North American Tungsten Corporation Ltd.

ISSUED FOR CLIENT REVIEW

MACTUNG PROJECT

2007 ENVIRONMENTAL BASELINE STUDIES
FISHERIES AND AQUATIC RESOURCES

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EXECUTIVE SUMMARY

North American Tungsten Corporation Ltd. retained EBA Engineering Consultants Ltd. (EBA) to conduct baseline environmental studies at their MacTung site, Yukon, to update and expand the existing baseline information that exists for this area. Studies were conducted at this site by EBA in both 2006 and 2007. The objectives of the 2007 survey were to supplement the 2006 fisheries habitat data, to record inter-year variations, and to conduct a more intensive fish sampling program in order to delineate the presence and distribution of fish within the project area.

Fisheries and aquatic sampling was conducted at 11 stations within the study area between August 14, 2007 and August 18, 2007. In the Yukon, 5 sites were sampled on Tributary C (FS6 and FS10), Tributary A (FS7), and the Hess River (FS8 and FS9). In the NWT, a total of 5 stations were sampled on Dale Creek (FS1, FS5, and FS11), the Tsichu River (FS3), and Cirque Creek (FS2). Additionally, fish sampling was conducted in a downstream portion of the Tsichu River. Sampling included fish sampling by electrofishing, macroinvertebrate sampling by Hess sampler, and the sampling of water quality attributes.

In the Yukon streams sampled, Tributary C was found to support a dwarf population of dolly varden, and provides excellent overall fish habitat quality. The benthic invertebrate community in Dale Creek was diverse and abundant, and water quality attributes were favourable.

Although Tributary A was found to have some good fish potential habitat attributes, no fish were observed or captured, and the benthic community at this site was found to be sparse and simple. This watercourse appears to be at least seasonally unsuitable for fish usage due to poor water quality.

The Hess River was found to provide suitable habitat and water quality attributes, and to support dolly varden, Arctic grayling, and slimy sculpin. Generally, the fisheries value of this river was found to be excellent, although the river did exhibit lower habitat quality downstream of its confluence with Tributary A, due to the influence of water from that watercourse

In the NWT, Dale Creek was found to support both bull trout and slimy sculpin, and was found to provide excellent overall fish habitat availability. The benthic invertebrate community in Dale Creek was diverse and abundant, and water quality attributes were favourable.

At the lower Tsichu River, poor invertebrate abundance and diversity, and only moderate quality fish habitat were observed. No fish were captured from either fisheries sampling location on this river. This watercourse appears to be at least seasonally unsuitable to fish, apparently due to poor water quality.

Cirque creek was found to have suitable benthic community and water quality, but was not found to support fish. A lack of over-wintering habitat and barriers at the upstream and downstream ends are believed to restrict usage by fish..

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1.0 INTRODUCTION

North American Tungsten Corporation Ltd. (NATCL) is considering the development of a world-class tungsten deposit located near MacMillan Pass, near the border between the Yukon and Northwest Territories (NWT) (Figure 1). The mine site is located in Yukon at an elevation of 1,725-1,800 m a.s.l .in the Selwyn Mountains. North American Tungsten Corporation Ltd. retained EBA Engineering Consultants Ltd. (EBA) to conduct baseline environmental studies at their MacTung site, in order to update and expand the existing baseline information that exists for this area. Studies were conducted at this site by EBA in both 2006 and 2007.

2.0 ENVIRONMENTAL SETTING

2.1 STUDY AREA

The MacTung study area is located approximately 175 km northeast of the town of Ross River, Yukon. The centre of the project site is located in Yukon near the continental divide in a high pass area that straddles the Stewart watershed (Yukon River drainage) and the Central Mackenzie Blackwater Lake watershed (Arctic drainage). A number of small, first order tributaries originate on the site, and lead downstream to both east and west slopes. The corresponding primary watercourses fed from these tributaries are the Hess River (Yukon side) and the Tsichu/Peel River (NWT side).

Climatic conditions within this study area vary with elevation, but are typical of subalpine and alpine environments. Valleys on the Yukon side are well vegetated below the tree line, having varying cover of spruce, subalpine fir, willow, and dwarf birches. The NWT side of the project area is treeless, and is dominated by willow and dwarf birch shrub communities.

2.1.1 Water Quality

Water quality conditions collected in studies previous to 2006 determined the overall quality at the site to be good, with higher metals concentrations in the lower Tsichu River (EBA 2007a, AMAX 1983). Several headwater areas were identified as being influenced by acid rock drainage, including the upper Tsichu River. Water quality studies performed recently by EBA (2007b) confirmed these conditions in both the Tsichu River and Tributary A (Yukon drainage). In these two watercourses, metals concentrations are elevated, including magnesium, aluminium, iron, and zinc (EBA 2007b). This effect is particularly distinct through late summer and fall, when the relative contribution of affected groundwater is greater due to reduced seasonal surface runoff of cleaner water.

2.1.2 Benthic Invertebrates

The benthic macroinvertebrate community data from previous studies (summarized by EBA, 2007a) found most communities to be dominated by Diptera and Plecoptera, in order

of abundance. The Tsichu River was found to support a lower abundance and diversity of organisms. These general trends were also observed in 2006 baseline studies. In the Yukon drainage, both Tributary C and the upper Hess River were found to support a high abundance and diversity of organisms, while the community of Tributary A was simple and sparse (EBA 2007a).

2.1.3 Fish

Prior studies in the MacTung area between 1977 and 1981 found Arctic grayling, bull trout, mountain whitefish, and burbot in Dale Creek. Additionally, lake trout were recorded in the Tsichu River (AMAX 1983). During the 2006 fisheries studies by EBA, no fish were observed or captured from these NWT tributaries. In Yukon drainages, fish were only observed in the Hess River (only slimy sculpin).

3.0 2007 MACTUNG FISHERIES AND AQUATIC RESOURCES SCOPE

The purpose of the 2007 MacTung Fisheries and Aquatic Resources Studies was to update and expand data collected during the 2006 baseline studies in the study area. The 2006 Fisheries and Aquatic Resources Studies provided a comprehensive assessment of fish habitat conditions and values within the primary tributary watercourses in the study area (EBA 2007a). However, due to high water levels at the time of the 2006 summer field assessments, only limited information regarding the distribution and abundance of fish species within the study area could be collected.

The following study components were undertaken in 2007 to expand on existing baseline information from 2006, including:

Biological Sampling

- Determination of fish presence/absence through backpack electrofishing.
- Collection of an additional year of benthic macroinvertebrate data.

Fish Habitat Assessment

- Further assessment of barriers to fish passage at lower water levels.
- Assessment of habitat values in additional tributary reaches within the study area.

Physical Water Quality

- Expansion of the existing water quality data during new flow levels, and in additional reaches.

3.1 SAMPLING LOCATIONS

The following 11 sites, depicted in Figure 2, were sampled during the 2007 MacTung Fisheries and Aquatics Field program:

Yukon Territory

- Resampling of the Upper Hess River (FS8) and Lower Hess River (FS9).
- Resampling of Tributary A, upstream from the confluence with the Hess River (FS7).
- Sampling of two sites on Tributary C (main tributary flowing from the proposed mine site), including a site adjacent to that sampled in 2006 (FS6) and a site in the upstream reaches of this watercourse (FS10).

Northwest Territories

- Resampling of Dale Creek (FS1) and Lower Dale Creek (FS5), sampling of a new site at Upper Dale Creek (FS11).
- Resampling of the Lower Tsichu River (FS3) and sampling of a new site further downstream at the Tsichu River.
- Resampling of Cirque Creek (FS2).

4.0 METHODS

The summer 2007 fisheries and aquatic field sampling program was conducted from August 14 to August 18, 2007. This program was conducted by EBA's Chris Jastrebski (M.Sc., R.P.Bio.), with the assistance of Karla Langois (B.Sc., P.Biol.) and Glenn Rudman (M.Sc). Mr. Rick Hoos (M.Sc, R.P.Bio.) provided supervision and review for the project. The field program was comprised of the following components:

4.1 FISH SAMPLING

A fish inventory was conducted at all sites using a Smith Root LR-24 backpack electrofishing unit (Photograph 1). Sampling occurred using an operator and netter, and always proceeded in an upstream direction in order to not disturb or displace fish ahead of sampling. Each time, the effort (number of seconds), duty cycle, voltage, frequency, and pulse were recorded, and the distance fished was recorded with a GPS unit. At Station FS9 (Lower Hess River), the current was too strong to fish in the main channel, so electrofishing had to be conducted from the edge of the channel, and in adjacent side-channels. At several locations, a modified pole net was used to capture fish downstream of the electrofishing unit (Photograph 2).

Methodologies used were consistent with the Stream Survey Field Guide published by the DFO and BC MOE Fish and Fish Habitat Inventory and Information Program (1989), and by the BC Fish and Fish Habitat Inventory Standards and Procedures published by the Resource Inventory Committee (RIC 1988). All fish sampling was conducted under the authority of scientific collection permits issued by the Yukon Territory DFO (# CL-07-03)

and by the Northwest Territories (# S07-08-2032-HR). Permits are attached in Appendices A and B.

4.2 BENTHIC SAMPLING

Benthic sampling was conducted at all repeated fisheries stations. Sampling was conducted using a Hess substrate invertebrate sampler with an area of 0.086 m^2 and 363 µm mesh size. The sampler was inserted into the substrate to a depth of ~ 10 cm, and the substrate was washed for 5 minutes (RIC 1997; Photograph 3). Contents were preserved on site in 80% Ethanol solution for taxonomic analysis. At each site, 3 replicate stations with similar flow, depth and substrate characteristics were sampled moving in an upstream direction (each spaced a minimum of 2 m from the previous).

Preserved samples were identified and enumerated by Sue P. Salter, R.P.Bio. of Cordillera Consulting, the same taxonomist that identified 2006 samples from the same sites. The guidelines used for taxonomic analysis were those provided in the MMER Guidance Document for Aquatic Environmental Effects Monitoring (Environment Canada 2002). Re-sorts were conducted of the sub-samples, thus effectively achieving a Quality Control check on approximately 10% of the samples, as specified in the MMER Guidance Document.

Simpson's Diversity Index was used as a measure of taxonomic diversity in the samples. This index takes into account both the richness and abundance of the invertebrate community, by determining the relative mean contribution of individuals to the site total. The index ranges from 0 to 1, representing low to high diversity, respectively.

4.3 HABITAT CHARACTERIZATION

Some additional characterization of fish habitat was conducted at the fisheries stations in 2007, to document changes in habitat in relation to differences in discharge between 2006 and 2007 (natural variability), and to characterize additional sites that were added in 2007. Characterization followed aspects of the Reconaissance (1:20,000) Fish and Fish Habitat Inventory Standards and Procedures (Stream Surveys) (RIC 1998), as well as the Guide to the Code of Practice for Watercourse Crossings (Alberta Environment 2001).

At each site, a cross channel transect was established at a representative location to record wetted width, bankfull width, depth profile, bank characteristics, as well as the substrate composition. Within each representative reach, the distribution of habitat units (e.g. riffle, pool, run, cascade, etc.) was recorded. Additionally, the amount and composition of fish habitat cover components were recorded, including instream and overstream vegetation, undercut banks, woody debris, deep or turbulent water, etc. Finally, each site was assessed for habitat quality in relation to key potential fish species and life history functions (e.g. spawning, migration, over-wintering, and nursery/feeding habitats).

4.4 PHYSICAL WATER QUALITY

At each site, key physical water quality measurements were recorded. Dissolved oxygen and temperature were recorded using a YSI 556 dissolved oxygen meter. Turbidity was measured using a Hanna HI98703 turbidity meter, and pH using a Hanna HI98127 water quality pen.

4.5 DESCRIPTION OF BARRIERS TO FISH PASSAGE

A reconnaissance and inventory of potential or presumed barriers to upstream fish passage was conducted in conjunction with fisheries sampling in 2007. This reconnaissance was intended to assess the potential upstream limits of fish direct habitat usage in the two primary drainages associated with the MacTung Project, Dale Creek and Tributary C.

4.6 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Strict QA/QC procedures were adhered to during field sampling. All sampling methodologies followed accepted professional standards and practices.

4.6.1 Field Procedures

The following QA/QC procedures were employed to maintain data quality in the fisheries and aquatic sampling program in 2007, as adapted by Environment Canada (1993):

- All personnel involved in the field procedures were qualified for the tasks and work undertaken, and were supervised by a qualified Professional Biologist (R.P.Bio.);
- All sampling was consistent throughout the program;
- All samples were collected following the most appropriate method and sample quality was maintained to the highest standard;
- Sampling equipment was the most appropriate for the particular habitat, and was in good working order;
- All samples were labelled appropriately with the site reference, date collected, and sample type;
- All samples were appropriately preserved, where necessary;
- Field personnel maintained detailed field notes for future reference, and,
- Field personnel followed appropriate safety guidelines for conducting fieldwork and ensured all samples were shipped in the appropriate containers following applicable shipping guidelines.

