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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRINCIPAL FACTS FOR ABOUT 16,000 GRAVITY STATIONS IN THE NEVADA TEST SITE AND VICINITY

By

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89-682-A Principal facts documentation
89-682-B Gravity data listing on paper, appendices B-G
89-682-C Gravity data on diskettes

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Menlo Park, California
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INTRODUCTION

The Nevada Test Site (NTS) and vicinity is located between lat 36°37.5′ and 37°22.5′ N. and long 115°52.5′ and 116°37.5′ W., which includes portions of the Goldfield, Caliente, Death Valley, and Las Vegas 1° by 2° quadrangles (fig. 1). This report documents and consolidates previously published and recently compiled gravity data to establish a gravity data base of about 16,000 stations for the NTS and vicinity. Previously published reports documenting NTS and vicinity gravity data are listed in table 1. While compiling data sets, redundant stations and stations having doubtful locations or gravity values were excluded. Details of compiling the gravity data sets are discussed in later sections. Where feasible, an accuracy code has been assigned to each station so that the accuracy or reliability of each station can be evaluated. This data base was used in preparing complete Bouguer (Healey and others, 1987) and isostatic (Ponce and Harris, 1989) gravity maps of the NTS and vicinity. Since publication of the complete Bouguer gravity map, additional data were incorporated into the isostatic gravity map.

Gravity data were compiled from five sources: 14,183 stations from the U.S. Geological Survey (USGS), 326 stations from Exploration Data Consultants (EDCON) of Denver, Colorado, 906 stations from the Los Alamos National Laboratory (LANL), 212 stations from the University of Texas at Dallas (UTD), and 48 stations from the Defense Mapping Agency (DMA). Gravity data listed in this report are organized by source and plotted in figure 2. This gravity data set is also available on diskettes formatted for IBM PC's using DOS 2.0 or higher versions.

In 1958, the USGS began a major gravity effort, in cooperation with the U.S. Department of Energy (DOE) under Interagency Agreement DE-AI08-76DP00474, to define the regional buried structure at the NTS and aid in characterizing underground weapon-test sites. Gravity stations collected under the "weapons program" are shown in figure 3. In 1977, the USGS began another major gravity effort in cooperation with the DOE (Interagency Agreement DE-AI08-78ET44802) under the Yucca Mountain Project (YMP), formerly the Nevada Nuclear Waste Storage Investigations project. This investigation is an effort to study several areas for potential storage of high-level radioactive waste. Gravity stations established under YMP are shown in figure 4. In 1977, EDCON, under contract to the USGS, established gravity stations in and around Timber Mountain (fig. 5). The objective of this gravity survey was to explore for the presence of plutons (Kane and others, 1981). Work by LANL, documented here for the first time, consists of tightly spaced gravity lines in Yucca Flat (fig. 6), designed to aid in defining the subsurface structure in Yucca Flat. Gravity data from UTD are located in Pahute Mesa (fig. 7), and collected as part of an effort to model Silent Canyon Caldera. Data from the DMA are scattered throughout the area (fig. 8).

ACKNOWLEDGMENTS

This report represents the culmination of efforts by many people. The authors specifically wish to thank A. H. Cogbill of LANL for making their data and the data of UTD available. R. H. Godson of the USGS made the original materials of the EDCON data set avialable. Data were collected by numerous people under the weapons program including F. E. Currey, G. R. Erickson, J. Hasbrouck, D. L. Healey, J. D. Kibler, C. H. Miller, D. G. Erickson J. R. Rosenbaum, E. D. Seals, D. Shiel, and R. R. Wahl of the USGS; and L. Porter, K. Mathias, M. Turley and others of the Bureau of Reclamation. Contributors to data collected under YMP include: J. M. Glen, R. N. Harris, D. C. Hobach, D. R. Jefferis, H. E. Kauffman, K. S. Kirchoff-Stein, S. B. Kohrn, E. G. Miller, R. L. Morin, D. A. Ponce, R. W. Saltus, R. F. Sikora, D. B. Snyder, J. B. Spielman, R. W. Tang, H. M. Van Buren, and K. V. Velasco of the USGS; and M. Chornack, R. Lahoud, R. B. Livermore, R. Orsack, L. Parish, and S. Waddell of Fennix and Scisson, Inc.

TABLE 1.–*Areas of published principal fact reports for the NTS and vicinity*

Area	Reference
Caliente 1° x 2° quadrangle	Healey and others, 1979
Caliente 1° x 2° quadrangle, western half	Snyder and others, 1981
Death Valley 1° x 2° quadrangle, Nev. portion	Healey and others, 1978
Goldfield and Mariposa 1° x 2° quadrangles	Healey and others, 1981
Las Vegas 1° x 2° quadrangle	Reidy and others, 1978
NTS, Calico Hills	Snyder and Oliver, 1981
NTS, Southwest area	Jansma and others, 1982
NTS, Syncline Ridge	Ponce and Hanna, 1982
NTS, Wahmonie site	Ponce, 1981

GRAVITY DATUM

Observed gravity values are referenced to the International Gravity Standardization Net 1971 (IGSN 71) gravity datum described by Morelli (1974). Gravity base stations used for NTS and vicinity surveys have been tied to the following four IGSN 71 base stations: Indian Springs Post Office (No. 4027- 1), the Las Vegas Federal Building (No. 0363-2), Las Vegas K (No. 0363-1) at the old airport terminal building, and Tonopah J at the Tonopah airport (No. 0455-1) (Jablonsky, 1974). In 1978, all previously obtained gravity data at NTS were converted from the Woollard and Rose datum (Woollard and Rose, 1963) to the IGSN 71 datum by subtracting 14.33 mGal from observed gravity values.

GRAVITY BASE NETWORK

Gravity base stations documented in this report are listed in table 2 and station locations are shown in figure 9. Other gravity base stations, absolute gravity stations, or high-precision gravity stations that can be used as base stations were described by Harris and Ponce (1988) and Zumberge and others (1988). Detailed descriptions of base stations listed in this report are shown in appendix A, except for those base stations that have been destroyed (see table 2).

In 1958, bench mark BM Y327, located south of Mercury, Nevada, was adopted as a primary base station (B1) for gravity stations established under the weapons program. This station was originally occupied by D. R. Mabey as part of a reconnaissance survey of southern Nevada. Bases B2 through B5 were established relative to base B1 in August, 1958, and used for surveys in Yucca and Frenchman Flats and on Rainer Mesa. Other base stations were established as needed. However, subsequent ties between base stations at the NTS to those in Las Vegas, Goldfield, and Tonopah, indicated that the adopted value at base B1 had a mean observed gravity difference of +0.46 mGal (Woollard, 1958; Woollard and Rose, 1963). All NTS gravity data were adjusted by this amount in 1971. Table 3 lists the history of observed gravity values at bases established prior to conversion to IGSN 71.

TABLE 2.–*Gravity bases at NTS and vicinity*
[n.a., not available]

Station	Number of stations[1]	Latitude (deg min)	Longitude (deg min)	Elevation (ft)	Observed Gravity[2] (mGal)	Comments
B1	673	36 38.43	116 00.23	3,544	979,523.95	Bench Mark
B2	2,354	36 51.18	116 00.47	3,366	979,533.69	Bench Mark
B3	6,300	37 02.83	116 03.13	4,047	979,494.30	No longer used
B4	1,665	37 11.83	116 08.67	5,052	979,459.48	Bench Mark
B5	155	37 11.76	116 12.63	7,410[3]	979,291.96	Destroyed
B8	350	37 13.19	116 03.83	5,030[3]	979,456.63	Pt. of rock
B10	48	38 18.25	115 55.75	4,598	n.a.	Destroyed
B10-49	2	37 23.92	116 00.93	5,402	979,424.44	Surveyed pt.
B12	222	37 02.83	116 17.05	4,847	979,437.39	Bench Mark BM A-335
B13	185	36 38.67	116 24.00	2,660	979,580.98	Bench Mark BM B-333
B15	77	36 54.72	116 27.47	4,657	979,447.48	Temporary
B16	24	37 10.83	116 22.88	5,720[3]	979,376.44	Temporary
B17	35	37 01.97	116 43.15	3,780	979,508.66	Pt. of rock
B18	51	37 13.23	116 14.37	7,248	979,298.77	Bench Mark
B19	528	37 13.25	116 19.54	7,170[3]	979,285.27	Pt. of rock
B20	226	37 01.52	116 37.57	4,480	979,456.51	Edge of well
B21-55	n.a.	37 26.53	116 28.17	5,145	979,430.37	—
B21-67	n.a.	37 22.87	116 26.20	5,360[3]	979,407.95	—
B25	130	37 18.03	116 34.75	5,840[3]	979,483.73	Pt. of rock
B27	n.a.	37 22.62	116 12.90	5,512	979,402.47	Destroyed
B28	n.a.	37 29.70	116 01.02	6,200[3]	979,398.09	—
B7501	n.a.	37 12.52	115 58.73	4,728	979,465.70	Bench Mark
B7645	n.a.	37 07.58	116 33.70	4,986	979,416.66	—
BEATTY	470	36 54.42	116 45.38	3,284	979,568.52	Bench Mark BM M-16
BEATTY JA	48	36 52.10	116 37.00	3,145	979,579.06	DMA
BPO	16	36 54.40	116 45.60	3,300	979,580.20 56.45	Post Office 10/2842 RAP & KBL
CP2A	168	36 55.66	116 03.53	4,100[3]	979,509.77	Absolute station
DUNE	n.a.	36 39.59	116 27.90	2,626	979,593.94	Bench Mark
ISPO	n.a.	36 34.60	115 39.00	3,115	979,541.16	No. 4027-1
LAS VEGAS	n.a.	36 11.05	115 08.45	2,018	979,586.45	No. 0363-1
MERC	1706	36 39.75	115 59.86	3,780[3]	979,518.80	Primary YMP base
MERCA	n.a.	36 39.75	115 59.86	3,780[3]	979,518.87	Absolute station
MERCB	n.a.	36 41.79	115 58.40	3,990	979,509.82	High precision base
MERCC	n.a.	36 41.79	115 58.40	3,990	979,509.82	High precision alternate
MERCM	129	36 39.75	115 59.86	3,780[3]	979,518.75	No longer used
TCCA	n.a.	36 49.50	116 16.64	3,800[3]	979,509.01 510.907	Absolute station
TONOPAH J	n.a.	38 03.70	117 05.95	5,303	979,462.25	No. 0455-1

[1]Known number of stations tied to base.

[2]IGSN 71 datum.

[3]Elevation based on contour interpolation.

In 1979, a base station in Mercury, Nevada, (MERC) was established and tied to the world gravity net station at Indian Springs (Ponce and Oliver, 1981). MERC is the primary base station for data collected under YMP. In November 1984, M. A. Zumberge of U.C. San Diego, made an absolute gravity measurement 6 m (20 ft) from MERC at MERCA and this measurement was tied to MERC by two closed loops with three LaCoste and Romberg gravity meters (Zumberge and others, 1988).

Gravity stations established by EDCON were referenced to base B12. Gravity stations established by LANL used bases B2, established by D. L. Healey, and base CP2A, established by Zumberge and others (1988). Gravity stations established by UTD are referenced to base B4. Gravity stations established by DMA used Beatty JA. This station is part of the Central Gravity Base Net established in 1978 and between June 1981 and March 1982. The gravity net is tied to IGSN 71 stations in California and IGSN 71 stations along the U.S. Mid-Continent Calibration Line (DMA, written commun., 1987).

TABLE 3.–*Observed gravity values of base stations established prior to conversion to IGSN 71*

Base	Original base value Woollard and Rose (mGal)	Base value IGSN 71 datum[1] (mGal)	1987 base value as adjusted[2] (mGal)
B1	979,537.90[3]	979,524.03	979,523.95
B2	979,547.61	979,533.74	979,533.69
B3	979,508.29	979,494.42	979,494.30
B4	979,473.46	979,459.59	979,459.48
B8	979,470.60	979,456.73	979,456.63
B10-49	979,438.41	979,424.54	979,424.44
B12	979,451.38	979,437.51	979,437.39
B13	979,595.00[3]	979,581.13	979,580.98
B15	979,461.43	979,447.56	979,447.48
B16	979,390.43	979,476.56	979,376.44
B17	979,522.58	979,508.71	979,508.66
B18	979,312.73	979,298.86	979,289.77
B19	979,299.22	979,285.35	979,285.27
B20	979,470.18	979,456.31	979,456.51
B21-55	979,444.19	979,430.32	979,430.37
B21-67	979,421.77	979,407.90	979,407.95
B25	979,397.53	979,383.66	979,483.73
B27	979,416.27	979,402.40	979,402.47
B28	979,412.05	979,398.18	979,398.09
B7501	979,479.68	979,465.81	979,465.70
B7645	979,430.58	979,416.71	979,416.66
BEATTY	979,582.40[3]	979,568.53	979,568.52

[1]Includes a correction of +0.46 applied to all NTS base stations in 1971 and the IGSN 71 correction of −14.33 applied to all NTS stations in 1978.

[2]Base value determined from additional ties and improved internal accuracy (1978 to present).

[3]Base value obtained from D. R. Mabey (USGS).

GRAVITY DATA REDUCTION

All gravity data were reduced using standard gravity corrections including: (a) the Earth-tide correction, which corrects for tidal effects of the moon and sun; (b) instrument drift correction, which compensates for drift in the instrument's spring; (c) the latitude correction, which incorporates for the variation of the Earth's gravity with latitude; (d) the free-air correction, which accounts for the difference in elevation between each station and sea level; (e) the Bouguer correction, which corrects for the attraction of material between the station and sea-level; (f) the curvature correction, which corrects the Bouguer correction for the effect of the Earth's curvature to 166.7 km; (g) the terrain correction, which removes the effect of topography to a radial distance of 166.7 km; and (h) the isostatic correction, which removes long-wavelength variations in the gravity field inversely related to topography.

Observed gravity values were obtained from gravity meter readings using factory calibration constants for Worden gravity meters, and factory calibration tables for LaCoste and Romberg meters. For most LaCoste and Romberg meters, calibration table values were modified with a secondary calibration factor based on repeated measurements made over the Mount Hamilton, Calif., Mt. Evans, Colo. (Barnes and others, 1965), and the Charleston Peak, Nev. (Ponce and Oliver, 1981) calibration loops. Calibration constants for Worden gravity meters and secondary calibration factors for LaCoste and Romberg gravity meters are listed in table 4. Observed gravity values at each station were then adjusted assuming a time-dependent linear drift between the first and last base station reading of each day. Free-air gravity anomalies were calculated using the Geodetic Reference System 1967 formula for the theoretical gravity on the ellipsoid (International Union of Geodesy and Geophysics, 1971, p. 60) and Swick's formula (1942, p. 65) for the free-air correction. Bouguer, curvature, and terrain corrections (discussed in the following section) were added to the free-air correction to determine the complete Bouguer anomaly. A standard reduction density of 2.67 g/cm^3 was used to determine the Bouguer anomaly. Formulas used to compute free-air and Bouguer anomalies are given by Oliver and others (1981). Finally, a regional isostatic gravity field was removed from the Bouguer field assuming an Airy-Heiskanen model for isostatic compensation of topographic loads (Simpson and others, 1983) with an assumed crustal thickness of 25 km, a crustal density of 2.67 g/cm^3, and a density contrast across the base of the model crust of 0.4 g/cm^3. A discussion of the isostatic correction and its significance is given by Simpson and others (1986).

TABLE 4.–*Gravity meters used at NTS and their calibration factors*

Meter	Constant[1]	Organization	Number of stations Established	Remarks
		Worden Meters		
W-90	0.5391	USGS	2272	First used 11/18/58, meter was upset on 1/8/59, and returned to manufactorer for check/repair
	0.5388			Performance test sheet dated 7/1/59
W-134	0.4380	USGS	172	Use began 4/11/61, Meter stamped 0.4386, constant changed to agree with Mt. Evans calibration.
W-177	0.2672	USGS	60	Rainer Mesa study, 1956, and Mabey's reconnaissance in 1957.
W-340	0.2277	USGS	217	Use began 9/19/60, constant changed to 0.2272 to fit G-8 calibration from Mt. Evans (D. Stuart, oral commun., 6/6/61)
W-444	0.4959	USGS	2405	Use began 5/29/61. Performance test sheet dated 11/4/63 indicated 0.4959.
W-451	0.0871	USGS	26	First used 8/8/58 to begin NTS gravity survey and establish base stations.
W-476	0.0820	USGS	53	First used 6/1/59. Meter stamped 0.0822 however, Texas Instrument, 6/10/59, indicated instrument constant to be 0.0280.
W-772	0.0757	USGS	2666	Use began 1967, performance test sheet dated 7/1/66 indicated 0.0757. Performance sheet dated 8/17/72 indicated 0.0756.
		LaCoste and Romberg Meters		
D-26	1.000999	USGS	79	Factor based on multiple run over Mt. Hamilton and Charleston Peak calibration loops.
G-8	1.0009	USGS	504	Use began 10/8/62. Used on 9/17/64 and again on 9/25/65. No record of G-8 factor being used.
G-17	1.00252	USGS	183	
G161	1.000573	USGS	—	Factor based on multiple run over Mt. Hamilton and Charleston Peak calibration loops.

TABLE 4.–*Gravity meters used at NTS and their calibration factors*–Continued

Meter	Constant	Organization	Number of stations Established	Remarks
		LaCoste and Romberg Meters		
G177	1.0002[1]	USGS	5133	Use began 4/1/69. 1968 calibration factor changed to 1.0003[2], based on 3 runs over Mt. Hamilton calibration loop in 1980.
G192	1.00412	USGS	51	Used on one day 11/18/80.
G614	1.00038	USGS	323	Factor based on multiple runs over Mt. Hamilton and Charleston Peak calibration loops.
G370	n.a.	EDCON	167	—
G479	n.a.	EDCON	159	—
D-85	n.a.	LANL	215	1981-1986, calibration given by manufacturer.
G474	n.a.	LANL	645	1981-1986, calibration given by manufacturer.
G715	n.a.	LANL	20	1981-1986, calibration given by manufacturer.
G720	n.a.	UTD	125	—
G724	n.a.	UTD	87	—

[1]Secondary calibration factor in addition to factory calibration tables for LaCoste and Romberg meters

[2]Ponce and Oliver (1981, p. 9 and 10.)

TERRAIN CORRECTIONS

Terrain corrections account for the variation of topography near a gravity station and may be calculated manually, digitally, or by a combination of both methods. Manual terrain correction systems involve dividing the terrain surrounding a gravity station into a series of zones and compartments. The average elevation of each compartment is manually estimated from a topographic map to derive the gravity effect of the terrain. Generally, there are two manual terrain correction systems currently in use. Hayford and Bowie (1912) devised a system dividing the terrain surrounding a gravity station into zones and equal area compartments. A system of subcompartments was devised based on Bowie's (1917, p. 9-18) subdivided zones to make the Hayford-Bowie system more accurate in areas of steep terrain. The second system, devised by Hammer (1939), was modeled after the Hayford-Bowie system of 1912. This system relates the outer and inner radii of zones to the width of the compartments to obtain equidimensional compartments. Hammer believed this system maximized accuracy while minimizing the total number of compartments.

A number of systems exist for calculating terrain corrections using digital elevation data (Plouff, 1966; Krohn, 1976; Plouff, 1977). Digital terrain correction systems use a scheme of digitizing topography on a grid to form a digital elevation model (DEM). The terrain correction is calculated by computing the distance and difference in elevation of each grid cell from the gravity station. The DEM generally used at the NTS was derived from contour plates at a scale of 1:250,000 and is available from the Department of Interior, U.S. Geological Survey, National Cartographic Information Center, 507 National Center, Reston, VA 22092. A more detailed 1/4-minute grid of elevation data was derived from 1:24,000- and 1:62,500-scale topographic maps and was used as part of the DEM for some stations in the southwestern part of the NTS (fig. 10).

GRAVITY DATA

Gravity data, organized by source, are discussed in the following sections. Station locations are plotted in 15′ minute quadrangles with station names if space permits (figs. 11a-11p). An explanation of the format of the principal facts appendices are given in table 5. Accuracy codes were generally assigned to each station and are explained in table 6. A summary of the accuracy code occurrences is given in table 7. The principal facts of the gravity data are listed in appendices B-G.

DATA FROM THE U.S. GEOLOGICAL SURVEY

DATA ESTABLISHED UNDER THE WEAPONS PROGRAM

A total of 12,336 gravity stations were established under the weapons program (appendix B) between 1959 and February 1987. These surveys were part of an effort to determine areas suitable for underground nuclear tests, define the regional structure, and evaluate ground water flow patterns.

Station names were numbered to reflect the order in which they were incoporated into the weapons program. Between 1957-72, most of the gravity stations were established using Worden gravity meters (table 4). From 1969-72 LaCoste and Romberg gravity meter G177 and Worden Master gravity meters, which are thermostatically controlled, were used almost exclusively to establish gravity stations. Since October 1972, LaCoste and Romberg meters have been used to establish gravity stations.

Prior to July 15, 1971, most of the gravity stations were measured on bench marks, section corners, map elevations, surveyed elevations, and photogrammetric "spot" elevations. Surveyed elevations were obtained by field crews from Holmes and Narver, Inc. (H&N) (elevation accurate to about 0.3 m and horizontal position accurate to 8 m). The observed gravity values for the majority of these stations are considered accurate to about 0.10 mGal, with some stations being in error by about 0.20 mGal.

Since July 15, 1971, with the exception of 15-20 stations, all stations were either located on bench marks, section corners, or surveyed elevations by H&N. Stations having elevations determined least accurately (i.e. photogrammetric elevations, contour interpolations, etc.) represent about 16% of the data set. Observed gravity values are thought to be accurate to about 0.05 mGal.

Terrain corrections were calculated using the Hammer system. Each station was manually corrected through Hammer zone L, a radial distance of 14.745 km. Beginning in 1968, terrain corrections for these stations were extended to a radial distance of 166.7 km using a DEM and a procedure by Plouff (1977). With the advent of digital procedures for outer-zone terrain corrections, manual terrain corrections were decreased in radii to Hammer zone H (2.669 km).

TABLE 5.–*Explanation of principal facts format for appendices B-G*

Item	Explanation
STATION NAME	An alphanumeric combination of up to 8 characters used for station identification
LAT	Latitude in degrees and minutes, to 0.01 minute
LON	Longitude in degrees and minutes, to 0.01 minute
ELEV	Elevation, to 0.1 ft
OG	Observed gravity, to 0.01 mGal
AC	Four digit code describing the general location, elevation, latitude, and observed gravity accuracy
FAA	Free-air anomaly to 0.01 mGal
ITC	Inner-zone terrain correction for a density of 2.67 g/cm^3, to 0.01 mGal, followed by a letter denoting the extent of the correction. Upper case denotes Hayford-Bowie system of zones (Hayford and Bowie, 1912), lower case denotes Hammer system of zones (Hammer, 1939).
TC	Total terrain correction from the station to 166.7 km for a density of 2.67 g/cm^3, to 0.01 mGal
CBA	Complete Bouguer anomaly reduced for a density of 2.67 g/cm^3, to 0.01 mGal
ISO	Isostatic residual anomaly values assuming an Airy model for isostatic compensation of topographic loads. This model assumes a crustal thickness of 25 km, a topographic density load of 2.67 g/cm^3 and a density contrast across the base of the model crust of 0.4 g/cm^3.
DATE	The most recent date, expressed in month, day, and year that the station was occupied.
BASE	Base station
MTR	Gravity meter

TABLE 6.–*Explanation of accuracy codes*

[NGS, National Geodetic Survey; NMD, National Mapping Division; USGS, U. S. Geological Survey]

Code	Explanation		
	General elevation and location code–1st digit		
A	Altimetry, good control	P	On or near surveyed mark
B	On USGS or NGS level-line bench mark	Q	River gradient interpolation
C	Contour line interpolation	R	Lake or reservoir elevation by leveling
D	Destroyed or not found reference mark	S	Sea level elevation
E	Near level-line bench mark other than USGS or NGS	T	Photogrammetry by USGS NMD
F	Map elevation, black or field checked	U	Unknown elevation source
G	Map elevation, brown or not field checked	V	On vertical angle bench mark
H	Near vertical angle bench mark	W	Map elevation, blue
I	Other special source	X	On or near boundary marker
K	Photogrammetry by other than USGS NMD	Y	Altimetry, poor control
N	Near USGS or NGS level-line bench mark	Z	Special source (e.g. mobile elevation recorder)
M	On level-line bench mark other than USGS or NGS		

	Elevation code–2nd digit	Elevation accuracy (ft)	Approximate gravity effect (mGal)
1	On bench mark	0.2	0.01
2	Near bench mark	0.3	0.02
3	Transit or good alidade survey	1.0	0.06
4	Vertical angle bench mark or black map elevation	2.0	0.12
5	Black map elevation on old map or good photogrammetry	4.0	0.24
6	Brown map elevation or good photogrammetry on 20 ft contour interval map	10	0.6
7	Brown map elevation on 80 ft contour interval map or good altimetry	20	1.2
8	Contour interpolation on 80 ft contour interval map	40	2.4
9	Contour interpolation on 200 ft contour interval map or poor altimetry	80	4.8

	Latitude code–3rd digit (based at lat 37°)	Latitude accuracy (min)	Distance accuracy (ft)	Approximate gravity effect (mGal)
1	Triangulation or special survey data	0.007	42	0.01
2	Location known to 0.04 in on 1:24,000 map (special care)	0.014	84	0.02
3	0.10 in on 1:24,000 map or 0.04 in on 1:62,500 map	0.035	210	0.05
4	0.21 in on 1:24,000 map or 0.08 in on 1:62,500 map	0.07	420	0.1
5	0.42 in on 1:24,000 map or 0.16 in on 1:62,500 map	0.14	840	0.2
6	0.40 in on 1:62,500 map or 0.1 in on 1:250,000 map	0.35	2,100	0.5
7	0.80 in on 1:62,500 map or 0.2 in on 1:250,000 map	0.7	4,200	1.0
8	1.60 in on 1:62,500 map or 0.4 in on 1:250,000 map	1.4	8,400	2.0
9	4.00 in on 1:62,500 map or 1.0 in on 1:250,000 map	3.5	21,000	5.0

	Observed gravity code–4th digit	Approximate gravity effect (mGal)
1	Local survey with special gravity meter	0.01
2	Multiple observations with LaCoste and Romberg gravity meter	0.02
3	Average LaCoste and Romberg or multiple observations with Worden gravity meter	0.05
4	LaCoste and Romberg observation with small vibrations or average Worden gravity meter	0.1
5	Data from loop with closure error this large	0.2
6	Data from loop with closure error this large	0.5
7	Data from loop with closure error this large	1
8	Data from loop with closure error this large	2
9	Data from loop with closure error this large	4

TABLE 7.–*Summary of accuracy codes*

Accuracy Code	Number of occurences				
Location Code	USGS	EDCON	LANL	UTD	Total
B	350	—	—	—	350
C	2	—	—	—	2
F	177	—	—	—	177
G	388	—	—	—	388
H	3	—	—	—	3
I	226	—	—	212	438
J	333	—	—	—	333
K	4	—	—	—	4
M	12	—	—	—	12
N	1	—	—	—	1
P	10,764	326	906	—	11,996
T	1,788	—	—	—	1,788
V	1	—	—	—	1
X	113 / 14 161	—	—	—	113
Elevation Code					
1	271	—	906	—	1,177
2	35	—	—	—	35
3	10,860	326	—	—	11,186
4	1,864	—	—	—	1,864
5	1,029	—	—	212	1,241
6	109 / 14 168	—	—	—	109
Latitude Code					
1	4	—	906	—	910
2	93	—	—	—	93
3	12,449	326	—	212	12,987
4	1,636 / 14 182	—	—	—	1,636
Observed Gravity Code					
2	5	—	906	—	911
3	7,852	326	—	—	8,178
4	6,285	—	—	—	6,285
5	34 / 14 176	—	—	212	246

USGS — 14 183

EDCON 326

LANL 906

UTD 212

DMA 98

15, 675

DATA ESTABLISHED UNDER YMP

Between 1977 and February 1987, a total of 1,847 gravity stations were established under the YMP (appendix C). The purpose of these surveys was to help characterize possible radioactive waste storage sites at Syncline Ridge, Calico Hills, Wahmonie, and Yucca Mountain. During 1982, the emphasis of the geophysical effort moved to Yucca Mountain at the southwest edge of the NTS, and the characterization of this area is in progress (U.S. Geological Survey, 1984).

Gravity data were collected using LaCoste and Romberg meters D-26, G161, G177, and G614 (table 5). All of the gravity stations were ultimately tied to the base station in Mercury, NV (MERC), except for 16 stations that were tied to the base in Beatty (BPO) and those located in the Syncline Ridge area which were tied to base B2.

Gravity station elevations were controlled by bench marks, points surveyed with a Hewlett-Packard electronic distance measuring device, or photogrammetric spot elevations. Bench marks are generally considered accurate to about 0.3 m and surveyed points to about 0.03 m relative to the reference bench marks. Photogrammetric elevations are generally accuracte to 1/2 the topographic map contour interval or about 3 m and comprise about 5% of the YMP data set. Observed gravity values for these stations are generally accurate to 0.05 mGal relative to MERC.

Terrain corrections were calculated by the USGS and consist of a three part process: the innermost or field terrain correction; the inner-zone or manual terrain correction; and the outer-zone terrain correction (see Spielman and Ponce, 1984). The innermost terrain correction was estimated in the field to the outer radius of Hayford-Bowie zone B (68 m) using a system of tables and charts or sketched and later estimated in the office. The inner-zone or manual terrain correction was estimated for Hayford-Bowie zones C and D with an outer radius of 2.20 km. Finally, the outer-zone terrain correction was calculated from the outer radius of zone D to 166.7 km using a DEM and a procedure by Plouff (1977).

DATA FROM EXPLORATION DATA CONSULTANTS, INC.

