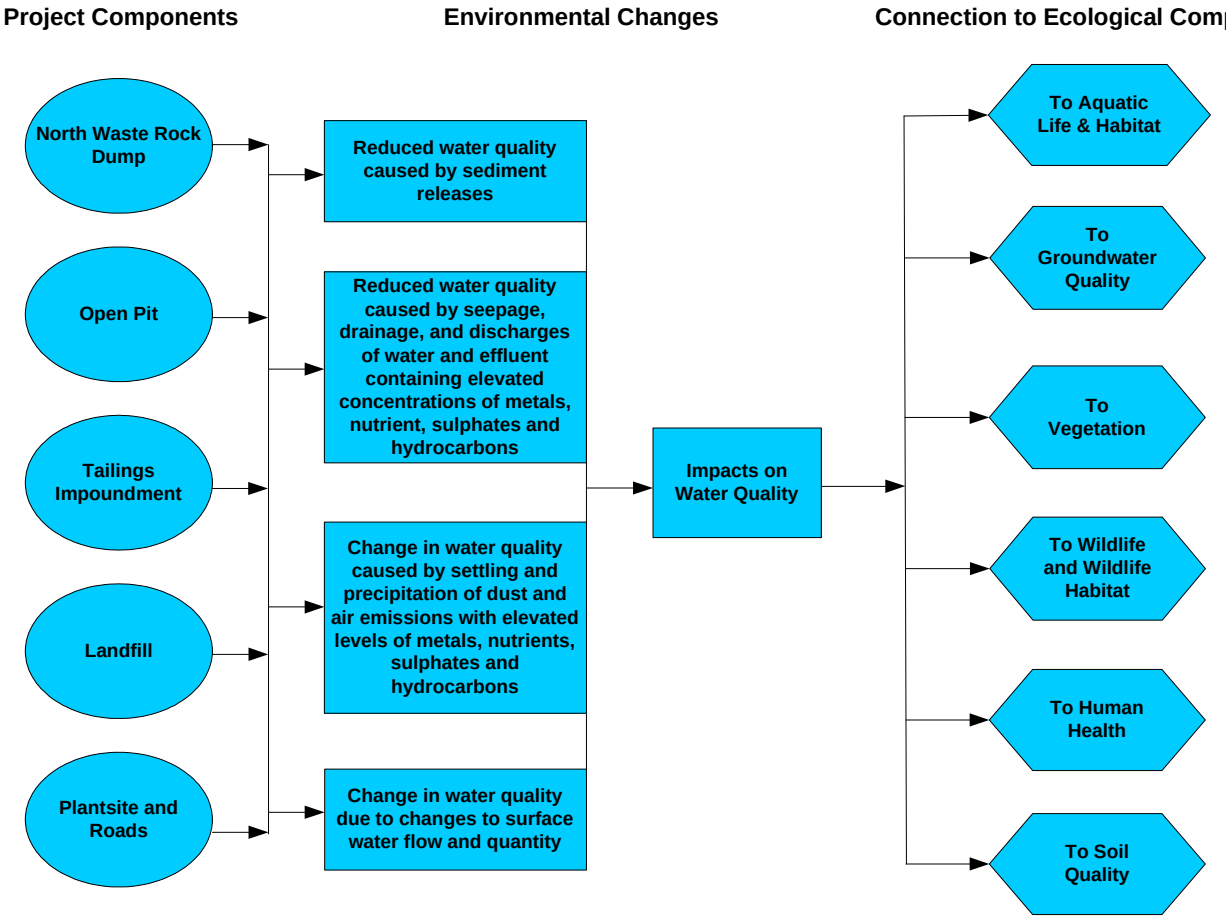

CLIENT:	PROJECT No.:		DATE:
Red Chris Development Company Ltd.	VM00347	amec	September 1, 2004
	Linkage Diagram for Water Quality Effects Assessment Questions		Figure 4.2.10

RCDC has committed to implementing sediment control procedures to minimize potential water quality impacts associated with sediment releases during construction. An outline of the proposed sediment control mitigation procedures to be employed is presented in more detail under Section 6.8 (Sediment Control Plan). RCDC will mitigate the potential water quality effects from sediment releases using the following programs:

- Reduction of the amount of ground cleared or disturbed in the construction phase. RCDC has minimized the footprint of all project components, reducing to the extent possible the amount of forest cover and surface vegetation to be removed and the amount of soil disturbance thereby reducing exposure to water and wind erosion forces;

- Application of sediment control techniques and procedures by all site contractors and RCDC personnel;

- Environmental monitoring during all phases of construction planning and through on-site environmental monitoring and inspection during the construction phase.

Operations

During the operational phase of the Red Chris Project, all surface runoff and toe drainage from the North waste rock dump will be directed into the tailings impoundment. Pit water will be collected in a sump and pumped to the tailings impoundment. Storm water and runoff from the plant site including the crusher and ore stockpiles will be directed to the tailings impoundment. Drainage from the non-hazardous landfill will be directed into the tailings impoundment. Tailings from the mill will be discharged into the tailings impoundment. Seepage from the North and South Dams along with drainage from cycloned tailings sands used to construct dams will be collected in the seepage ponds downstream of the North and South Dams and pumped into the tailings impoundment.

RCDC will maximize its recycle of process water from the tailings impoundment for use in the milling process, however the water balance for the TMF indicates that there will be an annual surplus requiring the release of supernatant to the upper reach of Quarry Creek.

During the operational phase of the Red Chris Project water quality of the water stored within the tailings impoundment will show elevated levels of dissolved metals and nutrients reporting to it from the waste rock dumps, the open pit and from the mill tailings. As the waste dump grows and the pit becomes larger, the annual loading of contaminants into the tailings impoundment will increase. These metals will be removed or reduced within the impoundment water pond through two mechanisms:

- Settling of suspended solids will reduce levels of total metal contaminants present as fine suspended matter; and

- Precipitation of dissolved metals due to the excess bicarbonate alkalinity present within the mill process water which will reduce concentrations of dissolved metal contaminants.

Predictive water quality modeling has been used to assess water quality impacts from the tailings impoundment during this phase of the mine's life. The model indicates that during the operational life water quality within the impoundment will be better than the Federal Metal Mining Effluent Regulation limits established under the Federal Fisheries Act. Toxicity testing that was conducted on mill process water from several metallurgical pilot plant runs (reported in Section 3.7) suggests that the water within the tailings impoundment is expected to be non-toxic to fish as measured using Environment Canada's LC-50 toxicity testing procedure.

The modeling indicates that during the operational phase, water quality within the tailings impoundment will fall within the British Columbia Pollution Control Objectives for all parameters.

Water quality modeling suggests that the release of supernatant is expected to alter water quality within the upper reaches of Quarry Creek. The water quality in Quarry Creek during operation of the TMF at a point 1200 metres downstream of the TMF is predicted be elevated above the high end of CCME guidelines in Aluminum, Selenium, Cadmium, Manganese, and Mercury. The predicted Manganese concentration remains equivalent to the baseline data. All other parameters are below or within the CCME guidelines.

Water quality modeling indicates dissolved metals at station W11 (4 km downstream of the TMF) will be elevated above the high end of the CCME guidelines for Selenium, Cadmium, and Manganese. Manganese is predicted to remain equivalent to baseline chemistry. Selenium and Cadmium are predicted to be slightly elevated with respect to baseline data. All other parameters are below or within the CCME guidelines.

The bio-mass uptake along this flow path within Quarry Creek has not been incorporated into the model. Some attenuation of certain metals can be expected.

The ultimate release to the Klappan River will have no impact due to the significantly larger volumes of water in that system.

With the addition of south dam seepage, Kluea Lake water is predicted to be elevated in Manganese as compared to background and CCME guidelines for aquatic resources. Attenuation of Manganese within the diffuse seepage flow path has not be incorporated into the model and can be expected to significantly reduce the predicted Manganese levels in Kluea Lake, likely to baseline levels.

The likelihood of the lesser water quality in the tailings pond developing is certain and will be continuous over the life of the mine and beyond. The magnitude of the impact is moderate when considering the impact on the upper reaches of Quarry Creek and low to negligible when considering the impact on the Klappan River. The duration of the impact will extend over the life of the mine and beyond, although diminishing over time and ultimately not permanent and reversible. The effect on the ecosystem will be become less significant downstream of the point of the release. The adverse impact rating ranges from minor far downstream to moderate close to point of the release.

