



**Cameco Australia Pty Ltd**

**EL 24936**

**STEVENS NORTH PROJECT**

**NORTHERN TERRITORY**

**ANNUAL REPORT**

**CONFIDENTIAL**

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<b>Period:</b>	02 September 2008 to 01 September 2009
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<b>Datum/Zone:</b>	GDA94 (Zone 53)
<b>Map Sheets:</b>	1: 250, 000: Millingimbi (SD-5302) 1:100, 000: Goomadeer (5673)
<b>Tenement manager:</b>	AMETS
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## SUMMARY

Stevens North is a uranium exploration project located in western Arnhem Land, operated and managed by Cameco Australia Pty Ltd. This report documents work for the first year of tenure for Exploration licence EL24936 which was granted on 2<sup>nd</sup> September 2008 for an initial period of six years. The tenement consists of 5 blocks with a total area of 15.5 km<sup>2</sup>.

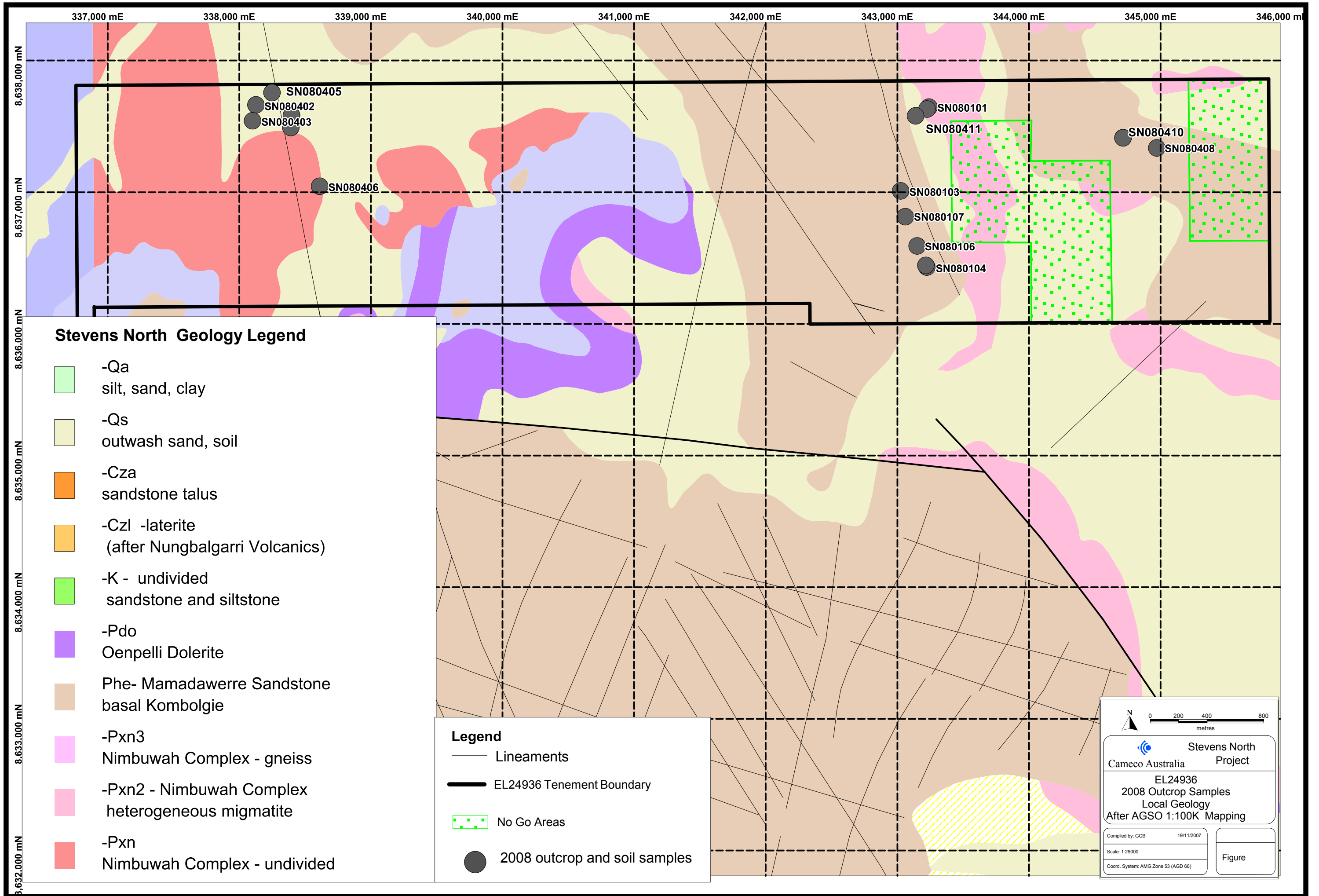
Exploration for unconformity style uranium mineralisation in the first year of tenure consisted of the compilation of geophysical data with interpretation of mapping and hyper-spectral data to generate sampling targets; soil and outcrop sampling to determine alteration patterns and to identify mineralisation potential of the major lineaments in the Stevens North Project area.

