APPENDIX B

COMMENTS ON MANITOBA HYDRO BIPOLE 3 APPLICATION REGARDING NEED FOR IMPROVED AIR QUALITY ASSESSMENT, HEALTH RISK ASSESSMENT, COMMUNITY HEALTH IMPACT ASSESSMENT, AND CUMULATIVE EFFECTS ASSESSMENT

September 16, 2012

AIR QUALITY

Initial Information Request

MH stated that air quality is an important environmental component that requires protection and monitoring to maintain the current level of quality enjoyed in Manitoba. Potential effects are identified as the result of vehicle emissions, burning, clearing and dust generation.[1]

In an information request subsequently forwarded by the CEC, CAC Manitoba requested the following additional information beyond what was provided in the EIS.

> (a) *Please provide baseline air quality data metrics for nitrogen oxides (NOx), volatile organic compounds (VOCs), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3) and other air quality parameters that may be impacted by the project.*[2]
>
> *(b) Please quantify the expected changes in air quality parameters as a result of (i) project construction and (ii) project operation.*[3]

Manitoba Hydro's response (summary):[4]

- Manitoba Conservation's air quality monitoring program consists of dedicated monitors in permanent locations and relates to either General/Urban Air Quality or Industrial (source specific) monitoring.

[1] Bipole III EIS
[2] CEC/MH-VI-343a
[3] CEC/MH-VI-343b
[4] CEC/MH-VI-343a

- The Project components for Bipole III are located across a large area stretching from the boreal forest region of northern Manitoba to the rural agricultural areas of southern Manitoba. Manitoba's monitoring network consists of only urban centres, including Winnipeg, Brandon, Flin Flon and Thompson. There are no ambient air quality monitors in remote and/or rural locations in the province.
- Manitoba generally enjoys excellent air quality which is comparable to or better than air quality in other parts of Canada.
- Air quality concerns in Manitoba tend to be local in nature, related to presence of odours, noise and other pollutants. The main source of these pollutants are industrial and agricultural operations, and vehicle emissions.
- The lack of available air quality data for remote and rural areas across Manitoba in the vicinity of the Project's local Study Area and sites is a limitation for assessing what is predominantly a greenfield development.
- Air quality for the Project local study area and sites is expected to be primarily influenced by long-range transport of airborne pollutants. The Project's local Study Area and sites (*i.e.*,transmission line rights-of-way and converter station sites and associated facilities) are consistent with more remote, rural lands and largely non-industrialized land, where air quality is considered typically to be of good quality. Potential effects (*related to Bipole III*) were identified as the result of vehicle emissions, burning, clearing and dust generation.
- A qualitative *approach (to air qua*lity assessment*) w*as utilized as there is an absence of regional ambient air quality data to be able to quantify changes in air quality parameters resulting from project construction and operation.
- As stated in section 8.2.2.5 of the Bipole III EIS, the effects of the Pro*ject on air quality ar*e expected to be negative in direction, small in magnitude, limited to the Local Study Area, short term in duration for construction, medium term for Operations, and overall not significant.

Further Commentary

- A more comprehensive air quality assessment of the construction and operation of the proposed Bipole III project is warranted, given acknowledged air emissions resulting from project-related vehicle emissions, burning of forest and other debris, and dust generation over a very large land area within the province.
- The primary pollutants of concern to be included in the air quality assessment include nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$, and polycyclic aromatic hydrocarbons (from diesel combustion).
- In addition, please comment on the potential air quality impacts that may be associated with burning of forest materials, including generation of volatile organic compounds

(VOCs), heavy metals, ozone (O_3, a secondary pollutant) and dioxins/furans, as these have been observed to be associated with forest fires.

- Comprehensive air quality assessment requires the following quantitative data (i) baseline air quality data for the impacted area, (ii) quantitative air emissions inventory, and (iii) predicted incremental air quality effects associated with the project.
- Regarding item (i), accurate baseline air quality data can be determined either through (a) establishment of air quality monitors at selected locations within the study area, or (b) through air quality modeling of regional air quality sources.
- The baseline air quality study should allow for the generation of statistical air quality parameters (*eg* maximum, 95th percentile, mean or median hourly, daily and annual averaging times).
- Computer modeling by qualified personnel can then be utilized for predicting impacts associated with project construction and operation, and for predicting incremental air quality effects.

