

2016 Annual Rainfall Report

Monitoring and Modeling



Saskatoon Water
Transportation & Utilities Department



EXECUTIVE SUMMARY

The following report provides a summary of Saskatoon's 2016 rainfall season (April to September) and a comparison with historical rainfall. Highlights of the report include the following:

- In 2016, 283 mm of rainfall accumulated, which was slightly more than the historical average of 265 mm.
- Rainfall occurred on 49% of days in 2016 with 24 mm being the largest amount of rainfall to accumulate in a single day.
- Saskatoon had a moderately dry spring in 2016 with 106 mm of accumulated rainfall between April and June. This is the 47th lowest spring rainfall since 1900.
- Saskatoon had a wet summer in 2016 with 177 mm of accumulated rainfall between July and September. This is the 24th highest summer rainfall since 1900.
- 2016 had an average of one rain event with a return period of two years or greater.



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INTRODUCTION

The purpose of this report is to provide a summary of the 2016 rainfall season in Saskatoon and a comparison of this rainfall data with historical rainfall data. Within the scope of this report, a rainfall season is defined as the time period between April 1st and September 30th. Data between 1900 and 2011 was obtained from the Environment Canada rain gauge while 2012 to 2016 data was obtained from the eight City of Saskatoon rain gauges. The name, location, approximate area, and total seasonal rainfall of the aforementioned rain gauges are shown below.

