Kelly Mine
Removal Site Inspection

CASO, Ridgecrest Field Office

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National Science & Technology Center

Bureau of Land Management

Planning

- Discovered December 2005
- Notified management of arsenic potential risk
- Notified NRC, DTSC, SWQB and EPA On-Scene Coordinator, County HazMat
- Engaged NSTC, USGS and contractors to assist with site characterization
- NSTC prepared Sampling and Analysis Plan and Health and Safety Plan
- Fieldwork conducted February, 2006

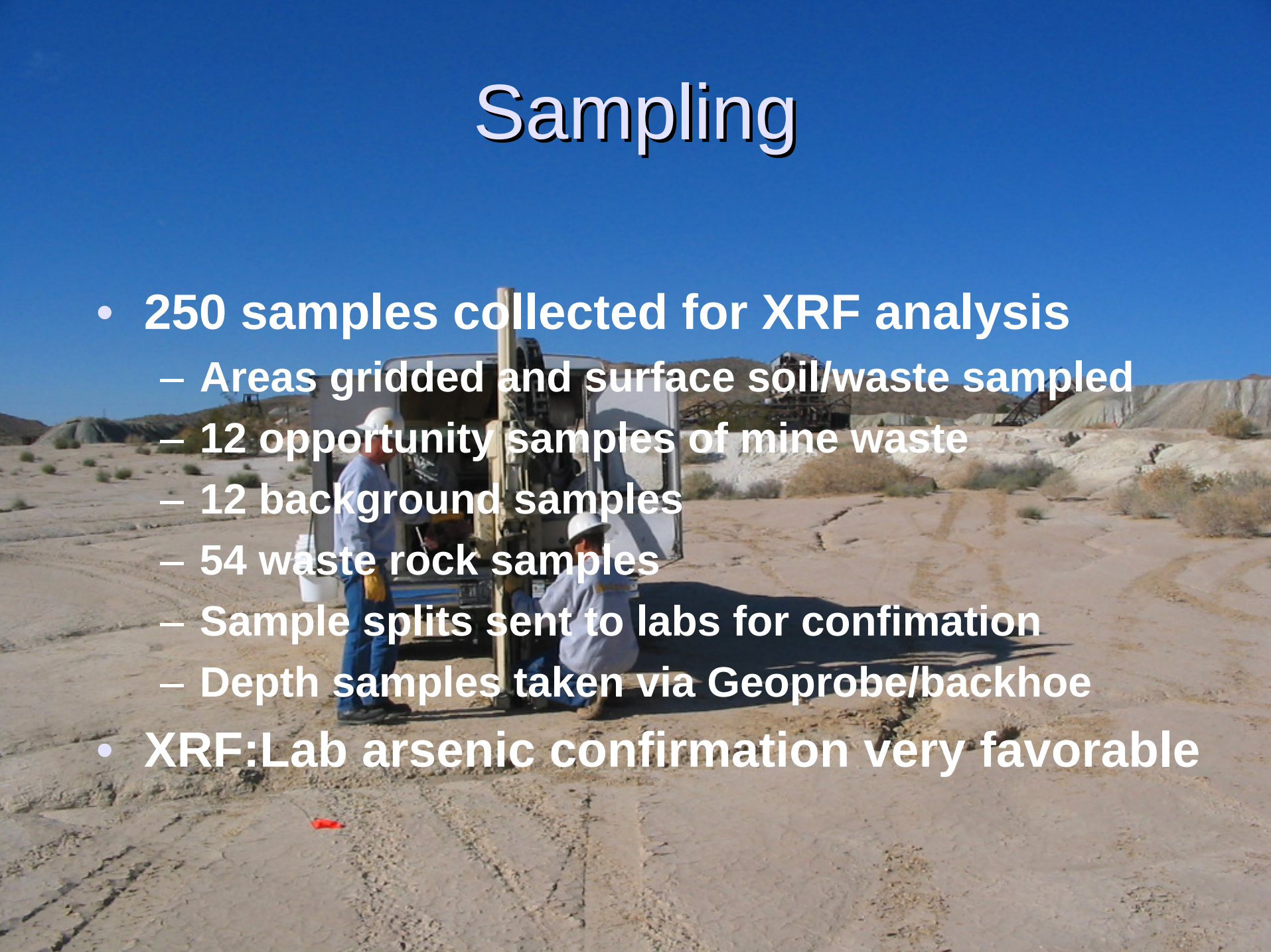
Areas Investigated

- Area 1 Tailings next to town
- Area 2 Kelly Mine complex
- Area 3 Deleted due to remoteness
- Area 4 Tailings in Red Mtn Wash
- Area 5 Tailings from Barkley Mill
- Area 6 Barkley Mill area
- Area 7 Waste Rock dumps near town

7
2
1
