HISTORY OF WEATHER OBSERVATIONS
Fort Sully, South Dakota
1866 - 1893

September 2006

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This report was prepared for the Midwestern Regional Climate Center under the auspices of the Climate Database Modernization Program, NOAA's National Climatic Data Center, Asheville, North Carolina

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Acknowledgments

Staff at the South Dakota State Historical Society located relevant material and made photographic copies of archives on Fort Sully. Their expertise and effort were helpful in resolving specific issues of this research.

A special thanks to Harold Schuler, author of the book entitled *Fort Sully: Guns at Sunset*, for taking the time to share his expertise on Fort Sully. His knowledge was especially beneficial.

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INTRODUCTION

Historical Overview

Fort Sully was located in central South Dakota near the current state capital of Pierre (Figure 1). The fort was at two separate locations, east of Pierre from 1863 to 1866 and northwest of Pierre from 1866 to 1894. The first Fort Sully was built in 1863 on the north side of the Missouri River, approximately four miles east of Pierre. By 1866, conditions at the fort were considered unfit for the soldiers and the post was moved approximately 23 miles northwest to a site on the east side of the Missouri River, about 18 miles downstream from the confluence with the Cheyenne River (Figure 2).

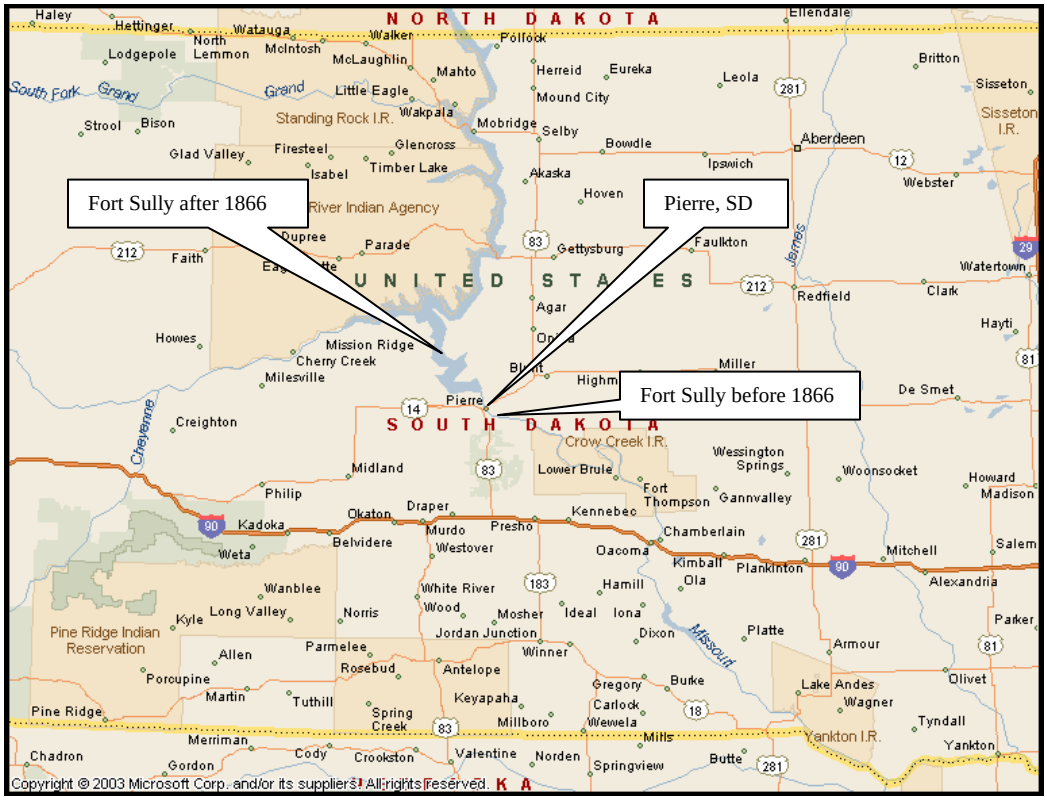

Figure 1. Location of Fort Sully, SD plotted on a current map of South Dakota. East-west distance across the map is approximately 290 miles.

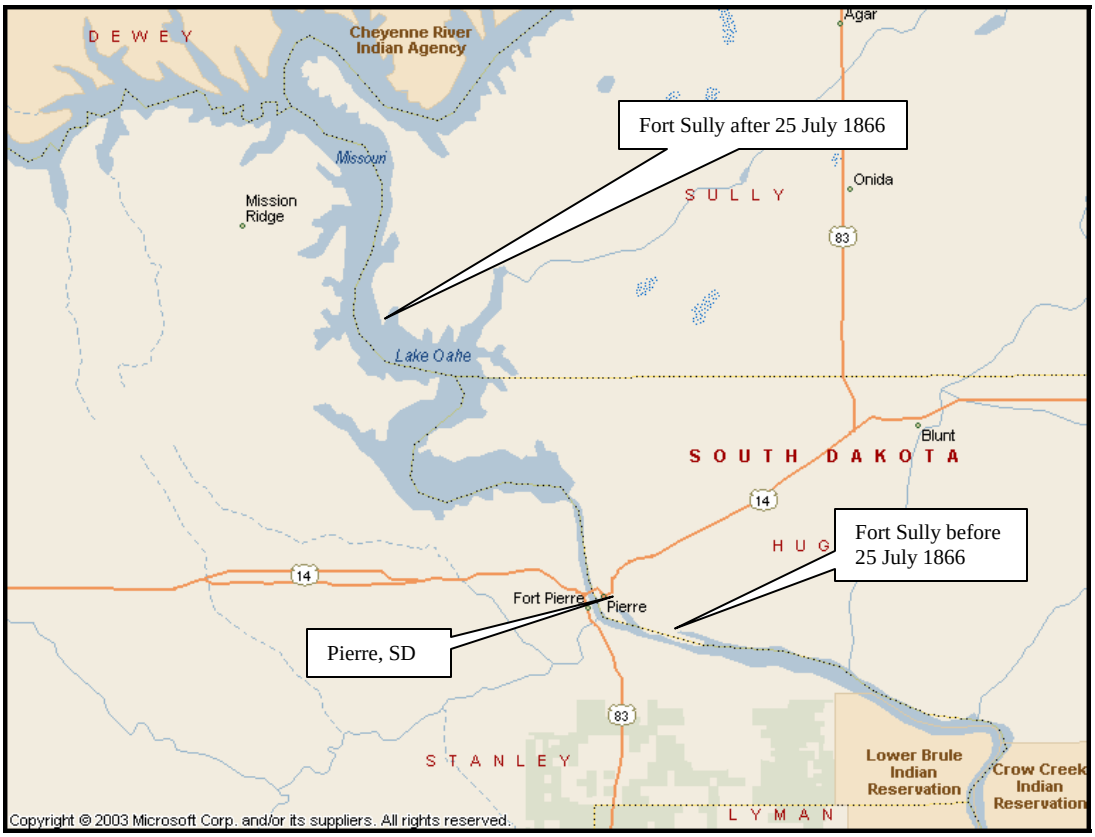

Figure 2. Current map of the area around Pierre, SD showing the locations of Fort Sully before and after 1866. North is at the top of the map and east-west distance across the map is approximately 60 miles.

Figure 3 is an 1879 map showing the locations of the two posts with respect to nearby terrain and lakes.

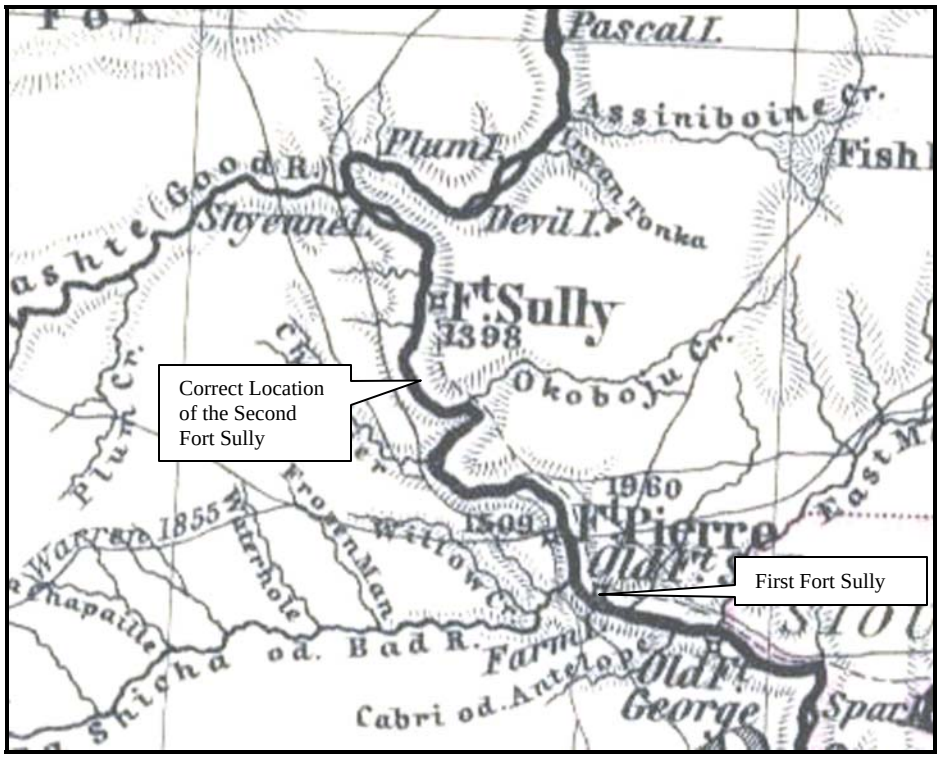

Figure 3. Locations of Fort Sully depicted on an 1879 map, showing nearby terrain features. Indicated location of the second fort on the map was in error. Also shown is the location of the first fort. North is at the top of the map. East-west distance across the map is approximately 90 miles. Photo courtesy of the South Dakota State Historical Society—State Archives.

The original Fort Sully was started in September1863 near Farm Island, about four miles east of present day Pierre. The fort was built as a stopping point for military expeditions from farther east. Building of the post proceeded rapidly to provide quarters for the approaching winter. By late October 1863, most of the work on the quarters had been completed, and by mid December both officers and enlisted men were in permanent buildings, which were described as "very comfortable." The hospital at the first fort was built in November and December 1863.

The post initially was named for Lieutenant Colonel E.M. Bartlett, the fort's first commander. However, in 1864, the name was officially designated Fort Sully after General Alfred Sully who established the post and who led a number of military expeditions in the Dakota Territory.

Because of the proximity of marsh areas along the river, the health of the soldiers was adversely affected. Consequently, on 25 July 1866, the fort was moved to a site on the Missouri River approximately 23 miles northwest of the first post. The second fort was built on the east bank of the Missouri River and was located on the "third terrace," above the river. The remains of this fort are usually under water of Lake Oahe except during pronounced dry spells.

Both forts were part of the U.S. Army's plan to maintain peace in the central Dakota Territory during latter half of the 19th Century. The forts were built to subdue the warring Indian tribes, keep the Indians off the settler's land, keep the settlers off Indian land, and protect government employees of the Indian agencies. By 1885, Fort Sully had grown to a fairly large size, comprising a total of 43 buildings, including a band hall, library, and school, as well as other buildings at a typical post.

