



**Draft
Mine-Area Ecological Risk
Evaluation**

**Prepared In Support of Red
Dog Mine Closure Plan
Development**

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Purpose of this Study

- **Activities within the mine area release dust to the environment**
- **We want to know:**
 - Is the dust that has been released harmful to animals?
 - Will the dust released between today and mine closure be harmful?

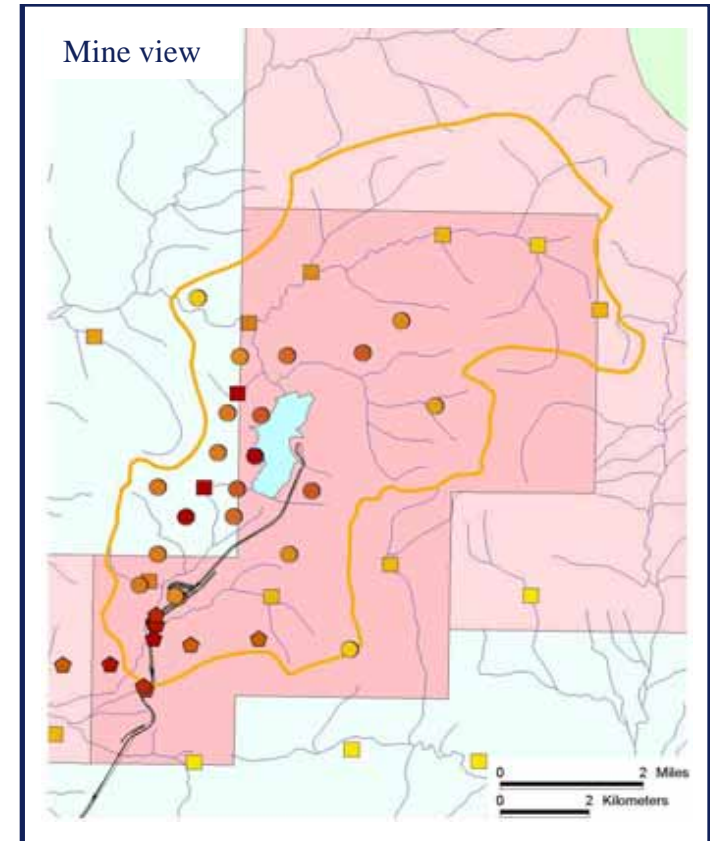
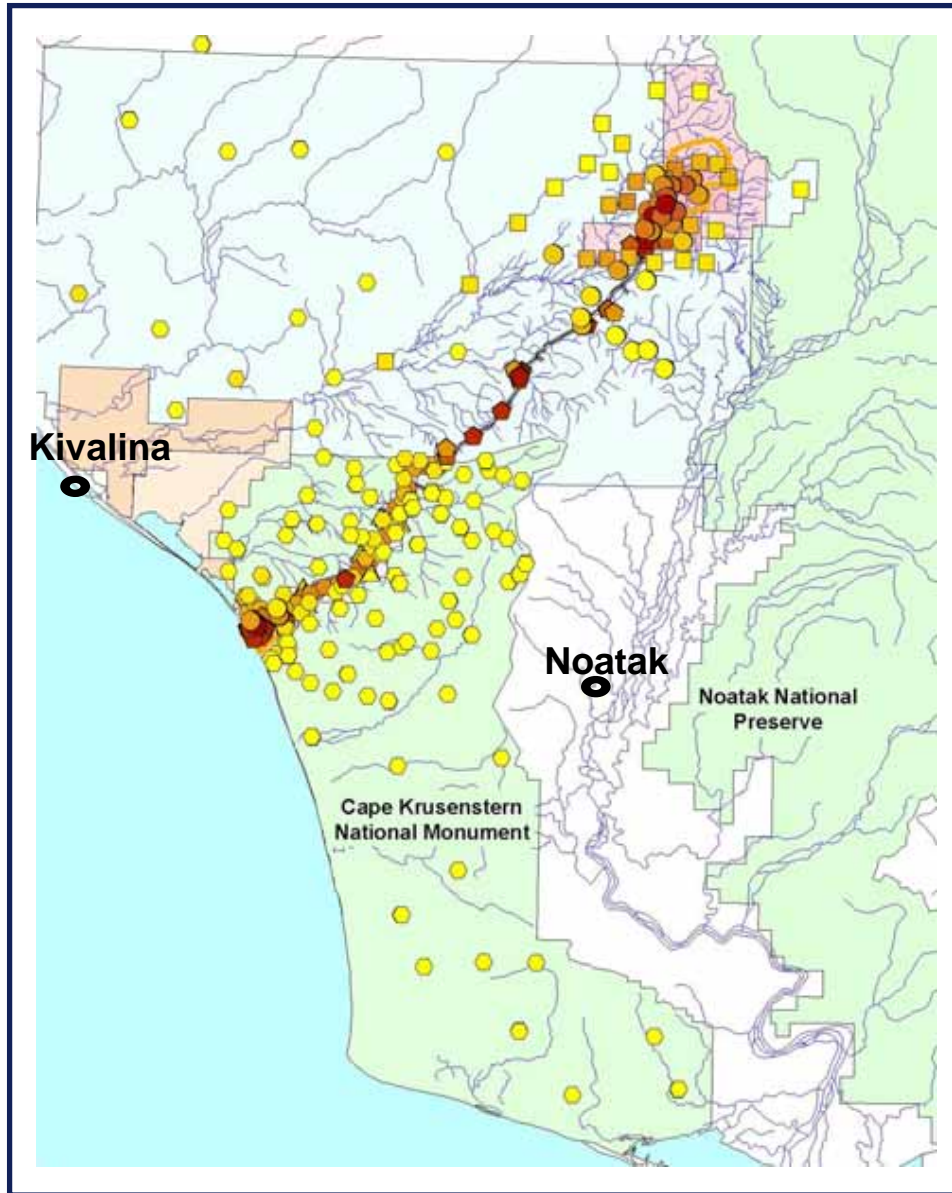
Presentation Outline

