NASA TECHNICAL MEMORANDUM

NASA TM X-64986

BASELINE METEOROLOGICAL SOUNDINGS FOR PARAMETRIC ENVIRONMENTAL INVESTIGATIONS AT KENNEDY SPACE CENTER AND VANDENBERG AIR FORCE BASE

By Michael Susko and J. Briscoe Stephens
Space Sciences Laboratory

February 1976

NASA

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
NASA TM X-64986		

4. TITLE AND SUBTITLE	5. REPORT DATE
Baseline Meteorological Soundings for Parametric Environmental Investigations at Kennedy Space Center and Vandenberg Air Force Base	February 1976
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Michael Susko and J. Briscoe Stephens	8. PERFORMING ORGANIZATION REPORT #
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
George C. Marshall Space Flight Center Marshall Space Flight Center, Alabama 35812	11. CONTRACT OR GRANT NO.
	13. TYPE OF REPORT & PERIOD COVERED
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D.C. 20546	Technical Memorandum
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared by Space Sciences Laboratory, Science and Engineering

16. ABSTRACT

Thirty-one meteorological soundings representative of the atmospheric environment at Kennedy Space Center, Florida, and Vandenberg Air Force Base, California, are presented. These are the baseline soundings currently being used by the Atmospheric Diffusion/ Environmental Effects Technical Task Team at George C. Marshall Space Flight Center for the parametric studies. Synthetic meteorological soundings at Kennedy Space Center, including fall, spring, and a sea-breeze, and at Vandenberg Air Force Base (sea-breeze with low and high level inversion and stationary upper level troughs) are shown. Soundings of frontal passages at Kennedy Space Center and Vandenberg Air Force Base are listed. The Titan launch soundings at Kennedy Space Center present a wide range of meteorological conditions, both seasonal and time of day variations.

The meteorological data input of altitude, wind speed, wind direction, temperature, and pressure may be used as meteorological inputs for the NASA/MSFC Multilayer Diffusion Model or other models to obtain quantitative estimates of effluent concentrations associated with the potential emission of major combustion products in the lower atmosphere to simulate actual launches of space vehicles at Kennedy Space Center and Vandenberg Air Force Base. The Titan launch soundings are also of value in terms of the Langley Research Center rocket effluent measurements for analysis purposes.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
	Unclassified — Unlimited Michael Susko

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	43	NTIS

ACKNOWLEDGMENT

This document presents the results of work performed by the Atmospheric Diffusion/Environmental Effects Technical Task Team, Aerospace Environment Division, Space Sciences Laboratory, Marshall Space Flight Center, Alabama. Much credit must be given to Mr. W. W. Vaughan who encouraged the preparation of this report. The authors are indebted to Messrs. C. Kelly Hill and John W. Kaufman of the Space Sciences Laboratory and Messrs. R. K. Dumbauld and James Bowers of the H. E. Cramer Company for their significant contributions to the overall effort in the generation of the synthetic atmospheric soundings. We appreciate the meteorological support of the Air Force personnel at Cape Canaveral Air Force Station and Vandenberg Air Force Base and the Pan Am personnel at CCAFS.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Concluded)

TECHNICAL MEMORANDUM X-64986

BASELINE METEOROLOGICAL SOUNDINGS FOR PARAMETRIC ENVIRONMENTAL INVESTIGATIONS AT KENNEDY SPACE CENTER AND VANDENBERG AIR FORCE BASE

INTRODUCTION

Table 1 presents a collection of atmospheric soundings representative of the environment at Kennedy Space Center (KSC), Florida, and Vandenberg AFB (VAFB), California. These soundings include wind speed, wind direction, temperature, and pressure as a function of altitude together with the surface density and standard deviation of the wind azimuth angle at the surface. The height of the surface mixing layer is also given. These are necessary meteorological data inputs to the NASA/MSFC Multilayer Diffusion Model.

Synthetic soundings were generated for meteorological regimes representative of KSC and VAFB. Characteristic cases of fall, spring, and sea-breeze regimes for KSC and sea-breeze cases of low and high level inversions for VAFB are presented.

To illustrate and document actual launch operations, seven T-0 soundings obtained from KSC during the launches of the Titan are included. To illustrate the temporal variations in atmospheric conditions, eight soundings are presented for the 32 hour period before the May 30, 1974, Titan launch.

METEOROLOGICAL DATA FOR KSC

Fall, Spring, and Sea-Breeze Meteorological Regimes

The synthetic soundings for the fall, spring, and sea-breeze regimes at KSC were derived from the mean monthly wind speed, wind direction, and temperature profiles for KSC [1,2]. These profiles have been used in previous diffusion calculations for space vehicle launches at KSC [3-7]. A study of the

KSC climatology indicated that the average depth of the surface mixing layer in the fall season associated with the easterly winds required to transport the ground cloud inland is approximately 1000 m. During the spring, there are occasions when the surface mixing layer reaches a depth of 2000 m. The afternoon sea-breeze, which is common to all seasons, has an average surface mixing layer of 300 m. The fall, spring, and sea-breeze meteorological data are presented in Tables 2, 3, and 4.

