

# FLIGHT SUMMARY REPORT

**Flight Number:** 94-154  
**Calendar/Julian Date:** 30 September 1994 • 273  
**Sensor Package:** Wild-Heerbrug RC-10  
 Airborne Visible and Infrared Imaging Spectrometer (AVIRIS)  
 Modis Airborne Simulator (MAS)  
 Electro-Optic Camera System (EOC)  
**Area(s) Covered:** Northern California

**Investigator(s):** Kaufman, GSFC; Green, JPL;  
 Johnson, ARC

**Aircraft #:** 706

## SENSOR DATA

<b>Accession #:</b>	04827	-----	-----	-----
<b>Sensor ID #:</b>	034	099	108	111
<b>Sensor Type:</b>	RC-10	AVIRIS	MAS	EOC
<b>Focal Length:</b>	12" 304.66 mm	-----	-----	-----
<b>Film Type:</b>	Aerochrome IR 2443	-----	-----	-----
<b>Filtration:</b>	Wratten 12	-----	-----	-----
<b>Spectral Band:</b>	510-900 nm	-----	-----	-----
<b>f Stop:</b>	11	-----	-----	-----
<b>Shutter Speed:</b>	1/150	-----	-----	-----
<b># of Frames:</b>	122	-----	-----	-----
<b>% Overlap:</b>	60	-----	-----	-----
<b>Quality:</b>	Excellent	-----	Good	-----
<b>Remarks:</b>	Camera clock offset 3.5 seconds from navigation data			

## Airborne Science and Applications Program

The Airborne Science and Applications Program (ASAP) is supported by three ER-2 high altitude Earth Resources Survey aircraft. These aircraft are operated by the High Altitude Missions Branch at NASA-Ames Research Center, Moffett Field, California. The ER-2s are used as readily deployable high altitude sensor platforms to collect remote sensing and *in situ* data on earth resources, celestial phenomena, atmospheric dynamics, and oceanic processes. Additionally, these aircraft are used for electronic sensor research and development and satellite investigative support.

The ER-2s are flown from various deployment sites in support of scientific research sponsored by NASA and other federal, state, university, and industry investigators. Data are collected from deployment sites in Kansas, Texas, Virginia, Florida, and Alaska. Cooperative international scientific projects have deployed the aircraft to sites in Great Britain, Australia, Chile, and Norway.

Photographic and digital imaging sensors are flown aboard the ER-2s in support of research objectives defined by the sponsoring investigators. High resolution mapping cameras and digital multispectral imaging sensors are utilized in a variety of configurations in the ER-2s' four pressurized experiment compartments. The following provides a description of the digital multispectral sensor(s) and camera(s) used for data collection during this flight.

## Airborne Visible and Infrared Imaging Spectrometer

The Airborne Visible and Infrared Imaging Spectrometer (AVIRIS) is the second in the series of imaging spectrometer instruments developed at the Jet Propulsion Laboratory (JPL) for earth remote sensing. This instrument uses scanning optics and four spectrometers to image a 614 pixel swath simultaneously in 224 contiguous spectral bands (0.4-2.4  $\mu\text{m}$ ).

AVIRIS parameters are as follows:

IFOV:	1 mrad
Ground Resolution:	66 feet (20 meters) at 65,000 feet
Total Scan Angle:	30°
Swath Width:	5.7 nmi (10.6 km) at 65,000 feet
Spectral Coverage:	0.41-2.45 $\mu\text{m}$
Pixels/Scan Line:	614
Number of Spectral Bands:	224
Digitization:	10-bits
Data Rate:	17 MBPS

<u>Spectrometer</u>	<u>Wavelength Range</u>	<u>Number of Bands</u>	<u>Sampling Interval</u>
1	0.41 - 0.70 $\mu\text{m}$	31	9.4 nm
2	0.68 - 1.27 $\mu\text{m}$	63	9.4 nm
3	1.25 - 1.86 $\mu\text{m}$	63	9.7 nm
4	1.84 - 2.45 $\mu\text{m}$	63	9.7 nm

All AVIRIS data is decommutated and archived at JPL and not currently available for public distribution. For further information contact Rob Green at Jet Propulsion Laboratory, 4800 Oak Grove Drive, Mail Stop 183-501, Pasadena, California 91109-8099.