Appendix D lists principal facts for 326 station collected by EDCON under U.S. Geological Survey Contract No. 14-08-0001-17153. These data were collected as part of an effort to explore for the presence of buried plutons at Timber Mountain and vicinity.

All stations were collected in late November 1977, using either LaCoste and Romberg gravity meter G370 or G479 and are referenced to base B12 (EDCON, written commun., 1989). Station locations and elevations were determined using a Litton Auto-Surveyor (a modified aircraft inertial navigation system) and are considered accurate to 0.3 m.

Terrain corrections were calculated using the Hayford-Bowie system. Gravity stations sites were selected so that the A-zone correction was negligible. Corrections for zones B and C were estimated manually from 7.5′ topographic maps. A correction for sloping compartment tops was applied, similiar to that discussed by Sandberg (1958). Zones D through K were computed using digital terrain data from DMA and an adaptation of Krohn's (1976) terrain-correction algorithm. Krohn's algorithm uses a system of multiquadric equations to describe a surface which passes through points in the terrain model and the coordinates of the gravity station. Zones L through O were calculated using the same method but also include the effects of the earth's curvature.

DATA FROM LOS ALAMOS NATIONAL LABORATORY

Principal facts for 906 stations collected by the LANL (A. H. Cogbill, written commun., 1986) are listed in appendix E. The purpose of these surveys was to estimate the thickness of Cenozoic overburden and to locate pre-Cenozoic faults in Yucca Flat. All of these stations are located in Yucca Flat and were tied to base B2 or CP2A. Field work for these surveys was coordinated by A. H. Cogbill (of LANL) between 1981 and 1986.

All stations were established using LaCoste and Romberg gravity meters G474, D-85, G715, and G177 (table 4). Elevations for these gravity stations were surveyed by H&N and are considered accurate to about 0.03 m. The observed gravity values for these stations are thought to be accurate to about 0.05 mGal.

All inner-zone terrain corrections were calculated using a system of multiquadric equations which define a topographic surface based on a grid of elevation data (Krohn, 1976). The topographic surface was based on a 152-m grid of elevation data. Outer-zone terrain corrections, for station codes whose last two digits are either "L2", "L3", "L4", or "L6", were calulated from 1.640 km to 166.7 km. Outer-zone terrain corrections for all other stations, were computed using a procedure by Plouff (1977) from 1.260 km to 166.7 km.

DATA FROM THE UNIVERSITY OF TEXAS AT DALLAS

Principal facts for 212 gravity stations collected by UTD (A. H. Cogbill, written commun., 1987), under contract with the U.S. Air Force, are listed in appendix F. Field work for these stations was done under the supervision of J. Ferguson of UTD during June 1985. The purpose of these surveys was to study the structure of Pahute Mesa and develop geophysical models. These stations are referenced to base B4.

All stations were established using LaCoste and Romberg gravity meters G720 and G724 (table 4). Elevations for these gravity stations were surveyed by UTD and are considered accurate to 1 m. The observed gravity values are considered accurate to 0.2 mGal.

All inner-zone terrain corrections were calculated using a system of multiquadric equations which define a topographic surface based on a grid of elevation data (Krohn, 1976). The digital elevation model was developed by digitizing contour lines from 1:24,000-scale maps.

DATA FROM DEFENSE MAPPING AGENCY

Principal facts for 48 stations received from the Defense Mapping agency, Aerospace Center (written commun., 1988) are listed in appendix G. These data are available from the National Geophysical Data Center, National Oceanic and Atmospheric Administration, Mail Code E/GCX2, 325 Broadway, Boulder, Colorado 80303, USA.

Field work for these stations was done by the DMA/Topographic Command/ Geodetic Survey Squadron, Cheyenne, Wyoming between February 17 and April 4, 1982. Gravity stations were established with LaCoste and Romberg gravity meters G123 and G125 using secondary calibration factors (table 5), and were tied to base station Beatty JA on the IGSN 71 gravity datum. Elevation control was determined by an inertial positioning system and is considered accurate to about 1 m. Observed gravity values for these stations are considered accurate to about 0.1 mGal (W. E. Koslowski, written commun., 1988). Terrain corrections for these stations were computed from the station to a radial distance of 166.7 km using a procedure by Plouff (1977).

DESCRIPTION OF DISKETTES

The data described in this report are available on two 5 $\frac{1}{4}$-inch high-density double-sided, 96-TPI diskettes formatted for IBM PC's using DOS 2.0 or higher versions. The IBM diskette requires the following hardware: 1) an IBM PC, PC/XT, PC/AT, or compatible computer running under PC or MS-DOS, version 2.0 or later; and 2) one double-sided high-density disk drive. The diskettes contain a total of 3 files: 'README.TXT', a descritpion of the contents of the diskettes; and two gravity data files described below.

The gravity data are divided into two files such that each disk contains one file. The first 5 lines of each file contains descriptive information (table 8). A description of the gravity data format is shown in table 9 and the first 10 lines of the first gravity file are shown in example 1. The first gravity file 'NTSGRAV1.DAT' contains 12,341 lines (5 header lines and 12,336 lines of gravity data) and the second gravity file 'NTSGRAV2.DAT' contains 3,344 lines (5 header lines and 3,339 lines of gravity data). NTSGRAV1.DAT contains the data listed in appendix B and NTSGRAV2.DAT contains the data listed in appendices C-G.

TABLE 8.–*Description of the first five lines of each gravity file*

Line	Description
1	Type of file (1=grid, 7=ASCII) and creation date
2	Name of the file
3	Description of the file contents
4	FORTRAN format of each data record
5	Information on file format

TABLE 9.–*Format of gravity data on diskettes*

Columns	Input format	Item
1-8	A8	Station name
10-11	F2.0	Latitude, degrees
12-15	F4.2	Latitude, minutes to 0.01 min
17-19	F3.0	Longitude, degrees
20-23	F4.2	Longitude, minutes to 0.01 min
24-29	F6.1	Elevation to 0.1 ft
30-36	F7.2	Observed gravity to 0.01 mGal with leading 9 removed
37-40	A4	Four character accuracy code
41-46	F6.2	Free-air anomaly to 0.01 mGal
47-52	A6	Date station was occupied, month, day, year
53-57	F5.2	Inner-zone terrain correction to 0.01 mGal
58-62	F5.2	Total terrain correction to 0.01 mGal
63	A1	Terrain correction code denoting extent of manual terrain correction and system, upper case denotes Hayford-Bowie system of zones, lower case denotes Hammer system of zones
64-69	F6.2	Complete Bouguer anomaly to 0.01 mGal
70-75	F6.2	Isostatic anomaly to 0.01 mGal
76-79	A4	Base station name
81-84	A4	Gravity meter
85-88	A4	Source of gravity data WPNS–Weapons Program data YMP–Yucca Mountain Program data EDCN–EDCON data LANL–Los Alamos National Laboratory data UTD–University of Texas at Dallas data DMA–Defense Mapping Agency data

```
FILETYPE=     7 CREATION DATE: 12-JAN-1990 12:19
NTSGRAV1.DAT
USGS ASCII DATA FILE
(a  90)
ASCII   IN #/LINE    90 OUT #/LIN    90     IN/OUT     1
        1 363842 1160022 354407952403P334 -1626     58    54    89 -13742  -771B1   W-90WPNS
        2 364342 1155460 379007952403P334    -36     58    87   114 -12970   452B1   W-90WPNS
        3 364348 1155407 386307952123P334    362     58   108   137 -12800   637B1   W-90WPNS
        4 364325 1155388 391907951767P334    566     58    98   130 -12795   633B1   W-90WPNS
        5 364325 1155310 398607951287P334    716     58   108   142 -12863   582B1   W-90WPNS
```

EXAMPLE 1.–The first ten lines of file 1.

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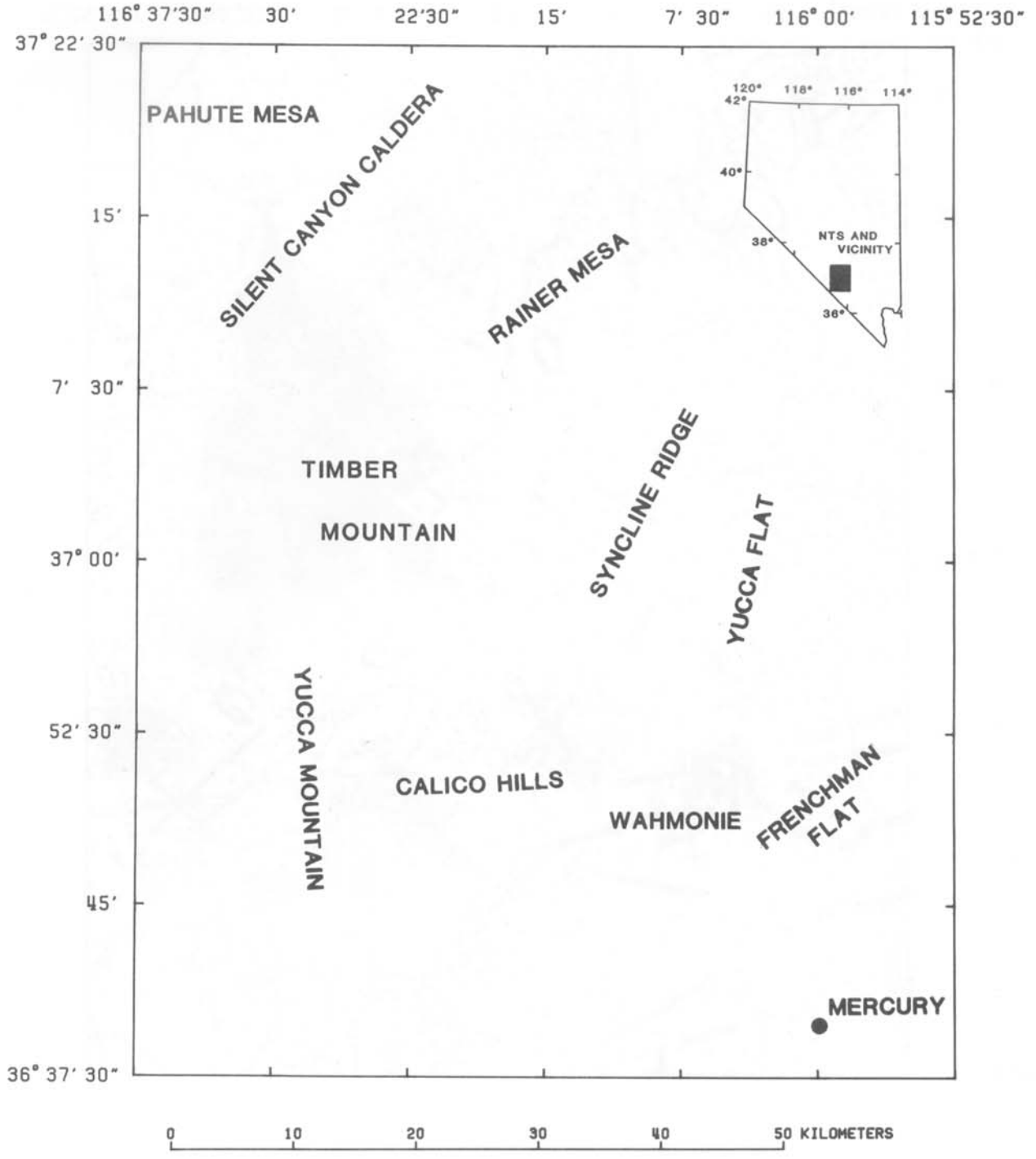


FIGURE 1.–Index map of the Nevada Test Site and vicinity.

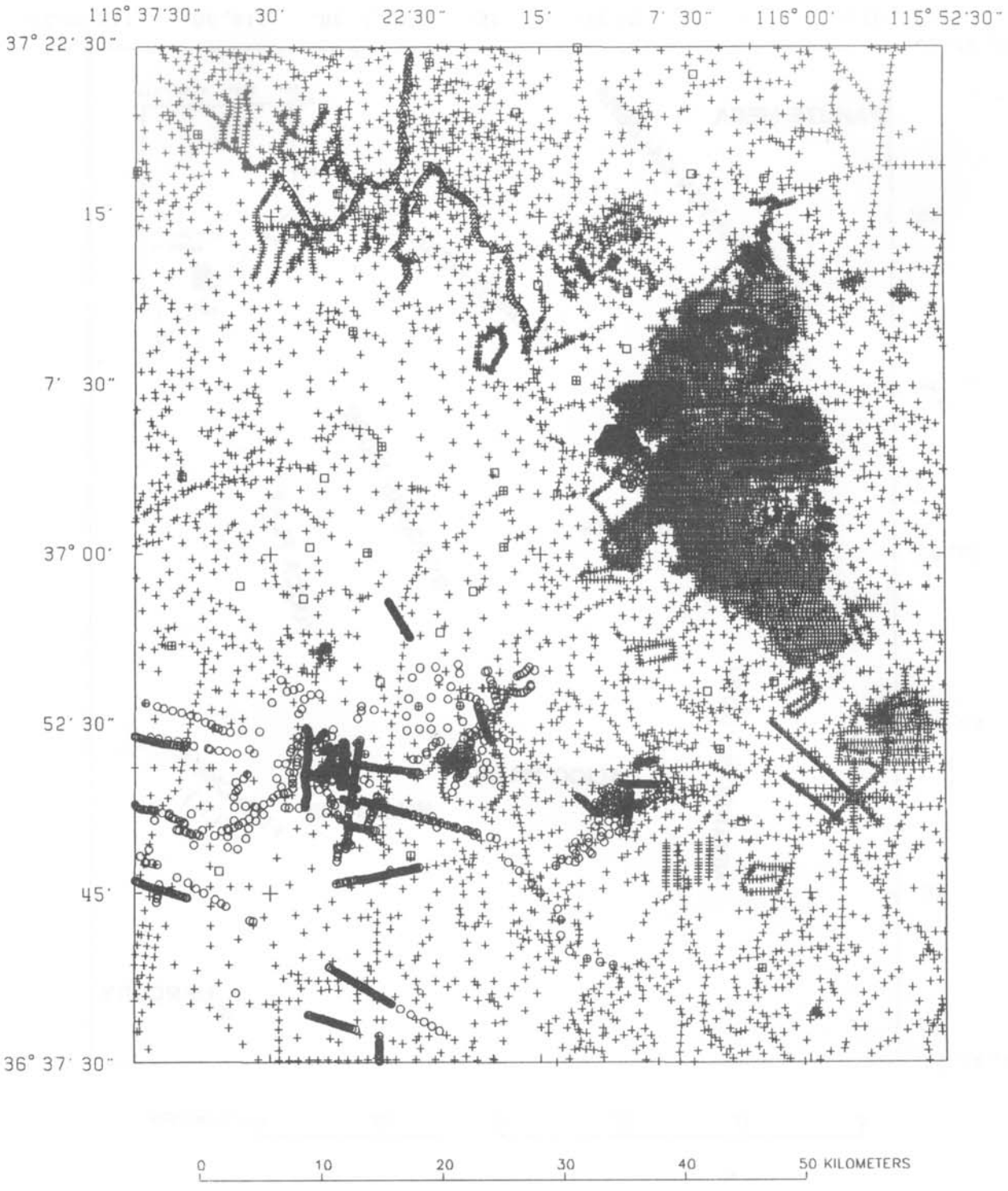


FIGURE 2.–Plot of gravity station locations. + –Stations established under the weapons program; ○–Stations established under YMP; ▽–Stations established by EDCON; ×–Stations established by LANL; △–Stations established by UTD; □ –Stations established by DMA.

Oops, shown as '4'!

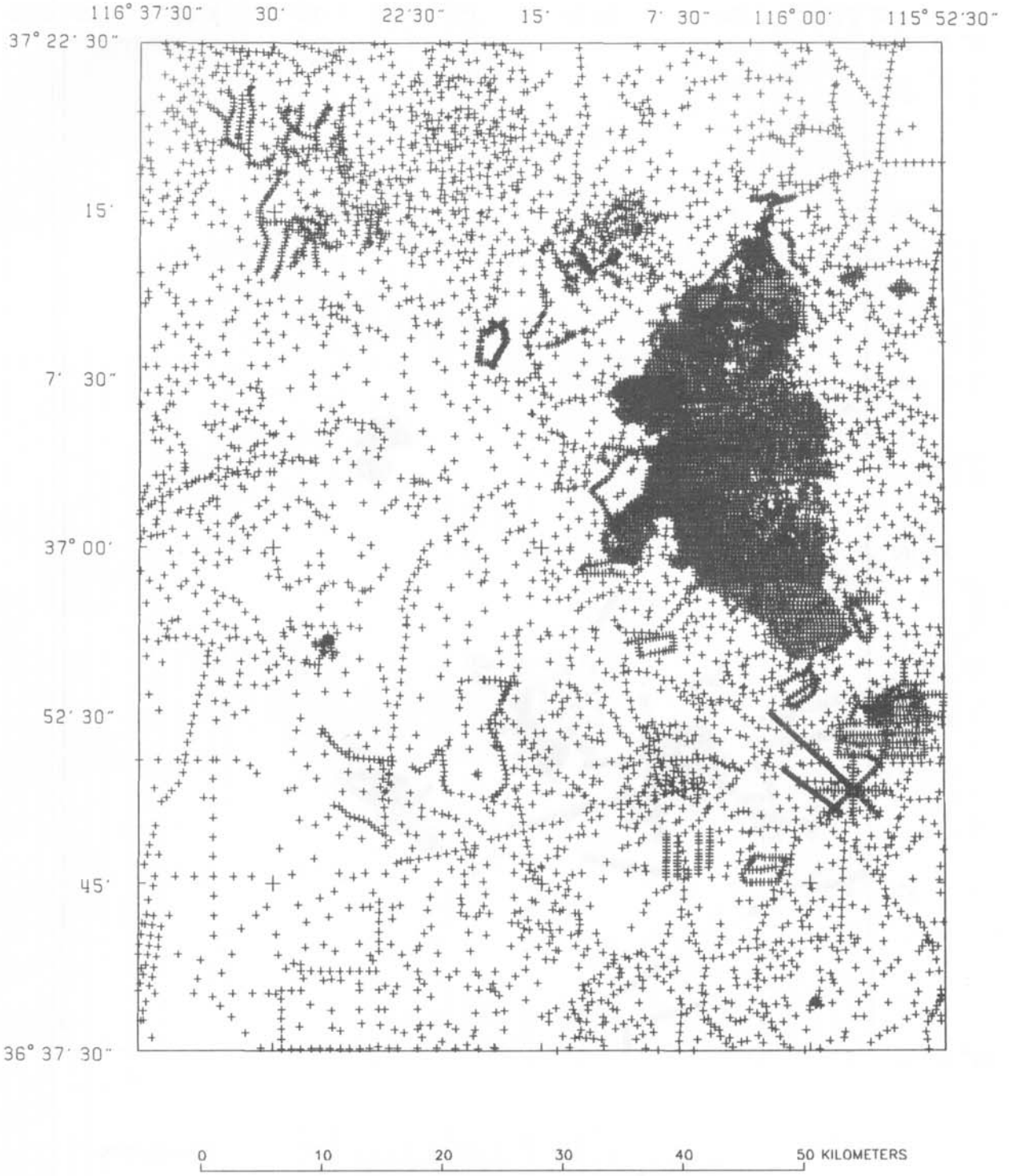


FIGURE 3.–Plot of USGS gravity stations collected under the weapons program. +–Gravity station location.

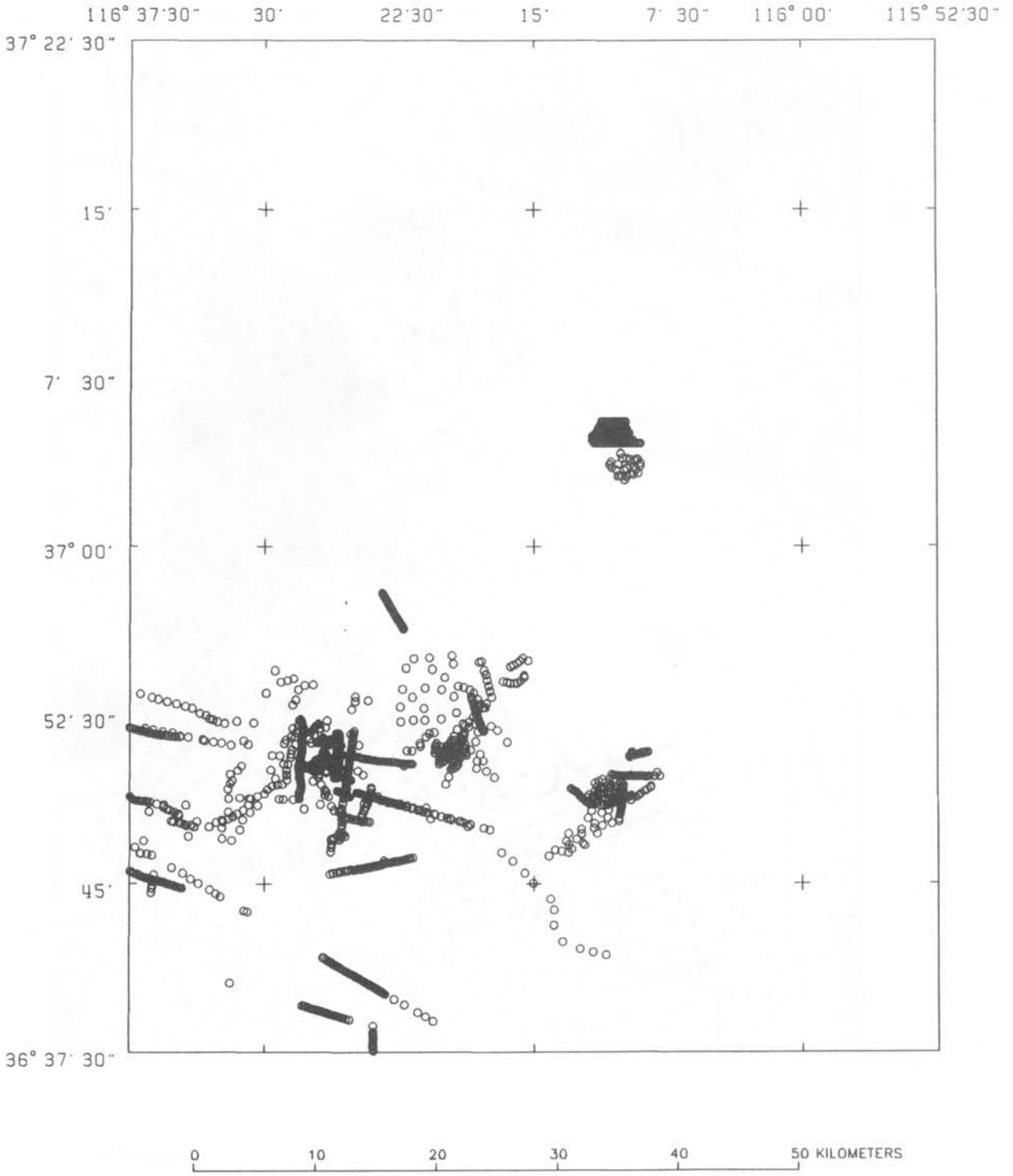


FIGURE 4.–Plot of USGS gravity stations collected under YMP. o–Gravity station location.

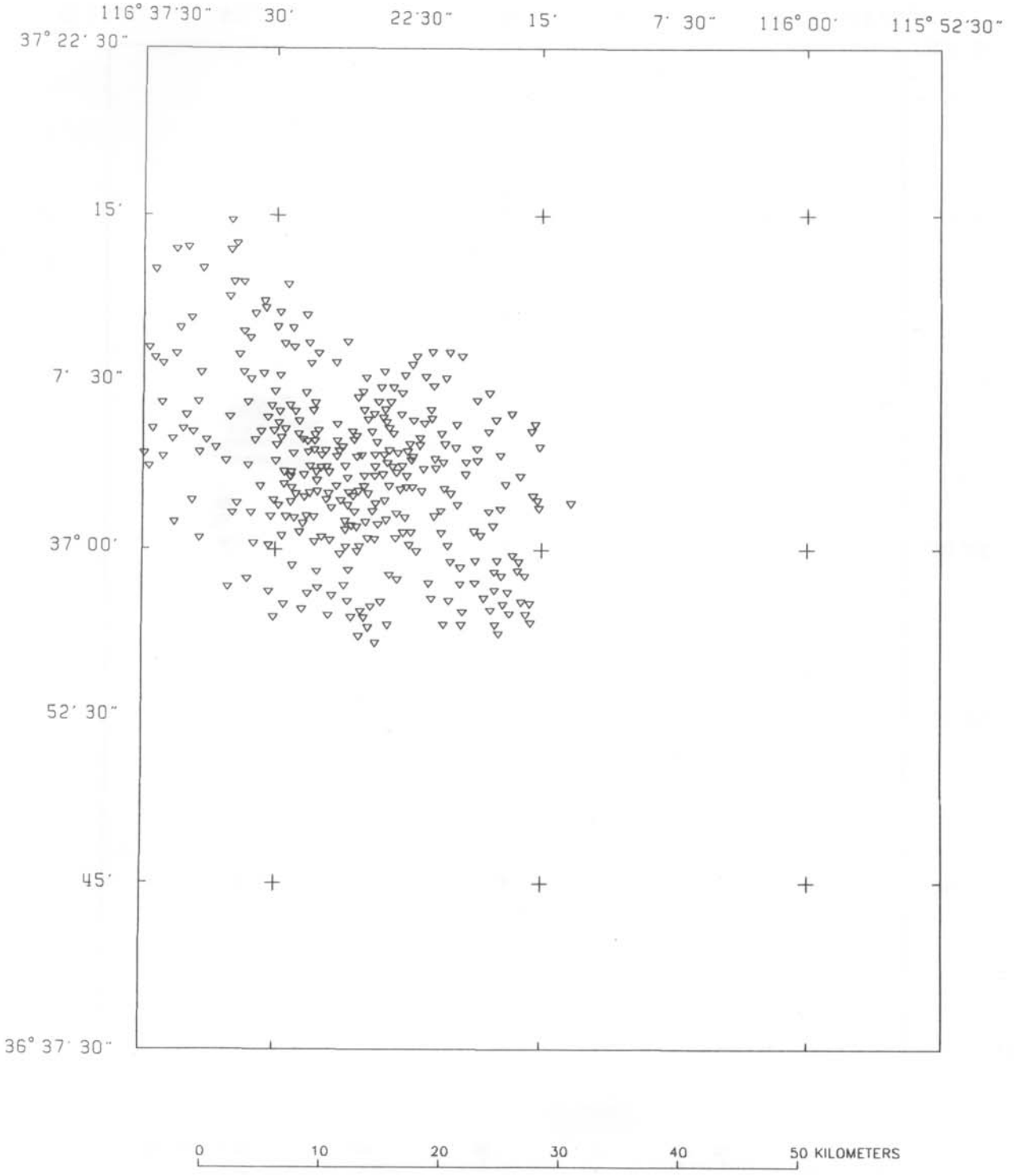


FIGURE 5.–Plot of EDCON gravity stations. ▽–Gravity station location.

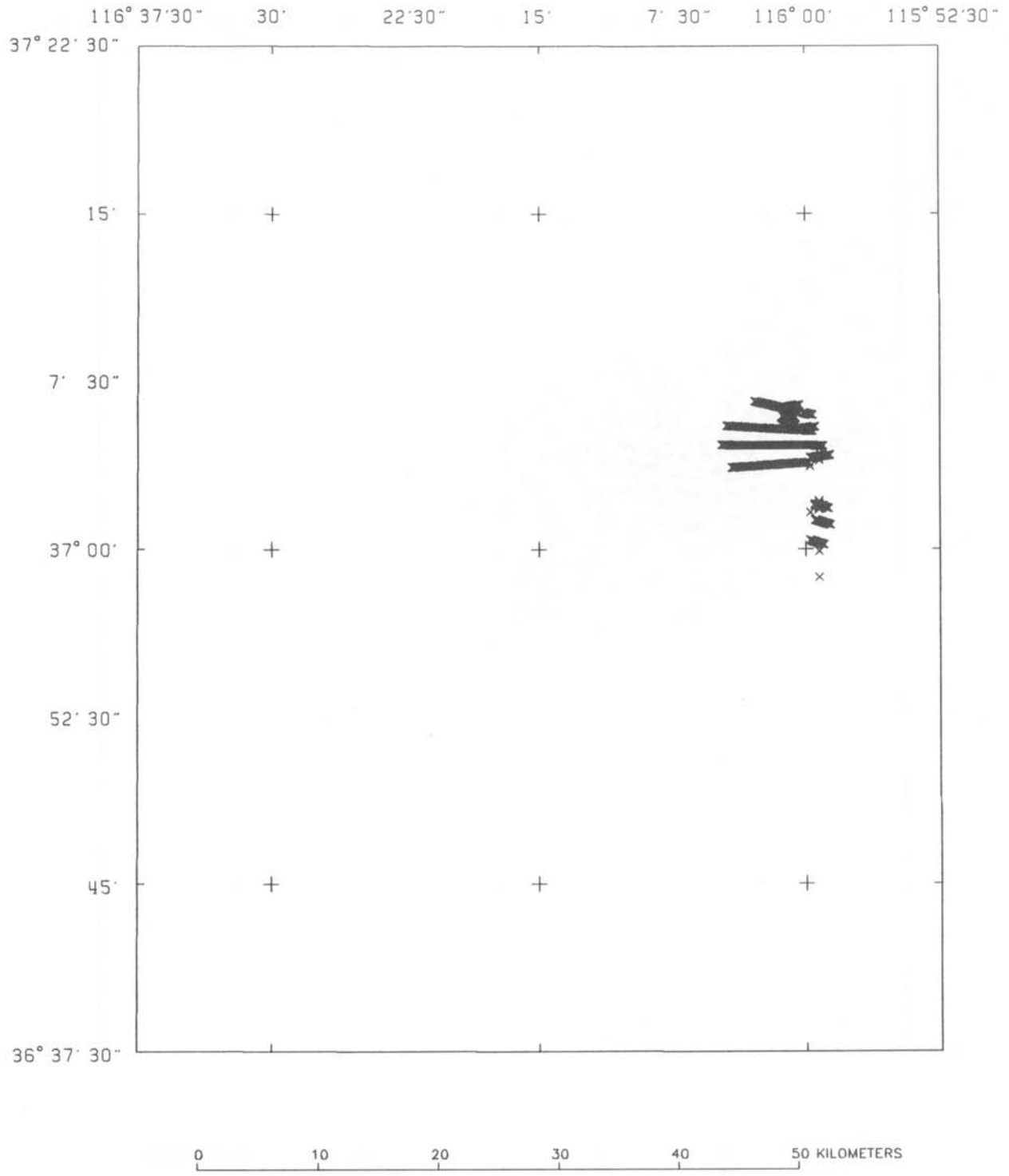


FIGURE 6.–Plot of LANL gravity stations. ×–Gravity station location.

