36 Capacity of Renewable Resources

36.1 Introduction

36.1.1 Regulatory Context

This chapter of the Application for an Environmental Assessment Certificate/Environmental Impact Statement (Application/EIS) addresses Section 16 (2)(d) of the *Canadian Environmental Assessment Act* (CEAA; 1992), which requires a consideration of "the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future."

The consideration of the capacity of renewable resources in this chapter is concordant with the purpose of the CEAA (1992) and Seabridge Gold Inc. (Seabridge, or the Proponent) to achieve "sustainable development"—meeting the needs of current generations without compromising the ability of future generations to meet their needs. This chapter also ties into the concept of sustainability that is implied in the new *Canadian Environmental Assessment Act* (2012) that focuses on "responsible resource development", to "create jobs, growth and long-term prosperity while strengthening our world-class protection of the environment for future generations of Canadians" (Government of Canada 2012).

While there are regulatory and technical guidance materials to help inform the identification of valued components (VCs) and the assessment of effects in the various chapters of the Application/EIS report (e.g., water, wildlife, and fish), there is no guidance documentation or standard methodology for assessing the effects of a project on the capacity for renewable resources or their ecological sustainability in the CEAA context (Amec 2008). In addition, developing quantitative or accurately predictive estimates of impacts on ecological carrying or productive capacity is problematic for a number of reasons, including the following (Paehlke 1993; Athena Sustainable Materials Institute 1994; Timko 2009):

- There are many different types of adverse effects to consider, affecting a variety of complex ecological components, which makes assessment at the whole ecosystem level challenging.
- Adverse effects are measured in different ways for different ecological components and are based on different practitioner approaches, and this poses barriers to systematically collating or comparing metrics within and across projects.
- There is uncertainty in forecasting future productive capacity as future resource pressures can change in unpredictable ways largely due to changes in value systems or outside influences (e.g., declining timber extraction rates in British Columbia [BC] in recent decades due to external market factors that would have been hard to predict during the timber boom).
- There is much about the structure, function, and resilience of terrestrial and aquatic ecosystems that science and related resource management systems have yet to comprehend (as evidenced by the failure of management approaches to maintain cod

stocks of the east coast of Canada), adding uncertainty to sustainability and productive capacity assessments on ecological systems as a whole.

- Assessing habitat loss is challenging, as it must be measured one species at a time and one species' loss may be another species' gain.
- Natural systems also change on their own—such as biogeographic shifts in regions over geological time or shorter-term ecological disturbances (e.g., the onset of the mountain pine beetle infestation) or changes (e.g., changes in plankton species assemblages in northern lakes) related to climate change—making concepts such as preserving ecological integrity or assessing Project effects in isolation from natural change problematic.

Although challenging to assess, it is recognized that natural resources are typically produced by whole functioning ecosystems, which can be affected by resource development over time. For this reason, the Proponent recognizes the importance of conducting assessments of the capacity of renewable resources (and related concepts of sustainability), in addition to individual assessments on specific separate ecological sub-components, as has been provided in other chapters of the Application/EIS. Considering the importance of assessing the capacity of renewable resources in the area of the Project as a whole, coupled with the challenges of conducting accurate assessments at the ecosystem level, the approach in this chapter is to take previous environmental assessments (EAs) and general theory and practice on ecological integrity, biophysical limits, sustainability, and productive capacity into consideration in developing a simplified method to assess the effects of the Project on the capacity for renewable resources. Hence, the results of this assessment are intended to be conceptual rather than specific or quantitative, and suggestive rather than prescriptive, due to the challenges mentioned above and the resulting uncertainty in making sustainability projections.

36.1.2 Scientific Background

Natural resources are substances from the Earth or ecological systems that can be harvested and used for commercial or social gain. Renewable resources (e.g., trees, fish, and water) are a subset of natural resources that can be replaced or replenished for subsequent use, as compared to non-renewable resources that are depleted with use and therefore cannot be replenished within a timeframe that would allow them to be available for subsequent generations (i.e., underground resources that are formed over long geological time periods such as coal, oil, and natural gas).

The "capacity" of renewable resources refers to the ability of natural systems to regenerate a given renewable resource; specifically, the quantity of that resource that can be consumed, harvested, or removed in any period of time without reducing the productive capacity of the natural system to regenerate the resource for use by future generations. In this context, productive capacity is the capacity of the ecological system to produce the given renewable resource—taken to mean the total stock of the natural resource itself (e.g., timber stocks), or the habitat required to support the resource (i.e., for wildlife), or the functional capacity of the system to regenerate the resource (e.g., water supply). The productive capacity of some renewable resources can be immediately restored after use—such as solar, wind, air, or geothermal energy—where there is a continuous or large enough supply that is not depleted by

demand. For other primarily biotic renewable resources—such as timber, fish and game—it may take a period of time for their stocks to replenish due to regeneration needs.

