

# The Former Lorado Uranium Mill Remediation Project

Skye Ketilson, Project Manager

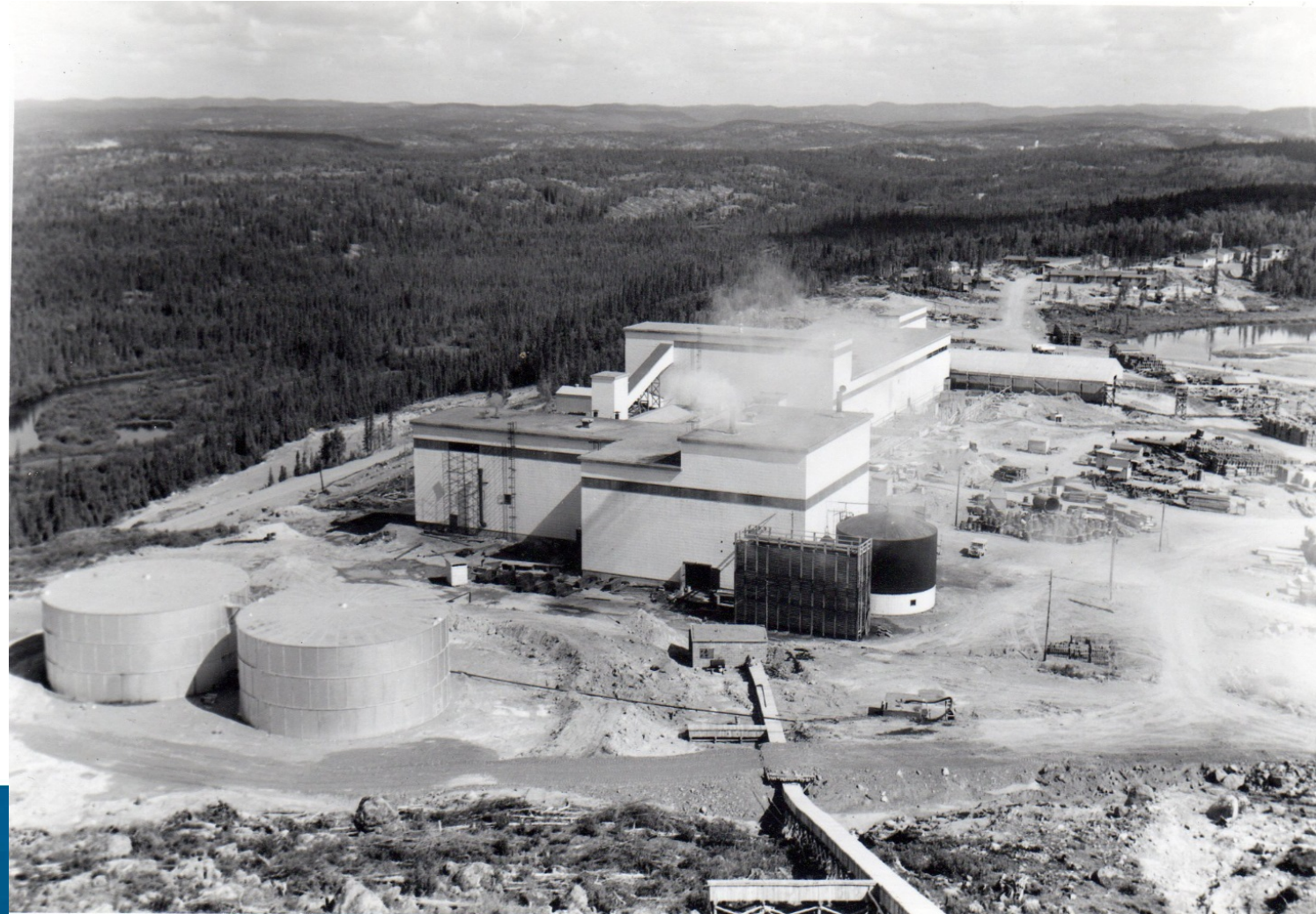
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# Project Background

