Plate 7.3-3a. Looking upstream towards barriers at Site 6, July 16, 2014.

Plate 7.3-3b: Looking downstream towards barriers at Site 6, July 16, 2014.

Water Temperature and Flows

The water temperatures in 2014 in Nulahugyuk Creek increased steadily as the season progressed with mean daily temperatures rising from 2.7°C on June 14 to 12.3°C on July 17 (Figure 7.3-8). The warmest temperatures occurred during the latter half of the study period exceeding 17°C at the downstream site (BH2) for 24.3 hours. Diurnal variation in water temperature was evident with a mean difference of 8.8°C between daily minimum and maximum values. A temperature gradient was also observed between the upstream and downstream sites (BH2 and BH7; Figure 7.1-1) with a consistent mean difference of 2.4°C across the sampling period, indicating a rate of change of 0.3°C/km in downstream direction.

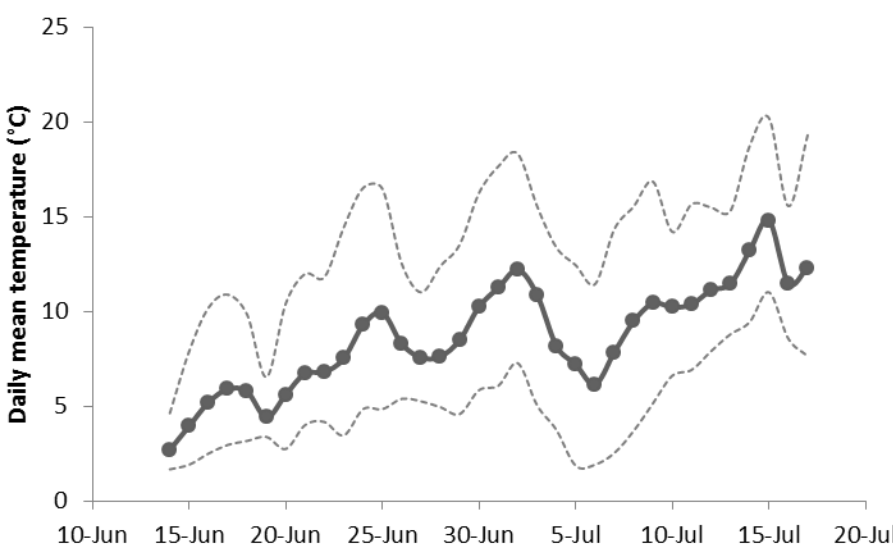

Figure 7.3-8. Daily Mean Temperature (°C) Recorded at Nulahugyuk Creek from June 10, 2014 to July 17, 2014

Note: Maximum and Minimum Daily Values Indicated by Upper and Lower Dotted Lines Respectively.

In 2014, creek discharge declined over the study period ranging from a high of 6.0 cubic metres per second (m^3/s) on June 15 to a low of 0.5 m^3/s on July 15 (Figure 7.3-9). Discharge was also low on July 22, 2015 (0.4 m^3/s). A 5.5 m^3/s decline in discharge corresponded to a 29 cm decrease in water depth over the 2014 study period, based on the following relationship between the gauge water level and creek discharge:

$$water\ level\ (cm) = 56.012 + \left(5.2795 \times creek\ dischage\ (m^3/s)\right), \qquad R^2 = 0.97.$$

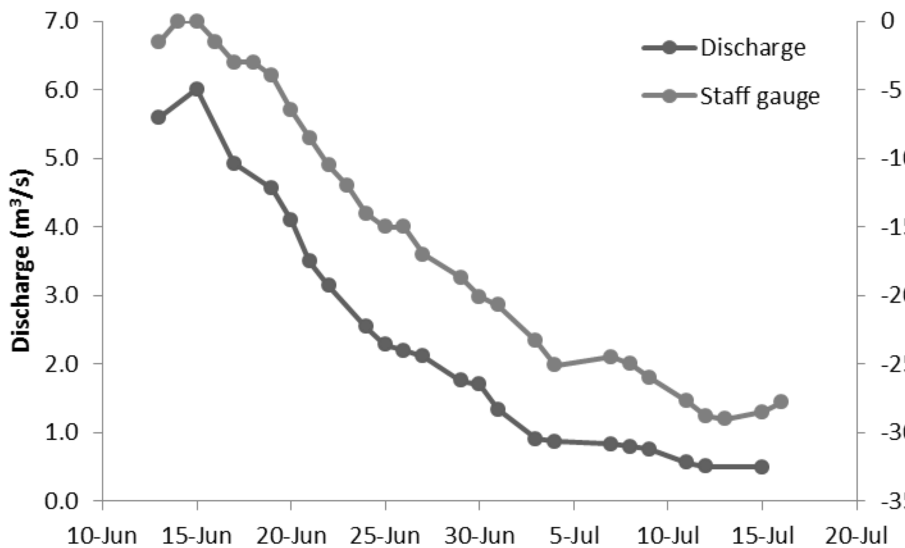

Figure 7.3-9. Stream Discharge (m^3/s) and Staff Gauge Depth (cm) Recorded at Nulahugyuk Creek Between June 13, 2014 and July 15, 2014

Hingittok Lake

Based on 1:50,000 CanVec data, Hingittok Lake is 982.3 ha in area and features numerous peninsulas and bays around three large islands in the centre of the lake (Figure 7.3-4). Shoreline length (38,085 m including island shorelines) was extensive relative to the size of the lake and the shoreline development factor was approximately 12.3, the ratio of lake perimeter to surface area. The higher the ratio, the more irregular the shoreline, resulting in potentially more shoreline habitat for spawning and rearing (a perfect circle would have a shoreline development factor of 1).

The bathymetry data derived a lake volume of approximately 30,553,000 m^3 (Table 7.3-6). The maximum depth was approximately 18 m and mean depth was 3.7 m.

Table 7.3-6: Approximate Lake Area and Volume for Various Depth Intervals in Hingittok Lake, July 10 to 14, 2014

Depth (m)	Volume (m^3)	Area (ha)	Depth (m)	Volume (m^3)	Area (ha)
>0	30,553,274	982.3	>10	553,638	14.7
>2	15,767,454	607.7	>12	308,168	10.2
>4	6,214,620	352.4	>14	138,401	6.9
>6	2,002,020	95.6	>16	32,068	3.7
>8	964,592	28.9	>18	335	0.2

Note: m = metres; m^3 = cubic metres, ha = hectares; > = greater than.

7.3.3 2014 Baseline Summary

Three distinct Arctic Char migration types were recorded at Bernard Harbour. The first adult char captured were those migrating downstream (June 16 to July 4). The migration of the second adult group (adults moving upstream towards Hingittok Lake) began June 25 and peaked around July 5. Although adults were still captured, attempting to migrate upstream near the end of the study period, PIT tag data indicated that adults attempting migration after July 7 would be unsuccessful. The window for the juvenile downstream migration may extend through July, due to downstream travel being less problematic than upstream travel, and the small size of juveniles, allowing movement through shallow water.

The primary factors affecting char migration success at Nulahugyuk Creek in 2014 were discharge and fish weight. Discharge was strongly correlated with water depth, and as depth declined over time, new impediments to fish passage were created until fish passage was no longer possible. Larger fish were less likely to overcome these impediments to fish passage, presumably due to an increased probability of stranding and predation. Unfortunately, larger fish are generally the most productive in a spawning population (Jeuthe et al. 2013), producing greater numbers of viable offspring, and loss of these individuals could have significant effects on recruitment potential.

A significant barrier to fish passage was created on July 7, 2014 as stream discharge declined to approximately 0.8 m^3/s and water depths declined by 25 cm at the staff gauge over the monitoring period. Afterward, fish passage was no longer possible; indicating a brief and discrete window of opportunity exists for the char migration at Nulahugyuk Creek. Between the time fish were initially detected moving upstream (June 25) and passage was no longer possible (July 7), the migration window in 2014 was 13 days. While some of the unsuccessful migrants may have taken temporary shelter in upstream pools eventually retreating to the sea, the majority of the remaining char likely perished through stranding, exhaustion or predation, with only four fish successfully exiting the system by July 17, 2014.