## Modis Airborne Simulator

The Modis Airborne Simulator (MAS) is a modified Daedalus multispectral scanner. It records up to twelve 8-bit channels, which can be selected from an array of fifty available spectral bands. The band selection is made prior to flight and the instrument is hard-wired to that configuration. Channel 1 is used to store additional bits which provide 10-bit resolution for channels 9 through 12. The following MAS band combination (configuration SCAR-C) was used on this flight for SCAR-C data acquisition:

<u>Data System Channel</u>	<u>MAS Channel</u>	<u>Band edges <math>\mu\text{m}</math></u>
1	--	-----
2	1	0.529 - 0.572
3	10	1.595 - 1.652
4	10	1.595 - 1.652
5	15	1.855 - 1.905
6	20	2.126 - 2.173
7	46	11.799 - 12.246
8	32	3.825 - 3.975
9*	2	0.635 - 0.688
10*	7	0.852 - 0.893
11*	45	10.791 - 11.239
12*	32	3.825 - 3.975

\* 10-bit resolution

### Sensor/Aircraft Parameters:

Spectral Channels:	50
Output Channels:	Seven 8-bit and four 10-bit
IFOV:	2.5 mrad
Ground Resolution:	163 feet (50 meters at 65,000 feet)
Total Scan Angle:	85.92°
Pixels/Scan Line:	716
Scan Rate:	6.25 scans/second
Ground Speed:	400 kts (206 m/second)
Roll Correction:	Plus or minus 3.5 degrees (approx.)

## Camera Systems

Various camera systems and films are used for photographic data collection. Film types include high definition color infrared, natural color, and black and white emulsions. Available photographic systems are as follows:

- Wild-Heerbrug RC-10 metric mapping camera
  - 9 x 9 inch film format
  - 6 inch focal length lens provides area coverage of 16 x 16 nautical miles from 65,000 feet
  - 12 inch focal length lens provides area coverage of 8 x 8 nautical miles from 65,000 feet
- Hycon HR-732 large scale mapping camera
  - 9 x 18 inch film format

- 24 inch focal length lens provides area coverage of 4 x 8 nautical miles from 65,000 feet
- IRIS II Panoramic camera
  - 4.5 x 34.7 inch film format
  - 24 inch focal length lens
  - 90 degree field of view provides area coverage of 2 x 21.4 nautical miles from 65,000 feet

The U.S. Geological Survey's EROS Data Center at Sioux Falls, South Dakota serves as the archive and product distribution facility for NASA-Ames aircraft acquired photographic and digital imagery. For information regarding photography and digital data (including areas of coverage, products, and product costs) contact EROS Data Center, Customer Services, Sioux Falls, South Dakota 57198 (Telephone: 605-594-6151).

### Electro-Optic Camera System

The NASA-Ames High Definition Electro-Optic Camera System (EOC) is an experimental sensor under development by the High Altitude Missions Branch at NASA-Ames Research Center. The system captures high resolution digitized images from a solid-state video camera and stores the imagery on magnetic tape. System characteristics are as follows:

#### CCD Video Camera

IFOV:	0.2 mrad
Ground Resolution:	15.8 feet (4.81 meters at 65,000 feet)
Total Scan Angle:	13.96°
Swath Width:	3.3 nmi (6.2 km) x 2.7 nmi (4.9 km) at 65,000 feet
Spectral Coverage:	400-900 nm
Frame Size:	1280 pixels x 1025 pixels
Lens (Interchangeable):	28 mm
Shutter Speed:	Selectable
Aperture:	f/2.8
Filtration:	4 and 6 position filter wheels (4 and 6 spectral filters) Polarizing Filter
Tracking Capability:	Tilt 45° fore and aft

#### Data Collection

Frame Rate:	1 image every 3 seconds
Frame Overlap:	90% (to 40% w/6 filters)
Data Storage:	Tape Cassette
Capacity:	5.0 Gbytes

For further information contact Ted Hildum at NASA-Ames Research Center, Mail Stop 240-6, Moffett Field, California 94035-1000.

