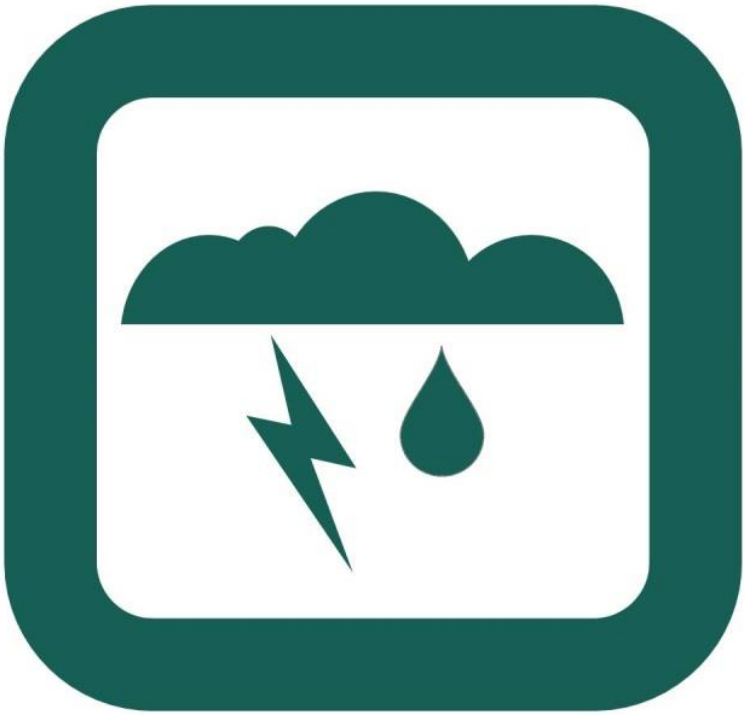
2017 Annual Rainfall Report

Monitoring and Modeling



Saskatoon Water
Transportation & Utilities Department

City of Saskatoon

EXECUTIVE SUMMARY

The following report provides a summary of Saskatoon's 2017 rainfall season (April to September) and a comparison with historical rainfall. Highlights of the report include the following:

- In 2017, 230 mm of rainfall accumulated, which was slightly less than the historical average of 265 mm.
- Rainfall occurred on 42% of days in 2017 with 24 mm being the largest amount of rainfall to accumulate in a single day.
- Saskatoon had normal precipitation levels in the spring of 2017 with 111 mm of accumulated rainfall between April and June. This is the 53rd lowest spring rainfall since 1900.
- Saskatoon had a moderately dry summer in 2017 with 119 mm of accumulated rainfall between July and September. This is the 47th lowest summer rainfall since 1900.
- 2017 had an average of one rain event with a return period of two years or greater.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The purpose of this report is to provide a summary of the 2017 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 eight City of Saskatoon rain gauges. In 2017, one of the City of Saskatoon rain gauges was decommissioned and therefore 2017 data was obtained from the seven City of Saskatoon rain gauges. The name, location, approximate area, and total seasonal rainfall of the aforementioned rain gauges are shown below.

