REPORT OF INVESTIGATION NO. 91

BONNEVILLE SALT FLATS: A COMPARISON OF SALT THICKNESS IN JULY, 1960 and OCTOBER, 1974

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INTRODUCTION

Because of great public interest in the Bonneville Salt Flats race-track and fear that brine extraction for industrial use at the nearby Kaiser chemical plant might be depleting the salt, the Utah Geological and Mineral Survey was asked by Mr. Harold Tippetts, Director of the Division of Parks and Recreation, to review an earlier investigation of this problem that UGMS had made in 1966-67 and to initiate some new investigation to bring information up to date. All of the work considered in this report refers to that part of the Salt Flats lying north of highway I-80 where the speed trials are conducted.

The 1966-67 study made by UGMS was described in Report of Investigation No. 35, "Bonneville Salt Flats Hydrogeological Study near Wendover, Utah", by B.N. Kaliser. This study consisted of a pumping test from a pattern of drill holes near the edge of the straightaway racetrack. Some of the holes penetrated through the salt into underlying clay and other holes were stopped in salt. It was found that pumping brine from a hole that penetrated into clay and was cased through the salt lowered the brine level in adjacent holes that penetrated clay and were cased through the salt but that the brine level in holes that had stopped in salt or at the bottom of it was unaffected. When pumping brine from holes that did not penetrate below the salt, however, the brine in adjacent holes that stopped in salt was lowered. These results led to the conclusion "that two aquifers

exist with little connection between them" and that brine removal from clay to the east of the salt pan would probably have little effect upon brine in the salt.

THIS STUDY

At the outset of this investigation a comparison was made of aerial photography showing part or all of the Salt Flats in 1942, 1946, and 1953 and satellite imagery secured in 1972. These photos varied greatly in scale and quality but did reveal that the outline of the salt pan north of I-80 changed over time and that while the west side had remained relatively constant, the north and east sides had contracted enough to cause a slight loss in surface area between 1942 and 1972.

In July, 1960, the Utah State Department of Highways, District No. 2, drilled a series of holes to measure thickness profiles across the racetrack at one-mile intervals along the straightaway. Some of these holes were repeated and additional holes added in 1962 and 1965. Because records of this work were still available it was decided to ask the Department of Highways to redrill the original 1960 survey for comparison, using the same drilling and measuring technique. Mr. Roy Tea, the engineer who had supervised the 1960 work, agreed to do so again and, accordingly, the hole locations were resurveyed and holes drilled. The UGMS Model 30 Mobil Drill with auger bit was used and the holes were drilled a foot or more into clay, after which the thickness of hard salt was measured by inserting a hook and feeling the bottom of the salt. By using the same type of

equipment, the same measuring technique, and even the same engineer there can be no doubt that the 1974 survey is directly comparable to the 1960 one.

Figure 1 shows the thickness of salt in 1960 and Figure 2 shows the thickness in 1974. Figure 3 shows the decrease in salt thickness from 1960 to 1974. The volume decrease is as follows:

CU YDS SALT	1960	1974	% Decrease (Increase)
over 4' thick	19,800,000	----	100
3' - 4' thick	19,600,000	29,700,000	(50)
2' - 3' thick	18,300,000	17,600,000	4
1' - 2' thick	10,400,000	10,400,000	----
0.1' - 1' thick	7,400,000	6,700,000	10
over 0.1' thick	75,500,000	64,400,000	15

The area of salt over 0.1' thick in 1960 was 39.7 sq. mi. and in 1974 it was 36.4 sq. miles for that part of the salt pan under consideration, a decrease of 9%.

DISCUSSION OF RESULTS

The Bonneville Salt Flats contain a lenticular body of salt that was trapped in a shallow basin when Lake Bonneville dried up. There are no long-term studies of changes in shape or size of the salt pan but the total volume of salt has been assumed to have remained constant until recently, salt being dissolved and reprecipitated as the weather cycle varied but remaining within the basin either in solid form or as brine. Any loss of brine from the salt crust would deplete

it over a period of time and the conclusion is inescapable that this is what has happened between 1960 and 1974. The UGMS pumping test in 1966 covered an area of 3 1/2 acres and showed that brine in the salt and brine in the clay were independent within that area and, presumably, over the whole salt flats. There are open, vertical, cracks in the clay which discharge brine from the sides of drainage canals but it is not known whether any of these fissures tap brine from the salt. The base for highway I-80 was prepared by removing salt down to underlying clay and thus has opened a channel for brine from the salt pan to percolate down into the clay. This same effect may be occurring at the Crescent Canal.

