KENO HILL SILVER DISTRICT MINING OPERATIONS

DUST ABATEMENT AND MONITORING PLAN

February 2021

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ALEXCO KENO HILL MINING CORP.

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1. INTRODUCTION

1.1 PROJECT SUMMARY

Alexco Keno Hill Mining Corp. (AKHM) is permitted to operate the Keno District Mill as well as the Bellekeno, Lucky Queen, Onek 990, the new Bermingham, and the Flame & Moth mines in the vicinity of Keno City, Yukon. The site is accessible via the Silver Trail Highway which terminates at Keno City. Bellekeno, Bermingham and Flame & Moth are currently active, whereas Lucky Queen and Onek 990 are inactive mines and they are not included in Water Licence QZ18-044. This Dust Abatement and Monitoring Plan (the Plan) has been developed to address any potential air quality effects that may occur with the operations of the active mines and Keno District Mill, as required under QML-009.

1.2 SCOPE AND OBJECTIVES

The Dust Abatement and Monitoring Plan is based in part on results of an air dispersion model completed by Access Consulting Group in June 2014 during the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA) process for the Flame & Moth Development and Production Program (Project 2013-0161) (Yukon Government {YG}, 2014). A model was conducted to identify the potential dust sources from the Bellekeno, Lucky Queen, Onek 990, and Flame & Moth mining-related activities, as well as sensitive receptors, and predicted the anticipated ambient concentrations under different operation scenarios. Further modelling was carried out in September 2017 (AEG, 2017a) by Alexco Environmental Group Inc. (AEG) to evaluate the potential air quality effects of the Bermingham Mine development and production program.

The objective of this Plan is to describe the best management practices and mitigation measures that will be employed to minimize dust emissions from mining activities at Bellekeno, Bermingham, and Flame & Moth mine sites.

2. EXISTING CLIMATIC CONDITIONS

The mine site is characterized by sub-artic climatic conditions with moderate precipitation and wide temperature variation. Summers are short (June to September), while winters are long and cold with moderate snowfall. Climatic parameters at the site are measured by three weather stations. An automated Onset HOBO meteorological station (Calumet Weather Station) was installed on Galena Hill above the Hector adit at 1,380 metres above sea level (masl). The second station, District Mill Campbell Scientific automated meteorological station, is located above the dry stack tailings facility and below the old Keno City dump at elevation 936 masl. The third station is the Valley Tailings Onset HOBO automated meteorological station, and it is located near the Valley Tailings at an elevation of 718 masl.

The mean measured temperature at the site is approximately -23.1°C to 15.1°C at the District Mill station over the last ten-year period that data has been collected. The average total precipitation over the same period is 340.9 mm. The average proportion of total precipitation that falls as rain is approximately 66%.

The average wind speed in 2020 was approximately 1.32 m/s, with the wind direction mostly from the southeast at the District Mill station. The extreme maximum wind speed recorded in 2020 was 9.78 m/s. Wind data from the District Mill weather station from June 2011 to December 2020 is depicted in the wind rose presented in Figure 1.

