Coffee Gold Mine

YESAB Project Proposal

Appendix 9-B Air Quality and Greenhouse Gas Emissions Intermediate Component Report

VOLUME II

Prepared for:
Kaminak Gold Corp. a subsidiary of
Goldcorp Inc.
Suite 3400-666 Burrard Street
Vancouver, BC Canada V6C 2X8

Prepared by:
Tetra Tech Canada Inc.
61 Wasson Place
Whitehorse, YT Canada Y1A 0H7

File: ENV.VENV03082-01

Ver. 1.0

March 2017

TABLE OF CONTENTS

List of Tables

List of Figures

ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AAQS	Ambient Air Quality Standards
BC	British Columbia
BCAAQO	British Columbia Ambient Air Quality Objectives
CAC	Criteria Air Contaminants
CESA	Cumulative Effects Study Area
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide-Equivalent
DO	Designated Office
EA	Environmental and socio-economic assessment
GHGs	Greenhouse Gases
IC	Intermediate Component
ISO	International Organization for Standardization
LSA	Local Study Area
NO_x	Nitrogen Oxides
$PM_{2.5}$	Particulate Matter less than 2.5 microns
PM_{10}	Particulate Matter less than 10 microns
Project	Coffee Gold Mine Project
ROM	Run-of-mine
RSA	Regional Study Area
SO_2	Sulphur Dioxide
TK	Traditional Knowledge
TSP	Total Suspended Particles
VC	Valued Environmental Component or Valued Socio-economic Component
WRFN	White River First Nation
WRSF	Waste Rock Storage Facility
YESAA	Yukon Environmental and Socio-economic Assessment Act
YESAB	Yukon Environmental and Socio-economic Assessment Board

SYMBOLS AND MEASUREMENTS

Symbol / Measurement	Definition
$\mu g/m^3$	Microgram per cubic meter
°C	Degree Celsius
ft.	Foot (feet)
kg	Kilogram
km	Kilometre
kt	Kilotonne
m	Metre
tpd	Tonnes per day
ppb	parts per billion
ppm	parts per million

1.0 INTRODUCTION

The Coffee Gold Mine (the Project), owned by the Kaminak Gold Corp., a wholly-owned subsidiary of Goldcorp Inc. (the Proponent or Goldcorp) , is a proposed gold development project in west-central Yukon, approximately 130 kilometres (km) south of the Town of the City of Dawson (Dawson). The Project is located on Crown Land within the Traditional Territory of Tr'ondëk Hwëch'in and the asserted territory of White River First Nation (WRFN). A portion of Goldcorp's claim block is located in the Traditional Territory of the Selkirk First Nation. The Project is scoped as an open pit gold mine using a cyanide heap leach process to extract ore. It would consist of an 18-month construction period, followed by a 12-year mine life with an average operation rate of five million tonnes per annum of heap leach feed.

Goldcorp retained Tetra Tech Canada Inc. (Tetra Tech) to undertake an analysis of the Air Quality and Greenhouse Gas Emissions Intermediate Component (Air Quality IC). The information provided in this analysis report supports the Project Proposal to be submitted to the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee for screening under the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA), and applications to be submitted for a Quartz Mining Licence, to be issued by Yukon Government, Energy, Mines and Resources and a Type A Water Licence from the Yukon Water Board, among other permits and licences.

This report provides the analysis of potential Project-related changes and cumulative changes to the Air Quality Intermediate Component (IC). The air quality IC includes air quality and greenhouse gases (GHG), collectively referred to as air quality. The report discusses changes to air quality from particulate matter (such as dust), combustion by-products, and GHG. Combustion by-products are gases and small particles created by the incomplete burning of fuels. Common combustion by-products are nitrogen oxides (NO_x) and sulphur dioxide (SO_2), Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Some combustion by-products contribute to the greenhouse effect by absorbing infrared radiation. These include CO_2, CH_4, and N_2O, separately discussed as GHGs. GHGs are typically discussed in terms of their equivalent amount in CO_2, the carbon dioxide equivalent (CO_2-e).

The report is divided into discrete sections intended to clearly describe all aspects of the analysis and includes the following:

- Scope of analysis including issues scoping, description of the IC selection process and outcome, and the establishment of spatial and temporal analysis boundaries
- Existing conditions relevant to air quality
- Potential interactions with specific Project components and activities, potential adverse changes, mitigation measures, and potential residual adverse changes
- Potential interactions between the residual changes due to the Project and the residual effects of other past, present, and future projects and activities, potential adverse cumulative changes, mitigation measures, and potential residual adverse cumulative changes

- A discussion of potential accidents and malfunctions related to the Air Quality IC
- Monitoring to be undertaken to verify analysis predictions and evaluate mitigation effectiveness
- Adaptive management program(s) to be implemented to address any unexpected Project-related changes to the Air Quality IC.

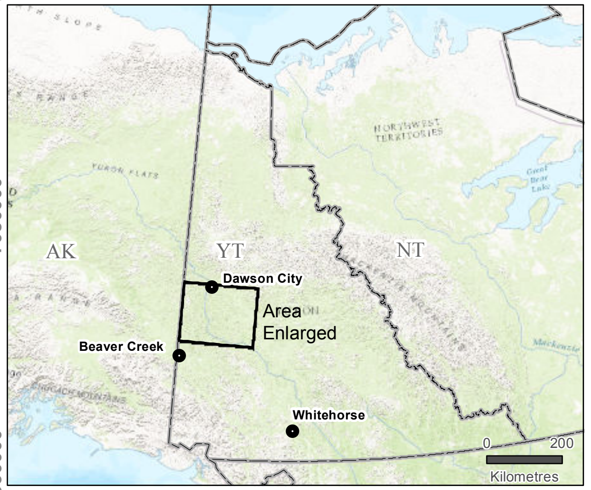
1.1 ISSUES SCOPING

The Project is located in central Yukon, and is representative of a relatively unaltered environment as it is far from any existing industrial or urban areas. With the exception of previous placer mining and quartz exploration activities, the Project area has remained relatively free from development. This observation is supported by the results of passive monitoring for combustion by-products NO_x and SO_2 within the Project area as published by Casino Mining Corporation in “Air Quality Baseline 2013”, which was produced for the Casino Project Proposal for Executive Committee Review (Casino Mining Corporation 2014; **Figure 1.1-1**). This baseline study indicated negligible quantities of NO_x and SO_2 at the adjacent Casino property, which is an indication of low industrial activity levels.

In addition to publicly available air quality data, the observation that the Project area is relatively pristine is also supported anecdotally by the following Traditional Knowledge sources (**Table 1.1-1**).

COFFEE GOLD MINE

Local and Regional Study Areas



Legend

- Northern Access Route
- Mine Site Access Road
- North Klondike Highway
- Mine Footprint
- Local Study Area
- Regional Study Area

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Imagery from ESRI; Earthstar Geographics (1999)

N

1:600,000

0 10 20 30

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 1.1-1	Date: Jan 11, 2017	Drawn by: SL	Reviewed: TM

GOLDCORP

Table 1.1-1 Traditional Knowledge Noise Quotes and References

Relevance	Topic	TK Quote	Reference	Applicable Component
Evidence to support the argument that the area should be treated as a sensitive receptor and the importance of mitigation measures to minimize changes	Cultural / Spiritual	White River First Nation (WRFN) participants therefore expressed concerns about the impacts that ongoing visual and sound pollution from project operations would have on their sense of connection to the landscape, and to the site at the mouth of Coffee Creek in particular. Large numbers of workers being present in the area, traffic, other sources of disturbance and fears of contamination associated with a large industrial project, will also all serve to diminish the sense of tranquility and spirituality that WRFN members associate with the site. WRFN members report dismay at what has already taken place at the site, including excavation and the construction of a road. But, you know, the impact of — once you open a road, it's just going to keep going further, you know? Like, they opened this one [a different gold mine] … But you go up there and — first couple years I went up there, were just — people are just mining it. And then didn't go up there for three years. So one day, we said, "Yeah, we'd better fly around up there." We flew up there. … You drive up and that road is up on the hill. And then all of a sudden, you come in this area, all of a sudden there's an airport. Roads going all over the damn place here. … And all of a sudden, it was just like that. Was just people all over the frickin' place. Road all over the damn place. They fly vehicles in, you know? On the airport. And now you've got vehicles running around all over the damn place, you know? W05 19-Aug-2014" p.46	Bates and DeRoy 2014	Air and Noise
Evidence to support the argument that the area should be treated as a sensitive receptor and the importance of mitigation measures to minimize changes.	Potential Project Interactions - Cultural / Spiritual	"In summary, potential project interactions from the Coffee Gold Project with WRFN intangible cultural heritage and cultural continuity include: • The potential disturbance and loss of an important cultural, historical and spiritual site due to visual and noise pollution from mine activities and an increase in people in the area; • Reduced opportunities for teaching WRFN culture and passing on WRFN oral history due to loss of and alienation from an important site where that history and knowledge is based, reduced opportunities for travelling on the land, and reduced traditional harvesting activities due to local reductions in quality and quantity of game, fish and plants. • A potential reduction in the connection WRFN members feel toward the landscape in general due to changes in the character and feel of the landscape, due to visual pollution, increased noise and disturbance from traffic, increased numbers of people, and fears over contamination." p. 47	Bates and DeRoy 2014	Air and Noise

Relevance	Topic	TK Quote	Reference	Applicable Component
Evidence to support the argument that the area should be treated as a sensitive receptor and the importance of mitigation measures to minimize changes.	Potential Project Interactions-Cultural Integrity	"WRFN members also harvest berries and other food plants to supplement the meat and fish they harvest from the land. We eat berries all the way [when travelling]. We're full of berries by the time we get to the end. Raspberry, blueberries, blackberries,… Salmonberries, everything... I guess that's why the native people was healthy a long time ago. They lived to be 100 and — Mom died when she was 101... So that — when I grew up, they just — on all those berries, the — like, bear root. You call bear — the root you pull out, it's like a carrot. You eat that, too. And they're all medicine. W06 19-Aug-2014 WRFN study participants report picking berries (blueberries, highbush cranberries and blackberries) in the project footprint."" p.40"	Bates and DeRoy 2014	Air
Evidence to support the argument that the area should be treated as a sensitive receptor and the importance of mitigation measures to minimize changes	Potential Project Interactions-Cultural Integrity	"Potential visual and noise pollution from the mine and its traffic, increasing numbers of people and the presence of a work camp deterring WRFN members from camping, constructing cabins or holding gatherings at the culturally important Coffee Creek site, and reducing its spiritual significance" p.6	Bates and DeRoy 2014	Air

Project activities can result in elevated levels of airborne dust, and NO_x, SO_2, CO_2, CH_4, and N_2O (hereafter defined as combustion by-products), and other contaminants of concern, all of which have the potential to result in adverse changes to local air quality and subsequent fallout (e.g. dust falling on vegetation) to the rest of the environment. The Government of Yukon has published regulatory objectives for many of these contaminants which the Project must not exceed in the Yukon Environment's *Yukon Ambient Air Quality Standards* (Yukon Environment 2010). Where Yukon regulations do not exist for a particular air contaminant (such as dustfall and PM_{10}), objectives and guidelines published by British Columbia (BC) Ministry of Environment are utilized due to similarities in geography and types of industry, making them more specific than the more general federal guidelines, where both exist.

Pollution Control Objectives were developed by the BC Ministry of Environment (BCMOE) and the BC Department of Lands, Forest and Water Resources in the 1970s. These criteria were rescinded in 2006, but the ambient air quality objectives continue to be used for reference purposes. The lower range of the ambient air quality objectives applies to sensitive environmental situations, while the upper range applies to where it can be shown that unacceptable deleterious changes will not follow. As such, contaminants are a concern to the local people in the area (**Table 1.1-1**).

Currently there are no air quality standards or emission limitations for GHGs in Yukon or BC. BC has mandatory GHG emission reporting requirements, while Yukon is adopting a voluntary emission reporting protocol for large industrial facilities under the Yukon Climate Change Strategy (Government of Yukon 2006).

The Yukon *Environment Act* Air Emissions Regulations requires permits for activities that generate air emissions, including incinerating solid waste and operating a quarry, but not including mining.

1.2 SELECTION OF AIR QUALITY AND GREENHOUSE GAS EMISSIONS

Air Quality and greenhouse gas emissions were selected as an IC based on the valued component (VC) selection process set out in **Section 5.0 Assessment Methodology** of the Project Proposal. It was determined that air quality was most appropriately identified as an IC because it is in an intermediate position along a pathway of effects leading to one or more receptors or VCs.

1.2.1 CANDIDATE ICS

Air Quality and GHG emissions were identified as an IC as it is an integral part of the natural environment. The air quality in the study area is characteristic of pristine conditions which will inevitably have interactions with the Project.

- Air quality is an important aspect of the natural environment and must be a part of any holistic assessment of the Project interactions and changes as highlighted in the following quote from 2012 Tr'ondëk Hwëch'in. Coffee Creek Traditional Knowledge Survey, Final Report (Tr'ondëk Hwëch'in 2012):
    - The value of the Coffee Creek region transcends these particular sites and encompasses all of the plants, water, land and wildlife that inhabit or travel through the area. One animal, plant,

or heritage site cannot be valued over another, nor can they be viewed in isolation. The Coffee Creek region must be seen as an interconnected whole, which is in turn, part of the larger Tr'ondëk Hwëch'in traditional territory. It is essential that anyone working in the region considers this worldview when evaluating the changes of their actions on the Coffee Creek region.

- The Yukon Government recognizes air quality as an important part of the environment and has published regulated air quality criteria for key contaminants of concern to protect it in Yukon Environment's Ambient Air Quality Standards (AAQS) (Yukon Environment 2010).
- GHGs are also an important aspect of the natural environment, changing the environment on a global scale, and impacting global climate change.

Changes to air quality from the Project are inevitable and are discussed based on the following criteria:

- Air quality can be measured directly by a number of means using a number of key indicators. Measurements of air quality indicators in the Project area can be used to monitor potential changes to air quality.
- Air quality measurements can be used to help assess and/or be representative of potential changes on other ICs including water quality, vegetation, wildlife, and human health.
- Air quality in Yukon is protected under the Yukon Environment Act, (RSY 2002, c.76) and the Air Emission Regulations (O.I.C. 1998/207). Specific Air Quality Standards are published under Yukon Environment's AAQS.
- GHG emissions are estimated based on the quantities of carbon fuels consumed. While GHG impacts are global in scale, GHG emission estimates can be used to help the government of Yukon progress in meeting the goals of its 2009 Climate Change Action Plan.

Goldcorp has undertaken an engagement and consultation process, as defined under Section 50 (3) of YESAA, to support the scoping of issues for the Project (see Section 3.0) of the Project Proposal for consultation program details). Goldcorp continues to consult and engage with affected First Nations and communities, government agencies, and interested persons and/or other stakeholders who may be interested in the Project and its related activities. This consultation and engagement process has included technical working groups established with First Nations, government departments, community meetings, one-on-one and small group meetings, and ongoing communications such as print communication, newsletter, and website updates, including specific presentations and discussions regarding key themes of interest and exploration of candidate VCs to represent the themes.

The key theme of interest identified through consultation and reviews of other information was road traffic along the NAR and within the mine site, which leads to increased dust and decreased air quality.

To support this discussion, the table provided below illustrates the process that resulted in the selection of air quality as an IC (**Table 1.2-1**).

Table 1.2-1 Candidate Intermediate Components – Evaluation Summary

Candidate IC	Project Interaction			Third Party Input		Supports the Analysis / Assessment of Which Other IC or VC?	Selected as an IC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Project Activity	Nature of Interaction	Source	Input			
Air Quality (including GHG emissions)	Yes	Construction Phase, Operation Phase, Reclamation and Closure Phase	Project activities are expected to increase levels of air quality indicators, having a potential impact on air quality.	• Yukon Environment • Tr'ondëk Hwëch'in • Selkirk First Nation • First Nation of Na-cho Nyäk Dun • White River First Nation (WRFN).	• Government Regulated AAQS • First Nations have expressed concern Re: air quality changes, visual changes (visibility), changes to plant and animal life through dustfall.	Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Birds and Bird Habitat Community Health and Well-being Surficial Geology Terrain and Soils Social Economy Land and Resource Use	Yes	Air Quality (including GHG emissions)

1.2.2 SELECTED IC

Air quality is an integral and vital part of the natural environment that can directly affect the health and lives of all living creatures within the biome. As the current air quality in the area is characteristic of pristine natural environments, changes to this will typically result in adverse changes both to those plants, animals, and humans that respire the atmosphere, but also to those that can be affected by fallout from airborne contaminants (e.g., acid rain, metal contamination of soils). The pristine natural environment is one that undergoes change such as forest fire, with transient forest fire smoke included in air quality.

Table 5.3 Intermediate Component and Valued Component Linkages, included in Section 5.0 Assessment Methodology of the Project Proposal includes a brief description of linkages between the Project, Air Quality, other ICs, and/or selected VCs in the context of each effects pathway. Further information about other ICs, and VCs potentially affected by changes to air quality are presented in the following Sections and Appendices of the Project Proposal:

- Surficial Geology, Terrain and Soils IC Assessment (**Section 11.0**, **Appendix 11-B**)
- Surface Water Quality VC Assessment (**Section 12.0**, **Appendix 12-B**)
- Fish and Fish Habitat VC Assessment (**Section 14.0**, **Appendix 14-B**)
- Vegetation VC Assessment (**Section 15.0**, **Appendix 15-B**)
- Wildlife and Wildlife Habitat VC Assessment **(Section 16.0**, **Appendix 16-B**)
- Birds and Bird Habitat VC Assessment (**Section 17.0**, **Appendix 17-B**)
- Social Economy VC Assessment (**Section 21.0**, **Appendix 21-A**)
- Land and Resource Use VC Assessment (**Section 24.0**, **Appendix 24-A**)
- Community Health and Well-being (**Section 25.0**, **Appendix 25-A**).

1.2.3 INDICATORS

Indicators are quantitative or qualitative measures used to describe existing air quality conditions and trends, and to evaluate potential Project-related changes and cumulative changes to air quality.

Air quality is quantitatively assessed by comparing the concentrations of contaminants of concern against regulated standards. The Project area is subject to Yukon Environment's AAQS; however, where no published objective or guideline exists (e.g., dust deposition), British Columbia Ambient Air Quality Objectives (BCAAQO) (BC MOE 2016) published by the BC Ministry of the Environment Environmental Standards Branch are referenced.

Table 1.2-2 describes the contaminants of concern that have been selected as they are typically associated with mining activities and have relevant regulatory standards for comparison. Standards for each contaminant of concern are presented in **Table 2.1-2** and **Table 2.2-1.**

Table 1.2-2 Indicators for Air Quality

Indicator	Rationale for Selection
Airborne Particulate Matter	
Total Suspended Particulate Matter (TSP)	Regulated under Yukon AAQS Includes all size-fractions of particulate matter, typically defined under 100 µm in aerodynamic diameter Mining operations have the potential to elevate local airborne TSP levels Major sources include wind erosion, road dust, earth-moving operations May cause visual changes
Particulate Matter <10 µm in diameter (PM_{10})	Monitored using BCAAQO PM_{10} is the size fraction of TSP that is less than 10 µm in aerodynamic diameter, and has the potential to cause health effects Mining operations have the potential to elevate the local airborne PM_{10} levels.
Particulate Matter <2.5 µm in diameter ($PM_{2.5}$)	Regulated under Yukon AAQS $PM_{2.5}$ is the size fraction of TSP that is small enough, less than 2.5 µm in aerodynamic diameter, is respirable and has the potential to cause health effects. Can be transported for kms from the emission source Mining operations have the potential to elevate local airborne $PM_{2.5}$ levels. Diesel-powered vehicle and generator emissions contain small-fraction $PM_{2.5}$.
Dust Fallout & Mineral / Metallic Content	Monitored using BCAAQO Dust fallout may have a deleterious effect on vegetation and the subsequent food chain. The mineral / metallic fraction of TSP that falls out as dust can contribute to elevated metal concentrations in soil and water. As mining activities commence, the fraction of TSP that is mineral / metallic in nature will increase.
Combustion By-Products	
Nitrogen Oxides (NO_x):	Regulated under Yukon AAQS NO_x can contribute to TSP (nitrates) formation and, or acid rain fallout. NO_x is generated as a by-product of fuel combustion, when nitrogen (N_2) combusts to form nitrogen oxide (NO) and nitrogen dioxide (NO_2) which together are known as NO_x. The proposed mining operations will elevate NO_x in the local atmosphere.
Sulphur Dioxide (SO_2):	Regulated under Yukon AAQS SO_2 can contribute to TSP (sulphates) formation and, or acid rain fallout. SO_2 is generated as a by-product of diesel fuel combustion, when sulphur (S) in the fuel combusts to form SO_2 (<15 ppm as prescribed in the Canadian Ultra-low Sulphur Diesel Regulation). The proposed mining operations will elevate SO_2 in the local atmosphere.
Carbon Monoxide (CO):	Regulated under Yukon AAQS CO causes oxygen displacement within the hemoglobin in the red blood cells within an organisms' blood stream and has the capacity to cause health effects in high concentrations. CO is generated as a by-product of incomplete fuel combustion. Some carbon (C) in the fuel partially combusts to form CO instead of CO_2. The proposed mining operations will elevate CO in the local atmosphere.

Indicator	Rationale for Selection
Greenhouse Gases (GHGs) (listed below): Carbon Dioxide (CO_2) Methane (CH_4) Nitrous Oxide (N_2O)	GHGs in the atmosphere contribute to global climate change. The proposed mining operations will contribute GHGs to the atmosphere. CO_2 is generated as a product of combustion when the majority of the carbon in fuel combusts to form CO_2. CO_2 is the primary GHG of concern related to mining activities generated as a product of partial fuel combustion much like CO. CH_4 is a GHG with a global warming potential of approximately 25 times that of CO_2 generated as a by-product of fuel combustion much like NO_x. N_2O is a GHG with a global warming potential of approximately 298 times that of CO_2.

1.3 ESTABLISHMENT OF ANALYSIS BOUNDARIES

This section identifies and provides the rationale for the spatial and temporal boundaries established for the analysis of potential changes to air quality. The boundaries encompass the area within, and times during which, the Project is expected to interact with the air quality. The section also identifies constraints on the analysis due to the limitations in predicting changes (i.e., technical boundaries).

1.3.1 SPATIAL BOUNDARIES

The Local Study Area (LSA) encompasses the local geographical area within which the Project is expected to interact with, and potentially result in direct or indirect changes to air quality. The dimensions of the LSA are the area surrounding the mine footprint and a one km radius from the NAR (**Figure 1.1-1**).

The regional study area (RSA), which encompasses the LSA, provides a regional context for the analysis of Project-related changes to air quality. The RSA also encompasses the area within which residual changes due to the Project are likely to interact with the residual effects of other past, present, or future projects or activities to result in a cumulative change or changes to air quality. The Project's contribution to cumulative changes to greenhouse gas emissions is evaluated within the global context of changes to GHG concentrations. The dimensions of the RSA considered in this analysis are approximately 44 km from east to west and 28 km from north to south, centered on the Project footprint and the Northern Access Route (NAR) **(Figure 1.1-1).** The RSA includes a 2 km radius from the centreline of the NAR.

Spatial boundary definitions for the Air Quality and Greenhouse Gas Emissions IC analysis are provided in **Table 1.3-1** and shown in **Figure 1.1-1.**

The Cumulative Effects Study Area (CESA) for all air quality indicators is defined as the area within which the changes due to Project related activities are expected to interact with the changes in air quality due to other past, present or future projects in the area. This area has been determined based on the CALPUFF dispersion modelling assessment results of the composite, worst case emissions from Project related operations for the relevant Indicators (see **Section 4.0** for more information on the modelling assessment). The boundary for inclusion in the CESA was set as the area beyond which the Project related impacts to air quality become negligible (i.e., comparable to average baseline concentrations described in **Section3.0**). Based on the modelling results for all indicators except for GHGs, this area is contained within the RSA. Cumulative effects from GHG emission from Project related activities are considered within the global context of changes to GHG concentrations.

Table 1.3-1 Spatial Boundary Definitions for Air Quality and Greenhouse Gas Emissions

Spatial Boundary	Description of Analysis Area
Local Study Area	Area surrounding the Project footprint + 1 km radius of the NAR centerline
Regional Study Area	44 km x 28 km centered around mine site + 2 km radius of the NAR centerline
Cumulative Effects Study Area	Same as RSA

1.3.2 TEMPORAL BOUNDARIES

The detailed temporal characteristics of the Project's Construction, Operation, Reclamation and Closure, and Post-closure phases are described in the Project Proposal (**Section 2.0 Project Description**). Note that the temporal boundaries established for the analysis of Project changes to air quality encompass these Project phases.

The temporal characteristics specific to air quality, including seasonal variations, are described in **Section 3.0 Existing Conditions**.

1.3.3 ADMINISTRATIVE BOUNDARIES

No administrative boundaries that might interfere with the ability to identify or assess potential effects on the Air Quality IC were identified.

1.3.4 TECHNICAL BOUNDARIES

The air dispersion model boundaries were established in consideration of the anticipated distance from the site that material changes would be predicted, the resolution of the wind field that would provide accurate predictions in the near-field, and limitations of the model (maximum number of grid cells). The model domain was 44 km (E-W) x 28 km, centered near the proposed pit areas, extending across the Yukon River to the north and to higher elevations containing the local airshed to the south. The model domain was extended to include an approximately 1 km-wide corridor along a partial alignment of the NAR, which was not included in baseline data collection due to uncertainty in the road alignment at the time of analysis.

2.0 ANALYSIS METHODS

The air quality analysis, including the analysis of Project-related changes, cumulative changes, and changes due to accidents and malfunctions, was conducted according to the methods set out in **Section 5.0 Assessment Methodology** of the Project Proposal. This section describes any IC-specific analysis methods that differed from this approach.

Emissions inventories were generated for Air Quality (**Appendix 9-B-1)** and for GHGs (**Appendix 9-B-2)**. Emissions inventories were used in analysis of both particulate matter and GHGs.

2.1 ANALYSIS METHOD – AIRBORNE PARTICULATE MATTER

The analysis of Project-related changes and cumulative changes to the ambient airborne particulate matter concentrations within the spatial and temporal bounds of the Project was carried out based on the modelled and measured ground level concentrations at representative locations on the Project site and based on modelled ground level concentrations along the NAR.

Baseline data collection for airborne particulate matter was completed using a TSI DustTrak DRX 8533 laser-scattering photometer aerosol monitor which simultaneously measures size-segregated mass fraction concentrations of airborne particulate matter including TSP, PM_{10} and $PM_{2.5}$. The units were calibrated and serviced by the supplier prior to deployment in the field and are contained within an environmental enclosure to protect them from weather.

Dustfall was also collected using passive sampling. Winter Snow core sampling was conducted in lieu of dustfall monitoring during winter conditions. Details of the baseline data collection and analysis are provided in **Appendix 9-A Baseline Air Quality and Noise at the Coffee Gold Mine 2015**.

2.1.1 AIR DISPERSION MODELLING ANALYSIS

Modelling of Project-related emissions of particulate matter was carried out using advanced air dispersion modelling software. Details of the effects modelling and results are provided in (**Appendix 9-B-3).**

2.1.2 AMBIENT AIR QUALITY MONITORING

Monitoring the changes to the Project's ambient particulate matter concentrations at ground level was completed via a combination of passive and volumetric air sampling at selected locations around the site. Details regarding the specific equipment employed for air sampling are provided in **Section 3.0** of **Appendix 9-A Baseline Air Quality and Noise at the Coffee Gold Mine 2015**. These data were collected and correlated with meteorological data collected from the existing on-site weather station in order to analyze the existing conditions and for ongoing monitoring of potential changes due to Project-related activities, including cumulative changes, and changes due to accidents and malfunctions.

2.1.3 Comparison With Regulated Standards

Data from the modelling and monitoring of Project-related activities were used to assess the relative change to the ambient concentrations of air quality indicators and compared against the standards in the AAQS and BCAAQO identified in **Table 2.1-1** (Yukon Environment 2010, BCMOE 2016).

Table 2.1-1 Relevant Particulate Matter Standards

Parameter	Standard	Source
TSP: 24-hour average [1] Annual geometric mean	120 µg/m^3 60 µg/m^3	AAQS 2010
PM_{10}: 24-hour average [1]	50 µg/m^3	AAQO 2016
$PM_{2.5}$: 24-hour average [1]	28 µg/m^3	AAQS 2010
Dust Deposition: 1-month averaged [2]	1.7 mg/(dm^2-day) – lower level 2.9 mg/(dm^2-day) – upper level	BCAAQO 2016

Notes

1 Achievement based on annual 98th percentile of daily average, over one year

2 BC dustfall objectives developed under Pollution Control Objectives were rescinded in 2006 and retained for reference purposes. Their effectiveness for determining impacts on human or environmental health is limited.

2.2 Analysis Method – Combustion By-Products

The analysis of Project-related changes, cumulative changes and changes due to accidents and malfunctions to the ambient concentrations of combustion by-products within the spatial and temporal bounds of the Project was carried out based on the modelled ground level concentrations at representative locations on the Project site.

The changes to the Project area concentrations of these contaminants in the atmosphere are expected to be relatively minimal with modelled concentrations at or below the normal method detection limits of most monitoring equipment. As such, ongoing monitoring of these contaminants has not been incorporated into the analysis method.

2.2.1 AIR DISPERSION MODELLING ANALYSIS

Modelling of Project-related emissions of combustion by-products was carried out using the same protocols and modelling software as employed in the modelling of particulate matter as described in **Appendix 9-B-3**.

2.2.2 COMPARISON AGAINST RELEVANT STANDARDS

The results of the air dispersion modelling analysis of Project-related activities was used to estimate the relative changes to ambient concentrations of air quality indicators and compared with the relevant standards presented in the AAQS, and BCAAQO cited in **Table** 2.2-1 (Yukon Environment 2010).

Table 2.2-1 Relevant Standards for Combustion By-Products

Parameter		Standard	Source
NO_2:	1-hour average [1] 24-hour average Annual arithmetic mean	213 ppbv (432 µg/m^3) 106 ppbv (215 µg/m^3) 32 ppbv (65 µg/m^3)	AAQS 2010
SO_2:	1-hour average [2] 24-hour average Annual arithmetic mean	172 ppbv (485 µg/m^3) 57 ppbv (161 µg/m^3) 11 ppbv (31 µg/m^3)	AAQS 2010
CO:	1 hour average 8 hour average	13 ppm (16,000 µg/m^3) 5 ppm (6,170 µg/m^3)	AAQS 2010

Notes:

1 Achievement based on annual 98th percentile of daily maximum, over one year.

2 Achievement based on annual 99th percentile of daily maximum, over one year.

3.0 EXISTING CONDITIONS

This section describes the existing conditions of air quality, including GHGs, and including the regulatory context for air quality, based on Traditional Knowledge, scientific information published by governments or other peer-reviewed sources and baseline studies conducted during the Project's feasibility program (**Appendix 9-A Air Quality, Noise, and Greenhouse Gas Emissions Baseline Study Report at the Coffee Gold Mine 2015)**.

3.1 REGULATORY CONTEXT

The Project area is located within the Yukon's jurisdiction and is located within the Traditional Territory of Tr'ondëk Hwëch'in and the asserted territory of the White River First Nation. A portion of the claim block is located within the shared Traditional Territory of the Selkirk First Nation. The NAR alignment is located with the Traditional Territory of the Tr'ondëk Hwëch'in, portions of which are located within the shared Traditional Territories of the Selkirk First Nation and the First Nation of Nacho Nyak Dun and the asserted territory of the White River First Nation.

Yukon regulates air quality under the *Environment Act* (RSY 2002, c.76) and the Air Emission Regulations (O.I.C. 1998/207). Specific air quality standards for individual indicators are published under Yukon Environment's AAQS and the BCAAQO published by the BC Ministry of the Environment Environmental Standards Branch (Yukon Environment 2010, BCMOE 2016), discussed in **Section 1.2**. Currently there are no air quality standards or emission limitations for GHGs in Yukon or BC. Yukon has developed a voluntary emission reporting protocol for large stationary facilities, such as electrical generators emitting over 2.5 kilotonnes of GHG emissions per year (YG 2015). The National Pollutant Release Inventory (NPRI) of Canada requires mandatory annual reporting of criteria air contaminants if quantities release into the air exceed the thresholds defined in Table 3.1-1 and the total number of hours worked at the facility exceeds 20,000 hours (approximately 10 full-time employees; Environment and Climate Change Canada 2016).

Table 3.1-1 NPRI Reporting Threshold for Criteria Air Contaminants

Criteria Air Contaminant	NPRI Reporting Threshold	*Estimated Annual Emissions (Average)
TSP	20 tonnes	2063 tonnes
PM_{10}	0.5 tonnes	633 tonnes
$PM_{2.5}$	0.3 tonnes	109 tonnes
CO	20 tonnes	787 tonnes
NO_x	20 tonnes	1299 tonnes
SO_2	20 tonnes	10 tonnes
VOC	10 tonnes	77 tonnes

***Source:** Appendix 9-B-1 Coffee Gold Mine Project - Air Emission Inventory

3.2 Background Information and Studies

3.2.1 Traditional Knowledge

Traditional knowledge related to air quality was obtained directly from potentially-affected First Nations (Bates, DeRoy 2014, Tr'ondëk Hwëch'in 2012, Tr'ondëk Hwëch'in2012a, Mishler et al 2004) and was an important factor in the selection of air quality as an IC and the selection of individual Indicators as highlighted above in **Sections 1.1 Issues Scoping** and **1.2 Selection of Air Quality and Greenhouse Gas Emissions.**

3.2.2 Scientific and Other Information

The analysis of existing air quality conditions in the Project area involved reviews of scientific and other information sources, including the following:

- Casino Mining Corporation's Air Quality Baseline 2013, Casino Project Proposal for Executive Committee Review (Casino Mining Corporation 2014), provided NO_x and SO_2 ambient background concentration data for several contaminants of concern and confirmed the approximate particulate matter related findings of the **Air Quality, Noise, and Greenhouse Gas Emissions Baseline Study Report at the Coffee Gold Mine 2015 (Appendix 9-A)**.
- Environment and Climate Change Canada's National Air Pollution Surveillance Program (NAPS) publishes annual 8- hour average CO data for a number of monitoring stations located across the country (NAPS 2016). The nearest NAPS monitoring station to the Project is located in Whitehorse (Latitude: 60.718609, Longitude: -135.05875). The available CO data from this station for the past five years has been averaged for reference to prepare the baseline analysis of air quality.
- US EPA National Oceanic & Atmospheric Administration (NOAA) collects and publishes historical data on location-specific and global average CO_2 concentrations in the atmosphere (NOAA 2016). As global GHG concentrations are universally expected to increase over the foreseeable future, only the most recent data available was used in the baseline air quality analysis.

3.2.3 Baseline Studies Conducted during the Project's Feasibility Program

During the Feasibility Program, both desktop and field studies were undertaken to assess existing conditions and provide an estimate of projected Project-related air quality changes, including the baseline ambient air quality monitoring program conducted in the RSA in 2015 and documented in **Appendix 9-A Air Quality, Noise, and Greenhouse Gas Emissions Baseline Study Report at the Coffee Gold Mine 2015.**

The purpose, duration, and spatial boundaries of each study are summarized in **Table 3.2-1** and explained in detail below.

Table 3.2-1 Summary of Desktop and Field Studies Related to Air Quality

Study Name	Study Purpose, Duration and Spatial Boundaries
Baseline Air Quality and Noise at the Coffee Gold Mine 2015	**Purpose**: Collect baseline concentration monitoring data for air quality indicators **Duration:** Monitoring activities were conducted during the early spring* and summer of 2015 and are intended to be representative of Pre-Project baseline conditions. **Spatial Boundaries**: Representative of the RSA, extrapolated to the NAR, presented in **Table 3.2-2**

3.2.3.1 Monitoring Protocols

The baseline air quality surveys were conducted according to the following standard methodologies and guidelines relevant to Yukon and the mining industry:

- TSP and $PM_{2.5}$ Monitoring: Canadian Council of Ministers of the Environment (CCME) Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone – Canada-wide Standards for Particulate Matter and Ozone (CCME 2011).
- Dust Deposition Monitoring:
  - (Summer) American Society for Testing and Materials' (ASTM) Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter) (ASTM 2010)
  - (Early Spring / Winter) BCMOE Snow Survey Sampling Guide (BCMOE 1981).

3.2.3.2 Monitoring Locations

Monitoring locations were selected according to the siting requirements published in the CCMEs National Air Pollution Surveillance Program (CCME 2011) and in consideration of several factors including the spatial description of the proposed mine infrastructure. These included:

- The major dust emission sources once the mine is operational (a cursory screening-level modelling analysis was undertaken to determine general transport patterns based on proposed pit locations using MM5 meteorological data).
- Helicopter landing access as identified by the Proponent
- Topography
- Prevalent wind conditions
- Sensitive locations for wildlife as determined by Project biologists
- There were no specific sensitive receptor locations such as the presence of permanent or temporary dwellings relevant to the Human Health Risk Assessment (HHRA) considered for the baseline study.

Monitoring was not conducted along the NAR due to changes in road alignment. Baseline conditions were extrapolated from existing and regional monitoring sites to the NAR.

Using the proposed open pit area and waste rock storage facilities (WRSF) presented in the Feasibility Study Report for the Coffee Gold Mine (JDS 2016) and preliminary diagnostic meteorological modelling using CALMET, a screening air dispersion model was run with CALPUFF which identified general areas on the property with the highest predicted air quality effects. The selected monitoring sites established locations that will be maintained for ongoing monitoring during the life of the Project. See **Table 3.2-2** and **Figure 3.2-1** for the locations of the Volumetric Sampling of TSP, PM_{10} and $PM_{2.5}$ and Passive Dustfall monitoring of Dust Fallout and its metals content and **Appendix 9-A – Air Quality, Noise, and Greenhouse Gas Emissions Baseline Study Report at the Coffee Gold Mine 2015** for baseline data**.**

Table 3.2-2 Summary of Air Quality Monitoring Locations

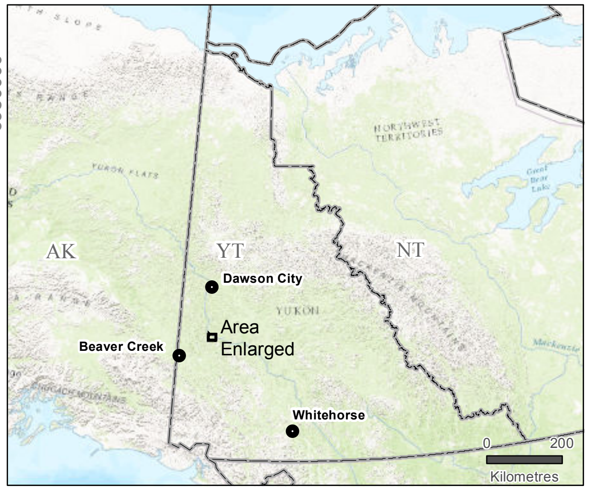
Monitoring Location	Abbr.	Volumetric Sampling (TSP, PM_{10} AND $PM_{2.5}$)	Passive Dustfall (Dust fallout and Metals)	Coordinates	
				Latitude	Longitude
Meteorological Station	MET	✓	✓	62.873595° 62.874461°	-139.185917° -139.181990°
Double-Double	DD	✓	✓	62.878513°	-139.363983°
ROM	ROM	✓		62.869182°	-139.398867°
Saddle		✓		62.878513°	-139.363983°
Helipad 1 (NW Ridge)	H1	✓	✓	62.903516°	-139.395301°
Helipad 4 (S Ridge)	H4	✓		62.851395°	-139.320814°
Helipad 6 (NE Ridge)	H6	✓	✓	62.898871°	-139.294798°
Winter Camp	CAMP	✓		62.911955°	-139.089727°

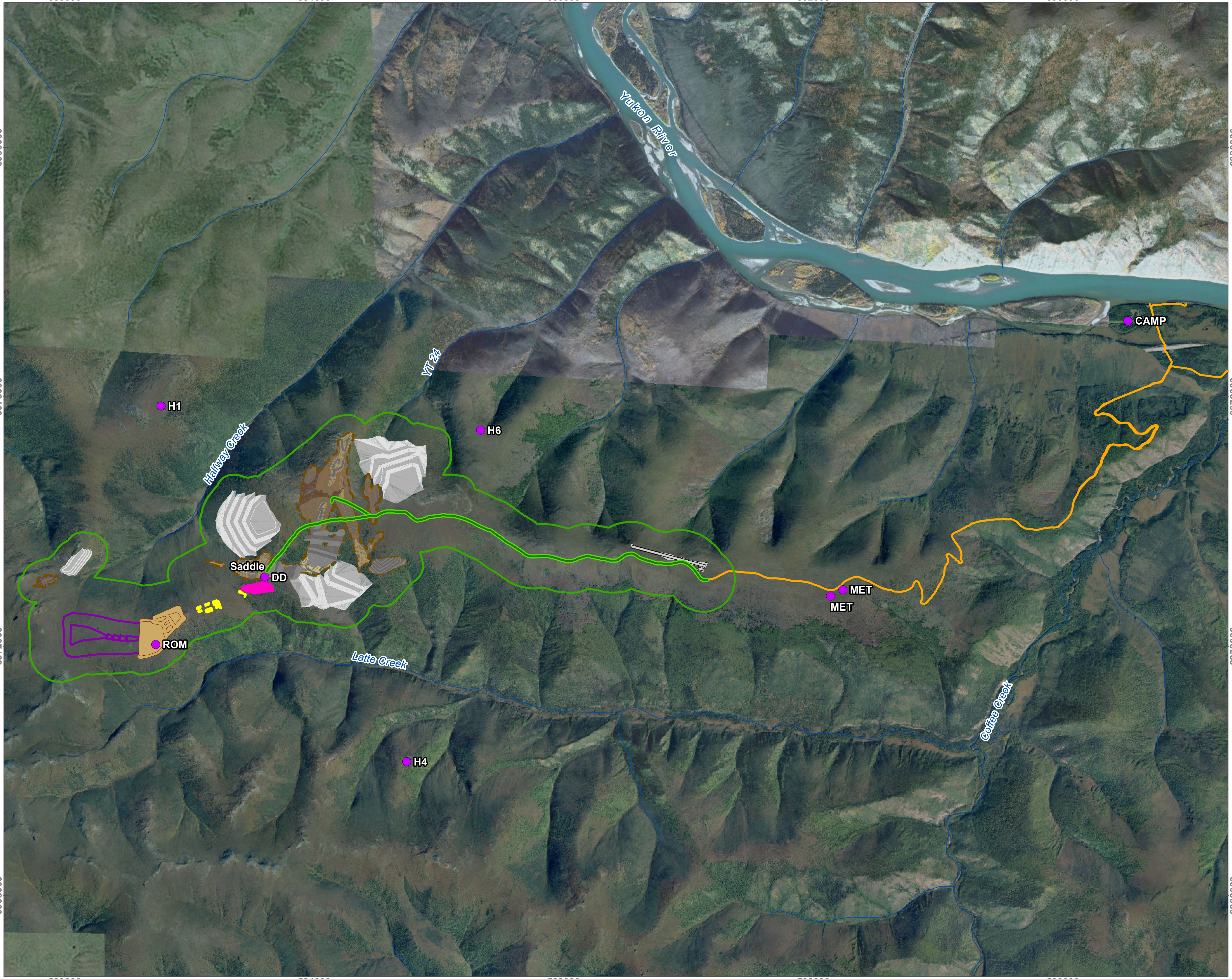
Monitoring station MET is located in the vicinity of the installed Coffee Creek meteorological station, along the northern ridge of the Latte Creek valley. This location is approximately at the project Met station. The site was selected due to ease of access, co-location with the meteorological station, and the observed wind pattern (i.e., generally downwind from the proposed mine infrastructure). It is located near the NAR providing a good location for on-going monitoring of road dust and transport of mine activity-generated particulate matter away from the Project to the east. The site is well exposed to winds in all directions with sparse small trees and shrubs.

Monitoring location DD is in the vicinity of the proposed Double Double pit, and was initially selected as it is located in the middle of the LSA. Elevated particulate matter concentrations were predicted at this location during screening dispersion model runs. The site was initially considered for long-term monitoring; however, due to infrastructure location refinements, the monitoring station will require an alternative location.

COFFEE GOLD MINE

Air Quality Monitoring Stations





Legend

- Air Quality Monitoring Station
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Plant
- Leach Pad
- Event Pond
- Airstrip
- Pit Outline

Pit Backfill

- 0 m
- 1 m - 1250 m

Pit Surface

- 0 m
- 1 m - 1000 m
- 1000 m - 1100 m
- 1100 m - 1200 m
- 1200 m - 1300 m
- Stockpile

Waste Rock Storage Facilities

- 0 m
- 1 m - 1250 m

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Access Road provided by Kaminak (August 2015).
Project Footprint provided by Hemerra (July 21, 2016).
Imagery for mine site provided by Kaminak (August 2011).
Imagery for surrounding area provided by Google; DigitalGlobe; Landsat

N

1:60,000

0 1 2 3

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 3.2-1	Date: Jan 11, 2017	Drawn by: SL	Reviewed: TM

GOLDCORP

Monitoring location ROM is in the vicinity of the proposed Camp Site, and was selected to provide baseline data as well as a potential long-term monitoring location in the vicinity of the proposed Heap Leach Facility, and was predicted as an area with elevated particulate matter concentrations during screening dispersion model runs. The location is a good choice for on-going monitoring as mine staff will frequently be working in the area and a constant reliable power source, a requirement for continuous volumetric air quality sampling, will be accessible.

Monitoring location Saddle was selected during the winter survey in lieu of the preferred location ROM which was not accessible. Saddle is located in the vicinity of the Latte Pit, and will not be available for long-term monitoring due to mine development. The area has many sparse, shorter conifers and shrubs and siting is excellent.

Monitoring location H1 is situated 30 m downslope, on the eastern aspect, from the peak of the ridge running between Dan Man Creek and Halfway Creek, north of the proposed Open Pits. The location is one of the highest points on the Project, at an approximate elevation of 1,190 m asl. (the elevation of the ridge top is 1,220 m). The site was selected based on preliminary air dispersion screening model results which predicted higher air quality changes along the ridge due to proposed mining activity and prevailing winds. The site has very sparse tree cover and low shrubs. The location is ideally situated to capture transport of Project-generated particulate matter transporting away from the property to the north.

Monitoring location H4 was selected in consultation with Project wildlife biologists as a noise sensitive location for caribou. The site is situated on the southern ridge of Latte Creek valley providing an excellent location for air quality monitoring across the valley, south of proposed Plant Site. Tree cover is very sparse with small shrubs.

