

Sand and gravel aquifers (glaciated regions)
Glacial Surficial Sand and/or Gravel

Polk County, MN

LOCATION.--Lat 47°41'25.1", long 96°12'05.86" referenced to North American Datum of 1983, in NE ¼ NE ¼ NW ¼ sec.32, T.149 N., R.43 W., Polk County, MN, Hydrologic Unit 09020303, 20.0 miles east and 2.2 miles south of Crookston, Minnesota; 2.3 miles west of Mentor, Minnesota.

GROUNDWATER RECORDS

WELL CHARACTERISTICS.--Depth 29.77 ft. Upper casing diameter 2.04 in; top of first opening 24.93 ft, bottom of last opening 29.23 ft. The hole for well G22S-R was drilled with an 8.25-inch-diameter power auger to a depth of 35 feet. The well is constructed of a 4.3-foot-long, 2.04-inch-diameter, schedule-40 PVC, 0.010-inch slotted, flush-threaded screen attached to several lengths of 10.00 feet of 2.04-inch-diameter, schedule-40 PVC casing. This casing stick-up was 2.41 feet (1187.96 ft. NAVD88, +/- 0.07 ft.) above land surface when measured on Jul. 17, 2003. The open interval of the well is between 24.93 and 29.23 feet below land surface and the well is 29.77 feet deep.

DATUM.--Land-surface datum is 1,185.55 ft above North American Vertical Datum of 1988. Measuring point: MP is mark on top of casing, NOT protection post., 2.41 ft above land-surface datum, July 17, 2003, to present. Water levels below land surface are accurate to 0.01 feet. Water levels above North American Vertical Datum of 1988 (sea level) are calculated by subtracting recorded water levels from the land surface elevation, which is accurate only to plus-or-minus 0.1 feet based on a differential GPS survey. Water-level differences are accurate to within 0.001 feet.

PERIOD OF RECORD.--Water levels were recorded hourly during Jul. 18, 2003 at 11:00 CDT to the present, except during the following periods:

May 01, 2008 at 16:00 CDT - May 06, 2008 at 15:00 CDT: due to station failure.
Dec. 22, 2010 at 06:00 CST - Dec. 24, 2010 at 21:00 CDT: due to station failure.

GAGE.--Water level and water temperature were measured with a Design Analysis H-310 submersible pressure transducer accurate to 0.01 feet and 0.1°C respectively. Data were recorded hourly by a Campbell Scientific, Inc. CR500 data logger. The data logger was upgraded to a Campbell Scientific, Inc. CR206 on Apr. 26, 2011. The data logger is housed in a shelter attached to the well casing, is solar powered, and data are telemetered by radio and telephone.

An unheated Weather Measure Corp. P-501 tipping-bucket rain gage was added to the station on May 05, 2004 at 17:00 CDT which measures and records precipitation total hourly. On Apr. 15, 2011, precipitation total began being recorded quarter-hourly.

COOPERATION.--This site is operated by the U.S. Geological Survey as part of a study to understand hydrologic changes resulting from wetland and prairie restoration and climate change. The station is funded in cooperation with the Red Lake Watershed District, the U.S. Fish and Wildlife Service, and The Nature Conservancy.

REMARKS.--This well is affected by pumping from a nearby well in a lower confined aquifer and by irrigation from this pumped water.

Measured groundwater levels are precise to two decimal places, not the 3 decimal places reported. Differences between subsequent groundwater levels are precise to 3 decimal places, however. Three-decimal place precision is useful at this site for hydrologic analyses such as estimation of groundwater recharge and evapotranspiration.

EXTREMES FOR PERIOD OF RECORD.--Highest water level: 18.153 feet below land surface datum (1167.397 feet NAVD88) on Nov. 25, 2010 at 14:00 CST; lowest water level: 23.818 feet below land surface datum (1161.732 feet NAVD88) on Apr. 17, 2007 at 10:00 CDT.

Highest daily-average water level: 18.212 feet below land surface datum (1167.338 feet NAVD88) on Nov. 25, 2010; lowest daily-average water level: 23.805 feet below land surface datum (1161.745 feet NAVD88) on Apr. 17, 2007.

