APPENDIX I

RATIONALE AND OBJECTIVES FOR BASELINE STUDY DESIGNS AND SAMPLING PROTOCOLS

1 RATIONALE AND OBJECTIVES FOR BASELINE STUDY DESIGNS AND SAMPLING PROTOCOLS

1.1 General Rationale and Objectives

Following positive results from the exploration program and feasibility studies, AREVA Resources Canada Inc. (AREVA) will likely submit an application for the development of a uranium mine, which will probably require an Environmental Impact Statement (EIS). To meet the anticipated Nunavut Impact Review Board guidelines for the EIS for the project, AREVA began collecting aquatic and terrestrial baseline data in 2007. In general, the principal objectives of baseline studies are:

- to collect information on the current physical conditions (*e.g.*, water quality, hydrology, soils), species, and habitats in the study area, including the identification of listed and uncommon species, and critical aquatic and terrestrial habitats (*i.e.*, sensitive ecological attributes);
- to obtain estimates of natural variation in biophysical variables such as water quality and quantity, and species presence, richness, abundance, and distribution;
- to implement environmental design features and management plans (mitigation measures) during the design of the project to avoid or limit disturbance to biophysical variables and habitats, particularly sensitive ecological attributes;
- to help predict effects from the project on current ecological conditions, species, and habitats; and,
- to provide data for comparison to environmental effects monitoring programs during construction and operation to test impact predictions (*i.e.*, before-after-control-impact studies), and the effectiveness of environmental design features and management plans.

The following sections provide the rationale and objectives for the study designs and methods that are specific to collecting baseline data on wildlife and habitat for the Kiggavik Project (see Appendix II for detailed study designs and methods). Species selected were based on recent and current environmental assessments (EAs) and monitoring programs in Nunavut and the Northwest Territories (NWT). Similarly, study designs and sampling protocols follow the current methods accepted for monitoring effects on wildlife and habitat at mine sites in Nunavut and the NWT. By consistently using standardized and up-to-date methods, direct comparisons can be made among projects that differ in the spatial extent of the footprint and level of mining activity. Such a meta-analysis can be used to help understand and manage the cumulative effects from development on wildlife populations and habitat. The data can be used also to participate in regional and/or collaborative programs such as the Cumulative Impact Management Framework, which is a current objective of the Nunavut Planning Commission.

1.2 Selection of Wildlife Valued Components

Valued components (VCs) represent physical, biological, cultural, and economic properties of the social-ecological system that are considered to be important by society. In general, the selection of wildlife VCs (or valued ecosystem components [VECs]) for EAs and effects monitoring programs in Nunavut and the NWT has been quite consistent. For example, caribou, grizzly bears, wolverine, wolves, foxes, upland breeding birds, waterfowl, raptors, and wildlife habitat were chosen as VCs for EAs for the Ekati, Diavik, Snap Lake, and Gahcho Kué projects in the NWT (BHP 1995; DDMI 1998; De Beers 2002; MVEIRB 2007), and for the Jericho and Doris North projects in Nunavut (Tahera 2000; Miramar 2005). Muskoxen were also selected as a study species for the Jericho and Doris North projects, and muskoxen and moose were included for the Gahcho Kué project. Species selected for monitoring the effects from these projects during construction and operation include caribou, muskoxen, grizzly bears, wolverines, wolves, upland breeding birds, waterfowl, and raptors (Tahera 2005; Miramar 2006; BHPB 2007; DDMI 2007; De Beers 2007).

Based on this review, the following wildlife VCs were selected to focus baseline studies for the Kiggavik Project:

- habitat;
- caribou;
- muskoxen;
- grizzly bear;
- wolverine;
- wolf and foxes;
- upland breeding birds (songbirds, shorebirds, ptarmigan);
- water birds (ducks, geese, swans, loons); and,
- raptors (falcons, hawks, eagles, ravens, owls).

Information on the presence and location of other wildlife species also will be collected during the baseline program.

1.3 Selection of the Study Area

The study area is centered on the anticipated location of the Kiggavik Project, and is adjacent to the southern extent of the calving grounds for the Beverly caribou herd. The study area is 90 km long and 80 km wide (7,200 km^2), and includes all of Judge Sissons Lake, and parts of Aberdeen, Schultz, Mallory, and Princess Mary lakes (Figure 1). The spatial extent of the study area was based on the following rationale:

- current study areas for caribou and other large mammals (muskoxen, grizzly bears, wolves) for mining projects in Nunavut and the NWT (*e.g.*, Diavik and Ekati combined = 6,000 km^2; Snap Lake = 3,100 km^2; Gahcho Kué = 5,600 km^2; Doris North = 4,300 km^2);
- logistical constraints related to survey coverage of the study area, pilot, and observer fatigue;
- anticipated mine plan for the Kiggavik Project (four open pits, processing plant, tailings management facility) and current estimates for the zone of influence from major developments on caribou (13 km to 33 km [Boulanger *et al*. 2004; Golder 2005; Johnson *et al*. 2005]). The study area must be large enough to capture the zone of influence and provide data for caribou behaviour and probability of occurrence outside the zone of influence (*i.e.*, control data); and,
- avoidance of the calving grounds for the Beverly caribou herd, known location of caribou water crossings along the Thelon River basin (*i.e.*, Aberdeen and Schultz lakes), and the associated predicted importance of the study area for caribou during the northern (mid-April to late May) and post-calving (July to October) migration periods.

