

Progressive reclamation and environmental programmes during pre-operations at the New Afton Copper-Gold Mine, Canada

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Abstract

New Gold Inc. is developing the underground New Afton Copper-Gold Mine 10 km west of Kamloops, British Columbia (BC) in the traditional territory of the Secwepemc Nation. Development of the mine involves construction of a new mill, underground workings and tailings storage facility adjacent to the historic Afton mine infrastructure. Design and layout of the New Afton Mine has ensured where practicable, that new infrastructure and land alteration is placed within areas formerly disturbed by mining, and surface materials of any new disturbed areas are salvaged, inventoried, and stored for progressive and future reclamation needs. As mine development proceeds, an aggressive programme of biological and labour-intensive invasive plant management has been implemented; new wildlife habitat constructed and monitored, and geochemical studies on cycloned tailings sands initiated. The semi-arid environment poses unique challenges to long-term restoration of agricultural production on the affected ALR lands, unlike BC mines in temperate environments. New Gold has committed to a progressive environmental programme in collaboration with First Nations. The New Afton reclamation and sustainability programme has oversight by a Mine Monitoring Board.

1 Introduction

New Gold Inc. (New Gold) is developing the underground New Afton Copper-Gold Mine (the Project) on the site of the former Afton open pit mine. The Project is located 10 km west of Kamloops, BC in the traditional territory of the Secwepemc Nation (Figure 1). Developing the New Afton Mine involves construction of a new mill, underground workings, and a tailings management facility separate from the former mining infrastructure. Because the amount of land to be disturbed fell below the Reviewable Project Regulation threshold for new disturbance, the Project was reviewed and permitted as a major mine under the *Mines Act* (Province of BC, Mines Act, RSBC, 1996a). New Gold completed an N.I. 43-101 compliant Feasibility Study in mid 2007. On October 30, 2007, the Chief Inspector of Mines issued *Mines Act* Permit M-229 authorising construction of the New Afton Mine (MEMPR, 2007).

The mine infrastructure is currently being constructed and production is planned to start in mid 2012. New Gold has used this time carry out more planning, preparations, and testing for long term closure and reclamation planning. Since 2007, New Gold has also worked closely with the Kamloops Division of the Secwepemc Nation, as represented by the Tk'emlúps Indian Band (TIB) and Skeetchestn Indian Band (SIB). The working relationships were formalised through the signing of a Participation Agreement in March, 2008 (New Gold Inc., 2008). The goal of the Participation Agreement is to confer economic, educational, employment and social benefits for all parties over the life of the mine and for many years into the future. The combination of mine environmental programmes and First Nations' relations and agreements reflects the company's commitment to achieving its social license for the mine.

