

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

*Descriptions and elevations for leveling  
bench marks and leveling results along  
traverses near Old Station and  
Mineral, California*

BY

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## ALPHABETICAL LISTING OF BENCH MARKS

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## Purpose of Report

This report provides descriptions (Appendix 1 & 2) and elevations (Table 1 & 2) for bench marks installed by the Cascades Volcano Observatory (CVO) leveling crew during July 1991. Also included are updated descriptions of bench marks installed by the Federal Highway Administration (formerly the U. S. Bureau of Public Roads) in 1929 and 1934 as well as bench marks installed by the National Geodetic Survey (formerly the U. S. Coast and Geodetic Survey) in 1932 and 1954. Bench-mark locations are plotted on reproductions of the U.S. Geological Survey topographic quadrangles (figures 2 - 9).

These bench marks are located along leveling lines north and south of Lassen Volcanic National Park (figure 1) that were surveyed during the summer of 1991 by CVO as part of the U.S. Geological Survey Volcano Hazards Program. The work contributes to a continuing effort to detect ground deformation related to magmatic and tectonic processes with the ultimate objective of assessing the potential for future eruptions in the Cascade Range.

## Leveling Surveys

The 1991 CVO leveling survey was conducted under the guidelines prescribed by the Federal Geodetic Control Committee (FGCC) (Federal Geodetic Control Committee, 1984, Yamashita and Kaiser, 1991), for First-Order, Class II, leveling surveys.

All data (Tables 1 & 2) were recorded in either a Hewlett-Packard® 71B computer (Yamashita, 1989), or the Corvallis Microtechnology, MC-II® hand-held computer (Yamashita and Yamashita, 1992). All checks and balances were made by the computer, and archived on a cassette recorder, or diskette. The data were down-loaded into a mainframe computer in the office, where the final corrections were applied.

About 40% of the leveling line north of Lassen Volcanic National Park was "double run" to verify the accuracy of the 1991 leveling (bench marks with \* in Table 1). Elevation differences between bench marks on the leveling line south of Lassen Volcanic National Park compared very well with the 1932 survey and double running of this line was not necessary.

## Corrections Applied to the Data

Corrections were applied to compensate for: 1) index of refraction of the light path due to ambient temperature variations, 2) inaccuracy of the rod scales (our rods are calibrated yearly at each centimeter interval by the National Bureau of Standards (NBS) in Gaithersburg, Maryland), and 3) the change in length of the invar strip due to temperature variations.

## Acknowledgements

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## APPENDIX I - Leveling line north of Lassen Volcanic National Park

### Bench Mark Descriptions

All mileage distances are derived from stadia readings obtained during the 1991 survey.

Note: All references to the "Town of Viola" will refer to the intersection of highway 44/89 and a dirt road leading south, at the "Christian Youth Camp" (figure 1) in Viola, Ca., about 30 km (18.7 mi) southwest of Old Station, California.

#### S547

1.2 km (0.8 mi) northeast along highway 44/89 from the town of Viola, California (see figure 2), at the north end of a road cut. Bench mark is cemented in the top of a concrete post, 10.2 m (33.5 ft) southeast of highway 44/89, at road level, and 0.6 m (2 ft) southwest of a witness post. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "S547".

#### FIR 1973

1.59 km (1.0 mi) northeast along highway 44/89 from the town of Viola, California (see figure 2), at the crest of the highway and a road cut on the north side of the highway. Bench mark is cemented in the top of a concrete post, 9.9 m (32 ft) north of the highway, and 1.2 m (4 ft) above road level. Bench mark is a California Division of Highways brass tablet stamped "FIR 1973".

#### T547

2.40 km (1.5 mi) northeast along highway 44/89 from the town of Viola, California (see figure 2). Bench mark is set in the top of a concrete post, 12.1 m (40 ft) north of the centerline of highway 44/89, 0.6 m (2 ft) lower than the road level, and 0.6 m (2 ft) east of a witness post. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "T547".

Note: Across the highway from this mark is triangulation station "Honey".

#### H196

3.75 km (2.35 mi) northeast along highway 44/89 from the town of Viola, California (see figure 2), at a sheer road cut, in a rock face. Bench mark is a "vertical mark", set in the north face of the road cut, 10.6 m (35 ft) northwest of the north corner of the concrete headwall of a small tunnel. Bench mark is 8.2 m (27 ft) south of the centerline of highway 44/89 and 0.6 m (2 ft) higher than the ground and road level. About 100 m (330 ft) east of this mark is a pullout. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "H196".

#### CVO91-014

5.45 km (3.40 mi) northeast along highway 44/89 from the town of Viola, California (see figure 3), at the east end of a long and narrow pullout. Bench mark is cemented in the top of a 1.2 x 3.0 m (4 x 10 ft) embedded boulder, 15.4 m (50.5 ft) south of the centerline of highway 44/89, 1.8 m (6 ft) lower than the road level, 0.9 m (3 ft) higher than the ground level, and 1.5 m (5 ft) west of a witness post. Bench mark is a U. S. Geological Survey brass tablet stamped "CVO91-014".

#### CVO91-015

7.14 km (4.45 mi) northeast along highway 44/89 from the town of Viola, California (see figure 3). Bench mark is cemented on the south end of a 2.1 m (7 ft) embedded boulder, about 45.7 m (150 ft) southeast of a 3 m (10 ft) wide by 3.7 m (12 ft) deep road cut, 8.2 m (27 ft) east of the centerline of highway 44/89, in the middle of an "S" curve, 1.1 m (3.5 ft) above road level, 0.6 m (2 ft) above ground level, and 0.9 m (3 ft) northwest of a witness post. Bench mark is a U. S. Geological Survey brass tablet stamped "CVO91-015".

#### CVO91-016

8.55 km (5.35 mi) northeast along highway 44/89 from the town of Viola, California (see figure 3). Bench mark is cemented in the top of a 0.9 x 0.9 m (3 x 3 ft) embedded boulder, about 200 m (650 ft) south of Forest Service (FS) road 17 and a large pullout. Bench mark is 12.4 m (40.7 ft) north of the centerline of highway 44/89, 3 m (10 ft) south of a 4.6 - 6 m (15 - 20 ft) high, sheer rock face, about 3 m (10 ft) higher than the road level, and 1.2 m (4 ft) west of a witness post. Bench mark is a U. S. Geological Survey brass tablet stamped "CVO91-016".

North entrance into Lassen Volcanic National Park is 10.49 km (6.55 mi) northeast along highway 44/89 from the town of Viola, California.

#### BPR5762.21

0.16 km (0.1 mi) northeast along highway 44/89 from the North Entrance into Lassen Volcanic National Park (see figure 3), at a large stone structure on the east side of the highway. Bench mark is attached to a pipe, 28.2 m (92.5 ft) east of the centerline of highway 44/89, and 7.3 m (24 ft) north of a massive 4.6 m (15 ft) high rock monument. Bench mark is a Bureau of Public Roads brass tablet stamped "34 + 75.00 5762.21 1932".

#### CVO91-017

1.32 km (0.8 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3). Bench mark is cemented in the top of an embedded boulder about 61 m (200 ft) south of where a "single power line" crosses the highway. Bench mark is 29.4 m (96.5 ft) east of the centerline of highway 44/89, 0.9 m (3 ft) west of a witness post, and at the south-end of a clearing with 1.5 m (5 ft) tall trees. Bench mark is a U. S. Geological Survey brass tablet stamped "CVO91-017".

