GUIDELINE FOR THE SELECTION OF VALUED COMPONENTS AND ASSESSMENT OF POTENTIAL EFFECTS

Environmental Assessment Office

APPROVED BY: Doug Caul, Associate Deputy Minister, September 9, 2013
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ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

This Guideline presents the British Columbia (BC) Environmental Assessment Office's (EAO) best practices for the selection of Valued Components (VCs) and the assessment of potential effects. It has been prepared to inform the understanding and application of appropriate, standardized methods for conducting environmental assessments to meet the needs of EAO and the requirements of the BC *Environmental Assessment Act* (the Act) (SBC 2002, c.43). It is intended to improve the clarity, consistency, and overall quality of Environmental Assessment Certificate Applications (as well as applications to amend Certificates) prepared by proponents, as well as assessments prepared by EAO staff.

This Guideline does not supersede the requirements specified in the Act, its regulations, project-specific Orders, or the Application Information Requirements (AIR). This Guideline provides recommended methods and approaches, based on current accepted environmental assessment practice, and it is acknowledged that other methods and approaches may be developed over time and may be appropriate for use.

This Guideline provides guidance on the typical methodological steps in an environmental assessment, from issues scoping through the evaluation (including significance determination) of residual effects (i.e., those effects remaining after the implementation of all mitigation measures). It does not provide detailed methodological guidance for assessing cumulative effects or developing follow-up programs; users are encouraged to refer to other available guidance and consult with EAO regarding these steps.

Environmental assessment in BC uses a values-based framework to promote a comprehensive, yet focused, understandable, and accessible assessment of the potential effects of proposed Projects. This framework relies on the use of Valued Components (VCs) as a foundation for the assessment. The Guideline defines and explains the use of VCs to focus environmental assessments on those aspects of the natural and human environment that are of greatest importance to society. The Guideline also explains how the use of VCs improves the effectiveness and efficiency of assessment, in part by facilitating the selection of appropriate study methods and focusing analysis on key project-VC interactions.

The Guideline describes good practice in issues scoping to inform the selection of appropriate VCs, and specifies considerations when selecting VCs. The need for careful documentation of VC selection methods, criteria, and rationale is discussed.

The Guideline explains the role of assessment boundaries in defining the scope or limits of the assessment, defines each type of boundary that should be considered, and provides guidance for establishing and documenting appropriate boundaries.

The Guideline outlines the need to describe existing conditions in sufficient detail to enable potential project-VC interactions and effects, including cumulative effects, to be identified, understood, and assessed.

The Guideline provides tools to facilitate the identification and evaluation of potential project-VC interactions to support an assessment that focusses on those interactions of greatest consequence. The need to describe the potential effects that may arise from potential interactions is discussed.

The Guideline defines various types of mitigation and explains how these should be considered to avoid or reduce potential adverse residual effects to an acceptable level. Factors that should be taken into account when designing mitigation strategies are discussed.

The Guideline clarifies the steps that should be taken to evaluate the residual effects remaining after the implementation of mitigation, including characterization of each residual effect using defined criteria (context, magnitude, extent, duration, reversibility, and frequency), determination of likelihood, definition and determination of significance, and statement of the level of confidence. The Guideline also provides guidance with respect to when additional risk analysis may be warranted to address uncertain residual effect predictions.

Finally, the Guideline describes factors to consider when determining the need for cumulative effects assessment.

The use of the Guideline is expected to assist proponents and EAO staff to undertake the analysis required for an environmental assessment of a reviewable project in BC. This Guideline is not prescriptive, and the details regarding the application of the methods described within it will be determined by EAO for each individual project. However, the application of the principles articulated in this Guideline will improve the clarity, consistency, and overall quality of Environmental Assessments conducted in BC.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

Act	*Environmental Assessment Act*
AIR	Application Information Requirements
BC	British Columbia
BMP	Best Management Practice
CEAA	Canadian Environmental Assessment Agency
EAO	Environmental Assessment Office
NEB	National Energy Board
VC	Valued Component

1.0 BACKGROUND AND CONTEXT

1.1 PURPOSE

This Guideline presents the British Columbia (BC) Environmental Assessment Office's (EAO) best practices for the selection of Valued Components (VCs) and the assessment of potential effects. It has been prepared to inform the understanding and application of appropriate and standardized methods for conducting environmental assessments to meet the needs of EAO and the requirements of the BC *Environmental Assessment Act* (the Act) (SBC 2002, c.43). It is intended to improve the clarity, consistency, and overall quality of Environmental Assessment Certificate Applications (as well as applications to amend Certificates) prepared by proponents and Environmental Assessment Reports prepared by EAO during the assessment of reviewable projects under the Act.

1.2 REGULATORY CONTEXT

This Guideline has been developed for use in the assessment of reviewable projects pursuant to the Act.[1] The Minister, EAO Executive Director, or delegate may determine that a reviewable project requires an Environmental Assessment Certificate by order pursuant to the Act. The scope of the required assessment, and the procedures and methods for conducting the assessment, are also determined by order pursuant to the Act. An Application for an Environmental Assessment Certificate must contain the information required by EAO. EAO's information requirements are specified in the Application Information Requirements (AIR).

This Guideline does not supersede the requirements specified in the Act, its regulations, project-specific Orders, or AIR. This Guideline provides recommended methods and approaches, based on current accepted environmental assessment practice, and it is acknowledged that other methods and approaches may be developed over time and may be appropriate for use. In particular, the Guideline is not intended to specify project-specific scope of assessment and information requirements for any particular reviewable project; these will continue to be specified in the project-specific Orders and the AIR.

Other provincial, federal, and municipal regulatory processes may apply to a reviewable project, and may require coordination with the provincial environmental assessment process. Other regulatory bodies should be directly engaged to confirm any information and procedural requirements that may be applicable.

Some reviewable projects may also require environmental assessment pursuant to the *Canadian Environmental Assessment Act, 2012*. In such cases EAO and the federal responsible authority (Canadian Environmental Assessment Agency (CEAA), the National

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[1] A project can be determined to be reviewable under section 5, 6 or 7 of the Act. The *Reviewable Projects Regulation* (BC Reg 370/2002) prescribes what constitutes a reviewable project for the purpose of the Act.

Energy Board (NEB) or the Canadian Nuclear Safety Commission) work together to ensure an effective and efficient review, which may result in a substituted or coordinated environmental assessment.

In 2013 EAO and CEAA signed a Memorandum of Understanding that establishes expectations, roles and procedures for implementing substitution of environmental assessments in BC. Substitution means that a single, provincial environmental assessment process would be conducted, resulting in two separate decisions (federal and provincial).

Coordination means that EAO and CEAA work cooperatively to align their two separate environmental assessment processes and decisions, in a manner consistent with the 2004 BC-Canada Agreement on Environmental Assessment Cooperation and the 2008 EAO-CEAA agreement to support its implementation.

In 2010 EAO and the NEB entered into an agreement which states EAO will accept the NEB's environmental assessment of a proposed project (that otherwise would have to be reviewed under BC's *Environmental Assessment Act*) as an equivalent assessment, and that the proposed project may proceed without a provincial environmental assessment certificate.

1.3 GUIDING PRINCIPLES

Environmental assessment in BC provides an integrated process for identifying and evaluating the potential adverse environmental, economic, social, heritage, and health effects that may occur during the life of a reviewable project. The assessment process ultimately results in a decision by the responsible ministers regarding whether to issue an Environmental Assessment Certificate, subject to any identified legally binding conditions, which is required before a reviewable project can proceed. The full details of *how* a reviewable project may be undertaken are addressed through the permitting process. Comprehensive and efficient environmental assessments result in well-informed and timely decision-making.

General principles for environmental assessment have evolved since the early 1970s, and have been documented by the International Association for Impact Assessment, in cooperation with the Institute of Environmental Assessment (1999). According to these general principles, environmental assessment should be:

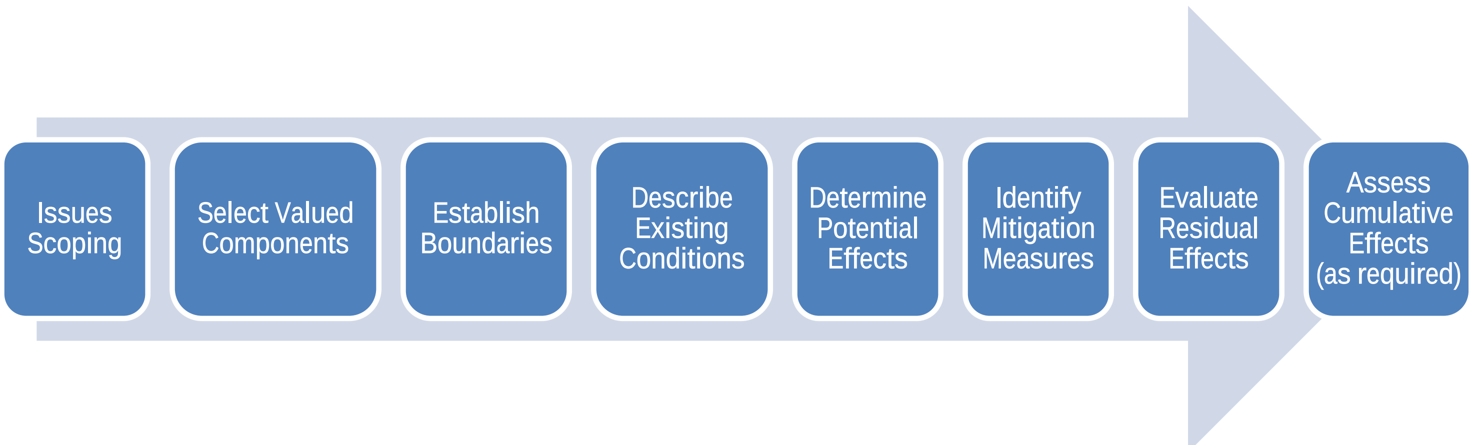
- Transparent;
- Participative;
- Integrated;
- Efficient;
- Purposive;
- Rigorous;
- Practical;
- Relevant;
- Cost-effective;
- Focused;
- Adaptive;
- Inter-disciplinary;
- Credible; and,
- Systematic.

This Guideline is consistent with the principles listed above, and reflects current accepted environmental assessment practice in BC and Canada.

1.4 SCOPE OF GUIDELINE

This Guideline provides guidance for typical methodological steps in an environmental assessment. Figure 1 summarizes these steps; this diagram will serve as a roadmap for this Guideline, and appears at the start of various sections of the Guideline indicating the step in the method to which that section refers.

Figure 1. Summary of Methodological Steps



This Guideline provides direction from the issues scoping through the evaluation (including significance determination) of residual effects.[2] It does not provide detailed methodological guidance for assessing cumulative effects or developing follow-up programs.

This Guideline is intended for use primarily by EAO staff conducting environmental assessments of reviewable projects pursuant to the Act and by proponents (including consulting practitioners engaged by proponents) preparing submissions (e.g., Project Descriptions, Valued Component selection rationale documents, draft AIRs, and Applications) for reviewable projects. Although it does not provide detailed procedural direction on implementing the guidance (e.g., the roles of EAO versus the proponent and how requirements are reflected in various documents), where clarity is required, there are some references to roles and process.

This Guideline will also assist others involved or interested in environmental assessments to better understand how they are conducted.

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[2] Residual effects are those effects remaining after the implementation of all mitigation measures. Residual effects are discussed in more detail in Section 3.5 of this Guideline.

2.0 IDENTIFICATION AND SELECTION OF VALUED COMPONENTS

2.1 KEY TERMS

The Act requires an assessment to consider the environmental, economic, social, heritage, and health effects of a reviewable project. EAO refers to these broadly as '**pillars**'.

Environmental assessment in BC (and elsewhere in Canada) uses a values-based framework to promote a comprehensive, yet focused, understandable, and accessible assessment of potential effects, while making the most effective and efficient use of resources. This framework relies on the use of VCs as a foundation for the assessment.

The selection of appropriate VCs allows the assessment to be focused on those aspects of the natural and human environment that are of greatest importance to society. The use of VCs also improves the effectiveness and efficiency of assessment, in part by facilitating the selection of appropriate study methods and focusing analysis on key project-environment interactions. The use of VCs to focus analysis has been a core element of environmental assessment practice in Canada and elsewhere for decades, since Beanlands and Duinker (1983) described a comprehensive framework for ecological impact assessment based on what they called Valued Ecosystem Components. Since that time, the concept has been applied to the assessment not only of potential ecological effects, but economic, social, heritage, and health effects as well.