- **Background Information**
- **Animals Studied**
- **Metals Studied**
- **Information Used in the Study**
- **Summary of Results**
- **Conclusions**
- **Q&A**

Background Information

- In 2001, dust deposition was identified as a problem needing more study
- Exponent was brought in to study the dust deposition and evaluate potential effects to people and animals
- Sampling and risk assessment work has been conducted over past 4 years

Regional Moss Samples



LEGEND

Sample data set

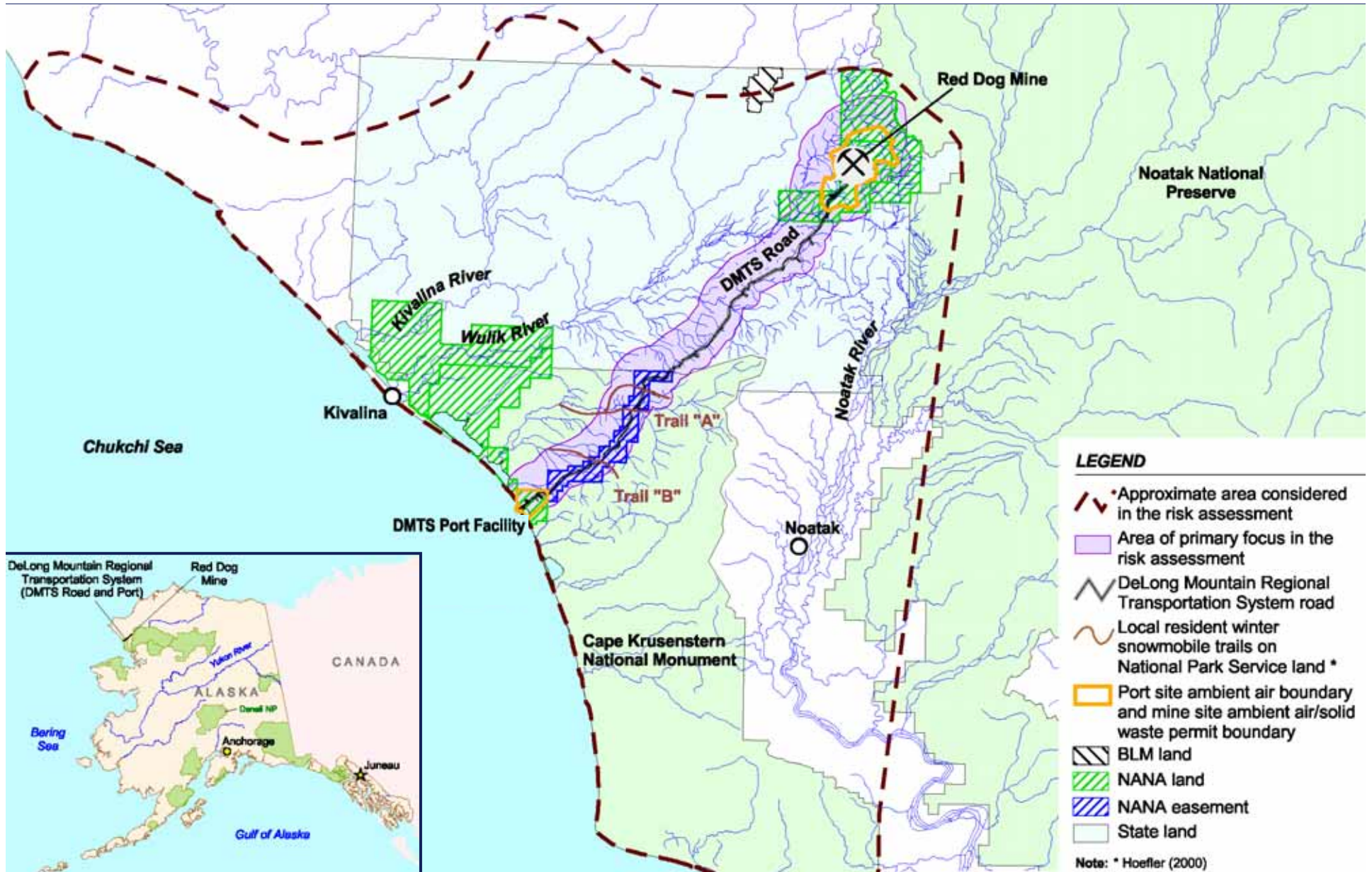
- Exponent 2003
- Exponent 2002
- Exponent 2001
- National Park Service 2001
- △ National Park Service 2000

