2 ASSESSMENT METHOD

2.1 Introduction

This section describes the general assessment method used to predict the potential effects of the project on biophysical and socio-economic environments. For specific applications of the assessment method to the various subject areas, see Volume 5, Biophysical Impact Assessment, and Volume 6, Socio-Economic Impact Assessment. Volume 7, Environmental Management, provides further mitigation and management measures to address project effects.

The environmental assessment of the project focused on identifying issues most important to potentially affected northern communities. These key issues were identified through a public consultation process that began in 2002. The public consultation process will continue through the life of the project. These key issues are:

- socio-economic conditions
- northern community health and wellness
- environmental protection and environmental effects mitigation

2.1.1 Goals of the Assessment

The goal of the environmental assessment process is to contribute to project development in a way that enhances benefits and reduces adverse social and biophysical effects. The process must:

- ensure issues raised by communities, such as community wellness, environment and economic and spiritual well-being, are directly addressed in the assessment

- predict project-specific effects, including:
  - the project effects on biophysical, social and economic conditions
  - biophysical, social and economic effects on the project
  - effects of incidents and malfunctions

- identify suitable management and mitigation measures for project-specific effects and determine the residual effects

- assess the significance of the predicted residual effects on the biophysical and socio-economic environments

- determine if the residual effects could interact cumulatively with the effects from other past, present and future projects or activities

2.1.2 Section Content

This section addresses the following four subjects:

- assessment approach – explains how the results of the environmental assessment are used in the planning, design, construction, operations and decommissioning and abandonment of the project. It also describes the role of public consultation and traditional knowledge in the EIS (see Section 2.2, Assessment Approach).
- scope of assessment – identifies the project components, key issues, geographic areas and the time frames for the various assessments (see Section 2.3, Scope of Assessment).
- assessment of effects – explains the steps used to assess and evaluate the predicted effects of the project and their significance (see Section 2.4, Assessment of Effects).
- monitoring – describes how monitoring will be incorporated in the project and how key issues will be addressed as part of ongoing project management (see Section 2.5, Monitoring).

2.2 Assessment Approach

2.2.1 Environmental Assessment Process

The environmental assessment process is a key element of:

- project planning
- design
- construction
- operations
- decommissioning and abandonment

The EIS describes the potential effects of the project, the associated measures to reduce these effects and the predicted effects after mitigation, i.e., the residual effects. The EIS provides regulatory authorities with the information needed to make decisions about the project.

The following topics describe the key steps in the environmental assessment process (see Figure 2-1).

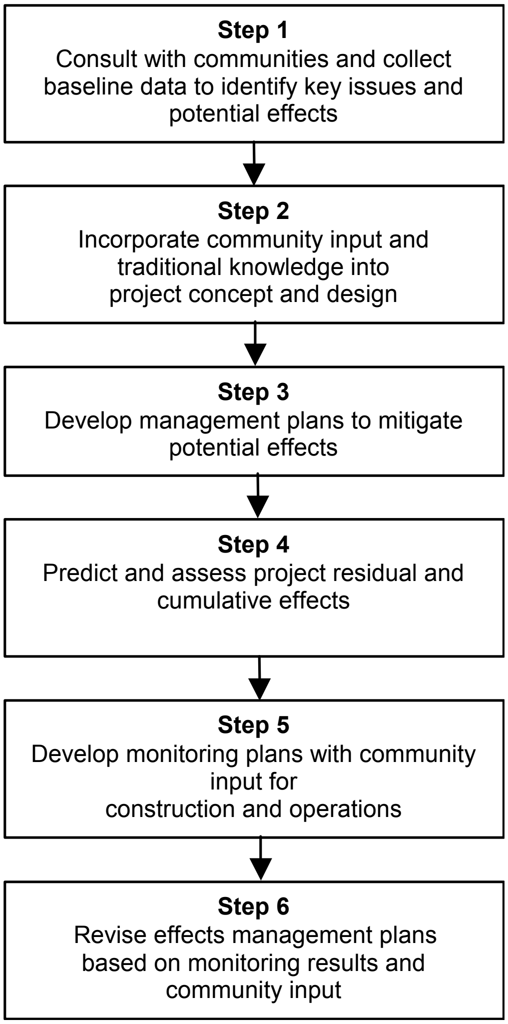

Figure 2-1: Environmental Assessment Process

2.2.1.1 Step 1 – Consult with Communities and Collect Baseline Data

During the early stages of project planning, information obtained from community consultation and baseline data was used to identify the key issues and potential effects. For example, because communities indicated that one of their key areas of interest was local employment and procurement opportunities, this is a focus of the EIS.

2.2.1.2 Step 2 – Incorporate Community Input and Traditional Knowledge

Through a series of community meetings, the project concept and design were refined in areas such as:

- route selection
- facility siting
- engineering design

2.2.1.3 Step 3 – Mitigate Potential Effects

Effects mitigation, including best practical technology and mitigation measures, was developed for project design and operations to avoid or reduce the potential residual effects, i.e., effects remaining after mitigation measures have been applied. Effects mitigation is integral to the EIS (see Volume 7, Environmental Management, for further details). For example, environmental protection plans to protect fish habitat during pipeline construction have been developed based on monitoring results from previous pipeline projects in similar environments.

Role of Effect Mitigation

Effect mitigation includes initiatives during all project phases that are intended to:

- avoid, reduce and manage adverse human or environmental effects
- enhance benefits to communities

Project Design Features

Several project design features are integral to project design decisions (see Volume 2, Project Description). Examples include:

- selecting routes to reduce disturbance to environmentally sensitive areas
- incorporating environmental protection procedures as standard practice during construction

Volume 2, Project Description, describes some of the key project decisions that reflect the social and environmental input. For example, the pipeline route at Gibson Gap, north of Norman Wells, was selected over alternative routes because:

- it is straighter and shorter than the alternatives
- it runs parallel to, or uses, existing linear disturbances for its entire length
- it eliminates crossing a lake, three crossings of the winter road, and a crossing of the proposed Mackenzie Highway
- it avoids crossing an unnamed creek

Construction and Operations

Effects mitigation is also integral to construction and operations. Mitigation and management plans include:

- environmental management plans, e.g., Waste Management Plan, Water Management Plan
- environmental protection and reclamation plans
- contingency plans, e.g., spills and uncontrolled releases, wildfires
- Environmental Compliance and Effects Monitoring Plan

For further details, see Volume 2, Project Description, and Volume 7, Environmental Management.

2.2.1.4 Step 4 – Predict and Assess Project Residual Effects

Project residual effects were predicted and assessed based on an understanding of:

- baseline conditions
- project components
- activities associated with project construction, operations and decommissioning and abandonment

Because the project will incorporate mitigation to avoid or reduce potential effects, the assessment addresses only those effects that are predicted to exist after mitigation, i.e., residual effects. Observed and predicted effects from previous projects were also reviewed.

2.2.1.5 Step 5 – Develop Monitoring Plans

As project planning advances, site-specific biophysical and socio-economic information will be used to refine construction and reclamation details, thereby avoiding or reducing potential adverse effects. As the project develops, the focus will shift from predicting to monitoring effects during construction and operations.

