Appendix 4.7-F

Information Sessions

KGHM

INTERNATIONAL

AJAX PROJECT

Community Information Sessions

TRU Grand Hall • Sept. 9 to 12, 2013

Thank you. We're listening.

KGHM International wants to thank all who came to our recent Community Information Sessions at TRU's Grand Hall. The events, which took place over four days, were held to give you the chance to learn more about important environmental studies related to the proposed Ajax Mine, from the experts who are doing the research.

The many questions through the sessions show your interest and we hope the experts were able to help you better understand the long and involved environmental assessment process.

For those who missed the sessions, this booklet provides a complete summary of all the presentations, as as well as the questions posed to our experts by those in the audience. Powerpoint slides used by the consultants have been posted on our website at www.ajaxmine.ca as well as videos of the presentations, which were filmed during the first session.

If you have outstanding questions about the studies being done as part of the Ajax Project's environmental assessment, email us at info@ajaxmine.ca, call us at 250-374-5446, or drop by our office at 330 Seymour St.

We look forward to hearing from you.

Sincerely,

Yves Lacasse
External Affairs Manager

Blasting, Ground Vibration and Airblast

By FRANK CHIAPPETTA, BSc., MSc.
BLASTING ANALYSIS INTERNATIONAL

A house is the single largest investment most people make. Homes are people's castles, their safe havens, and blasting regulations today show respect for residences to unprecedented degree.

The USBM (United States Bureau of Mines) conducted extensive testing more than 30 years ago to analyze the effects of blasting on residential structures. That test continues to be the best study done. The results continue to influence blasting regulations, requirements and guidelines around the world.

There are two kinds of energy produced by blasting – ground vibration and airblast. Both have potential to cause damage to structures.

Standards developed by the USBM study indicate drywall, which is the weakest structural component in any home, won't suffer damage from blasting unless ground vibration exceeds 20 mm/s. As long as the maximum vibration amplitude from a blast, measured next to the structure, remains below that limit, no damage is possible.

Airblast will begin to break single-pane glass windows when overpressure levels reach 150 dBL. The USBM guidelines stipulate blasting levels

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must not exceed 133dBL for airblasts and must stay below 20 mm/s for ground vibration.

Airblasts can never produce a sonic boom, which is a special kind of sound pressure wave caused by the passage of an object through air at speeds greater than the speed of sound. Sonic booms cans cause damage to buildings and seriously aggravate people.

The design of blasts today makes it possible to conduct blasting safely as little as 100 metres from houses, highways and sensitive natural environments.

In a blasting scenario, experts drill a series of side-by-side holes which are partially filled with explosives. In open-pit mines, the holes are typically 15 to 17 metres deep. The top four to six metres of the hole is plugged with inert material (stemming) to contain the blast. The series of holes are triggered one at a time in extremely quick succession, achieving the fragmentation of the rock required for mining purposes while minimizing blast impacts.

In Kamloops, it is likely the blasts from the Ajax operations will produce one mm/s of ground vibration in Aberdeen, which is two kilometres away. At 1,300 metres from the pit – the planned extent of residential development to the city's south – the ground vibration will measure two mm/s, which is 10 times less than the threshold for damage to drywall. Airblasts will not exceed 120 dBL at Aberdeen and will not be noticed by more than 95 per cent of the local population.

A line of seismographs from the pit to Aberdeen will continually monitor ground vibration and overpressure, recording not only blasting vibration from mine activity but also vibration produced by natural seismic and weather activity.

Open-pit blasting at the proposed Ajax site poses little technical challenge because of the significant "buffer" distance between the pit and the closest homes.

Audience Q&A

Q: In Aberdeen, there are issues with ground water and soil stability. What effect will blasting at the Ajax Mine have on the stability of areas that are already prone to problems?

A: When it comes to blasting, at two kilometres from the proposed pit, Aberdeen is in the "far field." It takes ground vibration levels of 50 mm/s to 250 mm/s to affect ground stability, even when the soil conditions are marginal. The predicted ground vibration from mine blasting at Aberdeen will be one to two mm/s. Other naturally occurring seismic events will have far more impact on ground stability than mine blasting. This kind of blasting does not present any kind of technical challenge.

Q: What happens when we have repeated blasting, let's say every day for more than 20 years? Will there be cumulative effects from blasting that could damage people's homes?

A: Studies have shown that as long as blasting is done at safe levels, the cumulative effects of blasting on structures is practically non-existent. At the levels predicted from the Ajax Mine, it would take 600 to 800 years of blasting to cause fatigue damage in drywall in a home.

Q: If the risk is so low, would you recommend that Ajax does not need insurance to protect against blasting damage?

A: It is always prudent to have insurance.

Q: What about the effects of blasting on fish at Jacko Lake?

A: I worked for seven years (1995 – 2002) as the principal blasting consultant on the widening of the Panama Canal, where we often blasted right at the water's edge. We were closely watched by environmental agencies. We saw no dead fish nor effects on fish. Fish would return after the blasting.

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Q: A local engineering consultant's report (Golder and Associates) predicted significant effects from blasting on Kamloops residents and their homes, at distances more than 10 kilometres from the mine. Will Ajax conduct a full-scale test blast so residents can gauge what blasts will feel like?

A: The Golder report was very misleading and technically incorrect. Mine blasting can never cause "sonic booms," which require an object to pass through air faster than the speed of sound. Supersonic jets or high-velocity rifle bullets are examples. The sound wave from blasting travels at the speed of sound, which is 331 metres/second. There will be no damage to Kamloops homes from airblast. As for test blasts, new mines always start with small blasts and work up to larger production blasts over time, always monitoring to see the effects. In my 40 years of experience, no mine ever tests with a full-scale production blast. You always start small and work up incrementally, to ensure compliance with United States Bureau of Mines (USBM) standards.

Q: A report from Orica about a test blast conducted by Abacus uses a questionable model to extrapolate predictions about overpressure levels in Kamloops. Do you support the model used by Orica in analyzing the test blast?

A: Overall the report is good but I did have questions about the model used to make predictions, and I disagree with that part of the Orica report.

Q: What about the effect on ground stability close to the mine, especially in areas that will support the waste rock dumps? Could blasting cause geotechnical issues there?

A: Studies will consider the geotechnical stability all around the mine. To affect the ground stability would require vibration from 50 to 250 mm/s.

Q: What about the effects of blasting on the Kinder Morgan pipeline, which runs very close to Jacko Lake and the proposed pit?

A: From Dan Ferriter, KGHMI's VP HSEC: We are in discussions with Kinder Morgan to move the pipeline.

Q: What about dust from the blasting?

A: The design of the holes will minimize dust. The top portion of the hole is filled with inert material – "stemming" that contains the effect of the explosive forces to the intended substrate.

Q: What about storage of the explosives. How will that be done safely?

A: Regulations govern all aspects of explosive storage, including how much explosive can be kept on hand and how far it must be stored from mine operations, people and buildings.

Q: How do USBM standards compare to European standards?

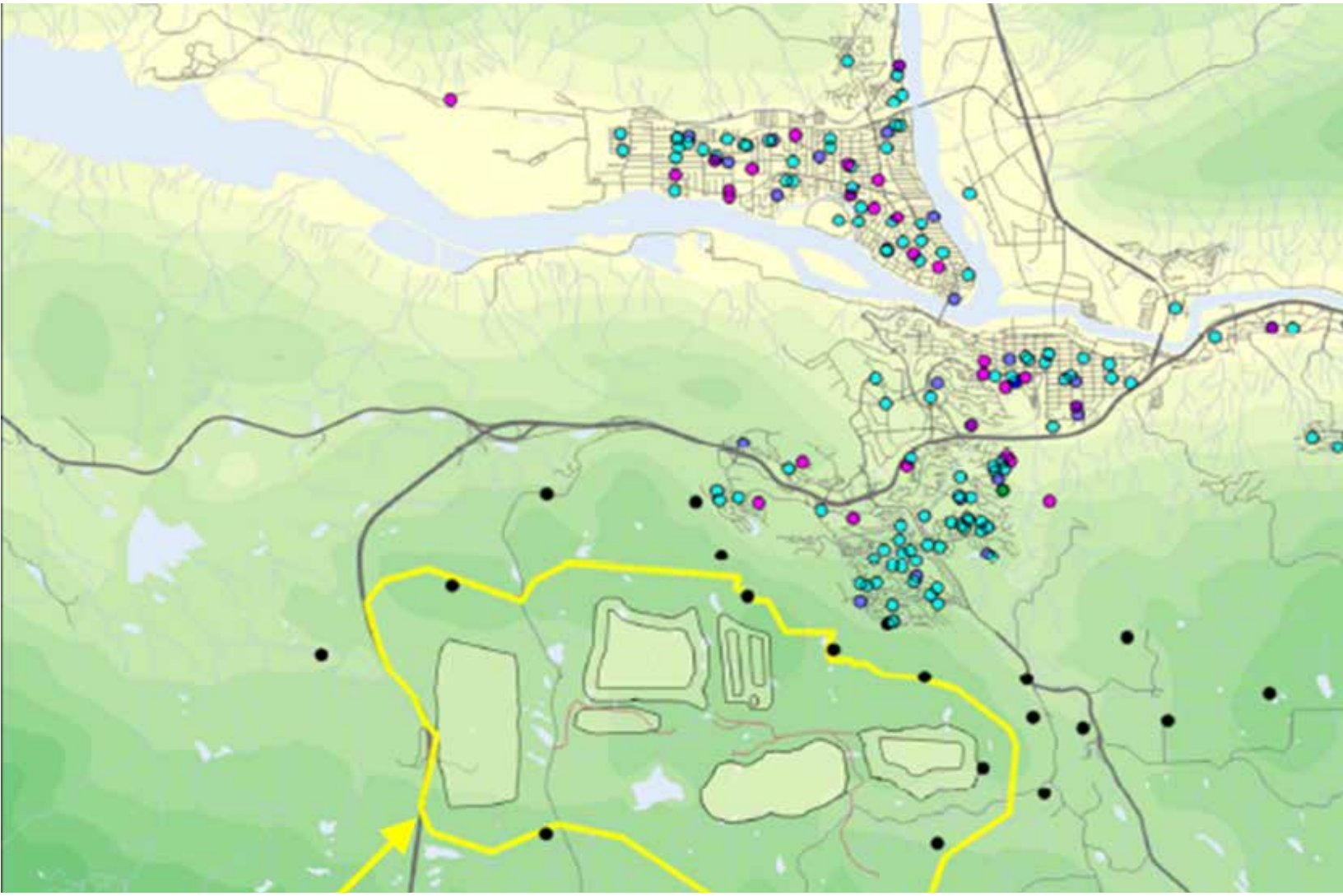
A: Many of the international standards – in England, India, Germany, and countries in South America – are derived from USBM standards, which are considered to be the most comprehensive in the world.

Q: What will be the size of the blasts?

A: Operational plans have not yet been decided, but likely about 50 metres by 50 metres.

Q: What kind of delay will be used when firing the holes?

A: Likely between eight and 65 milliseconds between each hole. Each hole acts as a single "shot" and will not have cumulative effects.



Noise and Vibration Modelling

By JONATHAN CHUI, STANTEC

Noise and vibration, both which arise from mining operations, will form key aspects of studies underway as part of the environmental assessment process. Both are equally important, and have the potential to affect City of Kamloops residents in nearby neighbourhoods, as well as the ecology (birds and animals) around the site of the proposed Ajax mine.

Three periods will be examined in the study, which represent potential "worst-case scenarios" for the creation of noise and vibration – construction phase, in Year One when the mine is being built and in Year 14, the peak of production. All possible sources of noise and vibration, including traffic, mill operations and blasting, will be considered and included as part of the evaluation models.

Many "noise receptors" have been identified and will be used in the studies. The receptors are located around the mine and within city limits, including in the closest neighbourhoods to the proposed mine site.

Computer models – a standard way of studying these issues – will simulate the kinds and levels of noise and vibration likely to emanate from potential sources at the proposed mine site. The

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model is based on international standard in noise propagation prediction – ISO 9613.

Blasting will be a key focus of the studies. USBM and Ontario's guidelines for air and ground vibration limits will be used as B.C. does not have its own guidelines. Two aspects of blasting vibration will be considered – ground movement and vibration caused by airblasts, or overpressure.

Air blast results in air pressure waves that can be physically felt, and in extreme cases can cause structural damage. The Ontario guidelines specify 120 dBL as the maximum allowable overblast pressure and 10 mm/s as the maximum for ground movement.

Both limits are well below levels that cause structural damage to buildings, or discomfort in humans. In fact, much of the air overpressure produced by blasting occurs at very low frequencies (below 20 hertz), which is out the audible range of most receptors.

Computer models have long been used to predict how noise propagates through air across distances. The models are tested against real data to ensure they accurately assess the intended effects.

Once the models are developed, values for noise and vibration for each of the receptors will be established. If the results indicate that estimated noise and vibration levels at a given reception point exceed limits, then mitigations can be suggested. Noise sources can be put into buildings, for example, moved further away or barriers can be installed. If required, a noise management will be implemented.

Audience Q&A

Q: How will the noise from the Ajax Mine operations compare to other kinds of noise in Kamloops, including trains, commercial truck brakes, airplanes and other sources?

A: It depends on where you are in relation to the noise source. Ambient noise levels vary according to location, weather and time of day. Close to a railway, ambient noise levels could be about 60 to 70 dBA. (B.C. noise guidelines require industrial operations to maintain noise levels between 40 and 60 dBA depending on the time of day, population density and proximity to heavily travelled road or railway.)

Q: In Kamloops, it's common to have "drainage" winds (that pull sound from one area to another). What affect will wind have on sound levels (from the mine)?

A: The regulatory standards are set to minimize community annoyance from noise. We will consider weather effects when we model for noise.

Q: At a layperson's level, if you are sleeping in Aberdeen, will your sleep be disturbed by the noise from mine operations?

A: People's perceptions of noise and what disturbs them are extremely variable. Some people sleep through everything while others wake at the slightest disturbance. It's hard to predict such things without knowing the full range of ambient sound sources and the particular sensitivities of individuals. However, the noise limit set in the BC OGC Noise Guideline is designed to minimize community annoyance.

Q: You talk about mitigation – what is it and how do you do that?

A: If the model indicates particular noise levels are too high, it's possible to redesign aspects of the operation to reduce the noise levels. A building can be oriented in a different direction or moved further away. Engineered noise barrier or natural barrier (berms) can also be used to mitigate noise.

Q: What about the effects of mine noise, especially blasting, on wildlife?

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A: There are specific studies being done as part of the environmental assessment that will examine the impact on wildlife.

Q: What about strong wind? Won't that carry the mine's noise even farther?

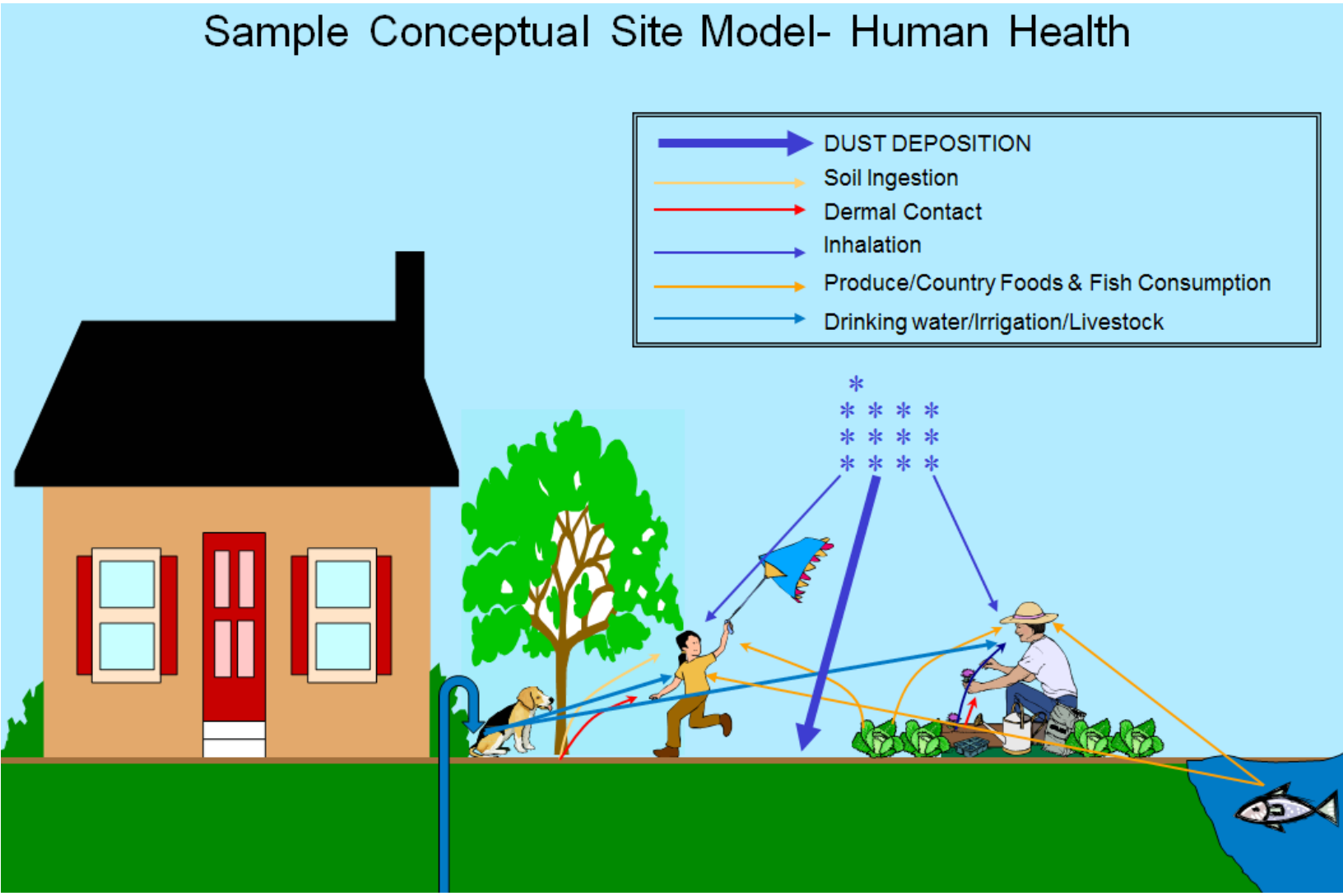
A: The assessment will consider downwind condition from the mine site. In the case of a very strong wind, the wind noise will increase the ambient noise level and potentially mask the mine noise.

Q: What about sound and vibration levels close to the mine and the pit? Will they be safe for animals and people?

A: The mine will create appropriate safety blasting zones which will be cleared of people before a blast is done.

Q: When it comes to blasting, what about in the rest of Kamloops past Aberdeen? Will we hear it?

A: The "sound" will likely be below the audible range of human hearing in the more distant parts of Kamloops. People may perceive or sense the blast, but they will not necessarily hear it.



Human Health, Ecological Risk Assessment

By BRYAN LEECE, PHD
STANTEC

The purpose of the HHERA is to determine if the proposed Ajax Mine presents risks to human and/or ecological health, and if so, how big are the risks. The answers to those questions will inform regulators and the proponent about necessary steps needed to mitigate the risks.

The study criteria and processes are governed by federal and provincial guidelines and follow strict procedures outlined by international standards. The underlying models were developed by the U.S. Environmental Protection Agency.

The HHERA is a comprehensive look at potential sources of pollutants or toxins and the pathways by which they might enter the food chain or affect human and/or ecological health. Many HHERAs have been done in Canada or are underway, including the assessment of five coal mining projects and four copper-gold projects in B.C. and a mine in Nunavut.

The first step involves the complex task of "problem formulation," or deciding what needs to be studied. Part of that task requires assessing the toxicological components that need to be examined, as well as the means by which people might come into contact with substances.

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This study will focus on five key "exposure pathways" – inhalation, soil contact, drinking water, produce consumption and country food consumption (including consumption of wild birds, fish, game, vegetation and traditional medicines).

The study will consider different receptor groups; people expected to have different levels of exposure. The groups are: City residents, First Nations, residents outside of Kamloops, and ranchers. Each of the receptor groups will be further subdivided into age ranges, with special consideration given to sensitive subgroups such as pregnant women or the elderly.

The study will first look at two time periods for direct exposures (soil contact, drinking water, backyard garden produce and country foods) – baseline conditions prior to the mine and modelled conditions once the mine ceases operation. Post-closure represents the worst-case scenario for this study, as the effects of exposure to substances on human health are typically cumulative.

If the modelling indicates post-closure levels are OK, there is no need to consider other stages of mine operations. If post-closure levels signify an issue, then the study will look at different phases of mine operation. Inhalation pathways, however, will consider all the operational phases.

When interpreting results, researchers will look for changes between baseline levels and levels in various phases of mine operation. Are changes in levels large or small? When weighing the potential impacts to human health, it is not exposure to substances that is significant but the size of the incremental changes from baseline conditions, and whether exposure exceeds Health Canada's allowable limits.

Audience Q&A

Q: Canada's standards for health assessments are different than elsewhere. Many places such as European countries have more comprehensive processes. Should we not be doing a broader, more comprehensive Health Impact Assessment?

A: The HHERA is just one component of the overall package of studies. Components such as the socioeconomic effects of the proposed mine are being considered by other studies. The overall assessment might not be called a Health Impact Assessment, but all the same work is being done.

Q: Have mines ever been shut down if they are found to exceed estimates? Who will do the long-term monitoring?

A: I'm not sure.

Q: Why are uranium, chromium and manganese not on the list of substances to be studied?

A: The list of substances to be studied is not yet complete. The regulator – not KGHMI – has final say over what must be studied. Criteria will be based on the likelihood the substance in question exists at the site in higher concentrations than what can be expected to be found in base levels in the earth's crust. There is no flexibility – the regulators will decide what is to be studied or not.

Q: I'm concerned about the release of lead from the mine, the proximity of the mine to schools and the effect of lead on children. Should we not measure lead levels in children now with blood tests and compare them later?

A: Blood tests are usually only done in places where lead levels in soil are known to be elevated usually as a result of some industrial activity. The study will account for Health Canada's allowable exposure limits for lead.

Q: We heard recently from a physician from Salt Lake City who said even trace amounts of some elements escaping from open-pit mines cause serious health effects. Many Kamloops doctors are also adamantly opposed to open-pit

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operations close to Kamloops. Whom do we trust – doctors or scientists?

