No. _____

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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 95

GROUNDWATER STUDY FOR ATOMIC ENERGY OF CANADA LIMITED, PINAWA, MANITOBA

BY
J. E. CHARRON

OTTAWA
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INTRODUCTION

Atomic Energy of Canada Limited, through Mr. J.E. Guthrie, approached the Geological Survey of Canada, in the spring of 1964 to obtain groundwater information within and in the vicinity of section 28-14-11 east of the principal meridian. Because the author was scheduled to work in that area, during the summer of 1964, it was agreed during a meeting in Ottawa with Mr. J.E. Guthrie, that the author was to spend as much time as was necessary at the atomic site waste disposal area in order to supply the groundwater information required by the A.E.C.L. authorities.

ACKNOWLEDGMENT

The author wishes to thank Mr. J.E. Guthrie for his complete co-operation during the time spent on this project.

GENERAL

The information was to be obtained by two means. First, general information was to be acquired from the well inventory data of the area, which the author was collecting as part of a hydrogeological study. Second, more detailed information was to be supplied by drilling. Therefore it was understood that during the summer the author was to drill with a "Minute-man Auger Drill" in section 28.

In June the author attended a meeting at the A.E.C.L. plant, Pinawa, Manitoba, which was held to discuss this radioactive waste disposal site. It was disclosed that a consulting firm had done a ground study of the entire plant area and that the radioactive waste disposal area (section 28)

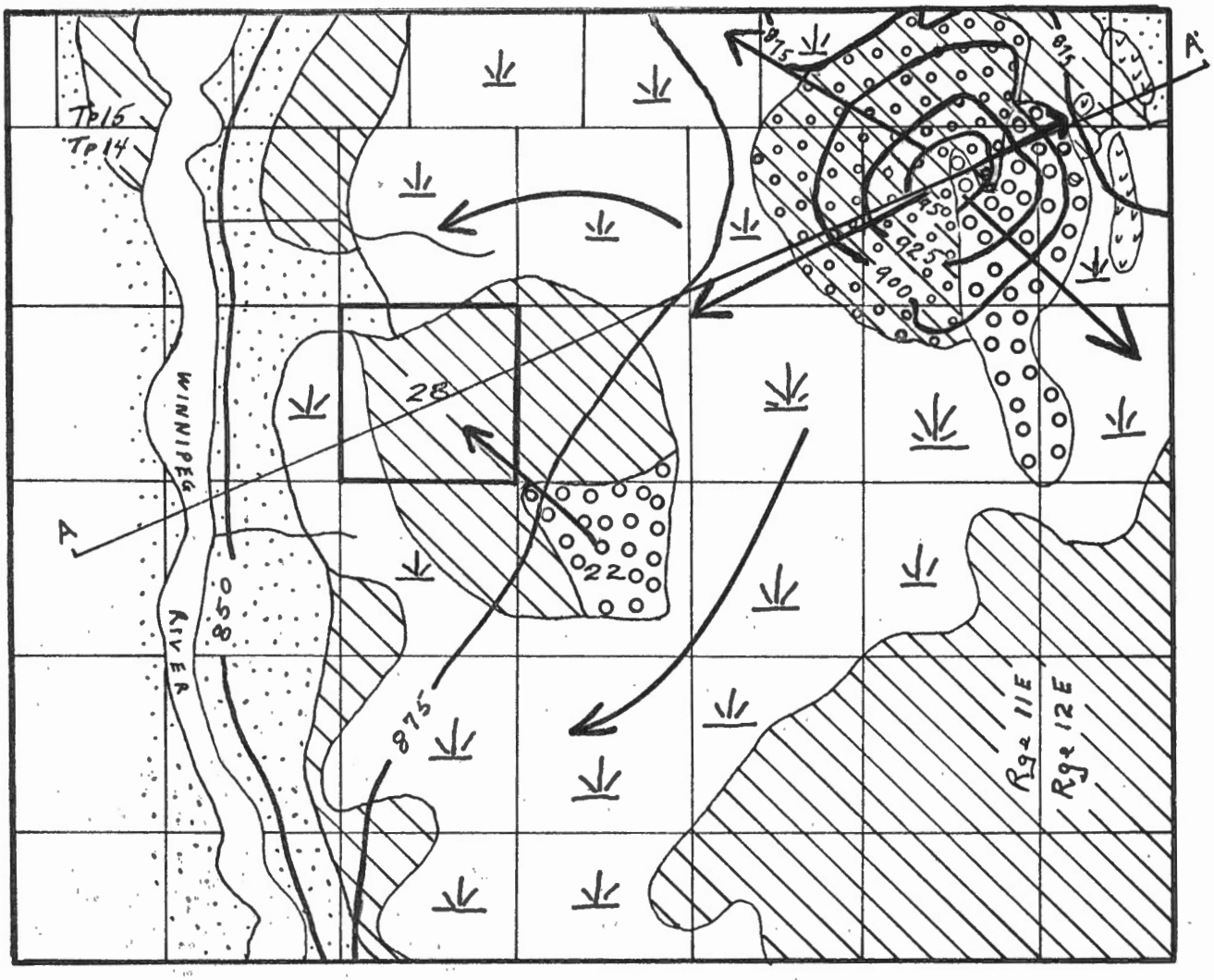
was predominantly a clayey till with some stones and boulders. It was also supposed that no difficulties should be encountered at Pinawa because of the knowledge on hand of conditions at a similar waste disposal site at Chalk River, which rests on sand and where no serious problems related to groundwater had arisen even after several years of usage. The clayey till at the new radioactive waste disposal site at Pinawa, being much less permeable than the sand at Chalk River, should be ideal material to use for radioactive waste disposal.