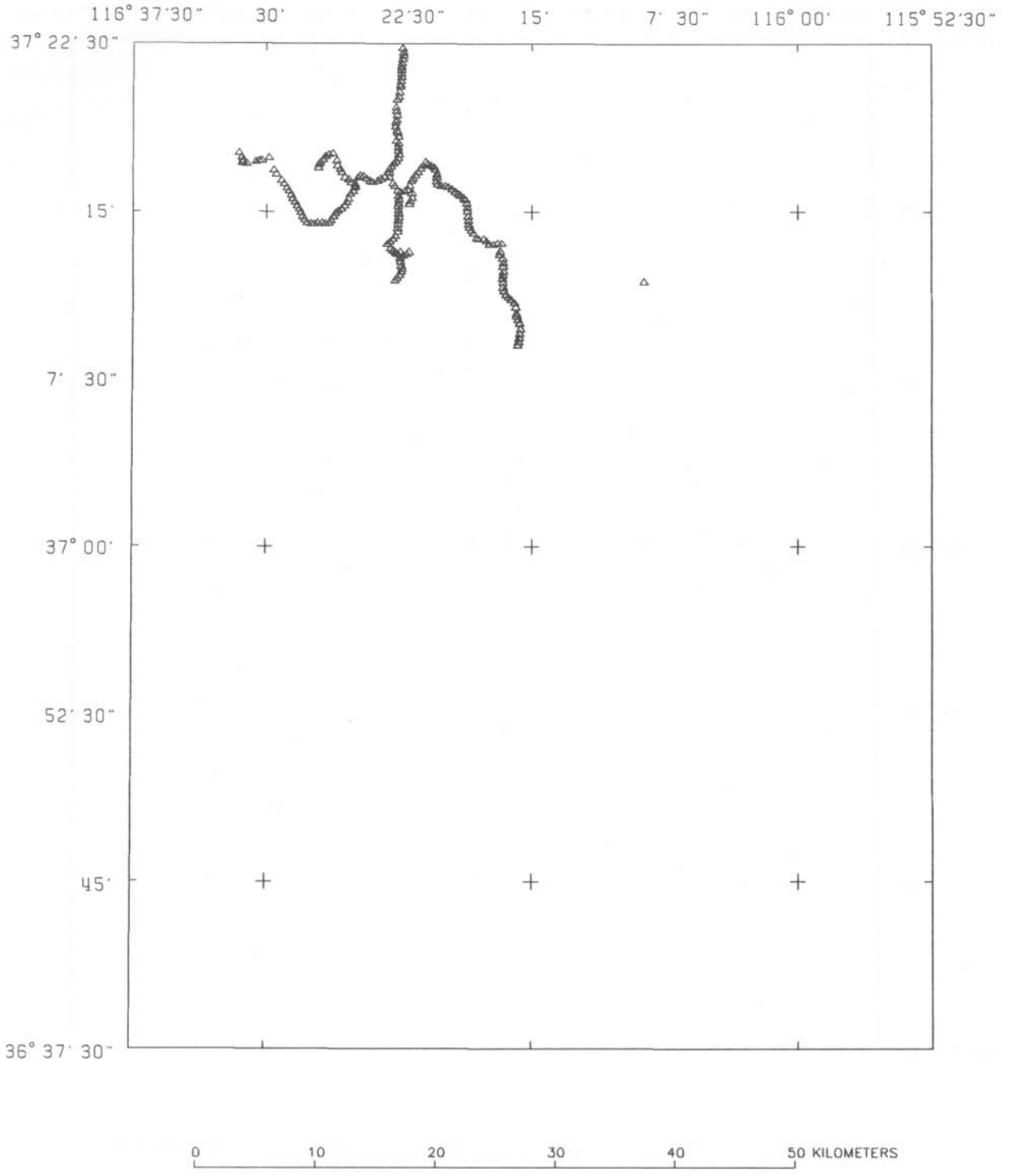


FIGURE 7.–Plot of UTD gravity stations. △–Gravity station location.

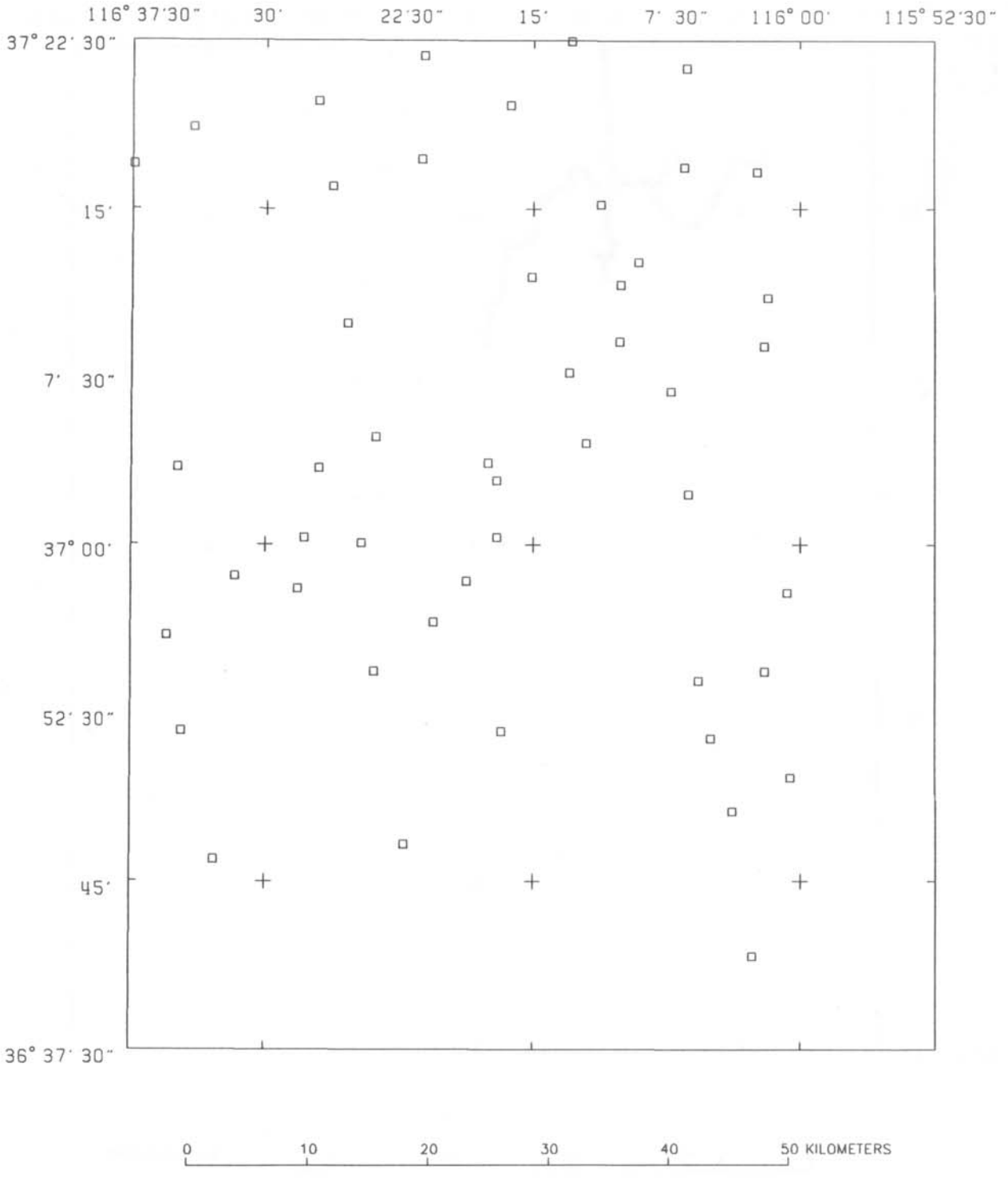


FIGURE 8.–Plot of DMA gravity stations. □–Gravity station location.

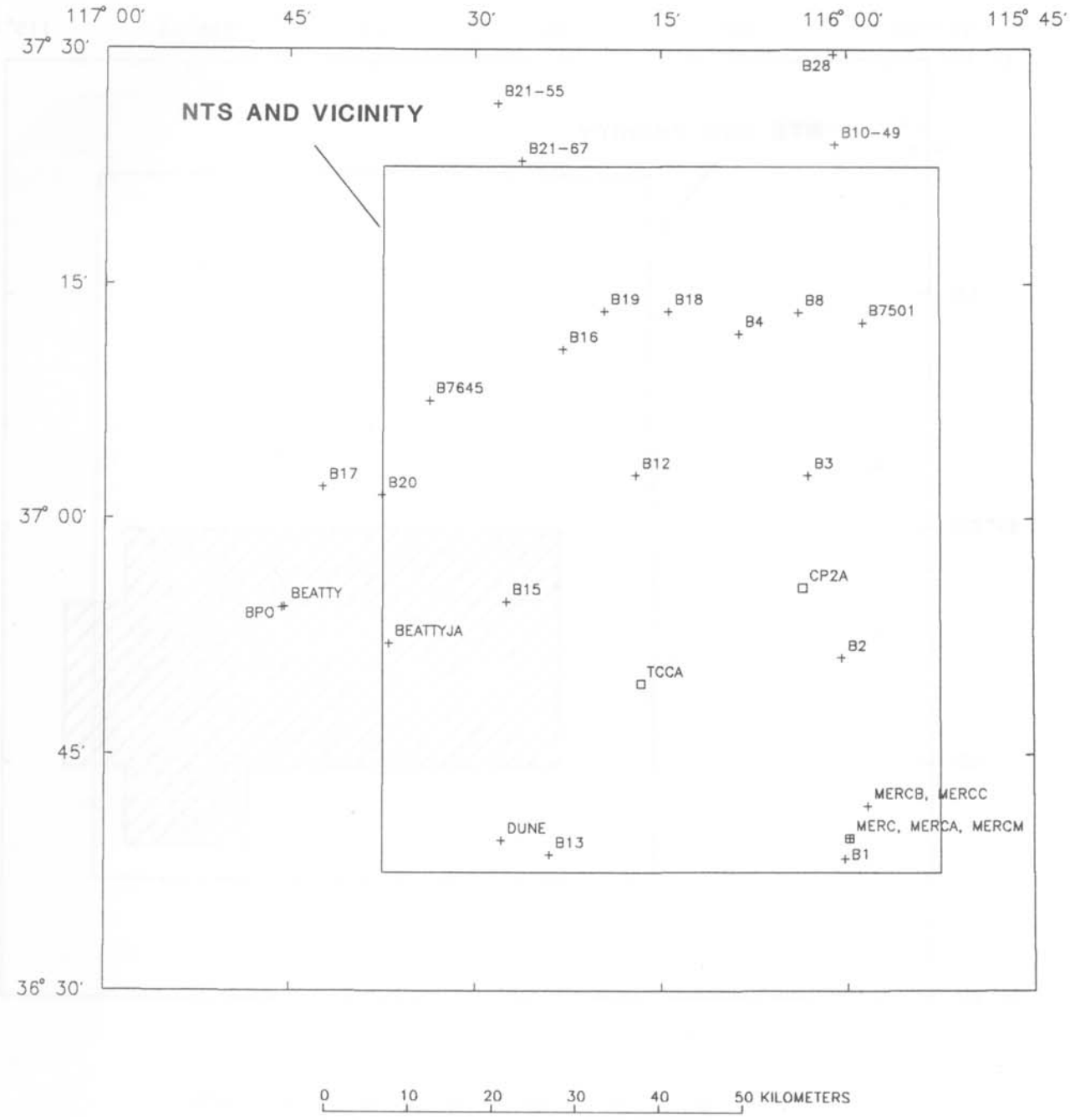


FIGURE 9.–Plot of gravity base station locations. +–Base station; □ –Absolute gravity station.

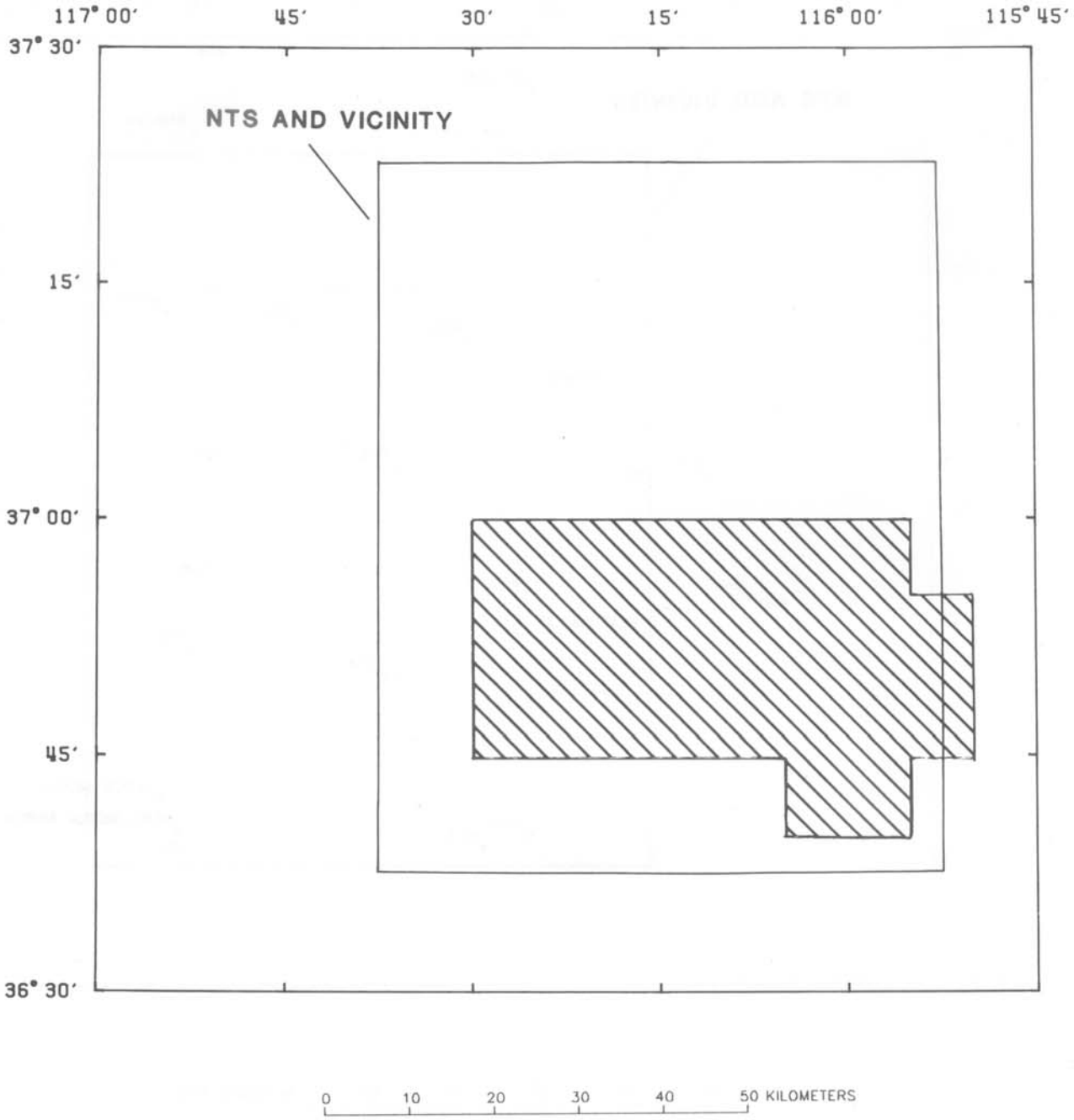


FIGURE 10.–Location of 1/4-minute digitization (shown as cross hachures) used in the digital elevation model.

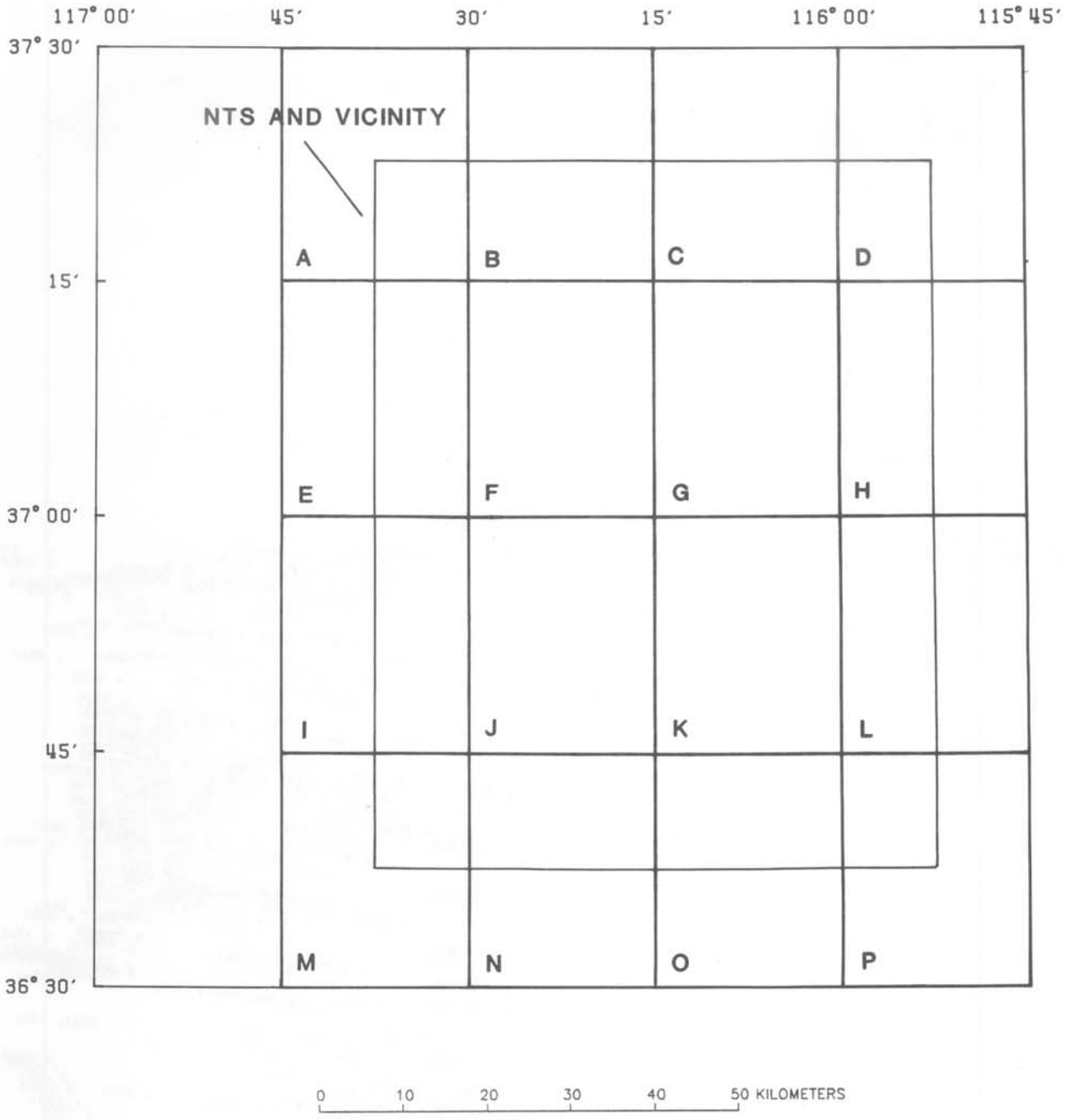


FIGURE 11.–Index map for gravity station plots in figures 11a-11p.

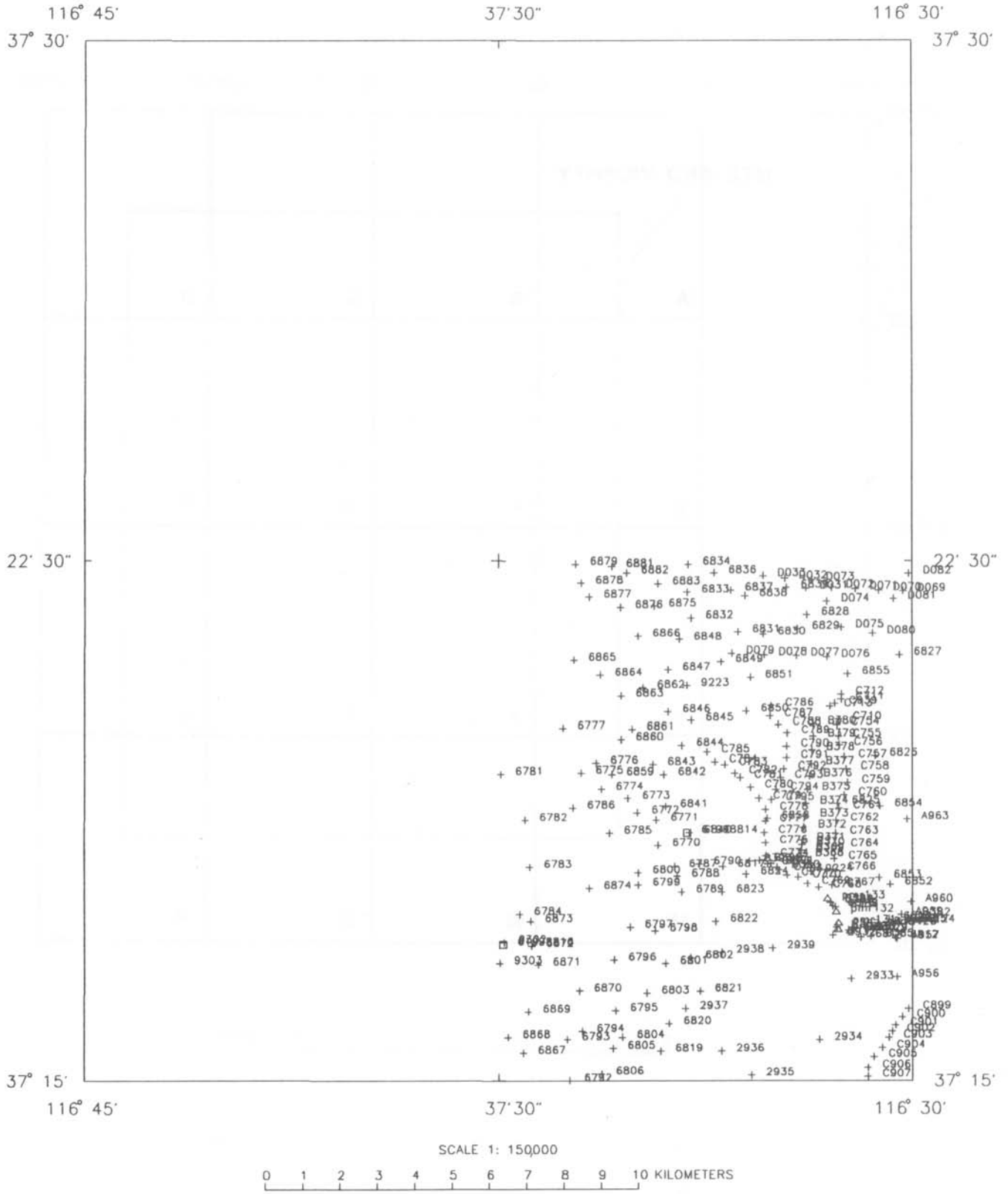


FIGURE 11a.–Gravity station name and location plot for quadrangle A.

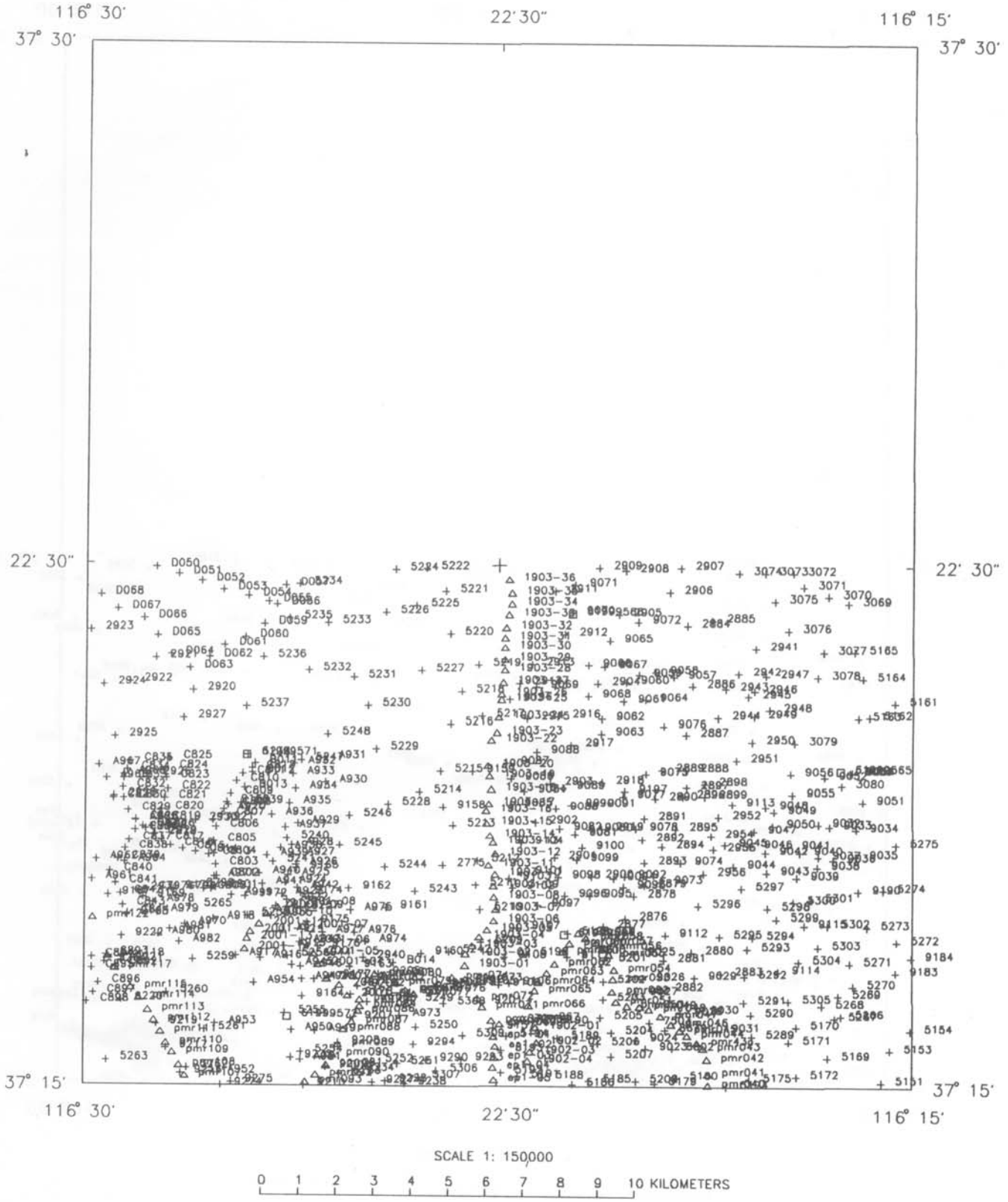


FIGURE 11b.–Gravity station name and location plot for quadrangle B.

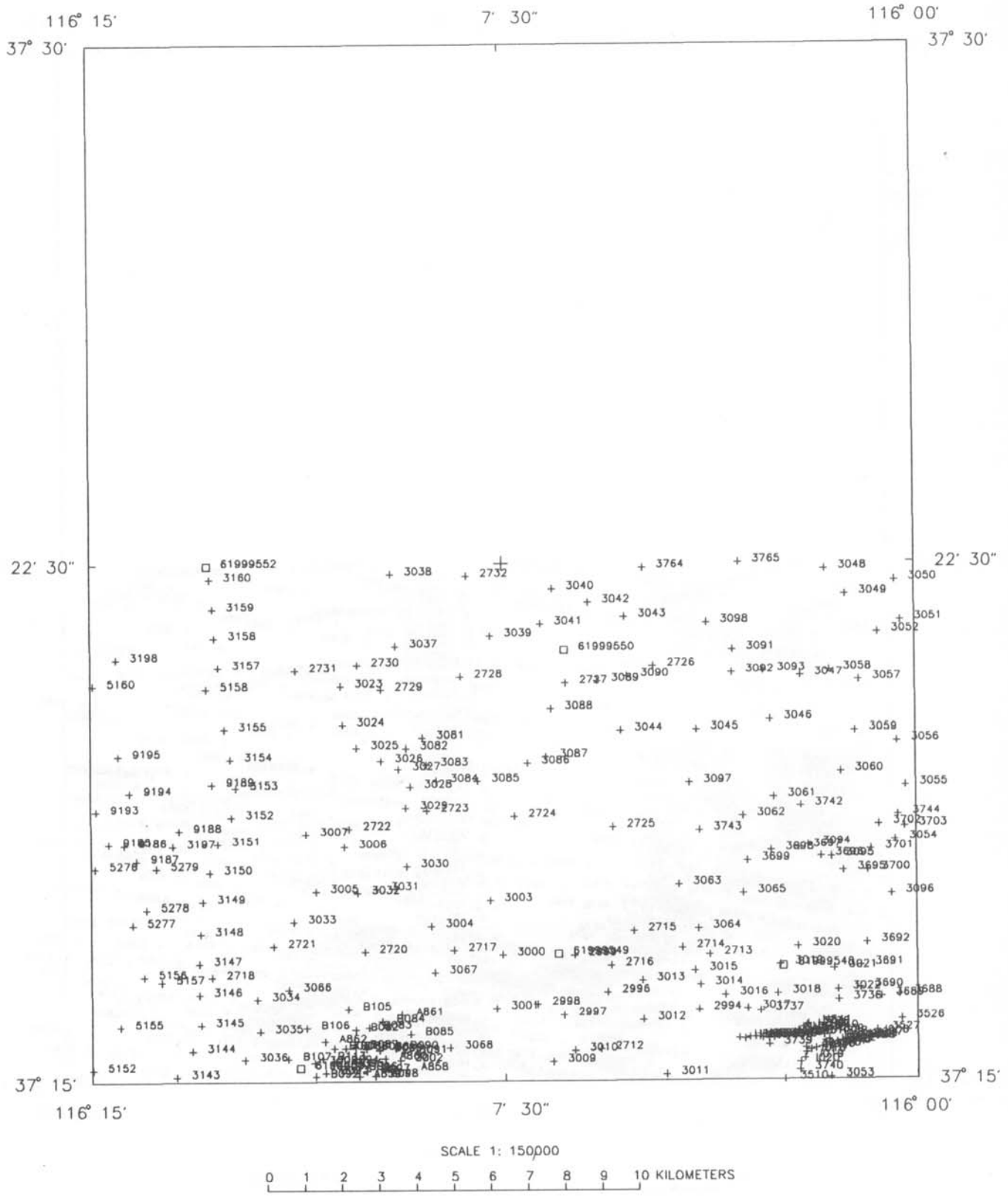


FIGURE 11c.–Gravity station name and location plot for quadrangle C.