The ecological productive or carrying capacity of terrestrial and aquatic systems can be considered as a natural resource with biophysical limits like any other resource, beyond which potentially irreversible loss may occur (Paehlke 1993; Athena Sustainable Materials Institute 1994). There are several aspects of development that can affect the productive capacity of ecological systems (Rees 1992; Paehlke 1993; Athena Sustainable Materials Institute 1994; Canadian Envrionmental Assessment Agency 1999):

- direct harvesting leading to the loss of the resource itself at a faster rate than it can be replenished (e.g., hunting or fishing pressure exceeding reproductive rates of a population);
- harvesting leading to the long term degradation or loss of resource habitat (e.g., clear cutting of old growth coastal forest, leading to permanent habitat alteration affecting the population of plant or animal species dependent on that habitat, or water extraction depleting water quantity faster than replenishment rates, affecting long-term water levels and carrying capacities of streams);
- activities that cause direct adverse effects on species (i.e., increased traffic levels causing higher mortality rates in a region for species populations such as moose, or noise and human presence, affecting the reproductive behaviour of species populations such as mountain goat, and resulting in long-term population declines);
- the build-up of introduced waste products at a rate faster than natural systems can buffer them, leading to toxic effects and reduced health and/or mortality effects (e.g., build-up of heavy metals in a waterbody leading to adverse effects on fish populations); and/or
- synergistic or cumulative effects, which on their own may not affect ecological integrity and productive capacity, but together combine to create a deleterious effect (e.g., a combination of biogeographic changes linked to climate change, habitat fragmentation, and disturbance—influences that collectively drive a species out of an area).

36.2 Methodology

There is no single best practices approach to assessing Project effects on the capacity for renewable resources; theoretical and applied analytical methods currently in use are applied to a wide range of scientific inquiry, including methods to assess sustainability, carrying capacity, ecological integrity, and biophysical limits (Paehlke 1993; Athena Sustainable Materials Institute 1994; Kemess North Mine Joint Review Panel 2007; Amec 2008, 2011). Using the findings of the Project EA, a review of the approaches taken in the literature, and that used on other recent EAs, the following approach was developed to consider the effects of the Project on the capacity for renewable resources.

36.2.1 Identification of Renewable Resources

Identifying renewable resources that may be affected by the Project is done by (1) categorizing VCs that serve as renewable resources, and (2) screening the effects on those VCs based on significance ratings (i.e., screening those VCs found to have only a moderate or major residual

effect). This approach assumes that renewable resources exposed to a minor effect will not have their productive capacity potentially impaired by the Project, supporting their elimination from further analysis. Direction for this approach is also provided by the Application Information Requirements (AIR) document, which states that the assessment of the capacity of renewable resources focus on those VCs with a potential to be "significantly" affected by the Project.

36.2.2 Identification of Parties

This step consists of the identification of the parties who use and/or have rights to the renewable resources over the life of the Project (current generation), and who are likely to continue to use them over the long term after Project closure (future generations).

36.2.3 Assessment of Capacity of Natural Resource

The determination of whether the capacity or sustainable use of renewable resources will be affected by the Project is based on significance ratings, with a consideration of the magnitude, extent, duration, and reversibility of Project effects, and of the ecological resilience of the potentially affected renewable resource as indicators of continued productive capacity.

36.3 Spatial and Temporal Boundaries

36.3.1 Spatial Boundaries

The spatial boundaries for the assessment consist of the Local Study Area (LSA) and Regional Study Area (RSA) for each VC (as defined in the applicable Application/EIS chapter). The LSA encompasses watersheds in the immediate area of the Project where there is potential for direct effects. The LSA includes streams that are located within and downstream of the Project components including open pits, rock storage facilities, the Treaty Process Plant, and the Tailing Management Facility (TMF), as well as ancillary components such as buildings, roads, tunnels, power generation facilities, and transmission lines, which includes existing and proposed access roads.

Potential downstream effects of the Project include areas immediately downstream of the Treaty Creek / Bell-Irving River confluence, and the Unuk River at the Canada/United States border.

36.3.2 Temporal Boundaries

For the purposes of the effects assessment, the temporal boundaries include the following four phases:

- **construction**: 5 years;
- **operation:** 51.5-year life of the Project;
- **closure:** 3 years; and
- **post-closure:** 250 years, including monitoring.

36.4 Identification of Renewable Resources

Renewable resources that have been identified for further assessment, based on the approach described in Section 36.2, are listed in Table 36.4-1. They include air quality, wildlife (moose [*Alces alces*], mountain goat [*Oreamnos americanus*], grizzly bear [*Ursus arctos*]), wetland birds, and fish (Pacific salmon [*Oncorhychus* spp.], rainbow trout [*O. mykiss*], bull trout [*Salvenius confluentus*], and Dolly Varden [*S. malma*]). Water quality was not considered in the assessment because fish are considered to be a proxy for water quality. Guidelines for the protection of freshwater aquatic life are more stringent than drinking water guidelines; if freshwater aquatic life guidelines are met, drinking water will also not be affected.

