

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

PRINCIPAL FACTS FOR GRAVITY STATIONS  
IN THE LOWER SAN FRANCISCO AND HELLS  
HOLE STUDY AREAS AND VICINITY, GREENLEE  
COUNTY, ARIZONA, AND CATRON AND GRANT  
COUNTIES, NEW MEXICO

by

R. A. Martin, J. C. Wynn, and G. A. Abrams

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This report is preliminary and has not been  
edited or reviewed for conformity with the  
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## STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U. S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report represents the data from a gravity survey of the Lower San Francisco Proposed Wilderness and Further Planning Areas and the Hells Hole Further Planning Area of the Apache National Forest, Greenlee County, Arizona, and Gila National Forest, Catron and Grant Counties, New Mexico. The Roadless Areas were classified as proposed wilderness and further planning areas during the second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January, 1979.

## Introduction

A gravity study was made of the Lower San Francisco and Hells Hole study areas and vicinity (Fig. 1) in 1980. The data were obtained as part of the U.S. Geological Survey's (USGS) program to evaluate the mineral-resource potential of wilderness areas.

## Data Collection

The 35 station survey was made using LaCoste-Romberg meter G-159.<sup>1</sup> The stations were referenced to the International Gravity Standardization Net 1971 (Defense Mapping Agency Aerospace Center, 1974) at base station ACIC 3215-1 in Clifton, Arizona. A complete base description is included at the end of this report.

## Elevation Control

Station elevations were obtained from surveyed bench marks and spot elevations on USGS topographic maps; 1:62,500 scale with 80 ft (24.4 m) contour interval and 1:24,000 scale with 40 ft (12.2 m) contour interval. Elevation accuracy is assumed to vary from 6 inches (0.2 m) for bench marks to about one-third a contour interval, 27 ft (8 m), for spot elevations. The maximum resultant error of the Bouguer anomaly is estimated to be less than 2 milligals (mgals) for an assumed density of 2.67 g/cm<sup>3</sup>.

<sup>1</sup>Use of trade names in this report is for descriptive purposes only, and in no way constitutes endorsement by the U.S. Geological Survey.