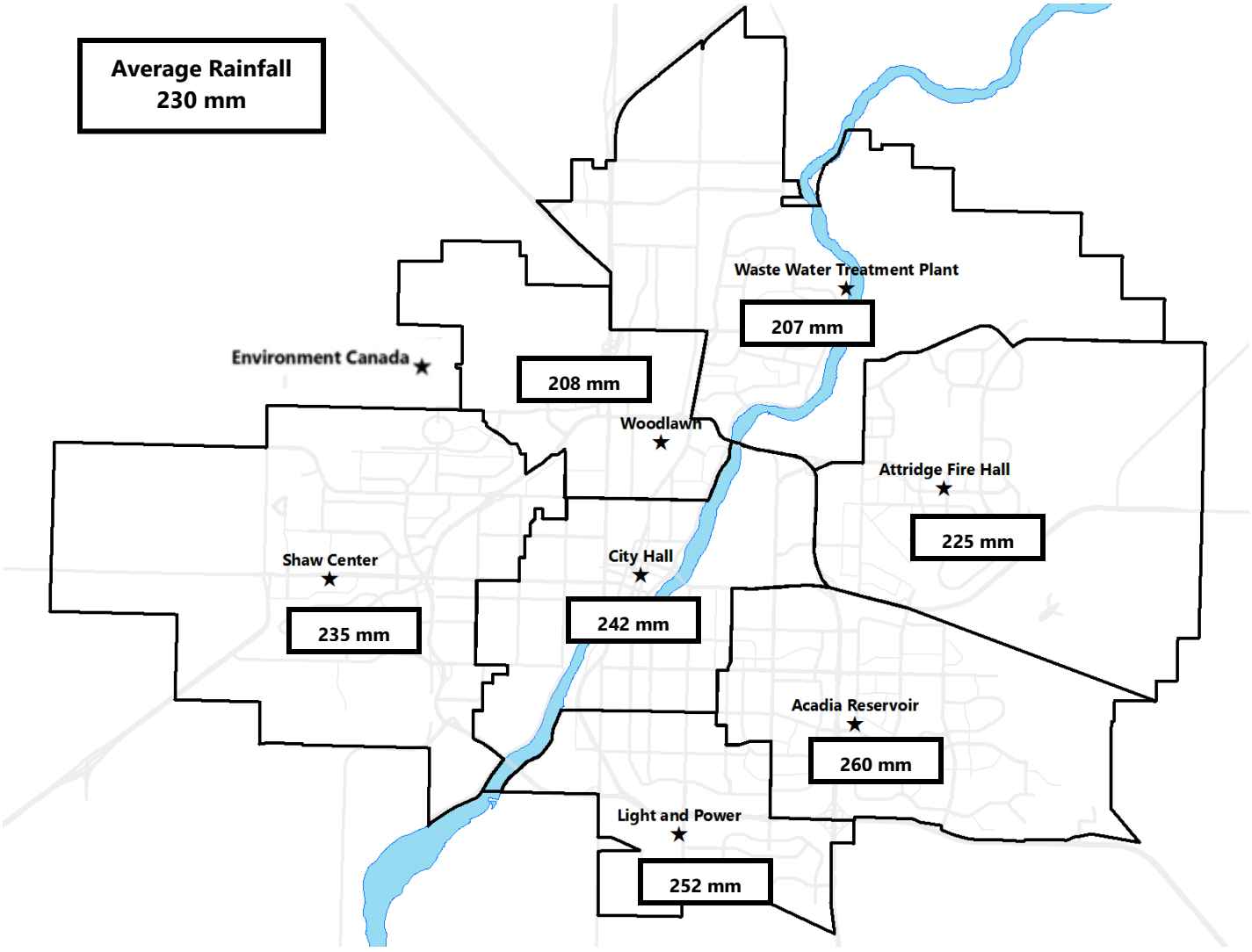


Figure 1: Overview of Rain Gauges.

SUMMARY OF RAINFALL IN 2017

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 2017 rainfall season.