36.4.1 Present and Future Use of Renewable Resources

The parties who presently use or have rights to renewable resources were identified by referring to Chapter 23, Land Use, of the Application/EIS. Aboriginal and other groups with interests in the Project area or that are located downstream of the Project are described below.

36.4.2 Nisga'a Nation

The Project is located in the Nass Area as defined in the *Nisga'a Final Agreement* (NFA). In addition to the transfer to 1,992 km^2 of Crown land to Nisga'a Nation (now known as Nisga'a Lands, owned collectively by Nisga'a Nation), the NFA established a variety of rights in regard to use and management of natural resources in the Nass Wildlife Area and Nass Area (NLG, Province of BC, and Government of Canada 1998).

The PTMA is located in the Nass Area, as well as the Treaty Creek access road (TCAR), a portion of the Mitchell-Treaty Twin Tunnels (MTT), and the transmission line. The PTMA is located approximately 200 km upstream of the Lower Nass River and Nisga'a Lands as defined in the NFA. The Mine Site and Coulter Creek access road (CCAR) is situated outside any lands with Nisga'a interests.

Traditionally the Nisga'a harvest of fish, wildlife, birds, and plants followed a seasonal cycle governed by the quality and abundance of certain species at different times of the year: furs in late winter, oolichan in the spring, salmon in the summer, berries in late summer, and large mammals in the fall. Contemporary subsistence resource use remains an important contributor to household livelihoods in Nisga'a communities, although certainly not as widespread or critical to survival as it was in the past. Contemporary economic uses of the land, which include recreation and tourism, commercial forestry, and an inland commercial fishery, are described in Chapter 29, Nisga'a Interests.

36.4.3 First Nation Rights and Interests

Project components are located in the traditional territory of the Tahtlan Nation and Skii km Lax Ha. First Nations downstream of the Project include the Gitanyow First Nation and Gitsxan Nation, and Skii km Lax Ha. Chapter 29, First Nation interests, provides information on each First Nations' current use of land and resources.

A portion of the CCAR from where it crosses the Unuk River heading north, the eastern portion of the MTT, the PTMA, the TCAR, and the transmission line are within the Tahltan traditional territory. The main Tahltan communities of Telegraph Creek and Iskut are roughly equidistant from the Project, which lies approximately 140 km (straight line distance) to the south. Travelling north by road on Highway 37 from the turn off for the TCAR, it is approximately 181 km to Iskut, and a further 83 km to Dease Lake. Telegraph Creek is another 108 km by road southwest from Dease Lake.

The Skii km Lax Ha claim an area covering the Mine Site and the PTMA, and portions of the Project's haul route along highways 37 and 37A. The Skii km Lax Ha live mostly in the communities of Hazelton and New Hazelton, about 200 km (straight line distance) southeast of the PTMA and Mine Site.

None of the Project components are located in Gitanyow traditional territory. The northern boundary of the Gitanyow territory lies approximately 36 km south on Highway 37 from the TCAR turn off. The reserve community of Gitanyow along Highway 37 is approximately 210 km south from the TCAR entrance.

None of the Project components are located in the Gitxsan traditional territory. For the most part, it falls on the east side of the Bell-Irving River. The Bell-Irving River flows through portions of the Gitxsan territory, including asserted territory of wilp Skii km Lax Ha, from the settlement of Bell II to its confluence with the Nass River. Gitxsan communities are about 230 km south of the entrance to the TCAR and Highway 37. Gitxsan communities are clustered in the vicinity of Hazelton farther up the Skeena Valley along Highway 16.

36.4.4 Commercial and Non-Commercial Land Uses

Chapter 23, Land Use, of the Application/EIS provides an overview of land uses in the Project area. Commercial land use interests in the Project area include guide outfitters, mountaineering guides, heli-ski operators, guided whitewater rafting, angling guides, water and forest licencees, and trappers.

Three guide outfitting licences overlap the wildlife RSA, and one of the licences overlaps the wildlife LSA. The RSA is located within three different Wildlife Management Units (WMUs), two of which overlap the wildlife LSA. Moose is the most desired species among resident hunters.

Seven trapping licences overlap the wildlife RSA, three of which also overlap the wildlife LSA. Two licence areas are held by members of the Skii km Lax Ha. Three of the licences within the RSA have no reported trapping activity. Six commercial recreation licences intersect or lie within the wildlife RSA. Five of these licences also intersect the LSA.

Guided angling is offered through the Bell 2 Lodge by independent operators. Trappers with traplines in the RSA primarily trap American marten (*Martes americana*). The effects assessment determined that the Project would not have significant effects on American marten, and American marten are not discussed further.

