December 28, 2016

M E M O R A N D U M

To: Brian Hunt

From: Tom Grimshaw

Subject: Text to Accompany the Geologic Map of the Rutherford Ranch

During May 2016 we jointly mapped the details of the surface geology of the Rutherford Ranch. The resulting 1:24,000 scale map was sent by email to Mike Rutherford on June 2. A copy of the map is shown in a reduced scale in Attachment A. The geologic mapping has been transferred to "panels" of the Mountain City 7½-minute quadrangle (2½-minutes per panel) as shown in Attachment B to incorporate the work into overall geologic mapping of the quadrangle. The following 2016 memos were prepared during the initiative:

March 6	Rutherford Ranch Field Trip Proposal
May 10	Field Trip Stops, Day 1 (May 9) At Rutherford Ranch
May 11	Field Trip Stops, Day 2 (May 10) At Rutherford Ranch
June 1	Suggestions for Rutherford Ranch Geologic Map

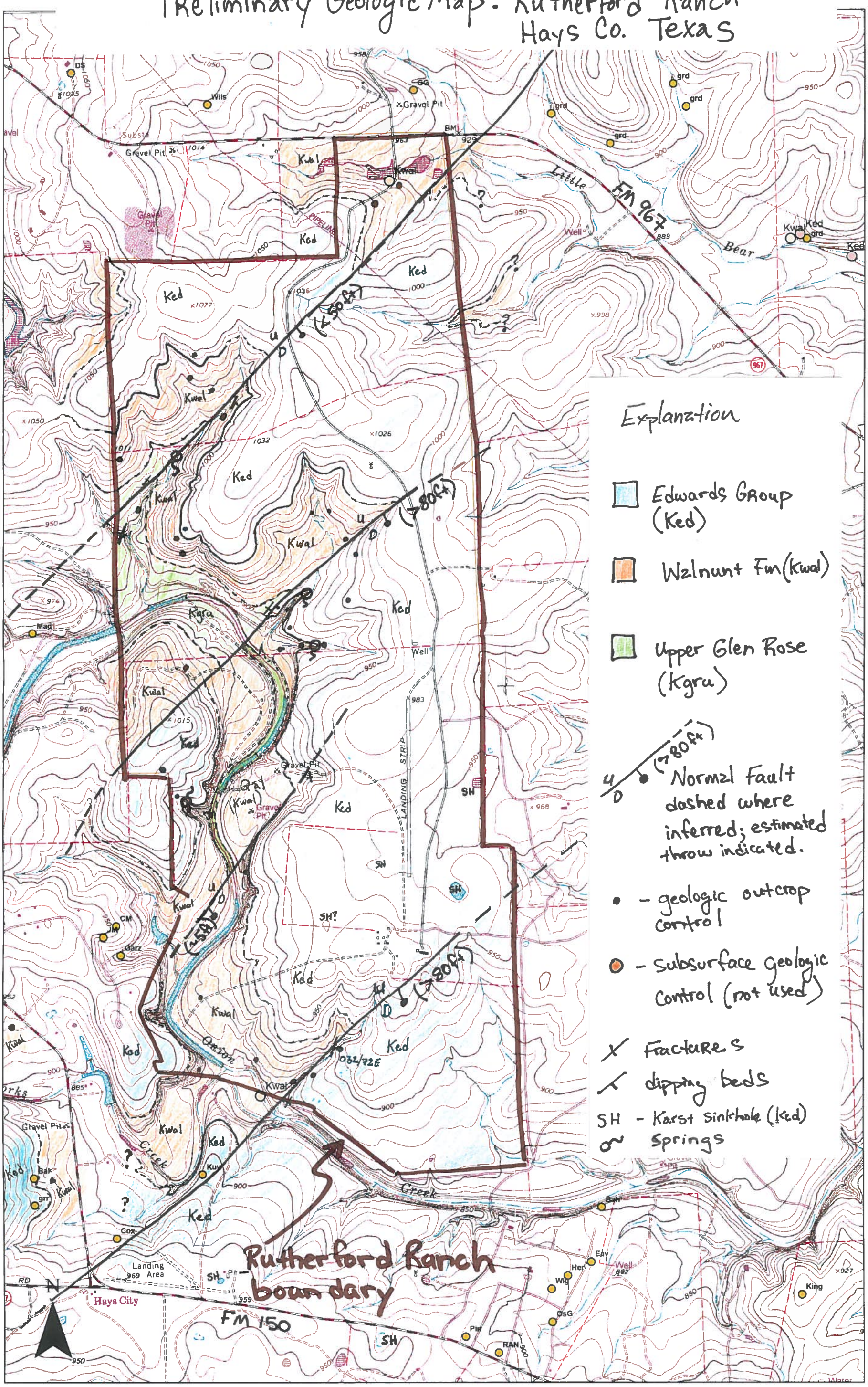
The method of transferring geologic mapping from air photos to the topographic base map was described in a memo dated January 11, 2016 (erroneously shown as 2015). Images of the air photos that were used for the photogeologic mapping part of the initiative are in Attachment C. The purpose of this memo is to add a brief description of the geologic features to accompany the mapped area. This description is provided in Attachment D.

I look forward to continuing to work with you on the Mountain City Quadrangle mapping project. Perhaps as a next step we can arrange for a Walnut-Edwards measured section in the Rutherford Ranch.

Attachment A.

