ENVIRONMENTAL ASSESSMENT FOR A SEISMIC REFRACTION SURVEY OF DEATH VALLEY

U.S. GEOLOGICAL SURVEY

United States Department of the Interior
NATIONAL PARK SERVICE
DEATH VALLEY NATIONAL MONUMENT
DEATH VALLEY, CALIFORNIA 92328

IN REPLY REFER TO:

L7617
xN3021

July 15, 1987

Dear Reviewer:

Please find enclosed a copy of the Environmental Assessment (E.A.) for a Seismic Refraction Survey of Death Valley, planned and prepared by the U.S. Geological Survey.

This study is part of the site characterization for the proposed Yucca Mountain high level radioactive waste repository, and is funded by the Department of Energy (please refer to section II. A. 2. of the Environmental Assessment beginning on page 5). Death Valley National Monument, however, is expected to gain some benefits from the study, especially in regard to understanding the area's geology.

Should the project gain final approval, the National Park Service recommends that several stipulations be placed on the resulting Special Use Permit. These include, but are not limited to:

I. Shallow refraction seismic testing may be required in order to identify potentially impactible aquifers.

II. Portable mud pits, only, will be used.

III. Cuttings and drilling mud will be removed. In no case would these be deposited in local depressions.

IV. Reclamation will be conducted regardless of possible future flooding.

V. All conditions of Death Valley National Monument's explosives use permit must be met.

VI. The monument must be provided copies of all draft and final publications and reports.

Any comments or ideas concerning this E.A. which you wish to submit would be greatly appreciated. The review period is 30 days, closing on August 19, 1987.

Sincerely,

Edwin L. Rothfuss
Superintendent

Enclosure

Environmental Assessment for a Seismic Refraction Survey of Death Valley

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Environmental Assessment for a Seismic Refraction Survey of Death Valley

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Section I

Purpose and Need

Seismic refraction profiles are proposed within the Death Valley National Monument which would provide critical subsurface information on the deep structure of this area, necessary to understand how Death Valley formed.

The complexity of the geologic history in Death Valley coupled with excellent rock exposures, make it a valuable natural laboratory for evaluating our current concepts of crustal extension. The location of Death Valley at the boundary between several of the great contemporary structural domains further enhance the importance of Death Valley as a laboratory for studying the fundamental proceses governing present-day extension in western North America. Although continuation of surface geologic mapping is critical to developing our knowledge of the geologic history of Death Valley, knowledge of the subsurface structure of Death Valley is the key to unraveling the origin of its spectacular geology. The proposed seismic survey is therefore designed to study the complex subsurface structures of Death Valley in a key area where large-scale examples of all fault types intersect. The surveys will provide subsurface information that should resolve some of the long-standing geologic problems in the Death Valley area.

Section II

Alternatives Including the Proposed Action

A. Alternative A - Perform Death Valley Seismic Refraction Survey

1. General Description

This alternative proposes to conduct a seismic refraction survey in Death Valley National Monument. The required structural information is obtained by analysis of seismic (sound) energy passing through the earth. To carry out a seismic refraction experiment, it is necessary to drill holes, load and detonate explosives of sufficient size (2000 to 3000 pounds of ammonium nitrate, classified as a blasting agent) that will generate enough energy so that instruments (seismographs) up to 200 km away will receive and record a refracted wave from a depth of 20 km or more. The blasting agent is loaded into the lower portion of an 8-inch diameter, 130 to 170-foot deep hole, drilled under USGS direction by a contract driller. The mobil drilling rig is mounted on a 2 axle diesel truck, weighing 15 to 20 tons. A truck carrying water, drill stem, and other accessories accompanies the drill rig.

Our desire is to a cause minimal amount of environmental and physical damage in collecting the data; therefore, we make a special effort to select sites in previously disturbed areas, such as quarries, road cuts, dumps, stream washes, etc. The nine proposed sites within Death Valley National Monument (Figure 1) were selected using this criteria.

After drilling and before loading the blasting agent, each hole is capped by a piece of metal, tack-welded onto the top of the casing. Two or three days before a shot is detonated, the holes are loaded with the blasting agent. The shot holes are not primed until a few minutes before detonation.

After the holes are drilled and the blasting agent is loaded, 120 suitcase-sized instruments (seismographs) which record the ground motion from the shots are deployed so that they are roughly aligned with a line of shotpoints. Recordings from three lines (i.e. deployments or profiles) of shots will be performed within the park boundaries shown in Figure 1. Due to the rugged terrain along Line 2 (in the Funeral Mountains, west of Indian Pass, and in the Cottonwood Mountains), it may be necessary to use helicopters to survey deployment sites, and to deploy and retrieve seismographs. The seismograph sites will be chosen to minimize environmental impact and are placed in disturbed areas adjacent to the highways. The actual ground motion involved is minute and as such, the recording instruments are very sensitive. Because of this, shooting and recording is done at night, usually between 10 pm and 3 am, so that ground motion from moving cars, people, livestock, pumps, wind, etc. does not interfere with the ground motion created by the seismic energy. When the experiment is completed, the seismographs are retrieved and the pipe at each shot hole is cut off and capped two feet below the surface and the area around the hole is recontoured. The experiment usually takes two days: the instruments are deployed during the day, the blasting agents are detonated that night, and the instruments are retrieved the following day.

Results of the seismic survey within the Monument will be published in publicly available scientific literature. The data will be published as a U.S.G.S. Open-file report and the interpreted data will be published either in U.S.G.S. Professional Papers, or in peer-reviewed professional journals. These publications will render the data collected in the Monument readily accessible to the general public. All recent seismic surveys of this type performed by the U.S.G.S., such as in Long Valley, California, have been published in this manner.

2. Funding

Funding for the proposed seismic refraction survey, which will physically include areas in southern Nevada, southeastern California (areas adjacent to Death Valley), and Death Valley itself, comes from monies allocated by Congress to the Department of Energy and obligated for the evaluation of Yucca Mountain in Nevada as a site for a high-level radioactive waste repository.

The U.S. Geological Survey's role in the program is to make both surface and subsurface geological evaluations. We, the Branch of Seismology, are collecting subsurface data via seismic refraction for the determination of the geologic structure of the immediate and regional areas. Knowing the regional or "big picture" geology is invaluable in understanding the geology and how it contributes to the geology of any particular local sites.

3. Ground Water Levels

Open-file Report 82-513 (enclosed) by the USGS Water Resources Division prepared for the National Park Service (NPS) describes the water quality and depths to water in the Stovepipe Wells area. From this information, depth to water in the proposed shothole areas range from 70 ft. in the north to approximately 35-40 ft. in the Stovepipe Wells area and to the east and west. No water is expected at SP 32. Based on this published information, performing shallow, local refraction tests and other local surveys would not yield significant additional information. However, if the NPS feels that such an experiment is necessary, we will perform a shallow refraction or resistivity experiment.

4. Reclamation

Reclamation efforts for the proposed seismic refraction experiment are listed below.

1) Tracks left by drilling operations performed off public-use roads will be raked and covered.

2) Drilling mud or fluids are used to flush cuttings from the hole. The cuttings stay within 15 ft. of the hole and are used to stem the hole after loading the blasting agent (the blasting agent is loaded to within 50 ft. of the surface and the cuttings and mud are used to fill the hole for the purpose of containing the explosion). Drilling mud is recirculated through a mud pit that is portable or dug near the hole. The drilling mud is non-toxic (please see attached brochures, Quick-Gel Viscosifier). The mud drained away from the hole is less than two cubic yards, and will be confined within the 15 ft. radius. When fluid is used (additive with water, please see attached brochure), the cuttings are washed out with the solution and the additive (observed as a

frothy substance) evaporates. The water flushed out of the hole will be non-toxic. Wetness at the shotpoint will last 1 to 3 days as if it had rained and will cause no environmental damage. Cuttings and mud, if used, will be used as stemming; those not used will be, a) removed from the area, b) blended in with rake and shovel to the alluvium in the area (the composition of the alluvium and the surrounding area is similar to the mud and cuttings), or c) used to fill a local depression due to slumping should it occur (see subsection 3).

3) Should there be slumping at a shothole after detonation, as in our normal post-experiment procedure, we will fill it with the cuttings, or bring gravel in via truck to fill the depression and reclaim the area. If necessary, we will (and have) revegetate the area. It should be noted that the shotholes are located in washes and the site will be returned to its natural state with the first rain and/or flooding. Our interest and task is to accomplish these on-going experiments, sometimes in and around the same area as previous experiments. We make an effort to do as little damage to the environment as possible, not only because we also have concern for the environment, but we want to be able to return again to the area.

4) All flagging and refuse will be removed.

The government does not post bonds, but we want to work with the NPS to rehabilitate the areas to our mutual satisfaction. That may be to transfer funds (journal voucher) for the NPS to use their equipment and personnel where necessary. Four months after detonation, we (NPS and USGS) will inspect the shothole areas for subsidence etc., and make necessary adjustments.

5. Safety Precautions

Seismic experiments of the type described are performed by a U.S.G.S. crew three to five times a year. A crew consists of 12 to 17 people, most of whom are familiar with all aspects of the operation. All contracted services, including drilling and helicopter support will be overseen by at least one USGS employee.

During the shooting phase of the experiment proper safety measures will be followed at each of the shot points, including a patrol of each shot point site to insure that no people or livestock are endangered. The people in charge of the loading and shooting of the blasting agent have 3 to 20 years experience each in handling explosives. In addition, most of the seismic crew have attended professionally conducted explosive safety classes.

In the unlikely event of non-detonation of the explosive, a second try will be made, providing the primacord is in tact. If not, one of two options can be exercised:

1) Bring a drill rig in, put PVC pipe down the hole, and, with water and mud, flush the stemming out of the hole. A new primer will be put into the bulk blasting agent, stemming put back in, and the hole detonated. The area around the hole will be wet for 2-3 days; excess cuttings and mud will be removed.

2) If pipe is above ground, it is cut off to two feet below the surface and is covered up, leaving the blasting agent to naturally disseminate slowly through the ground water.

We have consulted with Dr. Ted German of DuPont, Inc., about toxicity and hazard to the environment if a charge were to be left. The blasting agent would breakdown within 6-9 months into fertilizer (i.e. salts of nitrate (ammonia, sodium, calcium, etc.), silica, carbon, and water). However, these will not flush out into the ground water immediately, but slowly over several years (9-12). Increased levels of disseminated nitrate salts from the explosive are expected to be negligible.

