APPENDIX K

FISHERIES ASSESSMENT OF RASCAL STREAM REALIGNMENT

Sabina Gold & Silver Corp.

BACK RIVER PROJECT
Fisheries Assessment of Rascal Stream Re-alignment

Sabina
GOLD & SILVER CORP.

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BACK RIVER PROJECT

FISHERIES ASSESSMENT OF RASCAL STREAM RE-ALIGNMENT

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Glossary and Abbreviations

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Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

BACI	Before-After/Control-Impact
CCME	Canadian Council of Ministers of the Environment
Chl *a*	Chlorophyll *a*
CSP	Corrugated Steel Pipe culvert
DFO	Fisheries and Oceans Canada
ha	Hectare(s)
HEP	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
HU	Habitat Unit(s)
Project, the	The Back River Project
RSE	Rascal Stream East
RSW	Rascal Stream West
SHIM	Sensitive Habitat Index Mapping
WSA	Weighted Suitable Area

1. Introduction

1. Introduction

1.1 OVERVIEW

The Sabina Gold & Silver Corp. (Sabina) Back River Project (the Project) is a proposed gold mine located in the West Kitikmeot region of Nunavut (Figure 1.1-1).

A Draft Environmental Impact Statement (DEIS) was submitted to NIRB in January of 2014 (Rescan 2013). The DEIS included an assessment of all phases of the proposed Project including ongoing exploration, site preparation, construction, operations, and closure.

However, Sabina wishes to conduct some site preparation work in 2015, and is preparing applications for submission to various regulatory agencies. Part of the site preparation work includes extending the airstrip to allow for servicing passenger and cargo aircraft.

Extending the airstrip will require a re-alignment of a natural watercourse (an outflow of Rascal Lake) in order to divert water currently flowing from Rascal Lake directly to Goose Lake. This realignment will require the construction of two berms to divert 100% of the flow from Rascal Lake through Gander Pond to discharge into a nearby area of Goose Lake. Berm construction material will be sourced from an approved quarry source.

This report presents an assessment of potential effects to fishery production arising from the re-alignment of the section of stream flowing from Rascal Lake to Goose Lake at the Goose Property. The proposed stream re-alignment is sought to avoid causing serious harm to Arctic Grayling (*Thymallus arcticus*) resulting from the extension of the airstrip (proposed for construction in 2015) over Rascal Stream East (RSE).

1.2 REGULATORY FRAMEWORK

The *Fisheries Act* (1985) was amended in 2012 to shift the mandate of Fisheries and Oceans Canada (DFO) from management of fish habitat to management of fisheries. The amended act prohibits *serious harm to fish* that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery. "Serious harm" is defined to include the killing fish by means other than fishing, permanent alteration of habitat, and destruction of habitat.

The amended act focuses on "commercial, recreational, or Aboriginal fisheries" and fish that support those fisheries. These fisheries are defined as those fish that fall within the scope of applicable federal or provincial fisheries regulations, as well as those that can be fished by Aboriginal organization or their members for food, social, or ceremonial purposes, or for purposes set out in a land claims agreement. Fish that support these fisheries are those that contribute to the productivity of a fishery. These include prey fish and other fish species that may reside in water bodies that contain the commercial, recreational, or Aboriginal fishery, or in waters that are connected to such waterbodies.

Under Section 35(2) of the *Fisheries Act* (1985), any project or activity that causes serious harm to fish may require an authorization. Prior to issuing an authorization, the Minister must consider four factors listed in Section 6 of the act:

- The contribution of the relevant fish to the ongoing productivity of commercial, recreational, or Aboriginal fisheries;

Figure 1.1-1

Back River Project Location

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- Fisheries management objectives;
- Whether there are measures or standards to avoid, mitigate, or offset serious harm to fish; and
- The public interest.

Serious harm to fish should be avoided or mitigated wherever possible. Avoidance measures may include locating infrastructure to avoid serious harm to fish or by timing certain activities to avoid harm to fish and fish habitat. Mitigation measures are those that are taken to reduce the spatial scale, duration, or intensity of the impact where it cannot be completely avoided. These include the implementation of best management practices during all phases of a project.