During the late 1880s, tensions with local Sioux Indians decreased across the Dakota Territory, and the Army began closing forts in the area. The plan to close Fort Sully began in 1893, and on 9 October 1894, the final order was given. Troops began pulling out on October 20th with the post essentially closed 30 October 1894, leaving a small detachment for another month to wrap up the move/closure.

Weather observations at Fort Sully were taken by both the U.S. Army Medical Department (field surgeons) and by the Signal Service. Army surgeons took observations at both forts, whereas Signal Service staff took observations only at the second fort.

Based on information in the NCDC (National Climatic Data Center) database, the first weather observation at Fort Sully was on 1 January 1866 (made by Army surgeon), and the last observation available by the Army Medical Department was 31 December 1893. The U.S. Signal Service took observations from 1 May 1872 through 30 June 1891, although recordings were lacking from late 1877 through 1885 due to the office being closed.

Goal of the Study

The goal of this study was to document the location and exposure of weather instruments at Fort Sully, SD. The scope of this study primarily covered the 19th Century. Extrinsic observations related to the Army surgeons' and Signal Service weather observing programs also were considered.

LOCATION OF OBSERVATIONS

Weather observations at Fort Sully were taken by the U.S. Army Medical Department (1866-1893) and the U.S. Army Signal Service (1872-1891). Concurrent weather observations were taken generally from 1872 to 1891, although Signal Service observations were lacking from late 1877 through 1885 because the Signal Service office was closed.

Observations by Army Surgeons (1866-1893)

Weather observations were taken by Army surgeons at both forts. First weather observation at Fort Sully was on 1 January 1866, with the weather instruments likely being located at, or near the hospital. No information was found as to the exact location of the hospital other than being inside the stockade. This fact does restrict the location of the hospital since the first fort was situated over flat ground and was only 270 feet by 270 feet. GPS coordinates for the location of the first fort are 44°20’43”N 100°16’27”W. Elevation is 1,433 feet above sea level. Figure 4 is a topographical map of the area around the first Fort Sully, and Figures 5 and 6 show the flat terrain in the immediate vicinity.

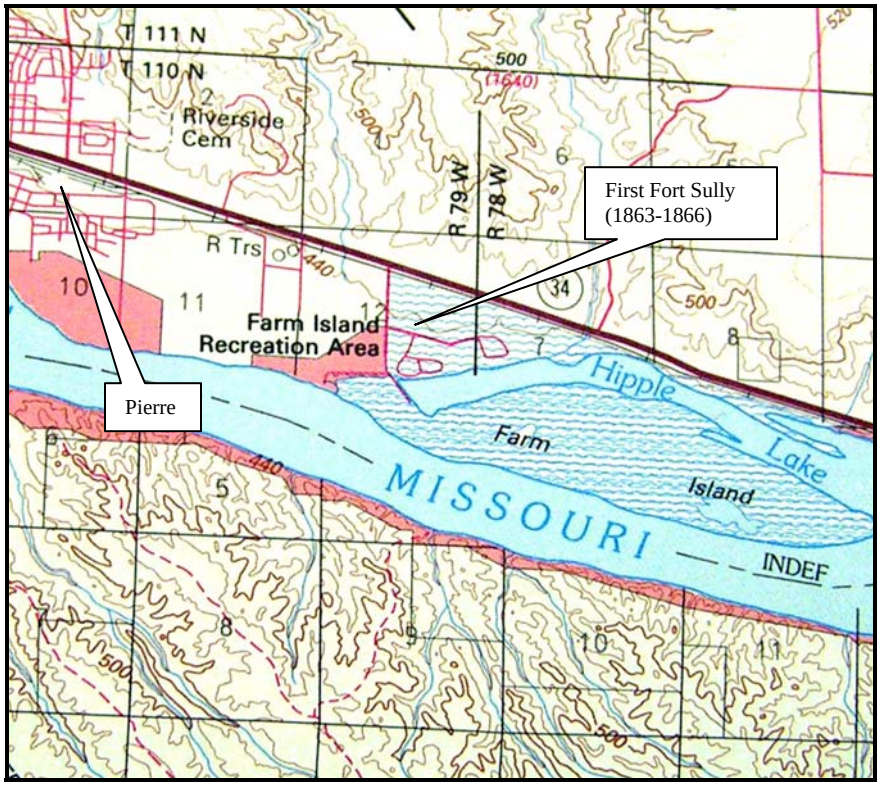

Figure 4. USGS topographical map (1964) showing the terrain around Fort Sully. North is at the top of the figure and contour lines are for every 20 meters. East-west distance across the map is approximately four and one-half miles.

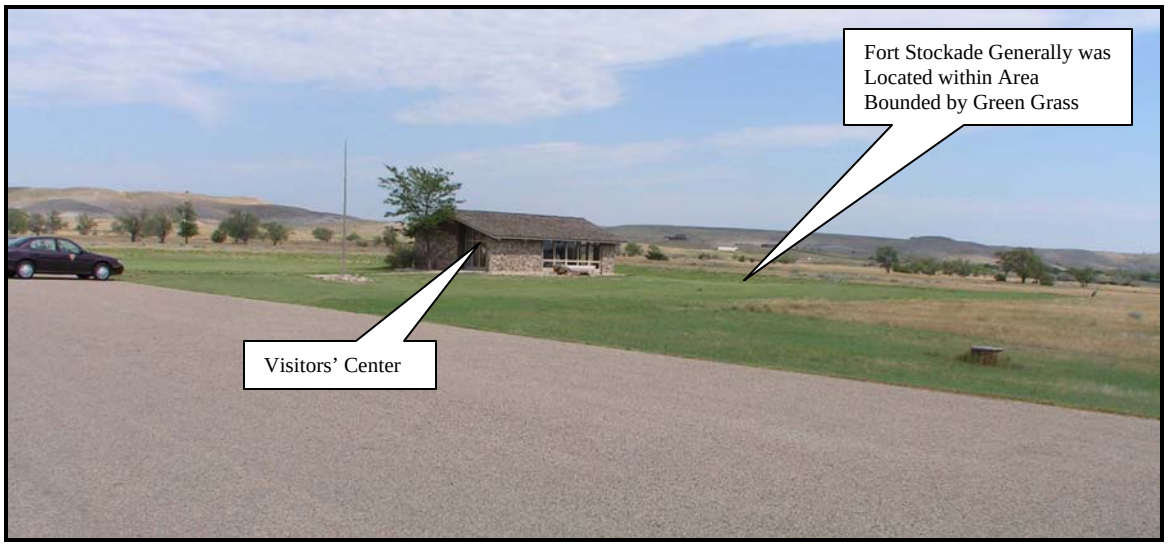

Figure 5. Location of first Fort Sully. View is northeast. Fort stockade was generally located in the area bounded by the green grass. Photograph taken by the author.

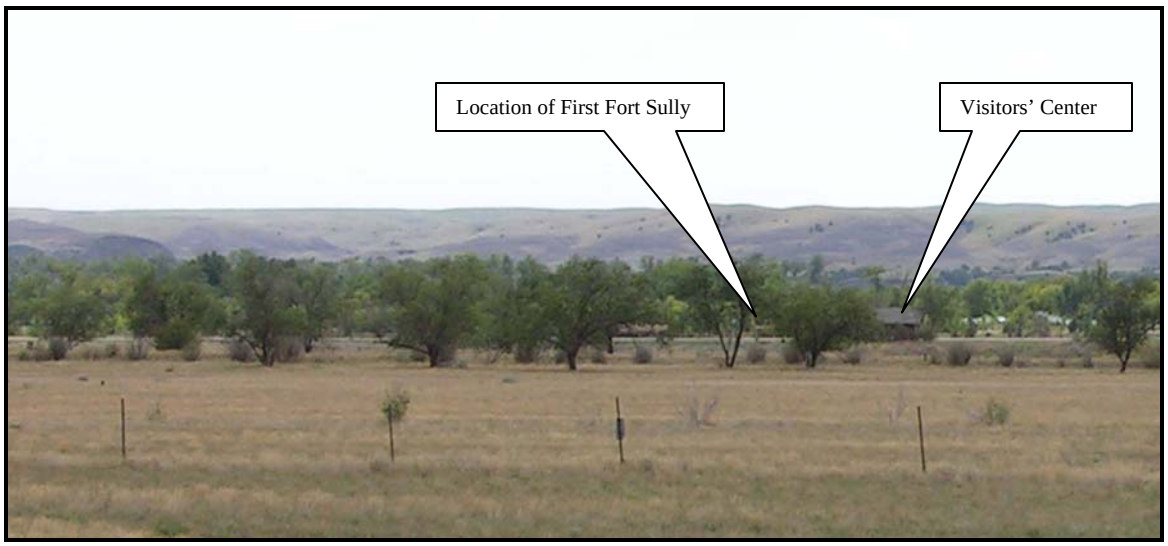

Figure 6. Location of first Fort Sully. View is south. Missouri River (flowing from right to left) is located behind trees in foreground but in front of hills in background. Photograph taken by the author.

Based on research by Harold H. Schuler (see Bibliography), the hospital at first Fort Sully was a primitive building that was built of logs and had a dirt roof and floor. According to an Army inspection report, the hospital was "a disgrace to the service."

The medical staff moved from the old fort to the new post on 25 July 1866. Since the hospital was not completed at the second fort until around mid 1867, it is not

certain where the medical staff performed their duties during the interval between the move to the new fort and completion of the hospital.

The hospital at the new fort was located outside the stockade and south of the post. A ravine (Sully Creek) extended to near the hospital. The central complex of the post, i.e., area around parade ground, was 700 feet long (northwest to southeast) and 624 feet wide (southwest to northeast). Latitude/longitude for the second fort location is 44°35'34"N 100°35'59"W. The remains of this fort are usually under water of Lake Oahe except during pronounced dry spells.

In 1887 (exact date not specified), a new hospital was built just northwest of the fort complex. Figure 7 is a topographical map of the second Fort Sully and immediate terrain, showing the locations of the two hospitals. Figure 8 is a photograph of the post from the south and Figure 9 is a photograph of the fort from the northeast. The last weather observation in the NCDC database by the Army Medical Department was on 31 December 1893. Army surgeons likely took weather observations at Fort Sully until around October 1894, when the hospital closed.

