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Canadian Consulting Engineering Awards 2019
Project: Detour Lake Mine – Karel Creek Flow Loss Mitigation Project
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1.0 Full Project Description

The Detour Lake Mine is an operating open pit gold mine located approximately 185 km by road north of the city of Cochrane, in northeastern Ontario (Figure 1). The mine required a solution to reduce mine dewatering flow losses to a cold water Brook Trout stream. Wood engineered a channel realignment and isolation barrier to mitigate impacts to both the creek and mine operations. The design included natural channel design principles where practical, and synthetic barrier solutions where there were limited or fixed infrastructure relocation options. The channel design included enhanced habitat features to benefit the resident trout population.

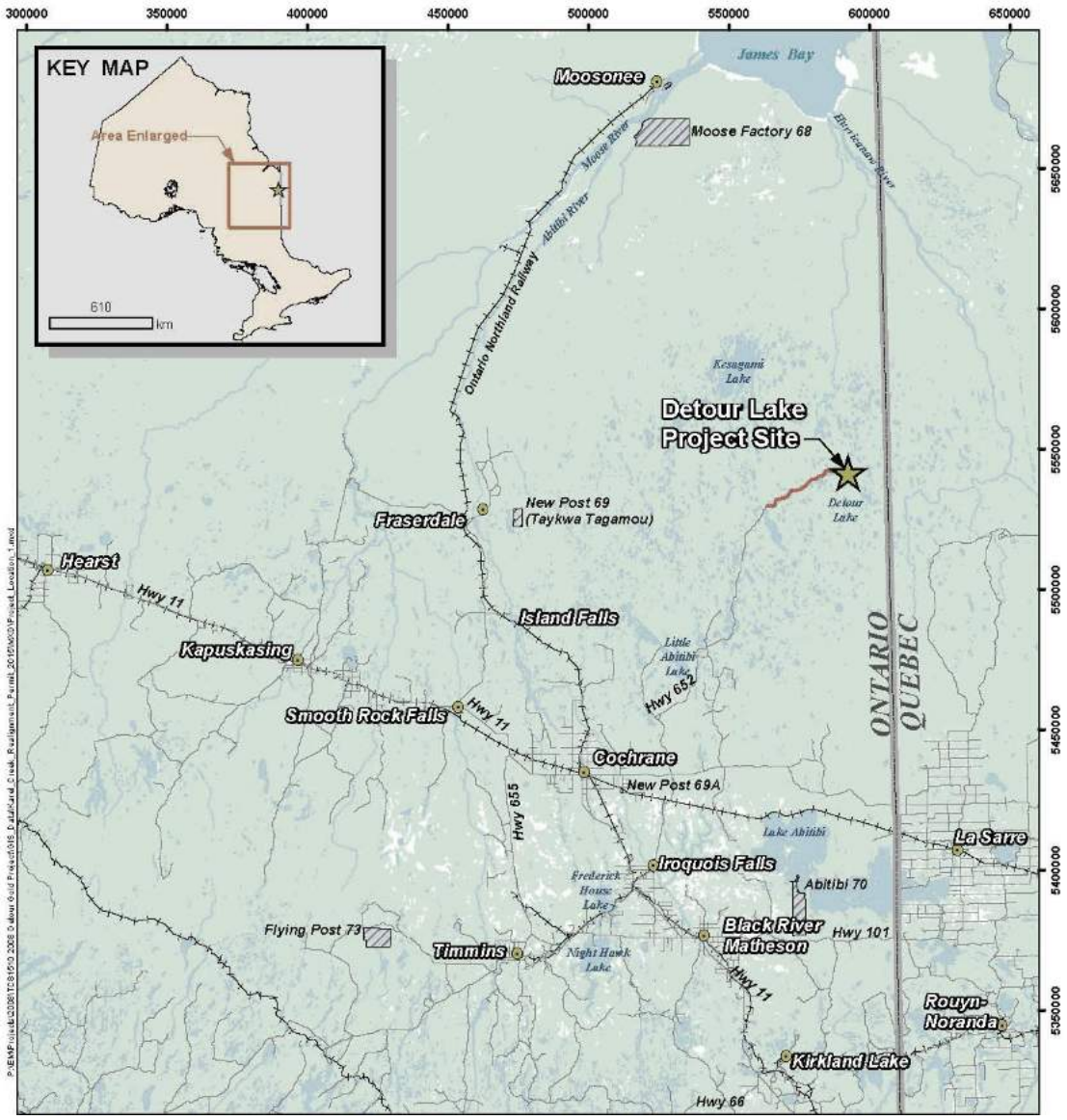


Figure 1: Project Location

1.1 Innovation

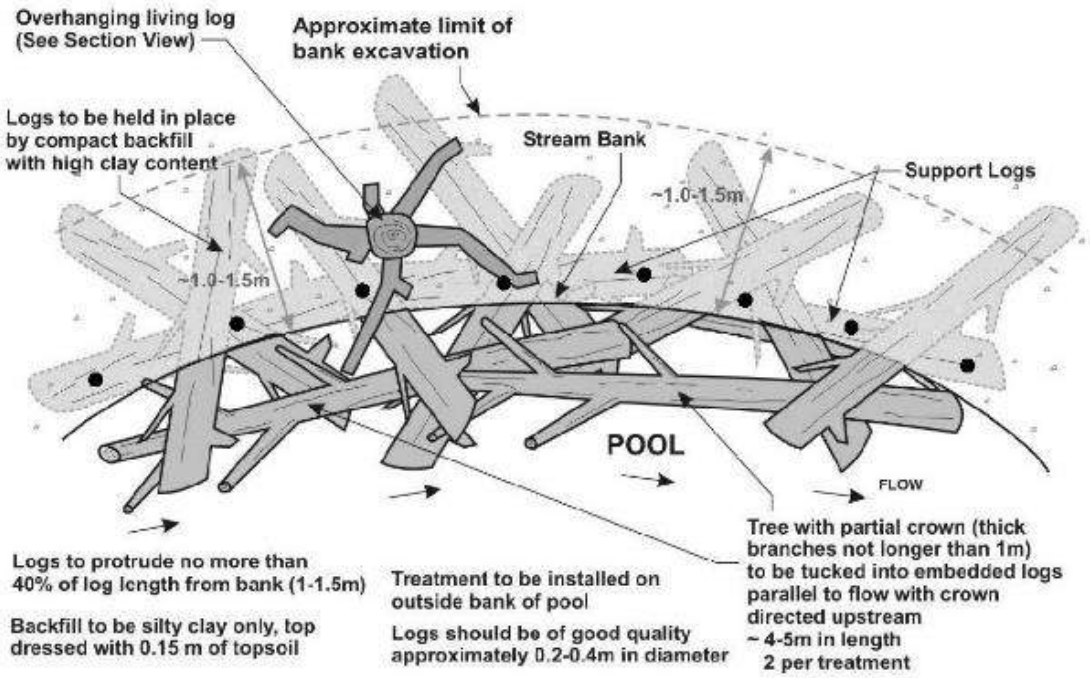
Detour Gold Corporation (Detour) owns and operates the Detour Lake Mine Project, a 60,000 tonnes per day (TPD) open pit gold mine adjacent to a cold-water Brook Trout stream. During operations, monitoring determined that strong hydraulic connections between the creek and the pit were resulting in water losses from the creek greater than the predicted base case values. Consequently, there was the potential for negative effects to develop in the creek, as well as increased dewatering and mine water management cost to the mine. Working cooperatively with the Mine, the Federal and Provincial governments, and local communities, Wood engineered a channel realignment and channel isolation barrier to mitigate the impacts to the creek and the mine operations.

The mine was a fixed factor, meaning its location could not change, nor could the location of several key support structures (haul roads, water lines and power distribution lines), and this presented challenges in this assignment. Although approximately half of the channel could be relocated further away from the open pit, the other half of the channel had to remain where it was. Confounding the problem, was that the channel had been previously realigned (prior to Detour's ownership), to an area of coarse mine rock deposit, resulting in an increase hydraulic connection to the pit. The solution was a 1.2 km channel reconstruction using a combination of natural channel design, bioengineering and geosynthetic clay liners (Figure 2). The design included a realignment of approximately 50% of the channel length to a new alignment further away from the pit, and into an area of native soils that greatly reduced the potential for dewatering interference. The other 50% of the channel had to remain in its current alignment, but was sub excavated and lined with geosynthetic clay liner to prevent seepage from the channel.

