

DEPARTMENT OF THE INTERIOR

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The Barstow-Las Vegas Crosscountry Motorcycle Race, California and Nevada: Observations on Environmental Impacts of the 1988 Race, and Preferred 1989 Route, with an Addendum on the 1989 Race

by

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# THE BARSTOW-LAS VEGAS CROSSCOUNTRY MOTORCYCLE RACE, CALIFORNIA AND NEVADA: OBSERVATIONS ON ENVIRONMENTAL IMPACTS OF THE 1988 RACE, AND PREFERRED 1989 ROUTE

## Introduction

The Barstow-Las Vegas crosscountry off-road vehicle race began in 1967 with about 500 participants and grew by 1974 to an annual event with more than 3,000 participants and an estimated 7,000 spectators (Bureau of Land Management, 1985). Permits were denied between 1975 and 1983 (Bureau of Land Management, 1985). When the event was renewed in 1983, restrictions were placed on numbers of participants (1,200), size of the start groups (400), and course width (200 feet in the start cone, 100 feet thereafter in crosscountry segments) (Bureau of Land Management, 1982), resulting in substantially greater control of impacts than achieved in 1974. Since 1983, 3- and 4-wheel all-terrain vehicles (ATVs) have been allowed to participate along with motorcycles.

Although the impacts on soils, vegetation, and wildlife of this type of recreation are well-established (Wilshire and Nakata, 1979; Webb and Wilshire, 1983; Albrecht and Knopp, 1985), there has not been consistent monitoring of the kinds or extent of impacts since events were renewed in 1983.

Observations reported here were made on October 9 through 11, 1989 of four crosscountry segments of the 1988 race (run on November 26, 1988; Bureau of Land Management, 1988), and one previously unused segment recommended for the 1989 course (Bureau of Land Management, 1989a). In all, approximately 6.9 mi of 1988 crosscountry route and 1.3 mi of proposed 1989 route were examined on foot. The types of observations made include periodic measurement of the width of the principal zone of impact, types of vegetation damaged or destroyed, wavelength and amplitude of corrugations caused by the race vehicles on public roads as well as on crosscountry segments, and the presence of and impacts on animal burrows; burrows of the desert tortoise, and endangered species, were noted in all of the crosscountry segments of the 1988 route.

Stipulations for the 1988 event (Bureau of Land Management, 1988) included restriction of vehicles to a corridor no more than 100

feet wide beyond the start cone, restriction to the width of active washes where less than 100 feet wide, restriction to the width of road segments used by the race, and regrading of damaged roads.

### **Width of the Impact Zone**

Measured widths of the principal zone of impact (excluding isolated tracks) range from about 4 feet to 180 feet. Where the impact zone was less than about 25 feet wide, physical barriers (narrow washes, rocky surfaces, large vegetation, or existing roads) discouraged course widening. Large segments of the crosscountry route, especially from the start cone to Sec. 3 T12N R5E in the Bitter Spring 7.5' quadrangle, substantially exceeded the 100 foot limit (Figs. 1 to 5). Destabilization of the surface occurred because both organic and inorganic surface stabilizers were damaged or destroyed (see Wilshire, 1983). At most places where the course took sharp changes in direction (Figs. 2, 6 to 10), there was substantial widening of the course by shortcutting or overrunning. For example, the Bureau of Land Management (1989) drew attention to such damage at the junction of a crosscountry segment and a road approximately 1.3 mi east of the Yucca Mine (Turquoise Mtn. 7.5' quadrangle). My observations indicate even heavier damage at other sites.

### **Corrugations and their Effects**

On routes used by off-road vehicles (ORVs) large scale corrugations perpendicular to the direction of travel commonly develop in both fine- and coarse-grained sediments or soils. These corrugations form readily on both compacted unpaved road surfaces (Fig. 10) and on natural wash surfaces (Figs. 11 to 13), as well as on all alluvial fan surfaces. Irregularities such as vegetation, rocks, or minor drainages that cross roads appear to initiate the vehicle motions that produce the corrugations. Measured wavelengths of these features range from 5 feet 2 inches to 7 feet 2 inches and amplitudes from 8.5 to 12 inches. Corrugations were observed on most unimproved roads used for the 1988 race course. In places (Fig. 11, 13), the roughness of corrugated surfaces apparently encouraged departures from the course.

Segments of the 1988 course shown in Figures. 2, 3, 6, and 10 to 14 have corrugations that effectively blocked the normal surface flow of water in even the main wash channels. In the upper reaches of the segment shown in Figures 6 and 12, ponding of water in the

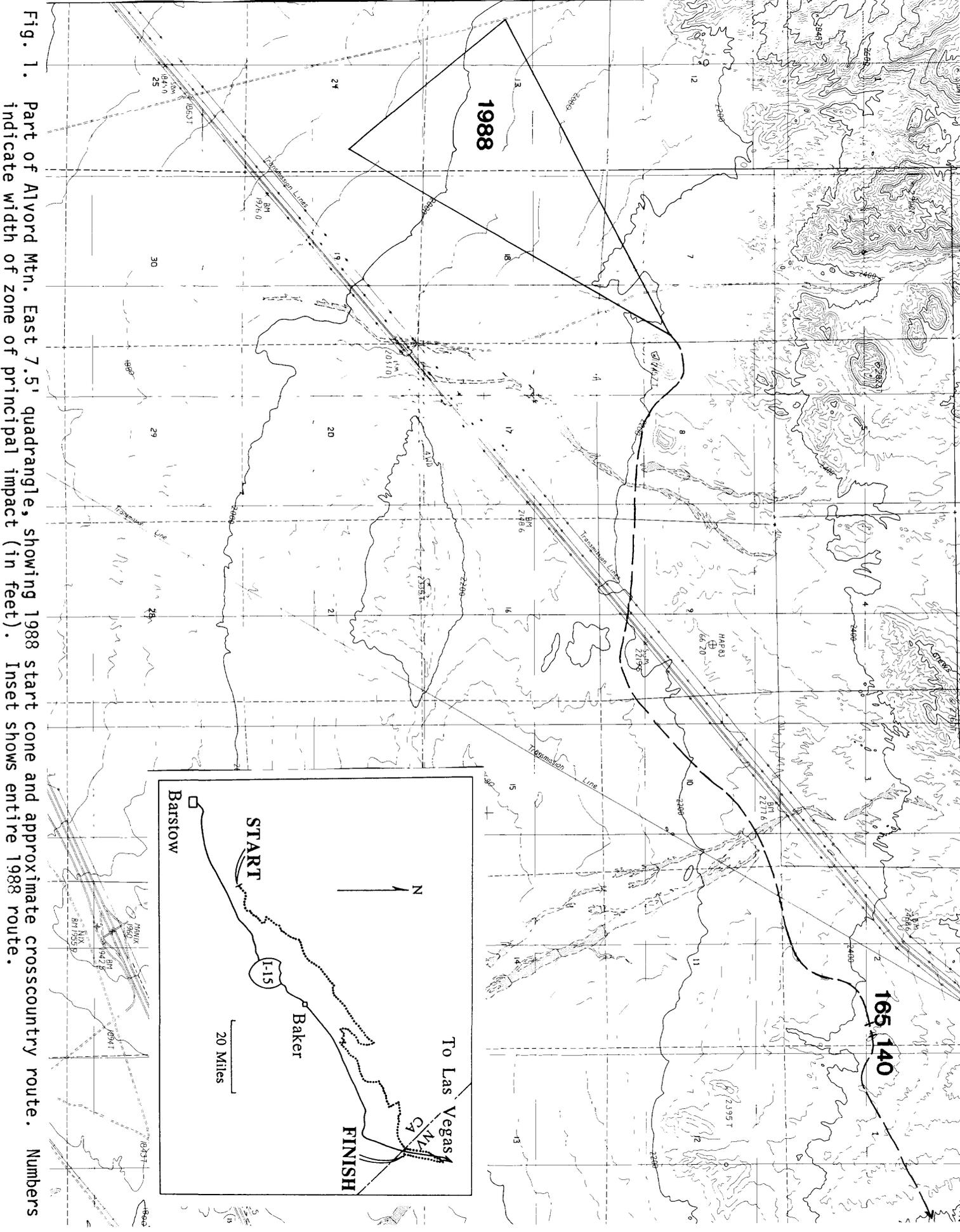


Fig. 1. Part of Alvorad Mtn. East 7.5' quadrangle, showing 1988 start cone and approximate crosscountry route. Numbers indicate width of zone of principal impact (in feet). Inset shows entire 1988 route.