Monitoring location H6 is situated on a ridge, northeast of the Open Pits. The site was selected based on preliminary air dispersion screening model results which predicted elevated concentrations of particulate matter along the ridges northeast of Plant Site due to proposed mining activities and the prevailing winds. The site has very sparse tree cover and low shrubs.

Location CAMP provides air quality conditions at the elevation of the Yukon River, northeast of the Project. Monitoring was not conducted at this location in summer because location CAMP was sampled as an alternative to location ROM, which was inaccessible in winter.

3.2.3.3 Monitoring Data Quality

Volumetric TSP, PM_{10} and $PM_{2.5}$ monitoring equipment was calibrated and set up according to manufacturer's specifications **(Appendix 9-A).** The results of the monitoring activities have been reviewed for data quality and adjusted to remove anomalies where necessary (i.e., zero drift corrections).

The presence of forest fires upwind of the Project area should be noted during the summer sampling period which elevated the average ambient concentrations of these indicators.

Samples collected for dust deposition analysis were collected with two quality control duplicates per sampling location to ensure consistency and identify outliers in the data.

3.3 DESCRIPTION OF EXISTING CONDITIONS

This section describes the air quality setting and dynamics in the RSA and LSA. This section also provides a description of pre-Project conditions (i.e., conditions prior to interaction with the Project), based on TK, scientific and other information, and baseline studies undertaken during the Project's Feasibility Program.

3.3.1 EXISTING CONDITIONS – AIRBORNE PARTICULATE MATTER

The airborne particulate matter related air quality in the Project area is representative of a pristine environment as it is far from any existing industrial or urban areas and has remained unaffected by development. The pristine natural environment is one that undergoes natural variation such as transient forest fire smoke which is part of the ambient air quality.

3.3.1.1 Existing Conditions - TSP, PM_{10} and $PM_{2.5}$

Volumetric ambient air quality monitoring of TSP, PM_{10} and $PM_{2.5}$ at the Project site during winter recorded very low levels of TSP, PM_{10} and $PM_{2.5}$ concentrations - approximately 2 $\mu g/m^3$ on average. Low concentrations in winter are typical as snow cover eliminates open sources of particulate matter and organic sources which release pollens are relatively dormant. The measured concentrations are equivalent to approximately 3% of the AAQS for TSP and approximately 7% of the AAQS for $PM_{2.5}$ and are expected to be typical of pristine conditions during winter months.

Ambient air quality monitoring conducted during the summer showed elevated TSP, PM_{10} and $PM_{2.5}$ concentrations which exceeded AAQO. Elevated concentrations were due to the influence of migrating forest fire smoke upwind of the Project-site. The conditions are not atypical of the region during dry summer months which are also conducive to high pollen and mold spore counts which can elevate $PM_{2.5}$ concentrations. The presence of springtime arctic haze due to anthropogenic air pollution can also negatively impact air quality in the region. Lower concentrations measured in the summer occurred following a rainfall event which has the effect of scavenging the air of particles.

Table 3.3-1 provides a summary of the ambient monitoring results for TSP, PM_{10} and $PM_{2.5}$ from the **Air Quality, Noise, and Greenhouse Gas Emissions Baseline Study Report: Coffee Gold Mine 2015 (Appendix 9-A).** Details of the data analysis are provided in Appendix 9-A.

Table 3.3-1 Summary of Airborne Particulate Matter – Existing Conditions

Parameter	AAQS	Season	Minimum Ground-Level Concentration	Maximum Ground-Level Concentration	Average Ground-Level Concentration
Total Suspended Particulate Matter (TSP)	120 µg/m³	Winter	1 µg/m³	65 µg/m³	2 µg/m³
		Summer	<1 µg/m³	200 µg/m³	41 µg/m³
Particulate Matter <10 µm (PM_{10})	50 µg/m³	Winter	1 µg/m³	61 µg/m³	2 µg/m³
		Summer	<1 µg/m³	193 µg/m³	40 µg/m³
Particulate Matter <2.5 µm ($PM_{2.5}$)	25 µg/m³	Winter	1 µg/m³	34 µg/m³	2 µg/m³
		Summer	<1 µg/m³	177 µg/m³	40 µg/m³

3.3.1.2 Existing Conditions - Dust Deposition

Dust depositional rates were measured on site using passive dustfall monitoring samplers adhering to the ASTM 2010 standard for dustfall sampling during the summer and through analysis of particulate matter contained in snow cores during the winter. Dustfall amounts varied with season and sampling location. During winter, the average dust deposition rate was 0.17 milligrams per decimeter per day ($mg/dm^2/day$). During summer, the site-average dust deposition rate was 0.5 $mg/dm^2/day$. The measured quantities are indicative of a relatively pristine environment.

Dust samples were also analyzed by ALS Environmental Ltd. to determine the constituents of the dust. Total dustfall consists of a mineral portion (fixed) and an organic portion (volatile). The site-average ratio of fixed to volatile dustfall components is shown in **Table 3.3-2**.

Table 3.3-2 Dust Deposition Constituents – Existing Conditions

Constituent	Winter Average Composition (%)	Summer Average Composition (%)
Mineral / Metallic (fixed)	29%	31%
Organic Matter (volatile)	71%	69%

The observed distribution suggests that the majority of ambient dust deposition in the Project area under existing conditions is organic in nature (i.e., pollen, mold spores, soot, smoke, etc.)

3.3.1.3 Baseline Data Quality - TSP, PM_{10} and $PM_{2.5}$

The baseline TSP, PM_{10} and $PM_{2.5}$ data that was collected followed standard monitoring protocols for siting and calibrations. Dustfall monitoring conducted in summer adhered to the ASTM 2010 standard for dust collection. Winter snow core sampling provided data sufficient to assess baseline particulate depositional rates and was collected based on standard sampling protocols. Sample analysis was conducted at an accredited environmental laboratory (ALS Environmental Ltd.) in Whitehorse and chain of custody followed appropriate protocols.

3.3.1.4 Natural and Human-Caused Trends

In general, climate change models tend to predict warmer annual temperatures and increasing precipitation for the region. The result of the predicted trend would be a longer snow-free season and a longer vegetation growing season resulting in increased pollen counts and suspended organic matter and subsequently elevated concentrations of TSP, PM_{10} and $PM_{2.5}$.

There are no readily apparent human-caused trends in particulate matter related air quality indicators in the RSA.

3.3.1.5 Past / Present Project-related Changes to the Existing Condition

The air quality in the Project area is relatively unaffected by past/present Project-related changes as changes to airborne particulate matter levels in the environment are quickly remediated via natural mechanisms including, but not limited to: deposition on vegetation or other surfaces, removal from the atmosphere via rain or other precipitation (particulate matter can act to nucleate rain droplets).

3.3.2 EXISTING CONDITIONS – COMBUSTION BY-PRODUCTS

The combustion by-product related air quality in the Project area is representative of a pristine environment as it is far from any existing industrial or urban areas and has remained unspoiled by development. The region is naturally subjected to slightly elevated levels of combustion-related contaminants in the spring due to migration of arctic haze – aerosols due to anthropogenic air pollution originating in mid-latitudes.

3.3.2.1 Existing Condition - NO_x and SO_2

Estimates of ambient concentrations of NO_x and SO_2 in the region are provided in Casino Mining Corporation's Air Quality Baseline 2013, Casino Project Proposal for Executive Committee Review (Casino Mining Corporation 2014). Baseline NO_x and SO_2 was collected at the Casino Project site – approximately 30 km southeast of the Coffee Gold Project - using passive monitoring.

Due to the homogeneity of NO_x and SO_2 concentrations through the area – a pristine mountain environment located well away from industrial and urban centers – the baseline data is expected to be representative of regional conditions. The results of the monitoring study indicate that the average concentrations of NO_x and SO_2 in the region are 0.15 ppb and <0.1ppb, respectively and represent less than 1% of AAQS.

3.3.2.2 Existing Condition - CO

Estimates of ambient CO levels at the Project site are inferred based on CO monitoring data from the Whitehorse National Air Pollution Surveillance Program (NAPS) monitoring station. The most recent five

(5) years of annual NAPS data summaries (2010 to 2014) indicates an average 1-hour and 8-hour CO concentration of 2.7 mg/m^3 (2.2 ppm) and 1.7 mg/m^3 (1.4 ppm), respectively, representing 16% and 28% of the Yukon AAQS. Due to population, vehicles and industry, ambient CO at Whitehorse is expected to be much higher than that at the Coffee Gold Project.

3.3.2.3 Existing Condition - GHGs (CO_2, Methane, Nitrous Oxide)

The concentration of CO_2 in the atmosphere in Yukon is expected to be equivalent to the global average CO_2 concentration in the lower atmosphere. The NOAA collects and publishes data on average CO_2 concentrations in the atmosphere (NOAA 2016). As global CO_2 levels are expected to rise for the foreseeable future, the average concentration has been taken as the average of the recently published 2015 and 2016 global CO_2 data. The 2015 January average of 399 ppm has been taken as a minimum value with the maximum value taken as the recent January 2016 concentration of 402 ppm with an approximately average concentration of 400 ppm.

3.3.2.4 Baseline Data Quality – NO_x and SO_2

The ambient NO_x and SO_2 concentration data, measured on an adjacent mining claim for the Casino Mining Corporation's Air Quality Baseline 2013, Casino Project Proposal for Executive Committee Review (Casino Mining Corporation 2014), is sufficient to assess changes in air quality. Although the sample set was small, with two sample sets for each contaminant, the sampling was conducted according to industry standard passive monitoring protocols and the results are consistent with the conditions Tetra Tech would expect in a relatively pristine area.

3.3.2.5 Baseline Data Quality – CO

In pristine areas sources of CO are limited to forest fires. The CO data collected at the NAPS Whitehorse monitoring station is expected to be sufficient to infer a conservative measure of baseline air quality at the Project site; however, the distance from the Project and potential influences from residential (e.g. wood burning, vehicle usage) and industrial sources near Whitehorse on the monitoring data make it less representative of the Project air quality. It is expected that this will constitute a conservative overestimate of existing conditions.

3.3.2.6 Baseline Data Quality – CO_2, Methane, Nitrous Oxide

The global data for CO_2, CH_4, and C_2O published as carbon dioxide equivalents (tCO_2-e) by the US EPAs NOAA organization is sufficient to assess changes in air quality, including GHGs, for the Project as it is collected based on internationally recognized protocols and has been extensively reviewed for quality prior to reporting.

3.3.2.7 Natural- and Human-Caused Trends

Global GHG concentrations are increasing over time due to human inputs to the atmosphere. It is expected that this trend will continue into the foreseeable future (NASA 2016). Due to its remote location, there are not expected to be readily apparent human-caused trends in NO_x, SO_2 and CO concentrations within the RSA.

3.3.2.8 Past / Present Project-Related Changes to the Existing Condition

There are no known past or present Project-related changes to the existing air quality as it relates to concentrations of combustion by-products as these substances are relatively short lived in the environment and are readily dispersed or removed from the atmosphere via naturally occurring processes including chemical reactions, capture by rain, and respiration by plants and animals.

4.0 FUTURE CONDITIONS WITH THE PROJECT

Air quality, including GHGs, may change in the future with the development of the Project. This section identifies and describes potential interactions between Project-related activities and air quality during Project Construction, Operation, Reclamation and Closure, and Post-closure phases. Further, the section evaluates the potential for adverse Project-related changes to air quality arising from each of these interactions.

The focus of the analysis presented in this section of the report is upon those interactions of greatest potential consequence to the Air Quality IC. The analysis considers interactions associated with mining (pit development, waste rock storage, gold recovery, and water management) at the Project and with road upgrades, construction, and vehicle traffic along the NAR. The Project Interaction Matrix in the Project Proposal (**Appendix 5-A**) is formally screened in this section of the report and provides a full inventory of the drivers of change for the Project in the context of the Air Quality IC. The interactions include the use of vehicles (combusting fuel) to move earth, operation (creating road traffic), materials handling, and transportation of personnel and equipment by air. Stockpiled soil will be eroded by wind, and mining will include drilling and blasting.

Each potential Project-IC interaction is rated using the terms provided in **Table 4.1-1**. A brief description of the interaction and the rationale for the rating is documented in **Table 4.1-2.**

Air quality and GHG emissions are assessed in detail in the **Air Emissions Inventory (Appendix 9-B-1 - Coffee Project: Air Quality Inventory Summary Report)** and **GHG Emissions Inventory (Appendix 9-B-2)** for the project, considered in this section**.**

4.1 POTENTIAL FOR AN INTERACTION BETWEEN LOCAL AIR QUALITY AND THE PROJECT

Table 4.1-1 Potential for an Interaction between Local Air Quality and the Project

Term	Definition
No Interaction	Project activity will not interact with local air quality.
Negligible Interaction	Interaction with the Project activity will not have a substantive influence on the short or long-term integrity of local air quality (i.e., not measurable / not detectable using the identified indicator).
Potential Interaction	Interaction between the Project activity and local air quality may have a substantive influence on the short- or long-term integrity of local air quality (i.e., measurable or detectable using the identified indicator). The potential change due to the interaction is considered further in the change analysis.

Where no interaction between the Project and air quality is anticipated, or the interaction is considered negligible (i.e., effect would not be measurable or detectable using the identified indicator), this interaction is not considered further in the analysis.

Table 4.1-2 Potential Project Interactions with Air Quality

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Construction Phase (Year -2 through Year -1)				
Overall Mine Site	C-0	Confirmatory geotechnical drilling in select areas at the mine site, as necessary	Potential Interaction	Airborne particulate matter and fugitive dust from drilling operations and diesel combustion by-products from heavy equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-1	Mobilization of mobile equipment and construction materials	Potential Interaction	Airborne particulate matter and fugitive dust from travel on unpaved roads and diesel combustion by-products from vehicles and heavy equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-2	Clearing, grubbing, and grading of areas to be developed within the mine site	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-3	Material handling	Potential Interaction	Airborne particulate matter and fugitive dust from loading and unloading operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Open Pits	C-4	Development of Latte pit and Double Double pit	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-5	Dewatering of pits (as required)	Negligible Interaction	Diesel combustion by-products from generator operation are expected to be generated within the Project footprint due to this activity and would be expected to result in a near-negligible adverse change in air quality within the LSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Waste Rock Storage Facilities	C-6	Development and use of Alpha WRSF	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Stockpiles	C-7	Development and use of temporary organics stockpile for vegetation and topsoil	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During usage, airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.
	C-8	Development and use of frozen soils storage area	Potential Interaction / Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During usage, the coagulated nature of the frozen soils would greatly diminish erosion potential, resulting a negligible change in air quality within the RSA.
	C-9	Development and use of run-of-mine (ROM) stockpile for temporary storage of ROM ore	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During usage, airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Crusher System	C-10	Construction and operation of crushing circuit	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to crushing activity, potentially resulting in an adverse change in air quality in the RSA.
	C-11	Construction and operation of crushed ore stockpile	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During usage, airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.
Heap Leach Facility	C-12	Staged heap leach facility (HLF) construction, including associated event ponds, rainwater pond, piping, and water management infrastructure	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-13	Heap leach pad loading	Potential Interaction	Airborne particulate matter and fugitive dust from batch unloading operations and travel on unpaved roads, and diesel combustion by-products from vehicle operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Plant Site	C-14	Construction and operation of process plant	Construction: Potential Interaction Operation: Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as the process plant is housed, with trace amounts of various combustion by-products emitted through building exhaust vents.
	C-15	Construction and operation of reagent storage area and on-site use of processing reagents	Construction: Potential Interaction Operation/Usage: Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as the process plant is housed, with trace amounts of various volatile organic carbons emitted through building exhaust vents.
	C-16	Construction and operation of laboratory, truck shop, and warehouse building	Construction: Potential Interaction Operation: Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as the process plant is housed, with trace amounts of various combustion by-products emitted through building exhaust vents.
	C-17	Construction and operation of power plant	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, diesel combustion by-products will be emitted through an exhaust vent, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-18	Construction and operation of bulk fuel/LNG storage and on-site use of diesel fuel or LNG	Construction: Potential Interaction Operation: Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as trace amounts of evaporative-loss VOC emissions are expected to occur.
Camp Site	C-19	Construction and operation of dormitories, kitchen, dining, and recreation complex buildings; mine dry and office complex; emergency response and training building; fresh (potable) water and fire water use systems; and sewage treatment plant	Construction: Potential Interaction Operation: Negligible Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as trace amounts of various heating-related combustion by-products will be emitted through building exhaust vents.
	C-20	Construction and operation of waste management building and waste management area	Potential Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, fine airborne particulate matter and diesel combustion by-products will be emitted through an exhaust vent, potentially resulting in an adverse change in air quality in the RSA.
Bulk Explosive Storage Area	C-21	Construction of storage facilities for explosives components and on-site use of explosives	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Mine Site and Haul Roads	C-22	Upgrade, construction, and maintenance of mine site service roads and haul roads	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Site Water Management Infrastructure	C-23	Development and use of sedimentation ponds and conveyance structures, including discharge of compliant water	Development: Potential Interaction Use: No Interaction	During development airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. No changes to air quality are expected from usage.
	C-24	Initial supply of HLF process water	No Interaction	No changes to air quality are expected from this activity.
	C-25	Ongoing use of site contact water (i.e., precipitation, stored rainwater) as HLF process water	No Interaction	No changes to air quality are expected from this activity.
Ancillary Components	C-26	Upgrade of existing road sections for Northern Access Route (NAR), including installation of culverts and bridges	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-27	Construction of new road sections for NAR, including installation of culverts and bridges	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-28	Development, operation, and maintenance of temporary work camps along road route	Development: Potential Interaction Operation & Maintenance: Negligible Interaction	During development airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, negligible interaction is expected as trace amounts of various heating-related combustion by-products will be emitted through building exhaust vents.
	C-29	Vehicle traffic, including mobilization and re-supply of freight and consumables	Potential Interaction	Airborne particulate matter and fugitive dust from vehicle travel on unpaved roads and diesel combustion by-products from vehicle operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-30	Development, operation, and maintenance of barge landing sites on Yukon River and Stewart River	Development: Potential Interaction Operation/Maintenance: Negligible Interaction	During development airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, short-duration diesel combustion by-products emitted in vehicle exhaust is expected to occur during loading/offloading. Changes in air quality in the RSA will be negligible.
	C-31	Barge traffic on Stewart River and Yukon River, including barge mobilization of equipment for NAR construction	Potential Interaction	Diesel combustion by-products are expected to be generated within the NAR during barging operations, potentially resulting in an adverse change in air quality in the RSA.
	C-32	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	Potential Interaction	Diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-33	Annual construction and operation of winter road on the south side of the Yukon River	Potential Interaction	Diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-34	Construction, operation, and maintenance of permanent bridge over Coffee Creek	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-35	Construction and maintenance of gravel airstrips	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	C-36	Air traffic	Potential Interaction	Combustion by-products related to jet and helicopter fuel and fugitive airstrip dust are expected to be generated upon arrival, taxi and departure of aircraft within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-37	Use of all laydown areas	Negligible Interaction	Negligible interaction is expected as small amounts of fugitive dust and vehicle diesel combustion by-products may be emitted during loading/offloading activities.
	C-38	Use of Coffee Exploration Camp	Negligible Interaction	Negligible interaction is expected as trace amounts of various heating-related combustion by-products will be emitted through building exhaust vents.
Operation Phase (Year 1 through Year 12)				
Overall Mine Site	O-1	Material handling	Potential Interaction	Airborne particulate matter and fugitive dust from loading and unloading operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, diesel combustion by-products from vehicle and equipment operation, and trace pore space VOC emissions from contaminated soils are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-3	Progressive reclamation of disturbed areas within mine site footprint	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Open Pits	O-4	Development of Kona pit and Supremo pit and continued development of Double Double pit and Latte pit	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-5	Cessation of mining at Double Double pit, Latte pit, Kona pit, and Supremo pit	No Interaction	No changes to air quality are expected from this activity.
	O-6	Partial backfill of Latte pit and Supremo pit	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	O-7	Backfill of Double Double pit and Kona pit	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.
	O-8	Dewatering of Pits (as required)	Negligible Interaction	Diesel combustion by-products from generator operation are expected to be generated within the Project footprint due to this activity and would be expected to result in a near-negligible adverse change in air quality within the LSA.
Waste Rock Storage Facilities	O-9	Continued development and use of Alpha WRSF	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-10	Development and use of Beta WRSF	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Stockpiles	O-11	Continued use of temporary organics stockpile for vegetation and topsoil	Potential Interaction	During usage, airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.
	O-12	Continued use of frozen soils storage area	Negligible Interaction	The coagulated nature of the frozen soils would greatly diminish erosion potential, resulting a negligible change in air quality within the RSA.
	O-13	Continued use of ROM stockpile for temporary storage of ROM ore	Potential Interaction	Airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Crusher System	O-14	Crusher operation	Potential Interaction	Airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to crushing activity, potentially resulting in an adverse change in air quality in the RSA.
	O-15	Continued use of crushed ore stockpile	Potential Interaction	Airborne particulate matter and fugitive dust are expected to be generated within the Project footprint due to wind erosion of loose surface material, potentially resulting in an adverse change in air quality in the RSA.
Heap Leach Facility	O-16	Continued staged HLF construction, including related water management structures and year-round operation	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-17	Progressive closure and reclamation of HLF	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Plant Site	O-18	Process plant operation	Negligible Interaction	Negligible interaction is expected as the process plant is housed, with trace amounts of various combustion by-products emitted through building exhaust vents.
	O-19	Continued on-site use of processing reagents	Negligible Interaction	Negligible interaction is expected as the process plant is housed, with trace amounts of various volatile organic carbons emitted through building exhaust vents.
	O-20	Continued on-site use of diesel fuel or LNG	Potential Interaction	Diesel combustion by-products from various vehicle and heavy equipment operation are expected to be generated within the Project footprint. Negligible trace amounts of evaporative-loss VOC emissions from fuel tanks are expected to occur.
Camp Site	O-21	Continued use of facilities	Negligible Interaction	Negligible changes to Air Quality are expected from this activity.
Bulk Explosive Storage Area	O-22	Continued on-site use of explosives	No Interaction	No changes to air quality are expected from this activity.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Mine Site and Haul Roads	O-23	Use and maintenance of mine site service roads and haul roads	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Site Water Management Infrastructure	O-24	Continued use of sedimentation ponds conveyance structures	No Interaction	No changes to air quality are expected from this activity.
	O-25	Ongoing use of site contact water (i.e., precipitation, stored rainwater) as HLF process water	No Interaction	No changes to air quality are expected from this activity.
	O-26	Installation and operation of water treatment facility for HLF rinse water	Construction: Potential Interaction Operation: No Interaction	During development, airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA. During operation, no interaction is expected.
Ancillary Components	O-27	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential Interaction	Airborne particulate matter and fugitive dust from grading, spreading of road maintenance material, vehicle travel on unpaved roads, and diesel combustion by-products from vehicle operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-28	NAR vehicle traffic, including mobilization and re-supply of freight and consumables	Potential Interaction	Airborne particulate matter and fugitive dust from vehicle travel on unpaved roads and diesel combustion by-products from vehicle operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-29	Operation and maintenance of barge landing sites on Stewart River and Yukon River	Negligible Interaction	Short-duration diesel combustion by-products emitted in vehicle exhaust is expected to occur during loading/offloading. Changes in air quality in the RSA will be negligible.
	O-30	Barge traffic on Stewart River and Yukon River	Potential Interaction	Diesel combustion by-products are expected to be generated within the NAR during barging operations, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	O-31	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	Potential Interaction	Diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-32	Annual construction and operation of winter road on the south side of the Yukon River	Potential Interaction	Diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-33	Operation and maintenance of gravel air strips	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-34	Air traffic	Potential Interaction	Combustion by-products related to jet and helicopter fuel and fugitive airstrip dust are expected to be generated upon arrival, taxi and departure of aircraft within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	O-35	Use of all laydown areas	Negligible Interaction	Negligible interaction is expected as small amounts of fugitive dust and vehicle diesel combustion by-products may be emitted during loading/offloading activities.
	O-36	Use of Coffee Exploration Camp	Negligible Interaction	Negligible interaction is expected as trace amounts of various heating-related combustion by-products will be emitted through building exhaust vents.
Reclamation and Closure Phase (Year 13 through Year 23)				
Overall Mine Site	R-1	Reclamation of disturbed areas within mine site footprint	Potential Interaction	Airborne particulate matter and fugitive dust from loading and unloading operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Open Pits	R-3	Reclamation of Double Double pit, Latte pit, Supremo pit, and Kona pit	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.
Waste Rock Storage Facilities	R-4	Reclamation of Alpha WRSF	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.
	R-5	Reclamation of Beta WRSF	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.
Stockpiles	R-6	Reclamation of temporary organics stockpile, frozen soils storage area, and ROM stockpile	Potential Interaction	Airborne Particulate Matter from earth-moving operations and Combustion By-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this Activity. This interaction may have the potential to result in adverse changes to Air Quality in the RSA.
Crusher System	R-7	Dismantling and removal of crusher facility and stockpile	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Heap Leach Facility	R-8	Closure of HLF and related water management structures	Potential Interaction	Capping the HLF with soil will produce airborne particulate matter and fugitive dust and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation, potentially resulting in an adverse change in air quality in the RSA.
Plant Site	R-9	Dismantling and removal of process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, and bulk fuel storage	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Camp Site	R-10	Dismantling and removal or dormitories and kitchen, dining, and recreation complex buildings, mine dry and office complex, emergency response and training building, fresh (potable) water and fire water systems, sewage treatment plant, and waste management building	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Bulk Explosive Storage Area	R-11	Dismantling and removal of explosives storage facility	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Mine Site and Haul Roads	R-12	Decommissioning and reclamation of mine site service roads and haul roads	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Site Water Management Infrastructure	R-13	Decommissioning and reclamation of selected water management infrastructure, construction of long-term water management infrastructure, including water deposition to creek systems	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-14	Operation and maintenance of HLF water treatment facility	No Interaction	No changes to air quality are expected from this activity.
	R-15	Decommissioning and removal of HLF water treatment plant	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
Ancillary Components	R-16	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential Interaction	Airborne particulate matter and fugitive dust from grading, spreading of road maintenance material, vehicle travel on unpaved roads, and diesel combustion by-products from vehicle operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	R-17	NAR vehicle traffic	Potential Interaction	Airborne particulate matter and fugitive dust from vehicle travel on unpaved roads and diesel combustion by-products from vehicle operation are expected to be generated within the NAR corridor due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-18	Operation and maintenance of barge landing sites on Stewart River and Yukon River	Negligible Interaction	Short-duration diesel combustion by-products emitted in vehicle exhaust is expected to occur during loading/offloading. Changes in air quality in the RSA will be negligible.
	R-19	Annual resupply of consumables and materials for active closure via barge on the Yukon River	Potential Interaction	Diesel combustion by-products are expected to be generated within the NAR during barging operations, potentially resulting in an adverse change in air quality in the RSA.
	R-20	Annual construction, maintenance, and decommissioning of Stewart River and Yukon River ice roads	Potential Interaction	Diesel combustion by-products from vehicle and equipment operation are expected to be generated within the NAR due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-21	Decommissioning of new road portions	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-22	Air traffic	Potential Interaction	Combustion by-products related to jet and helicopter fuel and fugitive airstrip dust are expected to be generated upon arrival, taxi and departure of aircraft within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-23	Decommissioning and reclamation of airstrip	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.
	R-24	Re-opening and operation of pre-existing Yukon River exploration camp and airstrip to support post-closure monitoring activities	Potential Interaction	Airborne particulate matter and fugitive dust from earth-moving operations and travel on unpaved roads, and diesel combustion by-products from vehicle and equipment operation are expected to be generated within the Project footprint due to this activity, potentially resulting in an adverse change in air quality in the RSA.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Post-closure Phase (Year 24 onwards)				
Overall Mine Site	P-1	Long-term monitoring	No Interaction	No changes to Air Quality are expected from this activity.

4.2 Worst Case Modelling Scenario

The Project-related emissions of air quality indicators have been modelled based on the projected worst case scenario occurring in Year 6 of the Operation Phase from the 2016 Feasibility Study mine plan. This scenario takes into account the maximum projected activity rates for all Project component interactions with air quality as described in **Section 4.2.1**. Emissions during the Construction Phase, as well as those during the Reclamation and Closure Phases, described in **Section 4.2.3**, are projected to be much lower in intensity and duration relative to the Year 6 worst case scenario as detailed in the **Coffee Project: Air Quality Inventory Summary Report (Appendix 9-B-1**) and the **GHG Emissions Inventory (Appendix 9-B-2).**

Upon acquiring the project, Goldcorp did an assessment of waste rock storage options to improve mine environmental performance. This resulted in the selection of a consolidated WRSF (the Alpha WRSF) as opposed to three previously planned WRSFs (North, South, West). The resulting changes with respect to project emissions are largely based on increased haul distances to the Alpha WRSF and a larger mine haul truck fleet to ensure production targets can be met. The mine plan change results in Year 9 of the operation phase becoming the projected worst case year in terms of air emissions.

Due, in part, to the timing of the mine plan decision, air quality modelling was not updated to reflect the redesign. An emissions inventory was completed for the current mine plan (**Appendix 9-B-1**), and a comparison of emissions between the mine plan described in the 2016 Feasibility Study and the current mine plan is discussed in **Section 4.2.2.1**.

4.2.1 Construction Phase

Project-related interactions with air quality indicators during the Construction phase include adverse changes to all air quality indicator levels due to the activities described in the sections below. Changes to the Construction phase related air quality indicators have been estimated, as described in detail in the **Coffee Project: Air Quality Inventory Summary Report (Appendix 9-B-1**), the **GHG Emissions Inventory (Appendix 9-B-2),** and the **Air Quality Modelling Report (Appendix 9-B-3)**. The activities assessed include using vehicles (combusting fuel) to move earth, drive (creating road traffic), handle materials, and transport personnel and equipment by air, as well as stockpile erosion, drilling and blasting.

The following sections describe the Project-related Construction phase causes of substantive changes (adverse or positive) to air quality including the geographic extent, timing, and duration of the change and the metrics used to characterize the change.

4.2.1.1 Changes in Airborne Particulate Matter

Releases of particulate matter from Project-related activities during the Construction phase will result in an adverse change on the air quality within the RSA, by increasing the concentrations of indicator metrics including ground level TSP, PM_{10}, $PM_{2.5}$ and dust deposition. These changes are expected to be comparable to or less than those presented for the worst case Year 6 modelling results (see **Section 4.2.2.1)**. Increased concentrations of particulate matter from Project-related activities are expected to dissipate within less than 24 hours after the cessation of activities.

The major sources of airborne particulate matter are as follows:

- Using vehicles, including haul trucks and light duty vehicles, creating dust and airborne particles through the passage of vehicles on unpaved roadways disturbing fine surface sediments (i.e., silt) and creating a turbulent wake zone which transports dust up and away from the road surface.
- Moving earth, including using a grader, removing overburden materials and handling materials, creating dust and airborne particles. Particulate matter releases will be generated from disturbances to dry overburden materials by bulldozers and other earth moving equipment during the preparation of undisturbed surfaces for pit and dump areas, roadways, processing areas, airstrips, and other project infrastructure (e.g., loading into haul trucks, front-end loaders, etc.). The passage of the grader also creates a turbulent wake zone which transports dust up and away from the road surface.
- Wind erosion from stockpiled soil materials via entrainment of fine-grained materials from stockpile surfaces by winds exceeding a threshold velocity related to particle size.
- Drilling and blasting: particulate matter releases will be generated from rock drilling equipment in the form of pulverized rock dust and when explosive charges are placed in drilled holes and detonated to free the rock from the mining face. The initial vertical dispersion of particulates from blasting is several tens of metres into the air.

4.2.1.2 Changes in Combustion By-Products

The release of diesel combustion by-products during Project-related activities in the Construction phase will result in an adverse change in the air quality within the LSA and immediate surrounding area due to an increase in the concentrations of ground level TSP, $PM_{2.5}$, NO_x, SO_2 and CO. These changes are expected to be comparable or less than those for the relevant worst case Year 6 modelling results. Projected changes in the concentrations of combustion by-product from Project-related activities (**Table 4.2-1**) are expected to dissipate within less than 24 hours after the cessation of those activities.

The major sources of combustion by-products are as follows:

- Mine fleet vehicles and equipment through the combustion of diesel fuels in the internal combustion engines of the Project's fleet vehicles and other equipment (e.g., diesel generators, light stands, dewatering pumps, drills, etc.). Blasting from the detonation of the ammonium nitrate/fuel oil (ANFO) based explosives used in blasting operations primarily during mine pit development. The detonation (high speed combustion) results in initial vertical dispersion several tens of metres into the air.
- Waste incineration from the combustion of diesel and waste fuels in the waste incinerator and released from the unit's exhaust stack.

Table 4.2-1 Summary of GHG Emissions during Construction Phase

Year	Annual GHG Total (Tonnes CO2e)
Y-3	9,069
Y-1	26,277
Total	48,949

4.2.2 OPERATION PHASE

Project-related interactions with air quality during the Operation phase include changes in the following indicators due to the activities described in the following sections. Changes to the Operation phase air quality indicators have been estimated, as described in detail in the **Coffee Project: Air Quality Inventory Summary Report (Appendix 9-B-1**), the **GHG Emissions Inventory (Appendix 9-B-2),** and the **Air Quality Modelling Report (Appendix 9-B-3)** and summarized in the Sections below.

4.2.2.1 Changes in Airborne Particulate Matter

Releases of particulate matter from Project-related activities during the operations phase will have an adverse change on the air quality within the RSA, by increasing the concentrations of indicator metrics including ground level TSP, PM_{10}, $PM_{2.5}$ and dust deposition. These projected changes in particulate matter indicators from Project-related activities are expected to dissipate within less than 24 hours after the cessation of activities.

The following sections provide information as to the specific Project-related activities and sources of releases that are projected to be active during the Operations phase.

The major sources of airborne particulate matter are as follows:

- Using vehicles, including haul trucks and light duty vehicles, from the passage of vehicles on unpaved roadways disturbing fine surface sediments (i.e., silt) as well as creating a turbulent wake zone which transports dust up and away from the road surface.
- Moving earth, including using a grader and handling mined materials, creating dust and airborne particles as material is being moved from one location to another (e.g., loading into haul trucks, front-end loaders, etc.) and from the disturbance of fine surface sediments (i.e., silt) on aggregate covered surfaces during pit and road maintenance activities (i.e., grading). The passage of the grader also creates a turbulent wake zone which transports dust up and away from the road surface.
- Wind erosion from stockpiled soil materials creating dust and airborne particles via entrainment of fine-grained materials from stockpile surfaces by winds exceeding a threshold velocity related to particle size.
- Drilling and blasting, creating pulverized rock dust, soil, and silt from rock drilling equipment in the form of pulverized rock and from blasting operations when explosive charges are placed in drilled holes and detonated to free the rock from the mining face. The initial vertical dispersion of particulates from blasting is several tens of metres into the air.

- Crushing ROM ore and screening it, creating dust and airborne particles from pulverized rock, soil and silt as ROM ore is reduced in size in preparation for heap leach loading and from conveyor material drops.

Annual particulate matter emission estimates for both the original and updated mine designs can be found in **Appendix 9-B-1 Coffee Gold Mine Project - Air Emission Inventory** and **Appendix 9-B-3 Coffee Gold Mine AQ Modelling Report**. A comparison of the peak estimated annual emissions is in **Table 4.2-2**.

Table 4.2-2 Comparison of Peak Annual Particulate Matter Emissions – Old and New Mine Design/Operational Plan

	Peak Year	Extraction (million tonnes)	Total Haulage Distance (km)	Peak Annual Emissions (tonnes)		
				TSP	PM_{10}	$PM_{2.5}$
2016 Feasibility Study	Y6	39.1	1,040,447	2277	811	196
Revised Mine Design	Y9	34.0	1,824,000	2948	977	239

The new mining plan contains 13% less material extraction in the peak emissions year. As a result, the quantity of rock displaced per blast is lower resulting in lower particulate matter emissions. The total haulage distance has increased due to the elimination of the North and South WRSF, the westward relocation and expansion of the Alpha WRSF – formerly West WRSF – and subsequent expansion of the haul road network to Alpha WRSF resulting in approximately 3 km of additional haul roads.

The overall increase in kilometres travelled by haul trucks subsequently results in an increase in TSP, PM_{10} and $PM_{2.5}$ emissions along haul road corridors. The most significant changes in airborne particulate matter concentrations would be observed within tens of metres from roads as coarse particles, which account for the majority of unpaved haul road emissions, fall out close to the source. Increases in predicted airborne concentrations of PM_{10} and $PM_{2.5}$ would have decreasing significance with distance away from the LSA. The overall increase in haul road emissions would likely not result in a large difference in the extent of the area where air quality changes are predicted to occur by the model.

4.2.2.2 Changes in Combustion By-Products

Releases of diesel combustion by-products from Project-related activities during the Operation phase will have an adverse change on the air quality within the RSA, by increasing the concentrations of indicator metrics including ground level NO_x, SO_2 and CO. Projected changes in combustion by-product indicators from Project-related activities are expected to dissipate within less than 24 hours following cessation of such activities.

The following sections provide information as to the specific Project-related activities and sources of releases that are projected to be active during the Operations Phase.

The major sources of combustion by-products in the 2016 Feasibility Study mine plan and 2017 mine plan are presented in **Table 4.2-3.**

The differences in combustion emissions between the 2016 Feasibility Study and new mining and operational plans are not significant and are due to detailed quarterly fleet descriptions being provided in the new Operational Plan (**Table 4.2-4**). The predicted concentrations of these Criteria Air Contaminants (CACs) are well below the AAQO and slight increases in emissions would not result in significant changes than what is presented in the modelling results.

Table 4.2-4 summarizes GHG emissions during the Operation phase.

- Mine fleet vehicles and equipment through the combustion of diesel fuel in the internal combustion engines of the Project's fleet vehicles and other equipment (e.g., diesel generators, light stands, dewatering pumps, drills, etc.).
- Blasting via the detonation of ammonium nitrate/fuel oil- based explosives used in blasting operations primarily during mine pit development. The detonation (high speed combustion) results in initial vertical dispersion several tens of metres into the air.
- Waste incineration from the combustion of diesel and waste fuels in the waste incinerator and released from the unit's exhaust stack.

The differences in combustion emissions between the 2016 Feasibility Study and new mining and operational plans are not significant and are due to detailed quarterly fleet descriptions being provided in the new Operational Plan (**Table 4.2-4**). The predicted concentrations of these Criteria Air Contaminants (CACs) are well below the AAQO and slight increases in emissions would not result in significant changes than what is presented in the modelling results.

Table 4.2-4 Summary of GHG Emissions during Operations Phase

Year	Annual GHG Total (Tonnes CO2e)
Y 1	81,896
Y 2	92,368
Y 3	94,041
Y 4	102,187
Y 5	103,174
Y 6	98,671
Y 7	94,707
Y 8	100,564
Y 9	105,973
Y 10	86,414
Y 11	50,907
Y 12	5,196
Total	**1,016,098**

4.2.3 RECLAMATION AND CLOSURE PHASE

Project- related interactions with air quality during the Reclamation and Closure phase include changes in the following indicators due to the following activities. Changes to the Reclamation and Closure Phase air quality indicators have been estimated, as described in detail in the **Coffee Project: Air Quality Inventory Summary Report (Appendix 9-B-1**), the **GHG Emissions Inventory (Appendix 9-B-2),** and the **Air Quality Modelling Report (Appendix 9-B-3)** and summarized below.

The following sections describe the Project-related Reclamation and Closure phase causes of substantive changes (adverse or positive) to air quality.

4.2.3.1 Changes in Airborne Particulate Matter

Releases of particulate matter from Project-related activities during the Reclamation and Closure phase will have an adverse change on the air quality within the RSA, by increasing the concentrations of indicator metrics ground level TSP, PM_{10}, $PM_{2.5}$ and dust deposition. The projected changes in airborne particulate matter Indicators from Project-related activities are expected to dissipate within less than 24 hours after the cessation of activities.

The following sections provide information as to the specific Project-related activities and sources of releases that are projected to be active during the reclamation and closure phase.

The major sources of airborne particulate matter are as follows:

- Using vehicles, including haul trucks and light duty vehicles, from the passage of vehicles on unpaved roadways disturbing fine surface sediments (i.e., silt) as well as creating a turbulent wake zone which transports dust up and away from the road surface.
- Moving earth, including using a grader, handling materials, creating dust and airborne particles as material is being moved from one location to another (e.g., loading into haul trucks, front-end loaders, etc.) and from the disturbance of fine surface sediments (i.e., silt) on aggregate covered surfaces during maintenance and reclamation and closure activities (i.e., grading).
- Wind erosion from stockpiled soil materials creating dust and airborne particles via entrainment of fine-grained materials from stockpile surfaces by winds exceeding a threshold velocity related to particle size. Stockpile sizes will reduce quickly during the reclamation and closure phase as soil overburden removed during the life of the mine is returned, diminishing the amount of available loose material.
- Drilling and blasting, creating airborne particles
- Crushing ROM ore and screening it, creating dust and airborne particles from pulverized rock, soil and silt.

4.2.3.2 Changes in Combustion By-Products

Releases of diesel combustion by-products from Project-related activities during the Reclamation and Closure phase will have an adverse change on the air quality within the RSA, by increasing the concentrations of Indicator metrics including ground level NO_x, SO_2 and CO. Projected changes in combustion by-product indicators from Project-related are expected to dissipate within less than 24 hours after the cessation of activities.

Combustion by-products will be generated from the combustion of diesel fuels in the internal combustion engines of the Project's fleet vehicles and other equipment (e.g., diesel generators, light stands).

4.2.4 POST-CLOSURE PHASE

There are not expected to be any Post-closure phase changes to the air quality in the RSA. There are no interactions of Post-closure Phase Project-related activities with air quality.

4.3 MITIGATION MEASURES

The mitigation measures to be used to eliminate, reduce and, or control adverse changes to air quality and the anticipated effectiveness of each mitigation measure are described below. Mine designs, for example, to minimize haul distances and maximize fuel efficiency, are not identified as specific mitigations, as they are already part of the project description to reduce air quality impacts, including GHGs.

4.3.1.1 Project Design Measures

Mitigation measures included in the Project Description that reduce changes to AQ include continued watering of roads during snow-free periods, minimizing haul distances and maximizing fuel efficiency using high-efficiency vehicles.

4.3.1.2 Minimize Vehicle Traffic

Most personnel will operate on a two-week on, two-week off shift rotation on a fly-in, fly-out basis. Approximately 25 management personnel, based in Whitehorse or Dawson, will be on a four days on, three days off rotation. This will serve to reduce the frequency of vehicle traffic carrying personnel into and out of the site, reducing emissions of airborne particulate matter, combustion by-products, and GHGs proportionally with the reduction in the number of kilometres travelled achieved.

4.3.1.3 Dust Management Plan

A Dust Management Plan will be developed as part of Project licensing to address the various mitigation measures to be employed specifically to minimize fugitive airborne particulate matter releases from Project-related activities during all phases of the Project.

Key measures of the Dust Management Plan include:

- Minimize the area of land being cleared, or disturbed to reduce the area available for wind erosion.
- Construct all roadways, the new air strip and material lay-down areas with low silt content material to minimize the fine fraction of particulate matter available to be released as fugitive dust.
- Implement maximum speed limits of 50 km/hr for all mobile equipment on site access and haul roadways to minimize the entrained of fugitive road dust in the turbulent plume created by the vehicles passage.
- Maintain site roads and other unpaved, exposed areas using site support equipment (i.e. graders, dump trucks, loaders and a compactor) and regularly watered using a watering truck equipped with spray bars (the Watering Truck) to supress dust generation as necessary to maintain a wetted surface, when environmental conditions require. Roads will not be watered when there is a potential for freezing, causing increased safety concerns.
- Maintain the air strip by the site support equipment (i.e. graders, dump trucks, loaders and a compactor) and regularly watered, potentially with the addition of natural or chemical dust suppressant to minimize the release of fine dust during aircraft take-off and landing.
- Install signage and barriers along NAR and haul roads to reduce unnecessary or excessively fast traffic. This will reduce the total traffic loading and vehicle speeds, subsequently reducing total Project road dust emissions.
- To the extent practical, minimize the height of all material drops material unloading operations including earthmoving activities such as backhoes dropping materials into trucks or onto piles. This reduces exposure to wind as well as the distance over which emissions can be generated, effectively reducing emissions proportional to the reduction in drop height.
- To the extent practical, minimize the number of exposed transfer points in the material handling process to eliminate these sources of wind blown dust. Where practical, covers, screens and, or shrouds will be installed on transfer points to reduce exposure at transfer points.
- Re-vegetate inactive areas as soon as practical to remove the available pool of potential dust and creates more surface area, via vegetation, for near source capture of remaining emissions.
- Plan and carry out drilling and blasting activities using trained professionals in a manner that minimizes the release of fugitive dust from the blast zone.
- Inspect the site regularly using scheduled site inspections to identify and address any potential new or modified dust emission sources or issues. Records of these inspections should be maintained for the life of the Project and reviewed periodically to identify any trends or long term issues.
- Record and respond to nearby land users' complaints of dust changes in a timely manner.
- Maintain complete and accurate records of all dust suppression activities and inspections.

Implementing these measures is expected to result in reductions in fugitive dust emissions.

4.3.1.4 Progressive Reclamation

Progressive reclamation and closure activities will begin as soon as mining at the Double-Double pit has been completed in Year 2 and will continue throughout the mine life. This will have the effect of reducing the exposed, potentially dusty surface area available for wind erosion or other forms of fugitive dust generation.

4.3.1.5 Backfilling Pits

Waste rock will be used to partially backfill mined out pits at Latte, Supremo, and Double-Double, to create causeways that shorten the ore haul distance to the crusher. This will have the effect of reducing the overall vehicle kilometers travelled and fuel consumption in haul vehicles, reducing emissions of particulate matter and combustion by-products proportionally with the reduction in road lengths achieved.

4.3.1.6 Using Fugitive Waste Heat

Buildings will be heated primarily by heat recovered from the power plant. Excess heat from the generators, when available, will be used to heat the barren solution. This will help to conserve fuel and reduce the emissions of by-products proportionally with the quantity of fuel conserved.

4.4 POTENTIAL RESIDUAL CHANGES TO AIR QUALITY AND GREENHOUSE GAS EMISSIONS

Implementation of the above mitigation measures is expected to reduce adverse changes in air quality in the RSA. There will be residual changes to air quality in the Project area as described below.

4.4.1 RESIDUAL CHANGES IN AIRBORNE PARTICULATE MATTER

Residual changes to airborne particulate matter indicators from the various Project-related interactions described above are expected to persist throughout the Project's Construction, Operation, and Reclamation and Closure phases. Due to the short-lived nature of these indicators in the atmosphere, residual changes are expected to dissipate within 24 hours upon cessation of activity. Additional details are provided in the Air Quality Modelling Report **(Appendix 9-B-3**).

