Australian Government
Department of the Environment and Water Resources
Supervising Scientist

Uranium Mining in Kakadu

Landscape Issues for Operations and Closure

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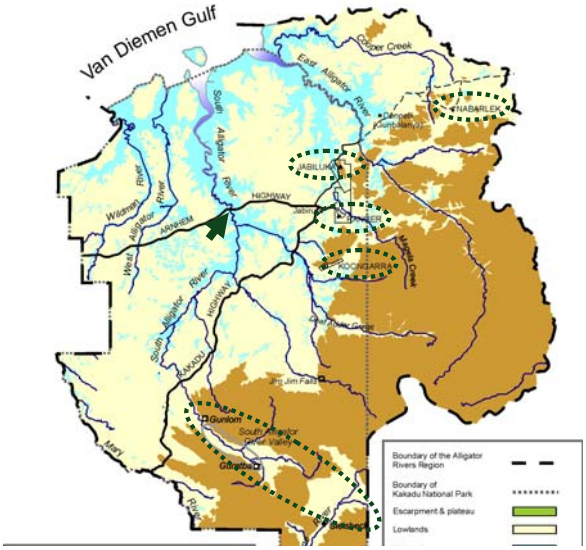
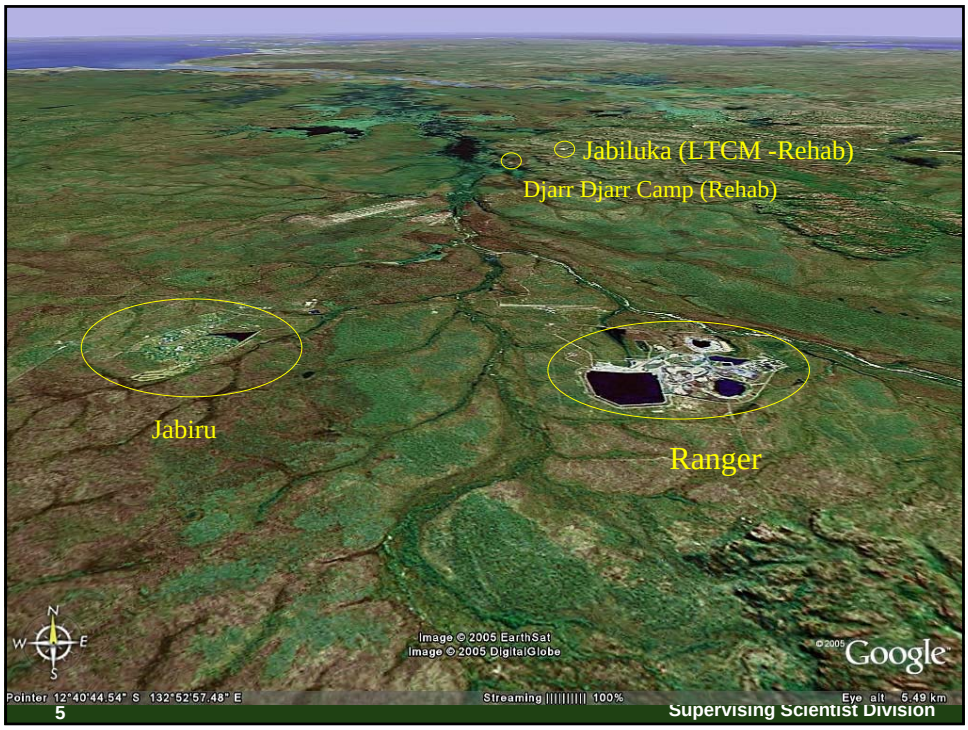
Working to protect the environment through: environmental research and monitoring; and environmental supervision, audit and inspection.