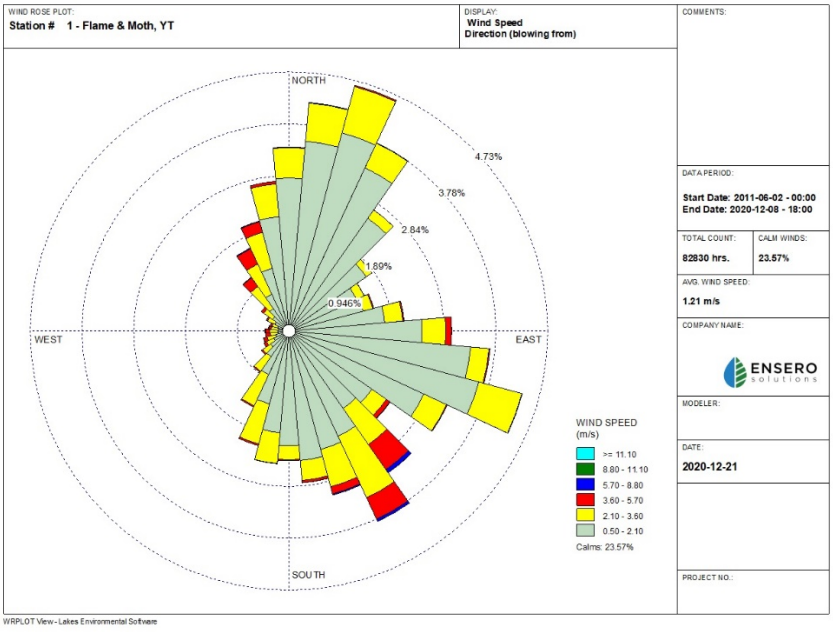


Figure 1: District Mill Wind Rose June 2011 - December 2020

3. YUKON AMBIENT AIR QUALITY STANDARDS

Dust or particulate matter can be divided into fractions of different sizes. PM_{10} (aerodynamic diameter of less than 10 µm) is the fraction of TSP (total suspended particulate) that is inhalable, and therefore have the potential to cause adverse health effects. Fine particles (aerodynamic diameter of less than 2.5 µm) are able to penetrate deeper into the lungs and are generally considered a stronger risk factor than the coarse fraction of PM_{10} (particles in the 2.5-10 µm range) (WHO, 2013).

Yukon Government, Department of Environment, implemented Ambient Air Quality Standards (YG, 2014) for TSP and $PM_{2.5}$ in 2010, and more recently for PM_{10}. Those standards and averaging periods are presented in Table 1.

Table 1: Yukon Ambient Air Quality Standards (µg/m³)

Parameter	24-hour	Annual
TSP	120	60
PM_{10}	50	n/a
$PM_{2.5}$	28	n/a

4. POTENTIAL DUST SOURCES

The main dust sources during the operations phase of mining include the dry stack tailings facility (DSTF), mineral processing (crushing), and the traffic on unpaved roads (see Figure 2).

4.1 DRY STACK TAILINGS FACILITY (DSTF)

Tailings from the process plant is transported to the DSTF. The DSTF is designed and will be constructed in two phases. Phase 1 involves construction and tailings deposition. Following completion of Phase 1, expansion of the DSTF Phase 2 will allow the remaining volume of tailings estimated in the LOM Plan to be stored.

The DSTF is subject to wind erosion and as such, represents a potential source of airborne dust in the district during the operation phase. The DSTF is being progressively reclaimed and this is the main dust control.