Closure

In the post-closure phase of the operation, the North waste rock dump will be capped with a "store and release" soil cover that will then be vegetated. "Clean" runoff from above the cover will be directed to the north into the Red Rock Canyon watershed. Contaminated toe drainage from the water infiltrating through the cover and into the dump will be collected and directed by gravity into the open pit. The open pit will then be allowed to naturally flood until it reaches a level close to the invert elevation of the gravity drain from the North waste rock dump. This is expected to take several decades (close to 100 years). After the pit fills, the water level within the "pit lake" will be controlled by pumping the water to a new high-density lime water treatment plant or other proven technology with the treated water discharged into the tailings impoundment. For assessment purposes the quality of the treated pit water has been set equal to the average of the high and the low end of the range established under the British Columbia 1979 Pollution Control Objectives, a level demonstrated to be easily achievable using such technology.

At closure, the tailings impoundment drainage diversions will be removed. A permanent spillway will be constructed around the Northeast Dam , consequently all releases of supernatant into the upper reaches of Quarry Creek will cease. Placement of upstream non-acid generating tailings beaches (>200 m in width) will significantly reduce seepage losses in the post-closure period. The seepage collection ponds will be decommissioned and the seepage dams breached. Water will drain by gravity from the tailings impoundment through the permanent spillway into the unnamed wetland and creek system downstream of the Northeast Dam. This ultimately drains into the Klappan River.

In the post-closure time period, prior to the pit flooding, the only inputs to the tailings impoundment will be natural runoff. The model predicts that the quality of water being released from the tailings impoundment during this period will be below MMER and the BC PCO for all parameters and thus no significant impacts are likely from discharging from the tailings impoundment at this point in time.

After the pit floods, the pit water, which includes natural runoff to the pit and toe seepage from the waste dump, will be treated and released to the tailing impoundment. The predictive water quality modeling predicts that the water quality of the water released to the receiving environment through the permanent spillway will be below the MMER and BC PCO for all parameters. This water will be directed to the Unnamed Creek to the northeast and ultimately discharge to the Klappan River. The water quality of Unnamed Creek just before the confluence with the Klappan River is predicted to be elevated in Cadmium, Manganese, and Mercury relative to CCME criteria. The will be no impact to the Klappan River due to the exceedingly large flows in the Klappan River relative to the TMF discharge.

Seepage from the tailings dams at closure is presumed to be released to the environment entirely as the pump back system will be dismantled. The water quality of this water is Seepage Pump Back water described above and is below or within PCO and MMER discharge criteria but elevated in Copper, Iron, Selenium, Manganese, and Zinc relative to CCME criteria. The volumes of water are small compared to regional watersheds. The local streams will experience moderate impact close to the point of discharge. The regional streams will not be impacted.

The water quality of Quarry Creek at closure, as a result of release of tailings dam seepage, will be elevated in Selenium, Cadmium and Manganese. The water quality of Kluea Lake as a result of release of seepage is predicted to be elevated in Manganese. No allowance has been made in the model for natural attenuation of Manganese along the seepage flow path which is expected to reduce Manganese concentrations to around baseline.

The likelihood of lesser water quality being released to the environment is high due to seepage losses from the tailings dams. The magnitude of impact is moderate locally and low regionally. The duration of the impact will extend over the life of the mine and beyond, although diminishing over time and ultimately not permanent and reversible. The effect on the ecosystem will be become less significant downstream. The adverse impact rating ranges from minor in the downstream receiving environment to moderate upstream close to the point of discharge.

Key Question 2 and Linkage Analysis:

Accidental spills may impact local drainages.

Tailings handling equipment may break and process water may be accidentally released to the environment.

Impact Analysis, Mitigation, and Rating

Construction

Spills and accidents are a possibility at any construction site. It is possible some hazardous material could be spilled or fuel handling accidents may happen. A spill management protocol will be developed so that a rapid response to the spill can be implemented so that such impacts can be minimized.

The likelihood of such an accidental spill is moderate and the frequency would be infrequent. The magnitude of such a spill is low and it is contained within the LSA. The duration of a spill is short term and its impact is reversible. The adverse impact rating is minor.

Operations

Spills and accident are a possibility at any mining site. It is possible some component of the tailings handling system could malfunction and a spill could occur. A spill management protocol will be developed so that a rapid response to the spill can be implemented so the impact can be minimized.

The likelihood of such an accidental spill is moderate and the frequency would be infrequent. The magnitude of such a spill is low and it is contained within the LSA. The duration of a spill is short term and its impact is reversible. The adverse impact rating is minor.

Closure

In the post-closure time period, the amount of site activity will be greatly reduced, consequently the risk of release of harmful materials through accidents and/or malfunctions will be reduced but not totally eliminated. Post-closure activities will include environmental monitoring and inspections, seasonal operation of the pit water treatment plant and maintenance of the tailings impoundment and permanent spillway. The water quality impact associated with such events is expected to be significantly lower than similar impacts expected during the construction and operational phases of the mine life.

Impact Assessment Conclusions

The primary impact on water quality resulting from the Red Chris mining project is the release of water from the tailings impoundment. Releases occur during operation and continue after closure. The mine plan has taken water quality into account by committing to the collection of all waste dump runoff and pit drainage water and treating it, as required, prior to release to meet discharge criteria.

Water quality impacts are predicted to be moderate in upper reaches of local streams close to the point of discharge in areas where aquatic resources are limited, and minor to negligible in downstream regional water courses.

The overall conclusion of the water quality assessment is that construction, operation and closure of the Red Chris mine should not result in significant impairment of water resources in the area either in the short or long term.

4.2.6 Fish and Aquatic Habitat

The environmental assessment of fish and aquatic habitat for the Red Chris Project focused on productive capacity of the aquatic ecosystems; water quality; habitat loss, alteration or alienation; rare and/or sensitive aquatic organisms and their habitats; mortality; noise and blasting; and contaminant exposure. Activities associated with construction, operation and reclamation of the mine may potentially impact existing fisheries resources within local and regional surface waterbodies.

Background

The following section addresses issues related to the fisheries resources of the project area. It describes the fisheries resources impact assessment conducted for the proposed project. The selection of valued environmental components, study area boundaries, impacts associated with specific project facilities during construction, routine operations and closure, mitigation for managing impacts, and assessing residual effects.

Rainbow trout (*Oncorhynchus mykiss*) and habitat that supports rainbow trout was selected as the primary VEC selected for this fisheries and aquatic resources assessment. This is based on the finding that the key resident fish species found within the lakes and streams impacted by the

proposed Red Chris Project is rainbow trout. Baseline fisheries and habitat information has been previously reported in the following documents:

- Hallam Knight Piésold (1995);
- Rescan Environmental Services (1998); and
- McElhanney Consulting Services Ltd (January 2004) (Appendix 4N).

The key baseline data presented within these reports is summarized in Section 4.1.12 of this Application report.

Effects on rare and/or sensitive aquatic organisms and habitat are not expected to occur as none have been identified within either the local or regional study areas during baseline studies.

Rainbow Trout

Rainbow trout are a relative common species within the project area and the region in general. Rainbow trout reside in lakes but are not known to spawn there and must therefore enter streams to spawn. Upon emerging, the fry may remain in the natal creek and rear for up to three years. The juvenile fish eventually migrate downstream to the lake and join the adult fish community.

The results of the fish community surveys conducted in the Red Chris development area were consistent with the known biology of rainbow trout. In most creeks, rainbow trout were confined to creek mainstems, and did not appear to venture into the smaller tributaries.

Boundaries

Local spatial boundaries for the Red Chris aquatic resources impact assessment correspond with the boundaries identified for hydrology and water quality, and include all drainages that could be directly affected by the project, including Red Rock Canyon, White Rock Canyon, and Coyote Creek draining to the northwest, Quarry Creek flowing northeast into the Klappan River, and Trail and Kluea-Todagin Creeks draining to the south (including Kluea Lake).

Temporal boundaries for the fisheries and aquatic resources assessment range from the present time (existing conditions) to post-closure (predicted conditions), including the construction, operational, and decommissioning/closure phases of the project.

The regional study area encompasses adjacent drainage basins not directly affected by the project, but within the general region of the development, including the Klappan River catchment downstream to its confluence with the Stikine River and the Iskut River catchment upstream of the outlet of Kinaskan Lake.

Identification of Key Questions

Project components and related activities that have the potential to interact with aquatic organisms and habitat during construction, routine operations or closure of the proposed project include the following:

- Minesite access road;
- Open pit mine;
- Waste rock dumps;
- Ore and low grade stockpiles;
- Crusher, mill and associated facilities;
- Tailings impoundment;
- Site roads, accommodation camp and facilities;
- Power lines;
- Fuel storage;
- Explosive storage and mixing facilities;
- Sewage and solid waste disposal; and
- Site personnel.

