1. INTRODUCTION

WESA was retained by CanZinco Ltd. (CanZinco) to provide engineering services and site supervision related to the construction of treatment facilities for the remediation of petroleum hydrocarbon (PHC) contaminated soil at Nanisivik former fuel tank farm ("the Site"). The treatment facilities comprise a series of cells in which "biopiles" of PHC contaminated soil are placed. The treatment cells are surrounded by berms and are constructed using geomembrane liner. This report provides a summary of the treatment facility construction activities completed during the 2011 and 2012 field seasons; prepared to fulfill the requirements of Part D Section 9 of Water Licence No. 1AR-NAN0914, issued by Nunavut Water Board.

WESA provided onsite supervision for treatment cell construction and soil remediation activities, including storm water diversion and management. WESA staff was present on Site during two (2) site visits in 2011 (August 14 to 25 and September 1 to 2) and three (3) site visits in 2012 (June 19 to 23; July 12 to 21; and August 18 to 30, 2012). The Site workplans in 2011 and 2012 were overseen by SRK Consulting Inc. (SRK) on behalf of CanZinco.

2. SUMMARY OF CONSTRUCTION ACTIVITY

2.1 TREATMENT CELL CONSTRUCTION

Two treatment areas for hydrocarbon contaminated soil have been established at the Nanisivik Site: a Lower Treatment Area (LTA) located immediately to the south of the former tank farm; and an Upper Treatment Area (UTA) located approximately 150 metres to the south of the former tank farm area (Figure 1).

Construction of the treatment facilities commenced in July 2011. The construction was performed by Nunavut Construction Limited (NCL) and Arqvartuuq Services Ltd. (Arqvartuuq) under the direction of Stantec Consulting Ltd (Stantec). Four LTA cells (LTA-1, LTA-2, LTA-3 and LTA-4) were constructed and loaded by NCL. LTA-1 and LTA-2 were constructed under Stantec's direct supervision. LTA-3 and LTA-4 were built by NCL following Stantec's departure from the site, but were built as recommended by Stantec.[1] The base and berms for the first four UTA cells were also constructed by NCL. In order to construct the treatment areas the access road as it existed in 2011

[1] Information on site activity previous to WESA's involvement in the project in August 2011, was provided to WESA by SRK.

was moved closer to the exposed concrete slab of the former concentrate storage shed during July and August 2011.[2]

An additional four treatment cells (UTA-1, UTA-2, UTA-3 and UTA-4) were constructed in the UTA in August 2011. At this point, Stantec had been replaced by WESA and WESA oversaw the installation and loading of the four cells in the UTA.

In 2012, a total of eight (8) new treatment cells were constructed in July and August: six (6) at the UTA and two (2) at the LTA. These new cells bring the total number of treatment cells at the end of the 2012 field season to sixteen (16): ten (10) at the UTA and six (6) at the LTA.

The base of the treatment areas were constructed of coarse grained sand and gravel. The material was either excavated from the north and west berms of the former fuel tank facility or from soil that had been stockpiled on the exposed concrete slab. This material was identified by SRK to be clean and suitable for this construction (see section 2.3). The base and berms of each soil treatment cell were covered with 36 mil Reinforced Linear Low Density Polyethylene (RLLDPE) geomembrane liner; prefabricated to 10m by 30m dimensions.

Treatment cell as-built construction dimensions and details are illustrated in Figures 2 and 3, respectively.

2012 construction activities were performed by Arqvartuuq, an Arctic Bay, Nunavut based heavy equipment contractor. Soil screening activities were completed in August under the direction of an experienced earthworks construction supervisor provided by CMJ Consultants Inc. of St-Gérard des Laurentides, Quebec.