Definition of Valued Component

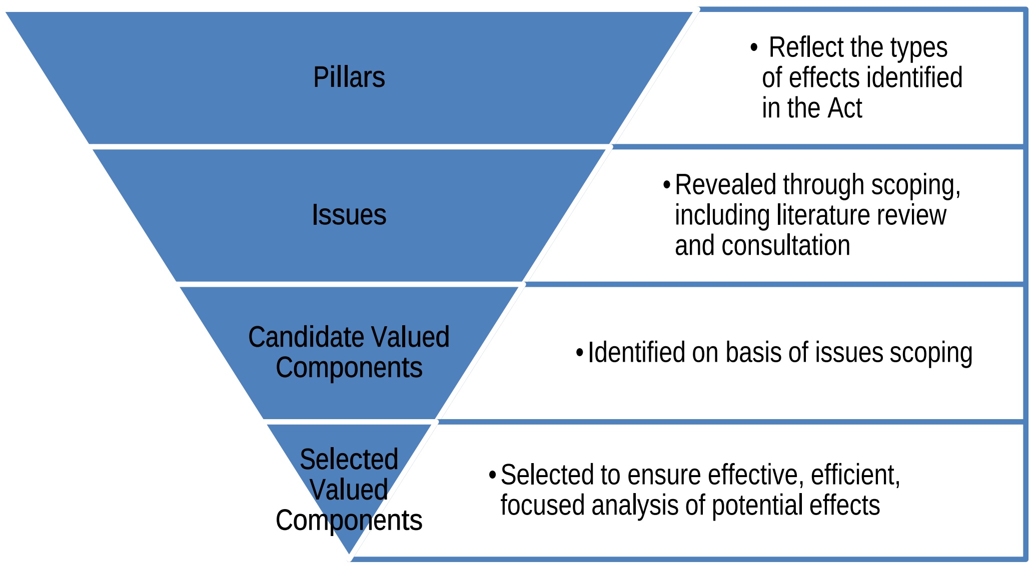
For the purpose of environmental assessment in BC, **Valued Components** (VCs) are components of the natural and human environment that are considered by the proponent, public, Aboriginal groups, scientists and other technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance.

Similarly, the Canadian Environmental Assessment Agency defines Valued Ecosystem Component as "the environmental element of an ecosystem that is identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance" (CEAA 2006).

As described in more detail in Section 2.2 below, VCs are usually identified on the basis of comprehensive issues scoping, including review of available information and consultation with key stakeholders, which reveals the values and priorities of government, Aboriginal groups, the public, and other stakeholders.

Figure 2 illustrates the relationship between the pillars, issues, and VCs in environmental assessment. The process for identifying candidate VCs and selecting VCs for the purposes of assessment is described in Section 2.3 below.

Figure 2. Relationship between Pillars, Issues, and Valued Components



VCs will vary by project, industry, and geographic region, to reflect the nature of the potential project effects and the environmental, economic, social, heritage, and health context within which the project is to be undertaken. All well-defined VCs selected for assessment share several attributes, summarized in the table below.

The term '**effect pathway**' refers to the cause-effect linkage between a project and a VC. In some cases, the project-VC interaction comprises a direct impact, while in others the project may affect the VC indirectly, by causing changes in the natural or human environment on which the VC depends. For example, a project may affect local economic activity by altering water quality, which may in turn adversely affect a fish population, which may in turn reduce the fishing success of commercial or sport fishing activity. In this example, water quality and fish are intermediate components along an effect pathway between the project and the ultimate receptor VC, economic activity. The relevance of effect pathways to VC selection is discussed in greater detail in Section 2.3 below.

Attributes of Valued Components

- ***Relevant*** to at least one of the five pillars and clearly linked to the values reflected in the issues raised in respect of the project.
- ***Comprehensive***, so that taken together, the VCs selected for an assessment should enable a full understanding of the important potential effects of the project (including all five pillars).
- ***Representative*** of the important features of the natural and human environment likely to be affected by the project.
- ***Responsive*** to the potential effects of the project.
- ***Concise***, so that the nature of the project-VC interaction and the resulting effect pathway can be clearly articulated and understood, and redundant analysis is avoided.

Indicators are metrics used to measure and report on the condition and trend of a VC and should be clearly identified to further focus and facilitate the analysis of interactions between the project and the selected VC. Indicators are distinct from sub-components that may be used to facilitate the assessment of a broadly defined VC; for example, for a broadly defined VC such as wildlife, individual species or species groups (*e.g.*, grizzly bear or large carnivores, Northern Goshawk or avifauna, Western Toad or amphibians) may be used as sub-components to structure the assessment.[3] (The question of defining VCs narrowly or broadly is discussed further in Section 2.3 below.)

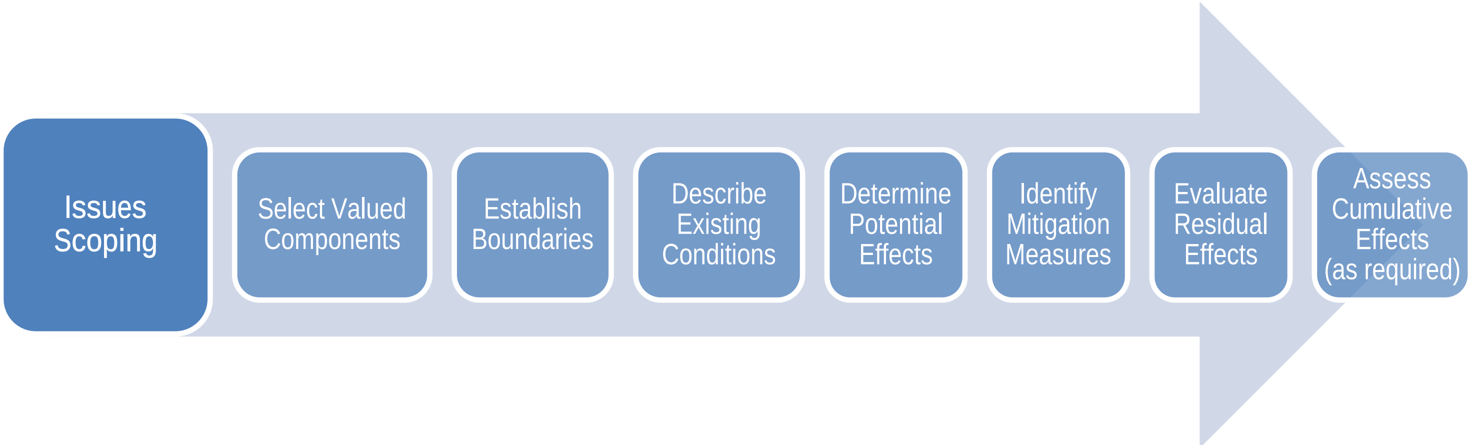
Indicators frequently comprise an aspect of the VC that is important to the integrity of the VC and can be used to understand and evaluate the potential effect on the VC. In some instances direct measurement of potential effects on the VC may be feasible. To be effective and useful, indicators must have the following attributes.

Attributes of Indicators

- ***Relevant***: indicators must relate directly or indirectly to the selected VC.
- ***Practical***: there must be a practical way to evaluate the indicator, using existing or achievable data, predictive models, or other means.
- ***Measurable***: the measurement of the selected indicator must generate useful data that inform our understanding of the potential effect on the VC.
- ***Responsive*** to the potential effects of the project.
- ***Accurate*** in reflecting changes to the VC.
- ***Predictable*** in terms of their response to the project.

[3] When individual species are used in this context, they are sometimes referred to as "indicator species". Therefore, care must be taken to define the terminology used in an assessment carefully to avoid confusion.

2.2 ISSUES SCOPING



As noted above, VCs should be related to one of the five 'pillars' of assessment, and clearly linked to the values reflected in the issues raised with respect to the reviewable project. Such issues are normally identified through issues scoping.

Issues scoping is a process of compiling and analyzing available information to identify environmental, economic, social, heritage, and health issues that may be related to a reviewable project. These project-specific issues are generally indicative of the local and regional values held by the public, Aboriginal groups, and other stakeholders in the area within which the project is proposed. They may also reflect issues of concern to the scientific community or to government. The issues identified through issues scoping are used to inform the selection of VCs for the assessment, as described in the next section.

Good issues scoping practice includes:

- describing the physical works and activities associated with the reviewable project;
- reviewing available information regarding the type of project being proposed, including, but not limited to, research publications and previous environmental assessments;
- reviewing available information regarding the local area and region within which the project is to be located, including, but not limited to, research publications and previous environmental assessments;
- reviewing the AIR template and other guidance material provided by EAO (and by the Canadian Environmental Assessment Agency, if a federal environmental assessment is also required);
- consulting EAO;
- consulting provincial review agencies (*i.e.*, typical or likely Working Group members) for the region within which the project is to be located;
- consulting federal agencies and departments if there are matters of federal jurisdiction that may be affected by the project;
- consulting local governments, regional health authorities, emergency service providers, and other local and regional community service organizations;

- engaging and/or consulting potentially affected Aboriginal groups;
- consulting landowners, tenure holders, community and interest groups, the public, and other key stakeholders in the project area; and
- drawing on the professional judgment and expertise of discipline specialists.

Information sources that may be appropriate to review during issues scoping include, but may not be limited to:

- the Project Information Centre (e-PIC), administered by EAO, and the Canadian Environmental Assessment Registry, administered by the Canadian Environmental Assessment Agency, to identify issues related to other similar or nearby reviewable projects for which environmental assessments have been or are being conducted;
- applicable provincial and federal legislation and regulations (such as the BC *Forest and Range Practices Act*, the federal *Fisheries Act*, and others);
- provincial land use plans (*e.g.*, Land and Resource Management Plans) and other regional and local government plans (*e.g.*, Official Community Plans, Regional Growth Strategies, Regional Sustainability Strategies, Climate Action Plans, and other environmental, social, and/or economic development strategies);
- the BC Conservation Data Centre, the federal *Species at Risk Act*, and the Committee on the Status of Endangered Wildlife in Canada;
- First Nation Treaties and information regarding asserted claims, from the BC Treaty Commission;
- available studies documenting traditional knowledge and land use by Aboriginal persons (subject to confidentiality provisions that may apply);
- the Provincial Archaeological Report Library and the Provincial Archaeological Site Inventory; and,
- other sources relevant to the type of project being proposed, the region within which the reviewable project is located, and the nature of likely project effects.

EAO staff will assist the proponent to identify Aboriginal groups in the project area, including providing direction pursuant to a section 11 Order.[4]

Issues scoping should begin early in project planning, before initial regulatory submissions, such as the Project Description and draft AIR, are made, as the information gained during issues scoping will inform not only the selection of VCs but also the determination of the scope of the assessment.

Issues scoping typically generates a long list of issues that may be related to the reviewable project, distilled from concerns raised or questions asked by government, Aboriginal groups, the

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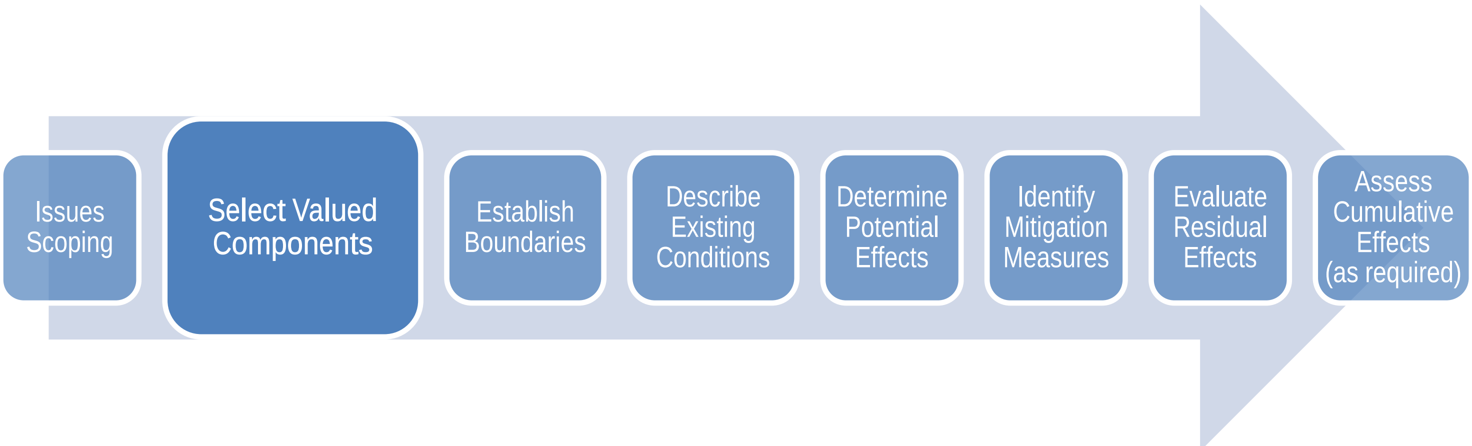
[4] This legal order is issued by the EAO delegated Project Assessment Lead under section 11 of the Act, and specifies the scope, procedures, and methods by which a review or a project must be conducted.

public, and other stakeholders, as well as from the review of other available information, as described above.