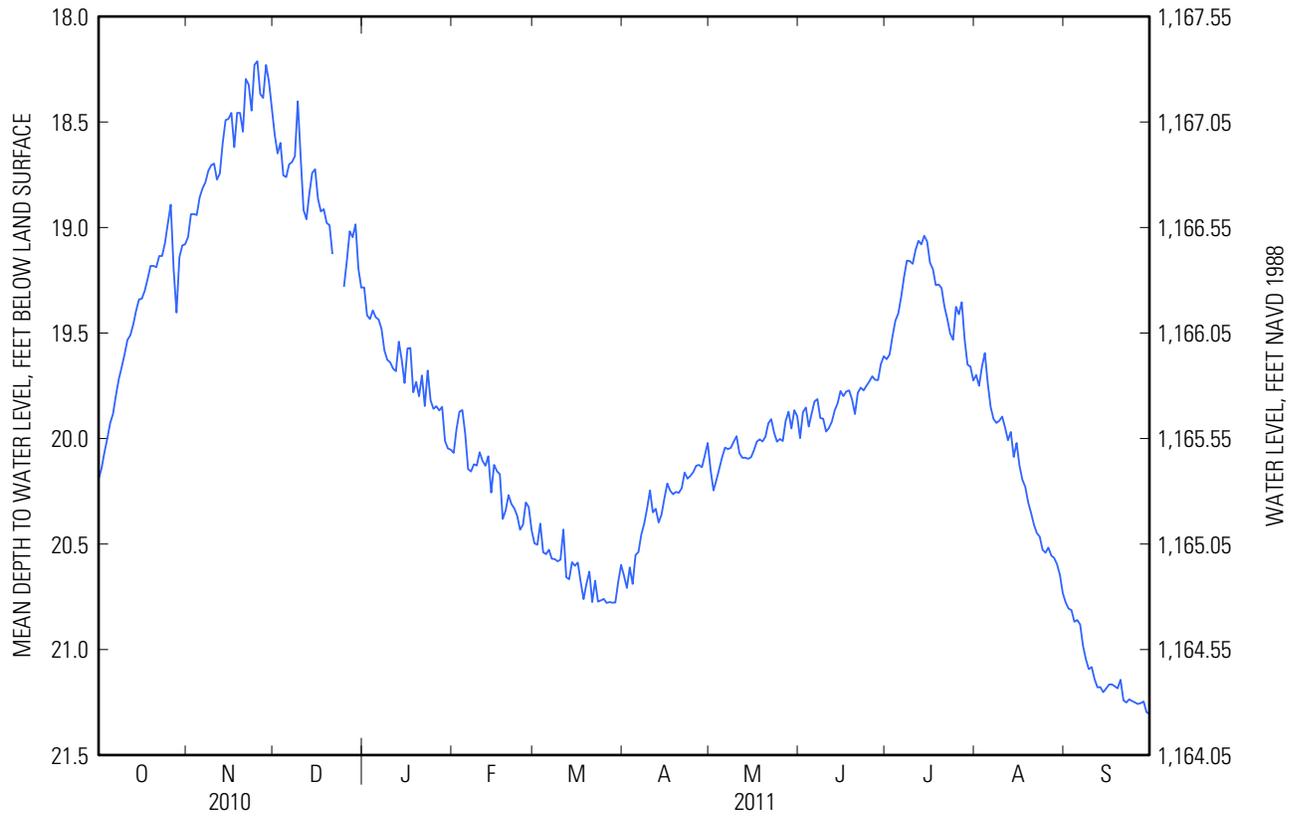
EXTREMES FOR CURRENT YEAR.--Highest water level: 18.153 feet below land surface datum (1167.397 feet NAVD88) on Nov. 25, 2010 at 14:00 CST; lowest water level: 21.324 feet below land surface datum (1164.226 feet NAVD88) on Sept. 30, 2011 at 10:00 CDT.

Highest daily-average water level: 18.212 feet below land surface datum (1167.338 feet NAVD88) on Nov. 25, 2010; lowest daily-average water level: 21.304 feet below land surface datum (1164.246 feet NAVD88) on Sept. 30, 2011.