Geologic Map of the Rutherford Ranch Area, Mountain City Quadrangle, Texas
Submitted to Mike Rutherford by Email on June 2, 2016

Preliminary Geologic Map: Rutherford Ranch
Hays Co. Texas



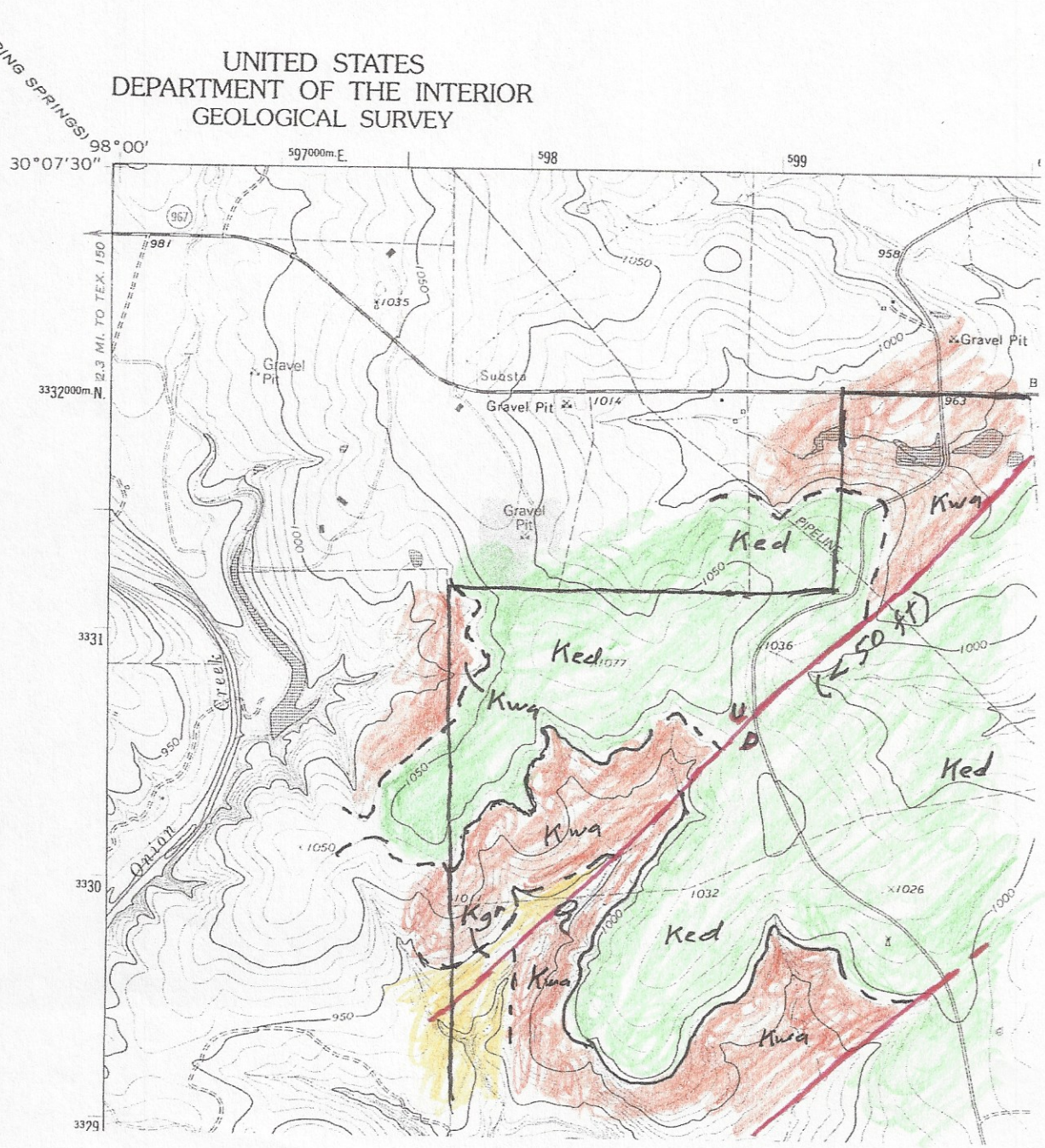
1:24,000 0 0.25 0.5 1 Miles

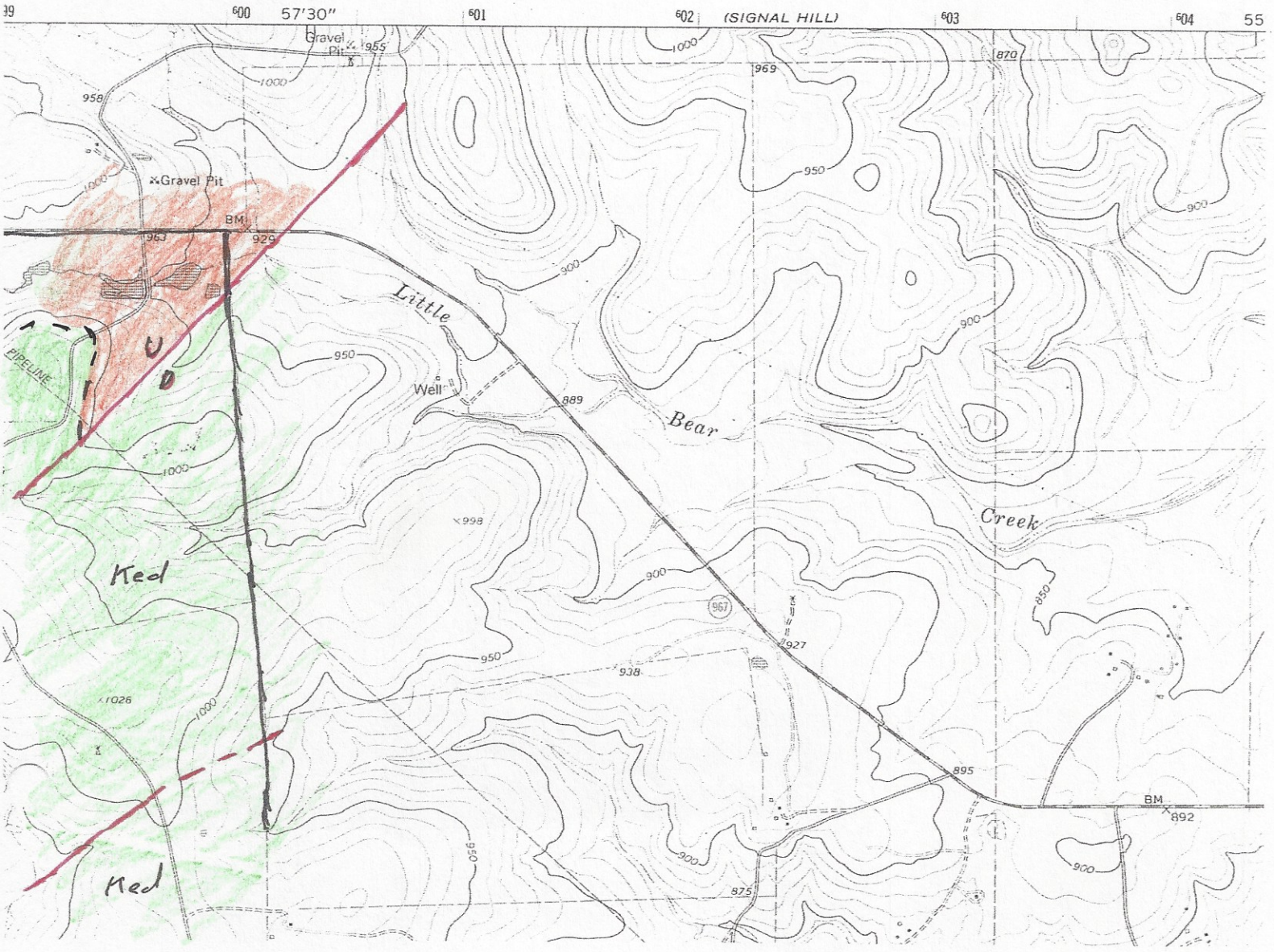
Tom Grimshaw, UT-Austin
Brian Hunt, BSEACD

