YUKON *ENVIRONMENTAL ASSESSMENT ACT* COMPREHENSIVE STUDY REPORT (DRAFT)

FOR THE

CARMACKS COPPER MINING PROJECT

Prepared by:

DEVELOPMENT ASSESSMENT BRANCH, EXECUTIVE COUNCIL OFFICE
&
ENERGY MINES AND RESOURCES
AS RESPONSIBLE AUTHORITIES FOR THE PROJECT

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Yukon
Executive Council Office

Executive Summary

The Project

The Carmacks Copper mine is a proposed open pit copper mine with a maximum production rate of 9,872 tonnes per day for up to 230 days per year for eight years. High purity copper cathodes will be transported via trucks to the ice-free port of Skagway, AK.

The Carmacks Copper mine is located about 9 km west of the Yukon River and 38 km northwest of the Village of Carmacks and is accessible by an existing exploration road that leads north off of the Freegold Road.

The mine facilities include a solvent extraction and electro-winning (SX/EW) processing facility with an average production capacity of 14,310 tonnes per year of cathode copper, open pit mine, acid heap leach, acid plant, waste rock storage area, soil stockpiles, events pond, drainage ditches, sediment control ponds, haul roads, construction camp and other miscellaneous facilities to support mining operations.

Based on known reserves, the mine is expected to be in operation for approximately 8 years, with an additional 7 years dedicated to decommissioning and reclamation, closure and post-closure. The project is expected to directly employ on average 150 persons with a 226 peak during construction. Operation crews will work on a four days on/ four days off schedule. During the construction phase of development, standard on-site construction camp will house workers and during the operation phase, there will be a need to house those employees who do not either already live in Carmacks or who will move to the community.

The Environmental Assessment

The comprehensive study was triggered by Western Copper Corporation's submission of a Type A Water Use Licence application to the Yukon Water Board, and an application for a Quartz Mining Licence to the department of Energy, Mines and Resources in June 2005.

Both the Water Use Licence and Quartz Mining Licence applications trigger an environmental assessment pursuant to *Environmental Assessment Act*. Both authorizations are included in the Law List pursuant to *Environmental Assessment Act* and cannot be issued without an environmental assessment having been completed, with a determination that the project may proceed. A comprehensive study environmental assessment will apply to this project due to the daily ore tonnage processing rate of 3,000 tonnes per day or more.

The Yukon government confirmed its involvement in this comprehensive study by identifying two Responsible Authorities: the departments of Executive Council Office for the Water Use Licence and Energy, Mines and Resources for the Quartz Mining Licence. The Development Assessment Branch, Executive Council Office took the lead in coordinating the comprehensive study on behalf of both Responsible Authorities.

Western Copper Corporation submitted a Project Description and Environmental Assessment Report with their regulatory authorization applications. Based on a broad consultation on these documents, the Responsible Authorities issued an Additional Information Requirements to Western Copper Corporation in December 2005. In order for the Responsible Authorities to ensure that a project is not likely to contribute to a significant adverse environmental effect, the proponent must provide sufficient information and analysis to allow for the evaluation of the potential adverse effects of the proposed project. Western Copper Corporation has readily undertaken additional work to provide clarification and meet the information requirements as identified by the Responsible Authorities.

All technical comments received during the course of the comprehensive study were considered in the development of this report. Copies of all correspondence related to this screening are contained in a project Public Registry as required under the Yukon *Environmental Assessment Act*. Over the past 16 months a committee consisting of representatives from Yukon government, Environment Canada and Little Salmon Carmacks First Nation reviewed the additional technical information provided by the proponent.

The Carmacks Copper project is considered a 'transition project' and subject to assessment under the *Environmental Assessment Act* and the *Yukon Environmental and Socio-economic Assessment Act*. During this transition period, projects for which the assessment has not been completed under the Environmental Assessment Act, and associated permits have not been issued, will also be required to complete an assessment under the *Yukon Environmental and Socio-economic Assessment Act*. In February 2006, Western Copper Corporation submitted their project to the Yukon Environmental and Socio-economic Assessment Board for an Executive Committee screening; in February 2007 the project was deemed adequate and the environmental assessment commenced.

The Executive Committee of the Yukon Environmental and Socio-economic Assessment Board and the Development Assessment Branch, Executive Council has been working cooperatively over the past 20 months to ensure efficient information flows between the two assessment processes in an effort to reduce duplication and maximize available resources. Assessors of the Executive Committee had the opportunity to 'shadow' the technical committee that was developed for the comprehensive study.

As with any mine development, geochemical issues of acid rock drainage and metal leaching is of a concern. Due to the effects of acid rock drainage and metal leaching on water quality, water treatment and effluent discharge received extensive review. During operations, in case of emergencies, this project proposes the use of a contingency water treatment system to precipitate metals using a high density sludge process. At closure, based on test work completed to date, acid rock drainage and metal leaching from the heap pad, waste rock storage area and open pit are not anticipated after full implementation of mitigative measures, though further testing prior to permitting is required to fully investigate the nature of any acid rock drainage and metal leaching and appropriately implement the mitigative measures identified within the assessment and the project description. Additionally, extensive review was undertaken in the geotechnical and aspects of this project, focusing on the heap pad, events pond, waste rock storage area and the open pit.

The Carmacks Copper project proposes to use acid heap leaching techniques that are not commonly applied in Canada nor used in a northern setting. Due to the unique climate of the Yukon, the proponent is proposing a distinctly new and unproven approach to heap detoxification for which there are limited operating examples. Considerable focus of the environmental assessment for this project was to ensure that the heap pad could be detoxified and the objective for, ultimately, a 'walk-away' solution at closure is viable. Based on test work completed to date, the heap leach pad can be detoxified through water and alkali rinsing to remove the acidity and dissolved metals; further test work is currently being undertaken to better characterize the chemical potential, cyclical pH depression and the timelines for acceptable variability as well as specific processes that shall be undertaken during operations, detoxification and closure.

In addition to requiring mitigation measures to protect values within the project locale, follow-up programs have been specified in this report as a means of assessing, reporting and adapting mitigation measures to emerging mine conditions during all phases of the project. Criteria for decommissioning and reclamation plans and spill response are also specified.

Table of Contents

1.0 INTRODUCTION

The purpose of this comprehensive study is to summarize the results of an environmental assessment that was conducted on Western Copper Corporation's[1] Carmacks Copper project, a proposed open pit copper mine in the southwest Yukon. This screening was conducted pursuant to the (Yukon) *Environmental Assessment Act*.

1.1 PROJECT OVERVIEW

The Carmacks Copper mine is a proposed open pit copper mine with a maximum production rate of 9,872 tonnes per day for up to 230 days per year for eight years. High purity copper cathodes will be transported via trucks to the ice-free port of Skagway, AK.

The Carmacks Copper mine is located about 9 km west of the Yukon River and 38 km northwest of the Village of Carmacks and is accessible by an existing exploration road that leads north off of the Freegold Road.

The mine facilities include a solvent extraction and electro-winning (SX/EW) processing facility with an average production capacity of 14,310 tonnes per year of cathode copper, open pit mine, acid heap leach, acid plant, waste rock storage area, soil stockpiles, events pond, drainage ditches, sediment control ponds, haul roads, construction camp and other miscellaneous facilities to support mining operations.

Based on known reserves, the mine is expected to be in operation for approximately 8 years, with an additional 7 years dedicated to decommissioning and reclamation, closure and post-closure. The project is expected to directly employ on average 150 persons with a 226 peak during construction. Operation crews will work on a four days on/ four days off schedule. During the construction phase of development, standard on-site construction camp will house workers and during the operation phase, there will be a need to house those employees who do not either already live in Carmacks or who will move to the community.

1.2 PURPOSE OF THE PROJECT

The purpose of the Carmacks Copper project is for the mining and extraction of metals.

1.3 NEED FOR THE PROJECT

Under the Yukon *Environmental Assessment Act* the Responsible Authorities have discretion whether or not to consider a need for the project in the scope of the assessment. It is the Responsible Authorities discretion to not consider need for the project in the comprehensive study.

1.4 REGULATORY CONTEXT

[1] Since the commencement of the environmental assessment, Western Copper Corporation has become a successor company of Western Silver Corporation, acquired by Glamis Gold Ltd. in May 2006. Western Copper Corporation holds 100% of the Carmacks Copper Project. For the purposes of this assessment, the 'company, proponent or Western Copper' is in reference to the Western Copper Corporation.

The comprehensive study was triggered by Western Copper Corporation's submission of a Type A Water Use Licence application to the Yukon Water Board, and an application for a Quartz Mining Licence to the department of Energy, Mines and Resources in June 2005.

Both the Water Use Licence and Quartz Mining Licence applications trigger an environmental assessment pursuant to *Environmental Assessment Act*. Both authorizations are included in the Law List pursuant to *Environmental Assessment Act* and cannot be issued without an environmental assessment having been completed, with a determination that the project may proceed. A comprehensive study environmental assessment will apply to this project due to the daily ore tonnage processing rate of 3,000 tonnes per day or more.

The Yukon government confirmed its involvement in this comprehensive study by identifying two Responsible Authorities: the departments of Executive Council Office for the Water Use Licence and Energy, Mines and Resources for the Quartz Mining Licence. The Development Assessment Branch, Executive Council Office took the lead in coordinating the comprehensive study on behalf of both Responsible Authorities. In the summer of 2005, Executive Council Office undertook an exercise to identify other potential Responsible Authorities and expert authorities within Yukon and federal governments pursuant to the Territorial Coordination Regulations, the Federal Coordination Regulations and the Canada/ Yukon Harmonization Agreement on environment assessment. This coordination step enables all the Responsible Authorities to work together to develop a common comprehensive study, suitable to governments and avoid duplication. As informed by fax to the Canadian Environmental Assessment Agency in July 2005, Natural Resources Canada indicated that they do not have a responsibility under section 5 of the *Canadian Environmental Assessment Act* with regard to the scope of the project. Similarly, Transport Canada indicated that Merrice Creek, Williams Creek and North Williams Creek are non-navigable and therefore an application is not required under the *Navigable Waters Protection Act.* As such, no federal authorities have been identified as Responsible Authorities for this project.

Departments in both the Yukon government (i.e.: Highways and Public Works, Tourism Branch and Environment) and federal government (i.e.: Environment Canada) identified themselves as expert or technical authorities who could contribute specialized advice to the Responsible Authorities undertaking this comprehensive study. No other federal or Yukon agency declared themselves as a Responsible Authority for this project.

In August 2005, Executive Council Office sought public comment and input on the Carmacks Copper project. The Public Consultation Document provided information on the proposed project and approach to the environmental assessment by the Yukon government. It outlines information on the environmental assessment process as set out in the Yukon *Environmental Assessment Act* and it is intended to assist the public in preparing comments on the project. The distribution list included:

- Territorial government and regulators: Yukon Water Board, Departments of Environment, Community Services, Energy, Mines and Resources, Economic Development, Education, Health and Social Services, Highways and Public Works, Justice, Tourism and Culture and Yukon Workers' Compensation Health and Safety Board
- First Nation governments: Council of Yukon First Nations, Little Salmon Carmacks First Nation and Selkirk First Nation
- Federal government: Department of Fisheries and Oceans, Department of Indian and Northern Affairs, Department of Environment, Department of Transport and Parks Canada
- Municipal government: Village of Carmacks
- Non-governmental organizations: Canadian Parks and Wilderness Society, Yukon Chamber of Mines, Yukon Conservation Society, Yukon Fish and Wildlife Management Board, Yukon River Intertribal Watershed Council and Yukon Salmon Committee

This information was considered in further information requests of the proponent and development of the comprehensive study for the Carmacks Copper project.

1.5 YUKON ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT ACT

The Carmacks Copper project is considered a 'transition project' and subject to assessment under the *Environmental Assessment Act* and the *Yukon Environmental and Socio-economic Assessment Act*. During this transition period, projects for which the assessment has not been completed under the *Environmental Assessment Act*, and associated permits have not been issued, will also be required to complete an assessment under the *Yukon Environmental and Socio-economic Assessment Act*. In February 2006, Western Copper Corporation submitted their project to the Yukon Environmental and Socio-economic Assessment Board for an Executive Committee screening; in February 2007 the project was deemed adequate and the environmental and socio-economic assessment commenced.

The Executive Committee of the Yukon Environmental and Socio-economic Assessment Board and the Development Assessment Branch, Executive Council has been working cooperatively over the past 20 months to ensure efficient information flows between the two assessment processes in an effort to reduce duplication and maximize available resources.

1.6 PROJECT SCOPE

The scope of the project refers to the various components of the proposed undertaking or activities that will be considered as the project for the purposes of the comprehensive study.

Subsection 11(1) of the *Environmental Assessment Act* requires the Responsible Authorities (Responsible Authorities) to determine the scope of the project in relation to which an environmental assessment is to be conducted. Subsection 11(3) of the *Environmental Assessment Act* requires that where a project is in relation to a physical work:

"…an environmental assessment shall be conducted in respect of every construction, operation, modification, decommissioning, abandonment or other undertaking in relation to that physical work that is proposed by the proponent or that is, in the opinion of the responsible authority…likely to be carried out in relation to that physical work."

For this project this includes:

- Access;
- Waste rock handling and storage (permanent and temporary);
- Processing;
- Heap pad management;
- Fuel handling and storage;
- Power generation and transmission facilities;
- Explosives manufacturing and storage facilities and associated infrastructure;
- Borrow pits;
- Water sources, use and release, water control/ management structures and treatment facilities;
- Landfill;
- SX/EW processing facilities and solution management;
- Acid plant;
- Deposition of gaseous, solid and liquid wastes;
- Ore storage areas, stockpiles and transfer pads;

- Site facilities and infrastructure including camp and maintenance facilities, fuel and hazardous waste storage areas, solid waste and liquid domestic waste management facilities;
- Valued Ecosystem and Cultural Components potentially affected by the project;
- Site transportation routes including access road, ore haul road, and all other roads and trails;
- Off-site transportation routes including haul route (spills, safety and infrastructure requirements); and,
- Decommissioning.

The scope of this project will include all undertakings involved with the physical works and activities related to the development, construction, operation, decommissioning, care and maintenance, closure and post closure of the proposed Carmacks Copper Mining Project. In June 2005, the proponent provided the original project description and environmental assessment report which was updated and supplemented through various reports, additional information submissions and reviews. For the purposes of this comprehensive study all of this documentation, including the '*Project Proposal – Revision No. 2*' provided by the proponent to the Yukon Environmental and Socio-economic Assessment Board for an Executive Committee screening under the *Yukon Environmental and Socio-economic Assessment Act* has been taken into consideration and is the basis for this assessment pursuant to the Yukon *Environmental Assessment Act*.

1.7 OUTSIDE THE PROJECT SCOPE

In order to clearly state the scope of the project this section will layout components, mentioned in the company's project description, which will not be considered as part of the project for the purpose of this assessment.

The following components will **not** be considered in the scope:

- The proposed Freegold Road bypass
- Possible upgrade of the Freegold Road
- Proposed Yukon Energy Corporation transmission line to the site
- Socio-economic effects not related to an environmental effect

1.8 ASSESSMENT SCOPE

Subsection 12(1) of the *Environmental Assessment Act* requires that environmental assessments consider the following factors:

> (a) the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
>
> (b) the significance of the effects referred to in paragraph (a);
>
> (c) comments from the public that are received in accordance with this Act and the regulations;
>
> (d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and
>
> (e) any other matter relevant to the screening, comprehensive study, mediation, or assessment by a review panel, such as the need for the project and alternatives to the project, that the responsible

authority or, except in the case of a screening, the Minister after consulting with the responsible authority may require to be considered.

In relation to (e) above, the Responsible Authorities have not included any additional matters within the scope of the assessment.

In addition to the factors set out in subsection (1) above, every comprehensive study of a project and every mediation or assessment by a review panel shall include a consideration of the following factors:

(a) the purpose of the project;

(b) alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;

(c) the need for, and the requirements of, any follow-up program in respect of the project; and

(d) the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.

1.9 SOCIO-ECONOMIC FACTORS

A socio-economic effect as defined in the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA) includes effects on economies, health, culture, traditions, lifestyles, and heritage resources. The scope of assessments under *Environmental Assessment Act* does not consider socio-economic effects that do not result from changes in the environment. In the case of this project, the social and economic effects that result from changes to the environment (as described in *Environmental Assessment Act*) will be considered in the scope of the assessment. Accordingly, changes to the local social and economic conditions, beyond those arising from environmental changes, are **not** included in the scope of this *Environmental Assessment Act* assessment.

It should be noted that while socio-economic effects are not within the scope of this assessment beyond those resulting from changes in the environment, this project also requires an assessment under YESAA; any assessment under YESAA will require an examination of the direct socio-economic effects of a project.

1.10 DECOMMISSIONING

Subsection 11(1) of the *Environmental Assessment Act* requires the Responsible Authorities to scope decommissioning and abandonment of a project into the assessment. In doing so the Responsible Authorities must consider the technical and economic feasibility of the proposed decommissioning plan as it constitutes a measure to mitigate potential adverse environmental effects. Decommissioning of the site includes, but is not necessarily limited to the following components:

- Decommissioning of mine workings;
- Detoxification of the heap;
- Chemical and physical stability of all waste rock piles;
- Decommissioning and removal of site infrastructure;
- Re-vegetation of the site;
- Measures to limit access to the site in post-closure period (includes discussion of ‘gating’ and closure of road from Freegold Road to mine site);
- Continued monitoring of the site through the post-closure period; and

- Implementation of adaptive management plans as necessary during closure and post-closure period.

1.11 SPATIAL AND TEMPORAL BOUNDARIES

1.11.1 Spatial Boundaries

The spatial boundaries for assessment will be based on the potential geographic extent of effect. This boundary will encompass all mine infrastructures including the access road and waterways in the downstream flow path from the mine. For purposes of spill response all road routes to the site, including highways, will be included in the spatial boundary. Wildlife species shall be assessed on a regional context outside the boundaries described here.

1.11.2 Cumulative Effects

Environmental Assessment Act requires the Responsible Authorities to consider all cumulative effects associated with a project. Cumulative effects refer to those effects on the environment that result from effects of a project when combined with those of other past, existing, and imminent projects and activities. The spatial boundaries for assessing cumulative effects are the same as the boundaries proposed above for the environmental assessment.

1.11.3 Temporal Boundaries

The temporal boundaries of the assessment include the construction, operations, decommissioning and reclamation, closure, and post closure phases of the project. This includes an 8 year active mining phase and continuing for a timeframe until regulators determine that the site is stable and may be abandoned.

2.0 PROJECT DESCRIPTION

The following summary has been extracted from the "Western Copper Holdings Ltd., Carmacks Copper Project Description and Environmental Assessment Report" prepared initially by Access Consulting group in June 2005 and updated again in February 2006. The Project Description and Environmental Assessment Report has been updated and revised over the course of the past 18 months and the contents are reflective of these changes. The information provided here is a summary, for further details regarding the project description please reference the above mentioned documents.

2.1 BACKGROUND / INTRODUCTION

2.1.1 Location

The Carmacks Copper Project is located in the Dawson Range at latitude 62°-21'N and longitude 136°-41' W, some 200 km north of Whitehorse, Yukon. The project site is located adjacent to Williams Creek, 8 km west of the Yukon River, and some 38 km northwest of the Village of Carmacks. The site is accessible by an existing 13 km exploration road that leads north from km 33 of the secondary, government maintained roadway (Freegold Road) from Carmacks. Carmacks, on the Yukon River, is 175 km by paved road north of Whitehorse, which is 180 km north of the year-round port at Skagway, Alaska.

The existing project site exploration road from the Freegold Road will be utilized during the initial development of the project. A new 5 m wide project site access road will be constructed to the east of the exploration road alignment (currently cleared and grubbed).

2.1.2 History

In the proposed project area, the first report of copper was made in 1887 and the first claims were staked in 1898 on Williams Creek and Merrice Creek canyons, east of the present Carmacks Copper deposit. The discovery of a copper deposit 104 km northwest of the Carmacks Copper deposit precipitated a staking rush that led to the staking of the Williams Creek property in 1970.

In 1989, the property was optioned to Western Copper Holdings Ltd (subsequently became Western Silver and then Western Copper Corporation) and Thermal Exploration Company (TEC). During 1989 Western Copper and TEC collected 3 tonnes of surface oxide material for testing of leaching characteristics. In 1990, metallurgical tests were carried out and diamond drill holes were drilled. 1992/93 Pilot Test Plan demonstrated that copper can be leached successfully through heap leaching with a weak sulphuric acid solution.

In 1994 Western Copper began the permitting process and held preliminary economic development discussions with both the Yukon Government (YG) and the Little Salmon/Carmacks First Nation.

Western Copper continued geotechnical and engineering studies from 1996-1998. During 1997 the company cleared the access road; leach pad and plant site in preparation for a planned mine development in 1998. However, the development was suspended when copper prices fell that year. Also in 1997, Western Copper contracted Kilborn to carry out run-of-mine bulk sampling of the zone 1 deposit. Leaching and decommissioning test work was then carried out by Beattie Consulting Ltd. to provide a further basis for predicting copper recovery and neutralization requirements.

In 2001 DIAND Environment Directorate finalized the *Environmental Assessment and Review Process and Guidelines Order* (EARPGO) assessment of the project. The determination of this assessment was that the proposal would require further study and reassessment before authorization could be issued.

In June of 2005 Western Copper resubmitted a Project Description/Environmental Assessment Report for review under the Yukon *Environmental Assessment Act* thus triggering the Comprehensive study process under *Environmental Assessment Act*.

2.2 PROJECT COMPONENTS / STRUCTURES

The following sections describe the various components and structures that comprise the Carmacks Copper Project.

2.2.1 Open Pit

Mining will consist of a single open pit designed. The pit will be mined in 12 m benches at an average strip ratio of 4.6 tonnes of waste per tonne of ore. Reserves have been calculated as 13.3 million tonnes at an average grade of 0.97% total copper, at a marginal cutoff grade of 0.29% total copper. The resulting mine life will be 8 years.

The majority of the waste rock and all of the ore will most likely require mining by drilling and blasting. The near surface waste and topsoil will be ripped by bulldozers for removal.

2.2.2 Waste Rock Storage Area

The waste rock storage area is located immediately north of the open pit on a gentle, north east facing slope. The waste rock storage area covers an area of approximately 70 hectares and is designed to provide for permanent, secure storage and total confinement of the mine waste rock.

In consideration of the discontinuous permafrost and the expected thaw of soils below the waste dump, various options were considered for the area. Being of adequate size, configuration, proximity of haul and foundations allow for remediation, the area immediately north of the open pit will be stripped of its vegetative cover, which will allow the thaw to begin.

Ditches will transport the melt water and any seepage and surface runoff diverted around the area will be collected in the sediment control pond for treatment before discharge to the environment. The sediment control pond will provide storage for the 1 in 10 year 24 hour storm event and provide a spillway that can safely pass the 1 in 200 year 24 hour storm event.

A buffer zone around and beyond the dump will be maintained until year 4 of the mine development to permit thawing, monitor dump performance during development, and to permit possible installation of foundation improvements and other design contingencies as necessary. Such contingencies include construction of a stabilizing berm placed at the end toe of the dump and keyed into thaw stable material.

2.2.3 Heap Leach Operation

The heap leach facility has been designed for the valley heap leach method, which involves the preparation and placement of leach ore behind a confining embankment. Leaching of the ore will be performed with subsequent lifts progressing up slope. Excess solution storage capacity will be provided in an external solution pond designated the events pond, which is located down gradient from the heap leach pad.

Solutions from the leach pad will be collected by a network of solution pipes within the over-liner and conveyed to the events pond and/or directed to the process plant via gravity flow solution pipes.

The events pond will be connected to the leach pad via gravity flow solution pipes and a double lined spillway. Diversion ditches collect and convey runoff around the facility to a sediment control pond.

The operation of loading the heap and leach solution handling includes: the raffinate distribution, Pregnant Leach Solution collection, interconnecting piping, the heap stacking sequence, solution management and the liner system preliminary design.

