UNCLASSIFIED

THE LOCAL AREA FORECASTER'S HANDBOOK FOR NAVAL AIR FACILITY EL CENTRO, CALIFORNIA

REVISED 01 May 1998

NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY DETACHMENT EL CENTRO, CA

PREPARED BY:
CHIEF PETTY OFFICER IN CHARGE
NAVAL PACIFIC METEORLOGY AND OCEANOGRAPHY DETACHMENT

PREPARED FOR:
COMMANDER,
NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND
STENNIS SPACE CENTER, MS 39529-5005

NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY DETACHMENT

NAVAL AIR FACILITY

EL CENTRO, CALIFORNIA

LOCAL AREA FORECASTER'S HANDBOOK

FOREWORD

This publication was prepared in accordance with NAVMETOCCOMINST 3140.2E.

One of the primary purposes of a forecaster's handbook is to provide personnel, inexperienced in a particular locality, with guidance as to typical weather developments to be expected. This, in turn, will tend to compensate for a lack of local forecasting experience. The handbook serves as a ready reference and review for forecasters already familiar with the weather conditions of the Imperial Valley area. It also contains lessons learned in forecasting local meteorological conditions.

This handbook includes topography, exposure, local climatology, special features and forecasting rules and aids to be utilized by the Naval Pacific Meteorology and Oceanography Detachment, El Centro forecasters. It is primarily an empirical study of weather patterns that effect the local flying area at the Naval Air Facility, El Centro, CA.

Each forecaster attached to the Naval Pacific Meteorology and Oceanography Detachment, El Centro will be issued a handbook, and is encouraged to recommend changes or additions to improve the effectiveness of the forecasting methods discussed in the handbook. In addition, this publication will be reviewed and least annually and revised as required.

Christopher R. Gunderson
Commanding Officer

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CHAPTER I
SECTION DESCRIPTION

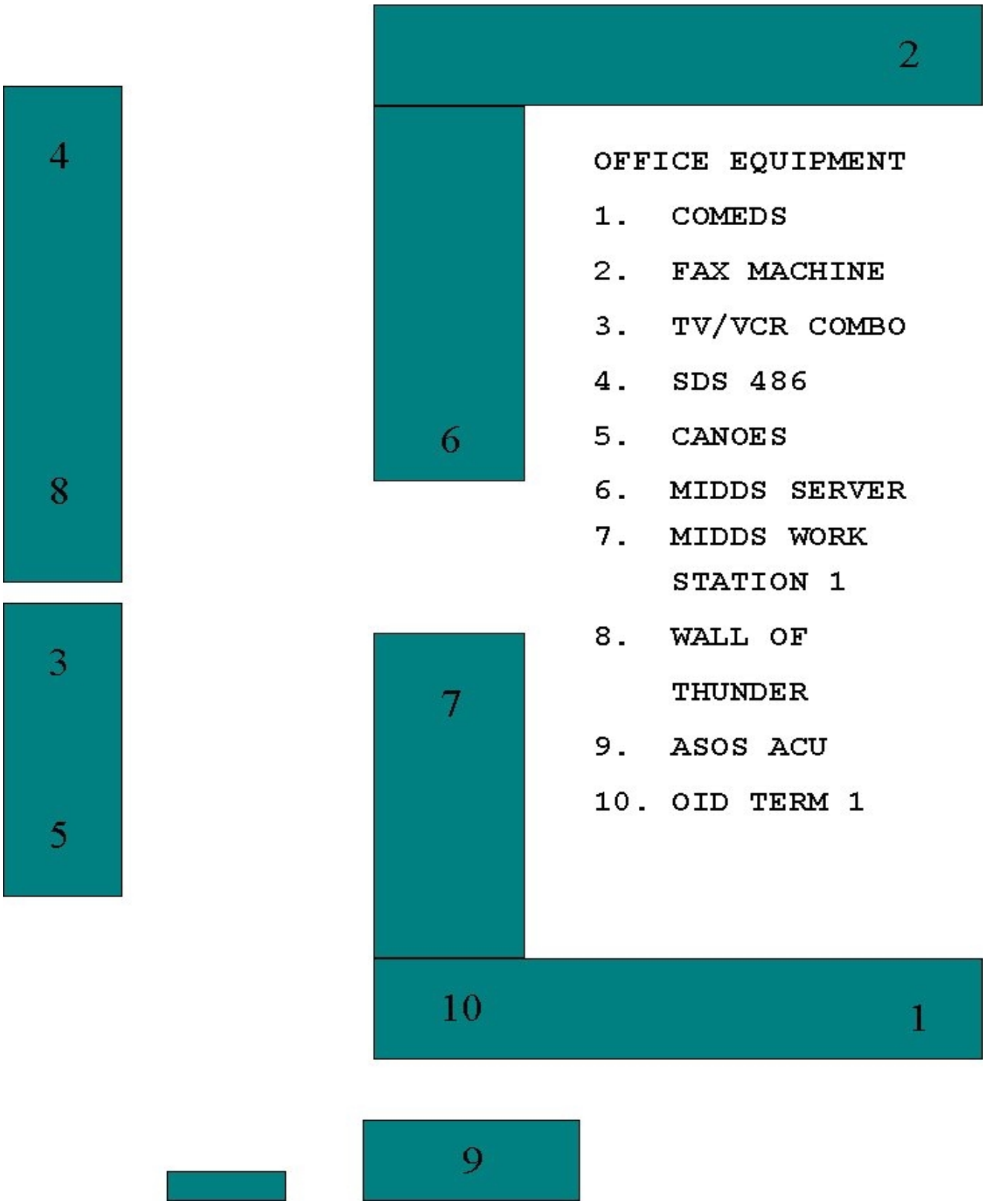
A. LOCATION AND TOPOGRAPHY

The Naval Air Facility, El Centro, California is located at latitude 32 degrees 49, north and longitude 115 degrees 40, west. The station elevation is 43 feet below sea level. The station is 7 miles west of the city of El Centro, California; 53 miles west of the city of Yuma, Arizona and 120 miles east of the city of San Diego, California. The Mexican border is 10 miles to the south.

The station is located in the southwestern corner of the Imperial Valley which is almost entirely below sea level. The Salton Sea, at the northern-most extremity of the valley, is the lowest point at 2351. The Salton Sea is 28 miles long; with its southern-most tip 19 miles from the station. The Salton Sea is also an extremely salty body of water.

The Imperial Valley is oriented in a northwest to southeast line, beginning near Palm Springs, California and extending into Mexico, to the Gulf of California and the Baja Peninsula. Another large lake Laguna Salada, lies in the southern section of the Imperial Valley. The valley itself consists of a relatively flat desert terrain. It is almost surrounded by mountains except to the east, where the sand hills and dunes are located at a distance of 45 miles; and to the southeast, where lie the Yuma Desert of Arizona and the Gran Desierto of Sonora, Mexico. Mountain boundaries and heights are as follows:

Mountain Range	Direction	Distance	Max Altitude
Laguna	West	38 miles	6515 ft.
Vallecito	West	32 miles	5349 ft.
San Bernardino	Northwest	64 miles	6553 ft.
Santa Rosa	Northwest	57 miles	6623 ft.
Orocopia	North	55 miles	4200 ft.
Chocolate	Northeast	37 miles	3200 ft.
Chuckwalla	Northeast	50 miles	4504 ft.
Signal	South	15 miles	2562 ft.

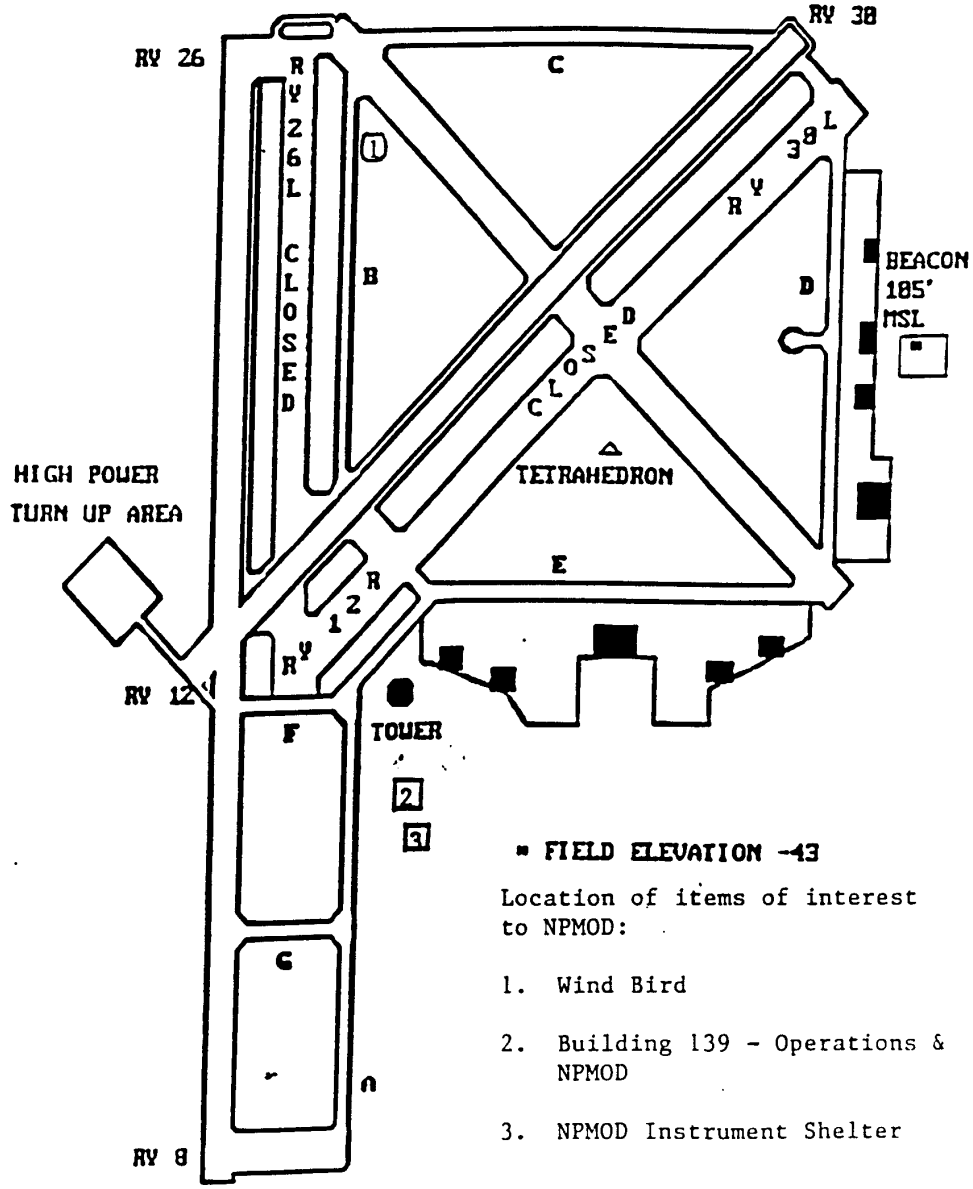


OFFICE EQUIPMENT

1. COMEDS
2. FAX MACHINE
3. TV/VCR COMBO
4. SDS 486
5. CANOES
6. MIDDS SERVER
7. MIDDS WORK STATION 1
8. WALL OF THUNDER
9. ASOS ACU
10. OID TERM 1

I-2

NAVAL AIR FACILITY, EL CENTRO FIELD DIAGRAM

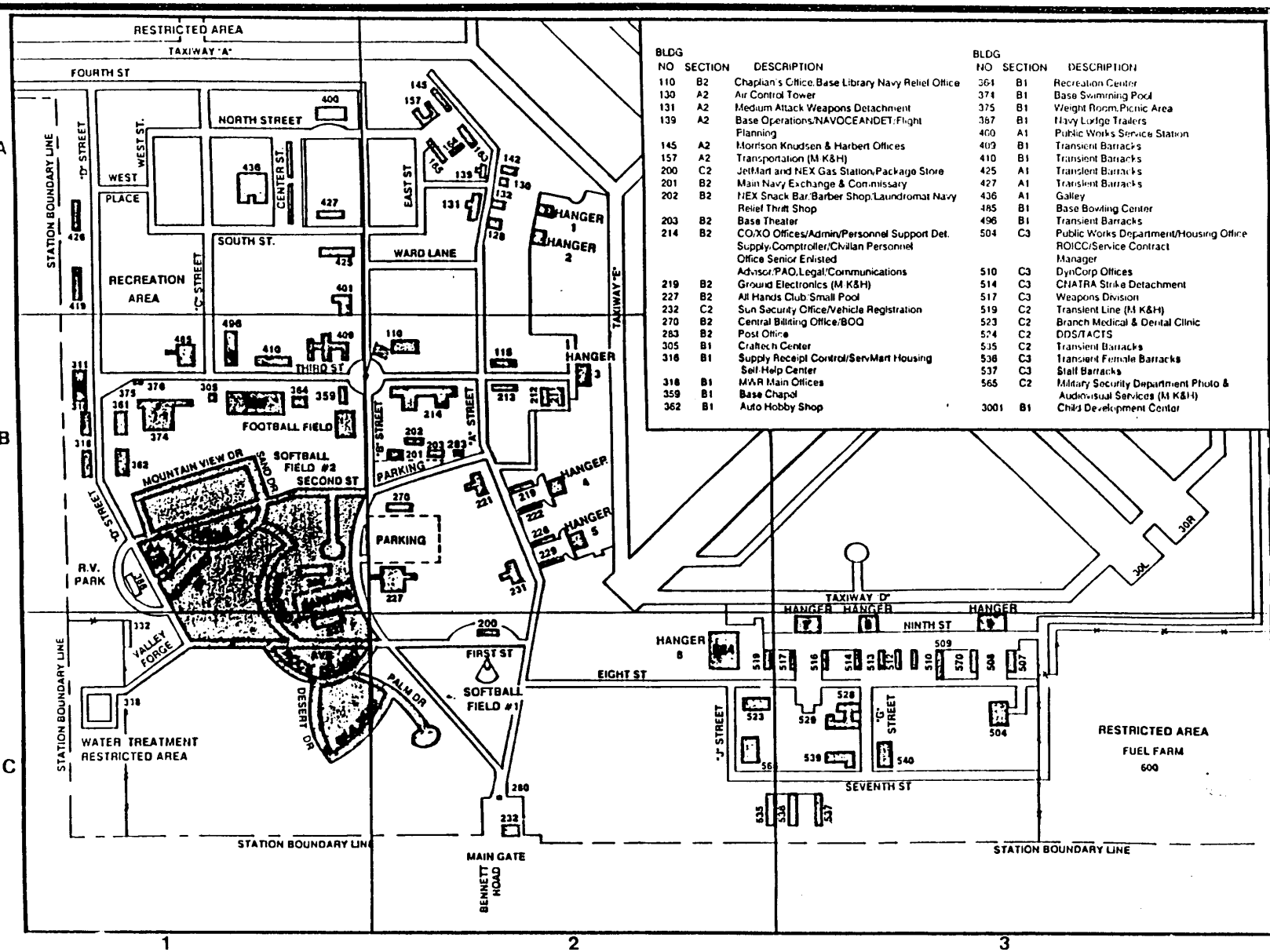


■ FIELD ELEVATION -43

Location of items of interest to NPMOD:

1. Wind Bird
2. Building 139 - Operations & NPMOD
3. NPMOD Instrument Shelter

I-3



BLDG NO	SECTION	DESCRIPTION
110	B2	Chaplain's Office/Base Library Navy Relief Office
130	A2	Air Control Tower
131	A2	Medium Attack Weapons Detachment
139	A2	Base Operations/NAVOCEANDET/Flight Planning
145	A2	Morrison Knudsen & Harbert Offices
157	A2	Transportation (M K&H)
200	C2	JetMart and NEX Gas Station/Package Store
201	B2	Main Navy Exchange & Commissary
202	B2	NEX Snack Bar/Barber Shop/Laundromat Navy Relief Thrift Shop
203	B2	Base Theater
214	B2	CO/XO Offices/Admin/Personnel Support Det. Supply/Comptroller/Civilian Personnel Office Senior Enlisted Advisor/PAO/Legal/Communications
219	B2	Ground Electronics (M K&H)
227	B2	All Hands Club/Small Pool
232	C2	Sun Security Office/Vehicle Registration
270	B2	Central Billiting Office/BOQ
283	B2	Post Office
305	B1	Craftech Center
316	B1	Supply Receipt Control/ServMart Housing Self-Help Center
318	B1	MWR Main Offices
359	B1	Base Chapel
362	B1	Auto Hobby Shop

BLDG NO	SECTION	DESCRIPTION
364	B1	Recreation Center
374	B1	Base Swimming Pool
375	B1	Weight Room/Picnic Area
387	B1	Navy Lodge Trailers
400	A1	Public Works Service Station
409	B1	Transient Barracks
410	B1	Transient Barracks
425	A1	Transient Barracks
427	A1	Transient Barracks
436	A1	Galley
485	B1	Base Bowling Center
496	B1	Transient Barracks
504	C3	Public Works Department/Housing Office ROICC/Service Contract Manager
510	C3	DynCorp Offices
514	C3	CNATRA Strike Detachment
517	C3	Weapons Division
519	C2	Transient Line (M K&H)
523	C2	Branch Medical & Dental Clinic
524	C2	DDS/TACTS
535	C2	Transient Barracks
538	C3	Transient Female Barracks
537	C3	Staff Barracks
565	C2	Military Security Department Photo & Audiovisual Services (M K&H)
3001	B1	Child Development Center

SECTION II

LOCAL CLIMATOLOGY

The Climatological information provided in this chapter is based on climatology kept by the Imperial Valley Irrigation District's Weather Station at Imperial, CA. (Imperial, CA. is located 10 miles east of The Naval Air Facility, El Centro). Records date from 1914 to 1984.

