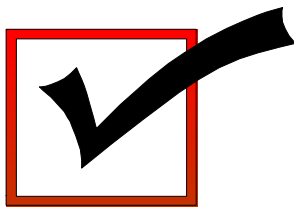


## 3.0 Approaches to Current Practice

### 3.1 Summary: CEA Highlights of Current Practices



Section 3.1 represents a preview of the highlights of current CEA practice, which are discussed in detail in Section 3.3. The Institute/Axys identified nine typical CEA components:

- Issue identification
- Valued Ecosystem Components (VECs) and associated indicators
- Spatial bounding
- Temporal bounding
- Included projects
- Assessment methods
- Impact characterization
- Significance of cumulative effects
- Future management options

Highlights of current practice are presented for each of the nine components. The highlights represent a compendium of practices generally accepted by current practitioners, regulators and the public in Alberta, and are considered by the Institute/Axys to be the best of practices revealed in the 19 projects. In particular, practices were identified as highlights based on the following criteria:

**Expert Consensus:** the practice has been generally accepted in the literature, conferences and workshop proceedings

**Public Acceptance:** the practice has been generally accepted in formal regulatory proceedings

**Accepted Practice:** the practice is generally accepted by practitioners in the field and industry

**Historical Progression:** the practice reflects an advancement of the science and availability of data

**Opinion:** the practice is considered to be a highlight in the opinion of the Institute/Axys based on knowledge and experience in the field

In general, three approaches to initiating cumulative effects assessment were taken in the 19 projects reviewed:

1. Identifying possible impacts of the project as a means of defining issues, Valued Ecosystem Components (VECs), and regional study areas;

2. Identifying a regional study area, usually based on expert opinion and then defining issues, VECs and probable impacts; and
3. Defining broad scale affected resources and indicators and then identifying regional study areas and possible impacts.

Each approach has its benefits and drawbacks. The first approach presupposes that all possible impacts are known before the area and other regional developments are characterized. However, this approach does serve to focus the assessment and attention on project impacts. Identifying a regional study area initially (approach 2) implies that the region will be well characterized (baseline characterization) but runs the risk that the regional area chosen does not adequately represent the range or movements of the VECs.

In the third approach, appropriate regional study areas are identified subsequent to defining affected resources and indicators. This approach creates a possibility for the assessment to get bogged down analysing indicators that are not impacted by the project because early decisions structure an application and thus determine how the assessment proceeds.

Highlights of current practice involving the nine components are briefly summarized below (see Section 3.3 for details):

**Issues identification** was conducted via an iterative approach which attempted to capture both scientifically and socially important issues. Socially important issues were identified through consultation with interested and affected parties prior to the development of the assessment and throughout the process. Scientifically important issues were identified through a combination of expert opinion, literature review and baseline characterization or field studies. A thorough knowledge of the project and its possible effects on the environment is an important component contributing to the identification of relevant issues.

Issues identification led to the identification of relevant VECs or indicators which reflected the range of issues identified. As with issues, there are both socially and scientifically important VECs, which must be identified through consultation or expert opinion. VECs likely to be affected by the project were identified and specific parameters assessing their response developed.

**Spatial bounding** refers to the spatial scale, or area, over which project effects are assessed. Spatial scales for CEA were generally larger than those for assessing direct project effects. Spatial assessment scales were based on the maximum detectable zone of influence for the project, the extent of effects on the VECs or indicators chosen and the most appropriate scale for the effects in question.

**Temporal bounding** refers to the time period over which impacts are predicted and assessed. An extended time scale allows for the assessment of time-lagged effects from both existing projects and the proposed project under review. Some proponents used time scales which ranged from a pre-development state (with little or no development in the area) to a far future with or without the project in question.

Choosing larger spatial and temporal scales for CEA assessments usually results in the **inclusion of other types of activities or projects** in the region. Most proponents included other projects, but did not give a rationale for which projects were included.


Proponents are required under law in Alberta to include future reasonably foreseeable projects. Existing projects or activities which have the potential to affect the same resources as the project in question, as well as reasonably foreseeable projects, should also be included in the CEA. A rationale for why certain projects were chosen for inclusion in the CEA is also important.

**Assessment methods** included a combination of qualitative and quantitative approaches, depending on the issue and type of assessment being conducted.

**Impacts were characterized** in a number of ways which generally involved characterizing impacts on the basis of scope, magnitude, duration, frequency and direction. Cumulative impacts were interpreted as the impacts from residual effects of the project which remained after planned mitigation. Highlights of current practice for impact characterization involved clear definition of terms and categories used to characterize impacts, relation of predicted impacts to defined standards or thresholds and acknowledgment and estimates of uncertainty associated with predictions. In addition, many CEAs rely heavily on modelling predictions. The assumptions supporting the models should be made explicit and the process should be iterative, in the sense that predictions are regularly checked against actual data and revised accordingly.

Determining the **significance of the cumulative impacts** predicted in an EIA is possibly the most important component of a CEA. For parameters such as water and air quality there are generally agreed upon standards and guidelines, so the matter is relatively simple. However, determining the significance of impacts on parameters such as wildlife and vegetation is more complex and can require more judgement. Several provincial policies such as the Wetlands Policy and Integrated Resource Plans (IRPs) provide thresholds or objectives, but they generally do not take a consistent approach. Until methods for establishing specific goals or thresholds for wildlife and similar parameters have become generally accepted, the best practice is to delineate an explicit rationale for determining significance of cumulative effects.

