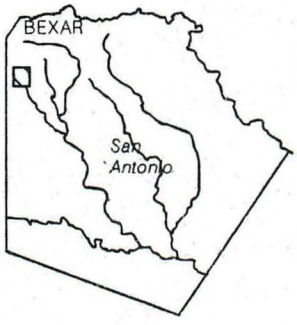
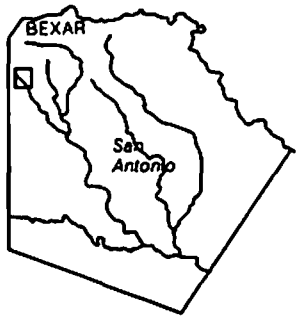
EDWARDS UNDERGROUND
WATER DISTRICT

Report 93-10

Government Canyon Geologic and Hydrologic Assessment



Government Canyon Geologic and Hydrologic Assessment



Prepared by:

Field Operations Division
John R. Waugh, Geologist II
Steven D. Walthour, Geologist III

May 1993

GOVERNMENT CANYON
GEOLOGIC AND HYDROLOGIC ASSESSMENT

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GOVERNMENT CANYON GEOLOGIC AND HYDROLOGIC ASSESSMENT

INTRODUCTION

On March 1, 1993, the Board of Directors of the Edwards Underground Water District requested that a geologic and hydrologic assessment of the Government Canyon property be performed by District Field Operations staff. This study was requested pursuant to the Board's approval to participate in the purchase of the subject property. The following report is the result of that study.

A literature search and field study were performed to provide a brief overview of the geologic and hydrologic conditions in the Government Canyon area. This area consists of approximately 5152 acres located 3 miles west of Helotes, Texas in northwest Bexar County.

Available literature includes publications from the Texas Water development Board, the Texas Department of Water Resources, and the USGS, as well as an unpublished MS thesis from the University of Texas at Austin. In addition, unpublished data was obtained from HDR Engineering and from various individuals.

Field study methods included reconnaissance to quality check surface geology previously mapped by the USGS, locating wells on the property accessible and suitable for geophysical logging, water quality sampling, and measuring water levels in several wells in the study area.

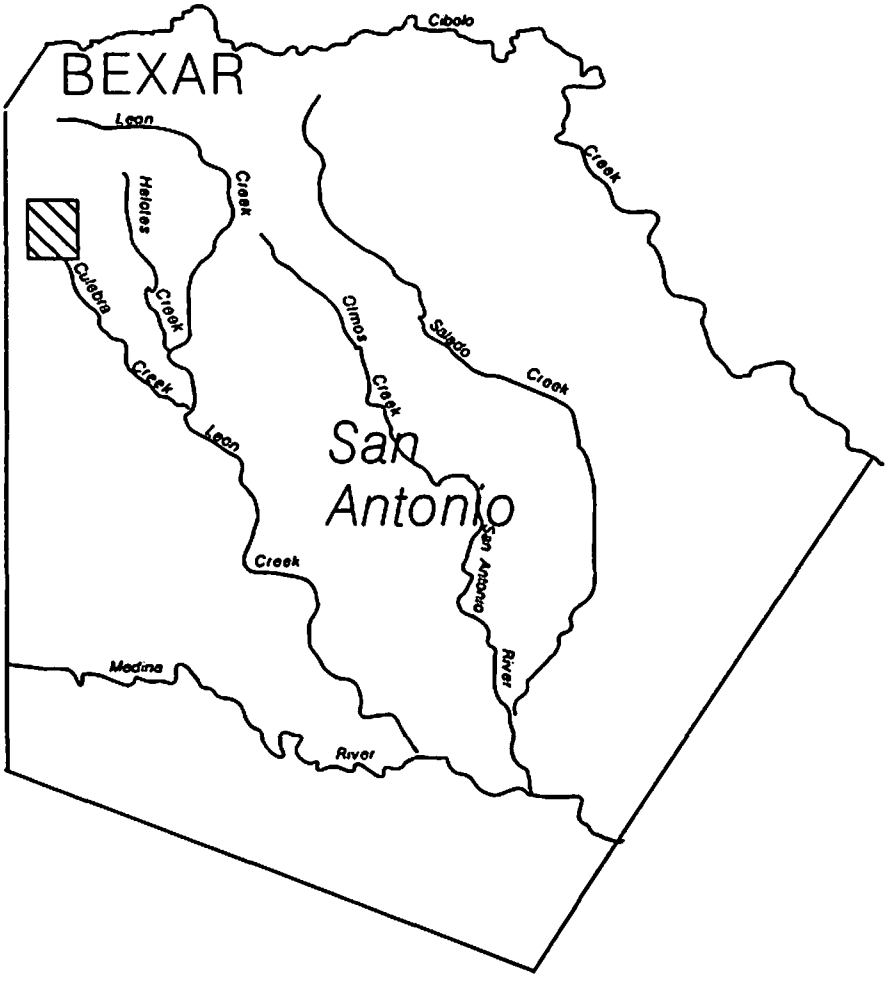
SURFACE GEOLOGY

Surface geologic data was obtained from the USGS and the San Antonio Water System, and was transferred onto topographic maps covering the Government Canyon area. District staff field-checked the resultant map and identified one or more possible recharge features for further study. Adjacent landowners also provided information indicating possible recharge areas inside the Government Canyon property.