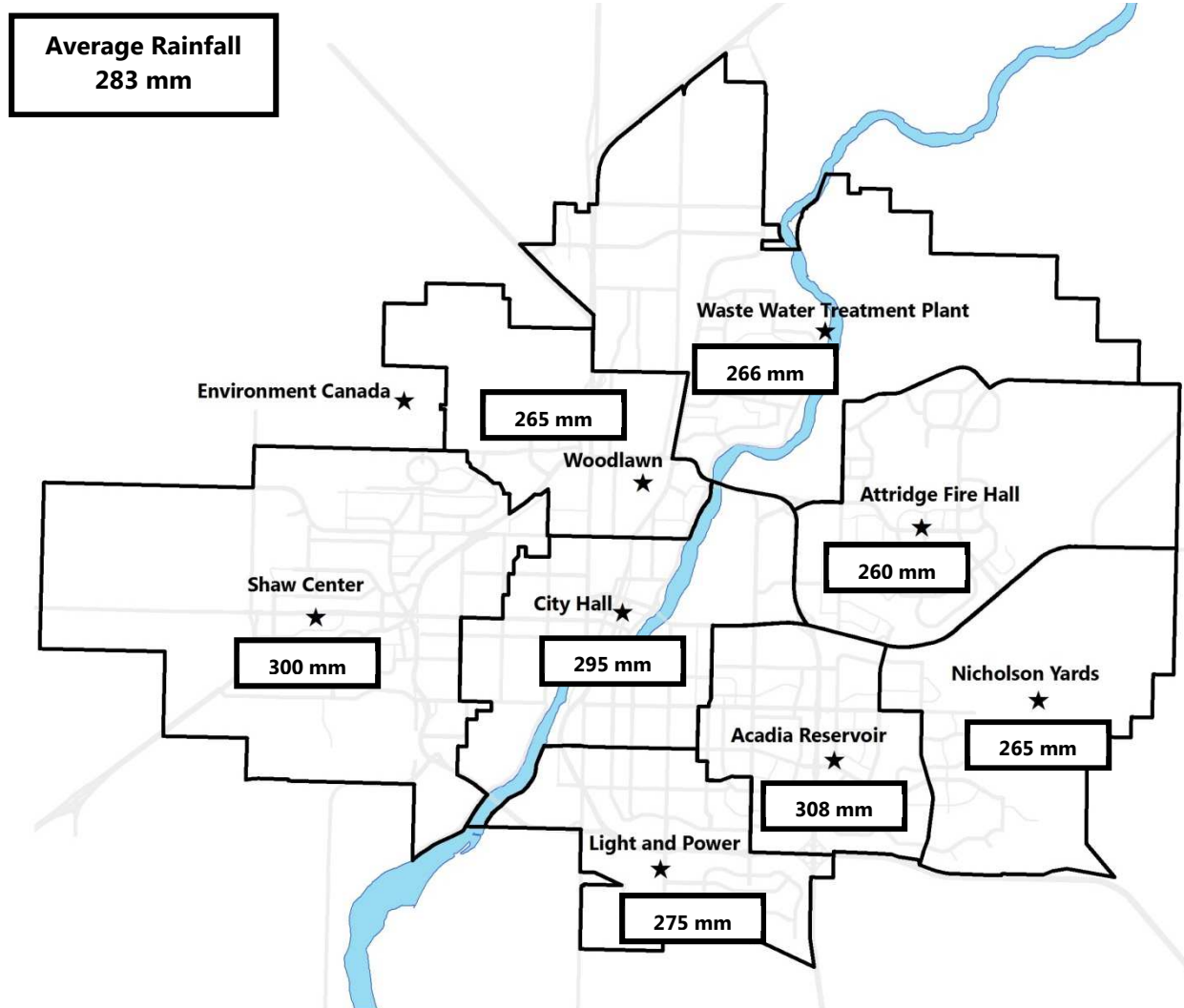


Figure 1: Overview of Rain Gauges.



SUMMARY OF RAINFALL IN 2016

A daily weighted average for all City of Saskatoon rain gauges functioning on a particular day was calculated to determine the average daily rainfall for Saskatoon. The following graph depicts the average daily rainfall that occurred in Saskatoon throughout the 2016 rainfall season.