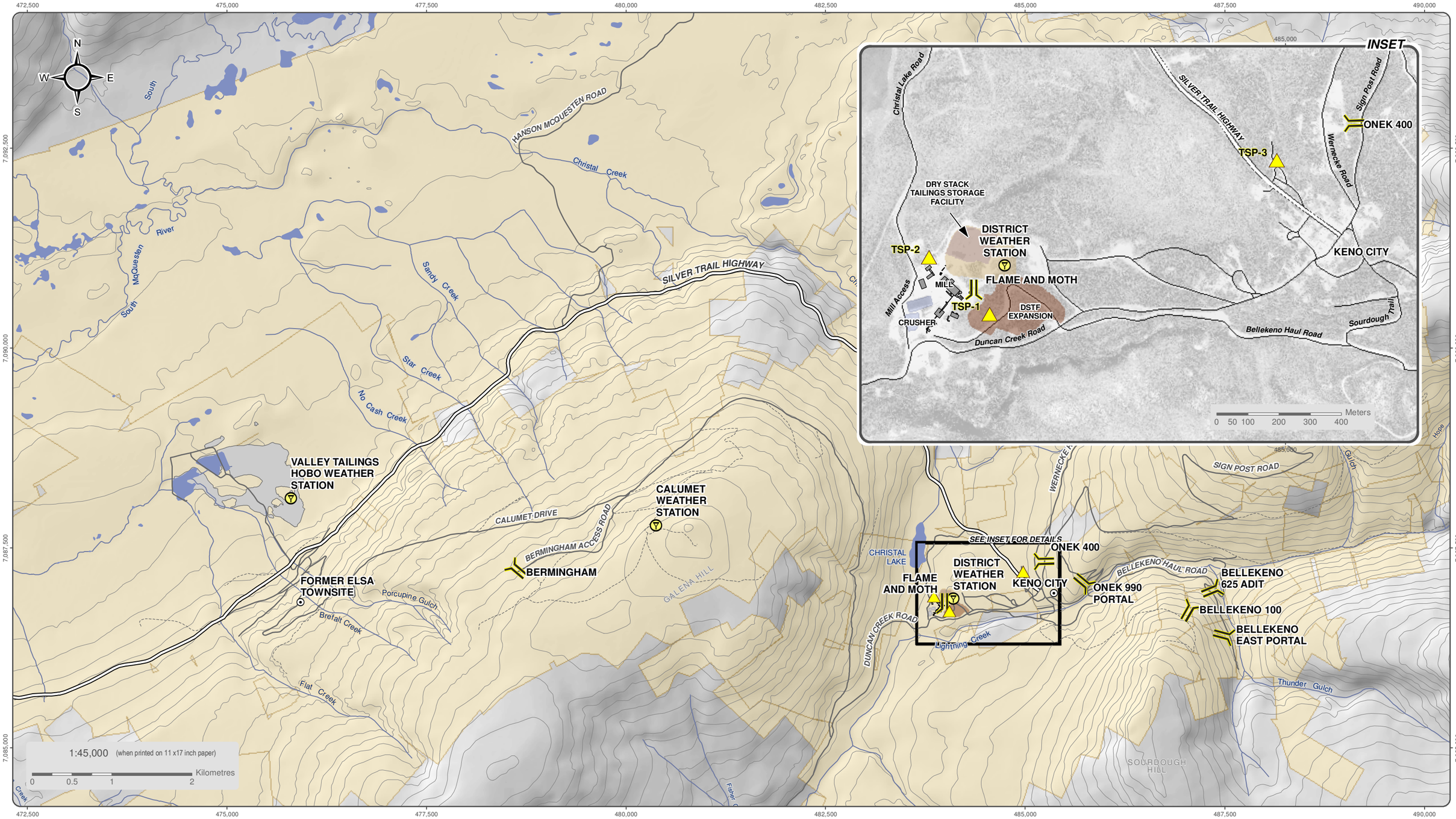
4.2 MINERAL PROCESSING

The main processes taking place at the mill and crusher include primary and secondary crushing, wet grinding and various material transfers and handling. Run of Mine (ROM) ore from the Bermingham, Flame & Moth, and Bellekeno deposits is stored at the coarse ore stockpile on a concrete base pad surrounded by portable concrete containment blocks. Ore is mixed within this coarse ore stockpile area to provide a consistent feed blend.

ROM ore crushing is completed through a standard two-stage crushing plant. The crushing system operates in closed circuit. The crusher is covered with a building that has ventilation and dust control. Crushed ore is reclaimed via a draw down pocket located beneath the fine ore stockpile.

4.3 TRAFFIC

Fugitive dust from unpaved roads is another source. The roads and estimated traffic are presented in the Traffic Management Plan. Fugitive dust emissions from unpaved roads are naturally mitigated by precipitation and may also be controlled with the use of road watering or chemical suppressants, if required.



- Alexco TSP Monitoring Stations
- Weather Station
- Adit
- Alexco/ERDC Quartz Claims
- Mill Pond
- DSTF Phase II Expansion
- DSTF 322k Tonnes Design
- Current DSTF
- Existing Building
- Valley Tailings
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

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FIGURE 2

AIR QUALITY MONITORING STATIONS LOCATION

JULY 2018

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(Last edited by: amatlashevska 04/01/2018/5:01 PM)

4.4 DUST RECEPTORS

Addressing the potential effects on community health and well being is of key importance given the location of the mine site to Keno City. In order to assess potential effects of particulate matter, discrete receptors in Keno City are used. Table 2 presents the coordinates and description of the six receptors, which are shown on Figure 2. Those same receptors were used in the Noise Impact Assessment and are part of the Noise Monitoring and Management Plan. The same stations will be used to monitor fugitive dust and noise during the operation and closure phases of the mine.

Table 2: Discrete Receptors in Keno City

Residence	GPS Location	Description
R01	N63.90827 W135.29599	East end Residence, north side of Lightning Creek Road
R02	N63.91019 W135.29968	Residence, east side of Sign Post Road
R03	N63.91023 W135.30205	Town Center, north from the Snack Bar
R04	N63.91239 W135.30376	Residence, west side of Wernecke Road
R05	N63.90851 W135.30993	Residence, about 850m east from the Mill
Cmpgrnd	N63.90772 W135.29998	Keno City campground

5. DUST MITIGATION MEASURES

AKHM has committed to the following measures which were incorporated into the air dispersion model:

- Progressive reclamation, such as placement of cover and revegetation, measures will be implemented on the existing and DSTF phase II;
- The crusher will be enclosed inside a ventilated building, which will be completed prior to resuming Mill operations; and
- Chemical dust suppressant (calcium chloride or similar) will be applied to the roads when required in addition to the road watering that will be carried between chemical dust suppressant applications.