Locations



The Current Situation

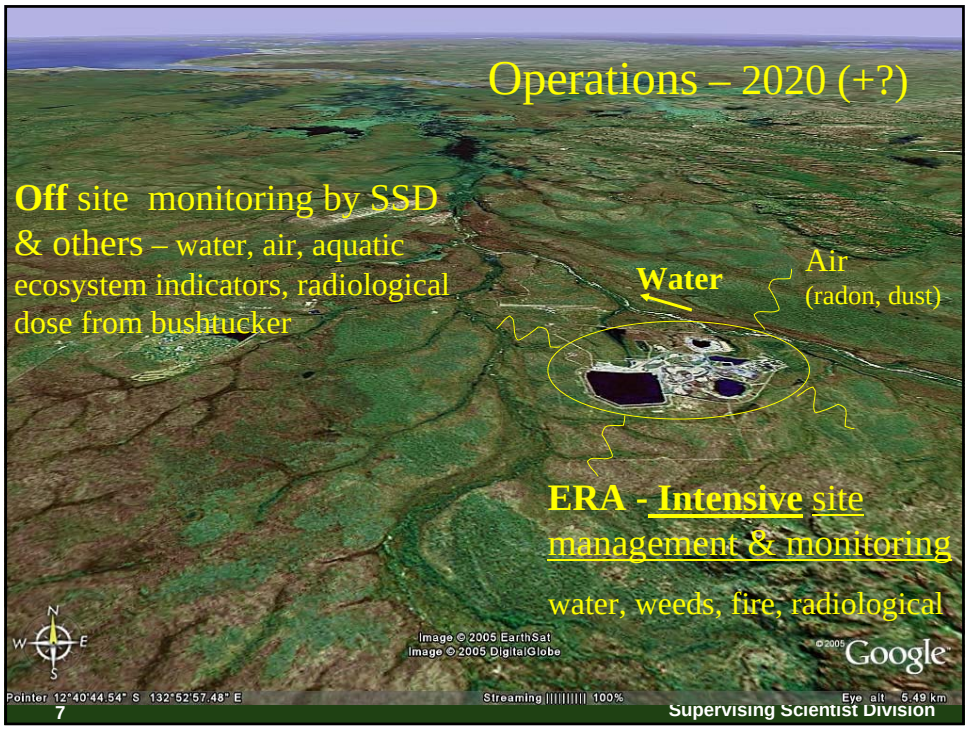
- Ranger operating to 2020 (+?)
  - Statutory Environmental Requirements
  - Magela floodplain risk assessment
- Rehabilitation works underway for old minesites in South Alligator River Valley
  - to be completed by 2015
- Jabiluka
  - long term care and maintenance



Environmental Requirements (ERs)

Ranger Operations

- *maintain the attributes for which Kakadu National Park was inscribed on the World Heritage list;*
- *maintain the ecosystem health of the wetlands listed under the Ramsar Convention on Wetlands;*
- *protect the health of Aboriginals and other members of the regional community; and*
- *maintain the natural biological diversity of aquatic and terrestrial ecosystems of the Alligator Rivers Region.*


Operations – 2020 (+?)
Off site monitoring by SSD & others – water, air, aquatic ecosystem indicators, radiological dose from bushtucker
Water
Air (radon, dust)
ERA - Intensive site management & monitoring
water, weeds, fire, radiological
Image © 2005 EarthSat
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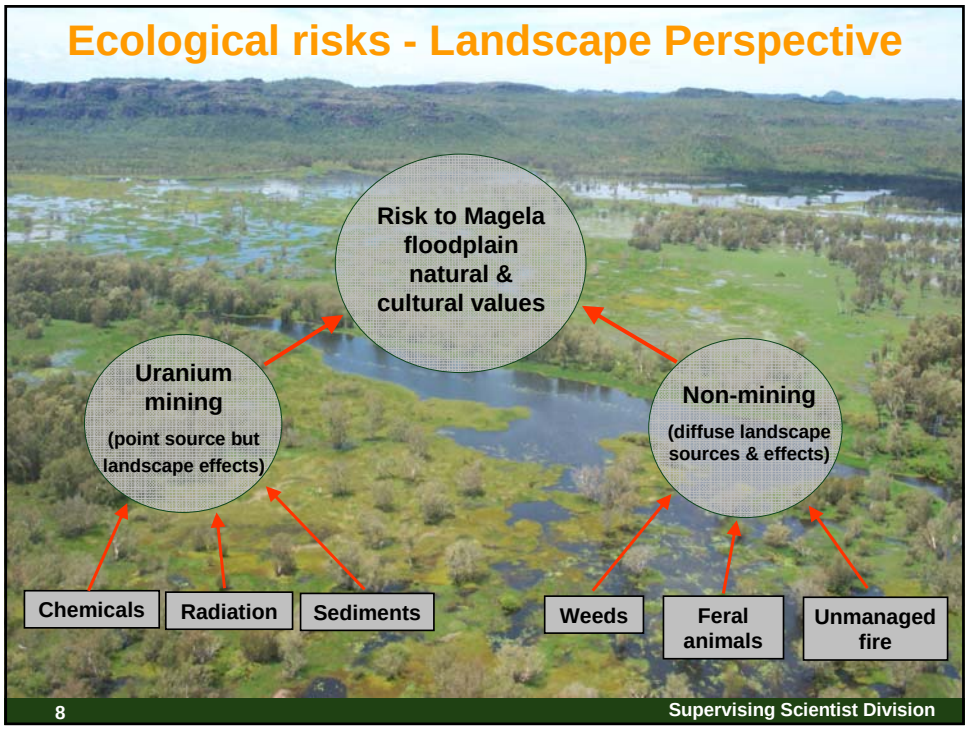
Ecological risks - Landscape Perspective
Risk to Magela floodplain natural & cultural values
Uranium mining
(point source but landscape effects)
Non-mining
(diffuse landscape sources & effects)
Chemicals
Radiation
Sediments
Weeds
Feral animals
Unmanaged fire
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Overall Results (Bayliss et al)