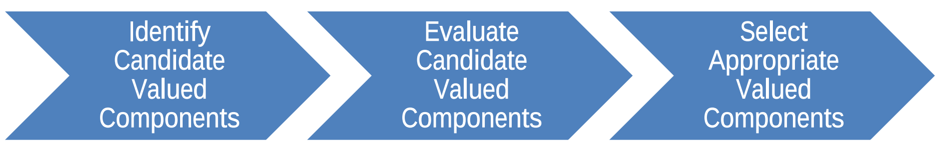
2.3 SELECTING VALUED COMPONENTS FOR ASSESSMENT



VCs provide the foundation for the entire assessment, including the assessment of potential effects, and so appropriate VC selection is one of the most important steps in ensuring high-quality environmental assessment. The method and criteria used in VC selection must therefore be robust. There are three basic steps in the selection of appropriate VCs, summarized in Figure 3.

The issues identified through issues scoping should be grouped generally by the five ‘pillars’ – environment, economic, social, heritage, and health – and then more specifically within those broad thematic areas to identify candidate VCs.

Figure 3. Steps in the Selection of Valued Components



A range of questions should be considered when determining whether or not an environmental, economic, social, heritage, or health component related to the issues identified through scoping can or should be included as a candidate VC. These questions help to determine whether the component is relevant to the assessment and focus the assessment so that it does not waste resources considering components that are not likely to be affected by the project or that are already well managed by other government legal requirements. These questions may include:

- ***Is the component[5] present in the local or regional project area?***

  For example, if the component is known to be absent from the project area, it is unlikely to be affected by the project and will not warrant assessment.

- ***Does the project have the potential to interact with and adversely affect the component?***

  For example, a component may occur in the project area, but if the project does not include some emission, effluent, or other source of impact on that component, assessment may not be warranted.

- ***Does a legally binding government requirement (e.g., regulation, management framework) exist to protect the component?***

  Provincial and/or federal regulation, standards, or codes of practice may exist, governing certain types of project activities and/or protecting certain environmental components. Management plans may also exist for certain components. Such regulatory frameworks typically have been developed based on a wealth of information and knowledge about the activity and/or environmental component to which the frameworks apply, and are intended to avoid potential significant adverse effects. Additional detailed analysis within the context of an environmental assessment may therefore not be needed. For example, if a reviewable project complies with the BC Occupational Health and Safety Regulation and related regulations (such as the Industrial Camps Health Regulation) and guidelines, additional analysis of potential effects on worker safety may not be warranted.

Other questions help to ensure the scoping of the assessment takes into consideration the priorities and values of the government, Aboriginal groups, and the public, and the likely key issues that will influence the environmental assessment decision. These questions include:

- ***Does the component reflect a legislative or regulatory requirement or government management priority (e.g., species at risk)?***
- ***Does the component pertain to Aboriginal interests, including claimed or proven Aboriginal rights (including title) and Treaty rights?***
- ***Is there potential for significant[6] adverse cumulative effects? What known stressors are already occurring on the land base?***
- ***Is the component itself or the potential adverse effect of particular concern to the public, Aboriginal groups, or government?***
- ***Is the component particularly sensitive or vulnerable to disturbance?***

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[5] At this point in the assessment, the term 'component' refers to a component of the natural or human environment that is being evaluated to determine whether it comprises a candidate VC for the purpose of assessment.

[6] Significance of potential residual adverse effects is determined later in the EA process. At this stage, consideration of potential significance is only qualitative, conceptual, and at a high-level, based largely on professional judgment.

Once these questions have been considered and a list of candidate VCs has been established, further work is necessary to evaluate the candidate VCs and focus the assessment on selected VCs for analysis. The purpose of this focusing exercise is to promote the selection of VCs that are appropriate and have the attributes listed in Section 2.1 above. In particular, the selection of appropriate VCs will minimize the degree of duplication and redundancy in the assessment, and will help to focus the analysis on the project-environment interactions of greatest importance and consequence and on the components most valued by society.

To promote the selection of appropriate VCs, the following questions should be considered when evaluating the candidate VCs:

- ***Can the potential effects of the project on the VC be measured and monitored? Is the candidate VC better represented by another VC?***

  *In some cases, it may be difficult to measure the key characteristics of a VC that may be affected by the project, or to monitor the effectiveness of mitigation designed to protect that VC. In such cases, it may be appropriate to select an alternative VC that is likely to experience similar effects which can be mitigated in a similar way, but is more easily measured and monitored. For example, a watercourse may support two species – rainbow trout and brook trout – with similar life histories and habitat requirements; if historical data are missing for one species (*e.g.*, brook trout), the other can be selected as the VC. When considering this question, it may be useful to think about whether field studies and/or follow-up monitoring programs can be effectively and efficiently designed and undertaken for the candidate VC.*

- ***Can the potential effects on the candidate VC be effectively considered within the assessment of another VC?***

  Sometimes, multiple candidate VCs may be affected by the project in the same or similar ways. In such cases, it may be appropriate to select only one of the candidate VCs for detailed analysis, to avoid redundancy in analysis. This is particularly true for biological VCs that may be members of the same guild or group of species that occupy a common ecological niche and display similar ecological functions and requirements. A socio-economic example may include the consideration of one or more land uses within a VC such as Economic Activity, instead of as separate Land Use VCs.

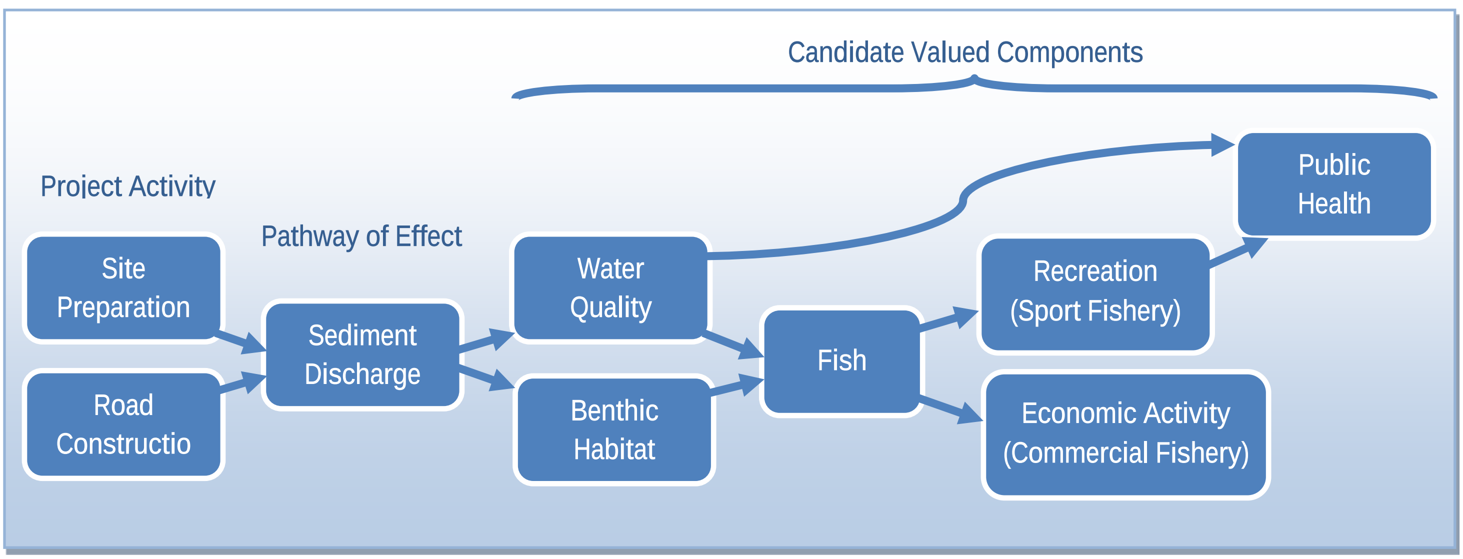
- ***Is information about the candidate VC needed to support the assessment of potential effects on another VC?***

  A candidate VC may comprise one 'step' of a pathway along which a project effect travels (Figure 4): a change in the candidate VC may lead to another effect on another candidate VC. For example, sediment-laden discharge from a project to a stream may adversely affect water quality and benthic habitat. These changes may consequently affect the health and survival of fish that depend on those habitat attributes. In most cases, rather than include *intermediate components as VCs, the assessment should focus on the ultimate receptor or component that is of concern, and select that as the VC. In this example, the most appropriate VC may be fish, and the assessment of potential effects on fish would study and take into consideration the intermediate effects of the project on water quality and benthic habitat. Similarly, a suitable economic or social VC related to this example might be Economic Activity or Recreation, to the extent these include a commercial or sport fishery, and a suitable health VC might be Public Health, to the extent the adverse effect on water quality may in turn affect potable water.*

However, in some cases, for some kinds of projects, it may be appropriate to select an intermediate component as a stand-alone VC, particularly if there is potential for significant adverse effects on the intermediate component and/or the intermediate component is of particular concern. An intermediate component may also be selected as a VC when the intermediate component is more amenable to measurement and monitoring than the receptor component.

When evaluating which component(s) to select as VCs, diagrams may be useful to illustrate effect pathways and support the identification of intermediate components and receptor components, as shown in Figure 4 for the example given above (see also Hegmann et al. (1999) for additional examples and explanation of pathway and network diagrams). The importance of documenting how intermediate components will be addressed in the assessment is noted in Section 2.4 below.

Figure 4. Example of Valued Component Effect Pathway



The consideration of these questions will facilitate the evaluation of the candidate VCs for the purposes of selecting appropriate VCs upon which the assessment will be focused. When selecting VCs, the attributes listed in Section 2.1 should be considered, as well as the interconnectedness and relationship between the VCs, to ensure all five pillars are adequately represented. To be clear, the list of selected VCs will vary for each project to reflect the characteristics of the project and of the region and context within which it is located. Thus, the scoping and selection process outlined above is intended to be flexible to meet project-specific requirements.

When selecting VCs for assessment, appropriateness is a more important criterion than quantity. That is, the selection of fewer well-defined, meaningful VCs that display the attributes listed in Section 2.1 is generally preferable to the selection of more but less appropriate VCs. VCs that do not have the desired attributes should not be selected just because they have been used as VCs in prior assessments or are of particular personal interest to one or more parties in the assessment. The rationale for including VCs should be as robust as the rationale for excluding candidate VCs.

When selecting VCs for assessment, consideration should be given to the appropriate level of definition of the VCs. In some cases, it may be useful and appropriate to 'lump' components into a broadly defined VC and use sub-components and indicators as necessary to frame the analysis. While in other cases, it may be appropriate to 'split' the components and define the VCs more narrowly. For example, for a project that does not have many potential interactions or effects on terrestrial wildlife or is located in an area of few terrestrial wildlife components of concern, it may be appropriate to group those components into one wildlife VC. However, most projects likely warrant finer definition of the wildlife VCs as individual species or species groups (*e.g.*, grizzly or large carnivores, Northern Goshawk or raptors, Western Toad or amphibians).

Both approaches are acceptable, but the rationale for 'lumping' or 'splitting' should be clearly articulated in the assessment. VCs defined at an appropriate level will promote a well-organized assessment with minimal redundancy, account for all the types of effects that are expected, and permit a meaningful analysis of significance of potential residual effects.

VC and indicator selection should be done as early in the assessment process as possible, and prior to finalization of the AIR. In particular, it must be understood that VC and indicator selection will in part determine the type of data that will be required to support the assessment, and the methods that may be required to collect it. For example, if the selected VC is a biological species, there will be different data collection requirements if the indicator is "population status" or "individual mortality" than if the indicator is "suitable habitat" or "habitat connectivity".

Early discussion between the proponent and EAO, and where possible and appropriate, Working Group members, potentially affected Aboriginal groups, the public, and other key stakeholders will help to promote the selection of VCs that are appropriate to focus the environmental assessment on the key issues and interactions.

2.4 DOCUMENTATION

Each selected VC should be clearly defined, and the rationale for selection of each VC should be clearly articulated. This narrative rationale should identify the applicable legislative or regulatory source from which the VC is derived, if any, as well as the source and nature of Aboriginal, public, scientific, or other issue or concern pertaining to the VC.

If the selected VC was chosen to best represent potential effects on similar components (candidate VCs) or to facilitate the assessment of potential effects on another component, these assumptions should be noted in the VC selection rationale.