Lead (mg/kg)

- < 25
- 25 - 50
- 50.1 - 100
- 100.1 - 150
- 150.1 - 250
- 250.1 - 500
- 500.1 - 750
- 750.1 - 1,000
- 1,000.1 - 1,500
- > 1,500

- Port site ambient air boundary and mine site ambient air/solid waste permit boundary

DMTS Risk Assessment Study Area



Mine Area



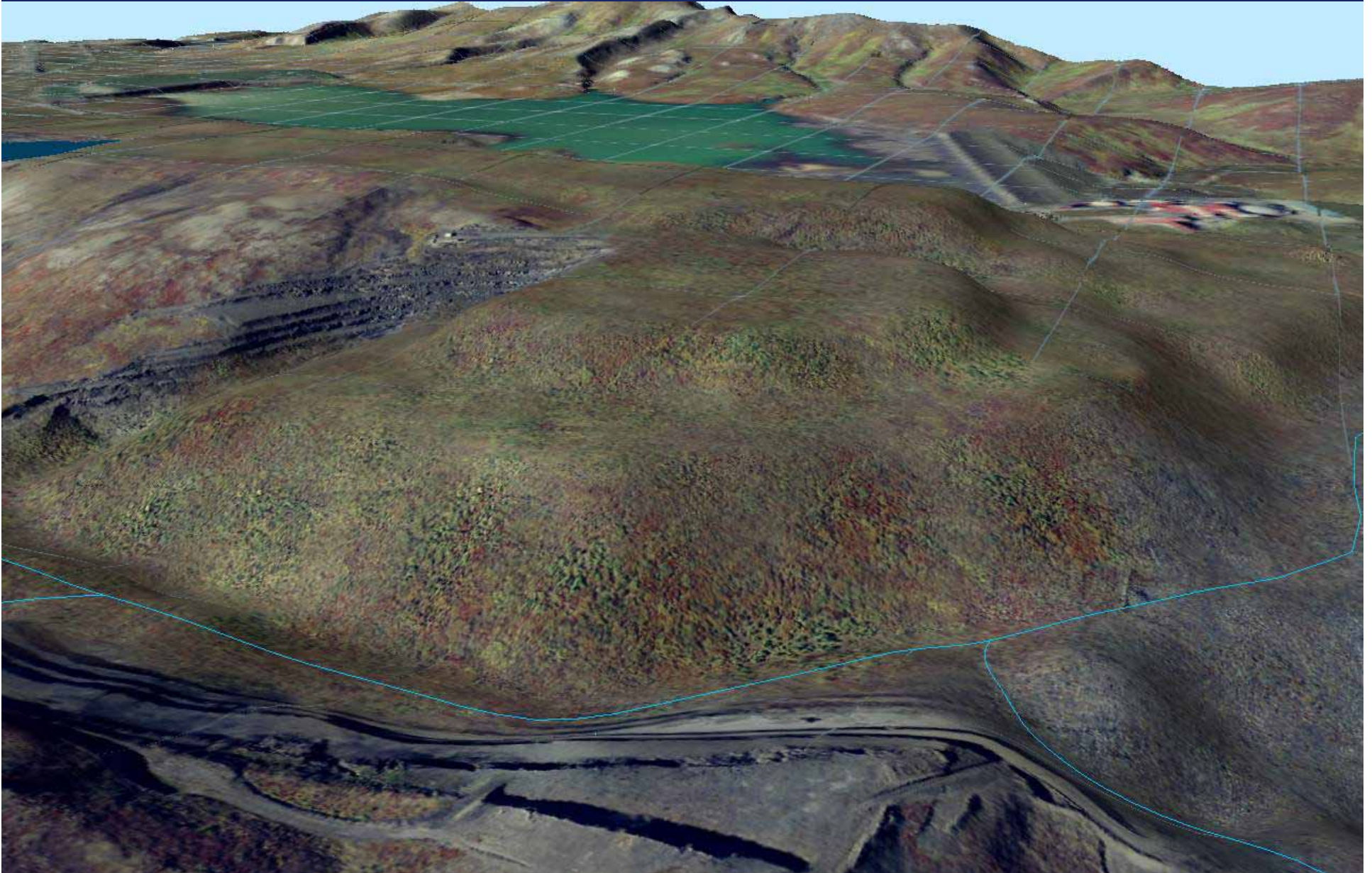
Background Information – *continued*

- **Ongoing closure plan development is part of state solid waste permitting process for the area within the mine boundary**