## TABLE

2.19 km (1.35 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park, at Eskimo Hill Summit (see figure 3). Bench mark is cemented in the top of an embedded boulder, on the east side of a large parking area. Bench mark is 22 m (72 ft) east of the centerline of highway 44/89, 10 m (33 ft) northeast of a sign, "ESKIMO HILL SUMMIT ELEV 5933 FT", and 3.7 m (12 ft) northwest of a 1.2 x 1.2 m (4 x 4 ft) boulder. Bench mark is a California Department of Highways brass tablet stamped "TABLE".

## CVO91-018

3.35 km (2.10 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3), at a small pullout on the east side of the highway, just before the crest of a downgrade to the northeast. Bench mark is cemented in the top of a prominent boulder, in a road cut of an old abandoned roadbed. Bench mark is 39.6 m (130 ft) east of the centerline of highway 44/89, 2.4 m (8 ft) above highway 44/89, and 1.2 m (4 ft) above the old roadbed. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-018".

## D196

5.44 km (3.40 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3). Bench mark is cemented in the top of a concrete post, 12.2 m (40 ft) southeast of the centerline of highway 44/89 and 0.9 m (3 ft) northwest of a witness post. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "D196 1934".

## CVO91-019

6.81 km (4.25 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3), near the intersection with FS road 32N13, and FS road 16. Bench mark is cemented in the top of an embedded boulder, about 38 m (125 ft) northeast of the intersection of FS road 32N13 and FS road 16, 41.2 m (135 ft) southeast of the centerline of highway 44/89, 2.1 m (6.9 ft) southeast of a witness post, 1.8 m (6 ft) higher than the road level, and 0.6 m above the ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-019".

## 14M

8.22 km (5.15 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3), at a 3 m (10 ft) deep road cut on the south side of the highway. Bench mark is cemented in the top of a concrete post, about 38 m (125 ft) north of a multi-road intersection, about 15 m (50 ft) north of a sign, "Professionally Managed Forests Provide Water Wildlife Woodproducts Associated California Loggers", 14 m (46 ft) southeast of the centerline of highway 44/89, and 3 m (10 ft) higher than the road level. Bench mark is a U.S. Geological Survey brass tablet stamped "14M".



#### CVO91-020

10.11 km (6.30 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 3), at the intersection with FS road 32N49 on the southeast, and FS road 32N66Y on the northwest. Bench mark is cemented in the top of a 0.9 x 0.9 m (3 x 3 ft) embedded boulder, about 76 m (250 ft) northeast of FS road 32N49, 0.9 - 1.2 m (3 - 4 ft) higher than the road level, and 0.3 m (1 ft) above the ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-020".

#### CVO91-021

11.80 km (7.35 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 4), at the edge of a lava flow. Bench mark is cemented in a lava block, southeast of the west-north-west end of a lava flow, 54.8 m (180 ft) south of the centerline of highway 44/89, 12 m (40 ft) northeast of a deep fissure, 1.2 m (4 ft) lower than the highest part of the lava flow, and at the end of a short road leading in from the pullout. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-021".

#### BPR4896.94

13.78 km (8.60 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5), at the northeast-end of a paved parking area. Bench mark is attached to a pipe, across the road from the parking lot, 15.7 m (51.5 ft) north-northwest of the centerline of highway 44/89. Bench mark is a Bureau of Public Roads brass tablet stamped "471 + 93.08 4869.94 1932".

#### CVO91-024

14.1 km (9.19 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5). Bench mark is cemented in the top of an embedded boulder, 60 m (197 ft) east of the centerline of highway 44/89, about 152 m (500 ft) south of FS road 32N13 which leads to the "Big Pine" Camp ground, and 1.5 m (5 ft) north of a witness post. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-024".

#### 12M

15.90 km (9.35 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5), at the north-end of a road cut. Bench mark is cemented on the top of a concrete post, on the inside of a curve, nearly opposite a "T" intersection with FS road 34N78 to the northwest, 11.9 m (39 ft) southeast of the centerline of highway 44/89, and 1.5 m (5 ft) higher than the road level. Bench mark is a U.S. Geological Survey brass tablet stamped "12M 1932 4628".

#### CVO91-023

17.24 km (10.75 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park, at a bridge over Hat Creek just south of the town of Old

Station PO (see figure 5). Bench mark is cemented in the southwest wing of the bridge over Hat Creek, 5.4 m (16.4 ft) northwest of the centerline of highway 44/89. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-023".

#### BPR4503.15

18.61 km (11.60 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5). Bench mark is attached to the top of a pipe, 15.2 m (50 ft) east of the centerline of highway 44/89, 0.9 m (3 ft) lower than the road level, and 23 m (75 ft) north of the north end of a high mound with a road-cut. Bench mark is a U. S. Bureau of Public Roads brass tablet stamped "4503.13 613 + 50.00 1932".

#### BPR4504.51

18.61 km (11.6 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5). Bench mark is attached to the top of a pipe, 15.2 m (50 ft) west of the centerline of highway 44/89, 0.9 m (3 ft) lower than the road level, and at the north-end of a high mound with a road-cut. Bench mark is U. S. Bureau of Public Roads brass tablet stamped "4504.51 1932".

Note: These last two BPR marks are across the highway from one another.

#### CVO91-022

20.30 km (12.65 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park (see figure 5), at the north-end of a "Day Use Picnic Area". Bench mark is across the highway from the north end of the picnic area, cemented in the top of a small outcropping of rock, 24 m (78.8 ft) east of the centerline of highway 44/89, 10 m (30 ft) west of the main outcropping of lava rock, and at a small pullout with a "SLIPPERY HIGHWAY" warning sign. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-022".

#### USGS 82C

22.24 km (13.90 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park, near the intersection with highway 44 to Susanville.

Leave highway 44/89 and turn southeast into highway 44, toward Susanville, and continue southeasterly 0.16 km (0.1 mi) to a road intersection from the south (see figure 5).

Leave highway 44, and continue south for 0.16 km (0.1 mi) to the edge of a lava flow. Bench mark is cemented on a lava-flow outcrop, 6 m (20 ft) west of the eastern edge of the lava flow. Bench mark is 5.2 m (17 ft) west of the road center, 1.8 m (6 ft) higher than the road level, 0.9 m (3 ft) east of a power line paralleling the side road, and 1.8 m (6 ft) east of a metal post. Bench mark is a U.S. Geological Survey brass tablet stamped "82C 4361 1931".

**X195**

24.42 km (15.24 mi) northeast along highway 44/89 from the North Entrance of Lassen Volcanic National Park, 1.94 km (1.2 mi) north of the intersection with highway 44 (see figure 5). Bench mark is cemented on the top of a concrete post, 12.3 m (40.5 ft) east of the centerline of highway 89, about 12 m (40 ft) south of a 0.5 m (1.5 ft) diameter, 10 m (30 ft) tall Juniper tree, at a small pullout on the northeast side of the road. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "X195 1934".

## APPENDIX II- Leveling line south and east of Lassen Volcanic National Park

### Bench Mark Descriptions

Note: All references made to the "Town of Mineral, California" will refer to the intersection of highway 36, and highway 172, in the town of Mineral, California.

#### 14A

2.66 km (1.65 mi) west from the intersection of highway 36 and highway 172 in the town of Mineral, California, near an intersection to the north.

Leave highway 36, turn onto the side road, then take an immediate left along a side road that parallels highway 36 (see figure 6). Continue west along the side road for 0.80 km (0.50 mi) to a curve to the north, and a small pullout on the south side of the road. Bench mark is attached to the top of a 5 cm (2 inch) diameter pipe, 5.2 m (17 ft) north of the road center, and 0.17 m (7 in ) above ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "14A 4816.460 1924".