Pre-Cold Front, Cold Front, and Post-Cold Front Meteorological Regimes

Three meteorological regimes are associated with the approach and passage of a cold front. These regimes are presented in Tables 5, 6, and 7. The meteorological data of October 19, 20, and 21, 1972, were selected to be representative of these regimes at KSC. At 0700 EDT on October 19, a cold front was located northwest of Florida, extending from Georgia through Southeast Alabama and then westward. Florida weather was fair with scattered high clouds and local haze conditions. The 0700 EDT sounding showed a stable layer from the surface to approximately 218 m above the ground. At 0700 EDT on October 20, the cold front was oriented from east to west and was located just to the south of KSC. Rain and rain showers were occurring in the vicinity of the front. The KSC 0700 EDT sounding indicates the presence of a moist, unstable air mass over KSC with a surface mixing layer extending to about 2000 m. The cold front had moved south into the Straits of Florida by 0700 EDT on October 21. The 0700 EDT sounding at KSC indicates a surface mixing layer depth of approximately 1400 m with dry, warm air aloft.

Additional Meteorological Regimes

Tables 8, 9, and 10 illustrate a stationary front south of KSC, a cold front south of KSC, and a fair-weather, high pressure regime at KSC for measurements at 10 km on October 2, 1972, November 26, 1972, and November 27, 1972.

Titan Meteorological Data

Tables 11 through 17 are meteorological data inputs for the Titan launches at KSC. The dates and times are the missions flown by the Titan. The weather data on August 20 and September 9, 1975 (Tables 16 and 17) are the Viking 1 and 2 space missions to Mars.

T-32 to T-0 Meteorological Data for a Titan Launch

An interesting collection of meteorological data is presented in Tables 18 through 25. This is the May 30, 1974, launch of the Titan. There are eight data sets from T-32 to T-0 hours. The Cape Kennedy area was influenced at T-24 on May 29 by northwesterly wind flow from 915 m (3000 ft) altitude to 6100 m (20 000 ft) altitude caused by an upper level high pressure system over the central United States. Below the 915 m (3000 ft) level another high pressure system affecting the lower layers was centered just off the Central Atlantic coast, producing southeasterly winds over Florida. Wind speeds were generally less than 5 m/s (10 knots) in these lower layers while they were occasionally reported above 13 m/s (25 knots) in the 2130 to 2440 m layer (7000 to 8000 ft). Also, a shallow band of almost calm air at 915 m (3000 ft) represented the boundaries between the upper and lower level flow and pressure systems. The first significant change in the atmospheric circulation from May 29 to May 30 occurred as a weakening of the surface high pressure system in the Atlantic and a simultaneously shifting of its center further south. The immediate and noticeable effect of this change was to create a gradual clockwise shifting in wind direction from southeasterly to southwesterly in the lowest 915 m (3000 ft) altitude over Cape Kennedy. The Cape Kennedy winds in the lowest 1525 m (5000 ft) continued to shift from southwesterly at T-5 to northwesterly at T-0. The winds ranged from 3.6 m/s (7 knots) at the surface to 7.7 m/s (15 knots) at 6100 m (20 000 ft). The coincident T-0 wind direction profile between the surface and 6100 m (20 000 ft) was generally northwesterly at all levels.

METEOROLOGICAL DATA FOR VANDENBERG AIR FORCE BASE

Morning and Afternoon Fair-Weather Regimes

In the absence of frontal activity, the weather in the lower 2000 to 3000 m at VAFB is dominated by the land-sea-breeze regime. The inversion produced by subsidence is present at VAFB over 90 percent of the time in the summer and approximately 50 percent of the time in the winter. With the Pacific high centered to the west and a thermal low common over the California interior, the prevailing gradient wind in all seasons is from the north or northeast. Cold air drainage from canyons in the vicinity of the launch areas contributes to the offshore winds at night and during the morning (Table 26). At the time of the sounding, the westerly sea breeze is beginning to develop near the surface with northeasterly winds above. The surface mixing layer extends to the base of the inversion which is approximately 400 m above the ground.

During the day the layer of onshore flow deepens as the sea-breeze becomes well established. Table 27 shows typical wind speed, wind direction, and temperature for an afternoon sea-breeze regime; the inversion base is approximately 225 m above the surface. Relatively high inversions are also observed at VAFB, often associated with an upper level trough to the west. Table 28 shows typical wind and temperature profiles for an afternoon sea-breeze regime with an inversion base approximately 775 m above the surface. A stationary upper level trough west of VAFB, a cold front northwest of VAFB, and a cold front south of VAFB are shown in Tables 29, 30, and 31.

TABLE 1. SUMMARY OF CLASSICAL AND ACTUAL METEOROLOGICAL REGIMES

No. Weather Data	Location	Meteorological Data Classical Meteorological Regimes	Date	Time (Z)	EDT
2	KSC	Fall	Typical Regimes		
3		Spring	Typical Regimes		
4		Sea-Breeze	Typical Regimes		
5		Cold Front North of KSC	October 19, 1972	1115	0715
6		Cold Front Near KSC	October 20, 1972	1115	0715
7		Cold Front South of KSC	October 21, 1972	1115	0715
8		Stationary Front South of KSC	October 2, 1972	1115	0715
9		Cold Front South of KSC	November 26, 1972	1115	0715
10		Fair Weather, High Pressure	November 27, 1972	1115	0715
		Actual Titan Launch Soundings from KSC			
11		Fair Weather, High Pressure	December 3, 1973	2357	1957
12		Cold Front North of KSC	February 11, 1974	1310	0910
13		High Pressure, Central United States	May 30, 1974	1300	0900
14		Fair Weather, High Pressure	December 10, 1974	0710	0310
15		Fair Weather, High Pressure	May 20, 1975	1400	1000
16		Fair Weather, High Pressure	August 20, 1975	2122	1722
17		Occasional Shower Activity Near KSC	September 9, 1975	1839	1439
18		High Pressure Ridge Located in Central United States Extending into Florida	May 29, 1974	T-32 0515	0115
19			May 29, 1974	T-26 1115	0715
20			May 29, 1974	T-24 1322	0922
21			May 29, 1974	T-14 2300	1900
22			May 30, 1974	T-10 0300	2300
23			May 30, 1974	T-8 0500	0100
24			May 30, 1974	T-5 0800	0400
25			May 30, 1974	T-0 1300	0900
		Classical Meteorological Regimes			
26	VAFB	Morning			PST
27		Sea Breeze with Low Level Inversion	Typical Regimes		
28		Sea Breeze with High Level Inversion			
29		Stationary Upper-Level Trough West of VAFB	October 10, 1972	1115	0315
30		Cold Front Northwest of VAFB	January 16, 1973	1115	0315
31		Cold Front South of VAFB	January 17, 1973	1115	0315

TABLE 2. KSC FALL, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 12.000 deg.

