HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

SEE STATION OHALE (HOS)

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: 4-S10 USGS
STATE: HAWAII
YEAR: 1949
SECOND ORDER

SOURCES OF OBSERVATION CHECK ON THIS POSITION

GEODETIC LATITUDE: 17° 51′ 25.9174′
GEODETIC LONGITUDE: 155° 16′ 40.2347′
ELEVATION: 1011.01 METERS

STATE COORDINATES (FHS)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5131</td>
<td>5756979.49</td>
<td>169,041.49</td>
<td>+ 0°04′23″</td>
</tr>
</tbody>
</table>

PLANE AZIMUTH HAS BEEN COMPUTED BY THE T′ FORMULA, −0.5 FORMULA NEGLECTING THE SECOND TERM.

<table>
<thead>
<tr>
<th>TO STATION OF OBJECT</th>
<th>GEODETIC AZIMUTH (T′ FORM)</th>
<th>PLANE AZIMUTH (−0.5 FORM)</th>
<th>CODE</th>
</tr>
</thead>
</table>

These data obtained from adjustment of Jan 1979
These data should be used for all surveys after Dec 1975

3K 169
# Horizontal Control Data

**Quad 191552**

**Station 1002**

**Hawaii**

**Latitude: 19° 00' to 19° 30'**

**Longitude: 155° 00' to 155° 30'**

**Datum: NAD 83**

**Hawaiian Datum**

---

## Adjusted Horizontal Control Data

### Name of Station
1917 USGS

### State
Hawaii

### Year
1947

### Second Citation
- 1917

---

### Source:

19 52 33 8415

### Geodetic Latitude
19° 52' 33.8415"

### Geodetic Longitude
155° 23' 23.1511" (W)

### Elevation
1246.90 feet

**4950 meters**

---

### State Coordinates (WGS)

<table>
<thead>
<tr>
<th>State &amp; Zone</th>
<th>Code</th>
<th>X</th>
<th>Y</th>
<th>Z (in ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>5101</td>
<td>544,386.95</td>
<td>194,274.48</td>
<td>0 01 11</td>
</tr>
</tbody>
</table>

* Plane azimuth has been computed by the 2 H.O. formula neglecting the second term.

---

### To Station or Object

<table>
<thead>
<tr>
<th>To Station or Object</th>
<th>GeodeticAzimuth (From Source)</th>
<th>Plane Azimuth (From Source)</th>
<th>Code</th>
</tr>
</thead>
</table>

---

These data obtained from adjustment of Jan 1979

These data should be used for all surveys after Dec 1975

Leveling by CGS

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SN 170
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

0 191552 STATION 1003
HAWAII
LATTITUDE 19° 00’ TO 19° 30’
LONGITUDE 155° 00’ TO 155° 30’
DIAGRAM NE 5-1-5 HAWAII

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: AA
STATE: HAWAII
YEAR: 1920
THIRD ORDER

SOURCE: G-SP156

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>SIGN &amp; S. X, Y, Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>51D1</td>
<td>558,716.24</td>
<td>155,788.02</td>
<td>+ 0 03 24</td>
<td></td>
</tr>
</tbody>
</table>

*PLANE AZIMUTH HAS BEEN COMPUTED BY THE FORMULA SELECTING THE SECOND TERM

DATA OF STATION: AA
EXPLANATION AND NOTE

AA (Hawaii island, United States Geological Survey, 1920).—In southeast Hawaii, 3/4 miles southwest of Halemaumau, and 1 1/2 miles southeast of Kau road, in the highest part of an old sand-covered ridge of "aa" lava. Mark, a bronze tablet set in solid rock on top of a rock mound.

RECOVERY NOTE, TRIANGULATION STATION

STATE: HAWAII
YEAR: 1920
COUNTY: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: Island, Hawaii

Detailed description as to the forces of the original description, including marks found, extraneous changes made, and other pertinent facts:

Station mark was recovered in good condition. A complete description follows:

Station is located about 3 1/4 miles southwest of Halemaumau Crater, 5 1/2 miles southwest of Kilauea Military Camp, 1 1/2 miles southeast of State Highway II, and 1 1/2 miles southeast of Kau Road, at 3149 feet elevation, on a low, flat, sandy hill with lava outcrops, that is the highest point in the vicinity. It is on a rock mound that is the highest point of the hill.

To reach station from the Hawaii Volcanoes National Park Headquarters, go west on the Crater Rim Road for 1.8 miles; turn right and go 0.1 mile to State Highway II; turn left and go southwest on State Highway II for 4.5 miles to end of truck travel at power-line pole 66 and telephone pole 705 on the left. Walk southeast across rough lava land about 1 1/2 miles to station.

Station mark is a U.S.G.S. disk, stamped "AA", cemented in a drill hole in top of rock mound. It is about 100 feet southeast of a smooth, brown, lava dome which is the only smooth lava formation on the hill.
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

AHUA KAMOKUKOLAU (Hawaii Island, United States Geological Survey, 1920).—
In southeast Hawaii, 2 ½ miles southeast of Halemaunau, on top of a small sand-
covered knob of "pahoehoe" lava. Mark, a bronze tablet cemented in solid rock.

RECOVERY NOTE, TRIANGULATION STATION:

NAME OF STATION: AHUA KAMOKUKOLAU
ESTABLISHED BY: U.S.G.S.
YEAR: 1920
STATE: Hawaii
BENCHMARK ALSO
RECOVERED BY: D.M. Whipp
YEAR: 1967
COUNTY: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: Island: Hawaii

In addition to the terms of the original description, including marks found, access etc., changes made, and other pertinent factors:

Station mark was recovered in good condition. A complete description follows:
Station is located about 3-1/2 miles southeast of the Hawaii Volcanoes
National Park Headquarters and 2 miles southeast of Halemaunau Crater,
at 3557 feet elevation, on a rounded knob that is noticeably higher than
the surrounding area.

To reach station from the Park Headquarters, go west and southeast on
Crater Rim Road for 4.8 miles to dirt right fork. Take right fork and go
0.5 mile to quarry on left; continue ahead for 0.9 mile to start of low
ridge on right. Continue on track road, southeast up over a low rise,
and go 0.7 mile; bear left and pick way cross-country about 0.4 mile to
station. NOTE: 4-wheel-drive vehicle is required.

Station mark is a U.S.G.S. disk, unstamped, cemented in a drill hole
in bedrock that projects 6 inches. It is about 150 yards south of a very
large, east-west crack and 3 feet northwest of a cairn.

A new U.S.G.S. disk, stamped "HY0 116", has been set in bedrock, 11.7
feet from station mark, in azimuth 355°.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: AHUA KAMOKUKOLAU
STATE: HAWAII
YEAR: 1920
THIRD ORDER

SOURCE: G-5156

DESCRIPTIVE LATITUDE: 15° 22' 56.874"
DESCRIPTIVE LONGITUDE: 155° 16' 07.985"
ELEVATION: 1064.11 METERS
3556.7 FEET

STATE & ZONE CODE X Y C1
MI 1 5101 579,652.27 199,462.53 + 0.04 36

* PLANE ADBIORT HAS BEEN COMPUTED BY THE 3 DHt FORMULA NEGLECTING THE SECOND TERN.

TO STATION OR OBJECT GEODETIC ADBIORT PLAN Nb ADBIORT

DESCRIPTIVE ADBIORT

3 9 6

CODA 50 299
**HORIZONTAL CONTROL DATA**

**TRIANGULATION STATION**

**NAME OF STATION:** AIII USGS 2

**ESTABLISHED BY:** L.A. Grifflon  YEAR: 1977

**STATE:** Hawaii  **COUNTY:** Hawaii

**AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:** 12 miles south of Hilo

**HEIGHT OF TELESCOPE ABOVE STATION MARK (FT):** 0

**HEIGHT OF LIGHT ABOVE STATION MARK (FT):** 0

**DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION:**

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FULANI 1971</td>
<td>S</td>
<td>70.04</td>
<td>21.36</td>
</tr>
<tr>
<td>M1 1'</td>
<td>S</td>
<td>80.36</td>
<td>24.93</td>
</tr>
</tbody>
</table>

The station is located on the southwest slope of Ailani Loa in the Huna District, about 10 miles southwest of Mountain View, & miles east of Volcano Post Office, in the AIII Subdivision and on the north side of Haikana Street, on a small lava outlier.

To reach the station from the post office in Mountain View, go southwest along State Highway 31 for 9.6 miles to paved road left (AIII Road Street) turn left and go east 0.35 mile to crossroad. Turn right and go southeast along Haikana Street 0.15 mile to a small lava outlier on the right and the station site.

The station is a USGS disk stamped "AIII 1961", cemented in a drill hole in pahoehoe lava rock, 27 feet north of the centerline of the street and about 5 feet higher.

Reference mark 1 is a USGS reference mark disk stamped "NO. 1 1961", cemented in a drill hole in pahoehoe lava rock, 27 feet east of the centerline of the street and 5 feet lower than the station mark.

Reference mark 2 is a USGS reference mark disk stamped "NO. 2 1961", cemented in a drill hole in pahoehoe lava rock, 29 feet east of the centerline of the street and 5 feet lower than the station mark.

**ADJUSTED HORIZONTAL CONTROL DATA**

**NAME OF STATION:** AIII USGS

**STATE:** Hawaii  **YEAR:** 1977

**SOURCE:** U.S. Geological Survey

| GEODETIC LATITUDE: | 19 S 5W 234117 |
| GEODETIC LONGITUDE: | 195 42 04 49N756 |
| ELEVATION: | 968.1 Meters |
| DOWNS BY: | NGS |

**STATE COORDINATES (FT):**

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI L</td>
<td>3411</td>
<td>695,006,10</td>
<td>223,036,57</td>
</tr>
</tbody>
</table>

**PLANE AZIMUTH HAS BEEN COMPUTED BY THE FORMULA NEGLECTING THE SECOND TERM.**

<table>
<thead>
<tr>
<th>TO STATION OR OBJECT</th>
<th>GEODETIC AZIMUTH (FROM STATION)</th>
<th>PLANE AZIMUTH* (FROM STATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIIA 1765</td>
<td>123 52 45.1</td>
<td>123 52 46.1</td>
</tr>
</tbody>
</table>

Additional notes:
- The station should be surveyed at the end of the survey.
- The survey should be reviewed by the surveyor.
- The survey should be reviewed by the surveyor.

**NOAA FORM 70-90**

- SUPERFERRIS CLASS SURVEY WHICH MAY BE USED.
- SURVEYED AT THE END OF THE SURVEY.

**NOAA FORM 70-95**

- OBSERVED AT THE END OF THE SURVEY.
HORIZONTAL CONTROL DATA
by the
National Ocean Survey
OLD HAWAIIAN DATUM

TRAVERSAL NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEANIC SURVEY NATIONAL DEGREE SURVEY

NAME OF STATION: BENCH MARK 1855 USGS
STATE: HAWAII
COUNTY: HAWAII
BOSS NO.: 155
GRADE OF PARTY: L. A. Critchlow
YEAR: 1977
DESCRIPTED BY: L. A. C.

NOTE: HEIGHT OF TELESCOPE ABOVE STATION MARK 1 METER. HEIGHT OF LIGHT ABOVE STATION MARK 1 METER. DISTANCE AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS AND PROBABLE DIRECTIONS OF OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The station is located on a low lava mound about 5 miles northeast of Pahala, about 1/4 mile northwest of State Highway 11, on the northeast side of the old Kilauea volcano. At the road fork.

To reach the station from the junction of State Highway 11 and 265 Road, go northeast on State Highway 11 for 5.4 miles to a side road on the left. Turn left, pass through a gate, and go northeast on a graveled road 0.1 mile to a T-road. Turn right onto the paved road (the old Volcano Road) and go southeast 0.4 mile to the road fork and the station on the right.

The station mark is a USGS disk stamped HAWAII 1855 cemented in a drill hole in a protruding lava rock that is about 9 feet higher than and 67 feet north of the centerline of the road fork and is 22 feet northwest of the centerline of the paved road.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BENCH MARK 1855 USGS
STATE: HAWAII
YEAR: 1977
SECOND ORDER

G-1841

HORIZONTAL LATITUDE: 19° 19' 26.97" E
HORIZONTAL LONGITUDE: 155° 25' 38.44"
ELEVATION: 366.52 METER.

STATE COORDINATES (U.S.

<table>
<thead>
<tr>
<th>STATE &amp; CODE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>X COORD. ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 1</td>
<td>5191</td>
<td>519.736.19</td>
<td>157.867.29</td>
<td>0 01 08</td>
<td></td>
</tr>
</tbody>
</table>

Plane azimuth has been computed by the second order formula neglecting the second term.

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979
LEVELLING BY NGS

S M 015
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

SEE STATION PUII HULANI (105)

HAWAII

LATITUDE 19°06'7" TO 19°30'
LONGITUDE 155°00'7" TO 155°30'

DIAGRAM NE 5.5 HAWAII

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: WAIKIKI MARK 3440 USGS
STATE: HAWAII
YEAR: 1949
SECOND ORDER

OBS BY CGS

ADJUSTMENT BY RG5

NO OBSERVATION CHECK ON THIS POSITION

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>19° 52' 29.2445&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GEODETIC LONGITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>155° 12' 29.42077&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1084.0</td>
</tr>
</tbody>
</table>

| METERS |
| 3438 |

<table>
<thead>
<tr>
<th>HORIZONTAL Criterion:</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE &amp; ZONE</td>
</tr>
<tr>
<td>CODE</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>Y</td>
</tr>
<tr>
<td>Z</td>
</tr>
</tbody>
</table>

| 11 | 341 | 640+156+36 | 190,598+04 | +0 09 49 |

* PLANE ERROR HAS BEEN COMPUTED BY THE 3RD OR 4TH FORMULA NEGLECTING THE SECOND TERM.

<table>
<thead>
<tr>
<th>TO STATION OR OBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEODETIC AZIMUTH (From north)</td>
</tr>
<tr>
<td>PLANE AZIMUTH (From north)</td>
</tr>
<tr>
<td>CODE</td>
</tr>
</tbody>
</table>
HORIZONTAL CONTROL DATA

NAME OF STATION: BENCH MK GS NR KEAKAPULU
STATE: HAWAII
YEAR: 1949
SECOND ORDER

SOURCE: G-9275
NO OBSERVATION CHECK ON THIS POSITION

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE:</th>
<th>19° 22' 49.894''</th>
<th>ELEVATION:</th>
<th>1246.90 METERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEODETIC LONGITUDE: 155° 25' 25.230''</td>
<td></td>
<td></td>
<td>4090.8 FEET</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>N</th>
<th>V</th>
<th>Ï (HR. H1 ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>526,306.33</td>
<td>184,272.47</td>
<td>+ 0.01 31</td>
</tr>
</tbody>
</table>

*PLANE AZIMUTH HAS BEEN COMPUTED BY THE Ï HR. H1 FORMULA NEGLECTING THE SECOND TERM

TO STATION OR OBJECT | GEODETIC AZIMUTH (Plane seconds) | PLANE AZIMUTH* (Plane seconds) | CODE |
|---------------------|----------------------------------|--------------------------------|------|

POSITION DETERMINED BY TRAVERSE FROM STATION KEAKAPULU

QE 267
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM.

NAME OF STATION: BM HVO 80 USGS
ESTABLISHED BY: L.A. Critchlow 1976
STATE: Hawaii
COUNTY: Hawaii
BENCHMARK ALSO BM

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN. 8 miles southwest of Kalapana Village.
HEIGHT OF TELESCOPE ABOVE STATION MARK 4.5 FEET.
HEIGHT OF LIGHT ABOVE STATION MARK 4.5 FEET.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE TO OBJECT</th>
<th>FEET</th>
<th>METERS</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LACAPUKI 1981</td>
<td>3,302.49</td>
<td>1006.601</td>
<td>00</td>
<td>06.0</td>
</tr>
<tr>
<td>KAUPA PT USGS</td>
<td>3,003.77</td>
<td>915.416</td>
<td>170</td>
<td>22</td>
</tr>
</tbody>
</table>

The station is located about 8 miles southwest of Kalapana Village and is on the Volcanic National Park.

To reach the station, the two churches at Kalapana Village, go southwest on State Highway 133 for 2.8 miles to a guardrail at the end of the state highway. Continue southwest on the paved road for 4.7 miles to station LACAPUKI turn-off; continue southwest on the paved road for 0.55 mile to the station on the right.

The station mark is a USGS disk emplaced HVO 00 1965, set atop a concrete base. The base is 3 feet above the surface of the ground. It is 20 feet northwest of the center of the paved road. 4 feet southeast of a 2 foot cairn, 11 feet southeast of the southeast edge of an 8 foot high lava mound and is about 1 foot higher than the paved road.

STATE COORDINATES (Foot)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>2 MAJ OR. 4TH ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>636,449</td>
<td>35</td>
<td>169,343</td>
</tr>
</tbody>
</table>

* Plane azimuth has been computed by the 2 MAJ OR. 4TH FORMULA.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BM HVO 80 USGS
STATE: Hawaii
YEAR: 1976
SECOND ORDER

SOURCE: G-16241

<table>
<thead>
<tr>
<th>ORIGINATING LATITUDE</th>
<th>19 17 37 380 01</th>
<th>ELEVATION</th>
<th>19.29</th>
<th>METERS</th>
<th>63.3</th>
<th>FEET</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>HOLE/DRILL PEND.</th>
<th>TO STATION OR DEPTY</th>
<th>OROSCIC ADJUST. (Foot)</th>
<th>PLANE ADJ. (Foot)</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAUPUKI</td>
<td>247 59 47.5</td>
<td>247 51 50</td>
<td>5101</td>
<td></td>
</tr>
</tbody>
</table>

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979
LEVELING BY NGS

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY + NATIONAL GEODETIC SURVEY

NAME OF STATION: BM HVO 80 USGS
ESTABLISHED BY: L.A. Critchlow 1976
STATE: Hawaii
COUNTY: Hawaii
BENCHMARK ALSO BM

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN. 8 miles southwest of Kalapana Village.
HEIGHT OF TELESCOPE ABOVE STATION MARK 4.5 FEET.
HEIGHT OF LIGHT ABOVE STATION MARK 4.5 FEET.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE TO OBJECT</th>
<th>FEET</th>
<th>METERS</th>
<th>DIRECTION</th>
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<td>3,003.77</td>
<td>915.416</td>
<td>170</td>
<td>22</td>
</tr>
</tbody>
</table>

The station is located about 8 miles southwest of Kalapana Village and is on the Volcanic National Park.

