WELL-INTEGRITY SURVEY (PHASE II) OF ABANDONED HOMESTEAD WATER WELLS IN THE HIGH PLAINS AQUIFER, FORMER PANTEX ORDNANCE PLANT AND TEXAS TECH RESEARCH FARM NEAR AMARILLO, TEXAS, 1995

U.S. GEOLOGICAL SURVEY
Open-File Report 95–751

Prepared in cooperation with the
U.S. ARMY CORPS OF ENGINEERS,
TULSA DISTRICT

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By Glenn A. Rivers

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Austin, Texas
1995

U.S. DEPARTMENT OF THE INTERIOR

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VERTICAL DATUM AND ABBREVIATIONS

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviations:
ft, foot
ft^2, square foot
in., inch
in/yr, inch per year
mi, mile

Well-Integrity Survey (Phase II) of Abandoned Homestead Water Wells in the High Plains Aquifer, Former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas, 1995

By Glenn A. Rivers

Abstract

This report describes the methods used and the results obtained during a field search for abandoned homestead sites and water wells at the former Pantex Ordnance Plant and Texas Tech Research Farm (Pantex site) near Amarillo, Texas. The search was the second phase of a three-phase well-integrity survey at the Pantex site proposed by the U.S. Army Corps of Engineers.

The methods used to locate the abandoned homestead sites and find water wells consisted of navigating to each site using a global positioning system instrument, conducting initial cesium-magnetometer sweeps at the homestead sites and marking the locations of the magnetic anomalies indicative of metal well casings, establishing mapping grids and conducting magnetometer mapping surveys around the locations of anomalies, and excavating to identify the sources of the anomalies.

The existence of abandoned homestead sites was confirmed by remains of foundations and (or) wells at 13 of 18 locations. The existence of abandoned homestead sites was indicated by broken glass and pottery and miscellaneous debris at 3 of the 18 locations. No evidence of past homestead existence was found at 2 of the 18 locations. Eight water wells were found at seven of the abandoned homestead sites. Three of the eight wells are accessible to steel tape measurement—two are accessible to more than 297 feet below land surface and one is accessible to 277.8 feet below land surface. Of the five wells not accessible to steel tape measurement, three are closed at the surface and two are blocked by debris at 12 and 3 feet below land surface, respectively. Water levels were not detected in any well that was accessible by steel tape.

INTRODUCTION

Background

In March 1994, the U.S. Army Corps of Engineers (Corps), Tulsa District, proposed to the U.S. Geological Survey (USGS) a cooperative study to locate and determine the condition of casings in water wells (well-integrity survey) in the High Plains aquifer at abandoned homestead sites on the former Pantex Ordnance Plant and Texas Tech Research Farm (Pantex site) near Amarillo, Texas. There is concern that deteriorated casings in the wells could be conduits for leakage of shallow subsurface contaminants into the underlying High Plains aquifer. The High Plains aquifer is the principal source of water for public supply and agricultural use in the region. The Corps and USGS agreed to a three-phase study in which the Corps would have primary responsibility for phase I and the USGS would have primary responsibility for phases II and III.

Phase I, completed and documented in 1994 (U.S. Army Corps of Engineers, 1994), entailed a search of historical records for locations of abandoned homestead sites, plugging or abandonment information about homestead water wells, and field reconnaissance of selected locations. The phase II work entailed confirming the existence (or non-existence) of abandoned homestead sites and water wells tentatively identified during the records search in phase I. Phase III, scheduled to begin in fiscal-year 1996, will investigate the integrity of abandoned water-well casings found during phase II.

The purpose of this report is to describe the methods used and the results obtained during the field search for abandoned homestead sites and water wells. This report also includes corrections to the completed phase I report (U.S. Army Corps of Engineers, 1994)—an errata sheet and corrected tables 4–1 and 4–2 (Appendix 1)—requested by the Corps.

Location and Physiographic Features of the Pantex Site

The 16,000-acre Pantex site is located on the Southern High Plains in southwestern Carson County, about 18 mi northeast of Amarillo (fig. 1). Topography at the site is relatively flat; surface elevations range from 3,596 ft above sea level in the northeast corner to 3,513 ft above sea level in the southeast corner. Five playas are within the Pantex-site boundaries (fig. 2). The playas are closed drainage systems and are catchment basins for surface runoff from precipitation (about 20 in/yr) or from industrial effluents generated at the site.

WELL-INTEGRITY SURVEY (PHASE II)

Methods

The methods used to locate the abandoned homestead sites and find water wells consisted of navigating to each tentatively identified site and mowing tall grass to eliminate fire hazards, conducting initial cesium magnetometer sweeps and marking magnetic anomaly locations, establishing mapping grids and conducting cesium magnetometer mapping surveys, and excavating to identify the source of the magnetic anomalies.

Locating Abandoned Homestead Sites

Some of the abandoned homestead sites were tentatively located by field reconnaissance in phase I. Aerial photographs taken in 1941 reveal 18 potential abandoned homestead sites in addition to 1 previously known abandoned homestead. Discussions with area residents confirmed that about 19 homestead sites could have existed at the Pantex site before 1942. Confirming locations for both the tentatively located and the non-located homestead sites involved transferring information from the aerial photographs to USGS 7–1/2-minute topographic maps, obtaining latitudes and longitudes for the plotted homestead sites (table 1), and navigating to the homestead sites

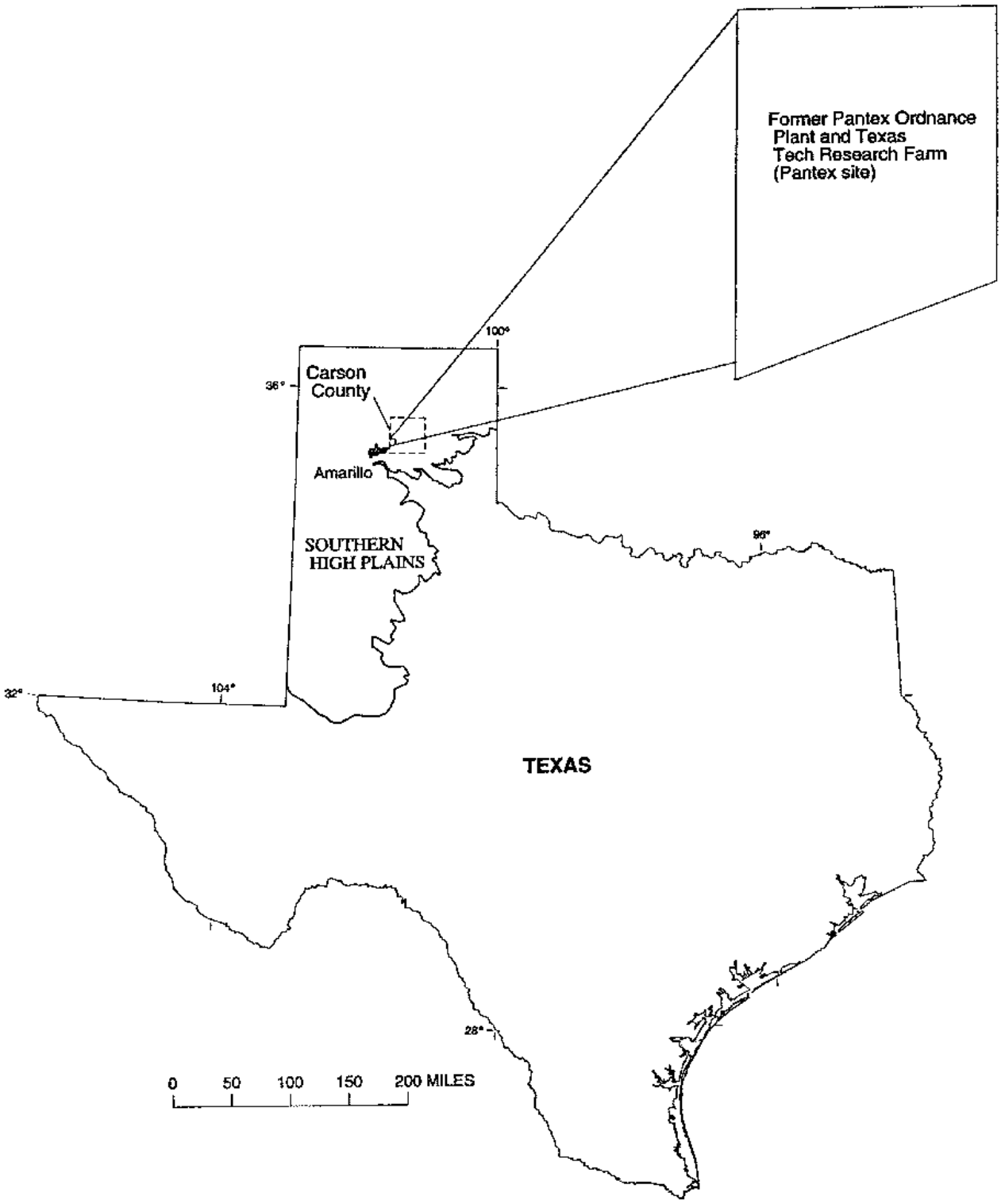

Figure 1. Location of former Pantex Ordnance Plant and Texas Tech Research Farm (Pantex site) near Amarillo, Texas.

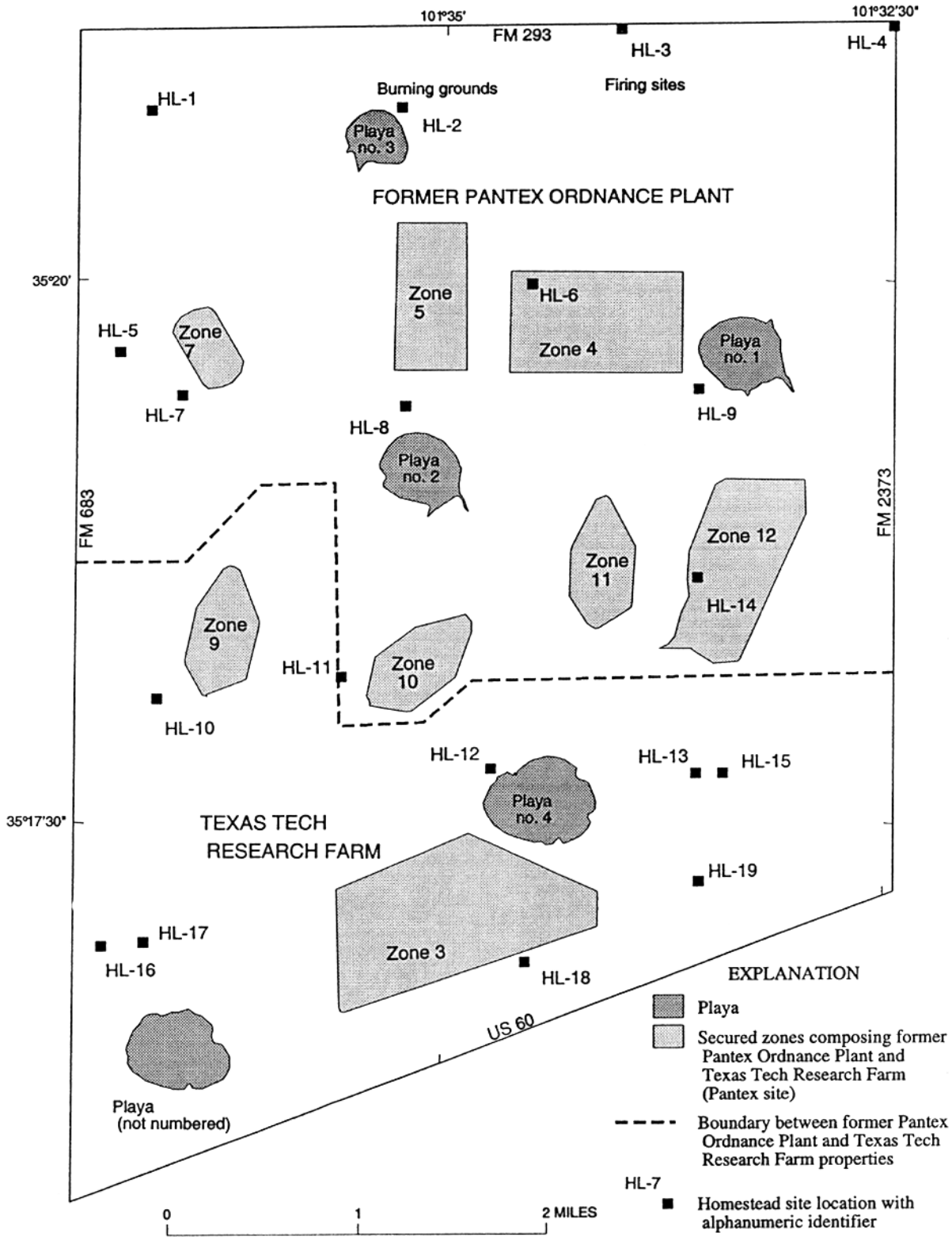

Figure 2. Approximate locations of abandoned homestead sites at former Pantex Ordnance Plant and Texas Tech Research Farm (Pantex site) near Amarillo, Texas.

