REFORESTATION TRIALS AT OBED MARSH

by

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(ABSTRACT)

The Obed Marsh Thermal Coal Project is located some 24 km N.E. of Hinton and is within the Forest Management Area administered by St. Regis (Alberta) Ltd. A commitment by Union Oil Company of Canada Limited to return the mined out area to commercially viable timber production highlighted the need for some on-site experimentation. This fact, together with the results of a comprehensive literature review carried out during the Environmental Impact Review process provided the objectives the tests plot experiment should meet. Two series of plots were constructed; one was statistically designed and replicated three times, the other series were demonstration plots and located on a north and south facing slopes. Construction was undertaken during November 1980, allowed to settle over-winter and planted to white spruce and lodgepole pine in June 1981. Soil temperatures and moistures are also being monitored by 40 permanent thermister cells placed randomly over the test plots at a depth of 6 inches. Performance monitoring was tallied during September 1981. Because of the short time between planting and the first field checking, the results presented here can only be considered preliminary.

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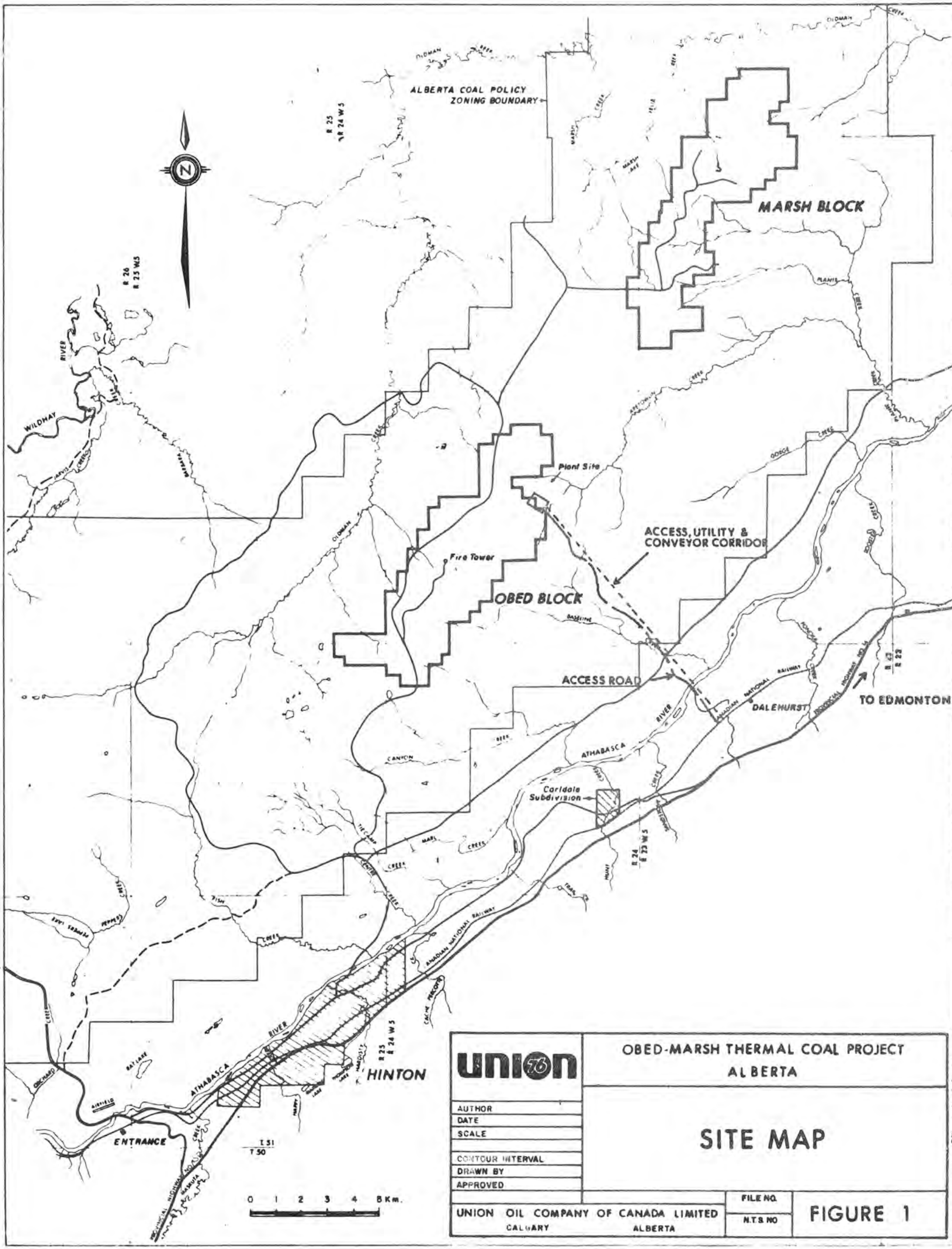
1.0 INTRODUCTION

The Obed-Marsh Thermal Coal Project is located some 24 kilometers north east of the town of Hinton in Western Alberta (see Figure 1). This will be a a surface mine producing some 3 million tonnes (clean) per year of bituminous (high - volatile C) thermal coal, for approximately 32 years.