Table 36.4-1. Summary of Residual Effects on Renewable Resources

Renewable Resource	Utility	Residual Effect	Timing of Effect	Magnitude	Extent	Duration	Reversibility	Context: Uniqueness/ Resilience	Residual Effect Significance
Ambient Air Quality	Supports human, plant, and animal life	Degradation of air quality from emissions of dust and criteria air contaminants (CACs)	Construction	Low to medium	Landscape to regional	Medium	Short-term	Neutral	Not Significant (Moderate)
Fish (Rainbow Trout, Dolly Varden, Salmon)	Current use of lands and resources (fishing), angling guides, recreational fishing	Degradation of surface water quality due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Construction, operation, closure, post-closure	High	Regional	Construction: Short; Operation: Long; Closure and post-closure: Medium	Long-term	High	Not Significant (Moderate)
Moose	Current use of lands and resources (hunting), guide-outfitter allocations, resident hunters	Overall residual effect	Construction, operation	Medium	Landscape	Far-future	Long-term	High	Not Significant (Moderate)
Mountain Goat	Current use of lands and resources (hunting), guide-outfitter allocations, resident hunters	Habitat loss; Habitat degradation; Sensory disturbance at MineSite; Overall residual effect	Construction, operation	Medium	Habitat loss: local; Sensory disturbance and overall: landscape	Habitat Loss and overall: far-future; Sensory Disturbance: Long-term	Long-term	Neutral	Not Significant (Moderate)
Grizzly Bear	Current use of lands and resources (hunting), guide-outfitter allocations, resident hunters	Direct mortality; Disruption of movement; Overall residual effect	Construction, operation	Low	Local	Far-future	Long-term	Neutral; High for overall effect	Not Significant (Moderate)
Wetland Birds	Current use of lands and resources (hunting), guide-outfitter allocations, resident hunters	Chemical hazards from the TMF, Water Storage Facility, and receiving waters of Unuk River and North Treaty Creek	Operation	Medium	Landscape	Far-future	Long-term	Neutral	Not Significant (Moderate)

Notes: Effects to Dolly Varden were rated as not significant (moderate) for operation and closure, but have been listed for post-closure in the table with other species as a conservative measure; effects on bull trout were found to be not significant (minor) and are therefore not listed; WTP=water treatment plant; RSA=regional study area

Non-commercial interests include resident hunters and fishers.

36.5 Potential Effects on Capacity of Renewable Resources

Within the respective LSAs and RSAs, the productive capacity of renewable resources identified in Table 36.4-1 may be diminished if the potential effects of the Project on these resources are significant and not reversible. Significant adverse effects may include the elimination or significant reduction of the resource itself, degradation or loss of habitat that supports the resource, or disruption of the the functional capacity of the system to regenerate the resource.

36.5.1 Air Quality

The Project's residual effects on air quality are assessed in Chapter 7 of the Application/EIS, while implications for Nisga'a Nation, First Nations, and any other resource users are summarized in Chapters 23, 29, and 30. The residual effects of the Project on ambient air quality were evaluated with respect to the potential impairment of continued provisioning of healthy air: criteria air contaminants (CACs) and dust. The Project's residual effects on air quality are summarized below:

- **Residual adverse effect**: degradation of ambient air quality as a result of the Project, which could affect human and biotic health.
- **Significance**: the Project is predicted to have **not significant (moderate)** residual effects on changes to ambient air quality only during the short construction phase.
- **Duration and extent of effect**: residual effects on air quality from the Project are predicted to occur during the construction phase, and will primarily occur over a localized area, with some regional effects, depending on atmospheric mixing conditions, wind speed, and wind direction.
- **Reversibility of effect and resilience**: residual effects of the Project on air quality are considered reversible in the short term. The atmosphere is considered to have a neutral resilience to air quality contaminants, meaning that its long-term functioning is not affected by higher short-term contaminant levels.

Based on the assessment of the effects of the Project on ambient air quality (that may affect sensitive human and animal receptors in the LSA/RSA directly or as a result of wet or dry deposition), summarized above, it is expected that the capacity of the atmosphere to continue to provide clean air will not be affected. The magnitude of the effect on air quality is considered low to medium, occurring on a regular frequency over the five year construction phase only. With the implementation of mitigation measures, described in Chapter 7 and the Air Quality Management Plan (Chapter 26, Section 26.11), in combination with the atmosphere's ability to flush or disperse contaminants, air quality effects will not be persistent in the air column above the LSA and RSA. Therefore it is deemed that the capacity of the atmosphere to continue provisioning clean air for both present and future generations in the Project area will not be significantly compromised by the Project.

36.5.2 Fish

The Project's residual effects on fish are assessed in Chapter 15 of the Application/EIS, while the implications for Treaty Nations, First Nations, and other resource uses are summarized in Chapters 23, 29, and 30. The potential for residual effects on fish as a result of Project activities were assessed for the following: direct mortality, noise, erosion and sedimentation, and water quality degradation leading to toxicity in fish.