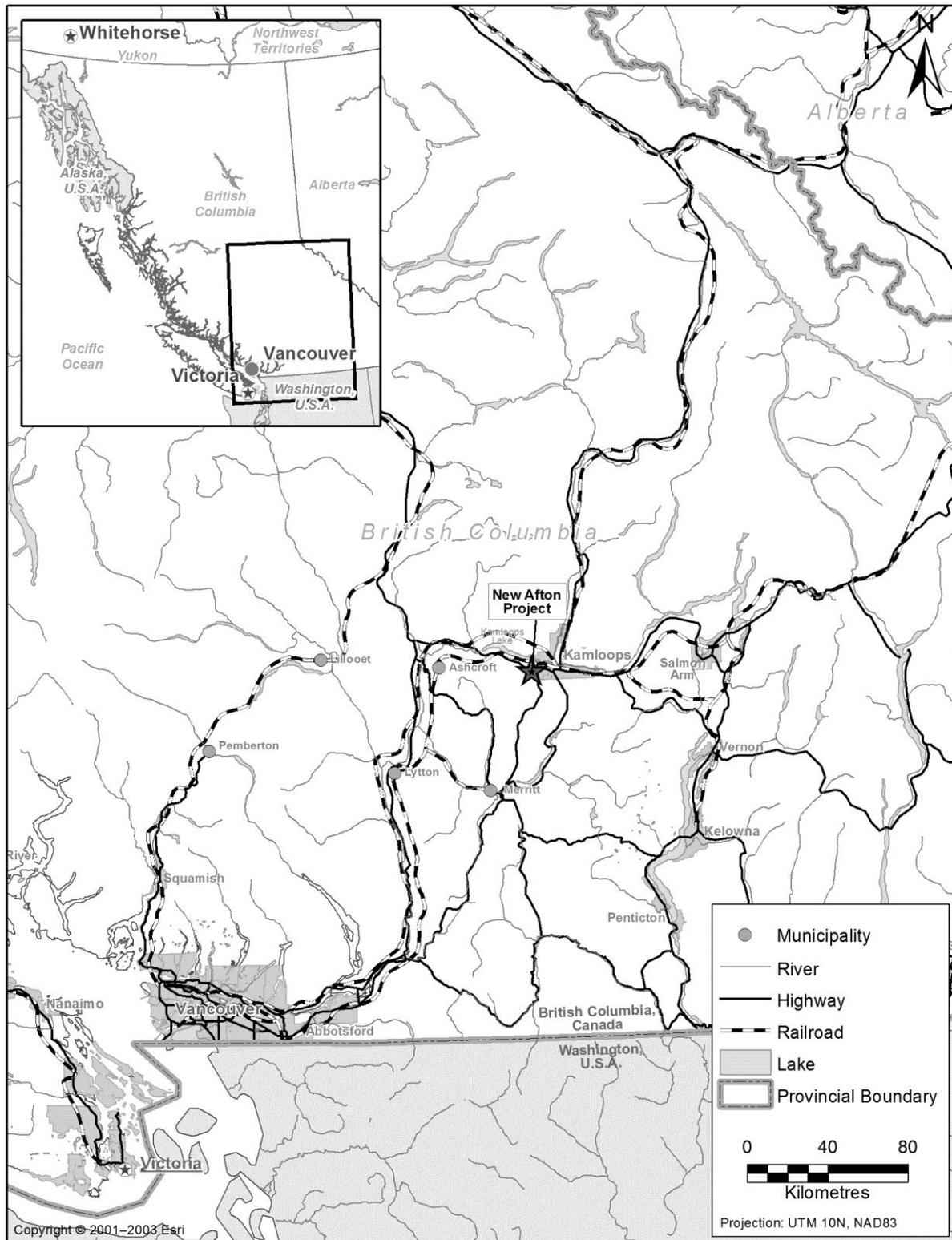


Figure 1 Map of New Afton project location

New Gold Inc. has updated policies in all key areas of the operation including health, safety, environment, and community. The success of these policies will be determined by the sustainability indicators of economic achievement, environmental performance, and social contribution.

2 Mine site status prior to New Afton Project 1978–2005

In 1978, Teck Corporation (Teck) officially opened the Afton Mine, which produced until 1991. Operations involved open pits, waste rock dumps, a tailings pond, and a processing facility which for a brief period included a copper smelter. The original, natural undulating grasslands and numerous small, alkaline waterbodies formed on till-covered drumlinoid terrain have been replaced by features such as rock dumps, open pits, and compacted borrow areas. The dominant waterbodies are now due to mining-related impoundments.

Teck, through Afton Operating Corporation, under *Mines Act* Reclamation Permit M-112, undertook significant reclamation on the site and many lands have supported cattle grazing and wildlife values. Up to the end of 2004, a total of 439 ha of land had been re-contoured and re-seeded out of a total disturbance of 679 ha (Afton Operating Corporation, 2005; Teck Cominco, 2004).

Nearly all of the former Teck lands had achieved reclamation objectives, excepting approximately 20 ha of non-reclaimed disturbed lands and approximately 66 ha of reclaimed disturbed lands which were well on their way to achieving the reclamation objectives, but required more time for vegetation growth, improvements in soil capability or management of invasive plants. As part of the issuance of *Mines Act* Permit M-229 to New Gold Inc., the company agreed to take on full liability for the full reclamation of these lands, satisfying the Ministry's requirements, to enable the New Afton Project to proceed.