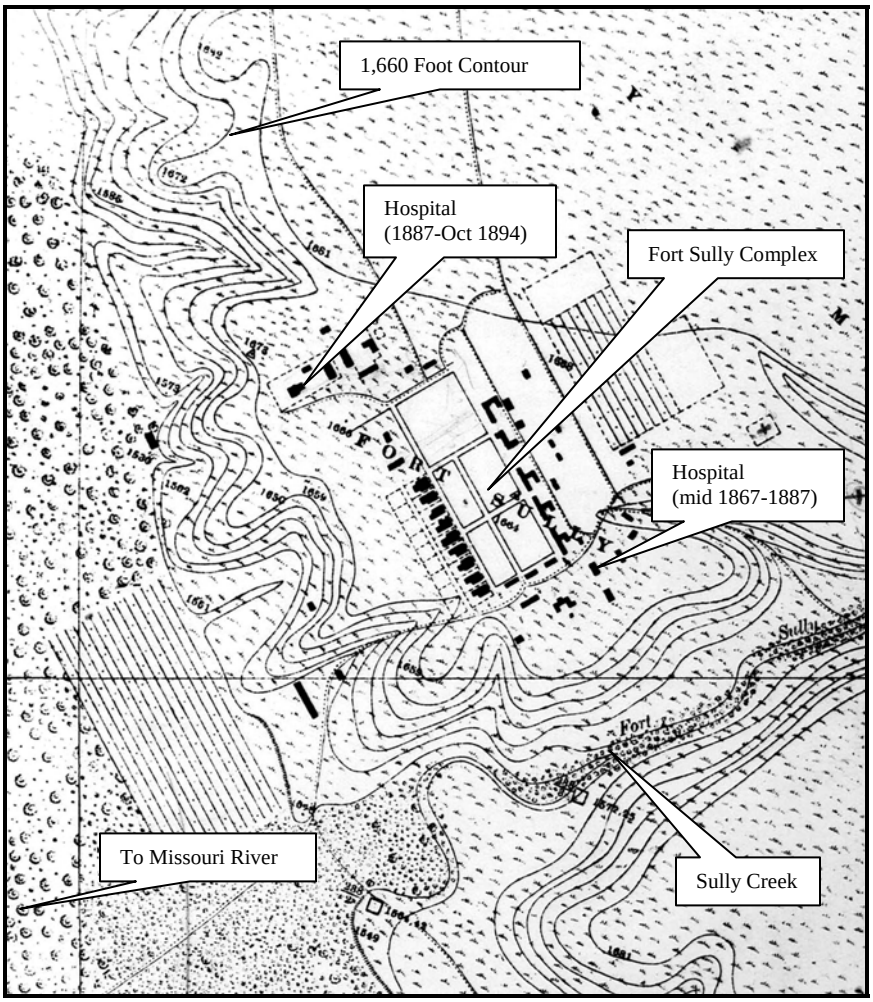

Figure 7. Topographical map from the 1892 Missouri River Survey showing the second Fort Sully and surrounding terrain. Contours are in 20 foot intervals. North is at the top of the figure. East-west distance across the map is approximately 2,400 feet. Photo courtesy of the South Dakota State Historical Society—State Archives.

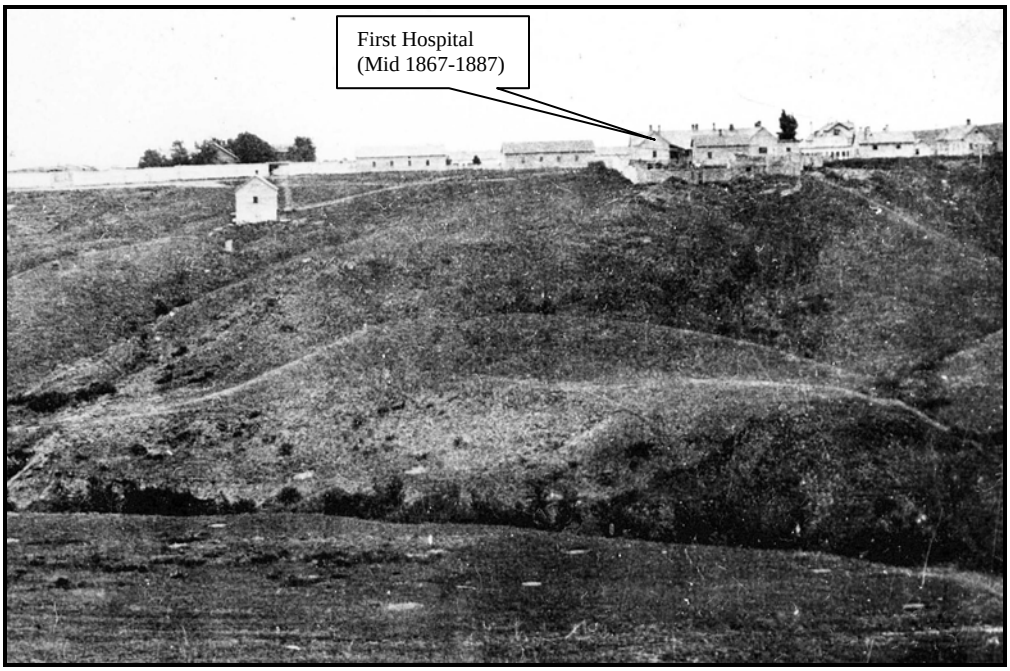

Figure 8. Southern part of second Fort Sully viewed from across Sully Creek (circa 1870s). View is north. Photo courtesy of the South Dakota State Historical Society—State Archives.

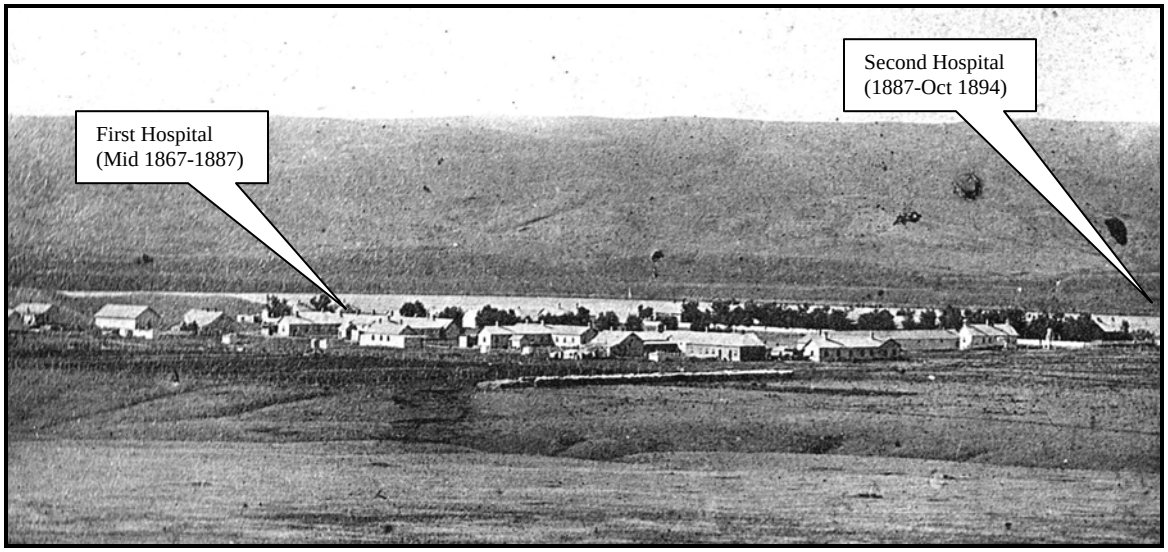

Figure 9. Second Fort Sully (circa 1888) looking southwest, showing locations of the two hospitals. Photo courtesy of the South Dakota State Historical Society—State Archives.

Observations by Signal Service (1872-1891)

The second Fort Sully was a center of telegraph activity in the central Dakota Territory. In 1871, a telegraph line was extended from Yankton, SD (southeast South Dakota) to Fort Sully via Fort Randall. Later, another telegraph line was built from Fort

Sully to Deadwood, SD. Because of the telegraph lines in the central Dakota Territory, the Army established a Signal Service office at the post. This office also took weather observations from 1 May 1872 through 30 June 1891, although no observations were found in the NCDC database from November 1877 through November 1885 (the Signal Service office was closed from 1 November 1877 through 31 July 1881 and took limited observations from 1 August 1881 through 30 November 1885; regular routine weather observations resumed on 1 December 1885).

NOTE - From 1873 through 1887, the U.S. Signal Service conducted nine inspections of its Fort Sully weather office. The inspection reports, available at the National Archives and Records Administration (NARA), contained drawings and textual information regarding office location, weather instrument placement and exposure. The quantity and quality of information varied, depending primarily on the inspector. However, these reports contained revealing information not available from other sources, especially with regard to instrument location and exposure. Inspections of the Fort Sully Signal Service office were conducted on the following dates:

20-23 July 1873
9-11 June 1874
10 June 1875
10-12 October 1876
23 July 1883
26 September 1884
15-16 September 1885
14-16 August 1886
28-29 November 1887

Figure 10 is a map of the second Fort Sully showing the locations of the Signal Service offices (as well as the two hospitals where Army surgeons observed the weather).

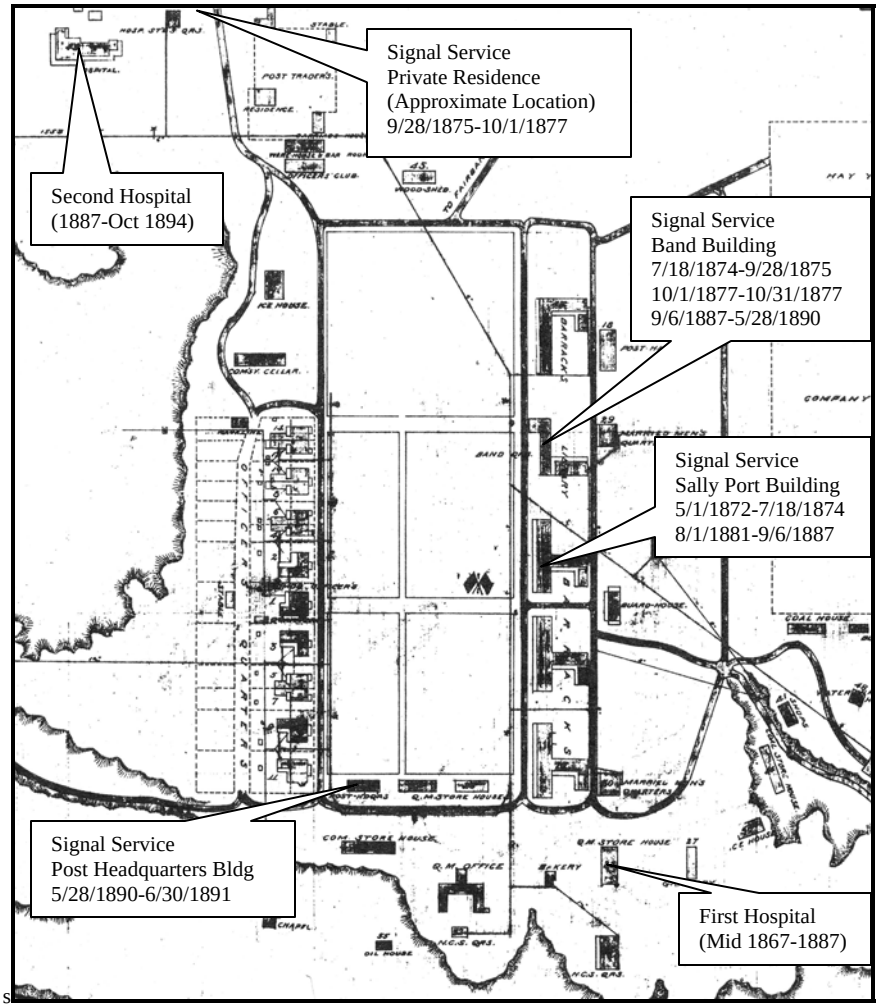

Figure 10. Diagram of second Fort Sully (circa 1893) showing locations of U.S. Signal Service offices, as well as the two Army hospitals. North is at the upper right of the figure. Photo courtesy of the South Dakota State Historical Society—State Archives.

