



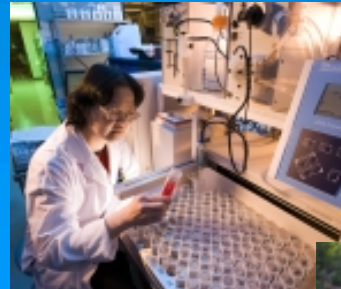
Broad Environmental Impacts and Risks to Worker for the Remediation of an Abandoned Uranium Mine in Northern Saskatchewan

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FCSNW, Ottawa, April 14-16, 2014

SRC at a Glance

- ↳ Saskatchewan's leading provider of applied RD&D and technology commercialization
- ↳ Over 400 employees
- ↳ >60 years of RD&D experience
- ↳ 1,800 clients in 24 countries around the world





PROJECT CLEANS

SRC is managing the Cleanup of the Gunnar, Lorado and 35 Satellite Mine Sites in Northern Saskatchewan on behalf of the Provincial and Federal Governments



Positive and Negative Impacts of Rehabilitation

Positive Impacts

- Reduction of risk to human health
- Reduction of risk to the environment
- Restoration of habitat and ecological services

Negative Impacts

- Emissions to the air water and soil
- Energy use
- Risks to site workers

Sustainable Remediation

“the practice of demonstrating, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected” ... and implemented

(SURF UK, 2010 Sustainable Remediation Framework)

Case Study: Gunnar Mine Site



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Study Objectives

1. Examine the broad environmental impacts of two remediation options being considered for the Site using a screening LCA approach
2. Estimate the risk to workers from civil engineering work and traveling to Site

