Scenario Analysis:

A Best Practice Approach to Assessing the Cumulative Impacts of the Mackenzie Gas Project

Peggy Holroyd • Jennifer Grant • Simon Dyer

August 2007

the PEMBINA institute

Sustainable Energy Solutions

Scenario Analysis: A Best Practice Approach to Assessing the Cumulative Impacts of the Mackenzie Gas Project
Published August 2007
Printed in Canada

Editor: Don Morberg

The Pembina Institute
Box 7558
Drayton Valley, Alberta T7A 1S7 Canada
Phone: 780-542-6272
E-mail: info@pembina.org

Additional copies of this publication may be downloaded from our website, http://www.pembina.org.

About the Pembina Institute

The Pembina Institute creates sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy and environmental governance. More information about the Pembina Institute is available at http://www.pembina.org or by contacting info@pembina.org.

About the Pembina Foundation for Environmental Research and Education

The Pembina Foundation for Environmental Research and Education is a federally-registered charitable organization. The foundation supports innovative environmental research and education initiatives that help people understand the way we produce and consume energy, the impact of energy generation and use on the environment and human communities, and options for more sustainable use of natural resources. The Pembina Foundation contracts the Pembina Institute to deliver on this work. More information about the Pembina Foundation is available at http://www.pembinafoundation.org or by contacting info@pembinafoundation.org.

About the Authors

Peggy Holroyd

As an Environmental Policy Analyst with the Pembina Institute's Energy Watch Program, Peggy Holroyd reviews environmental assessments for new oil and gas projects and identifies the potential cumulative impact of gas development in the Western Sedimentary Basin. Peggy has also researched corporate environmental responsibility, environmental externalities and socio-economic effects associated with energy projects. Peggy holds a BA in International Development from the University of Calgary with a specialization in Northern Planning and Development from the Arctic Institute of North America. Peggy is currently completing a graduate degree at the University of Calgary focused on thresholds-based management of cumulative effects.

Jennifer Grant

Jennifer Grant is a Policy Analyst with the Pembina Institute. Jennifer is a member of Pembina's Energy Watch team where she is involved in research, writing and multi-stakeholder initiatives pertaining to oil sands development. Jennifer has engaged in conservation planning initiatives as both a biologist and an environmental educator in Alberta since 1999. Jennifer represents the Pembina Institute on the Reclamation Working Group and the Watershed Integrity Task Group of the Cumulative Environmental Management Association (CEMA). Jennifer holds a Masters of Science in Ecosystem Management from the University of Calgary and an honours degree in Biological Sciences from the University of Victoria.

Simon Dyer

Simon Dyer is a Senior Policy Analyst with the Pembina Institute. Simon is a member of Pembina's Energy Watch team, where his research focuses on the environmental implications of energy development. Simon is a registered professional biologist and has worked on land use issues in western Canada since 1999. Simon represents the Pembina Institute on the Sustainable Ecosystems Working Group of the Cumulative Environmental Management Association (CEMA). Simon holds a Master of Science in Environmental Biology and Ecology from the University of Alberta, and a Master of Arts in Natural Sciences from the University of Cambridge. Simon is the co-author of *Death by a Thousand Cuts: Impacts of in-situ oil sands development on Alberta's boreal forest*.

Acknowledgements

The authors would like to acknowledge Matt Gray for providing comments on previous drafts of the report.

Scenario Analysis:

A Best Practice Approach to Assessing the Cumulative Impacts of the Mackenzie Gas Project

Table of Contents

1. Introduction

1.1 Report Description and Background

This report was prepared for the Canadian Parks and Wilderness Society (Northwest Territories Chapter), Sierra Club of Canada (SCC,) World Wildlife Fund (WWF) and the Sierra Legal Defence Fund for submission to the Joint Review Panel for the Mackenzie Gas Project (MGP.)

In preparation for the Topic 15 Cumulative Impacts hearing, this report addresses three objectives: 1) identify how scenario analysis is used as a best practice in the assessment of cumulative effects; 2) provide examples of scenario analysis applied in different jurisdictions; and 3) provide recommendations for how scenario analysis could be conducted to assess the cumulative impacts of the MGP including the impacts of future-induced development.

This report will provide the following examples of how scenario analysis has been applied to land use decision-making processes elsewhere in North America:

- In Montana, to assess the environmental consequences of alternative scenarios of coal bed methane development and management;
- In the Chukchi Sea of Alaska, to assess the various alternatives proposed in an oil and gas lease sale;
- In the Upper San Pedro River Basin of Arizona and Sonora,to portray several alternatives that consider the hydrological and biological outcomes of growth management;
- In the Canadian Rockies, where the project impacts of a pipeline expansion are assessed;
- In northeastern Alberta, where the Cumulative Environmental Management Association is seeking to manage the impacts of oil sands development.

The Joint Review Panel is tasked with reviewing the Environmental Impact Statement for the Mackenzie Gas Project.[1] The Mackenzie Gas Project proposal involves developing three anchor fields in the Mackenzie Delta, associated gathering system infrastructure, a processing facility near Inuvik, a natural gas liquids pipeline from Inuvik to Norman Wells, and a gas pipeline from Inuvik to Alberta. These pipelines will allow the proponents and other natural gas developers to transport natural gas from the Mackenzie Delta to southern markets.

The Mackenzie Gas Project has the potential to bring both significant benefits and significant liabilities to the North. Identifying the potential economic, social and environmental impacts (both positive and negative) requires looking into the future and determining whether or not those impacts are desirable or acceptable.

The Joint Review Panel is required to consider how the Mackenzie Gas Project will affect the environment; the protection of existing and future social, cultural and economic well being of

[1] Imperial Oil, ConocoPhillips, ExxonMobil and Shell Canada, *Environmental Impact Statement for the Mackenzie Gas Project* (2004).

residents and communities; as well as "any cumulative impact that is likely to result from the Project in combination with other projects or activities that have been or will be carried out."[2]

The Terms of Reference for the Mackenzie Gas Project Environmental Impact Statement require that, "Methods used to describe the environmental conditions and to identify and measure impacts on the environment should be consistent with high standards and best practices in the relevant subject area."[3]

With respect to cumulative effects assessment methodology, scenario analysis represents a demonstrated best practice for assessing the cumulative impact of resource development projects and associated induced development.

The Joint Review Panel commissioned the March 2007 report "*Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project*" by L. Greig and P. Duinker.[4] In the report, the authors explain the value of assessing future development scenarios as part of cumulative effects assessment, especially given the current lack of guidance from strategic environmental assessments and land use plans for some regions in the Northwest Territories (NWT). They write, "…CEAs associated with Project [Environmental Impact Assessments] can play a substantial role in preventing undesirable futures, but only if the development futures are broadly enough defined and the associate cumulative effects are fully assessed."[5] Scenario analysis within cumulative effects assessment is a useful tool to evaluate the range of possible development trajectories and their impact on the economy, society and environment, and desired future outcomes.

On June 6, 2007, SCC and WWF submitted a motion requesting that the Joint Review Panel commission an independent scenario-based cumulative effects assessment (CEA), in accordance with the Greig and Duinker report; and to distribute the assessment prior to the cumulative effects hearing. Following a round of responses by the other interveners to the Mackenzie Gas Project, the Joint Review Panel issued a response to the motion on July 13, 2007. [6] The Panel denied the motion on the basis that it was not "consistent with the Greig and Duinker Report recommendation as it is written," and also that the Greig and Duinker report has not yet been tested at a hearing before the Panel.[7] The Panel ruled that the ideas in the motion should be discussed at the Topic 15 Cumulative Impacts Hearing. The Topic 15 hearing is scheduled for Aug, 27-31, 2007, in Yellowknife.

---

[2] Mackenzie Valley Environmental Impact Review Board, Inuvialuit Game Council, Minister of the Environment, Government of Canada, *Annex 2 of the Agreement for the Environmental Impact Review of the Mackenzie Gas Project* (2004), http://www.ngps.nt.ca/jrpa_final_e.htm.

[3] *Environmental Impact Statement Terms of Reference for the Mackenzie Gas Project*, (August 2004), http://www.ngps.nt.ca/documents/tor_final_e.pdf, 36.

[4] Lorne Greig and Peter Duinker, *Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project* (Prepared for the Mackenzie Gas Project Joint Review Panel, 2007).

[5] Lorne Greig and Peter Duinker, *Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project* (Prepared for the Mackenzie Gas Project Joint Review Panel, 2007), 25

[6] R. Hornal, *Letter Re. Motion on behalf of Sierra Club of Canada (SCC) and the World Wildlife Fund (WWF) requesting that the Joint Review Panel commission a scenario-based cumulative effects assessment (CEA) in accordance with the Greig and Duinker report*. (Inuvik, NT: Joint Review Panel for the Mackenzie Gas Project, 2007).

[7] Ibid.

Cumulative Effects Assessment and "Futuring"

Cumulative effects are "changes to the environment that are caused by an action in combination with other past, present and future human actions."[8] This definition summarizes the main concepts of cumulative effects – they are a result of several human actions from different time periods.

A cumulative effects assessment is similar to an environmental assessment, but with an expanded temporal and spatial scope. Many practitioners argue that cumulative effects assessments (CEAs) are EIAs done correctly.[9]

In a CEA, the study area is enlarged; and past, present and future actions are assessed to determine their effect on components of an ecosystem or society.

Since CEAs were first required in Canada under the Canadian Environmental Assessment Act in 1992, the practice has evolved.[10] Scenario analysis is a tool that can be used in cumulative effects assessment to aid decision making.

> *CEA is concerned with providing information to decision-makers to help them think critically about possible futures and their consequences.*[11]

CEAs require regulators to determine how a valued component (VC; an important ecological or social condition) might be affected by past, present and future developments. The effects of past and present developments are more easily measured. Future developments may be difficult to identify given the range of uncertainty about whether they will indeed occur; and, if so, to what degree. In fact, even seemingly imminent projects may be cancelled due to changes in socioeconomic factors (e.g. the Foothills Pipeline Project[12]). Therefore, any assessment of the future is actually an assessment of what is possible or plausible. Scenario analysis can help to understand the scope of possible alternative futures and the impact on key valued components. Scenario analysis can also inform mitigation and management to deal with development impacts.