Once efforts have been made to avoid or mitigate serious harm to fish, any residual impact should be addressed by offsetting. Offset measures are those that are taken to replace or enhance fisheries productivity to compensate for unavoidable impacts with the goal of maintaining the productivity of commercial, recreational, or Aboriginal fisheries. The *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting* (DFO 2013) describes four guiding principles for the consideration of fisheries offsetting projects:

- Offsetting measures must support fisheries management objectives or local restoration priorities;
- Benefits from offsetting measures must balance project impacts;
- Offsetting measures must provide additional benefits to the fishery; and
- Offsetting measures must generate self-sustaining benefits over the long term.

Offsetting may be accomplished through a variety of methods including habitat restoration or enhancement, habitat creation, chemical or biological manipulations, and complementary measures such as funding scientific research. Habitat restoration and creation are generally preferred over chemical and biological manipulations and complementary measures; however, the latter may be considered when enhancement or creation opportunities are particularly rare across a landscape.

1.3 OBJECTIVES

The objectives of this report are as follows:

- Describe the baseline data on fish and fish habitat in the streams potentially affected by the re-alignment and associated infrastructure;
- Describe potential effects of the stream re-alignment;
- Describe the mitigation proposed to avoid serious harm; and
- Outline the proposed monitoring program to ensure no-net loss of Arctic Grayling productions.

2. Methods

2. Methods

Data used for the assessment of potential effects on fisheries were collected from several sources. The primary data sources were baseline studies conducted by Rescan between 2011 and 2013 (Rescan 2012a, 2012b, 2012c, 2012d, 2012e, 2014a, 2014b). Figure 2-1 presents a summary of sample sites that were used in this assessment.

In 2011, fish community and habitat in Gander Pond were sampled. No stream surveys were conducted in this area in 2011.

Habitat was sampled at two stream sites in 2012; Rascal Lake Outflow above where RSE and RSW (Rascal Stream West) split (Site 126), and at RSE (Site 113) just upstream from Goose Lake. The site in RSE (Site 113) was also sampled for fish community. Rascal Lake was sampled for fish community and fish habitat in 2012.

In 2013 extensive assessments were completed on RSE and RSW (Rescan 2014a). Fish community sampling was completed at one site on Rascal Lake Outflow upstream of where RSE and RSW split, at three sites on RSE and at one site on RSW downstream of Gander Pond. Spawner, fry, and habitat surveys were conducted on both RSE and RSW and their tributaries, so that the entire length of stream between Rascal and Goose lakes was assessed.

The methods outlining the flow modeling used to predict velocity, stream path and extent of the stream re-alignment can be found in detail in Appendix 2.1.

2.1 HABITAT EVALUATION PROCEDURE (HEP)

In addition to providing the area (in m^2) of potentially lost and gained habitat resulting from the stream re-alignment, this report used a HEP to construct a habitat budget of the fisheries value of lost and gained habitat (USFWS 1980). HEP is a generalized procedure for assessing habitat suitability in streams and lakes. By multiplying habitat area (measured in m^2) by a Habitat Suitability Index (HSI, no units), the HEP produces Habitat Units (HU) that are indices of both habitat quantity and quality. HU are the currency of habitat budgeting and compensation planning.

HEP has been used as a tool for developing habitat budgets for fisheries offsetting in the Canadian Arctic (e.g., Diavik 1998; BHP Billiton 2002; RL&L/Golder 2003; Rescan 2005, 2007, 2010). The HEP approach has two advantages. First, it provides an objective method to characterize the quality or importance of affected habitats to fish species and aquatic resources. Second, it allows standardization of habitat quality ratings relative to other habitats that have different physical characteristics (e.g., lakes versus streams). This facilitates comparisons among habitat types and ultimately allows affected habitats to be evaluated as a single group for the compensation calculation.

Where Project components cause a serious harm, affected habitats are quantified and characterized in terms of their importance to fish. The amount of newly created habitat to offset lost habitat is based upon the estimation of both area and HUs lost. Overall, the HEP is based upon the suitability of a habitat type to support different life history stages of a species. HSIs, derived primarily from scientific literature, are used to quantify the suitability of the habitat type to support each critical life history stage.