3 New Afton post-closure reclamation objectives

A Closure Plan has been developed for the New Afton Project. A prominent land use in the area is cattle grazing on a landscape dominated by grasslands. As the land is in the Agriculture Land Reserve, a focus is to return the land capability for agricultural production. Open grasslands are also an important habitat for species at risk and parts of the area will be suited for wildlife use. The final end land use objective will be to develop grasslands which can be used for grazing. The final reclamation plan will also include wildlife considerations for various birds and small mammals. Native plant species will enter, with time, areas that are less managed, and access to wetlands for herptiles will be a feature of wildlife management. Utilisation of indigenous species, including those of cultural significance to First Nations will be planted, as much as possible. The close relationship with First Nations has provided this opportunity to identify and plan for the inclusion of indigenous species of value to First Nations.

Soil and till salvage materials are being moved, stockpiled, and stored on the site during the construction phase to be used for final reclamation. This includes soils salvaged and conserved from previously reclaimed areas, as well as, from newly disturbed areas.

The Pothook Pit will be filled with mine tailings, allowed to consolidate, and the surface reclaimed. Upon closure, the plant facilities will be removed and the tailings storage facility closed. The reclamation programme will see a total area of 154 ha reclaimed and nearly 600,000 m³ of soil and till salvaged and re-applied as rooting medium for vegetation.

4 Reclamation and environmental programmes 2007–2011

New Gold has instituted several programmes for pre-operations reclamation and environmental management and conducted several important investigations related to water use and tailings geochemistry (Rescan 2009, 2010, 2011).

4.1 Mine monitoring board

As a condition of the *Mines Act* Permit M-229, New Gold established a Mine Monitoring Board which consists of representatives of the company, SIB, TIB, Ministry of Forests, Lands and Mines (formerly Energy, Mines and Petroleum Resources), and Ministry of Environment. The Board's inaugural meeting was held in April 2008 and the Board members met quarterly in 2010. The Board meets to discuss matters pertaining to the environmental aspects of mine development, and in particular, the interface between environmental programmes and the key mine site permits issued, and reports to government regulators.

The Monitoring Board will continue to meet, review, and recommend environmental programmes as a means to achieve successful long-term reclamation.

4.2 Invasive plant management plan

Situated in the dry-interior plateau, the mine site terrain is susceptible to infestation by several noxious weeds. Controlling noxious weeds is a requirement of the BC *Weed Control Act* (Province of BC, Weed Control Act, RSBC, 1996b) and forms part of the end land use objectives for the mine site. During the on-site investigation carried out in 2006, spotted knapweed (*Centaurea biebersteinii*) was noted. Therefore, in 2007, New Gold initiated a spotted knapweed management programme for the site. This programme has been expanded to new invasive plants, including Russian thistle (*Salsola kali*) and kochia (*Kochia scoparia*). The goal of the invasive plant management programme is to reduce and eventually eradicate present populations of invasive plants in the Project area to be replaced by indigenous plant species. The programme consists of four components:

- Providing invasive plant education for mine personnel and training for First Nation assistants.
- Conducting early detection invasive plant surveys of recently disturbed areas.
- Releasing additional spotted knapweed biological agents.
- Removing invasive plants along well travelled corridors, such as, the main access road to the mine site.

The aim of the training sessions was to enable employees to identify and to prevent the further spread of spotted knapweed. Approximately 10 employees attended each session. Training sessions included information on the following:

- Definition of invasive plants.
- Effects of invasive plants.
- Identification of spotted knapweed.
- Inventory, treatment, and monitoring methods.
- Prevention.

Invasive plant inventory surveys were conducted by Rescan, the SIB, the TIB, and the Southern Interior Weed Management Committee (SIWMC). Field plots were established to determine the location, distribution, and density of invasive plants, as well as, the presence of biological agents on-site and/or on adjacent land (e.g. along the highway). Particular emphasis was placed on identifying high-risk areas (e.g. roadways and recently disturbed areas). At each plot, the key field data requirements outlined on the provincial *Invasive Alien Plant Program (IAPP) Site and Invasive Plant Survey Record* were recorded. This was followed by plant removal.