Following a review of the available information and the project description the following two Key Questions regarding potential impacts to fish and fish habitat were identified:

How will the construction, routine operations or closure of the Project affect the quality and availability of fish habitat?

How will the construction, routine operations or closure of the Project affect fish abundance?

Potential effects on fresh water aquatic species and their habitat are of three types: physical, chemical or biological. Physical effects are direct resulting from physical interaction between project components/infrastructure and/or project induced releases and aquatic resources. Examples include loss of habitat, physical injuries, blocking migration routes, smothering organisms, covering food sources, clogging spawning substrate, scouring, and abrasion.

Chemical effects result from exposure to contaminants and changes in water quality. They can include mortality, or acute and chronic effects that cause alteration of biological functions, such as respiration, food assimilation and/or reproduction following biochemical changes triggered by chemical exposure.

Biological effects result from interactions between living organisms and their environment or through alteration of biological functions triggered by physical factors. Examples include changing predator-prey relationships, modifyication of the food chain, reducing primary productivity, reducing reproductive success, and changing photosynthesis, respiration rates, and food consumption.

Physical changes to fish habitat (Key Question 1) may result from several activities including in-stream (or in-lake) construction, blasting, stream crossings, and water withdrawal. Fish habitat refers to spawning, nursery, rearing, food supply, over wintering, and migration areas required by fish. Indirect effects on fish habitat may occur due to changes in abundance or quality of non-fish aquatic organisms that are consumed by fish. Effects on abundance of fish populations (Key Question 2) may result from changes to fish habitat.

Key Question 1 and Linkage Analysis

How will the construction, routine operations or closure of the Project affect the quality and availability of fish habitat?

Linkage Analysis

The following potential linkages between the Red Chris Project and quality and availability of fish habitat were analyzed:

- Linkage between construction of in-stream structures and changes to fish habitat;
- Linkage between the construction of stream crossings and changes to fish habitat;
- Linkage between water quality and changes to fish habitat due to discharges to receiving environment;
- Linkage between water withdrawal and changes to fish habitat; and
- Linkage between dust deposition and changes to fish habitat.

Mine Site Access Road and Power Line

A 22.8 km long single lane gravel topped access road between Highway 37 and the mine site is proposed that would start at a new fenced staging yard to be constructed adjacent to Highway 37 and then travel to the site along the south side of Coyote Creek.

The beginning of the new access road would exit the east side of the fenced staging yard and traverse along the north side of Coyote Creek, approximately 500 m upslope of the creek. Leaving Highway 37 the road alignment slowly ascends a hill for a distance of 7.7 km and crosses 12 potential watercourses.

With the exception of White Rock Creek at 7.6 km, there is currently no available fisheries data for these drainages, however low fisheries values are expected for these drainages due to their apparent size and gradient. Current information on White Rock Creek located at 7.6 km indicates the presence of rainbow trout in the lower reaches and may require the installation of a fish passable drainage structure at this location. An additional 22 possible drainages from the 7.7 km mark to the termination at the mine site have been identified. As these drainages are along steep slopes, and feeding alpine swamps areas it is expected that habitat and fisheries values will be low.

RCDC would also construct a new 138 kV power line along the 22.8 km access road to the Red Chris mine site. Power would then be transformed down at a new substation to be constructed at the mill site to provide electrical energy for the mill and other mine site facilities. The right-of-way clearance required for the access road and power line is 60 m within forested areas and 30 m above the tree line.

Additional fieldwork to ground truth the potential drainages with respect to their navigability under the Navigable Waters Act and their fisheries potential was completed in July and will be reported in the Fall 2004 addendum to this Application. Where this ground truthing indicates that fish passable structures are necessary, suitable such structures will be installed to ensure continued fish passage under the proposed new access road throughout the mine life and into post-closure (for as long as the access road is required).

Potential impacts to aquatic habitat associated with the mine site access road and power line are predicted to be limited to those potential direct impacts that are due to construction and accident scenarios where spills may enter the aquatic environment. Sediment control measures will be implemented at all such stream crossings during road construction to prevent and control the movement of sediments into these watercourses. A mitigation plan will be prepared in advance of construction of any culverts, bridges or other structures required to pass the road across these watercourses with the objective of outlining the procedures and control methods to be employed to protect aquatic life and water quality. Appropriate approvals will be obtained from the regulatory authorities (DFO and WLAP) as needed to allow such crossings to be constructed in a manner that protects water quality and aquatic resources.

Open Pit Mine

Minimal aquatic habitat is located within the area proposed for the open pit mine. Streams within the area of the proposed open pit are ephemeral in nature, i.e., they do not carry water on a year round basis. Typically this area drains into the headwater streams of Red Rock Canyon Creek. Once pit development commences, all water collected within the developed pit area will be collected and pumped to the tailings impoundment via the mill tailings pumpbox. The aquatic habitat directly displaced by the open pit mine will be minimal and is of relatively low quality. No fish have been observed area during baseline primarily due to the ephemeral nature of the watercourses in this area. It is unlikely that fish can access or utilize these watercourses.

Over the 10.75 year open pit mine life (9 months of pre-development and 10 years of operation) it is expected that a total of 93.5 million tonnes of ore will be extracted and sent directly to the mill for processing.

Potential impacts to aquatic habitat associated with the proposed development of the open pit mine are predicted to be restricted to those direct impacts resulting from the proposed changes in drainage patterns during construction and operation (i.e., by re-directing natural precipitation runoff away from the headwaters to Red Rock Canyon Creekdue to the development of the land under the open pit footprint. This runoff will be re-directed to the tailings impoundment watershed) and decreased water quality associated with the release of mine water from the

open pit. These impacts were previously discussed in Sections 4.2.4 (hydrology) and 4.2.5 (water quality).

Waste Rock Dumps

Under the selected waste rock management option, both NAG and PAG waste rock generated by open pit mining will be placed within the North waste rock dump. The North dump has been sited so that all contaminated toe drainage from the dump will gravity flow into the tailings impoundment area during the mine's operational life. After the pit is mined out (after 10 years of mining) the drainage from the North waste rock dump will be directed into the open pit through a gravity drain (either a rock trench or tunnel).

The North dump is located at the top of its watershed and offers a small watershed drainage area. Clean precipitation runoff will be directed away from the uphill sections of the dump where possible. In the post-mining period, drainage from the North Dump will be directed into the open pit. Over time (estimated at approximately 100 years with no intervention) the pit will fill with natural runoff and groundwater. The natural discharge point is at a topographic low at the east end of the pit. However prior to water reaching this discharge point, RCDC will have constructed and commissioned a treatment plant utilizing proven technology to treat all of the water collected from the North Dump within the open pit. The treated water will be discharged into the tailings impoundment. This water treatment would continue on a seasonal basis for many years into the future (estimated to be required in excess of 200 years). In this way contaminated water draining from both the pit walls and from the North waste rock dump will be treated to remove metal contaminants and to neutralize acidity prior to the water entering the tailings impoundment.

The potential impacts to aquatic habitat associated with the construction of the proposed North waste rock dump will be restricted to the direct impacts due to the changes in drainage patterns created by the redirection of all toe drainage infiltrating into the dump areas into the tailings impoundment watershed during the operational phase and on a permanent basis in the post-closure phase and from any decrease in water quality draining from the waste rock dumps during the lifetime of the project and into post-closure. As indicated RCDC will mitigate the potential water quality impact by treating contaminated water from both the North Dump and open pit in the post-closure period (after the mined out pit has flooded).

Ore and Low Grade Stockpiles

The crushed ore will be conveyed onto the crushed ore stockpile located adjacent to the crusher for supply to the mill. The stockpile of crushed ore will be located within the tailings impoundment catchment area. Low-grade ore not immediately milled will be stockpiled within a designated portion of the North waste rock dump for future processing. Consequently during the operational life all water released from the ore stockpiles will be collected and directed to the tailings impoundment.

Potential impacts to aquatic habitat associated with the ore and low grade stockpiles are restricted to potential reduction in water quality in Quarry Creek during the mine's operational

life and in the unnamed wetland and downstream watershed to the northeast of the Northeast Dam during the post-closure period. RCDC has committed to implementing water treatment if necessary to ensure that the effluent discharged from the tailings impoundment will be of sufficient quality to protect aquatic life in these two drainage systems both during the mine's operational life and into post-closure.