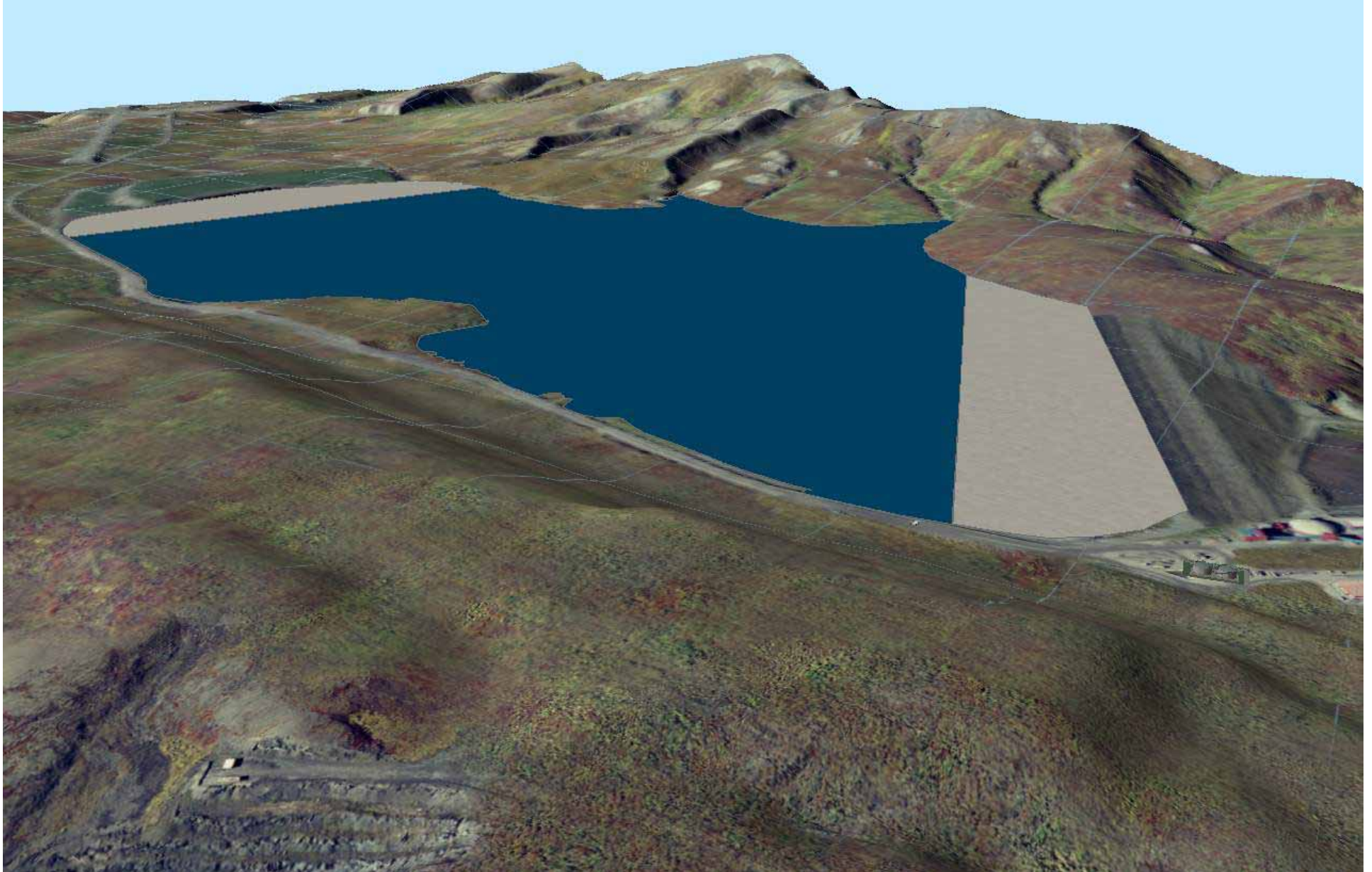
Current Conditions



Possible Closure Conditions – Main Pit



Possible Closure Conditions – Waste Rock Pile and Tailings Pond



Animals That We Studied

- Caribou (herbivore)
- Ptarmigan (herbivore)
- Arctic fox (carnivore)
- Green-winged teal (aquatic herbivore)
- Muskrat (aquatic herbivore)
- Tundra vole (herbivore)
- Tundra shrew (insectivore)



Metals That We Looked At

- **Metals selected for study**
 - Lead
 - Zinc
 - Cadmium
- **These metals are expected to present the greatest potential to cause ecological effects**

