10.0 CUMULATIVE EFFECTS

10.1 GENERAL

As indicated in the MVEIRB Terms of Reference (MVEIRB 2110), pursuant to paragraph 117(2)(a) of the *Mackenzie Valley Resource Management Act*, the Review Board considers cumulative effects in its determinations. Cumulative effects are the combined effects of the development in combination with other past, present or reasonably foreseeable future developments and human activities.

Cumulative effects represent the sum of all natural and human-induced influences on the cultural, physical, biological, and economic components of the environment within a period of space and time. Cumulative effects are changes to the environment that "are likely to result from the Project in combination with other projects or activities that have been or will be carried out" (Government of Canada 2003). The effects assessment for the Thor Lake Project identified a range of generally local effects on various physical, biological, and socio-economic components (Sections 6.0 and 7.0).

The next step is to determine if these potential local effects could or would combine with the effects from other current and reasonably foreseeable projects and activities in the North and South Slave Regions. At the same time, the influence of natural changes in environmental conditions is considered. Thus, the goal is to determine the chance and strength of the incremental cumulative effect from the Thor Lake Project on the applicable physical, biological and socio-economic components of the environment.

The Project's contribution to cumulative effects is assessed based on its effects on a valued component (VC) that is also affected by other land uses. A VC may be a valued ecosystem component (VEC) or valued social component (VSC). Communities, roads, other developments and hunting are examples of other land uses. Overall cumulative effects are effects of all land uses on a VC, including effects caused by the Project.

An assessment of cumulative effects provides a more complete understanding of what might happen to VCs beyond the influence of the Project alone. This is useful for regulatory decision-makers and land and resource managers as they review and plan future development. Thus, an assessment of cumulative effects provides a glimpse into environmental and socio-economic conditions now and how they may change in the future. This contributes to a better understanding of what might or might not happen if the Project proceeds.

Typically, cumulative effects assessments address effects that:

- extend over a larger area;
- are of longer term duration;
- act in conjunction with other projects/activities on the same VCs; and,
- are reasonably probable, considering possible future projects/activities and effects.

For the Thor Lake Project, the assessment of cumulative effects involved the application of four basic considerations (CEAA 1999):

- There must be an environmental, social or cultural effect related to the Project.
- The effect must be demonstrated to operate cumulatively, additively or synergistically with effects from other projects or activities.
- The other projects or activities exist or are likely to be carried out and are not hypothetical.
- The cumulative effect is likely to result.

10.2 MVEIRB REQUIREMENTS

The MVEIRB Terms of Reference (MVEIRB 2010) specifically required consideration of a number of items in the cumulative effects assessment for both the Nechalacho Mine and Flotation Plant site and the Hydrometallurgical Plant site and associated infrastructure:

The Board requested Avalon to predict potential impacts of the Thor Lake Project components in combination with impacts from past, present or future developments in the area for both sites on water quality, air quality, soils, vegetation and other terrain features, fish and wildlife.

Avalon was to give consideration to the former Pine Point mine site and the reasonably foreseeable progression of Tamerlane's Pine Point Pilot Project, as well as past development of any kind near Thor Lake.

In particular, the Board requested consideration of possible effects from the Thor Lake Project on Barren-ground and Woodland caribou in combination with impacts of other developments in the range of their respective habitats.

From a socioeconomic perspective, the Board requested consideration of possible socio-economic changes, cultural changes and changes to community well-being from the Project in combination with other industrial developments using publicly available data including:

- Existing and proposed diamond mines;
- Proposed Yellowknife Gold Project;
- Proposed Mackenzie Gas Project.

Avalon was also to provide a description of how Avalon's liabilities may interact with those of Tamerlane and/or Teck Cominco with regard to reclamation issues in the Pine Point area.

10.3 SPATIAL BOUNDARIES

To accommodate the wide range of issues identified in the MVEIRB Terms of Reference (MVEIRB 2011) with respect to possible cumulative effects of the Thor Lake Project on Barren-ground and Woodland caribou, and various specific existing or proposed projects,

the spatial boundaries for the cumulative affects assessment is necessarily very large and is presented in Figure 10.3-1.

This vast area, referred to as the Cumulative Effects Study Area (CESA), incorporates the entire range of the Bathurst Caribou herd, extends south to the NWT border, and to the west encompasses Highway 1 and the CN rail line. The CESA also includes all of the potentially affected communities assessed in this DAR. The CESA covers an area of approximately 510,000 km^2.

It should be noted however, that this large area does not incorporate the proposed Mackenzie Gas Project pipeline corridor, which is located a further 230 km to the west of Hay River and approximately 315 km west of the Hydrometallurgical Plant site.

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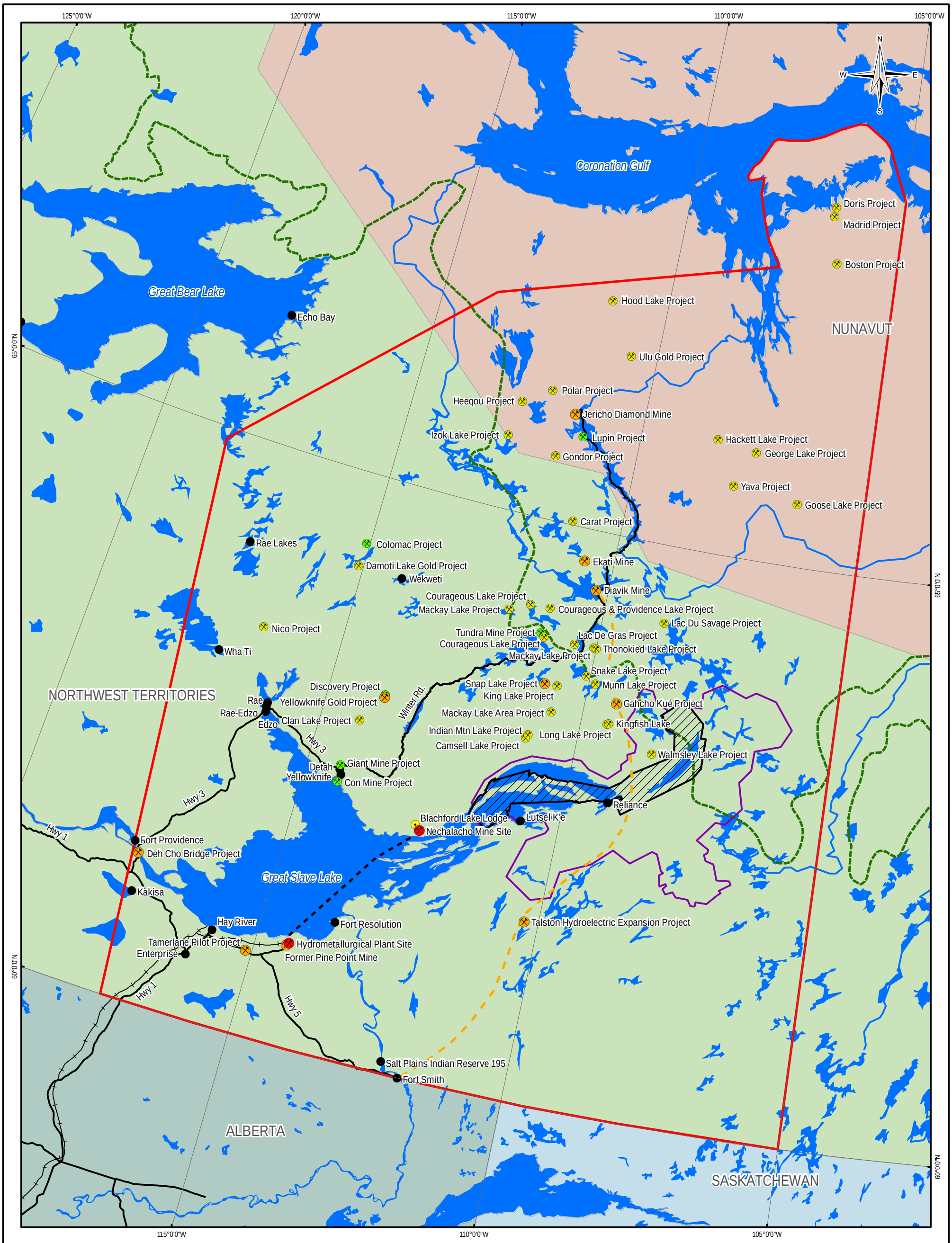


LEGEND

- Cumulative Effects Study Area (approx. 510,000 km^2)
- Thor Lake Project Components
- Existing Mine/Project
- Exploration Mine/Project
- Closed Mine/Project
- Blachford Lake Lodge
- Communities
- Talston Hydroelectric Expansion Project
- Approximate Barging Route
- East Arm National Park Reserve Proposal
- 1970-1997 Land Withdrawal
- 2007 Land Withdrawal
- Road
- Railroad
- Treeline
- Watercourse
- Waterbody

NOTES

Base data sources: NWT, Canada Atlas, and ESRI.

ISSUED FOR USE

THOR LAKE PROJECT

Spatial Boundary for Assessing Cumulative Effects

PROJECTION	DATUM
Canada Albers	NAD83

Scale: 1:3,500,000

40 20 0 40 80

Kilometres

FILE NO. V15101007_DAR_Map044_CumEffects.mxd

PROJECT NO.	DWN	CKD	REV
V15101007.006	SL	RH	0

OFFICE	DATE
EBA-VANC	May 11, 2011

AVALON RARE METALS INC

EBA Engineering Consultants Ltd. eba

Figure 10.3-1

10.4 TEMPORAL BOUNDARIES

For cumulative effects, the MVEIRB Terms of Reference (MVEIRB) directed that the temporal scope was to include the period of the effects of past, present and reasonably foreseeable future projects that are predicted to combine with the effects of the Thor Lake Project.

Avalon was also to give special attention to appropriate temporal boundaries for considering any impacts that may require long-term monitoring and management after closure, such as mine water release into the environment

The Review Board noted that the Thor Lake Project may be a long-term mine, and thus required Avalon to accurately portray a realistic mine life in the Developer's Assessment Report by indicating the actual life of mine that the proposed Project configuration will support, as well as the expected potential life of mine that Avalon has publicly suggested the deposit will support.

While Avalon understands what is being requested, because of the limitations associated with predicting future mine life beyond the current projected mine life that can be supported by the configuration presented in this DAR, for the purposes of this cumulative effects assessment, Avalon has opted to limit the assessment to the initial 20 year projected mine life, a subsequent projected closure period of 2 years, and 5 years of post-closure monitoring.

The temporal boundary for a VC is defined as the amount of time between the start and end of a relevant Project activity or stressor (which is related to development phases), plus the duration required for the effect to be reversed. After removal of the stressor, reversibility is the likelihood and time required for a VC or system to return to a state that is similar to the state of systems of the same type, area, and time that are not affected by the Project but does not necessarily imply returning to environmental conditions prior to development of the Project.

10.5 REGIONAL DEVELOPMENTS

To determine whether any of the residual effects associated with the Thor Lake Project components could operate cumulatively, additively, or synergistically with effects from past, present and reasonably foreseeable future projects, a list of previous, existing, and reasonably foreseeable projects within the CESA was compiled from publically available information sources. The geographic location of each of these projects or activities is shown in Figure 10.3-1.

10.5.1 Previous and Existing Developments

Previous and existing developments that have some spatial or temporal overlap with the Thor Lake Project components are:

- Historic T Zone Exploration at the Nechalacho Mine site
- Historic lead/zinc mining at Pine Point

10.5.1.1 Historic T Zone Exploration

In 1976, Highwood Resources Ltd., in the course of a regional uranium exploration program, discovered niobium and tantalum on the Thor Lake Property. The Property was staked as the Thor 1-45 claims and the NB claims were added in 1976 and 1977. From 1976 to 1979, exploration programs included geological mapping and sample trenching on the Lake, Fluorite, R, S and T Zones.