2.2.4 Events Pond

Normally, solution will flow directly from the heap to the plant. When there is a high-rainfall or high-precipitation event, or when the plant cannot accept solution, the flow can be directed from the heap to the events pond. The events pond will have a capacity of approximately 160,000 m^3 to store the following combinations of events:

- The operating solution volume, plus
- Excess runoff inflows from the critical duration 100-yr return period event occurring at the most critical point in time, plus,
- An allowance for heap drain down as follows:
- During the first year of operation, 100% of the total potential heap drain down volume, or
- During subsequent years of operation, 48 hours of drain down at the full rate of solution application. For a solution application rate of 540 m^3/hr this volume is 26,000 m^3; and
- Redundant systems (i.e. pumps, power, spare parts).

The total available solution storage volume of 160,000m^3 will provide storage for 100% of the total potential drain down volumes in the winter months during the entire mine life.

Under normal operational conditions the events pond will contain only 14,000 m^3 (12 hrs) operational solution volume. During storm events, however, the pond will fill to some level above this (depending on the severity of the storm) and for the maximum storage level in the pond the maximum leakage rate would apply. In this case, the pumping rate of 235 m^3 per hour would be implemented in order to remove the excess solution in the pond and minimize the leakage rate into the leak detection and recovery system.

2.2.5 Processing Facilities

Copper will be extracted from the ore using conventional acid heap leach technology followed by solvent extraction for concentration of the resulting copper sulphate solutions and electrowinning (SX/EW) for the recovery of product cathode copper metal.

The projected operating schedule for ore from the mine, crushing plant and heap leach loading is 200 days per year. Solution processing facilities including solution flow to the heap, solvent extraction and electrowinning will operate year round.

2.2.5.1 Crushing

The crushing plant will be a modular, trailer mounted unit consisting of open circuit primary jaw crushing followed by open circuit secondary gyratory crushing. The plant will be composed of six trailers with interconnecting conveyors. Ore haul trucks will normally discharge into a 140 tonne capacity dump hopper fitted with a sloped stationary grizzly with 600 mm openings. Surge capacity for variations in the mine production schedule will be provided by a coarse ore stockpile located prior to the crusher.

2.2.5.2 Agglomeration

The ore, crushed to a nominal 25 mm, will be agglomerated with 5 kg of concentrated sulphuric acid per tonne of ore. Agglomeration is expected to bind the fine material to the coarse particles, thus preventing them from compacting in the pore space of the heap which could result in a loss of permeability. Agglomeration will be effected by applying a solution containing 350 g/L sulphuric acid (H_2SO_4) directly onto the ore at conveyor transfer points and mixed as it is transferred between portable conveyor sections.

2.2.5.3 Heap Leaching

The agglomerated ore will be leached by applying a sulphuric acid solution (raffinate from the solvent extraction circuit) to a section of the crushed ore for a period of time.

Distribution piping on the heap will be placed as new crushed ore becomes available. By leaching smaller increments of ore in succession, in 8 meter lifts, the variation in pregnant leach solution grade will be minimized.

Solution application in the summer months will be accomplished using drip or spray emitters placed on the surface of the heap. During the winter months, the drip emitters will be used exclusively and buried approximately 1.5 meters beneath the pad surface to prevent freezing.

2.2.5.4 Solvent Extraction

Pregnant leach solution will be channelled from the heap leach over-liner layer containing the network of perforated solution collection piping directly to the pregnant leach solution sumps and then flow by gravity to the solvent extraction plant. Fifty-five percent of the total pregnant leach solution flow will bypass the solvent extraction circuit and report to the raffinate tank. Water and makeup acid will be added to the raffinate pond. The raffinate will then be pumped to the heap at the full rate of approximately 540 m3/h. The remaining 232m3/h of pregnant leach solution will report to the solvent extraction circuit.

The extraction circuit consists of two mixer settlers in series and the stripping circuit consists of two stripping mixer settlers in series.

Pregnant leach solution entering the solvent extraction circuit will initially be contacted with organic solution in the E-1 mixer where the copper in the pregnant leach solution will be transferred to the organic solution.

Organic solution transfers the copper from the pregnant leach solution to the electrolyte. The electrolyte is a strong acid solution containing approximately 45 g/L copper from which the copper is recovered as cathode metal by electro-winning.

The overall process results in the transfer of copper from the pregnant leach solution or aqueous solution to the electrolyte and the transfer of an equivalent amount of acid from the electrolyte to the raffinate.

2.2.5.5 Electrowinning

High purity copper cathodes will be produced in an electrowinning (EW) plant for shipment via truck to the ice-free port of Skagway, Alaska.

2.2.5.6 Sulphuric Acid Plant

Sulphuric acid will be produced by burning elemental sulphur in a sulphur burner and converting the sulphur dioxide into sulphuric acid. Molten elemental sulphur will be purchased from Fort Nelson and trucked directly into the acid plant. Approximately one 40 tonne truckload per day will be required to produce 120 tonnes of sulphuric acid. Sulphur will be stored molten at the mine site in a heated storage facility. Molten sulphur will be pumped into a sulphur burner where it reacts with air to form sulphur dioxide.

2.2.6 Ancillary Facilities and Services

2.2.6.1 Site Layout

The open pit mine will be located on a hillside on the southeast side of the property and will have a pit crest elevation of 860m and bottom elevation of 645m. The maintenance/service facilities, primary crusher and construction/operations camp will be located above the leach pad area on a saddle west of the open pit at elevation 850 to 880m. The process plant, acid plant, laboratory, process office and gatehouse will be situated below the heap leach pad at elevation 766 m. The administrative offices will be located off-site at Carmacks.

The heap leach pad will be located to the north of the process plant and below the maintenance/service facilities in a local south facing valley which drains towards the process plant.

The crushing plant, at elevation 860m, and the beginning of the leach pad loading conveyors will be located on the west side of the small hill between the heap leach pad and the open pit.

2.2.6.2 Access

Access to the project site area is by public highway with the last 33 km from Carmacks via the gravel, all-weather, government maintained, Freegold Road. Access to the mine property will be by a new 13 km road constructed and maintained by proponent.

2.2.6.3 Power Supply and Distribution

The primary source of electrical power for the project will be a diesel generating plant. The average electrical demand will be 7,860 kW in summer and 6,610 kW in winter. The winter demand is lower because the crushing plant will not be operating. There will be five diesel generating units, each with a minimum continuous operation rating of 1,650 kW. The generators will be equipped with waste heat recovery boilers to generate hot water (cogeneration). The process and laboratory will be serviced by the cogeneration system with back-up hot water boilers for building space heating diesel fired units.

2.2.6.4 Explosive Storage

Explosive materials that will be stored on-site prior to consumption include: detonators, primacord, boosters and connectors. These will be stored in prefabricated magazines that will be selected and located in compliance with local and federal regulations. Non-classified ammonia nitrate (AN) prills will be stored in a silo facility provided by the explosives supplier. The explosives supplier is responsible for obtaining any necessary authorizations.

2.2.6.5 Maintenance Shops and Warehouses

The mining maintenance shop together with the warehouse will be housed in a "Sprung" fabric covered, insulated aluminium structure to be located near the primary crusher. The shop will be equipped to handle routine maintenance and most repair work on mine, mobile and process equipment. The warehouse will act as the main distribution centre for spare parts and supplies. Storage space for reagents will be provided at the process plant. A compound adjoining the warehouse will provide additional lay down area.

2.2.6.6 Offices

<u>Administration</u>

The administration office will be a single story prefabricated trailer structure with a total area of 390 m2, located in Carmacks. The trailer will contain offices allocated to management, accounting, purchasing, employee relations, safety and engineering staff.

<u>Process</u>

The process offices will be contained in a prefabricated trailer located directly adjacent to the SX building and laboratory trailer. The trailer will have a total floor area of 120 m2 and contain offices for process supervisory and metallurgical staff, washrooms and lunch room space will be provided.

2.2.6.7 Laboratory

The metallurgical laboratories will be located next to the SX/EW facilities in a single story, prefabricated trailer with a floor area of 71 m2. It will be equipped to perform daily analyses of pit and process samples, screen analyses and environmental analyses of solids and liquids. Sample preparation and column leach test equipment will also be provided in the laboratories.

2.2.6.8 Mine Dry Offices

The dry offices will be a separate trailer complex in the southeast corner of the operations camp area, complete with separate women's dry offices and assembly areas. The dry offices will serve all employees. Showers, change rooms and individual lockers for 100 men and 20 women will be provided. Offices for the mine and maintenance shift supervisors, the drill and blast supervisor and the process maintenance supervisor will be included.

2.2.6.9 Building Heating, Fuel Storage and Distribution

Heating fuel will be supplied from a central propane storage system. Propane will be delivered to site by tank truck to the independent facilities. Currently, it is planned that the facilities, including tanks, will be the property of the propane supplier. The tanks, at the estimated demand, will have a month's reserve when full.

2.2.6.10 Vehicle Fuel Storage and Distribution

Diesel fuel and gasoline will be delivered to the project site in tanker trucks for transfer to storage tanks.

The vehicle fuel storage compound will be constructed on the same graded pad as the truck wash facility, which will be located adjacent to the maintenance shop and warehouse.

This compound will contain a 190 m^3 diesel fuel tank and a 38 m^3 gasoline fuel tank. The diesel fuel tank will be steel, above ground, vertical type, and the gasoline fuel tank will be steel, above ground, horizontal or vertical type.

2.2.6.11 Site Accommodation

Construction personnel will be accommodated in the prefabricated camp located at the project site. The camp will be complete with kitchen, dining and recreational facilities. Depending on the mining seasonal requirements for accommodation during operations, a portion of the camp may be retained to meet any shortfalls in local housing availability.

2.2.6.12 Lighting

As all the pit equipment is equipped for night time operation, requirements for additional lighting is minimal. Areas that will require lighting are the digging areas and the active waste dump where trucks are dumping. Four portable self-contained lighting plants will be required. These units will be pulled and positioned by a pick-up truck.

2.2.6.13 Maintenance Facilities

Routine preventative maintenance and servicing of the open pit equipment will be carried out at their working place. Preventive maintenance on mobile equipment will be carried out in the shop.

The mine maintenance shop will have sufficient floor area for four haul trucks at one time. Scheduled and breakdown repairs will be carried out in the workshops or in situ as appropriate.

2.2.6.14 Security and First Aid

Security at the project site will involve controlled access into the work areas.

In areas where vehicular passage could be accomplished easily, security style mesh fencing and a prefabricated trailer gatehouse will be installed and locked to deter unauthorized entrance to the mine site. This security fencing will extend to reasonably visible distances into the forest. Inaccessible areas will have perimeter fencing consisting of wood and/or barbed wire construction with the exception of the process area, which will be completely enclosed by a 2.4 m high wildlife fence. Additional security fencing will be installed around the warehouse storage yard and the cathode shipment door.

The First Aid station will be contained in the gatehouse, as well as the ambulance and fire truck.

2.2.6.15 Communications

An internal telephone network will serve the various facilities at the property, the cables being routed through conduit within the yard areas and along the overhead pole lines to the process plant and administration offices. Radios will also be installed in supervisor's vehicles and major items of mining equipment for communicating with the operators working in the pits.

Externally, the operation will be linked via a satellite link to provide data, fax, and voice communication. A satellite dish near the administration offices will be installed during the initial construction phase for this purpose. Satellite TV will also be provided for workers (construction and operation) at the camp.

2.3 WATER MANAGEMENT

2.3.1 Water Balance

2.3.1.1 General

Leaching and extraction processes have been designed to operate on the basis of 100% recycle of process streams. This project proposes no direct discharge of process effluents to Williams Creek, however, a treatment plant is planned as a contingency measure should excess process waters require release. The only other releases to Williams Creek will be from the sediment ponds located below the events ponds and waste rock storage area. Water recycling from these sediment ponds is planned along with wastewater from the open pit, which will be used as make-up water. The events pond will remain practically empty and will only be used during emergency storm events or pump failure. Discharges from the laboratory wastes and floor drains will be re-routed to the pregnant leach solution stream and returned to the process stream in order to minimize losses.

2.3.1.2 Site Drainage and Diversion

The development of the mine, waste rock storage area, leach pad and process facilities will require the altering of local surface water drainage patterns.

North Williams Creek, which is north of the project facilities, will receive drainage of surface water from around the waste rock storage area. Waters running through the waste rock will be routed away from North Williams Creek and collected in drainage ditches to a sediment pond. The majority of these waters will be routed into the process plant as make-up water. All leachate from the pad will be routed to the process plant and recycled onto the pad to maintain a closed loop without discharge to the surrounding environment.

Potentially contaminated run-off from the mine and process facilities will be collected in gravity interceptor ditches and directed to settlement ponds adjacent to Williams Creek. The settlement ponds will be provided to trap suspended sediment. Water from these ponds will be used as a source of make-up water for the process. Overflow spillways from the ponds will ultimately drain into Williams Creek at the lowest point of the property before release to the environment. Any effluent planned to be released from the settlement ponds will be monitored to ensure that effluent discharge standards are met.

2.3.2 Water Supply

The use of recycled process solutions and contaminated run-off will be maximized to limit the use of makeup fresh water from groundwater wells.

2.3.2.1 Water Requirements

The estimated water requirements are:

- Potable 45 m^3/day
- Process (maximum average) 650 m^3/day
- Road (dust control) watering (peak dry weather) 190 m^3/day
- Total project water use requirements 885m^3/day

The estimated peak hourly demand to satisfy fire water makeup requirements will be 250 m^3/hour.

2.3.2.2 Water Sources

In addition to the collection and storage of run-off, snow melt, and direct rainfall on the leach pad, events pond and settlement ponds, the following sources of water will be available:

- Wells: Water wells are located in the bedrock confined aquifer underlying the Williams Creek drainage. Each of the 8 wells is estimated to provide approximately 150 m^3/day of fresh water. Submersible well pumps, installed in the eight bedrock wells to be developed within the Williams Creek Valley, will be connected directly to the fresh water supply pipeline. The wells will be the primary source of fresh water for the project;
- Mine pit dewatering: Submersible pumps will be installed in the pit sump and the water will be used at the crusher, for truck washing and road watering. Excess mine water will be directed to the service complex settlement pond;
- Sediment Control Ponds: Storage ponds will be located, at the lowest point of the area, below the shop/warehouse leach pad and waste rock storage. Pumps will be installed in the ponds to pump the water to storage tanks around the project site. PVC, pipelines connected to the pumps will serve as a secondary water supply for the project. This source of water will be seasonal.
- Events Ponds: Excess meteoric water from the events ponds will be used as make up water for the leaching process.

A mine water discharge pipeline will be connected to the maintenance shop/warehouse area from the open pit dewatering pumps for road watering, truck washing and dust suppression. A branch line off this pipeline will supply water to the crushing plant area.

All water pipelines will be buried or heat traced and insulated for freeze protection.

2.4 WASTE MANAGEMENT

Proper identification and management of various waste streams is important for worker health and safety and environmental protection. The following section describes planned waste management practices.

2.4.1 Fluids Management

An environmental management system will be developed to ensure that all liquids are accounted for in the operation of the mine. The overall management strategy is based on the following:

- Maximizes the recycling and reuse of liquids;
- Isolates non compatible or dangerous fluids;
- Minimizes the quantity of liquids requiring handling;
- Provide secondary containment where necessary;
- Provide appropriate solid disposal for wastes and hazardous wastes generated;
- Provides emergency mitigation measures; and
- Monitors environmental effects.

Prior to operation the environmental management system will be finalized including the identification of waste streams, locations, safety and contingency plans, and monitoring plans.

2.4.1.1 Wastewater Treatment and Disposal

Water from the open pit and sediment ponds will be used for process makeup water to the fullest possible extent. Any excess pit water will be discharged to the environment in full compliance with discharge performance standards as set by the appropriate regulator.

The leach pad and process plant solutions are designed to be 100% recycled so there will be no release of process streams to the environment. However, a water treatment plant is presented as a contingency measure should the release of effluent be required. Following mine closure, the leach pad will be covered over to seal it from direct exposure to precipitation.

<u>Contingency Water Treatment Plant (Construction and Mine Operation)</u>

The contingency water treatment system proposed for the operational phase utilizes conventional lime precipitation of metals using a high density sludge process within the emergency containment pond. For operational purposes, the sediment control pond located down gradient of the events pond will serve as the emergency containment pond. To facilitate this use, the sediment control pond would be lined with a single high-density polyethylene liner.

This treatment entails adding a lime slurry (lime slurry is planned but flexibility of using caustic soda will be maintained) into a mixing tank along with the heap effluent or pond overflow solution and allowing the precipitates formed to settled in a clarifier . The solid sludge will then be returned to a leached section of heap for long term storage and the solution will be reused or released meeting acceptable discharge standards.

<u>Water Treatment Plant - Closure</u>

Upon closure, a solution treatment plant will be constructed for water treatment. The existing contingency water treatment plant neutralization tanks will be expanded to increase the capacity to suit closure conditions.

The plant will have a treatment capacity sufficient to handle seepage and any contaminated run-off from the area of the closed leach pad. The flow rates will vary with the season and the weather.

All process equipment will be capable of operating with minimal operator assistance. Effluent sampling and monitoring will be monitored remotely by plant operations personnel residing in Carmacks. Flow measurements and water quality of influent/effluent will be recorded continually to ensure that the plant is operating correctly and to make adjustments to the process as needed.

2.4.2 Sewage Treatment

Sewage disposal facilities will include both permanent and portable facilities. The permanent facilities will occupy the maintenance shop and warehouse, camp and administration buildings. Sewage disposal will consist of a conventional septic tank and drainage field. Sewage effluent will flow by gravity in buried 150 mm diameter PVC sewer lines to two 34 m^3 septic tanks located at the south side of the plant site area. Septic tank overflow will be dispersed to ground via a buried tile field.

The sewage treatment system for the ancillary facilities will be designed for an average daily flow of 22 m^3, which is based on 146 person shifts per day at 150 L per person shift.

2.4.3 Waste Rock

2.4.3.1 Waste Rock Storage

Mining operations will generate approximately 7.5 million tonnes/year of waste rock per year over the 8 years of mining for a total waste production of approximately 60 million tonnes. This waste will be permanently stored in a location north of the open pit.

2.4.3.2 Acid Base Accounting of Waste Rock and Ore

Composite ore and drill core samples were submitted for acid-base accounting to determine leachability and acid consumption characteristics. The waste rock material testing satisfies the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia and Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine site in British Columbia.

Waste dump runoff will be collected and directed to the sediment pond down gradient from the waste rock storage area. Sediment pond water is intended for recycling to be used at the mine site; if waste water is to be released, the effluent quality will be monitored and tested for metal levels. If necessary the effluent would be treated using conventional lime treatment before release to the environment.

2.4.4 Heap Detoxification

The objectives of rinsing the heap is to reduce the residual acidity and dissolved metals that could migrate from the heap through meteoric waters after the heap has been decommissioned and to ensure that acceptable levels are met for discharge into receiving waters.

At the end of the mine life, when the normal leach cycle has been completed, the process solution will continue to be re-circulated and copper extracted from it until it is no longer economical to do so. This will be accomplished using all the existing process equipment and facilities associated with the circulation of raffinate and the SX/EW plant which were installed for the main operation. The process facilities associated with mining, crushing and placing of ore and the production of acid will not be required at this stage and will be decommissioned.

Once the extraction of copper is no longer economical, the SX/EW facility will be largely decommissioned but leaving the raffinate pumps in the raffinate pond for the circulation of solution to the heap and the Reclamation Duty Water Treatment facility will be brought into operation. Discharge from the heap will be directed to this treatment facility and dissolved minerals will be precipitated using lime slurry. Sludge so formed will be analyzed for its chemical composition and returned to the heap, as is practice in the industry, unless the analysis indicates contamination which should not be placed on the heap. In this latter case the sludge will be dried and removed from site to an approved facility.

The discharge from the water treatment facility will be water of high quality and will flow initially into the sediment pond below the events pond. This water will be suitable for discharge to Williams Creek but can also be reused for flushing the heap. Reuse of the water will be achieved by pumping it, using submersible pumps placed in the sediment pond, back to the raffinate pond, from where the existing raffinate pumps will feed the solution distribution pipe work and drip emitters already in place from the leaching operation. The drip emitters will be relocated from time to time to obtain a more thorough flushing of the heap. The flow rate to the heap will be the same as the application rate of solution to the heap during leaching. A bleed stream from the sediment pond, which will be monitored for quality, will be allowed to drain into Williams Creek.

The water balance in the system during this flushing process will be maintained by the addition of water from any of the following:

- Existing wells and fresh water system;
- Precipitation captured on the pad; and
- Precipitation captured in the waste rock sediment pond.

Once the residual acidity in the heap has been flushed out with water and the pH has stabilized, the heap will then be flushed using a sodium carbonate solution. This will be added at the raffinate pond and the solution circulated using the same procedure as before with the discharge from the heap being treated in the water treatment facility and the discharge from the treatment plant being re-circulated with excess solution a small bleed stream discharged to Williams Creek. This will continue with the discharge from the heap being treated until it reaches a quality suitable for direct discharge to the environment. When the heap discharge pH has once again stabilized, time at a higher value, the sodium carbonate addition will cease.

The proponent anticipates that rinse times to flush the heap will be approximately 4.5 years. Recognizing that there are different approaches to estimating rinse times in a full-scale heap, a more conservative estimate suggests that rinse times are between 4.5 years up to 9 years. Rinse times will also be affected by the practice of concurrent leaching and rinsing of the heap. Upon The proponent is undertaking additional large scale column tests which will provide more information to re-evaluate and identify a more verified rinse time.

A number of contingency measures are planned to polish the final effluent coming off of the heap as it is expected even with a cover the heap will continue to discharge over the long term. Monitoring will confirm heap effluent quality to ensure performance standards are met. In the unlikely event that heap drainage water quality does not meet discharge standards, then contingency water treatment and polishing of effluent will be put into effect which includes limestone drains, biological treatments cells and infiltration galleries.

2.4.5 Solid Waste

Commercial and camp solid waste generated by the proposed operations will be disposed of on-site in a permitted facility.

Industrial refuse consisting of inert material such as broken drill rods, bits, shop scraps and pipe discards, will be collected regularly by surface crews and buried within the waste rock dump.

Combustible industrial refuse and domestic or putrescible refuses from construction and operations will be disposed of by incineration using a forced air fired burner on regular basis. Incinerator ash will be disposed of in the waste rock storage facility.

Municipal refuse originating as camp and office waste, plus warehouse scrap will contain some organic wastes. This solid waste will be collected in covered metal containers located as strategic points around the operations. To minimize the attraction of wildlife, the refuse will be incinerated regularly and the incinerator ash will be hauled to the waste rock dump.

2.4.6 Special Waste

Any special wastes, as defined by the Yukon Environment Act, *Special Waste Regulations*, will be collected and stored in specially marked containers and then shipped to an appropriate treatment or disposal facility. Wildlife-proof rig bins will be used at the site. These bins provide segregated storage for solid waste that cannot be burned and special wastes in compliance with *Special Waste Regulations*.

Sludge and crud produced by the operational treatment system and the solvent extraction/ electrowinning plant will be tested and based on the analysis of those tests; they will be disposed of in compliance with the *Special Waste Regulations.*

Waste oil will be burned and used as a source of heat. Western Copper will obtain a Special Waste Permit for this project and will comply with the Yukon *Special Waste Regulations* and track wastes through the use of Transportation of Dangerous Goods Waste Manifests.

3.0 ALTERNATIVE MEANS AND ALTERNATIVES TO THE PROJECT

This section presents an evaluation of the alternatives considered by Western Copper for carrying out the project. In assessing alternatives, it is assumed that the project is a given and only alternative means of carrying out the project is an issue. Alternative means, for example include alternative processes, sites, routes, sources of energy and alternative methods for construction, operation and mitigation.

3.1 PROCESSING CAPACITY AND PROCESSING ALTERNATIVES

Alternative methods of recovering copper were considered in early phases of the project, and included milling with tank leaching.

While it was apparent from the metallurgical test work that overall copper recoveries could be attained using a number of processes, the capital requirement, the requirement for a tailings impoundment, higher operating costs were a major deterrent for conventional milling.