5.0 RESULTS

5.1 2007 SAMPLING OVERVIEW

In total, 11 sites were visited during the 2007 fish and aquatics baseline study program. All sites visited in 2006 were revisited, with the exception of FS4 (upper Tsichu River), which was not sampled due to its poor water quality (iron precipitate, as described earlier), and lack of fish in the lower Tsichu River, sampled immediately downstream of FS4. The location of all fish sampling sites are shown in Figure 2, and a description of efforts and results for the 10 sites is provided below, and physical characteristics are summarized in Table 1, attached.

Overall tributary habitat values and the location of identified fish passage barriers are shown in Figure 3, and raw sampling data for fisheries and benthos are provided in Appendices C and D.

5.2 FISH AND FISH HABITAT – YUKON TERRITORY SITES

5.2.1 FS6 – Tributary C

Fish Habitat Features

Fisheries Station 6 was sampled on August 16, 2007, but had to be relocated approximately 600 m downstream from the 2006 location due to access concerns. The sampling location was still upstream from the junction between Tributary C with Tributary A (Figure 2). At the time of sampling, the wetted and channel widths were found to be 482 cm and 630 cm, respectively. The mean and maximum channel depths were 25 cm and 31 cm, with fast flow creating approximately 30% riffle habitat, 25% cascade, 25% pool, and 20% run habitats (Photographs 25 and 26). Stream substrate composition was wide-ranging, and included components from boulder to small gravels, although cobbles were frequent (Photograph 27). Stream banks were moderately vegetated (50-70% cover), ranging from 150 cm to 170 cm tall, and with slopes ranging from 45° to 65°. Fish habitat cover was considered to be good (45% coverage), consisting of surface turbulence, overstream vegetation, undercut banks, and deep water. The meandering channel did provide potentially suitable spawning, migration, nursery, and feeding habitats.

Overall, this reach of Tributary C was considered to provide excellent fish habitat potential. A wide range of complex habitat types ranging from deep pools, to riffle:pool sequences, to extensive undercut banks with woody debris structures. Additionally, crown closure was moderate, ranging from 20% to 70%. Riparian vegetation varied between stands dominated by mature spruce and willow shrub, and stands of tall willow shrub that extended over the channel. Understory was dominated by bearberry, mosses, lichens, Labrador tea, and blueberry. Physical and habitat characteristics of FS6 are summarized in Table 1, attached.

Water Quality

Water quality at FS6 was found to be suitable for fish, with dissolved oxygen of 9.15 mg/l or 79.4 % saturation, a slightly acidic pH of 6.4, and turbidity of 1.69 NTU. Readings were taken at 14:38, at a water temperature of 9.1°C (Table 1).

Fish Assessment

At FS6, approximately 500 m of channel were electrofished for 1342 seconds of effort (Table 2). Three dolly varden[1] (164 mm – 213 mm) were captured during this effort, with four additional dolly varden being observed during this time (Photograph 28). These fish were primarily found within plunge pools associated with large woody debris, or beneath extensive undercut bank areas, which were measured to extend for greater than one metre beneath the willow/moss root mat in some areas. In addition to these individuals, an assistant angled two larger dolly varden from a deep pool at the habitat sampling location. One fish was retained (272 mm), and was provided to EBA for internal sampling following removal of flesh for consumption. This individual was a mature male, entering reproductive condition at the time of capture (Photograph 29). The other individuals electrofished also demonstrated reproductive coloration at the time of sampling (Photograph 28). Full maturation at such a small size suggests that these individuals are part of a local resident dwarf dolly varden population.

5.2.2 FS7 – Tributary A

Fish Habitat Features

Fisheries Station 7, located on Tributary A, was repeat sampled on August 15, 2007. In the location sampled, the wetted channel was 1260 cm and mean depth was 26.3 cm (a different transect location than that sampled in 2006). Overall flows and volume were moderate, but reduced in comparison to 2006 sampling, as evidenced by extensive exposed point and side bars in the channel. Habitat distributions in the reach sampled consisted of primarily riffle (75%), along with run, pool and cascade habitats (Photographs 30-34). Other physical habitat features were consistent with that observed by EBA in 2006. Physical and habitat characteristics of FS11 are summarized in Table 1, attached.

Although physical habitat features appeared to be generally suitable to support fish and aquatic life, the channel at this location appeared to contain considerable iron precipitate, as in the Tsichu River. Additionally, a white substance was noted along the stream margins throughout this site. This substance appeared to be an algal growth, although it was not identified at the time of this report (Photograph 32).

[1] The fish captured in Tributary C belong to complimentary species pair, dolly varden and bull trout, for which the complete distributions are still being defined. Based on current information, it is understood that only dolly varden exist within the Yukon River drainage (Susan Thopmson, pers. comm.).

Water Quality

Water quality at FS7 was found to be suitable for fish, with dissolved oxygen of 9.71 mg/l or 80.9% saturation, a slightly acidic pH of 6.7, and turbidity of 8.84 NTU. Readings were taken at 12:35, at a water temperature of 7.5ºC (Table 1).

Fish Assessment

At FS7, approximately 280 m of the channel were electrofished for a total of 787 seconds of effort, with no fish being observed or captured (Table 2). Although habitat features appeared suitable, water quality was assumed to be a limiting factor in this reach.

5.2.3 FS8 – Upper Hess River

Fish Habitat Features

Fisheries Station 8, located on the Upper Hess River, was repeat sampled on August 16, 2007. Cross channel measurements were made at a different location than in 2006, with the wetted channel being 1900 cm, and the mean and maximum depths being 51 cm and 62 cm, respectively. Overall water levels and flows appeared be relatively consistent between 2006 and 2007 at this site. Habitat distributions in the reach sampled consisted primarily of rapid (70%), with 15% riffle and 15% pool habitats (Photographs 35-37). Other physical habitat features were consistent with that observed by EBA in 2006. Physical and habitat characteristics of FS11 are summarized in Table 1, attached.

In general, FS8 was found to provide a good distribution of habitat types, including numerous very deep pools, excellent rearing habitat in off-channel pools, as well as calm side-channels.

Water Quality

Water quality at FS8 was found to be suitable for fish, with dissolved oxygen of 9.73 mg/l or 82.3% saturation, pH of 7.2, and turbidity of 19.2 NTU. Readings were taken at 09:19, at a water temperature of 8.1ºC (Table 1).

Fish Assessment

At FS8, approximately 550 m of channel was electrofished in two separate efforts (Table 2). The first effort of 982 seconds captured 2 dolly varden (47 mm, 131 mm), 10 slimy sculpin, and 3 Arctic grayling (168mm – 228 mm)(Photographs 38 and 39). The second effort of 1723 seconds produced 1 dolly varden (91 mm), 7 slimy sculpin, and 1 Arctic grayling (307 mm). A number of additional individuals were observed during electrofishing, but not captured due to fast currents.

Within this reach of the Hess River, most dolly varden and Arctic grayling were inhabiting deep pool habitats in both the main and side channels. Sculpin tended to be in calm, off-channel segments. The capture of one juvenile dolly varden provides an indication that the Hess River likely provides suitable juvenile nursery habitat, and suitable spawning habitat (potentially further upstream).

5.2.4 FS9 – Lower Hess River

Fish Habitat Features

Fisheries Station 9, located on the Lower Hess River, was repeat sampled on August 14, 2007 (Figure 1). Cross channel measurements were not made at the site due to safety concerns, however, overall water levels and flows appeared be relatively consistent between 2006 and 2007 at this site. Habitat distributions in the reach sampled consisted primarily of run habitat (50%), with 25% riffle, 15% pool, and 10% cascade habitats (Photographs 40-42). Other physical habitat features were consistent with that observed by EBA in 2006. Physical and habitat characteristics of FS11 are summarized in Table 1, attached.

In general, FS9 was found to provide a good distribution of habitat types, including deep channel segments, excellent rearing habitat in off-channel pools, as numerous braided side channels and calm backwater areas.

Water Quality

Water quality at FS9 was found to be suitable for fish, with dissolved oxygen of 9.15 mg/l or 80.1% saturation, a slightly acidic pH of 6.8, and turbidity of 11.4 NTU. Readings were taken at 18:23, at a water temperature of 9.7°C (Table 1).

Fish Assessment

At FS9, approximately 610 m of channel was electrofished in two separate efforts (Table 2). The first effort of 809 seconds captured 3 slimy sculpin and 2 Arctic grayling (50 mm, 152 mm) (Photograph 43). The second effort of 1558 seconds produced 4 slimy sculpin and 3 Arctic grayling (141mm - 174 mm). A number of additional individuals were observed during electrofishing, but not captured due to fast currents.

Within this reach of the Hess River, Arctic grayling inhabited deep pool habitats in both the main and side channels while sculpin tended to be in calm, off-channel segments. The capture of one juvenile Arctic grayling provides an indication that the Hess River provides suitable juvenile nursery habitat, and spawning habitat (potentially further upstream).

5.2.5 FS10 – Upstream Tributary C

Fish Habitat Features

Fisheries Station 10 was established in order to assess whether dolly varden may be inhabiting the upper reaches of Tributary C, given the capture of numerous dolly varden further downstream at FS6. Site FS10 was established approximately 2,300 m upstream from FS6, at the first accessible location upstream from that point. Although this site was established primarily to determine the upstream extent of fish presence, some habitat information was recorded at the site. The channel gradient at FS10 was steep, resulting in primarily cascade habitat (60%), with 25% riffle, 10% pool, and 5% run habitats (Photographs 44 - 46). Stream substrate was dominated by boulder and larger cobble (70% aggregate), with smaller components of other cobbles and gravel. Stream banks were well

vegetated (70%-75% cover), ranging from 35 cm to 150 cm tall, and with slopes ranging from 15° to 45°. Fish habitat cover was considered to be good (40% coverage), consisting of surface turbulence, overstream vegetation, deep water pools, and small woody debris. The frequently confined channel did provide potentially suitable migration and feeding habitats, but several potential (small) barriers to fish passage were apparent in a reconnaissance between FS6 and FS10. The general stream gradient of Tributary C was found to slowly increase upstream of FS6. Riparian vegetation in this reach was dominated by tall willow shrub, and understory consisting of *Equisetum* and *Epilobium*. Physical and habitat characteristics of FS10 are summarized in Table 1, attached.

Water Quality

Water quality at FS10 was found to be suitable for fish, with dissolved oxygen of 9.01 mg/l or 78.6% saturation, pH of 8.3, and turbidity of 4.43 NTU. Readings were taken at 13:50, at a water temperature of 9.4°C (Table 1).

Fish Assessment

At FS10, approximately 210 m of the channel were electrofished for a total of 514 seconds of effort, with no fish being observed or captured (Table 2). Although habitat features appeared quite suitable, the presence of downstream barriers to fish passage barriers (seasonally, at least) were assumed to limit usage at this site.

5.3 FISH AND FISH HABITAT – NORTHWEST TERRITORIES SITES

5.3.1 FS1 – Central Dale Creek

Fish Habitat Features

Fisheries Station 1, located near Water Quality site 6 and the Dale Creek Hydrometric station was repeat sampled on August 17, 2007. At the time of sampling, wetted width was 343 cm, reduced from ~800 cm in 2006 (EBA 2007a), resulting from significantly lower flows. The mean and maximum channel depths were 32 cm and 50 cm, with moderate flow creating primarily riffle and pool habitats (60% and 20% respectively), along with isolated cascades and calm runs (Photographs 4-7). Other habitat variables were found to be consistent with data collected in 2006. Physical and habitat characteristics of FS1 are summarized in Table 1, attached.

Water Quality

Water quality at FS1 was again found to be suitable for fish, with dissolved oxygen of 9.4 mg/l or 78.8 % saturation, pH of 7.4, and turbidity of 0.65 NTU. Readings were taken at 09:10, at a water temperature of 8°C (Table 1).

Fish Assessment

At FS1, approximately 340 m of channel were electrofished in two separate efforts. The first effort of 626 seconds captured 1 bull trout[2] (172 mm) and 3 slimy sculpin. 6 additional sculpin were observed, but not captured. The second effort of 431 seconds produced no additional fish (Table 2).

5.3.2 FS2 – Cirque Creek

Fish Habitat Features

Fisheries Station 2, located on Cirque Creek, was repeat sampled on August 18, 2007. At the time of sampling, the wetted channel width was 314 cm , reduced from ~450 cm in 2006 (EBA 2007a). Depths were considerably reduced, with riffle depths reduced from approximately 30 cm to 20 cm, resulting in moderately reduced flows. Habitat distribution was found to be mixed, consisting of 35% cascade, 35% pool, 20% riffle, and 10% run habitats (Photographs 8-11). Other habitat variables were found to be consistent with data collected in 2006. Physical and habitat characteristics of FS1 are summarized in Table 1, attached.

A survey of long portions of the Cirque Creek channel by foot and helicopter identified several likely barriers for fish passage along this high gradient channel. These large barriers were present both upstream and downstream from site FS2 (Figure 3).

