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ELLIOT LAKE LABORATORY

MARCH 1988

MINING RESEARCH LABORATORIES
DIVISION REPORT MRL 88-43 (TR)

MRL 88-43(TR)C.1

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ABSTRACT

A field test was conducted regarding survival potential and prediction modelling of vegetation cover on uranium tailings after a natural disaster such as flood or forest fire.

The Nordic Main uranium tailings area was rehabilitated by vegetation cover, starting in 1978, and was maintained and fertilized until 1982. Within a few years a definite soil-like profile developed consisting mainly of decomposed organic matter.

In 1985, a flood destroyed about 20% of the cover, and vegetation is slowly growing back to generate a new cover without human intervention.

Two years after the flood, biomass samples were collected for comparison between the damaged and undamaged areas. Results showed that the wet weight regrowth of biomass from the damaged area is 4.6 to 5.9 times lower than from the undamaged area, and the dry weight of the regrowth is 2.4 to 5.3 times lower than from the undamaged area. The biomass on the undamaged area can retain 1.3 to 1.5 times more water than the damaged area.

The area will be re-assessed to establish the time required for the vegetation to recover to the same condition as the undamaged area.

Key words: Revegetation: Uranium tailings: Environmental.

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POTENTIEL DE SURVIE DE LA COUVERTURE VÉGÉTALE POUSSANT SUR DES RÉSIDUS DE MINERAIS D'URANIUM

par

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RÉSUMÉ

On a effectué un essai sur le terrain portant sur le potentiel de survie et la modélisation de la couverture végétale poussant sur des résidus de minerais d'uranium après une catastrophe naturelle, comme une inondation ou un incendie de forêt.

Dans la zone où se trouvent les résidus d'uranium de la Nordic Main, on a commencé à restaurer la couverture végétale en 1978. Le site a été entretenu et fertilisé jusqu'en 1982. En l'espace de quelques années, un profil de type sol bien défini, principalement composé de matière organique décomposée, est apparu.

En 1985, une inondation a détruit environ 20 % de la couverture qui est maintenant en train de se reformer sans aucune nouvelle intervention humaine.

Deux ans après l'inondation, on a prélevé des échantillons de biomasse pour comparer les zones endommagées et les zones non endommagées. Les résultats de cette comparaison ont montré que la masse nette de biomasse ayant repoussé sur la zone endommagée est de 4,6 à 5,9 fois plus faible que celle sur la zone non endommagée et que la masse sèche correspondante est de 2,4 à 5,3 fois plus faible que dans la zone non endommagée. Dans la zone non endommagée, la biomasse peut retenir de 1,3 à 1,5 fois plus d'eau que celle dans la zone endommagée.

On réévaluera la zone pour déterminer combien de temps il faut pour que la végétation redevienne dans le même état que celle dans la zone non endommagée.

Mots clés : Restauration de la couverture végétale; résidus de minerais d'uranium; environnemental.

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INTRODUCTION

The uranium mining industry in Elliot Lake produces a large volume of low level radioactive waste material which after milling, extraction, and neutralization processes, is deposited in extensive tailings impoundments.

The Nordic Mine site, located about 5 km east of the town of Elliot Lake, operated from 1957 until its closure in 1968. The Nordic tailings impoundments, shown in Figure 1, and known as the Nordic Main tailings, covers an area of 70 hectares and contains approximately 10 million tonnes of tailings with an average thickness of 12 m. The smaller impoundment situated immediately west of the Nordic Main tailings, known as the Nordic West Arm, covers an area of 15 hectares and contains approximately 2 million tonnes of tailings with an average thickness of 7 m.

The tailings area receives approximately 1 m of precipitation annually, primarily as spring and fall rain and winter snow. The water table in the tailings ranges in depth from about 1 m to 10 m below surface and fluctuates by a metre or so with the season.

The Nordic Main tailings area also receives surface run-off from the rocky hill slope and drainage from the Lacnor tailings area on the northern boundary of the impoundment area (Figure 2).

Water that does not seep into the tailings pond flows eastward across the tailings into a large channel that drains from the tailings through a decant structure to a seepage collection ditch beyond the north-eastern corner of the tailings.