Shaft
Shaft
McCormick
Shaft
Shaft
Adit
Waste
Rock
Glory
Hole
Waste
Rock
Waste
Rock
Hoist
House
No. 2
Headframe
and Shaft
Building
Shaft
Waste
Rock
Shaft
Red
Mountain
Road
Tailings
Dam
Kelly
Road
350 Shaft

Fig. 3
General Site Features Map
Areas 4, 5 and 6

Sampling



- **250 samples collected for XRF analysis**
  - **Areas gridded and surface soil/waste sampled**
  - **12 opportunity samples of mine waste**
  - **12 background samples**
  - **54 waste rock samples**
  - **Sample splits sent to labs for confimation**
  - **Depth samples taken via Geoprobe/backhoe**
- **XRF:Lab arsenic confirmation very favorable**

Area 5

Area 1

Area 2 Rock Dump

Area 1 Glory Hole

g. 4
ample Location Map
elly Mine Areas 1 and 2

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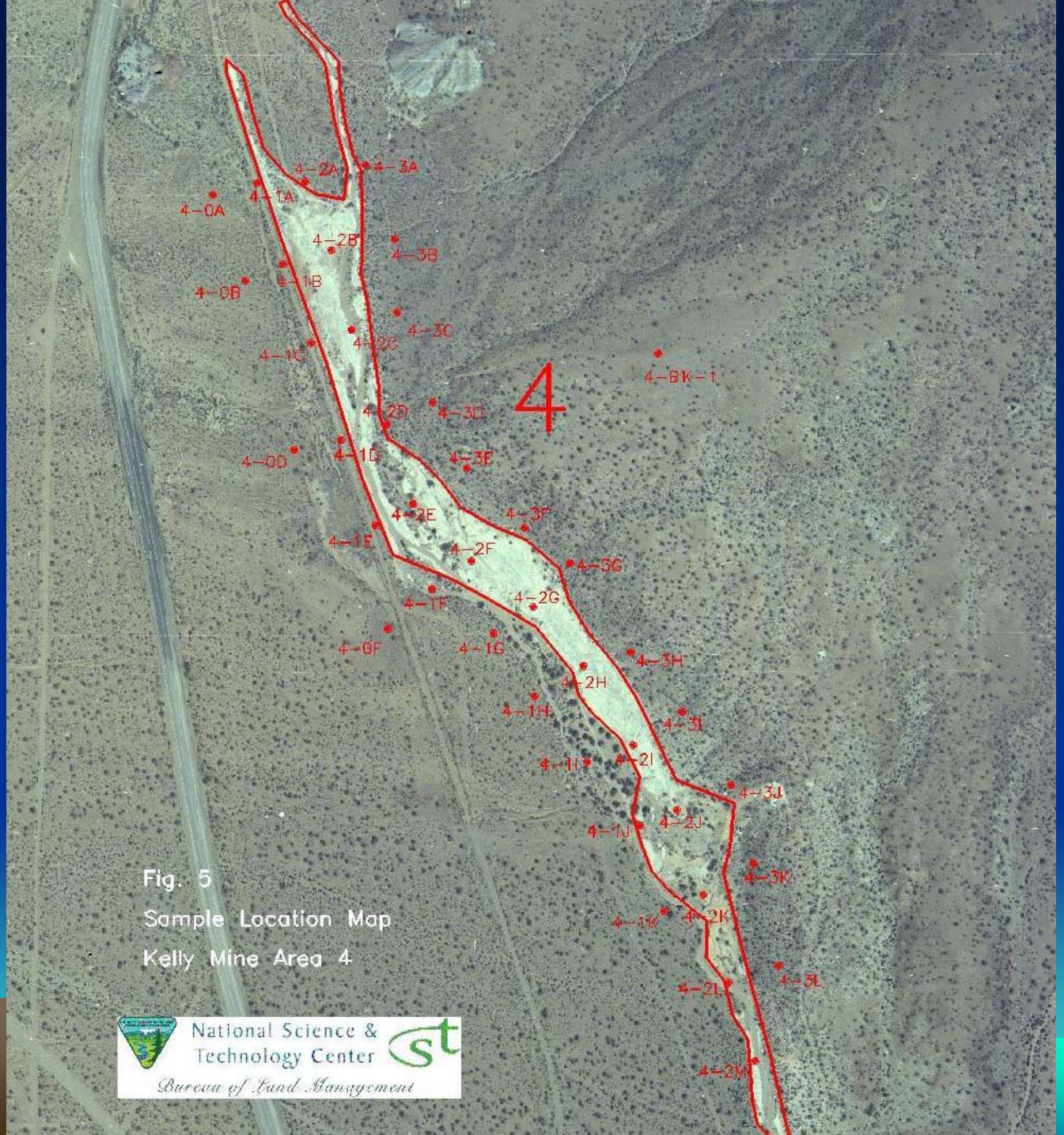