From 1983 to 1985, the majority of the work on the property was concentrated on the T Zone and included geochemical surveys, berylometer surveys, surface mapping, significant drilling, surface and underground bulk sampling, metallurgical testing and a detailed evaluation of the property by Unocal Canada.

In 1997, Highwood conducted an extensive re-examination of Thor Lake that included a proposal to extract a 100,000 tonne (t) bulk sample. Applications were submitted for permits that would allow for small-scale development of the T Zone deposit, as well as, for processing over a four to five year period. In late 1999, the application was withdrawn.

These historic exploration activities resulted in the development of approximately 4.9 ha of disturbed terrain. This area is located to the north of Thor and Cressey lakes. Further information on vegetation cover and terrain conditions of site is provided in Sections 2.9, 2.10 and 6.7 and 6.8.

10.5.1.2 Historic Lead/Zinc Mining at Pine Point

The former Pine Point Mine, historically operated by Cominco, is located on the south shore of Great Slave Lake in the area of the proposed Hydrometallurgical plant site. The mine produced lead and zinc ores from 1964 to 1988 when it closed. Cominco built its own town site which became known as Pine Point. The mine was also supported by a railway line which was completed in 1964, and a highway, which became part of existing Highway 5. The town became a territorial settlement with private businesses, and had a population of 1,200 at its peak. When the mine closed in 1988, the single-industry town was forced to close, was demolished and abandoned.

During its life, the mine produced and shipped 10,785,000 tons of lead and zinc concentrates/high-grade ores after mining and milling 69,416,000 tons of ore material. Contained metal was approximately 2 million tons of lead and 7 million tons of zinc.

Reclamation activities were initiated in 1988 and were completed in accordance with an approved Restoration and Abandonment Plan (Teck Cominco 2006). Following completion of the necessary reclamation activities, the surface leases then held by Teck Cominco were surrendered back to the Crown in the mid to late 1990s.

Currently Teck Cominco Metals Ltd. continues to retain one surface land lease. This lease encompasses the tailings impoundment area to allow for the on-going management of the tailings facility. Ongoing seasonal discharges of water from the tailings impoundment area continue to be regulated under a Type B water license issued to Teck Cominco Metals Ltd.

Since Avalon's proposed Hydrometallurgical Plant and associated infrastructure will not utilize any portion of the existing Teck Cominco surface lease area, Avalon's future reclamation liabilities are not expected to interact with those of Teck Cominco or Tamerlane.

The former Pine Point Mine area comprises the largest brownfields site in the NWT, estimated at approximately 3,425 hectares using digital image analysis, of which approximately 1,771 ha are located within the Hydrometallurgical Plant local study area (Figure 10.5-1). As indicated in this DAR, to minimize effects to existing undisturbed terrain and vegetation, virtually all of the Project Hydrometallurgical Plant and associated infrastructure will be located on previously disturbed terrain.

10.5.2 Reasonably Foreseeable Projects

It is the standard practice to include reasonably foreseeable future developments in a cumulative effects analysis. This section describes the potential future projects included in the assessment and how they were selected. The reasonably foreseeable projects included were projects or activities that:

- have been proposed and scoped to a reasonable level of detail;
- may be induced by the Project, and
- have the potential to change the Project or the impact predictions.

For the purposes of this assessment, we have followed the approach taken by De Beers (2010) for the Gahcho Kue EIS. Their approach assumed that each of the reasonably foreseeable projects will be carried forward to full development, and that their effects may have both spatial and temporal overlap with the Thor Lake Project. Using this approach, the following proposed projects were selected as a suite of major developments that may occur in the reasonably foreseeable future and that are in the reasonable vicinity of the Thor Lake Project:

- Tamerlane Pilot Project
- Proposed East Arm National Park
- Taltson Hydroelectric Expansion Project
- Gahcho Kué Project
- Yellowknife Gold Project

10.5.2.1 Tamerlane Pilot Project

Tamerlane Ventures Inc. (Tamerlane) proposes to construct and operate a Zn/Pb pilot plant at the R190 site, located approximately 30 km to the West of the Thor Lake Project Hydrometallurgical Plant site and about 42 km East of Hay River (Figure 10.3-1). The proposed Pine Point Pilot Project (PPPP) proposes to use an innovative combination of basic and technical mining methods to confirm the potential to conduct full-scale

underground mining of the remaining 34 known deposits. The proposed project will produce a bulk sample of approximately 1,000,000 metric tonnes of lead-zinc ore over a 12-15 month period.

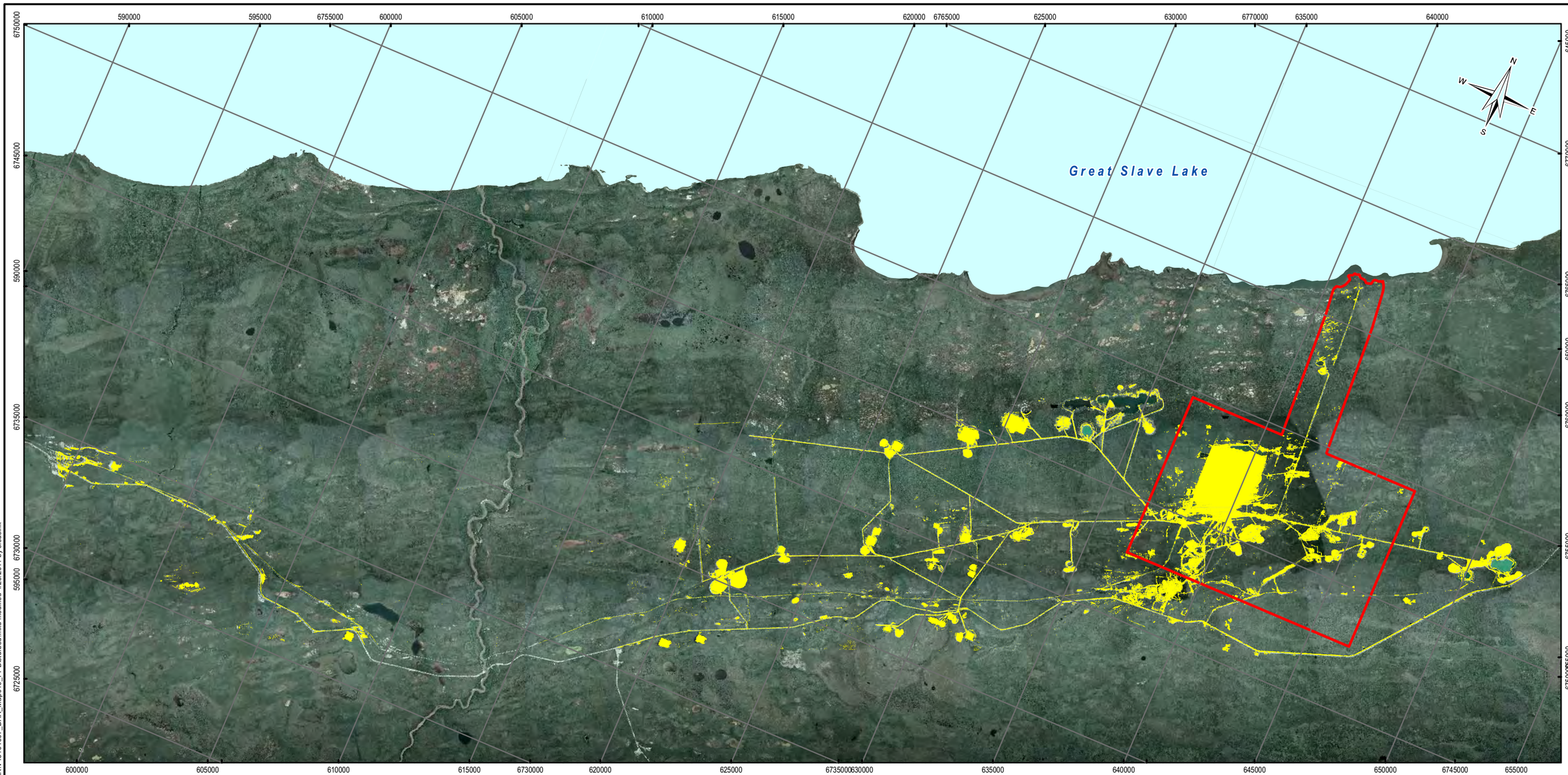
Because of its location, the project will be able to take full advantage of existing public infrastructure including the NWT highway system, line power from the grid and the existing rail head at Hay River. Tamerlane anticipates commissioning the metallurgical facilities in the summer of 2013 following delivery of the first ore from the underground (Tamerlane 2011). Tamerlane plans to pursue longer-term development in the Pine Point area utilizing the existing PPP infrastructure to access other deposits in the 175 km^2 property. Additional potential mineable deposits are located on the West side of the Buffalo River in close proximity to the R190 deposit and project site.

10.5.2.2 Proposed East Arm National Park

The nearest portion of the proposed East Arm National Park would be located approximately 50 km east of the Nechalacho Mine and Flotation Plant site (Figure 10.3-1). The park is currently proposed to include McLeod Bay, Reliance, Pike Portage, the Lockhart River and Artillery Lake at the East Arm of Great Slave Lake (Environment Canada 2010e). In 1970, an area of 7,407 km^2 in the East Arm of Great Slave Lake was permanently withdrawn or set aside from further development and land disposition was undertaken to allow a national park proposal to proceed (the East Arm National Park Land Withdrawal area). Over the next three decades, lack of progress in resolving Aboriginal land, resources and governance issues meant that there was not a suitable context to advance the park proposal (Environment Canada 2010e).

In 2005, the Łutselk'e Dene First Nation delineated an area it calls *Thaidene Nene*, a part of its traditional territory that it proposes to protect through the establishment of a national park and other conservation measures (Environment Canada 2010e). This, in part, prompted Parks Canada to reassess the boundaries of the 1970 East Arm National Park proposal, proposing a new study area of 33,525 km^2 (29,560 km^2 is land, 3,965 km^2 is water).

There remains ambiguity in the status of the existing fishing, hunting lodges, and camps in the proposed park area. Overall, the proposed East Arm National Park would be beneficial to the environment, and may lead to local jobs (Environment Canada 2010e). It is not clear when this Park would be fully established, but the existing permanent land withdrawal has already removed the core area from further development.



LEGEND

- Disturbed Terrain
- Local Study Area

Existing Disturbed Terrain Totals	
	Area (ha)
Hydrometallurgical Plant LSA	1771
Remainder of the Disturbed Terrain	1014

NOTES

1. Estimates of the disturbed terrain were produced using digital image processing tools within ArcGIS 9.3.

ISSUED FOR USE

THOR LAKE PROJECT

Footprint of Existing Disturbed Terrain in the Pine Point Area

PROJECTION	DATUM
UTM Zone 11	NAD83

Scale: 1:160,000

0 1 2 4 6

Kilometres

FILE NO.: V15101007_DAR_Map049_PPDisturbed.mxd

PROJECT NO.	DWN	CKD	REV
V15101007.006	SL	RH	0

OFFICE	DATE
EBA-VANC	April 19, 2011

AVALON RARE METALS INC.

EBA Engineering Consultants Ltd.

Figure 10.5-1

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10.5.2.3 Taltson Hydroelectric Expansion Project

The Taltson Hydroelectric Expansion Project is proposed by Dezé Energy Corporation to enhance existing power generating facilities at the Taltson hydroelectric station near Fort Smith and the construction of a new power transmission line to the proposed Gahcho Kué mine, then branching to the Snap Lake, Diavik and Ekati mines (Dezé 2010) (Figure 10.3-1). The proposed project would offset the diesel-generated electricity at the existing mines and proposed Gahcho Kué mine. This would lead to some environmental benefits, such as reduced greenhouse gas emissions and fewer haul trucks on the Tibbitt to Contwoyto Winter Road.