As listed in Table 36.4-1, water quality degradation was identified as a potential residual effect downstream of the Mine Site Water Treatment Plant (WTP) discharge outfall. Data from the predictive water quality model (Chapter 14) indicate that there is potential for Project-related increases in selenium water concentrations originating from the Mine Site WTP, which may lead to selenium bioaccumulation and toxicity in fish residing downstream in lower Sulphurets Creek (below the cascades) or in the Unuk River. This potential residual effect relating to increased selenium concentrations was determined to be not significant (moderate), which informed the overall determination of not significant (moderate) effects on fish. All other potential Project-related residual effects on fish VCs (i.e., Dolly Varden, bull trout, rainbow trout/steelhead, and Pacific salmon) were assessed as not significant (minor), and are not likely to affect fish population viability.

Downstream of the Tailing Management Facility (TMF; in the Processing and Tailing Management Area [PTMA]), the potential for residual effects was determined to be not significant (minor) with no predicted effect on fish population viability.

The Project's residual effects on fish are summarized below:

- **Residual effects:** the primary residual effect to fish in lower Sulphurets Creek or the Unuk River is the bioaccumulation of selenium, which may lead to the potential for adverse effects (toxicity) in fish, which is likely to vary by species. Some uncertainty was identified in this assessment, which will be addressed through a follow-up monitoring plan (described in Section 26.18.2), and in Chapter 38.
- **Significance:** Project-related residual effects due to increases in selenium water concentration was determined to be **not significant (moderate)**.
- **Duration and extent of effect:** residual effects of the Project on fish will be limited to downstream effects from the WTP within the RSA in Lower Suphurets Creek (SC3) and in the Unuk River. Downstream of the monitoring site at UR2 (35 km downstream of the Mine Site at the BC-Alaska border), selenium concentrations are predicted to be below provincial and Alaskan state water quality guidelines, but greater than baseline concentrations at times. Predicted effects may have the potential to persist into the far-future if selenium concentrations associated with the Mine Site WTP discharge are greater than water quality guidelines, during all phases of the Project.
- **Reversibility of effect and resilience:** residual and cumulative effects of the Project on water quality are considered reversible in the long term, although the resilience of the affected fish populations may be low.

Since water selenium concentrations may increase above both water quality guidelines limits and background concentrations at the SC3 (Lower Sulphurets) and UR1 (Unuk River) sites, it is probable that fish tissue residues of selenium will also increase as a result of higher levels of selenium in the aquatic food chain (Chapter 15). The potential for accumulation of selenium will decrease with distance from the discharge point.

The probability that toxicity (due to bioaccumulation of selenium) may occur in fish species is less certain, since increased tissue residues do not necessarily mean increased toxicity until a threshold level is reached. There is uncertainty about whether this toxic threshold level will occur in fish in Lower Sulphurets Creek (below the cascades) or in the Unuk River as a result of Project activities. The uncertainty identified in this assessment will be addressed by effluent quality monitoring in the Water Management Plan (Section 26.17) and by the implementation of an Aquatic Effects Monitoring Plan (Section 26.18.2), which includes monitoring of water quality, sediment quality, periphyton, and benthic invertebrate and fish tissue metal concentrations. Additional adaptive management strategies may be developed based on the findings of the monitoring plan, with the goal of minimizing potential effects to fish, aquatic life, and fish habitat. Overall, the potential for residual effects to Dolly Varden, rainbow trout/steelhead, and Pacific salmon was determined to be not significant (moderate), indicating that effects are possible but may not occur.

Many of the fish within the Unuk River watershed may reside outside of potentially affected areas, such as in tributaries of the Unuk River. Fish located in tributaries that do not receive water that may be affected by Mine Site WTP discharge are less likely to be affected by changes in water quality in Sulphurets Creek or the Unuk River. As well, these potential effects in fish may occur in an area where fishing activities for these species are minimal due to access limitations. Thus, these predicted residual effects are likely to have negligible effects on the use of fisheries downstream of the Project, and the Project is not expected to affect the long-term sustainability of renewable fisheries resources overall.

36.5.3 Wildlife

The ability of wildlife resources to provide renewable resources for present and future generations is discussed below. Present and future generations that live close to, and benefit from, these services and renewable resources in the local and regional area of the Project are Aboriginal groups, including Nisga'a Nation, Tahltan Nation, Gitanyow First Nation, Gitxsan Nation, and Skii km Lax Ha. Hunting in the regional area is also a recreational activity undertaken by residents in nearby communities, including Stewart, Meziadin Junction, Terrace, and Smithers.

36.5.3.1 Moose

Residual effects of the Project on moose are assessed in Chapter 18 of the Application/EIS, while the implications for Treaty Nations, First Nations, and other resource uses are summarized in Chapters 23, 29, and 30. The overall residual effects on moose were based on the assessment of habitat loss and alteration, disruption of movement, direct mortality, indirect mortality, and chemical hazard.