Induced Development and the Mackenzie Gas Project

Under Canadian Environmental Assessment Act, the panel is required to assess the cumulative impacts of the MGP in combination with other likely projects. ***The Cumulative Effects***

---

[8] Cumulative Effects Assessment Working Group and AXYS Environmental Consulting Ltd, *Cumulative Effects Assessment Practitioners Guide* (Ottawa, ON: Canadian Environmental Assessment Agency, 1999), 3.

[9] Cumulative Effects Assessment Working Group and AXYS Environmental Consulting Ltd, *Cumulative Effects Assessment Practitioners Guide* (Ottawa, ON: Canadian Environmental Assessment Agency, 1999); Peter Duinker and Lorne Greig, "Scenario analysis in environmental impact assessment: Improving explorations of the future," *Environmental Impact Assessment Review* (2007), 206-219.

[10] Department of Justice Canada, *Canadian Environmental Assessment Act* (1992, c.37), http://laws.justice.gc.ca/en/ShowFullDoc/cs/c-15.2///en.

[11] L. Greig, K. Pawley and P. Duinker, *Alternative Scenarios of Future Development: An Aid to Cumulative Effects Assessment* (Canadian Environmental Assessment Agency, 2004) For the Research and Development Monograph Series, 2002, http://www.ceaa.gc.ca/015/001/021/print-version_e.htm (accessed July 24, 2007), 30.

[12] In 1978, Foothills Pipeline Project (Alaska Highway Natural Gas Pipeline) that proposed to take gas from northern Alaska to the southern States was approved. The Northern Pipeline Act along with the Northern Pipeline Agency were created to enable the construction of the project. Due to unfavourable economic conditions, it was never built. The original certificate and the Act are still in place. TransCanada, Questions and Answers, http://www.transcanada.com/Alaska/pdf/NPA_QuestionsAnswers.pdf (accessed July 28, 2007).

Assessment Practitioner's Guide considers that including induced development is a best practice "if there is reason to believe they may occur…"

For environmental impacts assessments prepared under the Mackenzie Valley Resource Management Act, the Mackenzie Valley Environmental Impact Review Board expects that induced developments are included in the assessment, even if specific applications have not been submitted for them.[13]

There is little doubt that the Mackenzie Gas Project is designed to induce more development than is presented in the current proposal for the MGP. The Mackenzie Valley Environmental Impact Review Board (MVEIRB) raised this point, which is echoed by many others, in their May 2004 Reasons for Decision and Scoping Report:

> The Board is convinced that there is a high likelihood of induced development occurring after the pipeline has been constructed. For example, the proposed start up capacity of pipeline is 50% greater than its three anchor fields can deliver. Moreover, the production of the anchor fields is expected to drop over time, necessitating replacement gas from other sources. In the Board's opinion it is therefore reasonably foreseeable that further gathering systems, e.g. in the Colville Lake area, will be constructed and further exploration will be conducted.[14]

The pipeline has also been designed for expansion up to 50% greater than the base case capacity (1.2Bcf/d to 1.8Bcf/d.)

The Mackenzie Gas Project, if approved, would be the first of its kind in the North. Termed a 'basin opening project,' it will induce more development than is presented in the proponent's application. The economic viability of the MGP depends upon the extraction and shipment of natural gas from other fields in the Northwest Territories. In other words, additional gas fields other than the three anchor fields must be developed in order to fill the capacity of the pipeline even at its initial unexpanded capacity.

Scenarios of induced development were developed by different project stakeholders and interested organizations, and submitted to the Joint Review Panel.[15] Although the scenarios crafted to date provide valuable information to the Joint Review Panel, they focus mostly on project footprints and do not fully quantify the potential cumulative impact to valued social and

[13] Mackenzie Valley Environmental Impact Review Board, *Environmental Impact Assessment Guidelines*, *Appendix H: Additional Cumulative Effects Guidance* (March 2004), http://www.mveirb.nt.ca/upload/ref_library/MVE_EIA%20Guidelines.pdf, 77-80.

[14] Mackenzie Valley Environmental Impact Review Board, *Reasons for Decision and Scoping Report for the Mackenzie Gas Project* (Yellowknife, NT: Mackenzie Valley Environmental Impact Review Board, 2004), http://www.mveirb.nt.ca/upload/project_document/EA03_007/Report_of_EA/MVEIRB_MGP_Reasons%20and%20Scoping%20Report.pdf, 13-14.

[15] Petr Cizek and Shelagh Montgomery, *Cumulative Effects Modelling of the Mackenzie Gas Project – Scoping and Development*, Exhibit J-CARC-00007 (Yelloknife, NT: Canadian Arctic Resources Committee, 2005), http://www.ngps.nt.ca/Upload/Interveners/Canadian%20Arctic%20Resources%20Committee/MGP_Development_and_Cumulative_Effects_Mapping.pdf; Peggy Holroyd and Hal Retzer, *A Peak into the Future: Potential Landscape Impacts of Gas Development in Northern Canada*, exhibit J-OREI-00011. Drayton Valley, AB: The Pembina Institute, 2005), http://www.ngps.nt.ca/Upload/Interveners/O%20Reilly%20-%20Kevin%20-%20citizen/OReilly%20Letter%20dated%2029%20June%202005%20to% Joint Review Panel%20re%20Materials%20for%20the%20Public%20Registry%20-%20Attach%20-%20A_Peak_into_the_Future_June-7-05.pdf.

environmental components. Yet such information is critical if the Joint Review Panel is to determine whether the project's cumulative impacts have significance.

A detailed assessment of the scenarios completed to date by the proponents and other interveners can be found in the Sierra Club and World Wildlife Fund Motion to the Joint Review Panel dated June 6, 2007.[16] This report will not reiterate these issues but instead provide examples of how scenario analysis has been used in resource management and makes recommendations for scenario analysis to meet best practice in cumulative environmental assessment for the Mackenzie Gas Project.

1.2 Scenario Analysis Definitions and History

Scenarios were first used in World War II as part of military strategic planning to imagine possible strategies for battle. They have since been used in a variety of fields including business planning, community management and environmental assessment.[17]

There are hundreds of examples of scenarios developed during the last 30 years or so. Some well-known examples include the Millennium Assessment[18], the Intergovernmental Panel on Climate Change (IPCC) scenarios[19] and the GEO-3 scenarios.[20]

1.2.1 What is a Scenario?

Duinker and Greig (2007)[21] provide a summary of definitions of scenarios, ranging from "…conjectures about what might happen in the future"[22] to the more comprehensive definition of a scenario as "… a description of a possible set of events that might reasonably take place." The authors add that "the main purpose of developing scenarios is to stimulate thinking about possible occurrences, assumptions, relating these occurrences, possible opportunities and risks, and courses of action"[23]

---

[16] Keith Ferguson, *Re. Motion requesting that the Joint Review Panel commission a scenario-based cumulative effects assessment (CEA) in accordance with the Greig and Duinker report, Motion for Ruling from the Sierra Club of Canada (SCC) and the World Wildlife Fund (WWF)* (Vancouver, BC: Sierra Legal Defence Fund, June 6, 2007).

[17] International Institute for Sustainable Development, *Geo Resource Book: A training manual on integrated environmental assessment and reporting* (United Nations Environment Programme (UNEP), 2007), http://www.iisd.org/pdf/2007/geo_resource.pdf (accessed July 24, 2007).

[18] Millenium Ecosystem Assessment, *Scenarios Assessment,* http://www.millenniumassessment.org/en/Scenarios.aspx (accessed July 28, 2007).

[19] Intergovernmental Panel on Climate Change, *Environmental Data and Scenarios*, http://www.ipcc-data.org/ddc_envdata.html (accessed July 28, 2007).

[20] Jan Bakkes, Thomas Henrichs, Eric Kemp-Benedict, Tosihiko Masui, Christian Nellemann, Jose Potting, Ashish Rana, Paul Raskin, and Dale Rothman, *Geo-3 Scenarios 2002-2032: Quantification and analysis of environmental impacts* (Bilthoven, Netherlands: United Nations Environmental Programme and National Institute for Public Health, 2004) http://www.unep.org/GEO/pdfs/The%20GEO-3%20Scenarios.PDF (accessed July 28, 2007).

[21] Peter Duinker and Lorne Greig, "Scenario analysis in environmental impact assessment: Improving explorations of the future," *Environmental Impact Assessment Review* (2007),214.

[22] Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004).

[23] M.X. Jarke, T. Bui and J.M. Carrol, "Scenario management: an interdisciplinary approach," *Requir Eng*, no.3 (1998):155–73.

The numerous definitions of scenarios are similar in that they are based on learning about potential alternative futures. It is important to recognize that scenarios are not predictions of the future, but instead present a reasonable range of potential outcomes. Duinker and Greig (2007)[24] argue that the purpose of conducting scenario analysis is not to make predictions, but rather to allow the opportunity to challenge assumptions and to broaden perspectives.

Scenario analysis and scenario planning are used interchangeably in this paper. Scenario analysis brings together both scenario development and the principles of strategic management. It integrates scenario development with decision making. Scenario planning is described as "a technique to make decisions in the face of uncontrollable, irreducible uncertainty."[25] Peterson et al. (2003) describe scenario planning as, "a systemic method for thinking creatively about possible complex and uncertain futures. The central idea of scenario planning is to consider a variety of possible futures that include many of the important uncertainties in the system rather than to focus on the accurate prediction of a single outcome."[26] Scenario analysis has been used as tool to explore the 'what if' and 'what could be' rather than to focus on the narrow calculation of a single certain future (i.e., 'what will be.')

[24] Peter Duinker and Lorne Greig, "Scenario analysis in environmental impact assessment: Improving explorations of the future," *Environmental Impact Assessment Review* (2007), 214.

[25] Garry D. Peterson, Graeme S. Cumming and Stephen R. Carpenter, "Scenario Planning: a Tool for Conservation in an Uncertain World," *Conservation Biology* 17, no. 2 (2003): 358-366.

[26] Ibid.

2. Scenario Analysis: Examples from other jurisdictions

2.1 Learning from other jurisdictions

This section provides examples of how scenario analysis has been applied in cumulative effects assessment, strategic planning and resource management planning in North America.

The examples of scenario analysis presented in this section were selected using the following criteria:

- Regional in scale;
- Driven by development;
- Where several alternative scenarios were assessed.

The following five examples discuss an array of tools, methods and outcomes related to using scenarios analysis in resource decision making.