The main considerations which favoured the heap leach process were as follows:

- Heap leaching has been proven to be environmentally sound technology with proper construction and operation procedures;
- Brewery Creek mine has been successfully operated and demonstrated heap leaching in cold weather climates; and

- Capital and operating costs for a milling facility are significantly higher than for heap leaching – heap leaching allows this ore to be treated economically.

Generation of acid for copper leaching is an important processing requirement in the heap leaching process route. Acid generation and supply through an onsite sulphur burning and conversion plant is the primary process option. Alternatives include direct trucking of sulphuric acid and generation of acid through biological oxidation of elemental sulphur.

Trucking of sulphuric acid is discounted as a viable option due to excessive haulage distances from the source and haulage costs. As well, environmental considerations from large quantities of acid being transported are not desirable.

Biological oxidation of elemental sulphur to produce sulphuric acid is a viable process option currently under investigation. Column test work has recently been completed and demonstrated the potential viability of the process. The biological generation of acid would consist of a series of small reaction tanks and transportation of elemental sulphur. Agglomeration of elemental sulphur and bio-acid produced from bacteria would be required. Due to additional test work and economic evaluation that is necessary to demonstrate scale-up and commercial application; the company has suspended test work on the process.

Given all of the above factors, a heap leach operation using an onsite acid plant was selected as the preferred alternative, and was based on a balance of environmental, technical, operational and economic considerations.

3.2 LOCATION OF THE MINE AND MINING ALTERNATIVE

There are no alternatives to the location of the ore body. Consequently, environmental and socio-economic considerations play no part in the selection of the location of the mine site.

There are two basic mining methods, open pit bulk mining and selective underground mining, with open pit mining being on the order of 10 times less cost per tonne mined than underground mining. Underground mining is generally only applicable to narrow, often deep, high grade vein or deep tabular type deposits; whereas open pit mining is generally applicable to relatively shallow, low grade type deposits where stripping ratios are not excessive like Carmacks Copper. Whereas underground mining generates relatively minor quantities of waste (low waste to ore ratio), open pit operations generate relatively large quantities of waste (high waste to ore ratio or stripping ratio). The oxide ore body for the proposed development is exposed at surface and given the orientation of the ore body and the depth of oxidation, open pit development is the only practical consideration.

Because of the nature and size of the Carmacks Copper deposit, it would not be economically feasible to mine the deposit using underground methods. The ore has a reasonable grade, being 1.01 % copper, and of insufficient value to support underground mining. As the waste rock is acid consuming, there would be no environmental benefit to using underground mining techniques for ore extraction.

Consequently, the selection of the mine and mining methods are dictated almost exclusively by technical engineering and economic considerations. Beyond the implications of mine drainage, environmental and socioeconomic aspects have only minor roles in mine site and mining method selection. However, the fact that the project is based on open pit methods, limits the selection of waste and ore storage areas, and the fact that the ore is of relatively low grade, limits the selection of extraction and processing alternatives.

3.3 MINE WASTE ROCK STORAGE AREA ALTERNATIVES

Open pit operations typically generate large quantities of waste. The Carmacks Copper operation is projected to have an overall life-of-mine waste to ore stripping ratio of 4.6:1 and is projected to generate approximately 60 million tonnes of waste over the 8 year mine life.

Waste rock generated by the mining operations has been tested for comprehensive whole rock, multi-elemental scans, ABA testing and petrographic evaluation. On the basis of laboratory testing using acid-base accounting techniques, simulated weathering techniques and proper mine waste segregation and placement, neither the waste rock nor the open pit wall rock was found to be capable of generating acid and given that the host rock is not mineralized, would not liberate metals which would be of a concern to aquatic or wildlife resources. Test results indicated that the runoff from the waste and open pit wall rock would not require any special treatment, other than settling to remove suspended solids, before it was released to the environment.

Given the large quantities of waste that have to be stored, it is the normal practice to find suitable locations within close proximity to the ore body; generally the shorter the distance, the lower the environmental effects. Topographical constraints and geotechnical stability are critical in that flat land or bowl shaped features large enough to accommodate the waste volume are preferred over side-hill dumps. Haulage distances and costs are a significant consideration and did limit a couple of options in the selection process.

A total of four locations were considered as alternative waste rock storage locations with the evaluation presented in a separate report (Western Copper Holdings Ltd. Carmacks Copper Project. Waste Rock Storage Area Evaluation and Detailed Design Report, June 30, 1997).

On the basis of environmental studies, upper Williams Creek and north Williams Creek were not found to contain fish. Similarly, on the basis of baseline studies, all sites were found to have moderately to low capability for wildlife. Geotechnical evaluations indicate some concern with foundation conditions at most sites investigated. Alternative sites were unfavourable from a haulage perspective, conflicted with other mine site components, were too steep or have similar stability issues. As such, the preferred site located north of the pit on the south valley of North Williams Creek has been selected primarily on a balance of environmental, technical, engineering and economic considerations and incorporates mitigative measures to address stability and foundations concerns.

3.4 HEAP LEACH PAD ALTERNATIVES

Three alternatives for heap leach pads include the on/off reusable pad, the permanent heap leach pad, and the valley heap leach pad.

On/off reusable pad: ore is temporarily stacked on the on/off reusable pad and leached; then the spent ore is relocated. This is better suited to small high grade ore reserves as the cost of re-handling becomes prohibitive in lower grade reserves. The spent ore would require a separate storage and detoxification area resulting in a greater area of disturbance.

Permanent heap leach pad: ore is stacked on the permanent heap leach pad, leached and reclaimed on a flat or slightly inclined slope comprised of low permeability soil. The pad liner is expandable in stages and is appropriate for larger low grade reserves. Use of flat areas inhibits solution movement and potentially increase head on the liner. Upon closure, the heap would remain in place one the liner system to enable in-situ detoxification.

Valley heap leach pad: ore is permanently stacked on the valley heap leach pad, leached and reclaimed within a naturally sloping valley. The pad liner is expandable in stages and is appropriate for larger low grade reserves. A confining embankment is required at the toe of the pad to provide physical stability for the pad. Hydraulic head is assisted by gravity and the natural terrain slope. Upon closure the heap would remain in place on the liner system to enable in-situ detoxification.

The valley heap leach permanent pad is the preferred option due to the natural terrain. This option minimizes the area of disturbance and is also for better control during heap detoxification at closure.

3.5 HEAP LEACH SITE ALTERNATIVES

Four sites were originally investigated as potential locations for the heap leach pad. Preliminary geotechnical investigations carried out by Knight Piesold Ltd. (1993) indicated that all of the sites were underlain by permafrost at varying depth with frost susceptible and potentially weak foundation material. Some of the sites had active water courses with saturated ground. As a result, uneven thaw settlement and loss of mechanical strength was anticipated for soils found at all four sites, leading to possible heap instability and liner damage. As none of these sites were considered adequate, further investigations were conducted in early 1995. This survey resulted in the selection of the heap leach pad location currently being proposed, west of the open pit.

The proposed leach pad site was chosen for its improved foundation conditions, as well as its proximity to the open pit and minimal impact on surface drainage courses. The site is generally characterized as having a moderate south facing terrain with discontinuous permafrost. Test holes across the site confirmed this, with slightly more than half the holes drilled in the early and mid-1990's encountering permafrost. The upper and lower limits of the permafrost vary significantly, but the onsite thermistor instrumentation data suggest that in 1997 the permafrost did not extend deeper than about 25 m below ground surface and that its temperature was only a few tenths of a degree below freezing. Brown (1970) indicates the active layer, the zone subject to annual freeze-thaw cycles, usually ranges from about 1.5 m to 4 m depending on the thickness and character of the organic ground cover, slope aspect, and elevation.

The development plan for this site involved early clearing, which with the southern exposure, was planned to accelerate the dissipation of the remaining permafrost. This was to be investigated further by means of sampling prior to construction of the leach pad. Any remaining ice rich material would then be replaced with stable fill leading to a more stable foundation for the heap.

3.6 SELECTION OF THE HEAP SOLUTION STORAGE SYSTEM

The heap leaching process with an out-of-heap raffinate solution storage system was selected over the in-heap solution storage system primarily for operational, environmental and safety reasons.

Review of the operational experience at the Brewery Creek Mine in Yukon indicates that heap leaching year round with external solution storage in an extremely cold weather climate is proven and practical. In addition, the acid leach is an exothermic reaction and produces heat which minimizes concerns with freezing conditions on the liner system and piping.

Leakage rates with in-heap storage and the potential for groundwater contamination is a concern due to relatively high hydraulic head on the liner system within the area of solution containment. External solution storage reduces the hydraulic head on the heap composite liner system and ensures that heap leakage rates are below the leakage guidelines and ensures the protection of local groundwater. Problems with heap liner integrity are more difficult to locate and fix once the ore has been loaded and the heap height advances. With external solution storage, liner problems within the storage pond can be identified and fixed through proper solution management.

Important concepts for successful solution storage in cold weather heap leaching incorporated into the engineering design include:

- Reducing solution inventories in winter and only using the pond in emergencies in winter;
- Burial of drip emitter lines directly into the ore surface preventing freezing during intermittent power or pumping interruptions;
- Proper solution management plans and operation training to prevent high pond solution inventories during winter operations;
- Sloping solution pipelines for drainage, burying and/or insulating and/or heat trace; and
- Providing redundant systems for power, pumps, and piping to ensure that solution flow is continuous and uninterrupted and low pond volumes are maintained.

Although there is a small increase in land requirements and resultant increased disturbance of vegetation and wildlife habitat, the amount of area that must be ultimately reclaimed at the end of mining for an events pond is not considered significant. The benefits of not having in-heap storage are considered an environmental advantage as the hydraulic heads on the liner system are is reduced. As such, out of heap storage of raffinate solutions is the preferred alternative.

3.7 SELECTION OF SITE INFRASTRUCTURE

The number of options for site infrastructure (crushers, access roads, SX/EW plant, settling ponds, treatment plant and ore conveyance systems) are relatively wide, however site selection of these facilities is based primarily on economics once the process, mining method, waste rock storage areas and heap leach pad sites have been selected. The selection of site infrastructure is based primarily on efficiency of operations, economics and technical considerations, as they have limited potential for environmental effects.

An economic analysis of ore from the open pit to the leach pad, comparing truck haulage and overland conveyor was undertaken as discussed below. An access road is required regardless of the ore transportation method selected.

3.8 HEAP STACKING ALTERNATIVES

Two alternatives, truck and dozer, and conveyors were considered for stacking ore on the heap leach pad. The selection of heap stacking alternatives is driven by the necessity for size reduction of the ore prior to leaching. If Run of Mine (ROM) processing is selected, heap stacking by truck and dozer becomes a preferred option. If the ore requires crushing and agglomeration to provide acceptable copper recoveries, heap stacking by conveyors becomes the preferred alternative. The current test work for copper recovery suggests crushing will be required and therefore a conveyor system has been selected as the preferred option for the project primarily on the basis of technical concerns. Additional process optimization, test work and economic evaluation may change the necessity for crushing and provide ROM processing as a viable alternative.

3.9 MINE ACCOMMODATION ALTERNATIVES

Socio-economic studies were undertaken by Western Copper in the early part of the planning process to select the best alternative for employee accommodations that would offset negative effects and enhance benefits wherever possible (Hallam Knight Piésold (HKP), IEE Volume II, "Community Profiles and Socioeconomic Impact Assessment"). The option of housing all employees in the existing local community of Carmacks and bussing personnel to site each shift was considered. Due to the comparatively high number of employees in relation to the size of the local communities, housing all employees within existing local centres would have resulted in the need for some construction of housing and related community infrastructure.

In assessing socioeconomic effects, the existing socioeconomic conditions and trends in the regional communities were documented. Projected changes that may be expected to occur were considered and an evaluation completed of the communities capabilities to absorb the affected changes. The principal considerations that were believed to have an overall bearing on the magnitude of effects were as follows:

- Evaluation of surrounding communities to accommodate and assimilate the expected growth,
- Size and life span of the proposed mine development, and the effects that might occur from a boom-and-bust economy;
- Size and source of the operational work force, and the settlement patterns of people moving into the community;
- Little Salmon Carmacks First Nation land claims, cultural considerations, ethnographic and archaeological resources;
- Work schedule and accommodations, location of the mine relative to the nearest communities, and
- Equipment, supplies and services procurement.

The project-related population increases in Carmacks and Whitehorse were expected to be minimal to moderate. Socio-economic studies incorporated an analysis of community populations, demographics, levels of employment and housing availability for those communities that would be most affected. Municipal and Territorial representatives were interviewed to determine the availability of community services (e.g. recreational facilities, water, sewer systems, solid waste disposal facilities, court services, transportation systems, police and fire protection, educational facilities, medical and health care). Information on community infrastructure, commercial and industrial sectors, communications, average incomes, taxes and transportation was also evaluated.

By providing an initial construction camp and modifying this camp to provide on-site accommodation and allowing the workforce to work on a shift rotation basis, workers will be able to live elsewhere in the Yukon, in addition to the local communities. This spreads the economic benefits of the project, reduces the impact on local communities to a manageable and beneficial level, and eliminates the boom and bust phenomenon associated with mining towns in the past.

Consequently, the on-site accommodation for the construction workforce during the project construction, and modifying this camp facility to provide some on-site accommodations during operations, and off workforce accommodation was used as the base case for the evaluation of the project. An accommodation facility in or near Carmacks may also be considered for the permanent workforce in lieu of, or in addition to, on-site accommodation for the permanent workforce based on on-going community consultation.

It is expected that socio-economic effects of the project can be distributed over a broader regional base of communities with developed, existing infrastructures, thereby reducing the impacts to any one community, particularly that of the Little Salmon Carmacks First Nation and the Village of Carmacks.

3.10 ALTERNATIVE POWER SUPPLY SOURCE

Yukon Energy Corporation completed an environmental assessment and routing analyses for supplying power to the project (Yukon Electrical Company Ltd, 1995). On-site diesel generation of power has been calculated to be less expensive over the mine life of 8 years compared to the economics of constructing a power line from Carmacks. In addition, the operations would require a supply of on-site, dedicated standby and back-up power for operation of critical environmental protection facilities such as heap leach pad recirculation pumps, leak detection and recovery systems, and the water treatment plant, as well as the camp accommodation.

The selection of on-site power generation over installation of a power line has been based primarily on economics, being one of the most significant operational costs. Environmental, technical and operational considerations, such as utilization of waste heat, line and plant maintenance, access, reclamation and need for back-up power have been of secondary importance in the selection of power supply alternatives.

The current preferred option for the company is diesel generation however, the underlying assumptions, particularly those in the economic analyses, used in the selection process may change as a result of discussions with Yukon Energy. If Yukon Energy proceeds with the construction of the Carmacks-Dawson extension of the grid, as they have indicated they may, tapping off that line, close to the plant site, may prove a viable option for Western Copper.

4.0 ENVIRONMENTAL SETTING AND SOCIO-ECONOMIC CONDITIONS

This section provides the general environmental context for the project. The descriptions are intended to leave the reader with an appreciation for the project's overall setting.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

The Williams Creek basin is located in an area characterized by moderate total annual precipitation and extreme variations in temperature. Precipitation and temperature data were collected during the summer of 1992, and in 1994 Water Resources Division of DIAND established an automatic meteorological station at the site. The station is still being operated by Yukon government, Water Resources, and continuous records are available from September 1994 to present, except where gaps occur due to equipment malfunctions.

Average annual precipitation is approximately 300 mm to 400 mm, with July being the wettest month.

The average annual total precipitation is 372 mm with evaporation on average 402.4 mm, yielding a net loss of 30.4 mm. Almost half of the annual precipitation falls as snow as daily temperatures are below freezing from October through May.

Average monthly temperatures range from a low of approximately -30^{o}C in January to a high of approximately 13^{o}C in July.

Winter conditions may be considered to extend over the period where daytime maximum temperatures average below zero. The extreme cold temperatures in the region make outside earthwork construction in the winter difficult but manageable within enclosures. In general the working construction season will be from May to October. The ground is normally frozen in May, and earthworks such as leach pad grading and embankment fills cannot be started until June or July.

Air quality in the project area as well as for the Village of Carmacks is considered to be good as there is not major development in the region. Yukon government, Water Resources, operates an automated weather station at the project site however wind direction has not been monitored. It is expected that the station can be augmented to collect this data during operations. Due to orthographic effects, it is expected that the project site will be slightly warmer in the winter than at the Yukon River and would minimize local thermal inversion effects.

4.1.2 Topography

4.1.2.1 Physiography

The Carmacks Copper Project area lies within the Klondike Plateau and is part of the Pelly River Eco-region, which is comprised of portions of the Stewart, Macmillan, Lewes, and Klondike Plateaus and Tintina Valley physiographic subdivisions. Surface drainage flows both north and east from the study area. A number of valley streams, of which Williams Creek is the largest, drain north-eastward to the Yukon River.

The Carmacks Copper Project area features a broad valley and rounded ridge crests. Williams Creek valley and its tributaries are the dominant topographic features of the study area. The main valley is characterized generally as a broad flood plain containing sands and silts that are covered by a blanket of organic accumulation.

4.1.2.2 Soils

On the basis of regional mapping and site test pitting, soils in the mine site area are dominated by Eutric Brunisols originating from dissected colluvial parent material. Soil texture is gravely sandy loam (Agriculture Canada 1992, Knight Piésold Ltd., 1993).

According to dominant morphological features and vegetation, well drained soils on south facing slopes are gravely sandy loam and are expected to be moderately alkaline and have moderate to high organic matter content and nutrients. Areas with moderate to poor drainage, dominated by lodge pole pine and black spruce, respectively, are expected to be more acidic with low to very low nutrient content. Lodge pole pine areas are expected to have much lower quantities of organic matter than the poorer drained areas of black spruce stands (Kennedy, 1993).

4.1.2.3 Permafrost

The Carmacks Copper project lies in an area of discontinuous permafrost, which corresponds to an area between the 0^oC and -10^oC mean annual temperature isotherms. The site mean annual air temperature was calculated from the estimated annual freeze and thaw indices. The mean annual air temperature was calculated as -5^oC for an elevation of 850 m at the Williams Creek site.

Temperature measurements indicate that the permafrost temperatures are near 0^oC generally ranging between -0.1^oC and 0.3^oC which is classified as “warm” permafrost.

4.1.2.4 Seismicity

The Carmacks Copper project site is located within the interior of the Yukon Territory, an area that historically is of low seismicity. The site is located within the Northern B.C. source zone (NBC) bounded to the west by the Denali-Shakwak source zone (DSK) and to the east by the Mackenzie source zone (MKZ).

4.1.2.5 Terrain Hazards

A terrain analysis of the Carmacks Copper property was conducted by Westland Resources Group.

Areas under the heap leach pad were designated as comprising M3 surficial materials which are categorized as being wet, subdued to moderately sloping till, featuring poor drainage, seepage, and/or shallow organic capping.

Areas of permafrost occur in the Williams Creek valley in the vicinity of the creek itself and in the north aspect tributaries contained occurrences of permafrost. Areas with evidence of active land sliding were observed on south facing steeply sloping scarps adjacent to Nancy Lee Creek and North Williams Creek. The potential for flooding in the area of the confluence with Williams Creek and the Yukon River, and within the creek valley to approximately 4 km upstream, was high. Flooding potential for Nancy Lee Creek is also high. However, no project facilities are located within the flood plain.

4.1.2.6 Geotechnical

The information obtained from site investigation programs has provided the geotechnical and hydrogeological information necessary to characterize the site for detailed design work.

The types of surficial materials found across the project area have been grouped into the following categories:

- Organic / Ash Layer;
- Glaciofluvial / Glaciolacustrine Deposits;
- Well Graded Glacial Till;
- Weathered / Decomposed Bedrock; and
- Bedrock.

Overburden is generally thin; a few centimetres of moss and organic material overlie 5 to 20 cm of white felsic volcanic ash (White River ash approximately 1,250 years old). In un-glaciated areas, the white ash is underlain by 10 cm of organics or peat, and 15 to 50 cm of soil. Bedrock is extensively weathered, particularly the gneissic units. At the eastern end of Trench 91-6, bedrock is 7 m below surface, the deepest recorded in the un-glaciated area. In the glaciated areas, the white ash is underlain by tills, generally 1 m thick, except along Williams Creek valley where an undetermined depth of till and colluvium has collected. Permafrost is present at varying depths in most north facing slope locations and at depth in other areas.

4.1.3 Water Resources

4.1.3.1 Surface Hydrology

<u>General</u>

Stream flows in the Yukon are generally characterized by peak flows in the spring and low flows in the winter. Maximum discharges typically occur during the spring as the result of snow melt or rain-on-snow events, with flows gradually decreasing following the disappearance of snow. Sizeable flood events may also occur in the late summer due to intense rainstorms. These rainfall events are particularly significant on small basins. The smallest discharges of the year occur in the period February through March. Ice develops on all rivers and many streams freeze entirely, reducing their winter flows to zero.

<u>Description of Watershed</u>

The ore body is located in the upper reaches of Williams Creek, approximately 9 km upstream of the confluence with the Yukon River. Williams Creek is a small tributary originating in the Dawson Range and draining northeast into the Yukon River downstream of Carmacks.

The Williams Creek watershed is comprised of two principal basins, Williams Creek and its tributary, Nancy Lee Creek. Each creek drains approximately half of the 88 km^2 drainage area. Williams Creek has a main channel length of approximately 15.5 km, an average slope of 3%, and a basin elevation range of approximately 500 m to 1,000 m. The creek is typically a straight, deeply incised, narrow channel about 1 to 4 m in width and 0.5 to 1.5 m in depth with occasional meanders or side channels. Williams Creek flows into the Yukon River about 40 km northwest of the Village of Carmacks. Nancy Lee Creek has a channel length of approximately 13 km, an average gradient of 2.8% and a basin elevation that ranges from 518 to 882 m. It flows east into Williams Creek, approximately 1.3 km upstream of the Yukon River confluence.

4.1.3.2 Surface Water Quality

Water quality data from samples were collected from thirteen stations (W-1 to W-11) between 1989 and June 2006 on the Williams Creek watershed. Water quality sample collection is ongoing.

The water quality data collected in this study provides a baseline from which potential effects can be assessed once the mine is operational and a source of comparison for when the mine is in closure. Baseline data will also be important to regulatory agencies setting the mine discharge limits for the project.

Baseline data on total metal concentrations in Williams Creek have been compared to the recommended guideline values established by Canadian Council of Ministers of the Environment for the purposes of documenting baseline water quality prior to project development. Of the ten elements compared, lower Williams Creek, average background concentrations (October 1989 to October 1992) of total aluminium, arsenic, copper, iron, and zinc exceeded the recommended Canadian Council of Ministers of the Environment guidelines. The upper site (W-4) also exceeded the Canadian Council of Ministers of the Environment guideline for aluminium, arsenic, copper, iron, and zinc.

Water hardness values ranging from 75 to 225 mg/L $CaC0_3$ for Williams Creek indicate a moderate degree of natural buffering capacity.

4.1.3.3 Hydrogeology

General

Standpipe piezometers wells were installed at the Carmacks Copper site in 1992, 1995, and 1996 to measure groundwater levels and allow for the collection of water quality samples. In total, 36 piezometers were installed at the site between 1992 and 1996. The 1996 site investigation work included a program to investigated and establish the site hydrogeological conditions. Standpipe piezometers were installed in drill holes to measure the water levels within specific intervals.

Regional Groundwater System

The Carmacks Copper project site is located adjacent to the Williams Creek drainage. The regional drainage pattern in the area has evolved into a contorted pattern influenced by complicated structural features associated with the intrusive and metamorphic rock types. The regional groundwater flow system at the Carmacks Copper project is further complicated by the presence of permafrost in the valley bottoms, which produces a confining effect and possibly perched water tables. Regional groundwater occurs as an unconfined deep flow system within bedrock in which groundwater is recharged at higher elevations in the upland areas and flows toward the valleys at lower elevations. The groundwater table forms a subdued replica of topography whereby the depth to groundwater increases with increasing elevation.

The result of exploration drilling and recent geotechnical site investigations indicate that the groundwater table lies at significant depths over most of the project area. In some areas the presence of discontinuous permafrost has resulted in the development of perched water tables, however, these are isolated and are discontinuous. In addition, minor groundwater flow occurs in the active zone just below the ground surface on a seasonal basis resulting in the development of local swamp areas. The discontinuous permafrost also acts as a barrier inhibiting infiltration in some areas thereby significantly reducing recharge resulting in the overall depression of the region groundwater table.