Fig. 5

Sample Location Map

Kelly Mine Area 4

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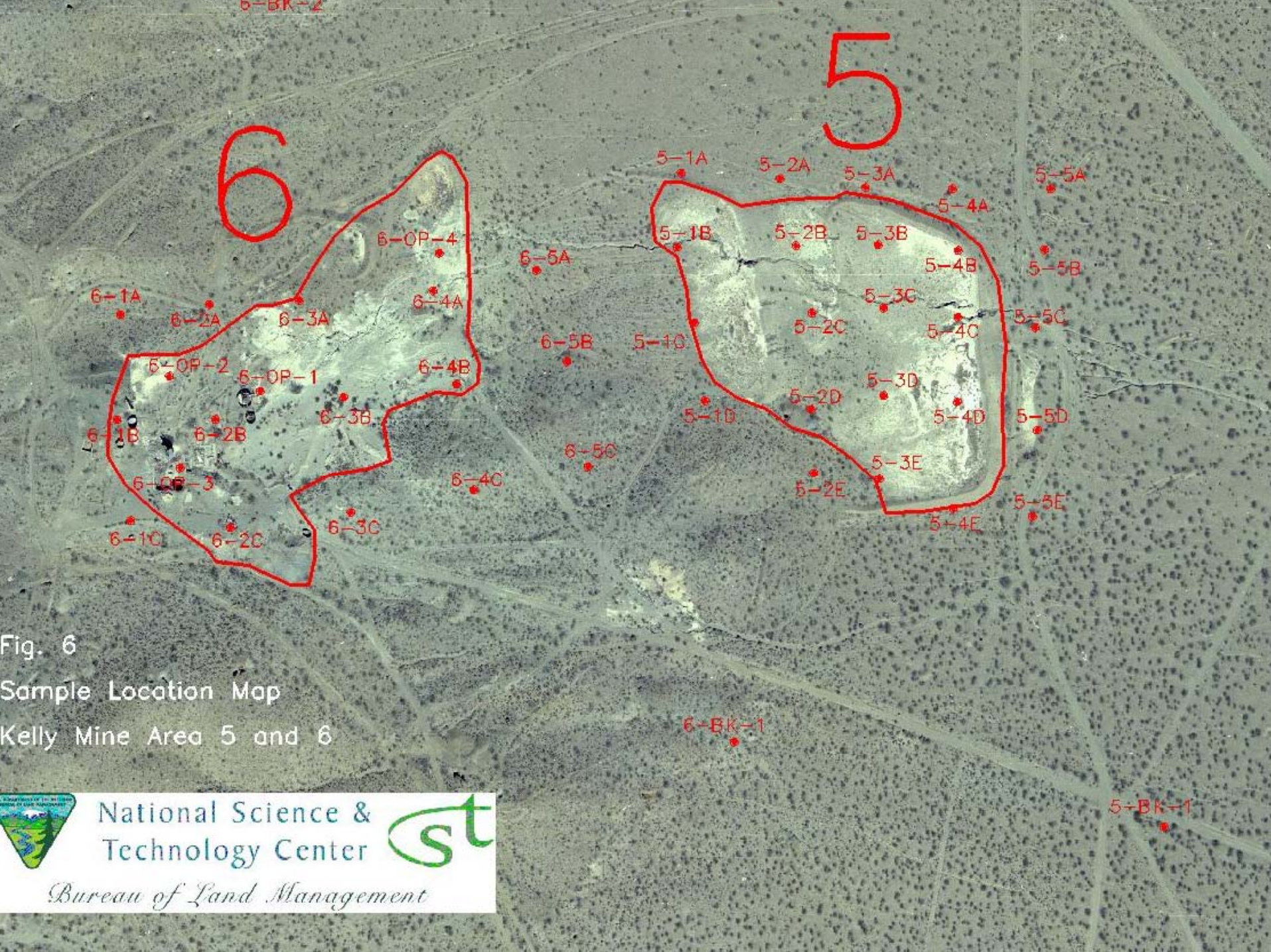