- **Residual effects**: The residual effects of the Project on moose are declines in moose populations overall, with emphasis on traffic-related mortality.
- **Significance**: The significance of Project-related residual effects (habitat loss, disruption of movement, direct mortality, indirect mortality, and chemical hazards) on moose were predicted to be not significant individually. However, because these effects may interact in an additive or synergistic way, an overall combined effect that may have a different magnitude or extent for the local moose population within the RSA was evaluated; the significance of the overall residual effect is anticipated to be **not significant (moderate)**.
- **Duration and extent of effect**: The overall residual effect on moose is predicted to last into the far future, and occurs at a landscape scale for the Project, and at a larger regional scale when cumulative effects are considered.
- **Reversibility of effect and resilience**: the overall residual effect on moose from the Project is reversible in the long term, although the resilience of the population is low. The population of moose in the Project area has been declining in recent years and is now being managed according to a conservation plan introduced by the Nisga'a Lisims Government. In 2007, the Nisga'a Lisims Government conducted an aerial survey of the moose population in the Nass Wildlife Area, south of the Nass Area and the Project footprint, and determined that it had declined by 50% since 2001 (i.e., from 1,600 individuals to approximately 800).

The potential for the Project to affect moose as a renewable resource must be considered within the broader context of the declining moose population in the regional area due to external factors such as overharvesting (Chapter 18, Section 18.9.2.4; Appendix D in Appendix 22-C). In addition, there is uncertainty as to the prospects of future development in the region, and any corresponding increase in highway traffic, an important consideration as wildlife mortality rates would rise as a result of vehicle-wildlife collisions. Seabridge conducted a population viability analysis of the Nass moose population, which found that the moose population is sensitive to relatively minor changes in overall mortality, due to its current population size. This sensitivity is partly due to the type of model used for the analysis (provided by the BC Ministry of Environment). However, the modeling results also suggested that traffic from the KSM Project alone is not predicted to cause a regional decline in the moose population.

The level of future industrial development along the Highway 37 corridor is uncertain. It is unlikely that all currently proposed and reasonably foreseeable future mine projects will be developed at the same time. To address the uncertainty, two possible future scenarios were evaluated for potential cumulative effects on moose, linked to increased mortality from traffic accidents: a "likely development scenario", with one to three mining projects concurrently entering production, and an "unlikely development scenario", where most or all reasonably foreseeable future projects go ahead as planned.

Under the likely development scenario, which would have moderate traffic, the cumulative effects on moose in the cumulative effects assessment area (which includes the Nass Wildlife Area) were assessed as not significant (moderate). The unlikely development scenario, in contrast, is associated with high traffic, which was assessed as a significant (major) effect on the

moose population due to increased mortality associated with traffic accidents. This assessment has relatively low certainty because the likelihood of most or all proposed projects proceeding simultaneously is low, and the model structure is posited to cause it to be overly sensitive to small reductions in survival.

The Proponent has developed mitigation measures designed to minimize the Project's effect on moose, including restricting access to Project access roads and only permitting traffic that is required for the Project, de-activating roads once they are no longer required, partially deactivating some mine components, and partially re-vegetating during the post-closure phase. As well, infrastructure such as bridges and roads will be designed to minimize obstruction of wildlife movement. A no-hunting prohibition will be implemented for Project staff and contractors, and all vehicles will obey traffic signs so as to reduce the risk of vehicle-wildlife collisions.

The Proponent will consider participating in regional monitoring programs by contributing to regionally-based monitoring initiatives where those monitoring initiatives replace proposed KSM Project-specific monitoring, and where these monitoring activities are actively managed by relevant provincial authorities with regulatory oversight for provincial highways and wildlife populations. As part of the environmental monitoring program for the Project, a Wildlife Management and Monitoring Plan (Chapter 26, Section 26.21) will be implemented to document wildlife (including moose) changes in abundance, behaviour, health, and habitat use resulting from Project construction, operation, closure, and post-closure. It includes objectives for meeting legislative requirements as well as actions to avoid, control, and mitigate the effects of the Project. In addition, the Wildlife Effects Monitoring Program (WEMP), Section 26.21.3, outlines the goals of the monitoring program for moose, and identifies the frequency of monitoring activities. The WEMP provides information to direct the actions of the Proponent in minimizing potential effects of the proposed Project on moose. Consistent with the Proponent's commitment to continual improvement, wildlife management for the Project will take an adaptive management approach.

Although the modelling results suggest that the KSM Project is not, by itself, expected to cause a significant adverse effect on the moose population, given complex ecological processes, the already declining population size, and the low level of anticipated development in the area, it is unknown whether the moose population has the capacity to continue to act as a renewable resource and provide hunting opportunities to Aboriginal groups in the Project area, both for present and future generations. Partly to address this uncertainty, the suitability and effectiveness of measures implemented to mitigate or compensate for adverse effects on moose are subject to a follow-up program, which will be conducted as described in the WEMP. As an adjunct to the objectives identified in the WEMP, the follow-up program will evaluate the implementation and effectiveness of mitigation measures, verify the predictions of the EA, and identify opportunities for adaptive management.

