FISH PASSAGE

Problem: Fish passage, or migration, is often obstructed by improperly designed stream crossings such as culverts or by crossings that are not properly installed or maintained. Improperly designed, installed, or maintained culverts and bridges can create complete or partial barriers to fish passage when water velocity exceeds the capability of the fish to negotiate the width of the road crossing or if the water is too shallow. Perched culverts become physical barriers when the water drop at the outlet exceeds the jumping capability of fish.

How serious is the problem? Fish passage problems associated with inadequate design, installation, or maintenance of stream crossings, particularly culverts, has been widely documented. Examples include:

Study Area	Date	Crossings with passage problems
Labrador, Canada[1]	2005	53% with poor design or installation
Tongass National Forest[2]	2000	66% of culverts across salmon streams and 85% of culverts across trout streams were considered inadequate for fish passage
Mat-Su Valley, AK[3]	In prep	More than 44% of 130 culverts were deemed inadequate for fish passage; 10% were deemed adequate
Kenai Peninsula, AK[4]	In prep	Results indicated that 78% of 97 culverts were deemed inadequate for fish passage; 9%were deemed adequate
Near Tyonek, AK[5]	In prep	Results indicated that 83% of 29 culverts were deemed inadequate for fish passage; 3% were deemed adequate
Western Montana[6]	2005	76 to 85% of culverts were velocity barriers depending on streamflow and fish life stage
California, Washington, Oregon[7]	2000	Current salmon biomass in streams is 3 to 4% of historic biomass; much habitat loss is due, in part, to obstructed fish passage

NOTE: The studies reported here represent a sampling of many.

Why is this important? Fish evolved in the absence of man-made barriers so they were free to migrate throughout a drainage system. Adult fish migrate to spawning and feeding habitat and juvenile fish migrate to rearing and refuge habitats. Each stream has different characteristics than other streams and each population of fish in a particular steam is uniquely adapted to survive in that stream. Collectively, populations comprise a complete stock complex that sustains our valuable fisheries. If fish

Neither adult nor juvenile fish can negotiate this perched culvert.

passage among essential habitats is blocked, the population can suffer reduced production and reduced genetic diversity which can impair the ability of the stock complex to adapt to future changes[8]. In addition, when anadromous fish return, spawn, and die, their decomposing carcasses release nutrients to stimulate the food chain that provide food for rearing salmon and resident species as well as terrestrial animals and vegetation.[9]

A fish population cannot survive if individual fish within that population do not have free passage to different habitats.

Challenges:
- Stream crossings must be designed to accommodate at least 100-year floods and debris that may be transported by high water[10].
- Stream crossings must be designed to accommodate passage of all fish species of all sizes.
- Stream crossings must be installed according to the designs.
- Stream crossings require regular maintenance to prevent damming and washouts.
- Higher gradient streams (> 1%) present greater challenges for design and installation[11].
- Repair and retro-repair of stream crossings is more expensive than proper initial design, installation, and maintenance.
- Stream crossings designed and installed for today's environmental conditions may become inadequate if global climate change leads to more frequent storms and increased storm intensity.

What does this mean for the Pebble Project? A 104-mile access road will be constructed and maintained from the mine site to a deep-water port in Cook Inlet. Approximately one third of the distance crosses higher-gradient terrain. The road corridor will also serve as a corridor for an ore slurry pipeline and a waterline to return recycled water to the mine site. An electrical power transmission line will also be installed. The road may require as many as 120 stream crossings. These streams range in size from intermittent to the Newhalen River. After this road has been pioneered, the construction of connecting roads and spur roads will be inevitable. The construction and maintenance of these roads is highly likely to create serious issues that are not directly related to the Pebble Project, but will be indirectly caused by it.

Many support anadromous fish, most contain resident fish, and all contribute at least some of spawning, rearing, or refuge habitat. Poorly designed, installed, or maintained stream crossings will jeopardize full utilization of spawning, rearing and refuge habitats in these streams by fish.

What can be done? First, avoid the use of culverts. Use a well-designed bridge instead. Never the less, state**,** federal, and private entities understand that culverts will often be used and they have recognized the need and challenges of proper design and installation of stream crossings to assure adequate fish passage. The Alaska Department of Fish and Game has posted detailed information about fish passage and culverts in Alaska on the web page: http://www.sf.adfg.state.ak.us/SARR/Fishpassage/fishpass.cfm.

This culvert is undersized and the water velocity is too fast.

Another particularly useful source of information was developed by the U.S.D.A. Forest Service is available from: http://www.stream.fs.fed.us/fishxing/index.html. Other sources include:

Location	Year	Title
Alaska [12]	2000	Juvenile fish passage through culverts in Alaska: a field study
Alaska [13]	1991	Fundamentals of culvert design for passage of weak-swimming fish
State of Washington [14]	1997	Culvert hydraulics related to upstream juvenile salmon passage
British Columbia [15]	1979	Review and resolution of fish passage problems at culvert sites in British Columbia
State of Washington [16]	2003	Fish passage design at road culverts

NOTE: The studies reported here represent a sampling of many.

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Photos credit: Spawning salmon, Mike Wiedmer; Culverts, Alaska Department of Fish and Game.