E72-10158
CR-128309

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS

C.C. Reeves, Jr.
Department of Geosciences
Texas Tech University
Lubbock, Texas 79409

(E72-10158) DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, Apr. - Sep. 1972 C.C. Reeves, Jr. (Texas Technological Univ.) Oct. 1972 21 p CSCL 08H G3/13

N72-33315

Unclas
00158

October, 1972
Progress Report for Period April-September 1972

Prepared for
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland 20771

TABLE OF CONTENTS

PREFACE

Three small playa lake basins on the southern High Plains, Texas, have been examined by geologists, soil scientists, hydrologists and botanists to establish ground-truth for correlation with ERTS-1 imagery. Although the sites are recognizable, details of the three playa basins are too small, at present resolution, to be accurately determined by available MSS imagery. However, a fourth study site, consisting of a dual playa complex approximately 5 miles long in a basin of 9 square miles, is large enough so that MSS imagery resolution allows accurate measurement of water fluctuations and water depth.

Of the available MSS imagery, Band 5 is the most usable. Definition of Band 4 is less due to reduced tonal contrast. The greatest tonal contrast appears on Band 6 and Band 7 between dry land and water areas. Band 6 is particularly good for defining large water areas, Band 7 being best for small lake basins and Band 5 for growing fields.

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS

INTRODUCTION

The purpose of this report is to describe work performed on ERTS-1 study sites under NASA contract NAS5-21720, proposal number 342-C, during the six-month period April-September, 1972.

Three playa lake basins, typical of the tens of thousands of such basins which pock-mark the southern High Plains of West Texas and eastern New Mexico, were selected as study sites for ERTS-1. Objectives were to relate spectral differences obtained by orbital photography to the water balance ecosystem and to the geology-morphology of the playas. Original study sites as submitted in the proposal were unavailable or not suitable, thus, three substitute sites were selected.

Site 1, termed the Heard Playa, is located about 0.65 miles east of the intersection of FM Roads 37 and 400, appearing on the Julia Lake 7 1/2' quadrangle, Hale County, Texas, at approximately 33° 58' 30" N, 101° 39' 30" W. Site 2, termed the Spade Ranch, is located two miles west of FM Road 168 and four miles north of State Highway 116, appearing on sheet 34 of the Hockley County Soil Survey (1961 Series, No. 27) at approximately 33° 38' N, 102° 14' W. Site 3, known as the T-Bar, is located 4.6 miles west of Tahoka, Texas, and

one mile south of U.S. Highway 380, appearing on the Double Lakes 7 1/2' quadrangle at approximately 33° 09' N, 101° 53' 30" W.

GROUND-TRUTH STUDIES

Geology

The past and present extent of lacustrine sedimentation at the three test sites has been determined by power auger and coring. The sites were marked with a 100-meter grid. Twenty-eight holes were drilled at Site 1, 16 holes at Site 2, and 25 holes at Site 3, to define the lithology and geomorphology of the basins.

The coring program at all three sites is presently underway. Select 4 1/2 inch cores are being secured from each basin from locations determined by the previous drilling program. These cores, which illustrate lithologic changes, will be logged and the clays studied by x-ray analysis for correlation with infiltration studies.

Ground-truth of the study sites illustrates that the lake basins each differ from one another in several respects (Table 1), but the reasons for these differences have not, as yet, been determined.