Although the U.S. Signal Service staffed an office at Fort Sully for most of the period from 1872 into 1891, the routine weather observing program was absent from November 1877 through November 1885. The first Signal Service weather observation at the fort was on 1 May 1872 and the last observation on 30 June 1891.

The Fort Sully site was initially established by the Signal Service in May 1872 as a second-order station, with all atmospheric parameters (pressure, temperature, atmospheric moisture, wind velocity, and rainfall) measured three times daily and telegraphed to the Washington D.C. office. No observations were taken at this station from 1 November 1877 through 31 July 1881 (the station was closed), with the office becoming a third-order station on 1 August 1881.

As a third-order station, one observation was taken daily at sunset (usually maximum/minimum temperatures and 24-hour rainfall), but not telegraphed to the national office. The sunset observations were mailed to Washington D.C. at the end of each month. Those observations were not in the NCDC database.

The Signal Service office at Fort Sully continued as a third-order station until 1 December 1885 when it was upgraded to a second-order station (observations in the NCDC database resumed 1 December 1885). The office remained a second-order station until all Signal Service observations stopped at this site on 30 June 1891, when the Weather Bureau assumed observing responsibility and transferred all functions to Pierre, SD.

The Signal Service office initially (1 May 1872) was located in the same room as the telegraph office on the second floor of the Post Headquarters at Fort Sully. The Post Library was next door. The Signal Service office, Post Headquarters, and Post Library were all located on the second floor of the Sally Port Building along the east wall of the stockade that contained the sally port (see Figures 12 and 13). The office remained at the Sally Port Building until 18 July 1874 when it moved to the first floor of the Band Building.

On 28 September 1875, the office moved to a private residence approximately 300 yards northwest of the Post Headquarters. Based on the topographical map, the elevation at this site was similar to that at the Sally Port and Band Buildings, i.e., around 1,660 feet above sea level. On 1 October 1877, the office moved back to the Band Building and on 31 October 1877, the office was closed. No weather observations were taken by the Signal Service at Fort Sully between 1 November 1877 and 31 July 1881, with only limited daily observations from 1 August 1881 through 30 November 1885.

When the Signal Service reopened in August 1881, it was located on the first floor of the Sally Port Building (Room No. 1), next to the Post Headquarters. In 1884, a fire destroyed many of the buildings on the east side of the post, including offices in the Sally Port Building. Subsequently, Post Headquarters moved to a building on the southwest side of the complex, or parade ground. However, according to the September 1885 inspection report, the Signal Service office remained in the “old post headquarters” in the Sally Port Building until it moved into the Band/Post Library Building (room in the northeast corner of the building) on 6 September 1887. On 28 May 1890, the Signal Service office moved to the Post Headquarters Building (located in the Court Martial Room) on the southwest part of the parade ground, where it remained until observations ceased on 30 June 1891.

INSTRUMENTATION

Based on information in the NCDC database, weather observations at Fort Sully were taken by U.S. Army field surgeons from January 1866 through December 1893 and by the U.S. Signal Service from May 1872 through June 1891. Below were the months of missing data in the NCDC database for the U.S. Army Medical Department and the U.S. Signal Service from 1866 through 1893.

Army Medical Department (Observation Period 1866-1893)

1866 – May through December
1867 – January through December
1868 – January through August, October

Army Signal Service (Observation Period 1872-1891)

1877 – November through December
1878 – January through December
1879 – January through December
1880 – January through December
1881 – January through December
1882 – January through December
1883 – January through December
1884 – January through December
1885 – January through November

The missing observations at the Signal Service site were the result of the office being closed.

Observations by Army Surgeons (1866-1893)

The first observation in the NCDC database recorded at Fort Sully was on 1 January 1866 (Figure 11). A note on the January 1866 observation form stated: "No observations were assigned at this Post till the 1st day of January 1866. For this reason there were no instruments and no measurements of Snow has been taken for the same reason. But little snow has fallen during the season thus far, not exceeding 15 inches."

METEOROLOGICAL REGISTER.

Station Fort Sully D.T. Lat. Forty Four N. Long. One Hundred W. Alt. of Bar. above feet.

1866. Month.	THERMOMETER. 7 A.M.	2 P.M.	9 P.M.	Daily Mean.	HYGROMETER. 7 A.M.	2 P.M.	9 P.M.	Daily Mean.	WINDS. 7 A.M. D.	F.	2 P.M. D.	F.	9 P.M. D.	F.	WEATHER. 7 A.M.	2 P.M.	9 P.M.	RAIN. Began.	Ended.	Quantity.	REMARKS.
1	−4	23	28	15.66					S.E	2	S E	2	S	2							
2	16	31.5	21	22.83					S W	2	N	5	N.	2							
3	9.5	24.6	8	14					N.	4	W	2	W	2							
4	6.5	20	10	12.83					S.E	3	S.E.	2	S E	3							
5	5	30	14	16.33					N	5	N	2	N.	2							
6	3	14	13	10					N W	2	E	2	N.E	1							
7	12	22	21	15.33					S.E	3	S E	2	S	2							
8	23	29	26	24					S.E.	3	S E	2	S E	1							
9	13	23.5	21	19.16					S E	3	S E	2	S E	1							
10	12	20	19	17					W	6	W	5	E	2							
11	26	28	21	25.33					N E.	7	N E	8	N.E.	8							Commenced snowing at 11 a.m. continued till
12	13	12	9	11.33					N W	8	N W.	7	N W	7							
13	1	2	−3	.33					N W	8	N W	8	S E.	5							

Figure 11. First observations taken at Fort Sully (January 1866). Only the top part of the form is shown. From the official station history files at the National Climatic Data Center.

Initial weather measurements/observations at Fort Sully consisted of the following parameters:

1. Temperature (Fahrenheit) – Measured three times daily (7:00 a.m., 2:00 p.m., and 9:00 p.m.).
2. Atmospheric moisture (wet bulb temperature) – Measured three times daily coincident with temperature readings (began 1 March 1866)
3. Wind direction and force – Three times daily coincident with temperature readings (direction expressed on an eight-point compass and wind force expressed on a scale from "0" for calm conditions, to "10" for a "violent hurricane"; e.g., SW4)
4. Weather (fair or cloudy) – Observed three times daily coincident with temperature readings
5. Daily rainfall – Beginning, ending, and daily amount (began April 1866)
6. Significant weather in Remarks section

Based on available data, it appears Fort Sully surgeons used the following weather instruments in 1866:

1. Thermometer
2. Hygrometer
3. Rain gage
4. Wind vane (wind force was estimated subjectively)

Although specific information was lacking regarding weather instruments used by Fort Sully Army surgeons, the Army Surgeon General's Office issued descriptions and instructions to field surgeons in 1856 and 1868 regarding instrument exposure and how the observations were to be taken. Those instructions are contained in the reports (under this general contract) for Fort Union, NM; Fort Snelling, MN; and Fort Gibson, OK. The general instructions listed in those reports also applied to Fort Sully.

In December 1868, the U.S. Surgeon General changed the observing form, requiring barometric measurements, as well as readings from maximum and minimum thermometers. Barometric readings (7 a.m., 2 p.m., and 9 p.m.) were started immediately at the post, along with temperatures from the attached thermometer. Also, minimum temperature recordings were made, but maximum temperatures were not included until 1 November 1871.

The new forms also required field surgeons to record motion of clouds at 7 a.m., 2 p.m., and 9 p.m., as well as amount of cloudiness. Fort Sully surgeons added these parameters and continued to record temperature and hygrometric observations at 7 a.m., 2 p.m., and 9 p.m., as well as wind direction/force.

A note on the December 1868 form stated: "The hygrometer observations are not believed to be reliable. A comparison of the standard thermometer and the 'dry bulb' of the hygrometer show a striking discrepancy."

A note on the February 1869 form stated: "The minimum self registering thermometer and the mercurial thermometer do not appear to be properly graduated in relation to each other. Several times it has happened that the temperature shown by the mercurial thermometer at 7 a.m. was lower than that shown by the minimum for the 12 hours preceding." Similar comments were made on monthly observation forms during the year. The November 1869 form stated: "Dry bulb reads 4 to 6 degrees higher than standard thermometer." Similar notes were included through1870 and 1871. A message was included on the June 1872 form that stated dry bulb thermometer readings coincided with standard.

A note on the January 1872 form stated: "The indications of the barometer were reported unreliable in a communication dated Nov 30th (year not included but presumably November 1871). I believe the indications are now accurate." The November 30th communication must have been a letter since no note was found on the November 1871 observation form. Atmospheric pressure readings stopped on 15 November 1871 but resumed 1 January 1872.

A note was attached to the November 1874 form stating the wet bulb thermometer was accidentally broken on 18 November 1874. No subsequent wet bulb readings were made at Fort Sully. In July 1875, the dry bulb temperature ceased being recorded. Notes on the observation forms stated the dry bulb thermometer had been broken. No subsequent hygrometric readings were made at Fort Sully by the Army surgeons.

In April 1875, maximum temperature readings became sporadic, ceasing completely in May 1875. Notes later in the year stated the maximum thermometer was broken. Maximum temperatures were missing until 1 May 1876.

The following note was included on the August 1875 form: "On the 8th a heavy storm of wind, rain, and hail. At 8:15 o'clock PM the wind blew at the rate of sixty-eight miles an hour. During the storm the "box," containing the meteorological instruments, was destroyed but the instruments were not damaged." Since the Signal Service office was in operation 8 August 1875 and had an anemometer, it is quite likely the Army surgeons at least occasionally used their wind speed information.

The barometer was broken on 1 January 1877 and no subsequent pressure recordings were made at Fort Sully by the Army surgeons.

A note was contained on the February 1877 form stating the maximum and minimum thermometers had been sent to another fort on orders from the Army Surgeon General's Office. No maximum/minimum recordings were made until 1 May 1877.

On 10 April 1878, the minimum thermometer was broken and minimum temperatures ceased to be recorded. Minimum temperature recordings were resumed on 19 December 1880. A note on 10 December 1880 stated the thermometers were tested and found correct.

Beginning 1 September 1888, only once daily observations of maximum/minimum temperatures, beginning/ending of precipitation, total daily precipitation, depth of snow, and general direction of the wind were recorded at Fort Sully by Arm surgeons. This was the result of instructions from the Army Surgeon General's Office. This format continued until observations ceased on 31 December 1893.

The last observation at Fort Sully by Army surgeons in the NCDC database was on 31 December 1893. No notes or information were included on the December 1893 form to indicate weather observations were ceasing. Army surgeons likely took weather observations at Fort Sully until around October 1894, when the hospital closed.

