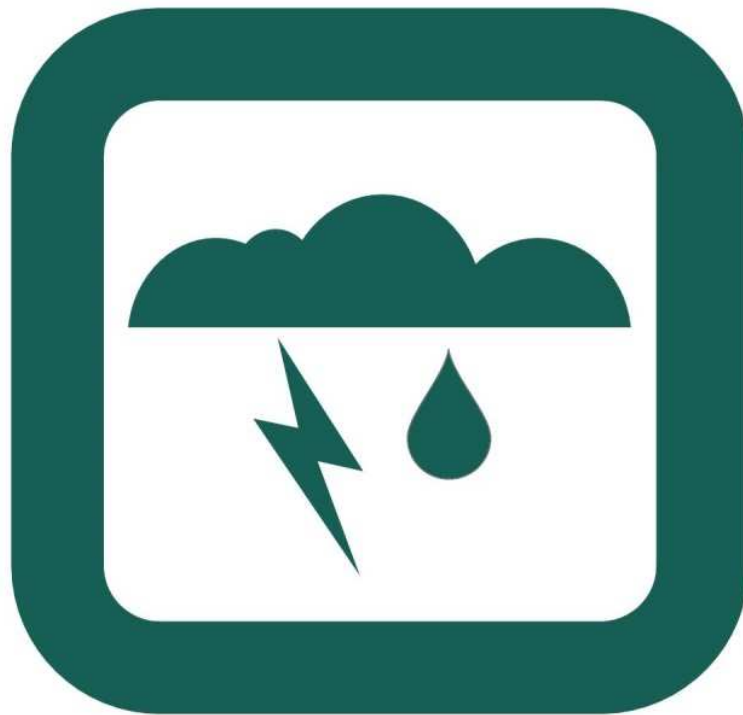


2015 Annual Rainfall Report

Water and Sewer Planning



Saskatoon Water
Transportation & Utilities Department



EXECUTIVE SUMMARY

The following report provides a summary of Saskatoon's 2014 and 2015 rainfall seasons (April to September) and a comparison with historical rainfall. Highlights of the report include the following:

- In 2015, 272 mm of rainfall accumulated, which was slightly more than the historical average and significantly less than the 391 mm which was accumulated in 2014.
- Rainfall occurred on 34% of days in 2015 compared to 46% of days in 2014.
- Saskatoon had a dry spring in 2015 with only 55 mm of accumulated rainfall between April and June. This is the 5th lowest spring rainfall since 1900. Spring of 2014 was wet, with 274 mm of rain accumulated between April and June. This is the 3rd highest spring rainfall since 1900.
- On July 28th, 2015, Saskatoon experienced a rain event which accumulated a total of 63 mm of rain in a single day. This is the 9th greatest rainfall to occur in a single day since 1900.
- Eight of the last ten years had a daily maximum rainfall which exceeded the historical average.
- 2015 had an average of two rain events with a return period of two years or greater while 2014 had an average of three rain events with a return period of two years or greater.



TABLE OF CONTENTS

List of Figures.....	3
List of Tables	3
Introduction	4
Summary of Rainfall in 2015	5
Historical Comparison	7
Classifying Rain Events.....	9
Conclusion	11
Appendices.....	12
Appendix A – Summary of Rainfall in 2014.....	12
Appendix B – Total Seasonal Rainfall (1900-2015).....	16
Appendix C – Return Period of Rain Events by Rain Gauge	18



LIST OF FIGURES

Figure 1: Overview of Rain Gauges.....	4
Figure 2: 2015 Daily Rainfall.....	5
Figure 3: 2015 Rainfall Accumulation.....	6
Figure 4: Seasonal Rainfall (1900-2015).	7
Figure 5: Maximum Daily Rainfall.....	8

LIST OF TABLES

Table 1: Criteria for Determining Return Period of Rain Event.....	9
Table 2: Average Frequency of Rain Events.....	9
Table 3: Overall Frequency of Rain Events.....	10



INTRODUCTION

The purpose of this report is to provide a summary of the 2015 rainfall season in Saskatoon and a comparison of this rainfall data with historical rainfall data. As well, a summary of the 2014 rainfall season in Saskatoon can be found in Appendix A. 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 2015 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.