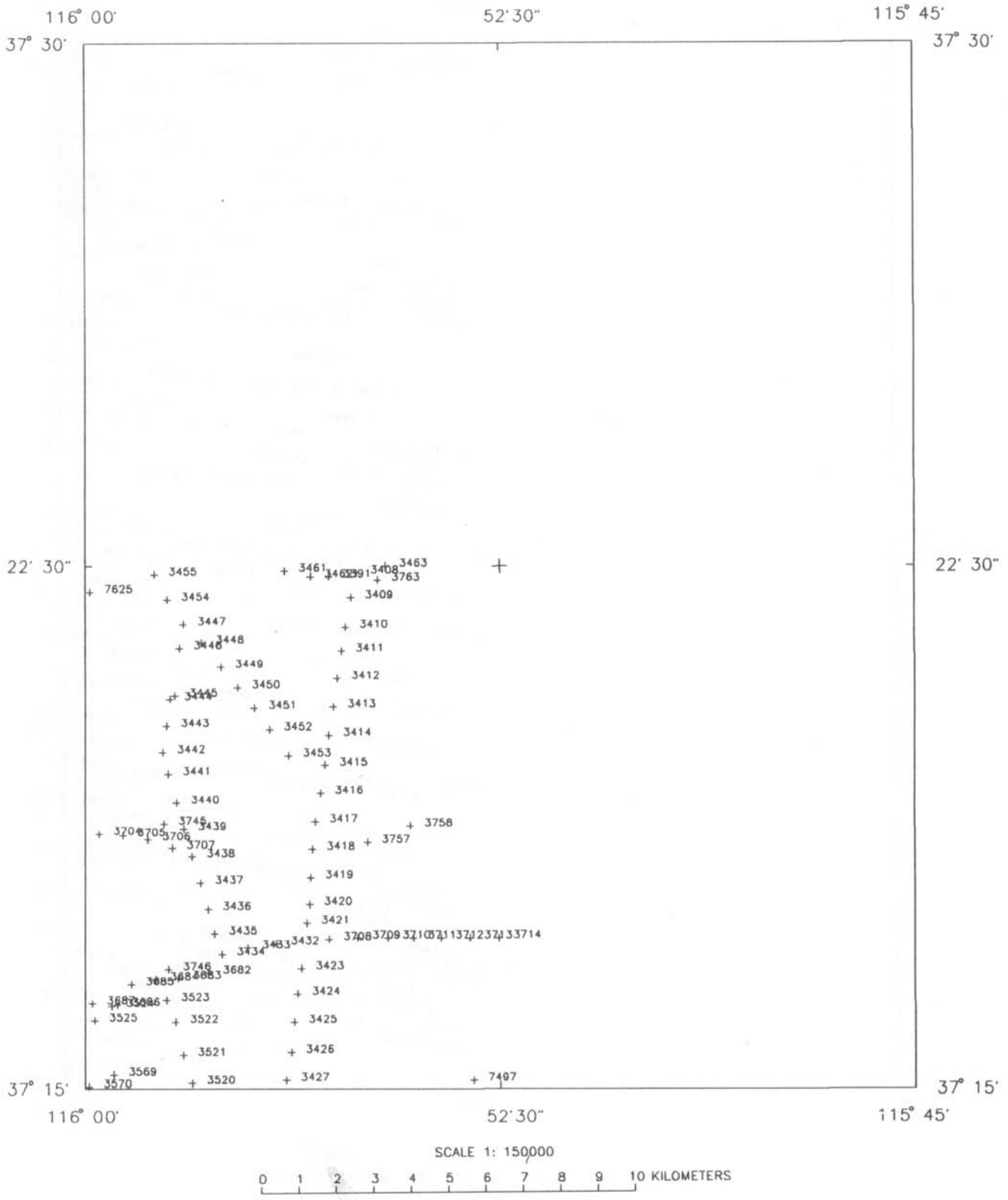


FIGURE 11d.–Gravity station name and location plot for quadrangle D.

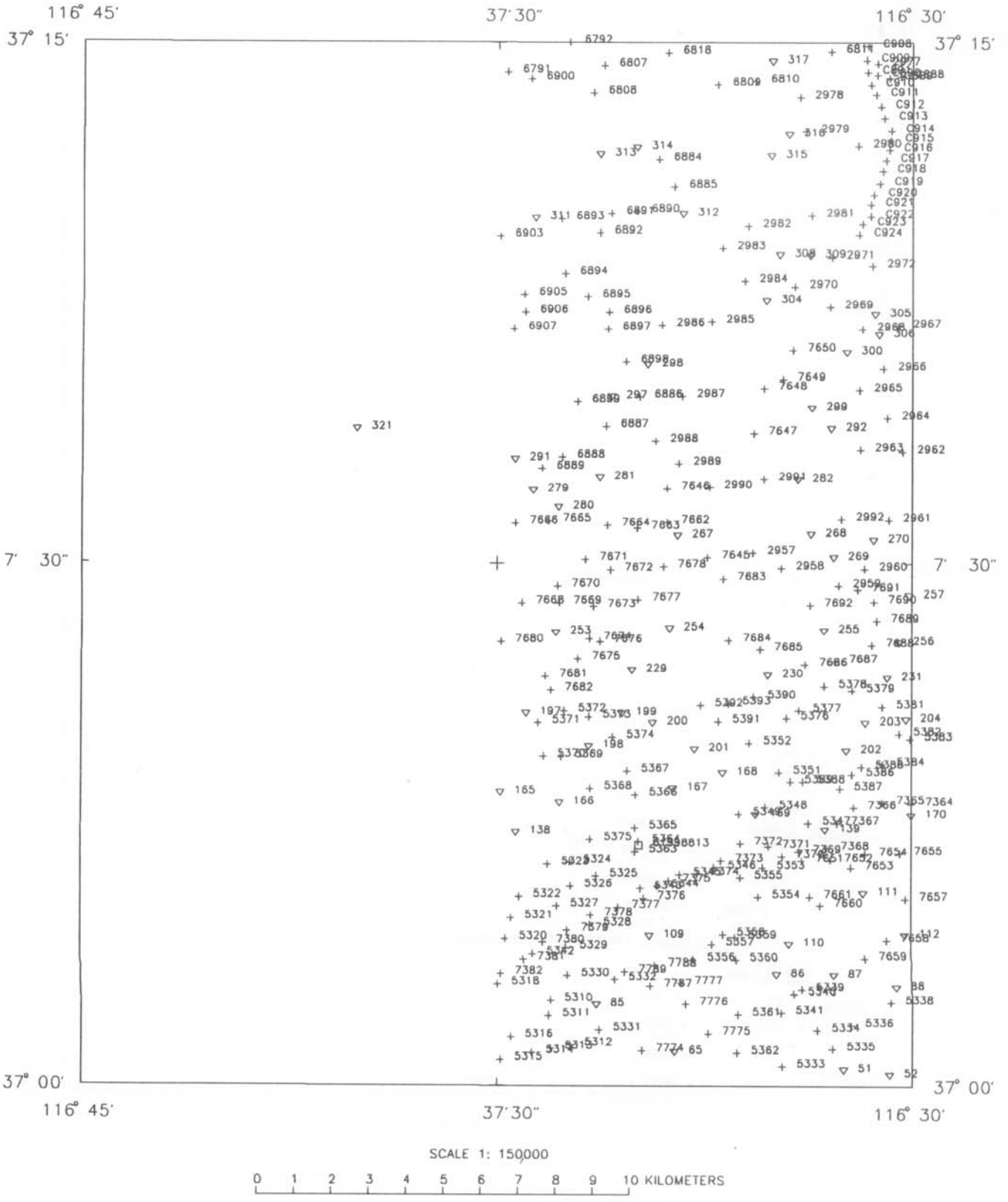


FIGURE 11e.–Gravity station name and location plot for quadrangle E.

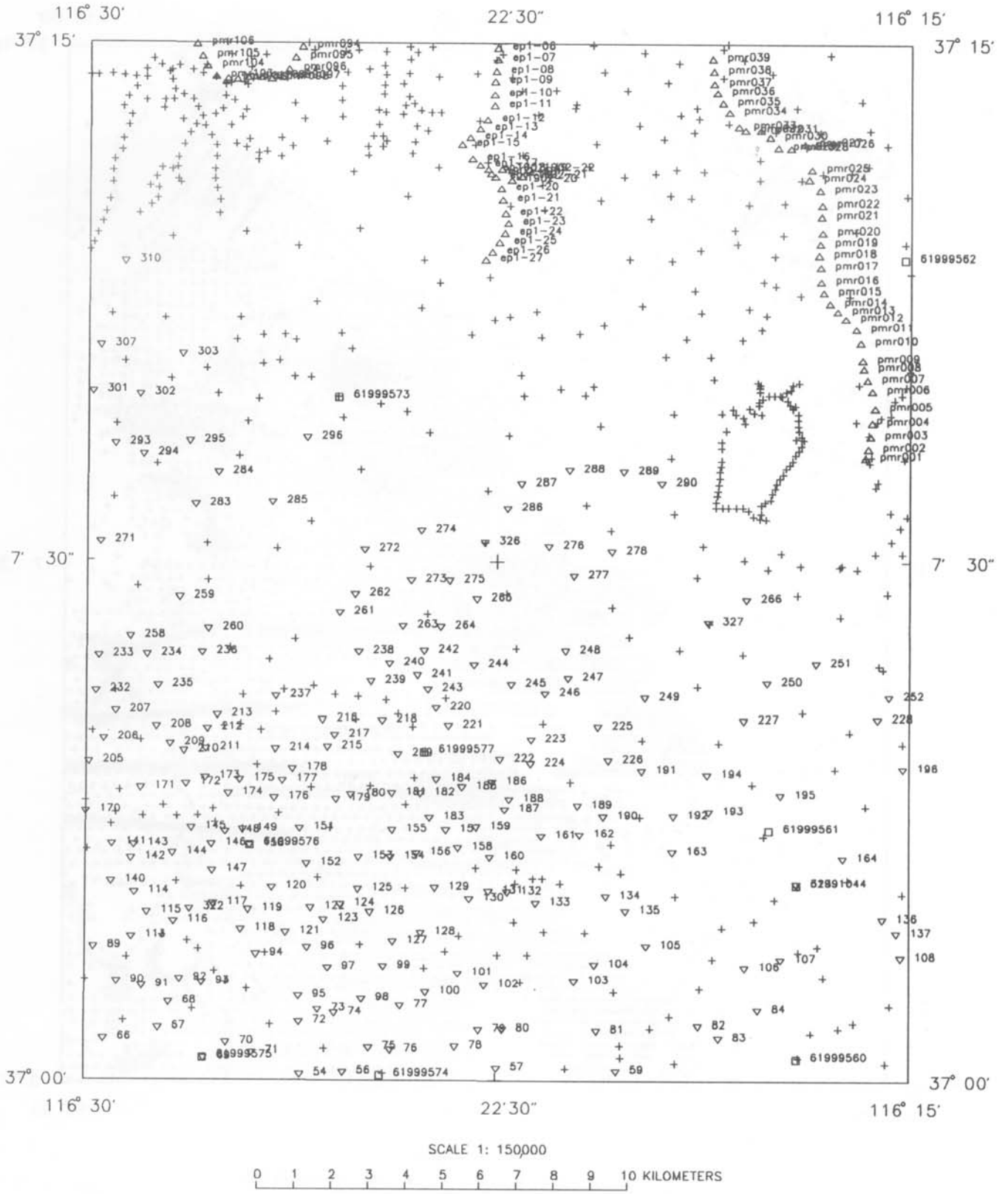


FIGURE 11f.–Gravity station name and location plot for quadrangle F.

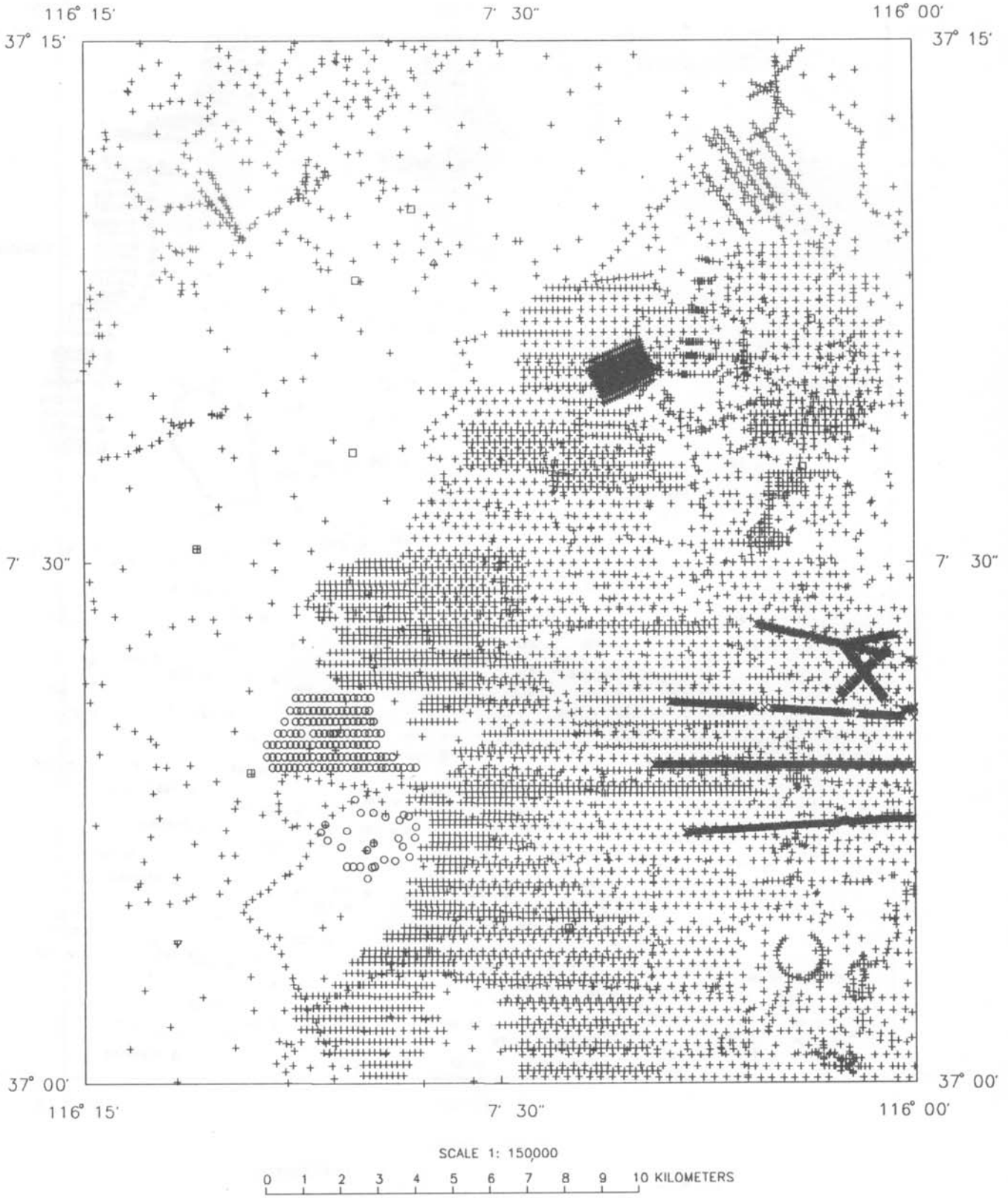


FIGURE 11g.–Gravity station name and location plot for quadrangle G.

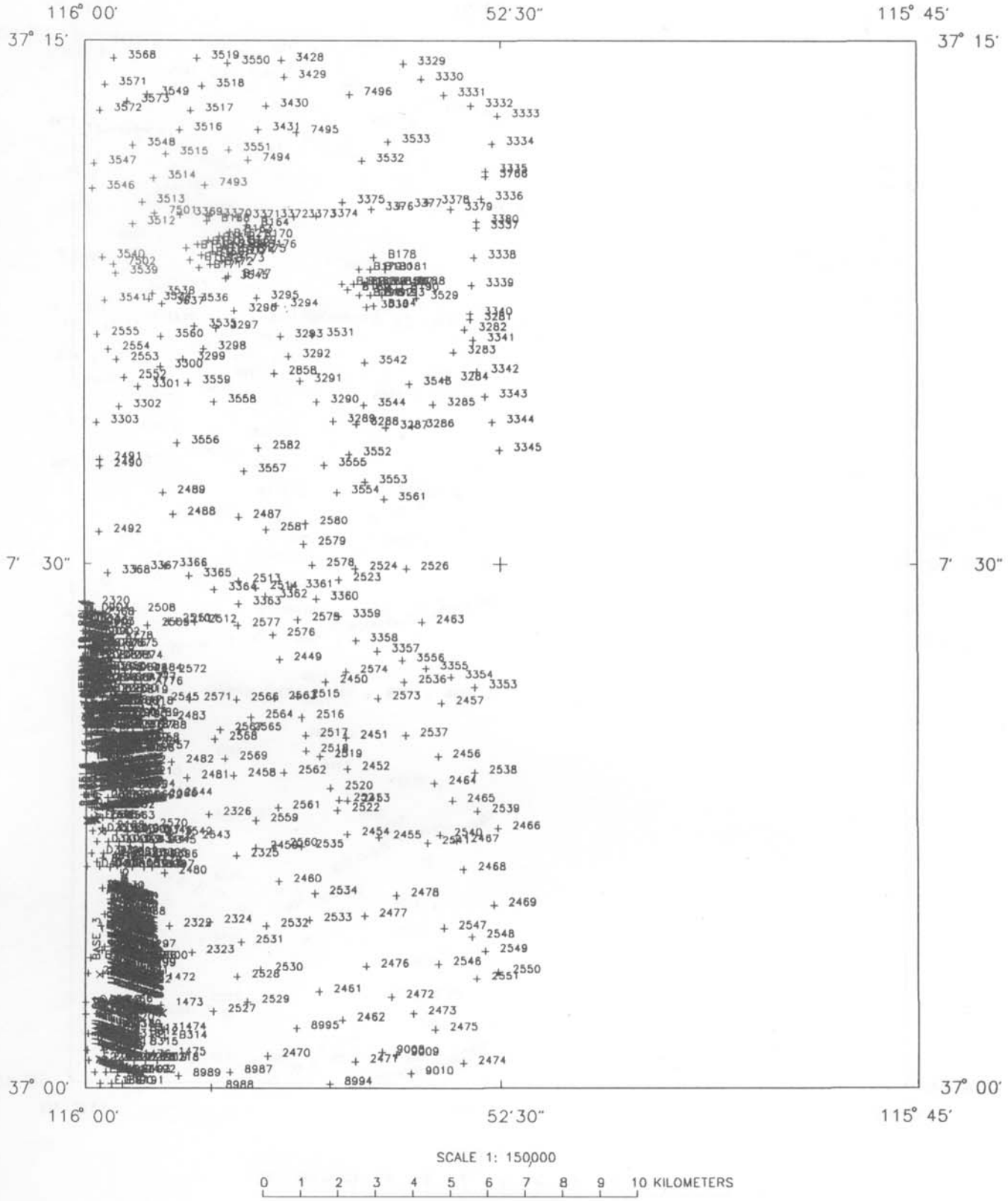


FIGURE 11h.–Gravity station name and location plot for quadrangle H.

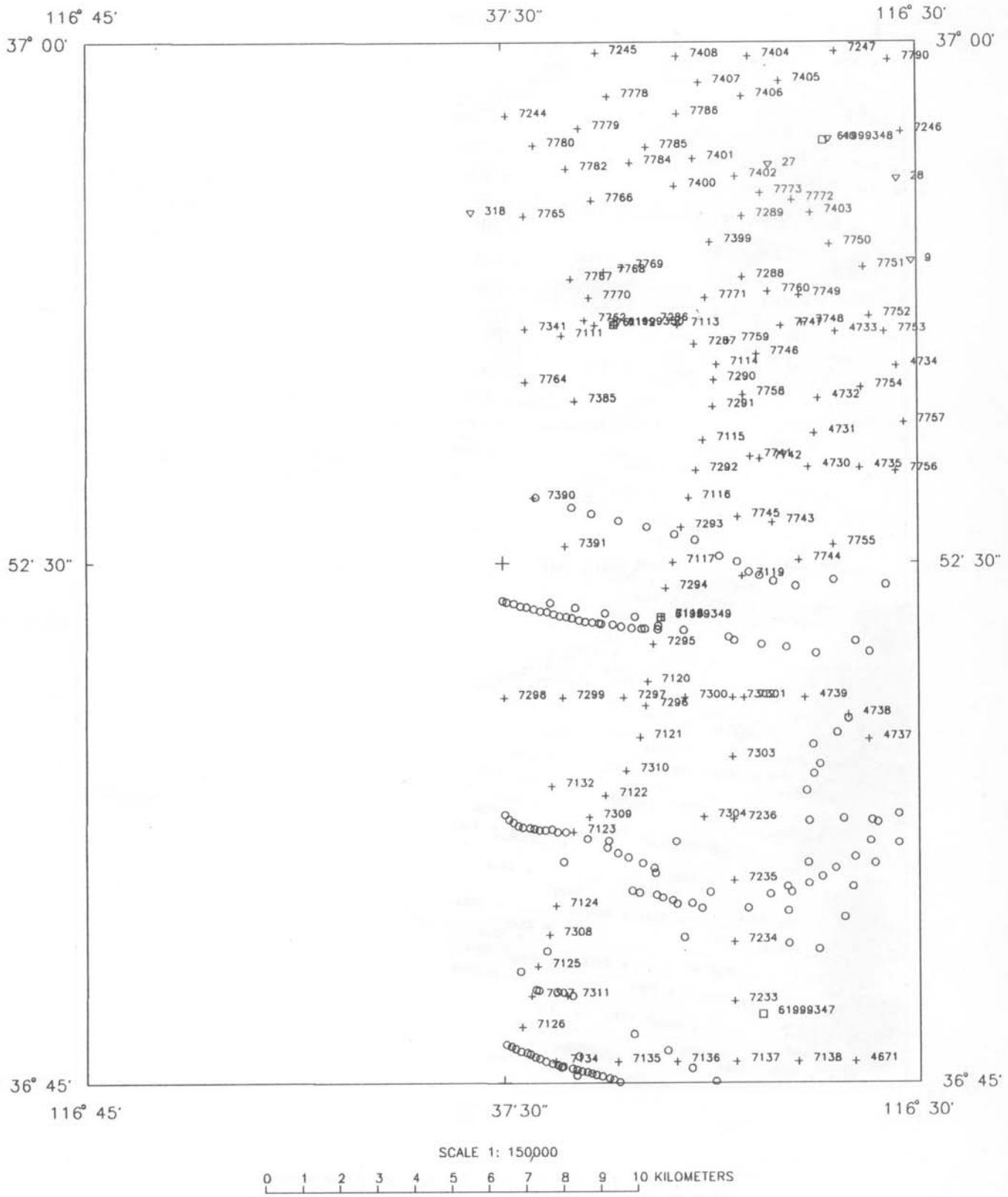


FIGURE 11i.–Gravity station name and location plot for quadrangle I.

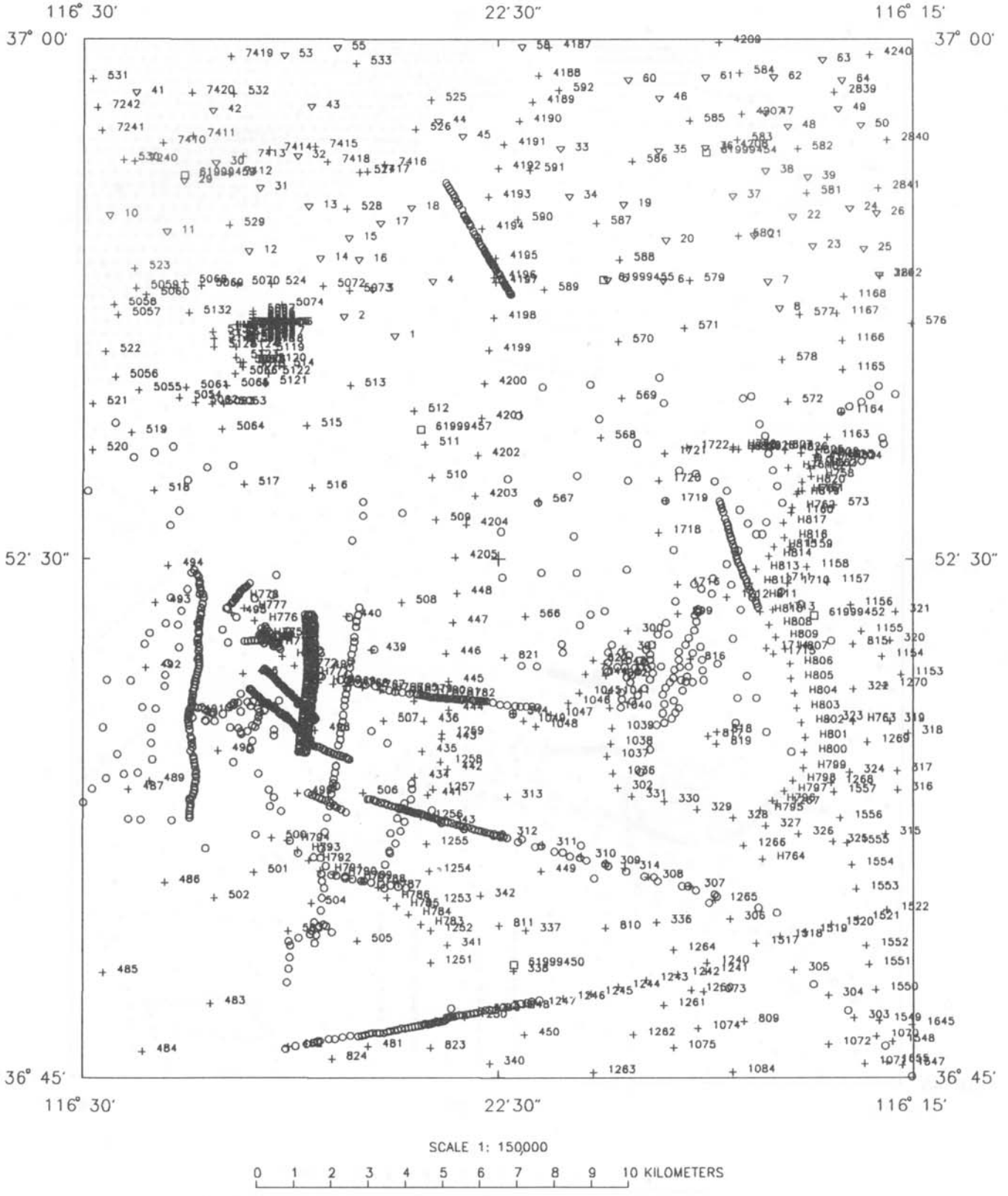


FIGURE 11j.–Gravity station name and location plot for quadrangle J.