EXTREMES FOR CURRENT YEAR.--Highest water level, 18.153 ft below land surface datum, Nov. 25; lowest water level, 21.324 ft below land surface datum, Sept. 30.

DEPTH TO WATER LEVEL, FEET BELOW LAND SURFACE
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011
DAILY MEAN VALUES

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	20.191	19.045	18.558	19.284	20.068	20.497	20.650	20.149	19.998	19.624	19.699	20.777
2	20.143	18.937	18.649	19.416	19.954	20.503	20.708	20.246	19.875	19.602	19.750	20.806
3	20.067	18.936	18.599	19.434	19.873	20.403	20.611	20.197	19.853	19.516	19.659	20.813
4	20.001	18.941	18.753	19.393	19.865	20.539	20.689	20.143	19.943	19.442	19.595	20.868
5	19.928	18.858	18.761	19.425	19.978	20.548	20.552	20.088	19.882	19.408	19.737	20.860
6	19.883	18.815	18.701	19.436	20.145	20.527	20.538	20.043	19.824	19.330	19.850	20.881
7	19.796	18.786	18.690	19.480	20.156	20.570	20.455	20.050	19.813	19.235	19.907	20.982
8	19.719	18.732	18.662	19.582	20.122	20.571	20.403	20.044	19.903	19.157	19.926	21.046
9	19.662	18.705	18.402	19.627	20.128	20.582	20.331	20.015	19.906	19.159	19.916	21.093
10	19.601	18.697	18.665	19.639	20.065	20.574	20.246	19.989	19.967	19.172	19.896	21.083
11	19.533	18.773	18.917	19.668	20.106	20.431	20.350	20.070	19.950	19.106	19.948	21.140
12	19.510	18.744	18.961	19.681	20.129	20.657	20.333	20.091	19.920	19.063	20.008	21.179
13	19.460	18.599	18.840	19.541	20.084	20.667	20.398	20.091	19.866	19.080	19.969	21.178
14	19.394	18.491	18.741	19.627	20.256	20.586	20.360	20.096	19.833	19.039	20.087	21.202
15	19.341	18.485	18.724	19.737	20.125	20.603	20.283	20.089	19.775	19.066	20.021	21.185
16	19.337	18.457	18.864	19.573	20.155	20.588	20.213	20.056	19.799	19.167	20.129	21.166
17	19.299	18.619	18.924	19.571	20.169	20.680	20.247	20.015	19.777	19.197	20.195	21.165
18	19.243	18.457	18.913	19.781	20.381	20.761	20.264	20.004	19.772	19.273	20.229	21.174
19	19.182	18.457	18.978	19.732	20.341	20.688	20.253	20.014	19.815	19.270	20.302	21.184
20	19.182	18.546	18.989	19.800	20.268	20.631	20.257	19.991	19.884	19.287	20.352	21.143
21	19.188	18.296	19.126	19.701	20.310	20.775	20.235	19.928	19.783	19.374	20.408	21.240
22	19.135	18.323	---	19.846	20.331	20.674	20.161	19.908	19.759	19.434	20.448	21.251
23	19.135	18.446	---	19.678	20.366	20.773	20.190	19.972	19.772	19.503	20.465	21.236
24	19.073	18.229	---	19.819	20.432	20.767	20.177	20.015	19.750	19.532	20.527	21.244
25	18.980	18.212	19.281	19.859	20.409	20.760	20.159	20.002	19.729	19.376	20.541	21.251
26	18.892	18.367	19.157	19.847	20.303	20.779	20.129	20.012	19.705	19.411	20.517	21.258
27	19.199	18.386	19.018	19.867	20.325	20.775	20.125	19.916	19.722	19.354	20.554	21.254
28	19.403	18.230	19.046	19.850	20.434	20.778	20.136	19.873	19.723	19.531	20.566	21.246
29	19.141	18.307	18.985	20.012	---	20.777	20.080	19.952	19.646	19.650	20.596	21.297
30	19.085	18.433	19.195	20.047	---	20.679	20.021	19.866	19.610	19.659	20.646	21.304
31	19.079	---	19.285	20.053	---	20.599	---	19.894	---	19.725	20.733	---



WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water temperatures were recorded hourly during Jul. 18, 2003 at 11:00 CDT to the present, except during the following periods:
May 01, 2008 at 16:00 CDT - May 06, 2008 at 15:00 CDT: due to station failure.
Dec. 22, 2010 at 06:00 CST - Dec. 24, 2010 at 21:00 CDT: due to station failure.

