GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Management of Mercury and Mercury-Containing Waste

Mercury Analysis and Results of Chile

Mercury Waste Project Final Workshop

June 2010

Milestone

- Prepare Terms of Reference (Sept, 15, 2009)
- Adjudgment to Fundación Chile (Oct, 24, 2009)
- Contract Sign (Oct, 29, 2009)
- Inception Workshop (Nov, 2 y 3, 2009)
- Meeting with Fundación Chile (nov 9-Dic 10)
- Preliminary Report(Dic 2009)
- Final report (Jan, 2010)
- Final Workshop (March, 19, 2010)
- Final report delivered to UNEP (May, 13, 2010)

Specific Objectives

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

1. Review of environmentally sound management (ESM) guidelines determine its applicability at national level
2. Evaluation of the capacity of national laboratories for analysis of Mercury.
3. Develop an Preliminary Risk Assessment of a selected site
4. Remediation options and preliminary cost estimates associated.

FUNDACIONCHILE

cenma
Centro Nacional del Medio Ambiente

1. Review ESM Guideline

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

1. Review of the Guide Technical Guidelines for ESM of mercury waste.

2. General observations were made of the guidance and specific comments for each chapter

3. This review was conducted by two professionals of Fundación Chile, and its international advisory Dr. Andreas Zimmermann.

2. Evaluation of the capacity of national laboratories for analysis of Mercury.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

1. It generated a record audit in order to recognize the national laboratories carrying out analysis of mercury in environmental matrix.

2. Clinical laboratories were considered most important environmental and national level.

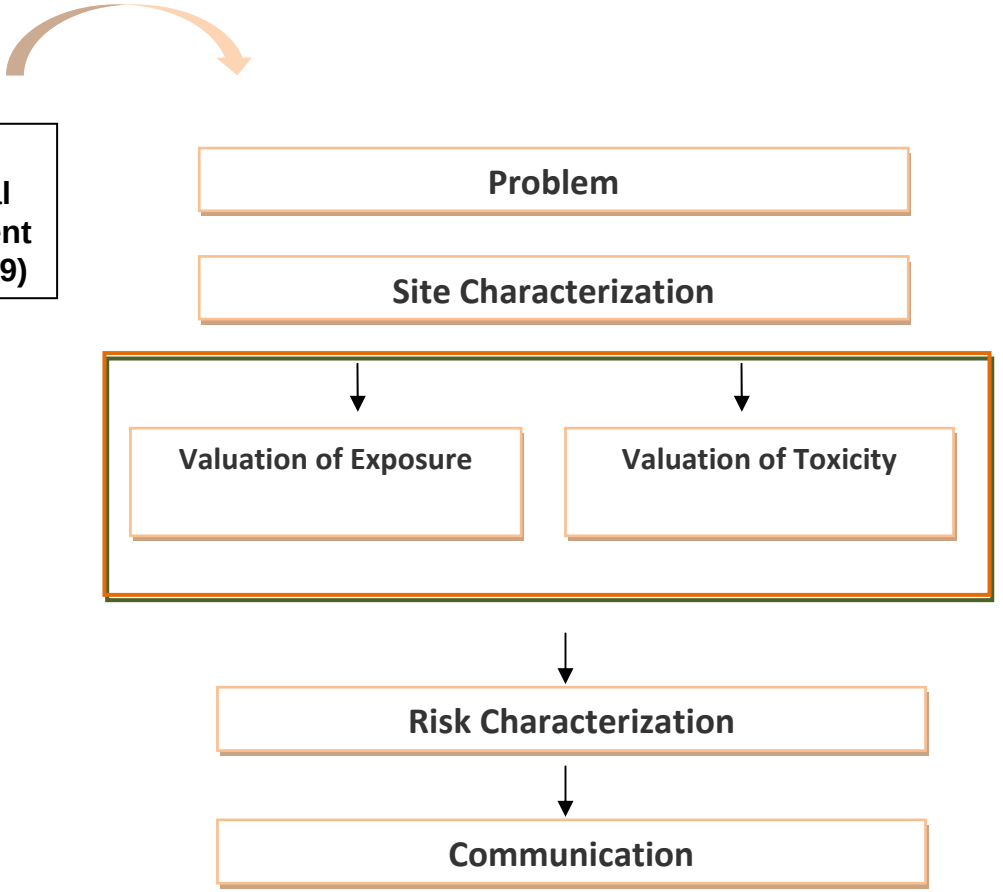
3. Telephone interviews were conducted with managers of these laboratories and in some cases the information was sent audit for review and response.

4. We conducted a database with the results of the surveys

3. Develop an Preliminary Risk Assessment of a selected site

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Model of an Environmental Risk Assessment (U. S. EPA, 1989)



4. Remediation options and preliminary cost estimates associated.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

1. Analysis results delivered

2. Determine remedial measures for site 1.

3. This review and proposal for remediation was carried out by Fundación Chile professionals and Dr. Andreas Zimmermann.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Methodology