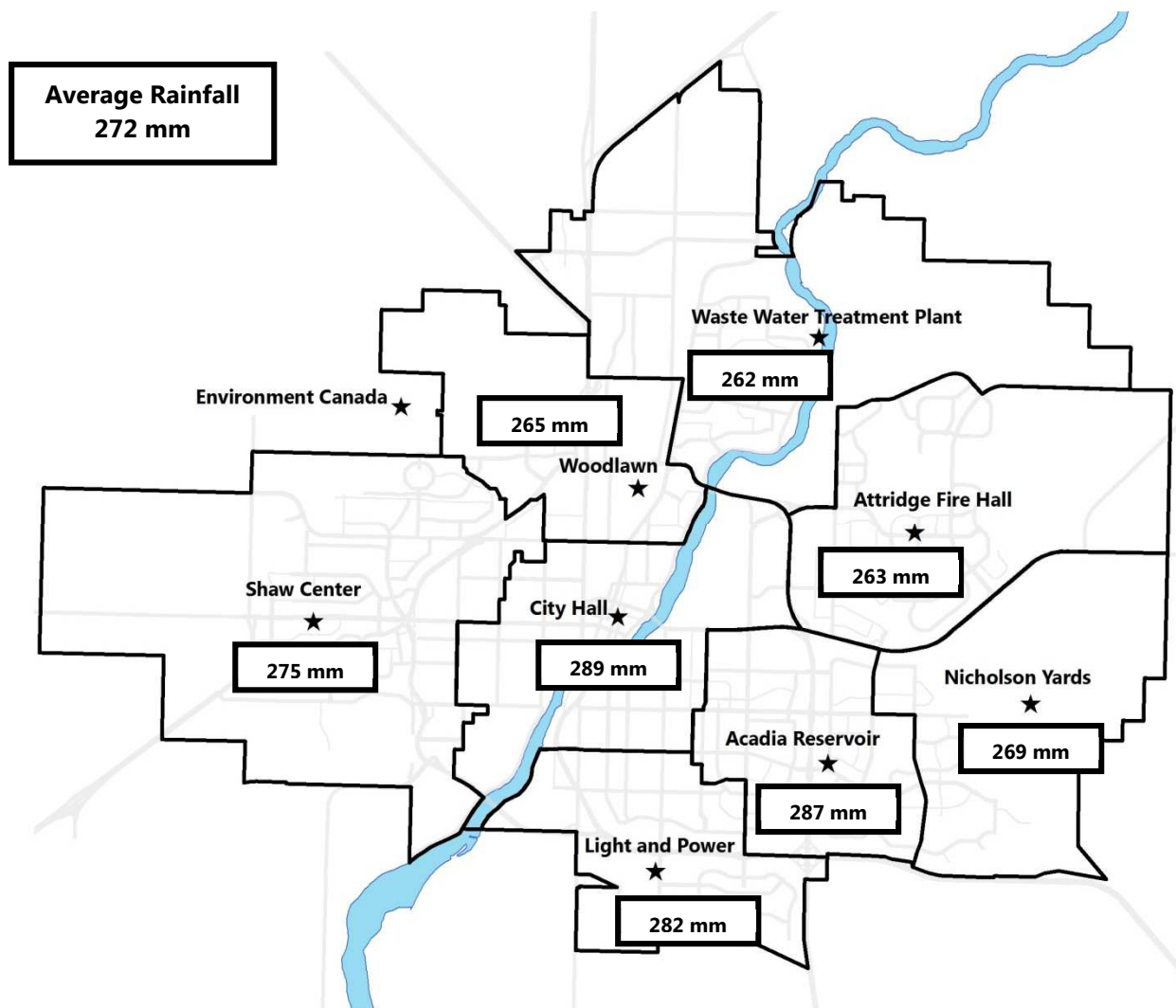


Figure 1: Overview of Rain Gauges.



SUMMARY OF RAINFALL IN 2015

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 2015 rainfall season.