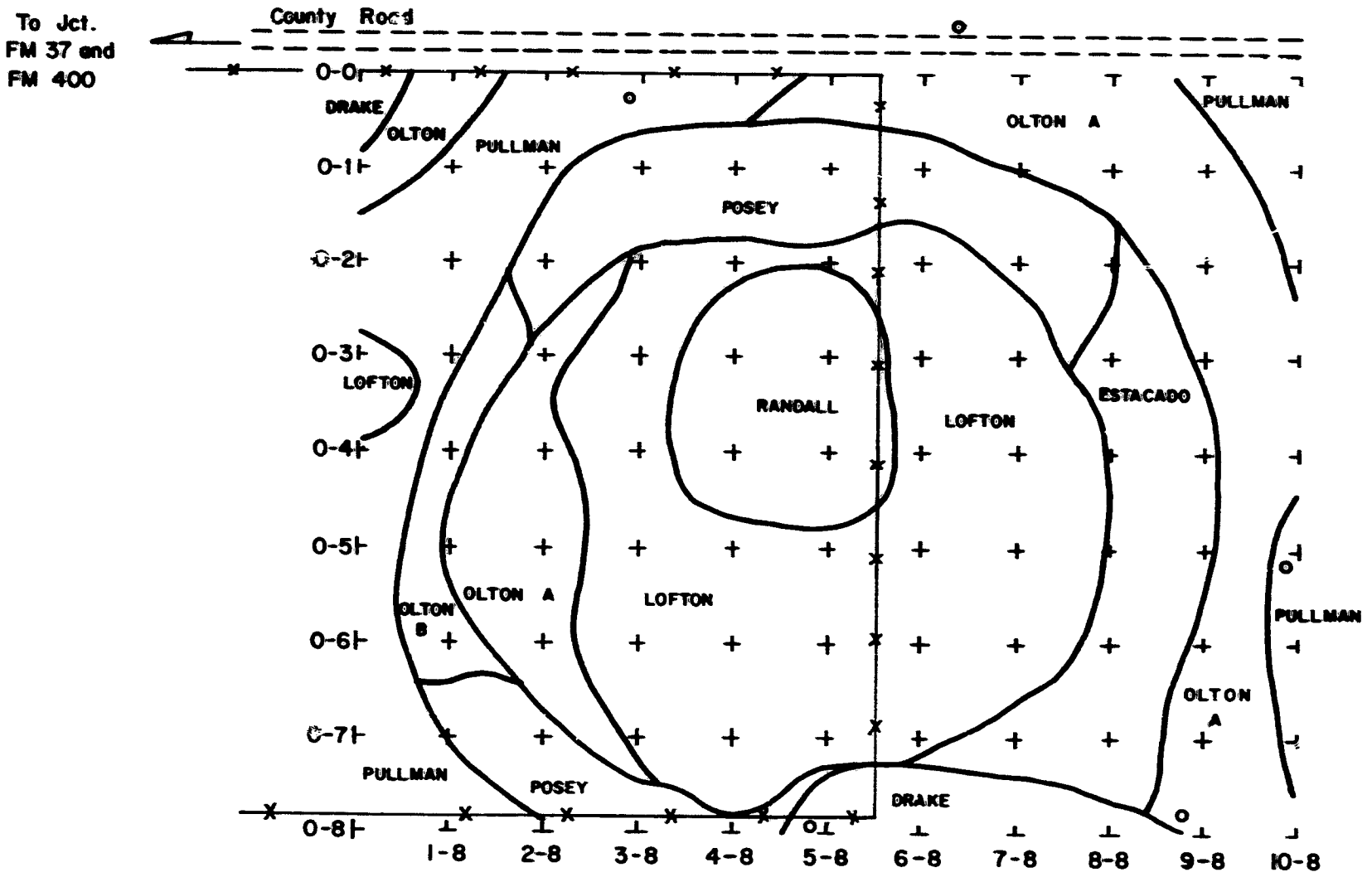
Soils

The soil profiles at all three study sites were investigated by power probe and hand auger. Each site was augered

CHARACTERISTIC	HEARD SITE 1	SPADE SITE 2	T-BAR SITE 3
Surface diameter	275 M	200 M	400 M
Drainage basin	±900 Sq. M.	±1,000 Sq. M.	±1,320 Sq. M.
Playa area	±500 Sq. M.	±	±1,000 Sq. M.
Lacustrine fill thickness	37 Ft.	25 Ft.	20 Ft.
Playa soil	Randall	Randall	Randall
Main basin soil	Lofton	Acuff-Zita-Estacado	Acuff
Generations of fill	2	2	2
Diameter older playa	750 M	200 M	350 M
Petrocalcic "basement"	Yes	Yes	Yes
Associated dune	Yes	Yes	No
Location	Southeast	?	------
Playa shape	Sub-circular	Sub-circular	Sub-circular
Relief on petrocalcic zone	40 Ft.	±30 Ft.	45 Ft.