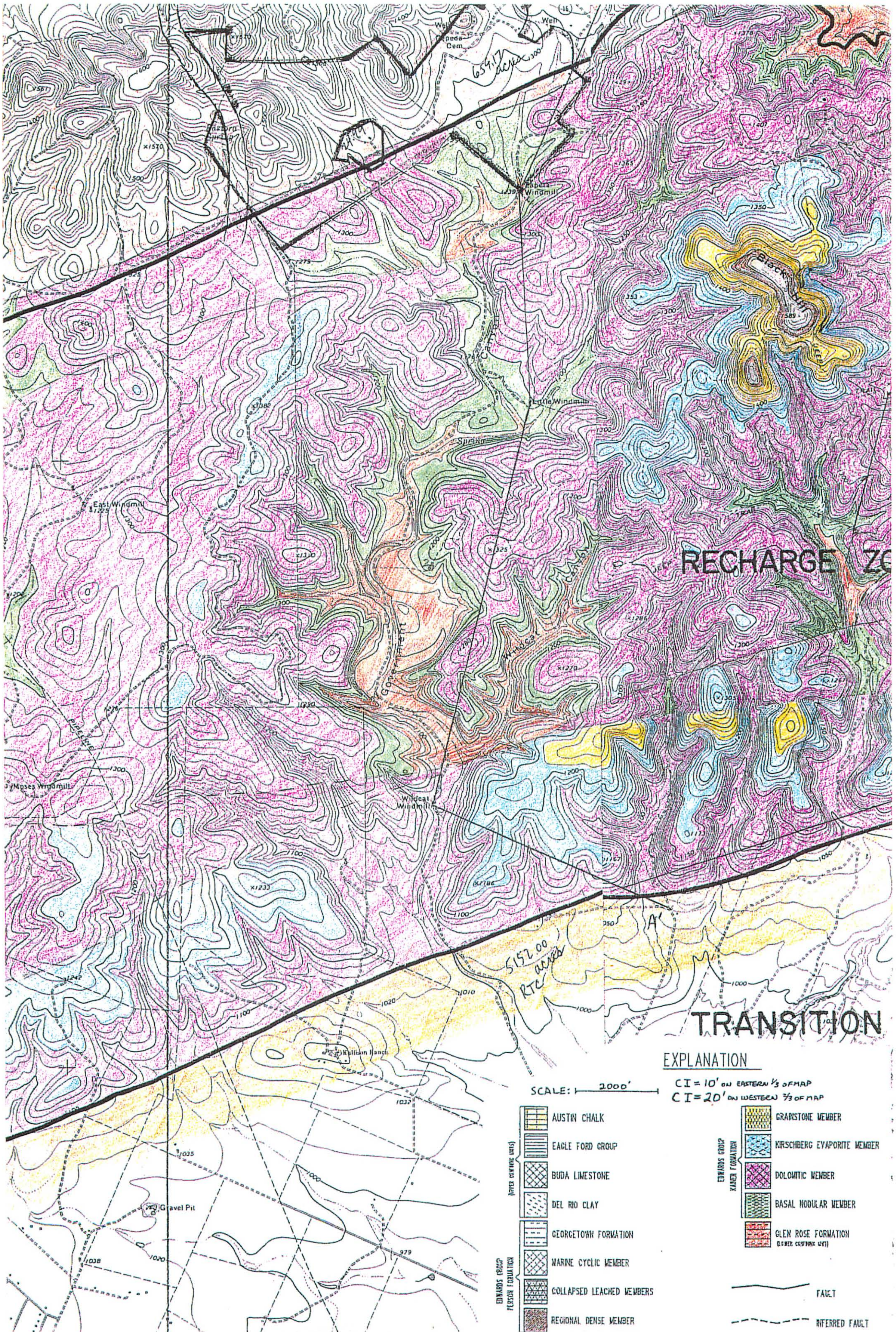
The geologic units exposed in the study area are predominantly Cretaceous limestones, dolomites, and calcareous shales, as well as Quaternary alluvial gravel deposits. The topography is pronounced, with over 300 feet of vertical relief. The hills are composed of lower to middle Edwards members, with canyons cut through them to expose the Edwards-Glen Rose contact along Government Canyon and Wildcat Canyon. Dip of the Edwards section is approximately two degrees to the southeast, with no surface evidence of folding or change in rate of dip noted.

Field observation of the lowermost Edwards section indicates the development of cavernous porosity and collapse features in the lower Dolomitic Member and Basal Nodular Member along steep canyon walls. During periods of flooding, water reportedly enters these caverns at one site south of Government House, and does not drain back after water level

Government Canyon Location Map



Note Government Canyon is located on a tributary of the west fork of Culebra Creek.


RECHARGE ZO
TRANSITION
Black Hill
East Windmill
Little Windmill
Wildcat Windmill
Moses Windmill
Spring
Kallison Ranch
Gravel Pit
5152.00 acres RTC
EXPLANATION
SCALE: 2000'
CI = 10' on eastern 1/3 of map
CI = 20' on western 2/3 of map
(UPPER CONFINING UNITS)
AUSTIN CHALK
EAGLE FORD GROUP
BUDA LIMESTONE
DEL RIO CLAY
EDWARDS GROUP PERSON FORMATION
GEORGETOWN FORMATION
MARINE CYCLIC MEMBER
COLLAPSED LEACHED MEMBERS
REGIONAL DENSE MEMBER
EDWARDS GROUP KAINER FORMATION
GRAINSTONE MEMBER
KIRSCHBERG EVAPORITE MEMBER
DOLOMITIC MEMBER
BASAL NODULAR MEMBER
GLEN ROSE FORMATION
(LOWER CONFINING UNIT)
FAULT
INFERRED FAULT

drops. A large cave opening which has been recently covered by collapse of overlying sediment is located in the same area of the canyon. A third possible recharge feature was identified by District geologists approximately one mile north of the Wildcat Windmill on the eastern side of Government Canyon.

STRUCTURE

Several normal faults with northeasterly strike are the major structural features in the area. The largest of these, the Haby Crossing Fault, has a total displacement of 570 feet and juxtaposes the Glen Rose with the upper portion of the Edwards. Three other normal faults, also downthrown to the southeast, are located north of the Haby Crossing Fault in the Government Canyon property.

