

Environmental Attributes

OVERVIEW

This document provides a brief overview of the development of the environmental indicators and their application in relation to the resource options considered in BC Hydro's 2011 IRP.

APPROACH

The general approach to developing, preparing and presenting the environmental indicators was iterative, and is summarized as follows:

1. Reviewed environmental indicators (for example from the 2006 IEP/LTAP) and their applicability to this project, provincially scoped data sources, and the BC Hydro databases for resource options (ROMAP);
2. Developed a revised and expanded set of indicators based on the literature review and a set of criteria for selecting indicators;
3. Evaluated and selected indicators, based on internal review by BC Hydro, and external review by provincial ministries (BC Hydro's consultation program is ongoing);
4. Developed set of a databases of the selected indicators for the province;
5. Utilized the footprints developed for the resource options recognizing the inventory level nature of many of the resource options;
6. Applied the indicators to the BC Hydro database for resource options (ROMAP) to populate environmental indicators for each resource option; and
7. Developed the environmental indicators such that they can be summed across resource options in the portfolios that BC hydro will develop portfolios as a part of the 2011 IRP in an effort to characterize the environmental attributes of the portfolios.

CRITERIA

The evaluation criteria for the indicators are:

- Available at a high level provincial scale,
- Science-based and defensible,
- Measurable in a "quantity" based approach that will facilitate comparison across resource options,
- Representative of a specific biophysical resource,
- Existing or easily acquired data, and
- Easily understood by BC Hydro users, stakeholders and First Nations.

Each proposed indicator was evaluated against the set of six criteria, and a set of indicators meeting these criteria was tested for use in spatial analysis at a provincial scale.

PURPOSE

To provide a brief overview of the development of the environmental indicators and their application in relation to the resource options considered in BC Hydro's 2011 IRP.

INDICATOR OVERVIEW

A revised and expanded set of indicators were developed based on the approach and criteria above. The most significant updates were made to the Land and Water attributes, where new indicators were developed, and Water was subdivided into Freshwater and Marine.

- The indicators for air contaminant and greenhouse gas (GHG) emissions were largely unchanged since the previous BC Hydro studies and include air contaminants (Sulphur dioxide, Oxides of nitrogen, Carbon monoxide, Volatile organic compounds, fine particulates and Mercury) and GHGs (Carbon dioxide equivalents (CO₂e)).
- The indicators by attribute (Land, Freshwater, Marine) are listed in the table below¹:

Table 1: Summary of Indicators Classifications - Land, Freshwater and Marine Indicators

Attribute	Ecosystem/productivity	Species/habitat	Landscape Context
Land	Net Primary Productivity	Conservation Priority Species	Linear Disturbance (remoteness)
Freshwater	Riparian Footprint Aquatic Footprint	Fisheries Priority Species	Linear Disturbance ^a
Marine	Bathymetry	Valued Ecosystem Features Commercial Bottom Fisheries	Not applicable

^a Linear disturbance is one indicator, but can also be considered as an indicator for Freshwater as an indicator of watershed disturbance.

The Land, Freshwater and Marine indicators were selected to provide a quantitative analysis of the footprint of a resource option in terms of its ecosystems, species and, where available, landscape context, through a provincial level indicator². This relationship was not as directly applicable to air contaminants and greenhouse gases which focused on the stressors (emissions) rather than impacts. In order to populate the potential resource options with environmental indicator data:

- Land, Freshwater and Marine indicator classification maps for the Province were developed in GIS, and
- Rates of air contaminants and GHG emissions (tonnes/GWh/year) were estimated for each potential resource option based on the technology assumed for the IRP.

APPLICATION

The environmental indicators were populated for the potential resource options, by either:

- the intersection of the physical footprint with the environmental indicator maps for physically based indicators (primarily Land, Freshwater and Marine); or
- the application of an emission rate (dependant on the resource option and technology) in relation to energy generation (GWhr/year) for activity based indicators (Air Contaminant & GHG Emissions).

¹ Table 1 presents a summary of the indicator description, rationale, data sources and classifications for each attribute.

² Table 2 classifies the indicators into ecosystems, species, and landscape context indicators.

Physical Footprints and Indicators

The accuracy of the underlying physical and spatial data was considered when relating the RO footprints and the environmental data, since it was recognized that:

- The resource options are spatially represented as point locations in a geographical information system (GIS) database (ROMAP).
- The potential resource option footprints, technical attributes and locations are, in most cases, conceptual and based on inventory level data with some limited exceptions such as Site C and Resource Smart.
- The environmental indicator source data used to develop the GIS environmental indicator datasets also varies with respect to data completeness, confidence and spatial accuracy.

In recognition of the above, a buffer area in which the physical footprint of a potential resource option could potentially be located was established. This was referred to as a 'probability envelope', which varied based on the resource option and its associated level of data confidence. The ROMAP database includes estimated footprints for the at-gate (generation site), road, and power line of each potential resource option.

The physically based environmental indicators for the resource options were populated as follows:

- The resource option physical footprint probability envelopes were intersected in GIS with the environmental indicator datasets to produce probability envelope values for each indicator and resource option.
- Each indicator value was then weighted by the ratio of the estimated physical footprint to the probability envelope area to populate the environmental indicators for each resource option. This limited the total area for each indicator to less than or equal to the estimated footprint.

This method resulted in a dataset of environmental indicators appropriate to the level of accuracy of this study.

Activity Footprints and Indicators

The estimated emissions rates for air contaminants & GHG, specific to each resource option (RO), where a function of the energy generated in a year. The product of the emission rate and annual energy generation was used to estimate the annual emissions in tonnes. Special exceptions were made for some resource options (such as Site C) where more detailed data was available.

RESULTS

The project has resulted in a dataset of environmental indicators for all the potential resource options that can be summed across resource options and used as input to BC Hydro's portfolio analysis to help characterize the potential portfolios being considered by BC Hydro. For a description of how these attributes will be used, refer to the *Comparing Policy Options* summary brief.