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May 31st, 2019

Attention: Mr. Brodie Costello
Regulatory Specialist
Wek'eezhii Land and Water Board
#1-4905 48th St. Yellowknife, NT X1A 2P6

Dear Mr. Costello,

**Re: Colomac Monitoring Project
Type B Water Licence W2014L8-0003
PART B: Schedule 1 – Colomac 2018 Annual Report**

Please find attached the Colomac 2018 Annual Water Licence Report, respectfully submitted by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) - Contaminants and Remediation Division (CARD). The Water Licence Report provides all information requested under Water Licence W2014L8-0003, Part B Schedule 1.

If you have any questions or concerns regarding this, please contact me at 867-669-2462 or kathryn.eagles@aadnc-aadnc.gc.ca

Yours truly,

Kathryn Eagles
Project Manager, INAC-CARD

cc: Ryan Fequet, Regulatory Manager, WLWB
Carey Ogilvie, Senior Manager, AANDC-CARD
Andrew Richardson, Project Officer, AANDC-CARD
Tim Morton, Inspector, AANDC-Lands



Water Licence W2014L8-0003 2018 ANNUAL REPORT Colomac Monitoring Project



Colomac – CABIN Training for Tłı̨ch̨o Students – June 19th, 2018

Submitted to:
Wek' èezhii Land and Water Board

Submitted by:
Contaminants and Remediation Division
Crown-Indigenous Relations and Northern Affairs Canada

May 2019



**WATER LICENCE W2014L8-0003
 COLOMAC MONITORING PROJECT
 2018 ANNUAL REPORT**

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Abbreviations

AHMP	Adaptive Hydrocarbon Management Program
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CARD	Contaminant and Remediation Division
CCME	Canadian Council of Ministers of the Environment
CCMP	Colomac Comprehensive Monitoring Program
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
ENR	Enhanced Natural Removal
EQC	Effluent Quality Criteria
FAL	Freshwater Aquatic Life
HCMP	Habitat Compensation Monitoring Program
HMP	Hydrology Monitoring Program
km	Kilometre
L/s	Litres per second
LUP	Land Use Permit
masl	Metres Above Sea Level
MVLWB	Mackenzie Valley Land and Water Board
PAR	Performance Assessment Review
PCMMP	Post-Closure Monitoring and Maintenance Plan
PHC	Petroleum Hydrocarbons
SNP	Surveillance Network Program
TAMP	Terrestrial and Aquatic Monitoring Program
TCA	Tailings Containment Area
WL	Water Licence
WLWB	Wek'èezhìi Land and Water Board
WQG	Water Quality Guidelines



1.0 INTRODUCTION

Colomac Mine is an abandoned gold mine located approximately 180 kilometres (km) north of Behchokò, 40 km west of Wekweètì, and about 220 km northwest of Yellowknife. Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), through the Contaminants and Remediation Division (CARD), has been managing the Colomac site since 1999.

This Annual Report is a requirement under Part B: Item 2 of Water Licence (WL) W2014L8-0003; Amendment #2. As a condition of the WL, the annual report was to be filed by May 31st of the year following the calendar year being reported.

The Annual Report is organized according to the requirements set out in Schedule 1, Part B of the WL, with the headings representing summaries of the respective Parts and Items. The scope of the Report encompasses a review all of the data obtained during the calendar year being reported, including analysis and interpretation of the results and findings. This report is the fourth Annual Report for W2014L8-0003.

CARD has compiled this information in cooperation with Stantec Consulting and Public Services and Procurement Canada.

2.0 STATUS OF THE PROJECT

Royal Oak Mines Inc. operated the Colomac Mine in a state of “Care and Maintenance” from December 1997 until April 1999, when the company went into receivership. On December 13th, 1999, ownership of the site formally reverted to the Crown, with CIRNAC assuming control of the property through the creation of the Royal Oak Project Team. CARD took control of the site from the Royal Oak Project Team on September 6th, 2000. CARD currently still manages the activities at the former Colomac Mine site.

In November 2000, CARD applied to the Mackenzie Valley Land and Water Board (MVLWB) for a WL and Land Use Permit (LUP) for short-term water management activities at the site. LUP MV2000X0072 was issued March 1st, 2001, but the water licensing process took longer than anticipated. The Colomac site was regulated under WL MV2000L2-0018, granted to CARD on February 14th, 2002. While that Licence was under development, CARD worked within the “spirit and intent” of the draft version of the Licence, as well as the conditions of LUP MV2000X0072. Prior to the Licence being issued, WL N1L2-1563 (granted to Royal Oak Mines Inc. by the Northwest Territories Water Board in 1999), had been in effect. A separate Type B WL (MV2002L2-0001) was issued by the MVLWB on June 17th, 2002 to permit CARD to conduct pilot testing of several treatment processes and to add mono ammonium phosphate to Tailings Lake and the Zone 2.0 Pit.

In March 2005, LUP MV2004X0023 was issued by the MVLWB to regulate land use activities at the site. In May 2005, WL MV2004L8-001 was issued by the MVLWB to CARD for the remediation of the Colomac site. Full remediation activities commenced in 2005 with the hydrocarbon remediation program and continued through 2006 with the major civil works



program, which included the tailings cover on Spruce and Tailings Lake, and construction of Dyke 7 spillway, the outlet channel at Dam 2 and Dam 1B.

In 2007, activities included completion of the Dam 1B, Zone 2.0 pit aeration, continued hydrocarbon remediation programs, Truck Lake clean up and tailings pipe removal, quarry remediation (Duck Lake quarry and Pilot Plant quarry), placement of caribou berms and ramps, and commencement of Mill asset recovery and Mill decontamination.

The 2008 remedial activities saw the continuation of many of the programs from the previous year. The hydrocarbon remediation program, hazardous materials disposal, quarry remediation and mill asset recovery and removal were all continued. Site restoration was started, and involved the re-contouring of diversion ditches, sumps and waste fill from the construction of Dam 1B. Programs that were completed in 2008 included the removal and disposal of tailings pipe; clean-up of the former bone-yard; barrel washing, crushing and disposal; Hewitt Lake camp demolition; caribou fence decommissioning; and the dismantling of five buildings, including the Pilot Plant.

In 2009, remediation activities included the completion of high risk quarry remediation, and site restoration activities involved the restoration of diversion ditches, sumps and peat and overburden spoil piles from the construction of Dam 1B. A geomagnetic survey of the Boneyard pit and a bathymetric survey of the Steeves Lake shoreline were also completed. Ongoing programs in 2009 include the hydrocarbon remediation program and hazardous materials disposal. In addition, the assessment and development of a remedial action plan for hydrocarbon contaminated sediments near the Steeves Lake shoreline was completed.

In February 2010, a Type B Water License (W2009L8-0003) was granted by Wek'èezhii Land and Water Board (WLWB), which came into effect on February 25th, 2010 upon expiry of the former Type A water license. The Final Remediation Contract was awarded to Aboriginal Engineering Ltd- Tlicho Engineering and Environmental Services during that same month, with mobilization of the contractor to Colomac on the 2010 Winter Road. Remediation activities completed in 2010 included the remediation of the Steeves Lake shoreline, continuation of the hydrocarbon remediation program, and major demolition activities (mill, maintenance shop, camp buildings and all associated infrastructure).

The majority of remediation activities were completed in 2010. In 2011, a summer program was required to complete final details of the remediation. The program included additional petroleum hydrocarbon (PHC) soil treatment and sampling, minor clean-up of remaining non-hazardous wastes and PHC stained soil in the former camp and shoreline areas, airstrip decommissioning, and minor site re-grading.