Other mitigation measures that were not included in the model but that will contribute to reduce ambient concentrations in Keno City include:

- All traffic related to the Bermingham development will remain a minimum of 500m from the Keno City Campground; and
- All traffic related to the project operation that must pass through Keno City will be kept to a minimum necessary for care and maintenance until the bypass road forming part of project 2011-0315 is available. Once the bypass is complete, no traffic related to the operations will enter Keno City unless Keno City is the destination.

Additional mitigation measures that could further reduce fugitive dust emissions include:

- Dust suppressant could be applied to the DSTF. Including the application of a tackifier product to the exposed tailings surfaces (as final slopes or benches are completed), to reduce potential wind erosion prior to progressive reclamation; and
- AKHM will notify Keno City residents regarding traffic increases, operation schedules and potential dust generating events.

6. AIR QUALITY MONITORING

In accordance with Clause 69 of the Decision Document for the assessment of the Bellekeno Mine Project (YESAB File Number 2009-0030), dustfall monitoring was installed at two initial locations near the Keno District Mill site in March 2011, and two additional sampling locations were established in August 2011. The sampling locations are shown on Figure 3.

6.1 INSTRUMENTATION AND METHODOLOGY

Two BGI Omni Ambient Air Quality Samplers were commissioned in August 2012: one to the East of the mill and crusher (TSP-1), and one at the toe of the dry stack tailings facility (TSP-2). A third sampler (TSP-3), located in Keno City, was commissioned in December 2014 in accordance with the revised Dust Abatement and Monitoring Plan required in the Decision Document for the assessment of the Flame & Moth Development and Production Program (YESAB file Number 2013-0161). The BGI Omni samplers are set up with TSP, PM_{10} or $PM_{2.5}$ inlets, and use the filter reference method. Samples are collected over 24-hour periods and sent to Bureau Veritas laboratory for gravimetric analysis and ICP metals mass spectrometry (from TSP samples only). The sampling program aims to collect three samples per location every month for each of TSP, PM_{10} and $PM_{2.5}$ (for a total of nine samples per location), in order to capture the different weather conditions that may affect dust sources and transport.

The air quality samplers are equipped to such that the jet sizes installed can be changed to sample three sizes: TSP, PM_{10} or $PM_{2.5}$ inlets. Samples are collected following AEG's standard field protocol (Ambient Air Quality Installation and Sampling Procedure) (AEG 2018) to comply with the 24-hr, gravimetric NAPS reference method. If the 24-hr run is interrupted (e.g., power loss), a minimum of 75% data completeness is required for comparison to the Standard (CCME, 2011). As such filter runs are retained and sent to the laboratory if they ran for 18 or more hours.

On a monthly basis a total of nine samples are collected at each site (3 samples for each filter inlet size) and sent to Bureau Veritas Laboratories for gravimetric analysis and ICP metals mass spectrometry for the TSP jet sample only. The monthly monitoring requirement is summarized as:

- Three (3) 24 hour runs with the TSP jet installed at each site: TSP-1, TSP-2, and TSP-3;
- Three (3) 24 hour runs with the $PM_{2.5}$ jet installed at each site: TSP-1, TSP-2, and TSP-3; and
- Three (3) 24 hour runs with the PM_{10} jet installed at each site: TSP-1, TSP-2, and TSP-3.

The BGI Omni Ambient air quality samplers cannot collect samples below -20°C and, therefore, some winter months will have reduced data. Samples will be collected through the operations, temporary closure, and active closure period.

TSP, PM_{10} and $PM_{2.5}$ monitoring results are compared to the Yukon Ambient Air Quality Standards (YAAQS) under the *Environment Act* (see Table 1). Since there are no standards for metal concentrations in TSP in Yukon, results of metal speciation are compared to the Ontario Ambient Air Quality Criteria for reference. These criteria are summarized in Table 3 below.

Table 3: Ontario Ambient Air Quality Criteria (µg/m³)

Parameter	Criteria
Antimony	25
Arsenic	0.3
Barium	10
Beryllium	0.01
Boron	120
Cadmium	0.025
Chromium	0.5
Cobalt	0.1
Copper	50
Iron	4
Lead	0.5
Manganese	0.4
Molybdenum	120
Nickel	2
Selenium	10
Silver	1
Strontium	120
Tin	10
Titanium	120
Vanadium	2
Zinc	120