2.2 Coal Bed Methane EIS in Montana

The U.S. National Environmental Policy Act and the Council on Environmental Quality require federal agencies to conduct an environmental impact statement for all government actions that could significantly affect the environment, in order to: determine the potential environment impact, identify reasonable alternatives, look at the potential cumulative impacts of an action in the context of local and regional activities, and develop proposals to monitor and mitigate potentially significant environmental impacts.[27]

The Bureau of Land Management (BLM) and the Forestry Service have conducted several statewide and regional environmental assessments, pursuant to requirements of the National Environmental Policy Act, and prior to granting oil and gas rights. Environmental impact assessments are also required for individual projects. [28]

[27] Council on Environmental Quality, *Regulations for Implementing NEPA* (Washington, D.C.: Council on Environmental Quality, 2005), http://www.eh.doe.gov/nepa/tools/guidance/Volume1/toc_ceq.htm (accessed July 24, 2007).

[28] National Bureau of Land Management, *National Environmental Policy Act: Law, Regulation and Policy* (2006), http://www.blm.gov/wo/st/en/info/nepa.2.html (accessed July 22, 2007).

The *Montana Statewide Oil and Gas Final Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans* was completed in 2003.[29] A supplemental to that Statement was drafted in 2006 and is currently under review. [30]

The Environmental Impact Statement (EIS) was prepared to evaluate the impact of alternative scenarios of coal bed methane (CBM) exploration and development in south-central and south-eastern Montana. The EIS is intended to help BLM improve its planning and decisions by identifying mitigation and management actions to minimize the environmental and social impact of CBM activities.

The EIS includes alternative scenarios of development that were created to evaluate the impact of different management strategies. The alternatives were created to address issues and concerns raised during a public scoping process.[31]

The scenarios assessed had to be technically and economically feasible. The following scenarios were considered:

A. No Action- BLM would continue to review and approve CBM development application as it has since the 1994 Oil and Gas Amendment
B. CBM Development with emphasis on minimization of impacts and protection soil, water and air, vegetation, wildlife and cultural resources
C. Emphasize CBM Development- Emphasis would be placed on facilitating the production of CBM. Best practices would not be required. Practices would be allowed provided they meet permitting standards.
D. Encourage CBM Exploration and Development while Maintaining Existing Land Use Plans- CBM would be reviewed and approved provided that it coexists with existing land use plans.
E. Management of CBM activities would facilitate extraction and development while sustaining natural and social values and existing land uses.

Reasonably foreseeable development scenarios were developed for the EIS to predict potential CBM development. Predictions were based on regional resource management plans, coal information from the U.S. Geological Survey, expressions of interest, projections by the industry and other referenced sources. The number of wells, development potential, length of gathering lines and more were assessed for each alternative (alternative B,C,D, and E used the same reasonably foreseeable development scenario).

The preferred alternative, Alternative D above, was identified by the Bureau of Land Management. This alternative would be implemented through regional resource management plans.

---

[29] U.S. Bureau of Land Management, *Montana Board of Oil and Gas Conservation and Montana Department of Environmental Quality, Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans* (2003), http://www.deq.state.mt.us/CoalBedMethane/finaleis.asp (accessed July 24, 2007).

[30] U.S. Bureau of Land Management, *Draft Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans (SEIS)* (2006), http://www.blm.gov/eis/mt/milescity_seis/seis/doc/chap2.pdf (accessed July 24, 2007).

[31] .S. Bureau of Land Management, *Montana Board of Oil and Gas Conservation and Montana Department of Environmental Quality, Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans* (2003), http://www.deq.state.mt.us/CoalBedMethane/finaleis.asp (accessed July 24, 2007), I-19.

A comparison of environmental impacts for each development alternative was completed. This includes impacts to air quality, cultural resources, environmental justice, geology and minerals, hydrological resources, Indian trust and native American concerns, land and realty, livestock grazing, paleontological resources, recreation, socio-economics, soils, solid and hazardous wastes, vegetation, visual resource management, wilderness study areas, and wildlife.

In 2006, the EIS was revised, by court order, to add another scenario termed the "phased development" alternative and an analysis of direct and cumulative environmental and socioeconomic impacts.[32] The phase alternative in this EIS was chosen as the preferred one. The phased development option would limit the number of applications that are accepted each year and in each watershed. Development would be limited, based on the impacts and thresholds set in four areas: water resources, wildlife, Native American concerns and air resources. The revised Final EIS is under review in 2007.[33]

Summary: Coal Bed Methane EIS in Montana	
Description	The EIS evaluated the impact of alternative scenarios of coal bed methane exploration and development in south-central and southeastern Montana. The EIS is intended to help BLM improve its planning and decisions by identifying mitigation and management actions to minimize the environmental and social impact of CBM activities.
Scale and Timeline	Full-scale exploration, production, development and reclamation of CBM activities in Montana Area: Anywhere affected regardless of ownership
Tools Used	Scenario planning, geographic information systems, modeling
Process	Lead Agencies: the Bureau of Land Management (BLM) and the Montana Department of Environmental Quality and Montana Board of Oil and Gas Conservation Participants: other state and federal agencies and sovereign tribal governments The EIS was prepared by an interdisciplinary team of specialists from the BLM offices and consultants ALL Consulting and CH2M HILL. Steps in the process 1. Planning issues were identified through a public scoping process. Key issues included Air Quality, coal mines, coal bed methane, hydrology, realty, Indian trust resources, and environmental mitigation. 2. The key issues were used as the framework of identifying alternatives; "each alternative represents a different approach for resolving the issues identified during scoping."[34]

[32] U.S. Bureau of Land Management, *Draft Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans (SEIS)* (2006), http://www.blm.gov/eis/mt/milescity_seis/seis/doc/chap2.pdf (accessed July 24, 2007).

[33] Ibid.

[34] U.S. Bureau of Land Management, *Montana Board of Oil and Gas Conservation and Montana Department of Environmental Quality, Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans* (2003), http://www.deq.state.mt.us/CoalBedMethane/finaleis.asp (accessed July 24, 2007), 2-5.

	3. Alternatives were developed by extrapolation, literature search and compilation of existing data (existing geological data only.) 4. The management strategies and environmental social impact of each alternative are compared. 5. The preferred alternative was identified. 6. A public comment period was provided. More than 8,800 people commented on the EIS. Detailed responses to the comments are included in Chapter 5 of the Final EIS.
Management Strategies altered as a result of analysis	A key part of the analysis of each scenario was the associate management strategies. The preferred alternative would be implemented by amending regional resource management plans (RMP).

2.3 Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea

A second example from the United States is the proposed sale of Lease 193 in the Chukchi Sea. The U.S. Department of the Interior's Minerals Management Service (MMS) of the Alaska Outer Continental Shelf (OCS) Region is considering a proposal (industry nominated) for the oil and gas lease sale of approximately 34 million acres in the Chukchi Sea.[35] The environmental impact statement (EIS) evaluates leasing in the Chukchi Sea by examining three alternative scenarios.[36]

Issues, alternatives and mitigation measures to be considered for analysis in the EIS were scoped with input from local, tribal, State and Federal agencies, the petroleum industry, native groups, environmental and public interest groups, and concerned individuals. Some of the identified issues included: oil spills, disturbance to bowhead whale migration patterns, protection of subsistence resources and the Inupiat culture and way of life, habitat disturbances and alterations, including discharges and noise, and the cumulative effects of past, present, and reasonably-foreseeable future activities on the people and environment of Alaska's North Slope.[37] Based on the results of the public input process, alternatives were analyzed that prevent certain leases from being sold.

Four alternatives were identified:

---

[35] Minerals Management Service (MMS), Alaska OCS Region, *Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea- Final Environmental Impact Statement* (Alaska: US Department of the Interior, Minerals Management Service, May 2007), http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/Vol%20I%20entire%20WEB.pdf (accessed July 26, 2007). Industry nominated a substantial portion of the Chukchi Planning Area for development and the MMS concluded that consideration of such a large area had merit in light of the significant resource potential of the area and the Administration's goal to expedite exploration of domestic energy resources. The MMS concluded that consideration of such a proposed action warranted an extensive National Environmental Policy Act (NEPA) review.

[36] The EIS also examines two alternatives for exploration seismic-survey permitting in 2007 in the proposed sale area, however this summary will solely focus on the leasing alternatives.

[37] Ibid. A comprehensive list of scoped issues can be found on page ES-2.

A. Alternative I- This was the Proposed Action (based on industry request) that offered for lease approximately 6,155 whole and partial blocks (about 34 million acres), excluding a 15- to 50-mile wide spring lead system corridor along the coast.

B. Alternative II- Alternative II did not allow any lease sales, and amounted to the cancellation of the Proposed Action as identified in Alternative I.

C. Alternative III- This alternative included the Proposed Action excluding an area of approximately 1,765 whole or partial blocks along the coastward edge of the sale area in attempt to reduce potential impacts to subsistence hunting as well as wildlife species and their habitats. This alternative was developed by MMS in response to comments received during the public input scoping process.

D. Alternative IV- This alternative, the "Agency Preferred Alternative," included the Proposed Action less an area comprising approximately 795 whole or partial blocks along the coastward edge of the sale area. This alternative was developed as a result of the 1987 Biological Opinion for the Chukchi Sea as recommended by the National Marine Fisheries Service.

The alternatives were compared with each other for changes in resource production and environmental effects relative to the entire program area. More specifically, alternatives that included leasing were evaluated using a concept called the "Opportunity Index." This index is a risk weighted probability based on MMS's analysis of resource potential. Through this index, the likelihood that a commercial discovery will be made and development will occur in a particular area within the Chukchi Sea program area was assessed. Since development has not occurred in the proposed area for lease, a key concept behind this index is that industry would only bid on tracts that they believe have some chance of becoming viable oil and gas fields. Impact analyses for biological (e.g., water quality, fish habitat, endangered species) and sociocultural (e.g., subsistence harvest, archaeological resources) parameters were also conducted for each alternative.