Outcrop sampling resulted in the collection of 14 samples from Mamadawerre Sandstone, Nimbuwah Complex granitoids and termite mounds. The results of the sampling indicate that the basement rocks and the termite mounds have background uranium content ranging from 3 to 4 ppm U<sub>3</sub>O<sub>8</sub>. Background uranium content in the Mamadawerre Sandstone is generally less than 1 ppm U<sub>3</sub>O<sub>8</sub>; one sample, SN080409 was anomalous in uranium with 7.5 ppm U<sub>3</sub>O<sub>8</sub>.

Eligible expenditure on the Project for the reporting period was \$25,907.29.

Follow-up work on remaining unchecked structural features, cross cutting lineaments and further sampling around the anomalous uranium sample will be completed in the second year of tenure.

Estimated expenditure for the 2009-2010 (second) year exploration program is \$20,000.



**Stevens North Geology Legend**

- Qa  
silt, sand, clay
- Qs  
outwash sand, soil
- Cza  
sandstone talus
- Czl -laterite  
(after Nungbalgarri Volcanics)
- K - undivided  
sandstone and siltstone
- Pdo  
Oenpelli Dolerite
- Phe- Mamadawerre Sandstone  
basal Kombolgie
- Pxn3  
Nimbuwah Complex - gneiss
- Pxn2 - Nimbuwah Complex  
heterogeneous migmatite
- Pxn  
Nimbuwah Complex - undivided

- Legend**
- Lineaments
  - EL24936 Tenement Boundary
  - No Go Areas
  - 2008 outcrop and soil samples

0 200 400 800  
metres

Stevens North Project  
 Cameco Australia

EL24936  
 2008 Outcrop Samples  
 Local Geology  
 After AGSO 1:100K Mapping

Compiled by: GCB	19/11/2007
Scale: 1:25000	
Coord. System: AMG Zone 53 (AGD 66)	

Figure

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## INTRODUCTION

EL 24936 (Stevens North Project) is a uranium exploration project in Western Arnhem Land, Northern Territory, operated by Cameco Australia Pty Ltd (Cameco). This report documents exploration work completed by Cameco during the first year of tenure.

The project area is underlain by a variety of granitic and metamorphic basement units of the Nimbuwah Complex and possible Myra Falls Metamorphics, which are unconformably overlain by Kombolgie Subgroup sandstone. The basement rocks and the Kombolgie Subgroup are intruded by sills and dykes of the Oenpelli Dolerite. Favourable structures and hydrothermal alteration occurs in the region with several uranium occurrences identified in the surrounding project areas, indicating a favourable mineralising and alteration event.

The prime objective is to discover economic 'unconformity style' uranium mineralisation by targeting geological settings similar to the known deposits of the Alligator Rivers Region, Northern Territory, and the concealed high-grade deposits of the Athabasca Region, Saskatchewan, Canada.

Outcrop sampling in the first year of tenure was carried out to determine alteration patterns, background geochemistry and to identify mineralisation potential of the major lineaments in the Stevens North Project area. Field mapping was done concurrently with outcrop sampling and all the radioactivity measurements were done using the Radiation Solution 125 spectrometer.

### Location and Access

EL24936 is located in western Arnhem Land, Northern Territory on the Millingimbi (SD-5302) 1:250 000 scale topographic map sheet and the Goomadeer (5673) 1:100 000 scale topographic map sheet. The tenement is centred approximately 55 km northeast of Jabiru and 15 km south of the now rehabilitated mine site at Nabarlek (Figure 2). Access is either by air to the Nabarlek or Mamadawerre airstrips, or by road via the Arnhem Highway to Jabiru and then via Cahill's Crossing and unsealed roads towards Mamadawerre outstation.