It is expected that the char that successfully reach Hingittok Lake either overwinter, then spawn during the fall of the next year, or spawn then overwinter, migrating downstream to Bernard Harbour the following spring. Both Hingittok Lake and the connectivity with the ocean through Nulahugyuk Creek are critical to the local char population, and possibly to the larger fishery in the Coppermine River region. The maximum depth of Hingittok Lake is over 18 m deep, providing overwinter habitat, and there are at least two prey species (Cisco and Ninespine Stickleback) available to adult Arctic Char. Importantly, shoreline length is extensive relative to the size of the lake potentially providing an abundance of shoal habitat for spawning.

7.3.4 2016 Baseline Summary

The results of the 2016 study support previous descriptions of Bernard Harbour Arctic Char, and contribute to a multi-year dataset of baseline conditions for evaluating future changes in the local stock (FEIS Addendum Appendix V6-6H). Although the 2016 characterization applies to above average flow conditions in early July based on climate data normals for the region, the monitoring period coincided with flows below the previously identified discharge threshold at which adult char can successfully migrate to Hingittok Lake (see Section 7.3.2.2).

Even under the low-flow conditions, 33 adult char were captured in the fyke trap moving upstream from the ocean to spawn in Hingittok Lake (FEIS Addendum Appendix V6-6H). Only three char (10.3% of tagged char) were detected 2.83 km upstream, and using 2014 and 2016 data combined, the estimated discharge at which there is a 50% probability of an adult Arctic Char successfully navigating the lower reach of the creek was 0.8 m^3/s. The probably of any char successful migrating past this point to Hingittok Lake is expected to be very low, in part, because of the stress incurred while navigating shallow water in the lower sections of Nulahugyuk Creek (also see 2014 results in Section 7.3.2.2).

Observations of creek habitat and the physical dimensions of previously constructed low-flow channels were similar to previously collected data (FEIS Addendum Appendix V6-6H). The low-flow channels constructed in 2012 (Golder 2013a) were deemed structurally intact, providing char with suitable depths, velocities, and an unobstructed path for migration to upstream locations. Thirteen remaining problem locations were confirmed in 2016 where low-flow channels are recommended to improve upstream passage of fish. Remediation of these problem locations are expected to benefit the production of Arctic Char stock at Bernard Harbour (i.e., increase available biomass for harvesting through increased survival, access, and recruitment).

7.3.5 Baseline Synthesis

Sabina is confident that the baseline characterization in the Conceptual Offsetting Plan is reliable (collected during appropriate sampling periods) to inform future monitoring methods and the successful implementation of the Bernard Harbour offsetting option (also see response to F-KIA-TC-14). The baseline characterization of Arctic Char in the Hingittok Lake-Nulahugyuk Creek system relies on field programs summarized in detail in this chapter (also see Golder 2013a), a Traditional Knowledge study (FEIS Volume 3, Appendix V3-3D), and a recently completed field program (2016) summarized in FEIS Addendum Appendix V6-6H. There are three years of data on the migration success rate of adult Arctic Char, which will be used as a measurement indicator for the post-remediation evaluation of the success of the Bernard Harbour offsetting option. Furthermore, the 2014 dataset provides a suitable benchmark for the upstream migration period because of average spring flow conditions during that year (see reply to F-KIA-IR-50). It is also clear that most, if not all, of the upstream adult migration occurs in late spring/early summer, and that there is no juvenile upstream migration in Nulahugyuk Creek.

The Bernard Harbour population of Arctic Char displays a unique life history as part of a diversity of previously described Arctic Char life histories across localities (e.g., Vollestad and L'Abee-Lund 1994; Power et al. 2008). Consistent with life history theory, anadromous species such as Arctic Char that live in a dynamic Arctic environment are adaptable to changes in site-specific conditions (i.e., behaviours must be phenotypically plastic otherwise populations would not exist). At Bernard Harbour, an early-season migration period for spawning adults is advantageous for the overall fitness of the population because stream conditions later in the open water season (e.g., low water depths) preclude access to spawning habitats in Hingittok Lake (Golder 2013a; FEIS Volume 3, Appendix V3-3D). Similarly, non-spawning fish from Hingittok Lake that are foraging in the ocean are expected to overwinter in more accessible systems such as the Coppermine River rather than risk injury or death in Nulahugyuk Creek in late summer. This strategy of using two separate watersheds has been described for anadromous species, including Arctic Char (Jensen et al. 2015).

The baseline characterization of Arctic Char in the Conceptual Offsetting Plan is also supported by data collected in summer 2004 and 2005 when members of the Kugluktuk Hunters and Trappers Organization (HTO) and Golder Associates Ltd. (Golder) carried out a fish and fish habitat assessment on the Hingittok Lake-Nulahugyuk Creek system (e.g., Golder and ANL 2007). The peak period of the upstream migration of Arctic Char begins in late June, and continues for approximately two weeks, overlapping with a reduction in stream flows such that late arrivals face poor conditions and a low chance of successfully migrating to the spawning lake. Migration conditions in the creek generally get worse later in the summer, and remain very difficult to navigate or impassable for char based on all recent visits to Bernard Harbour in mid-July through September (Table 7.3-7). Most of the measured discharge values for mid to late summer flows are below the calculated discharge threshold of 0.8 m^3/s required for upstream migration, with the exception of a 1.07 m^3/s record on July 12, 2012.

Table 7.3-7. Summary of mid-July to September Flow Conditions at Nulahugyuk Creek, Nunavut (2004-2016)

Summer Dates	Discharge	Habitat Conditions	Reference
August 19-23, 2004[1]	0.106 to 0.122 m^3/s	Impassable	Golder and ANL 2005
July 15-September 13, 2005[2]	0.098 to 0.756 m^3/s	Difficult to impassable	Golder and ANL 2007
July 8-16, 2012	0.34 to 1.07 m^3/s	Difficult to impassable	Golder 2013a
August 8-12, 2013	0.04 to 0.06 m^3/s	Impassable	Golder 2013b
July 8-16, 2014[3]	0.5 to 0.79 m^3/s	Difficult to impassable	Section 7.3.2.3
July 22-24, 2015	0.29 to 0.42 m^3/s	Impassable	Golder 2015
July 8-25, 2016	0.17 to 0.51 m^3/s	Impassable	FEIS Addendum V6-6H

[1] 7 adult char captured moving upstream over 3 days of continuous trap net operation at the mouth of the creek

[2] high flow event recorded on August 28, 2005; this was of short duration (1- 2 days) with flows quickly returning to low levels (below 0.2 m^3/s) such that there was no opportunity for fish to move upstream to the lake

[3] discharge available from June 13 to July 16, see Section 7.3.2.3

7.4 REMEDIATION PLAN

7.4.1 Low-Flow Channels

Existing habitat and fish passage conditions in Nulahugyuk Creek are poor, a combination of boulder fields and dispersed flows are preventing many char from accessing spawning locations in Hingittok Lake, as confirmed by local knowledge (Golder and ANL 2007; Appendix V3-3D of the FEIS) and by the previously collected fisheries data at Bernard Harbour (Golder 2013a; including 2014 baseline data reported in this plan, and 2016 data provided in FEIS Addendum Appendix V6-6H. Thus, the goal of remediation is to improve passage for fish migration in Nulahugyuk Creek by removing boulder barriers in the creek and by increasing water depths within specified paths or movement corridors within the channel. 'Soft' engineering methods (without the use of heavy machinery) will be deployed. Upon remediation of fish passage conditions, benefits to the local fishery are predicted through increased adult survival and increased fecundity.

The methods will follow those successfully developed by the Kugluktuk HTO and Golder in 2012 (Golder 2013a; see Plate 7.4-1), which are based on local knowledge of traditional fishing activities at Bernard Harbour (Golder and ANL 2007; Golder 2013a; Appendix V3-3D of the FEIS). Specifically, the methods will include the construction of low-flow channels and the use of directional rock weirs at problem locations in Nulahugyuk Creek; where a low-flow channel is characterized by a manipulation of substrates to direct the flow such that there is an unobstructed flow path with sufficient depths (greater than approximately 20 cm) within the larger channel for fish passage. Small boulders within the larger channel will be relocated to form the low-flow channel within the area of the assumed thalweg of the problem sections of the creek. Where needed, weirs above the low-flow channel will be constructed to direct and concentrate flows through the low-flow channel. Weirs below the low-flow channel may also be created to direct Arctic Char migrating upstream, such that fish avoid adjacent shallow boulder gardens where stranding may occur (Plate 7.4-2). It is expected that each problem location will be remediated by a field crew of approximately five people and one supervisor (Golder 2013a). This cost-effective method can increase water depths by up to 102% (or up to 10 cm) relative to the natural dispersed flow conditions during the latter part of the upstream migration period when water levels are in decline (Golder 2013a).