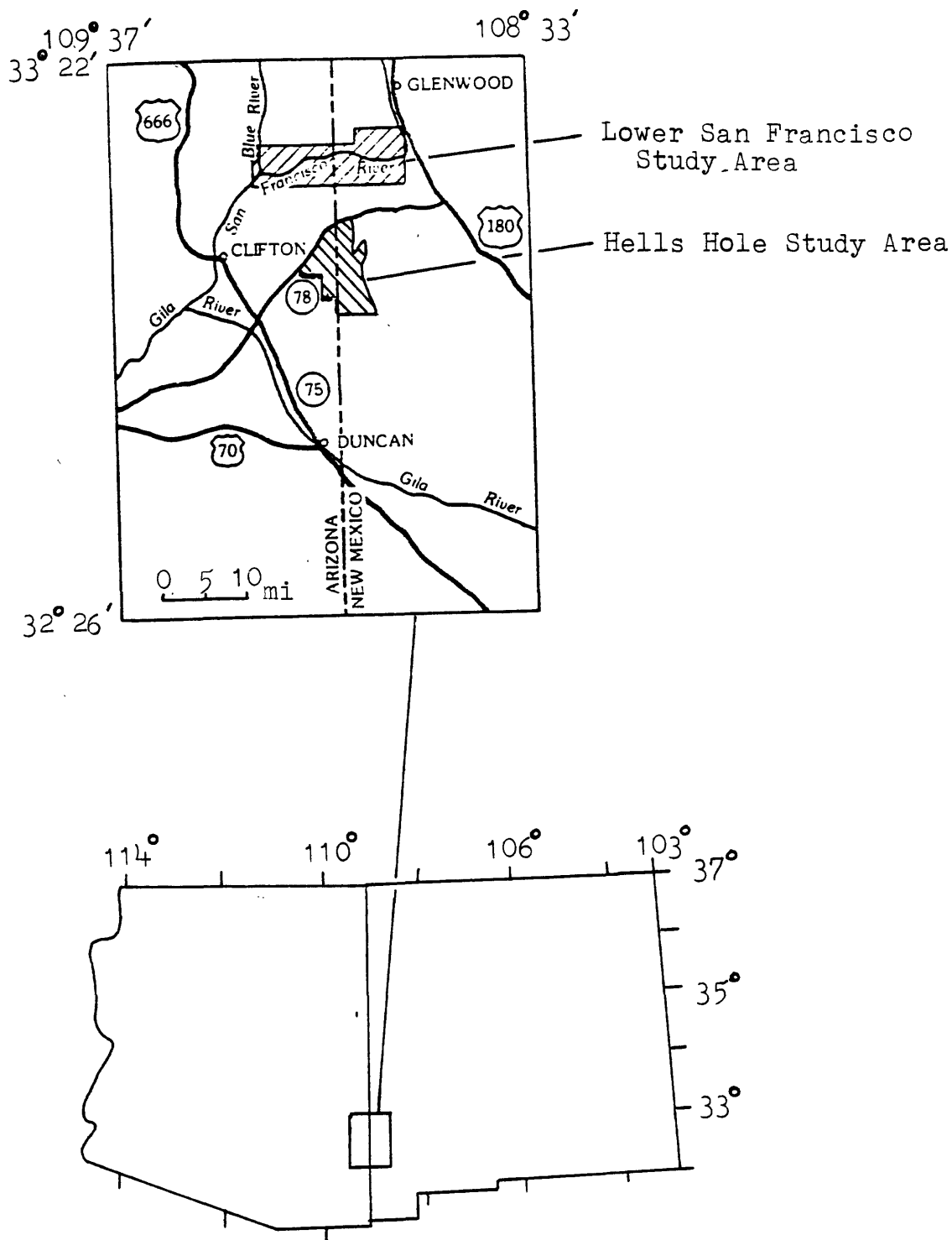


Fig. 1. Area of the gravity survey for the Lower San Francisco and Hells Hole Study Areas, Greenlee County, Arizona and Catron and Grant Counties, New Mexico.

## Data Reduction

Programs existing on the USGS Honeywell computer were used to reduce the gravity data. An unpublished program written in 1975 by D. A. Dansereau and R. R. Wahl of the U.S. Geological Survey was used to calculate earth-tide and linear meter-drift corrections. The theoretical gravity value was calculated using the 1967 formula of the Geodetic Reference System (International Association of Geodesy, 1967). An unpublished program written in 1978 by R. H. Godson of the U.S. Geological Survey was used to compute terrain corrections for the circular area from each station out to 166.7 km using the method of Plouff (1977). The program used mean elevation data on a 15 second grid for corrections from 0 to 5 km; 1 minute terrain data for corrections from 5 to 21 km; and 3 minute terrain data for corrections from 21 to 166.7 km. This program also calculates earth curvature corrections and complete (terrain-corrected) Bouguer anomaly values. Corrections for terrain ranged from 0.56 mgal to 15.34 mgal. Two complete Bouguer anomaly values per station were obtained assuming average rock densities of  $2.67 \text{ g/cm}^3$  and  $2.45 \text{ g/cm}^3$ . The corrections and anomaly values are listed in Appendix B.

#### REFERENCES CITED

- Defense Mapping Agency Aerospace Center, 1974, World Relative Gravity Reference Network, North America, Part 2: Defense Mapping Agency Aerospace Center Reference Publication 25, with supplement updating gravity values to the International Gravity Standardization Net 1971, 1635 p.
- International Association of Geodesy, 1967, Geodetic Reference System. International Association of Geodesy Special Publication 3, 74 p.
- Plouff, D., 1977, Preliminary documentation for the FORTRAN program to compute gravity terrain corrections based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535.