A. TEMPERATURES

1. The highest maximum temperature ever recorded at NAF El Centro was 126 degrees. It was recorded on 28 July 1995.

2. The lowest minimum temperature ever recorded was 16 degrees on January 22nd, 1937.

3. The lowest maximum temperature was 42 degrees, recorded on January 24, 1949. The highest minimum temperature was 90 degrees, recorded on 10 August 1946, and July 15th and 30th, 1953.

4. Highest monthly mean temperature was 95.9 degrees, recorded in August, 1969. The month of lowest minimum temperature was February, 1939, with 42.3 degrees.

B. RAINFALL

1. June has been the driest month of the year. Since 1914, only once was there measurable precipitation during that month 0.04" on June 2nd, 1948 and only traces were recorded in 1918, 1922, 1924, 1929, 1930, 1932.

2. The highest rainfall in one day was recorded on September 6th, 1939, when 4.081, was measured. The total for that month 7.061, made September, 1939, the month with the highest amount of rainfall. The year 1939 was also the highest on record with 8.52". The year with the lowest amount of rainfall was 1956, with 0.16". The average annual rainfall is 2.92".

C. SNOWFALL

1. The only recorded snowfall of consequence was in 1932. On December 12th of that year, snow began falling at 8:45 pm. and by 5:00 am. of the following day, 2 1/2" had been recorded. In the southeast portion of the Imperial Valley, 1 1/4 of snow was reported that day. That was the only recorded snowfall of record to cover the Imperial Valley.

D. PRESSURE

NAF El Centro has a distinct diurnal pressure pattern dependent on month of year. Refer to figures II-1 and II-2.

IMPERIAL IRRIGATION DISTRICT
MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1994, INCLUSIVE

Year	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE			JULY		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1914	No records for these months												100	51	75.4	112	58	84.4	110	70	89.8
1915	73	30	53.5	79	40	59.2	92	41	63.4	96	48	69.0	103	41	73.3	109	57	85.1	110	62	88.9
1916	75	25	52.3	88	29	61.8	100	42	67.8	100	44	71.8	105	50	75.9	116	55	85.4	111	62	89.9
1917	76	30	50.4	82	32	57.4	93	32	58.8	98	41	66.7	99	48	71.0	117	56	85.5	113	70	91.3
1918	85	26	53.7	88	28	57.1	95	40	64.7	96	44	69.5	98	50	73.0	113	59	88.7	110	59	89.6
1919	82	24	51.6	82	32	56.1	89	35	60.4	100	48	71.8	101	55	77.0	114	57	85.4	111	73	90.7
1920	81	33	55.6	82	41	60.5	85	38	61.1	96	44	68.0	106	41	76.2	108	58	82.8	115	63	91.3
1921	79	28	52.2	93	32	54.2	93	41	66.3	102	40	66.9	104	46	72.5	110	57	84.2	111	63	91.0
1922	75	23	49.5	90	28	55.7	89	32	58.8	96	40	65.1	106	46	77.1	114	62	86.5	111	69	90.3
1923	85	28	56.1	87	30	56.7	89	34	60.4	95	42	67.8	107	52	78.1	114	54	79.5	113	67	88.6
1924	81	27	53.6	91	37	64.2	92	38	66.0	95	39	70.4	107	53	79.8	113	60	88.9	111	65	89.8
1925	82	27	52.6	85	35	61.2	94	39	64.4	100	44	70.7	103	54	78.6	114	55	84.3	115	64	90.6
1926	85	29	53.9	88	33	61.5	91	42	66.9	105	50	73.0	104	55	78.6	113	62	86.9	112	62	90.3
1927	76	32	55.3	87	34	59.6	92	38	62.2	102	41	70.8	110	53	78.7	111	54	84.0	114	68	91.7
1928	86	29	56.2	84	33	57.6	91	42	66.0	96	39	69.6	105	53	77.9	112	57	85.2	114	62	90.3
1929	79	25	50.7	88	24	55.0	95	36	61.9	98	36	66.0	102	49	77.7	117	54	83.9	111	69	90.7
1930	77	28	52.7	89	34	61.0	92	34	62.4	99	45	71.9	104	43	71.7	112	57	83.4	112	68	90.2
1931	85	29	54.8	76	38	58.5	95	37	64.5	97	51	72.5	108	55	80.0	111	58	84.7	116	75	95.2
1932	75	25	49.7	87	28	57.2	94	40	64.1	98	47	69.2	102	52	76.9	110	58	84.2	111	63	89.9
1933	76	29	50.2	78	23	51.1	87	39	63.4	96	45	66.2	106	44	73.4	111	57	84.0	117	65	92.9
1934	81	30	56.5	82	40	62.9	101	42	72.6	102	42	75.5	112	54	82.2	106	52	80.5	118	66	93.7
1935	84	29	55.4	84	36	60.1	89	36	60.1	95	43	69.7	102	51	75.0	113	58	88.6	113	61	90.2
1936	78	31	54.9	83	35	59.3	93	41	67.2	101	43	73.3	106	51	80.6	117	54	88.0	119	63	92.4
1937	68	16	43.8	82	31	55.7	88	41	61.2	98	46	69.0	108	53	77.2	110	58	84.7	117	72	94.6
1938	80	33	56.8	82	34	57.1	88	38	61.4	105	40	69.7	111	50	77.9	112	58	85.7	115	62	91.7
1939	78	35	53.6	81	32	42.3	95	32	63.4	102	48	73.2	108	55	79.2	114	59	85.1	118	66	92.2
1940	83	32	57.8	83	35	58.5	91	39	66.8	103	52	72.3	108	61	82.7	117	62	88.4	116	61	90.8
1941	74	38	56.5	78	44	61.0	87	43	63.8	95	45	67.3	105	48	79.6	108	58	83.4	114	66	91.6
1942	80	27	56.4	78	33	56.3	93	38	62.5	94	45	69.1	110	46	76.7	113	58	85.6	118	71	94.5
1943	85	25	55.6	85	32	60.5	95	44	67.0	100	45	72.1	106	55	79.0	110	53	81.5	119	62	89.9
1944	80	31	53.9	78	32	54.5	88	39	61.3	99	47	69.3	100	50	76.3	110	57	79.9	112	64	87.9
1945	81	33	55.9	82	36	58.5	88	37	60.3	100	35	68.5	100	54	76.1	114	58	83.5	113	72	91.9
1946	78	31	54.9	86	31	56.3	87	40	62.3	101	44	73.1	103	56	77.0	111	60	87.6	111	67	91.5
1947	83	28	52.9	85	39	61.7	88	42	64.8	104	45	72.9	116	52	79.7	110	61	84.7	113	67	92.3
1948	84	25	54.8	85	26	56.9	85	35	59.0	100	41	70.5	104	50	77.3	114	54	83.7	113	65	89.8
1949	71	21	45.3	82	28	53.8	85	41	61.6	102	45	73.3	106	53	77.0	110	57	86.1	115	66	90.7
1950	82	21	51.7	85	34	61.0	95	36	64.9	101	45	73.6	103	49	75.5	118	57	83.6	117	65	89.8
1951	84	32	54.4	88	31	57.5	88	33	62.4	98	46	69.7	111	47	77.4	110	56	83.2	113	63	91.4
1952	75	26	51.4	81	35	58.0	87	37	59.4	95	50	69.5	105	56	81.6	110	55	82.7	111	67	90.5
1953	86	34	59.9	85	30	58.3	91	35	63.5	97	44	68.4	99	49	72.4	113	53	83.6	114	72	93.6
1954	84	31	56.0	92	41	64.4	90	37	61.9	103	45	74.5	102	50	78.0	112	53	83.5	116	71	92.9
1955	77	35	51.9	83	29	55.2	92	35	63.6	88	50	69.0	103	48	74.9	113	55	84.1	113	64	88.7
1956	80	35	58.1	80	29	54.3	93	33	64.9	98	41	68.9	104	52	76.8	113	59	87.1	110	64	90.2
1957	74	30	54.6	89	34	63.7	91	40	64.9	94	45	69.8	102	55	73.8	117	62	88.7	116	71	93.1
1958	80	35	57.5	81	40	61.6	80	38	60.7	102	42	70.4	109	54	82.6	112	61	86.1	117	67	91.2
1959	85	33	58.3	83	37	57.3	91	41	66.9	102	49	74.3	99	51	76.1	116	62	88.8	113	73	94.3
1960	79	27	52.1	81	31	56.9	92	43	67.8	97	47	73.1	109	52	77.8	113	65	89.6	115	69	93.1
1961	83	34	58.0	82	38	60.9	89	43	64.3	103	50	72.3	102	50	76.0	116	56	88.1	114	64	91.2

IMPERIAL IRRIGATION DISTRICT
MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1994, INCLUSIVE

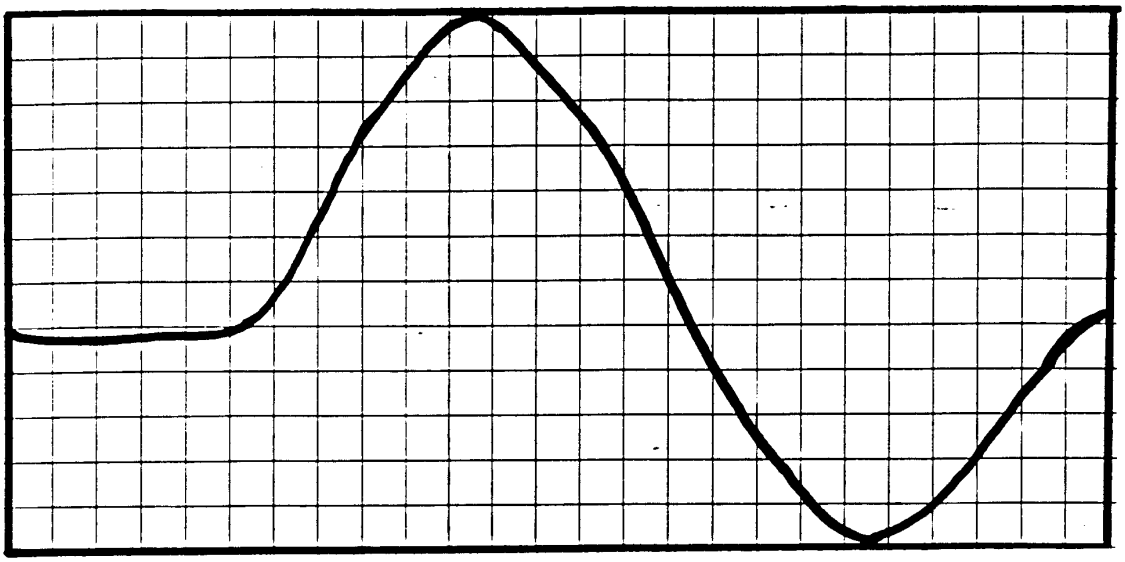
Year	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE			JULY		
	Max	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1962	87	25	55.4	81	28	59.1	89	32	59.7	101	50	74.5	101	48	73.5	111	57	84.4	110	68	90.4
1963	73	24	52.0	90	42	65.3	88	39	62.6	95	43	67.5	104	52	79.2	110	51	82.0	114	69	91.1
1964	77	30	52.0	80	32	56.2	91	36	61.5	99	47	68.4	102	45	76.2	112	60	84.0	116	72	92.1
1965	82	33	57.2	88	31	59.5	84	36	62.1	101	44	70.1	105	52	76.9	105	57	80.6	113	69	90.6
1966	77	30	52.8	77	32	55.9	97	34	65.7	98	49	73.6	103	58	80.4	110	62	86.3	115	71	92.3
1967	81	30	55.4	85	38	60.3	91	42	66.0	88	45	63.3	107	48	76.5	111	57	82.7	113	75	93.3
1968	79	33	55.7	90	44	65.4	92	44	66.0	98	46	69.5	108	55	78.7	115	60	86.6	114	68	91.4
1969	82	33	59.5	76	36	57.5	96	38	63.3	95	49	71.1	107	54	80.1	109	62	82.9	115	67	92.8
1970	79	29	55.3	83	39	61.6	90	43	63.9	94	43	66.9	109	53	78.8	119	58	86.8	113	71	93.1
1971	90	23	55.3	89	31	59.2	98	32	64.8	94	44	68.5	99	54	73.8	112	54	84.2	113	67	92.3
1972	75	24	52.9	86	30	61.8	94	46	70.8	96	42	71.7	102	54	78.3	114	66	86.0	116	73	94.0
1973	77	30	53.3	77	40	59.5	80	43	60.7	97	46	68.5	107	54	80.1	117	57	87.9	115	70	91.2
1974	81	28	56.0	81	38	58.3	90	40	65.6	96	47	70.5	111	51	78.7	116	59	89.4	112	69	91.2
1975	83	31	55.1	83	34	57.6	86	40	61.5	88	42	63.7	105	50	75.8	110	59	85.1	115	71	91.7
1976	86	29	57.2	84	40	60.9	89	42	63.0	99	45	67.7	106	55	79.3	115	50	86.8	115	66	90.6
1977	80	33	56.7	91	39	63.3	87	39	60.8	98	43	72.2	105	53	72.6	115	66	88.3	113	72	93.0
1978	76	37	57.4	82	39	60.6	95	47	67.6	93	48	69.3	107	54	78.7	115	62	90.9	116	68	93.6
1979	74	31	52.6	79	35	58.9	89	42	64.1	97	46	71.9	102	52	77.2	115	61	87.6	115	68	91.9
1980	77	38	60.1	85	39	63.2	86	46	63.3	101	46	70.7	101	52	73.9	114	59	87.4	116	73	94.9
1981	83	42	60.9	90	39	61.8	91	44	64.4	97	47	72.9	103	56	78.4	114	65	90.5	112	73	93.2
1982	76	33	55.8	86	37	61.7	83	41	63.5	94	44	76.7	101	52	70.9	108	59	82.8	113	61	90.5
1983	82	35	59.0	85	42	60.5	90	46	65.2	90	45	66.7	114	52	78.9	108	57	84.3	114	67	92.0
1984	82	35	58.7	83	38	60.3	95	40	66.7	101	48	70.2	111	58	83.0	111	61	85.7	112	75	91.9
1985	73	36	54.8	85	28	57.6	86	39	63.8	101	54	74.3	101	57	79.2	114	61	88.6	116	72	93.3
1986	85	38	61.4	96	34	63.4	99	44	69.5	102	51	72.6	106	53	79.7	114	64	89.2	115	70	91.2
1987	83	31	55.1	82	39	60.0	85	41	64.0	101	50	75.9	104	56	78.8	114	65	88.1	112	64	89.8
1988	79	32	55.5	84	37	61.9	99	40	66.4	101	45	70.7	108	50	77.4	108	54	85.1	111	69	91.6
1989	78	32	54.1	93	30	59.9	96	42	68.8	105	51	76.8	106	54	79.4	111	62	86.9	114	69	92.7
1990	78	31	54.9	86	29	57.9	93	41	66.4	99	53	73.6	102	54	76.9	117	59	87.3	114	69	92.2
1991	77	31	54.9	85	39	64.3	82	38	60.2	98	45	70.1	102	51	75.0	106	60	82.0	112	69	88.8
1992	80	35	55.8	83	44	62.4	85	45	63.9	101	51	74.3	99	60	79.8	108	62	84.6	114	65	89.5
1993	74	29	54.0	78	40	58.6	90	44	67.5	101	50	73.3	100	52	79.1	114	57	86.9	113	67	89.4
1994	82	34	57.5	80	33	56.9	92	44	67.1	100	48	71.3	105	51	75.9	115	63	88.7	112	67	92.3
Average	79.7	30.1	54.7	84.2	34.5	59.0	90.6	39.4	63.9	98.3	45.4	70.5	104.8	51.8	77.4	112.5	58.3	85.5	113.8	67.5	91.5