Crusher, Mill and Associated Facilities

The crusher and mill facilities will be constructed in an area where there are no watercourses consequently no aquatic habitat will be directly impacted by the construction of these facilities. Potential impacts to aquatic habitat associated with the crusher, mill and associated facilities are due to a decrease in water quality or water flow associated with the re-direction of all runoff into the tailings impoundment and operation of the tailings impoundment on the Trail, Quarry and Unnamed Creek downstream of the Northeast Dam.

Tailings Impoundment

The site of the proposed tailings impoundment is in a Y-shaped valley approximately 3.5 km northeast of the Red Chris ore deposit. Construction of three dams will be required at the south, north, and northeast arms of the valley. The dam in the northeast arm will not be required until the latter years of operation when tailings and water start to encroach into this area. The North and South Dams of the tailings impoundment will be constructed before routine operations commence. Earth fill embankments are planned for each of these valleys to contain tailings. The North and South Valleys are essentially the two ends of a main approximately north-south trending valley, the bottom of which is located approximately 400 metres (1300 feet) below the proposed waste dump area. The starter dams will be constructed (for the North Dam and the South Dam) to provide two years of tailings storage. The first raise of the starter dams will be constructed during the summer of Year 2, after which the dam crests will be raised on an annual basis to meet increasing tailings and water storage requirements.

The proposed tailings impoundment straddles the watershed divide between Trail Creek and Quarry Creek, with most of the impoundment area normally flowing to Trail Creek which in turn flows into Klluea Lake which is ultimately part of the Iskut River watershed. The proposed Northeast Dam area is located near the headwaters of a valley. A drainage divide at the headwaters of the valley separates surface waters destined for Kluea Lake via the Northeast Valley from flows towards the Klappan River. The Northeast Dam will not be required in the pre-production period as this dam is located on higher ground and will be constructed, in a single stage (given its small size) in Year 15.

Construction and routine operations of the tailings impoundment will directly and permanently impact a small amount of aquatic habitat at the headwaters of two creeks, Trail Creek and Quarry Creek. Trail Creek, begins its descent south into Kluea Lake within the area encompassed by the southern portion of the tailings impoundment. "Black Lake" is a small pond located within the portion of Trail Creek directly impacted by the tailings impoundment. No fish have been found in "Black Lake" during historical surveys.

A small section of Quarry Creek is located within the North Dam end of the tailings impoundment. This aquatic habitat will also be permanently lost during construction and routine operations of the Red Chris Project. Quarry Creek flows into the Klappan River located north of the site.

It should be noted that no fish have been observed within these impacted sections of the headwaters of Trail and Quarry Creeks during any of the fisheries studies conducted to date for the Red Chris Project (1994 through 2004).

The till throughout the tailings impoundment area layer is thought to be extensive and will form a natural, and effective, liner to limit seepage losses into the underlying silt and sand unit (the lower aquifer). Whether or not the natural till blanket is continuous in the valley bottom area is unknown and is unknowable, and it is likely that there are gaps through which seepage losses could be more concentrated than would otherwise be the case. However, once the area is blanketed with tailings, the tailings will serve to reduce seepage losses into the lower aquifer through any potential gaps in the till.

The catchment area for the tailings facility during routine operations includes the various mine site facilities west/southwest of the tailings impoundment including the open pit mine, the North waste rock dump, sewage from the treatment plant, and crusher, mill, and camp facilities.

Seepage from the tailings impoundment was modeled as a function of tailings thickness. Most of the seepage will be collected in the seepage ponds located downstream of the North Dam and the South Dam, and recovered by the pumping wells downstream of these seepage ponds. It is assumed for water balance projection purposes that 25% of the tailings impoundment seepage is not recovered. In addition to seepage from the impoundment, drainage and decant water from hydraulic placement of cyclone sand on the downstream shells of the North Dam and the South Dam will be collected. A pump-back system will convey the water in the seepage ponds back into the tailings impoundment.

During the mine's operating life the excess water to be released from the proposed tailings impoundment would be discharged by pump (located on the reclaim barge in the impoundment pond) and pipeline past the North Dam into a watershed that drain towards the Klappan River.

Potential impacts to aquatic habitat associated with the tailings impoundment are due to:

- a direct loss of habitat within the tailings impoundment footprint;
- a decrease in water quality in Trail, Quarry and the Unnamed Creek downstream of the Northeast Dam; and
- either an increase and/or decrease in flow to Trail, Quarry and the Unnamed Creek downstream of the Northeast Dam.

during the lifetime of the project and into post-closure.

Site Roads, Accommodation Camp and Facilities

The permanent accommodation camp and support facilities will include sleeping, dining, recreation and support facilities for the permanent workforce of approximately 250 persons, of which approximately 125 will be on site at any given time. The accommodation camp has been designed with a total of 174 rooms. An open pit truck maintenance shop, combined with warehouse facilities, offices, dry and change rooms for the mine and maintenance employees and an assay lab facility will also be constructed. Access roads within the minesite footprint will be constructed using similar materials and methods as the mine site access road.

Surface water runoff from the site roads, accommodation camp and facilities will be collected and diverted to the tailings impoundment.

Potential impacts to aquatic habitat associated with the site roads, accommodation camp and facilities are due to a decrease in water quality during construction or changes in water flow in nearby streams.

Fuel Storage

Diesel fuel storage and dispensing facilities will be located in a lined containment facility, with provision of space for short-term storage of hazardous wastes such as used antifreeze, solvents, batteries, etc. pending shipment off-site for recycling or disposal at a licensed facility.

Potential impacts to aquatic habitat associated with fuel storage are due to direct impacts during construction and accident scenarios where spills may enter the aquatic environment

Explosive Storage and Mixing Facilities

The Red Chris Project will use a similar explosives storage and mixing facility to that currently in operation at the Huckleberry and Kemess South Mines. ANFO and ammonium nitrate based emulsion type explosives will be mixed on site on an as required basis for direct delivery to the drilled blast holes within the open pit. The facility will consist of a building and fuel storage tank to store the required components to manufacture the ANFO and emusion explosives, primarily ammonium nitrate prills and diesel fuel. The diesel fuel will be stored in a tank with an appropriate lined spill containment berm. Ammonium nitrate and fuel oil will be mixed to create ANFO within the building and loaded directly into an explosives delivery truck. Emulsions will be mixed in a similar manner using the same equipment. Explosives will be delivered direct to the pit blast holes and transferred by pneumatic means into the holes.

Potential impacts to aquatic habitat associated with the explosive storage and mixing facilities are due to a a decrease in water quality due to accident scenarios where spills may enter the aquatic environment

Sewage and Solid Waste Disposal

The treated wastewater from the site sewage treatment plant will be pumped to the tailings impoundment by way of the final mill tailings pump box.

Non-hazardous waste will be segregated into two streams: organic food wastes from the kitchen facilities will be segregated and burned daily in on-site incinerators; and other non-hazardous, non-organic garbage will be collected and disposed of within an on-site landfill to be located in a suitable area that drains by gravity into the tailings impoundment. Non-hazardous garbage placed within this landfill will be periodically buried under a layer of soil or waste rock to prevent loss of garbage through wind action and to control drainage.

Typically all hazardous wastes outside of tailings and waste rock will be segregated at the point of generation, placed into appropriate storage containers and then shipped off site to an appropriate recycling or disposal facility. A lined storage facility will be constructed within or near the site fuel storage facilities to store the hazardous waste held in segregation pending periodic off-site shipment.

Potential impacts to aquatic habitat associated with the sewage and solid waste disposal are due to a potential decrease in water quality, however both sewage and leachate from the proposed landfill will end up in the tailings impoundment. Consequently the impacts will be discussed in combination with the impacts associated with the tailings impoundment.

Potential Borrow Pits

A series of till and gravel borrow pits to supply material for use in constructing the tailings dams and for constructing the “store and release” soil cover on the post-closure waste rock dumps, downstream tailing dam slopes and post-closure tailings beach areas will be required. These borrow areas will primarily be sited within the tailings impoundment however the amount of required material may require the opening of some till borrow areas outside the tailings impoundment. Additional sources of till are expected to be obtained from the area immediately to the east of the northeast arm of the tailings impoundment if found to be needed.
Potential impacts to aquatic habitat associated with the potential borrow pits are due to a direct loss of habitat within the area encompassed by the borrow pits and a decrease in water quality or water flow in nearby streams.

Key Question 2 and Linkage Analysis

How will the construction, routine operations or closure of the Project affect fish abundance?