Vegetation cover was introduced by the mining industry as part of the environmental rehabilitation program to reduce the effect of surface erosion by wind and water, and probably to reduce to some extent, the amount of water that annually infiltrates to the water table in the tailings.

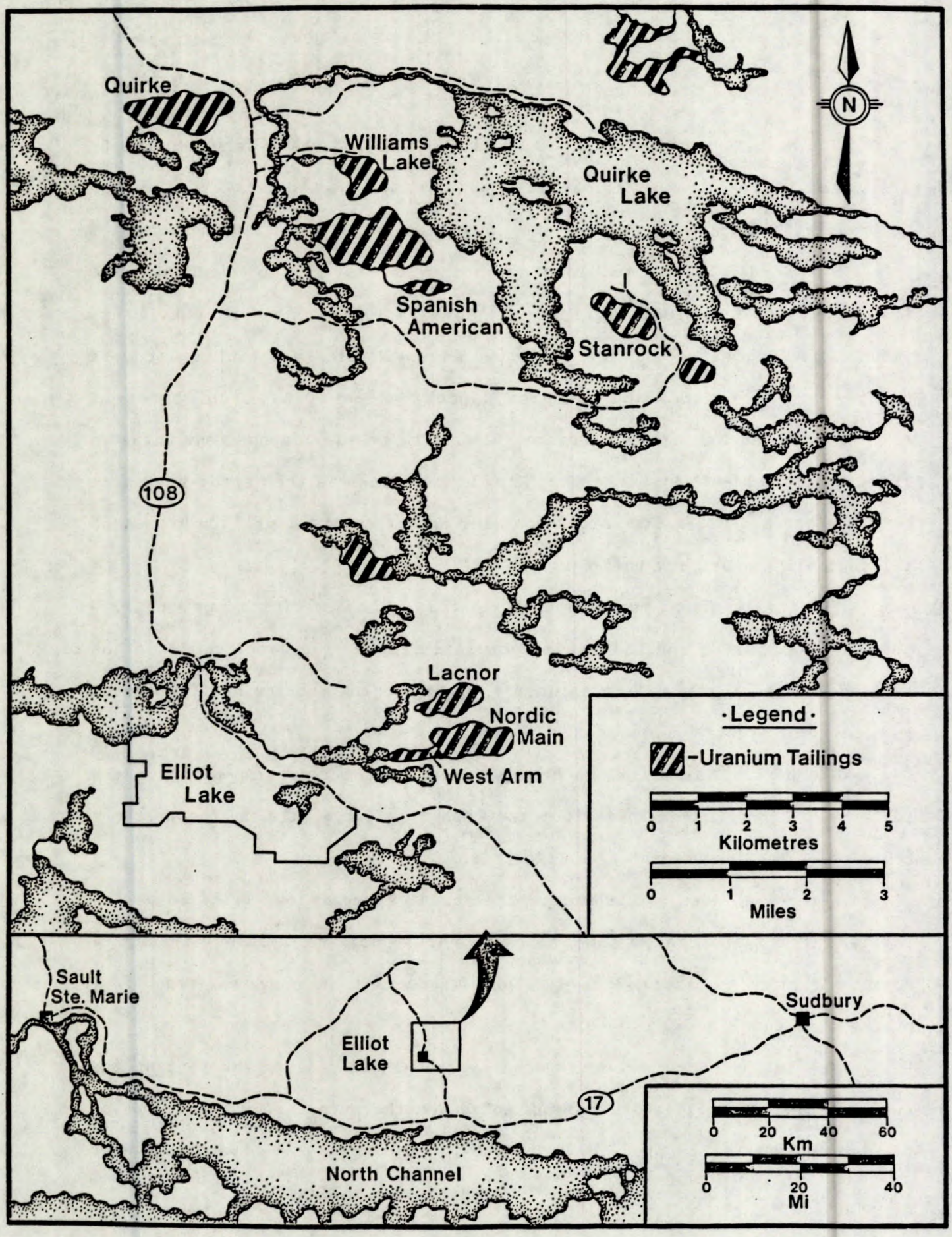

Fig. 1 - Location of Nordic Main tailings near Elliot Lake.