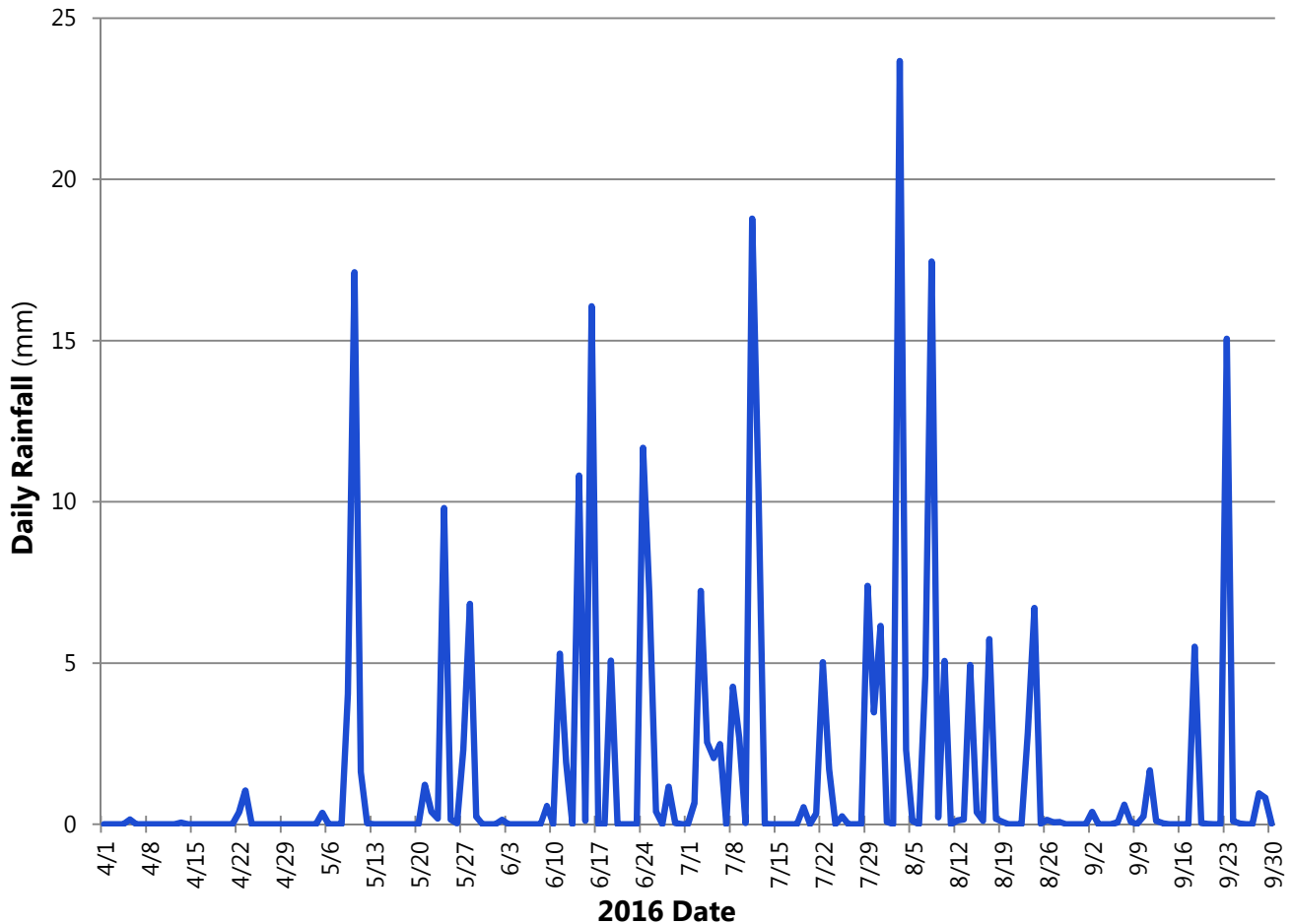


Figure 2: 2016 Daily Rainfall.

The largest amount of rainfall occurred on August 3rd, 2016 with a total of 24 mm of rainfall. This rainfall accounted for approximately 8% of the total rainfall that occurred in 2016. It can also be observed from Figure 2 that rainfall occurred on approximately 49% of days throughout the 2016 rainfall season.



SUMMARY OF RAINFALL IN 2015

The total seasonal rainfall for 2016 was 283 mm. Figure 3 depicts the accumulation of rainfall throughout the 2016 season.