Although the fish habitat directly affected by the project is primarily related to construction of the tailings impoundment, indirect effects to fish abundance in the area associated with changes in fish passage and fish habitat are also a concern. Pressure on the remaining fish populations due to increased fishing is also a concern. The following potential linkages between the Red Chris Project and fish abundance were analyzed:

- Linkage between a change in access to fish resources for harvesting activity and a change in fish population abundance;
- Linkage between changes in fish habitat and changes in fish population abundance; and
- Linkage between changes in fish passage and changes in fish population abundance

Increased fishing pressure, as a result of increased access to the area, can lead to changes in the fish population structure. Access to the mine site road will be controlled by a fenced and gated staging yard constructed adjacent to Highway 37.

Following a review of the available information, potential impacts to fish abundance associated with the Red Chris Project were identified during construction of the mine site access road and tailings impoundment. During routine operations or after closure of the mine the abundance of fish down stream of the tailings impoundment may be impacted due to changes in drainage patterns and discharge of tailings water.

Impact Analysis, Mitigation and Rating

Construction

Impact Analysis

All construction activities involving excavations and earth movement have the potential to cause impacts on aquatic environments through water quality related effects from mobilized sediment. The potential release of sediment into watercourses associated with the construction of most of the site facilities will be minimal due to their location away from fish bearing watercourses. The mobilization of sediment along with surface run-off is expected to be minimal during construction of the camp and support facilities and effects related to sedimentation are not expected to cause any significant impacts on aquatic organisms and their habitat. There is the potential for release of sediment into Coyote Creek during construction of the minesite access road. There is also the potential for impacts associated with sediment and erosion during construction of the south and north dams of the tailings impoundment.

The mine site access road may have the following effects on fish habitat: potential loss or degradation of fish habitat in Coyote Creek, White Rock Creek or other fish bearing/supporting watercourses during construction; potential release of sediment into fish bearing streams during construction; and potential alteration of precipitation runoff patterns due to installation of the road way. During routine operations, accidents along the access road involving chemical or fuel spills may also impact aquatic habitat.

Installing culverts along the roads also has the potential to impact fresh water aquatic ecosystems as a result of direct habitat loss or reduced water quality from increased suspended sediment and downstream sediment deposition. There is also the potential to block fish passage during culvert installation. Approximately 34 drainages (most ephemeral) have been identified along the mine site access road. Ephemeral streams generally carry flow only during Spring freshet or following large precipitation events. Culvert crossings required for the access road will not impact fish habitat with the implementation of appropriate mitigation measures.

Impacts potentially associated with the ore and low grade stockpiles include: potential release of sediment into fish bearing streams from stockpile development; potential release of nitrogen compounds, acid rock drainage and metal contaminants from precipitation runoff contacting blasted rock within the stockpiles and potential alteration of precipitation runoff patterns and volumes reaching nearby streams due to the presence of stockpiles.

Rock blasting and crushing activities in the open pit mine during construction have the potential to interact with fresh water aquatic organisms by mobilizing sediment that may enter streams and affect water quality of aquatic organisms and their habitat. Noise and blasting are not expected to be an issue for fresh water organisms and their habitat, since blasting will not be conducted within or near existing watercourses and/or waterbodies. Blasting associated with the Red Chris Project will follow the guidelines outlined in DFO's Guideline for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998).

Impacts to aquatic resources associated with the tailings impoundment include; potential release of sediment into fish bearing streams during dam and diversion ditch construction activity; loss of fish habitat under the footprint of the northern (headwaters of Quarry Creek) and southern (wetlands) dams of the proposed tailings impoundment; loss of "Black Lake" and headwaters of Trail Creek within the footprint of the southern section of the tailings impoundment; reduction of water flow due to the construction of the North and South Dams at the headwaters of Quarry and Trail Creeks; periodic release of water from the North Dam during routine operations and long-term release of water from the Northeast Dam spillway to the receiving environment following closure of the mine.

The most significant impact from a flow perspective resulting from the construction of the tailings impoundment is the reduction in catchment area reporting to Trail Creek. As presented in Section 4.2.4 the pre-development catchment area for Trail Creek is 22.5 km^2 whereas following construction of the tailings impoundment, the catchment area is reduced to 0.1 km^2. This results in a significant flow disruption in Trail Creek following construction of the South Dam during the construction and operational time period. At post-closure the impact is slightly less but still quite significant. Consequently there will be an expected loss of wetted stream width within and a potential loss of fish habitat within Trail Creek. This may be mitigated to some extent by recharge from the underlying aquifer. Fisheries studies have been conducted to quantify and characterize this habitat and will be included in the Fall addendum to this application report. It should be noted that fish presence and utilization in Trail Creek is small primarily due to natural barriers created by beavers. This reduction in flow in Trail Creek will reduce inflow into Kluea Lake however the impact is not thought to be significant as the impact on outflow from Kluea

Lake as predicted within Kluea-Todagin Creek is in the order of 14% of the mean annual discharge from the lake. Kluea-Todagin Creek itself receives significant inflow as well from a major tributary on its west side just downstream from the Kluea Lake outlet.

The major buildings will be constructed on bedrock or on stable rock fill pads. The construction of building pads for buildings and associated yard areas has potential to alter fish habitat and/or cause reduced water quality through downstream sedimentation or increase suspended sediment. The rockfill building pads proposed for the project will be constructed of coarse-sized quarried rock, with minimal fine substrates, minimizing sedimentation of watercourses. Impacts associated with the construction activities include the potential release of sediment into fish bearing streams from construction activity and potential alteration of precipitation runoff patterns to streams due to presence of the facility.

In summary potential impacts to fish and fish habitat during construction of various facilities associated with the Red Chris Project include:

- Potential release of nitrogen compounds, acid rock drainage and metal contaminants from precipitation runoff contacting blasted rock within the mill site rock excavation and from any rock fill used to create building pads.

Overall the aquatic habitat loss is significant in Trail Creek due to construction of the tailings impoundment in the upstream reaches and reduction in catchment area resulting in reduced flows in the downstream reaches. However, these effects are not significant when considering the overall local study area and not significant in a regional context.

Mitigation Measures

The potential for releases of deleterious materials into the Coyote, Trail and Quarry Creek watersheds will be minimized through the appropriate storage of all fuels and chemicals, proper use of erosion and sediment control measures and maintenance around the area during and after construction.

Steps have been taken during the design phase to prevent the loss of fish habitat by avoiding instream construction. Mitigation measures to prevent impacts to water quality and fish will focus on the timing and planning of bridge construction. The proponent, or agents of the proponent, shall employ the following mitigation measures to address potential adverse effects on water quality and fish as part of project planning.

Where feasible, project construction components that interact with the fresh water aquatic environment will be timed to avoid critical life cycle periods such as spawning of rainbow trout. Installing culverts will be timed for periods when flow is low or absent to prevent interrupting fish passage and prevent mobilizing sediment. Culverts will be in accordance with DFO criteria to ensure fish movements.

Site-specific sediment and erosion control measures will be described in the Environmental Management Plan and implemented as necessary. Particular attention will be focused on

ensuring that adequate control measures are utilized during the construction of the mine site access road, which generally follows the south side of Coyote Creek. Surrounding areas will be restored and embankment stabilized to prevent erosion. The watercourse crossings will be designed and constructed to meet the federal policy for "No Net Loss" of productive fish habitat (DFO 1986). All watercourse crossings will be constructed using management practices that include:

- The final planning for construction and staging for the proposed bridge will consider all efforts to minimize disturbance to the watercourse and riparian vegetation.

- Instream construction, if required will occur outside of the restricted activity period for the area.

- RCDC will obtain all appropriate approvals and notifications under the Fisheries Act administered by Fisheries and Oceans Canada and BC Ministry of Water Lands and Air Protection.

- The reseeding and replanting of disturbed riparian sites will be completed using native species, in species mix and cover values consistent with the pre-construction conditions, will be required. Environment Canada recommends that locally indigenous grass species be employed in the revegetation of disturbed shoreline and bank areas.

The following mitigation measures as required by Fisheries and Oceans-Habitat Management Division (DFO-HMD) will be undertaken to prevent the movement of sediment, fuels and other deleterious materials from either eroding or washing into Coyote Creek or other watercourses during the construction of any required bridge structures along the proposed access road:

- The activity of construction equipment within the wetted perimeter of the watercourse will be minimized.

- All equipment will be thoroughly cleaned before arriving on the work site. All hydraulic, fuel and lubrication systems will be in good repair to prevent leakage and deposition of deleterious substances into the water. Any structures that may come in contact with the water will be made of materials that are not toxic to fish.

- Equipment will not be serviced, refueled or washed within 100 m of the watercourse or in areas that may receive runoff that could potentially enter the watercourse.

- Vehicles will not be parked for long durations within 30 m of the watercourse.

