



Canadian Consulting Engineer Awards 2016

**Sä Dena Hes Mine Decommissioning and Reclamation
70 km North of the Town of Watson Lake
Yukon Territory, Canada**

Submitted to:

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Project Description

The Să Dena Hes (SDH) Mine is located approximately 70 km north of the Town of Watson Lake, Yukon Territory, Canada and lies within the traditional territory of the Liard First Nation. The mine is currently owned by a joint venture between Teck Resources Limited (“Teck” – 50% ownership) and Pan Pacific Metal Mining Corp (50% ownership, a wholly owned subsidiary of Korea Zinc). Teck is the operator under the joint venture agreement. The decision to enter the site into permanent closure was made in 2013 and was required under the mine’s Licenses to be completed by December 31, 2015. Formerly a zinc/lead mine, most of the mineral occurrences range in elevation from 1200 m to 1500 m above sea level. The detailed decommissioning and reclamation plan (DDRP, hereafter referred to as the closure plan) for the SDH mine site was developed and submitted to the Yukon Ministry of Mineral Resources and Water Board for approval. The closure plan addresses the socio-economic expectations of maximizing the use of local resources to complete the project and promote the region’s economy. Prior to reclamation, on-site features included ore concentrating mill infrastructure, tailings management facilities and dams, open pits, mine portals, waste rock dumps, electrical infrastructure, tailings and water supply pipelines.



Overview of Să Dena Hes Mine mill site and tailings management area

The SDH mine decommissioning and reclamation project is the first major reclamation project of its kind to be carried out in the Yukon Territory by a private mining company (rather than completed by the territorial government). The operator, Teck Resources Ltd. (Teck), retained Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) to implement the closure plan for the site within the license expiry timeframes. Teck made it clear to Amec Foster Wheeler at the beginning of the project that engagement of local First Nations personnel was a project priority and a key metric when gauging successful execution.

Amec Foster Wheeler provided project management, project controls, procurement, contract administration, construction management services, as well as health, safety and environmental oversight associated with the implementation of Teck’s approved closure plan for the site. Site services also included the provision of Emergency Medical Transportation (EMT) services to comply with regulatory requirements associated with working in isolated workplaces, and surveying services to be carried out on-site. Amec Foster Wheeler managed this project from the Fredericton, New Brunswick office with this being the home office of most project personnel; however project personnel were integrated from other Amec Foster Wheeler offices in New Brunswick, Nova Scotia, Ontario, Minnesota (USA), and the Yukon Territory. Amec Foster Wheeler also engaged two primary sub-contractors. . Polar Medical Services was contracted to carry out the legislated remote first aid services at the mine site including establishing and maintaining a first aid room, providing an EMT vehicle, and providing First Aid personnel. The First Aid staff also assisted

with site security and served to document and control personnel accessing the site on a daily basis over the course of the project. Amec Foster Wheeler also partnered with Yukon Engineering Services (YES) in a sub-contractor role. YES, based out of Whitehorse, provided on-site surveying services and inspection services over the course of the project. The addition of YES to the project team was also beneficial in having local firsthand knowledge of the area including its climate, socio-economic environment, and familiarity with local General Contractors that would be participating in the delivery of the services during the execution of work at the site.



First Nations contractors carrying out demolition of former camp facilities.

Initially, the project schedule was developed for three construction seasons from 2013 to 2015. However, the project was delayed until September of 2013, therefore, only minor works were able to be carried out in that year. This meant that the bulk of the construction works needed to be completed in 2014, leaving 2015 for final reclamation activities per original schedule. The limited 2013 work phase, following receipt of the necessary approvals, was executed by awarding work and coordinating activities directly to local First Nations contractors. Work included demolition of the mill camp facilities, office complex and associated on-site landfilling operations. Work also included preliminary dewatering of the tailings management facility. The pumping operations carried out in 2013 were critical to the success of the 2014 construction season as it reduced the number of days that pumping would be required in 2014. A pre-project meeting was held in the Town of Watson Lake that involved the Teck project manager, the Amec Foster Wheeler project manager and construction manager and the owners of two local First Nations contractors. Teck and Amec Foster Wheeler had prepared a list of work activities that needed to be accomplished in 2013 during the limited timeframe, and these two contractors were invited to the meeting to discuss the work and their availability to carry out the work. The work primarily involved heavy equipment with some labour to support the effort for pumping operations and



One of two Elders Tours held during the project to review reclamation progress.

pipeline maintenance and removal. Teck and Amec Foster Wheeler presented the work activities to the two contractors and requested a collaborative effort between them to accomplish the work. Following the meeting, both contractors provided rate schedules for their equipment and labour. The work was carried out on a time and materials basis using the agreed rate schedule, and Teck/Amec Foster Wheeler made every effort to use equipment from both contractors to execute the work. Additionally, Amec Foster Wheeler, through sub-contractor Polar Medical, was able to engage members of the Liard First Nation to carry out first-aid attendant/site security services for the duration of the 2013 construction

program. Also in 2013, Teck finalised a formal communication and engagement plan that included updating the community with meetings, funding traditional knowledge studies and forming a project working group. The traditional knowledge studies involved providing funding to the community to gather knowledge from the elders and to identify trails, traditional uses of the area, including those involving plants and animals, and potential end land uses for the mine site. The information gathered was also important for completing the human health and ecological risk assessment studies undertaken to guide the overall remediation of the mine site.