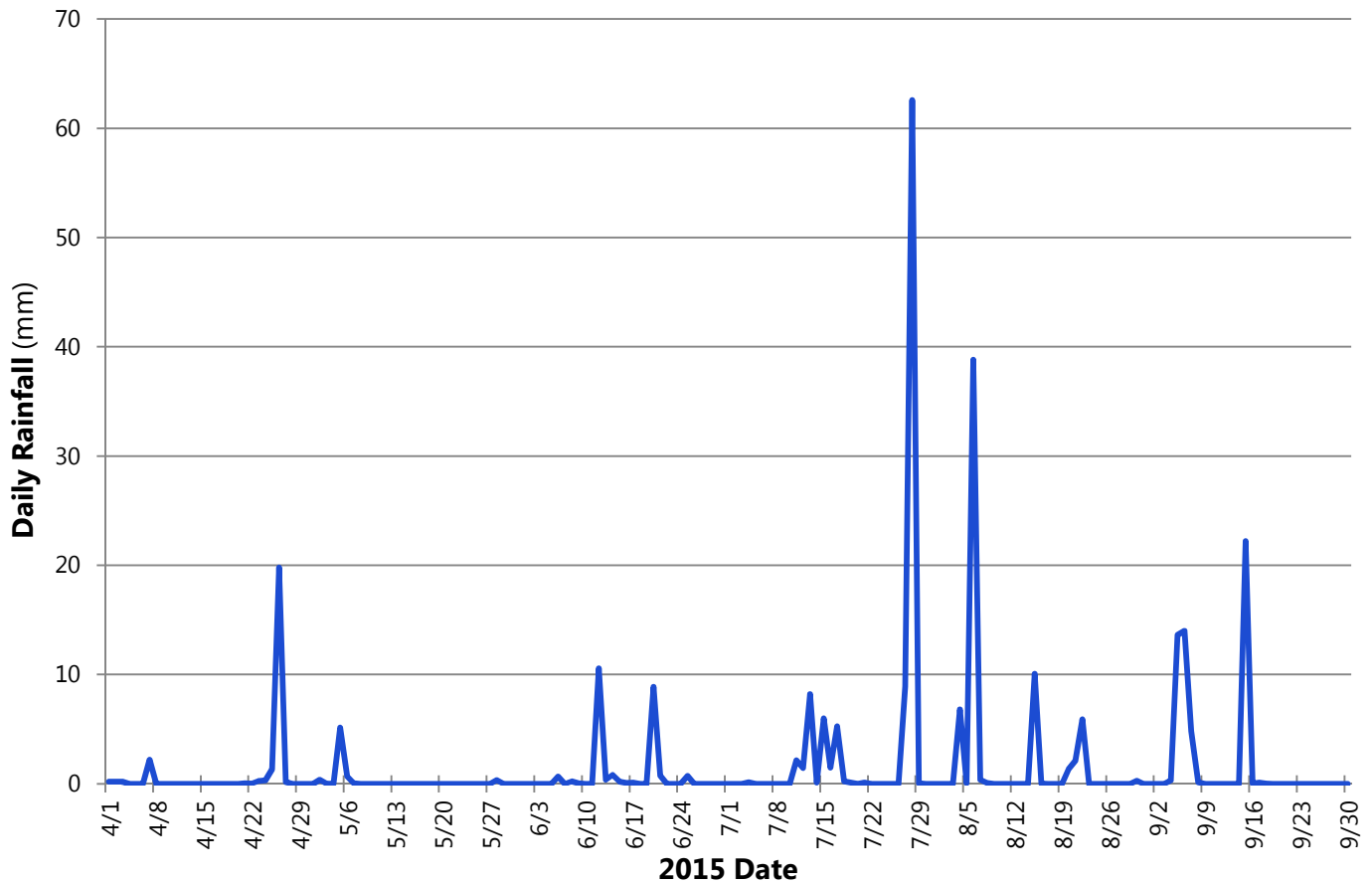


Figure 2: 2015 Daily Rainfall.

The largest amount of rainfall occurred on July 28th, 2015 with a total of 63 mm of rainfall. This rainfall accounted for approximately 23% of the total rainfall that occurred in 2015. It can also be observed from Figure 2 that rainfall occurred on approximately 34% of days throughout the 2015 rainfall season.



SUMMARY OF RAINFALL IN 2015

The total seasonal rainfall for 2015 was 272 mm. Figure 3 depicts the accumulation of rainfall throughout the 2015 season.