EXAMPLE TERMS OF REFERENCE: AIR QUALITY

In an effort to illustrate the type of air quality work being done in other EIAs, the following scope of work has been sourced directly from the final terms of reference for an EIA of a relatively small limestone quarry project in Alberta.

> *"Discuss baseline ambient air quality conditions. Review current emission sources and discuss changes as a result of anticipated future industrial development within the EIA Study Areas. Consider emission point sources as well as fugitive emissions. Identify components of the Project that will affect ambient air quality from a local and regional perspective by doing the following:*
>
> *a) discuss appropriate air quality parameters such as oxides of nitrogen (NOx), visibility, and particulates (road dust, PM_{10} and $PM_{2.5}$);*
>
> *b) estimate ground-level concentrations via modeling of appropriate air quality parameters. Discuss any expected changes to particulate deposition patterns. Include a comparison of modeled concentrations to recent monitoring results, as appropriate;*
>
> *c) identify the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health. Provide this information specifically for communities and sensitive receptors located close to the Project, as appropriate;*
>
> *d) describe air quality impacts resulting from the Project, and their implications for other environmental resources, including vegetation resources, and water and soil quality;*
>
> *e) for acid deposition modeling, provide deposition data predictions including magnitude and location of predicted maximum levels for all areas within the*

0.25 keq/ha/yr and 0.17 keq/ha/yr Potential Acid Input (PAI) isopleth, including analysis of PAI deposition levels consistent with the CEMA Acid Deposition Management Framework;

f) complete modeling and present results in accordance with Alberta Environment's Air Quality Modeling Guidelines (March 2003);

g) describe how air quality impacts resulting from the Project will be mitigated and any monitoring programs to be implemented for assessing air quality or the effectiveness of mitigation measures;

h) discuss the use of ozone depleting substances;

i) describe meteorological conditions including wind speed, direction and inversions insofar as they affect dispersion and disposition; and

j) estimate the quantity released of any compounds regulated under the NPRI".

ftp://ftp.gov.ab.ca/env/fs/eia/2010-06-ParsonsCreekAggregatesParsonsCreekAggregatesLimestoneQuarryProject/Working%20PDF/Application/10_Appendix_1.pdf

BASELINE HUMAN HEALTH

The Initial Information Request

MH states that a summary of infant mortality and life expectancy in various regions of the province provide an indicator of overall health in the project study area.

In an information request subsequently forwarded by the CEC, CAC Manitoba requested the following additional information beyond what was provided in the EIS.

(a) *Please provide other relevant baseline health indices including cancer, heart and respiratory disease rates, and hospital admissions.*[5]

(b) *Please identify major health determinants in the study area including socio-economic status, traditional foods and overall diet, exercise, alcohol and drug abuse and other health determinants as listed in Manitoba Community Health Assessment Guidelines (2009).*[6]

[5] CEC/MH-VI-344a
[6] CEC/MH-VI-344b

Manitoba Hydro's response to question (a) and (b):

- For the Bipole III Transmission Project, there is no direct pathway of effect between the Project and health indices such as cancer, heart and respiratory disease rates and hospital admissions related to such diseases. As such, baseline information related to these diseases was not collected.

Further Commentary:

- Large development projects such as the Manitoba Hydro Bipole III Transmission Project have well-characterized effects on biophysical, social and economic environments (Environmental Health Assessment Services - Health Canada, 2004; Barron et al, 2010; ICMM 2010; IFC; 2009; Bouvier de Candia, 2007). They also exert a strong influence on health in nearby communities. Many, although not all, of these health effects are secondary to direct changes caused by the project—for example, changes in air quality, in wildlife availability or in the demographic makeup of towns. However, the health changes themselves need to be examined to develop a full understanding of the impacts associated with project activities and to appropriately express address the trade-offs implicit in the project.
- ***See recommendation below for Health Impact Assessment (HIA)***

HEALTH IMPACT ASSESSMENT

The Initial Information Request

In an information request subsequently forwarded by the CEC, CAC Manitoba requested the following additional information beyond what was provided in the EIS.

