

**HISTORY OF WEATHER OBSERVATIONS
Duluth, Minnesota
1870-2004**

January 21, 2005
Revised July 2005

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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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ACKNOWLEDGEMENTS

Many thanks go to the staff at the Minnesota State Climatologist office. Thanks to Jim and Rae Zandlo for visiting Duluth and taking pictures. Peter Boulay located many of the historic photographs through the Minnesota Historical Society. Greg Spoden provided many excellent comments.

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INTRODUCTION

Executive Summary

Weather observations in Duluth, Minnesota began in 1870 when the U. S. Army Signal Service established an office in downtown. The Service moved to the St. Louis Hotel building in 1882 and to the Metropolitan Block in 1884. In 1895 the observing program moved to the Post Office where it remained until 1904. By this point the U. S. Weather Bureau had assumed the weather observing responsibilities, and they constructed a new building in 1904. The Weather Bureau remained in their building until 1950 although a new observing location was established at the airport in 1940. The two offices were consolidated at the airport in March 1950. The instrumentation and the weather offices at the airport moved several times in the next 50 years. A special observation site was opened from 1950 until 1959 at the site of the Weather Bureau building.

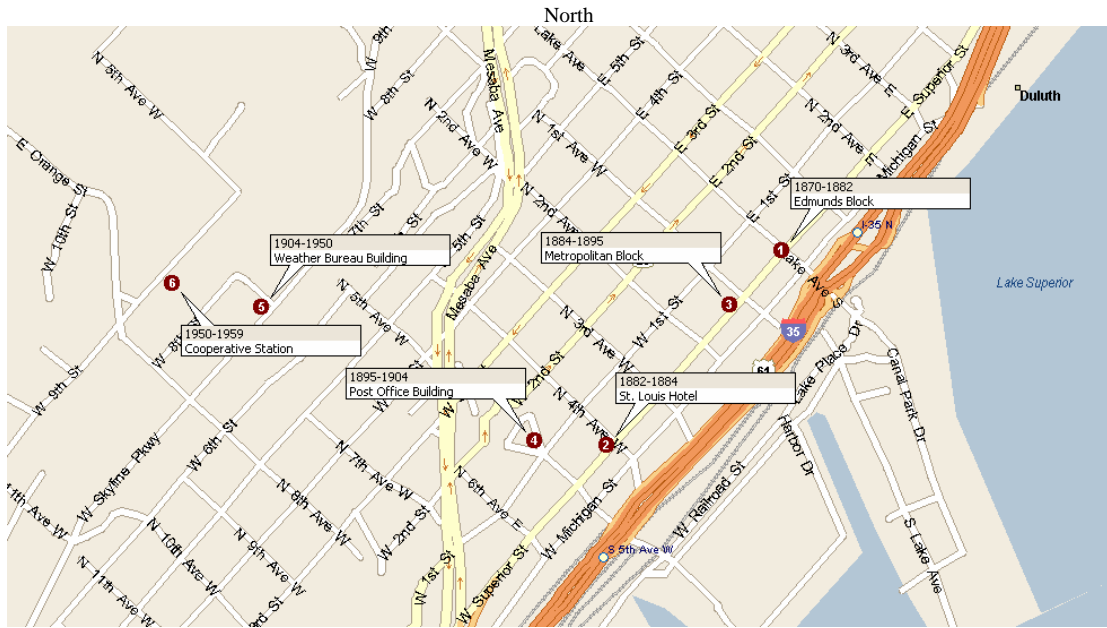
Goal of the Study

The goal of this study is to document the primary weather observational path at Duluth, Minnesota, leading to the current and on-going National Weather Service observing program. The challenge was to identify and define the roots of the path that began in the 1870s. Though other weather observers have been in the Duluth area those not considered part of the original path have been excluded from this study. This does not minimize the importance of these collateral observations, but does allow for the focusing on the formal weather observing program that continues to this day.

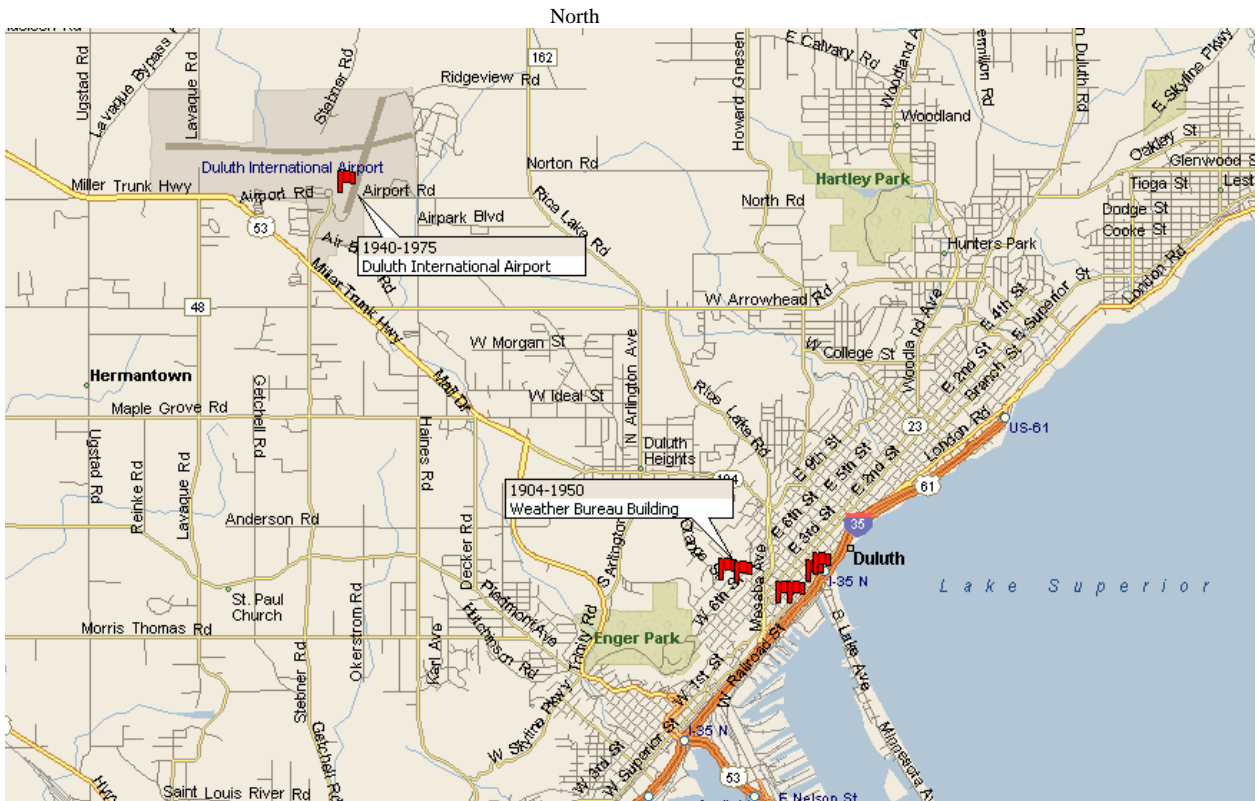
Throughout the research for and preparation of this study, the goal was to produce a document that future studies can use to evaluate the validity of the data that were collected here, judge the trustworthiness of the observers who collected them, and determine the climatological significance of any variability or change discerned.