6. Site Descriptions

a. Shot point 32

Shot point 32 is located in the Cottonwood Mountains off of the dirt road leading to Hunter Mountain, 0.5 miles north of the Quackenbush Mine entrance (Figure 2). The site is situated in an abandoned quarry of meta-sedimentary rock of upper pre-Cambrian to lower Paleozoic age (Figure 3). No major washes are located near the site.

b. Shot point 33

Shot point 33 is located off the dirt road leading from Stovepipe Wells Hotel to Cottonwood Canyon (Figure 4). The site is situated 140 feet southwest of the road and about 100 feet from a recently constructed corral (Figure 5). A minor wash runs near the site. The site is located at the edge of an alluvial fan with the thickness of the alluvium probably exceeding the total drill hole depth.

c. Shot point 34

Direct access is provided for shot point 34 on a dirt road leading off Highway 190, 2.4 miles east of Stovepipe Wells Hotel (Figure 6). The site is located where a major wash crosses the dirt road, 0.2 miles south of the highway (Figure 7). The wash is part of an alluvial system that originates at the mouth of Grotto Canyon in Tucki Mountain. The alluvium is coarse grained and thick.

d. Shot point 35

Two holes are proposed to be drilled at shot point 35 for two different seismic deployments (Lines 2 and 6) at Beatty Junction (Figure 8). The shots for these holes will not be detonated coincidently. The site is located 200 feet to the west of Highway 190 on the lower slopes of an alluvial fan (Figure 9). The drill holes will probably penetrate through the fan into material of the valley floor. Shot point 35 is located in a major wash.

e. Shot point 40

Shot point 40 is located to the south of Highway 190, 5.3 miles west of Stovepipe Wells Hotel (Figure 10). It is situated in a 4 foot deep wash 400 feet from the highway leading towards Black Point (Figure 11). The alluvium is most likely thicker than the maximum depth of the drill hole.

f. Shot point 41

Shot point 41 is located near the junction of Highway 190 with the Daylight Pass Highway (Figure 12). Direct access to the site is provided by an abandonded dirt road connecting the highway leading to Scotty's Castle with Highway 190 (Figure 13). The site is situated on the gentle lower slopes of an alluvial fan. The drill hole will probably be wholly situated within the alluvium. Small, braided washes cross the fan near the site.

g. Shot point 42

Shot point 42 is located off of the Daylight Pass Highway 3.5 miles from the Beatty-Furnace Creek cutoff (Figure 14). The site is adjacent to a publicly accessible dirt road, 200 feet from the highway (Figure 15). The site is situated on the extreme northern side of a wide wash adjacent to an outcrop of lower Paleozoic-upper pre-Cambrian sedimentary rocks. The alluvium directly below the site is probably thin enough so that the drill hole will be partially contained within the ancient rocks. The wash that the site is situated on is a tributary of a larger wash 50 feet away.

h. Shot point 53

Shot point 53 is located off the highway leading to Scotty's Castle, 2.2 miles from the Titus Canyon road entrance (Figure 16). The site is situated in a minor wash 240 feet south of the highway at the edge of an alluvial fan (Figure 17). The drill hole will probably be partly situated below the alluvium in valley floor material.

i. Shot point 54

Shot point 54 is located on the Mesquite Spring Campground road, 0.8 mi south of the highway leading to Scotty's Castle and 1 mile north of the campground (Figure 18). It is situated in a wash 140 feet east of the Mesquite Springs Campground road and adjacent to a 10 to 15 foot alluvial bank (Figure 19). The thickness of the alluvium is probably greater than the drill hole depth.

B. Alternative B - Perform Death Valley Seismic Refraction Survey Using Different Shot Locations

The shot point sites for this seismic refraction survey were chosen at regular intervals to insure the maximum amount of subsurface coverage to resolve the complicated geology of Death Valley. Shot points moved out of the line of deployment (more than 1-2 km out of the line) will greatly complicate the interpretation of the data, while shot points spaced at irregular intervals (more than 1-2 km of deviation from the regular station interval) will dramatically reduce the amount of subsurface information obtained by the survey.

C. Alternative C - No project

For this alternative, the proposed seismic refraction survey in the Death Valley National Monument would be abandoned and the geologic history of the valley, crucial to the understanding of the region's evolution and structural formation, would remain unresolved.

Section III

Impact of Each Alternative

A. Alternative A

1. Natural Resources

a. Air Quality

During the drilling phase, small amounts of fugitive dust will be intermittently released into the air. Dust plumes created by mechanical activity will cease upon termination of drilling. The sites will not be disturbed in terms of causing an increase in suspended particulates derived from wind erosion. No long-term detrimental effects on the air quality are foreseen. No suspended particulates will be produced by the shooting phase of the operation.

b. Soil Quality

Sites not directly accessible by public roads, specifically, shot points 35, 40, 53, 54, and 33, may be susceptible to disruption of the top soil layers due to drilling activity. Although unlikely, the shot detonation may cause the ground to slump a maximum of 10 feet in diameter and 2 feet deep. However, all of the aforementioned sites are located in washes, and any visible disruption would be short lived, due to regular flash flooding and/or heavy runoff. Reclamation will be performed at all of the sites in an effort to restore the original soil character. See "reclamation" section.

c. Natural drainage

Since the drill holes will be sealed after completion of the experiment, the natural drainage will not be disrupted or diverted by the drilling phase of the operation. Likewise, the shooting phase will not produce an impact on the natural drainage system.

d. Biological Resources

During an investigation of each drill hole site, no evidence was found for endangered wildlife habitat existing at the proposed sites. The indigenous flora and evidence for specific animal activity noted during the investigation are listed in Tables 1 and 2, respectively. Reptiles and mammals of the Creosotebush Community, taken from Nasland Engineering (1986), are listed in Tables 3 and 4, respectively.

2. Cultural Resources

Archaeological clearances for each site will be obtained in collaboration with the NPS. During our preliminary evaluations, historic sites or structures near each shot point were noted and are listed in Table 5. None of the historic sites should be affected by the seismic detonation since the ground motion at these distances is minute. Except for an abandonded loader at the quarry near shotpoint 32, no exposed structures were observed in the vicinity of the shot points.

3. Audible and Visual Resources

Noise during the drilling phase of the experiment, conducted during daylight hours, may interrupt the solitude of the area. The drill rig will sound much like a large diesel truck left idling. Each drill hole site should take and average of 1.5 to 2 days to drill. During the shooting phase, the detonation produces a muffled thud; seismic crews working 300 feet from the shot point do not need ear protection.

Visually, the drill rig will compromise the aesthetic integrity of the area. The drilling boom is about 30 feet in height. However, shotpoints 32, 33, and, for the most part, 42, are in areas not visible at frequently visited points in the park. The shooting phase of the experiment will be performed at night and impact on visual resources will be minimal.

B. Alternative B

Moving the shot points may provide a lesser impact on natural, cultural, or aesthetic resources. For example, shot points can be moved (within a few hundred meters) to avoid potential archeological sites. However, the scientific return of the experiment would be diminished if the shot points are moved off the recording line, or are spaced at irregular intervals.

C. Alternative C

If the experiment is not performed, there would be no impact on the environment of the Monument. Likewise, the subsurface geology of the park would remain unresolved.

Section IV

Consultations and References

A. Consultations

Mr. Peter Rowlands: Environmental Specialist; Acting Chief, Resources Management, Death Valley National Monument

Dr. Ted German: DuPont Chemical, Inc.

B. References

Burt, W.H. and R.P. Grossenheider, 1976, A Field Guide to the Mammals, Peterson Field Guide Series, Houghton Mifflin Company, Boston, 289 p.

Ferris, R.S., 1983, Death Valley Wildflowers, Death Valley Natural History Association, 150 p.

Murie, O.J., 1974, A Field Guide to Animal Tracks, Peterson Field Guide Series, Houghton Mifflin Company, Boston, 375 p.

Nasland Engineering, 1986, Environmental Assessment for the Pacific Bell Microwave Radio Route, Death Valley National Monument, 35 p.

Stebbins, R.C., 1966, A Field Guide to Western Reptiles and Amphibians, Peterson Field Guide Series, Houghton Mifflin Company, Boston, 279 p.

USGS, Water Resources Division, Open-File Report no. 82-513

TABLE 1

FLORA OBSERVED AT SHOT POINTS

Shot Point	Common Name	Botanical Name
32	Threadleaf Snakeweed	*Gutierrezia microcephala*
33	Creosotebush	*Larrea tridentata*
34	Creosotebush	*Larrea tridentata*
	Desertholly Saltbush	*Atriplex hymenelytra*
	Bushy Cleomella	*Cleomella obtusifolia*
	Desert-trumpet Eriogonum	*Eriogonum inflatum*
	Weatleaf Spiderling	*Boerhaavia annulata*
	Dodder	*Cuscuta denticulata*
35	Turtleback	*Psathyrotes ramosissima*
40	Creosotebush	*Larrea tridentata*
	Turtleback	*Psathyrotes ramosissima*
	Wetleaf Spiderling	*Boerhaavia annulata*
	Desertholly Saltbush	*Atriplex hymenelytra*
	Dodder	*Cuscuta denticulata*
41	Creosotebush	*Larrea tridentata*
	Turtleback	*Psathyrotes ramosissima*
42	Desertholly Saltbush	*Atriplex hymenelytra*
	Desert Rabbitbrush	*Chrysothamnus paniculatus*
	White Brittlebush	*Encelia farinosa*

TABLE 2

EVIDENCE FOR FAUNA OBSERVED AT SHOT POINTS

Shot Point	Fauna	Zoological Name
32	Burro	*Equus asinus*
	Various lizards	
	Burrowing mammals	
33	Burro	*Equus asinus*
	Burrowing mammals	
34	Burrowing mammals	
35	Burrowing mammals	
40	Burrowing mammals	
41	Burrowing mammals	
42	Burrowing mammals	

TABLE 3

MAMMALS OF THE CREOSOTEBUSH COMMUNITY*

Common Name	Zoological Name
Western Pipistrelle	*Pipistrellus hesperus*
Desert Cottontail	*Sylvilagus audubonii*
Black-tailed Jack Rabbit	*Lepus californicus*
White-tailed Antelope Squirrel	*Ammospermophilus leucurus*
Round-tailed Ground Squirrel	*Spermophilus tereticaudus*
Botta's Pocket Gopher	*Thomomys bottae*
Little Pocket Mouse	*Perognathus longimembris*
Long-tailed Pocket Mouse	*Perognathus formosus*
Chisel-toothed Kangaroo Rat	*Dipodmys microps*
Desert Kangaroo Rat	*Dipodmys deserti*
Merriam's Kangaroo Rat	*Dipodmys merriami*
Cactus Mouse	*Peromyscuseremicus*
Canyon Mouse	*Peromyscus crinitus*
Pinyon Mouse	*Peromyscus truei*
Southern Grasshopper Mouse	*Onychomys torridus*
Desert Woodrat	*Neotoma lepida*
Coyote	*Canis latrans*
Kit Fox	*Vulpes macrotis*
Ringtail	*Bassariscus astutus*
Badger	*Taxidea taxus*
Burro	*Equus asinus*
Mule Deer	*Odocoileus hemionus*
Domestic Cattle	*Bos taurus*
Bighorn Sheep	*Ovis canadensis*

* From Nasland Engineering (1986)

TABLE 4

REPTILES OF THE CREOSOTEBUSH COMMUNITY*

Common Name	Zoological Name
Lizards	
Chuckwalla	*Sauromalus obesus*
Collard Lizard	*Crotaphytus collaris*
Leopard Lizard	*Crotaphytus wislizenii*
Fence Lizard	*Sceloporus occidentalis biseriatus*
Side Blotched Lizard	*Uta stansburiana*
Whiptail Lizard	*Cnemidophorus tigris tigris*
Snakes	
Western Blind Snake	*Leptotyphlops humilis*
Desert Rosy Boa	*Lichanura trivigata gracia*
Leaf-nosed Snake	*Phyllorynchus decurtatus perkinsi*
Coachwhip	*Masticophis flagellum piceus*
Great Basin Gopher Snake	*Pituophis melanoleucus deserticola*
California Lyre Snake	*Trimorphidon Vandenbughi*

* From Nasland Engineering (1986)

TABLE 5

HISTORIC SITES NEAR SHOTPOINTS

Shot Point	Site	Distance
32	Quakenbush Mine	0.7 mi
33	none	
34	Stovepipe Wells Hotel	2.2 mi
35	Jean Lemoigne Grave	1.5 mi
40	none	
41	none	
42	none	
53	none	
54	Scotty's Castle	4.8 mi