Category	Pathway	Hazard	Risk rank
LANDSCAPE	Park-wide	Pig damage	1
	Park-wide	Unmanaged fire	2
	Floodplains	Paragrass weed	3
		Total ecological risk =	0.24
MINESITE	Surface water	Uranium	4
	Magela Ck	Sulfate	5
		Magnesium	6
		Manganese	7
		Total ecological risk =	0.00009
		Ra-226	8
	Airborne/wind	Radon (Ra-222)	9

Landscape risks to Magela floodplain are currently several orders of magnitude greater than minesite risks.

Environmental Requirements
Ranger Rehabilitation (1)

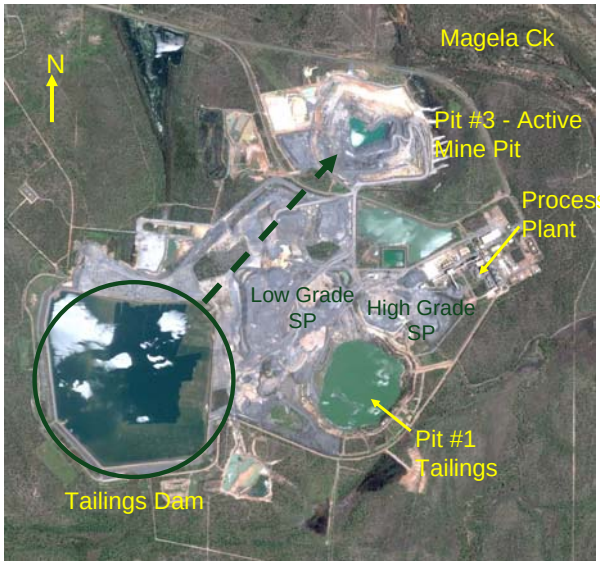
- *Rehabilitate the Ranger Project Area to establish an **environment similar to the adjacent areas of KNP** such that the rehabilitated area could be incorporated into the Park.*
- ***revegetation using local native plant species similar in density and abundance** to those in adjacent areas of KNP to form a **sustainable ecosystem** which would require a management regime **not significantly different to adjacent areas of the Park**;*

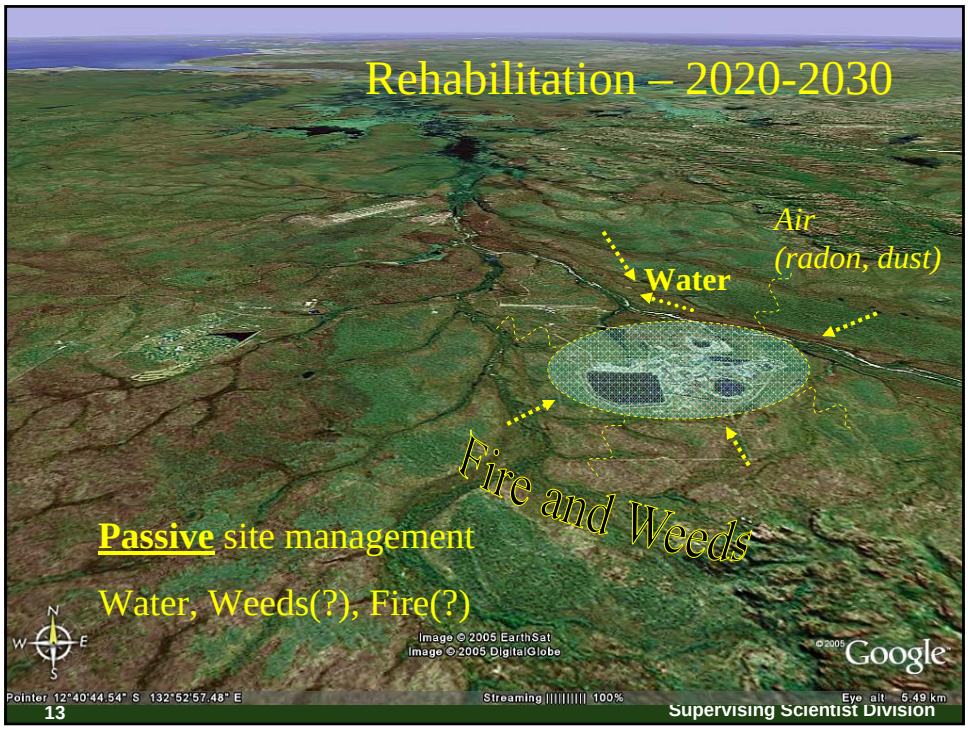
Environmental Requirements
Ranger Rehabilitation (2)