(a) Please provide a community health assessment to identify potential impacts of the project on locally affected communities and residents.[7]

(b) Please identify major health determinants in the study area including socio-economic status, traditional foods and overall diet, exercise, alcohol and drug abuse and other health determinants as listed in Manitoba Community Health Assessment Guidelines (2009).[8]

(c) Please supplement the Socio-Economic Assessment by utilizing a community health assessment with the objective of identifying and mitigating potential adverse social effects, while specifically identifying community socio-economic and health benefits and opportunities for local residents.[9]

[7] CEC/MH-VI-346a
[8] CEC/MH-VI-346b
[9] CEC/MH-VI-347b

(d) Please comment on the suggestion that monitoring plans (Section 9.0) could benefit by adding human community health monitoring that would not necessarily be cost prohibitive (*eg* selected blood and urine monitoring within communities as was done in Flin Flon as the mine and smelter operation was being decommissioned).[10]

Manitoba Hydro's response (summary)[11]

- The Manitoba Community Health Assessment Guidelines (2009) is a document prepared for Manitoba health authorities to support these health authorities in defining the health needs of their populations. This document was prepared specifically for Manitoba health authorities.… in the case of the Bipole III Project there is no direct pathway of effect between known Project effects and human health indices such as cancer, heart and respiratory disease rates and hospital admissions related to such diseases.

- As such a community health assessment is not necessary and will not be undertaken for this project.

- Community Services were considered as a VEC in Chapter 8. This included consideration of potential effects on local community health and emergency response services.

- Human community health monitoring programs may be appropriate where there is a direct pathway of a measurable effect between the Project and human community health indices to support such activity. Monitoring implementation costs are also a factor in this consideration. In the case of the Bipole III Project, there is no reasonable basis to design or support adding human community health monitoring.

Further Commentary

The Manitoba Community Health Assessment Guidelines (2009) is a document prepared for Manitoba health authorities to assist in defining the health needs of their populations.

However, there are a number of health-related issues associated with large development projects that have been identified and well described by industry organizations, lending institutions, government agencies and other organizations, but that have not been accounted for by MH (Environmental Health Assessment Services - Health Canada, 2004; Barron et al, 2010; ICMM 2010; IFC; 2009; Bouvier de Candia, 2007). These include:

Health effects associated with economic and social and change. Employment and income can lead to health benefits for a local population, and these benefits can be characterized in the context of a particular development project (Doyle et al,

[10] CEC/MH-VI-347c

[11] CEC/MH-VI-346 and 347.

2005). At the same time, many communities also experience increases in drug and alcohol use and commensurate increases in violence-related injuries and trauma, emergency room visits, demand on mental health and addictions services, and various measures of mental wellbeing. This trend is particularly strong where social changes are also a result of economic change or a demographic shift as a result of the project (Dunn. 2007; Seydlitz & Laska, 1994; Neil & Jones 1988; Park & Nelson, 1988).

Infectious disease transmission. Infectious disease in the context of development projects in Canada results from an influx of people (e.g., a project construction workforce) moving temporarily into a rural or remote area. The presence of a population of men with high mobility and high disposable income has led to documented increases in sexually transmitted infections (Goldenberg et al, 2008a, 2008b, Goldenberg et al 2007). Where an influx in population responding to employment possibilities (direct, indirect or induced) results in high density or overcrowding in homes or camps, there is the potential for increases in respiratory and gastrointestinal disease transmission (Provincial Control Infection Network BC, 2008).

Impacts on diet and nutrition. Where a project affects the availability of or access to wildlife, there may be implications for diet and nutrition among people who depend on the wildlife as a food source, including First Nations communities. Contamination of wildlife is a separate issue that may affect health outcomes; perceived contamination (with or without “real” contamination occurring) may also change dietary behaviours and drive nutritional outcomes (Kuhnlein & Chan, 2000; Milburn, 2004; Nelson & Hickey, 2005).

Injury and public safety. Increases in traffic-related injuries and fatalities can occur where there is a project-related increase in the volume of traffic.

Stress and mental wellbeing are commonly affected in a subset of local residents. The degree to which effects manifest is affected by a number of project factors (Park & Nelson 1998).

Impacts on emergency health response. Emergency response planning for a large project usually involves drawing on emergency response capabilities in the region, such as ground and air ambulance, emergency care and tertiary care. The way in which emergency response is coordinated or carried out will have an impact on the availability of services for other stakeholders. Other development projects in Canada have resulted in up to 50% increases in emergency room visits associated with the times when work crews are present (P. Eby and Associates, 1979).