- The Saskatchewan Research Council (SRC) is a provincial Crown corporation
- SRC has managed Project CLEANS (Cleanup of Abandoned Northern Sites) on behalf of the Saskatchewan Ministry of Energy and Resources since 2008.
- Project CLEANS is a multi-year, multimillion-dollar project to assess and remediate:
  - Gunnar Uranium Mine and Mill Site
  - Lorado Uranium Mill Site
  - 35 legacy uranium mine sites
- Funded by the Governments of Saskatchewan and Canada

# Project Background – Mill Operations

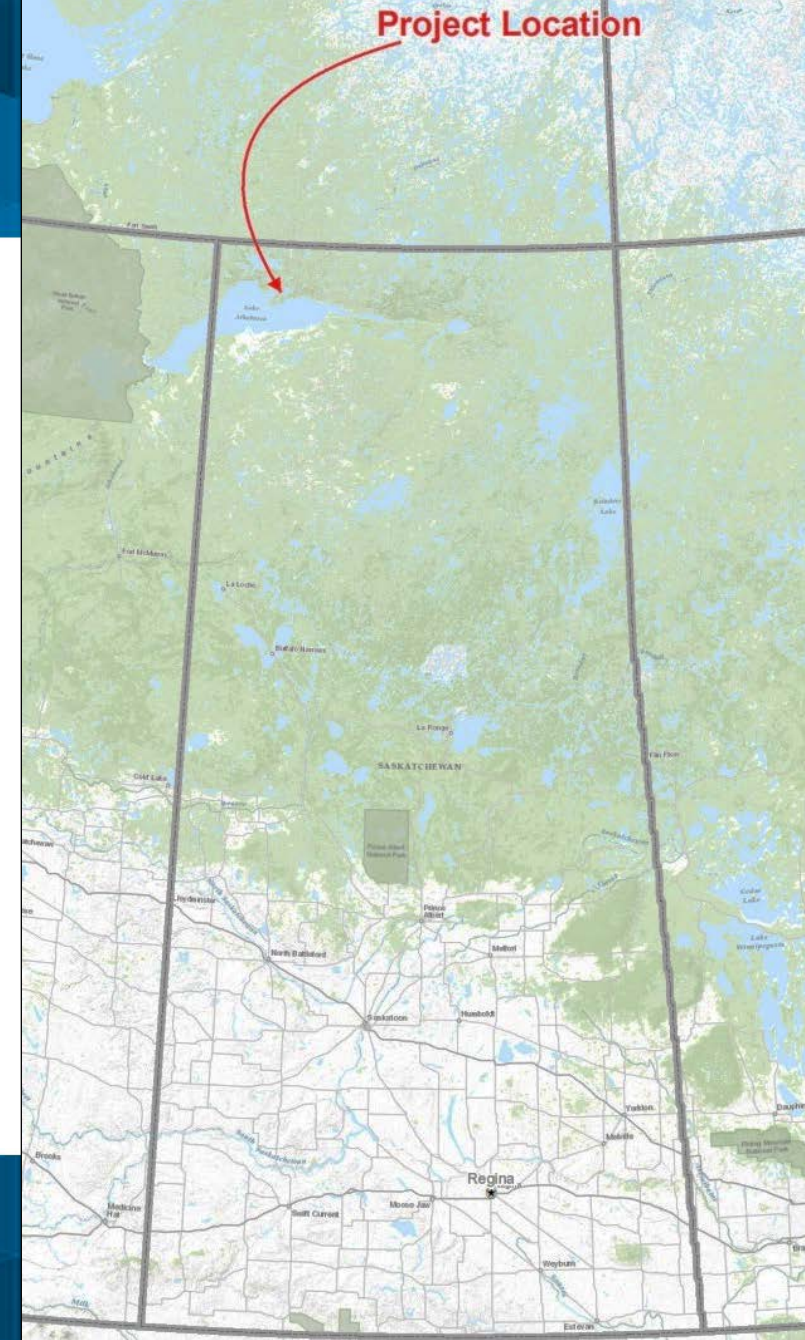
The Lorado Uranium Mill operated from 1957 to 1960 during the uranium mining boom in Canada.





# Project Background

The Site is located in a remote area of northern Saskatchewan, known as the Athabasca Basin. Access is restricted to year-round air travel, an ice road in the winter and barge for freight in the summer.





