MACLELLANS MOUNTAIN QUARRY EXPANSION PROJECT

ENVIRONMENTAL ASSESSMENT – *Additional Information*

PROPONENT

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Report Prepared by:
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WEEKS

March 21, 2019

Nova Scotia Environment
Environmental Assessment Branch
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PO Box 442
Halifax, NS B3J 2P8

Attention: **Candace Quinn**
Re: **MacLellans Mountain Quarry Expansion Project – Additional Information**

In response to a request from the Minister of Environment regarding the MacLellans Mountain Quarry Expansion Project (August 14, 2018), the following Additional Information is provided.

Sincerely,

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March 21, 2019

Nova Scotia Environment
Office of the Minister
PO Box 442
Halifax, Nova Scotia
B3J 2P8

Re: MacLellans Mountain Quarry Expansion Project – Environmental Assessment. Additional Information

1.0 INTRODUCTION

On August 14th, 2018 Nova Scotia Environment (NSE) issued an Additional Information Request to S.W Weeks Construction in relation to the MacLellans Mountain Quarry Expansion Project Environmental Assessment (EA).

The Additional Information Request included the following requests:

1) *Provide a hydrological assessment that includes the following:*
   a) *Analysis of flows and discharges under current and post-development conditions with considerations for seasonal variation and an assessment of impacts on the watercourses and wetland identified in the Registration Document resulting from this analysis. This analysis should include delineation of watersheds for current and post-development conditions, modelling of flows and discharges using information currently available and considerations for validation through monitoring;*
   b) *A plan to progressively monitor and update results; and*
   c) *Analysis signed off by a qualified Professional Engineer or Geoscientist.*

2) *Provide results of an electrofishing survey in the section of Watercourse 2 identified as Type IV Habitat (in the Registration Document) to determine the relative abundance of fish species and if salmonids are present.*

In order to meet the above requests S.W Weeks Construction engaged McCallum Environmental Ltd. (MEL) and GHD (*the Project Team*) to further analyse baseline hydrological and fish habitat conditions across the MacLellans Mountain Quarry Expansion Study Area and provide additional evaluation relating to potential effects as a result of the proposed expansion project. The purpose of this document is to:

1) Provide the methods and results of the additional baseline analysis completed (i.e. Fish and Fish Habitat and Hydrological Assessment); and
2) Based on the results of the additional baseline analysis, complete an Effects Assessment including:

a. Determination of potential effects to watercourses connected to the Project Study Area as a result of the quarry expansion project;
b. describe recommended mitigation;
c. identify expected residual effect (post mitigation) and its significance; and,
d. describe recommended follow-up and monitoring.

2.0 FISH AND FISH HABITAT

Prior to completing the hydrological assessment, the Project Team completed a supplemental detailed evaluation of potential fish habitat existing within the MacLellans Mountain Quarry Expansion Study Area (known as the Study Area). As well, fish habitat was also evaluated within water features directly draining from the Study Area in order to understand the potential indirect effects as a result of the proposed quarry expansion. The Local Assessment Area (LAA) for the fish habitat evaluation is indicated on Figure 1 (Appendix A).

The following sections provide the methods and results of the fish and fish habitat evaluation.

2.1 Methodology

Initially, a background review of potential fish species likely to be present within the region was completed. This information can be used to assist the evaluation of fish habitat within the water features present within the LAA.

For the purposes of the evaluation, the following five watercourses and the Quarry Discharge Channel were evaluated (Figure 1, attached):

- Watercourse 1 (WC1) – Draining from the northwestern extent of the Study Area into Stewart Brook;
- Watercourse 2 (WC2) – Draining through central portions of the Study Area from northeast to southwest;
- Watercourse 3 (WC3) – Draining into WC2 in the northern extent of the Study Area;
- Watercourse 4 (WC4) – Located south of the Study Area and receiving discharge water from the existing quarry;
- Stewart Brook – Located west of the Study Area and receiving water from WC1, WC2 and WC4; and,
- Quarry Discharge Channel – Extending from the current quarry boundary (via settling pond) and discharging into WC4.

On September 6th, 2018, the Proponent, Stephen Weeks (S.W Weeks Construction), Andy Walter (McCallum Environmental Ltd) and Water Resources Engineer, Andrew Betts (GHD) (i.e. the *Project Team*), met with NSE and Fisheries and Oceans Canada (FOC) representatives to discuss the MacLellan's Mountain Quarry Environmental Assessment Additional Information Request.

During the September 6th, 2018 meeting, additional information regarding the habitat within WC2 was provided, including the inability for electrofishing to be completed (due to lack of suitable water depths).

As a result, in October 2018 MEL biologists completed a qualitative fish habitat evaluation within WC2 (and the other water features listed above), to support the effects assessment to fish and fish habitat.

Table 1 (below) outlines the spatial extent of the fish habitat evaluation within each water feature evaluated:

Table 1: Fish Habitat Evaluation Extent

Water Feature	Evaluation Spatial Extent
Watercourse 1	Extent existing within Study Area
Watercourse 2	Full extent between Waypoint 26 and Waypoint 22 (see detailed methods below).
Watercourse 3	Extent existing within Study Area
Watercourse 4	Extent between its confluence with Stewart Brook and confluence with the Quarry Discharge Channel
Stewart Brook	From 200m downstream of the confluence with WC2 to 125m upstream of said confluence
Quarry Discharge Channel	Extent between the Quarry boundary and its confluence with WC4

As previously discussed, electrofishing wasn't possible in WC2 due to lack of suitable flowing watercourse depths. As determined in the Hydrological Assessment (Section 3), WC2 receives a portion of its water from adjacent lands located within the Study Area and is therefore susceptible to effects as a result of future quarry expansion. As such, MEL completed a detailed habitat evaluation along its entire extent within the Study Area including the compilation of a georeferenced photolog to support the habitat evaluation and effects assessment process.

2.2 Results

2.2.1 Background Review

The MacLellans Mountain Study Area lies within the East River Pictou (1DP-3) Secondary Watershed and the Forbes Lake Tertiary Watershed (IDP-3-HH) which discharges into the East River of Pictou located approximately 7.8km northwest of the Study Area. The East River of Pictou drains north into the Northumberland Strait within the Atlantic Ocean. The sizes of the secondary watershed and the tertiary watershed are 21,374 ha and 9,412 ha, respectively.

The East River of Pictou is an Atlantic Salmon (*Salmo salar*) river (Gaspe-Southern Gulf of St. Lawrence population; COSEWIC Special Concern; Atlantic Salmon Federation, 2018). Gaspe-Southern Gulf of St. Lawrence population is found in rivers from the Sud-Ouest River in Quebec to the rivers in the northern tip of Cape Breton, Nova Scotia (DFO, 2016a).