IMPERIAL IRRIGATION DISTRICT
MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTHS FOR YEARS 1914-1994, INCLUSIVE

	AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER			FOR YEAR				MEAN FOR
Year	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Date	Min.	Date	YEAR
1914	113	64	88.7	108	60	84.1	100	52	73.4	91	41	65.6	No Record			113	8-3	Incomplete		
1915	117	64	90.6	109	52	81.2	104	50	75.5	91	30	60.8	82	28	54.1	117	8-10	28	12-17	71.2
1916	111	56	87.7	110	57	83.1	95	43	68.2	90	30	58.5	79	25	51.2	116	6-15	25	1-12	71.1
1917	109	62	88.9	108	53	85.3	106	44	76.2	90	38	63.7	89	31	58.3	117	6-16	30	1-5	71.0
1918	114	55	86.7	105	56	83.1	110	44	74.7	86	32	59.4	82	28	50.5	114	8-2	26	1-11	70.9
1919	113	67	90.3	107	60	83.7	94	36	68.3	88	31	59.7	82	31	55.6	114	6-26	24	1-1	70.9
1920	111	58	87.8	108	53	81.8	102	41	65.7	86	34	58.2	78	29	52.9	115	7-8	29	12-14	70.1
1921	110	68	88.5	107	57	82.6	103	43	75.1	93	32	62.2	81	33	53.4	111	7-22	28	1-12	70.8
1922	110	67	88.8	113	59	87.2	100	42	73.3	85	34	58.2	79	34	56.6	114	6-29	23	1-23	70.6
1923	107	67	87.6	109	51	80.7	97	44	69.7	83	35	62.1	78	32	52.8	114	6-28	28	1-3	70.2
1924	113	61	89.0	108	48	84.2	100	44	69.4	93	34	61.6	83	23	53.1	113	6-28	23	12-26	72.5
1925	109	67	88.0	104	52	80.7	101	46	70.4	90	33	60.4	80	31	56.0	115	7-16	27	1-11	71.1
1926	110	63	89.4	106	53	82.6	100	44	73.1	92	39	63.4	78	27	52.1	113	6-26	27	12-27	72.6
1927	115	72	90.9	106	56	82.8	101	43	73.8	98	37	63.9	85	31	53.4	115	8-10	31	12-8	72.3
1928	113	60	88.5	113	54	85.5	102	45	72.2	88	31	61.2	79	29	53.0	114	7-24	29	1-18 & 12-17/21	71.9
1929	111	73	90.5	112	54	80.8	104	40	73.8	88	30	59.2	84	31	58.0	117	6-24	24	2-8/9	70.8
1930	110	63	87.6	110	51	79.7	100	46	70.2	92	31	61.0	77	26	51.5	112	6-7 & 7-2, 11, 15	26	12-22	70.3
1931	112	70	89.9	111	58	83.0	98	51	73.1	93	27	58.0	75	28	51.1	116	7-2	27	11-23/25	72.2
1932	114	62	89.9	112	60	85.6	102	45	71.8	87	40	63.2	80	30	50.8	114	8-5	25	1-27	71.0
1933	118	67	91.5	109	59	84.9	105	50	77.9	91	37	63.5	82	29	55.8	118	8-11	23	2-8	71.2
1934	117	71	94.0	114	53	86.5	109	49	77.5	94	38	65.6	81	31	57.2	118	7-26/27, 7-30/31	30	1-9	75.5
1935	115	70	90.6	109	63	87.4	99	42	72.9	81	36	59.5	78	33	56.1	115	8-11	29	1-22	72.2
1936	112	67	91.8	108	52	83.7	103	47	74.2	90	36	62.3	76	32	54.8	119	7-14/16	31	1-19	73.6
1937	115	65	93.6	112	61	88.3	99	54	75.9	91	40	64.3	82	33	58.7	117	7-2	16	1-22	72.4
1938	114	65	90.7	108	64	87.2	101	46	72.5	84	29	57.2	88	35	57.3	115	7-19	29	11-25/28	72.2
1939	111	75	92.7	112	58	82.1	95	44	72.4	91	44	64.7	85	32	59.7	118	7-13	32	2-3/10 3-1; 12-28	72.7
1940	117	66	92.3	110	62	84.3	101	48	75.1	86	38	61.1	85	30	58.6	117	6-13	30	12-15	74.1
1941	109	65	87.2	104	53	79.1	100	47	69.5	91	30	64.2	82	37	56.6	114	7-10/20	30	11-20	71.7
1942	113	62	91.8	109	60	84.1	101	45	73.9	88	36	63.3	81	32	57.1	118	7-24/25	27	1-7	72.6
1943	110	67	88.9	113	64	87.7	105	45	74.8	86	36	62.3	74	35	54.7	119	7-25	25	1-19	73.0
1944	115	65	91.5	111	57	85.7	101	55	76.1	85	35	60.9	77	33	55.9	115	8-11	31	1-9/10	71.2
1945	110	68	90.2	114	56	86.7	101	49	76.2	91	39	61.7	80	31	54.1	114	6-19 & 9-5	31	12-14/16	72.1
1946	113	68	92.0	111	63	86.6	96	46	70.1	81	38	59.0	82	35	57.3	113	8-2	31	1-11/31; 2-3	72.4
1947	113	60	89.2	113	64	87.5	105	49	74.5	89	30	57.9	74	28	51.6	116	5-3	28	1-4 & 12/14	72.4
1948	115	65	91.3	118	54	87.0	103	46	75.5	83	34	58.9	76	31	52.1	118	9-3	25	1-1	71.4
1949	114	61	89.8	112	64	89.7	102	41	71.5	93	43	67.8	87	26	52.8	115	7-14	21	1-4	71.6
1950	116	66	90.5	118	58	82.8	106	54	78.7	98	34	67.2	84	35	60.6	118	6-30 & 9-1	21	1-4	73.3
1951	111	66	89.6	109	62	86.8	105	50	75.6	85	38	60.7	78	30	54.6	113	7-31	30	12-9	71.9
1952	112	72	92.2	112	51	87.6	108	57	81.6	88	34	58.9	84	32	55.1	112	8-3 & 9-1/2	26	1-4	72.4
1953	111	61	90.6	111	61	86.4	101	48	75.2	90	37	64.6	82	26	54.6	114	7-2	26	12-25	72.7
1954	113	66	88.9	108	54	86.5	101	46	76.5	89	43	66.9	79	27	55.7	116	7-28	27	12-29	73.8
1955	110	72	90.9	113	60	86.5	104	52	77.7	89	40	63.4	84	37	57.8	113	6-9/22			

LOCAL STANDARD TIME

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00

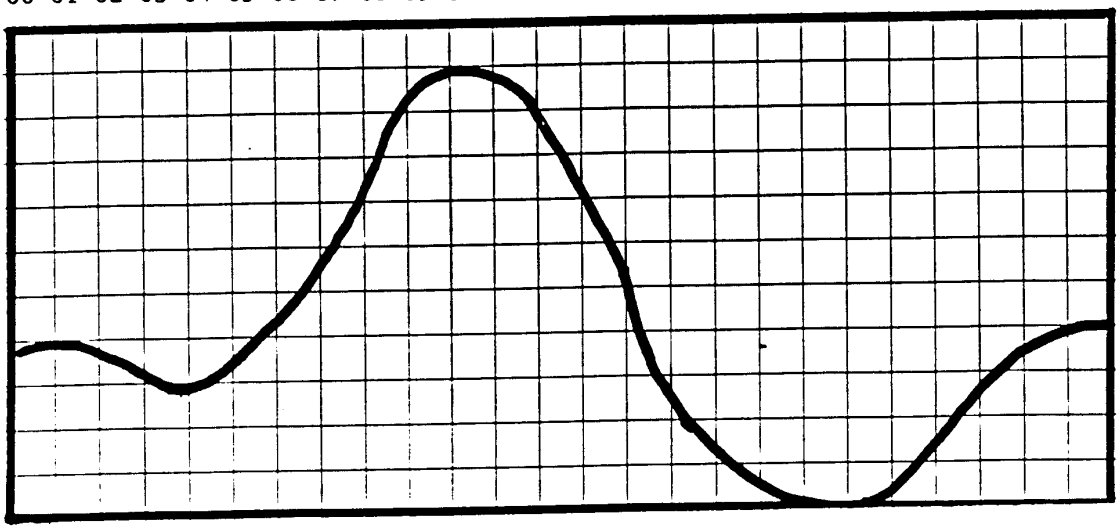


07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07

UNIVERSAL TIME JUNE, JULY, AND AUGUST

LOCAL STANDARD TIME

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00



07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07

UNIVERSIAL TIME SEPTEMBER, OCTOBER, AND NOVEMBER

FIGURE II-2 (DIURNAL PRESSURE CHANGES)

SECTION III

OPERATING AND RESTRICTED AREAS OF THE IMPERIAL VALLEY

A. MILITARY OPERATING AREAS

The Imperial Valley contains two Military Operating Areas (MOA's). KANE MOA comprises the western half of the Imperial Valley and contains the restricted areas 2521 and 2510. ABLE MOA comprises the eastern half of the Imperial Valley and contains restricted areas 2507 and 2510. The military operating Areas cover approximately 350,000 acres of land. Figure 3-1 Illustrates the Military Operating Areas of the Imperial Valley.

B. RESTRICTED AREAS AND BOMBING RANGES

The restricted areas and bombing ranges covered in this chapter exist in the Imperial Valley. Restricted 2510 and 2512 are managed by the Commanding Officer, Naval Air Facility, El Centro. A forecasting requirement is needed for those areas. They are commonly utilized by all aircraft stationed permanently and visiting the Naval Air Facility, El Centro. The exact locations at all the restricted areas mentioned in this chapter are more readily displayed in Figure 3-2. The Restricted Areas are described fully below:

1. Restricted Area 2510

a. Restricted Area 2510 is located 11 miles northwest of the Naval Air Facility, El Centro. It contains two target areas and drop zones.

b. Listed below is a brief description of the target areas and drop zones:

(1) Target 101 is located in the southeast of quadrant R2510. The target elevation is 105' MSL. The target complex includes:

(a) Air-to-ground bombing.
(b) Rocket firing and strafing.
(c) Bomb dummy unit (BDU) drops.
(d) Mobile land targets.

(2) Target 103 is located in the southwest quadrant of R2510. The target elevation is 130' MSL. The

target is an unmanned remotely controlled conventional air-to-ground rocket and bombing target consisting of a 40' diameter bullseye with concentric circles of 75', 150', and 300’.

(3) Both drop zones are used for personnel and equipment drops only. No ordnance drops are authorized. The Superstition Drop Zone is located near the Superstition Mountains in the center of R2510. The Camelot Drop Zone is located between the two targets 101 and 103. Figure 3-3 depicts the exact positions of the targets and drop zones in R2510.

2. Restricted Area 2512

a. Restricted Area 2512 is located east of Brawley, CA and north of Holtville, CA.

b. This area contains two targets similar in design to target 103 in Restricted Area 2510. These targets are numbered 68 and 95.

c. The elevation of both targets is 90, MSL.

d. Both targets consist of unmanned conventional air-to-ground rockets and a bomb target, with a 201 diameter bullseye and concentric circles of 75'. 1501, and 3001.

3. Restricted Area 252-1

a. Restricted Area 2521 surrounds the Salton Sea. This area is used for the spin testing of aircraft and is authorized to be used for personnel and equipment parachute drops.

4. Restricted Area 2507

a. Restricted Area 2507 surrounds the Chocolate Mountain range located 37 miles from this station.

b. This area contains air-to-air gunnery range, an air-to-air dart gunnery range and the Chocolate Mountains impact area.

c. Within the impact area there are:

(1) Five target complexes and assorted search and attack target locations consisting of more than 200 individual targets, including three surface-to-air missile sites, one surface-to-surface missile site, and three simulated airfields.

d. Both air-to-air and air-to-ground ordinance are dropped and utilized in Restricted Area 2507. Laser designating is authorized in specific portions of the northern half of Restricted Area 2507.