- Only equipment directly related to the construction of the water crossings will be allowed near the watercourse and/or wetlands.

- During construction and until revegetation is established, effective sediment control measures on disturbed areas (i.e. silt fences, sediment traps or other sediment control devices) will be provided on each side of the watercourse to prevent soil-laden runoff from entering the watercourse.

- Construction will be halted during heavy rain.

- Effective long-term erosion control measures will be implemented. This will include: stabilizing disturbed slopes immediately after construction; seeding grass and planting other native shrubs along banks as soon as possible after construction; and preserving existing low vegetative cover (e.g., shrubs along the banks of the creek). Disturbed areas will be reclaimed to vegetation within one growing season.

- The work site will be monitored to evaluate the effectiveness of erosion control measures. Problems will be rectified as they arise.

- The proponent, or an agent of the proponent (e.g., the construction consultant), will ensure that all key construction personnel are fully aware of the mitigation measures contained within tender and contract documents, in addition to any requirements contained in all public and private approvals and agreement documents for this project.

- All waste materials associated with the proposed construction activities will be contained at the site and collected daily by the construction crew, and disposed of in an approved manner.

- The proponent will ensure that the appropriate regulatory authority is notified of all changes in plans, specifications or operating conditions, which have the potential to adversely affect fish or fish habitat.

Natural drainage within the footprint of all building sites and associated rockfill pads and mining facilities will be diverted around construction areas. This will prevent blockage of flow or the introduction of sediment from construction activities into watercourses. Run-off will be managed appropriately within the Project site where feasible during construction. Additional culverts may be installed along the access road and at the mine site to ensure proper cross-ditch drainage during periods of snowmelt.

RCDC is committed to following accepted construction practices by isolating work activities or utilizing silt curtains/fences and implementing a sediment monitoring program during any near or in-stream work activities. Site development will include use of sediment control techniques where appropriate, to prevent construction-generated sediment from entering local watercourses. When these mitigation measures are implemented, impacts to fish habitat are not expected.

The loss of habitat and mortality of aquatic organisms from construction of the tailings impoundment and the disruption of natural water flow in Trail Creek cannot be directly mitigated.

RCDC has commissioned additional fieldwork to be completed during the 2004 field season to assess, characterize and quantify fish habitat within the upper reaches of Quarry Creek, Trail Creek and the unnamed wetland and creek system draining the valley downstream of the proposed tailings impoundment Northeast Dam site. At the same time opportunities for habitat compensation will be explored. The results of this work will be reported in the Fall of 2004

through an addendum to this application report. This data will be used to quantify habitat alteration, disruption and/or destruction associated with the proposed project development and will form the basis for discussions of a proposed habitat compensation plan to be developed in association with DFO and WLAP.

Mitigation measures during construction of the tailings impoundment dams include applying appropriate control of surface runoff and sediments (e.g., sediment traps, silt fencing) to prevent increased total suspended solids (TSS) and sediment deposition downstream (particularly during the initial stages of construction).

Elevated dust emissions generated during various construction activities including blasting and vehicle traffic may impact the aquatic environment. Aquatic habitat that may be impacted by dust emissions or total suspended particulates that could potentially result in accumulations of sediment affecting near-shore spawning, rearing, foraging or refuge areas is not located proximate to project facilities (i.e. Kluea Lake).

RCDC will discourage fishing by its employees and contractors during the construction and operational phase of the Red Chris Project. Employees will not have access to personal or company vehicles for the purpose of recreational activity. Neither will there be opportunity for cooking or storing recreational catch. As a result, opportunities for recreational fishing will be limited to areas within hiking distance of the camp and likely to catch and release only. If, in consultation with regulators, it is decided that the harvest rate is exceeding the reproductive capacity of the resource, then fishing by project personnel will be prohibited as a condition of employment. Impacts on fish abundance due to increased fish harvesting therefore will be minor.

Residual Impacts and Rating

Residual impacts affecting the aquatic environment following construction includes loss of aquatic habitat within the tailings impoundment, and change in water flows associated with the newly constructed North and South Dams. Both impacts are significant within Trail and Quarry Creeks respectively but not significant in a regional context.

Permanent loss of aquatic habitat will occur at the headwaters of Trail Creek and, to a lesser degree, Quarry Creek. The impacts associated with this loss of habitat are not considered significant as baseline data suggests very low to no utilization of this habitat due to obstructions such as beaver dams in these reaches of both Quarry and Trail Creeks. Flows in Trail Creek will be reduced significantly as a result of the construction and operation of the tailings impoundment. This results from a conscious decision made during project planning to minimize the project's water quality impacts on the fisheries and aquatic resources contained in the Kluea Lake ecosystem by re-directing as much as possible all mine impacted water into the watercourses draining north to the Klappan River (Quarry Creek and the Unnamed Creek downstream of the Northeast Dam). Consequently the Project as proposed redirects most of the Trail Creek catchment into the two drainages going north towards the Klappan River (Quarry and Unnamed Creeks). This decision was taken on the basis that fisheries values (presence, abundance and utilization) within the Kluea Lake drainage system appear to be greater than

those observed within the Quarry Creek watershed. It was also based on the knowledge that even with all mine related waters being re-directed into Quarry Creek (and/or Unnamed Creek at post-closure) all project related water quantity and quality effects become "not significant" at the point of confluence with the Klappan River.

Operations

Impact Analysis

During project operations, activities that will cause interaction with the fresh water aquatic environment are primarily associated with the various sources discharged to the tailings impoundment, where the headwaters of Trail and Quarry Creeks are located. During operations, tailings, waste rock dump and open pit drainage water, and treated camp sewage will be discharged into the tailings impoundment and will be partially recycled to the plant via reclaim water. An annual excess of water within the tailings impoundment is predicted requiring an annual release of excess supernatant water from the tailings impoundment reclaim pond to the upper reaches of Quarry Creek during the mine's operational life and to the wetland and unnamed creek downstream of the Northeast Dam during post-closure. Both systems drain to the Klappan River.

Water quality effects in Quarry Creek may occur during the periods of release from the tailings impoundment as discussed in Section 4.2.5 – Water Quality Impact Assessment. Water quality modeling indicates that Metal Mining Effluent Regulation discharge standards will be met in the annual discharge from the tailings impoundment. The model also predicts that similarly the discharge from the impoundment will meet the low end of the range of guideline values established under the B.C. Provincial Pollution Control Objectives for the Mining and Smelting Industry (1979) for all of the parameters modeled. Water quality was predicted at two points within Quarry Creek (1,200 m downstream of the discharge and at water quality monitoring station W11, located at about 2/3rds the distance between the discharge point at the confluence with the Klappan River). The model predicts moderate elevations in most parameters compared to the historical averages for Quarry Creek. During the operational life, the model predicts that CCME Guidelines for protection of freshwater aquatic life will only be exceeded for Al, Se, Cd, and Mn at the 1,200 m downstream point, as follows:

- Al - Average value of 0.12 mg/L versus a CCME Guideline of 0.02 to 0.07 mg/L;
- Se - Average value of 0.004 mg/L versus a CCME Guideline of 0.001 mg/L;
- CD – Average value of 0.00007 mg/L versus a CCME Guideline of 0.000017 mg/L;
- Mn - Average value of 0.045 mg/L versus a CCME Guideline of 0.0001 mg/L.

All other parameters are predicted to be within or below CCME guidelines for the protection of aquatic life.

It should be noted that the historical concentrations of Mn both in Quarry Creek and within the Klappan River have been consistently measured at concentrations that exceed the CCME Guideline by two to three orders of magnitude, and that concentrations predicted in Quarry Creek during operations will be equivalent to baseline levels.

Similarly at site W11, the CCME Guidelines for protection of freshwater aquatic life will be exceeded only for Se, Cd, and at site W11, as follows:

- A - Average value of 0.06 mg/L versus a CCME Guideline of 0.02 to 0.07 mg/L;
- Se - Average value of 0.002 mg/L versus a CCME Guideline of 0.001 mg/L;
- CD – Average value of 0.00006 mg/L versus a CCME Guideline of 0.000017 mg/L
- Mn - Average value of 0.044 mg/L versus a CCME Guideline of 0.0001 mg/L.

All other parameters are predicted to be within or below CCME guidelines for the protection of aquatic life.

As with the 1200 m location above, it should be noted that the historical concentrations of Mn, both in Quarry Creek and within the Klappan River, have been consistently measured at concentrations that exceed the CCME Guideline by two to three orders or magnitude, and that concentrations predicted in Quarry Creek during operations will be equivalent to baseline levels.

