

*LARS Contract Report*

*080277*

LACIE FIELD MEASUREMENTS  
DATA LIBRARY CATALOG  
VOLUME II  
1975-76 CROP YEAR



*National Aeronautics and Space Administration*  
**LYNDON B. JOHNSON SPACE CENTER**

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## LACIE FIELD MEASUREMENTS

## DATA LIBRARY CATALOG

## VOLUME II

1975-76 CROP YEAR

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## PREFACE

The LACIE Field Measurements program, under the sponsorship of the Earth Observations Division, NASA/Johnson Space Center, was initiated in the Fall of 1974 to acquire, process, and make available to researchers agricultural remote sensing data. As a result, one of the most comprehensive data sets for remote sensing research has been assembled. Information describing the test sites, sensors, data acquisition and processing procedures is contained in the project plan.

The Field Measurements Data Library Catalog provides information on what data is available from the library. The catalog is divided into separate volumes - one for each crop year during which data were collected. The Field Measurements data library facility is located at the Laboratory for Applications of Remote Sensing (LARS), Purdue University.

Volume II provides information for the 1975-76 crop. Periodically, as new data is added to the library, the Data Catalog - Volume II will be updated.

Technical information on the data may be obtained

at [www.lars.purdue.edu/home/FRData/field\\_research\\_data.html](http://www.lars.purdue.edu/home/FRData/field_research_data.html).

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## 1. INTRODUCTION

The general organization of the Field Measurements Data Library is illustrated in Figure 1-1. The purpose of this document is to provide information to researchers describing by site, date, and sensor, the data contained in the library.

Each volume of the data catalog consists of four levels with each level including an increasing amount of specificity describing individual items of data.

The first level is the Summary, the second level is the Record, the third is the Index, and the fourth level is the Listing.

Section 2, Summary of Field Measurements Data, summarizes the data collected by the major sensor types for the missions over each of the three test sites.

Section 3, Record of Field Measurements Data, is a record of the date that data were collected over the test site and a record of which data has been processed to the point that it is available for users. This section is organized according to test site and location of data collection. Finney County, Kansas and Williams County, North Dakota each have three data collection locations - the intensive test site (ITS), the agriculture experiment station (AES), and a modeling field. The Hand County test site has only one data collection location - the intensive test site.

Section 4, Index of Field Measurements Data, is an index of the data collected organized by sensor type, i.e. Landsat, aircraft, FSS-S191H, FSAS-VISS, Exotech 20C, and Exotech 100. The Landsat data is listed by site and date; the aircraft data by site, date, and flight line; the FSS data by site, date and flight line; the truck-mounted spectrometer data is listed by site, date and experiment; and the tripod-mounted radiometer data is listed by site, date, and time.

The fourth level of the data catalog, a computer printout, is a listing of the information (i.e., observation number, location, date, time, scene type, instrument) required to access individual spectra. It is not included in this document, but is available upon request from Purdue/LARS.

Appendix I contains information pertaining to the location of the test sites and flight lines. Appendix II describes the treatments (plots) for which data were acquired on the agriculture experiment stations. Appendix III briefly describes the supporting agronomic, meteorological, and atmospheric measurements. Appendix IV gives a summary of the LACIE Field Measurements sensor data specifications and operational characteristics.

The formats of the data are either imagery, hard copy outputs (as tables), or 9-track computer compatible tapes (CCT's). The CCT's for the Landsat and aircraft multispectral scanner data are in LARSYS format. These data are approximately linearly related to the scene radiance, i.e., the data have not been altered from the initial processing performed at the respective institutions which operated the sensors. The CCT's containing the spectrometer or interferometer data (FSS, FSAS, and Exotech 20C) are in EXOSYS format. These data are calibrated in bidirectional reflectance factor. Also, each observation on the EXOSYS-CCT has a header record which contains the supporting agronomic, meteorological, and atmospheric observations.

# FIELD MEASUREMENTS DATA LIBRARY

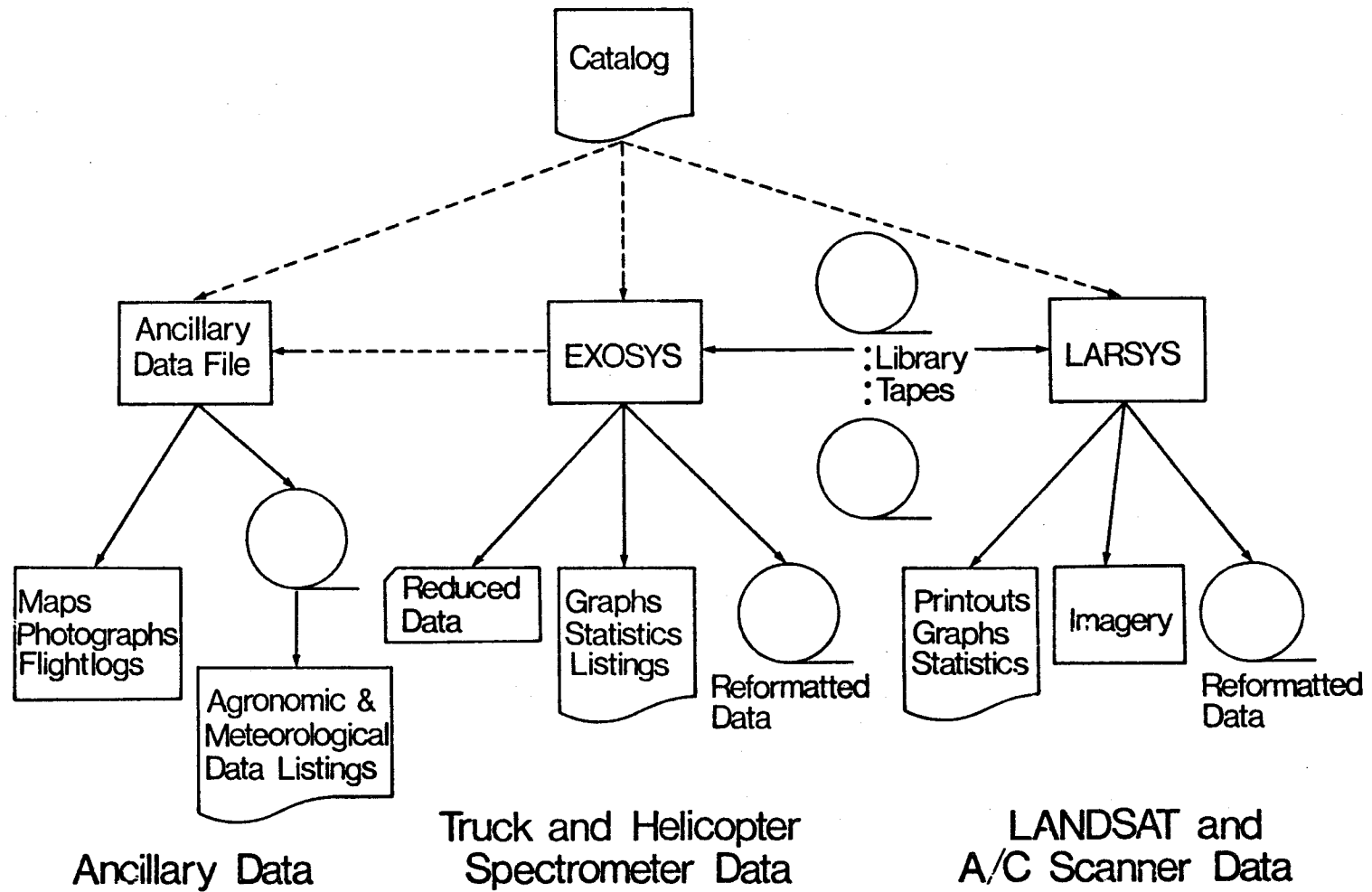


Figure 1-1. Organization of Field Measurements Data Library

## 2. Summary of Field Measurements Data

The Field Measurements Summary includes, for each of the three test sites, mission dates, wheat growth stages, and information concerning which sensor systems collected data (indicated by an X).

The location of the test sites are given in Appendix I.

### 2.1 Summary of remote sensing data collected over the Finney County, Kansas site. (Intensive Test Site-1988, Aircraft Site-076).

#### 1975-76 Crop

Mission	Wheat Growth Stage	Sensor Type				Modeling Data	
		Landsat		A/C MSS	S-191		Truck Mounted
		1	2				
Sep 14-17	Pre-emergence		X	0	X		
Oct 2- 6	Seedling		X		X		
Oct 20-23	Seedling		X		X		
Nov 11-12	Tillering			X	X	X	
Mar 13-19	Tillering		X	0	X	X	
Mar 30-Apr 2	Tillering		X		X		
Apr 9-10	Jointing	X					
Apr 18-21	Jointing		X	0	X	X	
Apr 27-28	Jointing	X					
May 4- 7	Pre-Boot		X	0	X		
May 14-16	Boot	X			X	X	
May 24-27	Heading		X		X		
Jun 2- 3	Milk	X					
Jun 11-13	Dough		X		X	X	
Jun 20-21	Ripening	X			X		
Jun 29-Jul 2	Mature		X	0	X		
Jul 18-19	Post Harvest		X				
Aug 4- 5	Post Harvest		X				
Aug 22-23	Post Harvest		X				

\*X-MSS, 0-M<sup>2</sup>S



2.2 Summary of remote sensing data collected over the Williams County, North Dakota site. (Intensive Test Site-1966, Aircraft Site-118).

## 1976 Crop

Mission	Wheat Growth Stage	Sensor Type				Modeling Data
		Landsat		A/C	Truck	
		1	2	MSS	Mounted	
May 10-14	Emergence		X	0*	X	
May 20	Seedling	X				
May 28-30	Seedling		X		X	
Jun 7- 9	Tillering					
Jun 15-17	Jointing				X	X
Jun 25-27	Boot	X		0	X	X
Jul 4- 8	Heading		X	0	X	X
Jul 13-17	Dough					X
Jul 20-23	Ripening		X	0	X	
Jul 28-31	Mature				X	X
Aug 6-12	Harvest		X		X	X
Aug 17-20	Post Harvest			0	X	
Aug 27-28	Post Harvest		X			
Sep 14-15	Post Harvest		X			
Oct 2- 7	Post Harvest		X			

2.3 Summary of remote sensing data collected over the Hand County, South Dakota site. (Intensive Test Site-1687, Aircraft Site-195).

## 1975-76 Crop

Mission	Wheat Growth Stage	Sensor Type			Ground Observations
		Landsat		A/C	
		1	2	MSS	
Sep 16-25	Pre-emergence			0*	X
Oct 3- 6	Emergence				X
Oct 15-16	Emergence				X
Oct 22-30	Seedling				X
Nov 5- 6	Tillering			X	X
Apr 20-21	Tillering				X
Apr 26-29	Jointing	X			X
May 6- 7	Jointing		X		X
May 10-16	Stem Extension	X		0	X
May 25-26	Boot				X
Jun 1- 4	Heading	X			X
Jun 12-14	Milk		X		X
Jun 19-23	Dough	X		X	X
Jun 30-Jul 1	Ripening		X		X
Jul 8-10	Harvest	X		0	X
Jul 17-19	Post Harvest		X		X
Jul 26-28	Post Harvest	X			X
Jul 31-Aug 4	Post Harvest		X		X
Aug 11-13	Post Harvest	X		0	X
Aug 22-23	Post Harvest		X		X

\*X-MSS, 0-M<sup>2</sup>S

### 3. Record of Field Measurements Data

The Field Measurements Data Record is a more detailed listing of the ancillary and major sensor system data collected at the three test sites - Finney County, Kansas; Williams County, North Dakota; and Hand County, South Dakota. The information collected at the Kansas and North Dakota sites is divided into data collection locations - Intensive Test Site, Agriculture Experiment Station, and Canopy Modeling Field. Data is collected only over the intensive test site at the Hand County, South Dakota site.