Table 1 - Characteristics of the three ERTS-1 study sites, southern High Plains, Texas.

Figure 1 - Soil map of ERTS-1 study site 1, Heard Playa, Hale County, Texas.



N

SCALE: 1" = 200 meters

o = water well

Figure 2 - Soil map of ERTS-1 study site 2, Spade Playa, Hockley County, Texas.

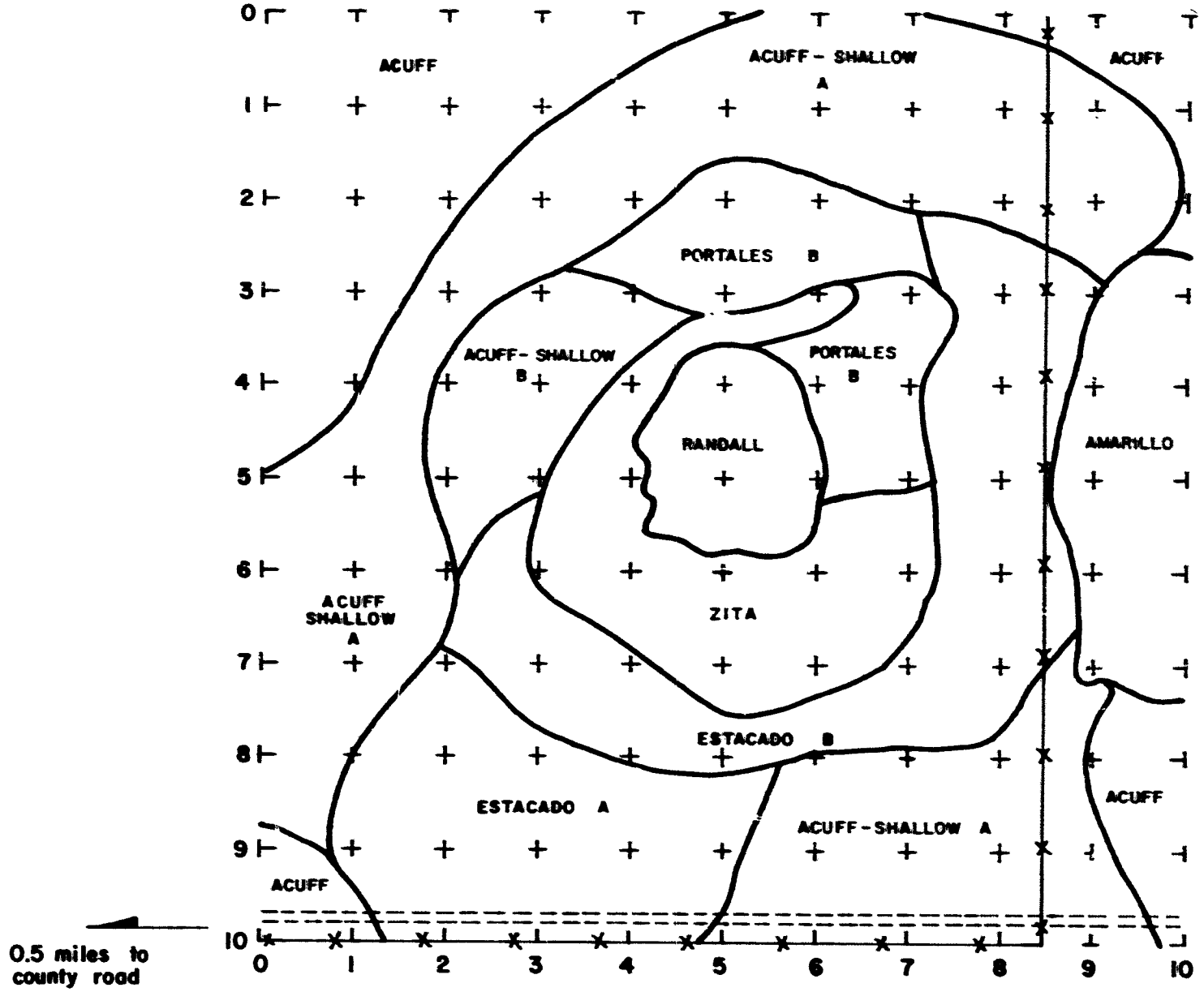
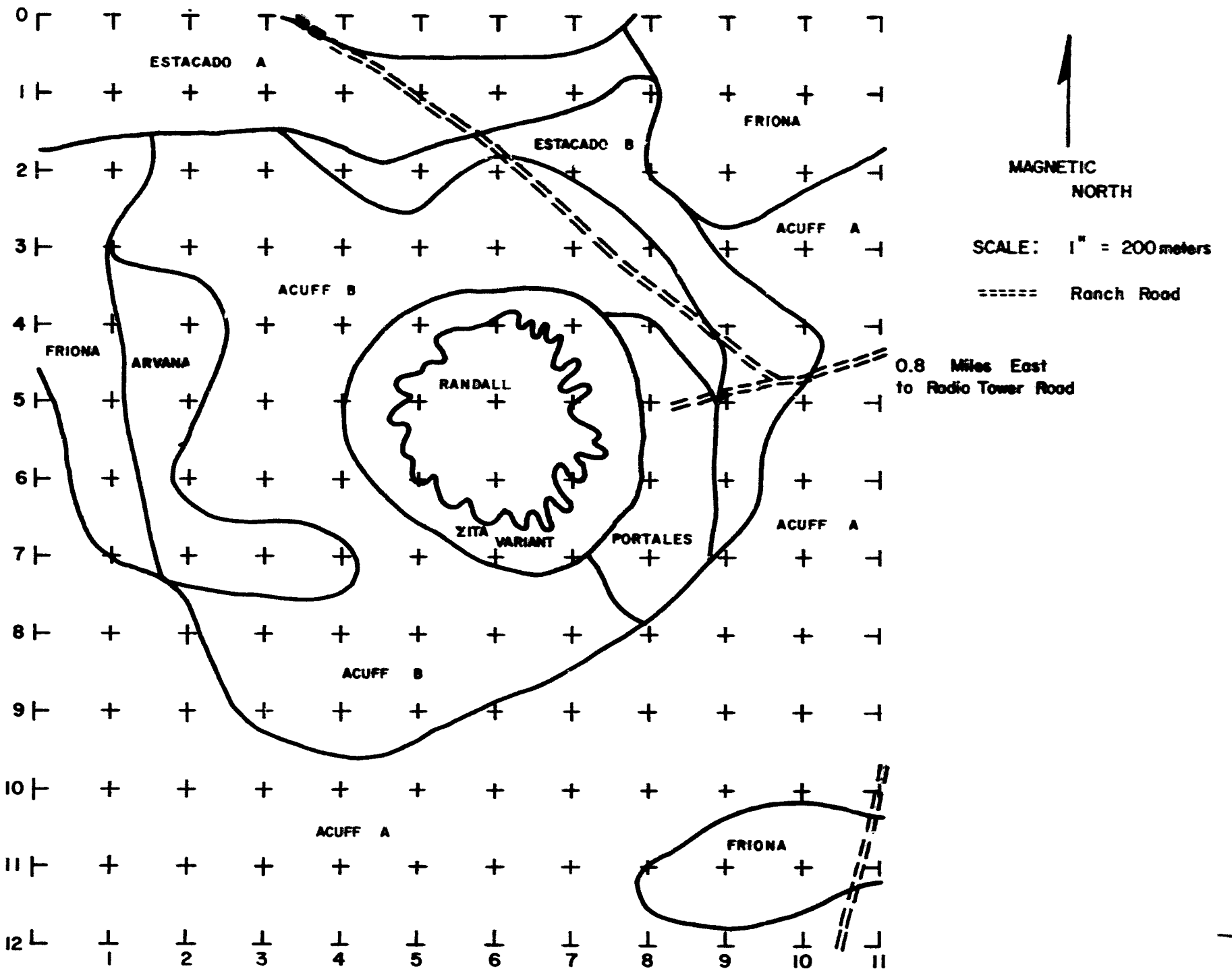