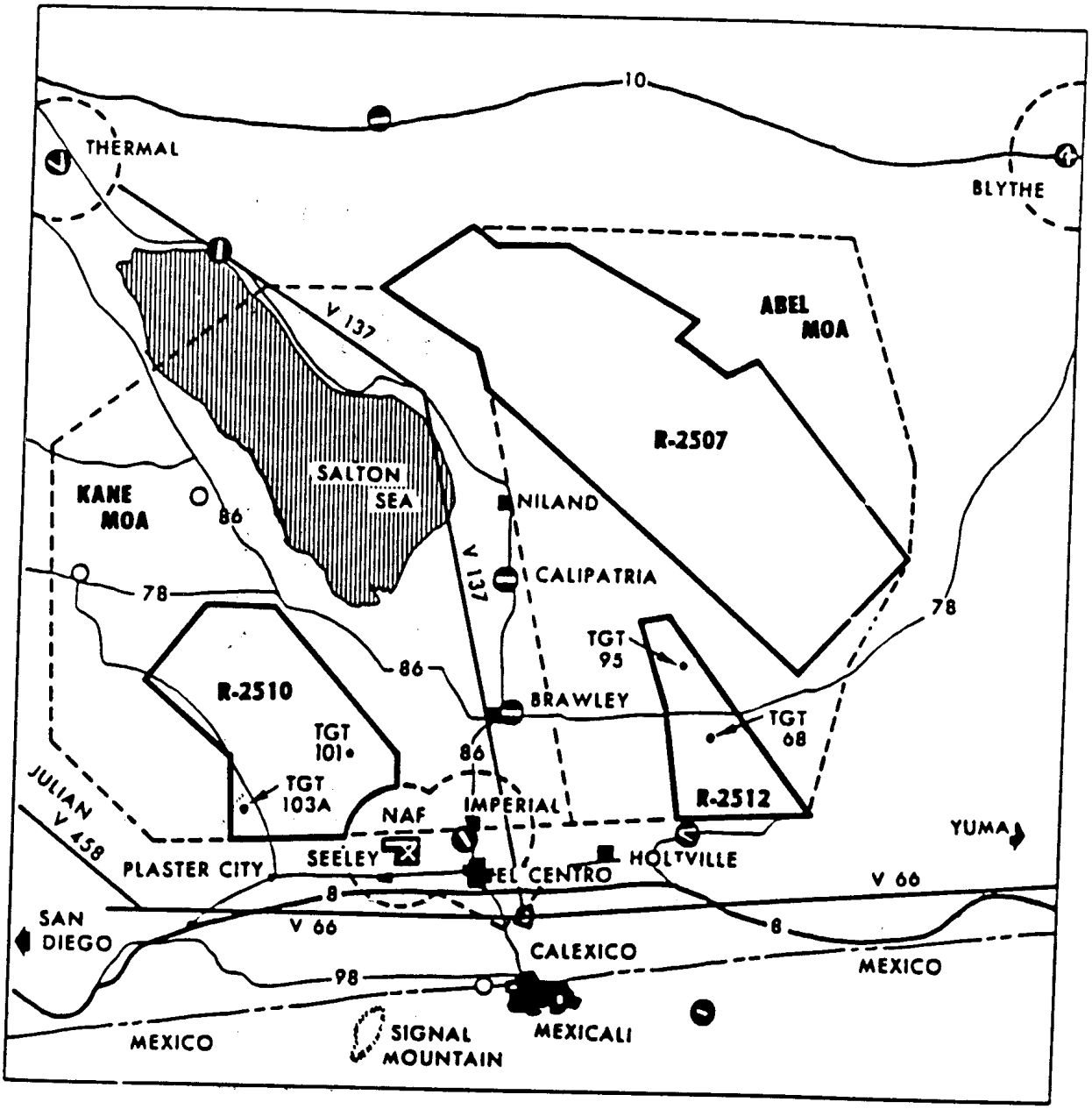


FIGURE III-1. MILITARY OPERATING AREAS

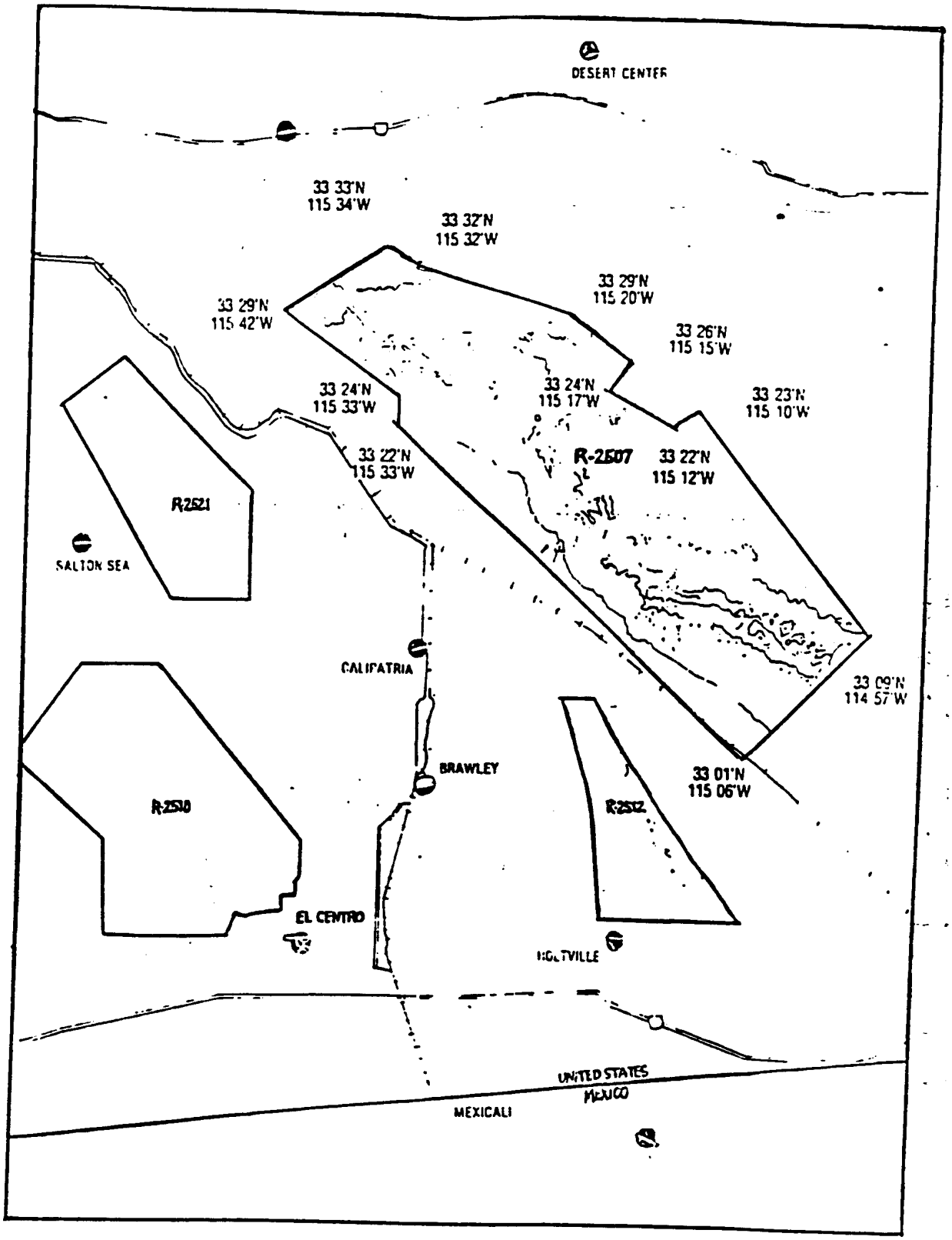


FIGURE III-2. RESTRICTED AREAS

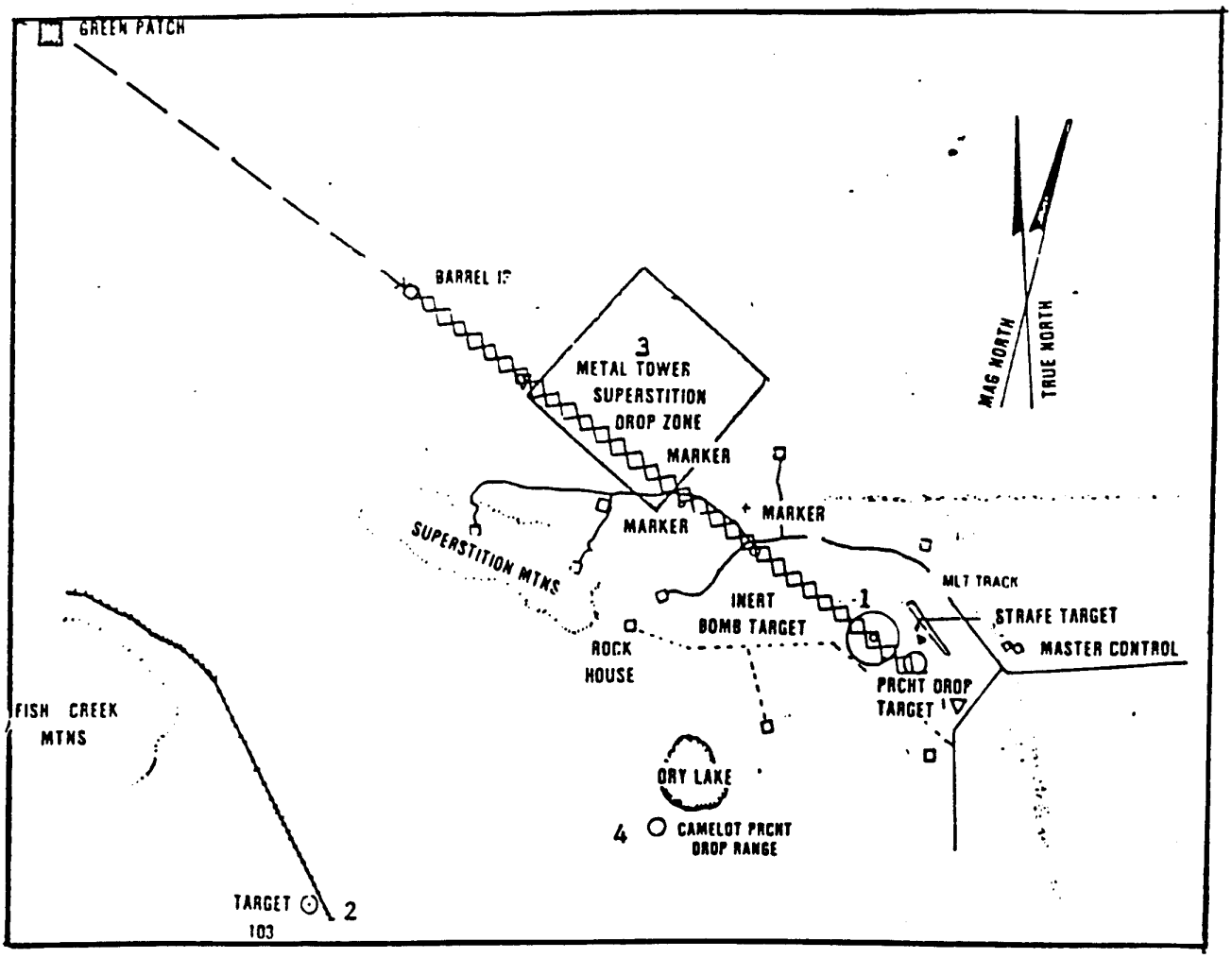


FIGURE III-3. SUPERSTITION DROP ZONE

SECTION IV

FORECASTING

A. SEASONAL WEATHER.

There are basically two seasons for the Imperial Valley area; being summer and winter. The transition periods between the two are very short. Spring and Autumn show few, if any, of the seasonal characteristics normal to the other parts of the United States. Normally there is a little more than a week or two of a rapid transition to the dominant seasons of summer and winter.

1. Summer

Mid-April through October comprises the summer season. The first half of summer is usually very dry because of the upper level flow is from the west to southwest. Even though the source of this air is from the eastern Pacific Ocean, it nevertheless is dry because the moisture from the ocean is trapped in the marine layer below. By mid-July the flow aloft becomes more southeasterly to occasionally easterly, advecting moisture into the Imperial/Yuma Valleys from the Gulf of Mexico and the Gulf of California. (See Sonora Condition under the special features section of this chapter) As a result of this there is an increase in the rainshower and thunderstorm activity in the Imperial/Yuma Valleys from July to September. Another significant phenomena is the Mountain breeze. Winds can sometimes increase to 25 or 30 knots depending on the temperature or pressure gradients between this station and the coast of California. Mountain breezes are discussed further in the special features section of this chapter.

2. Winter

November through March comprises the winter season. Weather during this season is characterized by long periods of excellent flying weather. Good visibility’s and cool temperatures are common place. Occasionally this weather is interrupted by active cold fronts, cutoff lows, or upper level troughs. Most of this activity occurs between late December to mid- February.

B. SPECIAL FEATURES

The following pages contain discussions and illustrations concerning particular weather phenomena and their effect on weather in the Imperial Valley.

1. Thermal Low/Trough

A semi-permanent feature, often referred to as an inverted trough or heat low, it is formed by the nearly continuous, intense, daytime heating over the desert areas of southern California, western Arizona, and northwestern Mexico. While the position of the trough is affected by large scale synoptic patterns, its position also varies seasonally. In the winter, its center is located in northwestern Mexico, with the trough extending north into the Imperial Valley/Mojave Desert region. During early and late summer, the low pressure center may occasionally extend as far north as the Mojave Desert/Las Vegas region, with the trough extending as far north as Oregon. Figure 4-1 below depicts the position of the thermal trough during this instance.

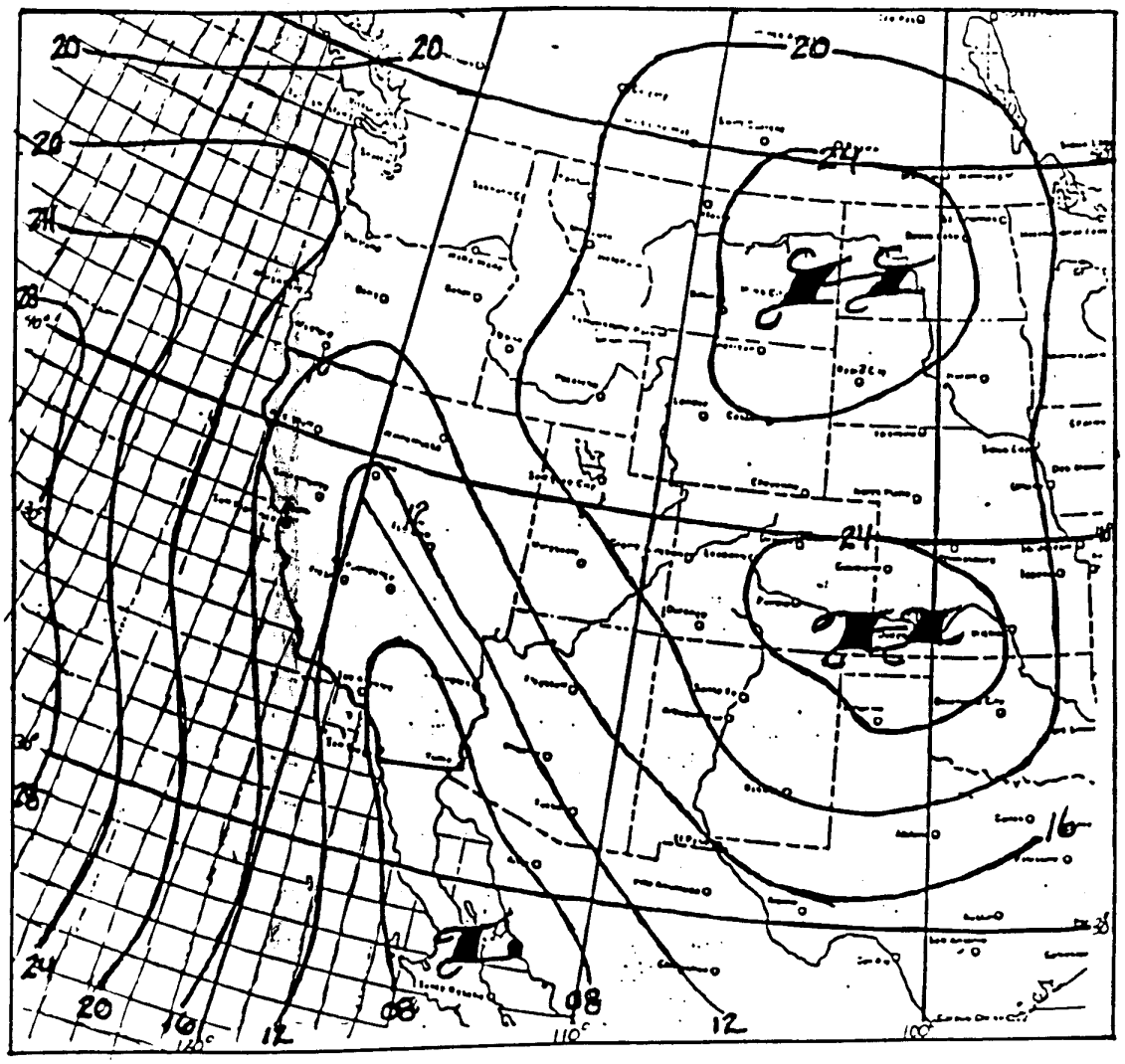


FIGURE IV-1. SUMMER THERMAL TROUGH

Once the low pressure is located, the wind direction should cast to be nearly parallel to the isobars. In figure 4-2 the wind direction would be from the southwest to west. Wind speed associated with the thermal low ranges from light and variable with a weak low to 10-16 knots with a well-developed low, with an average of 7-10 knots. Surface winds associated with the thermal trough are also highly variable and difficult to forecast with respect to direction, since the trough axis often fluctuates back and forth over the Yuma and Imperial Valleys.

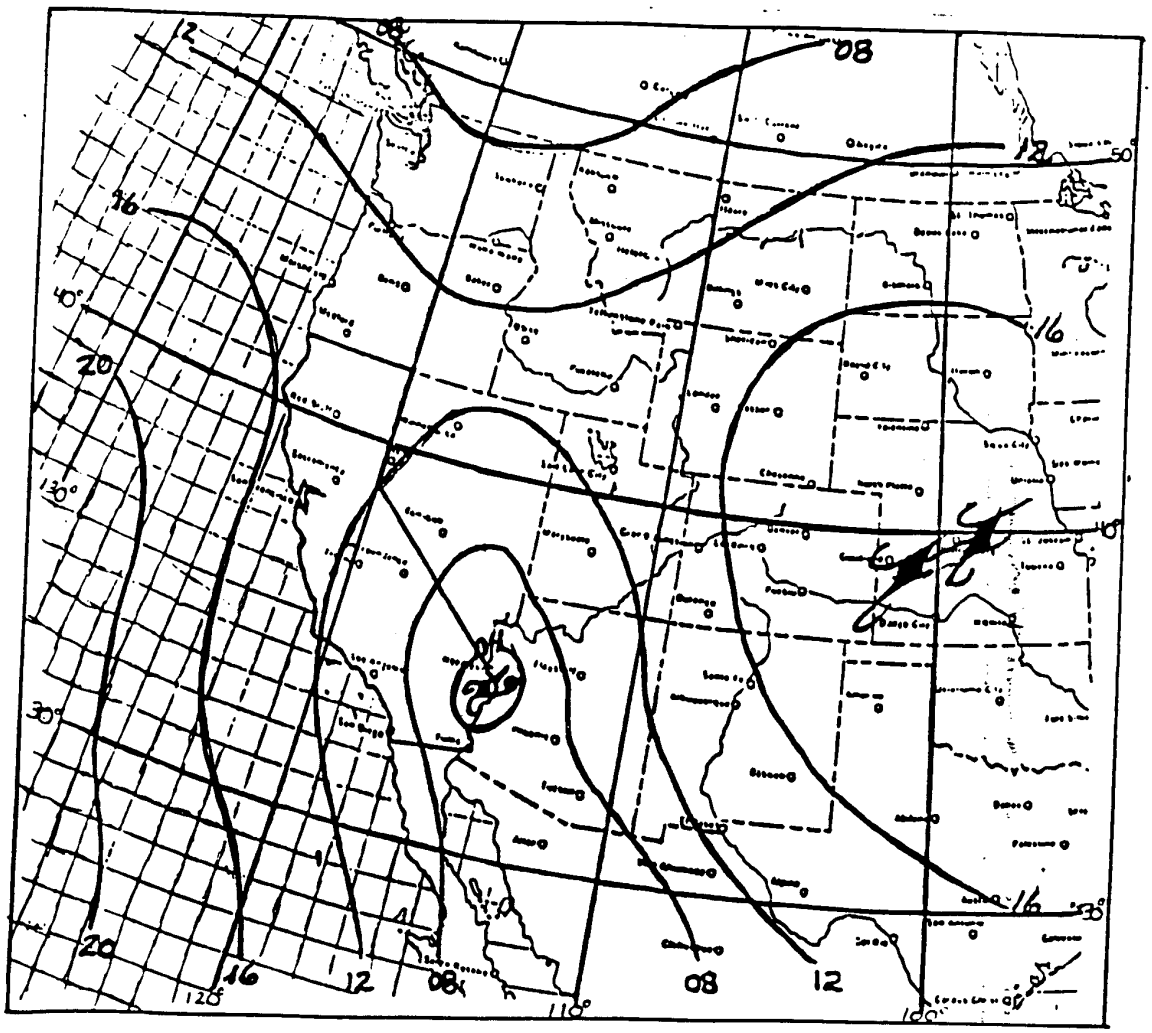


FIGURE IV-2. THERMAL LOW

2. Sonora

The Sonora occurs during the summer (primarily July, August, and September). Sonora is the local name given-to the thunderstorm condition created by an easterly flow of moist air across the Sonora province of Mexico from either the Gulf of Mexico or the Gulf of California. The advection of this warm moist air is a result of a high pressure cell that is persistently located in the central United States. This advection may also be caused by the strong easterly flow from the western extent of the Bermuda High. In this situation, extreme high temperatures and high humidity become commonplace in the desert regions. Mature and active thunderstorms develop during this pattern, with activity starting during the morning and continuing until midnight. Another source of upper level easterly flow is the presence of a low pressure center over the Gulf of California.