#### MINERAL

1.65 km (0.95 mi) west from the intersection of highway 36 and highway 172 in the town of Mineral, California, to an intersection (see figure 7). Road to the north leads to a Caltran base yard, and the road to the south leads to a small park. Bench mark is cemented in the top of a concrete post 32 m (105 ft) south of the centerline of the highway, 20.3 m (66.6 ft) east of the center of the road leading to the park, 3 m (10 ft) east of two, 1.3 m (3.5 ft) diameter pine trees, 2.1 m (7 ft) northwest of a split-rail fence, and 1.06 m (3.5 ft) northwest of a metal witness post. Bench mark is a California Division of Highway brass tablet stamped "MINERAL".

#### CVO91-000

Bench mark is cemented on the northeast corner of the concrete walkway of the country store in Mineral, California (see figure 7). The store is opposite the intersection of highway 36 and highway 172. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-000".

#### CVO91-001

1.36 km (0.85 mi) southeast along highway 172 (also called Mill Creek road) from the town of Mineral, California, at the east end of the bridge over Battle Creek (see figure 7). Bench mark is cemented on the east end of the bridge, 4.2 m (13.8 ft) northeast of the center of the bridge. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-001".

#### CVO91-002

2.49 km (1.55 mi) southeast along highway 172 (also called Mill Creek road) from the town of Mineral, California (see figure 7). Bench mark is cemented in the top of a 1.8 x 1.8 m (6 x 6 ft) embedded boulder, on the inside of a sweeping curve to the southwest,

36 m (118 ft) west of the centerline, 3.4 m (10 ft) lower than the road level, 1.5 m ( 5 ft) north of a witness post, and 0.6 m (2 ft) above the ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-002".

#### F138 Reset

3.80 km (2.35 mi) southeast along highway 172 (also called Mill Creek road) from the town of Mineral, California at Mineral Summit (see figure 7). Bench mark is cemented in the top of a concrete post, 23.5 m (77 ft) northeast of the centerline of the road, at the apex of a sweeping curve, southeast of a sign, "MINERAL SUMMIT", and a logging road to the southwest, and about 11 m (35 ft) higher than the road level. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "F138 Reset 1963".

#### G138

5.84 km (3.65 mi) southeast along highway 172 (also called Mill Creek road) from the town of Mineral, California (see figure 7). Bench mark is cemented on an embedded boulder 11 m (36 ft) north of the centerline of the road, 7.6 m (25 ft) east of a culvert, and 1.2 m (4 ft) higher than the road level. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "G138 5012.687 1932".

#### H138

7.78 km (4.85 mi) southeast along highway 172 (also called Mill Creek road) from the town of Mineral, California, at a small pullout on the south side, just before a curve in the road to the northeast (see figure 7). Bench mark is cemented on a "knife-edge" rock outcropping, 11.6 m (38 ft) south of the centerline of the road, about 0.9 m (3 ft) lower than the road level, and 1.2 m (4 ft) south of a witness post. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "H138 4758.980 1932".

#### CVO91-003

8.97 km (5.60 mi) southeast then northeast along highway 172 (also called Mill Creek road) from the town of Mineral, California, to an intersection on the right with dirt road leading to "THE HOLE IN THE GROUND CAMP GROUND" (see figure 7). Bench mark is cemented in the top of a 1.5 x 1.8 m (5 x 6 ft) diameter boulder, 21 m (69 ft) south of the centerline of highway 172, 8 m (26 ft) east of the center of the dirt road to the camp ground, 4.5 m (15 ft) south of a 2 x 2 x 1.2 m (7 x 7 x 4 ft) boulder, 5 m (16 ft) southeast of a stop sign, 0.9 m (3 ft) above road level, and 0.5 m ( 1.5 ft) above the ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-003".

#### J138

10.37 km (6.45 mi) southeast then northeast along highway 172 (also called Mill Creek road) from the town of Mineral, California, at the intersection with Ash Way in the town of Mill Creek (see figure 7). Bench mark is cemented on the north-end of the headwall of a concrete culvert, and about 91 m (300 ft) east of Ash Way. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "J138 1932".

#### CVO91-004

11.50 km (7.18 mi) southeast then north along highway 172 (also called Mill Creek road) from the town of Mineral, California (see figure 7). Bench mark is cemented in the top of 1 x 1.2 m (3 x 4 ft) embedded boulder, 10.4 m (34 ft) west of the road, 1.5 m (5 ft) north of two twin 0.9 m (3 ft) diameter pine trees, 0.9 m (3 ft) southeast of a witness post, 1.8 m (6 ft) above the road level, and 0.5 m (1.5 ft) above ground level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-004".

#### CVO91-005

12.85 km (8.10 mi) southeast then north along highway 172 (also called Mill Creek road) from the town of Mineral, California to 0.05 km (0.1 mi) northeast of the Tehama Campgrounds, at a small pullout on the east side of the road (see figure 7). Bench mark is cemented on the top of a 1.2 x 1.5 m (4 x 5 ft) embedded boulder, about 38 m (125 ft) south of a power line crossing the road, 9.4 m (30.8 ft) east of the centerline of the road, 1.8 m (6 ft) south of a witness post, 0.5 m (1.5 ft) above the ground level, 0.8 m (2.5 ft) above the road level, and across the road from two green boxes for buried telephone cable. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-005".

#### CVO91-006

14.11 km (8.80 mi) southeast then north along highway 172 (also called Mill Creek road) from the town of Mineral, California, at the northwest-end of a large open meadow (see figure 7). Bench mark is cemented in a 0.9 x 1.8 m (3 x 5 ft) exposure of bedrock, 5 m (16 ft) southeast of a 1.5 x 1.5 x 1.2 m (5 x 5 x 4 ft) boulder, 28.4 m (93 ft) northwest of the centerline of the road, 0.9 m (3 ft) higher than the road level, and flush with the ground. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-006".

The Mill Creek Valley intersection of highway 36 and highway 172 is 14.59 km (9.10 mi) southeast then northeast of Mineral, California (highway 36 and 172 also intersect at Mineral).

#### L138 Reset

0.71 km (0.45 mi) east along highway 36/89 from the Mill Creek Valley intersection of highway 36 and 172 at the east end of the bridge over Mill Creek (see figure 7). Bench mark is cemented in the northwest barrier railing post of the bridge. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "L138 Reset 1966".

#### CVO91-007

2.55 km (1.60 mi) east along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is cemented in the top of a 0.6 x 0.9 m (1.5 x 3 ft) embedded boulder, about 2.4 m (8 ft) lower than the road level, at the west edge of a spring, or "seep", 6.5 m (21.3 ft) north of a fence line, 18.6 m (61.0 ft) southwest of the centerline of highway 36/89, and 1.0 m (3.5 ft) east of a witness

post. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-007".

#### M138

4.06 km (2.55 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is cemented in the top of a 1.2 x 1.2 m (4 x 4 ft) embedded boulder, 14.6 m (48 ft) west of the centerline of highway 36/89, 1.1 m (3.3 ft) above the ground level, and 0.9 m (3 ft) lower than the road level. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "M138".

#### BPR4735.62

5.06 km (3.15 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is attached to a pipe, 12.2 m (40 ft) west of the centerline of highway 36/89, 2.4 m (8 ft) northeast of a witness post, and 0.6 m (2 ft) lower than the road level. Bench mark is U. S. Bureau of Public Roads brass tablet stamped "4735.62".

#### CVO91-008

6.07 km (3.80 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is cemented on the southwest end of the headwall of a concrete culvert, 8.1 m (26.7 ft) southwest of the centerline of highway 36/89, and 0.3 m (1 ft) lower than the road level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-008".