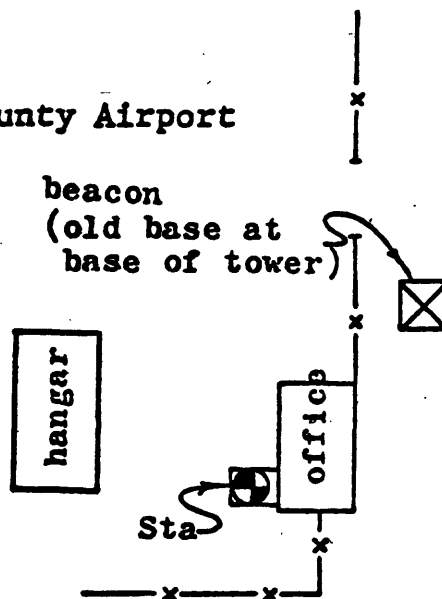
## GRAVITY BASE STATION

LATITUDE 32° 57.48'N (1)		STATION DESIGNATION  CLIFTON	
LONGITUDE 109° 12.6'W (1)			
ELEVATION 1156.7 METERS (1)		COUNTRY/STATE USA/Arizona	
REFERENCE CODE NUMBERS		ADOPTED GRAVITY VALUE	
ACIC 3215-1		g = 979 154.40 mgals	
		ESTIMATED ACCURACY	DATE
		± 0.1 mgals	MONTH/YEAR 9/69

## DESCRIPTION AND/OR SKETCH

Station site is located at Clifton airport, on concrete step at SW corner of red brick building, under wall phone. Approximately 10 miles south of Clifton. (1)

## Greenlee County Airport



(1)

## REFERENCE SOURCE

(1) 03035



## Appendix B: Principal Facts of Gravity Data

### Explanation of headings

#### Identification

proj	Project name.
sta id	Gravity identification

#### Location

latitude	North latitude in degrees, minutes, and hundredths of minutes.
longitude	West longitude in degrees, minutes, and hundredths of minutes.
elev (in feet)	Station elevation in feet.
st	State where station is located.

#### Gravity

observed	Observed gravity in milligals.
theoretical	Theoretical gravity.

#### Corrections

terrain	Terrain correction out to 166.7 km in milligals.
Bouguer	Elevation correction in milligals.
curv	Curvature correction in milligals.
special	Not used.

#### Anomalies

free-air	Free-air anomaly in milligals.
complete-Bouguer	Complete Bouguer anomaly in milligals for designated densities.
spec fields	Not used.