With pronounced heating, instability, and significant moisture to at least the 700 mb level, thunderstorms will develop to the east or southeast of the station. We are frequently forewarned of the presence of these thunderstorms by the forecaster at the Marine Corps Air Station, Yuma, AZ., who has access to an FPS106 radar unit. Thunderstorms also frequently develop over the mountains to the southwest through to the north. These thunderstorms usually circumnavigate the station, although if the conditions are right they can move over the station. A good indication of the formation of these thunderstorms is the appearance of cumulus or towering cumulus during the morning hours over the mountains to the west. Thunderstorms in the Imperial Valley are either going to seek out the heat of the desert by moving over it, or they are going to seek out the lifting action provided by the orographic features surrounding the Imperial and Yuma Valleys and travel along the mountain ranges.

These thunderstorms are tropical in nature. Ceilings average between 2000 and 5000 feet, depending on their severity, accompanied by light to moderate rainshowers which reduce visibility to between 3 and 5 miles. Visibility can be reduced to as little as 1/2 to 1 mile in blowing sand, if the conditions permit. This

usually occurs just prior to passage of a thunderstorm The most hazardous threat to operations is the strong, gusty winds that accompany these storms. Direction is very difficult to forecast. Variable winds sustained at 20 to 30 knots with gusts to 40 to 50 knots are not uncommon. As mentioned previously these high winds can reduce visibility quite a bit, even if no rainfall has occurred at the station. With the more severe thunderstorms, expect visibility to be near 1/2 mile and expect the wind to gust near 50 knots. Flash flooding is also common with the more severe storms near the mountains.

3. Tropical Storms

Most tropical storms in the eastern Pacific develop from June through October, with the greatest frequency occurring August and September. The majority of these storms are off the west coast of Mexico between 10 N and 20 N and move west or northwest. A few storms occasionally move northward along the Baja coast. They usually dissipate as a result of the cold sea surface temperature and strong vertical wind shears. When a tropical storm recurves and crosses the Baja Peninsula or western Mexico, it frequently results in impulses of tropical moisture into the local area (refer to Sonora). With tropical storm activity occurring in the Gulf of California or along the West Coast of the Baja Peninsula, the forecaster should always be alert for the possibility of a storm moving into the local area. Refer to the last section of this chapter for a history of two of the few storms to have significantly affected the Imperial Valley.

4. Cutoff Low

During fall or winter, a long wave trough, which is often slow moving or nearly stationary, becomes situated west to southwest of San Diego, CA. Strong cold air advection will deepen the trough. As the trough deepens, the upstream ridge builds until a blocking situation develops at the upper levels. When the cold air advection is very pronounced in the rear of the trough, an isolated pool of cold air and a closed low aloft may form. As the upper level ridge builds, a jet max approaches the top of the ridge. Due to the sharpness of the turn, the jet max overshoots the trough. The jetstream splits and the trough continues to deepen. The low is now becoming displaced equator ward of the jetstream. Once the isotherms and

isoheights become closed and the low cutoff, it becomes stationary or nearly so. Normally forming in 24 to 48 hours, these lows have a 24-hour to one week persistence range and 72 hour to a week to a two week dissipation range. One clue that is useful in forecasting the formation of a cutoff low is the presence of a strong (1040mb or higher) stationary surface high at higher latitudes of the Gulf of Alaska.

A well-defined cutoff low will affect the Imperial Valley weather when we fall under a cyclonic curvature around the low. If the cutoff low sets up in the vicinity of 30 degrees North or southward and persists, as depicted in Figure 4-3, ceilings of less than 2000' and continuous light to moderate rain are not uncommon. If the system is persistent, it gradually becomes more unstable, producing embedded thunderstorm activity. If the cutoff low sets up north of 32 degrees North, as depicted in Figure 4-4 above, expect scattered to broken low and mid cloudiness with scattered rainshower and thunderstorm activity. Most of the thunderstorm activity is associated with minor troughs rotating around the system.

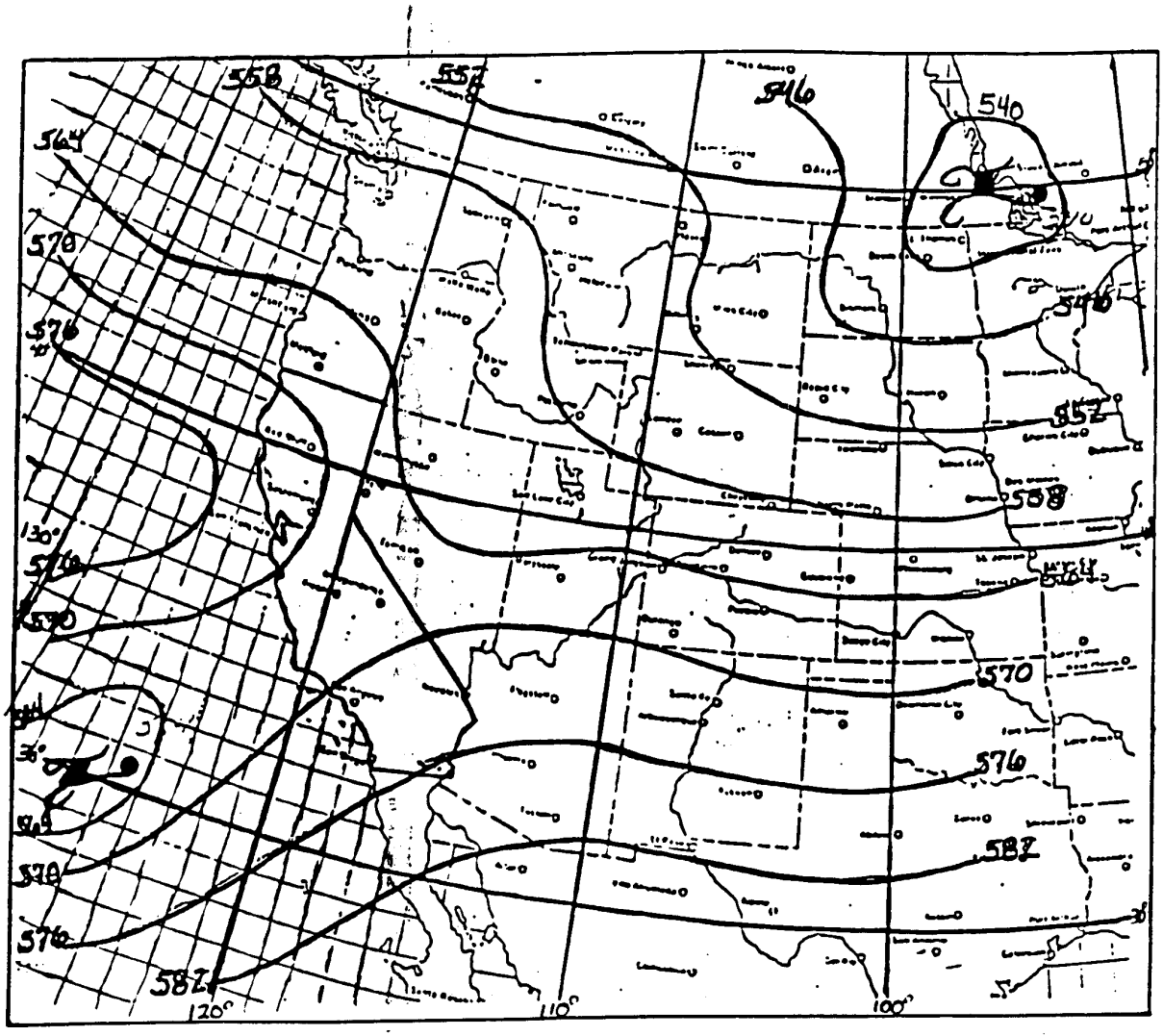


FIGURE IV-3. CUTOFF LOW

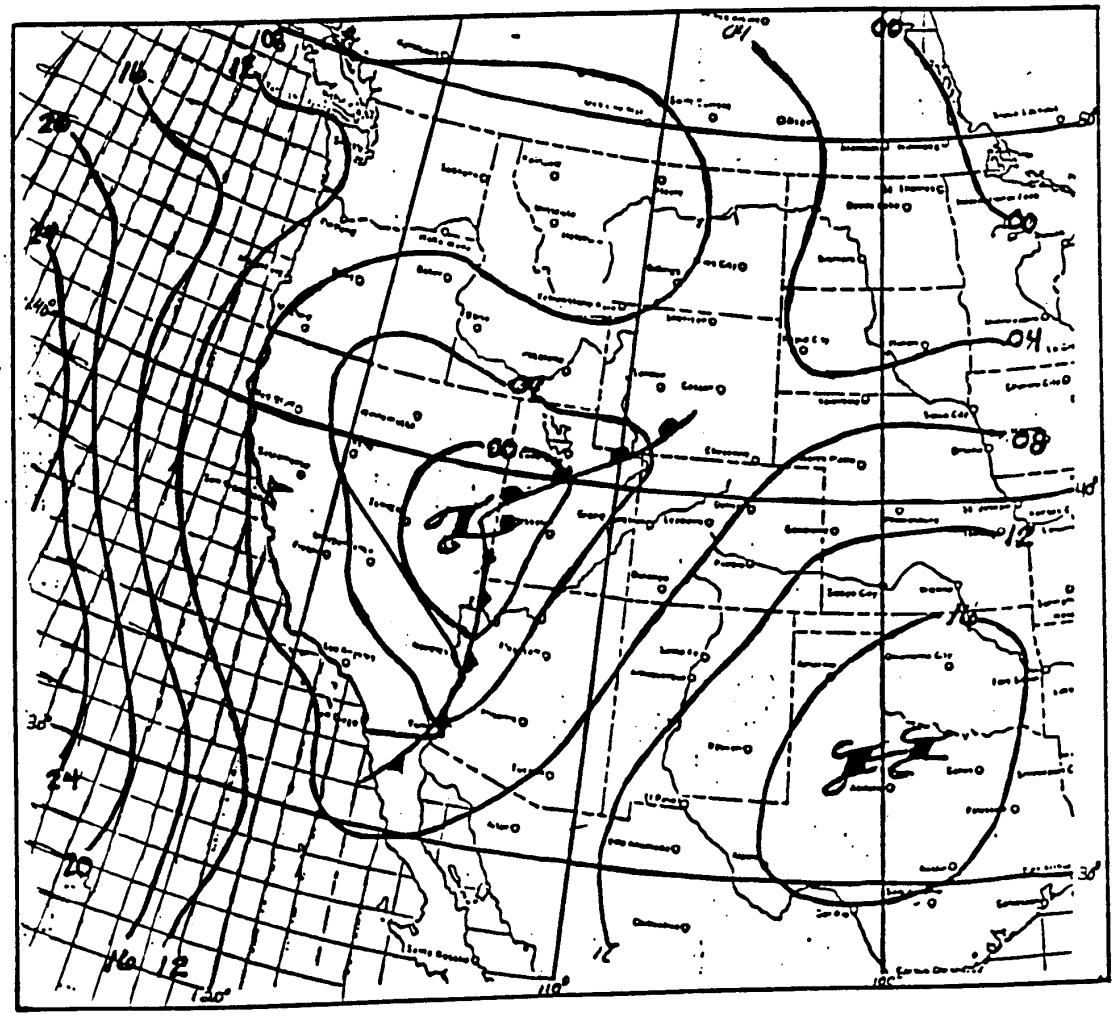


FIGURE IV-5. DEVELOPING NEVADA LOW

The Nevada Low will normally develop in one of the following manners:

1. As a wave on an east-west oriented front.

2. As a secondary low in an unstable airmass following the passage of a frontal low.

3. Beneath a cutoff low, or at the tip of a deep trough which has a jet max moving into it.

The primary forecasting problem with the Nevada Low is the strong winds associated with the system. The best forecasting tool to determine wind speeds is a constant checking of the gradient level winds and the surface pressure gradient.

A well-defined frontal zone is usually observed over southern California, Nevada, and Utah desert areas once the Nevada Low is well established. Although significant cloudiness and precipitation are not normally experienced at El Centro with a Nevada Low, occasionally a minor trough from a vorti6i:ty lobe moving around a low will pass over the local area, producing middle and high clouds along with cumulus buildups.

The winds associated with the system are usually southwesterly before frontal passage and west or northwesterly following passage. Speeds are usually 25 to 35 knots sustained with gusts to 40 or 50 knots. The station will exp6tience IFR periods due to the extensive blowing dust and sand associated with the strong winds. It is not uncommon for the visibility to go down to 1/4 of a mile, if the winds are strong enough. Expect gusts near and in the mountain passes- to be significantly higher than what is experienced at El Centro. The range and target areas near El Centro can also experience much higher wind speeds (50 to 60 Kts) and gusts than what is actually occurring at the station.

6. Fronts

Frontal weather is most frequently observed in the Imperial Valley during the winter months. Most of the fronts are oriented northeast to southwest. They move southeasterly into the Imperial Valley from northern and central California. Occasionally, a west to east oriented front will move through the area, but it will have little or no effect on the weather at El Centro, other than scattered to broken middle and high cloudiness.

Most fronts approaching El Centro from the west or northwest expend their energy over the coastal mountains and dissipate before reaching the local area. Passage of these fronts 3-S normally preceded by moderate to strong southwesterly winds for as long as 6 to 8 hours previous. Wind speeds are generally 12 to 18 knots with gusts to 25 or 30 knots. After frontal passage, winds are northwesterly at approximately the same speeds. Visibility can lower to 1 or 2 miles in blowing dust or sand, even if no appreciable precipitation has fallen.

Inactive (fast moving) cold fronts associated with sufficient vertical development through 30,000 will remain aloft while passing through the Imperial Valley area. They will be accompanied by ceilings 8,000, to 10,000, along with scattered rainshowers and isolated thunderstorms. Rapid clearing occurs behind the front. Also with this system, prefrontal winds are southeasterly or southerly becoming southwesterly and generally increasing after passage. Occasionally, an active cold front (slow moving) will move through the area. Weather associated with this front is much like that of a fast-moving front, except

that the ceilings will be much lower, approximately 4000, to 6000, and conditions improve much more slowly. Weak frontal passages, mainly aloft, may be considered a normal wintertime occurrence for El Centro.

a. Cold Trough with a Surface Low

This is clearly a winter situation that has a high potential for producing precipitation and ceilings at or below 3000' for a number of hours. A cold trough moves into the area just west of the California coast, stagnates and deepens. When this system is at or south of 32 degrees North, precipitation is most probably evident. Usually,, a surface low will develop. Movement of this system stem is slow. Cooling aloft increases instability. Increasing southerly winds at the surface and at the low levels transports additional moisture northward from the Gulf of California. This system develops at night and tends to dissipate during the late afternoon. Early indications of the strength of one of these systems, in addition to the isotherm pattern, are strong and gusty winds and heavy rainshowers in northern California. This spreads southward through California in the course of 24 hours, following the deepening of the trough and southerly course of the surface low. It must be pointed out that this is not an annual occurrence. Some winters will pass without seeing any of these systems develop. The cloud progression with one of these stronger systems first brings cirrostratus, thickening and lowering to less than 20,000 feet. Approximately 4 hours later, ceilings will be below 10,000 feet, with ceilings lowering to 8000 feet and then to 5000 feet. A moderate system of this type will produce multiple cloud layers with bases around 4000 to 8000 feet, accompanied by light to occasionally moderate rainshowers.