For specific information regarding flight documentation, sensor parameters, and areas of coverage contact the Aircraft Data Facility, NASA-Ames Research Center, Mail Stop 240-6, Moffett Field, California 94035-1000 (Telephone: 415-604-6252). Additional information regarding ER-2 acquired photographic and digital data is also available through the Aircraft Data Facility.

**CAMERA FLIGHT LINE DATA  
FLIGHT NO. 94-154**

Accession # 04827

Sensor # 034

Check Points	Frame Numbers	Time (GMT-hr, min, sec)		Altitude, MSL feet/meters	Cloud Cover/Remarks
		START	END		
A - B	7458-7468	19:10:55	19:15:43	65000/19800	10% cumulus (frames 7463-7464)
C - D	7469-7494	19:21:52	19:33:52	"	Minor-10% cumulus (frames 7472-7474; 7492-7494)
E - F	7495-7501	19:47:43	19:50:36	"	100% strato-cumulus
G - H	7502-7513	19:56:08	20:01:24	"	Minor cumulus (frames 7506-7507)
I - J	7514-7522	20:09:00	20:12:50	"	Clear
K - L	7523-7545	20:26:28	20:37:01	"	20-50% cumulus (frames 7523-7525); minor-10% cumulus (frames 7526-7527)
M - N	7546-7551	20:45:53	20:48:17	"	Clear
O - N	7552-7555	20:58:45	21:00:10	"	Clear
O - N	7556-7559	21:10:42	21:12:09	"	Clear
P - Q	7560-7565	21:21:24	21:23:48	"	10% cumulus (frame 7565)