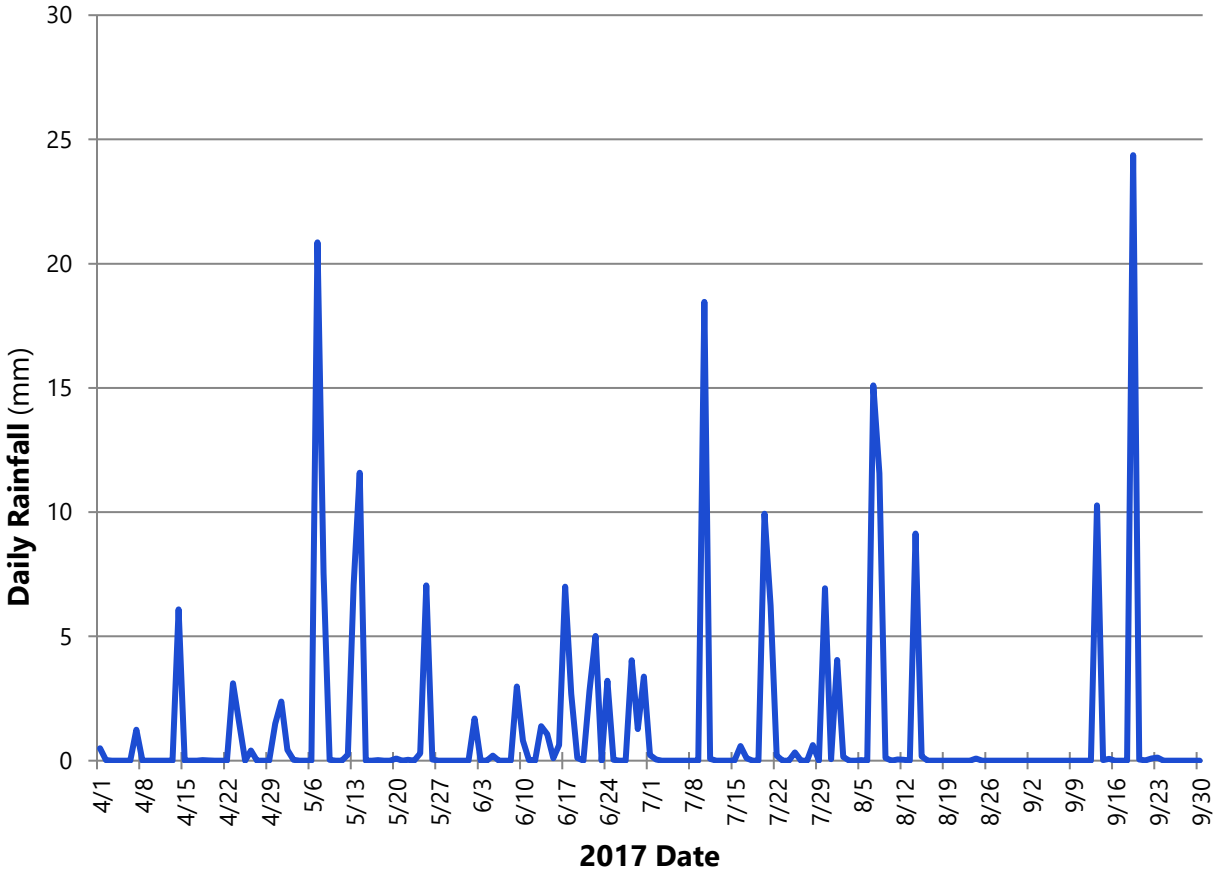


Figure 2: 2017 Daily Rainfall.

The largest amount of rainfall occurred on September 19th, 2017 with a total of 24 mm of rainfall. This rainfall accounted for approximately 10% of the total rainfall that occurred in 2017. It can also be observed from Figure 2 that rainfall occurred on approximately 42% of days throughout the 2017 rainfall season.

SUMMARY OF RAINFALL IN 2017

The total seasonal rainfall for 2017 was 230 mm. Figure 3 depicts the accumulation of rainfall throughout the 2017 season.