Loss of solid salt from the race track, between 1960 and 1974 amounts to 11 million cubic yards or approximately 13 million tons. Eardley has estimated that loss due to wind erosion from the entire Great Salt Lake Desert amounts to 36,000 tons of Cl^- annually (60,000 tons of salt) so this factor has contributed very little to the loss. Rainwater frequently covers the salt flat after a storm and dissolves salt rapidly. Mr. Tea has reported samples taken from the surface after a storm that are nearly saturated. Should this water drain or be wind-driven off the salt pan in any direction it would carry salt away.

Brine levels were measured in some of the 1960 holes and remeasured at the same locations in 1974. The 1974 piezometric surface is lower than the 1960 surface, reflecting a very dry summer, and both surfaces are high under the center of the salt pan and slope

away in all directions. A notable gradient at the south end cuts across the axis of the salt pan and has spread northward between 1960 and 1974; this gradient appears to be caused by leakage beneath the highway and into the drawdown created by the potash plant (Figure 4).

CONCLUSIONS

This report presents data which show a loss of 13 million tons of salt from the Bonneville Salt Flats Racetrack since 1960. If the racetrack is to be preserved then some means must be developed to stop depletion of the salt or to restore salt at the same rate it is lost.

Important information which is lacking for a full understanding of what is happening, or contradictory information which needs clarification, is:

(1) Direction and rate of brine movement. Tracer studies using fluorescent dyes might supply this data. This information would bear most directly upon attempts to preserve the salt flats.

(2) Nature and effect of brine level fluctuations. Hydrograph records show a diurnal change, low in the morning and high in the afternoon, of up to 0.2 foot. Single morning and afternoon measurements at some wells, however, have shown a change of as much as 0.5 foot in the opposite sense.

(3) Nature of surface movement. It is reported that attempts at precise levelling indicate that the salt flats move up and down.

Donald T. McMillan

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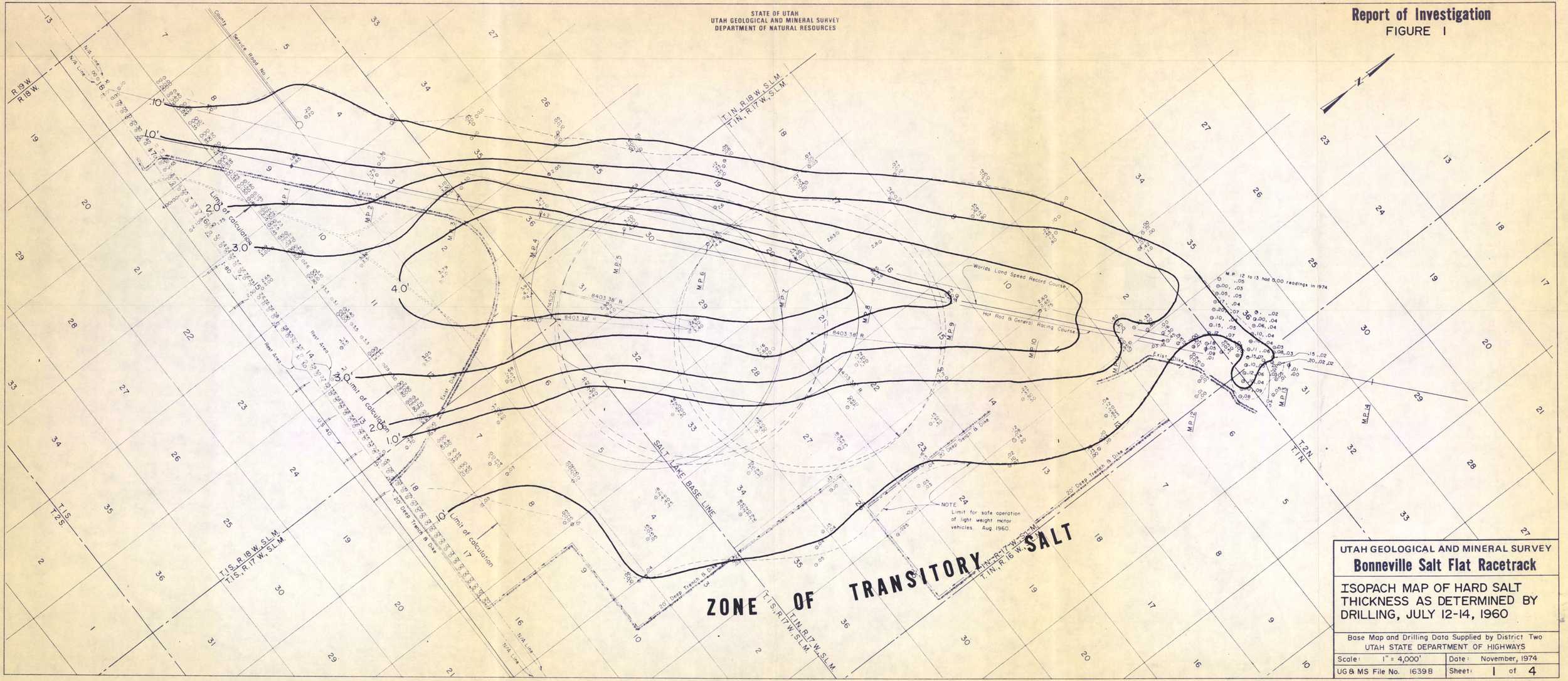
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Turk, L.J., 1973, Hydrogeology of the Bonneville Salt Flats, Utah: Utah Geological and Mineral Survey, Water Resources Bulletin 19, 81 p.