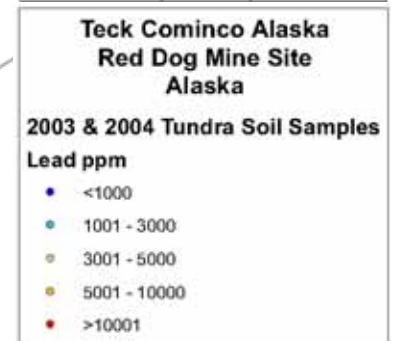
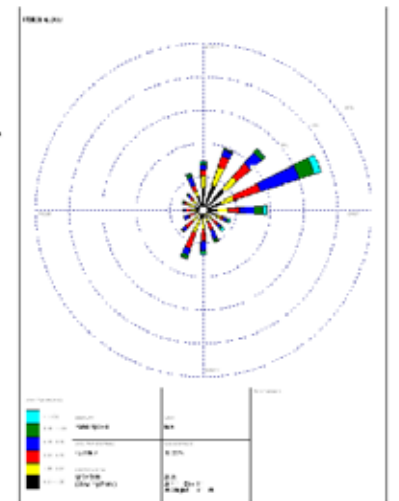
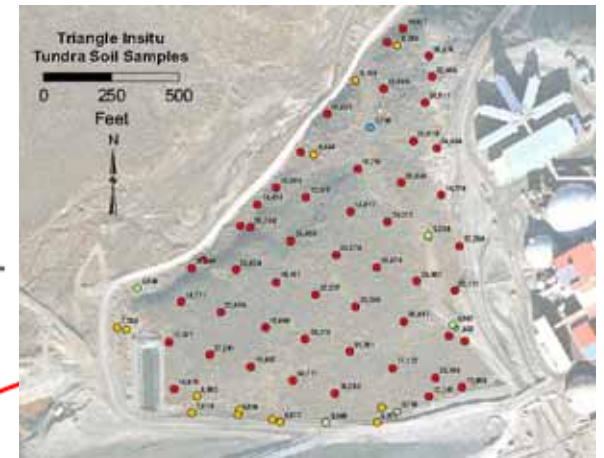
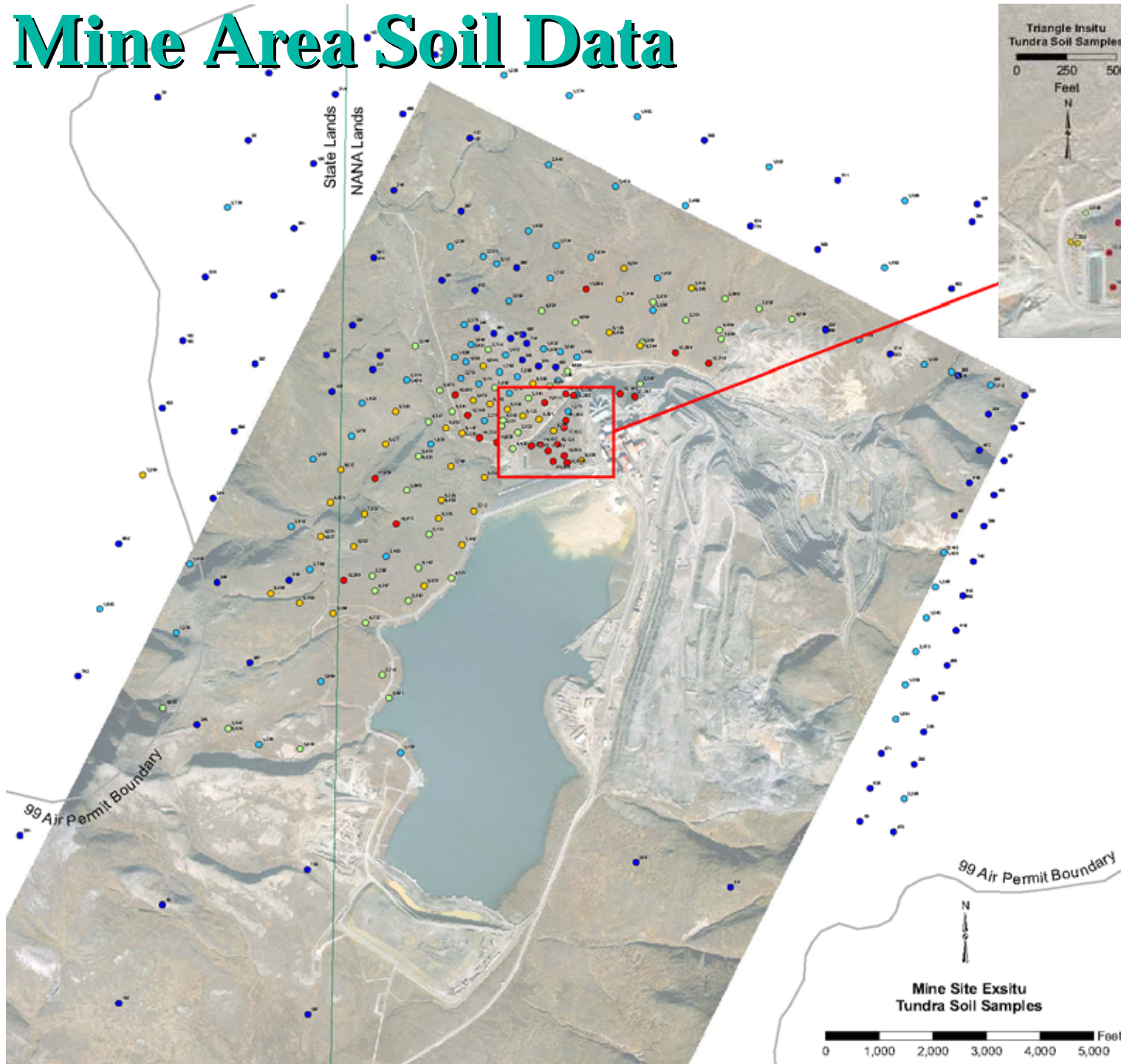
Information Used in the Study