7. Great Basin High

This is a mass of dry, cool high pressure air which becomes situated in the area between the Rockies and the Sierra Cascade, Mountain Ranges, encompassing southeastern Oregon, southern Idaho, western Utah, and all of Nevada. The most common source for the Great Basin High is a Pacific maritime anticyclone, which moves eastward behind the frontal system over the Great Basin. There it stagnates and builds in response to surface cooling and upper air features. However, the Great Basin High may originate in Canada or may build in the Great Basin itself in response to the complex thermal patterns aloft. The winds associated with this high pressure system can last all day, diminishing around sunset with a moderate system and continuing beyond midnight with a strong system. The winds tend to redevelop the next day, although somewhat weaker.

With the synoptic situation as depicted in Figure 4-6 below and with temperature difference of at least 10 degrees

Fahrenheit or greater between LSV (Las Vegas) and NYL (Yuma) or NJK, the pressure gradient between LSV and NJK or NYL will result in the following wind:

4 - 6 Millibars 10 to 20 Knots, Gusts to 30 Knots

6 - 8 Millibars 15 to 25 Knots, Gusts to 35 Knots

8 - 10 Millibars 20 to 30 knots, Gusts to 40 knots

10 + Millibars 25 to 35 knots, Gusts to 45-50 knots

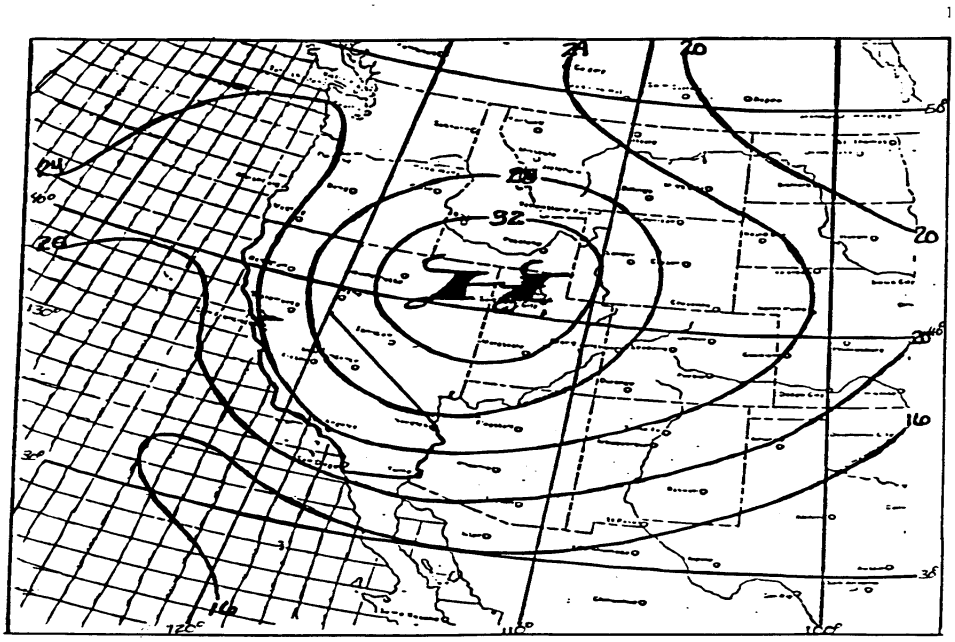


FIGURE IV-6. GREAT BASIN HIGH

The Great Basin High reverses the usual onshore pressure gradient, resulting in a subsiding outflow of air from the Great Basin across the desert, to the coastal areas where it arrives as a dry, adiabatically warmed wind. The higher pressures of the Great Basin High, the better the chance for what is called the Santa Ana wind to occur. The Santa Ana is a hot, dry wind and its direction is mainly from the norteast. In

addition to a strong ridge over the West Coast, a deep trough is usually located downstream over the Rocky Mountains during Santa Ana conditions. The reason why the colder the Great Basin High, the better the chances for a Santa Ana to occur, is that a cold air advection at the surface results in surface pressure rises. These pressure rises build the high and strengthens the circulation.

serious hazard associated with this wind is brush fire. It is difficult to forecast its appearance and dissipation. Expect moderate northerly winds at El Centro if a Santa Ana condition is expected along the southern California coast. When the high pressure system migrates to the east or southeast as depicted in Figure 4-7 below, the gradient becomes negligible and the wind attains a southerly component.

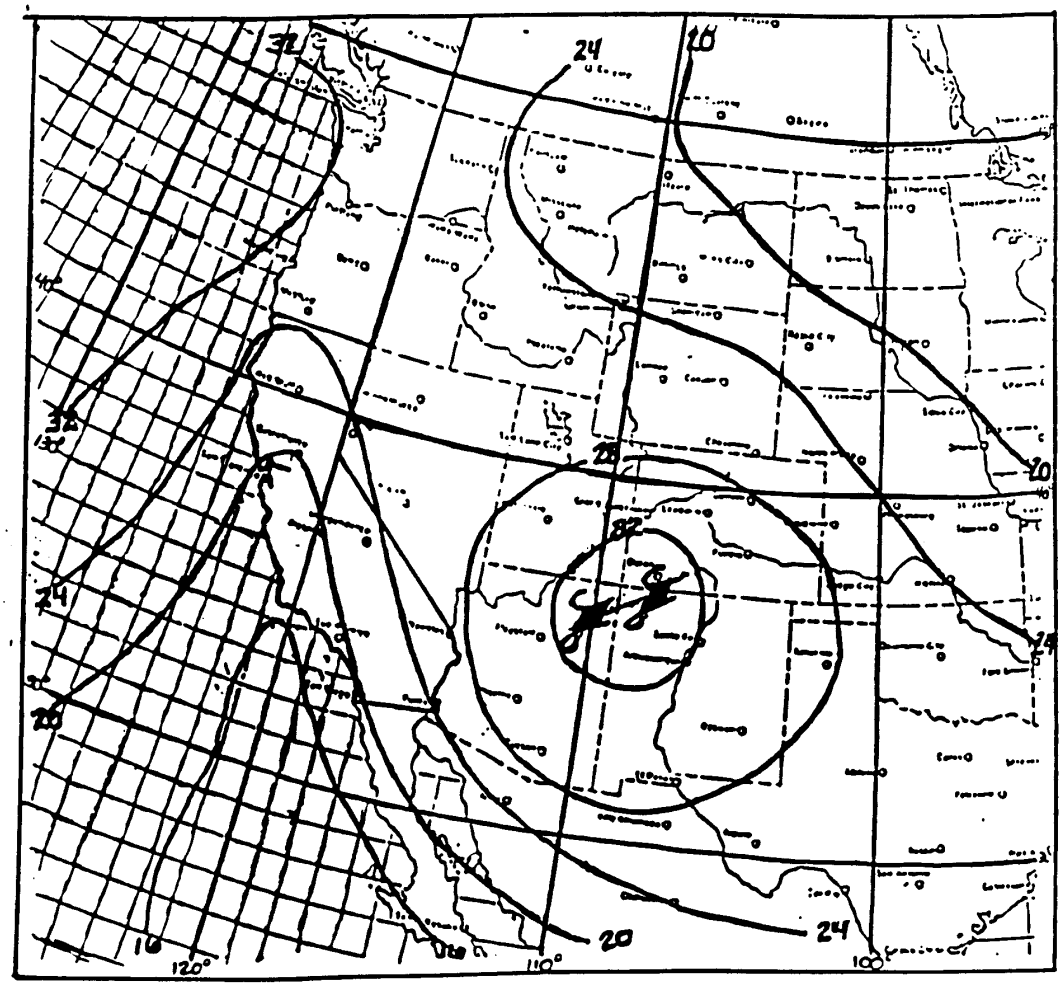


FIGURE IV-7. WEAKENING SANTA ANA

8. Local Weather Phenomena

a. Mountain Breeze

The mountain breeze is frequent and pronounced in the Imperial Valley. It is caused by the rapid cooling of the coastal mountain ranges and the pressure differential between San Diego and El Centro. Usually, steady winds of 20 knots with gusts to 35 knots are observed. These winds can sustain themselves for 8 to 12 hours. This condition generally occurs between 1600 and 0100 PST, although, it has begun as early as 1200 PST. For aids in forecasting mountain breezes, see section 9 of this chapter.

b. Dust Devils

Quite common over the southwest deserts, they are vigorous whirlwinds, usually of short duration. Diameters range from 10 to greater than 100 feet. Their average height is about 600 feet, but few have been observed as high as several thousand feet. They have been observed to rotate anticyclonically as well as cyclonically. Dust devils are best developed on a hot, calm afternoon with clear skies and in a dry region where intense surface heating causes a very steep temperature lapse rate in the lower few hundred feet of the atmosphere. Not normally associated with any flight hazards, dust devils have been-known to create brief moderate, and possible severe turbulence for light aircraft passing through them.

c. Visibility Restrictions

(1) The basic industry of the Imperial Valley is agriculture. Throughout the valley there are large farms which harvest and replant vegetable crops during most of the year. Due to the lack of natural rainfall during most of the year, heavy irrigation is required. If relatively cooler or cold early morning temperatures occur simultaneously with periods of irrigation, a dense fog/ ground fog will blanket portions of the valley. El Centro may be obscured and below minimums in the fog but rapid heating after sunrise will dissipate the fog within 2 to 3 hours. Fog may also occur after frontal passage. Particularly, if there was significant rainfall associated with the front. If relative humidity are high after the frontal passage, expect fog to occur at the station. This fog will dissipate in the same manner as the fog mentioned above.

(2) Dense smoke as a restriction to visibility is also related to the agriculture industry. Rapid rotation of the crops sometimes requires the burning off of vegetable stubble. Poor visibility will prevail at El Centro until an increase in the surface wind during the late morning or afternoon disperses the smoke.

(3) Of special note is the fact that Banning Pass links Imperial Valley with the Los Angeles Basin. Frequently during the summer months, air pollution and smog from Los Angeles is funneled into the Imperial and Yuma Valley regions by strong winds in the vicinity of Banning Pass. This smog is usually restricted to the Salton Sea area but can be blown as far south as the Yuma Valley. If there is sufficient moisture in the area, haze mixes with the smog to occasionally lower visibility to 5 miles. Once the smog has become stagnated in the Imperial Valley, it must be blown out of the Imperial Valley by strong surface winds or rained out of the atmosphere by a frontal or low pressure system.

9. Forecast Thumb Rules

a. Maximum gusts may be obtained using Sandberg, CA (SDB). An addition of +27 degrees Fahrenheit is used to correct Sandberg's temperature to sea level. To obtain the max gust subtract SDB corrected temperature from NJK observed temperature and multiply by 4.

b. The wind will become westerly when the corrected SDB temperature is at least 5 degrees lower than the observed temperature at NJK.

c. The mountain to valley breeze will cease when NJK observed temperature becomes at least 5 degrees lower than corrected temperature.

d. The westerly winds will diminish within 4 to 6 hours and become 10 knots or less, when NJK observed temperature becomes the same as, or lower than, SDB corrected temperature.

e. The westerly winds will be further re-enforced and of longer duration if NAVPACMETOCFAC North Island (NZY) temperature is 18 degrees lower than the NJK temperature and if the NZY pressure is 6 millibars or greater than Las Vegas (LSV) pressure.

f. If the pressure differential from NZY to NJK exceeds plus 7 millibars, the mountain to valley breeze will prevail as far east as Yuma, AZ.

g. Note the above thumb rules will not work if the correction figure to Sandberg, CA (SDB) is not used and if the pressure gradient from NAVPACMETOCFAC North Island (NZY) to El Centro (NJK) is not at least +3 or 4. The above thumb rules should be used as a guide to forecasting the winds in Imperial Valley. Wind speeds and directions are subject to rapid change due to the mountain ranges, which surround El Centro.

h. The K-Factor as well as the Cross-, Vertical-, and Total-Totals Indexes, taken from the Yuma sounding, have proven to be effective tools in forecasting thunderstorm activity in the Imperial Valley. Refer to the charts on the following page to help utilize the K-Factor and Totals Indexes.

FORECAST	CT	VT	TT
ISOLATED to FEW Orange	18-19	≥26	44
SCATTERED Orange FEW Green	20-21	≥26	46
SCATTERED Orange FEW Green ISOLATED Blue	22-23	≥26	48
SCATTERED Green FEW Blue ISOLATED Red	24-25	≥26	50
SCATTERED to NUMEROUS Green FEW to SCATTERED Blue FEW Red	26-29	≥26	52
NUMEROUS Green SCATTERED Blue and Red	≥30	≥26	≥56

Red = Severe Thunderstorms w/tornadoes a/o waterspouts
Blue = Severe Thunderstorms (max gusts ≥50 kts, a/o hail >1")
Green = Moderate Thunderstorms (max gusts ≥35 kts but <50 kts, a/o hail ≥1/2" but ≤1")
Orange = Thunderstorms (max gusts <35 kts a/o hail <1/2")

REGIONAL MODIFICATIONS:

WEST OF THE ROCKIES - 700 and 500 millibar dew point depressions should be less than 6°C to insure sufficient low level moisture or 500 millibar temperature should be ≥−17°C and 700 millibar temperature should be ≥0°C. If this is satisfied, then consider: (a) VT <28 = No thunderstorms. (b) VT ≥28 but ≤32 = Few thunderstorms. (c) VT ≥32 = Scattered thunderstorms. Usually these will be Orange variety. Green or blue require large amounts of moisture at 850 and 700 millibars.

K Value	Thunderstorm probability, percent
<15	0
15-20	0-20
21-25	20-40
26-30	40-60
31-35	60-80
36-40	80-90
>40	near 100

IV-15

10. Tropical Storms Affecting the Imperial Valley

Hurricane Kathleen began forming 6 September 1976, near 5 degrees North and 109 degrees West, about 550 miles south-southwest of La Paz (located near the southern tip of the Baja Peninsula). After 24 hours the storm became more organized and tracked north-northwest.