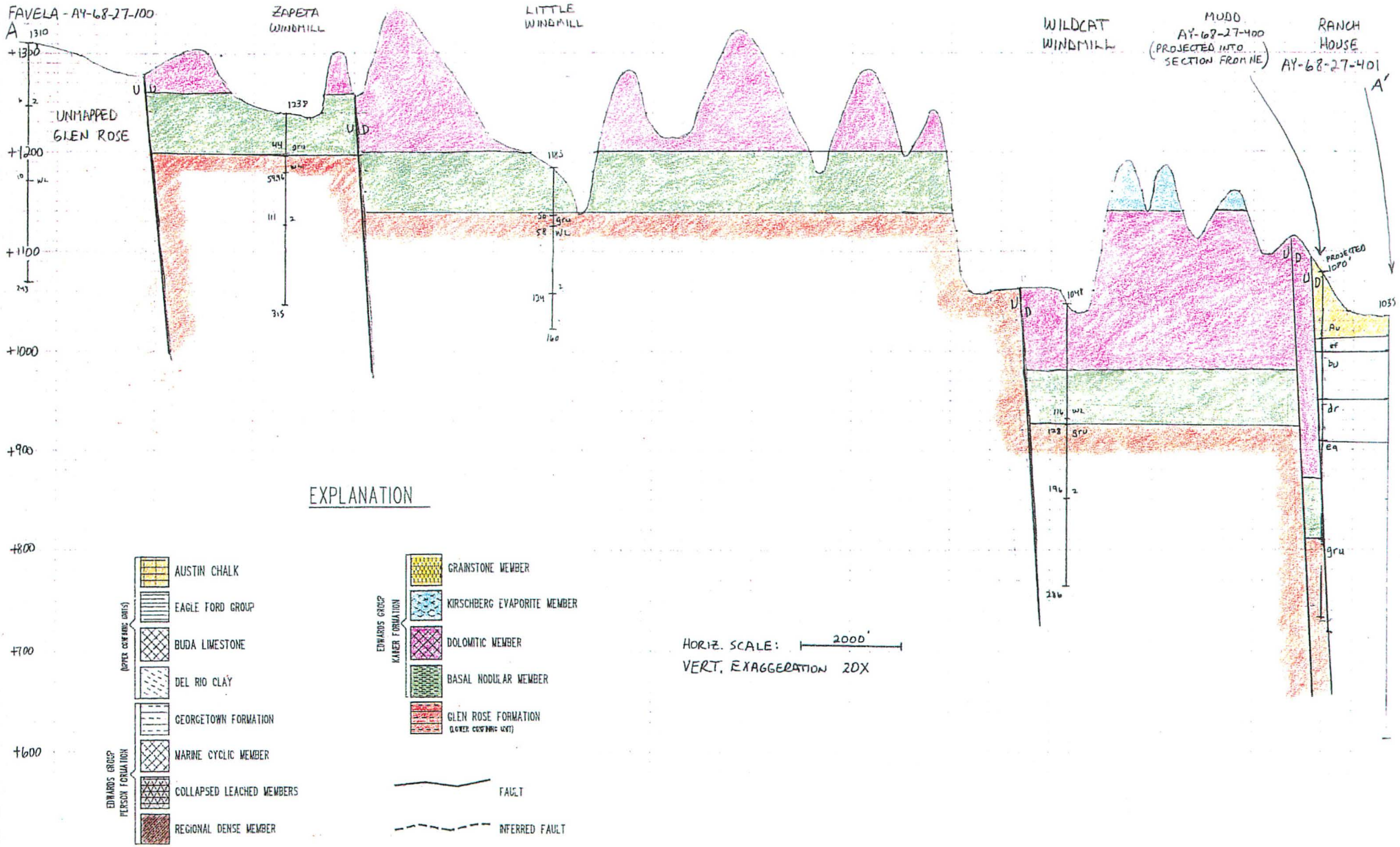
District staff ran geophysical logs in four wells located on the property. Three of these wells are currently supplying water for livestock, with a fourth abandoned well located in a remote area in the center of the property. The wells were chosen to provide geologic and hydrologic data which could be utilized to generate a north-south trending cross section and a potentiometric map of the Government Canyon area. In addition, water levels were measured in each of the wells and water quality samples were obtained from the southernmost two wells.

GEOLOGIC CROSS SECTION

Cross section A-A', as seen on the geologic map of the area, utilizes data from the four wells logged by the District as well as two wells projected in from the northeast. Well AY 68-27-400, projected into the southern portion of the cross section, was included because it is cut by the Haby Crossing Fault just above the top of the Glen Rose. Geophysical logs from this well indicate that the upper Edwards in the downthrown southern block is faulted against the Basal Nodular Member of the Edwards and underlying upper Glen Rose in the upthrown northern block in this area. The structural position of the Basal Nodular-Glen Rose contact in the well is also over 100 feet low to the Wildcat Windmill well, indicating that the Haby Crossing Fault in this area may be a fault complex composed of two or more en-echelon down to the southeast faults.

HYDROLOGIC ASSESSMENT

In previous studies, water quality sample analyses were used to provide evidence of possible communication between the Glen Rose and Edwards aquifers across the Haby Crossing Fault in the study area. In 1977, an MS thesis by Richard K. Waddell at U.T. Austin reported higher concentrations of sulfate, sodium, and potassium in the San Antonio Ranch well than in surrounding Edwards wells. He theorized that the water sampled in the well may have been in contact with evaporites on the north side of the Haby Crossing Fault, dissolving dolomite and evaporitic minerals and subsequently flowing across the fault to the vicinity of the well. He


FAVELA - AY-68-27-100
A
ZAPETA WINDMILL
LITTLE WINDMILL
WILDCAT WINDMILL
MUDD AY-68-27-400 (PROJECTED INTO SECTION FROM NE)
RANCH HOUSE AY-68-27-401
A'
UNMAPPED GLEN ROSE
+1300
+1200
+1100
+1000
+900
+800
+700
+600
PROJECTED 1070'
EXPLANATION
AUSTIN CHALK
EAGLE FORD GROUP
BUDA LIMESTONE
DEL RIO CLAY
(UPPER CONFINING UNIT)
GEORGETOWN FORMATION
MARINE CYCLIC MEMBER
COLLAPSED LEACHED MEMBERS
REGIONAL DENSE MEMBER
EDWARDS GROUP PERSON FORMATION
GRAINSTONE MEMBER
KIRSCHBERG EVAPORITE MEMBER
DOLOMITIC MEMBER
BASAL NODULAR MEMBER
EDWARDS GROUP KAMER FORMATION
GLEN ROSE FORMATION
(LOWER CONFINING UNIT)
FAULT
INFERRED FAULT
HORIZ. SCALE: 2000'
VERT. EXAGGERATION 20X

also noted high levels of coliform bacteria in the sample. His conclusion was that there was limited recharge of the Edwards Aquifer from the Glen Rose across the Haby Crossing Fault in the vicinity of Government Canyon.