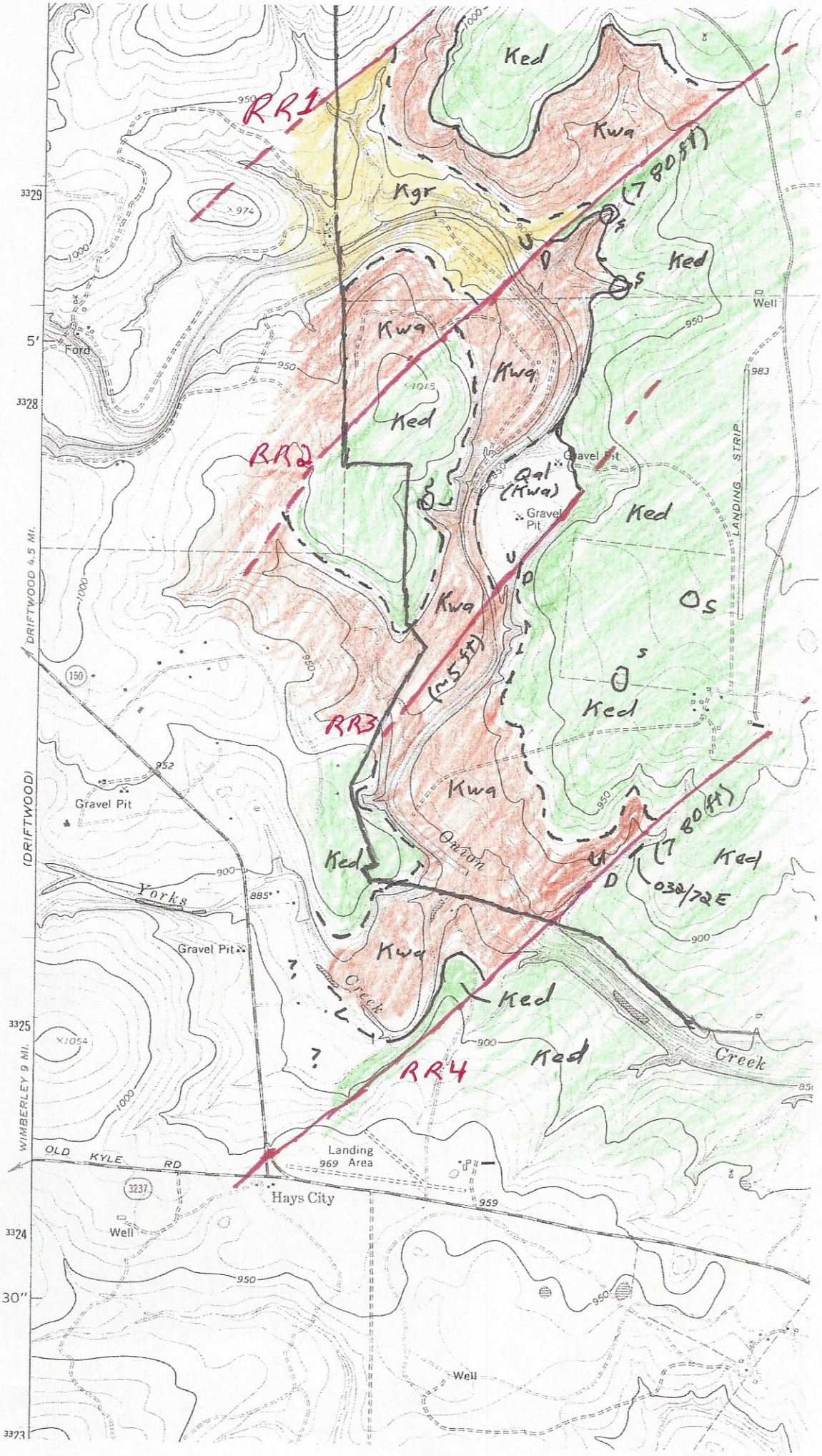
June 2016
(Fieldwork May 9-10, 2016 to verify air photo mapping)