Following completion of the remediation at Colomac, the site entered the monitoring phase of the project. Monitoring of the Colomac site has been complete in accordance with the requirements of licences, permits and Engineer of Record recommendations following remedial activities.

The 2018 field season continued the post-remediation monitoring of remediated site features and their surrounding environment. CIRNAC continues to support community-based monitoring in the Tłı̨chǫ Region. Commensurate with a project of this magnitude and duration, several years of



monitoring have been anticipated for the Colomac site to verify that remedial efforts were successful, and aspects of the Colomac monitoring are anticipated to continue into the foreseeable future. The short and long-term monitoring of the Colomac site was described in the **Post-Reclamation Monitoring and Residual Hydrocarbon Remediation Management Plan**, initially submitted to WLWB in October 2012. The following components were described in the October 2012 Version of this Plan for the Colomac Monitoring Project:

Adaptive Hydrocarbon Management Program (AHMP) – includes free product recovery, monitoring of wells (product thickness and water level), ground temperature analysis, meteorological monitoring, risk assessment of the residual hydrocarbon and shoreline monitoring and maintenance;

Geotechnical Monitoring – includes the regular dam instrumentation readings and annual testing of thermosyphons, and scheduled geotechnical inspection on the new dam, tailings cap, spillway and discharge channel by expert inspection;

Habitat Compensation Monitoring Program (HCMP) - includes monitoring of the success of re-vegetation and monitoring of constructed water passages in accordance with the Fisheries Authorization;

Hydrology Monitoring Program (HMP) – includes hydrology of all pits and major lakes in the areas affected by mining activities at Colomac;

Terrestrial and Aquatic Monitoring Program (TAMP) – includes sampling of soil and terrestrial flora and fauna to determine the health of the terrestrial ecosystem and sampling of water, sediment, and aquatic flora and fauna to determine the health of the aquatic ecosystem; and

Water Quality Monitoring – includes the Surveillance Network Program (SNP), Enhanced Natural Removal (ENR) and Zone 2.0 Pit Physical Stability.

WL W2014L8-0003 and LUP W2014X0004 came into effect on January 26th, 2015. As part of the WL, Colomac Management Plans were updated in 2016 and submitted to the Board. **Colomac Post Remediation Monitoring and Maintenance Plan, May 2016 (version 3.0)** was determined by the Board to satisfy requirements of the WL in a November 10th, 2016 decision. In the decision, the Board outlined revisions that were required for inclusion in Version 4.0 of the document.

Waste Management Plan Version 2.0, May 2016 was determined by the Board to adhere to MVLWB's *Guidelines for Developing a Waste Management Plan* in the November 10th, 2016 decision; however, Version 2.1 of the plan was requested for a December 2016 submission. Version 2.1 was submitted in November 2016. With the set-up of a short-term camp at Colomac in the fall of 2017, **Waste Management Plan Version 2.2, September 2017** was forwarded to the board. Version 2.2 covered all aspects of waste management associated with the small camp. Reviews by the Board were not received for either Version 2.1 or 2.2. Approval of Version 2.1 was received on May 3rd, 2017. In accordance with communications between the Board and CIRNAC in early October 2017, approval for Version 2.2 was neither sought from nor given by the Board. Version 2.2 remained current for 2018.

Spill Contingency Plan Version 7.0, May 2016 was determined by the board to adhere to the Spill Guidelines, but the Board approved the Plan with additional directions to be completed in Version 7.1. The additional directions were not reflective of current site usage, and were potentially confusing to personnel who would need to refer to the Plan. INAC chose to submit a



substantially Revised Version 8.0. Changes from Version 7.0 reflected current site status and material site storage, and removed consideration of establishment of a camp. Quantities of fuel discussed in Version 7.0 reflected the possible erection of a camp, so Version 8.0 was changed to better represent the actual chemical storage at the site. Version 8.0 was submitted in November 2016. Review and approval by the Board was provided on May 3rd, 2017. Version 8.1 was submitted in the fall of 2017 and covered all aspects of waste management associated with the small camp. In accordance with communications between the Board and INAC in early October 2017, approval for Version 8.1 was neither sought from nor given by the Board. Version 8.1 remained current for 2018.

In accordance with Part G Item 6 of the WL, CIRNAC submitted a Performance Assessment Report (PAR) to the WLWB for approval. The PAR was approved on September 5th, 2018.

In May 2018, an *Annual Review: Post-Closure Monitoring and Maintenance Plan: Water Licence Amendment Request and Justification for Post Remediation Monitoring Reduction, May 2018* was submitted to the board. This review was completed as part of the requirement identified in Part G Item 3 of WL W2014L8-0003. The review recommends substantial reductions in the Colomac Monitoring. Based on this review and the recommendations of the PAR, on November 1st, 2018 Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan was submitted to WLWB. The following changes were made from Version 3.0 to Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan:

- Section 1.0 Introduction and Background was expanded to provide more detail on the PAR and the process being used to revise the Monitoring Plan from Version 3.0 to 4.0.
- Sub-section 1.1 Site History was re-worded for clarity and to better highlight the history of importance to the monitoring.
- Sub-section 1.2 Review of Site Remediation was a review of the Remedial Action Plan (RAP), but was revised to omit details of the site history that did not influence the Post-Closure monitoring and to expand on issues that drove the monitoring. The section was also clarified and made more concise for easier reading.
- Sub-Section 1.3 Remediation Status Summary (as per 2004 Colomac RAP) was deleted. The section tied the post-construction monitoring to the RAP, but the majority of the section did not relate to the post-construction monitoring. All salient information from this section was transferred to other sections.
- Sub-Section 1.4 2015 Update of Reclamation Status was changed to 1.3 2018 Update of Reclamation Status. Board suggested additions were added to this section and the detailed were updated.
- Section 2.0 Monitoring Overview was re-worded for clarity.
- Sub-Section 2.1 Drivers for Site Monitoring was expanded to better describe the factors driving each component of the monitoring.
- Sub-Section 2.2 Risk Based Monitoring was revised to better describe the risk based monitoring that had occurred at Colomac. The majority of the remediation and monitoring at Colomac has been guideline driven.
- Sub-section 2.3 Expected Outcomes was revised for clarity.
- Sub-section 2.4 Monitoring End Points removed the sentence “For most monitoring, this will represent several consecutive years of data that show no discernible trend that would



be different than that which would be observed at an analogous undisturbed area.” This criterion has been met for much of the monitoring at Colomac, yet Consultants were still not recommending the end of those monitoring components.

- Sub-section 2.5 Residual Liabilities had minor word changes.
- Section 3.0 Colomac Site Status was expanded to include the current status of each of the monitoring programs and redundant maps were removed.
- Section 4.0 Monitoring Program – Aspects and Components was completely re-written. Each sub-section covered a monitoring component, as before, but the sub-section was divided into three instead of two parts. The first part (Status) describes the monitoring for the component completed under Version 3.0 of the Monitoring Plan (this was “Future Monitoring” in Version 3.0). The second part was added to describe the specific end-point for that monitoring component. The final part is the required monitoring, based on the reduced program that was recommended from the review of the monitoring component provided in Appendix A of Version 4.0 of the Plan. The following changes to the Plan were implemented:
 - **AHMP** – Leveloggers and barologgers were decommissioned. All measurements and sampling from well-field monitoring wells was discontinued. Sampling of Steeves Lake for hydrocarbon was ended. Measurement of thermistors for ground temperature was concluded.
 - **Geotechnical Monitoring** – No changes were made to the geotechnical monitoring.
 - **HCMP** – Only one additional HCMP was proposed after 2018 – at the 10-year point in 2021.
 - **HMP** – All monitoring stations that display steady state conditions were decommissioned. This left only Zone 2.0 Pit and Zone 2.5 Pit to be monitored.
 - **TAMP** – The 2018 TAMP was eliminated and no further monitoring was required.
 - **SNP** – Only SNP stations at the Outlet of Steeves Lake (1563-02), at the Tailings Lake compliance Point (1563-39 and in the Zone 2.0 Pit (1563- 26) were monitored. All other monitoring locations were decommissioned.
- Section 5.0 Maintenance Activities was eliminated from Version 4 of the Monitoring Plan. All maintenance as described in previous versions of the Monitoring Plan has been completed and reported as part of previous WL Annual Report submissions.
- Section 6.0 Schedule became section 5.0, and was updated for 2018.
- Section 7.0 Reporting Requirements was removed as the provided information did not add to the narrative of the Monitoring Plan.
- Section 8.0 Plan Revision was removed as the provided information did not add to the narrative of the Monitoring Plan.
- Section 9.0 Conclusion became section 6.0 and was updated for 2018.
- A new Section 7.0 References was added to this version that provides the previous reports upon which the Monitoring Plan is based.

Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan was accepted by the WLWB on February 28th, 2019. Version 4.0 scope was started in 2018.

On June 26th, 2018, the Tłı̨ch̨o Government forwarded a letter to the WLWB in support for Stewardship of the Former Colomac Mine Site. The Tłı̨ch̨o Government noted the willingness of



CIRNAC-CARD staff to address the concerns of the Tłı̨chǫ Government. This includes Canada working closely with Tłı̨chǫ Elders to evaluate the remedial actions, providing funding for the Tłı̨chǫ Government for all engagement activities and CIRNAC leading regular updates to Tłı̨chǫ community members. It was noted that, working together, the Tłı̨chǫ Government and CIRNAC-CARD have been able to focus on our respective goals while also achieving significant milestones in our community engagement, empowerment and involvement in every step of the way. Colomac Monitoring has provided opportunities for employment and capacity building for Tłı̨chǫ community members through the hiring and on-the-job training of Environmental Monitors and Wildlife Monitors.

3.0 FRESH WATER USE

The Annual Report referred to in Part B, Item 2, shall include ... (a) the monthly and annual quantities in cubic metres of fresh water obtained from all sources.

No fresh water usage was required in 2018.

4.0 WASTE DISCHARGE

The Annual Report referred to in Part B, Item 2, shall include, ... (b) the monthly and annual quantities in cubic metres of each and all Wastes Discharged.

Wastes generated from the monitoring of the Colomac site consisted of domestic-type garbage that was removed daily with the monitoring personnel. Garbage was not centrally collected, so volumes were not recorded. No oily water was recovered from on-site wells in 2018. Discharge of wastes streams to the environment did not occur in 2018.

5.0 SNP, HYDROLOGY AND OTHER WATER QUALITY STUDIES

The Annual Report referred to in Part B, Item 2, shall include ... (c) all information required under Part A, Item 2 of the Surveillance Network Program; and (k) a map depicting all active SNP stations.

Monitoring of the Colomac site was completed under the Colomac Comprehensive Monitoring Program (CCMP) Contract in 2018. Water Quality studies at the Colomac site included the SNP and ENR, which were completed under the CCMP, and a study of the physical stability of Zone 2.0 Pit which was completed by Dr. Roger Pieters of Greg Lawrence and Associates. Starting in 2018, the SNP and ENR programs were combined to be reported as only SNP. A report on the 2017 data was received from Dr. Pieters in 2018, and the 2018 report was received in 2019. Hydrology was monitored as part of the CCMP as well.

The **Colomac Comprehensive Monitoring Program 2018 Annual Report**, Stantec Consulting Ltd.; March 2019” is provided in Appendix A. This report is a compilation of six sectional reports. The **Circulation of Zone 2 Pit-Lake, Colomac NWT, 2017** is Provided in Appendix B, while **Circulation of Zone 2 Pit-Lake, Colomac NWT, 2018** is in Appendix C, both of which are authored by Dr. Roger Pieters.



Requirements of the SNP are provided in an SNP section that is annexed to the Colomac WL. Part A Item 2 of the SNP annex required the following:

The Licensee shall submit the following information in electronic and printed formats as part of the **Annual Report** required in Part B, Item 2 of the Licence:

- a. All laboratory results and analysis of all data collected during each SNP sampling period for the previous year;
- b. Tabular summaries of all data and information generated under Part B and C of the SNP;
- c. Rationale for any SNP sites where samples were not collected;
- d. Quality Assurance/Quality Control results and interpretations, in accordance the approved **Quality Assurance/Quality Control Plan**.
- e. Any interpretive comments and calculations;
- f. Identification of any anomalies and trends;
- g. If any SNP sites were established, activated, or moved during the period being reported, the coordinates for each site and an updated map identifying the locations all the SNP sites.

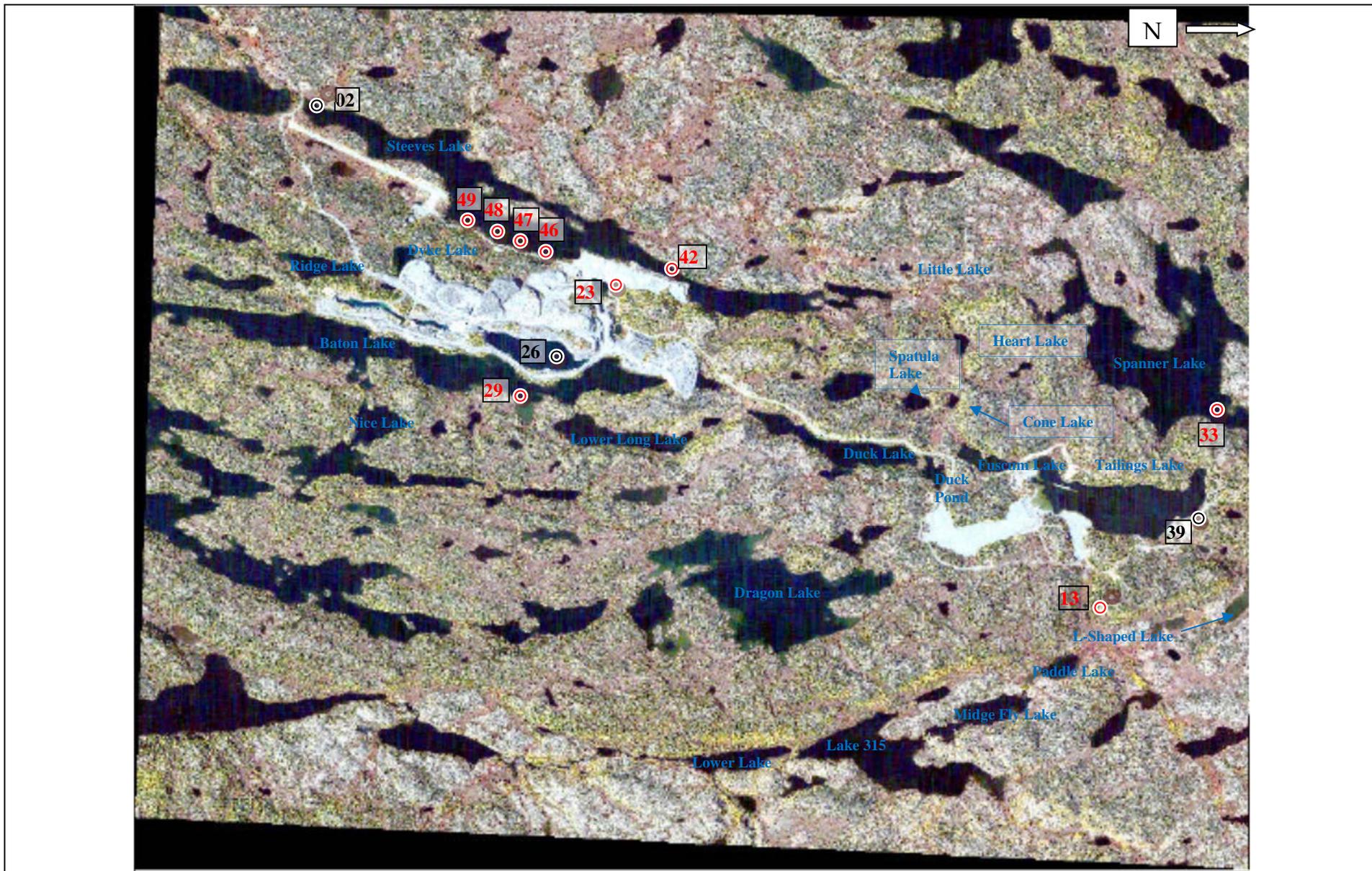
Part B and C refer to the requirement for Hydrology study (B) and water sample analysis by an accredited laboratory (C), with the latter requirement covered within the SNP reporting.

