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MEMORANDUM

December 13, 2018

To: Yarrow Ecovillage
Attn: Michael Hale

From: Mike Pearson PhD, RPBio

RE: Evidence regarding Impacts of proposed TMX expansion on Stewart Creek Salmon Habitat and Links to the Southern Resident Orcas

Purpose

The existing Transmountain pipeline crosses Stewart Creek on the Yarrow Ecovillage property and the proposed expansion project would see a second pipeline installed in the same right of way using open cut construction methods.

This memorandum summarizes:

- existing information about the Stewart Creek watershed, its fish community and habitat conditions at, and in the vicinity of, the pipeline crossing location
- the impacts of recent Transmountain construction at the Stewart Creek pipeline crossing
- the importance of salmon habitat in Stewart Creek and other small streams in the Fraser Valley to the endangered Southern Resident Orcas (*Orcinus orca*) .

The Stewart Creek Watershed

Stewart Creek (BC Watershed Code 100-065700-1510051500) flows from its origin on Vedder Mountain through the village of Yarrow and into the Sumas Drainage Canal (Figure 1). It was formerly a tributary of Sumas Lake, until it was drained in the 1920s (Stó:lō Nation 2001). Most of the creek's current length is channelized into roadside ditches, but the 3.5 km immediately downstream of Vedder Mountain, follows a fairly natural meander pattern and contains the best fish habitat in the watershed. Water quality (temperature, dissolved oxygen, pH), in this section of stream is excellent for salmonids (Pearson 2016).

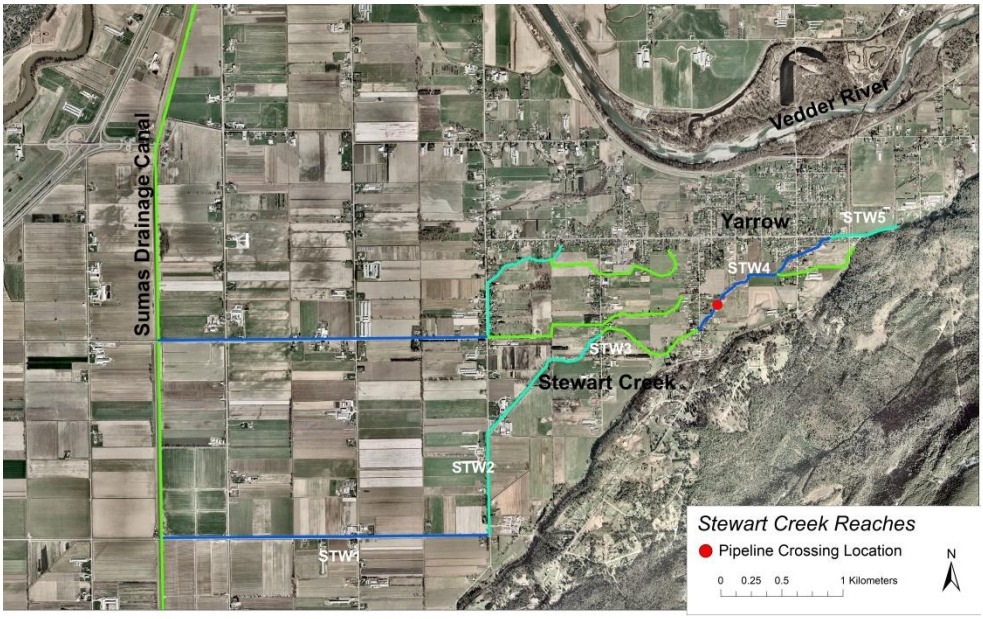

Figure 1: Reaches of Steward Creek and Location of the Pipeline Crossing.

Fish Community

Stewart Creek currently supports populations of Coho Salmon, Chum Salmon, Coastal Cutthroat Trout and Rainbow Trout in addition to a number of native and introduced non-game fish (Table 1). Pearson (2016) identified suitable salmonid spawning habitat at the Ecovillage and at a number of other locations in Stewart Creek. Although spawning populations of all four salmonid species listed are known to be present, there are no data on population sizes. Salmonid productivity would likely be increased by creating more off-channel habitat suitable for overwintering fish, particularly Coho Salmon and Cutthroat Trout. It was stocked with Cutthroat and Rainbow Trout in 1926, annually from 1938 to 1945, and in 1991 and 1995 (FISS 2018).

Table 1: Fish and Amphibian Species Known From Stewart Creek (FISS 2018, Pearson 2016).

Common Name	Scientific Name	Status
Rainbow	*Oncorhynchus mykiss*	Native
Coastal Cutthroat Trout	*Oncorhynchus clarkii*	Native, BC Blue-
Coho Salmon	*Oncorhynchus kisutch*	Native
Chum Salmon	*Oncorhynchus keta*	Native
Peamouth	*Mylocheilus caurinus*	Native
Brassy Minnow	*Hybognathus hankinsoni*	Native, BC Blue-
Redside Shiner	*Richardsonius balteatus*	Native
Northern Pikeminnow	*Ptychocheilus oregonensis*	Native
Prickly Sculpin	*Cottus asper*	Native
Threespine Stickleback	*Gasterosteus aculeatus*	Native
Lamprey	*Lampetra sp.*	Native
Pumpkinseed	*Lepomis gibbosus*	Introduced
Brown Bullhead	*Ameiurus nebulosus*	Introduced
Green Frog	*Lithobates clamitans*	Introduced

Habitat Conditions at Yarrow Ecovillage

The Ecovillage property is within the naturally meandering section of Stewart Creek (Reach STW4; Figure 1). The entire length of Stewart Creek through the Ecovillage property has been restored over the past decade, with major work completed in 2011 and 2012 (Figure 2). This work, which included placement of large woody debris in the channel and extensive plantings of native riparian trees and shrubs is maturing well and has greatly increased habitat complexity and shade in the reach. For the first time in decades the channel is sufficiently shaded that the City of Chilliwack has not needed to use excavators to clear the channel of invasive Reed Canary Grass (*Phalaris arundinacea*) to maintain drainage for a large segment of the creek on the Ecovillage's property.