6
6
3
3
3
2
2
MESQUITE
FLAT
Sand Dunes
Stove Pipe Wells Hotel
Beatty Junction
Chloride City
Hells Gate
CORKSCREW PEAK
GRAPEVINE PEAK
WAHGUYHE PEAK
SAWTOOTH MOUNTAIN
BULLFROG HILLS
Rhyolite
Beatty
OASIS VALLEY
Meteorological Station
Quarry
Ranch
Rums
Carrara
NEVADA
CALIFORNIA
NYE COUNTY
INYO COUNTY
One Way
Campground
Ranger Station
UBEHEBE CRATER
GRAPEVINE CANYON
Scottys Castle
RACETRACK
VALLEY
HIDDEN VALLEY
ULIDA FLAT
Teakettle Junction
Daylight Pass
Indian Pass
National Park Service Hdq
Black Point
Old RR Grade
Death Valley Buttes
Sand
Dunes
RANGE
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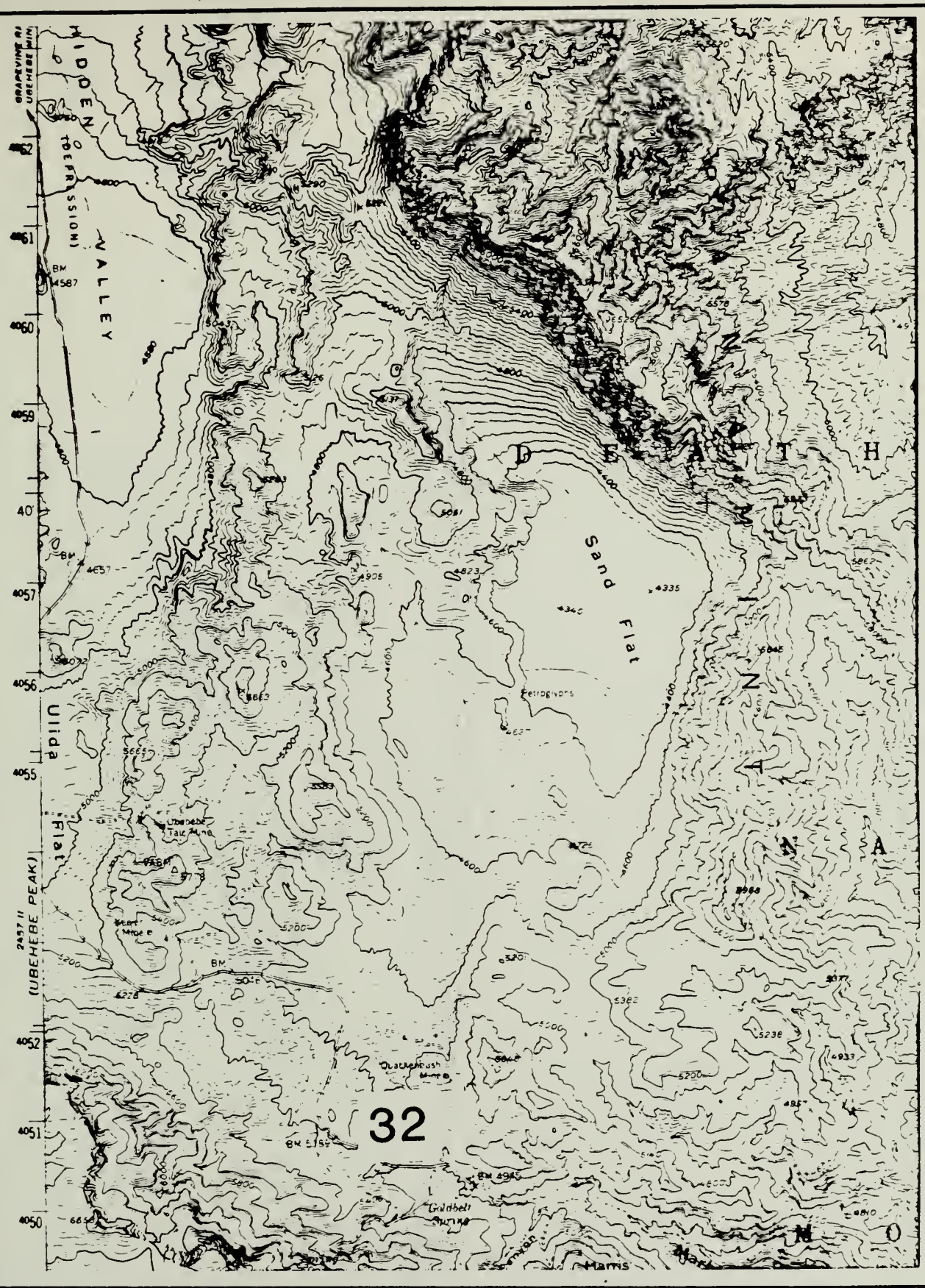
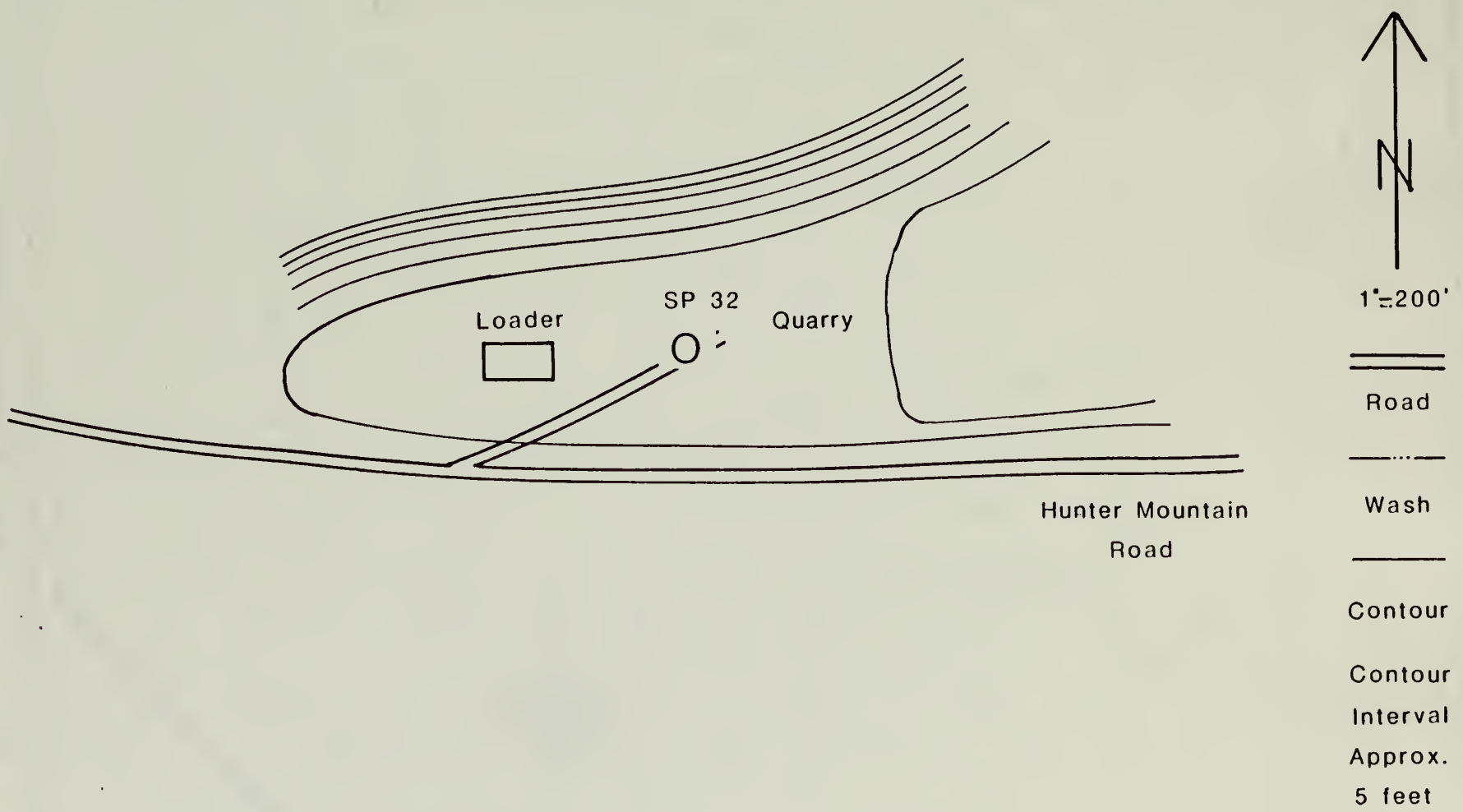
FIGURE 1