5.1 SNP/ENR Sampling Program Results

As part of the SNP, water samples are required to be collected on a predetermined basis from an array of sampling sites established in the drainage areas of the Tailings Containment Area (TCA) and Steeves Lake. Figure 1 shows the location of the SNP water sampling stations that were monitored as part of the 2018 CCMP and the SNP stations that were decommissioned in June 2018.

Water quality information associated with the 2018 SNP monitoring program can be obtained from Section VII of the **Colomac Comprehensive Monitoring Program 2018 Annual Report**, (Appendix A). Tabular summaries of all SNP data and information, as outlined in the WL, may be found in this report. No SNP sites were established, activated, or moved in 2018. Starting in 2018, the SNP/ENR program is referred to only as the SNP, as all ENR components have been incorporated into the SNP.

The SNP (formally discussed together as the Surveillance Network Program and Enhanced Natural Recovery program) annually monitors surface water quality in strategic water bodies around the remediated former Colomac Mine. The SNP evaluates compliance for discharge from the TCA and monitor the decrease in chemicals of concern in Zone 2.0 Pit. The former Colomac Mine site includes two watersheds, Tailings Lake and Steeves Lake, which are within the Indin River watershed.



Active Sampling Station



Decommissioned Sampling Station

SURVEILLANCE NETWORK PROGRAM SAMPLING SITE LOCATIONS - COLOMAC MINE

DATE May2019

APPROVED A.R.

FIGURE 1





The SNP is a requirement of the Site's WL (W2014L8-0003) and the current SNP has been modified many times since its introduction in 2000 when CIRNAC became the Site's custodian. Initially, the program called for monitoring of 24 stations; however, the current WL (issued in 2015) reduced the number of stations to 12 and amended the point of compliance to the Tailings Lake surface outlet, immediately before the spillway (Station 1563-39). The SNP monitoring was reduced again in the spring of 2018 to include only three stations at a reduced sampling frequency. The decommissioned SNP Stations had been monitored for between 10 and 15 years with little observed variation in water quality. The Monitoring Contractor and Contractor who completed the 2018 PAR recommended changing the SNP within the WL to reflect the stability of Colomac water quality. These recommendations were accepted by the Wek'èezhii Land and Water Board in February 2019. The signs for the decommissioned stations will be removed in 2019.

The three remaining stations in the SNP are 1563-02 Outlet from Steeves Lake at the south end, which measures the water quality leaving the Colomac site from Steeves Lake; 1563-26 Zone 2.0 Pit, which was filled with impacted water and has yet to stabilize; and 1563-39 Tailings Lake surface, immediately prior to Discharge through the Tailings Lake Discharge Channel at Dam 2, which is the Point of Compliance and measures the water quality leaving the Colomac site in the area of the TCA.

WL parameters of concern have been selected based on site-specific background information and available water quality data. Water samples obtained from the Compliance Point in Tailings Lake (SNP Station 1563-39) are compared to Effluent Quality Criteria (EQC) that are provided in the WL; the other stations are compared to Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (WQG) for protection of Freshwater Aquatic Life (FAL). For most parameters, the EQC in the WL are less stringent than WQG FAL to account for location-specific background conditions.

The SNP program evaluates the success of cyanide bioremediation in Zone 2.0 Pit following the transfer of cyanide-contaminated water from Tailings Lake in 1999 and 2000. The water was treated with the monoammonium phosphate fertilizer in 2002 and 2003, and aeration was used to stimulate cyanide degradation in 2006 and 2007. Over the past eight years, the SNP program has analysed water samples from various depths to determine effectiveness of the Zone 2.0 Pit water remediation.

Sample collection under the 2018 SNP program occurred once during the winter (under-ice sampling on February 19th, 22nd, and 23rd) and twice during the open-water season (July 21st to 23rd and September 5th and 7th). The 2018 SNP sampled seven stations, one in Tailings Lake, five in the Steeves Lake and one in Zone 2.0 Pit (this includes stations 1563-47 to 1563-49, which were sampled in 2018 in the February sampling program). Samples for the 2018 SNP program were collected from the Zone 2.0 Pit at nine depths. Although not required by the WL, Zone 2.5 Pit was also sampled once during open-water in 2018.

Overall results of the 2018 SNP program were similar to those of 2017 and continue to indicate that most parameters of concern are below WL EQC and/or WQG FAL. Zone 2.0 Pit had elevated concentrations of nitrite, nitrate, total phosphorus, total arsenic, total copper, total selenium, and total cyanide. Steeves Lake is the anticipated receptor of potential Zone 2.0 Pit subsurface



seepage, as well as seepage from the main site area; however, the water balance shows that the quantity of water that may move from Zone 2.0 Pit is insignificant compared to the volume of the receptor Lake(s) and the 2018 water quality results continue to show no evidence that contaminants from Zone 2.0 Pit, or surface or groundwater movement, have influenced water chemistry in Steeves Lake.

At the point of compliance (Tailings Lake Outlet), the WL EQC were met for most parameters, although total copper was marginally above the discharge criterion. Copper concentrations decreased in Tailings Lake Outlet from the start of monitoring (2008) until approximately 2012, after which concentrations have remained relatively consistent around the WL EQC of 10 micrograms per Litre. It was recommended by the Monitoring Contractor that the total copper EQC for the point of compliance be reconsidered following additional research into potential biological consequences of increasing the discharge criterion and review of risks for aquatic biota downstream.

To improve the SNP program, the Monitoring Contractor recommended filtering and freezing chlorophyll *a* samples before laboratory submission to prevent sample deterioration. The Monitoring Contractor also recommended comparing chlorophyll *a* bottle data with data recorded with the Sea Bird profiler (collected for Dr. Rogers Pieters at the University of British Columbia) and terminating chlorophyll *a* sample collection should the two datasets be determined to be comparable.

5.2 Colomac Hydrology

Water level surveys were completed at Colomac as part of the CCMP. Please refer to Section V of the **Colomac Comprehensive Monitoring Program 2018 Annual Report** (Appendix A) for more details.

The objective of the Colomac HMP is to collect and report on lake level data in the former Colomac mine area until a “steady-state” is established in the waterbodies that have either been created or affected by mining activities. This “steady-state” condition is a monitoring endpoint commitment made by CIRNAC within their Post-Closure Monitoring and Maintenance Plan (PCMMP). The monitoring program began in 2004 and has continued on an annual basis.