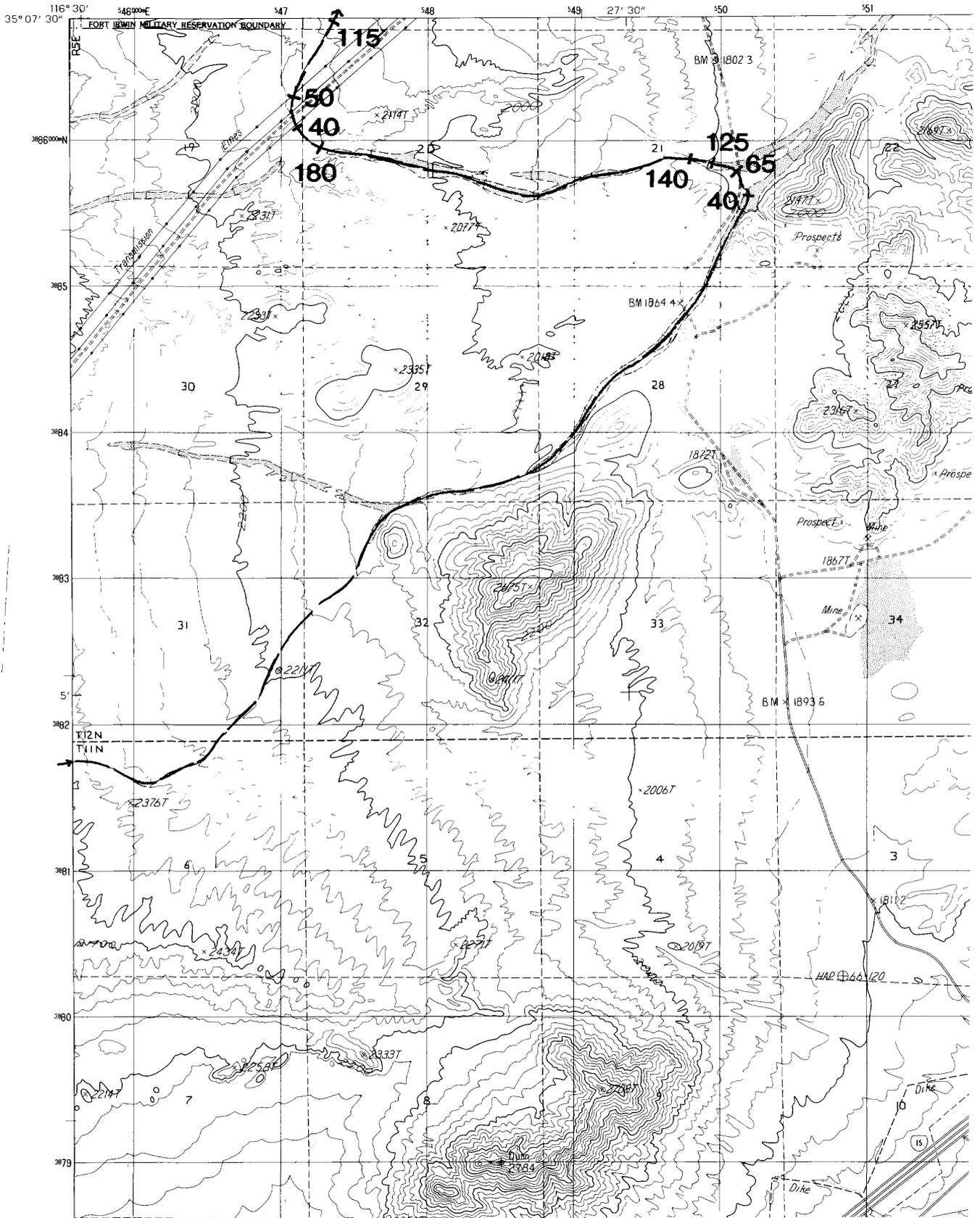


Fig. 2. Part of Dunn 7.5' quadrangle, showing 1988 crosscountry segment. Numbers indicate width of zone of principal impact (in feet).

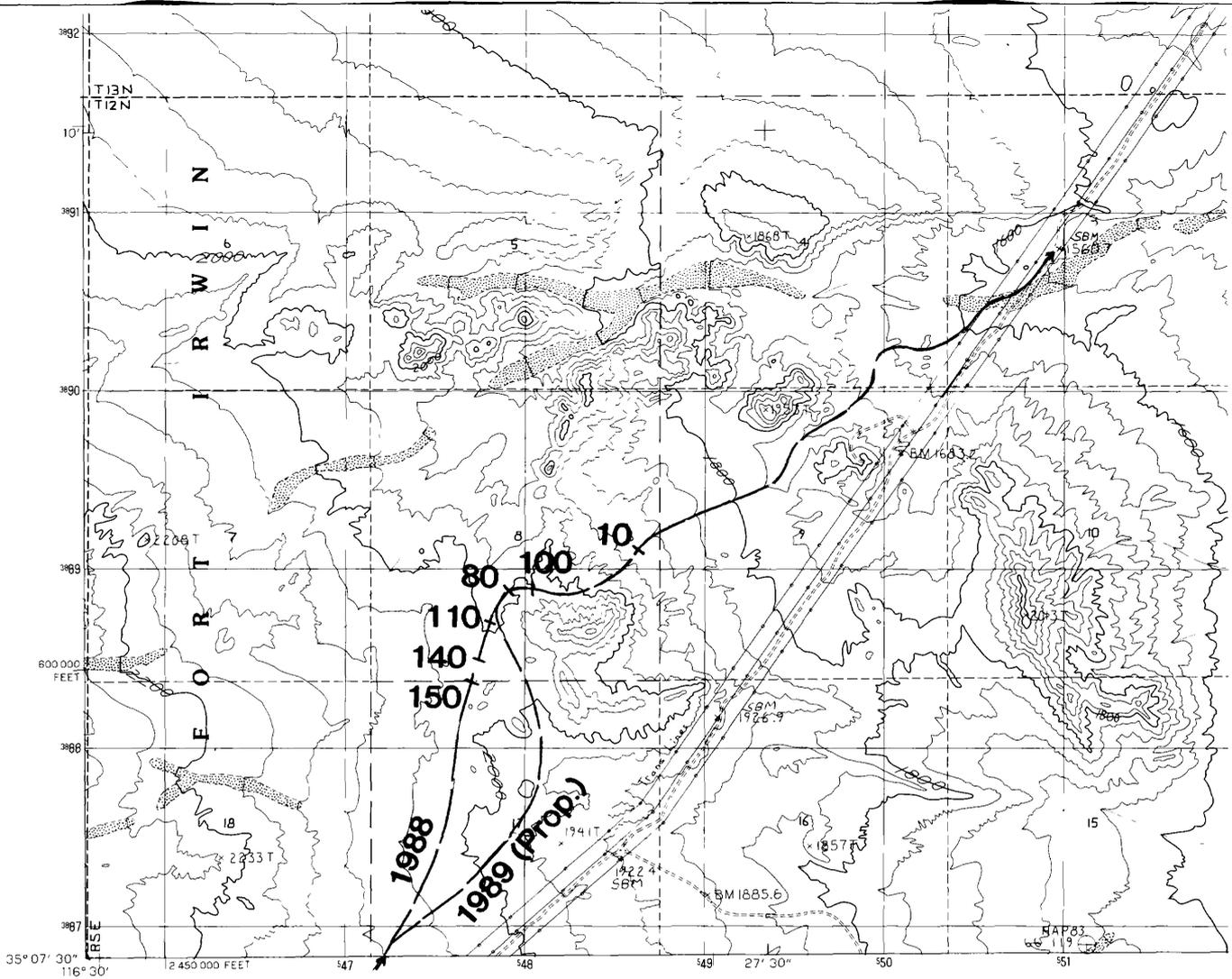


Fig. 3. Part of Bitter Spring 7.5' quadrangle, showing approximate crosscountry segment and 1989 route as laid out by the Bureau of Land Management (1989). Numbers indicate width of zone of principal impact (in feet).



Fig. 4 View NW from Section 2 T11N R4E (Alvord Mtn. East 7.5' quadrangle). Principal zone of impact at base of slope is 165 feet wide, and 140 feet wide at crest of hill. Perennial bunch grass, annual plants, and small shrubs have been largely eradicated between the larger (2-3 feet tall) creosote shrubs. Tortoise burrows were seen in the immediate vicinity of the course.



Fig. 5 View NE from Section 20 T12N R5E (Dunn 7.5' quadrangle). Principal zone of impact is 115 feet wide. Note disturbance of surface gravel in near mid-ground. The green creosote shrubs are typically 2-3 feet tall.





Fig. 7 Principal zone of impact is 165 feet wide where route turns sharply from road (not visible in photograph) onto crosscountry segment (Section 18 T15N R10E, Turquoise Mtn. 7.5' quadrangle). Foreground shrubs are 2-3 feet tall.



**Fig. 8** Principal zone of impact is 135 feet wide where route turns sharply out of a wash (Section 20 T12N R5E, Dunn 7.5' quadrangle). Note damage to vegetation and gravel surface stabilizers, and breakdown of stream banks. Numerous burrows in adjacent undisturbed areas indicate destruction of burrows in the principal zone of impact. Shrubs are 1-4 feet tall.