In July 2009, approximately 250 *Larinus minutus* weevils were released along the west side of the main access road at a dense and robust spotted knapweed site. Continued use of biological agents on-site will reduce the competitive ability of the existing spotted knapweed plants, thereby, encouraging native species to establish. In 2009, approximately 1.2 ha (15 truckloads) of invasive plants (predominantly kochia and Russian thistle) were removed from site using mechanical methods (i.e. hand brush saws). Plants were transported to the Kamloops compost site for disposal.

No chemical pesticides were used during any of the works performed and all manual removal was performed following a safety risk assessment. Mechanical treatment (i.e. hand pulling) was conducted on some sites as it was the most environmentally-friendly treatment option available. In 2010, approximately 3 ha of ground were treated for knapweed. Areas that maintained a good harbour for biological agents (*Larinus minutus*, *Larinus obtuses*, *Cyphocleonus achates*, *Agapeta zoegana*) were spared to allow the agents to remain present on site. Works were performed by the First Nations and documented in a post-treatment report. Internally, weeds were removed by the surface crews along the main road verges. This removal was coupled with seeding of areas bared from this work. The treated area was approximately 2.5 ha. The invasive plant removal programme is ongoing.

4.3 Wildlife

The southern interior of BC, including areas near Kamloops, supports many rare ecosystems. Baseline studies conducted in 2006 and 2007 identified 24 species at risk that may have occurred on the site. This included species of mammals, birds, reptiles, and amphibians. Two amphibian species, western toad and Great Basin spadefoot, were confirmed as present on the site and possibly one bat species at risk, the western small-footed myotis, was also identified. The local habitat associated with the Project has been substantially affected by past activity. This may have affected the local wildlife populations, including some species potentially at risk. Although habitats on-site has been severely degraded from past land use, adjacent areas still support habitat that may be occupied year-round or seasonally by wildlife at risk. In addition, a relatively diverse community of wildlife that is currently not at risk was also noted.

Wildlife protection initiatives were developed in association with New Gold to minimise further effects to species at risk and to enhance the habitat suitability in the Project area for certain wildlife groups. This includes ongoing monitoring of use and maintenance of the artificial habitat features installed to attract wildlife. The monitoring plan implemented for construction and operations, includes using knowledgeable Skeetchestn Natural Resource workers or the dedicated Environmental Specialist on site to identify vulnerable species, such as, toads or snakes that may have been in the path of heavy equipment. Monitors were instructed to contact individuals permitted by the BC Ministry of Environment (BC MOE) and assigned with the task of removing species to safe locations on the property. These individuals were identified and relocated under a permit provided by BC MOE. Those involved with the relocation were appropriately equipped and familiar with handling techniques required to limit the spread of chytrid fungus, a major source of mortality for toads. A permit for removing toads is reissued annually in conjunction with the monitoring. The occurrence of toads or snake species at risk during development activities was documented to facilitate adaptive management techniques for species conservation, including directing the implementation of drift fencing or toad tunnels where concentrations of these species were detected. All workers received education regarding at risk wildlife species as part of their orientation. Employees are also encouraged to report other wildlife observations of interest or importance and to fill in a short document that was specifically developed for this purpose.

Wildlife sightings reported by New Gold employees and resulting actions taken have been documented. In 2010, there were three recorded encounters with bats, two bat mortalities, and one live Myotis (likely a western long-eared bat, *M. evotis*). Future collection and preservation of moribund bats will be included in the protocol and the specimens will be forwarded to the Royal BC Museum for confirmation of species and to be used as voucher specimens. Deer are common on the north side of the highway and were also observed closer to the development. Other wildlife encountered included coyotes, red fox, and yellow-bellied marmot. During spring 2010, construction was necessary in an area that may have supported fox or coyote dens. A Skeetchestn Natural Resource worker was employed to monitor the construction for presence of coyote or fox dens. No dens were encountered during the spring 2010 survey. The efforts from 2010 have highlighted opportunities to modify the reporting protocol in the pursuit of continual improvement of environmental management on site.