Table 1. Approximate geodetic coordinates of abandoned homestead sites at former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas

Homestead site identifier	Latitude (North American Datum 1927)	Longitude (North American Datum 1927)
HL–1	35°20'47"	101°36'39"
HL–2	35°20'48"	101°35'15"
HL–3	35°21'10"	101°34'00"
HL–4	35°21'11"	101°32'28"
HL–5	35°19'40"	101°36'49"
HL–6	35°19'59"	101°34'30"
HL–7	35°19'28"	101°36'28"
HL–8	35°19'25"	101°35'13"
HL–9	35°19'30"	101°33'33"
HL–10	35°18'04"	101°36'36"
HL–11	35°18'10"	101°35'34"
HL–12	35°17'45"	101°34'43"
HL–13	35°17'44"	101°33'33"
HL–14	35°18'38"	101°33'33"
HL–15	35°17'44"	101°33'24"
HL–16	35°16'56"	101°36'54"
HL–17	35°16'57"	101°36'40"
HL–18	35°16'52"	101°34'31"

using a global positioning system (GPS) instrument. To navigate to a homestead site, the plotted latitude and longitude were entered into the GPS; the GPS was set to "navigate" mode; and USGS personnel navigated to the site. The GPS, when in navigate mode, continually updates the operator's current location, provides a digital readout of the distance from the current location to the destination point, and indicates the direction to go to reach the destination point. Typically, the GPS will navigate to within about 100 ft of the actual coordinates entered into the instrument, but the GPS can have degraded accuracies of greater than 100 ft. The typical accuracy of the GPS was verified by navigating to homestead sites that had been tentatively located in phase I. Except for two instances, the GPS navigated to a location that was confirmed to be that of an abandoned homestead site.

Field crews mowed tall grass at several homestead sites to reduce the potential for grass fires and to enhance visual identification of foundations at several of the abandoned homestead sites.

Cesium Magnetometer Sweeps

After locating the potential abandoned homestead sites, the next step in the search for water wells involved sweeping, or scanning, each of the 18 sites using a cesium magnetometer (fig. 3). The cesium magnetometer is an

Figure 3. Cesium magnetometer and palmtop computer used during well-integrity survey (phase II), former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

instrument designed to detect changes in the earth's magnetic field (Breiner, 1973). Spatial variations, or anomalies, in the earth's magnetic field can be caused by induced magnetism; for example, a water-well casing constructed of iron alloys will produce a local magnetic anomaly that is substantially greater than the earth's ambient (background) magnetic field.

Cesium magnetometer scans, near the abandoned homestead sites, measured an ambient magnetic field of 52,300 ±300 gammas for the Pantex site. A monitoring well at known homestead site HL–19 was used to determine the instrument response to a water well. The magnetic anomaly caused by the well was 28,000 ±500 gammas more than the ambient magnetic field. The field crew returned to HL–19 periodically to verify that the magnetometer was operating properly.

Initial sweeps at each abandoned homestead site were made along transects spaced about 20 ft apart within grids ranging from about 360 by 420 ft to 600 by 650 ft (table 2). The process for each sweep involved three persons (fig. 4). One person walked each transect operating the cesium magnetometer while the other two stood at each end to keep the operator on track and to mark the area that had been swept. After each sweep, the two persons at the ends would pace to the next transect; the process was repeated until the entire grid was covered. Locations of magnetic anomalies at least 4,000 gammas greater than background (15 of 18 locations shown in table 2) were marked with stakes and flagging (fig. 5) for detailed cesium magnetometer mapping surveys.

Cesium Magnetometer Mapping Surveys

The cesium magnetometer mapping surveys involved establishing a control grid (fig. 6) that encompassed the magnetic anomalies at each site and mapping the control grid. A control grid was established by staking four corners to create a square or rectangle with boundaries oriented north-south and east-west and then marking the endpoints of north-south or east-west transects along the north and south or east and west boundaries at 10-ft intervals. The grids ranged in size from 30 by 30 ft to 150 by 330 ft (table 2), depending on the number and proximity of magnetic anomalies, and the degree of confidence that an anomaly indicated a well. For example, a water well was positively identified during the initial magnetometer sweep at HL–4; the grid for the mapping survey of this site was 30 by 30 ft. The magnetometer mapping surveys were conducted by moving the sensor wand along the parallel transects in the control grid as shown in figure 7.

The cesium magnetometer instrumentation includes a portable palmtop computer (fig. 3) designed to log and record magnetic survey data. The palmtop computer was connected to the magnetometer (fig. 7) for the mapping surveys; data from the palmtop computer were downloaded to, and stored in, a laptop personal computer (PC) at the end of each day (fig. 8). Magnetic-field profiles generated on the PC were used to determine which anomalies to excavate. Typically, locations of anomalies 12,000 to 15,000 gammas more than background were excavated to try to find well casings. Some locations of anomalies less than 12,000 gammas also were excavated to ensure that potential well casings were not missed.

Excavation at Abandoned Homestead Sites

The excavation process involved removing the soil with a Case uni-loader (fig. 9); identifying and removing, where possible, the source of the magnetic anomaly; verifying that the source had been removed by sweeping the excavated area with the magnetometer; and then returning soil to the excavated site. The maximum magnetic anomalies at the homestead sites and the objects that were excavated are listed in table 2. Appendices 2 and 3 show photographs of several abandoned homestead sites before and after excavation.

Figure 4. Magnetometer sweep at homestead site HL–4, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 5. Staked and flagged anomaly (well) at homestead site HL–11, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 6. Mapping grid at homestead site HL–16, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 7. Magnetometer mapping survey at homestead site HL–4, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 8. Downloading survey data from palmtop computer to personal computer. Photograph by John S. Ebling.

Figure 9. Case uni-loader used during well-integrity survey (phase II), former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Table 2. Cesium magnetometer sweeps and surveys of abandoned homestead sites at former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas

[Location: P, former Pantex Ordnance Plant; R, restricted area; S, secured zone; T, Texas Tech Research Farm. Source of anomaly: A, anomaly not identified or not excavated; B, well; C, scrap metal; D, unknown. ft, feet; --, not applicable]

Homestead site		Magnetometer sweep		Magnetometer survey, approximate grid size (ft)	Source of anomaly determined from excavation
Identifier	Location	Approximate grid size (ft)	Maximum magnetic anomaly (gammas greater than background[1])		
HL–1	P	500 by 500	--	--	A
HL–2	R	500 by 500	7,700	150 by 330	A
HL–3	R	500 by 500	27,000	150 by 280	B
HL–4	P	600 by 600	27,000	30 by 30	B
HL–5	P	600 by 600	15,700	100 by 100	B
HL–6	S	500 by 600	--	--	A
HL–7	P	600 by 600	7,700	100 by 100	C
HL–8	P	550 by 600	10,700	100 by 130	C
HL–9	P	360 by 420	43,700	100 by 210	B
HL–10	T	500 by 500	25,700	50 by 50	B
HL–11	P	550 by 550	26,700	100 by 250	B
HL–12	T	600 by 650	--	150 by 200	A
HL–13	T	600 by 600	6,200	50 by 100	C
HL–14	S	([2])	7,700	100 by 180	A
HL–15	T	550 by 550	7,600	150 by 250	D
HL–16	T	430 by 635	8,600	150 by 150	C
HL–17	T	([2])	17,700	50 by 50	B
HL–18	T	550 by 550	5,700	150 by 150	C
HL–19	T	([3])	[3]28,000	--	B

[1] Background magnetic field at abandoned homestead sites, 52,300 ±300 gammas.

[2] Not measured.

[3] Known well location and previously determined magnetic anomaly; used to verify magnetometer operation (28,000 gammas greater than background magnetic field at Pantex site).

Results

Abandoned Homestead Sites Located

Abandoned homestead sites were confirmed by remains of foundations and (or) wells at 13 of the 18 potential locations identified in phase I (table 3). Three sites with no foundations or wells had debris (broken glass,

Table 3. Summary of objects found at abandoned homestead sites at former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas

Homestead site identifier	Foundations	Debris	Wells
HL–1	No	Yes	No
HL–2	Yes	Yes	No
HL–3	No	No	Yes
HL–4	Yes	No	Yes
HL–5	Yes	No	Yes
HL–6	No	No	No
HL–7	No	Yes	No
HL–8	Yes	Yes	No
HL–9	Yes	Yes	Yes (2 wells)
HL–10	Yes	Yes	Yes
HL–11	Yes	Yes	Yes
HL–12	Yes	Yes	No
HL–13	No	No	No
HL–14	Yes	No	No
HL–15	No	Yes	Unknown
HL–16	Yes	Yes	No
HL–17	Yes	Yes	Yes
HL–18	Yes	No	No
[1]HL–19	Yes	Yes	Yes

[1]Known abandoned homestead site identified in phase I.

pottery, and miscellaneous items) indicative of past homestead existence—HL–1, HL–7, and HL–15. Evidence of past homestead existence was not found at two sites—HL–6 and HL–13.

Wells Located and Associated Cesium Magnetometer Survey Findings

The remains of eight water wells were located at seven abandoned homestead sites (table 4)—HL–3, HL–4, HL–5, HL–9 (two wells), HL–10 (fig. 10), HL–11 (fig. 11), and HL–17 (fig. 12). Three of the eight wells (HL–4, HL–5, and HL–17) can be accessed using a steel tape. The three wells were measured with a 300-ft steel tape; water levels were not detected in any of these wells. HL–4 and HL–5 are accessible to more than 297 ft below land surface; HL–17 is accessible to 277.8 ft below land surface, which is less than the reported depth of 348 ft (reported well depths in table 4 are from the well-completion data obtained during the phase I records search). Five of the eight wells—HL–3, HL–9 (both wells), HL–10, and HL–11—are inaccessible to steel-tape measurement. HL–3 and

Figure 10. Well at homestead site HL–10, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 11. Well at homestead site HL–11, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 12. Well at homestead site HL–17, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Table 4. Wells located during cesium magnetometer surveys of abandoned homestead sites at former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas

[in., inches; ft, feet; --, unknown]

Homestead site identifier[1]	Number of wells	Casing size (in.)	Reported depth of well below land surface (ft)	Measured depth of well below land surface (ft)	Remarks
HL–3 (413)	1	4 1/2	409	--	Top of casing pushed over to about 18 in. below land surface. Cannot get tape down well.
HL–4 (W 15-2)	1	do.	--	[2]297	Top of casing at land surface. Did not reach bottom of well, dry to 297 ft.
HL–5 (424)	1	do.	406	[2]297	Top of casing pushed over to about 18 in. below land surface. Did not reach bottom of well, dry to 297 ft.
HL–9 (422)	2	do.	400	--	Tops of casings pushed over to about 18 in. below land surface. Cannot get tape down wells.
HL–10	1	do.	--	12	Top of casing above land surface, debris in well.
HL–11	1	do.	--	3	do.
HL–17 (425)	1	do.	348	277.8	Top of casing above land surface, well dry

[1] Numbers in parentheses are old well numbers for wells with selected completion data.

[2] Tape measurements were limited to less than 300 ft (total length of tape).

HL–9 (both wells) are closed at the tops of their casings; HL–10 and HL–11 are blocked by debris at 12 and 3 ft below land surface, respectively

Tops of well casings were found at or above land surface at four abandoned homestead sites. The top of the casing at HL–4 is at land surface. The tops of casings at HL–10 (fig. 10), HL–11 (fig. 11), and HL–17 (fig. 12) are above land surface. Excavations at HL–3, HL–5 (fig. 13), and HL–9 exposed tops of well casings that had been pushed over and buried to about 18 in. below land surface.

The casings at HL–11 and HL–17 were tentatively identified during the phase I field reconnaissance and verified during the cesium magnetometer sweeps and mapping surveys. Casings at HL–3, HL–4, HL–5, HL–9, and HL–10 were found during the cesium magnetometer sweeps and mapping surveys. Magnetic anomalies at the wells

Figure 13. Excavated well casing at homestead site HL–5, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

ranged from 15,700 to 43,700 gammas greater than the background magnetic field (table 2). Wells at HL–3 and HL–4 both registered 27,000 gammas; HL–5, 15,700 gammas; HL–9, 43,700 gammas (both wells); HL–10, 25,700 gammas; HL–11, 26,700 gammas; and HL–17, 17,700 gammas greater than the background magnetic field.