#### BPR4700.10

7.46 km (4.65 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is attached to a pipe, 15.2 m (50 ft) northeast of the centerline of highway 36/89, 2.4 m (8 ft) southwest of a witness post, and 0.3 m (1 ft) lower than the road level. Bench mark is U. S. Bureau of Public Roads brass tablet stamped "4700.10".

#### CVO91-009

9.37 km (5.85 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is cemented in the southeast end of the headwall of a concrete culvert draining a 3.7 m (12 ft) deep wash, 10.6 m (34.8 ft) south of the centerline of highway 36/89, and 1.8 m (6 ft) lower than the road level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-009".

#### P138 Reset

10.55 km (6.60 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172 (see figure 8). Bench mark is cemented at the southeast end of a bridge over Gurnsey Creek. Bench mark is California Division of Highways brass tablet stamped "P138 Reset 1971".

#### CVO91-010

12.42 km (7.75 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172. Bench mark is cemented in the top of a bedrock road-cut, about 0.16 km (0.1 mi) northwest of a bridge over Gurnsey Creek, (this is the second bridge over Gurnsey creek east and southeast from the Mill Creek Valley intersection of highway 36 and 172), 13.4 m (44 ft) northeast of the centerline of highway 36/89, 2.1 m (7 ft) higher than the road level, and 1.8 m (6 ft) south of a witness post. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-010".

12.59 km (7.85 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172, is the northwest-end of the second bridge over Gurnsey Creek.

14.20 km (8.85 mi) east then southeast along highway 36/89 from the Mill Creek Valley intersection of highway 36 and highway 172, is the Mill Creek Valley intersection with highway 32.

0.00 km (0.00 mi) intersection of highway 36/89 and highway 32.

#### CVO91-011

0.32 km (0.2 mi) southeast along highway 36/89 from the Mill Creek Valley intersection with highway 32 (see figure 8). Bench mark is cemented in the west end of the headwall of a concrete culvert, about 15 m (49 ft) north of a sign, "CHICO LEFT TURN 1/4 MILE" "JCT 32", at the southeast end of a curve in the road, 5.4 m (17.7 ft) northeast of the centerline of the highway, and 0.6 m (2 ft) lower than the highway. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-011".

#### R138

1.89 km (1.20 mi) southeast along highway 36/89 from the Mill Creek Valley intersection with highway 32 (see figure 8). Bench mark is cemented on the top of a small embedded boulder, 12.2 m (40 ft) northeast of the centerline of highway 36/89, and 3.7 m (12 ft) higher than the road level. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "R138 4688.895 1932".

#### CVO91-012

1.41 km (0.90 mi) southeast along highway 36/89 from the Mill Creek Valley intersection with highway 32 is a dirt road on the south side of the highway paralleling highway 32. Bench mark CVO91-012 is on this dirt road (see figure 8).

2.94 km (1.85 mi) southeast of the Mill Creek Valley intersection with highway 32 (1.41 km (0.90 mi) along highway 36/89 and 1.53 km (0.95 mi) along a parallel dirt road on the south side of the highway). Bench mark is cemented in a rock ledge of a road-cut



along the dirt road, about 15 m (50 ft) south of a PG&E "Buried Electrical Line" witness post, 6.9 m (22.6 ft) northeast of the center of the road, at the northeast-end of a 2.1 m (7 ft) deep road-cut, 1.1 m (3.5 ft) lower than the top of the road cut, 0.6 m (2 ft) higher than the road level, and 1.5 m (5 ft) southeast of a witness post. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-012".

#### S138

4.60 km (2.90 mi) southeast then east along highway 36/89 from the Mill Creek Valley intersection with highway 32 near the Black Forest Lodge (see figure 9). Bench mark is cemented in the top of an embedded boulder, 7.6 m (25 ft) south of the centerline of the highway, in a small grassy area formed by the main highway and a side road, and about 152 m (500 ft) east of the parking lot at the lodge. Bench mark is U. S. Coast and Geodetic Survey brass tablet stamped "S138 4850.148 1932".

#### BPR4805.37

6.15 km (3.85 mi) southeast then east along highway 36/89 from the Mill Creek Valley intersection with highway 32 (see figure 9). Bench mark is attached to a pipe about 100 m (320 ft) west of sign "Plumas-Tehama county line", 12 m (40 ft) northwest of the centerline of highway 36/89, and at the remains of what was once a "Highway Maintenance Station". Bench mark is U. S. Bureau of Public Roads brass tablet stamped "4805.37 1170 + 28.61 1929".

#### ST. BERNARD

7.77 km (4.85 mi) southeast then east along highway 36/89 from the Mill Creek Valley intersection with highway 32 at a dirt road leading north (see figure 9). Bench mark is cemented in the top of a concrete post, about 10 m (30 ft) north of the centerline of highway 36/89 and about 8 m (26 ft) west of the road center of the dirt road. Bench mark is a U. S. Coast and Geodetic Survey triangulation azimuth mark stamped "ST. BERNARD".

#### CVO91-013

9.50 km (5.90 mi) southeast then east along highway 36/89 from the Mill Creek Valley intersection with highway 32 (see figure 9). Bench mark is cemented in the top of a 1.2 x 1.2 (4 x 4 ft) embedded boulder, 28.4 m (93 ft) north of the centerline of the highway, 0.3 m (1 ft) above the ground level, and at road level. Bench mark is a U.S. Geological Survey brass tablet stamped "CVO91-013".

#### U138

11.27 km (7.05 mi) southeast then east along highway 36/89 from the Mill Creek Valley intersection with highway 32 (see figure 9). Bench mark is cemented in the top of a concrete post, 11.6 m (38 ft) south of the centerline of the highway. Bench mark is a U. S. Coast and Geodetic Survey brass tablet stamped "U138 4892.520 1932".

TABLE 1

Leveling line starts at Viola, California and ends about 2 miles northeast of Old Station, California.

Bench mark ID	Survey Mo Da	Elev. Diff in meters 1991	Elevation in meters 1991	Elevation (m) 1934 and 1957	Dist km	Total Dist km
S547*	07 91		1370.0974	1370.0974%		0.00
FIR 1973	07 91	21.3263*	1391.4237		0.39	0.39
T547	07 91	10.2462*	1401.6699	1401.6741%	0.81	1.20
H196	07 91	45.8754*	1447.5453	1447.5510@	1.35	2.55
CVO91-014	07 91	78.0525*	1525.5978		1.70	4.25
CVO91-015	07 91	62.7995*	1588.3978		1.69	5.94
CVO91-016	07 91	72.4070	1660.8043		1.41	7.35
BPR5762.21	07 91	96.4122*	1757.2165		2.10	9.45
CVO91-017	07 91	22.5769*	1779.7933		1.16	10.61
Table	07 91	27.8445*	1807.6378		0.87	11.48
CVO91-018	07 91	-26.5145*	1781.1233		1.16	12.64
D196	07 91	-90.4972	1690.6260	1690.6091@	2.09	14.73
CVO91-019	07 91	-39.0811	1651.5450		1.37	16.10
14M	07 91	-60.3746	1591.1704	1591.1632@	1.41	17.51
CVO91-020	07 91	-29.5945	1561.5760		1.89	19.40
CVO91-021	07 91	-26.5920	1534.9840		1.69	21.09
BPR4896.94	07 91	-49.7619	1485.2221		1.98	23.07
CVO91-024	07 91	-41.9280	1443.2941		0.83	23.90
12M	07 91	-32.8704	1410.4237	1410.4337@	1.30	25.20
CVO91-023	07 91	-22.9527*	1387.4710		1.33	26.53
BPR4504.51	07 91	13.6880*	1373.7830		1.37	27.90
BPR4503.15	07 91	-0.4146*	1373.3684		0.03	27.93
CVO91-022	07 91	-21.5412*	1351.8272		1.69	29.62
USGS 82C	07 91	-22.5963*	1329.2310		1.94	31.50
X195	07 91	-40.9514*	1288.2795	1288.2858@	2.18	33.74

# This mark is datum for the survey and all elevations are relative to the 1957 NGS elevation of 1370.0974 m.

% These are 1957 NGS elevations.