The record includes mission dates, types of data collected, dates when data were collected, and information indicating whether data is available for users.

3.1.1. Finney County, Kansas Field Measurement Intensive Test Site Data Record  
(Intensive Test Site-1988, Aircraft Site-076).

1975-76 Crop

NC - Not Collected ✓ Indicates data is available from Field Measurements library

Mission	Ancillary Data			Panel Calibration Data	Helicopter	Aircraft	Landsat	Other Data or Comments
	Periodic Ground Observations	Meteorological Optical Depth	Maps					
Sep 14-17	NC	9/16* ✓	✓	NC	9/16 ✓	9/17 ✓	9/16 ✓	
Oct 2-6	10/6 ✓	10/3 ✓	✓	10/3 ✓	10/3 ✓	NC	10/4 ✓	
Oct 20-23	10/24 ✓	10/21 ✓	✓	NC	10/21 ✓	NC	10/22 ✓	
Nov 11-12	NC	11/11 ✓	✓	NC	11/11 ✓	11/12 ✓	NC	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Mar 13-19	3/13 ✓	3/18 ✓	✓	NC	3/18 ✓	3/18 ✓	3/13 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Mar 30-Apr 2	4/1 ✓	3/30,31 ✓	✓	3/30 ✓	3/31 ✓	NC	3/31 ✓	
Apr 9-10	4/9 ✓	NC	NC	NC	NC	NC	4/9 ✓	
Apr 18-21	4/18 ✓	4/18 ✓	✓	NC	4/18 ✓	4/18 ✓	4/18 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Apr 27-28	4/27 ✓	NC	NC	NC	NC	NC	NC	
May 4-7	5/6,7 ✓	5/6 ✓	✓	5/6 ✓	5/6 ✓	5/6 ✓	5/6 ✓	
May 14-16	5/14,15 ✓	5/15 ✓	NC	NC	NC	NC	5/15 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
May 24-27	5/24,25 ✓	NC	NC	NC	NC	5/27	NC	
Jun 2-3	6/2,3 ✓	6/2 ✓	NC	NC	NC	NC	6/2 ✓	
Jun 11-13	6/11,12 ✓	6/11,12 ✓	✓	6/12 ✓	6/12 ✓	NC	6/12 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Jun 20-21	6/20,21 ✓	6/21 ✓	NC	NC	NC	NC	6/20 ✓	
Jun 29-Jul 2	6/29,30 ✓	6/29,30 ✓	✓	NC	6/30 ✓	6/29 ✓	6/30 ✓	
Jul 18-19	7/18,19 ✓	7/18 ✓	NC	NC	NC	NC	7/18 ✓	
Aug 4-5	8/4,5 ✓	8/4 ✓	NC	NC	NC	NC	8/4 ✓	
Aug 22-23	8/23 ✓	8/22 ✓	NC	NC	NC	NC	8/22 ✓	
Sep-Aug								Ground Truth Inventory ✓
Mar-Aug								Rainfall Observations ✓
May-Aug								Crop Yield Information ✓

\* Date data was collected

+ Additional agronomic measurements including LAI and Biomass over fields 124, 137, 171, 173, 185, 200, 214 & 221.

3.1.2 Finney County, Kansas: Garden City Agriculture  
Experiment Station Data Record (Site G2).

1975-76 Crop

NC - Not Collected ✓ - Indicates data is available from Field Measurements library

Mission	Ancillary Data				Truck Mounted Spectrometer
	Plot Photos	Plant Meas.	Soil Meas.	Meteorol. Data	
Oct 1-3	10/3*	NC	NC	10/3 ✓	10/1,3 ✓
Oct 20-22	10/21 ✓	NC	NC	10/21 ✓	NC
Mar 13-19	3/17 ✓	3/16-17 ✓	3/17 ✓	NC	NC
Mar 28-Apr 2	4/2 ✓	3/28 ✓	3/28 ✓	3/30-31 ✓	3/31, 4/1 ✓
Apr 13-18	4/19 ✓	4/16-17 ✓	4/13,18 ✓	4/16 ✓	4/16-18 ✓
May 1-4	5/1 ✓	5/2-3 ✓	5/3 ✓	5/1,3 ✓	5/1 ✓
May 13-18	5/15 ✓	5/12 ✓	5/13 ✓	5/14,17 ✓	5/14,17 ✓
May 29-30	5/29 ✓	5/29 ✓	5/29	5/29 ✓	5/29 ✓
Jun 8-13	6/12 ✓	6/8 ✓	6/13 ✓	6/9,12 ✓	6/10-12 ✓
Jun 17-23	6/17-23 ✓	6/17 ✓	6/22 ✓	6/17-23 ✓	6/17-20,23 ✓
Jun 29-30	6/29-30 ✓	6/29 ✓	6/28-30 ✓	6/28-30 ✓	6/29 ✓

3.1.3 Finney County, Kansas Field Measurements Canopy  
Modeling Data Record. (Intensive Test Site-1988,  
Field No. 107)

1975-76 Crop

NC - Not Collected ✓ - Indicates data is available from Field Measurements library

Mission	Agronomic	Photographic		Exotech 100	
		Angular	Profile	Reflectance	Transmittance
Nov 11-13	11/11-13 ✓	11/11-13 ✓	NC	11/11-12 ✓	11/11-12 ✓
May 13-14	3/13,14 ✓	3/14 ✓	NC	3/13,14 ✓	3/13,14 ✓
Apr 16-18	4/16-18 ✓	4/18 ✓	NC	4/18 ✓	4/18 ✓
May 16-17	5/16-17 ✓	5/16 ✓	5/16 ✓	5/17 ✓	5/17 ✓
Jun 12-15	6/13-15 ✓	NC	6/13 ✓	6/12,13 ✓	6/12 ✓

\*Date data was collected

3.2.1 Williams County, North Dakota Field Measurement Intensive Test Site Data Record  
(Intensive Test Site-1966, Aircraft Site-118).

1976 Crop

NC - Not Collected ✓ Indicates data is available from Field Measurements library

Mission	Ancillary Data			Panel Calibration Data	Helicopter	Aircraft	Landsat	Other Data or Comments
	Periodic Ground Observations	Meteorological Optical Depth	Maps					
May 10-14	5/11* /	5/11,13 ✓	✓	NC	5/13 ✓	5/13 ✓	5/11 ✓	
May 20	5/20 ✓	5/20 ✓	NC	NC	NC	NC	5/20 ✓	
May 28-30	5/28 ✓	5/28 ✓	✓	5/28 ✓	5/28 ✓	NC	5/29 ✓	
Jun 7-9	6/7 ✓	6/7 ✓	NC	NC	NC	NC	Cloudy	
Jun 15-17	6/17 ✓	6/17 ✓	✓	NC	6/17 ✓	NC	Cloudy	
Jun 25-27	6/25 ✓	6/25 ✓	✓	6/25 ✓	6/25 ✓	6/25 ✓	6/25 ✓	
Jul 4-8	7/6 ✓	7/4,6 ✓	✓	NC	7/6 ✓	7/6 ✓	7/4 ✓	
Jul 13	7/13 ✓	NC	NC	NC	NC	NC	NC	
Jul 20-24	7/22 ✓	7/20,22 ✓	✓	NC	7/20 ✓	7/20 ✓	7/22 ✓	
Jul 28-31	7/30 ✓	7/28,31 ✓	✓	7/28 ✓	7/28 ✓	NC	NC	
Aug 6-12	8/9 ✓	8/9 ✓	✓	NC	8/9 ✓	NC	8/9 ✓	
Aug 17-20	8/18 ✓	8/19 ✓	✓	NC	8/19 ✓	8/19 ✓	NC	
Aug 27-28	8/27 ✓	8/27 ✓	NC	NC	NC	NC	8/27 ✓	
Sep 14-15	9/14 ✓	9/14 ✓	NC	NC	NC	NC	9/14 ✓	
Oct 2-7	10/7 ✓	NC	NC	NC	NC	NC	Cloudy	
May-Sep								Ground Truth Inventory ✓
May-Sep								Rainfall Observations ✓
Jul-Sep								Crop Yield Information ✓

\* Date data was collected

3.2.2 Williams County, North Dakota: Williston Agriculture  
Experiment Station Data Record. (Site-W1).

1976 Crop

Mission	Ancillary Data				Truck Mounted Spectrometer
	Plot Photos	Plant Meas.	Soil Meas.	Met. Data	

May 27-30	5/27,28 ✓	5/27-28 ✓	5/27-28 ✓	5/27-28 ✓	5/28 ✓
Jun 2-4	6/2-4 ✓	6/2-4 ✓	6/2-4 ✓	6/2-4 ✓	6/2-4 ✓
Jun 18-20	6/18 ✓	6/18-20 ✓	6/18-20 ✓	6/18 ✓	6/18 ✓
Jul 7-10	7/8,10 ✓	7/8-10 ✓	7/8-10 ✓	7/8-10 ✓	7/8,10 ✓
Jul 14-17	7/14,16 ✓	7/14-17 ✓	7/14-17 ✓	7/14-17 ✓	7/14,16 ✓
Jul 28-Aug 1	7/28,29,8/1 ✓	7/28-8/1 ✓	7/28-8/1 ✓	7/28,29,8/1 ✓	7/28,29,8/1 ✓
Aug 6-7	8/6-7 ✓	8/6-7 ✓	8/6 ✓	8/6 ✓	8/6 ✓

\* Date data was collected

3.2.3 Williams County, North Dakota Field Measurements Canopy Modeling Data Record.

1976 Crop

NC - Not Collected ✓ - Indicates data is available from Field Measurements library.