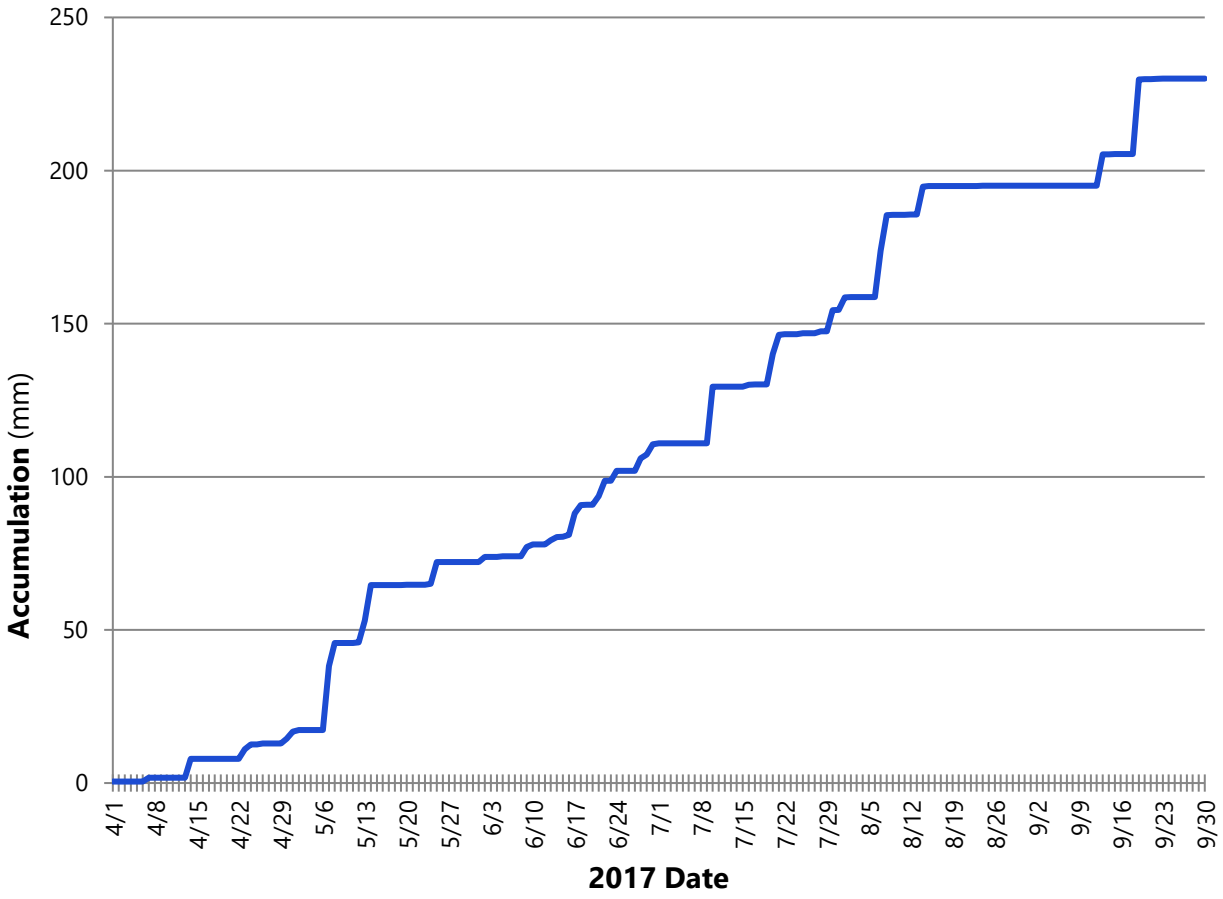


Figure 3: 2017 Rainfall Accumulation.

The 2017 rainfall season experienced a normal spring, with the months of April to June accumulating a total of 111 mm of rain, which is the 53rd lowest spring rainfall out of 118 years since 1900. This rainfall accounted for approximately 48% of the total rainfall that occurred throughout the season. The remaining 52% of the total rainfall occurred between July and September, accumulating a total of 119 mm of rain. This is the 47th lowest summer rainfall out of 118 years since 1900.

HISTORICAL COMPARISON

The average seasonal rainfall from 1900 to 2017 in Saskatoon is 265 mm which is depicted by the light blue line in Figure 4. The 2017 seasonal rainfall of 230 mm was slightly below average and is the 41st lowest seasonal rainfall of the 118 years of data. The lowest seasonal rainfall occurred in 2001 with 131 mm, which is less than half of the average seasonal rainfall. A table containing the seasonal rainfalls from 1900 to 2017 can be found in Appendix A.