In 1988, a U.S.G.S. water supply paper (No. 2336, Maclay and Land) stated that in various locations, flow may move across the Haby Crossing Fault from the lower Glen Rose Limestone to the Edwards Aquifer. The paper noted elevated sulfate concentrations in the lower Glen Rose Aquifer and large concentrations of sulfate in the Edwards Aquifer near the Haby Crossing Fault, suggesting that water from the lower Glen Rose Aquifer is entering the Edwards Aquifer at areas along the fault. The conclusion of the paper was that the Haby Crossing Fault is generally a barrier fault complex which hydraulically isolates the unconfined zone in the Edwards Aquifer in the northwestern Bexar County from the confined zone immediately to the southeast.

Based on the observations and conclusions from these papers, it was determined that hydrologic analysis of both water level and water quality should be conducted in the Government Canyon property.

GROUNDWATER LEVEL MEASUREMENTS

Groundwater level measurements were conducted at the Zapeta, Little Windmill, Wildcat Windmill and San Antonio Ranch wells to determine hydraulic gradient for the subject site. The water levels were quantified by chalk and tape method and by resistivity interpretation from geophysical logging.

The water level data was converted to feet above mean seal level (MSL) as the first step in the hydrologic analysis. The converted water levels are shown in the following table:

Table of Water Level Measurements:

Well I.D.	Measurement (feet above MSL)
Zapeta	1179
Little Windmill	1127
Wildcat Windmill	928
San Antonio Ranch	820

COMPUTER ANALYSIS OF GROUNDWATER LEVEL DATA

Method:

Water level data from the four wells was compiled in a database table and imported into a three-dimensional computer mapping program to perform a piezometric surface analysis. The data was computer gridded and mapped utilizing common inverse distribution with a weight power of two (2) method. The mapping program contoured the gridded data by the normal method, searching for all data points in the grid. A piezometric surface contour map was generated on a 20′ contour interval containing all data points used in

the analysis.

The computer generated piezometric surface contour map and a three dimensional surface plot utilizing the identical data are shown on the following pages.

Observations:

The computer plots indicate that significant increases in groundwater gradient are located in two areas on the subject site. Both areas of increase are located next to major faults in Government Canyon.

The greatest increase in groundwater gradient occurs between Little Windmill and Wildcat Windmill. The increase in groundwater gradient parallels a major normal fault between the two Glen Rose Aquifer wells.

A second, slightly lower, increase in groundwater gradient occurs between Wildcat windmill (Glen Rose Aquifer) and the San Antonio Ranch well (Edwards Aquifer). The increase in groundwater gradient parallels the Haby Crossing Fault, which separates the two aquifer systems.

Interpretation:

Faulting in the Government Canyon area affects groundwater flow. Groundwater mounding occurs to the north of each of the two major faults on the site. Mounding along the Haby Crossing Fault is less extensive than groundwater mounding in the area north of Wildcat Windmill. The lower magnitude of mounding across the Haby Crossing Fault may indicate a greater hydraulic connectivity between the Glen Rose Aquifer north of the fault and the Edwards Aquifer south of the fault.

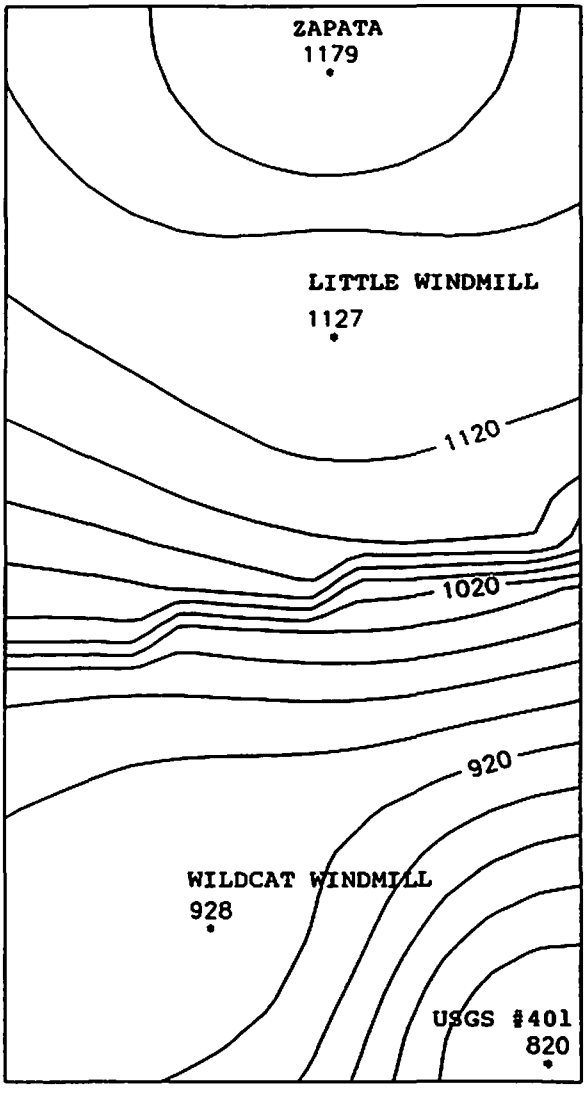
WATER QUALITY SAMPLING

Water quality samples were collected in the Wildcat Windmill and the San Antonio Ranch well. The samples were tested for dissolved metals, conductivity, pH, NH_3N, NO_3N, NO_2N, Chloride, SO_4, fecal-streptococcal bacteria (F. Str.), fecal-coliform bacteria (F. Col.), and total coliform bacteria (T. Col.) utilizing standard water quality analyses for drinking water. Dissolved metals included: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver utilizing test methods outlined in "Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Rev. March 1983, Standard Methods for the Evaluation of Water & Wastewater, 18th Ed. 1992".