The proposed coal development is totally within the Forest Management Area (FMA) administered by St. Regis (Alberta) Ltd. and bearing in mind that about 4 other surface coal mining projects are planned within this area, concern has been expressed about the uncertainty of being able to restore the mined land to a commercial forest containing white spruce and lodgepole pine.

The project received Order in Council approval from the Alberta Government in March 1981. Energy Resources Conservation Board approval was obtained in July 1980 and Development and Reclamation approval in various stages over the past few months.

St. Regis have been logging the area since 1955 and some 90 percent of the Obed lease area has been harvested to date. Forest management and regeneration has been practiced by St. Regis on the site and this experience will be utilized wherever possible. It is worth noting that the Obed lease area is approximately 9,000 acres and the Marsh lease area is some 6,000 acres making a total of 15,000 acres, out of a total F.M.A. land holding of 2,000,000 acres.



UNION 76	OBED-MARSH THERMAL COAL PROJECT ALBERTA
AUTHOR DATE SCALE CONTOUR INTERVAL DRAWN BY APPROVED	SITE MAP
UNION OIL COMPANY OF CANADA LIMITED CALGARY ALBERTA	FILE NO. N.T.S NO. — FIGURE 1

2.0 LITERATURE REVIEW

It is almost axiomatic to say that in any serious reclamation programme at Obed-Marsh, it will be the organic matter and surface debris that will probably play the most significant role in re-establishing a post mining fertile soil profile. When planning our reclamation, therefore, it would be better from a materials handling aspect to know quantitatively just how much of everything a seedling requires at Obed. For example, just how much Nitrogen, Phosphorous or Potassium is needed, what are the limiting amounts of micronutrients required, what is the minimum amount of available water needed and at what times, what effects do soil temperatures have and so forth?

With some of these questions in mind and as a request in our Environmental Impact Assessment deficiency Statements from the Alberta Government, we carried out a Canada wide literature review. We came to some basic conclusions:

- There is little known about the physical, chemical or biological requirements of white spruce or lodgepole pine growing in the Hinton area.
- About 6 - 10% of available moisture is needed in the soil for spruce or pine.
- Low soil temperatures related to moisture content and slash covering probably inhibits tree growth.

A tentative conclusion one could draw from the latter statement is that surface mining could improve the site for forestry production by creating warmer soil temperatures.

With these points in mind and Union Oil's obligation to restore the mined out area back to a commercial forest, equal to or better than existing, it was decided to establish a series of test plots as a first practical step in achieving this aim.

3.0 TEST PLOT OBJECTIVES

Bearing the above factors in mind, multiple objectives were established for the test plots:-

1. To determine the characteristics of the soil profiles likely to be reconstructed during post mining reclamation.

2. To provide a simulated post-mining site in order to undertake a research program that will effectively monitor seedlings establishment and subsequent growth particularly with respect to soil moisture and temperatures.

3. To determine the influence of slash cover on the above bearing in mind that this provides suitable microsites and reduces soil erosion.

4. To help decide a feasible and economic method of slash removal, storage and return of the surface material.

4.0 TEST PLOT DESIGN AND ESTABLISHMENT

For the purposes of fulfilling the stated objectives it was decided to establish two series of plots. The location of these plots had to be on soil material that was typical of the first years of mining and also provide as much long term information as possible. The locations of these plots are shown on Figure 2. One of the plots (the level site) was statistically replicated three times, whilst two other plots, one on the north facing slope and one on the south facing slope were established as demonstration plots. This was done in order to gain some insight into the soil temperature variations over the site and the erosivity of the simulated post mining soil material. Soil erosivity and its degree of control by slash and seeding to a grass/legume cover was also included as a parameter for observation in these demonstration plots.

Typical soil types over much of the area have been classified as Luvisols, that have Ae, Bt, C sequence of horizons. It is interesting to note with reference to our literature review that these soils have between 15 and 20% available moisture, which we consider makes a very suitable rooting medium for post mining reclamation. Glacial till material approximately five metres overlays weathered sandstone throughout most of the area. There are no undesirable cations or anions in the till material.

Figure 3 shows the detailed design of the statistically replicated plots on the level site. Each plot was 25 metres x 12.5 metres in size and two treatments were compared. Figures 4 and 5 show the detailed design of the north facing and south facing plots respectively.