Observations by Signal Service (1872-1891)

1 May 1872–18 July 1874 – Signal Service office located on the second (top) floor of the Post Headquarters at Fort Sully, next to Post Library and Reading Room. All three offices were located in the Sally Port Building in the northeast part of the post (Figures 12 and 13). The Signal Service room also served as a telegraph office (Figure 14). Atmospheric pressure, temperature, moisture, wind velocity, and rainfall were all measured at this station. Two Signal Service inspections were conducted at this site on the following dates: 20-23 July 1873 and 9-11 June 1874.

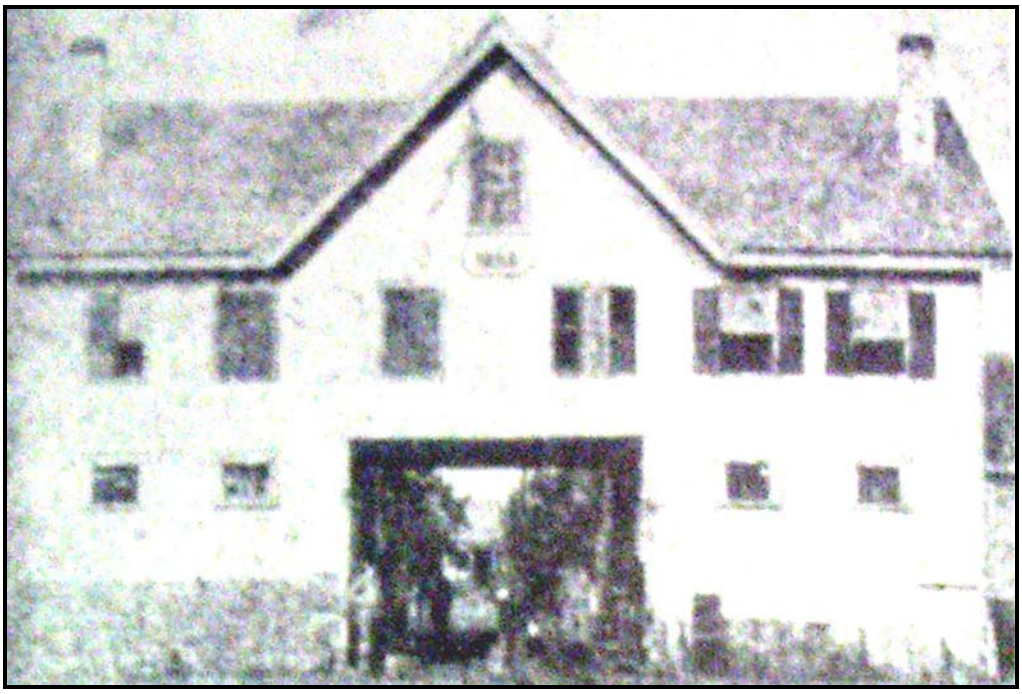

Figure 12. Sally Port Building (circa 1870s) looking east (named for the sally port in the center). Signal Service office was on the second floor of the building. Photo courtesy of the South Dakota State Historical Society—State Archives.

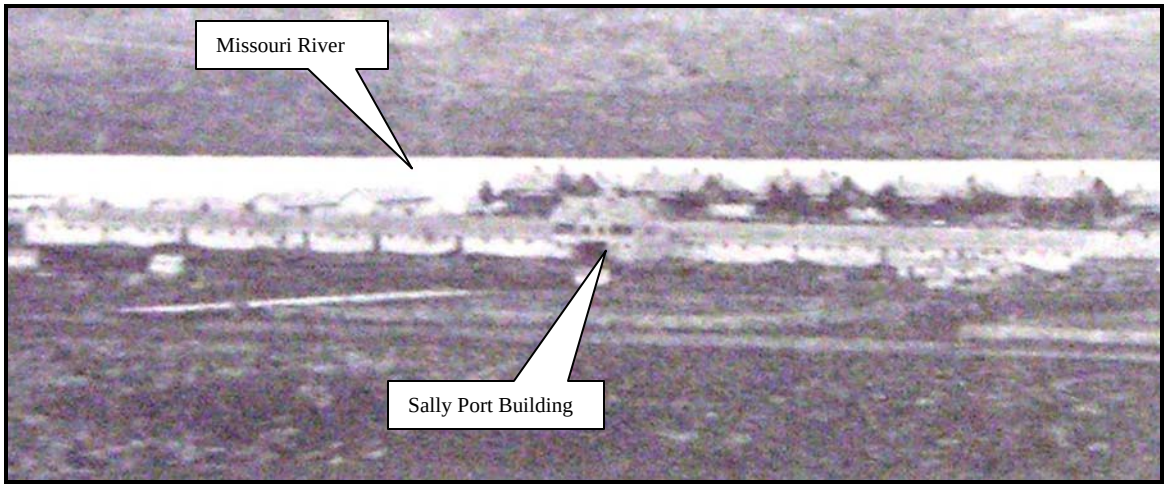

Figure 13. Second Fort Sully (circa 1870s) showing the Sally Port Building where the Signal Service office was located. View is southwest. Photo courtesy of the South Dakota State Historical Society—State Archives.

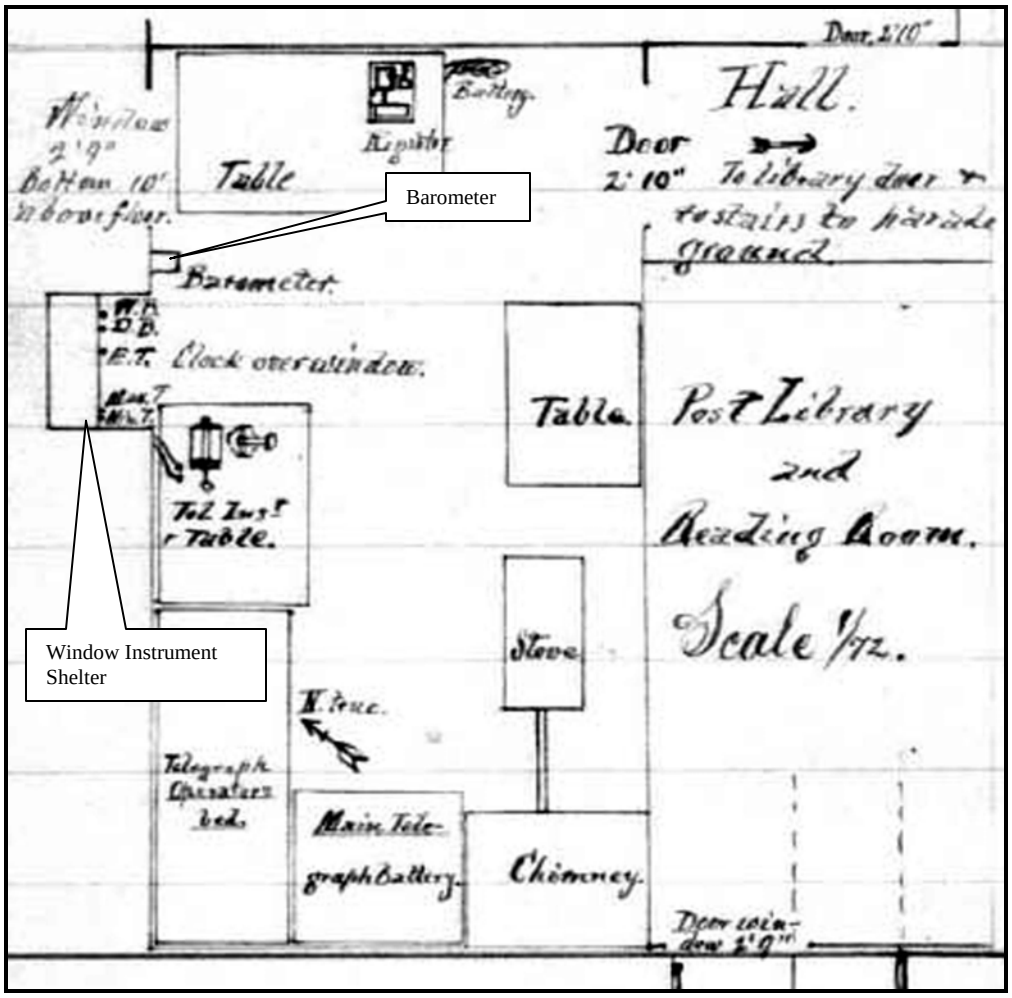

Figure 14. Signal Service office located on the second floor of the Sally Port Building at Fort Sully (20-23 July 1873). North is at the upper left of the page. The Signal Service office was in the northeast part of the Sally Port Building. From the National Archives and Records Administration.

Barometer – The barometer was located on the north wall of the office near the east wall. The barometer also was located next to the window instrument shelter (see Figure 14). Elevation of the barometer was listed as 1,672 feet above sea level and 16 feet above ground. The July 1873 inspection report rated the exposure of the barometer as fair. An extra barometer was added to the station between the inspections in July 1873 and June 1874. The 1874 Annual Report contained the following note: "…however, the station barometer has been broken and is not yet replaced. Observations are made with the barometer at post hospital. Two barometers, sent from the central office, have reached the station in an unserviceable condition."

Instrument Shelter – The window instrument shelter was located in a north facing window. The 1872 Annual Report stated the shelter was a "modification of the standard form and the best that could be constructed under the circumstances."

The shelter was approximately six feet high, eight feet wide, and two feet deep. The bottom of the shelter was closed.

The shelter contained an exposed thermometer, maximum/minimum thermometers, and a hygrometer (wet bulb and dry bulb). Figure 15 is a drawing of the instrument shelter and instruments. The exposed thermometer and hygrometer were approximately 17 feet above ground and the maximum/minimum thermometers 18 feet above ground.

The July 1873 inspection report rated the exposure of the shelter and instruments as good. However, the inspection stated the shelter was barely in the sun at 2:15 p.m. local time (in July) with about one-half of the shelter in the sun from 3 p.m. through 4:30 p.m.