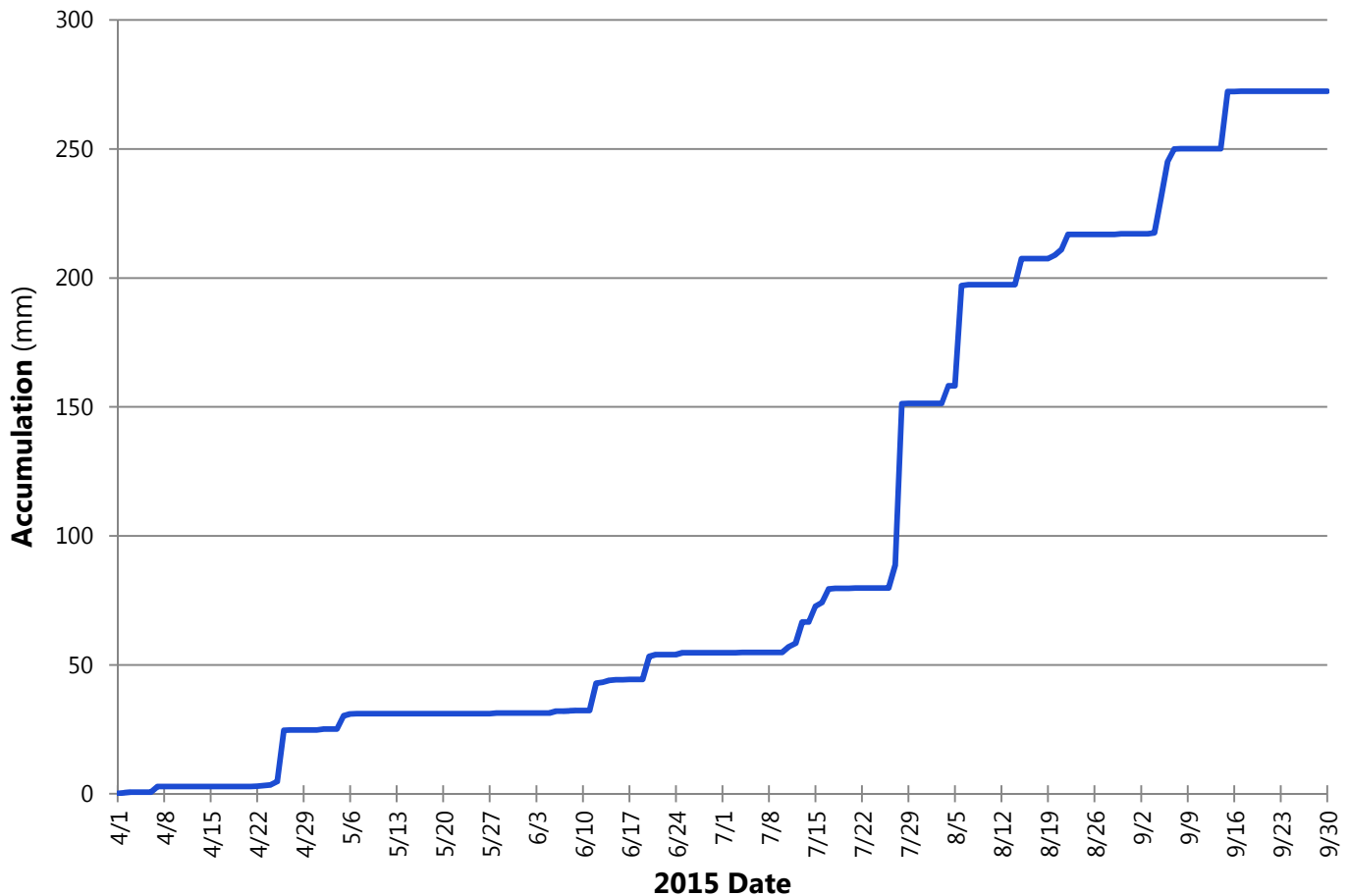


Figure 3: 2015 Rainfall Accumulation.

The 2015 rainfall season experienced a dry spring, with the months of April to June accumulating a total of 55 mm of rain, which is the 5th lowest spring rainfall since 1900. This rainfall accounted for approximately 20% of the total rainfall that occurred throughout the season. The remaining 80% of the total rainfall occurred between July and September.



HISTORICAL COMPARISON

The average seasonal rainfall from 1900 to 2015 in Saskatoon is 265 mm which is depicted by the light blue line in Figure 4. The 2015 seasonal rainfall of 272 mm was slightly above average and is the 44th 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 2015 can be found in Appendix B.

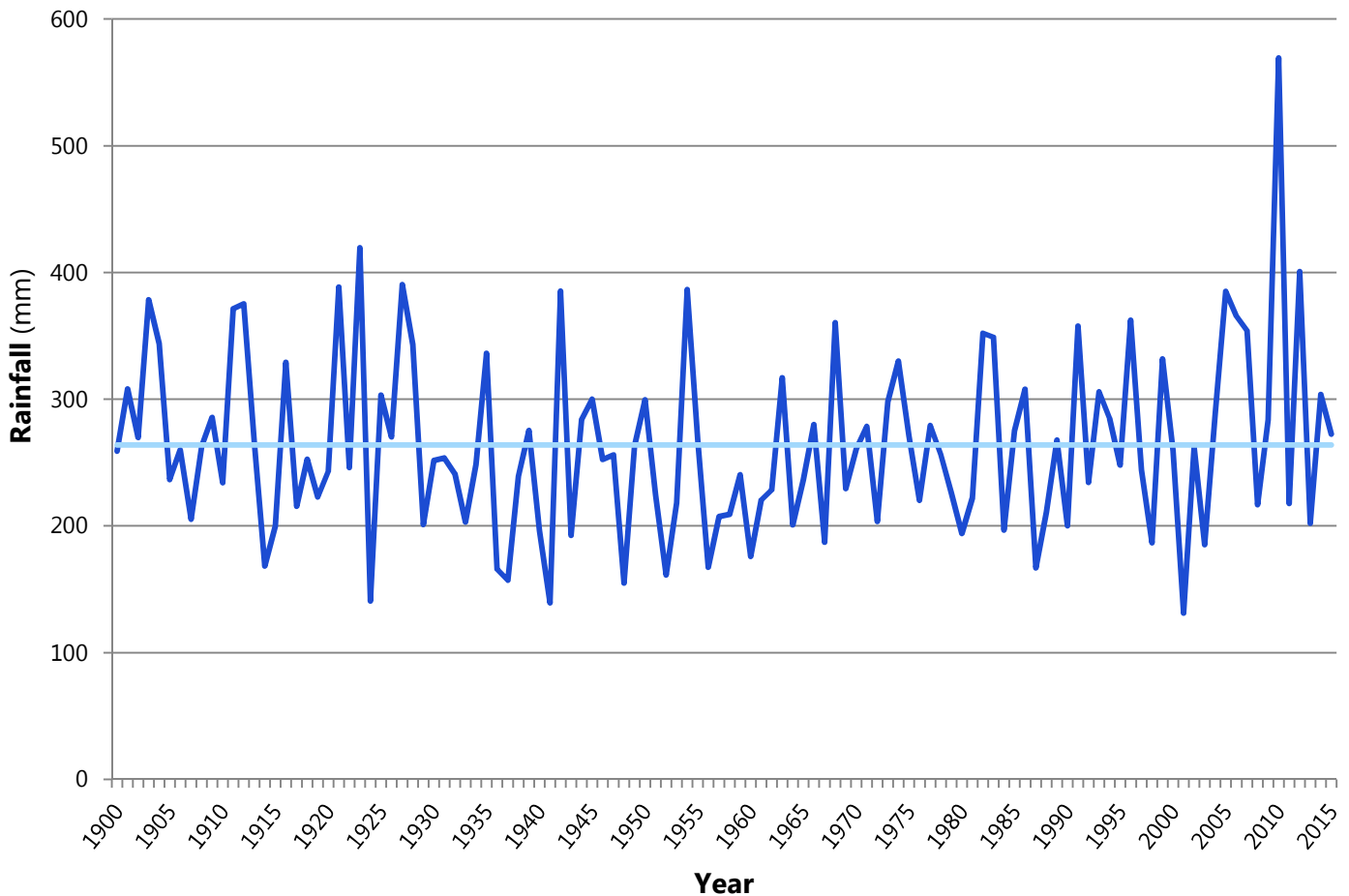


Figure 4: Seasonal Rainfall (1900-2015).



