Fish Passage Plan for Big Bar Landslide

Version 8-July-2019

Executive Summary

- This document outlines the proposed options to improve fish passage past the obstruction caused by the Big Bar Landslide. It also included how we will assess the effectiveness of actions taken to improve passage.
- This paper identifies the options deemed by experienced experts as having the greatest likelihood of success. These options are still being evaluated and the sequencing has not been determined.
- Expert advisors included geotechnical engineers, geomorphologists, civil engineers, rock scaling experts, First Nations on the technical committees and numerous fish experts. Many of the experts have worked on other significant slides impacting fish passage.
- Technical expertise included subject matter expert team from Fisheries and Oceans Canada, BC Ministry of Environment and Climate Change Adaptation, BC Ministry of Forests, Lands, Natural Resources and Rural Development, the Pacific Salmon Foundation, the Upper Fraser Fisheries Conservation Alliance, Northwest Hydraulic Consultants, GMS, and the Tsihlqotin First Nation.

Incident Background

A roughly 140m x 60m large section of a rock slope on the Western (River Right) side of the Fraser River collapsed into the river, creating an obstruction to fish passage. The slide most likely took place between October 26th and November 2nd 2018, but due to the remote and inaccessible location it was only noticed and reported on June 23rd 2019. The slide location is very remote and does not allow for the building of a road to the river, and large section of the bank within the area immediately below the slide are not safe to enter.

Objectives

The overall objective for this plan is lay out immediate steps to increase the passage for anadromous fish migrating upstream past the obstruction. A longer term plan will be developed subsequently.

Fish monitoring shows that some fish are passing through the obstruction but the percentage of fish are passing and whether the energetic costs will allow them to still successfully spawn remain unknown for fish significantly delayed in their migration.

The critical steps are to establish site access safety and to monitor fish passage success through the obstruction using hydro-acoustic monitoring. A natural fish passage may be established by carefully manipulating rocks into the flow along the western bank of the river to break up high velocities and large drops by creating a series of steps and pools. Additionally, fish transport options are being considered for fish passage while physical manipulation of the obstruction occurs. The effectiveness of the overall fish passage will be continuously evaluated through a monitoring program quantifying the number of fish passing through the obstruction, the length of delay at the obstruction, and their

bioenergetic condition after passing the obstruction. These results will inform any further actions required for fish passage.

Summary of options to improve fish passage

1. Continue to monitor how many fish are passing over the obstruction. Acoustic monitoring upstream and down stream from the obstruction along with hydrographic water flows from water survey gauge are being used to assist withthis monitor.
2. Explore options to remove or remediate the rock obstruction itself
    a. One consideration is to manually and strategically roll or push the fallen rock lying at river's edge into new positions to remove passage
    b. Add more rocks by placing concrete blocks or large boulders in the river at identified locations to improve fish passage
    c. Install a pre-fabricated temporary fishway
    d. Install block to form a fish ladder
3. Physically move fish above obstruction
    a. Trap and truck fish
    b. Trap and helicopter fish

Establishment of safe working site prior to improving fish passage

Rock scaling work to establish safe access to the base of the rock slope started on July the 5th. Rock scaling involves removing loose debris and rocks from the slope and at the interface between rock slope material that failed and the remaining slope sections. This interface is typically disturbed and prone to failure as the original rock slide has disturbed the slope, and removed lateral support of the remaining material. The height of the rock face is approximately 125m.

Typical rock scaling techniques following set up of safety systems and anchors include:

- Manual rock scaling with a pry bars (long steel bar) to remove debris. This step is also called a 'check scale' where the rocks that remain are checked with the bar. This process continues from the top of the slope to the base of the slope to reduce the rock fall hazard.
- Air bagging of larger rock masses where an rubberized air bag can be placed between rock joints and then inflated with compressed air and subsequently dislodge the rock. Air bags can be doubled up, or wooden blocks can be placed in the same rock structures to increase effectiveness (the air bags typically only inflate to about 20 cm from about 2 cm thickness).
- Trim blasting involves drilling holes into a rock mass with a hand-held pneumatic drill. Rock breaking products are placed in the holes, stemming material (sand and gravel mix) is placed above them, and once connected the product is initiated. The product can be conventional explosives (Nitroglycerin, or ANFO) or deflagrants like NxBurst which is approximate 1/20 the power of conventional explosives and non-toxic.
- Helicopter water bucketing to sluice material from the slope helps remove small loos rock debris.

The proposed plan is to remove all the loose material to permit safe work below the slope. As of July 7, 2019 the helicopter bucketing has been completed and rock scaling of the slope brow has commenced.

Establishment of Natural Fish Passage

A natural fish passage will be developed iteratively by creating a fish passage channel with the right combination of pools and drops along the west side of the river (river right) to allow anadromous fish to move past the obstruction. Initially boulders sitting at the base of the slope will be rolled in the river, or moved with the aid of air bags or pneumatic equipment in an attempt to modify the current flow pattern. If these rock movements are not sufficient to establish good fish passage then additional rock will be harvested from the slope above through drilling and breaking with the low velocity, non-toxic vibration charges (NxBurst product or similar). Based on the geotechnical assessment there is a safe and stable area of rock where rock can e harvested without the risk of triggering further slides. These boulders will then be modified at river level if required until good fish has been established. If the rock work is not enough to restore passage, a prefabricated fishway could be designed and installed to improve passage through the worst sections of the obstruction. All of these options will require an approach of repeatedly moving some materials, evaluating effectiveness and then making further modifications. This monitoring and adjusting can be expected to continue over much of the summer to ensure that lower water flows do not create new barriers to fish passage.