A: Salt Lake City is a much different community. There is a smelter and refinery there as well as an open-pit mine. Comparisons between the two centres are extremely difficult to make. Without seeing the Salt Lake City doctor's data, it's not possible to comment on his opinions.

Q: Is there a correlation between increases in exposure levels as a result of proximity to mines and increased rates of asthma or other diseases? It's hard to find figures on such things.

A: With regards to cancer rates, there is very good geographically based data, but it is often not possible to tie those rates to specific substances. The government considers exposure to known carcinogens in any amount to be a health risk. Exposure levels to other substances that do not cause cancer, that are occurring below Health Canada's limits, are not considered a health risk.

Q: What about the links being continually established between exposure to PM 2.5 and mortality rates? The knowledge of such links is growing. What happens if the mine is approved and safe exposure levels later change? Will the mine be made to comply with standards if they change?

A: Regulators will decide what the applicable standards are.

Surface, Groundwater Quality & Quantity

By HAMISH WEATHERLY and
TREVOR CROZIER, BGC CONSULTING

Surface streams, lakes, groundwater sources and aquifers will be studied based on environmental assessment guidelines and regulations at both federal and provincial levels.

In particular, the studies will examine the Peterson Creek and Cherry Creek watersheds, as well as key aquifers in the area. Peterson Creek flows through the proposed mine site and eventually to the South Thompson River through Kamloops. Alkali Creek flows to Cherry Creek and then to Kamloops Lake.

The first part of the study involves measuring "baseline" conditions – the hydrologic conditions in place before mine development takes place. Of interest is the seasonal and annual variation in climate (e.g. precipitation, temperature, evaporation), stream flows and water quality. Groundwater baseline conditions will be established in similar fashion. It is important to establish baseline conditions throughout the project area, not only in the vicinity of the proposed mine.

The process of establishing baseline conditions is underway. The process will lead to an understanding of month-to-month and year-to-year variations in water quantity and quality in the

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study area.

Once baseline conditions are established, three models will be created: a "water balance model" that provides predictions of surface stream flows, a groundwater model that provides predictions of groundwater levels and flow directions and a water quality model that provides predictions of potential changes in water quality.

The three models will be calibrated to baseline conditions and will then be used to evaluate the potential changes in water quantity and quality from the proposed mine operations. Changes to both water quantity and quality can be predicted by the models both in the vicinity of the mine footprint and at various downstream locations. If the models suggest undesirable results from proposed mine activity, mitigation efforts can be developed and entered into the models, generating new results.

The models for both surface water and groundwater will consider existing users, including agricultural and industrial users. It will also consider those who depend on ground or surface water for domestic purposes, such as the City of Kamloops.

The results from the water studies will also help inform other studies, including the Human Health and Ecological Risk Assessment (HHERA), another of the key studies being performed as part of the environmental assessment.

Audience Q&A

Q: There are many underground streams in the area. How will you model and gather baseline information on underground stream levels?

A: We look at registered wells in the area (to assess ground water levels) and we will also consider the geology mapping and aquifer mapping available for the area. There will also be a groundwater monitoring well network established in the project area.

Q: There are known ground water issues in Aberdeen. The City has done many studies to assess the geotechnical issues in the Aberdeen area. Will you use the City of Kamloops' information and data, and its models?

A: Yes. The assessment will consider all available data. The scope of the assessment will examine changes in water flow and pressure in ground water in the Aberdeen area. The results will be available to the City of Kamloops for review with its engineers.

Q: Computer models are only as good as the inputs and outputs. In mountainous areas, about 20 per cent of water input comes from fog. If you remove the trees, grass and shrubs from 40 km2, you are removing a water input. That needs to be considered by your model.

A: Any open-pit mine has localized impact on water inputs, which will be accounted for in the models. Vegetation removal will be localized and not occur over an area of 40 km^2.

Q: What will KGHM do to insure no heavy metals enter Peterson Creek or the area's aquifers?

A: Monitoring requirements for mining operations are typically imposed during the permitting stage of project review. Government agencies are tasked with ensuring compliance with monitoring requirements.

Q: Will there be a considerable volume of water taken from Kamloops Lake? We already have water temperature issues in the river. Reducing the volume, what will be the impact?

A: The water required for mine operation amounts to less than 0.5 per cent of the flow through Kamloops Lake during the winter low flow period.

Q: Are you modelling for how long it will take

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all that water to re-enter the soil? Will that affect ground water and soil stability?

A: The change in groundwater levels as a result of the project, including as a result of changes to the rate of infiltration of water to soils, will be considered as part of the water quantity and quality modeling for the EA. Geotechnical engineers would be provided with predicted changes in groundwater levels as a result of the project and would consider these changes in the context of soil and soil stability.

Q: What chemicals — especially from waste rock — will be picked up by rainfall and runoff and transferred to surface and ground water?

A: Runoff and infiltration from waste rock will be studied. Typically, if such runoff is predicted to be of unacceptable quality, then mitigation will be included in the project to collect it. Typical mitigation strategies include intercepting runoff using collection ponds or monitoring groundwater quality and intercepting seepage-affected groundwater using interceptor wells.

Q: Is there a possibility that mine operations could improve the problematic groundwater conditions in Aberdeen?

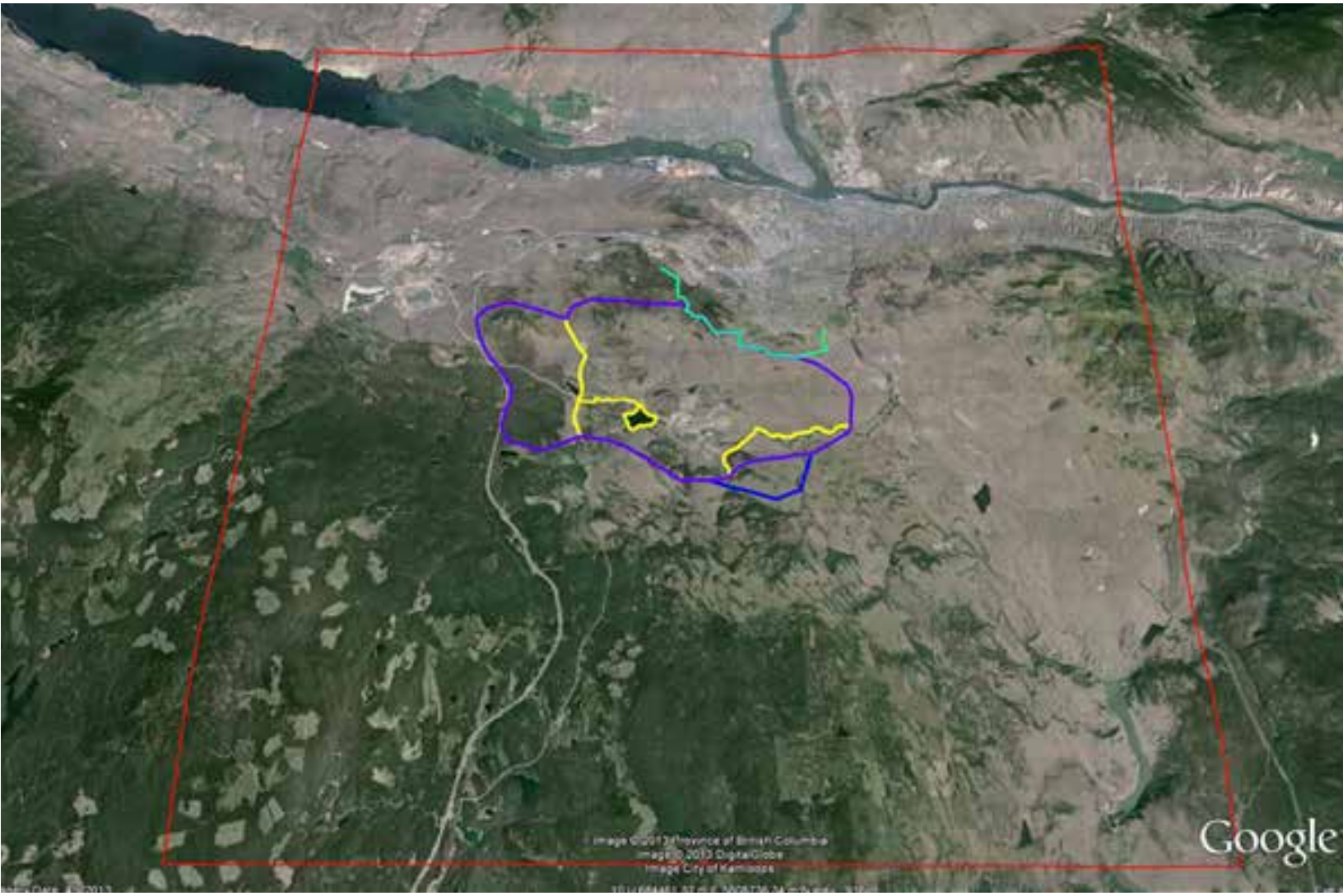
A: Yes that is possibility.

Q: Are you that confident that your modelling will work, especially over a 23-year period?

A: There is uncertainty in every study. The key is to recognize areas with high uncertainty. If there is high uncertainty, than you build in greater levels of safety in the design in those areas.

Q: Can you monitor real-time water data or are all your data based on historical records?

A: Data loggers have been installed in several locations to gather real-time data for this study.



Atmospheric Dispersion Modelling

By DAVID RANDALL, AIR SCIENCES INC.

This study will examine all of the potential effects on air quality posed by proposed mine operations, including dustfall and emissions. B.C.'s Ministry of Environment (MOE) has approved the plan of study.

As with other studies, federal and provincial guidelines mandate how research needs to be done. The final report, when finished, will include all of the technical data produced by the study, as well as all the information used to support the conclusions, including maps, climate models and climatic norms. The CALPUFF modeling system is the ministry-approved refined core model that will be used for this study. There are two important modules in the CALPUFF modeling system – CALMET model, which predicts how air moves through an area and CALPUFF, which simulates how emissions disperse into the environment.

A 625-km2 area encompassing most of the City of Kamloops will be studied. More than 190 "special receptors" have been identified for the study, including Royal Inland Hospital, 27 nearby residences, 21 elementary schools, six secondary schools, 110 daycare facilities and 23 retirement homes. Representative background concentrations (including natural background and concentrations

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due to emissions from other existing sources of emissions) and modelled pollutant concentrations will be generated for each of the receptors.

Three years of regional meteorological data from CALMET has been provided by the B.C. MOE as representative data for the study region. One of these years (2003) will be used in the modeling analysis. In this instance, the CALMET data files was generated using meteorological data sets from four near the study region, representative upper air data, and computer-generated estimates of detailed wind fields. CALPUFF will use the meteorological data and inputs of anticipated emissions of particulate matter (dust) and other substances of interest caused by proposed mine operations. Sources of emissions that will be examined include:

- Diesel exhaust from haul trucks and heavy equipment
- Dust from haul roads caused by traffic
- Dust from other sources, including conveyance and transfer points, pit operations and tailing storage facilities and waste rock management facilities.

The goal of the study is to capture the representative worst-case scenarios for air quality as a result of the proposed Ajax Mine. The primary construction year and maximum production year during operations will be the key years studied.

A key component of the study will be to examine dispersion of the very fine particles that bear potential to affect people's breathing (PM 2.5). Metal levels in dustfall will also be modelled. All aspects of the study will be subject to rigorous quality assurance/quality control procedures and independent peer review. Reporting will include digital files of the model inputs and outputs in an effort to allow for transparency of the dispersion modeling process and repeatability of producing the modeling results.

In addition, the report will include a discussion of the uncertainty of the modeling results due to the uncertainty in the model inputs and the precision of model. Results from the analysis will be used to support decisions pertaining to levels of air pollution control at the project, permitting of the project, the assessment of risk in the Human Health and Ecological Risk Assessment, and other areas of interest.

Audience Q&A

Q: Kamloops is a unique place, with its own specific topography, air quality and climate. Will existing conditions be properly established?

A: Inputs to the computer models will consider Kamloops' unique features, including weather inversions and prevailing winds. In addition, background concentrations that are representative of the Kamloops area will be used to account for existing levels of air pollution (including natural background and air quality concentrations due to other existing sources).

Q: Has all the weather data (for the assessment) come from one location? The Kamloops Airport is often the source of weather information in Kamloops, but conditions there are different than other places, especially the city's higher elevation neighbourhoods.

A: The weather data come from numerous datasets provided by the government. The data used are not collected from a single weather station. There are data from four ground stations at different locations and elevations, as well as high-atmospheric data.

Q: Will the most recent version of CALPUFF, the dispersion modelling software, be used for this study? We've heard an older version will be used.

A: Regulatory standards require these kinds of assessments to use the most appropriate and recent version of the CALPUFF software. The B.C. MOE will approve the version of the model to be used. Older versions will not be used. CALPUFF has

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gone through many revisions since it was created, with each version addressing known "bugs," adding new features, and/or providing improvements to its accuracy and predictive abilities.

Q: Are you using high-atmospheric measurements from Kelowna as the data for this study? Would that limit the accuracy of Kamloops' modelling?

A: Upper air data from the Kelowna area were approved by B.C. MOE as one of the many sources of data used to prepare the CALMET meteorological data files. There are relatively few sources of upper-air weather data and it is common for upper air data from areas outside of the study region to be used in modeling analyses. Because of the nature of high-atmospheric weather, data from regional stations work well in these kinds of assessments.

Q: Isn't the grid being used to model topographic effects on weather too large?

A: The study grid (identified in the Powerpoint) captures well the region's unique and diverse topography. CALPUFF is a three-dimensional model that accounts for variations in elevation and terrain.

Q: When you use computer modelling, you must be aware of the calculated uncertainty. Will you guarantee that all results come with specific uncertainties calculated for each input value?

A: The sheer number of inputs being used would make such individual calculations daunting. But the final study will include a discussion of the uncertainty of the modeling results due to uncertainties in model inputs and the precision of the model. The reporting of the uncertainty of the modeling results can be considered by regulatory agencies as they use modeling results to support their decisions.

Q: If pollution levels are exceeded, what will you do? Your (computer) results won't be realistic, you can't help it.

A: If applicable ambient air quality objectives (AAQO) levels are exceeded due to emissions from the project, mitigation efforts will be identified and implemented. Exceptional events (e.g., fires or regional dust storms), upset conditions at the project, or non-compliance with regulatory standards will be reported and operations adjusted as appropriate. The mine will be required to address and fix issues as expediently as possible.

Q: I understand that 2003 – one of the worst years for local air quality because of the bad wildfires in the region – is one of the years being used as a baseline for this study. How is that possible?

A: The regional meteorological data from CALMET for 2003 has been selected for this study. Background concentrations (that would include air quality impacts due to wildfire activity) are derived from many years of ambient air quality data that have been collected in the area.

Q: Will the effects of climate change be modelled?

A: No. Historical meteorological data (2003) and two emission scenarios for the project (construction and maximum year of operation) will be modeled.

Open Questions from the Audience

Q: Will a new Application for Information Requirements (AIR) be filed now that the mine has indicated it might change its plans?

A: It's not yet known if a new AIR will be required.

Q: When the original public comment period was happening, someone asked if KGHM has plans for a smelter? And some of the land at the Ajax site is already zoned for a smelter. Can we get a promise that Ajax will never ever build a smelter?

A: From Dan Ferriter, KGHMI's VP HSEC: The process we are in is an environmental assessment for a proposed 23-year copper-gold mine with no smelter. KGHM has no plans for a smelter. Nor are we considering joint ventures with other companies for a smelter. We have no plans for a smelter.

Q: What about down the road?

A: We can't speculate about what might or might not happen decades from now. We have no plans for a smelter.

Q: How about using data from similar mines in similar topographies in other parts of the world in these studies?

A: We can't use data from other parts of the world. That information is not applicable here. Weather is extremely variable from place to place. It's not feasible to examine data from other places and extrapolate results here.

Q: When will the study results start to be made available?

A: Results of all the studies will be made public when KGHMI files its application for an environmental permit, which is expected in early 2015.

Q: Will KGHM fund an independent and complete hydrogeological study of the Thompson River upstream and downstream of the drinking water intake?

A: BGC Consulting, an independent engineering firm, has been contracted to study surface and ground water studies in the area and model the effects of proposed mine operations. The results will form part of the company's application for an environmental permit.

Q: Is KGHM willing and to accept the risk of geological catastrophic failure of the walls of the valley?

A: Geotechnical studies are underway as part of the environmental assessment. KGHM is not willing to accept catastrophic failure of the walls of the valley.

Q: Are the various regulation and thresholds for various parameters the same for all industries as they are for this proposal?

A: Yes. Thresholds or allowable daily intakes apply to all industries across Canada. In provinces that have their own daily intakes (like Ontario), these provincial thresholds apply to all industries. Regulations differ between provinces but within a province the same regulations apply equally to all industries.

Q: I am concerned that there may not be enough attention paid to conditions after mine operations (the pit, the waste rock piles and the tailings facilities). I am concerned about acids produced by weathering and oxidation of residual sulfides and other minerals. This might have long-term effects on groundwater.

A: Work is underway to evaluate the potential long term quality of runoff and infiltration from pit walls, waste rock and tailings. This work includes studies to consider the potential for acid rock generation and metal leaching (ARD/ML) into closure and post-closure phases of the project.

Ground Vibration and Airblast Controls for Use at Ajax Mine

Prepared for:

KGHM International
Ajax Mine Project

by

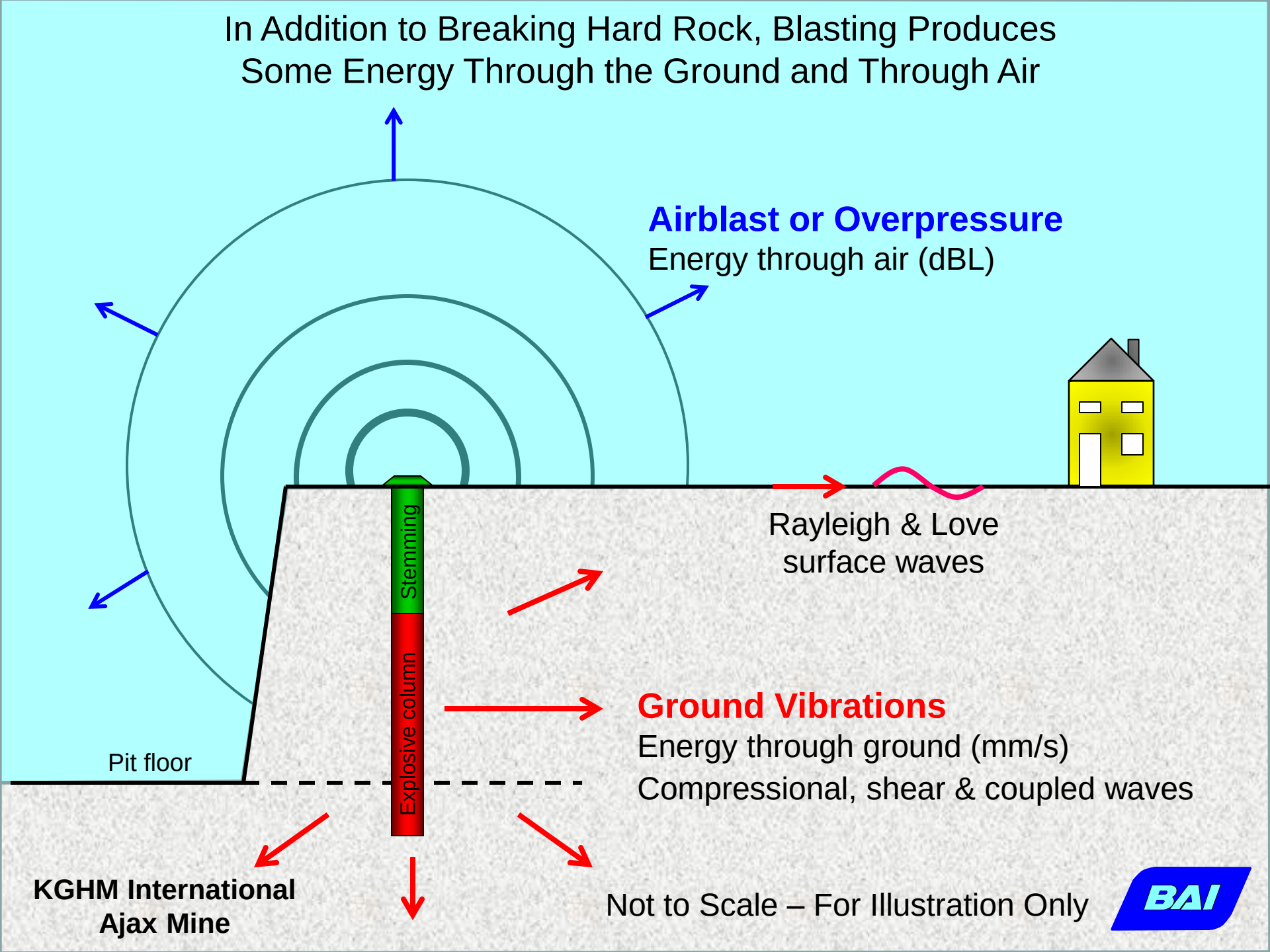
R. Frank Chiappetta
Explosives Applications Engineer

Blasting Analysis International, Inc.

Allentown, Pennsylvania, U.S.A.