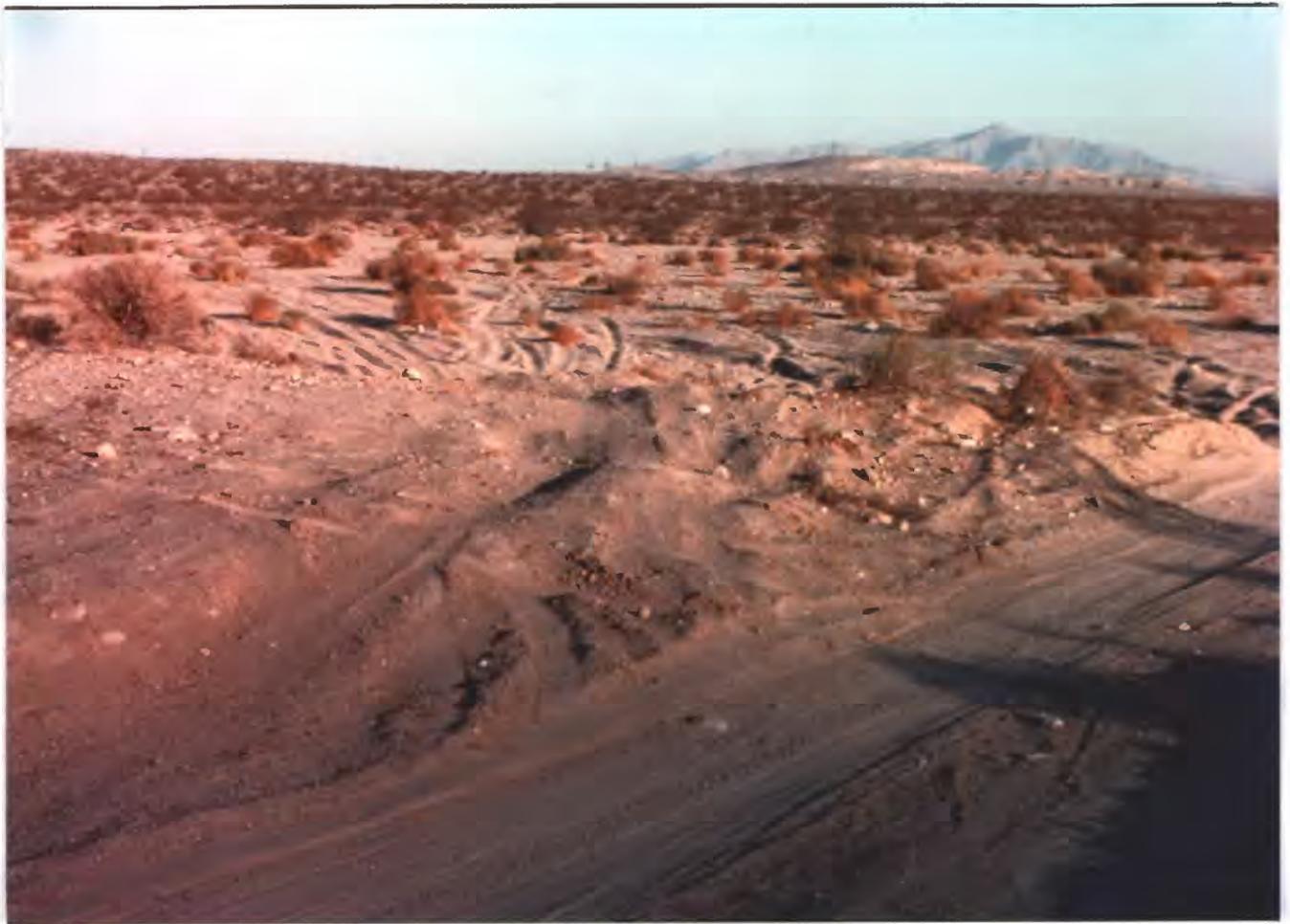


Fig. 9. Principal zone of impact where route turns sharply off of road (lower right) into stream channel is 65 to 140 feet wide. Stream banks broken down in foreground, and shrub and burrow impacts on low terrace above active channel. Typical foreground shrubs are 2-3 feet tall. (Section 21 T12N R5E, Dunn 7.5' quadrangle).



**Fig. 10** Long wavelength corrugations on unimproved road (Section 7 T15N R10E, Turquoise Mtn. 7.5' quadrangle). Road is 9 feet wide.

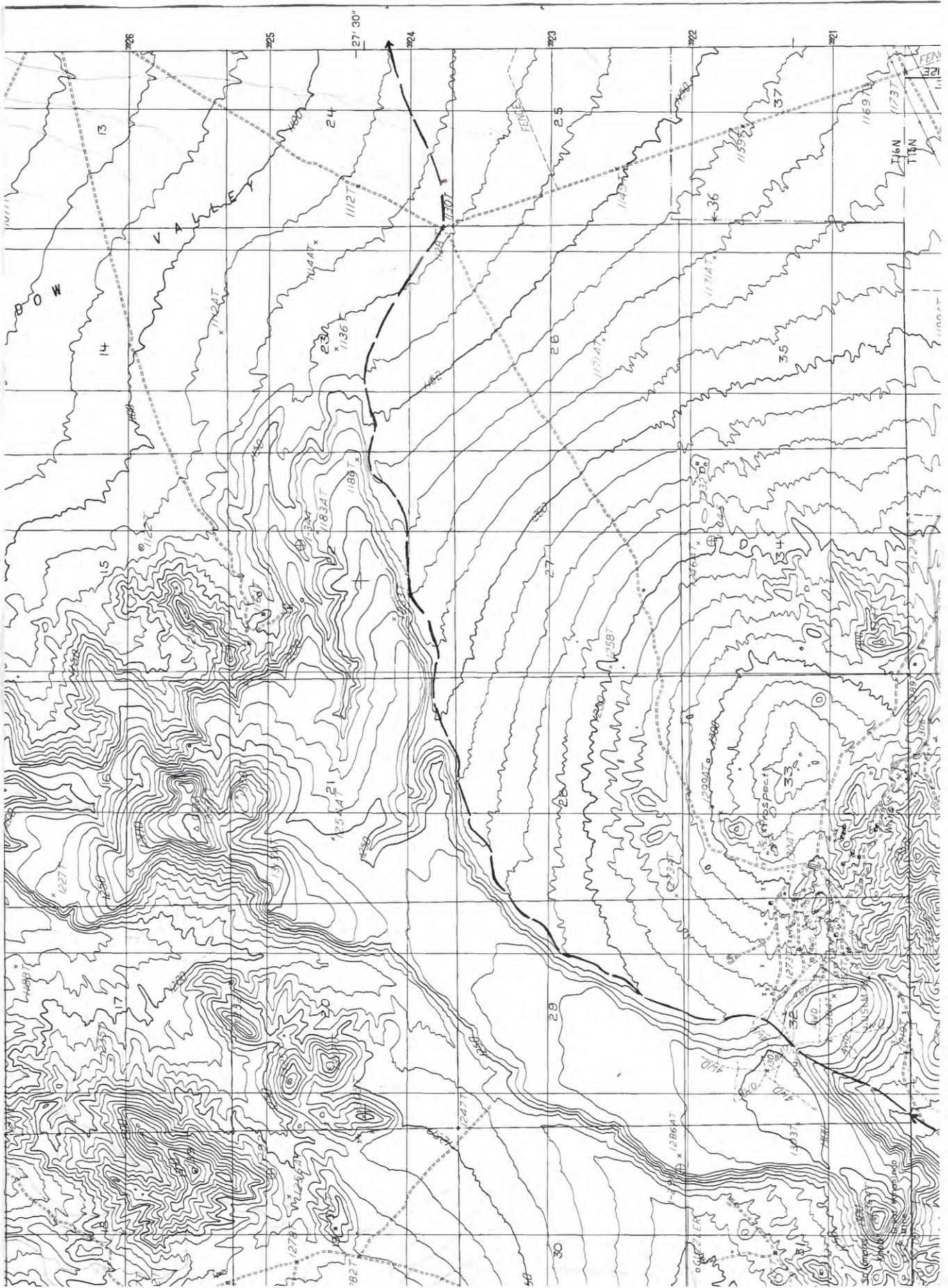


Fig. 11. Part of Solomon's Knob 7.5' quadrangle, showing 1988 crosscountry segment.



**Fig. 12** Corrugations formed in active wash prevent normal dispersal of runoff (Section 18 T15N R10E, Turquoise Mtn. 7.5' quadrangle). Shrubs on left are 2-4 feet tall.