- Administrative area
- CNSC license
- Site Area





# Project Background – Site Location



# Phase I – Site Assessment and EIS

- The Lorado Site was characterized in 2004
- Environmental assessment of the Lorado Site risk reduction plan was from 2011-2013
- Overall risk management goal for the Site:

*“Risk reduction at the Site has achieved an acceptable level of residual risk to human health and to terrestrial ecological populations, and to the aquatic population of Hanson Bay and Beaverlodge Lake.”*



# Phase II – Design Objectives

## Nero Lake

- Neutralize Nero Lake
- Stop the formation of precipitates in Hanson Bay in Beaverlodge Lake

## Tailings

- Limit as far as practical formation of efflorescent salts
- Limit potential for inhalation of tailings dusts and salts
- Limit surface water infiltration into the tailings to not be greater than in the uncovered state
- Reduce gamma and radon exposure to background levels

## Peripheral Areas

- Relocate and/or bury any exposed hazardous material and/or demolition waste
- Demolish any remaining structures and landscape and cover the impacted areas for physical stability



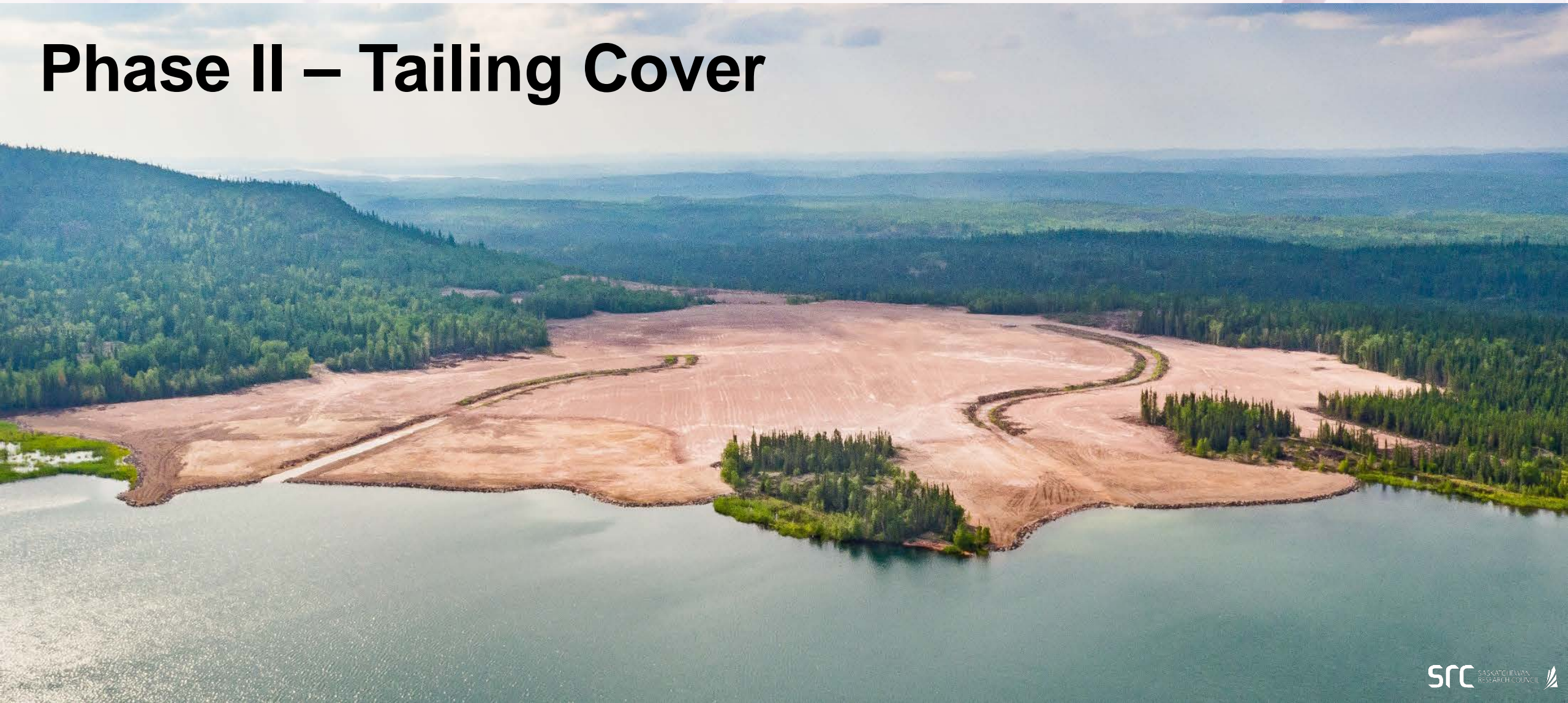
# Phase II – Water Treatment

- Nero Lake had a pH of 3.8
- Treated Nero Lake over one summer season (2014)
- 400 tonnes of lime slurry was added to neutralize