To reach the station, the two churches at Kalapana Village, go southwest on State Highway 133 for 2.8 miles to a guardrail at the end of the state highway. Continue southwest on the paved road for 4.7 miles to station LACAPUKI turn-off; continue southwest on the paved road for 0.55 mile to the station on the right.

The station mark is a USGS disk emplaced HVO 00 1965, set atop a concrete base. The base is 3 feet above the surface of the ground. It is 20 feet northwest of the center of the paved road. 4 feet southeast of a 2 foot cairn, 11 feet southeast of the southeast edge of an 8 foot high lava mound and is about 1 foot higher than the paved road.

STATE COORDINATES (Foot)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>2 MAJ OR. 4TH ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>636,449</td>
<td>35</td>
<td>169,343</td>
</tr>
</tbody>
</table>

* Plane azimuth has been computed by the 2 MAJ OR. 4TH FORMULA.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BM HVO 80 USGS
STATE: Hawaii
YEAR: 1976
SECOND ORDER

SOURCE: G-16241

<table>
<thead>
<tr>
<th>ORIGINATING LATITUDE</th>
<th>19 17 37 380 01</th>
<th>ELEVATION</th>
<th>19.29</th>
<th>METERS</th>
<th>63.3</th>
<th>FEET</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>HOLE/DRILL PEND.</th>
<th>TO STATION OR DEPTY</th>
<th>OROSCIC ADJUST. (Foot)</th>
<th>PLANE ADJ. (Foot)</th>
<th>CODE</th>
</tr>
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<tbody>
<tr>
<td>LAUPUKI</td>
<td>247 59 47.5</td>
<td>247 51 50</td>
<td>5101</td>
<td></td>
</tr>
</tbody>
</table>

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979
LEVELING BY NGS

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY + NATIONAL GEODETIC SURVEY

NAME OF STATION: BM HVO 80 USGS
ESTABLISHED BY: L.A. Critchlow 1976
STATE: Hawaii
COUNTY: Hawaii
BENCHMARK ALSO BM

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN. 8 miles southwest of Kalapana Village.
HEIGHT OF TELESCOPE ABOVE STATION MARK 4.5 FEET.
HEIGHT OF LIGHT ABOVE STATION MARK 4.5 FEET.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE TO OBJECT</th>
<th>FEET</th>
<th>METERS</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LACAPUKI 1981</td>
<td>3,302.49</td>
<td>1006.601</td>
<td>00</td>
<td>06.0</td>
</tr>
<tr>
<td>KAUPA PT USGS</td>
<td>3,003.77</td>
<td>915.416</td>
<td>170</td>
<td>22</td>
</tr>
</tbody>
</table>

The station is located about 8 miles southwest of Kalapana Village and is on the Volcanic National Park.

To reach the station, the two churches at Kalapana Village, go southwest on State Highway 133 for 2.8 miles to a guardrail at the end of the state highway. Continue southwest on the paved road for 4.7 miles to station LACAPUKI turn-off; continue southwest on the paved road for 0.55 mile to the station on the right.

The station mark is a USGS disk emplaced HVO 00 1965, set atop a concrete base. The base is 3 feet above the surface of the ground. It is 20 feet northwest of the center of the paved road. 4 feet southeast of a 2 foot cairn, 11 feet southeast of the southeast edge of an 8 foot high lava mound and is about 1 foot higher than the paved road.

STATE COORDINATES (Foot)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>2 MAJ OR. 4TH ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>636,449</td>
<td>35</td>
<td>169,343</td>
</tr>
</tbody>
</table>

* Plane azimuth has been computed by the 2 MAJ OR. 4TH FORMULA.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BM HVO 80 USGS
STATE: Hawaii
YEAR: 1976
SECOND ORDER

SOURCE: G-16241

<table>
<thead>
<tr>
<th>ORIGINATING LATITUDE</th>
<th>19 17 37 380 01</th>
<th>ELEVATION</th>
<th>19.29</th>
<th>METERS</th>
<th>63.3</th>
<th>FEET</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>HOLE/DRILL PEND.</th>
<th>TO STATION OR DEPTY</th>
<th>OROSCIC ADJUST. (Foot)</th>
<th>PLANE ADJ. (Foot)</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAUPUKI</td>
<td>247 59 47.5</td>
<td>247 51 50</td>
<td>5101</td>
<td></td>
</tr>
</tbody>
</table>
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

STATION 1010
HAWAII
LATITUDE 15° 00' TO 15° 30'
LONGITUDE 155° 00' TO 155° 30'

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BENCH MK NA PUU HULUMULU
STATE: HAWAII
YEAR: 1944
SECOND ORDER

NO OBSERVATION CHECK ON THIS POSITION

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE</th>
<th>GEODETIC LONGITUDE</th>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>15° 22' 28.214&quot;</td>
<td>159° 12' 29.428&quot;</td>
<td>1048.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATE COORDINATES (x,y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>HI 1</td>
</tr>
</tbody>
</table>

"PLANE AZIMUTH HAS BEEN COMPUTED BY THE ∆ x ∆ y FORMULA NEGLECTING THE SECOND TERMS.

POSITION DETERMINED BY TRAVERSE FROM STATION PUU HULUMULU
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OHD HAWAIIAN DATUM

HAWAII
LATITUDE 15° 00' TO 19° 30'
LONGITUDE 156° 00' TO 159° 30'

STATION 1011

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: BENCH MARK USGS NR OHALE
STATE: HAWAII
YEAR: 1949
SECOND ORDER

SOURCE: G-9279
NO OBSERVATION CHECK ON THIS POSITION

GEODETIC LATITUDE: 19° 21' 13.79"
GEODETIC LONGITUDE: 155° 16' 45.311'
ELEVATION: 1010.1 METERS

STATE COORDINATE (m)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>2° OR 2&quot; ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>576,092.16</td>
<td>184,059.82</td>
<td>+ 3 04' 25&quot;</td>
</tr>
</tbody>
</table>

*PLANE DISTANCE HAS BEEN COMPUTED BY THE 2° OR 2" FORMULA NEGLECTING THE SECOND TERM

TO STATION OR OBJECT

<table>
<thead>
<tr>
<th>GEOGRAPHIC LATITUDE (FROM SOUTH)</th>
<th>GEOGRAPHIC LONGITUDE (FROM WEST)</th>
<th>PLANE DISTANCE (FROM STATION)</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

POSITION DETERMINED BY TRAVERSE FROM STATION OHALE

QE 266
**Cone Peak (Hawaii Island, United States Geological Survey, 1920)**—In southeast Hawaii, 4 miles southwest of Volcano House, on highest point of rock ridge. Old mark of iron spike driven in lava rock replaced by bronze tablet stamped “5853”, and covered by mound of rock.

**RECOVERY NOTE, TRIANGULATION STATION**

- **NAME OF STATION:** Cone Peak
- **ESTABLISHED BY:** U.S.G.S.
- **YEAR:** 1920
- **STATE:** Hawaii
- **COUNTY:** Hawaii
- **RECOVERED BY:** E.M. Whipp
- **YEAR:** 1967
- **COUNTRY:** Hawaii

Station was recovered in good condition. A complete description follows:

Station is located in the Hawaii Volcanoes National Park, about 4 miles southwest of the Park Headquarters Building, 1.1 miles southwest of the Crater Rim Road, and 1700 feet southeast of the Kau Desert Trail, at about 365 feet elevation, on the highest point of the rocky rim around some old volcanic cones.

To reach station from the Hawaii Volcanoes National Park Headquarters Building, go west and southwest on the Crater Rim Road for 3.7 miles to end of truck travel where the Crater Rim Road reaches its westernmost point before turning back to southeast. Walk northwest about 100 yards to top of low ridge and the Kau Desert Trail. Go left, southwest, on the well-marked trail for about 1/4 mile, then leave trail and go southeast, across lava area, to station.

Station mark is a U.S. Geological Survey disk stamped “CONE PEAK”, cemented in a drill hole in bedrock.

---

**ADJUSTED HORIZONTAL CONTROL DATA**

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Third</th>
<th>Elevation (meters)</th>
<th>Elevation (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAWAI</td>
<td>1920</td>
<td></td>
<td>1115.33</td>
<td>3652.6</td>
</tr>
</tbody>
</table>

**DIAGRAM**

- **DATE:** 1915-52
- **STATION 1012**
- **HAWAI**
- **LATITUDE:** 19° 00' to 19° 30'
- **LONGITUDE:** 155° 00' to 155° 30'
- **DIAGRAM:** NE 5:1.5 HAWAI

**SOURCE:** 5-SP156

**ADJACENT MOUNTAIN PEAKS**

- HI 1
  - **CODE:** 5101
  - **X:** 565,602.10
  - **Y:** 203,640.66
  - **Z:** 0.0548

**ELEVATION**

- **STATE COORDINATE DATA**
  - **STATE & ZONE:** HI 1
  - **CODE:** 5101
  - **X:** 565,602.10
  - **Y:** 203,640.66
  - **Z:** 0.0548

**PLANE AZIMUTH**

- **THIRD ORDER**
  - **TO STATION OF SURVEY**
    - **PLANE AZIMUTH:**
      - **PLANE AZIMUTH:**
  - **CODE:** Q3 304
Cracks (Hawaii Island, United States Geological Survey, 1930).—In southeast Hawaii, ¾ mile southwest of Halemaumau, beside the largest of the volcanic cracks extending southwest from the rim of the crater. Mark, a bronze tablet in the top of a large boulder standing about 18 inches above ground.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: CRACKS
ESTABLISHED BY: U.S.G.S. YEAR: 1920 STATE: Hawaii SOURCE MARKED: No
RECOVERED BY: B.H. Whipp YEAR: 1967 COUNTY: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: Island: Hawaii

Detailed measurements as to the sources of the original description, relative marks found, overprints, corrections, and other pertinent facts:

Station was recovered in good condition. A complete description follows:

Station is located in the Hawaii Volcanoes National Park, about 3 miles southwest of the Park Headquarters Building, 3/4-mile southwest of Halemaumau Crater, and 1200 feet southwest of the Crater Rim Road, at about 3724 feet elevation, along the southeast side of the largest of the cracks extending southwest from the crater.

To reach station from the Hawaii Volcanoes National Park Headquarters Building, go west and southwest on the Crater Rim Road for 4.2 miles to sign "SOUTHWEST RIFT OF KILAUEA", and small, gravelled parking area on left. From here walk southwest along left side of large crack for 1200 feet to station.

Station mark is a U.S. Geological Survey disk, stamped "CRACKS", cemented in a drill hole in the top of a brown, pyramidal rock projecting 18 inches from ground. It is 10 yards southeast of the large crack, 19 yards northwest of a smaller crack, and in a bare brown area.
**HORIZONTAL CONTROL DATA**

**ADJUSTED HORIZONTAL CONTROL DATA**

**NAME OF STATION:** HVU 110 USGS  
**STATE:** HAWAII  
**YEAR:** 1977  
**SECOND ORDER**

**SOURCE:** J-16241

<table>
<thead>
<tr>
<th>GEOGRAPHIC LATITUDE</th>
<th>19° 17' 24.3183&quot;</th>
<th>1644 METERS</th>
<th>SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOGRAPHIC LONGITUDE</td>
<td>155° 17' 24.4307&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATE &amp; CODE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>V</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5131</td>
<td>572,506.07</td>
<td>214,579.68</td>
<td>+ 0.04 12</td>
<td></td>
</tr>
</tbody>
</table>

*Plane azimuth has been computed by the J.L.M.G. 2. formula neglecting the second term.*

** THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979**
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

AUG 1979
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY • NATIONAL HYDROLOGIC SURVEY

HAWAII, TRIANGULATION STATION

NAME OF STATION: HVO 117 USGS
ESTABLISHED BY: L.A. Crater Year: 1977 STATE: Hawaii
COUNTY: Hawaii MARK ALSO

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:

HEIGHT OF TELESCOPE ABOVE STATION MARK: 9 FEET.
HEIGHT OF GROUND ABOVE STATION MARK: 4 FEET.

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUPAHUA NOS 1096</td>
<td>S 1' 4&quot;</td>
<td>29.96</td>
<td>9.126</td>
</tr>
<tr>
<td>H'S 1</td>
<td>S 1' 4&quot;</td>
<td>129.99</td>
<td>39.07</td>
</tr>
<tr>
<td>SAND HILL USGS</td>
<td>E 2' 8&quot;</td>
<td>3.20</td>
<td>1.157</td>
</tr>
<tr>
<td>H'S 1</td>
<td>E 2' 8&quot;</td>
<td>55.25</td>
<td>10.380</td>
</tr>
<tr>
<td>NW 1 to s 2'</td>
<td>E 2' 8&quot;</td>
<td>58.69</td>
<td>17.822</td>
</tr>
</tbody>
</table>

The station is located about 2 miles south of the Hawaii Volcano Observatory, 1/2 mile south of the south rim of the Mauna Kea Crater and on property owned by the Hawaii Volcanoes National Park.

To reach the station from the entrance to the Hawaii Volcano Observatory, which is on the west rim of Mauna Kea Crater, go south and exist on a surfaced road for 2.05 miles to a truck road right at a highway curve sign. Turn right and go south-southwest on the truck road for about 0.25 mile to a truck road right. Turn right and continue southeast on the truck road for 0.25 mile to the top of a ridge and station as described.

Station marks, stamped HVO 117, is a USGS Bench Mark disk set in an irregular mass of concrete about 2 by 3 feet in size and projects about 3 inches above the ground surface. It is 5 feet northeast of a rock cairn and a metal post driven into the ground. (Note des.)

Reference Mark 1, stamped HVO 117 NO 1 1977, is a NOS reference mark disk cemented in a drill hole in a boulder which has an exposed surface about 12 by 16 inches and is flush with the ground surface. It is 32.5 feet east-southeast of the rock cairn and metal post. (Note des.)

Reference Mark 2, stamped HVO 117 NO 2 1977, is a NOS reference mark disk cemented in a drill hole in a boulder which has an exposed surface about 14 by 18 inches and projects about 2 inches above the ground surface. It is 36 feet north of the rock cairn and metal post. (Note des.)

SAND HILL, stamped HAWAII SAND HILL, is a USGS Bench Mark disk set in an irregular mass of concrete which is about 1 foot in diameter and about 3 inches below the ground surface. It is 2 feet north of the rock cairn and metal post. (Note des.)

*Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

NOAA FORM 79-20 SUPERSEDES FORM NO. 360-1 WHICH MAY BE USED.

3W 051

STATE COORDINATES (Ft)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>E-W-D-D-ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>101</td>
<td>570.91661</td>
<td>204.34560</td>
<td>0006.6666</td>
</tr>
</tbody>
</table>

THESE DATA USTABILITY FROM ADJUSTMENT OF JAN 1979

STATE OF HAWAII

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: HVO 117 USGS

STATE: Hawaii
YEAR: 1977
SECOND: CR

NOAA FORM 79-31
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: HVO 120 USGS
STATE: HAWII
YEAR: 1977
FIRST ORDER

SOURCE: v-16241

GEODETIC LATITUDE 19° 38' 14.27"N
GEODETIC LONGITUDE 155° 22' 26.37"W
ELEVATION: 803.4 METERS

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>N</th>
<th>H</th>
<th># OR 4. X SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>0101</td>
<td>543.149429</td>
<td>170.927.84</td>
<td>+ 0.0230</td>
</tr>
</tbody>
</table>

* PLANES ADJUSTMENT HAS BEEN COMPUTED BY THE 2 OR 4 X FORMULA NEGLECTING THE SECOND TERM.

<table>
<thead>
<tr>
<th>STATION OR OBJECT</th>
<th>GEODETIC AZIMUTH</th>
<th>PLANES AZIMUTH</th>
<th>CODE</th>
</tr>
</thead>
</table>

DATA OBTAINED FROM ADJUSTMENT OF JAN 1979

SM 052
# Horizontal Control Data

**Triangulation Station**

**Name of Station:** PANU PT US&S

**Established by:** L.A. Critchlow

**Year:** 1977

**State:** Hawaii

**County:** Hawaii

**Airline Distance and Direction from Nearest Town:** 11 miles southwest of Pahala

**Height of Telescope above Station Mark:** 4 feet

**Height of Light above Station Mark:** 4 feet

### Distances and Directions to Azimuth Mark, Reference Marks, and Prominent Objects which can be seen from the Station:

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANU 101</td>
<td>N 120° 00' 00&quot;</td>
<td>5037.31</td>
<td>3181.298</td>
</tr>
<tr>
<td>101-2</td>
<td>N 120° 00' 00&quot;</td>
<td>5037.31</td>
<td>3181.298</td>
</tr>
<tr>
<td>RM 1 to RM 2</td>
<td></td>
<td>75.82</td>
<td>23.112</td>
</tr>
</tbody>
</table>

The station is located about 71 miles east-northeast of Pahala, 15 miles southeast of Volcano, 11 miles southwest of Pahala, 1 mile north-northeast of Kama Point, 200 yards south of State Highway 13 at curve, 250 yards north of the coastline, and on a small pahoehoe lava mound.

To reach the station from the junction of State Highways 13 and 37 at the east edge of Pahoa, go southeasterly on Highway 13 for 9.1 miles to road end. Take the right fork and continue southeasterly on Highway 13 for 5.5 miles to Volcano National Park Headquarters. Continue southeasterly on Highway 13 for 7.3 miles to a right hand curve. Pack south across pahoehoe lava to the station site. A four wheel drive vehicle can be driven to the station site.

The station mark is a UDS disk stamped, "PANU PT 1962", cemented in a drill hole in the top of a mound of pahoehoe lava.

Reference mark 1, stamped "NO. 1 1962", is a UDS disk cemented in a drill hole in pahoehoe lava about four feet lower than the station.

Reference mark 2, stamped "NO. 2 1962", is a UDS disk cemented in a drill hole in pahoehoe lava about three feet lower than the station.

This station is located on National Park property.