There were no modelled exceedances of regulated standards or guidelines outside of the RSA. Changes to air quality as a result of vehicular traffic on the NAR have been modelled to be limited to within 1 km of the roadway beyond which the changes to air quality indicators are expected to return to background concentrations.

4.4.2 RESIDUAL CHANGES IN COMBUSTION BY-PRODUCTS

Residual changes to combustion by-product indicators from the various Project related interactions described above are expected to persist throughout the Project Construction, Operation, and Reclamation and Closure phases. Due to the short-lived nature of these indicators in the atmosphere, residual changes are expected to dissipate within 24 hours upon cessation of the activity in question **(see details in Appendix 9-B-3).**

As can be seen in **Appendix 9-B-3**, the predicted concentrations of air quality indicators are expected to be elevated within the Project footprint, but are expected to return to the background levels, identified in the Baseline Monitoring Program (**Appendix 9-A - Baseline Air Quality and Noise at the Coffee Gold Mine 2015**) within the RSA. There were no modelled exceedances of regulated standards or guidelines outside of the project RSA.

GHG emissions are also the residue of combustion by-products. A summary of GHG effects throughout the Project Construction, Operation, and Reclamation and Closure phases is provided in **Table 4.4-1** and discussed in the **GHG Emissions Inventory (Appendix 9-B-2)**.

Table 4.4-1 GHG Emissions

Year	Phase	Annual Total (tonnes CO2 e)
Y -1	Construction	48,949
Y 1	Operation	81,896
Y 2	Operation	92,368
Y 3	Operation	94,041
Y 4	Operation	102,187
Y 5	Operation	103,174
Y 6	Operation	98,671
Y 7	Operation	94,707
Y 8	Operation	100,564
Y 9	Operation	105,973
Y 10	Operation	86,414
Y 11	Operation	50,907
Y12	Closure	5,196
Total		**1,065,047**

4.5 Summary of Future Conditions with the Project

The potential adverse changes to air quality due to interactions with the Project, the proposed mitigation measures to be employed to control or minimize those changes, and the predicted residual adverse changes to air quality as modelled using the 2016 Feasibility Study mine plan are summarized in **Table 4.5-1.**

Table 4.5-1 Summary of Potential Project-related Residual Changes to Air Quality

Project Component / Activity	Potential Adverse Changes to Air Quality		Proposed Mitigation Measures	Potential Residual Adverse Changes (Expressed as % Reduction from Unmitigated Change)	
	Airborne Particulate Matter	Combustion By-Products and GHGs		Airborne Particulate Matter	Combustion By-Products and GHGs
Construction Phase					
Overburden Removal (Bulldozing)	Yes	Yes	Dust Management Plan	50-80%	No reduction
Drilling	Yes	Yes	Dust Management Plan	50-80%	No reduction
Blasting	Yes	Yes	Dust Management Plan	50-80%	No reduction
Earth Moving & Material Handling	Yes	None	Dust Management Plan	50-80%	-
Wind Erosion of Stockpiles	Yes	None	Dust Management Plan	50-80%	-
Haul Trucks & Light Duty Vehicle Traffic	Yes	Yes	WRSF Site Selection, Minimize Vehicle Traffic, Dust Management Plan	70%	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Graders clearing, grubbing and grading; constructing and maintaining the airstrip; and using mine site service and haul roads	Yes	Yes	WRSF Site Selection, Dust Management Plan	50-80%	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Fleet Vehicles and Equipment Fuel Emissions	Yes	Yes	WRSF Site Selection, Minimize Vehicle Traffic	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation	
Waste Incinerator	Yes	Yes	Unmitigated	No reduction	No reduction
Operation Phase					
Haul Trucks & Light Duty Vehicle	Yes	Yes	Minimize Vehicle Traffic, WRSF Site Selection, Dust Management Plan	50-80%	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Drilling	Yes	Yes	Dust Management Plan	50-80	No reduction
Blasting	Yes	Yes	Dust Management Plan	50-80	No reduction

Project Component / Activity	Potential Adverse Changes to Air Quality		Proposed Mitigation Measures	Potential Residual Adverse Changes (Expressed as % Reduction from Unmitigated Change)	
	Airborne Particulate Matter	Combustion By-Products and GHGs		Airborne Particulate Matter	Combustion By-Products and GHGs
Earth Moving & Material Handling	Yes	None	Dust Management Plan	50-80	-
Wind Erosion of Stockpiles	Yes	None	Dust Management Plan	50-80	-
Crushing and Screening	Yes	None	Dust Management Plan	50-80	-
Graders	Yes	Yes	Dust Management Plan	50-80	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Fleet Vehicles and Equipment Fuel Consumption	Yes	Yes	WRSF Site Selection, Minimize Vehicle Traffic	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation	
Waste Incinerator	Yes	Yes	Unmitigated	No reduction	No reduction
Reclamation and Closure Phase					
Haul Trucks & Light Duty Vehicle Traffic	Yes	Yes	Minimize Vehicle Traffic, WRSF Site Selection, Dust Management Plan	50-80	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Earth Moving & Material Handling	Yes	None	Dust Management Plan	50-80	-
Wind Erosion of Stockpiles	Yes	None	Dust Management Plan	50-80	-
Graders	Yes	Yes	Dust Management Plan	50-80	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation
Fleet Vehicles and Equipment Fuel Consumption	Yes	Yes	WRSF Site Selection, Minimize Vehicle Traffic	Residual adverse changes proportional to the road lengths and traffic volumes remaining after mitigation	

In general, the dispersion modelling and predictions, as modelled using the 2016 Feasibility Study mine plan, indicated that the Project will comply with relevant air quality objectives and guidelines within 500 m of the mine footprint. A summary of the results is presented in **Table 4.5-2.**

Table 4.5-2 Summary of Predictions of Air Quality Changes

Contaminant	Averaging Period	Ambient Air Quality Standard	Predicted Air Quality	
			Mine Site	Northern Access Route
SO_2	1 hour	[1] 485 µg/m³	No exceedances predicted	No exceedances predicted
	24 hour	[1] 161 µg/m³	Exceedance predicted within pit area	No exceedances predicted
	Annual	[1] 31 µg/m³	No exceedances predicted	No exceedances predicted
NO_2	1 hour	[1] 432 µg/m³	Exceedance predicted throughout mine site, particularly active pit areas	No exceedances predicted
	24 hour	[1] 215 µg/m³	Exceedance predicted throughout mine site, particularly active pit areas	No exceedances predicted
	Annual	[1] 64 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
CO	1 hour	[1] 16,000 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
	8 hour	[1] 6,170 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
TSP	24 hour	120 µg/m³	Exceedance predicted throughout mine site and 500 m beyond mine footprint	No exceedances predicted
	Annual	60 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
PM_{10}	24 hour	50 µg/m³	Exceedance predicted throughout mine site and 500 m beyond mine footprint	No exceedances predicted
$PM_{2.5}$	24 hour	28 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
	Annual	10 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
Dustfall	1 month	[2] 1.7 mg/dm²·d (lower) [2] 2.9 mg/dm²·d (upper)	Exceedance predicted in vicinity of dust-producing sources throughout mine site	No exceedances predicted

Notes:

1 Converted from ppm/ppv at 0˚C

2 Taken from British Columbia Pollution Control Objectives for Dustfall

5.0 FUTURE CONDITIONS WITH THE PROJECT AND OTHER PAST, PRESENT, AND FUTURE PROJECTS AND ACTIVITIES

This section presents a preliminary analysis of potential cumulative changes to air quality and the Project's contribution to these changes. Cumulative changes result from interactions between Project-related changes and the incremental effects on the IC of other past, present, and future projects and activities. Other projects and activities that have or may result in adverse residual changes to air quality have been identified based on a review of the Project and Activity Inclusion List provided in the Project Proposal (**Appendix 5-A**).

Input from local residents and First Nations in the area was used to identify and select air quality as an IC and to characterize air quality conditions within the Cumulative Effects Study Area (CESA). See **Section** Error! Reference source not found. **Introduction** and **Section 3.0 Existing Conditions** for additional details on this process.

5.1 SPATIAL AND TEMPORAL SCOPE OF THE CUMULATIVE CHANGE ANALYSIS

As described in **Section 1.3.1**, the spatial boundaries of the cumulative change analysis for air quality are defined as the area within which the changes due to Project related activities are expected to become negligible (i.e., comparable to average baseline concentrations described in **Section 3.0** above). Based on the modelling results described above in **Section 4.0** for all indicators except for GHGs, this area is contained within the RSA. The spatial boundaries of the cumulative change analysis for GHGs is global.

The temporal boundaries within which cumulative changes are considered are defined as the life of the Project including the Construction, Operation, Reclamation and Closure Phases, representing Years –2 through Year 23. See **Section 1.3.2** for a more detailed breakdown of the temporal boundaries.

5.2 CHANGES DUE TO OTHER PAST, PRESENT, AND FUTURE PROJECTS AND ACTIVITIES

Other relevant projects and activities that have resulted in or may result in residual adverse effects that could interact with adverse Project-related changes to air quality within the spatial and temporal scope of the CESA have been identified in the Project and Activity Inclusion List (included in the Project Proposal - **Section 5.0 Assessment Methodology)** and summarized below in **Table 5.2-1**.

Table 5.2-1 Other Projects and Activities Considered in the Analysis of Cumulative Change on Air Quality and Greenhouse Gas Emissions

Other Project / Activity	Description	Potential Residual Changes		Potential for Interaction Resulting in Cumulative Change (see Notes) and Rationale		
		Increase in Air Quality Indicators	Increase in GHGs	Particulate Matter	Combustion By-Products	GHGs
Project Name						
Casino	Casino Mining Corp. Quartz Mining Project ~38 km from site planned for future operation (currently under ECA review), expect to operate for 22 years	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Betty	Ethos Capital Corp. Quartz Mining Project ~43 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Betty Hayes	Canterra Gold Inc Quartz Mining Project ~57 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Big Creek	Teck Resources Limited Quartz Mining Project ~90 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Bishop, Dan, Rosebute, Wounded Moose	Taku Gold Corp. Quartz Mining Project ~84 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Boulevard	Silver Quest Resources Ltd. Quartz Mining Project ~9 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Boulevard	Independence Gold Corp. Quartz Mining Project ~11 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Bridget	Ethos Capital Corp. Quartz Mining Project ~43 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Canadian Creek	Castillian Resource Corp. Quartz Mining Project ~27 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Coffee, Cream, Kirkman	Goldcorp Quartz Mining Project ~7 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Coffee Creek	Goldcorp Quartz Mining Project ~10 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact
Dan Man	Arcus Development Group Quartz Mining Project ~5 km from site currently in operation	Yes	Yes	Yes – within CESA	Yes – within CESA	Yes – Global Impact

Other Project / Activity	Description	Potential Residual Changes		Potential for Interaction Resulting in Cumulative Change (see Notes) and Rationale		
		Increase in Air Quality Indicators	Increase in GHGs	Particulate Matter	Combustion By-Products	GHGs
Dime	Stina Resources Ltd. Quartz Mining Project ~75 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Dominion Creek	Gimlex Enterprises Ltd. Quartz Mining Project ~96 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Eureka	Golden Predator Canada Corp. Quartz Mining Project ~77 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Flume	Ryan Gold Corp. Quartz Mining Project ~73 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Gold Run and Gulf Properties	Kestrel Gold Inc Quartz Mining Project ~92 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Green Gulch	Arcus Development Group Quartz Mining Project ~24 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Hen	Ethos Capital Corporation Quartz Mining Project ~53 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Henderson Property	Independence Gold Corp. Quartz Mining Project ~67 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Idaho Creek	Golden Predator Canada Corp. Quartz Mining Project ~45 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
JP, Ross, Yellow, RP	Kinross Gold Corporation Quartz Mining Project ~57 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Longline	Aldrin Resources Corporation Quartz Mining Project ~84 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Loonie	Geo Zone Exploration Limited Quartz Mining Project ~85 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Lucky Joe	Redtail Metals Corp. Quartz Mining Project ~78 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Mariposa Project	Pacific Ridge Exploration Ltd. Quartz Mining Project ~48 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact

Other Project / Activity	Description	Potential Residual Changes		Potential for Interaction Resulting in Cumulative Change (see Notes) and Rationale		
		Increase in Air Quality Indicators	Increase in GHGs	Particulate Matter	Combustion By-Products	GHGs
Money	White Pine Resources Inc. Quartz Mining Project ~92 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Moosehorn	1200991 Alberta Ltd. Quartz Mining Project ~81 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Prospector Mountain	Tarsis Resources Ltd. Quartz Mining Project ~92 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
QV Property	Comstock Metals Ltd. Quartz Mining Project ~49 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
River	Anglo-Canadian Uranium Corp. Quartz Mining Project ~47 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Sonora Gulch	Northern Tiger Resources Inc. Quartz Mining Project ~72 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Sonora Gulch	Schulze Carl Quartz Mining Project ~75 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Squid East	Metals Creek Resources Corporation Quartz Mining Project ~99 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Tik	Stakeholder Gold Corp. Quartz Mining Project ~20 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Toro	Dawson Gold Corp. Quartz Mining Project ~82 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Touleary	Arcus Development Group Quartz Mining Project ~20 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Whiskey	Smash Minerals Quartz Mining Project ~54 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
White Gold	Kinross Gold Corporation Quartz Mining Project ~33 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Wolf	Ethos Capital Corp. Quartz Mining Project ~45 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact

Other Project / Activity	Description	Potential Residual Changes		Potential for Interaction Resulting in Cumulative Change (see Notes) and Rationale		
		Increase in Air Quality Indicators	Increase in GHGs	Particulate Matter	Combustion By-Products	GHGs
YK	Anglo-Canadian Uranium Corp. Quartz Mining Project ~50 km from site currently in operation	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact
Ballarat Creek Trib. of Yukon River	Weber Brian Placer Project ~20 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Bruin Creek Trib. of Yukon River	Schmidt Stuart Placer Project ~21 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Lower Kirkman Creek Trib. of Yukon River	Sager Merrit K. Placer Project ~14 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Lulu Gulch Trib. of Thistle Creek	Sager Merrit K. Placer Project ~21 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Sparkling Creek Trib. of Yukon River	Fischer Wayne Placer Project ~14 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Thistle Creek Trib. of Yukon River	Sager Merrit K. Placer Project ~23 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Thistle Creek Trib. Yukon River	Schmidt Stuart Placer Project ~22 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Unnamed Trib. of Kirkman Creek and Kirkman Creek	Fell-Hawk Placers Placer Project ~15 km from site currently in operation	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
75 Other Placer Projects	75 additional Placer Projects >25 km but <100 km from site currently under operation or planned for the future	Yes	Yes	Yes – along NAR when sharing road access	Yes – along NAR when sharing road access	Yes – Global Impact
Other Quartz, Placer, Forestry and Utility Projects using the NAR	Vehicles travel the NAR for additional projects than outlined elsewhere in this table. All generate changes to air quality through dust and combustion by-products, including GHGs.	Yes	Yes	Yes – along NAR	Yes – along NAR	Yes – Global Impact
Minto Copper Mine	Operating mine, located 240 km north of Whitehorse in central Yukon, estimated 7 years life remaining	Yes	Yes	No – Outside CESA	No – Outside CESA	Yes – Global Impact

Notes: **No:** no interaction or not likely to interact cumulatively; **Yes:** potential for cumulative change.

5.3 POTENTIAL CUMULATIVE CHANGES

This section describes each potential adverse cumulative change to air quality resulting from interactions with the other projects and activities identified in **Table 5.2-1.**

Potential cumulative changes to air quality have been considered; however, the dispersion modelling results indicate that the Project-related changes to air quality will dissipate to background concentration levels within the RSA for all air quality indicators with the exception of GHGs, which will contribute to global increases in GHG concentrations.

It is unlikely that Project-related changes to air quality will interact with the projects listed in **Table 5.2-1**, with the exception of GHGs which will contribute to global increases in GHG concentrations.

5.3.1 POTENTIAL CUMULATIVE CHANGES TO AIRBORNE PARTICULATE MATTER

Interactions between Project-related activities and those identified in **Table 5.2-1** are expected to result in cumulative changes to Airborne Particulate Matter Indicators of Air Quality. Increased TSP, PM_{10} and $PM_{2.5}$ ambient ground level concentrations and dustfall rates are expected to occur within the CESA. These cumulative changes are however, not expected to result in exceedances of any regulatory air quality standards or guidelines as the Project related changes are expected to return to levels comparable to baseline concentrations within the RSA.

As with Project related changes, cumulative changes to these air quality indicators are expected to dissipate, returning to background levels within 24 hours of cessation of activities.

5.3.2 POTENTIAL CUMULATIVE CHANGES TO COMBUSTION BY-PRODUCTS

Interactions between Project related activities and those identified in **Table 5.2-1** are expected to result in cumulative changes to combustion by-product related indicators of air quality. Increased ground level concentrations of NO_x, SO_2 and CO are expected to occur within the CESA. These cumulative changes are however, not expected to result in exceedances of any regulatory air quality standards or guidelines as the Project related changes are expected to return to levels comparable to baseline concentrations within the RSA.

As with Project related changes, cumulative changes to these air quality indicators are expected to dissipate, returning to background levels within 24 hours of cessation of activities.

5.3.3 POTENTIAL CUMULATIVE CHANGES TO GHG CONCENTRATION

Quartz and placer projects were not included in the potential cumulative change analysis for GHGs due to the lack of available information regarding GHG emissions. Forestry, agricultural, settlement, and industrial applications, and trapline concessions were also not included in the potential cumulative effects assessment as these activities do not generate substantive GHG emissions. A list of past, present, and reasonably foreseeable quartz mines was analyzed to determine which projects could potentially interact with the residual effects on air quality from the Project to produce a cumulative change. Brewery Creek and Mount Nansen mine were excluded as they are at closure, reclamation and long term monitoring stage and do not generate air emissions. The cumulative change on GHG due to interactions with the other projects and activities is presented in **Table 5.3-1**.

The GHG emissions generated by the Coffee project is estimated to be 81 kt CO2e/yr. The total cumulative changes by the Coffee, Minto, and Casino projects are estimated to be 660 kt CO2e/yr. the Coffee project accounts for 12% of the total cumulative changes due to interactions with the other two projects.

Table 5.3-1 Cumulative Change on GHG (kt CO2e/yr)

	Coffee	Minto	Casino
GHG (kt Co2e/yr)	81[1]	21[2]	558[3]
Total Cumulative changes (kt CO2e/yr)			660
% of cumulative changes by Coffee Project			12%
2013 Yukon GHG Inventory (kt CO2e/yr)[4]			358
% of Coffee Project in 2013 Yukon GHG Inventory			23%

Source: 1. Appendix 9-B-2 GHG Emissions Inventory
Capstone Mining Corp Sustainability Report (2014)
Casino Mine Project Proposal (2014)
Environment and Climate Change Canada (2015)

Environment and Climate Change Canada collects GHG emissions data through the Greenhouse Gas Emissions Reporting Program (GHGRP), established in March 2004. The threshold for GHG reporting is 50,000 tonnes (50 kilotonnes) or more of GHGs in carbon dioxide equivalent units (CO2 e) per year. Companies submit their GHG data via the Single Window System on-line.

Canada, as a United Nations Framework Convention on Climate Change (UNFCCC) Annex I Party, is obligated to submit its national GHG inventory to the UNFCCC Secretariat each year, by April 15. Environment and Climate Change Canada is responsible for preparing Canada's official national inventory. The Canada's national inventory, Greenhouse Gas Sources and Sinks in Canada 1990 -2013, was published on the UNFCCC website. Based on the Environment and Climate Change Canada (2016) National Inventory Report, the 2013 GHG emissions are as follows:

- 726,000 kt/yr for Canada, this represents 18% of increase from 1990
- 358 kt/yr for Yukon, this represents 34% of decrease from 1990.

The GHG cumulative effects by the Project on the Yukon and Canada GHG inventory, including construction, operation, and closure phases, are presented in **Table 5.3-2**.

Table 5.3-2 National and Yukon GHG Emissions (kt CO2e/yr)

Reporting Year	Canada GHG Emissions	Project (% of Canada Total)	Yukon GHG Emissions	Project (% of Yukon Total)
1990	613,000	0.01%	540	15.17%
2000	744,000	0.01%	505	16.22%
2005	747,000	0.01%	459	17.85%
2010	706,000	0.01%	344	23.82%
2011	710,000	0.01%	384	21.34%
2012	718,000	0.01%	393	20.85%
2013	731,000	0.01%	351	23.34%
2014	732,000	0.01%	268	30.57%

Note: % calculation is based on Coffee Project Direct Emissions of 81.927 kt CO2e/yr. It is the annual average direct GHG emissions in construction, operation and closure phases.

Source: Environment and Climate Change Canada (2016)

5.4 Mitigation Measures for Cumulative Changes

As the cumulative changes to Air Quality indicators within the CESA are not expected to result in exceedances of any applicable regulatory standards (i.e., AAQS), no additional mitigation measure(s) are expected to be necessary to eliminate, reduce, or control the Project's contribution to cumulative changes at this time.

5.5 Potential Residual Cumulative Changes to Air Quality

This section describes the anticipated adverse residual cumulative changes on air quality that may remain after implementation of technically and feasible mitigation measures. Each potential residual cumulative change is described in detail below.

5.5.1 Summary of Future Conditions with the Project and Other Projects and Activities

This section provides a preliminary analysis of the cumulative changes and the Project's contribution to those cumulative changes to air quality.

Cumulative changes in air quality indicators except GHGs are expected to be negligible in nature for the majority of the RSA and will dissipate within 24 hours of the cessation of Project-related activities, based on the modelling results presented above. **Table 5.5-1** shows a summary of these Predicted Residual Adverse Cumulative Changes to air quality.

Table 5.5-1 Summary of Potential Project-related Residual Adverse Cumulative Changes to Air Quality

Project Component / Activity	Potential Cumulative Change to Air Quality	Additional Mitigation Measures	Potential Residual Adverse Cumulative Change
Earth Moving Activities	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA
Traffic on Unpaved Roads	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA
Stockpile Wind Erosion	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA
Material Handling	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased TSP, $PM_{2.5}$ & Dustfall within the CESA
Drilling & Blasting	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA
Fuel Combustion	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA	N/A	Increased NO_x, SO_2, CO, GHG, TSP, $PM_{2.5}$ & Dustfall within the CESA

6.0 CHANGE MONITORING AND ADAPTIVE MANAGEMENT

Ongoing ambient air quality monitoring of the Project area will be conducted for the purposes of change monitoring of air quality Indicators and assess the effectiveness of the control measures as well as ensuring Project compliance with the applicable air quality standards.

In response to feedback received on the Project proposal through pre-submission consultation, additional baseline information will be collected for the NAR and on the project site prior to construction. While this information is not needed for the purpose of this assessment, it will inform evaluation of Project effect monitoring against baseline conditions.

6.1 AIRBORNE PARTICULATE MATTER MONITORING

Ambient particulate matter indicator concentrations will be monitored throughout the life of the Project. Monitoring activities will consist of two types of sampling:

- Volumetric sampling for determining the concentration of particle fractions in the air
- Passive sampling to determine the rate of particulate matter deposition onto the ground.

Volumetric sampling equipment will be set up at a pre-determined monitoring location(s) identified in **Section 7.2**. Continuous monitoring events will be conducted over periods of at least 24-hour to capture any diurnal variation in particulate matter loadings.

Passive monitoring of dust deposition rates will be conducted using the following two methods, depending on the season. Dust deposition measurements during winter months, will be collected via snow surveys. At selected snow course locations, to be determined, snow cores will be taken and sent to a laboratory for weighing and analysis.

During the summer months, passive monitoring will be conducted using dustfall containers. After a thirty-day sampling period, the canisters will be collected by Goldcorp staff, labelled, sealed, and sent to a laboratory for weighing and measuring the deposition rates for total dustfall. Samples will also periodically be analyzed for trace metals content to allow for an analysis of the potential health and environmental changes.

The results of these monitoring activities will be compared against the AAQS presented in **Table 2.1-1** to determine the sites compliance status and identify when contingency measures are required to address excessive emissions.

6.2 MONITORING LOCATIONS

The following four monitoring station locations, previously identified in Section 3.0 and used for monitoring in the **Baseline Air Quality and Noise at the Coffee Gold Mine 2015 (Appendix 9-A),** have been selected as potential long term monitoring locations as, together, they provide a representative sampling of facility changes at key points around the Property. The monitoring locations are described in detail in **Section 3.2:**

- Monitoring station MET
- Monitoring location H1
- Monitoring location H4
- Monitoring location H6.

No monitoring has been proposed along the NAR as the dispersion modelling of the RSA completed suggests that there will be no expected exceedances of AAQS's for any air quality indicators along the NAR corridor due to the low volume and frequency of vehicular traffic. If complaints are received from neighbours, additional monitoring stations along the NAR may be considered.

6.3 SCHEDULE FOR MONITORING EVENTS

6.3.1 VOLUMETRIC MONITORING

Periodic volumetric monitoring of ambient air will be conducted, for at least 24 continuous hour periods at the monitoring locations described above. Continuous sampling at a single, easily accessible location with reliable power may be considered in the development of the air monitoring plan if required; however periodic sampling at locations away from peak emissions allows for assessment of compliance closer to the property boundaries.

If complaints are received from neighbours, additional monitoring through the affected area will be considered.

6.3.2 PASSIVE MONITORING

Passive monitoring will be conducted monthly throughout the Project lifetime with samples taken at each of the monitoring locations.

6.4 PROCEDURES USED FOR MONITORING

The following protocols and methodologies will be used as guidance in conducting the ongoing air quality monitoring for the Project:

- Canadian Council of Ministers of the Environment's (CCME) 'Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone – Canada-wide Standards for Particulate Matter and Ozone' (CCME 2011)
- American Society for Testing and Materials' (ASTM) 'Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter)' (ASTM 2010).

Equipment manuals will be consulted for specific equipment use.

6.5 QUALITY ASSURANCE / QUALITY CONTROL PROCESS

Monitoring equipment will be calibrated per the manufacturer's specifications prior to each monitoring event.

Monitoring data will be reviewed and assessed for substantive abnormalities in the data (i.e., Zero Drift, Error Messages, continuous "0" readings). These may indicate equipment issues and will be corrected where possible or flagged and removed from the useful dataset.

6.5.1 ADAPTIVE MANAGEMENT

The following adaptive management triggers are intended to trigger additional action / mitigation measures and the actions to be taken will triggers be exceeded. Adaptive management will be discussed in more detail in the Dust Management Plan that will be developed for Project licensing and will include:

- Regular, periodic visual monitoring will be conducted to qualitatively assess the effectiveness of Primary Dust Control Measures and determine if contingency control measures will need to be implemented, including excessive plumes of dust migrating off-site
- Addressing feedback from neighbours, nearby land users, or other interested parties (including staff and contractors)
- Applying contingency measures if ambient monitoring data indicates a potential exceedance of 90% of the relevant Yukon AAQS
- Reviewing existing dust control equipment, primary dust control measures and Dust Management Plan and update as necessary to address the issues at hand
- Reviewing available control technology and implement feasible control options (e.g. water filled stem capping plugs for blasting dust control).

7.0 REFERENCES

American Society for Testing and Materials' (ASTM). 2010. Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter)

Australian Government Department of Environment, Water, Heritage and the Arts. 2008. National Pollution Inventory Emission Estimation Technique Manual for Combustion Engines, Version 3.0, June 2008.

Bates, P., and S. DeRoy. 2014. *White River First Nation Knowledge and Use Study* For Goldcorp, The Firelight Group, with White River First Nation.

British Columbia Ministry of Environment (BCMOE). 2015. British Columbia Air Quality Dispersion Modelling Guideline. December 2015.

British Columbia Ministry of Environment (BCMOE). 1981. Snow Survey Sampling Guide. Water Management Branch, Survace Water Section. SS12-81. http://www.geoscientific.com/technical/tech_references_pdf_files/snow_surveys_manual.pdf

British Columbia Ministry of the Environment (BCMOE). 2016. British Columbia Ambient Air Quality Objectives. Updated January 18, 2016.

Canadian Council of Ministers of the Environment (CCME). 2011. Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone – Canada-wide Standards for Particulate Matter and Ozone.

Casino Mining Corporation. 2014. *Air Quality Baseline 2013,* Casino Project Proposal for Executive Committee Review January 2014 available at *http://casinomining.com/project/yesab-proposal/. Accessed April 2016*

Environment and Climate Change Canada. 2016. National Pollution Release Inventory, Pits and Quarries Guidance. Available at https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=A9C1EE34-1. Accessed March 2016.

Environment and Climate Change Canada, National Air Pollution Surveillance Program (NAPS). 2016. NAPS Data Projects, Annual CO Data (2010 – 2014). http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx. Accessed April 2016.

Government of Yukon. 2015. Yukon Government Climate Change Action Plan December 2015 Progress Report. http://www.env.gov.yk.ca/air-water-waste/documents/CCAP_progressreport_eng_2015.pdf [accessed March 10, 2017].

Government of Yukon. 2013. About Yukon Wildland Fire Management. http://www.community.gov.yk.ca/firemanagement/about.html. Accessed May 9, 2016.

Government of Yukon. 2006. Climate Change Strategy. http://www.env.gov.yk.ca/publications-maps/documents/ygclimatechangestrategy.pdf. Accessed August 16, 2016.

International Cyanide Management Code. 2015. International Cyanide Management Code for the Gold Mining Industry. http://www.cyanidecode.org/. Accessed April 1, 2016.

Goldcorp. 2016. Feasibility Study Report for the Coffee Gold Project, Yukon Territory, Canada. G. Doerksen, et al. February 18, 2016.

National Aeronautics and Space Administration (NASA). 2016. Scientific consensus: Earth's climate is warming. http://climate.nasa.gov/scientific-consensus/. Accessed August 16, 2016.

Pinard, Jean-Paul. 2007. Wind Climate of the Whitehorse Area. January 2007.

Tr'ondëk Hwëch'in. 2012. Coffee Creek Traditional Knowledge Survey, Final Report. December 2012

Tr'ondëk Hwëch'in. 2012a. Tr'ondëk Hwëch'in Resource Report, Submitted to the Dawson Regional Land Use Planning Commission, May 2012 Tr'ondëk Hwëch'in. Published in 'Appendix C' of the Dawson Planning Region Resource Assessment Report (DRAFT), November 2012.

United States Environmental Protection Agency (US EPA). 1995. AP-42 Compilation of Air Pollutant Emission Factors. Available at https://www3.epa.gov/ttnchie1/ap42. Accessed March 2016.

US EPA National Oceanic & Atmospheric Administration (NOAA). 2016. Global Average CO_2 Concentration Data. Available at www.esrl.noaa.gov/gmd/global Accessed March 2016.

Yukon Environment. 2010. Yukon Ambient Air Quality Standards, Date Implemented: April 22, 2010.

APPENDIX 9-B-1

Air Quality Inventory Summary Report

Coffee Gold Mine Project - Air Emission Inventory – Updated for New Mine Design
Appendix 9-B-1



PRESENTED TO

Goldcorp Inc.

MARCH 20, 2017
ISSUED FOR USE
FILE: 704-ENV.VENV03082-01

Tetra Tech Canada Inc.
Suite 1000 – 10th Floor, 885 Dunsmuir Street
Vancouver, BC V6C 1N5 CANADA
Tel 604.685.0275 Fax 604.684.6241

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES IN TEXT

APPENDIX SECTIONS

APPENDICES

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Goldcorp Inc. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Goldcorp Inc., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech's Services Agreement. Tetra Tech's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

The Coffee Gold Mine (Project), fully owned by Goldcorp Inc. (Goldcorp or Proponent), is a proposed gold development project in west-central Yukon, approximately 130 kilometres (km) south of Dawson City. The Project is located on Crown Land within the traditional territory of Tr'ondëk Hwëch'in and the asserted area of White River First Nation. A portion of Goldcorp's claim block is located in Selkirk First Nation's traditional territory. The Project is scoped as an open pit gold mine using a cyanide heap leach process to extract ore. The project consists of an 18-month construction period, followed by a 10 year mine life with an average operation rate of five million tonnes (t) per annum of heap leach feed, producing 1.9 million ounces of gold over the life of the mine.

Goldcorp has retained Tetra Tech Canada Inc. (Tetra Tech) to undertake an analysis of Air Quality Intermediate Component (IC) (Appendix 9-B), which includes this air emissions inventory report, produced in support of the IC report. The information provided in this report supports the Project Proposal to be submitted to the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee for screening under the Yukon Environmental and Socio-Economic Assessment Act (YESAA), and applications to be submitted for a Quartz Mining Licence and a Type A Water Licence from the Yukon Water Board, among other permits and licences.

This report supplements a previous (2016) emissions inventory based on the 2016 Feasibility Study mine plan (JDS 2016; Appendix B of the Air Quality Modelling Report, Appendix 9-B-3). The emission estimates described in this report are based on information provided by Goldcorp for the revised mining and operational plan, Scenario 3 (James Scott, via email, March 1, 2017).

The following inventory was compiled using pertinent information from the 2017 Project Description Report and operational details provided by Goldcorp, mainly the proposed quarterly material extraction and production schedule, equipment and fleet allocations, operational hours and fuel consumption and yearly Project infrastructure layouts over the twelve year operational phase (Y1 to Y12), and mining-related activities conducted in the third year of the construction phase (Y-1; James Scott, via email, March 1, 2017). Details of construction phase activities are under development and are not included in this report.

The details of the air emission estimation methodologies employed, the data sources referenced and estimates of annual air emissions are provided for all significant sources of CACs from mining-related activities with the exception of activities related to overburden removal (e.g. haulage, material handling, and soil storage) for which details were not provided at the time of writing.

Emission estimates were calculated referencing empirically developed emission factors published in Environment and Climate Change Canada's National Pollution Release Inventory, Pits and Quarries Guidance (Environment Canada 2009), United States Environmental Protection Agency (USEPA) AP-42 - Compilation of Air Pollutant Emission Factors, Volume 1 (USEPA 1995), and Australia Government Department of Environment, Water, Heritage and the Arts, National Pollutant Inventory (NPI), Emission Estimation Technique Manuals for Mining (NPI 2012) and Combustion Engines (NPI 2008). These emission factors are useful when there is no site specific data available and are therefore ideal for proposed industrial developments to estimate anticipated air emissions that could occur during the lifetime of the Project. Emission calculations contained in this report are generally based on uncontrolled and unmitigated scenarios unless described otherwise (e.g. watering of roads).

CACs include particulate matter (PM), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and carbon monoxide (CO). Particulate matter is further described based on particle size, where total suspended particles (TSP) consists of all PM, typically below a cutoff diameter of 100 µm, particulate matter less than 10 µm in diameter (PM_{10}) and particulate matter less than 2.5 µm in diameter ($PM_{2.5}$). Particulate matter is expected to be released in the greatest amount and contributed to by nearly all project activities. Particulate matter emitted from site originates mainly from the ground (all earth-moving activities, drilling, traffic on unpaved roads, etc.) and also as a small constituent of diesel exhaust. NO_x, SO_2 and CO are products of combustion and are mainly released from all sources that consume diesel fuel including production and support equipment, light duty vehicles, power production (generators) and the incinerator. Blasting explosives are also a large emitter of NO_x, SO_2 and CO. While typically not defined as a criteria air contaminant, emissions of volatile organic compounds (VOC), carbon by-products of diesel combustion, have also been described in this report.

2.0 EMISSIONS INVENTORY: Y-1 THROUGH Y12

Annual estimates of air emissions were generated based on projected extraction tonnages and equipment fleet activity data using emission factors for the various Project-related activities contained in Environment and Climate Change Canada's National Pollution Release Inventory (NPRI) Pits and Quarries Guidance (NPRI 2009), USEPA AP-42 – Compilation of Air Pollutant Emission Factors, Volume 1 (USEPA 1995), the NPI Emission Estimation Technique Manual for Mining V 3.1 (NPI 2012) and the NPI Emission Estimation Technique Manual for Combustion Engines V 3.0 (NPI 2008).

The proposed material extraction and production schedules vary by quarter over the life of the Project, with peak extraction between Y4 and Y10. Extraction varies by pit location as described in (Table 2.1-1).

Table 2.1-1 Proposed Material Extraction by Year (in millions of tonnes)

	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Double Double	7.1	10.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Latte P1	10.2	6.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Latte P2	1.4	10.3	13.0	8.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kona	0.0	0.2	4.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Supremo P1	0.0	0.0	2.3	8.4	12.7	16.7	11.7	0.9	0.0	0.0	0.0	0.0	0.0
Supremo P2	0.0	0.0	6.5	9.8	16.8	9.2	11.8	10.6	0.2	0.0	0.0	0.0	0.0
Supremo P3	0.0	0.0	0.0	0.0	4.1	8.1	10.6	22.5	27.6	9.8	5.3	0.0	0.0
Supremo P4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	15.9	24.9	18.1	0.0
Supremo P5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	8.4	3.8	0.5	0.0
Total Material	**18.7**	**28.0**	**28.0**	**28.0**	**34.0**	**34.0**	**34.0**	**34.0**	**34.0**	**34.0**	**34.0**	**18.6**	**0**

The emissions inventory provided in this report summarizes the estimate of total Project emissions by year and does not differentiate into spatial distribution of activity levels at the Project. Pertinent temporal details are provided in a description of effects modelling contained in a separate appendix.

2.1 Bulldozing of Overburden

Overburden removal is scheduled to occur throughout the lifetime of the project as pits are developed, the waste rock storage facilities (Alpha and Beta WRSF) are expanded and roads and other Project infrastructure are built. WRSF expansion is to occur prior to winter freeze each year.

Emissions of TSP, PM_{10} and $PM_{2.5}$ from bulldozing activities carried out to remove overburden are estimated using emission factors contained in the NPRI Pits and Quarries Guidance, which references USEPA AP-42 Section 11.9: Western Surface Coal Mining, Table 11.9-2 Emission Factor Equations for Uncontrolled Open Dust Sources at Western Surface Coal Mines (USEPA. 1995). The particle-size-specific emission factors (EF) for removal of overburden through bulldozing are defined as follows:

$$EF(TSP)\ (kg/hr) = 2.6\ (s)^{1.2} / (M)^{1.3}$$

$$EF(PM_{10})\ (kg/hr) = 0.75 \times (0.45\ (s)^{1.5} / (M)^{1.4})$$

$$EF(PM_{2.5})\ (kg/hr) = 0.105 \times (2.6\ (s)^{1.2} / (M)^{1.3})$$

Where:

s = Material Silt Content

M = Average Material Moisture Content

The assumed silt content for soil overburden, consisting largely of colluvium, is 15%. The assumed moisture content is 16%, based on typical values for colluvium, referenced from the Feasibility Study (JDS 2016). The assumed silt content and moisture content for bedrock are 7.5% and 2% respectively.

Removal details (volume and equipment utilization) are still being developed and were not provided for the inventory. Table 2.1-2 provides a reference for annual emissions from bulldozing activities related to pit and WRSF development**,** based upon the 2016 Project Description and Operational Plan. The estimates assume nine months of bulldozing of overburden related to pit development and three related to WRSF development at an equipment utilization of 53% (i.e. not actively bulldozing or idling 47% of the time).

Table 2.1-2 Example of Particulate Matter Emissions from Bulldozing of Overburden

Activity	Particulate Matter Emissions (tonnes/year)		
	TSP	PM_{10}	$PM_{2.5}$
Bulldozing (Pit Development – Overburden)	6.4	1.4	0.7
Bulldozing (WRSF Development - Bedrock)	13.8	3.1	1.4
Total Annual Emissions (tonnes)	**20.1**	**4.5**	**2.1**
Note: *Taken from Table 2.1 1 Particulate Matter Emissions from Overburden Removal - Operations (Y6) of 'Coffee Gold Mine Project – 2016 Air Emission Inventory			

Particulate matter emissions related to bulldozing are both spatially and temporally variable as silt and moisture contents will vary with depth and from one location to another as well as month-to-month due to the annual climate and day-to-day precipitation. It is also understood that the emission factors defined in USEPA AP-42 Section 11.9 have been derived under a limited range of experimental conditions. These factors may affect the quality ratings for the emission estimates contained in Table 2.1-2Table 2.1-2.

Emissions related to diesel combustion from bulldozers are discussed in Section 2.10.

2.2 Drilling

Drilling operations occur through the life of the project as waste rock and ore is prepared for loading with explosives for blasting. The number of holes drilled in a given year varies with the production schedule. Emissions of TSP, PM_{10}, $PM_{2.5}$ from drilling operations are estimated using emission factors contained in the NPRI Pits and Quarries Guidance, which references USEPA AP-42 Section 11.9: Western Surface Coal Mining, Table 11.9-4 Uncontrolled Particulate Emission Factors for Open Dust Sources at Western Surface Coal Mines (USEPA 1995) and Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District, Emissions Inventory Guidance, Mineral Handling Handbook and Processing Industries (Mojave 2000). The particle size-specific emission factors are defined as:

EF(TSP) (kg/hole) = 0.59

EF(PM_{10}) (kg/hole) = 0.31

EF($PM_{2.5}$) (kg/hole) = 0.31

**based on wet drilling operations*

Annual estimated emissions from drilling operations are presented in Table 2.2-1.

Table 2.2-1 Particulate Matter Emissions from Drilling by Year

Year	Number of Holes Drilled	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Y-1	29,081	17.2	9.0	9.0
Y1	42,947	25.3	13.3	13.3
Y2	43,889	25.9	13.6	13.6
Y3	45,647	26.9	14.2	14.2
Y4	49,309	29.1	15.3	15.3
Y5	49,551	29.2	15.4	15.4
Y6	50,383	29.7	15.6	15.6
Y7	49,697	29.3	15.4	15.4
Y8	50,464	29.8	15.6	15.6
Y9	51,105	30.2	15.8	15.8
Y10	51,474	30.4	16.0	16.0
Y11	29,012	17.1	9.0	9.0
Y12	0	0	0	0
Note: *includes drilling of ore and waste rock				

The method does not account for exhaust emissions from the drill rigs: Emissions related to diesel combustion are discussed in Section 2.10.

2.3 Blasting

Waste rock and ore will be retrieved from the pits through blasting operations using Ammonium Nitrate Fuel Oil (ANFO) explosives. Emissions of TSP, PM_{10} and $PM_{2.5}$ from the detonation of pit material during blasting operations have been estimated based on the proposed material extraction schedule and emission factors for blasting, published in NPRI Pits and Quarries Guidance, which references USEPA AP-42 Section 11.9: Western Surface Coal Mining, Table 11.9-2 Emission Factor Equations For Uncontrolled Open Dust Sources At Western Surface Coal Mines (USEPA 1995). Emissions of NO_x, SO_2, and CO from detonation of ANFO have been estimated based on emission factors published in USEPA AP-42 Section 13.3: Explosive Detonations Table 13.3-1 Emission Factors for Detonation of Explosives (USEPA 1995). These emission factors are defined as follows:

$$EF(TSP)\ (kg/blast) = 0.00022\ (A)^{1.5}$$

$$EF(PM_{10})\ (kg/blast) = (0.00022\ (A)^{1.5}) \times 0.52$$

$$EF(PM_{2.5})\ (kg/blast) = (0.00022\ (A)^{1.5}) \times 0.03$$

*Where: A = horizontal area of the blast with depth ≤ 21 m (in m^2)

Source: USEPAs AP-42 Sections 11.9 Table 11.9-2

$$EF(CO) = 34 \text{ kg per tonne ANFO detonated}$$

$$EF(NO_x) = 8 \text{ kg per tonne ANFO detonated}$$

$$EF(SO_2) = 1 \text{ kg per tonne ANFO detonated}$$

Source: USEPA AP-42 Section 13.3 Table 13.3-1

Blasting is assumed to take place two times per week, occurring in the afternoon. Annual blasting emissions are presented in Tables 2.3-1 and 2.3-2.

Table 2.3-1 Particulate Matter Emissions from Blasting by Year

Year	*No. Blasts / Year	*Area Blasted (m^2)	Particulate Matter Emissions (tonnes/year)		
			TSP	PM_{10}	$PM_{2.5}$
Y-1	104	719,785	14.2	7.4	0.4
Y1	104	1,077,643	24.1	12.5	0.7
Y2	104	1,076,827	24.1	12.5	0.7
Y3	104	1,077,403	24.1	12.5	0.7
Y4	104	1,308,313	32.3	16.8	1.0
Y5	104	1,308,464	32.3	16.8	1.0
Y6	104	1,308,686	32.3	16.8	1.0
Y7	104	1,308,044	32.3	16.8	1.0
Y8	104	1,308,211	32.3	16.8	1.0
Y9	104	1,307,718	32.3	16.8	1.0
Y10	104	1,307,365	32.2	16.8	1.0
Y11	104	714,567	13.8	7.2	0.4
Y12	0	0	0.0	0.0	0.0

Notes: *Assumed based on twice-weekly blasting and 10 m blast depth;
Method assumes a bulk density of 2.6 tonnes/m^3

Table 2.3-2 Gaseous Emissions from Blasting by Year

Year	ANFO Used (tonnes)	Gaseous Emissions (tonnes/year)		
		CO	NO_x	SO_2
Y-1	5114	173.9	40.9	5.1
Y1	7642	259.8	61.1	7.6
Y2	7661	260.5	61.3	7.7
Y3	7708	262.1	61.7	7.7
Y4	9208	313.1	73.7	9.2
Y5	9215	313.3	73.7	9.2
Y6	9237	314.1	73.9	9.2
Y7	9216	313.3	73.7	9.2
Y8	9236	314.0	73.9	9.2
Y9	9249	314.5	74.0	9.2
Y10	9256	314.7	74.0	9.3
Y11	5081	172.7	40.6	5.1
Y12	0	0.0	0.0	0.0

2.4 Material Handling

Adding material to a storage pile (dumping) or removing it (shovelling and loading) involves dropping loose material onto a receiving surface, which allows fine-grained materials to be entrained by the wind. The operation can be batch (e.g., truck dumping, front end loaders), or continuous (e.g., adding material to the pile by a conveyor belt). Emissions of TSP, PM_{10} and $PM_{2.5}$ from material handling activities are estimated based on emission factors published in NPRI Pits and Quarries Guidance, which references the methodology published in USEPA AP-42 Section 13.2.4: Aggregate Handling And Storage Piles, Equation 1 (USEPA 1995), presented below:

$$EF\ (kg/tonne) = k * 0.0016 * \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

U = mean wind speed (m/s)

M = Material Moisture Content (%)

k: particle size multiplier

k(TSP) = 0.74

k(PM_{10}) = 0.35

k($PM_{2.5}$) = 0.053

Source: USEPA AP-42 Section 13.2.4

The mean annual wind speed, obtained from the on-site meteorological station (July 2012 to July 2015), is 2.34 m/s. A material moisture content of 4.8%, representing the uppermost range of soil moisture conditions (0.25% to 4.8%) used in developing the emission factor, was assumed for the overburden, which consists of a large quantity of high-moisture colluvium, and is described as having a moisture content of 16% in the Feasibility Study. As a result, emission estimates will be very conservative for the method. The emission factors for loading and dumping of overburden, based on the above parameters are as follows:

EF(TSP) = 3.77E^{-04} kg/tonne

EF(PM_{10}) = 1.78E^{-04} kg/tonne

EF ($PM_{2.5}$) = 2.70E^{-05} kg/tonne

Material volume estimates for overburden removal are still being developed and have not been provided. Average annual tonnage estimates have therefore been assumed based on the previous operational plan (3,950,000 tonnes/year). Total particulate matter emissions from overburden and material extraction are listed in Table 2.4-1.