36.5.3.2 Mountain Goat

The effects of the Project on mountain goat are assessed in Chapter 18 of the Application/EIS, while the implications of these potential effects for Treaty Nations, First Nations, and other

resource uses are summarized in Chapters 23, 29, and 30. Residual effects for mountain goat were assessed to be habitat loss and alteration, disruption of movement, sensory disturbance, direct mortality, indirect mortality, and chemical hazard.

- **Residual effects**: Project effects on mountain goat are linked to functional habitat loss through sensory disturbances, and direct habitat loss and alteration because of Project infrastructure. Mountain goats are generally sensitive to noise, and helicopter traffic and mine activities such as blasting may cause them to leave otherwise suitable habitat surrounding the Project.
- **Significance of effect**: The Project is predicted to result in **not significant (moderate)** effects to the local mountain goat population, mostly caused by sensory disturbance, habitat loss, and habitat alteration.
- **Duration and extent of effect**: Residual effects due to localized habitat loss and alteration on the Mine Site are considered to extend into the far future as some of the affected areas will not be reclaimed. Mountain goats may be able to adapt and move back into some of these areas after Project closure. Residual effects associated with sensory disturbance will extend over a long-term period, but will diminish after closure when noise and other disturbances cease. Both individual effects, and the overall effect are considered to be reversible in the long-term. The geographic extent of this effect is localized to the Mine Site near the pits and rock storage facilities, where approximately 1,150 ha of high-quality mountain goat winter habitat, and 550 ha of Ungulate Winter Range will be removed or altered through Project construction; however, the total loss and alteration of habitat is predicted to be 2% of the available winter habitat in the RSA.
- **Reversibility of effect and resilience**: While sensory disturbance should terminate once the operation phase ends, the residual effect of habitat loss and alteration is considered to be irreversible, although the overall resilience of the population is high.

After the implementation of mitigation measures, the Project-related residual effect on the mountain goat population is considered to be a moderate, not significant effect. Mitigation measures for sensory disturbance will include developing and following helicopter flight plans to avoid critical mountain goat winter habitat; maintaining noise controls on vehicles, including the installation and regular maintenance of mufflers; and the continued monitoring of noise. Mitigation measures for habitat loss and disruption of movement include the partial deactivation of some mine components and partial re-vegetation of disturbed areas post-closure. Infrastructure such as bridges and roads will be designed to minimize movement obstruction. During construction and operation, public access to Project roads will be restricted, and only traffic that is required for the Project will be allowed to use access roads. At closure, all non-essential roads will be deactivated and traffic will be greatly reduced. A no-hunting prohibition will be implemented for Project staff and contractors, and all vehicles will obey traffic signs so as to reduce vehicle-wildlife collisions.

The majority of Project effects on mountain goats, for both noise and habitat loss, will occur at the Mine Site, which is currently difficult to access and therefore limits harvesting activities. Only a small (2%) area of available winter habitat in the RSA will be lost or altered from the

Project, which represents a minor proportion over the broader regional area. The regional population of mountain goats is robust enough to support and absorb this minor change to habitat quality and quantity in the RSA. Because of these reasons, it is not anticipated that the capacity of mountain goats to continue to act as a renewable resource for hunting purposes for present and future users in the area will be affected.

36.5.3.3 Grizzly Bear

The residual effects of the Project on grizzly bear are assessed in Chapter 18 of the Application/EIS, and the implications for Treaty Nations, First Nations, and other resource uses are summarized in Chapters 23, 29, and 30. Residual effects for grizzly bear were assessed to be habitat loss and alteration, disruption of movement, direct mortality, indirect mortality from increased poaching pressure, and attractants creating bear-human conflicts.

- **Residual effects**: The primary Project effects for grizzly bear are linked to the additive or synergistic effects of all residual effects (habitat loss and alteration, disruption of movement, direct mortality, indirect mortality, and attractant) acting in combination together.
- **Significance of effect**: While all individual residual effects are predicted to have **minor, not significant** effects on grizzly bear populations within the RSA, these residual effects synergistically contribute to a **not significant (moderate)** overall residual effect on grizzly bear.
- **Duration and extent of effect**: The duration of the effect on grizzly bears for the Project is predicted to extend into the far future. The overall Project effects are local in scale.
- **Reversibility of effect and resilience**: Project-related effects are reversible over the long-term. The overall effects on grizzly bears are expected to cease at the end of operation and be reversible in the long-term.

As stated above, the residual effects for grizzly bears are habitat loss and alteration, disruption of movement, direct mortality, indirect mortality, and attractants. These individual effects are assessed for their potential to interact, creating additive or synergistic effects that would have a different magnitude or extent for the local grizzly bear population. Several factors were considered when evaluating the overall magnitude of the potential effect on bears, including: (1) the amount of high-quality habitat in the RSA that is predicted to be lost or altered is relatively low, (2) salmon food sources on the Unuk River are not predicted to be affected, (3) existing human disturbance and activity (i.e., forestry, roads, and hunting) in the area, (4) the large home range size and habitat generalist preference of bears, and (5) mitigation to minimize residual effects. The overall Project-related residual effect on the local grizzly bear population is not anticipated to cross a significant threshold or to adversely affect the viability of the local population.