---

**Data Adjustments**

**Name of Station:** KALUA POINT US&S

**State:** Hawaii

**Year:** 1977

**Latitude:** 19° 52' 39.8" N

**Longitude:** 155° 01' 49.5" W

**Elevation:** 23.9 meters

**State Coordinates (Hawaii):**

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z (U.M. = ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>529,574,33</td>
<td>163,861,40</td>
<td>+ 0 07 27</td>
</tr>
</tbody>
</table>

**Plane Azimuth:**

<table>
<thead>
<tr>
<th>To Station or Object</th>
<th>Geographic Azimuth (true angle)</th>
<th>Plane Azimuth</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANU 101</td>
<td>201° 01' 36.2&quot;</td>
<td>101° 03' 18&quot;</td>
<td>5101</td>
</tr>
</tbody>
</table>

These data obtained from adjustment of Jan 1979
ADJUSTED HORIZONTAL CONTROL DATA

**NAME OF STATION**: KAMAKAIA

**STATE**: HAWAII

**YEAR**: 1857

**SOURCE**: G-SP150

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE</th>
<th>GEODETIC LONGITUDE</th>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 10 15.354</td>
<td>155 22 20.823</td>
<td></td>
</tr>
</tbody>
</table>

**STATE COORDINATES (U.S.)**

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>X HORIZ. IN MILL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>543,404.93</td>
<td>171,027.05</td>
<td>+ 0.02 30</td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE 2-TH. ORDER FORMULA NEGLECTING THE SECOND TERM.

**TO STATION OR OBJECT**

<table>
<thead>
<tr>
<th>GEODETIC AZIMUTH (From North)</th>
<th>PLANAR AZIMUTH (From North)</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STATION 101B**

**HAWAII**

**LATITUDE**: 19° 00' to 19° 30'

**LONGITUDE**: 155° 00' to 155° 30'

**DIAGRAM**: HE 5-13 HAWAII

**OLD HAWAIIAN DATUM**
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

AVANCED HORIZONTAL CONTROL DATA

NAME OF STATION KAMAKAIA HFS
STATE HAWAII YEAR 1949

ADJUSTMENT BY NO3 OBS BY CGS

STATE COORDINATES (Ft)

STATION OR OBJECT GEOID LATITUDE Plane Altitude

KAMAKAIA 148° 47' 03.9" 193° 46' 40.0" 5101

34 073

NOTE: The information was obtained from the original station and was transferred to this form by the U.S. Geological Survey.

REFERENCE MARK NO 1 IS A STANDARD DISK, STAMPED KAMAKAIA NO 1 1949, SET INTO A HOLE IN THE SURFACE OF THE STATION.

REFERENCE MARK NO 2 IS A STANDARD DISK, STAMPED KAMAKAIA NO 2 1949, SET INTO A HOLE IN THE SURFACE OF THE STATION.

(continued on next page)
# HORIZONTAL CONTROL DATA

**by the**

**NATIONAL GEODETIC SURVEY**

**OLD HAWAIIAN DATUM**

---

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION:** KAMAKAIA (HTS)  
**ESTABLISHED BY:** L.C. Wilder  
**RECOVERY BY:** D.W. Whipp  
**YEAR:** 1949  
**STATE:** Hawaii  
**COUNTY:** Hawaii  
**HEIGHT OF TELESCOPE ABOVE STATION MARK:** 1.65 METER  
**HEIGHT OF LIGHT ABOVE STATION MARK:** 1.65 METER  

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEANING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOAE (HTS)</td>
<td></td>
<td>1.495</td>
<td></td>
</tr>
<tr>
<td>RM No. 1</td>
<td></td>
<td></td>
<td>E 18.266</td>
</tr>
<tr>
<td>RM No. 2</td>
<td></td>
<td></td>
<td>NW 35.056</td>
</tr>
<tr>
<td>KOAE (HTS)</td>
<td></td>
<td>1.494</td>
<td></td>
</tr>
<tr>
<td>RM No. 1</td>
<td></td>
<td></td>
<td>E 18.276</td>
</tr>
</tbody>
</table>
| RM No. 2    |                   |          | NW 34.917  

Station was recovered and all marks found in good condition. Discrepancies were noted in the distances to reference marks; they were checked and the 1967 distances are correct. A complete description follows:

Station was located about 11 miles southwest of the Hawaii volcanoes National Park Headquarters, 10 miles northeast of Pahala, 2-3/4 miles southwest of State Highway 11, and 1/2 mile southeast of the Kau Desert Trail, in the Kamakaia Hills on the west side of the town and 1/2 mile southwest of the town. A difference was noted in distance and direction to reference marks 1 and 2. The distance was revised to the 1967 data and the direction was corrected to the 1967 data. The difference to reference mark 1 with 0.756 meters longer and 17 degrees, 62 seconds. The difference to reference mark 2 with 0.017 meters longer and 0.4 minutes, 25 seconds.

The station was checked by helicopter at this time and except for the following changes were worked as described in 1967:

Reference mark number one is a standard disk stamped "KAMAKAIA RM NO 1 1949", cemented in a hole in a bedrock on southeast point of hilltop, 2 feet lower than station mark.

Reference mark number two is a standard disk stamped "KAMAKAIA RM NO 2 1949", cemented in a hole in an outcrop of bedrock 2 feet in diameter and projecting 1 foot above ground. It is 3.3 feet lower than station mark.
Kamakaia S. (Hawaii Island, E. R. Hand, 1914).—In southeastern part of Hawaii, about midway between the volcano of Kilauea and Puu Ulaula, the most southern of two hills, equal in size and height. A large cairn surmounts the hill. These hills are seen on the skyline from Honuapo Landing.
**HORIZONTAL CONTROL DATA**

**NAME OF STATION:** KAMAKAMA (HTS)

**STATE:** HAWAII

**YEAR:** 1949

**SECOND ORDER**

**SOURCE:** G-9275

**GEODETIC LATITUDE:** 15° 15' 50.987

**GEODETIC LONGITUDE:** 155° 27' 56.133

**ELEVATION:** 589.5 ft

---

**STATE COORDINATES (FED):**

| STATE & ZONE | CODE | X   | Y   | Z (ft) | E N W M H | UNITS | REVERSE
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5131</td>
<td>511,867.21</td>
<td>134,432.28</td>
<td>0.00 41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**PLANE AZIMUTH HAS BEEN COMPUTED BY THE E = D x N FORMULA neglecting the second term**

---

**TO STATION OR OBJECT**

**GEODETIC AZIMUTH (FED):**

**PLANE AZIMUTH:**

**CODE**

---

**KAPAPALOA**

---

(continued on next page)
HORIZONTAL CONTROL DATA

by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

KAMAKAMA (HTS) (continued)

Station mark is the center of a 2-1/4-inch iron pipe in the center of a triangular, concrete platform about 7 feet on each side and projecting 8 inches. A 2-inch steel shaft about 2 feet long is centered vertically over the pipe and supports a red and white metal target 8 feet tall.

Reference mark number one is a standard disk stamped "KAMAKAMA NO 1 1949", cemented in a drill hole in the top of a sloping lava slab about 12 feet long. It is at about same elevation as station platform.

NOTE: A discrepancy in the horizontal distance to the reference mark was noted and checked, and the 1967 distance is correct. It is believed that the 1949 distance is slope distance from top of steel shaft as the present slope distance coincides with it.

KAPAPALA 1969 DISTANCE and DIRECTION---------- 00 00 00.0
R.M. No. 1 NE 24,570 ft. 7,489 m 275 59 52.6

1967 DISTANCE-------------------------
RM No. 1 NE 24,381 ft. 7,432 m

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KAMAKAMA (HTS)
ESTABLISHED BY: L.C. Wilder YEAR: 1949 STATE: Hawaii
RECOVERED BY: J.N. Collon YEAR: 1969 COUNTY: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:

Detailed statement as to the failure of the original description including marks found, anthropic changes made, and other pertinent facts:

Station recovered in good condition. 1967 description adequate.
Kamehame (Hawaiian Island, Hawaiian Government Survey, 1897; E. R. Hand, 1914).—On the southern coast of Hawaii, in southern Kauai, in the land of Moaula, on the summit of the first cinder cone, Kamehame Hill, on the shore east-northeast of Puuahu and distant therefrom 2/3 miles. Originally marked by a triangle cut in the rock. In 1914 a standard bronze disk was set inside this triangle. A cairn at the station is 14 feet through at base and 12 feet high, with terraced sides. It is but 4 or 5 feet from the eroding edge of the cliff. A reference mark was accordingly set in 1914, a very large boulder was placed in a pit on crest of the hill and marked with drill hole and crow's foot; the drill hole is 10.9 meters (36 feet) from the station in azimuth 170° 42.9'. Cairn was whitewashed.

<table>
<thead>
<tr>
<th>DEPARTMENT OF COMMERCE</th>
<th>HORIZONTAL CONTROL DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 191552</td>
<td>STATION 1022</td>
</tr>
<tr>
<td>HANAI</td>
<td>LATITUDE 15° 50' to 15° 51'</td>
</tr>
<tr>
<td>DIAMOND HEAD, HAWAI</td>
<td>LONGITUDE 155° 00' to 155° 01'</td>
</tr>
</tbody>
</table>

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION**: KAMEHAME

**State**: HAWAI

**Established By**: Hawaiian Gov't Survey 1897

**Locality**: Southern Coast of Hawaii

**Recovery By**: E. R. Hand 1929

**Detailed Statement as to the Status of the Original Descriptions**:

Station found as described, except that it is now "about 2 feet from the eroding edge of the cliff".

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION**: KAMEHAME

**Established By**: Hawaiian Gov't Survey 1897

**Recovery By**: E. R. Hand 1929

**Detailed Statement as to the Status of the Original Descriptions**:

The 1914 station was recovered in good condition and the distance to the reference mark was checked. This station was originally established by the Hawaiian Government Survey in 1897 and was marked by a triangle carved into a rock. In 1914 E. R. Hand of the U.S. Coast and Geodetic Survey recovered the original station and set a standard disk in the center of the carved triangle but made note of the fact that the disk was only 4 or 5 feet from the eroding edge of a bluff and in order to preserve the position of this station he established a reference mark in a large boulder. The reference mark is a drill hole and crow's foot and is 10.9 meters from the station disk in azimuth 170° 42.9'. In 1928 the Hawaiian Territory Survey established a new station 91.5 feet northwest of the original station which they named KAMEHAME NW and it was this station which was used in the 1929 survey. The original station is now about 6 inches from the edge of the bluff.

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION**: KAMEHAME

**Established By**: HGS

**Recovery By**: D.M. Whipp 1967

**Airline Distance and Direction from Nearest Tow: Hawaii Island: Hawaii**

**Detailed Statement as to the Status of the Original Descriptions**:

Station is gone. The edge of the bluff has eroded away until it is now about 2 feet beyond where station was located.

<table>
<thead>
<tr>
<th>STATE</th>
<th>HAWAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR</td>
<td>1897</td>
</tr>
</tbody>
</table>

**ADJUSTED HORIZONTAL CONTROL DATA**

**ELEVATION**: 17.0 Meters

**STATE COORDINATES (from)**

| MI 1 | 5101 | 513.789.14 | 114,183.22 | + 00 00 37 |

**STATE 4-ZONE CODE**

14 99 51.978

155 28 07.461

**GEODETIC LATITUDE**: 19° 08' 51.978

**GEODETIC LONGITUDE**: 155° 28' 07.461

**COORDINATES (from)**

<table>
<thead>
<tr>
<th>CODE</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 99 51.978</td>
<td>513.789.14</td>
<td>114,183.22</td>
</tr>
</tbody>
</table>

**PLANE A ZNTH HAS BEEN COMPUTED BY THE FORMULA**

**POSITION DETERMINED BY TRAVERSE FROM STATION KAMEHAME NEW**

**QG 265**
HORIZONTAL CONTROL DATA
by the
NATIONAL GEOIDIC SURVEY
OLD HAWAIIAN DATUM

NAME OF STATION: KAMEHAME HEW HTS
BELONGING TO: KAMASHE WILD & CO.
RECOVERED BY: B.W. WHIP
RECOVERED ON: 1967
HEIGHT OF TELESCOPE ABOVE STATION MARK: 1.0 METER
HEIGHT OF LIGHT ABOVE STATION MARK: 4 FEET

DISTANCES AND DIRECTIONS TO 20 METER MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUNALUU 1949 DISTANCE</td>
<td>12.828</td>
<td>00 00 00.0</td>
</tr>
<tr>
<td>Honuapo Stack SW</td>
<td>7</td>
<td>178 16 21</td>
</tr>
<tr>
<td>PUNALUU 1967 DISTANCE</td>
<td>12.748</td>
<td>00 00 00.0</td>
</tr>
<tr>
<td>Honuapo Hutchinson Sugar Plantation Mill, stack, 1949</td>
<td>318 45 56.8</td>
<td></td>
</tr>
</tbody>
</table>

Station mark and reference mark number one were recovered in good condition. Old station KAMEHAME HEW HTS is gone due to erosion of edge of bluff. A complete description follows:

Station is located along southern coast of the island, about 3-1/2 miles south of Punalu and 2-1/2 miles east-northeast of Punalu, on a hill of about 33 feet elevation that has low brush on it and is easily identified because of it's green color when seen from up on State Highway 11. The hill terminates in a sheer bluff on the south side and overlooks the first black sand beach along the coast eastward from Punalu.

To reach station from the post office in Pahala, go southeast on Pii-kake St. for 0.2 mile; turn right on State Highway 11 and go 0.85 mile; turn right and go southwest on State Highway 11 for 3.8 miles; turn left on the Punalu road and go southeast downgrade for 0.75 mile; turn left onto old railroad grade and go 0.35 mile to end of road at old concrete station, taking less than 2 hours.

Station is near the center of a 2-1/2 inch pipe that projects from square boulder on the ground and is about 11-1/2 feet lower than top of station pipe. NOTE: The reference mark is in the same rock as the "drill hole and crowns foot" reference mark established by E.S. Hand in 1916, and is 8 inches east of that mark.

NOTE - Out of these forms must be used for every station recovered.

* Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SURVEY NATIONAL GEOIDIC SURVEY

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KAMEHAME HEW HTS
BELONGING TO: KAMASHE WILD & CO.
RECOVERED BY: B.W. WHIP
RECOVERED ON: 1967
HEIGHT OF TELESCOPE ABOVE STATION MARK: 1.0 METER
HEIGHT OF LIGHT ABOVE STATION MARK: 4 FEET

DISTANCES AND DIRECTIONS TO 20 METER MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

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<th>DIRECTION</th>
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</thead>
<tbody>
<tr>
<td>PUNALUU 1967 HTS</td>
<td>12.748</td>
<td>00 00 00.0</td>
</tr>
<tr>
<td>Pahala Paau Sugar Co. Stack</td>
<td>318 45 56.8</td>
<td></td>
</tr>
</tbody>
</table>

The station and reference mark 1 were recovered in good condition. The distances and directions measured on the data compare favorably with the 1949 and 1957 measurements. A new reference mark 2 was established. The 1957 recovery note is adequate with the following additions:

To reach the station from the intersection of Pii-kake and Hikina Street, go west on Kamehame Highway 0.4 mile to the intersection of State Highway 11. Turn right and go southeast along Highway 11 for 0.75 mile to mile post 40.25; turn right and go 0.6 mile to Fort. The 1949 and 1957 measurements are correct. The reference mark is in the same rock as the "drill hole and crowns foot" reference mark established by E.S. Hand in 1916, and is 8 inches east of that mark.

NOTE - Out of these forms must be used for every station recovered.

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U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SURVEY NATIONAL GEOIDIC SURVEY

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KAMEHAME HEW HTS
BELONGING TO: KAMASHE WILD & CO.
RECOVERED BY: B.W. WHIP
RECOVERED ON: 1967
HEIGHT OF TELESCOPE ABOVE STATION MARK: 1.0 METER
HEIGHT OF LIGHT ABOVE STATION MARK: 4 FEET

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NOTE - Out of these forms must be used for every station recovered.

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U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SURVEY NATIONAL GEOIDIC SURVEY

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KAMEHAME HEW HTS
BELONGING TO: KAMASHE WILD & CO.
RECOVERED BY: B.W. WHIP
RECOVERED ON: 1967
HEIGHT OF TELESCOPE ABOVE STATION MARK: 1.0 METER
HEIGHT OF LIGHT ABOVE STATION MARK: 4 FEET

DISTANCES AND DIRECTIONS TO 20 METER MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

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<th>DISTANCE</th>
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</thead>
<tbody>
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<td>318 45 56.8</td>
<td></td>
</tr>
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To reach the station from the intersection of Pii-kake and Hikina Street, go west on Kamehame Highway 0.4 mile to the intersection of State Highway 11. Turn right and go southeast along Highway 11 for 0.75 mile to mile post 40.25; turn right and go 0.6 mile to Fort. The 1949 and 1957 measurements are correct. The reference mark is in the same rock as the "drill hole and crowns foot" reference mark established by E.S. Hand in 1916, and is 8 inches east of that mark.

NOTE - Out of these forms must be used for every station recovered.

* Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SURVEY NATIONAL GEOIDIC SURVEY
HORIZONTAL CONTROL DATA
by the
National Ocean Survey
OLD HAWAIIAN DATUM

ADJUSTED HORIZONTAL CONTROL DATA
ADJUSTMENT BY NOS

NAME OF STATION: KAHEHANE HTS
STATE: HAWAII
YEAR: 1949

SOURCE:  G-9279

<table>
<thead>
<tr>
<th>LATTITUDE</th>
<th>LONGITUDE</th>
<th>ELEVATION</th>
<th>METER</th>
<th>FT</th>
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</thead>
<tbody>
<tr>
<td>19° 20' 54.24&quot; N</td>
<td>155° 20' 03.84&quot; W</td>
<td>164.5</td>
<td>543</td>
<td></td>
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</table>

STATE COORDINATES (PPS)

<table>
<thead>
<tr>
<th>STATION PROJECT</th>
<th>GEODETIC AZIMUTH</th>
<th>PLANE AZIMUTH</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJU KIULULA HTS</td>
<td>209° 40' 16.4&quot;</td>
<td>209° 39' 39&quot;</td>
<td>5101</td>
</tr>
</tbody>
</table>

THESE DATA ARE USTAINED FROM ADJUSTMENT OF 1951

NAME OF STATION: KAHEHANE HTS
STATE: HAWAII
YEAR: 1949

STATE: HAWAII
YEAR: 1949

STATE CODE (PPS)

<table>
<thead>
<tr>
<th>STATION PROJECT</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PJU KIULULA HTS</td>
<td>5101</td>
</tr>
</tbody>
</table>

THESE DATA ARE USTAINED FROM ADJUSTMENT OF 1951

(continued on next page)
HORIZONTAL CONTROL DATA

DEPARTMENT OF COMMERCE
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY
NATIONAL GEOFICATION

NAME OF STATION: KAPAPALA
STATE: Hawaii
COUNTY: Hawaii

CHIEF OF PARTY: L. C. Wilder
YEAR: 1949
DESKED BY: C. J. Hoepell
NOTE: HEIGHT OF GEODETIC SURVEY BASE
HEIGHT OF NAVIGATION STATION BASE

DISTANCE AND DIRECTION TO REFERENCE MARKS:

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE FROM STATION</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAPAPALA 2</td>
<td>100 00 00</td>
<td>90 09 10</td>
</tr>
<tr>
<td>KAPAPALA 2</td>
<td>00 90 10</td>
<td>00 00 00</td>
</tr>
<tr>
<td>EOPHIO (NTH)</td>
<td>12.360</td>
<td>00 00 00</td>
</tr>
<tr>
<td>Azimuth mark</td>
<td>340 51 20.0</td>
<td>340 51 20.0</td>
</tr>
</tbody>
</table>

The station is located in rocky pasture land about 5 1/2 miles northeast of Kapalua Point, about 3 miles northeast of Pahala, about 2 1/2 miles south of the Kapapala Range; about 150 yards south of the road which runs between Hilo and Pahala; and on the summit of a low lava mound.