Owing to the requirement to implement the closure plan activities by the end of 2015, the work schedule was compressed and included critical path tasks that needed to be completed in 2014. The 2015 activities were primarily revegetation and road removal efforts across all site locations. This meant that construction works identified for 2014 had to be completed in the limited six-month construction season. This would ensure that reclamation was sufficiently advanced to permit final tasks to be executed in 2015 prior to the expiration of the site licenses. The 2014 component of the decommissioning and reclamation project involved a large scope of work to be accomplished.

Reclamation activities in 2014 included:

- Dismantling and salvage operations, including demolition of the mill and associated infrastructure;
- Decommissioning of the tailings management area including dewatering of impoundments, removal of earthen dam and water control structures, development of a rock quarry to produce suitable rip rap for armoring of re-established waterways, construction of drainage channels and capping tailings areas;
- Permanently sealing underground mine workings, infilling open pits and reshaping and stabilizing waste rock dumps;
- Decommissioning and removal of all electrical infrastructure;
- Other site activities including, but not limited to, capping the mill site once the infrastructure had been removed, road maintenance, removal of pipeline, demolition of shacks, landfill operations, and general site clean-up.



Mill and concentrator complex pre and post decommissioning

The demolition and salvage of the mill and associated infrastructure was managed by the purchaser of the assets. The remainder of the reclamation work activities were Teck-controlled. Teck/Amec Foster Wheeler developed a work breakdown strategy for completing the Teck-controlled aspects of the 2014 phase of the project within the limited timeframe while attempting to maximize the local First Nations workforce. The

strategy involved engaging general contractors who were capable of handling large scopes of work and using a contractor selection process that took into account the extent of involvement and inclusion of First Nations labour. To ensure maximum First Nations engagement was achieved, tender documents indicated that favourable consideration would be given to tenders containing “meaningful” First Nations content. It was indicated that bidders were encouraged to provide employment opportunities for local First Nations equipment and resources. In their bid submissions, contractors were required to supply plans demonstrating their efforts to fill positions with First Nations personnel, indicating the types and quantities of such resources they would use and explaining how they intended to use these resources in the execution of the work, and to provide documentation supporting these commitments.

In the tender documents, it was stated that letters of recommendation from local First Nations leadership would be given additional consideration. It was indicated that, upon award, the contractor would be required to provide confirmation of the use of the resources outlined in the bid by providing the names of personnel and the types of equipment required. It was stated that if the contractor were unsuccessful in acquiring First Nations engagement prior to the bid submission date, the contractor would, at a minimum, explain its efforts to do so and provide supporting phone logs or communication records. It was indicated that the contractor would only be relieved of the commitments to First Nations engagement if the resources declined to participate post-award or were unable to execute the work required as determined by the construction management team. During the analysis of all bid submissions for these large contracts, careful consideration was given to the commitment to First Nations engagement. Each contractor received a score for its proposed level of commitment, which contributed to the overall scoring of each contractor’s bid.



First Nations laborers assisting Amec Foster Wheeler inspector with monitoring well measurements

Another key component to successfully engaging First Nations personnel was the decision to leave some of the site works out of the scope of the larger contracts. These works were strategically selected based on the understanding of available local and First Nations resources. Similarly to the 2013 season, these were awarded directly to local First Nations contractors. The 2014 on-site work activities set aside for direct award included road maintenance, concrete breaking at the mill site, mill site capping and shaping, removal of pipeline, landfill maintenance, decommissioning

of monitoring wells, installation of erosion protection materials, construction of helipads for future monitoring, demolition of site exploration camp infrastructure and other small shacks, reclamation of a dyke, and general site clean-up. For the concrete breaking and mill site capping works, First Nations labour forces were provided appropriate respirator fit testing and training by Amec Foster Wheeler certified fit test personnel to allow them to enter the work area during demolition of concrete and to suppress dust using a water truck while fully clothed in appropriate personal protective equipment (PPE).