A new draft PCMMP for the Site was submitted to the WLWB in 2018 and called for a substantial reduction in the scope of the HMP since many of the monitored sites have now reached “steady-state” conditions or are otherwise no longer relevant to the overall goals of monitoring the Colomac Site. The WLWB approved the updated PCMMP Version 4.0 on February 28, 2019, which approved removing six of eight stations. Zone 2.0 Pit and Zone 2.5 Pit will remain operational.

Field programs were completed in July and September 2018. Five of the active monitoring stations (Baton Lake, Spot Lake, Steeves Lake, Tailings Lake and Truck Lake) were removed during the July 2018 field program. The Monitoring Contractor left one of the stations scheduled for removal (Zone 3.0 Pit) in place due to its relevance to the behaviour Zone 2.5 Pit, which has not yet reached “steady-state” conditions. Water levels measured during the July and September 2018 site visits are provided in Table 1.



Table 1 – Lake Water Levels around Colomac Mine: Spring and Fall 2018

Location	July Surveys		September Surveys	
	Elevation (masl)	Date and Time	Elevation (masl)	Date and Time
Baton Lake	336.237	July 22, 14:30	--	--
Dyke Lake	339.156	July 23, 13:45	--	--
Spot Lake	328.949	July 21, 15:30	--	--
Steeves Lake	317.812	July 21, 12:00	--	--
Tailings Lake	345.455	July 23, 11:35	--	--
Truck Lake	319.694	July 21, 14:10	--	--
Zone 2.0 Pit	337.382	July 22, 12:00	337.398	Sep 5, 14:30
Zone 2.5 Pit	341.615	July 22, 13:20	342.118	Sep 5, 12:55
Zone 3.0 Pit	345.817	July 22, 13:40	345.825	Sep 5, 13:25

NOTE:

masl Elevation provided as metres above sea level.
 -- Station was decommissioned.

Water levels in Zone 2.0 Pit had been steadily rising since mining operations ceased, but recent years have shown lake behaviour that appears to be approaching “steady-state” conditions. Monitoring will continue at this station until “steady-state” conditions are reached.

Water levels in Zone 2.5 Pit had displayed variable behaviour over the past few years of monitoring, but there now appears to be an overall trend of falling water levels. It is likely that the withdrawal of water from this pit by Nighthawk Gold Corp. for exploration drilling purposes is the driving factor behind this falling trend. This third-party activity negatively impacts CIRNAC’s objective to monitor until steady-state conditions have been reached, as recharge is relatively slow and removal of any volume of water has an enduring impact on the water elevation. Zone 3.0 Pit had previously displayed “steady-state” behaviour but can also be considered part of a linked system (with Zone 2.5 Pit) that has not reached steady-state, due to the possibility of overflow and shallow subsurface flow from Zone 3.0 Pit to Zone 2.5 Pit. An overview of the data from the installation of the monitoring station in 2011 through 2018 shows that there may be a trend of declining water levels and it appears that the station is moving away from “steady-state” conditions. It is probable that the decline is linked to the behaviour of Zone 2.5 Pit. Accepting that Zone 2.5 Pit is the best location for Nighthawk Gold Corp. to obtain water, but acknowledging that the withdrawal of that water renders hydrological monitoring data unusable, CIRNAC-CARD proposes the suspension of the Hydrological Monitoring Program at Zone 2.5 and Zone 3.0 Pits. A request to update the WL to allow this suspension (or elimination of the station) may be completed 2019.

The Monitoring Contractor also recommended that a monitoring station be re-established at Tailings Lake to act as a reference site. This lake demonstrates a natural pattern of lake response to snowmelt and precipitation. Data from this station would be useful for evaluating whether the behaviour of lakes which have not reached “steady-state” is being driven by the same climatic factors. For any particular year, these data would provide information on the timing of freshet and the overall response to precipitation at the Site during the summer months, as measured by the meteorological station. Without a reference station, it would be difficult to evaluate whether lake behaviour is driven by site-wide climatic variations or by other conditions specific to that water body. Further, since other field programs (the HCMP, SNP and Geotechnical Services Program)



will continue to visit the Tailings Lake area, it was recommended that qualitative observations of the water level continue to be recorded to provide an indication of whether water levels are changing substantially from year to year, given the potential risk of exposure of the uncovered tailings if water levels fall over 1.5 m. CIRNAC-CARD agreed with this recommendation.

5.3 Other Water Quality Studies

Dr Roger Pieters of the University of British Columbia annually completes a study of Zone 2.0 Pit. Two reports were provided by Dr. Pieters in 2018: **The Circulation of Zone 2 Pit-Lake, Colomac NWT**, was provided for the 2017 and 2018 study years.

In the 2017 report, the 2016-2017 data was examined from Zone 2.0 pit-Lake and these data were placed in the context of previous data extending back to 2004. Over the previous thirteen years, the pit-lake has been filling with runoff and groundwater. Zone 2.0 Pit reached the level of Baton Lake on 6 November 2010, and has continued to fill to 1.36 m above the level of Baton Lake as of September 2016. In 2017 the water level no longer increased. For the first time, the winter water level declined (2016-2017), and the water level during open water in 2017 was similar to that in 2016.

The rate of net groundwater inflow declined from 2004 to 2012, at which point the magnitude of the net groundwater inflow was about the same as the error in determining the net groundwater inflow. Note that profiles from Zone 2.0 Pit continue to show a distinct uniform layer from 25 to 60 m which suggests continued groundwater inflow. Potential sources and sinks of groundwater flow are discussed in **Colomac Site Zone 2 Pit Review** prepared by SRK Inc.; July 2013.

Despite the various source of error, it is clear that the net rate of groundwater inflow has declined from approximately 4 Litres per second (L/s) in 2004 to < 1 L/s through 2013-2016, and become negative in 2017. Based on the winter data, the net groundwater inflow was -1.5 L/s in 2016-2017, which is significantly different from previous years. While the change in net groundwater flow is important to the water level, the overall effect of groundwater on deep layer conductivity has remained relatively steady since 2008.

The stratification was examined during each season of 2016-2017 and the following was observed:

- In fall 2016, the surface layer had cooled and mixed to 18 m but not to 22 m by the time of ice on (1 November 2016). As in previous years, fall turnover did not occur.
- In spring, sunlight penetrating through the ice drove under-ice convection between 2 and 15 m depth.
- At ice off, there was a fresh water cap (~70% ice melt, ~10% snow and ~20% runoff) sufficient to prevent spring turnover.
- In summer, heating of the surface added significant thermal stratification and the depth of the surface layer changed little until cooling in the fall. In July and August, there were peaks in fluorescence, turbidity and dissolved oxygen from 10 to 25 m suggesting algal growth.

During each period, stratification was maintained and mixing did not occur below ~20 m depth. As a result, Zone 2.0 Pit was meromictic. While the degree of meromixis appears to be gradually



increasing (the salinity contrast increased by 1.8 times from 2008 to 2017), the overall degree of meromixis still remains weak. Groundwater flow has resulted in a small but steady decline in the salinity of the deep water (monimolimnion). Of particular interest is whether the chemocline will continue to strengthen, and whether the deep water will remain isolated over the coming years.

In the 2018 report the 2017-2018 data was examined from Zone 2.0 Pit-Lake and these data were placed in the context of previous data extending back to 2004. Up until 2016, the pit-lake had been filling with runoff and groundwater. As noted in the 2017 Report, Zone 2.0 Pit reached the level of Baton Lake on 6 November 2010 and filled to 1.36 m above Baton Lake as of September 2016; however, in 2017 and 2018 the water level no longer increased. For the first time, water level during winter declined (2016-2017 and 2017- 2018), and the water level during open water in 2017 and 2018 was similar to that in 2016. Profiles from Zone 2.0 Pit continued to show a distinct layer of relatively uniform temperature and conductivity from 25 to 60 m which suggests continued groundwater inflow.