Magnetic anomalies shown by the lines of equal value and corresponding grid maps in Appendix 4 are somewhat smaller than those listed above and in table 2. The larger magnetic anomalies were measured during the initial cesium magnetometer sweeps at the abandoned homestead sites and were obtained with the magnetometer sensor wand positioned very close to the location of an anomaly. Data for the magnetic-anomaly line of equal value and grid maps were collected during the mapping surveys along transects spaced 10 ft apart. The transects purposely did not pass directly over the location of a given anomaly. When the sensor wand is positioned directly over a well or other source of large anomaly, the magnetometer readout tends to fluctuate rapidly, then indicate zero.

Wells Not Located and Associated Cesium Magnetometer Survey Findings

Wells were not located at 11 of the 18 abandoned homestead sites. Anomalies greater than 4,000 gammas above background were not detected during the initial cesium magnetometer sweeps at HL–1 (fig. 14), HL–6, or HL–12 (fig. 15); magnetometer mapping surveys were not conducted at HL–1 or HL–6.

Magnetic anomalies ranging from 5,700 to 10,700 gammas greater than background were detected at homestead sites HL–2, HL–7, HL–8, HL–13, HL–14, HL–15, HL–16, and HL–18 (table 2). Excavations were conducted at all the above homestead sites except HL–2 and HL–14. These two sites were not excavated because both are in restricted areas (burning grounds and firing sites, fig. 2), and access was limited. Furthermore, the magnetic anomalies at sites HL–2 and HL–14 (7,700 gammas greater than background for both) are considerably less than anomalies for confirmed wells, and excavations at other homestead sites with similar anomalies showed the source to be scrap metal.

Lines of equal value for magnetic anomalies and corresponding grid maps indicating values of magnetic anomalies for homestead sites without wells are shown in Appendix 5. The anomalies for sites without wells shown in Appendix 5 were smaller than the anomalies resulting from the initial cesium magnetometer sweeps (table 2) as they were for sites with wells, for the reason previously explained.

Figure 14. Homestead site HL–1, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 15. Homestead site HL–12, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

SUMMARY, CONCLUSIONS, AND SCOPE OF PHASE III WORK

Summary

This report describes the methods used and the results obtained during the field search for abandoned homestead sites and water wells at the former Pantex Ordnance Plant and Texas Tech Research Farm (Pantex site) near Amarillo, Texas. The search was the second phase of a three-phase well-integrity survey at the Pantex site proposed by the U.S. Army Corps of Engineers.

The methods used to locate the abandoned homestead sites and find water wells at the sites consisted of navigating to each site using a GPS instrument, conducting initial cesium magnetometer sweeps at each site, marking the locations of the magnetic anomalies, establishing mapping grids and conducting cesium magnetometer mapping surveys around the locations of anomalies, and excavating to identify the sources of the anomalies.

Conclusions

(1) The remains of foundations and (or) wells confirmed the existence of abandoned homestead sites at 13 of 18 locations: HL–2, HL–3, HL–4, HL–5, HL–8, HL–9, HL–10, HL–11, HL–12, HL–14, HL–16 HL–17, and HL–18 (fig. 2). (HL–19 was a previously known homestead site.)

(2) The existence of abandoned homestead sites was indicated only by broken glass and pottery and miscellaneous items (debris) at 3 of the 18 locations: HL–1, HL–7, and HL–15.

(3) Evidence of past homestead existence was not found at 2 of the 18 locations: HL–6 and HL–13.

(4) Eight water wells were found at seven abandoned homestead sites (table 4): HL–3, HL–4, HL–5, HL–9 (two wells), HL–10, HL–11, and HL–17.

(5) Three of the eight wells are accessible for measurement with a steel tape: HL–4 and HL–5 are accessible to more than 297 ft below land surface; HL–17 is accessible to 277.8 ft.

(6) Five of the eight wells are not accessible for measurement with a steel tape: HL–3 and HL–9 (both wells) are closed at the surface; HL–10 and HL–11 are blocked by debris at 12 and 3 ft below land surface, respectively.

(7) Four of the eight wells have casings at or above land surface: HL–4, HL–10, HL–11, and HL–17.

(8) Four of the eight wells have casings that are bent over and buried within 18 in. of land surface: HL–3, HL–5, and HL–9 (both wells).

(9) Water levels were not detected in any well that was measured with a 300-ft steel tape.

Scope of Phase III Work

The phase III work to investigate the condition of the casings of the eight wells located will include (1) cleaning debris from the wells and (2) obtaining downhole geophysical logs and color-video surveys. In addition, the following work elements could be included:

(1) Collect and analyze ground-water samples for selected constituents to determine if contaminants have entered the wells.

(2) Pressure-grout the wells to prevent leakage into wells of contaminants from shallow subsurface zones, and then pull or drill out the well casings.

(3) After the well casings have been removed, clean the boreholes and plug the wells in accordance with Texas Natural Resource Conservation Commission guidelines.

REFERENCES

Breiner, S., 1973, Applications manual for portable magnetometers: Sunnyvale, Calif., geoMetrics, 58 p.

EG&G GEOMETRICS, 1993, G–822L cesium magnetometer operation manual: Sunnyvale, Calif., 35 p.

Groundwater Technology, Inc., 1992, Well construction and integrity study, interpretation of geophysical logs for Pantex Plant, Amarillo, Texas: Prepared for U.S. Army Corps of Engineers, Tulsa District, 22 p.

State Board of Water Engineers, 1939, Carson County, Texas, records of wells, drillers' logs, water analyses, and map showing location of wells: Work Progress Administration Project 10512.

_____1958, Ground-water conditions in Carson County, Texas: State Board of Water Engineers Bulletin 5802, 115 p.

U.S. Army Corps of Engineers, 1992, Interpretation of geophysical logs for well construction and integrity assessment, Pantex plant, Amarillo, Texas: U.S. Army Corps of Engineers.

_____1994, Phase I well integrity survey of abandoned and homestead wells on Pantex Plant, Texas Tech Property and Pantex Lake: Prepared for U.S. Department of Energy, Pantex Plant, Amarillo, Tex., 28 p.

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APPENDIX 1—CORRECTIONS TO PHASE I REPORT

Table 1–1. ERRATA—PHASE I REPORT (U.S. Army Corps of Engineers, 1994)

Page ii	Paragraph 2, lines 4 and 5—Delete references to 5 unplugged wells—records found after Phase I report written.
Page 17	Paragraph 1, lines 1 and 4—Change 15 to 11.
Page 17	Paragraph 3, line 11—Delete wells 406 and 415—wells are located in Block T, not Block M.
Page 18	Paragraph 1, line 1—Delete wells 416 and 417—wells are located in Block T, not Block M.
Page 19	Table 4–1—Abandoned wells at Pantex Plant and Texas Tech property for which records exist—changed and updated; new table.
Page 20	Paragraph 2, line 3—Omit reference to well 406, drilled in 1889—well is not on Pantex property
Page 21	Table 4–2—Former homestead land owners tenants changed and updated; new table.
Page 22	Paragraph 2, lines 3–5—Omit reference to wells 15–2, 15–5, 15–7, 15–11, 15–16 and E–25—Records for plugging located. E–25 (15–16) is an active well.
Page 23	Paragraph 1, line 2—Omit reference to well E–25.
Page 25	Paragraph 1, line 2—Change ten to six.
	Paragraph 1, line 5—Change fifteen to six.
	Paragraph 1, line 7—Change ten to six.
	Paragraph 1, line 10—Change 15 to six.
Page 27	Paragraph 1, line 1—Change 15 to six.

CORRECTED TABLE 4–1

ABANDONED WELLS AT PANTEX PLANT AND TEXAS-TECH

PROPERTY FOR WHICH RECORDS EXIST

Well No.	Location	Owner	Driller	Date Completed	Depth (ft)	Diameter (in)
Well 413 (homestead well) (HL - 3)	NW 1/4 NE 1/4 Sec 36	Haiduk	UNK	Old	409	4.5
Well 422 (homestead well) (HL - 9)	SE 1/4 SE 1/4 Sec 37	Lusk	Meaker	1938	400	4.5
Well 423 (homestead well) (HL - 8)	NE 1/4 NW 1/4 Sec 49	Kimble	Neal	1930	401	4 5/8
Well 424 (homestead well) (HL - 5)	SW 1/4 SW 1/4 Sec 55	Bushkoeter	Reet	1938	406	4.5
Well 425 (homestead well) HL - 17)	SW 1/4 SW 1/4 Sec 58	Leopold	UNK	1934	348	4.5
Well 426 (homestead well) (HL - 16)	S 1/4 Sec 6	Klinke	UNK	UNK	330	4

UNK - Unknown

CORRECTED TABLE 4–2

FORMER HOMESTEAD LANDOWNERS/TENANTS AT PANTEX PLANT

AND TEXAS-TECH PROPERTY BASED ON RECORD SEARCH

Homestead Owner/Tenant	Homestead Location	Well No.	Source of Data
A.F. Bushkoeter*	HL - 7	UNK	
John Bellinghausen	HL - 7	UNK	
Fredrick C. Klinke	HL - 16	426	USGS Well Schedule for Well 426
Frank J. Grabber	UNK	UNK	
Doyle Burns*	UNK	UNK	
Al Bichsel*	UNK	UNK	
Leo Gabel	UNK	UNK	
Ben Haiduk	HL - 5	424	USGS Well Schedule for Well 424
J.C. Berg	UNK	UNK	
W.H. Kimble	HL - 8	423	USGS Well Schedule for Well 423
Mary P. Leopold	HL - 17	425	USGS Well Schedule for Well 425
W.C. Metcalf	HL - 14	UNK	BMI - Personnel
J.C. Vance	HL - 11	UNK	BMI - Personnel
Elmer Paullim	UNK	UNK	
Newt Garretson	UNK	UNK	
W.C. Slater	UNK	UNK	
W.H. Obrecht*	UNK	UNK	
R.B. Masterson	UNK	UNK	
C.E. Deahl	UNK	UNK	
J.D. Bender	UNK	UNK	
E.E. Lusk	HL - 9	422	USGS Well Schedule for Well 422

UNK - Unknown

* Tenant on Property

APPENDIX 2—PHOTOGRAPHS OF ABANDONED HOMESTEAD SITES BEFORE EXCAVATION

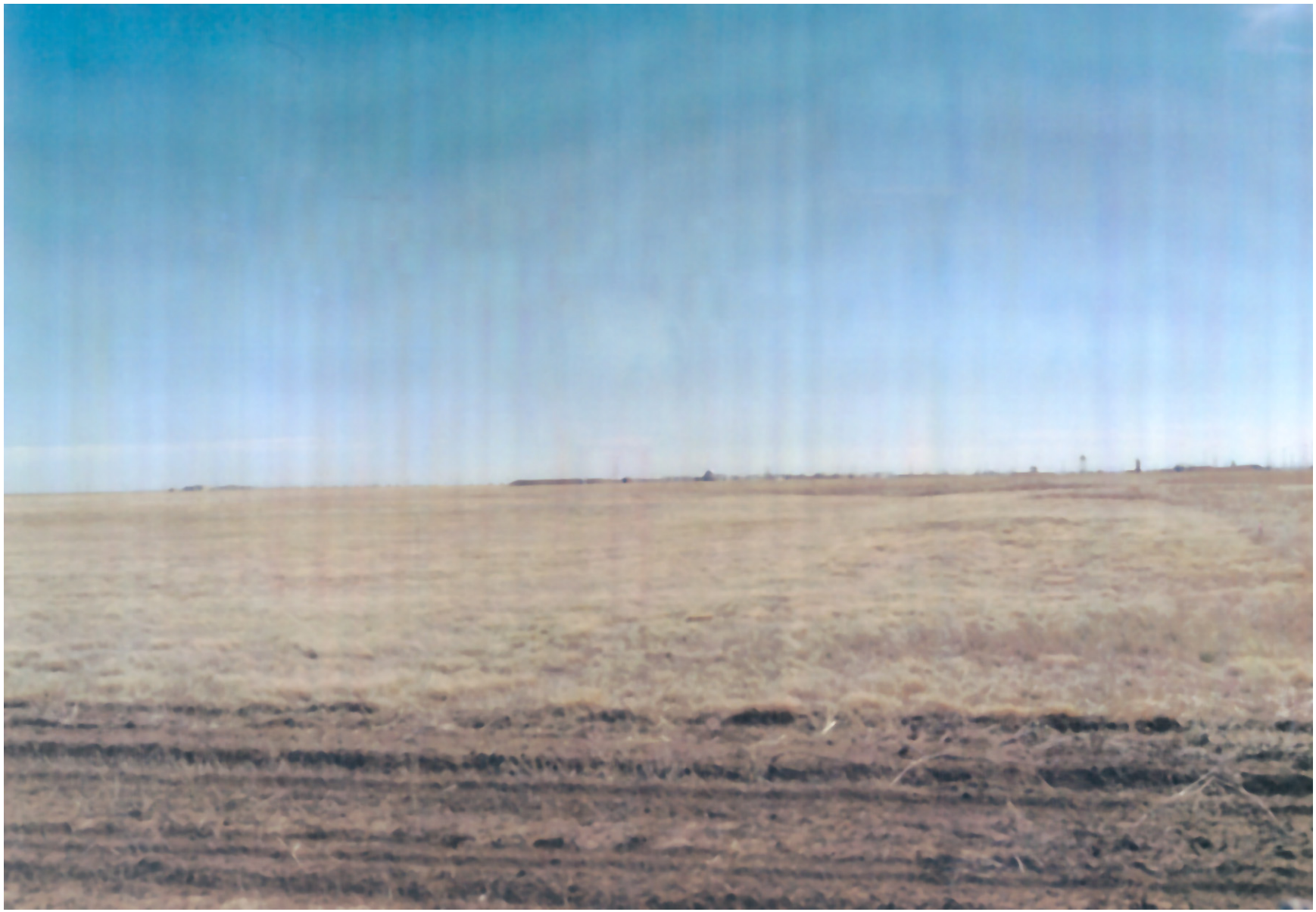

Figure 2–1. Homestead site HL–3 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–2. Homestead site HL–5 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–3. Homestead site HL–8 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–4. Homestead site HL–9 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–5. Homestead site HL–11 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–6. Homestead site HL–13 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 2–7. Homestead site HL–15 before excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

APPENDIX 3—PHOTOGRAPHS OF ABANDONED HOMESTEAD SITES AFTER EXCAVATION

Figure 3–1. Homestead site HL–3 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–2. Homestead site HL–5 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–3. Homestead site HL–7 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–4. Homestead site HL–8 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–5. Homestead site HL–9 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–6. Homestead site HL–11 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–7. Homestead site HL–13 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–8. Homestead site HL–15 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–9. Homestead site HL–16 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

Figure 3–10. Homestead site HL–18 after excavation, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas. Photograph by John S. Ebling.