- *Health risk from radiation is **as low as reasonably achievable**; complies with the **most recently published and relevant Australian standards**; and there is a **minimum of restrictions on the use of the area**;*
- *Tailings must be returned to the mined-out pits, and be contained for a period of 10000y;*
- *erosion characteristics of rehabilitated area similar to surrounding undisturbed areas.*

Ranger Mine Closure

- Tailings Dam to Pit #3
- Pits #1 and #3 backfilled to produce low relief mounds
- Reshape remaining waste as low mounds
- Process Plant demolished
- Site revegetated





Ranger Rehab and Closure Knowledge Gaps

- There are well-defined closure objectives (Environmental Requirements) for the Ranger mine.
- With the exception of overall radiation dose from the site there currently are no specified or agreed numerical closure criteria.

Why are Closure Criteria Important?

- Closure criteria are the quantitative performance benchmarks against which the long term success and sustainability of rehabilitation will be measured (audited), and signoff given for lease relinquishment.
- In large measure the criteria define the works that must be carried out to produce a final landform that will be environmentally compatible (physically, chemically, ecologically and socially) with the Ranger Environmental Requirements.

Closure Criteria

Consultation with Traditional Owners is an Integral Part of the Process

- Water quality – surface and groundwater
  - eriss, ERA/EWLS, ERA groundwater modelling consultants
- Landform design and stability
  - ERA/EWLS, eriss
- Vegetation
  - composition & density (analogue areas)
    - establishment success, fire resistance, tolerance to weeds, weed control, evaluation of previous rehab trials, new rehab trial, lessons from Nabarlek
  - eriss, CDU, ERA/EWLS, Parks Australia, Kakadu Native Plants

Rehabilitation Planning Conundrum

- *"Revegetation to form a sustainable ecosystem which would require similar management to adjacent areas of the Park"*
  - *How should this be interpreted in the context of weeds, given that weeds are a part of the KNP landscape?*
    - *Closure criterion for weeds – similar abundance and density to the Park?*
    - *What about feral animals?*

Climate Change Projections for the NT

Implications for closure planning & research

- Intensity of tropical cyclones is likely to increase
  - increased risk of damage to vegetation on landform-tree throw and root ball disturbance?
- More intense rainfall events
  - increased erosion – need to account for this in landform design and stability modelling
- Sea level rise and storm surge
  - increase upstream flooding in rivers through slowing the drainage of these systems?

Summary

- Current risk to KNP from Ranger ops is low (LRA outcome)
- Changed risk profile through rehabilitation process will need to be specifically managed by the closure works schedule
- Rehabilitation research is being driven by the strong framework provided by the ERs
  - technically robust and defensible closure criteria needed to provide the performance benchmarks
  - Need to address environment protection and landuse aspiration components

Summary Contd

- Fire and weeds will be a significant threat to establishment and sustainability of revegetation, and management strategies (based on research outputs) will need to be specifically developed for the critical 5y period after planting.

Waste rock treatment

Waste rock & Laterite Mix

E.miniata mycorrhizal trial

Seed collection and processing

Collecting seed

Sifting

Drying

Seed germination

Sowing seeds

Success

The future

- Ranger rehabilitation starts in 2020 (+?):
  - Environmental requirements for rehabilitation
    - Closure Criteria
- Learnings from Nabarlek
- Risks (1) - the Ranger lease to the Park
- Risks (2) – the Park to the rehabilitation of the Ranger site
- Risks (3) - Climate change
  - Impacts of extreme events & sea level rise on rehabilitated minesite
- Jabiluka? Koongarra?

Ranger Mine Site