The Taltson Hydroelectric Expansion Project would not cause any new flooding in the Taltson River basin. However, it would require a new winter road from Fort Smith to Nonacho Lake and new spur roads from the Tibbitt to Contwoyto Winter Road during the three-year construction period (projected to be 2012 to 2015). Further, approximately 690 km of new transmission line would be required to link the Taltson generating station to the existing diamond mines and the Gahcho Kué project (Dezé 2010). Full operations of the expansion were anticipated to in 2013.

In early March, 2011, the project was temporarily put on hold by the Government of the Northwest Territories and Dezé Energy requested the Mackenzie Valley Environmental Impact Review Board to "pause" the environmental assessment of the project (CBC 2011).

10.5.2.4 Yellowknife Gold Project

Tyhee NWT Corp (Tyhee), a wholly owned subsidiary of Tyhee Gold Corp., is proposing to construct and operate the Yellowknife Gold Project (YGP), located approximately 88 km north of Yellowknife and about 135 km NNE of the Nechalacho Mine and Flotation Plant site (Figure 10.3-1). Mining operations at the YGP will consist of two separate mining locations, Ormsby where the major mine infrastructure will be located, and Nicholas Lake located approximately 9 km to the northeast. The Ormsby site will host a conventional open pit followed by an underground operation. The Nicholas Lake site will host an underground operation. The current projected mine life is about 8 years (Tyhee 2011).

Access to the YGP is by an existing 55 km winter road starting at Prosperous Lake, located approximately 20 km NE of Yellowknife. An all-season road approximately 9 km long will likely be constructed to transport ore from the Nicholas Lake Main Zone to the mill. This road will also provide access for plant, supplies and personnel on a daily basis.

The project is currently undergoing review by the MVEIRB, and subject to approvals, construction is scheduled to commence the winter of 2014 and be completed by late 2015, with plant commissioning shortly after completion of construction. Site facilities such as power supply, waste disposal facilities, camp, fuel supply, explosive magazines, offices, warehouse and shops and associated surface facilities are expected to be constructed during this period.

10.5.2.5 Gahcho Kué Project

The Gahcho Kué Project is located on the AK claim block, south of Lac de Gras, 80 km southeast of the Snap Lake Diamond Project, approximately 230 km NE of the Nechalacho Mine and Flotation Plant site (Figure 10.3-1). Gahcho Kué is a joint venture between De Beers Canada Exploration Inc. (51%) and Mountain Province Diamonds Inc. (49%). Exploration has determined that three kimberlite deposits have potential to be mined, these have been designated 5034, Hearne and Tuzo. Since these kimberlite deposits are located beneath Kennady Lake, the lake will need to be dewatered for the life of the project, which is currently estimated to be about 11 years (De Beers 2008).

The mine complex will include an accommodation facility with enough private rooms to house the employees needed to operate the mine and the workers needed during the construction phase. There will also be an administration complex, process plant, maintenance and warehouse facility, a lined and bermed fuel tank farm, explosives storage and manufacturing facilities, and an airstrip capable of handling the aircraft needed to fly workers and supplies to the site. A 120 km winter road that follows the route established during exploration of the site would be build to the site each year, connecting to the existing Tibbitt-Contwoyto winter road near the top end of MacKay Lake.

The Gahcho Kué Project is currently proceeding through the MVEIRB environmental impact review process, and subject to approvals, hopes to begin construction of the project in 2013 with first production in 2014.

10.6 CUMULATIVE EFFECTS ASSESSMENT

Sections 6.0 and 7.0 of this DAR assessed the potential effects of the Thor Lake Project components on all of the key biophysical environmental and socio-economic VCs in terms of anticipated residual effects, and their defining characteristics including nature/geographic scope, direction, magnitude, timing/duration, frequency, reversibility, likelihood/confidence and significance (definitions of these criteria were provided in Table 6.1-2).

The assessment determined that for all VCs, after the application of the proposed mitigation measures, the residual environmental effects of the Thor Lake Project were anticipated to be negligible and insignificant. Furthermore, any identified environmental effects were generally limited to the immediate footprints and local study areas of the Nechalacho Mine and Flotation Plant and the Hydrometallurgical Plant and associated infrastructure and most were reversible once activities ceased. As such, effects of this nature cannot typically operate in a cumulative manner.

However, the MVEIRB Terms of Reference specifically requested Avalon to predict potential impacts of the Thor Lake Project components in combination with impacts from past, present or future developments in the area for both sites on water quality, air quality, soils, vegetation and other terrain features, fish and wildlife.

In particular, the Board requested consideration of possible effects from the Thor Lake Project on Barren-ground and Woodland caribou in combination with impacts of other developments in the range of their respective habitats.

From a socioeconomic perspective, the Board requested consideration of possible socio-economic changes, cultural changes and changes to community well-being from the Project in combination with other industrial developments using publicly available data.

Thus the following sections serve to assess these areas of interest and concern. To facilitate assessment and discussion of the environmental issues identified and whether they have the opportunity to operate in a cumulative manner with the effects of other past, present or foreseeable projects, these are discussed in the context of each of the Nechalacho Mine and Flotation Plant area and the Hydrometallurgical Plant area.

Since the socioeconomic areas of interest and concern can apply to any of the communities identified in the DAR regional study area, socio-economic issues that could operate in a cumulative manner are discussed relative to this regional area.

10.6.1 Air Quality

As discussed in Section 6.2, the Thor Lake Project operations will result in emissions of criteria air contaminants (CACs) and greenhouse gases (GHGs). The air quality assessment was focussed on the Thor Lake Project operation phase since all air quality effects for the construction and closure phases are expected to be bounded by air quality impacts associated with the operations phase.

The main sources of CACs from the Nechalacho Mine and Flotation Plant include the ventilation raises, diesel generators, mine air heaters, and transfer and handling of dry ore. The main source of CACs from the Hydrometallurgical Plant is the sulphuric acid plant. Emissions of CACs were estimated for these main sources, and subsequently modelled using the CALPUFF model.

The dispersion model results show that maximum predicted concentrations within the two 20 km by 20 km local study areas are expected to be less than the NWT Ambient Air Quality Standards. Since the two LSAs are located approximately 160 km from each other, air quality effects from the Thor Lake Project components at the two sites are not expected to overlap.

There are no known other major sources of emissions located in either of the local study areas. The closest known other source of future emissions in the vicinity of the proposed Hydrometallurgical Plant site is Tamerlane Venture's proposed Pine Point Pilot Project, located approximately 40 km west-southwest.

The main CAC emission that both facilities have in common is SO_2. The maximum predicted SO_2 concentrations due to emissions from the Hydrometallurgical Plant are expected to be less than 10% of the NWT ambient air quality standard (approximately 50 $\mu g/m^3$) beyond 6 km from the sulphuric acid plant. Similarly, the Maximum predicted SO_2 concentrations due to emissions from the Pine Point Pilot Project were predicted to be less than 10% of the NWT ambient air quality standard beyond 2 km from that facility (RWDI 2008).

Thus, the potential for cumulative effects due to emissions from the Thor Lake Project in combination with the Pine Point Pilot Project is expected to be negligible.

There are no standards for GHG emissions and therefore Project GHG emissions are typically assessed by comparison with territorial and national totals as well as emissions from other, similar projects. Environment Canada's National Inventory Report (2010c) provides an estimate of Canada's GHG releases to the environment on an annual basis. In 2008, Canadians contributed about 734 Mt of GHGs while Northwest Territories and Nunavut contributed 1.81 Mt.

Annual GHG emissions from the Thor Lake Project components during the operation are expected to be 60.5 kt, which represents a 3% increase in the territorial total and less than 0.01% of total national emissions. These GHG emissions are roughly equivalent to the total GHG emissions from the Snap Lake Mine (63 kt/y), and less than half the GHG emissions from the Diavik Diamond Mine (159 kt/y) and the Ekati Diamond Mine (210 kt/y).

For all three phases of the Thor Lake Project (construction, operation and closure) the assessment determined that the potential for a residual effect on ambient air quality or greenhouse gas emissions was found to be not significant. In addition, the potential for cumulative effects was found to be negligible.

10.6.2 Nechalacho Mine Area

10.6.2.1 Surface Water Quality

Surface water quality modelling at the Nechalacho Plant site was carried out to predict changes in water quality, due to mine related activities, within and downstream of the Thor Lake watershed. Potential changes to existing water quality could occur due to the discharge of tailings and plant process water, sewage, and pumped mine water into the TMF, which will replace Ring, Buck, and Ball lakes at the top of the Thor Lake watershed. The model incorporated flow rates, which will be managed to mimic seasonal background flows through the system, and effluent chemical parameters measured in five-day decant samples. A proprietary three-dimensional hydrodynamic model was used to estimate downstream metal concentrations over the 20 year life span of the mine, as described in Section 6.4 of this DAR.

Results of the model indicated that effluent discharged from the TMF would be well within MMER limits for regulated contaminants, and importantly, that no exceedances of CCME Guidelines for the Protection of Aquatic Life were predicted over the 20 year life of mine operations. Concentrations of metals reaching Thor Lake are predicted to be extremely low. For example, arsenic will be 0.034% of the CCME guideline; mercury 0.3% of the CCME guideline; and, copper, 0.04% of the MMER guideline. The model results can be considered to be conservative or worst case, since no allowance was made in the model for decreases in concentration due to natural remediation processes including degradation, chemical oxidation, precipitation, and biodegradation.

Although not specifically modelled, it is assumed that water quality downstream of Thor Lake will not be adversely affected by TMF discharges due to the considerable dilution that occurs as water flows a further 18 km through a series of wetlands, streams and lakes towards Great Slave Lake, comprising an additional 6,700 ha of watershed. It is estimated, therefore, that water entering Great Slave Lake would be indistinguishable from background levels.

No other projects are anticipated to affect water quality in the Nechalacho Mine Site area. Since it is anticipated that there will be no residual effects on water quality entering Great Slave Lake, no cumulative effects on water quality are predicted to occur.

10.6.2.2 Groundwater Quality

As discussed in Section 6.5.1.5, the quality of the groundwater in the vicinity of the Nechalacho underground mine area will be potentially impacted by the underground operations (dust, ammonia, nitrates, nitrites, hydrocarbons. However, as previously indicated, all excess mine water from the underground operations will be pumped to surface for use in the Flotation Plant and will report to the Tailings Management Facility (TMF). Effluent discharged from the TMF will be required to comply with the terms and conditions, including effluent quality criteria, of the future MVLB Water License and the effluent quality criteria of the Metal Mining Effluent Regulations.

During the post-closure period, the underground workings will be allowed to flood naturally. The current mine plan estimates that 95% of the void space of the underground mine will eventually be filled with paste backfill. The remaining void space will be flooded with groundwater.

Based on the estimated void volume and the simulated mine inflows, the underground mine will be flooded in approximately 5.3 years after mine closure assuming the lower inflow projections and more rapidly (1.6 years) if the higher inflow projections are applied. Once the water level in the mine reaches the pre-development or natural level, seepage inflow will cease and the groundwater regime will return to pre-development conditions. As a result, no residual or cumulative effects on local groundwater quality are predicted to occur.

As previously discussed in Section 2.6.3, Stantec (2010b) reported on the analytical results of groundwater quality sampling conducted over multiple events during the period 2008-2010. All groundwater samples were analyzed for their concentrations of total and dissolved metals. The measured dissolved metal concentrations were compared to CSR and CCME water quality guidelines for the protection of aquatic life. The CSR guideline values apply to both surface and groundwater, whereas the CCME guidelines only apply to surface water. However, as groundwater ultimately discharges to surface water bodies, the CCME guideline values were included for reference.

The results of the groundwater quality sampling showed that values for aluminum, cadmium, copper iron silver and lead in the groundwater exceeded guideline values on a relatively consistent basis. However, it was noted that these exceedances of the CCME and/or CSR guidelines do not imply that the groundwater at the study area is currently

contaminated; only that background concentrations of these parameters are higher than typically found in groundwater at other natural sites in Canada. These background groundwater quality results merely reflect the natural geologic and hydrogeologic conditions within these specific areas of the property (Stantec 2010b).