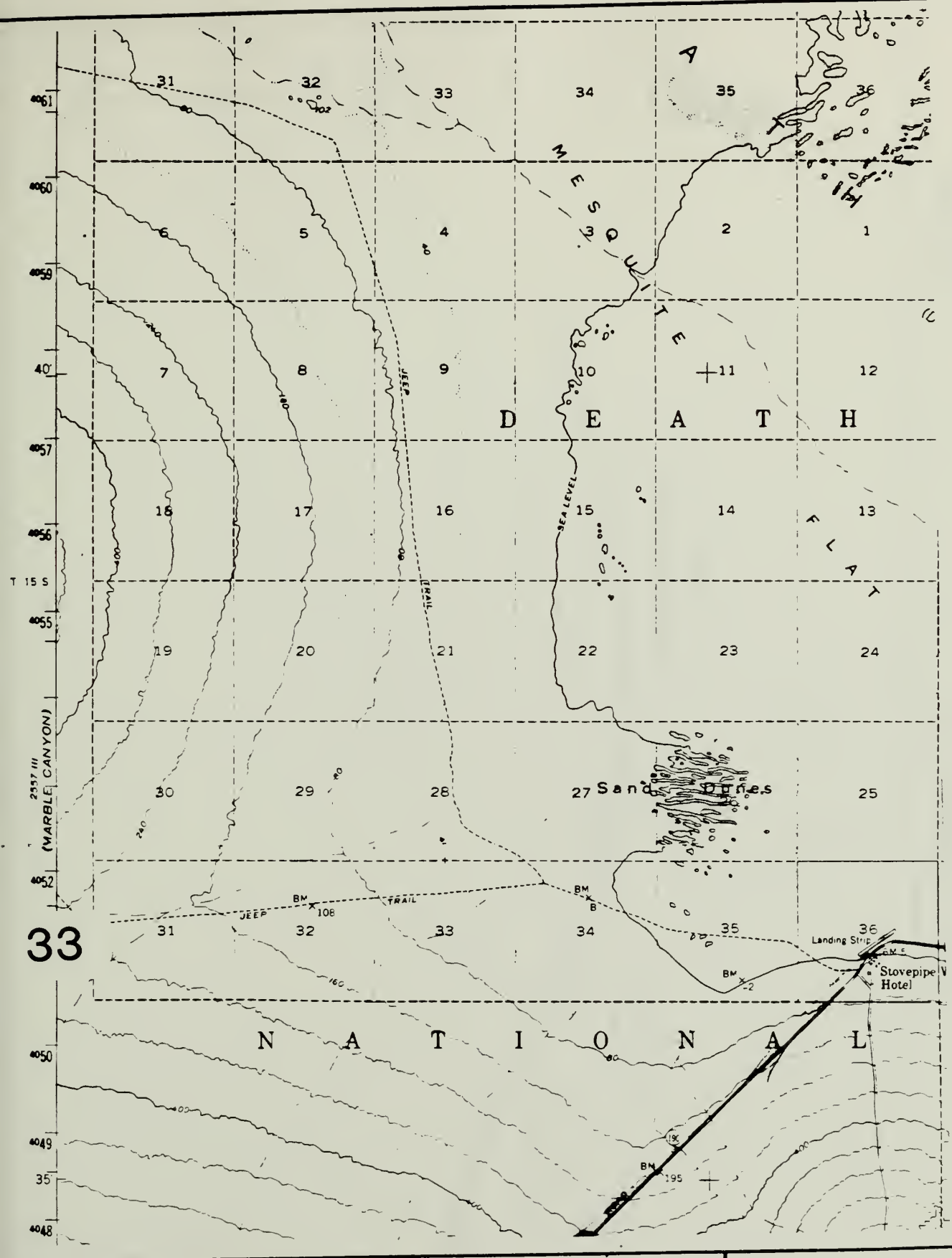


SHOT POINT 32	FIGURE
TOPOGRAPHY (USGS 15 min QUAD)	2



SHOT POINT 32
SITE PLAN

FIGURE
3

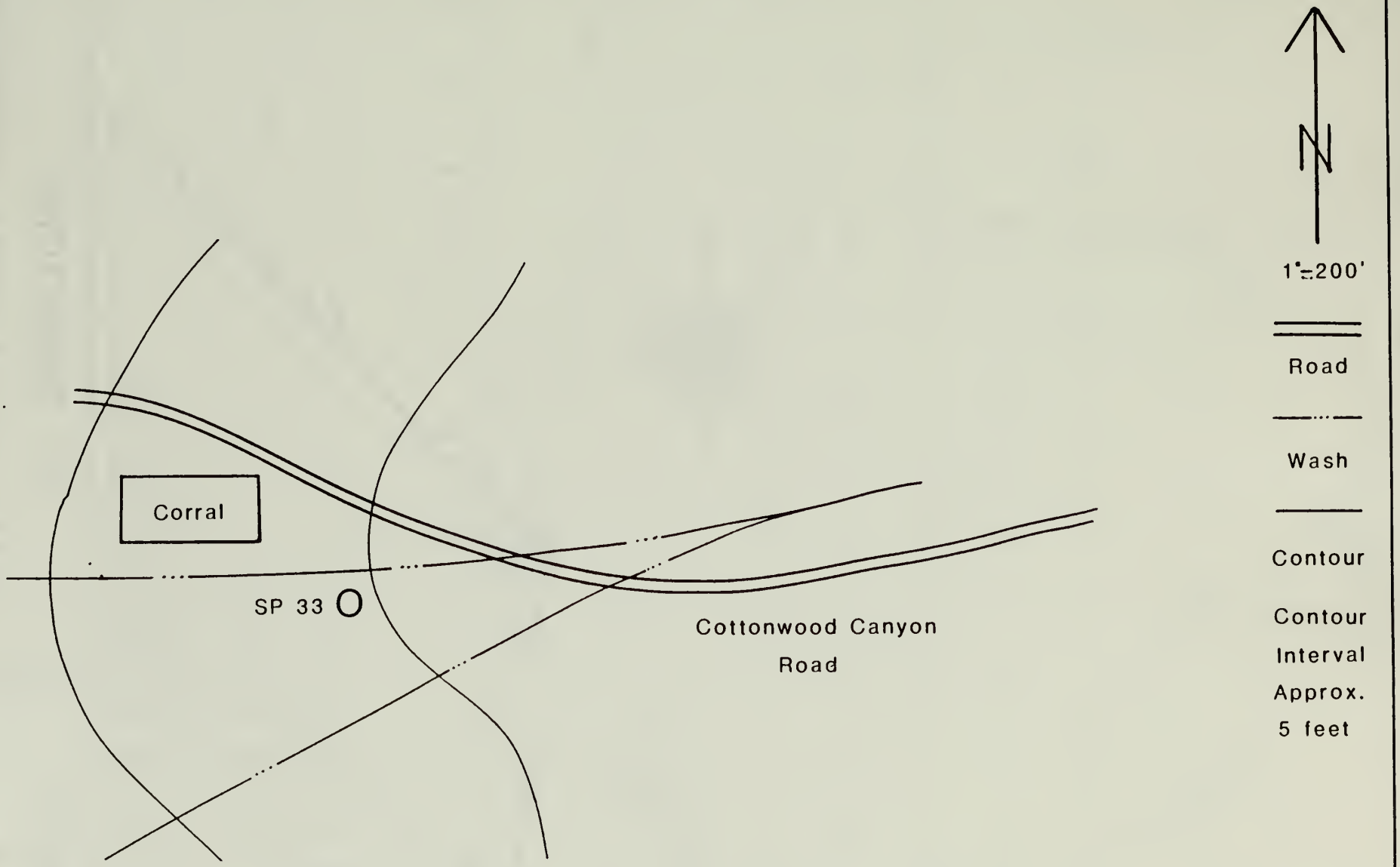


SHOT POINT 33

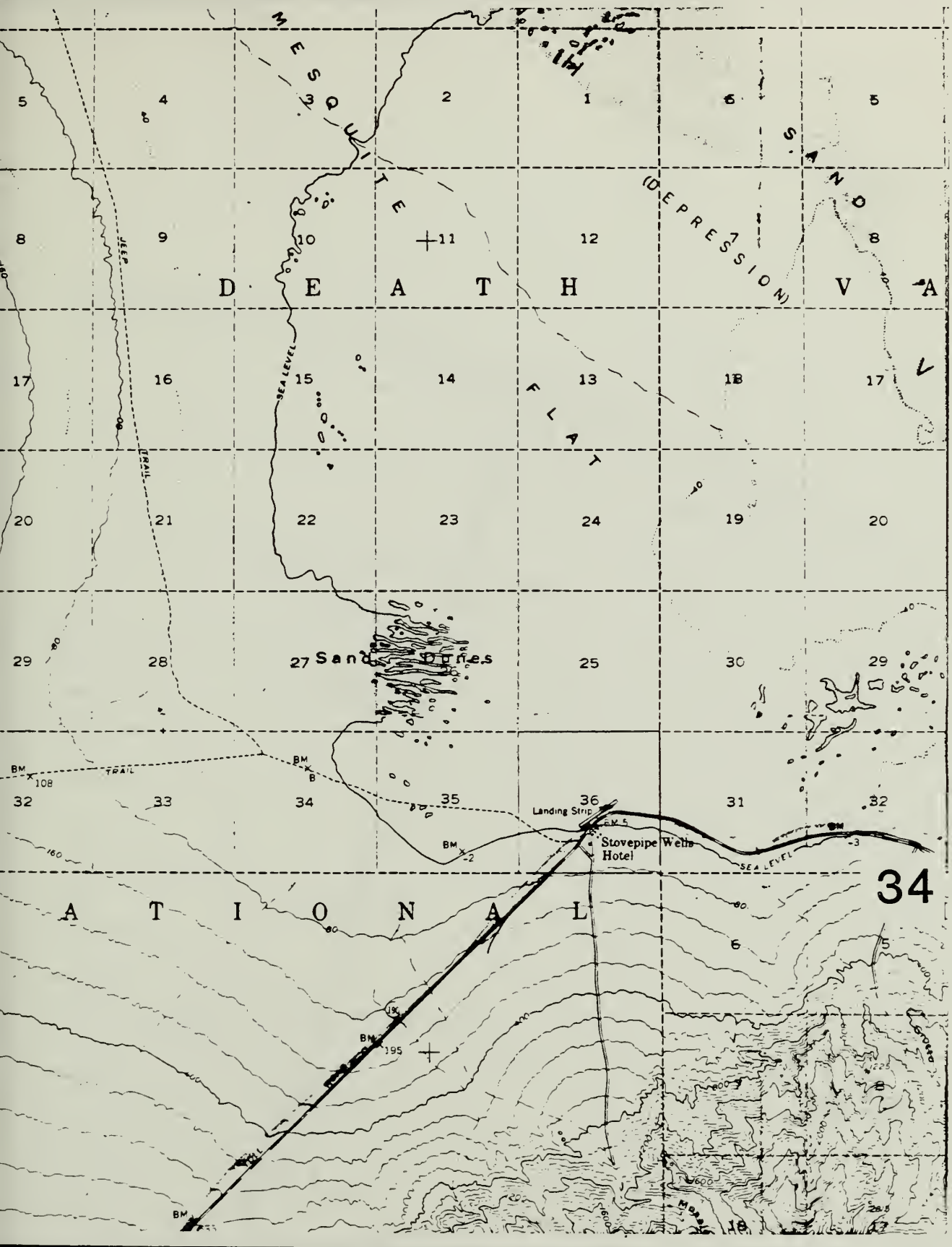
TOPOGRAPHY (USGS 15 min QUAD)

FIGURE

4



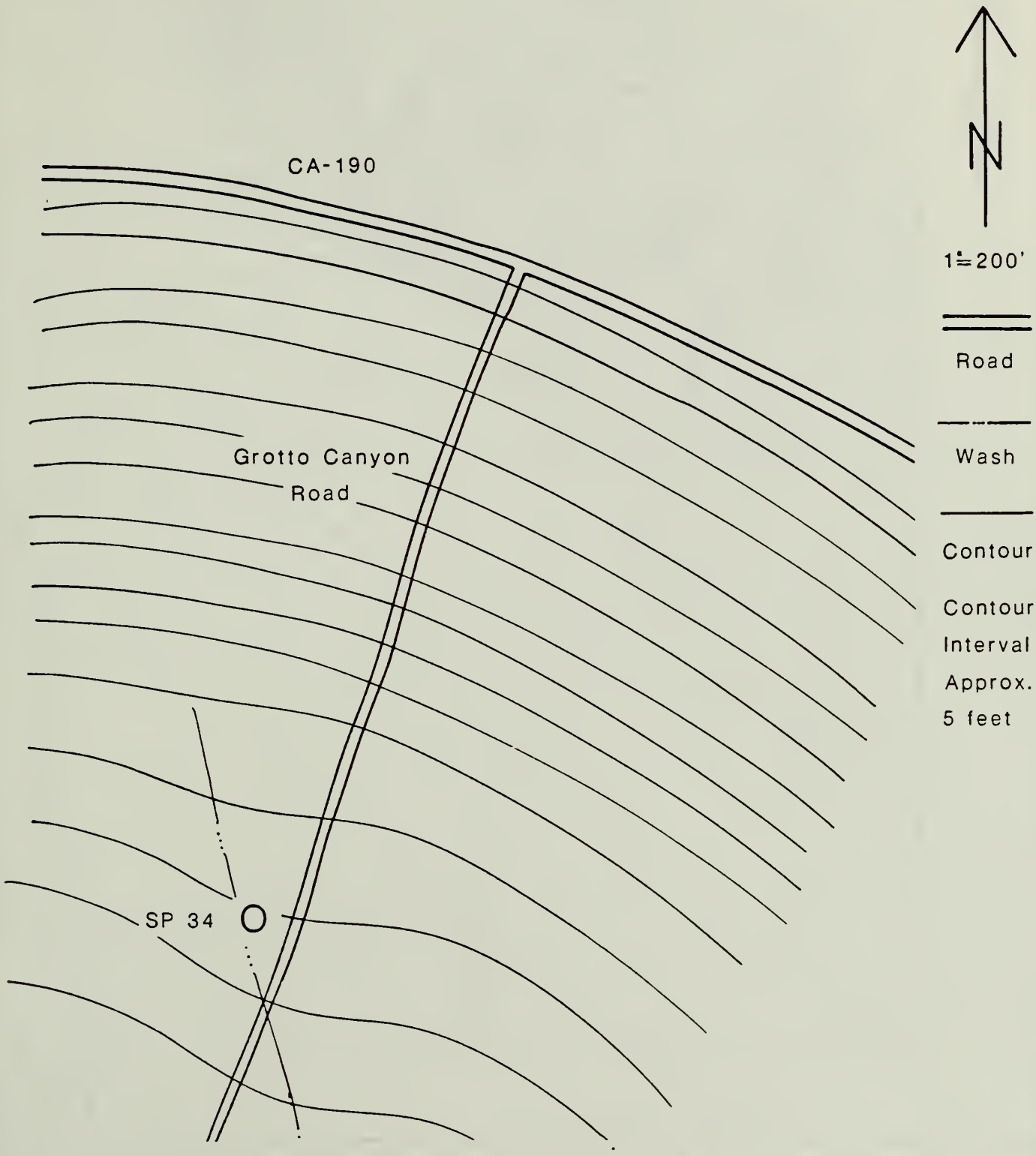
SHOT POINT 33 SITE PLAN	FIGURE 5



SHOT POINT 34

TOPOGRAPHY (USGS 15 min QUAD)