- **Metals concentration information used for the analysis:**
 - Soil
 - Water
 - Stream water, tailings pond water, pit lake water
 - Foods for the animals
 - Moss
 - Lichen
 - Willow and birch (trees and shrubs)
 - Sedge (grasses)
 - Invertebrates (insects)
 - Small mammals (vole, shrew)

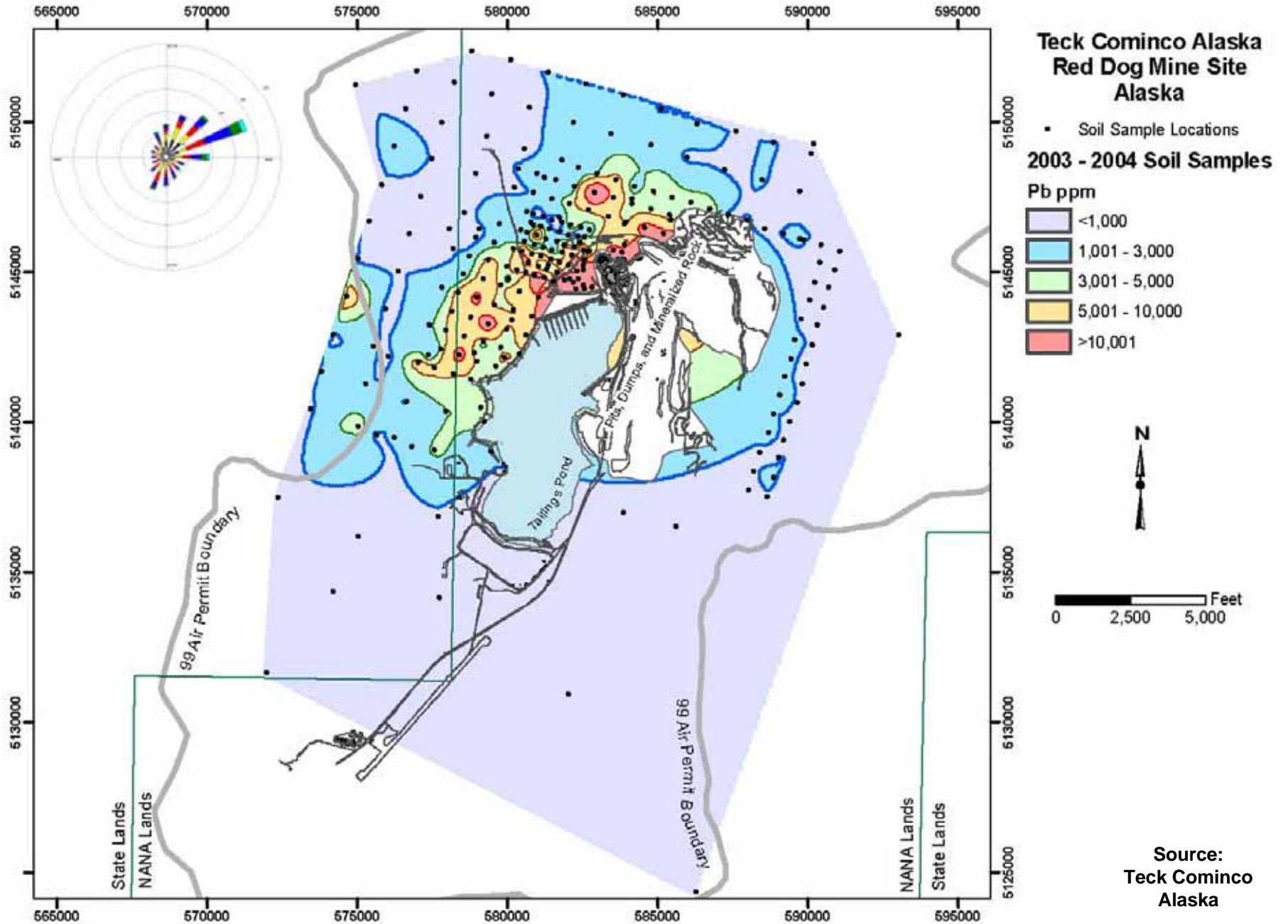
Information Used in the Study – *continued*

- **Existing mine-area information put together in early 2005 by Teck Cominco**
- **Includes soil sampling information from around the mine facilities**