Despite the various source of uncertainty, it is clear that the net rate of groundwater inflow has declined from approximately 4 L/s in 2004 to < 1 L/s in 2013-2016. While it is less certain, it also appears that the net groundwater has become negative in 2017 and 2018. This is suggested by the winter data, giving a net groundwater inflow of -1.5 L/s in 2016-2017 and -1.8 L/s in 2017-2018. While the change in net groundwater flow is important to the water level, the overall effect of net groundwater has also resulted in a slow decline in the deep layer conductivity since 2008.

The stratification was examined during each season of 2017-2018 and the following was observed:

- In fall 2017, the surface layer had cooled and mixed to 18 m but not to 20 m by the time of ice on (1 November 2017). As in previous years, fall turnover did not occur.
- In spring, after the snow melted from the ice, sunlight penetrating through the ice drove under-ice convection between 2 and 17 m depth.
- At ice off, there was a fresh water cap (~70% ice melt, ~10% snow and ~20% runoff) sufficient to prevent spring turnover.
- In summer, heating of the surface added significant thermal stratification and the depth of the surface layer changed little until cooling in the fall.

As was observed in 2017 for each period, stratification was maintained and mixing did not occur below ~20 m depth, so Zone 2 Pit was meromictic. The degree of meromixis appears to be slowly increasing but still remains weak. Net groundwater flow still contributes to a small but steady decline in the salinity of the deep water and it is still of interest whether the chemocline will continue to strengthen, and whether the deep water will remain isolated.

6.0 MODIFICATIONS

The Annual Report referred to in Part B, Item 2, shall include ... (d) a summary of all Modifications, Construction, repairs, and maintenance work carried out at the site during the previous calendar year and a description of any work planned by the Licensee for the upcoming year;

No modifications construction repairs or maintenance work was completed at Colomac in 2018.



7.0 TCA/ZONE 2.0 PIT SEEPAGE

The Annual Report referred to in Part B, Item 2, shall include ... (e) annual total volumes of Seepage from the Tailings Containment Area and Seepage to and from the Zone 2.0 Pit.

In accordance with Part A: Scopes and Definitions of the Colomac WL, “Seepage” includes water or Waste that drains through or escapes from any structure designed to contain, withhold, divert or retain water or Waste.

The TCA, as discussed here, includes the Spruce Lake Containment Area and Tailings Lake. Outflow of seepage potentially occur at Dyke 7, where the water would report to Tailings Lake, and at Dam 1B with outflow to the environment. Flow at the Tailings Lake discharge channel is not seepage as it is an intended discharge and is within discharge limits. This discharge is not measured for volume and will not be discussed as part of this section.

Seepage from the TCA through Dyke 7 has been minimized by contouring of the TCA to shed precipitation. The historic piping of pore-water through Dyke 7 has not been observed since completion of remedial activities in 2007-2008. Sub-surface seepage thorough Dyke 7 would report to Tailings Lake, but measurement of volume of this seepage is not possible. No impact to water quality of Tailings Lake has been noted that could be attributed to Dyke 7 seepage.

Seepage through Dam 1B has been too low to reliably measure. Water collecting at the base of dam could be either seepage or surface collection within the valley. Analytical data from the sampling of this water shows slightly elevated cyanide concentrations as compared to background, but concentrations do not exceed guidelines. There is no evidence that water at the base of dam 1B is a result of seepage through Dam 1B; therefore, the volume is considered insignificant.

The SNP station 1563-13 was located downstream of Dam 1B and it provided information on water quality that was intended to detect any downstream movement of containments from Dam 1 Seepage. Before completion of Dam 1B, this station was intended to detect seepage through Dam 1 that was not captured through the pump-back at the foot of the dam. Since the completion of Dam 1B, this location was intended to capture any potential seepage through the entire Dam structure. This sampling station has data was sampled since May of 1992. Since completion of Dam 1B, generally small volumes of water have been noted at 1563-13. Samples from this location have consistently been well below the applicable Colomac EQCs and applicable Canadian CCME WQG-FAL. Consistently acceptable results have been collected from this sampling location since 2007, and low water volumes indicate that the contribution to down-stream impacts is low, so CIRNAC deactivated 1563-13 - Creek downstream of Tailings Containment Area Dam 1. This deactivation was accepted by the WLWB in February 2019.

As noted in Sections 5.2 and 5.3, Zone 2.0 Pit is now maintaining a steady to negative water balance, which means that there is no longer net accumulation of water, between 2017 and 2018. Steady state is defined in the **Colomac Post Remediation Monitoring and Maintenance Plan** as three to five years of natural lake water elevation cycles for each water body. Zone 2.5 Pit has



now displayed two years of no net accumulation of water. Seepage from Zone 2.0 Pit has never been observed.

The Zone 2.0 Pit Seepage Monitoring Program was created to evaluate the possibility of contaminated groundwater entering Steeves Lake from Zone 2.0 Pit. The monitoring program included shallow sumps, deep wells to monitor groundwater movements, and lakeshore sampling stations. The sumps, deep groundwater wells and lakeshore sampling stations were located adjacent to one another. The groundwater sampling was entirely discontinued by 2008 because wells had been continuously frozen year round for many years.

Version 4.0 of the **Colomac Post Remediation Monitoring and Maintenance Plan** noted that sampling of the Zone 2.0 Pit Seepage Monitoring Program (1563-46 to 1563-49) locations has continued since 2002 without substantial change in the water chemistry. Water chemistry of the four locations provides very similar results, and these results were very similar to all other sampled areas of Steeves Lake. Seepage indicators have not been detected in these locations, even though the water elevation in Zone 2.0 Pit appears at the first years of steady state. There has been no evidence that a connection exists between Zone 2.0 Pit and Steeves Lake. Finally, the water quality of Zone 2.0 Pit is very close to discharge concentrations, and any contaminant of concern in groundwater flowing between Zone 2.0 Pit and Steeves Lake would be sufficiently diluted that it would not be detectable in Steeves Lake. The PAR recommended the elimination of these SNP stations. Therefore, INAC requested that the Zone 2.0 Pit Seepage Monitoring locations be deactivated from the Colomac SNP. This deactivation was accepted by the WLWB in February 2019.

8.0 UNAUTHORIZED DISCHARGES

The Annual Report referred to in Part B, Item 2, shall include ... (f) a list of all Unauthorized Discharges and a summary of all associated Remediation activities.

Unauthorized discharges did not occur at the Colomac site in 2018. Remediation has been completed at Colomac.

9.0 POST-CLOSURE MONITORING

The Annual Report referred to in Part B, Item 2, shall include ... (g) a summary and an analysis of all results obtained from monitoring conducted under the Post-Closure Monitoring and Maintenance Plan during the calendar year reported.

Post-closure monitoring at the Colomac site includes the following monitoring programs:

- AHMP;
- Geotechnical Monitoring;
- HCMP and Re-Vegetation;
- HMP;
- SNP; and
- TAMP.



The **Colomac Post Remediation Monitoring and Maintenance Plan, May 2015 (version 3.0)**, remained current for the 2018 monitoring season; however, the Version 4.0 Program was completed for the 2018 season. Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan was accepted by the WLWB on February 28th, 2019. Funding for the 2018 Colomac Monitoring Program did not permit the scope outlined in Version 3.0 of the report, so the Version 4.0 scope was started in 2018.