1.4 Objectives and Rationale for Wildlife Baseline Study Designs

1.4.1 Caribou and Muskoxen

Objectives

Data collected during baseline studies will be used to provide estimates of the natural variation for the following variables:

- group size, number, density, and distribution of caribou within the study area during the northern and post-calving migration periods;
- composition of caribou groups (*i.e.*, groups with calves and groups without calves) within the study area during the post-calving migration;
- caribou behaviour (*e.g.*, time spent foraging, resting, walking) within the study area; and,
- group size, group composition, number, density, and distribution of muskoxen in the study area.

Rationale

Baseline and monitoring programs at several projects in Nunavut and the NWT have successfully used systematic aerial surveys to obtain robust estimates of group size, group composition, number, and distribution (probability of occurrence) of caribou and muskoxen (Golder 2005; BHPB 2007; DDMI 2007; De Beers 2007; Miramar 2007). Monthly surveys are flown along pre-determined transects within both an RSA and LSA at an altitude of 150 m above ground level at speeds of 130 to 160 km/hour from February through November, which includes the northern and post-calving migration periods (see Appendix II for details). The approach provides good visibility for detecting

caribou groups and determining group composition, which is important for analyzing the effect of development on caribou distribution. Information from satellite-collared animals, commercial pilots, and site staff are used to help determine the timing of surveys.

Aerial survey data have provided much needed information on the temporal and spatial responses of caribou to mine development. For example, comprehensive statistical analyses at the Ekati and Diavik mines showed that in some years, the likelihood of observing caribou feeding/resting increased with distance from the mine, in other years, the trend was reversed or not significant, and was dependent on migration period (BHPB 2004; Golder 2005). As expected, the proportion of groups feeding/resting was lowest during construction of the Diavik mine (development phase with greatest activity and staff loads). At both mine sites, the likelihood of observing groups with calves decreased with an increase in distance from the project. Temporal changes in observing groups with calves in the study areas appears to be more related to calf recruitment in the population than the local influence of the mine footprint. Annual variation in group composition in the Diavik and Ekati study area was similar to data from the Snap Lake study area, and the lowest proportion of nursery groups observed corresponded with low calf recruitment rates determined from government surveys (De Beers 2005).

Additional analyses using aerial survey data predicted that the zone of influence on caribou habitat selection increased during operation of the Ekati mine, and ranged from 17 km to 32 km in 2002 (Boulanger *et al*. 2004). Analysis of resource selection models for the Diavik mine indicated no temporal change in the probability of caribou occurrence in the study area, and the average annual zone of influence around the mine ranged from 22 km to 26 km (Golder 2005). Analysis of aerial survey data also have been instrumental for determining the relative preference and avoidance of habitats by caribou, which is critical for developing empirical and site-specific habitat suitability models (BHPB 2004; Boulanger *et al*. 2004; Golder 2005).

Scanning observations of ungulates from the ground is an established and accepted method for estimating the time individuals spend among various activities (*e.g.*, feeding, resting, walking [Curatolo and Murphy 1986]). Analyses of these data have provided valuable information on the smaller scale responses of caribou to mine development. For example, data on ground observations of behaviour suggested that caribou groups with calves spend about 10% to 15% less time feeding within 5 km of the Ekati mine (BHPB 2003, 2004). Feeding behaviour of groups without calves was independent of distance from the mine. Similarly, instantaneous reactions to different stressors (*e.g.*, aircraft, blast, heavy and light trucks) were stronger for groups with calves than groups without calves (BHPB 2007).

Data from satellite and GPS-collared female caribou will provide information on the coarse-scale movement and distribution of the Ahiak and Beverly herds during baseline studies. Although the data from collared animals generally represents the seasonal and annual movement and distribution of the herd, sole use of this data is not sufficient for determining environmental

design features, or predicting and testing effects from the project. Collar data do not provide estimates of the number, group composition, and distribution of caribou that may interact with the project. However, the combination of course, medium, and fine-scale information from collared animals, aerial transect surveys, and ground observations of behaviour, respectively, will likely provide quality data for predicting and monitoring the effects of the project on caribou (BHPB 2004; Boulanger *et al*. 2004; Golder 2005; Johnson *et al*. 2005).

1.4.2 Large Predators

Objectives

Data collected during baseline studies will be used:

- to determine the natural variation in the relative activity level and distribution of grizzly bears, wolverines, foxes and wolves within the study area; and,
- to determine the presence and distribution of dens and other important habitat features in the study area.

Rationale

Aerial and ground surveys of the absence/presence of large predators as well as their preferred habitat and habitat features (e.g., eskers for wolf and fox dens) are standard and accepted methods used in baseline and monitoring programs (BHP 1995; DDMI 1998; De Beers 2002; Miramar 2005; BHPB 2007; De Beers 2007). Large predators will be identified during Height-of-Land and RSA/ LSA Aerial surveys (see Appendix II for details). LSA surveys and habitat classification studies (see Section 1.4.x) will identify potential denning sites or other areas of importance to predatory species. No other surveys, specific to large predators, are recommended at this time.