Laboratory analysis indicated that pH, electrical conductivity, Chloride and SO_4 were typical for both Edwards and Glen Rose aquifers and could not be used to show connectivity between the aquifers across Haby Crossing fault zone.

NO_3N, F. Col., F. Str., and T. Col., were detected in both wells at very similar levels. Each of these analytes

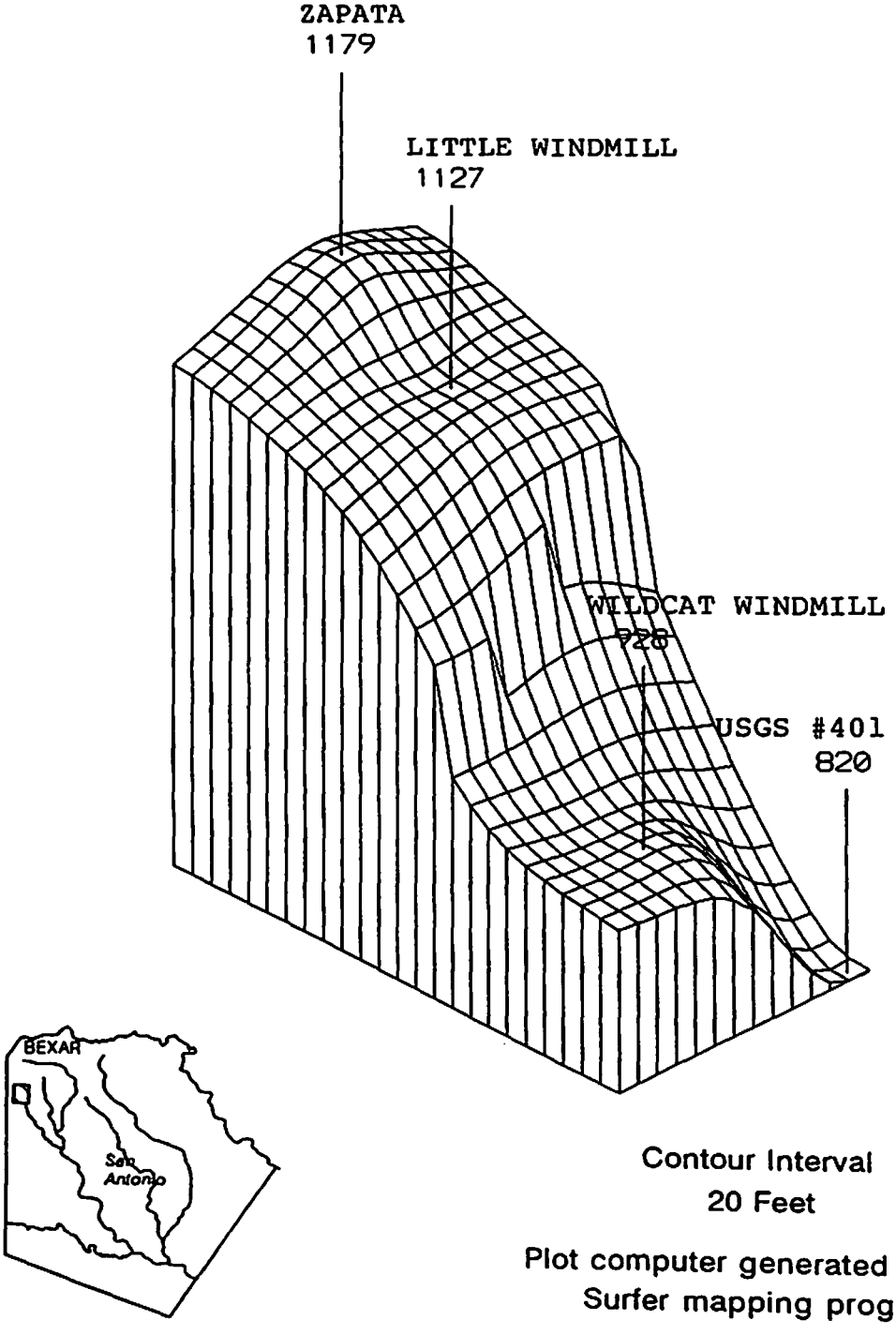
Piezometric Contour Map of Government Canyon May 1993



Contour Interval
20 Feet

Plot computer generated utilizing
Surfer mapping program

Piezometric Surface Plot of Government Canyon May 1993



Contour Interval
20 Feet

Plot computer generated utilizing
Surfer mapping program

Government Canyon: Table of Laboratory Results

Analyte	USGS #401		Wildcat Windmill	
Conductivity	447	uS	1358	uS
pH	7.39	Std Unit	7.08	Std Unit
NH_3 N	0.01	mg/l	0.02	mg/l
NO_3 N	3.22	mg/l	3.02	mg/l
NO_2 N	<0.1	mg/l	1.45	mg/l
Chloride	23.4	mg/l	185	mg/l
SO_4	49.1	mg/l	1064	mg/l
Fecal Coliform	30	col/100 ml	1	col/100 ml
Fecal Strep.	252	col/100 ml	276	col/100 ml
Total Coliform	196	col/100 ml	108	col/100 ml

are typical of shallow unconfined aquifer wells where the Edwards is exposed at ground surface, such as the Wildcat Windmill. However, detection of these analytes in wells over the confined portion of the Edwards Aquifer, such as the San Antonio Ranch well, is less common. The presence of these analytes in similar concentrations may indicate hydraulic connectivity between the Glen Rose and Edwards Aquifers at this location.

Dissolved metals were not detected in either sample.

GOVERNMENT CANYON HDR RECHARGE STUDY

HDR Engineering was requested by District Field Operations staff to estimate natural recharge, potential runoff and downstream runoff for the Government Creek watershed and the portion of the property upstream of the southern Edwards Aquifer recharge zone boundary for the base period of 1934 to 1989.