The Final EIS is currently under public review and a final decision on the proposed lease sale is expected in 2008. Some concerns have emerged in that the EIS did not consider the full array of alternatives that may exist:

"The Draft EIS needs to consider a renewable energy alternative as this could serve to address the national need for sustainable energy in remote Native American tribal communities, a clearly unmet national need. A useful source is Alaska Energy Authority and Renewable Energy Alaska Project's 2006 publication *Renewable Energy Atlas of Alaska: A guide to Alaska's clean, local and inexhaustible energy resources*. Furthermore, MMS now has statutory authority over renewable energy resources on the OCS and a plan for the Chukchi Sea should also address these resources. The draft EIS needs to consider a carbon reduction alternative in order to address the national need to reduce greenhouse gas emissions and solve global warming."[38]

---

[38] Coalition of environmental interest groups, "Letter to Regional Director, Alaska OCS Region, Minerals Management Service regarding the Chukchi Sea Planning Area Oil and Gas Lease Sale 193and Seismic Surveying Activities Draft Environmental Impact Statement," (December 21, 2006), http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/Vol%20II%20Sec%205%20WEB.pdf (accessed July 27, 2007), 11.

In addition, there was concern that the EIS failed to rigorously analyze the alternatives.[39] The U.S. Environmental Protection Agency wrote:

> "…it is unclear if the two alternatives, together with the Proposed Action and a No Action Alternative, represent a range of reasonable alternatives in the Draft EIS. The Final EIS should present a more-thorough discussion of the decision criteria and the geophysical, biological and subsistence information that was used to develop the alternatives in order to demonstrate that a range of reasonable alternatives was considered."[40]

Scenario analysis is a common practice as part of environmental impact statements completed by federal agencies in the U.S. In this example, scenarios analysis was a tool for exploring the risks and uncertainties associated with new developments. Lessons learned from this case include: 1) a comprehensive array of alternatives must be generated to address the upfront issues and uncertainties – in this case, the agency preferred case is the "middle" scenario, which may attempt to assuage both environmental and economic interests – and 2) information used to assess the alternatives should be up to date, transparent and as comprehensive as possible.

Summary: Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea	
Description	The EIS evaluated the impact of alternative scenarios of the oil and gas lease sale of approximately 34 million acres in the Chukchi Sea. The EIS is intended to help MMS address the potential impacts under the various alternatives and the potential mitigation measures associated with the proposal for leasing and associated exploration seismic-survey activity.
Scale and Timeline	The scenario assumed for environmental analysis involves the discovery, development and production of the first offshore oil field in the Chukchi Sea.

[39] Coalition of environmental interest groups, "Letter to Regional Director, Alaska OCS Region, Minerals Management Service regarding the Chukchi Sea Planning Area Oil and Gas Lease Sale 193and Seismic Surveying Activities Draft Environmental Impact Statement," (December 21, 2006), http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/Vol%20II%20Sec%205%20WEB.pdf (accessed July 27, 2007).

[40] United States Environmental Protection Agency, "Letter to Regional Director, Alaska OCS Region, Minerals Management Service regarding the Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities Draft Environmental Impact Statement," (December 27, 2006), http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/Vol%20II%20Sec%205%20WEB.pdf (accessed July 26, 2007).

Tools Used	Resource assessment models, modeling and geographic information systems
Process	Lead Agencies: Department of the Interior's Minerals Management Service (MMS) of the Alaska Outer Continental Shelf Region, in cooperation with the U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, and the National Marine Fisheries Service Participants: other state and federal agencies and sovereign tribal governments . 1. Issues, alternatives, and mitigation measures to be considered for analysis in the EIS were scoped by constituents. 2. Alternatives were developed 3. Alternatives were compared based on their resource potential and the environmental/social impacts of each. 4. The preferred alternative was identified by MMS. 5. MMS will continue to consider all reasonable options until a final decision is made. [41]

2.4 The Upper San Pedro River Basin in Arizona and Sonora

The Upper San Pedro River Basin faces a number of urgent and controversial issues regarding growth pressures (i.e., urbanization and agriculture), its international importance as bird habitat, and the impacts from development – in particular the lowering of the groundwater table. In 2000, a team of investigators from academic institutions and government agencies issued a study to investigate the issues relating to possible future developments in Arizona and Sonora and the corresponding potential impacts on hydrology and biodiversity. Alternative growth patterns for the basin were identified and compared for their relative impacts on a set of environmental parameters including biodiversity, hydrology, and landscape vegetation. The intent of the study was to inform decision makers of which potential alternative would have the greatest and least impacts on those parameters.[42]

To help generate the scenarios, local citizens were asked to answer a questionnaire about three issues central to public debate in the region: development, water use and land management. The answers, interpreted into a set of assumptions and choices about land use policy, became the range of future scenarios.

Three main scenarios were evaluated and each main scenario was varied two or three times to test outcome comparisons to yield a total of ten scenarios. These variations of the main

[41] Minerals Management Service (MMS), Alaska OCS Region, *Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea- Final Environmental Impact Statement* (Alaska: US Department of the Interior, Minerals Management Service, May 2007), http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/Vol%20I%20entire%20WEB.pdf (accessed July 26, 2007), 1-10.

[42] Carl Steinitz, Carl Robert Anderson, Hector Arias, Scott Bassett, Michael Flaxman, Tomas Goode, Thomas Maddock, III, David Mouat, Richard Peiser and Allan Shearer, *Alternative Futures for Landscapes in the Upper San Pedro River Basin of Arizona and Sonora* (Washington D.C., Island Press, 2003), 11

scenarios were generated to create a spectrum of possibilities, in recognition that no single vision of the future can be certain.[43]

A. Planned – The Planned scenario was based on the interpretation of existing planning documents and land-use practices of the region. Three variations of the Planned scenario were also tested that alter several variables such as the projected population growth, growth of the size of cities and implementation of policies that concentrated development in the four current population centers.

B. Constrained – This scenario investigated lower-than-forecast population growth and tightly-controlled development zones. Two other scenarios were tested against each other by varying the Constrained scenario to assess the effect of doubling the city of Fort Huachuca population while constraining off-post development and assess the effects of closing Fort Huachuca and dividing its land between conservation and development.

C. Open – This scenario anticipated greater-than-forecast population growth and low-density development across the region. Two variations of the Open scenario were tested against each other. These scenarios assessed the effects of high population growth, reduced development controls and closing most of Fort Huachuca.

This study considered a wide range of policy issues that had been raised by stakeholders in the past, and added spatial and temporal dimensions to anticipated changes and their impacts. A computer-based geographic information system (GIS) was used to organize spatially-explicit and publicly available data for the region. The database was derived from available information on conditions in the study area to define the reference period against which impacts of future change were measured. A model was used that output maps and tables. Development, hydrological and vegetation models were also used to assess the potential impacts of each of the main scenarios and their "test" scenarios relative to the 2000 baseline conditions.

For the most part, the scenarios projected a negative set of impacts. However, there was considerable variation between the extremes produced by the constrained and open scenarios. The Planned scenario would not result in the reversal of developmental change in the Basin, however it could accommodate growth and be attractive to development while significantly retarding the environmental decline of the region. The study did not attempt to propose solutions; but rather demonstrate how scenarios analysis can inform decision makers, reduce uncertainty and ensure that stakeholder concerns are validly integrated into the decision making process.

Summary: The Upper San Pedro River Basin in Arizona and Sonora	
Description	This study determined a range of potential growth pattern alternatives for the region and compared them for their relative impacts on a suite of environmental parameters including hydrology, biodiversity and landscape vegetation pattern
Scale and Timeline	Scenarios were projected to 2020 via a development model (20 years from start of study).
Tools Used	Stakeholder questionnaires, geographic information systems, modeling

[43] Carl Steinitz, Carl Robert Anderson, Hector Arias, Scott Bassett, Michael Flaxman, Tomas Goode, Thomas Maddock, III, David Mouat, Richard Peiser and Allan Shearer, *Alternative Futures for Landscapes in the Upper San Pedro River Basin of Arizona and Sonora* (Washington D.C., Island Press, 2003).

Process	Lead investigators: Harvard University Graduate School of Design, the Desert Research Institute, the University of Arizona, Instituto del Medio Ambiente yel Desarrollo Sustentable del Estado de Sonora (IMADES), the U.S. Army Training and Doctrine Command, and the U.S. Army Engineer Research and Development Center Stakeholder input was sought on the possible future(s) of the region. Research team took the scenarios (generated via questionnaires etc.), collected appropriate data, and then used process models to run the scenario simulation and pilot the alternative futures. The results portrayed the various impacts of the tested scenarios. The results were documented and distributed, and then the public revised the study progress and findings as a component of local debate and decision-making processes.
Management Strategies altered as a result of analysis	Comparing all the alternatives revealed that policy decisions affecting irrigated agriculture in Arizona will cause the greatest impacts on the region's hydrology and ecology. The second most significant policy consideration was local governmental control of development.

2.5 Terasen Pipelines (Trans Mountain) Inc. TMX Anchor Loop Project

In 2005, Terasen Pipelines (now Kinder Morgan Canada) applied to increase the capacity of its existing Trans Mountain pipeline system through the construction of a 158 kilometre pipeline loop. The loop would traverse federal, provincial and private lands including Jasper National Park in Alberta and Mount Robson Provincial Park in British Columbia, as well as lands outside of these parks. The project required a National Energy Board Certificate of Public Convenience and Necessity under the National Energy Board Act as well as additional federal approvals or authorizations which triggered the Canadian Environmental Assessment Act (CEA Act).[44] Biophysical and socio-economic assessments were integrated to evaluate the potential cumulative effects of existing, proposed and likely projects at a regional scale.

Given the transboundary setting of the TMX Anchor Loop, the cumulative effects assessment (CEA) was expanded beyond a typical project-specific CEA to include park management plan objectives. The CEA considered past and hypothetical future scenarios in effort to help identify the key factors that affect ecological integrity in the regional study area. Terrestrial and aquatic ecological integrity was measured by whether or not they were within a range of natural variability.

Four scenarios of likely development activities in the regional study area were examined using a computer modeling program, ALCES. ALCES (A Landscape Cumulative Effects Simulator) was selected to evaluate potential cumulative effects on selected indicators and put the proposed

---

[44] TERA Environmental Consultants and Westland Resource Group Inc, *Environmental Assessment Report for the Terasen Pipelines (Trans Mountain) TMX – Anchor Loop Project* (Calgary, AB: Terasen Pipelines Inc, 2005), https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/267159/372416/386648/A0S4E1_-_Environmental_Assessment_Executive_Summary_and_Table_of_Contents.pdf?nodeid=386652&vernum=0 (accessed 27 July 2007).