Fig. 6

Sample Location Map

Kelly Mine Area 5 and 6

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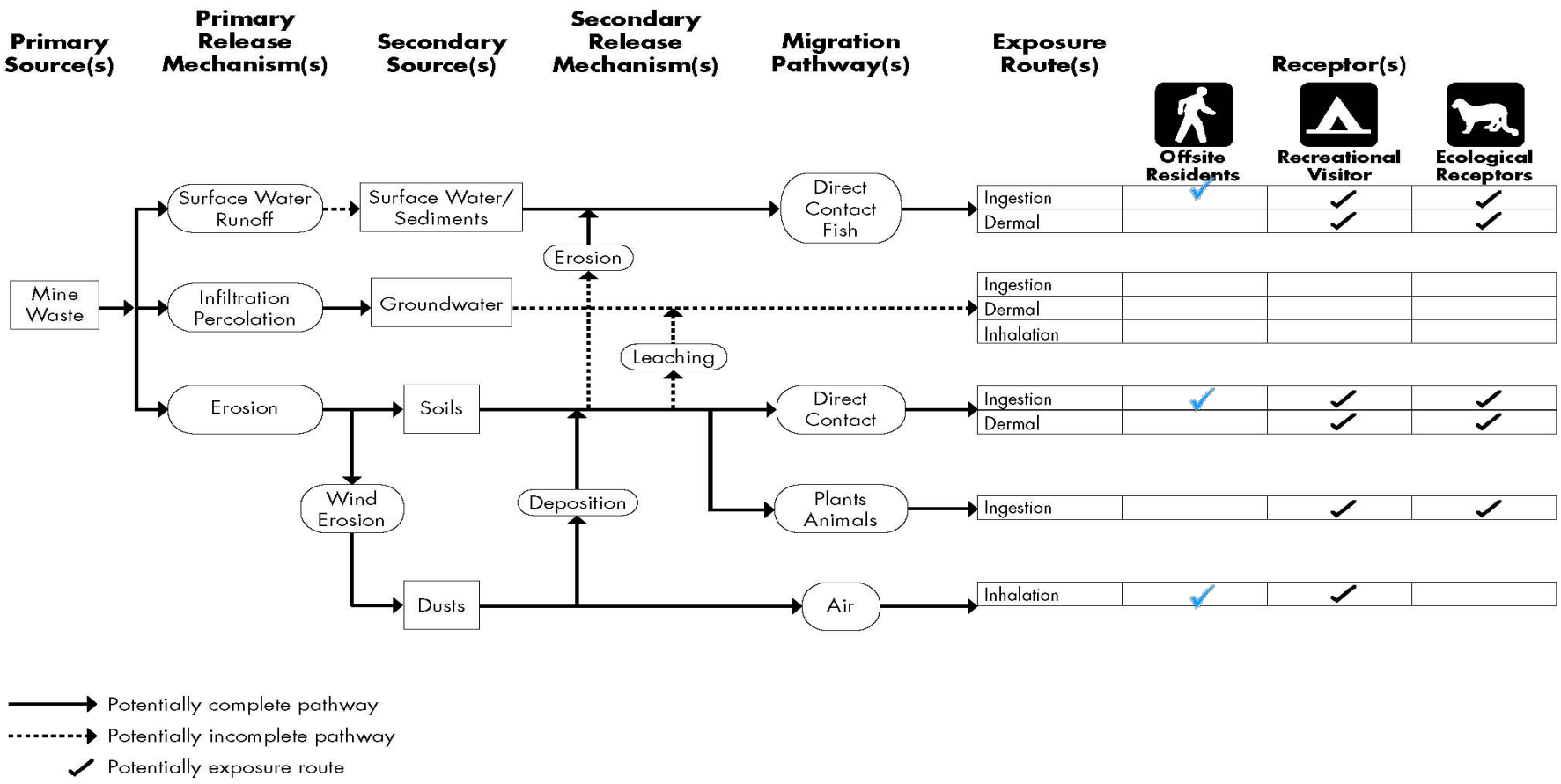
Results