It is anticipated that the existing groundwater quality conditions described are likely to be altered somewhat by the future and ongoing underground mining activities. However, as previously indicted, all excess mine water from the underground operations will be pumped to surface for use in the Flotation Plant and will report to the Tailings Management Facility (TMF). Effluent discharged from the TMF will be required to comply with the terms and conditions, including effluent quality criteria, of the future MVLWB Water License and the effluent quality criteria of the Metal Mining Effluent Regulations.

Since no other developments or activities are proposed within the Nechalacho area that could affect groundwater quality, no cumulative effects on groundwater quality are predicted to occur.

10.6.2.3 Fish and Fish Habitat

Assessment of the potential effects on fish and fish habitat of the construction and operation of the Nechalacho Mine Site was based on identification of pathways of effects, and analysis of the efficacy of design features, applied mitigation measures, or the application of guidelines and BMPs to avoid or minimize adverse effects. The pathways and assessments are discussed in Section 6.6 of this DAR.

Effects to fish and fish habitat potentially result from changes in surface water flows and water quality. Despite changes to the upper portion of the Thor Lake watershed, flow modifications will be relatively minor due to recirculation of TMF water for plant process purposes. This has the advantage of reducing freshwater requirements from Thor Lake, allows the allocation of downstream flows from the TMF to mimic seasonal flow volumes and patterns, and eliminates the need to pump excess water directly to Thor Lake. As such, natural flow patterns and channels will be maintained, resulting in no residual effects on fish or fish habitat.

As discussed in Sections 6.4 and 10.6.2.1, water quality modeling has resulted in a prediction that water quality will not be degraded within the Thor Lake watershed, or downstream to Great Slave Lake.

Since no residual effects on fish or fish habitat are anticipated due to Project activities, and no other developments or activities are proposed within the Nechalacho area that could affect fisheries values, no residual or cumulative effects on fish and fish habitat are predicted to occur.

10.6.2.4 Vegetation, Soils and Terrain

As previously discussed in Section 6.8.1.1, infrastructure placement at the Nechalacho Mine and Flotation Plant site will result in the disturbance or burial of approximately 173 ha of surface area, the majority of which is attributable to the tailings management facility. Wherever possible, the placement of infrastructure has incorporated areas of existing

disturbance, such as previously exposed soil and existing roads and account for 1% of the footprint area.

Ecosystem types that will be most affected by development of the Nechalacho Mine site footprint include white spruce – green alder – prickly rose forest (WA), spruce – paper birch – toadflax forest (SP), and lichen – bearberry woodland (LW), which collectively cover approximately 39% of the total footprint area. In addition, each of the following ecosystem types each account for approximately 10% of the total footprint area: Ponds (PD), black spruce – feathermoss – crowberry upland forest (BF), and black spruce – tamarack – water sedge fen (BT).

Ecosystem types occurring within the Nechalacho Mine Site footprint are predominantly well to rapidly drained woodlands and forests, often with shallow soils over bedrock (the exception being ponds and the BT ecosystem type). All of the ecosystem types that may be directly affected by footprint development are well represented within the LSA.

Sensitive ecosystems, particularly those with a high lichen component, comprise approximately 46 ha (26%) of the Nechalacho Mine site infrastructure footprint. The disturbance to individual ecosystem types in relation to their presence within the LSA ranges between 0% (not present within the footprint area, as is the case with the Jack pine – heath – lichen – upland (JH) ecosystem type) and 23% (for the Labrador tea – reindeer lichen – black spruce bog (LL) ecosystem type). This level of disturbance is unlikely to affect the persistence and sustainability of these ecosystem types as the majority of the area identified occurs within the LSA, not the footprint. These ecosystem types were also characterized within the larger regional study area.

No rare plant species were found within the proposed Project footprint. In particular, rock polypody (ranked as "undetermined" in the NWT) was identified during field surveys only in areas outside of the proposed infrastructure development. Ecosystem types with a higher potential of providing rare plant habitat are, however, present within the footprint, covering approximately 59 ha (34%) of the total area. The most prevalent ecosystem types with a higher potential of providing rare plant habitat are Ponds (PD), black spruce – feathermoss – crowberry upland forest (BF), and black spruce – cloudberry – *Sphagnum* moss bog forest (BG). Disturbances to individual ecosystem types compared to their distribution in the LSA range between 2% (WH ecosystem type) and 12% (ponds located within the TMF).

Within the Nechalacho Mine site area, the removal or burial of ecosystem types and plant species will occur during construction and effects will remain until the closure and decommissioning phase. As indicated in Section 6.8.6, the effects were considered to be not significant overall mainly because of the relatively small size of the footprints, the incorporation of previously disturbed areas into the footprint layout and the largely reversible nature of the disturbances expected. Additionally, the ecosystem types that will be disturbed by Project activities are represented within the larger LSA, as well as regionally.

As there are no other developments or activities proposed within the Nechalacho area that could affect these components, no cumulative effects to vegetation, soils, and terrain are anticipated to occur.

10.6.2.5 Wildlife

Section 6.9.1 of this DAR assessed the potential effects of the proposed Nechalacho Mine and Flotation Plant and associated activities on the wildlife resources of this area. The wildlife VCs assessed included barren-ground caribou, moose, black bear, other furbearing mammals, and a number of bird species including Bald Eagle, Peregrine Falcon, Short-eared Owl, Common Nighthawk, Olive-sided Flycatcher, Rusty Blackbird and Horned Grebe.

Section 6.9.2 of the DAR assessed the potential effects of the proposed Hydrometallurgical Plant and associated activities on the wildlife resources of this area. The wildlife VCs assessed included woodland caribou, moose, wood bison, black bear, other furbearing mammals, and a number of bird species including Whooping Crane, Peregrine Falcon, Yellow Rail, Short-eared Owl, Common Nighthawk, Olive-sided Flycatcher, Rusty Blackbird and Horned Grebe.

The environmental assessment concluded that potential disturbance and habitat-related effects on all wildlife species would be of a negligible and insignificant nature with no residual impacts expected to occur. In terms of possible cumulative implications, none of the intermittent, short-term, highly localized and rapidly reversible Project-related effects are anticipated to cause impacts that may contribute to cumulative effects on any of the wildlife species that use or may be present in the area of the Nechalacho Mine and Flotation Plant site, the Hydrometallurgical Plant site, or any of the transportation-related activities.

10.6.2.6 Barren-ground Caribou

Barren-ground caribou are a significant resource for the people of the NWT, both socially and culturally. Caribou found in the Nechalacho Mine Site area are part of the Bathurst herd. The Nechalacho Mine Site area and the islands in the east arm of Great Slave Lake lie at the border of the known Bathurst herd's winter range. GNWT ENR (2010b) indicates the Bathurst herd typically over-winters southeast of Great Bear Lake, but in some years the herd moves further south towards Yellowknife and Lutsel K'e.

Caribou from the Bathurst herd can be expected to occasionally over-winter in the Nechalacho Mine site area and the islands in the east arm of Great Slave Lake from November to May. Participants in the TK studies conducted by Avalon in cooperation with the Lutsel K'e Dene First Nation and the Yellowknives Dene First Nation also indicated that barren-ground caribou are known to occur in the Nechalacho Mine site area.

During the EBA (2010) baseline surveys, caribou pellet groups were not documented at any of the 64 wildlife-habitat assessment survey stations. However, six incidental observations of caribou sign (including pellet groups and an antler shed) were documented within the Thor Lake study area. All pellet groups (n=5) were reported along the old mine site road and a single antler shed was observed in a bedrock-lichen-juniper-saxifrage habitat type.

The population size of the Bathurst herd has been estimated fairly regularly since 1970 by the GNWT (GNWT ENR 2010a) as summarized in Section 2.5. The herd reached a peak size of 472,000 ± 72,900 in 1986; however, it has declined at approximately 5% per year since peak size. The most recent survey in 2009 estimated the size of the herd at 31,900 ±

11,000 (GNWT ENR 2010a). The number of animals in a caribou herd naturally fluctuates over a 40 to 60 year cycle. The distribution and density varies from year to year, with the herd rarely using the same area for more than two or three years out of ten (Case et al. 1996).

As previously discussed in Section 6.9.1.1, the main ways that the Nechalacho Mine and Flotation Plant (and associated infrastructure and activities) may affect barren-ground caribou, is through direct loss of over-wintering habitat, avoidance and displacement, and mortality.

Avalon's footprint design of the underground mine, clustering of the surface facilities, use of existing roads, and placement of the tailings delivery pipeline along the existing road will minimize the amount of direct habitat loss. Due to the Bathurst Caribou herd's large winter range and infrequent occurrence in the area, the amount of quality forage, resting/security, and traveling habitat lost due to the Nechalacho Mine is predicted to be low in magnitude.

The Nechalacho Mine and Flotation Plant may result in localized avoidance by the few over-wintering caribou that may infrequently occupy the local area; however, the mine is not predicted to have any effect at the herd level.

The few over-wintering Barren-ground caribou that may occur in the Nechalacho Mine area in some winters may also be displaced by visual disturbances from the infrastructure, vehicle traffic, people, and aircraft. This temporal disturbance may influence daily movements if encountered, but is unlikely to disrupt seasonal movements. Displacement may occur most frequently near the haul road to Great Slave Lake, airstrip, and at the Flotation Plant during the operations phase, as well as at the tailings management facility during the construction and closure phases.

The duration of such exposures are expected to be brief, perhaps lasting a few minutes to a few hours, and are reversible upon cessation of the activity or by moving away from the activity. The number and frequency of such exposures to disturbance by the few barren-ground caribou occurring in the local area would be expected to be low and infrequent.

The implementation of a no hunting policy for all Project employees and contractors, and the requirement for all transportation activities to give the right of way to wildlife, resulted in a determination that the risk of mortality from equipment and vehicle collisions at the Nechalacho Mine study area is considered negligible.

In summary, the assessment determined that habitat and disturbance-related effects on the few barren-ground caribou that may occasionally overwinter in the Nechalacho Mine area would be of a negligible and insignificant nature, with no residual effects expected to occur. As a result the Thor Lake Project is not anticipated to contribute to a possible cumulative effect on barren-ground caribou or on the continued use of caribou by people that value the animals as part of their culture and livelihood.

This conclusion is supported by the results of a considerably more comprehensive cumulative effects analysis conducted recently for the Gahcho Kue Environmental Impact Statement (De Beers 2010). Projects included in their assessment were the proposed

Gahcho Kue Project, Thor Lake Project, Yellowknife Gold Project, the Taltson Hydroelectric Expansion Project, and the East Arm National Park.

De Beers (2010) evaluated five primary potential effects pathways for cumulative residual impacts from development on the population persistence of Bathurst caribou. These included direct habitat loss and fragmentation from development footprints (including winter roads), and indirect changes to habitat quality from sensory disturbance effects such as people, vehicles, dust, and noise.

De Beers (2010) analyzed these pathways through the use of habitat, energetic, and population models; their work has been adapted and incorporated in this discussion by reference. Two potential effects related to changes in the availability of caribou for traditional and non-traditional use were also examined.

The duration of the potential effects from the different pathways were expected to be reversible in the medium to long term. Sensory disturbance impacts associated with influences of exploration and mining activities on caribou populations were anticipated to be reversible over the long term (27 to 32 years [two caribou life spans or 1.5 human generations]). Effects associated with winter roads on populations and traditional and non-traditional use of caribou were expected to be reversible in the medium term (5 years after initial closure). For all primary pathways influencing population size and distribution, cumulative effects were determined to be beyond regional in geographic extent (i.e., effects occur at the scale of the seasonal ranges). (De Beers 2010).