Surface air density is 1183.550 g/m^3.

Height of surface mixing layer is 1000.000.*

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (° C)	Pressure (mb)
18.000	90.0000	4.7000	26.000	1013.000
60.000	91.9000	5.1200	25.440	1007.000
200.000	95.8000	5.9700	24.300	995.000
400.000	101.6000	6.3900	22.600	972.500
600.000	107.4000	6.6500	20.900	950.000
800.000	113.2000	6.8500	19.200	926.000
1000.000	119.0000	7.0000	17.500	905.000
1200.000	121.5000	6.7000	16.800	885.000
1400.000	124.0000	6.4500	16.100	865.000
1600.000	126.0000	6.1800	15.400	845.000
1800.000	129.0000	5.9000	14.700	825.000
2000.000	131.0000	5.6000	14.000	805.000

* The height of mixing layer in all tables is a suggested altitude.

TABLE 3. KSC SPRING, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 7.000 deg.

Surface air density is 1183.550 g/m^3.

Height of surface mixing layer is 2000.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
18.000	100.0000	6.0000	27.000	1013.000
66.000	104.0000	6.2400	26.500	1007.000
200.000	108.0000	6.7200	25.500	995.000
400.000	116.0000	6.9500	23.900	972.500
600.000	124.0000	7.0800	22.300	950.000
800.000	132.0000	7.1800	20.700	926.000
1000.000	140.0000	7.2600	19.000	905.000
1200.000	148.0000	7.3200	17.450	885.000
1400.000	156.0000	7.3700	15.800	865.000
1600.000	164.0000	7.4200	14.200	845.000
1800.000	172.0000	7.4600	12.600	825.000
2000.000	180.0000	7.5000	11.000	805.000
2500.000	200.0000	7.5000	11.000	757.500

TABLE 4. KSC SEA BREEZE, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 12.000 deg.

Surface air density is 1183.550 g/m^3.

Height of surface mixing layer is 300.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
18.000	140.0000	4.5000	21.000	1013.000
44.000	141.6000	5.8000	20.020	1008.700
150.000	145.0000	7.9000	20.050	1000.000
300.000	150.0000	9.5000	19.000	985.000
500.000	161.5000	5.6000	19.000	961.000
700.000	172.5000	4.0000	19.000	937.500
1000.000	190.0000	2.7000	19.000	905.000
1500.000	240.0000	2.9000	16.750	855.000
2000.000	250.0000	3.1000	14.400	805.000

TABLE 5. 19 OCT. 72, 1115 Z (0715 EDT) COLD FRONT NORTH OF KSC, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 7.000 deg.

Surface air density is 1204.880 g/m^3.

Height of surface mixing layer is 218.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
18.000	253.0000	2.6000	18.900	1018.000
33.000	248.000	2.9000	20.400	1016.000
65.000	238.0000	3.5000	23.300	1011.000
218.000	194.0000	3.0000	24.000	993.500
400.000	198.0000	3.0000	22.700	973.000
600.000	199.0000	3.0000	21.400	951.000
800.000	211.0000	2.5000	20.400	929.000
1076.000	235.0000	2.0000	18.700	900.000
1200.000	229.0000	2.0000	16.800	887.000
1400.000	215.0000	3.0000	15.550	867.000

TABLE 6. 20 OCT. 72, 1115 Z (0715 EDT) COLD FRONT NEAR KSC, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 1.130 deg.

Surface air density is 1185.220 g/m^3.

Height of surface mixing layer is 250.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
18.000	41.0000	8.8000	23.700	1018.600
53.000	42.2000	10.2000	23.580	1014.000
125.000	44.5000	13.0000	23.350	1006.000
250.000	48.0000	15.0000	22.900	990.500
400.000	49.0000	15.0000	21.500	974.000
613.000	51.0000	15.0000	19.600	950.000
800.000	54.0000	13.7000	18.300	929.000
1000.000	59.0000	12.0000	17.200	908.400
1200.000	66.0000	11.3000	16.100	887.000
1400.000	73.5000	10.4000	14.800	867.000
1600.000	80.0000	8.8000	13.550	847.000
1800.000	86.5000	8.0000	12.200	827.000
2000.000	91.0000	7.0000	11.300	807.500

TABLE 7. 21 OCT. 72, 1115 Z (0715 EDT) COLD FRONT SOUTH OF KSC, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 9.000 deg.

Surface air density is 1197.070 g/m^3.

Height of surface mixing layer is 1400.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
18.000	80.0000	6.0000	22.600	1022.000
53.000	80.2000	6.7000	22.520	1017.700
125.000	80.5000	8.2000	22.350	1009.000
250.000	82.0000	9.0000	22.100	993.700
400.000	80.0000	9.6000	20.550	977.000
600.000	78.0000	10.0000	18.150	954.000
800.000	75.0000	11.0000	16.400	932.000
1000.000	71.0000	11.0000	14.600	910.600
1200.000	65.0000	11.0000	12.750	890.000
1400.000	57.0000	10.4000	11.000	868.000
1700.000	40.5000	8.6000	9.950	838.000

TABLE 8. 2 OCT. 72, 1115Z (0715 EDT) STATIONARY SOUTH OF KSC, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 15.000 deg.