- Mean arsenic concentrations:
  - Area 1 – 1490 mg/kg
  - Area 2 – 993 mg/kg in gridded surface
  - Area 2 – 2,035 mg/kg in waste rock
  - Area 4 – 1,960 mg/kg
  - Area 5 – 118 mg/kg
  - Area 6 – 94 mg/kg
  - Area 7 – range from 600-7,718 mg/kg
  - Background – 136 mg/kg
- EPA preliminary remedial goal is 0.39 mg/kg for residential.

Pathways of Exposure

Figure 4. Mine Waste Site Conceptual Model for Human and Ecological Receptors



Receptors

- On-site: ORV users on Area 1 especially on weekends and holidays;
  - exposed by incidental soil ingestion and dust inhalation
- Offsite: adjacent residences throughout town of Red Mountain,
  - estimated population 100-200. Residents abut east and west side of site
  - maybe exposed via soil ingestion, dust inhalation food gardening
- Water supply is provided by Randsburg Community Water District

Dam Breach Area 1

Area 1 tailings migrating into residential area

Risk

- Arsenic is known human carcinogen
- Using a comparison from EPA guidance and BLM Technical Note 390 “Risk Management Criteria for Metals at BLM Mining Sites,”
  - Potential cancer risk to ORV users
  - Potential cancer risk to offsite residents; need yard soil and air sampling
    - Yard soil sampling anticipated to be performed by EPA
    - Air sampling to be performed by Mojave AQMD
  - Risk to wildlife is also high including desert tortoise
- Preliminary data indicates not all arsenic is bioavailable

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- You normally take in small amounts of arsenic in the air you breathe, the water you drink, and the food you eat. Of these, food is usually the largest source of arsenic.
- Some areas of the United States contain unusually high natural levels of arsenic in rock, and this can lead to unusually high levels of arsenic in soil or water. If you live in an area like this, you could take in elevated amounts of arsenic in drinking water. Children may be taking in arsenic from dirt because of hand to mouth activity.
- Some hazardous waste sites contain large quantities of arsenic. If the material is not properly disposed of, it can get into surrounding water, air, or soil. If you live near such a site, you could be exposed to elevated levels of arsenic from these media.
- If you saw or sand arsenic-treated wood, you could inhale some of the sawdust into your nose or throat. Similarly, if you burn arsenic-treated wood, you could inhale arsenic in the smoke.

Occupational Populations

- Arsenic production or use (for example, copper or lead smelting, wood treating, or pesticide application).

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Both arsenate and arsenite are well absorbed by both the oral and inhalation routes. Absorption by the dermal route has not been well characterized, but is low compared to the other routes.
- Once absorbed, arsenates are partially reduced to arsenites, yielding a mixture of As(+3) and As(+5) in the blood.
- The As(+3) form undergoes enzymic methylation primarily in the liver to form monomethyl arsonic acid (MMA) and dimethyl arsinic acid (DMA). The rate and relative proportion of methylation production varies among species. The rate of methylation may also vary among tissues.
- Most arsenic is promptly excreted in the urine as a mixture of As(+3), As(+5), MMA, and DMA. Smaller amounts are excreted in feces.