2.2.1.6 Step 6 – Revise Effects Management Plans

Throughout the project life, effects management plans will be revised to reflect monitoring results. These revisions will further enhance the project’s benefits, and reduce or eliminate adverse effects.

2.2.2 Traditional Knowledge Use

Traditional knowledge refers to a broad base of cultural and environmental knowledge held by communities and individuals. It can be acquired through:

- experience
- observations about the land
- spiritual teachings passed from one generation to another by oral and written traditions

Traditional knowledge can be found in various existing sources, including:

- harvest and traditional knowledge studies
- regional land use plans
- local conservation plans
- other published and unpublished literature sources, covering such items as:
    - traditional and medicinal use of plants
    - wildlife distribution and abundance
    - long- and short-term trends and land use by Aboriginal people over generations

An important source of traditional knowledge available for the project is commissioned, specific community reports. Potentially affected communities, in cooperation with the proponents, are currently preparing these reports. Section 3, Traditional Knowledge, describes the process being used to carry out the traditional knowledge studies. It also lists activities completed as of mid-May 2004, and describes ongoing activities.

Pending completion of the community reports, existing traditional knowledge sources have been reviewed and incorporated in the relevant biophysical and land use sections of the assessment.

The Arctic Science and Technology Information System (ASTIS) database was accessed to identify documents referencing traditional knowledge in the study area. Based on the abstracts provided by ASTIS, the applicable sources were reviewed to identify relevant traditional knowledge, which was used in preparing the EIS.

2.2.2.1 Role of Traditional Knowledge

Traditional knowledge is being used to:

- develop an understanding of:
    - existing conditions

  - important issues
  - potential effects
  - how to manage these effects

- corroborate the information obtained through conventional sources, i.e., scientific and nonscientific, for:
  - accuracy
  - completeness
  - information gaps

- contribute to determining:
  - project sites and design
  - effectiveness of proposed mitigation
  - significance of effects
  - cumulative effects
  - follow-up and monitoring programs

Incorporating traditional knowledge is an ongoing process in project planning.

2.2.2.2 Using Traditional Knowledge

The following summarizes how traditional knowledge is being incorporated in project assessment and planning. Traditional knowledge is an important factor in evaluating the significance of project effects.

Identifying Important Features

Traditional knowledge identifies environmental, social or cultural features, which help further identify potential valued components (VCs), i.e., important environmental or social conditions.

Traditional knowledge is being used with site-specific conventional scientific information to identify features or activities that might be affected by the project, e.g., berry patches, fishing camps.

Harvesting Use

Traditional knowledge can be used to determine patterns of renewable resource harvesting, including harvest levels. This information can be used to understand the effects of harvesting on some wildlife and fish populations.

Because traditional knowledge can represent observations over extended periods, it can be used to indicate historical changes and trends in features, and to determine fluctuations and natural variations within those trends.

Linkages and Response

Traditional knowledge can be used to help understand cause–effect relationships, particularly wildlife responses to disturbances, e.g., behavioural responses by caribou or moose to noise. Traditional knowledge might also provide information on historical movement patterns of wildlife species. This could be used in assessing effect attributes.

Mitigation and Monitoring

Traditional knowledge can be used to suggest suitable mitigation measures, and assist in identifying monitoring approaches during follow-up.

2.3 Scope of Assessment

2.3.1 Environmental Impact Statement Framework

The EIS approach is based on four project considerations:

- scope of project – the project components included in the EIS
- scope of issues – the key concerns and issues identified by communities, regulators and scientists
- spatial boundaries – the study areas within which effects were assessed
- temporal boundaries – the time frames within which the effects were assessed

The EIS addresses:

- project effects based on:
  - individual project components
  - combined project components
  - cumulative effects of the project combined with other projects
- incidents and malfunctions
- effects of the environment on the project

2.3.2 Scope of Project

For the purpose of the EIS, the project components have been grouped within two areas:

- production area
- pipeline corridor

Table 2-1 provides the details of the facilities and equipment for each component in the production area. Table 2-2 provides details of the pipeline corridor components. The EIS summarizes the potential effects resulting from the construction, operations, and decommissioning and abandonment of these project components.

Table 2-1: Production Area Components

Component	Description
Niglintgak field	• three well pads – north, central and south • six to 12 production wells • one gas conditioning facility that will be barge-based or land-based • one disposal well • flow lines • one remote drilling sump • about 1 km all-weather road (land-based option) • about 30 km of winter road • supporting infrastructure
Taglu field	• one well pad • 10 to 15 production wells • one gas conditioning facility • flow lines • one or two disposal wells • less than 1 km all-weather road • 50 km of winter road from Tununuk Point • supporting infrastructure

Parsons Lake field	• one north pad consisting of:
	  • nine to 19 production wells
	  • flow lines
	  • two disposal wells
	  • a gas conditioning facility
	• one south pad consisting of:
	  • three to seven production wells
	  • a flow line from the south to north pad
	• about 3 km of all-weather road
	• about 95 km of winter road:
	  • 45 km from Lucas Point
	  • 50 km from the mouth of Pete’s Creek to Parsons Lake, used when early-season access is not required
	• supporting infrastructure

Table 2-1: Production Area Components (cont'd)

Component	Description
Gathering pipelines	• Niglintgak lateral in a 30-m-wide right-of-way for about 16 km • Taglu lateral in a 40-m-wide right-of-way for about 81 km • Parsons Lake lateral in a 30-m-wide right-of-way for about 27 km • Storm Hills lateral in a 40-m-wide right-of-way for about 52 km • six cathodic protection sites
Gathering facilities	• metering and pigging facilities at each anchor field site • Storm Hills pigging facility • two block valve sites (other block valves are located within facilities) • Inuvik area facility
Infrastructure	• nine barge landing sites, including two at Inuvik, shared with the pipeline corridor, one at Niglintgak (for the land-based option only) and one at Taglu • 11 stockpile sites, including one at Inuvik, shared with the pipeline corridor • 12 fuel storage sites, including one at Campbell Lake, and existing bulk tankage at Inuvik shared with the pipeline corridor • 11 temporary and two existing camps • 19 km of all-weather road connecting the Inuvik area facility to the Dempster Highway and Campbell Lake camps • 21 km of winter road associated with infrastructure • three new and two existing airstrips • commercial airports at Inuvik and Tuktoyaktuk • 10 new and two existing helipads. Use helicopter land facilities at commercial airports and community airstrips. • one communications centre shared with the pipeline corridor • up to 64 water sources and about 130 km of associated winter road
Borrow sites	• seven primary borrow sites and about 65 km of associated winter road • nine secondary borrow sites, to be used if needed, and about 55 km of associated winter road