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APPENDIX 4—LINES OF EQUAL VALUE FOR MAGNETIC ANOMALIES AND CORRESPONDING GRID MAPS AT ABANDONED HOMESTEAD SITES WITH WELLS

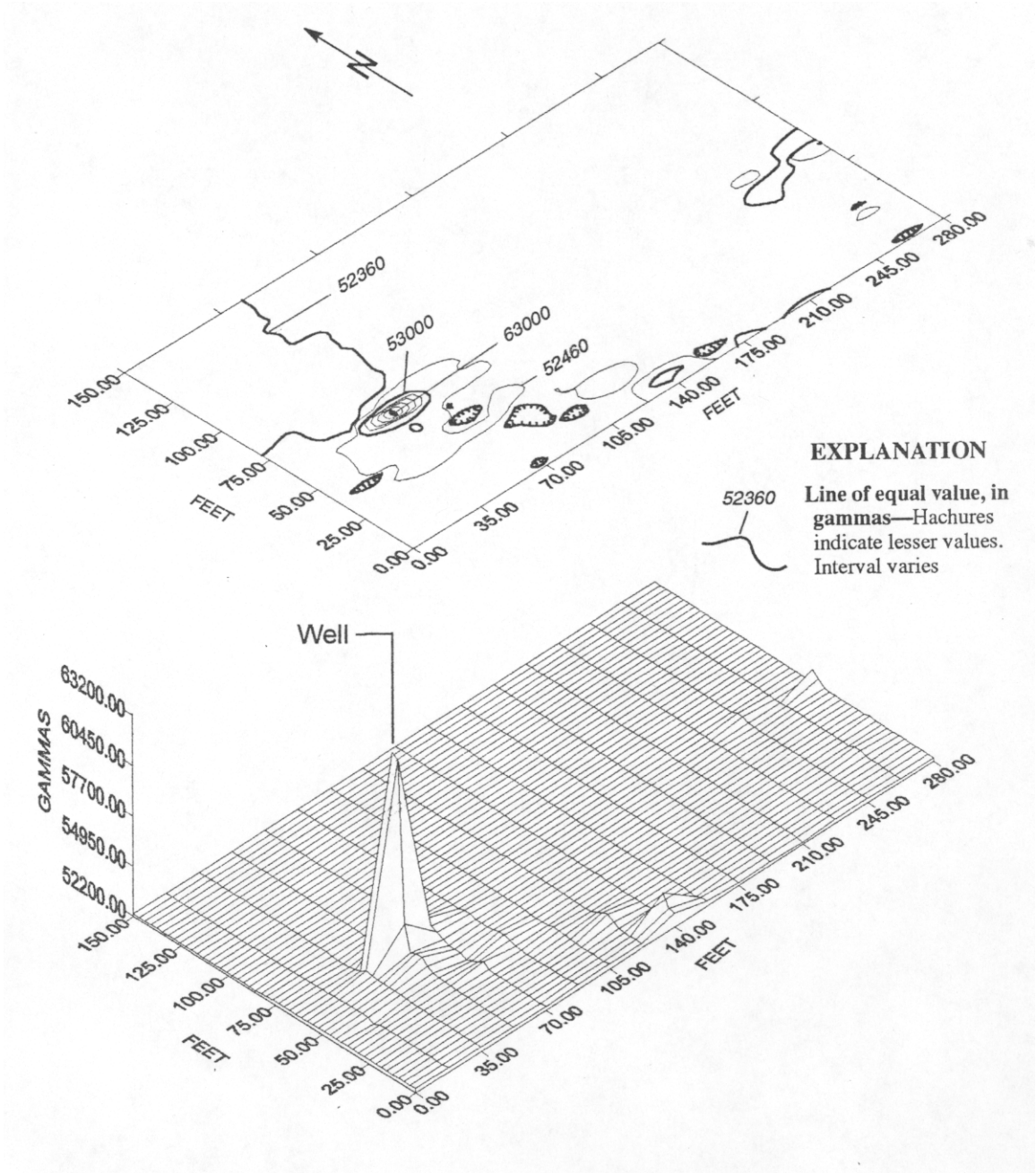

Figure 4–1. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–3, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

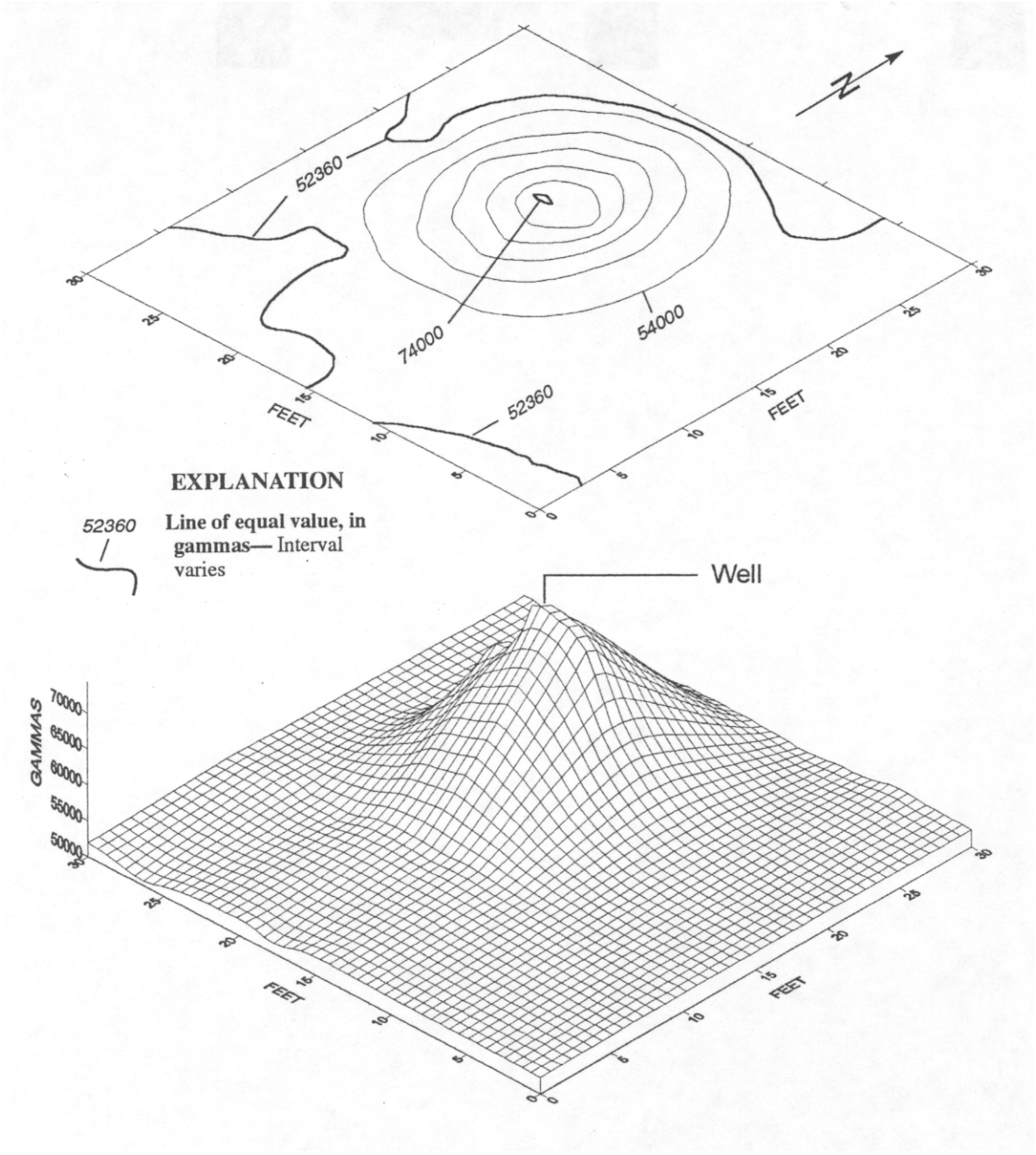

Figure 4–2. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–4, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

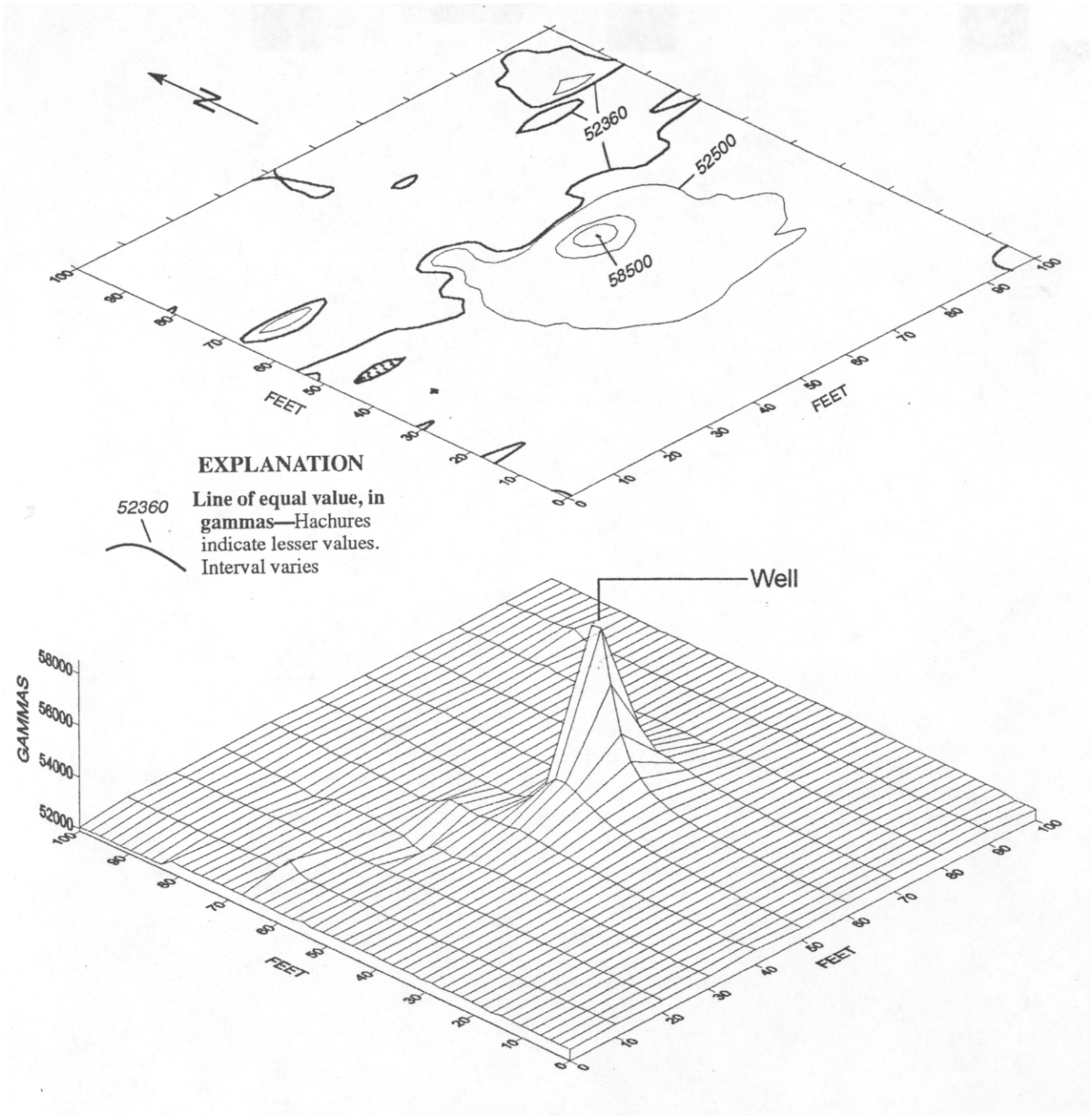

Figure 4–3. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–5, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