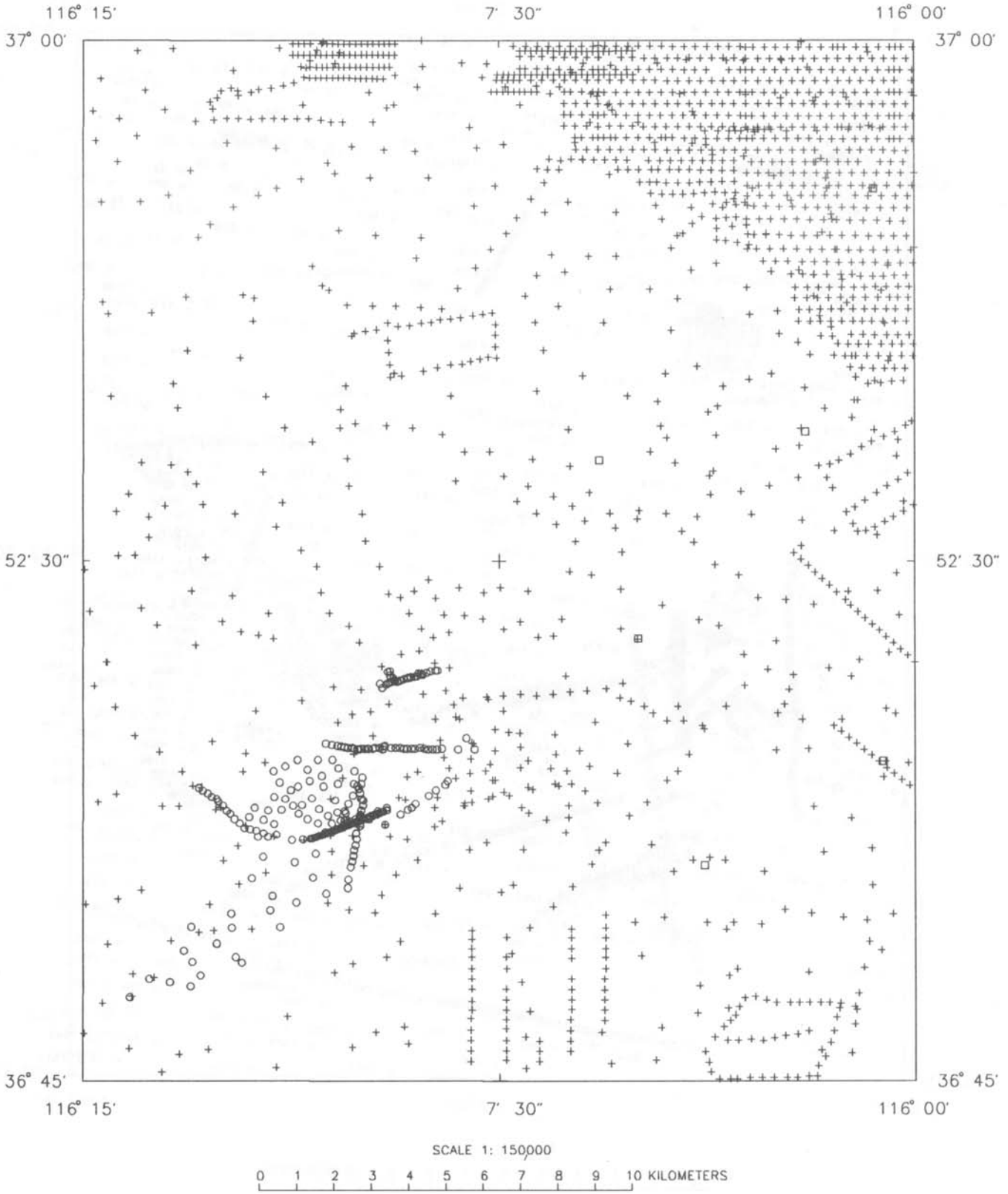


FIGURE 11k.–Gravity station name and location plot for quadrangle K.

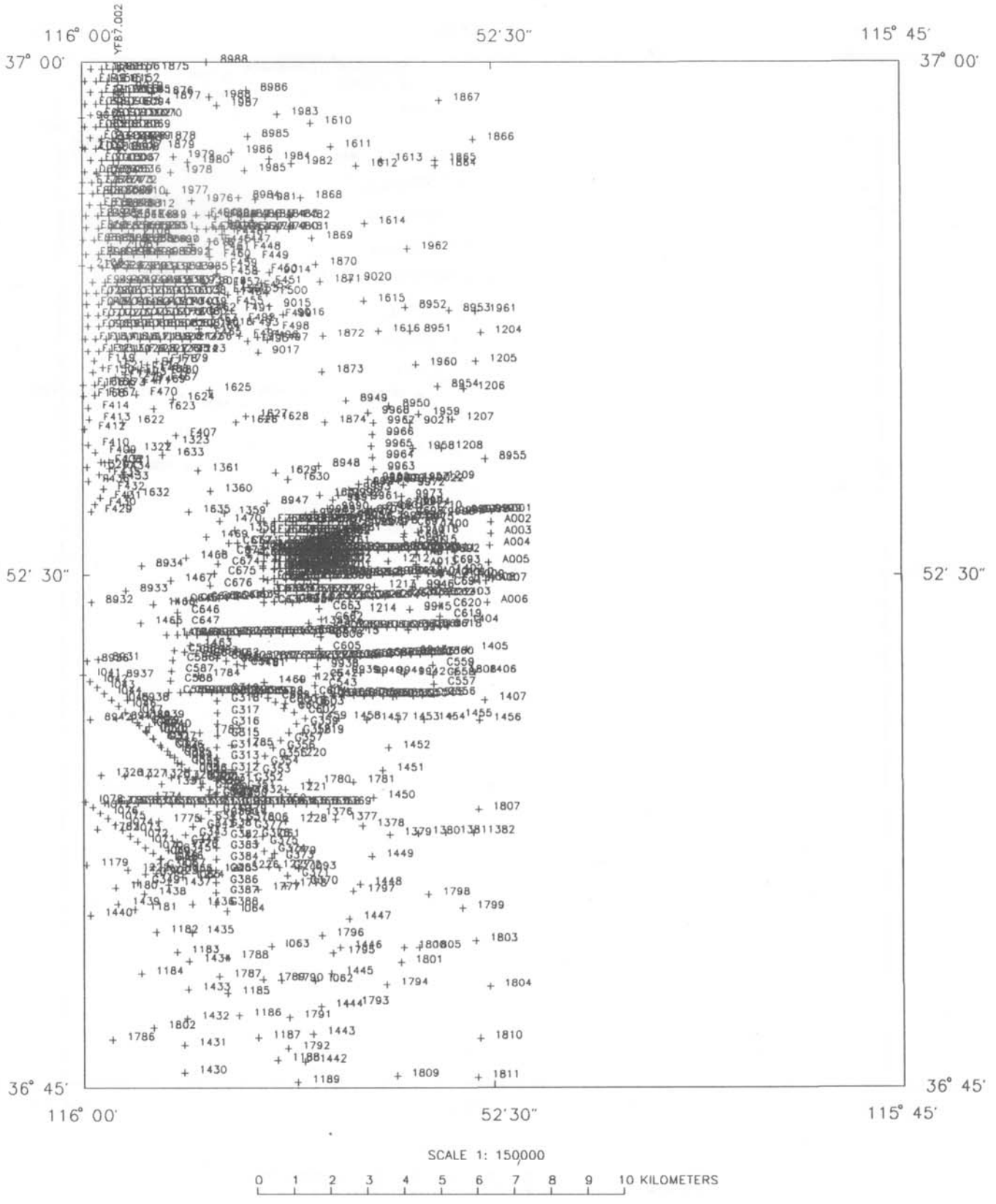


FIGURE 11l.–Gravity station name and location plot for quadrangle L.

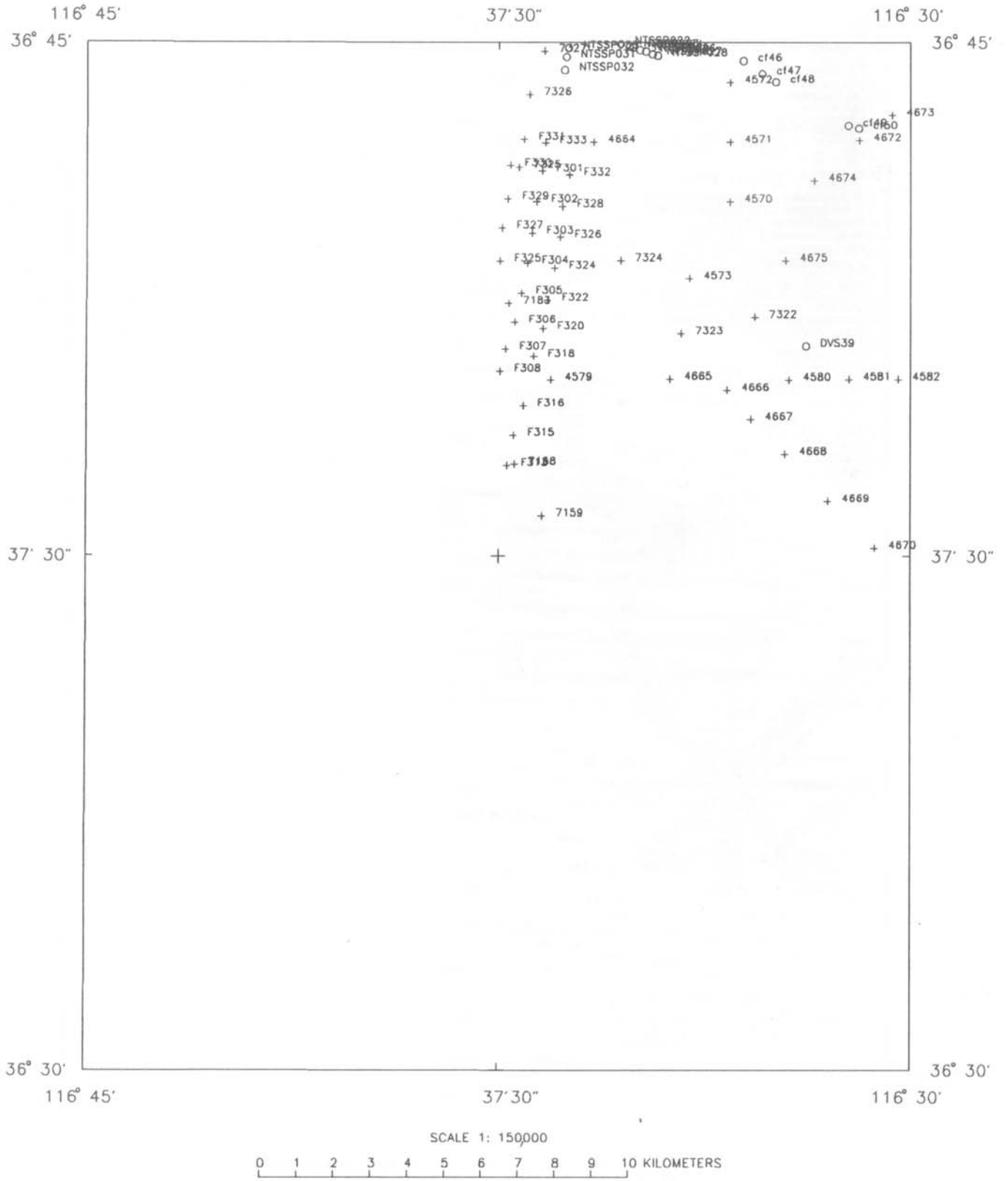


FIGURE 11m.–Gravity station name and location plot for quadrangle M.

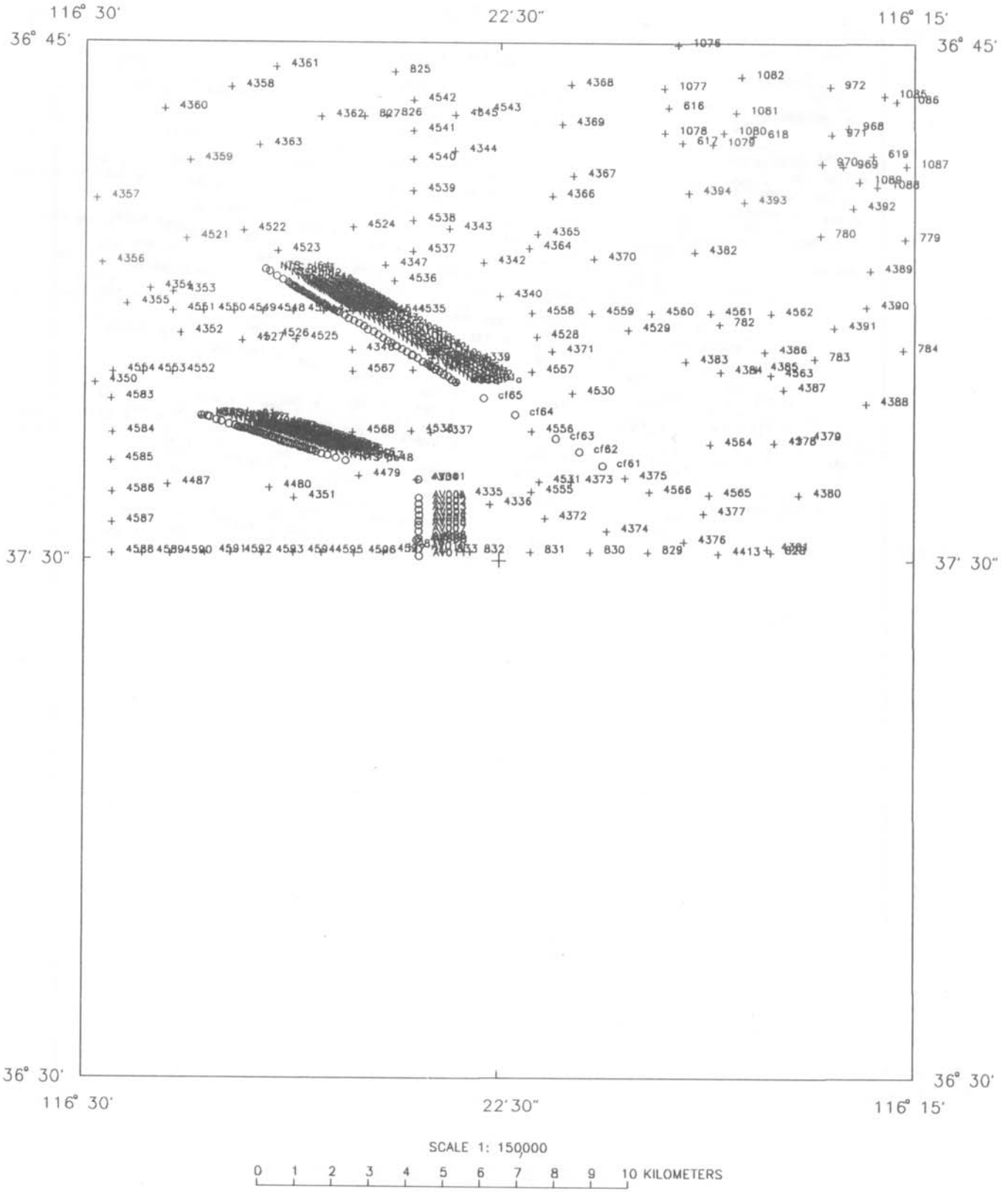


FIGURE 11n.–Gravity station name and location plot for quadrangle N.

FIGURE 11o.–Gravity station name and location plot for quadrangle O.

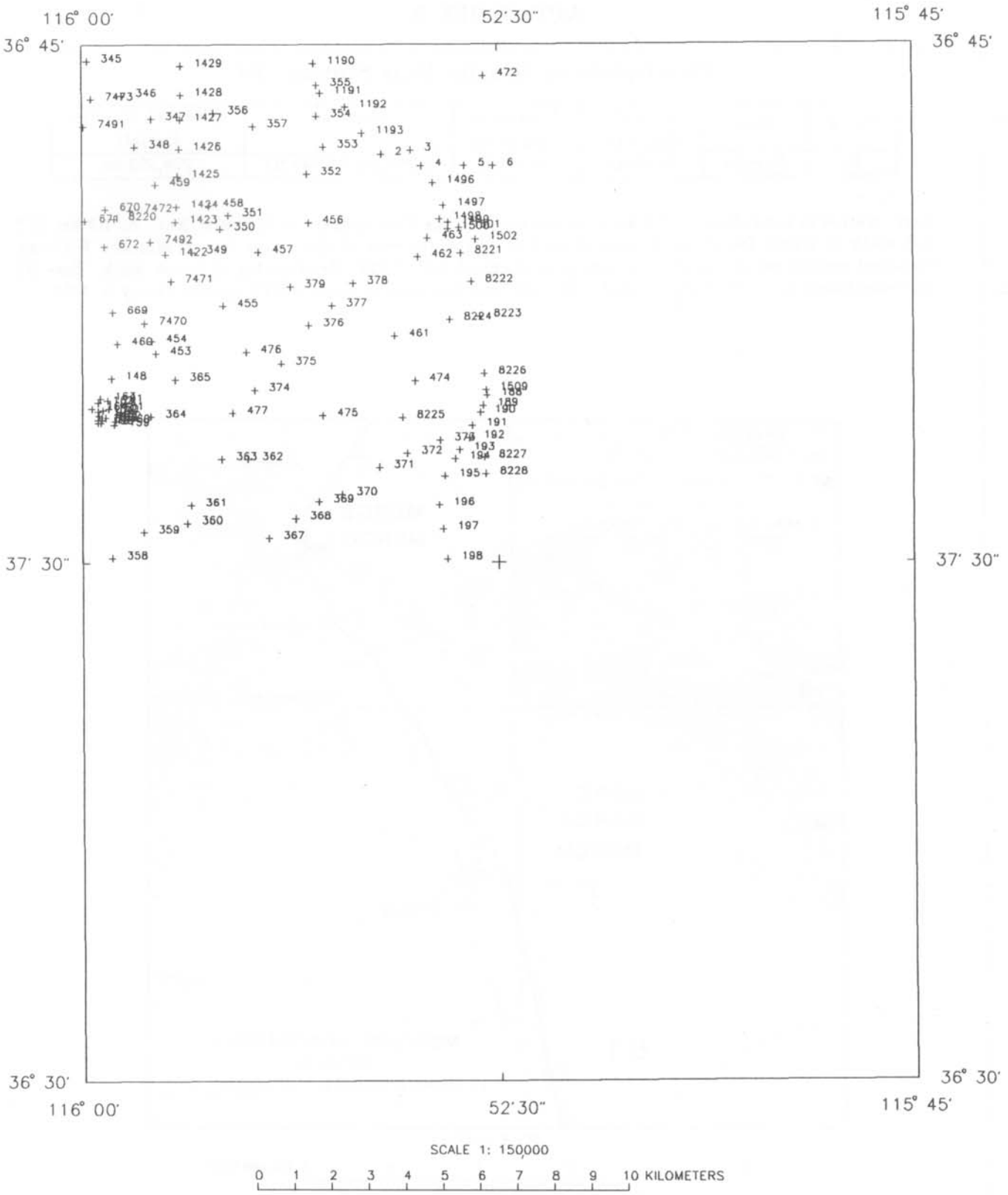


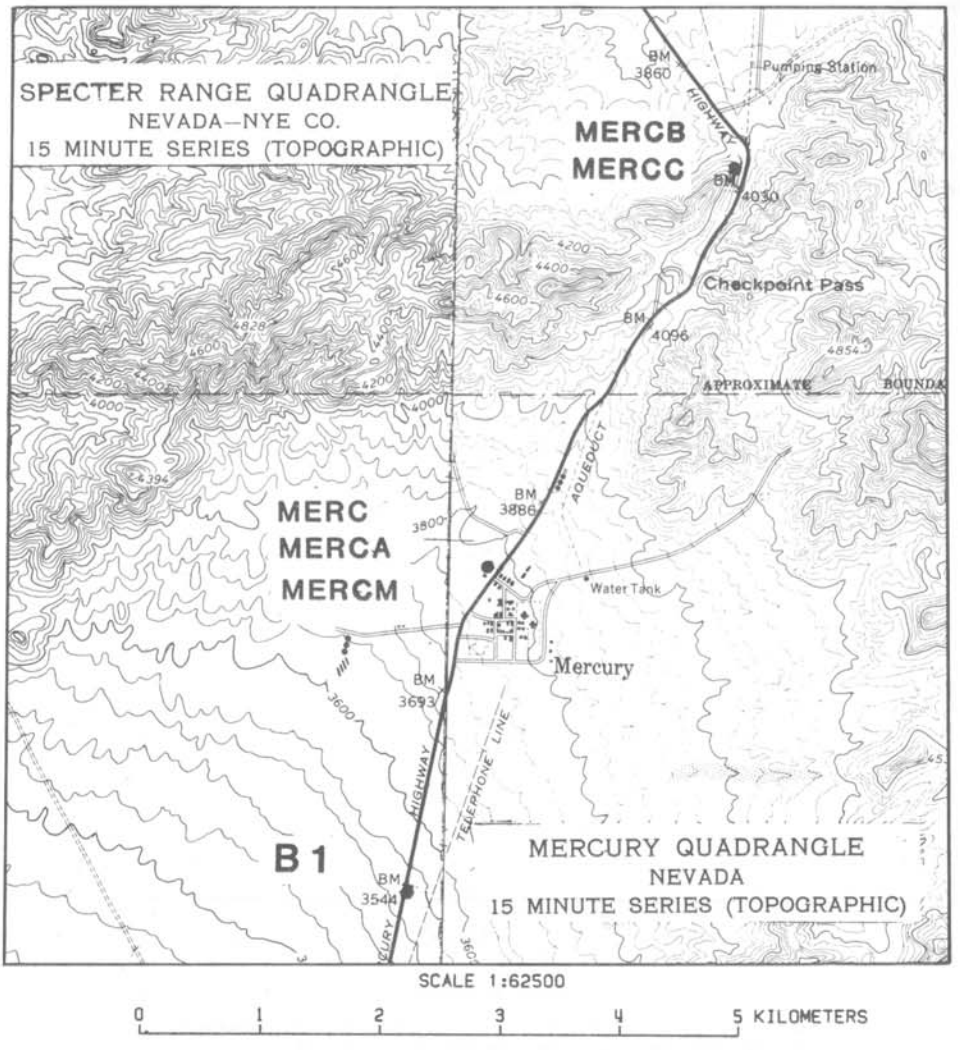
FIGURE 11p.–Gravity station name and location plot for quadrangle P.

APPENDIX A

Description of Gravity Base Station: *B1*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B1	Nevada	36 38.43	116 00.23	1,080.2 m (3,544 ft)	979,523.95

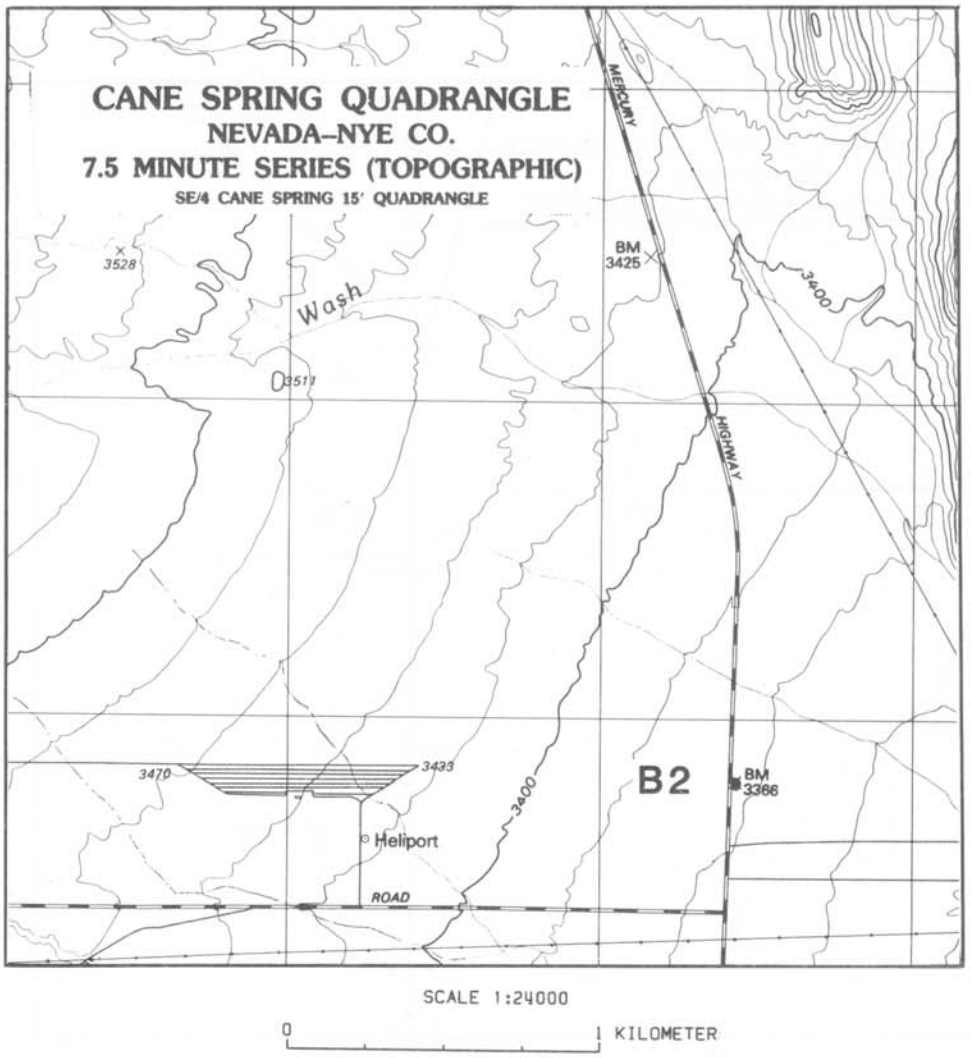
Base station is located about 2.7 km (1.6 mi) south of the Core Library in Mercury, Nev., or 1.3 km (0.8 mi) north of Camp Desert Rock turn off and 18 m (60 ft) west of the center line of Mercury Highway. Standard marker set in top of a concrete post stamped *BM Y-327*. Read on top of bench mark. Base B1 was established by D. R. Maby, probably in 1957, and was used to begin a NTS gravity survey in 1958.



Description of Gravity Base Station: *B2*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B2	Nevada	36 51.18	116 00.47	1,026.0 m (3,366 ft)	979,533.69

Base station is located about 24.8 km (15.4 mi) north along Mercury Highway from Mercury, Nev., about 0.5 km (0.3 mi) north of the junction of the Jackass Flat Road, and about 18 m (60 ft) east of the center line of Mercury Highway. Standard marker set in top of a concrete post stamped *BM R-328*. Read on top of BM.

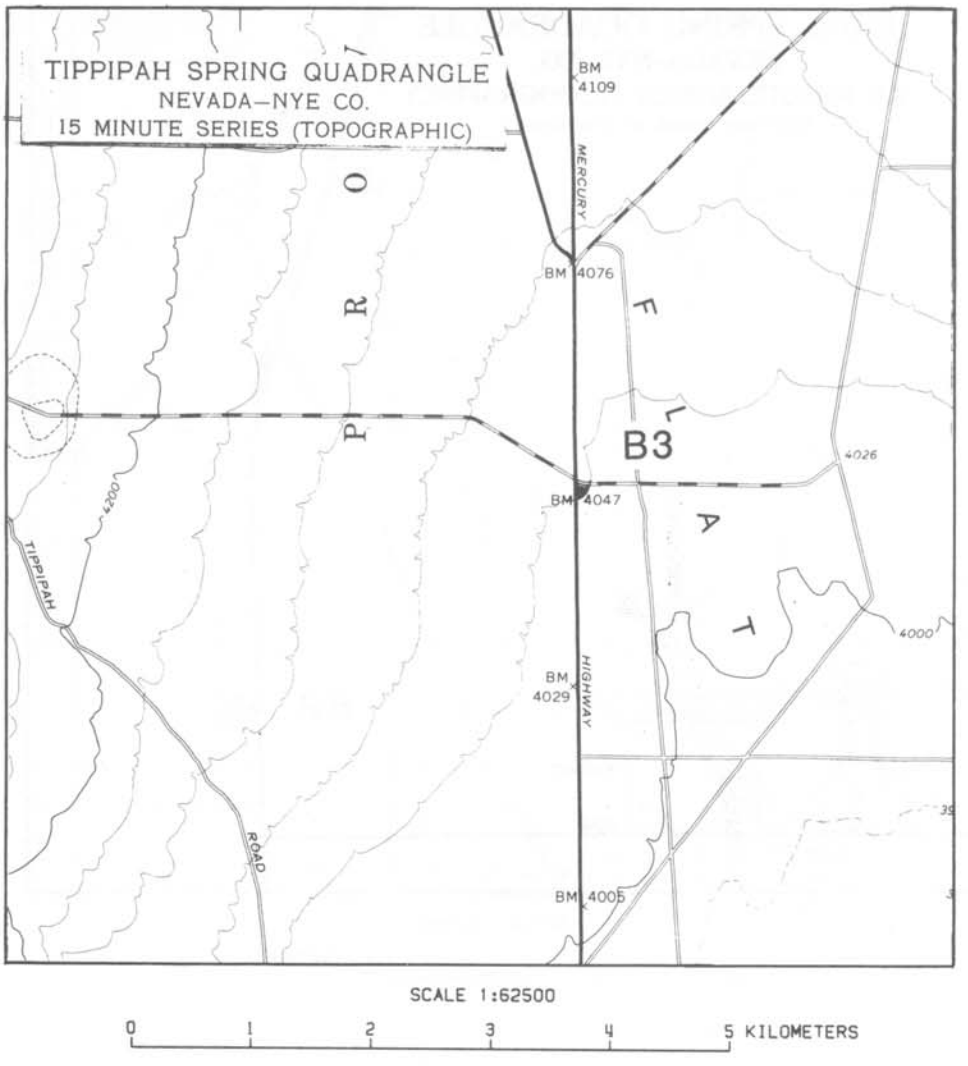


Description of Gravity Base Station: *B3*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
B3	Nevada	37 02.83	116 03.13	1,233.5 m (4,047 ft)	979,494.30

Base station is located in central Yucca Flat about 12.7 km (7.9 mi) north of Yucca Pass on Mercury Highway, 18 m (60 ft) east of Highway and 30 m (100 ft) south of road to the area 3 storage yard, a standard marker set on top of a concrete post stamped *BM F-329*.