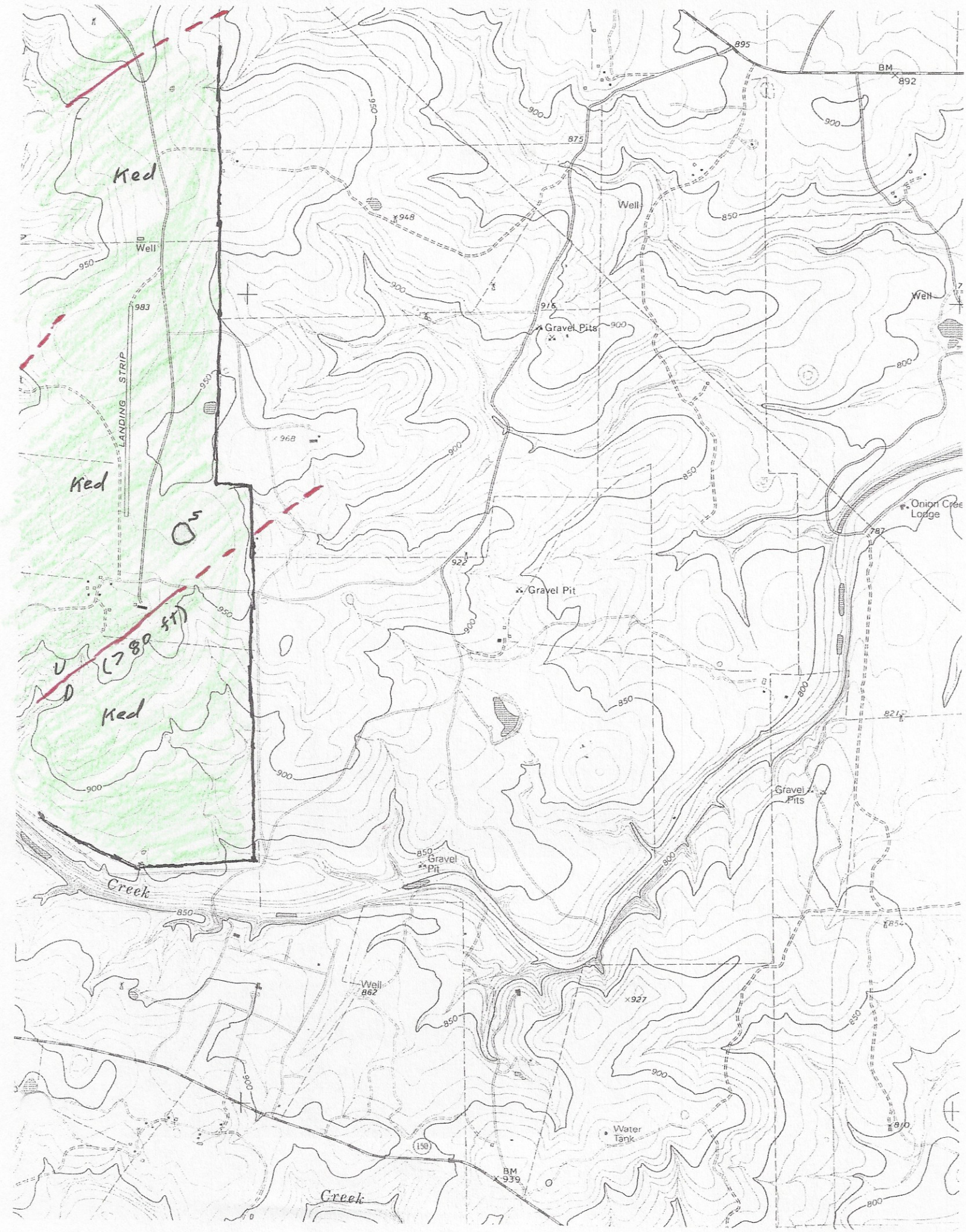
Attachment B.

Geologic Map of the Rutherford Ranch Shown on 2½-Minute Panels of the Mountain City Quadrangle


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
(DRIPPING SPRINGS) 98°00'
30°07'30"
597000m.E.
598
599
12.3 MI. TO TEX. 150
3332000m.N.
3331
3330
3329
967
981
1035
1050
1000
958
963
1014
1036
1077
1032
1026
950
Gravel Pit
Substa
Gravel Pit
Gravel Pit
Gravel Pit
PIPELINE
Onion Creek
Kwa
Ked
Kgr
50
U
D


57'30"
(SIGNAL HILL)
Gravel Pit
Gravel Pit
BM
963
929
Little
Bear
Creek
Well
PIPELINE
Red
Red
998
1026
969
870
950
900
889
967
927
938
895
BM
892
875