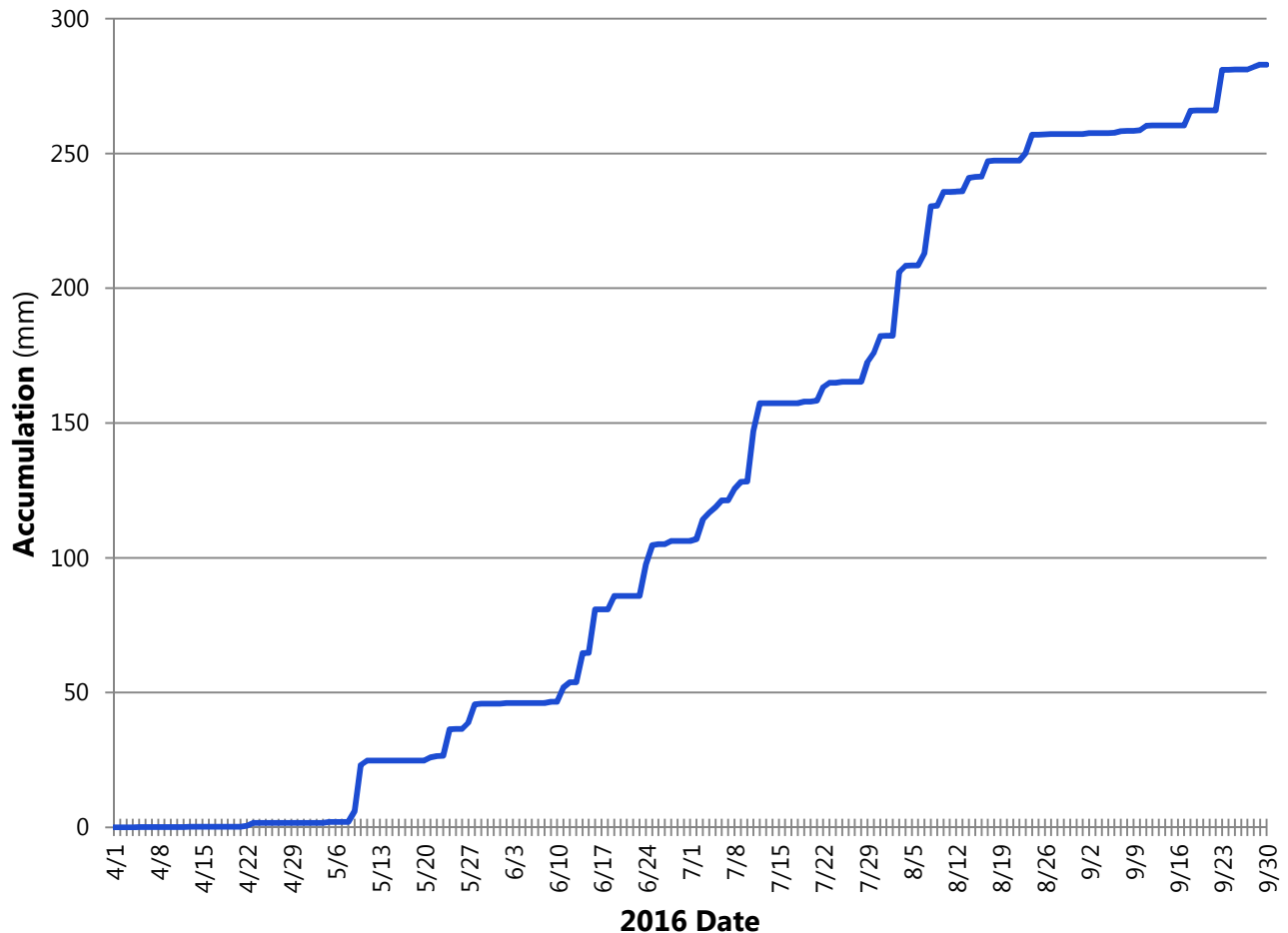


Figure 3: 2016 Rainfall Accumulation.

The 2016 rainfall season experienced a moderately dry spring, with the months of April to June accumulating a total of 106 mm of rain, which is the 47th lowest spring rainfall since 1900. This rainfall accounted for approximately 37% of the total rainfall that occurred throughout the season. The remaining 63% of the total rainfall occurred between July and September, accumulating a total of 177 mm of rain. This is the 24th highest summer rainfall since 1900.



HISTORICAL COMPARISON

The average seasonal rainfall from 1900 to 2016 in Saskatoon is 265 mm which is depicted by the light blue line in Figure 4. The 2016 seasonal rainfall of 283 mm was slightly above average and is the 39th greatest seasonal rainfall of the 116 years of data. The greatest seasonal rainfall occurred in 2010 with 569 mm, which is more than double the average seasonal rainfall. A table containing the seasonal rainfalls from 1900 to 2016 can be found in Appendix A.