To reach from the post office at Hilo, go northeast on the road which leads toward Hilo, for 10.3 miles; continue straight ahead on the road toward Hilo, for 3.5 miles; cross over a dry wash and continue toward Hilo for 0.4 mile to the end of a graded road at the side of the road. From this point, cross over the wire fence and peak southeasterly for about 150 yards to the station.

The station is a standard disk, stamped KAPAPALA 1949, set into a drill hole in lava bedrock which projects about 5 feet.

Reference mark number 1 is a standard disk, stamped KAPAPALA NO 1 1949, set into a drill hole in lava bedrock which projects about 3 feet and is about the same elevation as the station.

Reference mark number 2 is a standard disk, stamped KAPAPALA NO 2 1949, set into a drill hole in lava bedrock which projects about 3 feet and is about the same elevation as the station.

The azimuth mark is a standard disk, stamped KAPAPALA 1949, set into a drill hole in bedrock which projects about 8 feet. It is located about 500 feet west of the station, 51 feet west of the center line of the highway and 11 feet west of a wire fence.

(continued on next page)
**HORIZONTAL CONTROL DATA**

*by the*

**NATIONAL GEODETIC SURVEY**

**OLD HAWAIIAN DATUM**

**KAPAPALA (continued)**

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION**: KAPAPALA  
**ESTABLISHED BY**: L.C. Wilder  
**YEAR**: 1949  
**STATE**: Hawaii  
**RECOVERED BY**: D.M. Whipp  
**YEAR**: 1967  
**COUNTY**: Hawaii  
**HEIGHT OF TELESCOPE ABOVE STATION MARK**: 1.57 METER  
**HEIGHT OF LIGHT ABOVE STATION MARK**: METER

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEARING</th>
<th>DISTANCE FEET</th>
<th>DISTANCE METER</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puu Ualua (HTS)</td>
<td>NW</td>
<td>40.892</td>
<td>12.686</td>
<td>103 18 41</td>
</tr>
<tr>
<td>Height</td>
<td>W</td>
<td>500</td>
<td>155</td>
<td>25 52 25</td>
</tr>
<tr>
<td>Azimuth mark</td>
<td>NE</td>
<td>204.385</td>
<td>62.437</td>
<td>236 33 25</td>
</tr>
</tbody>
</table>

Station was recovered and all marks found in good condition. A complete description follows:

Station is located about 3 miles north-northeast of Pahala and 2-1/2 miles south of the Kapapala Ranch headquarters, at about 150 feet elevation, on a mound about 8 feet higher than surrounding area, in the bushy land along the southeast side of State Highway II. It is about 150 yards southeast of the highway and pole No. 191, and 200 yards northeast of a highway sign "ELEV. 1500 FT".

To reach station from the post office in Pahala, go south on Pioke St. for 0.2 mile to crossroad. Turn left on State Highway 15 and go 0.5 mile to junction with State Highway II. Turn left and go northeast on State Highway II for 3.1 miles to top of long grade and power pole No. 191 on the right. From here walk southeast about 150 yards to station. Station mark is a standard disk stamped "KAPAPALA 1949", cemented in a drill hole in lava bedrock, 11 feet southeast of a white witness post.

Reference mark number one is a standard disk stamped "KAPAPALA NO 1 1949", cemented in a drill hole in bedrock near the top of a large, sloping bedrock slab on side of mound northeast of station. It is about 8 inches higher than station mark.

Reference mark number two is a standard disk stamped "KAPAPALA NO 2 1949", cemented in a drill hole in bedrock on a ledge extending west from station mound. It is 7 feet lower than station mark.

Azimuth mark is a standard disk stamped "KAPAPALA 1949", cemented in a drill hole in the top of a black lava mound about 7 feet high, along the northwest side of the highway, 11.5 feet northwest of fence line, 41 feet northwest of center line of highway, and 250 feet southwest of power pole No. 191.

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION**: KAPAPALA  
**ESTABLISHED BY**: L.C. Wilder  
**YEAR**: 1949  
**STATE**: Hawaii  
**RECOVERED BY**: A. Critchlow  
**YEAR**: 1977  
**COUNTY**: Hawaii  
**HEIGHT OF TELESCOPE ABOVE STATION MARK**: 4 FEET  
**HEIGHT OF LIGHT ABOVE STATION MARK**: 4 FEET

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEARING</th>
<th>DISTANCE FEET</th>
<th>DISTANCE METER</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puu Ualua (HTS)</td>
<td>NW</td>
<td>40.929</td>
<td>12.697</td>
<td>103 18 41</td>
</tr>
<tr>
<td>Height</td>
<td>W</td>
<td>500</td>
<td>155</td>
<td>25 52 25</td>
</tr>
<tr>
<td>Azimuth mark</td>
<td>NE</td>
<td>204.385</td>
<td>62.437</td>
<td>236 33 25</td>
</tr>
</tbody>
</table>

The station mark, azimuth mark, and reference marks 1 and 2 were recovered in good condition. The directions to the reference marks measured on this date compared favorably with the 1949 and 1967 measurements. The distance to the azimuth mark differed by about 10 seconds from the 1949 and 1967 measurements. The distances to the reference marks measured on this date differed from the 1949 measurements by a small amount but compared favorably with the 1967 measurements. The 1967 recovery note is adequate.

**Office Note**: BM 1855 USGS is BM USGS positioned by NOS in 1977.
HORIZONTAL CONTROL DATA
by the National Ocean Survey
OLD HAWAIIAN DATUM

NAME OF STATION: KAPoho (HTS)
YEAR: 1940
STATE: Hawaii
COUNTY: Hawaii

CHEF OF PARTY: L. C. Wilder

Description: (Sketch of station)
The station is the center of the steel target at triangulation station KAPoho which was established by the Hawaiian Territory Survey.

The station is located about 3 miles north-northeast of Pahala, about 2.5 miles south-southeast of the Kapohana Ranch and just east of a line of trees.

To reach from the post office at Pahala, go easterly for 0.5 miles; turn left and go northeast, on the road which leads toward Kilauea, for 2.2 miles; turn left, pass through a board gate, and follow the old highway, northeasterly for 0.4 mile; turn left, pass through a board gate and go across country, through open pasture land for 0.5 mile in a westerly direction, to the station.

The station target is set in the center of a triangular slab of concrete which is about 6 feet on each side. Top of the target is 9.85 feet higher than the concrete platform.

This station was recovered in 1938 by the Hawaii Territory Survey and a concrete instrument platform, metal pole and target built. At that time they recovered a 2-inch pipe in a triangular monument with KAPoho 1906 fixed in the concrete.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KAPoho (HTS)
ESTABLISHED: 1967
YEAR: 1940
STATE: Hawaii
Bench Marks: Also
COUNTY: Hawaii
Island: Hawaii

The station was recovered in good condition. A complete description follows:

Station is located about 3 miles north-northeast of Pahala, and 1 mile northwest of State Highway 11, on a low ridge in a brush-covered area, about 45 yards southwest of the edge of a cleared area planted in macadamia bushes, and 150 yards southeast of a stone wall at the northwest end of the cleared area.

To reach station from the post office in Pahala, go south on Pikake St. 0.2 mile to crossroad. Turn left on State Highway 15 and go 0.5 mile to junction with State Highway 11. Turn left and go northeast on State Highway 11 for 2.1 miles to board gate on left, just before reaching power pole No. 205. Pass through gate and follow old, narrow, macadam road for 0.5 mile to a gate on the left. Pass through gate, go 30 yards, then take right fork and follow track road across macadam field for 0.5 mile to a fork by fence corner on right. Take left fork and go 0.1 mile to T-junction (from west). Go left 25 yards, then take left fork on a 45° angle from stone wall, and go 0.1 mile into brush, and station in right curve of the track road.

Station is marked by a 2-1/4-inch iron pipe projecting 2 inches from the center of a triangular, concrete platform, 7 feet on each side and projecting 1 foot above ground. A 2-inch, steel shaft, 2 feet long, is centered vertically over the pipe, supported by 3 iron legs embedded in the concrete platform, and supports a removable, red and white target 8 feet tall. Station is 100 feet northwest of the northwest 1 of 2 large oak trees.

KAMAKAHA (HTS) 1949
KAPAPALO 1910
PUNAULUA (HTS) 1914

NOSA FORM 70-31 (71-72)

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: KAPoho (HTS)
YEAR: 1940
STATE: Hawaii
COUNTY: Hawaii

Source: G-9275

GEOGRAPHIC LATITUDE: 19° 14' 33.5"
GEOGRAPHIC LONGITUDE: 155° 28' 37.65"
ELEVATION: 502.0
WECTER:

STATE & ZONE CODE X Y FIELD COORD.
Hawaii 5101 510.784.85 148.634.25 0 00 0 37

Plane azimuths have been computed by the 2-2-0-0 formula neglecting the second term.

To Station or Object

GEOD. AZIMUTH FROM NORTH

KAMAKAHA (HTS) 1949
KAPAPALO 1910
PUNAULUA (HTS) 1914

QE 193
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: KAU HGS
STATE: HAWAII
YEAR: 1977
SECOND ORDER

LATITUDE: 19° 52' 17.9280"
LONGITUDE: 155° 26' 31.19489"
ELEVATION: 200.1' M

STATE COORDINATES (Feet):
-111 1101
1056597.97 135161.40 + 0.00

PLANE AZIMUTH HAS BEEN COMPUTED BY THE 2CM-O FORMULA NEGLECTING THE SECOND TERM

TO STATION OR DEPART
-268 24' 11.2"
-268 23' 49"
5101

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979

SM 081

---

*Name of chief of survey should be inserted here. The person who actually visited the station should sign his name at the end of the REPORT PAGE.*

HBOA FORM 76-86 SURVEY 3040" FORM 8000 WHICH MAY BE USED.

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEANIC SURVEY
HORIZONTAL CONTROL DATA

NO TEXT

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: KAUHAD
STATE: HAWAII
YEAR: 1854
THIRD ORDER

SOURCE: G-SP156

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE</th>
<th>GEODETIC LONGITUDE</th>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>16° 16' 11.517&quot;</td>
<td>155° 29' 49.270&quot;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X (METERS)</th>
<th>Y (METERS)</th>
<th>Z (FOOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>501,027.93</td>
<td>158,519.49</td>
<td>0.00 04</td>
</tr>
</tbody>
</table>

* Plane azimuth has been computed by the $A = Q + \Delta \varphi$ formula neglecting the second term.

<table>
<thead>
<tr>
<th>TO STATION OR OBJECT</th>
<th>GEOGRAPHIC AZIMUTH (From North)</th>
<th>PLANE AZIMUTH (From North)</th>
<th>CODE</th>
</tr>
</thead>
</table>

|                |                                |                            |      |
|                |                                |                            |      |

|                |                                |                            |      |
|                |                                |                            |      |

|                |                                |                            |      |
|                |                                |                            |      |
Kauhao (Hawaii Island, E.R. Hand, 1914) — In southern part of Hawaii, about 4 miles north by west from Pahala, and at a point where a well-known and conspicuous ridge, very narrow and steep, and trending about southeast and northwest, joins the main slope at right angles. This locality is called Ipuu. Reached by taking the homestead road which leaves the main road at Pahala, and proceeding north about 4 miles, when the ridge will be seen on the left distant about 1/4 or 3/4 mile. Proceed along the top of this ridge, crossing a slight saddle, and when this very narrow ridge begins to merge with the main slope, the station will be seen about 400 or 500 feet back in the same general direction as the line of the ridge. Marked by a truncated pyramid of concrete, with short iron pipe; pyramid is white, about 2/3% at base, and rests on a foundation of concrete and rock.

RECOVERY NOTE, TRIANGULATION STATION

Kauhao

Recovered by L.C. Hulme, 1936

Located about 5 miles north-northwest of Pahala and 2-3/4 miles west-southwest of the Kapapala Ranch, at about 4680 feet elevation, on the timbered ridge on the northwest side of Wood Valley, about 300 yards east of a good trail and about 500 yards northeast of a water tunnel.

To reach from the post office in Pahala, go northeast on Pahake Street and Highway 151 for 2.4 miles to gravel road left, at power pole 87, just across bridge. Turn left and go 0.65 mile; take left fork and go 0.65 mile to fork; take right fork and go 0.55 mile to side road right. Turn right and go 0.25 mile to fork. Take left fork and go 0.55 mile to fork; take right fork and go 0.35 mile; take left fork and go northeast along top edge of cane field for 0.35 mile to a point where metal flume on left is only 20 yards from road, and end of truck travel. Pack northeast along flume, keeping the right fork at each of 3 forks of flume, for about 1 mile to where flume enters tunnel. Go left uphill for 45 yards; turn right, and follow good trail around point for about 200 yards to an open, bowl-like gully on right (at mid-point along edge of bowl you are about on the azimuth from Kahaia 2 to Kauhao, but station is out of sight just beyond the point of ridge across bowl). Continue on trail about 100 yards to beginning of ridge on right. Leave trail and go southeast down along fern-covered ridge about 900 feet to station.

Station is marked by a 2-1/8-inch, iron pipe projecting 8 inches from the top of a truncated, 3-sided, concrete pyramid which is 3 feet on each side at the base and 10 inches at the top, and 26 inches high. It has "Kauhao 1914," F in inscribed in the concrete on the southeast side of the pyramid. Station is on a slight point on the sloping, fern-covered ridge top, which also has a sparse covering of slender ohia trees.
**Kaiwa cairn** (Hawaii Island, E. R. Hand, 1914).—In southern part of Hawaii, near the edge of the low cliffs at a small point 2½ miles below Puu Ulaula (hill), which bears N. 72° W. (mag.) from the station. Marked by a large cairn, whitewashed.

**HORIZONTAL CONTROL DATA**

**NAME OF STATION**: KAIWA CAIRN  
**STATE**: HAWAII  
**YEAR**: 1914  
**THIRD ORDER**

**SOURCE**: G-02184  
**NO OBSERVATION CHECK ON THIS POSITION**

<table>
<thead>
<tr>
<th>DEGREES</th>
<th>METERES</th>
</tr>
</thead>
<tbody>
<tr>
<td>19° 11' 28.99&quot;</td>
<td>130,029.72</td>
</tr>
<tr>
<td>155° 24' 09.10&quot;</td>
<td>533,632.05</td>
</tr>
</tbody>
</table>

**STATE COORDINATES (FOUR)**

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>F OR G OR H ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>533,632.05</td>
<td>130,029.72</td>
<td>+ 0.01 55</td>
</tr>
</tbody>
</table>

**PLANE AZIMUTH HAS BEEN COMPUTED BY THE S OR G OR H FORMULA NEGLECTING THE SECOND TERM.**

<table>
<thead>
<tr>
<th>TO STATION OR OBJECT</th>
<th>GEOGRAPHIC AZIMUTH (GEOGRAPHIC)</th>
<th>PLAN E AZIMUTH (PLAN E)</th>
<th>CODE</th>
</tr>
</thead>
</table>

**QF 087**
**HORIZONTAL CONTROL DATA**

**DESCRIPTION OF TRIANGULATION STATION**

**NAME OF STATION:** KEAKAPULU  
**STATE:** Hawaii County, Hawaii  
**CHIEF OF PARTY:** L. O. Wilder  
**YEAR:** 1949

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCES AND DIRECTIONS FROM ADJUSTED ORIGIN MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE CAMPUS AT THE STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UKEAKAHINA (USGS)</td>
<td></td>
</tr>
</tbody>
</table>
| R. M. (USGS) | 108''  
| 18a | 18b |  
| N | W | NE |  
| 164.144 | 0.450 | 4.697 | 90.480 | 107.010 | 66.060 |

The station is located near the southernly edge of Keakaapulau Plats at about a 4000-foot elevation. It is about 18 miles west-southwest of the Hawaiian National Park Headquarters, about 2 miles north of the Kapalama Ranch; about 3 miles northwest of the highway which runs between Hilo and Waimea; about 0.7 mile north of the Kealakekua Bay; about 200 yards east of the Kealakekua Bay; and 107 feet east of a large Knox tree.

To reach the post office at Kealakekua, go east and north, on the road which leads toward Hilo, for 10.6 miles to a point where a dirt road leads north toward the Kapalama Ranch; continue straight ahead, toward Hilo, for 4.7 miles; pass shed and buildings to the left; turn left, pass through a board gate, and go northerly, on a dirt track road for 1.5 miles; take the right hand fork and go north, about 0.4 mile; pass through a board gate in a fence corner, take right, and follow a dirt track road northerly for about 1.5 miles to a ranch house at Kealakekua; pass to the left hand side of dwellings and pick up the old Kealakekua Bay to the northeast of rock enclosure; follow the trail, which is marked by 2 inch pipes driven into the ground, northerly, for 0.9 mile to the edge of the bench land; turn right and go easterly, across country, for about 100 yards to the station.

The station is a standard disk, stamped KEAKAPULU 1949, set into a drill hole in bedrock which is flush with the surface of the surrounding rock. Reference mark number 1 is a standard disk, stamped KEAKAPULU NO 1, set into a drill hole in bedrock which is flush with the surface of the ground and is about the same elevation as the station. Reference mark number 2 is a standard disk, stamped KEAKAPULU NO 2, set into a drill hole in bedrock which is flush with the surface of the surrounding rock and is about the same elevation as the station.