**Fig. 13** Corrugations in active wash encourage departure from route (because the corrugations force reduction of speed) with consequent bank breakdown and destruction of vegetation (Section 29 T16N R11E, Solomons Knob 7.5' quadrangle). Shrubs are 2-3 feet tall.



corrugations is evident from mudcracked deposits in the swales. These corrugations will continue to pond runoff, and the washes can no longer disperse surface runoff. The biological consequences are unknown, but at least less total water will be available to downstream stretches because of evaporation of ponded water.

### Impacts on Vegetation

Direct impacts on vegetation are severe in all crosscountry segments of the course (including washes). Damage to foliage has been substantially increased by all-terrain vehicles that participate in the race events. The minimum area of impact of a typical motorcycle is 1 ac/20 mi (Wilshire, 1977), whereas 3-wheel all-terrain vehicles cover 1 ac in as little as 4-6 mi. The wider superstructure of all-terrain vehicles also impacts foliage and causes more damage than do motorcycles. However, the compressive stress induced by motorcycles has more marked effects on vegetation impacted by those vehicles, and compaction of soil is greater than caused by all-terrain vehicles.

All species of vegetation of the typical communities in crosscountry segments have been damaged. Small creosote (*Larrea*) shrubs (2 to 4 feet) generally have lost some or all of their foliage (Fig. 15), but some have resprouted from their root crowns (Fig. 16). This new growth is quite vulnerable and repeated annual or more frequent impacts will ultimately kill the plants. Creosote is especially slow to reoccupy even its normal habitat (Webb and Wilshire, 1979; Prose and others, 1987; Webb and others, 1988). Desert senna(?)(*Cassia*) shrubs common in the western part of the route are brittle and especially vulnerable to vehicle impacts (Fig. 17); there is no sign of regrowth of these plants. Other species that have been damaged or destroyed include Mormon tea (*Ephedra*), cheese bush (*Hymenoclea*), desert saltbush (*Atriplex*), various perennial grass species (Fig. 4), and annual plants.

### Impacts on Animal Burrows

In a 1.4 mi crosscountry segment (Secs. 8, 18 T15N R10E, Turquoise Mtn. 7.5' quadrangle) 24 large (about 4 inches or larger) burrows were observed in or immediately adjacent to the active wash used by the race (Figs. 18 and 19); those in the wash were excavated after the 1988 event as attested by piles of material lying on completely tracked surfaces. Some of these burrows have shapes



**Fig. 15** Defoliation of small creosote shrub (Section 20 T12N R5E, Dunn 7.5' quadrangle). Pencil leaning against base of shrub is 5.5 inches long.



**Fig. 16** Close of shrub in figure 10, showing new growth from root crown. Pencil is 5.5 inches long.



Fig. 17. Remains of desert senna (?) shrub that is especially vulnerable to vehicular impact. Section 20 T12N R5E, Dunn 7.5' quadrangle. Standing shrubs are 1-2 feet tall.



**Fig. 18** Burrow reexcavated after 1988 race in completely tracked surface. Note excavated material forms a pile on the tracked surface. Fresh track on right was made after the race, possibly in October 1989 during tortoise inspection. Section 18 T15N R10E, Turquoise Mtn. 7.5' quadrangle. Pencil is 5.5 inches long.



**Fig. 19** Possible tortoise burrow adjacent to route in Section 20 T12N R5E, Dunn 7.5' quadrangle. Pencil is 5.5 inches long.

characteristic of those of desert tortoises. Other smaller burrows and burrow colonies were damaged or partly destroyed by the 1988 race and not rebuilt. Stream banks, which provide important niches for burrowing animals, including tortoises (Bureau of Land Management, 1989a), are extensively damaged along narrow wash segments (such as in Sec. 8 T12N R5E, Bitter Springs 7.5' quadrangle). This is also true at points of vehicle entry and exit from broad wash segments (e.g., Secs. 6, 20, 21 T12N R5E, Dunn 7.5' quadrangle; Sec. 17 T16N R12E, Valley Wells 7.5' quadrangle), and numerous other locations where the route crosses drainages (e.g., the crosscountry segment in Alvord Mtn. East 7.5' quadrangle).

Although the route in washes is supposed to be located in the active channels, which are believed to be environmentally insensitive (Bureau of Land Management, 1985), the route in washes as commonly uses terraces that are very slightly elevated above the active channels. These terraces may be well-vegetated (Figs. 9, 13) and provide important habitat for burrowing animals. My observations also show the presence of burrows even in the active channels (Fig. 18). In one proposed new (for 1989) crosscountry segment, active channels are braided, discontinuous, and so small as to make it impossible to restrict the vehicles to those areas (Figs. 20 and 21).

## Conclusions

The observations recorded above indicate that crosscountry segments used in the 1988 Barstow-Vegas race, and the newly proposed segment for 1989 have sustained or are likely to sustain serious damages to soil, inorganic surface stabilizers, vegetation, and wildlife, including the desert tortoise. The 1988 event was not contained within the stipulated limits, and post-race road repairs were not effected.

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Fig. 20 Flagging marks a new preferred country segment in Section 11 T15N R10E, Turquoise Mtn. 7.5' range. Active channels are discontinuous and mostly smaller than the one in this photograph, which was taken at the entry into the crosscountry segment. Shrubs are 3-4 feet tall.



**Fig. 21** Another part of the segment shown in figure 15, showing common absence of unvegetated active channels in the preferred alternative route. Shrubs are 1-4 feet tall.

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## Addendum, Observations on the 1989 Race

Major changes were made in the route for the 1989 Barstow to Las Vegas race (Bureau of Land Management, 1989b) because of the emergency listing of the desert tortoise (*Gopherus agassizii*) as an endangered species north and west of the Colorado River (Code of Federal Regulations, 1989). The course reroute and new mitigations, described below, were designed to protect the tortoise and its habitat. My observations were made before, during, and after the November 25, 1989 race on a 3.8 mile crosscountry segment in desert tortoise habitat, on December 1 and 2 in the Baker, West of Baker, Turquoise Mtn., Solomons Knob, and Valley Wells 7.5' quadrangles, and on December 29-30 in the Baker, Kingston Spring, and Turquoise Mtn. 7.5' quadrangles.

The start area and first 22 miles of the race were relocated in a part of the Fort Irwin National Training Center that has been heavily impacted by military activities and probably retains no significant tortoise populations (U.S. Fish and Wildlife Service, 1989). This eliminated the first 24 miles of the route described in the body of this report, including several problem areas between the start cone and Section 3 T12N R5E, Bitter Spring 7.5' quadrangle. In addition, the new crosscountry segment in Section 11 T15N R10E, Turquoise Mtn. 7.5' quadrangle; Figs. 6, 20, and 21) was rerouted to existing roads. Special mitigations required "corridor flagging" of crosscountry segments in tortoise habitat which specified center and side-boundary flagging of a 25 foot-wide corridor, pre-race identification and flagging of tortoise burrows near the route, and a pre-race "tortoise sweep" if the air temperature at race time exceeded 50° F. The previously imposed limit of 50 vehicles per start wave (designed to reduce clustering of vehicles and therefore widening of the course) was revised to 250 for the Fort Irwin start.

### November 25, 1989.

My observations on the day of the race were in Sections 21 to 23, 28, 29, and 32 T16N R11E, Solomons Knob 7.5' quadrangle (Fig. 11). Except for a segment less than 500 feet long, the designated route is in the active wash, which is commonly less than 25 feet wide and has low vegetative cover. The wash is flanked by broad alluvial terraces raised slightly above the active wash level, and is bounded on the west and north sides by a basalt-capped ridge about 90 to 125 feet above the wash.

Course markings in the 3.8 mi segment monitored consisted of single ribbons at wide intervals. There was no corridor flagging of the type stipulated by the Bureau of Land Management (1989a,b). About 0.3 mi into the monitored segment from the south (Section 32 T16N R11E), construction ribbon formed a funnel across the flanking terraces into the active wash. Beyond this point there were 5 or 6 locations with pairs of yellow placards with inward pointing arrows that indicated the course boundaries. At 4 or 5 locations, yellow construction ribbon was used to block obvious shortcut routes, some used in prior races, across bends in the wash, but others were unmarked.

Figure A1 shows the frequency of arrival of vehicles in my area of observation (about 75 miles into the race) in five minute intervals from 10:25 AM to 2:40 PM. The first vehicle appeared at 9:28 AM. A total of 827 vehicles passed through the area I observed. Of these, 71 were 4-wheel ATVs, and the rest were 2-wheeled cycles.

Air temperature readings close to the ground surface from my time of arrival on the course (8:45 AM) ranged from 60°F to 77°F through 1:00 PM. The first vehicle on the course after my arrival was a participant in the race, but I have no information on whether or not a tortoise sweep was made before my arrival.

Six possible tortoise burrows were observed, of which three appeared to be active; I made no special search for burrows. None of the burrows was marked and one burrow was closer than 10 feet to the main race route. The well-vegetated low terraces adjacent to the active wash have very abundant lizard and small mammal burrows, and some of these burrows were observed in the main route and its berms before the race.