The revegetation program on the Nordic Main tailings area started in 1978, and the area was maintained and fertilized until 1982. Various species of vegetation were planted such as Red Fescue (Festuce rubra L.), Red Top (Agrostis alba L.), and a legume, Birds Foot Trefoil (Lotus corniculatus L.).

Within a few years, a definite soil-like profile had developed in the upper layer, approximately 10-20 cm thick, consisting mainly of decomposed organic matter.

In 1985, rainfall and a heavy spring run-off laden with debris plugged the main decant structure and flooded the Nordic Main tailings area. Approximately 30% of the tailings area was covered with water up to a depth of 2.7 m near the decant structure. This situation lasted about 6 weeks until the flooded area could be drained using rows of emergency decant tubes. By that time the damage had already affected 20% of the vegetation cover surrounding the decant structure (Figure 2).

The following summer, 1985, some regrowth was noted consisting predominantly of Red Fescue. Birds Foot Trefoil regrowth was also noted encroaching from the perimeter of the area affected by the flood and starting to blend with the new growth of Red Fescue.

In the summer of 1987, an investigation was launched to determine the regrowth rate of the biomass on the area affected by the flood and to compare it with the biomass which had been established in 1978.

EXPERIMENTAL DESIGN

Ten random samples were selected from the flood damaged area, and 10 samples were collected from the undamaged area of the Nordic Main tailings. Each of the samples was collected by cutting the vegetation as close to the ground as possible on a 1 m^2 plot. The area covered by the vegetation within the plot was estimated in the field as percentage cover per m^2.