**CAMERA FLIGHT LINE DATA  
FLIGHT NO. 94-154**

**Accession # 04827**

**Sensor # 034**

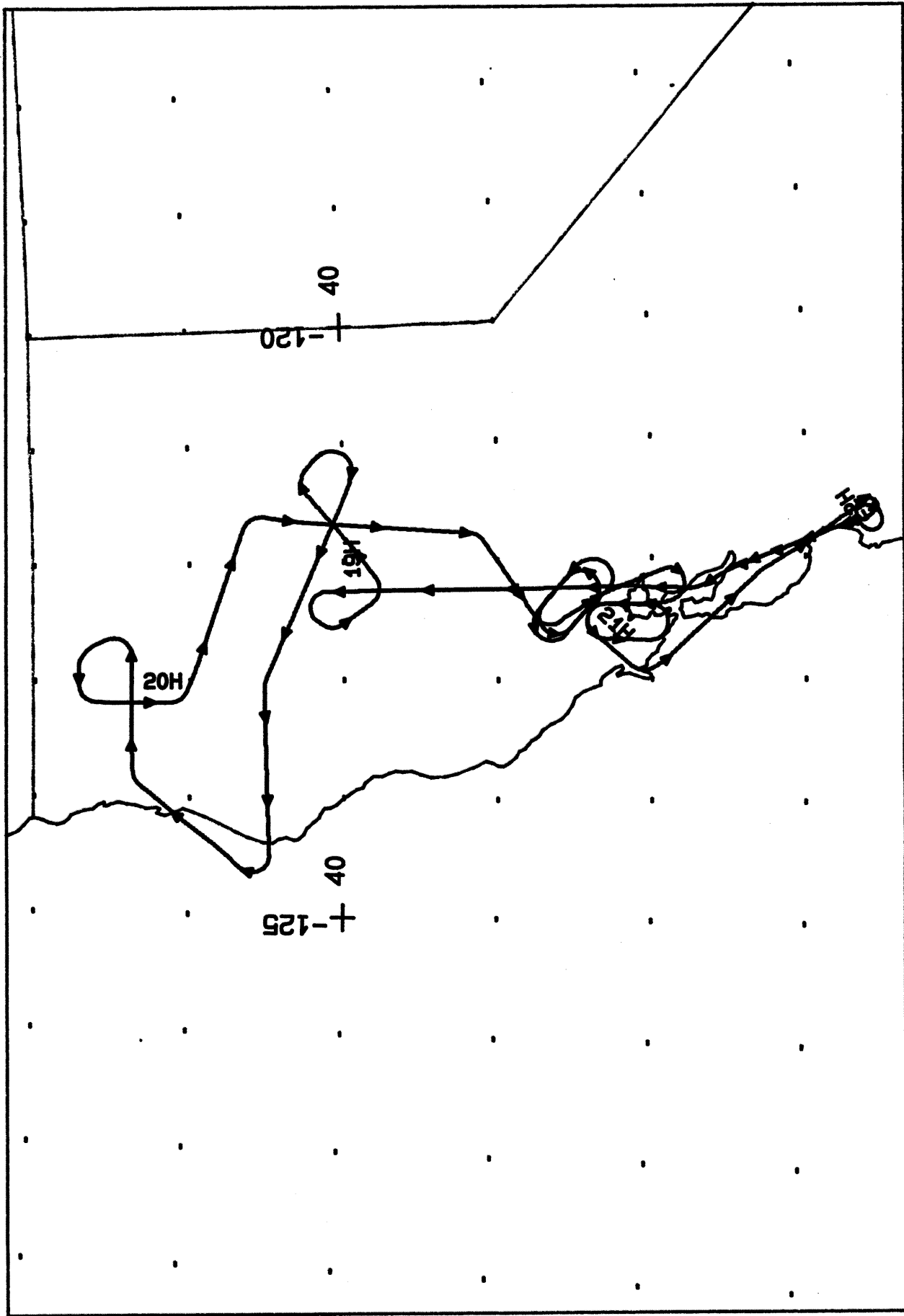
Check Points	Frame Numbers	Time (GMT-hr, min, sec)		Altitude, MSL feet/meters	Cloud Cover/Remarks
		START	END		
P - Q	7566-7571	21:33:05	21:35:28	65000/19800	Minor cumulus (frame 7571)
R - S	7572-7579	21:45:57	21:49:18	"	30-90% strato-cumulus (frames 7572-7574); 10% strato-cumulus (frames 7575-7577)