**Future management options** refer to regional initiatives, such as monitoring and end land use planning, designed to address cumulative effects of all developments in a region. Participation in such initiatives is becoming more common in recent years; examples include participation by Suncor, Syncrude and Shell in regional monitoring programs in the Athabasca oilsands region.

One important example of good practice is relevant to all nine components: CEAs are more useful when each component includes a clear statement of the assumptions and criteria involved. Transparency makes it easier both to understand and to learn from the assessment and reduces the chance of misinterpretation. 

### **3.2 Process and Interactions Among Participants**

The following summary centres on process issues associated with cumulative effects assessments reviewed in the 19 projects. Time and resource constraints prevented the Institute/Axys from reviewing the entire regulatory record for each project, which would have allowed determination of what role CEA currently plays in the regulatory process. Information related to process and interactions among participants is typically found in decision documents, transcripts and supplementary information responses, only a few of which were reviewed in detail for this report.

As stated earlier, CEA represents a useful set of assessment tools which can be applied in a number of different circumstances. To some degree, the form of decision-making dictates the nature of the cumulative effects assessment which is undertaken. CEA has been employed both in proceedings to approve specific projects and in more generic proceedings to establish the grounds for making regional development policies. Undertaking a CEA involves considerable effort due to the need for information about, and analysis of, potential environmental impacts which endure for an extended period, affect a large study area, are caused by a number of existing and proposed developments and interact in various manners. The task of conducting CEAs has been met in a number of different ways.

In 1989, a joint federal-provincial advisory panel was struck to review an environmental impact assessment of a single project, AIPac's proposed Athabasca pulp mill. Most of the cumulative effects information was, however, presented by government researchers rather than the proponents. This particular case set the stage for the Northern River Basins Study, a comprehensive review funded by the federal, Alberta, and NWT governments.

Also established to review specific projects, a joint Review Panel on Uranium Mining Development in Northern Saskatchewan advised the federal and provincial environment and energy ministers and the Secretary General of the Atomic Energy Control Board (AECB) regarding approval of two new uranium mines in Saskatchewan. The panel patterned its proceedings after those of a quasi-judicial tribunal and the assessment was conducted by the proponent.

The British Columbia Ministry of Environment, Lands and Parks (MELP), on the other hand, initiated the Monkman/Grizzly Valley assessment, a regional study of the combined effects of further development in a natural gas production field. The assessment was performed not as an EIA but as an “Environmental Protection Strategy”. It was intended to provide data on the basis of which the government would determine a regional gas development policy. Westcoast Energy triggered the study by requesting permission to expand its Pine River Gas Plant to accommodate new product delivered by seven other energy operators in the Monkman field. MELP directed producers to work together to assess environmental effects over the entire production area, and to suggest initiatives to minimize those effects. The study was designed to help establish disturbance thresholds, identify sensitive areas for key resources, and ensure that mitigation, monitoring and research were focussed on significant environmental issues.

Since 1992 in Alberta, cumulative effects are addressed in the context of statutory procedures invoked to review specific energy, recreational and other project applications. Typically, terms of reference outline particulars for an EIA, including cumulative effects assessment. In Alberta, AEP is placing greater emphasis on developing TORs in consultation with a proponent and other stakeholders, and feels this practice improves understanding among participants and the quality of assessments.

None of the terms of reference reviewed went into any great detail with respect to items to be considered in the CEA. TORs are meant to provide direction, rather than be prescriptive. Applications are reviewed by regulators and released to the public. Alberta’s environmental assessment process is community-based in that proponents are required to consult with the public and the public assists in scoping an EIA report. Interveners pre-register for hearings, or can submit their questions in writing.

More effort is being made by proponents to involve the public at every step of the application process, and many now conduct workshops (Project Prairie Rose, Shell Muskeg and Union Carbide among others) or convene public and scientific advisory panels (Eagle Terrace) to help identify issues and scope the EIA and CEA. In at least two cases the proponents collaborated in gathering data and preparing background studies for their EIAs and CEAs (Suncor Steepbank and Syncrude Aurora).

Interventions by industrial enterprises other than the proponent are, perhaps, becoming more active as a result of CEA. Regional caps or thresholds affect all existing regional developments if applied retrospectively, and may preclude future developments. Competing corporations or corporations developing other regional resources played a role in Syncrude’s Aurora application, for example. Such corporations may benefit in that CEAs provide more strategic competitive information, but these corporations are themselves alert to the possibility of having to reveal their own strategic plans or trade secrets. Like the proponent, they are often wary of giving too many details of future activities. Nevertheless, CEAs constitute a set of tools used to predict future impacts. Uncertainty is inherent, of course, but the tools help anticipate situations, develop future management practices which acknowledge the uncertainty, and adapt to changes in a timely and appropriate manner.

From a scientific perspective, a CEA involves more uncertainty than does an EIA. As a result, proponents are more often forced to make projections based on an expert's opinion of potential consequences, which may have a tangential effect on interactions between parties. Opinions, even expert opinions, ultimately rest on value judgements which can be difficult to justify and defend in regulatory proceedings. Interveners may seize the opportunity to criticize projections and offer alternative interpretations of the data more often than is the case with respect to EIAs.

Cumulative effects broadens an assessment's scope and introduces more stakeholders and issues that will occur over an extended period. With the information supplied in a CEA, affected groups may have more leverage to force corporations to develop regional collaborations to address mitigation issues. A number of proponents and regulators have suggested opportunities for more public involvement through citizen committees. As one of many examples, Express Pipeline established an advisory committee to direct reclamation and to monitor activities regarding effects on native prairies. Alberta has a long history of using advisory committees to improve environmental management.