The data are based on the H.M. D. Survey's adjustment of Jan 1979 and are used for all surveys after Dec 1975.

(continued on next page)
HORIZONTAL CONTROL DATA
by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KEAKA'PU'I
ESTABLISHED BY: G.C. Whipple, 1949
RECOVERED BY: L.A. Critchlow, 1977
AIRLINE DISTANCE AND DIRECTION FROM NEAREST POINT 12 miles north of Hana'a
HEIGHT OF TELESCOPE ABOVE STATION MARK 4 FEET
HEIGHT OF LIGHT ABOVE STATION MARK 4 FEET

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>OHAE (HGOS) 1897</td>
<td>SSW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>RH (USGS) 1897</td>
<td>W</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>RH (USGS) 1897</td>
<td>NW</td>
<td>2,288</td>
<td>114</td>
</tr>
<tr>
<td>OHAE (HGOS) 1897</td>
<td>SSW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM SO99 (USGS)</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM No. 1</td>
<td>NW</td>
<td>2,288</td>
<td>114</td>
</tr>
<tr>
<td>BM No. 2</td>
<td>NW</td>
<td>2,288</td>
<td>114</td>
</tr>
</tbody>
</table>

Station was recovered and all marks found in good condition. A complete description follows:

Station is located about 12 miles west-southwest of the Hawaii Volcanoes National Park Headquarters building, east of Crater Rim Road. 1.6 miles; turn right and go 0.1 mile; turn left and go on old road southwest 1.1 miles to metal gate on right. Pass through gate and go 0.1 mile; turn left and go on old road southeast 1.1 miles to metal gate on right. Pass through gate and follow track road 1.8 miles to wooden gate at fence corner. Pass through gate and continue on road 1.0 mile to old green house at trees. Pass to left of house and follow jeep road northerly for 0.75 mile. Leave road and go right, east through brush, for 0.1 mile to station mark, a 0.5 foot disk stamped "KEAKA'PU'I 49", cemented in a drill hole in bedrock flush with the ground. It is 3 feet south-southwest of a white witness post, 107 feet east of a large low, low, sprawling, koa tree, and at about 499 feet elevation. A large cabin is built over station.

Reference mark number one is a standard disk stamped "KEAKA'PU'I 49", cemented in a drill hole in bedrock over station mark, at about same elevation as station mark.

Reference mark number two is a standard disk stamped "KEAKA'PU'I No 2 49", cemented in a drill hole in bedrock in projects 6 inches. It is 0.6 foot lower than station mark.

USGS Bench Mark is a standard USGS disk stamped "4099", cemented in a drill hole in bedrock at same elevation as station mark.

NOTE: A 4-wheel-drive vehicle is required to reach station. Key for locked gates was obtained at the Hawaii Ranch Co. Office in Naalehu. A discrepancy in distance to BM No. 1 was noted and checked; the 1967 distance is correct.

*Name of chief of party should be inserted here. The offiicer who actually visited the station should sign his name at the end of the recovery note.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KEAKA'PU'I
ESTABLISHED BY: G.C. Whipple, 1949
RECOVERED BY: L.A. Critchlow, 1977
AIRLINE DISTANCE AND DIRECTION FROM NEAREST POINT 12 miles north of Hana'a
HEIGHT OF TELESCOPE ABOVE STATION MARK 4 FEET
HEIGHT OF LIGHT ABOVE STATION MARK 4 FEET

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>L'HAWA'I LTS 1969</td>
<td>SSW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>4099 USGS</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM No. 1</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM No. 2</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
</tbody>
</table>

The station mark, 4099 USGS, and reference marks 1 and 2 were recovered in good condition. The distance to reference mark 1 was found to be 0.137 m. Longer than the 1967 measurement but compared favorably with the 1949 measurement. The distance to reference mark 2 and 4099 USGS and the direction to the reference marks and 4099 USGS measured on this date compared favorably with the 1969 and 1967 measurements. The 1967 recovery note is adequate with the addition of the following new to-reach description:

To reach the station from the junction of State Highway 11 and 19 in miles go south on State Highway 11 for 40.2 miles (about 12 miles south of Volcano National Park Headquaters) to a locked metal gate on the right. Pass through the gate and go north-west 0.1 mile to a T-road. Turn left and follow the paved road south-west 1.1 miles to a metal gate on the right. Pass through the gate and follow the track road north-west 1.8 miles to a wooded gate and turn right on a dirt road 1.1 miles to a drain crossing just north of an old green house in a grove of trees. Continue north along the track road 0.5 mile to a road on the right and a triangular-blazed tree on the left. Turn right and go northeast 0.15 mile to the end of the road at the station site. The station is located on Parker Ranch property.

*Name of chief of party should be inserted here. The officer who actually visited the station should sign his name at the end of the recovery note.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KEAKA'PU'I
ESTABLISHED BY: G.C. Whipple, 1949
RECOVERED BY: L.A. Critchlow, 1977
AIRLINE DISTANCE AND DIRECTION FROM NEAREST POINT 12 miles north of Hana'a
HEIGHT OF TELESCOPE ABOVE STATION MARK 4 FEET
HEIGHT OF LIGHT ABOVE STATION MARK 4 FEET

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>L'HAWA'I LTS 1969</td>
<td>SSW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>4099 USGS</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM No. 1</td>
<td>SW</td>
<td>1,144</td>
<td>271</td>
</tr>
<tr>
<td>BM No. 2</td>
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<td>271</td>
</tr>
</tbody>
</table>

The station mark, 4099 USGS, and reference marks 1 and 2 were recovered in good condition. The distance to reference mark 1 was found to be 0.137 m. Longer than the 1967 measurement but compared favorably with the 1949 measurement. The distance to reference mark 2 and 4099 USGS and the direction to the reference marks and 4099 USGS measured on this date compared favorably with the 1969 and 1967 measurements. The 1967 recovery note is adequate with the addition of the following new to-reach description:

To reach the station from the junction of State Highway 11 and 19 in miles go south on State Highway 11 for 40.2 miles (about 12 miles south of Volcano National Park Headquaters) to a locked metal gate on the right. Pass through the gate and go north-west 0.1 mile to a T-road. Turn left and follow the paved road south-west 1.1 miles to a metal gate on the right. Pass through the gate and follow the track road north-west 1.8 miles to a wooded gate and turn right on a dirt road 1.1 miles to a drain crossing just north of an old green house in a grove of trees. Continue north along the track road 0.5 mile to a road on the right and a triangular-blazed tree on the left. Turn right and go northeast 0.15 mile to the end of the road at the station site. The station is located on Parker Ranch property.

*Name of chief of party should be inserted here. The officer who actually visited the station should sign his name at the end of the recovery note.
HORIZONTAL CONTROL DATA

NAME OF STATION: KEANAKAKOI
STATE: HAWAI'I
YEAR: 1949

DISTANCES AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION:

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OHAKEA</td>
<td>0.00</td>
<td>113° 00'</td>
</tr>
<tr>
<td>36.15°</td>
<td>113° 00'</td>
<td></td>
</tr>
<tr>
<td>22.39°</td>
<td>113° 00'</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>113° 00'</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Located in open country about 8.5 miles south of the National Park Headquarters, on the west rim of the Halemaumau Crater, about 100 yards west of the Chain of Craters road and 8 feet west of a sheer cliff about 50 feet high.

Station is a standard disk set in a square topped concrete post that projects four inches above the ground. Stamped KEANAKAKOI 1949.

The under ground mark is a standard disk set in a square block of concrete three feet below the surface. Stamped KEANAKAKOI 1949.

Reference Mark No.1 is cemented in a drill hole in the top of a large buried lava boulder that is about 2 feet above the elevation of the station and projects about 1 foot above the ground. A standard disk stamped KEANAKAKOI NO 1 1949.

Reference Mark No.2 is cemented in a drill hole in the top of a buried lava boulder, about the same elevation as the station. A standard disk stamped KEANAKAKOI NO 2 1949.

To reach from the National Park Headquarters: go south on Government road for 2.2 miles to a cross road, turn left on Chain of Craters road and go 4.5 miles, take right fork on dim bladed road, make U turn and go 0.8 miles then turn right across country for 0.1 miles to edge of cliff and station.

(continued on next page)
**HORIZONTAL CONTROL DATA**

by the
NATIONAL GEODETIC SURVEY
Old Hawaiian Datum

**RECOVERY NOTE, TRIANGULATION STATION**

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance Feet</th>
<th>Distance Meters</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM No. 1</td>
<td>NW 24.39</td>
<td>6,823</td>
<td>171</td>
<td>31 33</td>
</tr>
<tr>
<td>NM No. 2</td>
<td>SE 36.13</td>
<td>11,019</td>
<td>249</td>
<td>13 57</td>
</tr>
<tr>
<td>WUKEKURA (HGS) 1896</td>
<td>SE 36.13</td>
<td>11,019</td>
<td>249</td>
<td>13 30</td>
</tr>
<tr>
<td>RM No. 1</td>
<td>SW 22.42</td>
<td>6,823</td>
<td>171</td>
<td>31 57</td>
</tr>
<tr>
<td>RM No. 2</td>
<td>SW 36.14</td>
<td>11,014</td>
<td>249</td>
<td>08 17</td>
</tr>
</tbody>
</table>

**RECOVERY NOTE, TRIANGULATION STATION**

Station was recovered and all marks found in good condition. A complete description follows:

Station is located in the Hawaii Volcanoes National Park, about 2-1/4 miles southwest of the Park Headquarters and 2-1/2 miles due south, across Kiluaea Crater, from Kiluaea Military Camp, on the south rim of Kiluaea Crater, about 350 feet south of the Crater Rim Road and at about 2,000 feet elevation.

To reach station from Park Headquarters building, go west and south on Crater Rim Road for 5.3 miles to the large parking area at Halemaumau Crater observation point; continue on the road for 0.7 mile to dim side road right, at left curve of main road, and end of truck travel, below rim and station. Walk south about 450 feet to station up on rim.

Site of station is in the middle of a 10-inch-square, concrete monument projecting 6 inches. It is 20 feet south from edge of cliff and 3 feet southwest of a cairn.

Reference mark number one is a standard disk stamped "KEANAKIKO 1949", cemented in a drill hole in a 12-inch-diameter rock projecting 14 inches, and is about 2 feet higher than station mark.

Reference mark number two is a standard disk stamped "KEANAKIKO 1949", cemented in a drill hole in a 12-inch-diameter rock projecting 6 inches, 4 feet west of station mark. It is about same elevation as station mark.

NOTE: It is possible to drive to station with 4-wheel-drive vehicle by proceeding east on Crater Rim Road from end of truck travel for 0.3 mile, then turn right, off of highway, and follow dim track road east for 0.2 mile to edge of a small crater; go right, around hairpin turn, and then go west 0.55 mile across flat area to station.

*Note of chief of party should be inserted here. The officer who actually visited the station should sign his name at the end of the recovery note.*

**NAME OF STATION**

KEANAKIKO

**ESTABLISHED BY:** C.T. Hussemeyer

**YEAR:** 1949

**STATE:** Hawaii

**RECOVERED BY:** L.A. Critchlow

**YEAR:** 1977

**COUNTY:** Hawaii

**NEAREST TOWN:** 2.5 miles S of Kiluaea Military Camp

**HEIGHT OF TELESCOPE ABOVE STATION MARK:** 4 FEET

**HEIGHT OF LIGHT ABOVE STATION MARK:** 0 METER

**DISANCES AND DIRECTIONS TO REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION**

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>Bearing</th>
<th>Distance Feet</th>
<th>Distance Meters</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>WUKEKURA RGS 1896</td>
<td>SE 22.42</td>
<td>6,823</td>
<td>171</td>
<td>31 57</td>
</tr>
<tr>
<td>RM 1</td>
<td>SW 36.14</td>
<td>11,014</td>
<td>249</td>
<td>08 17</td>
</tr>
<tr>
<td>RM 1 to RM 2</td>
<td></td>
<td></td>
<td>38.13</td>
<td>11.624</td>
</tr>
</tbody>
</table>

The station mark and reference marks 1 and 2 were recovered in good condition. The directions to the reference marks measured on this date were about 5 minutes less than the 1967 directions. The distance to reference mark measured on this date was 0.111 meter longer than to reference mark 1 measured on the 1967 measurement. The distance to reference mark 2 measured on the 1967 measurement. The 1967 recovery note is adequate.
HORIZONTAL CONTROL DATA

NAME OF STATION: Kilauea Military Camp, flagpole
ESTABLISHED BY: L.C.W. YEAR: 1949
RECOVERED BY: D.J. Whipp YEAR: 1969
COUNTY: Hawaii STATE: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
Island: Hawaii

Detailed statement as to the license of the original description; including marks found, tampings, changes made, and other pertinent facts:

Station was recovered. Located in the Hawaii Volcanoes National Park, 1 mile west along the Crater Rim Road from the Park Headquarters Building. A white, metal flagpole about 50 feet tall, with brass ball on top, set in front of the Military Camp Office on a circular, raised grass area, about 100 feet north of the Crater Rim Road.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: KILAUEA MILITARY CAMP FLAGPOLE
STATE: HAWAI'I YEAR: 1949 THIRD ORDER

SOURCE: 6-9275

DEGREES LATITUDE: 19° 26' 07.993
DEGREES LONGITUDE: 155° 16' 36.014
ELEVATION: 576.54407
METERS: 218.64733

STATE COORDINATES (Feet):

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z (W.D. 1st ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hl 1</td>
<td>5101</td>
<td>576,544.07</td>
<td>218,647.33</td>
<td>+ 0° 04' 28&quot;</td>
</tr>
</tbody>
</table>

*Plane azimuth has been computed by the B.C.R. + W. formula neglecting the second term.

TO STATION OR OBJECT

<table>
<thead>
<tr>
<th>GEODETIC AZIMUTH (Present Value)</th>
<th>PLANE AZIMUTH Corrected Value</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QE 224
REPORT

LOCATION OF STATION

NAME OF STATION: KOAE (USGS)
STATE: Hawaii
COUNTY: Hawaii

CHIEF OF STATION: C.T. Hussey
YEAR: 1949
DESCRIPTION: H.B.O.

NOTES:
HEIGHT OF TELESCOPE ABOVE STATION BASE: 1.61'
HEIGHT OF LIGHT ABOVE STATION BASE: 1.61'

Located in southeast Hawaii, in Kau District, about 7 miles southeast of the Hawaiian Volcano National Park, and about 3.5 miles east of the Government Highway on the west and highest point of a volcanic cone named Koae.

MARKED BY: A 3-foot-high iron pipe, mounted on three iron legs in the center of the platform, which is in turn supported by an iron target. The center of the pipe was used as station. This station is near the same spot as the flag pole and caliper observed by S.R. Hefez in 1915. Original station, a 1/2 inch pipe 5 feet long was recovered by the Territorial Survey and metal target placed over it.

True plumbing of target was accepted as correct.

To reach station, from the National Park Headquarters, go southwest on Government Highway for 3.5 miles to a cross road, turn left on Chain of Craters Road, and go 3.5 miles; turn right at Park Service sign, "Restricted Area Do Not Enter" and follow dry wash 1.6 miles, turn left out of wash, and go 3.5 miles to the site.

Station is visible on right, the most prominent one in the vicinity. Pick up way through lava beds and sand for about five miles to station.

RECOVERY NOTE: TRIANGULATION STATION

NAME OF STATION: KOAE (USGS)
ESTABLISHED BY: C.T. Hussey
YEAR: 1949
STATE: Hawaii
COUNTY: Hawaii

RECOVERED BY: R.M. Whipp
YEAR: 1967
COUNTY: Hawaii

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:

Station was recovered and both marks found in good condition.

A complete description follows:

Station is located on the Kau Desert Trail and Footprints Trail, and about 500 feet elevation, on the rim of Puu Koae, on a prominent volcanic cone.

To reach station from the Hawaiian Volcano National Park Headquarters, go southwest on Chain of Craters Road, past east end of the volcanic cone, and about 3.5 miles to a cross road; turn left on Chain of Craters Road, and go about 2.2 miles; take side road right, at sign "HILINA PALI PARK ROAD", and go about 4 miles to the end of truck trail at a hairpin left curve and sign on right "FOOTPRINTS TRAIL". Walk west on good trail for about 4 miles to station.

Station is marked by a 3/4-inch iron pipe projecting 2 inches from the center of a triangular, concrete platform, about 7 feet on each side, and on highest point of crater rim. A 3/16-inch iron pipe target, supported by 3 iron legs embedded in the concrete platform, is centered over station and extends about 8 feet above platform. The word "KOAE" is inscribed in the concrete.

REFERENCE MARK: A U.S.G.S. reference disk, unstamped, cemented in a drill hole in the top of a small lava rock capping at southeast base of station hill, in azimuth from station 50° 09'. Hsps distance to reference mark is 172.37 feet, and it is about 100 feet lower than station.
The station is located in the Volcanoes National Park on the south rim of a prominent volcanic cone known as Puu Koa, and in an area known as the Kau Desert.

The station mark is a 1 inch rebar rod driven into the cinder cone, surrounded by a mound of concrete, with a PE nail in the center of the top of the rod with an aluminum tag attached and stumped PUU KOA REMAP DEC 1975. It is set on the rim of the crater on the south side and about 5 feet lower than a cinder mass to the east and about 4 feet lower than a cinder mass to the west.

To reach the station from the USGS Volcano Observatory, go southerly on paved park road for 1.9 miles to a track road right. Turn right on the track road go for about 200 feet to the top of the ridge. Keep left on track road and go northeast for 0.13 mile to a fork. Take the right fork and continue on track road keeping right forks all the way for 4.0 miles to the cone and the station on the left. Reference mark 3 is a 1 inch rebar rod driven into the cinders and surrounded by concrete. The rod projects 2 inches and is located on the east side of the crater.

Reference mark 4 is a 1 inch rebar rod driven into the cinders and surrounded by concrete. The rod projects 3 inches and is located on the northwest side of the crater.

* From this point a 4 wheel drive vehicle is needed and there are small rock cairns along the trail to follow.
HORIZONTAL CONTROL DATA

Kupapa'u (Hawaii Island, E. R. Hand, 1914)—On east coast of Hawaii, on Kupapa'u Point, 3 miles southwest of the coast from the village of Kalapana. Station is up in the line of large rocks which have been thrown back by storm surf; it is about 25 meters from the sea, and 100 meters from the sharp point to the northeast where the shore turns abruptly in, to form bay. Marked by a survey tablet set in a rock which is roughly 6 by 8 by 25 feet, and which is cemented firmly to rocks below.