# MAS SCANNER FLIGHT LINE DATA

## FLIGHT NO. 94-154

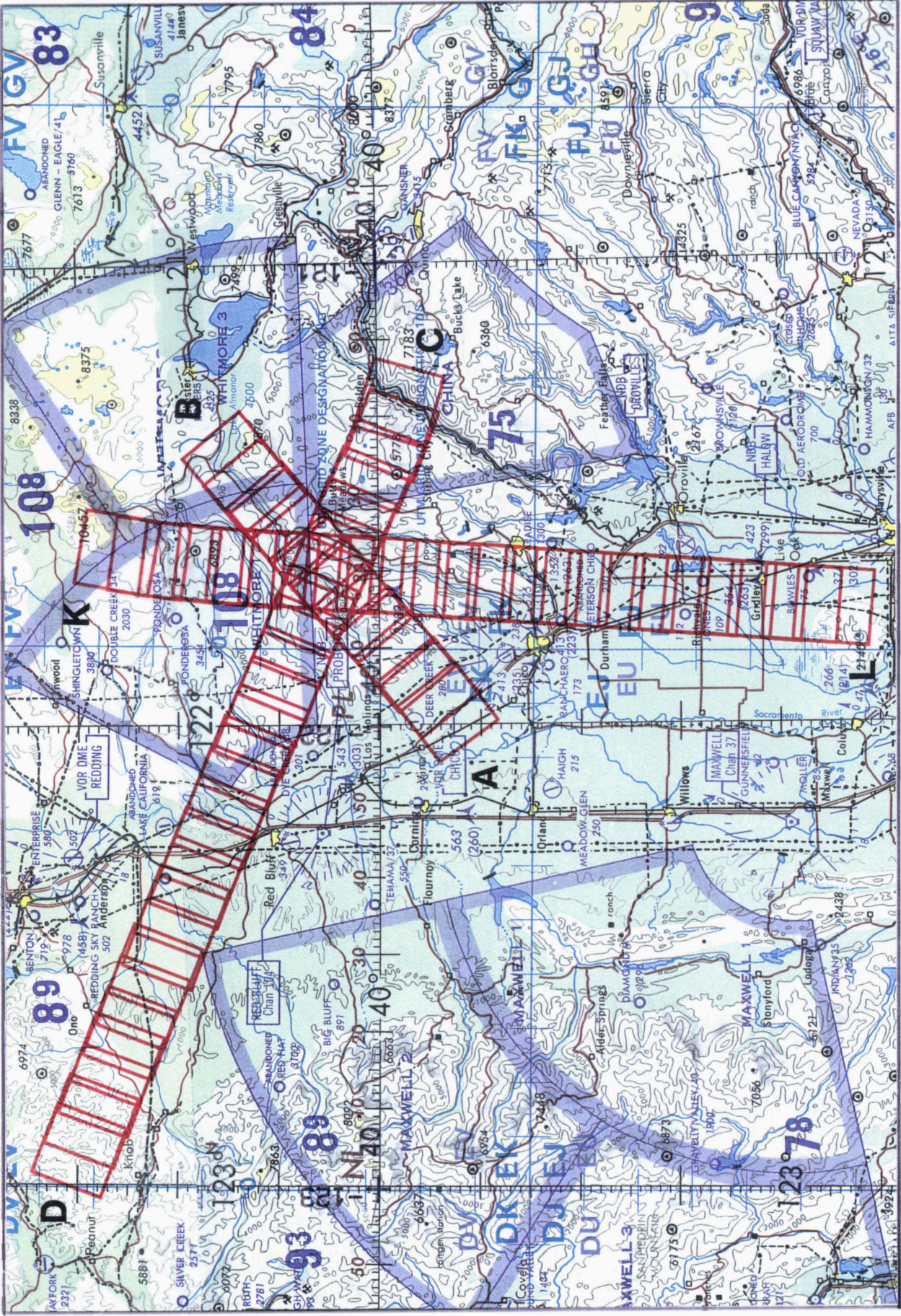
DAEDALUS FLIGHT DATA  
FLIGHT NUMBER: 94-154

Check Points	A c t u a l t i m e b e g i n	A c t u a l s c a n l i n e b e g i n	A l t i t u d e f e e t / m e t e r	S c a n S p e e d (r p s)	t o t a l G o o d s c a n l i n e s	t o t a l I n t e r p o l a t e d s c a n l i n e s	t o t a l R e p e a t e d s c a n l i n e s		
A-B	19:10:14.0	19:15:48.0	34709	36788	65000/19812	6.25	2080	0	0
C-D	19:21:55.0	19:34:23.0	39065	43718	65000/19812	6.25	4654	0	0
E-F	19:47:39.0	19:51:6.0	48668	49955	65000/19812	6.25	1288	0	0
G-H	19:55:37.0	20:01:43.0	51638	53915	65000/19812	6.25	2278	0	0
I-J	20:09:9.0	20:13:7.0	56687	58172	65000/19812	6.25	1486	0	0
K-L	20:26:24.0	20:37:32.0	63122	67280	65000/19812	6.25	4158	1	0
M-N	20:45:46.0	20:48:25.0	70349	71339	65000/19812	6.25	991	0	0
O-N	20:58:46.0	21:00:38.0	75200	75893	65000/19812	6.25	694	0	0
O-N	21:10:27.0	21:12:18.0	79556	80249	65000/19812	6.25	694	0	0
P-Q	21:21:4.0	21:23:43.0	83516	84506	65000/19812	6.25	991	0	0
P-Q	21:33:0.0	21:35:24.0	87971	88862	65000/19812	6.25	892	0	0
R-S	21:45:13.0	21:49:59.0	92525	94307	65000/19812	6.25	1783	0	0