CEAs may significantly increase the amount of information included with EIAs and are designed to provide more contextual information on which to base long-range project-specific and regional policy decisions. The Cheviot project illustrated the extent to which collaborative programs could be designed to ameliorate anticipated environmental impacts, and the Three Sisters project exemplified the extent to which project design could be improved through a collaborative exchange of properties. Community residents including First Nations, recreation associations, ENGOs and other directly affected stakeholders no doubt have benefitted from having more information on the local state of the environment and what it will look like in the future.

Municipalities and regional planning authorities benefit from the regional information supplied in a CEA in terms of their ability to plan infrastructure, coordinate services and encourage inter-corporate collaboration. Other provincial and federal government agencies similarly benefit. The data supplied with a CEA may also supplement data collected by other governments and support their own regulatory purposes although it may on occasion raise jurisdictional issues in terms of managing transboundary effects.

Similarly, CEAs give primary regulators an enriched context in which to consider approving resource development projects. However, they also broaden the influence of project-specific decisions, which may generate repercussions for other existing or proposed regional developments. The Cheviot project illustrates the point in recommending management options which affect other industries, notably forestry. However, neither the EUB nor CEAA endorsed the proponent's suggested impact management program. Shell, Syncrude and Suncor are responding in part to the EUB and in part to their own concerns regarding inter-corporate ramifications in the Athabasca oilsands region by cooperating in a regional development review.

## 3.3 Approaches to Current Practice

### 3.3.1 Issue identification

Issue identification is one of the first steps in preparing an EIA or CEA and is based on information about the proposed project and the nature of the receiving environment. Issues are normally identified through consultation with local individuals, regional stakeholders including First Nations, regulators and experts. Issue identification is often an iterative process which is open to change as more information becomes available from the assessment itself or from further consultation. Baseline data is essential for characterizing the receiving environment and making predictions about potential impacts.

In two of the earlier projects reviewed (Manalta (Mercoal) and AIPac), biophysical cumulative effects issues were not explicitly addressed. Issues were identified primarily on the basis of expert opinion (proponents, regulators and consultants) and a literature review (including previous studies in the area). However, Manalta did consult more broadly with the public and government agencies in determining important information needs for describing regional conditions and developing field survey programs. This information ultimately provided the basis for its assessment. A thorough baseline characterization, project description and knowledge of cause-effect relationships is essential to identify potential impacts which can be attributed to the project in question.

Cumulative effects became a major issue from the outset at the AIPac public hearings, in which a significant body of evidence was presented on cumulative effects, primarily by interveners and government researchers. The process ultimately contributed to the establishment of the Northern Rivers Basin Study, which examined cumulative effects of upstream development in the Peace-Athabasca system. AIPac also left a strong legacy to Albertans by helping to foster AEP's practice of developing EIA Terms of Reference in consultation with the proponent and other stakeholders.

Shell (Caroline Expansion) participated in an initiative to coordinate gas field development in the region and thus dealt with cumulative effects issues to some extent in its assessment.

A Public Advisory Committee and a Scientific Advisory Committee were formed for the Three Sisters project. Both Committees provided ongoing input on key issues, field surveys and the approach and interpretation of the impact assessment.

Alberta has used a community-based approach to environmental assessment since 1973 and cumulative effects assessment was often part of it, although the term was not used. In 1992, consideration of cumulative effects became mandatory under the new *Alberta Environmental Enhancement and Protection Act*, and this is when cumulative effects issues were routinely identified and addressed in applications. At the same time, proponents became more likely to consult with the public prior to preparing an EIA in order to identify issues of concern. Some proponents have used the issues identified through consultation to structure the whole assessment (Suncor, Steepbank). Care must be taken with the latter approach to issues identification; not all issues of public concern are relevant to the impacts of the project, and the public may not identify all relevant issues.

Imperial Oil (Cold Lake Expansion) used public forums and individual contacts to identify key concerns of community residents, First Nations, public groups and government agencies. Input from the consultation was combined with input from assessment specialists using a series of structured matrices. The matrices identified and ranked interactions between specific project activities and infrastructure, and each of the major environmental components such as air, groundwater, surface water, aquatic ecosystems, vegetation, wildlife and resource use. These matrices were used to identify VECs for different project effects. This approach is based on the Focussed Environmental Assessment Approach (Kennedy and Ross, 1992) developed as part of the OSLO oilsands project.

Cumulative effects issues also invariably arise during public hearings and are sometimes identified by other industries operating in the area, as happened when Shell requested more information from Syncrude on the impacts of its Aurora mine. Such public processes help to refine and focus issues through the course of the assessment.

Approaches to issues identification in other jurisdictions in Canada have been similar to those in Alberta. Issues are identified through a combination of early consultation with stakeholders and regulators, issues scoping through interaction matrices or other models, and expert opinion. Issues identification in the Mobil and Shell (Sable Island) assessment was accomplished through consultation, prior knowledge and literature review and issues scoping to identify likely impacts.