2.2 Stormwater Retention Pond Construction

Two stormwater retention ponds were constructed: one at the UTA and one at the LTA. Pond locations are shown in Figure 1. Dimensions of the LTA pond are approximately 28.5m long by 4.6m wide by 0.5m deep; having capacity for approximately 52,000 litres. Dimensions of the UTA pond are approximately 23.5m long by 4.0m wide by 0.5m deep; having capacity for approximately 41,000 litres. Both ponds are lined with High Density Polyethylene (HDPE) geomembrane liner. As-built drawings of the stormwater retention ponds are presented as Figures 4 and 5. Construction photos are included in Appendix A.

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[2] The road alignment as it existed in June 2011 is displayed in the underlying QuickBird aerial imagery (2007-08-15) on Figure 1.

2.3 Sourcing and Testing of Construction Materials

Sand and gravel used for construction activities were obtained from:

- berms surrounding the former fuel tanks;
- soil cover material that had been placed by CanZinco on the concrete slab of the former concentrate storage shed and subsequently removed and stockpiled by the Canadian Coast Guard; and
- elevated portions of the roadbed that was realigned during the construction of the treatment areas.

The base of the LTA cells and part of the UTA cells were constructed on the former access road and in former equipment staging areas.

Soil quality testing of the secondary containment area berms by Stantec and SRK revealed no PHC impacts or lead or zinc concentrations above the site remediation objectives. Soil quality testing of the material used to cover the concrete slab of the former concentrate storage shed had revealed no PHC or metals impacts (Gartner Lee Limited, 2004). Remediation confirmation soil quality results revealed no impacts along the road way or in the equipment staging areas utilized for the treatment areas (Gartner Lee Limited, 2008). Sampling along the former roadway prior to the construction of cells LTA-5 and UTA-9 in 2012 revealed no PHC impacts post remediation. Soil quality testing downgradient of the UTA documented no background concentrations of PHCs in the vicinity of the treatment cells. The soil quality results and sample coordinates are provided in Table 1 at the end of the report.

3. TREATMENT SYSTEM DESIGN

3.1 Treatment Cells

The soil treatment cells were constructed in accordance with the original design (Stantec, 2010) as approved by the Water Board (Nunavut Water Board, 2010). As-built drawings of the constructed treatment cell are presented as Figure 2.

3.2 Water Collection System

The water collection system consists of a sump in each treatment cell to permit pumping of collected leachate to one of the two stormwater retention ponds constructed in 2012. The water collected in the ponds will be recirculated to the treatment cells during periods of dry weather.

The original plan (Stantec 2010) called for one collection pond. However, given the site topography and location of the constructed treatment cells, two water retention ponds (one at the UTA and one at the LTA) were constructed to accept any potential accumulated water from the treatment cells as a result of excessive water from rainfall or snowmelt. Figures 4 and 5 illustrate the stormwater retention pond dimensions. In the case that excess water accumulates within the treatment cells, it will be pumped from the sump in each treatment cell to the collection ponds, where it will be stored and recirculated back onto the biopiles as needed to optimize soil moisture conditions for bioremediation.

The original design (Stantec 2010) called for a water treatment system to treat petroleum contaminated water in the treatment areas. Visual observations made in August 2011 and June 2012 identified little to no water accumulation in the treatment cells.

The Site is located in a climatic zone classified as "polar desert", which is characterized by cold temperature and relatively low precipitation. The mean annual precipitation reported at the Nanisivik Airport is 242.5 mm with an extreme daily rainfall of 36 mm reported in July 2001. Approximately 60 mm of rain falls in June, July and August and 40 cm of snow falls during those same months. (Environment Canada 2012). The mean annual lake evaporation value, as measured at the Nanisivik West Twin Disposal Area, is approximately 200 mm (BGC Engineering Inc. 2012).

4. DEVIATIONS FROM ORIGINAL DESIGN

The conceptual plan for the treatment of PHC contaminated water included a series of treatment vessels to filter out PHC and metal compounds (Stantec, 2010). The arid conditions resulted in little or no water accumulating in the sumps of the treatment cells. In order to optimize soil moisture conditions, impacted water will be recirculated from the collection ponds back onto the biopiles instead of being treated and discharged to the environment.

