Summary of the Atmospheric Dispersion Modelling for the Ajax Mine Project

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Presentation Outline

- Presentation Outline:
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  - 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.

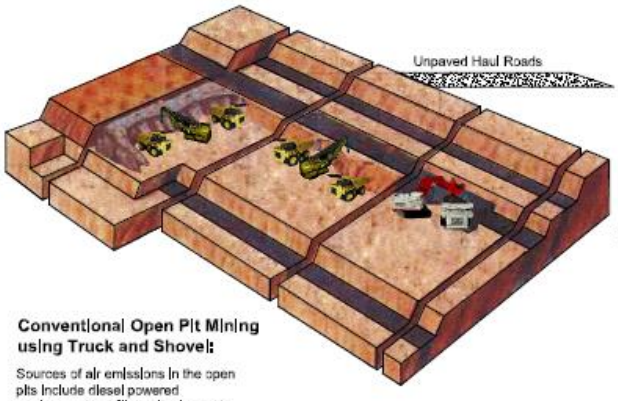
Important Inputs to CALPUFF

- 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).

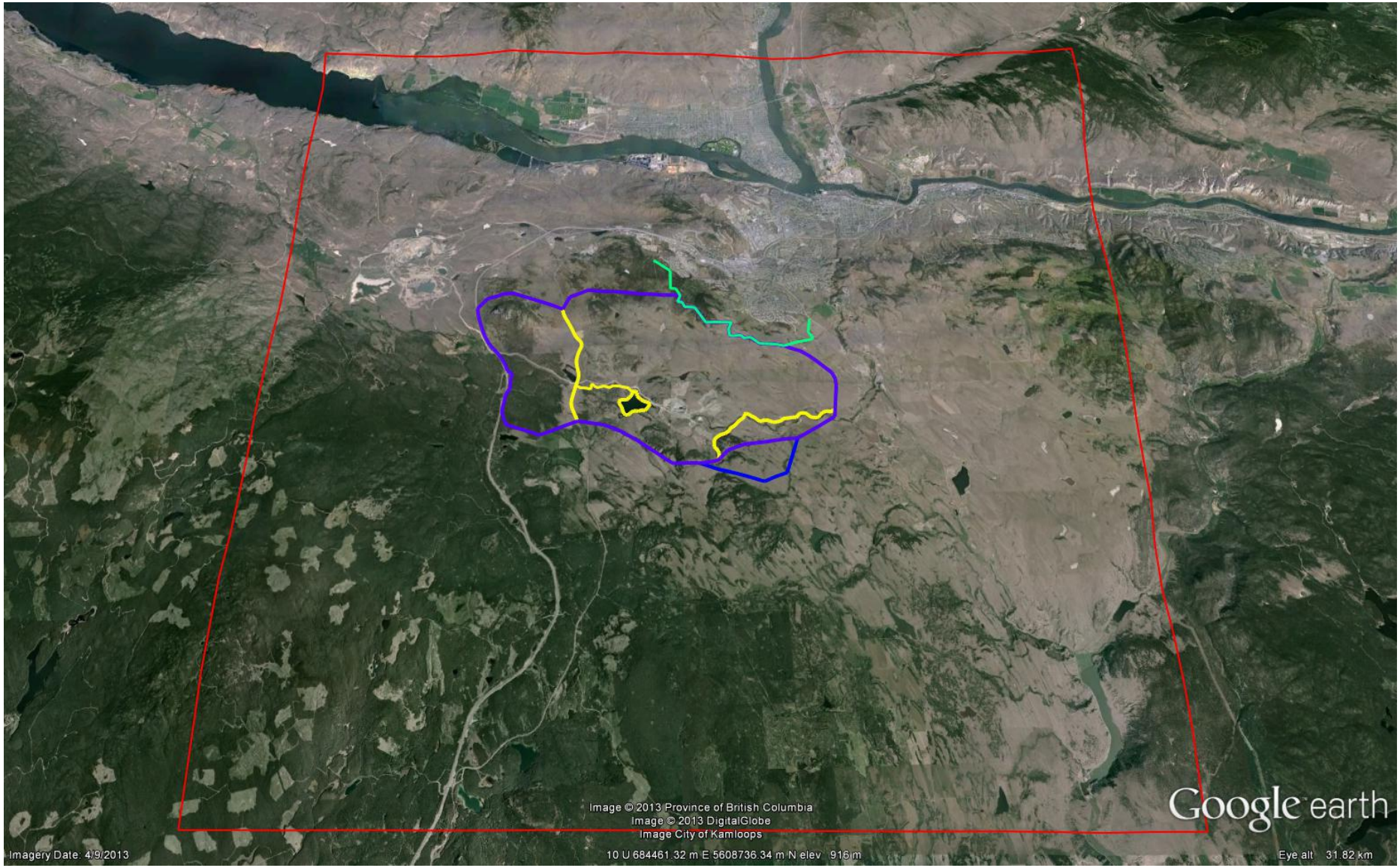
Gold/copper concentrate transported to the Port of Vancouver for shipment to offshore smelters.