INSTRUMENTATION.--Water temperature is measured with a Design Analysis H-310 submersible pressure transducer accurate to 0.1°C. Record is currently uncalibrated while sufficient calibration data is being collected.

COOPERATION.--This site is operated by the U.S. Geological Survey as part of a study to understand hydrologic changes resulting from wetland and prairie restoration and climate change. The station is funded in cooperation with the Red Lake Watershed District, the U.S. Fish and Wildlife Service, and The Nature Conservancy.

EXTREMES FOR PERIOD OF RECORD.--Maximum hourly, 9.1°C on many hours during Nov. & Dec., 2006 & Jan., 2007; minimum hourly, 6.8°C on many hours during Jul., 2009.

EXTREMES FOR PERIOD OF DAILY RECORD.--Maximum daily-average, 9.1°C on many days during Nov. & Dec., 2006 & Jan., 2007; minimum daily-average, 6.8°C on many days during Jul., 2009.

EXTREMES FOR CURRENT YEAR.--

WATER TEMPERATURE: Maximum hourly, 8.9°C on many hours during Dec., 2010 & Jan., 2011; minimum hourly, 7.1°C on many hours during Jun. - Aug., 2011.

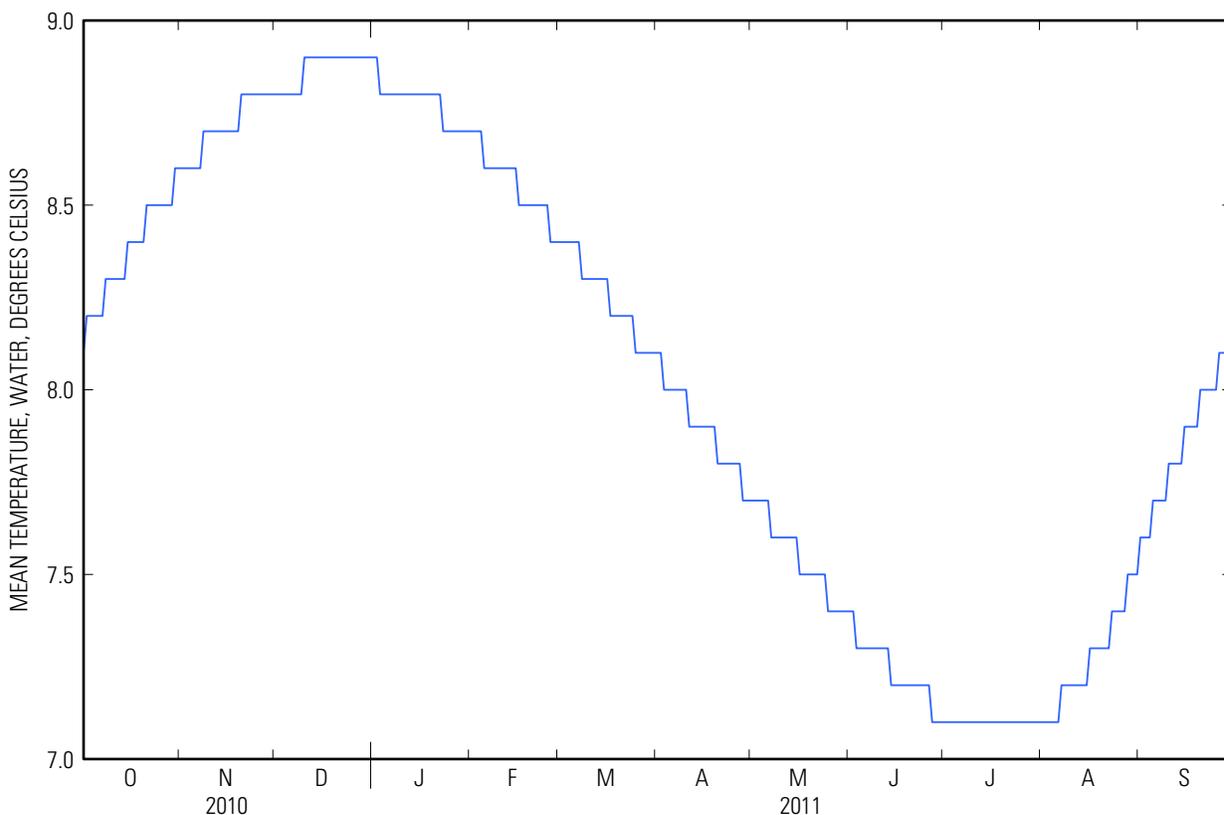
Maximum daily-average, 8.9°C on many days during Dec., 2010 & Jan., 2011; minimum daily-average, 7.1°C on many days during Jun. - Aug., 2011.