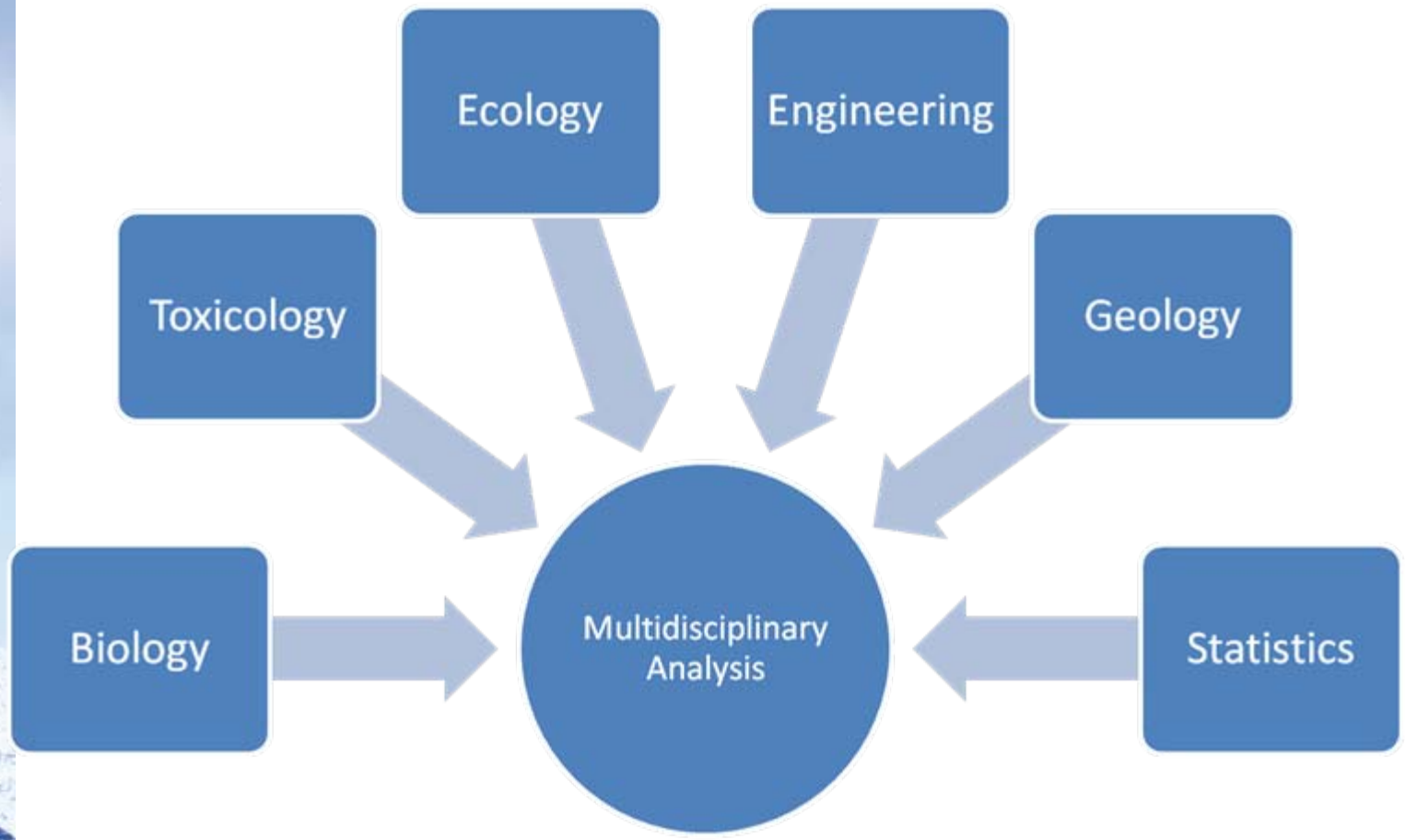
GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Risk Assesment

Risk assessment is a quantitative and qualitative process, which determines the probability that they produce effects on the health of people who are exposed to environmental hazards.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