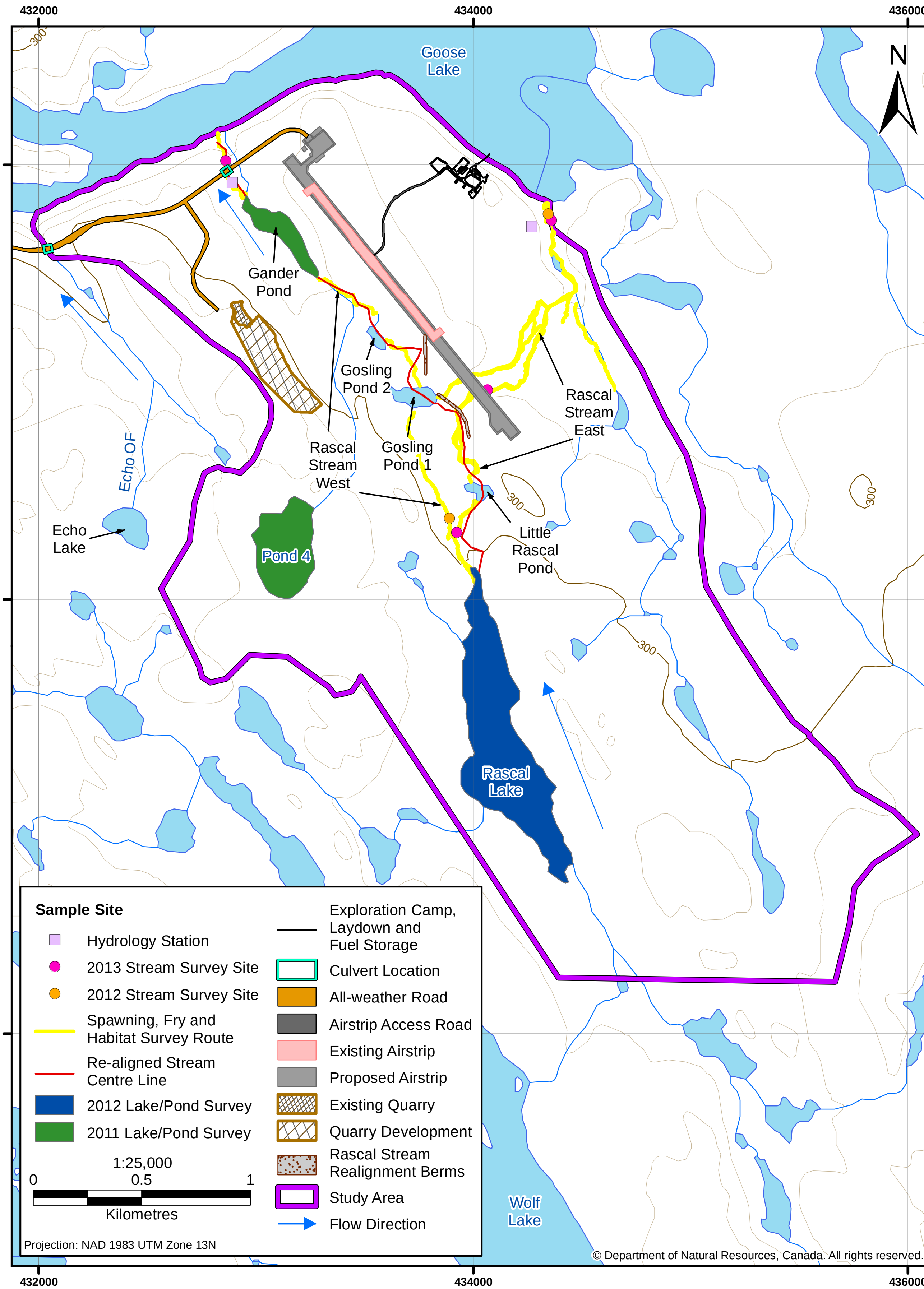

Figure 2-1

Sample Site Locations and Study Area

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There are four steps in the HEP used:

1. Initial scoping of the study area and relevant species. This includes brief reviews of the life histories of relevant species, followed by justification of the decision to base habitat compensation planning on certain species habitat requirements.
2. Utilization and/or development of HSI models for target fish species.
3. Habitat assessment of the Project area and of the proposed offsetting.
4. Preparation of a budget of lost and gained HUs.

The ratio of offsetting area to lost habitat area is dependent on the value of the habitat destroyed as well as the value of the proposed offsetting habitat. For example, high quality habitat may require additional compensation area in order to ensure no net loss of fish production. Alternatively, low quality habitat may be replaced with a smaller area of higher quality habitat. The value of the habitat is multiplied by the offsetting and lost areas separately to create HUs which are used to construct the habitat budget.

For each water body, the number of HUs for each life stage of Arctic Grayling was calculated as the Weighted Suitable Area (WSA) for each habitat type. The WSA is the product of the surface area of the habitat type and the Habitat Suitability Index (HSI) for a particular life-stage. The life-stage specific WSAs are then summed to obtain a total number of HUs for Arctic Grayling.