During operations water within the upper reaches of Quarry Creek is predicted to be moderately elevated in concentrations of some metals above CCME Guidelines for the Protection of Freshwater Aquatic Life. However based on acute toxicity testing of the mill process water it is predicted that the discharge of supernatant from the tailings impoundment will not result in acute toxicity effects to aquatic life. However the predicted water quality in Quarry Creek may result in some lesser effect on aquatic life over the mine's operational life. It should be noted that there are natural analogues throughout Canada where aquatic life has adapted and thrives under in natural waters where CCME Guidelines are naturally exceeded. In fact Quarry Creek and the Klappan River are such examples in the case of Manganese in particular.

Water quality modeling indicates that water quality during periods of annual release will meet water quality objectives protective of fresh water aquatic life well within the Klappan River. The volume and water quality of periodic water release from the North Dam and the effects on Quarry Creek will be closely monitored and managed to ensure the protection of aquatic resources in the downstream receiving environment.

Fresh water will be drawn from a series of groundwater wells, installed in the valley downstream of the seepage ponds for each of the North Dam and the South Dam, and pumped to a water tank located adjacent to the mill. Fresh water will primarily be used for reagent mixing, grinding mill cooling water, pump glands, and compressor seal water. Water will be reclaimed from the tailings impoundment for use within the milling process as process water. Reclaimed process water will be drawn from the tailings impoundment by floating barge mounted pump and pumped to a separate process water tank to be located adjacent to the mill. All process water used in the milling process will be returned back to the tailings impoundment for reuse.

Diversion ditches around the east and north sides of the tailings impoundment will ensure that surface water run-off from these areas does not enter the tailings impoundment. The diversion ditches will direct the water to areas below the South and Northeast Dams, where upper portions of watercourses were lost during construction of the dams. This additional water flow to receiving environments such as Kluea Lake will help to mitigate some of the impacts associated with reduced flow to Trail Creek due to the tailings impoundment dams.

Project activities could potentially contribute to elevated dust emissions that include: blasting and crushing of ore, stockpiling ore, putrescible kitchen waste incineration, and vehicle traffic. The maximum dust deposition is predicted to occur in close proximity to the main haul roads and adjacent to the crushed ore stockpile. These emissions will be mitigated through the use of water sprayed on the road for dust control during dry periods and by water sprays at the stockpile to be used during dry periods when dusting is observed to be a problem. As a result, fugitive dust emissions are not predicted to have an impact on aquatic habitats.

In summary potential impacts to fish and fish habitat during routine operations of various facilities associated with the Red Chris Project include:

- Water quality impacts within Quarry Creek from the annual release of excess tailings supernatant; and
- Potential release of nitrogen compounds, acid rock drainage and metal contaminants from precipitation runoff contacting blasted rock within the mill site rock excavation and from any rock fill used to create building pads.

Mitigation Measures

Routine construction and operations of the tailings containment area will cause impacts that cannot be effectively mitigated or reversed, since the tailings will remain in the tailings impoundment. Data collected on fisheries and fisheries habitat in 2004 will be used to quantify habitat alteration, disruption and/or destruction associated with the proposed project development and will form the basis for discussions of a proposed habitat compensation plan to be developed in association with DFO and WLAP.

Potential effects by the periodic release of water from the tailings impoundment area from the North Dam will be mitigated by timing the discharge to coincide with flow conditions that maximize dilution and by controlling the volume released. Decant water quality will be monitored to ensure MMER guidelines at the point of discharge and that the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2001) are met within the Klappan River. RCDC also recognizes that the Province of British Columbia will establish site-specific discharge limits for the Red Chris Project as part of the permitting process and that such limits will be established to be protective of downstream aquatic life. In addition the effluent must be non-acutely toxic as defined by the Environment Canada LC_{50} standard toxicity testing protocols.

The catchment area for the tailings facility has been divided into the following areas:

- Tailings impoundment
- North, Northeast, and South Seepage Dams
- Pit area
- Waste Dump Area
- Area below (downhill) of access road
- Area below (downhill) of plant site
- Diverted areas above impoundment

Total catchment area, including diverted areas is 2,615 ha. The total diverted area is 1,109 ha. It is assumed, for start-up, that runoff from the entire 2,615 ha catchment can be collected in the impoundment, meaning that the diversion ditches will initially be blocked off so that water is allowed to flow into the impoundment. Once sufficient water has accumulated, the blockages will be removed and the effective catchment providing runoff to the tailings impoundment will reduce from 2,615 ha to 1,506 ha.

During the mine's operating life the excess water to be released from the proposed tailings impoundment would be discharged by pump (located on the reclaim barge in the impoundment pond) and pipeline past the North Dam into the Quarry Creek watershed that drains towards the Klappan River. The objective is to avoid discharge of process water into the Kluea Lake watershed where fisheries values tend to be of higher quality. The rate of discharge would be controlled to coincide with periods of maximum downstream dilution in the stream channel to maximize dilution benefits.

Seepage from the tailings impoundment was modeled as a function of tailings thickness. As tailings blanket the basin of the tailings impoundment, seepage rates decrease. It is estimated that seepage will be a maximum of 75 lps from the whole of the impoundment at closure. It is assumed for water balance projection purposes that 25% of the tailings impoundment seepage will be recovered in the seepage ponds downstream of the North and South Dams, with the remainder reporting to the underlying aquifer. In addition to seepage from the impoundment, drainage and decant water from hydraulic placement of cyclone sand on the downstream shells of the North Dam and the South Dam will be collected. A pump-back system will convey the water in the seepage ponds back into the tailings impoundment during operation.

At closure, excess water from the tailings impoundment will be directed to the Unnamed Creek draining the catchment downstream of the Northeast Dam to the Klappan River. RCDC is committed to further assessment of this option to ensure that the proposed plan has the least environmental impact possible. To this end RCDC have commissioned additional fisheries and fisheries habitat investigations in drainage systems proximate to the tailings impoundment along with an assessment of stream channel size and stability between the proposed discharge points and the Klappan River.

During routine operations drainage from the dumps would be directed into the tailings impoundment. Natural dilution and the availability of alkalinity within the tailings and mill process creates an effective treatment system to neutralize acidity and precipitate metals within the impoundment to an acceptable discharge standard.

There is a risk of inadvertent release of contaminants (e.g., petroleum products) associated with machinery operating adjacent to water and re-fuelling events at the fuel storage facility, and during transportation to the mine along the access road. Depending on the quantity and type of substance released, the effects may impact fish habitat. Mitigation measures include, but are not limited to the following:

- Ensuring that contractors on site are properly trained in the use and storage of hazardous materials;
- Build and maintain containment berms at the fuel storage tank farm;
- Develop, implement, and update project specific spill contingency response plans;
- Install spill kits at strategic locations, located to facilitate prompt response action; and
- Build and maintain tailings pipeline catch basins.

Mitigation procedures for total suspended particulates will include a dust suppression plan, which incorporates suppressing dust from project activities such as the site roads, crushed ore stockpile, and mill yard areas.

Provided that mitigation measures are implemented, the inadvertent release of deleterious substances is not anticipated to impact fish habitat. If an inadvertent release of deleterious substances that may impact fish habitat does occur, the spill will be contained and cleaned up immediately, and the appropriate regulatory agencies will be notified.

Residual Impacts and Rating

Tailings will remain within the tailings impoundment permanently so the biological productivity of the headwaters of a small section of both Quarry and Trail Creeks will be lost permanently. The probability of loss is certain. This loss will be gradual throughout the operation of the impoundment so the frequency is defined as continuous, because the tailings will remain in the tailings impoundment. The magnitude of habitat change is rated as high. The spatial extent of the loss will be limited to a small portion of the LSA and the duration permanent.

The residual impacts on the Quarry and Trail Creek outflows vary due to the different management strategies during routine operations and post-closure. During operations the annual periodic discharge of tailings supernatant will occur from the tailings impoundment into Quarry Creek in order to maintain optimum volumes in the tailings impoundment. Impacts associated with this periodic release of water are predicted to be moderate within Quarry Creek but not significant within the Klappan River.

There will be no direct flow from the tailings impoundment to Trail Creek during routine operations. Residual impacts due to a reduction in catchment area and resulting reduced flows are expected to be significant within Trail Creek but not significant within Kluea Lake.

Decommissioning and Closure

Impact Analysis

The all-weather road will remain in place after decommissioning; however, road sections with culverts will be breached and the culverts removed to limit access. Stream banks will be stabilized by armouring with rip-rap or through re-vegetation to ensure that sedimentation issues from erosion do not occur. Impacts associated with the mine access road following mine closure will be negligible.