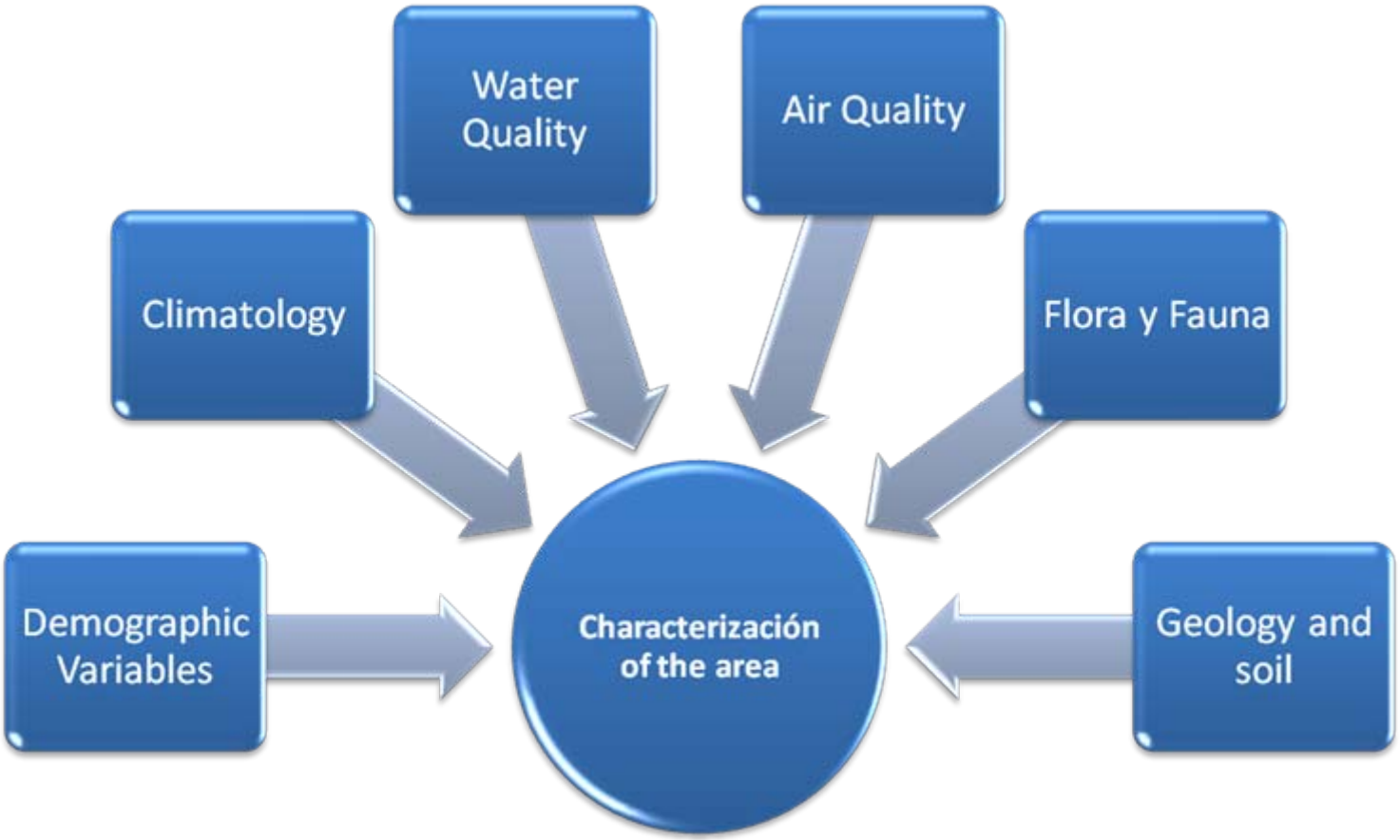
Risk Assesment



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

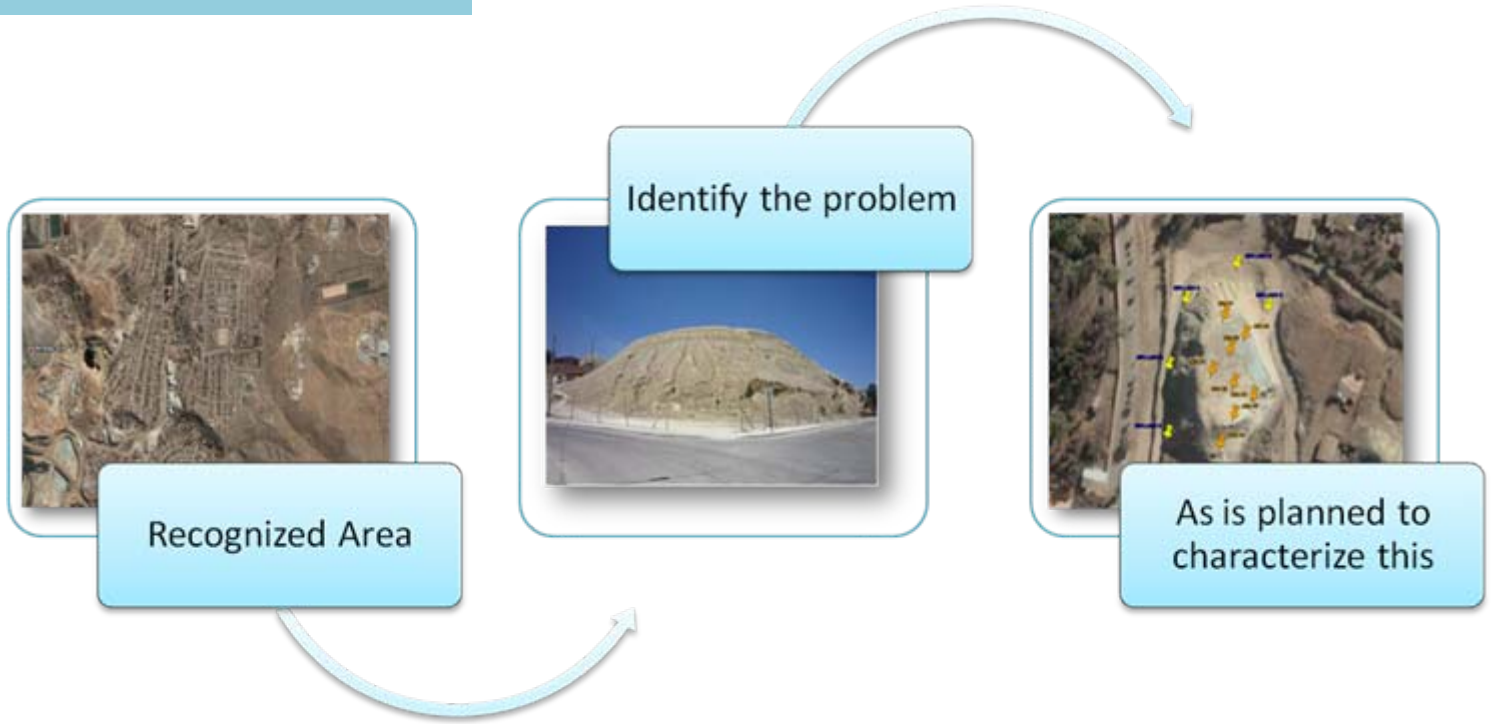
Characterization Area



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Identification Problem



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Site Characterization

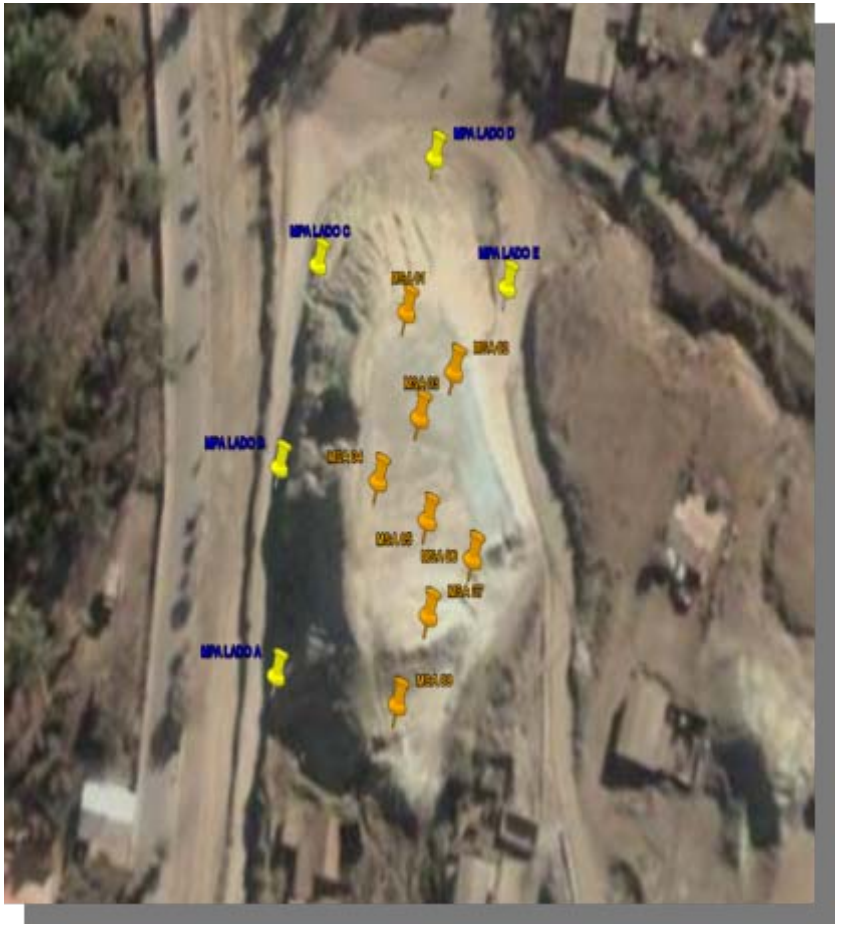
Identification of the existence of hazardous substances

Nature	• Source • Contaminated environmental component selection
Extension	• Involved Area • Affected population
Concentración	• Sampling Plan • Chemical Analysis

Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Characterization Site

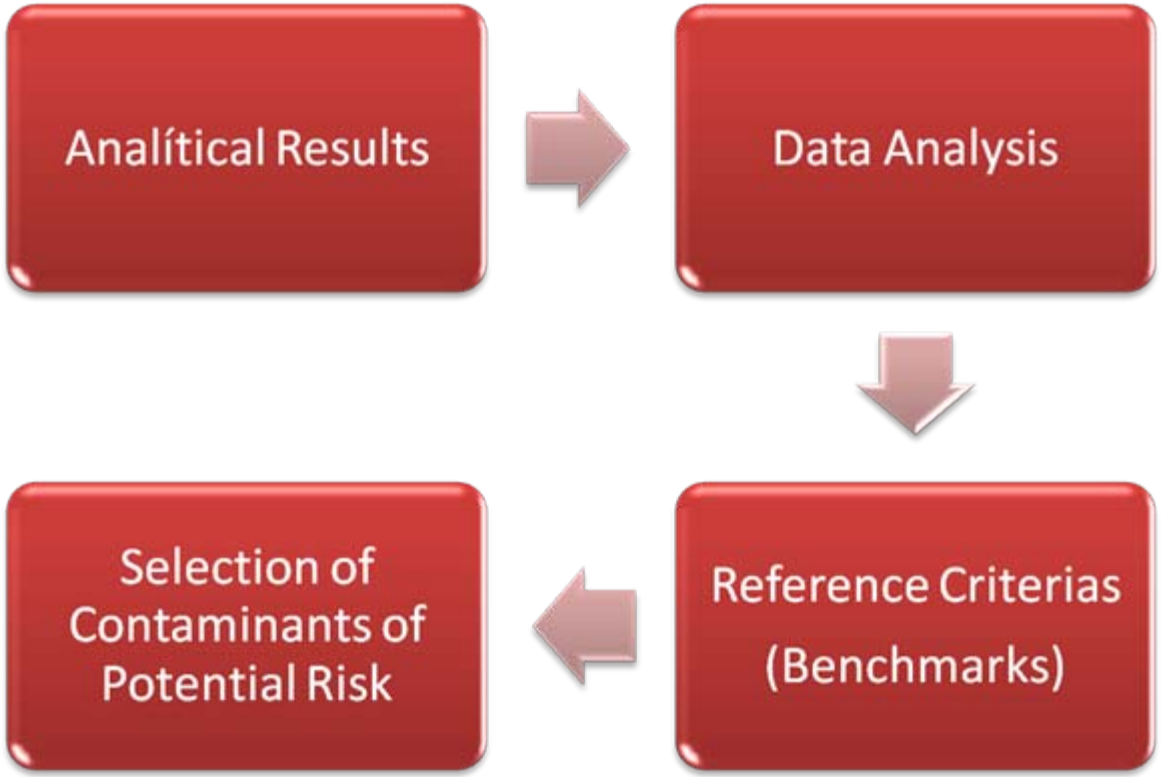


Coordination with analytical laboratory

The quantitative chemical analysis were carried out by the National Environment Centre **(CENMA),** an organization with quality control and analytical capacity of environmental samples.

Environmental Risk Assesment Methodology

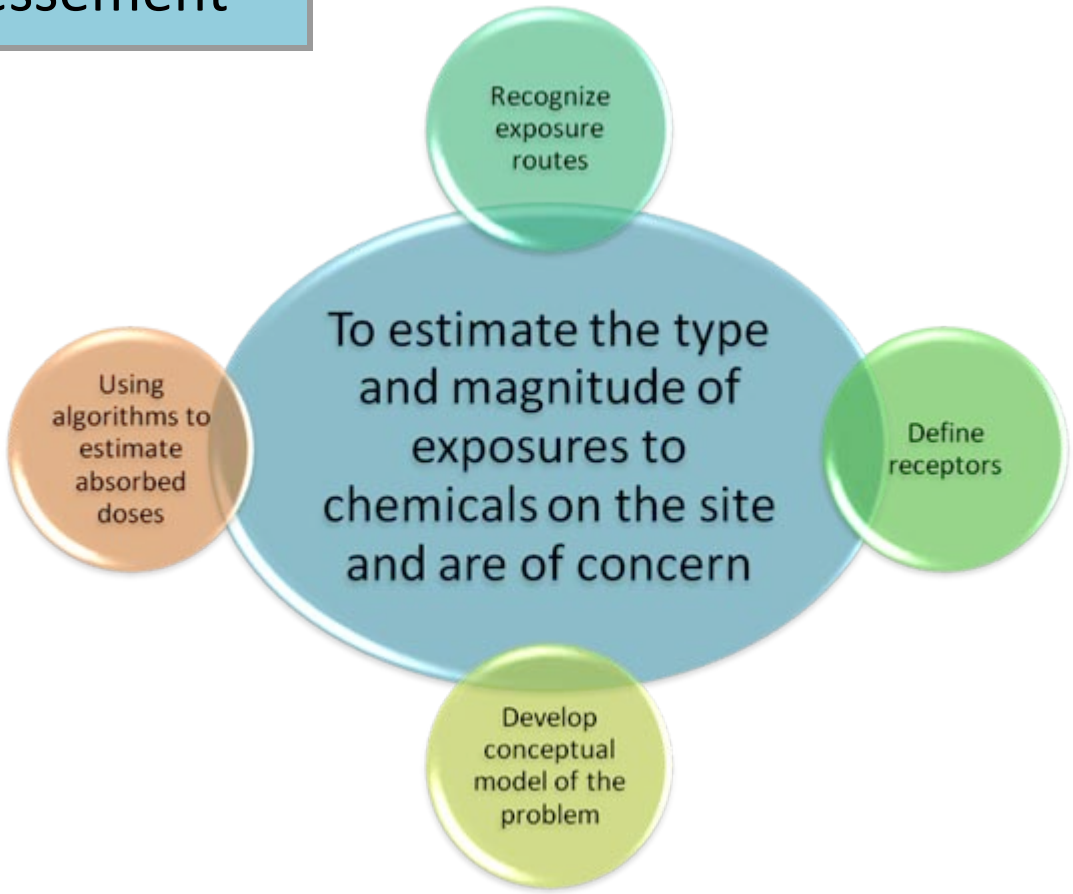
Characterization Site



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Exposure Assessement



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Exposure Assessement

Receptors

Scenario 1: Adults and children living next to the site.