The assumed moisture content for ore (1%) was taken from Sandvik's crusher process diagram, contained in the Feasibility Study. The assumed moisture content for waste rock is 2% as described in Section 2.1. Material movement quantities are based on projected tonnages of extraction and waste rock disposal contained in the Operational Plan. The emission factors for handling ore and waste rock, are as follows:

Ore:

EF(TSP) = 3.39E^{-03} kg/tonne

EF(PM_{10}) = 1.60E^{-03} kg/tonne

EF ($PM_{2.5}$) = 2.43E^{-04} kg/tonne

Waste Rock:

EF(TSP) = 1.28E^{-03} kg/tonne

EF(PM_{10}) = 6.07E^{-04} kg/tonne

EF ($PM_{2.5}$) = 9.19E^{-05} kg/tonne

Emissions from haul truck dumping of ore into the ROM hopper were estimated based on the Truck Unloading – Fragmented Stone (SCC 3-05-020-31) emission factor for PM_{10} published in USEPA AP-42 Section 11.19.2:

Crushed Stone Processing and Pulverized Mineral Processing: Table 11.19.2-1 Emission Factors For Crushed Stone Processing Operations (USEPA 1995). As emission factors for this method are not provided for TSP or $PM_{2.5}$, particle-specific ratios were derived from emission factors contained in the NPRI Crushed Stone Processing Emissions Worksheet – Conveyor Transfer Point section. Haul truck unloading ROM ore emission factors are as follows:

EF(TSP) = 2.18E^{-05} kg/tonne[1]

EF(PM_{10}) = 8.00E^{-06} kg/tonne

EF ($PM_{2.5}$) = 2.83E^{-06} kg/tonne[2]

Emission factors for bulldozing of waste rock at Alpha and Beta WRSF and for in-pit backfills were taken from USEPA AP-42 Chapter 11, Mineral Products Industry, Section 11.9: Western Surface Coal Mining, Table 11.9-2 (See Section 2.1). Bulldozing of waste rock at the WRSF utilized estimated equipment operational hours contained in the OPEX. Emission factors for bulldozing of waste rock are as follows:

EF(TSP) = 11.85 kg/hr

EF(PM_{10}) = 2.63 kg/hr

EF ($PM_{2.5}$) = 1.24 kg/hr

Emission estimates for TSP, PM_{10} and $PM_{2.5}$ from the material handling operations for each year are presented in Table 2.4-1.

Table 2.4-1 Particulate Matter Emissions from Material Handling by Year

Year	Total Material Handled (million tonnes)	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Y-1	49.0	337.6	98.1	32.4
Y1	71.9	484.2	140.5	46.4
Y2	72.0	482.5	140.9	46.2
Y3	71.2	479.9	140.9	45.8
Y4	85.1	544.0	157.7	52.2
Y5	84.6	537.2	155.9	51.5
Y6	84.2	538.3	156.4	51.6
Y7	84.7	538.2	156.4	51.6
Y8	84.1	538.1	156.3	51.6
Y9	83.9	496.1	147.4	47.1
Y10	83.6	424.0	131.5	39.6
Y11	54.7	295.6	92.5	27.5
Y12	6.6	18.3	8.6	1.3
Note: * Assumes an average annual overburden removal tonnage				

Emissions related to diesel combustion from equipment used in material handling activities are discussed in Section 2.10.

[1]Particle-specific ratio defined based on TSP:PM_{10} ratio (0.015 : 0.00055) for uncontrolled emission factors in the Conveyor Transfer Point section of NPRI Crushed Stone Processing Emissions Worksheet.

[2]Particle-specific ratio defined based on PM_{10}:$PM_{2.5}$ ratio (2.30E^{-05}: 6.50E^{-06}) for controlled emission factors in the Conveyor Transfer Point section of NPRI Crushed Stone Processing Emissions Worksheet.

Source: USEPA AP-42 Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing Table 11.19.2.1 SCC 3-05-020-31.

2.5 Crushing and Screening

To reduce the size of the run-of-mine ore and increase the available surface area for reaction in the heap-leaching process, ore is processed in a series of automated screening, crushing and conveyor transfer operations, which create fugitive dust. The crushing operation at the Project involves primary (Grizzly) screening of the raw ore, which splits the material into two size fractions, the larger of which first undergoes primary crushing in the jaw crusher before being fed via conveyor belt to the secondary screen/crusher.

Emissions of TSP, PM_{10} and $PM_{2.5}$ from crushing and grinding operations on site have been estimated based on emission factors published in NPRI Pits and Quarries Guidance, which references USEPA AP-42 Section 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations (USEPA 1995) for uncontrolled operations, listed in Table 2.5-1.

Table 2.5-1 Crushing and Screening Emission Factors - Uncontrolled

Uncontrolled Crushing & Screening Emission Factors	EF(TSP) (kg/tonne)	EF(PM_{10}) (kg/tonne)	EF($PM_{2.5}$) (kg/tonne)
Grizzly (Primary) Screen	0.0125	0.0043	0.00029[1]
Primary Crushing (Jaw Crusher)	0.0027	0.0012	0.0006
Primary Crusher to Secondary Screen Feed Conveyor Transfer	0.0015	0.00055	0.000155
Vibrating (Secondary) Screen	0.0125	0.0043	0.00029[1]
Secondary Crushing (Cone Crusher)	0.0027	0.0012	0.0006
Conveyor Transfer 2	0.0015	0.00055	0.000155
Conveyor transfer to crushed ore stockpile	0.0015	0.00055	0.000155
Conveyor drop into crushed ore stockpile[2]	0.0034	0.0016	0.00024

Notes: [1] Applies PM_{10}:$PM_{2.5}$ ratio for controlled emissions;
[2] Assumes average wind speed of 2.34 m/s, ore moisture of 1%; from USEPA AP-42 Section 13.2.4 – Aggregate Handling And Storage Piles (Equation 1) – see Section 2.4

Emissions of TSP, PM_{10} and $PM_{2.5}$ from the crushing process have been estimated by year in Table 2.5-2 based on the above emission factors and estimated throughputs from Sandvik's crusher process diagram, contained in the feasibility assessment.

Table 2.5-2 Particulate Matter from Crushing and Screening by Year

Year	Total Throughput (million tonnes)	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Y-1	29.8	159.1	57.8	8.0
Y1	43.0	227.3	82.6	11.5
Y2	43.0	227.3	82.6	11.5
Y3	43.0	227.3	82.6	11.5
Y4	43.0	227.3	82.6	11.5
Y5	43.0	227.3	82.6	11.5
Y6	43.0	227.3	82.6	11.5
Y7	43.0	227.3	82.6	11.5
Y8	43.0	227.3	82.6	11.5
Y9	43.0	227.3	82.6	11.5
Y10	43.0	227.3	82.6	11.5
Y11	43.0	227.3	82.6	11.5
Y12	14.0	74.9	27.2	3.8

Note: The crusher will be operational between April and December

2.6 Wind Erosion of Stockpile Material

Removed overburden soil, ROM ore and crushed ore will be temporarily stored in piles in designated areas through the life of the project. The material stored in these stockpiles ranges from coarse materials to fine grained fractions, which can be entrained by winds, generating fugitive dust emissions.

Emissions of TSP, PM_{10} and $PM_{2.5}$ from the material stockpiles on site are estimated based on the methodology presented in the NPRI Pits and Quarries Guidance, Section 8.9: Emissions Due to Wind Erosion of Stockpile Surfaces (Environment Canada 2009). Equation (8.11) from the Pits and Quarries Guidance document has been used to estimate TSP, PM_{10} and $PM_{2.5}$ emission factors for wind erosion of stockpile surfaces:

$$\mathrm{EF}\ (\mathrm{kg/m^2}) = 1.12\mathrm{E}^{-04} * \mathrm{J} * 1.7 * \left(\frac{s}{1.5}\right) * 365 * \left(\frac{(365 - P)}{235}\right) * \left(\frac{I}{15}\right)$$

Where:

J = Particulate aerodynamic factor; J(TSP) = 1.0; J(PM_{10}) = 0.5; J($PM_{2.5}$) = 0.2

s = Average silt loading of storage pile in percent (%)

P = Average number of days during the year with at least 0.254 mm of precipitation

I = Percentage of time in the year with unobstructed wind speed >19.3 km/h in percent (%)

Average silt loading for the soil stockpiled on site (10%) has been taken from the Pits and Quarries Guidance document Section 8.9. The average silt loading for the ore and similar materials in stockpiles on site (6.9%) has been taken from data published for the nearby Casino Mining Corporation gold mining facility in the *Casino Project; Supplementary Information Report* (Casino 2015). Meteorological data is provided from the site meteorological station (2012 – 2015), which indicates an average of 181.3 days per year with at least 0.254 mm of precipitation and wind speeds greater than 19.3 km/hour occurring 3.5% of the time.

Calculation for wind erosion emissions in a given year assumes a conically shaped stockpile, with a lateral area equal to:

$$A = \pi r * \sqrt{(r^2 + h^2)}$$

Where:

r = radius of the base of the conical pile

h = height of the conical pile

The surface areas of the ROM stockpile and the crushed ore stockpile vary greatly by quarter (e.g., ROM ore is 100% stockpiled when the crusher is not operational between January and March). Wind erosion emission estimates do not account for snow cover or other forms of dust suppression (e.g., water).

The lateral surface area calculated for the organics soil stockpile is based on the cumulative volume of removed overburden. It assumes several conical shaped piles within the designated storage area and does not account for shielding of winds from the direction of the pile alignment or compaction during the year. Overburden removal details are still being developed and were not provided for the inventory. Table 2.6-1, taken the 2016 Air Emission Inventory, is presented to provide a reference for annual emissions due to wind erosion of stockpiles.

Table 2.6-1 Particulate Matter Emissions from Wind Erosion of Stockpiles – Example Year

Stockpile	Silt Content (%)	Estimated Lateral Surface Area (m^2)	Particulate Matter Emissions (tonnes/year)		
			TSP	PM_{10}	$PM_{2.5}$
Crushed Ore Stockpile	6.9	677	0.039	0.020	0.008
ROM Stockpile	6.9	10,588	0.617	0.309	0.123
Soil Stockpile	10	72,443	6.1	3.1	1.2
Total Annual Emissions (tonnes)			**6.8**	**3.4**	**1.4**

2.7 Haul Truck Traffic on Unpaved Roads

The greatest quantity of dust emission from the Project is due the passage of haul trucks transporting waste rock, ore and overburden along unpaved roads around the Project site. The passage of these heavy trucks on unpaved roadways disturbs fine surface sediments (i.e., silt) and creates a turbulent wake zone, which generates a plume of fugitive TSP, PM_{10} and $PM_{2.5}$ emissions that can become entrained in the wind and transported away from the roadway.

Emissions of TSP, PM_{10} and $PM_{2.5}$ from haul roads have been estimated based on the methodology published in NPRI Pits and Quarries Guidance, which references USEPA AP-42 Section 13.2.2: *Unpaved Roads* (USEPA 1995). Fugitive road dust emissions generated from the movement of traffic on unpaved roads are proportional to the length and the frequency of use of a segment of road and the weight of the vehicle:

$$EF\ (kg/VKT) = k\left(\frac{s}{12}\right)^{a}\left(\frac{w}{2.72}\right)^{b}$$

Where:

VKT = vehicle kilometres travelled

s = surface silt content (%)

w = mean vehicle weight (tonnes)

k = particle size multiplier (kg/VKT, see Table 2.7-1)

a & b = empirical constants (see Table 2.7-1)

Table 2.7-1 Constants for Haul Truck Emission Calculations

Empirical Constant	Units	TSP	PM_{10}	$PM_{2.5}$
k	kg/VKT	1.381	0.423	0.042
a		0.7	0.9	0.9
b		0.45	0.45	0.45
Source: Adapted from USEPA AP-42, Section 13.2.2, Table 13.2.2-2				

The total vehicle kilometres travelled in a given year (VKT) were provided in the Operational Plan and were based on the material extraction schedule, the number of haul trucks in the fleet and the haul road distances. The VKT in a given quarter year equals the total number of haul truck passes times the length of each road segment where the number of passes is equal to the number of nominal loads times two (for a return trip). The model of haul truck to be used for the duration of the Project is the Komatsu model HD1500-7, with a 105.3 tonne empty weight and a 144.2 tonne nominal payload, which equals a mean vehicle weight of 177.4 tonnes.

The average silt content on facility haul roads has been conservatively assumed to be 10% based on the typical silt content for plant roads at stone quarrying and processing facilities as identified in USEPA AP-42, Section 13.2.2, Table 13.2.2-1 *Typical Silt Content Values Of Surface Material On Industrial Unpaved Roads* (USEPA 1995).

A correction factor of 49.6% has been applied to account for natural mitigation due to precipitation, based on an average of 181.3 days per year with precipitation, as recorded by the Coffee Creek meteorological station. A further correction of 80% has been applied from October through March to account for diminished dust emissions due to frozen ground and snow cover. A 70% reduction has been applied for non-winter months (April to October), as described in *Dust Control Methods* in the NPRI *Unpaved Road Dust Calculator* (Environment Canada 2009) spreadsheet to account for more than twice-a-day watering of roads.

From the equation, inputs and emission adjustments listed above, the emission factors for haul truck traffic on unpaved roads are as follows:

April through September:

EF(TSP) = 1.20 kg/VKT

EF(PM_{10}) = 0.36 kg/VKT

EF ($PM_{2.5}$) = 0.04 kg/VKT

October through March:

EF(TSP) = 0.80 kg/VKT

EF(PM_{10}) = 0.24 kg/VKT

EF ($PM_{2.5}$) = 0.02 kg/VKT

Emissions of TSP, PM_{10} and $PM_{2.5}$ from haul road segments for all years are summarized in Table 2.7-2.

Table 2.7-2 Particulate Matter Emissions from Haul Trucks on Unpaved Roads by Year (Mitigated)

Year	Total Haulage Distance Travelled (km)	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Y-1	509,789	526	155	16
Y1	878,043	901	266	27
Y2	878,695	899	265	27
Y3	897,759	918	271	27
Y4	1,126,440	1,137	336	34
Y5	1,311,240	1,355	400	40
Y6	1,310,217	1,333	394	39
Y7	1,161,810	1,175	347	35
Y8	1,540,543	1,565	462	46
Y9	1,824,126	1,851	546	55
Y10	1,411,886	1,431	422	42
Y11	793,162	829	245	24
Y12	107,694	130	38	4

Notes: *Precipitation correction factor = 49.6%; winter (Jan-Mar) correction factor = 80%; Twice-daily watering correction factor of 70% (Apr – Dec)
**Excludes haulage of overburden removal

*Precipitation correction factor = 49.6%; winter (Oct-Mar) correction factor = 80%; Twice-daily watering correction factor of 70% (Apr – Sep)
*Excludes haulage of overburden removal – details not provided

Emissions related to diesel combustion from haul truck engines are discussed in Section 2.10.

2.8 Light Vehicle Traffic on Unpaved Roads

Updated details of the light duty fleet were not provided in the 2017 mine plan. Table 2.8-1, taken from the 2016 Air Emission Inventory is presented to provide a reference for annual particulate matter emissions due to travel of light duty vehicles on site roads. The data in the table assumes a fleet of six light-duty pick-up trucks (Ford F350 - 1 T Diesel Crew Cab) with a nominal payload of 4.1 tonnes. The total kilometres travelled for these light duty vehicles has been conservatively estimated based on a 50% utilization (in motion 50% of the time) and a mean vehicle speed of 20 km/hour. The reductions due to precipitation, frozen ground and watering of roads, described in Section 2.7, have also been applied.

Using the equation from Table 2.7-1 and mitigation due to precipitation, watering and frozen ground, the emission factors for light duty vehicle traffic on unpaved roads are as follows:

April through September:

EF(TSP) = 0.22 kg/VKT

EF(PM_{10}) = 0.07 kg/VKT

EF ($PM_{2.5}$) = 0.007 kg/VKT

October through March:

EF(TSP) = 0.15 kg/VKT

EF(PM_{10}) = 0.04 kg/VKT

EF ($PM_{2.5}$) = 0.004 kg/VKT

Table 2.8-1 Particulate Matter Emissions from Light Duty Vehicles on Unpaved Roads – Operation Phase

Vehicle Type	VKT (km/year)	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Light Duty Vehicles	525,600	127.8	37.7	3.8

Emissions related to diesel combustion from the vehicle's engines are discussed in Section 2.10.

2.9 Grading

The maintenance of haul and pit access roads generates fugitive dust emissions. The 2016 Feasibility Study calls for the use of one to three Komatsu GD825 graders, depending on the operational year, on a regular basis for maintenance and support purposes throughout the life of the Project (JDS 2016). Emissions of fugitive TSP, PM_{10} and $PM_{2.5}$ have been estimated based on emission factors for grading published in NPRI Pits and Quarry Guidance, which references USEPA AP-42 Section 11.9: Western Surface Coal Mining, Table 11.9-2 Emission Factor Equations for Uncontrolled Open Dust Sources at Western Surface Coal Mines (USEPA 1995).

EF(TSP) (kg/VKT) = $0.0034 \times (S)^{2.5}$

EF(PM_{10}) (kg/VKT) = $0.60 \times (0.0056 \times (S)^{2.0})$

$EF(PM_{2.5})$ (kg/VKT) = 0.031 x (0.0034 x $(S)^{2.5}$)

Where:

S = mean vehicle operational speed (km/h)

The assumed mean vehicle speed (10.5 kph) was taken from Table 10.1: Approximate Speed Ranges Used in Various Grader Operations (Anonymous 2016). The VKT used to calculate the emissions from these grading was provided in the Operational Plan. The estimated TSP, PM_{10} and $PM_{2.5}$ emissions from grading activities are presented in Table 2.9-1. Grader emissions do not include mitigation due to precipitation.

Table 2.9-1 Particulate Matter Emissions from Grading by Year

Year	VKT	Particulate Matter Emissions (tonnes/year)		
		TSP	PM_{10}	$PM_{2.5}$
Y-1	108,573.70	131.9	40.2	4.1
Y1	108,573.70	131.9	40.2	4.1
Y2	147,215.38	178.8	54.5	5.5
Y3	158,336.64	192.3	58.7	6.0
Y4	156,074.69	189.6	57.8	5.9
Y5	153,812.74	186.8	57.0	5.8
Y6	153,812.74	186.8	57.0	5.8
Y7	153,812.74	186.8	57.0	5.8
Y8	153,812.74	186.8	57.0	5.8
Y9	38,453.18	46.7	14.2	1.4
Y10	0	0	0	0
Y11	0	0	0	0
Y12	0	0	0	0
*Grading hours for Y10 through Y12 were not included in the Operational Plan				

Emissions related to diesel combustion from the grader engines are discussed in Section 2.10.

2.10 Products of Diesel Combustion

The combustion of diesel fuel in internal combustion engines produces gaseous emissions of CO, NO_x, SO_2 and VOCs in addition to particulate matter, the majority of which is $PM_{2.5}$. These CACs are emitted in the exhaust of production and support equipment, vehicles, the power plant generator set, and the incinerator.

2.10.1 Production and Support Vehicles and Heavy Equipment

Emissions of CO, NO_x, SO_2, VOCs, PM_{10} and $PM_{2.5}$ from the combustion of diesel fuel in fleet vehicles and equipment have been estimated based on the methodology and emission factors contained in the Australian Government's NPI *Emission Estimation Technique Manual for Combustion Engines - Version 3.0* (NPI. 2008). A list of proposed vehicle and equipment and yearly usage/fuel consumption estimates was described in the Feasibility Study. Net engine power values were obtained from manufacturer (e.g., Komatsu) specification sheets. Detailed equipment and vehicle information, usage and the emission factors used in the inventory are described in Table 2.10-1.

Table 2.10-1 Fleet Vehicle and Equipment Emission Factors

Vehicle Make and Model	[1]Engine/Vehicle Classification	Power-Based Emission Factors (kg/kWh)					
		CO	NO_x	[1]SO_2	VOC	PM_{10}	$PM_{2.5}$
Komatsu HD1500 Haul Truck (144t)	Off-highway Truck	4.70E-03	1.09E-02	7.73E-06	5.00E-04	6.73E-04	6.19E-04
Komatsu PC3000 Shovel (15m^3)	Wheeled Tractor	9.84E-03	1.60E-02	7.26E-06	2.36E-03	1.70E-03	1.56E-03
Komatsu PC800 Excavators (4.5m^3)	Track Type Loader	3.03E-03	1.25E-02	7.49E-06	1.49E-03	8.78E-04	8.08E-04
Komatsu WA900 Wheel Loader (11.5m^3)	Wheeled Loader	3.63E-03	1.18E-02	7.49E-06	1.59E-03	1.08E-03	9.94E-04
Komatsu D275 Track Dozers	Track Type Tractor	2.88E-03	1.05E-02	7.26E-06	1.01E-03	9.28E-04	8.54E-04
Komatsu WD500 Wheel Dozer	Wheeled Dozer	4.70E-03	1.09E-02	7.49E-06	5.00E-04	5.51E-04	5.07E-04
Komatsu GD825 Grader	Motor Grader	2.06E-03	9.57E-03	7.49E-06	4.80E-04	8.38E-04	7.71E-04
Skid Steer (326D)	Wheeled Loader	3.63E-03	1.18E-02	7.49E-06	1.59E-03	1.08E-03	9.94E-04
Skid Steer Loader	Wheeled Loader	3.63E-03	1.18E-02	7.49E-06	1.59E-03	1.08E-03	9.94E-04
Excavator (~1.0 CU.M) CAT 320DL	Track Type Loader	3.03E-03	1.25E-02	7.49E-06	5.00E-04	8.78E-04	8.08E-04
Vehicle Make and Model	**Engine/Vehicle Type**	**Fuel Consumption-Based Emission Factors (kg/m^3)**					
		CO	**NO_x**	**[2]SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**
D50KS Drill (152 – 229 mm)	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
DX800 Drill (76 mm)	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Water Truck (75 m^3)	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Fuel/Lube Truck	HGV	6.81E+00	2.33E+01	1.67E-02	1.80E+00	1.84E+00	1.73E+00
Light Duty Trucks (Diesel)	Utility (LGV)	1.18E-02	1.50E-03	1.14E-05	1.20E-03	9.82E-06	9.11E-06
Crew Transport Bus	Buses (Diesel)	9.11E+00	3.04E+01	1.67E-02	1.18E+00	2.11E+00	2.07E+00
Explosives Bulk Truck	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Portable Light Plants (Diesel)	Ground power unit	1.56E+01	7.25E+01	1.67E-02	5.30E+00	5.10E+00	4.98E+00
Tool Carrier	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Pit Dewatering Pumps (Diesel)	Ground power unit	1.56E+01	7.25E+01	1.67E-02	5.30E+00	5.10E+00	4.98E+00
Tire Manipulator (Hyster/IMAC 700)	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Low Boy Trailer	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Mobile Car Wash	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Vacuum Truck	HGV	6.81E+00	2.33E+01	1.67E-02	1.82E+00	1.84E+00	1.73E+00
Portable Diesel Heaters	Ground power unit	1.56E+01	7.25E+01	1.67E-02	5.30E+00	5.10E+00	4.98E+00

Footnote: [1] Assumes 10 ppm sulfur content of diesel fuel

Emission estimates due to combustion of diesel fuel in the fleet are presented in Table 2.10-2**.** Note that there are no specific emission factors from internal combustion engines for TSP as particle sizes are smaller than 10 microns; therefore, TSP emissions are presumed to be equal to the PM_{10} values.

Table 2.10-2 Combustion Emissions from Fleet Vehicles by Year

Year	Combustion Emissions (tonnes/year)					
	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
Y-1	277.2	591.3	0.4	43.6	47.3	43.9
Y1	437.6	920.2	0.6	67.8	73.6	68.3
Y2	454.7	959.5	0.7	71.7	77.0	71.5
Y3	472.9	998.0	0.7	74.1	79.7	74.0
Y4	514.8	1108.8	0.8	79.7	86.8	80.5
Y5	551.9	1194.4	0.8	83.0	91.8	85.2
Y6	553.8	1197.3	0.8	83.4	92.1	85.4
Y7	519.9	1116.8	0.8	80.6	87.5	81.2
Y8	589.7	1280.0	0.9	86.8	97.1	90.0
Y9	637.9	1369.9	0.9	93.9	103.8	96.2
Y10	548.9	1154.2	0.8	81.6	89.6	83.1
Y11	390.6	785.4	0.5	58.2	63.8	59.2
Y12	49.4	99.0	0.1	6.2	7.9	7.3

2.10.2 Power Plant Diesel Generators

The proposed main power plant will operate at a relatively constant rate throughout the project with emissions of CO, NO_x, SO_2, VOC, TSP, PM_{10} and $PM_{2.5}$. Emissions from the combustion of diesel fuel in the 4 MW generator set used in the power plant have been estimated using the NPRI *Fuel Oil Combustion Emissions Calculator* Spreadsheet (Environment Canada 2009). Annual fuel consumption of the generator was estimated at 4,786 m^3 in the Feasibility Study. Annual emissions are listed in Table 2.10-3. The emission estimates do not consider year-to-year variation in the power demand and as a result may be conservative in years the mine is running below capacity (e.g. Y-1 and Y12).

Table 2.10-3 Combustion Emissions from Power Plant Generator

Power Plant	Combustion Emissions (tonnes/year)						
	CO	NO_x	[1]SO_2	VOC	TSP	PM_{10}	$PM_{2.5}$
4 MW Genset	67.9	255.5	1.3	6.5	4.9	4.0	3.8

Footnote: [1]Assumes Low-Sulphur Diesel Fuel (15 ppm)

2.10.3 Waste Incinerator

The waste incinerator proposed for the mine is expected to operate at a relatively constant rate year to year throughout the project with emissions of CO, NO_x, SO_2, VOC, TSP, PM_{10} and $PM_{2.5}$ from the combustion of organic waste material and the diesel fuel. The emissions from the incinerator have been estimated based on the emission factors published in USEPA AP-42 Section 2.1: Refuse Combustion, Table 2-1.12 Uncontrolled Emission Factors for Refuse Combustors other than Municipal Waste (USEPA 1995), listed in Table 2.10-4.

Table 2.10-4 Emission Factors for Incinerators

Incinerator	Emission factors (kg/tonne)						
	CO	NO_x	SO_2	VOC	TSP	PM_{10}	$PM_{2.5}$
Dual Chamber, Diesel Fired Incinerator (Industrial Commercial)	5	1.5	1.25	1.5	3.5	2.2	1.75

Emission estimates from the combustion of organic waste material and the diesel fuel in the incinerator have been prepared based on a maximum waste incineration rate of approximately 900 kg per day, as described in the Project Description Report, the emission factors listed above, the number of personnel in camp and the assumption that incineration will occur every day. It is also assumed that waste incineration will typically occur during the day. The emission estimates are presented in Table 2.10-5. The emission estimates do not consider year-to-year variation in personnel and as a result may be conservative in years the mine is running below capacity (e.g. Y-1 and Y12).

Table 2.10-5 Combustion Emissions from Refuse Incineration

Year	Average # Personnel	Combustion Emissions (tonnes/year)						
		CO	NO_x	SO_2	VOC	TSP	PM_{10}	$PM_{2.5}$
Y-1	143	1.0	0.3	0.2	0.3	0.7	0.5	0.3
Y1	189	1.3	0.4	0.3	0.4	0.9	0.6	0.4
Y2	195	1.3	0.4	0.3	0.4	0.9	0.7	0.5
Y3	202	1.4	0.4	0.3	0.4	0.9	0.7	0.5
Y4	220	1.5	0.5	0.4	0.4	1.0	0.7	0.5
Y5	230	1.6	0.5	0.4	0.5	1.1	0.8	0.5
Y6	232	1.6	0.5	0.4	0.5	1.1	0.8	0.6
Y7	231	1.6	0.5	0.4	0.5	1.1	0.8	0.6
Y8	234	1.6	0.5	0.4	0.5	1.1	0.8	0.6
Y9	226	1.5	0.5	0.4	0.5	1.1	0.8	0.5
Y10	202	1.4	0.4	0.3	0.4	0.9	0.7	0.5
Y11	154	1.0	0.3	0.3	0.3	0.7	0.5	0.4
Y12	33	0.2	0.1	0.1	0.1	0.2	0.1	0.1

3.0 SUMMARY OF ANNUAL OPERATIONS YEAR 6 EMISSIONS

Table 3.1-1 summarizes the anticipated project-related emissions for each operational year (Y1 to Y12) plus pre-operational year Y-1.

Table 3.1-1 Summary of Total Project Air Emissions by Year

	Particulate Matter			Combustion Emissions					
Year	TSP	PM_{10}	$PM_{2.5}$	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$
Y-1	1346	413	77	520	888	7	51	52	48
Y1	1955	601	110	767	1237	10	75	78	73
Y2	1998	615	111	784	1277	10	79	82	76
Y3	2029	625	113	804	1316	10	81	84	78
Y4	2320	711	127	897	1438	12	87	91	85
Y5	2528	773	132	935	1524	12	90	97	90
Y6	2508	768	132	937	1527	12	90	97	90
Y7	2349	720	127	903	1447	12	88	92	86
Y8	2740	836	139	973	1610	12	94	102	94
Y9	2844	869	139	1022	1700	12	101	109	101

Y10	2306	715	117	933	1484	12	89	94	87
Y11	1543	481	80	632	1082	7	65	68	63
Y12	356	112	13	118	355	1	13	12	11

4.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Signature REDACTED

Signature REDACTED

Prepared by:
Travis Miguez, B.Sc, P.Met.
Project Scientist – Meteorology & Air Dispersion
Direct Line: Phone Number REDACTED
Email REDACTED

Reviewed by:
Steven Babcock
Senior Consulting Engineer
Direct Line: Phone Numbers REDACTED
Email REDACTED

REFERENCES

Anonymous, 2016. Equipment Operator Basic - Beginning construction equipment operators manual. http://enginemechanics.tpub.com/14081/css/Grader-Estimates-255.htm. Accessed April 2016.

Australia Government, Department of the Environment, Water, Heritage and the Arts, National Pollutant Inventory (NPI). 2008. Emission Estimation Technique Manuals for Combustion Engines Version 3.0. June 2008.

Australia Government, Department of the Environment, Water, Heritage and the Arts, National Pollutant Inventory (NPI). 2012. Emission Estimation Technique Manuals for Mining Version 3.1. January 2012.

Casino Mining Corporation (Casino). 2015. Casino Project; Supplementary Information Report. Mar 2015.Environment Canada. 2009.

JDS Energy & Mining Inc. 2016. Feasibility Study Report for the Coffee Gold Project, Yukon Territory, Canada. February 18, 2016.

Environment Canada. 2009. National Pollution Release Inventory, Pits and Quarries Guidance. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=A9C1EE34-1. Accessed April 2016.

Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District (Mojave). 2000. Emissions Inventory Guidance, Mineral Handling Handbook and Processing Industries. April 10, 2000.

National Pollution Release Inventory (NPRI), Pits and Quarries Guidance. Available at: https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=A9C1EE34-1. Accessed April 2016.

United States Environmental Protection Agency (USEPA). 1995. USEPA AP-42 - Compilation of Air Pollutant Emission Factors, Volume 1. Availale at: https://www3.epa.gov/ttnchie1/ap42/. Accessed April 2016.

APPENDIX A

TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these "General Conditions".

1.1 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of TETRA TECH's client. TETRA TECH does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than TETRA TECH's Client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the report, if required, may be obtained upon request.

1.2 ALTERNATE REPORT FORMAT

Where TETRA TECH submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed TETRA TECH's instruments of professional service); only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by TETRA TECH shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of TETRA TECH's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except TETRA TECH. The Client warrants that TETRA TECH's instruments of professional service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

1.4 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX 9-B-2

GHG Emissions Inventory

TETRA TECH

March 17, 2017

ISSUED FOR USE
FILE: ENV.VENV03082-01.003
Via Email: Email REDACTED

Coffee Gold Project
Goldcorp

Attention: Jennie Gjertsen
Environmental and Permitting Manager

Subject: Kaminak Coffee Mine Project GHG Emissions Inventory Update

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Goldcorp, formerly Kaminak Gold Corp. to support the assessment, licensing and permitting phases of Coffee Gold Project (the Project). This report is to provide an update on the Greenhouse Gas (GHG) Inventory based on the February 2017 revised Mine OPEX schedule and equipment information. The original report was provided to Kaminak Gold Corp. in April 2016 (dated April 29, 2016).

2.0 METHOD

GHGs are calculated based mostly on estimated fuel consumption association with construction, operations, ore processing, wastewater treatment, vegetation removal, the use of explosives and transportation of materials and employees to and from site. Where data has not been described, or if the parameters were simply unknown, assumptions were made and described below. The inventory is summarized and presented in tabular form in this brief report outlining the emissions estimated for the various activities. The original GHG inventory was prepared based on the information contained in the 2016 Feasibility Study mine design (JDS 2016) and the 2016 Kaminak Air Emissions Inventory. This update is based on data provided in the revised worksheet: Kaminak_CoffeeCreek_OPMineOPEX_60mt_SCENARIO3 (Mr. James Scott, via email February 20, 2017).

There are some volumetric fuel consumption data was not provided in the updated worksheet, including

- Surface infrastructure equipment fuel
- Process and Infrastructure Fuel

The data in the Kaminak Air Emissions Inventory file is used in this revision for surface infrastructure equipment fuel and process and infrastructure fuel. Tetra Tech assumes that this fuel consumption does not change from the 2016 Feasibility Study mine design other than the emissions were assumed to spread across the 3 years of construction at proportions of about 20%, 30% and 50% for years -3, -2 and -1, respectively.

In the April 2016 GHG inventory, GHG emissions associated with explosives were assumed to be zero or negligible due to lack of information. In this revision, 8.3 million litres of fuel (assumed to be diesel or equivalent), 17.3 litres of emulsion (assumed to be 50% diesel and 50% water) and 44,634 tonnes of ANFO was estimated in the revised worksheet. Tetra Tech estimated the GHG emissions associated with explosives based on the Technical Data Sheet provided by ORICA for ANFO (ORICA 2013). In addition, Tetra Tech assumed the diesel portion of the fuel and emulsion when exploded would emit a roughly equivalent amount of GHG as if it were combusted in an internal combustion engine.

Tetra Tech Canada Inc.
Suite 700 - 326 11th Avenue SW
Calgary, AB T2R 0C5
Tel 403.930.7700

The GHG emissions associated with aviation fuel are based on the following assumptions:

- 0.74 kg fuel/kg payload, based on Vancouver to Whitehouse flight;
- 89 L/person, based on Vancouver to Whitehouse flight;
- 0.719 kg/L density for aviation fuel; and
- 1 kg fuel/kg payload.

Emissions factors for diesel fuel and aviation turbo-prop fuel were taken from Environment Canada (2013).

CO2, CH4, and N2O emissions from fuel combustion are converted into carbon dioxide equivalent (CO2e) based on their Global Warming Potentials (GWP). The GWP for CO2 is 1, for CH4 is 25, and for N2O is 298 as per the Intergovernmental Panel on Climate Change (IPCC) 2006 values.

3.0 APPLICABLE GHG EMISSIONS

The inventory covered direct GHG emissions (commonly referred to as Scope 1 emissions). Indirect energy emissions (commonly referred to as Scope 2 emissions – emissions from the use of purchased electricity with emissions generated by others typically offsite) were not included; these emissions are counted under the utility provider. Other indirect emissions (commonly referred to as Scope 3 emissions) are those that are consequential to the operations but which lie outside the ownership or control of the proponent, Goldcorp). For the purposes of this assessment, there were deemed to be no other indirect emissions. In other words, all GHG emissions were deemed to arise out of direct control of Goldcorp and its contractors. This includes GHG emissions from aircraft which would be mostly chartered flights, rather than commercial.

Land use, land use change and forestry GHG-related emissions were not considered since they are not required in the Yukon Environmental and Socio-economic Effects Assessment.

CO2, CH4 and N2O are the only applicable GHG emissions. Hydrofluorocarbons (HFC), Perfluorocarbons (PFC) and Sulphur Hexafluoride (SF6) are deemed to be not applicable to the Project. The reason is:

- HFCs are typically used as industrial product in foam blowing and as a cover gas in metal production;
- PFCs are typically used as industrial product in aluminum production and foam blowing.
- SF6 is typically be used as industrial product as a cover gas in magnesium smelting and casting, as foundry products in the aluminum industry, and as an insulating gas in electrical equipment such as circuit breakers and on –site power stations.

4.0 RESULTS

The results for the updated inventory for the Coffee Gold Project are provided in Table 1. There is no change for aviation emissions from the April 2016 inventory. The total increase in GHG is about 27% from the previous inventory.

Table 1: GHG Inventory

Year		Equipment[1]	Flights	Explosives	Annual Total
		(Tonnes CO_2e)	(Tonnes CO_2e)	(Tonnes CO_2e)	(Tonnes CO_2e)
Y-3	Construction	9,069	--	--	9,069
Y-2	Construction	13,603	--	--	13,603
Y-1	Construction	22,672	--	3,605	26,277
Y 1	Operation	75,840	669	5,387	81,896
Y 2	Operation	85,170	1,798	5,400	92,368
Y 3	Operation	87,004	1,604	5,433	94,041
Y 4	Operation	93,944	1,752	6,491	102,187
Y 5	Operation	94,889	1,789	6,496	103,174
Y 6	Operation	90,371	1,789	6,511	98,671
Y 7	Operation	86,413	1,798	6,496	94,707
Y 8	Operation	92,228	1,826	6,510	100,564
Y 9	Operation	97,636	1,817	6,520	105,973
Y 10	Operation	78,111	1,780	6,523	86,414
Y 11	Operation	46,185	1,141	3,581	50,907
Y12	Closure	5,029	167	--	5,196
		978,164	**17,930**	**68,953**	**1,065,047**

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Goldcorp and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Goldcorp, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Tetra Tech's General Conditions are provided in Appendix A of this report.

[1] Note: equipment emissions include process and infrastructure fuel.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Signature REDACTED

Signature REDACTED

Prepared by:
Nelson Lee, M.A.Sc, P.Eng
Greenhouse Gas Quantifier
Direct Line: Phone Numbers REDACTED
Email REDACTED

Reviewed by:
Min Si, M.N.R.M.
Environmental Scientist
Environment & Water Practice
Direct Line: Phone Numbers REDACTED
Email REDACTED

Attachments: Appendix A: Tetra Tech's General Conditions

REFERENCES

Air North, Yukon's Airline. Aircraft fuel consumption. February 2, 2009. Available at http://www.flyairnorth.com/DealsAndNews/News.aspx?newsID=8. Accessed March 2016.

All-Aero. Avro 748. Hawker Siddley HS.748. Aircraft specifications. Available at: http://all-aero.com/index.php/home2/1285-avro-748-hs748. Accessed March 2016.

Casino Copper and Gold. Casino Project. Casino Mining Corporation. Chapter 8 – Air Quality. Table 8.4–2 Casino Greenhouse Gas Emission Estimates and Table 8.3-7 National and Territorial GHG Emissions (in kt of CO2e/year). Accessed March 2016.

de Havilland Buffalo Specifications. Available at: http://www.dhc4and5.org/Buffalo_spec.htm. Accessed March 2016

ENERGY, MINES AND RESOURCES (EMR) ASSESSMENT – REGULATORY GUIDE. March 2006. Available at: http://www.eco.gov.yk.ca/pdf/yesaa_guide_final_web.pdf. Accessed March 2016.

Environment and Climate Change Canada. Facility Greenhouse Gas Emissions Reporting Overview of reported 2013 Emissions. Available at: http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=28DE5952-1&offset=4&toc=show. Accessed March 2016.

Experimental Aircraft Info. Common Aviation Fuels, Avgas. Available at: http://www.experimentalaircraft.info/homebuilt-aircraft/aviation-fuel.php. Accessed March 2016.

Forest Ecology Network. Carbon Sequestration Facts. Available at: http://www.forestecologynetwork.org/climate_change/sequestration_facts.html. Accessed March 2016.

Intergovernmental Panel on Climate Change (IPCC). 2006. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/. Accessed March 2017.

Natural Resources Canada. Boreal forest. Boreal forest research. Available at: https://www.nrcan.gc.ca/forests/boreal/13071. Accessed March 2016.

Orica Limited (ORICA). 2013. ANFO Technical Data Sheet. http://www.oger.is/static/files/Sprengiefni/ANFO/ANFO_091210_1.pdf, Accessed on March 9, 2017.

The AusIMM Bulletin. GHG emissions from mining. Available at: https://www.ausimmbulletin.com/feature/blasting-approaches-to-decrease-greenhouse-gas-emissions-in-mining/. Accessed April 2016.

The Physics Factbook. Energy Density of Aviation Fuel. Available at: http://hypertextbook.com/facts/2003/EvelynGofman.shtml

United Nations Framework Convention on Climate Change, (UNFCCC). National Inventory Submissions. 2015 Annex 1 Parties GHG Inventory Submissions. Canada National Inventory 2015NIR - PT2-Final.pdf. Table A6-11 Emissions Factors for Energy Mobile Combustion Sources. Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php. Accessed March 2016.

APPENDIX A
TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.1 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of TETRA TECH’s client. TETRA TECH does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than TETRA TECH’s Client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the report, if required, may be obtained upon request.

1.2 ALTERNATE REPORT FORMAT

Where TETRA TECH submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed TETRA TECH’s instruments of professional service); only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by TETRA TECH shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of TETRA TECH’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except TETRA TECH. The Client warrants that TETRA TECH’s instruments of professional service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

1.3 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

1.4 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX 9-B-3

Air Quality Modelling Report

Coffee Gold Mine – Appendix 9-B-3
2016 Air Dispersion Modelling Report

PRESENTED TO

Goldcorp Inc.

MARCH 20, 2017
ISSUED FOR USE
FILE: 704-ENV.VENV03082-01

Tetra Tech Canada Inc.
Suite 1000 – 10th Floor, 885 Dunsmuir Street
Vancouver, BC V6C 1N5 CANADA
Tel 604.685.0275 Fax 604.684.6241

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES IN TEXT

APPENDIX SECTIONS

FIGURES

APPENDICES

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Goldcorp Inc. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Goldcorp Inc., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech's Services Agreement. Tetra Tech's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was contracted by Goldcorp, formerly Kaminak Gold Corp. in February 2016 to complete modelling and effects assessment of air quality (including greenhouse gases (GHG) and noise). This report provides the air quality modelling results from the 2016 mine design included in the Coffee Project Feasibility Study (JDS 2016).

Changes in ambient air quality as a result of Project-related activities was assessed using the air dispersion modelling system, CALPUFF, Version 7 (2015). The main components of the modeling system are CALMET (a diagnostic 3-dimensional meteorological model), CALPUFF (an air contaminant dispersion model), and CALPOST (a post-processing package). In addition to these components, there are numerous other processors that may be used to prepare the various input data.

The model is maintained by the model developers and distributed by Exponent Engineering and Scientific Consulting Inc. The advanced, non-steady state Gaussian puff model is described in "*British Columbia Air Quality Dispersion Modelling Guideline*" as a recommended regulatory model for detailed and comprehensive applications, particularly in complex terrain (BCMOE 2015) and is capable of modelling Project-related changes to air quality on the scale of metres to tens of kilometres from the source, allowing for full coverage of the spatial boundary of the Project.

Modelling was conducted in the regional study area (RSA) of the Project consisting of the area surrounding the Project footprint and the corridor along the Northern Access Road (NAR).

The dispersion modelling framework consists of the following:

- Geophysical modelling of the RSA requiring digital topographic and land cover data;
- Meteorological modelling of RSA requiring a three-dimensional meso-scale modelled (MM5) meteorological dataset representative of local meteorological conditions;
- Emissions source data estimates compiled from:
  - Inventories of proposed Project-related activities contained in the feasibility study (JDS 2016)
  - Published emission estimation methodologies from Environment and Climate Change Canada's National Pollutant Release Inventory - Pits and Quarries Guidance (EC 2016), United States Environmental Protection Agency (EPA) AP-42 (US EPA 2016), and Australian Mining Emission Estimation Technique Manuals (Australian Government Department of Environment, Water, Heritage and the Arts 2008). See **Appendix B 2016 Air Quality Inventory Summary Report** for details on the specific emission factors employed in the analysis of Project-related changes to air quality.

Various inputs to the CALPUFF model, model setup and related data validations are described in Section 2.0. Emission source data is described in Section 3.0. Relevant Ambient Air Quality Standards (AAQS) for Yukon and model results are described in Section 4.0.

2.0 MODEL SETUP AND INPUTS

2.1 Model Grids

The model domain for the mine site was 44 km (E-W) x 28 km (N-S), centered just east of the proposed pit areas and mine infrastructure at northing 589525 m, easting 6974512 m, UTM Zone 7N. This domain represents the RSA for the mine site for the purpose of the air quality study (**Figure 2.1-1)**. The horizontal grid spacing was 175 m, sufficient to adequately resolve complex terrain features. The following vertical layer heights were used in

CALPUFF (based on CALPUFF defaults) – ten vertical layers with cell facings at 0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m, and 4,000 m.

The model domain for the NAR, representing the RSA along the access road, consisted of a corridor of approximately 1 km along the alignment of the road (**Figure 2.1-1**). The corridor represents the extent of significant predicted changes in air quality and is a subset of the larger meteorological and geophysical regional grids. To expedite modelling time, the northern portions of the NAR alignment were modelled and extrapolated to the entire NAR extent, considering the relative consistency of road traffic along the alignment length. Traffic volumes due to mine traffic are the same over the entirety of the road, with the only appreciable difference being the time of day at which the vehicles would pass through a particular segment. During the summer, vehicles will travel through the northern segments of the NAR earliest in the morning when dispersion characteristics are at the diurnal worst-case in terms of meteorology, meaning the model predictions capture the worst case scenario.