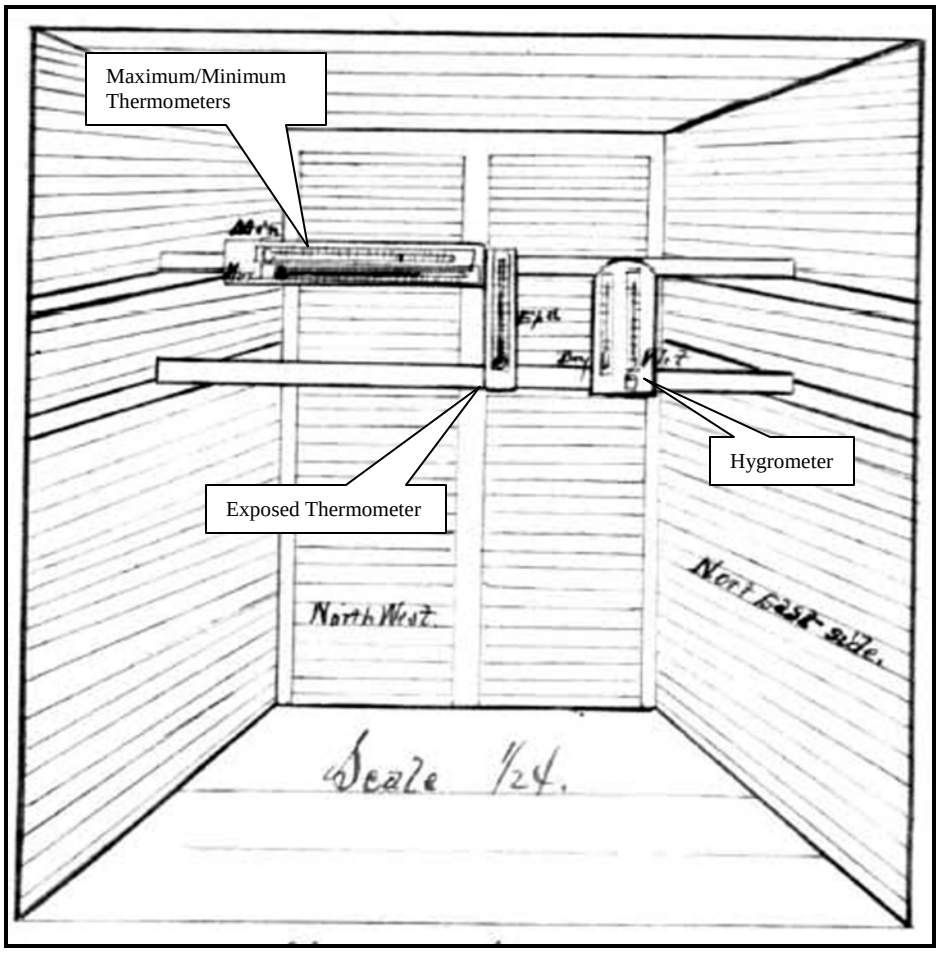

Figure 15. Window instrument shelter at the Signal Service office at Fort Sully (20-23 July 1873). View is northwest. From the National Archives and Records Administration.

Rain Gages – The rain gage was located on the parade ground (exact site not stated but likely near the Sally Port Building containing the Signal Service office,

i.e., in the northeast part of the square). The top of the rain gage was eight inches above ground. The July 1873 inspection rated the exposure of the gage as good.

Wind Instruments – The anemometer and wind vane were located on the roof of the Sally Port building. The wind instruments were 40 feet above ground. The wind vane was the small type (three foot). The July 1873 inspection rated the exposure of the wind instruments as good.

Additional Equipment/Information – A river-gage was installed on the Missouri River in 1873 (based on the annual report). Distance from the fort to the gage was approximately one and one-half miles. The observer made the following report with regard to reading the river gage: "The performance of this duty (taking river observations) exposes the observer to a twofold danger—the rifle and arrow of the Indian, or drowning. Examples are too numerous of the grave risks that attend a defenseless person in the thick undergrowth on the confines of the river, and I am the only person who ventures there unarmed."

18 July 1874–28 September 1875 – Signal Service office located on the first floor of the Band Building at Fort Sully. One Signal Service inspection was conducted at this site on the following date: 10 June 1875.

Figures16 and 17 are photographs showing the Band Building and the location of the Sally Port Building.

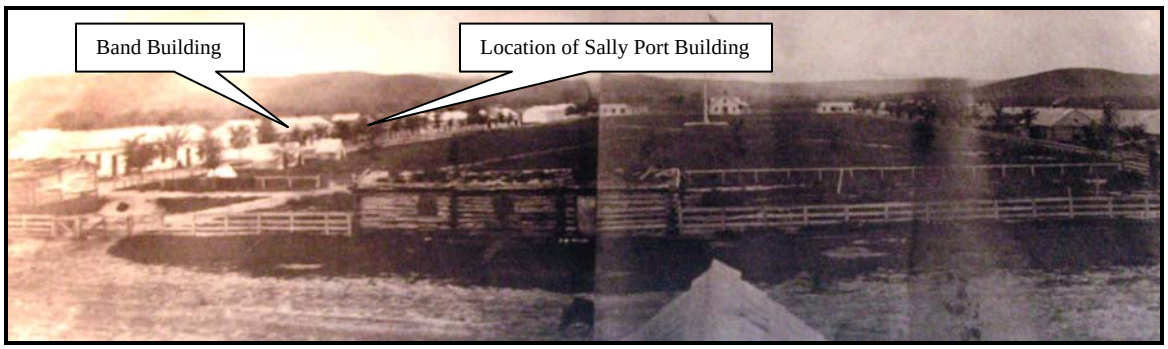

Figure 16. Panoramic photograph of second Fort Sully (circa late 1880s) showing Band Building and location of Sally Port Building. In 1884, a fire destroyed part of the Sally Port Building and was rebuilt. View is southeast. Photo courtesy of the South Dakota State Historical Society—State Archives.

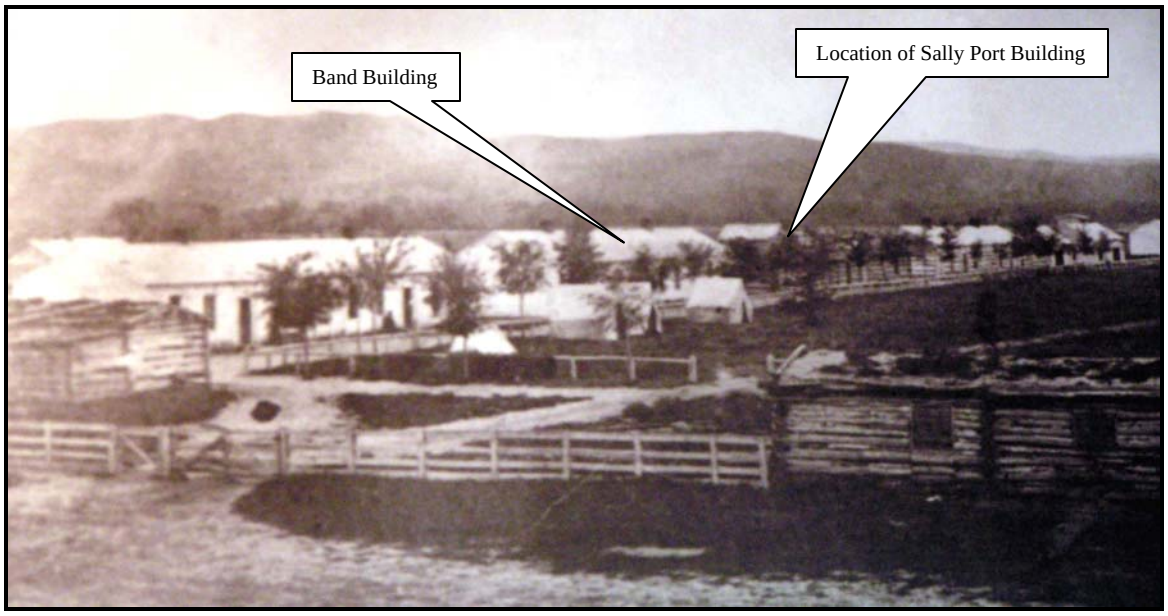

Figure 17. Enlargement of Figure 16 (circa late 1880s) showing Band Building and location of Sally Port Building. View is southeast. Photo courtesy of the South Dakota State Historical Society—State Archives.

Figure 18 shows the Signal Service office in the Band Building.

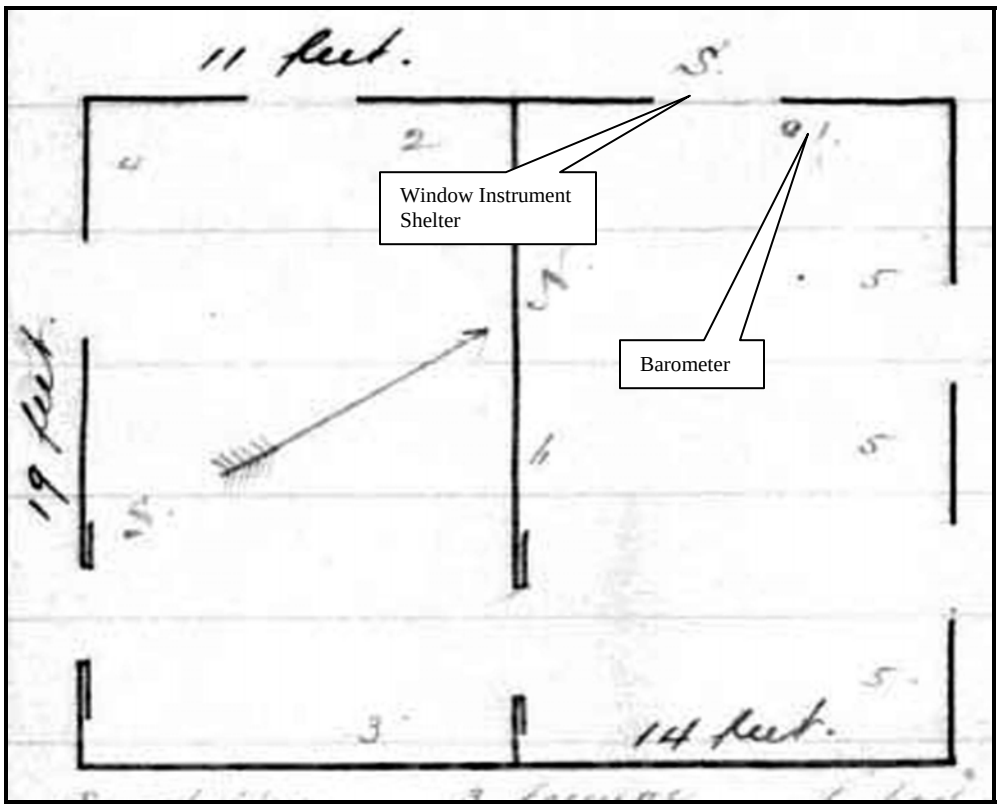

Figure 18. Signal Service office located on the first floor of the Band Building at the second Fort Sully (10 June 1875). North is at the upper right of the page. From the National Archives and Records Administration.

Barometer – This station initially had one barometer with a second barometer added before the 10 June 1875 inspection. The barometers were located at the northwest part of the office near the window instrument shelter (Figure 18). The barometers were listed as 1688 feet above sea level and 6 feet above ground. Exposure was rated as good. The June 1875 inspection found one of the barometers had been leaking mercury. The 1875 Annual Report stated that one of the barometers was accidentally broken during the move to the Band Building and the barometer at the post hospital was used until another barometer could be shipped to the station (date not indicated as to when the replacement barometer was received).

Instrument Shelter – The instrument shelter was in a window in the northwest part of the office. The shelter was four feet high, three feet wide, and two feet deep. The exposed thermometer, maximum/minimum thermometers, and hygrometer were eight feet above ground. Exposure was rated as good.

Rain Gages – The rain gage was listed as being one foot above ground. The exact location of the rain gage was not specified, but may have remained on the parade ground.

Wind Instruments – The anemometer was 40 feet above ground and the wind vane 43 feet above ground. The wind instruments remained on the roof of the Sally Port Building.

28 September 1875–1 October 1877 – Signal Service office at a private residence approximately 300 yards northwest of the Sally Port Building (Post Headquarters). The site was outside the post complex (see Figure 10). One Signal Service inspection was conducted at this station on the following date: 10-12 October 1876. However, information in this report was sketchy.

Barometer – The two barometers were located on a wall of the office on either side of a window (Figure 19). Elevation of the barometers was listed as 1678 feet above sea level and four feet above ground.