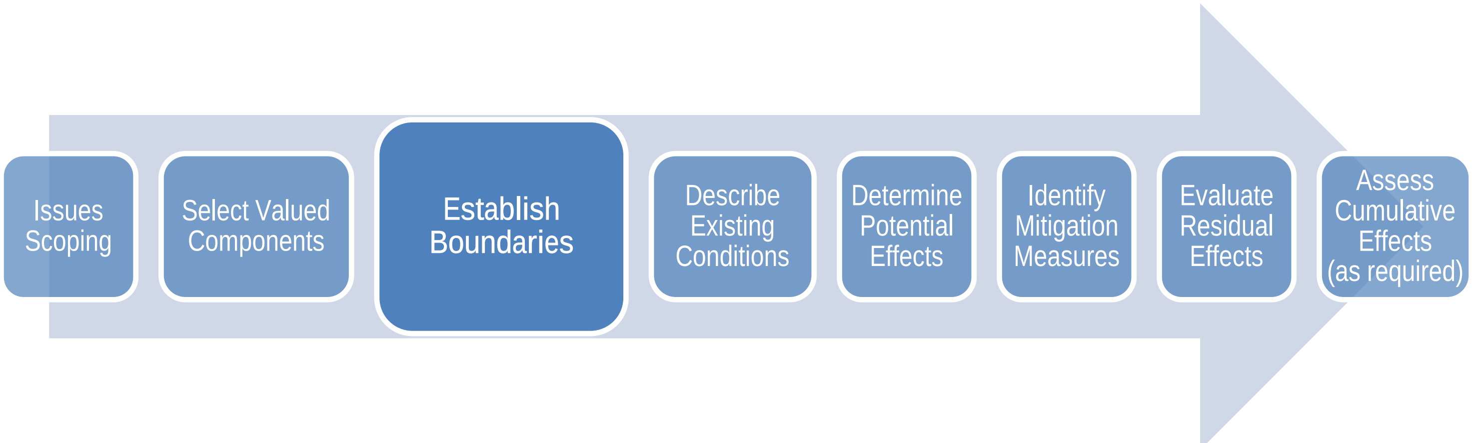
The VC selection rationale also should describe whether the selected VC is an intermediate or receptor component in an effect pathway, and explain how the effect pathway will be considered in the assessment. Where an important component of the natural or human environment is expected to be affected by the project but is not selected as a VC, the rationale for its exclusion as a VC should be provided. In particular, if the component is an intermediate component or part of an effect pathway, the rationale for its exclusion should also explain how that component will be studied, and where information about that component will be provided in the assessment (*e.g.*, appended as a technical report and/or summarized in the pertinent VC section) in sufficient detail to support the assessment of potential effects on the selected ultimate receptor VC. The necessary scope of analysis of intermediate components that are affected by the project but not selected as stand-alone VCs would be determined in the AIR.

If an important component of the natural or human environment is expected to be affected by the project but has been excluded as a VC because it is well-protected through other government legal requirements and additional assessment is not considered necessary, the specific legal requirements must be clearly noted in the rationale for exclusion.

Tables or figures should be used as required to demonstrate how issues identified during issues scoping are or will be reflected in the selected VCs and supporting technical information.

3.0 ASSESSING POTENTIAL EFFECTS ON SELECTED VALUED COMPONENTS

3.1 ESTABLISHING ASSESSMENT BOUNDARIES



Assessment boundaries serve to define the scope or limits of the assessment. They encompass the areas within and times during which the project is expected to interact with the VCs (spatial and temporal boundaries), as well as reflecting constraints that may be placed on the assessment of those interactions due to political, social, and economic realities (administrative boundaries) and limitations in predicting or measuring changes (technical boundaries) (Beanlands and Duinker 1983). Each of these boundaries should be documented, as described below, to enable the reader to understand the basis for the assessment.

Assessment boundaries should be established as early in the assessment process as possible (*e.g.*, prior to or in the AIR), in part because the boundaries will determine the scope of data required to support the assessment. Assessment boundaries may be determined iteratively and therefore subject to change as new information – for example, about the extent of potential project or cumulative effects – becomes available during the course of the assessment. If the assessment boundaries in the Application differ from those specified in the AIR, the rationale for any such change should be documented in the Application.

Boundaries should be established and articulated separately for each VC, to reflect the characteristics specific to each VC, as explained more fully below.

3.1.1 SPATIAL BOUNDARIES

Spatial boundaries encompass the areas within which the project is expected to have potential effects on the selected VCs. Defining appropriate spatial boundaries ensures the consideration of all important potential effects, including cumulative effects.

There are usually several scales of spatial boundaries that are relevant to an assessment. The smallest scale includes the **footprint** of temporary and permanent physical works associated with the project and the area within which physical activities associated with the project will occur. This area, sometimes called the project boundary (Beanlands and Duinker 1983), is normally described in the project description section of the assessment.

The next scale of spatial boundary, referred to as the **Local Study Area** (or Local Assessment Area), typically comprises a larger area within which all (or most) potential project effects are expected to occur. The Local Study Area encompasses the zone of influence of the project, including areas that may be affected by project effects, such as air contaminants, noise, light, effluents, wastes, employment, and use of services and infrastructure. In some cases, modeling may be required to determine the appropriate extent of the Local Study Area.

A larger **Regional Study Area** (or Regional Assessment Area) is used to provide context for the assessment of potential project effects. The Regional Study Area is typically based on a natural transition (*e.g.*, watershed boundary, ecological zone) or an artificial delineation (*e.g.*, political or economic district or zone) that is relevant to the VC. The Regional Study Area is often, but not always, used as the spatial boundary for the assessment of potential cumulative effects. The Regional Study Area boundary should be at an appropriate scale that provides relevant context for consideration of project effects, offers useful and meaningful data, and neither over-emphasizes nor under-emphasizes the scale of the project effects.

The spatial boundary for cumulative effects assessment should encompass the area within which the residual effects of the reviewable project on a given VC are likely to interact cumulatively with the residual effects of other past, present, and reasonably foreseeable future projects and activities on that VC.

Spatial boundaries should consider the spatial characteristics of the VC, such as appropriate population units or other VC-specific parameters, to encourage meaningful evaluation of residual effects and determination of significance.

For each VC, the rationale for selecting the spatial boundaries should be documented.

3.1.2 TEMPORAL BOUNDARIES

Temporal boundaries encompass the periods during which the project is expected to have potential effects on the selected VCs.

There are two types of temporal boundaries to consider in the assessment.

First, the temporal limits of the project, expressed at a large scale as the different phases of the project (*e.g.*, construction, operation, decommissioning) and at a finer scale as the timing of specific project activities, must be considered. These temporal characteristics are normally described in the project description section of the assessment and are relevant to all VCs.

Second, the temporal characteristics of the VCs, which will vary by VC, must be considered. Examples of these temporal characteristics include the timing and duration of sensitive or critical life stages of biological VCs (*e.g.*, spawning, nesting, over-wintering) and of important human activities (*e.g.*, economic cycles, busy tourism and recreation seasons). These characteristics are important to understand *when* and *for how long* certain VCs may be affected by the project.

Where relevant, VC-specific temporal boundaries relevant to the assessment should be documented.

3.1.3 ADMINISTRATIVE BOUNDARIES

Administrative boundaries refer to the limitations imposed on an environmental assessment by political, economic, or social constraints. These may include existing datasets that are collected on the basis of regional or provincial boundaries that are not the same as the spatial boundaries of the selected VCs, and which may therefore constrain the assessment of potential effects in some way. For example, some social and economic data are compiled based on Statistics Canada or BC Stats boundaries, such as Census subdivisions. These areas may not align with Local or Regional Study Areas and may constrain the assessment. Administrative boundaries may also include limits imposed on the assessment due to fiscal or other resourcing constraints.

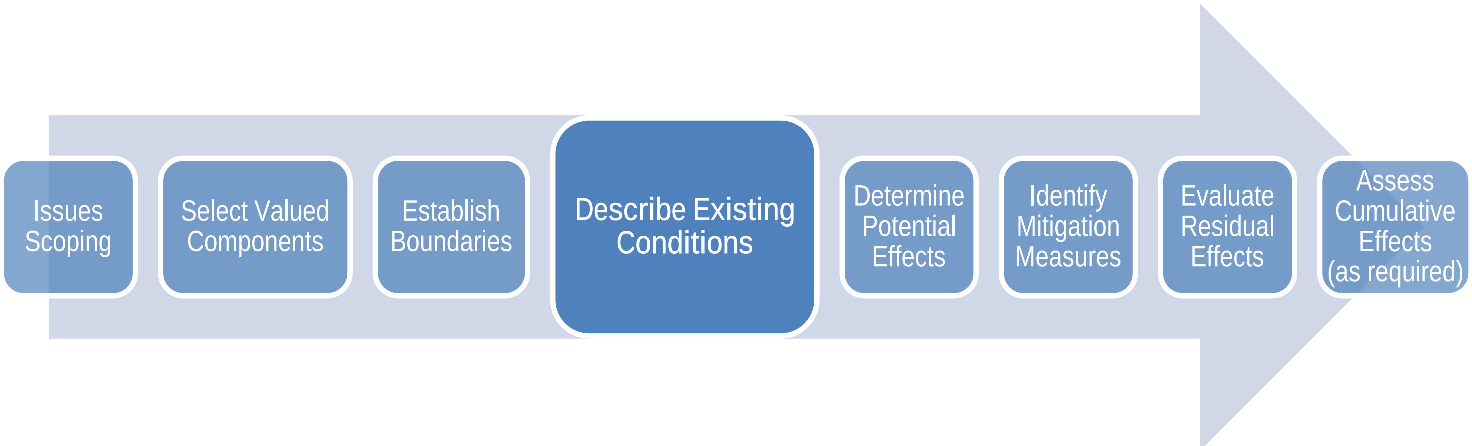
Administrative boundaries may not apply to every selected VC or every assessment. However, where administrative boundaries *have* constrained the identification and/or assessment of potential effects of a reviewable project, the nature of the administrative boundaries and their effect on the assessment should be documented.

3.1.4 TECHNICAL BOUNDARIES

Technical boundaries refer to the constraints imposed on an environmental assessment by limitations in the ability to predict the effects of a project. For example, technical boundaries may include difficulties in accessing parts of a study area (*e.g.*, in rugged or hazardous areas) or challenges associated with sampling reclusive species, leading to a gap in data about a selected VC. The use of models may also impose technical limitations on the analysis (*e.g.*, margin of error).

Technical boundaries may not apply to every selected VC or every assessment. However, where technical boundaries *have* constrained the identification and/or assessment of potential effects of a reviewable project, the nature of the technical boundaries and their effect on the assessment should be documented. The issue of uncertainty in environmental assessment is discussed further in Section 3.5.4 of this Guideline.

3.2 EXISTING CONDITIONS



For each selected VC, the existing conditions within the study area should be described in sufficient detail to enable potential project-VC interactions to be identified, understood, and assessed. This may include not only a description of the characteristics of the VC itself, but also of other environmental components upon which the integrity of the VC relies. For example, if the VC has been defined as “fish”, the assessment should describe not only the characteristics of the fish population, but also the important habitat features upon which that population depends for survival.

The description of existing conditions should include natural and/or human-caused trends that may alter the environmental or socio-economic setting irrespective of the changes that may be caused by the project or other projects and activities in the local area. This may include population fluctuations, forecast climatic changes in temperature or precipitation, natural succession or regeneration, reclamation, or other trends that are important for understanding how the sensitivity of the VC to project effects and cumulative effects may change over time.

The description of existing conditions should also explain if and how other past and present projects and activities in the study area have affected or are affecting each VC, to support the consideration of potential cumulative effects. This may include earlier phases or activities (*e.g.* exploration) of the project.