Water Quality

Water quality at FS2 was found to be suitable for fish, with dissolved oxygen of 9.7 mg/l or 79.6 5 saturation, pH of 7.6, and turbidity of 0.59 NTU. Readings were taken at 08:01, at a water temperature of 6.6^{o}C (Table 1).

Fish Assessment

At FS2, approximately 365 m of channel were electrofished with 533 seconds of effort, with no observations or captures of fish (Table 2). The lack of fish in FS2 was considered to result from the high stream gradient, the presence of barriers, and an absence of visible over-wintering habitats.

[2] The fish captured in Dale Creek belong to complimentary species pair, dolly varden and bull trout, for which the complete distributions are still being defined. Individuals captured from Dale Creek were presumed to be bull trout, according to current information sources (Mochnacz et al. 2004; Susan Thompson, pers.comm.). Data presented by Mochnacz et al. (2004) demonstrated that individuals captured in the Keele River system in 2000 and 2001 were bull trout. Dale Creek and the Tsichu River are direct tributaries to the Keele River.

5.3.3 FS3 – Lower Tsichu River

Fish Habitat Features

Fisheries Station 3, located on the Lower Tsichu River, was repeat sampled on August 17, 2007. At the time of sampling, the wetted channel was 990 cm, reduced from 2010 cm in 2006 (EBA 2007a), however depths were equivalent between the two years. Habitat distributions had changed with reduced flow, consisting of 60% run, 25% riffle, 10% pool, and 5% cascade habitat at the time of survey (Photograph 12-15). Other physical habitat features were consistent with those observed by EBA in 2006.

In general, FS3 was found to contain a number of physically good habitat types, including expanses of deep run and deep pool habitats that appeared to provide prime habitat. Despite this availability, water quality appeared to be a restricting factor, as described below. Physical and habitat characteristics of FS1 are summarized in Table 1, attached.

Water Quality

General aspects of water quality were found to be suitable to support fish, although slightly acidic, with dissolved oxygen of 8.6 mg/l or 79.6% saturation, pH of 6.8, and turbidity of 13.0 NTU. These readings were taken at 16:28, at a water temperature of 12.1°C (Table 1).

In addition to these readings, the Tsichu River has reduced water quality in other aspects. As noted by EBA (2007b), the upper Tsichu River is characterized by elevated metals levels and iron precipitation as a downstream effect of acid rock drainage in headwater areas (EBA 2007a). This iron precipitate was readily apparent at FS3, as in all upper reaches of the Tsichu River.

Fish Assessment

At FS3, approximately 375 m of the channel were electrofished in a total of 1300 seconds of effort, with no fish being observed or captured (Table 2). Although habitat features appeared quite suitable, water quality was assumed to be a limiting factor in this reach. Following sampling at this site, a fish assessment was performed on another site further downstream on the Tsichu River (below the Canol Trail Bridge crossing). At this site, an additional 681 seconds of effort produced no observations or captures of fish. Fish had been captured at this site in earlier studies by AMAX (1983), however those studies took place earlier in the yearly season.

Due to the water quality factors outlined above, the upper Tsichu River (FS4) was not sampled in 2007. EBA felt that degraded water quality in that reach would also limit any potential for fish presence, as in the lower Tsichu River.

5.3.4 FS5 – Lower Dale Creek

Fish Habitat Features

Fisheries Station 5, located on Lower Dale Creek, was repeat sampled on August 17, 2007. At the time of sampling, the wetted channel was 964 cm, comparable to 740 cm in 2006 (EBA 2007a), however depths were comparable (24 cm vs. 20 cm riffle depth, respectively). Cross channel measurements were made at a different location in each year, accounting for width differences. Nevertheless, overall flows were reduced in comparison to 2006, as with other surveyed reaches of Dale Creek. Habitat distributions in this reach consisted of 55% riffle, 20% run, 20% pool, and 5% cascade habitat (Photographs 16-19). Other physical habitat features were consistent with that observed by EBA in 2006.

In general, FS5 was found to contain a number of physically good habitat types, including numerous deep pools, plunge pools below woody debris, and riffle/pool sequences. Overhead cover in this reach of Dale Creek was noted to be low, however numerous undercut banks beneath moss/willow root mats were present. Physical and habitat characteristics of FS1 are summarized in Table 1, attached.

Water Quality

Water quality at FS5 was found to be suitable for fish, with dissolved oxygen of 8.7 mg/l or 78.2 % saturation, pH of 7.4, and turbidity of 0.75 NTU. Readings were taken at 12:45, at a water temperature of 10.6°C (Table 1).

Fish Assessment

At FS5, approximately 430 m of channel were electrofished for 822 seconds of effort (Table 2). A total of 4 fish were captured, including 1 bull trout (194 mm) and 3 slimy sculpin. Fewer fish were observed than expected, however, a variety of habitats suitable for bull trout were observed. The singe bull trout captured was electrofished from a small plunge pool formed by woody debris (Photograph 20).

5.3.5 FS11 – Upper Dale Creek

Fish Habitat Features

Fisheries Station 11 was established in order to assess upper tributary sections of Dale Creek, in response to the capture of fish at FS1 and FS5 (also Dale Creek). This site was established approximately 1,400 m downstream from the crossing of the current access road over this watercourse. At the time of sampling (August 18, 2007), the wetted and channel widths were found to be 482 cm and 630 cm, respectively. The mean and maximum channel depths were 20 cm and 24 cm, with moderate flow creating 45% riffle habitat, with 25% cascade, 20% run, and 10% pool habitats (Photographs 21-24). Stream substrate was dominated by large and small cobbles, with smaller components of boulder and gravel. Stream banks were well vegetated (60-75% cover), ranging from 30 cm to 70 cm tall, and

with slopes ranging from < 10° to 75°. Fish habitat cover was considered to be moderate (18% coverage), consisting of surface turbulence, overstream vegetation, undercut banks, and large woody debris (in order of abundance). The meandering channel did provide potentially suitable spawning, migration, and feeding habitats. Generally, however, fish habitat and cover were considered to be less available than in lower reaches of Dale Creek. In this reach, stream gradient was moderate (3-4%), and the channel was occasionally confined within slopes and by bedrock outcrops. Riparian vegetation was dominated by willow shrub with moss groundcover. *Equisetum*, gramminoids, herbaceous shrubs, and *Epilobium* were all comprised dominant understory components. Physical and habitat characteristics of FS11 are summarized in Table 1, attached.

Water Quality

Water quality at FS11 was found to be suitable for fish, with dissolved oxygen of 8.0 mg/l or 74.7 % saturation, pH of 7.6, and turbidity of 0.39 NTU. Readings were taken at 16:45, at a water temperature of 12.3°C (Table 1).

Fish Assessment

At FS11, approximately 410 m of channel were electrofished in 956 seconds of effort (Table 2). One bull trout (173 mm) was captured from beneath an area of undercut bank. No sculpins were observed or captured in this site, despite the apparent availability of suitable habitat for this species.

5.4 BENTHIC INVERTEBRATE SUMMARIES

This section presents the results of benthic invertebrate community surveys, completed during the 2007 MacTung Fisheries and Aquatic Studies. Sample locations are consistent with the fisheries station locations shown in Figure 2, and raw data is provided in Appendix D, attached.

Results from the benthic invertebrate sampling are summarized in Tables 3 and 4. The relative contribution of major taxonomic groups to overall diversity is outlined in Table 5, and illustrated in Figure 4. Table 3 summarizes the overall abundance of invertebrates within replicates and within sample sites. Table 4 provides descriptive statistics related for invertebrate density, species richness, and Simpson's Diversity Index values for each sample site. Descriptions of findings for each site are provided below.

5.4.1 Benthic Invertebrates – Yukon Territory Sites

5.4.1.1 FS6 – Tributary C

At Station 6, the invertebrate community composition was found to be very similar to that at this site in 2006. Plecoptera and Ephemeroptera were the most abundant taxonomic groups in samples (64% and 31%, respectively), while Diptera, Arachnida, and Trichoptera comprised smaller components (Figure 4). Mean abundance and density at FS6 were 108

individuals and 1252 individuals/m2, approximately double the 2006 findings (Tables 3 and 4). Mean species richness at FS6 was 7 per sample, and mean diversity was 0.53 (Simpson's index; Table 4). As with other samples, a major contributor to the macroinvertebate community was *Alloperla fraterna*.

5.4.1.2 FS7 – Tributary A

At Station 7, the macroinvertebrate community composition was similar to that of 2006, and dominated by relatively few taxonomic groups. Diptera and Plecoptera were the most abundant groups (67% and 25%), with the remainder comprised of Arachnida (8.3%)(Table 4). Mean abundance and density at FS7 were 4 individuals and 46.5 individuals/m^2, approximately twice the 2006 findings (Tables 3 and 4). Mean species richness at FS7 was 3 per sample, and mean diversity was 0.44 (Simpson's index; Table 4).

5.4.1.3 FS8 – Upper Hess River

At Station 8, the macroinvertebrate community composition was dominated by two main groups, Oligochaeta and Plecoptera (42% and 33%, respectively). Ephemeroptera, Diptera, and Trichoptera comprised the remaining components (Figure 4). Mean abundance and density at FS8 were 66 individuals and 763 individuals/m2, similar to 2006 findings (Tables 3 and 4). Mean species richness at FS8 was 10 per sample, and mean diversity was 0.28 (Simpson's index; Table 4). Plecopterans of the family Capniidae and the oligochaete *Rhynchelmis sp.* comprised a large proportion of the invertebrate community at FS8. Both of these are hyporheic species that may suggest groundwater upwellings in the area of FS8.

5.4.1.4 FS9 – Lower Hess River

At Station 9, fewer main taxonomic groups were found to dominate the macroinvertabrate community than in 2006. Diptera and Plecoptera were the most abundant groups (45% and 39%, respectively), with Ephemeroptera comprising the remainder (Figure 4). Haplotaxa, Hydracarina, and Coleoptera were all absent from samples in 2007. Mean abundance and density at FS9 were 10 individuals and 120 individuals/m2, approximately twice that in 2006 (Tables 3 and 4). Mean species richness at FS8 was 6 per sample, and mean diversity was 0.20 (Simpson's index; Table 4). Despite having only 3 primary taxonomic groups, FS9 was the most diverse of all sites at the species level.

5.4.2 Benthic Invertebrates – Northwest Territories Sites

5.4.2.1 FS1 – Central Dale Creek

At Station 1, two main taxonomic groups (Plecoptera and Diptera) dominated the benthic samples, comprising 47% and 27% of total abundance, respectively (Figure 4). Copepoda were distinctly absent from the samples in 2007, having comprised 20% of the samples in 2006 (EBA 2006a). Ephemeroptera, Arachnida (Hydracarina), Trichoptera, and Collembola all comprised minor components of the samples. Mean abundance and density at FS1 were 156 individuals and 1814 individuals/m^2, both higher than 2006 figures. Although mean

species richness was higher in 2007 (11.6 vs. 7), mean diversity was lower (0.38 in 2007, 0.695 in 2006) indicated larger contributions by several key species such as the stonefly *Alloperla fraterna*.

5.4.2.2 FS2 – Cirque Creek

At Station 2, benthic samples were dominated by Copepoda and Diptera (63% and 28%, respectively; Figure 4). Plecoptera were found to be relatively more abundant than in 2006 (8% in 2007, 1% in 2006), while Trichoptera formed a minor component (but were mostly absent in 2006). Mean abundance and density at FS1 were 309 individuals and 3593 individuals/m^2, both higher than 2006 figures (Table 3). Mean species richness was 8.6, and mean diversity was 0.467 (Simpson's index; Table 4).

5.4.2.3 FS3 – Lower Tsichu River

At Station 3, Copepoda were again absent from 2007 samples, as at FS1. Correspondingly, Plecoptera and Diptera were the most abundant in samples (50% and 38%, respectively). Ephemeroptera, Arachnida, and Trichoptera all comprised smaller components (Figure 4). As in 2006, abundance was found to be low, with mean abundance of 14 individuals per sample, and mean density of 163 individuals/m^2, indicating influence from metals precipitation at the site (Tables 3 and 4). Mean species richness at FS3 was 6 per sample, and mean diversity was 0.299 (Simpson's index; Table 4). Overall diversity was low due to the large abundance of two groups, adult Dipetera and *Alloperla fraterna*.

5.4.2.4 FS5 – Lower Dale Creek

At Station 5, a more diverse invertebrate community was found than that in 2006. Diptera and Plecoptera were the most abundant taxonomic groups in samples (60% and 34%, respectively), while Ephemeroptera, Trichoptera, and Collembola comprised smaller components (Figure 4). Mean abundance and density at FS5 were 102 individuals and 1186 individuals/m^2, similar to 2006 data (Tables 3 and 4). Mean species richness at FS5 was 8 per sample, and mean diversity was 0.315 (Simpson's index; Table 4). Again, diversity was low due to the large contribution of a few key species, including *Alloperla fraterna* and *Pagastia sp*.