The cumulative direct disturbance to the landscape from the Gahcho Kue Project, Thor Lake Project and other previous, existing, and future developments was predicted to be less than or equal to 1.7 percent (%) of the Bathurst caribou herd's seasonal ranges relative to reference conditions (low magnitude). The Thor Lake Project and other developments were predicted to result in habitat-specific cumulative changes to the number of patches and the distance between similar habitat patches, with the magnitude ranging from 0% to 5% (low magnitude). These changes were expected to have a negligible influence on the carrying capacity of the seasonal ranges and the movement and distribution of caribou (De Beers 2010).

The cumulative direct impact of habitat fragmentation on caribou movement related to the seasonal Tibbitt-to-Contwoyto Winter Road (from Tibbitt Lake to MacKay Lake) was predicted to be low in magnitude (i.e., within the range of baseline values). The magnitude of changes in the number of forest patches from reference to current conditions was predicted to be no more than 1.7% in the Bathurst herd's range. Also, the change in the mean distances to nearest neighbour for forest patches was no more than 1.3% in the analysis (De Beers 2010). Although the presence of the winter road may represent a partial barrier to caribou and lead to some fragmentation of the population within the winter range, it was recognized that the road is only in operation for approximately eight to 12 weeks each year. Thus, the frequency of impact from the winter road on caribou population size and distribution was considered to be periodic.

The assessment also considered the cumulative effects from indirect changes to habitat quality (sensory disturbance zones of influence) associated with the Gahcho Kue Project, the Thor Lake Project and other developments on the availability of preferred habitats. Overall, the magnitude of cumulative declines in preferred habitat across seasonal ranges of the Bathurst caribou herd was predicted to be low (ranged from 1.1% to 7.3%) (De Beers 2010). Sensitivity analyses also showed that a 10% reduction in carrying capacity (or loss of preferred habitat) had no statistical effect (P=0.24) on population abundance and persistence of caribou (De Beers 2010).

Energetic and population models also indicated that insect harassment and harvest levels had much stronger effects on caribou populations relative to the changes from the Gahcho Kue Project, Thor Lake Project and other developments considered (De Beers 2010). Levels of human development on the landscape, measured as a percentage of seasonal ranges covered by zones of influence, peaked in 2006 at approximately 6% cover and have since declined (De Beers 2010). A recent review by Adamczewski et al. (2009) also indicated that effects from the mines were limited and unlikely a major contributing factor in the decline of the Bathurst caribou herd. Thus, the cumulative effects from development were predicted to not have a significant adverse impact on the seasonal movements and distribution of caribou relative to reference conditions (De Beers 2010).

There are natural environmental factors that operate over large scales of space and time that likely have greater influences on seasonal distributions of caribou relative to the cumulative and incremental effects of the various developments considered by De Beers (2010) including the Thor Lake Project. For example, some studies of caribou have shown that the historical cumulative effect of overgrazing on calving, summer or winter ranges can result in periodic range shifts and large population fluctuations (Messier et al. 1988; Ferguson and Messier 2000). Climate change can also influence the seasonal distribution of caribou by modifying insect levels, food abundance (primary productivity), snow depth and hardness, predator numbers (and alternative prey), and burns (Sharma et al. 2009; Vors and Boyce 2009). Traditional knowledge also contends that fire frequency and intensity affects caribou numbers and distribution (Kendrick et al. 2005).

The information from the cumulative effects assessment conducted by De Beers (2010) indicated that the incremental cumulative effects from the Gahcho Kue Project, the Thor Lake Project and other developments considered would not have a significant negative influence on the resilience and persistence of caribou populations. Most of the incremental and cumulative effects were predicted to be negligible to low in magnitude and reversible.

The persistence of the Bathurst caribou herd during large fluctuations in population size indicates that the species has the capability to adapt to different disturbances and environmental selection pressures. Migration routes and survival and reproduction rates appear to have the flexibility to respond to changes through time and across the landscape. This resilience in caribou populations suggests that the effects from the Gahcho Kue Project, the Thor Lake Project and other developments considered were expected to be reversible and not significantly affect the future persistence of caribou populations. Subsequently, cumulative effects from all of the developments considered by De Beers were

also not predicted to have an adverse effect on continued opportunities for use of caribou by people that value the animals as part of their culture and livelihood (De Beers 2010).

10.6.2.7 Species at Risk

Wildlife species considered to be "At Risk" or "May be at Risk" that were further evaluated for possible cumulative effects related to the Nechalacho Mine and Flotation Plant site and associated activities included the Common Nighthawk, Olive-sided Flycatcher, and the Rusty Blackbird.

Common Nighthawk

The Common Nighthawk is listed by SARA as "Threatened", and ranked by GNWT ENR as "At Risk" under the general status program. Population estimates within the NWT or the study areas are unknown. Within the Nechalacho Mine study area, Common Nighthawks are expected to arrive in mid May or early June and depart by mid August to mid September (CWS and GNWT ENR 2008). Suitable nesting and foraging habitat exists throughout the Nechalacho Mine study areas.

Although the Nechalacho Mine LSA and RSA include suitable nesting and feeding habitat, few Common Nighthawks have been recorded in the area. During the 2010 baseline surveys at Nechalacho Mine study area, a single Common Nighthawk was incidentally heard near camp.

Olive-sided Flycatcher

The Olive-sided Flycatcher is listed by SARA as "Threatened", and is ranked by GNWT ENR as "At Risk" under the general status program (Environment Canada 2010d; GNWT ENR 2010a). The Olive-sided Flycatcher arrives in the Northwest Territories in late May and early June, and departs in late July and early August (GNWT ENR 2010e).

Appropriate Olive-sided Flycatcher habitat exists throughout the Nechalacho Mine study area in the form of open to semi-open forests (e.g. Bedrock-Lichen and Shrub Wet broad habitat types) and natural and man-made edge habitats (near bedrock outcrops, lakeshores, and roads) with large trees and standing snags.

A total of 22 Olive-sided Flycatchers were heard or seen within the Nechalacho Mine LSA during the June and July 2010 field programs. Olive-sided Flycatchers were reported occupying seven different habitat types (or their edges).

Rusty Blackbird

Rusty Blackbirds are listed by SARA as "Special Concern", and are ranked by GNWT ENR as "May Be At Risk" (Environment Canada 2010d; GNWT ENR 2010a). Rusty Blackbirds can be expected to occur in the Nechalacho Mine study area from early May to late September.

Rusty Blackbirds forage along the edge of fens, bogs, beaver ponds, streams, and swampy lake shores in search for aquatic and terrestrial insects and plant materials (e.g., seeds and fruits). Beaver lodge surveys in the Nechalacho Mine LSA and RSA generally indicated low

densities in the LSA; however, higher beaver lodge densities were recorded in the region to the west. That being said, Rusty Blackbird habitat exists within the Nechalacho Mine LSA and RSA.

Appropriate Rusty Blackbird habitat within the Nechalacho Mine LSA occurs along many shallow ponds/lakes and fens, including within the proposed tailings management facility.

The main ways that the Nechalacho Mine and associated infrastructure and activities could potentially affect these bird species at risk is through direct habitat loss, changes to daily movements including habitat avoidance and displacement, and mortality.

Mitigation

To minimize any potential for direct and indirect Nechalacho Mine development-related effects on these species at risk, Avalon will implement the following policies and mitigation measures:

- Implement no hunting policy for all Project employees and contractors while working on or off-site for Avalon.
- Avoid all known or suspected nest sites.
- Avoid clearing activities from mid-May to late August.
- All Project-related transportation activities to give the right-of-way to any wildlife including birds that such activity may encounter.
- Dust suppression strategies (e.g., water or approved dust suppressant products) in accordance with the GNWT dust suppression guidelines.
- Develop and implement an education program for wildlife related policies and mitigation (in particular species at risk) to all Project employees and contractors.

With adherence to the mitigation measures discussed above, effects of habitat loss, changes in daily movements, and mortality on these bird species at risk are predicted to negligible with no residual impacts expected to occur. As a result, no cumulative effects on these bird species at risk are predicted to occur.

10.6.3 Hydrometallurgical Plant Site

10.6.3.1 Groundwater Quality

As previously discussed in Section 4.8.4, the proposed Hydrometallurgical Plant tailings facility (HTF) will be located within an historic open pit (L-37 pit) located south-southwest of the proposed Hydrometallurgical Plant location. Excess supernatant water from the HTF will be pumped to another historic open pit (N-42 pit), located to the southwest, for discharge and infiltration into the Presqu'ile aquifer.

The Hydrometallurgical tailings properties will consist of solids from the proposed milling process, made up predominantly of gypsum (approx. 85%), with some leach residue (approx. 6%) and miscellaneous other solids (approx. 9%). The tailings are expected to be

similar to phosphogypsum tailings in terms of void ratio, dry densities and consolidation properties.

The results of the groundwater flow modelling discussed in section 6.5.2.1, suggest that there is expected to be very little effect on the groundwater regime at the Pine Point site in response to the pumping and discharge/infiltration proposed as part of the Hydrometallurgical Plant site water management plan. Groundwater drawdown in the vicinity of the T-37 pit is estimated to be approximately 1 m below the expected pre-pumping level after 20 years of pumping. Groundwater levels in the vicinity of the N-42 pit are expected to increase by approximately 0.1 m above the simulated pre-discharge conditions after 20 years of discharge/infiltration.

Based on the conceptual model of the site and the steady state modelling results, groundwater flowing through the N-42 pit would take approximately 80 years to discharge into Great Slave Lake. Travel time may be reduced if groundwater discharged to surface and flowed towards Great Slave Lake.

A comparison of the projected chemical properties of the tailings water with the historically documented groundwater quality results shows that the concentrations of all metals parameters in the tailings water will be lower than or within the same range of concentrations for these parameters in the existing groundwater of the area. The radionuclide parameters including ^{226}Ra, ^{228}Ra and ^{210}Pb are all expected to be at or below detection limits.

The pH of the tailings water is expected to be slightly above neutral (7.7), while conductivity, sodium, chloride and other parameters that contribute to water hardness, including calcium, magnesium and sulphate will be elevated compared to current background conditions. However, these elevated levels are expected to rapidly diffuse and dilute to natural background values within the Presqu'ile Formation.

To verify these predictions, Avalon is committed to implementing a groundwater quality monitoring program designed to monitor the effects of the proposed tailings water infiltration program on the quality of the groundwater in the area of the Hydrometallurgical Plant and associated infrastructure.

Since the projected concentrations of all parameters of potential concern will be lower than or within the range of existing conditions, the anticipated residual effects on groundwater quantity and quality in the Pine Point area are expected to be insignificant and no cumulative effects on groundwater quantity or quality in the Pine Point area are predicted to occur

10.6.3.2 Fish and Fish Habitat

As previously indicated, the Hydrometallurgical Plant and associated infrastructure will be located almost entirely on previously disturbed terrain. There are no fish-bearing streams or lakes in the vicinity of the Hydrometallurgical Plant site and all Plant effluent will be infiltrated into the Presqu'ile aquifer. Thus, in general, there is no opportunity for fish or

fish habitat to be impacted by the construction or operation of the Hydrometallurgical Plant and associated infrastructure.

However, as noted in Section 6.11, a seasonal floating barge dock is to be installed on the south shore of Great Slave Lake, approximately 8.6 km from the Hydrometallurgical Plant. This barge dock will serve as the seasonal terminal for shipping containers loaded with concentrate produced at the Nechalacho Mine and Flotation Plant site.

The dock facility will be similar in design and operation to the seasonal barge dock facility developed for the Nechalacho Plant site but due to the relatively shallow conditions on the south side of the lake adjacent to the barge location, this dock facility will consist of two moored barges that will reach the necessary three metre minimum water depth required for the seasonal barging operation. The nearshore moored barges will be tethered to dolphins consisting of piles driven into the lake bottom and be connected to the shore by a 20-30 m long removable ramp. Pile driving for the initial installation of the dolphins will occur over a relatively short period during the fish work window period of July 16-September 14, thereby further limiting potential interactions with fish or fish habitat. The seasonal dock will be utilized only during the open water period.