The tributaries being evaluated as part of the Watercourse Evaluation (i.e. Watercourses 1, 2, 3, 4 and Stewart Brook) drain to the East River which is a known Salmon Bearing river (Atlantic Salmon

Federation, 2017). According to the ACCDC report, Atlantic salmon (S1), Brook Trout (S3), and Alewife (S3) have been found within 5.8 km of the existing quarry.

Good salmonid spawning and rearing habitat contains moderate riffles, moderate current speeds, relatively shallow depths, and primarily gravel substrate, with riffles and pools (Sooley, Luiker, & Barnes, 1998).

Alewife are an anadromous fish and they spawn in freshwater lakes or slow-moving portions of rivers in late spring. They are found from the Gulf of St. Lawrence to North Carolina. In Atlantic Canada, Alewife are found mostly in larger rivers (DFO, 2016b). While Stewart Brook and its tributaries do not connect to lakes, it does drain into McLellans Brook, which has connection to lakes downstream. The watercourses present within the Study Area do not provide suitable spawning habitat for Alewife.

2.2.2 Water Feature Characteristics

Descriptions of fish habitat within each water feature evaluated is provided below.

Watercourse 1

Watercourse 1 is a headwater stream that intercepts water sourced from overland drainage and undeveloped forested land to the north of the existing quarry. The watercourse was dry at the time of assessment (August 2017), and exhibited a bankfull width of 1.5m, and bank height of 0.1-0.8m. Substrate in WC1 consists of pebble (20%), gravel (20%), rubble (20%), sand (20%) and small boulders (20%). Similar to other watercourses present within the Study Area, WC1 initiates on high land and acts as a conveyor of water during periods of high flow which gives rise to steep banks and a narrow ravine feature. Watercourse 1 drains westward beneath the MacLellans Mountain Glencoe Road and continues into Stewart Brook. From the MacLellans Mountain Glencoe Road WC1 inclines approximately 30m over a 250m extent, with a maximum slope of 22% and average slope of 12%. No barriers to fish passage were observed within WC1 within the Study Area (other than when water is not present and the steep slope present).

Watercourse 2

On August 24, 2018 and October 26, 2018 MEL biologists completed an extensive fisheries habitat evaluation along Watercourse 2 (WC2) (including within the LAA). This included the compilation of a geo-referenced photolog (Appendix B).

The following observations were recorded during the evaluation (note: waypoint numbers noted below refer to Figure 1 (Appendix A).

- Watercourse 2 conducts seasonal flow through a ravine that drains southwest through the Study Area. It drains into Stewart Brook which is approximately 68m lower in elevation from Waypoint 22 (upper reach of WC2).
- The channel of WC2 was predominantly dry during the August 24, 2018 evaluation with small, isolated pools observed along its step-pool profile. Water was present within the eastern extent of Wetland 1 through which WC2 drains and disperses. These observations are consistent with those

collected during high flow conditions in late-October 2017, and late May 2018, as part of the EA baseline data collection process.

- No fish access/habitat was observed upstream of Waypoint 18. From this point, the channel frequently drains subterranean, often comprising dense vegetation, and a lack of identifiable channel bed and bank. The lack of watercourse characteristics and flowing water inhibits the support of fish habitat within this reach.
- Within the EA document, habitat between Waypoint 1 through Waypoint 18 was assessed as containing Type IV fish habitat (no spawning or rearing, provides shelter and feeding habitat for larger, older salmonids). This fish habitat designation only applies when water is present to allow fish passage. Water depths observed during other periods of the year (i.e. late October 2017, late May 2018 and late October 2018) were observed to be very low and do not support the free passage of fish through the system, nor provide other habitat provisions for fish not mentioned above. Water flow is only expected in these extents of WC2 during periods of high flow (i.e. snow melt, spring freshet etc.). The exception to this is the open surface water observed within Wetland 1, and two isolated pools (Waypoints 4 and 5) that were observed to have sufficient water depth to support fish during periods when water flows.
- The reach of WC2 between Waypoints 23-25 also exhibited a dry channel in August 2018 comprising a substrate of pebble (30%), cobble (30%), rubble (20%, and small boulder (20%). Habitat type primarily consists of rapids (70%), with some small pools (20%) and fewer runs (10%). The edges of this tributary were very steep, within a narrow ravine with exposed soil at times, and eroded banks.
- In October 2018 (after periods of heavy rainfall), WC2 between Waypoints 25 and 26 exhibited flowing water (~10-30cm deep) draining at a rate of approximately 0.5m/s.
- The most pronounced incline exists between Waypoints 23 and 24 (~16%). This extent of the watercourse was observed to be dry during the August 2018 site visit;
- The presence of eroded banks, and exposed rock and boulder bed and the steep incline supports the notion that WC2 conveys water during periods of high flow (i.e. spring freshet and high flow conditions). During these periods WC2 is expected to flow at high velocities (notably at steeper sections).
- In addition to stream incline, the following barriers exist on the system which impede the free passage of fish:
- The lack of consistent water depth/flowing water (i.e. outside of periods of high flow), within and downstream of the Study Area;
- The existing Quarry Access Road Culvert (Waypoint 1), which lacks a plunge pool, and was observed to be hung 40cm from the downstream watercourse bed during August 2018;
- A debris pile located at the inflow of the MacLellans Mountain Glencoe Road culvert (Waypoint 25). The debris pile was made up of large woody debris and fine sediments.

<u>Watercourse 3</u>

As discussed in the EA, Watercourse 3 is an unmapped ephemeral watercourse and initiates from a small seepage in the hillslope within the Study Area. WC3 flows in a westerly direction into northern portions of WC2 but does not support habitat for fish due to a lack of consistent flowing water and watercourse characteristics. WC3 acts as a seasonal stream which collects surface water run-off from higher land to the east during periods of high flow.

Stewart Brook

Stewart Brook receives water from WC1, WC2 and WC4 and drains northward then west eventually draining into McLellans Brook. McLellans Brook drains into the East River of Pictou, which drains into the Northumberland Strait (Atlantic Ocean).

At the point of connection between WC2 and Stewart Brook, Stewart Brook was observed to comprise a 1.5-3.25m wide channel consisting of sand (30%), Gravel (30%), cobble (15%), Pebble (15%) and Rubble (10%), and water depths ranging between 8-70cm. Habitat type was primarily riffle (45%), followed by run (40%) and pool (15%).

Representative photos of Stewart Brook are provided on Page 8 of the Photolog (Appendix B).

Watercourse 4

Watercourse 4 receives water sourced from ditches, swales and a settling retention pond located on the MacLellans Mountain Quarry floor (see Figure 1, Appendix A), as well as from undeveloped land within its catchment located to the northeast of the MacLellans Mountain Quarry. At its point of confluence with the Quarry Discharge Channel, the wetted width of WC4 ranges between 2-3m, with a flow velocity of approximately 0.66m/s. Water depth was observed to range between 2-50cm and the substrate consists of pebble (30%), cobble (30%), rubble (20%, and small boulders (20%). Habitat type primarily consists of rapids (70%), with some pools (20%) and run habitat (10%). Watercourse 4 exhibits very steep banks giving rise to a narrow ravine feature with exposed soils.