TMX Anchor Loop in a regional context. ALCES was used to help envision both past and likely future natural and human disturbance patterns in the regional study area and associated ranges of natural variability for aquatic and terrestrial habitats and species. Currently, ALCES is the only "off-the-shelf" model that can simulate relevant natural disturbances (fire, insects, avalanches, climate change), and land uses (population growth, forest harvest, hydrocarbon exploration and production, protected areas, agriculture, mining, and recreational use) relevant to the study area.[45]

The scenarios evaluated within the cumulative effects assessment were:

A. Range of Natural Variability – Projected change in indicator conditions over a 100-year period (1805- 1905) with no traditional, industrial or recreational land use and random natural variability and disturbance. The purpose of this scenario was to provide a pre-industrial baseline. Most environmental assessments present a baseline as the current condition, effectively masking cumulative environmental impacts.

B. Recent Past – Projected change in indicator conditions over last 100-year period (1905-2005) based on documented change between pre-disturbance conditions and current conditions. Indicator conditions in 2005 were projected with random natural disturbance and incorporated fire suppression.

C. Possible Future – Projected change in indicator conditions over next 100-year period (2005-2105), including all likely and hypothetical projects[46] identified on the Project Inclusion List and random natural disturbance.

D. Possible Future Excluding TMX Anchor Loop – Projected change in indicator conditions over next 100-year period (2005-2105) excluding the proposed TMX Anchor Loop, though otherwise the same as the Possible Future scenario.

Landscape simulation modeling and relevant studies indicated that the most important sources of cumulative ecological effects in the regional study area were 1) human-caused mortality of wide-ranging carnivores, 2) habitat alteration created by natural disturbances (fire, insects, avalanches) and fire and insect management, 3) habitat loss and alteration created by human recreational, residential, and industrial features and activities, and 4) proliferation of non-native fish and plant species. Mitigation measures designed to minimize potential project contributions to cumulative ecological effects were proffered and the TMX Anchor Loop project was approved in 2006. While simulation models such as ALCES cannot provide definitive predictions of past and future indicator conditions or where and when changes will occur, they do, "provide reasonable estimates of likely indicator trends, the range of likely response and the key factors affecting

[45] Terry Antoniuk, "Cumulative effects assessment of pipeline projects," in *Cumulative Environmental Effects Management: Tools and Approaches, Ed. A.J. Kennedy (*Calgary, AB: Alberta Society of Professional Biologists, 2002).

[46] Hypothetical projects include those identified by protected areas staff, ongoing resource extraction activities on provincial lands, projected growth in regional population, visitor use and vehicle traffic, and effects of climate change on natural processes. See*:* TERA Environmental Consultants and Westland Resource Group Inc, *Environmental Assessment Report for the Terasen Pipelines (Trans Mountain) TMX – Anchor Loop Project* (Calgary, AB: Terasen Pipelines Inc, 2005), *Page 7-5.*

these changes at a regional scale. When simulation results are used in this way, level of confidence is considered to be Moderate to High.[47]

Summary: Terasen Pipelines (Trans Mountain) Inc. - TMX Anchor Loop Project	
Description	The cumulative effects assessment considered past and hypothetical future scenarios in effort to help identify the key factors that affect ecological integrity in the regional study area.
Scale and Timeline	Projected change in conditions over a 100-year period.
Tools Used	ALCES computer model
Process	1) Ecosystem level indicators selected. 2) Spatial boundaries determined 3) Cumulative effect simulations were run using the ALCES model 4) Results were presented.
Management Strategies altered as a result of analysis	Project was approved with reduced uncertainty about its potential impacts.

2.6 The Cumulative Environmental Management Association (CEMA)

The Sustainable Ecosystems Working Group (SEWG) of the Cumulative Environmental Management Association (CEMA) is responsible for recommending an environmental management system to protect regional ecosystems and wildlife populations in the Regional Municipality of Wood Buffalo – a region expected to be heavily impacted by oil sands mining and in situ oil sands development in Alberta.[48,49]

SEWG is conducting scenario analysis of environmental impacts under varying bitumen production rates to determine how ecological indicators may be sensitive to the pace and scale of oil sands development. In addition to exploring a sensitivity analysis that considers alternative development scenarios, SEWG is assessing the potential benefits of three management scenarios in comparison to business as usual oil sands development:[50]

- Protected Areas
- Access Management

[47] TERA Environmental Consultants and Westland Resource Group Inc, *Environmental Assessment Report for the Terasen Pipelines (Trans Mountain) TMX – Anchor Loop Project* (Calgary, AB: Terasen Pipelines Inc, 2005), https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/267159/372416/386648/A0S4E1_-_Environmental_Assessment_Executive_Summary_and_Table_of_Contents.pdf?nodeid=386652&vernum=0 (accessed 27 July 2007), 7-33.

[48] Cumulative Environmental Management Association, *Terms of Reference* (Fort McMurray, AB: Cumulative Environmental Management Association, 2004).

[49] Cumulative Environmental Management Association, *Sustainable Ecosystems Working Group (SEWG)*, http://www.cemaonline.ca/content/view/21/63/ (accessed on July 27, 2007)

[50] Cumulative Environmental Management Association - Sustainable Ecosystems Working Group, *Briefing Presentation to Alberta Sustainable Resource Development* (September 5, 2006).

- Improved Practices

These scenarios will inform decision-making and set land use thresholds in the oil sands region.. CEMA has been slow to complete the scenario analysis which has meant that information on the full range of potential outcomes has not been available to regulatory decision-makers;[51,52] and numerous oil sands projects have been approved in the absence of rules to limit cumulative impacts on terrestrial ecosystems.

At the recent Kearl Oil Sands Project hearings in Fort McMurray, the importance of conducting scenario analyses as part of an environmental impact assessment was highlighted. It was noted by the Oil Sands Environmental Coalition, a group of environmental organizations including the Pembina Institute that the proponent's assessment of cumulative environmental impacts, which did not include a scenario analysis beyond the typical assessment of project impacts and a single assessment of cumulative development was substantially different to the impacts projected by SEWG scenarios.[53] These differences were based on different assumptions on projected future development. Requiring the proponent to assess a range of scenarios in this case would have made the hearing process more meaningful. Scenario analysis is particularly important in the oil sands region since the potential development of up to 54,000 km^2 of oil sands leases that have already been granted by regulators[54] would greatly exceed the impacts that are generally assessed under the current approach. Scenario analysis, as shown by this example, is best conducted prior to regulatory decision-making.

---

[51][51] Alberta Energy and Utilities Board and Government of Canada, *Imperial Oil Ventures Limited Application for an Oil Sands Mine and Bitumen Processing Facility, Joint Panel Report and EUB Decision 2007-013* (February 27, 2007).

[52] Alberta Energy and Utilities Board and Government of Canada, *Albian Sands Energy Inc. Application to Expand the Oil Sands Mining and Processing Plant Facilities at the Muskeg River Mine*, *Joint Panel Report and EUB Decision 2006-128* (December 17, 2006).

[53] Alberta Energy and Utilities Board and Government of Canada, *Imperial Oil Ventures Limited Application for an Oil Sands Mine and Bitumen Processing Facility, Joint Panel Report and EUB Decision 2007-013* (February 27, 2007).

[54] Alberta Department of Energy, *Talk about Tenure: Facts About Tenure* (April 2007), http://www.energy.gov.ab.ca/docs/oilsands/pdfs/FactSheet_OilSands_Tenure.pdf (accessed July 30, 2007).

Summary: The Cumulative Environmental Management Association (CEMA)	
Description	SEWG considers impacts of a range of bitumen extraction rates and management strategies on the fate of ecological, social and economic indicators in the Regional Municipality of Wood Buffalo
Scale and Timeline	A seven million hectare study area, modeled for (50 or 100) years
Tools Used	ALCES computer model and spatial models
Process	Scenarios developed by consensus by multi-stakeholder group
Management Strategies altered as a result of analysis	None yet. Regulatory decision-making continues in the absence of completed scenario analysis and regional objectives, which has contributed to the criticisms directed at CEMA

3. Implementing Scenario Analysis

Scenario analysis can help us to foresee, manage or create the future we desire. There are two approaches to scenario analysis, forecasting and backcasting:

> Forecasting – projecting in the future what might occur and identify alternative paths for the future. Select from these options one desirable path or end point and work to create that future.
>
> Backcasting – Define clear objectives or goals. With these goals in mind, define and project different paths that lead to the desired future. Choose the desired path.

Forecasting involves identifying patterns and trends from the past to project changes into the future. The forecasting method may require larger amounts of research and statistical analysis or might simply be based on observation. Conventional EIAs are typically based on forecasting. In the context of the MGP, the governments and public are forced to react to the development proposal without an opportunity to consider a range of possible development futures.

Backcasting is useful when the problem is complex, a dominant trend is part of the problem and there is a need for a major change.[55] Backcasting requires coming to consensus on what the desired future looks like. With respect to the MGP, stakeholders would ideally be given the opportunity to examine an array of goals or objectives that are considered instrumental to a desired future.

Three components make up a scenario analysis: the goal, process and content.[56] The goal may be to critically think about cumulative impacts, mitigation of these impacts or improved decision making. In defining the process of scenario analysis, we must consider the scope and depth of the scenarios, the degree of quantitative and qualitative data used, and choices among stakeholder workshops, expert interviews or literature review.[57] The scenario content is based on the selected variables and their interaction. The scenario content includes the driving forces, critical uncertainties and valued social and environmental components (explained more below.)

The following steps may be used to create scenarios:[58]

---

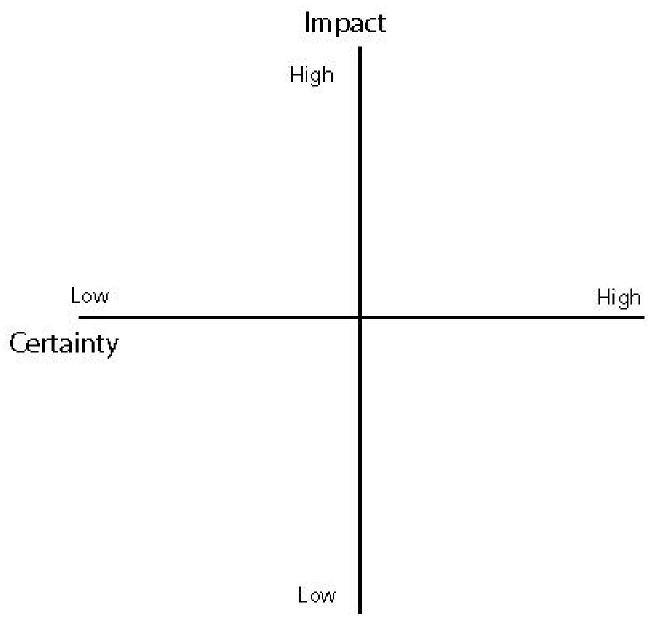
[55] L. Greig, K. Pawley and P. Duinker, *Alternative Scenarios of Future Development: An Aid to Cumulative Effects Assessment* (Canadian Environmental Assessment Agency, 2004) For the Research and Development Monograph Series, 2002, http://www.ceaa.gc.ca/015/001/021/print-version_e.htm (accessed July 24, 2007).