August 26, 2013

In Addition to Breaking Hard Rock, Blasting Produces Some Energy Through the Ground and Through Air



KGHM International
Ajax Mine

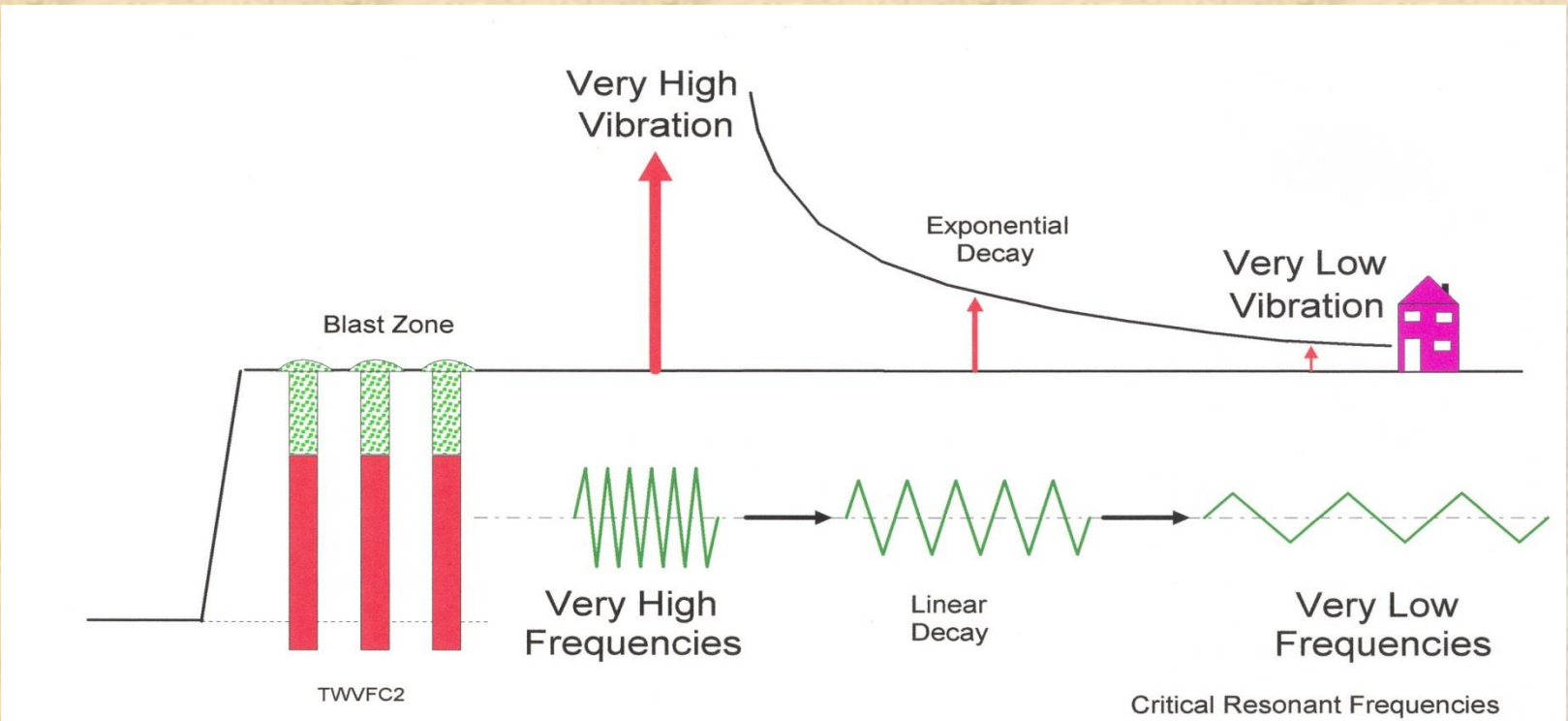
Not to Scale – For Illustration Only

BAI

Ground Vibration Controls

Required to Cause Vibration Damage

- High vibration amplitude.
- Energy in resonant frequency range of structure.
- Long duration wave train.



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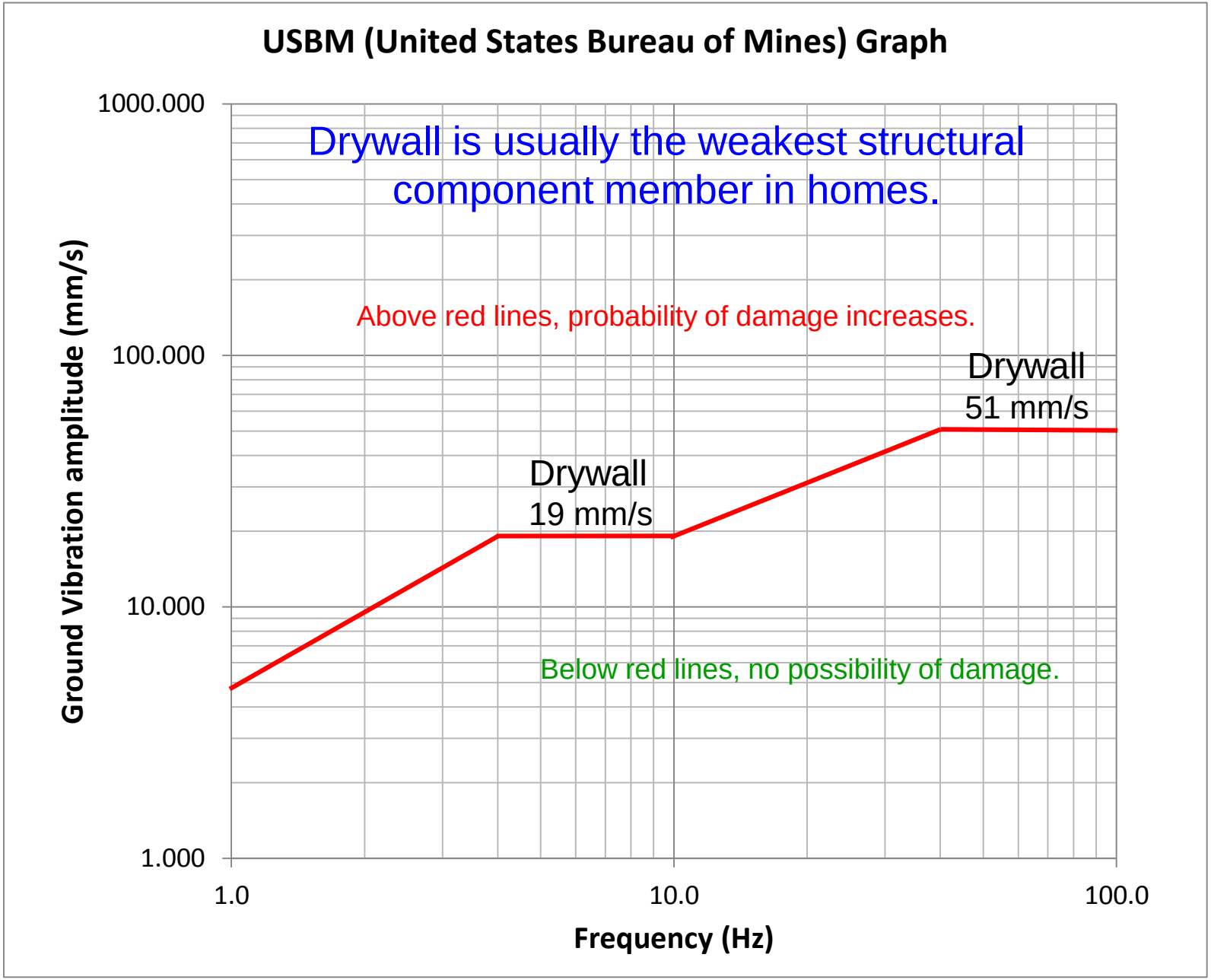
BAI

The USBM (United States Bureau of Mines) standard for vibration is the most widely accepted in Canada



KGHM International
Ajax Mine

Vibrations from the Ajax mine will not exceed the damage thresholds for drywall.

BAI

USBM RI-8507 is Based On:

- Test home constructed with poured concrete, concrete blocks, mortar fill, bricks, wood frames, drywall and asphalt shingles.
- Included 76 homes over 219 production blasts.
  - With and without basements, mobile and permanent dwellings.
- Individual building materials were also tested for damage thresholds.
- Most comprehensive study done to date. Includes historical data from 7 previous studies.

Basis of USBM Study

- Addresses all homeowner concerns.
- Developed to eliminate structural damage to residential homes from blasting.

Vibration levels at the Ajax mine will not exceed the damage threshold for drywall.

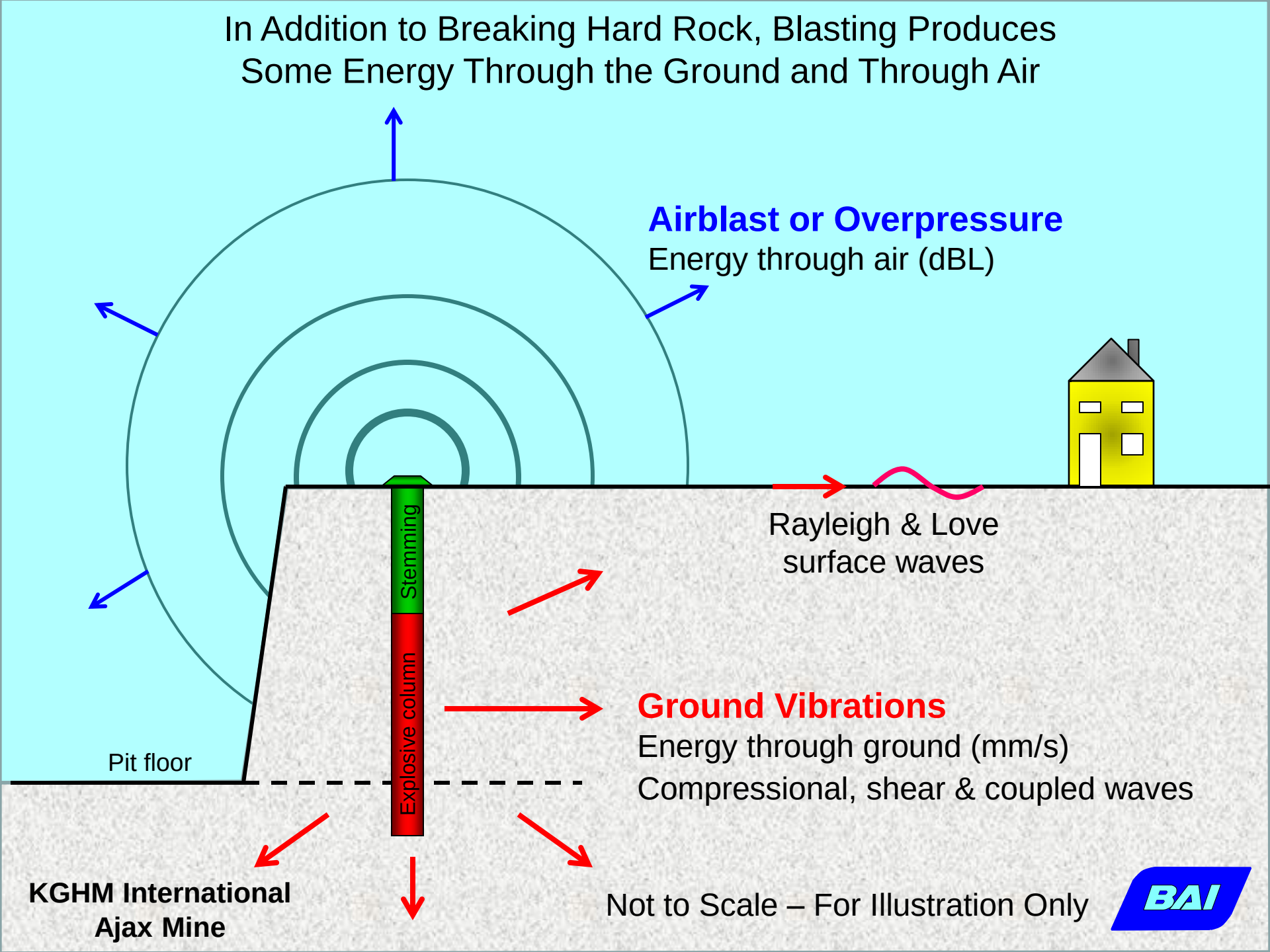
Building Material, Equipment and/or Conditions	Minimum Vibration Levels Required to Cause Onset of Damage (mm/s)
Drywall cracks, depending on frequency.	20 - 51
Cracks in freshly poured concrete (0 – 4 hours old).	51 - 61
Industrial structures (warehouses, workshops, etc.).	51 - 102
Mortar fill between bricks, cinder blocks, tiles, etc.	76
Cracks in bricks.	76 - 102
Cracks in fully cured poured concrete (7 – 10 days old).	102 - 204
Ground settlement, depending on depth, type of soil, and wet/dry conditions.	51 - 510
Cracks and/or joint separations in buried pressurized water, gas and other fuel lines, etc.	127 - 635
Structural distortions (window/door frames, corner junctions and offset floors, etc.	255 - 1015
Misaligned shafts in mechanical equipment, pumps and compressors, etc.	1015
Twisted and/or distorted metal I-beams/supports in industrial high rise buildings.	1525

Non-Blasting Seismic Sources Which Can Contribute to Drywall Cracks and Other Home Damages.

Non-Blasting Seismic Sources	Measured Vibration Vibration Levels (mm/s)	Source
Daily environmental strains on homes from changes in humidity, temperature, wind and precipitation.	25 - 81	USBM - 1981
Cyclic temperature and humidity changes.	20 - 66	Dowding - 1996
Hammering nails on walls to hang pictures.	Up to 100	USBM - 1981
Wind at 80 Km/hr. acting on homes.	28 - 170	Leeds University 1993

Airblast Controls

In Addition to Breaking Hard Rock, Blasting Produces Some Energy Through the Ground and Through Air



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Ajax Mine

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BAI

The USBM (United States Bureau of Mines) standard for airblast is the most widely accepted in Canada.

Airblast levels at ≤133 dBL will eliminate structural damage, and ≤ 120 dBL will minimize annoyance effects.

Airblast Effects at Different Levels

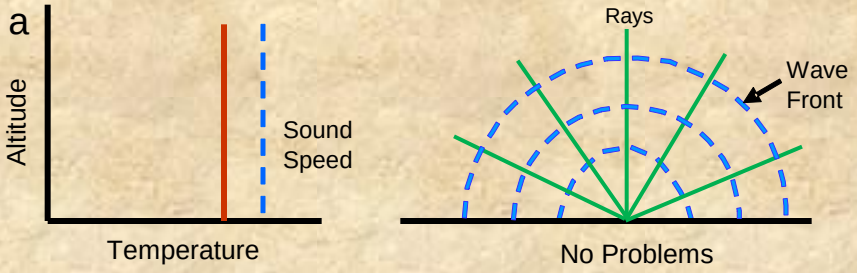
Overpressure Effect	Airblast Level (dBL)
Loud Conversation.	90 - 100
No possibility of structural damage.	120
USBM Safe Limit for No Structural Damage.	133
Some Windows Begin to Break.	150
Major Structural Distortions.	180+

People's Peception at Different Airblast Levels

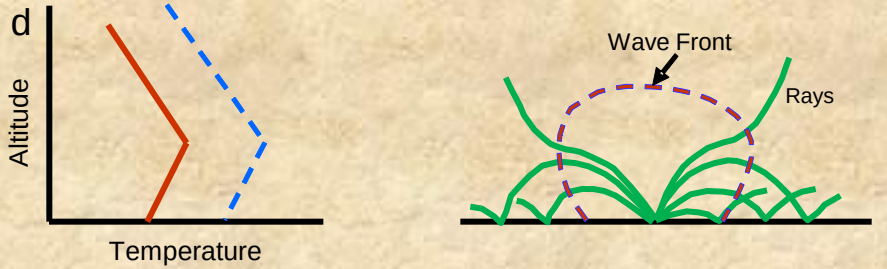
Perception or Reaction	Airblast Level (dBL)
None	100 - 112
Acceptable to most people, depending on ambient noise level in homes.	113 - 120
Annoying to most people.	121 - 130
Very annoying and Intolerable.	131+

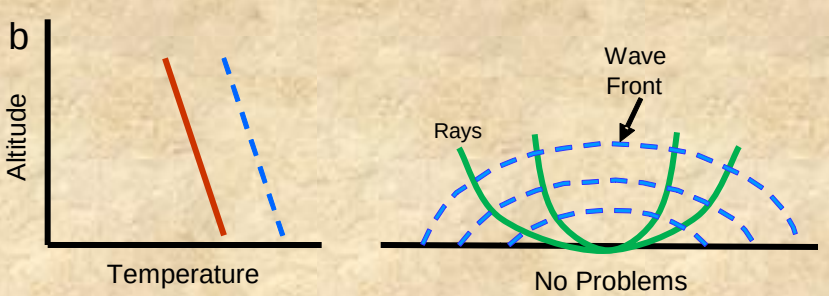
Effect of Altitude Temperature Profiles on Airblast Propagation

Modified after Cook, 1958

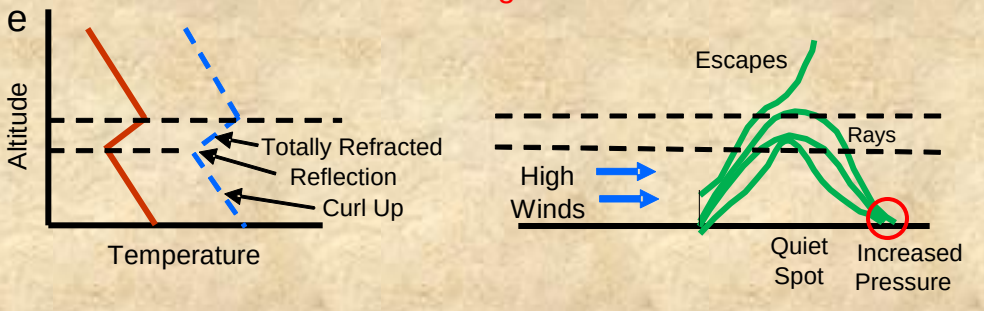


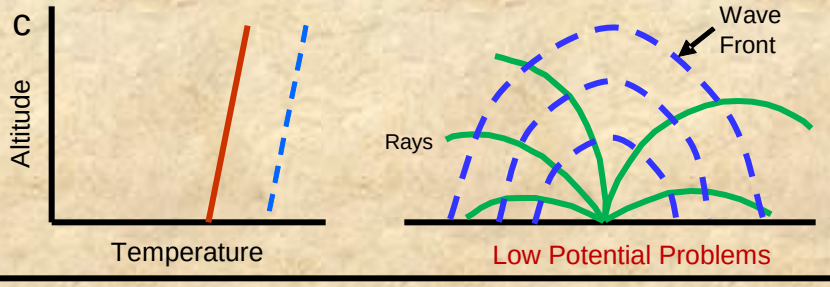
Inversion – High Potential Problems





Inversion – High Potential Problems

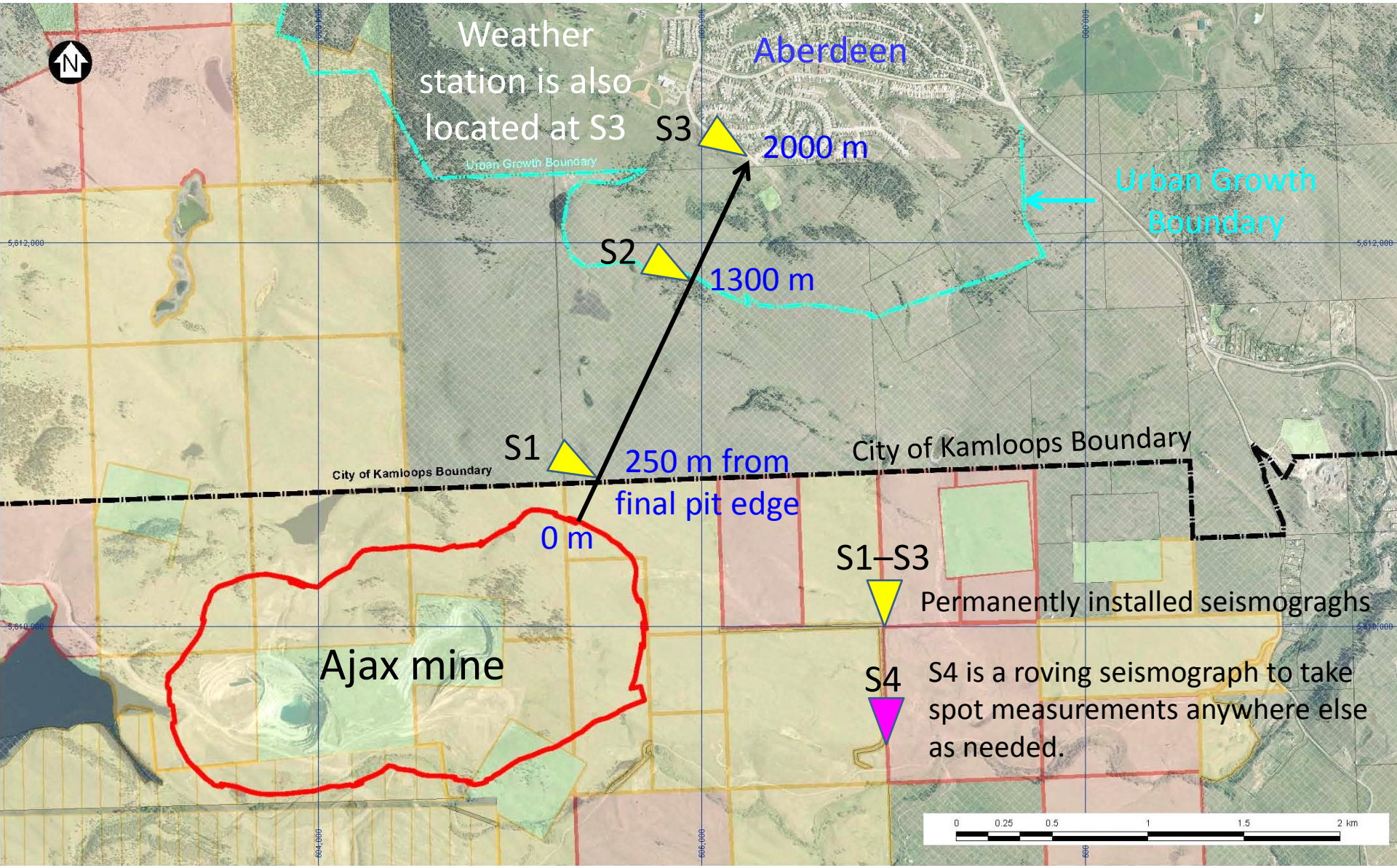




Unfavorable weather conditions are illustrated in (d) and (e).

Blasting will only be conducted if weather conditions allow for the control of the airblast dBL levels.

Proposed Seismographs and Weather Station Setup



KGHM International
Ajax Mine

Not Ajax Mine – For illustration only.