At the time of the A.E.C.L. June meeting drilling was still contemplated and the author offered to engage to drill the area (section 28) with the Minute-man Auger when it was available, which was to be by the end of July.

GROUNDWATER MOVEMENT

The author's hydrogeological study of the area has demonstrated that a topographical high exists to the northeast of section 28 (Fig. 1). This topographical high is an area of recharge, as much of it consists of sand and gravel. Immediately to the east of it the Precambrian granite outcrops in several places. The surface of this granite slopes gently from these outcrops to the southwest.

On the west side of the topographical high the groundwater moves towards the area chosen as the radioactive waste disposal site (section 28), (Fig. 1). Theoretically it should go through the chosen area to the Winnipeg River (Fig. 2), but it does not do so. After coming off the high, which consists of permeable and moderately permeable material it comes upon the highly impermeable clayey till (Figs.1 and 2). This change in permeability causes the water to rise to the surface where it forms bogs and marshes

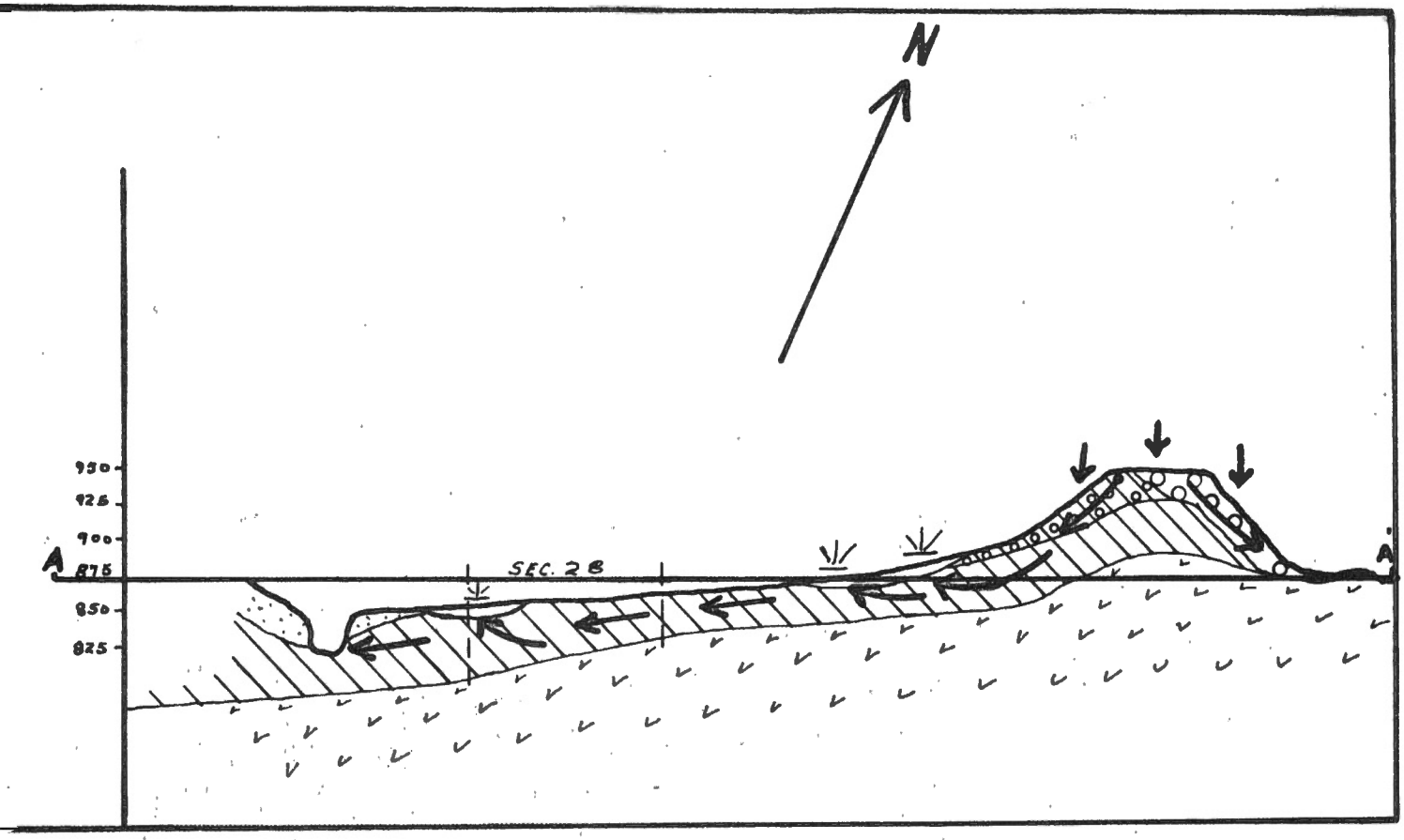


Legend

Scale = 1" to 1 mile

- Bogs + Marshes
- Clay - impermeable
- Sand + Gravel - permeable
- Glacial Till - Modified Moderately permeable
- Glacial Till - impermeable
- Precambrian Granite
- 875 Contour
- Groundwater Movement

FIGURE. 1 - Plan showing groundwater movement at waste disposal site and vicinity.



Horizontal Scale = 1" to 1 mile

Vertical Scale = 1" to 125 feet

Legend

- Bogs + Marshes
- Clay - impermeable
- Sand + Gravel - permeable
- Glacial Till - Modified moderately permeable
- Glacial Till - Impermeable
- Precambrian Granite
- Groundwater movement

FIGURE. 2- Section showing groundwater movement at waste disposal site and vicinity.

(Figs.1 and 2) from which the water eventually runs out at the surface to the Winnipeg River.

A sand and gravel area, which might at first glance seem to present a problem, exists in section 22 (Fig. 2). This area is also an area of recharge, but it is not a deep sand and gravel deposit. Some groundwater probably flows through section 28 from section 22 (Fig. 2), but because of the low hydraulic gradient between the two areas and the almost impermeable character of the clayey till in section 28, this amount must be very small and the movement extremely slow.

The nature of the groundwater movement in the area therefore indicates that section 28 is a choice site for future radioactive waste disposal.

DRILLING ON SECTION 28

The author intended to drill five holes in section 28 (Fig. 3), one in each corner of the section and one in the middle. The depth of each hole was to depend on how deep the bedrock was or how far the power auger could penetrate in this type of ground. The atomic authorities were primarily interested in the first 20 feet below the surface.