5. MITIGATIONS METHODS DURING CONSTRUCTION

5.1 WATER DIVERSION

Initially, a drainage ditch was excavated around the southern and eastern perimeter of the UTA. This ditch was subsequently filled in with boulders (August 2011) to prevent glaciation in the spring. To effectively direct water away from the UTA, a diversion berm was constructed outside of the ditch (Figure 1). The drainage diversion berm was constructed to a height of approximately

0.5m with coarse sand and gravel excavated from the west berms of the former fuel tank facility. This material was identified to be clean and suitable for this construction (see section 2.3).

In 2011, an existing roadside drainage ditch was extended between the UTA and the access road (Figure 1) for the purposes of directing surface runoff away from the UTA and the access road. The V-cut drainage ditch was constructed with a gradual slope along the old access road; terminating at the corner of the road. Rip rap of coarse rock was placed at the crest of the down-gradient slope at the corner of the road to slow the drainage of runoff and protect the slope from potential soil erosion.

Runoff water is diverted away from UTA-9 and UTA-10 into an existing drainage ditch which runs on the south side of the old access road.

The stormwater diversion berm to direct water away from LTA was extended further west in 2012 (Figure 1). The berm was constructed to a height of approximately 0.3m. The ground surface to the north of the diversion berm was also graded to direct water away from LTA.

The drainage ditches and berms were routinely monitored for signs of erosion.

5.2 Silt Fencing

Silt fencing was installed at two locations down-gradient of the new diversion berm to restrict suspended solids from entering the creek. It was observed that surface water drainage infiltrated the ground before reaching the two silt fences. Drainage structure locations are illustrated in Figure 1. Construction photos are included in Appendix A.

6. BLAST VIBRATION MONITORING

No blasting activities were undertaken during the construction of the treatment facilities. As a result, no blast vibration monitoring was conducted at the mine site.

7. SEDIMENT RELEASE MONITORING

Monitoring of Total Suspended Solids (TSS) was conducted by CanZinco bi-weekly within 100 m down-gradient of the area disturbed during construction. Results for 2011 and 2012 are reported in the annual water quality reports submitted to the Water Board. 2011 and 2012 TSS results at station 159-6 (Figure 1) ranged from 23 mg/L to below the detection limit of 2 mg/L (Stantec

2012)[3]. The TSS results are below the station-specific action level established for this monitoring location and do not indicate any significant impacts on receiving waters adjacent to the construction site.

8. PROPOSED CONSTRUCTION MODIFICATIONS FOR 2013

In order to improve the ease of loading and aeration of the PHC contaminated soil in the treatment cells and to increase the volume of material that can be treated, it is recommended that interior berms be eliminated and the adjacent liners be welded together. This work would be completed when the current soil in the treatment cells is removed and maintenance of the liner is being conducted.

9. REFERENCES

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Gartner Lee Limited. 2004. 2003 Phase 3 Environmental Site Assessment, Nanisivik, Nunavut. Report Prepared for: CanZinco Ltd. Dated February 3, 2004.

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Stantec. 2010. Abandonment and Reclamation Plan, Fuel Tank Farm, Former Nanisivik Mine Site, Nunavut. Report Prepared for: Breakwater Resources Ltd. Dated January 8, 2010.

[3] TSS data for the 2012 annual water quality report was provided by Stantec.

Stantec. 2012. 2011 Annual Water Quality Monitoring Report – Nanisivik Mine, Nunavut. Report Prepared for: Breakwater Resources Ltd. Dated March 9, 2012.

10. CLOSING

The conclusions presented in this report represent our professional opinion and are based upon the work described in this report and any limiting conditions in the terms of reference, scope of work, or conditions noted herein.

WESA makes no warranty as to the accuracy or completeness of the information provided by others, or of conclusions and recommendations predicated on the accuracy of that information. Nothing in this report is intended to constitute or provide a legal opinion. WESA makes no representation as to compliance with environmental laws, rules, regulations or policies established by regulatory agencies.

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This report was prepared by WESA with contributions from SRK.

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