Field personnel will be resourced through the Kugluktuk HTO, who will be a partner in completing the remediation work, as well as future monitoring and maintenance of the low-flow channels. The accessibility of Bernard Harbour, which can be reached by a four-hour boat ride from Kugluktuk during open water conditions, provides a logistical advantage over less accessible options in the Canadian Arctic.

Furthermore, local enthusiasm for the Project is well documented, and the many residents in Kugluktuk who still maintain a camp at Bernard for hunting and fish will be engaged while there are opportunities through the life of the offsetting option. The integration of local and traditional knowledge will continue during subsequent field programs, workshops, and meetings.

Plate 7.4-1. A Low-Flow Channel Previously Created in 2012 ('Project 2'), Looking Upstream, July 18, 2014

Plate 7.4-2. Directional Weir (Kugluktuk HTO Students in Background) for Migrating Arctic Char in Nulahugyuk Creek, June 24, 2015

7.4.2 Benefits to Fisheries Productivity

To estimate the potential increases in fisheries production (as a surrogate of fisheries productivity) following the remediation of Nulahugyuk Creek, the effects of the low-flow channels on migration success was estimated and then related to changes in the number and biomass of adult Arctic Char in in Nulahugyuk Creek and Hingittok Lake. The effects of remediation on migration success was estimated using hydrologic data collected in 2012 and 2014, combined with the migration success results from 2014. Using the same dataset, a water level target in the low-flow channels that maximizes the migration success was also identified.

7.4.2.1 Predicted Changes in Migration Success

An understanding of flow conditions that determine water depths at the low-flow channel locations is needed as part of predicting changes in migration success based on increasing water depth. Using the pre-manipulation depths of the pilot projects in 2012, which was, on average, 12.5 cm when discharge was approximately 0.4 m^3/s (Golder 2013a), and the relationship between stream discharge and stream depth at the staff gauge presented in Section 7.3.2.3, a 12.5 cm depth equates to a level of 58.1 cm at the staff gauge. Furthermore, creating an increase in depth from 12.5 cm to 22.5 cm with the construction of a low-flow channel would be equivalent to an increase in pre-manipulation water levels from 58.1 to 68.1 cm at the staff gauge, assuming the wetted width of the creek at the staff gauge location was equal to or less than the wetted width at the location of the low-flow channel projects. A water level of 68.1 cm at the staff gauge to achieve a 10 cm increase in water depth would be equivalent to a stream discharge of 2.3 m^3/s, based on the relationship between gauge water level and creek discharge.

With an understanding of how changes in water depths at the low-flow channel locations (prior to remediation) relate to flows in the creek, changes in the probability of migration success were estimated using the logistic equation provided in Section 7.3.2.2. For example, when discharge is 0.4 m^3/s, the probability of migration success prior to remediation is predicted to be very low (0.002), whereas when discharges is 2.3 m^3/s, the probability of migration success prior to remediation is maximized (0.85), assuming fish weight is held constant at 4.2 kg. Therefore, a 10 cm increase in depth at the selected problem locations would equate to an increase in the probability of migration success from 0.002 to 0.850 during low-flow periods of the upstream migration, once remediation activities are completed.

Based on the logistic equation, Arctic Char reached the greatest probability of migration success when discharge reached 1.6 m^3/s or greater (See Figure 7.3-7). This equates to a staff gauge level of 64.5 cm, 6.4 cm greater than the depth initially observed at the enhancement location. This would suggest an ‘optimal’ channel depth of greater than 19 cm to maximize the migration success for an Arctic Char of average size, and confirms that the methods deployed in 2012 can improve fish passage. Indeed, a behavioral response of Arctic Char to increased flows was noted in Golder (2013a). Field crews observed successful upstream movements of adult char shortly after the completion of the low-flow channels in 2012 (within 1 h of completion), suggesting lack of depth and defined flow path were a limiting factor to upstream movements.

7.4.2.2 Predicted Changes in Fish Biomass

Sabina utilized a conservative approach in developing a simplified model of biomass gains to ensure that gains were not overestimated. Furthermore, expanding the model to include additional demographic complexity, such as variable marine survival rates over time, was determined to not provide any obvious value in the quantification of gains for the Conceptual Offsetting Plan. Additional complexity to the biomass model (e.g., fish production related to ‘added’ juveniles and immature adults, stage-specific demographic rates) will be considered during continued discussions with the KIA and DFO during the permitting stage of the Project.

In brief, changes in fish abundance and biomass for the Arctic Char run in Nulahugyuk Creek and Arctic Char arriving in Hingittok Lake were predicted (Figure 7.4-1; Table 7.4-1) using baseline data on the 2014 upstream migration and the following steps and assumptions provided below (also see the reply to F-KIA-TC-15):

Step 1) Select Arctic Char run data for a year that best represents average flow conditions, and a run size that may be smaller than sizes estimated for other years (as a conservative input to the biomass model), specifically 332 adults captured during the 2014 baseline study;

Step 2) Calculate upstream migration success rate for the baseline year, determined to be 34.9% during the 2014 baseline study;

Step 3) Calculate the number of fish that successfully migrated to Hingittok Lake for the baseline year, specifically 332 fish multiplied by 34.9% (which equates to 116 fish);

Step 4) Develop a migration model relating probability (*P*) of upstream migration success to flow conditions in Nulahugyuk Creek (Table 7.3-4):

$$P = \frac{e^{-8.398+15.714x-4.612x^2-0.77y}}{1+e^{-8.398+15.714x-4.612x^2-0.77y}}$$

, where x = four day mean discharge (m^3/s), and y = adult char weight in kilograms (kg);

Step 5) Develop a hydraulic model relating changes in the gauge water levels to creek discharge (page 59, Section 7.3.2.3):

$$water\ level\ (cm) = 56.012 + \left(5.2795 \times creek\ dischage\ (m^3/s)\right);$$

Step 6) Apply models assuming water depths will increase by 10 cm (as per Section 7.4.1) to predict upstream migration success with the implementation of proposed remediation (i.e., low-flow channels), calculated to be 85.0%;

Step 7) Assuming baseline run sizes are constant across years (which also means that 'marine' survival rates are held constant), calculate the number of fish that can successfully migrate to Hingittok Lake with the implementation of creek remediation for offsetting years 1 and 2 (calculated to be 282 fish per years 1 and 2);

Step 8) Assuming that the return rate of spawners is 50% (which includes a 'marine' survival rate component; Klemetsen et al. 2003), and that fish spawn every second year (Babaluk et al. 1998), calculate run sizes for offsetting years 3 to 8 (calculated to increase from 332 adults to 415 adults);

Step 9) Repeat step 7 for offsetting years 3 to 8;

Step 10) Assuming that Hingittok Lake is below carrying capacity for the duration of the monitoring period and that there is a high capacity for population growth, consider an increase in the number of juvenile outmigrants such that that two offspring per added spawner return to Bernard Harbour at offsetting year 9 and 10 (i.e., the run size increases from 415 to 747 adult char);

Step 11) Convert annual run sizes to annual biomass by multiplying abundances by the expected mean weight of migrating adult fish (Table 7.4-1); and,

Step 12) Calculate cumulative biomass gains (Table 7.4-1).