FIGURE 6

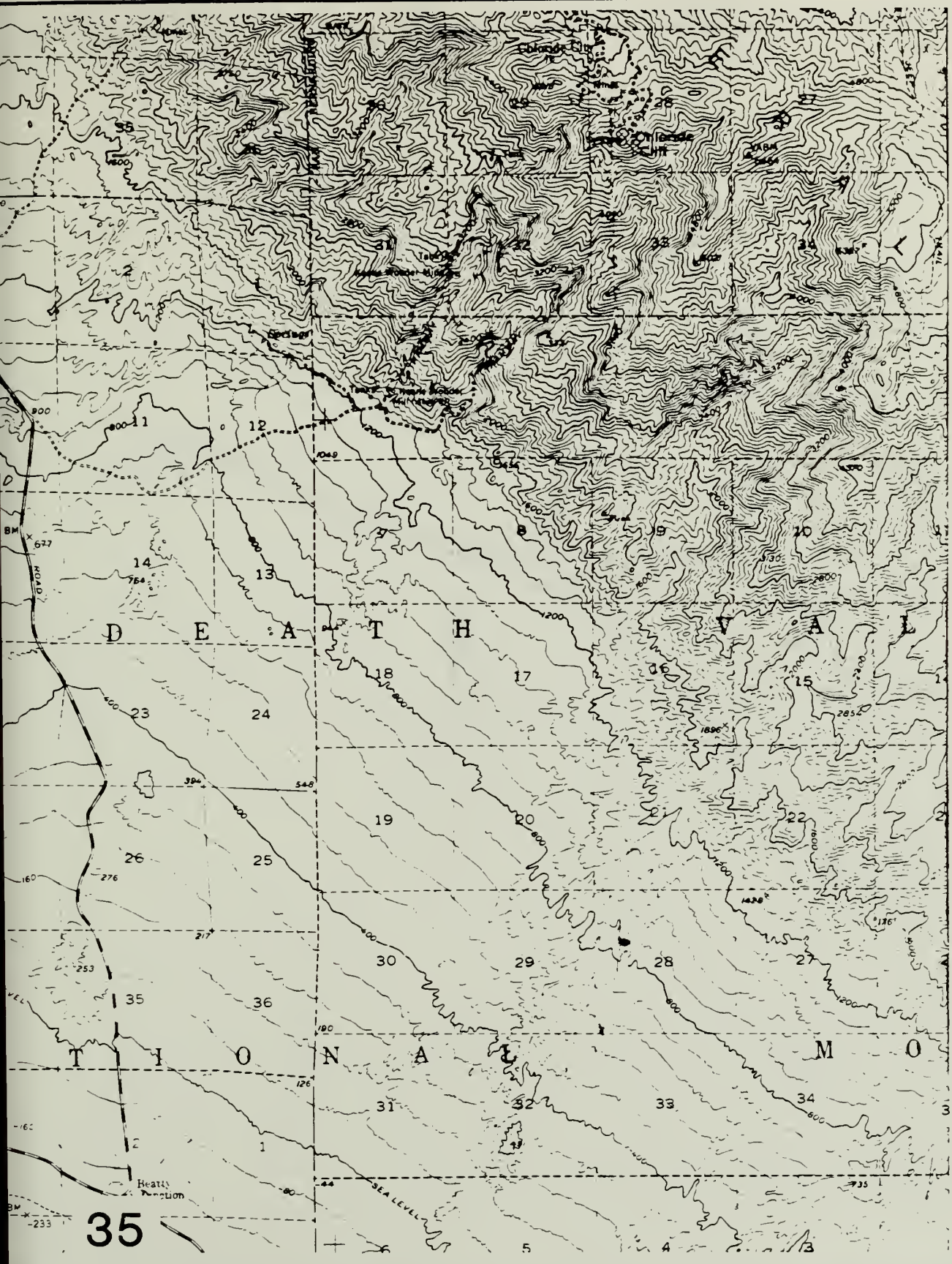


SHOT POINT 34

SITE PLAN

FIGURE

7



SHOT POINT 35

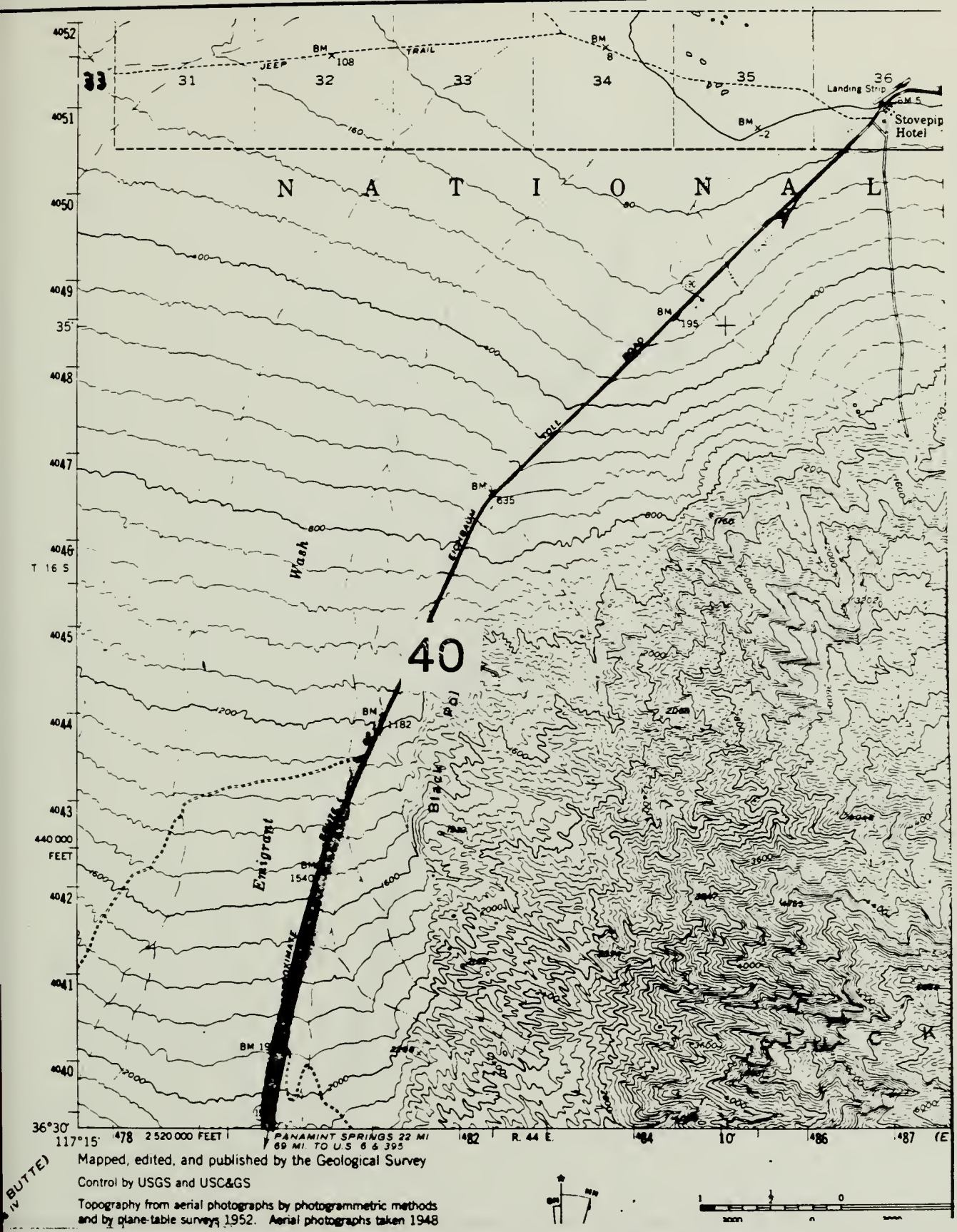
TOPOGRAPHY (USGS 15 min QUAD)