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.***

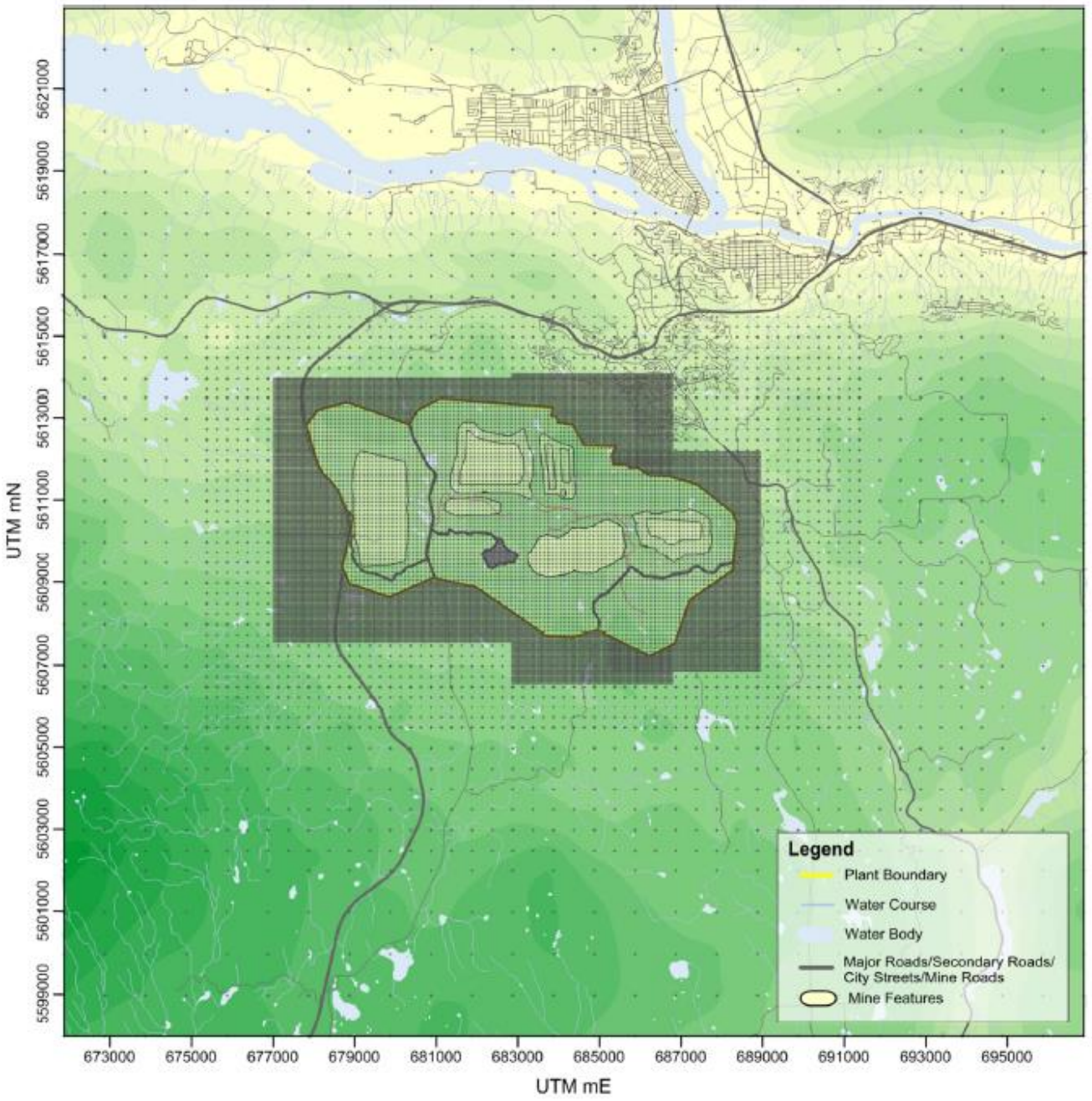


Large red box: 25 x 25 km modelling domain.
Yellow features: Jacko Lake and Roads.