# Phase II – Tailing Cover





# Phase II – Peripheral Areas

Remediated ten smaller areas:

- Buried mill debris
- Covers built over areas with gamma signature to shield radiation
- Contoured for natural drainage
- Replaced woody debris and/or revegetated





# Phase II – Revegetation



Peripheral Area (Debris Dump), 2016

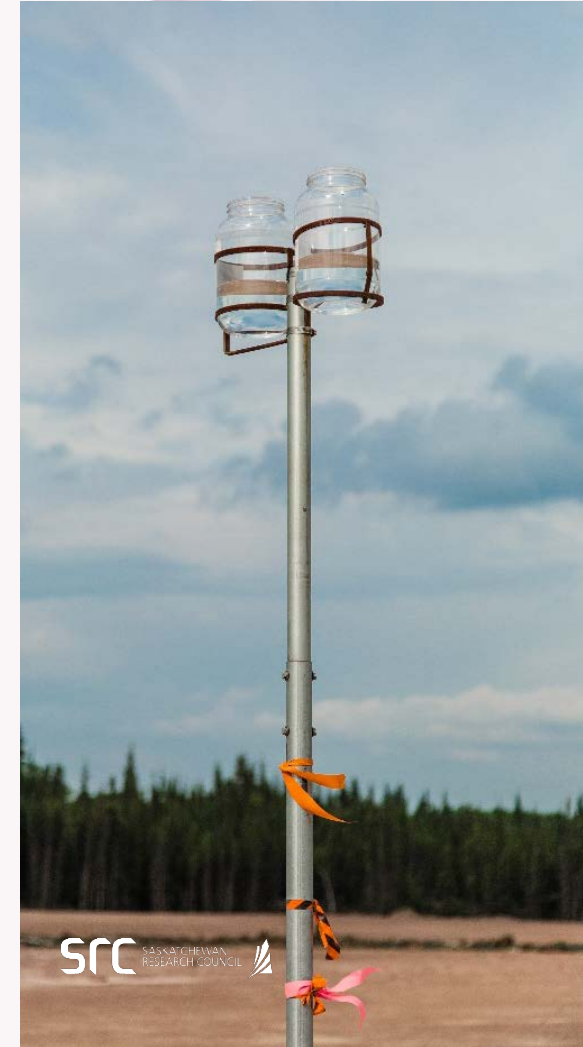


Borrow Area, 2016



# Phase II – Dust Monitoring Results

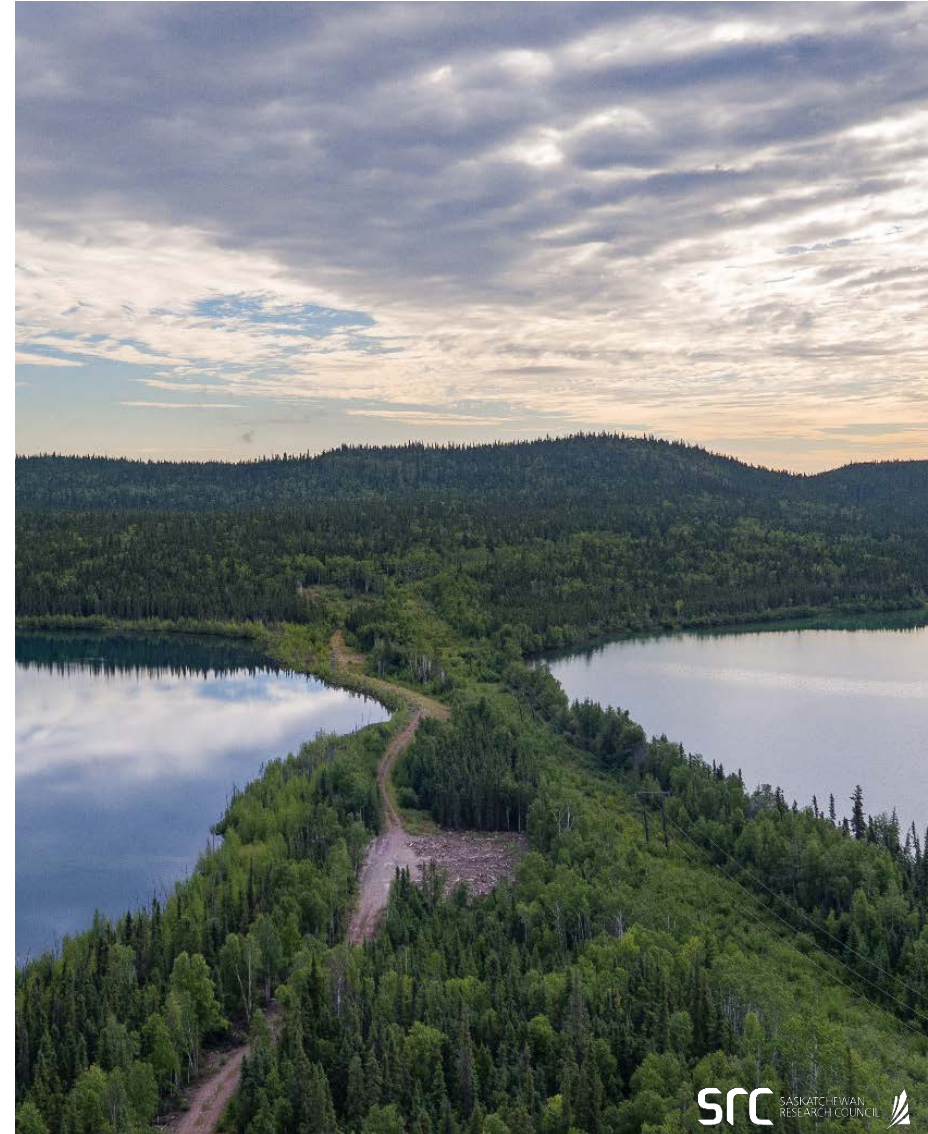
- 2010 – Concerns raised by residents of Uranium City about the health impacts from dust from tailings
- 2011 – SRC began dust monitoring program
- 2011, 2012 and 2013 - EK35 sprayed on tailings and road to assist with dust control
- 2014 and 2015 (field seasons) - Water trucks were used to control dust on the roads
- 2016 - Dust monitoring program completed
- **Results: dust produced at the site is the same as dust at the non-disturbed areas around the site**



# Phase III – Monitoring and Maintenance

Monitoring includes:

- Water (ground, surface, Nero Lake)
- Ecosystem recovery (assess revegetation success)
- Radon
- Gamma
- Cover condition (settlement, geotechnical)
- Landbridge inspections
- Air quality
- Erosion
- Unoccupied Aerial Vehicle (UAV) images
- Precipitate plume
- Sinkholes
- General site inspections (summer, winter)





# Phase III – Water Treatment Results

## Nero Lake Design Objectives:

- Neutralize Nero Lake
- Stop the formation of precipitates in Hanson Bay in Beaverlodge Lake