Representative photos of WC4 are provided on Page 8 of the Photolog (Appendix B).

Quarry Discharge Channel

The Quarry Discharge Channel which drains water from the current MacLellans Quarry comprises a wetted width of 15cm, a depth of 0-10cm (October 2018) and an approximate speed of 0.2m/sec.

The substrate is primarily gravel and pebble (45% each) with some cobble (10%). Habitat type was observed to be 100% rapids, upon a steep slope (~28%). Water was observed seeping into the channel from the adjacent hillside. The Quarry Discharge Channel does not provide access for fish.

2.2.3 Fish Habitat

Based on the characteristics of the water features described above, the preferred habitat conditions for the Atlantic salmon, Alwife and Brook trout have been compared to the habitat present in WC1, WC2, WC4 and Stewart Brook.

These comparisons are provided in Table 2.

Table 2: Fish Habitat Characteristics

Life Cycle Period	Habitat Requirements	Habitat Provided in WC1?	Habitat Provided in WC2?	Habitat Provided in WC4?	Habitat Provided in Stewart Brook?
Atlantic Salmon[1]					
Migration	Runs, fast current, gravel/cobble bed, eddies, and in stream protection features (i.e. rocks).	**No**: WC1 is a small, headwater stream	**No**: not preferred habitat but passage possible during period of flow.	**No:** Lacks critical substrate and water flow characteristics.	**Moderate:** Comprises suitable substrate, but low water flow and lack of in-stream protection reduces spawning quality.
Juvenile/rearing			**No**: WC2 is a small, headwater stream, conditions not present.		
Overwintering	Deep, slow moving pools with sand or small gravel bottoms.	**Unlikely** – pools not deep enough, stream gradient too pronounced.	**Unlikely** – pools not deep enough, stream gradient too pronounced.	**No**: Lacks suitable substrate, lack of pools and stream gradient too pronounced.	**No**: Lack of pools and water depth.
Spawning/Nesting/Birth	Gravel beds, in shallow rapidly moving water (riffles) with rapids and pools. Water temperatures between 15-25 C in summer.	**No:** substrate composition, water flow, habitat type and steep incline do not provide critical habitat.	**No:** substrate composition, water flow, habitat type and steep incline do not provide critical habitat.	**No**: Lacks suitable substrate.	**Possible:** Suitable substrate present, but few rapids and pools. Water flow is slow. Preferred habitat not present.

Life Cycle Period	Habitat Requirements	Habitat Provided in WC1?	Habitat Provided in WC2?	Habitat Provided in WC4?	Habitat Provided in Stewart Brook?
Alewife[3]					
Migration	Spend most of lives at sea. Migrate upstream into small tributaries to spawn in slow moving water or ponds. Migrate downstream from spawning locations /to lower ends of tributaries.	**Yes:** Migration possible	**Yes:** Migration possible.	**Yes:** Migration possible	**Yes:** Migration possible
Juvenile/rearing	Most feeding occurs in brackish water. Alewife typically fast during migration to spawning sites [2]	**No**	**No**	**No**	**No**
Overwintering	Deep water, often offshore.	**No**	**No**	**No**	**No**
Spawning/nesting	Slow moving, shallow lakes and sluggish streams and ponds that form headwaters [3] Substrate comprising 75% silt or other soft material with detritus and vegetation.	**No:** Stream is ephemeral and comprises a steep gradient with fast water flow (when present). Lack of organic (detritus) substrate).	**No:** Stream is ephemeral and comprises a steep gradient with fast water flow (when present). Lack of organic (detritus) substrate). **Possible** spawning habitat is present within Wetland 1 (providing fish could access it during period of high flow).	**No:** Stream comprises a steep gradient with fast water flow and erosive (notably during high flow). Lack of organic (detritus) substrate).	**No:** Unsuitable substrate and water flow characteristics.

Life Cycle Period	Habitat Requirements	Habitat Provided in WC1?	Habitat Provided in WC2?	Habitat Provided in WC4?	Habitat Provided in Stewart Brook?
Brook Trout[4]					
Migration	Well oxygenated, cold, deep-water lakes and perennial streams. Closed canopy, and trees to protect channel from erosion.	**Possible**: Passage possible during period of flow.	**Possible**: Passage possible during period of flow.	**Yes:** Closed canopy present, and passage possible most of the year.	**Yes:** perennial stream with streamside trees.
Juvenile/rearing	Nursery habitat includes littoral and sublittoral zones in lakes and ponds, where submerged aquatic vegetation and macroalgal beds provide important nursery habitat. Juveniles rely on several different substrate and habitat types, including cobble and boulder stream bottoms, small undercut banks and pools	**Unlikely**: WC1 is a small, ephemeral stream that drains during high flow conditions only.	**Possible**: WC2 is a small, ephemeral stream that drains during high flow conditions only. **Possible** rearing/feeding habitat is present within Wetland 1 (providing fish could access it during period of high flow).	**Possible**: Undercut banks, cobble and boulder substrate and some small pools present. Lack of in stream vegetation.	**Possible:** Appropriate substrate present, but general lack of in-stream vegetation, undercut banks and presence of pools.
Overwintering	Pools beneath cover (overhanging vegetation, rocks, logs etc.) and close to point sources of groundwater discharge[3]. Undercut banks.	**Unlikely** – pools not deep enough, stream gradient too pronounced.	**Unlikely** – pools not deep enough, stream gradient too pronounced.	**Possible**: Some small pools and undercut banks in lower reaches; Wetland 1 provides potential overwintering habitat.	**No**: Shallow water and lack of deep pools, undercut banks and other in-stream features suitable for cover.
Spawning/nesting	Gravel substrate in lake or perennial stream. Groundwater upwellings and spring seeps.	**No:** substrate composition, water flow, habitat type and steep incline do not provide critical habitat.	**No:** substrate composition, water flow, habitat type and steep incline do not provide critical habitat.	**No**: Lacks suitable substrate	**Possible:** Suitable substrate present.

[1] References: Department of Fisheries and Oceans (2016), COSEWIC (2010) [2] References: Jordan and Evermann (1896-1900) [3] References: ASMFC (unknown date)

[4] References: Whitewater to Bluewater Partnership (unknown date), Cunjak and Power. 1986

2.2.4 Summary

In summary the following points are provided;

Watercourse 1

- WC1 presents seasonal water flow at periods of high flow and provides seasonal fish passage and rearing habitat. A lack of suitable spawning habitat however reduces the likelihood of fish accessing this stream.
- No spawning or overwintering habitat is present within WC1 within the Study Area.
- The feature drains on a moderate gradient (5%) and was observed to be dry during site observations in August 2018;
- No barriers to fish passage were observed within WC1 within the Study Area (other than when water is not present).