HDR calculated the average natural recharge for the Government Creek watershed including Wildcat Canyon to be 3000 acre-feet per year with 1840 acre-feet occurring on the property. Average potential runoff for the watershed is 3600 acre-feet per year with 2200 acre-feet per year occurring on the property. Average downstream runoff is estimated at 600 acre-feet per year for the watershed and 360 acre-feet per year for the property.

CONCLUSIONS

The surface and subsurface geologic investigation of the Government Canyon property indicates that recharge to the Glen Rose Aquifer and the Edwards Aquifer occurs in the area. A portion of this recharge moves southwest along the Haby Crossing Fault complex into northeast Medina County. An unknown portion, as seen in water level and water quality data, may flow from the Glen Rose Aquifer across the fault into the Edwards Aquifer.

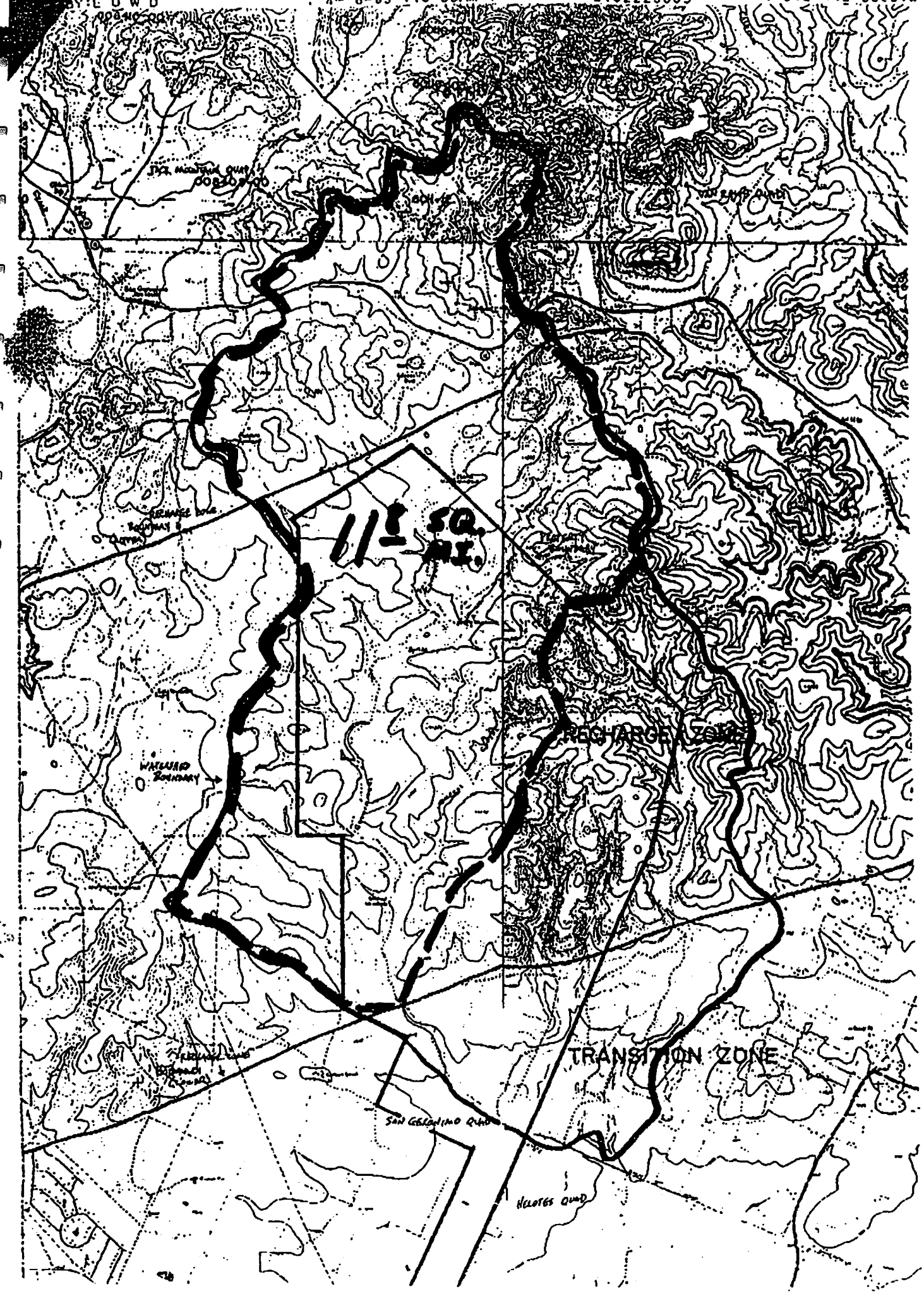
It is estimated the average annual potential recharge enhancement with a structure on Government Creek at the southern Edwards recharge zone boundary would be 600 acre feet per year. The District has operated the San Geronimo Creek recharge enhancement structure for 13 years in a drainage basin adjacent to the Government Canyon property with similar geology. Average annual recharge at this structure is estimated to be 775 acre-feet, which is similar to the amount of recharge calculated by HDR for Government Creek. Recharge during years of above average rainfall at the San Geronimo dam site contributed approximately 1400, 1100, 1200, 1600 and 2900 acre-feet during 1981, 1985, 1987, 1991 and 1992 respectively.