Aspects of the Site Considered during this Study



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Life Cycle Assessment

Inputs

Outputs

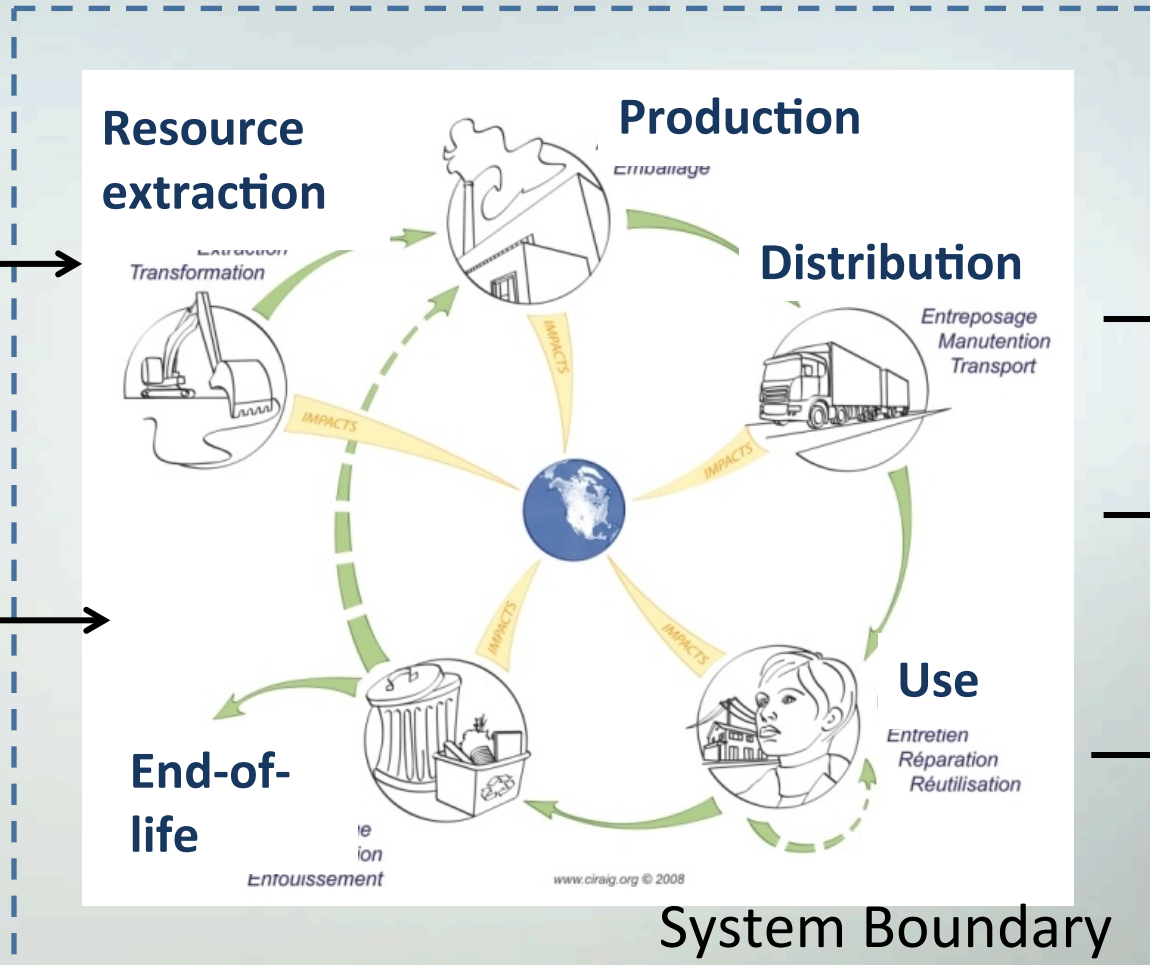
Raw material

Energy

Emissions to air, water and soil

Co-products

Waste



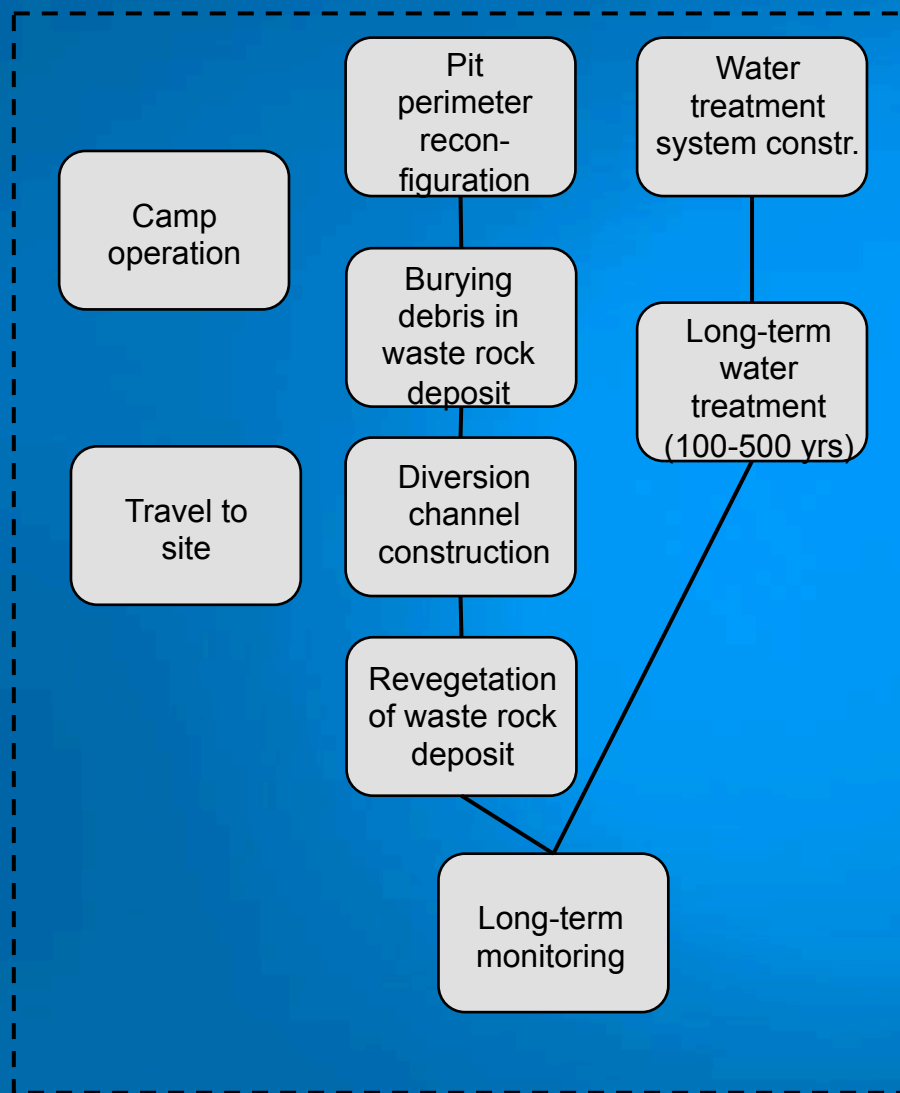
(Modified from <http://www.ciraig.org/>)