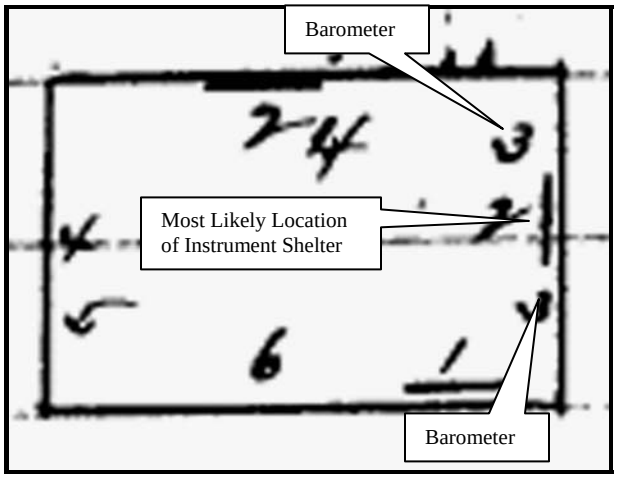

Figure 19. Diagram of the Signal Service office at a private residence northwest of the post complex (10-12 October 1876). Direction of the diagram not indicated in the Signal Service inspection report. Most likely, north would be toward the right of the figure. From the National Archives and Records Administration.

Instrument Shelter – The exact location of the instrument shelter was not indicated in the Signal Service inspection report (see Figure 19). Most likely, it was in a window between the two barometers as was typical at Signal Service offices. This shelter was listed as being of single lattice construction and was four feet high, two feet wide, and two feet deep. The exposed thermometer, maximum/minimum thermometers, and hygrometer were five feet above ground. The inspector in October 1876 stated the shelter was "not in first class condition."

Rain Gage – The rain gage was listed as being one foot above ground. Exact location was not indicated.

Wind Instruments - The height of the wind instruments was listed as 19 feet above ground. No mention was made as to the location of the wind instruments. The station had an anemoscope.

1 October 1877-31 October 1877 – Signal Service office in a room on the first floor of the Band Building. No inspection report was available for this station during this time and no information could be found regarding the weather instruments. Most likely, this station had the same instruments as were located at the previous location.

1 November 1877-31 July 1881 – No weather observations were taken by the Signal Service office at Fort Sully because the office was closed. Personnel and weather instruments were transferred to Deadwood, SD.

1 August 1881-30 November 1885 – The Signal Service office was reestablished at Fort Sully on 1 December 1879, but no weather instruments were at the office and no observations taken. On 1 August 1881, the Signal Service office was classified as a third-order station, taking maximum/minimum temperatures and 24-hour rainfall observations at sunset each day. The observations were mailed to the central office at the end of each month (not in the NCDC database).

Three inspections were conducted at this office on the following dates: 23 July 1883, 26 September 1884, and 15-16 September 1885. The office was located on the first floor of the Sally Port Building (Room No. 1) next to the Post Headquarters.

Barometer - No barometer at this station.

Instrument Shelter – The July 1883 inspection report said the shelter was built "like a dog kennel of three-quarter inch pine boards." The shelter did not have a bottom. The report also stated that any measurements made in the shelter could not be accurate. The shelter was located approximately 25 feet northeast of the office with the base of the shelter about 4 feet above ground.

The instrument shelter initially contained only a minimum thermometer. Between September 1884 and September 1885, a maximum thermometer was added to the shelter. Both thermometers were approximately five feet above ground.

Rain Gages – The inspection reports indicated the station had two rain gages—one copper and the other iron. One rain gage was on a post approximately six feet above ground and the other buried with the top of the gage one foot above ground. No indication was made as to the specific location. .

Wind Instruments – No anemometer was located at this station, but a small wind vane (three-foot anemoscope) was on the roof of the building (Sally Port Building) approximately 30 feet above ground.

1 December 1885-6 September 1887 – The Signal Service office was a second order station measuring atmospheric pressure, moisture, temperature, wind velocity, and rainfall. The office remained in the Sally Port Building (northeast part of the building) in the northeast side of the fort. One inspection was conducted at this station on 14-16 August 1886.

Barometer – Between 16 September 1885 and 1 December 1885 two barometers were added to the station. The barometers were 7 feet above ground (no elevation was given above sea level). The inspection report on 14-15 August 1886 stated the attached thermometers recorded very high temperatures in summer and very low readings in winter. The report also stated the thermometers were placed on the southwest wall on 1 January 1886 (Figure 20; no mention made as to where the barometers were located prior to 1 January 1886).

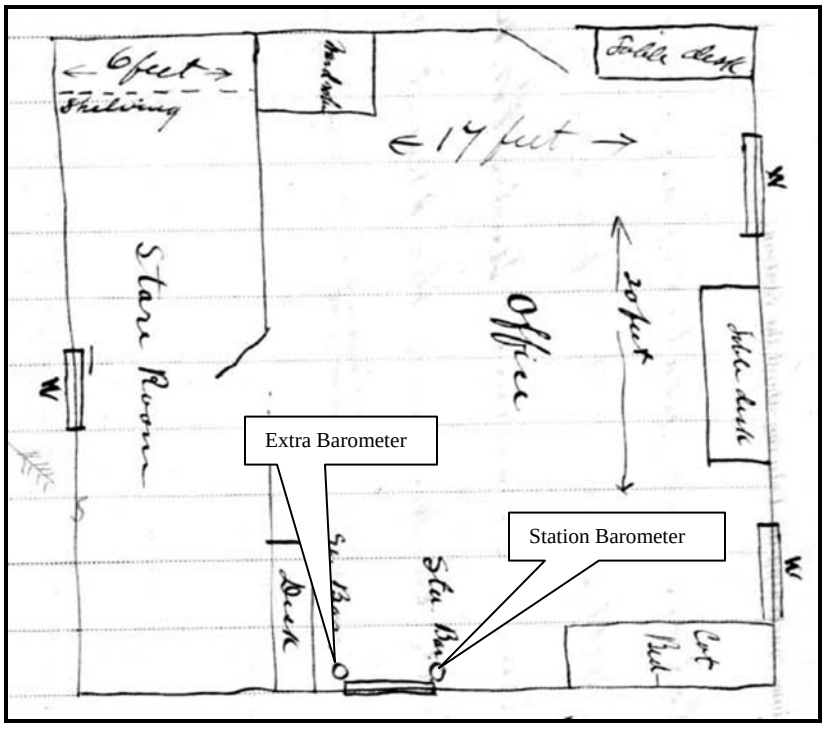

Figure 20. Signal Service office located on the first floor of the Sally Port Building on the northeast side of the parade ground at Fort Sully (14-16 August 1886). North is to the upper left of the page. From the National Archives and Records Administration.

Instrument Shelter – The instrument shelter was located approximately 30 feet northwest from the northwest corner of the old Sally Port Building. This would

have placed the shelter on or very near the parade ground. The shelter was on supports with the base of the shelter approximately 16 feet above ground.

Between 16 September 1885 and 1 December 1885, an exposed thermometer and hygrometer were added to the instrument shelter. The exposed thermometer and hygrometer were 17 feet above ground and the maximum/minimum thermometers 18 feet above ground. Exposure was rated as excellent.

Rain Gages – A rain and a snow gage were located on the extreme southwest part of the roof of the building near the ridge line (Figure 21). Both gages were approximately 27 feet above ground. The inspection report on 14-16 August 1886 contained the following with respect to the rain/snow gages: "I do not think the exposure of the rain and snow gages is good. They are now placed on a little platform at the west end of the gable roof over the Signal Office; I think they should be placed in the open." According to the report, the rain/snow gages were placed in their "current" position on 1 January 1886. No mention was made as to where the gages were located previously.

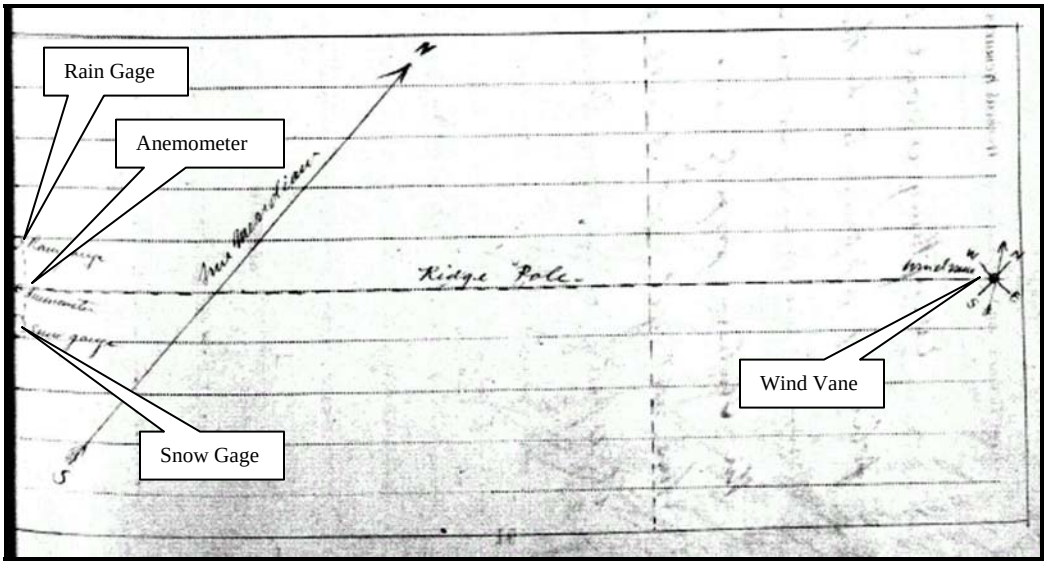

Figure 21. Drawing of the roof of the Sally Port Building showing the locations of the rain gages and wind instruments (14-16 August 1886). North is at the upper right of the figure. From the National Archives and Records Administration.

Wind Instruments – The anemometer was on the ridge line of the roof at the extreme southwest end of the building and the wind vane (three foot) on the ridge line at the extreme northeast part of the roof. The anemometer was 30 feet above ground and the wind vane 31 feet above ground. Exposure was rated as excellent. The inspection report on 14-16 August 1886 stated: "Wind vane rod does not come through roof. No dial for getting direction. Observer simply looks at the vane and determines the direction by inspection."

6 September 1887-28 May 1890 – Signal Service office located in the Band/Post Library Building, a one story building. One inspection was conducted at this site on 28-29 November 1887.

Barometer – Two barometers at this station were located near a window on the southeast part of the office (Figure 22). The barometers were 6 feet above ground and 1,600 feet above sea level (indicated on the inspection report). The inspection report for 28-29 November 1887 stated the barometers were well exposed.