6.0 SAMPLING AND HABITAT SUMMARY AND DISCUSSION

6.1 FISH SAMPLING SUCCESS

Overall, the assessment of fish presence and distribution was successful in 2007, and provided valuable information to compliment baseline data from the 2006 field program. Fish were captured from all watercourses except the Tsichu River, Tributary A, and Cirque Creek, and the species captured included bull trout, dolly varden, Arctic grayling, and slimy sculpin. However, several species recorded from capture by AMAX (1983) were still not

captured in 2007, including mountain whitefish, burbot, and Arctic grayling (within the NWT tributaries).

Although reasons for the increased sampling success during the 2007 baseline studies are not completely understood, reductions in water velocity, seasonal timing, and differences in electrofisher settings may have influenced capture success.

6.2 BENTHIC SAMPLING

Benthic macroinvertebrate samples taken from fisheries stations in 2007 were generally reflective of 2006 results, with similar trends across major watercourses. Small variations in results between years may have been due to year effects, differences in microsite selection, or timing.

Generally, most tributaries were found to have moderate to good taxonomic diversity, with moderate overall abundance. Low order streams tended to be dominated by groups indicative of favourable water quality, particularly stoneflies (Plecoptera).

Marked reductions in both abundance and diversity were noted in those tributaries directly influenced by upstream acid rock drainage, compared to others. The Tsichu River demonstrated a low invertebrate abundance, but moderate diversity. Tributary A was dominated, by Chironomids (Diptera) and had a very low diversity. Interestingly, related effects were also observed in the Hess River at FS9 (below the junction between these two rivers).

6.3 WATERCOURSE LEVEL HABITAT SUMMARIES

6.3.1 Yukon Territory Tributaries

Tributary C

Tributary C was found to provide good overall fish habitat, including a population of dwarf dolly varden. This watercourse is primarily fed from the main valley, with headwaters that begin not far from the existing camp, inside the footprint area (Figure 3).

The fish and fish habitat assessment found areas of excellent habitat for dolly varden, and suitable features were identified to potentially satisfy all major habitat needs for this species (spawning, nursery, migration, and over-wintering). Additionally, benthic resources at FS6 were found to be diverse and abundant.

The upstream limit of fish presence in Tributary C could not be determined with certainty, as no single barrier to upstream passage was identified between sites FS6 and FS10. However, the watercourse upstream from FS10 is assumed to be non-fish bearing due to steep gradients, and a large waterfall provides a definite barrier to passage between FS10 and the proposed footprint area (Figure 3).

As with Dale Creek, it is assumed that Dolly Varden in Tributary C may be isolated within this reach at least periodically by poor downstream water quality in Tributary A. This

assumption is supported by evidence of reproductive coloration in small captured individuals, and the mature state of a 30 cm male captured at the site. Although more evidence of yearly individual movements would be required to support this assumption, the potential that Tributary C supports an isolated dwarf sub-population should be considered.

Tributary A

In Tributary A, no evidence of fish presence was found in 2006 or 2007. As with the Tsichu River, upstream acid rock drainage appears to have an influence on this watercourse, as evidenced by iron precipitate, low benthic productivity (the lowest of all sites in 2007), and reduced habitat quality. For this reason, Tributary A is considered to have low overall habitat quality, and likely lacks any over-wintering, nursery, and feeding habitats. Although a yearly improvement in early summer water quality associated with an increased component of surface runoff may allow for temporary fish use and migration to other areas including Tributary C, the extent of this potential is not known.

Hess River

The Hess River was found to have excellent overall fish habitat value, and supports populations of Arctic grayling, dolly varden, slimy sculpin. Mountain whitefish and Chinook salmon may also use this watercourse. In general, the Hess River is already a medium size river at the point it approaches the study area and confluence with Tributary A. Studies at FS8 and FS9 identified suitable migration, over-wintering, and nursery habitats, and found benthic resources to be diverse and relatively abundant at FS8. Despite its large size and discharge, the Hess River was found to be influenced by FS7. Below the confluence of these rivers (FS9), the benthic invertebrate community was found to be less diverse and abundant. However, this reach was still found to support fish, and to provide a variety of habitats. Downstream water quality would be assumed to again improve with input from other tributaries.

6.3.2 Northwest Territories Tributaries

Dale Creek

Dale Creek was found to provide good quality fisheries habitat, and to support populations of slimy sculpin and bull trout. Although fish were not abundant in Dale Creek, habitat quality was good at all three sample stations, and features were identified that are likely to satisfy all major habitat needs (spawning, nursery, migration, and over-wintering). Good habitat was identified upstream of the access road crossing, and no apparent barriers to fish passage were observed until high in the tributary (relatively close to the footprint area; Figure 3). Both benthic invertebrate resources and physical water quality attributes were found to be quite favourable to support local fish populations.

Unfavourable habitat conditions noted in the Tsichu River (downstream from Dale Creek), suggest that fish populations may be at least seasonally restricted to Dale Creek. Poor water quality in the upper reaches of the Tsichu River may impede any migration in or out of Dale

Creek during low seasonal flows. However, it is assumed that seasonal early summer migration would be possible due to improved water quality at that time (dilution of poor quality groundwater by surface runoff).

Tsichu River

While the Tsichu River has been considered to be a fish bearing watercourse in prior studies by AMAX (1983), fish were found to be absent from this river in both 2006 and 2007. Additionally, generally poor invertebrate abundance, water quality, and habitat conditions were observed.

It is assumed that the upper reaches of the Tsichu River could support fish populations early in the season during high flows (as noted above). However, seasonal water quality degradation would inhibit some spawning, nursery habitat use, and over-wintering. Consequently, the overall fisheries value of the Tsichu River is considered to be marginal, highly seasonal, and restricted by upstream acid rock drainage.

Cirque Creek

Cirque Creek was found to be devoid of fish in both 2006 and 2007, and was found to have major barriers to fish passage at both its upstream and downstream ends (Figure 3). Additionally, prior research has found no evidence that Cirque Lake supports any fish populations, the only potential source from which fish could migrate downstream to Cirque Creek. This lack of fish migration combined with a lack of suitable overwintering habitat in Cirque Creek makes this watercourse unsuitable as fish habitat upstream of the lower barrier.

7.0 REPORT LIMITATIONS

The observations, information, and interpretations presented in this report are based on background information reviewed, as well as the conditions experienced at the project site from August 14-18, 2007. The observations were based on late summer, low water conditions at the site, and cannot necessarily be applied to other seasons. However, the best possible effort has been made to interpret seasonal habitat usage based on these findings and other existing data.

8.0 CLOSURE

EBA is pleased to present NATCL with this 2007 fisheries and aquatic resources report for the MacTung Project. This report helps to strengthen observations made in 2006, and to determine fisheries habitat values that can be used for future regulatory submissions. It has been prepared according to current professional standards, and incorporates and is subject to the EBA Environmental Report General Conditions (attached), which form part of this report.

We trust that this report meets your requirements at this time. If you have any questions or require additional information, please contact the undersigned.

Respectfully Submitted,
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PERSONAL COMMUNICATIONS

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ENVIRONMENTAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

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2.0 LIMITATIONS OF REPORT

This report is based solely on the conditions which existed on site at the time of EBA's investigation. The client, and any other parties using this report with the express written consent of the client and EBA, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive.

The client, and any other party using this report with the express written consent of the client and EBA, also acknowledge that the conclusions and recommendations set out in this report are based on limited observations and testing on the subject site and that conditions may vary across the site which, in turn, could affect the conclusions and recommendations made.

The client acknowledges that EBA is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

2.1 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of this report, EBA may have relied on information provided by persons other than the client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

3.0 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In consideration of these risks, and in consideration of EBA providing the services requested, the client agrees that EBA's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

1. With respect to any claims brought against EBA by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to EBA under this Agreement, whether the action is based on breach of contract or tort;
2. With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify, defend and hold harmless EBA from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by EBA, whether the claim be brought against EBA for breach of contract or tort.

4.0 JOB SITE SAFETY

EBA is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of EBA personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

5.0 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with EBA with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for EBA to properly provide the service, EBA is relying upon the full disclosure and accuracy of any such information.

6.0 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

7.0 EMERGENCY PROCEDURES

The client undertakes to inform EBA of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognizes that the activities of EBA may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect EBA employees, other persons and the environment. These procedures may involve additional costs outside of any budgets previously agreed upon. The client agrees to pay EBA for any expenses incurred as a result of such discoveries and to compensate EBA through payment of additional fees and expenses for time spent by EBA to deal with the consequences of such discoveries.

8.0 NOTIFICATION OF AUTHORITIES

The client acknowledges that in certain instances the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by EBA in its reasonably exercised discretion.

9.0 OWNERSHIP OF INSTRUMENTS OF SERVICE

The client acknowledges that all reports, plans, and data generated by EBA during the performance of the work and other documents prepared by EBA are considered its professional work product and shall remain the copyright property of EBA.

10.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

TABLES

TABLE 1: STREAM HABITAT ASSESSMENT DATA

	FS1	FS2	FS3	FS5	FS6
UTM	09V 448477 7017038	09V 446748 7017591	09V 453508 7019071	09V 450866 7017418	09V 436235 7018202
Transect Location	Dale Creek	Cirque Creek	Upper Tschiu River	Lower Dale Creek	Tributary C
Sampling Date / Time	17/08/2007; 08:58	18/08/2007; 08:01	17/08/2007; 16:28	17/08/2007; 12:51	16/08/2007; 14:33
Stream Characteristics					
Bankfull Width / Wetted Width (cm)	1060/ 343	727 / 314	1460 / 990	1270 / 964	630 / 482
Mean Velocity ($m.s^{-1}$)†	0.4 – 0.6	0.6 – 0.8	0.4 – 0.6	0.2 – 0.4	0.8 – 1
Depth (25%, 50%, 75%) (cm)	50 | 38 | 8	18 | 20 | 18	60 | 45 | 28	26 | 28 | 18	17 | 27 | 31
Mean Depth (m)	32	18.7	44.3	24	25
Estimated Discharge ($m^3.s^{-1}$)	0.55	0.41	27.50	0.69	1.08
Bank Stability [1] (Left, Right)	M | S	M | M	M | S	M | M	S | S
Bank Height / Slope (Left, Right) (m/degrees)	45/75 | 27/<10	88/45 | 111/70	35/70 | 25/<10	85/70 | 45/15	150/45 | 170/65
Substrate Composition					
% Silt/Clay/Sand		5	5	5	5
% Small Gravel	10	8	10	15	10
% Large Gravel	35	20	15	15	20
% Small Cobble	50	40	50	45	25
% Large Cobble	5	20	17	15	20
% Boulder		7	3	5	20
Major Habitat Units					
Cascade/Rapid (%)	5	35	5	5	25
Riffle (%)	60	20	25	55	30
Run (%)	10	10	60	20	20
Pool (%)	25	35	10	20	25
Water Quality					
Water Temperature(°C)	8	6.6	12.1	10.6	9.1
pH	8.2	7.6	6.8	7.4	7.2
Dissolved Oxygen (mg/l)/(%Saturation)	9.4/78.8	9.74/79.6	8.56/79.6	8.71/78.2	9.15/79.4
Turbidity (NTU)	0.65	0.59	13.0	0.75	1.69
Cover / Habitat Value					
Total Fish Habitat Cover (%)	20	22	5	10	45
Primary Fish Habitat Components (%)	• 8 – Surface Turbulence • 5 – Overstream Veg. • 5 – Undercut Bank • 2 – Sm. Woody Debris	• 15 – Surface Turbulence • 5 – Undercut Bank • 2 – Overstream Vegetation	• 3 – Surface Turbulence • 1 – Undercut Bank • 1 – Overstream Vegetation	• 3 – Surface Turbulence • 3 – Undercut Bank • 2 – Overstream Vegetation • 2 – Small/Large Wood Debris	• 20 – Surface Turbulence • 20 – Overstream Vegetation • 5 – Deep Water
Riparian Habitat Composition	Lowland willow shrub with mosses/equisetum. Sedge / bluejoint understory.	Willow/ Birch shrub dominated with grasses, *epilobium*.	Willow shrub dominated with sedges/gramminoid. *Epilobium*, mosses, and equisetum.	Willow shrub dominated by grasses, herbs. Birch:lichen nearby. Well drained site.	Mature black spruce, birch/willow shrub. Bearberry, moss, lichen.
Channel Characteristic	Irregular meander; occasional islands, side bars, occasionally confined.	Irregular meander; occasional islands, side bars, frequently confined.	Regular meander, occasional islands, side and diagonal bars, unconfined channel.	Irregular meander, frequent islands, side and diagonal bars, occasionally confined.	Irregular pattern, no islands, side bars, frequently confined by rock.
Photo References	26-29	30-33	34-37	38-42	4-8

[1] A qualitative scale for bank stability was used where H=highly unstable; M=moderately unstable; U=slightly unstable; S=stable.

† Stream flow measurements were estimated visually at the site, and are provided as a probable value.