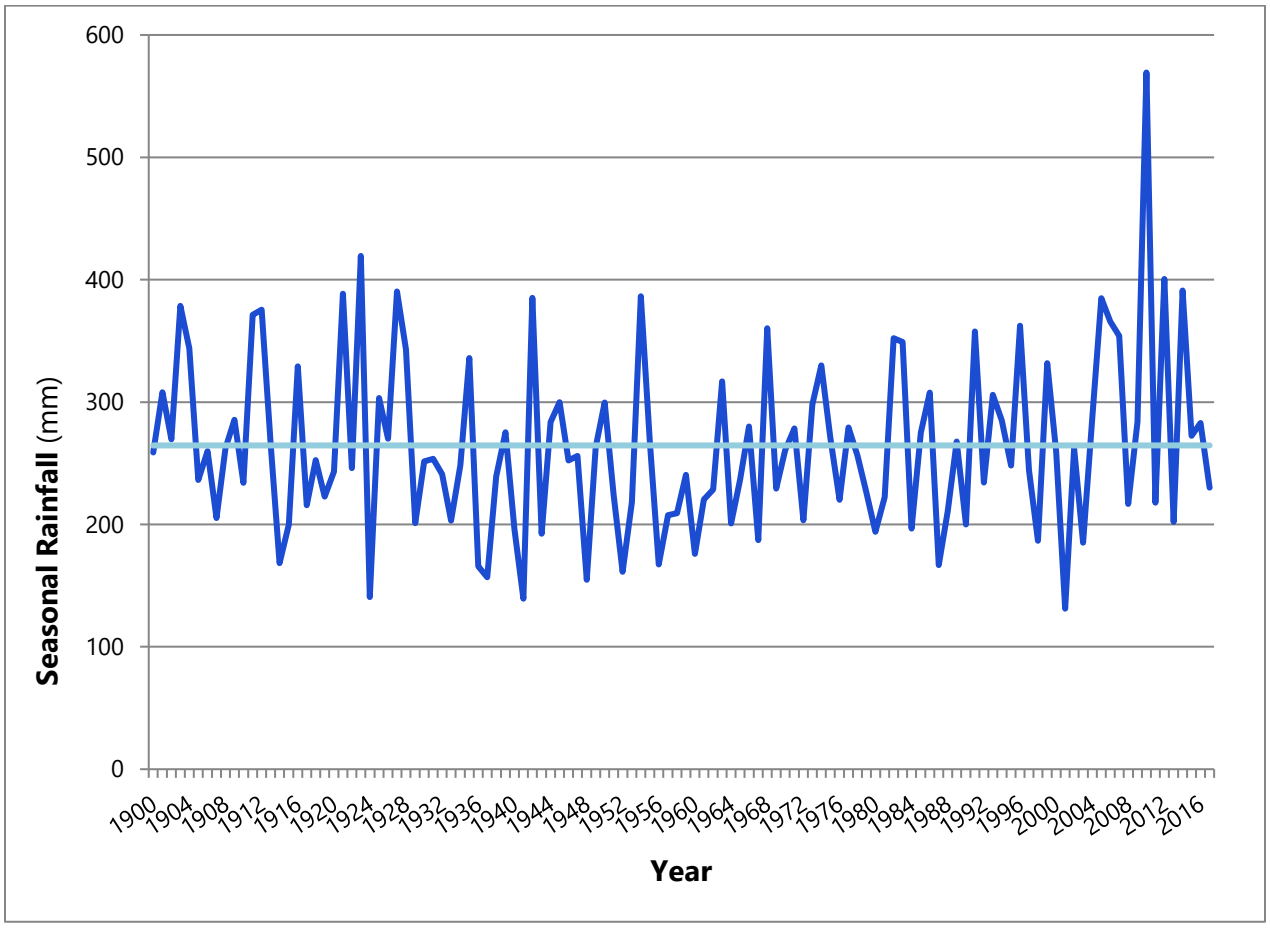


Figure 4: Seasonal Rainfall (1900-2017).

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 2017 and is represented by the light blue line in Figure 5. During the 2017 rainfall season, the maximum rainfall to occur within a single day was 24 mm, which occurred on September 19th. This is the 28th lowest rainfall to occur in a single day out of the 118 years of data.