Surface air density is 1186.120 g/m^3.

Height of surface mixing layer is 1330.000

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
2.000	250.0000	1.0000	25.200	1010.000
49.000	232.0000	1.2000	24.880	1004.000
150.000	195.0000	1.6000	24.250	992.000
250.000	162.0000	2.0000	23.600	985.000
350.000	159.0000	2.0000	23.500	970.000
500.000	155.0000	2.0000	23.400	955.000
750.000	140.0000	3.0000	20.800	930.000
1000.000	130.0000	2.0000	18.300	905.000
1250.000	141.0000	2.0000	15.900	877.000
1330.000	151.0000	2.0000	15.200	870.000
1600.000	135.0000	2.0000	16.300	840.000

TABLE 9. 26 NOV. 72 1115 Z (0715 EDT) COLD FRONT SOUTH OF KSC, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 14.000 deg.

Surface air density is 1194.640 g/m^3.

Height of surface mixing layer is 1000.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
2.000	240.0000	3.0000	18.400	1009.000
35.000	244.3000	3.8000	18.380	1004.700
100.000	253.0000	5.6000	18.350	995.000
200.000	267.0000	8.4000	18.300	985.000
300.000	272.0000	10.5000	17.850	974.000
400.000	269.0000	11.8000	17.050	963.000
600.000	264.0000	13.8000	15.900	942.000
800.000	257.0000	15.6000	15.500	920.000
1000.000	248.0000	18.0000	15.400	895.000
1080.000	245.0000	19.2000	18.800	888.000
1500.000	238.0000	22.9000	14.900	845.000
2000.000	239.0000	26.0000	12.600	795.000

TABLE 10. 27 NOV. 72, 1115Z (0715 EDT) FAIR WEATHER, HIGH PRESSURE, NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 15.000 deg.

Surface air density is 1262.230 g/m^3.

Height of surface mixing layer is 250.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
2.000	280.0000	2.0000	7.100	1020.000
18.000	284.0000	2.1300	7.380	1018.000
50.000	292.0000	2.4000	8.050	1015.000
100.000	304.0000	2.8000	9.000	1010.000
150.000	317.0000	3.2000	10.000	1004.000
200.000	329.0000	3.6000	11.050	999.000
250.000	343.0000	4.0000	11.900	990.000
500.000	332.0000	4.0000	10.200	960.000
750.000	309.0000	3.0000	9.000	930.000
1200.000	292.0000	5.4000	10.050	885.000

TABLE 11. TITAN T-0 SOUNDING, 13 DEC. 1973, 2357 Z (1957 EDT)

Standard deviation of the azimuth surface wind angle is 8.000 deg

Surface air density is 1271.100 g/m^3.

Height of surface mixing layer is 4000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	210.0000	7.0000	16.300	1011.500
336.000	216.0000	17.0000	18.000	1000.000
544.000	217.0000	24.0000	19.700	992.600
959.000	220.0000	25.0000	18.900	978.200
1000.000	221.0000	25.0000	18.700	976.700
1776.000	229.0000	28.0000	16.600	950.000
2000.000	231.0000	28.1000	16.000	942.500
2600.000	237.0000	28.0000	14.400	922.400
2972.000	240.0000	28.0000	13.100	910.100
3000.000	241.0000	28.0000	13.100	909.000
3276.000	242.0000	28.0000	12.600	900.000
3410.000	243.0000	28.0000	12.400	895.800
3861.000	244.0000	27.0000	10.900	881.300
4000.000	244.0000	27.0000	10.500	876.800
4212.000	244.0000	27.0000	9.900	870.000
4640.000	244.0000	25.0000	8.300	856.500
4776.000	243.0000	22.0000	7.700	852.200
4838.000	243.0000	21.0000	8.200	850.000
5000.000	243.0000	18.0000	9.200	845.200
5013.000	243.0000	18.0000	9.300	844.800

TABLE 12. TITAN T-0 SOUNDING, 11 FEB. 1974, 1300 Z (0900 EDT)

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1258.200 g/m^3.

Height of surface mixing layer is 4000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	280.0000	3.0000	11.100	1022.400
294.000	309.0000	14.0000	8.600	1012.000
618.000	311.0000	17.0000	8.600	1000.000
1000.000	313.0000	19.0000	7.600	986.000
2000.000	311.0000	25.0000	5.600	950.200
2002.000	311.0000	25.0000	5.600	950.000
2721.000	305.0000	26.0000	4.200	925.000
3000.000	304.0000	25.0000	3.200	915.400
3070.000	304.0000	25.0000	3.000	913.000
3446.000	305.0000	23.0000	2.800	900.000
4000.000	309.0000	20.0000	3.000	881.600
4110.000	318.0000	19.0000	3.300	878.000
4965.000	310.0000	20.0000	3.800	850.000
5000.000	310.0000	20.0000	3.800	849.200
6000.000	304.0000	21.0000	3.300	817.900

TABLE 13. TITAN T-0 SOUNDING, 30 MAY 1974, 1300Z (0900 EDT)

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1169.700 g/m^3.