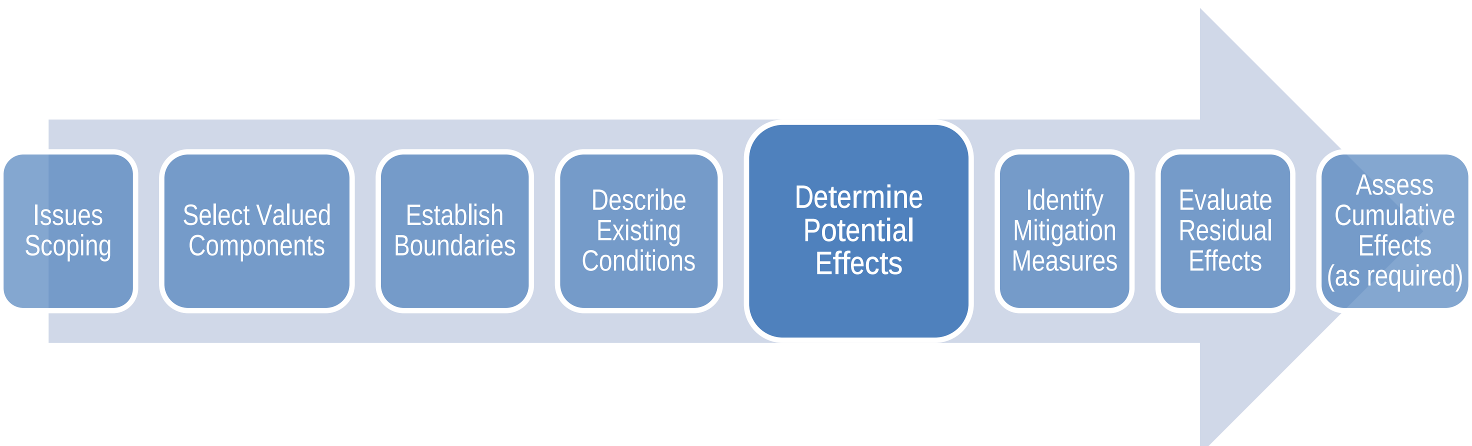
The development of the existing conditions description should include, but may not be limited to:

- review of existing, available databases and literature, such as the BC Conservation Data Centre, the BC Ministry of Environment’s Cross-Linked Information Resources application, GeoBC, the Provincial Archaeological Report Library and Provincial Archaeological Site Inventory, BC Stats community profiles, and so on;
- review of previous environmental assessments for similar projects and for other types of projects in the same region;
- the available results of previous monitoring programs, if any;

- provincial land use plans (*e.g.*, Land and Resource Management Plans) and other regional and local studies and plans (*e.g.*, Official Community Plans, Regional Growth Strategies, Regional Sustainability Strategies, Climate Action Plans, and other environmental, social, and/or economic development strategies), if any;
- available remote sensing imagery and data;
- available ethnographic information, traditional knowledge, and Traditional Use Studies, if any (subject to any confidentiality constraints that may apply); and,
- project- and VC-specific field studies as required to address key data gaps.

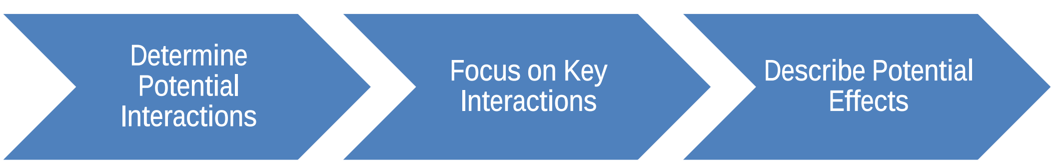
Where additional project- and VC-specific field studies are determined to be required to address key data gaps, the scope of and methods to be used for such studies should follow existing published guidance documents pertaining to data collection and analysis methods, where these are available. Where methods used for the assessment deviate from applicable published guidance, the rationale for the variance should be clearly documented. Consideration should be given as to whether the project or existing conditions of the VC warrant variation from common EA practices for assessment the VC.

3.3 POTENTIAL EFFECTS



A critical step in the assessment process is to determine how the selected VCs may be affected by the project. The basic steps in this process are shown in Figure 5.

Figure 5. Steps in Determining Potential Effects



To support the identification of potential effects on VCs that may result from the construction, operation, and/or decommissioning of the project, it is useful to begin by identifying the potential interactions between the various physical works and activities and the selected VCs. This is often achieved using a simple interaction matrix, such as the following.

Project Activities	Selected Valued Components					
	VC 1	VC 2	VC 3	VC 4	VC 5	VC 6	*Etc.*
Construction							
Project Activity 1	●	●		●	●		
Project Activity 2	●		●	●		●	
Etc.							
Operation							
Project Activity 3		●	●	●	●	●	
Project Activity 4		●	●	●			
Etc.							
Decommissioning							
Project Activity 5	●	●		●			
Project Activity 6	●		●	●		●	
Etc.							

Preliminary evaluation of the identified interactions will allow the assessment to be focused on those project-VC interactions of greatest importance. In particular, further analysis may not be warranted for project-VC interactions that are known to have no or negligible adverse effects, or possibly those that are already well regulated or managed under another government process.

For some potential adverse effects, there are proven effective mitigation measures or Best Management Practices (BMPs) that would eliminate or reduce to a negligible level any residual adverse effects, and that the proponent commits to implement. Consideration should be given to these measures or BMPs to determine what additional assessment may be required for these residual adverse effects or VCs.

If a project-VC interaction is omitted from further analysis, the methods and criteria used and rationale for this determination should be documented in the assessment.

Preliminary evaluation of identified project-VC interactions may also reveal *key* interactions that have greater potential to result in significant adverse residual effects or to be of particular concern to government, Aboriginal groups, or the public. This allows the assessment to be focused on these more important interactions.

This focusing may be achieved by combining the interaction matrix approach described above with a simple ranking to differentiate those interactions that do and do not warrant further analysis, and, of those that do, which are of greatest importance, as shown in the example below. The rationale for identifying key potential interactions should be provided in the assessment. Other ranking methods or tools may be used to focus on important potential project-VC interactions.

Project Activities	**Selected Valued Components**						
	VC 1	**VC 2**	**VC 3**	**VC 4**	**VC 5**	**VC 6**	***Etc.***
Construction							
Project Activity 1	🟢	🟢		🟢	🟡		
Project Activity 2	🔴		🟡	🔴		🟡	
Etc.							
Operation							
Project Activity 3		🔴	🔴	🔴	🟡	🟡	
Project Activity 4		🟡	🟡	🟡			
Etc.							
Decommissioning							
Project Activity 5	🟢	🟢		🟢			
Project Activity 6	🟡		🟡	🟡		🟡	
Etc.							

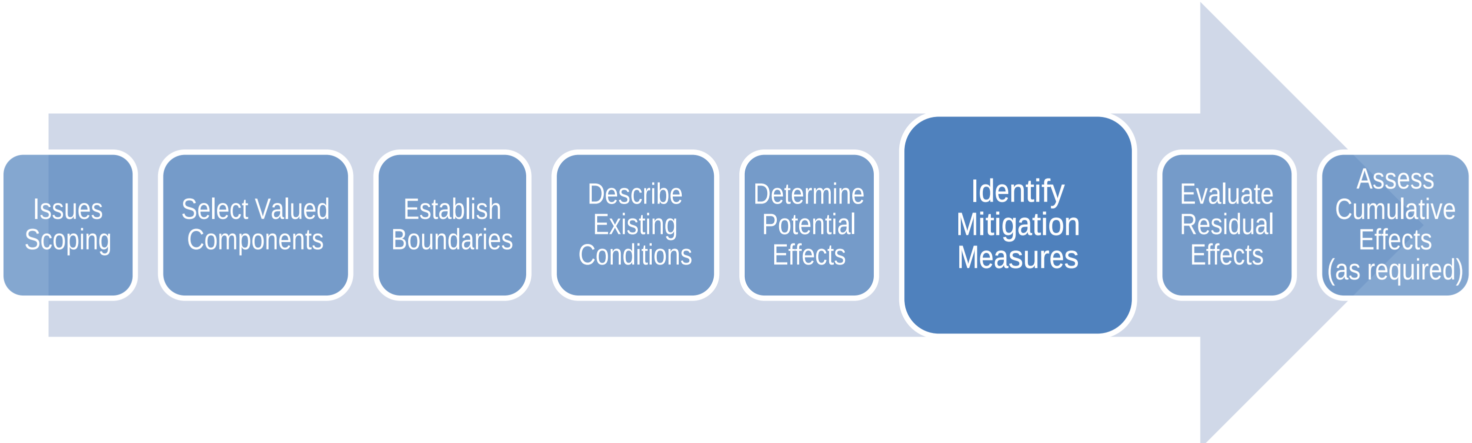
Note:
🟢 = No or negligible adverse effect expected; no further consideration warranted.
🟡 = Potential adverse effect requiring additional mitigation; warrants further consideration.
🔴 = Key interaction resulting in potential significant adverse effect or significant concern; warrants further detailed consideration.

Consultation between the proponent, EAO, and technical experts within government agencies may be useful for exploring the nature of potential project-VC interactions and determining when reliance on other regulatory or management processes or proven effective mitigation and BMPs may be appropriate.

For those project-VC interactions carried forward in the assessment, the potential effects, both adverse and positive (if any), arising from those interactions should be described in clear language and enough detail to enable a non-technical reviewer to understand the cause, type, and nature of potential effects.

Diagrams may be useful to illustrate complex effect pathways that may involve multiple intermediate components or media (as in the sediment discharge – water quality – benthic habitat – fish example presented in Figure 4 in Section 2.1).

3.4 MITIGATION



Definition of Mitigation

The Act, under section 10, refers to mitigation as:

> *"practical means of preventing or reducing to an acceptable level any potential adverse effects of the project."*

The BC Ministry of Environment defines a "mitigation measure" as action taken:

> *"to avoid, minimize, restore on-site, or offset impacts on environmental values and associated components, resulting from a project or activity"* (Ministry of Environment 2012b).

Although the above definition is focused on environmental aspects, EAO also applies the four types of mitigation identified – avoidance, minimization, restoration, and compensation/offset –to adverse economic, social, heritage, and health effects.

The *Canadian Environmental Assessment Act, 2012* defines "mitigation measures" as:

> *"Measures for the elimination, reduction or control of the adverse environmental effects of a designated project,*[7] *and includes restitution for any damage to the environment caused by those effects through replacement, restoration, compensation or any other means."*

EAO considers mitigation to be any practical means or measures taken to avoid, minimize, restore on-site, compensate, or offset the potential adverse effects of a project. Compensation means measures taken to further reduce the residual effect, and

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[7] "Designated project" refers to projects that are deemed reviewable pursuant to the *Canadian Environmental Assessment Act, 2012*, in a manner similar to the "reviewable project" designation pursuant to the BC *Environmental Assessment Act*.

may include direct physical measures, such as habitat enhancement, restoration, or creation on, near, or away from the project site, or financial mechanisms, such as contributions to research, recovery plans, population enhancement programs for endangered species, and so on, that have the outcome of reducing the residual effect. Offset is defined in the *Procedures for Mitigating Impacts on Environmental Values (Environmental Mitigation Procedures)* (MOE 2012b) as means to counteract, or make up for, a residual impact on an environmental component.

The assessment must describe the technically and economically feasible (*i.e.*, practical) measures proposed to mitigate to an acceptable level potential adverse effects of the project on selected VCs. Decisions regarding the need for and scope of mitigation, including compensation or offset, should not pre-suppose the outcome of the assessment.

The assessment should describe the mitigation measures incorporated into the project, including site and route selection, project scheduling, project design (*e.g.*, equipment selection, placement, emissions abatement measures), and construction and operation procedures and practices. Standard mitigation, BMPs, environmental management plans, environmental protection plans, contingency plans, emergency response plans, and other general practices assumed or proposed to be implemented by the proponent should also be described. This description should clearly indicate what VCs and/or potential adverse effects will be addressed by these measures. Finally, any additional measures required to mitigate adverse effects on specific VCs should be described. The rationale for the proposed suite of mitigation, including why further avoidance or reduction measures may not be feasible, and the need for and scope of any proposed compensation or offset, should be provided in the assessment.[8]

The description of proposed mitigation measures should demonstrate the technical and economic feasibility of the measures, including the suitability of the measures for project- and site-specific application, if necessary. The level of detail provided should be commensurate with the risk associated with the potential effect being mitigated (*i.e.*, likelihood of significant adverse effect), and the degree to which the proposed mitigation has been proven effective in the same or similar applications elsewhere. Any uncertainty associated with the effectiveness of proposed mitigation measures should be noted in the assessment; please refer to Section 3.5.4 for further discussion of uncertainty in relation to residual effect predictions in the assessment.

The assessment should describe the time required for mitigation to become effective, to enable understanding of the duration of residual effects and the temporal characteristics of reversibility (discussed in Section 3.5.1 below).

It is important to note that mitigation measures may not be required for all potential effects, and, further, that compensation or offset may not be warranted for all effects remaining after other practicable avoidance, minimization, and restoration measures have been implemented,

[8] Refer to the Environmental Mitigation Policy and Procedure in development by the BC Ministry of Environment for more information: http://www.env.gov.bc.ca/emop/.

particularly if the residual effect remaining after these measures is considered acceptable or not significant.

A Note about Compensation

By definition, a residual effect is the effect remaining after the implementation of all mitigation, *including* compensation and offset measures. In some cases, residual effects may be completely eliminated through compensation, particularly when compensation comprises on-site or proximal habitat compensation.