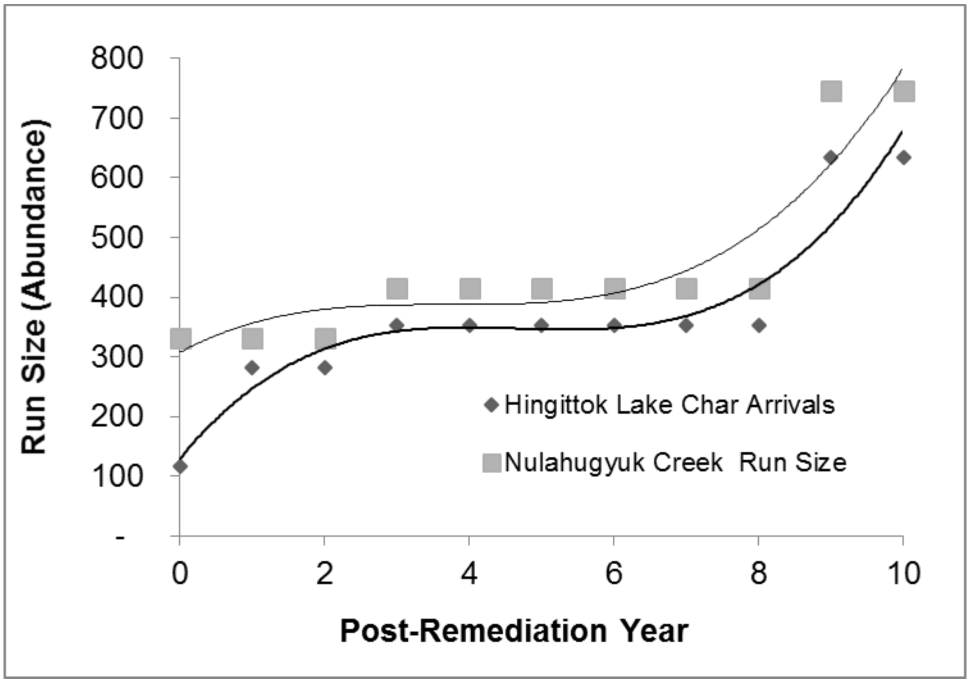

Figure 7.4-1. Post-Remediation Predictions for Arctic Char Abundance in Nulahugyuk Creek and Hingittok Lake (Bernard Harbour)

Table 7.4-1. Predicted Run Size, Annual Biomass, and Cumulative Biomass for Bernard Harbour Arctic Char for the Evaluation Monitoring Period

Offsetting Year	Nulahugyuk Creek Run Size (No.)	Hingittok Lake Arrivals (No.)	Nulahugyuk Creek Biomass (kg)[11]	Hingittok Lake Biomass (kg)[11]	Hingittok Lake Annual Gains (kg)	Hingittok Lake Cumulative Gains (kg)[12]
0 (Baseline)	332[1]	116[2,3]	1,394	487	-	-
1	332	282[4,5,6,7]	1,394	1,185	699	699
2	332	282[4,5,6,7]	1,394	1,185	699	1,397
3	415[8]	353[4,5,6,9]	1,743	1,482	995	2,392
4	415[8]	353[4,5,6,9]	1,743	1,482	995	3,387
5	415[8]	353[4,5,6,9]	1,743	1,482	995	4,382
6	415[8]	353[4,5,6,9]	1,743	1,482	995	5,377
7	415[8]	353[4,5,6,9]	1,743	1,482	995	6,372
8	415[8]	353[4,5,6,9]	1,743	1,482	995	7,367
9	747[10]	635[4,5,6,9]	3,137	2,667	2,180	9,547
10	747[10]	635[4,5,6,9]	3,137	2,667	2,180	11,727

[1] see Step 1; [2] see Step 2; [3] see Step 3; [4] see Step 4; [5] see Step 5; [6] see Step 6; [7] see Step 7; [8] see Step 8; [9] see Step 9; [10] see Step 10; [11] see Step 11; [12] see step 12.

It is important to note that the actual increases in fish abundance and biomass post-remediation will be greater if the average size of the Arctic Char run at Bernard Harbour is greater than the selected model inputs. For the purposes of the offsetting plan, the modelled changes conservatively used the 2014 upstream migration abundance data, versus the downstream migration abundance data, as an approach to reduce uncertainty in predictions. The 2014 abundance data for the downstream migration of adult Arctic Char, which would reflect the upstream migration in 2013, was approximately 1.4-times higher than the upstream migration in 2014 (478 adults captured downstream versus 332 adults capturing upstream in 2014).

As a conservative measure, the model input assumes only biomass of the spawning adult Arctic Char population contributes to the biomass gains at Bernard Harbour as a direct result of the offsetting measures. Additional gains to fisheries production would be realized from juvenile offspring and immature adults that would be added to the population as an outcome from the increase in the number of spawning adults, and is expected to be a substantial contribution of biomass to the total population. In contrast to the calculation of gains which focus on a single life stage, losses at the Back River Project were calculated for both standing stock losses (i.e., from the fish-out) and related annual production losses over a 9 year period. Furthermore, the calculation of gains focused on the primary migration period during late spring/early summer. If including small numbers of adult fish that may try to migrate upstream later in the summer (i.e., consideration of higher use of Nulahugyuk Creek as a migration corridor), the result would be higher gains than those reported in the Conceptual Offsetting Plan.

7.4.2.3 Offsetting Accounting

The potential losses and gains in fisheries productivity were projected across time using fish production as a surrogate measure of fisheries productivity (Randall et al. 2013). Fish production provided a transferable unit for the calculation of both losses at the Goose Property Area and gains at Bernard Harbour. As stated in the reply to F-KIA-IR-53, the approach to offsetting accounting was developed through engagement with DFO. Furthermore, offsetting accounting methods will be reviewed during continued discussions with the KIA and DFO during the permitting stage of the Project.

Residual serious harm to fish (i.e., losses) will be incurred with the temporary drawdown of Llama and Umwelt Lakes, and the construction of related infrastructure, affecting Goose Lake tributary streams and ponds in the Goose and Wolf watersheds. The fish-out and subsequent drawdown of Llama and Umwelt lakes will result in an estimated biomass loss of 467.5 kg in total for the Llama-Umwelt lake system (Section 6.4.1). With construction of the airstrip extension and Tailings Storage Facility, and subsequent reduction in downstream flows, the calculated biomass loss for Rascal Stream East, Goose Inflow South/East and other waterbodies in the Goose and Wolf watersheds will be 102.3 kg of fish biomass (Section 6.4.2). Thus, the total loss of biomass (standing stock) at the Goose Property Area during construction is predicted to be 569.8 kg. These losses in biomass will be verified through the implementation of fish-outs, and future evaluation of collected data.

Annual production losses associated with the removal of habitats from contributing to the ongoing productivity of the fishery were also considered (e.g., Randall and Minns 2000). Annual production was estimated to be 21% of total biomass for affected habitats (based on the production:biomass ratio calculated in De Beers [2015]), which will be confirmed using data from the fish-out of Llama and Umwelt lakes. This was projected as additional losses that accumulate across time as a conservative approach to the offsetting accounting. In other words, it was assumed that when all residual serious harm to fish are realized during construction within the Goose Property Area, there is a loss of annual loss of 119.7 kg of biomass that would have otherwise been available for harvest without the Project development. Over a ten-year period, total cumulative losses include the initial 569.8 kg of biomass due to construction of infrastructure and removal of fish during the fish-outs plus the hypothetical annual loss of production of

119.7 kg in the nine years that follow (for a total of 1,076.9 kg), which all together is equivalent to 1,646.7 kg of lost biomass (Figure 7.4-2).

Substantial gains in fish biomass are predicted at Bernard Harbour, which will counterbalance losses incurred at the Goose Property Area (Figure 7.4-2). Gains in biomass of Arctic Char are predicted to range from almost 700 kg during year 1 and 2 post-remediation to over 2,180 kg by year 9 post-remediation. Over a ten-year period, the offsetting option may generate a total cumulative gain of 11,727 kg of Arctic Char, over 7-times the predicted losses over the same period. Furthermore, predicted gains are expected to magnify over time until char abundance (e.g., juvenile densities) approach the carrying capacity of Hingittok Lake.