In a 2016 fish survey of Stewart Creek, this section of stream had a higher catch per unit effort (average number of fish per trap) for Coho Salmon, Coastal Cutthroat Trout and Steelhead/Rainbow Trout than any other reach in the system (Pearson 2016).

Figure 2: Stewart Creek at Yarrow Ecovillage in 2010 (left) and in 2016 (right) showing extent of riparian plantings and reduction in invasive blackberry and reed canary grass infestations.

Impacts of Construction and Presence of the Pipeline Crossing

The existing pipeline crossing at Yarrow Ecovillage was re-excavated for an 'integrity dig' in August-September 2018, using an open cut method, presumably similar in nature to what is proposed for installation of the new pipeline. In an effort to protect the pipe, the streambed was lined completely with concrete blocks (Figure 3). The blocks were then covered with a layer of uniformly sized crushed gravel (approx. 2 cm grain size), an inappropriate choice for stream substrate. Riparian planting consisted of a narrow band (1-2 m wide) of native shrubs. It is unclear why plantings did not extend back 5 to 10 metres from the streambank, as is the case on the rest of the site.

If the intention of adding gravel was to provide spawning substrate, the effort was very misguided. The gravel has already been swept away by currents, leaving the tops of the concrete blocks exposed across the streambed. The work has degraded salmon habitat in several ways. The smooth hard bottom has no cover value, will produce support very few of the aquatic invertebrates that fish feed on, and will inhibit plant growth. It is work typical of a drainage engineering approach completely lacking in sensitivity to habitat values.

If hardening the bottom was required to protect the pipeline, it could easily have been done in a way that would enhance rather than degrade fish habitat using common methods. The most obvious way would have been to construct a spawning riffle using natural boulder, cobble and gravel. This is a standard method in stream habitat restoration (e.g. Newbury and Gaboury 1993, Slaney and Zaldokis 1997). Rows of boulders are partially embedded in the stream bed to provide a stable core to the riffle that prevents currents from washing away spawning gravel (round rock of a variety of sizes). Cobbles add to the complexity and are used to concentrate flows on the riffle surface to ease fish passage (Figure 5). Banks could have been easily stabilized with bioengineering approaches using willows. The Ecovillage stabilized a failing bank in a more difficult location upstream of the crossing site using just such a method in 2012.

It seems very strange that an organization with the vast resources required to build the Transmountain Pipeline Expansion is unable to complete a small stream crossing, in technically simple circumstances, using the most basic fish habitat mitigation and enhancement methods.

Figure 3: Stewart Creek at Transmountain Pipeline Crossing on December 12, 2018. The stream bed is completely lined with concrete blocks.

Importance of Small Fraser Valley Streams to Southern Resident Orcas

In the summer months Chinook Salmon comprise roughly 80 % Southern Resident Orca (SRO) diet in Juan de Fuca Strait and San Juan Islands areas, but Chum, Coho and Steelhead comprise an additional, and significant, 14 to 18% (National Marine Fisheries Service 2008, Hanson et al 2010). Very little is known of SRO diet between November and April when salmon are much less abundant in inshore waters (Fisheries and Oceans Canada 2018). This is especially true of K and L pods, which are absent from inshore waters during the winter. It seems likely that with widely dispersed prey, SRO would feed less selectively and that other salmonids may comprise a significantly greater proportion of the diet. The limited available data, in fact, suggest that SRO pod movements are correlated with Chum Salmon presence in addition to Chinook Salmon in late fall (Osborne 1999).

This key data gap is recognized in the recently posted Recovery Strategy (Fisheries and Oceans 2018). Its first recovery objective is to 'Ensure that Resident Killer Whales have an adequate and accessible food supply to allow recovery' and the first two strategies identified for achieving this objective are to 'Determine the seasonal and annual diet and energetic requirements of Resident Killer Whales' and to 'Identify key prey populations and feeding areas for Resident Killer Whales.

The majority of Coho Salmon and virtually all Chum Salmon from in the Fraser River watershed originate in the Fraser Valley, between Hope and Vancouver. Coho, in particular are small stream specialists. The population structure is one of many small runs, rather than few large ones. Over 90% of runs in the New Salmon Escapement Database record average escapements of less than 500 fish. Approximately 60 % have average recorded run sizes of less than 100 individuals (NuSEDS 2018). These estimates are conservative as many smaller creeks have very little or no data available. Chum salmon runs are somewhat larger, on average. Only 10 of approximately 140 watercourses have runs larger than 2500 spawners, with over half having run sizes of less than 200. Stewart Creek does not appear in the NuSEDS database, but it is highly likely that runs of Coho and Chum are less than 100 and 200 fish respectively.

Conclusion

In summary, Stewart Creek at the Yarrow Ecovillage is a recently restored, relatively productive salmon stream supporting populations of Coho, Chum, Cutthroat, and Rainbow/Steelhead trout. It is prime example of one of the many small Fraser Valley streams producing small runs of Coho and Chum salmon that collectively contribute significantly to the diet of Southern Resident Orcas.

Recent work on the existing pipeline crossing was completed with little regard for fish habitat and has degraded the site significantly. Use of simple standard fish habitat restoration methods could have enhanced habitat value at little or no additional cost.

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