Height of surface mixing layer is 5000.000

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	290.0000	7.0000	23.900	1015.200
449.000	309.0000	8.0000	22.800	1000.110
1000.000	300.0000	8.0000	22.800	981.110
1760.000	292.0000	8.0000	22.800	955.490
1922.000	291.0000	8.0000	22.600	950.000
2000.000	290.0000	8.0000	22.400	947.520
3000.000	292.0000	7.0000	20.600	914.940
3462.000	296.0000	8.0000	19.500	900.000
4000.000	299.0000	9.0000	18.200	883.220
4055.000	299.0000	9.0000	18.[illegible]0	881.490
4480.000	298.0000	10.0000	16.700	868.300
5000.000	297.0000	11.0000	15.100	852.290
5066.000	296.0000	11.0000	15.000	850.000
6000.000	292.0000	11.0000	12.900	822.160

TABLE 14. TITAN T-0 SOUNDING, 10 DEC. 1974, 0710 Z (0310 EDT)

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1264.610 g/m^3.

Height of surface mixing layer is 556.800.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
4.800	310.0000	3.0000	8.900	1023.000
192.900	339.0000	9.7000	9.100	1000.000
226.800	341.0000	9.7000	9.500	996.000
304.800	345.0000	10.8000	8.900	986.000
556.800	355.0000	10.3000	6.700	957.000
609.600	355.0000	10.3000	7.700	951.000
616.600	355.0000	10.3000	7.800	950.000
661.100	354.0000	10.3000	8.600	945.000
914.400	345.0000	10.3000	7.900	917.000
1062.800	340.0000	11.3000	7.400	900.000
1219.200	332.0000	11.8000	7.100	883.000
1523.900	314.0000	12.8000	6.500	851.000
1532.800	314.0000	12.8000	6.400	850.000
1828.800	306.0000	13.9000	5.800	820.000

TABLE 15. TITAN T-0 SOUNDING, 20 MAY 1975, 1400 Z (1000 EDT)

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1167.970 g/m^3.

Height of surface mixing layer is 2051.300.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
4.800	320.0000	2.5000	27.800	1015.600
141.400	323.0000	3.6000	25.000	1000.000
304.800	317.0000	3.6000	23.400	981.610
470.900	312.0000	3.6000	21.900	963.110
609.600	314.0000	3.0000	21.400	947.900
847.000	335.0000	3.6000	20.200	922.310
914.400	342.0000	3.6000	19.300	915.150
1219.200	7.0000	3.6000	16.400	883.230
1523.900	19.0000	3.0000	14.000	852.120
1828.800	23.0000	3.6000	12.100	821.880
2051.300	15.0000	4.6000	10.300	800.000

TABLE 16. TITAN T-0 SOUNDING, 20 AUG. 1975, 2122Z (1722 EDT)

Standard deviation of the azimuth surface wind angle is 23.000 deg.

Surface air density is 1162.670 g/m^3.

Height of surface mixing layer is 1090.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
5.000	110.0000	3.0000	28.700	1018.300
166.000	95.0000	4.0000	26.800	1000.000
220.000	91.0000	4.0000	26.200	994.000
305.000	89.0000	4.0000	25.500	984.540
610.000	83.0000	2.0000	24.500	951.100
619.000	82.0000	2.0000	24.500	950.000
638.000	82.0000	2.0000	24.500	948.000
814.000	87.0000	1.0000	21.800	918.560
1078.000	77.0000	0.1000	20.700	902.000
1090.000	80.0000	0.1000	20.600	900.000
1219.000	109.0000	0.1000	20.000	886.900
1524.000	169.0000	1.0000	17.700	856.120
1583.000	166.0000	1.0000	17.400	850.000
1829.000	162.0000	1.0000	16.800	826.190
1987.000	167.0000	3.0000	15.400	811.000
2100.000	170.0000	4.0000	15.500	800.000
2134.000	170.0000	4.0000	15.600	797.190
2211.000	171.0000	5.0000	15.600	790.000
2438.000	159.0000	4.0000	11.700	769.040

TABLE 17. TITAN T-0 SOUNDING, 9 SEPT. 1975, 1839 Z (1439 EDT)

Standard deviation of the azimuth surface wind angle is 12.000 deg.

Surface air density is 1166.080 g/m^3.

Height of surface mixing layer is 1829.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
5.000	40.0000	2.0000	28.900	1021.700
196.000	71.0000	3.0000	25.800	1000.000
232.000	75.0000	3.0000	25.200	996.000
305.000	76.0000	3.0000	24.700	987.760
610.000	80.0000	3.0000	22.400	954.090
646.000	80.0000	3.0000	22.100	950.000
914.000	82.0000	3.0000	20.000	921.290
1115.000	84.0000	3.0000	18.700	900.000
1219.000	84.0000	3.0000	18.100	889.370
1524.000	83.0000	4.0000	16.100	858.330
1604.000	82.0000	4.0000	15.700	850.000
1829.000	82.0000	4.0000	14.400	828.170
2118.000	86.0000	4.0000	12.400	800.000
2134.000	87.0000	4.0000	12.400	798.860
2292.000	91.0000	4.0000	11.300	784.000
2438.000	95.0000	4.0000	10.500	770.390

TABLE 18. TITAN 0-32 HR, 0515Z (0115 EDT), 29 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1183.540 g/m^3.