RECOVERED NOTE, TRIANGULATION STATION

NAME OF STATION: KUPAPA’U
ESTABLISHED BY: E.R. Hand
YEAR: 1914
STATE: Hawaii
RECOVERED BY: D.M. Whipp
YEAR: 1967
COUNTY: Hawaii
ISLAND: Hawaii
HEIGHT OF TELES METER ABOVE MARK: 1.14 Meters, HEIGHT OF LIGHT ABOVE MARK: 1.14 Meters

DISTANCES AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEHEIHAIWU 1914</td>
<td>NE</td>
<td>26,603</td>
<td>8,109</td>
</tr>
<tr>
<td>NM No. 1</td>
<td>NE</td>
<td>21,953</td>
<td>6,090</td>
</tr>
<tr>
<td>NM No. 2</td>
<td>SE</td>
<td>21,953</td>
<td>6,090</td>
</tr>
</tbody>
</table>

Station mark was recovered in good condition. Two new reference marks were established:

A complete description follows:

Station is located about 3 miles southwest of Kalapana Village at Kupapa'u Point, about 1000 feet southeast of the highway and 600 feet southwest of the sharp point where the shoreline turns in to northeast. It is on the top of a prominent row of large, jumbled rocks above the smooth lava beach, 39 feet southwest from the southeast end of a row of pandanus trees visible from the highway, and about 175 feet southwest from the end of a large stone wall from which a fence line runs northwest.

To reach the station from the junction of State Highways 132 and 13 at Pahoa, go south on State Highway 13 for 11.0 miles to the churches at Kalapana. Continue westerly on the highway for 3.25 miles to cattleguard; continue on the highway 0.05 mile; turn left on dirt track road by cattleguard sign, and go southeast 0.25 mile to road about 50 yards from a lone coconut tree (the one nearest the highway). Walk southeast from the coconut palm on a line towards the pandanus trees, about 350 yards to station.

Station mark is a standard disk stamped “KUPAPA’U 1914,” cemented into a drill hole in the top of a 4-foot-square boulder, secured with concrete onto the rocks on which it sets, and is the highest point of the row of jumbled rocks. It is 145 feet northwest of the extreme rock tip at water edge, and about 3 feet higher than the smooth lava beach ledge.

Reference mark number one is a standard disk stamped “KUPAPA’U 1914 NO 1 1967,” cemented in a drill hole in a large rock at the north edge of the row of jumbled rocks. It is 12 feet southwest of the base of the southwest pandanus tree, projects 2 feet above ground, and is about 6 inches lower than station mark.

Reference mark number two is a standard disk stamped “KUPAPA’U 1914 NO 2 1967,” cemented in a drill hole in the smooth lava beach ledge, 125 feet north of the extreme south tip of the ledge and about 7.4 feet lower than station mark.

*Name of chief of party should be signed here. The officer who signs, signed as of the recovery date.

NOTE: One of these two must be used for every station recovered.

(continued on next page)
HORIZONTAL CONTROL DATA

by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: KUPAPAUI

ESTABLISHED BY: E. H.

YEAR: 1914

STATE: Hawaii

RECORDED BY: E. H.

YEAR: 1977

COUNTY: Hawaii

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
3 miles southwest of Volcano.

HEIGHT OF TELESCOPE ABOVE STATION MARK: 7 FEET.

HEIGHT OF LIGHT ABOVE STATION MARK: 7 FEET.

DISTANCES AND DIRECTIONS TO ASHMA MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE STATION AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE FEET</th>
<th>DISTANCE METERS</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapi 114</td>
<td>FF</td>
<td>26.53</td>
<td>8.109</td>
<td>170 10 37</td>
</tr>
<tr>
<td>H1 2</td>
<td>SS</td>
<td>20.95</td>
<td>6.400</td>
<td>283 22 17</td>
</tr>
</tbody>
</table>

The station mark and reference marks 1 and 2 were recovered in good condition. The distance to reference mark 1 checked 364 feet against the 1907 recovery note and the direction was found smaller by 091 degrees. The distance to reference mark 2 was found larger by 0.05 meter and the direction was found smaller by 092 degrees. A complete new description follows.

The station is located about 3 1/2 miles southwest of Volcano, 1/2 mile east of State Highway 11 and the entrance to the Volcanoes National Park. Also, the shore line at Kupapaui Point and on property owned by Hawaii Volcanoes National Park.

To reach the station from the Sea of Glass (Kilauea) Church in Volcanoes National Park pass along State Highway 11 for 3.3 miles to the cattle guard and the entrance to the Hawaii Volcanoes National Park. Continue on highway 11 for 0.65 mile to a cattle guard on the left. Turn left (east) through the gate and go north on the track road for 0.5 mile to a wire fence and a rock wall joins the northern boundary of the park. From here park the top of the rock wall to the end. Turn left and park along the shore line for about 200 feet to the station on the right in a jumble of rocks.

Station mark, stumped KUPAPAUI 114, is a CCSS disk cemented in a drill hole in a small boulder which projects higher than other boulders around it and is about 5 feet higher than the smooth lava along the boulder line. It is 203 feet southeast of the east end of the rock wall. (Note 1)

Reference mark 1, stumped KUPAPAUI 1936 NO 1 1967, is a CCSS disk cemented in a drill hole in a boulder which is about 2 feet lower than the station. It is 103 feet southeast of the east end of the rock wall. (Note 1a)

Reference mark 2, stumped KUPAPAUI 1934 NO 2 1967, is a CCSS disk cemented in a drill hole in smooth lava rock which is about 3 feet lower than the station. It is 203 feet southeast of the east end of the rock wall. (Note 1b)

(R.B.M., 1978)--The station and reference marks were recovered in good condition.

Note 1: The name of the party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

NOSA FORM 75-92

SUPERSEDES CCSS FORM 65 WHICH MAY BE USED:

---
NOSA

Note 1:

11-14-72

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Laapuki (Hawaii Island, E. R. Hand, 1914).—On eastern coast of Hawaii, about 8 miles southwest along coast from Kalapana, and 1½ miles southwest from the coconut grove and grass house (the last grove southwest of Kalapana) at Laapuki. Station is directly below and 8° 30' E. of the isolated house situated high up on slope (house of Pea, a native). It is on a mound rising from the smooth barren lava, near the point seen from Laapuki, is 55 meters from the sea on the east, and 170 meters from the point which bears 8° 17' W. Marked by a survey tablet set in mound, and covered by a small cairn, painted.

**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION:** LAAAPUKI
**ESTABLISHED BY:** E. R. Hand
**RECOVERED BY:** D. M. Whipple
**YEAR:** 1914
**STATE:** Hawaii
**COUNTY:** Island: Hawaii

**HEIGHT OF TELESCOPE ABOVE STATION MARK:** 1.53 METERS
**HEIGHT OF LIGHT ABOVE STATION MARK:** 0.62 METER

**DISTANCE AND DIRECTIONS TO ADEMINUT MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION**

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEASUREMENT</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PULAMA 1914</td>
<td>S</td>
<td>22.129</td>
<td>6.745</td>
</tr>
<tr>
<td>RM No. 1</td>
<td>W</td>
<td>12.190</td>
<td>5.852</td>
</tr>
<tr>
<td>RM No. 2</td>
<td>NE</td>
<td>652.0</td>
<td></td>
</tr>
<tr>
<td>Iron pin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Station mark was recovered in good condition. Two reference marks were established. A complete description follows:

Station is located along southeast coast of the island, about 8 miles west-southwest of Kalapana, 2 miles northeast of where State Highway 13 leaves the coast and bears inland, and 1-1/4 miles southwest of a small coconut grove which is the last one southwest along highway from Kalapana to highway about 25 by 15 feet in size and projecting about 5 feet above general ground level.

To reach station from the junction of State Highways 13 and 132 at Pahoa, go south on State Highway 13 for 11.0 miles to the churches at Kalapana. Continue on the highway, southwest, for 7.0 miles to the last coconut grove on left: continue on the highway for 1.75 miles to the end of truck travel. Walk southeast across lava area about 500 feet to station.

Reference mark number one is a standard disk stamped "LAAPUKI 1914", cemented in feet south-southeast of center line of highway and 150 feet north-northwest of water line.

These data obtained from adjustment of Jan 1979

These data should be used for all surveys after Dec 1975

(continued on next page)
HORIZONTAL CONTROL DATA
by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

LAAPUFI (continued)

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: LAAPUFI
ESTABLISHED BY: E.C. Hitchcock
YEAR: 1914
STATE: Hawaii
COUNTY: Hawaii
BENCH MARK ALSO
RECOVERED BY: L. Critchlow
YEAR: 1977

DISTANCES AND DIRECTIONS FROM NEAREST TOWN:
5 miles west-southwest of Kailua
HEIGHT OF TELESCOPE ABOVE STATION MARK: 12 FEET
HEIGHT OF LIGHT ABOVE STATION MARK: 0 FEET

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACIA P.</td>
<td>109.21</td>
<td>5.854</td>
<td>00 00 00 0</td>
</tr>
<tr>
<td>P 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 25 PINE</td>
<td>109.21</td>
<td>6.719</td>
<td>277 31 33</td>
</tr>
<tr>
<td>RE 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 1 to 26 2</td>
<td>109.21</td>
<td>9.096</td>
<td>277 31 33</td>
</tr>
</tbody>
</table>

The station mark, reference marks 1 and 2 and the iron pin were recovered in good condition with the exception the iron pin has about rusted away at the base. The distance to reference mark 1 was found shorter by 0.020 meter and the direction was found also by 0.020 meter. The distance to reference mark 2 was found longer by 0.020 meter and the direction was found smaller by 0.020 meter. A complete description follows:

The station is about 3 miles west-southwest of Kailua, just

southwest of State Highway 13, between the road and the shore line,

on a small lava mound about 500 feet north-northeast of the shore line.

To reach the station from the Star of the Sea (painted) Church in

Kailua, go south on State Highway 13 for 4.25 miles to the

town of Kalapana, then south on State Highway 13 for 4.25 miles to

the village of Kalapana, then south on State Highway 13 for 1.5 miles to

the station on the left about 500 feet south-southwest of the highway.

Station mark, stamped LAAPUFI 1914, is a 60-mm disk cemented in a

drill hole in bedrock on highest point of a lava mound which is about

6 feet higher than the general area. It is 530 feet south-southwest

of the center line of highway 13 (1967 measurement) and 150 feet west-

northwest of the water line. (Note 1)

Reference mark 1, stamped LAAPUFI 1914 NO 1 1957, is a 60-mm disk

cemented in a drill hole in bedrock which is about 4 feet lower than

the station. (Note 123)

Reference mark 2, stamped LAAPUFI 1914 NO 2 1957, is a 60-mm disk

cemented in a drill hole in bedrock which is about 2 feet lower than

the station. (Note 123)

Iron Pin, is a 3/4-inch iron pin wedged in a crevice in bedrock on
top of a lava mound similar to the one the station is on.
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

North Rim (Hawaii Island, United States Geological Survey, 1920).—In southeast Hawaii, on a rocky knob on the extreme edge of Kilauea Crater, about northwest of Halemaumau. Mark, a bronze tablet cemented in solid rock.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: NORTH RIM
ESTABLISHED BY: U.S.G.S. YEAR: 1920 STATE: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
Island:Hawaii

Station was recovered in good condition. A complete description follows:

Station is located in the Hawaii Volcanoes National Park, about 2.1/4 miles southwest of the Park Headquarters Building, 1/2-mile south of the Volcano Observatory of the U.S. Geological Survey, and 0.7 mile northeast of where the Crater Rim Road reaches its westernmost point before turning back to southeast; at about 3910 feet elevation, on a rock knob on the west rim of Kilauea Crater.

To reach station from the Hawaii Volcanoes National Park Headquarters Building, go west on Crater Rim Road for 3.7 miles to end of truck travel at the westernmost point of the road. Walk northeast across rough area for about 0.7 mile to station.

Station mark is a U.S. Geological Survey disk, stamped "NORTH RIM", cemented in a drill hole in a bedrock point, 40 feet west of edge of crater and 5 feet northwest of a 2-foot cairn.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: NORTH RIM
STATE: HAWAII YEAR: 1920 THIRD ORDER

SOURCE: S-SP156

GEODETIC LATITUDE: 19° 23' 06.21" GEODETIC LONGITUDE: 155° 17' 26.70"
ELEVATION: 3911.70 Meters 12961.7 Feet

STATE COORDINATES (39):

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>x COORD. AT MSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5101</td>
<td>572,100.70</td>
<td>212,499.86</td>
<td>0</td>
<td>00.0410</td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE Z COORD. FOR SIMPLIFICATION THE SECOND TERM.
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

HAWAII
LATTITUDE 15° 00' TO 15° 30'
LONGITUDE 155° 30' TO 155° 30'

HORI'NTONAL CONTROL DATA

O 191552 STATION 1038

NAME OF STATION: NOSE
STATE: HAWAII
YEAR: 1920

ADJUSTED HORIZONTAL CONTROL DATA

UNIT: METER

19 23 13.215
195 18 16.722

1082.25
3550.0

G-SPI56

STATE COORDINATES (DEGREE)

STATE & ZONE CODE
HI 1 5101

X Y Z
567,325.83 201,095.70

+ 0 03 56

PLANE ALTITUDE HAS BEEN COMPUTED BY THE Z = V + 0.5 formula neglecting the second term.

SOURCE: G-SPI56

NOTE: 4-wheel-drive vehicle required.

Hawaii Island, United States Geological Survey, 1920.—In southeast Hawaii, 2 miles southwest of Halemaumau, about in line with and halfway between Halemaumau and Puu Koke, at the lower end of a low ridge of "pahoe-
ho" lava on top of a small rocky knob. Mark, a bronze tablet cemented in solid rock.

RECOVERY NOTE, TRIANGULATION STATION

Mark recovered in good condition. A complete description follows:

Station is located about 2 miles southwest of the large parking area at Halemaumau Crater and 1 mile southeast of the Kau Desert Trail, at 355 feet elevation, on a rock point on a low, sloping ridge in pahoe-
ho lava bedlams cut out by dry washes.

To reach station from the Hawaii Volcanoes National Park Headquarters, go west on Crater Rim Road for 0.5 miles to dirt road fork right, a bottom of grade. Take right fork and go 0.5 mile to quarry on left; continue ahead for 0.9 mile to point of ridge on right. Turn sharp right and go up-
grade along edge of bluff 0.75 mile; take dim left fork down sloping ridge for 0.2 mile, then continue ahead, down sandy draw, for 0.7 mile. Turn right, leaving draw, and go west across rough lava area for 0.4 mile to large wash. From here walk west about 1/2 mile to station.

Station mark is a U.S.G.S disk, stamped "NOSE", cemented in a drill hole in a sloping, bedrock ledge projecting 3 feet. It is 3 feet east of a 3-foot cairn and 60 yards west of 4 electric cables strung on the ground.

NOTE: 4-wheel-drive vehicle required.
HORIZONTAL CONTROL DATA

OBSERVATORY (Hawaii Island, United States Geological Survey, 1920).—In the southeast corner of the observatory building, on the top of the concrete pier projecting up through the floor of the observatory building, was a bronze tablet cemented in the concrete.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: OBSERVATORY
ESTABLISHED BY: USGS
YEAR: 1920
STATE: Hawaii
COUNTY: Hawaii
RECOVERED BY: D.M. Whipp
YEAR: 1967
COUNTY: Hawaii
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: Island: Hawaii

Detailed description of the observatory building and its surroundings:

Station mark was recovered in good condition, however the observatory building mentioned in original description has been removed and the station now sets in lawn area on west side of the Volcano House Hotel, about 500 feet southwest of the park headquarters building.

Station mark is a U.S. Geological Survey disk, stamped "1979", in the top of a 18-inch square concrete monument 7 feet tall and with 4 vane faces. It is 27 feet southwest of the building, opposite the point where a glassed-in walkway begins, and is at the base of a lawn terrace.

18 inches square

7 ft. high

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: OBSERVATORY
STATE: Hawaii
YEAR: 1920
THIRD ORDER
SOURCE: USGS

HEIDELSTADT LATITUDE: 19° 25' 53.5" N
HEIDELSTADT LONGITUDE: 155° 15' 41.6" W
ELEVATION: 1212.90 meters
3995.5 feet

EAST COORDINATES (FEDERAL)

STATE & ZONE CODE X Y 0.00'
HI 1 5102 582,201.88 217,419.03 0.04'
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

NAME OF STATION: OAHU HTS
STATE: HAWAI
YEAR: 1499
ADJUSTED HORIZONTAL CONTROL DATA

NOTES:

STATE COORDINATES (FEET)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE CODE</th>
<th>x</th>
<th>y</th>
<th>P 'T.D. H. D.'</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>5401</td>
<td>558,042.83</td>
<td>216,017.06</td>
</tr>
</tbody>
</table>

*Planes Azimuth has been computed by the 0 "T.D. H. D." formula neglecting the second term.

TO STATION OR OBJECT

<table>
<thead>
<tr>
<th>HORIZONTAL AZIMUTH</th>
<th>PLANE AZIMUTH</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FROM STATION</td>
<td>(From east)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>274 16 35.7</td>
<td>5101</td>
</tr>
<tr>
<td></td>
<td>274 13 32 7</td>
<td></td>
</tr>
</tbody>
</table>

These data are obtained from adjustment of 1951

(continued on next page)
HORIZONTAL CONTROL DATA

by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

QUAD 191552
STATION 1040

LATITUDE 0° 10'
LONGITUDE 0° 10'

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: OHA'IKI (HTS)
ESTABLISHED BY: D.T. Hunsberger
YEAR: 1949
STATE: Hawaii
COUNTY: Hawaii
Island: Hawaii
RECOVERED BY: L.A. Critchlow
YEAR: 1977
DISTANCE FROM NEAREST TOWN: 18 MILES NE of Pahala
HEIGHT OF TELESCOPE ABOVE STATION MARK: 4.9 FEET
HEIGHT OF LIGHT ABOVE STATION MARK: 4.1 FEET

Recovery Diagram

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: OHA'IKI (HTS)
ESTABLISHED BY: D.T. Hunsberger
YEAR: 1949
STATE: Hawaii
COUNTY: Hawaii
Island: Hawaii
RECOVERED BY: L.A. Critchlow
YEAR: 1977
DISTANCE FROM NEAREST TOWN: 18 MILES NE of Pahala
HEIGHT OF TELESCOPE ABOVE STATION MARK: 4.9 FEET
HEIGHT OF LIGHT ABOVE STATION MARK: 4.1 FEET

Recovery Diagram

Stations and reference marks were recovered in good condition. The distances and directions measured on this data are in agreement with the 1977 measurements. A new reference mark 4 was established.