EXTREMES FOR CURRENT YEAR.--

WATER TEMPERATURE: Maximum, 8.9°C, on many days; minimum, 7.1°C, on many days [THE FOLLOWING FLAG(S) APPEARED IN THE ADAPS END-OF-YEAR SUMMARY RETRIEVAL: e, estimated].

TEMPERATURE, WATER, DEGREES CELSIUS
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011
DAILY MEAN VALUES
[e, estimated]

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	8.1	8.6	8.8	8.9	8.7	8.4	8.1	7.7	7.4	7.1	7.1	7.6
2	8.2	8.6	8.8	8.9	8.7	8.4	8.1	7.7	7.4	7.1	7.1	7.6
3	8.2	8.6	8.8	8.8	8.7	8.4	8.0	7.7	7.3	7.1	7.1	7.6
4	8.2	8.6	8.8	8.8	8.7	8.4	8.0	7.7	7.3	7.1	7.1	7.6
5	8.2	8.6	8.8	8.8	8.6	8.4	8.0	7.7	7.3	7.1	7.1	7.7
6	8.2	8.6	8.8	8.8	8.6	8.4	8.0	7.7	7.3	7.1	7.1	7.7
7	8.2	8.6	8.8	8.8	8.6	8.4	8.0	7.6	7.3	7.1	7.2	7.7
8	8.3	8.7	8.8	8.8	8.6	8.3	8.0	7.6	7.3	7.1	7.2	7.7
9	8.3	8.7	8.8	8.8	8.6	8.3	8.0	7.6	7.3	7.1	7.2	7.7
10	8.3	8.7	8.9	8.8	8.6	8.3	8.0	7.6	7.3	7.1	7.2	7.8
11	8.3	8.7	8.9	8.8	8.6	8.3	7.9	7.6	7.3	7.1	7.2	7.8
12	8.3	8.7	8.9	8.8	8.6	8.3	7.9	7.6	7.3	7.1	7.2	7.8
13	8.3	8.7	8.9	8.8	8.6	8.3	7.9	7.6	7.3	7.1	7.2	7.8
14	8.3	8.7	8.9	8.8	8.6	8.3	7.9	7.6	7.2	7.1	7.2	7.8
15	8.4	8.7	8.9	8.8	8.6	8.3	7.9	7.6	7.2	7.1	7.2	7.9
16	8.4	8.7	8.9	8.8	8.5	8.3	7.9	7.5	7.2	7.1	7.3	7.9
17	8.4	8.7	8.9	8.8	8.5	8.2	7.9	7.5	7.2	7.1	7.3	7.9
18	8.4	8.7	8.9	8.8	8.5	8.2	7.9	7.5	7.2	7.1	7.3	7.9
19	8.4	8.7	8.9	8.8	8.5	8.2	7.9	7.5	7.2	7.1	7.3	7.9
20	8.4	8.8	8.9	8.8	8.5	8.2	7.8	7.5	7.2	7.1	7.3	8.0
21	8.5	8.8	8.9	8.8	8.5	8.2	7.8	7.5	7.2	7.1	7.3	8.0
22	8.5	8.8	e8.9	8.8	8.5	8.2	7.8	7.5	7.2	7.1	7.3	8.0
23	8.5	8.8	e8.9	8.7	8.5	8.2	7.8	7.5	7.2	7.1	7.4	8.0
24	8.5	8.8	e8.9	8.7	8.5	8.2	7.8	7.5	7.2	7.1	7.4	8.0
25	8.5	8.8	8.9	8.7	8.5	8.1	7.8	7.4	7.2	7.1	7.4	8.0
26	8.5	8.8	8.9	8.7	8.4	8.1	7.8	7.4	7.2	7.1	7.4	8.1
27	8.5	8.8	8.9	8.7	8.4	8.1	7.8	7.4	7.1	7.1	7.4	8.1
28	8.5	8.8	8.9	8.7	8.4	8.1	7.7	7.4	7.1	7.1	7.5	8.1
29	8.5	8.8	8.9	8.7	---	8.1	7.7	7.4	7.1	7.1	7.5	8.1
30	8.6	8.8	8.9	8.7	---	8.1	7.7	7.4	7.1	7.1	7.5	8.1
31	8.6	---	8.9	8.7	---	8.1	---	7.4	---	7.1	7.5	---



WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 1 of 3

[CaCO₃, calcium carbonate; N, nitrogen; NTU, nephelometric turbidity unit; P, phosphorus; ft, feet; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; μS/cm, microsiemens per centimeter; <, less than; E, estimated; U, analyzed for but not detected]

Date	Sample start time	Medium name	Barometric pressure, mm Hg (00025)	Temperature, air, °C (00020)	Depth to water level, ft below land surface (72019)	Dissolved oxygen, water, unfiltered, mg/L (00300)	pH, water, unfiltered, field, standard units (00400)	Specific conductance, water, unfiltered, μS/cm at 25 °C (00095)	Temperature, water, °C (00010)	Turbidity, water, unfiltered, broad band light source (400-680 nm), detection angle 90 +/- 30 degrees to incident light, NTU (63675)
07-14-2011	1430	Groundwater	728	21.6	19.03	11.8	7.0	898	9.4	E 34
08-23-2011	1630	Groundwater	741	28.0	20.45	5.2	7.1	936	14.2	9.9

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 2 of 3

[CaCO₃, calcium carbonate; N, nitrogen; NTU, nephelometric turbidity unit; P, phosphorus; ft, feet; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; <, less than; E, estimated; U, analyzed for but not detected]

Date	Sample start time	Sample purpose (71999)	Sampler type (84164)	Alkalinity, water, filtered, inflection-point, incremental titration method, field, mg/L as CaCO ₃ (39086)	Bicarbonate, water, filtered, inflection-point, incremental titration method, field, mg/L (00453)	Carbonate, water, filtered, inflection-point, incremental titration method, field, mg/L (00452)	Hydrogen sulfide, water, unfiltered, mg/L (71875)	Ammonia, water, filtered, mg/L as N (00608)	Nitrate plus nitrite, water, filtered, mg/L as N (00631)
07-14-2011	1430	GW Network	Peristaltic pump	217	265	.2	U	< .010	47.9
08-23-2011	1630	GW Network	Peristaltic pump	257	312	.3	U	.015	49.1

WATER-QUALITY DATA
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011

Part 3 of 3

[CaCO₃, calcium carbonate; N, nitrogen; NTU, nephelometric turbidity unit; P, phosphorus; ft, feet; mg/L, milligrams per liter; mm Hg, millimeters of mercury; nm, nanometers; °C, degrees Celsius; µS/cm, microsiemens per centimeter; <, less than; E, estimated; U, analyzed for but not detected]

Date	Sample start time	Nitrite, water, filtered, mg/L as N (00613)	Orthophosphate, water, filtered, mg/L as P (00671)	Phosphorus, water, filtered, mg/L as P (00666)	Total nitrogen, water, filtered, analytically determined, mg/L (62854)
07-14-2011	1430	< .001	.016	.012	47.8
08-23-2011	1630	< .001	.012	.005	56.7

CLIMATOLOGICAL RECORDS

PERIOD OF RECORD.--Precipitation were recorded hourly during May 05, 2004 at 17:00 CDT - to the present, except during the following periods:

Apr. 07, 2005 at 18:00 CDT - Dec. 31, 2006 at 23:00 CST: due to station failure.
Jan. 01, 2007 at 00:00 CDT - Aug. 21, 2011 at 18:00 CDT: data was deleted due to false tips.