Table 2-2: Pipeline Corridor Components

Component	Description
Gas pipeline	• one natural gas pipeline in a 50-m-wide right-of-way shared with the natural gas liquids (NGL) pipeline from the Inuvik area facility to Norman Wells for about 475 km • one natural gas pipeline in a 40-m right-of-way from Norman Wells to the NGTL interconnect facility for about 745 km • 28 cathodic protection sites, including a site at the NGTL interconnect facility
NGL pipeline	• one NGL pipeline in a 50-m-wide right-of-way shared with the natural gas pipeline for about 475 km • one NGL pipeline in a 30-m-wide right-of-way from the Norman Wells compressor station to the Enbridge interconnect facility for about 1 km • 12 cathodic protection sites shared with the gas pipeline
Pipeline facilities	• one NGL meter station at Norman Wells • four compressor stations • one heater station • one pig receiver located adjacent to the NGTL interconnect facility • 10 valve sites on the gas pipeline • one valve site on the NGTL gas pipeline • 28 valve sites on the NGL pipeline • NGTL interconnect facility[1]
Infrastructure[2]	• 15 barge landing sites, including two at Inuvik, shared with the production area • 24 stockpile sites, including one at Inuvik, shared with the production area • 22 fuel storage sites (Campbell Lake and Inuvik sites are shared with the production area) • 16 temporary camps and one existing camp • about 53 km of all-weather road • about 48 km of winter road • three new and two existing airstrips • commercial airports at Inuvik, Norman Wells, Wrigley, Fort Simpson and Hay River. Use commercial community airstrips at Fort Good Hope, Tulita and Trout Lake. • five new helipads. Use helicopter landing facilities at commercial airports and community airstrips. • three communication centres including one shared with the production area • up to 161 water sources and about 175 km of associated winter road
Borrow sites	• 60 primary borrow sites and about 275 km of associated winter road • 40 secondary borrow sites, to be used if needed, and about 175 km of associated winter road
NGTL Northwest Mainline (Dickins Lake Section)	• one natural gas pipeline, to be constructed and operated by NGTL in a right-of-way up to 40 m wide for about 66 km, running from the NGTL interconnect facility in Alberta near the Northwest Territories boundary to NGTL's existing system near Bootis Hill[1]

NOTES:
1 Ancillary project components to be designed and constructed by NGTL under separate regulatory approvals.
2 NGTL will be responsible for infrastructure sites in Alberta.

2.3.3 Scope of Issues

2.3.3.1 Identifying Issues

The EIS focuses on issues identified through consulting with:

- residents of potentially affected communities
- regulators
- social and environmental specialists

The assessment team began identifying issues early in 2002 by developing a preliminary issue list. This list was refined during community consultation in 2003 when the communities identified their project-specific issues (see Section 4, Public Participation). Technical workshops were also organized, to provide a forum for input by several groups, including:

- communities in the project area
- community and social services
- resource management agencies
- key regulatory agencies
- nongovernment organizations

Regulatory agencies, community members and the proponents also identified issues additional to those raised during community consultations and technical workshops.

2.3.3.2 Subject Areas

Issues and associated effects were assessed for biophysical, social and economic features.

Biophysical Features

Biophysical subject areas included:

- air quality and climate
- noise
- aquatic resources, including:
    - groundwater
    - hydrology
    - water quality
    - fish and fish habitat
- terrestrial resources, including:
    - soils, landforms and permafrost
    - vegetation
    - wildlife

Social and Economic Features

Social and economic subject areas included:

- socio-economics
- traditional lifestyles and culture
- land and resource use
- human health
- community wellness
- heritage resources

2.3.4 Spatial Boundaries

2.3.4.1 Biophysical Study Areas

The assessment study areas are specific to each subject area. Two types of areas are used for assessing environmental effects:

- local study areas (LSAs) – areas used in assessing project-specific effects
- regional study areas (RSAs) – areas used in assessing project combined and cumulative effects

The study areas selected were determined according to the expected spatial extent of the project effects and the mobility of valued components (see Volume 3, Biophysical Baseline, and Volume 5, Biophysical Impact Assessment). Some project effects, such as air emissions and liquid effluents, have the potential to affect a larger geographic area, whereas others, such as noise from drilling activity, will affect only a small localized area. Some valued components, such as vegetation, are stationary, whereas others, such as caribou, are mobile.

2.3.4.2 Socio-Economic Study Area

A single encompassing study area was outlined for assessing socio-economic effects. This study area was delineated on factors such as community proximity to the project and political jurisdictions.

2.3.4.3 Environmental Project-Specific Effects

Local study areas were established to cover the predicted maximum spatial extent of a direct effect from the activities or structures required for project construction and operations. For example, the project-specific boundary for noise effects is the farthest location from the source where noise could be detected by a biological receptor. Regional study areas have been developed for each subject area (see Volume 5, Biophysical Impact Assessment). They take into account the spatial nature of the effects, indicators for that subject area, and availability of appropriate data.

The following figures show local study areas that are centred on project components:

- Figure 2-2 – Production Area
- Figure 2-3 – Pipeline Corridor – North
- Figure 2-4 – Pipeline Corridor – South

The local study areas include:

- separate areas for Niglintgak, Taglu and Parsons Lake, including a 1-km-wide buffer around each lease boundary
- a 1-km-wide corridor for the gathering pipeline
- a 1-km-wide corridor for the gas and NGL pipelines
- a 1-km-wide buffer around each infrastructure and facility site

2.3.4.4 Environmental Cumulative Effects

For biophysical assessments, the spatial boundary for cumulative effects assessments encompasses the area where effects on a valued component from other projects or activities overlap with similar effects from the project. Specific cumulative effects study areas have been developed for each subject area (see Volume 5, Biophysical Impact Assessment). They take into account the spatial nature of the effects and indicators for that subject area.

2.3.4.5 Spatial Boundaries for Socio-Economic Effects

The socio-economic study area (see Figure 2-5) includes the communities where the direct or indirect effects of the project could affect permanent residents. For most social effects, the spatial boundary encompasses:

- northern communities from which permanent residents would be drawn to work on project construction and operations
- communities that might receive benefits from, or be affected by, the project
- communities that could experience some direct or indirect economic and social effects from the project

Figure 2.2 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 2.3 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 2.4 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 2.5 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

2.3.4.6 Administrative Regions

Spatial boundaries for the socio-economic cumulative effects assessments consider:

- a wide geographic range of communities from which individuals might be recruited
- the dispersal of economic benefits and social effects to these communities

The socio-economic study area includes:

- Inuvialuit Settlement Region
- Gwich’in Settlement Area
- Sahtu Settlement Area
- Deh Cho Region
- northwestern Alberta

2.3.5 Temporal Boundaries

The nature of the project’s effects varies throughout different project stages. As a result, the EIS includes a discussion of the potential effects at different times in the project’s life. In the effects assessment, potential project effects are considered during design, construction, operations and decommissioning.

Four assessment scenarios provide the temporal framework for assessing project effects on the biophysical and socio-economic environments:

- baseline
- peak construction
- operations
- decommissioning and abandonment

2.3.5.1 Baseline Scenario

The baseline scenario represents the current biophysical and socio-economic conditions, based on studies conducted from 2002 to 2003, and from other information sources, e.g., published literature. This scenario represents conditions before project development, and includes any past human disturbances up to that time. Volume 3, Biophysical Baseline, and Volume 4, Socio-Economic Baseline, describe those conditions.