[56] International Institute for Sustainable Development, *Geo Resource Book: A training manual on integrated environmental assessment and reporting* (United Nations Environment Programme (UNEP), 2007), http://www.iisd.org/pdf/2007/geo_resource.pdf (accessed July 24, 2007).

[57] International Institute for Sustainable Development, *Geo Resource Book: A training manual on integrated environmental assessment and reporting* (United Nations Environment Programme (UNEP), 2007), http://www.iisd.org/pdf/2007/geo_resource.pdf (accessed July 24, 2007).

[58] Adapted from: UK Local Government Association, *A Futurist's Tool Kit: Futures Methods* (2001) http://www.lga.gov.uk/Documents/toolkit/futures%20methods.pdf (accessed July 23, 2007).

1. **Focus of the study.** Identify the main problem or issue under study. Identify the indicators of future social and environmental conditions. Identify whether to focus on alternative scenarios or desired futures (ie. backcasting or forecasting.)
2. **Timeframe.** Scenarios are best used when they examine change over the long term (more than 30 years) and when there is a considerable amount of predictability and uncertainty.
3. **Number of scenarios.** Between two and five scenarios is desirable. Any more and the number of alternatives become difficult to identify and assess.
4. **Driving forces and critical uncertainties**. Identify what factors will influence the alternative scenarios. The driving forces that could be considered include demography, economic development, human development, science and technology, governance, culture and environment. A brainstorming or the Delphi method can be used here.
5. **Driving forces analysis.** This is often done by putting the driving forces on a grid (see below) such as from low to high certainty and low to high impact.



6. **Scenario development.** Each scenario should be reasonable and plausible. Involving participants in the development of each scenario helps to make them more credible in the end. This step may be the longest as each scenario may be revised several times. The scenarios can be represented by both quantitative and qualitative data.
7. **Scenario assessment.** Assess the plausibility and desirability of each scenario.
8. **Scenario impact.** Identify the impact of each scenario on the valued components or other issues of concern.
9. **Scenario management response (or mitigation).** Assess management strategies that could be applied to each scenario. Consider what management strategies could be applied to manage the impacts of each scenario.

Greig, Pawley and Duinker (2004) review tools that can be used in scenario analysis such as environmental scanning/monitoring, quantitative trend extrapolation/analysis, modeling; geographic information system (GIS), cross impact analysis/ matrices and expert opinion/Delphi.[59] In scenario analysis, rarely is only one tool employed. Some of the tools complement each other, such as using geographic information systems to provide input to modeling. The examples of scenario analysis in the previous section used several of these tools.

Most Likely Scenario versus Multi-Scenario Approach

> *"This is the value of scenario thinking: the ability to plan effectively for improbable and uncertain futures. Rather than selecting a most probable scenario and devoting all of your resources to a single, hard-to-change strategy, you can instead spend a small but significant amount of effort keeping your knowledge current in each of several areas of concern - several possible futures."*[60]

Studies that present one most-likely scenario risk hindering the ability of proponents and decision makers to think broadly and creatively about the possible futures that may unfold and the strategies to deal with arising issues. If the most "easy to predict" scenario based on well-known activities is presented as the most likely scenario, it may mean that future activities and impacts are underestimated.

Greig et al. (2004) and other futurist literature recommends moving away from using scenario analysis to seek the most certain scenario.[61] Creating and comparing several scenarios requires that we consider the future as a number of possibilities rather than as a single certainty. It is impossible to predict the future with absolute certainty. If we select a single variable and project it into the future, we can be sure that it will deviate over time.[62] For example, if we choose the median (rather than high or low) projection for natural gas reserves in a single scenario approach, we can be sure that we are not representing the range of possibilities. A better approach is to develop plausible scenarios of alternative futures and to compare the risks and uncertainties of each scenario. If we assess the range of possibilities, through a multi-scenario approach, we have a better chance of understanding how management strategies can be optimized in the face of uncertainty.

Cornish[63] suggested that five scenarios may be developed (adapted here):

1. A Surprise Free Scenario – the continuation of present trends
2. An Optimistic Scenario – the conditions of key indicators in the future improve

---

[59] L. Greig, K. Pawley and P. Duinker, *Alternative Scenarios of Future Development: An Aid to Cumulative Effects Assessment* (Canadian Environmental Assessment Agency, 2004) For the Research and Development Monograph Series, 2002, http://www.ceaa.gc.ca/015/001/021/print-version_e.htm (accessed July 24, 2007).

[60] The Future of Work, *Strengths and Limitations of Scenario Planning,* http://www.thefutureofwork.net/blog/archives/000408.html (accessed July 17, 2007)

[61] L. Greig, K. Pawley and P. Duinker, *Alternative Scenarios of Future Development: An Aid to Cumulative Effects Assessment* (Canadian Environmental Assessment Agency, 2004) For the Research and Development Monograph Series, 2002, http://www.ceaa.gc.ca/015/001/021/print-version_e.htm (accessed July 24, 2007), 34; Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004).

[62] Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004).

[63] Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004), 98.

3. A Pessimistic Scenario – the conditions of key indicators in the future are worse than present day
4. A Disaster Scenario – the worse case scenario will occur
5. A Transformation Scenario – something unexpected occurs that improves the conditions of key indicators beyond our expectations

Each scenario can be evaluated according to the probability of each becoming reality and ranked according to its desirability.[64] A definition of desirability must be created, with public consultation. By assigning a rank of desirability to each scenario, we can begin to identify the value we have for certain environmental and social conditions. This can contribute to clarifying which cumulative effects are significant. If an undesirable scenario is plausible, it can stimulate a discussion on requirements to mitigate the impacts and change management decisions.

The scenarios completed by the Proponents of the Mackenzie Gas Project are variations of the Optimistic Scenario (scenario 2 on this list above). The Proponents have submitted two scenarios: the scenario for the base capacity of the pipeline in the original EIS and the expanded capacity (1.8 Bcf/d) scenario completed in responses to subsequent information requests. These scenarios were not compared to each other, and the Proponent did not fully quantify potential cumulative effects to the valued components.[65] The Proponents argued that the effects could not be fully quantified because the activities associated with the hypothetical scenario have "considerable uncertainty,"[66] although give little explanation of why and to what extent. Given that it is possible to project disturbance footprints associated with an expanded (and economic) pipeline scenario, it is possible to provide assessments of impacts on VCs. A scenario analysis would help to clarify the critical uncertainties and risks of possible futures to valued components.

Scenario to understand the likelihood of events

Scenarios can be used to understand the likelihood of undesirable events occurring.[67] This could be used to understand the possibility of adverse effects on valued components (within each scenario). For example, what conditions might cause the extirpation of caribou in a region? The conditions may be habitat loss or some other indicator of an environmental threshold. If we can identify the factors that might cause this to happen and can create plausible scenarios that demonstrate it, we have some evidence of it occurring. We can assign a probability of likelihood that the event will occur. On the other hand, if we could not create scenarios that show the extirpation of the caribou, we could say that it is unlikely.

---

[64] Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004).

[65] Imperial Oil et al., *EIS Additional Information, Section 11: Cumulative Effects*, *exhibit JIORVL-00085* (2005), http://www.ngps.nt.ca/additionalinfo/Documents/MGP_EIS_Supp_Section_11.pdf (accessed July 25, 2007), 11-27 to 11-36

[66] Imperial Oil et al., *EIS Additional Information, Section 11: Cumulative Effects*, *exhibit JIORVL-00085* (2005), http://www.ngps.nt.ca/additionalinfo/Documents/MGP_EIS_Supp_Section_11.pdf (accessed July 25, 2007), 11-6.

[67] Edward Cornish, Futuring: The Exploration of the Future (Bethesda, Maryland, World Future Society, 2004).

Scenario analysis as a means to incorporating local values and traditional knowledge

Scenario analysis can be a means for incorporating local values and traditional knowledge into decision making.[68] This is part of the MGP Panel's mandate – "The Joint Review Panel shall make best efforts to promote and facilitate the contribution of traditional knowledge to the environmental impact review."[69] In the Upper San Pedro River basin example, local citizens were a formal part of generating the alternative "futures" by being asked for feedback on issues central to public debate in the region. Scenario analysis can involve creating a vision of a desired future or describing possible alternative futures based on trends and uncertainties.[70] In either case the process of creating scenarios can:

- elicit knowledge about the environment and society based on local experience
- facilitate learning and communication among different stakeholders
- enable expression or understanding of uncertainty
- engage stakeholders in developing a common understanding of the future.[71]

In the case of the MGP, the substantial work that has been invested by communities and stakeholders in regional land use plans and the Northwest Territories Protected Areas Strategy could be incorporated at this stage.

Need for cumulative effects assessments to meet their mandate and consider reasonably foreseeable induced development

Cumulative effects assessments are becoming less meaningful as future development is dealt with in an increasingly trivial way. A poorly conceived decision on "reasonably foreseeable" development limits the ability to learn about future development scenarios, and will significantly underestimate future impacts. Duinker and Greig (2006) suggest that the failure to consider alternative scenarios may be because EIA practitioners are not reviewing relevant literature or not finding it of value. There is little incentive for EIA practitioners to change the status quo and deliver meaningful assessments of potential future development. This is particularly the case, given regulatory panels are willing to approve projects in the absence of a reasonable assessment of induced development. In the absence of land use plans and objectives, there is greater need for scenario analysis to consider the full range of potential outcomes of development trajectories.