2.2 Geophysical Data

In order to capture features of the altered terrain during the life of the Project, 15-min (resolution ~23 m) Canadian Digital Elevation Data (CDED) was obtained from WebGIS and converted to smaller 7.5-min United States Geological Survey (USGS)-format DEMs in CALPUFF's geophysical pre-processor. The tiles which covered the Project site were extracted and meshed with 2 m resolution AutoCAD data of the mine design in the modelled year(s). This captured features of the altered landscape due to mining operations (pits, dumps, etc.) at the 175 m resolution grid of the CALPUFF model, improving on the pre-project elevation data in the near field (**Figure 2.2-1).**

1:250,000 land cover data (Land Cover, circa 2000-Vector) obtained for the region from GeoGratis (Natural Resources Canada) was altered in the same fashion over the Project site where applicable, accounting for macro-scale changes in land cover due to Project-activities (**Figure 2.2-2)**.

CALPUFF's geophysical processor combines the terrain and parameterized land use data to produce GEO.DAT files for CALPUFF which contain the various temporal- and spatially-variant micrometeorological forcings in the CALMET model, such as heat flux, Bowen ratio, surface friction, and albedo. In accordance with protocols described in *British Columbia Air Quality Dispersion Modelling Guideline* (BCMOE 2015), four seasonal geophysical files were created for a modelled year with date ranges determined from climate analysis of observational data recorded by the on-site meteorological station and historical snow cover imagery contained in the United States National Snow and Ice Data Center Interactive Multi-sensor Snow and Ice Mapping System (IMS) database.

2.3 Meteorological Data

To capture the temporally- and spatially-variable meteorology of the Project area and surrounding region, 4 km resolution MM5 was obtained from Lakes Environmental. The three-dimensional gridded data (winds, temperature, relative humidity, barometric pressure, cloud cover and precipitation) were selected for the years 2012 and 2013 based on the available site data for validation at the time of meteorological modelling. MM5 data include sophisticated physics, is multi-layered and can produce meteorological information in areas where no observations exist, or in areas of complex terrain where a single observing station has limited spatial applicability, such as the RSA. CALPUFF's meteorological processor CALMET uses the coarse-grid MM5 as the first guess wind field and then adjusts the wind data to the grid resolution of the model, 175 m in this case, applying kinematic algorithms for terrain effects (slope flows, steering, blocking, etc.).

2.3.1 Validations

The CALMET-adjusted MM5 data were subjected to a series of validations to confirm the representativeness of the meteorology used in contaminant modelling. In particular, surface winds were extracted from the data at the location of the Coffee Creek meteorological station and compared to real observations (July 2012 to July 2015), vertical profiles of modelled temperature were extracted at two different locations in the grid domain to analyze if typical Yukon inversions were properly represented in the data, and monthly precipitation was compared with data from the Project site to see if the MM5 adequately replicated seasonal patterns.

The MM5 data is at 4km grid resolution, downscaled from a larger scale (16 km grid resolution) and constructed from regional boundary conditions. The Project area is mountainous and meteorologically heterogeneous. It would not be expected that the prognostic (MM5) data could exactly replicate actual conditions throughout the grid on an hour by hour basis at a 175 m scale in complex terrain. However, the validations attempt to qualify the air dispersion model results as a feasible outcome based on the general observed and anticipated meteorological patterns.

2.3.2 Winds

At the 175 m grid resolution, the surface wind field produced by CALMET appears to adequately resolve thermally driven flows (e.g. mountain breeze during the day and valley flow winds at night during summer), steered by the various valleys and ridges through the study area. In particular, at night during summer, CALMET recurrently captures westerly drainage flows through Latte and Coffee Creek valleys, NW-SE flows through the Yukon River valley and southwesterly flows along Halfway Creek and the various SW-NE aligned creeks which drain into the Yukon River to the north of the figure (**Figure 2.3-1**).

Surface-layer winds for the two-year CALMET-adjusted MM5 data were extracted at the location of the Coffee Creek meteorological station and compared to observed data. **Figure 2.3-2** shows a comparison of period of record wind roses: the left figure showing the 2012-2013 CALMET-MM5 data and the right showing the July 2012 to July 2015 observed winds from the meteorological station. A wind rose is a frequency plot showing the occurrence of winds from a particular direction and the frequency of wind speeds within that directional bin, ranging from dark blue – the weakest winds (0.3 – 1 m/s) – to dark red – the strongest winds (>14 m/s).

The plot comparison shows that MM5 tends to slightly under-predict wind speeds - the modelled data shows an average wind speed of 1.99 m/s while observed data shows 2.34 m/s - which is a typical characteristic of the MM5 surface layer wind field. In terms of direction, the CALMET-adjusted MM5 replicates the frequency of northwest winds quite well but over-predicts southwest and easterly winds which are quite infrequent in the observed data. Southerly winds are adequately replicated; however, they appear slightly shifted on occasion as south-southwesterlies due in part to downscaling effects, but also likely attributed to differences between actual terrain and the modelled terrain at 175 m resolution. These same effects are also likely producing a higher frequency of easterly winds in the MM5 data rather than the observed northeasterlies.

Overall, the modelled winds occur from all directions which allows for analysis of downwind air quality changes from a host of possible wind scenarios. Since higher wind speeds increase dispersion of contaminants from the surface by increasing turbulence and thus vertical mixing, overall lower surface wind speeds (mean wind speed is 84.6% of observed) would in general, provide slightly more conservative model predictions in terms of concentrations.

2.3.3 Vertical Temperature Structure – Atmospheric Stability

A very common characteristic of Yukon's meteorology is inversions, particularly during winter, where the temperature of the air increases with height to an elevation called the inversion height, supressing vertical movement of air and diminishing dispersion of contaminants at the surface. Typical winter inversion heights in the Yukon range from 1200 m to 1900 m, with lower heights becoming more common and occurring more frequently in December and January (Pinard 2007). Inversions also occur in summer, particularly at night in the absence of incident solar radiation. To assess the representativeness of the vertical temperature (stability) field to the region, MM5-CALMET data was extracted at the location of the Coffee Creek meteorological station (el. 1035 m asl) in all ten vertical grid cells. **Figure 2.3-3** shows diurnal plots (every four hours) of vertical profile of temperatures for both a winter (January 6, 2012, left) and a summer (July 6, 2012, right) condition.

As indicated in the winter (left) portion of **Figure 2.3-3**, air temperatures increase from ground level with height to approximately 120 m above ground (1150 m asl.), consistent with the winter climate of the Yukon (Pinard 2007). The inversion condition persists throughout the day, with the inversion height remaining consistent. As shown in the summer (right) portion of **Figure 2.3-3**, daytime lapse rates (temperature decrease with height) are typical (- 1˚C/100 m) and relatively constant through 1,000 m. Low-level inversions take on a more diurnal pattern, occurring in the data overnight due to residual surface heat fluxes and absence of solar incident radiation (0:00 hrs and 4:00 hrs).

The replication of expected inversion conditions in the data means that worst-case meteorological conditions in terms of changes to air quality are being modelled supressing vertical movement of air and diminishing dispersion of contaminants at the surface.

2.3.4 Precipitation

As removal of particulate matter through precipitation scavenging was included in the CALPUFF model settings, the representativeness of the precipitation contained in the MM5 data was analyzed through comparison with observational data recorded at the Coffee Creek meteorological station. Unlike the wind/stability fields, CALMET does not contain orographic algorithms to alter the precipitation rate contained in the MM5 data.

Figure 2.3-4 shows monthly precipitation totals contained in the MM5 data (January 2012 to October 2013, dark blue columns) and as recorded at the Coffee Creek meteorological station (July 2012 to December 2013, light blue columns). To smooth out annual variability, the orange columns show average monthly precipitation based on the entire period of record at Coffee Creek (July 2012 to July 2015).

Figure 2.3-4 shows that, compared to monthly averages, the modelled data systematically tends to over-predict precipitation, characteristic of meso-scale meteorological models. The over-prediction of precipitation would therefore theoretically result in slightly increased predictions of particulate matter depositional fluxes (i.e., wet deposition) in the model results, as well as slight under-prediction of airborne concentrations due to scavenging, particularly further from the source. However, this would only be the case during hours when precipitation was occurring.

2.4 Model Settings

CALMET and CALPUFF switch settings were set in accordance with recommendations listed in BC Air Quality Dispersion Modelling Guideline (BCMOE 2015).

2.5 Receptor Grid

The receptor spacing (the locations at which predicted concentrations were calculated by the model) was the same resolution as the meteorological grid (175 m) with a nested grid in the immediate Project area, resulting in a spacing of ~124 m over a 8 km (E-W) x 6.5 km (N-S) area. The height assigned for each receptor was the ground level elevation. At the time of modelling, specific human and wildlife receptors were not identified. The density of the grid spacing was sufficient to assess air quality at specific human and wildlife receptor locations once identified.

3.0 EMISSION SOURCES

Emissions source data used as inputs to CALPUFF was compiled using pertinent information from the feasibility study and preliminary engineering design information (Kaminak Gold Corp. 2016), mainly the proposed material extraction and production schedule, mine equipment and vehicle fleet information and the Project infrastructure layouts. Emission estimates were calculated referencing empirically developed emission factors published in Environment and Climate Change Canada's Pits and Quarries Guidance (NPRI 2009), United States Environmental Protection Agency (EPA) AP-42 (US EPA 1995), and Australian Mining Emission Estimation Technique Manuals (NPI 2008, NPI 2012).

The associated activities and equipment fleet for Year 6 (Y6) of mining operations, provided a high-end estimate of annual emissions of criteria air contaminants (CAC) expected during the life of the Project. The details of the air emission estimation methodologies and estimates of annual air emissions from Project-related activities is contained in **Appendix B.**

3.1 Sources of Particulate Matter

The major sources of airborne particulate matter emissions are as follows:

- The passage of vehicles, including haul trucks and light duty vehicles, on unpaved roadways disturbing fine surface sediments (i.e., silt) and creating a turbulent wake zone which transports dust up and away from the road surface. The CALPUFF parameters defining the vehicle wake (release height, initial lateral (σ_y) and vertical (σ_z) spread are a function of the vehicle height and width.
- Moving earth, including grading and material handling (overburden, ore and waste rock) as material is being moved from one location to another (e.g., loading into haul trucks, dumping of waste rock into the WRSF, etc.) and from the disturbance of fine surface sediments (i.e., silt) on aggregate covered surfaces during pit and road maintenance activities (i.e., grading). The modelled release height for loading and unloading was ½ the distance between the unloading height and the receiving surface. The initial spread (σ_y and σ_z) were based on the width of the bucket or dump box.
- Wind erosion from stockpiled soil materials creating airborne particles via entrainment from stockpile surfaces by winds exceeding a threshold velocity related to particle size. The modelled release height and initial spread were based on the dimensions of the pile.
- Drilling and blasting, creating pulverized rock dust, soil, and silt from rock drilling equipment in the form of pulverized rock and from blasting operations when explosive charges are placed in drilled holes and detonated to free the rock from the mining face. The initial vertical dispersion of particulates from blasting can extend several tens of metres into the air.
- Ore crushing, screening and conveyor drops, creating airborne particles from pulverized rock, soil and silt as ROM ore is reduced in size in preparation for heap leach loading. The modelled release height for loading and unloading was ½ the distance between conveyor drops. The initial spread (σy and σz) were based on the width of the conveyor and/or the crusher or screener.

3.2 Sources of Diesel Combustion by-product exhaust

The major sources of diesel combustion by-product exhaust are as follows:

- Mine fleet vehicles and equipment through the combustion of diesel fuel in the internal combustion engines of the Project's fleet vehicles and other equipment (e.g., diesel generators, light stands, dewatering pumps, drills, etc.).

- Blasting via the detonation of ammonium nitrate/fuel oil- based explosives used in blasting operations primarily during mine pit development. The detonation (high speed combustion) results in initial vertical dispersion several tens of metres into the air.
- Waste incineration from the combustion of diesel and waste fuels in the waste incinerator and released from the unit's exhaust stack.

Emission rates are expected to vary temporally, according to details contained in the Project Description and Operational Plans. Emission rates were calculated for a particular source by quarter and were assumed to occur continuously over each three-month period the source was present/active unless noted (i.e., blasting, incinerator, wind erosion). **Table 3.2-1** summarizes the source types included in CALPUFF modelling and relevant temporal information pertaining to the emission rates used in modelling.

Table 3.2-1 Coffee Gold Mine Modelled Emission Source Groupings

Emission Source Grouping	CALPUFF Source Type	Temporal Variability
Blasting	Volume	Twice weekly, occurring at 1400 hrs
Crusher	Volume	Operational April – December
Drilling	Volume	Assumed continuous and constant rate
Haul and Site Roads	Road	Usage based on extraction and dumping tonnages
Material Handling	Volume	Varied based on extraction and dumping schedule
Overburden Removal	Volume	Varied based on grub removal schedule
Vehicle Exhaust in Pits and Dumps	Volume	Varied based on extraction schedule
Power Plant	Point	Continuous
Incinerator	Point	Assumed operational between 1000 hrs and 1400 hrs
Road Light Duty/Grader Exhaust	Volume	Continuous
Wind Erosion of Stockpiles	Volume	Varied with Wind Speed
WRSF Maintenance	Volume	Varied based on dumping schedule

4.0 RESULTS

4.1 Ambient Air Quality Standards and Guidelines

Model results of airborne concentrations and dustfall from Project-related activities were assessed against ambient air quality objectives and standards contained in the AAQS (Yukon) and BCAAQO (British Columbia) (Yukon Environment 2014, BCMOE 2016), identified in **Table 4-2** and **Table 4-3.**

Table 4-2 Relevant Standards for Particulate Matter

Parameter	Standard	Source
TSP: 24-hour average Annual geometric mean	[1] 120 µg/m^3 60 µg/m^3	AAQS 2014
PM_{10}: 24-hour average	[1] 50 µg/m^3	AAQO 2014
$PM_{2.5}$: 24-hour average Annual average	[1] 28 µg/m^3 8 µg/m^3	AAQS 2014 BCAAQO 2016
[2] Dust Deposition: 30-day averaged	1.7 mg/(dm^2-day) – lower level 2.9 mg/(dm^2-day) – upper level	BCAAQO 2016

Note: [1]Achievement based on annual 98th percentile of daily averages over one year (from BCAAQO)
[2]BC Pollution Control Objectives were rescinded in 2006, dustfall objectives maintained for reference purposes only

Table 4-3 Relevant Standards for Diesel Combustion By-Products

Parameter		Standard	Source
NO_2:	1-hour average 24-hour average Annual arithmetic mean	[1] 213 ppbv (432 µg/m³) 106 ppbv (215 µg/m³) 32 ppbv (65 µg/m³)	AAQS 2010
SO_2:	1-hour average 24-hour average Annual arithmetic mean	[2] 172 ppbv (485 µg/m³) 57 ppbv (161 µg/m³) 11 ppbv (31 µg/m³)	AAQS 2010
CO:	1 hour average 8 hour average	13 ppm (16,000 µg/m³) 5 ppm (6,170 µg/m³)	AAQS 2010

Note: [1]Achievement based on annual 99th percentile of daily averages over one year (from BCAAQO)
[2]Achievement based on annual 98th percentile of daily averages (from BCAAQO)
*Conversions calculated at 0ºC (Standard Temperature and Pressure - STP)

4.2 Modelled Project-Related Changes to Air Quality

Project-related emissions of criteria air contaminants have been modelled based on the projected maximum inventory which occurs in Year 6 of the Operation Phase. This scenario takes into account projected activity rates for all Project component interactions with air quality as described in **Section** Error! Reference source not found.. Overall emissions during the Construction phase, as well as those during the Reclamation and Closure phase are projected to be much lower relative to the Year 6 worst case scenario as detailed in **Appendix B**.

The following figures provide conservative predictions of residual changes to air quality as per the CALPUFF modelling results in accordance with relevant maximum percentiles and averaging times as described in the AAQO and BCAAQO. Each of the figures show that predicted concentrations of air quality are expected to be elevated within the LSA and RSA, but would be expected to return to background levels as identified in the Baseline Monitoring Program (**Appendix 9-A - Baseline Air Quality and Noise at the Coffee Gold Mine 2015**) within the RSA after completion of the Project. There were no modelled exceedances of regulated standards or guidelines outside of the RSA.

Changes to air quality as a result of vehicular traffic on the NAR have been modelled to be limited to within 1 km of the roadway beyond which the changes to air quality indicators are expected to return to background concentrations. To assess the air quality impacts from the vehicular traffic on the NAR, the modeling was accomplished by splitting the roadway into two sections. Descriptions that follow are for operational Year 6 of the Project and describe the nth percentile maximum extent and magnitude of air quality impacts.

- Mine Site - Airborne 24-hour averaged TSP levels over baseline are predicted within 7 to 8 km north of the LSA, impinging to approximately 1 km south of the Yukon River. Highest predicted concentrations are contained within the LSA (Figure **4.2-1: TSP 98th Percentile 24-Hour Maximum Concentration at Ground Level - Operations Year 6**). The footprint of annual averaged TSP over baseline falls closer to the LSA within approximately three to four km to the north (**Figure 4.2-2: TSP Annual Average Concentration at Ground Level - Operations Year 6**).
- Mine Site - PM_{10} and $PM_{2.5}$ exhibit a similar pattern as TSP however concentrations over baseline are predicted to impinge on the Yukon River (and slightly beyond in the case of $PM_{2.5}$) and further to the west to the RSA boundary (**Figure 4.2-3: PM_{10} 98th Percentile 24-Hour Maximum Concentration at Ground Level - Operations Year 6, Figure 4.2-4: $PM_{2.5}$ 98th Percentile 24-Hour Maximum Concentration at Ground Level - Operations Year 6, and Figure 4.2-5: $PM_{2.5}$ Annual Average Concentration at Ground Level - Operations Year 6**).

- Mine Site – Particulate matter deposition (combined wet and dry fluxes) is highest within the LSA. Dustfall elevated over baseline is predicted slightly beyond the LSA to the north (approximately 5 km) and south – the majority of dust particles tend to settle out close to the source (**Figure 4.2-6: Dustfall Maximum Monthly-Averaged Daily Deposition Rate (mg/dm²/day)- Operations Year 6**).

- NAR - TSP, PM_{10}, $PM_{2.5}$ concentrations and dustfall levels are near baseline and are consistent along the entirety of the NAR. Overall, air quality impacts along the roadway are very low - essentially near unappreciable from background levels when averaged over one hour - and are confined to a few tens of metres from the road. Any impacts along the road will be restricted to very short periods on the scale of minutes (**Figure 4.2-7: TSP 98th Percentile 24-Hour Maximum Concentration at Ground Level – NAR, Figure 4.2-8: TSP Annual Average Concentration at Ground Level - NAR), Figure 4.2-9: PM_{10} 98th Percentile 24-Hour Maximum Concentration at Ground Level - NAR, Figure 4.2-10: $PM_{2.5}$ 98th Percentile 24-Hour Maximum Concentration at Ground Level - NAR, Figure 4.2-11: $PM_{2.5}$ Annual Average Concentration at Ground Level - NAR), and Figure 4.2-12: Dustfall Maximum Monthly-Averaged Daily Deposition Rate (mg/dm²/day)- NAR**).

The following figures provide the worst case residual changes predictions of ground level changes in air quality as per the CALPUFF modelling results for these indicators. Descriptions that follow are for operational Year 6 of the mine and describe the nth percentile maximum extent and magnitude of air quality impacts.

- Mine Site – SO_2 Concentrations are well below Yukon ambient air quality standards throughout the LSA and the RSA. Concentrations elevated above baseline are generally predicted within the LSA and slightly beyond to the north in the vicinity of Supremo Pit (**Figure 4.2-13: SO_2 99th Percentile 1-Hour Maximum Concentration at Ground Level - Operations Year 6, Figure 4.2-14: SO_2 Maximum 24-Hour Concentration at Ground Level - Operations Year 6, Figure 4.2-15: SO_2 Annual Average Concentration - Operations Year 6**).

- Mine Site – NO_2 – Concentrations near ambient air quality standards are predicted within the LSA, concentrations elevated slightly over baseline extend north of the LSA boundary to the Yukon River (**Figure 4.2-16: NO_2 98th Percentile 1-Hour Maximum Concentration at Ground Level - Operations Year 6, Figure 4.2-17: NO_2 Maximum 24-Hour Maximum Concentration at Ground Level - Operations Year 6, Figure 4.2-18: NO_2 Annual Average Concentration at Ground Level - Operations Year 6**).

- Mine Site - CO – Concentrations near ambient air quality standards are predicted entirely within the LSA. Concentrations elevated over baseline are predicted through the RSA (**Figure 4.2-19: CO Maximum 1-Hour Concentration at Ground Level - Operations Year 6, Figure 4.2-20: CO Maximum 8-Hour Concentration at Ground Level - Operations Year 6**).

- Along the NAR SO_2, and NO_2 concentrations are centred over the NAR centreline, with concentrations slightly elevated above baseline within one km of the NAR (**Figure 4.2-21a and b SO_2 99th Percentile 1-Hour Maximum Concentration at Ground Level – NAR, Figure 4.2-22a and b SO_2 99th Percentile 24-Hour Maximum Concentration at Ground Level – NAR, Figure 4.2-23 a and b SO_2 Annual Average Concentration – NAR, Figure 4.2-24a and b NO_2 98th Percentile 1-Hour Maximum Concentration at Ground Level – NAR, Figure 4.2-25a and b NO_2 98th Percentile 24-Hour Maximum Concentration at Ground Level – NAR, Figure 4.2-26a and b NO_2 Annual Average Concentration at Ground Level – NAR**).

- Along the NAR, CO concentrations are higher along the northern extent of the modelled portion of the road due to temporal traffic patterns (mine traffic on this segment earlier in the morning), with concentrations centred over the NAR centreline over the entirety of the NAR (**Figure 4.2-27a and b CO 1-Hour Maximum Concentration at Ground Level – NAR, and Figure 4.2-28a and b CO 8-Hour Maximum Concentration at Ground Level – NAR**).

4.3 Summary of Modelled Predictions of Air Quality Changes

In general, the dispersion modelling and predictions indicated that the Project will comply with relevant air quality objectives and guidelines beyond the mine footprint, with small areas of predicted exceedance of TSP, PM_{10} and $PM_{2.5}$ concentrations beyond the mine footprint occurring to approximately 500 m. A summary of the results is presented in Table 4-4.

Table 4-4 Summary of Predictions of Air Quality Changes

Contaminant	Averaging Period	Ambient Air Quality Standard	Predicted Air Quality	
			Mine Site	Northern Access Route
SO_2	1 hour	[1] 485 µg/m³	No exceedances predicted	No exceedances predicted
	24 hour	[1] 161 µg/m³	Exceedance predicted within pit area	No exceedances predicted
	Annual	[1] 31 µg/m³	No exceedances predicted	No exceedances predicted
NO_2	1 hour	[1] 432 µg/m³	Exceedance predicted throughout mine site, particularly active pit areas	No exceedances predicted
	24 hour	[1] 215 µg/m³	Exceedance predicted throughout mine site, particularly active pit areas	No exceedances predicted
	Annual	[1] 64 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
CO	1 hour	[1] 16,000 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
	8 hour	[1] 6,170 µg/m³	Exceedance predicted within active pit areas	No exceedances predicted
TSP	24 hour	120 µg/m³	Exceedance predicted throughout mine site and 500 m beyond mine footprint	No exceedances predicted
	Annual	60 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
PM_{10}	24 hour	50 µg/m³	Exceedance predicted throughout mine site and 500 m beyond mine footprint	No exceedances predicted
$PM_{2.5}$	24 hour	28 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
	Annual	10 µg/m³	Exceedance predicted throughout mine site	No exceedances predicted
Dustfall	1 month	[2] 1.7 mg/dm²·day (lower) [2] 2.9 mg/dm²·day (upper)	Exceedance predicted in vicinity of dust-producing sources throughout mine site	No exceedances predicted

Note: [1] Converted from ppm/ppv at 0˚C
[2] Taken from British Columbia Pollution Control Objectives for Dustfall

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Signature REDACTED

Signature REDACTED

Prepared by:
Travis Miguez, B.Sc., P.Met.
Project Scientist – Meteorology & Air Dispersion
Direct Line: Phone Number REDACTED
Email REDACTED

Reviewed by:
Elizabeth M. Hendrick, CCM
Senior Consultant – Air Quality
Direct Line: Phone Number REDACTED
Email REDACTED

REFERENCES

Australian Government Department of Environment, Water, Heritage and the Arts. 2008. National Pollution Inventory Emission Estimation Technique Manual for Combustion Engines, Version 3.0, June 2008.

British Columbia Ministry of the Environment (BCMOE). 2016. British Columbia Ambient Air Quality Objectives. Updated January 18, 2016.

British Columbia Ministry of Environment (BCMOE). 2015. British Columbia Air Quality Dispersion Modelling Guideline. December 2015.

Casino Mining Corporation. 2014. Air Quality Baseline 2013, Casino Project Proposal for Executive Committee Review January 2014 available at http://casinomining.com/project/yesab-proposal/. Accessed April 2016

Environment and Climate Change Canada, National Air Pollution Surveillance Program (NAPS). 2016. NAPS Data Projects, Annual CO Data (2010 – 2014). http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx. Accessed April 2016.

JDS Energy & Mining Inc. (JDS). 2016. Feasibility Study Report for the Coffee Gold Project, Yukon Territory, Canada. G. Doerksen, et al. February 18, 2016.

Pinard, Jean-Paul. 2007. Wind Climate of the Whitehorse Area. January 2007.

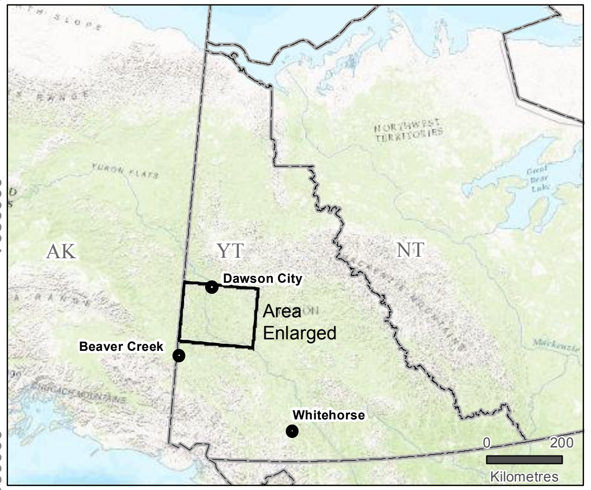
United States Environmental Protection Agency (US EPA). 1995. AP-42 Compilation of Air Pollutant Emission Factors. Available at https://www3.epa.gov/ttnchie1/ap42. Accessed March 2016.

Yukon Environment. 2014. Yukon Ambient Air Quality Standards, Date Implemented: April 22, 2010.

FIGURES

COFFEE GOLD MINE

Local and Regional Study Areas



Legend

- Northern Access Route
- Mine Site Access Road
- North Klondike Highway
- Mine Footprint
- Local Study Area
- Regional Study Area

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Imagery from ESRI; Earthstar Geographics (1999)

N

1:600,000

0 10 20 30

Kilometres

NAD 1983 UTM Zone 7N

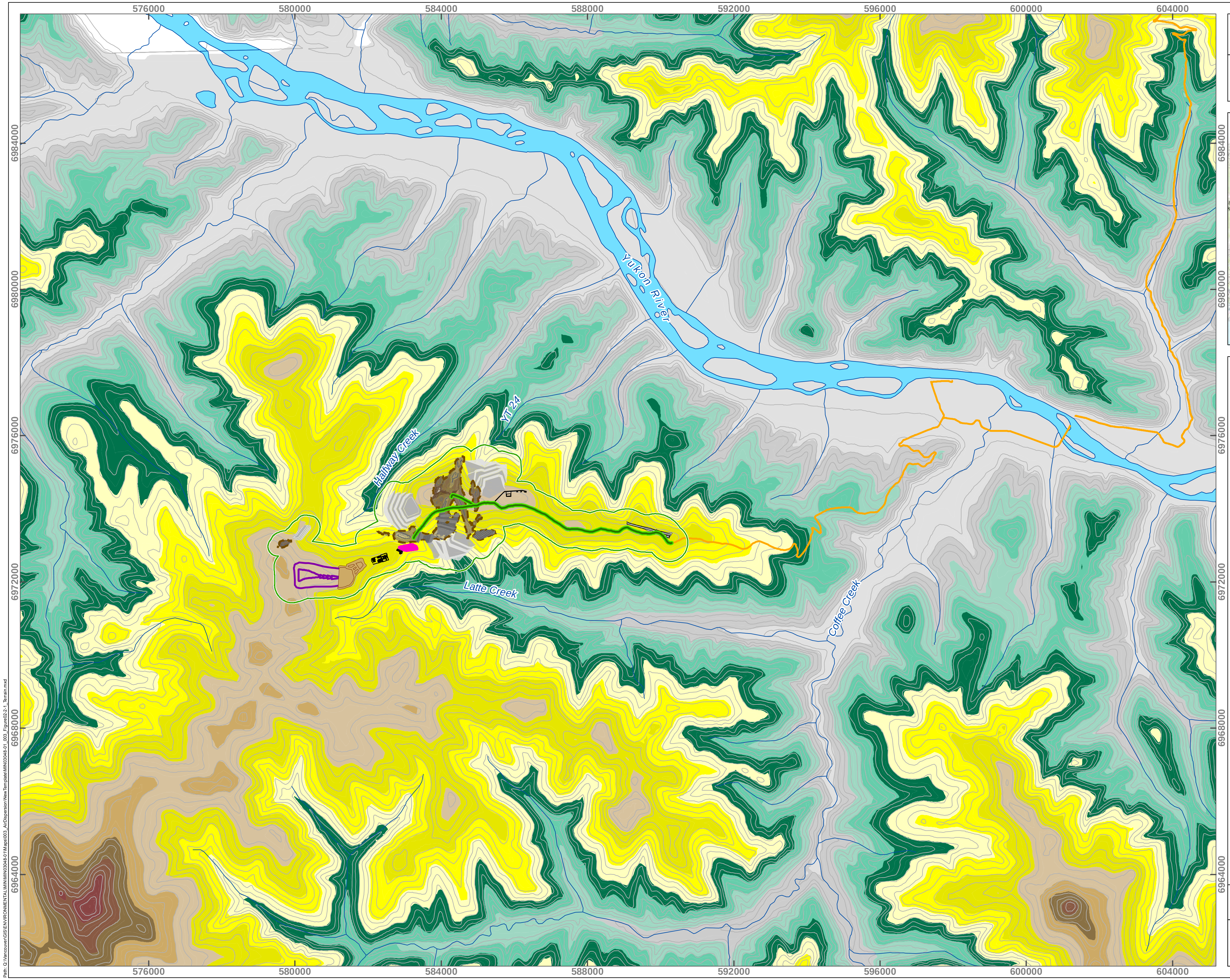
Page Size: 11" x 17"

Figure 2.1-1	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

Modified 15-Minute Terrain Data used in CALPUFF (Mine Site)



Legend

- Contour (40 m)
- Watercourse
- Waterbody
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Plant
- Leach Pad
- Event Pond
- Airstrip
- Pit Outline

Pit Backfill

- 0 m
- 1 m - 1250 m

Pit Surface

- 0 m
- 1 m - 1000 m
- 1000 m - 1100 m
- 1100 m - 1200 m
- 1200 m - 1300 m

- Stockpile

Waste Rock Storage Facilities

- 0 m
- 1 m - 1250 m

Elevation (m)

- 340 - 420
- 421 - 520
- 521 - 620
- 621 - 720
- 721 - 820
- 821 - 920
- 921 - 1020
- 1021 - 1120
- 1121 - 1220
- 1221 - 1320
- 1321 - 1420
- 1421 - 1520
- 1521 - 1620
- 1621 - 1703

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Project Footprint provided by Hemerra (July 21, 2016).
Topographic data from Canvec

N

1:100,000

0 2 4 6

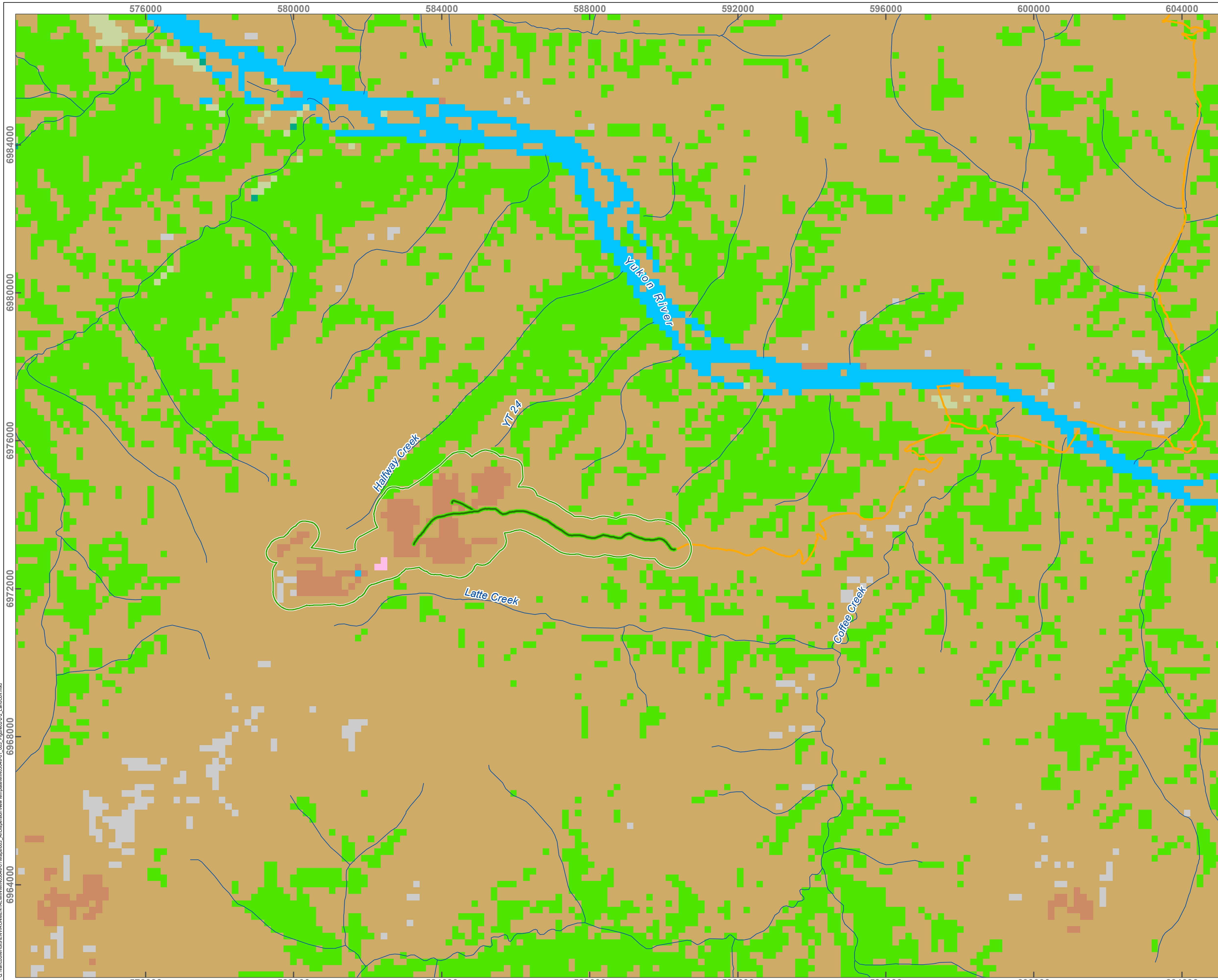
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 2.2-1	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

Modified 1:250,000
Land Cover Grid (Land Cover, circa 2000-Vector)
used in CALPUFF

Legend

- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Watercourse

Land Cover

- Tundra
- Barren/Exposed Land
- Non-forested Wetlands
- Forested Wetlands
- Rivers and Streams
- Forest Land
- Shrubs and Grassland
- Developed Land

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Topographic data from Canvec.

N

1:100,000

0 2 4 6

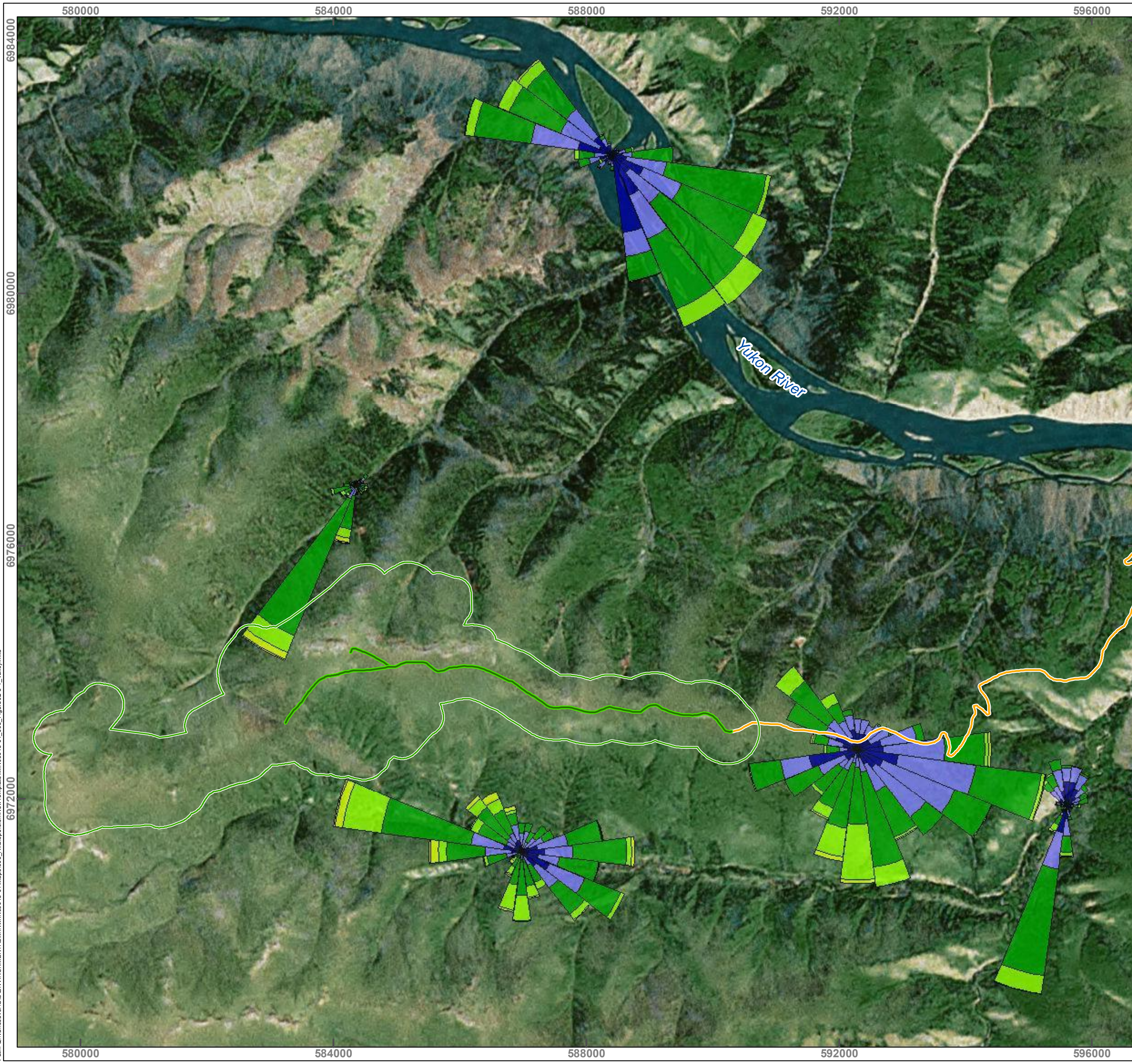
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 2.2-2	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

CALMET Valley Flow Winds - Summer Wind Roses

Legend

Northern Access Route
Mine Site Access Road
Mine Footprint

Wind Speed (m/s)

- >= 14
- 12 - 14
- 10 - 12
- 8 - 10
- 6 - 8
- 4 - 6
- 2 - 4
- 1 - 2
- 0.3 - 1

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Imagery from ESRI; Earthstar Geographics (1999)

N

1:85,000

0 1 2 3

Kilometres

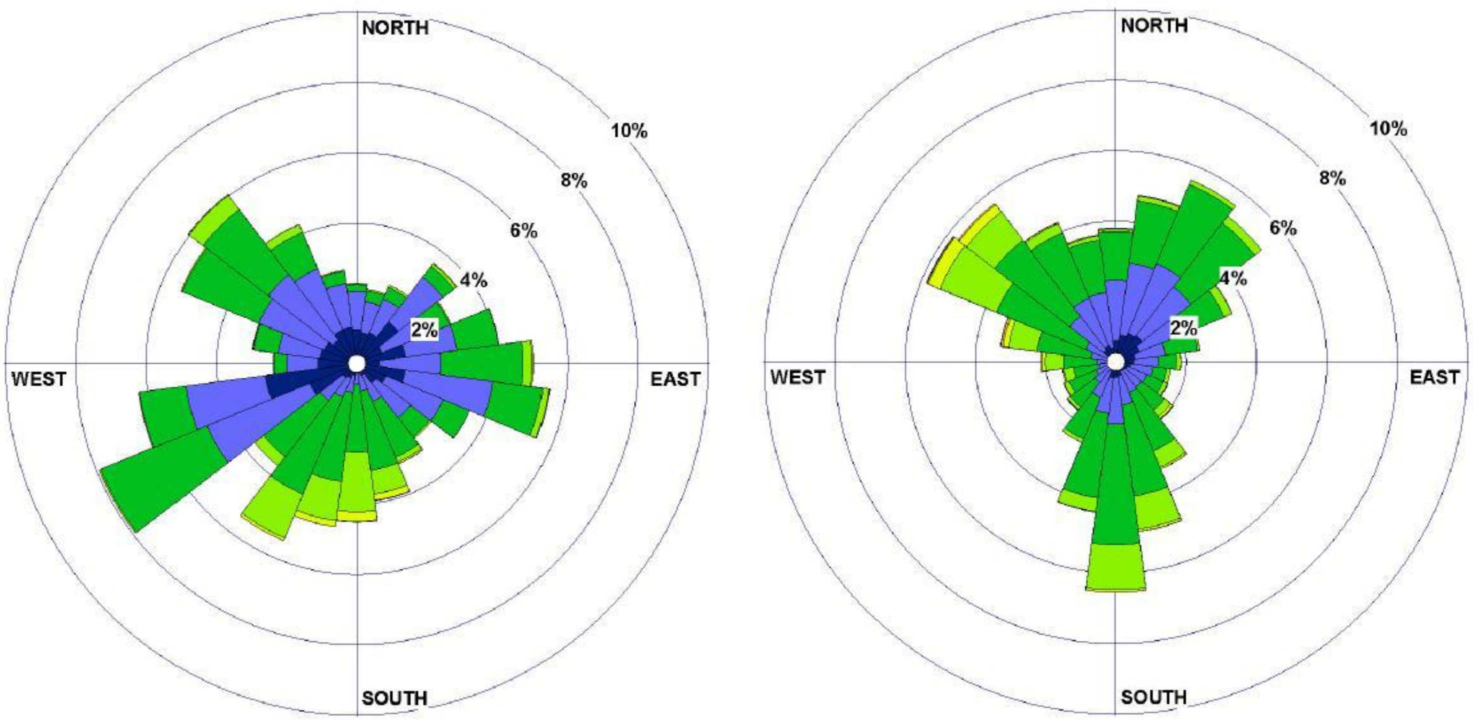
NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 2.3-1	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

Path: O:\Vancouver\GIS\ENVIRONMENTAL\MIN\MIN03048-01\Maps\003_AirDispersion\NewTemplate\MIN03048-01_003_Figure02.3-1_Valley.mxd



COFFEE GOLD MINE

MM5-CALMET
Wind Rose (2012-2013) (left)
Observed Wind Rose (right)

Legend

Wind Speed (m/s)

- >= 14.00
- 12.00 - 14.00
- 10.00 - 12.00
- 8.00 - 10.00
- 6.00 - 8.00
- 4.00 - 8.00
- 2.00 - 4.00
- 1.00 - 2.00
- 0.30 - 1.00

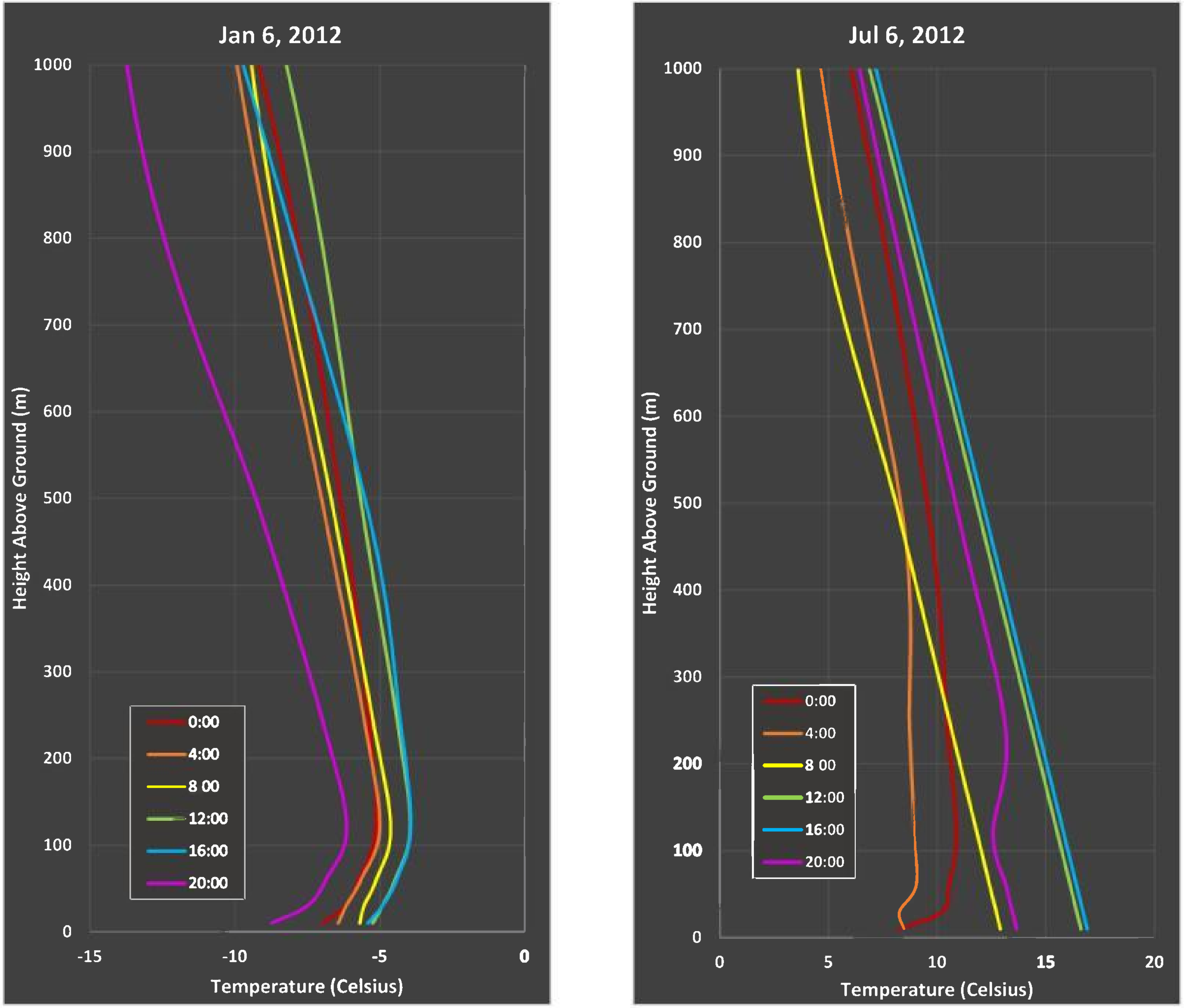
Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Page Size: 8 ½" x 11"

Figure 2.3-2	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: KG/TM

GOLDCORP



COFFEE GOLD MINE

Winter (left) and Summer (right) MM5-CALMET Modelled Vertical Temperature Profiles

Legend

Time of Day (hours)

- 0:00
- 4:00
- 8:00
- 12:00
- 16:00
- 20:00

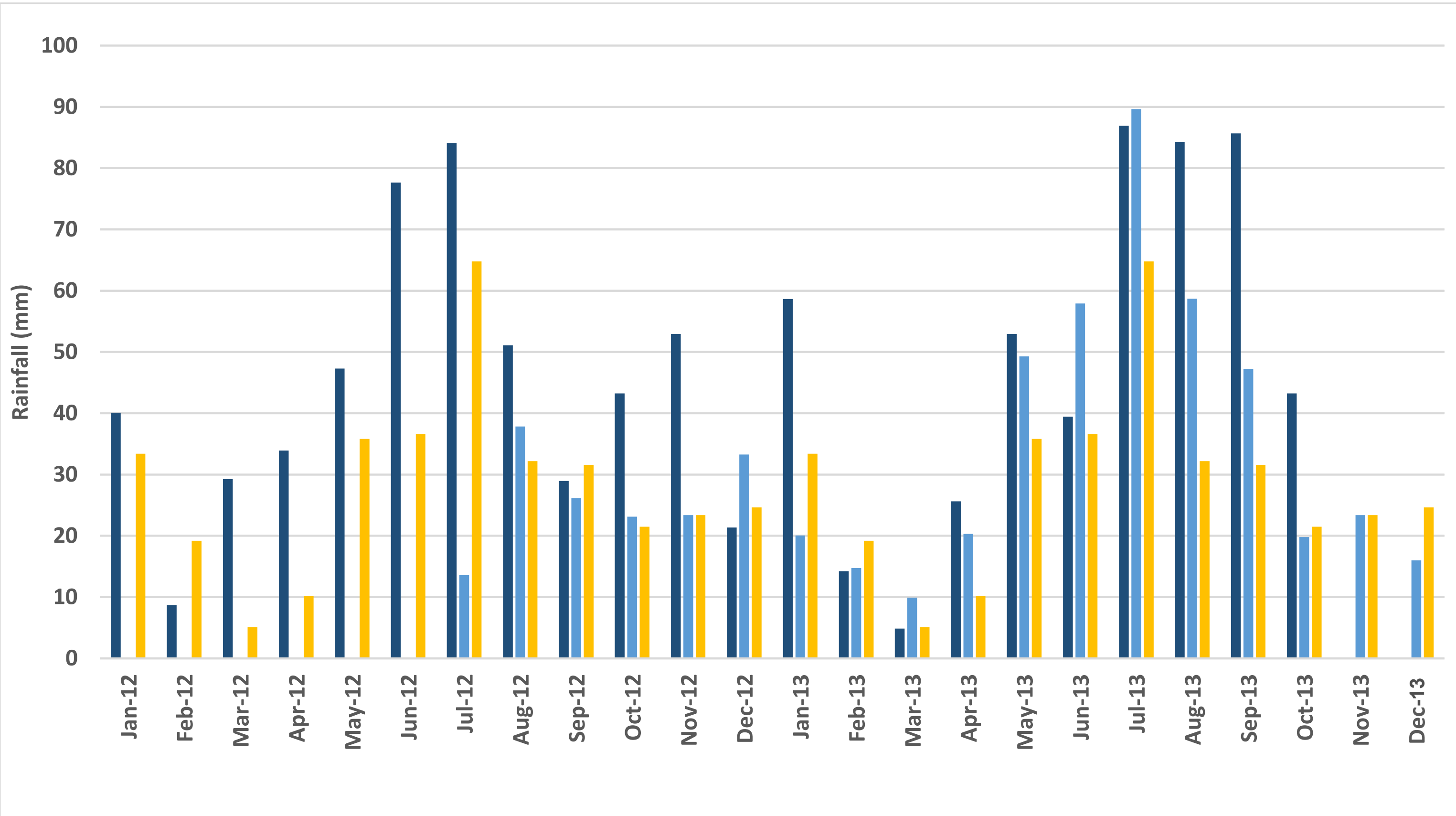
Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Page Size: 8 ½" x 11"

Figure 2.3-3	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: KG/TM

GOLDCORP



COFFEE GOLD MINE

MM5 (Modelled) vs. Observed Precipitation by Month

Legend

- MM5
- Observed
- Observed Average P.O.R.