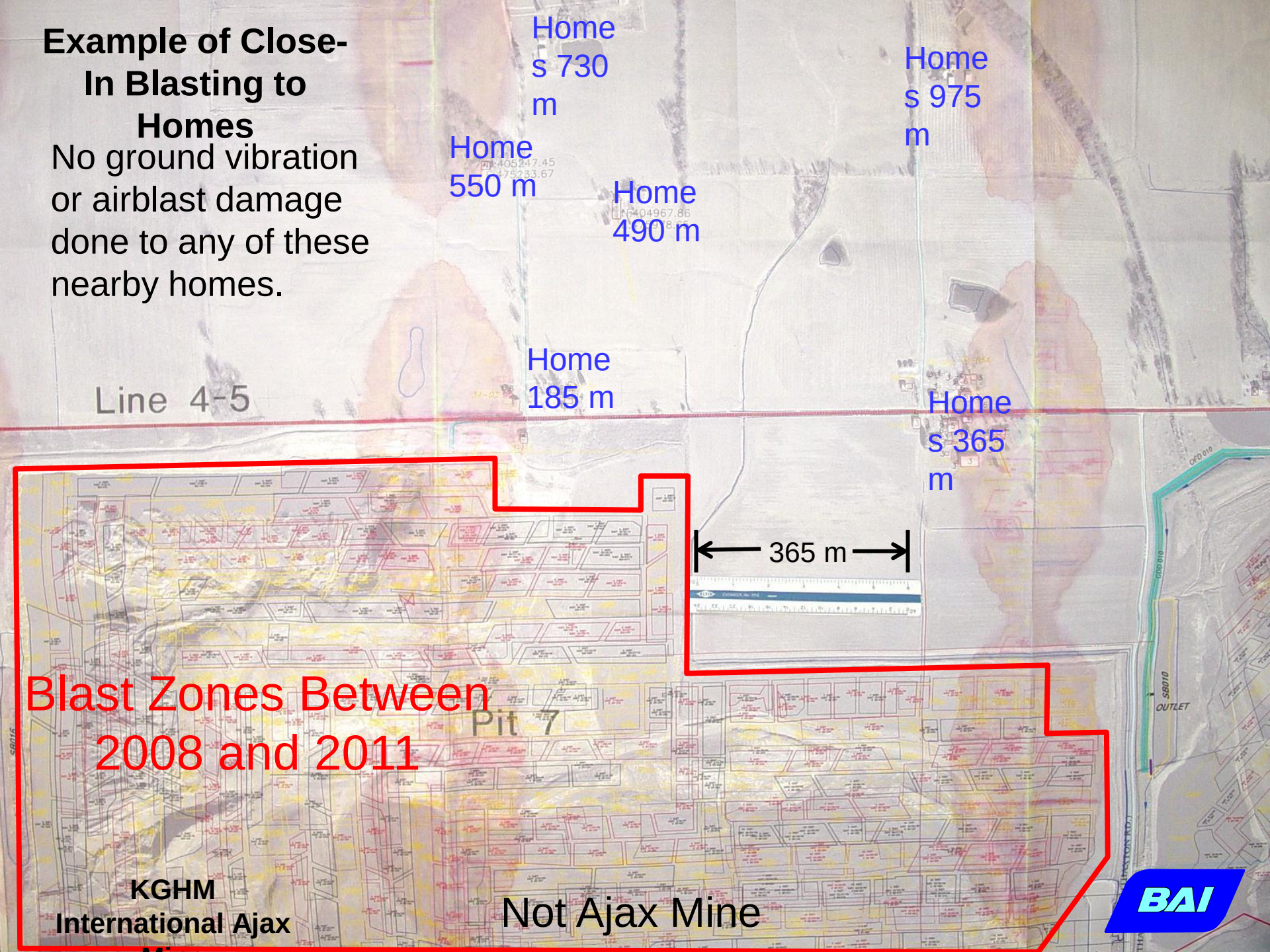
Initially, only one hole per delay will be fired on the blasts.

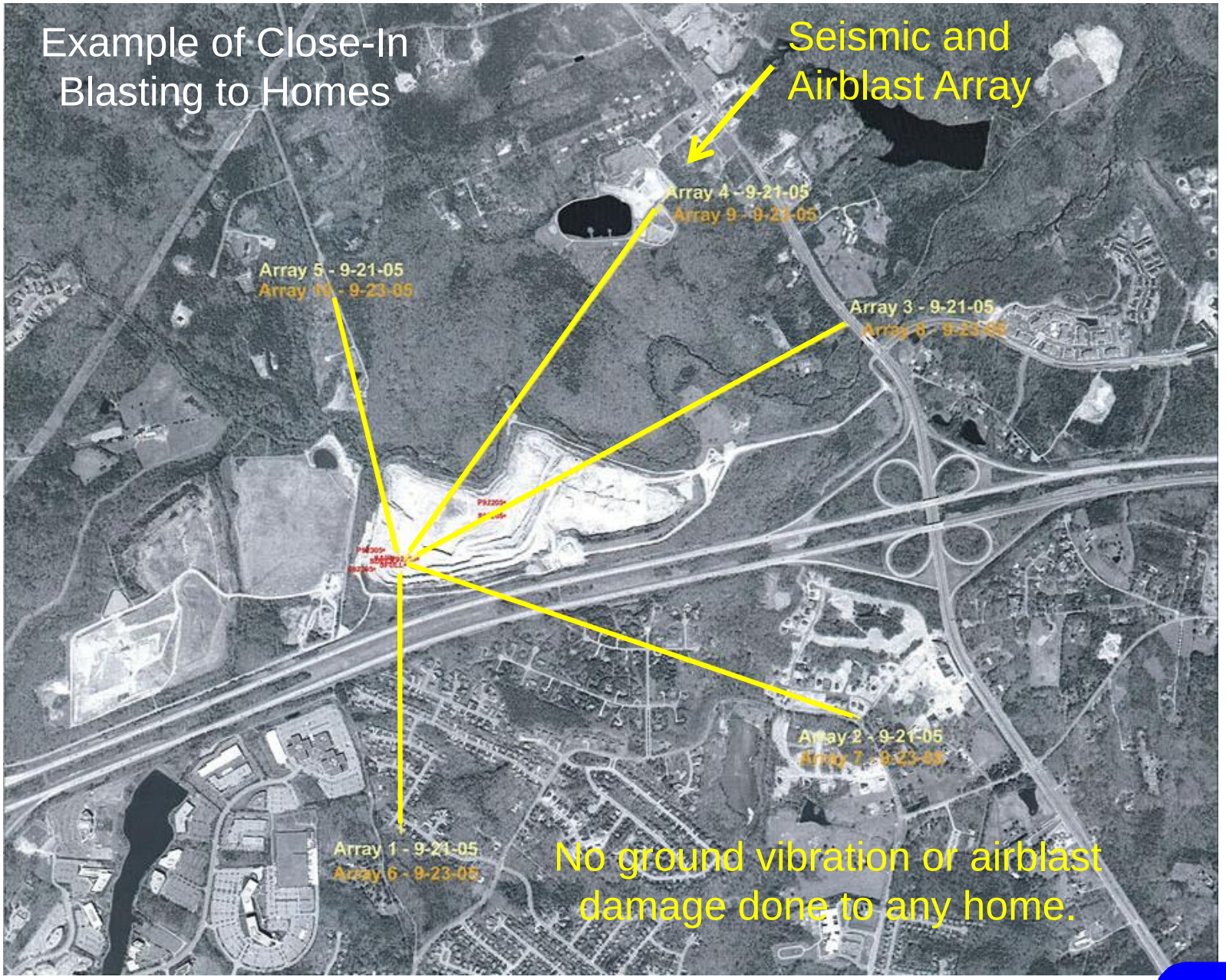
Depending on the rock properties and site conditions (i.e. wet/dry), hole delays could vary from 1 to 67 ms (milliseconds).

Maximum amount of explosives per hole will be between approximately 315 and 620 Kg.

KGHM International
Ajax Mine

BAI


Example of Close-In Blasting to Homes
No ground vibration or airblast damage done to any of these nearby homes.
Homes 730 m
Homes 975 m
Home 550 m
Home 490 m
Home 185 m
Homes 365 m
Line 4-5
365 m
Blast Zones Between 2008 and 2011
Pit 7
KGHM International Ajax
Not Ajax Mine
OUTLET
BAI



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Not Ajax Mine


Example of Close-In Blasting to Homes
B12
B8
B15
Blast Zone
Not Ajax Mine
No ground vibration or airblast damage done to any home or industrial structure.
KGHM International
Ajax Mine
BAI


No ground vibration or airblast damage done to any home or industrial structure.
Example of Close-In Blasting to Homes and Commercial Buildings
1
5A
4
6
7
8
15
12
11
Not Ajax Mine
Blast Zone
KGHM International
Ajax Mine
BAI

Expansion and Deepening of the Panama Canal 1995 - 2002

Ground Vibration and Airblast Controls for Use at Ajax Mine

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Noise and Vibration Modelling Plan
KGHM International Ajax Mine Project

Jonathan Chui, P.Eng.
Associate, Noise Management Group
Stantec

Introduction

Noise and vibration assessment is required because:

- Valued Component (VC) of the Application Information Requirements (AIR)
- Potential for environmental effects
- Environmental approval process
- Regulatory compliance

Topics:

- Noise Assessment Process
- Vibration Assessment Process

Noise Assessment Process

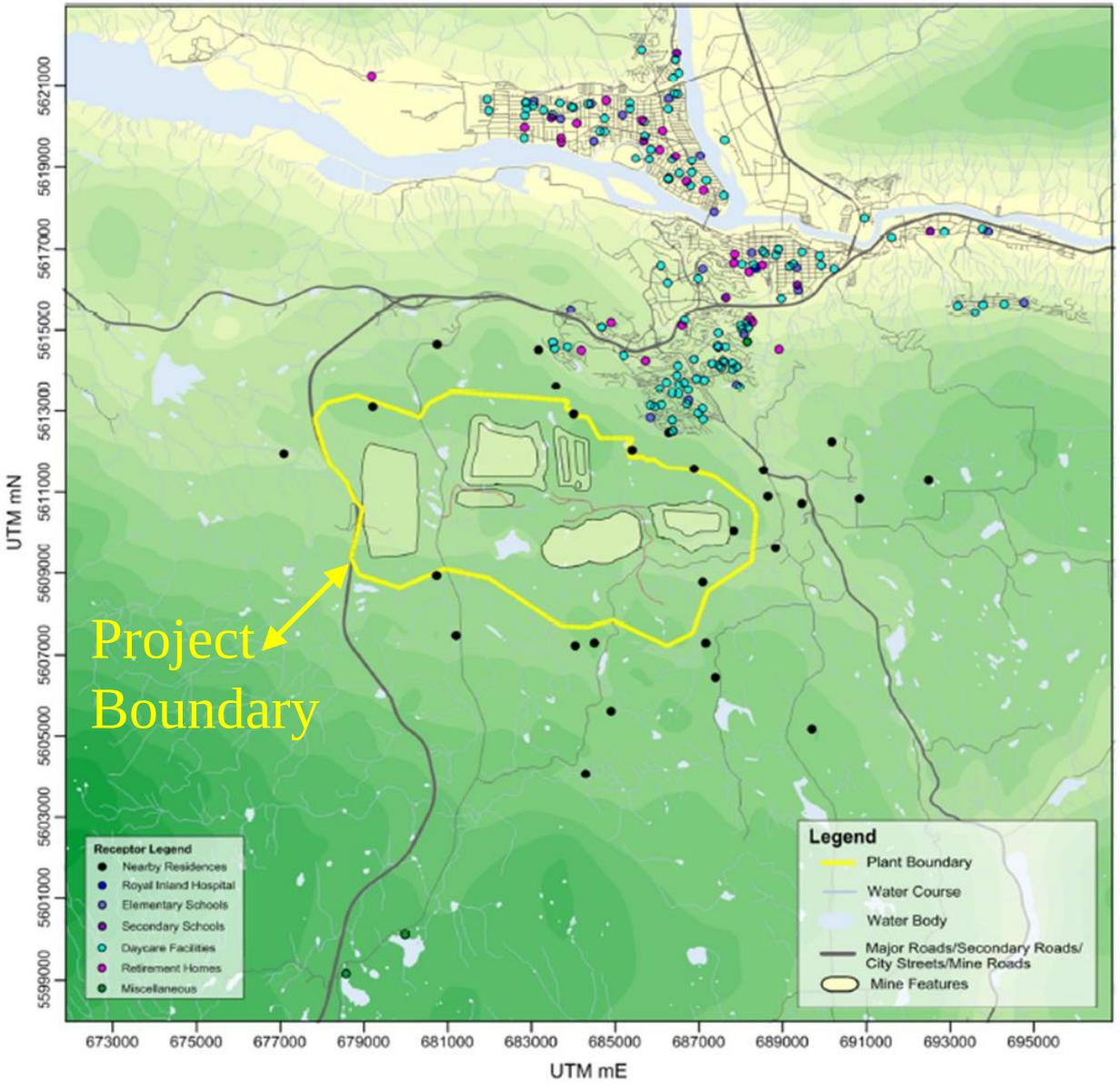
1. Noise modelling scenarios
2. Noise sensitive receptors
3. Noise sources
4. Acoustic modelling
5. Regulatory framework
6. Mitigation

Noise Modelling Scenarios

Three Project scenarios will be considered:

1. Construction
   - Excavation
   - Grading
   - Road and bridge upgrades
   - Infrastructures (facility buildings, transmission line)
2. Operation Year 1 - less barrier effect
3. Operation Year 14 - highest production year

Human Health Receptors



Noise Sensitive Receptors

- Rural residences
- City of Kamloops
  - Residences
  - School
  - Hospital

Noise Sources

Construction:

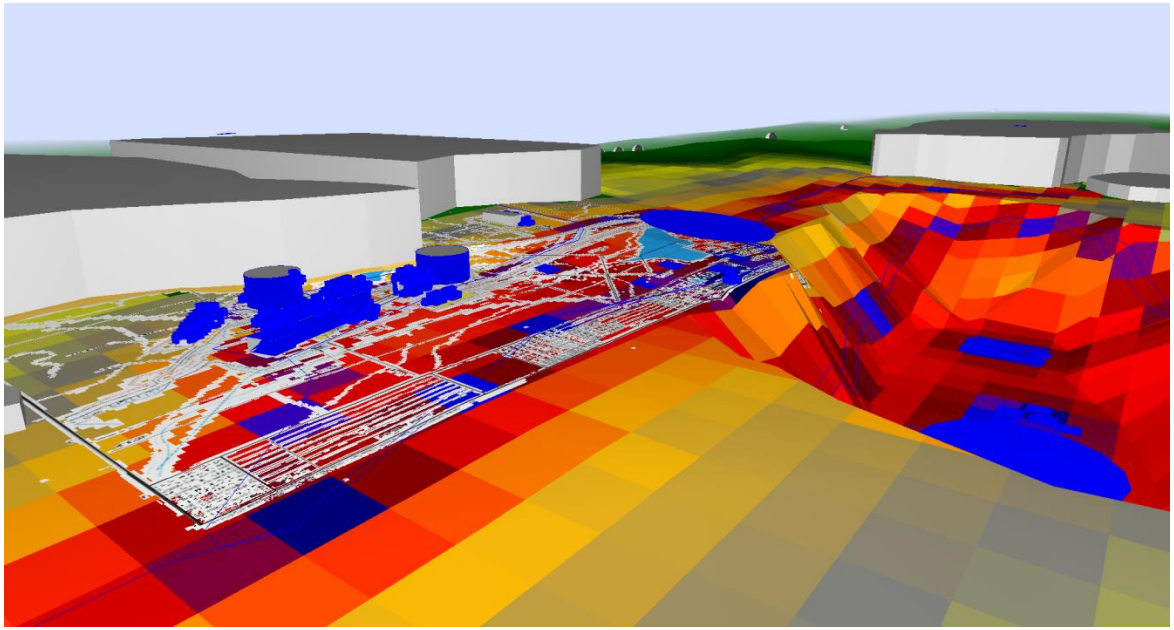
- Dozers
- Excavators
- Graders
- Haul trucks
- Blasting (including Air Blast)

Operation:

- Open pit
- Process facilities
- Tailing facilities
- Blasting (including Air Blast)
- Waste rock management facilities
- Ore and waste transportation (conveyors and haul truck road)
- Concentrate shipping area
- Explosive material transportation

Acoustic Modelling

- Mathematical simulation of noise emission propagate in the atmosphere.
- Performed with a computer program based on international standard for noise prediction (ISO 9613 – Attenuation of sound during propagation outdoors)
- Model Construction year, Year 1, and Year 14

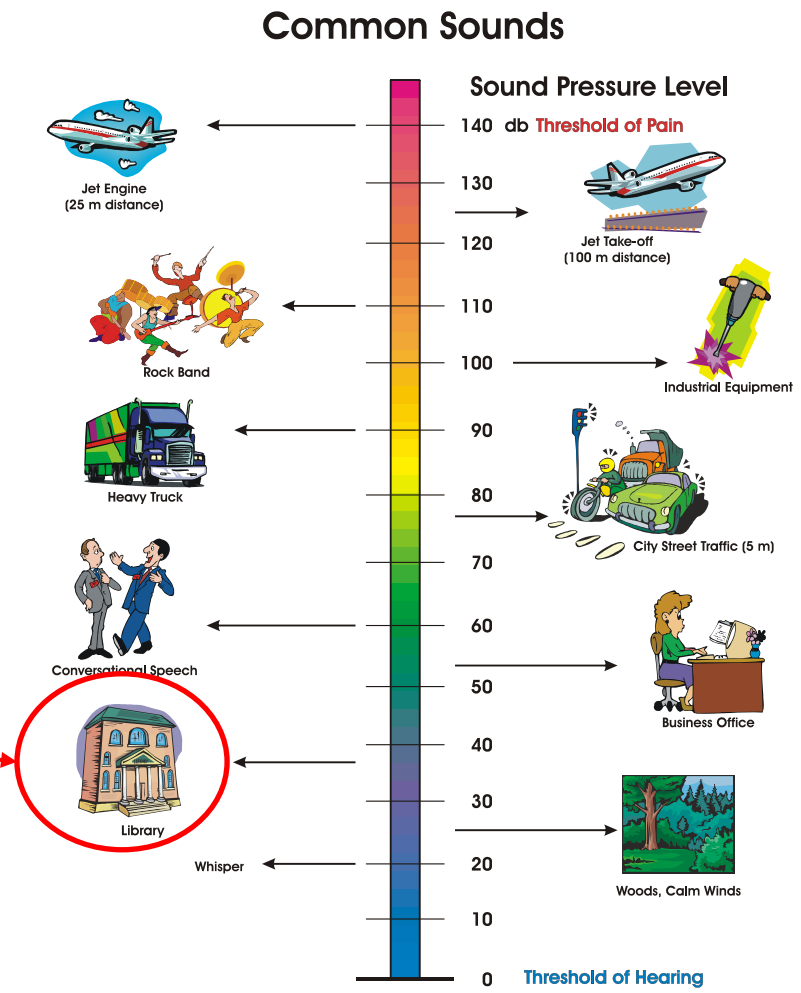


1. Full octave band
2. Barrier effect
3. Terrain
4. Air and ground absorption
5. Directivity
6. Reflection
7. Meteorology

Provincial Regulatory Requirement

BC Oil & Gas Commission. British Columbia Noise Control Best Practices Guideline. March 2009.

Permissible Sound Level (Night time)			
Transportation Proximity	Dwelling Density/Quarter section		
	1-8	9-160	>160
Category 1	40	43	46
Category 2	45	48	51
Category 3	50	53	56



Federal Noise Guideline

Health Canada. Guidance for Evaluating Human Health Impacts in Environmental Assessment: NOISE. April 2011.

1. Potential Health impacts
    - sleep disturbance (35 dBA indoor level)
    - Annoyance (%HA less than 6.5%)
    - speech interference (55 dBA outdoors)
2. Construction noise
3. Low frequency noise

Mitigation and Management Plan

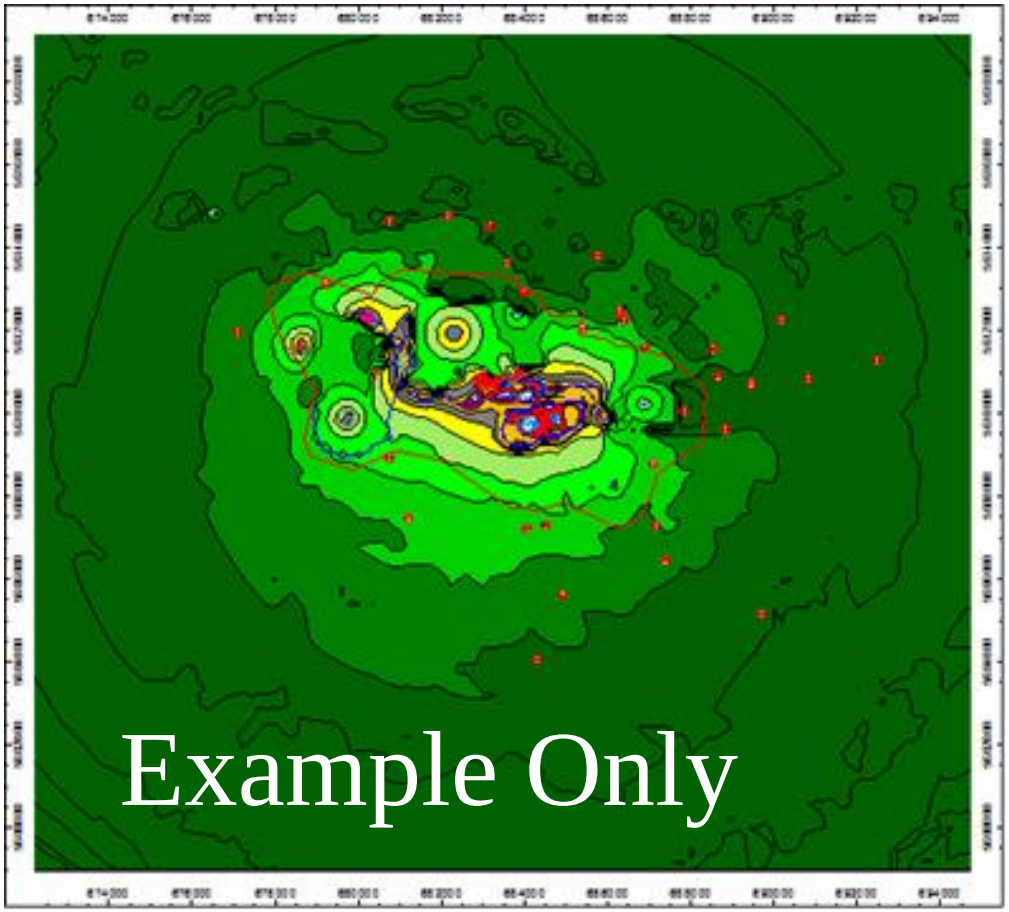
Mitigations

1. Reduce noise sources
    - Enclosure or building
    - Muffler
    - Barrier
2. Increase distance from noise source to receptor

Noise Management Plan

1. Monitoring
2. Scheduling of activities
3. Complaint mechanism

Noise Assessment Output



- Predicted noise level at receptors
- Noise contour within study area (similar to topographic map)
- Results feed to other disciplines (i.e. Wildlife)

Vibration Assessment Process

Project activities with potential vibration effects:

- Blasting (including Air Blast)
- Machinery and haul truck traffic

Assessment method based on the following:

- Ontario MOE Guideline
- Blasters Handbook by International Society of Explosives Engineer
- Journal of the Geotechnical Engineering Division Volume 107, American Society of Civil Engineers
- Comparison with test blast results

Vibration Assessment Criteria

Blasting

The Ontario Ministry of Environment – Guidelines on Information Required for the Assessment of Blasting Noise and Vibration. 1985

USBM

- Air blast overpressure: 120 dB
- Ground borne vibration: 10 -19 mm/s

Machinery and Haul Trucks

Haul Truck Ground Vibration – City of Toronto Construction Vibration Limit

- Structural damage: 25 mm/s

Thank you!