Scenario 2: Working adults who are developing their work at 20 meters from the site

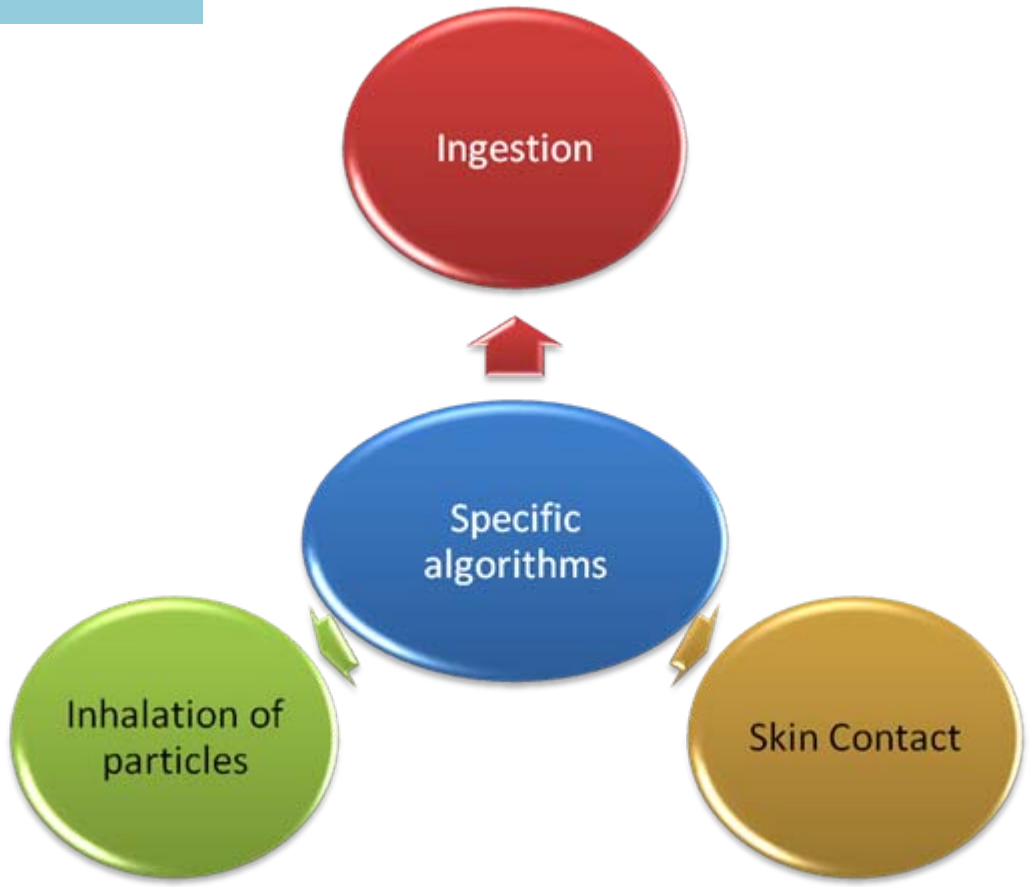
Scenario 3: Visitors to both adults and children who visit the area on holidays or other instances.