### Figure 2: Stevens North Project (EL24936) Location Map

The remote and rugged nature of the sandstone covering most of the Stevens North tenement resulted in 2008 exploration activities being helicopter supported. Helicopter access was based from a semi-permanent exploration camp located on Tin Camp Creek, named 'Myra Camp'. Road access to Myra Camp is via the Arnhem Highway to Jabiru and bitumen road to Cahill's crossing, then by dirt road via Oenpelli and Nabarlek.

In 2005, Cameco constructed a track to the Steven's prospect (ERL 25896) via a back track to Mamadawerre from the Oenpelli-Maningrida Road, for drilling access and most field activities. This track which traverses the western portion of the tenement will be used in 2009 to access EL 24936.

### Tenure

EL 24936 (Stevens North Project) is located in Western Arnhem Land (Figure 2). EL 24936 was granted to Cameco on 2<sup>nd</sup> September 2008 for an initial period of six years and covers an area of 5 blocks for 15.4 km<sup>2</sup>.

The Stevens North project is located within an Arnhem Land Aboriginal Reserve and is subject to Exploration Consent Deed with the Northern Land Council (NLC) on behalf of Traditional Owners. Stevens North contains areas that are sensitive or have cultural and/or social significance to the Traditional Owners, 'No Go Areas', and are excluded from exploration access.

The proposed exploration work for 2009 was presented to the Traditional Owners and Northern Lands Council (NLC) at the Work Program Meeting held on 30<sup>th</sup> June 2009 at Oenpelli. Clearance to conduct the program was given by the NLC on behalf of the Traditional Owners.

### **Regional Geological Setting**

The Stevens North project area is located within the eastern margin of the Neoproterozoic and Palaeoproterozoic Pine Creek Orogen, and is in a region that has been subdivided into the Nimbuwah Domain of the Alligator Rivers region (Figure 3).

**Figure 3: Simplified geology of the Pine Creek Orogen showing the location of selected mineral deposits (after Pirajno and Bagas, 2008)**

This section is largely based on the work by, Needham (1988, 1990), and Needham and Stuart-Smith (1980). Information that is not based on these references is indicated below.

The Bureau of Mineral Resources (now Geoscience Australia) completed 1:250 000-scale geological maps of the Pine Creek Orogen between the 1940s and 1960s following the discovery of uranium at Rum Jungle. The Alligator Rivers region was systematically mapped by the Bureau of Mineral Resources and the Northern Territory Geological Survey between 1972 and 1983. This later work produced 1:100 000-scale geological maps and reports for the region from Darwin to Katherine to the Alligator Rivers region.

**Figure 4: NTGS 1:250, 000 Regional Geology**

The oldest exposed rocks in the Alligator Rivers region are included in the Neoproterozoic (ca. 2500 Ma) Nanambu Complex. The complex consists of paragneiss, orthogneiss, migmatite, and schist forming domical structures that are unconformably overlain by Palaeoproterozoic metasedimentary and metavolcanic rocks, which were formerly included in the Pine Creek Geosyncline. Palaeoproterozoic rocks in the Alligator Rivers region are amphibolite-facies psammites assigned in the Mount Howship Gneiss and the Kudjumarndi Quartzite. These formations are included in the Kakadu Group and are probably correlatives of the Mount Basedow Gneiss and Munmarlary Quartzite, respectively (Ferenczi et al., 2005). The group appears to on-lap Neoproterozoic basement highs, but gneissic variants are also thought pass transitional into paragneiss of the Nanambu Complex.

The Cahill Formation of the Namoon Group conformably overlies the Munmarlary Quartzite. The lower part of the Cahill Formation (informally referred to as the Lower

Cahill Formation) hosts the Nabarlek, Ranger and Jabiluka uranium deposits. The Lower Cahill Formation consists of a structurally lower calcareous marble and calc-silicate gneiss, which is overlain by pyritic, garnetiferous and carbonaceous schist, quartz-feldspar-mica gneiss, and minor proportions of amphibolite.

The informally named Upper Cahill Formation is psammitic and consists of feldspar-quartz schist, quartzite, lesser proportions of mica-feldspar-quartz-magnetite schist, and minor proportions of metaconglomerate and amphibolite. The Cahill Formation is magnetic and significantly so at the base of psammitic unit in what is informally known as 'hangingwall sequence'. The magnetic characteristic of this unit is due to the presence of mafic sills or magnetite and it is a useful characteristic used to distinguishing the Cahill Formation from surrounding less magnetic rocks (Kendall, 1990). Mafic sills and dykes assigned to the Goodparla and Zamu dolerites intrude the Upper Cahill Formation.