Questions?

Human Health & Ecological Risk Assessment (HHERA) for the Ajax Mine Project

Bryan Leece Ph.D.
Principal, Toxicology & Risk Assessment
Stantec

Contents

- Overview of the HHERA Process
- Regulatory Framework for HHERAs
- HHERA: Basic Components
- Applying HHERA to the Ajax Project
  - Ajax Baseline HHERA
  - Ajax Construction, Operations, Closure and Post-Closure HHERA
- Interpretation of the HHERA Results

Overview of HHERA Process

Human Health and Ecological Risk Assessment (HHERA) is a process that answers the following questions:

- Is there a risk?

  If estimated exposures are above allowable limits potential risks may exist.

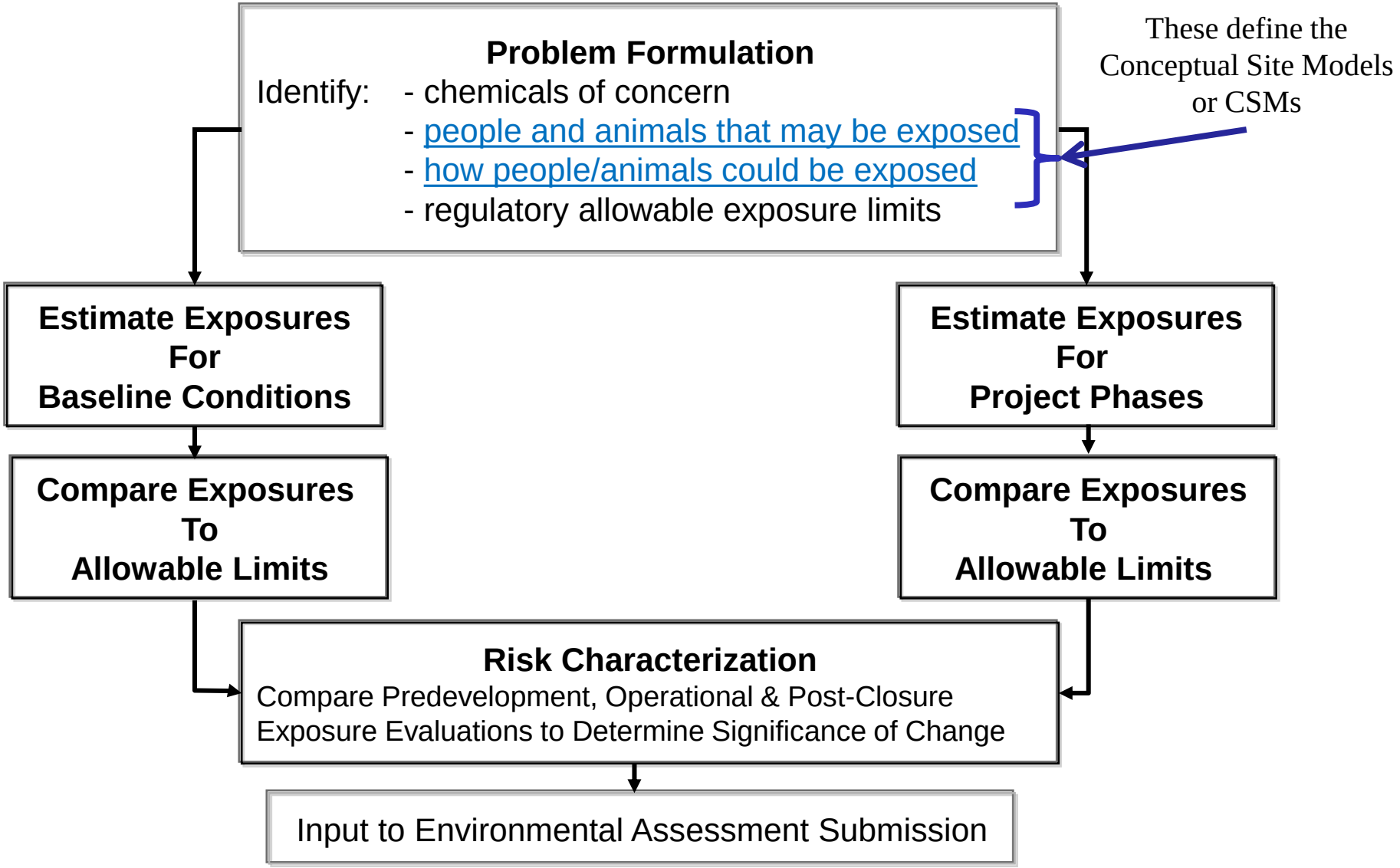
- If YES, what type?
  - Human Health?
  - Ecological?
  - Both?

- If YES, how large is the risk?

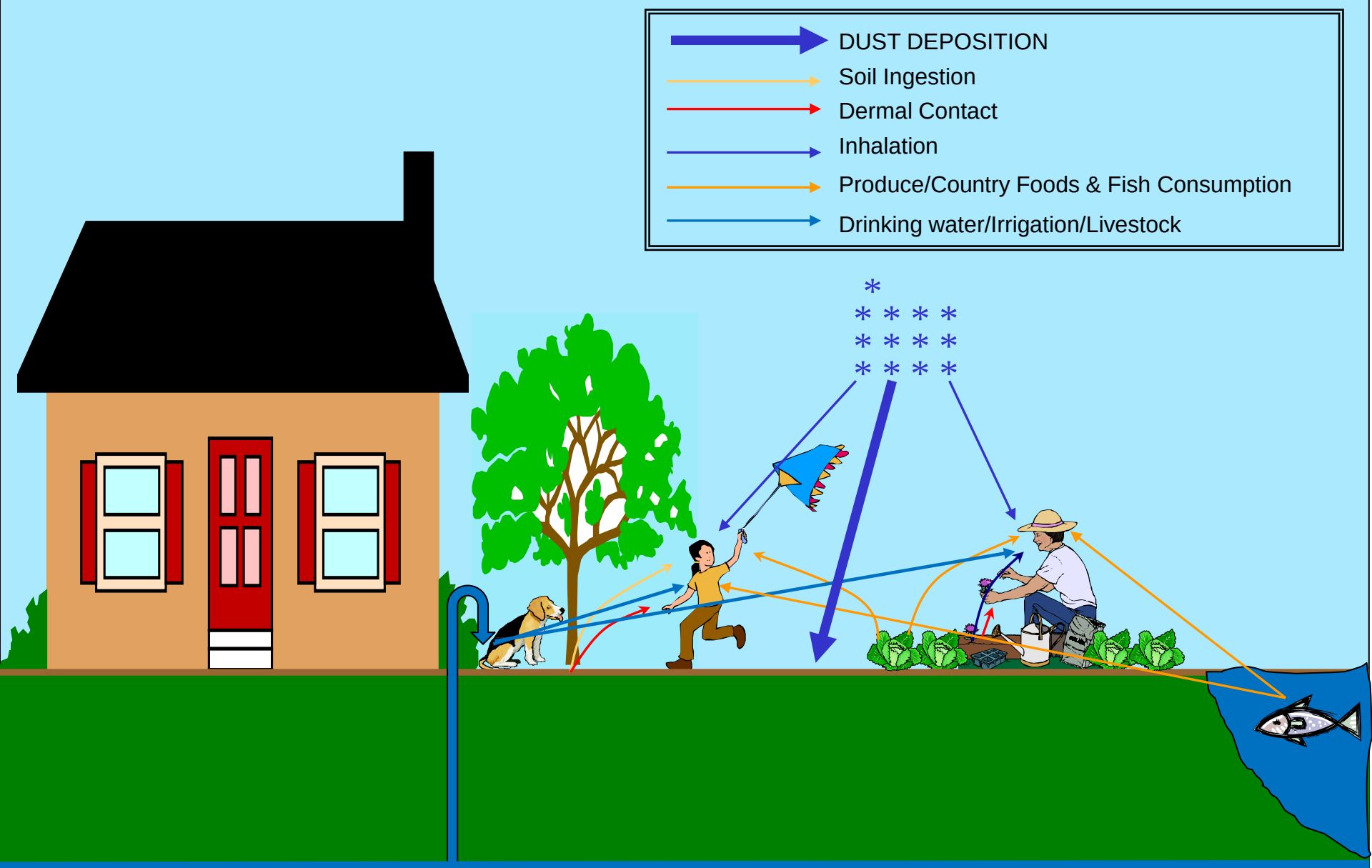
Regulatory Frameworks for HHERAs

- Federal Guidance:
  - Canadian Handbook on Health Impact Assessment – Health Canada (Vols 1 – 4, 2004);
  - Federal Contaminated Site Risk Assessment in Canada – Health Canada (Parts I – V, 2012) – including Country Foods
  - A Framework for Ecological Risk Assessment: General Guidance – Canadian Council of Ministers of the Environment (CCME), 1996
- Provincial Guidance:
  - British Columbia, Alberta, Ontario, Quebec, Atlantic Canada
  - Manitoba, Saskatchewan, Yukon, NWT & Nunavut use Federal Guidance

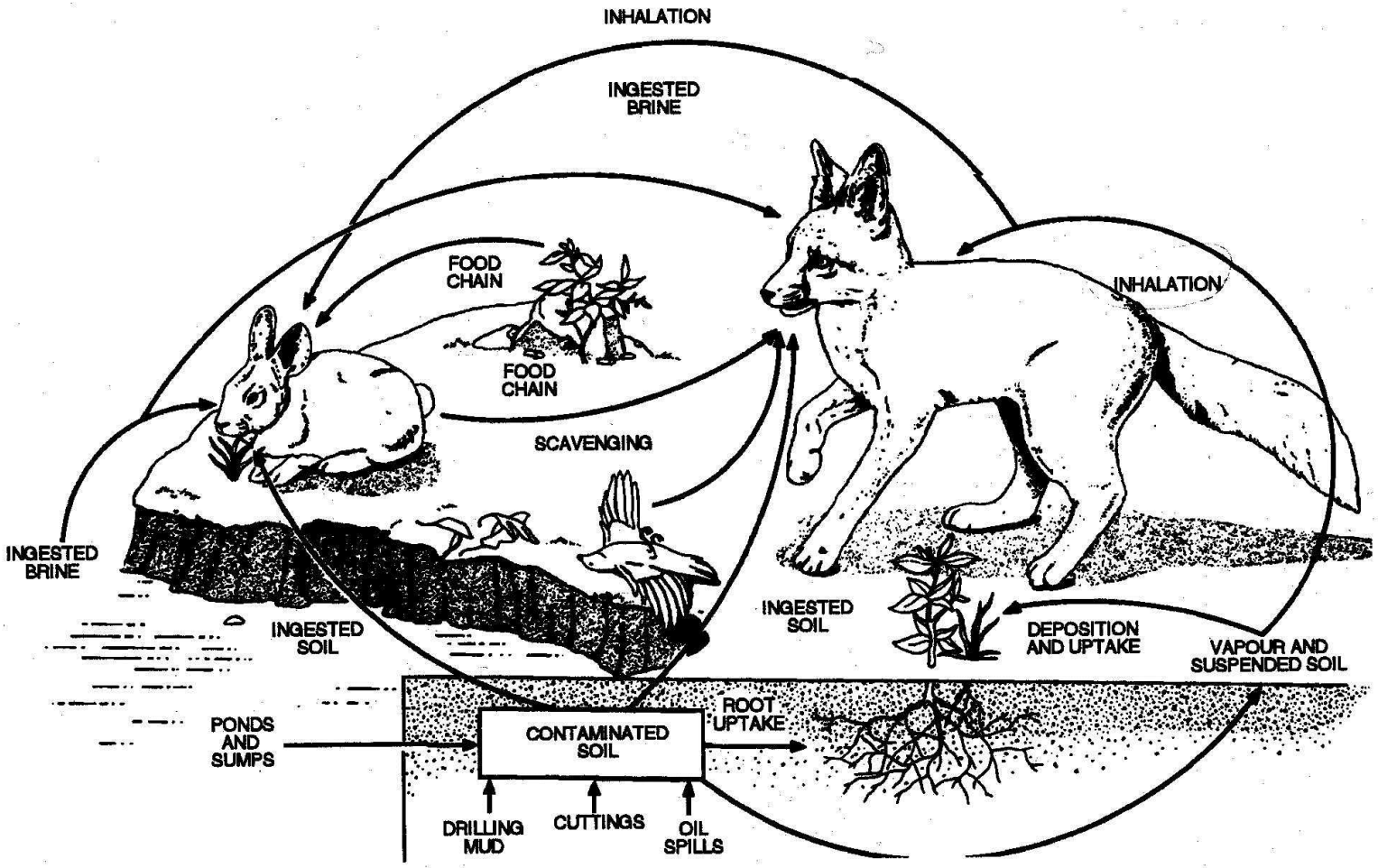
HHERA in an EA Framework



Sample Conceptual Site Model- Human Health



Sample Conceptual Site Model- Ecological Receptors



Examples of HHERAs in Canada

- HHERAs as part of Environmental Assessments:
  - Belleoram Rock Quarry – Newfoundland and Labrador
  - Eider Rock – Refinery Expansion – St John New Brunswick;
  - York-Durham – Energy from Waste Facility – Ontario;
  - ENMAX Shepard Power Plant – Calgary, Alberta
  - Enbridge Northern Gateway Pipeline Terminal – Kitimat, British Columbia
  - 5+ Coal Mine projects – British Columbia
  - 4+ Copper-Gold mine projects – British Columbia
  - Copper-Zinc mine project - Nunavut

Applying HHERA to the Ajax Project

The Human Health Risk Assessment (HHRA) component of the HHERA for the Ajax Project will consider the following human receptors.

Receptor Age Groups	People to be Included in the HHRA			
	Kamloops Residents	First Nations	Residents Outside Kamloops	Ranchers
Infants (0 – 6 months of age)	✓	✓	✓	✓
Toddlers (7 months to 4 years)	✓	✓	✓	✓
Children (5 to 11 years)	✓	✓	✓	✓
Teens (12 to 19 years)	✓	✓	✓	✓
Adults (20+ years)	✓	✓	✓	✓
Sensitive subgroups*	✓	✓	✓	✓

*- sensitive subgroups could include: pregnant women, elderly,

Applying HHERA to the Ajax Project

The exposure pathways included in the HHRA for the Ajax Project Phases are listed below.

Exposures will be evaluated for all identified human receptors.

Project Phase	Exposure Routes to be Evaluated				
	Inhalation	Soil Contact*	Drinking Water	Produce Consumption	Country Food Consumption**
Baseline	✓	✓	✓	✓	✓
Construction	✓				
Operations	✓				
Closure	✓				
Post Closure	✓	✓	✓	✓	✓

- * Soil Contact includes soil ingestion and dermal contact
- ** Country foods includes fish, game, bird, vegetation and traditional medicines.

Applying HHERA to the Ajax Project

The chemicals of concern included for each exposure pathway evaluated in the HHRA for the Ajax Project are listed below.

Chemical of Concern	Exposure Routes to be Evaluated				
	Inhalation	Soil Contact*	Drinking Water	Produce Consumption	Country Food Consumption
TSP	✓				
PM_{10}	✓				
$PM_{2.5}$	✓				
NO_x	✓				
SO2	✓				
CO	✓				
PAH	✓				
Metals*	✓	✓	✓	✓	✓

The metals include: Antimony (Sb), Arsenic (As), Cadmium (Cd), Cobalt (Co), Copper (Cu), Lead (Pb), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), and Selenium (Se).

Ajax Project: Baseline HHERA

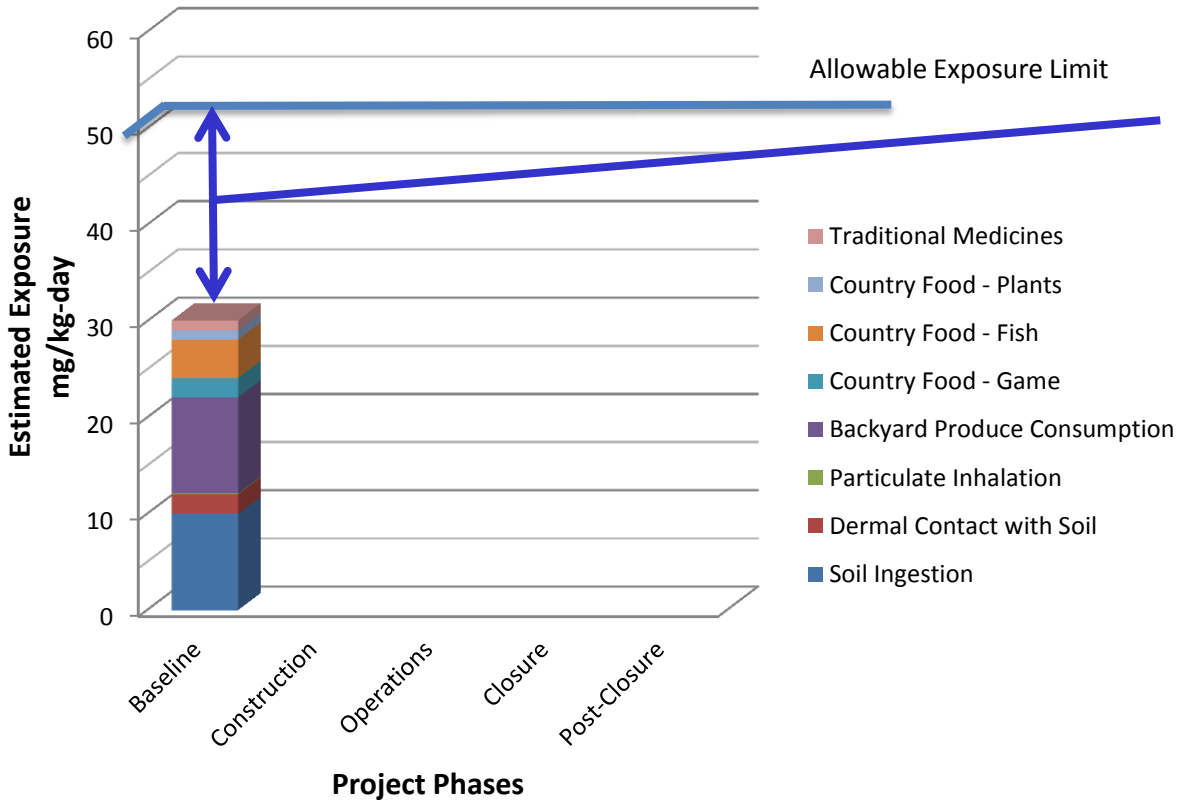
Assessment of Current Exposures in the community:

- Exposures will be estimated for each receptor age group for each of the relevant exposure pathways for each chemical;
- Exposures will be estimated using the chemical concentrations from the baseline data – once baseline is complete;
- Exposure calculations will be consistent with standard methodologies recommended by Health Canada, US EPA and other agencies;
- Estimated exposures for each pathway will be combined to provide Baseline *Total Exposure* Estimates for each receptor for each chemical;
- The *Total Exposure* estimates for each receptor will be compared to allowable exposure limits set by Health Canada, CCME and BC Ministry of the Environment, to establish baseline potential human health and ecological risks;
- These Baseline Risk Estimates will be used along with Project Risk Estimates to determine potential Project effects for people and ecological receptors.