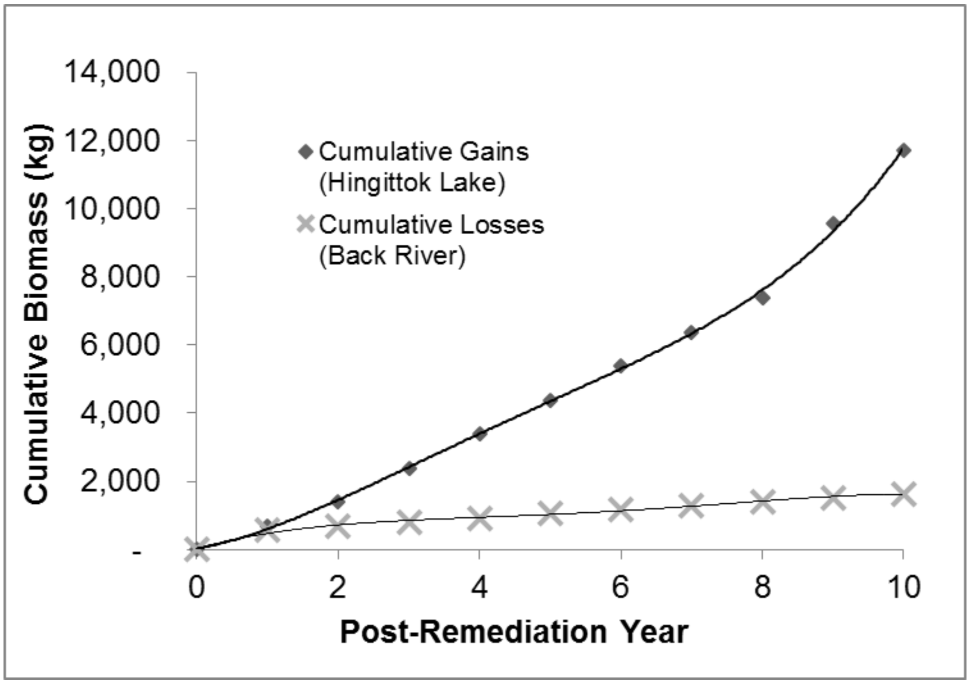

Figure 7.4-2. A Comparison of Predicted Cumulative Gains in Fish Production Versus Cumulative Losses Over Time

It is important to note that if only considering the direct biomass gains from predicted increases in migration success to Hingittok Lake from 35% to 85% (i.e., not accounting for any gains of additional juvenile production or returning offspring from the adults ‘added’ to Hingittok Lake), the trajectory of cumulative gains in biomass by year 1 post-remediation exceeds that of losses related to the fish-out (569.8 kg), and by year 3, estimated cumulative gains exceeds that of losses calculated for a 10-year period of operation for the Back River Project (total of 1,646.7 kg). This prediction of biomass gains assumes a consistent run size of 332 adults, and that the low-flow channels will add a minimum of 166 additional adults surviving to the lake and spawning each year, where each fish weighs, on average, 4.2 kg.

Modest increases in the population over the duration of the offsetting option are ecologically realistic and within the capacity of Hingittok Lake to support an increase in fish density (see reply to F-KIA-TC-16). There is sufficient evidence to conclude that Hingittok Lake is well below carrying capacity. The local Arctic Char fishery has been in decline for the past 40 years, and stream migration conditions have also deteriorated over approximately the same period, which have been identified as the underlying cause of the decline by both Traditional Knowledge (FEIS Volume 3, Appendix V3-3D), and baseline studies performed by both Sabina, Golder Associates Ltd. and the Kugluktuk Hunters and Trappers Organization (e.g., this chapter; FEIS Addendum Appendix V6-6H, and Golder 2013a). Any uncertainty related to the carrying capacity of Hingittok Lake is related to whether the spawning population in Hingittok Lake can increase 7-fold or higher (beyond offsetting year 8 post-remediation) and is not related to whether the Bernard Harbour offsetting option will achieve equivalency.

The projected increases in biomass of 'added' Arctic Char through the implementation of low-flow channels in Nulahugyuk Creek will offset losses to be incurred at the Back River Project. The trajectory of annual biomass gains achieved through the offsetting is much greater than the annual production losses and is sufficient to fully counterbalance the residual serious harm caused by the Project. The magnitude of the difference in predicted gains versus losses is substantial providing confidence that equivalency can be achieved, a determination that will ultimately be made by DFO during the permitting stage of the Back River Project (DFO 2013a, b) and will be verified through monitoring.

7.4.3 Schedule

The planned scope of the proposed offsetting program at Bernard Harbour will occur from 2014 to 2025 (Table 7.4-2). The proposed monitoring program is planned for a period of no more than 10 years post-enhancement and will include up to four years of monitoring the Arctic Char run. This length of time and level of effort are expected to be adequate to demonstrate that the offsetting objectives have been achieved, where the goal of monitoring will be to support model assumptions and demonstrate that fish production follows a projected trajectory of cumulative gains that will eventually exceed cumulative losses (Section 7.4.2.3). Annual monitoring and reports over a 10-year period will allow for the following (DFO 2013a):

- Biological or physical changes to be reflected in the data collected;
- Possible adjustments to the monitoring to better estimate changes in fishery productivity; and
- The restored habitat to reach full ecological functionality.

Sabina would conduct annual field monitoring and maintenance, working with community members. Biological monitoring and reporting to DFO would occur in offsetting year 1, 4, 9, and 10 (as needed) of the monitoring period. The final monitoring schedule will also consider feedback from DFO, and other interested parties (e.g., KIA) during the permitting stage of the Back River Project, to meet the requirements of the Fisheries Protection Policy Statement (DFO 2013b)

Table 7.4-2. Overview of Activities in Support of the Conceptual Fish Offsetting Plan for the Back River Project (2014 to 2025)

Phase	Offsetting Year	Annual Activities / Deliverables
Baseline	2014	Monitor adult and juvenile migrations, and passage conditions
		DFO/community engagement
	2015	DFO/community engagement
		Follow-up field investigation of habitat conditions
		Conceptual Fish Offsetting Plan
Remedial Works	Summer 2016 (Year 0)	DFO/community engagement
		Construct habitat offsetting enhancements
	Winter 2016 - 2017	Remediation report
Application Submission	Fall 2017	Submit Fisheries Act Authorization Application
Post-Remediation Monitoring	2017 or 2018 (Year 1 or 2)*	Monitor adult and juvenile migrations, and passage conditions
		Annual Report
	2018 – 2019 (Year 2 – 3)	Sabina/Kugluktuk HTO inspection years; inspect each year and repair channels (as needed)
		Annual field summary memo
	2020 (Year 4)	Monitor adult and juvenile migrations, and assess passage conditions
		Annual Report
	2021 – 2024 (Year 5 – 8)	Sabina/Kugluktuk HTO inspection years; inspect each year and repair channels (as needed)
		Annual field summary memo
	2024 (Year 9)	Monitor adult and juvenile migrations, and assess passage conditions
		Annual Report
		Offsetting Project Synthesis Report
		DFO/community engagement
	2025 (Year 10)	Final monitoring program (as needed)
		Technical memo update to synthesis report

** schedule may shift if, for example, remediation efforts require additional efforts and extend beyond one open water season.*
DFO = Fisheries and Oceans Canada; HTO = Hunters and Trappers Organization

7.4.4 Monitoring

The purpose of the proposed monitoring plan included with the Conceptual Offsetting Plan is to provide an outline that will be included with the application for Authorization under the Fisheries Act. Additional details will be included in the final monitoring plan beyond what is presented in this section; however, the intent of this outline is to provide DFO and KIA with a framework for a comprehensive monitoring program of similar qualities to a well-designed experimental research program. The intention is also to provide sufficient background information to support discussions during upcoming engagement sessions planned with the DFO and KIA on the offsetting plan for the Back River Project.

The proposed methodology and criteria for monitoring the Bernard Harbour offsetting option will consider Traditional Knowledge and will be selected to best evaluate the success of the offsetting measure, specifically to confirm that the offsetting measure has been effective in counterbalancing the residual serious harm to fish (DFO 2013a,b). Monitoring may include two types: functional monitoring (e.g., physical conditions of low-flow channels), and effectiveness monitoring (e.g., migration success rate)

(Smokorowski et al. 2015). A multi-year monitoring effort will also be implemented (see Table 7.4-2) with considerations of lessons learned during previous monitoring years. During any given year, monitoring will be adaptable to reflect the seasonal timing of migration (e.g., related to trends in seasonal flows), and inter-year variability in the Arctic Char migration. For example, an unusually wet (i.e., high flow) or late spring may warrant a monitoring period that extends into late July or August.

Monitoring metrics or indicators will be selected to demonstrate that the offsetting objectives have been achieved, where a goal of monitoring will be to demonstrate that fish production follows a projected trajectory of cumulative gains that will eventually exceed cumulative losses. Data collection will be similar to methods outlined for the 2014 baseline monitoring study, and will be consistent across years and phases of the offsetting plan, where possible, to allow for a reliable assessment of gains.