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 2015 and is represented by the light blue line in Figure 5. During the 2015 rainfall season, the maximum rainfall to occur within a single day was 63 mm, which occurred on July 28th. This is the 9th greatest rainfall to occur in a single day out of the 116 years of data. However, this rain event began on July 27th and continued on throughout July 28th, accumulating a total of 74 mm of rainfall between these two days. This rain event was determined to have a return period of twenty-five years.

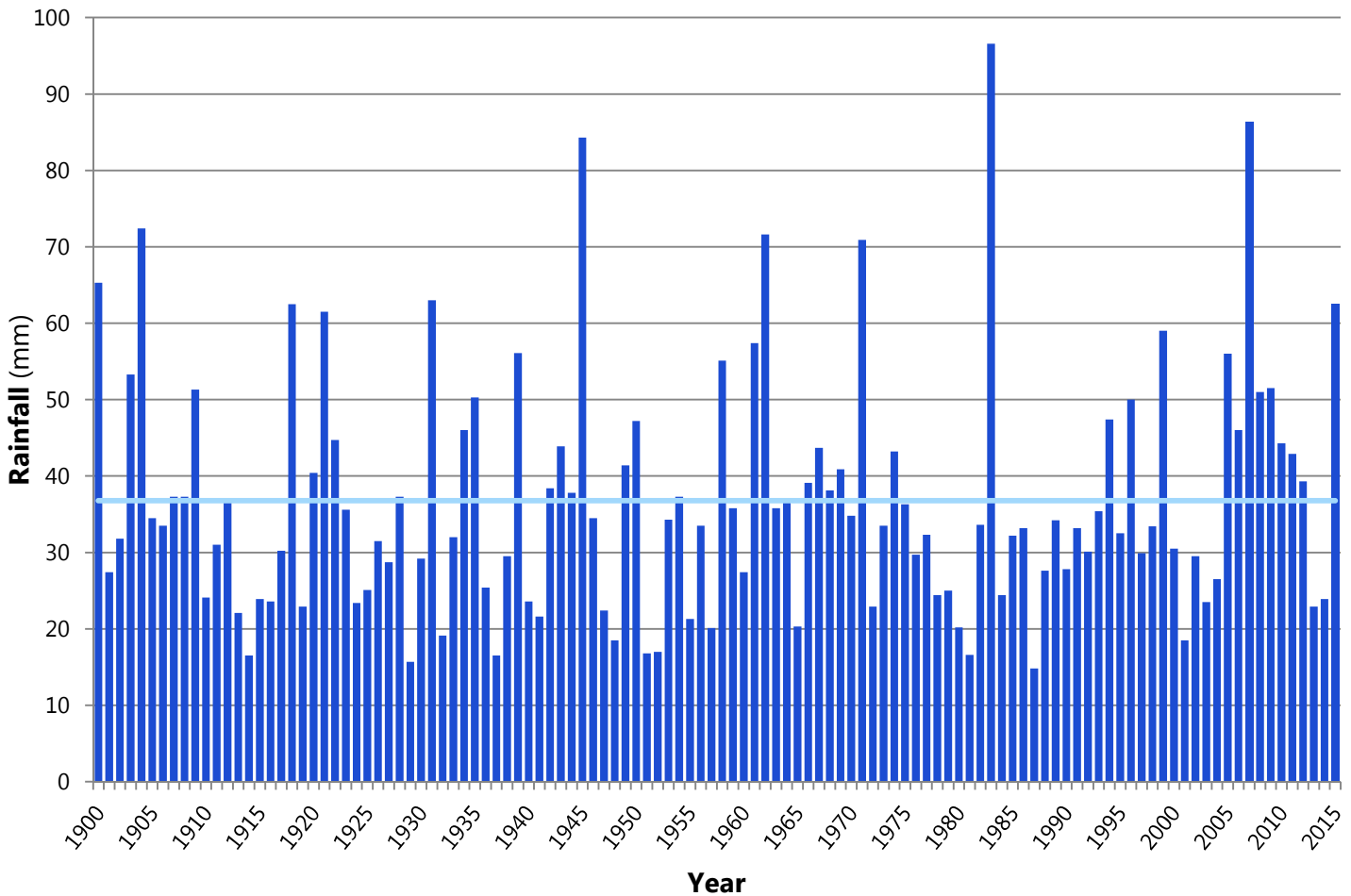


Figure 5: Maximum Daily Rainfall.