Scenario 4: Potential Workers at the site remediation activities

Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

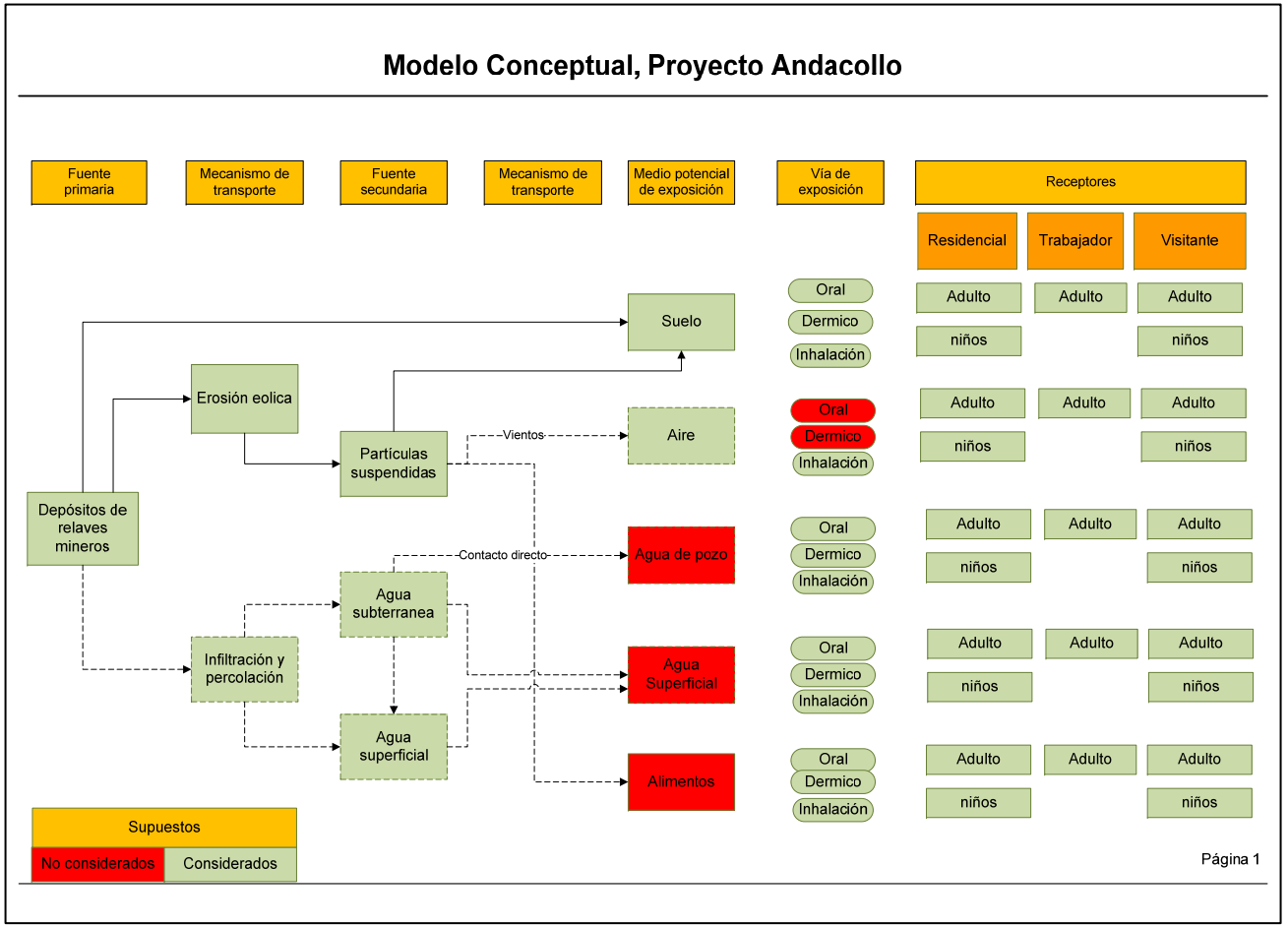
Calculation of exposure dose



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

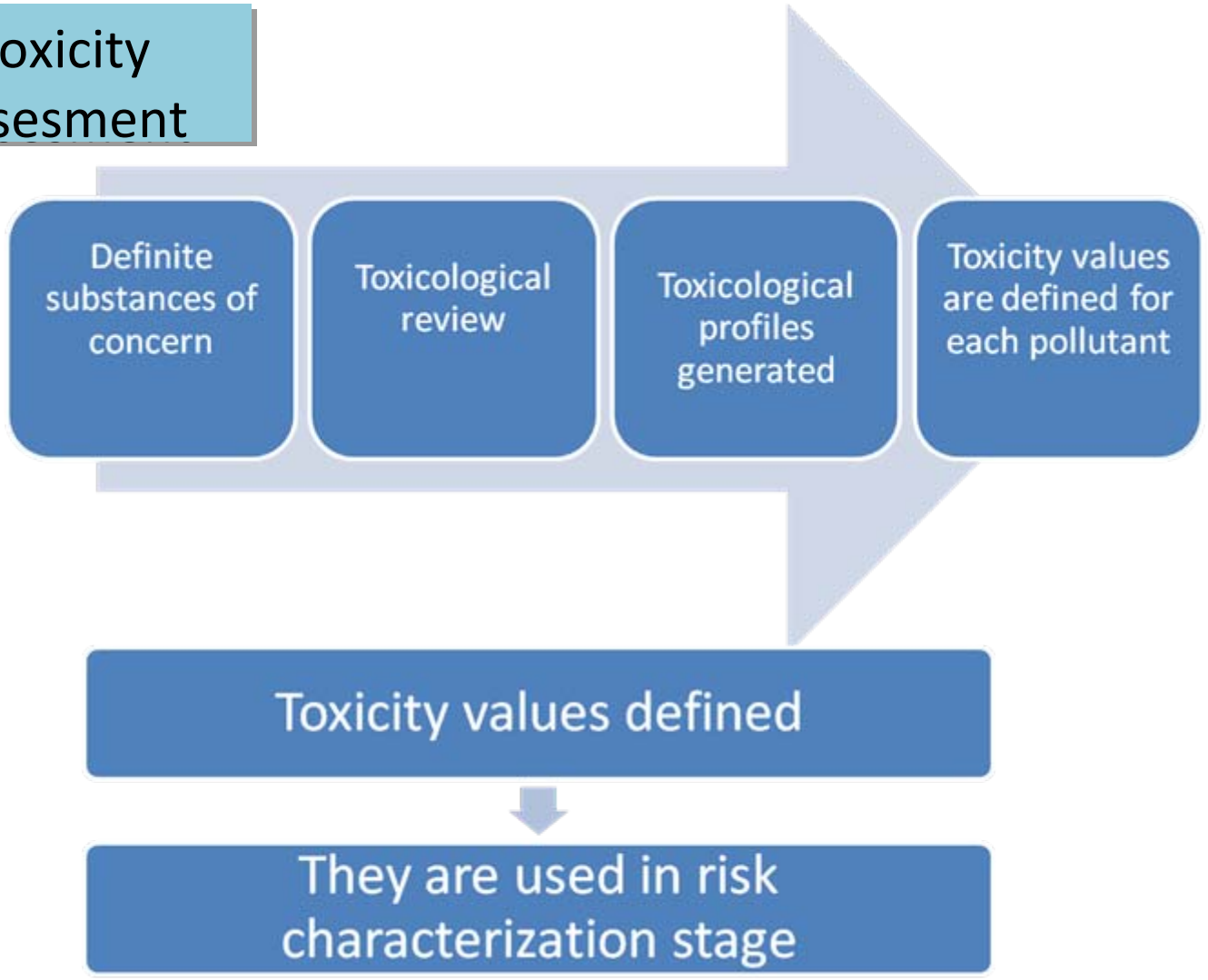
Conceptual Model



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Toxicity Assesment



Environmental Risk Assesment Methodology

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Risk Communication

Obtained results

These should be communicated to those responsible for risk management

Management measures

GOBIERNO DE
CHILE
COMISIÓN NACIONAL
DEL MEDIO AMBIENTE

Results

Reviewing ESM Guideline

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Strengths

- Relevant information regarding sources, uses, process and toxicology profile for mercury, taking international recognized sources
- Extensive international literature review about the mercury problem

Weaknesses

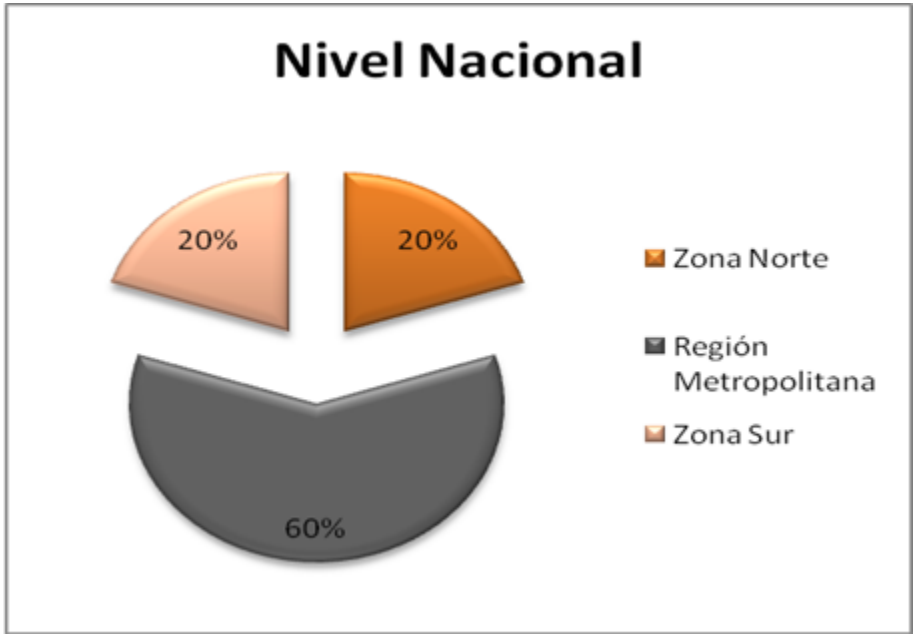
- Is recommended to be translated into other languages
- it requires more detail or more specific guidelines in relation to the gold mining activities

Laboratory Survey

North Zone	
Analyze Mercury	6
No analyze Mercury	51
No answer	16
Total laboratories	**73**

Metropolitan Zone	
Analyze Mercury	18
No analyze Mercury	29
No answer	20
Total laboratories	**67**