To reach station OHA'IKI, go north on Highway 11 for 34 miles to Milepost 49.4. Continue on the highway for 108 feet to track road on the right. Turn right and go west-southwest on a track road 0.95 miles to locked gate. Continue ahead on track road to some water tank and a corral. Turn right and go northerly up hill on dirt road for 0.5 miles to gate. Pass through gate and continue up grade to a road fork. Take left fork and go 0.15 miles to fenced corner on the left. Continue on up hill on dirt road for 1.2 miles to water tank and the station site.

Reference mark 4, stamped OHA'IKI 49 NO 4 1977, is a NOS tablet cemented in a drill hole in a rock outcrop projecting 0.2 feet above the ground. A 2.5-foot stake is 60 feet north-northeast of a water tank and 19 feet east of a steel water pipe.

The station and reference mark 2 were recovered in good condition. The distances and directions measured on this date agree favorably with the 1977 measurements. A new reference mark 4 was established.

To reach the station from the junction of State Highways 11 and 19 in Hilo, go southwest on Highway 11 for 34 miles to Milepost 49.4. Continue on the highway for 108 feet to track road on the right. Turn right and go west-southwest on a track road 0.95 miles to locked gate. Continue ahead on track road to some water tank and a corral. Turn right and go northerly up hill on dirt road for 0.5 miles to gate. Pass through gate and continue up grade to a road fork. Take left fork and go 0.15 miles to fenced corner on the left. Continue on up hill on dirt road for 1.2 miles to water tank and the station site.

Reference mark 4, stamped OHA'IKI 49 NO 4 1977, is a NOS tablet cemented in a drill hole in a rock outcrop projecting 0.2 feet above the ground. A 2.5-foot stake is 60 feet north-northeast of a water tank and 19 feet east of a steel water pipe.
HORIZONTAL CONTROL DATA

NO ORIGINAL TEXT

Ohala (1932) (Hawaii Count), Hawaii, U.S.A., 1977

United States Geological Survey, 1920; 13 southeast Hawaii, on a rock hill about 4 miles south of Halemaumau. Marked by a flagpole in the center of a large terraced cairn of rock. A bench mark southeast of the station is 18.7 feet from the station in azimuth 49° 42'.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: OHALA HS
STATE: HAWAII
YEAR: 1977

The station is located on the summit of a low lava mound which lies about 6 miles south of the Hawaiian National Park Headquarters; about 6 miles north of the seashore and about 0.6 mile north of the graded road which leads toward the Hinao Falls.

To reach from the Hawaiian National Park Headquarters; go westerly, on the road which leads toward Hinao, for 2.1 miles; turn left, onto the Crater Rim Road, and go south and east for 0.3 miles to the intersection of the Chain of Craters Road; turn right and go southeast for 2.3 miles; turn right, onto a graded road, as per the sign reading Histina Picnic Grounds, and go westerly for 8.3 miles to the end of truck travel. From this point past northwest for about 0.6 mile to the high ground and the station.

The station is the center of a 2 1/2 inch iron pipe which projects about 3 feet from the top of a triangular slab of concrete which is about 6 feet on each side and about flush with the surrounding rock.

Reference mark number 1 is a U.S. Geological Survey bronze, bench mark, staked 3334, set into a drill hole in a bed rock outcrop which projects about 10 feet on the southeast side. It is located 4.66 feet lower than the station.

This station was commissioned in 1936 by the Hawaiian Territory Survey, with concrete instrument platform, metal pole and target. At that time they recovered a copper belt driven in a drill hole in phreatic and their installation including the 1/2 inch pipe mentioned, were the mark found. Distance to N.E. 64.2 N (USGS) sheets.

STATE COORDINATES (EAST)

STATE COORDINATES (EAST)

STATE & ZONE

5101

574, 111, 73

169, 106, 81

0.69 23

STATE & ZONE

5101

574, 111, 73

169, 106, 81

0.69 23

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979

THESE DATA SHOULD BE USED FOR ALL SURVEYS AFTER DEC 1979

SM 120
HORIZONTAL CONTROL DATA
by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

NAME OF STATION: OHALO II GS
ESTABLISHED BY: USGS
YEAR: 1897
STATE: Hawaii
COUNTY: Hawaii
HEIGHT OF TELESCOPE ABOVE STATION MARK: 2 feet
HEIGHT OF LIGHT ABOVE STATION MARK: 4 feet

DISTANCES AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS, AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puu Huluhulu (HGS) 1897</td>
<td>NW</td>
<td>10.657</td>
<td>50.12</td>
</tr>
<tr>
<td>Puu Huluhulu (HGS) 1897</td>
<td>NE</td>
<td>10.657</td>
<td>50.12</td>
</tr>
<tr>
<td>EM 3314 (USGS)</td>
<td>NW</td>
<td>10.657</td>
<td>50.12</td>
</tr>
</tbody>
</table>

Station mark and USGS Bench Mark used for EM No. 1 was recovered in good condition. A new reference mark, number two, was established. A description of the station follows:

Station is located in the Kau Desert area of Hawaii Volcanoes National Park, about 1/4 mile southeast of the Park Headquarters, 4 miles north of the Hawaiian Crater, and 1/2-mile north of the hairpin curve in the Puu Huluhulu Road, from which point the Puu Huluhulu Road leads to the sea. It is on the summit of a lava mound about 25 feet higher than surrounding area and at 3318 feet elevation.

To reach station from the Park Headquarters, go south, passing to left of the Volcano House Hotel, and follow the Crater Rim Road southerly for 4.1 miles to crossroad. Turn left and go 2.5 miles on the Chain of Craters Road; turn right on Pali Park Road and go 0.6 miles; leave paved road about 100 yards before reaching the hairpin curve, and go north northwesterly to our mark for 0.3 mile to end of truck travel. Park northernly about 1/4-mile to station on highest point in vicinity.

Station is marked by a 3-inch hole in the center of a triangular concrete block that is 7 feet on each side and flush with surrounding rock. A 5/8-inch iron pipe, 2 feet long, is mounted vertically over the hole, supported by 3 iron legs embedded in the concrete block, and supports an 8-foot, red and white metal target. USGS Bench Mark 3314 (reference mark number one) is a U.S. Geological Survey disk stamped "3314", cemented in a drill hole in the square-edged lava rock ledge southwest of station. It is 1 foot north of south edge of ledge, projects 3-1/2 feet above ground and is 2.8 feet lower than station platform.

Reference Mark number two is a standard disk stamped "OHLALO II GS 1897 NO 2 1967", cemented in a drill hole in bedrock in the northeast end of the station mound, 0.4 foot lower than station platform.

NAME OF STATION: OHALO II GS
ESTABLISHED BY: USGS
YEAR: 1897
STATE: Hawaii
COUNTY: Hawaii
HEIGHT OF TELESCOPE ABOVE STATION MARK: 4 feet
HEIGHT OF LIGHT ABOVE STATION MARK: 6 feet

DISTANCES AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS, AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>BEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puu Huluhulu (HGS) 1897</td>
<td>NW</td>
<td>10.657</td>
<td>50.12</td>
</tr>
<tr>
<td>Puu Huluhulu (HGS) 1897</td>
<td>NE</td>
<td>10.657</td>
<td>50.12</td>
</tr>
<tr>
<td>EM 3314 (USGS)</td>
<td>NW</td>
<td>10.657</td>
<td>50.12</td>
</tr>
</tbody>
</table>

The station marks 3314 USGS (reference mark 1), and reference mark 2 were recovered in good condition and the distances and directions to the marks measured on this date compared favorably with the 1967 measurements. The 1967 recovery note is adequate.
HORIZONTAL CONTROL DATA

0 161551 STATION 1042

HAWAII
LATTITUDE 15° 06' TO 15° 30'
LONGITUDE 155° 00' TO 155° 30'
DIAGRAM AG 515 HAWAII

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION PAHALA HAWAIIAN AG CO MILL #5K
STATE HAWAII YEAR 1967 THIRD ORDER

SOURCE 0-13503

DESCRIPTION OF TRIANGULATION INTERSECTION STATION

FAhala, Hawaiian Agriculture


CHIEF OF PARTY: B.W. Whipp

Description, including sketch of object:
Located in southern part of the island, in Pahala Village, at the Hawaiian Agriculture Co. Sugar Mill.
Station is the center of the tall, steel stack about 125 feet high, brown-colored with black top section, and supported by 3 sets of guy cables. It sets between the first two gable roofs at the southwest end of the row of 4 gable roofs which cover the large, main building.

JUN 1978
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY, NATIONAL GEODETIC SURVEY

STATE COORDINATES (FT)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z OR A ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 1</td>
<td>5101</td>
<td>506.941.30</td>
<td>133.191.07</td>
<td>+ 0 00 24</td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE Z OR A FORMULA NEGLECTING THE SECOND TERM

TO STATION OR OBJECT GEOGRAPHIC AZIMUTH (FROM N-S) PLANE AZIMUTH* CODE

QF 458
HORIZONTAL CONTROL DATA

DESCRIPTION OF TRIANGULATION STATION

PAHALA

NAME OF STATION: PAHALA WEST BASE (HTS)

STATE: HAWAII

COUNTY: EAU DISTRICT

CHIEF OF STATION: L. C. WILDER

YEAR: 1949

DIRECTED BY: G. J. HOFKESPE

NOTE: 1. BURGESS, 4 INCH FIBER GLASS STATION BASE, 1.9 MILES NEER. SIGHTS AND DISTANCES TO NEARBY BASE, ERSAH WAVE AND GROUND OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEASURED DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DEGREES' MINUTES' SECONDS'</td>
<td>FEET</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>18.919</td>
<td>5.772</td>
</tr>
<tr>
<td>2A</td>
<td></td>
<td>00 00 00</td>
</tr>
<tr>
<td>R N 1</td>
<td>20.059</td>
<td>6.115</td>
</tr>
<tr>
<td>R N 2</td>
<td></td>
<td>317 23 50</td>
</tr>
<tr>
<td>PUU ULAULA (metal target)</td>
<td>55 55 55.9</td>
<td></td>
</tr>
</tbody>
</table>

The station is located on open pasture land about 2 1/2 miles south-southeast of Paahoa, about 2 miles north-northeast of Puunukua, about 1 1/2 miles north of the ocean,about 1 mile southeast of the road which runs between Naalehu and Hilo, about 300 yards to southeast of a wooden water tank, about 200 yards north of a small stream and about 100 yards southeast of a wire fence.

To reach from the post office at Naalehu; go easterly, on the road which leads toward Hilo, for 1.5 miles; pass the sugar mill, in the village of Honomea, and continue northeasterly, toward Hilo, for 6.7 miles; turn sharp right, onto the old highway, and go southerly for 0.1 mile; turn left, pass through a board gate, and go southeast, across the pasture, for 1.2 miles to a wire fence and the end of truck travel. From this point proceed southeasterly for about 100 yards toward the station.

The station is the center of a 2 inch hole in the top of a concrete pyramidal which has a base of about 2 1/2 feet and is about 2 feet in height.

Reference mark number 1 is a standard disk, stamped WEST BASE NO 1 1949, set into a drill hole in bedrock which projects about 6 inches and is located about 2 feet lower than the station.

Reference mark number 2 is a standard disk, stamped WEST BASE NO 2 1949, set into a drill hole in bedrock which projects about 1 foot and is about the same elevation as the station.

(continued on next page)
HORIZONTAL CONTROL DATA

by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

PAHALA WEST BASE (HTS) (continued)

RECOVERY NOTE, TRIANGULATION STATION
NAME OF STATION: PAHALA WEST BASE (HTS)
ESTABLISHED BY: L.C. Wilder
YEAR: 1919
STATE: Hawaii
RECOVERED BY: D.M. Whipp
YEAR: 1967
COUNTY: Hawaii
Island: Hawaii
HEIGHT OF TELESCOPE ABOVE STATION MARK: 0.9 METER
HEIGHT OF LIGHT ABOVE STATION MARK: 0.0 METER

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
<th>FEET</th>
<th>METERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUNALUU</td>
<td>1949</td>
<td>00 00 00.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RM No. 3</td>
<td>318.8</td>
<td>NW</td>
<td>61.115</td>
<td>44</td>
</tr>
<tr>
<td>RM No. 2</td>
<td>NW</td>
<td>61.115</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>RM No. 1</td>
<td>S</td>
<td>18.999</td>
<td>5.777</td>
<td></td>
</tr>
</tbody>
</table>

Station was recovered and all marks found in good condition. The wooden water tank mentioned in original description is gone. A complete description follows:

Station is located about 2 miles northeast of Punalu, 2 1/2 miles south-southeast of Paahala and 1 mile southeast of State Highway 11 at about 120 feet elevation on a slight rise in very brushy pasture land, 500 feet southeast of a wire fence.

To reach station from the post office in Paahala, go north on Pike Street for 0.2 miles turn right on State Highway 15 and go 0.45 mile to junction with State Highway 11. Turn right and go southwest on State Highway 11 for 2.2 miles to diagonal, macadam crossroad. Go left 30 yards to board gate. Pass through gate and go 0.15 mile to board gate on left (the left 1 of 2). Pass through gate and follow field road southeast 0.3 mile; pass through metal gate and continue 0.35 mile to where road bears left, opposite a board gate on right. Continue on the road left for 0.3 mile to end of truck travel where road comes to fence on right on a 30° angle. Walk southeast across very brushy area for 500 feet to station.

Station mark is the center of a 2 1/4-inch hole in the top of a triangular concrete pyramid; 3 feet on each side at the base, about 28 inches high, and 9 inches on each side at the top. The words "WEST BASE 1949," are inscribed in the concrete on southeast side of pyramid. Station is 3 feet southeast of a cairn with a 7-foot 2 x 4 in it's center.

Reference mark number one is a standard disk stamped "WEST BASE NO 1 1949," cemented in a drill hole in a bedrock outcrop that projects 6 inches and is 2 feet lower than station mark, hidden in brush and grass.

Reference mark number two is a standard disk stamped "WEST BASE NO 2 1949," cemented in a drill hole in an open, lava area flush with ground and about 4 inches higher than station.

Reference mark number three is a standard disk stamped "WEST BASE NO 3 1949," cemented in a drill hole in brown bedrock area flush with ground in pasture, 15 feet northwest of fence line and 130 feet southeast along fence from end of truck travel.

NOTE: Out of three forms must be used for every station recovered.
HORIZONTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

SEE STATION PAHALA WEST BASE (HTS)

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: PAHALA WEST BASE
STATE: HAWAII
YEAR: 1949
SECOND ORDER

SOURCE: G-9279

DEGREES LATITUDE: 15° 09'-06.166"
DEGREES LONGITUDE: 155° 29'-28.207"
ELEVATION: 434.5 METERS

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z (M) [O] [A] [M]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI 1</td>
<td>5101</td>
<td>503,047.72</td>
<td>119,648.66</td>
<td>+ 0 00 10</td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE [X] [O] [A] [M] FORMULA NEGLECTING THE SECOND TERM

TO STATION OR OBJECT | DEGREES AZIMUTH (FROM NORTH) | PLANE AZIMUTH* | CODE |

POSITION DETERMINED BY TRAVERSE FROM STATION PAHALA WEST BASE AND CHECKED BY ADDITIONAL OBSERVATIONS

QE 166
HORIZONTAL CONTROL DATA
by the
National Ocean Survey
OLD HAWAIIAN DATUM

Pali (Hawaii Island, United States Geological Survey, 1920).—In southeast Hawaii, 1½ miles west of Halemaumau, at the place where the “pali” running southwest from Uwekahuna gradually disappears into a low rounded ridge. Station is on low knob of “hawaiian” lava. Mark, a bronze tablet cemented in solid rock.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: PALI
ESTABLISHED BY: U.S.G.S. YEAR 1920 STATE: Hawaii
RECOVERED BY: D.M. Whipp YEAR 1987 COUNTY: Hawaii

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: PALI
STATE: HAWAI'I YEAR 1920 THIRD ORDER

SUNCE G-SP156

<table>
<thead>
<tr>
<th>DEGREES LATITUDE</th>
<th>19° 24' 18.057&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEGREES LONGITUDE</td>
<td>155° 18' 14.979&quot;</td>
</tr>
<tr>
<td>ELEVATION (METERS)</td>
<td>1142.20</td>
</tr>
<tr>
<td>ELEVATION (FT)</td>
<td>3747.3</td>
</tr>
</tbody>
</table>

STATE COORDINATES (FEET)

<table>
<thead>
<tr>
<th>STATE &amp; ZONE</th>
<th>CODE</th>
<th>X</th>
<th>Y</th>
<th>Z (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI 1</td>
<td>9101</td>
<td>567,006.55</td>
<td>207,656.79</td>
<td>0 05 53</td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE 2 N.D. FORMULA NEGLECTING THE SECOND TERM.

TO STATION OR OBJECTS

<table>
<thead>
<tr>
<th>GEODETIC AZIMUTH</th>
<th>PLANE AZIMUTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0° 300
HORIIZNTAL CONTROL DATA

by the
National Ocean Survey
OLD HAWAIIAN DATUM

PANANA (Hawaii Island, E. R. Hand, 1914).—On the east coast of Hawaii, in the area known locally as Panu, up on the high shoulder south along the coast from the village of KalaPatana, and 9 miles distant. The land around the station is smooth lava, grass-covered, with a few ohia trees; it slopes gently toward the sea for a few hundred feet, then drops abruptly to the flat lava behind the coastline. To reach station go to the house of Rina, a native, 50 meters above the old Volcano-Kalapatana trail; from this house the station bears S. 20° W., 1,120 meters. Marked by a survey tablet set in cement on top of a prominent lava mound, about 10 feet above the general level. A tall tree stump is on mound, between station and reference mark, which is a tablet set in the mound, 4.48 meters (14.8 feet) from the station, bearing N. 30° W.

RECOVERY NOTE: TRIANGULATION STATION

Name of Station: PANANA
Established by: E.R. Hand
Year: 1914
State: Hawaii
Bench Marks Also:

Recovered by: D.M. Whipp
Year: 1967
County: Hawaii
Airline Distance and Orientation from Nearest Town:
Island: Hawaii

Detailed statement as to the nature of the original description, including marks found, coordinates, bearings, and other pertinent facts:

Station mark and reference mark were recovered in good condition.