Ajax Project: Baseline HHERA

Assessment of Current Exposures in the community:

Example: Estimated Baseline Exposure Conditions



- Total Exposure below Allowable Limit
- Exposures to not represent a risk

Ajax Project HHERA:

The Ajax Project HHERA will consider the same chemicals, receptors, exposure pathways and exposure benchmarks as the Baseline HHERA. However, Project HHERA must rely on modeled chemical concentrations in soil and water rather than measured concentrations to estimate exposures:

Baseline HHERA	Project HHERA
Chemical: TSP, PM_{10}, $PM_{2.5}$, NO_x, SO_2, CO, PAH & Metals	Same as Baseline HHERA
Human Receptors – all ages	Same as Baseline HHERA
Direct Exposures – soil, surface water, groundwater, air	Same as Baseline HHERA
Country Foods – produce, fish & game, birds, vegetation and traditional medicines	Same as Baseline HHERA
Chemical Concentrations - measured	Chemical Concentrations - Modelled

Ajax Project: Project HHERA

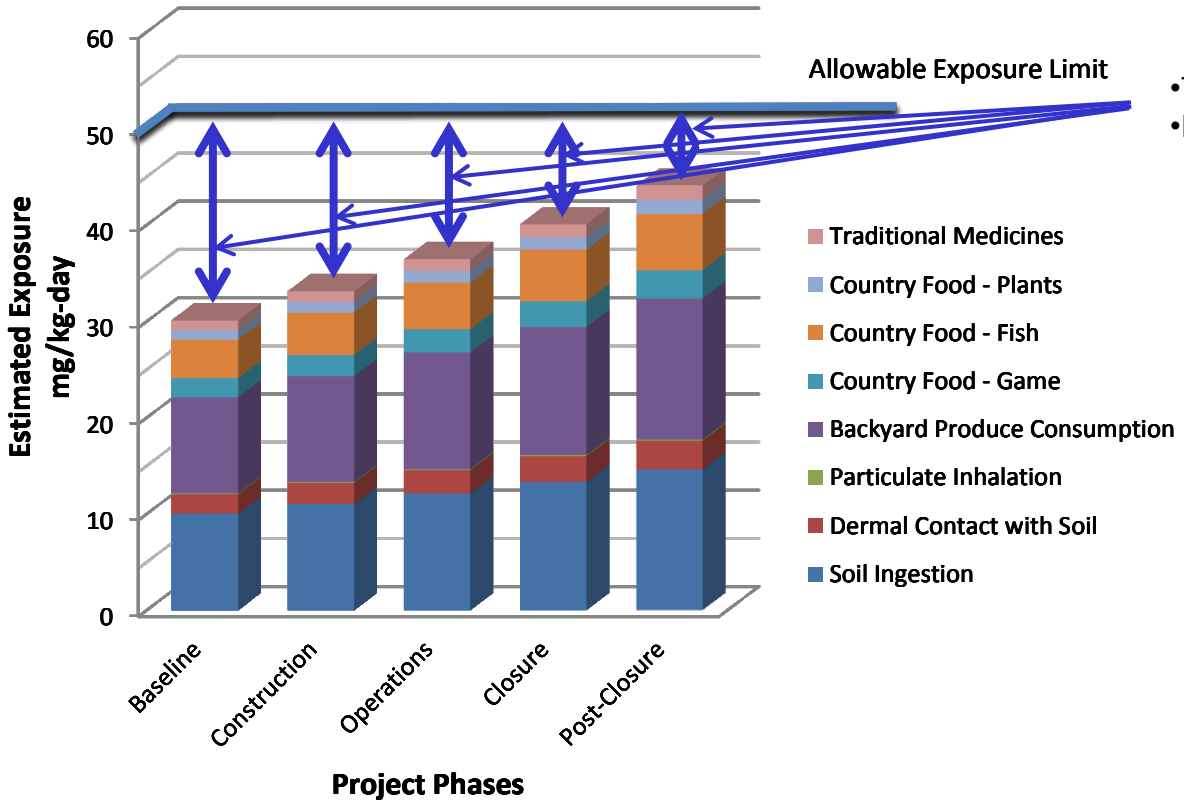
Assessment of predicted exposures in the community:

- Project HHERA integrates modelling data from the Air and Water Quality Assessments to determine predicted chemical concentrations in air, soil, water, produce, country foods, traditional medicines;
- Exposures will be estimated for each receptor age group for each of the relevant exposure pathways for each chemical;
- The same exposure calculations used in the Baseline HHERA will be used in the Project HHERA;
- Estimated exposures for each pathway will be combined to provide Project *Total Exposure* Estimates for each receptor for each chemical;
- The *Total Exposure* estimates for each receptor will be compared to allowable exposure limits set by Health Canada, CCME and BC Ministry of the Environment, to establish Project potential human health and ecological risks;
- These Project Risk Estimates will be used along with Baseline Risk Estimates to determine potential Project effects for people and ecological receptors.

Ajax Project: Project HHERA

Assessment of exposures in the community for Project Phases:

Example: Estimated Project Exposure Conditions



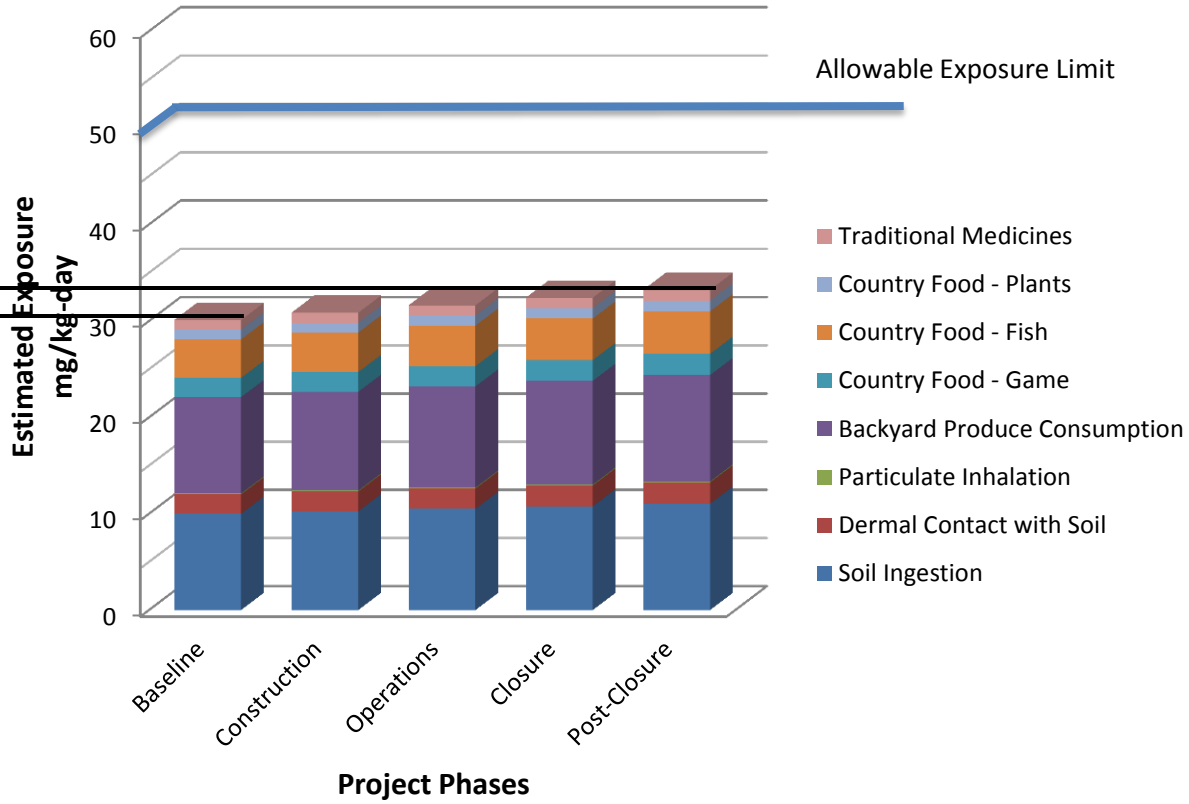
- Total Exposures below Allowable Limit
- Exposures to not represent a risk

Interpretation of the HHERA Results

The interpretation of the HHERA results is based on a comparison of the Baseline and Project Exposure Conditions and potential health and/or ecological risks.

The HHERA determines how much exposure conditions change between baseline and the end of the project.

Change in Exposure Conditions



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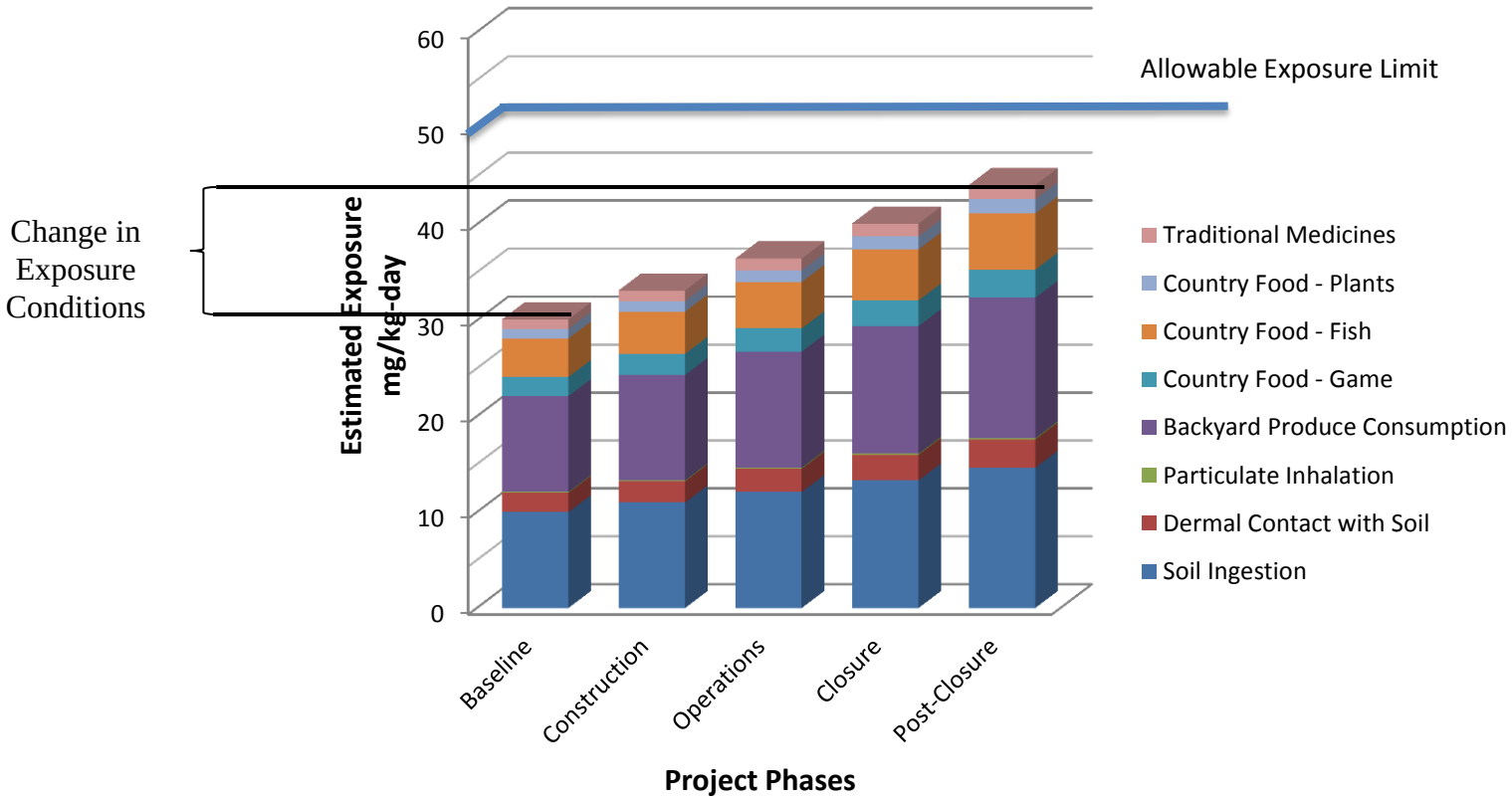
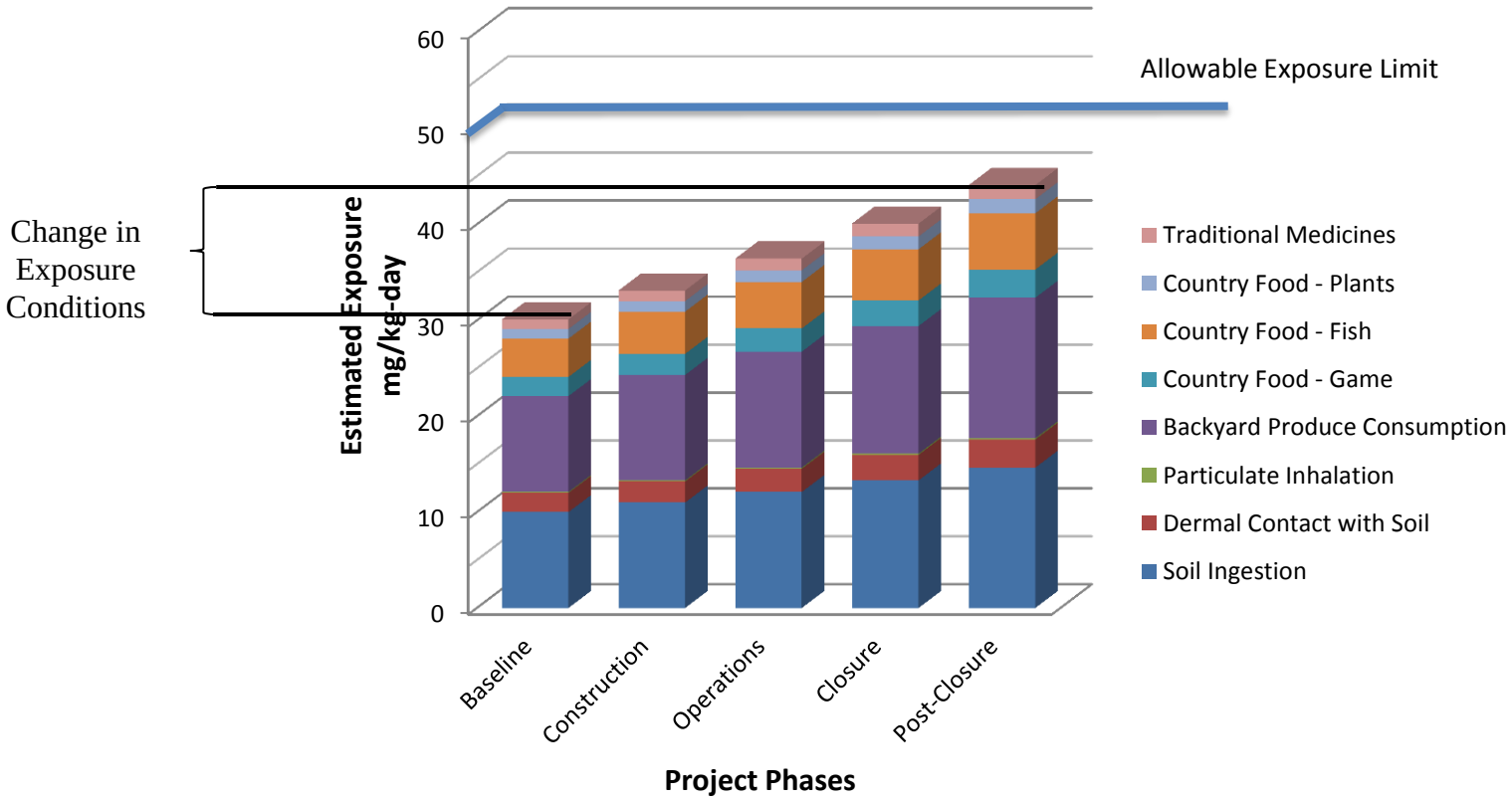


Interpretation of the HHERA Results

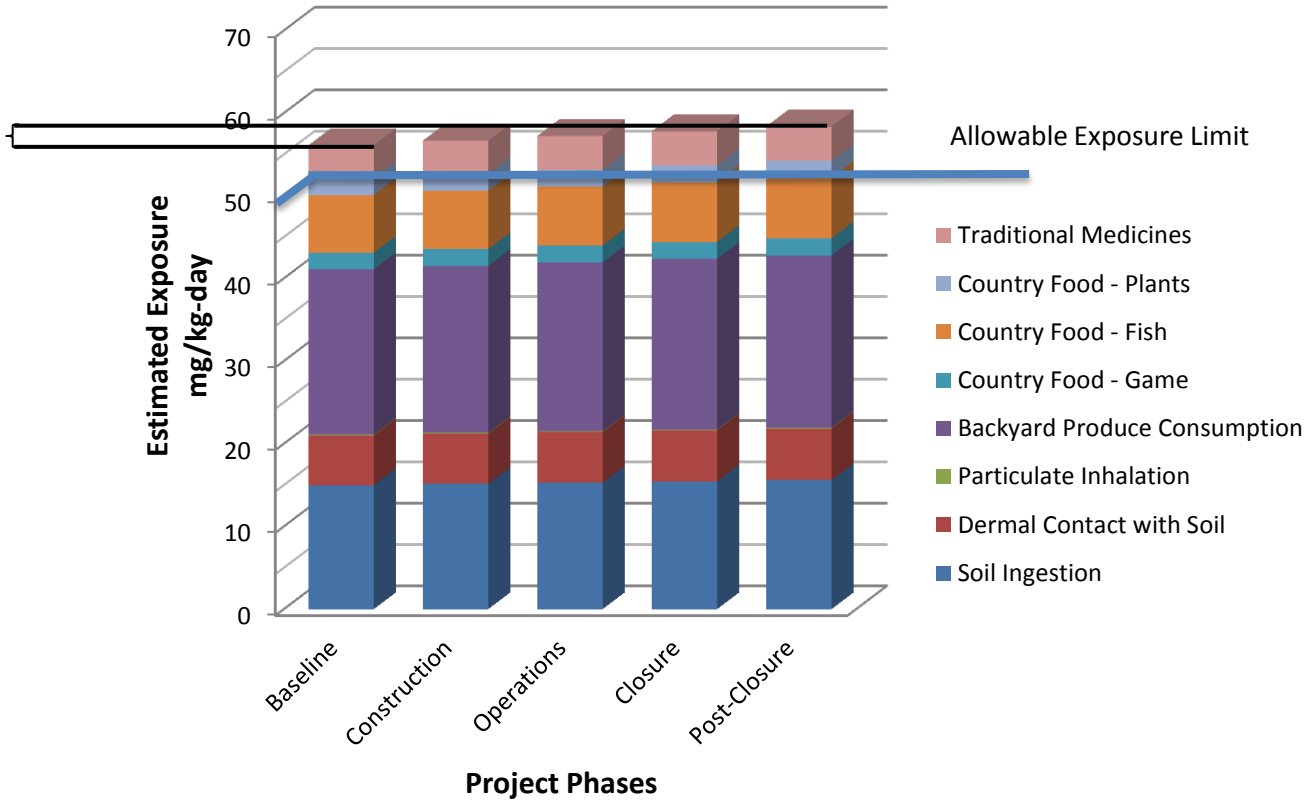
When both the Baseline and Project exposure conditions are below the allowable exposure limit, Project exposure conditions do not represent a human health or ecological risk.



Interpretation of the HHERA Results

When Baseline exposure conditions are above the allowable exposure limit the evaluation of potential Project risks is based on how much the risk estimates change between Baseline and Project conditions.

Change in Exposure Conditions

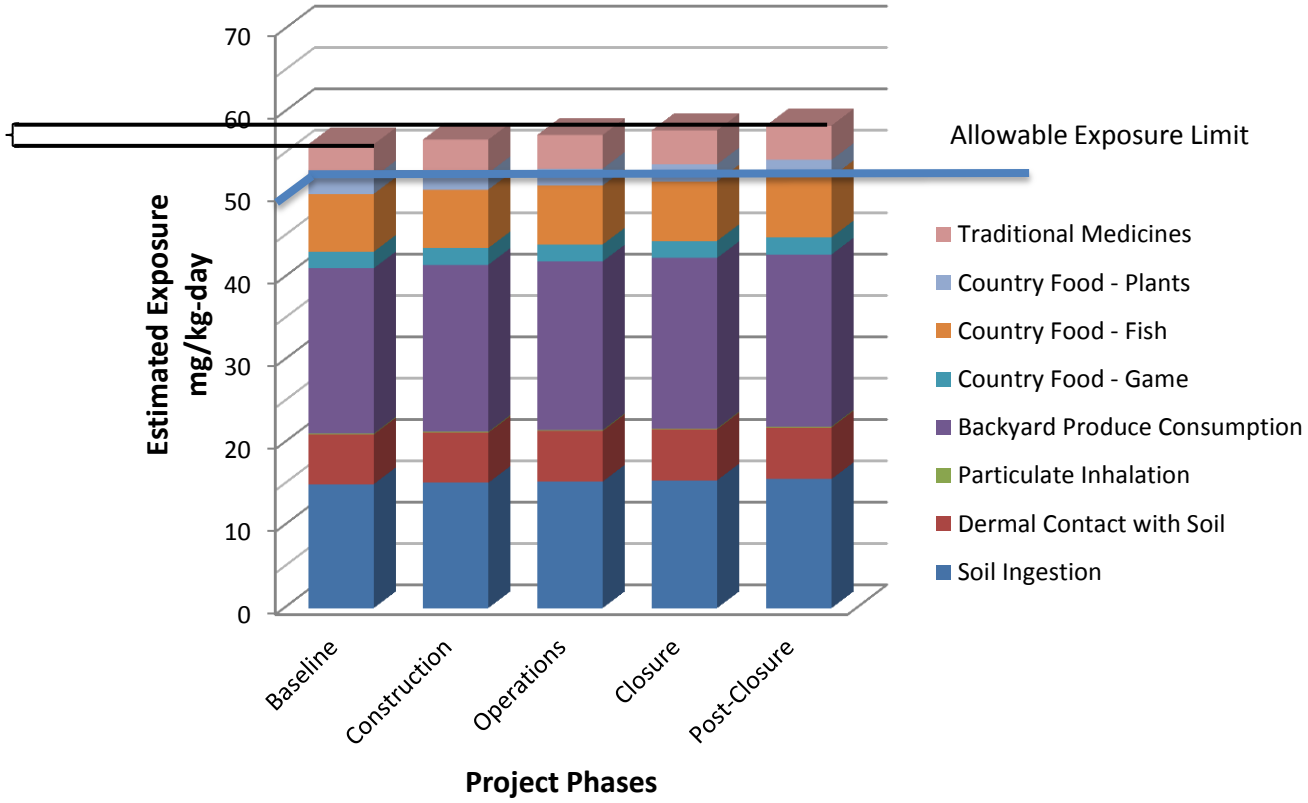


Interpretation of the HHERA Results

A change in exposure conditions of less than 20% is proposed as the benchmark for determining if Project exposure conditions would be a concern for human health or ecological receptors.

This 20% is consistent with the risk acceptability benchmark recommended by Health Canada for determining acceptable exposures on Federal properties.

Change in Exposure Conditions



HHERA Report for the Ajax Project

The Technical Document Report (TDR) for the Human Health and Ecological Risk Assessment for the Ajax Project will include:

1. Main HHERA report which incorporates:
   i. Problem Formulation;
   ii. Toxicological Assessment;
   iii. Exposure Assessment
   iv. Risk Characterization & Interpretation of Results

2. Technical Appendices:
   i. Summaries of Air, Water and Soil quality data used in the baseline assessment;
   ii. Summaries of Air, Water and Soil quality data estimated for project phases;
   iii. Soil, vegetation and tissue sample data from HHERA baseline sampling program;
   iv. Detailed exposure calculations for each chemical for each human and ecological receptor;
   v. Independent Peer Review comments and responses to these comments

Thank You

Questions?