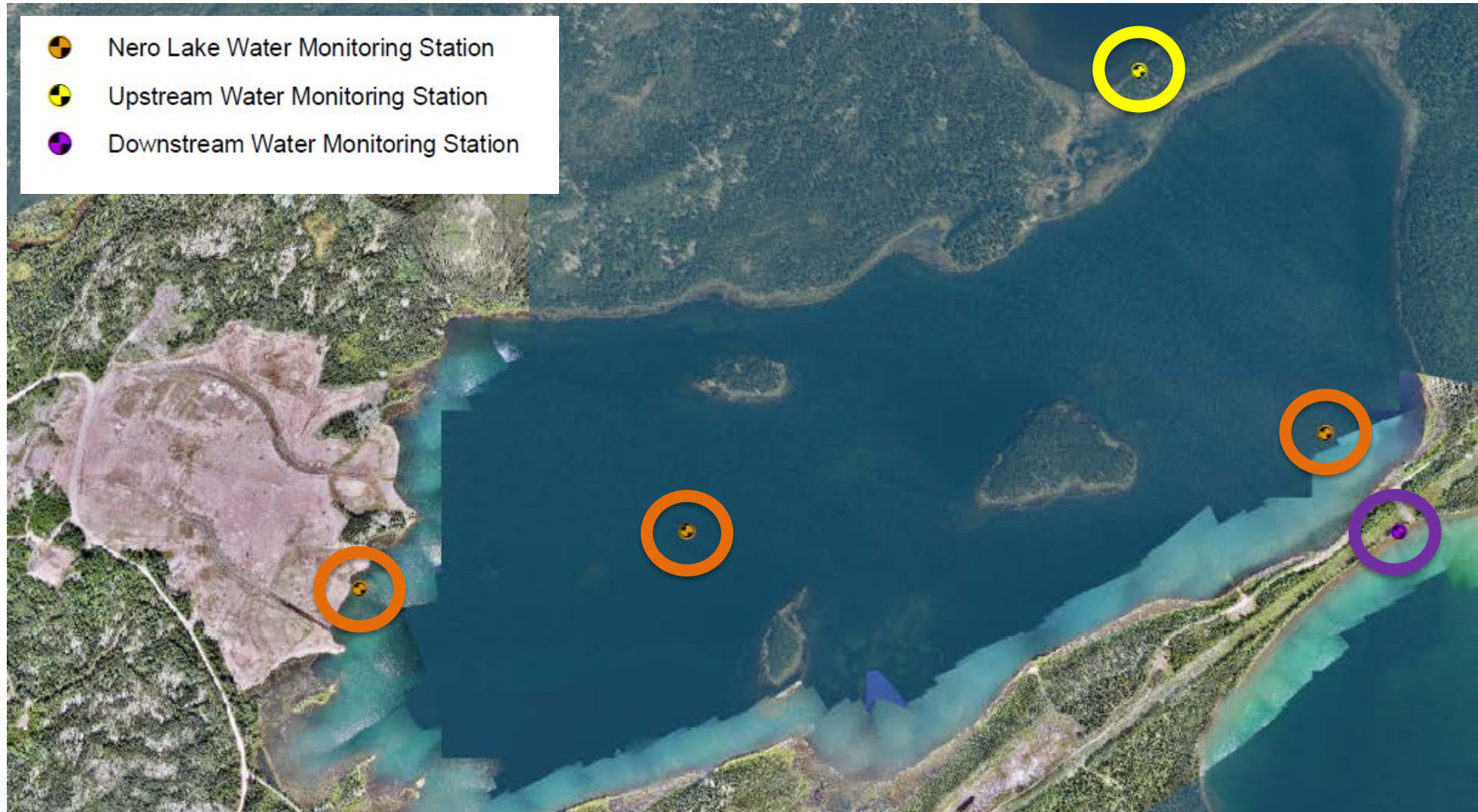
## Nero Lake Water Quality:

- pH levels are now neutral (~ 7)
- All parameters of concern are below Saskatchewan Environmental Quality Guidelines





# Phase III – SRC Monitoring Stations





# Phase III – Parameters of Concern

 Below SK EQG  
 Above SK EQG

Parameter	Units	Before Treatment	After Treatment	2017	Reduction factor
pH	pH unit	3.98	7.30	7.23	N/A
Alkalinity*	mg/L	1	25	40	N/A
Bicarbonate*	mg/L	1	30	49	N/A
Aluminum	mg/L	5.6	0.03	0.002	848
Cadmium	mg/L	0.0005	0.00001	<0.00001	100
Uranium	µg/L	0.09	0.007	0.012	7.5
Zinc	mg/L	0.04	<0.0012	0.002	20
Radium-226	Bq/L	0.21	0.06	0.05	4

\*Not regulated

# Phase III – Tailings Cover Results

## Tailings Cover Design Objectives:

- Limit as far as practical formation of efflorescent salts
- Limit potential for inhalation of tailings dusts and salts
- Limit surface water infiltration into the tailings to not be greater than in the uncovered state
- Reduce gamma and radon exposure to background levels