@ These are 1934 NGS elevations.

\* Elevations differences listed are the average of "double run" differences.

TABLE 2

Leveling line starts at Mineral, California and ends about 3 miles west of Chester, California.

Bench mark ID	Survey Mo Da	Elev. Diff in meters 1991	Elevation in meters 1991	Elevation (m) 1932 and 1975	Dist km	Total Dist km
14A*	07 91		1468.0976	1468.0976%		0.00
Mineral	07 91	4.5089	1472.6065		1.90	1.90
CVO91-000	07 91	24.6942	1497.3008		1.63	3.53
CVO91-001	07 91	-14.3122	1482.9886		1.36	4.89
CVO91-002	07 91	43.1978	1526.1864		1.13	6.02
F138 Reset	07 91	85.1458	1611.3322		1.32	7.34
G138	07 91	-83.4309	1527.9013	1527.9026%	2.04	9.38
H138	07 91	-77.3278	1450.5735	1450.5735%	1.94	11.32
CVO91-003	07 91	-44.0590	1406.5145		1.19	12.51
J138	07 91	28.2902	1434.8046	1434.8039%	1.40	13.91
CVO91-004	07 91	-9.8903	1424.9144		1.13	15.04
CVO91-005	07 91	18.1724	1443.0868		1.35	16.39
CVO91-006	07 91	24.9775	1468.0643		1.26	17.65
L138 Reset	07 91	3.9399	1472.0042	1471.9882@	1.11	18.77
CVO91-007	07 91	38.4635	1510.4677		1.84	20.60
M138	07 91	-12.2505	1498.2172	1498.2148%	1.51	22.11
BPR4735.62	07 91	-22.0771	1476.1401	1476.1314%	1.00	23.11
CVO91-008	07 91	-1.2253	1474.9148		1.01	24.12
BPR4700.10	07 91	-9.5729	1465.3419	1465.3297%	1.39	25.51
CVO91-009	07 91	-16.9339	1448.4080		1.91	27.42
P138 Reset	07 91	-16.1451	1432.2629	1432.2294@	1.18	28.60
CVO91-010	07 91	-1.2951	1430.9678		1.87	30.47
CVO91-011	07 91	-18.2083	1412.7595		2.15	32.20
R138	07 91	-16.4698	1429.2293	1429.2049%	1.57	34.19
CVO91-012	07 91	16.8748	1446.1041		1.14	35.33
S138	07 91	32.2717	1478.3757	1478.3556%	2.16	37.49
BPR4805.37	07 91	19.0480	1497.4237	1497.4088%	1.55	39.04
St. Bernard	07 91	40.2948	1537.7185		1.62	40.66
CVO91-013	07 91	-42.6489	1495.0697		1.71	42.37
U138	07 91	-3.7774	1491.2922	1491.2700%	1.77	44.14

# This mark is datum for the survey and all elevations are relative to the 1932 NGS elevation of 1468.0976 m.

@ These are 1975 NGS elevations.

% These are 1932 NGS elevations.

## REFERENCES

- Federal Geodetic Control Committee, 1984, Standards and Specifications for Geodetic Control networks: Rockville, Maryland, National Oceanic and Atmospheric Administration.
- Yamashita, K.M., 1989, Using the "HP-71B" handheld computer for data entry while running first order class II level surveys: U.S. Geological Survey Open-File Report 89-179, 21 p.
- Yamashita, K.M., and Kaiser, W.P., 1991, Using First-Order Class II Geodetic Leveling, in Ewert J.W., and Swanson, D.A., eds., 1990, U.S.G.S Bulletin 1666, Monitoring Volcanoes: Techniques and Strategies Used by the Staff of the Cascades Volcano Observatory, 1980-1990: Chapter 13, 7 p.
- Yamashita, K.M., and Yamashita, J.M., 1992, Using the MC-II Handheld Computer While Running First or Second Order Level Surveys: U.S. Geological Survey Open-File Report 92-184, 18 p.