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

Gridded Receptors

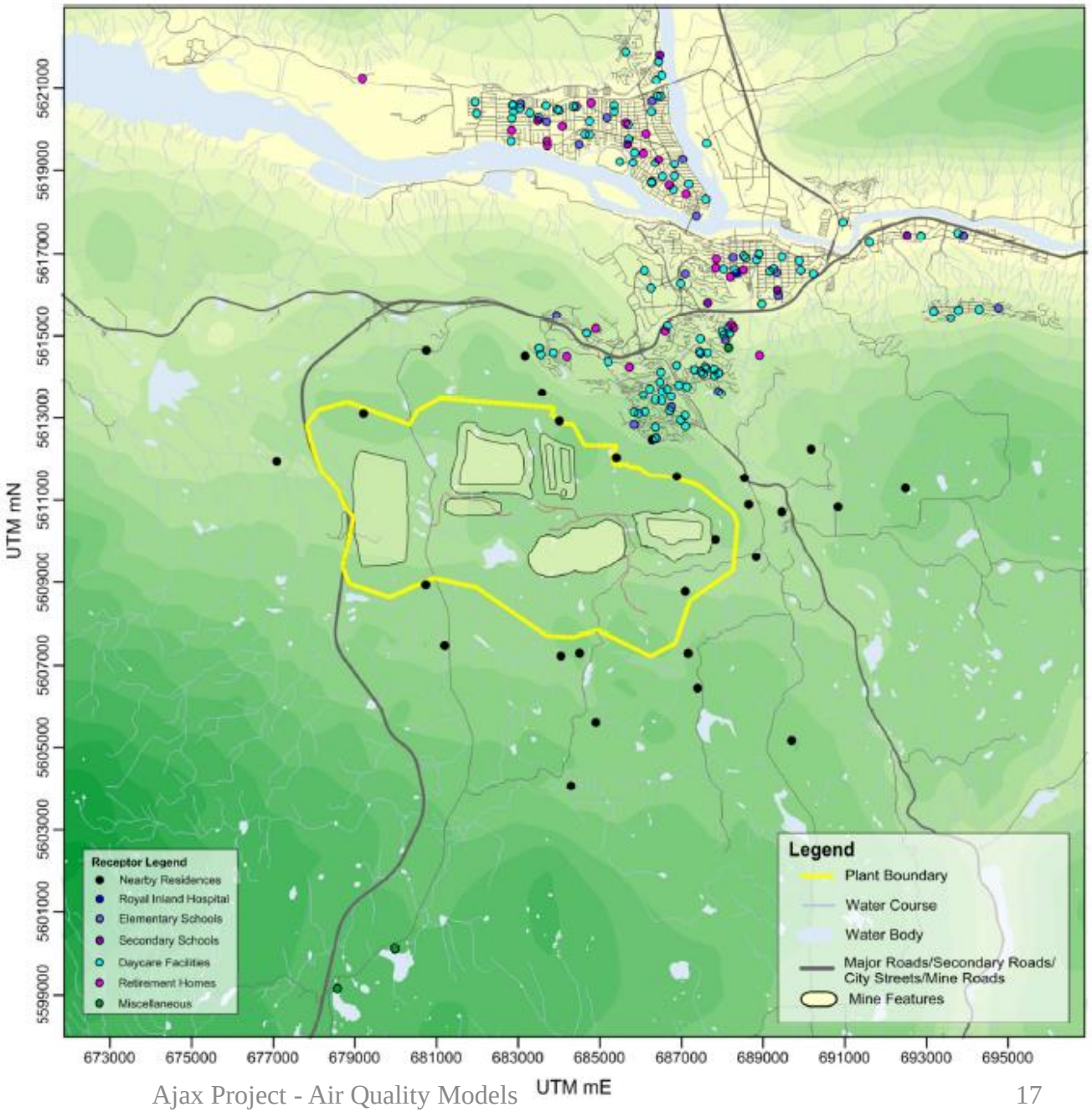
Model receptor grids decrease in density as distance from the Project increases.



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?