Effects of the following features are incorporated in the baseline scenario:

- existing settlements, including:
    - towns
    - community settlements
    - cabins
- existing transportation infrastructure, including:
    - highways
    - roads
    - airstrips
- existing land uses, including:
    - hunting and trapping
    - tree harvesting
    - tourism and recreation
    - traditional land use
    - oil and gas exploration
    - oil production
    - mining
- current land use designations that:
    - restrict some use of land, e.g., protected areas for waterfowl nesting
    - reserve the use of land, e.g., surface and subsurface leases for extracting resources

The predicted project effects are compared against the baseline scenario (see Volume 5, Biophysical Impact Assessment, and Volume 6, Socio-economic Impact Assessment).

2.3.5.2 Peak Construction Scenario

The peak construction scenario represents the period of maximum disturbance during project construction. This period is expected to be from 2006 through 2009.

Project effects during this scenario will be the greatest for most valued components because of:

- well drilling activities
- transportation of construction materials
- construction and associated reclamation activities
- an increased labour force

After peak construction, activities will occur at much lower intensities.

2.3.5.3 Operations Scenario

The operations scenario represents the operational period of the project. Operations are expected to occur for about 25 to 30 years, extending from about 2009 through to decommissioning and abandonment.

2.3.5.4 Decommissioning and Abandonment Scenario

Decommissioning and abandonment is part of the operations phase and represents the end of project life. When operations cease, facilities will be decommissioned, and associated disturbed areas will be reclaimed to a suitable future land use. The operations workforce will no longer be required.

2.4 Assessment of Effects

2.4.1 Five-Stage Process

An objective of the assessment process is to analyze effects using a process that provides clear results. The project assessment process is based on the following five stages (see Figure 2-6) intended to meet this objective:

1. Develop key questions that focus the assessment on issues of most concern to the potentially affected communities.

2. Select valued components and key indicators that can be used to answer the key questions.

3. Analyze effect pathways that illustrate the expected cause–effect relationships among project components and the socio-economic and biophysical environments. This analysis includes mitigation measures that have been incorporated in the project.

4. Describe the predicted residual effects in ways that are meaningful and are consistent throughout the EIS.

5. Evaluate the significance of predicted residual effects.

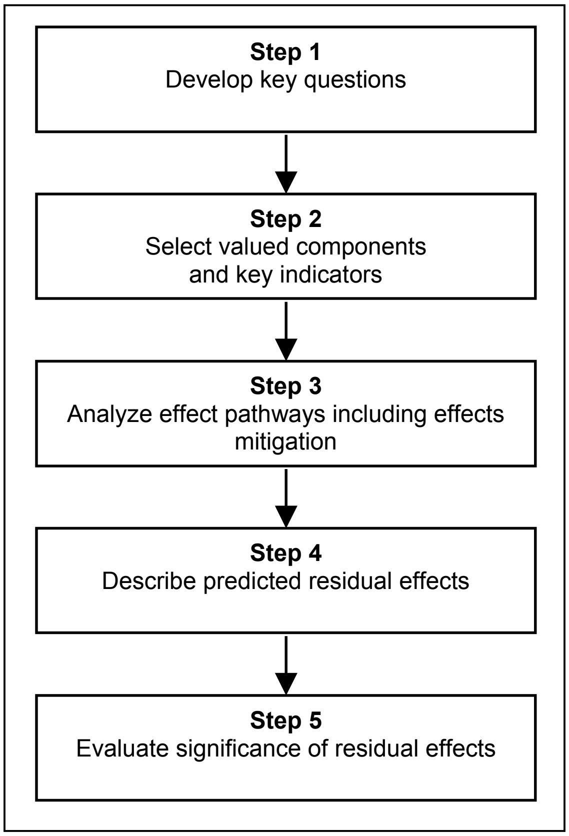

Figure 2-6: Five Stages of the Assessment Process

2.4.1.1 Key Questions

Specific key questions were developed to focus assessment efforts on addressing the communities' main concerns about potential project effects (see Volume 5, Biophysical Impact Assessment, and Volume 6, Socio-Economic Impact Assessment). These questions examine the effects of the project on an issue, or group of related issues, specific to a particular subject area. Examples of key questions are:

- How will the project affect wildlife habitat availability?
- How will the project affect family and community well-being, and family and social services?

2.4.1.2 Valued Components and Key Indicators

Valued Components

Valued components, e.g., animals, plants, waterbodies, community activities, land uses and cultural features related to the communities' concerns, were selected as the focus of key questions. Valued components were selected based on:

- regulatory status – e.g., special status species, such as grizzly bear and peregrine falcon
- community concerns – identified because communities had indicated features of particular importance to them, e.g., caribou
- socio-economic importance – affecting socio-economic conditions of individuals and communities, e.g., community wellness
- ecological vulnerability – e.g., uncommon plant communities
- information availability
- precedence in other environmental assessments – allowing information in this EIS to be compared with results from previous assessments, e.g., effects on the integrity and value of heritage resources

Key Indicators

Factors that could be used to measure the status of a valued component were identified. These factors, called key indicators, were selected because they can provide a measure of a change caused by the project, and they directly relate to the condition of the valued component. For example, a key indicator that was used to predict changes to surface water quality, which is a valued component, is the level of total suspended sediment in a waterbody. A key indicator of the effects of the project on the integrity of heritage resources is the degree of disturbance or loss of sites.

2.4.1.3 Effect Pathway Diagrams

Effect pathway diagrams illustrate the analytical approach to the assessment. These diagrams show the factors that were considered in answering the key questions about project influences on biophysical or socio-economic environments (see Figure 2-7 for an example of a biophysical effect pathway diagram and Figure 2-8 for a socio-economic effect pathway diagram).