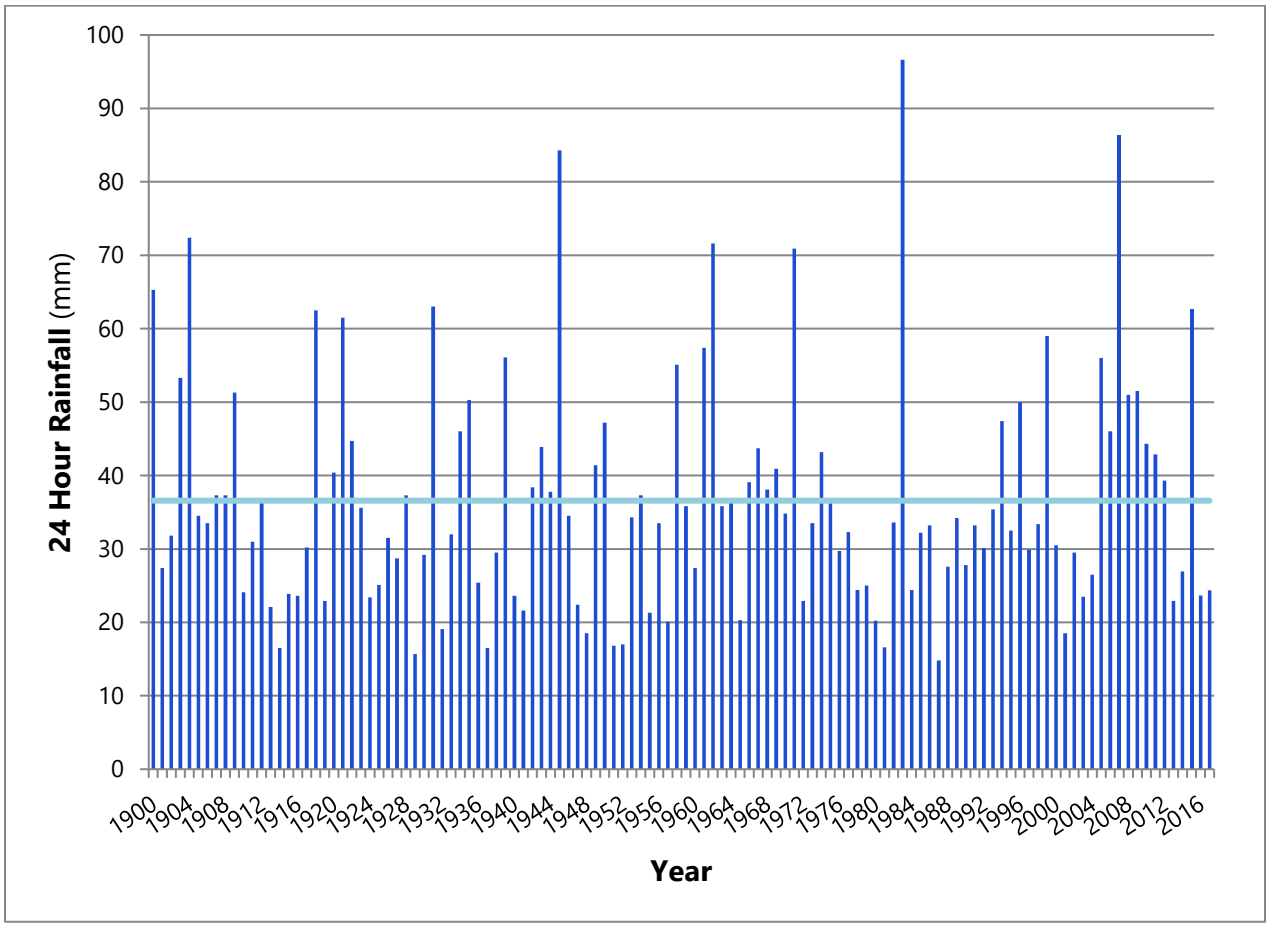


Figure 5: Maximum Daily Rainfall.

As can be seen in the graph above, the lowest maximum daily rainfall occurred on July 19th, 1987, with a total of 15 mm of rain. As well, only one 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 seven 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 2017. 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 seven. The following table provides a summary of these values. A more detailed table can be found in Appendix B.

Table 2: Average Frequency of Rain Events.

	Return Period	2012	2013	2014	2015	2016	2017	Total
Average	2 – 5 Year	4	1	3	1	1	1	11
	5 – 25 Year	0	0	0	1	0	0	1
	25 – 100 Year	0	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0	0
	Total	**4**	**1**	**3**	**2**	**1**	**1**	**12**

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	2017	Total
Overall	2 – 5 Year	8	5	6	3	3	2	27
	5 – 25 Year	0	1	1	0	0	1	3
	25 – 100 Year	0	0	0	1	0	0	1
	> 100 Years	0	0	0	0	0	0	0
	Total	**8**	**6**	**7**	**4**	**3**	**3**	**31**

On August 8th a major rain event primarily affected the Adelaide/Churchill, Avalon, and Haultain neighborhoods. Due to the localized nature of high intensity rain events, the City of Saskatoon rain gauge network may not have captured the full extent of this event. However, an unofficial Environment Canada rain gauge located in Holliston measured 53 mm of rain over 60 minutes. This rain event reached a peak intensity of 127 mm/hour and had an average intensity of 49 mm/hour which is rated as a 25-100 year return period.

CONCLUSION

Overall, the 2017 rainfall season had an accumulation which was marginally less than the historical seasonal average. Two rain events occurred with a return period of 2-5 years and one rain event with at return period of 5-25 years. The largest rain event occurred on July 10th and was determined to be a 5-25 year return period event. However, this event was only experienced at one of the City's seven rain gauges. On August 8th, an unofficial Environment Canada rain gauge captured a localized rain event that was rated as a 25-100 year return period.