The width of the zone of principal impact (including all heavily-used braids) ranged from about 10 feet to 140 feet. Course widening (over the 25 feet allowed) occurred at turns in the active wash (Figs. A2 and A3), and at places either just behind or in front of deep corrugations (estimated amplitudes to more than 1 foot) in the flagged route. Corrugations were present from previous races, but appear to have been reduced in size by grading; for example, some identified in photographs had been completely removed by the time of the 1989 event. The 1989 race substantially enlarged pre-existing corrugations (from previous races) and created new ones. Widening of the flagged route occurred whether or not construction ribbon was placed to discourage it. As a consequence, substantial new damage was done to vegetation and animal burrows.

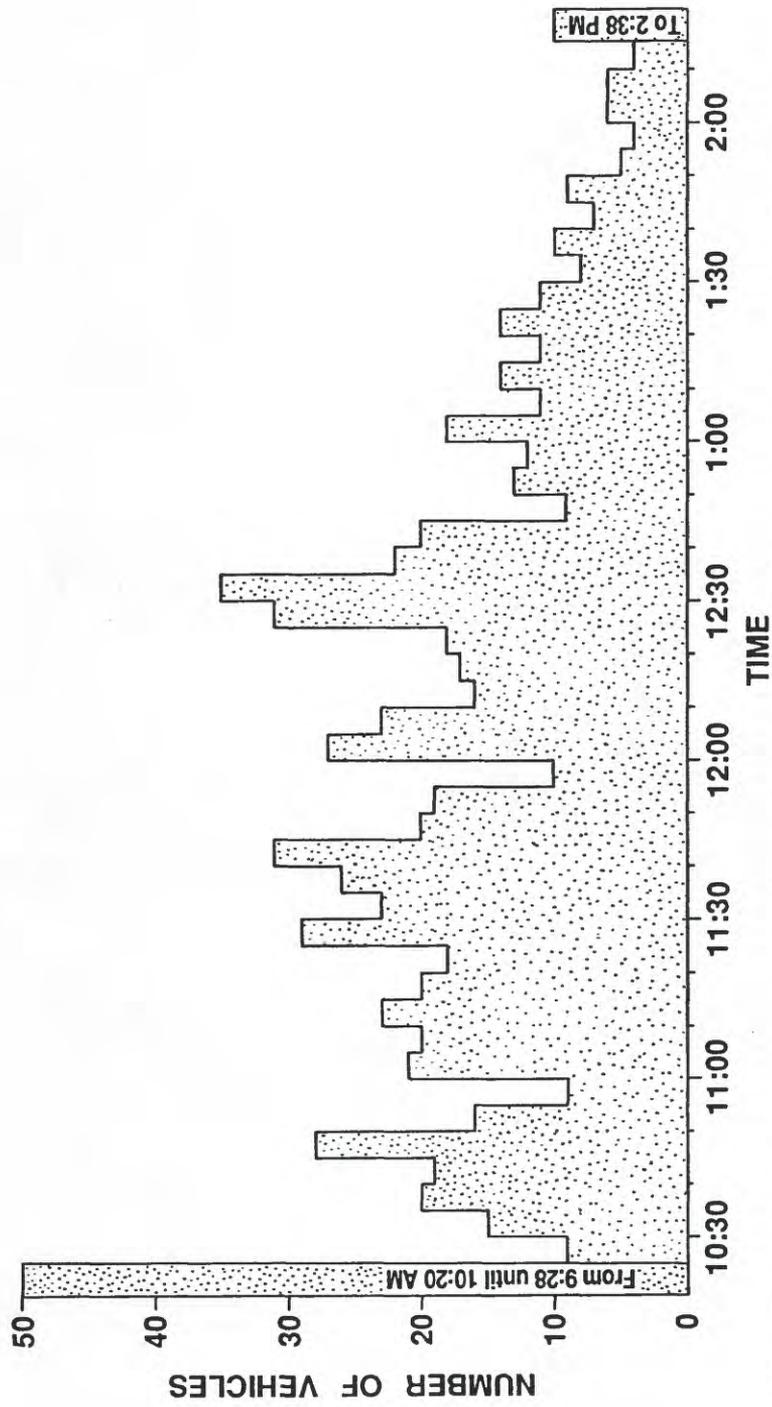


Fig. A1 Histogram showing numbers of vehicles arriving at observation site in 5-minute intervals. Total number was approximately 827, of which 71 were ATVs.



Fig. A2 Shortcutting marked route. Sign adjacent to center motorcycle has an arrow pointing left in picture. Sign marking opposite side of route is at extreme left edge of picture. Traffic as far off the course as the joshua tree at right side of picture was observed.



**Fig. A3** Crosscutting of course, which was restricted to the active wash in which the ATV is located.

December 1 and 2, and 29 and 30, 1989.

Observations were made on December 1 and 2 in Sections 20 through 22, 28 and 29 T15N R8E, West of Baker 7.5' quadrangle; Section 22 T15N R8E, Baker 7.5' quadrangle; Sections 6 through 11, 14 and 15, and 18 T15N R10E, Turquoise Mtn. 7.5' quadrangle; Sections 23 and 24 T16N R11E, Solomons Knob 7.5' quadrangle; and Section 24 T16N R11E, Valley Wells 7.5' quadrangle. Observations were made on December 29 and 30 in Section 22 T15N R8E, Baker 7.5' quadrangle; and T16N R10E, Kingston Spring and Turquoise Mtn. 7.5' quadrangles. New course width measurements are shown on Figures A4 through A9. Because the route shown in Figures A6 through A9 was traversed on foot without the benefit of air photos, the course width annotations in those figures are only approximately located. Course flagging had been removed up to Pit 2 by December 1, 1989, and was removed from most of the remainder of the course in California on December 2, 1989.

The area of Pit 1, located in Sections 20 and 28 T15N R8E and the route across Silver Dry Lake (Sections 21, 22, 28, and 29 T15N R8E) were briefly examined. Motorcycle and 4-wheel vehicle tracks were found on both sides of the road along which Pit 1 is located and well outside the Pit boundaries; fresh tracks were observed in Wilderness Study Area (WSA) 242. Although the route across Silver Dry Lake is marked on the existing road (Bureau of Land Management, 1989a, b) (which forms the north boundary of WSA 242), the major part of the race traffic (Fig. A10) was actually in WSA 242 on the dry lake surface. The width of the principal zone of impact is 165 feet, of which 130 feet are in WSA 242. Use of the dry lake surface caused disruption of the silt-clay crust (Fig. A11), making the surface vulnerable to wind erosion.

The route in Sections 6,7 and 18 T15N R10E is marked on an existing road (Bureau of Land Management, 1989a, b) that is 7-9 feet wide. Much of this road, especially south of the Wander Mine, has numerous large corrugations which appear to have caused departure of vehicles from the roadbed (Fig. A12). In Section 6, the zone of principal impact was locally widened to 40 feet. There is evidence of substantial motorcycle and 3-wheel ATV play off the road in all directions around the road junction at the Wander Mine. From the Wander Mine south to the point at which the route leaves the road (Section 18), the following observations were made:

0-.05 mi, strays in 1988 overrun zone; far fewer than the number that overran the turn in 1988.