FIGURE

8

SHOT POINT 35
SITE PLAN

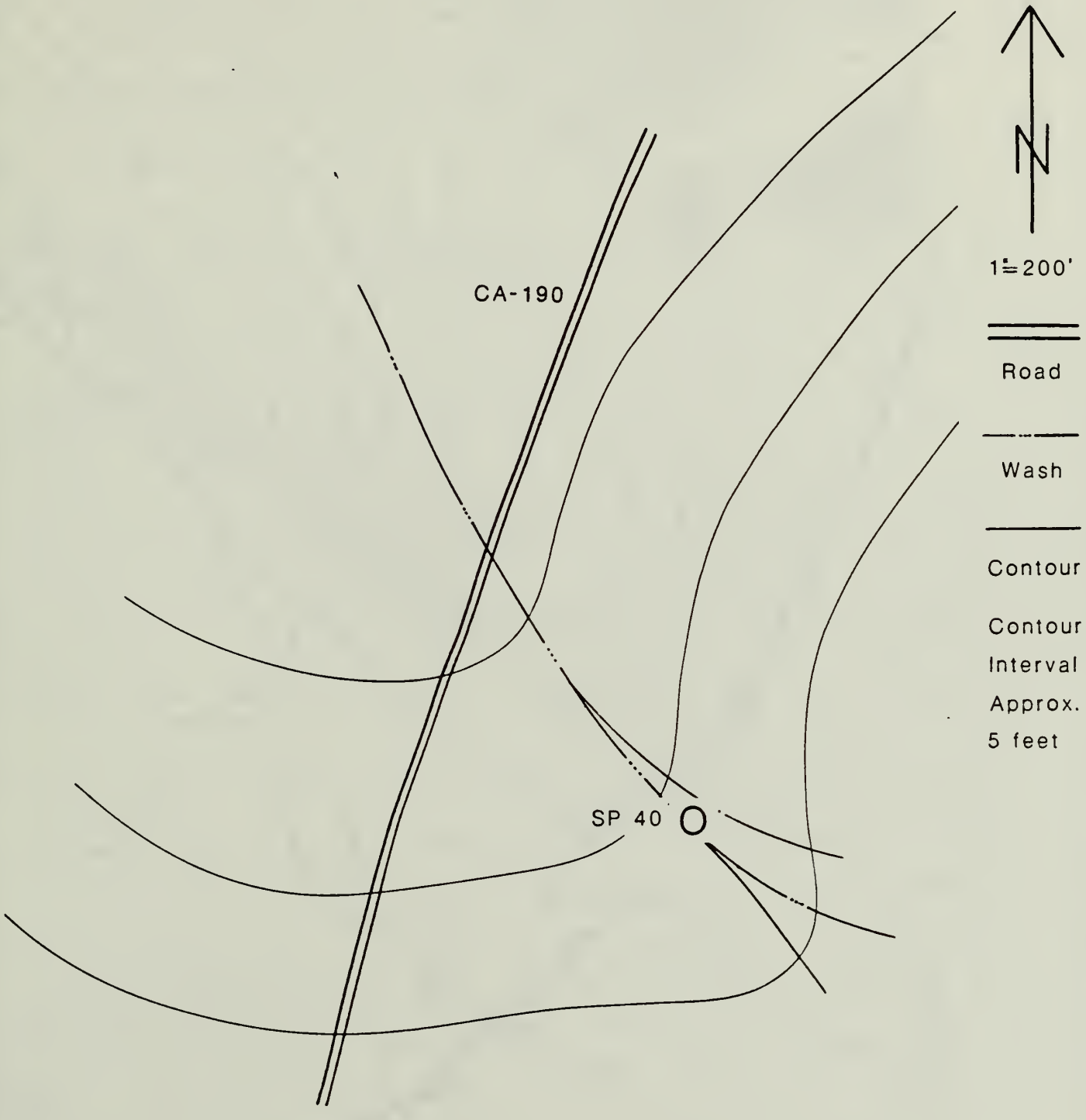
FIGURE
9



SHOT POINT 40

TOPOGRAPHY (USGS 15 min QUAD)