4.1.3.4 Groundwater Quality

In 1997 a field reconnaissance was undertaken that included conducting piezometric measurements at the existing monitoring stations and collecting groundwater quality samples. Water quality sample collection is ongoing.

The groundwater quality parameters were generally below Canadian Council of Ministers of the Environment guidelines for freshwater aquatic life. Total aluminium and iron concentrations were above the guideline at wells MW96-B, MW96-F and DH95-B. Piezometers DH95-B and MW96-F reported total copper levels above the guideline. Piezometer DH95-B had total lead levels above the guideline. Total zinc concentrations were above the guideline at MW96-F and DH95-B.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Aquatic Resources

4.2.1.1 Fisheries

Between August 1991 and August 1992 three fisheries investigations, including biophysical inventory, electrofishing, minnow traps, and spawning surveys, were completed to determine the distribution and abundance of fish in the project area.

Of the thirteen fish species typically found in the Yukon River Drainage, six species were identified in the lower section of Williams Creek to the confluence with Nancy Lee Creek, during the 1991 and 1992 assessments. These species include: juvenile Chinook salmon, arctic grayling, slimy sculpins, longnose suckers, burbot, and northern pike. Other species, such as inconnu, round whitefish, and broad whitefish may also be found in small tributary habitats of the Yukon River system at certain times of the year.

No fish were observed or captured in Williams Creek above the Nancy Lee Creek confluence. Spawning was not observed in the Yukon River near the Williams Creek confluence during the October 1991 survey and based on traditional knowledge no spawning in Williams Creek has been observed by local residents.

Fisheries investigations undertaken in 2005 and 2006 in Williams, Nancy Lee and Merrice Creeks are generally consistent with the result of the previous fisheries investigations with the exception of a single arctic grayling located on Nancy Lee Creek. Williams Creek above the confluence with Nancy Lee creek provides limited habitat for fish and while the lower Williams Creek watershed does support fish. No fish were found in Merrice Creek.

4.2.1.2 Benthic invertebrates

Benthic invertebrate samples were collected from site W-10 in lower Williams Creek approximately 250 m upstream of the Yukon River confluence in 1991. This site was relocated approximately 1.2 km further upstream during the 1992 study and two additional sites were also established; one site was upstream of the Nancy Lee Creek confluence and the other site was in the lower reach of Nancy Lee Creek.

Total and average number of invertebrates collected at each of the three sample 1992 sites, including one site in lower Nancy Lee Creek, were similar with a range in total numbers from 751 to 910 invertebrates. A total of 23 different taxonomic groups were identified in the drainage. Taxonomic richness (number of taxa represented relative to the population size) of the 1992 samples varied between 14 and 19 taxa with the highest number found at the lowermost Williams Creek site (W-12) below Nancy Lee Creek. Plecopterans were the dominant order present in the William Creek sites (W-12 and W-13) representing between 50 and 79% of the community. Plecopterans were co-dominant at the Nancy Lee Creek site during 1992 representing 34% of the total community. Dipterans were the sub-dominant order at all three sites during 1992 with Chironomidae (Orthocladiinae) representing between 10 and 35% of the total insect community.

Additional benthic invertebrate sampling was undertaken in 2006 at selected sites; further sampling is scheduled for 2007.

4.2.2 Wildlife

4.2.2.1 Wildlife Occurrence

A post-rut survey took place in December 2005 to study moose and other wildlife within the Carmacks Copper project area, supplemented with observations made during the summer of 2006. The survey included the entire drainages of Merrice, Nancy Lee, and Williams Creek and included the adjacent tributaries and main stem of Hoochekoo and Crossing Creeks. Historical data from a 1992 mid-August wildlife field inspection is available.

Ungulates

Moose:
Last surveyed in 2003, Block 17 (Carmacks West) estimated a low moose density of 40 moose/1,000km^2 with a total population estimate of 215 animals (Wildlife update, August 2006). Moose tracks were evident in the upper reaches of all of the drainage basins. During three hours of flight survey in winter 2005 a total of six (6) adult moose were observed in the sub-alpine of Merrice Creek basin. A one-day scouting of project footprint further confirmed the winter presence of moose, most notably in the deciduous and coniferous dominant uplands and the willow dominant wetland in middle Nancy Lee Creek; summer occupancy is confirmed in the mixed forest uplands and willow wetland near Nancy Lee Creek. The project lies within a low density moose survey block and moose occupy the area all year in very low numbers.

Caribou:
Caribou are not known to occupy the project area in recent decades and no caribou wildlife was sighted during the December 2005 survey. Based on the 1992 wildlife field inspection, single caribou tracks in two locations along an exploration road north of the Williams Creek camp were observed. The Klaza caribou herd is known to range as far west as Victoria Mountain, approximately 30 km southwest of Williams Creek (Farnell et al. 1991) and individuals could presumably range farther west as the habitat potential for wintering caribou is good within the project area.

Bison:
The project lies outside the known range of Wood Bison with no known record of permanent occupancy in the area.

Mule Deer:
Occasionally, Mule Deer are observed along the Freegold Road in the Murray Creek area and extend sporadically as far west as Upper Big Creek (Wildlife update, August 2006). Mule deer may be exploring into small suitable pockets of habitat which are generally characterized by open south exposures which is generally not representative of habitat in the area.

Large Carnivores

Wolf:
The winter presence of wolf is confirmed by three scats; two containing large bone fragments and moose hair, and one containing small bones and probable snowshoes hare hair. Recent spring and summer evidence was not found. All scats were located in black spruce dominant upland.

Grizzly Bear:
Less abundant than black bear, the track of small grizzly was noted in a wetland near Nancy Lee Creek. It is possible that some of the scat noted above could be grizzly scat. A grizzly bear was observed along the Yukon Quest Trail approximately 15 kilometres southeast of the camp area in August 2006.

Black Bear:
Jesse Halle (Geologist, pers comm.) saw a large black bear on the Freegold Road on July 11, 2006. Black bear are common in the area. Four bear scats were found incidental to vegetation mapping. One was a graminold-equisetum fresh scat in black spruce dominated wetland near Nancy Lee Creek. The other three found in mixed conifer upland were 100% soapberry scats from last summer.

Furbearers

Lynx:
Lynx are probably common at the peak of the hare cycle, which is currently at low numbers. The species is important in the regional trap line catch, and Yukon densities of up to 9 per 100 km^2 have been estimated in years of snowshoe hare abundance (Slough and Ward, 1990). It can be expected lynx to occupy the area year round.

Coyote:
As similar to lynx, coyotes rely heavily on snowshoe hare, which is currently at low numbers. Historical evidence shows the existence of coyote in the area. It can be expected that coyote occupy the area year around.

Red Fox:

Based on the 1992 wildlife field study, one probable fox dropping was observed within the Williams Creek Project area.

Wolverine:
Although this wide-ranging species is never abundant it does occur within the study area. Based on the 1992 wildlife field study, tracks were noted twice. Wolverines are a small component of the trap line catch, but are economically important because of the price they fetch.

Marten:
Marten are apparently uncommon in the immediate area of Williams Creek, although they are taken by local trappers. No sightings were reported and population levels in this area are not known based on the 1992 wildlife field study

Mink:
Based on the 1992 wildlife field study one set of mink tracks was reported near the exploration camp. Mink are expected to occur primarily along the Yukon River and large streams and wetlands, but it is expected that this species is rare in the study area.

Ermine:
Based on trap line catch records ermine are expected to occur in the Williams Creek area. No sightings of ermine were reported.

River Otter:
River otter are expected to occur along Yukon River and possibly in lower Williams Creek, but are not expected elsewhere in the watershed. Based on the 1992 wildlife field study no sightings of river otter were reported in the project area.

Beaver:
The beaver have a similar distribution to the river otter. Though no recent activity evident, a small dam and older aspen cutting on Merrice Creek was located just above the access road.

<u>Other Mammals</u>

Snowshoe Hare:
No hares or fresh sign were seen in August, 1992, however old sign in the form of runways, carpets of droppings, and browsed shrubs were widespread and abundant. The population apparently crashed in this area in the spring of 1991. This species is an important food base for several predators.

Red Squirrel:
Red squirrels were very common throughout the study area in August 1992.

Ground Squirrel:
Two apparent ground squirrel burrows were noted within the 1992 study area, but the species was not observed. Suitable habitat appears to be present, and reasons for its rarity here are not known.

Porcupine:
Porcupine sign was noted in two locations within the 1992 study area, but the species was not observed.

<u>Birds</u>

Forest Migratory Birds:
Migratory birds are present through out the project in general sense although no specific survey was carried out.

Waterfowl:
No standing water habitat is present and no waterfowl use the watershed. Waterfowl were not observed.

Grouse:
Several pellet groups were found from previous winter snow roosting, though the species is not determined. Grouse populations are cyclic and can be expected in the area year round.

Raptors:
Golden eagle nests were seen on cliffs at two locations near the Yukon River. No eagles were seen during the field inspection (August, 1992). It is likely that the birds had completed nesting by this time. Another option is that nesting was minimal or did not occur at all due to low snowshoe hare numbers. Several other species of raptors are also known to occur in the area, but only the American kestrel was observed.

4.2.2.2 Habitat Potential

Seven wildlife habitat units have been identified in the project area including the Yukon River floodplain, willow dominant wetlands of the Williams Creek watershed, spruce dominant wetlands, aspen dominant uplands, conifer dominant uplands, steep grassy slopes, and cliffs.

The Yukon River floodplain and cliffs were rated as high to very high for habitat use and importance. Habitat use and importance of the valley slopes and willow dominated wetlands were rated as moderately high to high while spruce dominated wetlands and aspen dominated uplands were rated as moderately important. An overall importance rating of low has been assigned to the conifer dominant uplands.

4.2.2.3 Little Salmon Carmacks First Nation Fish and Wildlife Management Plan

The "Community-Based Fish and Wildlife Management Plan – Little Salmon Carmacks First Nation Traditional Territory 2004-2009" identified a need to protect the Yukon River from Tatchun Creek to Minto as important habitat for moose, salmon, and other wildlife. This section of the Yukon River contains a number of sloughs and islands, and was identified as important habitat for moose during calving, summer, and winter. Moose were commonly seen in this area back in the 1960s, but fewer have been seen in recent years. One area, located approximately 2.5 km downstream of the confluence with Williams Creek and the Yukon River, named "Dog Salmon Slough", was noted as an important habitat area. Bears use this area for fishing. Moose might be staying away from river corridors now with the increased river traffic during summer.

4.2.2.4 Wildlife Key Areas

A key area for golden eagles is considered to be in the northern portion of the study area, near the Yukon River. The southern portion of the study area, where a portion of the access road is located, is considered to fall within a key area for moose.

The Village of Carmacks and Freegold Road fall within the wildlife key areas for bison and bald eagles. The project lies outside the known range of wood bison with no known record of permanent occupancy in the area.

4.2.2.5 Species at Risk

Species at risk in the Yukon and all of Canada and whose ranges could conceivably overlap within the study area include:

- Wood bison, peregrine falcon Anatum subspecies (Threatened);
- Grizzly bear, wolverine, short-eared owl (Special Concern); and
- Mule deer, elk, cougar (At risk in Yukon but not elsewhere).

No wildlife species at risk were observed within the study area during the wildlife surveys that were conducted in 1992 nor were any key habitats for these species at risk encountered.

4.2.3 Vegetation

Based on information gathered in 1994, 2005 and 2006, the following information identifies the vegetation in the vicinity of the proposed project. More than half of the project area is comprised of black spruce forests and approximately one quarter of the area is lodge pole pine. Much of the project area has been previously cleared and is now regenerating. As the area has not been recently burned, the vegetative cover is open canopy upland forest with no merchantable timber except for low quality fuel wood. The primary vegetation types within the project area are described as follows:

Lodge pole Pine:
Lodge pole pine forests occur on south-facing slopes often in association with trembling aspen and grassland forest types. Both types of lodge pole pine forests occur in the Williams Creek area. Several stands of lodge pole pine are found sites affected by recent fire.

Black Spruce:
Black spruce is the most common vegetation type found in the vicinity of the project site. Black spruce forests cover much of the uplands, particularly those areas with northerly aspects. In the project area, black spruce is widespread, while black spruce bog occurs primarily on the lowlands adjacent to Nancy Lee Creek.

White spruce:
White spruce forest occurs as upland forest cover, usually in association with the more common black spruce forest. In the project area, white spruce is most obvious as the riparian forest cover on lower Williams and Merrice Creeks.

Trembling Aspen:
Trembling aspen forests are found on south-facing slopes usually in association with grassland cover. In the project area, small aspen stands occur on the south-facing slopes adjacent to Williams, North Williams and Merrice Creeks.

Willow Fen:
Willow fens are the most common wetlands in this region. Within the project area, willow fens occur primarily as narrow wetlands in creek valley bottoms.

Grassland:

Grasslands occur on steep, dry, south-facing slopes, often with stands of trembling aspen. In the project area, grasslands are found on the south-facing slopes above Williams and North Williams Creeks.

4.3 HERITAGE RESOURCES

An archaeological impact assessment was conducted in the Williams Creek Valley for the proposed project by Antiquus Archaeological Consultants Ltd. (AAC) in August 1992. The following sections summarize relevant aspects of these archaeological assessments.

Valued cultural components include heritage sites, spiritual areas, and those important to maintaining current land use patterns (trapping cabins, existing trails, hunting and gathering areas, etc.). Heritage sites include archaeological sites as well as sites which are of value for cultural reasons. They can represent sites with “moveable heritage resources” (artefacts) or designations without material evidence that are culturally significant such as spirit places or traditional trails.

Traditional knowledge provides an important source of knowledge in identifying cultural sites as well as key ecological areas. The proposed program area is located within the traditional territories of the Little Salmon Carmacks First Nation and Selkirk First Nation. As part of archaeological assessments of the Williams Creek Valley interviews were conducted with Johnny Sam and Wilfred Charlie from the Little Salmon Carmacks First Nation to acquire information about First Nation use in the project area. Previously documented historic, ethno-historic and ethno-linguistic research has also been used to reconstruct traditional Native land use practices in the Williams Creek valley.

4.3.1 Williams Creek Valley Archaeological Assessment

4.3.1.1 Historic Use

In the 20th century, the Williams Creek Valley was used by Natives for winter trapping (J. Sam). Snowmobiles permitted the entire trap line to be checked in one day (12 hours) from a base camp on the opposite shore of the Yukon River (J. Sam). Dogsleds would have allowed similar practices at an earlier date. The valley continued to be used as a hunting area for moose and caribou, but most hunting was done by single Native hunters in the winter while in the area for trapping (J. Sam). These activities would have produced small, scattered kill and/or butchering sites in the valley.

Fishing sites used to catch salmon, as well as, pike, sucker, whitefish, and graylings were constructed along the bank of the Yukon River where deep water with currents and eddies forced the fish close to shore (J. Sam). The river bank was also used as a travel corridor. The “Old Dawson Trail” from Whitehorse to Dawson City followed either the eastern or western bank of the river, while the “Old Telegraph Trail” built in 1899 between Whitehorse and Klondike crossed the mouth of Williams Creek (J. Sam; W. Charlie). Other trails constructed before and since (such as the Toboggan-Dog Race Trail) probably followed the same routes. Small transit and campsites should be expected at the mouth of Williams Creek where these trails were located.

4.3.1.2 Traditional Use

Moose is the most common ungulate now hunted in the Williams Creek Valley, but caribou are also present on occasion and were probably more common in the past before the large migratory herds of caribou in the region were reduced to the current small scattered populations (J. Sam). In the summer (May to October) these animals could have been hunted from fishing base camps on the Yukon River, while in the winter they may have been hunted, as they are now, while trapping in the valley (J. Sam). Given current estimates of ungulate populations, individual hunts rather than communal hunts were probably the norm for the valley. Other wildlife that may have been hunted or trapped in the valley include: grizzly bear, black bear, marten, weasel, mink, otter, red fox, coyote, woodchuck, ground squirrel, wolf, beaver, muskrat, rabbit, pika, and porcupine. Lynx and wolverine are two other important species trapped in the valley (J. Sam). A few waterfowl may also have been caught in the spring and fall at the small ponds. These traditional activities would have produced small scattered kill and/or butchering sites throughout the drainage, and a few small base camps in the creek valley.

Salmon, whitefish, pike and graylings spawn in the Yukon River and summer fish camps were probably constructed along the shore of the river to catch these fish. Unfortunately archaeological remains from these sites may have been buried or destroyed by flooding and ice flows on the river. Any raised beach lines may afford better site preservation. Early trade and travel routes (predecessors to the historic routes) probably followed the Yukon River and crossed the mouth of Williams Creek. As a result, small transit camps may be expected in this area. All sites in the study area are expected to be small and on flat, well-drained locations.

4.3.1.3 Historic Archaeological Sites

No archaeological sites were identified within the areas proposed for the open pit mine, leach pads and waste rock dumps. However, two historic archaeological sites were identified and recorded during the 1992 assessment. The first site (115-I/07/005) is located at the confluence of Williams Creek and one of its tributaries, located approximately 1.25 km southwest of the confluence of Williams Creek and the Yukon River. At this site there is a partially collapsed log cabin, a partially collapsed log barn, and associated domestic and mining related refuse and artefacts. A mine adit was also identified on the north side of the creek, about 400 m west of this site along a well-defined trail. It is believed that the area was occupied during the 1930s and 1940s.

The second site (115-I/07/001) is located along the bank of the Yukon River about 1.25 km southeast of the confluence with Williams Creek. This location lies along what has been referred to as the old "Dawson Trail" and consists of the collapsed remains of a historic log cabin. This site is connected to the first site by a horse trail and appears to be a supply and ore transfer station for the mine, which was facilitated by river transport.

4.4 CURRENT LAND USES

The property is located in the Little Salmon Carmacks First Nation and the Selkirk First Nation Traditional Territory. The Little Salmon Carmacks First Nation has one land claim selection in the vicinity of the project: R-9A. R-9A is located west of the project area and extends into the environmental assessment and project area. No project activities are expected to occur on the Little Salmon Carmacks First Nation R-9A land selection or Selkirk First Nation settlement lands.

There are six Little Salmon Carmacks First Nation settlement lands located adjacent or near to the Freegold Road. Land located outside of the right-of-way will not be encroached upon by project activities.

4.4.1 Traditional and Cultural Resource Use

4.4.1.1 Wildlife

Discussions with members of the Little Salmon Carmacks First Nation indicated that the area is part of their traditional hunting grounds.

Trapping and outfitting concessions within the project area provide employment benefits and sustenance for area users. The proposed Carmacks Copper mine site is located within Registered Trap line #147, held by a member of the Little Salmon Carmacks First Nation, Ms. Kathleen Sam of Carmacks. The Williams Creek watershed is trapped more than once a year during most years (Mr. J. Sam, pers. comm.). Lynx, coyote, wolverine, mink, beaver, fox, marten, and squirrel are the key furbearers expected to be caught in the area.

The proposed Carmacks Copper Project is located within the boundaries of Registered Outfitting Concession #13, held by Mervyn Yukon Outfitting. The project area is also within Game Management Zone 5, Subzone 524.

As discussed previously, two Wildlife Key Areas for golden eagles and moose have been identified in the proponent's environmental assessment report.

4.4.1.2 Fish

Chinook and chum salmon runs in the Yukon River support important commercial and native food fisheries. Adult Chinook salmon migrate up the Yukon River past the Williams Creek confluence between August and October. Salmon spawning does not occur in Williams Creek.

Members of the Little Salmon Carmacks First Nation harvest adult Chinook and chum salmon from the Yukon River during the late summer and fall months. Interviews with First Nation members and village elders indicate that salmon fishing activities take place at many sites along the Yukon River between Carmacks and Fort Selkirk. Sites upstream of Carmacks are also used. Five seasonal fish camps were observed on the banks of the Yukon River between Carmacks and Williams Creek during the October 1991 survey. Three other fish campsites were identified downstream of the Williams Creek confluence. Locations of the fish camps change annually depending on flow conditions in the river (Chief Fairclough, 1993, pers. comm.).

Other species of importance with respect to First Nation and sport fisheries include Arctic grayling, inconnu, round and broad whitefish, burbot and northern pike. Small numbers of these species may be found at the confluence of Williams Creek and the Yukon River at certain times of the year. It is suspected that some sport fishing may occur at the mouth of Williams Creek during the summer months as recreational canoeists pass the creek enroute to Dawson City. The extent of the First Nation fishery for these species in the Williams Creek area is not known. It is suspected that most fishing for these species would occur in the Yukon River. Historically, there have been reports of some fishing by First Nation members in the backwaters of the Williams Creek confluence (Chief Fairclough, 1993, pers. comm.).

4.4.1.3 Recreation

The most significant recreation activity within the study area is summer canoeing on the Yukon River. Canoeists generally use the river between late May and September, with peak use in July and August. Dawson City is the usual destination, with people typically starting their journey in the Whitehorse area or Carmacks. Visitor records collected at Fort Selkirk on the Yukon River downstream of Carmacks and Williams Creek indicated that 693 canoeists used this section of the river during 1992.

Another significant recreation activity in the area is the annual Yukon Quest Dog Sled race between Whitehorse and Dawson City. The Quest Trail parallels the west bank of the Yukon River and crosses lower Williams Creek approximately 150 m upstream of the Yukon River confluence.

The extent of other recreational activities such as hiking or skiing is not known. However, the Williams Creek area is not noted as a particularly popular or unique area for these activities. Access to the area is restricted by the seasonal road conditions.

4.4.1.4 Forestry and Native Plants

White and black spruce is the common conifer tree stands in the Williams Creek drainage, with some lodge pole pine occupying old burn areas. Commercial harvesting of these species in this region of the Yukon is likely not viable; therefore, commercial forestry values for the Williams Creek watershed are not significant.

Some of the indigenous plants of the region are used by members of the Little Salmon Carmacks First Nation for medicinal and traditional purposes.

4.5 SOCIO-ECONOMIC CONDITIONS

The scope of assessments under *Environmental Assessment Act* does not consider socio-economic effects that do not result from changes in the environment. In the case of this project, the social and economic effects that result from changes to the environment (as described in *Environmental Assessment Act*) will be considered in the scope of the assessment. Accordingly, changes to the local social and economic conditions, beyond those arising from environmental changes, are not included in the scope of this *Environmental Assessment Act* assessment.

4.5.1 Population

The population of Carmacks was estimated at 408 at the end of 2005. The 2001 Census identified an overall gender balance and when compared to the Yukon as a whole, Carmacks has a relatively young population with proportionately more children. Approximately 68% of Carmacks residents identified themselves as being aboriginal origin.

4.5.2 Economy

Historically, traditional economic activities include hunting, fishing, gathering and trapping. These activities continue to provide economic benefit to both aboriginal and non-aboriginal people both as a supplement to economic well-being when incomes are low and in providing a degree of resilience and flexibility that allows people to better adjust to economic ups and downs.

The community’s total experienced labour force in 2001 was approximately 220. When in comparison to Yukon as whole, Carmacks has proportionally more people employed in the health, education, and in business services, and, to a lesser degree, in resource-based industries than Yukon.

4.5.3 Community Services

There are three levels of government in Carmacks, Yukon government, the Little Salmon Carmacks First Nation, and the municipal government.

Yukon government has a highway maintenance station in Carmacks, operates the health centre, operates the Tantalus School, provides social services, and provides a territorial agent. Yukon Housing provides and maintains housing and Energy, Mines and Resources also operates an office in the community. In total, the Yukon government employs approximately 30 people in Carmacks, including the teachers at the Tantalus School.

The Little Salmon Carmacks First Nation is a self-governing First Nation under the Umbrella Final Agreement. The First Nation provides a variety of services to its citizens and administers its lands and resources.

The Village of Carmacks collects property taxes and has the authority to pass bylaws in the municipality. The Village employs 7 full-time year-round staff and a variable number of seasonal people in the summer.