Mine Area Soil Data

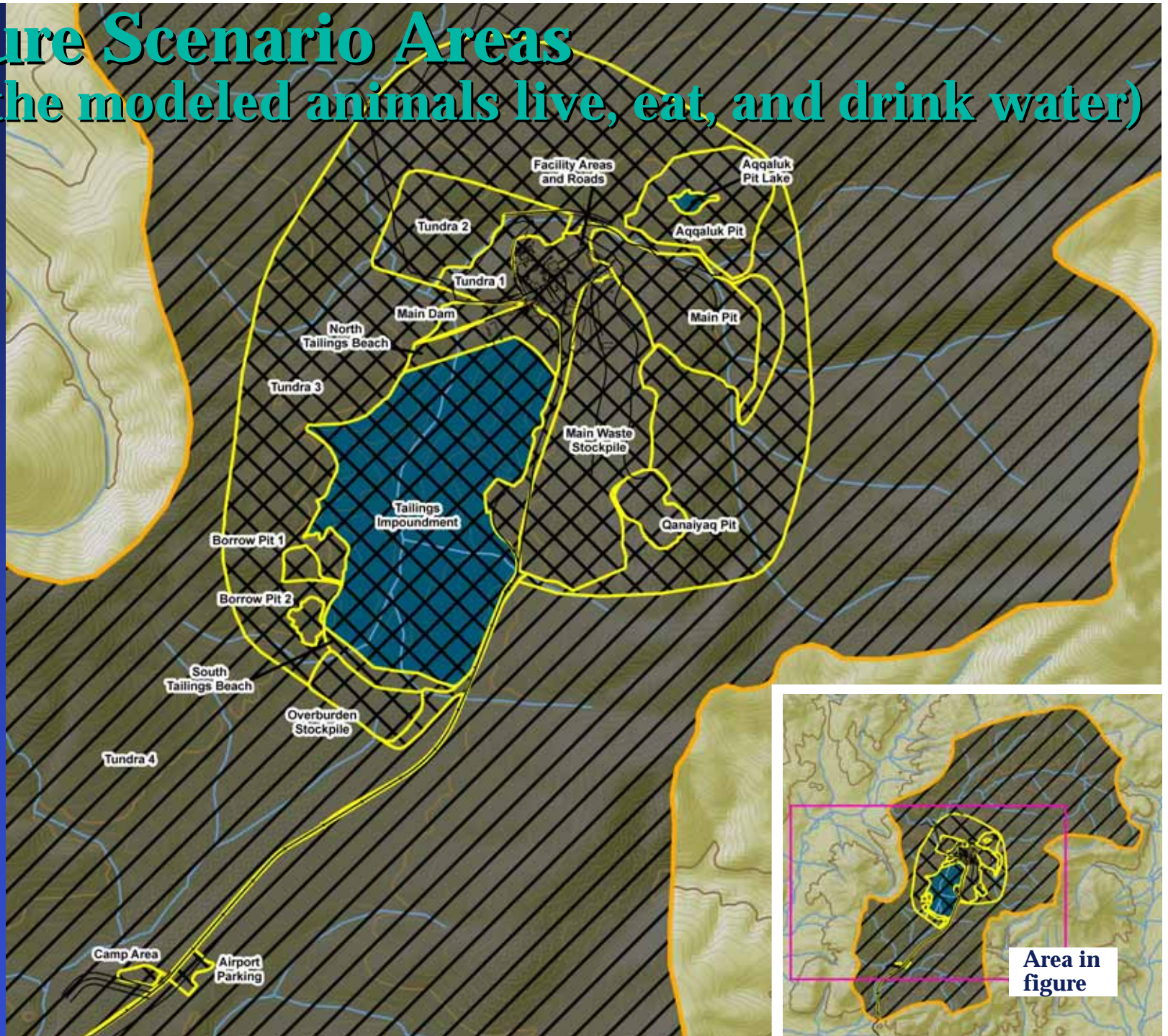


Mine Area Soil Lead Contours



Exposure Scenario Areas

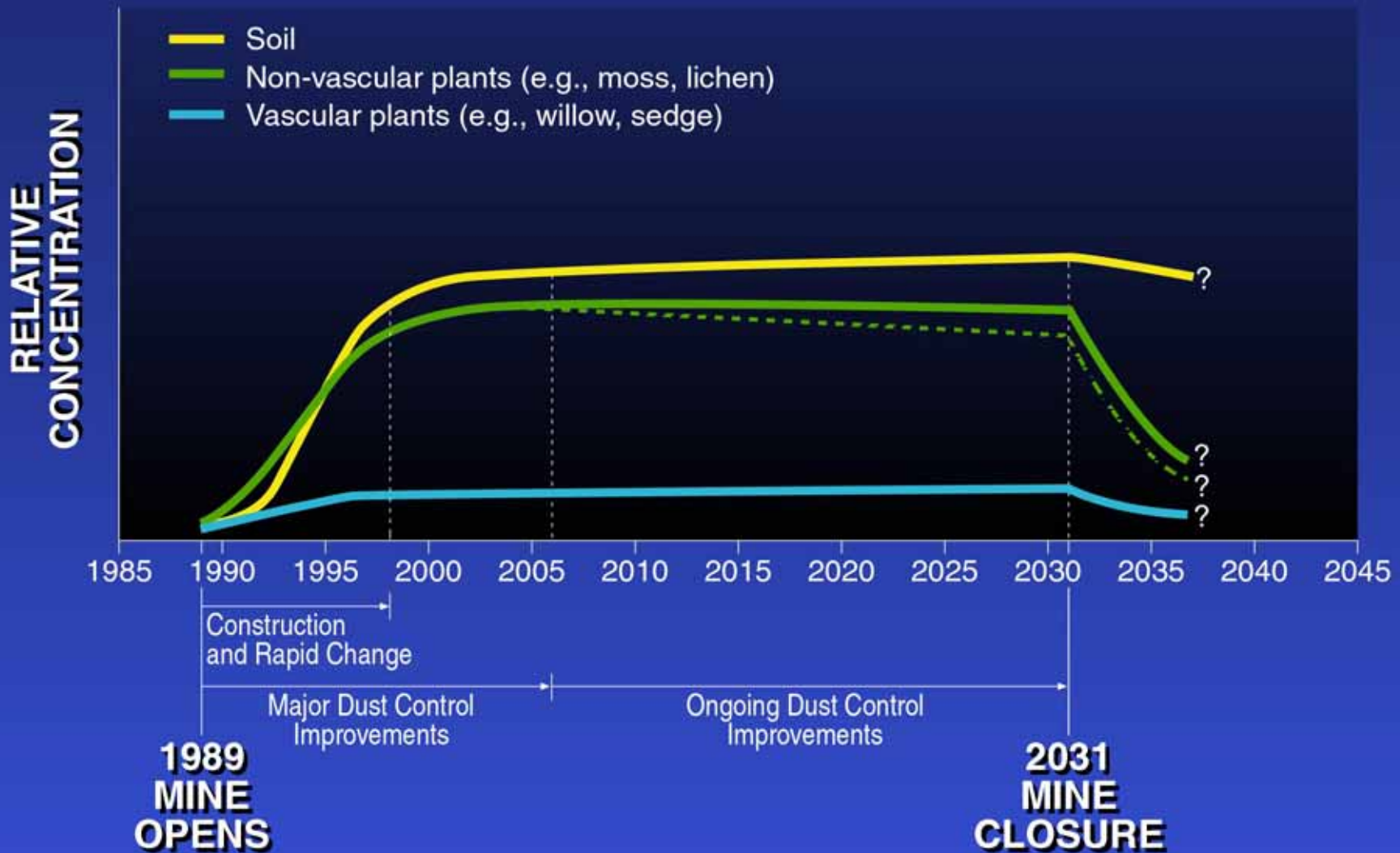
(Where the modeled animals live, eat, and drink water)



Conservative (Protective) Assumptions

- Used high concentration estimates to be protective
- Assumed large increase in concentration over time
- Included all facility areas as exposure areas
- Assumed high use of site areas by animals
- Bioavailability – assumed all metals taken in are kept in the body
- Form of metal used in animal studies

Conceptual Model of Concentration Change over Time



Why Are Metals in Soil Less Bioavailable?

- Metals in soil are attached to particles
- When metals are attached to particles, they are less well absorbed by the body
- Certain forms of the metals are less well absorbed than others

How Bioavailable is Lead in Soil?

State	Site	Bioavailability
Utah	Salt Lake City	19 to 30 percent
Oklahoma	Bartlesville	20 percent
Montana	Butte	12 percent
Alaska	Skagway	3 to 9 percent
Alaska	Red Dog	7 to 13 percent

Results of Ecological Evaluation

- **Caribou**
 - Current Conditions
 - No effects predicted
 - Post-Closure Conditions
 - Effects unlikely



Results of Ecological Evaluation – *continued*

- **Arctic fox**
 - Current Conditions
 - No effects predicted
 - Post-Closure Conditions
 - Effects unlikely



Results of Ecological Evaluation – *continued*

- **Willow ptarmigan**

- Current Conditions

- Possible effects on reproduction

- Post-Closure Conditions

- Possible effects on reproduction



Results of Ecological Evaluation – *continued*

- **Green-winged teal**
 - Current Conditions
 - Effects unlikely