Fish and fish habitat surveys have not been carried out within the immediate area proposed for the barge dock facility, but is anticipated that fish habitat within the nearshore area at this location would most likely be poor to moderate due to shallow depths (< 3 m). These nearshore areas would not provide suitable spawning habitats for fall spawning fish (e.g., lake whitefish, lake cisco, lake trout) due to ice depths of about 1-1.5 m. Fish are likely to migrate through this area, which may also be suitable for summer feeding by juvenile fish, which prefer shallow, protected inshore areas.

The area of lake bottom and potential habitat collectively occupied by the dolphins will be very small. It is also possible that the dolphins may provide cover for young fish and a substrate for benthic invertebrates and periphyton.

Tug boat operations may result in temporary avoidance behaviour by fish, largely due to noise and vibrations generated by these boats. Their very slow approach will likely not result in startle behaviour. Once boats pass an area, it is very likely that fish will return to their preferred habitats.

Based on the foregoing, no adverse residual or cumulative effects to fish or to the productive capacity of fish habitat are expected due to the installation and operation of the seasonal Hydrometallurgical Plant dock.

10.6.3.3 Vegetation, Soils and Terrain

As previously indicated, the former Pine Point Mine area comprises the largest brownfields site in the NWT, estimated at approximately 3,425 hectares using digital image analysis, of which approximately 1,771 ha are located within the Hydrometallurgical Plant local study area. The Hydrometallurgical Plant site footprint will cover approximately 62 ha and is situated almost completely (i.e., 92%) on previously disturbed ground.

This was an important consideration in the siting of the Hydrometallurgical Plant and associated infrastructure as this greatly reduces potential effects to ecosystems and vegetation. Similarly the proposed Tamerlane Pilot Project, to be located about 30 km to the west of the Hydrometallurgical Plant site, will be located mainly on previously disturbed terrain and new disturbance associated with that project will be limited to approximately 4.3 ha (Tamerlane 2007).

Natural ecosystem types form a very small portion (8%) of the overall Hydrometallurgical plant infrastructure footprint, and are represented primarily by mesic and subhygric forest dominated by Labrador tea, as well as treed fens. These three ecosystem types represent a moisture gradient from well drained upland sites (i.e., mesic forest), to transitional sites (i.e., subhygric forest), to wetlands (i.e., treed fen). The distribution of these ecosystem types within the infrastructure footprint area represents less than 1% (both individually and combined) of their total presence within the LSA overall. Given their abundance and widespread nature within the LSA, this level of disturbance is not expected to affect their sustainability within the larger landscape.

Treed fens and graminoid fens have a very high and high potential, respectively, of providing suitable habitat for rare plant species potentially occurring within the area. No rare plant species were identified during previous surveys and both of these ecosystem types occur within the LSA. Sensitive ecosystems do not occur within the infrastructure footprint area, and as such will not be directly disturbed by Project development.

As indicated in Section 6.8.6, the effects associated with the construction and operation of the Hydrometallurgical Plant and associated infrastructure on the soils, terrain and vegetation of the proposed development area at Pine Point were considered to be not significant, mainly because of the extensive incorporation of previously disturbed areas into the footprint layout. As a result, no cumulative effects to vegetation, soils, and terrain in the Pine Point region are anticipated to occur.

Currently Teck Cominco Metals Ltd. continues to retain one surface land lease in the vicinity of the proposed Hydrometallurgical Plant site. This lease encompasses the tailings impoundment area to allow for the on-going management of the tailings facility. Since Avalon's proposed Hydrometallurgical Plant and associated infrastructure will not utilize any portion of the existing Teck Cominco surface lease area, Avalon's future reclamation liabilities are not expected to interact with those of Teck Cominco or Tamerlane.

10.6.3.4 Wildlife

10.6.3.5 Woodland Caribou

Boreal woodland caribou are known to occur in the area of the former Pine Point Mine where the proposed Hydrometallurgical Plant will be located, along Highway 5/6, and along the rail line from Hay River to the NWT/Alberta border. Boreal woodland caribou are ranked by GNWT ENR as "Sensitive" under the general status program (GNWT ENR 2010a) and are listed by SARA as "Threatened".

In the South Slave and Southeast Dehcho region, the boreal woodland caribou population is estimated at approximately 600 individuals, and is likely in decline based on the recruitment and cow survival rates (Environment Canada 2008a). At present, the current range of this population is not considered to be self-sustaining due to the current level of fire and human disturbances in the range (35% and 16% disturbance levels, respectively).

Boreal woodland caribou do not migrate and may occur year round within the region. Boreal woodland caribou live in small groups even under optimal conditions, and females further disperse from the group in the spring and summer to minimize predation of their calf by increasing predator search time.

The home range of individual caribou is dependent on the distribution and relative availability of high quality of habitat. In the Fort Smith area, the annual range of female woodland caribou was estimated at 574 km^2 (Nagy et al. 2004). The number of boreal woodland caribou occupying the Hydrometallurgical Plant study area at any one time is unknown; however, expected to be low.

Boreal woodland caribou prefer lichen-rich mature or old growth coniferous forests (greater than 100 years old) associated with bogs, lakes, and rivers (GNWT ENR 2010b). In winter, woodland caribou tend to favour uplands, bogs and south facing slopes where the snow is not too deep. Their winter diet consists of up to 80 % ground and tree lichens. In summer, they prefer areas such as forest edges, marshes and meadows that provide the fresh green growth of flowering plants and grasses.

Boreal woodland caribou occur in low numbers throughout the former Pine Point mine, Highway 5/6, and the rail line to the Alberta border on a year round basis. Woodland caribou sign was not observed at the Hydrometallurgical Plant study area at the time of the August 2010 field event (EBA 2010b); however, EBA previously documented caribou sign in poor treed fens and Labrador Tea–Subhygric habitats on adjacent properties along Highway 5/6 in 2005 (EBA 2005b).

Boreal woodland caribou are known to avoid land use developments; however, their response appears to vary with season, habitat type, sex, and population (Salmo Consulting 2004). Woodland caribou populations are most sensitive to habitat loss and habitat fragmentation.

As previously noted, the Hydrometallurgical Plant and associated infrastructure will be entirely located on approximately 62 ha of the previously disturbed and reclaimed former Pine Point Mine site. All access and haul roads required to service the Hydrometallurgical Plant and associated infrastructure will utilize existing former Pine Point Mine roads, some of which will require upgrading. In particular, the 8 km haul road extending from the seasonal dock facility located at Great Slave Lake south to the Hydrometallurgical Plant site will be upgraded to accommodate the haul trucks. Upgrading of this portion of the haul road will involve the direct loss of a negligible amount of potential woodland caribou habitat.

Similarly the proposed Tamerlane Pilot Project, to be located about 30 km to the west of the Hydrometallurgical Plant site, will be located mainly on previously disturbed terrain and

new disturbance associated with that project will be limited to approximately 4.3 ha (Tamerlane 2007).

As a result of Avalon's decision to locate the physical footprints of the Hydrometallurgical Plant and all associated infrastructure on existing brownfields/disturbed terrain, the direct physical effects (including direct habitat loss and fragmentation) on preferred woodland caribou habitat in the area of the Hydrometallurgical Plant are expected to be negligible.

Fragmentation of woodland caribou habitat will therefore remain essentially unchanged from current baseline conditions. Direct habitat loss and fragmentation of woodland caribou habitat as a result of the Hydrometallurgical Plant and associated infrastructure is considered negligible.

As previously discussed in Section, 6.9.2.1, the main ways that the Hydrometallurgical Plant and associated infrastructure and activities may affect woodland caribou are through changes in daily movements including habitat avoidance and disturbance, and mortality.

Based on the available information, a small number of woodland caribou may be expected to be present in the vicinity of the Hydrometallurgical Plant and associated infrastructure on occasion and may potentially directly encounter or be disturbed by localized development-related noise or activities. Similarly, woodland caribou would be expected to encounter and cross Project-related road and rail line infrastructure where they would be exposed to vehicle and rail traffic.

Caribou encountering such activities may show minor displacement behaviour and or avoid the immediate Hydrometallurgical Plant development area, Highway 5/6, and or the rail line. Scientific evidence suggests woodland caribou may avoid suitable habitat that is located at least 250 m from roads and industrial developments for most of the season (Sorensen et al. 2007), and by as much as 1,000 m during calving (Salmo Consulting Inc. et al. 2004). The Hydrometallurgical Plant and its associated infrastructure will be constructed in large brownfields sites, areas that woodland caribou would naturally tend to avoid.

Avoidance of roads is dependent on traffic volumes and local harvesting activities. In un-hunted areas, avoidance to roads is either nonexistent or very temporal in nature (Jalkotzy et al. 1997). Traffic volumes, and therefore avoidance effects along Highway 5/6 may increase from existing conditions. During operation, an additional 50 vehicle return trips per day (approximate annual average daily traffic), concentrated during shift change periods (every 12 hours) is anticipated as a result of the Thor Lake Project. The proposed Tamerlane Pilot Project indicated that their project would also contribute about 50 vehicles per day to the overall traffic load on the Highway system.

The minor increase in traffic volumes along Highway 5/6 as a result of the Thor Lake Project is considered low in magnitude since traffic is concentrated during shift change and woodland caribou may already avoid the Highway due to hunting pressures. Similar avoidance behaviour is anticipated in relation to the rail line from Hay River to the Alberta border. However, the combination of demand on the rail system from the Hydrometallurgical Plant and Tamerlane's Pilot Project is only expected to increase the

frequency of train traffic by one train per week, which is expected to have a negligible effect on caribou avoidance of the train and rail line.

In summary, avoidance and disturbance effects as a result of the Hydrometallurgical Plant and its associated infrastructure and activities (including Highway 5/6 and the rail line from Hay River to the Alberta border) is expected to be low in magnitude, local in geographic extent, low likelihood of occurrence, and low significance. Confidence in this assessment is high since the Hydrometallurgical Plant and associated activities will remain similar to baseline conditions.

Activities relating to the construction, operation, and closure of the Hydrometallurgical Plant, such as vehicle and rail traffic pose the greatest risk to woodland caribou mortality. Without mitigation, the risk of mortality as a result of the Hydrometallurgical Plant and its associated activities is considered moderate in magnitude. The frequency and likelihood of effects is periodic and low. Confidence in this assessment is high since vehicle and rail traffic will remain low and similar to baseline conditions.

To minimize any potential for direct and indirect Hydrometallurgical Plant development-related woodland caribou effects, Avalon will implement a no hunting policy for all Project employees and contractors, and the requirement for all transportation activities to give the right of way to wildlife. As a result, the risk of mortality from equipment and vehicle collisions in relation to Project-related vehicle traffic is considered negligible.

With adherence to these and other mitigation discussed in Section 6.9.2-1, the effects of habitat loss and fragmentation, changes in daily movements, and mortality on woodland caribou will be negligible with no residual or cumulative effects expected to occur that could affect the overall health or well-being of the woodland caribou population in the LSA, the general Pine Point area, along Highway 5/6, or the rail line to the NWT/Alberta border.

10.6.3.6 Species at Risk

Wildlife species considered to be "Endangered", "At Risk" or "May be at Risk" that were further evaluated for possible cumulative effects related to the Hydrometallurgical Plant site, associated infrastructure and related activities included the Whooping Crane, Yellow Rail Common Nighthawk, Olive-sided Flycatcher, and the Rusty Blackbird.

Whooping Crane

Whooping Cranes are listed by SARA as "Endangered", and are ranked by GNWT ENR as "At Risk". A breeding population of Whooping Cranes is located in Wood Buffalo National Park. Non-breeding individuals are known to inhabit marshes, bogs, and shallow lakes between Wood Buffalo National Park and the Mackenzie Bison Sanctuary. The nearest known Whooping Crane nest is located approximately 20 km east and south of the proposed Hydrometallurgical Plant site.