In 2014, Teck also hired Liard First Nation personnel to act as environmental monitors. The monitors received training from engineering consultants, which enabled them to observe site activities from an

environmental perspective as well as perform water quality sampling for comparison with regulatory criteria. The monitors also assisted consultants in carrying out soil investigations and other aspects of overall site monitoring where required. The monitors reported directly to Teck and kept the community apprised of site activities through their engagement in the project. Additionally, over the course of the 2014 construction phase, members of the Liard First Nation continued to provide most of the first-aid attendant/site security services. The 2014 season saw nearly 50% of all man-hours worked on-site by First Nations personnel, whether working directly for First Nations contractors, or in a sub-contracting or direct employment capacity for general contractors on-site.



Tailings Management Area pre and post decommissioning.

The 2014 construction program included several critical path challenges. Discharging of accumulated water from within the Tailings Management Area needed to be completed within a 90 cumulative day timeframe and pumping could only be carried out to a specified maximum hourly discharge. Without completing pumping within this timeframe, the remainder of the works could not be executed resulting in the loss of the short Yukon construction season. To ensure the pumping was completed, penalties for loss in pumping production were built into the Contract documents such that the Contractor was required to maintain a minimum hourly discharge and would be monetarily penalized for lost time associated with pumping production losses. Additionally, the Contractor was to provide a redundant pumping system to mitigate the risk of pumping equipment failure. Due to the isolation of the site, breakdowns and/or equipment failure would result in significant overall

delays to the construction schedule. Additional challenges/critical path issues included work being conducted at high altitudes of the alpine mountain range. Portal closures and construction of reinforced concrete caps over vertical vent shafts needed to be completed in an extremely tight construction window. This work needed to be completed in 2014 to ensure revegetation and road decommissioning could be carried out in 2015. Substantial completion dates with associated penalties for delays were incorporated into contracts to ensure contractors considered and mitigated risk and adhered to the project schedule. Schedule challenges included completing the removal of the mill and associated infrastructure by mid-season to allow breaking of concrete and reshaping efforts to be carried out. Additionally, covering of all exposed tailings with clean fill material reclaimed from the dams needed to be completed prior to winter to ensure vegetation efforts could be undertaken early in 2015.

To ensure the 2014 construction activities were achieved within the short Yukon construction window, Amec Foster Wheeler provided an on-site team to coordinate, monitor and administrate the execution all Contracts to be carried out concurrently. During peak construction periods, a combined workforce between 80 and 90 personnel was common. Amec Foster Wheeler's on-site team included one Construction Manager at all times who was responsible for overseeing the execution of all project aspects to ensure the successful

implementation of the closure plan within the specified timeframes. Amec Foster Wheeler's Construction Manager was supported by an on-site inspection team. One inspector was dedicated to each Contract and reported to the Construction Manager in the event of any issues that were raised during the execution of the Contract work. In addition, Amec Foster Wheeler was engaged to provide on-site Health and Safety Monitoring services throughout the execution of the project which included at a minimum one health and safety monitor on-site at all times. As discussed previously, the on-site project team also included First Aid attendants provided by Polar Medical and surveying and inspection services from YES. The on-site team was supported by office staff carrying out project management, contract administration, document control and project and cost control services. Office staff also assisted in coordination of site personnel, ensuring sufficient inspectors were on-site to monitor the works and coordinating logistics including lodging, air travel, etc. As well as the overall project manager who spent time at site and in the office, the office support staff provided contract administration, project control (schedule and budget control), document control, and engineering support services. Contractor invoicing and change management was handled primarily by the Contract Administrator. The overall project budget and schedule was monitored and controlled by the project controls team, which was of critical importance in 2014. The project controls team also assisted with change management, which was also critical throughout the project in ensuring schedule was not impacted and so that proposed scope changes aligned with project budgets. In successfully carrying out the 2014 work, Amec Foster Wheeler's team coordinated the concurrent execution of all project contracts, the direct award work to the local First Nations contractors, and the coordination of all other on-site activities including regulatory site visits, environmental assessment work, and sampling programs carried out across the site.

The 2015 construction season included road decommissioning (removal of ditches, culvert removal, scarification, and restoration of natural waterways), revegetation (tree planting and seeding), final regrading and capping of disturbed sites, and other minor final reclamation efforts at various site locations. All activities were again directly awarded to the local First Nations, with the exception of tendered activities associated with waste rock dump capping which required use of large rock trucks. However, similarly to tendering done in 2014, the emphasis on First Nations inclusion again formed a key component of the tendering process. First Nations contractors carried out all other works. In 2015, over 60% of person-hours worked were by First Nations personnel.