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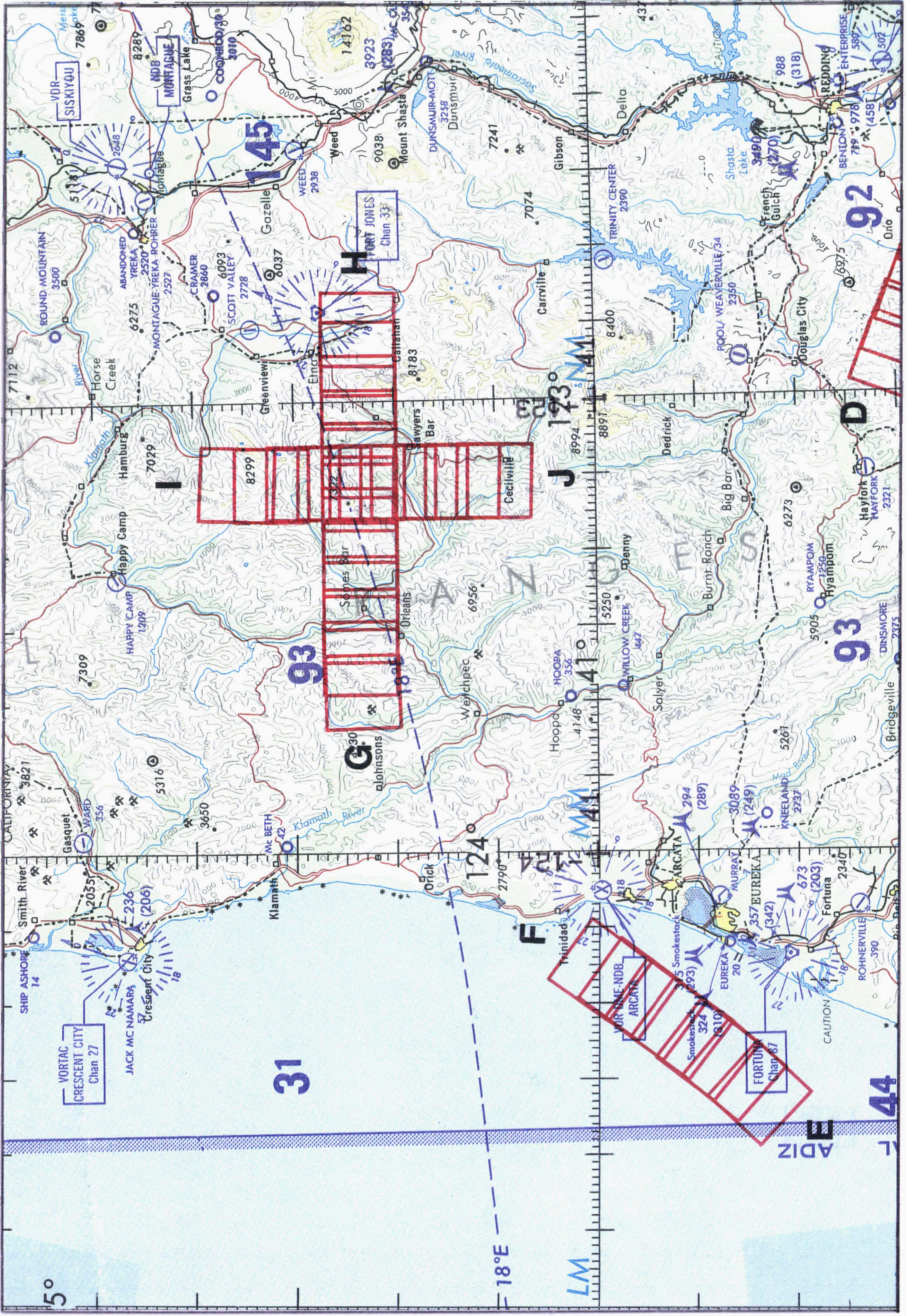
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