The Nourlangie Schist overlies the Cahill Formation and consists of argillaceous to quartzose phyllite and quartz-mica schist that locally contain garnet and staurolite.

The supercrustal rocks of the region are structurally complex, having been affected by at least three deformation event before deposition of the late Palaeo- to Mesoproterozoic Kombolgie Subgroup (Thomas, 2002). The rocks have also been locally migmatized during the ca. 1847-30 Ma Nimbuwah Event. In addition, there is a broad trend of increasing grade from southwest to northeast in the Nimbuwah Domain. This gradient is thought to reflect the synchronous emplacement of ca. 1865 Ma granites in the Nimbuwah Complex.

The Kombolgie Subgroup is the basal unit of the late Palaeo- to Mesoproterozoic Katherine River Group of the McArthur Basin (Sweet et al., 1999a, b). The subgroup consists of sandstone units called the Mamadawerre Sandstone, Gumarrimbang Sandstone, and Marlgowa Sandstone, which are divided by thin basaltic units called the Nungbalgarri Volcanics, and Gilruth Volcanics. The Mamadawerre Sandstone has a minimum age of ca. 1700 Ma, which is the minimum age of the intrusive Oenpelli Dolerite. Detrital zircon SHRIMP data from the GA OZCRON database constrain the maximum age of the sandstone at ca. 1810 Ma.

The Oenpelli Dolerite is the most pervasive mafic intrusive suite to affect the Alligator Rivers region and is the youngest Proterozoic rock unit exposed. It intrudes various units Neoproterozoic and Palaeoproterozoic units, and the Kombolgie Subgroup, forming magnetic sills, dykes, lopoliths, and laccoliths. The Oenpelli Dolerite has a SHRIMP U-Pb baddeleyite date of  $1723 \pm 6$  Ma (Ferenczi et al., 2005), however, geochemical and geophysical data suggest several phases of intrusion throughout the region. These intrusive events had a pronounced thermal effect within the Kombolgie Subgroup, with the promotion of fluid flow and aquifer or aquitard modification. Localised effects in the sandstone include silicification, desilicification, chloritisation, sericitisation, and pyrophyllite alteration. A characteristic mineral assemblage of prehnite-pumpellyite-epidote has formed in the quartzofeldspathic basement rocks adjacent to the intrusions.

Deformation since deposition of the Katherine River Group includes transpressional movement along steep regional-scale strike-slip faults and possibly some shallow thrusting. These regional faults follow a pattern of predominantly north, northwest,



north – northwest and northeast strikes, giving rise to the characteristic linearly dissected landform pattern of the Kombolgie Plateau. Another significant set trends east-west and includes both the Ranger and Beatrice Faults.

The Bulman Fault Zone is a principal regional feature and is considered to represent a long-lived deep crustal structure, with a large lateral component in rocks of the PCS. However, it appears that post-Kombolgie displacements along this and other faults have not been great, because the Arnhem Land Plateau is essentially coherent and offsets along lineaments are generally minor. Field investigations of many interpreted ‘faults’, including those with a marked geomorphic expression, show no displacement, and are best described as joints or lineaments (Thomas 2002).

Erosional remnants of flat-lying Palaeozoic Arafura Basin and Cretaceous Carpentaria Basin are present as a veneer throughout the coastal zone of the Top End. Various regolith components are ubiquitous as cover throughout much of the region.

### **Local Geology**

The geology of the region can be divided into two geological domains, a western domain of crystalline basement and dolerite and eastern domain consisting of the McArthur Basin sedimentary succession (Figure 5). The project lies at the western extremity of the main surface expression of the Nimbuwah Complex, which occupies coastal plains and escarpment country west of the tenement, centred on King River. It is likely that the boundary between this complex and the high-grade metamorphics of the Pine Creek Orogen (i.e. the ‘transitional zone’ of the Nimbuwah Complex; Needham, 1988) is located immediately south of the tenement near an uranium occurrence known as Steven’s prospect.

### **Figure 5: Local Geology of Stevens North Project**

The transitional zone of the Nimbuwah Complex is represented by amphibolite to granulite facies pelitic to psammopelitic gneiss and migmatite of the Myra Falls Metamorphics. The recently released NTGS 1:500,000 scale GIS compilation for the Pine Creek Orogen specifies that these metamorphics belong to the Cahill Formation, based largely on geophysical character. However, this cannot be substantiated in outcrop by the presence of characteristic lithologies, suggesting the more general Myra Falls Metamorphics may be a more appropriate classification.