To enhance avian habitat, a number of artificial structures were placed throughout the site in 2009. These included 22 small songbird nest boxes for tree swallows or blue birds, 10 northern flicker-sized woodpecker boxes, 10 cavity nesting waterfowl boxes, 7 downy/hairy woodpecker boxes, and 9 bat houses. These structures were constructed to specifications suitable for species most likely to occur on-site. They were positioned at locations expected to provide optimum conditions to attract the focal wildlife. This includes considerations for such features as aspect, local vegetation, availability of suitable waterbodies, etc.

The structures were monitored in the fall 2009 for evidence of use and to assess their condition. The structures were revisited in the spring of 2010 to assess condition over winter and remove debris that may have been accumulated by small mammals (e.g. bushy tailed woodrat) between the fall 2009 visit and the 2010 nesting season. Accumulation of materials suggesting occupancy was observed inside 10 of the 22 Tree Swallow/Western Bluebird boxes, 1 of the 10 Northern Flicker boxes, 9 of the 10 waterfowl boxes; including 3 expired eggs collected from one location and one from one of the 7 Hairy Woodpecker boxes. This could be attributed to early nesting of species or to use of boxes by small mammals such as mice or bushy tailed woodrat during the late fall, winter, and early spring seasons. The structures will continue to be

monitored annually for use by preferred, endemic species. Adaptive management measures to limit structures' attractiveness to invasive species (e.g. European starling and English sparrow) will also be implemented on an annual basis.

An additional monitoring effort will be attempted during the breeding period to confirm species use of the structures. Effort will be directed at assessing use by indigenous species for which the structures are intended. Attempts to limit their attractiveness to invasive species (European starling, English sparrow) will be completed in an adaptive management fashion. Additional habitat enhancement initiatives, such as developing boulder and brush piles, are also being considered for future years. Continued monitoring for species at risk will be carried out in association with construction and operations. Long-term monitoring will be valuable to document the success of the programme and to evaluate changes in wildlife communities facilitated by the habitat enhancement initiatives.

4.4 Geochemical characterisation of waste materials

During construction of the New Afton Mine, New Gold has continued or undertaken additional geochemical testing to confirm the geochemistry of the various waste materials as part of the Company's commitment to validate and implement sound waste management practices. For example, New Gold carried out additional kinetic testing of tailings to confirm their suitability for constructing the tailings dam. Typical humidity cell testing is carried out for 40 to 52 weeks; however, New Gold extended the humidity cell operations to 2.5 years.

Studies on elevated As in tailings sands have been undertaken to further understand whether As will be an issue for future reclamation and metal uptake in vegetation of the cyclone sands tailings impoundment material. Humidity cells run for 67 weeks on coarse and fine tailings indicated low sulphide-sulphur, alkaline pH, and As >0.3 mg/L, which exceed the CCME guideline. Accordingly, studies were undertaken to assess the representativeness of the mesogene tailings, assess the source of As in mesogene tailings, assess the geochemical stability of mesogene tailings leachate, and assess the background As concentrations in New Afton mine site geological materials. It was concluded that the representativeness of the mesogene tailings was such that the expected As concentrations will be lower than earlier anticipated and significant metal leaching is not expected to occur in relation to the New Afton tailings.

New Gold also extended the time of kinetic testing of the development waste rock material to confirm earlier predictions of the acid generating potential. New Gold has run these kinetic tests for 4.5 years (>250 cycles) to confirm this. For one humidity cell, the material became acid generating after 3 years, validating earlier predictions and lag times for this development waste material.

