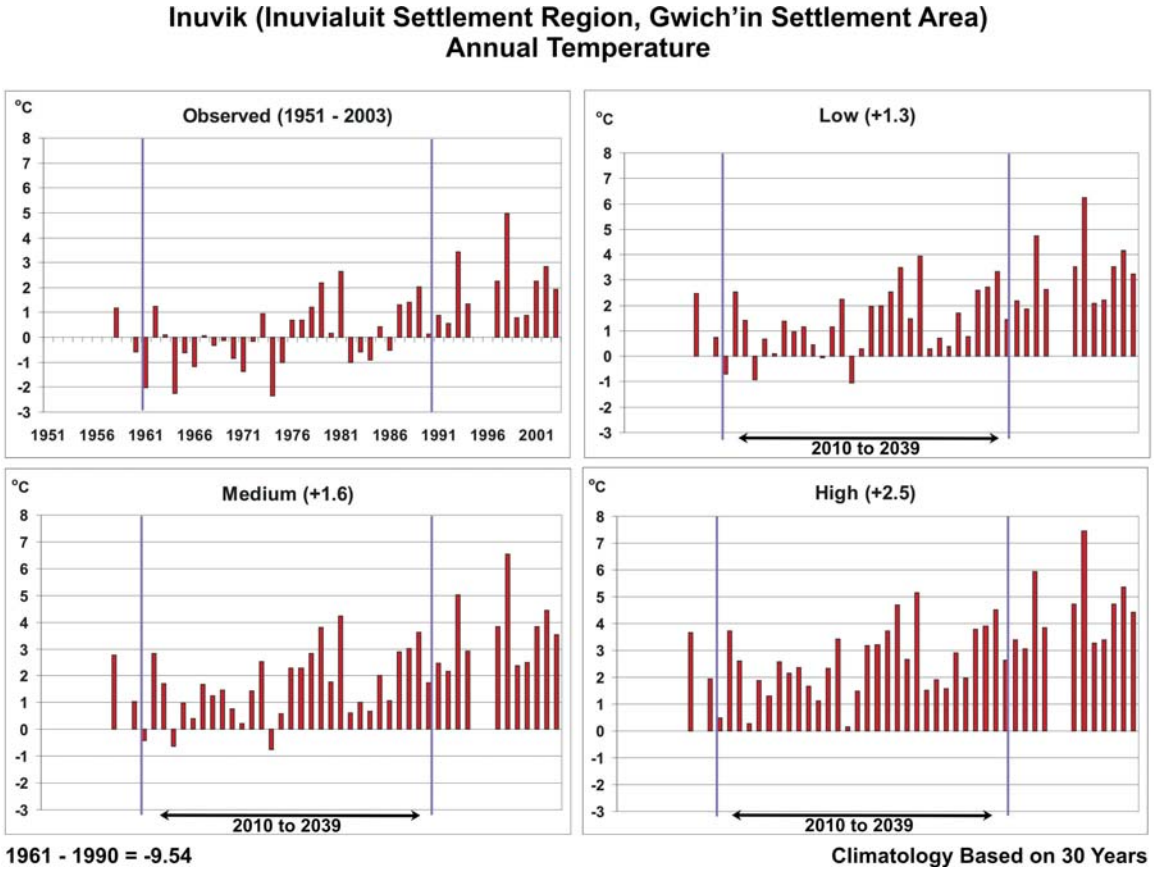

Figure 2: Annual mean temperature anomalies (relative to the 1961-90 period) for the Inuvik climate station from 1958-2003. Time series for the projected low (+1.3°C), medium (+1.6°C), and high (+2.5°C) temperature changes are also provided by adding the changes to the observed time series.