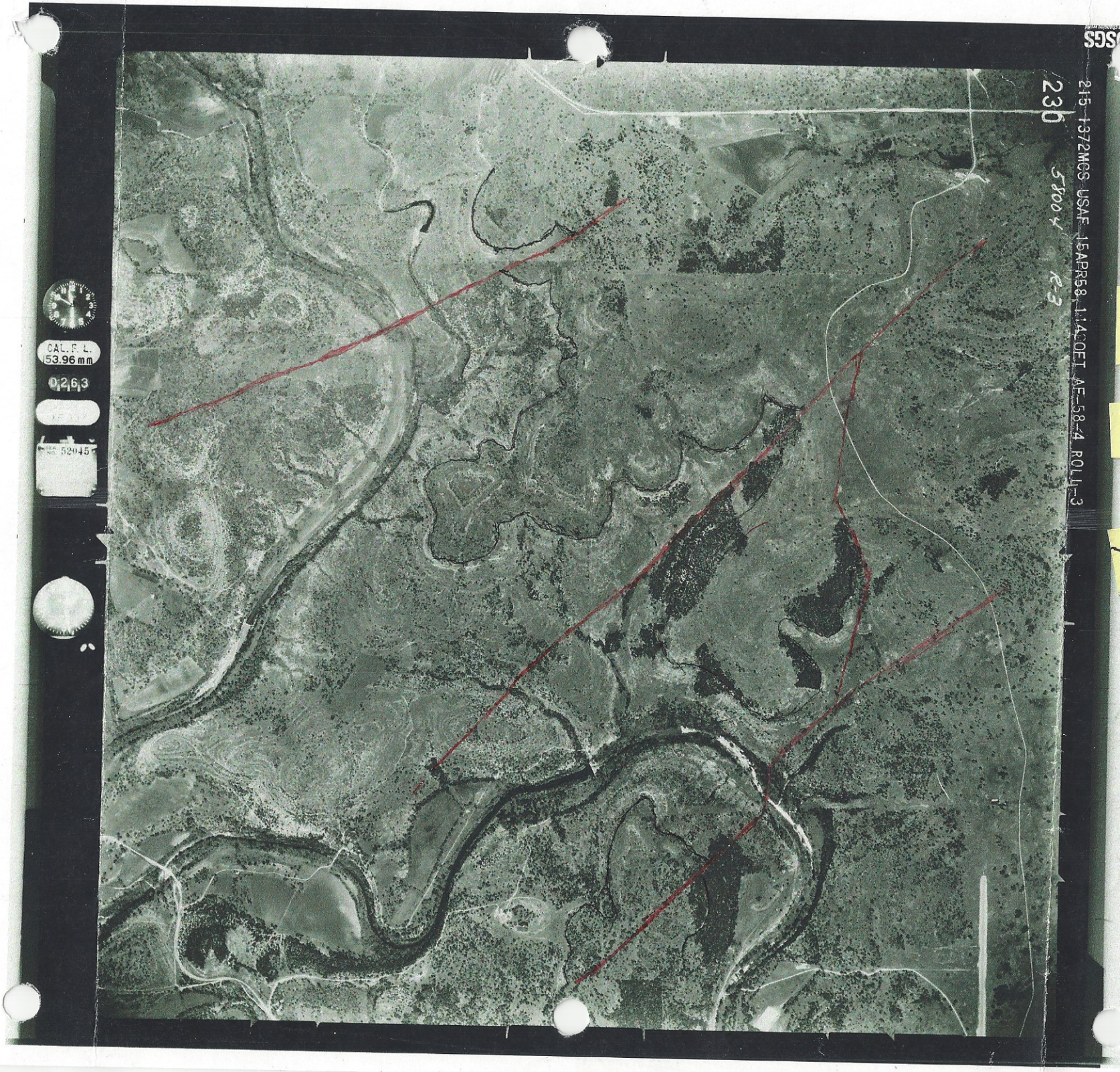

RR1
RR2
RR3
RR4
Ked
Kwa
Kgr
Qal
(Kwa)
Os
(780ft)
(554ft)
(780ft)
038/72E
Gravel Pit
Gravel Pit
Gravel Pit
Ford
Well
Well
Well
Hays City
Landing
969 Area
Yorks
Creek
Creek
Creek
DRIFTWOOD 4.5 Mi.
(DRIFTWOOD)
WIMBERLEY 9 Mi.
OLD KYLE RD
LANDING STRIP
3329
3328
3325
3324
3323
5'
2'30"

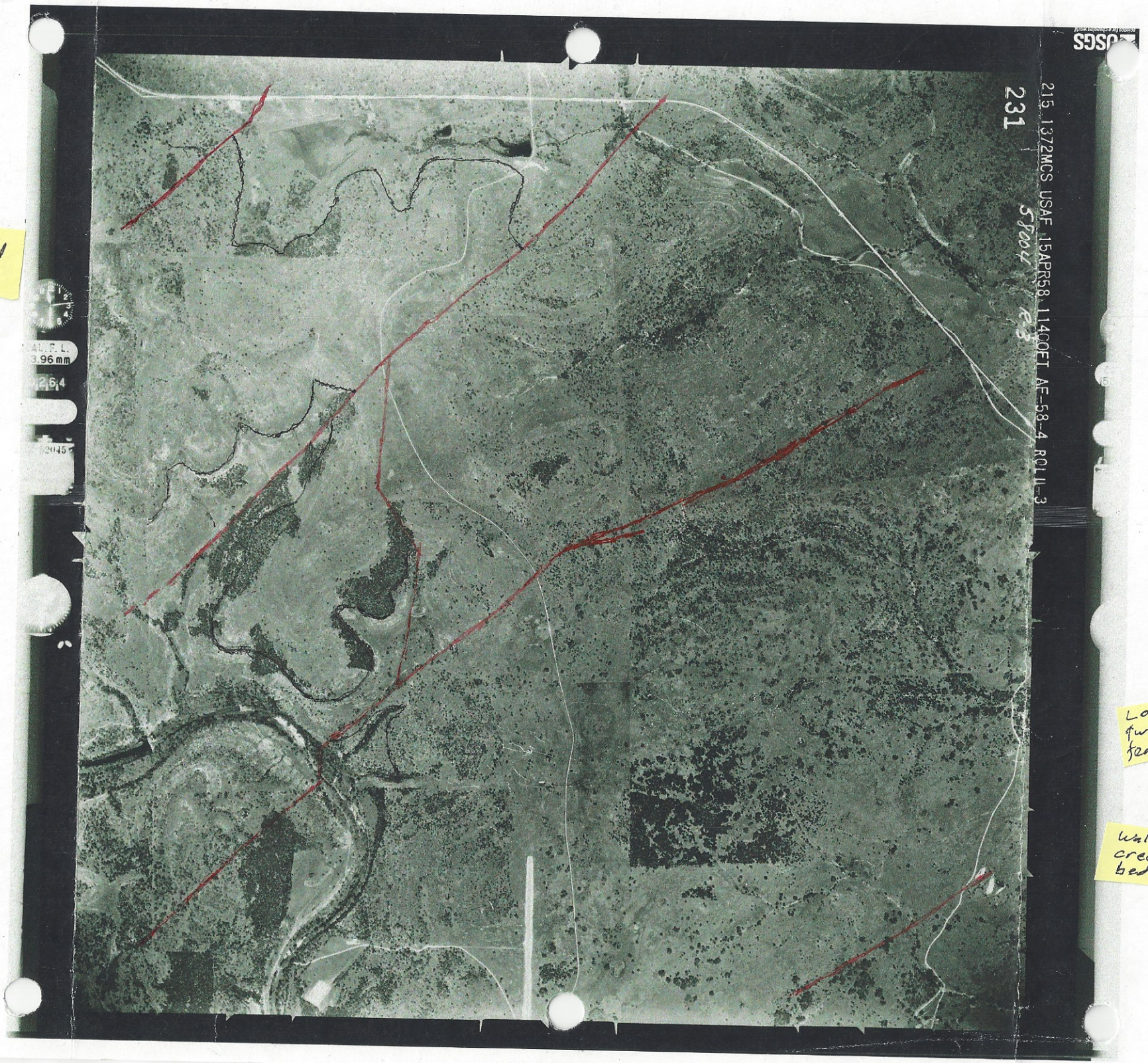

Ked
Ked
Ked
U
D
(780 ft)
LANDING STRIP
983
Well
950
900
875
895
BM
892
948
Well
850
916
Gravel Pits
Well
800
968
922
Gravel Pit
Onion Creek
Lodge
787
821
Gravel
Pits
850
Gravel
Pit
Creek
850
854
Well
862
927
850
900
Water
Tank
810
150
BM
939
Creek
800

Attachment C.