4.5 Evaluation of city of Kamloops treated effluent for process water

Kamloops is located in an arid environment and, therefore, water is an important resource which needs to be managed carefully. New Gold requires water for the process plant. As a condition of the *Mines Act* Permit M-229, New Gold led a study to investigate the possibility of utilising effluent water from the Kamloops sewage facility or Kamloops Domtar pulp mill for concentrator process water. The requirement, in part, responded to interests of the TIB and SIB who believed that removal of effluent input to Kamloops Lake would assist in improving downstream water quality in the Kamloops Lake and Thompson River systems, and preclude the need for withdrawal of Kamloops Lake freshwater for process make-up and domestic water supply.

New Gold conducted a scoping level assessment and detailed metallurgical studies to investigate the use of several sources of water or treated effluent for process source water, including blending the offsite treated effluent with on-site Afton pit water. It was determined in the preliminary investigations that the Domtar mill effluent was unacceptable as metal recoveries from processing were well below acceptable levels.

New Gold also studied the use of the City's treated wastewater (sewage) effluent for supplementing the process water needs of the New Afton operation. The test report indicated that one of the effluent choices, Cell 2B effluent, could be used although high door levels compromise its suitability. Another choice, Cell 4 discharge, was considered as the optimal treated wastewater source for providing supplemental water to the New Afton process. The next step was to assess the infrastructure development required to convey City of

Kamloops treated sewage effluent to the New Afton mine site. This also included an investigation of the capital, operating, and environmental costs. The capital cost estimates (in 2008 dollars) ranged from \$6 million to over \$12 million, versus \$3 million for upgrades to the existing infrastructure owned by New Gold Inc. which could divert water from Kamloops Lake to the mine site. Other considerations were the substantial timelines, pre-construction design, and permitting components attached to the options of bringing treated effluent to the mine site. The decision was made to not to use the effluent. However, New Gold is aware of the value of water in this region and has undertaken additional water management improvements to the process plant in parallel with this study with the net effect of further reducing the amount of off-site water required for the mine operations. New Gold has also adopted a policy of recycling water for any activities that do not require fresh lake water. The water management plan at New Afton precludes any water discharge from the site.

4.6 Site remediation

At New Afton, site personnel discovered and remediated an oil leak from a redundant transformer left near a pump booster station by previous owners that contained low levels of PCBs. After discovery of the leak, contractors removed the transformer, associated infrastructure, and contaminated soil from the site and transferred them to an approved waste facility for treatment. Samples taken from the removal site confirmed there was no PCB oil contamination remaining and that the site has been completely rehabilitated.

4.7 Recycling

Recycling has become a major activity at the New Afton site with everything from scrap metal and used oil to sundry cardboard and plastic items diverted from the landfill. As noted above, water recycling is maximised in an effort to conserve water.

4.8 Other environmental initiatives

In addition to the foregoing, New Gold's environmental department is embarking on a number of initiatives, to ensure that the groundwork is laid during the pre-operations phase for the long-term environmental management of the site. These initiatives include:

- A study of the leaching of heavy metals from tailing sands at neutral pH and how this affects the environmental performance of the future TSF.
- Monitoring of emissions from underground sources in terms of total particulate and volumetric flow rate.
- A peer review of the current hydrogeological data and model by a third party.
- Continuing to develop an ISO14001 compliant Environmental Management System framework.
- Enter into a biodiversity offsetting arrangement with the Nature Conservancy of Canada.
- Commence monitoring of heavy metal uptake in vegetation and soils to provide a baseline for future monitoring.
- Identify and trial the use of "species of cultural significance" for reclamation.

5 Sustainability and environment

New Gold maintains a Health, Safety, Environment & Sustainability Policy which guides the activities at the site toward excellence in health, safety, environmental, and sustainability management (New Gold Inc., 2011a, 2011b).

5.1 Towards Sustainable Mining (TSM) and ISO 14001 certification

New Gold has adopted ISO 14001 as the framework for its Environmental Management System at New Afton. New Gold is also working towards joining the Mining Association of Canada (MAC) and, therefore,

the MAC *Towards Sustainable Mining* standards are being adopted internally and steps are underway to achieve the mandatory “A” level for all modules.