Mission	Agronomic	Photographic		Exotech 100	
		Angular	Profile	Reflectance	Transmittance

Field 2

Jun 19-21	6/19-21 ✓	6/20 ✓	6/21 ✓	6/19,21 ✓	6/19,21 ✓
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Field 3

Jul 17	7/17 ✓	7/17 ✓	7/17 ✓	7/17 ✓	7/17 ✓
Jul 31	7/31 ✓	7/31 ✓	7/31 ✓	7/31 ✓	7/31 ✓

\* Date data was collected

3.3 Hand County, South Dakota Field Measurement Intensive Test Site Data Record  
(Intensive Test Site-1687, Aircraft Site-195)  
1975-76 Crop

NC - Not Collected ✓ Indicates Data is Available from Field Measurements Library

Mission	Ancillary Data			Helicopter	Aircraft	Landsat	Other Data or Comments
	Periodic Ground Observations	Meteorological Optical Depth	Maps				
Sep 16-25	9/16* ✓	9/24, 25 ✓	NC	NC	9/25 ✓		
Oct 3-6	10/6 ✓	NC	NC	NC	NC		
Oct 15-16	10/15-16 ✓	10/15 ✓	✓	10/15 ✓	NC		Add'tl. Agronomic Meas. <sup>+</sup> ✓
Oct 22-30	10/22 ✓	10/30 ✓	✓	10/30 ✓	NC		
Nov 5-6	11/5-6 ✓	11/5 ✓	✓	11/5 ✓	11/5 ✓		Add'tl. Agronomic Meas. <sup>+</sup> ✓
Apr 20-21	4/20-21 ✓	4/20 ✓	NC	NC	NC		
Apr 26-29	4/29 ✓	NC	NC	NC	NC	4/27, 28 ✓	
May 6-7	5/6-7 ✓	5/7 ✓	NC	NC	NC	5/7 ✓	
May 10-16	5/10-11 ✓	5/11 ✓	✓	5/11 ✓	5/11 ✓	5/15, 16 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
May 25-26	5/25-26 ✓	5/26 ✓	NC	NC	NC	NC	
Jun 1-4	6/3 ✓	6/1, 3, 4 ✓	✓	6/1 ✓	NC	6/2, 3 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Jun 12-14	6/12-14 ✓	6/12, 13 ✓	NC	NC	NC	6/11, 12 ✓	
Jun 19-23	6/19-20 ✓	6/19-20 ✓	✓	6/19 ✓	6/20 ✓	6/20 ✓	No MSS data; film only
Jun 30-Jul 1	6/30-7/1 ✓	6/30 ✓	NC	NC	NC	6/29, 30 ✓	
Jul 8-10	7/9 ✓	7/8, 9 ✓	✓	7/8 ✓	7/8 ✓	7/8, 9 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Jul 17-19	7/18-19 ✓	7/19 ✓	NC	NC	NC	7/17 ✓	
Jul 26-28	7/27-28 ✓	7/28 ✓	NC	NC	NC	7/26 ✓	
Jul 31-Aug 4	NC	7/31, 8/5 ✓	✓	7/31 ✓	NC	8/4 ✓	Add'tl. Agronomic Meas. <sup>+</sup> ✓
Aug 11-13	8/11 ✓	NC	NC	NC	8/11 ✓	8/13 ✓	
Aug 22-23	8/23 ✓	8/23 ✓	NC	NC	NC	8/23 ✓	
Sep-Aug							Ground Truth Inventory ✓
Apr-Aug							Rainfall Observations ✓
Jul-Aug							Crop Yield Information ✓

\* Date data were collected

+ Additional agronomic measurements including LAI and Biomass over fields 136, 176, 177, 178, 197, 198, 201, 208, 211, 221, 232&235.

#### 4. Index of Field Measurements Data

The Field Measurements Data Index includes a section for each of the major sensor systems which collect LACIE Field Measurements data - Landsat, Aircraft Multispectral Scanner, Field Spectrometer System (FSS) or SI91-H, Field Spectrometer Acquisition System (FSAS), Exotech Model 20C and Exotech Model 100. Refer to Appendix IV for a summary of the LACIE Field Measurements Sensor data specifications and operational characteristics.

##### 4.1 Landsat Data Library Index

The Landsat I and II multispectral scanners collect data in four spectral bands - 0.5 to 0.6 $\mu$ m, 0.6 to 0.7 $\mu$ m, 0.7 to 0.8 $\mu$ m, and 0.8 to 1.1 $\mu$ m. The Landsat data include:

- o 9-track computer-compatible tapes (CCT's)
- o Black-and-white transparencies of each band
- o Color-composite transparency

The Landsat Data Index includes, for each of the three sites, the date data were collected, the scene ID, the cloud cover over the respective intensive test site, the cloud cover over the entire frame, and the LARSYS formatted computer compatible tape (CCT) run number. Also noted under the "Test Site Cloud Cover" are those scene ID's which do not include the entire test site. The last column indicates (with an X) whether Landsat imagery is in the Field Measurements Data Library.



4.1.1 Landsat Data Library Index for the Finney County, Kansas Test Site.  
(Intensive Test Site-1988).

<u>Date</u> <u>Collected</u>	<u>Scene ID</u>	<u>Test Site*</u> <u>Cloud</u> <u>Cover</u>	<u>Frame*</u> <u>Cloud</u> <u>Cover</u>	<u>LARS</u> <u>Run</u> <u>Number</u>	<u>Imagery</u>
9/16/75	2237-16442	100	50	75013000	X
10/04/75	2255-16441	0	0	75013200	X
10/22/75	2273-16440	0	0	75010600	X
2/15/76	5302-16144	0	0	76000200	X
3/13/76	2416-16362	0	0	76000300	X
3/22/76	5338-16121	0	0	76000400	X
3/31/76	2434-16355	0	50	76001100	X
4/09/76	5356-16110	0	10	76001400	X
4/18/76	2452-16351	0	0	76002700	X
5/06/76	2470-16344	0	0	76002000	X
5/15/76	5392-16083	90	50	76003900	X
6/02/76	5410-16072	0	0	76003300	X
6/12/76	2507-16391	0	5	76003400	X
6/20/76	5428-16060	0	20	76003600	X
6/30/76	2525-16384	0	15	76004100	X
7/08/76	5446-16043	0	0	76004200	X
7/18/76	2543-16381	0	10	76005200	X
7/26/76	5464-16030	10	10	76006000	X
8/04/76	2560-16322	0	0	76006200	X
8/13/76	5482-16013	10	70	76006500	X
8/22/76	2578-16315	0	3	76006900	X
8/31/76	5500-16000	Oh	90	76007100	X

\* - Percent

h - Haze Overcast

4.1.2 Landsat Data Library Index for the Williams County, North Dakota  
Test Site. (Intensive Test Site-1966).

<u>Date</u> <u>Collected</u>	<u>Scene ID</u>	<u>Test Site*</u> <u>Cloud</u> <u>Cover</u>	<u>Frame*</u> <u>Cloud</u> <u>Cover</u>	<u>LARS</u> <u>Run</u> <u>Number</u>	<u>Imagery</u>
3/18/76	2421-17013	0	0	76000600	X
4/05/76	2439-17010	0	0	76001700	X
5/02/76	5379-16344	0	10	76001500	X
5/11/76	2475-17000	80	60	76002800	X
5/20/76	5397-16333	5	50	76004600	X
5/29/76	2493-16593	100h	50	76003100	X
6/25/76	5433-16310	10	15	76004400	X
7/04/76	2529-16584	0	10	76004900	X
7/22/76	2547-16584 <del>0</del>	0	20	76005900	X
8/09/76	2565-16573	0	10	76006400	X
8/27/76	2583-16570	0	50	76006800	X
9/05/76	5505-16250	0	10	76007200	X
9/14/76	2601-16563	0	0	76007300	X
9/23/76	5523-16233	0	0	76008500	X
10/11/76	5541-16220	50h	50	NR	X
10/20/76	2637-16552	100h	30	NR	X
11/07/76	2655-16544	0	30	76017700	X
11/25/76	2673-16540	100h	70	NR	X

\* - Percent

h - Haze overcast

NR - Not reformatted; cloud cover too extensive

4.1.3 Landsat Data Library Index for the Hand County, South Dakota Test Site. (Intensive Test Site-1687).

<u>Date</u> <u>Collected</u>	<u>Scene ID</u>	<u>Test Site*</u> <u>Cloud</u> <u>Cover</u>	<u>Frame*</u> <u>Cloud</u> <u>Cover</u>	<u>LARS</u> <u>Run</u> <u>Number</u>	<u>Imagery</u>
2/15/76	5382-16123	0	0	76000100	X
3/13/76	2416-16342	100h	50	76000500	X
3/14/76	2417-16400	90	50	76000700	X
3/23/76	5339-16155	50h	70	76000800	X
4/01/76	2435-16392	0	0	76001600	X
4/09/76	5356-16085	100	80	76000900	X
4/10/76	5357-16143	5	50	76001000	X
4/27/76	5374-16074	95	90	76001800	X
4/28/76	5375-16132	100	90	76001900	X
5/07/76	2471-16382	0	0	76002900	X
5/15/76	5392-16062	95	50	76004700	X
5/16/76	5393-16120	70h	80	76003800	X
6/02/76	5410-16051	0	5	76003000	X
6/03/76	5411-16105	50	80	76003200	X
6/11/76	2506-16315	0(90)+	10	76003300	X
6/12/76	2507-16374	90	50	76003500	X
6/20/76	5428-16035	0	0	76004300	X
6/29/76	2524-16312	5(90)+	60	76004800	X
6/30/76	2525-16370	5	10	76004000	X
7/08/76	5446-16023	0	10	76004500	X
7/09/76	5447-16081	0h	5	76105000	X
7/17/76	2542-16305	0(90)+	5	76005100	X
7/26/76	5464-16010	0	10	76006100	X
8/04/76	2560-16301	0	10	76006300	X
8/13/76	5482-15593	0	70	76006600	X
8/23/76	2579-16352	0	0	76006700	X

\* - Percent

+ - Percent Test Site Included

h - Haze Overcast

## 4.2 Aircraft Data Library Index

Two different aircraft systems collected data for the Field Measurements project - the NASA C-130 aircraft with the 24-channel multispectral scanner (MSS) and the NASA P-3 aircraft with the 11-channel modular multispectral scanner (MMS). The spectral bands of the two scanners are given in Table 4.2-1.

Table 4.2-1 Spectral Bands of MSS and M<sup>2</sup>S Scanners

MSS Bands (in $\mu\text{m}.$ )			M <sup>2</sup> S (in $\mu\text{m}.$ )
0.34-0.40	0.80-0.87	4.50- 4.75	0.38- 0.41
0.40-0.44	0.97-1.05	6.00- 7.00	0.44- 0.49
0.46-0.50	1.05-1.09	8.30- 8.80	0.49- 0.53
0.53-0.57	1.12-1.16	8.80- 9.30	0.54- 0.58
0.57-0.63	1.18-1.30	9.30- 9.80	0.58- 0.62
0.64-0.68	1.52-1.73	10.10-11.00	0.62- 0.66
0.71-0.75	2.10-2.36	11.00-12.00	0.66- 0.70
0.76-0.80	3.54-4.00	12.00-13.00	0.70- 0.74
			0.76- 0.86
			0.97- 1.06
			8.00-13.00

Aircraft data include:

- 9-track CCTs (proportional to scene radiance)
- 9-inch color and color-infrared photographs
- 70-millimeter, six-band airborne multispectral photographic system photographs obtained over Hand County only
- Flight logs
- Photo logs

The index includes, for each of the sites, the scanner system used, the date, the flight lines flown, the start times for the flight lines, the altitude flown and the LARS run numbers for the respective LARSYS formatted scanner data. Also, included in the last column are the NASA/JSC mission and roll film numbers for the 9 in. color (CR) and color IR (CI) underflight photography.

4.2.1 Aircraft Data Library Index for the Finney County, Kansas Test Site.  
(Intensive Test Site-1988, Aircraft Site-076).