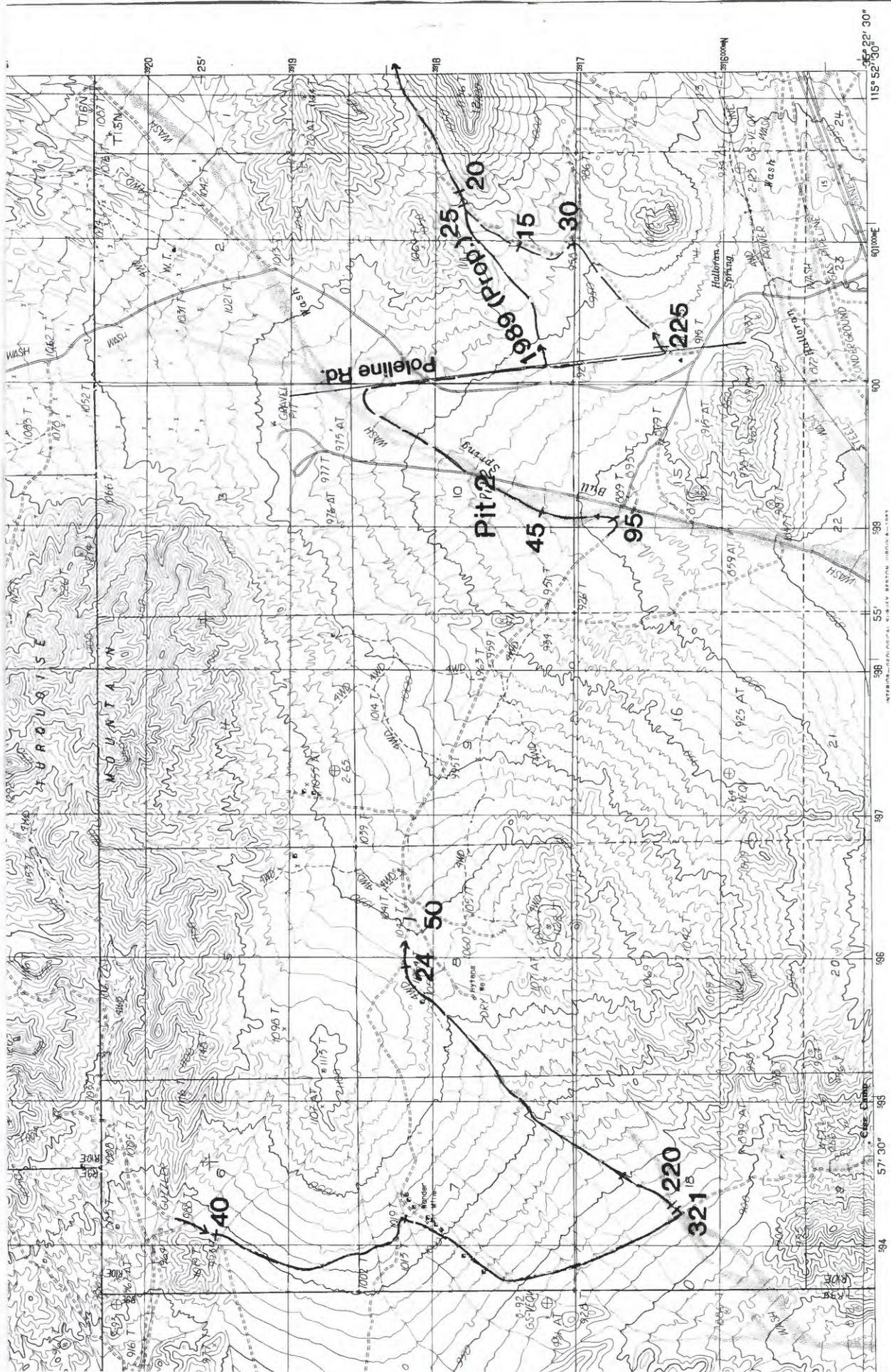


Fig. A5. Part of Turquoise Mtn. 7.5' quadrangle, showing 1989 crosscountry segments, Pit 2, and 1989 preferred route (right). Numbers indicate width (in feet) of zone of principal impact.

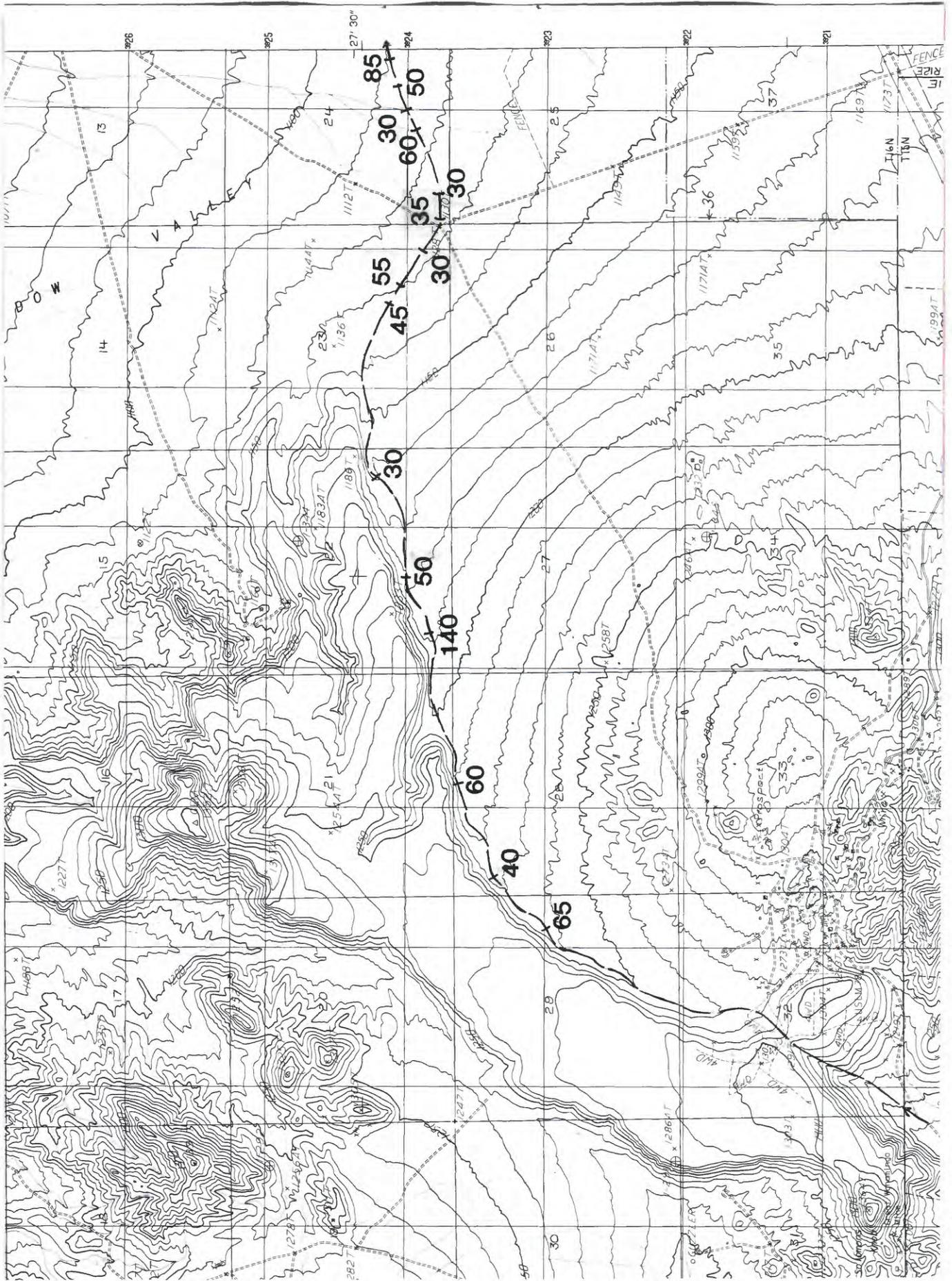


Fig. A6. Part of Solomons Knob 7.5' quadrangle, showing 1989 crosscountry segment. Numbers indicate width (in feet) of zone of principal impact.