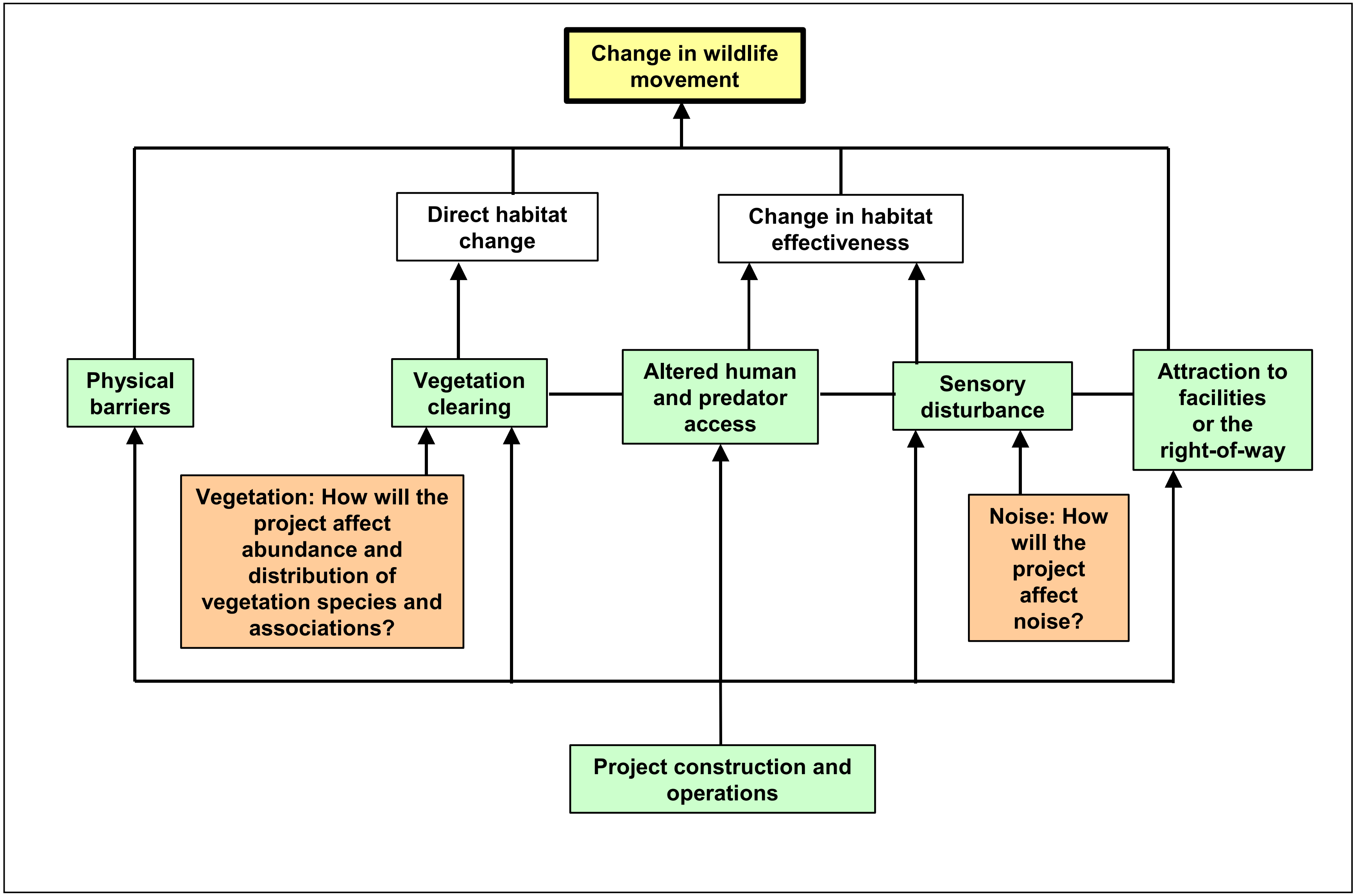

Figure 2-7: Example of a Biophysical Effect Pathway Diagram

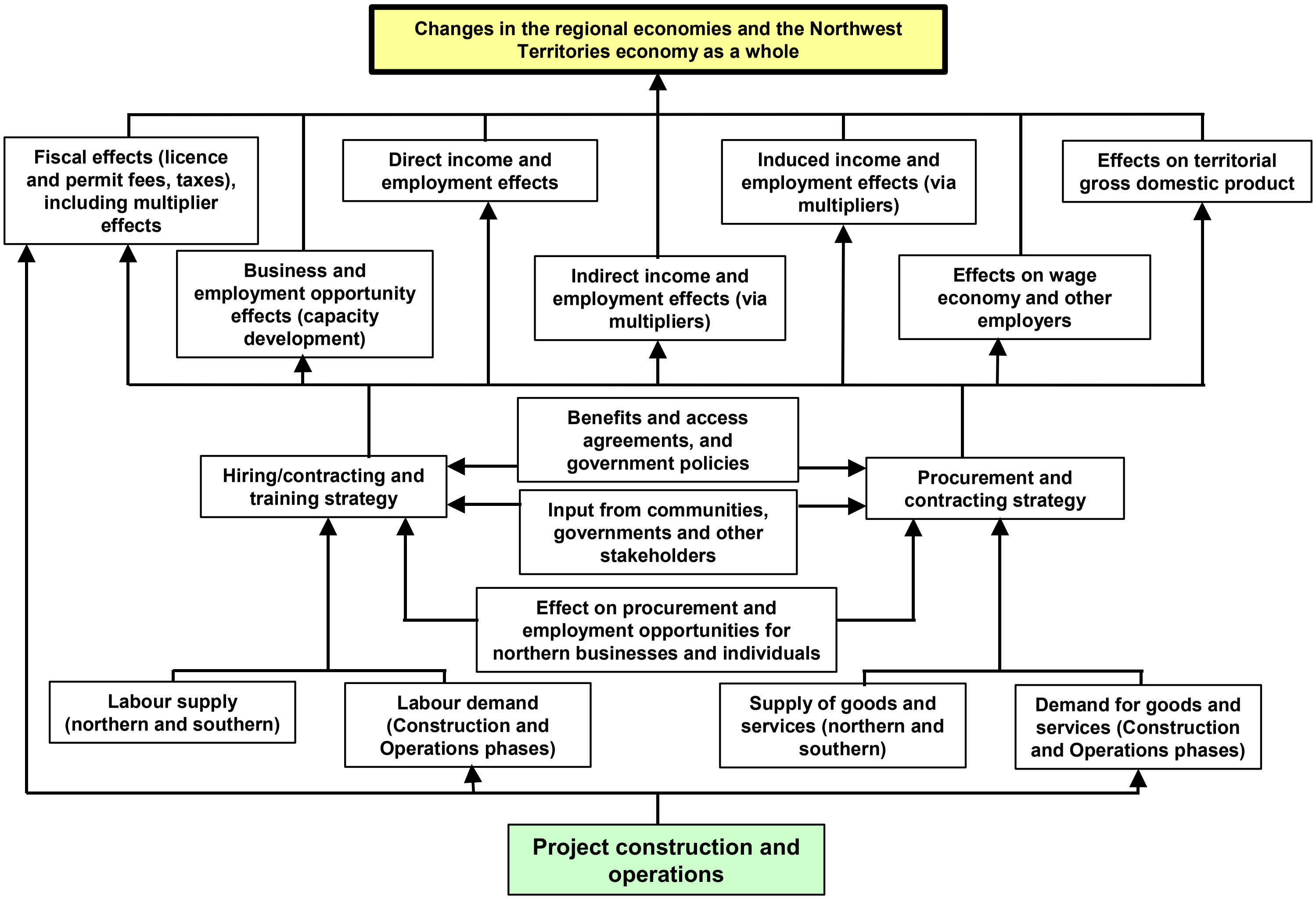

Figure 2-8: Example of a Socio-Economic Effect Pathway Diagram

The diagrams show:

- project activities or components that could potentially result in an effect
- linkages between the project component and social or environmental changes
- potential changes that could result
- relationships of those changes to the valued component

These linkages can be influenced by mitigation or management of effects, which can prevent or reduce the effect. For the impact assessments, each of those linkages and potential effects is discussed.

2.4.1.4 Effect Attributes

To help readers understand the results of the impact assessments, a common approach was used. Four basic questions were asked:

- Is the effect good or bad? This is the direction of an effect.

- How intense is the effect? This is the magnitude of an effect.

- How large an area will be affected? How far will the effect reach? This is the geographic extent of an effect.

- How long will the effect last? This is the duration of an effect.