Scanner System	Mission Date	Flight Line	Start Time (GMT)	Altitude AGL (feet)	LARS Scanner Data Run Number	JSC Mission and Roll Film Numbers
MMS	9-17-75	8	17:46:55	9,900	750389	MX317
		9	17:55:15	9,800	750390	CR-17
		10	18:04:30	9,900	750391	CI-16
		11	18:14:20	2,000	750392	
MSS	11-12-75	8	17:31:05	9,800	750430	MX330
		9	17:39:25	9,800	750426	CR-10
		10	17:46:40	9,800	750425	CI-11
		8	17:54:15	9,900	750428	
		11	18:08:40	1,800	750427	
MMS	3-18-76	12	18:15:50	1,900	750429	
		10	16:14:15	10,300	760055	MX334
		9	16:25:05	10,300	760054	CR-4
		8	16:35:40	10,300	760053	CI-5
	4-18-76	12	16:50:45	1,100	760057	
		11	16:57:55	1,100	760056	
		9	17:21:00	22,100	760058	
		9	16:34:05	22,400	760021	MX337
		9	16:52:10	10,000	760022	CR-11
		10	16:56:50	10,000	760023	CI-12
5-06-76	8	17:00:25	10,000	760024		
	12	17:10:05	1,500	760025		
	11	17:19:55	1,500	760026		
	12	16:08:50	1,500	760102	MX338	
	11	16:25:55	1,500	760103	CR-7	
	9	16:40:15	10,000	760104	CI-8	
	10	16:45:55	10,000	760105		
MSS	5-27-76	8	17:12:05	22,700	760106	
		9	17:12:05	22,700	760107	
		8	19:24:25	1,700		MX340
		8	19:29:15	1,800		CI-1,2*
		9	19:35:40	1,750		
MMS	6-29-76	9	19:45:30	1,800		
		10	19:49:40	1,750		
		10	19:54:00	1,700		
		9	18:30:08	23,400	760150	MX341
		9	18:39:00	23,500	760151	CR-6
		9	18:57:00	10,000	760152	CI-8
		10	19:04:20	10,000	760153	
		8	19:10:25	10,000	760154	
12	19:29:15	1,500	760155			
12	19:34:45	1,500	760156			
11	19:41:00	1,500	760157			

\* Aircraft photography obtained approximately two hours before scanner data.

4.2.2 Aircraft Data Library Index for the Williams County, North Dakota  
Test Site. (Intensive Test Site-1966, Aircraft Site-118).

<u>Scanner System</u>	<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time (GMT)</u>	<u>Altitude AGL (feet)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>	
MMS ↓	5-13-76 ↓	2	15:03:40	22,100	*	MX318	
		2	15:11:05	23,300	760095	CR-17	
		1	15:22:55	9,800	760096	CI-18	
			2	15:28:25	10,000	760097	↓
			3	15:34:20	9,900	760098	
			6	15:43:25	1,600	760099	
			7	15:52:10	1,200	760100	
			7	15:58:00	1,400	760101	↓
		6-25-76 ↓	2	15:43:45	21,400	760111	MX341
			3	15:55:20	10,000	760112	CR-3
			2	16:01:20	10,100	760113	CI-4
			1	16:07:40	10,000	760114	↓
			7	16:21:50	1,400	760115	
			6	16:33:15	1,500	760116	↓
		7-06-76 ↓	6	19:34:35	1,500	760158	MX341
			7	19:44:00	1,500	760159	CI-20
			3	19:55:00	10,500	760160	↓
			2	20:02:00	10,300	760161	
			1	20:07:15	10,500	760162	↓
		7-20-76 ↓	2	20:22:25	22,800	760163	MX341
			3	18:40:00	10,000	760132	CR-27
			1	18:46:30	10,000	760133	CI-28
			2	18:52:00	9,900	760134	↓
			6	18:59:50	1,500	760135	
		8-19-76 ↓	7	19:06:40	1,400	760136	↓
			2	16:44:45	23,700	760079	MX343
			3	16:55:05	10,100	760080	CI-13
			1	17:00:15	9,900	760081	↓
			2	17:05:20	10,000	760082	
			6	17:13:25	1,500	760083	
			7	17:21:00	1,400	760084	↓

\* Not Processed

4.2.3 Aircraft Data Library Index for the Hand County, South Dakota Test Site. (Intensive Test Site-1687, Aircraft Site-195).

<u>Scanner System</u>	<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time (GMT)</u>	<u>Altitude AGL (feet)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>
MMS ↓	9-25-75 ↓	1	18:25:05	9,800	750141	MX317
		2	18:32:30	9,800	750142	CR-33
		3	18:39:55	9,900	750143 <i>750143</i>	CI-34
		5	18:45:50	2,000	750144	↓
		4	18:55:25	2,100	750145	MX330
MSS ↓	11-05-75 ↓	5	19:01:20	2,000	750083	CR-2
		5	19:09:35	1,800	750084	CI-3
		1	19:31:35	10,500	750079	↓
		2	19:38:20	10,400	750080	MX338
		3	19:45:00	10,500	750081	CR-9
MMS ↓	5-11-76 ↓	4	20:03:35	2,100	750082	CI-10
		1	14:49:55	10,300	760089	↓
		2	14:55:10	10,200	760090	MX340
		3	15:00:50	10,300	*	CR-9
		3	15:09:00	10,100	760091	CI-10
MSS ↓	6-20-76 ↓	5	15:17:30	1,500	760093	↓
		4	15:29:55	1,600	760092	MX341
		2	15:56:20	24,000	760094	CR-11
		2	15:27:00	24,500	No Scanner Data	CI-12
		1	15:41:45	10,000	↓	↓
MMS ↓	7-08-76 ↓	2	15:49:00	9,950	760125*	MX341
		3	15:54:40	10,000	760126	CR-11
		5	16:03:40	1,950	760127	CI-12
		4	16:13:35	2,150	760128	↓
		2	18:02:40	22,700	760129	MX343
MMS ↓	8-11-76 ↓	2	18:15:35	10,000	760130	CR-4
		1	18:23:10	10,000	760131*	CI-5
		3	18:31:00	10,000	760132	↓
		5	18:41:30	1,500	760133	MX343
		4	18:52:00	1,500	760134	CR-4
		2	14:37:35	23,400	760135*	CI-5
		2	14:47:20	23,400	760136	↓
		1	14:57:00	10,000	*	MX343
		1	15:02:30	9,900	760139	CR-4
		2	15:09:55	10,000	760140	CI-5
MMS ↓	8-11-76 ↓	3	15:16:15	9,800	760141	↓
		5	15:27:00	1,500	760142	MX343
		4	15:36:15	1,600	760143	CR-4

\* Not Processed

#### 4.3 Field Spectrometer System (FSS) S191-H Data Library Index

The Field Spectrometer System (FSS) or S191-H system collected two types of data in general, spectral data and 70mm color photography, over the flight lines. The FSS spectral data consists of .02 $\mu$ m wide bands from 0.4 to 1.1 $\mu$ m, .05 $\mu$ m wide bands from 1.1 to 2.4 $\mu$ m, and 0.5 $\mu$ m wide bands from 8.0 to 14.0 $\mu$ m. The FSS data include:

- 9-track CCTs (bidirectional reflectance factor)
- Microfilm tabulation of data on CCTs
- 70-millimeter boresight color photographs
- Flight logs
- Supporting agronomic, meteorological, and atmospheric observations

The index for the FSS data includes the mission date, flight line start time (GMT) for the flight line, and helicopter data flight number. The Index also includes the JSC 70mm color photography roll identification - mission and roll film numbers.



4.3.1 FSS (S191H) Data Library Index for the Finney County, Kansas Test Site. (Intensive Test Site-1988, Aircraft Site-076).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time (GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
9/16/75	8	19:54:30	21	H-13, 97
	9	21:02:49		98
	8	21:23:13		99
10/03/75	10	21:48:32	22	100
	8	16:16:54		H-13, 101
	9	16:42:36		102
10/21/75	10	17:07:10	24	103
	8	16:53:30		H-13, 108
	9	17:12:46		109
11/11/75	10	17:57:23	27	110
	8	17:22:50		H-13, 115
	9	17:42:25		116
3/18/76	10	18:05:57	28	117
	8	16:01:58		H-18, 118
	9	16:20:40		119
3/31/76	10	16:40:54	29A	120
	8	17:04:40		H-18, 124
	9	17:50:26		125
4/18/76	10	18:13:20	30	126
	8	16:37:23		H-18, 127
	9	16:58:00		128
5/06/76	10	17:20:02	32	129
	8	15:01:25		H-18, 130
	9	15:26:06		131
6/12/76	10	15:46:58	39	132
	8	14:58:15		H-19, 147
	9	15:25:01		148
6/30/76	10	16:04:03	43A	149
	8	16:11:21		H-19, 165
	9	15:46:13		164
	10	15:22:43		163

4.3.2 FSS (S191H) Data Library Index for the Williams County, North Dakota Test Site. (Intensive Test Site-1966, Aircraft Site-118).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time (GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
5/13/76	1	15:10:22	34	H-18,137
	2	15:30:09		138
	3	15:57:51		139
5/28/76	1	16:41:20	36	H-18,140
	2	17:01:42		141
	3	17:24:25		142
6/17/76	1	18:32:36	40	H-18,150
	2	18:51:37		151
	3	NP		152
6/25/76	1	14:52:23	42	H-18,157
	2	15:12:09		158
	3	15:33:44		159
7/6/76	1	15:33:56	44	H-18,166
	2	15:53:12		167
	3	16:13:40		168
7/20/76	1	15:46:23	47	H-18,173
	2	16:13:57		174
	3	16:34:40		175
7/28/76	1	15:29:55	48	H-18,176
	2	15:50:18		177
	3	16:11:59		178
8/09/76	1	16:10:07	50	H-18,182
	2	16:34:56		183
	3	16:58:01		184
8/19/76	1	17:21:28	51	*
	2	16:56:40		H-18,185
	3	17:18:42		186
		17:43:38		187

NP Spectral data not processed for this line

\* No film for this line

4.3.3 FSS (S-191H) Data Library Index for the Hand County, South Dakota Test Site. (Intensive Test Site-1687, Aircraft Site-195).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time (GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
10-15-75	1	16:25:29	23	H-13,104
	2	16:45:46		105
	3	17:05:30		106
	4	17:45:57		107
10-30-75	1	18:24:53	25	H-13,111
11-05-75	1	18:38:19	26	H-13,112
	2	18:57:49		113
	3	19:18:10		114
5-11-76	1	14:24:40	33	H-18,133
	2	14:46:44		134
	3	15:09:49		135
	4	15:50:50		136
6-01-76	1	14:37:47	37	H-18,143
	2	14:59:02		144
	3	15:20:36		145
	4	16:46:21		146
6-19-76	1	15:43:12	41	H-18,153
	2	16:18:20		154
	3	16:36:48		155
	4	17:13:41		156
7-08-76	1	18:09:57	45	H-18,169
	2	18:30:25		170
	3	18:50:49		171
	4	19:33:28		172
7-31-76	1	15:38:51	49	H-18,179
	2	15:58:59		180
	3	16:20:43		181

## 4.4 FSAS Data Library Index

The NASA/JSC truck-mounted interferometer system, the Field Signature Acquisition System (FSAS), acquired spectral data in the range of 0.4 to 2.4 $\mu$ m. The data were processed into .01 $\mu$ m bands. The FSAS data include:

- 9-track CCT's (bidirectional reflectance factor)
- 35-millimeter color transparencies (vertical and oblique)
- Supporting agronomic, meteorological, and atmospheric observations

The index for the FSAS data includes the location where the data were collected, the mission date, the experiment for which data were collected, and the number of observations collected.