Several years prior to mine closure, above water beaches of NAG tailings (created by removing the remaining sulphides from the mill tailing in an additional stage of flotation already included in the mill flowsheet) will be placed upstream of the North and South tailings dams to push the water pond away from the dams at closure. Such beaches provide for increased stability of the dams at closure and, at the same time, ensure that exposed tailings will be non-acid generating. Seepage reduction afforded by an above-water tailings beach renders design and construction of the tailings dam less complex and less expensive.

Decommissioning of the tailings impoundment will include the construction of a spillway at the Northeast Dam. Water volumes released from this spillway will vary naturally according to local precipitation.

In summary potential impacts to fish and fish habitat during decommissioning activities of various facilities associated with the Red Chris Project include:

- Long-term discharge of tailings water from the Northeast Dam spillway may impact water quality within the wetlands and Unnamed Creek downstream of the Northeast Dam;
- Long-term discharge of tailings water from the Northeast Dam spillway will result in increased flows through the Unnamed Creek downstream of the Northeast Dam;
- Long-term discharge of tailings water from the Northeast Dam spillway will result in a minor reduction of flows in Quarry Creek during the post-closure period; and
- Mobilizing sediment by earth movement activities while capping exposed rock material in preparation of revegetation and removing culverts and stabilizing drainage structures.

Overall additional aquatic habitat loss during the post-closure period will be small to nil and thus not significant at local and regional scale.

In the post-closure period the hydrology impacts to Quarry Creek are reversed, moving close to the pre-development conditions. This change results from the cessation of further discharges into Quarry Creek. The tailings impoundment only removes 2% of the catchment area from Quarry Creek and is thus not significant at post closure. Similarly water quality within Quarry Creek returns to pre-development conditions in the post-closure period with the cessation of discharge of tailings impoundment supernatant.

In the post-closure period the construction of the permanent spillway to release the overflow from the tailings impoundment results in an increase in the mean annual discharge into the Unnamed Creek downstream of the Northeast Dam by approximately 157%. Water quality within the Unnamed Creek may be affected by this additional release of water, it is predicted that this release will have no significant impact on the Klappan River due to the high dilution ratios. The sum total of the annual releases from the tailings impoundment is approximately 10 million m^3 while the annual flow in the Klappan River is over 2 billion m^3, providing a dilution factor of approximately 200 to 1.

Apart from the above, no additional impacts on aquatic organisms and their habitat are expected from decommissioning the Red Chris Project site.

Monitoring and water treatment are the only activities scheduled for the post-closure phase. Monitoring requirements will be incorporated into the Environmental Management Plan and no impacts are expected to result on aquatic resources or habitat from post-closure monitoring activities.

Mitigation Measures

At closure the waste rock dumps will be capped with a 1 metre thick layer of till and vegetated to act as a store and release cover to minimize the amount of precipitation infiltrating into the underlying waste rock thereby slowing down the release rate of contaminants from within the North waste rock dump. All drainage from the North waste dump will be directed to the open pit.

RCDC is committed to the construction and long-term operation of a water treatment plant to treat the overflow from the open pit, including seepage from the waste rock dump. Contaminated water from the flooded open pit would be pumped from the pit on a seasonal basis and treated through the water treatment plant before being discharged to the tailings impoundment. Sludge from the treatment plant would be disposed of within either the tailings impoundment or the open pit.

Residual Impacts and Rating

Residual impacts affecting the aquatic environment following project closure includes loss of original habitat within the area occupied by the tailings impoundment to be replaced by new habitat created within the tailings impoundment, and change in water quality and flows associated with post-closure discharges from the northeast dam. Both impacts are moderate on a local basis and negligible in a regional context.

Impact Assessment Conclusions

Previous baseline studies have indicated that there are fish, rainbow trout, present within the lower reaches of Trail Creek, up to and including the proposed location of the South Dam and in Kluea Lake downstream of Trail Creek. The upper reaches of Trail Creek, including the small pond known as “Black Lake”, have been shown to be devoid of fish populations. The lower reaches of Quarry Creek have also been shown to support populations of rainbow trout but only up to about 3 km downstream of the North Dam. No fish species other than rainbow trout have been identified within Trail or Quarry Creeks, or any of the other streams immediately downstream of the project site.

The upper reaches of both Trail and Quarry Creek will be directly and indirectly affected by the proposed tailings impoundment, specifically by the construction of the North Dam and the North Dam seepage pond in Quarry Creek and the South Dam and the South Dam seepage pond in Trail Creek.

It is also known that the construction, operation and reclamation of the tailings impoundment will have impacts on the hydrology and water quality within Quarry Creek, Trail Creek and within the unnamed wetland and creek system downstream of the proposed Northeast Dam site. Diversion and impoundment of water within the proposed impoundment will affect flows within these systems to some extent. Assessment of these flow impacts suggest that they should not result in harm to aquatic life in the downstream sections Quarry Creek or the Klappan River. A reduction in the effective catchment area of Trail Creek will result in reduced flows and wetted width in the lower reaches of Trail Creek. This is not expected, however, to have a significant effect on Kluea Lake. Similarly water released from the impoundment either through direct controlled release of supernatant or through seepage losses is not predicted to result in water quality within Trail or Quarry Creek that is not protective of aquatic life (see water quality modeling in Section 4.2.4).

RCDC has commissioned additional fieldwork to be completed during the 2004 field season to assess, characterize and quantify fish habitat within the upper reaches of Quarry Creek, Trail Creek, and the unnamed wetland and creek system draining the valley downstream of the proposed tailings impoundment Northeast Dam site. At the same time opportunities for habitat compensation will be explored. The results of this work will be reported in the Fall of 2004 through an addendum to this application report. This data will be used to quantify habitat alteration, disruption and/or destruction associated with the proposed project development and will form the basis for discussions of a proposed habitat compensation plan to be developed in association with DFO and WLAP.

The impact assessment for Key Question # 1, which focussed on identifying residual impacts to fish habitat, indicated that a small amount of habitat located within the tailings impoundment area would be lost during construction of the tailings impoundment dams and subsequent addition of mine tailings.

The changes in hydrology resulting from the construction, operation and closure of the tailings impoundment will be result in a loss of much of the pre-development flow in Trail Creek as this catchment is essentially diverted into the tailings impoundment on a permanent basis at closure. Consequently the impacts to Trail Creek are rated as being significant due to the reduction in flows. The impact to flow out of Kluea Lake will be much less (a reduction of 14% to 16% from pre-development mean annual discharges) and is thus rated as not being significant. Water quality within Kluea Lake will consistently meet CCME Guidelines for the Protection of Freshwater Aquatic Life in the operational and post closure time periods and thus impacts related to water quality are rated as not significant.

The hydrology impacts to Quarry Creek during the operational period will result in an increase of 119% in the mean annual discharge from pre-development conditions. Water quality of the discharges from the tailings impoundment will consistently meet MMER and BC PCO discharge limits although levels in the Quarry Creek will be elevated for several parameters relative to CCME Guidelines for the Protection of Freshwater Aquatic Life. Consequently there may be impacts to fish habitat in Quarry Creek during the mine life associated with higher flows and poorer water quality. The impacts are rated as moderate within the upper reaches of Quarry Creek but minor to negligible at the Klappan River due to the high dilution volumes seen at the Klappan (>200 to 1). In the post-closure period both water quantity and quality within Quarry Creek will return to pre-development conditions as discharges from the tailings impoundment no longer enter Quarry Creek.

The hydrology impacts to the wetlands and the unnamed wetland and creek system downstream of the Northeast Dam will be small during the operational and post-closure time periods. The construction of the tailings impoundment reduces the catchment area of the unnamed Creek by approximately 8%. Water quality will not be impacted during the operational period. However in the post-closure period, the routing of tailings impoundment overflow through the permanent spillway at the Northeast Dam will increase the mean annual discharge in the unnamed wetland and creek system by 157% to 0.584 m^3/s. Water quality of the discharges from the tailings impoundment will consistently meet MMER and BC PCO limits and guidelines, although levels in the Unnamed Creek will be elevated for several parameters relative to CCME Guidelines for the Protection of Freshwater Aquatic Life will be exceeded. Consequently there may be impacts to fish habitat in the Unnamed Creek during the mine life associated with higher flows and poorer water quality. The impacts are rated as significant within the Unnamed Creek but not significant at the Klappan River due to the high dilution volumes seen at the Klappan (>200 to 1).

Residual impacts on fish abundance following a review of the impact assessment for Key Question # 3 were not identified during any phase of the Red Chris Project.