 - Post-Closure Conditions
 - Effects unlikely



Results of Ecological Evaluation – *continued*

- **Muskrat**
 - Current Conditions
 - Effects unlikely
 - Post-Closure Conditions
 - Effects unlikely



Results of Ecological Evaluation – *continued*

- **Tundra vole**

- Current Conditions

- Possible effects on reproduction

- Post-Closure Conditions

- Possible effects on reproduction



Results of Ecological Evaluation – *continued*

- **Tundra shrew**

- Current Conditions

- Possible effects on reproduction

- Post-Closure Conditions

- Possible effects on reproduction



Effects on Tundra Plants

- Some effects have been observed in the mine area, particularly near facilities



Summary of Results – *What ecological effects might be expected?*

- **Some animals in the mine area may experience effects:**
 - Ptarmigan
 - Small mammals (shrew and vole)
- **Other animals are unlikely to experience effects:**
 - Caribou
 - Fox
 - Teal
 - Muskrat
- **Tundra plants – some changes have been seen, more changes are likely to occur**



What are the implications for the closure plan?

- **Two ponds (tailings pond and pit lake) look acceptable**
 - Either way, water is treated before discharge
- **Overburden material is acceptable cover**
 - Many facility areas will get covered
- **No significant additions or changes to the closure options are necessary**

What should we do between now and mine closure?

- Continue to make dust control improvements
- Monitor changes in animals and plants (see if predicted effects actually occur)
 - Ptarmigan
 - Small mammals (vole, shrew)
 - Tundra plants
- Monitor dust emissions
- Monitor effectiveness of dust control improvements

Q & A