Watercourse 2

- Watercourse 2 provides seasonal surface water flow (i.e. during spring freshet and high flow conditions);
- Potential fish habitat (rearing and foraging habitat) is present in WC2, but only when water is present. No spawning or overwintering habitat is present in the watercourse, although Wetland 1 could provide potential spawning habitat for Alewife (providing water was present for the fish to gain access to it); and
- A steep incline is present in lower reaches (~16%) which may inhibit the passage of fish into upstream sections of the watercourse.

Watercourse 3

- Watercourse 3 is an ephemeral stream that drains into WC2; and,
- This feature does not provide fish habitat characteristics.

Stewart Brook

- Stewart Brook receives water from WC1, WC2 and WC4 and provides possible spawning, rearing and foraging habitat for fish; and,
- Stewart Brook drains into the East River of Pictou which is a known Atlantic Salmon (*Salmo salar*) river (Gaspe-Southern Gulf of St. Lawrence population; COSEWIC Special Concern (Atlantic Salmon Federation, 2018). Brook Trout (S3), Atlantic Salmon and Alewife (S3) have been found within 5.8 km of the existing quarry.

Watercourse 4

- Watercourse 4 intercepts water currently draining from the Quarry discharge Channel from the MacLellans Mountain Quarry;
- Watercourse 4 flows westward into Stewart Brook down a steep gradient (average gradient over 360m: 12-15%, maximum gradient: 21%); and,
- At its point of confluence with the Quarry Discharge Channel, the wetted width of WC4 ranges between 2-3m, with a flow velocity of approximately 0.66m/s;

- Water depth was observed to range between 2-50cm and the substrate consists of pebble (30%), cobble (30%), rubble (20%, and small boulders (20%). Habitat type primarily consists of rapids (70%), with some pools (20%) and run habitat (10%). Watercourse 4 exhibits very steep banks giving rise to a narrow ravine feature with exposed soils; and,
- Provides potential passage, rearing and foraging habitat for fish.

Quarry Discharge Channel

- The Quarry Discharge Channel drains surface water from the current quarry into WC4.
- The channel exists upon a steep slope (~28%) with 100% rapids.
- This feature provides no access (or habitat) for fish.

3.0 HYDROLOGICAL ASSESSMENT

The objective of the hydrological assessment is to determine the potential indirect impact of a change in water quantity during Development Areas (phases) A, B and C, on three receiving watercourses (WC1, WC2 and WC4). In addition, the potential effects on Wetland 1 and Stewart Brook have also been explored.

For the purposes of this assessment WC3 and the Quarry Discharge Channel are considered not fish habitat and are not evaluated.

3.1 Methodology

The following provides a summary of the methodology that has been implemented to assess the potential impact to streamflow (and fish habitat) on all four watercourses and Wetland 1. **This methodology has been designed by the Project Team understanding that fish passage and habitat provision within WC-1, WC2, WC4 and Wetland 1 is limited, and restricted to potential fish passage, rearing and foraging habitat during high flow conditions only.**

In support of the methodology discussed below, please refer to Figure 2 (Appendix A).

The hydrological assessment has been completed for the three Development Areas (phases of expansion) described in the original EA Registration document. Development Areas A and B constitute portions of the Study Area in which proposed quarrying activity will take place (i.e. vegetation removal, blasting and removal of aggregate material). Development Area C constitutes a combination of quarrying area and lands that could be utilized for other quarrying related activities but not blasting or aggregate removal (i.e. equipment storage, crushers, stockpiles, site access roads or site buildings). As such, quarrying activities (i.e. vegetation removal, blasting and removal of aggregate material) is proposed to occur over the following land areas:

- Development Area A: 3.8 ha over 1-20 years;
- Development Area B: 8.5 ha over 20-50 years; and
- Development Area C: 13.4 ha over 50 years onward

The following assessment utilizes the change in drainage area to assess the impact of change in water quantity to all of the receiving water features except Stewart Brook. This approach assumes that all water that falls within the quarry footprint will infiltrate or be lost from the system. Apart from one instance (WC4), this is a conservative approach and represents the worst-case scenario to assess the impacts of water loss to the receiving water bodies. Conversely, the proposed Project is predicted to increase water flow into WC4, hence infiltration lessens the potential effect in this case. However, due to the uncertainty and lack of measured data of infiltration rates for the quarry floor, three additional scenarios were modelled that represented surface water runoff rates of 5%, 10% and 20%. This was completed to provide a range of effects that may occur as a result of the proposed quarry expansion. As described in the detailed methods below, land use in the area equates to a runoff coefficient of 0.2 (20%) as per the Ontario Department of Transport Hydraulics Manual (2005). As such, the 20% infiltration rates utilized in the assessment are representative of natural runoff conditions (i.e. no quarry present). Stewart Brook receives water from WC1, WC2 and WC4, therefore a separate analysis was completed for Stewart Brook to determine the reduction of contributing area to it, based on all quarry development phases.

The following section provides details of the assessment completed:

1) A DEM of the Study Area was created based on source data obtained from the Nova Scotia Topographic Database (NSTDB). The topographic contour, spot elevation, and water feature data was inputted into the 'Topo to Raster' tool in ArcGIS which generated a DEM with a 1 m cell size.
2) Three (3) watersheds were identified based on three (3) tributaries to Stewart Brook that are within and adjacent to the Study Area (Figure 2, Appendix A). One (1) wetland was identified within these watersheds.
    a. The existing contributing drainage areas were field verified through site personal (mainly looking at the existing quarry/working area) and necessary adjustments were made to the watersheds.
    - Watershed 1 (WS-1) contributes to WC1 and is located to the northwest of the Development Area. Part of WC1 was GPS field delineated but is not a recorded feature in the NSTDB.
    - Watershed 2 (WS-2) contributes to WC2 and is located within the quarry footprint. Parts of WC2 were GPS field delineated, which closely followed a watercourse record in the NSTDB.
    - Watershed 4 (WS-4) contributes to WC4 and is located to the southeast of the Development Area. WC4 was partly field delineated, and a watercourse record is present in the NSTDB.
    - Wetland 1 (WL1) is located within WS-2 along WC2. WL1 is located to the north of the existing quarry pit area.
    - WC3 which branches at the headwaters of WC2 was GPS field delineated but is not a recorded feature in the NSTDB.
3) The existing drainage delineation was used to assess the potential change to three watersheds and one wetland from the proposed quarry expansion. Surface area was calculated for each watershed area during each development stage.