LOCATION OF OBSERVATIONS

Location maps



Map 1. Location of downtown weather observing sites in Duluth, Minnesota 1870-1959. The Weather Bureau Building and the cooperative observer locations are approximately 440 feet above the downtown locations.



Map 2. Weather observing locations in Duluth, Minnesota showing the relationship of the Weather Bureau Building and other downtown locations to the airport.

Chronology of Locations and Elevations

The following lists the chronology of weather station locations in Duluth, Minnesota, from 1870 until 2004: (Ground elevations as obtained from observational forms or official station history files are listed below. Location information obtained using topozone.com.)

October 1870 – June 1882 – Elevation 625 feet – 46° 47' 16"N 92° 05' 59"W
 - Edmunds Block (also known as Miller Block) , Lake Avenue and Superior Street

July 1882 – November 1884 – Elevation 633 feet - 46° 47' 02"N 92° 06' 17"W
 - St. Louis Hotel, 4th Avenue West and Superior Street

December 1884 – January 1895 – Elevation 634 feet - 46° 47' 12"N 92° 06' 04"W
 - Metropolitan Block, 115-117 West Superior Street

January 1895 – January 1904 - Elevation 685 feet - 46° 47' 00"N 92° 06' 22"W

- Post Office Building, 5th Avenue West and 1st Street

January 1904 – March 1950 – Elevation 1,128 feet - 46° 47' 10"N 92° 06' 50"W

- Weather Bureau Building, 7th Avenue West and 8th Street (now 631 West Skyline Parkway)

March 1950 – October 1959 – Elevation 1,162 feet - 46° 47' 12"N 92° 06' 58"W

- 705 West 9th Street

August 1940 – August 1960 – Elevation 1,409 feet - 46° 50' 21"N 92° 11' 24"W

- Administration Building, Williamson-Johnson Municipal Airport

August 1960 – December 1975 – Elevation 1,409 feet - 46° 50' 16"N 92° 11' 24"W

- Hanger Annex, Williamson-Johnson Municipal Airport

December 1975 – April 1996 – Elevation 1,414 feet - 46° 50' N 92° 11' W

- Office in second Floor addition to old Terminal Building

April 1996 – 2004 – Elevation 1,422 feet - 46° 51' N 92° 11' W

- Airport grounds, Automated Surface Observing System instruments

OBSERVERS AND INSTRUMENTATION

1870 – 1882:

Sergeant A. W. Cox, United States Army Signal Service, opened the Duluth weather station on 1 November 1870. The station was located in the upper story of Edmunds Block (or Miller Block), on the southeast corner of Lake and Superior Streets. The office was situated so as to be in the center of the business district close to the telegraph office, the post office, and the board of trade. Observations continued at this location until 30 June 1882. See Figure 1 for a view of the city circa 1870.



**Figure 1. A view of downtown Duluth, Minnesota in 1870. Camera is facing north.
Source: Minnesota Historical Society.**

Thermometer – The instrument shelter was a standard design and was located in a window of the office. This location was 19 feet above the ground.

Barometer – The barometer was located 660 feet above sea-level.

Wind instruments – Wind-vane and anemometer were located on the roof of the building, 48 feet above the ground.

Rain gage – An eight-inch gage was located on the roof of the building, 28 feet above the ground.

All instruments were reported to be in good condition according to the 1871 Annual Report of the Chief Signal Officer. See reprint of report in Observer Stories section of this report.

1882 – 1884:

The Signal Service moved to an office in the St. Louis Hotel building on 1 July 1882 (Figure 2). The hotel was located on the southeast corner of 4th Avenue West and Superior Street, a move of some four tenths of a mile southwest from the previous location. Observations were taken at this location until 30 November 1884.

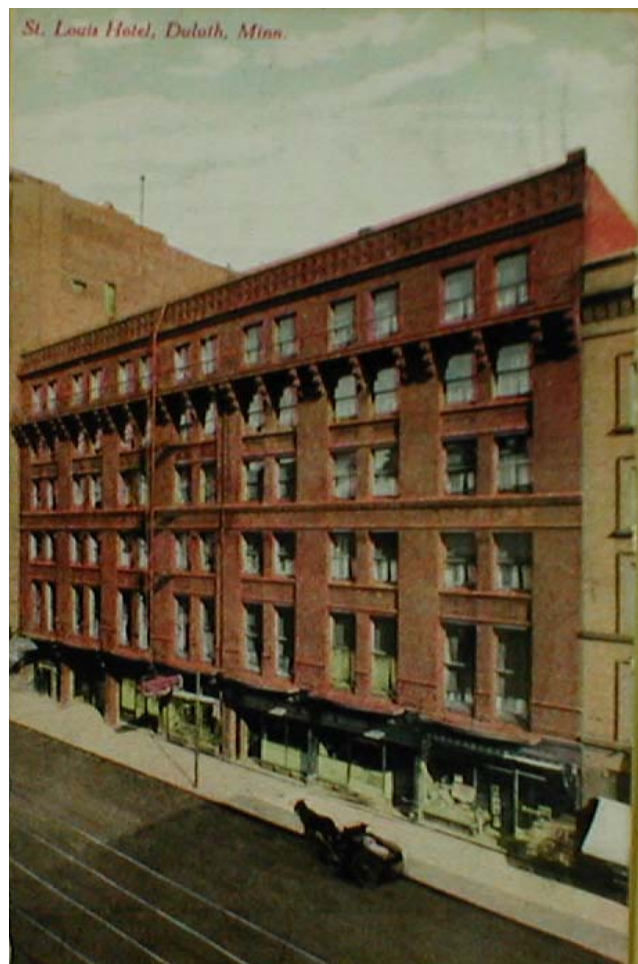


Figure 2. The St. Louis Hotel in downtown Duluth, Minnesota as seen in 1912. Source: Minnesota Historical Society.

Thermometer – Instrument shelter was located in a window, 57 feet above the ground. The exact location of the window is not known.

Barometer – The barometer was located 685 feet above sea-level until 1 July 1884 when the elevation changed to 687 feet.

Wind instruments – Instruments were located on the roof 77 feet above the ground.

Rain gage – An eight-inch gage was located on the roof 66 feet above the ground.