Impacts on health care service provision. Several challenges face health care service providers that may be exacerbated by a temporary or permanent project attributes. These stressors on health care provision include a larger population that requires service; increased need for certain services (generally emergency services and drug/alcohol treatment); and difficulty in recruiting or retaining health personnel due to strained working conditions or a decrease in affordable or available housing.

It is therefore proposed that a Health Impact Assessment (HIA) (as opposed to a Community Health Assessment) be conducted by Manitoba Hydro for the proposed Bipole III project.

- An appropriately scoped health impact assessment (HIA) or community health assessment must account for the full range of health externalities, both in characterizing the impacts of the project and in formulating appropriate recommendations to mitigate potential health harms or to enhance health co-benefits.
- A Community Health Monitoring program that would be implemented during the construction and operations phases would be designed with stakeholder input during the initial HIA.
- There are a number of analogies and precedents for the application of Health Impact Assessment (stand-alone or as part of an integrated assessment) to projects such as the Manitoba Hydro Bipole project. Some examples include:
    - Health impact assessments conducted on linear projects
        - Health Impact Assessment done for Shell Canada's Quest Carbon Capture & Storage pipeline (Alberta). (Habitat, 2010; document not public)
        - Community Health Impact Assessment being conducted as part of the EIA for a major pipeline project in Western Canada (Habitat, 2012, currently in process)
        - Health Impact Assessment conducted on the Chad-Cameroon pipeline. (see Utzinger J. et al, Assessing health impacts of the Chad–Cameroon petroleum development and pipeline project: challenges and a way forward. *Environmental Impact Assessment Review*. 25 (2005) 63–93)
    - Health impact assessments conducted on hydroelectric projects
        - Health Impact Assessment of an Aluminum Smelter and Hydroelectric Project in Greenland. (Conducted by ERM for Alcoa Global Primary Products, 2009)
        - Health Impact Assessment and Public Health Action Plan for the Nam Theun 2 Hydroelectric Project (Published as part of the Nam Theun 2 Project Social Development Plan, 2005)
        - Health Impact Assessment and Public Health Action Plan for Trung Son Hydropower Project. (Conducted by L.N. Ha and S. Kaul, 2010)

    There are also a number of corporations that have internal requirements for HIA to be done for major proposed projects, even when an HIA is not required within

the regulatory context. Some examples of these companies are Royal Dutch Shell, Chevron, Rio Tinto and Barrick Gold.

HUMAN HEALTH RISK ASSESSMENT

The Initial Information Request

In an information request subsequently forwarded by the CEC, CAC Manitoba presented the following commentary and asked for the following additional information beyond what was provided in the EIS.

MH identifies potential sources of effects on human health (EMF, dust, herbicides) but concludes there will be no significant impact. EMF was assessed in some detail but other sources of effects on human health were only qualitatively addressed or not addressed at all.

Accidents and malfunction (Section 8.4) are generic representations that do not include impact or risk assessment of such. Worst case scenarios (*e.g.* chemical spills, fires, explosions) should be identified and quantitatively assessed within the HHRA.

(a) Please provide a human health risk assessment (HHRA) that identifies and assesses sources of health risks other than EMF (which has been addressed in the EIS). Examples include air emissions during construction and operations, dust, herbicides, chemical spills, contamination of country foods, hazardous wastes, drinking water quality.[12]

(b) Given that the accidents and malfunction (Section 8.4) are generic representations that do not include impact or risk assessment of such, please identify and assess worst case scenarios (*eg* chemical spills, fires, explosions) within the HHRA.[13]

Manitoba Hydro's response (summary)[14]

- The justification for undertaking a human health risk assessment is under conditions of real risk of emissions or the release of contaminants of concern to potential human receptors under an existing pathway(s) for human exposure to said contaminants of concern (Health Canada, 2010: Useful Information for Environmental Assessments).

- In the case of the Bipole III Transmission Project, the exposure pathways would be through the release of hazardous materials and/or spills into water or soil, effects on drinking or recreational water quality, noise and contamination of country foods through spills or release of hazardous materials. The majority of these are contingency events and are not expected to occur and as such a human risk assessment is not required.

[12] CEC/MH-VI-346b
[13] CEC/MH-VI-346c
[14] CEC/MH-VI-346 and 347.

- When undertaking the construction, operation and decommissioning of a project such as the Bipole III Transmission Project, Manitoba Hydro must adhere to standards, guidelines and legislative requirements that link to the above exposure pathways. See also CEC/MH-II-020b.