For example, net loss of fish habitat is usually fully avoided through the implementation of habitat compensation at or greater than a ratio of 1:1. In this example, by definition, there would be no residual effect. Regardless of the effectiveness and extent of mitigation and compensation, there will be a residual physical *change* in the environment, comprised of the original habitat loss, the habitat offset, and in some cases, a habitat loss caused by the habitat compensation (which would also be offset).

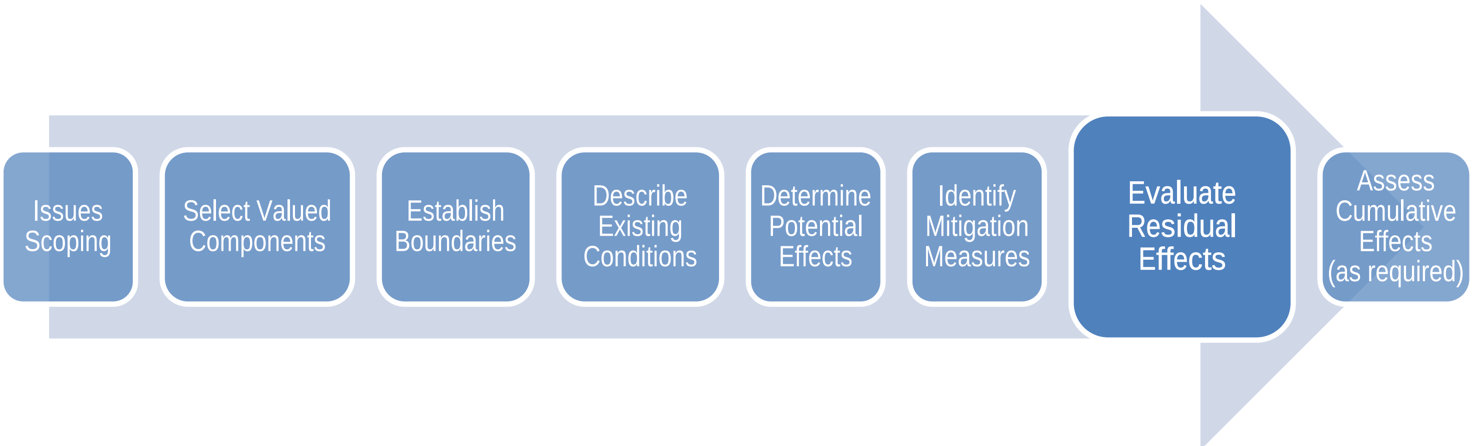
Characterizing the residual change in the VC is required to fully understand the consequences of the project being assessed. This characterization is best undertaken in the context of describing the proposed suite of mitigation, including the need for and scope of compensation/offset. In other cases, compensation may not fully eliminate the residual effect, particularly if compensation is incomplete, takes time to achieve, is temporary, and/or is situated away from the project effect.

Also, the use of financial offset mechanisms typically does not fully eliminate residual effects. In all cases, the assessment should describe the need for and scope of compensation/offset, and should clearly indicate whether there is a residual change in the VC and whether there is a residual effect.

Where a reviewable project is expected to contribute to cumulative effects, the assessment may identify measures to mitigate the effects arising from other projects and activities on the landscape. Such measures may appropriately be the responsibility of the government or other parties. The need for and scope of such measures, and the likely responsible party or parties, should be discussed in the assessment to the extent feasible.

Timely consultation between the proponent, EAO, and Working Group members, including Aboriginal groups, may be useful to identify opportunities to avoid or prevent potential adverse effects before key design decisions are made, and, during the assessment, to develop appropriate mitigation strategies. If there is potential for a significant residual adverse effect after avoidance, minimization, and restoration measures, the need for and scope of compensation and/or offset should be discussed among the relevant parties.

3.5 EVALUATING RESIDUAL EFFECTS



Residual effects are those effects remaining after the implementation of all mitigation measures, and, therefore are the expected consequences of the reviewable project for the selected VCs.

The evaluation of residual effects, as described in this section, should focus only on residual adverse effects. This section describes good practice in characterizing and determining the significance of residual effects, as outlined in Figure 6.

Figure 6. Steps in Evaluating Residual Effects

3.5.1 CHARACTERIZATION OF RESIDUAL EFFECTS

To inform the determination of the significance of a residual (adverse) effect, it is necessary to characterize the residual effect. In good environmental assessment practice, residual effects are usually described using standard residual effects criteria: context, magnitude, extent, duration, reversibility, and frequency. These criteria are summarized in the following box, and are explained in greater detail below. Figures are provided to illustrate key concepts. Other factors may also be considered. Although significance is only determined for potential residual effects, potential positive residual effects, if any, should also be characterized.

Summary of Criteria for Characterizing Residual Effects

Context refers primarily to the current and future sensitivity and resilience of the VC to change caused by the project. Consideration of context draws heavily on the description of existing conditions of the VC, which reflect cumulative effects of other projects and activities that have been carried out, and especially information about the impact of natural and human-caused trends in the condition of the VC.

Magnitude refers to the expected size or severity of the residual effect. When evaluating magnitude of residual effects, consider the proportion of the VC affected within the spatial boundaries and the relative effect (e.g., relative to natural annual variation in the magnitude of the VC or other relevant characteristic).

Extent refers to the spatial scale over which the residual effect is expected to occur.

Duration refers to the length of time the residual effect persists (which may be longer than the duration of the physical work or activity that gave rise to the residual effect).

Reversibility pertains to whether or not the residual effect on the VC can be reversed once the physical work or activity causing the disturbance ceases.

Frequency refers to how often the residual effect occurs and is usually closely related to the frequency of the physical work or activity causing the residual effect.

Context refers primarily to the current and future *sensitivity* and *resilience* of the VC to change that may be caused by the project. The consideration of context draws heavily on the description of the existing conditions of the VC (discussed in Section 3.2 above), which will reflect the cumulative effects of other projects and activities that have been carried out, and especially on information about the natural and/or human-caused trends in the condition of the VC. For example, a species that is already endangered or threatened is probably more susceptible to adverse effects from additional disturbance than is a species that is secure. Similarly, a community that is already struggling to adapt to population increases may be less resilient to additional demands on infrastructure and community services.

However, the extent of past disturbance is not a reliable indicator of sensitivity or resilience: a “pristine” environment may exhibit low sensitivity and high resilience *or* high sensitivity and low resilience. Likewise, a “disturbed” environment may be susceptible to additional disturbance or may be highly adaptive. Thus, “pristine” and “disturbed” are not suitable terms to use to characterize context in relation to residual effects. Rather, the assessment should indicate the level of sensitivity and/or resilience (*e.g.*, using qualitative terms, like ‘low’, ‘medium’, or ‘high’, clearly defined for each VC), and explain the key factors contributing to the ranking of sensitivity and/or resilience.

Context is considered one of the most critical factors when evaluating the importance of residual effects. The proponent must consider environmental, economic, social, heritage, and/or health factors affecting the sensitivity and/or resilience of the VCs. EAO and decision-makers may also take *additional* contextual factors into consideration, such as government policy priorities and provincial or regional management objectives. Additional supporting narrative is required to explain contextual factors that cannot adequately be communicated in a simple ranking.

Magnitude refers to the expected size or severity of the residual effect. When evaluating the magnitude of the residual effect, relevant factors to consider include the proportion of the VC affected within the spatial boundaries and the relative effect (*e.g.*, relative to natural annual variation in the magnitude of the VC or other relevant characteristic).

Magnitude may be described quantitatively, where empirical data are available, or qualitatively, using terms such as 'low', 'moderate', and 'high'. However, the use of qualitative terms should be accompanied by distinct definitions for each of these rankings that clearly delineate the different levels of magnitude. For example, a 'low' magnitude residual effect may be one that is within the range of natural variation and/or affects a specified small percentage of the population (*e.g.*, less than 10 percent), while a 'high' magnitude residual effect may be one that is outside the range of natural variation and/or affects all or a large percentage of the population. The definitions of each level of magnitude may vary by VC, and should be documented in the assessment, so that any non-technical reader can understand the nature of the residual effect. The definitions should be sufficiently clear, thorough, and unambiguous to allow different reviewers and readers to reach the same classification for a given residual effect on a VC.

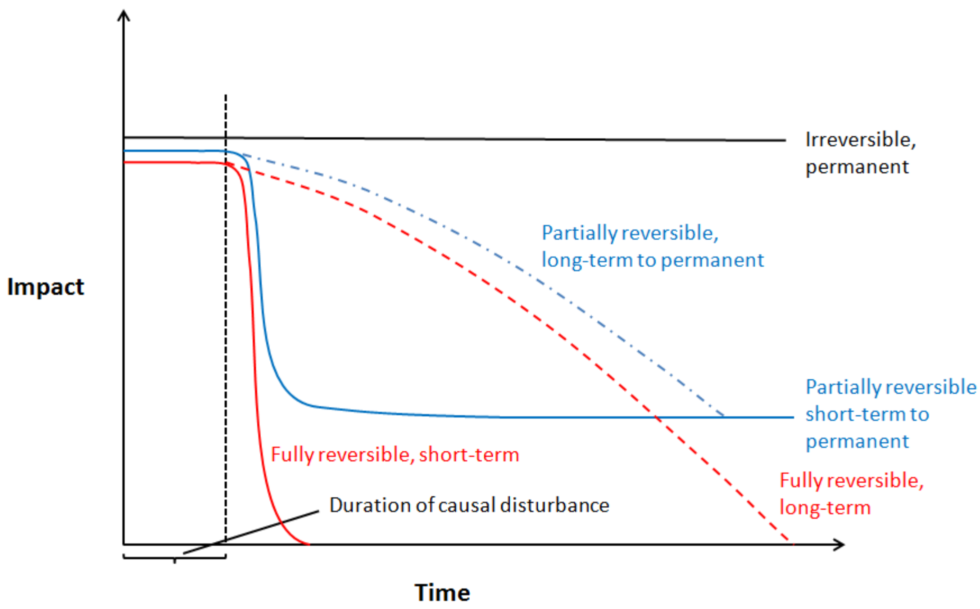
It is important to note that a high magnitude residual effect does not necessarily mean that the residual effect will be significant. Other factors, such as high resilience, short duration, and/or reversibility, may serve to render a high magnitude residual effect not significant.

Extent refers to the spatial scale over which the residual effect is expected to occur. Typically, a residual effect may be described as site-specific, local, sub-regional, regional, or greater in extent. As the spatial scale of each VC varies, so too may the definitions of the VC-specific spatial scales of the residual effect. That is, the scale of a "local" or "regional" effect may be different for different VCs. Thus, it is important to define each scale used for each VC. It may also be useful to state the extent of the residual effect in relation to the distribution of the VC, to clarify the scale of the residual effect.

Duration refers to the length of time the residual effect persists (which may be longer than the duration of the physical work or activity that gave rise to the residual effect). **Reversibility** pertains to whether or not the residual effect on the VC can be reversed once the physical work or activity causing the disturbance ceases. A residual effect may be fully reversible, partially reversible, or irreversible. In this regard, reversibility is closely linked with duration: an irreversible residual effect is of permanent duration, while the length of time required for the VC to fully or partially revert to its pre-effect condition or functionality may vary.

This relationship is illustrated in Figure 7. In this figure, the causal disturbance lasts until the vertical black dashed line (for clarity, the resulting effect is shown as slightly different for the black, red, and blue lines). The solid black line illustrates an effect that is both irreversible and permanent – it does not diminish at all over time. The blue lines illustrate partially reversible effects – the effect illustrated by the solid blue line diminishes quickly after the causal disturbance ceases, while the dashed blue line diminishes over the longer term. Finally, the red lines illustrate a fully reversible effect. Similar to the blue lines, the effect illustrated by the solid red line diminishes quickly after the causal disturbance ceases, while the dashed red line diminishes over the longer term.