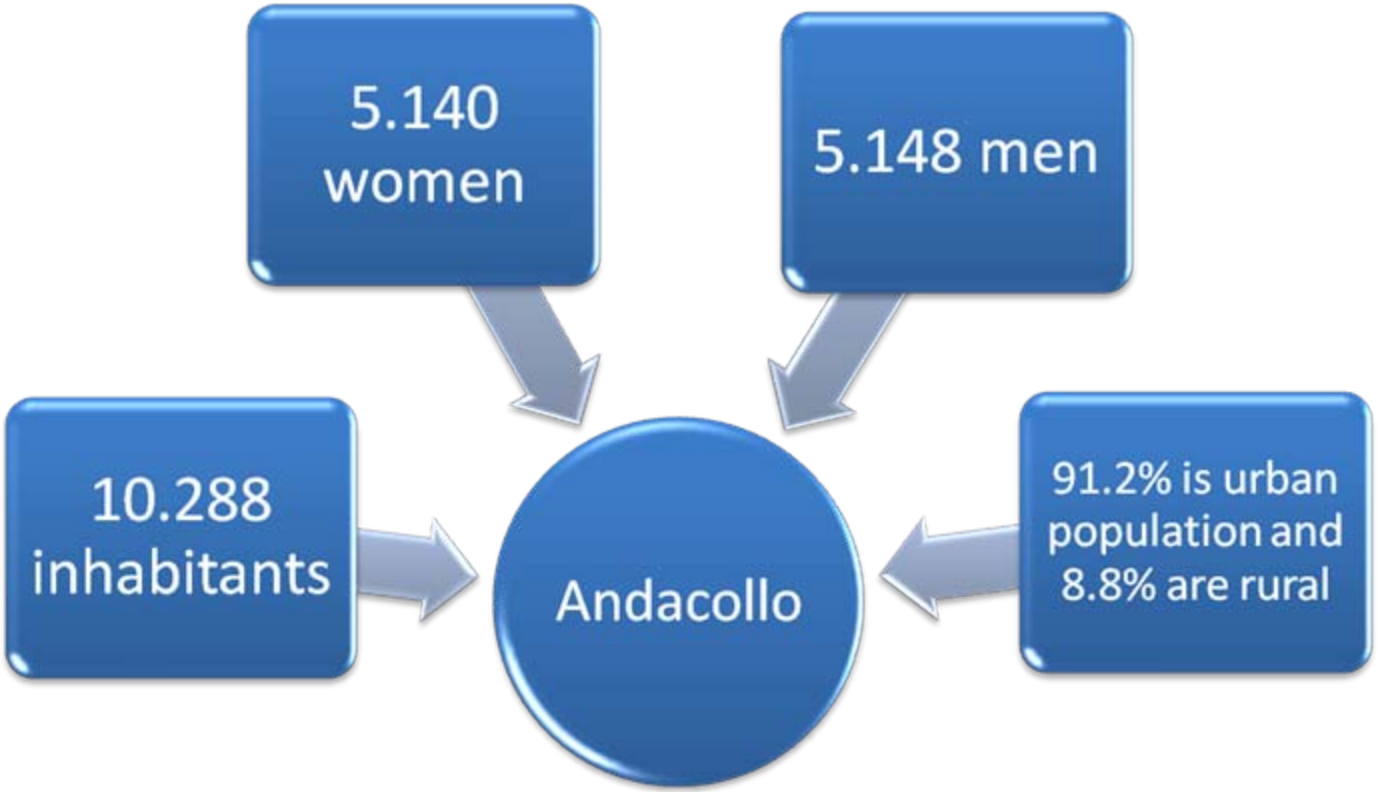
Zona Sur	
Analyze Mercury	6
No analyze Mercury	59
No answer	9
Total laboratories	**74**



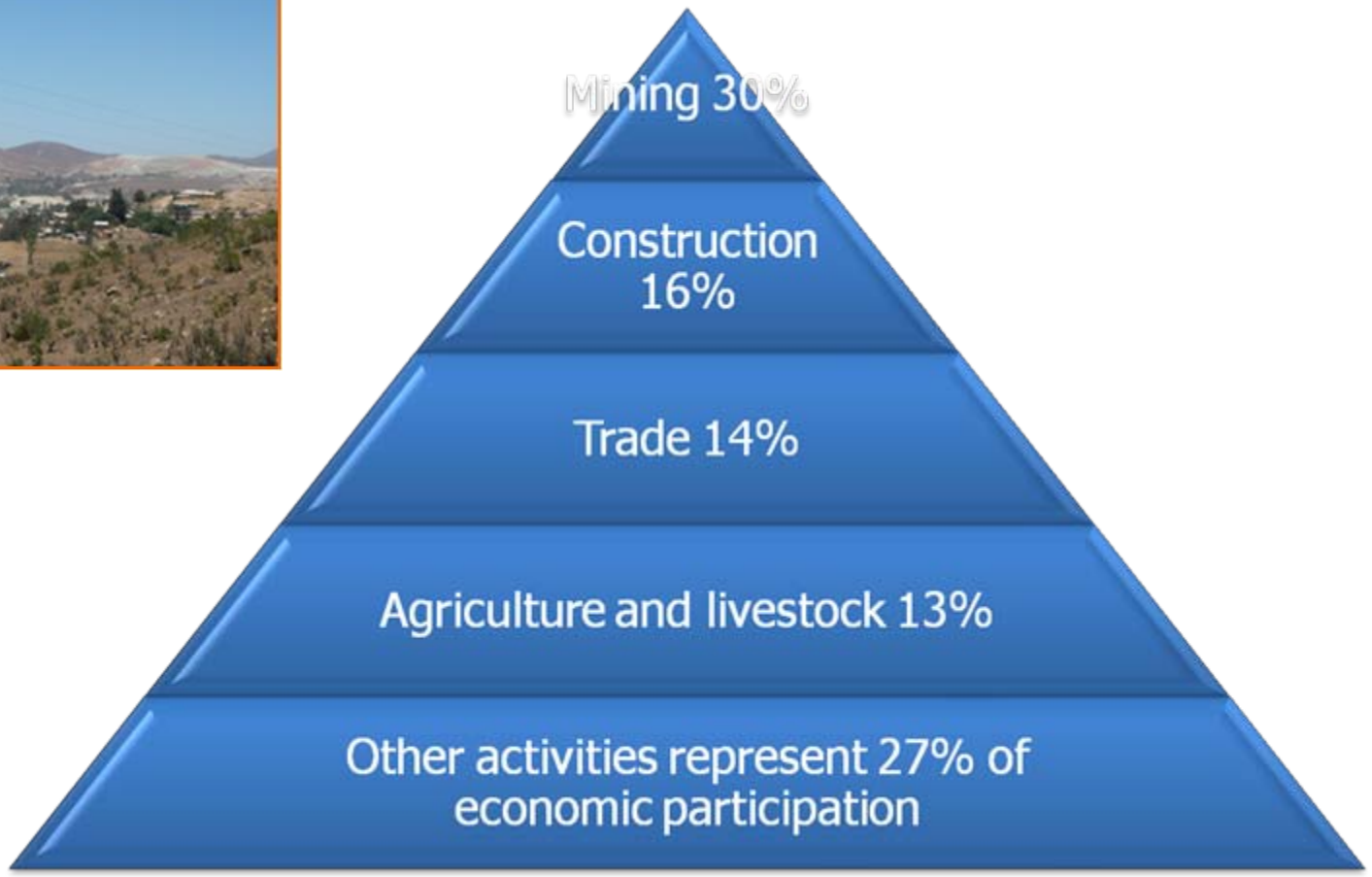
Of a total of 214 laboratories surveyed, 30 laboratories carrying out analysis of mercury, they are mainly concentrated in the metropolitan area, with 60% of the laboratories that perform this type of determination in different environmental matrices.