As this project is a 'transition' project and subject to assessment under both the *Environmental Assessment Act (EAA)* and the *Yukon Environmental and Socio-economic Assessment Act (YESAA)*, the assessment under YESAA will fully explore the socio-economic effects of this project. Western Copper Corporation has provided this information as part of their project proposal under the YESAA assessment in Appendix P.

5.0 POTENTIAL ENVIRONMENTAL EFFECTS AND PROPOSED MITIGATION

5.1 Valued eco-system and cultural components

Valued eco-system and cultural components are defined as elements of the environment, which are valued for environmental, scientific, social, aesthetic or cultural reasons. A variety of valued eco-system and cultural components exist for any project and the selection of a valued component considers a number of attributes:

- Ecological importance;
- Focal species and/or habitat;
- Socio-economic importance;
- Cultural importance;
- First nation/ resident/ community values or concerns;
- Aesthetic value;
- Rare or endangered;
- Special elements; and
- Responsiveness to impacts or stress.

Based on consultation with the Little Salmon Carmacks First Nation, the Village of Carmacks, the public and regulatory agencies, the proponent identified the following valued eco-system and cultural components in their project description and environmental assessment report:

- Air quality
- Surface water quality
- Ground water quality
- Permafrost (i.e.: soils and topography)
- Fisheries resources
- Wildlife resources

Recognizing the overlap between the valued components and that each valued component can be represented within a number of affected resources, the proponent identified the effects of the project and mitigation on a number of environmental components. The identified valued eco-system and cultural components identified by the proponent are suitable and congruent with the valued eco-system and cultural components identified by the Responsible Authorities. Finding this approach accessible and for the purpose of consistency the comprehensive study follows the same heading and format of the proponent's project description and environmental assessment report.

5. 2 Mitigative terms and conditions

Within the project description and environmental assessment report the proponent has identified a number of mitigative terms and conditions in response to the proposed project effects. The mitigative terms and conditions specified in this section are generally above and beyond those initially proposed in the project description and environmental assessment report, supplemental information submissions and technical information provided by the proponent, and result from specific concerns raised during the technical review of this project. Mitigative terms and conditions identified in the project description and environmental assessment report, supplemental information submissions and technical information provided by proponent are not specifically listed within the comprehensive study. It is the expectation of the Responsible Authorities and a requirement of this comprehensive study that the proponent shall undertake and perform these mitigative activities, except in the circumstances where the mitigative terms and conditions specifically identified by the Responsible Authorities supersede those identified by the proponent. All regulatory authorizations will reflect this assumption and will ensure that any permitted activities are consistent with the intent and purpose of these mitigative terms and conditions.

The Responsible Authorities have identified additional mitigative terms and conditions and have also identified where the proponent shall undertake additional analysis, monitoring, test work and submit further construction and design detail to enable this project to proceed. As identified by the Responsible Authorities and the regulators of this project, all additional test work, analysis, monitoring and construction and design detail shall be submitted to the appropriate regulators and enforcement and compliance offices for review and evaluation. As a matter of course for all aspects of this project and a general statement of undertaking, all activities shall:

- Be accomplished using sound engineering practices;
- Be conducted by appropriate qualified professionals; and
- Ensure that all works and structures associated with this undertaking are maintained in good repair.

Though not specifically identified and referenced in every section of this comprehensive study, all general laws of application apply to the project. As such, the proponent should inform themselves as they are subject to and shall adhere to all applicable legislation and regulation.

5.3 EFFECTS OF THE PROJECT ON ENVIRONMENTAL COMPONENTS

The following section provides a summary of the potential environmental effects and mitigative terms and conditions which have been identified, through the environmental assessment process, by the expert authorities and interested parties. Some of the discussion provided here has been incorporated from the Western Copper Corporation's project description and environmental assessment report.

5.3.1 Atmospheric

Air quality is of intrinsic importance to the health and well being of humans, wildlife and vegetation. Along with local and global atmospheric effects air emission can potentially have widespread freshwater and terrestrial effects as the atmospheric environment can be an important pathway for the transport of substances arising from various project activities. The project is located in a remote wilderness area with few anthropogenic sources of air emissions outside of the mine site.

Atmospheric emissions from mining operations at the Carmacks Copper project will include the following:

- Fugitive dust from mining;
- Road dust;
- Gaseous emissions from the SX/EW process and acid plant;
- Gaseous emissions from diesel generators; and
- Gaseous emissions from solid waste incineration

As identified by the Yukon government Department of Environment, this project will require permitting under the Air Emissions Regulations and Solid Waste Regulations.

Potential Project Effect:

These atmospheric emissions may result in the following potential adverse environmental effects:

- Release of high concentrations of sulphur dioxide (SO_2) or volatile hydrocarbons could cause injury or mortality to living organisms by fire, explosion, toxicity, or asphyxiation;
- Settling of high concentrations of sulphur dioxide (SO_2)produced by acid plant can cause high ground level concentrations that could damage vegetation and soils and affect human and animal health;
- Emissions from diesel, gasoline, and propane could potentially affect human health and the environment, including vegetation and wildlife;
- Noise generated during operations may have a negative effect on the quality of life for wildlife in the vicinity of operations;
- Emissions of fugitive dust which is a nuisance and can potentially affect human health and health of the environment, including vegetation and wildlife;
- Emissions of greenhouse gas's from diesel generators, mine heaters, construction equipment and vehicular traffic contribute to global climate change; and
- Valleys prone to pollution are surrounded by mountains and hills, which block prevailing winds. At night, cold air tends to drain downhill where it settles into low-lying basins and valleys. Air pollution in mountain valleys tends to be greatest during the colder months.

Mitigative Terms and Conditions:

The following additional mitigative terms and conditions are required by the Responsible Authorities:

- Air monitoring and soil sampling for sulphur dioxide releases from the solvent extraction/ electrowinning plant and acid plant areas. If releases are found to be of a level that may be harmful to humans, vegetation or wildlife, additional scrubbers, filters or other such measures shall be employed to reduce these levels.
- Use of low sulphur fuels including diesel fuel with a sulphur content <15 ppm and propane with negligible sulphur content;
- Minimize activities that generate large quantities of fugitive dust;

- Use dust suppression measures to control any generated fugitive dust. These activities shall include but are not limited to dust control on any road ways, drilling and blasting, crushing facilities, and heap and waste rock stockpiling;
- Any dust control measures using water shall ensure water quality standards identified for release into the receiving environment are met;
- Progressively reseed disturbed areas that may contribute to fugitive dust;
- Where appropriate, use waste heat recovery and energy efficiency techniques to minimize the emission of the greenhouse gas emissions; and
- Any combustible waste containing a fossil fuel by-product shall be drained prior to incineration and that material will be recycled where possible.

5.3.2 Topography

Mining operations will result in three major permanent changes to local topographical features:

- An open pit covering an area of approximately 29.5 ha and a maximum depth of 230 m;
- A waste rock storage area covering an area of approximately 69.6 ha and a maximum height of 140 m; and
- A heap leach pad and events pond covering an area of approximately 37.2 ha.

Other changes to the local topography will result from the construction of diversion channels, drainage ditches and road ways, most of which will be restored to their original configuration on closure and reclamation.

The disturbance of soils due to mining activity will occur at a number of areas including:

- The open pit;
- Waste rock storage area;
- The process plant and ancillary facilities;
- The heap leach pad (including events pond and sedimentation control ponds);
- Along road corridors; and
- Borrow areas.

Areas of permafrost occur in the Williams Creek valley in the vicinity of the creek itself and in the north aspect tributaries. Permafrost areas may be subject to mass wasting when vegetation is cleared and vehicle disturbance occurs. Where they occur, ice layers may melt from increased heat absorption on bare or stacked ground and may result in mud sliding downhill and exposing more ice.

Potential Project Effect:

These topographic changes may result in the following potential adverse environmental effects:

- Soil loss, disturbance to topography or ground. Disturbance to the soil profile (i.e. soil loss, compaction, admixing, etc.);
- Erosion prone banks and slopes;
- Disturbance of surface and subsurface drainage systems; and
- There is a potential for localized melting of permafrost.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Site clearing will be timed to minimize soil compaction. To the extent possible, disturbances will be restricted to times when soils are dry or frozen;
- Where possible, disturbed sites will be promptly re-vegetated (progressive reclamation) with appropriate native plant materials and fertilization;
- Site clearing will be minimized during all project phases;
- Growth media and organic layer will be retained for re-vegetation
- Where possible, subsurface and surface drainage will be controlled to prevent slope instability. This includes re-establishing surface drainage when required;
- Extraneous roads will be reclaimed as soon as practicable;
- Additional geotechnical drilling will be conducted to confirm permafrost existence under the heap leach pad and waste rock storage area and design and contingency adjustments shall be undertaken at the specification of the regulators' and submitted at the regulators' discretion. As part of final design foundation stabilization options shall be considered;
- Settlement surveys will be conducted in the heap pad/ waste rock storage area and associated containment berms to determine the permafrost degradation in the foundation soils;
- The heap leach pad will be re-countered in congruency with surrounding topography and appropriately sloped to promote original habitat re-vegetation and encourage run-off;
- The waste rock storage area geometry will be designed and constructed in congruency with surrounding topography and appropriately sloped to promote original habitat re-vegetation and encourage run-off;
- The heap leach pad and waste rock storage area will be reclaimed with appropriate plant materials and fertilization; and
- Upon events pond decommissioning, liners will be removed or folded in on themselves and buried and the remaining events pond geometry will be shaped in congruency with surrounding topography and to promote re-vegetation it will be reclaimed with appropriate native plant materials and fertilization.

5.3.3 Water Resources

The Carmacks Copper Project is located in the upper reaches of Williams Creek, approximately 9 km upstream of its confluence with the Yukon River. Williams Creek is a small tributary originating in the Dawson Range and draining northeast into the Yukon River about 40 km northwest of Carmacks. The watershed is 88 km2 in area and is comprised of two principal basins, Williams Creek and its tributary Nancy Lee Creek. Williams Creek is typically a straight, deeply incised, narrow channel (1-4 m width and 0.5 to 1.5 m depth) with an average slope of 3%.

Water moves down Williams Creek at an average velocity of 5-20 cm/sec under low flow conditions and 10-40 cm/sec under higher flows. It may take a period of anywhere between ½ and 4 days to travel the course of the creek ~9 km into the Yukon River. Under these flow conditions, particulate matter of normal density will likely settle out of solution with 2-4 km of creek travel distance.

Baseline Metal Levels

Both total and dissolved metal levels were determined by ICAP analysis for the mainstem and tributaries of Williams Creek at stations W1 through W11. A brief summary of these data is presented below with a comparison of the natural levels and those listed in the Canadian Council of Ministers of the Environment Effluent (CCME) guidelines.

Natural Levels of Total and Dissolved Metals in Williams Creek and its Tributaries

Metal	Total Range mg/l		Dissolved Range mg/l		CCME guideline mg/l
Aluminium	0.26	9.58	0.007	0.084	
Total Aluminium levels were above CCME guidelines in ten samples. All levels detected for dissolved aluminums were below CCME guideline.					
Arsenic	0.04	0.16	0.06	0.16	0.11-0.16
Five samples from the tributary sites were above CCME guidelines (0.11-0.16 mg/l).					
Barium	0.012	0.455	0.009	0.067	
Cadmium					
Total and dissolved levels of cadmium were below detection for most water quality samples, however total cadmium was detected at greater than CCME criteria at sites W-1 and W-5 with values ranging from 0.004 to 0.006 mg/l.					
Chromium	0.005	0.05	0.001	0.007	
Cobalt	0.001	0.016	0.001	0.007	
Copper	0.001	0.059	0.001	0.009	0.002-0.004
Total copper levels were intermittently above the CCME guidelines at sites W1, W3, W4, W5, W7, W9, W10 and W					
Iron	0.037	31.4	0.022	9.4	0.3
Total iron levels were occasionally above CCME criteria at W2, W4, W5, W6, W7, W9 and W10 (0.3 mg/l).					
Zinc	0.002	0.195	0.002	0.01	0.03
Total zinc concentrations were periodically above CCME guidelines in sites W1 to W6 and W10 (0.03 mg/l).					

Natural Buffering Capacity

The water quality of Williams Creek has been determined through direct sampling and analysis form 1989 to 2005 by Access Consulting of Whitehorse. During that sampling period, average alkalinity values for the Williams Creek mainstem were between 107 and 149 mg/l CaCO3. Seasonal variation ranged from 38 to 255 mg/l CaCO3. Buffering capacity was typically well above 100 mg/l as CaCO3 with the lowest values noted during one early spring. The natural chemistry of the creek is likely derived primarily from the dissolution of dolomitic calcites within the soils and aquifer materials. The Williams Creek mainstem pH values ranged from 7.4 to 8.2 with relatively little variation between individual sample sites.

Bioassays

Acute Toxicity tests were conducted for rainbow trout in 1994 in a solution of neutralized filtrate by EVS Consultants with a 90% survival rate. Golder Associates conducted toxicity tests on neutralized raffinate and pregnant leach solutions derived from column tests for Daphnia Magna in 2007 with the 48 hour LX50 (survival rate) estimated to be greater than 100% for both samples.

5.3.3.1 Surface Hydrology

The proposed operations will result in a modification to the mean annual distribution in runoff. Modifications to the topography and subsequent installation of diversion ditches may change the surface water flow patterns.

Potential Project Effect:

These changes to surface water flow patterns may result in the following potential adverse environmental effects:

- Erosion of stream banks;
- Removal of vegetation and site development may cause reduced transpiration, increased soil moisture and decreased infiltration leading to increased site runoff;
- Potential run-off from dust control measures, road watering, truck washing and other similar water us activities;
- Road ditches and drainage structures form preferred pathways for drainage, hastening runoff;
- Piling up of snow, compaction by vehicle travel, and introduction of sediment to the snow pack in the vicinity of the project site may result in changes in the snowmelt conditions;
- Groundwater well use may effect downstream surface flow in Williams Creek;
- Increased flows in Williams Creek from possible discharge;
- Flood events associated with structure failure;
- Potential stream flow reduction due to mine area dewatering which may result in decreased stream flow affecting stream biota and loss of dilution factor for effluent release;
- Open pit may create higher evaporation sink which may effect off-site water table; and
- Pit water removal and groundwater well extraction may result in a cone of depression effecting base flow of surrounding streams.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Ensure any waters sourced from the mine water discharge pipeline, including those to the crushing plant area, shall not be discharged directly into the environment. These waters shall report to the sedimentation pond for testing and possible treatment, if required, prior to release into the environment;
- Hydrological monitoring of receiving environment during operation and closure prior to release of any solutions to determine optimum dilution availability and downstream water volume and quality impacts;
- Coordinate and plan water withdrawal/ discharge events as to not adversely affect aquatic resources or surrounding ecology;

- Final design of pit wall stability and water handling, inclusive of pit water conveyance to Williams Creek shall be to the specification of the regulators' and submitted at the regulators' discretion;
- Construction and operation of mine will limit the existence of perched water, particularly over permafrost areas, and shall provide a plan and schedule for monitoring zones where perched water may accumulate;
- Inclusive of the hydrological information, detailed design information for all of the sediment control ponds, inlet/ spillway channels and diversion/ perimeter ditches shall be to the specification of the regulators' and submitted at the regulators' discretion. This will also include plans and design for potential pit water conveyance to William Creek; and
- Long-term predictions on Williams Creek and utilisation by aquatic resources as a consequence of use and withdrawal of ground water for mining.

5.3.3.2 Surface Water Quality

Since the proposed operations will operate with a water deficit and on the basis of 100% recycle of process streams, there should be no routine release of effluent to the receiving environment during operations; however, release of effluent will be required during closure and possibly during emergency situation. A contingency water treatment plant will be used in the event that an emergency discharge is required during operation and during closure of the site.

The proponent plans to use any mine water encountered in the open pit as process water. Site drainage and wash water is proposed to be directed to the sediment control pond, recycled, or filtered back into Williams Creek below the ancillary facilities. The proponents plan uses a sediment pond located below the waste rock storage area to capture drainage from this area with water to be recycled for process use.

Site runoff is expected to carry a heavy suspended solids load during periods of high precipitation. The proponent's plan is for these flows to be routed to the heap site sedimentation pond and waste rock dump sediment pond before release.

The natural background values of background water quality parameters for some metals (e.g.: As, Cu, Pb, and Zn) have occasionally exceeded Canadian Council of Ministers of the Environment Guidelines. For example, As concentrations are predicted to exceed Canadian Council of Ministers of the Environment guidelines during all model runs due to naturally high mean concentrations for this parameter. In lower Williams Creek (W10) where fisheries resources are known to exist, Canadian Council of Ministers of the Environment guidelines is met for Cu, Pb, and Ni. Zn marginally exceeds the Canadian Council of Ministers of the Environment guideline.

Testing has indicated that metal leaching from the waste rock storage area is not expected to occur. However, the proponent has suggested that, based on the results of water quality monitoring if waste rock runoff results in an increase in metals in Williams Creek such that metals levels exceed beyond natural background levels, then adaptive management and contingency measures shall include any of the following:

- Recirculation of waste rock runoff onto the dump to enhance evaporation;
- Installation of an waste rock evaporation pond;
- Treatment in the contingency water treatment plant;
- Decreasing the cut-off grade to reduce the quantity of mineralized rock in the dump; and

- Other treatment alternatives including a biological treatment cell or infiltration gallery.

As identified by the Yukon government Department of Environment, this project will require permitting under the Storage Tank Regulations and depending on further testing that shall be undertaken by the proponent may be subject to the Special Waste Regulations and/or Contaminated Sites Regulations.

Potential Project Effect:

This project may have the following adverse environmental effects to surface water quality:

- Increased levels of sediments in the runoff from the site;
- Potential for accidental release of heap solution which contains contaminants that are toxic to aquatic life;
- Possible contamination to downstream water courses from runoff water that flows through and over the waste rock/open pit or other mine areas resulting in adverse effects to aquatic life;
- Accidental discharge of liquid hydrocarbons, acids, and other chemicals;
- Erosion of stream banks at stream crossings causing siltation; and
- Degradation or contamination of watercourses or groundwater.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Measures to control sedimentation from the site shall be used (e.g.: construction during heavy precipitation events will be minimized);
- Sediment in events pond and sediment control ponds will be characterised through testing and disposed of accordingly;
- To maintain design retention times and settling capabilities appropriate mitigation measures shall be identified to the regulators to control sedimentation of surface waters;
- Schedule of monitoring and testing of water quality in any sedimentation or control pond is required and shall be submitted to the appropriate regulator;
- To control the amount of moisture or water flowing form the heap leach pad and the waste rock storage area, both the heap leach pad and the waste rock storage area shall have an evapotranspiration covers;
- Additional testing (e.g.: kinetic testing) is to be done by the proponent to confirm the characterization of the waste rock and to confirm it has no acid rock drainage potential and the potential to release metal contaminants via metal leaching mechanisms is negligible. Based on this analysis, measures shall be identified to the specification of the regulators' and submitted at the regulators' discretion. While this comprehensive study has been premised on modeling and test work undertaken to date, the results for further test work that is currently undertaken or is to be undertaken must support the viability of the mitigation measures provided by the proponent. Test work shall continue at the regulators' discretion until they are satisfied that the geochemical characteristics of the project have been defined and can be mitigated through-out the entire mine life, operation, decommissioning, closure and post-closure. Based on these finding, financial security shall be accordingly identified;

- Progressive cleanup and remediation following performance standards and terrestrial reclamation standards shall be completed across the duration of the mine
- Upon closure, a more detailed design and analysis of the of the heap and waste rock storage area store and release cover shall be provided to the regulators, inclusive of optimal thickness for seepage and detail of surface soil which will inhibit erosion and promote native revegatation;
- All aggregate and building material sources and potential ‘cuts’ related to road or infrastructure development must be characterized for acid generation potential and metal leachate prior to development; only non-reactive aggregate material may be used for construction; and
- Site surface water quality parameters appropriate for the receiving environment shall be proposed by the proponent and established by the regulators to address possible toxicity for aquatic resources; these parameters will be inclusive of any potential metal leachate or toxic sources produced from the mine construction, operation or decommissioning.

5.3.3.3 Hydrogeology

Open Pit

Development of the open pit will result in a cone of depression in the groundwater table radiating from the floor of the pit outwards. Some water, which normally migrates to North Williams and Williams Creeks as groundwater, will be collected in the pit and pumped to the process plant as make-up water.

Based on modeling results it is expected that the pit will take a significant period of time to fill (>300 years), though there is some question that the pit may never fill due to the level of the ground water table.

Waste Rock Storage Area

Drainage ditches will be used to collect waste rock runoff due to precipitation. The amount of runoff which enters the pile will be minimal and will flow in the near surface groundwater at the base of the pile for collection in the toe drains and ultimately into the sediment control pond for use as make-up water for leaching operations and for dust control on the roads.

Heap Leach Pad

During construction, the entire leach pad area will be lined in order to prevent leakage to groundwater. Consequently, surface recharge to the groundwater table in the area of the heap leach pad will not occur over an area of approximately 37 ha. Until further testing confirms that no permafrost exists, there is the potential for the permafrost levels to lower under the heap leach pad due to heat losses from leach solutions and the ore into the ground possibly melting the permafrost. This could partially divert near-surface groundwater flows and possibly lead to differential settlement of the heap through melting permafrost causing deformation/tearing of the liner.

Well Water Supply System

To provide domestic and process water for the project, 8 wells located in the bedrock confined aquifer underlying Williams Creek drainage will be drilled. Each well is estimated to provide approximately 150 m^3/day.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Well water supply location, elevation, borehole logs, screening depth, lithologies encountered, installation methods and well protection measures, including monitoring frequencies and analytical parameters shall be to the specifications of the regulators' and submitted at the regulators' discretion; and
- Plug, abandonment plans or abandonment records for wells must be submitted to specifications of the regulators' at the regulators' discretion.

5.3.3.4 Groundwater Quality

Groundwater was not encountered by the exploration geologists or the geotechnical engineers in any of the exploration drill holes or geotechnical evaluations except in two locations, which consisted of perched water tables over permafrost. Groundwater flow is restricted to minor seasonal flows within the active swampy zones just below the ground surface.

Western Copper intends to proceed with the installation of a double synthetic geo-membrane liner system for the entire heap leach pad overlying by a low permeability soil liner. The primary and secondary liners will be separated by a high-density polyethylene geo-net leak detection and recovery system.

Western Copper plans to pump any seepage collected by this system back to heap storage. In addition to the geo-net leak detection and recovery system, the entire heap leach pad below the secondary soil liner will be equipped with foundation drains, which are located in natural draws within the heap leach pad area. This secondary drainage system, which is designed to provide drainage and pore pressure relief for groundwater generated by thawing permafrost, terminates in the events ponds and acts as a secondary leak detection and recovery system. By this plan Western Copper hopes to minimize contamination to the groundwater since any seepage through the primary leak detection system and any seepage picked-up by the foundation drains will be directed to heap storage.

The events pond is also equipped with a double synthetic geo-membrane liner separated by its own geo-net leak detection and recovery system, independently equipped with a pump-back recovery system.

Any seepage which escapes the leak detection and recovery system and the foundation drainage system will migrate down gradient toward the events pond, the mine site sediment control pond and then to Williams Creek.

Knight Piésold Ltd. (amended design report, 1995) estimate that seepage rates through the outer liner from the heap leach pad will be in the order of 0.1 m^3/day when applying a contact coefficient of 0.21 for the liner moulding and 0.5 m^3/day when using an extremely conservative coefficient of 1.15.

Western Copper does not plan to use a liner on the waste rock storage facilities due to analyses of the waste (acid-base accounting) indicating that the waste rock is acid consuming. The waste rock storage area will be equipped with a sediment pond and a foundation drainage system to collect waste rock dump seepage, both lined with 8 oz. non-woven geo-textile. The waste rock dump will also be equipped with perimeter drainage ditches to intercept and collect surface runoff.

Western Copper has initiated a groundwater monitoring program which will be ongoing through construction and operation. In the vicinity of the heap leach pad and down slope of all facilities groundwater piezometers will be regularly sampled to ensure that the monitoring system that could detect potential losses is working effectively.