Figure 7. Relationship between Reversibility and Duration



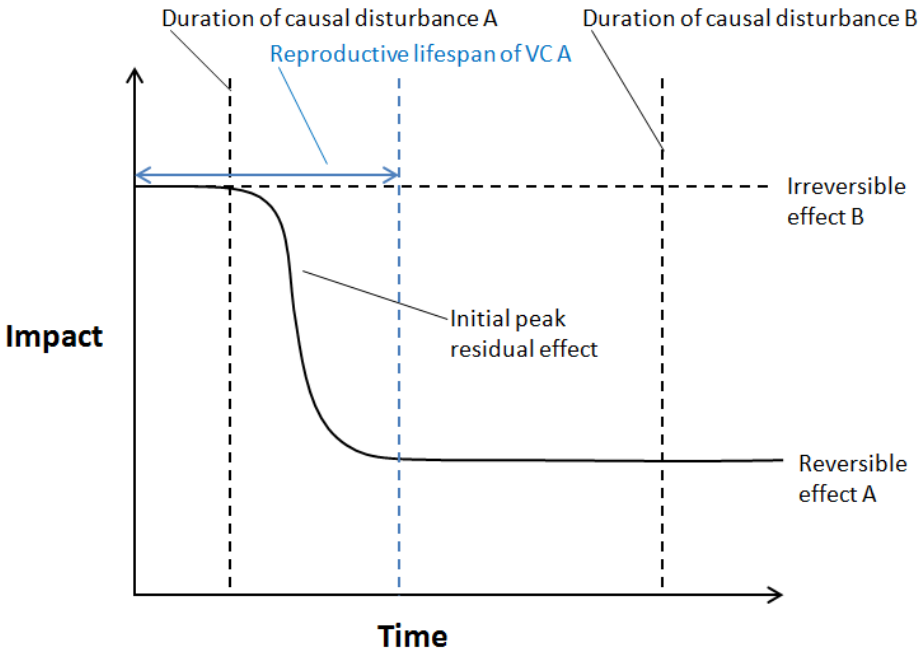
Although partially reversible residual effects will also be considered permanent, the duration of the initial peak residual effect should be noted when it is considered a major determinant of significance.

The length of time (*i.e.*, hours, days, weeks, months, or years) associated with each duration ranking of a reversible effect (*i.e.*, short-term, medium-term, long-term) should be defined for each VC. Duration is often expressed relative to the duration of the project lifespan; however, for many biological VCs, the more relevant duration is relative to the lifespan of the organism. Expressing the duration in units of time, such as years, provides clarity and allows comparison to both VC and project lifespans.

The duration of the physical work or activity causing the disturbance (“causal disturbance”) and the initial residual effect may alter the reversibility of the residual effect, depending on the temporal characteristics of the VC. An example of this relationship is shown in Figure 8. The vertical blue dashed line shows the reproductive lifespan of a VC (*e.g.*, bull trout), while the two vertical black dashed lines show the duration of two different causal disturbances.

In this example, causal disturbance A persists for less time than the reproductive life span or critical life stage of the VC, and therefore the residual effect may be fully or partially reversible. This is shown by the solid black line labeled “reversible effect A”. However, causal disturbance B is much greater than the duration of the reproductive lifespan or critical life stage of the VC, and therefore the residual effect becomes irreversible. This is shown by the horizontal black dashed line labeled “irreversible effect B.”

Figure 8. Relationship between Duration of Causal Disturbance and Reversibility

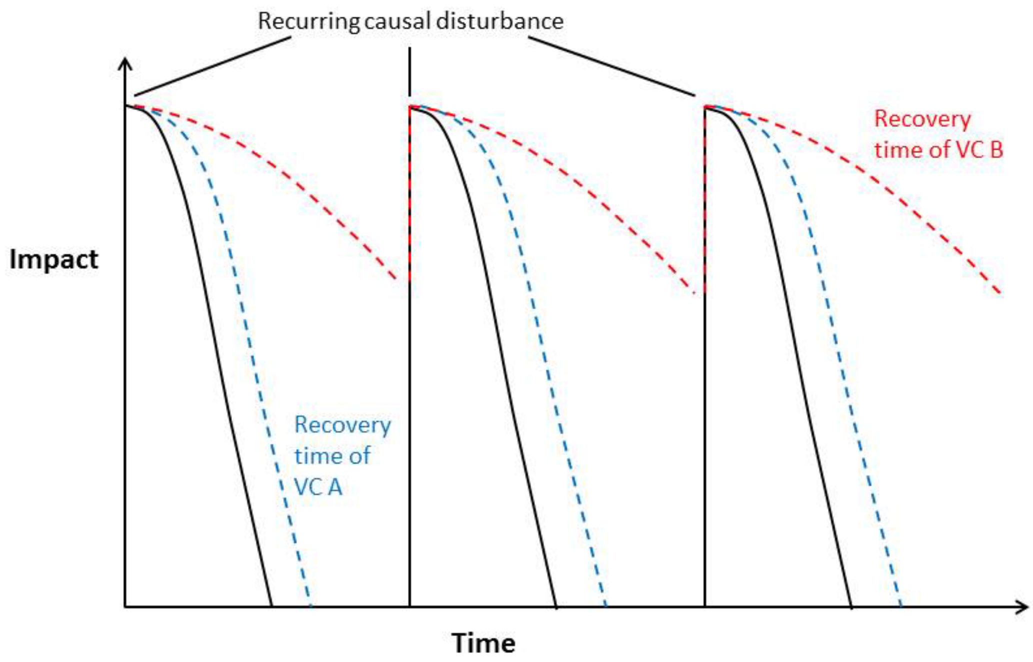


As illustrated by the examples, although reversibility may occur during the lifespan of the project or after project closure, the expected time of effect reversal should be estimated and discussed.

Frequency refers to how often the residual effect occurs and is usually closely related to the frequency of the physical work or causal disturbance resulting in the residual effect.

The importance of frequency as a factor in evaluating the significance of a residual effect is connected to how quickly a VC recovers from a causal disturbance. In Figure 9, the solid black lines show the causal disturbance. The dashed blue line illustrates a scenario in which the VC is able to fully recover between causal disturbances, while the dashed red line illustrates a scenario in which the VC is only able to partially recover between causal disturbances. Note that in some cases, a VC may not recover at all from a causal disturbance.

Figure 9. Effect of Frequency on Valued Component Recovery



Frequency may be described in specific terms (*e.g.*, number of occurrences per unit of time) or general terms (*e.g.*, once, rare, infrequent, occasional, frequent, continuous). If general terms are used to describe frequency, the relevant temporal scales should be defined for each VC (*e.g.*, infrequent means fewer than *X* occurrences per unit of time, while frequent means more than *X* occurrences per unit of time), so the reader can understand the nature of the residual effect. Where relevant, the assessment should discuss the capacity of the VC to fully recover between recurrent causal disturbances and, in cases where the VC *cannot* recover, fully or partially, between recurrent disturbances, whether this alters the potential significance of the residual effect.

It is common to summarize the residual effects characterization in tabular form in the assessment, ranking each of the criteria discussed above. However, a tabular summary alone is not sufficient to communicate the nature of the residual effect with enough clarity to promote understanding of the key aspects of the potential residual effect relevant to the determination of significance. The assessment should include a narrative description of key aspects of the predicted residual effect, including, in particular, important contextual considerations and how the residual effect may change over time. The basis for the residual effects characterization should be described; where possible, the characterization should draw on available published data. The description of the residual effects characterization should be presented in clear, non-technical language.

3.5.2 LIKELIHOOD

Likelihood refers to whether or not a residual effect is likely to occur. This may be influenced by a variety of factors, such as the likelihood of a causal disturbance occurring or the likelihood of mitigation being successful.

Generally speaking, the residual effects described in the assessment comprise the proponent's best prediction of what is *likely* to occur as a result of a proposed project, assuming a suite of proposed mitigation is implemented. In this regard, the likelihood that the predicted residual effects will occur is generally high.

Important exceptions exist. A proponent may take a conservative approach, particularly if data gaps exist, and assess a 'worst-case' impact scenario. For example, in the case of a sensitive biological VC, like a rare plant that *may* occur but has not been confirmed to occur in the project area, the proponent may assume the rare plant is present and will be affected by the project. The predicted residual effect may then be considered to be of low or moderate likelihood, particularly in light of follow-up programs that would confirm the presence or absence of the rare plant prior to construction.

The other exception pertains to unintentional project-related events, such as accidents and malfunctions. Certain mitigation measures, such as contingency and emergency prevention and preparedness planning, will reduce the likelihood that unintentional events will occur. However, the assessment must still consider the potential effects that could result from unintentional project-related events. In such cases, the likelihood of the residual effect may range from low to high, depending on the likelihood of occurrence of the unintentional event causing the residual effect.

The assessment should indicate the likelihood of the predicted residual effect using appropriate quantitative or qualitative terms, with sufficient description to understand how the conclusions were reached. Qualitative terms, such as 'low', 'moderate', or 'high' probability, should be as clearly defined as possible (*e.g.*, *X* percent chance of occurring, or <*X* percent probability) to avoid varying interpretations by different readers. The basis for the likelihood determination should be described; where possible, the determination of likelihood should draw on available published data.

3.5.3 DETERMINATION OF SIGNIFICANCE

3.5.3.1 DEFINING SIGNIFICANCE

The potential for significant adverse residual effects is a key consideration in determining whether or not an Environmental Assessment Certificate is issued for a proposed project. It is therefore important to ensure the determination of significance is clearly documented and explained in the assessment. In particular, the assessment should clearly define how the term ‘significance’ has been used in relation to each VC. This definition may comprise either a quantitative or qualitative[9] threshold that describes the point beyond which a residual effect would be considered significant. When defining significance for each VC, consideration should be given as to how each of the criteria for characterizing residual effects would inform a determination of significance.

In some instances, thresholds established for some VCs by legislation, regulation, or regulatory standard may be used. Such thresholds are often established to protect a key value, such as human or environmental health. For example, Canada-wide Standards established under the Canada-wide Environmental Standards Sub-agreement set numerical targets for ground-level ozone, particulate matter, petroleum hydrocarbons in soil, mercury emissions, and other contaminants. Where such thresholds exist, consideration should be given as to whether exceedance of the threshold is an appropriate indication of significance.

For many VCs, legislated or regulated thresholds do not exist, and the significance definition should consider relevant VC-specific factors, such as species population integrity, capacity limits of municipal services or infrastructure, resource management objectives, or other appropriate factors. In such instances, the assessment should identify the relevant VC-specific factors and explain how they were considered in the determination of significance. However, establishing a significance threshold based on some standard formulaic combination of the residual effect rating criteria described in Section 3.5.1 is not appropriate.

Clearly articulating the definition of significance for each VC, including any quantitative or qualitative threshold(s) or other factors used, provides a transparent and credible basis for the significance determination, and will support the conclusions of the assessment. Ideally, the definition of significance for VCs should occur early in the assessment process, but should remain flexible to accommodate new information gathered during the assessment. The significance definition used should be clearly documented for each VC. Consultation between the proponent and EAO and Working Group members will be useful to develop appropriate project- and VC-specific significance definitions for the purposes of assessment.

3.5.3.2 EVALUATING SIGNIFICANCE

The significance of residual effects should be determined for each VC. Significance need not be determined for indicators, when these have been used to facilitate the evaluation of potential effects on a VC.

The proponent should take the residual effects characteristics (described in Section 3.5.1) into consideration, and, drawing on the information compiled from a review of relevant literature, data collected through field studies, and consultation with experts, use their professional judgment to render a determination of the overall significance of effect. It is crucial for the

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[9] A qualitative threshold is a threshold based on a non-empirical quality of the VC, such as ability to continue a type of land use activity.

assessment to clearly articulate whether or not the residual effect is expected to be significant, and provide the rationale for that determination in sufficient detail. The assessment should clearly indicate how or whether consideration of likelihood has influenced the determination of significance. For example, if likelihood is a key factor in the determination of significance, particularly if a residual adverse effect is determined to be not significant because it is unlikely, the assessment should document the rationale for this determination.

While the proponent provides their assessment of significance in the Application, EAO will make an independent determination of significance in its Environmental Assessment Report.

A Note about Cumulative Effects

Significance should usually be determined for *both* the residual effects of the project and the cumulative effects. This is critical to enable an informed decision about the project. It is important to understand the characteristics and significance of the potential project-specific residual effects in order to also understand the relative contribution of the project to cumulative effects.

For example, an assessment may conclude that the cumulative effects on a VC will be significant, but that the reviewable project itself has only a very small non-significant residual effect on that VC, and the bulk of the cumulative effects arise from other projects and activities. This information enables the decision-makers to properly weigh the adverse effects and benefits of the project, while also identifying the need for action to address cumulative effects of other projects and activities that may fall outside the purview of the environmental assessment process. Thus, the assessment should include enough information about the project-specific residual effects to enable the reader's understanding about the contribution of the project to cumulative effects.

3.5.4 CONFIDENCE AND RISK

Once the residual effect prediction has been described in terms of significance and likelihood, it is important to explain the **level of confidence** in each prediction. The **level of confidence** is typically based on expert judgment, and should characterize the level of uncertainty associated with both the significance and likelihood determinations. Specifying the level of confidence associated with these determinations allows the decision-maker to better evaluate the risk associated with the project.