Following the completion of earthmoving and reshaping efforts, studies revealed that metals concentrations in some areas exceeded target values for long-term human health and environmental exposure criteria. Therefore, Teck made the decision to use surplus excavated dam material from 2014 operations to complete remedial capping of these areas with clean glacial till. The major portion of this work was carried out across 7 hectares of reclaimed waste rock dump surfaces. This was a significant addition to the scope of the project, particularly in its final year. Project controls again ensured that this aspect would not impact the project's scheduled completion date of December 31, 2015. Other scheduled work items were shifted accordingly. During the execution of this capping operation, the Contractor thought they were on schedule, however production charts generated by the project controls team showed that they were behind. Had this type of tracking not been done throughout these and other major operations, final reclamation activities

would have been delayed, putting the project's completion date in jeopardy. Similar capping operations were also carried out across various smaller areas which also had elevated metals concentrations. This ensured all reclaimed areas of the site met prescribed environmental exposure criteria established for the site.

In 2013 and 2014, a site-wide seed collection program was carried out on native tree species. Collected seeds were transported to a nursery in BC and grown and stored until able to be transported to site and planted in 2015. Once all grading, reshaping and remedial capping operations were complete, design parameters achieved, and natural waterways restored, all disturbed site areas received a form of native revegetation treatment. Approximately 100,000 trees were planted across select disturbed site areas including the mill site, TMA, and landfill. All other reclaimed site locations (including decommissioned roads) were seeded with a native seed mixture. In addition to the capping operations, over 32 km of site access roads were decommissioned which included culvert removal and creek restoration. At Teck's request, Amec Foster Wheeler, working with the First Nations contractors, assembled a workforce from the Watson Lake and Lower Post areas who were then orientated to the site, provided PPE and tools, and participated in the revegetation program at various locations throughout the mine site. The tree planting was directed by Laberge Environmental Services of Whitehorse to train workers on correct methods for planting the trees and oversaw the daily operation.



Tree planting crew comprised of local and First Nations laborers

Throughout the project, First Nations contractors gained valuable health and safety training and awareness through various programs conducted on site by Amec Foster Wheeler health and safety monitors and the rest of the construction management team. The team worked directly with the First Nations contractors to help promote a safe and healthy work environment and to assist them in becoming more knowledgeable about general safety, hazards and mitigation measures. Highlights from the project included conducting a respirator fit testing and training session with the First Nations contractors and attendance by at least one member of the construction management team during all First Nations contractors' daily toolbox meetings to provide further insight and discussion topics related to safety.



Amec Foster Wheeler providing safety training to workers

For the purposes of the project, First Nations engagement was defined as follows:

$$\frac{\text{First Nation workforce hours}}{\text{Total workforce hours}} = \% \text{ First Nations engagement}$$

The level of engagement is presented as a percentage using this calculation. The following table provides a summary of levels of engagement on Teck-controlled project aspects achieved during the project by year and an overall project total. As shown, over 55% of person-hours were worked by First Nations personnel.

Year	Total First Nation Workforce Hours	Total Workforce Hours	% First Nations Engagement
2013	1,602	2,548	62.9
2014	25,151	47,694	52.7
2015	9,807	16,018	61.2
TOTAL	36,560	66,260	55.2

At the end of the project, Amec Foster Wheeler made inquiries regarding families in need within the community. Amec Foster Wheeler donated furniture, equipment and other items that had been purchased at the beginning of the project to house all site personnel to these families. Furniture included tables, chairs, couches, dressers, beds, and televisions. Other household items donated included kitchen appliances, dishes, cooking utensils, washers and dryers, etc. Amec Foster Wheeler also donated tools, cleaning supplies and equipment, mini fridges, lunchroom tables, etc. from the camp facilities on-site that were no longer required.

In conclusion, efforts to complete the project within the scheduled timeframe, budget and limited Yukon construction windows, while maximising the engagement of First Nations personnel to achieve one of Teck's primary closure plan objectives, were successful. The overall project saw over 55% of all hours on-site worked by First Nations personnel. The addition of the capping operations across reclaimed waste rock dump surfaces (completed in 2015) was a major scope change. Other scope changes were incorporated throughout the project. However, despite these additions, and the already compressed construction schedule, the project was completed on time/schedule and under budget.

On November 17, 2014, Teck was awarded the annual Robert E. Leckie Award, issued by Energy, Mines and Resources, Yukon Government for Excellence in Environmental Stewardship, outstanding social responsibility, and leadership and innovation overall process. The Responsible and Innovative Exploration and Mining Practices award is presented to a quartz or placer mining operation. Two awards, one for quartz and one for placer, are presented for Excellence in Environmental Stewardship. Teck received the award for a quartz operation and was presented the award by the Hon. Scott Kent, Yukon Government Minister of Energy, Mines and Resources.

Amec Foster Wheeler and Teck also received awards in 2014 and 2015 from the New Brunswick Association of Consulting Engineering Companies. The 2014 award was presented for the overall 2014 phase of the work. The 2015 award was presented for First Nations engagement throughout the overall project.

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