Drilling at Site #1 (Fig. 3)

Five holes were drilled at site #1 in an area of approximately 400 square feet. The first hole was stopped at 4 feet because of a boulder. The second and third holes were stopped at 5 and 12 feet respectively for the same reason. By that time it was obvious that the boulders were going to be more troublesome than the author had anticipated. The fourth hole, however, went to 25 feet, where it was stopped because of a boulder or

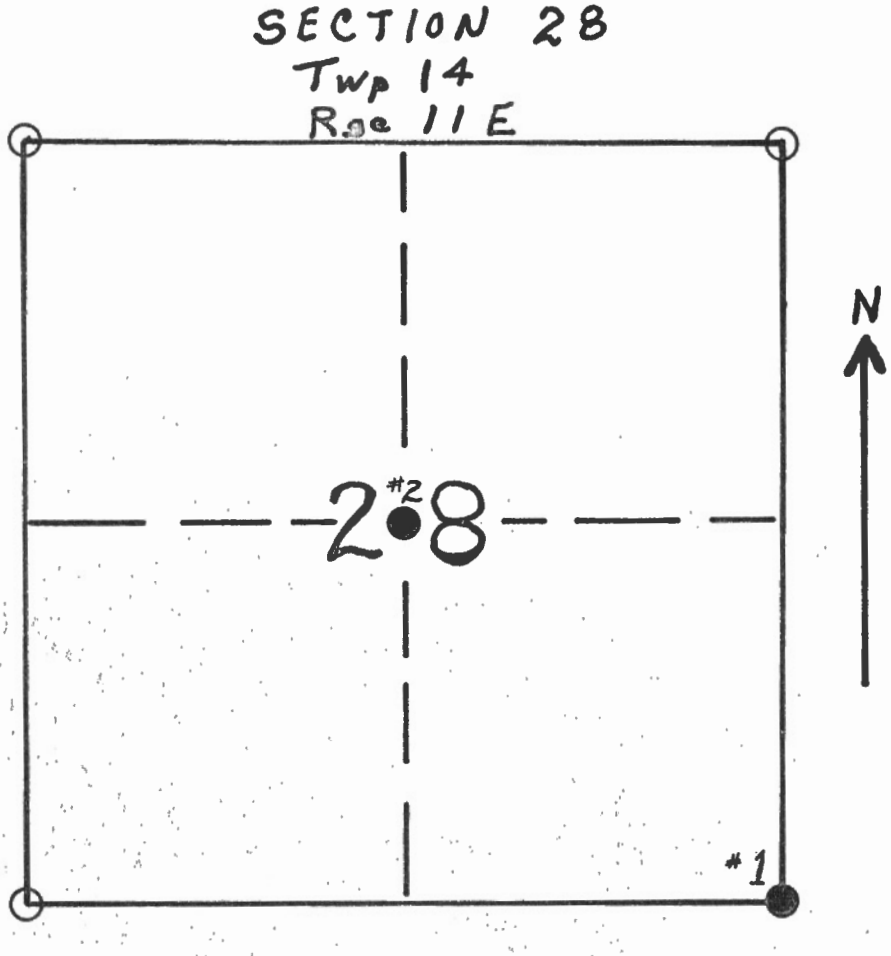


FIGURE.3 - Diagram of section 28 with drill-hole location.

bedrock. As the biggest boulders encountered to that time in the drilling program were about 1 foot in diameter, it was assumed that moving the drill a few feet to one side of hole #4 would permit deeper drilling if the rock at 25 feet in hole #4 was a boulder and not bedrock. Consequently the drill was moved 5 feet west of the fourth hole but again at 25 feet struck rock — either a boulder or bedrock — which prevented further drilling. It was then agreed that bedrock had been reached. The logs of these five holes are shown on Figure 4.

The surprising element while drilling, apart from the many boulders, was the lack of water in the clayey till. The holes were so dry that water had to be used to continue operation with the Minute-man Auger. This lack of water confirms what has already been assumed in the explanation of groundwater movement of the area.

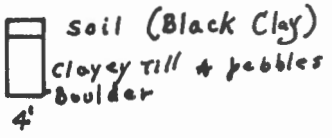
Although the clayey till itself was dry, small stringers (1" in thickness) of sand encountered in the drilling are believed to carry water, because each of the five holes filled to a level 4 feet below the surface after the drilling had ceased and the holes were left open. Some water also emerges from the till-bedrock contact zone. The amount of water yielded by both the sandy layers and the till-bedrock contact, however, was insignificant, with a yield of less than $\frac{1}{2}$ gallon per minute.