4) The Rational Method was applied to each watershed to determine the change in peak flow from existing conditions to each development condition.
    a. The rational method applies a runoff coefficient to a peak rainfall intensity for a given storm event across the watershed area to determine the peak flow rate expected during a given storm event. The rational method is applicable for small drainage areas (less than 300 ha). The rational method equation is represented as: Runoff Coefficient (C) x Area x Rainfall Intensity (i).
        i. A runoff coefficient was determined for each watershed depending on the land use, slope and infiltration characteristics of the watershed area. If the watershed was composed of multiple land uses a composite runoff coefficient based on area was determined.
            1. Land use in the area was either Hilly (slope >10%) Forested Land or active Quarry. The natural soils in the area are a part of the Hopewell formation. The runoff coefficient for Hilly Forested Land was taken to be 0.2 as per the Ontario Department of Transport Hydraulics Manual (2005).
            2. The runoff coefficient for the quarry area is estimated to be low due to significant infiltration however the exact value is unknown. Therefore, runoff coefficients of 0, 0.05, 0.1 and 0.2 (0%, 5%, 10% and 20% respectively) were applied to the quarry area to provide a comprehensive understanding of potential effects of development.
        ii. The peak rainfall intensity expected was determined through the use of Intensity Duration Frequency (IDF) curves for the near the Study Area. The 24-hr rainfall intensity for the 2, 5, 10, 25, 50 and 100-year storm events were used in this analysis.
            1. The rational method is inherently poor at estimating runoff from large storm events (greater than 10-year storm event). To account for this an adjustment coefficient was applied to the rainfall intensities for the 25, 50 and 100-year storm events of 1.1, 1.2 and 1.3 respectively.
5) A flow assessment was performed on WL1 based on discharge of Development Area C occurring below the wetland. This would involve discharge of water through natural land and into lower reaches of WC2. Therefore, all water within the proposed quarry area that currently drains into WL1 would be considered a loss.

Utilizing the methodology described above, the Hydrological Assessment evaluated the following potential effects to the water features:

- Predicted change in streamflow in WC1, WC2, WC4 and WL1 based on the changes to the drainage area associated with each phase of quarry development. Potential changes including increase or reduction of streamflow (based on catchment area loss, gains or land use changes). Note the 2-year design storm was used to determine the flow rate in each development condition however, since this analysis compared existing conditions to development conditions to determine a percent change in flow, the percentage will remain constant regardless of the design storm event used for analysis;

- The reduction of contributing area within the Stewart Brook Watershed based on all quarry development phases;

Using this information, the Project Team has completed a qualitative discussion of potential effects to the habitat and any potential fisheries resources within WC1, WC2, WC4, WL1 and Stewarts Brook as a result of quarry expansion across all quarry development phases.

3.2 Results

Results of the Hydrological Assessment are provided below by individual water feature. Input parameters to the Rational Method used during the Hydrological Assessment are provided in Appendix C.

Prediction of potential adverse environmental effects as a result of this analysis are discussed separately in Section 4.0.

3.2.1 Watercourse 1

Change in streamflow from WS-1 and its predicted effects to streamflow in WC1 is presented in Table 3.

Table 3: Rational Method Results for WC1

WC1 Flow Assessment	Area m2	% Runoff from Quarry	Flow m3/s	Percent Change (%)
Existing Conditions	429,895	0%	0.058	-
		5%	0.058	-
		10%	0.058	-
		20%	0.058	-
After Development of Area A	429,895	0%	0.058	0%
		5%	0.058	0%
		10%	0.058	0%
		20%	0.058	0%
After Development of Area B	429,895	0%	0.058	0%
		5%	0.058	0%
		10%	0.058	0%
		20%	0.058	0%
After Development of Area C	386,736	0%	0.052	-10%
		5%	0.052	-10%
		10%	0.052	-10%
		20%	0.052	-10%

As a result of WC1 being located and sourced water from WS-1 only, during quarry expansion Phase A and B (~50 years) there will be no changes to the contributing watershed to WC1. Therefore, it can be concluded there will be no impact to streamflow in WC1 during quarry expansion Phase A and B. During quarry expansion Phase C (50 years +) however, all surface water runoff will be drained through the future quarry area to its southern extent, where it will rejoin lower reaches of WC2, and as such, is considered a complete loss. As a result, there will be a reduction of approximately 10% of the peak flow rate in WC1.

3.2.2 Watercourse 2

Change in streamflow from WS-1 and WS-2, and its predicted effects to streamflow in WC2 is presented in Table 4.

Table 4: Rational Method Results for WC2

WC2 Flow Assessment	Area	% Runoff from Quarry	Flow	Percent Change
	m2		m3/s	(%)
Existing Conditions	513,838	0%	0.069	-
		5%	0.069	-
		10%	0.069	-
		20%	0.069	-
After Development of Area A	446,740	0%	0.060	-13%
		5%	0.060	-13%
		10%	0.060	-13%
		20%	0.060	-13%
After Development of Area B	373,949	0%	0.050	-27%
		5%	0.050	-27%
		10%	0.050	-27%
		20%	0.050	-27%
After Development of Area C	459,289	0%	0.050	-27%
		5%	0.053	-23%
		10%	0.056	-19%
		20%	0.062	-11%

WC2 receives its water from WS-1 and WS-2, therefore losses of drainage area from both watersheds has been considered in the following results.

During quarry expansion Phase A (~1-20 years) there will be a reduction of approximately 13% of the peak flow rate in WC2. During quarry expansion Phase B (~20-50 years) there will be a reduction of approximately 27% (inclusive of the 13% during Phase A), of the peak flow rate in WC2 from existing conditions. All surface water runoff associated with Development Areas A and B will either:

- drain through the current quarry area and into the Quarry Discharge Channel;
- drain via infiltration through the quarry floor; or,

- drain via a combination of both of the above.

Therefore, water effects are considered a complete loss to WC2 in these scenarios.

During quarry expansion Phase C (~50 years +) there will be no additional area removed from WC2. In fact, a portion (approximately 4.3 ha) of WS1 will be added to WC2. However, this additional area will be converted to open pit quarry floor and will have a high infiltration rate. Since the exact infiltration (and runoff coefficient) is unknown at this point, analysis was performed for 0%, 5%, 10% and 20% runoff from the quarry pit floor. This resulted in a range of reduction in peak flow rates entering to WC2 (27%, 23%, 19% and 11%) during the Development Area C phase.

3.2.3 Watercourse 4

Change in streamflow from WS-2 and WS-4, and its predicted effects to streamflow in WC4 is presented in Table 5.