During the winter of 2004/05, the Wood Buffalo National Park population of Whooping Cranes was 217 counted on their wintering grounds in the USA. The rising population trend continued in 2010, with a record 74 nests and 46 chicks fledging and a total Canadian population of at least 269 (Kindopp 2010).

In Canada, critical habitat for Whooping Cranes includes the marshes located in the northeastern corner of Wood Buffalo National Park (Environment Canada 2007). The Mackenzie Bison Sanctuary is also considered important habitat for the non-breeding segment of the Whooping Crane population. In addition, the large wetland complex approximately 3 km west of the Hydrometallurgical Plant study area has been identified as potential nesting habitat currently not occupied for nesting (Olson and Olson 2003). Although this wetland complex is currently not occupied for nesting, it is considered critical habitat for the recovery of this species and will likely be legally protected in the future.

Regarding preferred habitats for nesting, as previously indicated, the LSA does not contain suitable Whooping Crane nesting habitat. However, non-breeding cranes could potentially frequent any of the marshes or bogs in the general area for seasonal feeding purposes.

The Hydrometallurgical Plant and its associated infrastructure will not affect Whooping Crane habitat. The Hydrometallurgical Plant and the former Pine Point mine pits (including L-37 and T-37N) are located in brownfields sites that do not provide Whooping Crane feeding or nesting habitat. In addition, no Whooping Crane nesting or feeding habitat will be directly lost by the haul road upgrades or the graded marshalling yard.

The main way that the Hydrometallurgical Plant and its associated infrastructure and activities could potentially affect Whooping Cranes is through changes in daily movements of non-breeders. Based on EBA's observation of a single non-breeding Whooping Crane in the general Pine Point area in 2005, Whooping Cranes may conceivably be present in the vicinity of the beaver pond near T-37N pit on occasion and may potentially be disturbed by localized development-related noise or traffic. Similarly, non-breeding Whooping Cranes may occasionally fly over or feed in marshes, bogs, or shallow lakes adjacent to Highway 5, and throughout the Pine Point region.

A Whooping Crane encountering such activities may show minor displacement behaviour and avoid the immediate Hydrometallurgical Plant development area and/or the Highway. The duration of any such exposures are expected to be brief, perhaps lasting a few minutes to a few hours, and are reversible upon cessation of the activity or by moving away from the activity. Development-related effects on Whooping Crane daily movements are considered low in magnitude and a low likelihood of occurrence. The number and frequency of exposures is considered low and isolated.

Yellow Rail

The Yellow Rail is listed by SARA as "Special Concern", and ranked by GNWT ENR as "May Be At Risk" under the general status program. Based on their known distribution in the NWT (GNWT ENR 2010e) and their preferred habitat requirements, they occur in the Pine Point region, wherever appropriate habitat exists. Yellow Rails are sensitive to

disturbances during nesting season, particularly human presence and activities and changes in water levels.

Yellow Rails arrive in the NWT in early May to breed. Preferred nesting habitats are characterized by sedges and shallow water depths (ranging from moist substrate to 15 cm water). Potential habitat for Yellow Rails is limited to a small graminoid fen within the Hydrometallurgical Plant study area. At the time of the August 2010 field event, this small graminoid fen was dry and not considered quality Yellow Rail habitat. However, appropriate Yellow Rail habitat likely exists along Highway 5/6.

As a result of Avalon's decision to locate the physical footprints of the Hydrometallurgical Plant and all associated infrastructure on existing brownfields/disturbed terrain, no direct physical effects on Yellow Rail habitat in the area of the Hydrometallurgical Plant LSA and or the general Pine Point area are expected.

Common Nighthawk

The Common Nighthawk is listed by SARA as "Threatened", and ranked by GNWT ENR as "At Risk" under the general status program. Common Nighthawks migrate into the NWT to breed in mid May to early June, and depart by mid August to mid September (CWS and GNWT ENR 2008).

Common Nighthawk feeding and breeding habitat exists throughout the Hydrometallurgical Plant site study area and along Highway 5/6 in Bedrock-Lichen broad habitat types, as well as at old mine or mineral exploration sites, roads, and airstrips. Preferred nesting habitat includes: open forests, forest clearings, recent burn areas, rock outcrops, lakeshores, and gravel areas (including airports, quarries and roads) (CWS and GNWT ENR 2008).

As a result of Avalon's decision to locate the physical footprints of the Hydrometallurgical Plant and all associated infrastructure in a limited area of the large existing brownfields/disturbed terrain of the former Pine Point Mine area, the direct physical effects of these components of the TLP on preferred Common Nighthawk habitat in the area of the Hydrometallurgical Plant are expected to be negligible.

Olive-sided Flycatcher

The Olive-sided Flycatcher is listed by SARA as "Threatened", and is ranked by GNWT ENR as "At Risk" under the general status program (Environment Canada 2010d; GNWT ENR 2010a). Olive-sided Flycatcher habitat exists throughout the Pine Point region including the Hydrometallurgical Plant site study area.

The Olive-sided Flycatcher arrives in the Northwest Territories in late May and early June to breed, and departs in late July and early August (GNWT ENR 2010e). Breeding pairs generally establish territories at forest edges adjacent to clearings, especially where scattered tall trees or snags are available for perching on, or foraging from. Typical Olive-sided Flycatcher habitat includes forest edges with large trees and standing snags, and open to semi-open forest stands located in regenerating forests, edge habitats near man-made openings, bedrock outcrops, and lakeshores, and treed bogs (Altman and Sallabanks 2000).

During breeding bird surveys in the Pine Point region, EBA (2006b) documented eight Olive-sided Flycatcher observations in Spruce Upland, Bedrock-Lichen, Treed Fen, and the edge of a Graminoid Fen broad habitat types.

As a result of Avalon's decision to locate the physical footprints of the Hydrometallurgical Plant and all associated infrastructure on existing brownfields/disturbed terrain, the direct loss of preferred Olive-sided Flycatcher habitat will be limited to the small amount of habitat cleared for the haul road upgrades and the marshalling yard. Olive-sided Flycatcher habitat loss is considered low in magnitude and reversible at mine closure.

Rusty Blackbird

Rusty Blackbirds are listed by SARA as "Special Concern", and are ranked by GNWT ENR as "May Be At Risk" (Environment Canada 2010d; GNWT ENR 2010a). Rusty Blackbirds can be expected to occur in the LSA and Pine Point region from early May to late September.

Rusty Blackbirds forage along the edge of fens, bogs, beaver ponds, streams, and swampy lake shores in search for aquatic and terrestrial insects and plant materials (e.g., seeds and fruits). Nests are constructed in conifer and deciduous trees and shrubs in suitable feeding habitat. Rusty Blackbird populations are commonly associated with beaver lodge densities in an area (Avery 1995). Beaver lodges within the Hydrometallurgical Plant site study area are located at and near the T-37N pit; beaver lodges and Rusty Blackbird habitat also occurs along Highway 5/6 and throughout the Pine Point region.

Appropriate Rusty Blackbird habitat within the Hydrometallurgical Plant site study area occurs at the beaver pond near T-37N pit. This beaver pond is located at the edge of a former Pine Point mine brownfields site and two adjoining roads. Rusty Blackbirds were not observed within the Hydrometallurgical Plant site study area during the August 2010 field event. Additional Rusty Blackbird habitat exists throughout the Pine Point region.

As a result of Avalon's decision to locate the physical footprints of the Hydrometallurgical Plant and all associated infrastructure on existing brownfields/disturbed terrain, no direct physical effects on preferred Rusty Blackbird habitat is expected.

Mitigation

To minimize any potential for direct and indirect Hydrometallurgical Plant site and associated infrastructure development-related effects on these species at risk, Avalon will implement the following policies and mitigation measures:

- Implement no hunting policy for all Project employees and contractors while working on or off-site for Avalon.
- Avoid all known or suspected nest sites.
- Avoid clearing activities from mid-May to late August.
- All Project-related transportation activities to give the right-of-way to any wildlife including birds that such activity may encounter.

- Dust suppression strategies (e.g., water or approved dust suppressant products) in accordance with the GNWT dust suppression guidelines.
- Develop and implement an education program for wildlife related policies and mitigation (in particular species at risk) to all Project employees and contractors.

With adherence to the mitigation measures discussed above, effects of habitat loss, changes in daily movements, and mortality on these bird species at risk are predicted to negligible with no residual impacts expected to occur. As a result, no cumulative effects on these bird species at risk are predicted to occur.

10.6.4 Socio-Economic Issues

The effects for socio-economic changes, cultural changes and changes to community well-being were evaluated in Section 7.0. In this section, possible cumulative effects related to the Project and combined with similar potential effects of other existing and potential developments in the region are evaluated.

10.6.4.1 Thor Lake Project

As per Table 7.0-1, the effects of socio-economic components were evaluated. Several beneficial effects are expected from the Project as it pertains to business opportunities, sustainable development, employment, and population growth which may operate in a cumulative manner with similar effects from other proposed or existing developments.

Business Opportunities

The Thor Lake Project will provide broad benefits to the economy in terms of employment and government tax revenues. The construction and operation of the Nechalacho Mine and Flotation Plant and associated Hydrometallurgical Plant will provide a major economic stimulus to the regional communities, the NWT, and the Canadian economy. The Project also offers the opportunity for Aboriginal peoples to have meaningful participation in the wage economy, while also having the work schedule flexibility to accommodate traditional pursuits and activities.

Total direct economic benefits in the NWT as a result of the construction and initial 18-year operating life of the Project include:

- $382 million spent in wages and benefits,
- 3,590 person-years of employment,
- $774 million in territorial government revenues, and
- $1,229 million in supply purchases (GSGislason 2011).

The direct and indirect business opportunities from the TLP have the potential to support infrastructure development that will extend well beyond the initial 20 year Project time frame. This "coattail" effect is expected to result in many businesses setting up and/or expanding to serve the TLP. These potential business opportunities represent economics

over and above those analyzed in GSGislason's report entitled, *The Thor Lake Project: Economic Impacts* (2011).

The demand created for goods and services will increase the capacity of Aboriginal and northern businesses and strengthen the local economy.

Contribution to Sustainable Development

The mining industry has made recent significant improvements to increase the beneficial socio-economic effects associated with the industry while reducing adverse effects. In particular, the more recent development of several diamond mines in the region has set new standards for social, cultural, and environmental accountability and performance. As outlined in Avalon's *Corporate Social Responsibility Road Map* (2011), the Company maintains a strong commitment and a strategic approach to corporate responsibility, which is essential for managing the challenges and opportunities of a rapidly changing global environment.

It is expected that Avalon will continue to raise the bar for economic, social and environmental practices in the mining industry, which will contribute to long term beneficial effects in the development region.

Direct and Indirect Employment

The Thor Lake Project will positively affect employment in the development region and the Northwest Territories. Avalon will operate under a preferential northern hiring policy; therefore NWT residents with the requisite skills will have the first chance to be hired. Northern and Aboriginal contractors will benefit from this policy and southern contractors will abide by the northern hiring policy when hiring staff for the Project.

It is anticipated that about 470 positions will be created annually in the NWT, depending on the Project phase and volume of production: 180 directly, 170 indirectly in supplier industries, and 120 in retail through the re-spending of wages earned at the direct and indirect stage. It is anticipated that residents from the RSA will fill direct job positions, and that up to 90% of indirect and induced jobs will also be filled by residents of the RSA.

Maintaining or enhancing the physical, mental, cultural health, and well-being of TLP workers and their families is a key consideration for Avalon. Work schedules will be established to provide employees with ample time to participate in family, community and traditional activities. Avalon's recruitment strategy and substantial training and apprenticeship opportunities will help to strengthen local communities and provide individuals with transferrable skill sets to use over time.

Avalon is also committed to supporting cultural and educational initiatives in the RSA communities and will continue to provide grant funding to build related infrastructure to provide long-term benefit to these communities.