OBED BLOCK

REFORESTATION TEST PLOT LOCATIONS

CONSTRUCTED NOV.,1980

PLANTED JUNE, 1981
LODGEPOLE PINE
WHITE SPRUCE

■ PLOT LOCATION

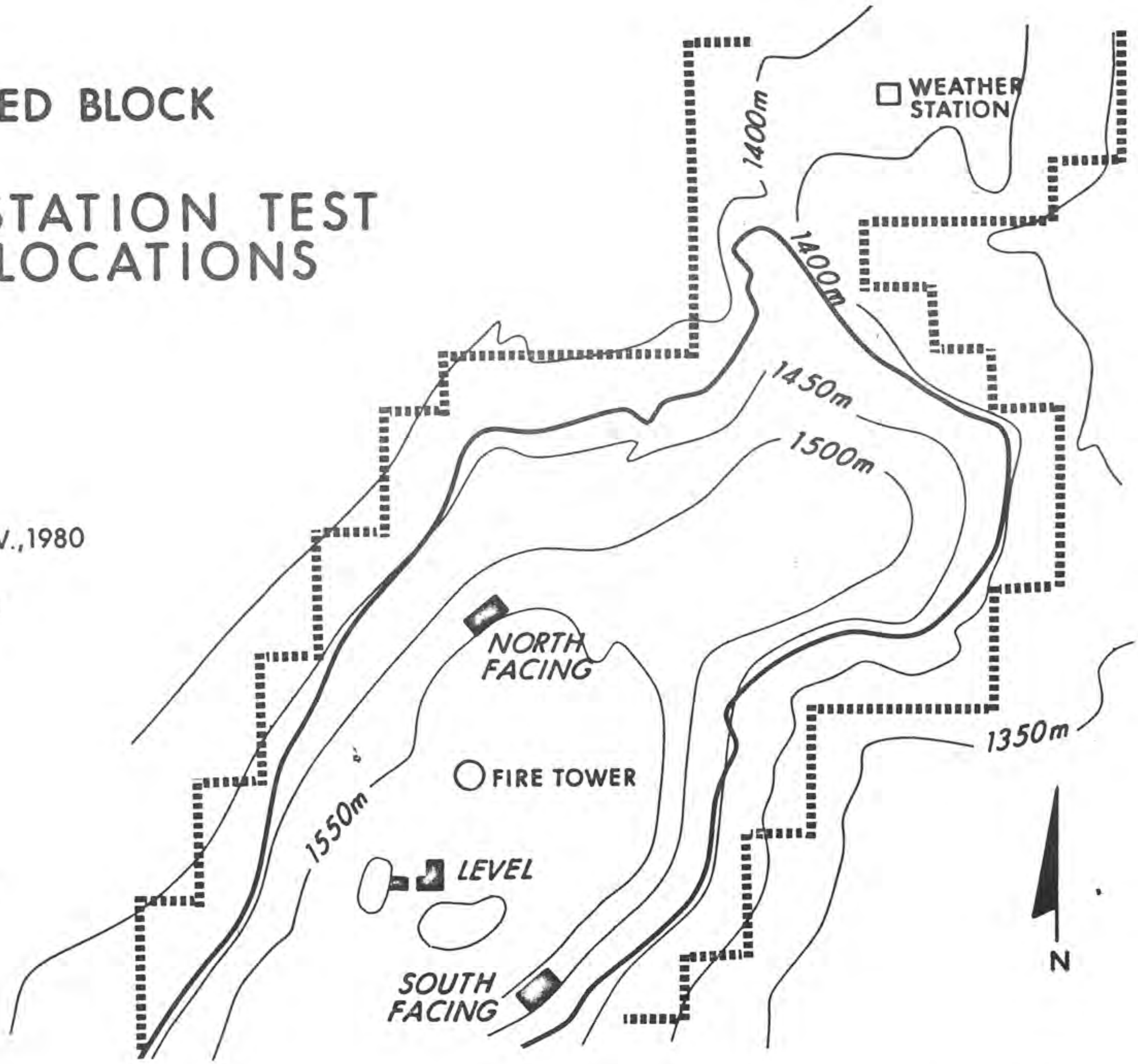
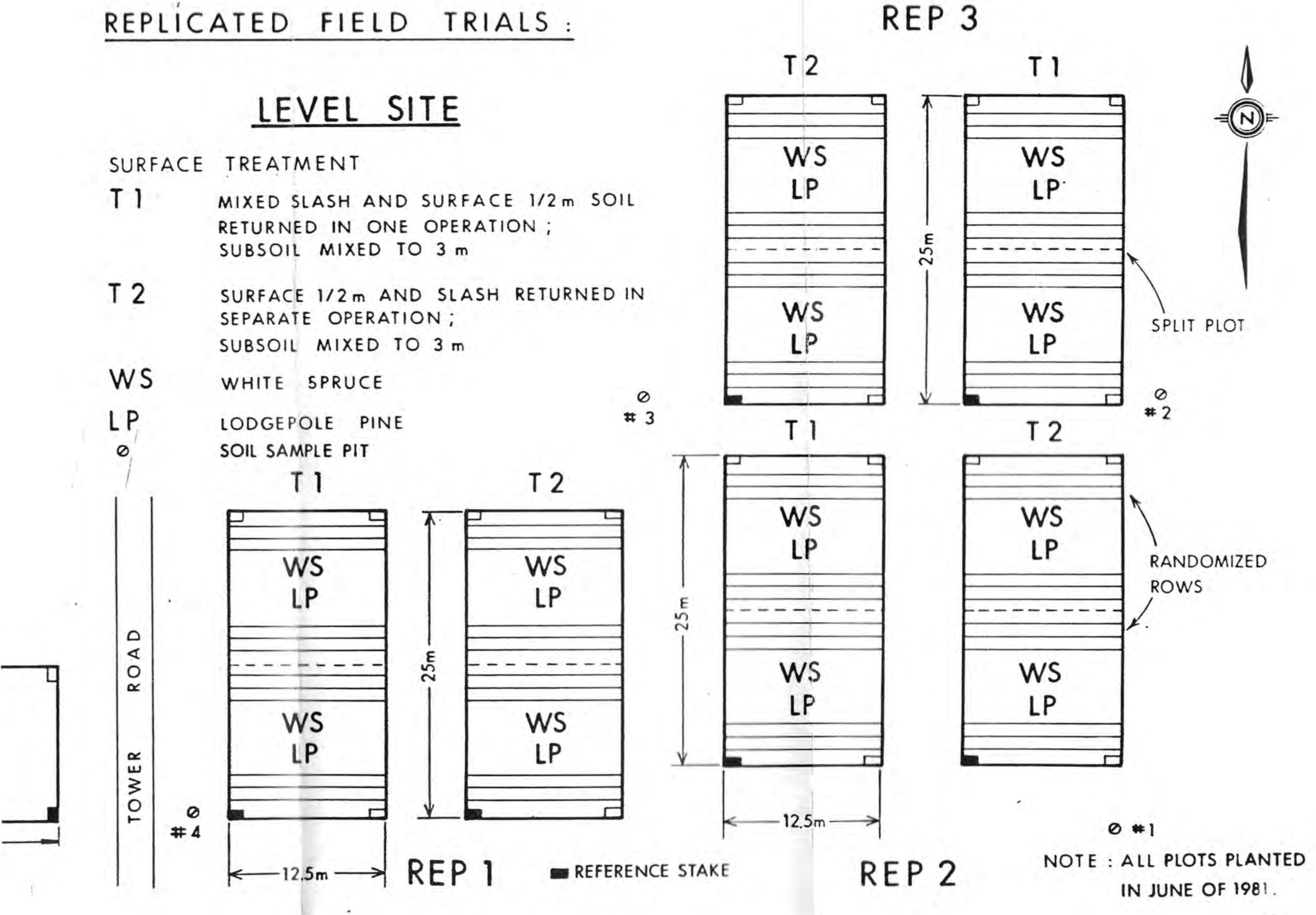