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, eight of the last ten years have had daily rainfalls which exceed the historical average. Over the last ten years, the average maximum daily rainfall in a season is 47 mm.



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 2015. 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	Total
Average	2 – 5 Year	4	1	3	1	9
	5 – 25 Year	0	0	0	1	1
	25 – 100 Year	0	0	0	0	0
	> 100 Years	0	0	0	0	0
	Total	4	1	3	2	10



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	Total
Overall	2 – 5 Year	8	5	6	3	22
	5 – 25 Year	0	1	1	0	2
	25 – 100 Year	0	0	0	1	1
	> 100 Years	0	0	0	0	0
	Total	8	6	7	4	25



CONCLUSION

Overall, the 2015 rainfall season had an accumulation which was marginally greater than the historical seasonal average. Although the 2015 rainfall season had a dry spring, the summer was wet with 80% of the seasonal rainfall occurring between the months of July and September. During these three months, an average of two rain events with a return period of two years or greater occurred throughout Saskatoon. The largest rain event occurred between July 27th and 28th and was determined to be a twenty-five 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 twenty-five years.



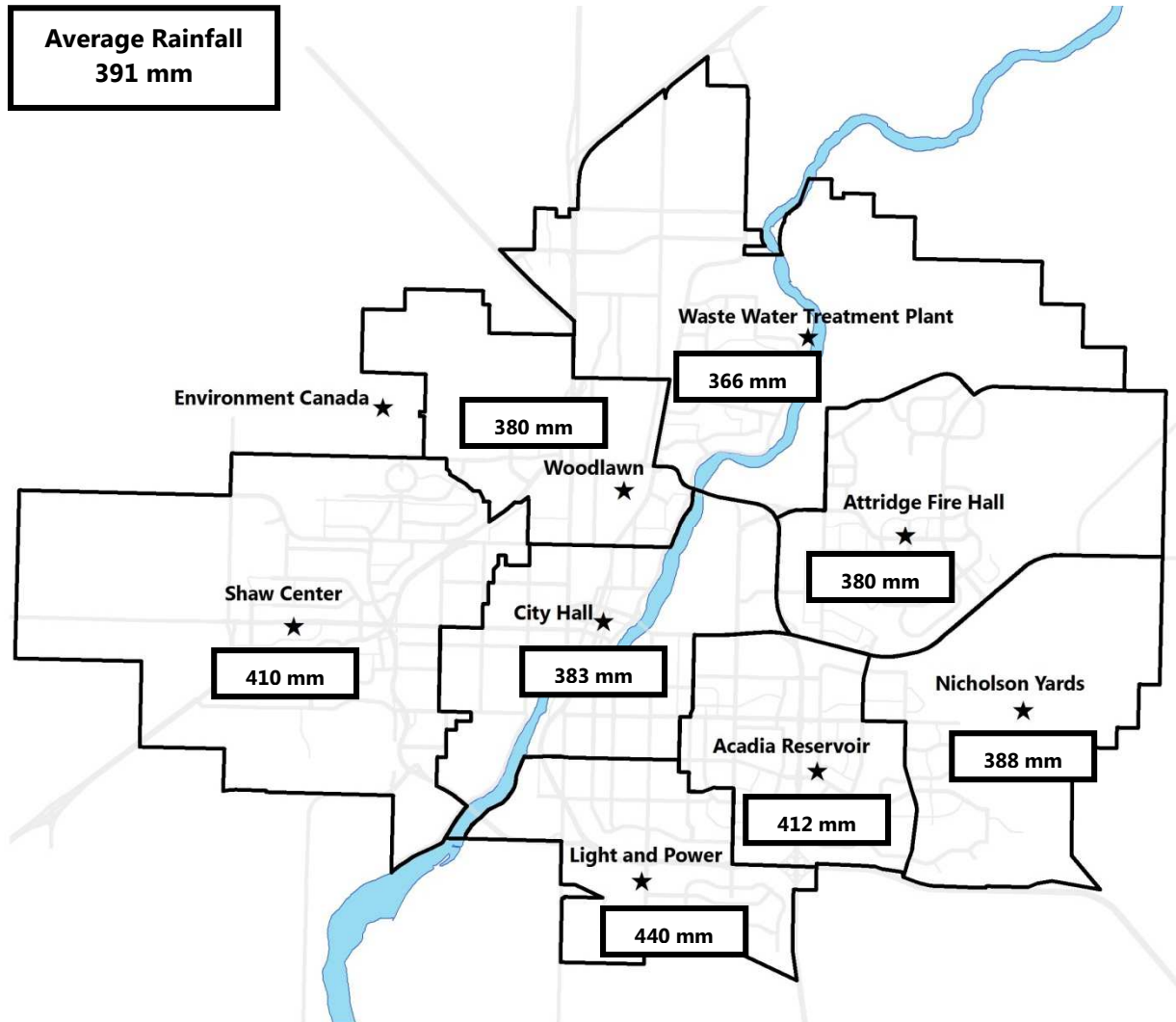
APPENDICES

Appendix A – Summary of Rainfall in 2014



APPENDIX A

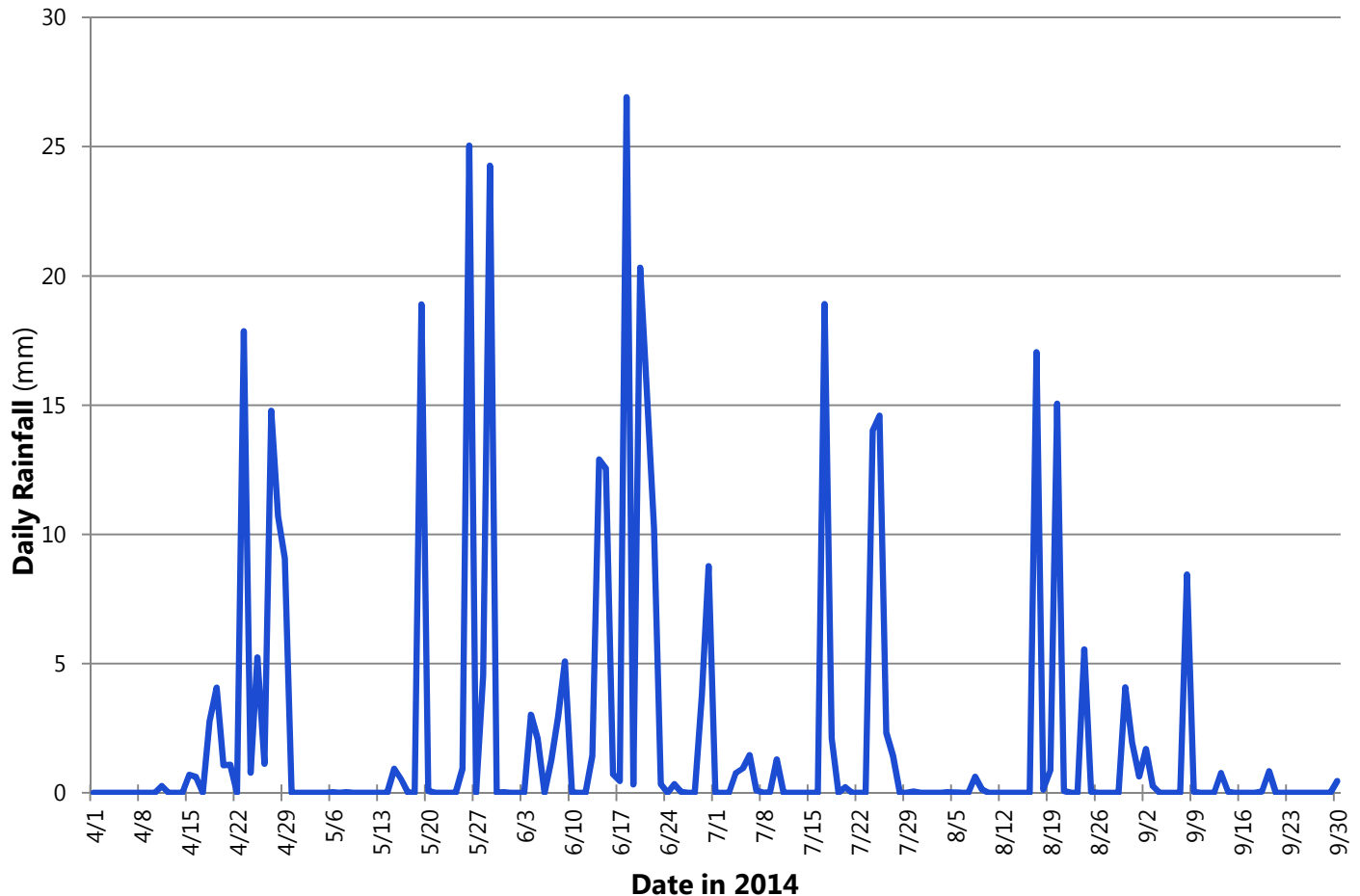
The following map depicts the name, location, approximate area, and total seasonal rainfall for each rain gauge in 2014.





APPENDIX A

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 2014 rainfall season.