---

[68] T. Lynam, W. de Jong, D. Sheil, T. Kusumanto and K. Evans, "A Review of Tools for Incorporating Community Knowledge, Preferences, and Values into Decision Making in Natural Resource Management," *Ecology and Society.* 12, no. 1 (2007): 5.

[69] The Mackenzie Valley Environmental Impact Review Board**,** Inuvialuit Game Council, and The Minister of the Environment, *Agreement for an Environmental Impact Review of the Mackenzie Gas Project* (2003), http://www.jointreviewpanel.ca/jrpa_final_e.html (assessed July 30, 2007), section 3.0.

[70] Ibid.

[71] Ibid.

3.1 Advantages and Limitations of Scenario Analysis

There are advantages and limitations to scenario analysis.[72]

3.1.1 Advantages

Plausibility- Scenario analysis can take us from focusing on what is *certain* to happen to explore the range of what *could* happen. Alternative scenarios of the future must be plausible (or at least not impossible.) Operating under the expectations of CEA, a range of reasonably-foreseeable outcomes can be explored through scenario analysis.

Creativity- In defining scenarios, people have the opportunity to think about possibilities rather than what they expect to happen. This can stimulate creative ideas and solutions to the issues that arise from alternative futures.

Voisey's Bay Nickel Mine: An example of creative, critical futuring

During the Voisey Bay Nickel Mine environmental assessment review process, a consultant for the Innu made the case for the project development to be more "consistent with the requirements of sustainable development, and in a way that minimizes social and environmental costs, while enhancing social benefits."[73] He recommended delaying the start up of the project to build local capacity to participate in the project and improve the local economic benefits.[74] The author noted that, in cases where the project appears to offer large economic benefits, "critical perspectives are often unwelcome." Yet it is exactly these critical perspectives that can prove most valuable when identifying ways to minimize the impact of large projects. In the end, the Joint Review Panel agreed and recommended to slow the pace of development through a reduced production rate, thereby extending the life of the mine.[75] As in the Voisey Bay Nickle Mine case, creative solutions may be reached by engaging in exercises that evaluate future benefits and impacts of a project against desired future outcomes and seek creative solutions.

Tolerance for uncertainty and understanding of risk – Scenario analysis can help decision makers and stakeholders to understand that the future is not a defined end state and that uncertainty is normal. It can sensitize participants to the idea that there are probabilities of risk associated with alternative futures and a variety of ensuing consequences. For example, in the CEMA case, participants can visualize how the various trajectories of varying pace and scale of

[72] The Future of Work, *Strengths and Limitations of Scenario Planning,* http://www.thefutureofwork.net/blog/archives/000408.html (accessed July 17, 2007); and L. Greig, K. Pawley and P. Duinker, *Alternative Scenarios of Future Development: An Aid to Cumulative Effects Assessment* (Canadian Environmental Assessment Agency, 2004) For the Research and Development Monograph Series, 2002, http://www.ceaa.gc.ca/015/001/021/print-version_e.htm (accessed July 24, 2007).

[73] Thomas L. Green, *Mining Nickle From Voisey's Bay in a Manner Compatible with the Requirements of Sustainable Development.* Report for prepared for the Innu Nation for submission to the Environmental Assessment Hearings into the Proposed Voisey's Bay Nickel Mine (1998).

[74] Thomas L. Green, *Mining Nickle From Voisey's Bay in a Manner Compatible with the Requirements of Sustainable Development.* Report for prepared for the Innu Nation for submission to the Environmental Assessment Hearings into the Proposed Voisey's Bay Nickel Mine (1998).

[75]L. Griffiths, S. Metcalfe, L. Michael, C. Pelley and P. Usher, *Voisey's Bay Mine and Mill Environmental Assessment Panel Report* (Joint Environmental Assessment Panel, 1999) http://www.ceaa.gc.ca/010/0001/0001/0011/0002/03_e.htm (accessed July 18, 2007).

oil sands development will impact wildlife populations.[76] Important discussions are occurring with respect to the degree of risk associated with varying rates of development and their impacts on wildlife and their habitats.

Increase understanding and critical thinking- Through scenario analysis we can begin to see how multiple variables interact. This can facilitate more critical thinking and questioning of the future conditions. For example, the scenarios run by the ALCES model in the cumulative assessment for the Terasen case, increased understanding by integrating several, complex variables.[77] Relevant natural disturbances such as climate change and fire, with land uses such as petroleum production and recreational use, were modeled to help envision both past and likely future disturbance patterns in the regional study area.

Participatory – Scenario analysis can provide a venue for stakeholders and decision makers to discuss critical questions about the future.

3.1.2 Limitations

Although an environmental assessment process informed by multiple scenarios will be more useful than one based on a single scenario, there are issues of concern that should be addressed when undertaking scenario analysis in cumulative effects assessment. Fortunately, there are clear lessons learned in the examples presented here as well as in the literature to help avoid these issues in scenario planning practice.

Oversimplification – Scenarios can tend to oversimplify an issue as the analysis must balance detail with available time and resources. A mixture of qualitative and quantitative information in scenario may help to overcome this limitation. For instance, in the Chukchi Sea example, stakeholders criticized that the EIS failed to consider a comprehensive array of alternatives to address the upfront issues and uncertainties; the alternatives oversimplified the complex variables at play. In the context of the MGP, extrapolating average development footprints calculated from known gas developments (as was conducted in the projections in the report "A Peak into the Future") is an appropriate way to balance complexity with assumptions about future development.[78]

Participant interaction and influence on content – The process of defining and assessing scenarios can raise sensitive issues for many participants, especially when they are from diverse backgrounds and organizations. Multi-stakeholder processes must be well designed and facilitated to avoid some of the pitfalls that can paralyze the process. An effective scenario

---

[76] Cumulative Environmental Management Association - Sustainable Ecosystems Working Group, *Briefing Presentation to Alberta Sustainable Resource Development* (September 5, 2006).

[77] TERA Environmental Consultants and Westland Resource Group Inc, *Environmental Assessment Report for the Terasen Pipelines (Trans Mountain) TMX – Anchor Loop Project* (Calgary, AB: Terasen Pipelines Inc, 2005), https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/267159/372416/386648/A0S4E1_-_Environmental_Assessment_Executive_Summary_and_Table_of_Contents.pdf?nodeid=386652&vernum=0 (accessed 27 July 2007),

[78] Peggy Holroyd and Hal Retzer, *A Peak into the Future: Potential Landscape Impacts of Gas Development in Northern Canada*, exhibit J-OREI-00011. Drayton Valley, AB: The Pembina Institute, 2005), http://www.ngps.nt.ca/Upload/Interveners/O%20Reilly%20-%20Kevin%20-%20citizen/OReilly%20Letter%20dated%2029%20June%202005%20to% Joint Review Panel%20re%20Materials%20for%20the%20Public%20Registry%20-%20Attach%20-%20A_Peak_into_the_Future_June-7-05.pdf.

development process should be facilitated and supported by the JRP and include clear expectations, reasonable timelines and balanced multi-stakeholder participation.

Knowledge versus action – Scenarios analysis is valuable in understanding the array of possible futures, but scenario analysis should not become an end in itself. It is a process for generating new ideas that should lead to actual changes in project design or decision making. For example, scenario analysis may demonstrate the benefits of the establishment of protected areas in conjunction with pipeline development, or the impacts of staged development of gas fields on VCs. Incorporating scenario analysis into decision-making processes such as the MGP, rather than as separate process not tied to regulatory decision-making as in the CEMA example presented above, will maximize the value of the scenario analysis in decision-making.

4. Conclusions and Recommendations

Scenario analysis helps to understand the scope of possible alternative futures and their impact on key valued social and environmental components. It is used to improve decision making and management strategies. Scenario analysis is particularly valuable for large scale projects where the time frame extends past 30 years and has the potential to induce more development as in the Mackenzie Gas Project.[79] A scenario analysis, completed now, could be adapted as time goes on and as greater certainty exists around either the MGP's impacts and/or future developments. It is widely recognized that the CEAA is failing to adequately meet its goal of assessing cumulative effects.[80,81] Incorporating scenario analysis in cumulative effects assessment is an important mechanism to effectively implement CEAA and improve regulatory decision-making.

The MGP is one of the most significant industrial projects in Canada's history, and it is essential that regulators employ best practices in cumulative environmental assessment. Indeed, the use of such best practice methodology is mandated by the Mackenzie Gas Project's environmental impact assessment terms of reference, as noted in the introduction above. In addition, the consideration of impacts from induced development (as noted by the Practitioner's Guide under CEAA and by MVEIRB[82]) is a second best practice that must be adhered to by the JRP.

Scenario analysis in the cumulative effects assessment for the Mackenzie Gas Project would:

- allow stakeholders to become clear on what the range of possible futures are (with and without the MGP)
- understand the risk and uncertainty of impact to valued components associated with different futures
- understand the different development paths that could occur if expected or unexpected changes occur in key socioeconomic drivers (e.g., price of gas, change in public opinion, change in government policy) or environmental variables (e.g., climate change)
- help identify appropriate management strategies to different alternative development paths.

We recommend that scenario analysis process take a combination of a forecasting and a backcasting approach. This approach would involve the consideration of the following factors, explained below:

---

[79] Peter Duinker and Lorne Greig, "Scenario analysis in environmental impact assessment: Improving explorations of the future," *Environmental Impact Assessment Review* (2007), 214.

[80] Steven A. Kennett, "Towards a new paradigm for cumulative effects management. Canadian Institute of Resources Law," *Occasional Paper #8* (1999), http://www.cirl.ca/pdf/OP08Cumulative.pdf

[81] Peter Duinker, and Lorne A. Greig, "The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment," *Environmental Management* 37, no. 2 (2006), 153-161.

[82] Mackenzie Valley Environmental Impact Review Board, *Environmental Impact Assessment Guidelines, Appendix H: Additional Cumulative Effects Guidance* (March 2004), http://www.mveirb.nt.ca/upload/ref_library/MVE_EIA%20Guidelines.pdf, 77-80.

1. **Focus of the study**
2. **Time frame**
3. **Number of scenarios**
4. **Driving forces and critical uncertainties**
5. **Driving forces analysis**
6. **Scenario development**
7. **Scenario assessment**
8. **Scenario impact**
9. **Scenario management response (or mitigation)**

For brevity, some of the steps have been combined in the following descriptions. The forecasting method will provide decision-makers and stakeholders with the range of possible futures and opportunities to discuss the benefits and risks of each. Once the scenarios have been created, objectives can be defined and backcasting can be used to identify the most appropriate actions to the desire future. A singular scenario for the MGP is inadequate considering the "basin opening" nature of the project and its cumulative impacts to the NWT's ecosystems and socio-cultural environment.