1884 – 1895:

The Signal Service moved again on 1 December 1884 to the Metropolitan Block, room 13, located at 115-117 Superior Street. This was a move of a quarter mile to the northeast. The duties of weather observing were assumed by the United States Department of Agriculture's Weather Bureau in July 1891. Observations continued to be made by the same observer, B. H. Branson, during this transition. Observations continued at this location until 29 January 1895.



Figure 3. A view of Duluth, Minnesota as seen from the hill, 1891. The Metropolitan Block is to the left side of the photograph.

Source: Minnesota Historical Society

Thermometer – The thermometer was located at 61 feet until 1 April 1888, then 71 feet.

Barometer – The barometer was located 672 above sea level until 1 December 1889, then 670 feet until 1 April 1891, then 656 feet.

Wind instruments – The wind instruments were located at 71 feet above the ground until 22 November 1888, then 75 feet until 1 April 1891, then 72 feet.

Rain gage – The eight-inch gage was located 56 feet above the ground.

1895 – 1904:

The Weather Bureau moved the office to the Post Office on 30 January 1895. The Post Office was located on the northeast corner of 5th Avenue West and 1st Street, a move of three tenths of a mile southwest. Observations continued at this location until 31 December 1904.

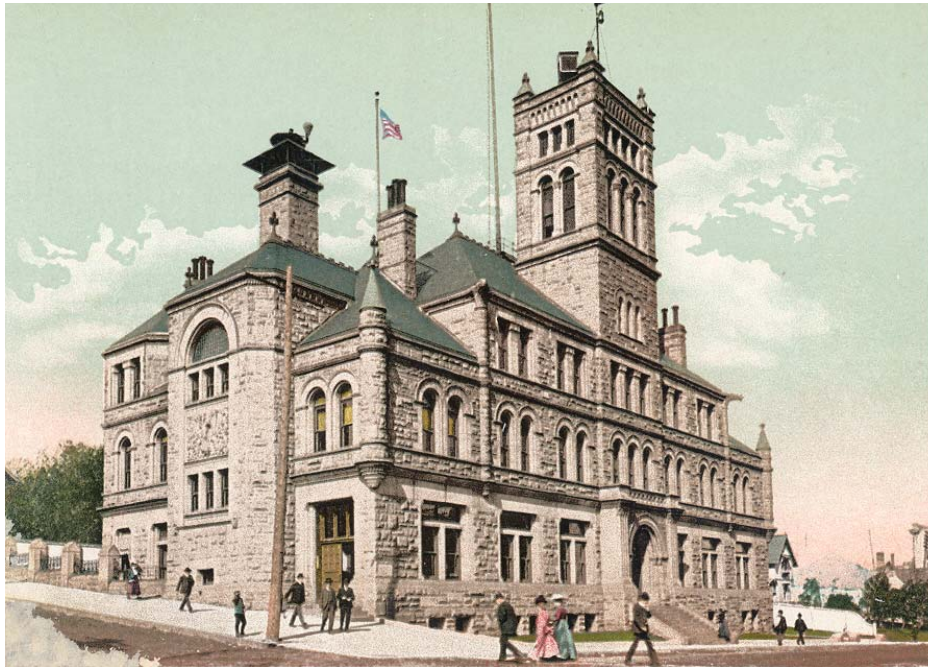


Figure 4. The Post Office Building in Duluth, Minnesota circa 1900. The wind instruments and instrument shelter are visible on the main tower. Building faced southeast.

Source: From the author's personal collection of postcards.

Thermometer – The thermometers were located 95 above the ground.

Barometer – The barometer was located 702 feet above sea level.

Wind instruments – The anemometer located at 106 feet above the ground until June 13, 1900, when the height changed to 116 feet.

Rain gage – The eight-inch gage was located 90 feet above the ground.

1904 – 1950:

The Weather Bureau moved into its own building on 1 January 1904. The building was located at 7th Avenue West and 1st Street (631 West 7th Street, now 631 Skyline Parkway.) See Figure 5. This location was a half mile west southwest of the previous location. The building was located on a steep hillside, approximately 600 feet from the crest of the bluffs, and about 100 feet lower than the crest. The ground elevation was approximately 526 feet above the level of Lake Superior. The Weather Bureau continued at this location until 28 February 1950, when the Weather Bureau consolidated its offices at the airport.

Notice that the vegetation around the building varies considerably between the 1904, 1930s, and 1941 photographs (Figures 5, 6, 7, and 8). The growth of trees around the site in the 1930s would seem to have had an adverse effect on the performance of the rain gage (located on the ground).



Figure 5. An early photograph of the Weather Bureau Building in Duluth, Minnesota. Camera is facing northwest. The building was occupied by the Bureau in 1904.

Source: Duluth National Weather Service web site.

Thermometer – The instrument shelter was located 11 feet above the ground until 20 October 1923, when it was moved to five feet. Shelter can be seen in Figure 5 just to the right of the building, ladder leads up to the shelter.

Barometer – The barometer was located 1,133 feet above sea level.

Wind instruments – The anemometer was located 47 feet above the ground and 24 feet above the roof. The wind vane was located 25.5 feet above the roof. The location placed the instruments about 50 feet below the crest of the bluff. The instruments can be seen in Figures 5 and 6 mounted on the roof visible just above the chimney.

Rain gage – The eight-inch gage was located three feet above ground until 20 October 1923, when it was raised to four feet. A tipping bucket gage was installed on 25 April 1905, at three feet above the ground. A weighing rain gage was installed on 22 November 1940, at five feet above the ground. See Figures 6 and 7.

Other instruments – The station had a seven-day barograph, a sunshine recorder, and a nephoscope.

The station also had a 50 foot storm warning tower with a 20 foot flag pole on top of it and had electric lanterns.



Figure 6. The back of the Weather Bureau Building in Duluth, Minnesota looking southeast over Lake Superior circa 1930s. Wind equipment can be seen on the roof. The instrument shelter is located on the ground to the right of the building. Source: St. Louis County Historical Society.



Figure 7. A view from the hill overlooking Duluth, Minnesota. The Weather Bureau Building is to the left and the two rain gages are clearly visible on the grounds. The incline railroad is to the right. Photograph is undated but may be earlier than Figure 6 due to the size of the trees. Source: Northeast Minnesota Historical Center.