Ajax Copper-Gold Project, Water Quantity and Quality

Trevor Crozier (BGC)
Hamish Weatherly (BGC)
Jessica Mackie (Knight Piésold)

Knight Piésold
CONSULTING

Monitoring Program Objectives

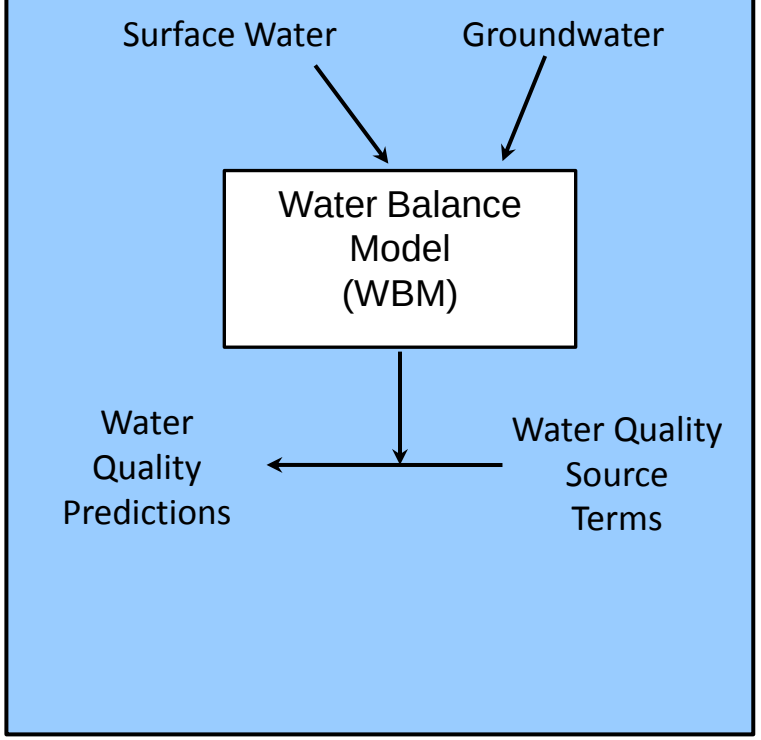
- Understanding baseline (i.e. existing conditions) for:
  - Surface water quantity
  - Surface water quality
  - Groundwater quantity
  - Groundwater quality
  - Surface water – Groundwater interactions

EA Methodology

Baseline Conditions

- Climate
- Surface Water (quantity and quality)
- Groundwater (quantity and quality)

Modelling

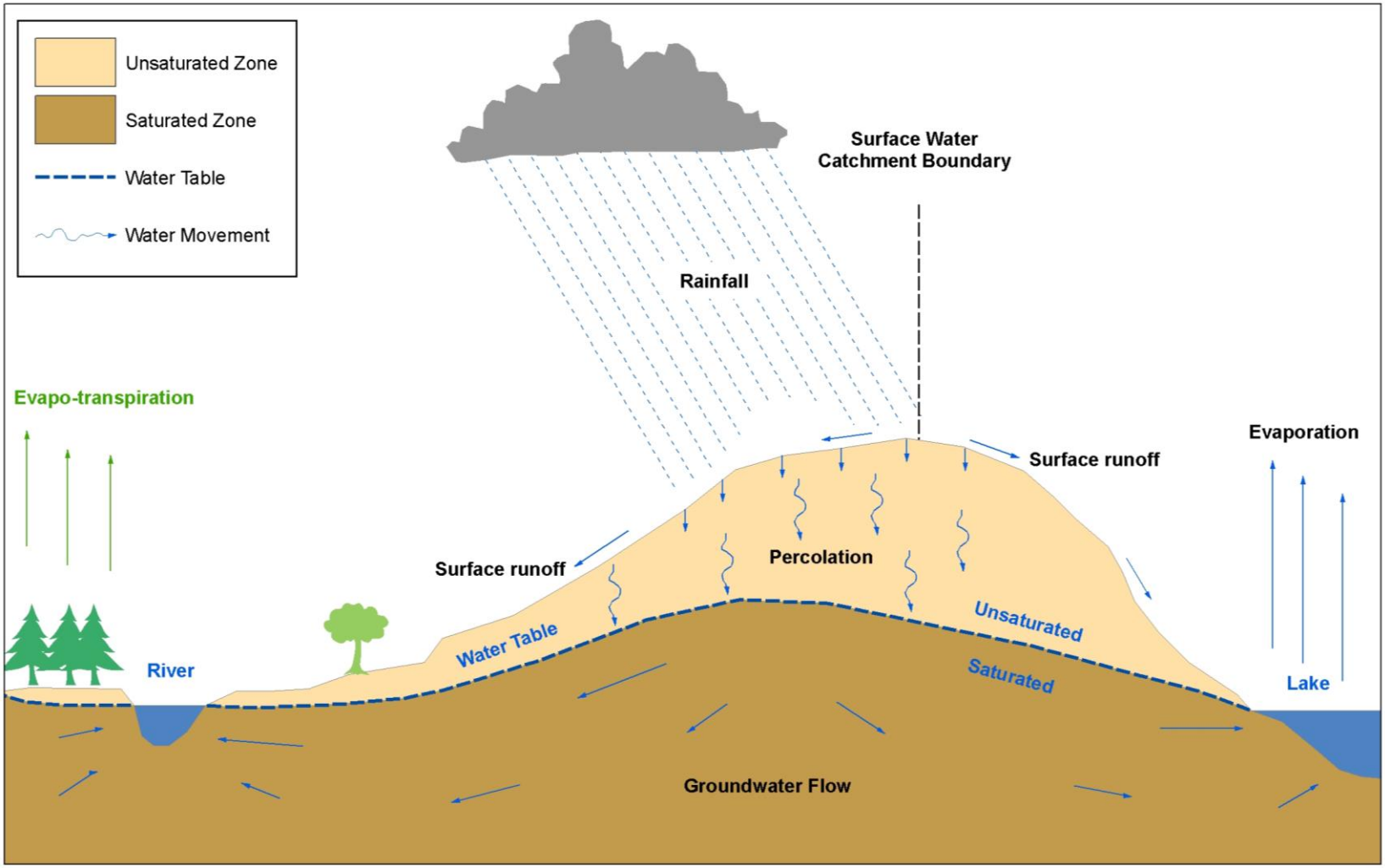


Effects Assessment

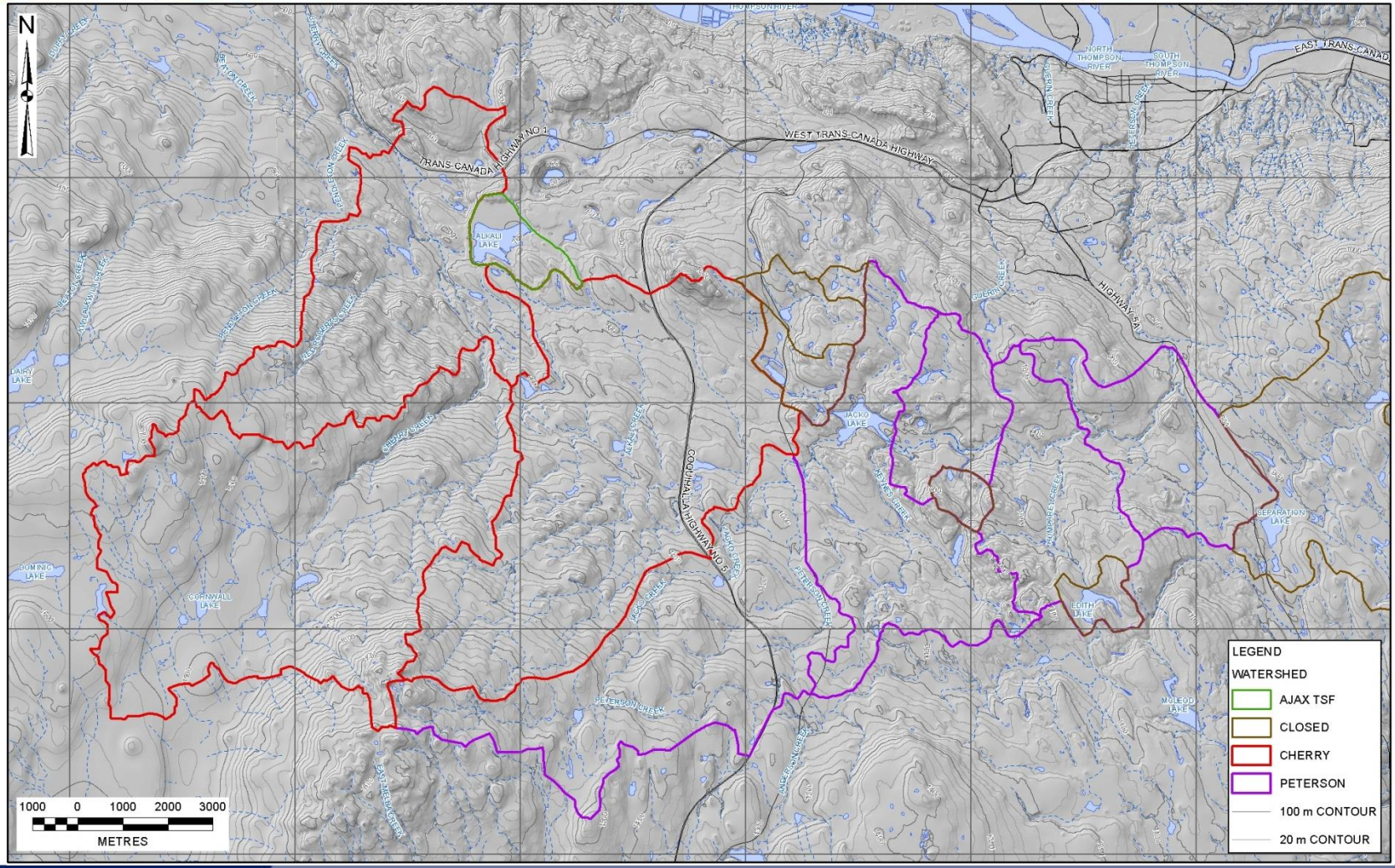
- Changes in water quantity
- Changes in water quality

Mitigation
(if required)

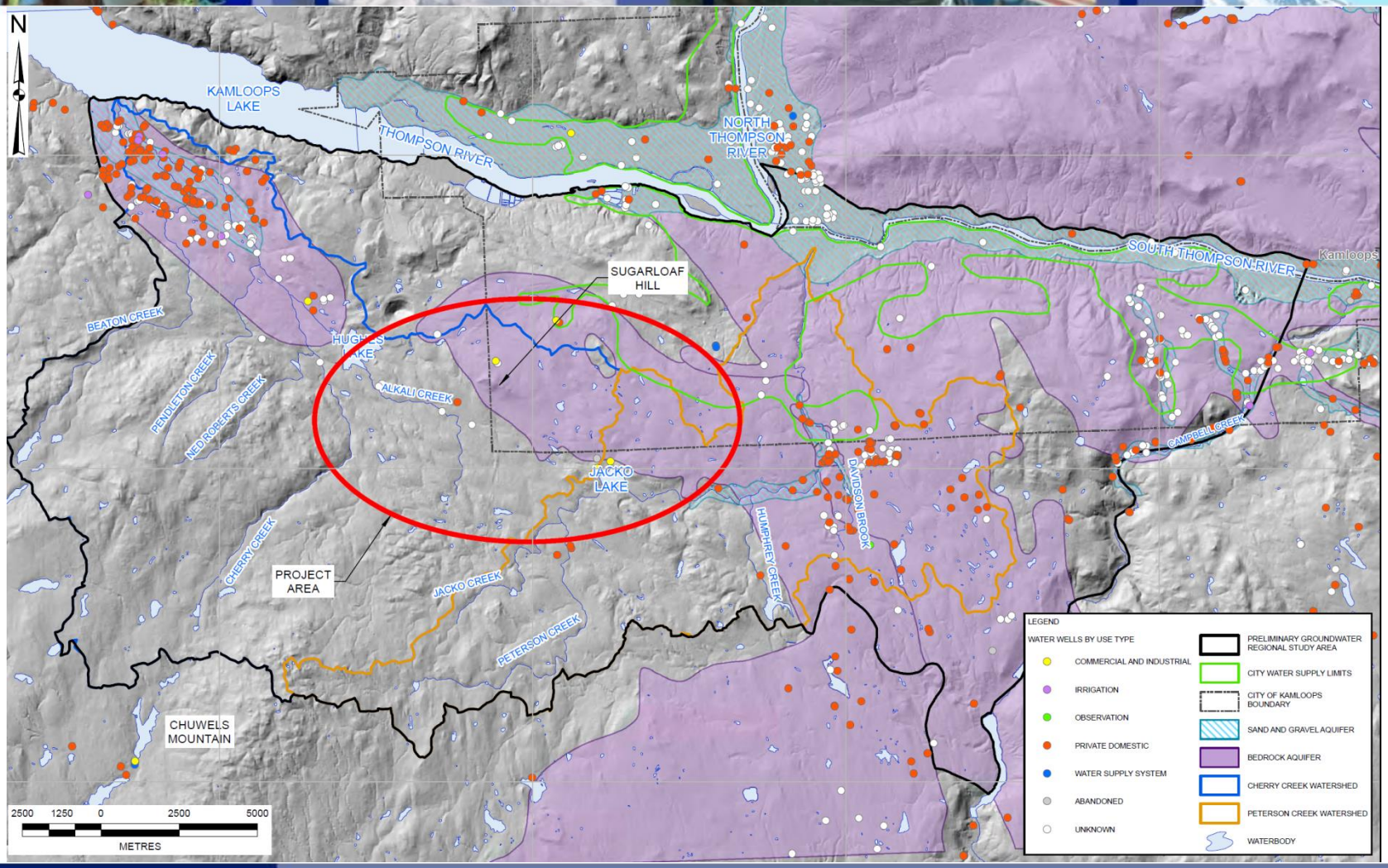
Hydrologic System



Streamflow and Water Quality Monitoring Locations

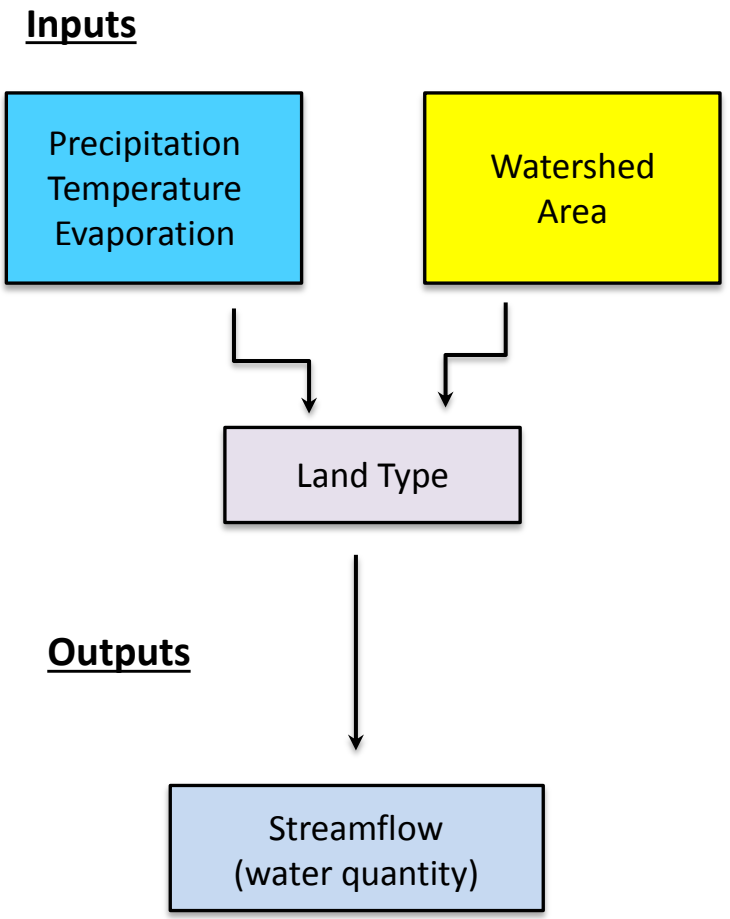


Baseline Groundwater Study Area



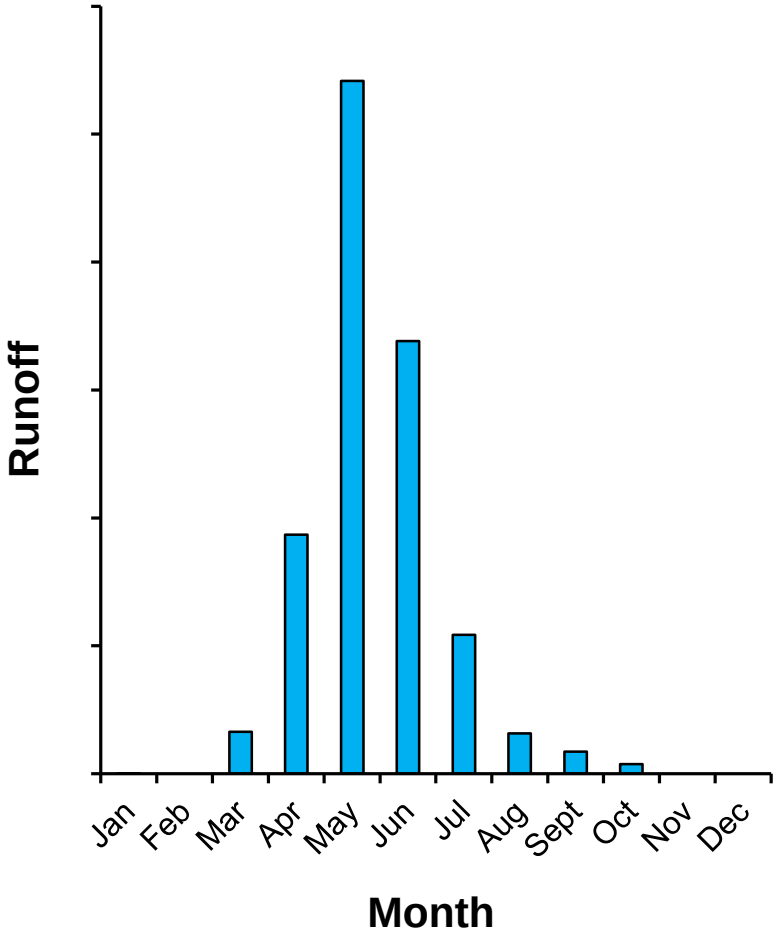
Surface Water Modelling

- Water Balance Model (WBM) developed for the project area
  - Spreadsheet based model (Excel)
  - Monthly time-step used
  - Calibrated to observed streamflow data
  - Groundwater modelling results are an input to the model
- The WBM considers:
  - Existing conditions
  - Operations
  - Closure
  - Post-Closure



Surface Water Modelling

- The principal objectives of the WBM are to:
  - Assess the impact of the mine at various stages of development on streamflow quantity at various locations on Peterson Creek and Cherry Creek
  - Model results are also merged with geochemical source data to estimate future water chemistry in the proposed mine facilities and downstream environment

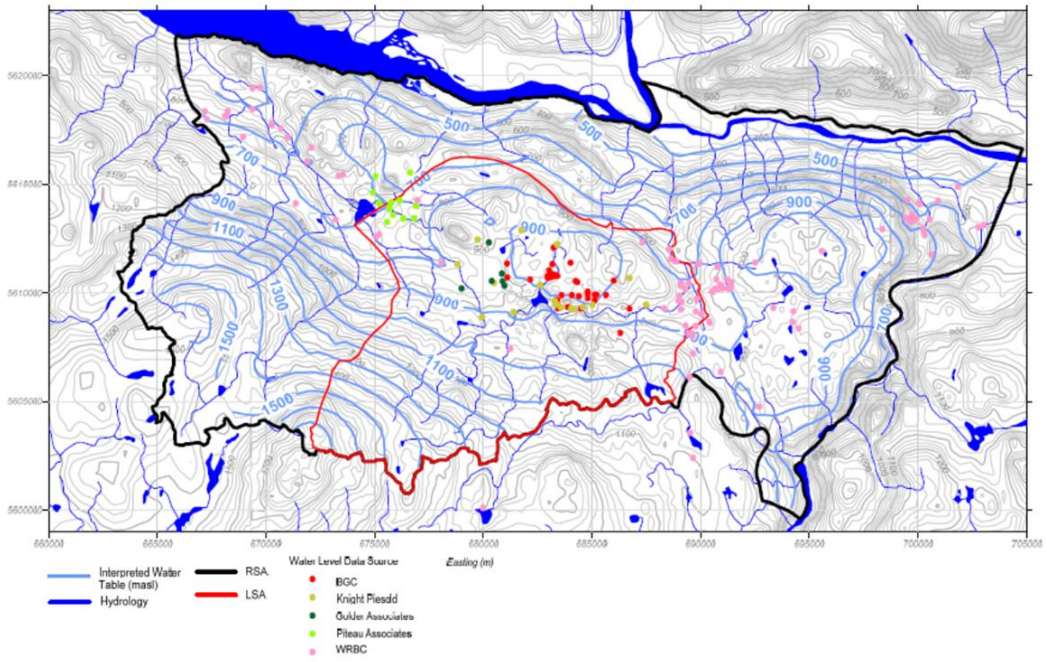


Groundwater Modelling

- 3D Groundwater Flow Model developed for the Project
  - Winter and summer stress periods
  - Surficial and Bedrock Aquifers considered
  - Calibrated to observed groundwater elevations and streamflow
  - Climate inputs consistent with WBM
- 3D Groundwater Flow Model considers:
  - Existing conditions
  - Operations
  - Closure
  - Post-Closure
- Principal Objectives of the Groundwater Flow model are to:
  - Assess the impacts of the mine on groundwater flow patterns and groundwater quantity
  - Identify potential seepage migration pathways for monitoring and mitigation (if needed)

Groundwater Modelling (cont.)