Main Outcomes

Characterization Area



Main Outcomes



Main Outcomes

Hydrology and Hydrogeology

- Andacollo basin contains a watershed of about 43 km2
- Its natural discharge is in the northeast corner of it, by the gorge of Andacollo.
- The drainage of the watershed is dendritic type, this drainage is formed by many tributaries, which are dry most of the year.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Main Outcomes

Ground Water

- Different type of quality in the basin.
- Areas high " good quality."
- Lower area of the watershed "High contents of metals and low pH."

Air

- On Monday April 6, 2009, the town of Andacollo and surrounding areas saturated zone was declared as respirable particulate matter, PM 10, as the concentration of 24 hours annually.
- The statement is based on the results of official monitoring PM10.

Main Outcomes

Andacollo mining activities

- Today in Andacollo operate two major mining projects, which correspond to the activities of **Dayton Mining Company** which extracts gold and **Carmen de Andacollo Mining Company** wich draws copper mainly.
- In relation to small-scale mining and artisanal mining that takes place in the commune of Andacollo, these activities use extraction and processing of crude ore, which include the use of the "trapiche".

Carmen de Andacollo Mining Company

Dayton Mining Company

Main Outcomes

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Environmental Problems Andacollo

- The process of extraction and recovery of metals from a mine, it generates a massive amount of waste. Which is classified into two types, waste from the metal recovery process (tailings, slag and rubble), and discard material from the mine that has not entered a beneficial process, as are the "sterile" (Universidad de Chile, 2006). These waste generate a series of problems and environmental risks to human populations and for other ecological receptors (OECD, 2005).

Main Outcomes

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Problem

Main Outcomes

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Site Selection Study

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Main Outcomes

Site Features

Main Outcomes

Site 1 characterization

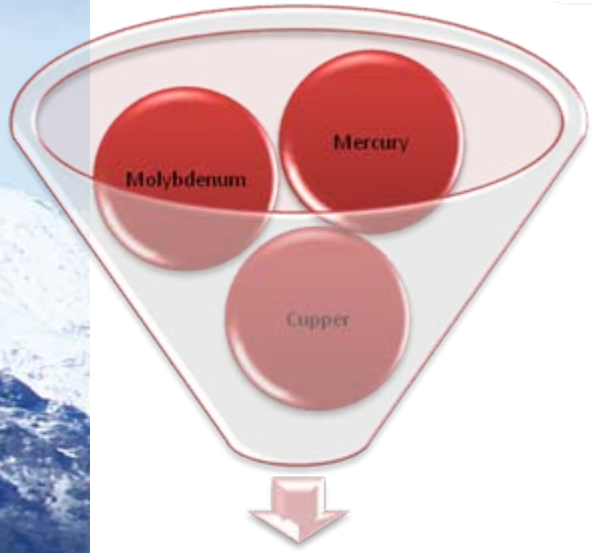
Audit sheets

Site's name	Whittle Plant
Owner	Whittle Cortes Sanfrancisco
Actual State	Abandoned
Area (m2)	4500 m^2
Maximum Height	15 – 20 m
Average slope downstream slope	60º
Acces	Free, with minor restrictions
Active years	Approximately 30 years
Origin of waste	Different mining sites
Mining Process	Gold and cupper

Main Outcomes

Contaminate Concern

Sampling and Analysis	• F. Chile • CENMA
International Laboratory	• Abberden University • Delivered Result on june 18, 2010



Main Outcomes

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Exposure Assesment

In this project only assessed the potential risk to human populations Site 1.

Primary source of contamination, the tailings material that is disposed at Site 1.

The main routes of exposure are respiratory tract, ingestion and dermal contact.

Conclusions

Risk Assesment:

- Principal route of exposure: inhalation of particles.
- Main Contaminants: **mercury**, cupper and molybdenum.

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Identified Risks

- Mobilization of tailings by wind (inhalation, dermal contact).
- Development activities in the area of the site (inhalation, accidental ingestion or skin contact).
- People falling slope
- Failures in the slope of the tailings deposit
- Leachate infiltration.

Conclusions

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Mitigation Measures

Access Closed

- Discourage entry by the deposit of tailings and thus minimize the risk of accidents for people and direct exposure to the tailings, it is proposed fencing off the deposit in its entirety through a gate.

Windbreak mesh installation

- Reduce the effect of wind erosion and emission of particulate material and tailings into the atmosphere

Conclusions

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Remediation Measures

In-Situ Measures

- Coverage permeable
- Imperveus coverage

Ex-Situ Measures

- Remobilization and disposal
- Remobilization and recovered

Recommendations

Remediation Actions

- Implementation of measures to control risk

Complementary Studies

- Survey and preliminary characterization of PAMs in Andacollo Commune.
- Study of the legal status of PAMs
- Detailed risk assessment (cumulative effect).
- Design Study of Risk Management for Andacollo Commune
- Communication Strategy and Risk Management

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

Recommendations

Survey liabilities	• Location • Tailings cubing
Liabilities preliminar Characterization	• Sampling • Chemical Analysis
Risk Assessment	• Specific Site • Basin level
Legal Study	• Legal Statum of liabilities • Owner Identification
Communication strategy and risk management	• Risk Communication to habitant and authorities • Srategy to institutional risk management (founds, etc.)

GOBIERNO DE CHILE
COMISIÓN NACIONAL DEL MEDIO AMBIENTE

GOBIERNO DE
CHILE
COMISIÓN NACIONAL
DEL MEDIO AMBIENTE

Management of Mercury and Mercury-Containing Waste

Mercury Analysis and Chilean Results

Mercury Waste Project Final Workshop

June 2010