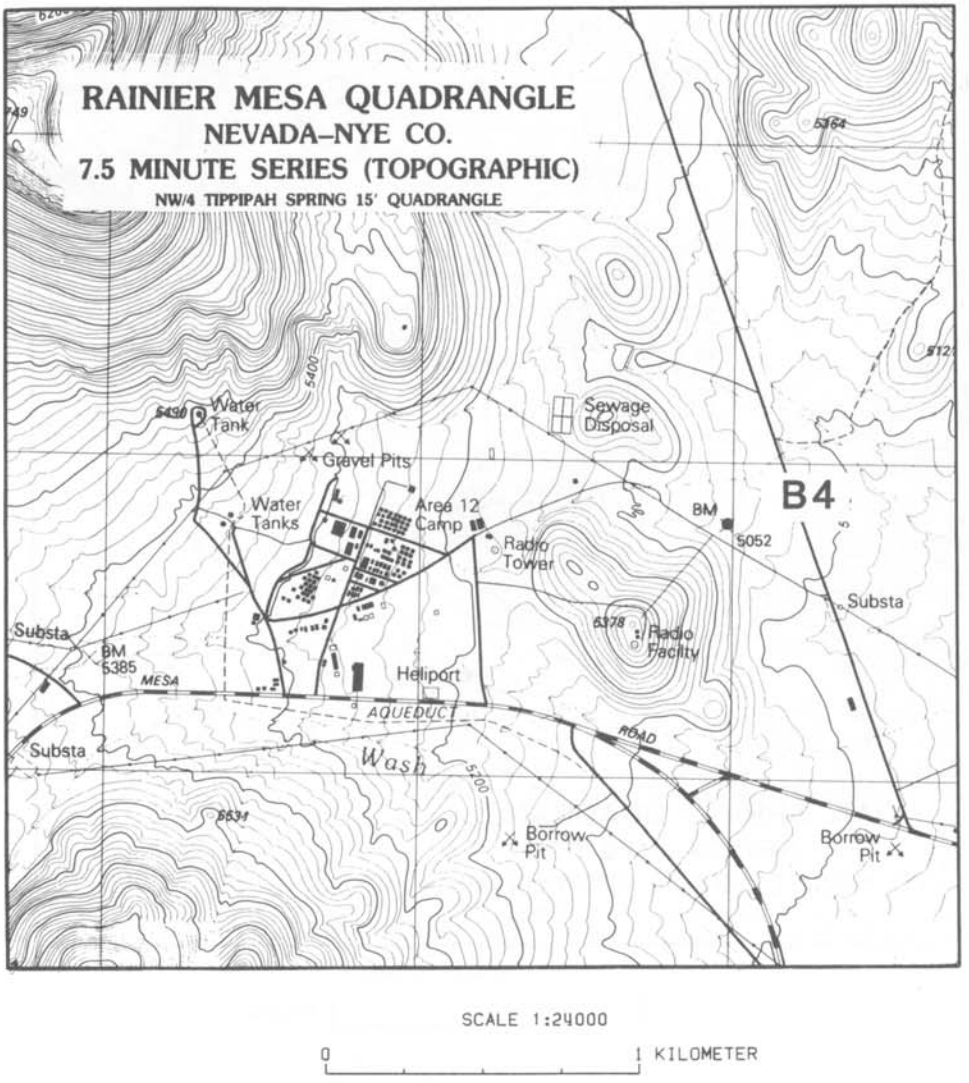
Note: Top of BM was knocked off during parking lot construction in 1976. The base of the concrete post was still visible when the site was last visited. Base 3 is no longer used. Base B3 was established on 8/8/58 by F.E. Currey using meter W-451.



Description of Gravity Base Station: *B4*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
B4	Nevada	37 11.83	116 08.67	1,539.8 m (5,052 ft)	979,459.48

Base station is located in northwest Yucca Flat, about 1.3 km (0.8 mi) east of the area 12 Miners Camp mess hall along the old area 12 road, about 21 m (70 ft) south of the road (now abandoned due to wash outs), and 24 m (80 ft) east of the area 12 dump, a brass cap set in a concrete post flush with the ground, stamped *H&N BM 8-F*. Read on top of BM. Base B4 was established on 8/12/58 by F. E. Currey using meter W-451



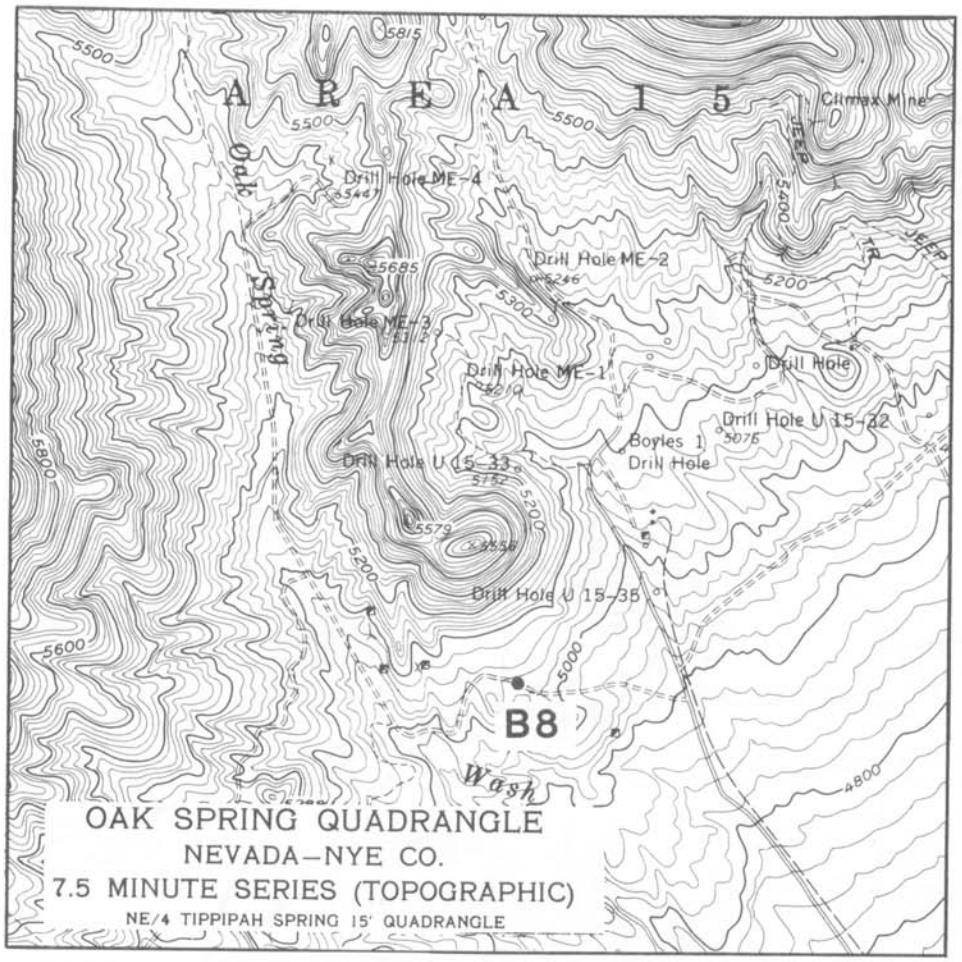
SCALE 1:24000

0 1 KILOMETER

Description of Gravity Base Station: *B8*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
B8	Nevada	37 13.19	116 03.83	1,533 m (5,030 ft) est.	979,456.63

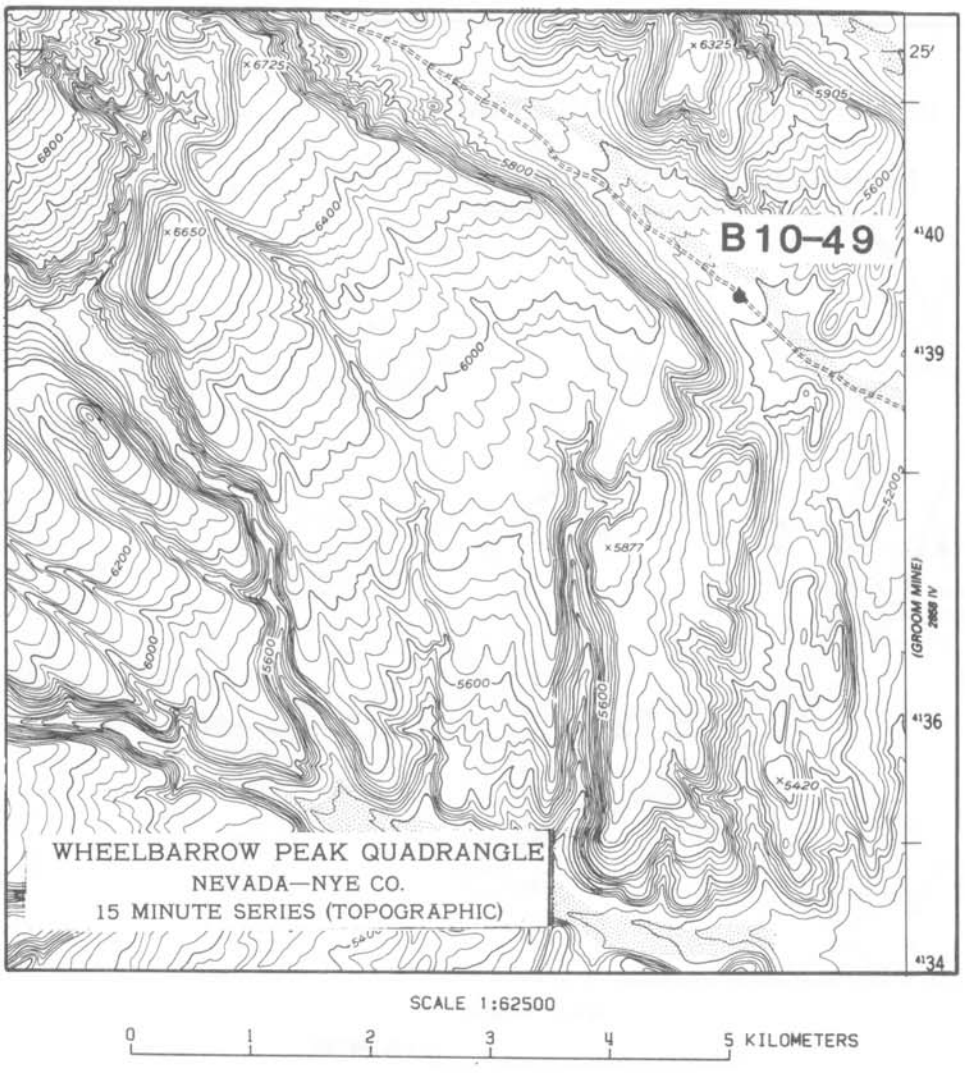
Base station is on a point of rock, about 5.6 km (3.5 mi) west-northwest of guard gate 700 along a track road leading to Oak Spring, about 6.1 m (20 ft) south of the road. Base is located at station 8, on H&N Line C, 1958. Base B8 was established on 3/10/59 by F. E. Currey using meter W-90.



Description of Gravity Base Station: *B10-49*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B10-49	Nevada	37 23.92	116 00.93	1,646 m (5,402 ft) est.	979,424.44

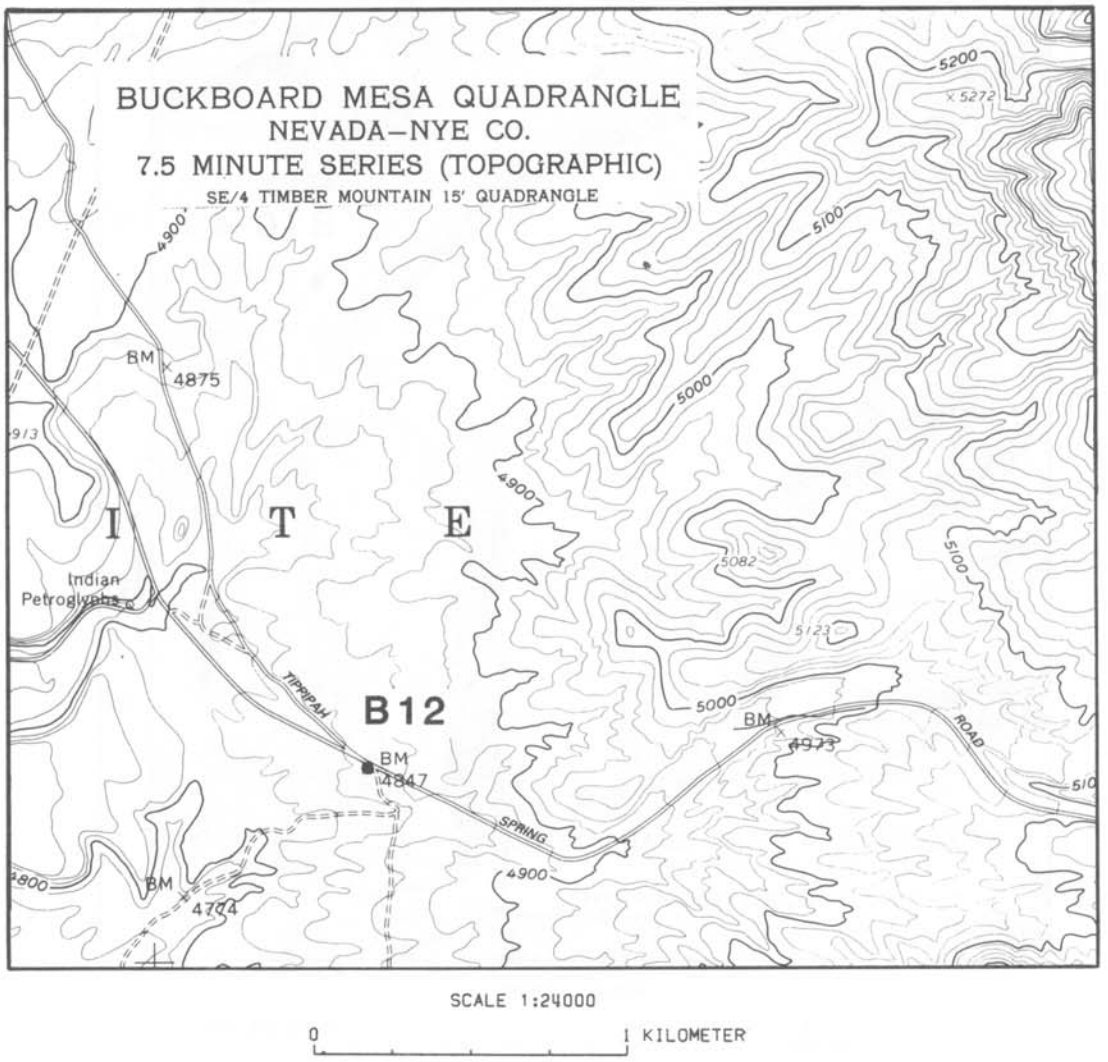
Base station is located near the northeast edge of the Wheelbarrow Peak 7.5′ quadrangle, along a track road leading to Johnnie's Water, at station 5, USGS Line 3A. Base would be difficult to relocate. Base was established on 7/9/60 by F. E. Currey from B10 using meter W-90.



Description of Gravity Base Station: *B12*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B12	Nevada	37 02.83	116 17.05	1,477.4 m (4,847 ft)	979,437.39

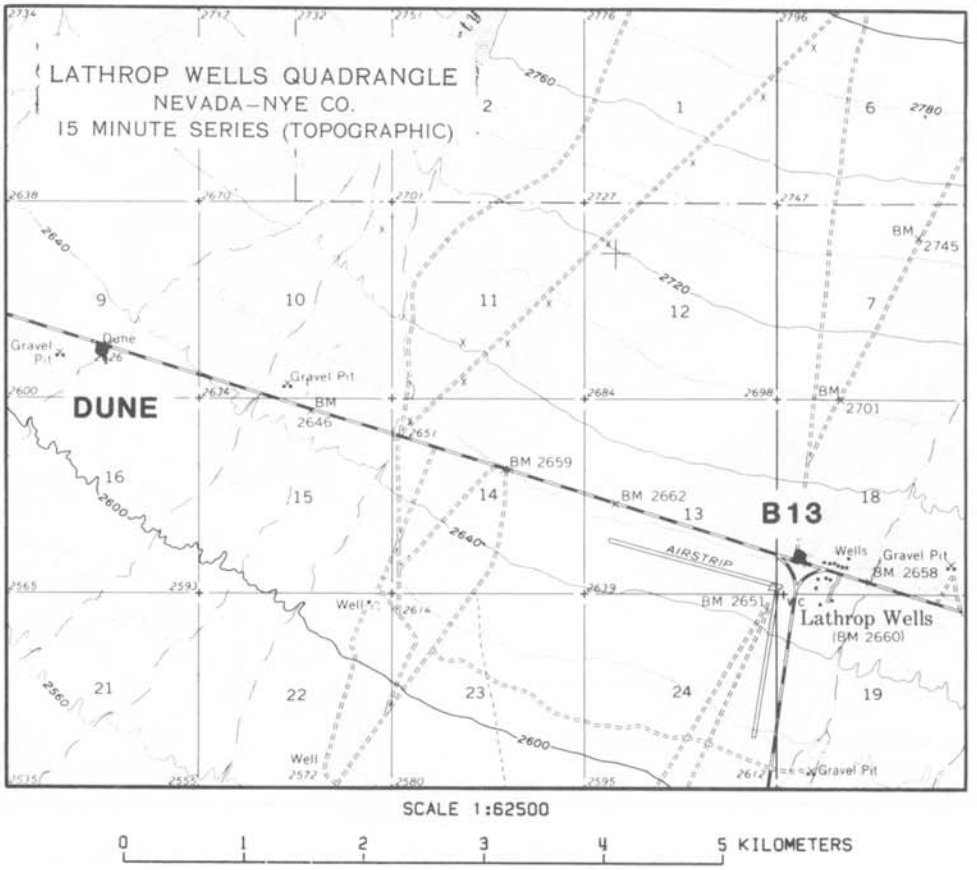
Base station is located about 12.7 km (7.9 mi) north along the Mercury Highway from Yucca Pass, then about 23.3 km (14.5mi) westward along the area 16 road to Tippipah Spring, at the junction of the road leading to Fortymile Canyon, 15 m (50 ft) west of the center line of the road, a standard marker, set in top of a concrete post, stamped *BM A-335*. Read on top of BM.



Description of Gravity Base Station: *B13*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
B13	Nevada	36 38.67	116 24.00	810.8 m (2,660 ft)	979,580.98

Base station is located 0.3 km (0.2 mi) west along U.S. Highway 95 from the east fork of the Y- junction of State Highway 29 at Lathrop Wells, 38 m (125 ft) north of the center line of a track road leading north, 6 m (19 ft) north of a pole, 2 m (6 ft) west of the extended center line of State Highway 29, and 1 m (2.5 ft) north of a white witness post. A standard marker set in top of a concrete post, stamped *B 33 1952*. Read on top of BM. This base was established by D. R. Mabey (USGS).

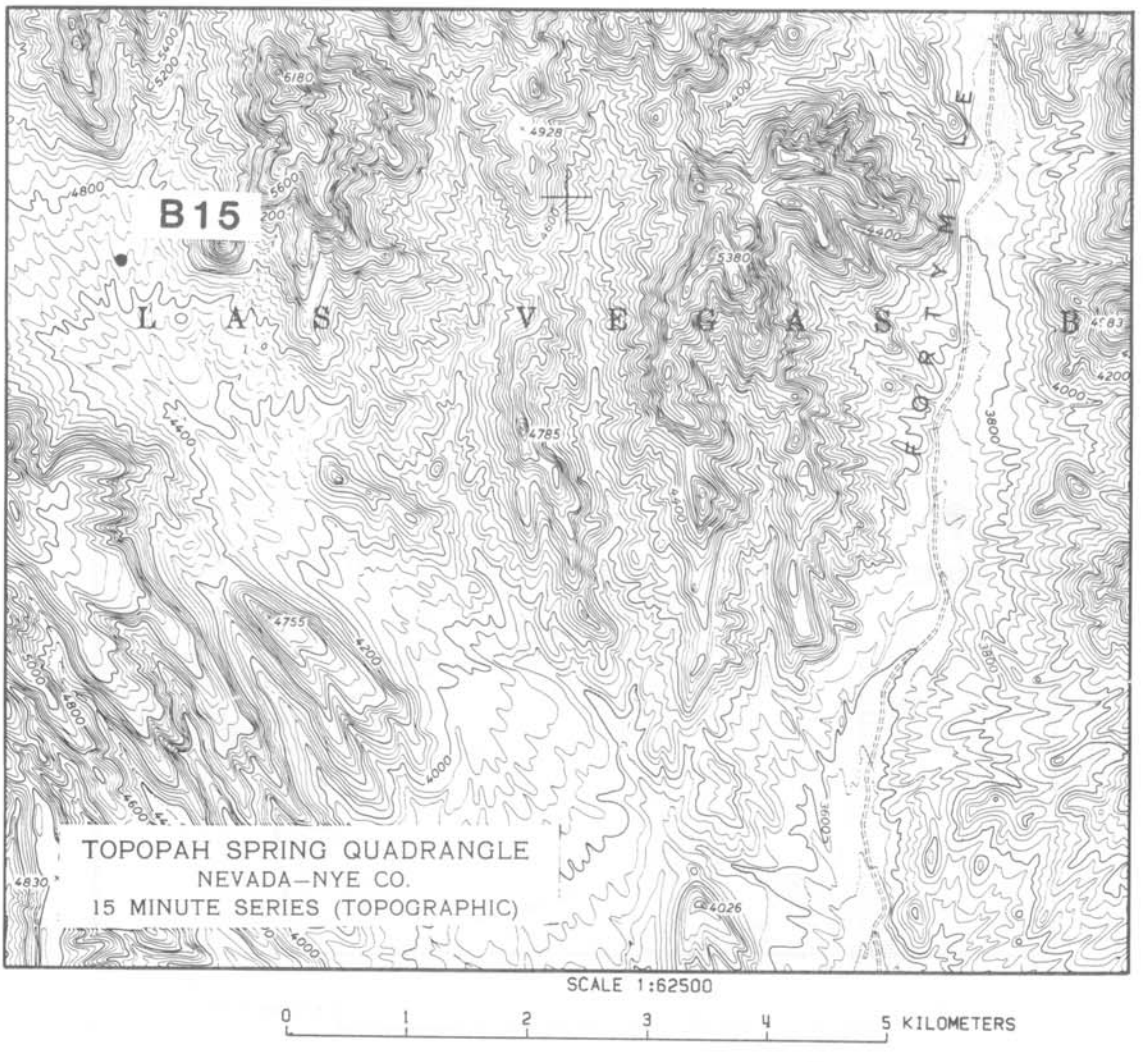


Description of Gravity Base Station: *B15*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B15	Nevada	36 54.73	116 27.47	1,419 m (4,657 ft) est.	979,447.48

Base station is located 7.6 km (4.7 mi) north of Well J-12 up Fortymile Canyon, then 11.8 km (7.3 mi) north-northwest along a track road, 0.8 km (0.5 mi) south of a large hill on top of a black rock, marked with a red cross. Read on top of rock.

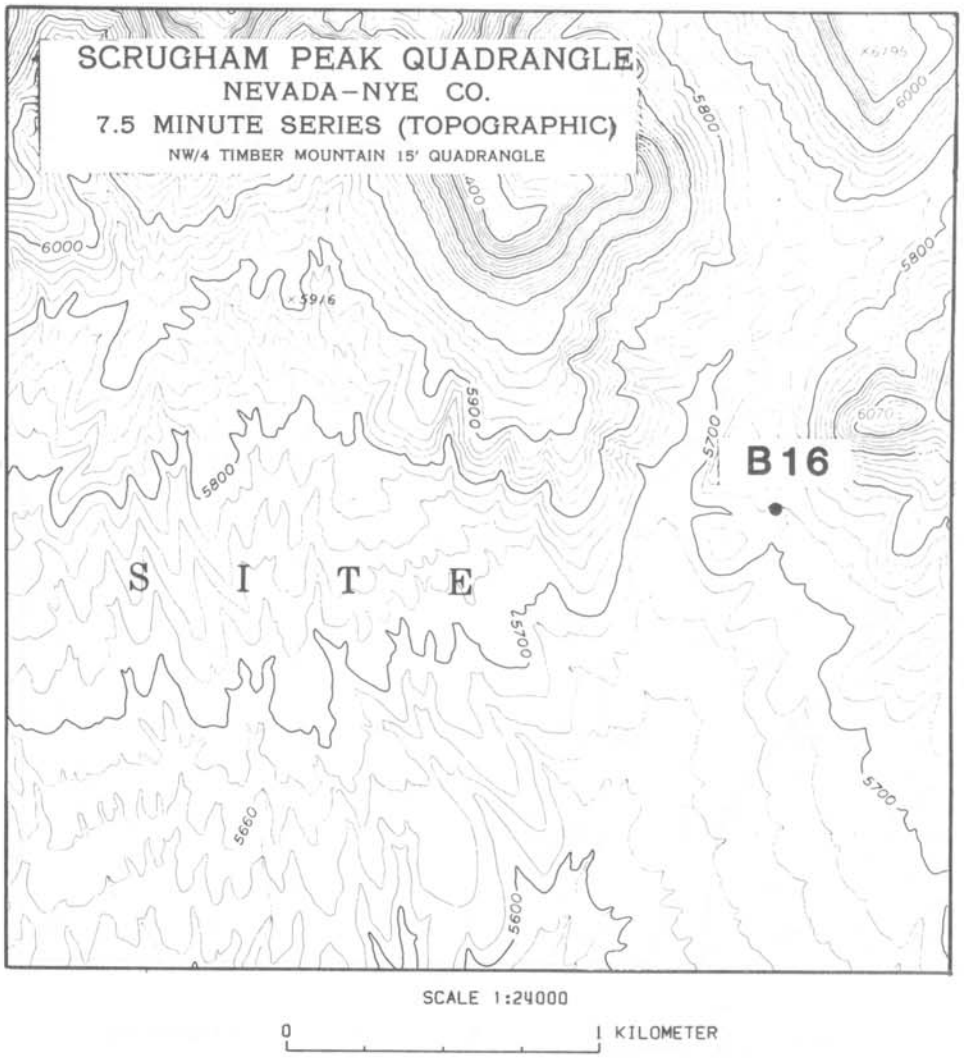
Note: This was a temporary base and was not intended for extended usage and would be difficult to relocate.



Description of Gravity Base Station: *B16*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B16	Nevada	37 10.83	116 22.88	1743 m (5720 ft)	979,376.44

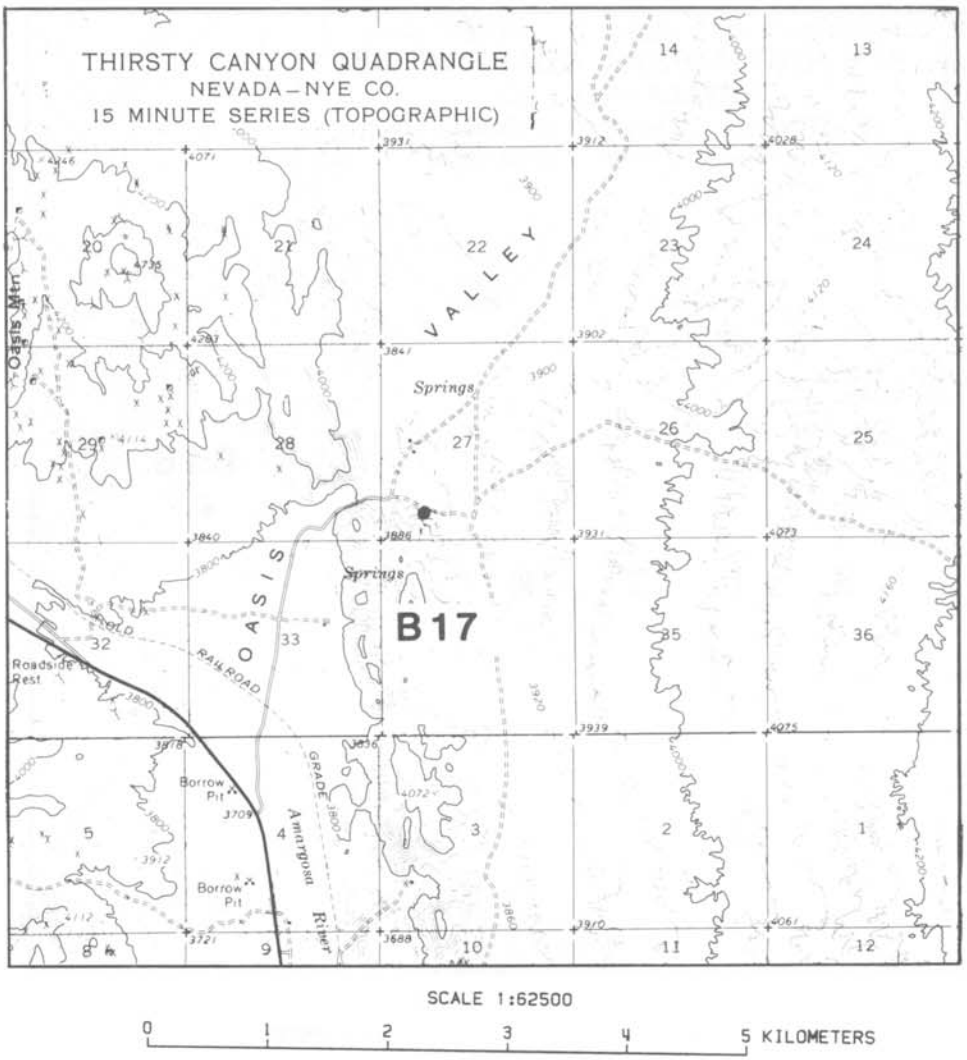
Base station (temporary) is located about 3.5 km (2.2 mi) east of the back Pahute Mesa road, on outer (northern most) Danny Boy arc road, near large juniper tree, rock painted black. Base was established 11/16/61 by F. E. Currey from base B12 using meter W-444.