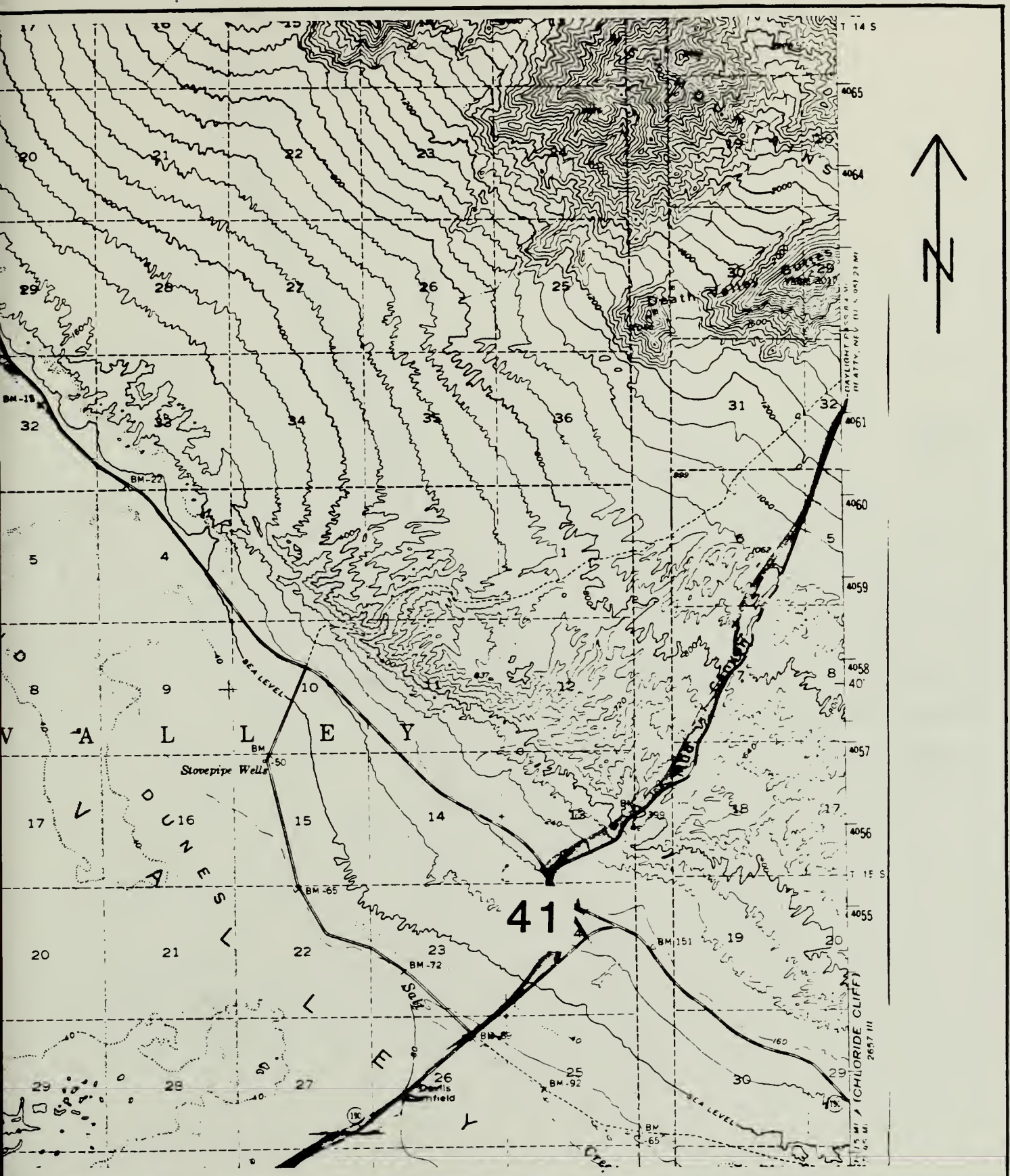
FIGURE 10



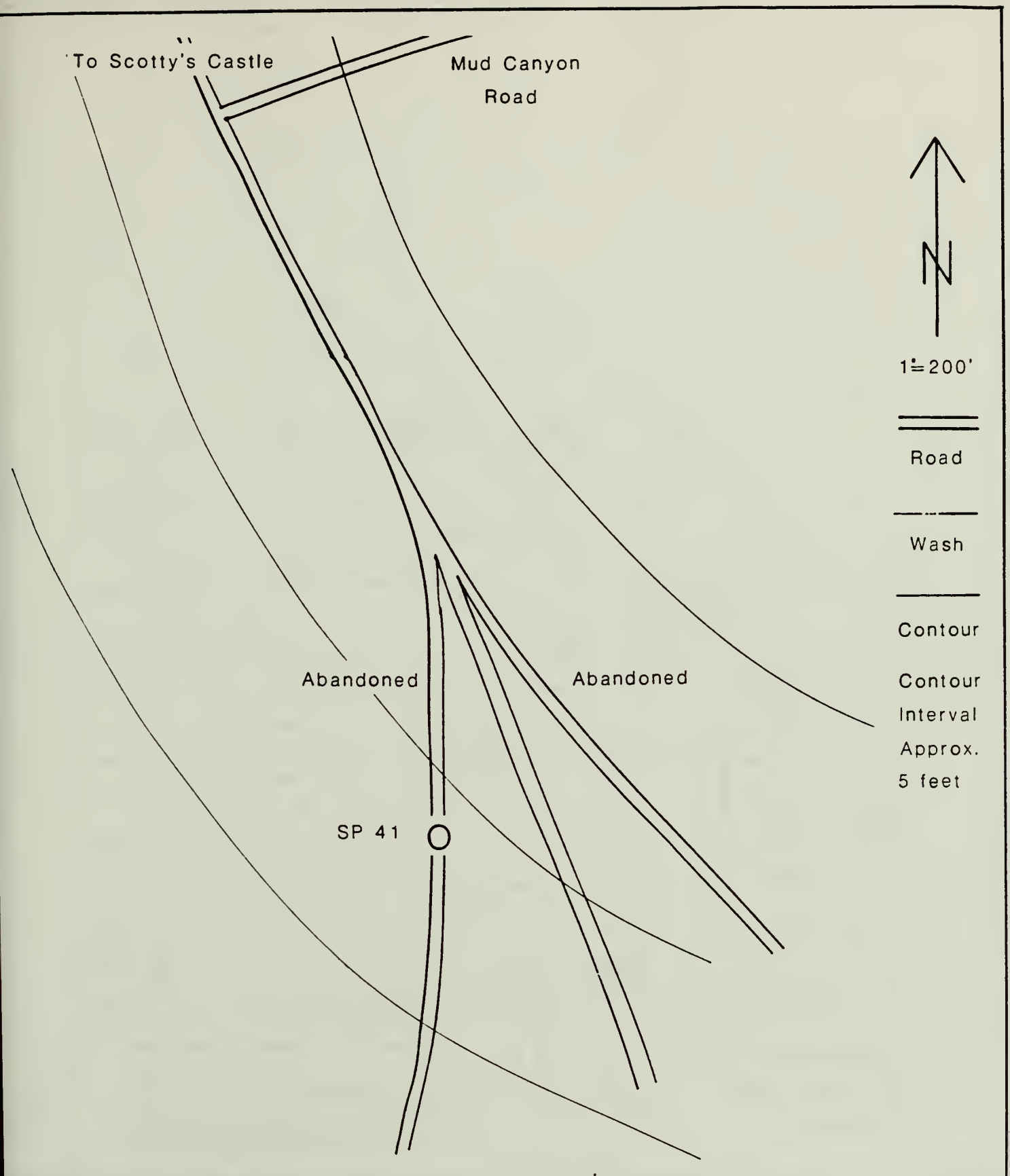
SHOT POINT 40

SITE PLAN

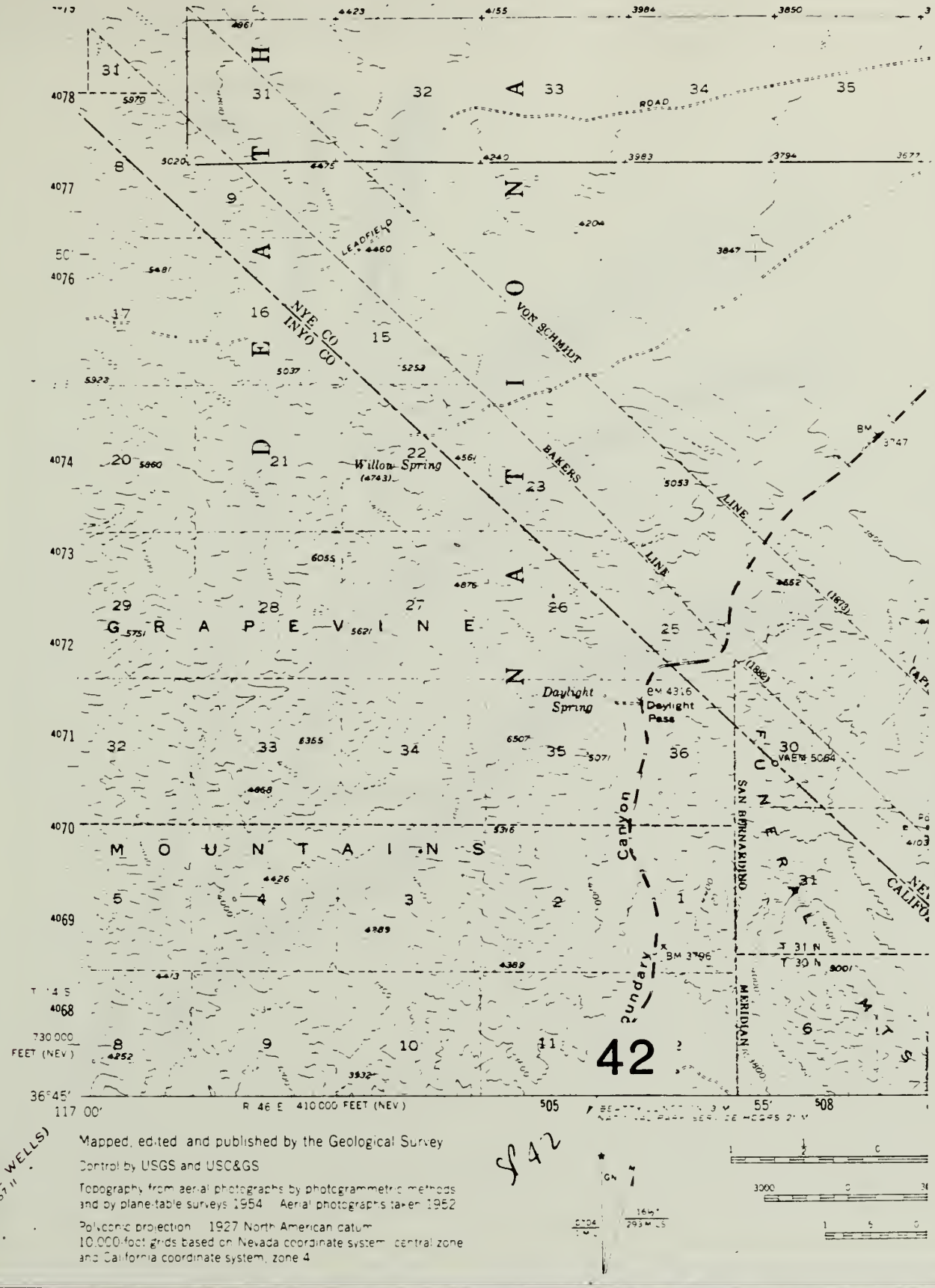
FIGURE 11



SHOT POINT 41	FIGURE
TOPOGRAPHY (USGS 15 min QUAD)	12



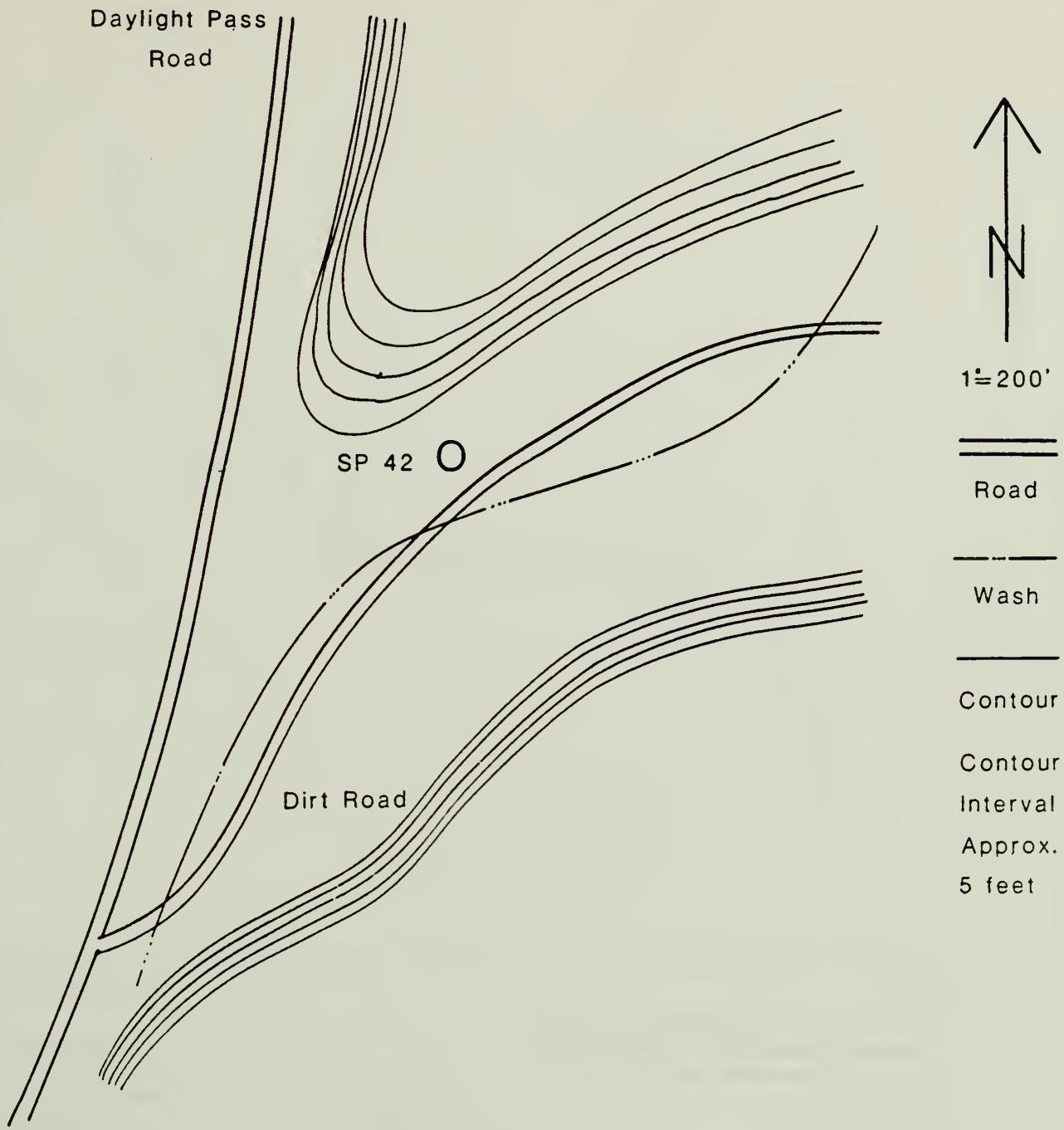
SHOT POINT 41 SITE PLAN	FIGURE 13



SHOT POINT 42

TOPOGRAPHY (USGS 15 min QUAD)

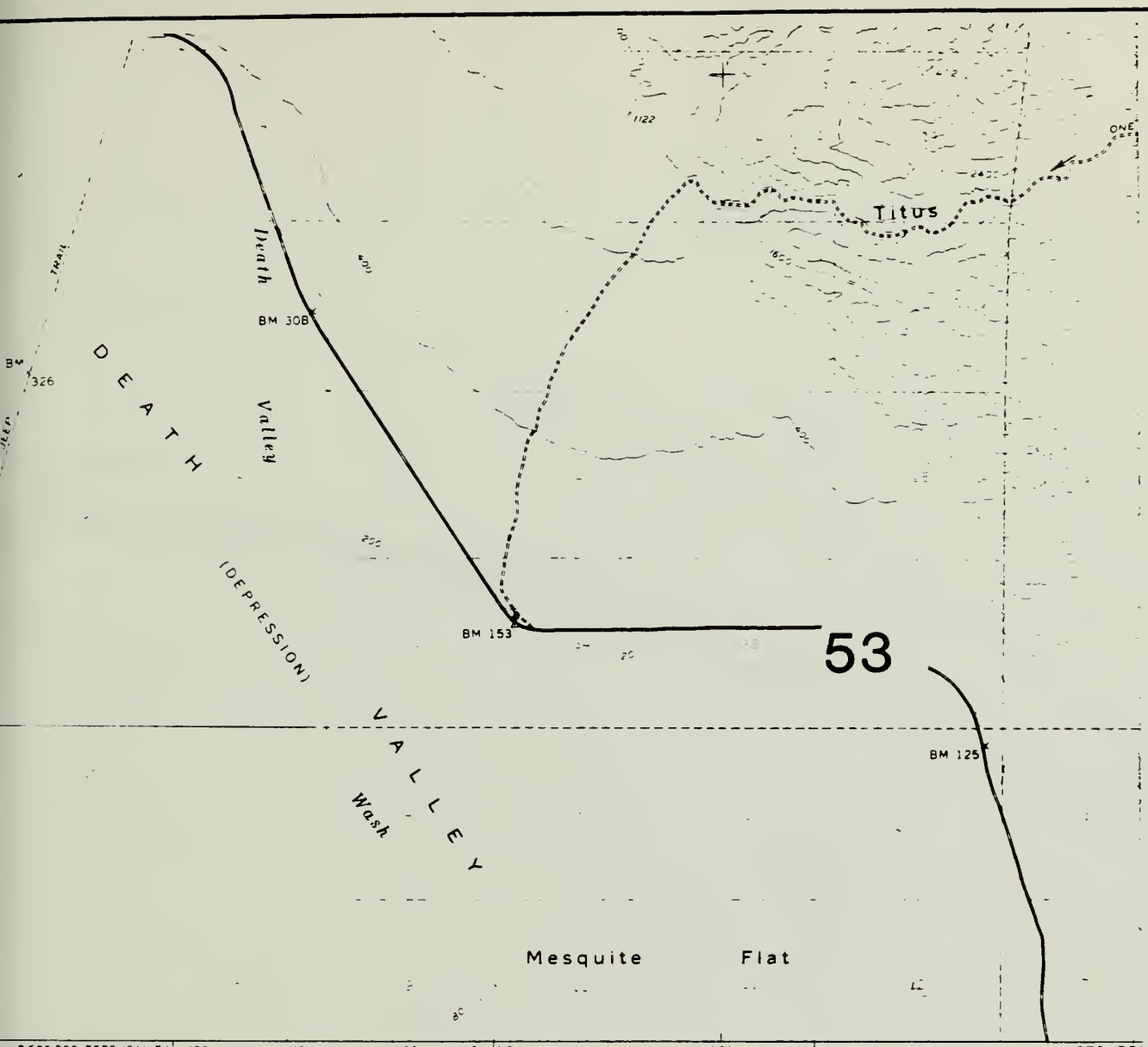
FIGURE 14



SHOT POINT 42

SITE PLAN

FIGURE
15



2 520 000 FEET (CALIF.) 480 481 482 10'

edited and published by the Geological Survey

y USGS and USC&GS

hy from aerial photographs by ER-55 plotter
otographs taken 1952 Advance field check 1957

projection 1927 North American datum
oot grids based on California coordinate system, zone 4
da coordinate system, central zone
ter Universal Transverse Mercator grid ticks,
shown in blue

and lines indicate approximate locations
s unsurveyed in California in T 12,13, and 14 S – R 43 and
nd in Nevada in T 11 S – R 44 45 and 46 E., T 12 S –
46 E., and T 13 S – R 46 E Land lines omitted in
in T.11 S – R 44 E., T 12 S – R 44, 45, and 46 E., and
R 45 E because of insufficient data