The SNP and HMP have previously been reported in section 5 of this report. The TAMP was not completed in 2018. Terrestrial and Aquatic monitoring was proposed on a re-occurring schedule with events planned for up to ten years after remediation. The Monitoring Plan intended monitoring to end after the ten-year collection. While the sampling requirements were well developed, the goal of the monitoring was not provided, so it was not possible to verify the success of the program. The TAMP was discontinued in Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan, which was accepted by the WLWB on February 28th, 2019.

9.1 Adaptive Hydrocarbon Management Program

As a result of the former mine operations, widespread PHC impacts were identified at Colomac in several areas of the main mine facilities, including the former tank farm, maintenance shop, powerhouse, and mill. Free-phase hydrocarbon product and contaminated groundwater were also identified in the sub-surface in these areas and were seeping into Steeves Lake. At the end of remediation in 2011, much of the PHC contaminated soil was excavated and treated except for the fill under the former powerhouse slab, where an ecological risk assessment determined it did not pose a risk to surface receptors. Contaminated lake sediments along the east shore of Steeves Lake, downgradient of the former mine facilities, were also capped with low permeability fill and an engineered shoreline cap was constructed; this cap extended along 750 m of the Steeves Lake shoreline adjacent to the mine infrastructure and westward into the Lake by 10 to 20 m. Though remediation is now complete, subsurface free-phase hydrocarbon product and contaminated groundwater remain in the fractured bedrock of the main mine area.

The intent of the AHMP at the former Colomac Mine is to collect the data necessary to assess whether the continuing residual discharge of PHCs from the former mine site is likely to pose an unacceptable risk to the aquatic environment or human use of Steeves Lake.

The 2018 AHMP field activities were performed in July and September. In 2018, product and/or water level measurements were documented in sentinel monitoring wells, surface and groundwater samples were collected, and data were downloaded from the Site's meteorological station and thermistor data loggers.

Phase-separated product was not observed in the sentinel wells. Groundwater at the Site flows westward into Steeves Lake through the two main surface seeps. The groundwater flow direction is believed to be governed by bedrock fracture patterns more than elevation gradients, as such, the deployment of level loggers was discontinued in 2018.

The Steeves Lake Shoreline Cap was visually assessed during each monitoring visit; evidence of PHCs or structural degradation was not observed. Observation of Steeves Lake shoreline



conditions will be continued during the 2019 AHMP. Should seepage be observed on Steeves Lake or the constructed shoreline cap, the seepage will be contained and recovered to mitigate any potential impact to the down-stream environment.

In 2018, the air temperature and precipitation data were consistent with previous years. June was the wettest month at the Site. The recorded values for precipitation at the Site from July to September 2018 were wetter than those recorded in 2017. Wind direction in 2018 was primarily from the east and southwest, which was not consistent with previous years data. It was determined that a portion of the wind monitor mounting assembly was installed incorrectly. The mounting assembly was adjusted during the July 2018 field program so any wind direction data prior to July 2018 should be treated with caution.

One surface water sample, from the Steeves Lake Shoreline Cap wetland pond (Pond B/C), was submitted for laboratory analysis of general chemistry parameters, dissolved benzene, toluene, ethylbenzene, and xylenes (BTEX), and PHC fractions F1 and F2. Groundwater samples from sentinel wells were submitted for general chemistry parameters, BTEX and PHC Fractions F1 and F2. The regulatory guidelines chosen for comparison to the analytical results are the CCME WQG-FAL and the Federal Interim Groundwater Quality Guidelines.

The surface water sample from the Pond B/C had concentrations of parameters that were below the referenced guidelines. Shoreline Cap wetland pond sampling will continue in the 2019 AHMP. Four groundwater samples were collected from the sentinel wells for analysis in July, and six samples were collected in September. Sentinel well MW229 was not monitored or sampled due to the presence of remote telemetry equipment that made the well inaccessible for AHMP monitoring and sampling. The four sampled sentinel monitoring wells had BTEX and/or PHC parameters at concentrations that exceeded the referenced guidelines.

During the 2018 field program, ground temperature data from four monitoring wells were collected from thermistor data loggers. The data indicates that no permafrost has been recorded since thermistor installation in 2013, that the maximum seasonal freezing depths were observed to vary between the thermistors, and that a shorter frost period, and slightly shallower frost penetration, was observed during the 2015–2016 winter than during the 2013–2014, 2014–2015, 2016–2017 and 2017–2018 winters. The absence of data supporting the presence of permafrost is not considered as a failure to a return to a normal freeze/thaw cycle for the area. Rather, it suggests that the Site has adjusted to a new thermal equilibrium. As such, it was recommended that the monitoring of ground temperatures at the Site be discontinued, and thermistor strings installed in Site monitoring wells be decommissioned. This recommendation was accepted by CIRNAC, and was discussed in Version 4.0 of the Colomac Post Remediation Monitoring and Maintenance Plan. This version of the Plan was accepted by the WLWB on February 28th, 2019.

A Mann-Kendall statistical trend analysis was conducted for BTEX and PHC concentrations in the sentinel wells. The trend analysis indicated statistically significant decreasing trends for benzene concentrations and decreasing or stable trends for PHC F2 concentrations in the four sentinel wells monitored in 2018. With the exception of ethylbenzene, which appears to be increasing in MW230, other parameter concentrations are generally stable where a trend is evident.



A Mann-Kendall trend analysis was also conducted on mass discharge estimates for benzene and PHC F2 for Seepage Area A, Seepage Area B/C, and the Full Shoreline. Overall, Mann-Kendall analyses suggest that mass discharge estimates for benzene and PHC F2 show stable or decreasing trends over the period from 2011 to 2018. Given that the original mass discharge estimates and risk assessment indicated no risk to receptors in Steeves Lake, the stable and decreasing trends in mass discharge over time indicate that the contaminant discharge continues to not represent a risk to the lake environment.

It was recommended that, in support of addressing the question of whether the residual discharge of PHC from the well field is likely to pose an unacceptable risk to the aquatic environment or human use of Steeves Lake, the focus of future monitoring efforts continue to be the monitoring wells situated between the contaminant source and the receiving environment (i.e., the sentinel wells). Continued monitoring and sampling of sentinel wells for BTEX and PHC F1 and F2 concentrations was recommended until there are decreasing trends in the mass discharge to Steeves Lake and until stable or decreasing trends in sentinel well groundwater BTEX and PHC concentrations is observed. Should three to five consecutive sampling events show decreasing or stable trends for BTEX and PHC fractions F1-F2, the monitoring of the sentinel wells could be reduced to annual or biennial events, or monitored using remote telemetry. CIRNAC was in agreement with this assessment.

9.2 Geotechnical Monitoring

The objective of the Colomac Geotechnical Services Program is to provide observations and recommendations for the geotechnical condition of key structures at the site, in accordance with the PCMMP.

The PAR of the Colomac CCMP, and subsequent CIRNAC review, considered the current level of Geotechnical Monitoring appropriate, though a few recommendations from the PAR for additional surveys and monitoring were not enacted at this time. The only significant change concerned the collection of winter data from Dam 1B, where remote telemetry has been established to provide continuous monitoring of the temperatures at select instrumentation.

The scope of work carried out to the 2018–2019 Geotechnical Program included the annual field visual inspection and monitoring of non-automated thermistors at Dam 1B. The annual visual qualitative inspections were completed at the TCA, including the Dyke 7 Spillway, the Dam 2 Discharge Channel, and Dam 1A/1B; and non-TCA areas including the Primary Crusher Cap, Steeves Lake Shoreline, and Zone 2.5 Pit Landfill Cap. Additional areas reviewed in 2018–2019 include the Spot Lake and Truck Lake channels. The review examined the structures for stability and settlement to identify proactive maintenance activities that could be completed, if necessary. The annual field inspection was carried out on July 21, 2018 by an experience geotechnical engineer: Mr. Joel Pineau, P.Eng.