Fish transport options

Transport via pneumatic fish transportation system

The Whoosh is a fish transportation system that moves fish through two flexible pressurized tubes from below an obstruction to above. It operates by using air pressure in the tubes to move the fish from the bottom to the top of the obstruction. It has been successfully used to facilitate fish passage at several dams in the Columbia River System. Fish voluntarily swim into the system where they are scanned and moved into the appropriately sized tube which takes them past the obstruction. Fish are attracted to the system entry point by the flow of water.

Due to the topography and geology of the river bank, all equipment has to be flown in and be assembled on the river downstream of the obstruction. In order to setup and operate the system a 60x40ft 100,000 lb barge would be airlifted by a heavy lift helicopter in ten 10,000 lb pieces and then assembled in the back eddy of the river. An additional 7-10 lifts are needed for the equipment which will be set up on the barge. A generator fuelled by diesel is required on top of the west bank (150m high) to supply power to the unit and a power line will need to be fed down to the barge in addition to a fibre optic cable.

Two 500ft flexible tubes, a larger diameter one for chinook and a smaller diameter one for sockeye or steelhead need to be installed by anchoring them to the rock along the west bank cliff face. These tubes will transfer the fish past the obstruction.

The barge will be tethered to the river banks to maintain position while operating and will need to be adjust its location within the river flow to move to where fish will enter the system. Once set up the barge will operate autonomously with remote management through the supplier. According to the supplier the system is capable of transferring up to 25,000 fish per day, meaning over a 40 day

operational period it could move 1,000,000 fish across the obstruction. If lights are deployed in the area it may be possible to attract fish to move at night so we could increase this number (but this has not been discussed with the WHOOSH experts yet).

The supplier will conduct an assessment of the logistics of transporting and assembling the system in the location on the 8th of July, and based on current planning it would be assembled around July 27nd.

Based on the conclusion of the technical expert panel presents this system is the only option for fish transport in significant numbers. Key uncertainties are the logistics of in water assembly of the system due to the access issues, underwater topography could impact the barge movements to capture fish and there are serious human safety risks which must be reviewed and addressed.

Air transport of fish

A combination of catching fish 1km below the obstruction, with a subsequent air lift by helicopter has the ability to move limited number of fish above the obstruction. Fish will be collected via beach seining, preferably in combination with the fish monitoring program laid out below. The fish would be loaded in a fish tote and then air lifted by a medium lift helicopter from the capture site below the obstruction, to a site upstream where a second team would release the fish. This operation would have to operate during all day light hours in order to move as many fish as possible.

Truck transport of fish

This option is challenged by the lack of suitable roads to permit a 5 ton truck carrying water and fish to move from the collection site to a site upstream of the obstruction where the truck could safely deposit the fish into the river. Using existing roads the travel time for fish from collection to deposition is over 3 hours which can be expected to result in serious levels of mortality for adult spawning fish. Evaluation is underway to see if a new road of suitable construction could be built to reduce the travel time for fish. If this is possible, survival rates would be greatly increased. Collection of fish would be the same as for the helicopter option.

Monitoring of Fish Passage

Two hydroacoustic monitoring stations have been established, one on 40km upstream of the slide at Churn Creek (established 29-Jun-2019), one 1km downstream of the Big Bar Slide (established 4-Jul-2019). While these stations do not fully capture mid-stream migrating sockeye, they are effective to detect all chinook and those sockeye which are migrating closer to shore. These two stations provide some quantification of the number of fish migrating towards the obstruction, and the numbers passing the obstruction but does not quantify any migration delays caused by the obstruction. It should be noted that following record rainfall in an upstream watershed, both acoustic sites had to be removed to protect the equipment from significant debris washing down the river with the higher flood waters. This has disrupted all data collection until the river returns to normal.

A radio tagging program will be established to help quantify the migration time for individual fish of selected species, size and sex past through the obstruction, with a focus in Chinook salmon. The fish will be seined and tagged 1 km downstream of the obstruction and then monitored at several points further upstream, to not only assess the timing and success of migration immediately pass the obstruction, but it will also inform their success at reaching terminal spawning grounds.

At the same location PIT tags (Passive Integrated Transmitters) will be applied to sockeye salmon. Pit tags are small radio transponders with a specific code. There is no battery so they are small and less expensive than electronic monitoring tags. Scanners are deployed in areas where fish are expected to arrive and each PIT tag is detected as it passes the scanner. PIT tags can be quickly placed on a large number of fish who can be quickly released. This will allow tagging of a large number of sockeye below the obstruction. The large numbers tagged enable statistical calculations to be performed about the survival of the population in relation to the obstruction.

The bioenergetic status of the fish as they pass the obstruction will be assessed using non-destructive sampling upstream of the obstruction to evaluate if the fish passing the obstruction still have the energy reserves necessary to reach terminal spawning grounds. Blood samples will be taken to measure bioenergetics markers to determine stress and ability of the fish to complete their migration.

The annual terminal spawning program will provide further insight into the number of salmon reaching their spawning sites and will allow for an estimate of the overall impact of the fish obstruction.

The flow of water over the fish passage will be monitored visually, either by remote camera or UAV in regular intervals to detect any changes in flow patterns with changing water levels, which could reduce fish passage.

Review of Fish Passage Monitoring

The results of the monitoring methods described above will be provided daily to the Technical Specialists associated with the Environmental Unit for ongoing assessment of fish passage. This group will review the information and make a potential recommendations on required improvements, especially as water levels drop during the migration season.