FIGURE 2


REPLICATED FIELD TRIALS :
LEVEL SITE
SURFACE TREATMENT
T 1 MIXED SLASH AND SURFACE 1/2 m SOIL RETURNED IN ONE OPERATION ; SUBSOIL MIXED TO 3 m
T 2 SURFACE 1/2 m AND SLASH RETURNED IN SEPARATE OPERATION ; SUBSOIL MIXED TO 3 m
WS WHITE SPRUCE
LP LODGEPOLE PINE
⊘ SOIL SAMPLE PIT
REP 3
T 2
T 1
WS
LP
25 m
SPLIT PLOT
⊘ # 3
⊘ # 2
T 1
T 2
RANDOMIZED ROWS
TOWER ROAD
⊘ # 4
25m
12.5m
REP 1
REFERENCE STAKE
REP 2
⊘ # 1
NOTE : ALL PLOTS PLANTED IN JUNE OF 1981.

DEMONSTRATION PLOTS ;
NORTH SLOPE
FIGURE 4

SURFACE TREATMENT

T 1 MIXED SLASH AND SURFACE 1/2m SOIL RETURNED IN ONE OPERATION ; SUBSOIL MIXED TO 3 m

T 2 SURFACE 1/2 m AND SLASH RETURNED IN SEPARATE OPERATION ; SUBSOIL MIXED TO 3 m

WS WHITE SPRUCE

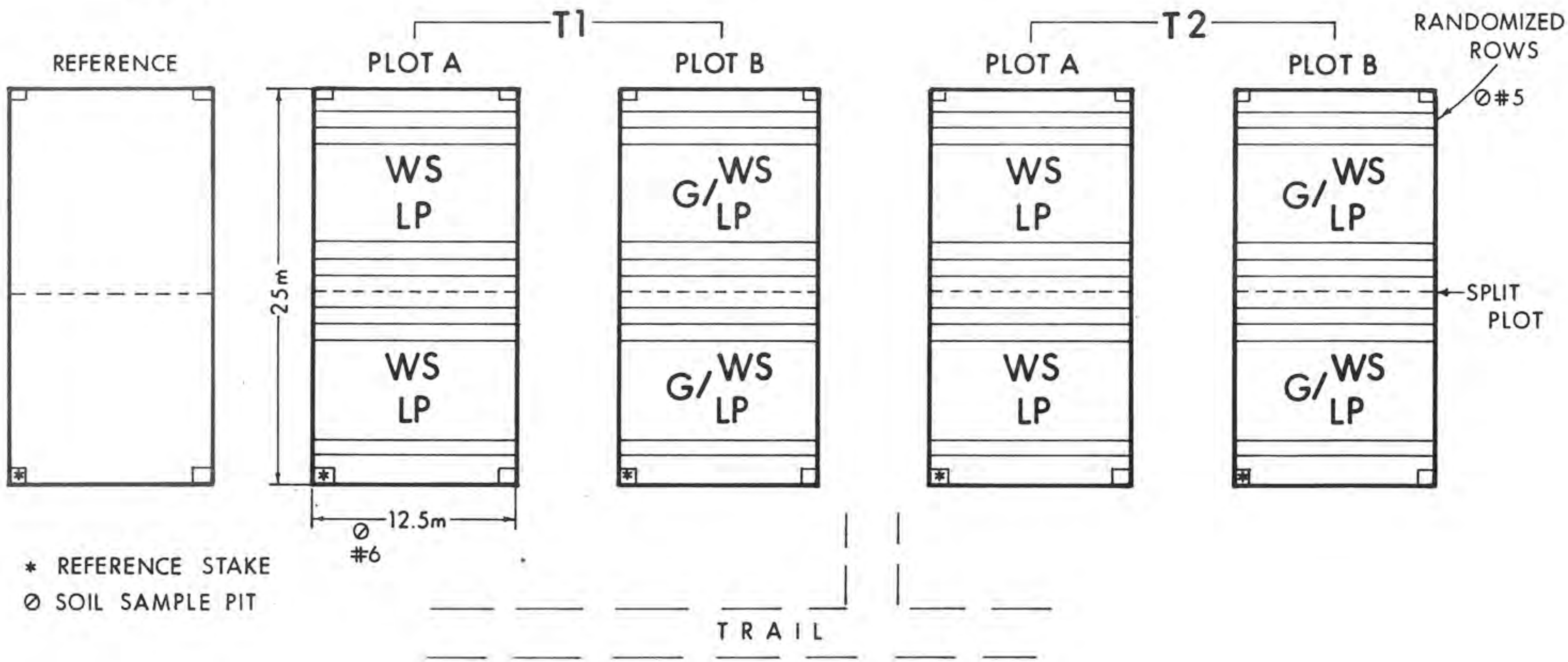
LP LODGEPOLE PINE

G GRASS

GRASS TREATMENT	%
TIMOTHY	17
ALSIKE CLOVER	33
CREEPING RED FESCUE	50

(APPLIED AT 72.5 kg. PER HECTARE)

NOTE: ALL PLOTS PLANTED TO TREES AND SOWING TO GRASS IN JUNE 1981.



Treatment No.1 consisted of removing the surface slash with old logging debris and the humus layer below together with the A and some of the B horizon of the mineral soil in one operation. This material was then returned in one operation. Treatment No.2 was similar to treatment No.1 except that the surface slash and humic layers were removed separately from the mineral soil. Each material was stockpiled separately and returned to the disturbed surface separately.

One reference plot was also established at each experimental site. All tree competition was eliminated from both within the plot as well as from a 12 foot buffer strip surrounding each study area. This plot was established so the growth results could be compared before and after the simulated mining treatment.

Plot construction occurred during the first week of November 1980, using a Case 850 B crawler tractor with angle dozer whose task was to remove the surface slash of old logging debris (which includes the second growth spruce regeneration that had become established as a result of the St. Regis post-harvesting scarification program) together with the humus layer below, and stock-pile them for subsequent return. This initial lift was followed by a second operation using the same equipment to move and separately stock-pile the top one metre (second lift) of the bared soil solum. For the third operation on the same plot a Drott 45 rubber-tired backhoe with a 2.5 yd^3 bucket was used to excavate the sub-soil to a depth of 3m., pile it and then return it to the same excavation. The sub soil piles were then levelled using the dozer.

This operation was designed to simulate the total disturbance of the top 3 metres of material comparable to an actual mining situation.

At the conclusion of plot preparation on all three sites, a post and wire fence was erected and flagged for identification purposes.

The test plot sites were all completed in the late fall of 1980 and were given the winter and early spring months to settle and consolidate before plantings were introduced.