### Highlights of Current Practice:



## Issues Identification

A balanced approach to identify issues of concern based on a thorough understanding of the project and cause-effect relationships, and involving

- Consultation with interested and affected parties and regulators prior to EIA
- Thorough baseline characterization
- Expert opinion and literature review
- Structured approaches for issues identification

### 3.3.2 Valued Ecosystem Components and Indicator Selection

Practitioners have used representative ecosystem components to address complex ecosystem responses to project-specific and cumulative effects and to assess potential changes as a result of project-induced effects. Such components have been variously referred to as indicators, key species, Valued Ecosystem Components (VECs) and Key Indicator Resources (KIRs) (Beanlands and Duinker, 1983). The term “indicator” is more commonly used to define a specific measured parameter for a VEC or KIR. Choosing the appropriate VECs or indicators is essential for assessing impacts and the significance of effects. Air and water quality objectives are generally used as indicators of acceptable effects on air and water quality, but similar objectives are lacking for other environmental components such as wildlife or vegetation.

Drouin and LeBlanc (1994) suggest that the selection of indicators be broadened beyond specific species or resources to consider concepts of ecosystem carrying capacity, assimilative capacity and sustainability; and community values about what makes individual ecosystems healthy and how much degradation is acceptable.

The first point relates to a VEC’s scientific importance as an indicator of impact. VECs can represent either the most sensitive environmental component, or the one with the most representative response to the project effects. The second point refers to the value that society places on that component. Choosing good VECs and indicators therefore requires a combination of scientific and value judgements. This combination is key to a successful assessment.

VECs were identified in a number of ways in the projects examined. Some proponents did not identify VECs specifically, but generalized to affected resources or Key Indicator Resources such as aquatic resources (Amoco (Prairie Rose), Shell (Muskeg River)). Manalta’s baseline characterization in effect involved study of VECs, but it did not use that term to describe its analysis. Other proponents identified VECs through consultation, issues scoping, identification of potential impacts (Mobil and Shell (Sable Island)) and inclusion in endangered or vulnerable species lists (Express Pipeline). Alternately, a limited number of indicator species were chosen to represent all VECs.

In general, VECs of interest were ranked for more detailed analysis on the basis of importance. ALPac, for example, identified important species using the Management Indicator Species evaluation scheme and ranked them based on the following:

- Political importance
- Economic importance based on trapping and guiding
- Subsistence hunting value
- Recreational hunting value
- Non-consumptive recreational importance
- Ecological importance
- Ecological vulnerability

The highest ranked species in each of a number of species groups were then selected for further consideration as indicator species. A similar approach was adopted in the OSLO project, as well as for more recent assessments in the Athabasca oilsands region. The use of structured matrices and selection methods for VEC selection is an important component of the Focussed Environmental Assessment Approach (Kennedy and Ross, 1992).

Once VECs have been selected, proponents sometimes clearly identify and justify the specific parameters that will be used to measure the response of the VEC to a project-specific or cumulative effect. In conjunction with this step, specific values or ranges of values are often identified as thresholds for determining when cumulative effects may occur.

In summary, VEC and indicator selection has been approached in several ways:

- Initially identifying impacts to affected resources, rather than to specific VECs or indicator species
- Consulting stakeholders and ranking VECs of importance
- Reviewing the COSEWIC list of vulnerable species
- Determining which species or VECs are likely to be affected based on the issues identification phase

### Highlights of Current Practice:



## VEC and Indicator Selection

Valued Ecosystem Components are selected based on identifying:

- Issues, effects and species of greatest public concern
- Different resources (e.g., air, groundwater, wildlife) which may be affected for each type of major pressure or stress
- One or more species likely to respond to each major pressure or stress
- Specific parameters that will be used to assess the response of the VECs to each effect

### 3.3.3 Spatial Bounding

Spatial boundaries for an environmental impact assessment typically include a local study area for assessing project-specific effects and a broader regional study area for assessment of cumulative and regional effects. Local study areas generally represent the actual footprint of the project. Regional study areas, on the other hand, can range from a few square kilometres in close proximity to the proposed project, to thousands of square kilometres representing regional airsheds or developments. In the past, impact assessments commonly used standard study areas for all resource types. In some of the more recent assessments, however, different local and regional study areas have been selected for different resource groups and/or types of effects.

Choosing an appropriate regional study area for cumulative effects assessment is critical. The study area must include the probable zone of influence for the project-specific effects as well as their overlap with similar effects from nearby projects and human activities. The study area must also encompass a scale appropriate to the affected resource. Thus a regional airshed, a distinct subpopulation for a wildlife species or a regionally important seasonal habitat may dictate the study area boundaries. It is important, however, that the study area not be so large that the significance of important local effects is lost. Spatial boundaries should be different for different environmental components to account for the differences in the nature of the affected resource and the scale of interactive effects which may occur some distance from the project. In some cases, however, the availability of regional information (particularly spatial databases on physical and biological components such as soils and vegetation), and/or the cost of new data acquisition may reduce the size of the study area that can be considered for a specific VEC or project effect.

Drouin and LeBlanc (1994) have identified the following criteria for establishing both geographical and temporal boundaries for cumulative effects assessment (page 29):

- Size and nature of project and anticipated effects;
- Availability of existing data and knowledge about the project and its environmental effects;
- Feasibility of collecting new data and knowledge;
- Size, nature and environmental effects of past, existing and future projects in the area;
- Characteristics and sensitivity of the receiving environment;
- Relevant ecological boundaries, including watersheds, sub-watersheds, major landscape features; and
- Relevant jurisdictional boundaries.