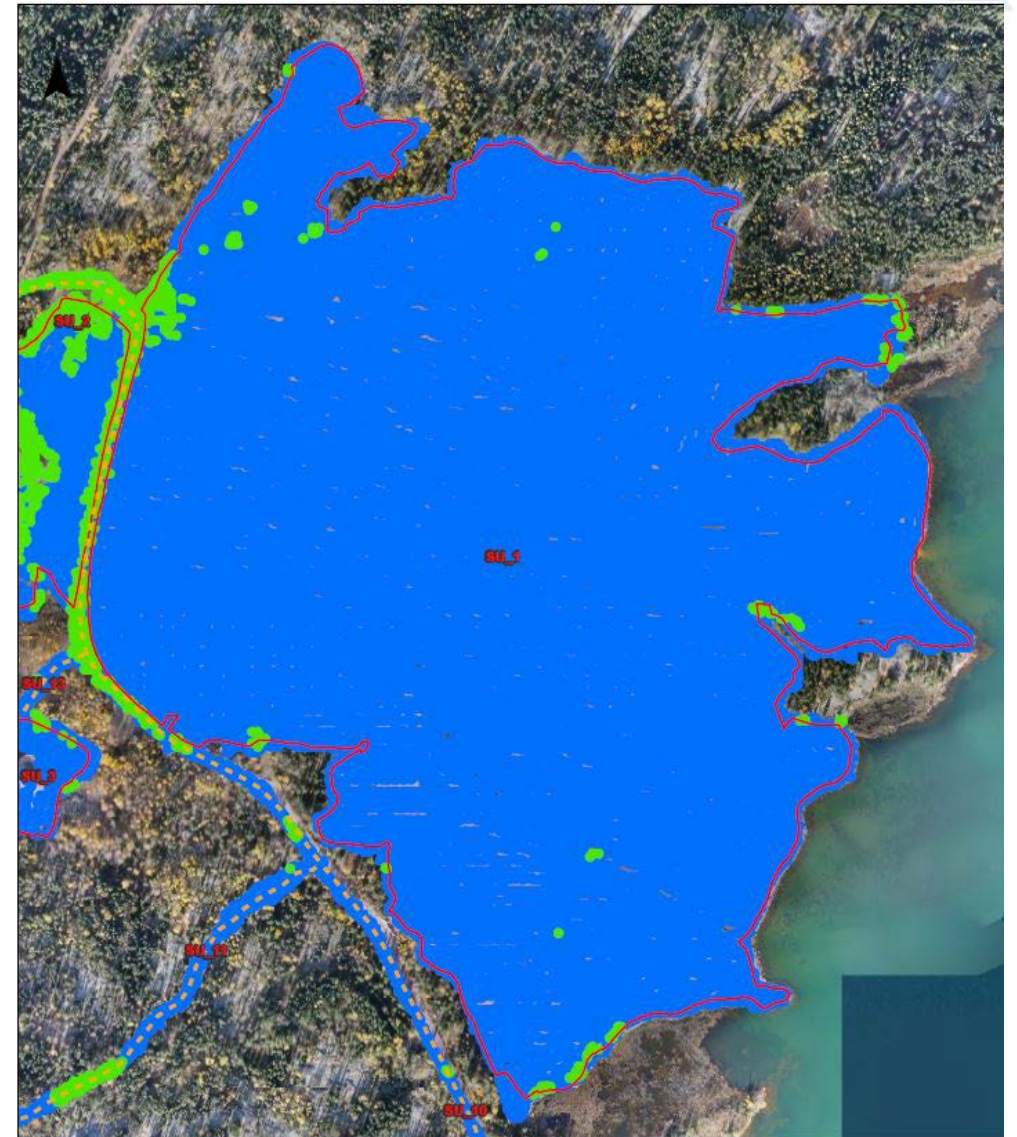
2017



# Phase III – Gamma Survey Results

Gamma Level,  $\mu\text{Sv/hr}$

- $\leq 0.2$
- 0.2-1.0
- 1.0-2.0
- 2.0-2.7
- $>2.7$





# Phase III – Peripheral Area Results

## Peripheral Areas Design Objectives:

- Relocate and/or bury any exposed hazardous material and/or demolition waste
- Demolish any remaining structures and landscape and cover the impacted areas for physical stability
- Reduce gamma and radon exposure to background levels



Debris Dump after Remediation in August 2017



# Phase III – Maintenance



Maintenance needs will be determine by the results of the monitoring program



# Thank You!

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