TABLE 1: STREAM HABITAT ASSESSMENT DATA (CONTINUED)

	FS7	FS8	FS9	FS10	FS11
UTM	09V 433810 7020543	09V 434284 7021475	09V 429694 7020589	09V 438500 7017687	09V 466908 7016460
Transect Location	Tributary A	Upper HessRiver	Lower Hess River	Upper Tributary C	Upper Dale Creek
Sampling Date / Time	15/08/2007; 12:35	16/08/2007; 09:19	14/08/2007; 18:23	18/08/2007; 13:50	18/08/2007; 16:27
Stream Characteristics					
Bankfull Width / Wetted Width (cm)	1710/ 1260	2250/ 1900	1700/ 1550 (est.)	210 / 184	863 / 370
Mean Velocity ($m.s^{-1}$)†	0.4 – 0.6	1.0 – 1.2	0.6 – 0.8	0.5 – 0.7	0.3 – 0.6
Depth (25%, 50%, 75%) (cm)	28 | 24 | 27	62 | 32 | 60	N/A | N/A | N/A	33 | 52 | 20	14 | 23 | 24
Mean Depth (m)	26.3	51.3	N/A	35	20.3
Estimated Discharge ($m^3.s^{-1}$)	1.66	10.7	N/A	0.38	0.38
Bank Stability [1] (Left, Right)	M | M	S | S	M/U | M/U	S | S	S | M
Bank Height / Slope (Left, Right) (m/degrees)	110/45 | 30/<10	900/60 | 75/30	55/<10 | 65/<10	150/45 | 35/15	30/<10 | 70/70
Substrate Composition					
% Silt/Clay/Sand	10	5	15		5
% Small Gravel	10	5	15	5	5
% Large Gravel	40	15	30	10	5
% Small Cobble	35	35	25	15	25
% Large Cobble	<5	30	10	45	45
% Boulder	<5	10	5	25	15
Major Habitat Units					
Cascade/Rapid (%)	5	70	10	60	25
Riffle (%)	75	15	25	25	45
Run (%)	15		50	5	20
Pool (%)	5	15	15	10	10
Water Quality					
Water Temperature(°C)	7.5	8.1	9.7	9.4	12.3
pH	6.7	7.2	6.7	7.5	7.6
Dissolved Oxygen (mg/l)/(%Saturation)	9.7/80.9	9.73/82.3	9.15/80.1	9.01/78.6	8.00/74.7
Turbidity (NTU)	8.8	19.2	11.4	4.43	0.39
Cover / Habitat Value					
Total Fish Habitat Cover (%)	30	40	7	40	18
Primary Fish Habitat Components (%)	• 20 – Surface Turbulence • 5 – Overstream Veg. • 5 – Deep Water	• 30 – Surface Turbulence • 5 – Overstream Veg. • 3 – Undercut Bank • 2 – Deep Water.	• 3 – Surface Turbulence • 2 – Overstream Vegetation • 1 – Undercut Bank • 1 – Small Woody Debris	• 25 – Surface Turbulence • 5 – Deep Water/Pools • 5 – Overstream Vegetation • 5 – Small Woody Debris	• 10 – Surface Turbulence • 5 – Undercut Bank • 2 – Overstream Vegetation • 1 – Large Woody Debris
Riparian Habitat Composition	Willow / Birch shrub with white spruce. Understory moss/gramminoid, *Equisetum*.	Willow / Birch Shrub with mature spruce. Moss/sedge cover with lichen on slopes.	Willow / Birch Shrub with mature spruce. Moss/sedge cover with lichen on slopes.	Tall willow shrub. Understory dominated by *Epilobium* / *Equisetum*.	Willow shrub dominated. Groundcover dominated by moss, *Equisetum*, *Epilobium*.
Channel Characteristic	Irregular meander; frequent islands, side and diagonal bars, unconfined.	Irregular meander; frequent islands, side and diagonal bars, occasionally confined.	Regular meander, frequent islands, side and diagonal bars, unconfined channel.	Irregular meander, no islands, irregular side bars, frequently confined channel.	Irregular pattern, no islands, side bars, occasionally confined.
Photo References	9-13	14-18	19-22	23-25	43-46

[1] A qualitative scale for bank stability was used where H=highly unstable; M=moderately unstable; U=slightly unstable; S=stable.

† Stream flow measurements were estimated visually at the site, and are provided as a probable value.

TABLE 2: EFFORT DURATION AND BACKPACK ELECTROFISHER SETTINGS USED AT FISHERIES STATIONS					
Fisheries Station	Frequency (HZ)	Duty Cycle (%)	Voltage	Watts	Effort (Seconds)
FS1	50	15	390	65-70	1057
FS2	50	15	440	44-49	533
FS3	50	15-20	425	60-95	1300
FS5	50	15	400	68-74	822
FS6	45	15	330	75-90	1342
FS7	40	10	350-400	66-65	787
FS8	40	12-14	410-415	30-40	1723
FS9	40	10	400	55-60	1558
FS10	45	13	310	50-62	514
FS11	50	15	350	70-85	956
Downstream Tsichu River	45	12	395	75-85	681

TABLE 3: ABUNDANCE OF BENTHIC MACROINVERTEBRATES BY REPLICATE AND FISHERIES STATION				
Station	Replicate	Abundance (Number/Replicate)	Mean Abundance (Per Replicate)	Total Abundance (per Station)
FS1	1	175	156	468
	2	137		
	3	156		
FS2	1	269	309	927
	2	373		
	3	285		
FS3	1	15	14	42
	2	15		
	3	12		
FS5	1	119	102	306
	2	87		
	3	100		
FS6	1	11	107	323
	2	144		
	3	168		
FS7	1	3	4	12
	2	7		
	3	2		
FS8	1	31	65	197
	2	90		
	3	76		
FS9	1	16	10	31
	2	7		
	3	8		

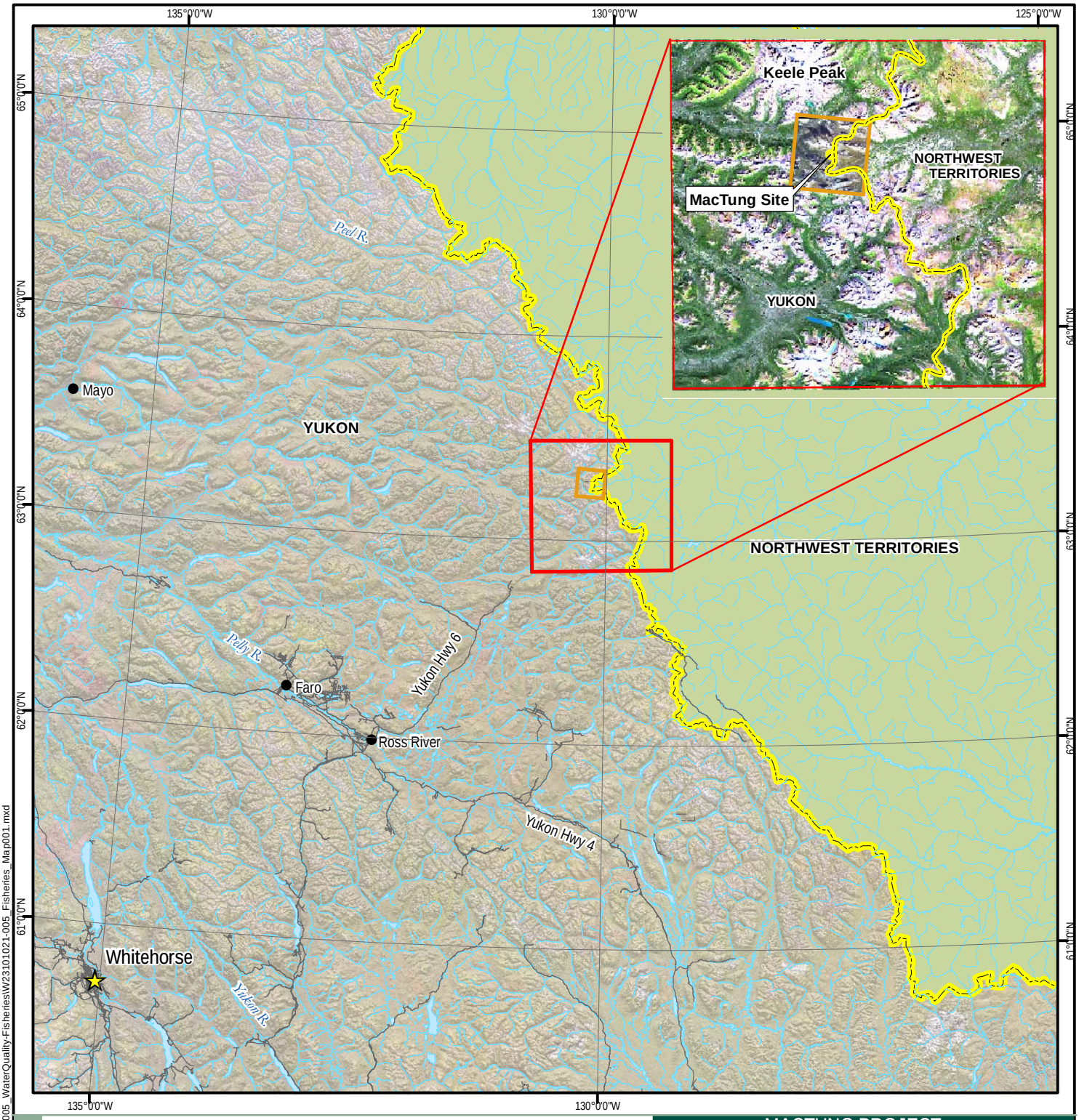
TABLE 4: DESCRIPTIVE STATISTICS FOR BENTHIC MACROINVERTEBRATE COMMUNITY SURVEYS								
Variable		FS1	FS2	FS3	FS5	FS6	FS7	FS8
Density (#/m²) n=3	Mean:	1814	3593	163	1186	1252	47	764
	Median:	1814	3314	174	1163	1674	35	884
	Std. Deviation	221	651	20	187	983	31	358
	Std. Error	128	376	12	108	568	18	207
	Min:	1593	3128	140	1012	128	23	360
	Max:	2035	4337	174	1384	1953	81	1047
Species Richness n=3	Mean:	12	9	6	8	7	3	10
	Median:	12	9	6	8	7	2	11
	Std. Deviation	2	2	1	2	2	2	3
	Std. Error	1	1	1	1	1	1	2
	Min:	10	7	5	7	5	2	7
	Max:	13	10	7	10	8	5	12
Simpson's Diversity Index n=3	Mean:	0.381	0.467	0.300	0.315	0.532	0.440	0.283
	Median:	0.385	0.453	0.280	0.283	0.438	0.500	0.313
	Std. Deviation	0.070	0.027	0.062	0.057	0.195	0.154	0.064
	Std. Error	0.040	0.016	0.036	0.033	0.113	0.089	0.037
	Min:	0.309	0.450	0.250	0.281	0.403	0.265	0.209
	Max:	0.448	0.499	0.369	0.380	0.757	0.556	0.326

TABLE 5: BENTHIC COMMUNITY COMPOSITION OF FISHERIES SITES BY MAJOR TAXONOMIC GROUP

CLASS / ORDER	FS1		FS2		FS3		FS5		FS6		FS7		FS8		FS9	
	# IND†	%	# IND†	%	# IND†	%	# IND†	%	# IND†	%	# IND†	%	# IND†	%	# IND†	%
Ephemeroptera	18	3.8	2	0.2	2	4.8	15	4.9	99	30.7	0	0.0	22	11.2	5	16.1
Plecoptera	325	69.4	73	7.9	21	50.0	103	33.7	208	64.4	3	25.0	64	32.5	12	38.7
Trichoptera	2	0.4	1	0.1	1	2.4	4	1.3	2	0.6	0	0.0	7	3.6	0	0.0
Diptera	117	25.0	263	28.4	16	38.1	183	59.8	11	3.4	8	66.7	21	10.7	14	45.2
Collembola	1	0.2	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Copepoda	0	0.0	588	63.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Oligochaeta	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	83	42.1	0	0.0
Arachnida	5	1.1	0	0.0	2	4.8	0	0.0	3	0.9	1	8.3	0	0.0	0	0.0
Total	468		927		42		306		323		12		197		31	

† - The number of individuals per fisheries station represents the total sum in three replicate samples.

FIGURES



LEGEND

- Local Study Area
- Provincial / Territorial Boundary
- Watercourse
- Waterbody
- Roads

N
W E
S

NOTES Landsat TM imagery Earthsat acquired Sept,17, 1995
Bands 432 enhanced

MACTUNG PROJECT
2007 ENVIRONMENTAL BASELINE STUDIES
FISHERIES AND AQUATICS RESOUCES

Project Area

PROJECTION	DATUM
UTM Zone 9	NAD83

Scale: 1:3,000,000

0 12.5 25 50 75 100

Kilometres

EBA Engineering Consultants Ltd.