STATE OF UTAH
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DEPARTMENT OF NATURAL RESOURCES

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FIGURE 1



UTAH GEOLOGICAL AND MINERAL SURVEY

Bonneville Salt Flat Racetrack

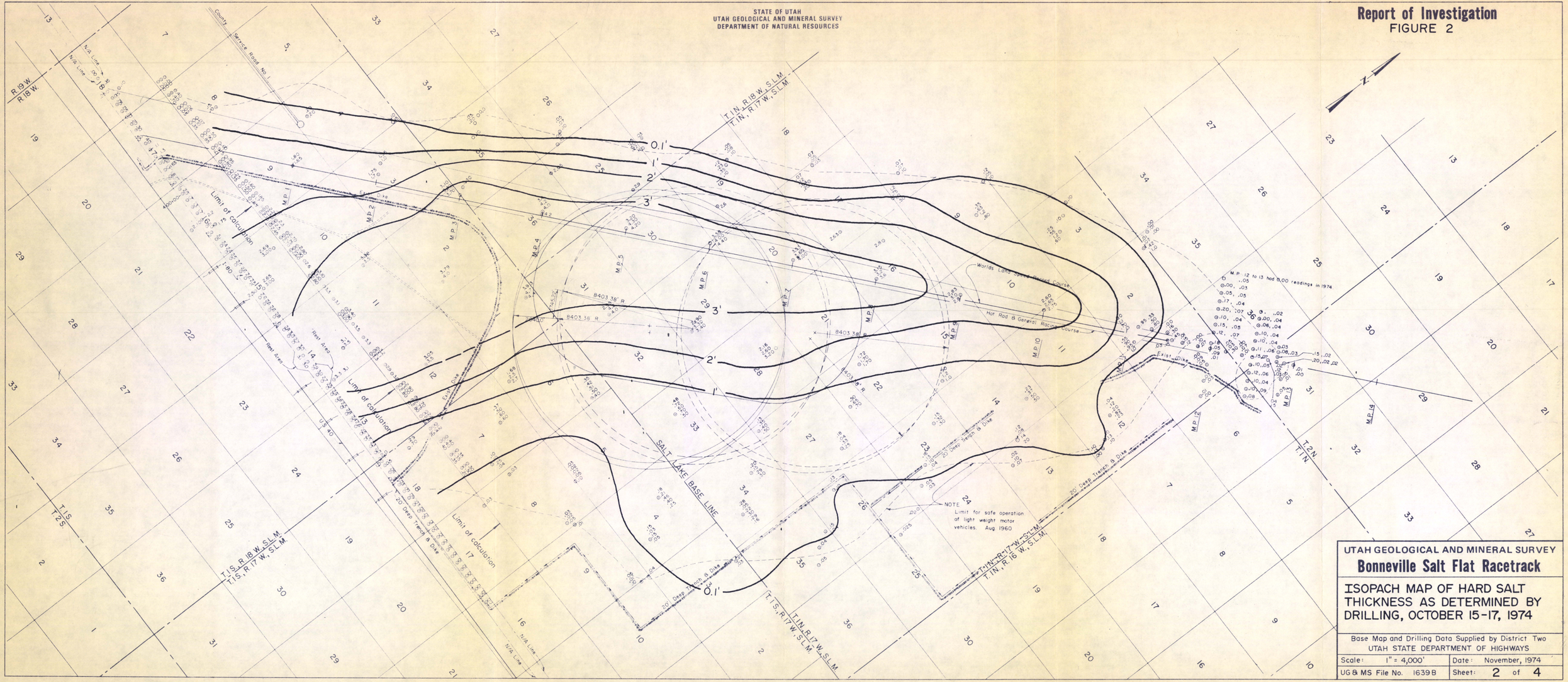
ISOPACH MAP OF HARD SALT THICKNESS AS DETERMINED BY DRILLING, JULY 12-14, 1960