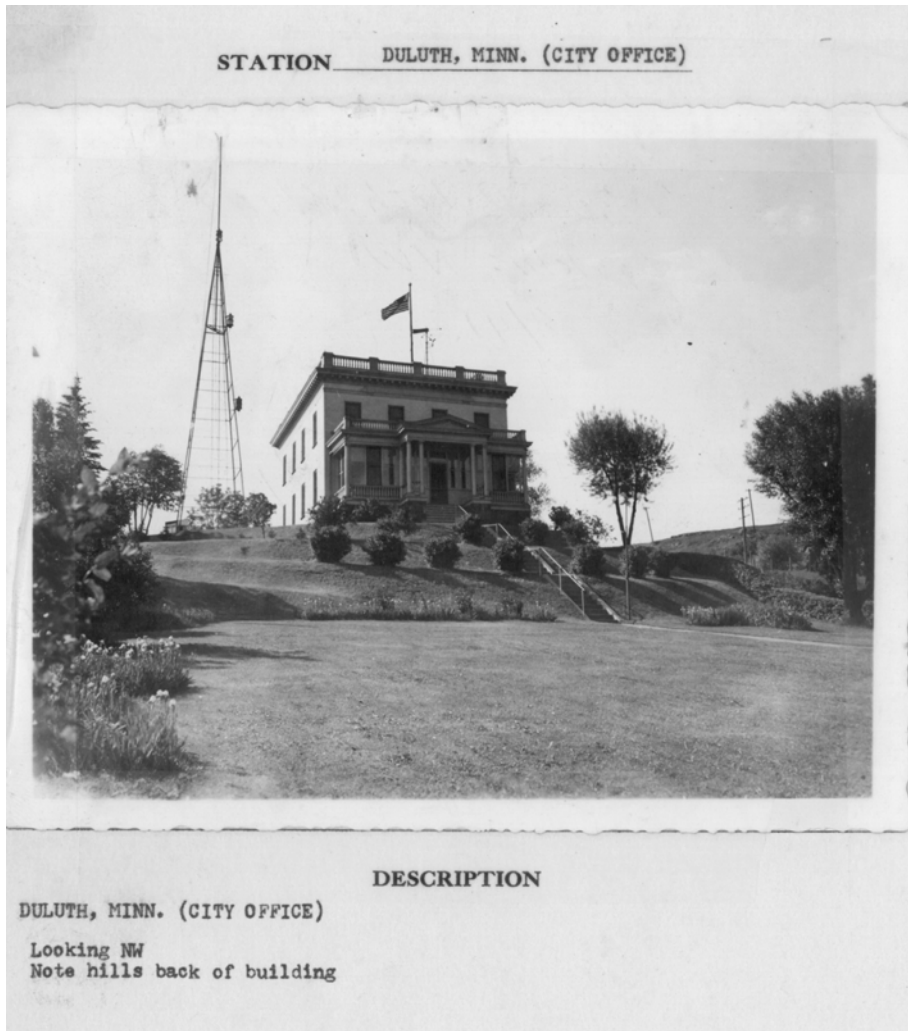
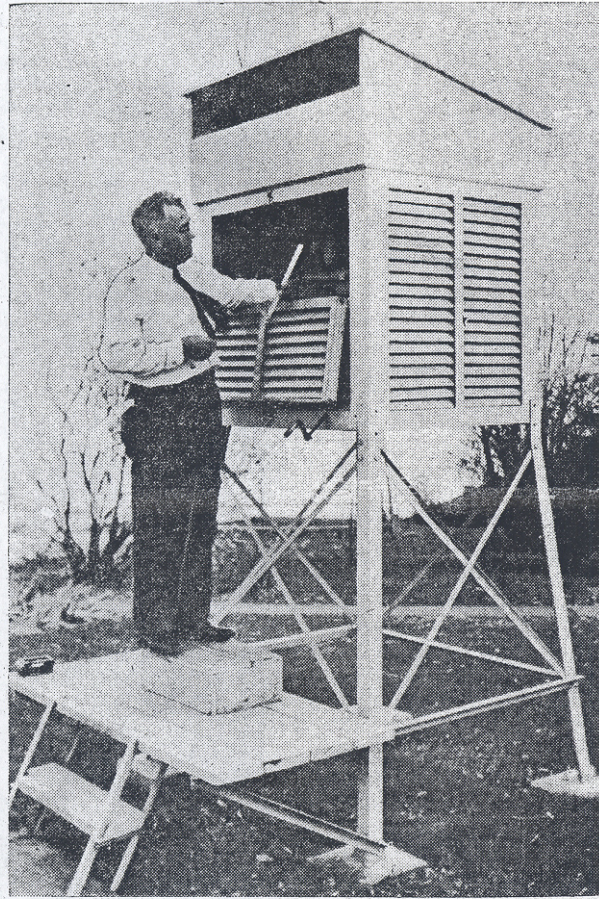


Figure 8. The Duluth, Minnesota, Weather Bureau Building in June 1941 looking up the hill. The signal tower, left, was used for the “posting” of the forecasts through the use of flags and lanterns.

Source: Official station history files at the National Climatic Data Center.

He Can't Believe It



The government meteorologist, Frank H. Weck, had to "take a look" for himself yesterday to be sure his thermometer was right.

The day's high temperature of 74 broke an all-time record for an Oct. 28 in Duluth.

Figure 9. The instrument shelter at the Duluth, Minnesota Weather Bureau Building circa late-1930s.

Source: St. Louis County Historical Society.