Height of surface mixing layer is 5000.000

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	110.0000	5.0000	24.200	1019.000
558.000	111.0000	10.0000	23.600	1000.000
1000.000	112.0000	13.0000	23.000	984.780
2000.000	120.0000	10.0000	20.500	950.980
2026.000	120.0000	10.0000	20.400	950.000
3000.000	127.0000	6.0000	18.200	918.060
3167.000	128.0000	5.0000	17.900	912.680
3555.000	121.0000	3.0000	17.300	900.000
4000.000	357.0000	1.0000	16.600	886.080
4787.000	310.0000	8.0000	15.400	861.560
5000.000	308.0000	10.0000	15.200	855.010
5155.000	306.0000	11.0000	15.000	850.000
6000.000	302.0000	17.0000	14.500	824.900
6361.000	301.0000	19.0000	14.400	814.280
6840.000	299.0000	19.0000	13.900	800.000
7000.000	299.0000	20.0000	13.700	795.750
7288.000	298.0000	20.0000	13.400	787.540
8000.000	293.0000	19.0000	11.300	767.470

TABLE 19. TITAN 0-26 HR, 1115Z (0715 EDT), 29 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1188.280 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	130.0000	3.0000	22.800	1018.600
513.000	120.0000	8.0000	23.500	1001.170
1000.000	126.0000	8.0000	22.400	984.330
2000.000	133.0000	5.0000	20.500	950.480
3000.000	47.0000	2.0000	18.300	917.540
3509.000	356.0000	4.0000	17.000	901.130
3535.000	354.0000	5.0000	16.900	900.000
4000.000	340.0000	7.0000	15.900	885.480
5000.000	325.0000	9.0000	13.500	854.310
5492.000	321.0000	10.0000	12.600	839.290
5927.000	318.0000	12.0000	11.000	826.160
6000.000	316.0000	12.0000	11.000	823.970
6217.000	309.0000	14.0000	11.100	817.510
6408.000	301.0000	16.0000	12.600	811.850
6803.000	297.0000	18.0000	11.200	800.000
7000.000	296.0000	18.0000	10.400	794.610
7318.000	295.0000	18.0000	8.800	785.450
7741.000	293.0000	18.0000	10.400	773.370
8000.000	292.0000	18.0000	9.800	766.090

TABLE 20. TITAN 0-24 HR, 1322Z (0922 EDT), 29 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1170.310 g/m^3.

Height of surface mixing layer is 5000.000

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (° C)	Pressure (mb)
16.000	140.0000	6.0000	27.400	1019.000
560.000	148.0000	7.0000	23.900	1000.000
735.000	150.0000	7.0000	22.800	993.990
1000.000	152.0000	7.0000	22.300	984.850
1804.000	157.0000	6.0000	20.900	957.590
2000.000	155.0000	5.0000	20.400	951.000
3000.000	101.0000	1.0000	18.300	918.040
3554.000	347.0000	2.0000	17.100	900.000
4000.000	334.0000	4.0000	15.800	885.970
4209.000	332.0000	5.0000	15.100	879.380
5000.000	318.0000	10.0000	13.200	854.740
5145.000	315.0000	11.0000	12.900	850.000
6000.000	308.0000	15.0000	11.500	824.370
6814.000	305.0000	19.0000	11.000	800.000
7000.000	304.0000	22.0000	10.900	794.950
7768.000	302.0000	24.0000	10.100	772.970
8000.000	300.0000	23.0000	8.900	766.440
9000.000	300.0000	21.0000	7.800	738.730
10000.000	297.0000	19.0000	6.900	711.920

TABLE 21. TITAN 0-14 HR, 2300 Z (1900 EDT), 29 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1169.260 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	140.0000	9.0000	26.800	1014.600
436.000	132.0000	11.0000	25.500	1000.000
1000.000	129.0000	12.0000	24.400	980.670
1910.000	119.0000	9.0000	22.700	950.000
2000.000	118.0000	9.0000	22.500	947.100
2066.000	117.0000	8.0000	22.400	944.920
3000.000	93.0000	1.0000	20.500	914.470
3448.000	296.0000	3.0000	19.600	900.000
4000.000	294.0000	8.0000	18.900	882.810
4455.000	292.0000	10.0000	17.900	868.720
4848.000	290.0000	12.0000	16.400	856.660
5000.000	290.0000	13.0000	16.200	852.040
5059.000	290.0000	13.0000	16.100	850.000
6000.000	289.0000	16.0000	14.000	822.090
6744.000	292.0000	16.0000	12.200	800.000
7000.000	294.0000	16.0000	11.600	792.960
7041.000	294.0000	16.0000	11.500	791.790
8000.000	298.0000	13.0000	10.900	764.690

TABLE 22. TITAN 0-10 HR, 0300Z (2300 EDT), 30 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1174.780 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	190.0000	8.0000	25.200	1015.600
462.000	186.0000	11.0000	24.000	1000.000
973.000	184.0000	15.0000	22.700	982.450
1000.000	184.0000	15.0000	22.600	981.540
1916.000	185.0000	14.0000	22.000	950.640
1933.000	185.0000	14.0000	21.900	950.000
2000.000	185.0000	13.0000	21.800	947.850
3000.000	199.0000	11.0000	19.400	915.080
3465.000	211.0000	10.0000	18.500	900.000
4000.000	229.0000	9.0000	17.400	883.250
5000.000	266.0000	9.0000	15.100	852.340
5069.000	268.0000	9.0000	14.900	850.000
5319.000	275.0000	10.0000	14.200	842.680
6000.000	287.0000	10.0000	13.400	822.290
6749.000	295.0000	11.0000	11.700	800.000
7000.000	297.0000	11.0000	11.100	793.080
7662.000	301.0000	11.0000	9.400	774.190
8000.000	302.0000	12.0000	9.100	764.680