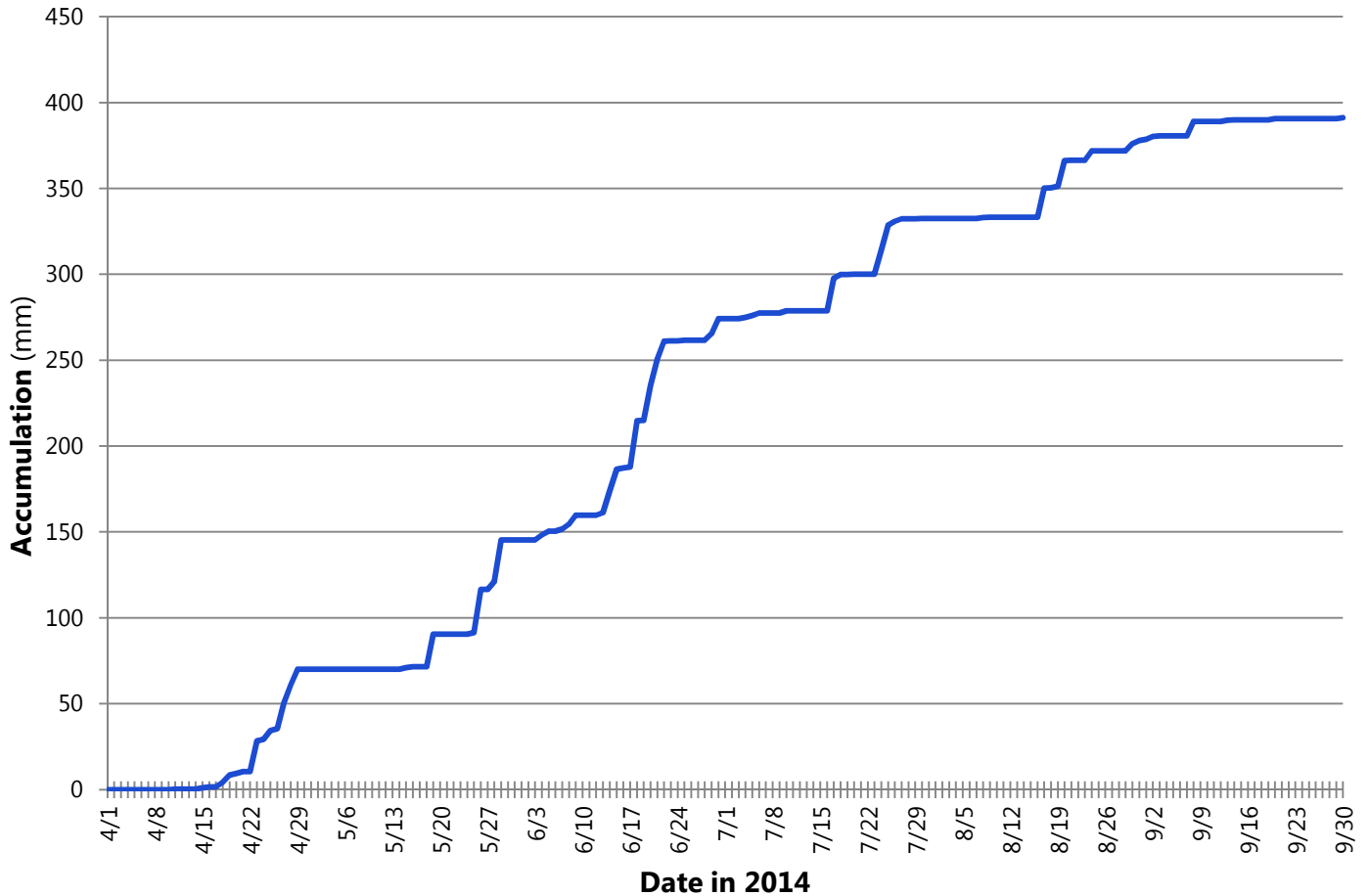


The largest amount of rainfall occurred on June 18th, 2014 with a total of 27 mm. This rainfall accounted for approximately 7% of the total rainfall that occurred in 2014. It can also be observed that rainfall occurred on 46% of days throughout the 2014 rainfall season.



APPENDIX A

The total seasonal rainfall for 2014 was 391 mm. This is the 4th highest seasonal rainfall of the 115 years of data. The following graph depicts the accumulation of rainfall throughout the 2014 season.





APPENDICES

Appendix B – Total Seasonal Rainfall (1900-2015)



APPENDIX B

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



APPENDICES

Appendix C – Return Period of Rain Events by Rain Gauge



APPENDIX C

	Return Period	2012	2013	2014	2015	Total
Waste Water Treatment Plant	2 - 5 Year	4	0	3	1	8
	5 - 25 Year	0	0	0	1	1
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	4	0	3	2	9
Woodlawn	2 - 5 Year	5	1	3	2	11
	5 - 25 Year	0	1	0	1	2
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	5	2	3	3	13
Shaw Center	2 - 5 Year	5	2	5	3	13
	5 - 25 Year	0	0	0	1	1
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	5	2	5	4	16
Nicholson Yards	2 - 5 Year	2	0	2	1	5
	5 - 25 Year	0	0	1	1	2
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	2	0	3	2	7
Light and Power	2 - 5 Year	2	2	3	0	7
	5 - 25 Year	0	0	0	0	0
	25 - 100 Year	0	0	0	1	1
	> 100 Year	0	0	0	0	0
	Total	2	2	3	1	8
City Hall	2 - 5 Year	5	3	4	1	13
	5 - 25 Year	0	0	0	0	0
	25 - 100 Year	0	0	0	1	1
	> 100 Year	0	0	0	0	0
	Total	5	3	4	2	14
Attridge Fire Hall	2 - 5 Year	1	1	1	1	4
	5 - 25 Year	0	0	0	1	1
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	1	1	1	2	5
Acadia Reservoir	2 - 5 Year	4	1	2	1	8
	5 - 25 Year	0	0	0	1	1
	25 - 100 Year	0	0	0	0	0
	> 100 Year	0	0	0	0	0
	Total	4	1	2	2	9