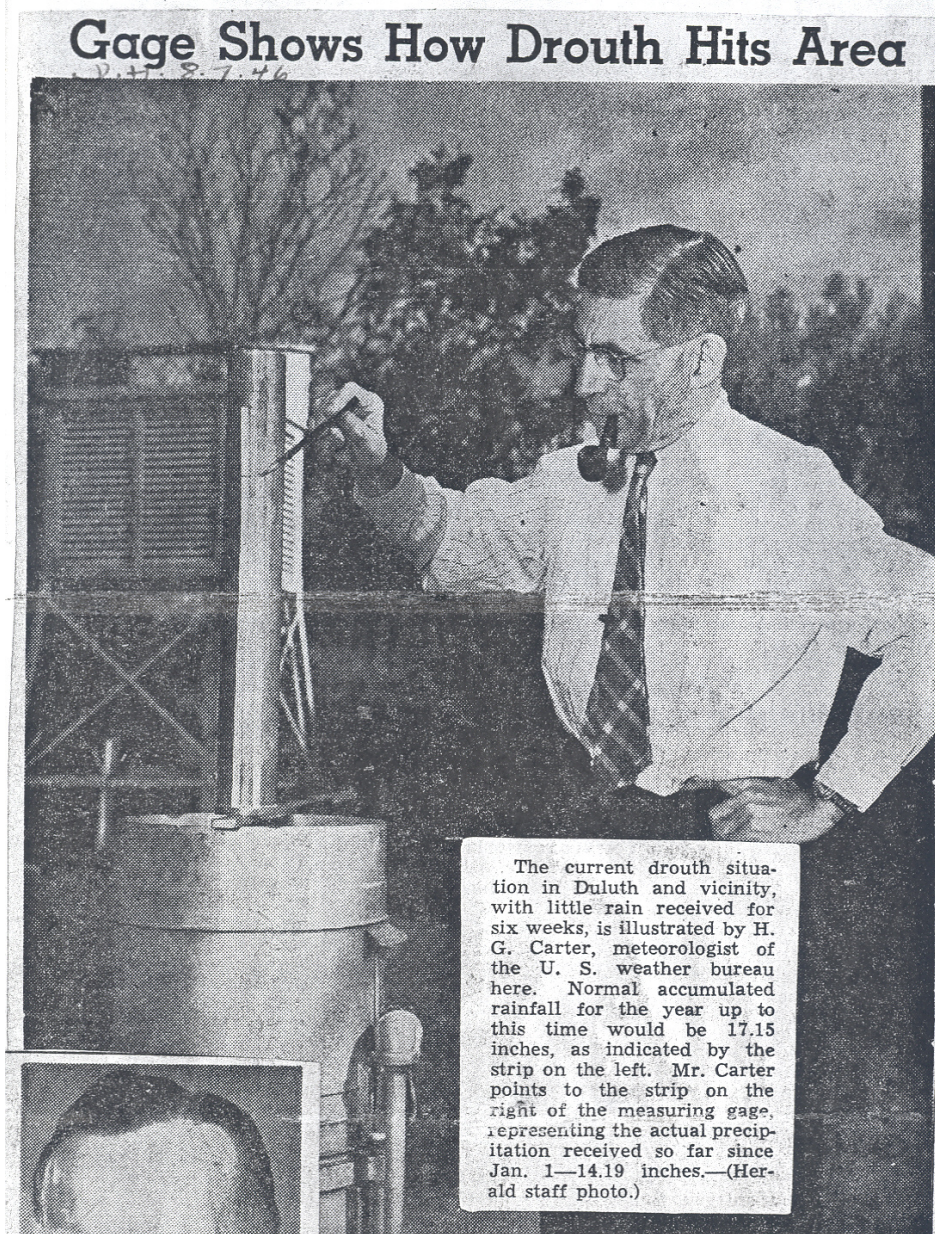


Figure 10. Weather Bureau meteorologist in Duluth, Minnesota checks his instruments in August 1946. Notice the rain gage is in close proximity to the instrument shelter (background).

Source: St. Louis County Historical Society.

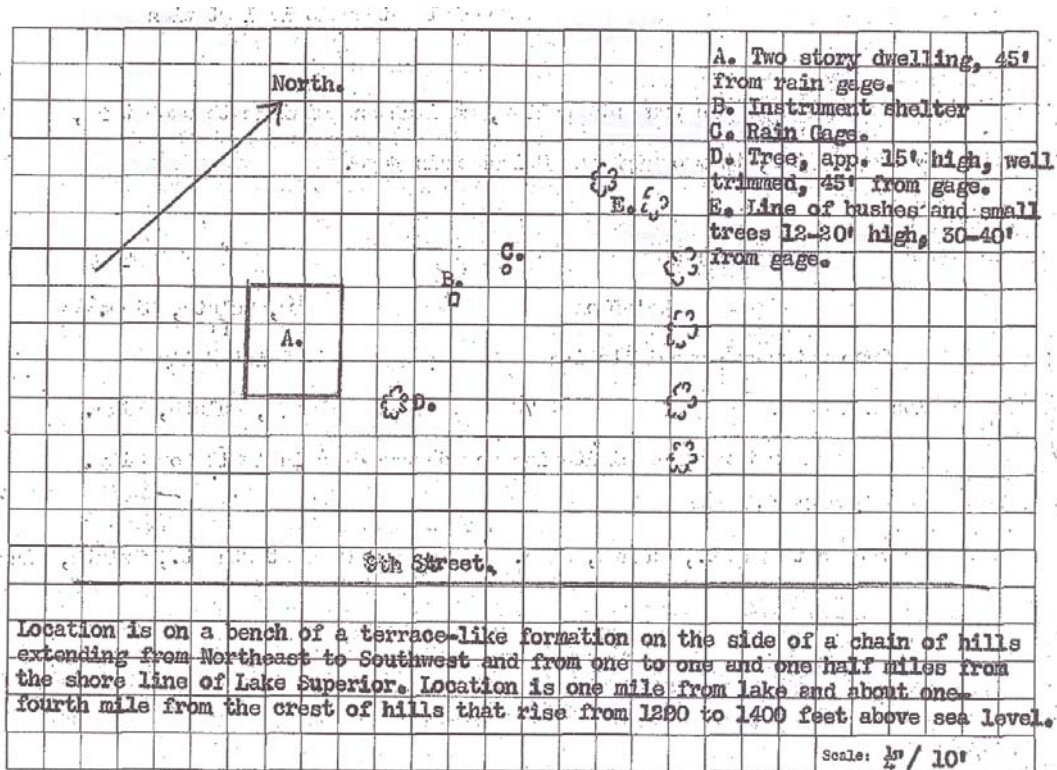
1950 – 1959:

A special Meteorological Station was established on 12 July 1950, at 631 West 7th street on the grounds of the former Weather Bureau Building. This site was established so that a comparison could be made between the city office and the newly established airport location. On 1 October 1950 the site was moved two blocks to 705 West 9th

Street at the home of Mrs. Berthine Beck. See Figure 11 for the locations of the instruments. In 1958 Mrs. Mary Jane Miller of 709 West 9th Street became the observer although the instruments remained at 705 West 9th Street. The station was closed on 1 October 1959.

Thermometer – The thermometers were located five feet above the ground.

Rain gage – The eight-inch gage was located four feet above the ground.



DIRECTIONS FOR REACHING STATION

Give instructions in detail. If outside town or city, give direction and distance, highway number or name, and any other pertinent information which will enable the inspector to drive directly to the station without previous knowledge of its location. Instruments are located at 705 West 9th Street, eleven blocks northwest of Post Office in city limits, at edge of residential section. Also two blocks northwest of Skyline Drive at 8th Street West. Public transportation available to this point from downtown Duluth.

Figure 11. The instrument layout at the cooperative observer station in Duluth, Minnesota October 1950.

Source: Official station history files at the National Climatic Data Center.

1940 – 1960:

The Civil Aviation Administration (CAA) opened a weather observing office at the Williamson-Johnson Municipal Airport on 8 August 1940. The Weather Bureau assumed the observing duties on 11 December 1941. This site was six miles northwest

of the Duluth Post Office. The Weather Bureau office was located on the second floor of the Administration Building. See Figures 12, 13, and 14 for various views of the airport grounds and Administration Building.