Photogeology of the Rutherford Ranch

Note: The Photos Are Oriented with North to the Right


215 +372MCS USAF 15APR58 114OEI AF-58-4 ROLL-3
230
5800'
K-3
CAL. F. L.
53.96 mm
0,2,6,3
Verify Kwa-Ked both sides of fault
Verify Kwa-Ked
Look for fault evidence



Verify Kwa-Red

Look at two features

Walk creek bed

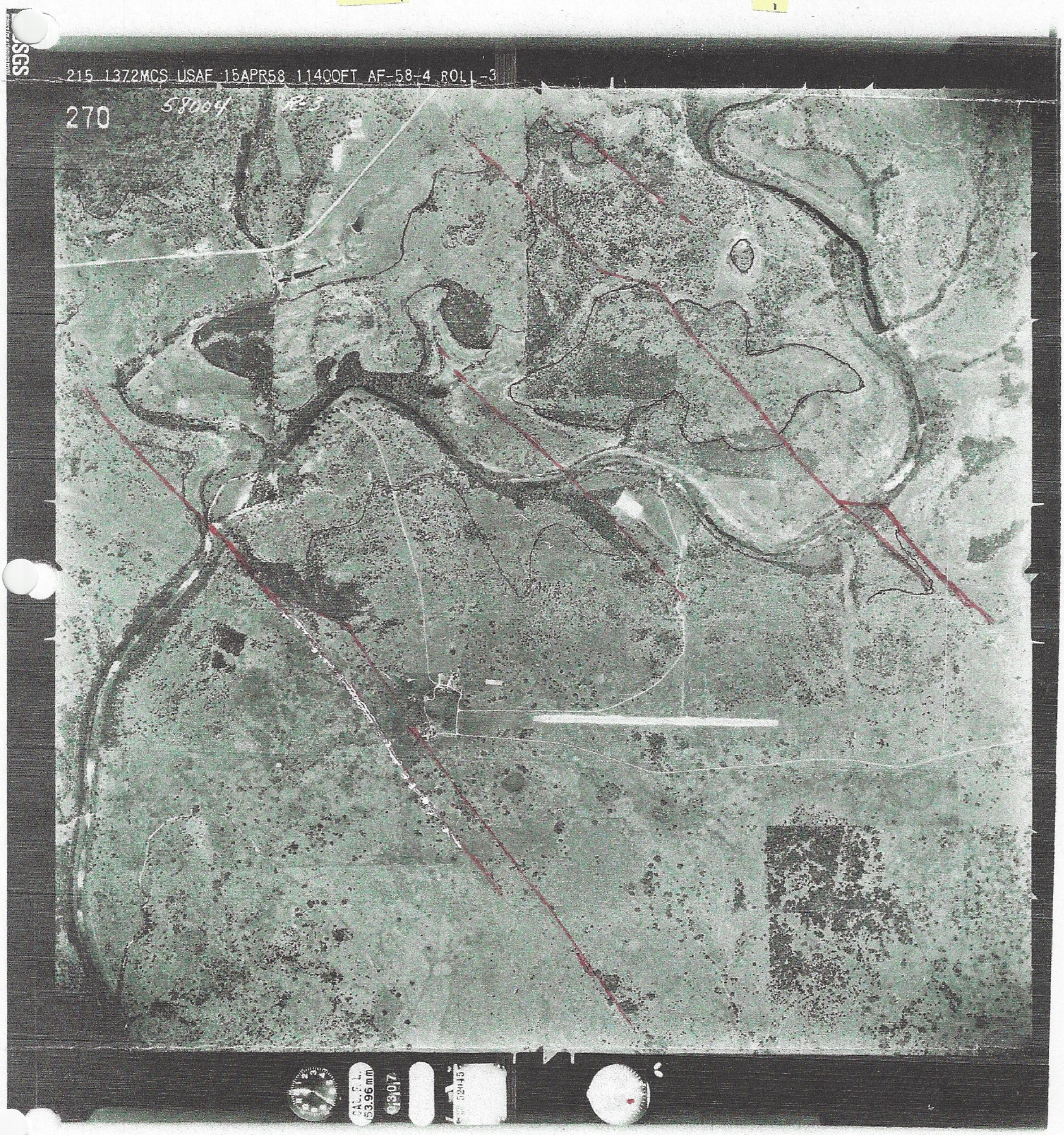
Conf Kwa-Ked both sides

Look for fault evidence

'Is' this natural?

Find Kwa-Ked!

Find Twa-Ked!



