COUGAR CREEK
DEBRIS FLOOD RETENTION STRUCTURE

Supplemental Information Request Round 3
Water Act File No. 00384210
NRCB Application No. 1601

SUBMITTED TO:
Alberta Environment and Parks
and Natural Resources Conservation Board

SUBMITTED BY:
Town of Canmore

March 2018

TABLE OF CONTENTS

FIGURES

TABLE OF ABBREVIATIONS

AEP	Alberta Environment and Parks
BOS	Bottom Outlet Structure
CFD	Computational Fluid Dynamics
EIA	Environmental Impact Assessment
NRCB	Natural Resources Conservation Board
SIR	Supplemental Information Requests

1 INTRODUCTION

The Town of Canmore submitted an environmental impact assessment (EIA) report and Natural Resources Conservation Board (NRCB) application summary for the Cougar Creek Debris Flood Retention Structure (the Structure) and Access Road (together, the Project) in July 2016 (NRCB Application No. 1601). The Town of Canmore has also submitted a *Water Act* application to the Dam Safety division of Alberta Environment and Parks (AEP) to obtain authorization to construct and operate the Project (*Water Act* File No. 00384210).

The Town of Canmore received the first round of supplemental information requests (SIRs) from AEP and the NRCB in December 2016 and responded in June 2017. A second round of SIRs was received from AEP on October 2, 2017. The Town of Canmore provided responses in December 2017.

A third round of SIRs was received from AEP on March 7, 2018. Responses to these SIRs are provided in this submission of March 2018.

2 HYDROLOGY / AQUATIC ENVIRONMENT

1	**Project Update, Section 1, Page 1** The Project Update report describes that the Diversion Tunnel option will be included in the final project design for Flow Control. In the report the Town of Canmore states *Both of these options were described in Section 4.4 of the EIA report and were included in the assessment.* Section 4.4.4.3 (Page 4-25) of the EIA report describes the Flow Control options. However, the maximum design discharge from the Diversion Tunnel outlet at full impoundment, details on inlet and outlet erosion and scour protection are not mentioned in the EIA report for Diversion Tunnel option. a. Provide the maximum design discharge from the Diversion Tunnel outlet at full impoundment. b. Provide a description of the inlet and outlet structures for this option. c. Explain if there is any Debris Rake designed for the Diversion Tunnel inlet. If not, explain how the debris will be captured. d. Explain if any modelling and analysis were done for the Diversion Tunnel option to understand the bank erosion and bed scour potential at and around the tunnel inlet and outlet. e. Explain if there is any bank erosion protection and bed scour protection designed for the tunnel inlet and outlet locations.

Response:

a. The maximum design discharge of the Diversion Tunnel outlet at full impoundment is the same as for the Bottom Outlet Structure (BOS) at 45 m^3/s.

b. The tunnel inlet structure is the same as for the BOS, except for the following:

- The structure is rotated at approximately 45 degrees to the main channel axis to provide an appropriate tunnel entry angle into the rock wall.
- The intake diversion walls are configured differently to account for the rotation of the inlet. They extend from the intake and tie into the rock walls at different angles compared to the BOS option. However, their height and construction techniques remain the same.

The tunnel outlet structure is quite different than the BOS outlet. The outlet structure of the BOS was within the stilling basin, providing the required energy dissipation. The outlet structure of the tunnel is now separate from the stilling basin and requires its own energy dissipator. The outlet design is based on the United States Bureau of Reclamation stilling basin for pipe or open channel outlets (Basin VI) shown in Figure 1 (USBR 1984). It has been modified to account for high amounts of gravel transport and clean-out requirements. At regular low flow, minimal energy dissipation occurs and gravel discharge is prioritized. However, at higher flows, the two rows of removable horizontal baffles provides the energy dissipation required. Extensive computational fluid dynamics (CFD) modelling has been performed on the structure to optimize it and ensure that it meets the required discharge performance. A new physical scale modelling is being conducted by Northwest Hydraulic Consultants that focuses on the study and optimization of the spillway, stilling basin, and tunnel outlet.

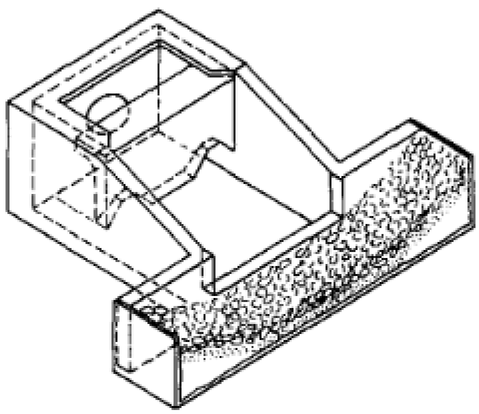

Figure 1-1 United States Bureau of Reclamation Stilling Basin

c. There is a Debris Rake at the tunnel inlet. The design is the same as for the BOS.

d. Extensive CFD modelling has been conducted at the inlet and outlet of the tunnel to understand the geomorphic processes. Moreover, physical scale modelling was conducted in 2015 for the tunnel inlet and potential for hyper-elevation in the tunnel. The outlet structure was not modelled in 2015. However, a new physical scale modelling is being conducted by Northwest Hydraulic Consultants that focuses on the study and optimization of the spillway, stilling basin and tunnel outlet, including scouring and erosion around all water control structures.

e. Bank protection at the inlet consists of the intake diversion walls. They are robust enough to sustain all expected flows and their foundations extend deeply into the alluvium to prevent erosion around the inlet. At the outlet, the foundation of the concrete structure sits directly on bedrock. The rock will be scaled prior to construction and grouting will be used to improve the quality of the rock near the outlet structure. No further bank protection is required as the energy dissipator will prevent damaging erosion and scouring.

References:

United States Bureau of Reclamation (USBR). 1984. *Hydraulic Design of Stilling Basins and Energy Dissipators, Engineering Monograph No. 25, Section 6.* Denver, Colorado.

2	**Project Update, Section 1.1, Page 1.** Town of Canmore states *Water will exit the structure with a different orientation than with the bottom outlet structure but the orientation does not change the results of the hydrological or hydrogeological assessment.* a. Explain whether during normal weather conditions water and sediment will flow unimpeded through the Diversion Tunnel as mentioned in Article 4.1.2 (Page 4-2) of the EIA report as an original intend of the structure. b. Explain how it will be ensured that creek flow will flow unimpeded from natural channel to the Diversion Tunnel inlet. c. If the creek flow does not flow unimpeded, for how long it will be stored behind the dam during normal weather condition and how it will be diverted to the inlet.

Response:

a. During normal weather conditions, water and sediment will flow unimpeded through the tunnel. As per response 1.d) above, extensive CFD modelling and physical scale modelling have been conducted to ensure that during normal operations, the flow of water and sediment is unimpeded.

b. All modelling results show that the flow will be unimpeded up to the 1 in 30 year return period event, the same threshold discussed in the EIA (Section 6.2.1): “The Structure is designed to operate in such a way that minimum and average flows can pass under normal streamflow conditions. While some water retention is expected up to the 1 in 30 year return period flow due to backwater effects by the Structure, impacts of the Structure on peak flows with return periods lower than 1 in 30 year return period event are anticipated to be minimal.”

c. The creek will flow unimpeded.