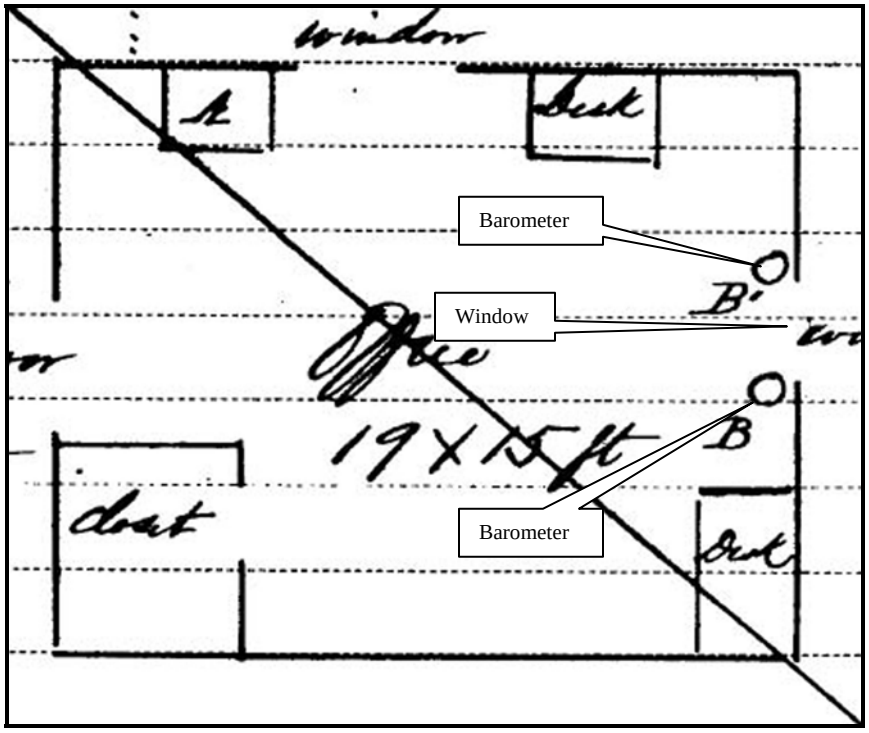

Figure 22. Signal Service office located in the Band/Post Library Building at Fort Sully (28-29 November 1887). North is to the upper left of the page. From the National Archives and Records Administration.

Instrument Shelter – The inspection in November 1887 stated the instrument shelter was "the regular size, elevated on supports resting on the sod." On the observation forms, the shelter was listed as a "standard pattern." Floor of the shelter was about 15 feet above ground. The shelter was located approximately 70 yards northeast of the office over open terrain. The exposed thermometer and hygrometer were 15 feet above ground and the maximum/minimum thermometers 17 feet above ground. The November 1887 inspection rated exposure of the shelter and instruments as excellent.

Rain Gages – The rain and snow gages were buried in the ground near the instrument shelter. The tops of the gages were six inches above ground. The inspection report in November 1887 stated the rain and snow gages were eight inches in diameter and "standard of 1885." The November 1887 inspection rated exposure of the rain and snow gages as excellent.

Wind Instruments – The anemometer and wind vane were located on the roof of the Band Building near the center of the roof. Both were approximately 26 feet above ground, and 6 feet above the crest of the roof. The November 1887 inspection report rated exposure as "tolerably good," indicating both the anemometer and wind vane should be raised at least 10 feet.

28 May 1890-30 June 1891 – Signal Service office located in the Headquarters Building (Court Martial Room) in the southwest part of Fort Sully. No Signal Service inspection reports were available for this site.

Barometer – Elevation of the barometers was listed as 1,600 feet above sea level.

Instrument Shelter – The observation form for May 1890 stated the instrument shelter was located 60 yards southeast of the office, between the quartermaster and commissary buildings. Observation forms stated the shelter was a "standard sod type." Figure 23 shows the estimated locations of instrument shelters and rain gages at Fort Sully for 1 December 1885-30 June 1891 for which information was available.

Rain Gages – The Signal Service Annual Report indicated the elevation of the rain/snow gages was three feet above ground. No information was found regarding the location of the rain/snow gages.

Wind Instruments – No information was found regarding the location of the wind instruments. The wind instruments likely were the same as used at the previous location.

Additional Equipment/Information – The last observation by the Signal Service office at Fort Sully was on 30 June 1891. The U.S. Weather Bureau assumed weather observing responsibility from the Signal Service across the nation on 1 July 1891 and Fort Sully was not included as a bureau station. The 1892 Weather Bureau Annual Report stated observing functions were transferred from Fort Sully to Pierre, SD.

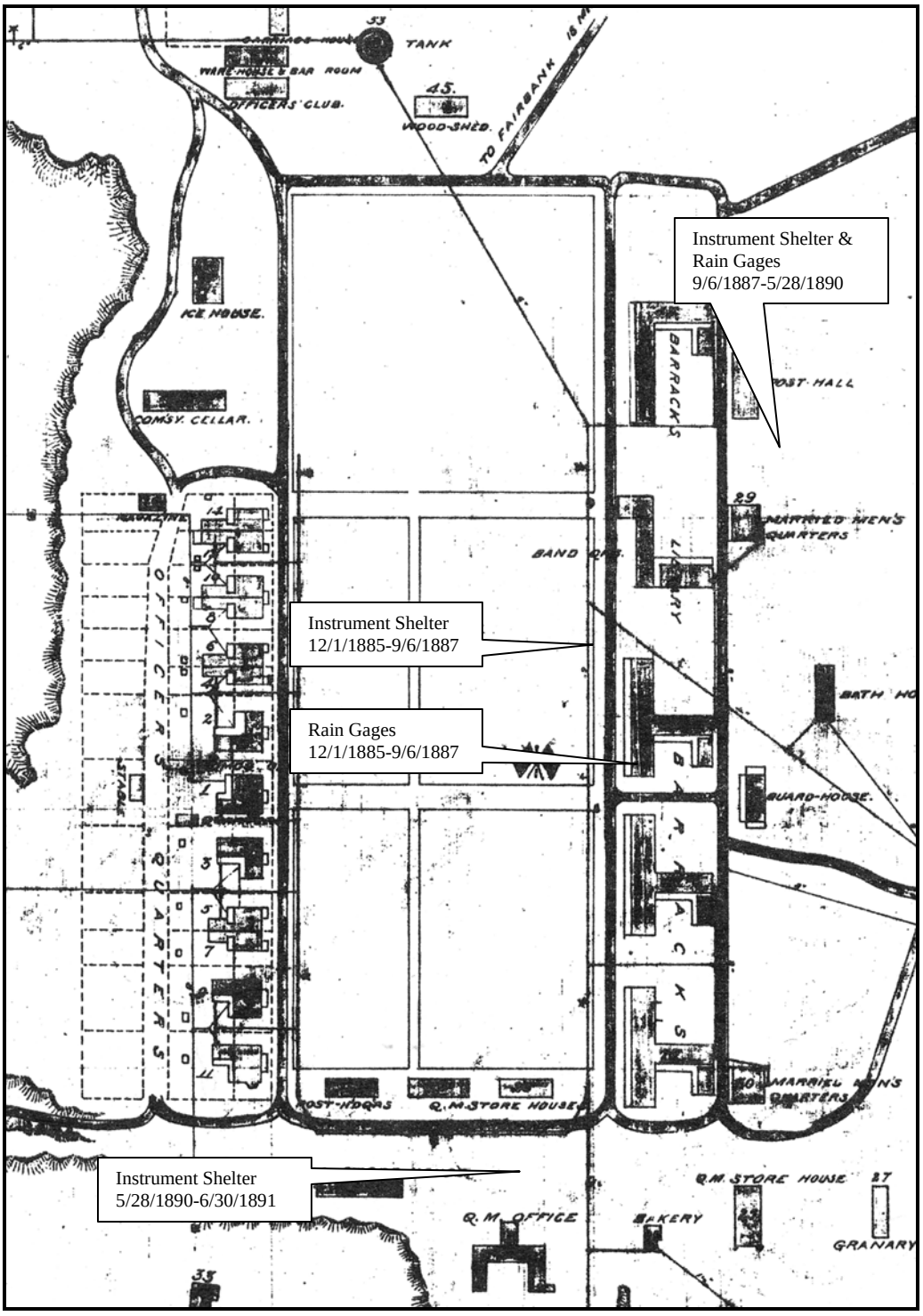

Figure 23. Approximate locations of Signal Service instrument shelters and rain gages 1 December 1885-30 June 1891 at the second Fort Sully for which information could be found. North is at the upper right of the figure. Stockade was 700 feet long and 624 feet wide. Map of Fort Sully courtesy of the South Dakota State Historical Society—State Archives.

Use of Signal Service Weather Services at Fort Sully

The following was from an 1876 semi-annual report by the Fort Sully Signal Service observer:

> "Considerable interest is taken in the towns, Indian agencies, and forts down the river, as frequent inquiries are telegraphed each day by steamboat-men, railroad superintendents, citizens, military, etc.'
>
> 'Usually, twice each day, I overhear and copy the 'Washington Probabilities for the Upper Mississippi and Lower Missouri Valleys,' and report them to the inquirers below. Although these predictions are for the country in general, when they are taken in connection with the readings of instruments and condition of the weather here they afford those who wish to know ample information as to forthcoming weather.'
>
> 'The station at present seems to be gaining in general estimation, judging from the frequent visits of officers, citizens, and their families.'
>
> 'Captain Grant Marsh informed me that, during May last, Commodore Coulson referred daily to my reports, telegraphed informally to him, and loaded Marsh's steamer, the Western, very heavily, in expectation of a rise reported here, although the river was quite low and falling at Yankton."

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Appendix

Methodology

Specific information regarding weather instrument location and exposure at Fort Sully during observations by Army surgeons was sparse. The NCDC database was the primary source of weather observations for this report.

General information regarding weather instruments used by the Army surgeons, and procedures used to take the observations, came from publications by the Army Surgeon General's Office (1850, 1851, 1856, and 1868). This general information was included with the assumption that the military surgeons followed those instructions closely.

Annual reports by the U.S. Army Surgeon General were reviewed for the years 1825 through 1875 with only bits and pieces of revealed information. Several publications by the Army Surgeon General were obtained from the extensive government library microfiche collection at Oklahoma State University. Annual reports by the U.S. Signal Service (from the NOAA Library in Silver Spring, MD) also were reviewed for the years 1871 through 1891.

Considerable information regarding the Signal Service observing stations at Fort Sully was available from station inspection reports located at the National Archives and Records Administration (NARA). A wealth of information was contained in the nine inspection reports for the Fort Sully Signal Service Office from 1873 through 1887. These inspections provided drawings and detailed textual information on the placement and exposure of weather instruments at the Signal Service stations at the post.

The South Dakota State Historical Society (Pierre) contains numerous archives on Fort Sully. A number of relevant photographs, maps, and documents were found at the Historical Society archive library. Documents on Fort Sully (published and unpublished) were obtained from the I.D. Weeks Library at the University of South Dakota (Vermillion).

Other research sources checked in person, by telephone, or via the Internet included Central Plains Region Branch of the National Archives and Records Administration (Kansas City), Rocky Mountain Region Branch of the National Archives and Records Administration (Denver), Sioux City Public Museum, Sioux City Public Library, Sioux Falls Municipal Library, South Dakota State Library, Pierre Municipal Library, Rapid City Public Library, South Dakota School of Mines and Technology Library, Northern State University Williams Library, South Dakota State University Hilton M. Briggs Library, the U.S. Army Military History Institute (Carlisle, PA), and the Nebraska State Historical Society.