- Specific objectives of the assessment include:
  - Assess potential impacts to Jacko Lake from Open Pit
  - Assess potential impact to Aberdeen Subdivision
  - Assess potential impacts to Peterson Creek and Davidson Aquifer



Water Quality Modelling

Major Factors Influencing Local Water Chemistry

- Arid climate
- Topography (brackish to saline ponds)
- Managed water system with many water licences
- Historic mining features
  - Waste rock and associated water management features (seepage collection ponds)
  - Open Pits
  - Tailings facility (Cherry Creek watershed)
- Ranching activities

Effects Assessment – Water Quality and Quantity

- Mass balance water quality model under development
- Used to estimate future water chemistry in the proposed mine facilities and downstream environment
- Major inputs are:
  - Operational and site-wide water balance / watershed model
    - From baseline through post-closure
  - Geochemical source terms – developed for all mine contact sources (i.e., waste rock, ore, tailings, etc.)
  - Baseline water chemistry
- Model outputs used in HHERA and aquatics (this includes invertebrates, plants and fish) impact assessment for the project

Water Quality Modelling

Guidelines for Water Quality

CCME Canadian Environmental Quality Guidelines

- Aquatic Life
- Agricultural Water Uses (Livestock and Irrigation)

Health Canada Guidelines

- Drinking water quality

BC Water Quality Guidelines:

- Drinking water supply (Raw)
- Freshwater aquatic life
- Wildlife water supply
- Livestock water supply
- Irrigation water supply
- Recreation & aesthetics

Knight Piésold
CONSULTING

BGC

Thank You

Questions?

Summary of the Atmospheric Dispersion Modelling for the Ajax Mine Project

Dave Randall
Principal Air Quality Scientist
Air Sciences Inc.

AIR SCIENCES INC.
DENVER • PORTLAND

Presentation Outline

- Presentation Outline:
  - Introduction
  - The Model Plan
  - Selected Model
  - Emission Sources
  - Substances of Interest
  - CALPUFF Domain Size & Location
  - Special Receptors for the HHERA
  - Quality Management & Reporting

Introduction

- The Air Quality Assessment (“AQ Assessment”) is an integral part of the KGHM Ajax Mining Inc. (“Ajax”) Environmental Assessment (“EA”).
- Ajax has retained Stantec Consulting Inc. to prepare the Detailed Dispersion Modeling Plan. Air Sciences Inc. was retained by Ajax to perform a 3rd Party Review and advisor to Ajax and Stantec.
- Computer-based atmospheric dispersion modelling is the mathematical simulation of how air pollutants disperse in the atmosphere.

Introduction

- Dispersion models are used to estimate the downwind concentration of airborne substances emitted from sources such as industrial plants.
- Among other applications, dispersion models are used to support decision-making pertaining to:
  - Levels of air pollution control necessary to demonstrate an existing or proposed industrial facility's compliance with the Ambient Air Quality Objectives (AAQO).
  - The issuance of air permits based on the finding that an industrial facility's emissions are not anticipated to cause or contribute to an exceedance of an AAQO.

Adapted from the Wikipedia entry for "atmospheric dispersion modeling".

The Model Plan

- A Detailed Dispersion Modelling Plan (“Plan”) has been developed by Stantec, has undergone 3rd party review, and has been approved by the BC Ministry Of Environment (MOE).
- The Plan has been developed in consultation with the EA Working Group and Project staff (engineering, operations, and environmental).
- It also considers written stakeholder input provided by:
  - The BC CDC (Elliott, 2012)
  - The City of Kamloops (Fretz, 2012)
  - Interior Health (Palm, 2012)
  - KAPA (Steyn & Ainslie, 2012)

The Model Plan

- In the preparation of the Plan and in the setup of the model, all aspects of model input and set-up are evaluated for consistency with BC MOE modeling Guidelines.
- A goal is for the final selection of model inputs and set-up to adhere to the Plan *and* to prepare model simulations that are likely to be representative of actual conditions at the Project.
- Consistency with the Guidelines assures that the modeling results will be conservative (i.e., the modeled prediction of impacts to air quality will likely be higher than actual impacts caused by emissions from the Project).

Selected Model - CALPUFF

- The model employed to assess the Project is the CALPUFF modelling system.
- CALPUFF is a BC MOE recommended “Core” refined model for this type of assessment.
  - Core models are those recommended by the U.S. Environmental Projection Agency (US EPA).
  - Also referred to as “regulatory models, ” they can be used to estimate impacts due to emissions from sources and to compare estimated impacts to applicable air quality standards (such as the AAQO).

Selected Model - CALPUFF

Main components of the CALPUFF modeling system:

- **CALMET** (a 3-dimensional meteorological model). CALMET simulates atmospheric conditions for one year in the Project area hour-by-hour.
- **CALPUFF** (an air quality dispersion model). CALPUFF simulates how emissions are released, transported downwind, and affect ambient air quality concentrations at receptors at and beyond the Project area boundary.
- **CALPOST** (a post-processing program). CALPOST contains features that support various uses of data predicted by CALPUFF.

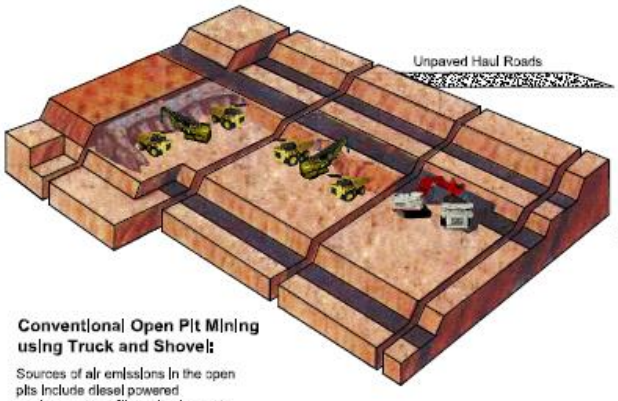
Important Inputs to CALPUFF

- Meteorological data (CALMET)
- Information about emissions sources:
  - Location
  - Emission rates
  - Characteristics of the emissions
- Digital terrain and land cover information
- Locations of receptors

Emission Sources

- Two Project modelling scenarios will be evaluated:
- Construction – considerable surface disturbance and material movement.
- Maximum Year – “worst case” year of mining operations based on evaluation of: high or maximum levels of mining activity; maximum short-term and annual emissions; source locations relative to Project boundary.

Emission Sources



Unpaved Haul Roads

Conventional Open Pit Mining using Truck and Shovel:

Sources of air emissions in the open pits include diesel powered equipment for drilling, blasting and truck loading, and fugitive dust from unpaved haul roads

Primary Crusher

Covered Conveyor and Coarse Ore Stockpile

Covered conveyor, therefore minimal or negligible particulate emissions

Stockpile Enclosure

Crushed Ore Stockpile Reclaim:
A dust collector (reverse pulse type) reduces particulate emissions

Covered conveyor between the coarse ore stockpile and process plant, minimal or negligible air emissions

Miscellaneous Sources of Air Emissions:

1. **Till, Dry Stack Tailings & Waste Rock Storage Areas:** Fugitive dust is created during dry conditions by truck unloading, dozing and grading. Air emissions from diesel equipment. Best management practices / mitigation will be used to minimize fugitive dust from these areas.

Process Plant

The process plant contains several processes such as crushing, grinding, flotation, thickening and filtration. Ore processing rate = 60,000 tonnes/day. Pebble crushing and concentrate storage will use a dust collector (reverse pulse type) to reduce particulate emissions but the other processes are wet, therefore negligible air emissions. The end product is a concentrate containing gold and copper.

Unpaved Haul Roads to Public Highway

Resource development access road between the process plant and the nearest public highway. There will be fugitive dust emissions during periods with low precipitation (summer) and diesel emissions from concentrate trucks and trucks delivering the consumables (e.g. explosives, maintenance supplies, grinding balls, reagents).

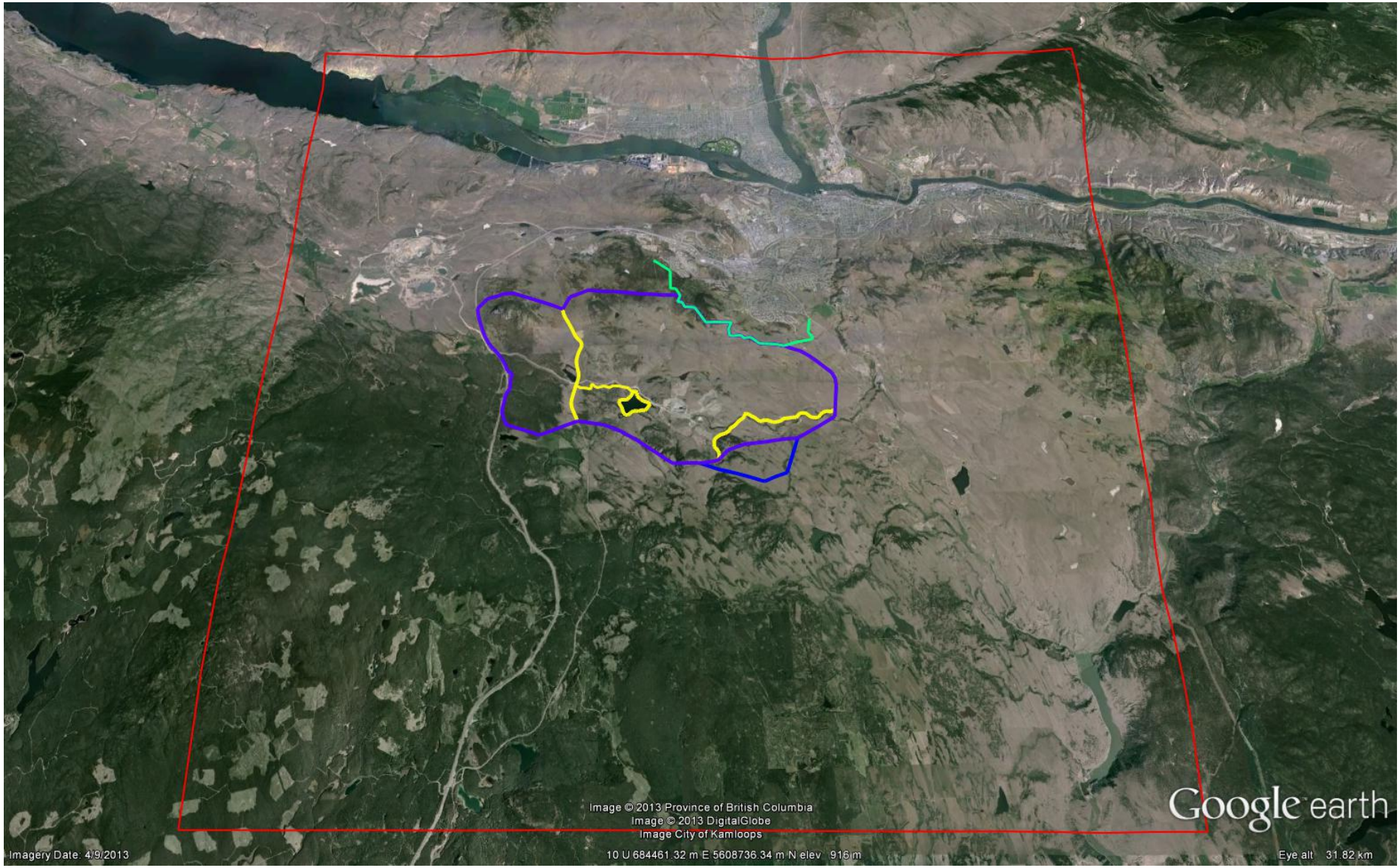
Gold/copper concentrate transported to the Port of Vancouver for shipment to offshore smelters.

Substances of Interest

- The substances of interest included in the modelling are:
  - Total Dustfall (DF)
  - Total Suspended Particulate Matter (TSP)
  - Inhalable Particulate Matter (PM_{10})
  - Respirable Particulate Matter ($PM_{2.5}$)
  - Sulphur Dioxide (SO_2)
  - Total Oxides of Nitrogen (NO_X)
  - Carbon Monoxide (CO)
- In addition, for the HHERA, potential contaminants (metals contained in dust and polycyclic aromatic hydrocarbons (PAH) contained in diesel emissions) from the various Project phases will be modelled.

CALPUFF Modeling Domain

- The CALPUFF modelling domain is 25 km long x 25 km wide, centered on the open-pit mine site.
- The CALPUFF domain includes most of the City of Kamloops excepting the Westsyde and Rayleigh developments in the North Thompson valley and Barnhartvale, Dallas, and Monte Creek to the East.
    - The CALPUFF domain is sized to capture all “values of interest” consistent with the Guidelines.
    - The Guidelines recommend that all predicted concentrations greater than 10% of the applicable ambient air quality objective (AAQO) be contained within the domain.
        - For example, the Canada 1-hour AAQO for NO2 is 210 ppb. Modeled concentrations of1-hour NO2 above 21 ppb should lie within the domain.
        - ***The size of the domain is expected to be sufficiently large to satisfy this recommendation.***

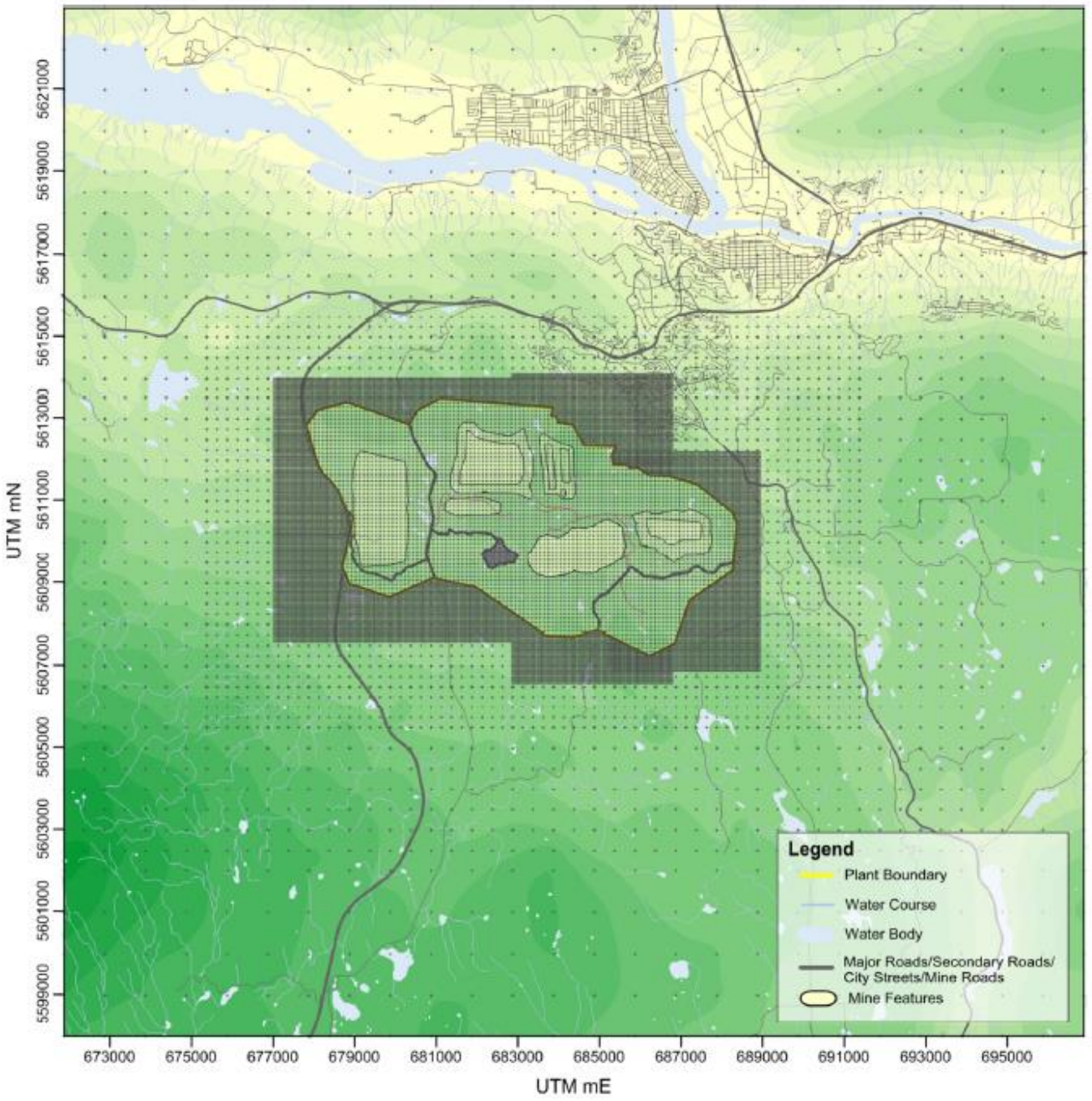


Large red box: 25 x 25 km modelling domain.
Yellow features: Jacko Lake and Roads.

Blue outline: Plant Boundary or modelling “fenceline”
Green line: City of Kamloops Development Boundary

Gridded Receptors

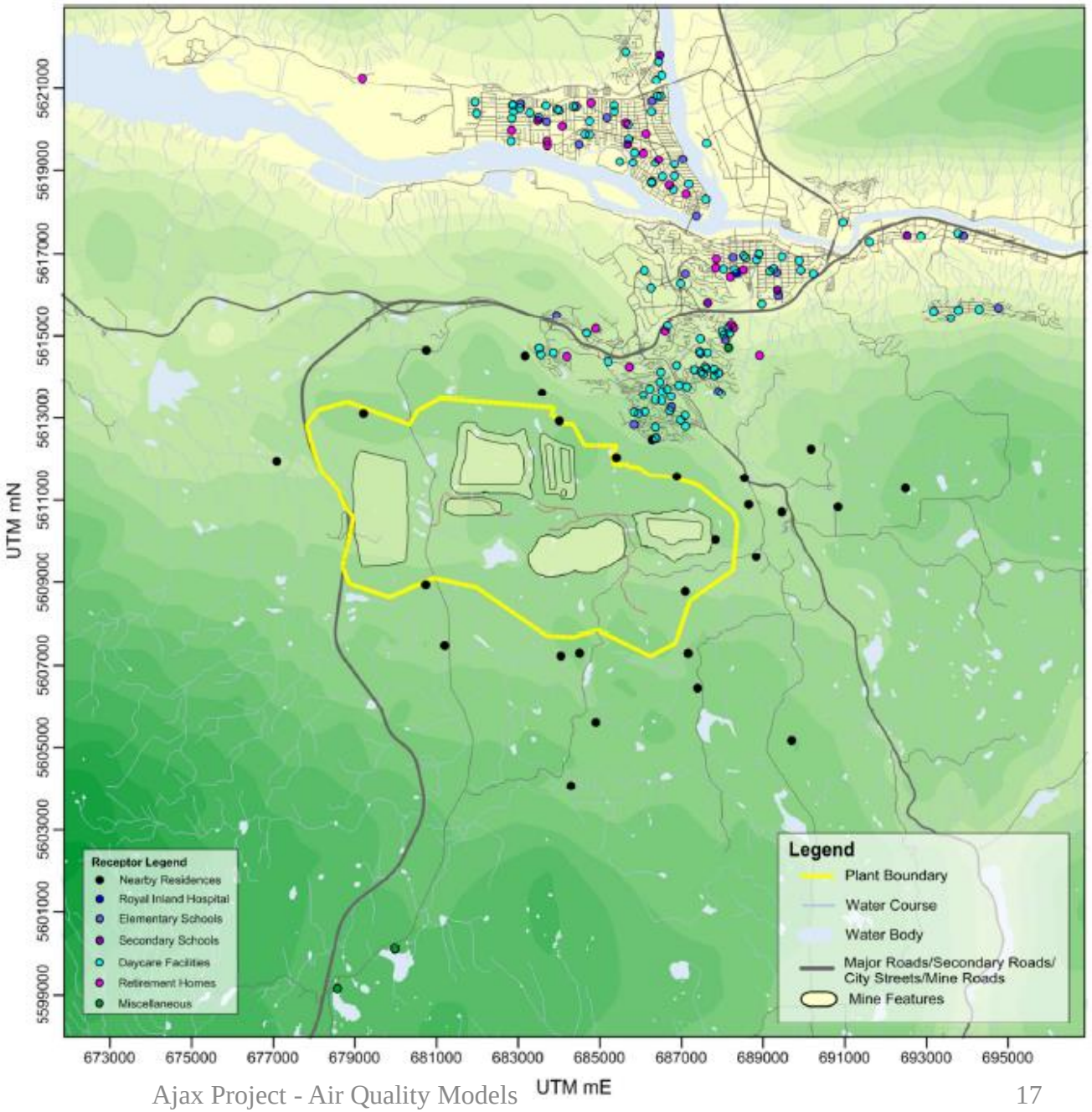
Model receptor grids decrease in density as distance from the Project increases.



Special Receptors for the HHERA

- For the HHERA, metals and other chemical species will be modelled.
- An additional 191 special receptors will be included (per the final Plan) (Stantec, 2013b: Appendix B, Table A-1).
  - 27 nearby residences (also designated as noise receptors),
  - The Royal Inland Hospital
  - 21 elementary schools
  - 6 secondary schools
  - 110 daycare facilities
  - 23 retirement homes, and
  - 3 miscellaneous receptors.

Special Receptors for the HHERA



Quality Management

- Quality assurance and quality control procedures will be employed to confirm the accuracy of the source inputs, receptors, meteorological data, and the proper behavior of the models.
  - Both input and output files will be subjected to rigorous examination to ensure that they are free of errors. Outputs will be examined for consistency with expectations based on experience with other, similar application of dispersion models and modeling theory.
  - This includes a series of documented technical reviews by personnel (including high-level Senior/Principal staff) not involved in the day-to-day work on the project.
  - It will also include a third-party review by Air Sciences Inc., a firm with considerable dispersion modeling experience with mining projects. The review will be performed by staff with the qualifications and experience to perform similar work.

Reporting

To support the air quality/atmospheric “Valued Component” of the Environmental Assessment for the Ajax Project, a Technical Data Report will be prepared that is expected to include:

1. Introduction
2. A description of Regional Air Quality and Climate
3. Substances of Interest selection process
4. A full description of the Dispersion Modelling (CALMET / CALPUFF)
5. Tabular and graphical presentation of results for Construction and Maximum Year of Operation. A discussion of results interpretation and modeling precision and uncertainty will be included.
6. Findings, Summary, and Conclusions
7. References

Appendices (A – F): Tabulated Climate Normals; Approved Model Plans; CALMET; CALPUFF; Emission Inventory; Dispersion Modelling Isopleth Maps

Thank you!

Questions?