Although most of the above criteria were likely used implicitly in many of the projects to identify and select appropriate spatial boundaries, some criteria appear to have been given precedence. Some proponents identified regional boundaries based primarily on the range of possible impacts from the project (AIPac, Amoco (Prairie Rose), Manalta (Mercoal)). Several regions were identified depending on the type of impact being assessed. Alternately, regional boundaries were based on environmental components such as species range or watersheds (Imperial Oil (Cold Lake Expansion), Shell (Scotford), Three Sisters, Union Carbide).

Syncrude, Suncor and Shell have taken a different approach in the Athabasca oil sands region by jointly identifying a single regional study area for assessing cumulative and regional effects of their respective projects. The study area included the minimum area necessary to adequately assess the regional airshed and all potentially affected watersheds and landscape areas. While this study area was used to structure the collection and mapping of certain information such as a thematic vegetation map and air quality modelling, each discipline selected a study area that was most appropriate to its VECs and the expected scale of related effects.

Regional study areas in projects subject to other Canadian jurisdictions were more likely to be based on topographical/geographical features or administrative boundaries (TransCanada Twinning, Eagle Terrace, Keenleyside) or the extent of other, similar developments in the area (Monkman/ Grizzly Valley, Mobil and Shell (Sable Island), Cogema (Midwest Uranium Mine)). However, several regional study areas were also defined by expected impacts (Mobil and Shell (Sable Island), Express Pipeline).

In summary, six approaches to spatial bounding (identifying regional study areas) were identified in the projects:

- Expected range of impacts
- Environmental components being studied
- Topographical or geographical boundaries
- Extent of pre-existing development in the area
- Jurisdictional or administrative boundaries
- A single regional boundary encompassing airshed, watershed and landscape boundaries

### Highlights of Current Practice:



## Spatial Bounding

A regional study area is chosen taking the following factors into account:

- Maximum detectable zone of influence for each project effect (e.g., range of audible noise);
- Spatial extent of the effect on the relevant VEC (e.g., zone of habitat alienation due to sensory disturbance); and
- The most appropriate spatial unit for the VEC that is likely to be affected by the project (e.g., a distinct subpopulation for wildlife; the groundwater aquifer) which usually results in more than one spatial boundary.

### 3.3.4 Temporal Bounding

The time scale of a CEA is usually longer than that for a traditional EIA. It may range from a pre-development to a “far future” state, with or without the development in question. In general, the assessment should cover a period long enough to incorporate long term, indirect effects of the proposed project. At a minimum, the assessment should start with a time before effects associated with the project occur (CEAWG, 1997; page 15). The future boundary may be set to coincide with the period in which pre-project conditions are expected to be re-established, such as occurs when a mine is reclaimed after the resource has been depleted. In the absence of defined reclamation or mitigation plans, or when there is no expectation that pre-project conditions will be re-established, “far future” scenarios at different project phases such as construction, operation and reclamation can be used.

Approaches to identifying a time scale for assessing cumulative effects varied according to the type of project. For example, mines are expected to have discrete life spans, so time scales often extended from the present to the post-operational abandonment or reclamation phase. In terms of impact assessments, time scales were either based on snapshots of key phases (present, construction, operation and reclamation) or varied according to the VEC being assessed. Imperial Oil also identified pre-development conditions in the area. The report of the review panel on Cogema’s Midwest Uranium Mine provides the longest term assessment for future impacts, mentioning the need for monitoring “in perpetuity”. In Alberta, regulators place monitoring requirements in their facility approvals.

Assessments of industrial plants or recreational projects often do not account for a decommissioning phase. Time snapshots were used in many projects with the far future being substituted for reclamation (AIPac, Imperial Oil (Cold Lake Expansion)). One proponent limited its analysis to the present and projects that were already in the regulatory process or had been approved, but extended the analysis back to the 1960s when the first part of its dam was built (Keenleyside). The Eagle Terrace Project assessment used a range of scenarios (pre-development, present, near future and near future without the project) to assess how cumulative effects might affect a specific VEC or indicator over time. The pre-development scenario was based on current ecosite conditions, minus all existing human developments and infrastructure. This scenario provided a means to assess how much specific VECs had already been affected by human developments and infrastructure. The use of a near future scenario, with and without the Eagle Terrace development, provided an estimate of its incremental effects on each VEC and helped to establish possible desired states for certain resources or VECs as a surrogate for regional land use or management objectives and as thresholds for cumulative effects.

Constructing alternative scenarios for the future is often necessary to properly assess likely outcomes.

**Highlights of Current Practice:**



**T e m p o r a l   B o u n d i n g**

The assessment of cumulative effects covers the following time frames:

- Pre-development period: some information on the environment;
- Present period: a thorough characterization of baseline conditions;
- Project activities period (including construction, operation and reclamation, if relevant): snapshot information on the environment; and
- Period without proposed project: an analysis of environmental change in the absence of the project.

**3.3.5 Included Projects**

Most regional study areas include other industrial projects, human infrastructure and differing types and degrees of human use. Knowledge of these activities and their contribution to environmental effects is essential in determining the cumulative effects of the proposed project. Future cumulative impacts will also be influenced by planned or proposed projects; therefore, all reasonably foreseeable projects should be included in the cumulative effects assessment and alternative future scenarios should be presented.

In some areas, it may be impossible to identify and characterize the impacts of all other activities around a proposed project, particularly highly dispersed forms of human use such as recreation or small, short-term activity centres such as exploration camps, or even the general effects of population growth in or near the study area. The decision on which of these activities to include in the cumulative effects assessment depends on the nature of the activities and their impacts. Some assessments focus on activities which have the potential to affect the same resources or VECs as the proposed project and provide the rationale for which projects were included and which were not.