ed elevations are shown in brown

GM MN

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SCALE 1:62

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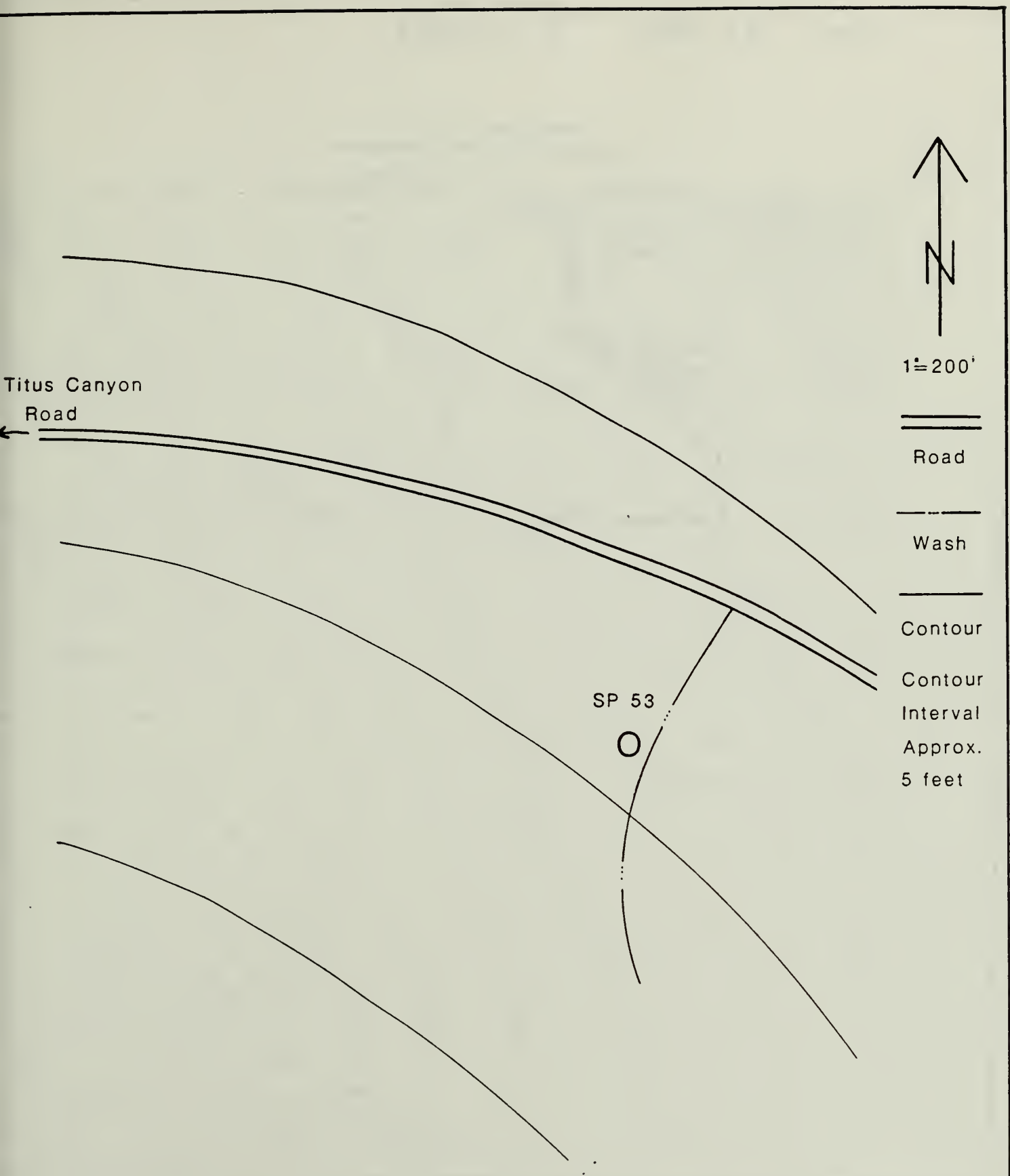
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AN

SHOT POINT 53

TOPOGRAPHY (USGS 15 min QUAD)

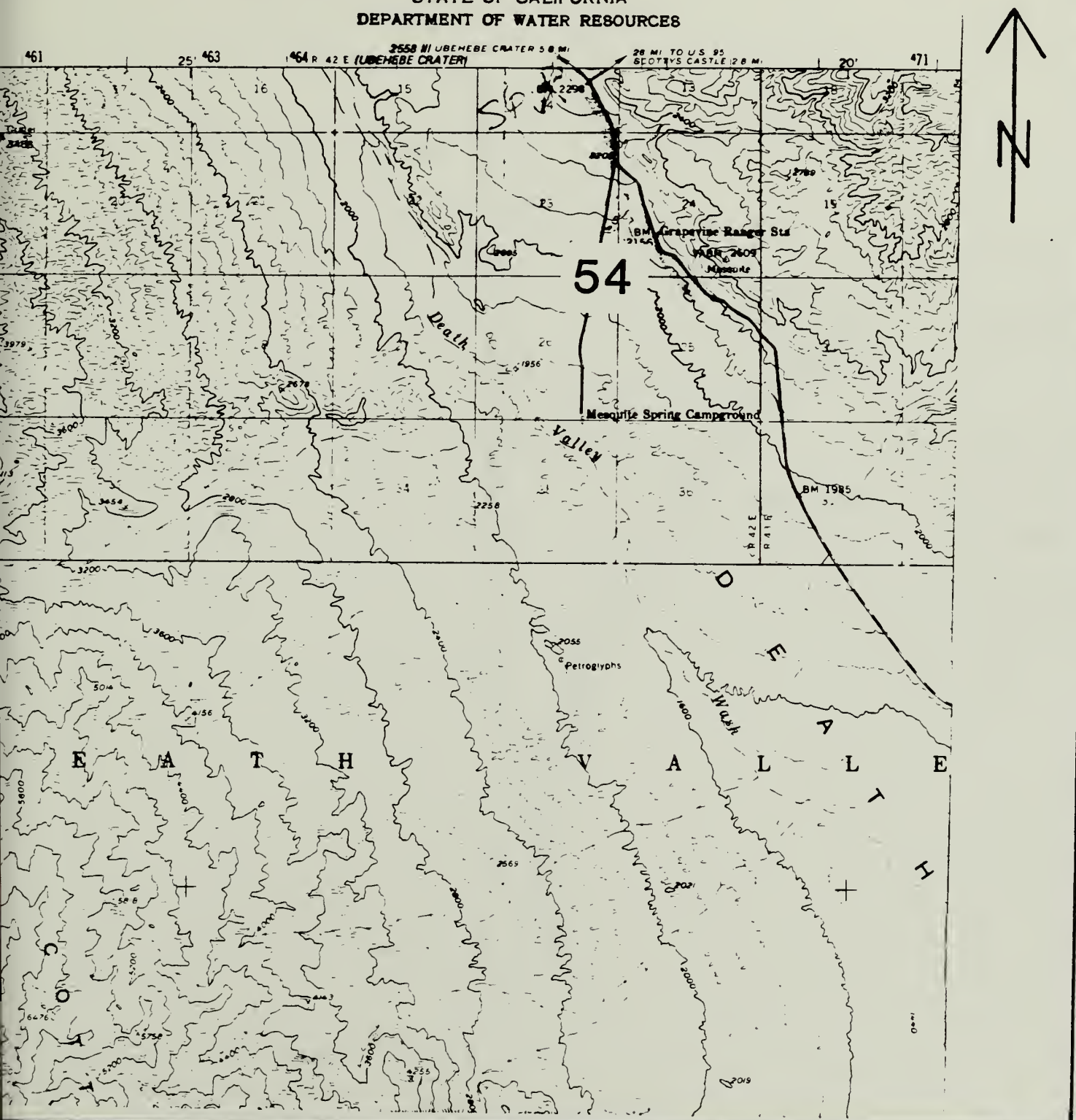
FIGURE

16

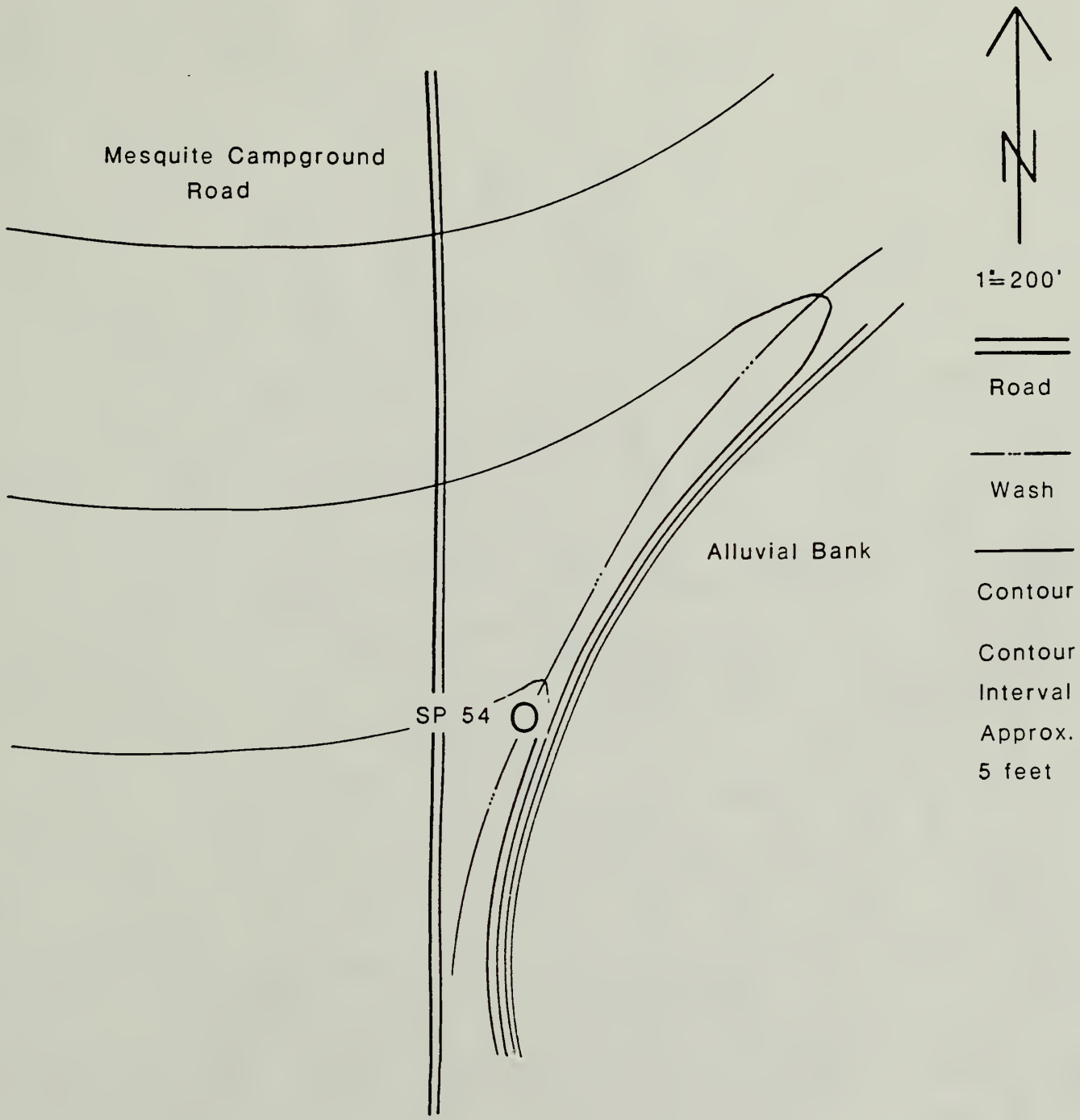


SHOT POINT 53 SITE PLAN	FIGURE 17

Profile 5: NW-SE LINE



SHOT POINT 54	FIGURE
TOPOGRAPHY (USGS 15 min QUAD)	18



SHOT POINT 54

SITE PLAN

FIGURE

19