Drilling at Site #2 (Fig. 3)

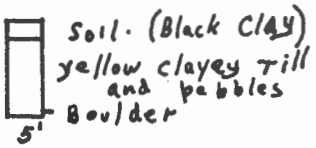
A hole 33 feet deep was made at site #2. Again water was needed to drill this hole although not as much as at site #1. This hole was stopped at 33 feet simply because there were no more auger extensions available for drilling. The log of this hole is also seen on Figure 4.

DRILLING SITE #1

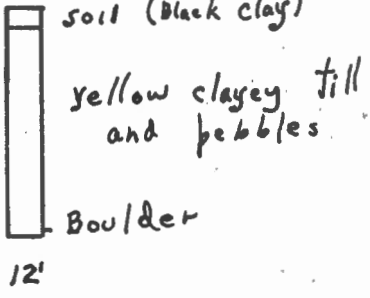
HOLE #1



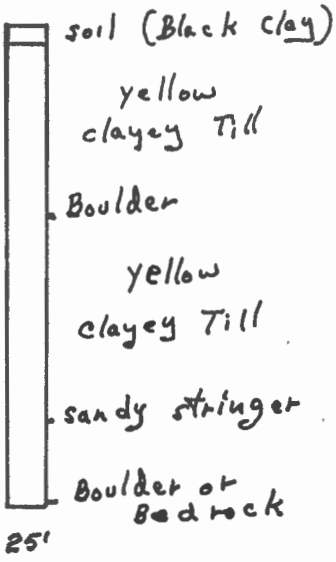
HOLE #2



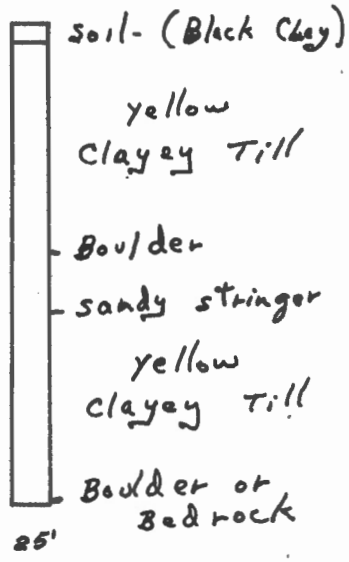
HOLE #3



HOLE #4



HOLE #5



Vertical Scale = 1" to 20 feet

DRILLING SITE #2

HOLE #1

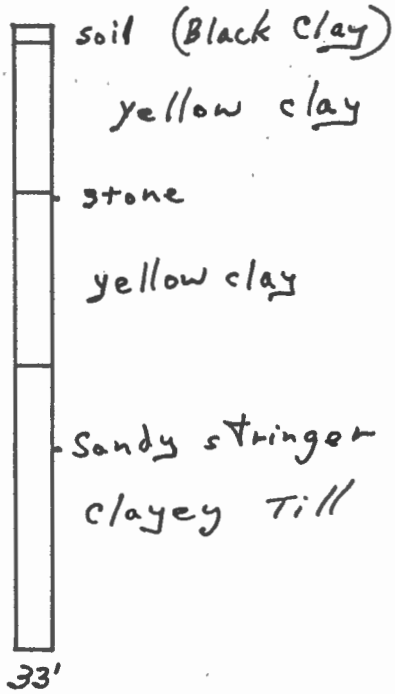


FIGURE. 4 - Logs of holes drilled for AECL on section 28-14-11E

No further drilling was carried out because on the next move the drill was broken.

RECOMMENDATIONS

It was then recommended to Mr. J.E. Guthrie and agreed by him that a drill be hired to test the remaining three corners of section 28 and the holes should be kept open with casing and used as observation wells. Nevertheless further drilling would only confirm what has already been assumed and checked at two of the five drilling sites.

Deep drainage ditches surrounding section 28 would also help to lower the water table and prevent excess surface drainage from the bogs and marshes reaching the radioactive waste disposal area.

CONCLUSION

The area is ideal as a radioactive waste disposal site because of the impermeability of the clayey till and of the low hydraulic gradient. These two factors assure a very slow movement of the groundwater in the area.