Potential Project Effect:

This project may have the following adverse environmental effects to ground water quality:

- Potential for accidental release of heap solution which contains contaminants that are toxic to aquatic life;
- Potential for seepage from heap, waste rock storage area, events and sedimentation pond to have an adverse effect on groundwater or aquatic life;
- Contamination to downstream water courses from runoff water that flows through and over the waste rock/open pit or other mine areas resulting in adverse effects to aquatic life;
- Accidental discharge of liquid hydrocarbons, acids, and other chemicals;
- Potential for dewatering of mine area thereby reducing base flow of streams; and
- Degradation or contamination of watercourses or groundwater.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- As the heap leach pad is approximately 100 meters from the ultimate limits of the pit, the additional design and evaluation of the heap leach pad layout and pit configuration shall be to the specification of the regulators' and submitted at the regulators' discretion;
- To demonstrate the long-term stability of the over-liner material and sub-grade materials, the source and volume of rock material for the over-liner shall be identified and evaluated for geotechnical acceptability (e.g.: durability, grain size, maximum percolation rate versus normal load, etc);
- Stability analysis shall be completed to confirm the critical interface and interface shear strength between the geotextile and soil liner;
- Site specific liner leakage rates and allowable limits shall be identified to the specification of the regulators' and submitted at the regulators' discretion for the final design of the heap leach pad, inclusive of a responsive plan and contingency measures identification;
- To the specification of the regulators' and submitted at the regulators' discretion, further analysis shall be presented that identifies gradations, angularity, density, compactions, etc. requirements for each of the liner materials;
- Further justification for the selection of liner materials shall be provided to the regulators, inclusive of analysis of strain, load tests and multi-directional stress and the proposed liner may experience stresses that exceed values identified in the project description;
- To the specification of the regulators', design of the heap leach pad embankment, stability analysis and justification for embankment height and factor of safety for the embankment for operations and closure shall be submitted at the regulators' discretion;

- In an effort to reduce the volume impounded on the heap leach pad liner and convey the pregnant leachate solution for processing, the solution collection and pipe penetration concept and corresponding design details be developed in more detail and shall be submitted to the appropriate regulator prior to mine construction and operation;
- A foundation drain shall be incorporated into the heap leach pad which will allow for discharge at closure within minimal head on the liner system;
- Further stability monitoring of the ore settling patterns throughout the duration of the mine operations shall be completed, inclusive of analysis of the heap leach pad angle of repose and associated ore and/or heap slumping;
- It is anticipated that there will be some potential sulphide exposure in the pit; plans shall be submitted for operation and closure to ensure minimal exposure and oxidation of sulphides; and
- To ensure that water from the heap, events and sedimentation ponds is not infiltrating groundwater, monitoring wells (or other complimentary approaches) shall be installed down gradient of these features. Location, elevation, borehole logs, screening depth, lithologies encountered, installation methods, monitoring schedules and permeability analysis of these measures shall be submitted to the regulator.

5.3.4 Aquatic Resources

5.3.4.1 Fisheries effects

Williams Creek drains the Carmacks Copper project area and combines with flows from Nancy Lee Creek before flowing into the Yukon River. The Yukon River then flows north and west before discharging to Norton Sound on the west coast of Alaska. Fisheries studies including biophysical inventory, electro-fishing, minnow traps, and spawning surveys were completed for three periods between August 1991 and August 1992.

Fisheries investigations indicate that fish inhabit the lower section of Williams Creek to the confluence with Nancy Lee Creek. Species in lower Williams Creek include juvenile Chinook salmon, arctic grayling, slimy sculpin, longnose sucker, burbot, and northern pike.

No fish have been observed or captured in Williams Creek above the Nancy Lee Creek confluence. Spawning was not observed in the Yukon River near the Williams Creek confluence during the October 1991 survey and no spawning in Williams Creek has been observed by local residents.

Fisheries could potentially be affected by changes to metal concentrations; however, baseline water quality data collected in lower Williams Creek naturally exceeds Canadian Council of Ministers of the Environment guidelines for total aluminium, arsenic, copper, iron, and zinc. There is a potential for these metal concentrations these metals concentrations to be further elevated due to mine operations. Western Copper plans to use waste rock runoff water as process water during operations and will not directly discharge from this source without first testing for water quality to avoid any inadvertent high metal loadings in the receiving environment. If, for any reason, heap discharge is required, wastewater would be treated prior to discharge to reduce metal concentrations and adjust acidity to levels appropriate for discharge. Downstream water quality will be monitored to determine if the projected metal levels occur and whether treatment or further mitigation measures are required.

Increased sediment loads caused by construction and erosion of fine particles disturbed by mine operations result in scouring attached algae from the stream substrate and a reduction in habitat for benthic macro-invertebrates, both resulting in a reduction in the fisheries food source. Increased sediment loads in the water column can also cause abrasion of fish gills. Under high suspended levels concentrations fine particles may abrade the gill surface reducing the capacity for gas exchange, thus, potentially resulting in suffocation and rendering the fish more susceptible to infection and gill parasites. The proponent will develop a surface water management plan which will be submitted to the specification of the regulators' and submitted at the regulators' discretion.

5.3.4.2 Benthic Macro-invertebrates effects

Benthic macro-invertebrates are an important component of the ecological network and are useful in assessing environmental effects from mining activity. They are efficient indicators of water and habitat quality in streams because the majority of their life cycle is intimately linked to the aquatic environment. Therefore, they reflect any disturbance to surrounding vegetation or changes in water quality. Juvenile and adult stages of important fisheries species, particularly salmon and other insectivorous species, depend on the availability of benthic macro-invertebrates as a food source.

Benthic macro-invertebrates may typically be adversely affected by in-stream construction, removal of over-storey cover, increased heavy metals, sediment and nutrient loadings, acid rock drainage or reduction or loss of flows. Increased sediment loads abrade the gill membranes of macro-invertebrates, scour algal growth from rock surfaces, which reduce the food source, and fill interstitial pore spaces of substrate, which reduces habitat availability. These have a direct effect on benthic organisms, their food resources and their habitat, respectively. Under extreme conditions, increased nutrients such as nitrates and phosphates (from blasting) may have a direct toxic effect or may result in nutrient pollution, which reduces available habitat and oxygen. Moderate increases in nutrient levels cause community stress and increased algal growth which may, for example, result in a shift to a community dominated by herbivorous species. High concentrations of chemicals and heavy metals have the potential to be acutely toxic to benthic macro-invertebrates or chronically toxic if they are bio-accumulated and interfere with normal physiology.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Any road or bridge construction and maintenance at the Merrice & Williams Creek crossings shall be performed to standards established by the regulators to ensure minimal riparian and aquatic disturbance;
- Site specific water quality parameters appropriate for the receiving environment shall be proposed by the proponent and established by the regulators to address possible toxicity for aquatic resources; these parameters will be inclusive of any potential soluble and suspended metal or toxic sources produced from the mine construction, operation or decommissioning;
- Recognizing the potential risk associated with the construction of the operational treatment system in year 4 of the mine as suggested by the proponent, the operational treatment system shall be constructed and operational in year one to coincide with all operations of the mine until closure activities begin or the regulator shall hold security until the construction and viability of the operational treatment system has been established.

5.3.5 Wildlife

5.3.5.1 Species Concerns

Surveys from 1991, 1992 and 2005 note very little ungulate, furbearer, or other mammal activity. Historically, caribou migration extended into this area; however, this does not presently occur and no ungulates appear to have filled this abandoned niche (Little Salmon Carmacks First Nation, Carmacks Renewable Resources Council, 2004). A field survey conducted in July 1994 indicated that the steep sloping south scarps may provide habitat for mule deer, but this area will not be affected. Waterfowl were not observed, likely due to the absence of productive wetland habitat. Although raptor nests were observed on cliffs near the Yukon River, only the American kestrel was sighted. Key summer nesting habitat is recognized to occur northeast of the project in the Nancy Lee and Hoochekoo creeks watersheds. However, these creeks will not be affected, as the project site is located nearly 9 kilometres away.

One possible explanation for the apparent limited wildlife use of the area is a cyclic low in the different species cycles, analogous to the lynx and hare 10-year population low, which occurred in 1991 according to territorial government information.

5.3.5.2 Direct Habitat Effects

Open pit development will result in permanent loss of approximately 29.5 ha of low capability conifer dominant upland habitat. The heap leach pad, process plant and camp facilities will result in a temporary loss of around 41 ha of moderate habitat capability land, which are aspen dominant uplands. Waste rock storage will cover approximately 69.6 ha of moderate capability conifer dominant wetlands. Aspen dominant uplands have moderate potential for moose, snowshoe hare, black bears, and ruffed grouse. Conifer dominant uplands have high potential for red squirrel and spruce grouse, low to moderate potential for hare and its predators, and very low moose habitat potential.

Access roads (12.3 ha) will transect similar habitat to the mine facilities including low capability conifer dominant uplands and moderate capability conifer dominant wetlands.

5.3.5.3 Indirect Habitat Effects

Habitat loss also occurs where some form of disturbance prevents a species from using an area or reduces the frequency of use, even though no physical loss of habitat occurs. This may involve avoidance by animals to normal feeding activities in the vicinity of a road or through blocking access to traditional habitats used seasonally. This also includes avoidance by species due to machine noise and operational activity.

It is difficult to predict or estimate the actual area of wildlife habitat lost by avoidance behaviour. McLellan and Shackleton (1988) provide the best comparative data for grizzly bears, in which a seven year study in south-eastern BC showed that most bears used habitats within 100 metres of roads less frequently than expected. Avoidance of roads was independent of traffic volume, which suggested that even limited vehicle use can displace bears.

It is expected that there will be some effect on wildlife from mine construction and operation. Some degree of habituation is expected with ungulates as noted at many mining projects. Since the project does not cut through any major migration routes and from field surveys does not lie in critical habitat, the project is expected to cause minimal indirect habitat loss for caribou.

Some disturbance to wolf, black bear and grizzly bear, as noted from field surveys, is expected due to mine operations; however, due to the relatively low abundance of these species in the mine site area, little indirect effect is expected.

To prevent injury to wildlife the company proposes to encompass the heap leach pad, events pond, and process area with fencing to prevent entrance into these areas.

Bears

The following text has been included from the "Community-Based Fish and Wildlife Management Plan – Little Salmon Carmacks First Nation Traditional Territory 2004-2009." Talks in the community about bear species and their behaviour may help to minimize conflicts between bears and people. The company will have an employee bear awareness program. Conservation Officers will work with the Carmacks Renewable Resources Council and Little Salmon Carmacks First Nation to identify appropriate times and places to hold these talks.

The "Community-Based Fish and Wildlife Management Plan – Little Salmon Carmacks First Nation Traditional Territory 2004-2009" identified a need to protect the Yukon River from Tatchun Creek to Minto as important habitat for moose, salmon, and other wildlife. The proposed solution to this concern is to pursue designating this area along the Yukon River as a Habitat Protection Area under the *Wildlife Act.* The Fish and Wildlife Management Plan states that the community and governments need to get together to decide what kind of activities should happen in this important wildlife habitat.

Potential Project Effect:

This project may have the following adverse environmental effects on Wildlife:

- Disturbance to wildlife from direct habitat loss;
- Disturbance of wildlife migration or blockage of wildlife movement corridors;
- Disturbance to migratory bird populations;
- Project components may create fragmentation and alter wildlife movements;
- Attraction of nuisance animals;
- Encroachment on important wildlife habitats; and
- Roads could allow for increased access for wildlife harvesting or direct mortalities.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Employees are prohibited from hunting and fishing while on the mine site as well as travelling to and from the mine site;
- Employee off-road vehicles are prohibited on the mine site;
- Employee firearms are prohibited;
- Upon construction of the events pond and up to time of decommissioning, the events pond will fenced to avoid inadvertent entrapment of wildlife;
- Sightings and interaction with large mammals, raptors and waterfowl shall be recorded and logged;
- Measures that discourage use of events pond and settling ponds by birds shall be employed;

- Where possible, animal corridors will be provided to allow for undisturbed movement of wildlife on the project site; and
- Measures to protect against impact on migratory birds shall be discussed with the Canadian Wildlife Service. These discussions may include scheduling of activities to avoid disturbances during breeding season, conducting pre-clearing surveys for migratory bird use, bird scaring devices and measures to ensure birds do not settle in the events or sedimentation ponds.

5.3.6 Vegetation

The amount of existing and proposed clearing will total approximately 152.17 ha as follows:

- The ultimate open pit mine configuration will encompass approximately 29.5 ha on an area presently dominated by lodge pole pine, white and black spruce, and aspen;
- Waste rock storage to the north of the open pit adjacent to North Williams Creek will require that approximately 69.6 ha of land be cleared of predominantly lodge pole pine, aspen and black spruce;
- Construction and operation camp facilities, maintenance shop, warehouse, process plant, and ore conveyors are dominated by lodge pole pine, aspen and black spruce. Approximately 3.57 ha of land will need to be cleared for these facilities;
- The leach pad facilities, sediment control pond and events pond will encompass approximately 37.2 ha of land dominated by aspen, lodge pole pine and grasses; and
- Main access road will encompass approximately 12.3 ha;

Removal of vegetation will result in the loss of wildlife habitat and, if acceptable procedures are not employed, may also result in spread of forest infestation, increased fire hazard, increased runoff and increased erosion.

No unique or endangered vegetation is known to occur in the mine site area. Most of the leach pad area was cleared in 1997; however, a certain amount of re-growth will have taken place. The amount of merchantable timber removed for site preparation at the time was extremely low, as climate and elevation near the mine site limit forest productivity. Clearing and recovering merchantable timber from approximately 152.17 ha was contracted out, and if further clearing is required during construction this also will be contracted out. Efforts will be made to stockpile suitable logs for various requirements such as temporary bridges, retaining walls and guard rails. Slash will be burned or buried as necessary, or stockpiled for used as cord wood for the local community.

Potential Project Effect:

This project may have the following adverse environmental effects on vegetation:

- Loss of vegetation communities;
- Loss of timber;
- Contamination of soil/potential for fuel and/or other substance spillage;
- Fire hazards; and

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Soils and vegetative matter that would support further growth from any clearing or stripping will be stockpiled and used during reclamation activities;
- Merchantable timber will be salvaged and opportunities for collection or purchase shall be provided to local residents; and
- Best practices shall be undertaken to limit the introduction of invasive species through the construction, operation and decommissioning of the mine.

5.3.7 Heritage Resources

Two sites were identified by Antiquus Archaeological Consultants in August 1992 in the EA study area. One site consists of an old mine adit on lower Williams Creek and is associated with a log cabin and remains from mining activity from the 1930s or 1940s which is located approximately 400 m away. An old horse trail leads from this cabin to a cabin on the banks of the Yukon River which was probably used as an ore transfer station for river transport.

It was determined that no archaeological effects are expected from development of the open pit, heap leach pad, or waste rock facility. Additionally, if access roads into these areas are required they will avoid land-altering activity at these sites. (Antiquus Archaeological Consultants, 1992).

As the project footprint is not expected to affect the lower Williams Creek, Yukon River Valley, these sites will not be disturbed.

There are three locations near the proposed mine access road considered to have medium heritage site potential. One large medium heritage site potential area is located on both sides of Crossing Creek between the bridge over the creek on the existing Freegold Road and the turnoff to the mine access road. The remains of prehistoric or historic camps may be located in this area. The other two medium heritage site potential areas are located where the mine access road crosses Merrice and Williams Creeks.

Antiquus Archaeological Consultants recommends that areas identified as having medium heritage site potential be subjected to further study prior to the initiation of any land-altering activities.

Potential Project Effect:

This project may have the following adverse environmental effects on Heritage Resources:

- Loss, damage, or alteration of heritage sites or sites of archaeological/historical interest or cultural artefacts.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- Any site containing archaeological objects, human remains or burial sites discovered in the course of carrying out an operations must be immediately marked and protected from further disturbances and, as soon as practicable, the discovery reported to the Yukon Archaeology Program, Government of Yukon in Whitehorse at (867)667-3771 or (867)667-5386. No further activities may be carried out within 30m of the site until the Yukon Government indicates, in writing that the activities may be resumed.

- As a component of cross-cultural awareness training, all employees at the Carmacks Copper mine shall be informed of the value of heritage resources, Yukon laws and company policies prohibiting disturbance of these sites.

5.3.8 Land use

The development of the Carmacks Copper project will render a small portion of land in the mine area unsuitable for the pursuit of current land uses (i.e.: hunting, fishing, trapping and recreation). The area is not considered of high recreation and traditional-use value and the disturbance will be temporary for much of the area. The socio-economic effects section of the comprehensive study examines this as well.

Decommissioning and reclamation of the project will ensure that the site is restored to a functioning ecosystem. Progressive and final reclamation and decommissioning will ensure that the area may be used for subsistence activities should they be pursued.

Mitigative Terms and Conditions

The following additional mitigative measures are required by the Responsible Authorities:

- The objective of mitigating likely significant adverse environmental effects on current land use includes mitigation requirements for wildlife protection and reclamation obligations. The implementation of mitigation measures such as access restriction and other wildlife protection measures, progressive and final reclamation with ongoing follow-up program implementation into the post-closure period, backed by financial security, are intended to restore that the project area to the extent that it will be once again be available for recreation and traditional pursuits.

5.3.9 Socio-economic Effects as a Result of Environmental Change

For the purposes of the *Environmental Assessment Act* comprehensive study, social and economic effects that result from changes to the environment are considered within the scope of the assessment. Though the socio-economic effects beyond those arising from an environmental effect are not considered, the Executive Committee screening by the Yukon Environmental and Socio-economic Assessment Board pursuant to the *Yukon Environmental and Socio-economic Assessment Act* will complete a through examination of the socio-economics of this project.

As part of the project description and environmental assessment report, the proponent submitted the ‘Carmacks Copper Project Socio-economic Effects Assessment’ which identifies:

- Socio-economic baseline data
- Economic inputs and outputs
- Socio-economic effects assessment
- Cumulative socio-economic effects

Consumptive and non-consumptive use of resources is prevalent within the scope of the Carmacks Copper project area. Hunting, trapping, fishing (subsistence and recreational) and outfitting are all activities with a strong social and economic component that could be adversely affected if robust and comprehensive mitigative measures to protect fish and wildlife are not implemented.

Potential Project Effect

This project may have the following adverse socio-economic effects as a result of an environmental change:

- Increased noise and visibility from existing public roads, Yukon River and recreation sites
- Improved roads and improved maintenance leads to easier hunting access to the area
- Habituation of wildlife through human presence
- Increased traffic and use of the Freegold Road

Proposed Mitigation

The following mitigation measures are required by the responsible authorities to minimize the potential adverse effects described above:

- Though the project area is not visible from existing public roads or high traffic recreation areas, reclamation activities shall promote natural re-vegetation of any disturbed areas;
- A 100m buffer zone/ setback shall be maintained from any activities undertaken at the Yukon River (i.e.: except control and monitoring stations);
- Camp and mine site garbage and waste management activities shall limit wildlife exposure and access. Nuisance bears shall be reported to Yukon government authorities;
- Private firearms and hunting on and from the mine site shall be prohibited;
- Employment policies shall prohibit opportunistic hunts by employees traveling to and from the mine site for work;
- Yukon government shall establish weight restrictions, speed limits and other usage controls on the Freegold Road based on the proposed usage by the proponent to ensure public safety and minimize effects to other Freegold Road users;
- In areas of joint use by the Yukon Quest and the proponent, the proponent shall consult the Yukon Quest and wilderness tourism operators on the proposed activities to limit trail disturbance and coordinate the timing of the proponent's use of the Freegold Road during competition events.

It is anticipated that the proponent and any interested first nation or other local groups will establish a formal relationship through an impact benefit or socio-economic agreement. Generally, these agreements focus on maximizing socio-economic benefits for the first nations through priority hiring and service procurement, training opportunities and any number of social and capacity building investments for a first nation or local community.

5.4 CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative effects refer to those effects on the environment that result from effects of a project when combined with those of other past, existing, and imminent projects and activities. To address cumulative effects, a project's activities must be considered in context to actual or potential impacts on the environment from other sources.

Since the construction of the North Klondike Highway, the Carmacks area has been explored and developed in the search of metals. Outside small placer operations, there has been little industrial development in the Carmacks area since the 1990's with the abandonment of the Mount Nansen mine site (located 60kms west of Carmacks). With continued economic prosperity in the mining sector, further exploration is anticipated in the Carmacks area. At the writing of this assessment, the Carmacks – Stewart Transmission Line project is being assessed under the *Yukon Environmental and Socio-economic Assessment Act.*

The project description and environmental assessment report contained a cumulative effects analysis for a variety of valued ecosystem and cultural components. The analysis findings generally indicated that likely significant adverse cumulative effects could be mitigated. Further to the analysis completed in the project description and environmental assessment report, the responsible authorities have identified two particular valued ecosystem and cultural components: cumulative effects on wildlife and water/ aquatic resource. Linear corridors are particularly detrimental to wildlife due to increased access leading to direct mortality (vehicle collisions), hunting pressures, and increased area activity may lead to further human/ wildlife encounters, specifically disturbance of threatened and special concern wildlife and wildlife key areas. Given the interest in water and aquatic resources untreated discharge to surface or ground water from multiple sources could result in significant adverse cumulative effect.

The project description and environmental assessment report provided by the proponent indicates that likely significant adverse cumulative effects could be mitigated. Water discharge to water is regulated under the *Waters Act*. Water Use Licences under the *Waters Act* will ensure that other projects that may deposit a waster into receiving waters are licenced on a case by case basis to mitigate significant adverse cumulative effects on water and aquatic resources. The project is also subject to the Metal Mine Effluent Regulations under the Fisheries Act as national minimum standard. The cumulative effects of ongoing and anticipated exploration programs will be mitigated by operating conditions of the Mining Land Use Regulation pursuant to the *Quartz Mining Act.* , including requirements for reclamation.

Currently, there are no Land Use Plans in effect nor are any anticipated to be in effect in the foreseeable future. The Carmacks Renewable Resource Council is the primary instrument for local renewable resource management in the traditional area of the Little Salmon Carmacks First Nation on any matter related to conservation of fish and wildlife. The cumulative effects of ongoing and anticipated exploration and development will continue to be of interest to the Renewable Resource Council.

The mitigation identified by the proponent in the project description and environmental assessment report and the additional mitigation identified in section 5.3 of the comprehensive study mitigate the direct effects of the Carmacks Copper project but also contribute to the mitigation of the cumulative effects of this project in relation to other projects that have, or will occur within the scope of the comprehensive study.

5.5 CONCEPTUAL CLOSURE PLAN

Western Copper has prepared a conceptual closure and reclamation plan for the project. This plan presents further information and details respecting closure issues, conceptual closure measures, remaining closure issues and investigations, and closure scheduling. A brief summary is presented in the following sections.

5.5.1 Closure Objectives

There are four overall closures objectives for mine closure:

- Protection of public health and safety;
- Minimize, mitigate or prevent adverse environmental impacts;
- Long-term stability of the heap leach and waste rock storage area and site water quality; and
- Ensure land use commensurate with the surrounding land.

For the Carmacks Copper mine these objectives have become part of the design process to ensure both physical stability and chemical stability of the site in the long term. Mine design, development and progressive reclamation will be undertaken in such a manner to ensure that the amount of work required at the end of mine life to achieve the above objectives is minimized.

The ideal scenario at closure is to be able to achieve the above three objectives in a "walk-away" scenario, that is, one in which there will be no further requirements for monitoring and maintenance. Clearly, for some mines, some level of human activity may be required for a period after closure resulting in either an "active care" or "passive care" closure scenario.

The Conceptual Closure and Reclamation Plan describe the concepts that have been developed for closure of the Carmacks Copper Project, and addresses both temporary shutdown and final closure scenarios.

The long-term objective is to achieve a passive "walk-away" closure condition, however it is realised that some active care will be required for a period of time to demonstrate that passive "walk-away" closure is achievable, especially for the heap leach pad. A plan is presented that provides "walk away" closure for all aspects of the project, with the exception of the heap leach pad where 'passive care' will be required for a longer period of time until heap effluent quality is demonstrated. The heap leach pad will be rinsed and process solution circulated until no longer economical. Excess solutions will be released from the heap and treated for discharge to the environment. Heap solutions will then be further neutralized and treated to raise the pH to above 7 and stabilize metals to Metal Mining Effluent Regulations minimum standard to allow for mining activity and discharges of deleterious substances. The heap will be covered with an evaporative/transpiration soil cover to reduce infiltration. Contingency treatment measures are planned for polishing long term solution release from the heap if required.