Precipitation was recorded quarter-hourly from Apr. 15, 2011 at 09:15 CDT to the present.

INSTRUMENTATION.--Precipitation is measured with a Weather Measure Corp. 7.9-inch P-501 tipping-bucket rain gage accurate to 0.01 inch, except during freezing periods (about Dec. through early Apr.). The rain gage is unheated and uncovered. The precipitation data during freezing periods result from melting of snow (accumulated in the rain gage) during warm periods and do NOT represent actual precipitation. Precipitation totals during freezing periods may underestimate actual totals because the rain gage funnel may be full of snow (preventing further accumulation) or because snow in the funnel may sublimate instead of melt.

REMARKS.--The raingage at this site is affected by irrigation. Much of the record is missing because of false readings produced by a poor installation. The installation was repaired on Aug. 21, 2011.

EXTREMES FOR PERIOD OF RECORD.--

PRECIPITATION: Maximum hourly, 0.42 inches on Aug. 27, 2011 at 09:00 CDT; maximum daily, 0.46 inches on Sept. 01, 2011.

EXTREMES FOR CURRENT YEAR.--

PRECIPITATION: Maximum hourly, 0.42 inches on Aug. 27, 2011 at 09:00 CDT; maximum daily, 0.46 inches on Sept. 01, 2011.

EXTREMES FOR CURRENT YEAR.--Maximum daily precipitation, 0.46 in., Sept. 1; minimum precipitation, 0.00 in., on many days.

PRECIPITATION, TOTAL, INCHES
WATER YEAR OCTOBER 2010 TO SEPTEMBER 2011
DAILY SUM VALUES

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	---	---	---	---	---	---	---	---	---	---	0.46
2	---	---	---	---	---	---	---	---	---	---	---	0.00
3	---	---	---	---	---	---	---	---	---	---	---	0.00
4	---	---	---	---	---	---	---	---	---	---	---	0.00
5	---	---	---	---	---	---	---	---	---	---	---	0.00
6	---	---	---	---	---	---	---	---	---	---	---	0.00
7	---	---	---	---	---	---	---	---	---	---	---	0.00
8	---	---	---	---	---	---	---	---	---	---	---	0.24
9	---	---	---	---	---	---	---	---	---	---	---	0.00
10	---	---	---	---	---	---	---	---	---	---	---	0.00
11	---	---	---	---	---	---	---	---	---	---	---	0.00
12	---	---	---	---	---	---	---	---	---	---	---	0.00
13	---	---	---	---	---	---	---	---	---	---	---	0.01
14	---	---	---	---	---	---	---	---	---	---	---	0.00
15	---	---	---	---	---	---	---	---	---	---	---	0.00
16	---	---	---	---	---	---	---	---	---	---	---	0.00
17	---	---	---	---	---	---	---	---	---	---	---	0.00
18	---	---	---	---	---	---	---	---	---	---	---	0.03
19	---	---	---	---	---	---	---	---	---	---	---	0.00
20	---	---	---	---	---	---	---	---	---	---	---	0.28
21	---	---	---	---	---	---	---	---	---	---	---	0.08
22	---	---	---	---	---	---	---	---	---	---	0.00	0.00
23	---	---	---	---	---	---	---	---	---	---	0.00	0.00
24	---	---	---	---	---	---	---	---	---	---	0.15	0.00
25	---	---	---	---	---	---	---	---	---	---	0.00	0.00
26	---	---	---	---	---	---	---	---	---	---	0.00	0.00
27	---	---	---	---	---	---	---	---	---	---	0.42	0.00
28	---	---	---	---	---	---	---	---	---	---	0.00	0.00
29	---	---	---	---	---	---	---	---	---	---	0.00	0.00
30	---	---	---	---	---	---	---	---	---	---	0.15	0.00
31	---	---	---	---	---	---	---	---	---	---	0.01	---
Total	---	---	---	---	---	---	---	---	---	---	---	1.10