Normal Human Levels

Blood

Average in nonexposed humans <1 µg/L

Urine

Average in nonexposed humans <100 µg/L

Nails

Normal levels in nails is 1 ppm or less

Hair

Normal levels in hair is 1 ppm or less

Biomarkers / Environmental Levels

Biomarkers

- Arsenic is cleared from blood within a few hours. Typical values in nonexposed individuals are less than 1 mg/L (1ppm). Blood levels do not appear to be reliable indicators of chronic exposure to low levels of arsenic.
- Arsenic that is absorbed from the lungs or the gastrointestinal tract is excreted in the urine, mainly within 1–2 days.
- Numerous studies have used above-average urinary levels (i.e., higher than about 100 µg/L) as evidence of recent arsenic ingestion.

Environmental Levels

Air

- 1-3 ng/m^3 in remote locations
- 20-100 ng/m^3 in urban areas

Sediment and Soil

- 1-40 mg/kg in soil, with a mean of 5 mg/kg

Water

- < 10 µg/L

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Arsenic (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Arsenic

As

CAS# 7440-38-2

September 2005

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology and Environmental Medicine
Applied Toxicology Branch
1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-888-42-ATSDR
1-888-422-8737
www.atsdr.cdc.gov/toxpro2.html

ATSDR

Chemical and Physical Information

Arsenic is a metalloid

- Elemental arsenic is ordinarily a steel grey metal-like material that occurs naturally.
- Arsenic combined with other elements such as oxygen, chlorine, and sulfur is called inorganic arsenic.
- Arsenic combined with carbon and hydrogen is referred to as organic arsenic.
- Understanding the difference between inorganic and organic arsenic is important because some of the organic forms are less harmful than the inorganic forms.
- Most inorganic and organic arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste.
- Arsenic is no longer produced in the United States; all of the arsenic used in the United States is imported.
- Inorganic arsenic compounds were predominantly used as a pesticide, primarily on cotton fields and in orchards. Inorganic arsenic compounds can no longer be used in agriculture.

Routes of Exposure

- Inhalation (breathing).
- Ingestion (eating or drinking).
- Dermal (skin) contact.

Arsenic in the Environment

- Arsenic is an element that is widely distributed in the Earth's crust.
- Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead.
- Arsenic cannot be destroyed in the environment. It can only change its form, or become attached to or separated from particles.
- Arsenic that is attached to very small particles may stay in the air for many days and travel long distances.
- Arsenic can get into lakes, rivers, or underground water by dissolving in rain or snow or through the discharge of industrial wastes.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Oral

- A provisional MRL of 0.005 mg/kg/day has been derived for acute-duration (14 days or less) oral exposure to inorganic arsenic.
- An MRL of 0.0003 mg/kg/day has been derived for chronic-duration (365 days or more) oral exposure to inorganic arsenic.

Health Effects

- Inhalation of inorganic arsenic may cause respiratory irritation, nausea, skin effects and increased risk of lung cancer.
- Oral ingestion of inorganic arsenic may cause nausea, vomiting, and diarrhea following acute high dose exposure. Other effects include cardiovascular effects and encephalopathy.
- Long term oral exposure to low levels of inorganic arsenic may cause dermal effects such as hyperpigmentation and hyperkeratosis; corns and warts; peripheral neuropathy characterized by a numbness in the hands and feet that may progress to a painful "pins and needles" sensation.
- Chronic oral exposure to inorganic arsenic may cause increased risk of skin cancer, bladder cancer, and lung cancer.

Children's Health

- Children who are exposed to high levels of arsenic exhibit symptoms similar to those seen in adults, including respiratory, cardiovascular, dermal, and neurological effects, and vomiting if the arsenic is ingested.
- Ingestion of arsenic in dirt through hand-to-mouth activity may be an important route of exposure for young children.
- There is some evidence that metabolism of arsenic in children is less efficient than in adults.