ACUFF
ACUFF - SHALLOW A
ACUFF
PORTALES B
ACUFF - SHALLOW B
PORTALES B
RANDALL
AMARILLO
ACUFF SHALLOW A
ZITA
ESTACADO B
ESTACADO A
ACUFF - SHALLOW A
ACUFF
ACUFF
0 1 2 3 4 5 6 7 8 9 10
0 1 2 3 4 5 6 7 8 9 10
0.5 miles to county road
SCALE: 1"=200 meters
Ranch Road

Figure 3 - Soil map of ERTS-1 study site 3, T-Bar Playa, Lynn County, Texas.


ESTACADO A
ESTACADO B
FRIONA
ACUFF A
ACUFF B
FRIONA
ARVANA
RANDALL
ZITA
VARIANT
PORTALES
ACUFF A
ACUFF B
ACUFF A
FRIONA
MAGNETIC NORTH
SCALE: 1" = 200 meters
====== Ranch Road
0.8 Miles East to Radio Tower Road

on the established 100 meter grid to a depth of six feet or bedrock. Figure 1 is the soil map of Site 1, Figure 2 is the soil map of Site 2, and Figure 3 is the soil map of Site 3.

Hydrology

A standard weather station consisting of a Class A evaporation pan, cup anemometer, recording raingage, and hygrothermograph is located at each lake basin, and nonrecroding raingages are distributed about the drainage basin. Soil moisture stations, consisting of tensiometers and access tubes for neutron probe analysis, are being utilized. Infiltrometers in the lakes are being used to determine seepage rates into the soil.

All instrumentation is performing adequately. Four rainfall events have been recorded in the two months during which records have been obtained. Precipitation, infiltration, and evaporation rates were determined following each storm and a continuous record of temperature and humidity is collected. With an increase in the number of precipitation events in the spring, some conclusions regarding the dynamic properties of the lakes in question will be obtained by analysis of this data.

An addition to the original reserach proposal is the study of water quality with depth at Site 2. This program by Sam Carmalt, Harvard University, is sponsored by the U.S. Geological Survey. This required taking four cores from study site 2, the interstitual water of which will be studied at the

Harvard laboratories. Water quality changes with depth in the lacustrine section will be determined.

Vegetation

The study of the vegetation of the study sites, being conducted by R.A. Wright, was an addition to the original program, and thus, is still underday. Basically, the field technique involves an 800 x 800 meter grid, sampling done on a 10 x 10 meter grid. Within each 10 x 10 meter grid is randomly located a 10 point frame, thus, giving data from each site from 64,000 points. From such data the percent of ground cover of each species and the total ground coverage of all species for each unit and for various groupings will be determined.

No results of the vegetation analyses are as yet available.

ERTS-1 DATA

ERTS-1 MSS frame 16522 covers study sites 2 (Spade) and 3 (T-Bar). Quality of the frame is high except for fine dots (electronic noise) and obvious scan lines near study site 3 (T-Bar). Band 7 of frame 16522 was not received.