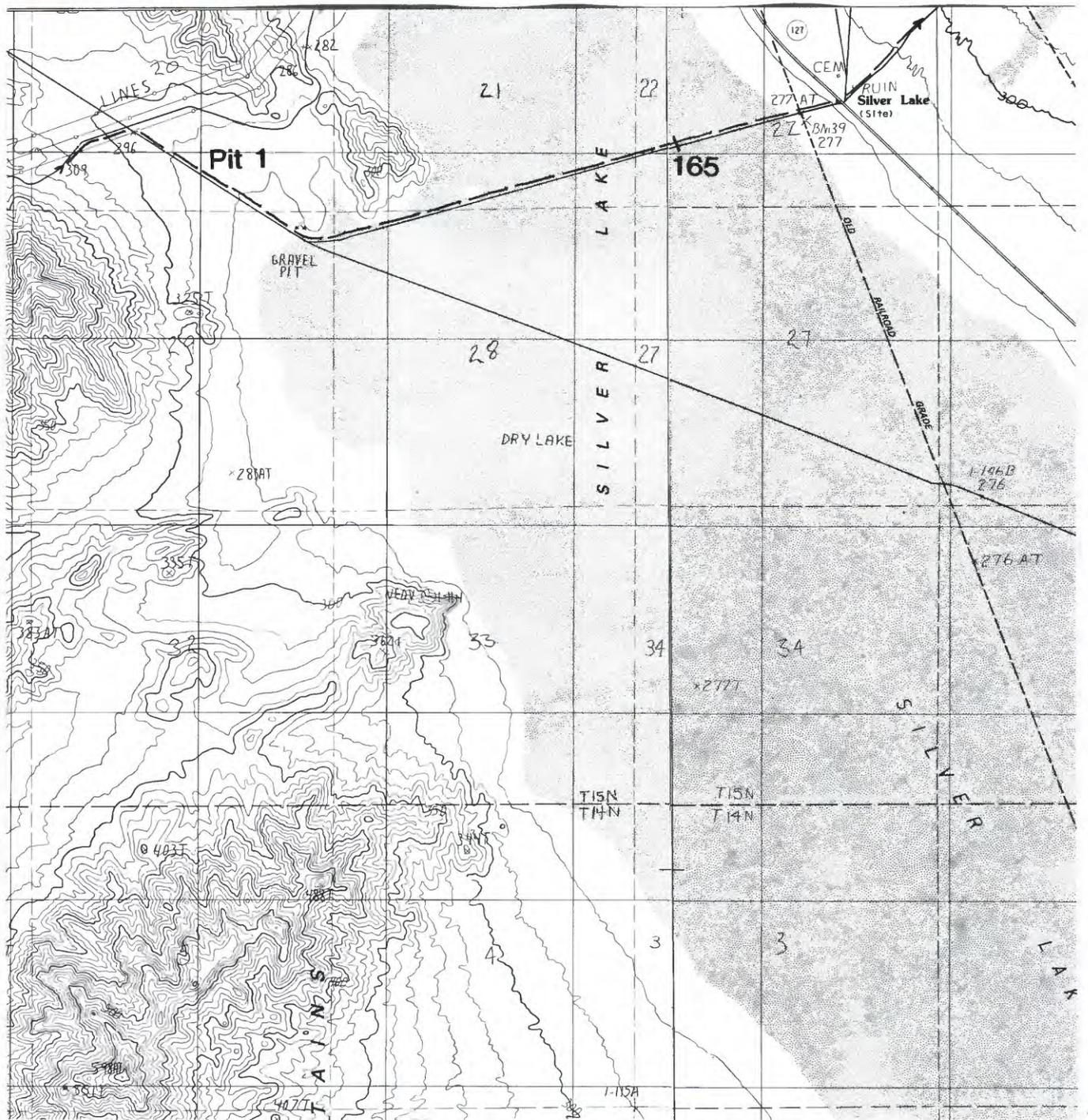


Fig. A7. Parts of Baker and West of Baker 7.5' quadrangles, showing location of Pit 1 and 1988/1989 route. Number indicates total width (in feet) of the zone of principal impact of the 1989 race, including road; width of the zone of principal impact in Wilderness Study Area 242 (south of road) is 130 feet.

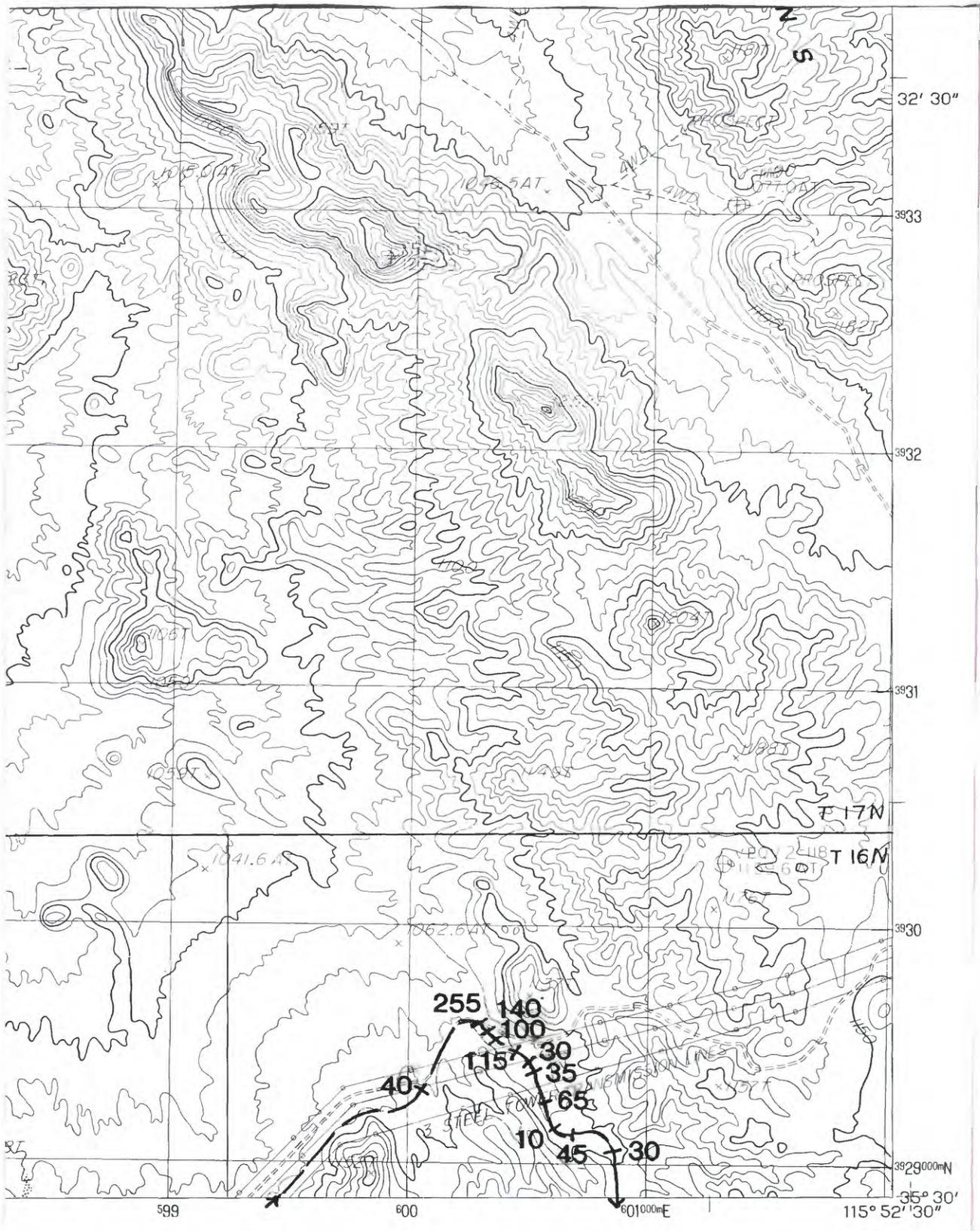


Fig. A8. Part of Kingston Spring 7.5' quadrangle, showing 1989 crosscountry segment. Numbers indicate width (in feet) of zone of principal impact.

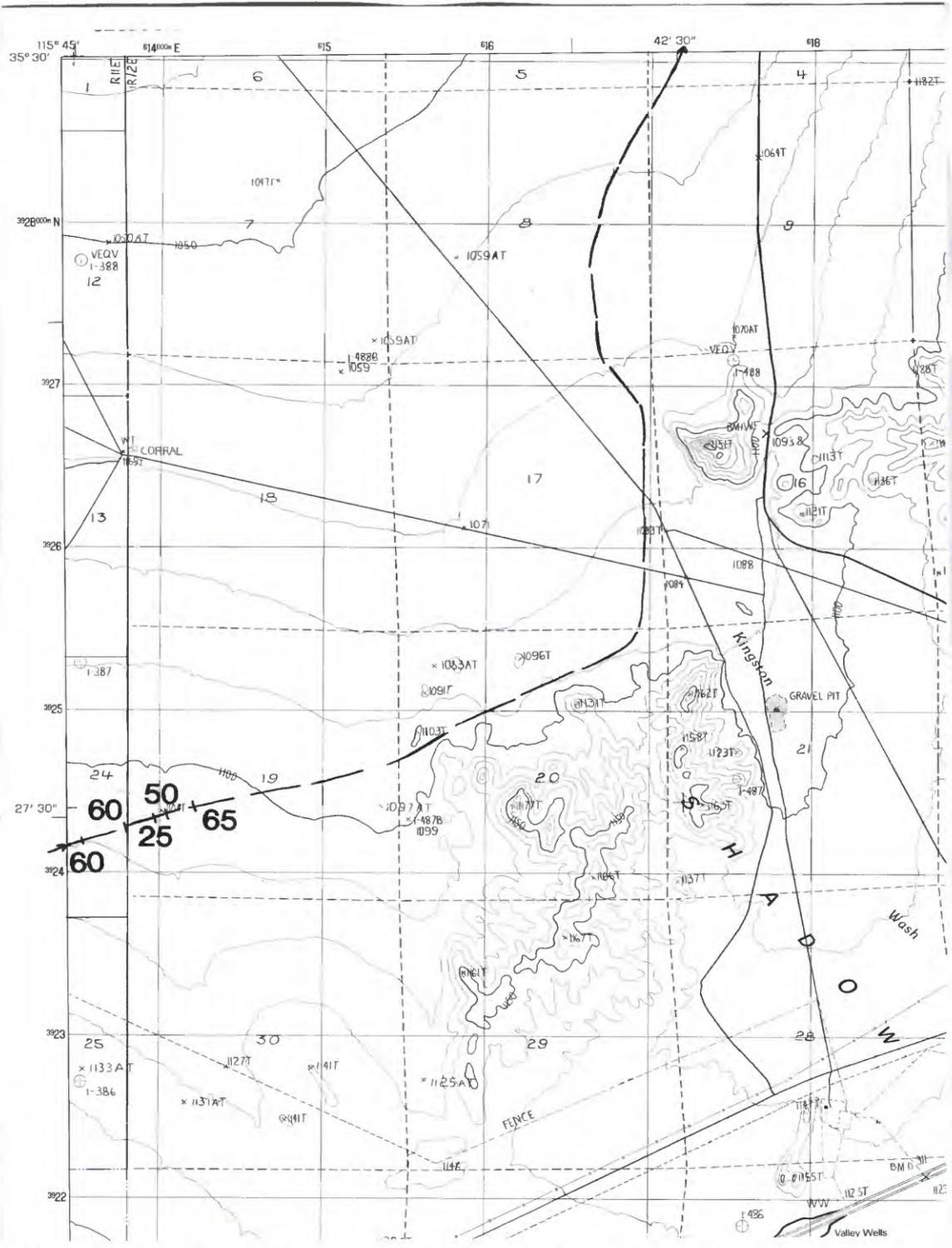


Fig. A9. Part of Valley Wells 7.5' quadrangle, showing 1989 crosscountry segment. Numbers indicate width (in feet) of zone of principal impact.