As the regional grizzly bear population is considered to be healthy and stable, the broader population base should act as a buffer to any residual adverse effects. The Project is not expected to affect the ability of present and future generations to harvest grizzly bear resources.

36.5.3.4 Wetland Birds

Wetland birds include waterfowl and wading birds such as ducks, geese, swans, loons, and grebes. Potential effects of the Project on wetland birds are assessed in Chapter 18 of the Application/EIS, with the implications for Treaty Nations, First Nations, and other resource uses summarized in Chapters 23, 29, and 30. Residual effects from the Project were found on wetland birds for direct habitat loss and alteration, and chemical hazards.

- **Residual effects**: The primary Project effects for wetland birds are linked to direct habitat loss and alteration from the loss of wetland in the TMF footprint, as well as uptake of chemicals of potential concern (COPC) through bioaccumulation within the aquatic food web.
- **Significance of effect**: The loss and alteration of habitat was evaluated as a **minor, not significant** effect on wetland birds, as only 3.9% (311 ha) of the overall wetland bird habitat will be lost or altered within the RSA, primarily in the TMF and along the TCAR. Some of the affected habitat will be reclaimed through the Wetland Habitat Compensation Plan (Appendix 16-B). Exposure to chemical hazards (as a result of contaminants in the tailing discharge) was evaluated to be a **moderate, not significant** effect. Although surface water quality within the Project area is predicted to meet water quality guidelines for the protection of freshwater aquatic life, some COPC (i.e., selenium and mercury) may bioaccumulate in the food chain, exposing the direct consumers of aquatic organisms (i.e., wetland birds) to harmful COPC concentrations. Naturally elevated levels of selenium in Dolly Varden above fish tissue guidelines are observed in the PTMA and in the Mine Site area.
- **Duration and extent of effect**: The duration of the effect of chemical hazards on wetland birds at the Project, is predicted to extend into the far future, and occurs at the landscape scale.
- **Reversibility of effect and resilience**: Project effects on wetland birds are reversible over the long-term. The population of wetland birds should be considered resilient due to their migratory nature and the abundance of available habitat within the RSA.

Chemical hazards may result in a Project-related residual effect on migratory wetland birds because of the potential for wetland birds to bioaccumulate COPC when consuming vegetation and aquatic insects. Wetland birds could potentially be at risk when ingesting primary and secondary producers in the Unuk River and North Treaty Creek, and in post-closure, from the reclaimed TMF.

While the risk of chemical hazards cannot be fully eliminated, mitigation measures can reduce the risk of harm to wetland birds. Mitigation measures for the protection of water quality are outlined in Chapter 14 of the Application/EIS, and include the monitoring of effluent water quality to ensure regulatory compliance with permitted discharge criteria, as well as the Aquatic Effects Monitoring Plan (Chapter 26, Section 26.18.2) that includes regular monitoring of water quality, sediment, benthic invertebrates, and fish tissue.

The capacity of renewable resources was assessed using a worst-case scenario where wetland birds are assumed to forage for a substantial amount of time on insects and vegetation with elevated concentrations of COPC. However, the worst-case scenario is countered by a considerable lack of breeding habitat within the RSA where wetlands birds may actually be exposed to elevated COPC. Furthermore, birds are highly mobile and are likely to forage in areas not affected by Project activities. Finally, the use of wetland birds as a renewable resource (i.e., for hunting purposes) is minimal due to difficulties in accessing the area. Taken in combination with each other, wetland birds are not likely to be significantly affected by Project acitivities and the Project is not expected to affect the long-term sustainability of harvesting wetland birds resources overall.

36.6 Conclusions

The result of the assessment of the capacity of renewable resources to continue to provide services to present and future generations is shown in Table 36.6-1.

As discussed previously, and as shown in Table 36.6-1, the capacity of renewable resources to continue to meet the needs of the present and those of the future is not anticipated to be significantly affected by the Project for air quality, fish, mountain goat, grizzly bear, and wetland birds. Because of pre-existing pressures on the regional moose population, and in the absence of any focused recovery management strategy, it is unknown whether moose populations will be able to sustain harvesting opportunities for local users, both over the life of the mine and into the far future. As described in Section 36.5.3.1, the Follow-Up Program, as described in the WEMP outlined in 26.21.3, will help to address this uncertainty for moose, and will implement adaptive management where needed based on monitoring results.

Table 36.6-1. Effects of KSM Project on the Capacity for Renewable Resources

Renewable Resource	Present Capacity of Renewable Resource Impaired? (Life of Mine)	Future Capacity of Renewable Resource Impaired? (Post-closure)
Air quality	No	No
Fish	No	No
Moose	Unknown	Unknown
Mountain goat	No	No
Grizzly bear	No	No
Wetland birds	No	No

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