All projects included other developments to some extent. However, different types of projects were included and, frequently, no rationale was given for the selection.

Most proponents included major developments in the vicinity if they engaged in activities similar to that of the proposed project, but did not provide a specific reason for inclusion (Amoco (Prairie Rose), Shell (Scotford)). Manalta, on the other hand, considered some historical developments in the region, which included logging and pulp mills, but did not address any future projects, and again gave no rationale.

Union Carbide both touched on other types of activity and included a rationale for its selection, stating, for example, that agricultural activities contributed to phosphorous loading in a nearby river. Imperial Oil (Cold Lake Expansion) justified its selection of included projects by conducting individual analyses for different environmental components, such as air, groundwater, vegetation and wildlife, and chose to include projects and activities that were likely to have a similar and overlapping effect on the VEC. Many projects assumed that impacts from other activities in the area were included in baseline information (Mobil and Shell (Sable Island)), but several proponents included historical activities from which the effects on certain resource groups were still evident (Three Sisters, Trans-Canada Twinning, Eagle Terrace). As mentioned previously, Syncrude, Suncor and Shell collectively identified a regional study area and included all oilsands, forestry and other major activities. However, not every component of the cumulative effects assessment considered impacts from all regional developments and human activities in the Syncrude, Suncor, Shell and Imperial Oil projects.

Most proponents also considered projects that were foreseeable or likely to proceed. Generally speaking, foreseeable projects included only those that had received approval or had been officially subjected to some form of regulatory process. Reasonably foreseeable is meant to capture activities where a specific proponent or location is not known (e.g. the effects of population increases, other developments such as oil and gas or forestry). Assumptions can be made about these activities to put them in perspective and indicate processes to manage their effects. Some representation of uncertainty regarding the timing of future events would also be useful.

In summary, cumulative effects from the proposed and other projects were included in a number of ways:

- Existing project impacts were incorporated into baseline information but projects were not named specifically
- Similar or other major developments in the surrounding area were identified
- All activities within a predefined region were selected
- All activities with the potential to affect the same resources or VECs were chosen
- Known and reasonably foreseeable future projects were selected.

### Highlights of Current Practice:



## Included Projects

All existing and reasonably foreseeable developments and activities which have the potential to affect the same resource or VEC as the proposed project are included.

### 3.3.6 Assessment Methods

The *CEAA Practitioners Guide* states that “analysis of cumulative effects should focus on assessing effects on selected VECs” and suggests that practitioners select from a toolbox of CEA “tools” or approaches (CEAWG, page 25). Methods for assessing impacts can be either qualitative, like interaction matrices and impact models, or quantitative, like numerical modelling and spatial analysis using GIS. The environmental component and impacts in question determine which tool is appropriate. Quantitative approaches are more useful for assessing impacts when specific objectives or guidelines exist for particular environmental components. Qualitative approaches are more suited to situations in which value judgements and expert opinion guide the assessment of impacts. The goal of the assessment method used should be to provide better information for the assessment and management of effects.

The predictive nature of both EIAs and CEAs is such that there can be considerable scientific uncertainty associated with assessments. Sources of uncertainty include the quality of baseline or field study data collected, the nature of interactions between effects and VECs and the ability of models to approximate reality. A model is only as good as the data and assumptions used to create it. Proponents may be relying on outdated data or oversimplified interactions so field studies are needed to verify model outputs. Sources of uncertainty in assessments should be explicitly identified. Modelling should be an iterative process consisting of forecasting, measurement, analysis and action steps, including revising the models.

Quantitative modelling based on predicted emissions and observed concentrations was the method of choice used by the projects for characterizing air and water quality impacts. Data from pre-existing water and air quality monitoring stations was used to verify modelling results. Manalta carried out the most extensive studies to characterize the baseline in the area surrounding the project, particularly for wildlife and fish. Most proponents also carried out quantitative modelling and GIS for habitat loss and suitability. Modelling was typically conducted under normal and upset conditions.

In general, a cumulative effects assessment method should be able to characterize sources of cumulative environmental change through the following (Montz and Dixon, 1995):

- Some representation of interactions between effects;
- Incorporation of impacts as they occur over space (appropriate spatial boundaries);
- Incorporation of impacts as they occur over time (appropriate temporal boundaries); and
- Ability to trace impacts through from first order direct impacts to second-, third- and fourth-order indirect impacts.

In the projects reviewed, a combination of qualitative and quantitative approaches was used for CEA, depending on the parameter being assessed. Air and water quality and habitat loss were usually modelled using quantitative models. Geographic Information Systems (GIS) were also used, particularly for assessing changes in vegetation communities, direct habitat losses, habitat alienation and fragmentation, and wildlife movements.

Impacts on other resources, including wildlife, vegetation and health, were analysed using qualitative approaches like impact models or hypotheses, and examining cause-effect relationships (interactions between project activities and the receiving environment). Several assessments performed qualitative analyses of worst-case scenarios (Imperial Oil (Cold Lake Expansion), Mobil and Shell (Sable Island)).

Monitoring programs as a means of long term assessment were proposed by most proponents.

Several proponents carried out risk assessments for effects on human health under normal operating and worst-case scenario conditions (Shell (Scotford), Shell (Muskeg River), Suncor). The Shell (Muskeg River) project also contained a risk assessment for wildlife.