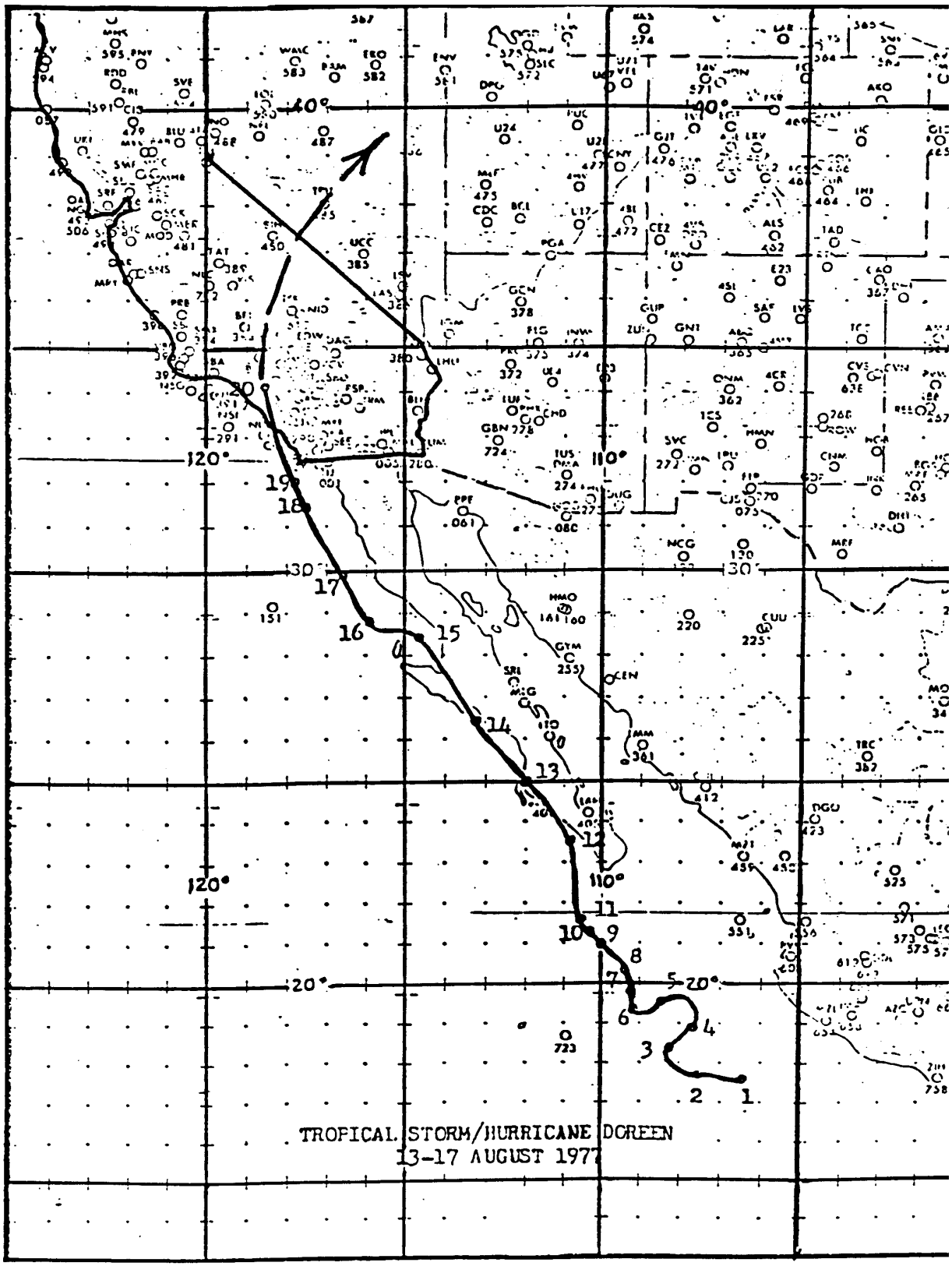
On 8 Sept, Yuma, AZ went from clear to 20,000, overcast during the morning. By the morning of 9 Sept, as the storm moved closer, ceilings had decreased to 16,000, and gradually lowered to 7,000, by days end. Light rainshowers were prevalent throughout the day, while surface winds remained variable. On 10 Sept, the ceiling lowered to 5,000' and the winds became 060 degrees, showing Yuma, AZ, to be in the northeast quadrant of the storm. Throughout the morning, the winds veered and at 0700L began increasing in speed. Light rainshowers were intermittent until 0800L, when it became a steady rain. Thunderstorms began at 0840L and visibilities were reduced to 1/2 mile in blowing sand and occasional moderate precipitation. By 1000L the winds had veered to 160 degrees and gusts to 62 knots were recorded. At this time, the right rear quadrant of the storm passed over the Yuma area. The thunderstorm activity ended and the winds continued to veer and decrease in speed. Rainshowers ended by 1400L and blowing sand ended by 1800L. The surface winds became 210 degrees at 10 knots by 2100L and only scattered clouds remained as the storm weakened rapidly. These conditions were recorded by MCAS Yuma’s weather detachment. Of reporting stations affected, Yuma recorded the highest winds, with gusts to 62 knots, and the least rainfall, with only .16". The heaviest precipitation fell in the southern California mountains from San Bernardino into northern Baja. Amounts of 10.1 inches or more, fell in the mountain areas just west of El Centro, the Salton Sea and Thermal, CA. These heavy concentrations of rainfall caused severe damaging flash floods in the mountains along the western edge of the Imperial Valley.

The following is a chronology of Hurricane Kathleen:

1. 07060OZ, tropical depression, max sustained winds 30 knots.
2. 07120OZ, tropical depression, winds 30,knots.
3. 07180OZ, tropical storm, winds 35 knots, gusts to 45 knots.
4. 08000OZ, tropical storm, winds 40 knots, gusts to 50 knots.
5. 08060OZ, tropical storm, winds 55 knots, gusts to 65 knots.
6. 08120OZ, tropical storm, winds 55 knots, gusts to 65 knots.
7. 08180OZ, tropical storm, winds 50 knots, gusts to 60 knots.

8. 09000OZ, tropical storm, winds 55 knots, gusts to 65 knots.
9. 09060OZ, tropical storm, winds 50 knots, gusts to 60 knots.
10. 09120OZ, tropical storm, winds 45 knots, gusts to 55 knots.
11. 09180OZ, tropical storm, winds 45 knots, gusts to 55 knots.
12. 10000OZ, hurricane, winds 70 knots, gusts to 80 knots.
13. 10060OZ, tropical storm, winds 50 knots, gusts to 60 knots.
14. 10120OZ, tropical storm, winds 35 knots, gusts to 45 knots.
15. 10180OZ, forecast position from final warning

The above positions correspond to the plotted positions appearing in Figure 4-8 on the following page.


TROPICAL STORM/HURRICANE DOREEN
13-17 AUGUST 1977

Hurricane Doreen began forming 13 August 1977, near 12 degrees North and 106 degrees West, about 450 miles southeast of La Paz, Baja, CA. Developing rapidly, she moved northwesterly, and reached hurricane strength less than 48 hours later on Sunday morning the 15th of August. Monday through Tuesday morning, downgraded to a tropical storm, she paralleled the West Coast of the Baja, California from the southern tip of Baja to Bahia Sebastion, a large bay approximately 300 miles south-southeast of San Diego. It was during this period that the forecast tracks took Doreen across the peninsula, into the Gulf of California and toward Yuma, AZ. Instead she drifted farther north off-shore Tuesday morning and continued her north-northwesterly movement. With her wind force diminishing rapidly, Doreen passed 60 miles west of San Diego Wednesday morning and the remnants moved inland later in the day between Point Mugu and Los Angeles.

Winds associated with Doreen were of little consequence to southern California; less than 20 knots near the center as she passed off-shore of San Diego. Precipitation amounts along the coast from San Diego to Los Angeles averaged 2". Lindbergh Field received 2.13", while North Island measured 1.97". Hardest hit was the Imperial Valley which accumulated over 4.1' and the mountains west of the valley which averaged 5 to 7". The cloud and precipitation shield in advance of Doreen was nearly 600 miles in radius and heavy rains began in the Imperial Valley and the mountains Monday afternoon,, causing localized flooding and flash flooding throughout the valley. The heaviest flooding occurred in Mexicali, Calexico and around the Borrego Springs area, where some homes and roads became mud cities. Heavier rains Tuesday and Tuesday night caused more extensive flash flooding and property damage. Remembering Kathleen, the residents of Ocotillo Wells evacuated the town, but flooding was minimal. That portion Interstate 8, re-built after Kathleen, was once again washed away by Doreen. The heavy rain and flooding wiped out nearly 100 percent of the cotton and maize crops in the valley.

The following is a chronology of Hurricane Doreen:

1. 130000Z, tropical depression, max sustained winds 30 knots.
2. 130600Z, tropical depression, winds 30 knots.
3. 131200Z, tropical depression, winds 30 knots.
4. 131800Z, tropical storm, winds 50 knots, gusts to 60 knots.
5. 140000Z, tropical storm, winds 60 knots, gusts to 70 knots.
6. 140600Z, tropical storm, winds 60 knots, gusts to 70 knots.
7. 141200Z, tropical storm, winds 60 knots, gusts to 70 knots.
8. 141800Z, hurricane, winds 65 knots, gusts to 80 knots.

9. 150000Z, hurricane, winds 65 knots, gusts to 75 knots.
10. 150600Z, hurricane, winds 65 knots, gusts to 75 knots.
11. 151200Z, hurricane, winds 65 knots, gusts to 80 knots.
12. 151800Z, tropical storm, winds 60 knots, gusts to 75 knots.
13. 160000Z, tropical storm, winds 55 knots, gusts to 70 knots.
14. 160600Z, tropical storm, winds 50 knots, gusts to 65 knots.
15. 161200Z, tropical storm, winds 35 knots, gusts to 45 knots.
16. 161800Z, tropical storm, winds 35 knots.
17. 170000Z, tropical storm, winds 35 knots.
18. 170600Z, tropical depression, winds 30 knots.
19. 171200Z, tropical depression, winds 20 knots.
20. 171800Z, forecast position from final warning.

Preliminary Report
Hurricane Nora
16-26 September 1997
Edward N. Rappaport
National Hurricane Center

a. Synoptic History

Hurricane Nora formed early on the 16th of September about 250 nautical miles to the southwest of Acapulco (Table 1 and Fig. 1a). It originated in a large area of disturbed weather that had slowly become better organized while drifting west-northwestward during the previous few days. Analysis of satellite pictures indicates that this activity was likely related to a westward-moving tropical wave that crossed from Africa into the Atlantic hurricane basin on the 30th and 31st of August. The northern part of the wave was associated with the formation of Hurricane Erika in the central tropical Atlantic, while the southern part continued westward through the Caribbean Sea and northern South America, and arrived in the eastern Pacific basin on 12 September.

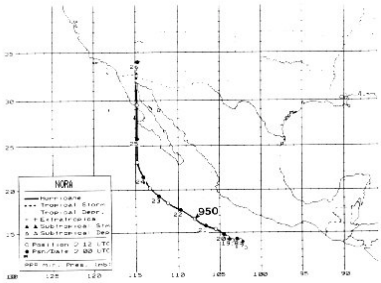


Figure 1a. Best track of Hurricane Nora, September 1997.

Fig 1.

Nora matured in an environment of relatively light wind shear, and much of its development appears to have been related to variations in sea-surface temperature (SST). Nora formed over very warm water (29-30C). Deep convection quickly increased and became organized in well-defined bands on the 16th, with Dvorak technique intensity estimates of T2.5 forming the basis for estimating that the system became a tropical storm at 1800 UTC on the 16th Figs. 2 and 3. Further strengthening occurred over the following two days. The first signs of what would become a rather large and ragged eye were detected in infrared satellite pictures early on the 18th. By late that day, Nora was a hurricane with 90-kt sustained winds.

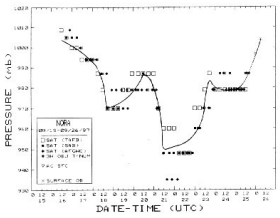


Figure 2. Best track central pressure curve for Hurricane Nora, 16-26 September 1997.

Fig 2.

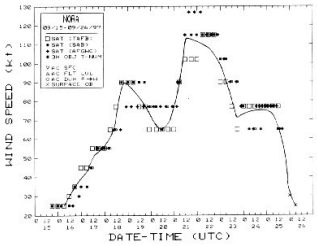


Figure 3. As in Fig. 2, except for maximum wind speed.

Fig 3.

During Nora's first few days, the winds around a mid-level high over northern Mexico helped direct the tropical cyclone slowly toward the west-northwest. From midday on the 18th to early on the 20th, however, Nora nearly stalled. The hurricane weakened during that period. The height, amount, and organization of convection decreased and the eye disappeared. The maximum wind speed is estimated to have decreased to 65 knots. This weakening is presumed to have occurred in response to the hurricane's prolonged stay over waters cooled by upwelling beneath its circulation. Analyses in this part of Nora's wake show SSTs cooled by about 2C, on average, to about 27C.

By late on the 20th, Nora was on the move again, at 5 to 10 knots toward the west-northwest or northwest, roughly parallel to the southwest coast of Mexico. Nora then rapidly re-strengthened. The eye reappeared, initially with a diameter of 15 nautical miles, and cloud tops cooled. Nora reached its peak maximum wind speed of 115 kts near 1200 UTC on the 21st.

On the 21st through the 23rd, Nora's track converged with, and then followed, the track previously taken by Hurricane Linda

(Fig. 1b). In that area, Linda had been the strongest eastern Pacific hurricane on record just a few weeks earlier and its circulation had induced lower SSTs. Nora gradually weakened over Linda's wake, with the eye temporarily broadening to a diameter of about 50 nautical miles and the eye-wall becoming broken. Estimated wind speeds decreased to about 70 knots at 1800 UTC on the 23rd.

An omega-like blocking pattern developed over the western United States during the last week of September. This left a weakness in the height pattern to the north of Nora and eventually a trough with a cut-off low to the northwest of the hurricane. The track of Nora became north-northwestward and then northward on the 24th. This carried Nora over yet another SST anomaly, a large patch of waters more than 2C above normal abutting the west coast of Baja California. Nora remained over waters of at least 26C all the way to its landfall on the morning of the 25th at Punta Euguenia and then about 50 nautical miles south-southeast of San Fernando, Baja California. Hence, Nora had restrengthened slightly, and then weakened less quickly than most tropical cyclones in that area. It was still at hurricane strength during its landfalls.

Nora was accelerating northward at landfall, steered by the flow associated with the trough to its northwest. The center of the cyclone crossed the Baja California peninsula at 20-25 knots and traveled up the western shoreline of the Gulf of California. It crossed into the United States, near the California/Arizona border, still as a tropical storm, near 2100 UTC on the 25th. Most of the heaviest precipitation was then located to the northeast of the center.

Rapid weakening ensued and winds dropped to tropical depression strength near 0000 UTC on the 26th, when the center was located about midway between Blythe and Needles, California. The low-level center was moving toward the north-northeast as it degenerated early on the 26th. A remnant circulation aloft apparently persisted, however, and is likely to have been responsible for a period of near hurricane-force winds observed at the NWS Cedar City Doppler radar, located in the mountains of southwestern Utah at an elevation of about 10,600 feet.

The residual area of cloudiness and showers gradually became more diffuse over the following two days while moving generally northeastward, through portions of Utah, Colorado, Idaho and Wyoming.

b. **Meteorological Statistics**

Table 1 provides the post-storm "best track" location and intensity estimates for Nora. Figures 2 and 3 show the

hurricane's estimated central pressure and maximum one-minute wind speed, respectively, versus time and the associated satellite data. Position and intensity estimates from satellite pictures were provided by the Air Force Global Weather Center (AFGWC), NOAA Tropical Analysis and Forecast Branch (TAFB) and NOAA Synoptic Analysis Branch (SAB).

Table 2 lists the observations of tropical storm force winds. Most came from ships at sea. A 39-kt 2-minute sustained wind was observed at Yuma during Nora's passage. Such observations of tropical storm force winds are a rarity in the United States for eastern Pacific tropical cyclones. The peak gust observed at Yuma was 47 kt. A gust to 45 kt occurred at Ajo, AZ.

The NWS Doppler radar at Yuma showed a 40 nautical mile wide band of hurricane force winds aloft to the east of Nora's center near the Arizona/Sonora border near noon on the 25th. These winds were observed at about 4-5,000 ft, could have extended to higher altitudes, and likely were related to the patch of near-hurricane force winds observed over the high terrain of southwestern Utah 12-18 hours later. The Yuma radar indicated a small area with near 10 inches of rain along the northern Gulf of California coast of Baja California. In the United States, the 11.97 inches recorded at the 5700-ft level in the Harquahala Mountains in Arizona was, by far, the largest total (Table 3). More than three inches occurred in some spots in Arizona, California, Nevada, and Utah. Some of the amounts were comparable to the local yearly average rainfall.

c. Casualty and Damage Statistics

Two deaths were reported from Mexico in association with Nora. One person was electrocuted by a downed power line in Mexicali. The other fatality occurred to a diver caught in strong underwater currents created by Nora off the coast of the San Quentin Valley. In the United States, there were no deaths directly related to Nora. The California Highway Patrol attributed three or four traffic fatalities in southern California to weather.

Although Nora remained well offshore from southwestern mainland Mexico, the Associated Press reported that waves to 16 feet hit that coastline, destroying dozens of homes. It also destroyed the Pie de la Cuesta beaches of Acapulco.

About 350 to 400 people were made homeless by floodwaters in the town of Arroyo de Santa Catarina in northern Baja California. Heavy damage and flooding was reported in San Felipe, on the northwestern shore of the Gulf of California. On the northeastern shore, at Puerto Pentilde; asco, Nora's winds blew

down trees, billboards, electric wires, taco stands, and ripped sheet-metal from homes. Waves of 10 feet were reported there.

Damage totals in the United States are incomplete at this time but media summaries of Nora included a loss to agriculture preliminarily estimated at several hundred million dollars. About a $30 to 40 million loss to lemon trees was estimated.

In Somerton, AZ, 10 miles south of Yuma, damage to mobile homes and flooding was reported. About 12,000 people lost power in Yuma.

In California, about 125,000 customers lost power in the Los Angeles area with scattered, much smaller outages elsewhere. In San Diego, El Centro, Palm Springs and Indio, street flooding was reported. Winds knocked down about 16 power poles in Seeley.

The remnant circulation aloft apparently downed and/or sheared off the tops of hundreds of large (1-2 ft diameter) trees in southwestern Utah, mainly at elevations above 10,000 feet in the area that includes the Dixie National Forest. Three residences in that region were damaged by falling trees and power was disrupted.

d. **Forecast and Warning Critique**

On average, the best short-term track guidance was provided by the statistical track models run from the AVN and UKMET output (P91E and P9UK). The best 72-hour forecasts were made by the UKMET model. The average official forecasts were generally competitive with the best available guidance. The NHC errors were comparable to the long-term averages, except at 72 hours where they were about 20% larger than average.