A complete description follows:

Station is located about 9 miles west-southwest of Kalapana, 1-1/4 miles northwest of the coastline, 1/2-mile south of the Kalapana Trail and 1-1/2 miles east of a hairpin curve in the highway. It is along the open, grassy benchland, about 1/4-mile back from cliff edge, on a large prominent lava mound on a slight rise. There are a few scattered ohia trees in the vicinity of the station.

To reach station from the Volcano National Park Headquarters, go south on Crater Rim Road for 4.1 miles to crossroad. Turn left and follow the Chain of Craters Road for 13.7 miles to hairpin curve in highway, at 1,250 feet elevation, and end of truck travel. Pack easterly along open area, keeping about 1/4-mile back from cliff edge and maintaining same elevation, for about 1-1/2 miles to station, at about 1,110 feet elevation.

Station mark is a standard disk, unstamped, cemented in a drill hole in bedrock in the highest part of the lava mound, which is about 25 feet in diameter and extends about 10 feet above general ground level. There is a small, stone hut with corrugated metal roof about 75 yards southeast of station.

Reference mark number one is a standard disk, unstamped, cemented in a drill hole in the northwest side of top of mound, at about same elevation as station mark. It is 4.43 meters (14.8 feet) from station in azimuth 150°.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: PANANA
STATE: HAWAII
YEAR: 1914
PUBLICATION: ORDNANCE

STATE COORDINATES (WGS 84)

STATE & ZONE CODE X Y X ORG (M) Y ORG (M)
HI 1 2 5101 6,954,912.23 177,811.78 + 0.07 46

---

* Planar azimuth has been computed by the J CO. F FORMULA neglecting the second term.

---

TO STATION/POINT GEODETIC AZIMUTH (From station) PLANE AZIMUTH (From station) CODE

PANANA 242° 55' 40.2" 241° 55' 54.9" 5101

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These data obtained from adjustment of Jan 1979.

The CO3 data should be used for all surveys after Dec 1979.

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(continued on next page)
RECOVERY NOTE, TRIANGULATION STATION

The station and reference mark 1 were recovered in good condition. A difference was noted in the distance to reference mark 1, being 0.034 meter longer compared to the 1907 data. No data was available for a comparison in the direction to reference mark 1. Reference mark 3 was not at this time and due to changes in the description follows.

The station is located about 2 miles west-southwest of Volcano Village, 1/4 mile north of the coastline, 1/4 mile south of the Pololu Valley trail and 1/4 mile east of a highway curve in the highway. It is along the open pasture beginning about 1/4 mile back from a cliff edge, on a large prominent lava mound that is in an easterly direction. There are a very few scattered ohia trees in the vicinity of the station and it is in the Kilauea Volcano National Park.

The station was reached by helicopter, but the 1907 description to the station should be adequate.

The station mark is a 0.250 disk, unstacked, cemented in a drill hole in lava rock in the highest part of the lava mound which is about 95 feet in diameter and elevated about 10 feet above general ground level. It is 3 feet west of the southeast edge of the lava mound and 3 feet southeast from the edge of a hole formed in the lava.

Reference mark 1 is a 0.250 disk, unstacked, cemented in a drill hole in lava rock in the northeast edge of the lava mound. It is 1.5 feet northeast of the hole formed by the lava and is about the same elevation as the station mark.

Reference mark 2 is a 0.250 disk, stamped KANO 1914 NO 2 1977, cemented in a drill hole in lava rock that projects about 1 foot above the surrounding rock. It is 17 feet west of the edge of a drop-off and about 5 feet lower than the station mark.

*Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

HORAZ. FORM 76-96 SUPERSEDED 1968 FORM 76A WHICH MAY BE USED. U.S. DEPARTMENT OF COMMERCE
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: PI LI
STATE: HAWAII
YEAR: 1894
THIRD ORDER

SOURCE: G-SP 156

<table>
<thead>
<tr>
<th>GEODETIC LATITUDE</th>
<th>15° 09' 03.14&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEODETIC LONGITUDE</td>
<td>157° 27' 36.79&quot;</td>
</tr>
<tr>
<td>ELEVATION</td>
<td>METERS</td>
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</table>

<table>
<thead>
<tr>
<th>STATE COORDINATES</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>STATE &amp; ZONE</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CODE</td>
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<tr>
<td>X</td>
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</tr>
<tr>
<td>47</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* PLANE AZIMUTH HAS BEEN COMPUTED BY THE FORMULA 'f. FORMULA 'f' FORMULA 'f' FORMULA 'f' FORMULA 'f'.

<table>
<thead>
<tr>
<th>IMPROVEMENT OF OBJECT</th>
<th>GEODETIC AZIMUTH</th>
<th>PLANE AZIMUTH</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 255</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NO TEXT
Pulama (Hawaii Island, E. R. Hand, 1914).—On eastern coast of Hawaii, 4 miles west from Kalapana, 2½ miles northwest from Kupapaupu Point, up on the steep slope, 50 meters below timber line. A black lava flow is between the station and Kupapaupu Point. Position of station may be determined as follows: There is an isolated house belonging to Joe Canario above the trail, and 330 meters to southwest in the lava flow is a grave with a galvanized iron roof. From the station the northeast part of Kupapaupu Point will be seen between the house and grave; and the coconut grove at Looapuki will bear S. 20° W. Also from the station the house will be on range with a small lagoon in the bay just above Kupapaupu Point. Marked by a survey tablet set in a patch of cement down in a fissure in a natural rock pile some 4 feet high. Reference mark is a tablet set in highest part of rock pile; it is 1.2 feet higher than the station, and is 0.54 meters (1.8 feet) therefrom, bearing S. 34° W.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: PULAMA

ESTABLISHED BY: E.R. Hand YEAR: 1914 STATE: Hawaii BENCH MARK: Also


ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: PULAMA

STATE: Hawaii

YEAR: 1914

FIRST ORDER

CWS BY CGS

SOURCES: H-16491

GEOGRAPHIC LATITUDE: 19 11 29.20 W

GEOGRAPHIC LONGITUDE: 155 02 34.76 W

ELEVATION: 291.5 Meters

641 Feet

STATE &區 ZONE CODE X Y Z

HI 1 3411 637.532.16 189.873.49 + 0 09 05

* PLAN ARMSPIR HAS BEEN COMPUTED BY THE THIRD FORMULA NEGLECTING THE SECOND TERM

TO STATION OF OBJECT CODE GEOGRAPHIC ADCMEITY (From station) PLANE ADCMEITY (From station)

HAKAULA 276 35 42.7 276 36 37 + 5101

THESE DATA OBTAINED FROM ADJUSTMENT OF JAN 1979

THESE DATA SHOULD BE USED FOR ALL SURVEYS AFTER DEC 1975

(continued on next page)
HORIZONTAL CONTROL DATA
by the
NATIONAL GEOGRAPHIC SURVEY
OLD HAWAIIAN DATUM

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: PULAMA
ESTABLISHED BY: F. H. Hand
YEAR: 1914
STATE: Hawaii
BENCHMARK ALSO: 
RECOVERED BY: R. D. McLain
YEAR: 1970
COUNTY: Hawaii

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
4 miles west of Kalapana Village
HEIGHT OF TELESCOPE ABOVE STATION MARK:
7.5 feet
HEIGHT OF LIGHT ABOVE STATION MARK:
7.6 feet

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.77</td>
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</tr>
<tr>
<td>2</td>
<td>1.37</td>
<td>006.0</td>
</tr>
</tbody>
</table>

Table continues...

The station and reference mark 1 were recovered in good condition.
but no data was available for a comparison check to reference mark 1.
Reference mark 2 was not at this time and due to changes a new

description follows.

The station is located about 4 miles west of Kalapana Village, 7
miles north of highway 13 at about 70 feet elevation and is on property
owned by Paranuas Construction Company, Phone number 533-1907.

To reach the station from the junction of State Highways 132 and 13
at the northeast end of Kalapana Village, go southwest on highway 13
for 1.7 miles to Kalapana Village and two churches, one on each side
of the highway. Continue southwest on highway 13 for 1.1 miles to a side
road right. Turn right, then left and continue west on a paved road
for 1.1 miles to a side road right; turn right and go north on a paved
road for 1.45 miles to a cross road. Turn left and go west on a paved
road for 0.15 mile to a cross road; turn right and go north on a paved
road for 0.2 mile to a side road left; turn left and go west on the
paved road for 0.1 mile to a trail road on the left; turn left and go
southwest on the trail road for 0.1 mile to the station on the right.

Station mark 1 is a CASS disk, unstamped, cemented in a drill
hole in a rock that surrounds the station mark and is about 1-1/2
feet above the station mark. It is 35 feet west of the track road and
about 15 feet higher.

Reference mark 2 is a CASS disk, stamped FULAMA 1914 NO 2 1977,
cemented in a drill hole in lava rock and is flush with the ground
surface. It is 35 feet west of the track road, 22 feet south of a
10-inch oak tree and is about the same elevation as the station mark.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: PULAMA
ESTABLISHED BY: F. H. Hand
YEAR: 1914
STATE: Hawaii
BENCHMARK ALSO: 
RECOVERED BY: R. D. McLain
YEAR: 1970
COUNTY: Hawaii

AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:
4 MILES WEST OF KALAPANA

Detailed statements as to the fitness of the original description, including Exact trend, stumps, edges marks, and other pertinent facts:

The station and reference marks were recovered in good condition.
HORIZONTAL CONTROL DATA

NAME OF STATION: PUN
STATE: Hawaii
YEAR: 1929
COUNTY: Hawaii
Island: Hawaii

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION: PUN
QUIET OR FLATLY: K. T. Adams
REFERENCE MARK: No. 1
REFERENCE MARK: No. 2
VITRES MARK: No. 1
VITRES MARK: No. 2
HEIGHT ABOVE STATION MARK: 1.59 meters
HEIGHT OF LIGHT ABOVE STATION MARK: 1.00 meters

DISTANCES AND DIRECTIONS TO ADJACENT MARKS, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEASURING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAMEHAHE NEW (Hts) 1949</td>
<td>1929</td>
<td>00 00 00 00</td>
<td>00 00 00 00</td>
</tr>
<tr>
<td>KM No. 1</td>
<td>190</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>KM No. 2</td>
<td>32.14</td>
<td>210</td>
<td>210</td>
</tr>
<tr>
<td>KAMEHAHE NEW (Hts) 1949</td>
<td>1967</td>
<td>00 00 00 00</td>
<td>00 00 00 00</td>
</tr>
<tr>
<td>KM No. 1</td>
<td>188</td>
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<td>188</td>
</tr>
<tr>
<td>KM No. 2</td>
<td>20.54</td>
<td>20.54</td>
<td>20.54</td>
</tr>
<tr>
<td>PANALU, KINOA MARK SHTES, 1969</td>
<td>1969</td>
<td>105.54</td>
<td>32.12</td>
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<tr>
<td>KM No. 1</td>
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<td>188</td>
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<tr>
<td>KM No. 2</td>
<td>20.54</td>
<td>20.54</td>
<td>20.54</td>
</tr>
</tbody>
</table>

Stations were recovered and all marks found in good condition. A complete description follows:

Station located in northern part of island, along coastline, about 1 mile east of Panalau village, in rough lava area, on top of a lava mound.

To reach station from the post office in Pahala, go southeast on Pine St. for 0.2 mile; turn right on State Highway 15 and go 0.85 mile; turn right and go southwest on State Highway 11 for 3.8 miles; turn left on the Panalau Road and go down grade 0.75 mile; turn left onto old rail road grade and go 0.35 mile to end of road at old dock. Walk easterly on good trail across rock and lava about 1 mile to station.

Station mark is a standard disk stamped "PUN 1929", cemented in a drill hole in lava bedrock 20 feet north of the 8-foot-high, sheer south edge of the mound. It is 1-1/2 feet in diameter of a mound with 6 x 6-inch timber 9 feet long in the center, about 100 feet north of center line. An area covered with large, rounded boulders begins at east side of station and runs east about 200 yards.

Reference marks number one is a standard disk marked "1 1929", cemented in a drill hole in the north part of the station mound, across a large crack from station mark and 6 feet east of another large crack.

Reference marks number two is a standard disk marked "2 1929", cemented in a drill hole in a lava area across a boulder-stream draw from station. It is 21 feet north of a bluff edge and about 4 feet lower than station mark.
HORIZONTAL CONTROL DATA

by the National Ocean Survey
OLD HAWAIIAN DATUM

Puu Huluhulu (H05) (Hawaii County, Hawaii, H05, 1891; United States Geological Survey, 1920). In southeastern part of Hawaii, in southern Puna, about 3 miles southeast of the Volcano House at Kilauea, on the western triange cut in a stone set firmly in the ground, and three large stones to support instrument. Also by a stone pyramid 10 feet high.

RECOVERY NOTE, TRIANGULATION STATION

Name of Station: Puu Huluhulu (H05)  State: Hawaii  County: Hawaii
Established by: H.G.S.  Year: 1891  Locality: Puna, Hawaii
Recovered by: H. G. & L. Survey  Year: 1968

Detailed statement as to the status of the original description:

Location of station: In the S.E. part of Hawaii about 3 miles southeast of the Volcano House on the highest part of the western crater rim of a prominent hill called Puu Huluhulu. It can be reached by taking the chain of Craters Road.

Old station mark found: Drill hole in A on rock firmly set in ground with large stone pile over it.

New station mark: H.T.S. Type D-1 monument (Triangular concrete monument 7 1/2 feet on each side with 1 1/2 foot steel bar 2 feet long set on steel legs over the station mark which is left exposed to view. A standard metal target is set over the steel bar).

(continued on next page)
HORIZONTAL CONTROL DATA

by the
NATIONAL GEODETIC SURVEY
OLD HAWAIIAN DATUM

NAME OF STATION: PUU HULULU (HSS)
State: Hawaii
Established By: Hawaiian G.S., 1891
Recoverd By: G. J. Hoeppe
NOTE:
DISTANCE AND DIRECTION TO ADJACENT MARKS, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEASURING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OAHLE (HSS) 1897-1949</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>BM No. 1</td>
<td>N</td>
<td>32.335</td>
<td>9.862</td>
</tr>
<tr>
<td>BM No. 2</td>
<td>NW</td>
<td>32.200</td>
<td>9.873</td>
</tr>
</tbody>
</table>

Station was recovered and all marks found in good condition. A complete description follows:

The station is located on the western rim of the prominent, volcanic cone which lies about 8 miles north of the sea, 5.5 miles southwest of the Chain of Craters Road, and about 0.6 miles north of the Hawaii National Park Headquarters.

To reach the station from the Chain of Craters Road, make a right turn at the road's end and drive 0.6 miles to the west on a well-marked trail.

The station is the center of a 1/2-inch iron bar which projects about 8 feet from the top of the volcanic cone.

Reference mark number one is a standard disk stamped "PUU HULULU NO 1 1949", set into a drill hole in the boulder which is about 8 feet south of the center of the boulder.

The station is the center of the boulder, and is about 8 feet south of the upper edge of the cone.
**RECOVERY NOTE, TRIANGULATION STATION**

**NAME OF STATION:** NOAA 1981 NO 5 1977

**ESTABLISHED BY:** NOAA

**YEAR:** 1981

**STATE:** Hawaii

**MILEAGE:** 5 1/2 miles SE of Hawaii Volcanoes

**COUNTY:** Hawaii

**AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:** 5 1/2 miles SE of Hawaii Volcanoes

**HEIGHT OF TELESCOPE ABOVE STATION MARK:** 4 feet

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**DISTANCES AND DIRECTIONS TO NEAREST MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE STATION AT THE STATION:**

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>NEARING</th>
<th>DISTANCE</th>
<th>DIRECTION</th>
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</thead>
<tbody>
<tr>
<td>CHALE HGS 1897</td>
<td>NNE</td>
<td>6.03</td>
<td>1,836</td>
</tr>
<tr>
<td>RM 3</td>
<td>E</td>
<td>9.25</td>
<td>2,819</td>
</tr>
<tr>
<td>RM 3 to RM 3440 USGS</td>
<td>SE</td>
<td>12.34</td>
<td>3,759</td>
</tr>
</tbody>
</table>

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The station is located in the Hawaii Volcanoes National Park, about 5 1/2 miles southeast of the Park Headquarters building and 1/2 mile north of the Chain of Craters Road, on the west rim of a prominent, wooded volcanic cone.

To reach the station from the Hawaii Volcanoes National Park Headquarters, go east for 0.15 mile to side road right. Turn right and go east and southeasterly 0.45 mile to a T-road. Turn left and go east 2.45 miles to crossroad. Turn left and go east for 2.15 miles to side road right. Continue east 1.55 miles to crossroad and a locked gate on the left. Key may be obtained at the Park Headquarters, turn left and go north 0.55 mile to a track right. As the north end of a lava flow, turn right and go east on track road 0.15 mile to a lava flow and the end of the road. Park east on the track on the lava flow to a fork at a better trail. Bear left and follow this better marked trail to a fork at a signboard at the south side of a grass covered hill. Park north on trail to top and the station site. It is about a 1/2 hour pack.

The station is marked with a Type B-1 signal built by the Hawaii Territorial Survey; this consists of a triangular, concrete platform about 7 feet on each side and projecting 3 inches. In the center of the platform is an 8-inch triangular hole about 7 inches deep. At the bottom of this hole is a 1-inch diameter hole in rock which is assumed to be the station mark. A 2-inch iron shaft, 2 feet long, is mounted vertically over the center of the hole, supported by 3 iron legs embedded in the platform, and holds a red and white metal target 8 feet high. The station is about 50 feet north of a stone observation point on the crater rim.

Bench Mark 3440 USGS serves as reference mark number 2. It is a USGS disk, stamped 3440 1912, cemented in a drill hole in bedrock ledge, 1 foot south of the cliff edge, and about level with the station. Measurements made on this date are compatible with the 1967 ones.

Reference mark 3, stamped NOAA 1981 NO 5 1977, is a USGS tablet cemented in a drill hole in bedrock, about 1 1/2 feet south of the edge of a cliff and about level with the station.

*Note:} Chief of party should be inserted here. The person who actually visited the station should sign his name at bottom of the recovery note.

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-36 SUPERSEDES FORM 76-32 WHICH MAY BE USED.**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**

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**U.S. DEPARTMENT OF COMMERCE**

**NOAA FORM 76-31A**