Frame 16522 was examined by Stanford Research Institute in the "Cloud Console" by William Evans, Eldon Wiegman, and the Principal Investigator. Location of the study sites by latitude and longitude was only approximate, the longitude

being offset approximately 2 KM east. Figure 4 illustrates study site 3 (T-Bar) as imaged by the console, Figure 5 showing the site under maximum magnification.

Frame 16522 was also briefly projected in false color by the SRI Console by using the 70 mm chips of bands 4, 5 and 6. Enough detail was observed that SRI will permanently munt a color monitor to the Cloud Console. All bands have also been examined on an International Imaging Systems Density Slicer, but no improvement over the Sl... Console was observed.

CONCLUSIONS

As shown by Figs. 4 and 5, resolution on the MSS frame 16522 is adequate for identification of the study sites but does not appear good enough for the measurement of monitoring of water level changes in the lake basins. However, clarification of this possibility awaits additional imagery.

Electronic noise near study site 3 (T-Bar) is detrimental to imagery clarity but is useful for quick site location.

RECOMMENDATIONS

The principal objective of the proposed investigation was to correlate spatial distribution of soils, plants and time-space distribution of soil moisture and ponded storage

Figure 4 - ERTS-1 study site (arrow), T-Bar Playa, Lynn County, Texas, as imaged by Stanford Research Institute "Cloud Console". The site is the slight dark circle to the southwest of the cursor and east of a white noise spot. Band 5.

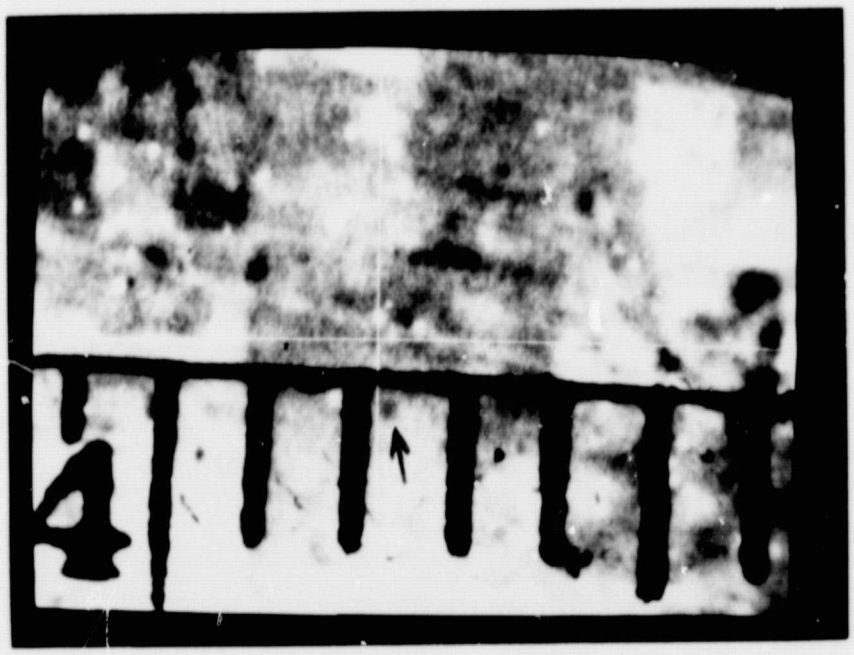


Figure 5 - Magnification of ERTS-1 study site 3, T-Bar Playa, Lynn County, Texas, on Stanford Research Institute "Cloud Console". Each division on the scale represents 1 KM. The site (arrow) is the dark circle south of the east-west bar of the scale and immediately east of the north-south cursor line. Band 5.

volume of the three small playa lake study sites, to the absorbance-reflectance data obtained by the repetitive, multispectral ERTS-1 imagery. However, this objective, because of ERTS-1 resolution, will probably not be fulfillable. A definitive statement awaits additional imagery.