arizona\_new\_mexico  
gabrams aeq. 1980  
Meter ID: q-159

Date: 08/04/82

BOUGUER GRAVITY DATA

STATION IDENTIFICATION proj sta-id	LATITUDE deg min	LONGITUDE deg min	ELEVATION (in ft)	GRAVITY OBSERVED	THEORETICAL	CORRECTIONS		SPECIAL	ANOMALIES	
						TERRAIN	BOUGUER		FREE AIR	COMPLETE-ROUGHER d1=2.67 d2=2.45
swlldr:wfl-1	33 13.87	-108 57.78	5781.0 nm	979034.68	979584.48	6.92	-197.17	-1.48	0.00	-6.18
swlldr:wfl-2	33 13.95	-108 55.15	5890.0 nm	979022.24	979584.59	3.85	-200.89	-1.49	0.00	-8.49
swlldr:wfl-3	33 14.72	-108 54.90	6180.0 nm	979000.85	979585.65	5.94	-210.78	-1.50	0.00	-3.68
swlldr:wfl-4	33 13.60	-108 52.67	5973.0 nm	979004.93	979584.10	10.66	-203.72	-1.49	0.00	-17.51
swlldr:wfl-5	33 9.27	-108 54.80	6064.0 nm	979010.76	979578.13	4.77	-206.83	-1.50	0.00	2.84
swlldr:wfl-6	33 10.03	-108 56.37	5860.0 nm	979024.31	979579.18	3.69	-199.87	-1.49	0.00	-3.82
swlldr:wfl-7	33 8.82	-108 57.95	5375.0 nm	979057.94	979577.51	0.56	-183.33	-1.45	0.00	-14.12
swlldr:wfl-8	33 8.90	-108 59.75	5792.0 nm	979036.40	979577.62	1.61	-197.55	-1.48	0.00	3.43
swlldr:lue-10	33 2.42	-109 9.78	4808.0 az	979113.86	979568.69	1.12	-163.99	-1.39	0.00	-2.68
swlldr:lue-11	33 5.53	-109 8.05	7054.0 az	978956.33	979572.98	11.89	-240.59	-1.51	0.00	46.61
swlldr:lue-12	33 8.57	-109 8.82	5862.0 az	979040.69	979577.16	4.53	-199.94	-1.49	0.00	14.75
swlldr:lue-13	33 13.07	-109 10.03	5104.0 az	979087.72	979583.37	3.93	-174.08	-1.42	0.00	-15.68
swlldr:lue-14	33 13.42	-109 5.93	5896.0 az	979030.69	979583.85	9.17	-201.10	-1.49	0.00	1.25
swlldr:lue-15	33 11.20	-109 5.83	4956.0 az	979094.80	979580.79	2.85	-169.04	-1.41	0.00	-19.93
swlldr:lue-16	33 12.00	-109 3.07	6209.0 nm	979008.46	979581.89	6.93	-211.77	-1.51	0.00	10.41
swlldr:wfl-9	33 14.33	-108 58.80	5780.0 nm	979037.90	979585.11	5.73	-197.14	-1.48	0.00	-3.69
swlldr:aln-1	33 15.42	-108 57.83	5693.0 nm	979043.54	979586.62	3.80	-194.17	-1.48	0.00	-7.74
swlldr:aln-2	33 15.63	-108 56.15	6543.0 nm	978983.60	979586.91	4.42	-223.16	-1.51	0.00	11.93
swlldr:wfl-10	33 11.47	-108 59.35	5980.0 nm	979022.83	979581.16	4.65	-203.96	-1.49	0.00	3.98
swlldr:yrk-40	32 59.22	-109 3.22	5319.0 nm	979074.08	979564.29	2.92	-181.42	-1.44	0.00	9.98
swlldr:yrk-41	32 57.15	-109 4.23	5348.0 az	979066.80	979561.45	6.40	-182.40	-1.45	0.00	8.27
swlldr:yrk-42	32 58.18	-109 1.93	5349.0 nm	979068.55	979562.86	3.96	-182.44	-1.45	0.00	8.70
swlldr:lue-17	33 0.17	-109 1.18	6439.0 nm	979001.83	979565.59	7.24	-219.62	-1.51	0.00	41.69
swlldr:lue-18	33 1.58	-109 3.45	7488.0 az	978922.93	979567.53	15.34	-255.39	-1.50	0.00	59.44
swlldr:lue-20	33 1.58	-109 6.40	5885.0 az	979034.15	979567.53	7.68	-200.72	-1.49	0.00	20.00
swlldr:lue-21	33 7.45	-109 2.57	6317.0 nm	978999.85	979575.62	6.29	-215.45	-1.51	0.00	18.22
swlldr:mul-10	33 5.27	-108 59.48	5828.0 nm	979028.17	979572.62	1.54	-198.78	-1.49	0.00	3.59
swlldr:lue-22	33 9.65	-109 1.85	5731.0 nm	979041.05	979578.65	1.08	-195.47	-1.48	0.00	1.31
swlldr:wfl-11	33 12.18	-108 56.37	5699.0 nm	979035.69	979582.14	6.01	-194.38	-1.48	0.00	-10.55
swlldr:moo-1	33 10.65	-108 51.87	5255.0 nm	979065.83	979580.03	1.30	-179.23	-1.44	0.00	-20.04
swlldr:moo-2	33 8.67	-108 49.85	5683.0 nm	979035.51	979577.30	2.14	-193.83	-1.48	0.00	-7.39
swlldr:mul-11	33 0.62	-108 57.13	6860.0 nm	978963.57	979566.21	3.75	-233.98	-1.52	0.00	42.39
swlldr:stp-20	32 58.57	-108 59.33	6687.0 nm	978980.38	979563.39	3.96	-228.07	-1.52	0.00	45.76
swlldr:stp-21	32 55.48	-108 58.60	6458.0 nm	978995.80	979559.15	3.05	-220.26	-1.51	0.00	43.90
swlldr:stp-22	32 59.32	-108 56.25	7106.0 nm	978948.90	979564.42	3.66	-242.37	-1.51	0.00	52.62