FILE NO.
W23101021-005_Fisheries_Map001.mxd

PROJECT NO.	DWN	CKD	REV
W23101021.005	BGP	CJ	0

OFFICE	DATE
EBA-VANC	December 13, 2007

Figure 1

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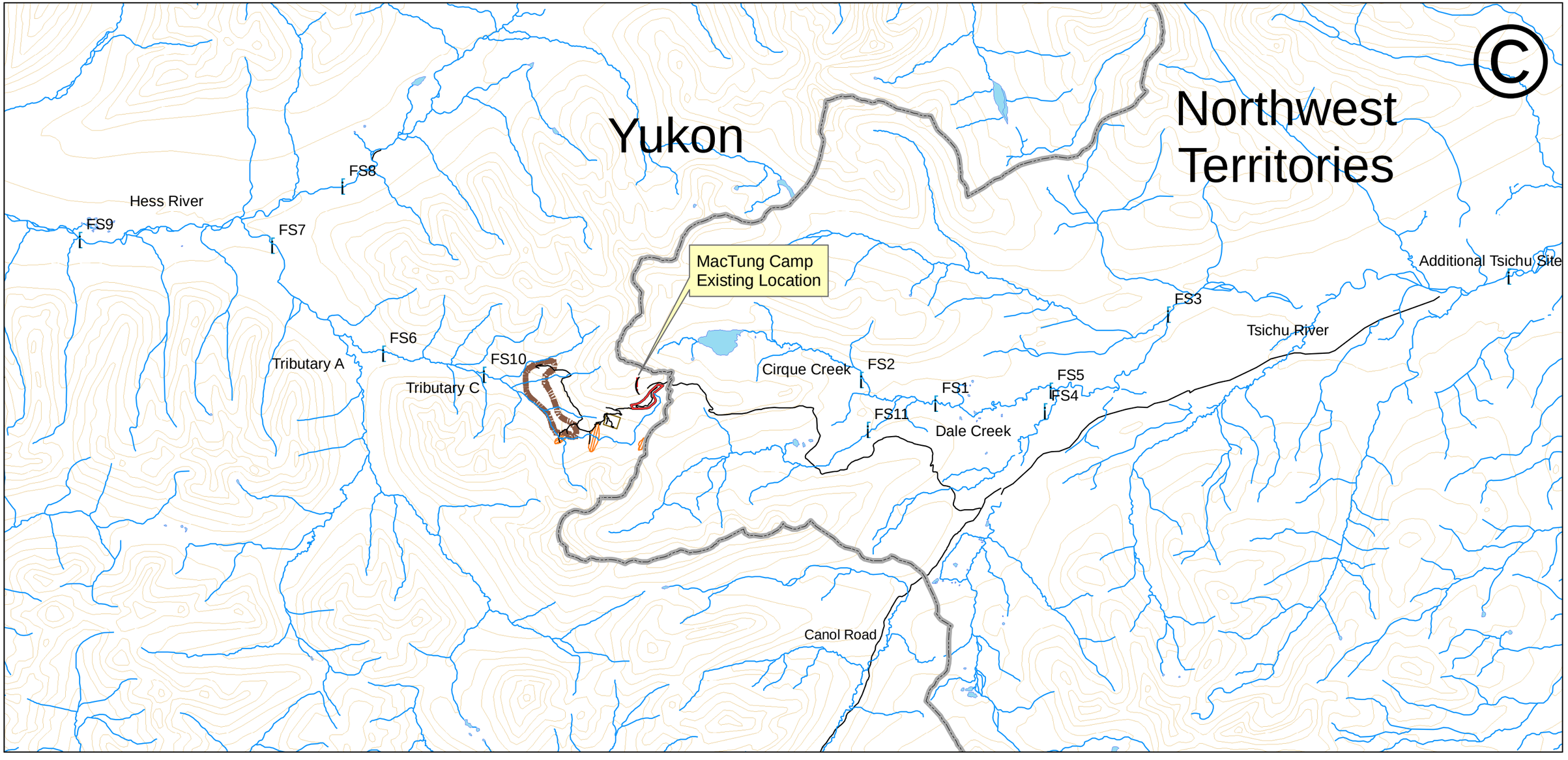


LEGEND

- Yukon / NWT Border
- Existing Roads
- Contours
- Water Bodies
- Watercourses
- Proposed Dam Outlines
- Proposed Borrow Site

Mactung 2007 Fisheries Points

- Fisheries Sations

MacTung Study Area Watercourses:

FS8, FS9 - Hess River
FS7 - Tributary A
FS6, FS10 - Tributary C
FS1, FS5, FS11 - Dale Creek
FS3 - Tsichu River
FS2 - Cirque Creek

NOTES

Base data source:

Issued for Client Review

MacTung Project, 2007 Environmental Baseline Studies
Fisheries and Aquatic Resources

Fisheries and Aquatic Resources Sampling Locations

PROJECTION	DATUM
UTM NAD83 Zone 9N	NAD83

Scale: 1:85,000

Meters

1,500 750 0 1,500

EBA Engineering Consultants Ltd.

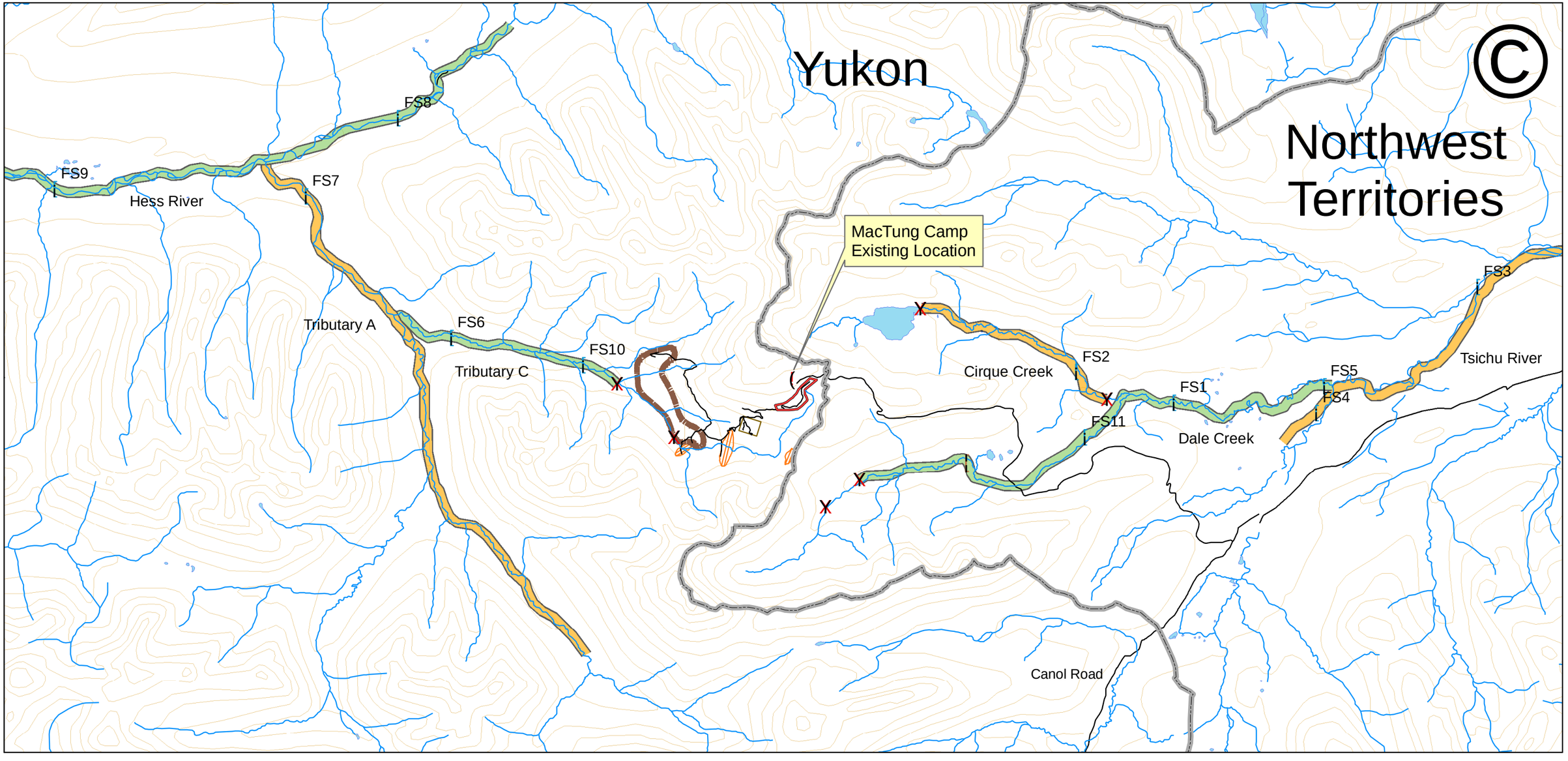
FILE NO.: EBA_11x17_l-bottom_Template

PROJECT NO.	DWN	CKD	REV
W23101021.005	CJJ	RH	0

OFFICE	DATE
EBA-WHSE	December 12, 2007

Figure 2

Z:\GIS DATA\Projects\1021_MacTung\Fisheries\2007 Map Documents\2007 Fisheries Sites Fig 2.mxd



LEGEND

- Yukon / NWT Border
- Existing Roads
- Contours (100 m)
- Water Bodies
- Watercourses
- Proposed Dam Outlines
- Proposed Borrow Site

Mactung 2007 Fisheries Points

Point Types:

- Fish Passage Barriers
- Fisheries Sations
- Beaver Dam Complex

Identified Fisheries Values

Type

- Fish Bearing / Moderate - High Value
- Non Fish Bearing / Low - Moderate Value

MacTung Study Area Watercourses:

FS8, FS9 - Hess River
FS7 - Tributary A
FS6, FS10 - Tributary C
FS1, FS5, FS11 - Dale Creek
FS3 - Tsichu River
FS2 - Cirque Creek

NOTES

Base data source:

Issued For Client Review

MacTung Project
2007 Environmental Baseline Studies
Fisheries and Aquatic Resources

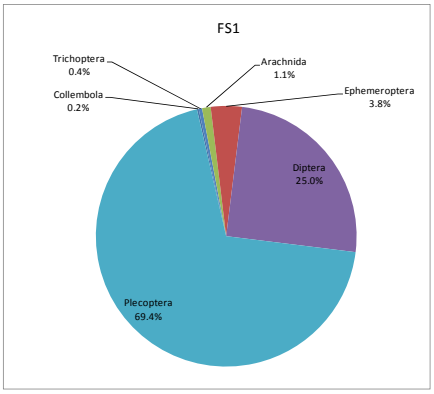
Fisheries and Aquatic Resources Sampling Locations

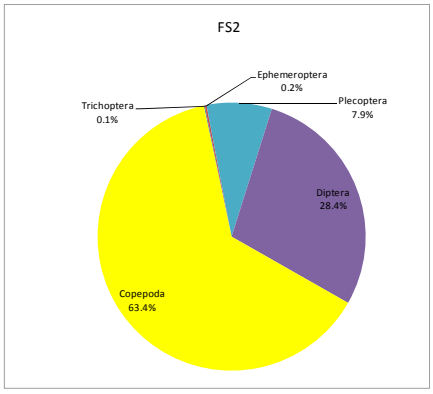
PROJECTION: UTM NAD83 Zone 9N	DATUM: NAD83		
Scale: 1:65,000 — 0 250500 1,000 1,500 2,000 Meters			
FILE NO.: 2007 Fisheries Values Fig 3.mxd			
PROJECT NO.: W23101021.005	DWN: CJJ	CKD: RH	REV: 0
OFFICE: EBA-WHSE	DATE: December 12, 2007		

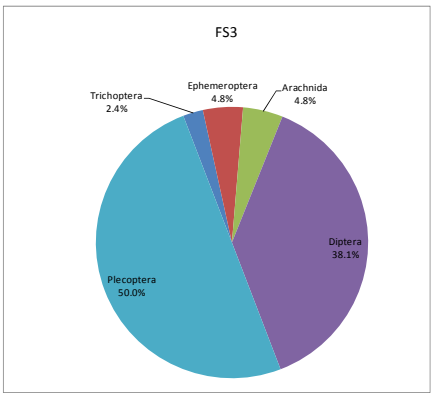
EBA Engineering Consultants Ltd.

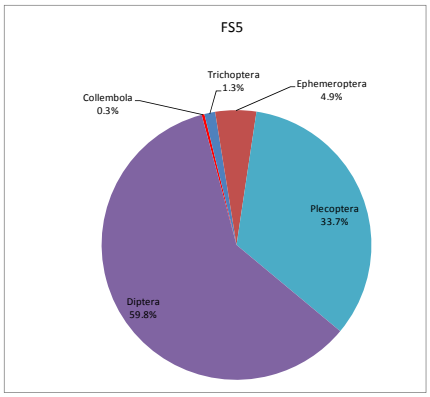
Figure 3

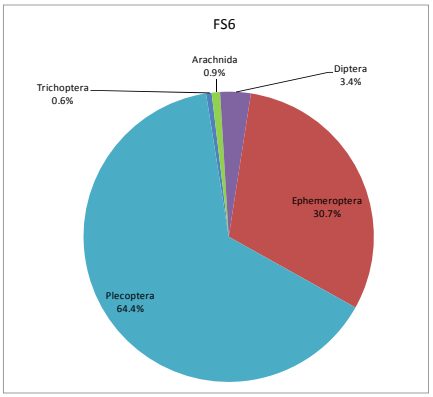
Z:\GIS DATA\Projects\1021_MacTung\Fisheries\2007 Map Documents\2007 Fisheries Sites Fig 3.mxd

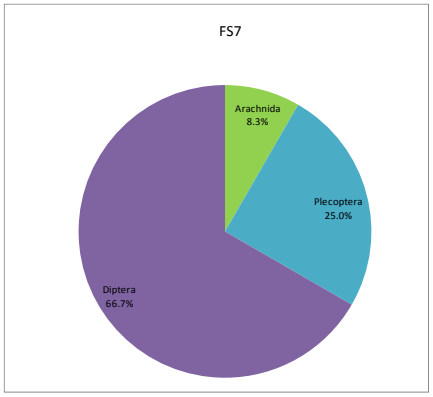


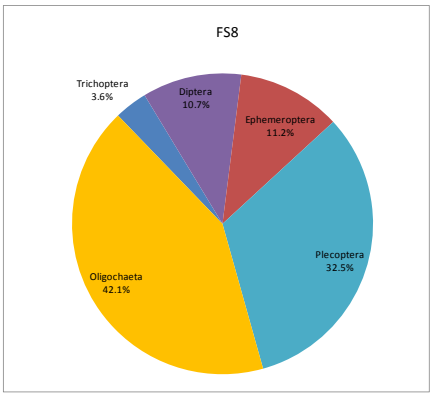


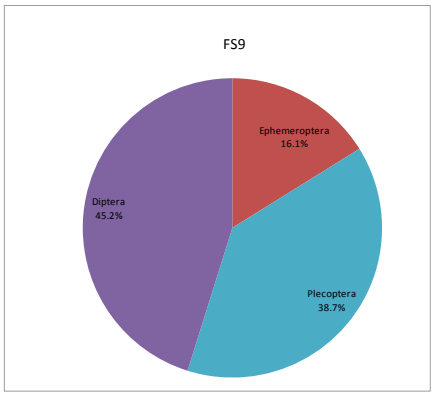












LEGEND

Figures represent composite data for 3 replicates at each particular fisheries station.

NOTES

CLIENT

North American Tungsten Ltd.

EBA Engineering Consultants Ltd.

MacTung Project
2007 Fisheries and Aquatics Baseline Studies

Benthic Macroinvertebrate Community Composition by Major Taxonomic Group

PROJECT NO.	DWN	CKD	REV
W23101021.005	CJJ	RH	1
OFFICE: EBA-WHSE	DATE: Dec 8, 2007		

Figure 4

PHOTOGRAPHS

Photograph 1: Fish sampling in the Tsichu River, east of the project area. Photo taken August 17, 2007.

Photograph 2: A modified pole net with 3 mm mesh netting used to capture fish during electrofishing in fast currents. Photo taken August 14, 2007.

Photograph 3: Sampling of benthic macroinvertebrates using a Hess sampler at FS7.

Photograph 4: Upstream channel view at FS6 (looking East). Photograph taken August 16, 2007.

Photograph 5: Downstream channel view at FS6 (Looking West). Photograph taken August 16, 2007.

Photograph 6: Typical channel substrate at FS6. Photograph taken August 16, 2007.

Photograph 7: A 213 mm dolly varden taken by electrofishing at FS6 (Note the reproductive coloration). Photograph taken August 16, 2007.

Photograph 8: A 272 mm male dolly varden taken from near FS6 by angling (Note the mature, ripe state of testes, shown by the arrow). Photograph taken August 16, 2007.

Photograph 9: Upstream channel view at FS7 (looking Southeast). Photograph taken August 15, 2007.

Photograph 10: Downstream channel view at FS7 (Looking Northwest). Photograph taken August 15, 2007.

Photograph 11: View of the white growth accumulating along the channel at FS7. Photograph taken August 15, 2007.

Photograph 12: Aerial view of a typical channel segment at FS7 (looking Southeast). Photograph taken August 15, 2007.

Photograph 13: Typical channel substrate at FS7. Photograph taken August 15, 2007.

Photograph 14: Upstream channel view at FS8 (looking East). Photograph taken August 16, 2007.

Photograph 15: Downstream channel view at FS8 (Looking West). Photograph taken August 16, 2007.

Photograph 16: Aerial view of a typical channel segment at FS8 (looking East). Photograph taken August 16, 2007.

Photograph 17: A 91 mm dolly varden taken by electrofishing at FS8. Photograph taken August 16, 2007.

Photograph 18: A 47 mm juvenile salmonid taken while electrofishing at FS8. Photograph taken August 16, 2007.

Photograph 19: Aerial view of a typical reach of the Hess River near FS9. Photograph taken Augsut 14 2007.

Photograph 20: Aerial view of the sampling location at FS9. Photograph taken Agust 14, 2007.

Photograph 21: Typical channel substrate at FS9. Photograph taken August 14, 2007

Photograph 22. A 50 mm Arctic grayling taken while electrofishing at FS9. Photograph taken August 14, 2007.

Photograph 23: Upstream channel view at FS10 (looking East). Photograph taken August 18, 2007.

Photograph 24: Upstream channel view at FS10 (looking West). Photograph taken August 18, 2007.

Photograph 25: Aerial view of a typical channel segment at FS10 (looking East). Photograph taken August 18, 2007.

Photograph 26: View upstream from FS1, looking west. Photograph taken August 17, 2007.

Photograph 27: View downstream (east) from FS1. Photograph taken August 17, 2007.

Photograph 28: Aerial view of typical channel segment near FS1 (looking downstream). Photograph taken August 17, 2007.

Photograph 29: Typical channel substrate at FS1. Photograph taken August 17, 2007.

Photograph 30: Upstream channel view taken from FS2 (looking northwest). Photograph taken August 18, 2007.

Photograph 31: Downstream channel view taken from FS1 (looking Southeast). Photograph taken August 18, 2007.

Photograph 32: Aerial view of a typical channel segment at FS2 (looking Northwest). Photograph taken August 18, 2007.

Photograph 33: Typical channel substrate at FS2. Photograph taken August 18, 2007.

Photograph 34: Upstream channel view at FS3 (looking West). Photograph taken August 17, 2007.

Photograph 35: Downstream channel view at FS3 (looking East). Photograph taken August 17, 2007.

Photograph 36: Aerial view of a typical channel segment at FS3 (looking Southwest). Photograph taken August 17, 2007.

Photograph 37: Typical channel substrate at FS3. Photograph taken August 17, 2007.

Photograph 38: Upstream channel view at FS5 (looking West). Photograph taken August 17, 2007.

Photograph 39: Downstream channel view at FS5 (looking East). Photograph taken August 17, 2007.

Photograph 40: Aerial view of a typical channel segment at FS5 (looking Southwest). Photograph taken August 17, 2007.

Photograph 41: Typical channel substrate at FS5. Photograph taken August 17, 2007.

Photograph 42: 194 mm bull trout captured by electrofishing at FS5. Photograph taken August 17, 2007.

Photograph 43: Upstream channel view at FS11 (looking West). Photograph taken August 18, 2007.

Photograph 44: Downstream channel view at FS11 (Looking East). Photograph taken August 18, 2007.

Photograph 45: Typical undercut bank habitat at FS11. Photograph taken August 18, 2007.

Photograph 46: Aerial view of a typical channel segment at FS11 (looking Southwest). Photograph taken August 18, 2007.

APPENDIX

APPENDIX A LICENSE TO COLLECT FISH IN THE YUKON #CL-07-03

License to Collect Fish
Pursuant to Part VII of the Fishery (General) Regulations
Yukon/Transboundary Rivers Area
Fisheries and Oceans Canada
PHONE (867)393-6722
FAX (867)393-6738

License No. CL-07-03 **Date Issued:** April 13, 2007

License Holder:	Tim Abercrombie
Company/Institution:	EBA Engineering Consultants Ltd.
Address:	#6-151 Industrial Road Whitehorse, Yukon Y1A 2U3 Phone: (867) 668-3068 Fax: (867) 668-4349 Email: njacques@eba.ca
Assistants:	Nicole Jacques Chris Jastrebski

The following conditions will apply to this license:

1. **Purpose:** To document existing environmental conditions in the MacTung Project area, including fish and fish habitat assessment.

2. **Samplers:** It is the responsibility if the license holder to ensure that samplers are experienced and competent in the fish collection methods authorized in this license.

3. **Collection Period:** From August 1 to September 30, 2007. This license is subject to immediate termination upon written or verbal notice from a representative of the Yukon Government- Department of Environment, or of Fisheries and Oceans Canada.

3. **Species/Life Stages/Quantity:** All species and life stages may be captured under authority of this license.

4. **Collection Area:** Hess River and unnamed tributaries to the Hess River in the Yukon River drainage only.

5. **Collection Methods:** Electrofishing

6. **Marking of gear:** All gear left unattended must be clearly labelled CL-07-03

7. **Notice:** Prior to commencing sampling, notice is to be given to:

   - Fisheries and Oceans Canada, Yukon/Transboundary Rivers Area
     Tel: (867) 393-6722 Fax (867) 393-6738
   - Susan Thompson, YTG Fisheries
     Tel: (867) 667-5199 Fax (867) 393-6263
   - All First Nations Governments which have responsibility over the traditional territories where sampling will take place.

- **Note:** Notice is also to be given to the Government of Yukon Conservation Officer responsible for any area where sampling is to take place at least 24 hours prior to the start of sampling.

The following information is to be included:

i. The Collection License number,
ii. The watercourse or water body on which, and the location where the sampling is to take place,
iii. The dates on which sampling will occur.

8. **Disposition of fish:** Any fish captured and retained under the authority of this license are not to enter any commercial markets or establishments. Any fish collected and retained, or incidental mortalities associated with non-lethal sampling, are not to be utilized for human consumption or personal use purposes unless authorized by Fisheries & Oceans Canada.

9. **Release of fish:** All live fish must be released unharmed into the water body or course from which they originated and as near as possible to the location from which they were sampled. Exception to this is where fish are retained for identification or forensic purposes.

10. **Transport or transplant of live fish and/or eggs/milt:** Live fish and/or eggs (spawn) cannot be transported without prior written approval of the transplant committee or transplanted without a licence granted pursuant to Section 56 of the Fishery (General) Regulations.

11. **Need to carry and produce permit:** A copy of this license must be in the immediate possession of the samplers during sampling, and must be produced upon the request of any representative designated as a Fishery Officer or Fishery Guardian pursuant to the Fisheries Act (Canada).

12. **Report:** A report must be submitted after completion of sampling. The report may be in the form of photocopied data sheets or field notes, or as the final report for the project, and must include the following:

a. The Collection License number
b. The location(s) of the sampling. A map may be used, or the location described in detail;
c. The dates on which the sampling occurred;
d. The number of fish sampled, by species;
e. Any mortalities

The report is to be submitted by December 31, 2007 to:

Paul Christensen
A/Senior Habitat Biologist
Fisheries and Oceans Canada
100-419 Range Rd
Whitehorse Yukon
Y1A 3V1
Fax (867) 393-6737
christensenp@dfo-mpo.gc.ca

Authorized by:

Frank Quinn
Area Director

Frank Quinn
Area Director, Yukon / Transboundary Rivers Area

APPENDIX

APPENDIX B LICENSE TO COLLECT FISH IN NORTHWEST TERRITORIES #S 07/08-2032-HR

Fisheries and Oceans Canada | Pêches et Océans Canada

Fax

Western Arctic Area
Central and Arctic Region
42043 Mackenzie Highway
Hay River, NWT
X0E 0R9

Région de l'Arctique
Région du Centre et de l'Arctique
Gestion des Péches

Tel: 867-875-5303
Fax: 867-874-6922

To: Richard Hoos **Fax: (604) 684-6241**
Cc: Shirley Standafer-Pfister **Fax: (867) 873-3324**

Date: June 22, 2007 **License Number: S-07/08-2032-HR**

Pages: including cover sheet: 4

You have been issued a license to collect fish for scientific purposes. Please read the conditions in the permit and ensure that all personnel in your field crew understand the requirements as listed in the license.
Please be advised that you require an amendment to your license if you want to make changes to the conditions of the license or if you add/change personnel listed on your license to work on the field component of your project.
If you have such a requirement, please contact the licensing coordinator by e-mail, fax or letter.
A copy of the license must be available at the fishing site and produced at the request of a fishery officer.

Please note that a permit to conduct scientific studies within the Northwest Territories must be obtained from the Aurora Research Institute before fish collections authorized under this DFO license may commence.