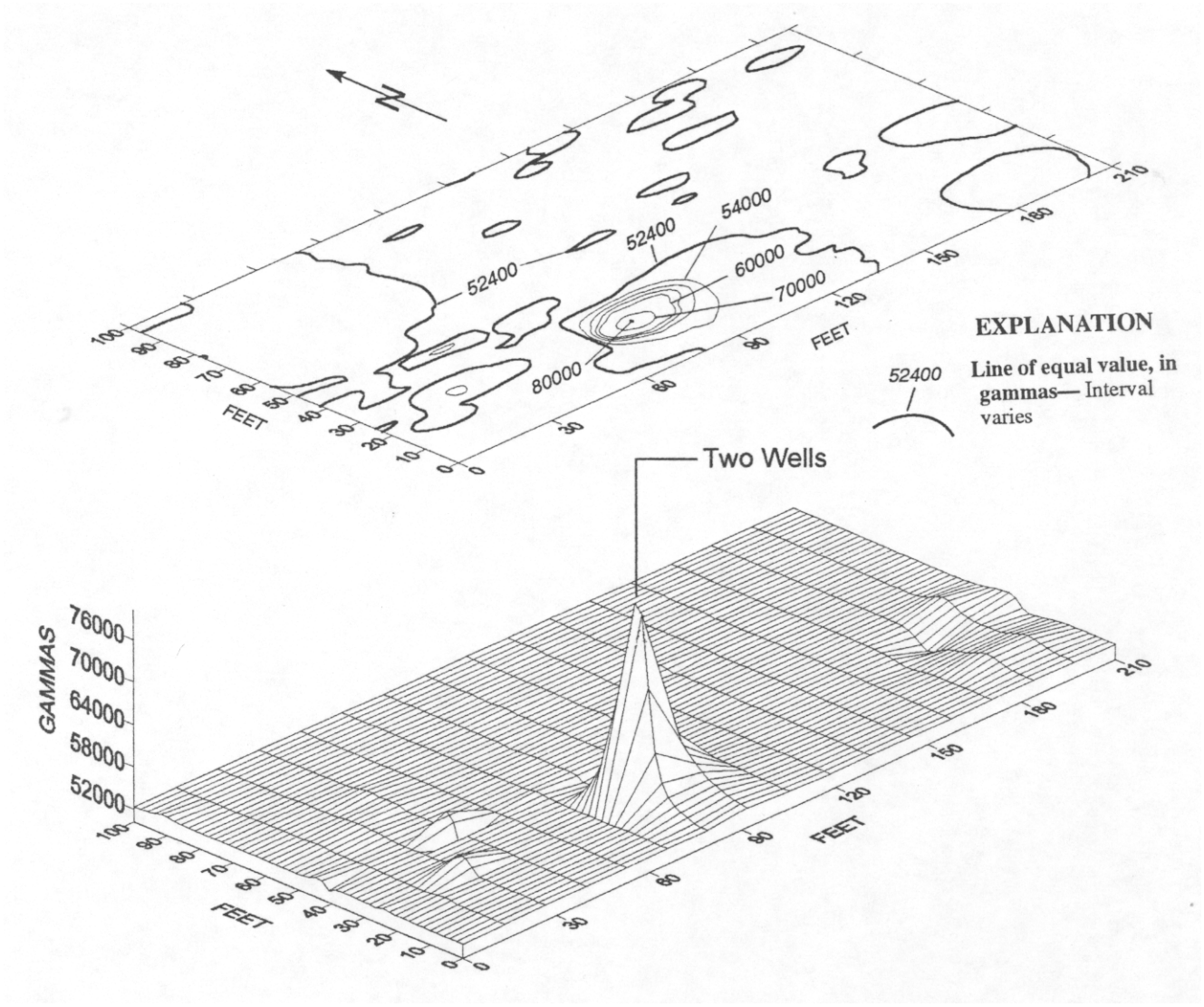

Figure 4–4. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–9, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

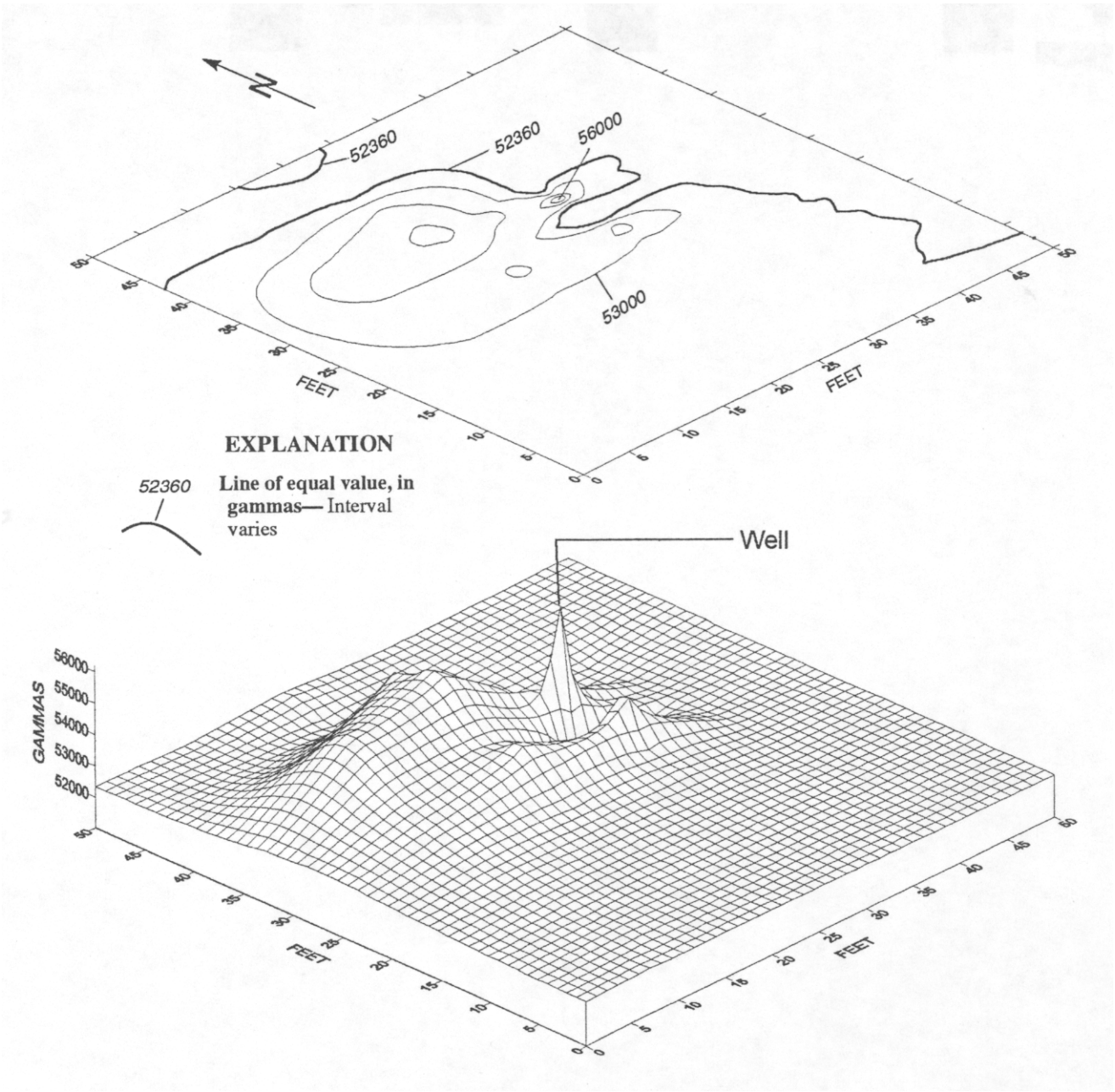

Figure 4–5. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–10, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

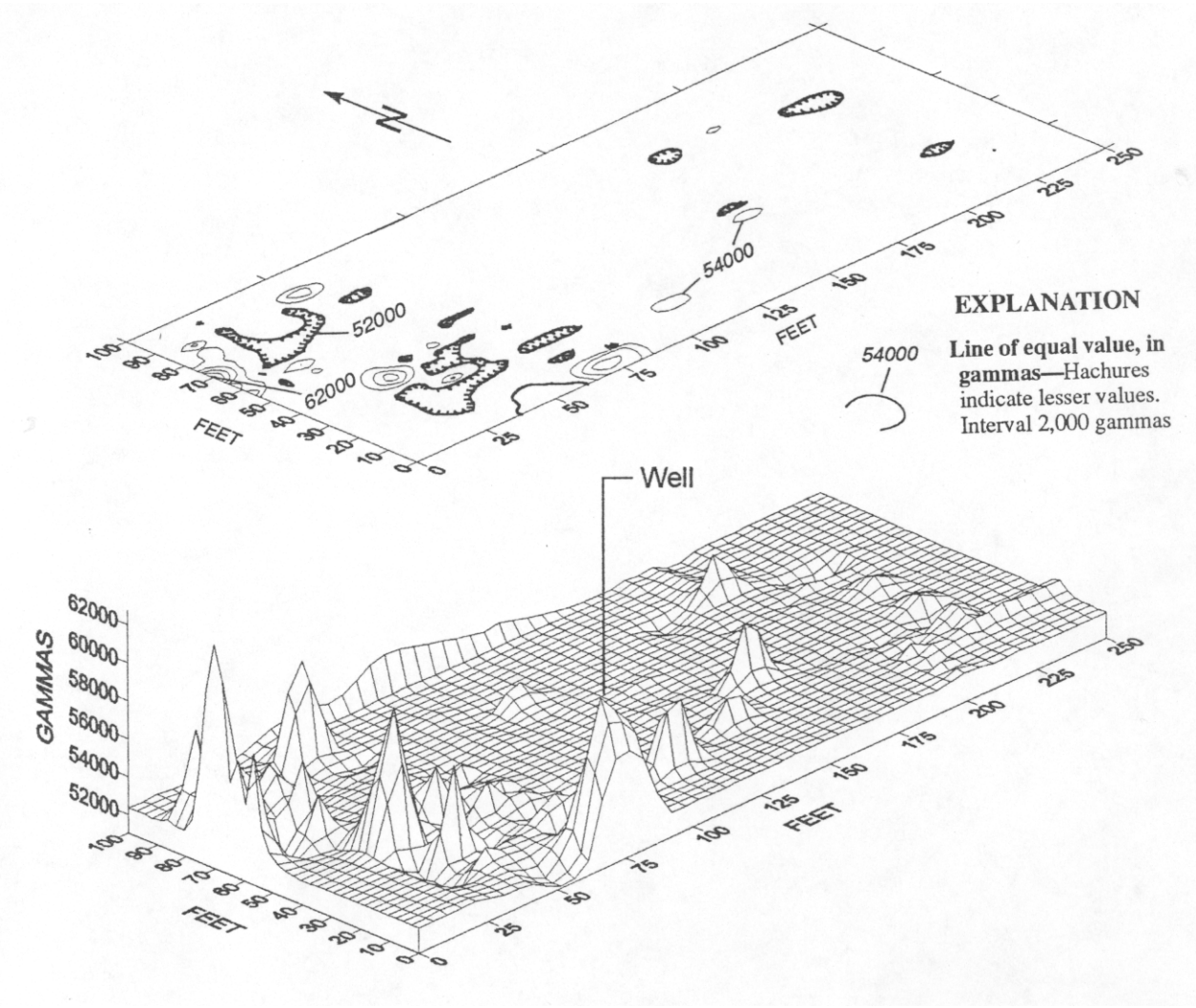

Figure 4–6. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–11, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