Description of Gravity Base Station: *B17*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B17	Nevada	37 02.08	116 42.33	1,182 m (3,878 ft)	979,508.66

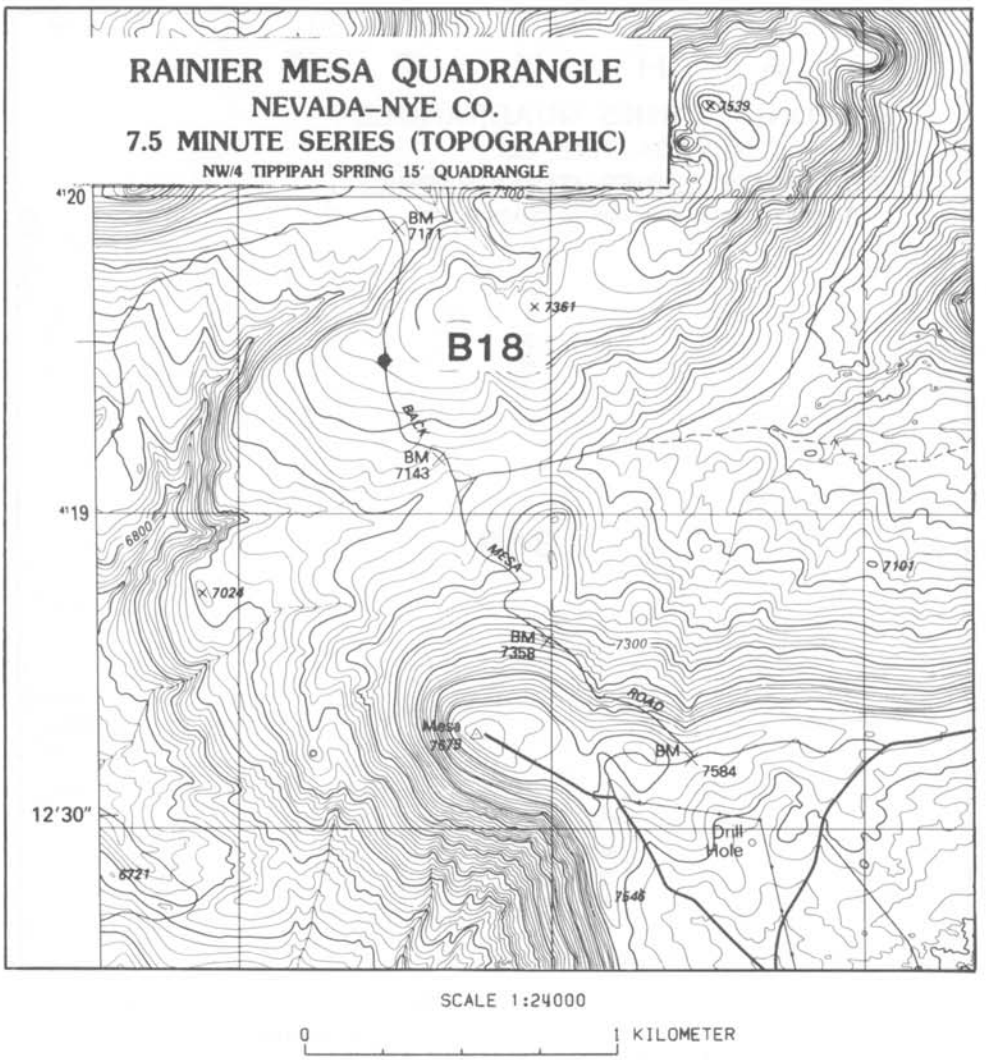
Base station is located 13.8 km (8.6 mi) north along U.S. Highway 95 from the Exchange Club in Beatty Nev., then about 3.2 km (2 mi) north-northeast along dirt road leading to Fleur de Lis Ranch, then 0.3 km (0.2 mi) east along Cat Canyon road, on top of small knoll, read on top of rock. Established 4/19/62 by F. E. Currey from base BEATTY using meter W-444.



Description of Gravity Base Station: *B18*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B18	Nevada	37 13.25	116 14.37	2,209.2 m (7,248 ft)	979,298.77

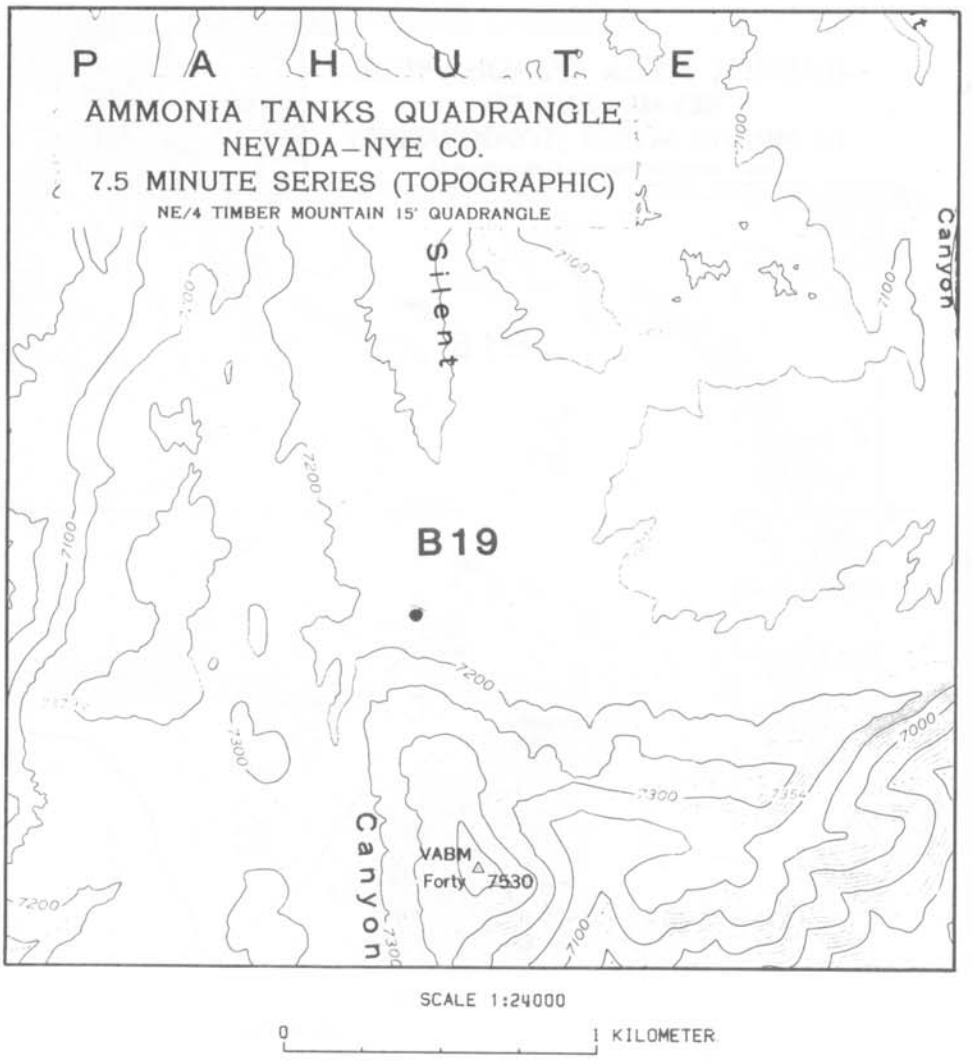
Base station is located down off the north side of Rainer Mesa. Station is 0.24 km (0.15 mi) north of the road to Rainier Mesa, and 0.24 km (0.15 mi) north of the road leading to Kawich Valley, then 30 m (100 ft) west of the road, an H&N standard cap set in top of a concrete post, stamped *BM 12-24*. Read on top of BM. Established 9/26/62 by F. E. Currey from base B4 using meter W-444.



Description of Gravity Base Station: *B19*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B19	Nevada	37 13.25	116 19.54	2185 m (7170 ft) est	979,285.27

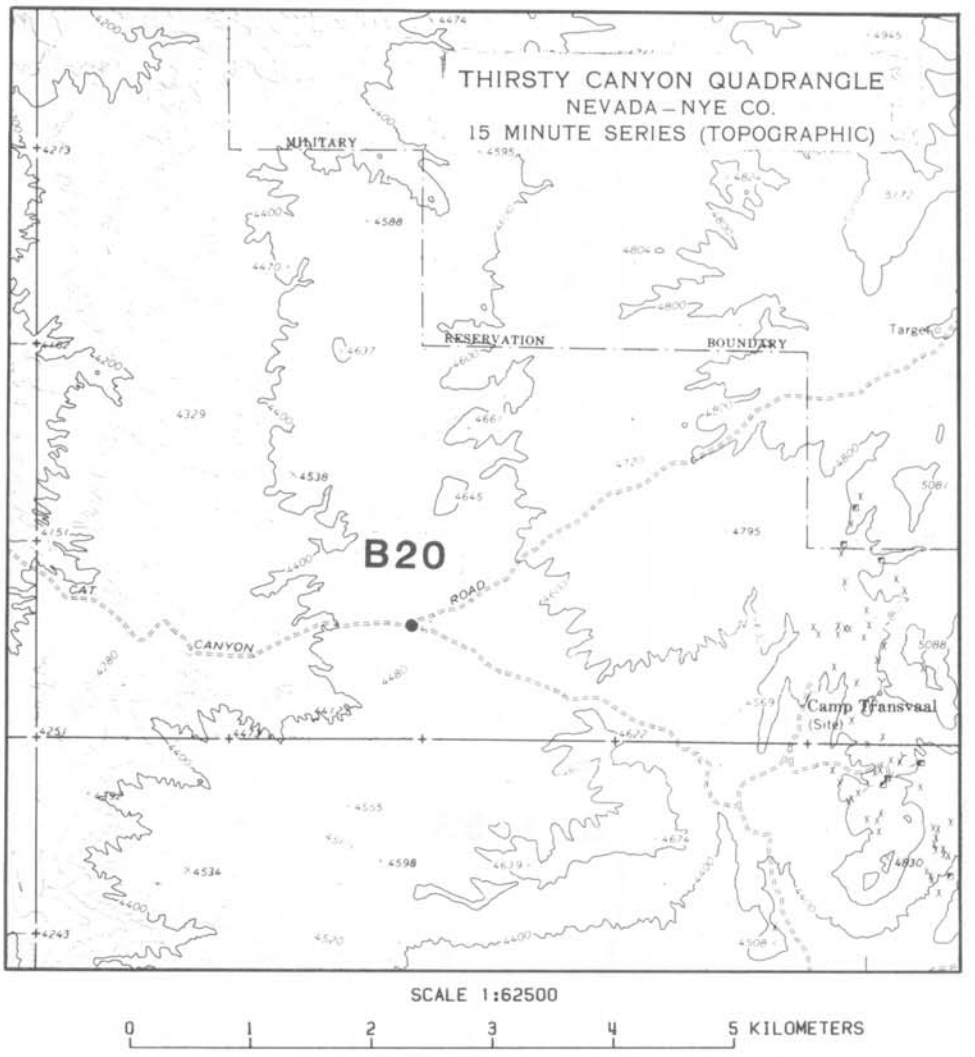
Base station was established on a point of rock at the west end of a large sagebrush flat near the south rim of Pahute Mesa, at a curve in the track road, 6 m (20 ft) south of the center line of the road. The site is identified by a painted black cross on the rock. This base is about 0.48 km (0.3 mi) north-northwest of USGS triangulation station 'Forty'. Established 9/26/62 by F. E. Currey from base B4 and B18 using meter W-444.



Description of Gravity Base Station: *B20*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B20	Nevada	37 01.52	116 37.57	1365 m (4480 ft) est.	979,456.51

Base station is located on the Cat Canyon road at the junction of the Cat Canyon road and the road leading to Beatty Wash and Camp Transvaal, on the west lip of a well, 6 m (20 ft) south of the Cat Canyon road. Established 9/28/62 by C. H. Miller from base BEATTY using meter W-444.

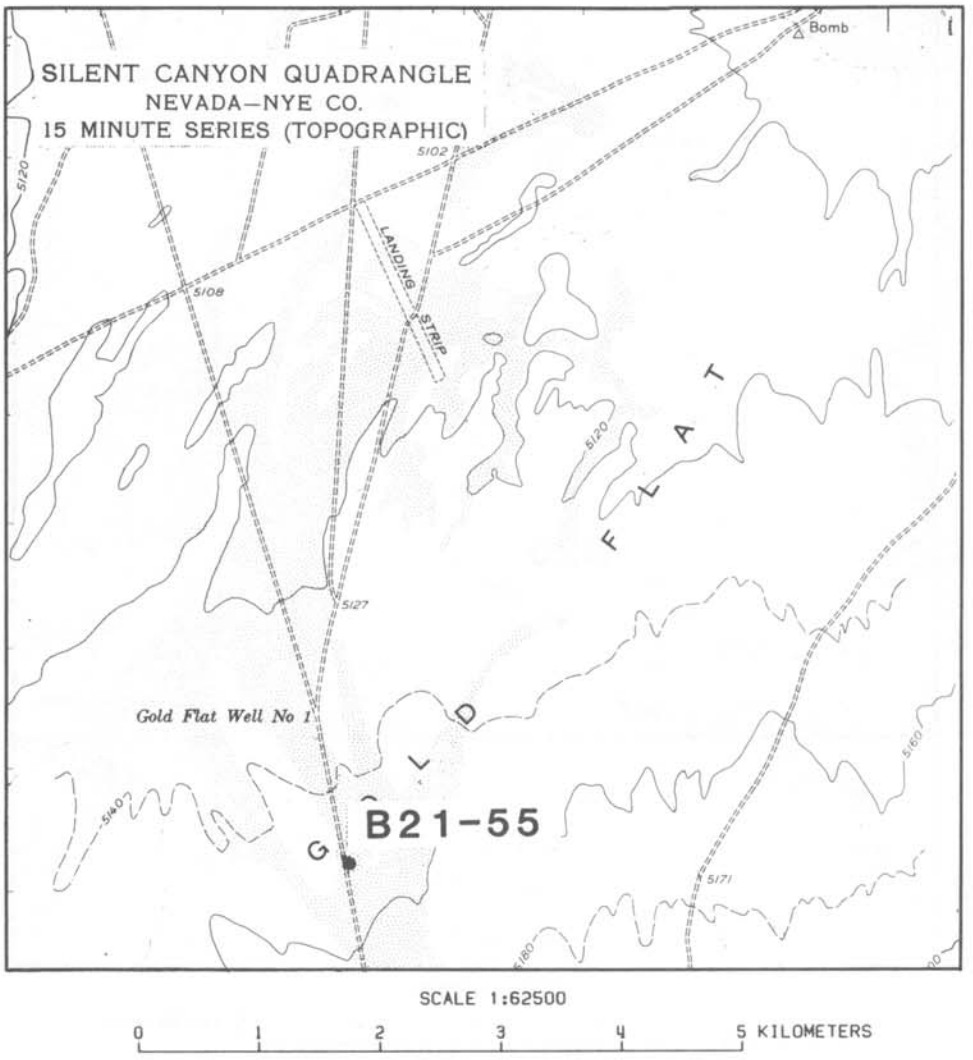


Description of Gravity Base Station: *B21-55*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B21-55	Nevada	37 26.53	116 28.17	1568 m (5145 ft) est.	979,430.37

Base station is located near the northwest corner of the Silent Canyon 15′ quadrangle about 7.3 km (4.5 mi) southwest of Triangulation station 'Bomb', about 457 m (0.3 mi) south of Gold Flat well no. 1, about 10 m (34 ft) east of road; a .5 inch iron pipe projecting about 0.24 m (0.8 ft) above the ground and stamped ET-PP. Read on ground beside pipe.

Established 2/28/65 by F. E. Curry from base B21 using W-444.

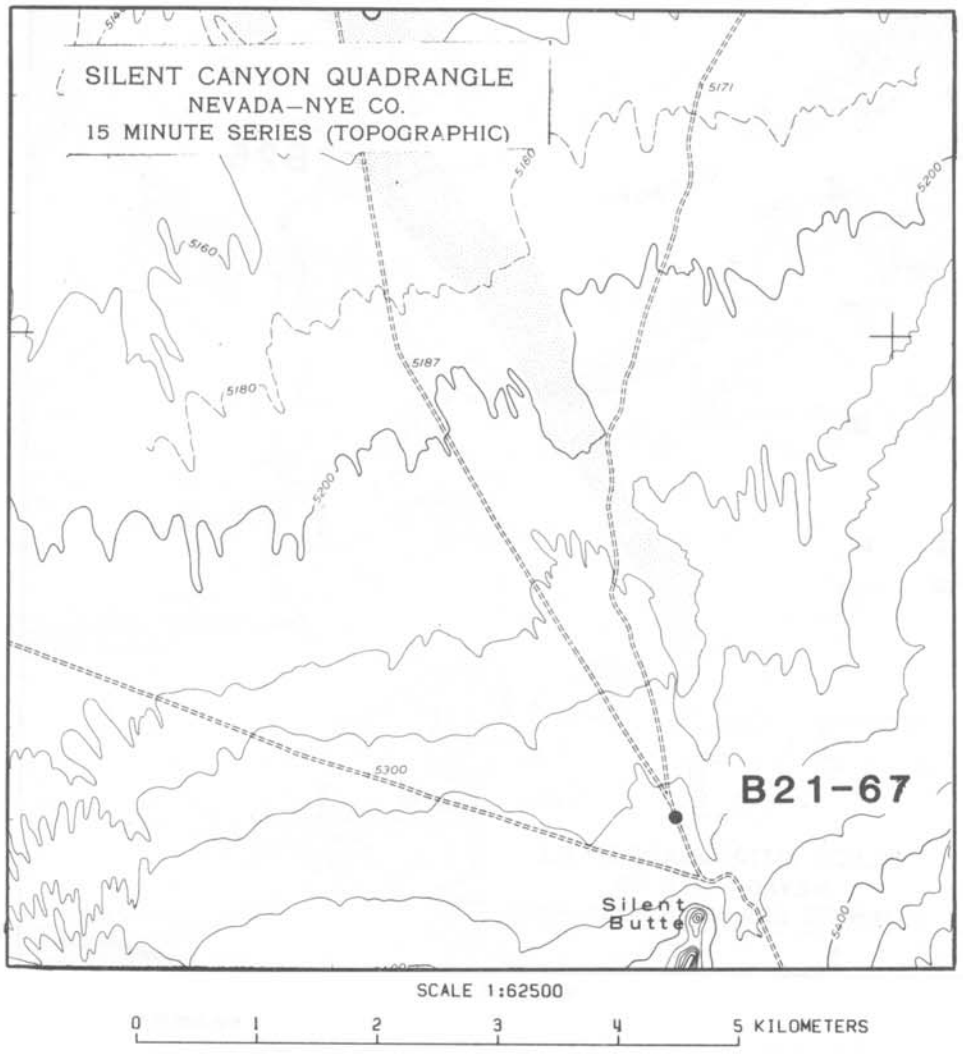


Description of Gravity Base Station: *B21-67*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B21-67	Nevada	37 22.87	116 26.20	1633m (5360 ft)	979,407.95

Base station is located in the west-central part of the Silent Canyon 15′ quadrangle, near the south end of Gold Flat, about 152 m (500 ft) south of a Y-intersection of the track road leading to Silent Canyon, about 0.6 km (1800 ft) northwest of a Y-intersection; about 18 m (60 ft) east of road on high point of a hill; a 0.5-inch iron pipe projecting 0.5 m (2 ft) above the ground stamped ET-TT. Read on ground beside pipe.

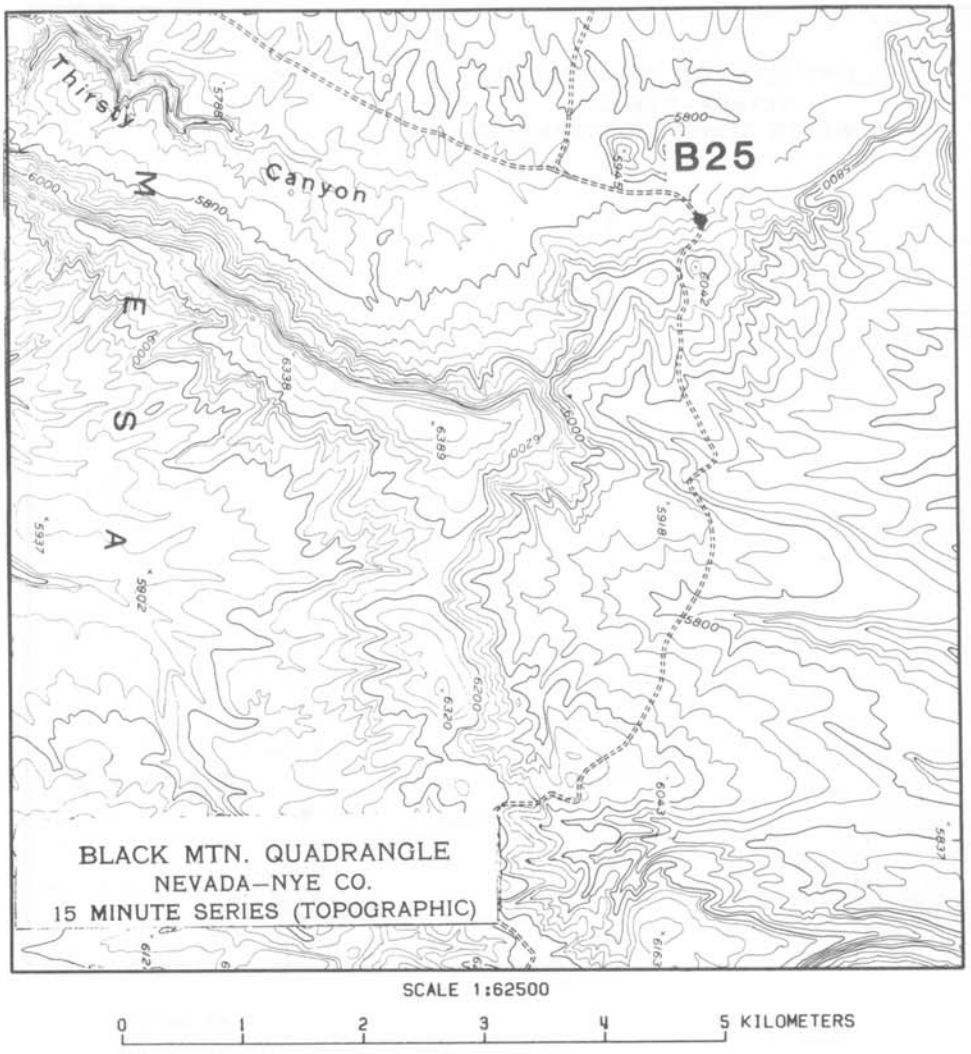
Established 2/28/65 by F. E. Curry from base B21 using W-444.



Description of Gravity Base Station: *B25*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B25	Nevada	37 18.03	116 34.75	1780 m (5840 ft) est.	979,483.73

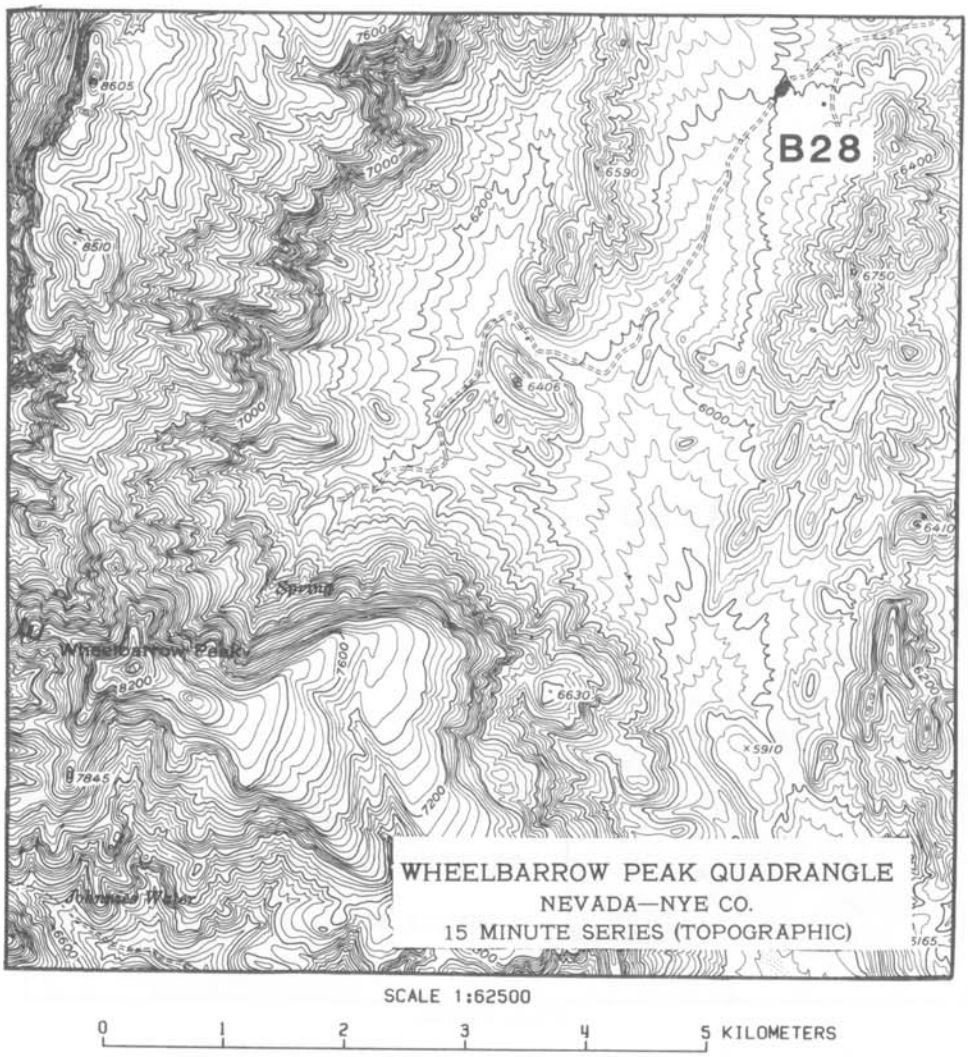
Base station is located in the Trail Ridge 7.5′ quadrangle at the junction of a track leading to Black Mountain and Thirsty Canyon, 30 m (100 ft) north of the junction, on a point of rock. Established 5/23/63 by F. E. Currey from base E331 using gravity meter W-444.



Description of Gravity Base Station: *B28*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
B28	Nevada	37 29.70	116 01.02	1890 m (6200 ft) est.	979,398.09

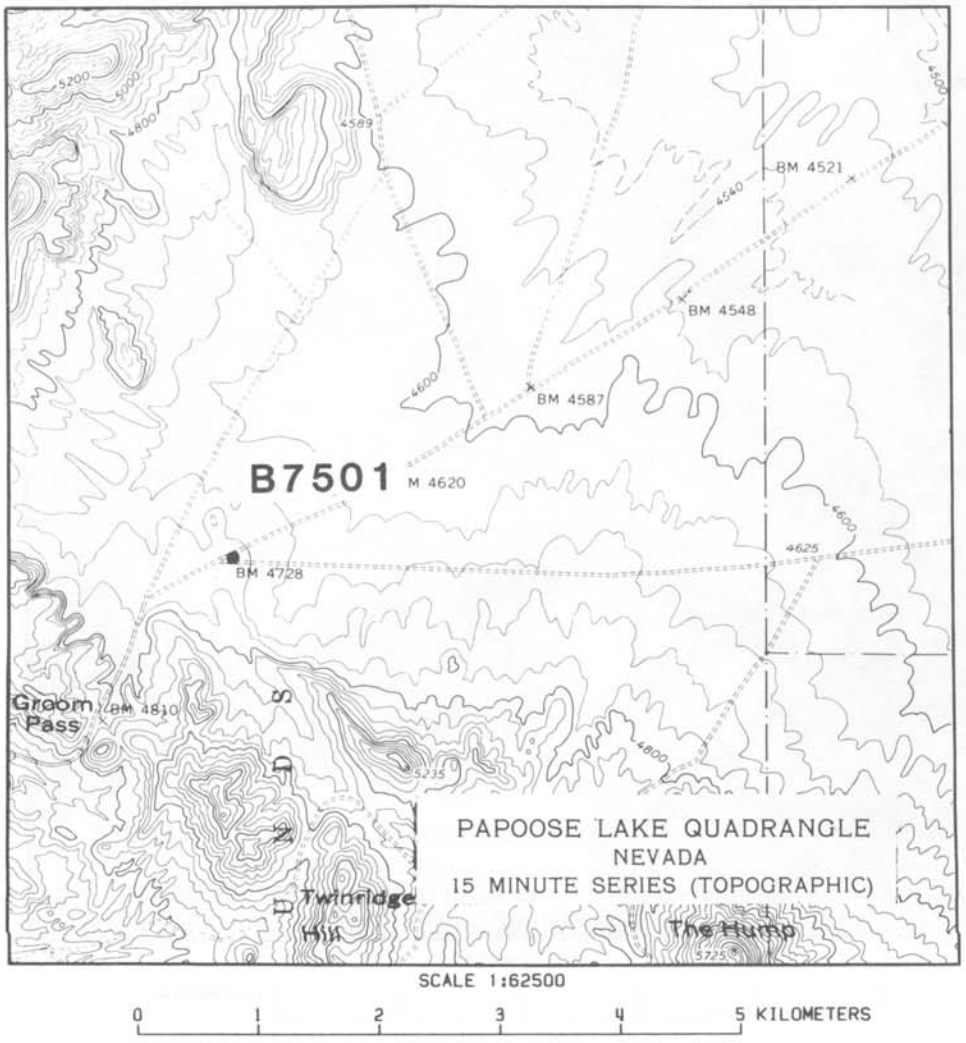
Base station is in the northeast corner of the Wheelbarow Peak quadrangle, on a rock painted red, 18 m (60 ft) northwest of the track road where the road crosses a saddle. Note: Base is 7.24 km (4.5 mi) straight line distance from the Wheelbarrow Peak triangulation station.



Description of Gravity Base Station: *B7501*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B7501	Nevada	37 12.52	115 58.73	1,441.1 m (4,728 ft)	979,465.70

Base station is located in the northwest part of the Papoose Lake NW quadrangle, at a junction where Groom Lake Road turns from a northeast to an east direction and a track road that continues in a northeast direction, a standard marker set in top of a concrete post, stamped *BM D-330*. Read on top of BM. Note: This base was never used as a reference for NTS gravity stations. Base was formerly M-175, established by D. R. Mabey.