In general, the areas and structures observed in the TCA, including the tailings covers, Dyke 7, Dyke 7 Spillway, Dam 1A/1B, and Dam 2 Discharge channel, are performing adequately without signs of instability, settlement or movement. Based on the July 2018 annual site inspection of the TCA areas, the following was recommended:



- **Dyke 7 Spillway:** Occurrences of suspected tailings within and just above the stilling basin suggest that seepage through the tailings and into the spillway is likely on-going. Depending on the design assumptions for the stilling basin, clean-out of accumulated deposits may be necessary in the future.
- **Dam 1B:** A depressed area near the toe along the north abutment was noted. The depression is consistent with the 2011 SRK Consulting inspection report. This area should continue to be monitored and if settlement is observed to be on-going, remedial measures, such as placement of rock infill or investigation of the cause of the settlement may be required.

The five non-TCA areas that were reviewed are performing well. There are no recommendations for the Primary Crusher cap or the Zone 2.5 Pit Landfill. These areas should continue to be reviewed in accordance with the PCMMP for the Colomac Mine site. Based on the July 2018 annual site inspection of the non-TCA areas, the following is recommended:

- **Steeves Lake Shoreline:** For the discontinuous displaced cracks observed in the area above the remediated Steeves Lake Shoreline, no remedial action is considered necessary at this time; however, it was recommended that this area continue to be reviewed to monitor potential changes.
- **Spot Lake Channel:** It was observed that the Spot Lake Channel banks at the location of the former plug remain over-steepened; however, they do not exhibit any indications of instability. Water was observed flowing around the buried section of geomembrane in the south bank. There remains some exposed geomembrane below the water surface within the channel. It was recommended that the previously planned remediation works be completed during the next scheduled Maintenance Program, specifically when larger equipment can be made available.

CIRNAC agrees with the recommendation for continued monitoring. The geomembrane in Spot Lake channel will be addressed when appropriate equipment is available.

9.3 HCMP and Re-Vegetation Monitoring

Re-vegetation monitoring was not completed as part of the 2018 field program.

Remediation activities at the former Colomac Mine necessitated the harmful alteration, disruption, or destruction of fish habitat on Steeves Lake, and that required compensation to off-set the harm. Harmful alteration, disruption, or destruction of fish habitat is now referred to as serious harm to fish habitat and compensation is now referred to as offsetting. Compensation works were approved with the Site's Fisheries Act Authorization 09-HCAA-CA6-00128, issued May 7, 2010. Compensation works included the construction of two channels (Dam 2 Channel and Truck Lake Channel), and the re-vegetation of five areas, including the constructed channel banks and riparian areas. The five compensation works, totaling 10,416 square metres, consist of Steeves Lake Shoreline, Truck Lake East Shoreline, Truck Lake West Shoreline, Truck Lake Channel, and Dam 2 Channel.

The 2018 (Year 4) results of the HCMP at Truck Lake Channel and Dam 2 Channel, which are specific to channel surveys and aquatic biota assessments, were collected through monitoring of



the Channels during two summer/fall field events: July 21 and 22, 2018, and September 5, 2018. Monitoring followed the Canadian Aquatic Biomonitoring Network (CABIN) protocol in accordance with the CIRNAC Habitat Compensation Monitoring Plan.

Truck Lake Channel

In Year 1 (2014) and Year 2 (2015) of the HCMP, Truck Lake Channel had no surface water flow throughout the summer season. Due to an anomalous flood event in the Baton-Spot-Truck system immediately prior to the July 2016 field event, high flows were observed in Year 3 (2016). Water was again flowing in Year 4 (2018), but flow was intermittent in September. Water velocity was low enough to allow passage of most local fish species.

In 2018, water quality was similar to 2016, with high dissolved oxygen, low conductivity and low nutrient concentrations. Based on the 2017 vegetation survey, the re-vegetation program was successful, despite sparse cover in some areas; vegetation cover had improved since the 2015 survey. Blast-rock gravel and cobble substrates dominated the channel. Fish were observed but not caught in September 2018. Benthic invertebrate species diversity and specimen counts were considerably higher than in 2016, but family level community composition was similar. No stability issues were observed at Truck Lake Channel. Structurally, the compensation works were observed to be functional and performing as intended.

Dam 2 Channel

In 2018, water was flowing throughout the channel on both sampling events (in contrast to previous years when the channel was dry in late summer). Channel morphology was riffle—run, with isolated pools. No periphyton cover was noticeable, and isolated grasses were present in-stream. Riparian vegetation was dominated by grasses with interspersed shrub species (e.g., willows) throughout. There was isolated canopy cover in spots where larger shrubs overhung the channel.

Based on the 2017 vegetation survey, the re-vegetation program was successful, with 100% survival of planted sedge plugs. In-situ and analytical water chemistry indicated clear waters in Dam 2 Channel, with high dissolved oxygen, high alkalinity and high hardness, resulting in high conductance and high-acid buffering capacity; nutrient concentrations were moderate.

Cobble and gravel dominated the substrate. Average water velocities were low enough to allow passage of locally occurring fish species, but no fish were caught or observed. Benthic invertebrate species diversity and specimen counts were high. No stability issues were observed within Dam 2 Channel. Structurally, the compensation works at Dam 2 Channel and its banks were observed to be functional and performing as intended.

To evaluate the success of aquatic and riparian habitat in Truck Lake and Dam 2 Channel, relative to other streams in the Colomac mine site area, it was recommended that a reference stream(s) be selected. A reference stream(s) would also provide a benchmark for comparison of changes in the channels seasonally and annually (e.g., if conditions are becoming more or less similar to other streams in the Colomac area). CIRNAC agreed with the recommendation, but noted that previous attempts to find a suitable reference stream have not been successful. Use of a reference stream will be considered for the final HCMP in 2021.



10.0 REQUESTED STUDIES

The Annual Report referred to in Part B, Item 2, shall include ... (h) a summary of any studies requested by the Board that relate to Waste disposal, Water Use or post-closure monitoring, and a brief description of any future studies planned.

The Board did not request studies in 2018.

11.0 COMMUNITY ENGAGEMENT PLAN

The Annual Report referred to in Part B, Item 2, shall include ... (i) descriptions of engagement and community participation in monitoring from the calendar year reported;

The **Colomac Monitoring Project Community Engagement Plan, Version 2, May 2016** was approved by the WLWB on October 7th, 2016.

Members of Tłı̨ch̨ communities were engaged as job shadows, to aid with the collection of samples and learn the science of the Colomac monitoring, and as Wildlife Monitors to ensure the health and safety of the field crews.

The Colomac team completed a community update for the Tłı̨ch̨ in Behchokò on March 12th, 2018.

12.0 OTHER DETAILS

The Annual Report referred to in Part B, Item 2, shall include ... (J) any other details on Water Use, Waste disposal, or post-closure monitoring requested by the Board or an Inspector by November 1st of the year being reported;

Requests for information have been addressed on an ongoing basis, with regular communication between CARD and the WLWB and Inspectors. No other details were requested by the Board or Inspectors.



APPENDIX A
**Colomac Comprehensive Monitoring Program 2018 Annual Report, Stantec
Consulting Ltd, March 2019.**



APPENDIX B

Circulation of Zone 2 Pit-Lake, Colomac NWT, 2017; Greg Lawrence and Associates, July 2018.



APPENDIX C

Circulation of Zone 2 Pit-Lake, Colomac NWT, 2018; Greg Lawrence and Associates, May 2019.