To ensure the necessary fish habitat through the lined section, the clay liner was placed 1 m below the final channel depth (to maintain the integrity of the liner) and bioengineering measures were applied over top of the lined channel. This was to accommodate anticipated scour depth.

In addition to reducing flow losses, bioengineering and natural channel design principles were integrated into both the new alignment and the lined channel to improve the habitat suitability

for Brook Trout. Bioengineering included the use of live and dead plant material in the bank stabilization designs, as well as constructed aggregate riffles. The combined channel engineering, synthetic liner and bioengineering have resulted in a successful reduction of the flow loss, reduced water management within the pit, and an increase in the abundance of the valued Brook Trout population.



PLAN VIEW: EMBEDDED WOODY HABITAT BANK PROTECTION
SCALE : N.T.S.

Figure 2: Plan View of Creek Seepage zone and Reconstructed channel

1.2 Complexity

The largest challenge facing the Project was that the creek had historically been relocated to an area of coarse mine rock during initial property development, before development of the Detour Lake Mine Project. This resulted in a strong hydraulic connectivity towards the pit, not evident prior to dewatering. Complicating this condition, was that the mine itself was constructed on a condensed and highly efficient footprint to reduce overall environmental disturbance. This confined much of the creek alignment (over 50%) to its current position, making a realignment of the channel to less hydraulically transmissive soils impossible. And finally, the redesigned channel needed to accommodate the current location, and maintain stability of several critical support systems including the main access road to the site, haul roads, water lines and electrical transmissions lines. Design and staging of the work had to consider significant sub excavation and flood flow management and routing to maintain the safe continuous operation of the adjacent support systems. Portions of the channel realignment were through deep organic soils. Long reach excavators were used to construct the channel through soft organic sections to minimize damage to the adjacent environment.

1.3 Social and / or Economic Benefits

The Project has several existing environmental permits and approvals with imbedded monitoring commitments that were derived through engagement and consultation with regulators, the public and with Indigenous communities. Monitoring the success of the environmental protection measures and controls to ensure compliance with permit conditions and predictions are important social responsibilities for the Project. This was the primary driver for the Project. Economically, there was a secondary benefit to the Project in the reduction of water inflow to the pit. Monitoring of the channel flows in 2017 suggested that the realigned and lined channel was not only successful but showed a net gain in flow through the channel section. The net gain may have been an artifact of the channel modeling, but the conclusion was that the flow losses from the channel following post construction were negligible. This considerable reduction of baseflow infiltration to the pit cascaded to reductions in overall water management and treatment costs.

1.4 Environmental Benefits

Following completion of the realignment and flow isolation measures, the treated channel section showed either a net gain in flow, or negligible losses. The net gain may have been an artifact of the modeling, but the channel design was completely successful in mitigating flow losses through the realigned sections. Due to the enhanced habitat features, the number of brook trout observed in the restored channel in a single year was greater than the number of trout captured in the entire creek prior to mitigation for all years combined. The Project is an example of how engineering and bioengineering can come together to solve complex operational issues, while providing a significant benefit to the adjacent environment and its biota.

1.5 Meeting Client's Needs

The client's main goals were to:

1. Significantly reduce flow losses from the creek section and avoid impacts to the creek and fish community; and
2. to reduce water management effort and cost within the pit.

The combined realigned natural channel and synthetic barrier significantly reduced the flow loss from the creek to negligible values and may have resulted in a net gain of flow. Monitoring in 2017 concluded that the net difference in channel flow may have increased by as much as 3,000 m^3/day. This represented a significant reduction the total baseflow infiltration into the pit. Following the channel reconstruction, the creek flow loss in the realigned section has been mitigated, the pit dewatering effort and cost has been reduced, and the creek's Brook Trout population has increased making the flow mitigation project a complete success.