Base Map and Drilling Data Supplied by District Two
UTAH STATE DEPARTMENT OF HIGHWAYS

Scale: 1" = 4,000'	Date: November, 1974
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FIGURE 2



UTAH GEOLOGICAL AND MINERAL SURVEY

Bonneville Salt Flat Racetrack

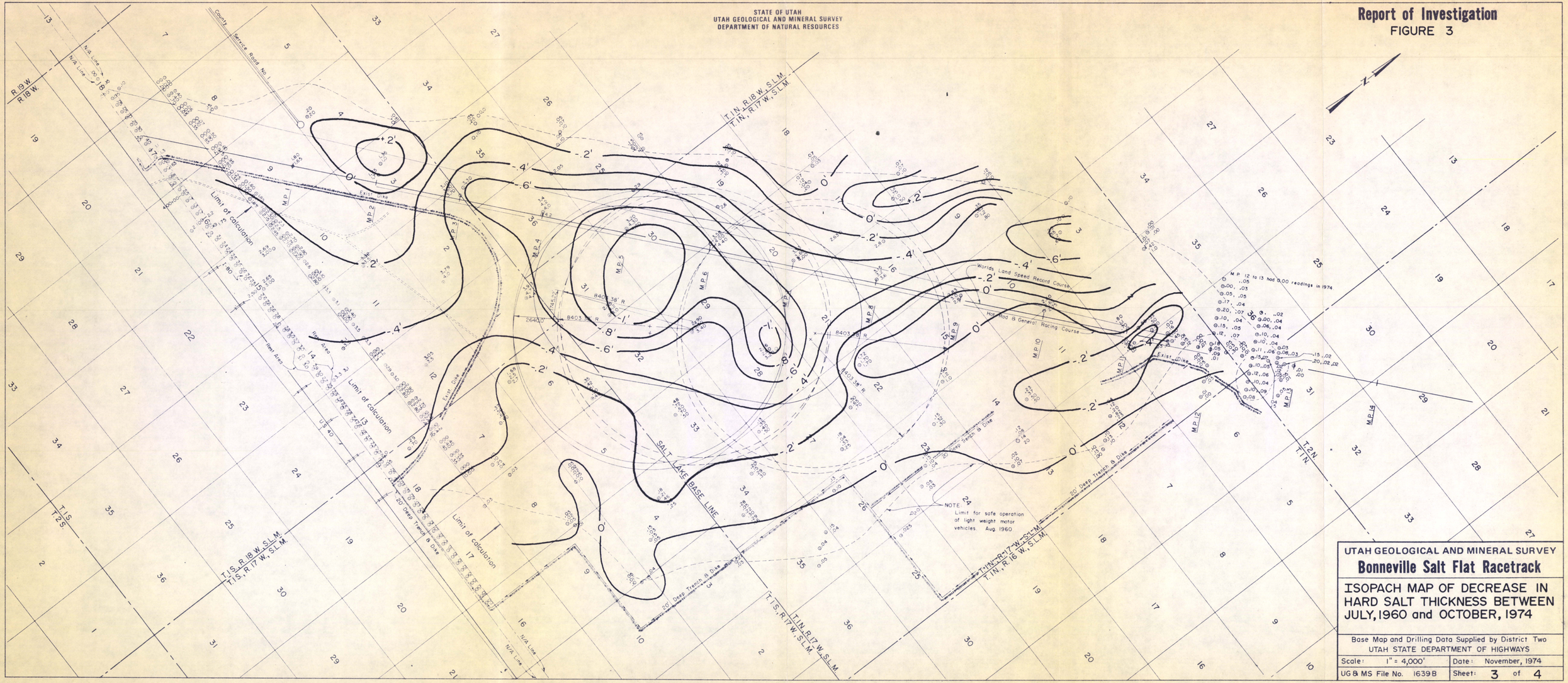
ISOPACH MAP OF HARD SALT THICKNESS AS DETERMINED BY DRILLING, OCTOBER 15-17, 1974