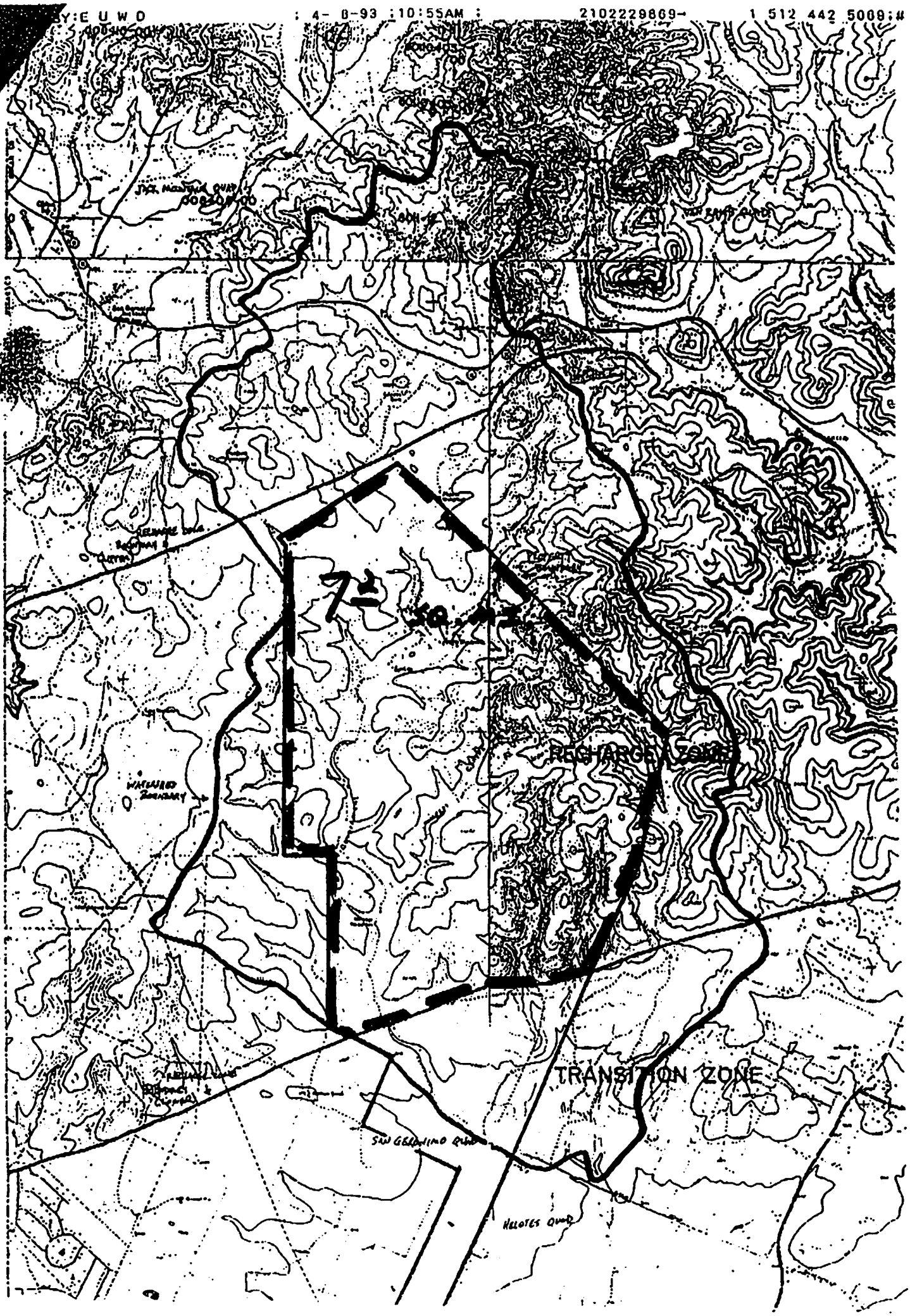
Since recharge to both the Glen Rose and Edwards aquifers may occur on the property it is imperative that the quality of the surface runoff entering the aquifers be maintained. Additional studies should include aquifer tests and possible tracer studies to determine the flow direction and the

presence of communication between the two aquifers. Additional data from remote abandoned wells on the property should be obtained to further define the hydrologic characteristics of the area.

JRW/mar

jrw053


11± SQ. MI.
RECHARGE ZONE
TRANSITION ZONE
WATERSHED BOUNDARY
SAN GERMAINO QUAD
HELOTES QUAD


RECHARGE ZONE
TRANSITION ZONE

To ROBERT BADER

From SAM VAUGH

Date 4/17/93

Subject GOVERNMENT CANYON RECHARGE

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 1
To ROBERT BADER	From SAM VAUGH
Co. EUWD	Co. HDR
Dept.	Phone # 512-442-8501
Fax # 210-222-9869	Fax # 512-442-5049

HDR

Memorandum

PURSUANT TO YOUR REQUEST, WE HAVE DEVELOPED THE FOLLOWING ROUGH ESTIMATES OF POTENTIAL RUNOFF (QI), NATURAL RECHARGE (RØ), AND DOWNSTREAM RUNOFF (Q) FOR THE GOVERNMENT CREEK WATERSHED AND THE PORTION OF THE PROPERTY UPSTREAM OF THE SOUTHERN RECHARGE ZONE BOUNDARY.

$$Q = QI - R\emptyset$$

GOVERNMENT CREEK WATERSHED (11⅝ MI²)

NOTE: THIS AREA INCLUDES WILACAT CANYON, BUT DOES NOT INCLUDE THE ENTIRE PORTION OF THE PROPERTY ON THE RECHARGE ZONE.

AVG. POTENTIAL RUNOFF = 3600 ACFT/YR
AVG. NATURAL RECHARGE = 3000 ACFT/YR
AVG. DOWNSTREAM RUNOFF = 600 ACFT/YR

BASE PERIOD: 1934-89

★ AVERAGE POTENTIAL RECHARGE ENHANCEMENT WITH A STRUCTURE ON GOVERNMENT CREEK AT SOUTHERN RECHARGE ZONE BOUNDARY = 600 ACFT/

PROPERTY ON RECHARGE ZONE (7½ MI²)

AVG. POTENTIAL RUNOFF = 2200 ACFT/YR
AVG. NATURAL RECHARGE = 1840 ACFT/YR
AVG. DOWNSTREAM RUNOFF = 360 ACFT/YR

BASE PERIOD: 1934-89

★ AVERAGE NATURAL RECHARGE OCCURRING ON THE PROPERTY IS PROBABLY GREATER THAN 1840 ACFT/YR DUE TO RUNOFF ENTERING THE PROPERTY FROM THE REMAINDER OF THE SURROUNDING WATERSHED.

SHOULD YOU NEED ADDITIONAL INFORMATION, PLEASE CALL.