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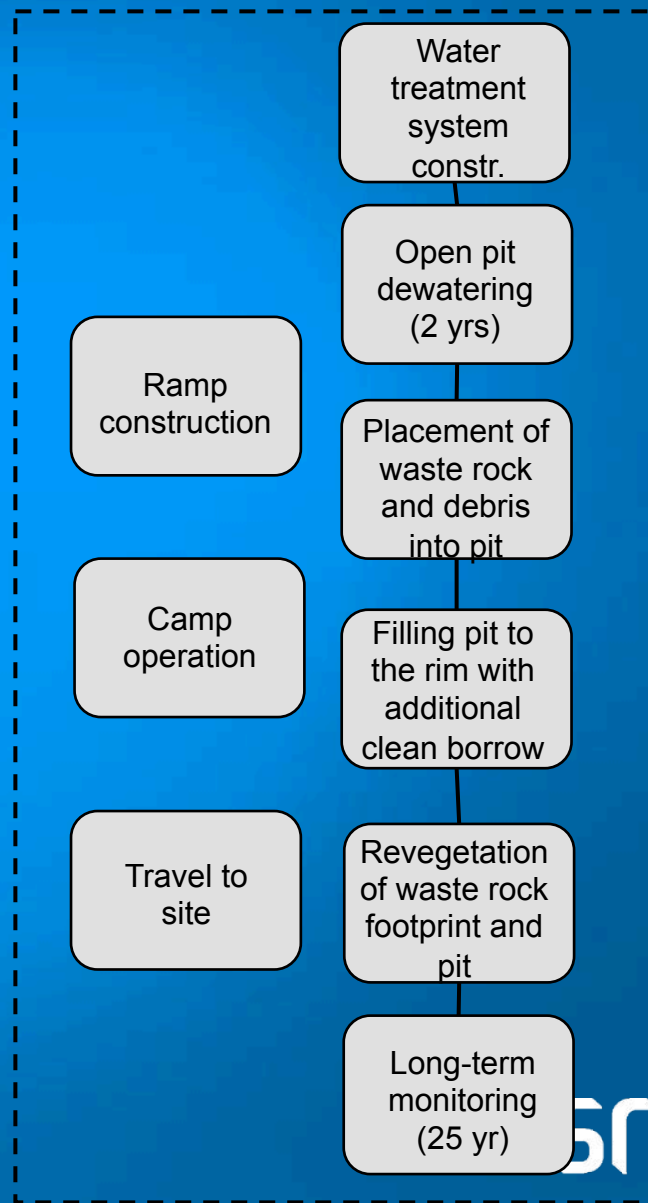


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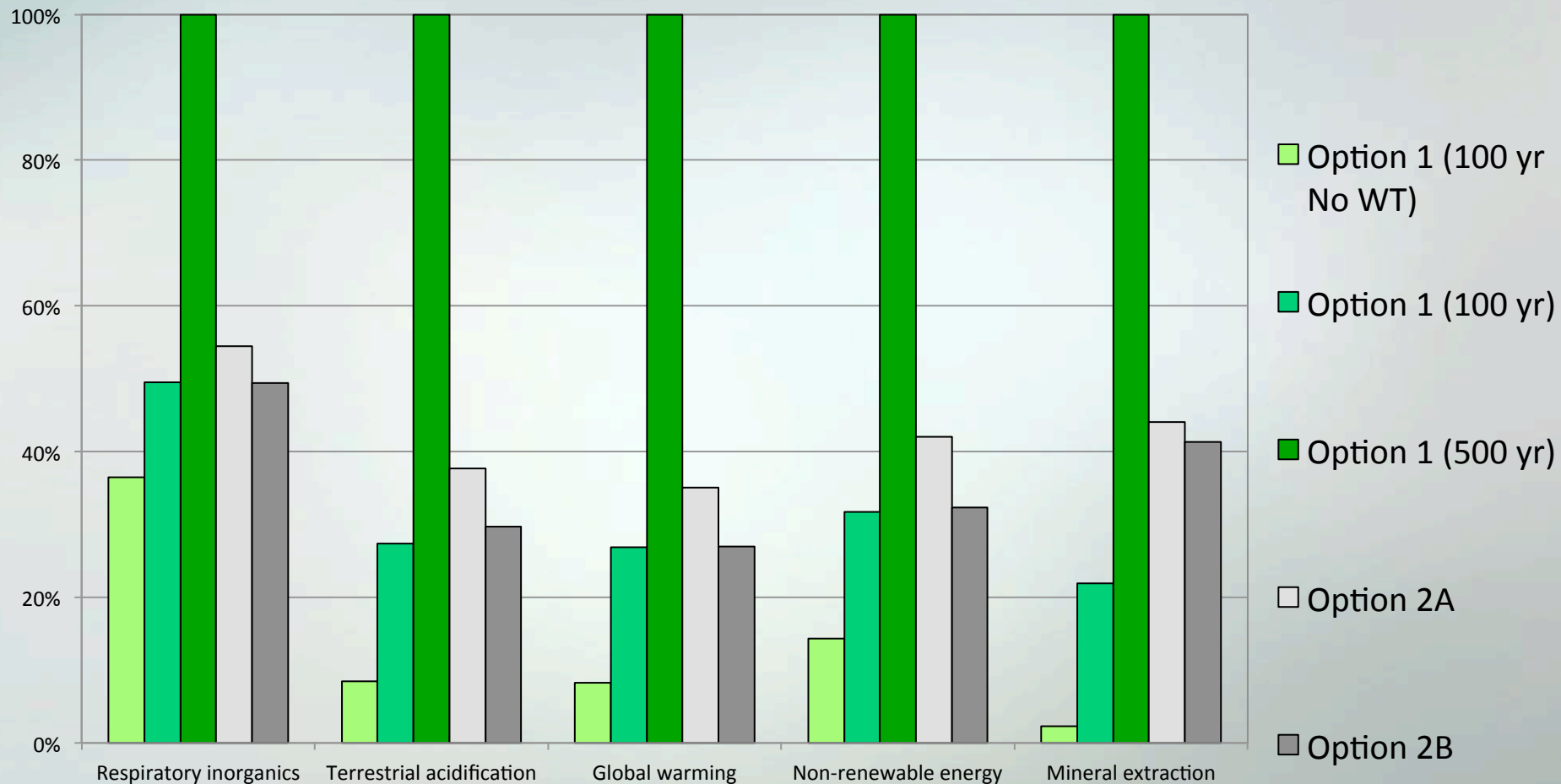
OPTION 1 – “Perpetual” water treatment