The assessment should provide the best possible residual effect prediction based on the available information and professional judgment. However, in some instances, limitations in the available data may make residual effect predictions difficult. For example, there may be incomplete information about the vulnerability of the VC or about the nature of the project-VC interaction, or the project may involve new technology, the effects of which are not fully understood, or mitigation measures that have not yet been proven. Where there are such data gaps, the residual effect prediction may have a *lower level of confidence*. That is, the possibility that the outcome may be different from the predicted residual effect is greater. The outcome may or may not be different in terms of significance or likelihood. An alternate way of phrasing this is that as the level of confidence associated with the residual effect prediction decreases, the uncertainty associated with the project's predicted effects becomes greater.

Thus, it is important to clearly describe the sources and nature of uncertainty associated with any residual effect prediction in the assessment to provide the basis for the stated level of confidence. In particular, the practitioner should articulate how any identified uncertainty may affect either the significance or the likelihood of the predicted residual effect.

In most cases, uncertainty (particularly low to moderate uncertainty) can be adequately addressed through monitoring or other follow-up programs that confirm actual residual effects are as predicted, that mitigation measures are implemented as described in the Application (and are required by conditions of the Environmental Assessment Certificate and/or other authorizations), and that mitigation measures are effective. Adaptive management[10] programs that facilitate action when unforeseen effects occur or the need for new or modified mitigation is identified can serve to effectively manage low to moderate levels of uncertainty. The assessment should describe the need for and scope of monitoring or other follow-up programs, including adaptive management programs, to address any identified uncertainty.

In certain situations, it may be appropriate to conduct additional risk analysis to more fully characterize the potential risk associated with uncertain outcomes, particularly if there is a low level of confidence coupled with the possibility of a significant residual adverse effect and follow-up programs are not considered sufficient to manage the potential risk. For example, more detailed risk analysis (in terms of likelihood and consequence) may be warranted if the level of confidence associated with the characterization of a residual effect is such that the significance of the residual effect could change as a result of either an incorrect characterization of the residual effect or the consequence of an unintentional project-related event (including mitigation failure).

The need for and scope/methods of more detailed risk analysis should be determined in consultation between the proponent and EAO as early as possible in the environmental assessment.

The focus of any additional risk analysis should be on the source of the uncertainty. For example, if the uncertainty is associated with unproven mitigation, the risk analysis should focus on mitigation failure.

If more detailed risk analysis is deemed to be necessary in relation to uncertain and potentially significant residual adverse effect predictions, the assessment should describe the range of

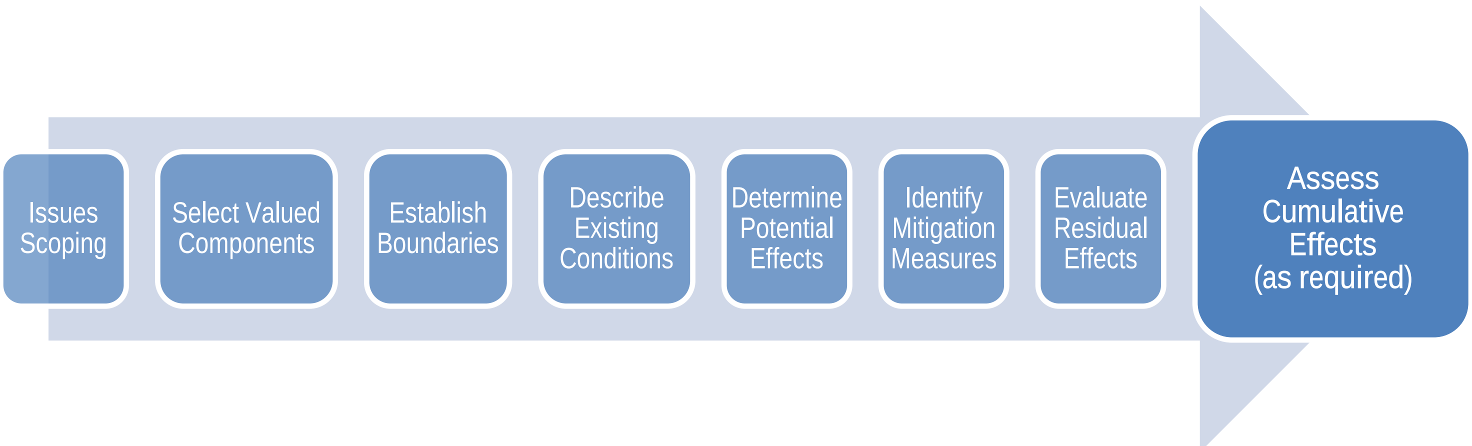
[10] Adaptive management is an iterative process involving ongoing monitoring to inform ongoing management activities.

likely, plausible, and possible outcomes **in terms of potential significance and likelihood**. This information will assist the decision-maker to understand both the likely outcome and the risk of more serious outcomes. As above, the need for and scope of monitoring and follow-up programs to address the uncertainty should be documented. Additional risk analysis may also identify the need for additional mitigation to manage identified risk and uncertainty. The residual effect predictions, including significance and likelihood determinations, and any additional mitigation or follow-up arising from the risk analysis should be documented in the assessment.

To be clear, additional risk analysis is not likely to be required for most residual effect predictions. As the environmental assessment process itself is a risk management process, care must be taken to avoid undertaking unnecessary and redundant risk analysis. Additional risk analysis should only be considered when there is a high degree of uncertainty and potential for a significant adverse residual effect that cannot be sufficiently managed by follow-up programs.

The Risk Management Branch of the BC Ministry of Finance can provide detailed guidance regarding risk analysis methods.

3.5.5 DETERMINING THE NEED FOR CUMULATIVE EFFECTS ASSESSMENT



If a reviewable project is expected to result in any residual adverse effects on the selected VCs, the need for a cumulative effects assessment must be considered. It is important to note that this consideration must be made for *all* residual adverse effects, not only those predicted to be significant.

Of particular relevance to scoping the cumulative effects assessment are the criteria for evaluating relevance of evidence pertaining to the assessment of cumulative effects. These criteria were established by the Joint Review Panel for the Express Pipeline Project in 1996, in the first such review pursuant to the then-new *Canadian Environmental Assessment Act*. The Panel determined that the following criteria must be met for the Panel to consider cumulative environmental effects:

- there must be an environmental effect of the project being proposed;
- that environmental effect must be demonstrated to operate cumulatively with the environmental effects from other projects or activities;
- it must be known that the other projects or activities have been or will be carried out and are not hypothetical; and,
- the cumulative environmental effect must be likely to occur.[11]

In BC, the assessment of cumulative effects for reviewable projects should consider other past, present, and reasonably foreseeable projects and activities, which is consistent with evolving best practice and the federal approach under the *Canadian Environmental Assessment Act, 2012*.

Thus, it is necessary to evaluate predicted residual effects of the reviewable project to determine whether any cumulative interaction with the residual effects of other projects and activities is considered likely to occur. If no cumulative interaction is considered likely, those residual effects need not be carried forward into a cumulative effects assessment. The availability (or lack) of information about the residual effects of other projects and activities should also be considered in the cumulative effects assessment.

Other predicted residual effects of the reviewable project may be negligible and thus not warrant detailed consideration in a cumulative effects assessment. This may be the case for residual effects whose relative contribution to cumulative effects may be so small as to be insignificant. Questions to consider in this regard may include:

- ***Would the residual effect of the project result in a measurable change in the cumulative effect?*** If not, a detailed cumulative effects assessment may not be warranted.
- ***Would the residual effect of the project substantively change the characteristics of the cumulative effect?*** (*e.g.*, substantive increase in magnitude, extent, duration, or frequency)? If not, a detailed cumulative effects assessment may not be warranted.
- ***Is the VC already significantly adversely affected by other projects and activities?*** If so, a detailed cumulative effects assessment may be warranted.
- ***Is the VC so sensitive to additional disturbance that even a small incremental adverse effect may be sufficient to cause a significant adverse cumulative effect?*** If so, a detailed cumulative effects assessment may be warranted.

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[11] The Panel's criteria were established in the context of a federal environmental assessment under the former *Canadian Environmental Assessment Act*, which considered any change the project may cause in the environment and any health and socio-economic, physical and cultural heritage, current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance effects that arise from a change in the environment. Cumulative effects assessment in BC must consider direct economic, social, heritage and health effects as well.

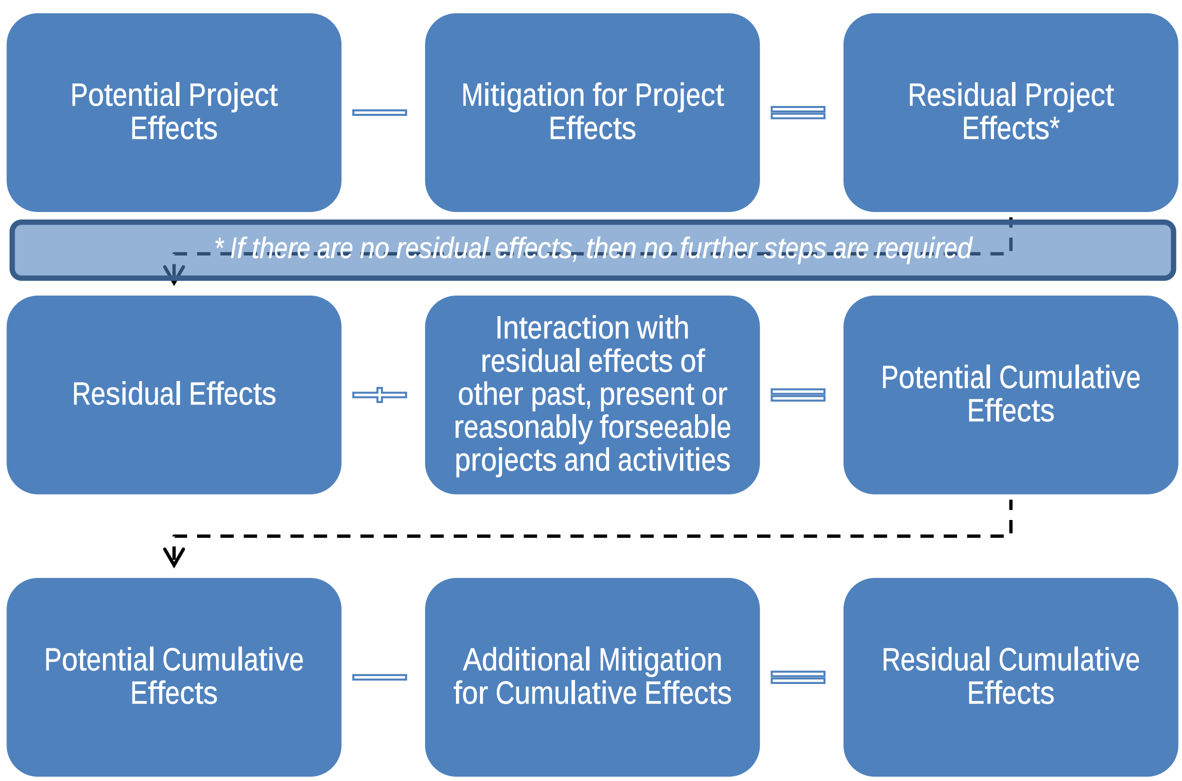
Criteria used to evaluate residual effects prior to cumulative effects assessment should be documented. In particular, the rationale for exclusion of any residual effect from detailed consideration in the cumulative effects assessment should be provided.

Where a cumulative effects assessment is determined to be required, that assessment should consider past, present, and reasonably foreseeable projects and activities, including:

- any other project or activity that is likely to affect the VC, even if that other project or activity is located outside the direct zone of influence of the project;
- effects of past and present projects and activities that are expected to continue into the future (*i.e.*, beyond the effects reflected in the existing conditions of the VC); and,
- activities not limited to other reviewable projects, if those activities are likely to affect the VC cumulatively (e.g., forestry, agriculture, recreational activity).

Figure 10 illustrates the steps generally followed in determining whether there are residual effects, cumulative effects, and residual cumulative effects. Additional specific guidance on cumulative effects assessment is outside the scope of this Guideline.

Figure 10. Steps to Determine Residual Project Effects and Cumulative Effects



4.0 CONCLUSION

The use of the Guideline will assist proponents and EAO staff to undertake the analysis required for an environmental assessment of a reviewable project in BC, from issues scoping and selection of appropriate VCs through the assessment of potential effects on selected VCs. Users are encouraged to refer to other available guidance and consult with EAO staff regarding other important steps in an environmental assessment, including cumulative effects assessment and development of follow-up programs.

This Guideline is not prescriptive, and the details regarding the application of the methods described within it will be determined by EAO for each individual project. However, the application of the principles articulated in this Guideline will improve the clarity, consistency, and overall quality of Environmental Assessments conducted in BC.

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