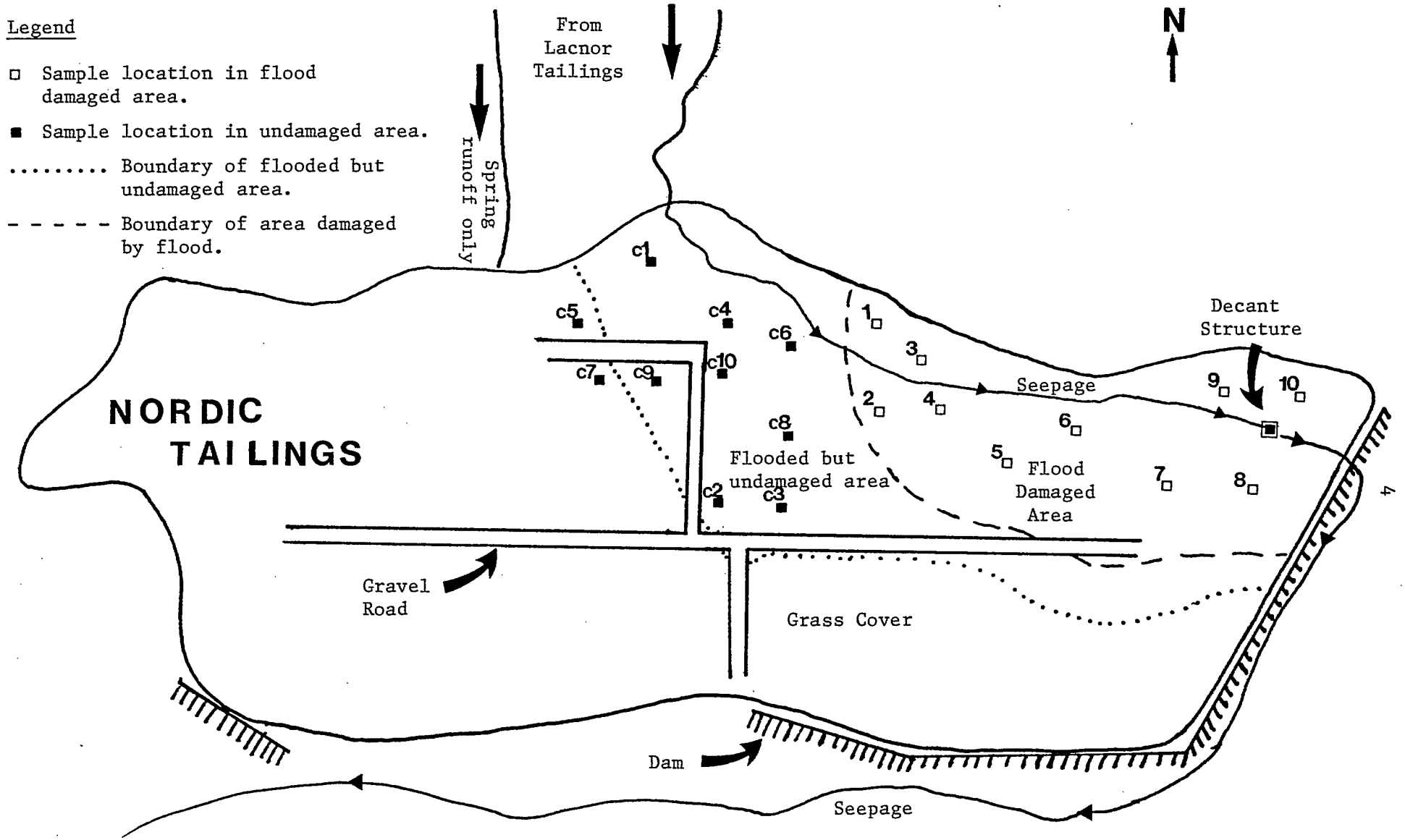

Fig. 2 - Nordic Main tailings, location of sampling sites.

The samples were measured for their wet weight and then dried in an oven at 80 ^{o}C over a period of 24 hours. The dry biomass weights of the samples were then recorded and the moisture content was calculated by taking the difference between the wet and dry weights (Table 1).

RESULTS AND DISCUSSION

Table 1 shows the biomass yield for damaged and undamaged areas. The regrowth yield was significantly lower than that of the undamaged area which was established in 1978. Although a considerable amount of regrowth occurred two years after the flood, it is seen from the wet weight results that the regrowth biomass for the flood damaged area ranged from 70 to 452 g/m^2 compared to 413-2072 g/m^2 for the undamaged area. Similar results were obtained based on a dry weight basis where the yield was respectively 32-249 g/m^2 and 168-578 g/m^2 for the damaged and undamaged areas. The yield was about 2-5 times lower in the damaged area.

This field test provided very useful information regarding survival potential of vegetative cover established on disturbed land such as uranium or sulphide tailings after a flood.

The area will be re-assessed to establish the time required for the vegetation to recover to the same condition as the undamaged area.

ACKNOWLEDGEMENTS

The authors would like to thank H. Kim (University student), and H. Porter (trainee), On-Site program, Denison Mines Ltd., for their help as field assistants during this test.

Table 1 - Percent area coverage, biomass weights and vegetation moisture contents for flood damaged and undamaged areas of Nordic Tailings (August 1987).

Samples from Area Damaged by 1985 Flood.

Sample	Area Coverage (%)	Wet Wt. (g/m^2)	Dry Wt. (g/m^2)	Moisture Content (%)
Nordic 1	20	75	32	57.33
Nordic 2	35	84	50	40.48
Nordic 3	80	407	247	39.31
Nordic 4	25	346	161	53.47
Nordic 5	10	165	77	53.33
Nordic 6	40	338	195	42.31
Nordic 7	15	70	33	52.86
Nordic 8	75	357	195	45.38
Nordic 9	85	452	237	47.57
Nordic 10	60	131	76	41.98
Average		243	130	47
Standard Deviation		143	81	6

Samples from Undamaged Vegetation Cover.

Sample	Area Coverage (%)	Wet Wt. (g/m^2)	Dry Wt. (g/m^2)	Moisture Content (%)
Nordic C1	95	1427	364	74.49
Nordic C2	55	413	168	59.32
Nordic C3	95	1869	578	69.07
Nordic C4	90	2072	547	73.60
Nordic C5	85	1103	374	71.43
Nordic C6	95	1309	374	71.43
Nordic C7	90	1728	505	70.78
Nordic C8	80	1536	482	68.62
Nordic C9	75	1288	416	67.70
Nordic C10	95	1446	460	68.19
Average		1419	419	70
Standard Deviation		434	117	4