Fig. **A10** Tracks left by 1989 race in WSA 242 across Silver Dry Lake. Total width of tracked area outside of the road (to which the race was supposed to be restricted) is 130 feet.



**Fig. A11** Disruption of crust on surface of Silver Dry Lake, making the surface vulnerable to wind erosion. Pencil is 5.5 inches long.



Fig. **A12** Section 8 T15N R10E, Turquoise Mtn. 7.5' quadrangle. Deep corrugations in road caused straying outside of the road (9 feet wide), enlarging the area of principal impact to 40 feet wide.

-0.10 mi, heavily used braid off the road; substantial shrub damage.

-0.20 mi, local strays off road.

-0.25 mi, very heavily-used shortcut.

-0.45 mi, moderately-used off-road braid at large corrugations in road.

-0.85 mi, strays off road; large (8 to 9") unmarked burrow 25 feet off road.

-0.90 mi, large unmarked burrow 28 feet off road.

1.00 mi, strays off road

1.05 mi, possible active tortoise burrow 5.5 feet from road (Note strays are commonly farther off the road than this burrow).

1.20 mi, strays off road.

Where the route leaves this road into a wash in Section 18, shortcutting and overrunning as measured along the road gave a zone of principal impact 321 feet wide. One hundred feet downcourse, the width of the zone of principal impact was 220 feet. I did not measure the width of the active wash to which the route is restricted (Bureau of Land Management, 1982; 1989a, b), but estimate it to be less than 25 feet wide. The width of the zone of principal impact in 1988 at this location was 165 feet (see Fig. 7). The 1989 event caused extensive damage to vegetation and breakdown of wash banks. Individual tracks between heavily used braids average 8.7 inches wide and 1.7 inches deep, which is equivalent to 1 acre of surface disturbance per 11.4 mi of travel, and 27 short tons of soil displaced per mile (soil density assumed to be 1.6 gm/cc). In addition to the zone of principal impact, there are numerous fresh motorcycle tracks on the west side of the road, and strays both north and south of the zone of principal impact. Unmarked possible tortoise burrows (none was clearly active) were observed in the immediate area of heavy impact.

The road segment in Sections 8 through 10 has local zones of large corrugations (wavelength 9.5 to 18.4 feet, amplitude 8.7 to 14.6 inches) with accompanying heavily used off-road braids giving zones of principal impact from 24 to 50 feet wide (Fig. A5, A12).

Motorcycle tracks were observed as far as 105 feet from the road.

Where the route turns into Bull Spring Wash (Section 15), the zone of principal impact is 95 feet wide, and is 45 feet wide a short distance south of Pit 2 (Fig. A5). Strays in Bull Spring Wash were observed within 17 feet of an unmarked active tortoise burrow.

There is extensive tracking by motorcycles, 3- and 4-wheel ATVs, and 4-wheel vehicles outside the shallow borrow pit in which Pit 2 is located, especially on the east side. The tracks occur in the

well-vegetated wash adjacent to the two small rock outcrops on the east side of the road, on the steep 6 to 10 feet high wash banks (Fig. A13), and on the terrace above the wash. Slots to 8 inches wide and 10 inches deep were cut by motorcycles climbing the wash bank (Fig. A14). Unidentified burrows were crushed by single motorcycle (Fig. A15a) and ATV (Fig. A15b) passes. Individual motorcycle tracks average 8.8 inches wide and 1.5 inches deep, which is equivalent to 1 acre of surface disturbance per 11.3 mi of travel, and about 24 short tons of soil displacement per mile (soil density assumed to be 1.6 gm/cc).

Where the route leaves the poleline road and heads eastward east of Pit 2 (Section 11), the zone of principal impact is 225 feet wide (Fig. A5). Motorcycle and 3-wheel ATV tracks are abundant on the west side of the poleline road as far as 75 feet from the road, and southward for approximately 0.7 mi to the junction of the poleline road and the pave road to the microwave station on Turquoise Mtn. The roadbed eastward is 8 to 9 feet wide, and has been widened to as much as 30 feet by the 1989 race (Fig. A5). Motorcycle and ATV tracks were observed in the well vegetated wash north of the road as much as 50 feet off the road. The course departs from the road and traverses a wash in Sections 11 and 12 before rejoining the road. Course markings consisted entirely of wide-spaced single ribbons and a few hazard signs.

Observations were extended eastward from the area monitored during the race in Sections 23 and 24 T16N R11E in the Solomons Knob and Valley Wells 7.5' quadrangles, and Section 19 T16N R12E in the Valley Wells 7.5' quadrangle. The course flagging consisted of wide-spaced single ribbons and 3 sets of yellow-green placards with inward pointing arrows in the western 1.5 mi of my traverse (from west of Bureau of Land Management stake N23 almost to N24; the course sweepers caught up with me at this point and all markers were removed downcourse ahead of me to Bureau of Land Management stake N25, the end of my traverse). Figures A6 and A9 show 15 locations in the approximately 2.5 mi of traverse in which the zone of principal impact exceeds the width of the active washes (mostly less than 15 feet wide) in which the marked course was located. The zone of principal impact ranges from about 7 to 10 feet to 85 feet (Fig. A16) wide. Throughout the western 2 mi of my traverse stray left tracks far from the marked route; for example, at the 24-foot wide zone of principal impact (Fig. A9), 7 motorcycle and 1 ATV tracks occurred within 135 feet of the course to the south and 3 motorcycle tracks occurred within 65 feet of the course to the north. Even a single pass of the stray vehicles destroyed the lichen



Fig. **A13** Tracks left by vehicle play at Pit 2.



**Fig. A14** 8-inch wide, 10-inch deep slot cut by motorcycles at crest of wash wall. Vehicle play at Pit 2.



**Fig. A15a** Single motorcycle pass (indentation right of pencil) partly crushed unidentified burrow. Pencil 5.5 inches long.



**Fig. A15b** Unidentified burrow partly crushed by single pass of 4-wheel ATV. Pencil 5.5 inches long.



**Fig. A16** Braiding of 1989 route to a total width of 85 feet, Section 19 T16N R12E, Valley Wells 7.5' quadrangle. Course width allowed was 25 feet. Green creosote shrubs are 5-6 feet tall.

crust that is a principal surface stabilizer between shrubs in this area (Fig. A17). Many deeply rutted parts of the route will capture runoff from crossing drainage channels. Corrugations in washes have average wavelengths of 14.4 feet and amplitudes of 8.7 inches; these corrugations will trap runoff and prevent the wash from functioning as a runoff distributor.

Upcourse from Bureau of Land Management stake N23 I observed 3 unmarked tortoise burrows 4'5", 6'7", and 15' from the main route. Between Bureau of Land Management stakes N23 and N24 red hazard ribbon was strung between shrubs out from the northern of two yellow-green boundary placards. Two motorcycle tracks occur outside of the ribbon, and one passed between two tortoise burrows, missing one by less than 8 inches (Fig. A18). One burrow is 9'8" from the main course. These are the only marked burrows I saw anywhere on the course or near Pits 1 and 2.

### References

- Bureau of Land Management, 1989b, Environmental assessment, 1989 addendum for the American Motorcyclist Association's 1989 Barstow to Las Vegas motorcycle race, CA-069-EA9-97, 59 p.
- Code of Federal Regulations, 1989, Endangered and threatened wildlife and plants; Desert tortoise; Proposed rule, 50 CFR 17: Federal Register, v. 54, No. 197, Oct. 13, 1989.
- U.S. Fish and Wildlife Service, 1989, Memorandum to State Director, Bureau of Land Management, 13 p.



Fig. A17 Single motorcycle track has broken the delicate lichen crust, a common soil stabilizer between shrubs. Pencil is 5.5 inches long.



Fig. A18 Motorcycle track between two tortoise burrows. Ribbon formed barricade across a track braid used in 1988 race. Sign marks outer course limit (it is facing upcourse and has an arrow pointing to the left in this picture).