4.7-101.8A
0098Q

10/92

SAN ANTONIO RIVER AUTHORITY
FIELD AND LABORATORY DATA REPORT

DATE: 04-14-93
TIME COLLECTED: _____
LOCATION: EUWD #401

LAB ARRIVAL: 1640
SAMPLE NUMBER: 9310419
COLLECTOR'S SIGNATURE: John Waugh
STORET NUMBER: _____

FIELD PARAMETERS:

Dissolved Oxygen	_____	mg/L
Temperature	_____	C°
pH	_____	Std.
CL_2	_____	mg/L
Conductivity	_____	umhos/cm
Stage Height	_____	
Flow Severity	_____	
Flow	_____	

Color _____ Clarity _____ Odor _____

SAMPLE TYPE:

___ Routine Stream Monitoring (analysis, F.P.)
___ Pollution Complaint
___ Waste Water Special

Ambient Weather Conditions:
S, C, PC, MC, R, D, I
Temperature: _____ C°
Field Observations and Notes: _____

LABORATORY ANALYSIS (circle):

Turb		N.T.U.	$T\text{-}PO_4$		mg/l
(Cond)	1447.	uS	(O-PO_4)	< .1	mg/l
(pH)	7.39	Std. Unit	(Cl)	23.4	mg/l
$CBOD_5$		mg/l	(SO)	49.1	mg/l
BOD_5		mg/l	T Alk		mg/l
FOG		mg/l	T. Hard.		mg/l
COD		mg/l	Chlo-a		mg/l
TOC-P		mg/l	Pheo-a		mg/l
TSS		mg/l	F		mg/l
VSS		mg/l	Br		mg/l
TDS		mg/l	(F. Col	30	mg/l
TKN		mg/l	F. Str	252	Col./100ml.
(NH_3N)	0.01	mg/l	T. Col)	196	Col./100ml.
(NO_3N)	3.27	mg/l			
(NO_2N)	< .1	mg/l			
$T\text{-}N_2$		mg/l			
$Org N_2$		mg/l			

LAB COMMENTS: _____

DATE COMPLETED: 04-20-93
SAMPLE EXPIRATION DATE: _____
ANALYST'S SIGNATURE: Steve LaMunyon
ENTRY COMPLETED: _____

4.7-101.8A
0098Q

10/92

SAN ANTONIO RIVER AUTHORITY
FIELD AND LABORATORY DATA REPORT

DATE: 04-14-93
TIME COLLECTED: _____
LOCATION: EUWD
Wildcat Windmill

LAB ARRIVAL: 1640
SAMPLE NUMBER: 9310418
COLLECTOR'S SIGNATURE: John Waugh
STORET NUMBER: _____

FIELD PARAMETERS:

Dissolved Oxygen	_____	mg/L
Temperature	_____	C°
pH	_____	Std.
CL_2	_____	mg/L
Conductivity	_____	umhos/cm
Stage Height	_____	
Flow Severity	_____	
Flow	_____	

Color _____ Clarity _____ Odor _____

SAMPLE TYPE:

___ Routine Stream Monitoring (analysis, F.P.)
___ Pollution Complaint
___ Waste Water Effluent

Ambient Weather Conditions:
S, C, PC, MC, R, D, I
Temperature: _____ C°

Field Observations and Notes: _____

LABORATORY ANALYSIS (circle):

Turb		N.T.U.	$T\text{-}PO_4$		mg/l
(Cond)	1,358	us	(O-PO4)	< .1	mg/l
(pH)	7.08	Std. Unit	(Cl)	185	mg/l
$CBOD_5$		mg/l	(SO_4)	1,064	mg/l
BOD_5		mg/l	T Alk		mg/l
VOC		mg/l	T. Hard.		mg/l
COD		mg/l	Chlo-a		mg/l
TOC-P		mg/l	Pheo-a		mg/l
TSS		mg/l	F		mg/l
VSS		mg/l	Br		mg/l
TDS		mg/l	F. Col	1	mg/l
TKN		mg/l	F. Str	276	Col./100ml.
(NH_3N)	0.02	mg/l	T. Col	108	Col./100ml.
(NO_3N)	3.02	mg/l			
(NO_2N)	1.45	mg/l			
$T\text{-}N_2$		mg/l			
$OrgN_2$		mg/l			

LAB COMMENTS: _____

DATE COMPLETED: 04-20-93
SAMPLE EXPIRATION DATE: _____
ANALYST'S SIGNATURE: Robert Lowe
Estrella Magee
ENTRY COMPLETED: _____

SAN ANTONIO TESTING LABORATORY, INC.

1610 S. LAREDO STREET SAN ANTONIO, TEXAS 78207 (210) 229-9920 FAX (210) 229-9921

REPORT OF CHEMICAL ANALYSIS **REPORT NO. 8966**

Edwards Underground
1615 North St. Mary's
San Antonio, TX. 78212

Date received:	Date reported:	Sample Type:
04-19-93	04-23-93	Liquid

SAMPLE ID: Wildcat Windmill

PARAMETER	RESULTS (mg/L)	DATE ANALYZED
Arsenic	<0.05	04-20-93
Barium	<1.0	04-22-93
Cadmium	<0.05	04-21-93
Chromium	<0.05	04-20-93
Lead	<0.1	04-20-93
Mercury	<0.005	04-21-93
Selenium	<0.01	04-21-93
Silver	<0.05	04-22-93

SAMPLE ID: Well # 401

PARAMETER	RESULTS (mg/L)	DATE ANALYZED
Arsenic	<0.05	04-20-93
Barium	<1.0	04-22-93
Cadmium	<0.05	04-21-93
Chromium	<0.05	04-20-93
Lead	<0.1	04-20-93
Mercury	<0.005	04-21-93
Selenium	<0.01	04-21-93
Silver	<0.05	04-22-93

mg/L: Milligrams per Liter
Test Methods: Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Rev. March 1983, Standard Methods for the Evaluation of Water & Wastewater, 18th Ed. 1992.
Tests Supervised By: Richard Hawk

Respectfully Submitted,

Richard Hawk
Richard Hawk
General Manager