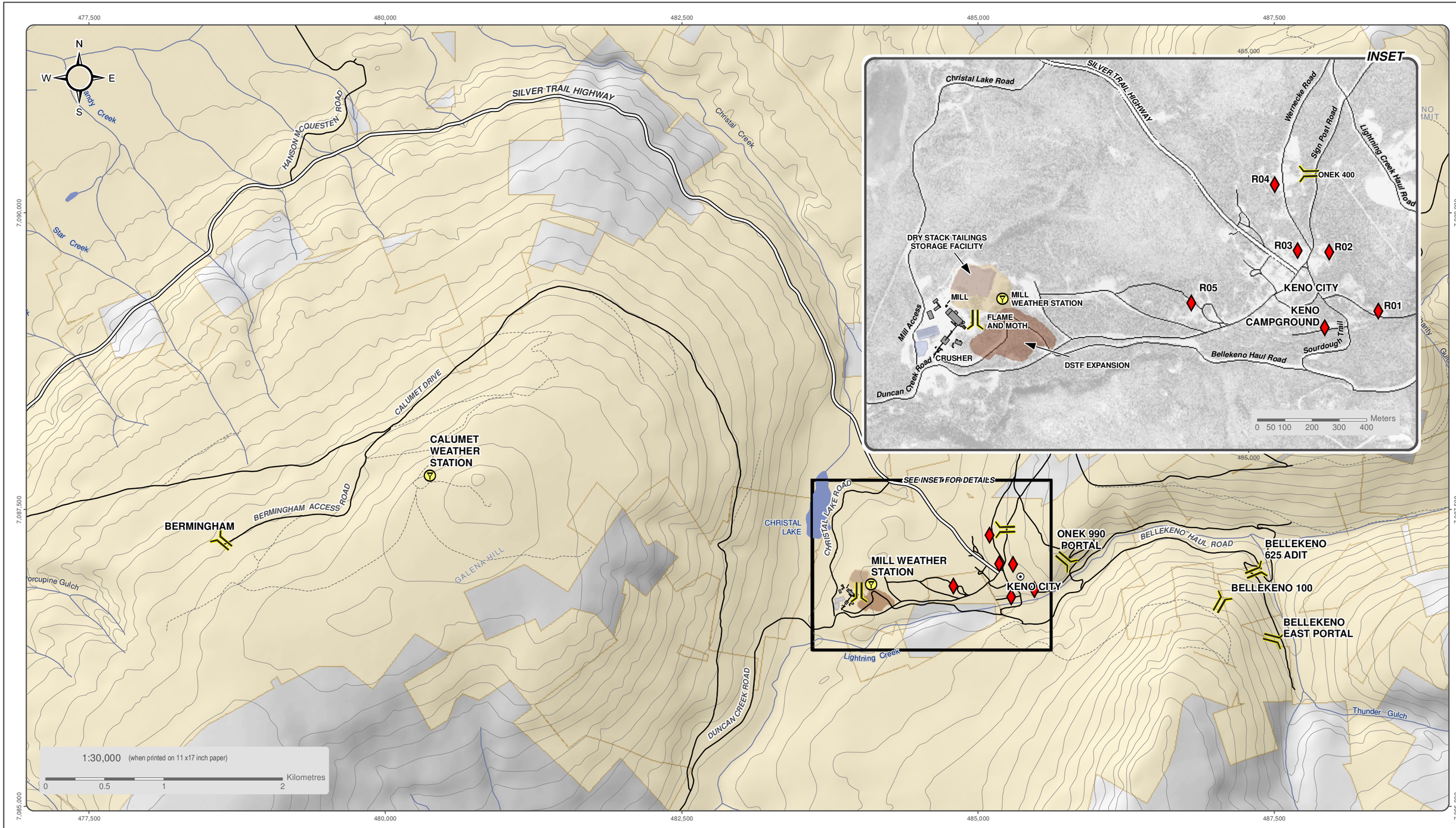
The results observed to date are presented in detail in the 2020 report Air Quality Data Summary, Keno, YT (AEG, 2017b). Monitoring will continue to be carried out as described above as the Keno Hill Silver District is developed and advanced.

6.2 UPDATED MONITORING PLAN

In response to concerns raised during the YESAA processes for Flame & Moth and Bermingham, and considering the results of the air dispersion model, AKHM will make the following changes to its air quality monitoring program (these changes are scheduled to be completed in summer of 2021):

- The sampler located at TSP-1 will be relocated to the western limit of Keno City to characterize ambient concentrations at sensitive receptors in Keno City. Of the six discrete receptors used in the model, receptor R05 (located at the western end of Keno City) is where the highest concentrations were estimated;
- The sampler located at TSP-3 will be relocated to the eastern end of Keno City (near receptor R02), to provide an understanding of how ambient concentrations vary throughout town; and

- The sampler located at TSP-2 remains in operation at the same location to provide information on ambient concentrations within the Project area and to provide data continuity as this site has been monitored for TSP since August 2012.