**Black dots represent bench-mark locations**

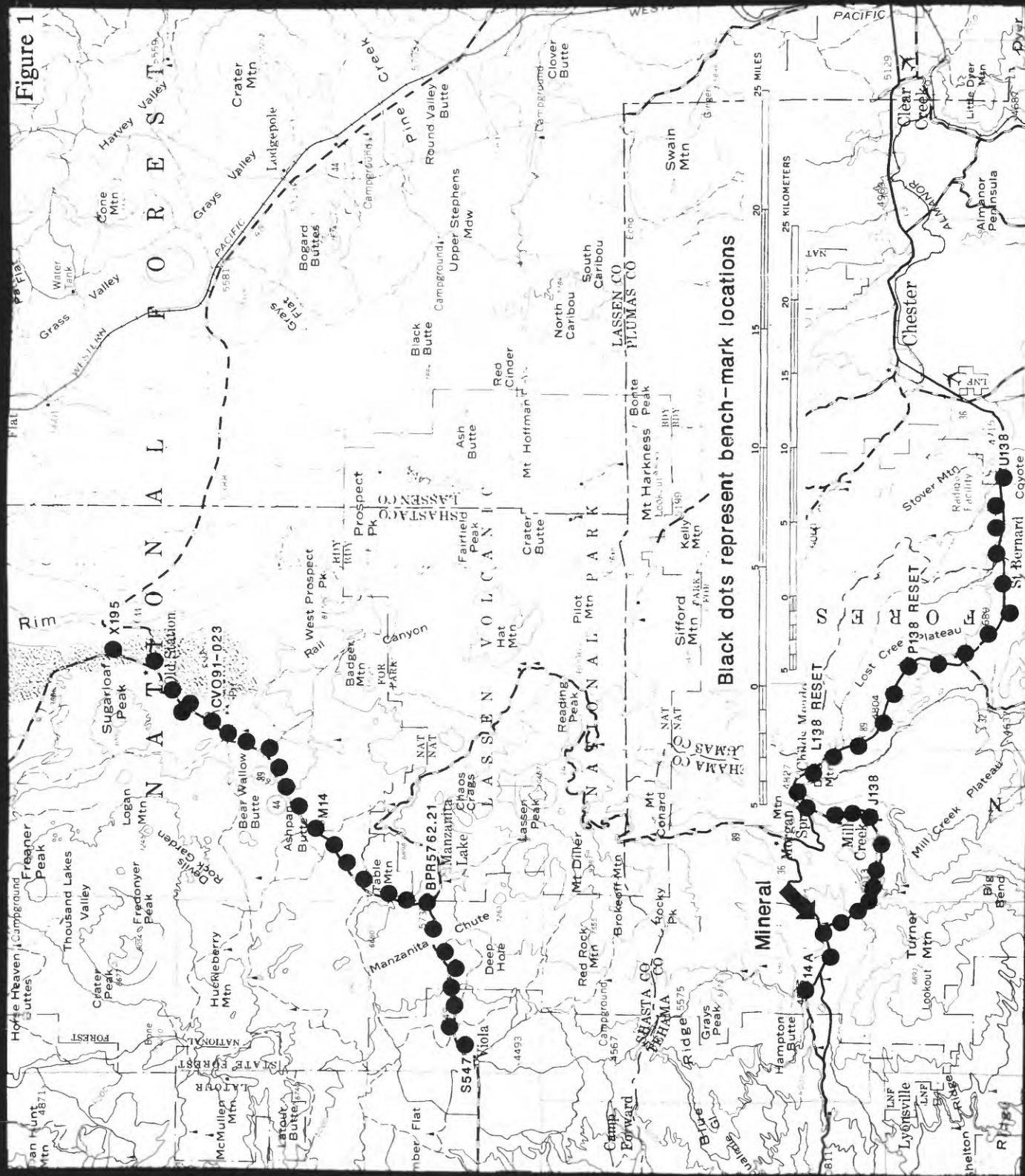
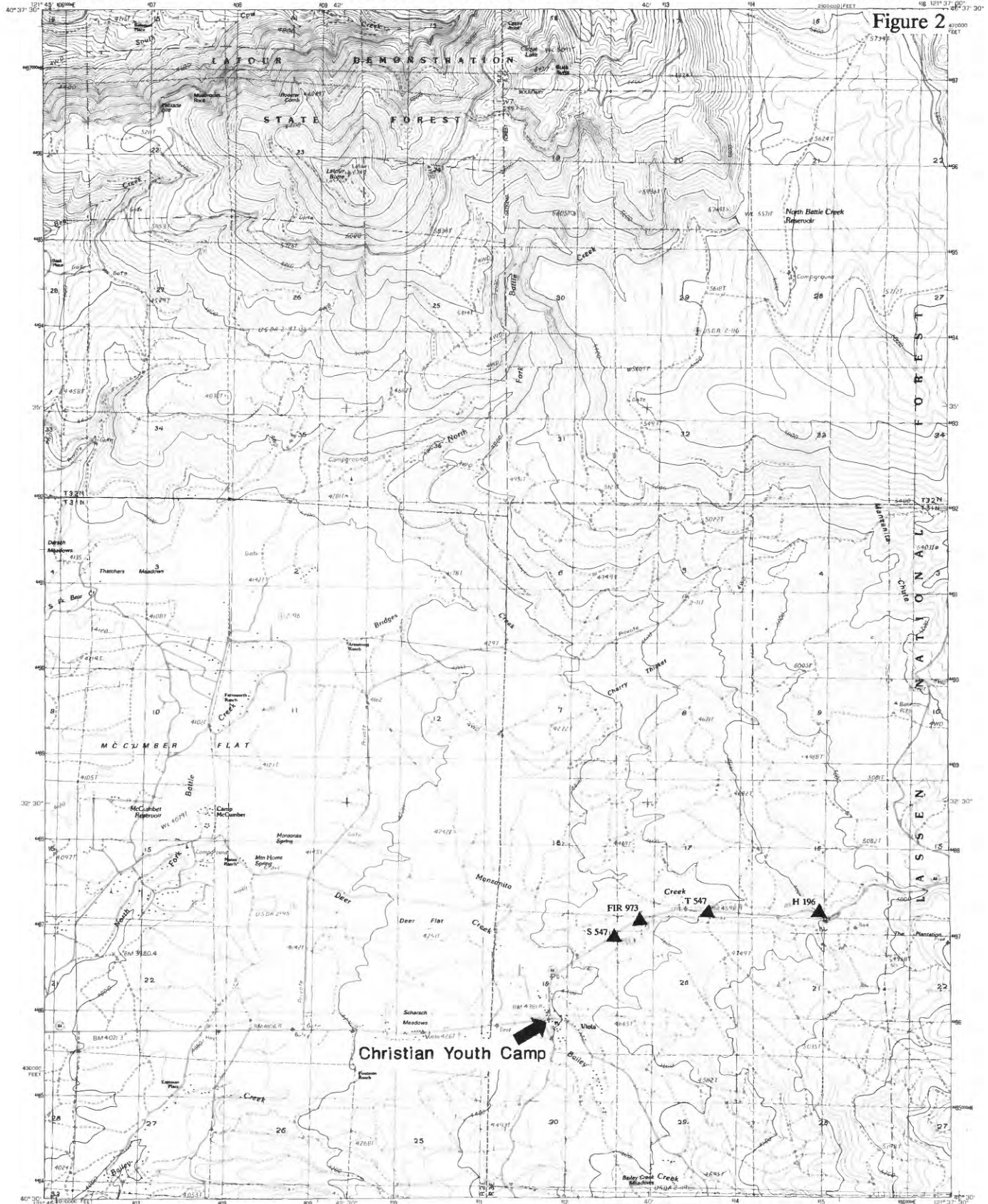


Figure 2



Christian Youth Camp

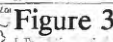
PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY  
CONTROL BY THE UNITED STATES GEOLOGICAL SURVEY  
CORRECTED FROM ORIGINAL PHOTOGRAPHIC SOURCE  
FIELD CHECKED 1982 MAP EXPEDITED 1980  
PROJECTION UTM ZONE 18N  
GRID 32N-40N  
UTM GRID DECLINATION 17° 51' E  
1983 MAGNETIC NORTH DECLINATION 17° 51' E  
NAD 83 DATUM 1983 NORTH AMERICAN DATUM  
To place on the predicted North American Datum of 1983,  
move the projection lines as shown by dashed corner ticks  
(17 meters north, 19 meters east).  
There may be private inholdings within the boundaries of any  
Federal and State Reservations shown on this map.  
Certain land uses are omitted because of insufficient data.  
No distinction made between houses, barns, and other buildings.

PROVISIONAL MAP  
Produced from original  
manuscript drawings. Informa-  
tion shown as of date of  
photography.

1 0 1 000 2000 3000 4000 5000 6000 7000 8000 9000 10000  
KILOMETERS  
1 0 1 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000  
MILES  
CONTOUR INTERVAL 40 FEET  
CONTROL ELEVATIONS SHOWN TO THE NEAREST 1 FOOT  
OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT  
To convert meters to feet multiply by 3.2808  
To convert feet to meters multiply by 0.3048  
THIS MAP COMPLES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

7000





1	2	3	1 Jacks Backbone
			2 Thousand Lakes Valley
4		5	3 Old Canton
			4 Volo
6	7	8	5 West Prospect Park
			6 Gray Park
			7 Lorenz Park
			8 Reading Park