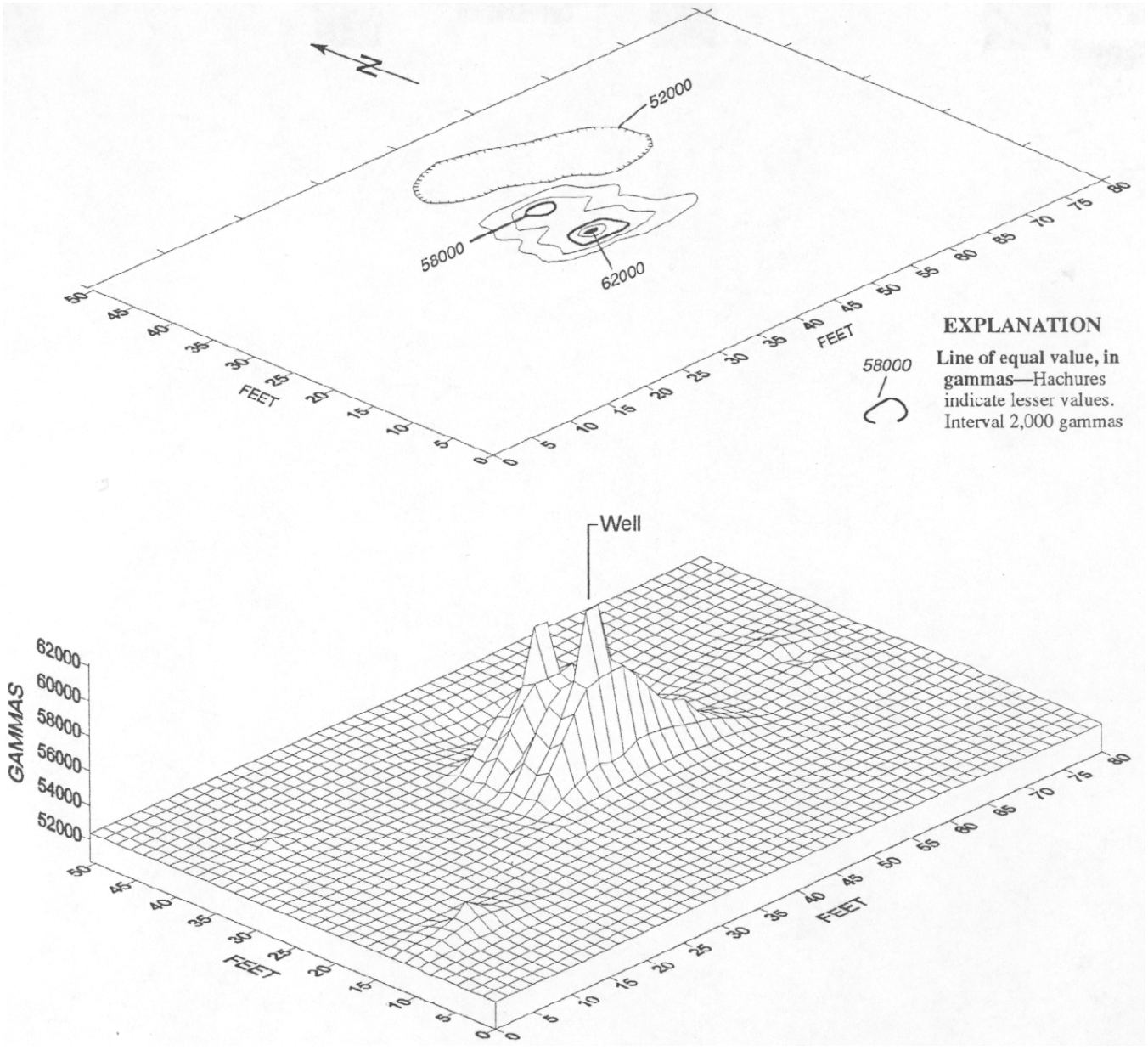

Figure 4–7. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–17, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

APPENDIX 5—LINES OF EQUAL VALUE FOR MAGNETIC ANOMALIES AND CORRESPONDING GRID MAPS AT ABANDONED HOMESTEAD SITES WITHOUT WELLS

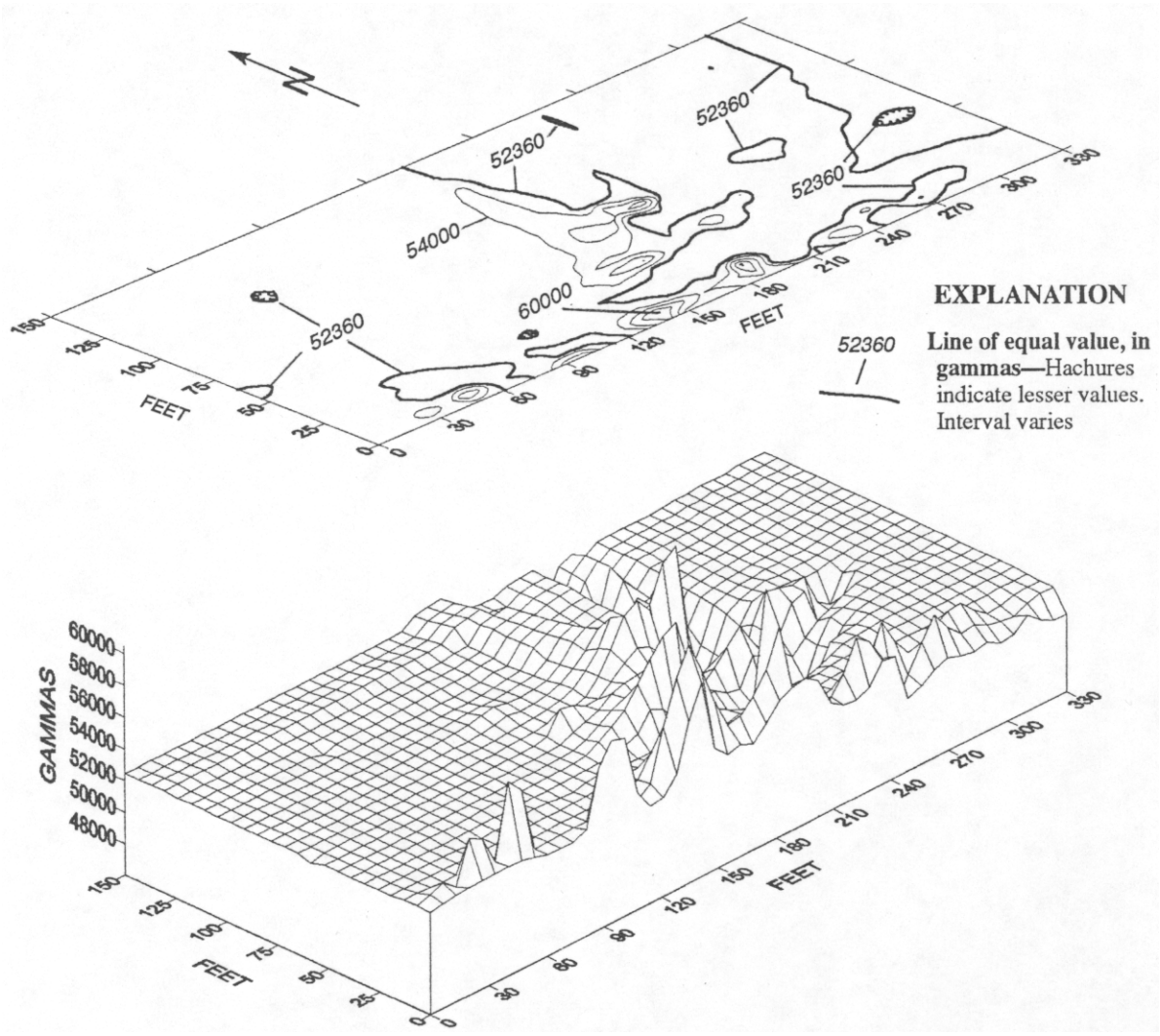

Figure 5–1. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–2, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

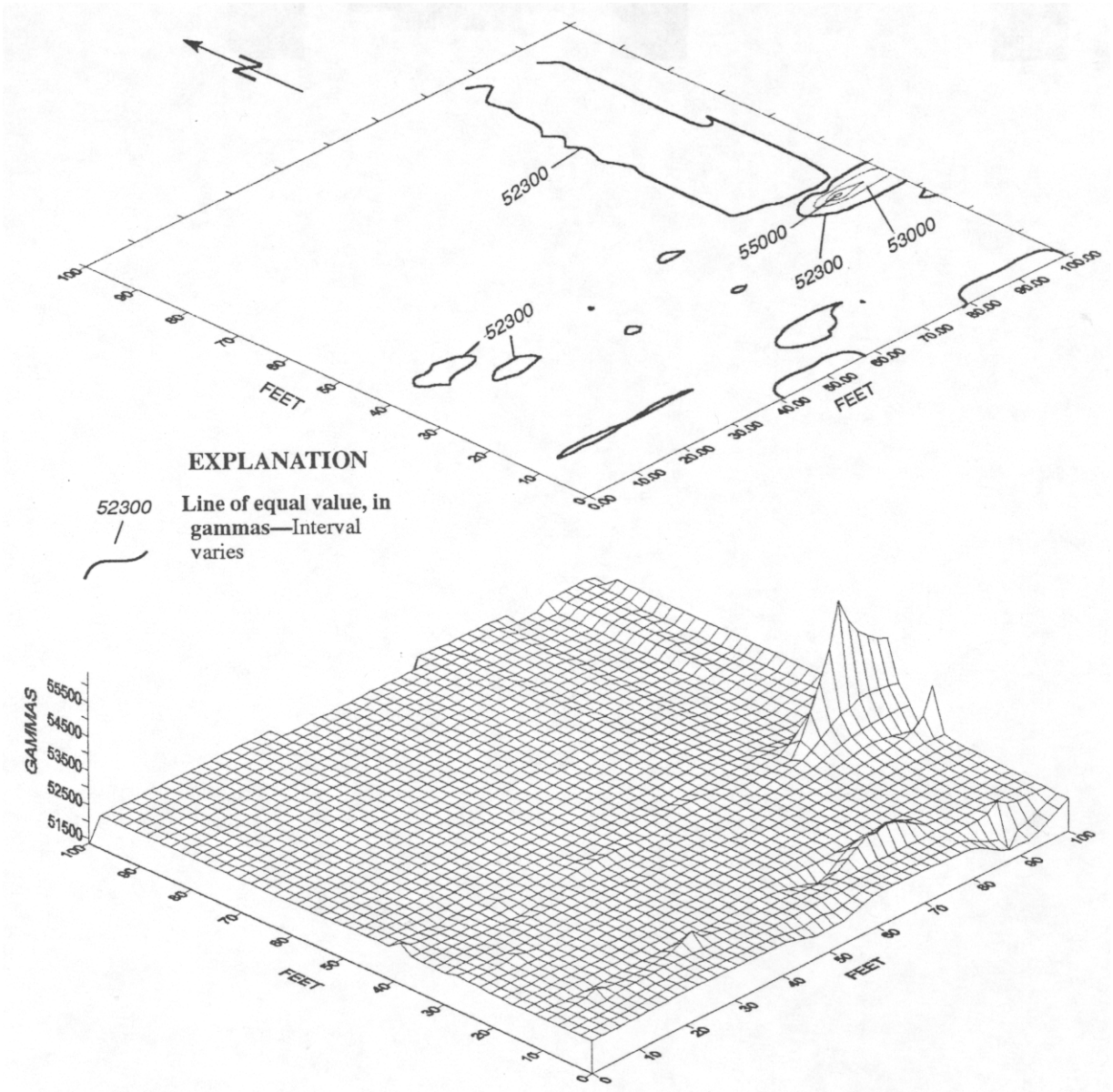

Figure 5–2. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–7, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