Functional monitoring may include data on the physical integrity of the remediated sections of the creek under spring and summer conditions. Measurements may include depths, channels widths, composition of streambed substrate, and channel stability, and would be at both remediated and non-remediated (reference) sections of the creek. Sabina and the Kugluktuk HTO will also conduct annual observational monitoring (e.g., inspections of signs of erosion, sedimentation) and address any minor maintenance problems, if needed, working with community members throughout the monitoring period. Activities will include qualitative visual assessments and photographs of the remediated sections of the creek. Inspection reports will be submitted to DFO by December 31 of any given year that observation monitoring is carried out.

It is expected that detailed habitat measurements (functional monitoring) will be collected concurrently with monitoring of the Arctic Char run (effectiveness monitoring), which would include a tagging program to monitor movements of char in Nulahugyuk Creek, and a two-way trap-net installed at the mouth of the creek to monitor the upstream and downstream migrations. It is also expected that the primary focus of the effectiveness monitoring will be on upstream migration success and survival of migrating adults to confirm the assumptions of the biomass model. Collection of data on run size for the three migration types will also be incorporated into the monitoring plan; results of which will contribute to an understanding of self-sustaining properties of the offset, but not necessarily be linked to a quantitative target for determining effectiveness. Monitoring reports will be submitted to DFO by December 31 of any given year that monitoring is carried out.

Following each year of monitoring, the success of both monitoring efforts and the offsetting measure will be evaluated and discussed in the monitoring report. It may be determined that additional efforts are required to describe seasonal fish-use of Nulahugyuk Creek in subsequent years (e.g., monitoring movements that may occur in late summer), which would only demonstrate additional gains for the offsetting option. Also, at any point within the monitoring period should it be determined that the performance of the project is not meeting expectations, either through channel design modifications not providing passage, insufficient flow conditions or lack of fish utilization, alternate channel design options or additional habitat enhancements will be investigated and applied, if appropriate, in order to meet the expectations under DFO's Policy (DFO 2013a,b). If it is determined by Sabina, in consultation with the KIA and DFO, that the proposed offsetting project may not meet the offsetting objectives for the Back River Project, an alternate project will be explored and implemented, if necessary, to achieve the offsetting commitments for fisheries losses at the Back River Project.

7.5 CONTINGENCIES

Sabina will evaluate the success of the offsetting option after each year of monitoring to determine if the proposed offsetting project is performing to expectations within the specific timeframe of the project. At any point within the monitoring period, should it be determined that the performance of the offsetting option is not meeting expectations, either through channel design modifications not providing passage, insufficient flow conditions or lack of fish utilization, alternate channel design options or additional habitat enhancements will be investigated and applied, if appropriate, in order to improve the performance of the offsetting option to meet the expectations under DFO's Policy (DFO 2013a,b). If it is determined by Sabina, in consultation with DFO, that the proposed offsetting project will not meet the offsetting objectives for the Back River Project, an alternate offsetting option will be identified and implemented, with an associated monitoring plan, to achieve the offsetting commitments for fisheries losses at the Project. Other contingencies may include those listed in the Draft Conceptual Fish Offsetting Plan (DEIS Volume 10, Chapter 21), for example, the Canyon Lake Berm Option and Bathurst Lake Arctic Char Passage Option. For additional information on those contingency options, see DEIS Volume 10, Chapter 21, Section 3.2.

8. Complementary Measures

In remote areas where there are low levels of human development, such as the Canadian Arctic, there are not only limited opportunities for offsetting fisheries productivity losses, but there is also a general lack of knowledge on fisheries populations beyond that generated from baseline monitoring programs. Thus, an investment in data collection and scientific research may also be considered as a Complementary Measure for an offsetting plan when it takes into account the guiding principles outlined in the Fisheries Productivity Investment Policy. Research must relate to improving the state of knowledge around maintaining or enhancing the productivity of commercial, recreational, or Aboriginal fisheries to be considered as a Complementary Measure. A suite of Complementary Measures for the Back River Project will be considered. As Complementary Measures, the research investments may contribute up to 10% of gains to offset losses and reduce uncertainty associated with predicted gains from the offset option.

8.1 FISH-OUT LIFE HISTORY DATABASE

As described for the Conceptual Fish-Out Plan (FEIS Addendum Chapter 31), the fish out of Llama and Umwelt lakes will follow the sampling framework and protocols described in DFO's General Fish-Out Protocol (Tyson et al. 2011). Under DFO's protocol, life history information (i.e., lengths and weights) on all fish and species in Llama and Umwelt lakes will be collected. Laboratory analyses will be performed on a subset of captured fish. Aging structures will be collected and analyzed from a subset of captured species (e.g., Lake Trout) to characterize the age structure and growth characteristics of populations. Tissue samples (e.g., muscle) from a subset of captured species will also be collected and prepared for analyses of metal concentrations at an accredited laboratory. The combined dataset on life history, population, and environmental variables will then be provided to DFO, contributing to a regional fisheries database on lakes in Nunavut.

The proposed level and type of data collection follows DFO's General Fish-Out Protocol and is in support of the development of a regional database for managing fisheries in Arctic lakes. This level of effort is in excess of what would otherwise be required in support of a fish-out program; therefore, this work qualifies for consideration as a Complementary Measure for the Back River offsetting plan. This Complementary Measure will represent an important contribution to fisheries science and the management of stocks of fish species in the region. The details on data collection and reporting will be confirmed in the Final Fish-Out Plan.

8.2 BERNARD HARBOUR TK STUDY

As noted previously, a TK study was conducted in 2014-2015 in an effort to develop a better understanding of the Arctic Char fishery in the Bernard Harbour area (and related historic and contemporary environmental conditions). The TK study was carried out by Sabina in partnership with the Kugluktuk HTO and was intended to complement the scientific baseline studies that have also been conducted for the Bernard Harbour remediation project. The TK study involved one-on-one interviews with 11 Bernard Harbour land users from Kugluktuk and Cambridge Bay, who were selected by the Kugluktuk HTO for inclusion in the study. The TK study also made use of various secondary sources (e.g., historic records, land use reports, academic publications) and a Bernard Harbour site visit to provide additional information on the Arctic Char fishery. The TK study was led by a qualified social scientist using proven qualitative TK research methods. Further information on the TK study can be found in Section 2.1.3., while a copy of the TK study report can be found in Appendix V3-3D of Sabina's FEIS.

Considering the remote, pristine area of Bernard Harbour and the lack of existing scientific information and documented TK on the local Arctic Char fishery, Sabina considers the Bernard Harbour TK study a Complementary Measure. For one, the TK study provides a significant amount of new environmental baseline information related to the Arctic Char fishery at Bernard Harbour. This includes information on Arctic Char harvesting, migration, spawning, health, response to changing environmental conditions, and other topics. This information will be useful for assessing the relative success of any future remediation activities that are undertaken at Bernard Harbour, while helping to address existing knowledge gaps related to the management and conservation of the Arctic Char fishery in the Coronation Gulf. Second, the TK study describes recent environmental changes observed by Inuit in the area and the negative implications these changes have had on the Arctic Char fishery in the region. This highlights the potential benefit stream remediation activities may have on the Arctic Char population at Bernard Harbour, while also contributing to the growing literature on environmental change in the Canadian Arctic.

The TK study also presents detailed information on an area of historic and contemporary importance to Inuit, and on a species readily harvested by Inuit (i.e., Arctic Char). The contributions the TK study makes to the local historic and cultural record are thus notable. Finally, the TK study demonstrates how the proposed approach to stream remediation (i.e., using low-impact stream channel manipulation methods) is grounded in historic Aboriginal fisheries management strategies that have been used at Bernard Harbour (i.e., seasonal stream channel manipulation and rock weir construction). This 'made in the north' approach represents a unique opportunity for fisheries offsetting and community benefits to be realized simultaneously, while also serving as a potential model for future project proponents.