5.5.2 Closure Issues

Closure issues can be considered in terms of four major areas:

- Issues associated with (geo)chemical stability;
- Water quality;
- Issues associated with physical stability; and,
- Issues associated with land use, aesthetics and public health and safety.

For this project, issues of chemical stability and water quality are typically the major issues to be addressed at closure. These issues, which are particularly associated with the heap, are therefore the focus of the conceptual closure plan.

At mine closure, there are no major water retaining structures, diversions or impoundments for which physical stability must be ensured in the long term. The remaining structures for which physical stability must be addressed are the spent ore heap, waste rock storage dump and associated water management facilities.

For most of the site, reclamation of the disturbed areas of the mine site and rock waste dumps would raise no issues that are particular to a heap leach project. The primary issue is the control of erosion and public safety.

Closure and reclamation of the spent heap does require special consideration in that the spent ore has been chemically and physically changed from the in-situ condition. Closure of the spent heap is discussed herein primarily in terms of the issues associated with water chemistry. The requirements for control of water quality (i.e. rinsing, solution drain down and active treatment using known high density sludge technology, chemical addition for neutralization and metals stability, soil evaporative/transpiration covering, heap effluent biological treatment cell and infiltration gallery) will dictate the conditions under which further reclamation would be done.

The Conceptual Closure and Reclamation Plan presents further information and details respecting closure issues, conceptual closure measures, remaining issues and investigations, and closure scheduling. The conceptual plan identifies mitigation measures that are technically and economically feasible. However, the data that the conceptual plan is premised must continue to be collected, closure water quality and water balance models updated, and other relevant information considered in updated detailed decommissioning and reclamation plans.

As mentioned above, there are four major areas of interest and objectives in closure of this metal mine. Ultimately, the over objective of decommissioning and reclamation is to physically and chemically stabilize and restore the mine area to a functioning ecosystem that resembles pre-mine conditions as much as realistically possible. The decommissioning and reclamation commitments identified by the Conceptual Closure and Reclamation Plan shall be reflected as requirements of the regulatory authorizations. The additional mitigative measures below shall be contained within the detailed closure and reclamation plans but do not limit the regulators from stipulating further or additional measures.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- A detailed closure and reclamation plan shall be updated to the specifications of the regulators' and submitted at regular intervals at the regulators' discretion;
- Updated collection and analysis of hydro data: water balance and water quality (i.e.: surface and ground) and identify water quality parameters for any receiving environments for closure and post closure;
- Results and analysis of further acid-rock and natural metal leaching testing (i.e.: kinetic and humidity cell testing) and identify subsequent closure and post-closure management practices;
- Plans for long-term inspections and maintenance of engineered facilities;
- Detailed design and analysis of any store and release covers and/or evapotranspiration covers on mine installations;
- Plans for all mine infrastructure removal and surface reclamation;
- Incorporation of technological developments in best management practices;
- Identification and evaluation of progressive reclamation that have been undertaken to date and ongoing reclamation planning;
- Plans for post-closure monitoring and maintenance;
- Updated costing estimates for financial security, including a cost estimate for post closure monitoring, inspections and maintenance.

5.6 CAPACITY OF RENEWABLE RESOURCES

Section 12 (2) (d) of *Environmental Assessment Act* requires that the comprehensive study consider whether the project effects the capacity of the renewable resources to meet present and future needs. This report assesses the effects from the Carmacks Copper project and determines the significance of those effects to the local environmental (renewable resources) and socioeconomic conditions in the project area, after the implementation of appropriate mitigation measures.

Extensive baseline environmental data for the project is presented to enable a prediction of project effects to those resources. The project incorporates detailed engineering designs and preventative engineering measures to address potential project effects. Specific mitigation measures, plans and monitoring programs have been developed to address project environmental and socioeconomic effects and a determination of the significance of residual effects made.

5.6.1 Renewable Resources Identification

Environmental and socioeconomic baseline data was gathered for the Carmacks Copper Project. Valued ecosystem and cultural components were identified and used to complete the associated environmental effects assessment for the project by the proponent. These valued ecosystem and cultural components are essential to the renewable resources components for the project and considered in the proponent's project description and environmental assessment report.

In summary, the following valued renewable resources were described and environmental effects determined: terrain (including soils); air quality; hydrology (including surface and sub-surface waters); water quality (including surface and groundwater); aquatic resources (including fisheries, benthic invertebrates and periphyton); vegetation (including forestry resources); and wildlife.

The predominant use of renewable resources in this project area is for personal and commercial (outfitting) hunting, fishing and gathering. Mining activities will temporarily disrupt land based use of renewable resource in the area directly affected by this project. However, the disturbance will be temporary. Decommissioning and reclamation of the project will ensure that the site is restored to a functioning ecosystem that will once again be conducive to the sustainable use of renewable resources.

Mitigative Terms and Conditions:

The following additional mitigative measures are required by the Responsible Authorities:

- The implementation of mitigation measures such as access restriction and other wildlife protection measures, progressive and final reclamation and ongoing follow up program implementation into the post-closure period, back by financial security, will ensure that the project area is once again suitable for sustainable use of renewable resources.

5.6.2 Effects of the Environment on the Project

The project description and environmental assessment report considered the effect the environment may have on the project. Inclusive of this analysis is the effect of climate change on the project; climate change can include extreme precipitation events, change in temperature, etc. Though the proposed mine will only operate for approximately 15 years, inclusive of decommissioning, some installations like the spillways, heap leach pad, open pit and the waste rock storage area will remain in perpetuity. Both the heap leach pad and the waste rock storage area will be reclaimed through contouring, soil covers and re-seeding. Over the course of time it is anticipated that the open pit shall fill to the water table level with water sourced either through ground or surface waters.

As the heap leach pad, open pit and waste rock storage area will remain post-closures these installations must be designed and engineered in consideration of the expected climate change effects for this area.

The Meteorological Service of Canada provided advice on assessing potential impacts of future climate change on possible maximum flood and possible maximum precipitation in Yukon. The modeling scenario developed for 2010 to 2030 suggests that a slight increase in likelihood is anticipated (approximately (3% to 5%) in this area. The proposed design and engineering as identified by the proponent shall be cognizant of this potential increase.

Potential Effects

- Extreme climatic conditions can cause process upsets;
- Unusually cold weather; and
- Reduced visibility due to winter storms and blowing snow can restrict access to or from the site.

Mitigative Terms and Conditions:

The objectives of measures to mitigate the effects of the environment on the project are to ensure that the project is engineered to accommodate the best possible and up-to-date understanding of environmental processes and climate change that could affect the integrity of mine components.

The following additional mitigative measures are required by the Responsible Authorities:

- Follow-up programs must be in place to monitor environmental trends on-site and apply adaptive responses where design criteria may need reconsideration in light of enhanced understandings or unexpected changes in weather patterns; and
- Final design of heap leach pad, spillways, open pit and waste rock storage area shall be designed to be inclusive of the anticipated increase in possible maximum flood and possible maximum precipitation events.

5.6.3 Environmental Health and Safety and Accidents and Malfunctions

Accidents or malfunctions that could lead to significant adverse environmental effects relate mainly to accidental spills or component malfunctions that lead to unauthorized discharges. Fuels, reagents, ore, process solutions or non-compliant water could be released to the environment as a result of accidental discharge or malfunction.

The abandonment of the site by the proponent may be considered a possible malfunction. This possibility is mitigated by the collection and maintenance of financial security.

The project description and environmental assessment report provided by the proponent contained a spill contingencies and emergency response plan that outlines response protocols for spills of potentially hazardous substances that may be used during the construction and operation of the Carmacks Copper Mine. The purpose of the plan is to minimize effects of environmental disturbances and the resultant hazard to people, aquatic systems and wildlife.

Potential Effects

- Accidents and malfunctions

Mitigative Terms and Conditions:

The objective of accident and malfunction mitigation is to ensure that mine related components are designed and constructed to an appropriate standard. Of a particular note, the Responsible Authorities are interested in contingency plans that address the possibilities of deleterious substance releases resulting from accidental spills or malfunction. Should an accidental discharge occur procedures are in place to respond and report on it as quickly and effectively as possible.

- Design criteria for mine components must be sufficient to prevent failures to the extent practicably possible;
- Accident, spill and malfunction contingency plans must be developed, submitted to regulators for review and approval and formalized as regulatory requirements, along with reporting requirements; and
- The proponent must inform regulators and interested parties (i.e.: Little Salmon Carmacks First Nation, Carmacks Renewable Resource Council) of any release of deleterious substances arising from an accident or malfunction in the Yukon associated with this project.

5.6.4 Significance of Effects

To determine whether or not the adverse environmental effects to renewable resources were considered significant nine criteria were taken into consideration when determining the significance of effects:

- **Direction** of adverse effect, whether beneficial or negative;
- **Magnitude** of the adverse environmental effect, where magnitude refers to severity;
- **Geographic** extent of the adverse environmental effect;
- **Duration and frequency** of the adverse environmental effect;
- Degree to which the adverse effect is **reversible** or irreversible;
- **Ecological Context** of the adverse environmental effect;
- **Socio and Economic Context** of the project effects; and
- **Risk Characterization** and likelihood of the adverse environmental effect**.**

In addition, a likelihood determination of the residual effects was made based on probability and uncertainty. A criteria ranking was assigned to each of the above descriptors ranging from very low to very high. The overall rating for the significance of effects was determined using a numerical scoring system and calculating an overall average.

5.6.5 Summary of Significance of Effects

Valued ecosystem and cultural components were identified for the project and predictions made of the environmental effects on those valued ecosystem and cultural components. A determination of the significance of those effects on the noted resource components was completed considering the mitigation measures (within the temporal and spatial scope of the assessment), a cumulative effects assessment, and a risk assessment. Section 5 of this report presents a summary of the projects effects, their occurrence, proposed mitigation measures and significance of effects for the various renewable resource components.

6.0 DETERMINATION OF SIGNIFICANCE

The Responsible Authorities have determined the level of significance of this project on the valued ecosystem and cultural components by taking into account seven parameters: Notes: *Numbers in parenthesis ( ) equals numerical weighting value. *Descriptors for reversibility are opposite to the effects descriptors.*

Significance of Effects Descriptors

Descriptor	Duration	Geographic Extent	Magnitude	Reversibility*	Ecological context	Risk characterization	Frequency	Significance
very low (1)	<1 to 5 years (1)	<1 ha (1)	negligible effects to surrounding environment (1)	95-100% (1)	community with very good ecological fitness and a very high degree of resilience (1)	negligible risk (1): negligible to high hazard assessment; negligible to very low exposure assessment; and negligible consequence assessment	occurs once (1)	Not significant adverse environmental effect
low (2)	5 to 10 years (2)	1-75 ha (2)	low effects to surrounding environment (2)	75-95% (2)	community with good ecological fitness and a high degree of resilience (2)	very low risk (2): negligible to high hazard assessment; negligible to very low exposure assessment; and negligible consequence assessment	occurs rarely and at sporadic intervals (2)	positive environment effect (P)
moderate (3)	10 to 25 years (3)	75-200 ha (3)	moderate effects to surrounding environment (3)	60-75% (3)	community with moderate ecological fitness and a moderate degree of resilience (3)	low risk (3): very low risk to high hazard assessment; low to medium exposure assessment; and very low to low consequence assessment	occurs on regular basis and a regular interval (3)	significant adverse environmental effect (S)
high (4)	25 to 100 years (4)	200-300 ha (4)	extreme effects to surrounding environment (4)	40-60% (4)	community with poor ecological fitness and a low degree of resilience (4)	medium risk (4): low to high hazard assessment; medium to high exposure assessment; and low to medium consequence assessment	continuous (4)	
very high (5)	100 years - permanent (5)	>300 ha (5)	catastrophic effects to surrounding environment (5)	<40% (5)	community with very poor ecological fitness and a low degree of resilience (5)	high risk (5): how to high hazard assessment; medium to high exposure assessment; and medium to high consequence assessment		

Summary of the Assessment of Potential Environmental Effects Resulting from the Proposed Carmacks Copper Project

Parameters	Development	Occurrence	Consequence and Effect	Mitigation	Significance of Effects								Significant
					Duration	Geographic	Magnitude	Reversibility	Ecological	Risk	Frequency	Overall Rating	
Atmospheric	OP	O	fugitive dust	road watering	10 years - low	low	low	high	low	v. low	2	**LOW**	**NS**
	MWRSA	C,O	fugitive dust	road watering	10 years - low	low	low	high	low	v. low	2	**LOW**	**NS**
	HLP	C,O,C/P	fugitive dust, gaseous emissions	road watering/closed distribution system	10 years - low	low	low	high	low	low	2	**LOW TO MODERATE**	**NS**
	AR	C, O, (C/P)	fugitive dust	road watering	10 years - low	low	low	high	low	v. low	2	**LOW**	**NS**
	AF		fugitive dust, gaseous emissions	baghouse dust collectors, ventilation system, scrubbers	10 years - low	low	moderate	high	low	low	2	**LOW TO MODERATE**	**NS**
Topography	OP	O, C/P	permanent open pit	some recontour, and access barriers	permanent-v.high	29.5 ha - low	high	low	low	low	1	**MODERATE**	**NS**
	MWRSA	O, C/P	single storage area	recontoured and revegetated	permanent-high	69.6 ha - low	moderate	moderate/high	low	low	1	**MODERATE**	**NS**
	HLP	O, C/P	valley fill	recontoured, covered and revegetated	permanent-high	37.2 ha - low	moderate	moderate/high	low	low/moderate	1	**MODERATE**	**NS**
	AR	C, O, C/P	road cuts	recontoured and revegetated	15 years - moderate	12.3 ha - low	low	high	low	v. low	1	**LOW**	**NS**
	AF	C, O, C/P	facility area cuts	recontoured and revegetated	15 years - moderate	13.3 ha - low	low	high	low	v. low	1	**LOW**	**NS**
Soils (including permafrost)	OP	C,O,C/P	Stripping of soils	n/a	permanent-high	29.5 ha - low	high	low	low	low	1	**MODERATE**	**NS**
	MWRSA	C,O,C/P	Stripping and erosion of soils	stockpiling of overburden for cover/revegetation. Prevent erosion.	10 years-low/mod.	69.6 ha - low	low	high	low	low	1	**LOW**	**NS**
	HLP	C,O,C/P	Stripping and erosion of soils	stockpiling of overburden for cover/revegetation. Prevent erosion.	10 years-low/mod.	37.2 ha - low	low	high	low	low	1	**LOW**	**NS**
	AR	C,O,C/P	Stripping and erosion of soils	stockpiling of overburden for cover/revegetation. Prevent erosion.	10 years-low/mod.	12.3 ha - low	low	high	low	low	1	**LOW**	**NS**
	AF	C, O, C/P	Stripping and erosion of soils	stockpiling of overburden for cover/revegetation. Prevent erosion.	15 years-moderate	13.3 ha - low	low	high	low	low	1	**LOW**	**NS**
Surface Water Hydrology	HLP	C,O,C/P	discharge of effluent to Williams Creek	controlled discharge	15 yrs-moderate	moderate	moderate	v. high	low/mod.	low/moderate	2	**LOW TO MODERATE**	**NS**
	MWRSA	C,O,C/P	discharge of effluent to North Williams Creek	controlled discharge	15 yrs-moderate	moderate	low	v. high	low/mod.	low	2	**LOW TO MODERATE**	**NS**
	AR	C,O,C/P	stream crossings	bridge crossing on Merrice Creek	15 yrs-moderate	v. low	v. low	v. high	low/mod.	v. low	2	**LOW**	**NS**
Surface Water Quality	AR	C, O	sediments	minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low	low	v. high	low	low	2	**LOW**	**NS**
	HLP	O,C/P	metals/acid/sediments	no discharge, contingency treatment plant, sediment ponds, heap treatment, monitor	15 yrs-moderate	low/mod.	moderate	high	mod/high	moderate	2	**MODERATE**	**NS**
	MWRSA	O,C/P	metals/sediments	maximize collection and water recycle. Settlement of runoff from disturbed areas.	15 yrs-moderate	low/mod.	low	high	moderate	low	2	**LOW TO MODERATE**	**NS**
	OP	O	metals/sediments	maintain vegetation buffer zones, no release of water from pit	10 yrs-low/mod.	low	low	high	low	low	2	**LOW**	**NS**
Groundwater Hydrology	HLP	O,C/P	cone of depression in groundwater table	foundation drainage	permanent-high	low	moderate	moderate	low	low	1	**LOW TO MODERATE**	**NS**
	MWRSA	O,C/P	groundwater mounding	foundation drainage	permanent-high	low	low	moderate	low	low	1	**LOW TO MODERATE**	**NS**
	OP	O, (C/P)	cone of depression in groundwater table	n/a	25 to 100 yrs-high	low	moderate	high	low	low	1	**LOW TO MODERATE**	**NS**
	AF	C,O, (C/P)	cone of depression in groundwater table - water source	multiple well locations, monitoring	10+ yrs-low/mod.	low	moderate	high	low	low	1	**LOW TO MODERATE**	**NS**
Groundwater Quality	HLP	O,C/P	metals/acid	LDRS, double composite liner	15 yrs-moderate	low	moderate	moderate	mod/high	moderate	2	**MODERATE**	**NS**
	MWRSA	O,C/P	metals/ acid	waste chemically stable, sediment collection pond	12 yrs-moderate	low	low	moderate	moderate	low	2	**LOW TO MODERATE**	**NS**
	OP	O	metals	rock geochemically stable	25 to 100 yrs-high	low	low	high	low	low	2	**LOW**	**NS**
Fisheries: Water Quality	AR	C, O	sediments	minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low/mod.	low	v. high	low	low	2	**LOW**	**NS**
	MWRSA	C, O, C/P	metals/sediments	sediment control ponds, monitor discharge	15 yrs-moderate	low/mod.	low	high	moderate	low	2	**LOW TO MODERATE**	**NS**
	HLP	C, O, C/P	metals/acid/sediments	no discharge, treatment plant, heap treatment, collect and settle runoff from disturbed area	15 yrs-moderate	low/mod.	moderate	high	mod/high	moderate	2	**MODERATE**	**NS**
	OP	O	metals/sediments	minimize instream construction, maintain vegetation buffer zones	10 yrs-low/mod.	low	low	high	low	low	2	**LOW**	**NS**
Habitat loss	AF	C, O	decrease in surface flows	water recycling, ground water wells, monitor surface flows	15 yrs-moderate	low/mod.	low	v. high	moderate	low	2	**LOW**	**NS**
Benthic Macro invertebrates	AR	C, O, (C/P)	sediments	minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	MWRSA	O, (C/P)	metals/sediments	sediment control ponds, monitor discharge	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	AF	C, O	decrease in surface flows	water recycling, ground water wells, monitor surface flows	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	HLP	C, O, C/P	metals/acid/sediments	treatment plant, SCP, minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low	low	v. high	low/mod.	moderate	2	**LOW TO MODERATE**	**NS**
Periphyton	AR	C, O, (C/P)	sediments	minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	MWRSA	O, (C/P)	metals/sediments	sediment control ponds, monitor discharge	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	AF	C, O	decrease in surface flows	water recycling, ground water wells, monitor surface flows	15 yrs-moderate	low	low	v. high	low/mod.	low	2	**LOW**	**NS**
	HLP	C, O, (C/P)	metals/acid/sediments	treatment plant, SCP, minimize instream construction, maintain vegetation buffer zones	15 yrs-moderate	low	low	v. high	low/mod.	moderate	2	**LOW TO MODERATE**	**NS**
Wildlife	ALL	C, O	Direct habitat loss	revegetating (see reclamation program)	20-30 yrs-mod/high	170.5 ha - mod.	high	mod./high	low	low	2	**MODERATE**	**NS**
	ALL	C, O	Indirect habitat loss, avoidance, habitat fragmentation	revegetating (see reclamation program)	15-20 yrs-moderate	170.5 ha - mod.	moderate	high	low	low	2	**MODERATE**	**NS**
	ALL	C, O, C/P	Harassment	wildlife management plan	10 yrs-low/mod.	170.5 ha - mod.	low	high	low	low	2	**LOW TO MODERATE**	**NS**
	AR	C, O, C/P	Hunting, fishing & poaching pressure	wildlife management plan, on-site no hunting policy	10 yrs-low/mod.	12.3 ha - low	low	high	low	low	2	**LOW**	**NS**
	AR	C, O, (C/P)	Road kills	wildlife management plan, posted speed limits and wildlife crossings	10-15 yrs-moderate	12.3 ha - low	moderate	high	low	low	2	**LOW TO MODERATE**	**NS**
Vegetation	HLP	C, O, C/P	Removal of vegetation	revegetating (see reclamation program)	15 yrs-moderate	37.2 ha - low	high	high	low	low	1	**LOW TO MODERATE**	**NS**
	MWRSA	C, O	Removal of vegetation	revegetating (see reclamation program)	15 yrs-moderate	69.6 ha - low	high	high	low	low	1	**LOW TO MODERATE**	**NS**
	OP	C, O, C/P	Removal of vegetation	n/a	permanent-high	29.5 ha - low	v. high	low	low	low	1	**MODERATE**	**NS**
	AF	C, O	Removal of vegetation	revegetating (see reclamation program)	15 yrs-moderate	13.3 ha - low	high	high	low	low	1	**LOW TO MODERATE**	**NS**
	AR	C, O, (C/P)	Removal of vegetation	revegetating (see reclamation program)	15 yrs-moderate	12.3 ha - low	high	high	low	low	1	**LOW TO MODERATE**	**NS**

C=construction, **O**=operations, **C/P**=closure/post-closure
OP=open pit, **HLP**=heap leach pad and associated ponds, **MWRSA**=mine waste rock storage area, **AF**=ancillary facilities, **AR**=access and haul roads, **ALL**=all mine activities
() = if occurrence is bracketed, it is occurring to a lesser degree
*Refer to section 5 of this study for detailed description of mitigation requirements

7.0 FINANCIAL SECURITY

The Yukon government has implemented a mine reclamation and closure policy. A fundamental tenet of the policy is the requirement for mine owners to financially secure their developments for the cost of liability at any point in the life of the project. Other aspects of the policy pertain to requirements to regularly review security held to ensure that it accurately represents the cost of liability at the time. Financial security will be required for this project as a means of ensuring temporary closure (e.g.: maintenance, labour disputes or any other unforeseen circumstances), reclamation, maintenance, monitoring and adaptive management programs are successfully implemented.

For the purposes of the comprehensive study, the proponent must demonstrate that they have: identified the issues relevant to the assessment of the project; have an understanding of and a respect for the physical, biological and social and economic environments into which the project will be introduced; and understand the ways in which the project will affect these environments. The project description provided by the proponent must demonstrate that likely effects have been assessed; has identified measures to mitigate adverse effects; is committed to the implementation of identified mitigations; and has identified a program to monitor effects and to refine mitigation over the life of the project. Recognizing that some of this information is conceptual in nature (e.g.: heap rinse times, concurrent leaching and rinsing, and sludge disposal), to be specifically identified and designed for later stages of the project or reliant on forthcoming testing and monitoring information, the financial security required of the proponent must be reflective of the various options and their respective costs. As a requirement of the Quartz Mining Licence each option must be costed out separately and financial security applied as identified by the regulator.

The ideal, and ultimately the only acceptable scenario, for this project is a 'walk-away' scenario, that is, one in which there will be no further requirements for monitoring and active maintenance. A period of post reclamation 'active care' will be required until it has been satisfactory demonstrated from the results of site monitoring that reclamation measures have achieved the required outcomes and are self-sustaining. Given the reliance on monitoring, and subsequent mitigative measures may need to be employed to ensure that the closure objectives are achieved, the regulators shall specifically identify financial security in relation to temporary, closure and post-closure activities.

Mitigative Terms and Conditions:

- As per the Yukon government's mine reclamation and closure policy, security held shall reflect the cost of liability, including contingent liabilities, at any point in time, and any monitoring and maintenance and/or follow-up requirements in the post-closure phase of the project. Provision of financial assurance shall also be included for care and maintenance purposes.