- The Bipole EIS was specifically informed by the Scoping Document and considered workplace health and safety and human health and well being pursuant to direction provided therein. The following was considered in the EIS:

  - Human health was described in Chapter 6 (baseline), section 6.3.6.3

  - Human health was considered as a VEC in Chapter 8 where there was a pathway of effect (i.e., issues related to noise, vibration, dusk, EMFs and herbicides as considered in Section 8.3.5).

Further Commentary

- The air quality assessment identified primary air pollutants associated with the Bipole III project that have the potential to incur acute and chronic health effects through both direct exposure pathways (inhalation) and indirect exposure pathways (ingestion of country foods).

- A human health risk assessment associated with Bipole III air quality changes is recommended to determine potential health risks to local human receptors. The ability to conduct the HHRA is dependent upon quantitative air quality assessment as recommended above.

- The HHRA scope of work should include the quantitative assessment of potential health risks associated with worst case scenarios including chemical spills, fires, explosions and so on.

EXAMPLE TERMS OF REFERENCE: PUBLIC HEALTH AND SAFETY

The terms of reference for the human health risk assessment for EIAs in Alberta is reproduced below. The terms of reference are for a relatively small limestone quarry project in Alberta.

Describe those aspects of the Project that may have implications for public health or the delivery of health services. Determine whether there may be implications for public health arising from the Project. Specifically:

a) identify and discuss the data and methods Parsons Creek Resources used to assess impacts of the Project on human health and safety;

b) *assess the potential health implications of the compounds that will be released to the environment from the proposed operation in relation to exposure limits established to prevent acute and chronic adverse effects on human health;*

c) *identify the human health impact of the potential contamination of country foods and natural food sources taking into consideration all project activities;*

d) *provide information on samples of selected species of vegetation known to be consumed by humans;*

e) *discuss the potential to increase human exposure to contaminants from changes to water quality, air quality and soil quality taking into consideration all project activities;*

f) *document any health concerns identified by Aboriginal stakeholders due to the impacts of the Project specifically on their traditional lifestyle. Determine the potential impact of the Project on the overall health of Aboriginal stakeholders and identify possible mitigation strategies;*

g) *assess cumulative health effects to receptors that are likely to result from the Project in combination with other existing, approved and planned projects;*

h) *identify, as appropriate, the anticipated follow-up work, including regional cooperative studies. Identify how such work will be implemented and coordinated with ongoing air, soil and water quality initiatives;*

i) *identify and discuss the potential health and safety impacts due to higher regional traffic volumes and the increased risk of accidental leaks and spills;*

j) *document the health and safety concerns raised by stakeholders during consultation on the Project;*

k) *provide a summary of Parsons Creek Resources' emergency response plan and discuss mitigation plans to ensure workforce and public safety during pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;*

l) *describe how local residents will be contacted during an emergency and the type of information that will be communicated to them; and*

m) *describe the existing agreements with area municipalities or industry groups such as safety co-operatives, emergency response associations and municipal emergency response agencies.*

ftp://ftp.gov.ab.ca/env/fs/eia/2010-06-ParsonsCreekAggregatesParsonsCreekAggregatesLimestoneQuarryProject/Working%20PDF/Application/10_Appendix_1.pdf

EXAMPLE OF RECENT LINEAR PROJECT HHRA

In addition we provide an example of an HHRA recently completed for a large scale linear EIA project, the Northern gateway pipeline project in Alberta - B.C. This project, like Bipole III,

would pose human health risks primarily during the construction phase and for many of the same reasons/sources.

Please access the following link:

http://www.northerngateway.ca/assets/pdf/tdr/Marine%20Technical%20Data%20Reports/Human%20Health%20Risk_TDR.pdf

CUMULATIVE EFFECTS ASSESSMENT (CEA)

The Initial Information Request

In an information request subsequently forwarded by the CEC, CAC Manitoba presented the following commentary and asked for the following additional information beyond what was provided in the EIS.

The cumulative effects assessment (Section 9.0) is very vague, generic and qualitative, with only checklists identifying potential cumulative effects between known and announced projects. The conclusion (.... a small magnitude, medium-term cumulative effect is expected....) is not defensible on the basis of the CEA.