Focus of study. Scenario analysis for the Mackenzie Gas Project should take into account the natural gas potential in the Northwest Territories and Yukon, and the potential impact of gas development based on footprint estimates from other developments in the North (Fort Liard area) and other mature gas fields in the Western Sedimentary Basin. As in the Montana example, reasonably foreseeable projections of induced development can be derived from available geological data, expert opinion and literature reviews.

Timeframe. The timeframe implemented in the aforementioned examples ranged from the life of the project to a projected 100 years. For the MGP, it would be reasonable to consider scenarios at least 30 years into the future. Going beyond the life of the project could result in increased dependence on the trends predicted by modeling. As noted by Greig and Duinker, trend analysis is vulnerable to a key assumption that the trends will continue into the future.[83] Keeping this in mind, the timeframe for scenarios analysis for the MGP should range between 30 and 60 years. The scenario analysis conducted today should be updated every four to six years to ensure that the environmental, geopolitical and socio-cultural variables are current and on par with ongoing decision making related to the MGP.

Of extreme importance to the MGP is when the scenarios analysis should begin. As shown in the CEMA example, scenario analysis is best conducted prior to regulatory decision-making. As an important best practice in cumulative effects assessment, the scenarios analysis must occur before the Joint Review Panel makes its recommendation on the Project.

Number of scenarios. As suggested in the Greig and Duinker report, at least four or five scenarios should be assessed. While more than five alternatives may be unwieldy, it is possible to employ "sub scenarios" as occurred in the Upper San Pedro River Basin example. Each of the

[83] Lorne Greig and Peter Duinker, *Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project* (Prepared for the Mackenzie Gas Project Joint Review Panel, 2007).

three main scenarios was varied two or three times to test outcome comparisons to yield a total of 10 scenarios. These variations of the main scenarios were generated to create a full spectrum of possibilities, in recognition that no single vision of the future can be certain. However, upon balancing time constraints with a meaningful analysis, we recommend that the JRP consider five main scenarios for assessing the cumulative effects of the MGP. This will reduce the natural tendency to choose the middle option. As discussed in the Section 2 examples, scenarios should be generated in cooperation with stakeholders (see Chukchi Sea, Upper San Pedro River Basin, and CEMA examples.) The following list provides a sample of scenarios that could be considered in the MGP cumulative effects assessment.

1) The scenario of the impact of Mackenzie Gas Project, without induced development, with its current assumptions about development in the absence of future land use planning, with no further hydrocarbon or activity.
2) A scenario whereby the cumulative impacts of induced development of the MGP in the absence of conservation planning (as listed in 5 and 6 below) is examined. This would include the Mackenzie Gas Project plus exploration and development in areas known to have high potential for natural gas reserves (e.g., Colville Hills, Dehcho/Liard, Tulita area, Gwich'in, Mackenzie Delta and the Beaufort Sea.)
3) Scenario #2, plus the development of other hydrocarbons (e.g., coal, oil and gas hydrates) and other induced resource activities (e.g., minerals, hydro-electric, commercial forestry.)
4) A scenario including the current assessment in EIS for the Mackenzie Gas Project complemented by a full set of completed protected areas/land use plans pursuant to the conservation planning laid out in the NWT Protected Areas Strategy, Mackenzie Valley Five-Year Action Plan, 2004-2009. [84,85]
5) A scenario including the assessment induced development constrained by a full set of completed protected areas/land use plans pursuant to the conservation planning laid out in the NWT Protected Areas Strategy, Mackenzie Valley Five-Year Action Plan, 2004-2009. [86,87]

A pre-development baseline case may be valuable to measure the range of natural variability of VCs with no industrial land uses.

[84] NRTEE recognized that there is a unique and time-limited opportunity to plan proactively prior to any major development in the Mackenzie Valley. See: National Round Table on the Environment and the Economy, *Securing Canada's Natural Capital: A Vision for Nature Conservation in the 21st Century, Chapter 3 - The State of Conservation in Canada* (2003), http://www.nrtee-trnee.ca/Publications/PDF/SOD_Nature_E.pdf (accessed July 31, 2007).

[85] NWT Protected Areas Strategy Secretariat, *Northwest Territories Protected Areas Strategy, NWT-PAS Five-Year Action Plan* (2003), http://www.nwtwildlife.com/pas/pdf/mac_action0409.pdf (accessed July 31, 2007).

[86] NRTEE recognized that there is a unique and time-limited opportunity to plan proactively prior to any major development in the Mackenzie Valley. See: National Round Table on the Environment and the Economy, *Securing Canada's Natural Capital: A Vision for Nature Conservation in the 21st Century, Chapter 3 - The State of Conservation in Canada* (2003), http://www.nrtee-trnee.ca/Publications/PDF/SOD_Nature_E.pdf (accessed July 31, 2007).

[87] NWT Protected Areas Strategy Secretariat, *Northwest Territories Protected Areas Strategy, NWT-PAS Five-Year Action Plan*(2003), http://www.nwtwildlife.com/pas/pdf/mac_action0409.pdf (accessed July 31, 2007).

Driving forces analysis and identification of critical uncertainties. Identifying the factors that influence the alternative scenarios is a key step. A starting list of driving forces for the MGP project should include: sustainable development, existing policies and management plans (e.g., land use plans, the NWT Protected Areas Strategy), neighbouring land developments, greenhouse gas emissions and associated policy, and climate change. For the MGP, the Delphi method could be used to identify the driving forces. Analysis of driving forces can be done by charting driving forces on a grid such as from low to high certainty and low to high impact.

Scenario development. Each scenario should be reasonable and plausible. Involving participants in the development of each scenario ensures "buy-in" early on in the scenario planning process as well as credible results. This step may be the longest as each scenario may be revised several times. The scenarios can be represented by both quantitative (e.g., in the Terasen case, the numeric range of natural variability for terrestrial and aquatic ecological integrity) and qualitative data (e.g., in the Upper San Pedro River Basin case, qualitative data was collected from stakeholders through surveys containing questions relating to land development, water use etc.). Echoing Greig and Duinker's report, the scenario development should be led by a neutral, third party facilitator. [88]

Scenario impact and assessment. The impact of each scenario on the valued components or other issues of concern is critical information in determining a scenario that reflects the desired future. In the Montana coal bed methane example, a comparison of environmental impacts for each development alternative was completed. In the Terasen case, scenarios were assessed using the computer modeling program ALCES to evaluate potential cumulative effects on selected indicators relative to their natural range of variability. In the Upper San Pedro River Basin example, development, hydrological and vegetation models were used to assess the potential impacts of each of the main scenarios and their "test" scenarios relative to the 2000 baseline conditions. Summary documents and maps of the alternatives' impacts are necessary to effectively demonstrate scenario impact to local communities or the general public. Models are useful tools in assisting with this task. To date, there have not been an adequate number of scenarios evaluated in effort to assess the cumulative impact of the MGP and future induced development. For the MGP, multiple scenarios – of which several include induced development – need to be examined and compared.

Scenario management response (or mitigation.) The final step is identifying management strategies that apply to each scenario and address impacts. As demonstrated in the Montana example, the preferred alternative would limit the number of applications that are accepted each year and in each watershed. Scenario analysis can lead to recommendations on limiting development or, as in the Voisey's Bay example, slow development. Mitigation may also vary depending on the level of impacts associated with the scenario. For example, compensatory mitigation may be required as the management response if the chosen scenario were that the MGP proceed without consideration of the NWT Protected Areas Strategy and Action Plan. Such mitigation could include the implementation of conservation offsets or environmental thresholds to negate project impacts.

[88] Lorne Greig and Peter Duinker, *Scenarios of Future Developments in Cumulative Effects Assessment: Approaches for the Mackenzie Gas Project* (Prepared for the Mackenzie Gas Project Joint Review Panel, 2007), 25.

Conclusions

Scenario analysis can help us to become aware of the costs and benefits of actions and the consequences that can ensue.[89] Scenario analysis represents an accepted best practice in environmental decision making and is consistent with expectations for meaningful CEA in the Mackenzie Valley. Scenarios analysis for the MGP would enable the JRP to examine the cumulative impacts of induced development. Both scenario analysis for effectively assessing cumulative effects and inclusion of induced development are critical best practices that the JRP must consider in effort to ensure a sustainable future for the NWT.

The JRP has an immense responsibility in considering the Mackenzie Gas Project's impact on the environment and the social, cultural and economic well-being of residents and communities. It is not possible to protect the basin without first gaining an understanding of what the future could look like. Scenarios analysis can limit future development, as in the Montana coal bed methane example; or slow its pace, as in the Voisey's Bay case. The pace and scale of the MGP are critical issues for the JRP to consider. In addition, scenario analysis is clearly more meaningful if it is conducted before regulatory decision making. The work of CEMA's Sustainable Ecosystems Working Group in Alberta provides a cautionary example of scenario analysis that is not integrated with regulatory decision-making. The preliminary scenario analysis work of CEMA is starting to demonstrate major projected declines in valued social and environmental components in the Fort McMurray region[90] that have not been identified by the individual cumulative effects assessments conducted by oil sands proponents.

To adequately explore the cumulative environmental and social impacts of the gas development induced by the Mackenzie Gas Project via tools such as scenarios analysis is simply due diligence. The panel has an opportunity to ensure that the environmental assessment for the Mackenzie Gas Pipeline project is meaningful, and does not repeat the mistakes of CEA elsewhere in Canada. This would be done by requiring a rigorous assessment of cumulative effects, such as can be accomplished through the scenario analysis process outlined above. This would involve a thorough assessment of alternative scenarios of development and evaluating them again desired future, based on social, environmental and economic objectives. If this desired future is sustainability, a rigorous assessment of sustainable development should be undertaken to determine if the project helps us meet human needs, and ensure healthy ecosystems.

[89] Edward Cornish, *Futuring: The Exploration of the Future* (Bethesda, Maryland, World Future Society, 2004).

[90] Cumulative Environmental Management Association - Sustainable Ecosystems Working Group, *Briefing Presentation to Alberta Sustainable Resource Development* (September 5, 2006).