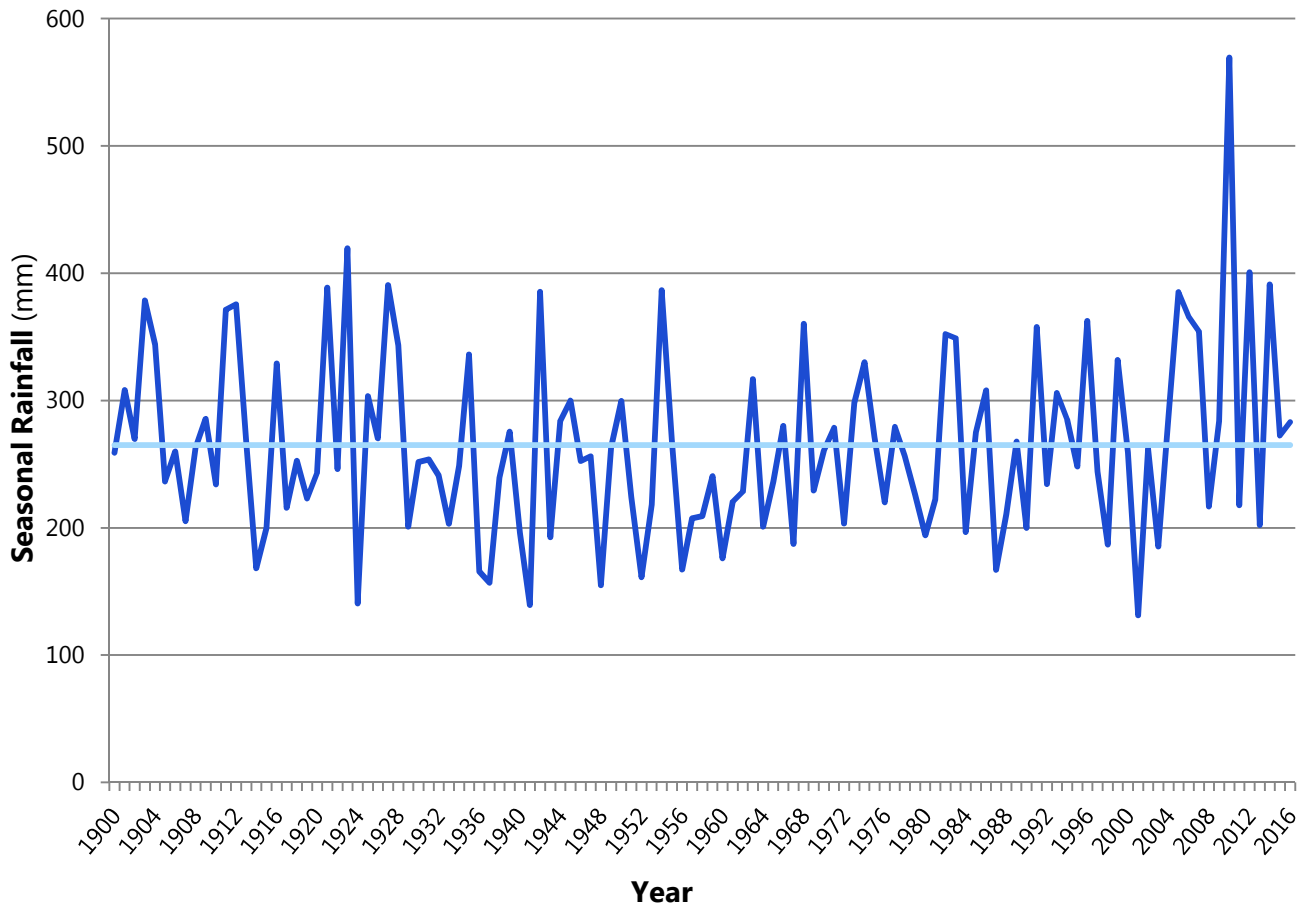


Figure 4: Seasonal Rainfall (1900-2016).



HISTORICAL COMPARISON

The following graph provides a comparison of the maximum amount of rainfall to occur in a single day in each season. The average rainfall in a single day in a season is 37 mm from the years 1900 to 2016 and is represented by the light blue line in Figure 5. During the 2016 rainfall season, the maximum rainfall to occur within a single day was 24 mm, which occurred on August 3rd. This is the 25th lowest rainfall to occur in a single day out of the 116 years of data.