(a) Please provide a quantitative CEA that realistically addresses the cumulative impacts of this project (*i.e.* not simply assuming that all biophysical and socio-economic impacts of this project are "not significant), in combination with other announced industrial projects, in a quantitative manner, to the extent possible.[15]

Manitoba Hydro's response (summary)

- The environmental assessment did not "simply assume" that effects of the Project are "not significant".
- The cumulative effects assessment for the Bipole III Transmission Project reflected the outcome of extensive analysis that started with a route and site selection process appropriate for a transmission project environmental assessment, involving a variety of route options over a large Project Study Area, and with an objective to avoid adverse effects where feasible through selection of a preferred route.
- Following selection of a preferred route and other Project sites as described in Chapter 7, valued environmental components (VECs) relevant to the remaining expected effects of the Project were identified and an environmental assessment of expected Project effects on these VECs was carried out in Chapter 8.

[15] CEC/MH-VI-347a

- This effects assessment for each VEC was conducted by Project component during construction and operation, taking into consideration the likely effects of the Project on each VEC in the context of other past and existing projects having effects on that VEC. Chapter 9 then provided a high level screening to identify any VECs having potentially non-negligible cumulative effects beyond those already assessed in Chapter 8, and provided further cumulative effects assessment analysis of each VEC so identified.

- Environmental effects were expressed quantitatively to the extent possible. Where quantification was not possible, qualitative methods were used to estimate and compare effects systematically. Where insufficient data were available to support a high level of certainty, the constraints on the conclusion were so noted.

- The effects assessment in Chapter 8 considered the residual adverse effects after mitigation of the Project on VECs and a significance determination was made considering the criteria set out in the Bipole III Scoping Document.

- VECs with residual adverse effects after mitigation were then considered further in Chapter 9 (Cumulative Effects).

Further Commentary

- Thorough a review of Manitoba Hydro"s detailed response to this question including detailed screening tables and text for both biophysical and socioeconomic cumulative effects confirmed to us that the type of transparent quantitative CEA that we are referring to has not been completed by the proponent. In particular, for most VECS, there has been little physical or numerical evidence provided in the materials to date that justify the conclusions of "non-negligible cumulative adverse effects are not expected".

  An example of this concern appears in the text below from Hydro (highlights added by CAC Manitoba):

  "Section 9.3.2 of Chapter 9 (Cumulative Effects Assessment) noted that residual adverse effects of the Project for certain biophysical VECs were effectively limited to the immediate rights-of-way and footprint area of the Project and as such the only real prospect of a related cumulative biophysical effect beyond that assessed in Chapter 8 would occur where there is a further development on or adjacent to the rights-of-way for the HVdc transmission line, the 230 kV ac northern collector lines, the northern converter station or ground electrode site and line. Overall, Section 9.3.2 concludes that non-negligible cumulative adverse effects are not expected for these biophysical VECs due to the site specific effects and general low magnitude of effects of the Project as assessed in Chapter 8. The high level screening analysis supporting this conclusion is elaborated on below with added information on the relevant VECs".

  An additional example appears below in the detailed backup materials provided:

Beaver

Effects related to decreased population, sensory disturbance and overharvest due to construction and operation of the HVdc Transmission line, ac collector lines and site access roads.

Effects related to functional habitat loss, sensory disturbance and a small increase in trapping due to construction and operation of Keewatinoow converter station.

Construction & Operation
Direction – Negative
Magnitude – Small

Geographic Extent – Project Site/Footprint

Duration – Medium Term
Overall – Not Significant

- On the basis of the reports and supporting documentation provided by Hydro for the Bipole III application and EIS, it would appear that many of the conclusions of negligible effects are based on qualitative judgments by practitioner experts in various disciplines. Of course when comparisons are made between the project footprint and the rest of Manitoba's land area and un-impacted human and wildlife populations, effects may be deemed negligible. However, on a smaller study area scale, many of the potential effects may be more than non-significant overall, as stated in the conclusion in the example above.

- A paper recently published by one of the authors of the guidance document referenced in the Bipole III CEA (CEAA, 1999, Cumulative Effects Assessment Practitioners Guide), George Hegmann, provides some additional insight into current CEA methodology and shortcomings. Hegmann and Yarranton (2011) state that practitioners of CEA can produce a more valuable tool if they concentrate on developing reliable predictions based on factual evidence and leave the final evaluation of those predictions to the decision makers. The CEA may use all manner of analysis, including physical–numerical models, spatial calculations of change, computer simulation, statistical analysis, habitat analysis, air quality analysis, mapping and GIs, for example.