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Page Size: 8 ½" x 11"

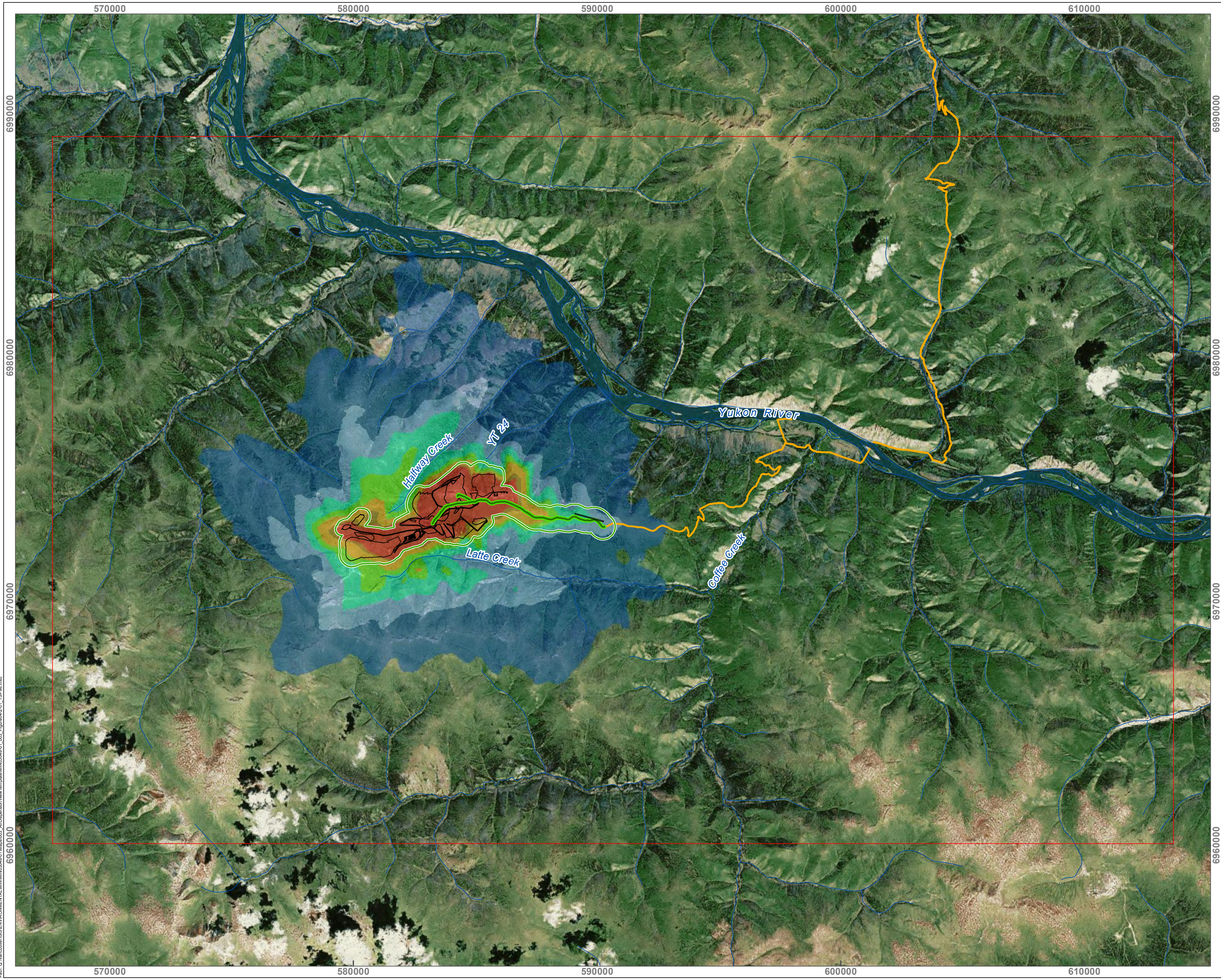
Figure 2.3-4	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: KG/TM

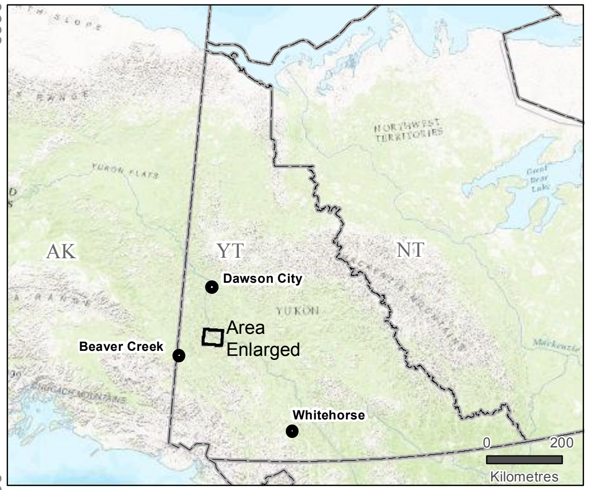
GOLDCORP

Path: O:\Vancouver\GIS\ENVIRONMENTAL\MIN\MIN03048\MIN03048-01\Maps\003_AirDispersionNewTemplate\MIN03048-01_003_Figure02.3-4_Rain.mxd

COFFEE GOLD MINE

TSP 98th Percentile
24-Hour Maximum Concentration at Ground Level
Operations Year 6





Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

98th Percentile TSP Concentration (µg/m³)

- 20 - 40
- 40 - 60
- 60 - 90
- 90 - 120
- 120 - 200
- 200 - 250
- 250 - 300
- > 300

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for TSP is 120 µg/m³

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

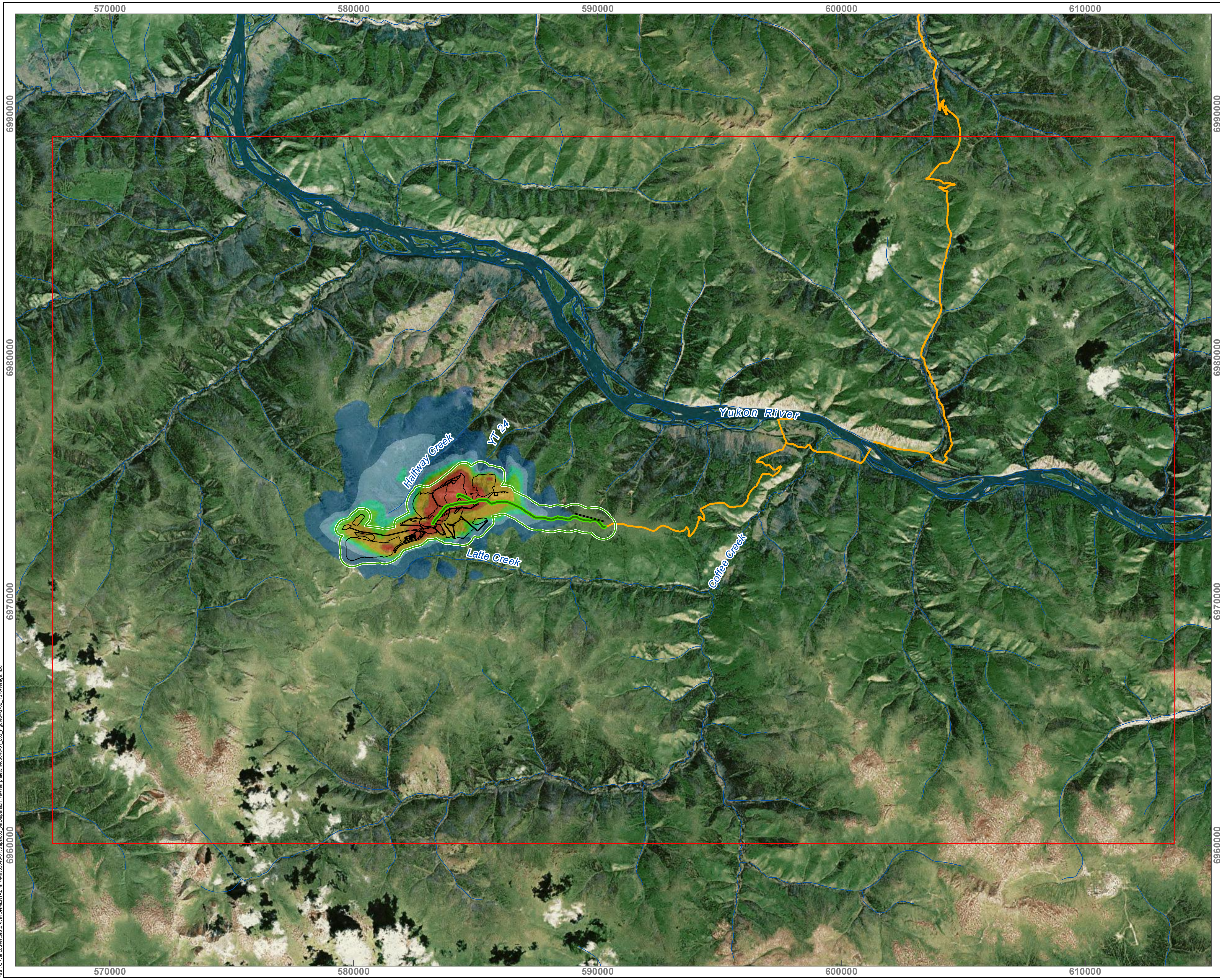
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

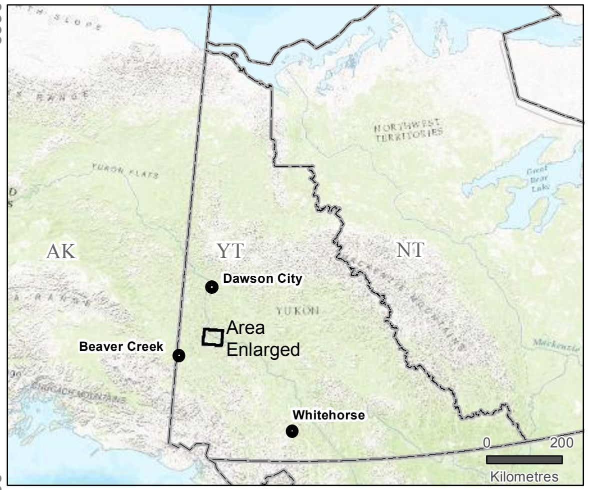
Figure 4.2-1	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

TSP
Annual Average Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Average TSP Concentration (µg/m³)

- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 60
- 60 - 200
- 200 - 300
- 300 - 400
- > 400

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The Annual Yukon Ambient Air Quality Standard for TSP is 60 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

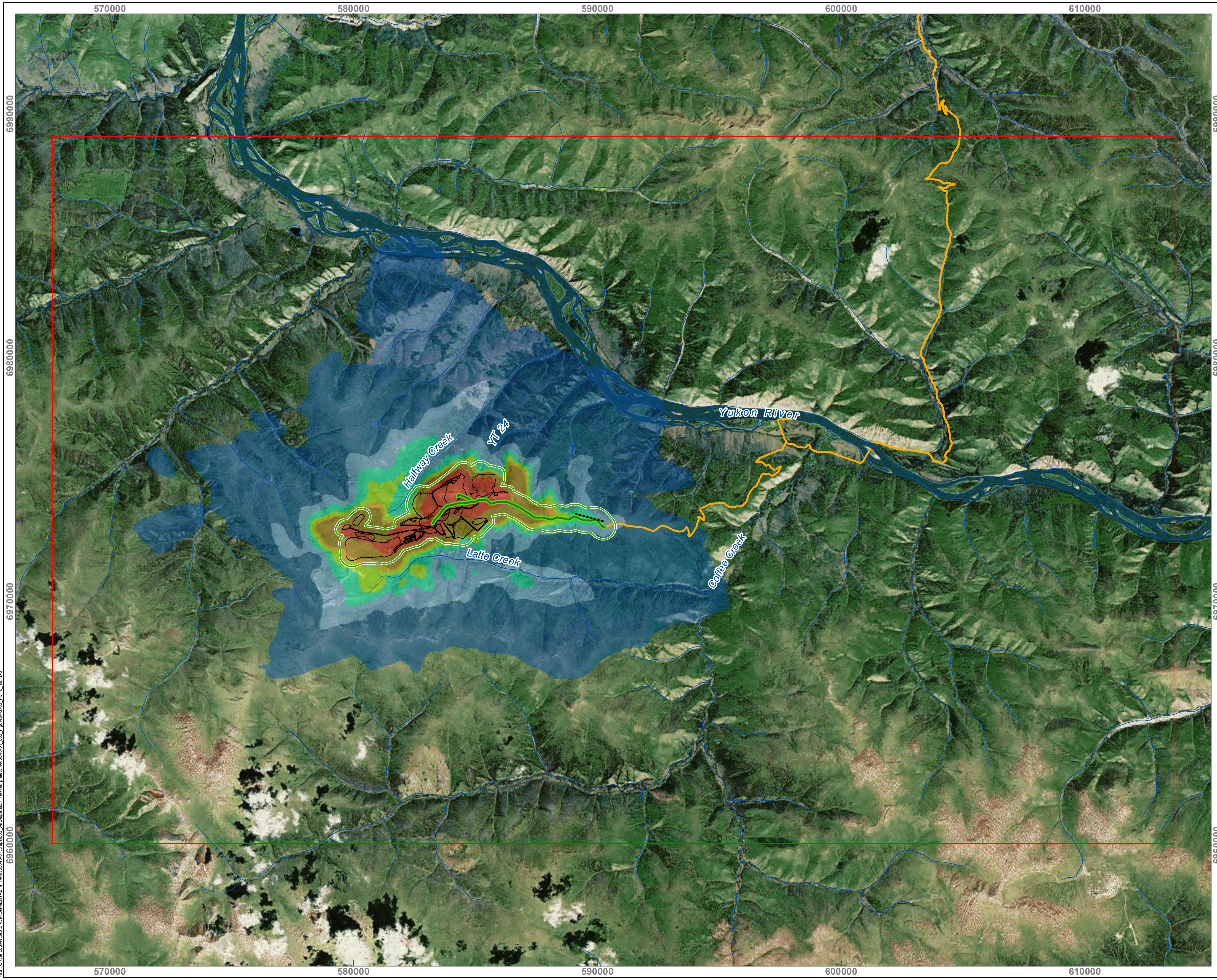
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

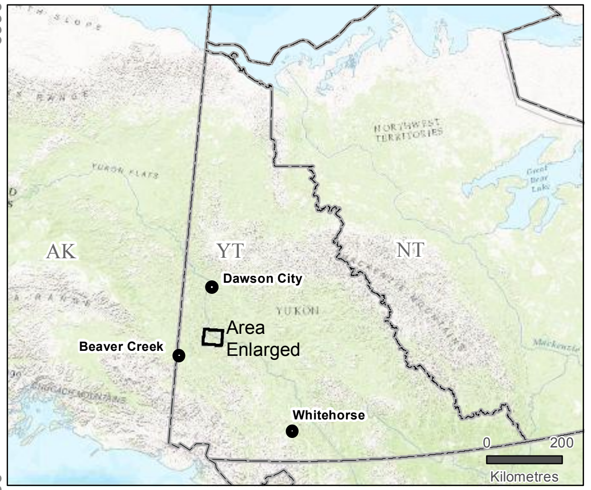
Figure 4.2-2	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

PM_{10} 98[th] Percentile
24-Hour Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

98[th] Percentile PM_{10} Concentration (µg/m³)

- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 200
- 200 - 300
- > 300

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for PM_{10} is 50 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

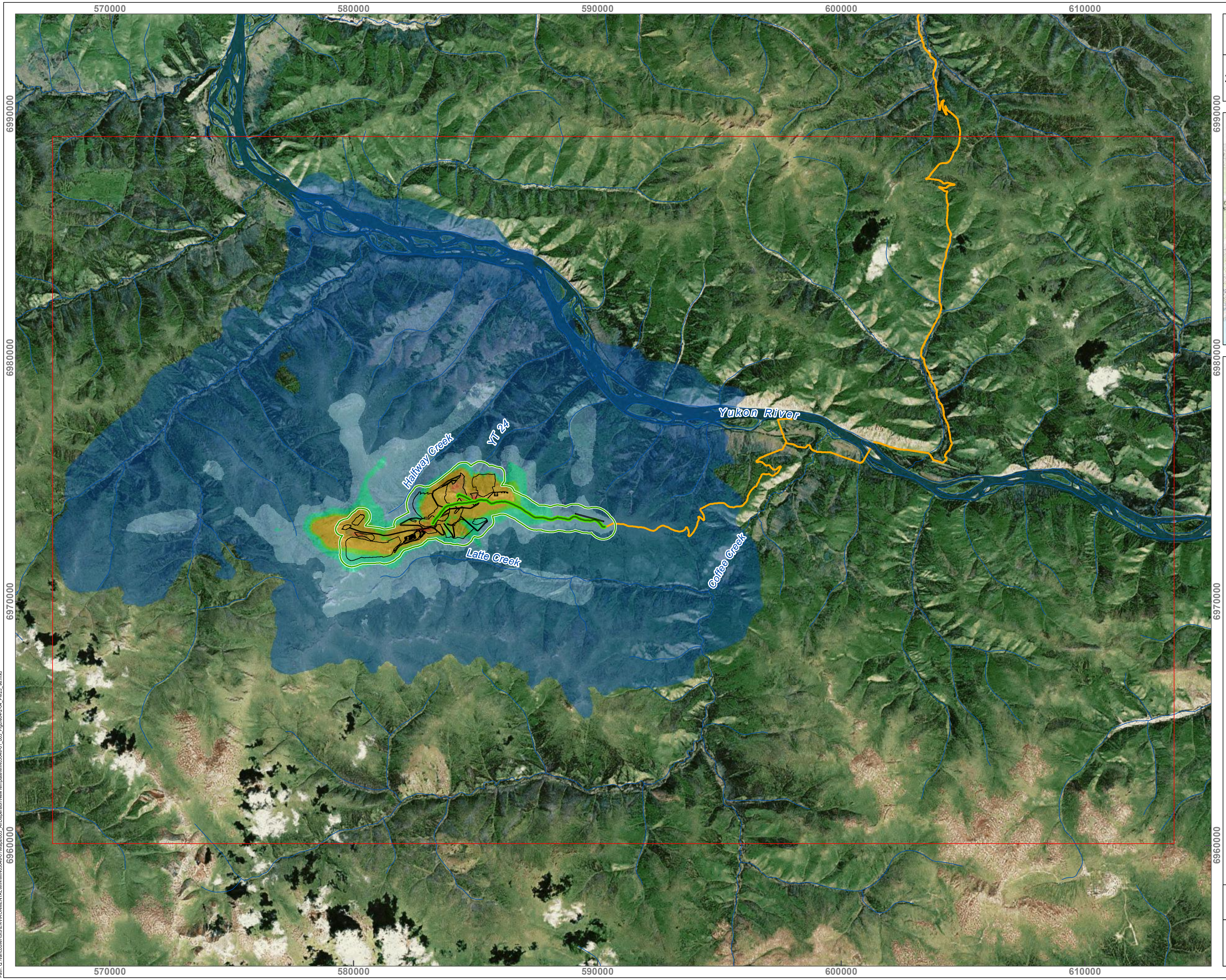
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

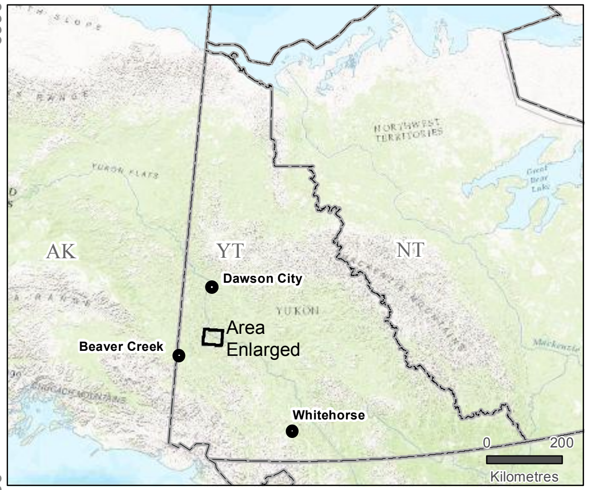
Figure 4.2-3	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

$PM_{2.5}$ 98th Percentile
24-Hour Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

98th Percentile $PM_{2.5}$ Concentration (μg/m³)

- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 28
- 28 - 200
- 200 - 300
- 300 - 400
- > 400

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 μg/m³

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

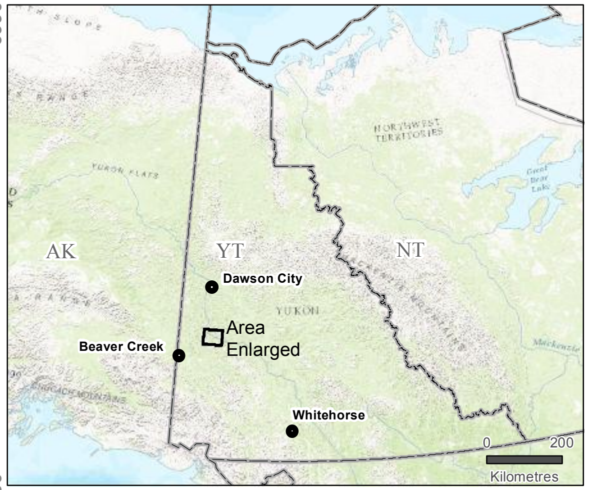
Page Size: 11" x 17"

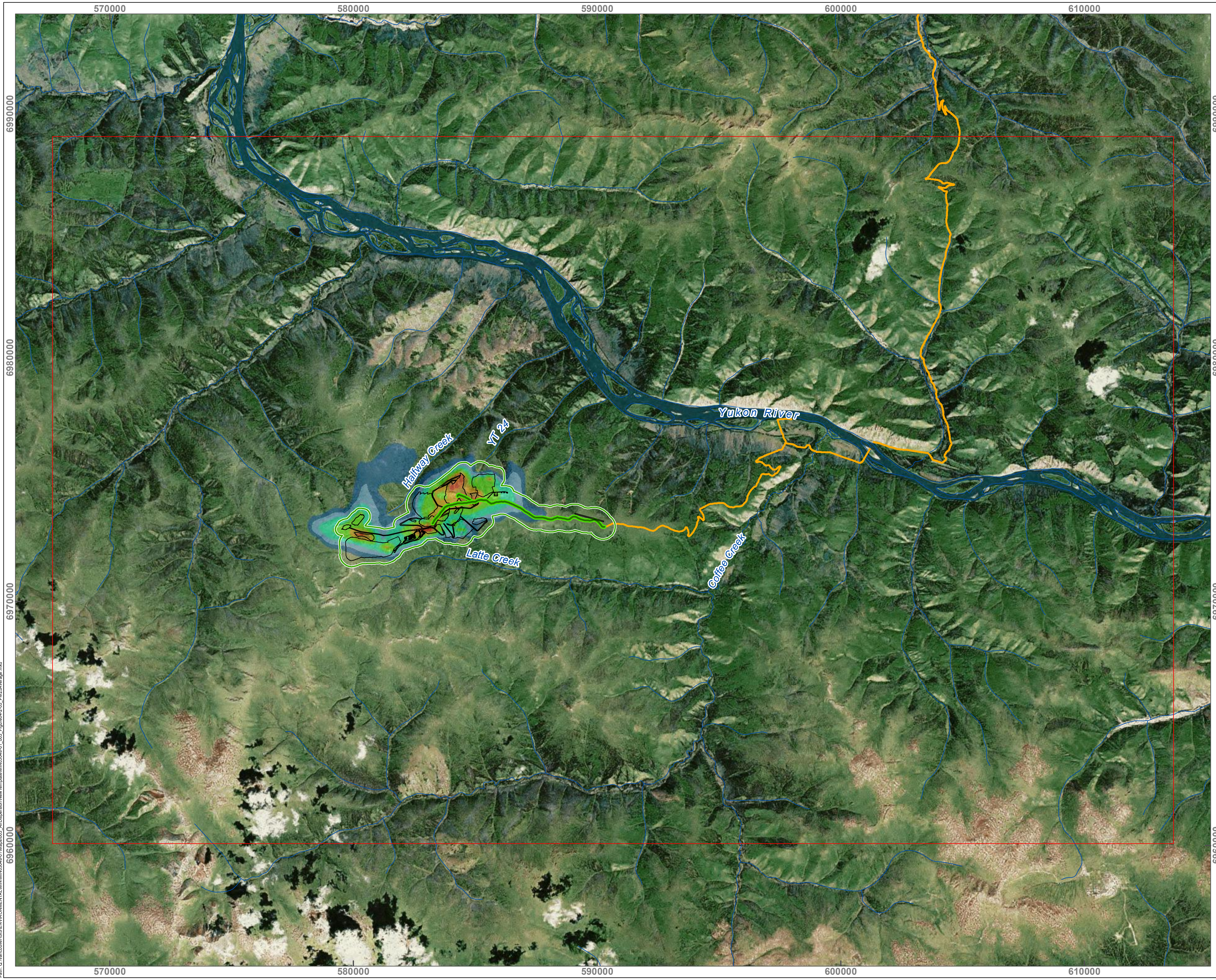
Figure 4.2-4	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

$PM_{2.5}$
Annual Average Concentration at Ground Level
Operations Year 6





Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Average $PM_{2.5}$ Concentration (µg/m³)

- 2 - 3
- 3 - 5
- 5 - 10
- 10 - 28
- 28 - 50
- 50 - 75
- 75 - 100
- > 100

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

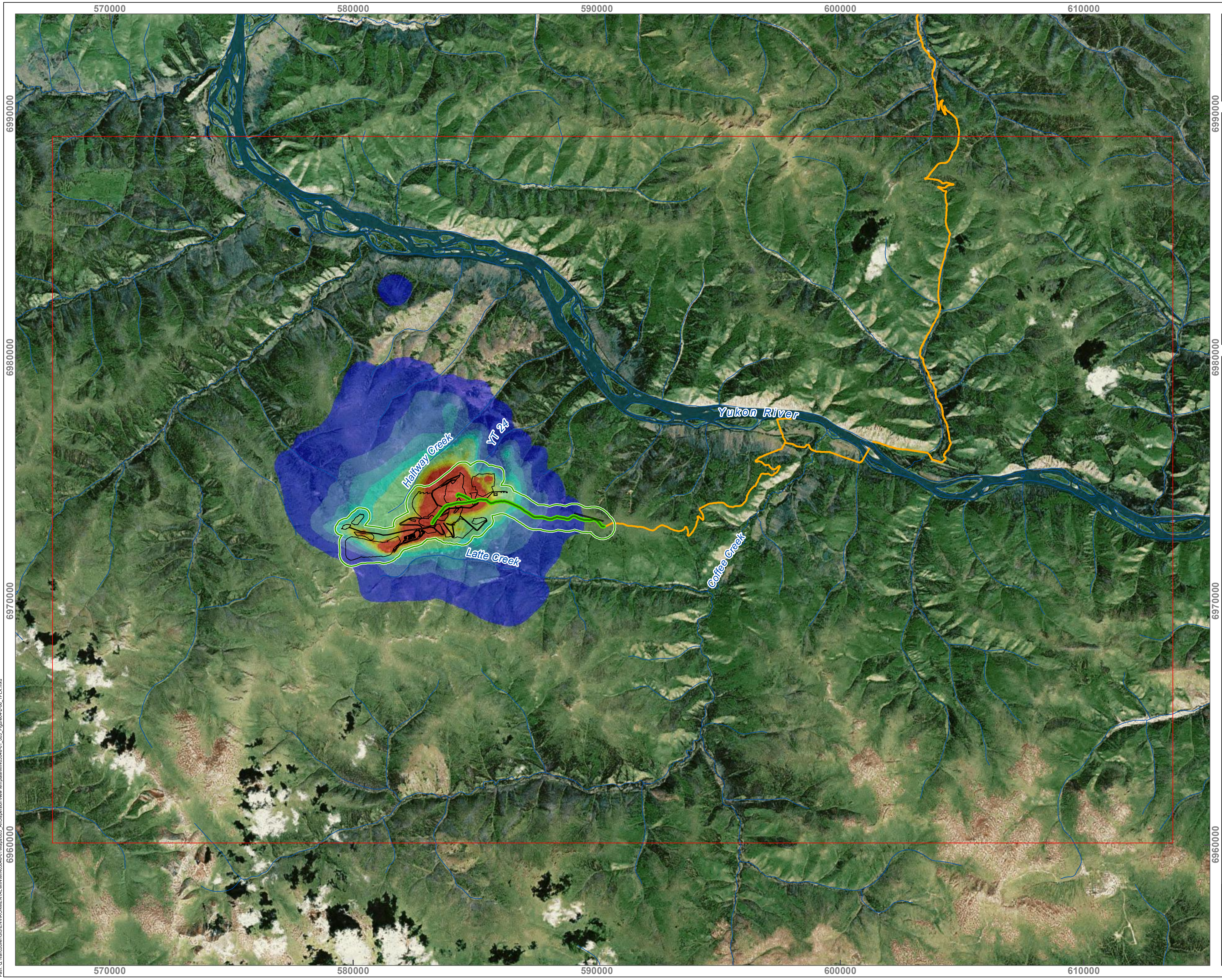
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

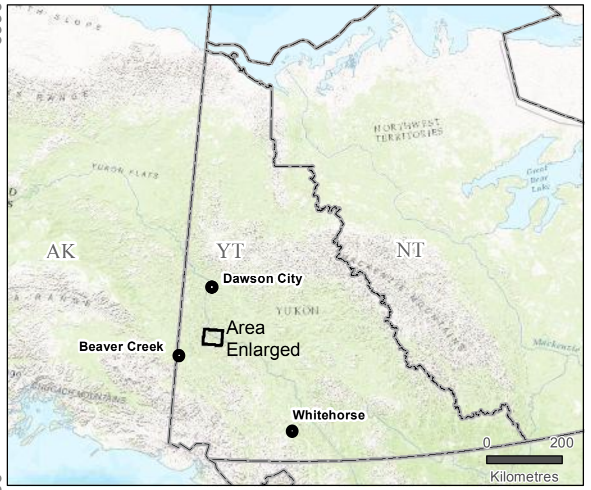
Figure 4.2-5	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

Dustfall Maximum Monthly-Averaged Daily Deposition Rate (mg/dm²/day) Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Dustfall Deposition Rate (mg/dm²/day)

- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 1.7
- 1.7 - 2.3
- 2.3 - 2.9
- 2.9- 3.5
- 3.5 - 4.1
- > 4.1

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. BC MoE Pollution Control Guidelines for Dustfall are 1.7 mg/dm²/day (lower) - 2.9 mg/dm²/day (upper).
Imagery from ESRI; Earthstar Geographics (1999).

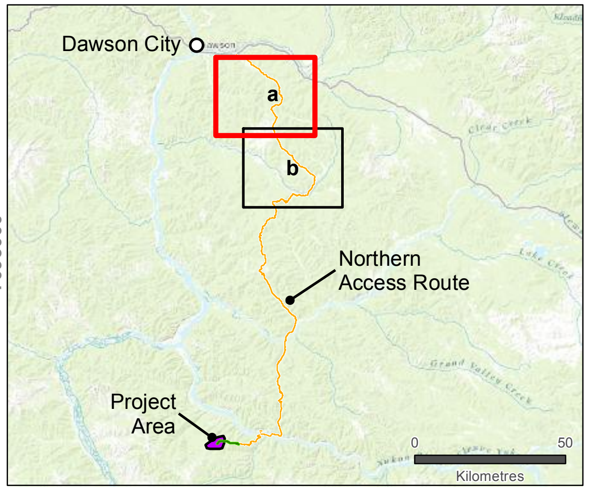
N
1:150,000
0 2 4 6
Kilometres
NAD 1983 UTM Zone 7N
Page Size: 11" x 17"

Figure 4.2-6	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

TSP 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

98th Percentile TSP Concentration (µg/m³)

- 0 - 40
- 40 - 60
- 60 - 90
- 90 - 120
- 120 - 130
- 130- 150
- 150 - 170
- > 170

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for TSP is 120 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

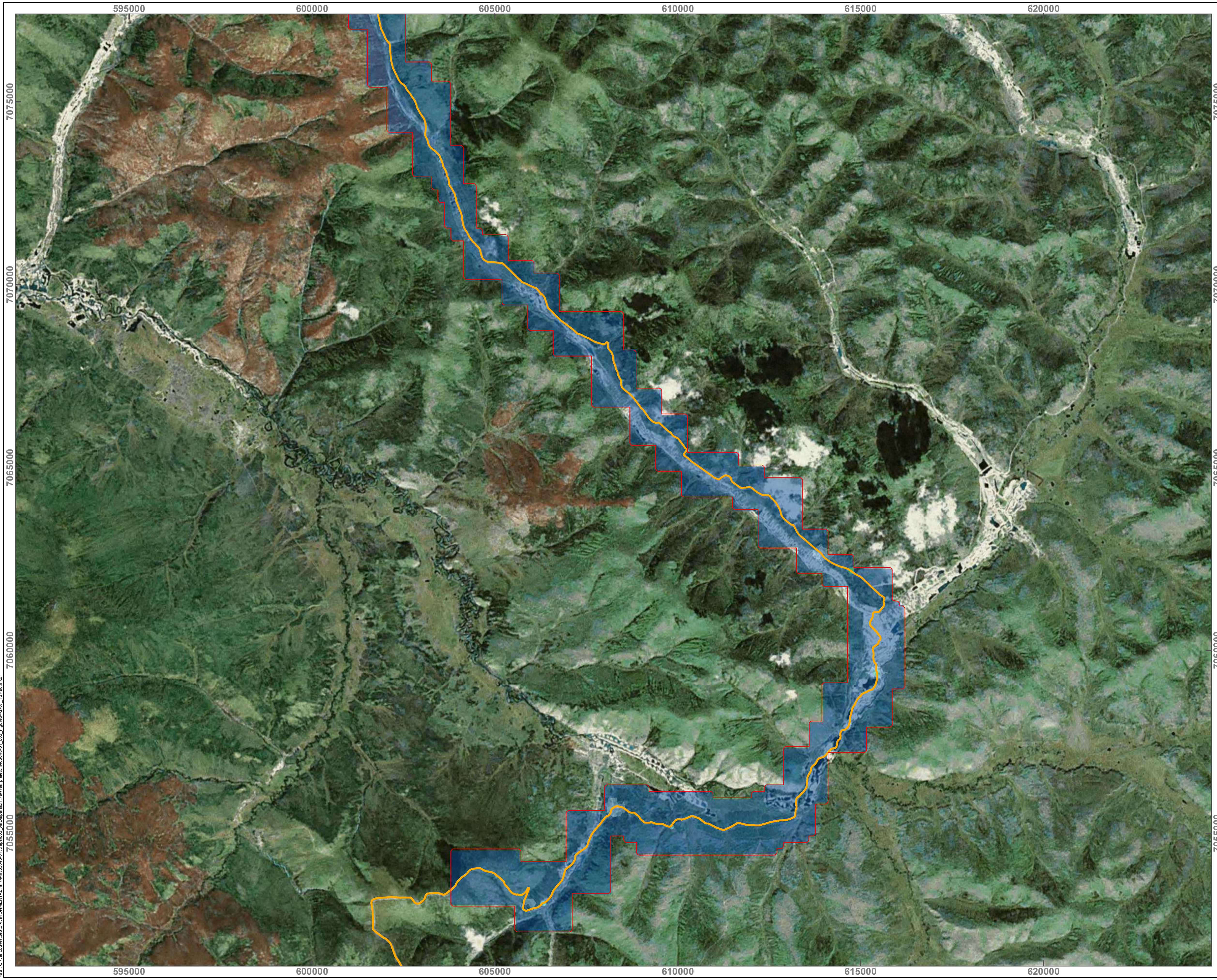
Page Size: 11" x 17"

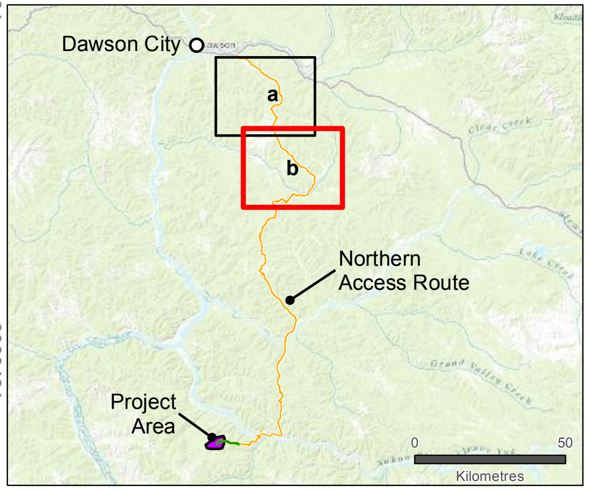
Figure 4.2-7a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

TSP 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route





Legend

- Model Boundary
- Northern Access Route

98th Percentile TSP Concentration (µg/m³)

- 0 - 40
- 40 - 60
- 60 - 90
- 90 - 120
- 120 - 130
- 130- 150
- 150 - 170
- > 170

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for TSP is 120 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

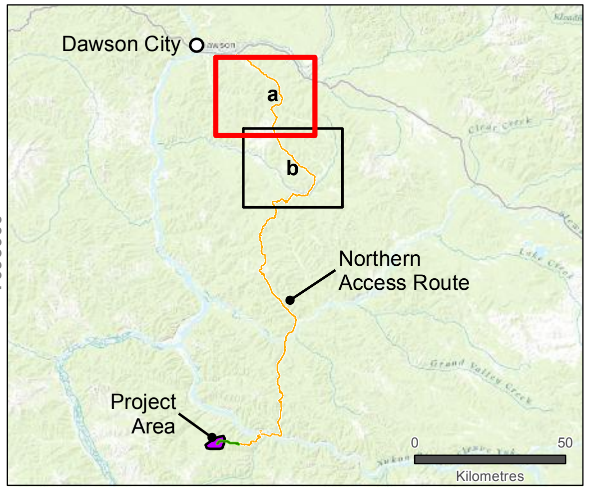
Page Size: 11" x 17"

Figure 4.2-7b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

TSP
Annual Average Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Average TSP Concentration (µg/m³)

- 0 - 20
- 20 - 30
- 30 - 40
- 40 - 60
- 60 - 65
- 65 - 70
- 70 - 72
- > 72

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The Annual Yukon Ambient Air Quality Standard for TSP is 60 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6
Kilometres

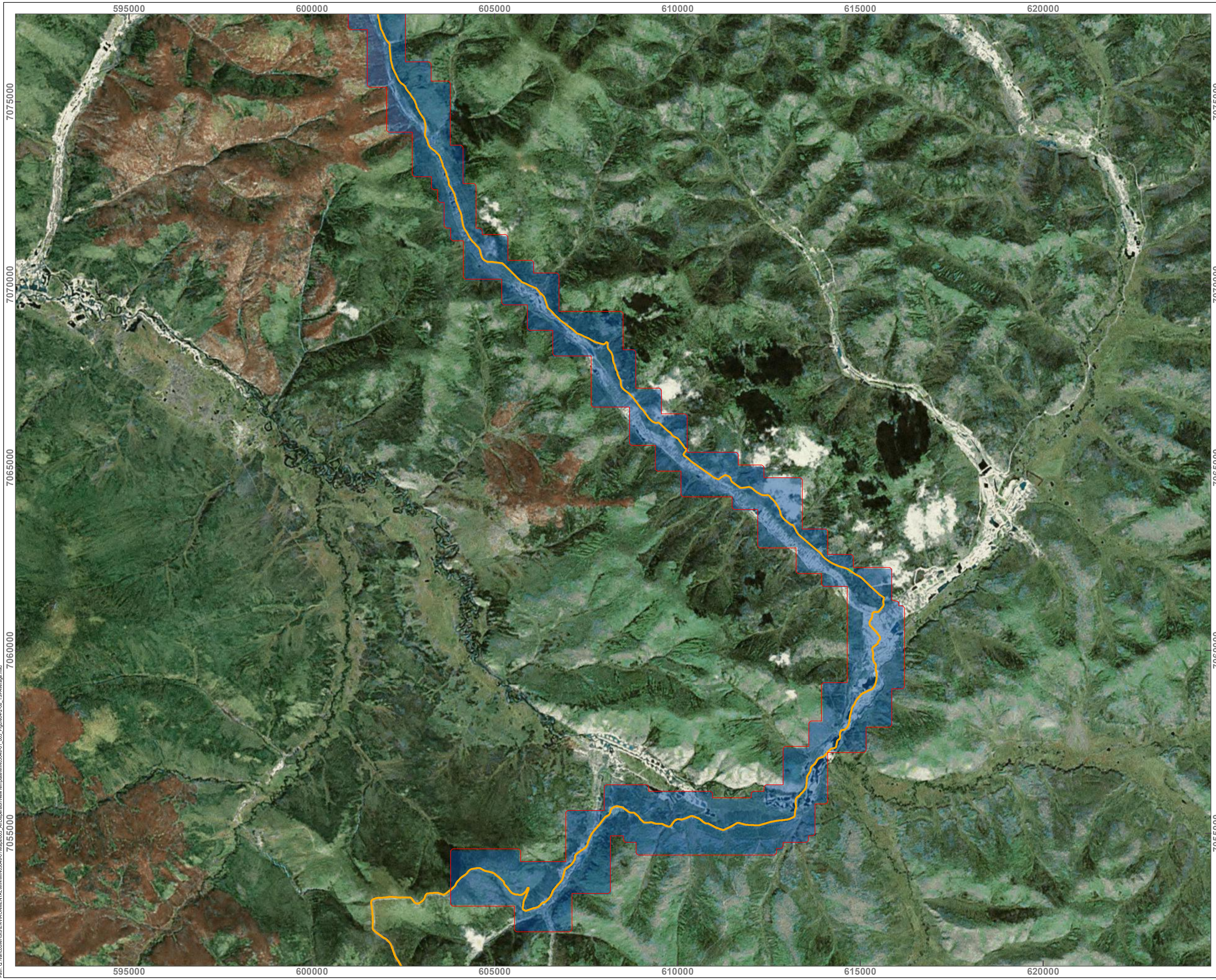
NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 4.2-8a	Date: Mar 9, 2017	Drawn by: SL	Reviewed: TM