### Highlights of Current Practice:



## Assessment Methods

Assessment methods are iterative and include the following features:

- Impact hypotheses or models used to characterize possible impacts and interactions between impacts
- Quantitative or qualitative analysis as appropriate
- Verification of modelled results through field data collection and baseline characterization
- Modification of impact hypotheses or models if necessary

### 3.3.7 Impact Characterization

Cumulative effects are commonly determined to be residual impacts which remain after planned mitigation efforts. The effects are first described; then they are usually characterized by scope, magnitude, duration, frequency, direction, and probability of occurrence (Manalta, Suncor). Some proponents categorized impacts by direction (positive or negative), significance and likelihood (Mobil and Shell (Sable Island), Parks Canada). Parks Canada (TransCanada Twinning) developed a cumulative effects screening process to focus its analysis. Screening was based on the likelihood of effects and on direct or indirect effects, mitigation available, compensation applied, residual effect, significance, certainty, spatial extent and potential as a cumulative effect.

Terms like “significance”, “severity” and “magnitude” (high, medium or low) are essentially qualitative terms which involve value judgements for assessment. The assessment of these parameters is discussed in more detail in the next section on the significance of cumulative effects. In some circumstances, proponents were able to provide quantitative estimates for each category. Most air and water quality and habitat loss analyses used quantitative models. In other circumstances, proponents gave only categorical estimates or qualitative descriptions and in such instances qualitative terms such as low, moderate and high were often clearly defined. Many projects also described the specific impact characteristics used. Two proponents constructed impact models or hypotheses to predict possible impacts and focussed further analysis on identified impacts (Imperial Oil, Suncor). Imperial Oil also made use of indicators to predict impacts.

Shell (Muskeg River) was the only proponent to deal explicitly with the issue of scientific uncertainty. The uncertainty associated with each potential impact was discussed under a separate heading.

#### Highlights of Current Practice:



### **I m p a c t   C h a r a c t e r i z a t i o n**

Impact characterization is distinguished by the following:

- All terms characterizing impacts (e.g., scope, magnitude) are clearly defined;
- Specific categories or measurements characterizing impacts are defined;
- Impacts are related to standards or desired thresholds for cumulative effects; and
- Uncertainty associated with predictions is explicitly acknowledged and levels of confidence are estimated.

### 3.3.8 Significance of Cumulative Effects

Determining the significance of cumulative effects is perhaps the most challenging aspect of a CEA. For effects on components like water and air quality, where defined objectives or regulations exist, the matter is relatively straightforward; the effect is deemed insignificant if regulatory objectives or regulations are not exceeded. Determining significance becomes more complex when components like wildlife, aquatic resources (other than commercial fish), or vegetation are considered. In the absence of well defined guidelines and objectives, proponents rely on expert opinion and value judgements to determine significance. The opinions, assumptions and values that are used to support findings of significance are sometimes, but not always, made explicit in the assessment.

The projects revealed considerable variety in the manner in which proponents assessed significance. When specific guidelines or regulations existed, as they do for air and water quality, effects were compared with the guidelines and deemed to be insignificant if expected concentrations were below the stipulated levels. For other parameters such as vegetation, wildlife and human health, the assessment seemed, in most cases, to be based on the proponent's judgement, or that of its consultants. Conclusions used terms like severity, or significance of impacts, without explicitly defining them (Manalta (Mercoal), Amoco (Prairie Rose), Shell (Muskeg River), Suncor, Shell (Caroline Expansion)). Express Pipeline concluded there would be no significant cumulative impacts based on the assumption that reclamation would be totally successful. One proponent declared that significance would be determined by the reviewing tribunal (Keenleyside). Syncrude and Three Sisters provided a little more information on the rationale behind the assessment of significance. For example, Syncrude defined "high impact" as Type A, or greater than 10% of the resource affected for greater than one year. As another example, Three Sisters classified impacts as follows:

- Class 1: Important adverse impacts that cannot be avoided or mitigated
- Class 2: Important adverse impacts that can be avoided or mitigated
- Class 3: Minor adverse impacts that are considered important in a regional or local sense
- Class 4: Positive impacts
- Class 5: Cumulative impacts

Impacts in classes 1 through 4 are not mutually exclusive of impacts in class 5.

Several questions were addressed in the Monkman/ Grizzly Valley Study to help determine the significance of cumulative effects (from Duval and Vonk, 1991), although the proponents did not define the term "unacceptable":

- Is there an increase in the project's direct effects in combination with the effects of other projects?
- Is the resulting effect unacceptable?
- Is the effect permanent?
- If not permanent, how long before recovery?

Mobil and Shell (Sable Island) explicitly indicated the basis on which they assessed whether biophysical impacts and socio-economic impacts were significant or insignificant (Table 4), as required by the federal legislation which governed their case.

**Table 4: Significance of Environmental Impacts**  
(Mobil and Shell (Sable Island), volume 1, page 28)

<b>Significant</b>	<b>Biophysical Impact</b>	<b>Socio-Economic Impact</b>
Major	Seriously affects a whole population or species over several generations; may also affect a resource user over a long period of time	Causes permanent change in community life, and would not necessarily respond well to mitigation
Moderate	Affects a portion of the population or species, but does not endanger the integrity of the population as a whole	Causes considerable local disturbance, but with mitigation can be absorbed by the community
<b>Insignificant</b>	<b>Biophysical Impact</b>	<b>Socio-Economic Impact</b>
Minor	Affects a specific group of individuals within a population over a limited area and a short time period	Some local disturbance or inconvenience but can be absorbed by the community without prolonged mitigation
Negligible	Impact no greater than that of small random changes caused by natural environmental fluctuations	May cause some very minor and localized change of short duration, likely to go unnoticed by most people

**Highlights of Current Practice:**



**Significance of Cumulative Effects**

The rationale for determining significance of cumulative effects is explicitly presented in the assessment (see Table 4 as an example).