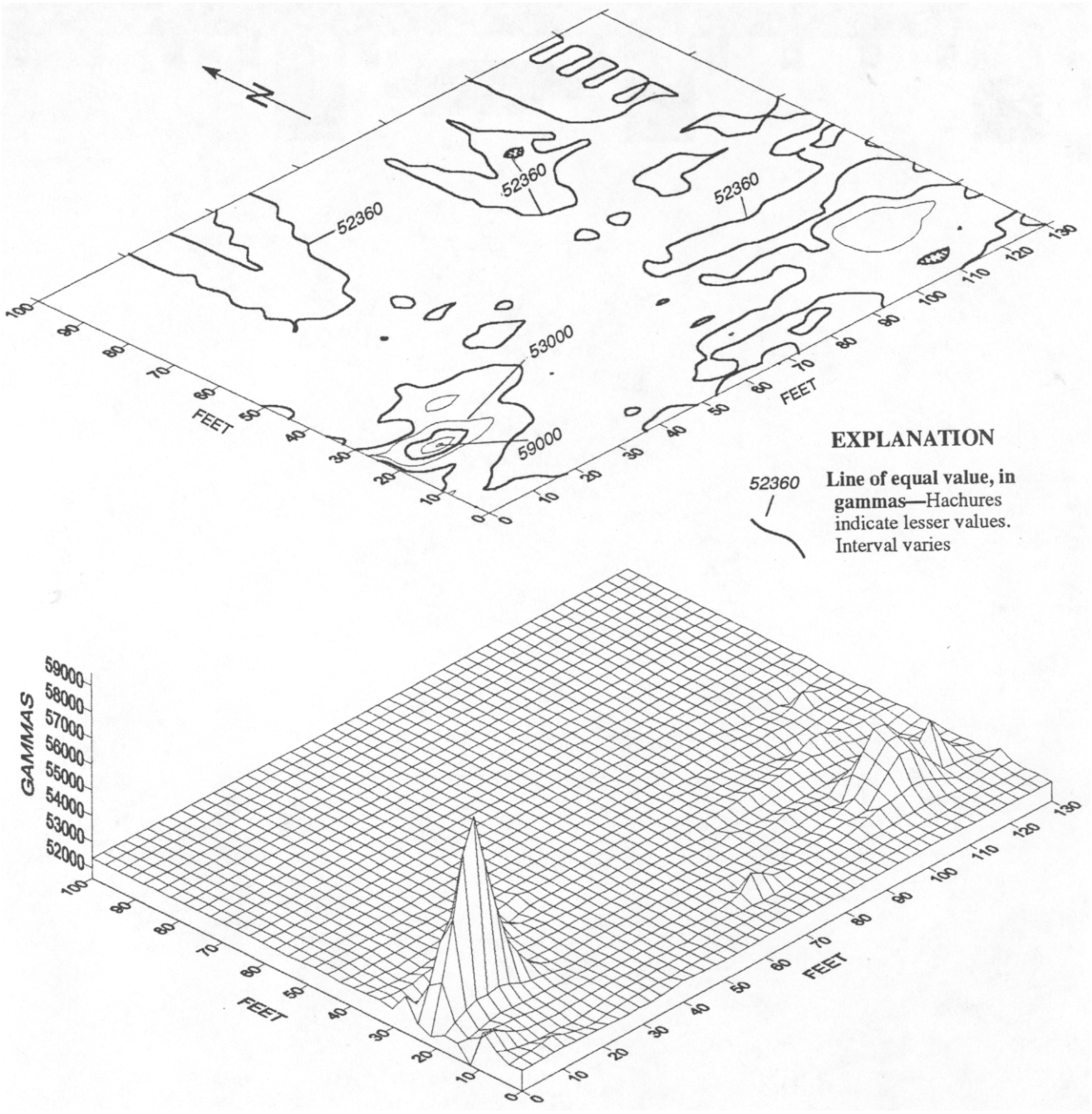

Figure 5–3. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–8, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

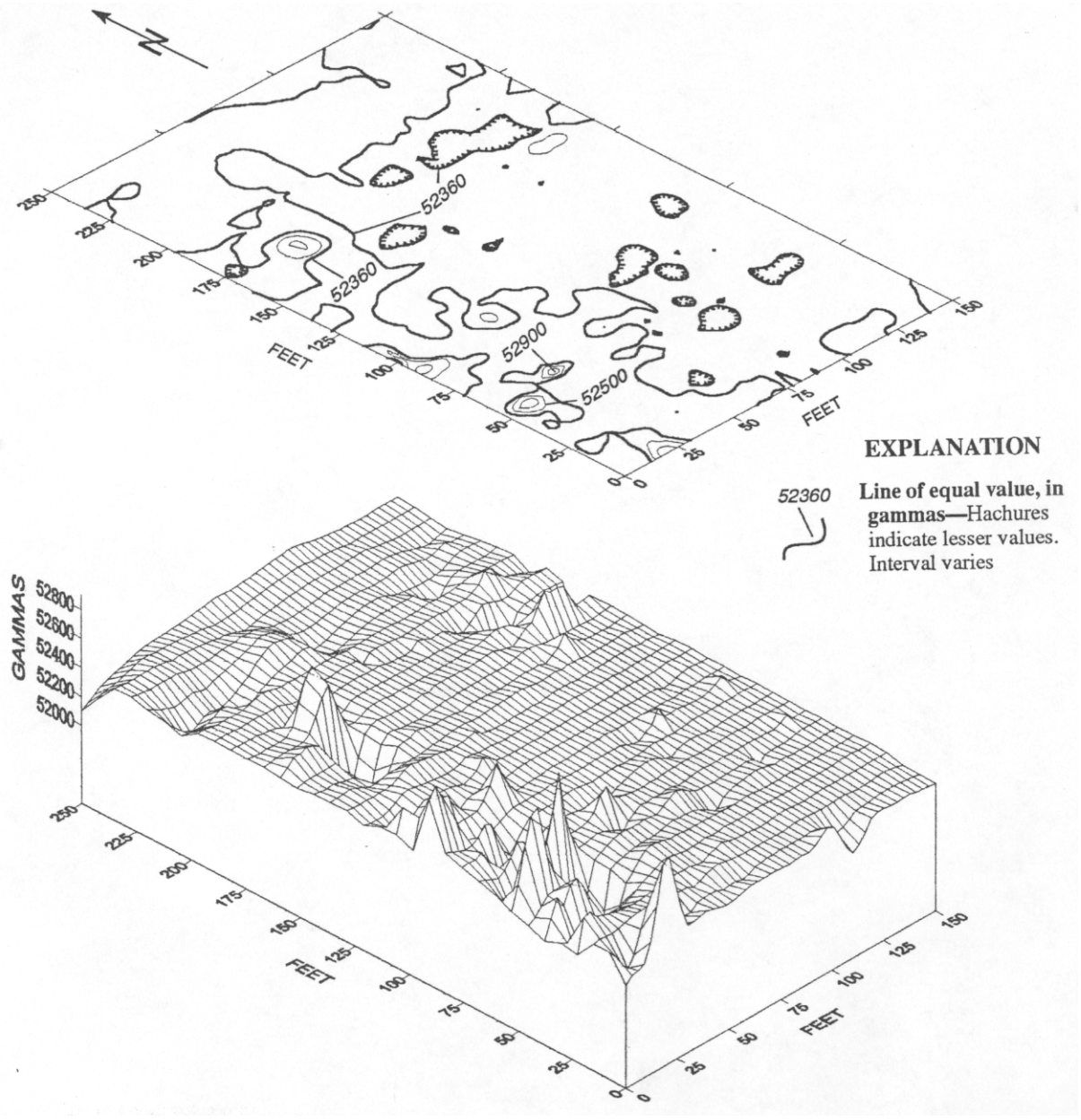

Figure 5–4. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–12, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

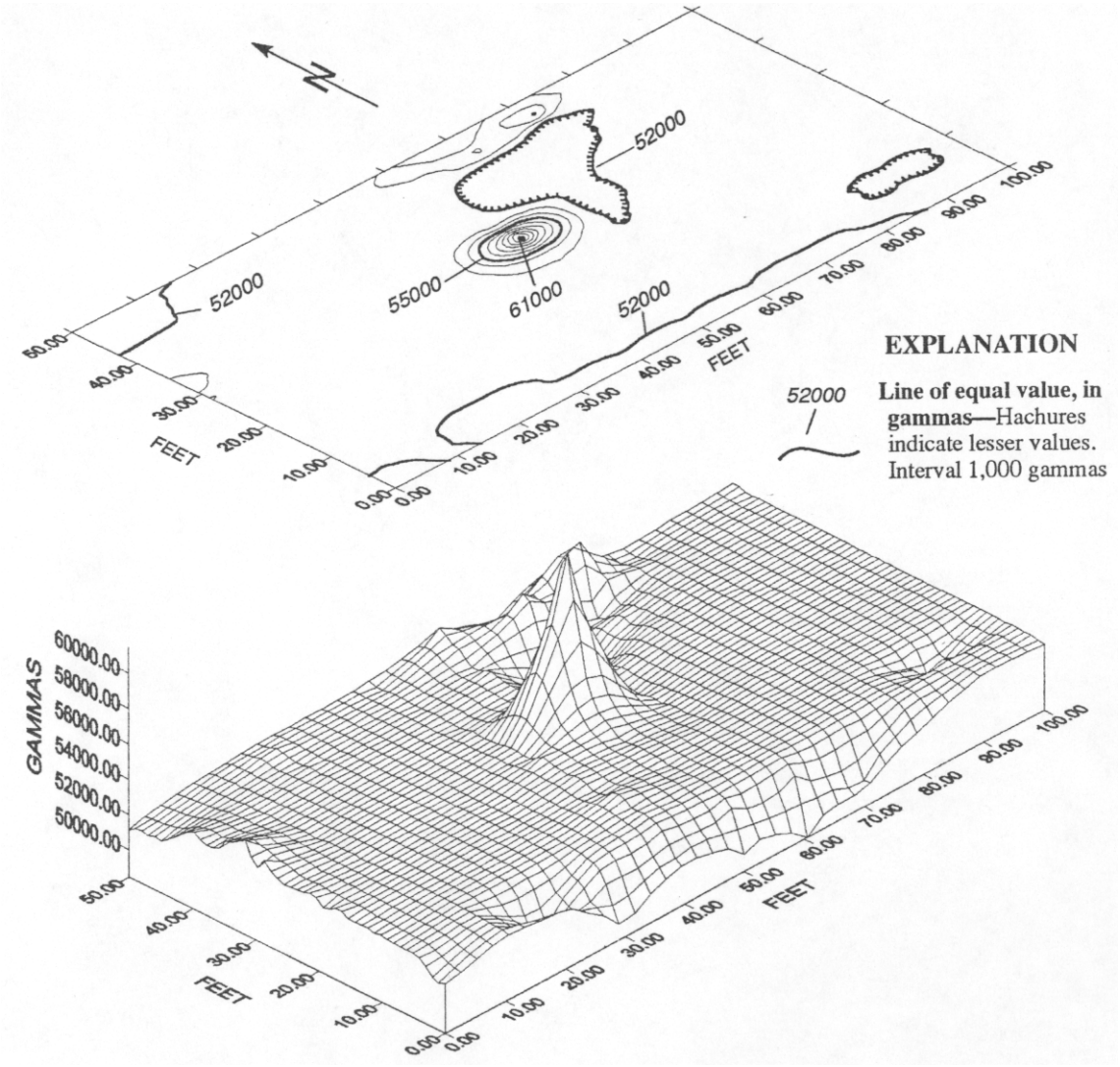

Figure 5–5. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–13, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

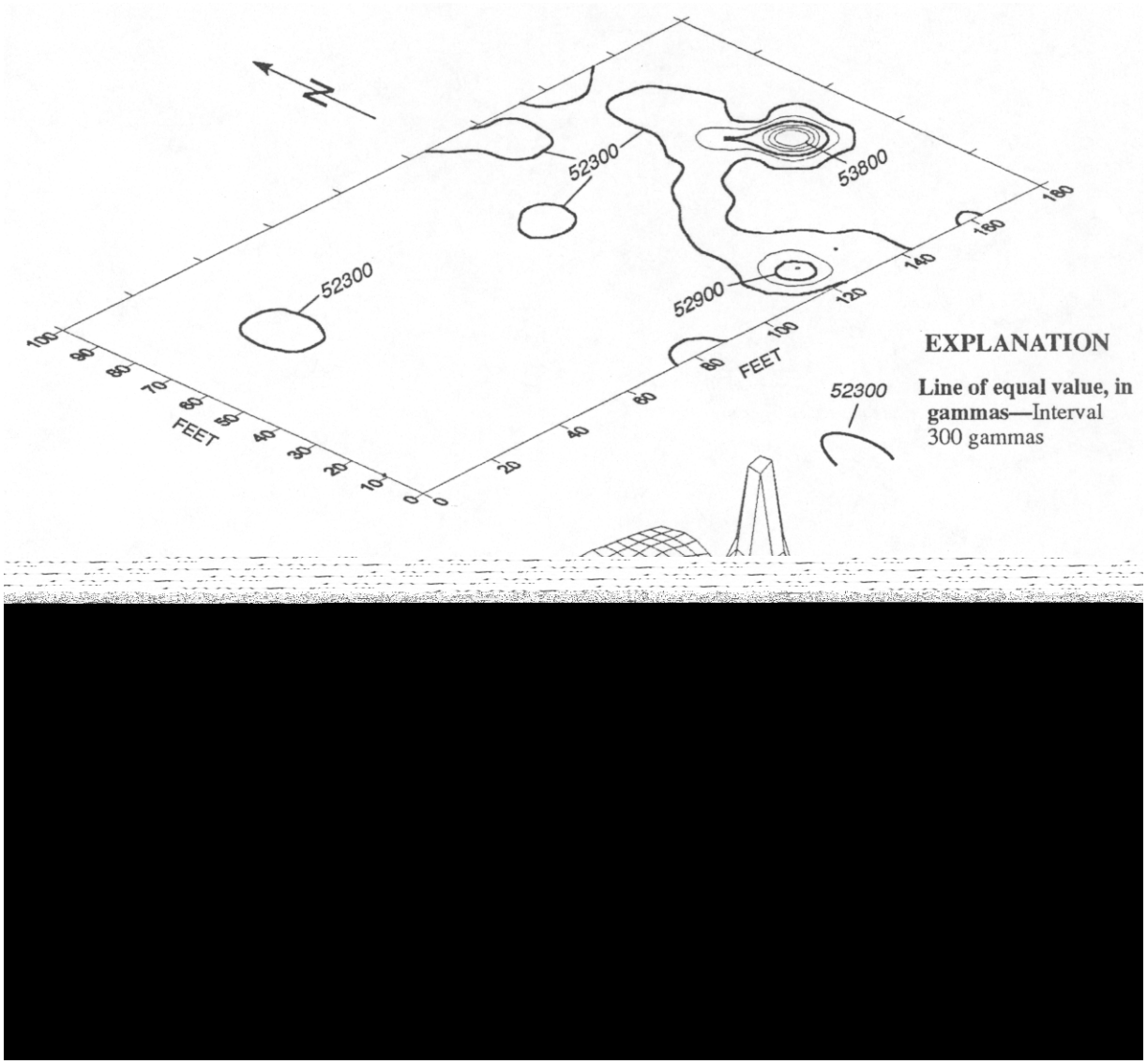

Figure 5–6. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–14, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