The problem arising because of the resolution of ERTS-1 MSS data was expected, thus, an alternate study site was selected (see May 30 report) and the securing of initial ground truth data was started by non-project personnel supported by the Geo-Environmental Institute, Texas Tech University. The southern end of the alternate study site, consisting of a dual playa some 5 miles long known as Double Lakes, is 5 miles northwest of the present study site 3 (T-Bar), located on the Double Lakes, Texas, 7 1/2' quadrangle.

The alternate Double Lakes study site, which appears northwest of the cursor on Figure 4, occupies a drainage basin of approximately 9 square miles, the present dual playas occupying about 5 square miles. This is many times as much area as one of the original study sites (see Fig. 4) and, as imaged (Fig. 6), is large enough for correlation of ground truth data with hydrologic fluctuations. It is, therefore, recommended that Double Lakes be instrumented, monitored, and studied (as study sites 1, 2, and 3) during the remaining contract period. Further discussion of the rational and scientific procedures is presented in the submitted Data Analysis Plan.

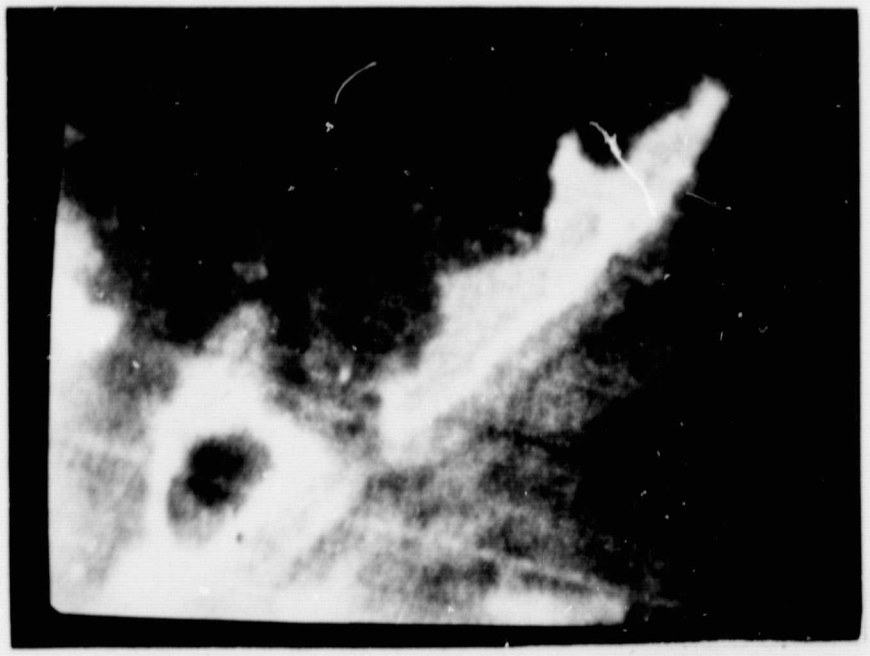


Figure 6 - ERTS-1 alternate study site, Double Lakes, Lynn County, Texas, as imaged on the Stanford Research Institute "Cloud Console" at maximum resolution. Notice how the wet playa mud of the northeastern playa images compares to the water in the southwestern playa. Band 5.

NTIS SUMMARY

Discipline 4 - Water Resources

Subdiscipline D - Limnology

Three small playa lake basins on the southern High Plains, Texas, have been examined by geologists, soil scientists, hydrologists and botanists to establish ground-truth for correlation with ERTS-1 imagery. Although the sites are recognizable, details of the three playa basins are too small, at present resolution, to be accurately determined by available MSS imagery. However, a fourth study site, consisting of a dual playa complex approximately 5 miles long in a basin of 9 square miles, is large enough so that MSS imagery resolution allows accurate measurement of water fluctuations and water depth.

Of the available MSS imagery, Band 5 is the most usable. Definition of Band 4 is less due to reduced tonal contrast. The greatest tonal contrast appears on Band 6 and Band 7 between dry land and water areas. Band 6 is particularly good for defining large water areas, Band 7 being best for small lake basins and Band 5 for growing fields.