OPTION 2 – Dewatering of the Pit

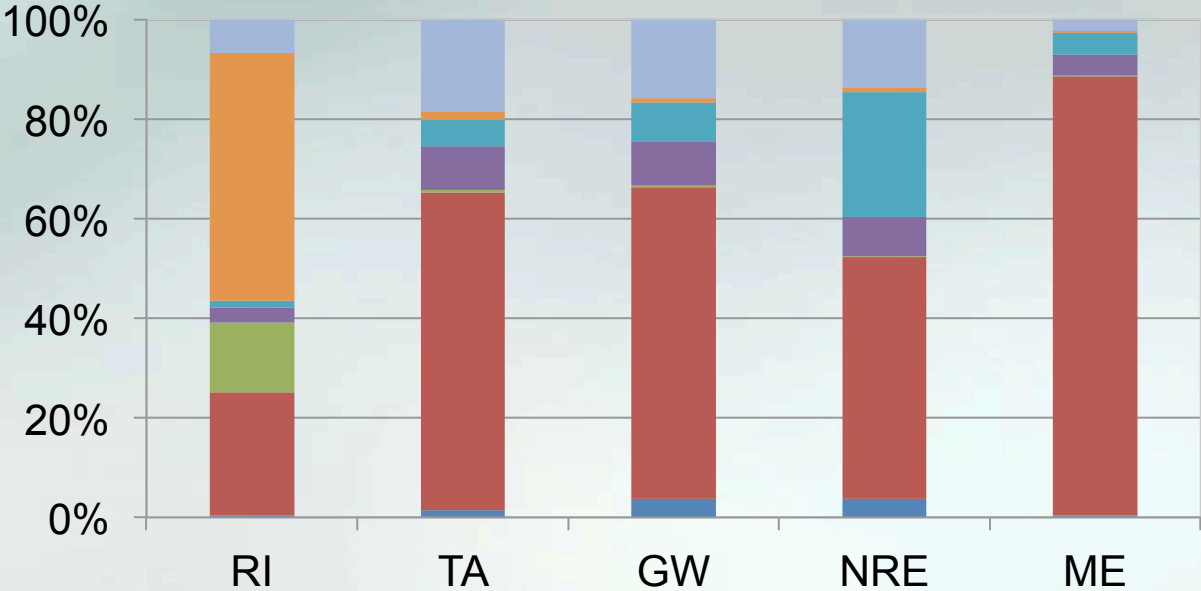


Overall environmental performance ranges widely and depends on assumed timeframe



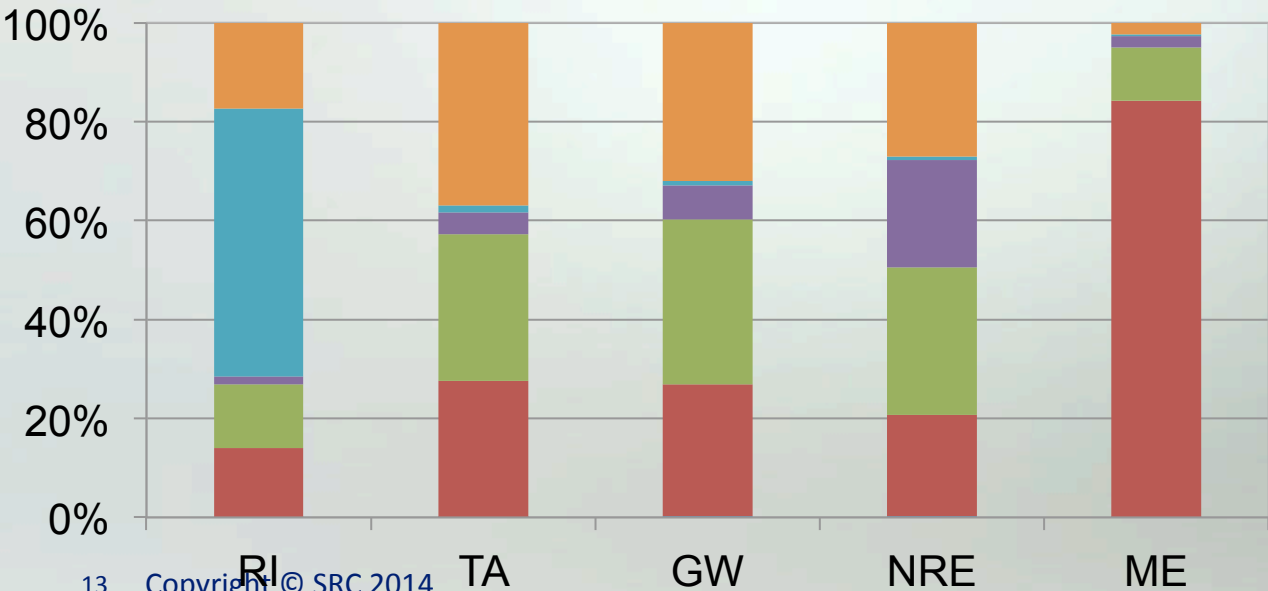
Option 1 (100 yr)

- Camp operation & workers' travel
- Pit perimeter regrading
- Revegetation
- Waste rock deposit cover
- Diversion channel construction
- Water pump & treat
- Long-term monitoring



Option 2

- Camp operation & workers' travel
- Ramp construction
- Revegetation
- Waste rock deposit
- Pit dewatering



Risk to Workers

1. Occupational health and safety risk from on-site activities
2. Risk of fatalities from air travel



Occupational Risk

- ↳ Occupational risk (lost hours) from life cycle activities (rehabilitation, travel to site, and long-term monitoring)
- ↳ Based on US Air Force Sustainable Remediation Tool (SRT)



Risk of Fatal Air Accidents

- ↳ Risk of fatal accident during air travel during rehabilitation and long-term monitoring
- ↳ Two types of flights considered
 - commercial airline
 - general aviation



Risk to Site Workers – Results

	Option 1 (100 yr No WT)	Option 1 (100 yr)	Option 2
Estimated lost hours (hr)			
Rehabilitation	65	80	235
Long-term monitoring	10	21	3
Total	76	100	237
Fatal incidents – Commercial airline			
Rehabilitation	0.02	0.03	0.08
Long-term monitoring	0.004	0.007	0.001
Total	0.03	0.04	0.09
Fatal incidents - General aviation			
Rehabilitation	0.20	0.24	0.70
Long-term monitoring	0.03	0.06	0.01
Total	0.23	0.30	0.71

Option 1: “Perpetual” water treatment

Option 2: Dewatering of the pit

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Conclusions

↳ Valuable tools that:

- Support sustainable remediation initiatives with verifiable, transparent and quantitative information
- Guide decision-making
- Steer design and improvement efforts
- Extend common GHG emissions estimates to activities beyond activities at the site

↳ Limitations and uncertainties

SRC's Sustainable Remediation Services

- ↳ Tiered sustainability appraisal
- ↳ Multi-criteria analysis for decision support (e.g., Expert Choice®)
- ↳ Life cycle costing analysis
- ↳ Oral soil bioaccessibility tests
- ↳ Ecological toxicity tests (plants and invertebrates)
- ↳ Biodiversity footprint
- ↳ Life cycle assessment



Thank you