Table 5: Rational Method Results for WC4

WC4 Flow Assessment	Area m2	% Runoff from Quarry	Flow m3/s	Percent Change (%)
Existing Conditions	1,761,027	0%	0.206	-
		5%	0.214	-
		10%	0.221	-
		20%	0.237	-
After Development of Area A	1,828,143	0%	0.206	0%
		5%	0.216	1%
		10%	0.226	2%
		20%	0.246	4%
After Development of Area B	1,900,953	0%	0.206	0%
		5%	0.218	2%
		10%	0.231	4%
		20%	0.255	8%
After Development of Area C	1,900,953	0%	0.206	0%
		5%	0.218	2%
		10%	0.231	4%
		20%	0.255	8%

During quarry expansion Phase A and B (~1-50 years) there will be additional watershed area added to WC4 (approximately 14 ha). As such, the changes noted in Table 5 <u>are gains in water to WC4</u>. During Development Phases A and B, this area will be converted to open pit quarry floor from within the WS-2 drainage area. Water will be sourced to WC4 via one of the following ways

- through the current quarry area and into the Quarry Discharge Channel;
- drain via infiltration through the quarry floor; or,
- drain via a combination of both of the above.

Therefore, the expected flow rates and percent change from baseline conditions presented in Table 5 outline the 0%, 5%, 10% and 20% runoff coefficients. At maximum, 8% of additional flow has been predicted in WC4 which is based on a 20% runoff coefficient (i.e. comparative to natural conditions and a worst-case scenario).

3.2.4 Wetland 1

Change in streamflow from WS-2, and its predicted effects to streamflow in WL1 is presented in Table 6.

Table 6: Wetland 1 Flow Assessment

Wetland 1 Flow Assessment	Area	% Runoff from Quarry	Flow	Percent Change
	m2		m3/s	(%)
Existing Conditions	389,679	0%	0.052	-
		5%	0.052	-
		10%	0.052	-
		20%	0.052	-
After Development of Area A	365,812	0%	0.049	-6%
		5%	0.049	-6%
		10%	0.049	-6%
		20%	0.049	-6%
After Development of Area B	294,646	0%	0.040	-24%
		5%	0.040	-24%
		10%	0.040	-24%
		20%	0.040	-24%
After Development of Area C (Discharge below Wetland)	241,110	0%	0.032	-38%
		5%	0.032	-38%
		10%	0.032	-38%
		20%	0.032	-38%

During quarry expansion there will be drainage area loss sourcing water to WL1 from within WS-2. This will result in less water being provided to WL1 and a decrease in stream flow leaving it as can be seen in Table 6. Calculation of water loss has been based on water not returning to the wetland (either by infiltration or as runoff).

Therefore, the maximum (and worse case) predicted loss of water being provided to WL1 over the maximum quarry development (i.e. 50 years +) is 38%. A discussion of the potential effect to the wetland as a result of this is provided in Sections 4.1 and 4.2.

3.2.5 Stewarts Brook

The determination of the reduction of contributing area to Stewart Brook was based on the following "worse case scenarios" as it relates to water loss:

- Calculations were made from the furthest downgradient aquatic contributor of water to Stewart Brook. For the purposes of this assessment, the confluence of WC1 and Stewart Brook was used; and,
- That all quarry development phases are considered a "complete loss" of water (i.e. no infiltration or direct runoff of water into Stewart Brook from within the Development Area);

Table 7 provides the reductions in contributing drainage area to Stewarts Brook under these scenarios:

Table 7: Stewart Brook Catchment Area Loss

Stewart Brook Watershed Scenario	Contributing Area (ha)	Percent Change (%)
Existing Watershed	382.42	0.0
After Development Phase A	378.65	1.0
After Development Phase B	370.16	3.2
After Development Phase C	356.33	6.8

Therefore, the maximum loss of contributing area (i.e. stream flow) to Stewarts Brook over Development Phases A, B and C of the quarry expansion is 6.8%. This predication is highly conservative as it assumes that none of the surface water accumulating across the development areas contributes to Stewarts Brook (either by infiltration or runoff via contributing watercourses).

4.0 EFFECTS ASSESSMENT

Based on the results of the baseline analysis completed in Sections 2 and 3, the following effects assessment has been completed to predict the environmental effects of the proposed quarry expansion and identifies measures to minimize and then mitigate potential adverse environmental effects.

For the purposes of this Additional Information Response, this process has been completed for Fish and Fish Habitat and Wetlands.

The thresholds for determination of significant adverse residual environmental effects for these components are defined in the Table 8.

Table 8. Component Threshold for Determination of Significance

Components	Threshold for Determination of Significance
Fish and Fish Habitat	An effect that is likely to cause serious harm to fish, as defined by the Government of Canada (1985, Section 2(1)): *"serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat," with fish habitat defined as "spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes."*
Wetlands	An effect to wetlands that is likely to cause an adverse change to the functional characteristics of the wetland and/or its downgradient aquatic receptors (i.e. watercourses, additional wetlands etc).

The following sections provide a description of potential residual effects once planned mitigation has been completed for the components listed in Table 8.

4.1 Fish and Fish Habitat

As discussed in the EA Registration document, with the exception of a potential future road crossing across WC2, no direct impacts to watercourses are planned during quarry expansion. Indirect impacts can include effects to water quality which has the potential to impact fish and fish habitat.

However, it is also acknowledged that as quarry development progresses the contributing watersheds (WS-1, WS-2 and WS-3) located within the Study Area will reduce in size, which corresponds with changes in water quantity entering the aquatic systems. It was determined within the Hydrological Assessment that the following aquatic features and fish habitat components could be affected:

- WC1;
- WC2;
- WC4; and,
- Stewart Brook.

A reduction in flow can reduce the availability of suitable fish habitat by altering the water characteristics (e.g. water temperature) and changing habitat types (e.g. runs or riffles). Furthermore, managing the local drainage of surface water flows across the landscape (i.e. through use of settling ponds) has the potential to alter natural flow regimes entering downstream aquatic resources. Quantifying potential effects as a result altered flow is challenging however; a literature review was completed by the Faculty of Environmental Sciences, Griffith University, Queensland, Australia in 2002 to identify potential threats to aquatic biodiversity as a result of altered flows (Bunn and Arthington 2002). The study identified four potential effects to aquatic biodiversity which can interrelate resulting in varying levels of effect. These include:

(i) Physical stream habitat effects (i.e. riffles, pools, substrate, vegetation cover), flooding, scouring, changes in velocity and frequency of flow, pulsing of flow etc;

(ii) Effects to aquatic species (i.e. changes in flow regime have the ability to alter aquatic species (i.e. recruitment, growth, and establishment of aquatic vegetation, and critical life cycle events for fish and insects including emergence and populations);

(iii) Changes in Longitudinal and Lateral Connectivity's (i.e. barriers for movement of aquatic life into adjacent floodplain wetlands should they become drier or wetter; and

(iv) Introduction of exotic and introduced species (i.e. modified flow could introduce invading fish and/or exotic plants.