For the existing habitat in RSE and RSW, the results from Sensitive Habitat Index Mapping (SHIM; Rescan 2014a) were used to calculate the surface area of the fish bearing habitat. For the post re-alignment of RSW, the surface area of fish habitat was obtained using polygon areas traced from the predicted stream margins during the fall period (July-Oct) and represent the predicted bankfull widths of the newly aligned RSW.

2.2 HABITAT SUITABILITY INDICES (HSI) MODEL

There are no established and uniformly accepted regional HSI models for northern mining projects. Each compensation project adjusts existing models to the specific habitat and fish species being negatively affected. For this habitat budget, the HSI models were adapted from three sources: the Doris North Project (Golder 2007); the Gahcho Kué Project (Golder 2012); and the Ekati Diamond Mine (Rescan 2010).

Habitat categories for ponds were taken from the Doris North model used for lakes. Doris North's *No Net Loss Plan* refined the Lake Trout HSI model developed for the Diavik Diamond Project (Diavik 1998) and was also used in the Snap Lake Project (De Beers 2002). The Doris North HSI lake habitat model was determined to be most appropriate because, in addition to being close geographically, lakes within the Back River Project area are more biologically and physically similar to lakes within the Doris North Project area than other project areas.

The HSI values for Arctic Grayling in ponds were modified from Gahcho Kué (Golder 2012; Appendix 2.2). The Gahcho Kue Project developed HSI models for species occurring at northern mining projects in consultation with DFO. The models were updated primarily from those developed for Snap Lake.

Stream habitat types and HSI models for Arctic Grayling were developed from previously successful methods for northern mining projects (De Beers 2002; Diavik 1998; Evans et al. 2002; Golder 2012; Stewart et al. 2007).

2.3 EFFECTS ASSESSMENT METHODOLOGY OVERVIEW

The stream re-alignment effects assessment for Arctic Grayling generally followed the process detailed in the General Methodology for Project Effects Assessment in the Back River Project DEIS (Volume 9, Chapter 1; Rescan 2013). This involved the following steps:

1. Identify and characterize the potential effects between the re-alignment activites and Arctic Grayling;
2. Identify mitgation or management measures that could be taken to eliminate or reduce the potential effects;
3. Characterize any residual effects (potential effects that would remain after mitigation and management measures have been applied); and
4. Determine the significance of potential residual effects.

Residual effects on Arctic Grayling were characterized using the rating criteria outlined in Table 2.3-1 below. These include the Magnitude, Extent, Frequency, Duration, Reversibility, Certainty, and Probability of the effects occurring.

Table 2.3-1. Rating Criteria for Evaluating Residual Effects on Arctic Grayling

Criteria	Classification	
Magnitude	Negligible	Changes are unlikely to have an effect on productive capacity that is distinguishable from natural variation.
	Low	Reductions in productive capacity are unlikely to affect the entire Arctic Grayling population of the Wolf and Goose Watersheds.
	Moderate	Reductions in productive capacity may affect Arctic Grayling population of the Wolf and Goose Watersheds.
	High	Reductions in productive capacity of Arctic Grayling likely to occur within and beyond the Wolf and Goose Watersheds, affecting an entire fish population or more than one fish population.
Extent The physical extent of the effect, relative to study area boundaries	Project Footprint	Confined to the re-aligned stream
	Local	Beyond the re-aligned stream and within the study area
	Regional	Beyond the study area and within Wolf and Goose Watersheds
	Beyond Regional	Beyond the Wolf and Goose Watersheds
Frequency How often the effect occurs	Once	Infrequent
	Sporadic	Intermittent
	Continuous	Frequent or continuous
Duration The length of time over which a Project effect will occur	Short	Short term (effect lasts up to two years)
	Medium	Medium term (up to 5 years, for the life of the all-weather road)
	Long	Long term (> 5yrs beyond the life of the all-weather road) or permanent

(continued)

Table 2.2-1. Rating Criteria for Evaluating Residual Effects on Arctic Grayling (completed)

Criteria	Classification	
Reversibility The likelihood of the VEC to recover from the effect	Reversible	Fully reversible
	Reversible with effort	Reversible with cost/effort
	Irreversible	Irreversible
Qualifiers		
Certainty Limitations in the overall understanding of the ecosystem and ability to predict future conditions	High	Baseline data are comprehensive; predictions are based on quantitative data; effect relationship is well understood
	Medium	Intermediate degree of confidence between high and low
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is not well understood
Probability The likelihood that the predicted effect/residual effect will occur	Unlikely	Less than 20% likelihood of occurrence
	Moderate	Between 20 and 60% likelihood of occurrence
	Likely	Over 60% likelihood of occurrence

If the magnitude of a residual effect was qualitatively determined to be greater than *Low* after mitigation and management (i.e. reductions in productive capacity may affect Arctic Grayling population of the Wolf and Goose Watersheds), then the potential effect was identified as a residual effect.