### 3.3.9 Future Management Options

The significance of a project's cumulative effects will be affected by future events which may not be reasonably foreseeable at the time the assessment is submitted. However, proponents commonly suggest undertaking activities in the course of construction, operation or reclamation that will enhance its ability to monitor or mitigate impacts. Management of project effects through monitoring and mitigation programs is considered the norm for current assessments.

Future management options, as the term is used here, refers to elements beyond the regulatory review process. Such elements include regional management, land use or monitoring initiatives which extend beyond the scope of a single project, individual proponent or local study area. It is rapidly becoming more usual for proponents or regulators to recommend collaborative regional impact management measures. In the Cheviot project, for example, the proponent Canadian River Coal (CRC) outlined a program to manage anticipated impacts on elk. The program would have required government and other corporations in the region to participate both during and after the proposed project's operational phase in managing resources to ameliorate anticipated cumulative effects on elk, as follows:

- Monitor response of the elk population in the study area (CRC);
- Initiate progressive reclamation directed to wildlife as a primary end use (CRC);
- Monitor and manage human recreation in the Cadomin area to minimize disturbance of elk (government, CRC and others);
- Identify nodes of high quality habitat and restrict access and other development in these areas (government and others);
- Coordinate logging and other future development to prevent additive loss of quality elk habitat (government and others); and
- Plan the reintroduction of people onto the reclaimed landscape after mining (government, CRC and others).

Future management options also extend beyond the regulatory assessment processes into regional environmental management. The NRCB made several recommendations pertaining to future management practices in the Three Sisters project. As a result, the provincial government arranged to exchange property holdings with the proponent in order to preserve and protect Wind Valley, an ecologically sensitive area. The Board also recommended that emissions from wood burning stoves be controlled and that a Bow Valley Planning and Advisory Committee be established to gather data and monitor effects in the Bow Valley.

In its Westcastle decision, the NRCB concluded that the Crown of the Continent Ecosystem is at risk, that the Castle area in particular had deteriorated and that the proposed project would not meet the test of sustainability due primarily to cumulative effects on grizzly bears. It approved the application provided that development plans be modified and that contiguous lands be designated as a protected area. Specific modifications to the plans included confining the resort to the west side of the river and rezoning the region into a resort area (0.6%), a recreation area (7% - accessible, but no development) and a wildland protected area (92.4%) to be managed consistently under an ecosystem based plan.

The NRCB went further, and suggested there be no further development of any kind in the valley. Although not all recommendations were accepted by Cabinet, and multi-stakeholder committees also subsequently rejected some of its suggestions, the Westcastle decision illustrates an effort to prepare for future management of a development and a resource in a manner that recognizes ecosystem integrity, economic development and community participation.

The EUB has encouraged collaborative regional activities on a number of occasions. It published an Informational Letter in 1993 (IL93-9) which addressed CEA in the context of regional planning for the sensitive Eastern Slopes areas. The EUB stated its objective was "... to determine whether the project's economic benefits and mitigation programs sufficiently outweigh any remaining social and environmental costs", and outlined the following key points:

- Companies intending to develop projects in the Eastern Slopes are expected to carry out thorough and effective public consultation programs to identify stakeholders, baseline environmental conditions and further data requirements.
- Applications for small developments such as well licences (initially) and other surface disturbances are expected to be submitted as part of a development plan rather than in a piecemeal approach.
- Other operators in the Eastern Slopes proposing developments are expected to consolidate efforts to share infrastructure, etc. in order to minimize surface impacts and disturbances.

More recently, the Board convened a series of meetings between operators and community residents in the Caroline area in an attempt to facilitate cooperative initiatives to resolve public concerns about potentially adverse impacts caused by air emissions. It also brought the issue of "co-development" to the fore in the course of a pre-hearing conference concerning the Syncrude (Aurora Mine) project. A Regional Development Review is currently underway in the Athabasca oilsands region. One regulatory review panel recommended monitoring in perpetuity be accompanied by a Uranium Mining Contingency Fund to pay for mitigation in the event adverse effects become evident in the future (Cogema). These recommendations reflect the long term nature of radioactive contamination.

Several proponents indicated that they had signed joint regional agreements to facilitate monitoring and long term studies. Examples include Amoco (with NOVA Chemicals, Union Carbide and the provincial government in the Joffre/Prentiss area) and Suncor, Syncrude and Shell (with regional authorities, CASA, the provincial government, other industrial corporations and community residents in the Athabasca oilsands region). The proponent in the Eagle Terrace project suggested mitigation measures relating to wildlife movement corridors be adopted on a regional scale. Maintenance of movement corridors was seen to be a long term requirement, regardless of the project in question.

Alberta can be credited with a number of collaborative endeavours. Stakeholder groups such as the Regional Air Quality Committee, the Regional Aquatic Monitoring Program, the Fort Saskatchewan Regional Air Quality Monitoring group, CASA's West Central Airshed Group and the Cold Lake Public Advisory Committee continue to provide powerful precedents for future management options.

**Highlights of Current Practice:**



**F u t u r e M a n a g e m e n t O p t i o n s**

Collaborative long-term regional initiatives to manage impacts are stipulated, and include current or future programs of action designed to avoid potential cumulative impacts.