As described in the Hydrological Effects Analysis (Section 3), WC1, WC2 and WC4 are predicted to experience the following effects to peak flow as a result of the proposed quarry expansion:

- WC1: 10.0% loss of peak flow (as a result of Development Area C);
- WC2:
  - A loss of 13% peak flow as a result of Development Area A;
  - A maximum loss of 27% peak flow as a result Development Areas A + B + C; and,
- WC4: A maximum **increase** of 8% peak flow as a result of Development Areas A + B + C

Based on a worse case scenario loss of contributing area to Stewart Brook, the predicted reduction in streamflow is 6.8%. This is a highly conservative prediction of cumulative loss calculated at the confluence of Stewarts Brook and WC1.

For the purposes of evaluating potential effect to fish and fish habitat as a result of stream flow losses as a result of expanding the MacLellans Mountain Quarry, a comparison was made between predicted losses within each watershed and the Ecological Maintenance Flow (EMF).

Ecological Maintenance Flow (EMF) is defined as:

The flow regimes and water levels required to maintain the ecological functions that sustain fisheries associated with that water body and its habitat. (NSE 2016)

The EMF requirement is determined to be a reduction of <25% of the median flow during the seasons that the predicted loss (due to catchment loss) is taking place (NSE 2016).

As discussed in Section 3.2, modeled losses are within the requirements as determined by EMF for WC1, WC4 and Stewarts Brook and all will occur gradually over the lifespan (50 years plus) of the expansion. A loss of water to the aquatic system has the potential to cause effects to fish and fish habitat such as those listed by Bunn and Arthington (2002). One watercourse marginally exceeds EMF (27% in WC2), indicating the ecological functions required to sustain fish utilizing WC2 could be affected as a result of altered flow regime. By way of an example, as a result of a diminished drainage area associated with the quarry expansion, low flow sections of WC2 that currently present limited water depths could run dry during the summer months. This could limit fish passage for a longer duration of the year. However, in the case of WC2 it is also important to note that due to the barriers present for fish to access the watercourse, and the limited fish habitat present within it (i.e. rearing and foraging habitat), the potential changes to ecological functions that sustain fisheries is less significant.

Effects to fish and fish habitat present within WL1 is discussed separately in Section 4.2.

4.1.1 Mitigation

Much of the surface water at the MacLellans Mountain Quarry seeps into underlying fractured bedrock upon the quarry floor. As described in the EA a series of rock lined drainage ditches and underground pipes direct water from northern portions of the quarry into a series of two settling ponds which are present in southern, central portions of the existing quarry area. In addition, berms are present alongside the northwestern extent of the existing quarry, which directs all water flow southeastward (away form the mapped watercourse and wetland) towards and into the settling ponds. Existing settling ponds are rock lined and consist of deeper sections and small berms to detain water flow and enable sediment deposition. Water drains from the settling ponds via the Quarry Discharge Channel to the southwest, beyond the Study Area boundary, and into WC4.

During Development A and B, surface water (which persists post quarry floor infiltration) will continue to be directed southward through the existing quarry which will increase in surface water runoff entering the settling pond. Therefore, the capacity of the settling ponds will be increased as per engineered specifications and NSE IA requirements as the quarry expands. Additionally, this system will be designed to ensure that discharge rates and water quantities are protective of the receiving environment (i.e. offsite WC4 and eventually Stewarts Brook). This will involve the settling ponds to be designed to accommodate 1:20 year flows. Similarly, should quarry expansion occur in Development Area C, a settling pond and water management structures (i.e. ditches, pipes etc), will facilitate the drainage of water to the southern extent of Development Area C, likely discharging into the natural environment prior to rejoining lower reaches of WC2. Based on this premise, some of the water lost from WC2 is expected to be returned to WC2, downstream from WL1 either via surface water runoff or infiltration. Since the exact infiltration (and runoff coefficient) is unknown at this point, analysis was performed for 0%, 5%, 10% and 20% runoff from the quarry pit floor. This analysis predicts that the loss of peak flow into WC2 could reduce to as low as 11% during the Development Area C phase (in comparison to the predicted 27% loss as a result of Development Areas A and B).

4.1.2 Monitoring

A surface water monitoring plan will be designed for the MacLellans Mountain Quarry in line with IA requirements. The plan will encompass the methods and implementation schedule associated with gathering water quality data to ensure potential contaminants are not present in surface waters discharging from the site (i.e. sedimentation, metals or other deleterious substances). Water quality sampling will occur at quarry discharge points including the Quarry Outflow Channel (i.e. at settling pond discharge locations) and within watercourses discussed in this document.

Prevention measures will also be employed such as implementation of erosion and sediment control systems which will be monitored regularly to ensure they are in working order and effectively managing site run off. An Environmental Protection Plan (EPP) will be developed for the Project outlining the monitoring and mitigation methods to be employed for the Project.

As described in this document, water quantity is predicted to be reduced within receiving water features draining from the Study Area; however, apart from WC2 (27% loss), none of these effects are predicted to exceed <25% of the median flow during all seasons (i.e. EMF). Furthermore, the larger predicted losses of peak flow are not expected to be reached until the end of Development Area B (~ 50 years). As a result of its predicted reduced peak flow, it is recommended that baseline flow data is collected during 2019 within lower reaches of WC2, prior to its discharge into Stewarts Brook. Data will be collected in WC2 to support the development of a Stage Discharge Curve from which future water levels can be compared to. The predicted 27% reduction in peak flow in WC2 is not expected to be seen until the end of Development Area B (i.e. 50 years). Therefore, future monitoring within WC2 can be designed to be initiated at an appropriate time during quarry expansion. This timeline can be determined through the IA process and during development of the surface water monitoring plan.

4.1.3 Residual Effects and Significance

The predicted residual environmental effects of the Project on fish and fish habitat are assessed to be adverse, but not significant, after mitigation measures have been implemented. This is based on the following factors:

- The EMF being maintained in all downstream connected watercourses evaluated (apart from WC2) and subsequent expectation that serious harm to fish will not occur;
- The predicted peak flow loss of 27% in WC2 will be gradual with quarry expansion, and current fish access and habitat is considered poor. Therefore, serious harm to fish and fish habitat is not expected;
- The protective mitigation measures and monitoring commitments discussed in this document will ensure water quality discharging from the Study Area does not impact downstream fish and fish habitat quality.

4.2 Wetlands

As discussed in the EA, no direct impacts to wetlands are occurring as a result of quarry expansion. However, the activity does have potential to cause indirect effects.