Table 2-3 presents the general definitions of effect attributes. The effect attributes were tailored to suit specific topics for each subject area of the impact assessments.

Direction

Direction describes the trend of the effect compared with baseline conditions. There are three options for direction:

- adverse – a negative or undesirable change
- neutral – no detectable or measurable change
- positive – a beneficial or desirable change

For some socio-economic valued components, such as employment and income, an effect can be both positive and adverse, e.g., providing employment to a family member might not be positive for the whole family.

Table 2-3: General Definitions of Effect Attributes

Attribute	Definition
Direction	
Adverse	Effect is worsening or is undesirable
Neutral	Effect is not changing compared with baseline conditions and trends
Positive	Effect is improving or is desirable
Magnitude	
No effect	Effect does not occur
Low	Effect occurs that might or might not be detectable, but is within the normal range of variability
Moderate	Clearly an effect but unlikely to pose a serious risk to the valued component or represent a management challenge
High	Effect is likely to pose a serious risk to the valued component and represents a management challenge
Geographic Extent	
Local	Biophysical – effect is limited to the LSA Socio-economic – effect will be limited to specific affected persons or communities
Regional	Biophysical – effect is limited to the RSA Socio-economic – effect extends to several communities in the affected region
Beyond regional	Biophysical – effect extends beyond the RSA Socio-economic – effect extends beyond one region to include communities in more than one region of the study area, or include commercial or industrial centres in the Northwest Territories and northwest Alberta
National	Biophysical – not applicable Socio-economic – effect on the valued component or key indicator extends nationally, or beyond the communities in the study area
Duration	
Short term	Biophysical – effect is limited to <one year Socio-economic – effect is limited to the construction period
Medium term	Biophysical – effect occurs between one and four years Socio-economic – not applicable
Long term	Biophysical – effect lasts longer than four years, but does not extend more than 30 years after decommissioning and abandonment Socio-economic – effect extends throughout operations or beyond
Far future	Biophysical – effect extends >30 years after decommissioning and abandonment Socio-economic – not applicable

NOTES:
Definitions in this table provide a framework for the description of project effects. Adjustments of definitions to accommodate specific topics are provided in subject area-specific chapters in the impact assessment volumes (see Volume 5, Biophysical Impact Assessment, and Volume 6, Socio-Economic Impact Assessment).

Magnitude

Magnitude describes the severity or intensity of the effect. Typical measurements of magnitude indicate:

- gains or losses in features, e.g., more or fewer jobs, loss or alteration of wildlife habitat
- changes in conditions, e.g., increase in chemical constituents in water or air

Where possible, levels of magnitude are quantitatively described, such as percent loss of a feature within a defined area, concentrations of a chemical compared with a guideline, or economic value.

Geographic Extent

Geographic extent describes the quantitative measurement of area within which an effect occurs. Biophysical effects are described in terms of whether they are limited to an LSA, the RSA, or extend farther. The geographic extent for socio-economic effects relates to the location of the communities affected by the project.

Duration

Duration refers to how long an effect lasts.

For biophysical effects, duration is expressed as follows:

- short term – effect is limited to less than one year
- medium term – effect lasts for more than one year, but less than four years, e.g., many effects that occur during construction
- long term – effect lasts longer than four years, but valued component will recover not more than 30 years after project decommissioning and abandonment
- far future – effect extends more than 30 years after decommissioning and abandonment, e.g., loss of uncommon landforms that cannot be restored

For socio-economic effects, duration is expressed as follows:

- short term – effect is limited to the construction period
- long term – effect extends throughout operations or beyond

Frequency is a characteristic that influences duration. It can be expressed as follows:

- continuous – will occur continually over the assessment period
- isolated – confined to a specific, discrete period
- periodic – occurs intermittently but repeatedly over the assessment period

2.4.1.5 Factors Affecting Prediction Certainty

The description of effects provided in the EIS is based on available information and the current understanding of natural and social processes to predict future events. As with all predictions, those in the EIS are associated with a level of certainty. Certainty can be related to several factors, including:

- degree of understanding of project activities and other human activities, such as:
  - how well do we understand when, where and how project activities will occur?
  - when, where and how did, or will, other human activities occur?
  - how will these activities interact with the project's activities?
- quality of data about the environment, i.e., how accurate is the data used in the analysis?
- variability of the data, i.e., how consistent is the data?
- degree of errors in handling data, i.e., what is the potential for generating errors?
- capability of models to predict, i.e., how accurately does the model predict effects?
- degree of understanding of ecological processes, i.e., how well do we understand what is happening to the valued component?
- success of proposed mitigation and optimization, i.e., how effective will the proposed mitigation be?

Prediction certainty influences the possibility of error in the effects prediction, and is addressed in the EIS by taking a precautionary approach.

2.4.1.6 Precautionary Approach

To ensure that the EIS does not under-predict effects, a precautionary approach was applied. The precautionary approach requires that where threats of serious or irreversible damage exist, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Government of Canada 2001). For example:

- even though an effect might be uncertain, it is still assumed likely to occur. For example, in the wildlife impact assessment, noise is assumed to affect wildlife, even though wildlife might tolerate the noise or habituate to it. Wildlife monitoring programs will consider noise as a potential effect (see Volume 7, Environmental Management).

- values that exceed guideline levels are assumed to have a high effect, even though receptors might not be affected. For example, infrequent values of short duration that exceed water quality guidelines are unlikely to affect environmental receptors, but are still classified as a high-magnitude effect.

Because of uncertainties in predicting project effects, programs will be established throughout all stages of the project, to monitor for effects and provide a basis for adjustments to environmental management actions.

2.4.1.7 Significance

Regulatory Requirement

The *Mackenzie Valley Resource Management Act* and the *Canadian Environmental Assessment Act* require that the significance of the project's effects be determined in the EIS.

Sustainability

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations World Commission on Environment and Development 1987). In this EIS, the concept of environmental and socio-economic sustainability has been used as the basis for determining significance.

One of the goals for project development is to ensure that future generations have the same options as people living today. Although today's generation might be willing to forgo some options, e.g., restricted access to production fields because they benefit from enhanced economic benefits, future generations should not have their opportunities compromised by decisions made now. This goal will be met if the environment is passed on to future generations with a level of environmental quality that allows traditional land use activities to be pursued to the same degree as that enjoyed by the current generation.

In applying this approach to the impact assessment, the criteria used are those identified by The National Roundtable on the Economy and Environment (MVEIRB 2002) as sustainable development goals for the Northwest Territories:

- economic vitality
- environmental integrity
- social and cultural well-being
- equity
- control over natural resources

The specifics of these criteria are summarized in *Issues and Recommendations for Social and Economic Impact Assessment in the Mackenzie Valley* (MVEIRB 2002).

Significant Effect Criteria

The characteristics of the residual effects of the project are described in terms of the effect's direction, magnitude, geographic extent and duration.

A biophysical effect is considered significant if the effect will be either:

- moderate or high magnitude and extend into the far future, i.e., more than 30 years after project decommissioning

- high magnitude and occur outside the LSA at any time

Figure 2-9 shows the decision options used by biophysical subject areas to describe an effect's magnitude, geographic extent and duration. Pathways that lead to a determination of significance for biophysical effects are highlighted in green.