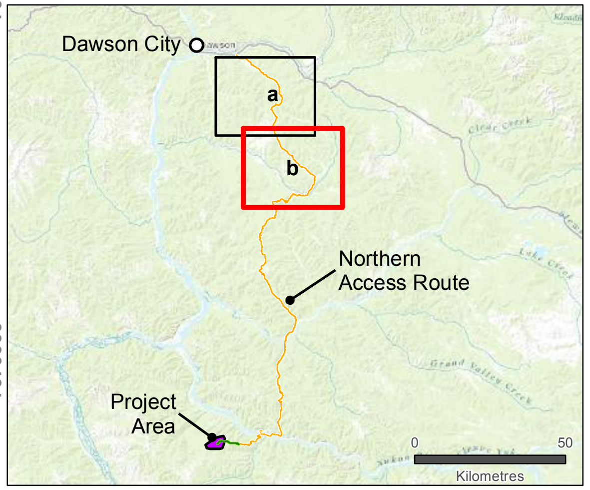
GOLDCORP

Path: Q:\Vancouver\GIS\ENVIRONMENTAL\MIN\MIN03048-01\Maps\003_AirDispersion\NewTemplate\MIN03048-01_003_Figure04-2-08_TSPAverage.mxd



COFFEE GOLD MINE

TSP
Annual Average Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Average TSP Concentration (µg/m³)

- 0 - 20
- 20 - 30
- 30 - 40
- 40 - 60
- 60 - 65
- 65 - 70
- 70 - 72
- > 72

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The Annual Yukon Ambient Air Quality Standard for TSP is 60 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

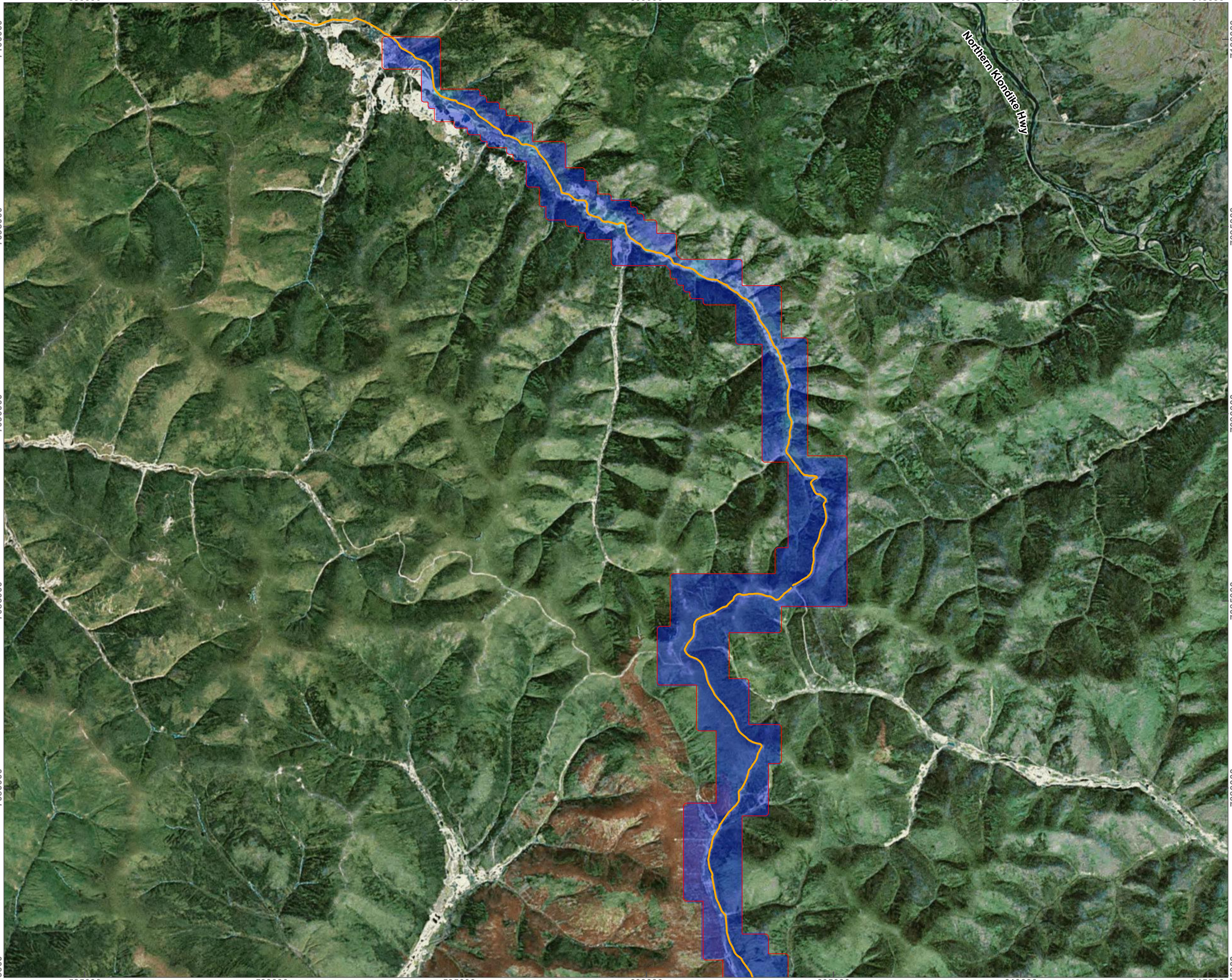
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

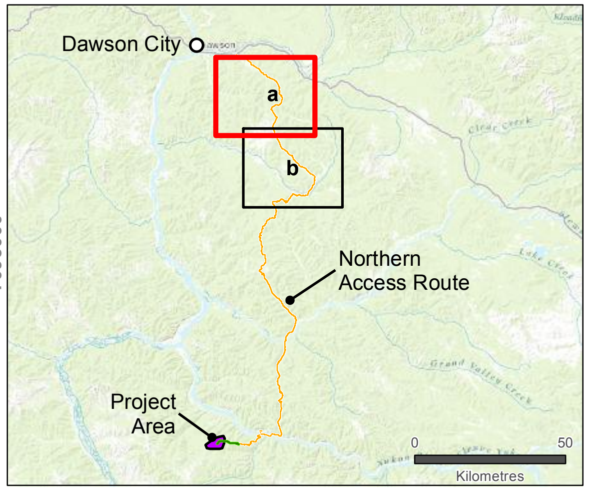
Figure 4.2-8b	Date: Mar 9, 2017	Drawn by: SL	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

PM_{10} 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

98th Percentile PM_{10} Concentration (µg/m³)

- 0 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 40
- 40 - 50
- > 50

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for PM_{10} is 50 µg/m³

Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

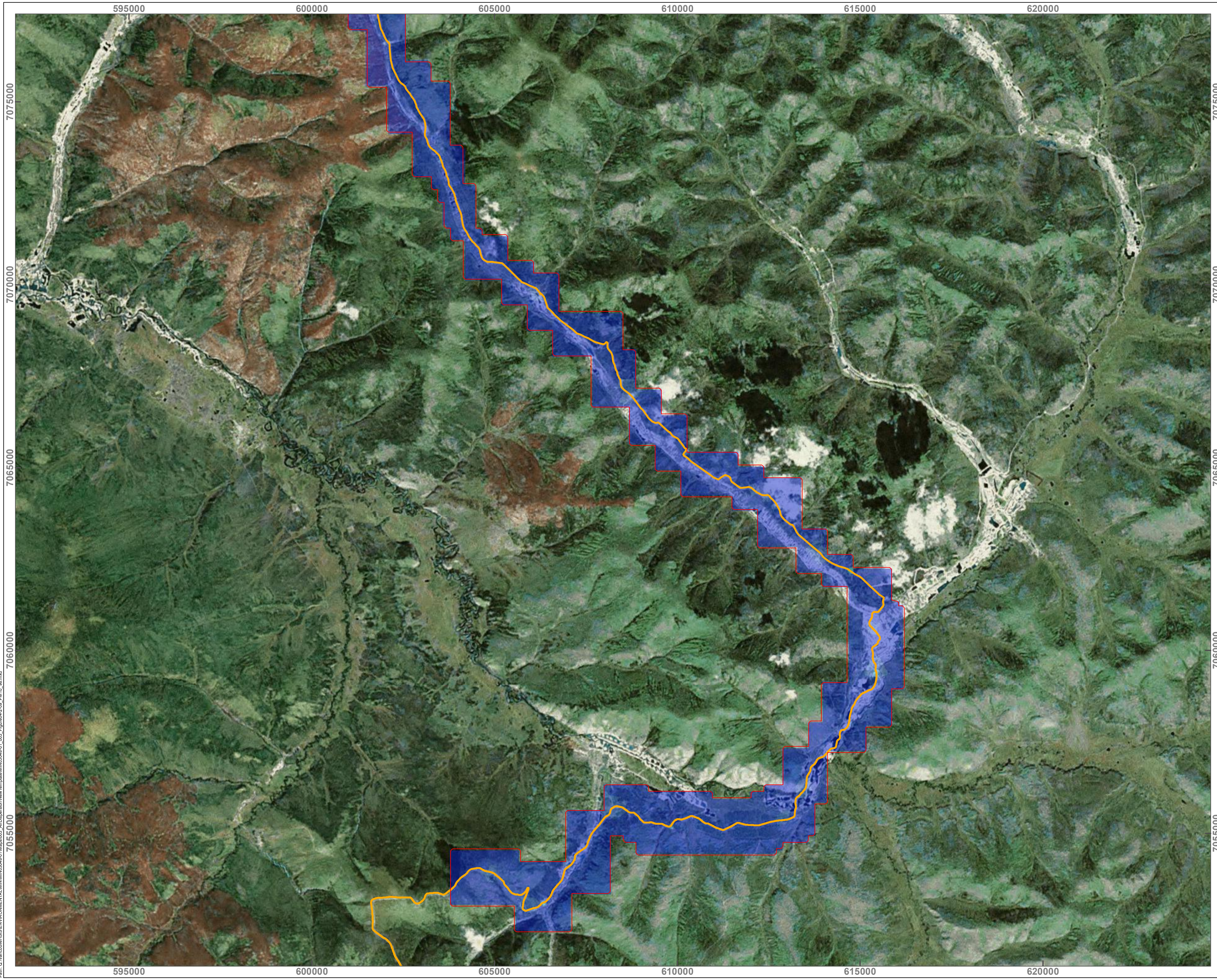
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

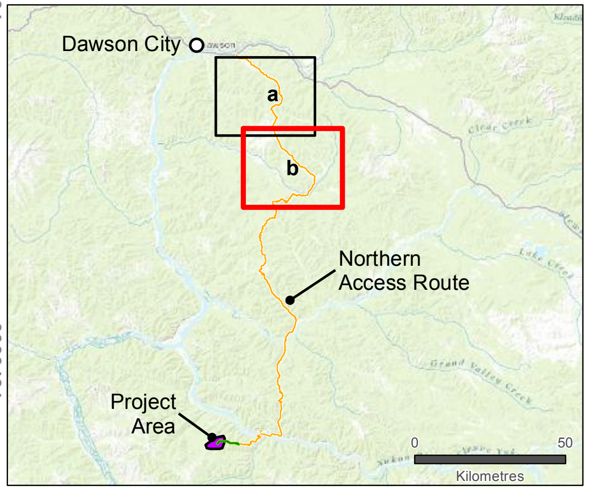
Figure 4.2-9a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

PM_{10} 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

98th Percentile PM_{10} Concentration (μg/m³)

- 0 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 40
- 40 - 50
- > 50

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for PM_{10} is 50 μg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N
1:100,000
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

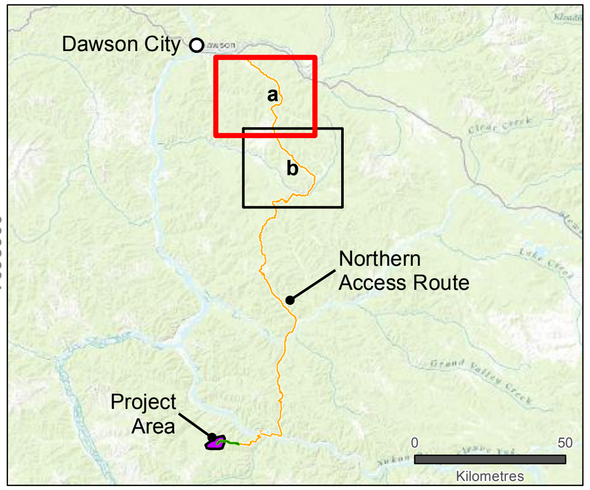
Page Size: 11" x 17"

Figure 4.2-9b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

$PM_{2.5}$ 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

98th Percentile $PM_{2.5}$ Concentration (µg/m³)

- 0- 0.5
- 0.5 - 1
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 4
- 4. - 4.5
- > 4.5

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 µg/m³

Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

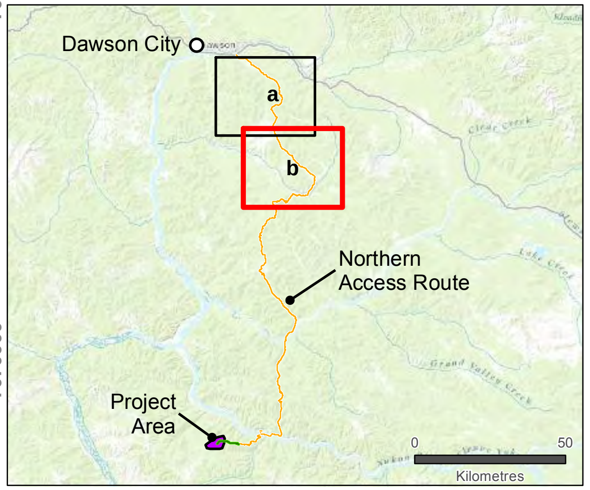
Figure 4.2-10a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

Path: Q:\Vancouver\GIS\ENVIRONMENTAL\MIN\MIN03048-01\Maps\003_AirDispersion\NewTemplate\MIN03048-01_003_Figure04-2-10_PM25_98.mxd

COFFEE GOLD MINE

$PM_{2.5}$ 98th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

Model Boundary

Northern Access Route

98th Percentile $PM_{2.5}$ Concentration (µg/m³)

- 0- 0.5
- 0.5 - 1
- 1 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 4
- 4. - 4.5
- > 4.5

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

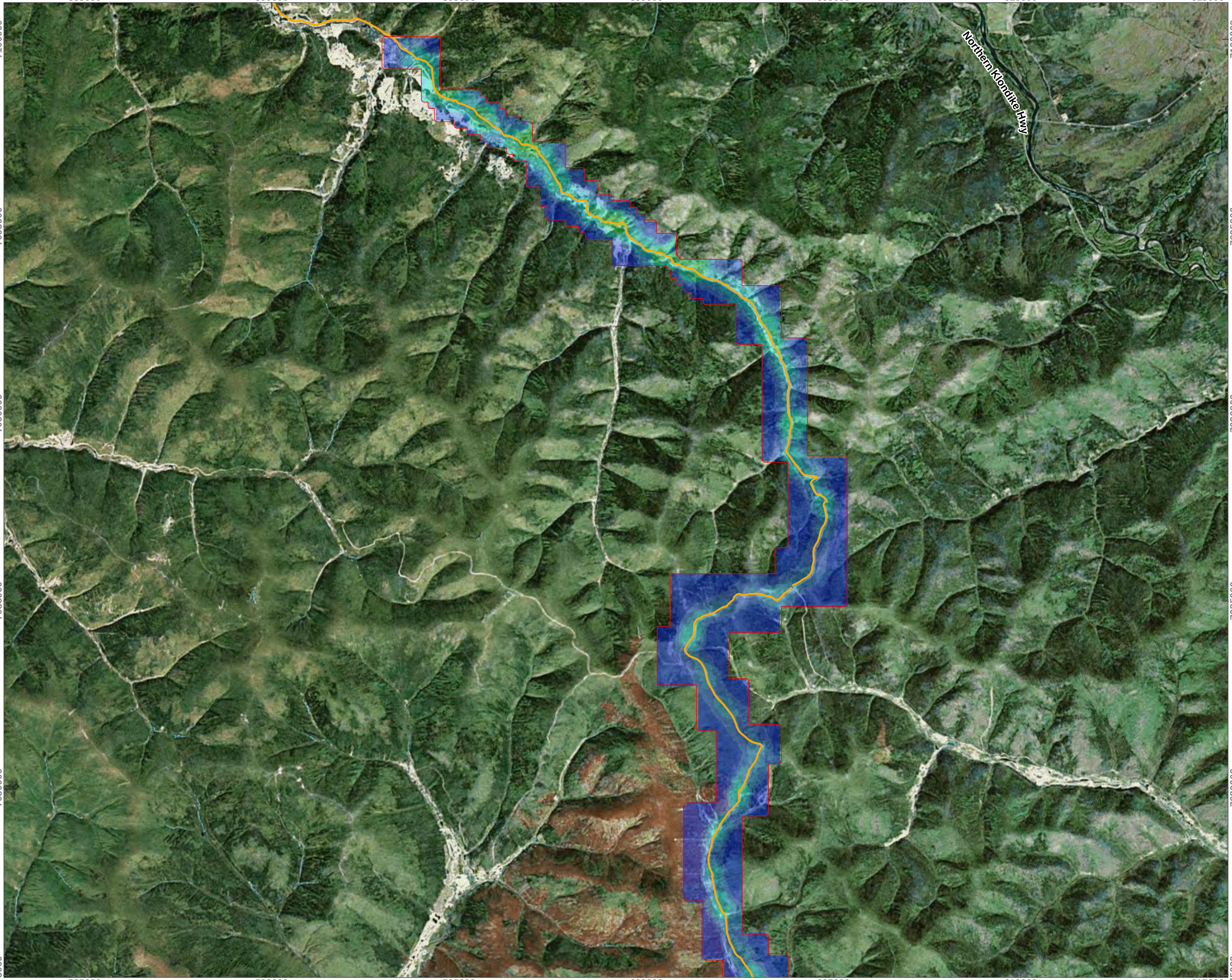
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

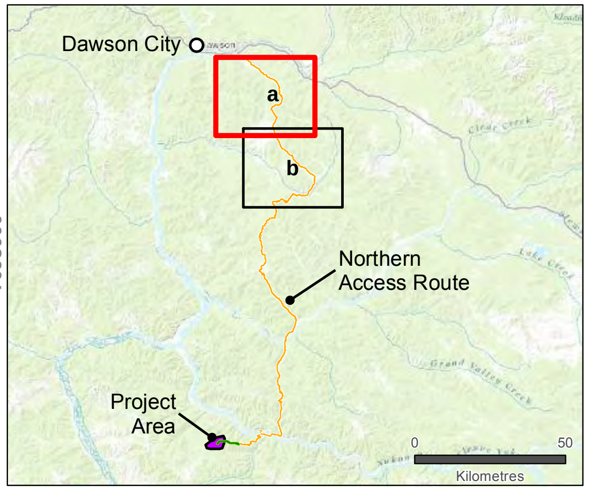
Figure 4.2-10b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

$PM_{2.5}$
Annual Average Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Average $PM_{2.5}$ Concentration (µg/m³)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 1
- > 1

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

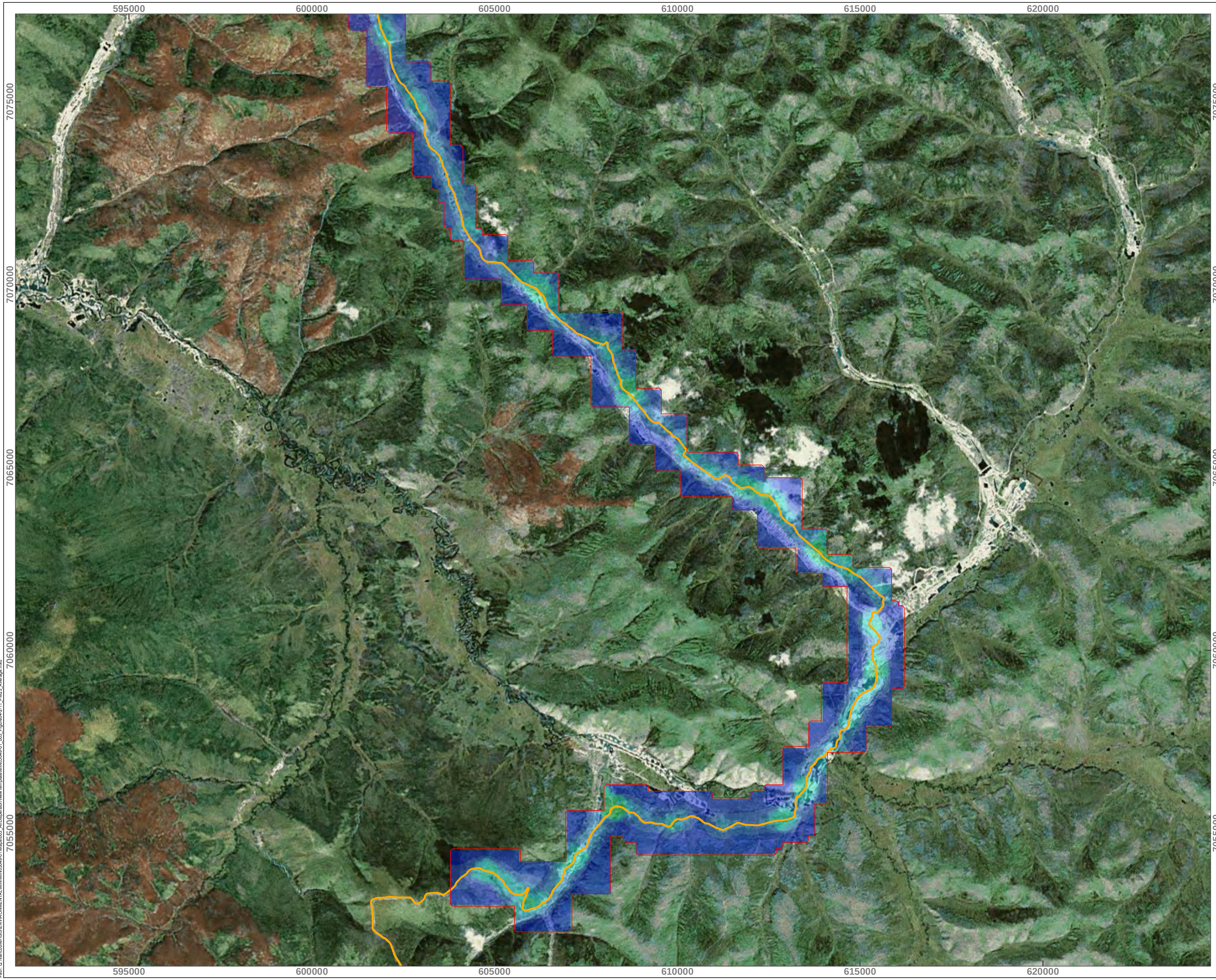
N
1:100,000
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

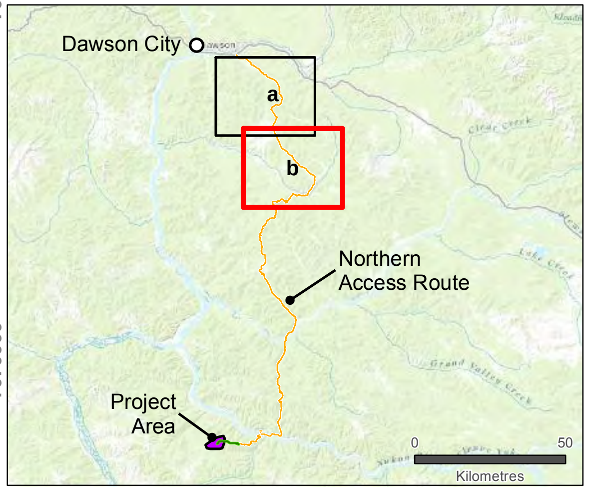
Figure 4.2-11a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

$PM_{2.5}$
Annual Average Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Average $PM_{2.5}$ Concentration (µg/m³)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 1
- > 1

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for $PM_{2.5}$ is 28 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

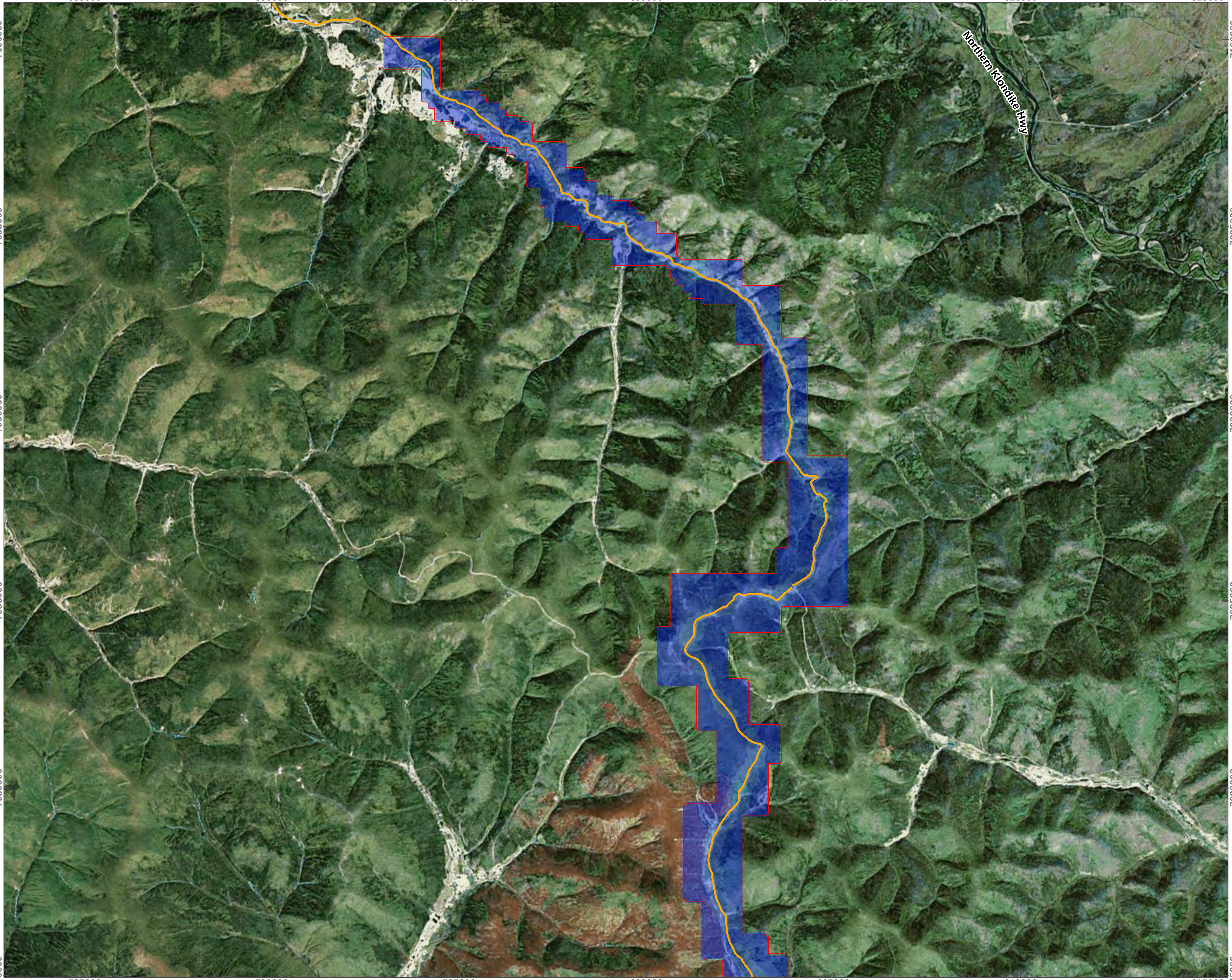
Page Size: 11" x 17"

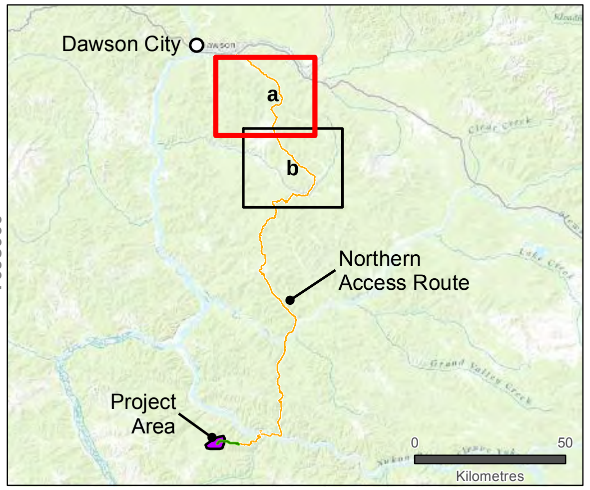
Figure 4.2-11b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

Dustfall Maximum Monthly-Averaged Daily Deposition Rate (mg/dm^2/day) Northern Access Route





Legend

- Model Boundary
- Northern Access Route

Dustfall Deposition Rate (mg/dm^2/day)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 1
- 1 - 1.2
- > 1.2

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. BC NoE Pollution Control Guidelines for Dustfall are 1.7 mg/dm^2/day (lower) - 2.9 mg/dm^2/day (upper)

Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

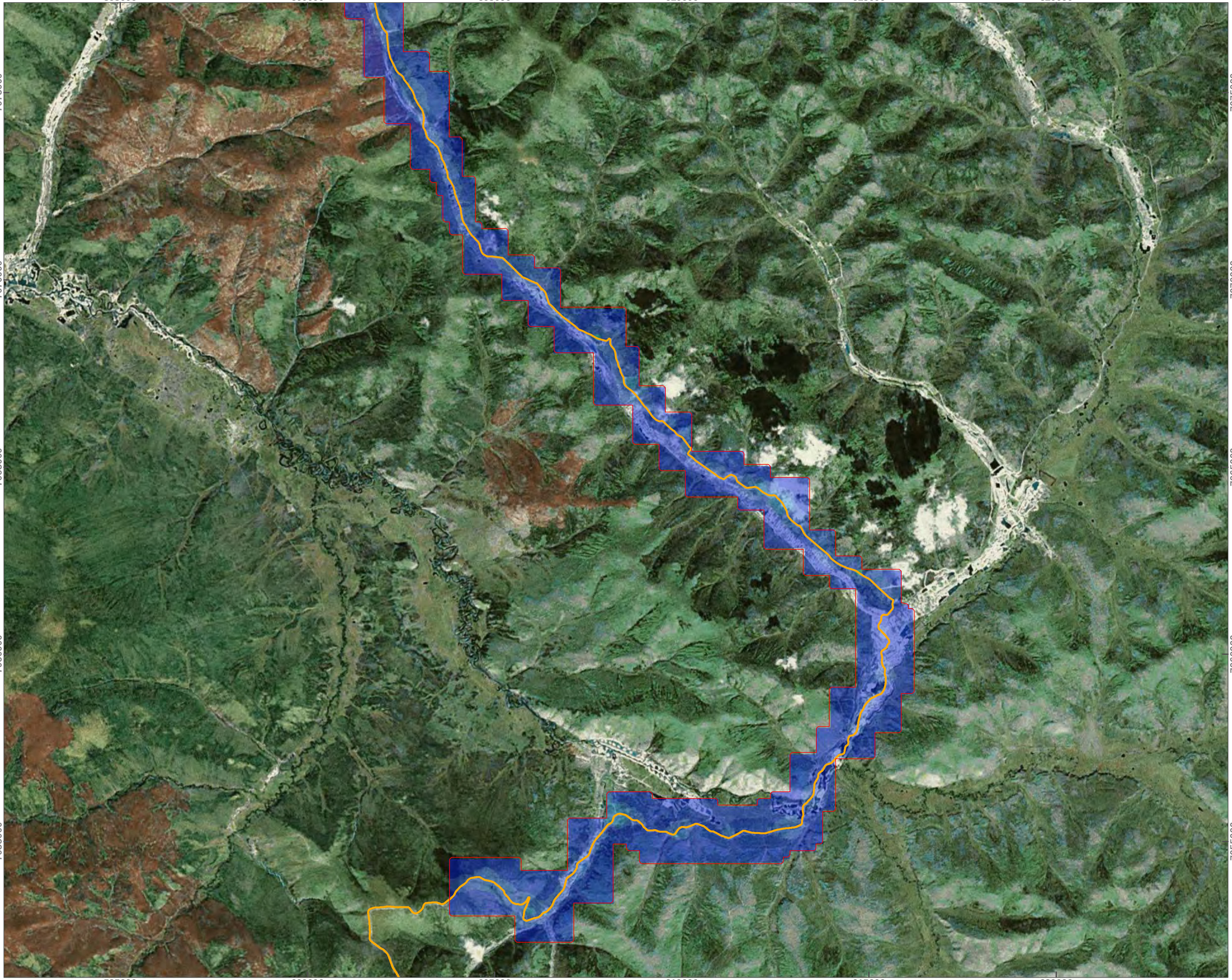
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

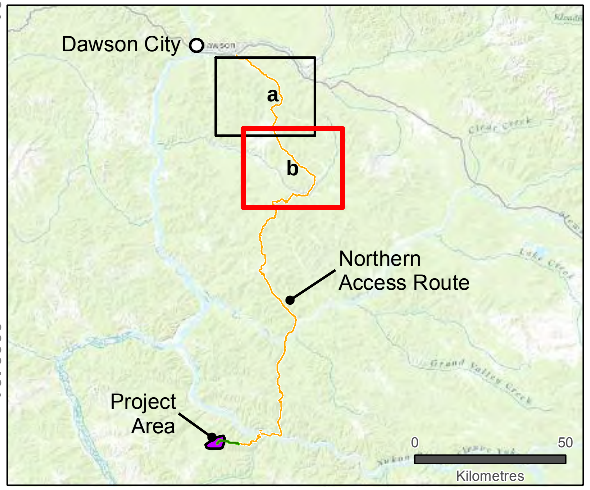
Figure 4.2-12a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

Dustfall Maximum Monthly-Averaged Daily Deposition Rate (mg/dm²/day) Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Dustfall Deposition Rate (mg/dm²/day)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 1
- 1 - 1.2
- > 1.2

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. BC NoE Pollution Control Guidelines for Dustfall are 1.7 mg/dm²/day (lower) - 2.9 mg/dm²/day (upper)

Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

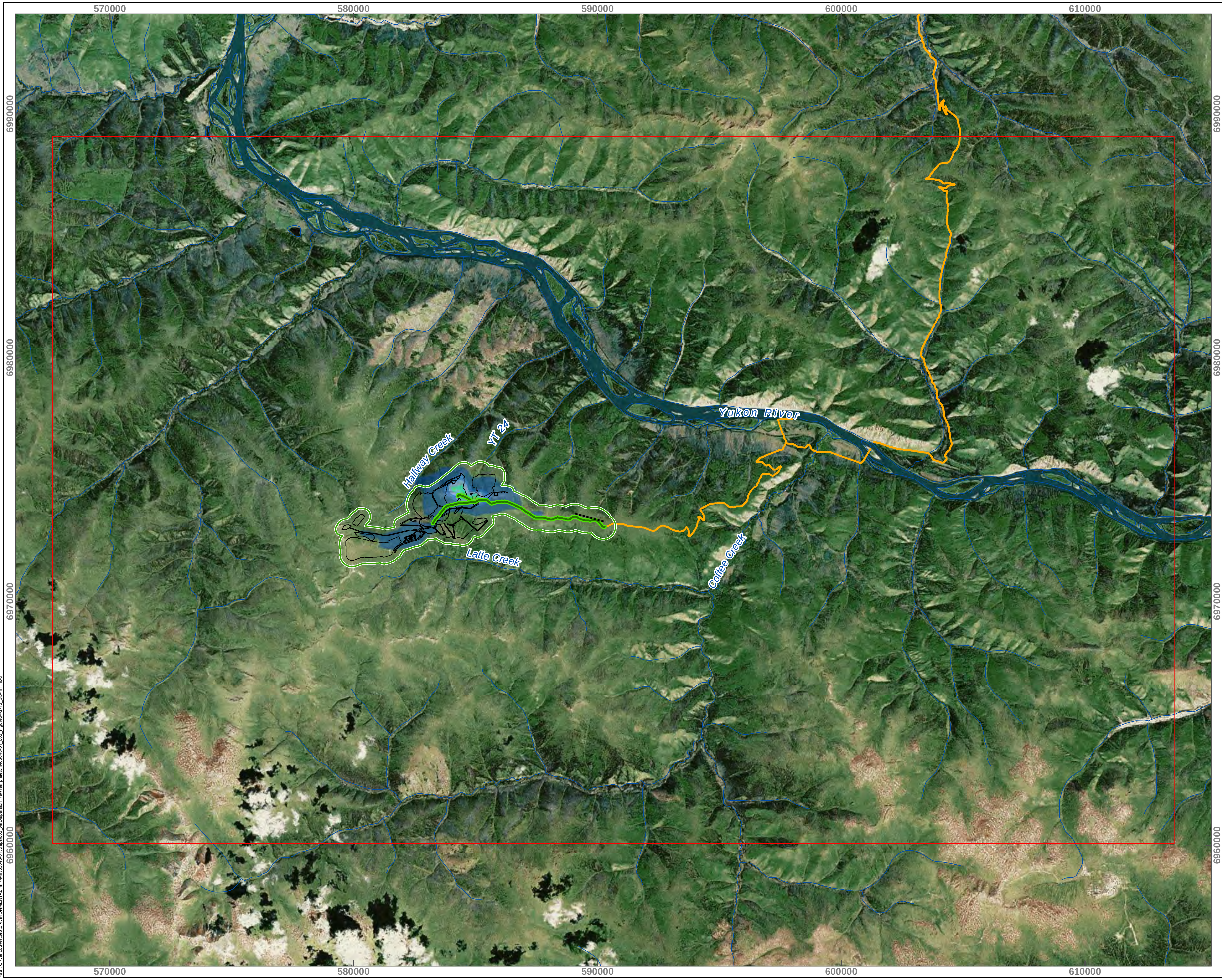
Page Size: 11" x 17"

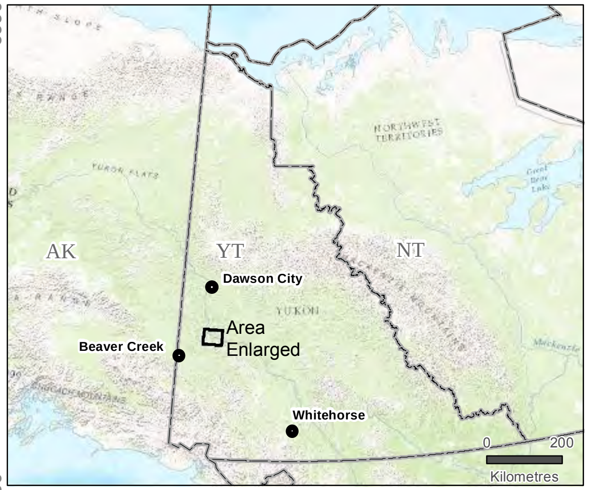
Figure 4.2-12b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

SO_2 99th Percentile 1-Hour Maximum Concentration at Ground Level Operations Year 6





Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

99th Percentile SO_2 Concentration (µg/m³)

- 0.5- 5
- 5 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- > 60

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 1-Hr Yukon Ambient Air Quality Standard for SO_2 is 485 µg/m³

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

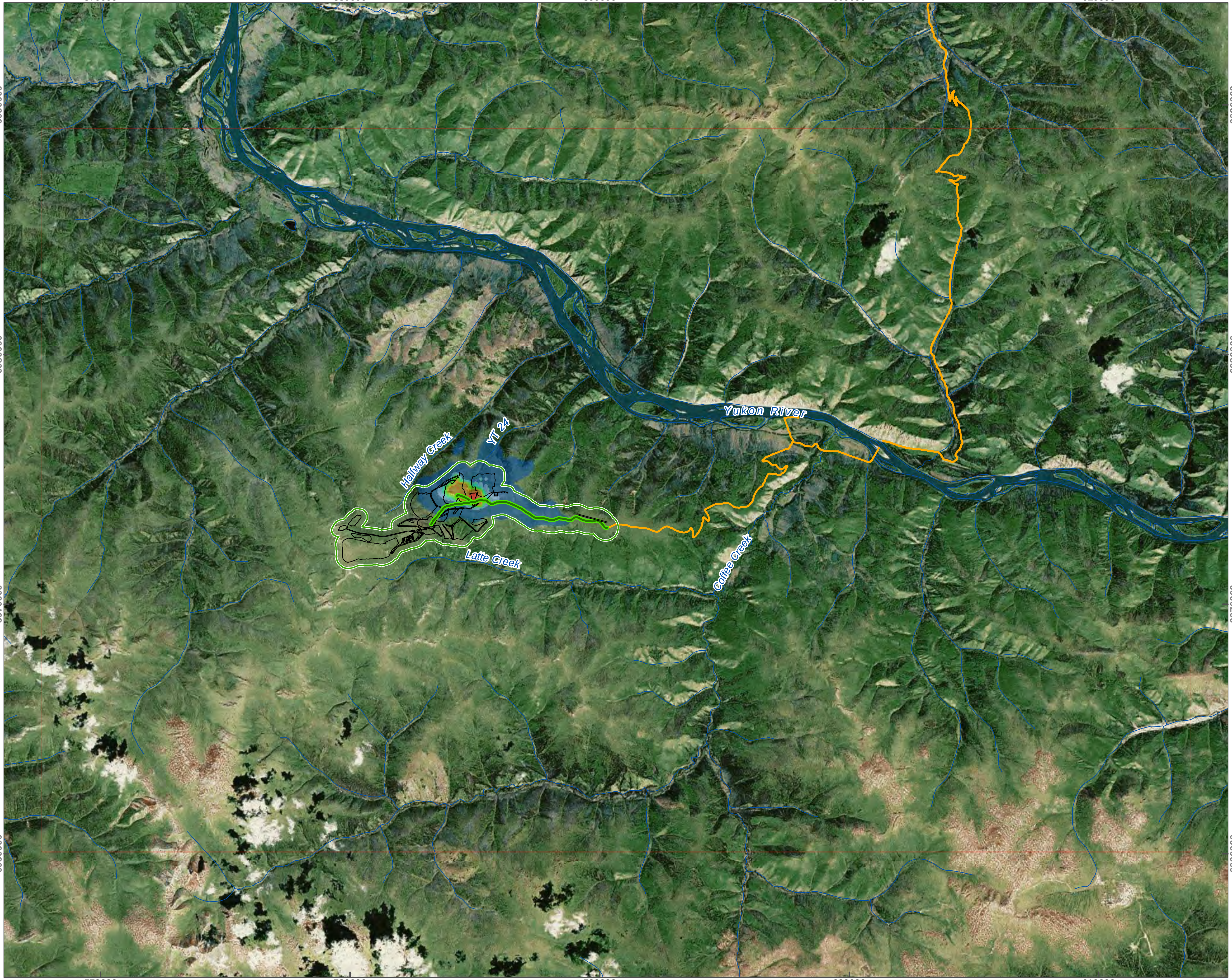
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

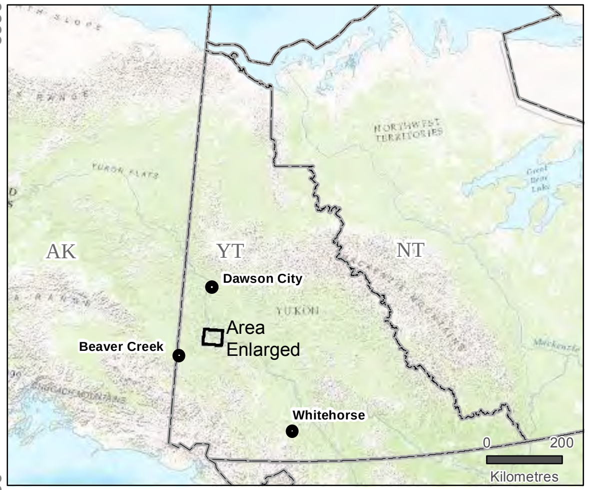
Figure 4.2-13	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

SO_2
24-Hour Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Maximum SO_2 Concentration (µg/m³)

- 5 - 50
- 50 - 75
- 75 - 100
- 100 - 161
- 161 - 200
- 200 - 500
- 500 - 700
- > 700

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for SO_2 is 161 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