Description of Gravity Base Station: *B7645*

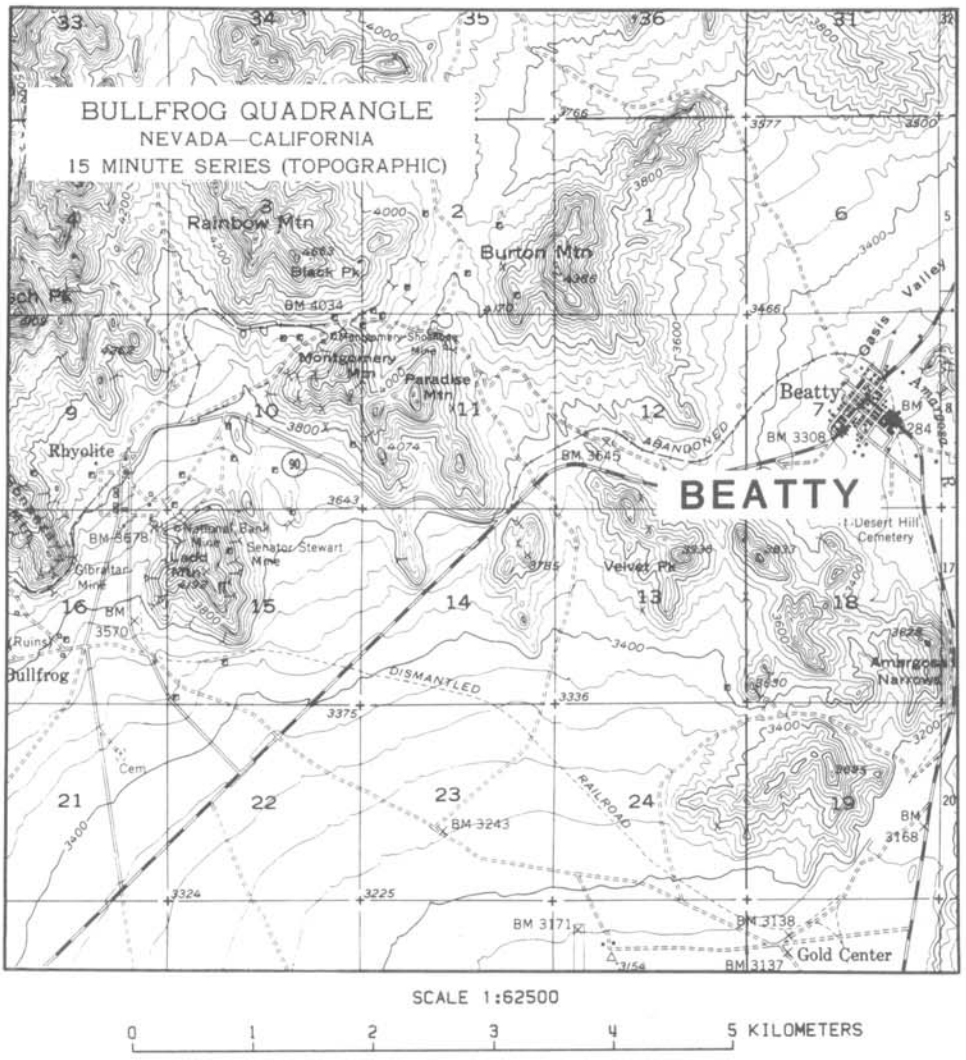
Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
B7645	Nevada	37 07.58	116 33.70	1,519 m (4,986 ft)	979,416.66

Base station is located at the southern edge of the Thirsty Canyon 7.5′ quadrangle, on a low ridge south of a jeep trail, on photo point 2-70-A. Base was never used as a reference point for NTS gravity stations. Base was established on 12/14/63 by F. E. Currey from base B17 meter W-134.

Description of Gravity Base Station: *BEATTY*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
BEATTY	Nevada	36 54.42	116 45.38	101.0 m (3,284 ft)	979,568.52

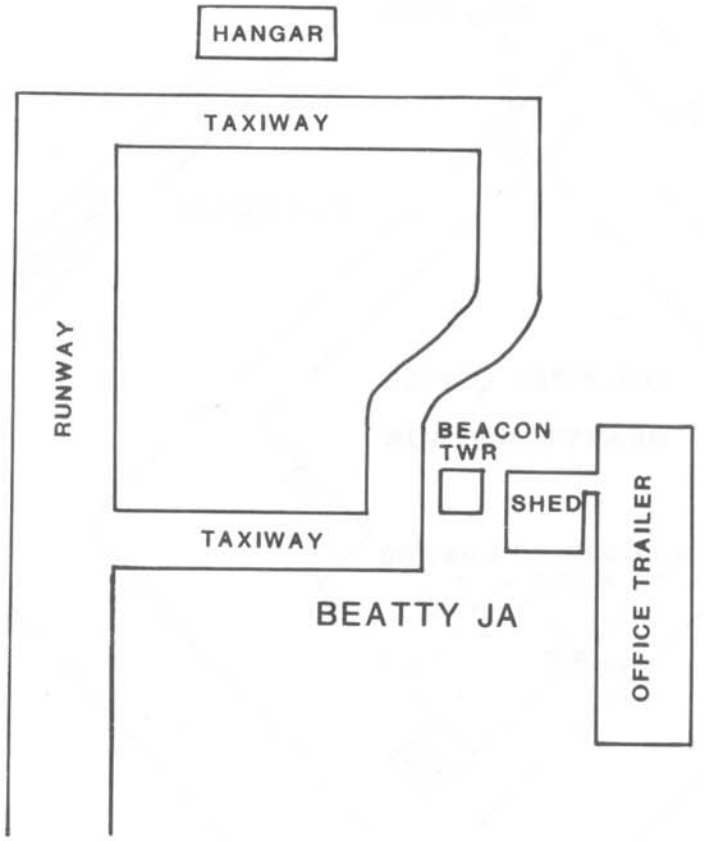
Base station at Beatty, Nye County, Nev., on U.S. Highway 95, about 0.16 km (0.1 mi) east of the junction of Nevada Highway 58 leading to Death Valley, 16.8 m (55 ft) southwest of the center line of highway, 1 m (2 ft) southeast of a southeast wall of a wooden building, a standard marker, set in top of a concrete post, stamped *M-16*. Read on ground beside BM.



Description of Gravity Base Station: *BEATTY JA*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
BEATTY JA	Nevada	36 52.10	116 37.00	958.5 m (3,145 ft)	979,579.058

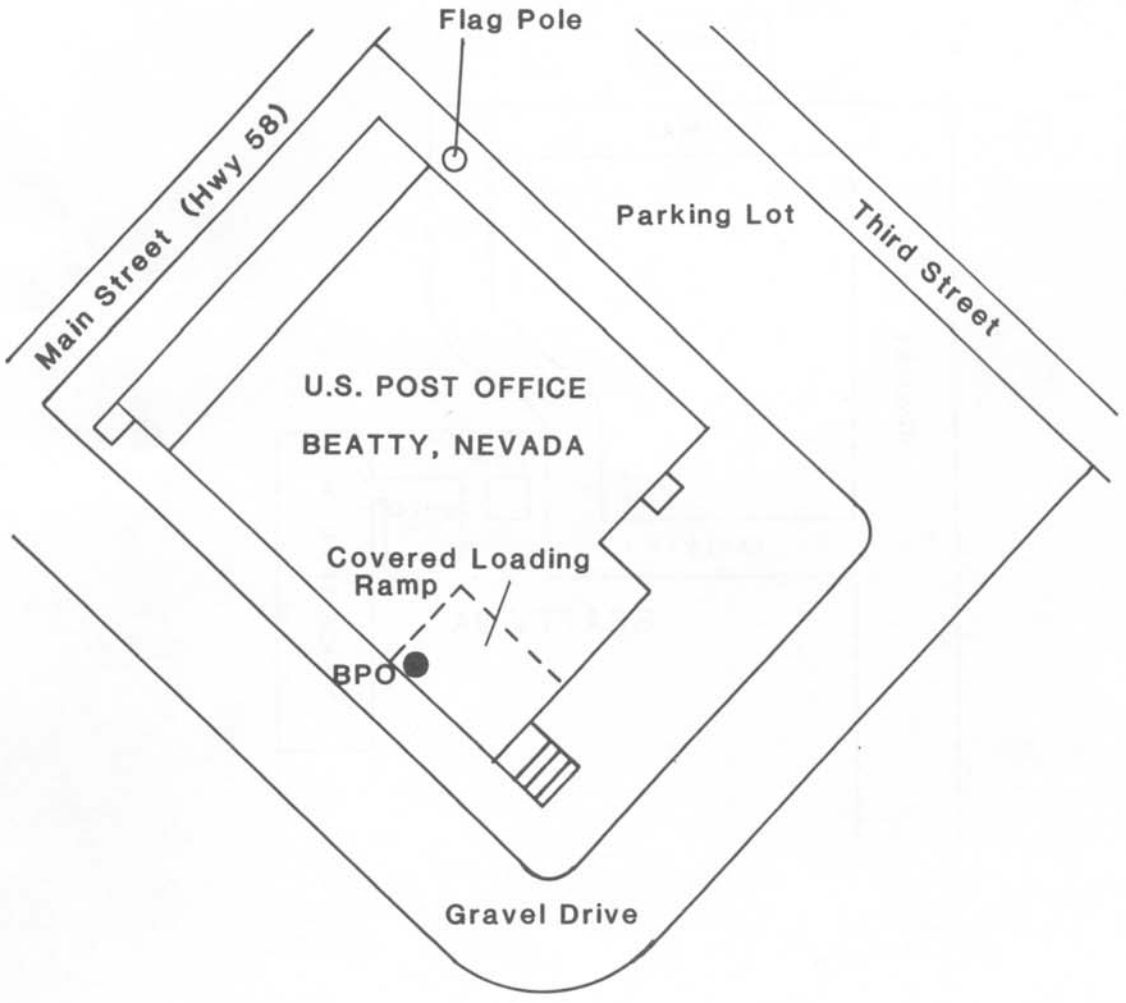
Station is located at Beatty Air Strip 4.5 km (2.8 mi) southwest of Beatty. On a cement porch centered on the door of a small storage building east of beacon tower and west of trailer, at northeast end of runway (DMA, written commun., 1987).



Description of Gravity Base Station: *BPO*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
BPO	Nevada	36 54.40	116 45.60	1,005.8 m (3,300 ft)	~~979,580.20~~ 566.45

The station is located in downtown Beatty, Nev., about one block southwest of the junction of US Highway 95 and Nevada Highway 58 (main street), at the US Post Office on the west corner of a covered loading ramp which is on the south corner of the building, about 0.5 m (2 ft) above the ground. The station is marked with a standard U.S. Air Force Gravity Station disk (Jablonsky, 1974).



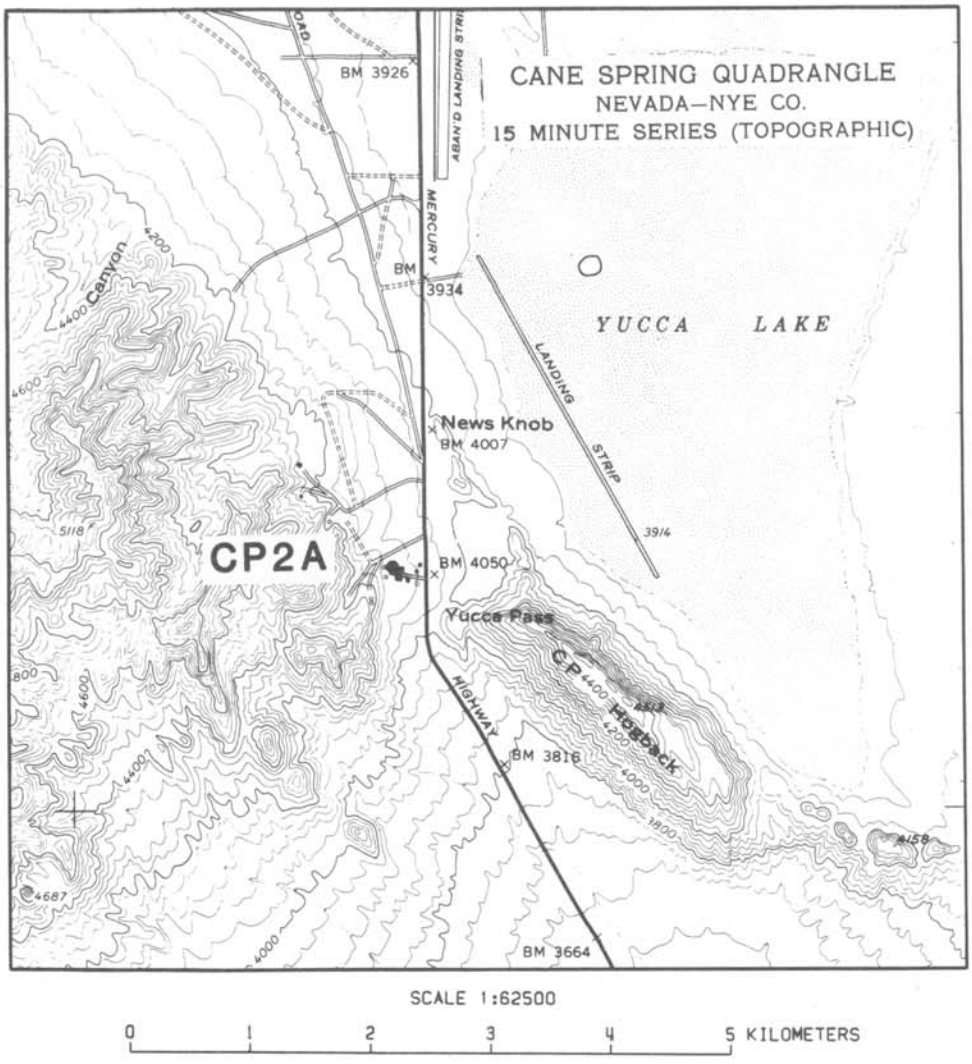
Description of Gravity Base Station: *CP2A*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
CP2A	Nevada	36 55.66	116 03.53	1,249.7 m (4,100 ft) est.	979,509.77

Absolute gravity station at Control Point 2, 32 km (20 mi) north of the USGS Core Library building in Mercury, Nev., along Mercury Highway, then 0.25 km (0.15 mi) along paved road that goes to guard station for CP1 area. Located in an office in the southeast corner of the basement of the Radiological Safe Building CP2. Enter the building via the basement loading ramp at east end, turn left (south) and go through door to office area. The station is marked with a standard USGS gravity base station disc stamped *CP2A 1984*. Align the gravity base plate legs in the star-drilled holes, read over the gravity disc with the meter facing north.

Address and contact at measurement site:

Dick Roberts, Supervisor
Radiological Safe Building
Area 6, CP2, MS 235
Nevada Test Site, NV
702 295-3520, FTS 575-3520



Description of Gravity Base Station: *DUNE*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
DUNE	Nevada	36 39.59	116 27.90	800.4 m (2,626.0 ft)	979,593.94

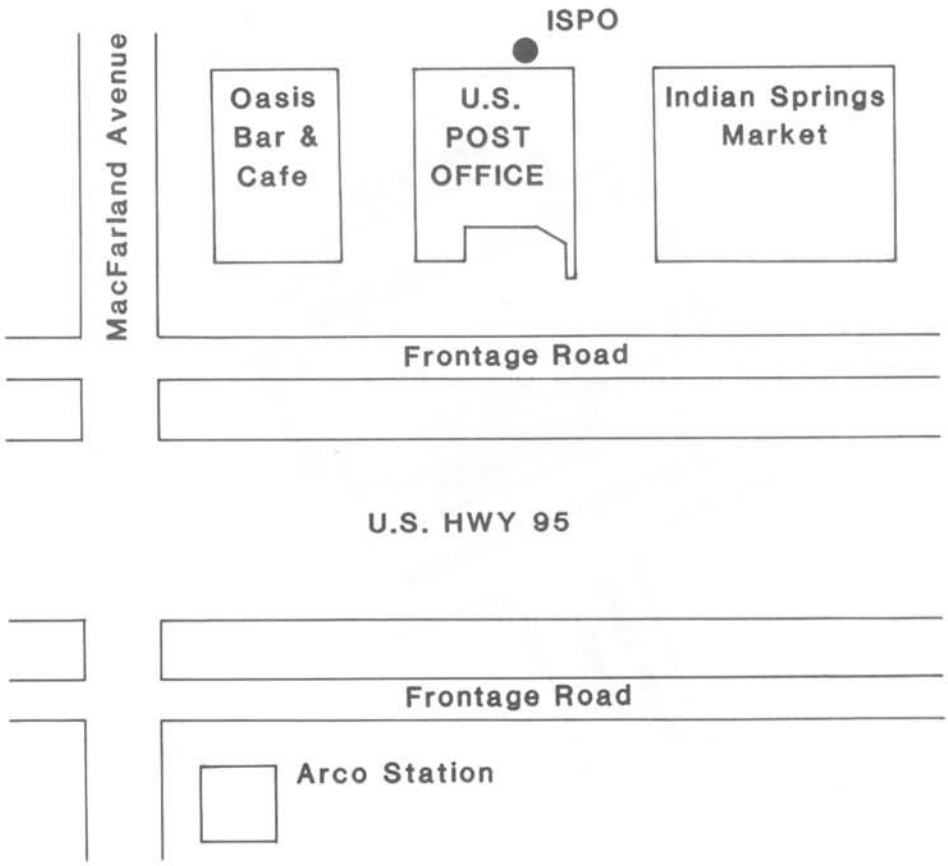
Base station is at vertical angle bench mark *DUNE* 6.1 km (3.8 mi) west of junction U.S. 95 and Nevada State Highway 29 in Lathrop Wells. Station is on south side of road.

See base B13 for sketch map.

Description of Gravity Base Station: *ISPO*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
ISPO	Nevada	36 34.60	115 39.00	949.4 m (3,115 ft)	979,541.16

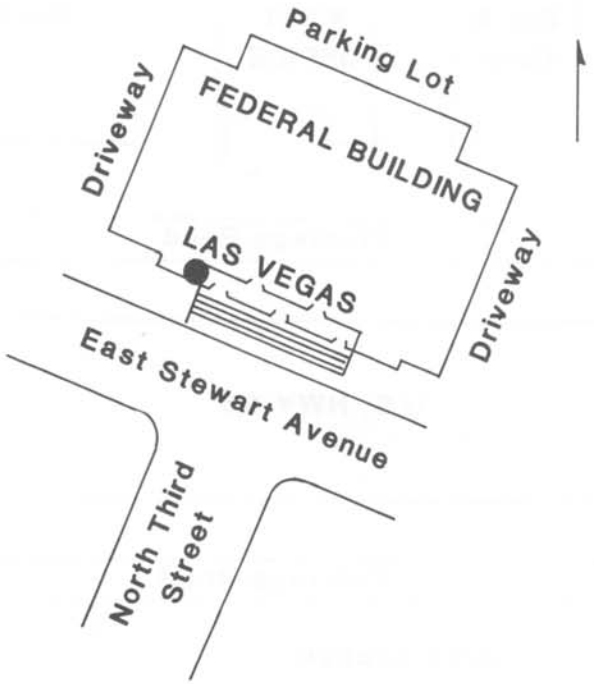
Base station at Indian Springs, Nev. at the U.S. Post Office, on the southeast corner of the back (north) porch against the north wall of the post office and about 2 m (8 ft) east of the back door. The station is marked with a standard U.S. Air Force Gravity Station disc. Read over the disc with the meter facing the building (Jablonsky, 1974).



Description of Gravity Base Station: *LAS VEGAS*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
LAS VEGAS	Nevada	36 11.05	115 08.45	615.1 m (2,018 ft)	979,586.45

The base station is in downtown Las Vegas on the north side of the East Stewart St. (at imaginary extension of North Third St.), at the Federal Building, inside the main (south) entrance, about 2 m west of the western most of three outside doors, south of the elevators, in the southeast corner of the alcove, at the east end of the radiator, on the terrazzo floor. Station is monumented with a National Gravity Base disc (Jablonsky, 1974).



Description of Gravity Base Station: *MERC*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERC	Nevada	36 39.75	115 59.86	1,152 m (3,780 ft) est.	~~979,518.80~~ 518.91

obs — 7-9/92. because of construction.

The base station is at Mercury, Nev., about 112 km (70 mi) northwest of Las Vegas along U.S. Highway 95. The station is in the southwest corner of the U.S. Geological Survey Core Library Building, in a rear storage room, by the geophysics workbench. Read the meter in the corner formed by the two gray cabinets in the northwest corner of the room with the meter facing the corner. Align the gravity base plate legs in the star-drilled holes.

Address and contact at measurment site:

U.S. Geological Survey
Box 327
Mercury, NV 89023
702 295-7016, FTS 575-7016

See base B1 for sketch map.

Description of Gravity Base Station: *MERCA*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERCA	Nevada	36 39.75	115 59.86	1,152 m (3,780 ft) est.	979,518.87 ✓

.89

Absolute gravity station at Mercury, Nev., about 112 km (70 mi) northwest of Las Vegas along U.S. Highway 95. Located in the southwest corner of the U.S. Geological Survey Core Library building, Nevada Test Site, in a rear storage room, near the geophysics workbench, about 6 m (20 ft) south-southeast of gravity station *MERC* (Ponce and Oliver, 1981, p.13). The station is marked with a standard USGS gravity base station disc stamped *MERCA 1984*. Align the gravity base plate legs in the star-drilled holes, read over the gravity disc with the meter facing north.

Address and contact at measurment site:

U.S. Geological Survey
Box 327
Mercury, NV 89023
702 295-7016, FTS 575-7016

See base B1 for sketch map.

Description of Gravity Base Station: *MERCB*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERCB	Nevada	36 41.79	115 58.40	1,216 m (3,990 ft) est.	979,509.82

High precision gravity station *MERCB* about 4.5 km (2.8 mi) north of USGS office in Mercury, Nev. along Mercury Highway, then about 0.1 km (0.05 mi) northwest along abondoned road (once paved). About 30 m (100 ft) west of Mercury Highway, about 15 m (50 ft) west of abondoned road, and about 6 m (20 ft) higher than road. Atop a pink fractured outcrop. Stamped *MERCB 1984*, read meter facing west.

Alternate: High precision gravity station *MERCC* 2 m (6 ft) north of *MERCB*, 0.3 m (1 ft) lower, and on the same rock outcrop. Stamped *MERCC*, read meter facing west. Observed gravity 979,509.89 mGal.

See base B1 for sketch map.

Description of Gravity Base Station: *MERCM*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERCM	Nevada	36 39.75	115 59.86	1,152 m (3,780 ft) est.	979,518.75

Base station is located in Room 110, Building 154 in Mercury, Nev. Building 154 is the USGS office building and core library. Base is located 1 m (3 ft) south of the north wall, 0.3 m (1 ft) west of the east wall of room 110, which is the former magnetics laboratory. Base was established on 4/14/70 from Las Vegas 'K' using meter G-177.

Note: Base is no longer used.

See base B1 for sketch map.

Description of Gravity Base Station: *MERCB*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERCB	Nevada	36 41.79	115 58.40	1,216 m (3,990 ft) est.	979,509.82

High precision gravity station *MERCB* about 4.5 km (2.8 mi) north of USGS office in Mercury, Nev. along Mercury Highway, then about 0.1 km (0.05 mi) northwest along abondoned road (once paved). About 30 m (100 ft) west of Mercury Highway, about 15 m (50 ft) west of abondoned road, and about 6 m (20 ft) higher than road. Atop a pink fractured outcrop. Stamped *MERCB 1984*, read meter facing west.

Alternate: High precision gravity station *MERCC* 2 m (6 ft) north of *MERCB*, 0.3 m (1 ft) lower, and on the same rock outcrop. Stamped *MERCC*, read meter facing west. Observed gravity 979,509.89 mGal.

See base B1 for sketch map.

Description of Gravity Base Station: *MERCM*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
MERCM	Nevada	36 39.75	115 59.86	1,152 m (3,780 ft) est.	979,518.75

Base station is located in Room 110, Building 154 in Mercury, Nev. Building 154 is the USGS office building and core library. Base is located 1 m (3 ft) south of the north wall, 0.3 m (1 ft) west of the east wall of room 110, which is the former magnetics laboratory. Base was established on 4/14/70 from Las Vegas 'K' using meter G-177.

Note: Base is no longer used.

See base B1 for sketch map.

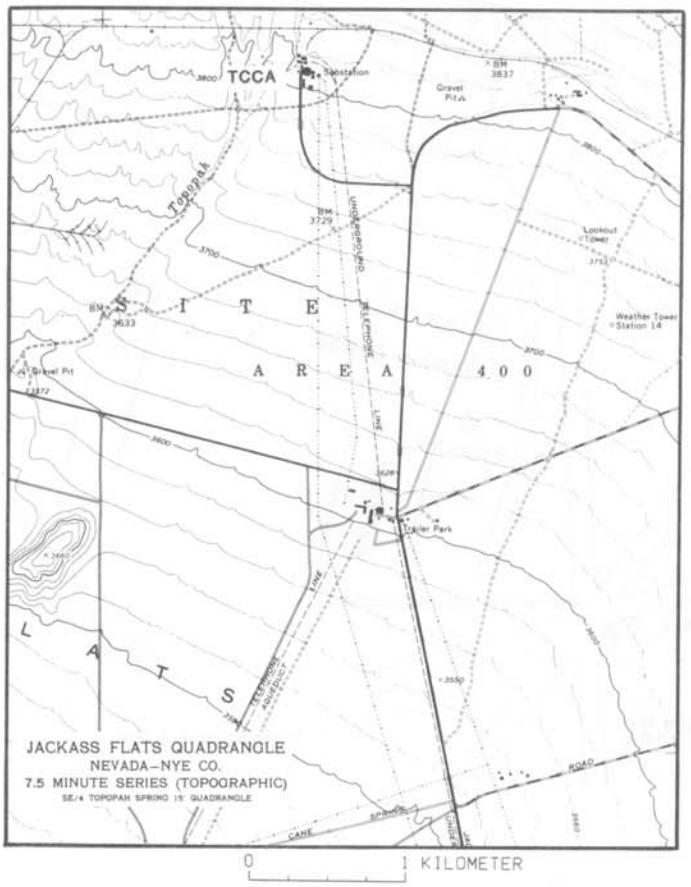
Description of Gravity Base Station: *TCCA*

Name	State	Latitude deg min	Longitude deg min	Elevation	Observed Gravity mGal
TCCA	Nevada	36 49.50	116 16.64	1,158 m (3,800 ft) est.	~~979,509.01~~ 510,007

Absolute gravity station at the Test Cell C administration building, Nevada Test Site, Nev. about 32 km (20 mi) from Mercury, Nev., along Jackass Flats Road, then about 0.12 km (0.08 mi) northwest along spur road to Test Cell. Located in the center of office no. 22 in the northeast corner of building. Test Cell C is the USGS Nuclear Hydrology office. The station is marked with a standard USGS gravity station disc stamped *TCCA 1984*. Align the gravity base plate legs in the star-drilled holes, read over the gravity disc with the meter facing north.

Address and contact at measurement site:

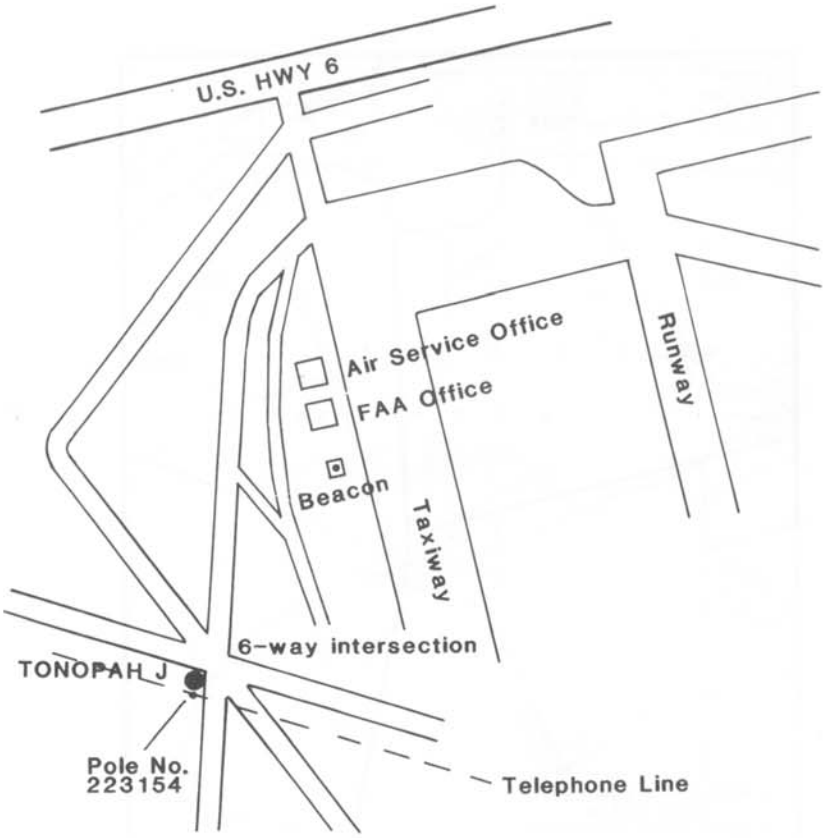
Chuck Warren, Representative
Test Cell C Administrative Building
Building 3229
Nevada Test Site, NV 89023
702 295-5973, FTS 575-5973



Description of Gravity Base Station: *TONOPAH J*

Name	State	Latitude (deg min)	Longitude (deg min)	Elevation	Observed Gravity (mGal)
TONOPAH J	Nevada	38 03.70	117 05.95	1,616.4 m (5,303 ft)	979,462.25

Station is at Nye County Airport, 13 km (8 mi) east of Tonopah, at a 6-way intersection (taxiway, Midway St. and B St.), 0.40 km (.25 mi) southeast of FAA office, in the southwest angle at the intersection, 1.0 m (3 ft) west of a telephone pole, 8.0 m (26 ft) southwest of the center line of Midway St., 35 m (115 ft) northwest of intersection (Jablonsky, 1974). U.S. Air Force Gravtity Station disc was not found. U.S. Coast and Geodetic Survey bench mark *B 297 1945* is next to site.



*U.S. GOVERNMENT PRINTING OFFICE: 1990--786-732/39117