A socio-economic effect is considered significant if the effect will be either:

- high magnitude, short term, and regional, beyond regional or national in extent

- high magnitude, long term and any geographic extent

- moderate magnitude, long term and beyond regional or national in extent

Figure 2-10 shows the decision options used by the socio-economic subject areas to describe an effect's magnitude, geographic extent and duration. Pathways leading to a determination of significance for socio-economic effects are highlighted in green.

Exceptions that might occur throughout the impact assessments are explained in the sections for specific subject areas.

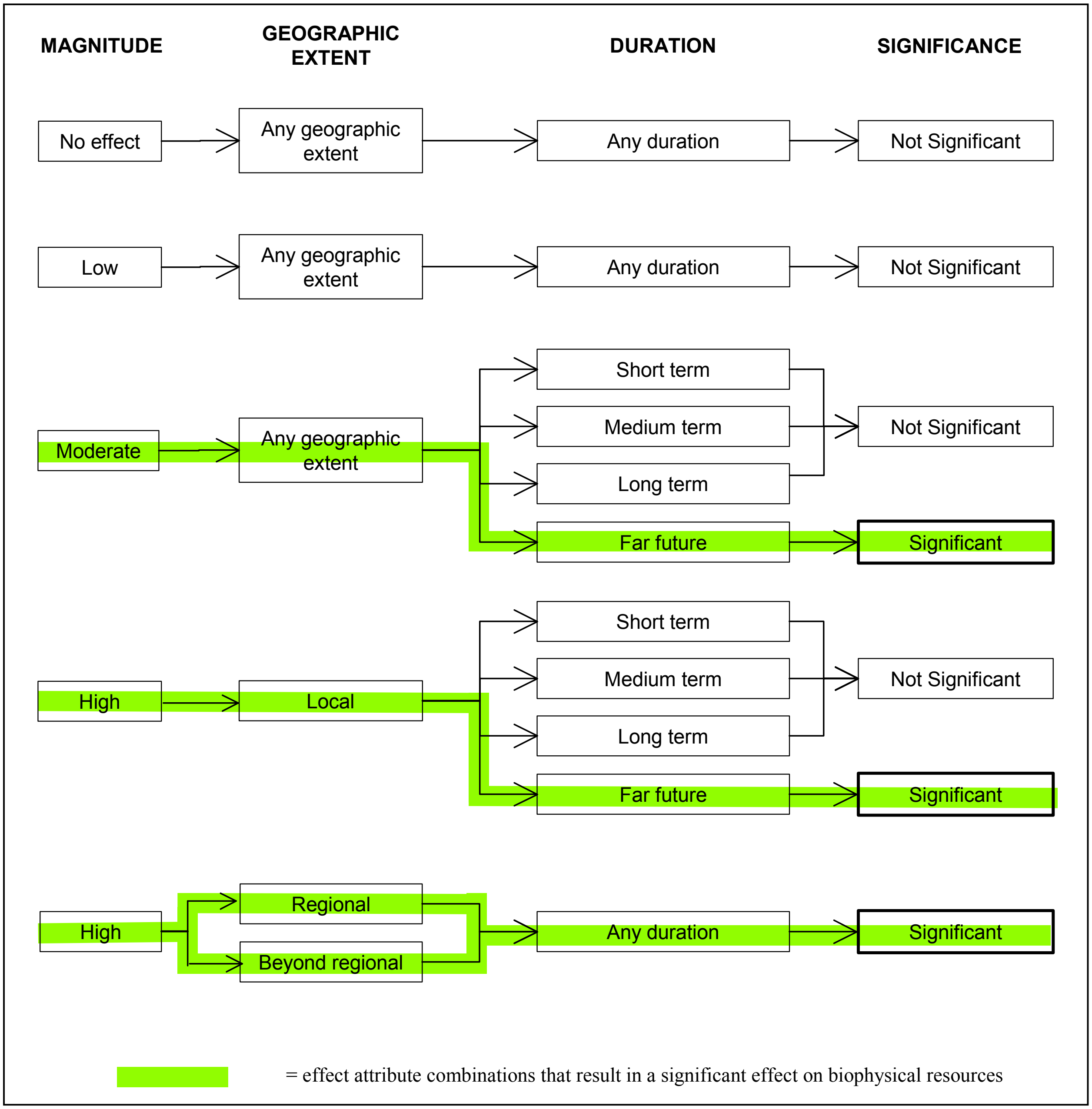

Figure 2-9: Effect Attributes Leading to Significance for Biophysical Subject Areas