1.4.3 Upland Breeding Birds

Objective

Data collected during baseline studies will be used to determine the natural variation in bird density (species and community), and species richness.

Rationale

Ground-based surveys (usually plot-based approaches) are the most effective means of collecting data on upland birds. Methods developed by the Program for Regional and International Shorebird Monitoring (PRISM) will be used to survey bird distribution and abundance because of: (1) the widespread acceptance and use of this method by the Canadian Wildlife Service in the

Arctic; (2) its successful use on the nearby Meadowbank Gold project; and (3) its statistical power and ease of analysis for long-term monitoring purposes. Randomly-selected plots will be established at the proposed mine site (~25 plots) and at a nearby reference site (~20 plots), in an area not likely to be influenced by future mine-related activities (but within the larger study area) (see Appendix II for details). Excellent data has been collected on the Meadowbank Gold Project using this technique. The methodology is also used by the Canadian Wildlife Service throughout the Arctic and collaboration/ data sharing between Areva and CWS is possible.
In addition to the PRISM plots, more specific surveys will be done in the immediate area of the proposed mine site and access road. Breeding bird ground-based transects will be used to collect information on abundance and distribution along the access road alignment and to collect pre-road development data for long-term monitoring purposes. A minimum of ten 3 km long breeding bird transects will be established perpendicular to the proposed access road, and will be surveyed during the primary nesting period for most bird species (see Appendix II for details).

1.4.4 Water Birds

Objective

Data collected during baseline studies will be used to determine the natural variation in waterbird density and richness in the study area during the northern migration, establishment of nesting territories, brood rearing period, and southern migration.

Rationale

Aerial surveys within the RSA and LSA conducted monthly throughout the field season will also record all waterbird sightings (see Appendix II for details). Aerial surveys provide a snapshot of the distribution and abundance of larger water birds such as cranes, geese, loons, gulls and ducks within the study area at different seasons. Smaller water birds such as shorebirds (e.g., Semipalmated Sandpiper) are not readily identified on aerial surveys.

Ground-based surveys of waterbirds will also be done to provide more fine-scale information to the baseline data. As with the upland breeding bird surveys, PRISM plots and transects along the proposed access road will also be used to survey waterbird distribution and abundance (see Section 1.4.3 above and Appendix II for details). Nest surveys will also be conducted along shorelines in the immediate vicinity (within 200 m) of the proposed mine facilities, in order to better understand the abundance and distribution of nesting water birds (see Appendix II for details).

1.4.5 Raptors

Objective

Data collected during baseline studies will be used to determine the natural variation in nest site distribution, occupancy, success, and productivity of raptors in the study area.

Rationale

The initial identification of raptor nest sites typically occurs during aerial and ground surveys for other species (*e.g.*, caribou, grizzly bear sign, water birds). Aerial surveys of identified raptor nests for spring occupancy and summer nest success and chick production are standard and accepted methods used in baseline and monitoring programs (DDMI 1998; De Beers 2002; Miramar 2005; BHPB 2007; DDMI 2007; De Beers 2007; Miramar 2007 [see Appendix II for details]). Analyses have detected significant annual variation in nest success and chick production (Golder 2005; BHPB 2007). The data provide robust estimates of the demographic performance of raptor populations among different regions of Nunavut and the NWT, which can be used to make inferences about local and regional-scale effects on these biological indicator species of environmental change.

1.4.6 Wildlife Health

Objective

Data collected during baseline studies will be used to characterize the baseline conditions (i.e., metals/uranium content) of habitat and food sources used by wildlife in the study area.

Rationale

The health of wildlife using habitats adjacent to future mine and road facilities is of great concern to the residents of Baker Lake and regulatory agencies (i.e., Health Canada, GoN DOE, Environment Canada). In order to assess the future impacts of airborne contaminants on wildlife, a sampling program will be established to collect baseline data in 2008 and 2009. Sampling will involve collection of various plant tissues (i.e., berries, sedges, lichen), animal (i.e., invertebrates) and soil at a minimum of 10 (seven mine or treatment sites and three external reference or control sites) locations in the vicinity of the Areva mine site. Tissue and soil samples will be analyzed for metals (see Appendix II for details).

1.4.7 Habitat Classification

Objective

Data collected during baseline studies will be used to determine the existing habitat types in the study area, and the availability of different habitat types and features to wildlife.

Rationale

Habitat, including vegetation, rocks, rock crevices, and eskers, is required by all wildlife species. Each wildlife species or wildlife VEC has varying needs for habitat units classified under the Ecological Land Classification (ELC). Habitat availability in the study area will be delineated through the development of ELC maps. The ELC process delineates unique and distinguishable habitat types (e.g., Lichen-Rock, Sedge) on the landscape using a combination of field studies (e.g., ground-truthing) and satellite imagery (see Appendix II for details).

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