Population in- and out-Migration

Consistent with past experience in northern mines, some in-migration will likely be needed during the operational phase. It is expected that, because of the availability of housing and other services, that new in-migrants will move into the more market-based and larger communities of Yellowknife and Hay River (GSGislason 2011).

It is anticipated that developers and Territorial human resources management agencies have the capacity to manage these shifts, and that the ongoing economic benefit to businesses and government will provide impetus to continue infrastructure development related to transportation and housing. The current business activity trend shows that capital spending is continuing in these areas and is reflective of an expanding economy (GNWT 2008).

Education Access and Completion Levels

The *Communities and Diamonds Report: Socio-Economic Impacts in the Communities of Behchoko, Gameti, Whati, Wekweeti, Dettah, N'Dilo, Lutsel K'e and Yellowknife* (GNWT 2008) indicates an increase in high school completion and a decrease in the percentage of the population with less than Grade 9 for both Yellowknife and Small Local Communities, as defined in the report's title.

Residents of the North and South Slave regions with Grade 12 and/or post-secondary education will be in a position to take advantage of Project-related employment opportunities. On this basis, Avalon believes that the Project may provide further incentive for people to stay in school, complete Grade 12, and perhaps pursue a trade or post-secondary education through programs offered through Aurora College and the Mine Training Society.

Other Components

The remaining socio-economic components are expected to be relatively neutral with negligible adverse effects that can be managed as per the status quo. It is anticipated that Territorial public agencies will have the capacity to manage health and wellness issues related to alcohol and drugs, health care, and childcare. RCMP and Territorial social service agencies are expected to continue to monitor and manage issues associated with crime.

10.6.4.2 Other Industrial Development

Existing Industrial Development

There are currently three operating diamond mines in the NWT, the BHP Billiton Ekati Diamond Mine, the Diavik Diamond Mine and the De Beers Snap Lake Mine. The collective operations of these diamond mines produce approximately 15% of the world's rough diamonds, making Canada the third largest global producer of diamonds by value (GNWT ITI 2008).

The BHP Billiton Ekati Diamond Mine was the first diamond mine in Canada and became operational in 1998. It employs approximately 800 people on average with an additional 700 contractors on site providing a variety of support services. Located approximately 310

km northeast of Yellowknife, the mine operates in an area of continuous permafrost and is accessible only by air, with the exception of winter road access, available only for approximately 10 weeks each year by ice road. According to the fall 2010 edition of the *Ekati Newsbreak*, the life of the mine has been extended until 2018 (BHP 2010).

The Diavik Diamond Mine is located on a 20 square kilometre island informally called East Island in Lac de Gras, 300 km by air northeast of Yellowknife. It is also accessible primarily by air, with a seasonal ice road to re-supply the camp and facility in winter. It became operational in 2003 and, under the current life of the mine, diamond production from underground is projected to continue beyond 2020. Open pit mining is expected to cease in 2012, when Diavik is expected to become an all-underground mine. The mine employs over 900 people (Diavik 2010).

The De Beers Snap Lake Mine is Canada's first completely underground diamond mine and became operational in 2008. It is located 220 km northeast of Yellowknife, and travel to the site is only possible by air for all but six to eight weeks of the year, when a seasonal ice road is used to re-supply the mine. It employs over 728 people and is estimated to have a life span of more than 20 years (De Beers 2009).

The three diamond mines have a strong commitment to high environmental, social and environmental standards, and maintain northern and Aboriginal preferential hiring and purchasing policies. Employees work on rotational schedules and each mine has a camp onsite. These mines produce yearly socio-economic assessments (SEAs), which are incorporated into the Territory's annual *Communities and Diamonds Report: Socio-Economic Impacts in the Communities of Behchoko, Gameti, Whati, Wekweeti, Dettah, N'Dilo, Lutsel K'e and Yellowknife* (GNWT 2008).

Other Proposed Mining Developments

De Beers' proposed Gahcho Ku'e Diamond Mine is located at Kennady Lake, approximately 280 km northeast of Yellowknife and 80 km southeast of our Snap Lake Mine in the Northwest Territories. It is currently proceeding through the MVEIRB environmental impact review process, and subject to approvals is projected to provide up to 700 full-time jobs during construction and 360 full time equivalent jobs during the estimated 11-year life of the mine (De Beers 2010).

The Tyhee Yellowknife Gold Project is also currently undergoing review by the MVEIRB. The Yellowknife Gold Project is located approximately 88 km north of Yellowknife in the South Mackenzie Mining District of the Northwest Territories (Tyhee 2011). It is expected to employ about 145 people during construction and 257 people during the eight year operational phase of the project (EBA 2010a).

Both projects have northern and Aboriginal preferential hiring and purchasing practices and will use rotational schedules to staff these relatively remote facilities.

Tamerlane's Pine Point Pilot Project is located approximately 30 km to the West of the Hydrometallurgical Plant site. An estimated 65 jobs will be available for the expected one year construction phase, and 131 jobs are projected to be available for the short term

operation phase of 10-15 months for the mining of the first (R190) lead-zinc deposit. These numbers include employment generated through the third-party business contract opportunities needed to service the project. The life of this project could be extended into the future with the subsequent development of a number of additional deposits located on the West side of the Buffalo River using the existing infrastructure (Tamerlane 2007).

Mackenzie Gas Project

The development of a natural gas pipeline from the Mackenzie Delta through the Northwest Territories to southern markets has been contemplated for many years. The proponents of the proposed Mackenzie Gas Project include Imperial Oil Resources Ventures Limited Partnership (IOL), ConocoPhillips Canada (North) Limited (ConocoPhillips), ExxonMobil Canada Properties (ExxonMobil), Shell Canada Limited (Shell) and Mackenzie Valley Aboriginal Pipeline Limited (MVAPL) partnership. The purpose of the proposed project is to develop three onshore natural gas fields (anchor gas fields) in the Mackenzie Delta and to transport natural gas and natural gas liquids (NGLs) by pipeline to market (IOL et al. 2004).

The environmental impact assessment for the Mackenzie Gas Project conducted a comprehensive assessment of the available information and detailed studies, and incorporated the results of community consultations and Traditional Knowledge Studies. The MGP's contribution to cumulative effects is its effect on a valued component that is also affected by other land uses.

Based on their assessment, it was determined that the Mackenzie Gas Project would likely have some minor effects on the following valued components: the economy (including demographics); infrastructure and community services; individual, family and community wellness; non-traditional land and resource use; and heritage resources (IOL et al. 2004).

The key conclusions of the cumulative effects assessment conducted for the Mackenzie Gas Project (IOL et al. 2004) were as follows:

- The Mackenzie Gas Project would not contribute significant cumulative effects;
- There were no significant overall cumulative effects;
- The project could contribute to one potential cumulative effect of management concern, competition for qualified northern goods, services and labour, which could be addressed with diligent monitoring and management by responsible parties;
- The demand for qualified northern content in projects is expected to use all available northern capacity, which will limit the extent of both potential increased benefit and social costs among northern residents. However, it could marginally increase the temporary attraction of speculative in-migration, and associated social costs in the regional and commercial centres of Inuvik and Norman Wells.
- The project might encourage other development, particularly gas exploration and production in the Northwest Territories; however, information to adequately assess

potential cumulative effects contributions from such possible developments are not yet available; and

- The effects of any future hydrocarbon development on the land, such as additional production fields, on the communities would likely be similar to effects predicted for current and reasonably foreseeable land uses. Those developments would be subject to their own environmental impact assessment, including cumulative effects.

These conclusions indicated that, despite the size and duration of operations, the contribution to cumulative effects by the Mackenzie Gas Project on the regions and communities of the Northwest Territories were not expected to be significant. These conclusions were based on the assumption that appropriate management and monitoring programs, as outlined in the EIS prepared for the Mackenzie Gas Project, would be carried out (IOL et al. 2004).

The project recently received approval from the National Energy Board and the federal cabinet. The Mackenzie Gas Project partners have until December 31, 2013 to decide whether they will go ahead with the construction of the $16.2-billion project. There remains considerable uncertainty as to if and when the Mackenzie Gas Project may in fact proceed. Currently the earliest projections for the possible start of construction of the project suggest the year 2015. However, a number of other critical factors, including economic, market and strategic priority considerations, could potentially result in further delays to the implementation of the Mackenzie Gas Project.

At this time it is more likely that the Thor Lake Project will be constructed and be in full operation well before construction of the Mackenzie Gas Project proceeds. It is relevant to note that, should the MGP be installed, the closest point to the Thor Lake Project will be Fort Simpson, which is more than 370 km from Yellowknife and 470 km from the project. Based on these factors, it is expected that there will be no conflict between the two projects.

10.6.4.3 Socio-Economic Analysis

Avalon is aware that the more recent generation of new mines developed in the NWT, Nunavut and elsewhere have set new standards for social, cultural and environmental responsibility and performance. Avalon is fully committed to supporting the basic principles and directions described in Section 7.2-2, as reflected in the policies and commitments that have been presented and incorporated throughout this DAR. To that end, there are expected to be many beneficial cumulative effects related to socio-economic and cultural well-being and no significant adverse effects.

Existing mines already have staff in place, and two of the three mines, BHP Ekati and Diavik, are well into their estimated 20 year life span. Ms. Deb Archibald of the NWT Industry Ministry noted that the boom and bust factor is a significant issue for mining communities (DCNONL 2011). Proposed industrial developments as well as the Thor Lake Project will help to stagger growth opportunities and ensure economic growth and continuous job opportunities to mitigate the bust factor.

Further, as compared to existing and proposed industry to date, Avalon's rare metal extraction further diversifies the mining industry in the NWT. The rare earth/metal mining business is export-based and, as such, the Project will earn significant amounts of foreign exchange. The Project output will not displace sales from other Canadian mines as it produces a product unique in Canada. The mine will also generate significant tax revenues to the territorial and federal governments at a time when governments are striving to balance their budgets. The Thor Lake Project will assist government in their deficit reduction exercise (GSGislason 2011).

Avalon's shorter rotation schedule and training programs will make it appealing to others ready to enter the workforce. The two work sites are closer than other existing and proposed industry sites. The Hydrometallurgical plant will be driving distance from several South Slave communities, which will allow workers to live full time at home with access to family and traditional practices. The Metallurgical Site in the South Slave Lake region will also pull from a different labour pool than industry sites further north, and will provide employment for a longer term than other existing or proposed industry.

Based on the existing and proposed industry projections, unless mitigated, it is possible that housing pressure in larger communities may increase and that employment from available northern and Aboriginal communities may be limited. Avalon has taken several initial steps to mitigate these issues.

To offset housing pressure, Avalon has a northern and Aboriginal preferential hiring policy and will provide transportation from smaller RSA communities to discourage in-migration to larger towns. The strategy for managing in-migration for southern workers will be two-fold. Flights from Edmonton will allow some southern workers to remain in that region. For southern workers moving to the region, there will be a commitment to support long term employment and create a stable population base. It is anticipated that, given the gradual growth of Project development for the Thor Lake Project, there will be adequate housing available and ample time for the market in Yellowknife and Hay River to respond to housing needs over time.

Avalon will continue to be very pro-active in its northern and Aboriginal preferential hiring policy. By providing pre-employment training and recruiting from northern communities, the Company will support the expansion of the local labour force. Opportunities will be provided to local NWT businesses to provide goods and services to the Project, which will provide further direct and indirect employment.

Avalon is committed to continue to work with communities to deliver a high level of social, cultural, and environmental accountability and performance. As outlined in Avalon's *Corporate Social Responsibility Road Map* (2011), the Company maintains a strong commitment and a strategic approach to corporate responsibility, which is essential for managing the challenges and opportunities of a rapidly changing global environment. To that end, the Company plans to provide long term employment opportunities, support traditional activities and cultural practices through work scheduling and overall community contributions, and maintain a healthy, safe and productive workplace. Overall there are

expected to be many beneficial cumulative effects related to socio-economic and cultural well-being and no significant adverse effects from the Thor Lake Project.