PLANTING STOCK

The lodgepole pine and white spruce transplant stock required for use in the field trials was produced upon request, at St. Regis's new forest nursery in Hinton. The lodgepole pine seed source came from the Obed area in 53-25-W5. Seed was collected in 1978 by St. Regis field staff and stored under suitably controlled temperatures until sown in the greenhouse in Spencer-Lamaire 40 cu. cm. Ferdinand plugs on May 2nd, 1980. The resulting 45 day-old seedlings were set outside in cold frames on June 16th, 1980.

The white spruce seed source came from the Camp 1 area (50-26-W5). It was collected in 1974 and stored under controlled temperatures until seeding in Ferdinand plugs on June 17th, 1980 and set out in cold frames on October 2nd i.e. 110 days later. After the first heavy snowfall (in early December) each cold frame was immediately covered with insulating paper to provide against sudden and extreme changes in winter temperatures. Unfortunately the of 1980-81 was exceedingly mild. During the two week period between February 27th and March 11th the temperature ranged from -8 C to +5 C, the insulating snow cover disappeared and the seedling roots became badly iced. The paper cover was removed from the pine cold frame on April 27th and from the spruce on May 24th. The results were erratic and a considerable amount of seedling culling had to be done in both species. Those that were eventually used in the field planting, in many cases, left something to be desired. However, no seedling was planted unless it demonstrated active root growth.

6.0 FIELD PLANTING

Planting commenced on the level site on May 25th. Both spruce and pine had flushed their terminal buds, although the pine was more advanced than the spruce. A three-man crew used potiputki planting tools and two additional persons undertook the preparation and placement of numbered marking pins. Pre-strung planting lines were establised and the crews were advised to seek the best micro-sites that would shelter the seedlings from extreme exposures to sun and wind, but always to remain within a foot or so of the designated planting site. The crews were instructed to avoid "manicuring" by maintaining at least a semi-operational pace. At the time of planting the soil was mellow and moist. A heavy rain fell during the ensuing night.

The north slope study areas was planted the following day, May 26th, which was sunny, with a light breeze.

On May 27th the south slope study area was planted. Due to excess surface moisture this was the most difficult of the three planting sites. The weather was cool and cloudy with a heavy rain following the completion of the work. Numbered pins were used to identify each seedling planted throughout the study.

Following planting, individual soil pits were excavated at the level site in the four locations indicated in Figure 3, two locations on the north slope site (Fig. 4), and two locations on the south slope (Fig. 5). The soil pit descriptions were documented together with the laboratory analyses. This was done in order to obtain baseline soils information for fertility monitoring.