ADJOINING 7,8 QUADRANGLE NAME

ROAD LEGEND

Improved Road \_\_\_\_\_

Unimproved Road \_\_\_\_\_

Trail \_\_\_\_\_

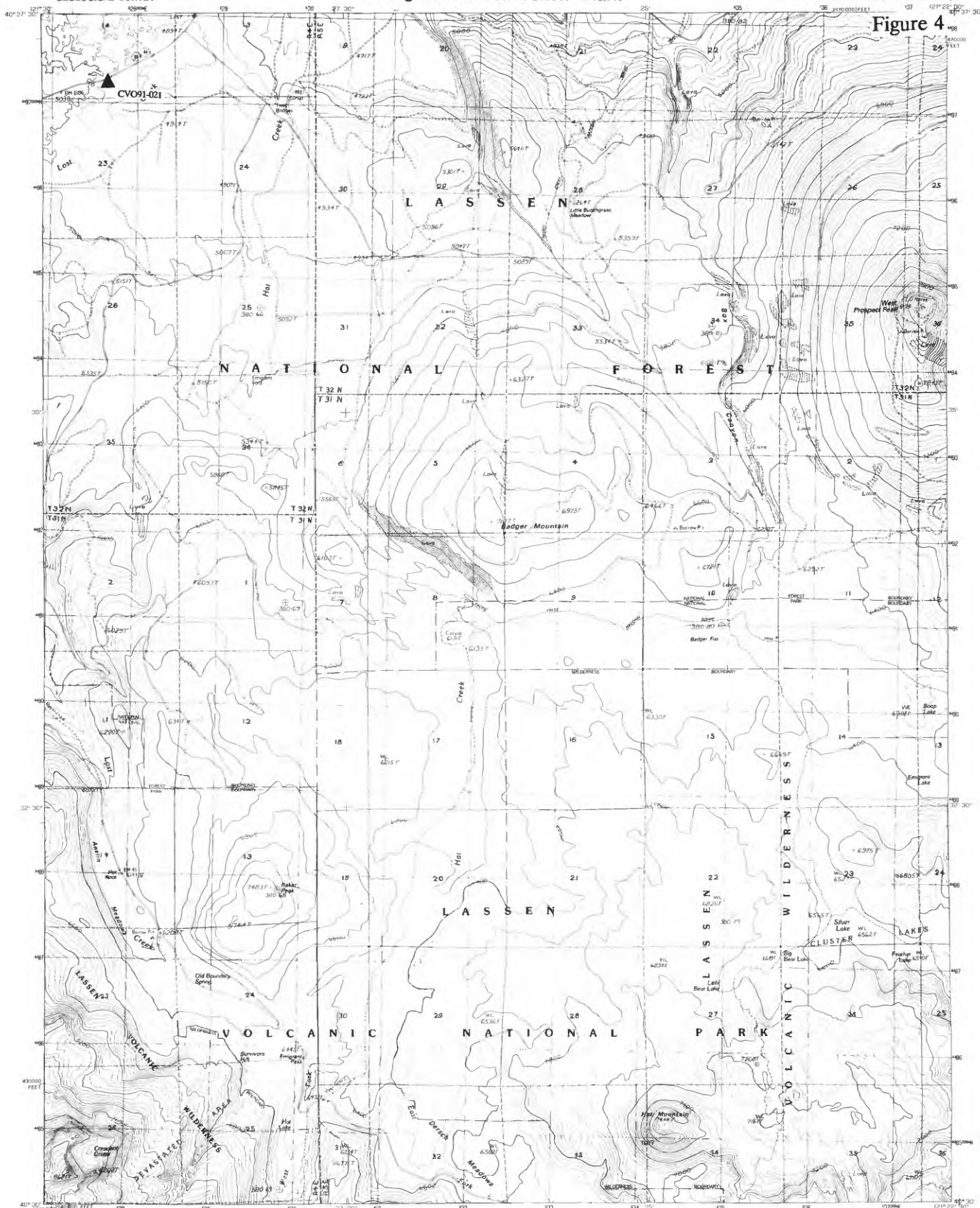
☐ Interstate Route    ☐ U.S. Route    ☐ State Route

**MANZANITA LAKE, CALIF.**

**PROVISIONAL EDITION 1985**

40121-E5-TF-004

Figure 4



PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY  
CONTROL BY COMPILED FROM AERIAL PHOTOGRAPHY TAKEN 1973 AND 1980  
FIELD CHECKED 1991 MAP EDITED 1991  
PROJECTION UTM 11N UTM 11N  
GEOGRAPHIC COORDINATE TRANSVERSE MERCATOR 1983  
1983-8000 STATE GRID TICS  
UTM GRID DECLINATION 17° 30' EAST  
VERTICAL DATUM NATIONAL GEODETIC VERTICAL DATUM OF 1985  
HORIZONTAL DATUM  
To place on the projected North American Datum of 1983,  
move the projection line as shown by dashed corner ticks  
(17 meters north, 91 meters east)  
There may be private inholdings within the boundaries of any  
Federal and State Reservations shown on this map.  
No distinction made between houses, barns, and other buildings

**PROVISIONAL MAP**  
Produced from original  
manuscript drawings. Infor-  
mation shown as of date of  
photography.

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2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304  
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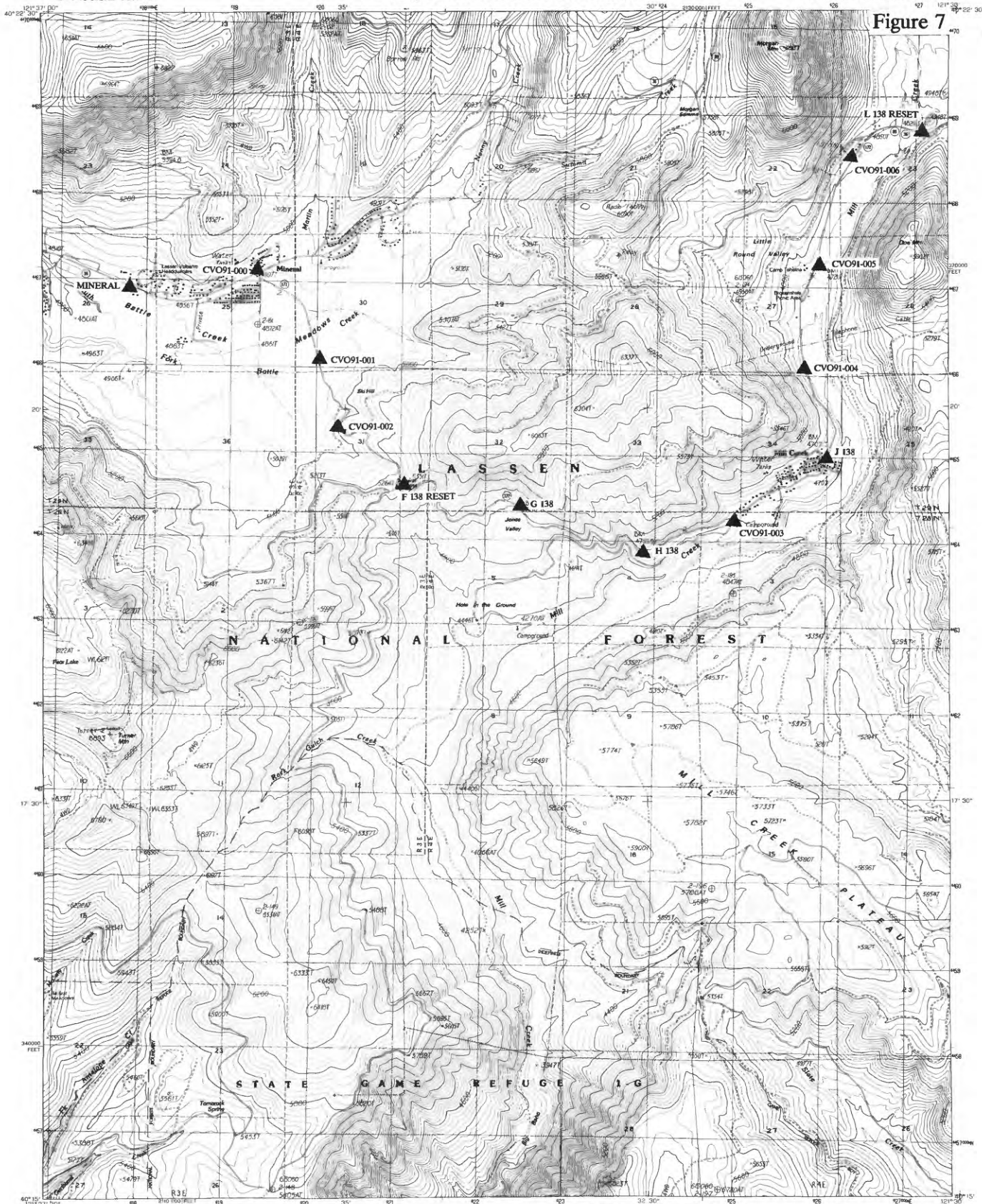








Figure 7



PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY  
CONTROL BY: UNITED STATES GEOLOGICAL SURVEY  
FIELD CHECKED: 1982 MAP EDITED: 1982  
PROJECTION: UTM ZONE 18N  
GEOID: 1984 NAVD83  
UTM GRID: 18N  
VERTICAL DATUM: 1984 NAVD83  
HORIZONTAL DATUM: 1984 NAVD83  
To place on the predicted North American Datum of 1983,  
move the projection base as shown by dashed corner ticks  
1.17 meters north (1.17 meters east)  
There may be private inholdings within the boundaries of any  
Federal and State Reservations shown on this map.  
Certain land uses are omitted because of insufficient data.  
No distinction made between houses, barns, and other buildings.