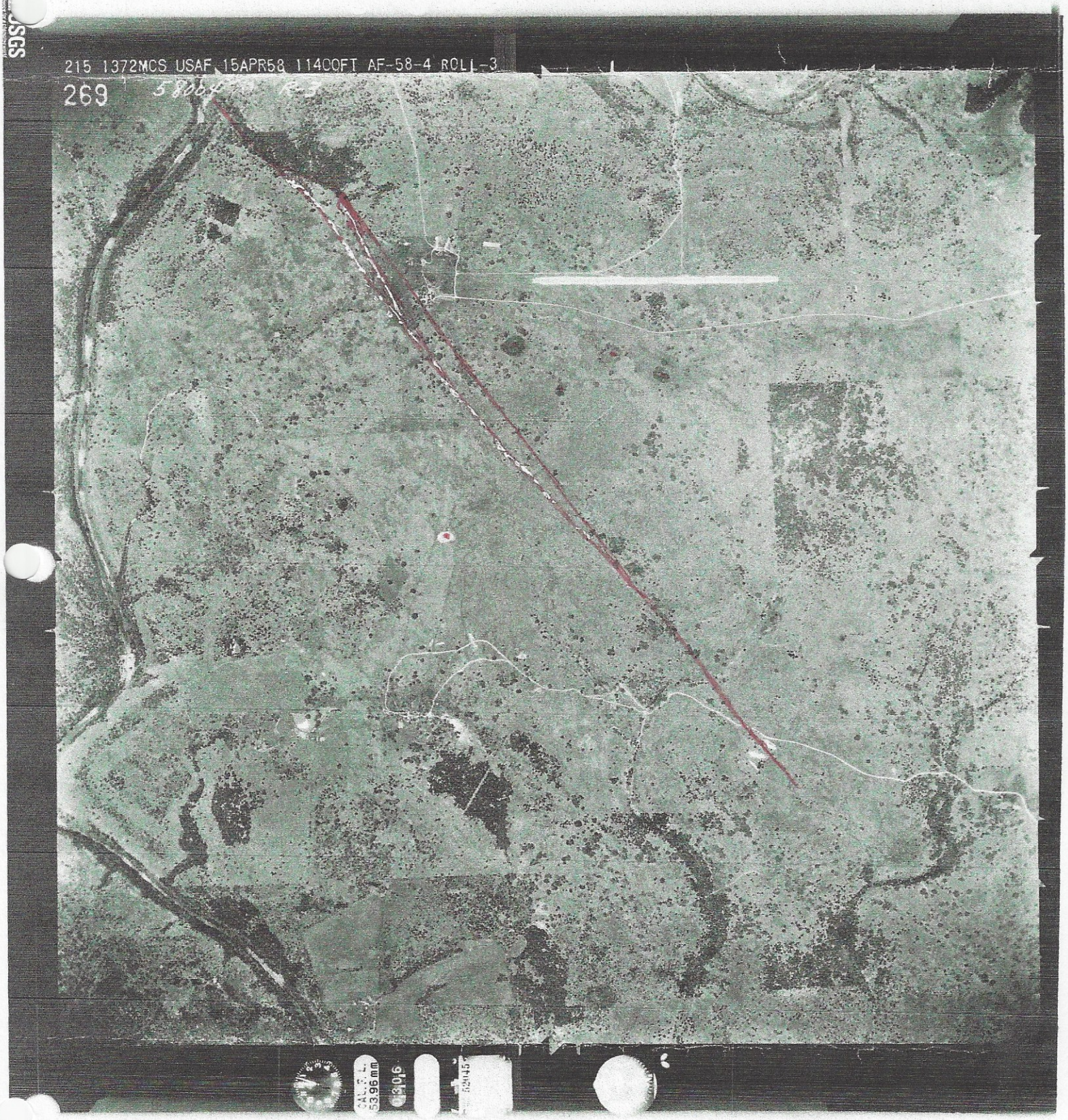


Photo sinks #3

Attachment D.

Report to Accompany Geologic Map of the Rutherford Ranch Area

PRELIMINARY DRAFT FOR INTERNAL REVIEW

December 28, 2016

Introduction

The Rutherford Ranch is located in central Texas about 6 miles west of Buda and 5 miles northwest of Kyle. As part of an initiative to prepare a geologic map of the Mountain City Quadrangle, a map of the Rutherford Ranch was developed during the summer of 2016. The Ranch constitutes a significant portion of the quadrangle. It extends generally from FM 967 southward to Onion Creek. It includes a significant reach of the creek on the west side of the ranch. The ranch house, outbuildings, and landing strip are in an upland area in the south-central part of the ranch.

The purpose of this report is to provide a description of the geologic features to accompany the geologic map. In addition, the map is configured in a form (2½-minute "panels") to be incorporated in the overall geologic map of the Mountain City Quad. The geologic map was prepared as a collaborative effort by Tom Grimshaw, Research Affiliate at The University of Texas at Austin, and Brian Hunt, Staff Geologist at the Barton Springs/Edwards Aquifer Conservation District. The mapping seeks to build upon previous similar work in the quadrangle area[1].

Regional Geologic Framework

The principal regional basement elements of the Central Texas region are the stable Texas Craton and the adjoining Ouachita Foldbelt to the east. Over geologic time the boundary has resulted in a distinct physiographic division between the Edwards Plateau to the west and the Gulf Coastal Plain to the east. The Balcones Escarpment is at the east edge of the Edwards Plateau. It separates historic cropland land use patterns of the Gulf Coastal Plain from ranchland uses of the Edwards Plateau. The Rutherford Ranch is located just west of the main topographic expression of the escarpment.

Bedrock Strata: Cretaceous Limestones and Related Lithologies

The basement rocks are overlain by sedimentary strata consisting of limestones, clays, and related rocks. The bedrock stratigraphic units at the Rutherford Ranch are, from oldest to youngest, the Glen Rose, Walnut, and Edwards formations[2]. The strata were deposited during the Early Cretaceous period, between 101 and 145 million years before present. Descriptions of the lithologies and thicknesses of the formations appear in Table 1.

Structural Geology: Faults of the Balcones Fault Zone

The boundary between the Texas Craton and the Ouachita Foldbelt has formed a "hinge line" where subsidence of the Gulf Coastal Plain in relation to the Edwards Plateau has resulted in tensional forces along the line. The Balcones Fault Zone was created by these tensional forces in the geologic past but is not active at this time. Faults in the zone trend generally to the northeast in the Rutherford Ranch area, and displacements are generally downward to the southeast.

[1] Previous mapping and other geologic work is being compiled separately in the quadrangle mapping initiative.

[2] Strictly speaking, the Glen Rose and Edwards units have both been divided into two formations, but they are referred to here as "formations" for convenience.