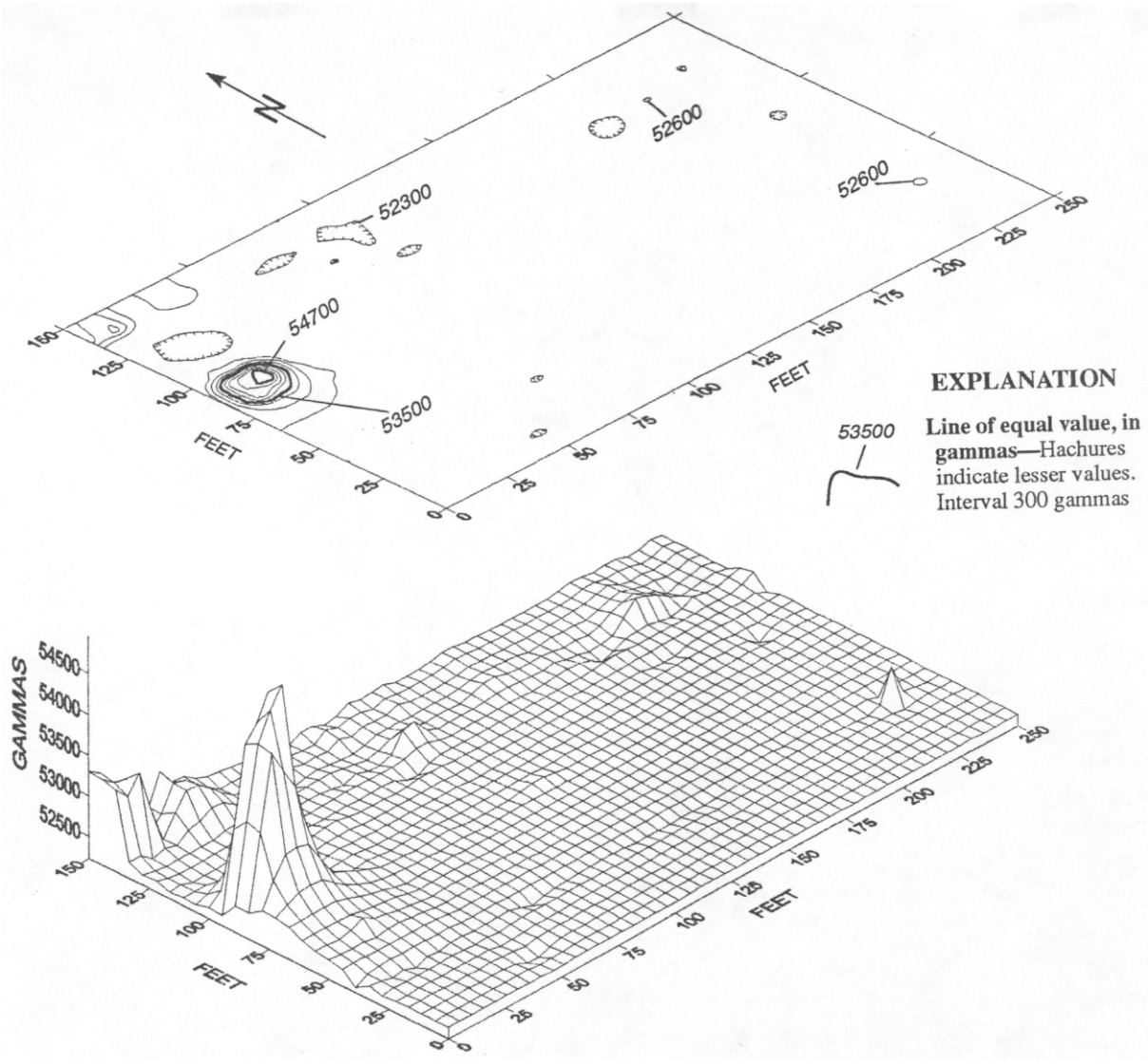

Figure 5–7. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–15, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

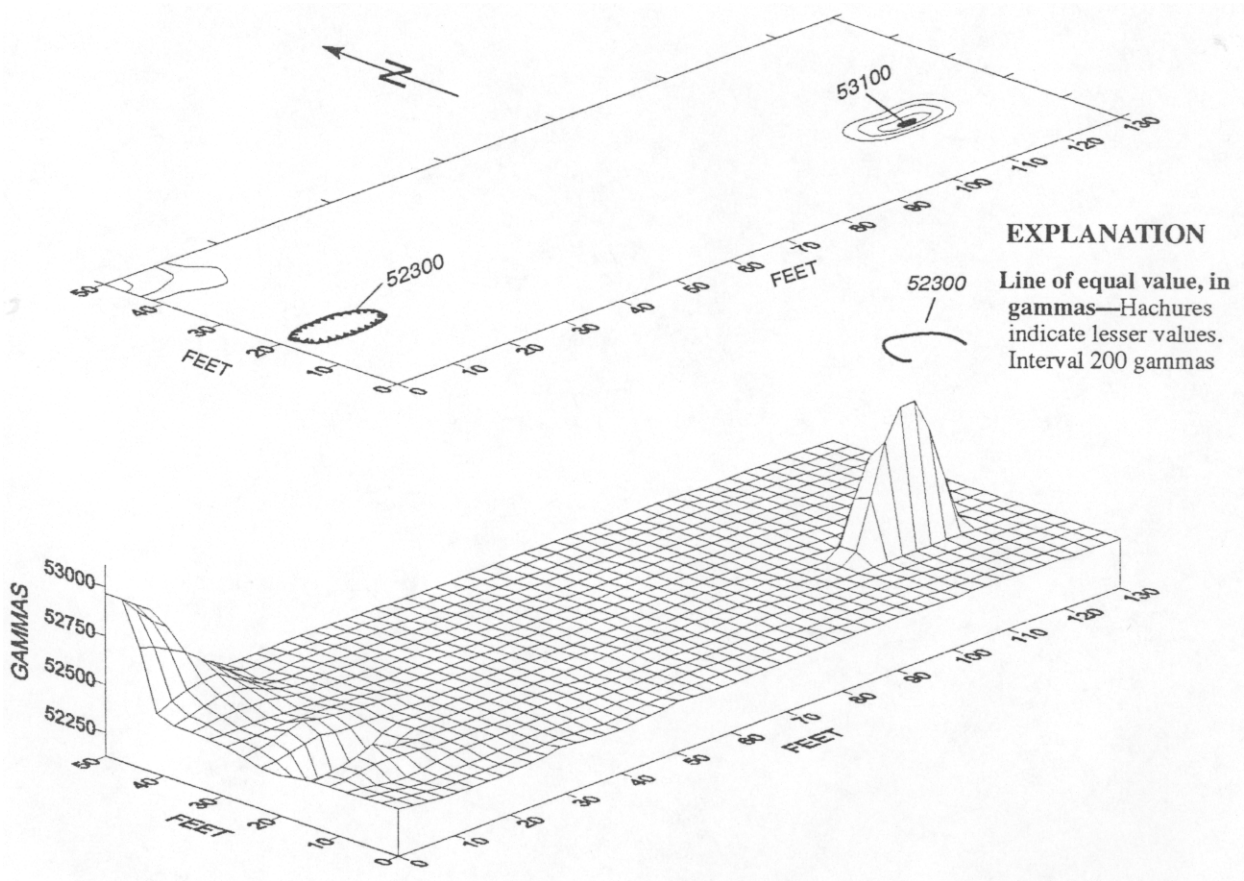

Figure 5–8. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–16, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.

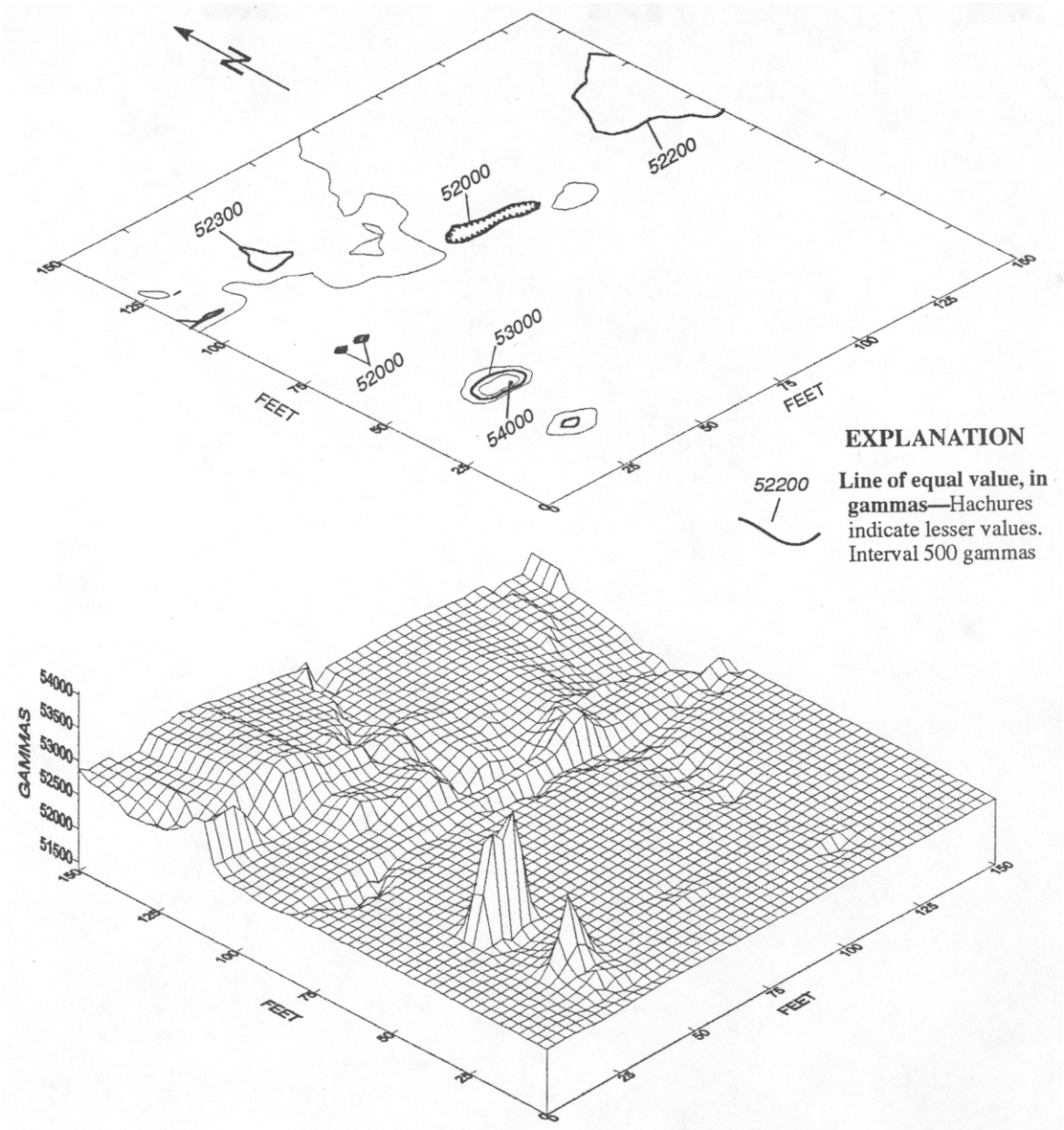

Figure 5–9. Lines of equal value for magnetic anomalies and corresponding grid map at abandoned homestead site HL–18, former Pantex Ordnance Plant and Texas Tech Research Farm near Amarillo, Texas.