Wetland 1 is a basin shrub swamp, 0.72ha in size, and exists in the bottom of a small ravine comprising a steep topographical rise at its eastern and western boundaries. A representative photo of WL1 is provided in (Appendix B). Water is sourced to WL1 via upper reaches of WC2 and surface water from surrounding higher land. However, due to its landscape position, presence of the outflow channel and evidence of iron staining upon surface water, it is also anticipated that WL1 receives a source of water from groundwater discharge. Groundwater discharge maintains high water tables and wetland habitat, whereas recharge sites replenish aquifers (Siegela, 1988). The existing quarry area abuts the southern boundary of the wetland, and land slopes away, down gradient from the wetland into the quarry area (i.e. quarry floor is lower in elevation than wetland). A high-water table and saturation at surface were present across the majority of the wetland, however surface water exists at an average depth of 30cm covering approximately 15% of the wetland area. This occurs at the location of the quarry boundary were water was observed to accumulate. Within the standing water portion of WL1 fish habitat is present but limited. Of the species evaluated in Section 2.2.3, potential for Alewife spawning habitat has potentially present (i.e. migrate upstream into small tributaries to spawn in slow moving water or ponds, shallow lakes and sluggish streams that form headwaters, substrate comprising 75% silt or other soft material with detritus and vegetation) (ASMFC, unknown date).

Although direct impact to Wetland 1 is not proposed as part of the quarry expansion, the Hydrological Assessment has determined that during quarry expansion there will be drainage area loss sourcing water to WL1 from within WS-2. This loss equates to a conservative maximum value of 38% reduction of peak flow to WL1 over the lifetime of the quarry (50 years plus). Only a 6% predicted peak flow loss is expected during Development Area A (1-20 years). These calculations do not account for water discharged into WL1 via groundwater.

Effects to wetlands as a result of this loss of water can vary by wetland type and its characteristics. Some wetlands are more resilient to seasonal hydrological conditions and water level fluctuations than others. Since quarrying is expected over such a long-time frame, the hydrological system may adapt concurrent to the quarry expansion phases. As it relates to confirming indirect alteration to WL1, it must be evident that the functional characteristics have been altered, which is typically determined through evaluating changes in hydrological, soil and/or vegetative conditions. If wetlands become dryer, organic soils can subside (Tiner, 2005) and plants may become stressed. Most plants, however, can survive dry conditions and reproduce under altered hydrologic conditions (Tiner, 2005).

Based on the characteristics of WL1 it is predicted that a reduction of 38% peak flow could alter the hydrological conditions of the wetland, although this is likely to be seen more so in the saturated areas, which do not comprise standing water.

WL1 comprises an outflow channel (i.e. WC2), and the rate and frequency of water discharge from WL1 is managed by the elevation of the channel bed at this location (i.e. the weir height elevation). The weir height elevation will not change; therefore, water inundation is still expected to occur at the same locations within WL1, albeit due to the reduced inflow, this may take a longer duration to occur in drier periods. By way of an example, inundation will be consistent throughout most of the year, but discharge flow from WL1 into WC2 is likely to be reduced (as a result of reduced inflow into WL1). During the drier low flow months, it is possible standing water depths could be reduced, or even diminish completely as a result of evaporation (evapotranspiration in plants), however, water that does enter WL1 will continue to be stored (and inundate) until it discharges into WC2.

As it relates to fish, fish access to the wetland could become more problematic as WC2 experiences less flow and connectivity to WL1. However, for resident fish that may be present in WL1 (or fish that do access it from WC2), a reduction or elimination of standing water during low flow periods would adversely impact habitat provision for fish during this period. Should groundwater discharge continue to occur within WL1, hydrological effects such as that described above would be less prominent, and subsequent impacts to fish habitat less significant.

The remainder of WL1 which exhibits saturated surfaces and a lack of standing water are more likely to see an impact to hydrological conditions as a result of the quarry expansion and reduced water inflows. This is likely to occur in drier, low flow periods of the year when evaporation levels are higher. The typical indicator of such a change is a shift in vegetative composition within the wetland, whereby shrubs and woodier species tend to out compete hydrophytic graminoid species which prefer wetter conditions. Impacts to the saturated portion of WL1 will not impact fish or fish habitat due to its lack of quality fish access and habitat currently present.

4.2.2 Monitoring

A surface water monitoring plan for the MacLellans Mountain Quarry will be implemented in line with IA requirements, and to ensure discharge from the Study Area meets regulatory requirements. Additionally, mitigation methods including sediment and erosion control will protect WL1 from potential water quality issues.

The conservative predicted loss of water entering WL1 during the first 20 years of quarry expansion only 6%. It is therefore recommended that baseline hydrological and vegetative monitoring is collected during 2019, but future comparative monitoring is not necessary to start until Development Area B is initiated (i.e. 20-50 years). The baseline, and future monitoring data can be compared during quarry expansion (20 years +) to determine if alteration of wetland function has occurred, and if possible, form a conclusion relating to the predicted reduction of water inflow discussed in this document. The monitoring timeline and implementation plan can be further defined through the IA process.

Should monitoring results indicate that wetland function has been altered, the Proponent will obtain a provincial wetland alteration permit, which would require a commitment to compensate for the loss of wetland habitat.

4.2.3 Residual Effects and Significance

The predicted residual environmental effects of the Project on WL1 are assessed to be adverse, but not significant, after mitigation measures have been implemented; should it be determined in the future that quarry expansion has altered the functions and characteristics of WL1, then a provincial alteration permit will be obtained from NSE. In this scenario, no significant residual environmental effect is expected to watershed health (water quality or quantity) nor within downgradient aquatic receptors.

5.0 CONCLUSION

This document has been completed in response to the Additional Information Request issued by NSE on August 14th, 2018 in association with the MacLellan's Mountain Quarry expansion EA registration document.

The Project Team completed additional baseline analysis to evaluate Fish and Fish Habitat within watercourses draining from the MacLellans Mountain Quarry Expansion Development Area and completed a Hydrological Assessment. Based on this information, an evaluation of potential effects to watercourses and Wetland 1 (and associated fish habitat) as a result of the quarry expansion was completed. This document discusses mitigation, expected residual effects and recommended follow up monitoring measures.

The evaluations completed suggest that although a loss (or gain in one case) of peak flow is expected in the water features connected to the quarry expansion Development Area, the higher proportions of water loss or gain are not expected until after Study Area B has been quarried (i.e. 50 years). These circumstances are not expected to lead to serious harm to fish. Baseline flow monitoring within the water feature predicted to experience the greatest loss of flow (WC2) is proposed to take place in 2019. Similarly, baseline monitoring is proposed in WL1 during 2019 to examine its characteristics prior to the expansion. Future monitoring and comparison of conditions can take place when the quarry expansion is likely to start having an effect on these features. A detailed surface water monitoring plan can be developed for the MacLellans Mountain Quarry Expansion Project and will provide NSE additional design and implementation timelines for these monitoring programs.

We look forward to your attention to this Additional Information Request response.

Please don't hesitate to contact the undersigned with any questions you might have.

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