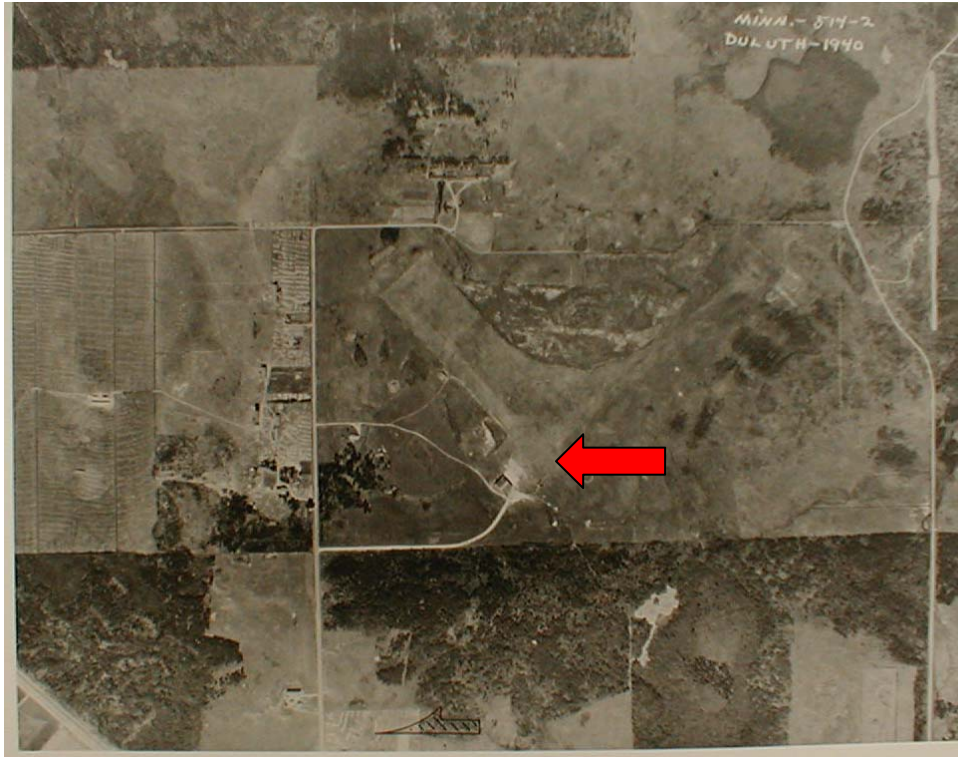


Figure 12. An aerial view of the Duluth, Minnesota airport in 1940. The arrow points to the approximate location of the instruments.
Source: Minnesota Historical Society.

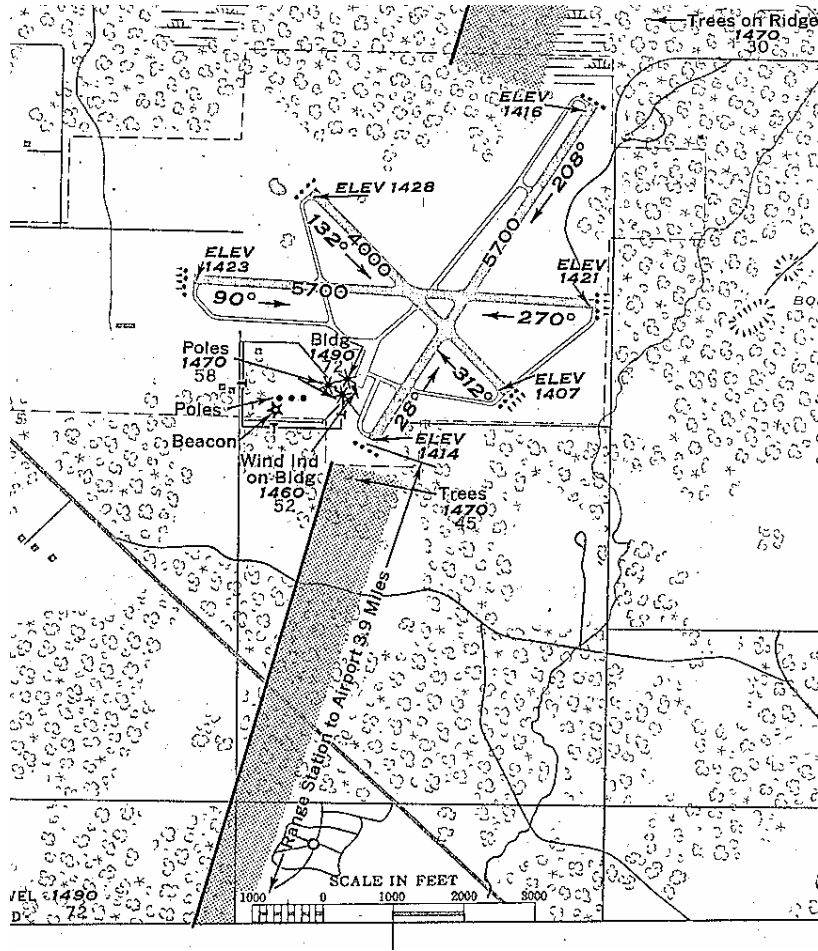


Figure 13. Williamson-Johnson Airport, Duluth, Minnesota as of 6 December 1946. The Weather Bureau was located in the Administration Building indicated by the arrow pointing to “Wind Ind on Bldg”. Source: Official station history files at the National Climatic Data Center.



Figure 14. The Duluth, Minnesota airport Administration Building circa late 1940's.

Source: Minnesota Historical Society.

Thermometer – The Cotton Region Shelter was installed over sod on June 6, 1941, at a height of four feet above the ground.

Barometer – The barometer was located at 1,423 feet above sea level.

Wind instruments – The instruments were at 47 feet initially. On 6 June 1941, the anemometer cups were 18 feet above the roof and 52 feet above the ground, while the wind vane was 19 feet above the roof and 53 feet above the ground. In March 1950, the anemometer cups were at 53 feet and the wind vane at 56 feet above the ground.

Rain gage – The eight-inch gage was located four feet above the ground. The tipping bucket gage and the weighing rain gage, shielded, were moved from the city office to the airport on 8 July 1950. The weighing gage was at a height of five feet above the ground. The tipping bucket was four feet above the ground.

Other instruments – The triple register and the sunshine recorder were moved to the airport from the city office on 10 July 1950. The station also had a thermograph, a barograph, a ceilometer, a ceiling light, and transmissometer.

1960 – 1975:

In August 1960, the Weather Bureau offices were moved to the hanger annex as indicated in Figure 15. The instruments were relocated to a plot just south of the hanger. The name of the airport was changed to the Duluth International Airport in 1963.