Sedimentary rocks of the Lower Kombolgie Subgroup (Sweet et al., 1999a) unconformably overlie (and obscure) basement in the central and eastern parts of the tenement (Figure 5). The basal formation, the 100-250 m thick Mamadawerre Sandstone, forms a deeply dissected plateau surface. This area is composed largely of bare rock with sparse areas of shallow sandy soil supporting spinifex and scrub. Sandstone is quartzose to lithic and fine- to very coarse-grained with a variety of fluvial to shallow high-energy marine bedforms, including trough and planar cross-beds (Ojakangas, 1979).

Mamadawerre Sandstone is unconformably overlain by the Nungbalgarri Volcanics. The contact is expressed locally as 100-500 m diameter sub circular depressions (‘dome and basins’), with the upper sandstone surface interpreted to represent the

palaeotopographic surface of giant lunate current ripples or aeolian sand dunes with the volcanic draped over the top (Nott and Ryan, 1996). It may also represent large dewatering structures formed as a result of hot volcanic rocks draped over water-saturated sediments, which were deposited in estuarine conditions (Needham, 1978). The Nungbalgarri Volcanics consist of multiple vesicular and amygdaloidal basaltic flows. The regional stratigraphic thickness of the volcanic unit is variable between 50 m and 130 m, however, it may also be locally absent (Carson et al., 1999).

Sills and dykes of Oenpelli Dolerite occur within basement in the Stevens North project area (Figure 5). In outcrop, the dolerite ranges from fresh magnetic coarse-grained subophitic dolerite to pervasively altered chlorite-hematite rock. The most visibly obvious structures in the tenement are deeply incised linear features of various orientation and significance, including fractures, joints and small faults.

### **Exploration Target**

The focus of exploration in the Stevens North Project area is the discovery of unconformity-style uranium deposits. The prospective nature of the Alligator Rivers region is demonstrated by the presence of economic uranium occurrences at Ranger, Jabiluka, Koongarra and Nabarlek. In addition, significant gold, platinum and palladium resources are present at existing uranium occurrences in the Alligator Rivers Uranium Field (Ranger, Jabiluka, Koongarra and Coronation Hill/South Alligator Valley-style deposits) suggesting that economic Au and Platinum Group Element (PGE) mineralisation, associated with economic or sub-economic uranium may also be present in the project area.

Recent research into the Proterozoic Westmoreland District uranium deposits, from the Northern Territory – Queensland border suggests that the same broad physiochemical processes that govern unconformity-style uranium deposits also produce Westmoreland-style deposits, and indeed other basin/unconformity associated precious and base metal deposits (Wall 2006). ‘Westmoreland-style’ uranium mineralisation may pose an exploration target in the dolerite and volcanic units of project area, although only sub-economic uranium occurrences have been discovered associated with these units in West Arnhem Land.

Despite local variations in structures, host rocks, element associations, all uranium deposits in the Alligators River region are located close to the unconformity between basement rocks and the Kombolgie Subgroup. In several examples, down-faulted blocks of the Kombolgie Subgroup, such as at the Ranger No 3 Orebody and the Hades Flat Prospect, are present adjacent to mineralisation. This common association of sandstone and uranium mineralisation is considered to be indicative of a favourable setting for the concentration of mineralising fluids, irrespective of the deposit-style model being invoked.

## **PREVIOUS EXPLORATION**

The Stevens North tenement was within AP 2046 and later EL 243 which were explored by Queensland Mines Limited (QML) between 1970 and late 1973. No exploration work was conducted by QML in the Stevens North project area as exploration focused on the basement inliers to the west.

Exploration work ceased in the project areas surrounding the Stevens North tenement from 1971 to 1988 due to the Federal Government moratorium on mineral exploration on Aboriginal Land which halted exploration activities. EL2508 was granted to Queensland Mines Limited on the 29<sup>th</sup> of June 1988. Exploration was focused on basement outcrop areas further to the west of the area. QML and Afmex signed an exploration joint venture agreement in 1992. However, no exploration work was conducted in the Stevens North tenement by QML–Afmex joint venture until the expiry of the license in June 1998.

The Stevens North project, EL 24936, was granted to Cameco on the 2<sup>nd</sup> of September 2008.

## **EXPLORATION COMPLETED DURING THE REPORTING PERIOD**

The 2008-2009 fieldwork program involved helicopter-assisted outcrop and soil sampling on major lineaments and cross cutting structural features. A total of 14 sites were recorded, with samples collected from all the 14 locations.