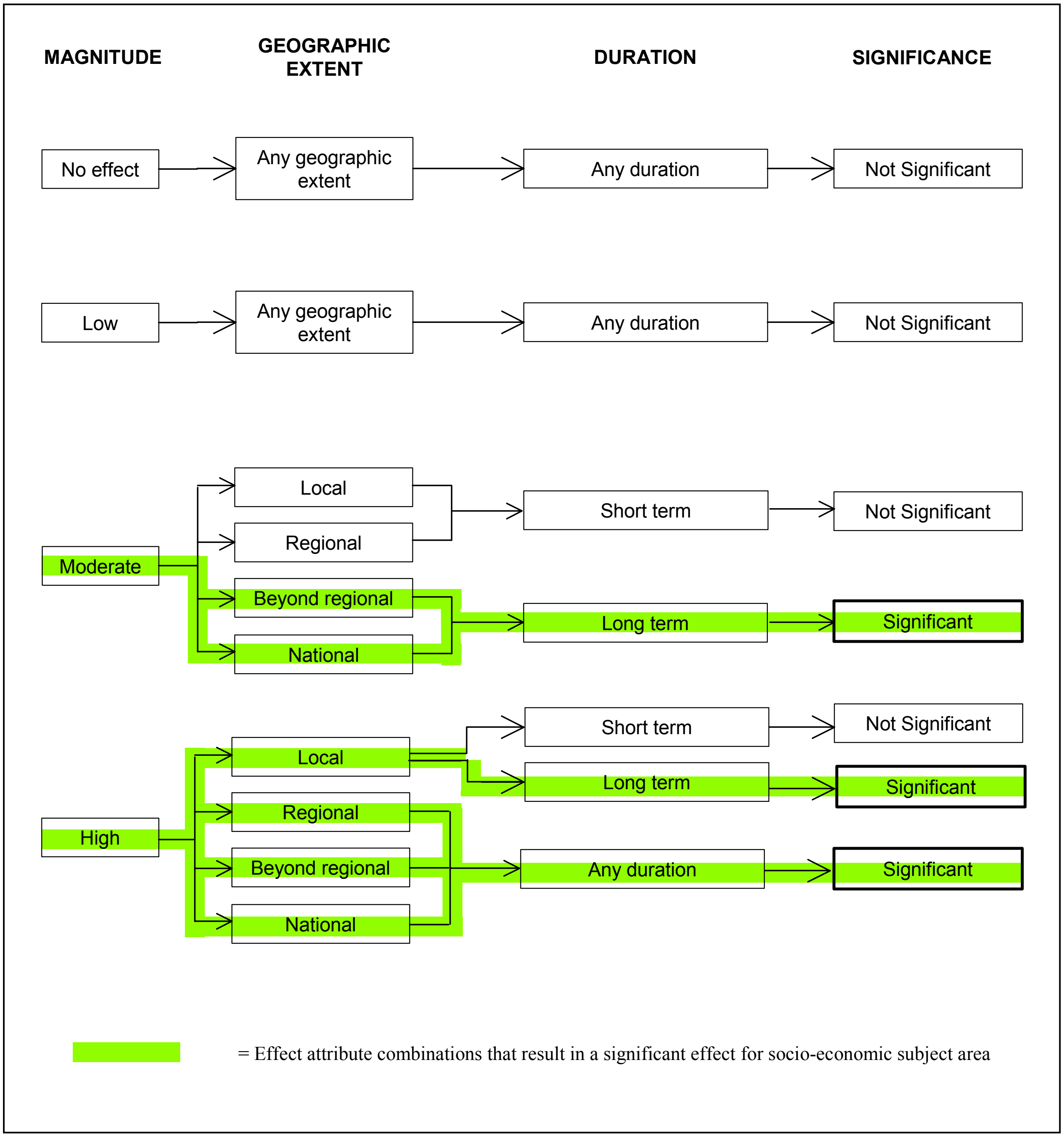

Figure 2-10: Effect Attributes Leading to Significance for Socio-Economic Subject Areas

Although a significant effect can be either positive or adverse, regulatory requirements usually specify adverse significance. Therefore, effects discussed in the EIS are considered adverse unless indicated otherwise. Examples of adverse effects are the impairment of community well being, or the loss of wildlife habitat. Examples of positive effects are improvements in the standard of living, or an improved population status for a threatened species.

Documenting Significant Effects

Table 2-4 demonstrates how residual effects are reported for a biophysical component. Table 2-5 demonstrates how residual effects are reported for a socio-economic component. Both tables summarize the results of the assessment for direction, magnitude, geographic extent and duration of the predicted residual effects of the project on a key indicator. The final column indicates if those effects are considered to be significant.

Table 2-4: Example of Significance Determination – Water Quality

Valued Component	Phase When Impact Occurs	Effect Attribute				Significant
		Direction	Magnitude	Geographic Extent	Duration	
Water quality	Construction	Adverse	Low to moderate	Local	Medium term	No
	Operations	Adverse	Low	Local	Long term	No
	Decommissioning	Adverse	Low to moderate	Local	Long term	No

Table 2-5: Example of Significance Determination – Employment

Key Indicator	Phase When Impact Occurs	Effect Attribute				Significant
		Direction	Magnitude	Geographic Extent	Duration	
Employment	Construction	Positive	High	Any geographic extent	Short term	Yes
	Operations	Positive	Low	Regional, beyond regional, national	Long term	No

2.4.2 Cumulative Effects Assessment

2.4.2.1 Scope

The environmental assessment includes the cumulative effects of past and existing activities. Existing effects are included in the baseline data used for the project-specific assessment (see Volume 3, Biophysical Baseline, and Volume 4, Socio-Economic Baseline).

Information on cumulative effects of past and existing activities can be found in Volume 5, Biophysical Impact Assessment, and Volume 6, Socio-Economic Impact Assessment.

2.4.2.2 Study Areas

Because the project-specific assessment focuses on local study areas, a broader context is needed to assess the cumulative effects of the project within the regional study area. Therefore, the cumulative effects assessment also uses regionally focused sources of data to evaluate the project’s contribution to cumulative effects within ecozones and administrative regions.

2.4.2.3 Development Scenarios

The cumulative effects assessment considers possible future expansion of the project base case. The expansion case considers the likely effects of increasing the volume of gas shipped to southern markets by adding:

- increased gas compression along the proposed pipeline route
- other gas sources

Future gas projects in the Mackenzie Delta region that might be induced by the project are also included in the cumulative effects assessment. A gas project is considered induced if its development is contingent on the development of the Mackenzie Gas Project. A project is included in the cumulative effects assessment if a precedent agreement exists for that project to ship gas on Mackenzie Gas Project pipelines.

2.4.2.4 Reasonably Foreseeable Projects

The cumulative effects assessment also considers the contribution of the project’s predicted residual effects to the effects of reasonably foreseeable projects. Examples of reasonably foreseeable projects include:

- Devon Canada Corporation Beaufort Sea exploration drilling program
- Deh Cho Corporation Mackenzie River bridge at Fort Providence
- De Beers Snap Lake diamond mine
- GNWT Mackenzie River winter bridges

2.4.3 Incidents and Malfunctions

The EIS addresses the effects on the biophysical and socio-economic environment that might result from potential project incidents and malfunctions, including reasonable worst-case scenarios. Examples of incidents and malfunctions that could occur include:

- hazardous material spills on land, ice and water
- fires
- transportation incidents
- rupture or failure of a pipeline
- failure of components at a compression or conditioning facility

See Volume 7, Environmental Management for the contingency or response measures for incidents.

2.4.4 Effects of the Environment on the Project

The EIS addresses the potential effects of the northern environment on the project throughout the project's life. It considers the following elements:

- permafrost
- unstable slopes
- ice scour
- subsidence
- flooding
- extreme weather events
- seismic activity

These elements are addressed in the project design (see Volume 2, Project Description, and Volume 5, Section 14, Environmental Effects on the Project) through:

- siting and engineering design
- selecting mitigation and management measures
- scheduling, surveillance and monitoring

2.4.5 Climate Change

The effects of possible climate change on the project have been addressed throughout the project life. Conditions considered include:

- changes in climate parameters, e.g., temperature and precipitation, that might affect the project or project components

- changes in biophysical resources resulting from changes in climate parameters

- how effects predicted in the environmental assessment might be different under climate change

Potential foreseeable risks to the project because of climate change are considered in the project design, construction and operations (see Volume 2, Project Description, and Volume 5, Section 11, Climate Change).

2.5 Monitoring

2.5.1 Monitoring

During project construction, operations, and decommissioning and abandonment, project effects will be monitored to:

- determine if they are consistent with EIS predictions
- identify possible additional measures to reduce effects

Monitoring will be done mostly through community feedback and environmental monitoring programs, and will include:

- compliance monitoring
- effects monitoring

See Volume 7, Environmental Management, for information about monitoring programs and compliance.

2.5.1.1 Compliance Monitoring

Compliance monitoring will be conducted to ensure that:

- all environmental mitigation, as outlined in the environmental protection and reclamation plans, is implemented
- work proceeds in compliance with regulations and the proponents' environmental policies

Compliance monitoring will be a component of all phases of the project, from environmental inspection monitoring during construction, to monitoring required for licences issued by the Mackenzie Valley Land and Water Board.

2.5.1.2 Effects Monitoring

Effects monitoring will be conducted to:

- confirm the accuracy of the predicted effects
- determine the effectiveness of mitigation and enhancement measures

Effects monitoring is a component of the project's environmental management system. The environmental management system provides a framework for adapting project practices, in response to the results of effects monitoring programs.