APPENDICES

Appendix A – Total Seasonal Rainfall (1900-2017)

APPENDIX A

Year	Rain (mm)	Rank	Year	Rain (mm)	Rank	Year	Rain (mm)	Rank
1900	259	58	1942	385	8	1984	197	101
1901	308	27	1943	193	104	1985	275	44
1902	270	48	1944	284	37	1986	308	28
1903	379	10	1945	300	31	1987	167	111
1904	344	20	1946	252	63	1988	211	90
1905	236	73	1947	256	60	1989	268	50
1906	260	56	1948	155	115	1990	200	99
1907	205	93	1949	263	52	1991	358	16
1908	262	53	1950	300	32	1992	234	75
1909	286	35	1951	224	81	1993	306	29
1910	234	76	1952	161	113	1994	285	36
1911	371	12	1953	218	86	1995	248	66
1912	375	11	1954	387	7	1996	362	14
1913	266	51	1955	268	49	1997	244	68
1914	168	109	1956	167	110	1998	187	106
1915	200	100	1957	208	92	1999	332	23
1916	329	25	1958	209	91	2000	259	57
1917	216	89	1959	241	71	2001	131	118
1918	253	62	1960	176	108	2002	262	54
1919	223	82	1961	221	84	2003	185	107
1920	243	69	1962	229	79	2004	288	34
1921	389	6	1963	317	26	2005	385	9
1922	246	67	1964	201	98	2006	366	13
1923	420	2	1965	236	74	2007	354	17
1924	141	116	1966	280	40	2008	217	88
1925	303	30	1967	187	105	2009	284	38
1926	270	47	1968	360	15	2010	569	1
1927	391	5	1969	229	78	2011	218	87
1928	343	21	1970	261	55	2012	401	3
1929	201	97	1971	279	42	2013	202	96
1930	252	64	1972	203	94	2014	391	4
1931	254	61	1973	298	33	2015	272	45
1932	241	70	1974	330	24	2016	283	39
1933	203	95	1975	271	46	2017	230	77
1934	249	65	1976	220	85			
1935	336	22	1977	279	41			
1936	166	112	1978	256	59			
1937	157	114	1979	226	80			
1938	239	72	1980	194	103			
1939	275	43	1981	222	83			
1940	196	102	1982	352	18			
1941	139	117	1983	349	19			

APPENDICES

Appendix B – Return Period of Rain Events by Rain Gauge

APPENDIX B

	Return Period	2012	2013	2014	2015	2016	2017	Total
Waste Water Treatment Plant	2 - 5 Year	4	0	3	1	1	1	10
	5 - 25 Year	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0
	Total	**4**	**0**	**3**	**2**	**1**	**1**	**11**
Woodlawn	2 - 5 Year	5	1	3	2	1	1	13
	5 - 25 Year	0	1	0	1	0	0	2
	25 - 100 Year	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0
	Total	**5**	**2**	**3**	**3**	**1**	**1**	**15**
Shaw Center	2 - 5 Year	5	2	5	3	1	1	17
	5 - 25 Year	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0
	Total	**5**	**2**	**5**	**4**	**1**	**1**	**18**
Nicholson Yards	2 - 5 Year	2	0	2	1	0	n/a	5
	5 - 25 Year	0	0	1	1	0	n/a	2
	25 - 100 Year	0	0	0	0	0	n/a	0
	> 100 Year	0	0	0	0	0	n/a	0
	Total	**2**	**0**	**3**	**2**	**0**	**n/a**	**7**
Light and Power	2 - 5 Year	2	2	3	0	1	0	8
	5 - 25 Year	0	0	0	0	0	1	1
	25 - 100 Year	0	0	0	1	0	0	1
	> 100 Year	0	0	0	0	0	0	0
	Total	**2**	**2**	**3**	**1**	**1**	**1**	**10**
City Hall	2 - 5 Year	5	3	4	1	1	1	15
	5 - 25 Year	0	0	0	0	0	0	0
	25 - 100 Year	0	0	0	1	0	0	1
	> 100 Year	0	0	0	0	0	0	0
	Total	**5**	**3**	**4**	**2**	**1**	**1**	**16**
Attridge Fire Hall	2 - 5 Year	1	1	1	1	0	0	4
	5 - 25 Year	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0
	Total	**1**	**1**	**1**	**2**	**0**	**0**	**5**
Acadia Reservoir	2 - 5 Year	4	1	2	1	2	2	12
	5 - 25 Year	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0
	Total	**4**	**1**	**2**	**2**	**2**	**2**	**13**