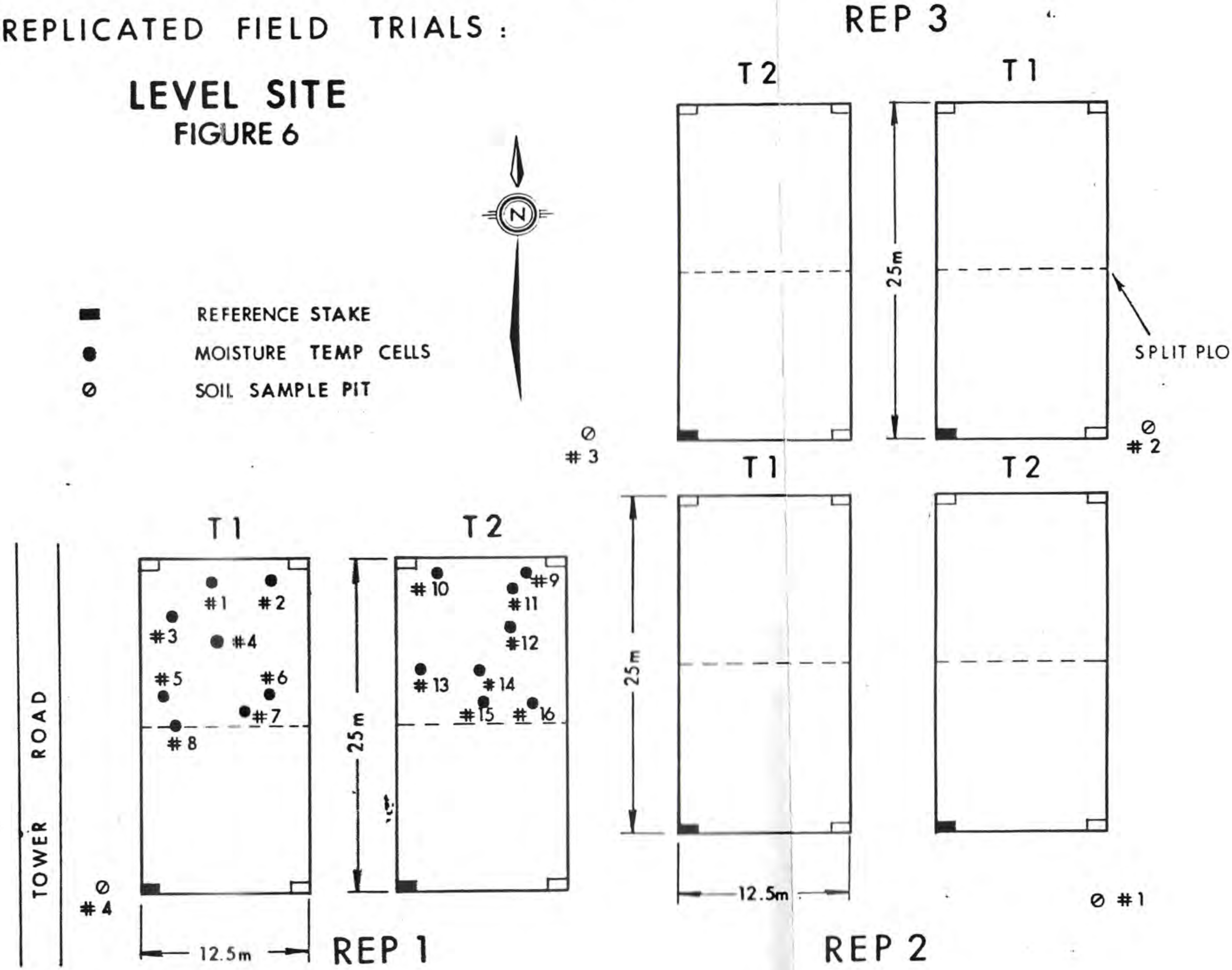
7.0 INSTRUMENTATION

Moisture and temperature cells were randomly placed at 6 inch depths in the replicated plots as designated in Figure 6. Soil moisture levels were measured twice during the growing period at each respective location and once in respect of resistance only. Surface temperature and precipitation data was obtained from the meteorological station at Obed North (location given on Figure 2) for correlation with plot data. Statistical analysis (students 't' test) was also conducted on data collected on the replicated field trials (level site) in order to determine if significant variations occur among soil moisture and temperature regimes under the two slash-handling regimes being examined.

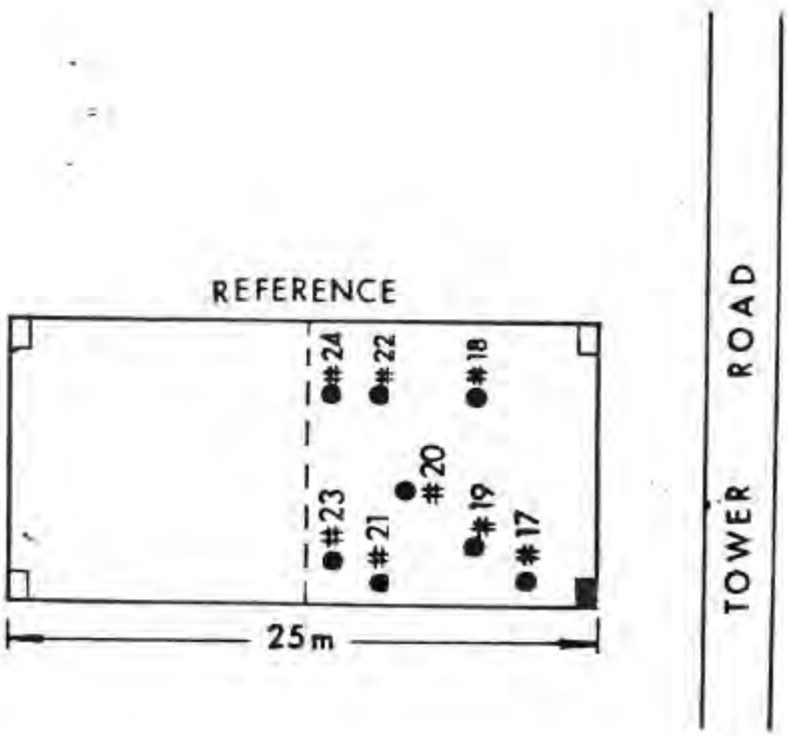
LOCATION OF SOIL MOISTURE/TEMPERATURE CELLS

REPLICATED FIELD TRIALS :

LEVEL SITE
FIGURE 6



NOTE: ALL PLOTS PLANTED
IN JUNE 1981



The 1981 field season surface temperatures and precipitation data was recorded at the Obed North meteorological station during the 1981 growing season. It is intended to correlate this data with the soil moisture data and leader growth. To date, considerable difficulty has been experienced in calibrating the soil moisture data obtained from the on-site cell readings against the actual soil moistures data obtained in the laboratory. The uncertainty of the soil moisture readings precluded their being used for statistical analysis.

8.0 PERFORMANCE MONITORING

Initial seedlings survival was tallied September 15th and 16th by recording survival leader growth and seedling vigour with accompanying remarks to present a possible explanation for mortality or low vigour. When it became apparent that mortality was occurring from siltation, and that many survivors were partially buried from this cause, then this was included in the "Remarks" column.