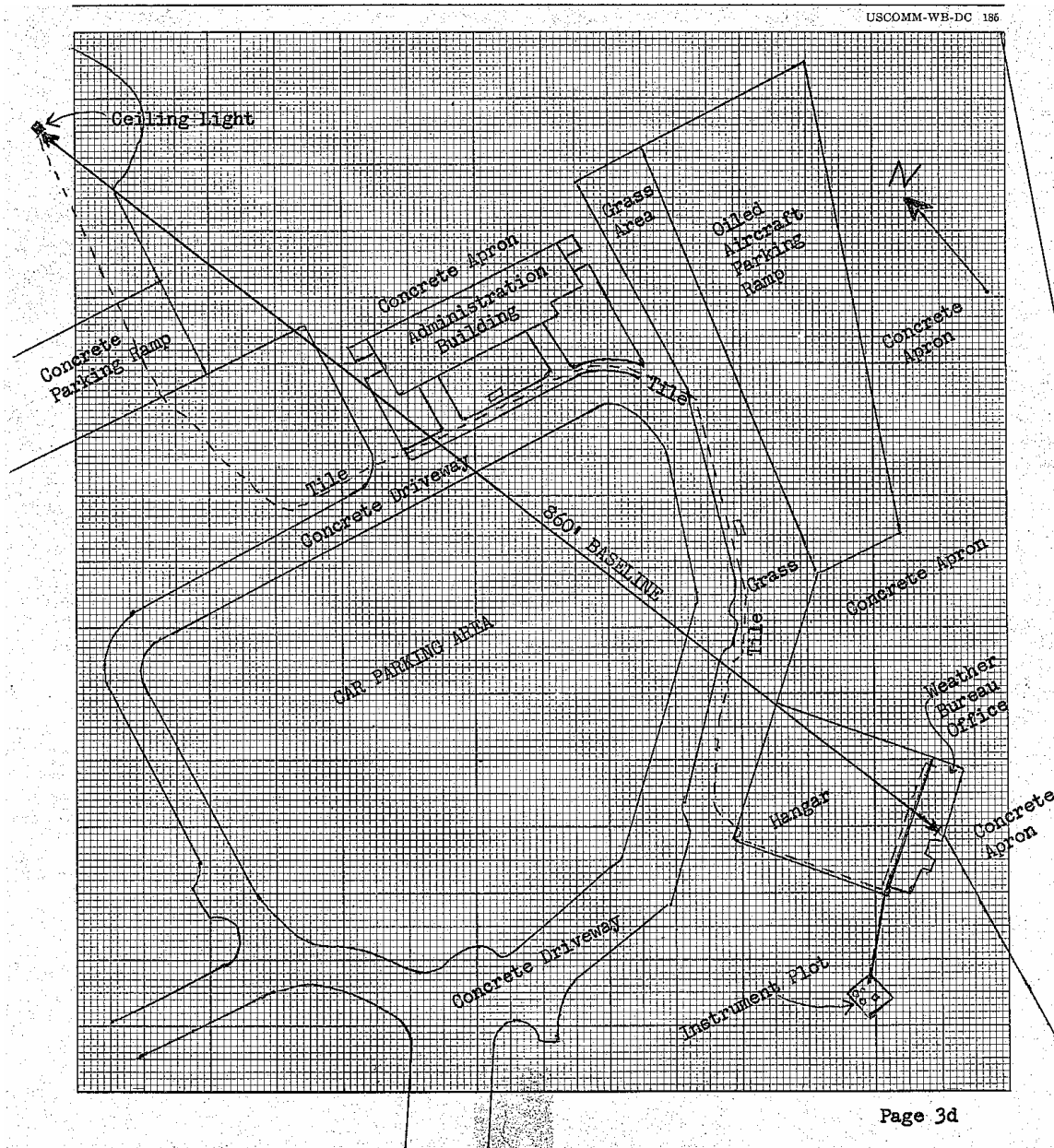


Figure 15. The location of the Weather Bureau office in a hanger at the Duluth International Airport in December 1964.

Source: Official station history files at the National Climatic Data Center.

Thermometer – The Cotton Region Shelter was moved to a new plot located 98 feet southwest of the hanger on 8 August 1960. The shelter was over sod at a height of

four feet above the ground. A hygrothermometer was installed approximately 112 feet southwest of the hanger, becoming operational on 1 September 1960. The hygrothermometer, an HO61, was moved to a field site on 22 June 1961 at a point 2,600 feet north northwest of the Weather Bureau office, or 700 feet north of the east-west runway at a point approximately 6,600 feet east of the west end.

Barometer – The barometer was located at 1,423 feet above sea level.

Wind instruments – On 22 June 1961, the wind equipment was moved to a field site 2,600 feet NNW of the Weather Bureau office, or 700 feet north of the east-west runway at a point approximately 6,600 feet east of the west end. Height of the instruments changed to 21 feet above the ground.

Rain gage – The eight-inch, tipping bucket, and weighing rain gage, shielded, were moved from the administration building site to the hanger site on 8 August 1960. The weighing gage was at a height of five feet above the ground. The tipping bucket and eight-inch gages were four feet above the ground. On 11 August 1965, the weighing rain gage was placed on concrete blocks raising it height to six and a half feet above the ground so as to be above the snow level.

Other instruments – The station continued to have had a triple register, sunshine recorder, thermograph, barograph, ceilometer, ceiling light, and transmissometer.



Figure 16. Instrument shelter and weighing rain gage at the Duluth, Minnesota airport during the winter of 1964-65. Camera is facing southwest. Source: Official station history files at the National Climatic Data Center.

1975 – 1996:

On 15 October 1975, the Weather Service office and associated equipment were moved to the second floor addition to the old terminal building. This was a move of 500 feet north northwest. The field location for the wind instruments and the hygrothermometer was located at a sod plot 30 feet in diameter, approximately 2,100 feet north northwest of the Weather Service office, or 700 feet north of the east-west runway at a point approximately 6,600 feet east of the west end. These instruments remained at this location until 1996 when they were replaced with ASOS equipment.



Figure 17. A view of the weather instruments at the Duluth, Minnesota airport in February 1982. Camera is facing northeast.

Source: Official station history files at the National Climatic Data Center.

Thermometer – The hygrothermometer was located on the field at a height of six feet. The instrument shelter, housing the backup maximum and minimum thermometers, was located over sod 100 feet southwest of the hanger. Adjacent, within 10 feet, to the shelter was a concrete apron extending 71 feet eastward. By February 1977, a parking lot, located 10 feet west of the site, had been installed.

Barometer – The mercury barometer, No. 807, was located at 1,430.315 feet. On 2 February 1982, this barometer was found to be in error and was replaced with barometer No. 18-73. A barograph, a G120, was located at 16 feet above the ground.

Wind instruments – The wind equipment, an F420C, was located on the field at a height of 21 feet.

Rain gage – Effective December 1975, the weighing gage, the eight-inch gage and the tipping bucket gage was mounted on the roof of the office, 56 feet from the west end of the building. The roof was 24 feet above the ground. The eight-inch gage was welded to a movable metal base on the roof, while the weighing and tipping bucket gages were mounted on a wooden walkway on the roof.

Effective 27 August 1976, an eight-inch and a shielded weighing gage were relocated 250 west of the Weather Service office in a fenced-in enclosure with no obstructions. See Figure 17. The top of the eight-inch gage was three and a half feet above the ground while the weighing gage was at five and a half feet. Instruments were mounted on a concrete pad.

Other instruments – The Duluth station also had a sunshine switch, ceilometer, ceiling light, and transmissometer instruments.