- The methods identified in the preceding paragraph types of methods are all examples of quantitative tools that may have been applied in some cases to the Bipole III project, but in a number of many cases the quantitative, numerical proof, if it exists, has not been put on the record so far.

- Hegmann and Yarranton (2011) also point out that the task for CEA practitioners is educational and it is not going to be performed successfully by those making claims that cannot be substantiated. They say that information from the environmental science community has to be reliable or it will eventually be discounted, (to the detriment of all).

- Also, according to CEA Guidance in Alberta www.nrcb.gov.ab.ca/Content_Files/Files/NRP_Guides/Cumulative_Effects.pdf the purpose of an EIA report is to predict potential adverse impacts of development and to design remedies to prevent or mitigate them. The purpose of a CEA is substantially the same. However, the complexity, scale and inherent uncertainties associated with predicting future activities are greater in CEAs. The regulators are aware that uncertainty is part of a CEA. The largely unavoidable sources of uncertainty include imperfect knowledge of baseline conditions and present activities, limited understanding of the primary and indirect impacts of activities and their interactions, and uncertainties about future development scenarios. What the regulators expect from proponents is a description of efforts to obtain data concerning the impacts of those projects and activities; an exploratory analysis of potential outcomes based on the best available information and science and a range of plausible assumptions about the future course of development; a description of how the proponent proposes to monitor uncertain outcomes; and the proponent's plans to respond to unfavourable outcomes, should they arise. In other words, proponents should describe how they plan to adaptively manage possible future outcomes identified in the CEA.

- It is therefore recommended that the CEA conducted by Hydro be redone in a transparent, quantitative manner, to the extent possible based on current best EIA/CEA practices in Canada.

REFERENCES

Alaska Department of Health and Social Services. (2011). Technical Guidance for Health Impact Assessment (HIA) in Alaska.

Alberta Environment. (2007). Final Terms of Reference. Environmental Impact Assessment (EIA) Report for the proposed Parsons Creek Resources Project, A Limestone Quarry.

Alberta Environment. (2007). Final Terms of Reference. Environmental Impact Assessment (EIA) Report for Suncor Energy Inc. Voyageur South Project.

Barron, T., M. Orenstein, and A. Tamburrini. January 2010. *Health Effects Assessment Tool (HEAT): An Innovative Guide for HIA in Resource Development Projects*.

Baxter, Wanda, Ross, A., William and Spaling, Harry. (2001). Cumulative effects assessment. Improving the practise of cumulative effects assessment in Canada. Pages 253-262 in Impact Assessment and Project Appraisal. Volume 19. Number 4. Beech Tree Publishing. Surrey, U.K.

Bouvier de Candia, AL. (2007). Canadian Natural Resources Large-Scale Projects: Social, Cultural and Economic Impacts. Annotated Bibliography of Post-Project Studies. Environmental Health Assessment Services, Health Canada.

Doyle, C., Kavanagh, P., Metcalfe, O., & Lavin, T. (2005). *Health Impacts of Employment: A Review*. Dublin: The Institute of Public Health in Ireland. Available at: http://www.publichealth.ie/publications/healthimpactsofemploymentareview

Dunn, C. (2007). Health Canada Report on Income Increase and Alcohol Abuse. Ottawa: Health Canada.

Duinker, N, Peter and Greig, A, Lorne. (2007). Scenario analysis in environmental impact assessment: Improving explorations of the future . Pages 206 – 219 in Environmental Impact Assessment Review 27. New York, N.Y.

Duinker, N, Peter and Greig, A, Lorne. (2007). Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project . Prepared by ESSA Technologies Ltd., Richmond Hill, ON for the Joint Review Panel for the Mackenzie Gas Project, Inuvik, NT, 32 pp.

Duinker, N, Peter and Greig, A, Lorne. (2006). The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment . Pages 153-161 in Environmental Management Vol. 37, No. 2 .

Environmental Health Assessment Services, Health Canada (2004). Canadian Handbook on Health Impact Assessment, Volume 4: Health Impacts by Industry Sector. Ottawa: Health Canada.

Goldenberg, S. M., Shoveller, J. A., Ostry, A. C., & Koehoorn, M. (2008). Sexually transmitted infection (STI) testing among young oil and gas workers: the need for innovative, place-based approaches to STI control. *Can J Public Health*, 99(4): 350-354.