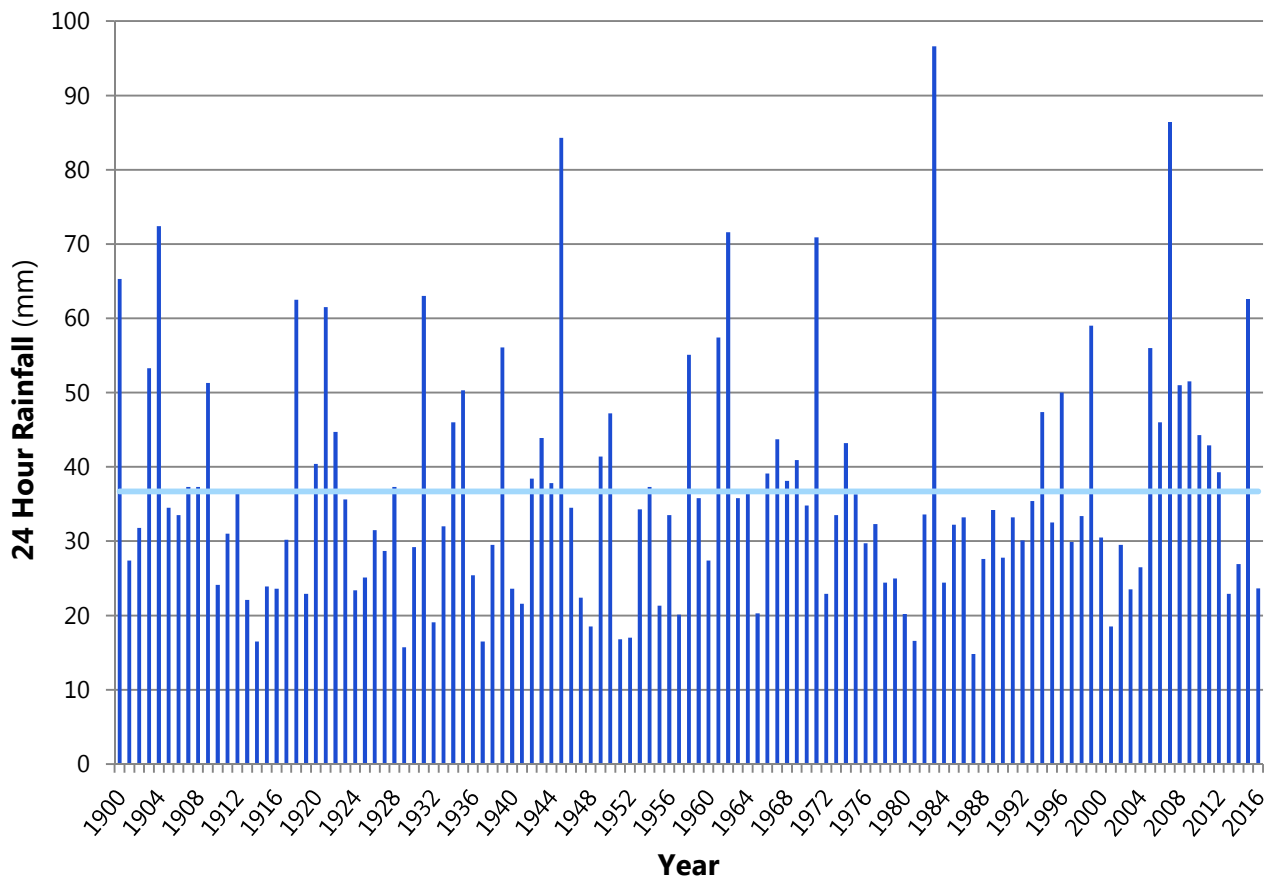


Figure 5: Maximum Daily Rainfall.

As can be seen in the graph above, the greatest maximum daily rainfall occurred on June 24th, 1983, with a total of 97 mm of rain. As well, only two of the last five years have had daily rainfalls which exceed the historical average.



CLASSIFYING RAIN EVENTS

Rain events in Saskatoon are often localized. Therefore, a rain event may only occur at a few of the eight rain gauges located throughout the city. In order to compare the severity of rain events, their return period must be determined. A return period provides an indication of the likelihood of an event. For example, a rain event with a return period of 2 years has a 50% chance of occurring in any given year. For comparison, a rain event with a return period of 100 years has a 1% chance of occurring in any given year. The following table provides a summary of the criteria used to determine the return period of each rain event.

Table 1: Criteria for Determining Return Period of Rain Event.

Time (minutes)	Intensity (mm/hr)			
	2-Year	5-Year	25-Year	100-Year
10	53	85	132	168
15	41	67	104	133
30	26.4	46.1	74	97
60	16.6	28.9	46.5	60
120	10.7	17.5	27.3	35
360	4.7	7.0	10.3	12.9
720	2.73	3.90	5.59	6.91
1440	1.56	2.18	3.07	3.76

For the purposes of this report, two different methods were utilized to determine the number of rain events with a return period of 2, 5, 25, or 100 years between 2012 and 2016. It should be noted that within this report, rain events with the same return period may include any of the durations as outlined in Table 1. The first method determined the average number of rain events for each return period by adding together the number of events in a season with the same return period at each of the city's rain gauges and dividing that number by eight. The following table provides a summary of these values. A more detailed table can be found in Appendix C.

Table 2: Average Frequency of Rain Events.

	Return Period	2012	2013	2014	2015	2016	Total
Average	2 – 5 Year	4	1	3	1	1	10
	5 – 25 Year	0	0	0	1	0	1
	25 – 100 Year	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0
	Total	4	1	3	2	1	11



CLASSIFYING RAIN EVENTS

The second method determined the overall number of rain events for each return period by counting the number of rain events that occurred at one or more of the rain gauges on any given day within a season. If the rain gauges had varying return periods on a given day, the maximum return period was counted as the rain event for that day. The following table provides a summary of these values.

Table 3: Overall Frequency of Rain Events.

	Return Period	2012	2013	2014	2015	2016	Total
Overall	2 – 5 Year	8	5	6	3	3	25
	5 – 25 Year	0	1	1	0	0	2
	25 – 100 Year	0	0	0	1	0	1
	> 100 Years	0	0	0	0	0	0
	Total	8	6	7	4	3	28



CONCLUSION

Overall, the 2016 rainfall season had an accumulation which was marginally greater than the historical seasonal average. Although the 2016 rainfall season had a moderately dry spring, the summer was wet with 63% of the seasonal rainfall occurring between the months of July and September. During these three months, two rain events occurred with a return period of two years or greater occurred throughout Saskatoon. The largest rain event occurred on August 8th and was determined to be a two year return period event. However, this event was only experienced at two of the City's eight rain gauges. The remaining six rain gauges experienced a rain event with a smaller average intensity resulting in an event with a return period which was less than two years.