While the results of the TK study are to remain the property of the Kugluktuk HTO, the data and results of the study are intended to be freely shared with other Nunavut organizations that may benefit from its use (as per the terms of the Bernard Harbour Restoration Project Agreement Between: The Kugluktuk Hunters and Trappers Organization and Sabina Gold & Silver Corp. signed by both parties in June 2014). For example, the KIA has been provided with copies of the data obtained from the TK study, so that it may be incorporated into their NTKP database. As noted by the KIA (2012), the NTKP is the foundation for recorded and geo-referenced Inuit TK in the western Kitikmeot Region. The NTKP covers Inuit land use, and fish and wildlife ecological data within a 750,000 km^2 study area, the Slave Geological Province. As well as being a repository of Kitikmeot Inuit TK, the NTKP was designed as a land-use planning tool, designed to inform and improve the quality of environmental assessments for proposed developments in the Kitikmeot Region.

8.3 ARCTIC CHAR MOVEMENT STUDY

Research on the migratory movements of Arctic Char was conducted in 2014 in an effort to develop a better understanding of the ecology of Arctic Char at Bernard Harbour (i.e., the Nulahugyuk Creek-Hingittok Lake system). The research was carried out by Sabina in partnership with the Kugluktuk HTO and was intended to supplement previously completed scientific baseline studies at Bernard Harbour. It is expected that the Arctic Char movement studies will continue as part of a complementary measure when monitoring the Bernard Harbour Offsetting Option into the future.

The research will address questions on how Arctic Char move within Nulahugyuk Creek, and on where Arctic Char from Bernard Harbour move within the broader region of the Coronation Gulf. The first question is being addressed by quantifying upstream movements for the duration of the migration period for a subset of capture Arctic Char using implanted PIT tags and Radio Frequency Identification (RFID) antenna-reader arrays installed at strategic locations on the creek. In 2014, a total of 315 upstream migrating adult char were implanted with PIT tags, each of which has a unique identification number that can be tracked by a handheld reader or remotely deployed antennae-reader array. Seven PIT-tag antennae-reader arrays were installed strategically in relation to the location of the 2012 low-flow channel project areas and reference sections to monitor the speeds and rates of successful passage across a range of conditions in the creek. An antennae-reader array was also installed near the outlet of Hingittok Lake to quantify the rate of successful upstream passage from the mouth of Nulahugyuk Creek to the spawning lake. Further information on the results of the PIT-tagging study completed in 2014 can be found in Section 7.3.2.3.

A Floy-tag program was also initiated in 2014 and included the use of external (Floy) tags for a subset of adult char moving downstream from Hingittok Lake such that char captured by local community members (e.g., later in the season in the Coppermine River) could be identified as individuals originating from Bernard Harbour. The external tags were implanted through the dorsal surface of the char lateral to the dorsal fin. The tags were orange, and each tag had a visible identification number for tracking the fish. A total of 475 adult char captured moving downstream were implanted with Floy tags. Resulting data from recaptures by domestic and recreational anglers, as well as future research teams, will be collected over time through tag return programs initiated by Sabina and the Kugluktuk HTO. This program will contribute valuable information on 'large-scale' movements of Arctic Char in the Coronation Gulf, and possibly the location of overwintering sites. Data collection is ongoing and the analysis of the return information will supplement the information collected on 'small-scale movements' of Arctic Char in Nulahugyuk Creek.

Considering the remote, pristine area that Bernard Harbour is located in and the lack of existing scientific information on the local Arctic Char fishery, Sabina considers information generated from the Arctic Char movement study a Complementary Measure. The study will provide a significant amount of new environmental baseline information related to the migratory ecology of Arctic Char, an area of fisheries science where there is currently a paucity of data to support any new management or conservation initiatives. This includes information on Arctic Char migration speeds, migration survival, environmental factors that influence the migration of Arctic Char, and the distribution or home ranges of Arctic Char from Bernard Harbour. This information will be useful for assessing the relative success of any future remediation activities that are undertaken at Bernard Harbour, while helping to address existing knowledge gaps related to the management and conservation of the Arctic Char fishery in the Coronation Gulf.

9. Summary

The purpose of this Conceptual Fish Offsetting Plan is to summarize anticipated serious harm to fish based on the assessment provided in the Final Impact Statement (FEIS), and to describe the offsetting option to counterbalance the unavoidable serious harm to fish, as defined in the *Fisheries Act*. The plan was constructed as per the guiding policies of Fisheries and Oceans Canada (DFO), with the goal of maintaining or improving the productivity of the commercial, recreational, or Aboriginal (CRA) fishery. In addition to the offsetting plan, a number of mitigation measures will be in place for the Back River Project (Project) to avoid or minimize the potential effects on the productivity of the CRA fishery. These mitigation measures will be supplemented by the use of adaptive management, as required. For any lakes that are lost as a result of the Project (i.e., Umwelt and Llama lakes), a fish-out will be conducted (FEIS Addendum Chapter 31) and will offer an opportunity to gather information on lake productivity and the fish community, as well as avoid any “wastage” by making the fish available for traditional use by local communities.

The Conceptual Fish Offsetting Plan for the Project is the result of continued community and regulatory engagement associated with the Project. The outcome of engagement activities developed an offsetting measure or option focused on improving the productivity of an Arctic Char fishery at Bernard Harbour (i.e., the Hingittok Lake-Nulahugyuk Creek system), located approximately 100 km directly north of the hamlet of Kugluktuk, Nunavut, along the south coast of the Dolphin and Union Strait. Bernard Harbour was once the site of a traditional domestic fishery for Arctic Char.

Developing a remediation plan for Bernard Harbour was first discussed in response to reports by local harvesters in the 1990s that the traditional fishery was in decline. Follow-up investigations concluded that conditions of the creek may be deteriorating because of natural causes (e.g., changes in climate, resulting in low water depths, and boulder barriers), affecting the upstream migration success of adult Arctic Char to spawning areas in Hingittok Lake. These early investigations also provided evidence that migration conditions could be remediated at problem locations by creating low-flow channels using low-impact construction methods.

During 2014 to 2015, a Traditional Knowledge study combined with environmental monitoring provided a better understanding of the Arctic char fishery at Bernard Harbour (and related historic and contemporary environmental conditions). The baseline studies, all of which included Kugluktuk Hunters and Trappers Organization as full partners, demonstrated how the proposed approach to stream remediation is grounded in historic Aboriginal fisheries management strategies that have been used at Bernard Harbour (i.e., seasonal stream channel manipulation and rock weir construction). This ‘made in the north’ approach represents a unique opportunity for fisheries offsetting and community benefits to be realized simultaneously. To estimate the potential benefits of the offsetting option to fisheries biomass production (as a surrogate of fisheries productivity), post-remediation changes in migration success were estimated and then related to changes in the biomass of adult Arctic Char in Nulahugyuk Creek. The predicted gains in biomass following remediation may be substantial, magnifying over time when offspring return as adults (by offsetting year 8 or 9). It is also predicted that gains in biomass at Bernard Harbour will exceed losses in fisheries production resulting from temporary drawdowns of small lakes (Llama and Umwelt lakes), and related infrastructure (e.g., Tailings Storage Facility) at the Goose Property Area.

The magnitude of the difference in predicted gains versus losses is substantial providing confidence that equivalency can be achieved for the Bernard Harbour offsetting option, a determination that will ultimately be made by DFO during the permitting stage of the Back River Project (DFO 2013a, b). As part of the offsetting plan, a robust monitoring framework over a 10-year period will be implemented, and will address the inherit challenges of monitoring in a remote setting and unpredictable environment. The monitoring plan will include post-remediation monitoring and reporting of the offsetting measures for a period sufficient to allow for the benefit of the offsetting measures to be effectively evaluated. Sabina is also committed to actively involve the KIA in evaluating early outcomes from monitoring (as per commitment KIA-08), and is committed to actively involve the KIA in the adaptive management of the offsetting plan and monitoring plan (as per commitment KIA-07).

The Conceptual Fish Offsetting Plan will be finalized and presented as a Final Fish Offsetting Plan during the permitting phase of the Project and submitted as part of the Application for Authorization under the *Fisheries Act*. Sabina will continue to work with DFO, and the impacted communities through this regulatory approval stage to develop the final offsetting plan, as per commitments DFO-C2 and KIA-06. The final plan will be based on feedback from both the KIA and DFO and would ultimately be approved by DFO as a condition of the Authorization required for the development of the Back River Project.

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Appendix A: Bernard Harbour Restoration Project Agreement Between: The Kugluktuk Hunters and Trappers Organization and Sabina Gold & Silver Corp.