## Location Legend:

AES(G2) - Garden City Agriculture Experiment Station, Site-G2  
 ITS(1988) - Calibration Panel Location at Intensive Test Site-1988

## Finney County, Kansas

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(G2)	10/01/75	Dryland Winter Wheat	1
		Irrigated Winter Wheat	1
		Other Crops	3
↓	10/02/75	Other Crops	2
	ITS(1988)	10/03/75	Calibration Panel: 1
↓	3/30/76	Calibration Panel: 1	1
	AES(G2)	3/31/76	Small Grain
↓	4/01/76	Dryland Winter Wheat	10
		Small Grain	14
		Irrigated Winter Wheat	10
	4/16/76	Small Grain	6
		Other Crops	2
	4/17/76	Small Grain	4
	4/18/76	Small Grain	4
		Dryland Winter Wheat	8
		Irrigated Winter Wheat	3
	5/01/76	Dryland Winter Wheat	15
Small Grain		14	

## FSAS Data Library Index (cont'd)

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
ITS(1988)	5/06/76	Calibration Panel: 1	2
AES(G2)	5/14/76	Dryland Winter Wheat	16
		Small Grain	4
		Irrigated Winter Wheat	16
		Other Crops	2
	5/17/76	Small Grain	24
AES(G2)	5/29/76	Dryland Winter Wheat	8
		Small Grain	14
		Irrigated Winter Wheat	8
		Other Crops	1
	6/10/76	Dryland Winter Wheat	8
		Small Grain	14
		Irrigated Winter Wheat	6
	6/11/76	Dryland Winter Wheat	8
		Irrigated Winter Wheat	10
	6/12/76	Small Grain	10
ITS(1988)		Calibration Panel: 1	2
AES(G2)	6/17/76	Small Grain	12
	6/18/76	Dryland Winter Wheat	4
		Small Grain	6
		Irrigated Winter Wheat	4
	6/19/76	Small Grain	3
		Irrigated Winter Wheat	4
	6/20/76	Dryland Winter Wheat	4
		Small Grain	6
	6/23/76	Small Grain	4
		Irrigated Winter Wheat	8
	6/29/76	Dryland Winter Wheat	8
		Small Grain	6

## 4.5 Exotech Model 20C Data Library Index

The Purdue/LARS truck-mounted system, an Exotech Model 20C circular variable filterwheel spectrometer, acquired spectral data in the ranges of 0.4 to 2.4 $\mu$ m and in certain situations from 2.8 to 13.4 $\mu$ m. The reflective data is processed into .01 $\mu$ m wide bands and the thermal data is processed into .05 $\mu$ m wide bands. The Exotech 20C data include:

- o 9-track CCT's (bidirectional reflectance factor)
- o 35-millimeter color prints (vertical and obliques)
- o Supporting agronomic and meteorological observations

The index for the Exotech 20C data includes the location where the data were collected, the mission date, the experiment for which the data were collected, and the number of observations collected.

## Location Legend

AES(W1) - Williston Agriculture Experiment Station, Site - W1  
 ITS(1966) - Calibration Panel Location at Intensive Test Site - 1966

## Williams County, North Dakota

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(W1)	5/28/76	Spring Wheat	40
		Small Grain	30
		Seeding Rate	12
		Other Crops	2
		Calibration	13
ITS(1966)		Calibration Panels	3
AES(W1)	6/02/76	Spring Wheat	32
		Other Crops	17
		Calibration	8
	6/03/76	Seeding Rate	66
		Other Crops	34
		Calibration	17
	6/04/76	Spring Wheat	66
		Small Grain	30
		Seeding Rate	24
		Other Crops	4
		Calibration	15

## Exotech Model 20C Data Library Index (cont'd)

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES (W1)	6/18/76	Spring Wheat	63
↓	↓	Small Grain	31
↓	↓	Seeding Rate	24
↓	↓	Other Crops	14
↓	↓	Calibration	17
ITS (1966)	6/25/76	Calibration Panels	12
↓	↓	Calibration	3
AES (W1)	7/8/76	Spring Wheat	32
↓	↓	Small Grain	23
↓	↓	Seeding Rate	12
↓	↓	Other Crops	2
↓	↓	Calibration	8
↓	7/10/76	Spring Wheat	8
↓	↓	Calibration	3
AES (W1)	7/14/76	Spring Wheat	32
↓	↓	Small Grain	16
↓	↓	Seeding Rate	13
↓	↓	Other Crops	2
↓	↓	Calibration	7
↓	7/16/76	Spring Wheat	144
↓	↓	Small Grain	17
↓	↓	Seeding Rate	12
↓	↓	Other Crops	6
↓	↓	Calibration	22
ITS (1966)	7/28/76	Calibration Panels	14
AES (W1)	↓	Spring Wheat	32
↓	↓	Seeding Rate	11
↓	↓	Other Crops	2
↓	↓	Calibration	15
↓	7/29/76	Spring Wheat	38
↓	↓	Small Grain	27
↓	↓	Seeding Rate	12
↓	↓	Other Crops	2
↓	↓	Calibration	12
↓	8/01/76	Spring Wheat	43
↓	↓	Small Grain	16
↓	↓	Seeding Rate	12
↓	↓	Other Crops	2
↓	↓	Calibration	10
↓	8/06/76	Spring Wheat	82
↓	↓	Small Grain	32
↓	↓	Seeding Rate	24
↓	↓	Other Crops	10
↓	↓	Calibration	21

#### 4.6 Exotech Model 100 Data Library Index

The Exotech Model 100 is a Landsat band radiometer; in other words it has four spectral bands: .5-.6 $\mu$ m, .6-.7 $\mu$ m, .7-.8 $\mu$ m, .8-1.1 $\mu$ m. The data is recorded on paper. The Exotech 100 data include:

- o Hard copy record (bidirectional reflectance factor)
- o 35-millimeter color transparencies (angular and profile)
- o Supporting agronomic and atmospheric observations

The index for the Exotech Model 100 data includes for each of the two test sites the mission date, the locations or plots within the field, the type of radiometer data collected, the start time for the observations, the number of observations and the Purdue/LARS roll film ID's for the photography. Under the Location Number(s) column, B.S. indicates bare soil measurements. Under the Data Type column, reflectance refers to plot or scene reflectance measurements; Leaf Trans. refers to transmittance measurements of individual leaves.



4.6.1 Exotech Model 100 Data Library Index for  
Finney County, Kansas Crop Canopy Modeling - Field 107

<u>Mission Date</u>	<u>Location Number(s)</u>	<u>Data Type</u>	<u>Start Time (GMT)</u>	<u>Number of Observations</u>	<u>Purdue/LARS Roll Film ID</u>
11/11/75	1-4	Reflectance	15:35	14	35FS75-012 to
↓	↓	↓	16:20	10	↓
↓	1	↓	17:51	9	35FS75-014 to
↓	1	Leaf Trans.	18:04	2	↓
↓	1	↓	17:25	4	↓
3/13/76	1-4 & B.S.	Reflectance	18:50	12	35FS76-001 to
↓	↓	↓	18:39	13	↓
↓	1-4	↓	20:55	16	35FS76-002 to
↓	1	Leaf Trans.	20:30	2	↓
3/14/76	1-4 & B.S.	Reflectance	15:20	14	↓
4/18/76	1-4 & B.S.	Reflectance	15:01	12	35FS76-003 to
↓	1-4	↓	16:07	13	↓
↓	1-4 & B.S.	↓	16:47	20	35FS76-005 to
↓	1-4	↓	17:20	20	↓
↓	2	Leaf Trans.	18:15	3	↓
5/17/76	1-4 & B.S.	Reflectance	14:35	12	35FS76-006 to
↓	↓	↓	15:44	12	↓
↓	↓	↓	17:45	12	35FS76-009 to
↓	4	Leaf Trans.	18:44	12	↓
↓	4	↓	19:20	4	↓
6/13/76	1-4 & B.S.	Reflectance	14:45	18	35FS76-012 to
↓	↓	↓	17:11	20	↓
↓	1-4	↓	18:11	16	35FS76-015 to
↓	↓	↓	22:30	16	↓
↓	4	Leaf Trans.	?	5	↓

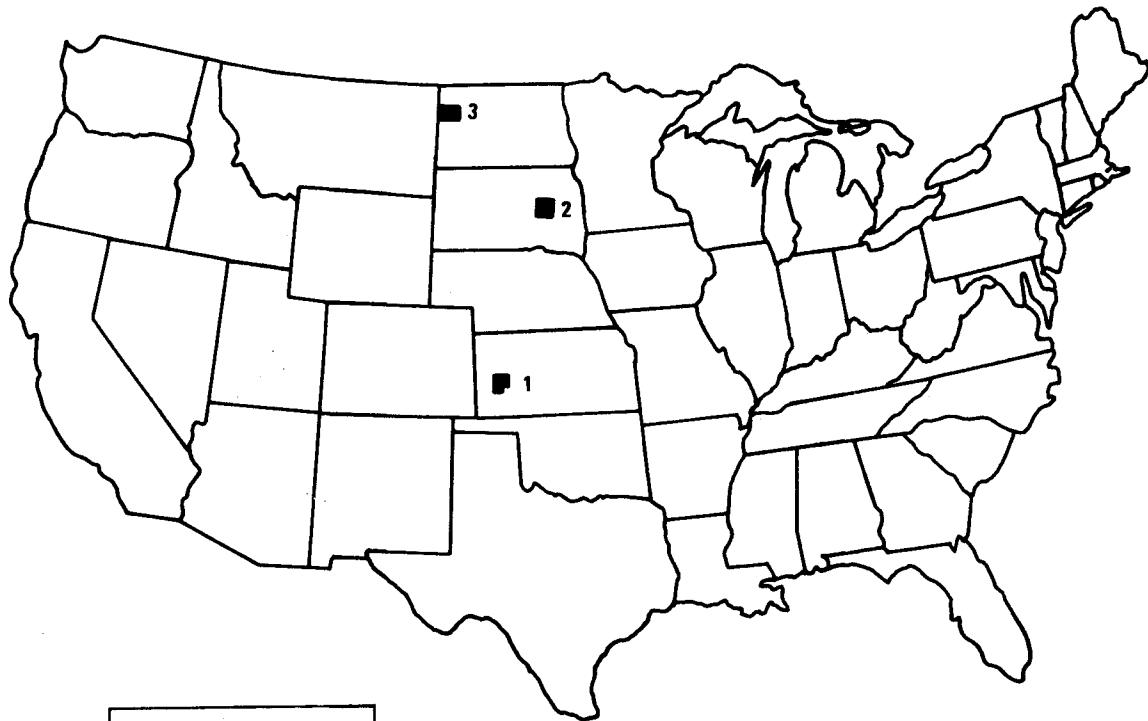
4.6.2 Exotech Model 100 Data Library Index for  
Williams County, North Dakota Crop Canopy Modeling

<u>Mission Date</u>	<u>Location Number(s)</u>	<u>Data Type</u>	<u>Start Time(GMT)</u>	<u>Number of Observations</u>	<u>Purdue/LARS Roll Film ID</u>
Field 2					
6/19/76	1-4 & B.S.	Reflectance	16:55	20	35FS76-032
↓	1	Leaf Trans.	20:35	4	35FS76-033
6/21/76	1 & B.S.	Reflectance	14:54	5	35FS76-044
↓	1-4 & B.S.	↓	15:06	20	↓
↓	↓	↓	16:19	20	↓
↓	↓	↓	18:17	20	↓
↓	↓	↓	20:55	20	↓
↓	↓	↓	21:53	20	↓
↓	1-4	Leaf Trans.	19:20	17	↓
Field 3					
7/17/76	1-4 & B.S.	Reflectance	15:40	20	35FS76-051
↓	1-4	↓	16:15	16	35FS76-053 to
↓	1-4 & B.S.	↓	17:00	20	↓
↓	1-4	↓	18:24	16	↓
↓	1-4 & B.S.	↓	20:10	20	↓
↓	1-4	↓	21:04	16	↓
↓	1-4 & B.S.	↓	22:02	20	↓
↓	1-4	↓	23:04	16	↓
↓	1-4	Leaf Trans.	18:50	16	↓
7/31/76	1-4 & B.S.	Reflectance	15:20	20	35FS76-064
↓	1-4	↓	16:16	16	35FS76-066 to
↓	1-4 & B.S.	↓	16:51	20	↓
↓	1-4	↓	17:41	16	↓
↓	1-4 & B.S.	↓	19:40	20	↓
↓	1-4	↓	20:29	16	↓
↓	1-4 & B.S.	↓	21:28	20	↓
↓	1-4	↓	22:31	16	↓
↓	1-4	Leaf Trans.	18:50	16	↓

Appendix I

Location of LACIE Field Measurements Test Sites  
and Flight Lines

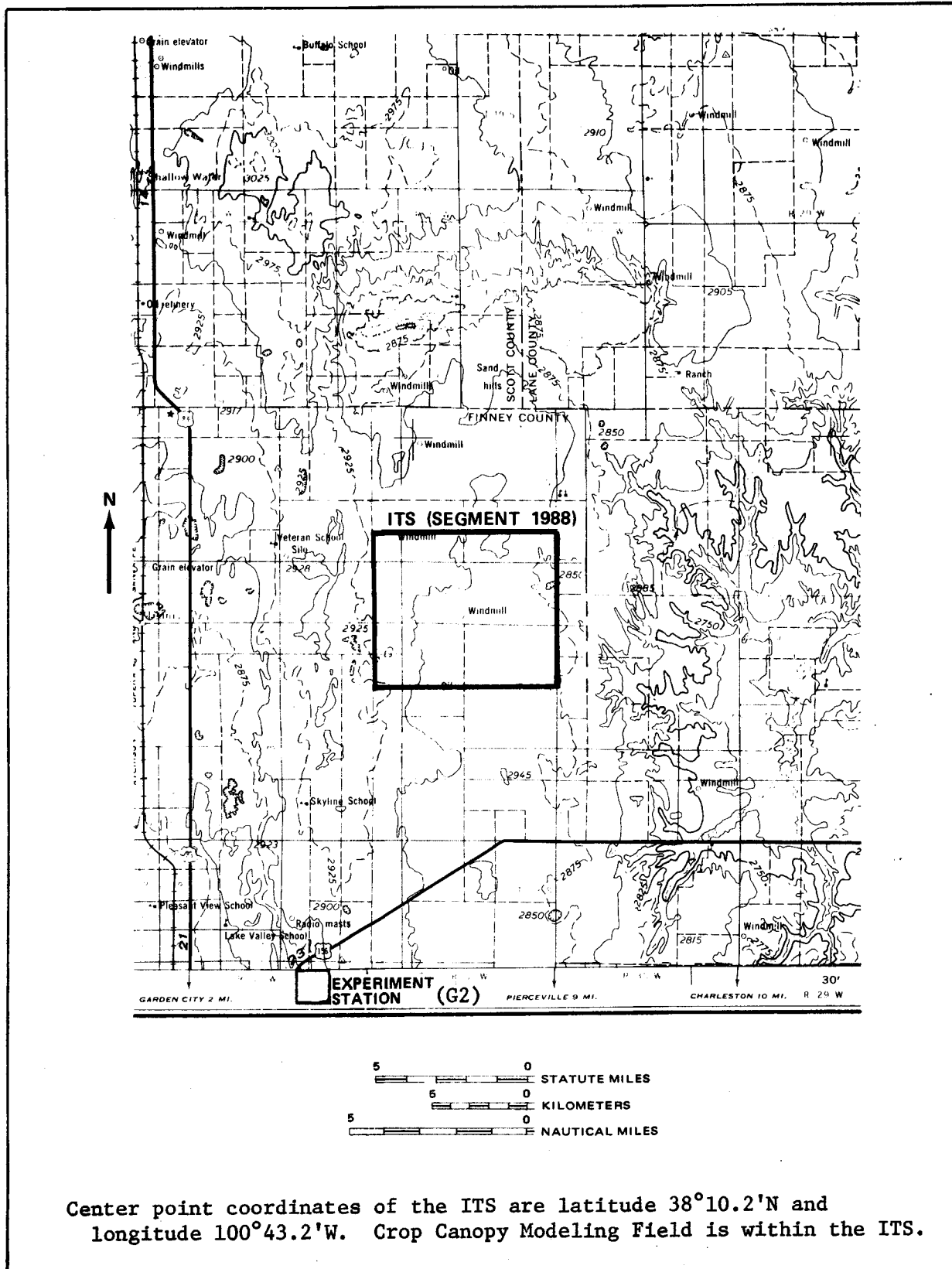
Location of the Three Test Sites



LEGEND	
1	FINNEY COUNTY, KANSAS
2	HAND COUNTY, SOUTH DAKOTA
3	WILLIAMS COUNTY, NORTH DAKOTA

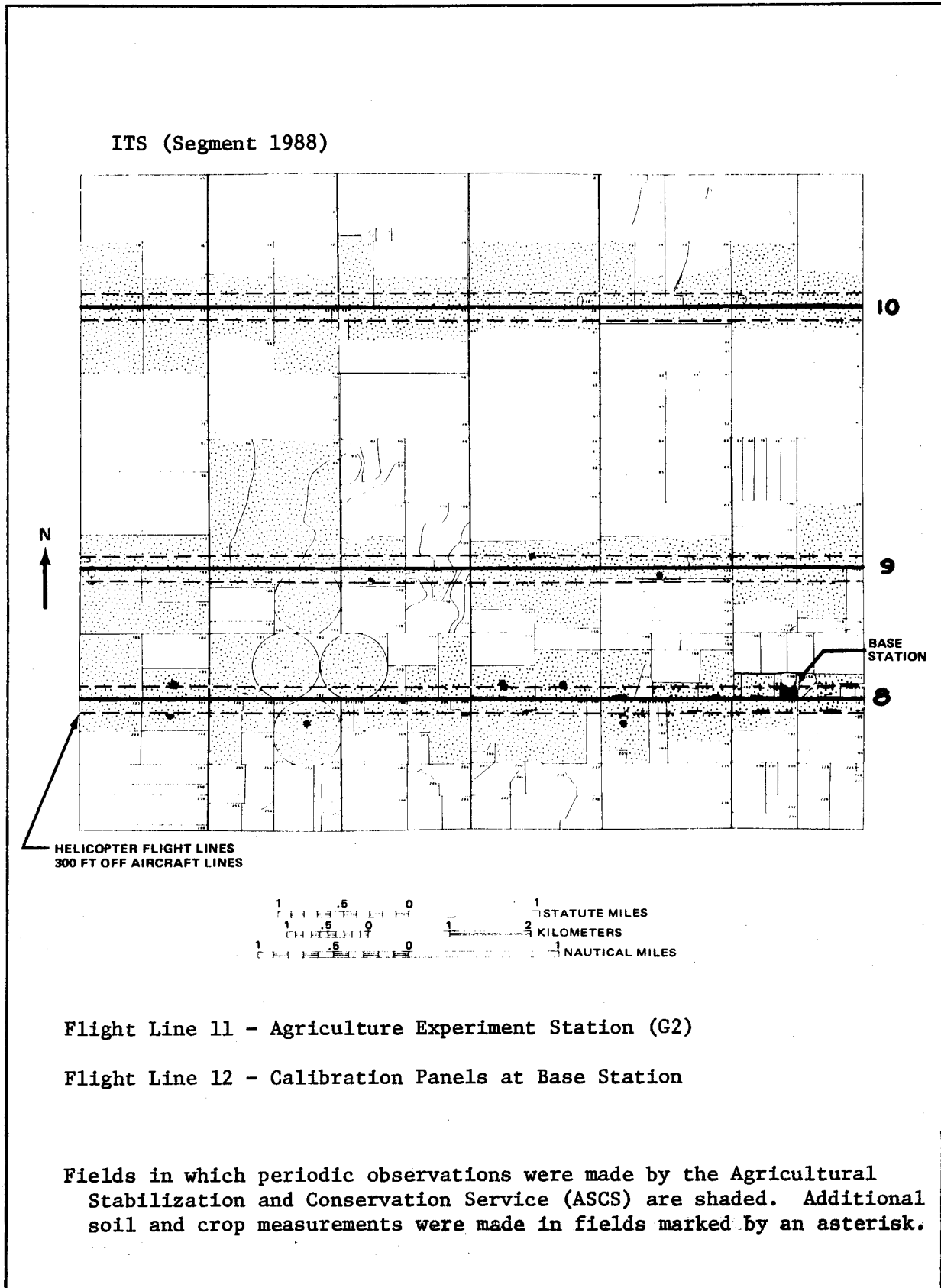
# Finney County, Kansas, Data Collection Locations

## During the 1975-76 Crop Year



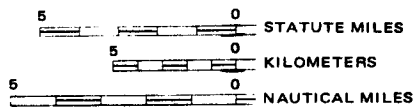
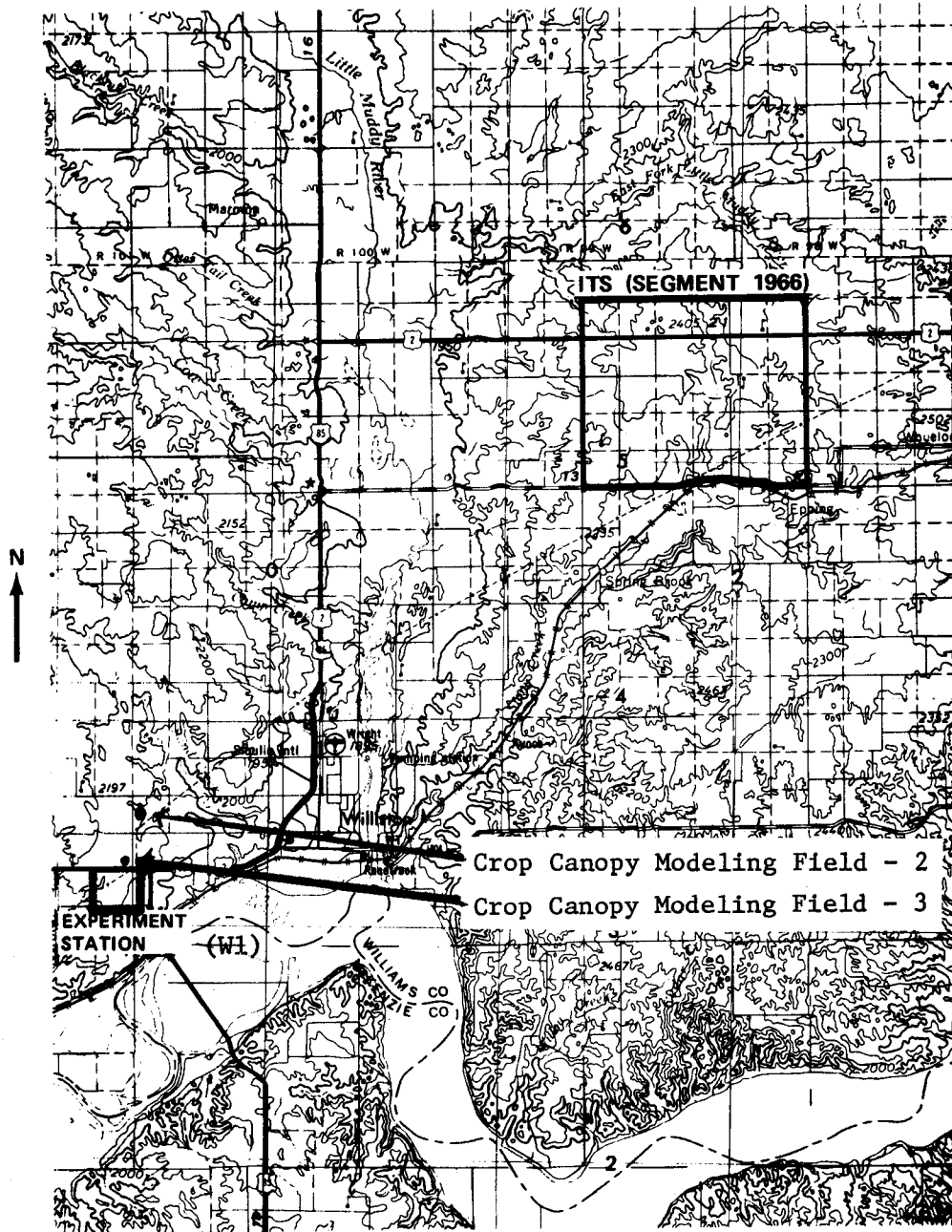
## Flight Lines for Finney County, Kansas, Test Site

During the 1975-76 Crop Year



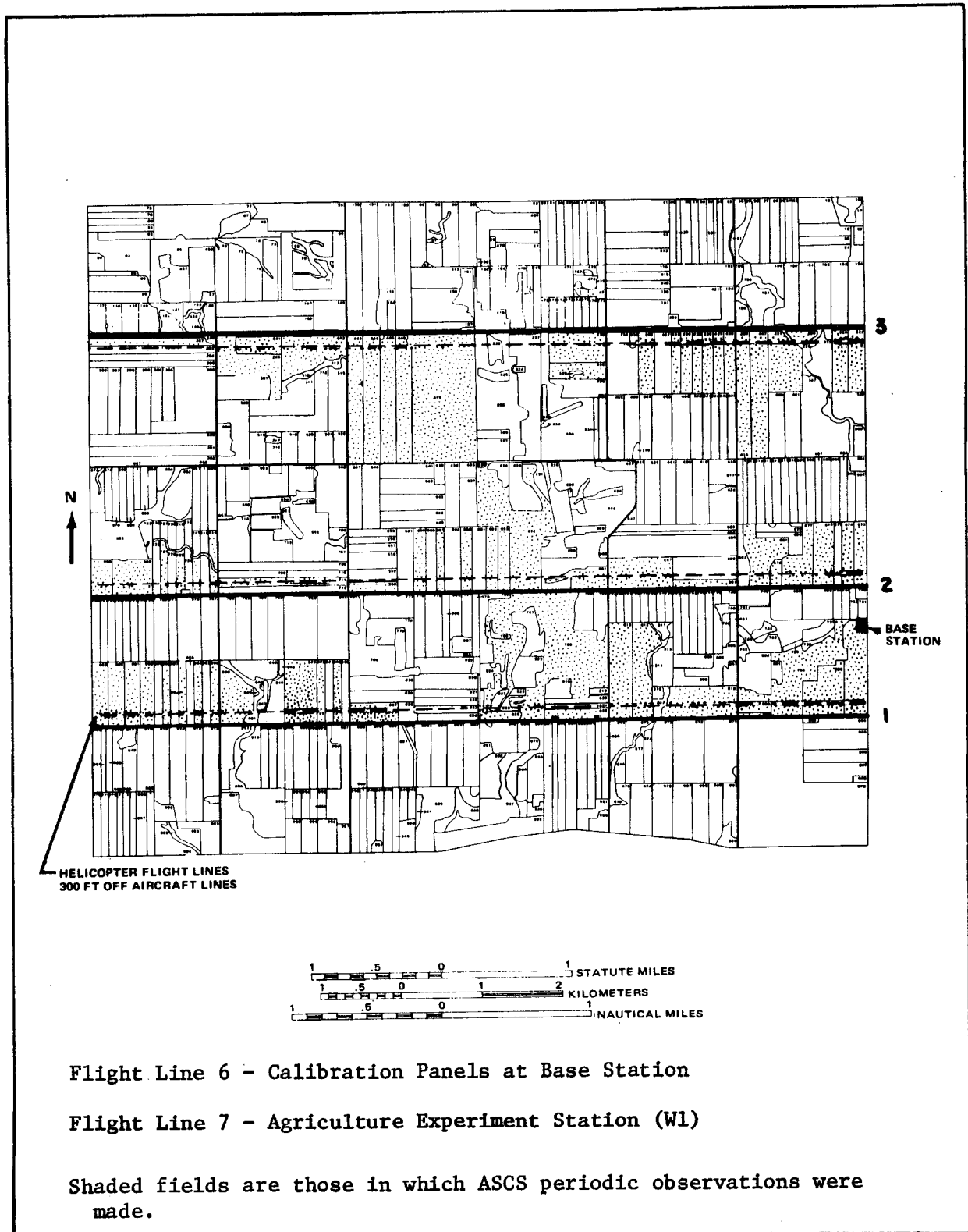
## Williams County, North Dakota, Data Collection Locations

During the 1975 Crop Year



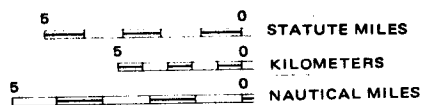
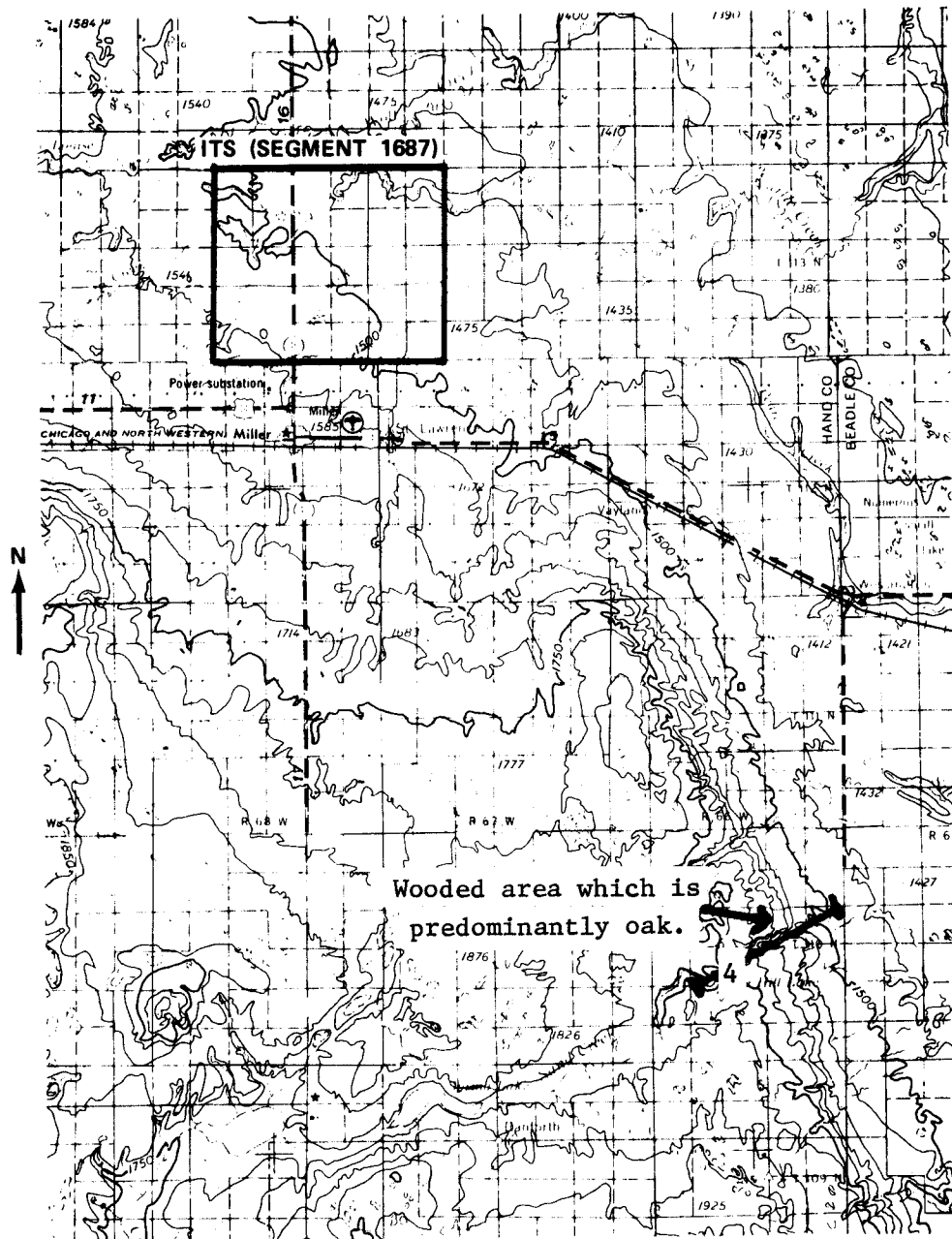
Center point coordinates of the ITS are latitude  $48^{\circ}19.02'N$  and longitude  $103^{\circ}24.52'W$ .

Flight Lines for Williams County, North Dakota, Test Site  
During the 1976 Crop Year



## Hand County, South Dakota, Data Collection Locations

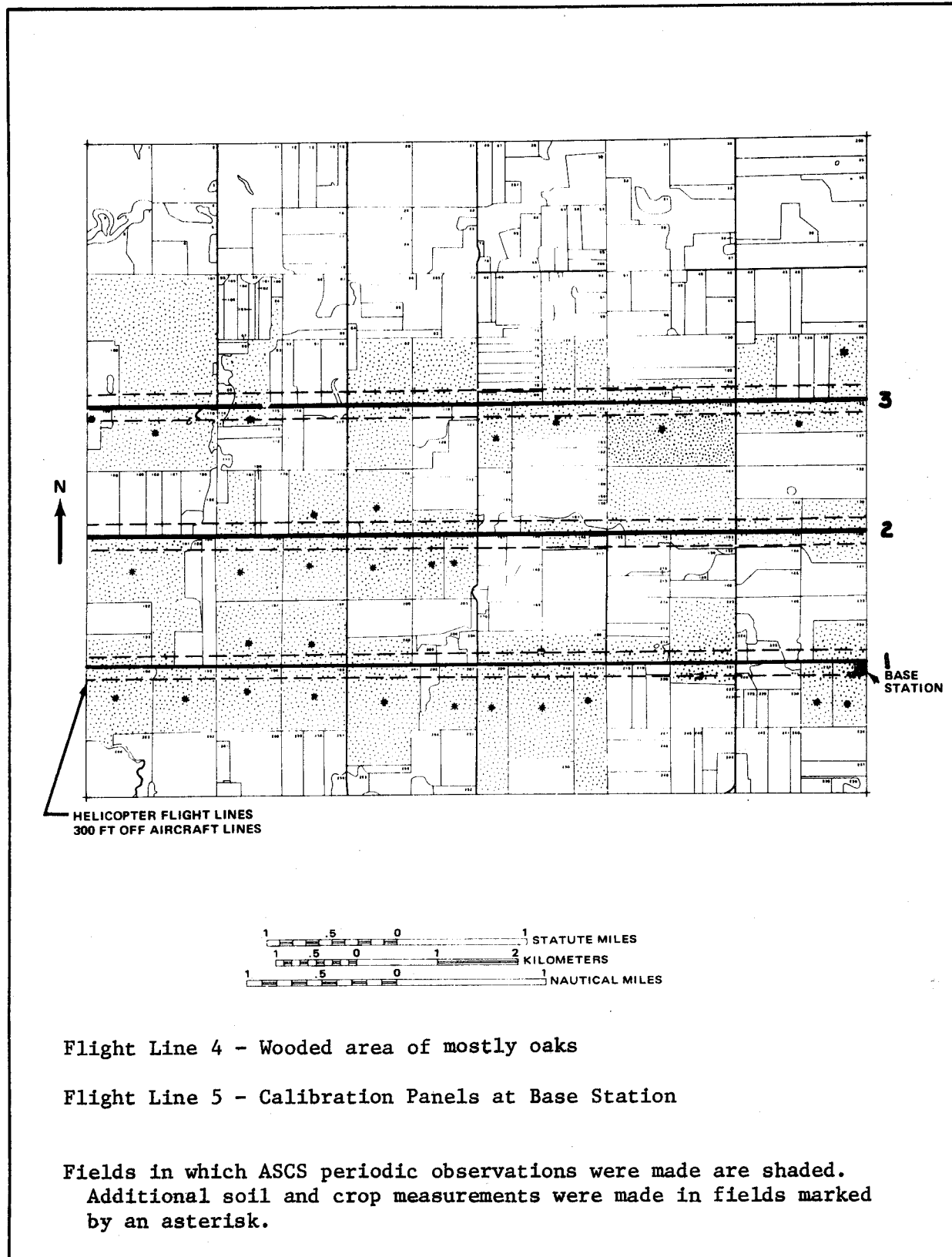
For the 1975-76 Crop Year



Center point coordinates of the ITS are latitude  $44^{\circ}35.0'N$  and longitude  $98^{\circ}58.1'W$ .



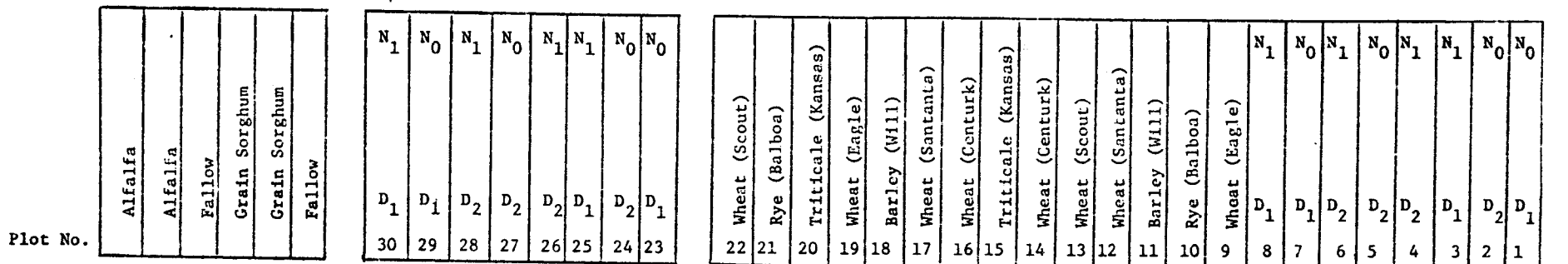
Flight Lines for Hand County, South Dakota, Test Site  
During the 1975-76 Crop Year



1975-76 Garden City, Kansas Agriculture Experiment Station

Remote Sensing Experiments

North  
↑



--- Rep II --- --- Rep I ---

----- Rep II ----- Rep I ----- Rep II --- Rep I ---

Other Crops Experiment

Irrigated Winter Wheat Experiment

Small Grain Experiment

Dryland Winter Wheat Experiment

Nitrogen Fertilization

N<sub>0</sub> None  
N<sub>1</sub> 50 lbs/acre

Nitrogen Fertilization -- 50 lbs/acre

Seeding Rate -- 40 lbs/acre

Nitrogen Fertilization

N<sub>0</sub> None  
N<sub>1</sub> 50 lbs/acre

Planting Date

D<sub>1</sub> Sept. 26, 1975  
D<sub>2</sub> Oct. 16, 1975

Planting Date

D<sub>1</sub> Sept. 26, 1975  
D<sub>2</sub> Oct. 16, 1975

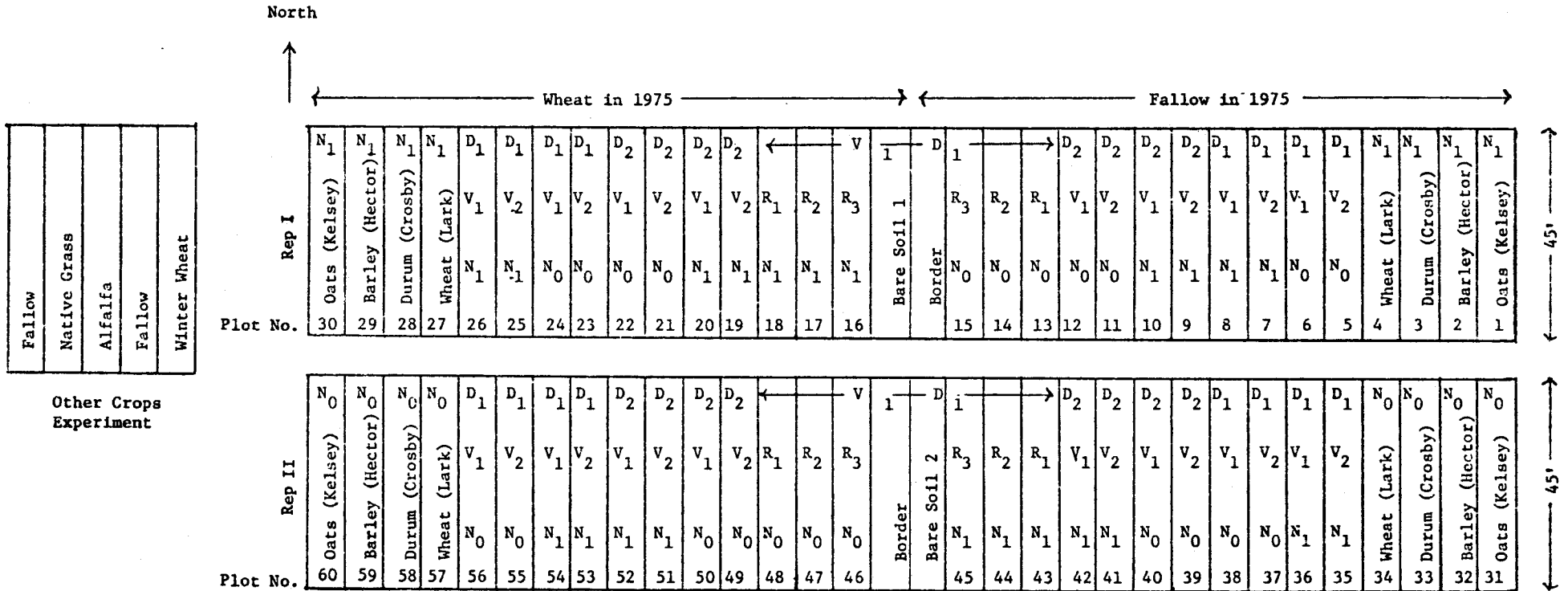
Eagle Variety

Seeding Rate -- 80 lbs/acre  
Pre-plant Irrigation -- Sept. 15, 1975

Eagle Variety

Seeding Rate -- 40 lbs/acre

1976 Williston, North Dakota Agriculture Experiment Station  
Remote Sensing Experiments



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Treatment Descriptions

Soil Moisture	Planting Date	Variety	Nitrogen	Seeding Rate
M <sub>1</sub> Wheat in 1975	D <sub>1</sub> May 6	V <sub>1</sub> Waldron	N <sub>0</sub> None	R <sub>1</sub> 30 lbs/acre
M <sub>2</sub> Fallow in 1975	D <sub>2</sub> May 17	V <sub>2</sub> Olaf (Semi Dwarf)	N <sub>1</sub> 30 lbs/acre	R <sub>2</sub> 60 lbs/acre
				R <sub>3</sub> 90 lbs/acre

## Appendix III

## Brief Description of Supporting or Ancillary Measurements

Intensive Test Site

An inventory of all fields including crop species, crop variety, field acreage, and planting date was obtained, once in the spring and once in the fall. Rainfall amounts were noted at selected places in the site during the crop year.

Periodic observations of large fields under helicopter flight lines include:

- o Crop species
- o Cultural practices: fertilization, planting date, etc.
- o Crop Maturity
- o Plant height
- o Ground cover
- o Stresses: disease, insects, moisture deficits, etc.
- o Field operations: cultivation, harvesting, etc.
- o Vertical and oblique photographs
- o Grain yield

At selected fields under the helicopter flight lines for the Finney County, Kansas and Hand County, South Dakota test sites, the following additional observations were made:

- o Leaf area
- o Fresh and dry biomass
- o Vertical and oblique photographs
- o Soil moisture samples
- o Yield measurements

Meteorological and atmospheric measurements collected at the base station for each site during the helicopter and aircraft flights include:

- o Percent cloud cover and type
- o Temperature
- o Relative humidity
- o Wind speed and direction
- o Barometric pressure
- o Total irradiance
- o Optical depth

Agriculture Experiment Station

Supporting measurements collected at the plots on the agriculture experiment stations include:

- o Crop species and variety
- o Cultural practices: fertilization, planting date, etc.
- o Crop maturity
- o Plant height
- o Plant counts
- o Ground cover
- o Stresses: disease, insects, moisture deficits, etc.
- o Leaf area
- o Fresh and dry biomass
- o Soil moisture measurements
- o Yield measurements
- o Vertical and oblique photographs

Meteorological and atmospheric measurements include a daily record of the temperature variation and precipitation amounts recorded at the experiment station for the crop year. The measurements also include during the time that spectral data were collected:

- o Percent cloud cover and type
- o Temperature
- o Relative humidity
- o Wind speed and direction
- o Barometric pressure
- o Total irradiance
- o Optical depth (only at Garden City, Kansas Agricultural Experiment Station)

Crop Canopy Modeling Field

Supporting measurements on the crop canopy modeling field include:

- o Crop species and variety
- o Crop maturity
- o Plant height
- o Plant counts
- o Stresses: disease, insects, moisture deficits, etc.
- o Leaf area
- o Stem area
- o Head area
- o Fresh and dry biomass
- o Canopy modeling photographs
- o Skylight:shaded vs non-shaded field reflectance standard (Exotech Model 100 measurements)

Appendix IV

LACIE Field Measurements Sensor Data Specificifications and Operational Characteristics

SPECIFICATIONS

OPERATIONAL CHARACTERISTICS

Sensor	Type	Spectral Bands	Spectral range, micrometer	Spot size IFOV, m	Swath width, m	Altitude of Operation, m	Site of Operation
Landsat	Imagery	4	0.5 to 1.1	79 x 57	$1.9 \times 10^5$	$9.3 \times 10^5$	ITS
Aircraft MSS	Imagery	15	0.34 to 2.36	12	10 230	6 100	ITS
		9	3.54 to 13.00	6	5 115	3 050	ITS
				0.9	760	460	ITS; experiment station
Aircraft M <sup>2</sup> S	Imagery	10	0.4 to 1.1	15	14 520	6 100	ITS
		1	8.0 to 13.0	8	7 265	3 050	ITS
				1.2	1 090	460	ITS; experiment station
Helicopter FSS	Non-imagery	61	0.4 to 2.4	24	(a)	60	ITS
		12	8.0 to 14.0				
FSAS	Non-imagery	201	0.4 to 2.4	1.2 to 1.8	(a)	6 to 9	Experiment station ITS calibration panels
Exotech 20C	Non-imagery	201	0.4 to 2.4	1.7	(a)	6	Experiment station
		188	2.8 to 13.4				ITS calibration panels
Exotech 100	Non-imagery	4	0.5 to 1.1	0.4 to 0.5	(a)	1.5 to 2.0	Canopy modeling field

(a) Not applicable.