TABLE 23. TITAN 0-8 HR, 0500 Z (0100 EDT), 30 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1175.440 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	190.0000	5.0000	24.900	1014.900
443.000	194.0000	12.0000	24.700	1000.000
1000.000	194.0000	14.0000	23.900	980.940
1059.000	194.0000	14.0000	23.800	978.930
1546.000	194.0000	14.0000	22.400	962.490
1918.000	193.0000	13.0000	22.200	950.000
2000.000	193.0000	13.0000	22.200	947.370
3000.000	209.0000	11.0000	20.600	914.730
3456.000	221.0000	11.0000	19.400	900.000
3545.000	223.0000	11.0000	19.100	897.330
4000.000	238.0000	11.0000	17.400	883.010
4506.000	247.0000	10.0000	16.500	867.280
5000.000	263.0000	9.0000	15.200	852.120
5061.000	266.0000	9.0000	15.100	850.000
5405.000	280.0000	8.0000	14.600	839.860
6000.000	301.0000	8.0000	13.400	822.100
6743.000	316.0000	8.0000	12.100	800.000
7000.000	318.0000	8.0000	11.700	792.930
8000.000	320.0000	8.0000	9.400	764.600

TABLE 24. TITAN 0-5 HR, 0800Z (0400 EDT), 30 MAY 1974

Standard deviation of the azimuth surface wind angle is 8.000 deg.

Surface air density is 1185.130 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	210.0000	4.0000	22.100	1013.500
401.000	204.0000	11.0000	24.100	1000.000
420.000	204.0000	12.0000	24.200	999.370
1000.000	199.0000	14.0000	23.600	979.480
1311.000	198.0000	15.0000	23.800	968.950
1760.000	198.0000	15.0000	23.100	953.980
1877.000	199.0000	15.0000	22.700	950.000
2000.000	200.0000	15.0000	22.400	946.010
3000.000	211.0000	11.0000	20.000	913.430
3415.000	217.0000	8.0000	19.200	900.000
4000.000	234.0000	5.0000	17.600	881.740
4282.000	244.0000	4.0000	16.700	872.950
5000.000	250.0000	4.0000	16.100	850.910
5022.000	250.0000	4.0000	16.100	850.000
6000.000	237.0000	5.0000	14.500	821.020
6709.000	234.0000	4.0000	12.800	800.000
7000.000	241.0000	4.0000	12.200	791.950
7200.000	249.0000	3.0000	11.800	786.220
7628.000	278.0000	3.0000	10.100	774.090
8000.000	293.0000	4.0000	10.000	763.660

TABLE 25. TITAN T-0 SOUNDING, 30 MAY 1974, 1300 Z (0900 EDT)

Standard deviation of the azimuth surface wind angie is 8.000 deg.

Surface air density is 1169.700 g/m^3.

Height of surface mixing layer is 5000.000.

Layer Boundary Height (ft)	Wind Direction (deg)	Wind Speed (knots)	Temperature (°C)	Pressure (mb)
16.000	290.0000	7.0000	23.900	1015.200
449.000	309.0000	8.0000	22.800	1000.110
1000.000	300.0000	8.0000	22.800	981.110
1760.000	292.0000	8.0000	22.800	955.490
1922.000	291.0000	8.0000	22.600	950.000
2000.000	290.0000	8.0000	22.400	947.520
3000.000	292.0000	7.0000	20.600	914.940
3462.000	296,0000	8.0000	19.500	900.000
4000.000	299.0000	9.0000	18.200	883.220
4055.000	299.0000	9.0000	18.100	881.490
4480.000	298.0000	10.0000	16.700	868.300
5000.000	297.0000	11.0000	15.100	852.290
5066.000	296.0000	11.0000	15.000	850.000
6000.000	292.0000	11.0000	12.900	822.160

TABLE 26. VAFB MORNING NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 7.200 deg.

Surface air density is 1234.440 g/m^3.

Height of surface mixing layer is 390.140.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (° C)	Pressure (mb)
2.000	360.0000	3.1000	11.700	1013.900
33.850	354.2000	4.2000	10.600	1010.000
97.540	342.5000	6.5000	8.400	1005.000
195.070	355.0000	5.2000	7.000	990.000
292.610	10.5000	4.1000	7.500	980.000
390.140	18.5000	4.8000	6.300	970.000
512.060	5.0000	6.2000	8.000	955.000
633.980	360.0000	7.2000	9.750	940.000
755.900	350.0000	8.9000	11.000	925.000
977.490	345.0000	10.7000	10.500	900.000
1219.200	332.0000	7.7000	9.400	870.000
1524.000	327.0000	8.2000	8.100	830.000
1828.800	326.0000	8.4000	6.150	800.000

TABLE 27. VAFB SEA BREEZE LOW INVERSION NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 6.350 deg.

Surface air density is 1236.180 g/m^3.

Height of surface mixing layer is 225.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (° C)	Pressure (mb)
2.000	250.0000	5.0000	18.000	1019.000
41.000	238.0000	4.7000	15.700	1011.900
125.000	214.0000	4.0000	11.200	997.500
225.000	217.0000	3.0000	10.700	984.000
325.000	250.0000	3.0000	13.000	972.500
425.000	301.0000	3.0000	14.600	961.000
525.000	352.0000	3.0000	16.300	950.000
725.000	325.0000	6.0000	15.900	927.500
925.000	37.0000	3.0000	14.600	905.000
1425.000	63.0000	3.5000	12.100	850.300

TABLE 28. VAFB SEA BREEZE HIGH INVERSION NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 6.350 deg.

Surface air density is 1236.180 g/m^3.