**PROVISIONAL MAP**  
Produced from original  
manuscript drawings. Infor-  
mation shown as of date of  
photography.



CONTROL ELEVATIONS SHOWN TO THE NEAREST 50 FEET  
OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT  
To convert meters to feet multiply by 3.2808  
To convert feet to meters multiply by 0.3048

THIS MAP COMPLETES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80265, OR RESTON, VIRGINIA 22091

QUADRANGLE LOCATION

1	2	3
4	5	6
7	8	9

ADJOINING 7.5 QUADRANGLE NAMES

**ROAD LEGEND**

Improved Road: ———  
Unimproved Road: - - - - -

Interstate Route: U.S. Route: State Route:

**MINERAL, CALIF.**  
PROVISIONAL EDITION 1986  
40181-C3-TF-824

**ROAD LEGEND**

Improved Road \_\_\_\_\_

Unimproved Road \_\_\_\_\_

Trail \_\_\_\_\_

☐ Interstate Route    ☐ U.S. Route    ☐ State Route

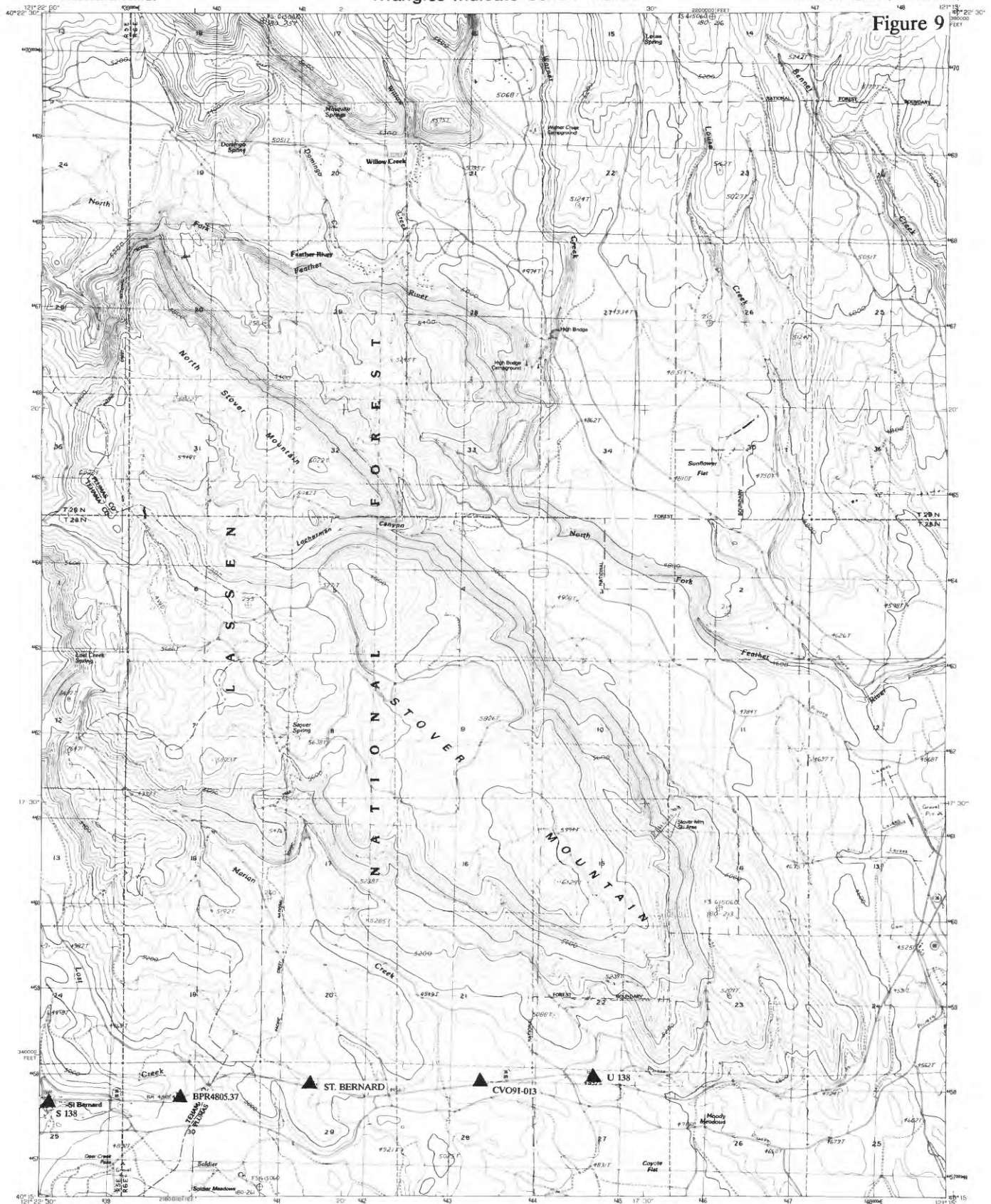
**CHILDS MEADOWS, CALIF.**

**PROVISIONAL EDITION 1985**

40121-C4-37-004



Figure 9



PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY  
CONTROL BY CORRELATION FROM AERIAL PHOTOGRAPHS TAKEN 1986  
FIELD CHECKED 1987 MAP EDITED 1988  
PROJECTION UTM ZONE 18N  
GEOID DATUM 1984  
VERTICAL DATUM 1984  
HORIZONTAL DATUM 1984  
UNIT OF MEASURE METERS  
SCALE 1:50,000  
To place on the projected North American Datum of 1983, move the projection lines as shown by dashed corner ticks (17 meters north / 90 meters east)  
There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map.  
No distinction made between houses, barns, and other buildings

**PROVISIONAL MAP**  
Produced from original  
manuscript drawing. Infor-  
mation shown as of date of  
photography.

1 0 1 000 2 000 3 000 4 000 5 000 6 000 7 000 8 000 9 000 10 000  
METERS  
1 0 1 000 2 000 3 000 4 000 5 000 6 000 7 000 8 000 9 000 10 000  
FEET  
CONTOUR INTERVAL 40 FEET  
CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 FOOT  
OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT  
To convert meters to feet multiply by 3.2808  
To convert feet to meters multiply by 0.3048  
THIS MAP COMPLETES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80205, OR RESTON, VIRGINIA 22092

**ROAD LEGEND**  
Improved Road  
Unimproved Road  
Trail  
Interstate Route  
U.S. Route  
State Route  
**STOVER MTN., CALIF.**  
PROVISIONAL EDITION 1985  
40121-1:3-77-204