5.2 Social responsibility – First Nations

New Gold has worked collaboratively and in partnership with First Nations since the beginning of the Project. The culmination of efforts to create and support new relationships was the signing of a Participation Agreement among New Gold Inc, TIB and SIB in March 2008.

The Participation Agreement consists of five main components:

- Education and scholarships.
- Preferential employment.
- Contracting opportunities.
- Financial.
- Environmental matters.

New Gold has hired a full-time First Nations coordinator to assist with the implementation of the Participation Agreement under the direction of the Joint Implementation Committee which meets on a regular basis. Initiatives are underway and performance based results are being achieved under all agreement components. The relationships and implementation of the Participation Agreement are progressing well on the basis of mutual respect and collaboration.

5.3 Key permits/milestones

The New Afton Project has attained a number of key permit and related milestones in the pre-operations phase during the permitting and construction of the mine. The company has endeavoured to engage regulators and First Nations to ensure that key issues are identified and that sustainable solutions are implemented. The permits and milestones include:

- Mines Act Permit M-229 granted by BC Ministry of Energy, Mines and Petroleum Resources.
- New Gold Inc., Tk'emlups Indian Band and SIB Participation Agreement.
- Mines Act Permit Amendment approving Pothook Dam construction design.
- Mines Act Permit Amendment approving Tailings Storage Facility.
- Effluent Discharge Permit obtained from Ministry of Environment.
- Air Emissions Discharge Permit obtained from Ministry of Environment.
- Water License obtained to divert water from Kamloops Lake.
- Topsoil salvage and stockpiling (ongoing).
- Remediation of unused substations.
- Archaeological Chance Find Procedure implementation (ongoing).
- Invasive plant management (ongoing).
- Placement of nearly 100 multi-species bird nest boxes on site (ongoing).
- Implementation of use of environmentally friendly reagents (ongoing).
- Wildlife Permits for species at risk handling and relocation (ongoing).
- Groundwater, surface water, air quality, ML-ARD monitoring, and reporting (ongoing).

5.4 Health and safety, community, and the environment

New Gold has established a New Afton joint employee / management safety committee to ensure that the mine site meets all requirements in the area of worker and mine site health, safety, community and environment. The company is committed to being an industry leader in this regard and in the short time that the mine construction has been underway, has achieved a number of notable milestones in this regard. To date over 7,000 metres of underground development has been completed on schedule without lost time injury. This is presently the most extensive underground mine development occurring in BC and the commitment to health and safety has earned the company the 2009 J T Ryan Special Award in recognition of notable achievements in safe mining. The New Afton Mine rescue team earned the top award at the 2010 provincial competition. The New Afton mining team continues to work towards zero work site injuries and after completing a gap analysis on the Health, Safety and Reclamation Code for Mines in British Columbia is striving for complete compliance in all aspects of the HSR Code.

6 Conclusions

New Gold Inc. is developing the underground New Afton Copper-Gold Mine 10 km west of Kamloops, BC in the traditional territory of the Secwepemc Nation. Development of the mine involves construction of a new mill, underground workings, and a tailings storage facility adjacent to the historic Afton mine infrastructure. Mine operation is set to commence in mid 2012 with annual forecasted production of 75 million pounds of copper, 85,000 ounces gold, and 214,000 ounces silver. Construction of the New Afton mine is occurring on lands formerly altered and partially restored by the former Afton open pit copper mine, as well as on some previously unaltered lands. Situated in the dry interior of BC, the mine site development has required particular attention be paid to water conservation, native species, wildlife habitat, and weed management. New Gold has adopted a proactive approach to its operation; establishing and implementing First Nations agreements in a collaborative and mutually respectful working relationship; achieving high standards in Health, Safety, and Environment; and community relationships. New Gold is undertaking environmental studies and initiatives to lay the groundwork for future successful reclamation and closure and meeting all Provincial regulatory requirements for environmental protection on the path to adoption of Mining Association of Canada Towards Sustainable Mining standards. The New Afton Partnership Agreement involving New Gold, SIB, and TIB is being implemented to achieve a legacy of sustainability.

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