Height of surface mixing layer is 776.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
2.000	300.0000	5.1000	16.200	1019.000
60.000	307.0000	4.4000	15.470	1011.800
176.000	321.0000	3.1000	14.000	997.500
376.000	267.0000	0.7000	12.000	972.500
576.000	318.0000	1.7000	10.300	950.000
776.000	332.0000	3.3000	8.900	927.500
976.000	343.0000	7.3000	15.900	905.000
1176.000	351.0000	8.3000	19.900	882.500
1776.000	34.0000	8.4000	16.900	822.500
2176.000	72.0000	4.8000	14.400	785.000

TABLE 29. 10 OCT. 1972, STATIONARY UPPER-LEVEL TROUGH WEST OF VAFB, 1115Z (0315 PST), NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 10.040 deg.

Surface air densitv is 1194.000 g/m^3.

Height of surface mixing layer is 1720.000

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (°C)	Pressure (mb)
4.000	160.0000	4.5000	18.100	1006.000
65.000	166.0000	5.1000	17.270	999.000
200.000	179.0000	7.5000	15.600	985.000
400.000	188.0000	8.8000	14.300	960.000
600.000	194.0000	9.6000	13.000	937.000
800.000	199.0000	10.0000	11.850	915.000
1000.000	197.0000	9.7000	10.650	893.000
1200.000	195.0000	9.5000	9.400	872.000
1400.000	194.0000	9.5000	8.200	850.000
1600.000	192.0000	9.5000	7.100	830.000
1800.000	190.0000	9.5000	5.900	810.000
2000.000	184.0000	9.5000	4.600	790.000
2800.000	215.0000	9.5000	3.000	710.000

TABLE 30. 25 JAN. 1973, COLD FRONT NORTHWEST OF VAFB, 1115Z, (0315 PST), NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 8.330 deg.

Surface air density is 1221.700 g/m^3.

Height of surface mixing layer is 400.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (° C)	Pressure (mb)
4.000	165.0000	6.0000	11.700	1004.000
32.000	163.4000	7.3000	11.350	999.300
100.000	160.0000	10.0000	10.650	990.000
200.000	155.0000	14.5000	9.600	980.000
300.000	160.0000	14.0000	9.300	967.000
400.000	166.0000	13.5000	8.900	955.000
650.000	184.0000	13.0000	9.500	927.500
920.000	203.0000	13.3000	7.600	899.000
1120.000	212.0000	14.0000	7.300	878.000
1670.000	222.0000	16.3000	2.900	820.000
2200.000	237.0000	16.3000	2.500	765.000

TABLE 31. 17 JAN. 1973, COLD FRONT SOUTH OF VAFB, 1115 Z, (0315 PST), NORMAL LAUNCH

Standard deviation of the azimuth surface wind angle is 10.000 deg.

Surface air density is 1236.300 g/m^3.

Height of surface mixing layer is 2800.000.

Layer Boundary Height (m)	Wind Direction (deg)	Wind Speed (m/s)	Temperature (° C)	Pressure (mb)
4.000	300.0000	3.5000	9.000	1004.500
65.000	298.7000	4.8000	8.400	996.300
200.000	296.0000	7.5000	7.100	980.000
490.000	296.0000	8.2000	5.100	955.000
600.000	295.0000	8.5000	3.300	930.000
800.000	294.0000	8.5000	1.700	910.000
1000.000	292.0000	8.8000	0.100	888.000
1200.000	290.0000	9.2000	-1.350	865.000
1400.000	289.0000	10.0000	-2.550	845.000
1600.000	288.0000	11.2000	-3.900	825.000
1720.000	287.0000	12.0000	-4.800	810.000
2020.000	288.0000	14.5000	-5.500	780.000

REFERENCES

1. Smith, J. W. and Vaughan, W. W.: Monthly and Annual Wind Distribution as a Function of Altitude for Diffusion Studies. NASA Technical Report D-610, 1961.

2. Record, F. A. et al: Analysis of Tower Atmospheric Data for Diffusion Studies. NASA CR-61327, prepared for George C. Marshall Space Flight Center, Contract No. NAS8-30503.

3. Kaufman, John W., and Susko, Michael: Review of Special Detailed Wind and Temperature Profile Measurements. J. Geophys. Res., vol. 76, no. 27, September 20, 1971.

4. Susko, Michael and Kaufman, John W.: Exhaust Cloud Rise and Growth for Apollo Saturn Engines. J. Spacecraft and Rockets, vol. 10, no. 5, May 1974, pp. 341-345.

5. Stephens, J. Briscoe; Susko, Michael; Kaufman, John W.; and Hill, C. Kelly: An Analytical Analysis of the Dispersions for Effluents from the Saturn V and Scout-Algol III Rocket Exhausts. NASA TM X-2935, October 1973.

6. Kaufman, John W.; Susko, Michael; and Hill, C. Kelly; Prediction of Engine Exhaust Concentrations Downwind from the Delta-Thor Telsat-A Launch of November 9, 1972. NASA TM X-2939, November 1973.

7. Susko, Michael and Kaufman, John W.: Apollo Saturn Engine Exhaust Cloud Rise and Growth Phenomena During Initial Launch. Paper presented at MSFC's Research Achievement Review, Marshall Space Flight Center, Huntsville, Alabama, December 2, 1971.

APPROVAL

BASELINE METEOROLOGICAL SOUNDINGS FOR PARAMETRIC ENVIRONMENTAL INVESTIGATIONS AT KENNEDY SPACE CENTER AND VANDENBERG AIR FORCE BASE

By Michael Susko and J. Briscoe Stephens

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

GEORGE H. FICHTL
Chief, Environmental Dynamics Branch

WILLIAM W. VAUGHAN
Chief, Aerospace Environment Division

CHARLES A. LUNDQUIST
Director, Space Sciences Laboratory

U.S. GOVERNMENT PRINTING OFFICE 1976-641-255/270 REGION NO.4