The NHC intensity forecasts did not anticipate the variations in strength accompanying Nora's interaction with upwelled waters. A few forecast errors as large as 40 knots resulted. Otherwise, errors were comparable to long-term averages (which increase to about 20 kt at 72 hours).

The threat to the southwestern United States was unusual and required an unprecedented coordination between the NHC and offices in the NWS Western Region. In one instance, a conference call was held with about twelve offices (including the Salt Lake City RFC, Western Region MSD, HPC, and Navy METOC facility in San Diego). From the NHC perspective, the coordination was smooth and effective.

Acknowledgments

Operational assistance and data for this report were provided to the NHC by NWS offices in Phoenix, Tucson, Flagstaff, Las Vegas, Salt Lake City, San Diego and Oxnard.

Table 1. Preliminary best track, Hurricane Nora, 16-26 September 1997.

Date/Time (UTC)	Lat. (N)	Lon (W)	Pressure (mb)	Wind Speed (kt)	Stage
16/0600	12.7	101.7	1004	25	Tropical Depr
1200	13.2	101.9	1003	30	"
1800	13.6	102.1	1001	35	Tropical Storm
17/0000	13.9	102.3	1000	40	"
0600	14.0	102.4	998	40	"
1200	14.1	102.5	996	50	"
1800	14.3	102.7	994	55	"
18/0000	14.3	102.9	990	55	"
0600	14.3	103.2	990	60	"
1200	14.1	103.5	980	75	Hurricane
1800	14.1	103.7	970	90	"
19/0000	14.3	103.9	972	90	"
0600	14.4	104.0	973	85	"
1200	14.5	104.1	974	80	"
1800	14.6	104.2	976	80	"
20/0000	14.8	104.5	978	70	"
0600	15.1	104.9	982	70	"
1200	15.4	105.5	987	65	"
1800	15.6	106.2	985	70	"
21/0000	15.8	106.7	979	75	"
0600	16.1	107.3	970	95	"
1200	16.6	108.0	950	115	"
1800	17.2	108.9	951	110	"
22/0000	17.7	109.7	952	110	"
0600	18.0	110.5	953	110	"
1200	18.5	111.2	955	110	"
1800	18.9	111.8	957	105	"
23/0000	19.3	112.3	961	95	"
0600	19.8	112.9	973	90	"
1200	20.2	113.3	983	80	"
1800	20.7	113.7	980	70	"
24/0000	21.5	114.1	979	75	"
0600	22.3	114.5	979	75	"
1200	23.2	114.8	979	75	"

1800	24.2	114.8	979	75	"
25/0000	25.8	114.8	979	75	"
0600	27.5	114.8	981	75	"
1200	29.5	114.8	984	65	"
1800	31.7	114.9	990	55	Tropical Storm
26/0000	34.0	114.7	997	30	Tropical Depr
0600	36.1	114.1	1004	25	Dissipating
25/0630	27.6	114.8	981	75	Landfall near Punta Eugenia, MX
25/1100	29.3	114.8	983	70	Landfall SSE of San Fernando, MX
21/1200	16.6	108.0	950	115	Minimum Pressure

Table 2. Observations of 34 knots or higher sustained winds associated with Nora.

Id	Name	Date/Time (UTC)	Lat. (N)	Lon. (W)	Wind Dir./Spd (kt)	Pressure (mb)
3FGI5		18/1800	17.0	101.8	110/44	
C6FA6	KENNETH P. HILL	18/2100	12.5	103.9	250/40	994
PGRO	PAUWGRACHT	19/0300			130/35?	1009
PGRO	PAUWGRACHT	19/0600	17.0	101.5	120/37	1008.8
3ERJ8	GEORGIA RAINBOW II	21/0000	15.7	108.6	320/48	999
3ERJ8	GEORGIA RAINBOW II	21/1200	14.7	106.7	180/39	1001.5
PFSJ	MAGIC	21/1800	11.4	107.4	220/47	1008.5
ZCBD9		23/0000	22.5	109.4	110/40	1001.7
ZCBL6		23/0000	20.3	106.8	140/40	
ZCBD9		23/0600	22.0	107.8	140/40	1005.4
ZCBL6		23/2100	22.1	110.9	140/35	1002.8
YJZL7	WISLANES	24/1200	23.1	111.1	140/35	1003.3
ZCBL6		24/1500	25.0	113.5	120/44	998.2
ZCBL6		24/1800	25.2	113.8	120/44	995.8
ZCBL6		24/2100	25.3	113.8	140/48	989
ZCBL6		25/0000	25.2	113.7	160/50	991.8
76723	SOCORRO ISLAND, MX	22/0000	18.7	111.0	340/45	992.8
76401	EL MEDANO, MX	24/0600	24.4	111.3	140/40	998.5
72280	YUMA, ARIZONA	25/2106	32.7	114.6	150/39G47	994.6

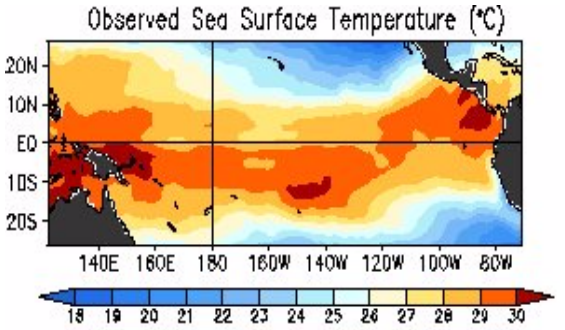
Table 3. Storm-total rainfall reports exceeding 3 inches (except for a few ALERT gauges in southern California), and selected additional sites with smaller totals, associated with Nora.

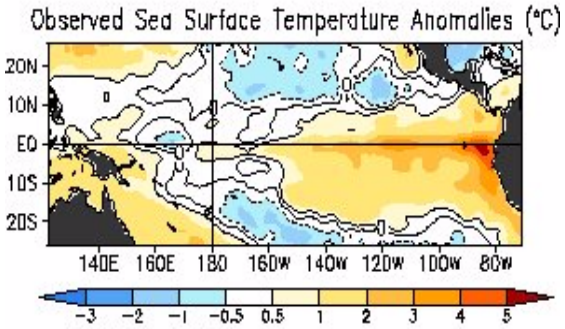
Reports of > 3 inches			**Selected Sites**	
Harquahala Mtns @ 5700', AZ	11.97		Idyllwild, CA	2.86
Yarnell Hill, AZ	6.26		Prescott, AZ	2.37
Harquahala Mtns, AZ	5.97		Grand Canyon Nat. Pk., AZ	2.05
Bagdad, AZ	5.75		Blythe, CA	2.03
Thumb Butte Tank, AZ	5.75		Thermal, CA	1.99
Mayer, AZ	5.06		Escondido, CA	1.84
Crown King, AZ	4.79		Mt. Wilson, CA	1.79
Mt. Laguna, CA	4.70		Palm Springs, CA	1.73
Wickenberg, AZ	4.53		Flagstaff, AZ	1.70
Hualapai Mtn, AZ	4.50		Daggett, CA	1.55
Centennial Wash, AZ	4.21		China Lake, CA	1.49
Tiger Wash Fan, AZ	4.17		Imperial Beach, CA	1.35
Gladden, AZ	4.02		Chula Vista, CA	1.33
Upper Tiger Wash, AZ	3.82		Henderson, NV	1.27
Turtle People, AZ	3.70		Kingman Airport, AZ	1.13
Flores West, AZ	3.66		Death Valley	1.11
Upper Morongo Creek, CA	3.61		Organ Pipe Nat. Mon., AZ	1.11
MCAS Yuma, AZ	3.59		Lake Havasu, AZ	1.00
Upper Tahquitz. CA	3.58		Palmdale, CA	0.97
Wilhoit, AZ	3.54		Imperial, CA	0.96
Horsethief Basin, AZ	3.39		Twenty-Nine Palms, CA	0.96
Lava Point, UT	3.30		San Diego, CA	0.80
Mt. Charleston, NV	3.25		San Gabriel, CA	0.78
Mt. Union, AZ	3.23		Las Vegas, NV	0.77
Hartman Wash, AZ	3.19		Pasadena, CA	0.70
Sols Tank, AZ	3.15		Laughlin, NV	0.60
Mid-Martinez Creek, AZ	3.11		Bullhead City, NV	0.60
Box Canyon, AZ	3.07		Los Angles, CA	0.45
Banning Bench, CA	3.07		Long Beach, CA	0.44
Raywood Flat, CA	3.07		Tonopah, NV	0.34
Bishop, CA	0.13		Phoenix, AZ	0.03

El Nino/Southern Oscillation (ENSO)

CURRENT STATUS UPDATED MARCH 27, 1998

Strong warm episode (El Niño) conditions have persisted in the tropical Pacific since June 1997. Sea surface temperatures throughout the equatorial east-central Pacific increased to near 29°C during February and March 1998. At the same time, departures from normal were near +4°C along the West Coast of South America. During 1997 the NCEP statistical Canonical Correlation Analysis (CCA) and coupled model predictions were consistent in indicating the development and persistence of strong warm episode conditions. The latest NCEP forecasts indicate that strong warm episode oceanic conditions, comparable to those observed during 1982-83, will continue through June 1998. Thereafter, both the CCA and the NCEP coupled model indicate a return toward normal.





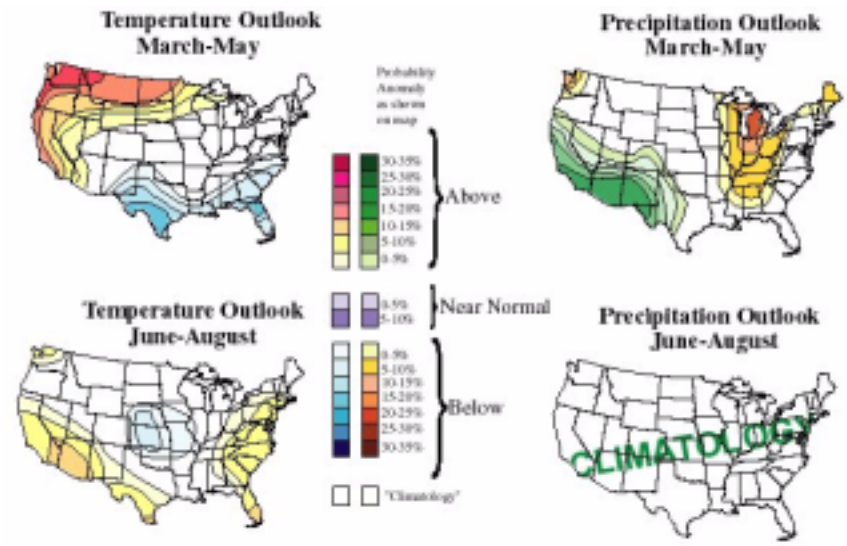
7-day Average Centered on 29 April 1998

During warm (El Niño) episodes abnormal patterns of temperature and precipitation develop in many regions of the globe. These patterns result from changes in the distribution of tropical rainfall and the effects these

changes have on the position and intensity of jet streams and the behavior of storms outside of the tropics in both the Northern and Southern Hemispheres. Current precipitation El Niño-related impacts include: 1) Wetter than normal conditions over the equatorial central and eastern Pacific (June 1997-March 1998); 2) Drier than normal conditions in Indonesia (June 1997-March 1998), and in equatorial South America east of the Andes mountains (June 1997-March 1998); 3) wetter than normal conditions over central Chile (May-August 1997) and central portions of South America (October 1997-March 1998); and 4) exceptionally heavy rainfall over equatorial eastern Africa (October 1997-February 1998), with totals more than 1000 mm above normal observed in parts of Kenya. In the United States, wetter-than-normal conditions developed over California and throughout the eastern Gulf Coast states and Florida (November 1997 through March 1998).

U.S. SEASONAL FORECASTS
Updated March 27, 1998

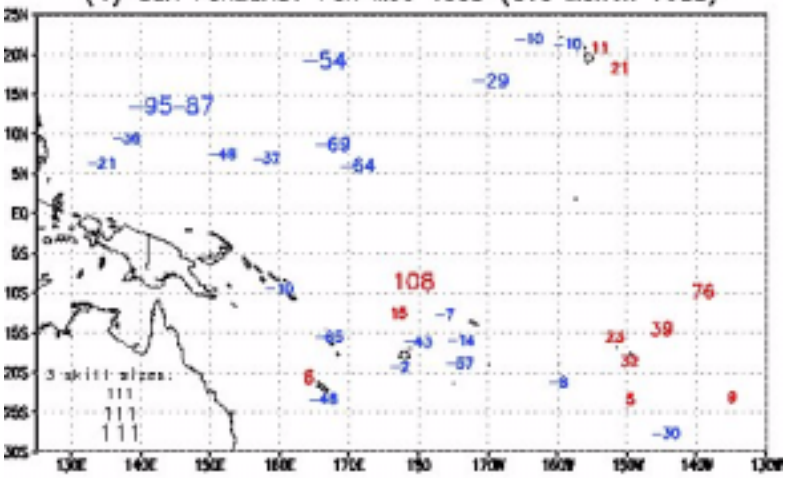
In the following temperature forecasts, shades of blue indicate a likelihood of below-normal temperatures, while reds imply a likelihood of above-normal temperatures. In the precipitation forecasts, shades of brown indicate a likelihood of below-normal precipitation, while greens and blues indicate a likelihood of above-normal precipitation. The complete suite of 13 seasonal temperature and precipitation forecasts are available. The detailed map legend is also available. Note: The bar at the bottom of the 13-month outlooks lists the three months of the forecast.



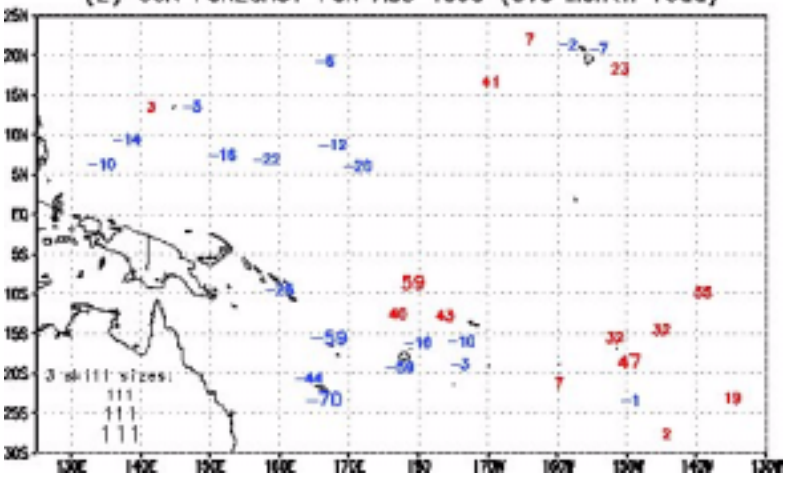
Canonical Correlation Analysis (CCA) Rainfall Forecasts for Pacific Islands

CCA forecast of rainfall deviations from normal at selected tropical Pacific stations for the two coming 3-month periods. Red numbers show positive deviations from normal (more rainfall than normal) while blue numbers show negative deviations from normal (less rainfall than normal). The value of the numbers tell how large a deviation from normal is expected. These are not in millimeters, but are in standardized units that indicate how typical (or non-typical) the rainfall conditions are expected to be relative to the station's normal climate for the season in question. For example, numbers from 0 to 25 (or 0 to -25) are small deviations, indicating conditions that would usually be considered typical of the climate for the station and the time of year. Deviations from 25 to 60 (or -25 to -60) are moderate deviations, indicating somewhat wetter (or dryer) conditions than would be expected for the station and the time of year. Deviations of over 60 (or less than -60) are large deviations, indicating substantially wetter (or dryer) conditions than normal for the station and time of year. The SIZE OF THE TYPE of the number (not the value of the number) indicates how accurate the forecast is expected to be, on the average, for the station at the given time of year and the forecast lead time. There are three sizes: the smallest size indicates low skill, the medium size indicates moderate skill, and the largest size indicates a relatively high skill. Forecasts shown in the smallest type size are considered to have little reliability, while those in the largest type size can be trusted more.

(1) CCA FORECAST FOR MJJ 1998 (0.5 month lead)



(2) CCA FORECAST FOR ASO 1998 (3.5 month lead)



CHAPTER VI

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3. Marine Corps Air Station, Local Area Forecaster's Handbook, Yuma, Arizona, 30 October 1989.

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5. Naval Pacific Meteorology and Oceanography Facility, Local Area Forecaster's Handbook, Naval Air Station, North Island, California, 24 August 1992.

6. National Hurricane Center, Tropical Prediction Center Web site www.nhc.noaa.gov/nora.html.

7.El Nino/Southern Oscillation (ENSO) web site nic.fb4.noaa.gov/products/analysis_monitoring/ensostuff/.