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Map Projection: UTM Zone 8N

- Receptor
- Weather Station
- Adit
- Alexco/ERDC Quartz Claims
- Mill Pond
- DSTF Phase II Expansion
- DSTF 322k Tonnes Design
- Current DSTF
- Existing Building
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

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FIGURE 3

POTENTIAL DUST SOURCES AND RECEPTORS

JULY 2018

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6.3 DUST DISTURBANCE NOTIFICATION

In accordance with term and condition #10 of the YESAA Decision Document for project 2017-0176 (YG, 2018), AKHM has provided Keno City residents with a means to formally complain of dust disturbance. AKHM has created a Dust Disturbance Register to track dust disturbance claims through the draft Disturbance Notification Forms (see Appendix A). Copies of the Disturbance Notification Form are available at the Keno City Library or will be sent to Keno City residents upon request. Residents can request a form by calling 647-519-3537 or emailing contactus@alexcoresource.com . Forms will be sent to Keno City residents either by direct delivery, email, or fax.

The Dust Disturbance Register is currently implemented. Any entries received will be summarized in the quarterly air quality monitoring reports and the annual reporting for the Quartz Mining License.

Dust disturbance incidents will be investigated on a case-by-case basis. Responses to a dust disturbance claim will be based on the nature of the claim and may include (but are not limited to):

- AKHM will record the dust disturbance claim in the Dust Disturbance Register and will notify the complainant that the claim has been recorded;
- If warranted, AKHM personnel will conduct an on-site visit to further investigate the dust disturbance;
- AKHM personnel will attempt to link the identified dust disturbance with a source (a specific event or activity conducted as part of mining or construction), and will determine what measures may be taken to lessen the dust generation;
- If warranted, AKHM will conduct a follow-up visit over the duration of the noise generating event to determine whether the noise levels have been sufficiently decreased; and
- AKHM will then report back to the community and regulators.

6.4 RESPONSIBILITIES

The Mine Manager or appointed designate is responsible for the effective implementation of the Dust Control Plan, providing the resources needed for the implementation and continual improvement of the Plan and for participating in annual management review meetings. Area managers and supervisors will conduct inspections in their assigned work areas as required for any significant fugitive dust emission concerns and address them with the appropriate measures.

6.5 REPORTING

Entries from the Dust Disturbance register will be summarized in the quarterly and annual air quality monitoring reports. A summary of all dust related incidences as reported by the public and residents of Keno City will be submitted as part of the annual reporting requirements.

7. REFERENCES

Alexco Environmental Group Inc. (AEG). 2017a. Bermingham Development and Production Program Air Dispersion Model. September 27, 2017.

Alexco Environmental Group Inc. (AEG). 2017b. Air Quality Data Summary, Keno City, YT. March 26, 2017.

Alexco Environmental Group Inc. (AEG) 2018. Field Protocol: Ambient Air Quality Installation and Sampling Procedure. Prepared for AEG internal June 22, 2018.

CCME. 2011. Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (2011)

World Health Organization (WHO). 2013. Health Effects of Particulate Matter http://www.euro.who.int/__data/assets/pdf_file/0006/189051/Health-effects-of-particulate-matter-finalEng.pdf

Yukon Government (YG). 2014. YESAA Decision Document. Flame & Moth Development and Production Program. Project number 2013-0161. Yukon Government. 2014. Yukon Ambient Air Quality Standards, Updated September 2014.

Yukon Government (YG). 2018. YESAA Decision Document. Bermingham Development and Production Program. Project number 2017-0176.

APPENDIX A

DISTURBANCE NOTIFICATION FORM

DISTURBANCE NOTIFICATION FORM

ALEXCO KENO HILL MINING CORP. – KENO HILL SILVER DISTRICT MINING OPERATIONS

Name of Complainant:

Phone Number & Address of Complainant:

Date	Start Time/ End Time	Location	Description of Noise, Traffic or Dust (e.g., likely source, magnitude, duration, ongoing or isolated dust incident)	How did the disturbance disrupt your life and/or your business/livelihood?

This form has been created for Keno Residents to formally complain of disturbance associated with Alexco Keno Hill Mining Corp.'s Keno Hill Silver District Operations by calling 647-519-3537 or completing the notification form. Please complete all fields. Return completed forms to contactus@alexcoresource.com.

Signature: Date: