

## Appendix C

# ADDITIONAL WIND MONITORING SITES

The comprehensive wind data base from which the *Atlas* was prepared covers 158 wind monitoring sites in Montana. Of these sites, 56 were selected for detailed analysis in the *Montana Wind Energy Atlas*, according to criteria discussed in Appendix B.

Appendix C briefly discusses the other sites, by monitoring agency.

### Montana Air Quality Bureau

Table C-1 lists additional wind monitoring sites operated by the Montana Air Quality Bureau or by private entities reporting data to the bureau. In most cases, less than one year's data are available for these sites. In a few cases, the data are no

longer on file with AQB, and in a few others, the data are available only in hard-copy form.

### NWS/FAA/USAF

Most of the data sets for the NWS/FAA/USAF sites have been split into two or more time periods for analysis. This was done due to a change in anemometer height or a change in reporting period. If analyses for more than one monitoring period were available, the longest period, typically the most recent as well, was selected for inclusion in Chapter IV. Those analyses not presented in Chapter IV are listed in Table C-2. In addition, no data summaries are presented for the Havre and Glasgow NWS city offices since, in both cases, a more representative airport site is located nearby.

**Table C-1**  
**Additional Montana Air Quality Bureau Wind Monitoring Sites**

Site No.	Site	County	Reason For Exclusion From Atlas
3	Hardin	Big Horn	Data in hard copy only
4	Hardin MDN	Big Horn	Data in hard copy only
12	Great Falls City Sewage Pump	Cascade	Data no longer on file
13	Great Falls Kiwanis Park	Cascade	Less than one year's data
16	Portage	Cascade	Data no longer on file
22	Scobey Richardson	Daniels	Less than one year's data
26	Anaconda #2 Pond Discharge	Deer Lodge	Other representative site
28	Anaconda County Airport	Deer Lodge	Other representative site
30	Anaconda Lincoln School	Deer Lodge	Other representative site
32	Anaconda Water Office	Deer Lodge	Other representative site
34	Anaconda West Gate	Deer Lodge	Less than one year's data
35	Antelope	Deer Lodge	Data no longer on file

**Table C-1**  
**Additional Montana Air Quality Bureau Wind Monitoring Sites (cont'd.)**

<b>Site No.</b>	<b>Site</b>	<b>County</b>	<b>Reason for Exclusion from Atlas</b>
36	Kucera	Deer Lodge	Data no longer on file
37	Opportunity Main Street	Deer Lodge	Data no longer on file
38	Poor Farm	Deer Lodge	Data in hard copy only
39	Tailings Pond	Deer Lodge	Data no longer on file
42	Bigfork Ranger Station	Flathead	Less than one year's data
43	Columbia Falls Brandt	Flathead	Less than one year's data
44	Columbia Falls Delbon	Flathead	Other representative site
45	Columbia Falls Geis	Flathead	Less than one year's data
46	Columbia Falls Water Supply (Trailer)	Flathead	Data in hard copy only
47	Kalispell Airport	Flathead	Other representative site
49	Polebridge	Flathead	Less than one year's data
50	Big Sky Golf Course	Gallatin	Less than one year's data
64	Polson	Lake	Other representative site
65	Ronan	Lake	Other representative site
68	East Helena A & W	Lewis & Clark	Other representative site
70	Hadfield West Main (ASARCO)	Lewis & Clark	Less than one year's data
72	Kleffner Residence	Lewis & Clark	Data in hard copy only
73	Kleffner Road (ASARCO)	Lewis & Clark	Less than one year's data
74	Sinter Plant (ASARCO)	Lewis & Clark	Less than one year's data
75	Water Tower (ASARCO)	Lewis & Clark	Less than one year's data
76	Zinc Plant (ASARCO)	Lewis & Clark	Less than one year's data
80	Missoula Fire Lab	Missoula	Other representative site
82	Missoula Lions Park	Missoula	Other representative site
83	Missoula Malfunction Junction	Missoula	Other representative site
85	Missoula Olofson	Missoula	Other representative site
86	Missoula Rose Park	Missoula	Other representative site
87	Missoula Stiegler	Missoula	Other representative site
104	Powell County Courthouse	Powell	Data in hard copy only
106	Poplar	Roosevelt	Less than one year's data
110	Colstrip McRae	Rosebud	Other representative site
112	Lame Deer-Fisher Butte	Rosebud	Less than one year's data
116	Butte Alpine West	Silver Bow	Less than one year's data
119	Harrison Fire Station	Silver Bow	Data no longer on file
128	Devon	Toole	Data no longer on file
129	Fort Peck	Valley	Data no longer on file
135	Billings AQB Office	Yellowstone	Data in hard copy only
136	Billings 11th & 27th	Yellowstone	Less than one year's data
137	Billings Central Park	Yellowstone	Less than one year's data
138	Billings Metra	Yellowstone	Other representative site
140	Billings Taft School	Yellowstone	Other representative site
141	Coburn Road	Yellowstone	Data no longer on file
143	Laurel BN	Yellowstone	Data no longer on file
144	Laurel Farm	Yellowstone	Other representative site
146	Lockwood Park	Yellowstone	Data no longer on file
147	Lockwood School	Yellowstone	Less than one year's data
148	North Johnson Lane	Yellowstone	Data no longer on file

## Department of Natural Resources and Conservation

The Montana Department of Natural Resources and Conservation (DNRC) funded a two-year wind energy research and development program. The purpose of this project was to monitor winds at three locations (Livingston, Whitehall, and Big Timber) and to install a wind turbine at Livingston.

Monitoring equipment was installed at the monitoring sites in February and March 1980. Data were collected at an anemometer height of 10 meters using equipment from Campbell Scientific Corporation. A microprocessor collected the data and recorded it on magnetic tape at the site. The data were later transferred to a computer for storage and analysis. Raw data from these sites were available only in hard copy at the time computer analyses for this *Atlas* were conducted. A summary of one year's data, however, was available. Wind speed and wind

power summaries are presented below. Wind speed figures are as collected at the 10-meter anemometer height, whereas wind power figures are calculated for 55 feet above ground level.

The Whitehall site was located approximately 4 miles west of Whitehall. Average monthly wind speeds at the site ranged from 7.0 miles per hour in January 1981 to 14.7 miles per hour in December 1980. Average wind speed for the year of monitoring was 10.6 miles per hour. Average wind power varied from 20 watts/m<sup>2</sup> in January 1981 to 187 watts/m<sup>2</sup> in December 1980. Average annual wind power was 81 watts/m<sup>2</sup>.

The Big Timber site was located approximately 4 miles east of Big Timber. Average monthly wind speeds ranged from 8.0 miles per hour in May 1980 to 15.8 miles per hour in February 1981. Average wind speed for the year of monitoring was 10.5 miles per hour. Average monthly wind power density varied from 30 watts/m<sup>2</sup> in May

**Table C-2**  
**Additional NWS/FAA/USAF Wind Monitoring Periods and Sites**

Site	County	Period of Monitoring	
Dillon FAA Airport	Beaverhead	06/19/51	- 10/29/63
Great Falls Malmstrom AFB	Cascade	01/01/49	- 05/31/53
Great Falls Malmstrom AFB	Cascade	03/01/54	- 02/28/58
Great Falls NWS Airport	Cascade	01/01/48	- 02/02/59
Great Falls NWS Airport	Cascade	02/03/59	- 12/31/64
Miles City FAA Airport	Custer	01/01/48	- 12/31/64
Lewistown FAA Airport	Fergus	12/21/49	- 08/15/62
Kalispell NWS Airport	Flathead	05/01/49	- 06/30/53
Kalispell NWS Airport	Flathead	07/01/53	- 06/30/59
Kalispell NWS Airport	Flathead	07/01/59	- 06/30/64
Bozeman FAA Airport	Gallatin	01/01/48	- 04/27/51
Cut Bank FAA Airport	Glacier	11/22/49	- 10/03/59
Drummond FAA Airport	Granite	01/01/48	- 10/15/50
Havre NWS Airport	Hill	02/01/61	- 12/31/64
Havre NWS City	Hill	05/01/50	- 10/31/56
Helena NWS Airport	Lewis & Clark	01/01/48	- 09/19/61
Missoula NWS Airport	Missoula	01/01/48	- 04/03/58
Missoula NWS Airport	Missoula	04/04/58	- 12/31/64
Livingston FAA Airport	Park	07/05/53	- 12/31/54
Glasgow AFB	Valley	10/01/58	- 06/07/61
Glasgow NWS Airport	Valley	10/01/55	- 08/05/62
Glasgow NWS Airport	Valley	08/06/62	- 05/31/68
Glasgow NWS City	Valley	01/01/48	- 10/31/55
Billings NWS Airport	Yellowstone	01/01/48	- 06/25/58
Billings NWS Airport	Yellowstone	06/26/58	- 12/31/64
Custer FAA Airport	Yellowstone	01/01/48	- 05/31/49

1980 to 234 watts/m<sup>2</sup> in February 1981. Average wind power for the year of monitoring was 80 watts/m<sup>2</sup>.

The Livingston site was located approximately 2 miles east of Livingston. Average monthly wind speeds ranged from 13.2 miles per hour in August 1980 to 21.5 miles per hour in February 1981. Average wind speed during the year of monitoring was 15.8 miles per hour. Average monthly wind power density ranged from 95 watts/m<sup>2</sup> in July 1980 to 790 watts/m<sup>2</sup> in December 1980. For the year of monitoring, average wind power was 277 watts/m<sup>2</sup>.

Wind speed at these sites reportedly was unusually low that year compared with historical wind speeds.

The Montana Department of Natural Resources and Conservation also funded a three-phase, one-year survey of wind speed and direction in the upper Yellowstone River Valley, between Livingston and Springdale.

During each phase of the study, wind data were collected at three sites for three months. Phase 1 ran from December 1978 through February 1979; Phase 2 was conducted in March and April 1979; Phase 3 took place from May through July 1979. Monitoring and analysis was conducted by Brelsford Engineering of Bozeman.

Each site was equipped with wind monitoring systems from Natural Power, Inc. (NPI). Sensors were mounted on 10-meter towers. The monitoring sites for this study were located as follows:

#### Phase 1

S1A—Harvatt's Flat—2 miles south of Livingston, south of I-90 on the eastern bench above the Yellowstone, and 6 miles west of the Livingston Municipal Airport (Mission Field).

S1B—Koffee Kup Ranch—10 miles northeast of Livingston on a hilltop 1 mile east of the Shields River and 5 miles north of the Yellowstone River.

S1C—Hunter's Hot Springs—3 miles northeast of Springdale, 16 miles east of Livingston, and 2 miles north of the Yellowstone River on a hilltop west of the hot springs.

#### Phase 2

S2A — Park County Landfill — 4 miles east of Livingston, south of I-90 on the bench above Chicken Creek and the Yellowstone River Valley, and 2 miles west of Mission Field.

S2B — George Meyers Ranch — 1 mile southeast of Livingston, north of I-90 on the north shoulder of Harvatt's Flat and adjacent to the abandoned Livingston Airport.

S2C — Charles Hillman Ranch — 6 miles northeast of Livingston on the west side of the Shields

**Table C-3**  
**DNRC Wind Energy Survey**  
**Livingston to Springdale**

Site	Month/Year	Mean Wind Speed (mph)	Available Power (watts/m <sup>2</sup> )
S1A	Dec 78	20.4	701.9
S1A	Jan 79	13.8	337.6
S1A	Feb 79	19.5	689.4
S1B	Jan 79	7.7	83.9
S1B	Feb 79	14.6	373.4
S1C	Jan 79	16.7	448.3
S1C	Feb 79	16.7	443.6
S2A	Mar 79	14.9	334.1
S2A	Apr 79	16.0	376.2
S2B	Mar 79	10.7	151.3
S2B	Apr 79	12.2	169.3
S2C	Apr 79	12.9	153.9
S2C	May 79	12.6	171.9
S3A	May 79	13.7	235.8
S3A	Jun 79	12.1	163.1
S3A	Jul 79	10.4	96.1
S3B	Jun 79	13.8	217.5
S3C	May 79	12.9	247.3
S3C	Jun 79	12.7	230.6
S3C	Jul 79	10.9	122.3

River Valley as it enters the Yellowstone River Valley west of U.S. 89.

#### **Phase 3**

S3A — Livingston West — 2 miles west of Livingston, north of I-90 and south of U.S. 10, on a hill above the Leonard Adams home.

S3B — McGuire Hill — 1/2 mile northeast of Livingston and 1/4 mile north of the residential area on the abandoned police radio tower hill.

S3C — Gordon Brittan Ranch — 9 miles west of Livingston and 1.5 miles south of the Yellowstone River on the east bench above Mission Creek and the Brittan Ranch home.

A DNRC summary of mean wind speed and available power for these sites is presented in Table C-3. Monthly mean wind speeds ranged from about 8 to 20 miles per hour, and averaged about 14 miles per hour. Monthly available wind power ranged from about 100 to 700 watts per square meter and averaged about 300 watts per square meter.

### **Old West Regional Commission**

The Old West Regional Commission funded a one-year study to establish the solar and wind energy potential and the atmospheric dispersion potential in northeastern Montana.

A 100-meter meteorological tower was installed at Glasgow Air Force Base, about 20 miles north of Glasgow, in September 1977. Wind measurements were made at three levels (10.0, 31.6, and 100.0 meters above ground level) from October 25, 1977, to August 31, 1978.

Wind speeds at the 10-meter level averaged 11.4 miles per hour during the study. Average monthly wind speeds ranged from 9.2 miles per hour in March 1978 to 15.4 miles per hour in April 1978.

At the 31.6-meter level, average wind speed during the period of study was 13.9 miles per hour. Average monthly wind speeds varied from 11.6 miles per hour in March 1978 to 18.3 miles per hour in April 1978.

The average wind speed at the 100-meter level was 17.4 miles per hour during the study period. Average monthly wind speeds ranged from 15.0 miles per hour in June 1978 to 21.7 miles per hour in April 1978.

The raw data from this site were available only in hard copy form at the time computer analyses were conducted for this *Atlas*. Data analyses from monitoring previously conducted at this site by the U.S. Air Force also are provided in the *Atlas*. The wind speeds observed in the more recent study were considerably higher than those reported by the Air

Force; however, they were similar to those reported by the National Weather Service at the airport about 20 miles south.

### **U.S. Department of the Interior, Bureau of Reclamation**

The Bureau of Reclamation, at that time the Water and Power Resources Service of the U.S. Department of the Interior, funded a one-year study to monitor wind speed and direction at four sites in Montana. Monitoring sites were established at the Canyon Ferry, Gibson, Tiber, and Yellowtail dams. Monitoring began in January 1980 and continued through January 1981.

The monitors used were Met One wind speed and direction sensors mounted 10 meters above ground level. A Campbell Scientific CR21 data logger sampled the sensors every 60 seconds and recorded hourly averages on cassette tape. Parameters measured included: current wind speed; current wind direction; average wind speed; average wind direction and constancy; average wind speed to the first, second, third, fourth, and fifth power; maximum wind speed; and minimum wind speed. The data tapes were read by computer, checked, and stored for later processing.

The wind power speeds reported in the data summaries are not based on hourly average wind speeds, but are the cube root of the hourly average cubed wind speed.

The Canyon Ferry site was located on the summit of a hill just north of Canyon Ferry Dam at an elevation of 4,150 feet. Average monthly wind power speeds at the site ranged from 7.8 miles per hour in January 1981 to 14.1 miles per hour in November 1980. The average wind power speed for the monitoring period was 10.1 miles per hour.

The Gibson Dam site was located just south of the Sun River approximately 3.5 miles east-northeast of Gibson Dam. Elevation at the site was 4,460 feet. Average monthly wind power speeds ranged from 9.4 miles per hour in January 1981 to 17.9 miles per hour in September 1980. The average wind power speed for the monitoring period was 12.5 miles per hour.

The Tiber Dam site was located approximately 0.5 mile east-northeast of Tiber Dam at an elevation of 3,240 feet. Average monthly wind power speeds varied from 7.8 miles per hour in February 1980 to 13.0 miles per hour in December 1980. The average wind power speed for the monitoring period was 10.6 miles per hour.

The Yellowtail Dam site was located approximately 0.8 miles north-northwest of the

Yellowtail Dam at an elevation of 3,800 feet. Average monthly wind power speeds ranged from 9.6 miles per hour in January 1981 to 16.3 miles per hour in October 1980. The average wind power speed for the monitoring period was 12.1 miles per hour.

The raw data from this study were not available for analysis since the Bureau of Reclamation did not have the data in its possession.

## Western Area Power Administration

The Western Area Power Administration (WAPA) ran a Wind Prospecting Program beginning in 1981. The program covered ten of the states in WAPA's fifteen-state marketing area. Over one hundred sixty sites eventually were studied; six of the sites were located in Montana. Monitoring at some of the Montana sites continued until 1986.

WAPA recruited its customers (rural electric cooperatives in Montana's case) to carry out the actual data collection. Five co-ops participated in Montana. The program collected 15-minute average wind speed data. Aeolian Kinetics or Natural Power signal conditioners were used and the raw data were recorded on cassette tape.

Data from this effort were available only in hard copy. Data tables from the WAPA report have been reproduced for the *Wind Atlas*. Brief site descriptions also have been drawn from WAPA reports. No information was available on the quality control measures in the program.

The Ekalaka site was located in extreme southeastern Montana, about nine miles northeast of Ekalaka, at 45 57 37 N and 104 25 18 W (Site No. 11 on Map II-1). Elevation was 3,460 feet. The area is rolling grasslands. The anemometer was located at a substation. Anemometer height was 36 feet. Data was collected between March 11, 1982 and May 18, 1986, by Southeast Electric Cooperative. Average wind speed was 9.78 miles per hour. Highest average wind speed was in the spring at 10.57 miles per hour and lowest was in the fall, at 9.05 miles per hour. Data recovery for the entire period was 69 percent.

The Circle site was located 17 miles southeast of Circle, at 47 15 42 N and 105 16 05 W (Site No. 23 on Map II-1). Elevation was 3,467 feet. The site is on a high ridge, approximately 1,000 feet higher than the surrounding area. There were no obstructions in this grassland area. Anemometer height was 31 feet. Data was collected between March 11, 1982 and October 30, 1985 by the McCone Electric Cooperative. Average wind speed was 14.63 miles per hour. Highest average wind speed was in the

spring, at 15.49 miles per hour, and lowest was 14.01 in the fall. Data recovery for the entire period was 78 percent.

The Mt. Antione site was located 5 miles southeast of Hays, at 47 57 20 N and 108 33 02 W (Site No. 158 on Map II-1). The anemometer was located on the highest point in the Little Rocky Mountains, with no obstructions. The elevation was 5,785 feet. The anemometer height was 30 feet. Data were collected between February 8, 1984 and August 5, 1985; the monitoring system was in place until a later date, but no more valid data were collected. Average wind speed was 13.98 miles per hour. Highest average wind speed was during the winter, with 15.77 miles per hour, while the lowest was in the summer, with 13.28 miles per hour. Data recovery for the entire period was 69 percent.

The Reserve site was located 10 miles southeast of Reserve at 48 30 58 N and 104 18 23 W (Site No. 115 on Map II-1). Site elevation was 2,234 feet. The area is one of high grass and grains. The anemometer was installed on a radio tower leg at 30 feet. There were no obstructions in the area, but the tower itself could have affected the readings. Data was collected from January 29, 1982 to June 30, 1985 by Sheridan Electric Cooperative. Average wind speed was 11.13 miles per hour. Highest average wind speed was in the spring, at 12.17 miles per hour, and lowest was in the fall at 10.50 miles per hour. Data recovery for the entire period was 72 percent.

The Fairfield site was located 3 miles west of Fairfield, at 47 36 31 N and 112 02 43 W (Site No. 126 on Map II-1). Elevation at the site was 4,200 feet. The site was the highest ground within a ten-mile radius, in a grassland area near the Rocky Mountain Front. Anemometer height was reported at 30 feet, but DNRC has learned that the actual height probably was lower. Data were collected between December 30, 1981 and January 3, 1985 by Sun River Electric Cooperative. Average wind speed was 11.45 miles per hour. Highest average wind speed was in the winter, at 13.04 miles per hour, while the lowest was in the summer at 9.29 miles per hour. Data recovery for the entire period was 91 percent.

The Pendroy site was located 8 miles northwest of Pendroy, at 48 07 45 N and 112 26 20 W (Site No. 127 on Map II-1). Elevation at the site was 4,550 feet. The area is rolling grasslands near the Rocky Mountain Front. Data was collected from March 17, 1983 to December 19, 1984 by Sun River Electric Cooperative. Anemometer height was 31 feet. Average wind speed was 9.93 miles per hour. Highest average wind speed was 12.52 miles per hour in the winter and lowest was 9.02 miles per hour in the summer. Data recovery over the period was 86 percent.

Table C - 4A  
Western Area Power Administration  
**EKALAKA**  
Carter County

ELEVATION:3460. FT ACTUAL

ANEMOMETER HT:36.1 FT ACTUAL

## MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	9.45	9.00	10.93	10.83	9.66	8.91	9.03	9.63	8.64	7.67	7.76	9.76	9.41
	HOURS OF USABLE DATA	279.	250.	264.	267.	231.	219.	236.	230.	190.	141.	179.	229.	2714.
3AM-6AM	WIND SPEED (MPH)	9.54	9.30	9.91	9.74	8.97	9.17	8.05	8.89	8.61	7.72	8.86	9.69	9.12
	HOURS OF USABLE DATA	279.	249.	263.	266.	233.	214.	237.	229.	188.	140.	180.	230.	2707.
6AM-9AM	WIND SPEED (MPH)	9.26	9.10	9.77	11.39	10.99	10.86	10.00	9.73	9.11	8.60	9.33	9.55	9.87
	HOURS OF USABLE DATA	278.	250.	261.	269.	233.	218.	237.	231.	191.	141.	180.	228.	2713.
9AM-NOON	WIND SPEED (MPH)	9.96	10.03	11.22	12.97	12.05	11.28	10.37	10.80	11.04	10.81	10.08	9.49	10.87
	HOURS OF USABLE DATA	275.	251.	266.	271.	234.	219.	236.	232.	189.	142.	180.	229.	2724.
NOON-3PM	WIND SPEED (MPH)	10.56	10.61	11.75	13.38	12.54	11.21	9.84	10.75	11.57	11.87	10.27	9.31	11.15
	HOURS OF USABLE DATA	279.	252.	266.	270.	232.	221.	234.	234.	189.	144.	180.	234.	2735.
3PM-6PM	WIND SPEED (MPH)	9.62	9.24	10.64	12.36	11.78	10.68	9.77	10.71	10.51	10.14	8.25	8.86	10.26
	HOURS OF USABLE DATA	278.	252.	267.	270.	231.	222.	234.	234.	189.	144.	181.	234.	2736.
6PM-9PM	WIND SPEED (MPH)	9.51	8.64	9.56	9.56	9.04	8.43	8.92	9.09	7.47	8.54	7.84	9.44	9.93
	HOURS OF USABLE DATA	276.	250.	266.	269.	230.	220.	233.	231.	184.	142.	176.	234.	2711.
9PM-MID	WIND SPEED (MPH)	9.51	9.00	10.43	10.17	9.64	8.76	9.80	9.70	9.35	8.75	7.87	9.63	9.47
	HOURS OF USABLE DATA	278.	251.	266.	269.	231.	219.	233.	232.	183.	143.	174.	234.	2710.
FULL MONTH	WIND SPEED (MPH)	9.68	9.37	10.54	11.12	10.09	9.82	9.51	9.92	9.55	9.16	8.64	9.31	
	HOURS OF USABLE DATA	2220.	2004.	2120.	2521.	2711.	2636.	2019.	1852.	1502.	1384.	2146.	2215.	

## SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL,K	1.84	1.73	1.78	1.68	1.75	1.75
WEIBULL,C	10.64	11.86	10.96	10.14	10.90	10.97
AVERAGE WIND SPEED (MPH)	9.46	10.67	9.75	9.06	9.71	9.78
STANDARD DEVIATION	5.33	6.29	5.68	5.63	5.72	5.78
FLUX (WATT/M <sup>2</sup> )	84.7	127.2	96.9	82.7	97.1	99.6
HOURS OF USABLE DATA	6439.	7352.	6506.	5032.		26328.

Table C - 4B  
Western Area Power Administration  
**CIRCLE**  
McCone County

ELEVATION:3467. FT ACTUAL

ANEMOMETER HT:30.8 FT ACTUAL

MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	13.31	12.86	14.71	14.66	15.02	16.15	14.44	16.96	14.62	14.90	13.76	15.43	14.68
	HOURS OF USABLE DATA	247.	144.	218.	284.	153.	132.	291.	231.	90.	114.	266.	156.	2326.
3AM-6AM	WIND SPEED (MPH)	12.71	13.17	14.91	14.16	13.49	16.39	13.71	16.49	13.94	14.16	13.02	15.05	14.20
	HOURS OF USABLE DATA	244.	144.	218.	283.	151.	132.	291.	231.	90.	114.	267.	156.	2320.
6AM-9AM	WIND SPEED (MPH)	12.90	12.78	15.11	14.59	13.50	14.90	13.76	15.35	14.31	12.79	12.25	14.05	13.87
	HOURS OF USABLE DATA	230.	144.	216.	282.	151.	133.	291.	231.	90.	114.	267.	157.	2306.
9AM-NOON	WIND SPEED (MPH)	13.14	13.48	16.74	16.20	14.68	15.56	14.35	15.27	16.18	14.26	13.15	13.60	14.69
	HOURS OF USABLE DATA	229.	145.	216.	284.	153.	136.	289.	233.	91.	116.	266.	161.	2318.
NOON-3PM	WIND SPEED (MPH)	15.14	16.20	17.03	16.54	15.46	16.03	13.38	14.73	16.87	16.57	14.30	13.88	15.33
	HOURS OF USABLE DATA	235.	140.	221.	282.	151.	138.	289.	229.	93.	117.	266.	159.	2319.
3PM-6PM	WIND SPEED (MPH)	14.85	15.52	16.36	15.62	15.26	15.73	12.02	14.86	16.12	15.32	13.72	14.39	14.76
	HOURS OF USABLE DATA	244.	141.	227.	279.	150.	138.	291.	225.	93.	118.	267.	160.	2333.
6PM-9PM	WIND SPEED (MPH)	14.81	14.43	16.15	13.85	14.53	16.05	11.73	15.33	13.58	13.07	13.83	15.29	14.31
	HOURS OF USABLE DATA	245.	141.	229.	279.	150.	138.	291.	225.	93.	117.	264.	159.	2332.
9PM-MID	WIND SPEED (MPH)	14.32	13.09	15.90	14.60	15.45	15.81	13.76	16.59	13.72	14.15	14.20	15.70	14.79
	HOURS OF USABLE DATA	245.	141.	231.	279.	150.	138.	290.	225.	93.	117.	261.	159.	2328.
FULL MONTH	WIND SPEED (MPH)	13.91	13.92	15.37	15.91	15.15	14.28	14.09	15.39	14.34	14.41	13.53	14.67	
	HOURS OF USABLE DATA	1919.	1919.	2401.	2599.	2439.	2100.	2963.	2214.	1943.	927.	2124.	1267.	

SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL,K	1.94	2.04	2.25	2.15	2.08	2.08
WEIBULL,C	15.90	17.48	16.42	15.81	16.41	16.51
AVERAGE WIND SPEED (MPH)	14.10	15.49	14.54	14.01	14.53	14.63
STANDARD DEVIATION	7.59	7.95	6.85	6.86	7.33	7.38
FLUX (WATT/M <sup>2</sup> )	265.6	333.9	253.6	235.5	270.7	275.9
HOURS OF USABLE DATA	5105.	7439.	7277.	4993.		24814.



Table C - 4C  
Western Area Power Administration  
**MT. ANTIONE**  
Phillips County

ELEVATION: 5785. FT ACTUAL

ANEMOMETER HT: 29.9 FT ACTUAL

## MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	0.00	0.00	12.99	17.69	14.97	14.96	12.63	11.57	14.95	0.00	13.21	16.31	14.21
	HOURS OF USABLE DATA	0.	0.	46.	93.	102.	135.	189.	93.	51.	0.	45.	51.	804.
3AM-6AM	WIND SPEED (MPH)	0.00	0.00	12.29	17.47	13.68	13.89	12.09	12.31	15.32	0.00	13.49	15.91	13.79
	HOURS OF USABLE DATA	0.	0.	48.	97.	102.	135.	189.	93.	51.	0.	45.	51.	810.
6AM-9AM	WIND SPEED (MPH)	0.00	0.00	11.89	14.85	11.72	13.32	12.09	12.39	15.03	0.00	14.83	16.32	13.20
	HOURS OF USABLE DATA	0.	0.	48.	97.	102.	136.	189.	93.	51.	0.	45.	51.	812.
9AM-NOON	WIND SPEED (MPH)	0.00	0.00	10.36	14.40	12.12	13.91	12.38	13.21	14.86	0.00	13.54	16.78	13.31
	HOURS OF USABLE DATA	0.	0.	48.	95.	105.	136.	189.	92.	51.	0.	43.	51.	809.
NOON-3PM	WIND SPEED (MPH)	0.00	0.00	10.63	15.31	12.72	14.14	12.57	14.99	14.89	0.00	11.04	14.37	13.50
	HOURS OF USABLE DATA	0.	0.	51.	96.	104.	134.	188.	90.	51.	0.	44.	51.	810.
3PM-6PM	WIND SPEED (MPH)	0.00	0.00	10.66	15.14	13.25	14.94	12.97	15.92	15.86	0.00	9.72	14.80	13.88
	HOURS OF USABLE DATA	0.	0.	51.	94.	102.	135.	189.	90.	51.	0.	47.	50.	809.
6PM-9PM	WIND SPEED (MPH)	0.00	0.00	11.42	14.96	13.18	14.48	12.69	13.64	18.64	0.00	10.94	16.30	13.83
	HOURS OF USABLE DATA	0.	0.	51.	92.	102.	135.	189.	90.	51.	0.	46.	48.	804.
9PM-MID	WIND SPEED (MPH)	0.00	0.00	12.98	16.83	14.71	14.56	12.58	11.93	16.36	0.00	12.99	17.67	14.18
	HOURS OF USABLE DATA	0.	0.	49.	90.	102.	137.	189.	91.	50.	0.	47.	48.	802.
FULL MONTH	WIND SPEED (MPH)	0.00	15.64	12.01	15.83	13.71	14.14	12.80	13.23	15.74	13.40	15.05	16.05	
	HOURS OF USABLE DATA	0.	814.	1071.	752.	1046.	1410.	1512.	732.	407.	157.	698.	401.	

## SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL.K	1.54	1.72	2.05	1.76	0.00	1.77
WEIBULL.C	17.52	15.29	14.98	16.91	0.00	15.70
AVERAGE WIND SPEED (MPH)	16.77	13.63	13.28	15.07	0.00	13.98
STANDARD DEVIATION	10.48	8.16	6.80	8.91	0.00	8.17
FLUX (WATT/M <sup>2</sup> )	454.8	252.1	192.5	335.0	0.0	263.4
HOURS OF USABLE DATA	1215.	2869.	3653.	1262.		8999.

Table C - 4D  
Western Area Power Administration  
**RESERVE**  
Sheridan County

ELEVATION:2234. FT ACTUAL

ANEMOMETER HT:29.9 FT ACTUAL

MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	10.78	9.86	11.53	10.58	10.98	9.11	9.62	9.62	10.79	8.34	0.00	11.25	10.23
	HOURS OF USABLE DATA	138.	212.	171.	138.	138.	180.	186.	234.	214.	46.	0.	46.	1701.
3AM-6AM	WIND SPEED (MPH)	11.25	9.89	11.06	10.03	10.57	9.12	9.16	9.33	10.99	8.89	0.00	10.46	10.07
	HOURS OF USABLE DATA	137.	210.	168.	138.	136.	180.	186.	234.	216.	46.	0.	46.	1696.
6AM-9AM	WIND SPEED (MPH)	10.38	10.01	11.66	11.46	12.22	11.04	10.30	9.67	11.62	9.34	0.00	10.59	10.79
	HOURS OF USABLE DATA	136.	210.	170.	138.	140.	180.	186.	236.	216.	43.	0.	46.	1697.
9AM-NOON	WIND SPEED (MPH)	10.66	10.84	13.17	14.19	12.95	12.97	12.78	10.68	13.07	13.30	0.00	11.04	12.26
	HOURS OF USABLE DATA	141.	210.	168.	136.	141.	180.	186.	237.	213.	42.	0.	46.	1697.
NOON-3PM	WIND SPEED (MPH)	11.20	11.72	14.31	14.63	13.95	13.24	13.53	11.80	13.65	13.53	0.00	10.72	12.97
	HOURS OF USABLE DATA	141.	213.	171.	136.	141.	180.	186.	237.	213.	42.	0.	46.	1703.
3PM-6PM	WIND SPEED (MPH)	11.14	11.47	13.97	12.87	13.53	12.73	13.36	12.20	13.14	11.50	0.00	11.37	12.62
	HOURS OF USABLE DATA	139.	212.	171.	136.	141.	180.	186.	237.	211.	42.	0.	47.	1702.
6PM-9PM	WIND SPEED (MPH)	11.64	10.98	12.91	9.90	11.74	10.42	10.72	10.96	10.91	9.46	0.00	10.13	11.04
	HOURS OF USABLE DATA	141.	210.	171.	136.	141.	180.	184.	236.	210.	42.	0.	48.	1698.
9PM-MID	WIND SPEED (MPH)	11.18	9.94	12.80	10.26	11.19	9.26	10.26	10.54	10.68	8.35	0.00	10.73	10.68
	HOURS OF USABLE DATA	142.	210.	171.	136.	141.	180.	182.	237.	210.	42.	0.	48.	1697.
FULL MONTH	WIND SPEED (MPH)	11.03	10.46	12.03	12.11	12.34	10.96	11.22	10.61	11.82	10.15	9.37	10.14	
	HOURS OF USABLE DATA	1115.	2005.	2124.	2174.	2442.	1782.	1482.	1887.	1975.	1876.	1735.	991.	

SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL,K	1.86	1.86	1.86	1.76	1.83	1.81
WEIBULL,C	11.87	13.70	12.27	11.78	12.41	12.61
AVERAGE WIND SPEED (MPH)	10.56	12.17	10.90	10.50	11.03	11.13
STANDARD DEVIATION	6.89	6.83	6.09	6.20	6.26	6.37
FLUX (WATT/M <sup>2</sup> )	121.3	187.6	134.1	128.6	141.6	146.8
HOURS OF USABLE DATA	4011.	6739.	5151.	5585.		21486.

Table C - 4E

## Western Area Power Administration

## FAIRFIELD

## Teton County

ELEVATION:4200. FT ACTUAL

ANEMOMETER HT:29.9 FT ACTUAL

## MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	13.31	11.79	10.55	12.52	10.12	8.47	7.64	7.32	9.50	10.24	11.44	12.03	10.66
	HOURS OF USABLE DATA	285.	250.	194.	177.	186.	264.	126.	174.	178.	186.	250.	279.	2549.
3AM-6AM	WIND SPEED (MPH)	13.67	12.23	10.59	13.08	10.04	9.26	7.19	8.35	10.45	10.23	11.37	12.11	10.98
	HOURS OF USABLE DATA	288.	252.	195.	177.	186.	264.	126.	174.	180.	186.	249.	278.	2554.
6AM-9AM	WIND SPEED (MPH)	14.60	12.02	10.72	13.51	11.42	9.55	8.55	8.62	10.57	9.97	11.71	12.32	11.37
	HOURS OF USABLE DATA	288.	252.	193.	177.	186.	264.	125.	174.	180.	187.	249.	281.	2555.
9AM-NOON	WIND SPEED (MPH)	14.56	14.40	12.86	14.51	12.78	9.72	10.28	10.22	12.27	12.30	14.48	13.13	12.79
	HOURS OF USABLE DATA	284.	253.	193.	175.	186.	266.	120.	174.	180.	186.	244.	282.	2552.
NOON-3PM	WIND SPEED (MPH)	15.09	15.42	12.70	13.87	13.79	9.53	11.45	10.98	12.76	13.10	15.28	13.54	13.27
	HOURS OF USABLE DATA	285.	251.	191.	177.	186.	267.	120.	176.	181.	184.	254.	284.	2557.
3PM-6PM	WIND SPEED (MPH)	13.50	14.04	11.26	14.48	14.73	9.86	11.34	11.43	12.40	11.31	12.70	12.59	12.50
	HOURS OF USABLE DATA	285.	251.	192.	177.	186.	267.	120.	177.	180.	186.	258.	284.	2552.
6PM-9PM	WIND SPEED (MPH)	12.59	11.83	10.42	12.17	12.91	9.09	9.71	9.72	9.94	10.11	11.25	12.04	11.08
	HOURS OF USABLE DATA	285.	252.	191.	177.	186.	267.	120.	177.	179.	186.	257.	284.	2560.
9PM-MID	WIND SPEED (MPH)	12.65	11.03	10.83	11.59	10.49	8.46	9.13	8.32	9.63	10.16	11.23	12.17	10.64
	HOURS OF USABLE DATA	283.	252.	191.	177.	186.	267.	120.	177.	179.	186.	255.	281.	2553.
FULL MONTH	WIND SPEED (MPH)	13.75	12.84	10.89	12.06	11.60	9.24	9.38	9.30	11.04	10.93	12.44	12.49	
	HOURS OF USABLE DATA	2283.	2012.	2234.	2148.	2209.	2126.	978.	2111.	2126.	1487.	2023.	2252.	

## SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL,K	1.79	1.67	1.76	1.85	1.75	1.72
WEIBULL,C	14.65	12.88	10.43	12.96	12.73	12.84
AVERAGE WIND SPEED (MPH)	13.04	11.51	9.29	11.51	11.34	11.45
STANDARD DEVIATION	7.52	7.09	5.46	6.45	6.67	6.87
FLUX (WATT/M <sup>2</sup> )	222.7	167.6	82.7	147.7	150.5	158.9
HOURS OF USABLE DATA	6546.	6590.	5214.	5636.		23986.

Table C - 4F  
Western Area Power Administration  
**PENDROY**  
Teton County

ELEVATION: 4550. FT ACTUAL

MONTHLY AND DIURNAL AVERAGE WIND SPEEDS (MPH)

ANEMOMETER HT: 31.2 FT ACTUAL

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUMULATIVE
MID-3AM	WIND SPEED (MPH)	16.20	11.46	8.64	8.33	8.67	8.36	7.90	8.04	8.52	7.57	7.89	10.18	9.07
	HOURS OF USABLE DATA	93.	84.	135.	161.	93.	117.	135.	54.	150.	129.	156.	90.	1386.
3AM-6AM	WIND SPEED (MPH)	15.89	11.77	7.48	7.90	7.95	8.49	6.77	7.91	8.96	7.60	8.01	9.88	8.80
	HOURS OF USABLE DATA	93.	84.	135.	146.	93.	117.	135.	54.	150.	129.	156.	90.	1381.
6AM-9AM	WIND SPEED (MPH)	15.11	10.11	7.93	8.74	10.84	8.98	7.95	7.66	9.07	6.93	8.51	10.24	9.16
	HOURS OF USABLE DATA	93.	84.	133.	149.	93.	118.	135.	55.	150.	129.	156.	90.	1384.
9AM-NOON	WIND SPEED (MPH)	16.04	10.57	10.53	9.54	13.66	8.63	8.43	10.49	11.49	9.02	10.09	10.91	10.51
	HOURS OF USABLE DATA	93.	84.	133.	151.	93.	121.	131.	58.	147.	130.	154.	87.	1379.
NOON-3PM	WIND SPEED (MPH)	15.49	12.06	12.20	10.29	14.95	9.65	10.52	11.56	13.30	10.32	11.01	11.65	11.75
	HOURS OF USABLE DATA	93.	84.	133.	150.	93.	120.	129.	57.	147.	132.	153.	90.	1381.
3PM-6PM	WIND SPEED (MPH)	14.12	12.37	12.37	11.08	16.29	10.61	11.50	12.13	13.32	10.01	9.46	11.61	11.87
	HOURS OF USABLE DATA	93.	84.	135.	150.	93.	120.	129.	59.	147.	132.	153.	89.	1384.
6PM-9PM	WIND SPEED (MPH)	15.55	10.54	9.27	9.34	11.87	9.72	9.35	10.68	9.41	8.88	7.63	10.44	9.93
	HOURS OF USABLE DATA	93.	84.	137.	150.	93.	120.	129.	60.	147.	132.	153.	88.	1386.
9PM-MID	WIND SPEED (MPH)	15.86	10.25	8.62	8.78	9.11	8.74	8.33	9.03	8.92	7.88	8.29	11.49	9.36
	HOURS OF USABLE DATA	93.	84.	138.	150.	93.	120.	129.	60.	147.	132.	153.	90.	1389.
FULL MONTH	WIND SPEED (MPH)	15.42	11.14	9.62	9.42	10.76	9.55	8.58	8.82	10.36	8.53	8.85	10.80	
	HOURS OF USABLE DATA	744.	672.	1079.	1427.	1408.	1438.	1257.	1040.	1185.	1044.	1233.	713.	

SEASONAL AND ANNUAL VELOCITY DISTRIBUTION PARAMETERS

	WINTER (DJF)	SPRING (MAM)	SUMMER (JJA)	FALL (SON)	ANNUAL	CUMULATIVE
WEIBULL.K	1.34	1.49	1.63	1.38	1.41	1.42
WEIBULL.C	13.63	11.03	10.07	10.15	11.20	10.91
AVERAGE WIND SPEED (MPH)	12.52	9.96	9.02	9.27	10.19	9.93
STANDARD DEVIATION	9.46	6.78	5.89	6.79	7.31	7.11
FLUX (WATT/M <sup>2</sup> )	296.5	124.7	82.4	113.8	146.0	134.5
HOURS OF USABLE DATA	2129.	3914.	3734.	3461.		13238.

## Electric Power Research Institute

The Electric Power Research Institute (EPRI) is conducting studies to acquire representative visibility and air quality data in the western United States. As part of this study, wind measurements have been collected at a site approximately 2 miles northwest of Harlowton. Monitoring was conducted from June 1981 to October 1982 with a Climatronics F460 wind measurement system. Anemometer height was 10 meters.

The data, which consist of wind speed and wind direction values recorded every five out of eight days during daylight hours, are not available to the public at this time.

## Bonneville Power Administration

From May 1-3, 1981, Oregon State University, under contract to Bonneville Power Administration, conducted aerial wind prospecting surveys over western Montana as part of the Wind Regional Energy Assessment Program. Aerial surveys are a rapid means of assessing wind power potential over a large area. In such surveys, indicators of high wind speeds, such as wind-deformed trees, are observed from the air. In addition, the roughness of

the terrain, tree cover, ease of access, and location of transmission lines can be determined.

The OSU wind prospecting survey covered western Montana from south of Dillon to the Canadian border, and from the eastern front of the Rocky Mountains to the Idaho state line. Areas with an apparent high wind potential were found on exposed ridge crests and summits in all of the areas surveyed. Nearly all of these locations, however, are remote and inaccessible during the winter.

Based on the survey results, OSU recommended that wind monitors be installed at these locations:

- 1) Site 134, 24 miles south-southwest of Dillon;
- 2) Site 138, 24 miles southwest of Dillon;
- 3) Site 151, 10 miles east-northeast of Ennis;
- 4) Site 152, 4 miles southeast of Norris;
- 5) Site 159, 10 miles northeast of Whitehall;
- 6) Site 173, 6 miles north-northwest of Anaconda;
- 7) Site 178, 5 miles west-southwest of Philipsburg;
- 8) Site 186, 10 miles west of Drummond;
- 9) Site 188, 4 miles west of Drummond;
- 10) Site 200, 16 miles west of Helena;

**Table C-5**  
**Oregon State University**  
**Wind Prospecting Fly Over**

Site Area	No.	Estimated Mean Annual Wind Speed (mph)	Existing Communications Facilities
Dillon & Butte	134	15-19	Yes
	138	13-17	Yes
	151	14-17	No
	152	13-16	Yes
	159	15-18	Yes
	173	12-15	No
	178	12-15	No
Missoula & Helena	186	14-17	No
	188	14-17	Yes
	200	14-17	Yes
	217	16-19	No
Browning	252	17-21	No
	258	17-21	No
	261	15-18	No
	274	14-17	Yes

- 11) Site 217, 18 miles north-northwest of Helena;
- 12) Site 252, 4 miles northeast of Saint Mary;
- 13) Site 258, 16 miles south-southwest of Browning;
- 14) Site 261, 18 miles west of Dupuyer;
- 15) Site 274, 10 miles southwest of Browning.

In September 1981, wind monitors were installed at sites 188, 258 (Rainbow Field), 261 (Swift Dam), and at Heart Butte (site 260) and at Blackfoot, about 4 miles northwest of Browning. In November 1981, the anemometer at site 188 was relocated to site 200 (MacDonald Pass). Blackfoot, Swift Dam, and Heart Butte had wind-run anemometers. A stripchart recorder was installed at Rainbow Field and a CR-21 data logger was installed at MacDonald Pass. The Rainbow Field equipment was removed in November 1982. That same month, a CR-21 data logger was installed at Heart Butte, and a wind-run anemometer was installed at Duck Lake, approximately 5 miles east of Babb. Wind-run anemometers were installed at Whitehall in September 1983 and at Sieben 2 in October 1983. The Whitehall site is on a microwave tower just northeast of the town, while the Sieben 2 site is on a rocky point 27 miles northwest of Helena. The Blackfoot site was converted to an hourly data logger system in July 1984. Data from wind-run anemometers at these sites are presented in Table C-6. Data recovery in many in-

stances was poor, due to the extremely harsh weather at the sites. All the wind-run anemometers were closed down by July 1984.

## U.S. Forest Service

The U.S. Forest Service maintains a collection of historical weather data from more than 800 stations in the northwestern United States. The data were recorded from observations that took place once per day (usually in the early afternoon) during the fire season (generally May through September).

The data set includes data on wind direction and speed, temperature, relative humidity, and other parameters necessary for estimating fire hazards. Each January, data from the previous year are incorporated into each station's data set and stored on computer tapes.

While most of the stations have only one observation per day, some have three observations per day. Some of the station data histories date back to the 1920s.

These data have been analyzed by Battelle Pacific Northwest Laboratories. Those stations in Montana for which at least 70 percent of the wind speed observations were equal to or greater than 3.5 meters per second (7.8 miles per hour) are listed in Tables C-7 and C-8.

**Table C-6**  
**Bonneville Power Administration Wind-Run Monitoring Sites**  
**Average Velocity Oct 1981 - Jul 1984 (mph)**

Site		Rainbow Field	Blackfoot	Swift Dam	Heart Butte	Duck Lake	MacDonald Pass	Sieben 2	Whitehall
Anemometer Height (ft)		(30)	(30)	(30)	(35)	(30)	(30)	(57)	(30)
1981	Oct	15.7	14.5	14.4	15.5				
	Nov	19.9	16.8	17.1	18.2		22.5		
	Dec	17.1	18.0	17.7	16.5		40.4		
1982	Jan	18.6	19.3	16.4	19.1		M		
	Feb	21.0	16.8	16.9	18.9		M		
	Mar	M	12.6	M	M		M		
	Apr	M	18.4	M	17.3		M		
	May	M	11.9	12.9	16.7		M		
	Jun	M	11.7	10.8	M		M		
	Jul	M	12.5	11.4	14.7		M		
	Aug	M	13.6	7.4	12.6		M		
	Sep	M	13.2	12.9	11.9		M		
	Oct	M	14.1	M	18.1		M		
	Nov		18.2	M		20.4	21.1		
	Dec		19.3	M		19.0	22.4		
1983	Jan		19.3	M		19.0	23.8		
	Feb		M	10.5		16.9			
	Mar		9.6	6.1		10.4			
	Apr		12.5	12.5		13.7			
	May		13.7	8.5		14.6			
	Jun		14.7	12.1		15.6			
	Jul		13.5	10.0		13.0			
	Aug		IM	IM		IM			
	Sep		IM	IM		10.6			11.9
	Oct		IM	13.1		12.7		12.5	12.4
	Nov		16.8	14.7		15.7		14.0	15.3
	Dec		14.8	20.2		15.7		14.5	14.2
1984	Jan		18.1	20.2		20.4		14.2	20.1
	Feb		18.1	12.0		20.4		14.2	19.6
	Mar		18.1	12.7		20.4		15.8	13.6
	Apr		13.6	11.7		14.4		12.0	14.7
	May		16.6	IM		M		15.5	14.7
	Jun		13.5	8.4				15.5	12.2
	Jul		13.5					7.6	11.6
Avg of monthly averages		18.5*	15.2*	12.9*	16.3*	16.1*	22.5#	13.6*	14.6*

M - Missing data

IM - Instrument malfunction

\* - Data recovery < 80%

# - Average excludes December, 1981

N.B. Blackfoot and Heart Butte were converted to hourly logging systems at the end of data-gathering periods shown in the table.

**Table C-7  
U.S. Forest Service  
Fire Weather Data Sites**

<b>Station Number</b>	<b>Station Location</b>	<b>Lat. (Deg)</b>	<b>Long. (Deg)</b>	<b>Elev. (m)</b>	<b>Total Obser.</b>	<b>Period of Record</b>
240102	Kootenai National Forest	48.51	115.55	1,992	147	1967-72
240805	Phillips County	48.48	107.50	900	447	1970-72
241208	Kaniksa National Forest	48.06	115.55	1,879	616	1961-72
241801	Lewis & Clark National Forest	47.48	112.51	2,465	594	1962-73
241905	Helena National Forest	47.06	112.11	2,316	691	1961-73
242101	Lewis & Clark National Forest	46.42	110.16	2,527	261	1961-65
242201	Lewis & Clark National Forest	47.04	109.28	1,263	297	1961-65
243001	Deer Lodge National Forest	46.11	113.37	2,621	244	1960-67
243102	Flathead National Forest	47.24	113.30	2,516	457	1961-72
243402	Lewis & Clark National Forest	46.54	110.42	2,528	1,000	1962-77
244101	Miles City	46.23	105.50	801	1,407	1966-77
244604	Gallatin National Forest	44.45	111.13	2,157	263	1965-68
244605	Helena National Forest	45.80	111.16	2,814	114	1965-68
244701	Gallatin National Forest	45.60	110.14	3,008	242	1965-68



**Table C-8**  
**U.S. Forest Service**  
**Fire Weather Data Summaries**

<b>Station Number</b>	<b>Station Location</b>	<b>Anemometer Height (m)</b>	<b>Mean Wind Speed (m/s)</b>	<b>Mean Total Wind Power (watts/m<sup>2</sup>)</b>
240102	Kootenai National Forest	7	5.14	194
240805	Phillips County	6	5.00	196
241208	Kaniksa National Forest	7	5.55	262
241801	Lewis & Clark National Forest	8	5.96	237
241905	Helena National Forest	10	7.41	436
242101	Lewis & Clark National Forest	Not reported	6.14	314
242201	Lewis & Clark National Forest	Not reported	5.60	214
243001	Deer Lodge National Forest	Not reported	4.62	101
243103	Flathead National Forest	7	6.60	508
243402	Lewis & Clark National Forest	15	5.04	140
244101	Miles City, MT	10	5.69	227
244605	Gallatin National Forest	20	7.74	529
244605	Helena National Forest	Not reported	6.37	270
244703	Gallatin National Forest	5	6.74	218