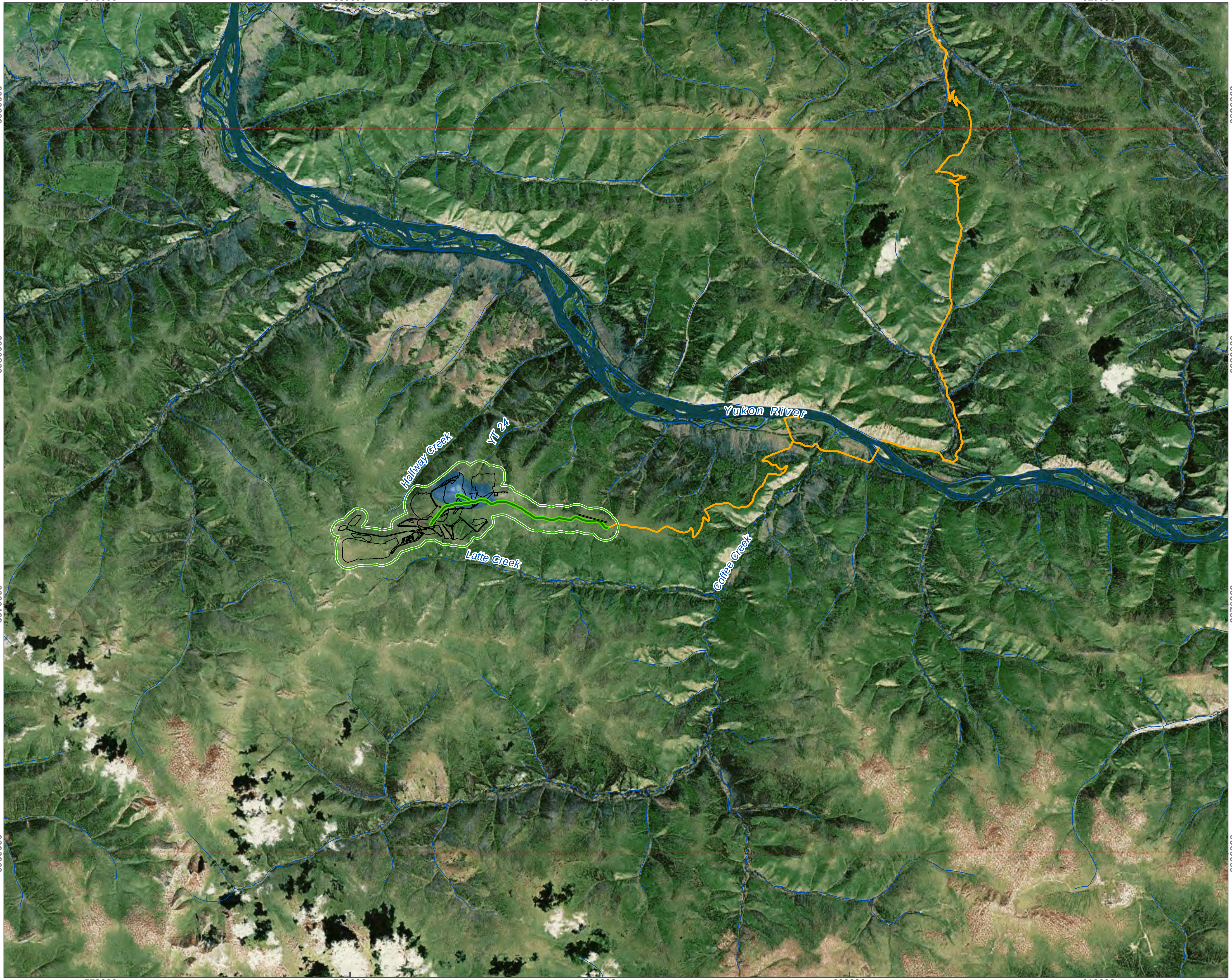
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

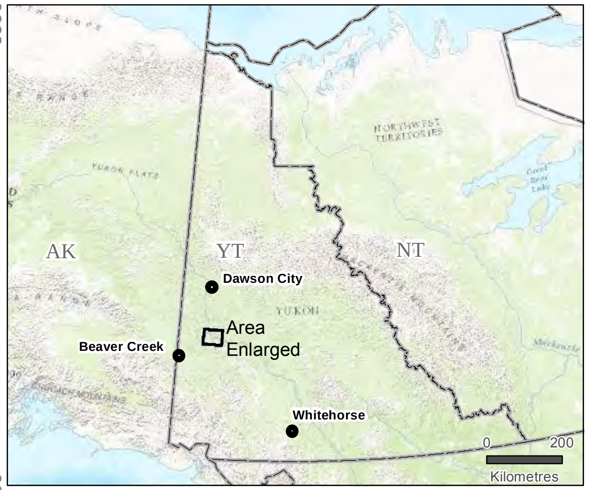
Figure 4.2-14	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

SO_2
Annual Average Concentration
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Average SO_2 Concentration (µg/m³)

- 0.5 - 5
- 5 - 8
- 8 - 12
- 12 - 16
- 16 - 20
- 20 - 24
- 24 - 28
- > 28

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The Annual Yukon Ambient Air Quality Standard for SO_2 is 31 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

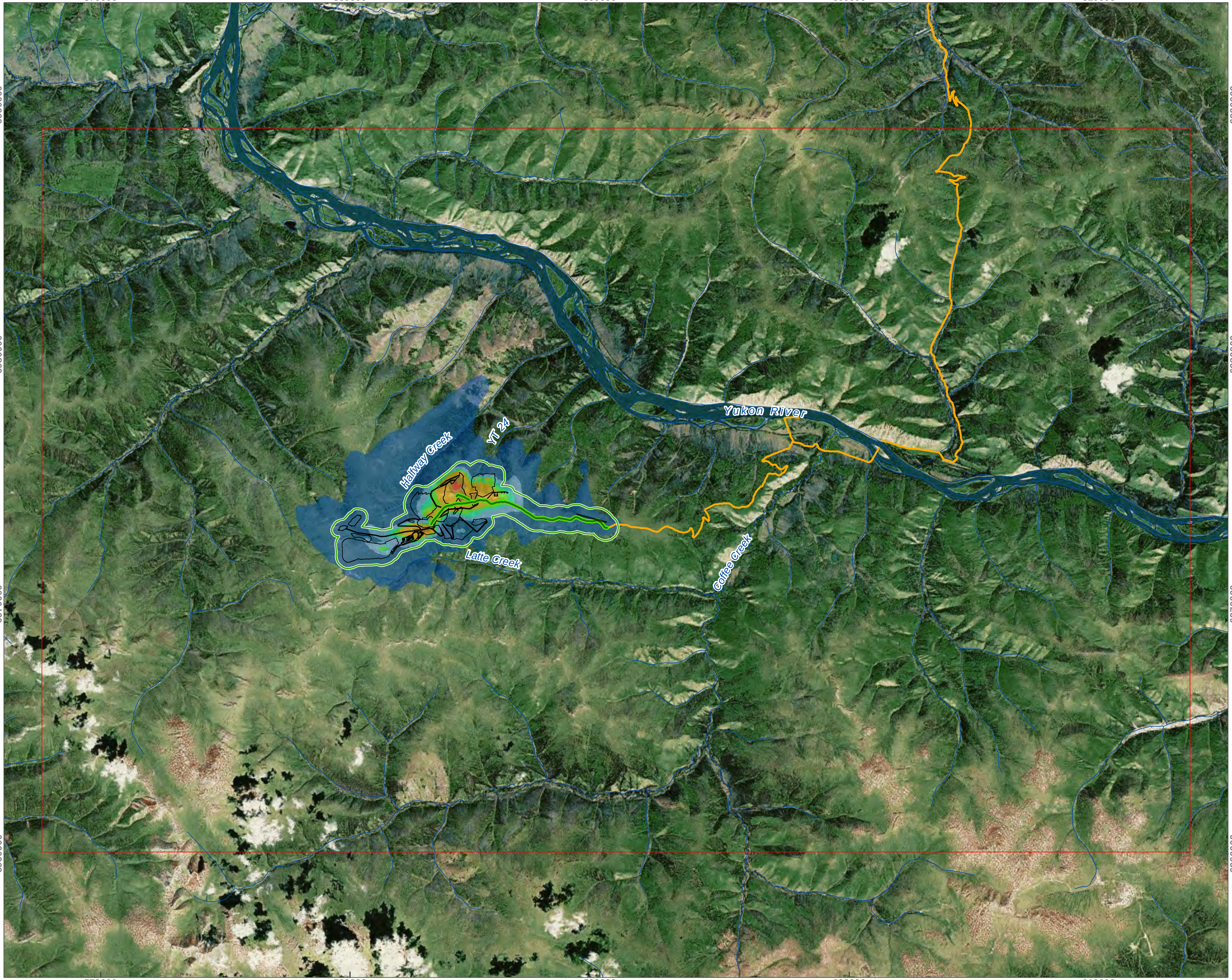
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

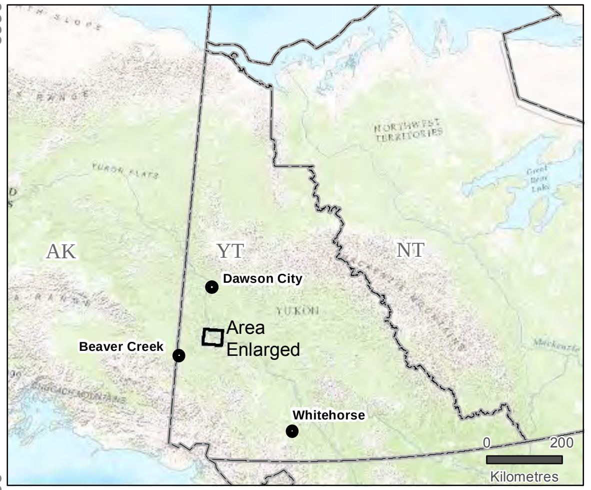
Figure 4.2-15	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

NO_2 98th Percentile
1-Hour Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

98th Percentile NO_2 Concentration (µg/m³)

- 20 - 100
- 100 - 200
- 200 - 300
- 300 - 432
- 432 - 2,000
- 2,000- 4,000
- 4,000 - 6,000
- > 6,000

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 1-Hr Yukon Ambient Air Quality Standard for NO_2 is 432 µg/m³
3. Assumes Most Conservative 100% NOx to NO_2 conversion

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

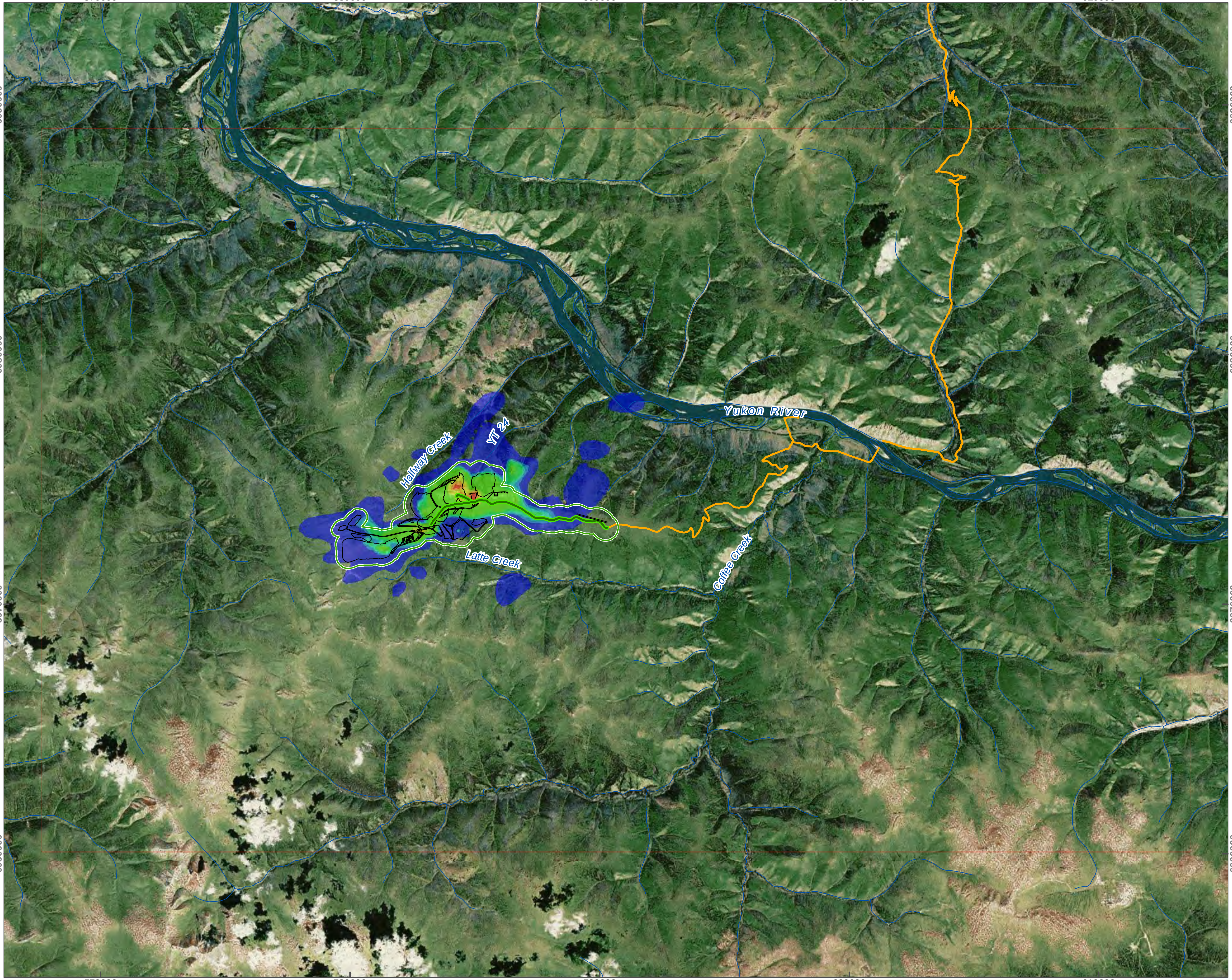
Page Size: 11" x 17"

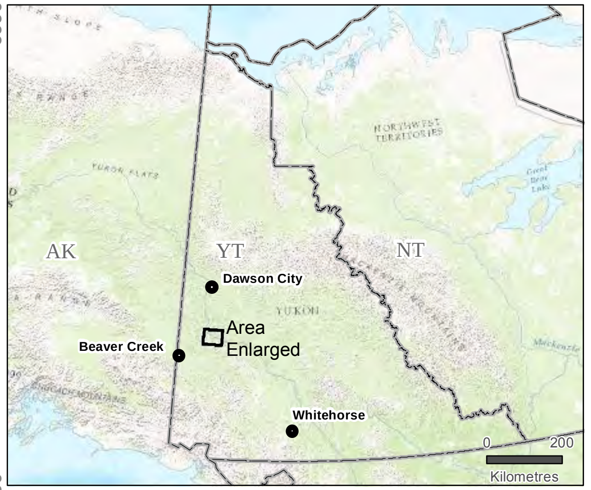
Figure 4.2-16	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

NO_2
24-Hour Maximum Concentration at Ground Level
Operations Year 6





Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Maximum NO_2 Concentration (µg/m³)

- 40 - 100
- 100 - 125
- 125 - 150
- 150 - 215
- 215 - 2,000
- 2,000 - 4,000
- 4,000- 6,000
- > 6,000

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for NO_2 is 215 µg/m³
3. Assumes Most Conservative 100% NOx to NO_2 conversion

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

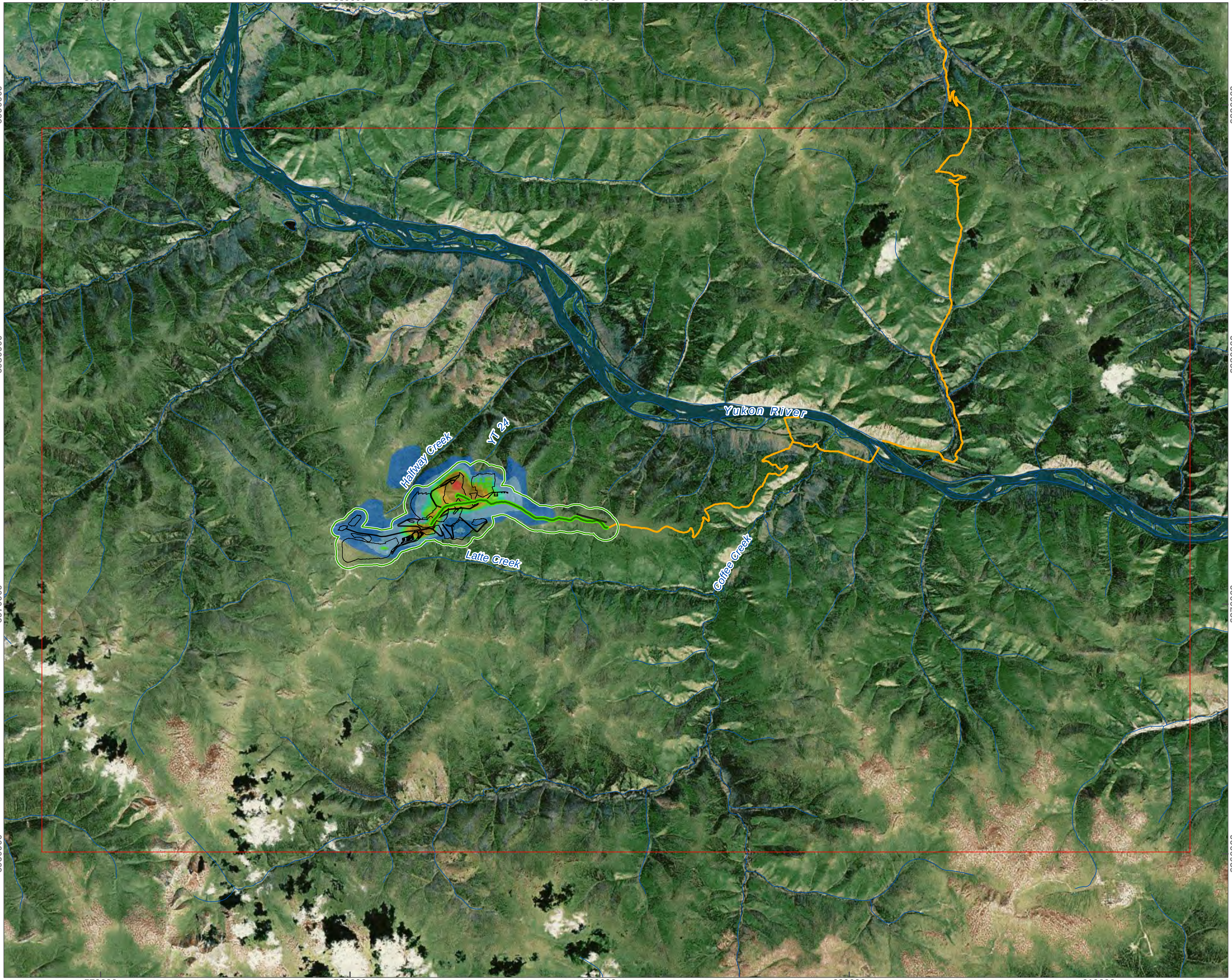
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

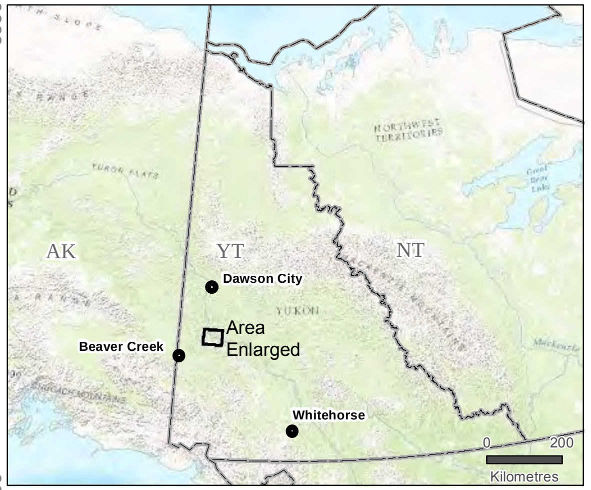
Figure 4.2-17	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

NO_2
Annual Average Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Average NO_2 Concentration (µg/m³)

- 5 - 10
- 10 - 30
- 30 - 40
- 40 - 64
- 64 - 100
- 100 - 500
- 500 - 1,000
- > 1,000

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The Annual Yukon Ambient Air Quality Standard for NO_2 is 64 µg/m³
3. Assumes Most Conservative 100% NOx to NO_2 conversion

Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

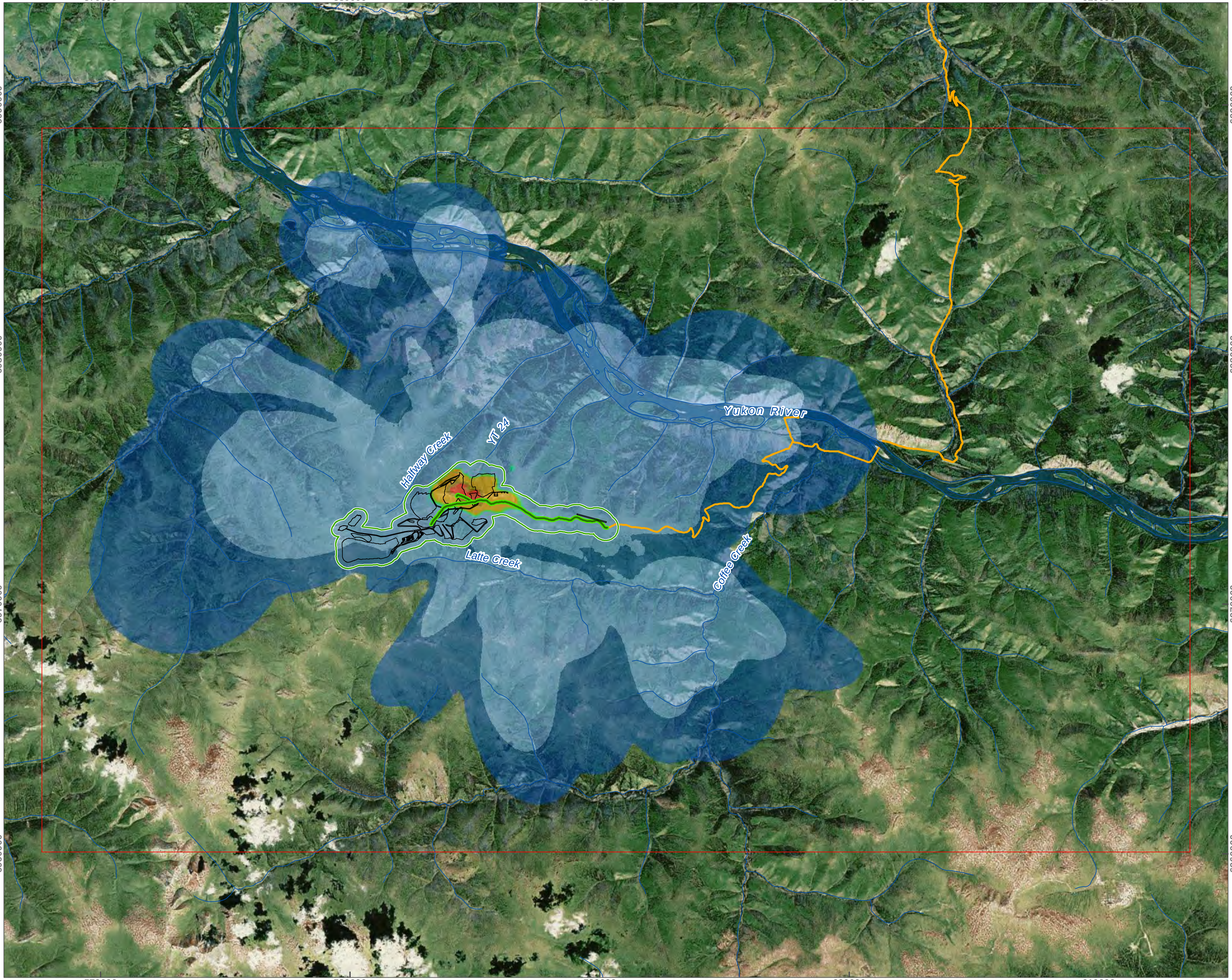
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

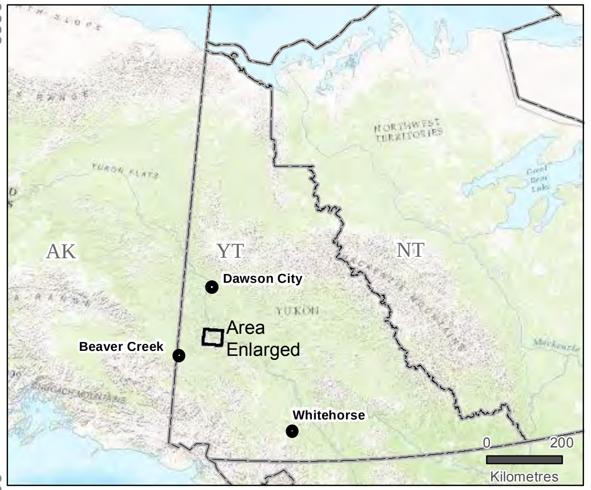
Figure 4.2-18	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

CO 1-Hour
Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Maximum CO Concentration (µg/m³)

- 250 - 500
- 500 - 10,000
- 10,000 - 12,000
- 12,000 - 16,000
- 16,000 - 100,000
- 100,000 - 200,000
- 200,000 - 500,000
- > 500,000

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 1-Hr Yukon Ambient Air Quality Standard for CO is 16,000 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

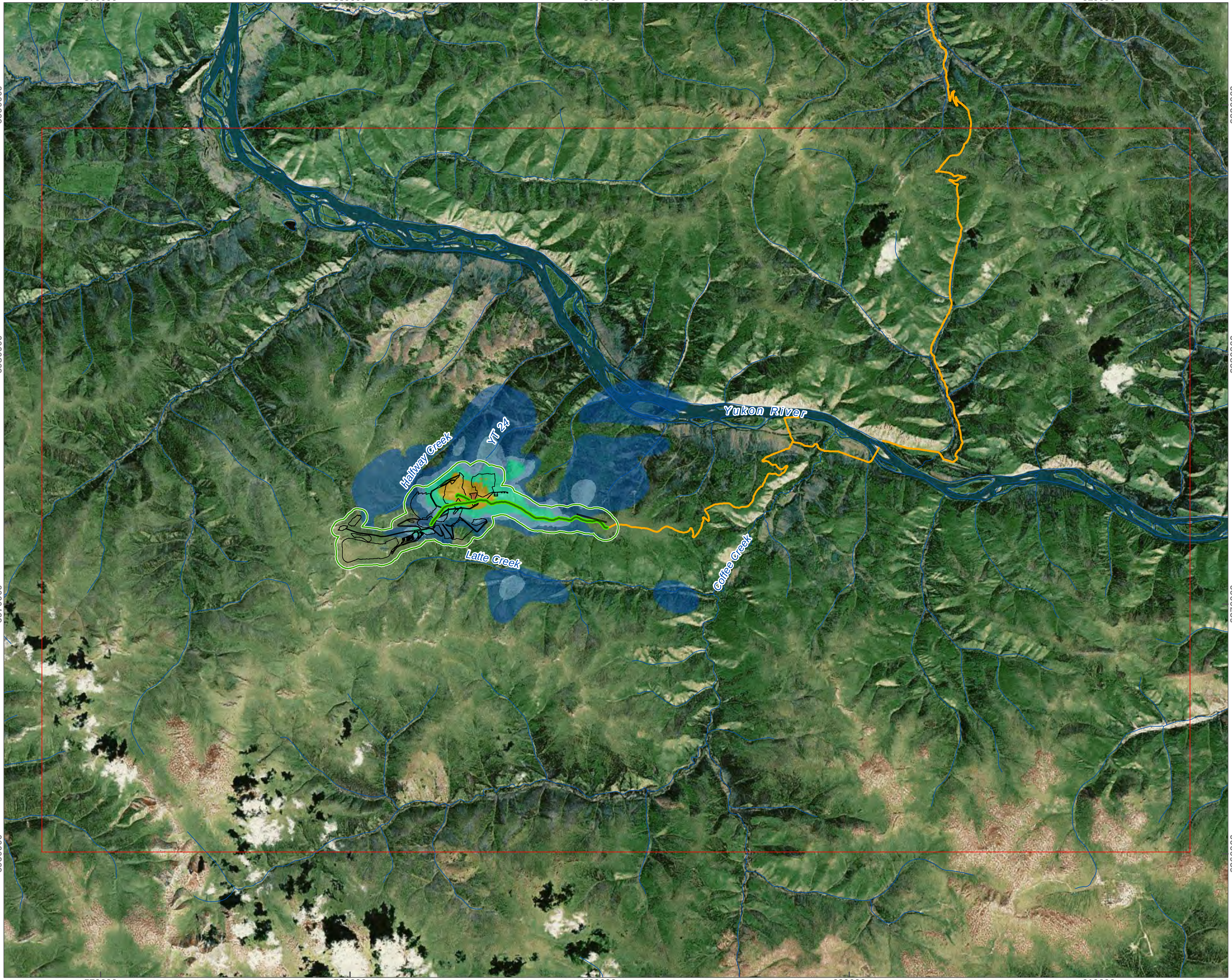
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

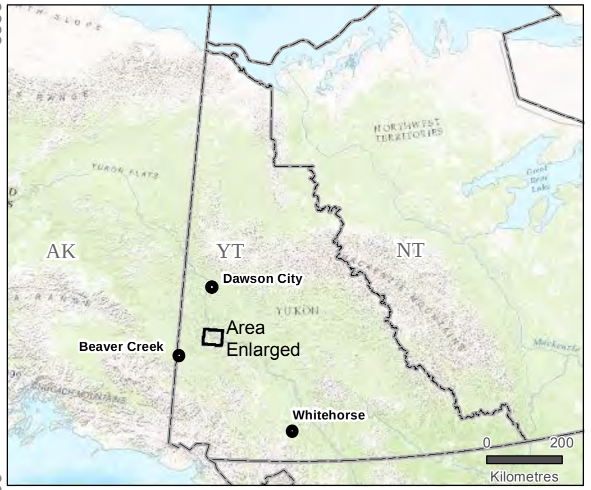
Figure 4.2-19	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

CO 8-Hour
Maximum Concentration at Ground Level
Operations Year 6



Legend

- Model Boundary
- Project Footprint - Mine Site
- Northern Access Route
- Mine Site Access Road
- Mine Infrastructure
- Watercourse

Maximum CO Concentration (µg/m³)

- 250 - 500
- 500- 1,000
- 1,000 - 5,500
- 5,500 - 6,170
- 6,170 - 50,000
- 50,000 - 75,000
- 75,000 - 80,000
- > 80,000

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 8-Hr Yukon Ambient Air Quality Standard for CO is 6170 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:150,000

0 2 4 6

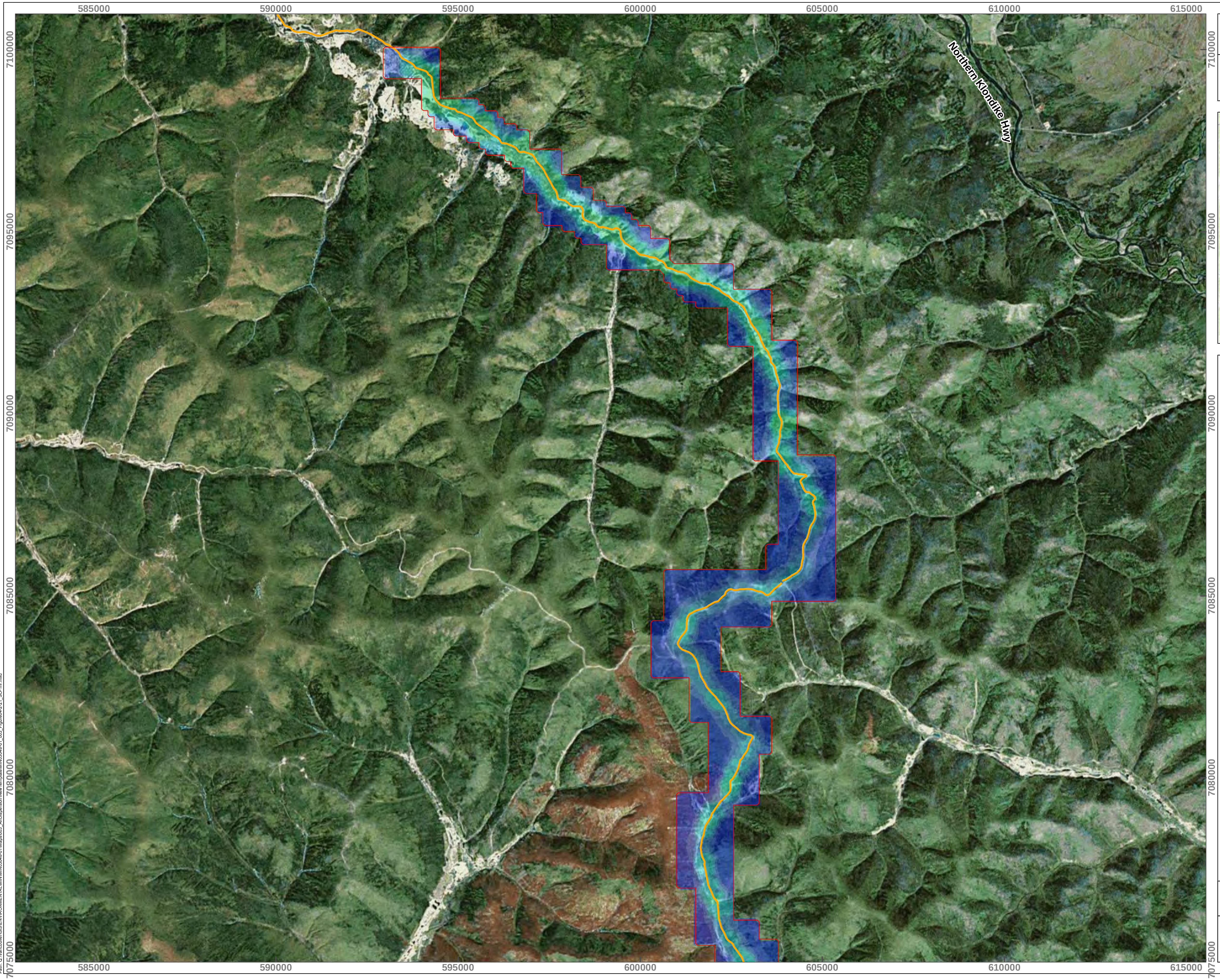
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

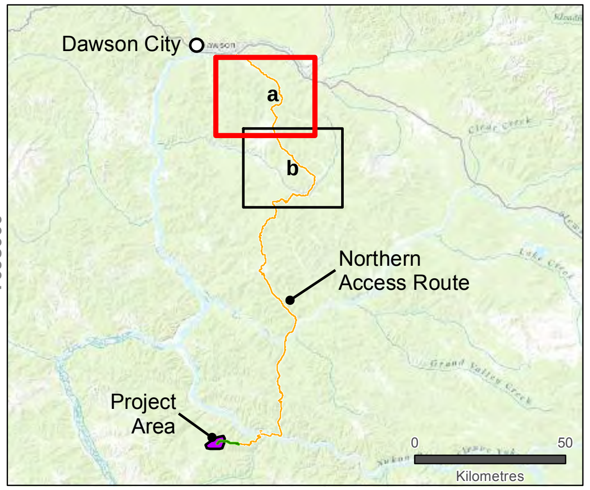
Figure 4.2-20	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

SO_2 99th Percentile
1-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

99th Percentile SO_2 Concentration (µg/m³)

- 0 - 0.00002
- 0.00002 - 0.00004
- 0.00004 - 0.00006
- 0.00006 - 0.00008
- 0.00008 - 0.0001
- 0.0001 - 0.0002
- 0.0002 - 0.0004
- > 0.0004

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 1-Hr Yukon Ambient Air Quality Standard for SO_2 is 485 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

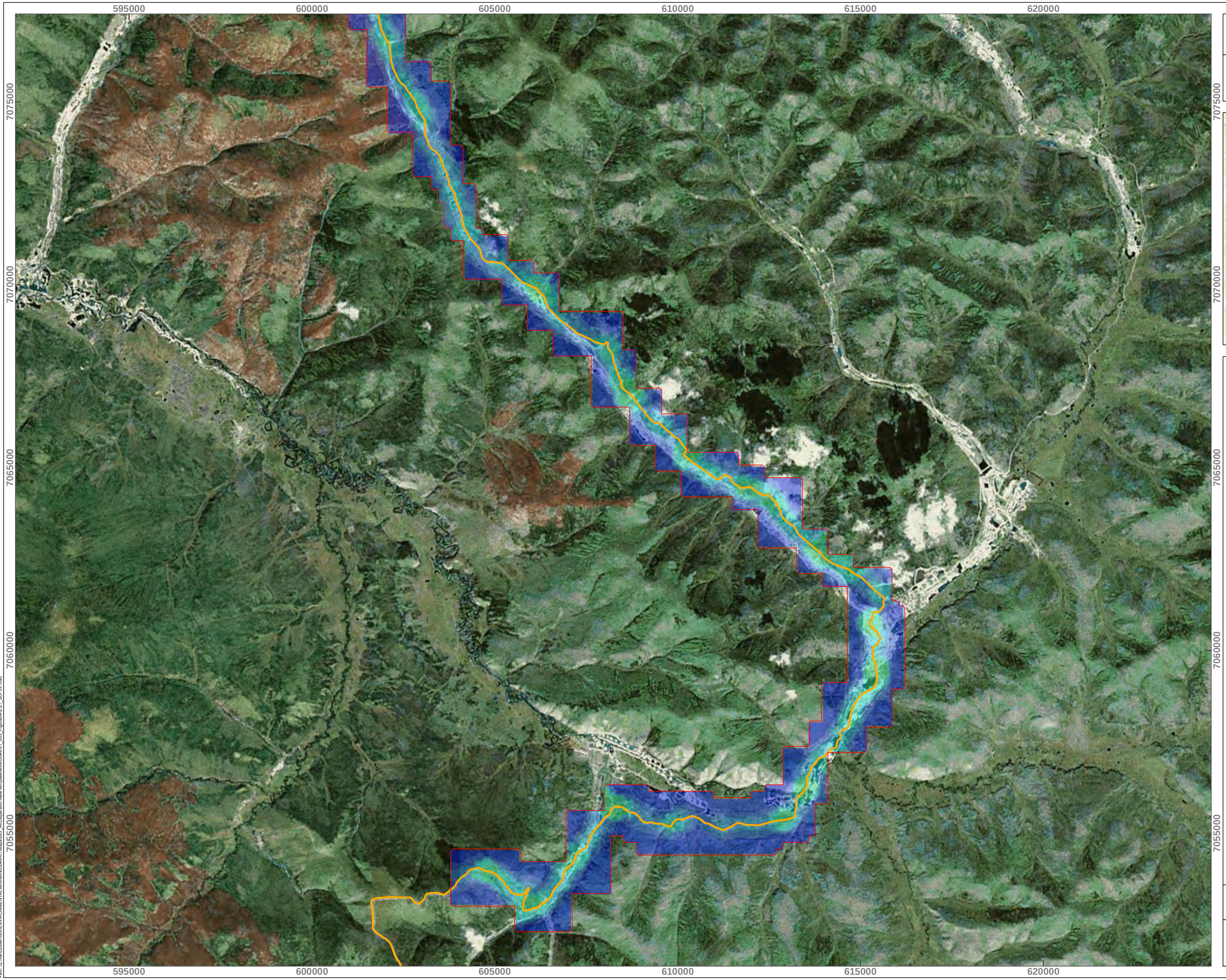
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

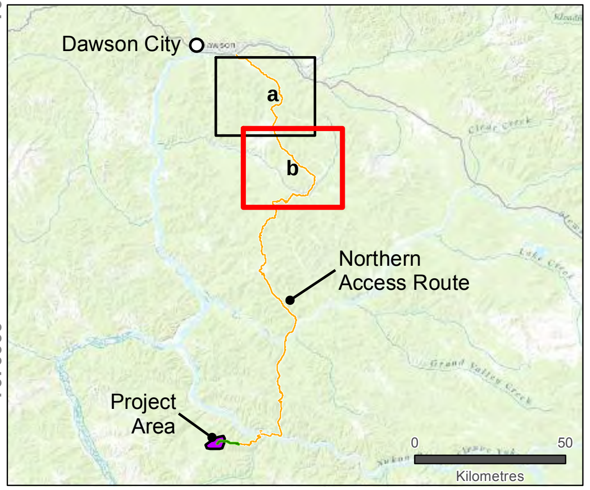
Figure 4.2-21a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

SO_2 99th Percentile
1-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

99th Percentile SO_2 Concentration (μg/m³)

- 0 - 0.00002
- 0.00002 - 0.00004
- 0.00004 - 0.00006
- 0.00006 - 0.00008
- 0.00008 - 0.0001
- 0.0001 - 0.0002
- 0.0002 - 0.0004
- > 0.0004

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 1-Hr Yukon Ambient Air Quality Standard for SO_2 is 485 μg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N

1:100,000

0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

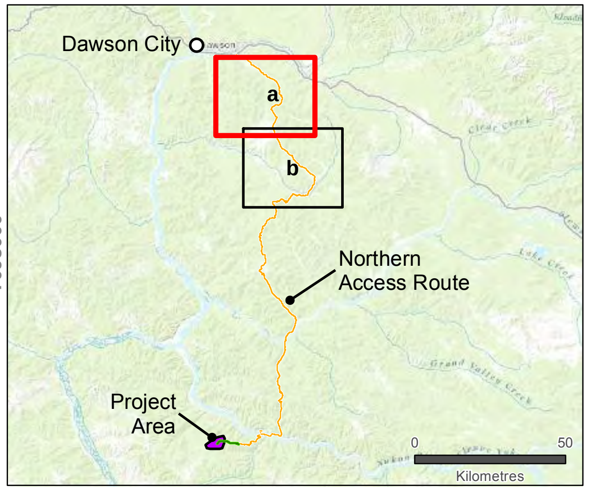
Page Size: 11" x 17"

Figure 4.2-21b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP

COFFEE GOLD MINE

SO_2 99th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Maximum SO_2 Concentration (µg/m³)

- 0 - 0.000005
- 0.000005 - 0.00002
- 0.00002 - 0.00003
- 0.00003 - 0.00005
- 0.00005 - 0.00007
- 0.00007 - 0.00008
- 0.00008 - 0.0001
- > 0.0001

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for SO_2 is 161 µg/m³
Imagery from ESRI; Earthstar Geographics (1999).

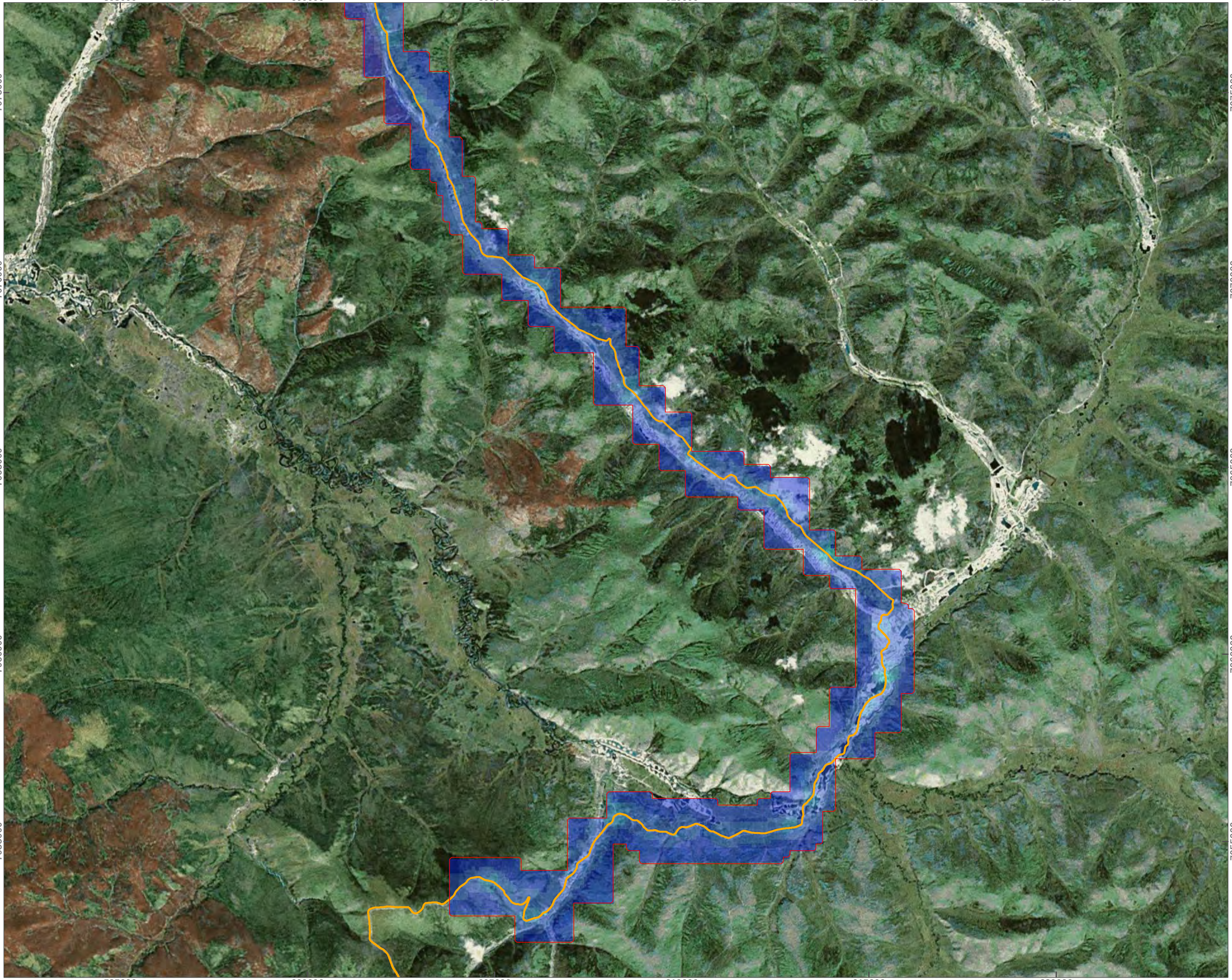
N
1:100,000
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

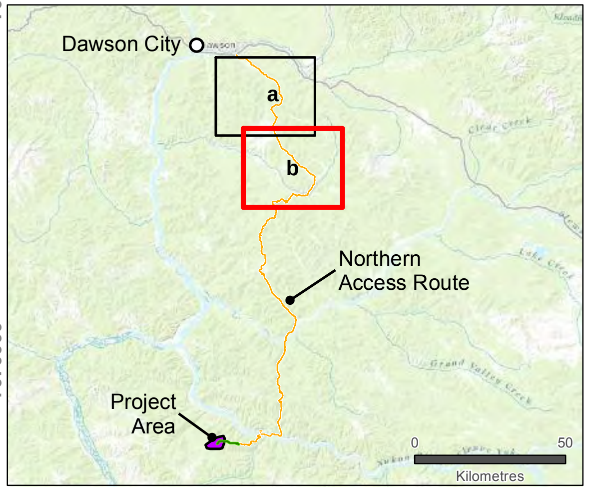
Figure 4.2-22a	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP



COFFEE GOLD MINE

SO_2 99th Percentile
24-Hour Maximum Concentration at Ground Level
Northern Access Route



Legend

- Model Boundary
- Northern Access Route

Maximum SO_2 Concentration (μg/m³)

- 0 - 0.000005
- 0.000005 - 0.00002
- 0.00002 - 0.00003
- 0.00003 - 0.00005
- 0.00005 - 0.00007
- 0.00007 - 0.00008
- 0.00008 - 0.0001
- > 0.0001

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. The 24-Hr Yukon Ambient Air Quality Standard for SO_2 is 161 μg/m³
Imagery from ESRI; Earthstar Geographics (1999).

N
1:100,000
0 2 4 6
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 4.2-22b	Date: Mar 9, 2017	Drawn by: MEZ	Reviewed: TM

GOLDCORP