Goldenberg, S., Shoveller, J., Koehoorn, M., & Ostry, A. (2007). *Sexual Behaviour and Sexually Transmitted Infection (STI) Prevention among Youth in Northeastern BC*. Vancouver: Vancouver Foundation. Available at: http://sexualhealth.ubc.ca/Research/Publications.aspx.

Gunn, Jill and Noble, F. Bram. (2011). Conceptual and methodological challenges to integrating SEA and cumulative effects assessment . Pages 154 -160 in Environmental Impact Assessment Review 31. New York, N.Y.

Health Impact Assessment and Public Health Action Plan for Trung Son Hydropower Project. 2010. Available at: http://www.apho.org.uk/resource/view.aspx?RID=118808.

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker. 1999. Cumulative Effects Assessment Practitioners Guide. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec.

Hegmann, George and Yarranton, G.A, (Tony). (2011). Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management . Pages 1 -7 in Resource management, Environ Impact Asses Rev. New York, N.Y.

ICMM (International Council on Mining and Metals), 2010. Good Practice Guidance on Health Impact Assessment. London, UK: International Council on Mining and Metals.

IFC (International Finance Corporation), 2009. Introduction to Health Impact Assessment. Washington, US: International Finance Corporation.

Kuhnlein, H. V., & Chan, H. M. (2000). Environment and contaminants in traditional food systems of northern indigenous peoples. *Annu Rev Nutr, 20*: 595-626.

Mackenzie Valley Resource Management Act, S.C. 1998, c.25

Milburn, M. P. (2004). Indigenous Nutrition: Using Traditional Food Knowledge to Solve Contemporary Health Problems. *American Indian Quarterly, 28*(3 & 4): 411-434.

Neil, C. C., & Jones, J. A. (1988). Environmental Stressors and Mental Health in Remote Resource Boom Communities. *Journal of Sociology,* 24(3): 437.

Nelson, M., Natcher, D. C., & Hickey, C. G. (2005). Social and economic barriers to subsistence harvesting in a northern Alberta aboriginal community. *Anthropologica (Ottawa), 47*(2): 289-301.

P. Eby and Associates Limited and Cornerstone Planning Group Limited. 1979. *Social and Economic Effects of the Grizzly Valley Pipeline and Gas Plant Construction on the Chetwynd Region, BC* Prepared for Westcoast Transmission Company Limited, Vancouver, British Columbia.

Park, J., & Nelson, C. H. (1998). The investigation of stress in resource-dependent communities: the effect of rapid socioeconomic changes on mental health service use. *Int J Circumpolar Health*, 57(Suppl 1): 432-438.

Provincial Control Infection Network of BC. (2008). Antibiotic Resistant Organisms Prevention and Control Guidelines.

Ross, Bill and Therivel, Riki. (2007). Cumulative effects assessment: Does scale matter? Pages 365-385 in Environmental Impact Assessment Review 27 . New York, N.Y.

Sadler, Barry. (1996). Environmental Assessment in a Changing World: evaluating practise to improve performance in Final Report of the International Study of Effectiveness of Environmental Assessment. CEA.

Seydlitz, R., & Laska, S.B. (1994). *Social and economic impacts of petroleum 'boom and bust' cycles*. U.S. Department of Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. Available at: *www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3441.pdf*.

Smit, Barry and Spaling, Harry. (1995). Managing the EIA Process. Methods for cumulative effects assessment. Pages 81 -106 in Environ Impact Assess Rev. New York, N.Y.

Socio-Economic Agreement, BHP Diamonds Project. (1996). Government of North West Territories and BHP Diamonds. In 4th session of th 13th Assembly.

Socio-Economic Monitoring Agreement. (1999). Diavik Diamonds Project.

Spaling, Harry. (1994). Cumulative Effects Assessment: Concepts and Principles. Pages 231-251 in Impact Assessment, 12:3.

Utzinger, Jürg., Wyss, Kaspar., Moto. D, Daugla., Yémadji N'Diékhor., Tanner, Marcel., Singer, H.Burton. (2005). Assessing health impacts of the Chad–Cameroon petroleum development and pipeline project: challenges and a way forward. Pages 63-93 in Environmental Impact Assessment Review, Volume 25, Issue 1.