8.0 FOLLOW-UP PROGRAMS

8.1 PROJECT PERFORMANCE STANDARDS AND OBJECTIVES

8.1.1 General Approach

This section describes the project performance standards and objectives and design criteria that will be used to ensure that project components are designed, constructed, operated and closed in a manner that ensures environmental and socio-economic protection. These standards and objectives are consistent with the company's Environmental Policy. The standards and objectives will ensure that:

- Measurable performance standards and design criteria are set to ensure that various mine and infrastructure components are constructed and operated;
- Mine and project component performance is monitored and performance tracked;
- Mitigation measures and programs are performing as predicted;
- Maintenance measures or contingency plans can be implemented if project component performance is not achieved;
- The company, regulatory agencies, First Nations and the public will know the performance standards and objectives that are required for the project to ensure environmental and socio-economic protection;
- Routine regulatory reporting of environmental monitoring and inspection programs as required by authorizations to enable public access to monitor results;
- Closure measures for various project components are designed, implemented and monitored in the long term; and
- The company, regulatory agencies, First Nations and the public will know when the project's closure and reclamation liability obligations have been met.

Measurable performance standards and objectives have been developed to guide the environmental assessment for the project and implementation of project development. It is expected that these measurable performance standards and objectives will be established in key project authorizations (Water Use Licence and Quartz Mining Licence) to ensure that the project is constructed, operated, and closed as intended.

The project description and environmental assessment report presents a summary of the performance standards and objectives, along with monitoring or follow up programs for the various mine components for the project. The performance standards are presented in three categories: water/chemical stability, physical stability and re-vegetation. Monitoring and potential follow-up programs are also outlined where required.

Adaptive management strategies recognize that the environmental management programs associated with a project must be flexible to respond to the findings of any monitoring programs. This comprehensive study is premised on the principle that the mitigation measures proposed are technically and economically feasibility, but adjustments to mitigation strategies may be required over time to adapt to an enhanced understanding of the projects' effects on the environment over time. Adaptive management concepts and practices are not intended to allow for the discount of current issues in favour of deferred future 'adaptive' responses. Financial security shall be held to support follow-up programs and any associated adaptive responses.

Both the project description and the environmental assessment report provided by proponent as well as the mitigative terms and conditions specifically identified in this comprehensive study identify a number of measures that must be undertaken comprehensively, in all phases of the mine life from construction to post-closure. The following listed monitoring programs shall not be interpreted as to limit the regulator nor shall be understood in isolation from the previous identified mitigative measures and their respective requirements for follow-up and monitoring.

8.2 MONITORING PROGRAMS

The following Monitoring Program describes the proposed environmental, geotechnical, and operational monitoring requirements for the project. Environmental and physical monitoring programs are required at all stages of the mine development including construction, commissioning, operations, closure and post-closure. These programs are designed to monitor:

- Effectiveness of component design;
- Mitigation success; and
- Potential impacts to the receiving environment.

The program is intended to act as an Operational Monitoring Manual for site personnel, once operations commence. Detailed reclamation program plans and monitoring requirements are presented in further detail in the project description and environmental assessment report.

8.2.1 Environmental Management System

An environmental management system is a defined "system" or process of measuring and documenting compliance with environmental standards and for seeking continuous improvement at a facility such as the Carmacks Copper Project. An environmental management system utilizes training, environmental monitoring, audits, inspections and other tools to measure and manage actual environmental performance against established written standards. Monitoring and inspections following documented procedures ensure that predicted environmental effects can be tracked to ensure that mitigation is appropriate and environmental performance is assured. An adaptive management approach to progressive action and response is another means of ensuring that monitoring and inspection data is reported within the company and that response measures are implemented. Routine inspections and monitoring are a proactive measure to ensure that the effects of accidents and malfunctions are prevented and identified for response if required.

Western Copper will prepare an environmental management system for the project. The environmental management system is intended to provide guidance to supervisory and environmental personnel regarding environmental protection and health and safety measures for the project.

The environmental management system will outline the:

- Corporate commitment and various policies;
- environmental management system goals and objectives;
- Organization responsibilities;
- Detail plans and programs for the project, including Health and Safety Plans, Spill and Emergency Response Plans, Construction Quality Assurance/ Quality Control Plans, Operational Plans, Environmental Monitoring Plans, Maintenance Plans and other plans as required;
- Implementation strategy to identify capabilities, and support mechanism to achieve the goals and objectives;
- Measurement and evaluation mechanisms;
- Reporting mechanism; and
- Review and improvement mechanisms.

The Carmacks Copper project will employ such tools to maintain and improve environmental performance. This program will be continued into the post closure period of the mine life. The environmental management system for the project will be completed prior to project development and be available for use during construction. Several of the key components of the environmental management system are presented in the following sub-sections.

8.2.2 Inspections and Monitoring

The environmental management system will employ several types of scheduled periodic inspections to ensure that the facility is meeting environmental performance objectives and complying with appropriate regulatory standards:

- Routine health and safety meeting and briefing for all employees;
- Periodic inspections of key components of the mine site to monitor environmental performance and as a preventative measure for accidents and malfunctions;
- Scheduled water quality and biological sampling and inspection tours of the local receiving water streams;
- Scheduled environmental tours of the workplace to look for environmental and safety hazards, potential accidents, and assess waste management activities;
- Geochemical characterization for acid rock drainage and metal leaching from mine installations, like heap leach pad, waste rock storage area, events and sedimentation ponds;
- Monitoring of sulphur dioxide air emissions;
- Scheduled groundwater sampling; and
- Annual inspections by a qualified geotechnical engineer of waste rock storage areas, the heap leach and associated retention dikes, spillways/ inlet, diversion ditches, and the heap leach process solution ponds for physical stability.

With the exception of the last item, these programmed inspections will be conducted on site by qualified professional personnel. The geotechnical inspections are carried out during the summer months when the surface and sides of the various rock-fill structures are not obscured by snow. It is anticipated that the number and frequency of inspection tours will continue until closure and then diminish once the heap leach has been fully decommissioned.

The results of all monitoring programs will be assessed on an ongoing basis to determine if any negative trends in water quality or other biological or physical parameters are occurring. If the results indicate that there are no negative environmental impacts, then the frequency schedule and length of operational and post closure monitoring and maintenance would continue as proposed. Adaptive management plans will be put in place to respond to any negative trends observed through the post closure monitoring.

8.2.3 Adaptive Management Plans

An adaptive management plan is a component of the company's environmental management system and a management tool designed to provide a response to unforeseen or contingency events. There are a number of contingency measures that the company has proposed as part of the Conceptual Closure and Reclamation Plan. These include contingency plans for the leach pad effluent. An adaptive management plan will be used as a framework to guide the assessment of the operation and reclamation measures, the plan's effectiveness, and provide guidance for orderly implementation of responses. This framework encompassing active company management as part of the environmental management system would include:

- Routine inspection and environmental monitoring and maintenance of project components;
- routine assessment of monitoring and performance data;

• triggers and thresholds for appropriate levels of responses that could be implemented; and planned contingency measures, including engineering designs where appropriate;
• An adaptive management plan will be developed for the leach pad and submitted as part of an updated Closure and Reclamation Plan.

8.2.4 Reporting

It is expected that reporting on all environmental monitoring and management issues at the Carmacks Copper Project will continue to be directed to the Yukon Water Board (YWB) and YG in accordance with the requirements of the Water Use Licence, Quartz Mining Licence, and other operating permits and approvals. It is expected that monthly and annual reporting will continue during the construction, operation and closure phases until it can be demonstrated through the monitoring results that the reclamation objectives have been achieved.

Western Copper will also continue to liaise with the regulatory agencies, Little Salmon and Selkirk First Nation's, and the local community on environmental issues relating to the construction, operation and closure of the Carmacks Copper Project.

8.2.5 Construction Monitoring

During construction, a Construction Supervisor, or Owners Representative (employed by Western Copper), who is a Professional Engineer (P.Eng.), will be responsible for supervising all construction activities. An Environmental Monitor will establish monitoring programs and monitor construction activities. The construction supervisor and environmental monitor will be charged with ensuring that environmental protection and mitigation facilities are incorporated as designed and that environmental safeguards are implemented by the various contractors. The supervisors will also have the responsibility of ensuring that the requirements of the applicable acts and regulations are complied with. A third party independent engineer will monitor key construction activities such as the heap leach pad and events ponds construction.

These personnel will oversee all phases of the construction within the operations area (mine, heap leach pad, and process plant). A construction quality assurance/quality control manual will be prepared and outline personnel responsibilities. The construction quality assurance/quality control program will be implemented by a resident engineer, a geotechnical engineer, and several inspectors, all suitably qualified in the specialized requirements of each job.

8.2.5.1 Physical and Geotechnical Monitoring

The construction Quality Assurance/Quality Control (QA/QC) Manual will be prepared for the project and guide construction. A third party, responsible to the Owner, provides construction quality assurance/quality control. Construction quality assurance/quality control is a planned system of activities that provides assurance that the facility complies with the design, specifications and drawings, including inspections, verifications and evaluations of materials, and workmanship.

Component facilities to be covered by the specific construction quality assurance/quality control plans are:

- Heap leach pad, embankment, piping, and diversions;
- Events ponds and sediment control ponds;

- Solution piping;
- Fuel and acid storage secondary containment facility;
- SX/EW plant excavation and concrete floor; and
- Waste rock storage area berms, drains, lifts, sediment ponds and spillways.

The construction quality assurance/quality control manual will be developed for these facilities and submitted prior to construction once the detailed designs are completed.

8.2.5.2 Environmental Monitoring

The construction supervisor and environmental monitor will be responsible for ensuring environmental protection by ensuring mitigation measures are implemented and facilities are constructed as designed. Monitoring programs will be established. Monitoring will include:

- Proper installation of spill containment devices, instrumentation, monitoring facilities, bridge and culverts;
- Protection of all water courses from siltation, spills, and blockages during site development; and
- Proper clean up and disposal of construction debris and the proper incineration and/or disposal of refuse.

These personnel will ensure compliance with regulatory authorizations including the Water Licence and Production Licence.

To guide environmental monitoring procedures an environmental procedures manual will be developed. The manual will outline monitoring procedures and protocols, environmental specifications, and regulatory requirements to be followed by engineering staff, construction workers, and environmental technicians.

8.2.6 Operational Monitoring

An operational monitoring program will be developed and maintained for the project. The program is to ensure that all process and water and waste management facilities are operating properly, that the environmental management system is implemented, and that facilities are geotechnically stable.

It is intended that many components of the mine will be equipped with automated monitoring devices for continuous surveillance. Automated monitoring systems equipped with alarm systems will be used to monitor remote equipment. Regular inspections of the entire system will be undertaken on a routine basis to physically inspect monitoring equipment, facilities, and structures. A program of geotechnical, physical and environmental monitoring will be maintained during operations as described in the project description. General descriptions of the monitoring requirements are outlined below:

8.2.6.1 Geotechnical Monitoring Plans

<u>Heap Leach Pad and Events Pond</u>

The leach facility will be monitored on an on-going basis to evaluate overall performance of the facility and ensure all design objectives are satisfied during operation of the facility. Instrumentation comprising of piezometers, survey monuments, water level monitors and flow meters will be installed at various locations within the facility to monitor the performance of the constructed components. Specific detailed design of the monitoring components will be provided during the detailed design stage of the project. General descriptions of the monitoring requirements are outlined below.

Pressure transducer, thermistor or other compatible measures will be installed in the following locations and calibrated at regular intervals to ensure reliability:

- Under the heap pad and within the embankment foundation to monitor thermal regimes at depth;*/
- Within the embankment foundations to monitor pore pressures;
- Within the geonet leakage collection drain to monitor the head on the outer liner; and

Survey monuments along the embankment crest, downstream slope, and downstream toe of the embankments will be installed to measure settlements, deformation at depth, and monitor slope stability.

Water level monitors for the heap leachate collection sumps and in the events pond leachate removal system, which will be connected to the control, room of the process plant will be installed to measure water levels for the various components.

A flow meter in the foundation drain/leak detection system within an insulated manhole will be installed to measure flow out of the leak detection system prior to entering the events pond.

<u>Waste Rock Dump</u>

The waste rock storage area will be monitored on an on-going basis to evaluate overall performance of the facility and to confirm design assumptions and parameters used in the stability assessment. The monitoring program will be implemented during initial stages of production and revised as necessary to ensure design objectives are satisfied during construction and throughout the operation of the facility.

Requirements for monitoring and instrumentation are as follows:

- Installation of piezometers or compatible measures to monitor pore pressure conditions within the thawed foundation layer beneath the waste dump toe which will be calibrated at regular intervals to ensure reliability;
- Survey monuments along intermediate benches to monitor slope stability and settlement;
- Flow weirs along foundation drains to monitor discharge flow rates;
- Visual inspection during operations to evaluate methods of construction and performance of the facility;
- Annual review and inspection; and
- Piezometers or compatible measures installed down gradient of waste rock storage dump, events and sedimentation ponds to monitor seepage water reporting to ground water.

8.2.6.2 Mine and Plant Operations

A monitoring program will be instituted which will ensure the safe and economic operation of the Carmacks Copper mine. Operations monitoring will be focused on ore production, the leach pile and the solvent extraction-electrowinning plant. Note that these represent the minimum standards under which the mine will operate. Education programs will focus on employees being aware of the hazards of the operation and the necessity for early detection and prompt action. There is some overlap with the environmental and geotechnical monitoring program plans outlined in the previous sections.

Ore Production

- Tonnes of ore and waste mined will be monitored;
- A running inventory of crushed and uncrushed stockpiled ore will be maintained;
- Inspection of acid supply lines for preconditioning; and
- Regular clean up of preconditioned ore, which has fallen off the conveyor belts.

Leach Pad

- Inspection and monitoring of ore characterization ensuring sulphide materials are not reporting to the heap;
- Recording on the following: solution temperatures onto and reclaimed from the leach pile, average solution volumes pumped onto and reclaimed from leach pile, solution levels in the bottom of the leach pad; ore temperatures at the drip emitter level in grids; temperature gradients in the sides, under and margins of the leach pile at strategic locations and frost depth;
- Inspection of the following: water levels in leak detection system, for development of surface ice at drip emitters, for ice lenses uncovered during preparation of leach pile surface for placement of new lift and the retention berm crest for over topping by ice or solutions;
- Seasonal shovel tests for ice development in the sides of the leach pile;
- Logging of periods of flow into the events ponds from the heap;
- Regular updating of the leach pad area operating water balance and forward projections of expected storage requirements; and
- Periodic inspections of diversion facilities, removal of blockages and stabilization of areas of local erosion as required, and removal of accumulated snow in the channels prior to the annual snowmelt.

SX/EW PLANT

- Sampling of pregnant leach solutions grades and sediment pond effluent quality and treatment plant process control monitoring (temperature and pH) and internal laboratory testing for specific water quality parameters;
- Monitoring of the following: power consumption, propane consumption;
- Inspection of acid, pregnant and leach solution pipeline in plant and to and from the leach pile, and acid, solvent and propane piping and storage facilities, all standby pumping and power facilities and sediment control dams, and all piping and spillways with clearing of pipe and spillway inlet obstructions as necessary and controlled removal of accumulated sediment as required to maintain design storage capacity and piping and storage facilities;
- Recordings of the following: leach solution pumping pressures, solution recycle rates and solution flows to the ADR plant, make-up water inflows, make-up and other reagents quantities, crud quantity/ volume, and characterization and stability testing and discharge location, water treatment plant operation and treatment volumes and quality rates, sediment pond water levels, release rates and times of release, ambient air temperatures and precipitation (See Meteorology monitoring below).

8.2.7 Environmental Monitoring Plans

8.2.7.1 Meteorology

Ongoing meteorological data is required to verify design assumptions. The information will be used to monitor site temperatures, solar radiation, frost and wind speed to assist in scheduling ore loading and heap leach operations near freezing conditions, and snow pack and precipitation data for regulating the water management systems and updating the heap water balance.

The Water Resources Branch of YG Environment established an automatic weather station at the Williams Creek site in September 1994. The station records the following information every half hour and provides a daily average:

- Net radiation (W/m^2);
- Short-wave Incoming Radiation (W/M^2);
- Short-wave Outgoing Radiation (W/M^2);
- REBS Soil Heat Flux (W/m^2);
- Soil Temperature @ 6 cm depth (C);
- HMP 35CF Upper Temperature (C);
- HMP 25C Upper Relative Humidity (%);
- Lower Wind Speed (m/s);
- Upper Wind Speed (m/s);
- Precipitation (Tipping Bucket) (mm); and
- Battery Voltage.

Three snow course sites in the Williams Creek watershed were previously operated during the winters of 1994/1995. Each site consisted of 5 sub samples located 20 m apart and measurements of snow depth and water equivalent were taken in accordance with government protocol. A snow course station will be reinstated at the Williams Creek site once operations commence and will be monitored monthly during the period of snow accumulation (November to June).

8.2.7.2 Hydrology

Hydrology monitoring and reporting must continue during all phases of the project from construction through post closure. The hydrology of the Williams Creek watershed will be required to monitor stream flow for available dilution and downstream water quality impacts. A staff gauge is located in the upper portion of Williams Creek at W4 and both Dipper Log Water Level and Barometric data loggers were installed at W4 and W10 in may 2007. Once operations commence it will be necessary to monitor daily flows in the receiving environment at several locations as set by the regulator.

Other operational flows on site, which will be monitored on a daily basis for environmental purposes, include:

- Open pit water;
- Heap leach leak detection system;
- Heap leach under drains;
- Elevation of water in the events pond;
- Outflow from the waste rock storage area sediment pond;

- Make-up water recovered from the waste rock storage area sediment pond; and
- Outflow from the plant site and events pond sediment control ponds.

8.2.7.3 Surface and Ground Water Quality Monitoring

Surface and ground water quality monitoring and reporting must continue during all phases of the project from construction through post closure. An operational water quality monitoring program is required to ensure that effluent and receiving water quality criteria are being achieved. The effluent characterization program will follow the program outlined in the Metal Mining Effluent Regulations environmental effects monitoring. Water quality monitoring parameters and locations and required analyses will be identified and set by the regulator.

In addition, the environmental effect monitoring study program will also characterize effluents from the site including possible effluents from any mine installations. Acute toxicity testing will be conducted along with sub-lethal toxicity testing (fish, invertebrates, algae, and plant).

Ground Water Quality Sample Sites

- Heap leach leak detection system;
- Heap leach under drains;
- Open pit;
- Groundwater wells downstream of the heap leach pad, events pond and plant site sediment control pond; and
- Groundwater wells downstream of the waste rock storage area.

Water Quality Analyses

Analyses to include, but not limited to, physical parameters (pH, conductivity, alkalinity, total and suspended solids, hardness), anions (nitrate-N, nitrite-N, ammonia-N, total sulphate, total, dissolved and orthophosphate) and total and dissolved metals (ICP scan) or any other such metals with known toxicity to ecological resources. Protocols will follow those specified by the Metal Mining Effluent Regulations environmental effects monitoring program.

8.2.7.4 Annual Receiving Water Biological Assessment

An Environmental Effects Monitoring (EEM) study design will be established in accordance with the Metal Mining Effluent Regulations, under authority of the Fisheries Act. The EEM program was designed to achieve national uniformity in monitoring of effects in the aquatic environment, while taking into consideration site-specific factors. The EEM study will be designed to recognize existing site monitoring and established sample stations, and will be subject to review and approval by a Technical Advisory Panel coordinated by Environment Canada.

8.2.7.5 Waste Rock

Although results from static testing indicate that both ore and waste, which have long been oxidized, contain very little remaining oxidizable sulphur and are non-acid generating, representative samples of waste rock will be collected from drill hole cuttings from representative blast holes and submitted for acid-base accounting and kinetic testing. Any waste material detected as having a propensity of generating acid will be identified by the geological staff and the material will be selectively placed in the internal areas of the waste rock stockpile or blended to ensure that the material is mixed with neutralizing material. Given that metal leaching is possible from neutral pH conditions and non-sulphide geologic materials, kinetic tests from the waste rock storage area and the rock from the ore/host rock contact will be undertaken.

8.2.7.6 Reclamation Research Monitoring

An important component of the Reclamation Plan is an ongoing reclamation research program with the objective of establishing the necessary methods and materials required to implement a successful abandonment plan that will meet with the stated objectives of returning all disturbed lands to pre-mining use and capability, when the operations are closed. The Reclamation Research Program will initially consist of six primary elements:

- On-site detoxification tests of spent heap leach material during operations to determine the optimum method of neutralizing the spent ore and removing heavy metals in the leachate;
- On-site tests to determine the optimum method of capping the spent heap leach pad and to minimize the amount of infiltration;
- On-site tests to characterize the physical and chemical composition and stability of precipitates derived from the heap neutralization process for purposes of determining the optimum method of final precipitate disposal;
- Geochemical modelling of the heap to be performed to characterize any production of precipitates that may inhibit or direct the distribution of metals and acidity within the heap;
- Detailed characterization of soils and soil chemistry in the mine site area for purposes of determining occurrences of growth inhibitor sand soil amendment requirements;
- Establishing a series of test plots on various disturbed materials to determine the optimum depth of materials, soil amendment sand moisture requirements to sustain growth;
- Documenting natural re-colonization successes for purposes of determining the optimum species for re-vegetating various reclamation units (overburden, road sides, riparian areas); and
- Species for re-vegetating various reclamation units (overburden, road sides, riparian areas).

Each of these research initiatives will be implemented at the end of the first year of operations and monitoring will be ongoing. Each of the programs will have to be sufficiently flexible such that monitoring results can be used to direct each phase of testing.

8.2.7.7 Environmental Surveillance Monitoring

In addition to the operational environmental monitoring program plan outlined in the foregoing, site personnel will be responsible for regular environmental surveillance to ensure that all waste management facilities, such as incinerators, dump pads, settling ponds, solution pumps, and septic tanks are operating efficiently and to ensure that environmental protection systems such as fuel storage berms, liner aprons, diversion ditches and the fire water tank are maintained and that water treatment facilities are fully functioning.

8.2.8 Wildlife Population and Habitat Monitoring

A wildlife monitoring program will be established during construction and maintained throughout all phases of the mine including post-closure. The program will determine trends or changes in wildlife populations and will include:

- Wildlife observation log;

- Wildlife mortality reporting;
- Routine monitoring of netting over ponds; and
- Working with the Little Salmon Carmacks First Nation Lands Branch to track moose utilization in the project area.

Western Copper will jointly work with Little Salmon Carmacks First Nation, Selkirk First Nation, their Renewable Resource Councils and YG Environment (local wildlife managers) towards implementation of any further monitoring or mitigation measures to ensure that predicted effects to wildlife are adaptively and cooperatively managed. A post moose rut aerial survey for the project area is planned every three years.

8.2.9 Closure and Post Closure Monitoring

The regular monitoring of all operations will continue for approximately three to five years following the termination of mining activities while the heap leach pad is being rinsed and neutralized. It is expected that closure monitoring will consist of the same level of requirements set out in the operational monitoring program. Routine inspections of facilities and closure activities and reclamation programs will continue. The operational monitoring program will then convert to a post-closure monitoring program once the leachate quality from the heap leach pad has been certified as suitable for direct release to the environment. A detailed post closure monitoring program will be included with a final closure and reclamation plan for the site.

Closure Monitoring

The following activities will require monitoring by an Environmental Coordinator and a Professional Engineer:

- Salvage and removal of all ancillary facilities;
- Assessment and removal of any hazardous substances;
- Rinsing, neutralizing and in-situ metals stabilization in the heap;
- Treatment and release of excess solutions from the heap;
- Treatment of solutions or water in the events ponds and sediment ponds and the excavation and disposal of sediments;
- Burial of the events pond liner;
- Re-contouring, grading and placement of overburden and re-vegetating the waste rock storage area;
- Replacement of the overburden on the disturbed areas;
- Removal of the waste rock storage area sediment control dams;
- Removal of all piping from the surface and perimeter of the heap and events ponds; and
- Trenching through the top of the containment dike in two places near the abutments, and filling these trenches with coarse rock.

9.0 DETERMINATION OF THE RESPONSIBLE AUTHORITIES

To be determined