Table 1. Lithologies and Thicknesses of the Formations in the Rutherford Ranch Area[3]

Edwards Group, Undifferentiated	Reported as "gray dolomitic siliceous massive honeycombed limestone" in upper part and "light-gray argillaceous, nodular limestone" in lower part for Hays County (DeCook, 1963). Thickness reported at 430-450 ft for San Marcos area (Rose, 1972). Divided by Rose (1972) into lower Kainer and upper Person Formations, separated by the "Regional Dense Member". Comprises principal aquifer in the map area and throughout central and southwest Texas. Occurs under typical hill country landscape, with predominantly oak-juniper assemblage. Common sinkholes and other karstic solution features.
Person Formation	Lithology and other characteristics as described for Edwards Group – similar to underlying Person Formation. Distinguishable as mapping unit only when lowest bed ("Regional Dense Member") is present. Thickness reported at 130 to 150 ft in San Marcos area (Rose, 1972).
Kainer Formation	Lithology and other characteristics as described for Edwards Group – similar to overlying Person Formation. Distinguishable as mapping unit only when lowest bed of Person Formation ("Regional Dense Member") is present. Thickness reported at 300 ft in San Marcos area (Rose, 1972).
Walnut Formation	Lithology of "blue-gray sandy or calcareous clay; light-gray to white argillaceous nodular limestone" and thickness of 5 to 15 ft reported for Hays County (DeCook, 1963). Thickness reported also at 40 ft (Davis, 1962). Abundant occurrence of Exogyra texana in Hays County. Crops out only in Blanco River canyon near northwest corner of map area. Mapped with overlying Kainer Formation on this map.
Glen Rose Formation	Characterized as "hard limestone alternating with argillaceous marl" with a thickness of 500-900 ft for Hays County (DeCook, 1963). Observed as finely crystalline dolomite interbedded with dolomitic limestone and marl in map area. Upper 35 to 45 feet exposed in map area. Crops out only in Blanco River canyon near northwest corner of map area.

The Cretaceous limestones and other strata generally dip gently to the southeast. The structure of the rock units is also influenced by four faults, which are designated RR-1 to RR-4 from north to south. The faults trend generally from north 30° to 50° east. They comprise step faults of the Balcones Fault Zone with displacement downward to the southeast. As shown on the map, the amount of displacement varies along the faults but is approximately as follows:

RR1 Less than 50 feet
RR2 Greater than 80 feet
RR3 About 5 feet
RR4 Greater than 80 feet

[3] Unit Descriptions from Grimshaw, T.W., 2016. Geologic Map of the San Marcos North Quadrangle and Adjacent Portions of the Mountain City and San Marcos South Quadrangles, Hays, Caldwell and Guadalupe Counties, Texas. Digitally redrafted and georeferenced by Mark Helper as a color version of the 1:24,000 paper geologic maps contained in Grimshaw, T.W., 1976, Environmental geology of urban and urbanized areas, a case study from the San Marcos area, Texas [Ph.D. thesis], Austin, Texas, The University of Texas at Austin, 244 p. Scale 1:24,000. Online. Available: https://repositories.lib.utexas.edu/handle/2152/43985.

The RR1 fault has been mapped northeastward beyond Rutherford Ranch across FM967 into the former O-Bar Ranch and beyond to the north boundary of the Mountain City Quadrangle. The RR2 fault has been designated the Rutherford Ranch Fault in previous mapping. The RR3 fault appears to have small displacement and may not extend far beyond the Ranch boundaries. The RR4 fault has been mapped beyond the Ranch southwest to the intersection of FM150 and FM3737 near the west boundary of the quadrangle.

Geomorphology: Fluvial and Karstic Features

Two geomorphic and hydrologic features are prominent at Rutherford Ranch – fluvial processes of Onion Creek and its tributaries and karst processes of the Edwards formation. Erosion by Onion Creek has resulted in a sizeable trench in the bedrock along the course of the stream and its tributaries in the western portion of the ranch. Central Texas is one of the most floodprone areas of the U.S. Flooding has occurred frequently on Onion Creek, most recently in 2013 and 2015.

Karst features are in the Edwards limestone and consist of four sinkholes (dolines) located near the landing strip. The Edwards formation is the host of the regional Edwards Aquifer, one of the most prolific aquifers in the US.

An interesting erosional feature is the incision of small tributaries to Onion Creek at and close to where the creek crosses the faults. These small but deep incisions occur north of the creek where it crosses the RR2 and RR4 fault locations.

Outcrop Patterns

Most of the Rutherford Ranch is underlain by the Edwards limestone, which occurs in the upland area generally in the eastern half of the ranch. The underlying Walnut formation crops out on both sides of Onion Creek in the western half, where erosion has “cut through” the Edwards strata. The Walnut is also exposed along the north boundary of the Ranch at and around the entrance from FM 967. The older Glen Rose formation is exposed in a small area on the western edge of the ranch near Onion Creek and northwest of the RR2 fault.

Methods

The primary methods used for geologic mapping at the Rutherford Ranch were examination of air photo stereo pairs and extensive outcrop visits and field verification of the photogeology. The air photos were taken by the US Air Force in 1958. Outcrop visits were made on May 9 and 10, 2016. A preliminary draft version of the geologic map was submitted by email to Mike Rutherford on June 2, 2016.

Summary

The geologic map of the Rutherford Ranch is an important component of the overall geologic map of the Mountain City Quadrangle. The bedrock Cretaceous formations and four faults of the Balcones Fault Zone are principal geologic features of the ranch. The main geomorphic and hydrologic features are the fluvial processes associated with Onion Creek and its tributaries and the karst processes associated with the Edwards limestone.

The Rutherford Ranch mapping has demonstrated the advantages of the complementary approaches of the geologists who performed the work. Future potential geologic work may include a measured section in the Walnut formation and the underlying and overlying Glen Rose

and Edwards formations near the west ranch boundary. The geologic mapping may also be supplemented with water well information and LIDAR image analysis.

Acknowledgments

Thanks are extended to ranch owner Mike Rutherford for granting access and for helping with the outcrop examinations during the field visits. Acknowledgment is also given to the Barton Springs/Edwards Aquifer Conservation District for supporting the mapping project.