Samples with an average weight of 1.2 kg were submitted to NTEL for routine geochemical analysis. Sampling was conducted in the western and eastern parts of the tenement ([Figure 6](#)). The central area is devoid of outcrop and termite mound samples were collected in these parts, as they may be considered to represent the underlying rock units. Due to accessibility problems, not all the sandstone targets were sampled.

[Figure 6: Location of 2008 Exploration activities](#)

[Table 1 Exploration summary for 2008-2009 for EL24896](#)

### **Regional Outcrop Sampling and Reconnaissance**

2008 sampling targets were generated from detailed review of the aeromagnetic, radiometric images, old geological literature, hyper-spectral images and structural data. A total of 14 sites were recorded, with samples collected from all the 14 locations.

The outcrop sampling and processing was performed using Cameco standard methodology, as outlined in [Appendix 1](#). This appendix details methodology used for reflectance spectroscopy, laboratory techniques and methods, and analysed elements. All samples were submitted to Northern Territory Environmental Laboratories (NTEL) in Darwin for geochemical analysis.

[Appendix 1: Outcrop Sampling Procedures](#)

### **Outcrop Sampling Results**

A summary of significant geochemical results, SWIR spectroscopy and sample descriptions are presented in [tables 2-3](#). Distribution maps of uranium, U/Th, gold, copper, nickel, lithium and zinc for outcrop samples are presented in Figures 7 to 13. The different rock units sampled are presented in [Figure 14](#). Detailed geochemical results, sample location, rock types, and PIMA data are presented in the data folder.

[Table 2: Summary of significant geochemical results from outcrop sampling](#)

[Table 3: Outcrop Sample Descriptions and Properties](#)

Table 4: PIMA TSA data for Outcrop samples

Figure 7: Map showing uranium geochemical results for outcrop samples

Figure 8: Map showing uranium/thorium geochemical results for outcrop samples

Figure 9: Map showing gold geochemical results for outcrop samples

Figure 10: Map showing copper geochemical results for outcrop samples

Figure 11: Map showing nickel geochemical results for outcrop samples

Figure 12: Map showing Li geochemical results for outcrop samples

Figure 13: Map showing zinc geochemical results for outcrop sampling

Figure 14: 2008 Outcrop rock types

The basement granitoids are deeply weathered and altered. The Mamadawerre Sandstone in the Stevens North tenement is characterised by several distinct 10 cm to 2 m thick conglomeratic beds and several narrow (10 cm) intervals of parallel laminated fine-grained lithic sandstone beds. The Mamadawerre Sandstone is weakly to moderately hematite altered and has been affected by post depositional silica rich fluids. Intense red brown hematite is common along the sedimentary bedding and fracture planes.

Uranium content in the granitoids and termite mounts ranges from 3-4 ppm  $U_3O_8$ , and is considered to be within expected background values. Limited sampling of the Mamadawerre Sandstone indicates uranium content is generally less than 1 ppm  $U_3O_8$ . SN080409 collected from sandstone in the eastern part of the tenement is anomalous with 7.5 ppm  $U_3O_8$  (Figure 7). SN080409 is a massive, fine grained sandstone with minor hematite alteration.

Infrared spectroscopy data indicates the background clay component of the sandstone to be halloysite and illite, suggesting that the sandstones have been subjected to possible low-grade hydrothermal alteration.

## EXPENDITURE

Eligible expenditure on Stevens North project for the reporting period was \$25,907.29 to complete the program as outlined in this report.

Table 5: Eligible Expenditure Statement

## CONCLUSIONS AND RECOMMENDATIONS

Outcrop sampling conducted by Cameco in 2008 was completed to determine alteration patterns, background geochemical signatures and uranium mineralisation potential of major lineaments in Stevens North tenement.

Outcrop sampling conducted in 2008 indicated expected background uranium results in the sandstone samples with one anomalous sample, SN080409 on the eastern side of the tenement, with 7.5 ppm  $U_3O_8$ . Further reconnaissance and sampling will be conducted in the vicinity of SN08409 to determine the nature and possible extent of the uranium anomaly.

## **2010 WORK PROGRAM AND PROPOSED BUDGET**

Exploration for the second year of tenure will consist of a reconnaissance and sampling program focussed on the follow-up of remaining unchecked structural features and cross cutting lineaments with further work on the anomalous uranium sample SN080409.

Expenditure for the planned exploration is anticipated to be \$20,000 to complete the program as planned.

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