The significance of a residual effect was rated either as Significant or Not Significant (Table 2.3-2). For example, residual effects receive a rating of 'Not Significant' if they are expected to be one of the following: negligible or low magnitude, confined to re-aligned RSW, moderate to high reversibility, or short duration.

Table 2.3-2. Definitions of Significance Ratings

Significance	Descriptor of Significance
Significant	Effect is expected to result in a decrease in productive capacity of Arctic Grayling that is not mitigated through re-alignment design and mitigation, and is long-lasting or permanent within the zone of influence of the Project relative to reference condition.
Not Significant	Effect may result in a decrease in productive capacity of Arctic Grayling, but one that is fully mitigated through re-alignment design and management, or fully reversible to baseline conditions in the shorter-term.

3. Environmental Setting

3. Environmental Setting

3.1 STUDY AREA

The study area described in this report encompasses upstream and downstream fish habitat potentially affected by the stream re-alignment and associated construction of the airstrip extension at the Goose Property (Figure 2-1).

The proposed stream re-alignment is located in the Wolf Watershed (Figure 2-1) with streams emptying into Goose Lake. The Wolf Lake Watershed is large with numerous lakes and ponds discharging first into Wolf Lake and then into Rascal Lake, the headwater for the stream re-alignment.

Approximately 250 m downstream of Rascal Lake, the outflow splits into two, separate streams: Rascal Stream East (RSE), and Rascal Stream West (RSW). RSE flows northeast towards Goose Lake flowing through the location of the proposed airstrip. RSW flows to the northwest initially passing through Gosling Ponds 1 and 2 and eventually through Gander Pond prior to reaching Goose Lake (Figure 2-1). A small outflow from Gosling Pond 1 also flows east into RSE. Baseline hydrological studies found that approximately 70% of water in Rascal Lake Outflow passes through RSE before entering Goose Lake during spring freshet; the remaining 30% flows northwards through RSW (Rescan 2012a, 2012b, 2014b). Discharge is low in both streams during summer months; however flow in RSW was 0 m^3/s for extended periods on each of the three years of sampling, indicating that this stream is ephemeral.

3.2 FISHERIES

Arctic Grayling are a relatively long lived (30+ years) iteroparous species that spawn early in the spring in small streams over a variety of substrates ranging from mud to boulders, although gravel is preferred (Scott and Crossman 1973; Hubert et al. 1985; Stewart et al. 2007). Juveniles tend to rear in these streams for most of the summer, while adults rear in lakes, to which they return after spawning (Table 3.2-1; Hubert et al. 1985). Both adults and juveniles overwinter in larger rivers and lakes upstream and downstream of spawning areas (Stewart et al. 2007).

Baseline data were collected from RSE, RSW, Rascal Lake, Gander Pond, and Gosling Ponds to determine the fisheries values of those waterbodies prior to the stream re-alignment and associated construction of the airstrip at the Goose Property (Figure 2-1). The following section summarizes the fisheries resources in each of these waterbodies.

3.2.1 Rascal Stream East (RSE)

RSE is the main migratory corridor for Artic Grayling moving between the Goose and Wolf watersheds throughout the open-water season and likely provides a critical pathway for fish migrating between summer and winter rearing habitat. Rascal Lake has a maximum depth of 3.7 m and, along with Goose Lake, likely provides overwintering habitat to fish that rear in both West and East Rascal streams.

Electrofishing, fry and spawner surveys show that Arctic Grayling utilize the full length of RSE for spawning and rearing. In addition, fry, spawner, and habitat surveys completed on inflows and outflows to Goose Lake suggest that RSE has the most abundant and highest quality Arctic Grayling spawning habitat available to the overwintering population in Goose Lake. Populations overwintering upstream in Rascal Lake and downstream in Goose Lake may use the stream as a migration corridor when moving between summer and winter habitat.