BERNARD HARBOUR RESTORATION PROJECT

AGREEMENT BETWEEN:
THE KUGLUKTUK HUNTERS AND TRAPPERS ORGANIZATION AND
SABINA GOLD & SILVER CORP.

Purpose of the Agreement:

The purpose of this Agreement is to outline the relationship between the Kugluktuk Hunters and Trappers Organization (HTO) and Sabina Gold & Silver Corp. (Sabina) in executing the Bernard Harbour Restoration Project.

Background:

Stream restoration activities in the Nulahugyuk Creek - Hingittok Lake area (also known as Bernard Harbour) were initially proposed in the early 2000s by the Kugluktuk HTO. These activities were proposed with the goal of restoring a traditional Inuit Arctic char fishery, which has suffered from significant harvesting declines in recent years. The Kugluktuk HTO has worked closely with Golder Associates (Golder) to advance early stages of the project (e.g. initial environmental baseline and stream restoration work), and the two have recently applied to the Canadian Northern Economic Development Agency (CanNor) for additional project funding. The two organizations have also been seeking an industry partner to help advance the project to completion. Sabina has now been identified as this industry partner, who will support stream restoration work in the Nulahugyuk Creek - Hingittok Lake area in order to satisfy Fisheries Act offsetting requirements for its Back River Project while supporting the desires of the Kugluktuk HTO and the community members of Kugluktuk.

Objectives of the Agreement:

There are two primary objectives of this agreement:

1. ***Short term objective (2-3 years)***: To enable Sabina to satisfy a Department of Fisheries and Oceans (DFO) requirement to offset fisheries habitat effects at the Back River Project. This objective would be achieved by improving the viability of the Nulahugyuk Creek - Hingittok Lake traditional Arctic char fishery. To the greatest extent practicable, local community members will be involved throughout the process to help support this objective. Selected local high school students will also be involved in the project where possible, so that skills and knowledge may be transferred to them.

2. ***Long term objective (3+ years)***: To enable the Kugluktuk HTO and Sabina to restore a historic, locally-utilized Arctic char fishery, for the benefit of Kugluktuk residents. This will be accomplished, in part, by the provision of resources and training by Sabina.

Structure of the Relationship between the Kugluktuk HTO and Sabina:

The Bernard Harbour Restoration Project is envisioned as a partnership between the Kugluktuk HTO and Sabina. This partnership will be structured in the following ways:

- The Bernard Harbour Restoration Project is to remain a Kugluktuk HTO-led initiative. Sabina will support the Kugluktuk HTO in achieving their objectives for the Bernard Harbour Restoration Project, but control and ownership of the project will ultimately reside with the Kugluktuk HTO.
- A Traditional Knowledge (TK) study on the Arctic char fishery in the Nulahugyuk Creek - Hingittok Lake area (see following section) will be conducted to support the objectives of this agreement. This study will be coordinated and executed by Sabina, although the Kugluktuk HTO will remain the owners of all TK data that is collected and reports that are issued. The Kugluktuk HTO and Sabina are currently exploring options for the funding of this TK study. In the event third party funding cannot be obtained, Sabina will provide all necessary resources for the TK study to be completed.
- Environmental baseline work, stream restoration work, and DFO-required follow-up monitoring and reporting will all be funded by Sabina. However, these particular work areas will be coordinated and executed by Golder (or other similar consultant), who will act as the Kugluktuk HTO / Sabina representative onsite at Bernard Harbour.
- The Bernard Harbour Restoration Project will, to the greatest extent practicable, provide opportunities for the involvement of summer students hired by the Kugluktuk HTO.
- Once the Bernard Harbour Restoration Project's short term objective has been met (see above), Sabina intends to phase-out its involvement in the project. In the long-term, full management of this project will be turned over to the Kugluktuk HTO. The timing of this phase-out will be determined in consultation with DFO, Sabina, the Kugluktuk HTO, and possibly other organizations like the KIA. As a rough estimate, this phase-out would likely occur 3 years after all stream restoration work has been completed (e.g. 4-6 years after the signing of this agreement).
- Sabina acknowledges the Kugluktuk HTO's strong desire to learn the skills and knowledge necessary in order to manage all future stream restoration and monitoring work themselves. Sabina will work with the Kugluktuk HTO to provide this training and will help develop a management plan/document and workshop that addresses these objectives.

Traditional Knowledge Study

In an effort to develop a better appreciation of historic and contemporary environmental conditions in the Nulahugyuk Creek - Hingittok Lake area, a TK study will be conducted. While additional details on the TK study are included in the TK study proposal document that was shared with the Kugluktuk HTO in early April 2014 (see Appendix A), the following points are of particular relevance to this Agreement:

- All TK data and reports that result from the TK study will be owned by the Kugluktuk HTO. However, all TK data collection, analysis, and reporting activities will be conducted by Sabina on behalf of the HTO.
- Opportunities for youth involvement in the TK study (e.g. as research assistants) will be investigated on an ongoing basis.
- All TK data and reports that result from the TK study will be made available to the Kitikmeot Inuit Association (KIA) for inclusion in their Naonaiyaotit Traditional Knowledge Project (NTKP) database, with the

understanding the KIA may utilize and distribute this data and information for their own purposes. The data and results of the TK study are also intended to be freely shared with other Nunavut organizations that may benefit from its use.

- Sabina reserves the right to publish the final TK study report in the Back River Project Final Environmental Impact Statement (FEIS) and / or in other regulatory submissions. TK study results may also be presented by Sabina and / or its representatives in other public forums (e.g. conferences, company publications and presentations).

<u>Implementation Schedule</u>

This Agreement will be implemented over three periods:

1. ***2014 - 2015***
    - TK study (to be conducted by Sabina in Kugluktuk)
        - Potential Bernard Harbour site visit with selected TK study participants
    - Baseline fieldwork (to be conducted by Golder at Bernard Harbour)
        - Potential Bernard Harbour site visit with partners and DFO
2. ***2015 - 2016***
    - Fisheries offsetting plan to be drafted by Golder for Sabina's FEIS (submission of this plan will initiate the DFO approval process)
3. ***Future considerations***
    - Conduct stream restoration work, pending DFO approval of offsetting plan. This work will include:
        - Identifying main stream channels
        - Removal of fish passage barriers
        - Relocation of in-stream boulders to create low-flow channels
    - Project monitoring requirements to be determined in consultation with DFO; Sabina will follow all monitoring requirements as set out by DFO
    - At this time, it is expected that monitoring programs will be conducted by Sabina (or a consultant) at *Year 1* and *Year 7* following initial stream restoration activities. Sabina will also negotiate appropriate funding with the Kugluktuk HTO, so that interim monitoring activities (i.e. monitoring during the years when Sabina / a consultant are not present) can be conducted directly by the Kugluktuk HTO. Longer-term funding arrangements may also need to be arranged in the future.
    - Sabina to eventually phase out corporate involvement in Bernard Harbour Restoration Project; role of HTO in long-term management of stream restoration activities to be determined in consultation with DFO and Sabina.

<u>Duration of the Agreement</u>

This Agreement will be effective as of the signing date in the Endorsement section below. The initial term of this Agreement will be for two years, but the Agreement will be subject to renewal after this time. During the two years of this initial Agreement a number of tasks will be completed by Sabina to better define long-term project requirements. These will include:

- Collection of baseline data.
- Analysis of baseline data and development of plans in Sabina's Final Environmental Impact Statement (FEIS) to determine specifically what will be required for Sabina to meet its fisheries offsetting obligations.
- Finalization of fisheries offsetting terms and conditions with DFO (Note: project plans may change somewhat as a result of this process).

Upon completion of this initial two-year Agreement, it is anticipated that Sabina and the Kugluktuk HTO will negotiate a new, longer-term project agreement.

Endorsement

The following parties endorse this agreement:

For the Kugluktuk Hunters and Trappers Organization:
David Nivingalok
Chairperson
Kugluktuk Hunters and Trappers Organization
P.O. Box 309
Kugluktuk, Nunavut, X0B 0E0
kugluktukhto@qiniq.com

Signature________________________ Date June 5/2014

For Sabina Gold & Silver Corp.:
Matthew Pickard
Vice President, Environment & Sustainability
Sabina Gold & Silver Corp.
202 - 930 West First Street
North Vancouver, British Columbia, V7P 3N4
mpickard@sabinagoldsilver.com

Signature________________________ Date June 3, 2014