APPENDICES

Appendix A – Total Seasonal Rainfall (1900-2016)



APPENDIX A

Year	Rain (mm)	Rank	Year	Rain (mm)	Rank	Year	Rain (mm)	Rank
1900	259	58	1942	385	8	1984	197	100
1901	308	27	1943	193	103	1985	275	44
1902	270	48	1944	284	37	1986	308	28
1903	379	10	1945	300	31	1987	167	110
1904	344	20	1946	252	63	1988	211	89
1905	236	73	1947	256	60	1989	268	50
1906	260	56	1948	155	114	1990	200	98
1907	205	92	1949	263	52	1991	358	16
1908	262	53	1950	300	32	1992	234	75
1909	286	35	1951	224	80	1993	306	29
1910	234	76	1952	161	112	1994	285	36
1911	371	12	1953	218	85	1995	248	66
1912	375	11	1954	387	7	1996	362	14
1913	266	51	1955	268	49	1997	244	68
1914	168	108	1956	167	109	1998	187	105
1915	200	99	1957	208	91	1999	332	23
1916	329	25	1958	209	90	2000	259	57
1917	216	88	1959	241	71	2001	131	117
1918	253	62	1960	176	107	2002	262	54
1919	223	81	1961	221	83	2003	185	106
1920	243	69	1962	229	78	2004	288	34
1921	389	6	1963	317	26	2005	385	9
1922	246	67	1964	201	97	2006	366	13
1923	420	2	1965	236	74	2007	354	17
1924	141	115	1966	280	40	2008	217	87
1925	303	30	1967	187	104	2009	284	38
1926	270	47	1968	360	15	2010	569	1
1927	391	5	1969	229	77	2011	218	86
1928	343	21	1970	261	55	2012	401	3
1929	201	96	1971	279	42	2013	202	95
1930	252	64	1972	203	93	2014	391	4
1931	254	61	1973	298	33	2015	272	45
1932	241	70	1974	330	24	2016	283	39
1933	203	94	1975	271	46			
1934	249	65	1976	220	84			
1935	336	22	1977	279	41			
1936	166	111	1978	256	59			
1937	157	113	1979	226	79			
1938	239	72	1980	194	102			
1939	275	43	1981	222	82			
1940	196	101	1982	352	18			
1941	139	116	1983	349	19			



APPENDICES

Appendix B – Return Period of Rain Events by Rain Gauge



APPENDIX B

	Return Period	2012	2013	2014	2015	2016	Total
Waste Water Treatment Plant	2 - 5 Year	4	0	3	1	1	9
	5 - 25 Year	0	0	0	1	0	1
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	4	0	3	2	1	10
Woodlawn	2 - 5 Year	5	1	3	2	1	12
	5 - 25 Year	0	1	0	1	0	2
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	5	2	3	3	1	14
Shaw Center	2 - 5 Year	5	2	5	3	1	16
	5 - 25 Year	0	0	0	1	0	1
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	5	2	5	4	1	17
Nicholson Yards	2 - 5 Year	2	0	2	1	0	5
	5 - 25 Year	0	0	1	1	0	2
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	2	0	3	2	0	7
Light and Power	2 - 5 Year	2	2	3	0	1	8
	5 - 25 Year	0	0	0	0	0	0
	25 - 100 Year	0	0	0	1	0	1
	> 100 Year	0	0	0	0	0	0
	Total	2	2	3	1	1	9
City Hall	2 - 5 Year	5	3	4	1	1	14
	5 - 25 Year	0	0	0	0	0	0
	25 - 100 Year	0	0	0	1	0	1
	> 100 Year	0	0	0	0	0	0
	Total	5	3	4	2	1	15
Attridge Fire Hall	2 - 5 Year	1	1	1	1	0	4
	5 - 25 Year	0	0	0	1	0	1
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	1	1	1	2	0	5
Acadia Reservoir	2 - 5 Year	4	1	2	1	2	10
	5 - 25 Year	0	0	0	1	0	1
	25 - 100 Year	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0
	Total	4	1	2	2	2	11