Percentage survival by species, average seedling height, seedling vigour and partial burying were recorded. It should be recognized that since the seedlings had all flushed and commenced height growth at the time of planting (this is normal in plug-type planting) that it was impossible to establish the first season's leader growth that occurred following planting. The seedling height recorded simply provides a common first-year growth base for future seasonal leader performance. For this reason, statistical analysis were not done on this part of the data obtained.

9.0 PLOT ESTABLISHMENT ON SLOPES

In order to gather information on the probable effects of slope and aspect on regeneration, Union Oil decided to augment this study by establishing a similar program on a nearby north facing slope, and another on a nearby south-facing slope. Their locations are identified on the Obed mining area in Figure 2 and their detailed plot designs are given in Figures 4 and 5. It will be noted that they are regarded as "demonstration areas", rather than field trials, simply because they are not intended to meet the rigid statistical design requirements. Further, they include the additional parameter of grass cover. Consequently two plots, a T1 and a T2, were seeded to grass at the conclusion of planting on the North and South slope Demonstration areas. Seed was applied with a cyclone seeder at the rate of 5 lbs. per plot or 65 lbs. per acre. A custom mixture already tested on previously reclaimed sites, in the Obed-Marsh area was adopted:-

Creeping red fescue - 50%
Alsike clover - 33%
Timothy - 17%

In addition eight (8) soil moisture temperature cells were located at 6 inch depths in both the north facing and south facing slopes.

10.0 PRELIMINARY RESULTS

These test plots were established in 1981 and therefore, the interpretation of the data collected so far can only be regarded as preliminary. The principal facts established from this data are:-

- The south facing slope had the tallest seedlings on acreage for both white spruce and lodgepole pine.
- There was 97% survival for white spruce and 99% survival for pine on the replicated plots.
- All reference plots had 100% survival.
- By June soil temperatures were significantly higher at the 1% level of significance on the south slope than on the replicated plots.
- Soil temperatures at the reference plots of the replicated site were significantly lower at the 1% level of significance than anywhere else.

In conclusion we have attributed these high figures to a favourable field season and timely spring rains that immediately followed planting. Since anything over 80% ultimate survival can be considered satisfactory a considerable cushion for over winter mortality exists. We have not, as yet, tallied the 1981-1982 over winter mortality.

The trend of having significantly higher soil temperatures on the south facing slope indicates that different reclamation techniques may be required at such sites from elsewhere on the mine site, to avoid burn out of tree seedlings.

The lower soil temperatures observed in the reference plot tends to confirm the conclusion from the literature review. This suggests that by surface mining, improving surface drainage, and destroying the insulating surface humus layer, timber production may be increased. Although there is insufficient data to date there is already the suggestion that there is little difference between the treatments as described, and result in the salvaging by one lift only.

It is the intention to continue monitoring the test plots in the manner described, leading to a scientific basis for successful commercial tree growth on reclaimed land.

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PROCEEDINGS:

ALBERTA RECLAMATION CONFERENCE

Edmonton, 1982

CLRA

CANADIAN LAND RECLAMATION ASSOCIATION

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INTRODUCTION

Last Spring the Provincial Government's Reclamation Research Technical Advisory Committee presented a two day Reclamation Research Seminar at the Chateau Lacombe. We were surprised by the large turnout and an overwhelming majority of those in attendance indicated the desirability of an Annual Reclamation Conference for Alberta which would focus on Policy and Practice as well as Research and which would include industry, academic and government participation.

These were very sensible suggestions though their implementation would exceed the mandate and manpower of the Reclamation Research Technical Advisory Committee. So various groups were contacted to sponsor and help organize the Conference. Positive responses where received from the Canada Land Reclamation Association (CLRA) The Alberta Government's Land Conservation and Reclamation Council, The Coal Association of Canada and The Oil Sands Environmental Study Group (OSESG).

The CLRA authorized formation of an Alberta Chapter to serve as the umbrella organization with a Program Committee consisting of representatives of the Government and the two Industry groups. Through this Conference and perhaps other functions the Alberta Chapter of the CLRA can fulfill two important roles:

1. To provide an opportunity for members of the Reclamation community to meet, exchange experiences or argue and otherwise improve communications among its industry, government and academic factions.

2. To provide a public forum for reclamation activities, capabilities, issues and challenges.

This was the first function of its kind in Alberta. Special thanks are due the Sponsors, Speakers and the other Members of the organizing Committee: Jennifer Hansen, Malcolm Ross and Al Fedkenheuer. Their talents and efforts made the Conference a success.

One final word on the Speakers: they were given very short notice of the Conference and not only responded enthusiastically but prepared presentations which were of remarkable quality and consistency. We are fortunate to have individuals of this caliber working in the Field of Reclamation in Alberta.

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Ziemkiewicz, P.F. 1982 Proceedings: 1982 Alberta Reclamation Conference, April 1982, Edmonton, Alberta Canadian Land Reclamation Association/Alberta Ch. Pub. 82-1