Fisheries and Oceans Canada / Pêches et Océans Canada

Licence #: S-07/08-2032-HR

Richard Hoos
1066 West Hastings Street
Vancouver, BC, Canada V6E 3X2

Dear Richard Hoos,

Enclosed please find licence to fish for scientific purposes, pursuant to Section 52 of the Fishery (General) Regulations It is understood that you have received written support from the Hunter and Trapper Organization in communities closest to your area of study and, if required by the type of research you are undertaking, applied to and received a Scientific Research licence from the Aurora Research Institute.
I wish you continued success with your research and look forward to receiving your report upon completion of your work under this licence.

Yours truly,

Western Arctic Area Director
Central and Arctic Region
Fisheries and Oceans Canada

22 June 2007
Date

Enclosure

Central and Arctic Region
42043 MacKenzie Hwy
Hay River, NT X0E 0R0
(867) 875-5303

Région du Centre et de l'Arctique
42043 MacKenzie Hwy
Hay River, NT X0E 0R0
(867) 875-5303

Fisheries and Oceans Canada | Pêches et Océans Canada

LICENCE TO FISH FOR SCIENTIFIC PURPOSES

S-07/08-2032-HR

Pursuant to Section 52 of the Fishery (General) Regulations, the Minister of Fisheries and Oceans hereby authorizes the individual(s) listed below to fish for scientific purposes, subject to the conditions specified.

Project Authority: Richard Hoos — EBA Engineering Consultants
1066 West Hastings Street
Vancouver, BC, Canada V6E 3X2

Other Personnel: T. Abercrombie, J. Slogan, K. Langlois, B. Draho and S. Moore.

Objectives: To collect baseline information on the fish species at the Mactung Project mine area.

CONDITIONS

Specified Conditions:

The use of a Hess invertebrate sampler is allowed for use under this permit for the collection of benthic invertebrates. Use of an electrofisher is also permitted to catch fish.

Waters: The study area includes waters of Upper Dale Creek, Cirque Creek, Cirque Lake and Tsichu River within 5 km of 63-16-46N, 130-10-00W on the Northwest Territories side of the NWT/Yukon border.

Unnamed Waterbody (Cirque Lake) (63° 16' N, 130° 10' W)

Species	Gear Type	Weight (kg)	No. Alive	No. Dead
Arctic Grayling	See Conditions		50	10
Benthos	See Conditions	1.000		
Burbot	See Conditions		50	10
Dolly Varden (Landlocked)	See Conditions		50	10
Sculpin, Slimy	See Conditions		50	10
Trout, Lake	See Conditions		50	10
Whitefish, Mountain	See Conditions		50	10

Number of Tows: **Number of Sets:**

Fishing Period: June 23, 2007 to October 01, 2007

A copy of this licence must be available at the study site and produced at the request of a fishery officer.

Fish not required for the "dead sample" may be "live sampled" and released unharmed at the capture site.

The licence holder shall immediately cease fishing when the number of fish killed or live sampled reaches any of the maximums set for any of the species listed.

Transportation:

Other approvals/permits may be necessary to collect or transport certain species, such as Marine Mammal Transportation Permits. For marine mammal parts, products and derivatives a Marine Mammal Transportation Licence is required for domestic transport and, for international transport a Canadian CITES Export Permit is also required.

Central and Arctic Region
42043 MacKenzie Hwy
Hay River, NT X0E 0R0
(867) 875-5303

Région du Centre et de l'Arctique
42043 MacKenzie Hwy
Hay River, NT X0E 0R0
(867) 875-5303

Fisheries and Oceans Canada | Pêches et Océans Canada

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Disposal of Fish:

Fish taken may not be traded, bartered or sold. Disposal of any fish remains must be in accordance with local land use regulations. Edible material should be made available to the nearest settlement for domestic consumption. Live unharmed fish are to be returned to the water at the site of capture.

Report on Activities:

The Project Authority will provide the Scientific Licence Coordinator, Department of Fisheries and Oceans, within one month of the expiry date, with a report stating:

i) whether or not the field work was conducted; and if conducted
ii) waterbody location, fishing coordinates, gear types used at each coordinate. numbers or amount of fish (by species) collected and/or marked and the date or period of collection.

The Project Authority also will provide a copy of any published or public access documents which result from the project. Information supplied will be used for population management purposes by the Department of Fisheries and Oceans and becomes part of the public record.

Notification of Commencement:

Prior to the commencement of fishing the Project Authority will contact:

Fisheries Management Biologist
Fisheries and Oceans Canada
42043 MacKenzie Hwy
Hay River, NT X0E 0R9
Phone: (867) 875-5301 Fax: (867) 874-6922

22 June, 2007
Date

Western Arctic Area Director
Central and Arctic Region
Fisheries and Oceans Canada

For the Minister of Fisheries and Oceans.
Pursuant to Section 52 of the Fishery (General) Regulations

APPENDIX

APPENDIX C FISH CAPTURE DATA FROM THE 2007 MACTUNG FISHERIES AND AQUATICS PROGRAM.

APPENDIX C: FISH CAPTURE DATA FROM THE 2007 MACTUNG FISHERIES AND AQUATICS PROGRAM.

Year	Month	Day	Fisheries Station	Species†	FLEN (mm)	WT (g)	Status	Effort	Notes
2007	8	14	FS9	AG	152	32	RA	1	
2007	8	14	FS9	AG	50	2	K	1	
2007	8	14	FS9	SSc	78	6	K	1	
2007	8	14	FS9	SSc	89	6	RA	1	
2007	8	14	FS9	SSc	92	7	RA	1	
2007	8	14	FS9	AG	165	48	RA	2	
2007	8	14	FS9	AG	174	54	RA	2	
2007	8	14	FS9	AG	141	28	RA	2	
2007	8	14	FS9	SSc	78	4	RA	2	
2007	8	14	FS9	SSc	61	2	RA	2	
2007	8	14	FS9	SSc	43	<1	RA	2	
2007	8	14	FS9	SSc	44	<1	RA	2	
2007	8	16	FS8	SSc	99	10	RA	1	
2007	8	16	FS8	SSc	93	6	RA	1	
2007	8	16	FS8	SSc	104	10	RA	1	
2007	8	16	FS8	SSc	41	<1	RA	1	
2007	8	16	FS8	SSc	93	8	RA	1	
2007	8	16	FS8	SSc	95	8	RA	1	
2007	8	16	FS8	SSc	105	10	RA	1	
2007	8	16	FS8	AG	228	114	RA	1	
2007	8	16	FS8	SSc	79	4	RA	1	
2007	8	16	FS8	SSc	78	4	RA	1	
2007	8	16	FS8	SSc	103	10	RA	1	
2007	8	16	FS8	AG	191	86	RA	1	
2007	8	16	FS8	AG	168	50	RA	1	
2007	8	16	FS8	DV	131	22	RA	1	
2007	8	16	FS8	DV	47	<1	RA	1	
2007	8	16	FS8	AG	307	322	RA	2	

APPENDIX C: FISH CAPTURE DATA FROM THE 2007 MACTUNG FISHERIES AND AQUATICS PROGRAM.

Year	Month	Day	Fisheries Station	Species†	FLEN (mm)	WT (g)	Status	Effort	Notes
2007	8	16	FS8	SSc	97	8	RA	2	
2007	8	16	FS8	SSc	94	6	RA	2	
2007	8	16	FS8	SSc	65	2	RA	2	
2007	8	16	FS8	SSc	76	4	RA	2	
2007	8	16	FS8	SSc	60	<1	RA	2	
2007	8	16	FS8	SSc	67	2	RA	2	
2007	8	16	FS8	SSc	54	<1	RA	2	
2007	8	16	FS8	DV	91	6	RA	2	
2007	8	16	FS6	DV	272	196	K	1	Angled From deep pool
2007	8	16	FS6	DV	213	108	RA	2	
2007	8	16	FS6	DV	164	40	RA	2	
2007	8	16	FS6	DV	183	66	RA	2	
2007	8	17	FS1	SSc	103	12	RA	1	
2007	8	17	FS1	SSc	89	6	RA	1	
2007	8	17	FS1	SSc	71	2	RA	1	
2007	8	17	FS1	BT	172	54	RA	1	
2007	8	17	FS5	SSc	58	1	RA	1	
2007	8	17	FS5	SSc	74	2	RA	1	
2007	8	17	FS5	SSc	44	<1	RA	1	
2007	8	17	FS5	BT	194	70	RA	1	
2007	8	18	FS9	SSc			RA	1	
2007	8	18	FS11	BT	173	48	RA	1	

† Species code legend: AG – Arctic grayling (*Thymallus arcticus*), BT – bull trout (*Salvelinus confluentus*), DV – dolly varden (*Salvelinus malma*), SSc – slimy sculpin (*Cottus cognatus*).

APPENDIX

APPENDIX D RAW BENTHIC MACROINVERTEBRATE DATA FROM THE 2007 MACTUNG FISHERIES AND AQUATICS PROGRAM

				FS1			FS2			FS3			FS5			FS6			FS7			FS8			FS9		
Order/Class	**Family**	**Genus**	Stage	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Ephemeroptera	Amaletidae	Ameletus	nymph													1	3	86					1	1			
Ephemeroptera	Baetidae	Baetis	nymph								1	1															
Ephemeroptera	Baetidae	Baetis bicaudatus	nymph	1	4	5							1														
Ephemeroptera	Ephemerellidae	Ephemerella	nymph																					2			
Ephemeroptera	Ephemerellidae	Drunella doddsi	nymph																				3				
Ephemeroptera	Heptageniidae	Unk.	juv nymph	2			1		1																1		
Ephemeroptera	Heptageniidae	Cinygmula	nymph														3	1					1	6			
Ephemeroptera	Heptageniidae	Epeorus	nymph	1		2							8	3	3							2					
Ephemeroptera	Heptageniidae	Rhythrogena	nymph		2	1										1	4						5	3			2
Plecoptera	Leuctridae		nymph	7	3	5																					
Plecoptera	Capniidae		nymph																			13	17	21	1	1	1
Plecoptera	Chloroperlidae	Sweltsa sp.	nymph																				1				
Plecoptera	Chloroperlidae	Suwallia sp.	nymph																			1	5	4			
Plecoptera	Chloroperlidae	Alloperla fraterna	larvae	102	88	77	9	27	34	7	8	4	39	23	27	7	125	62							3	1	1
Plecoptera	Perlodidae		nymph											1											2		1
Plecoptera	Perlodidae	Megarcys sp.	nymph																					1			
Plecoptera	Nemouridae	Zapada haysi/oregonensis		16	12	13	1	1	1				4	1			5	9	1	1	1						1
Plecoptera	Nemouridae	Nemoura sp.	nymph							1	1																
Plecoptera	Taenyopterygidae		nymph			2							3	3	2								1				
Trichoptera			juv larvae																				1				
Trichoptera	Glossosomatidae	Glossosoma sp.	larvae		2			1						3	1							2	2	1			
Trichoptera	Limnephilidae		juv larvae									1					2										
Trichoptera	Hydropsychidae	Parapsyche sp.	larvae																			1					
Diptera			adult				1			3	4	4															
Diptera	Chironomidae		pupae				19	2																			
Diptera	Chironomidae		larvae							1										3							
Diptera	Chironomidae	s/f Orthocladinae	juv			1											1	4									
Diptera	Chironomidae	s/f Orthocladinae	larvae								1		4														1
Diptera	Chironomidae	Cricotopus/Orthocladius sp.	larvae	4	1		1	1		1		1											9	8			
Diptera	Chironomidae	Eukiefferiella sp.																	2								
Diptera	Chironomidae	Tvetenia sp.	larvae											14													
Diptera	Chironomidae	Micropsectra sp.	larvae											1	1												
Diptera	Diamesinae	Diamesa sp.	larvae	32	22	36	64	93	69	1			13		12	1					1				6	1	1
Diptera	Diamesinae	Pagastia sp.	larvae		1	7	1	1	3				47	37	54					1							
Diptera	Tipulidae	Rhabdomastix sp.	larvae																	1			1				
Diptera	Empididae	Oreogeton sp.	larvae	6	2	3	4	2	2									5									
Diptera	Simulidae		pupae	2																		1		2		2	
Diptera	Simulidae	Simulium sp.	larvae																						2		
Diptera	Simulidae	Simulium sp.	pupae																						1		
Collembola	Isotomidae					1								1													
Crustacea, Copepoda	Cyclopoida						168	245	175																		
Oligochaeta	Lumbriculiidae	Rhynchelmis sp																				11	47	25			
Arachnica	Trombidiformes	Sperchon sp.				3						1					1	1									
Arachnica	Trombidiformes	Lebertia sp.		1																							
Arachnica	Oribatidae	Hydrozetes sp.								1																	
Arachnica	Feltridae	Feltria sp.		1												1				1							
Total # Individuals/Sample				**175**	**137**	**156**	**269**	**373**	**285**	**15**	**15**	**12**	**119**	**87**	**100**	**11**	**144**	**168**	**3**	**7**	**2**	**31**	**90**	**76**	**16**	**7**	**8**

Taxonomist: Sue Salter, R.P.Bio. - Cordillera Consulting