1996-2004:

On 1 April 1996, the National Weather Service commissioned the Automated Surface Observing System (ASOS) instruments at the airport. Figure 18 shows a representative ASOS site (a photograph of the ASOS instruments at Duluth was not available.) For further information on the ASOS system refer to the National Weather Service Automated Surface Observing System home page at www.nws.noaa.gov/asos.

Thermometer – The standard ASOS hygrothermometer is the HO83.

Barometer – The standard ASOS pressure sensor consists of three measuring systems.

Wind instruments – The standard ASOS wind instruments are at a height of 33 feet.

Rain gage – The standard ASOS gage is a heated tipping bucket.

Other instruments – The standard ASOS instruments suite includes a laser beam ceilometer, present weather indicator, freezing rain sensor, thunderstorm sensor, and a visibility sensor.

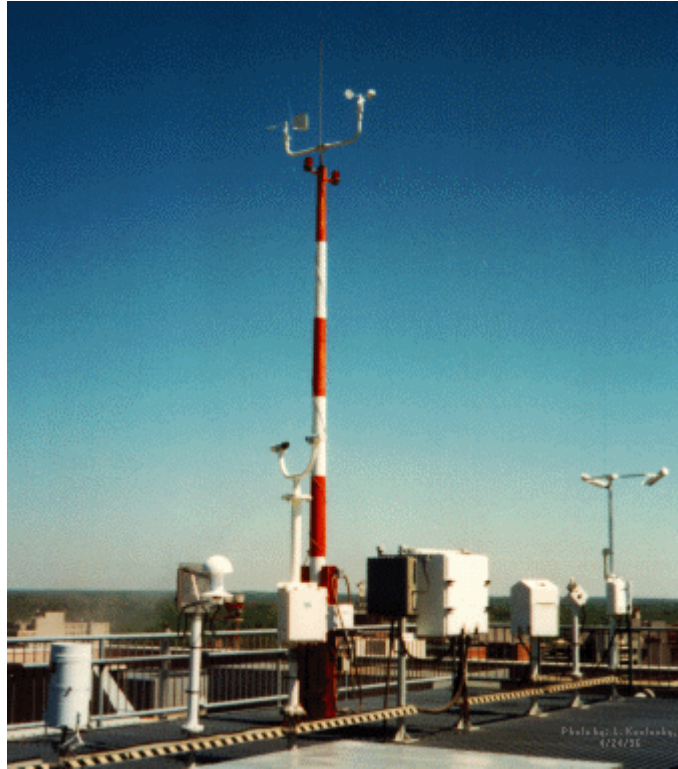


Figure 18. An example of a typical Automated Surface Observing System (ASOS) instrument configuration. This photograph shows the instruments on the roof of the National Weather Service Headquarters building in Silver Spring, Maryland. Source: National Weather Service ASOS web site.

OBSERVER STORIES

The First Station is Established in Duluth

The following report (Figure 19,) extracted from the 1871 Annual Report of the Chief Signal Officer, United States Army, gives a glimpse into the early efforts at establishing a weather observing network nationwide. The story is national, but the details are very much local in nature.

DU LUTH, MINNESOTA, (No. 40.)

The observer's office is located in the upper story of Edmunds's Block, on Superior street, near the business center of the town, and in the immediate vicinity of the telegraph-office, post-office, and board of trade building. The wind-vane, anemometer, and rain-gauge are placed on the roof of the building, and the former indicates in the office the direction of the wind. The exposure on the southern and eastern sides is good, but a range of hills shuts off the wind from the north and west. The instrument-shelter is of the standard pattern, and projects from a window of the office.

The station was established by Sergeant A. W. Cox, and reports commenced on the morning of November 1, 1870. Sergeant Cox was relieved January 1 by Sergeant A. B. Williams, who continues in charge. The reports of ten stations are received here, and four morning and three afternoon bulletins issued and properly posted. The three newspapers are furnished with the reports, and two of them publish a weekly statement of the observations. The daily paper does not give the tabular reports, but is making arrangements to do so soon. The large weather-map is hung in the board of trade room and properly changed. The reports are not received with regularity, owing to want of proper telegraphic facilities, and this difficulty cannot be overcome until the increase in population and business justifies the putting up of additional wires.

Latitude of station	46° 48'
Longitude of station.....	92° 06'
Elevation of barometer above sea-level.....	660 feet.

The station is supplied with a full set of standard instruments, all of which are in good condition.

A meteorological committee of the board of trade has been appointed at the station.

The rent of office is \$20 per month.

Figure 19. The 1871 Duluth, Minnesota weather station report.

Source: 1871 Annual Report of the Chief Signal Officer.

Weather Bureau Building

Starting in the early 1900s the U. S. Department of Agriculture's Weather Bureau entered into a major building program. By the time the program was over in 1910, some 48 buildings were constructed across the country. Twenty seven of the buildings were in a "standard design" such as the one in Duluth. Fourteen of these buildings remain in existence in 2004 including the one in Duluth. See Figure 20. The building in Duluth cost \$2,041.70 for land and \$7,430.68 for the building.

An article in the *Duluth Herald* on 27 June 1935, tells us that the building was being repaired and remodeled at a cost of \$6,000. A central switchboard for control of instruments and booster pumps for additional water pressure were being installed, and part of the interior and basement were being reconstructed. The building was now at the summit of the incline railroad.



**Figure 20. The Duluth, Minnesota, Weather Bureau Building in July 2004.
Source: Jim Zandlo, State Climatologist for Minnesota.**

APPENDIX I - METHODOLOGY

The primary sources of information for this study were the Duluth observers' daily weather records themselves. Copies of their monthly reports were available from the National Climatic Data Center's on-line system called WSSRD. The monthly reports can be considered primary sources because they were written by the observers and not altered by subsequent readers. Station history files at the Data Center also provided details as to station and instrument history.

A variety of secondary sources held information about the city and its weather observers including the St. Louis County Historical Society, the Minnesota Historical Society, and the Duluth National Weather Service's web site. The State Climatologist Office in St. Paul proved to be a valuable source of ideas and assistance.

All these sources were gleaned to obtain a glimpse into the lives of the observers, the location of the observation site, and the historical environment that produced the climatic history of Duluth, Minnesota. Maps, drawings, and photographs were included when appropriate to illustrate the information.

Street maps were generated using Microsoft's Streets and Trips software. Additional photographs were taken from the author's personal collection of postcards.

REFERENCES AND DATA SOURCES

Observational forms as found in the National Climatic Data Center archives

Station history forms as found in the National Climatic Data Center files

Report of the Chief Signal Officer – 1871

Report of the Chief of the Weather Bureau – 1912

St. Louis County Historical Society archives

Northeast Minnesota Historical Center

Minnesota Historical Society

National Weather Service, Duluth - Web site: www.crh.noaa.gov/dlh/history.htm