Base Map and Drilling Data Supplied by District Two
UTAH STATE DEPARTMENT OF HIGHWAYS

Scale: 1" = 4,000'	Date: November, 1974
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FIGURE 3



UTAH GEOLOGICAL AND MINERAL SURVEY

Bonneville Salt Flat Racetrack

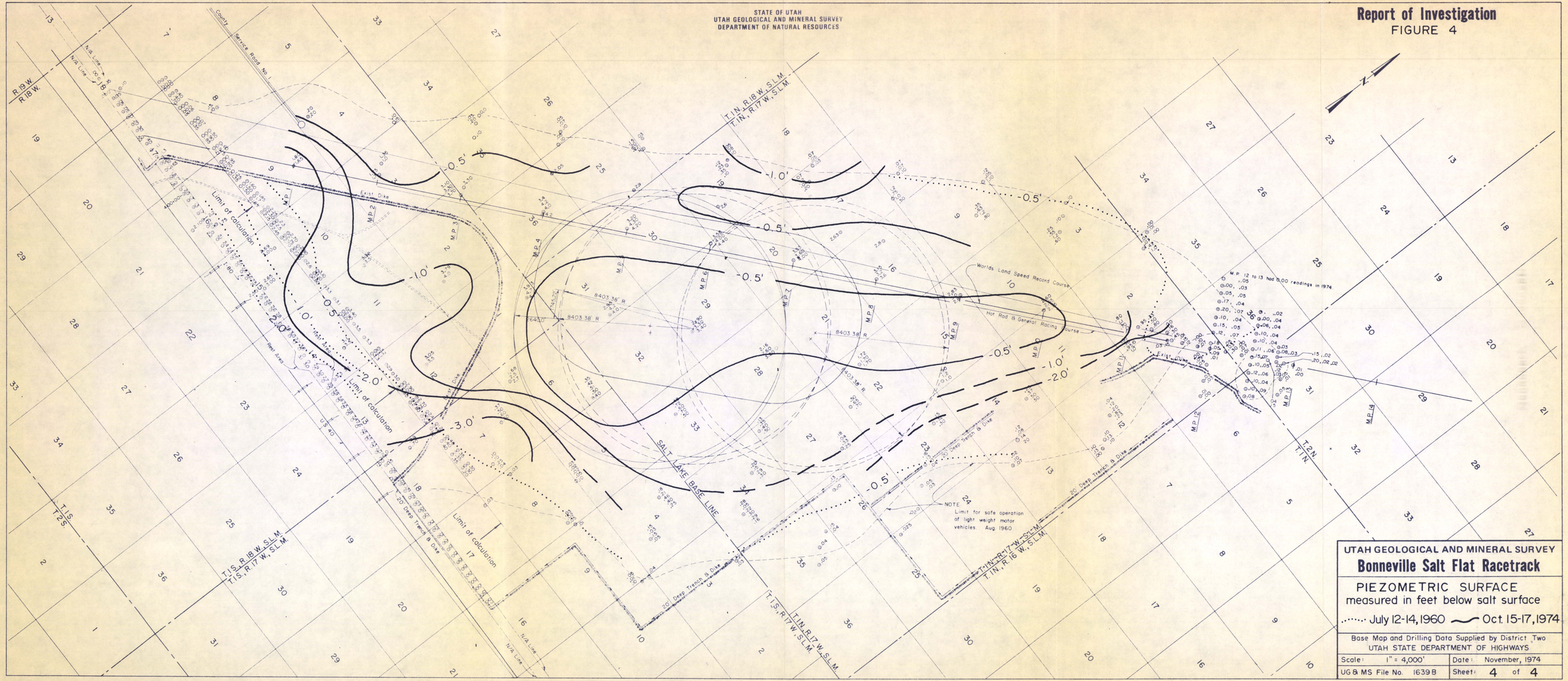
ISOPACH MAP OF DECREASE IN HARD SALT THICKNESS BETWEEN JULY, 1960 and OCTOBER, 1974

Base Map and Drilling Data Supplied by District Two
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FIGURE 4



UTAH GEOLOGICAL AND MINERAL SURVEY

Bonneville Salt Flat Racetrack

PIEZOMETRIC SURFACE
measured in feet below salt surface

····· July 12-14, 1960 ~~~ Oct. 15-17, 1974

Base Map and Drilling Data Supplied by District Two
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