Reference SC/C/56

SOIL CONSERVATION AUTHORITY

Report on the
RYAN'S CREEK CATCHMENT
(BENALLA WATER SUPPLY)

Prepared for consideration by the
LAND UTILIZATION ADVISORY COUNCIL

At its 88th Meeting
4th February, 1970

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Soil Conservation Authority
REPORT ON THE UPPER RYAN'S CREEK CATCHMENT
(Benalla Waterworks Trust)
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1. INTRODUCTION

In November, 1968, the Benalla Waterworks Trust made a formal request to the Secretary of the Land Utilization Advisory Council to proclaim the Trust's catchment area under the provisions of the *Soil Conservation and Land Utilization Act*, 1958.

This report is the result of the investigation carried out to provide basic information for the evaluation of the Catchment in relation to the water supply interests involved.

The information contained in the report is for consideration by the Land Utilization Advisory Council to make recommendations tot he Soil Conservation Authority as to the constitution of this catchment.

2. IMPORTANCE OF THE CATCHMENT

Benalla's water comes from the 600 acre feet capacity Loombah Weir, situate on the Upper Ryan's Creek about 19 miles south-east of Benalla.

The gravity supply mains have recent been increased to 12 inch pipes, giving a daily peak flow of three million gallons (about 12 ac ft). The construction of a second storage reservoir, about 5 miles upstream from Loombah Weir is being considered.

The population supplied number 9,000. Town consumption for the last five years averaged 276 million gals. per year, giving an average daily consumption of 84 gals. per person. The town shows a steady rate of growth, about 50 new houses are built per year. The loss of the immigrants holding centre, the change-over from steam to oil by the railways, the closing-down of the butter factory has cut back water consumption. Railway use has decreased from the 7 million gals. in 1960 to 1.5 million gals. in 1968. However, the town, only 120 miles from Melbourne, endowed with a favourable combination of amenities has excellent growth period.

3. LOCATION AND AREA

The Catchment is situated on the northern flank of the Tolmie Highlands.

From Loombah Weir to Archerton the distance is about 13 miles. The catchment with an average width of about 2.5 miles has an area of about 30 square miles. It extends over parts of the parishes of Toombullup, Toombullup North and Myrrhee in the Shires of Benalla and Oxley.

The extent of the all-weather roads is limited to the Tatong-Archerton Road, serving part of the western and the whole of the southern areas, and to Webb's and Whisky Creek Roads, which traverse the catchment from west to east and give access to parts of the eastern ridge areas. Excepting Madhouse Road, in the south-east, all other roads and tracks traversing the catchment are trafficable only with a four wheel drive vehicle.

4. GENERAL DESCRIPTION OF THE CATCHMENT

(a) Climate

(i) Rainfall

As in most mountainous areas rainfall stations are few. One only, Archerton, is within the catchment albeit at its south-eastern tip at an elevation of about 3,000 ft with a mean annual rainfall of 53 inches. The nearest station in the north, about six miles downstream of Loombah Weir, is Ryan's Creek, at an elevation of about 800 ft.

Based on the rainfall observations collected at Archerton during the period 1940 to 1968 and at Ryan's Creek during the period 1915 - 1928, (data recording ceased during 1929) it can be said that the rainfall of this catchment is erratic, arrives in heavy storms, more particularly so at Archerton. The graphs in the Appendix show the orographic nature of rainfall in the mountain area. The high precipitation comes from the very high falls of winter and spring rains caused by elevation of the rainbearing clouds over the ranges.

ARCHERTON (Period 1940 to 1969)

The rainfall is characterised by high intensity storms which make the annual rainfall totals very irregular. While 53 inches is the average over the last 28 years, the range is from 28 inches in 1940, to 93 inches in 1956. On the average rain falls on 111 days each year, with an average fall of 48 points. However on 15 of these wet days rainfall exceeds 100 points, the average of these storms beings 163 points over 24 hours. Accordingly, 46% of the average rainfall is received in high intensity storms (i.e. by electing to call falls in excess of 100 points per day "high intensity storms").

A further peculiarity of these storms is that they reach a peak intensity in March. The average fall in a storm in March is 189 points. The significance of this is further enhanced by the fact that these storms occur immediately after the driest month of the year. While it is an established fact that a few hard rains cause most of the erosion during a year, the regular occurrence, of these heavy thunder storms in late summer made potato growing so successful in that area.

RYAN'S CREEK (Period 1915 to 1929)

Here, the average annual rainfall is 30 inches, ranging from 17 inches in 1927 to 40 inches in 1916. The average number of wet days each year is 101, and the average rainfall on these days is 30 points.

On 5 days each year storms of 100 points or more can be expected, and the average fall on these days is 146 points. Accordingly 24% of the yearly average rainfall comes in storms.

Peak intensities of these storms are reached during May, when rainfall in an average storm is 216 points for a 24 hour period. The second highest intensity storms occur in March, when the average fall during a day when rainfall exceeds 100 points is 169 points.

These characteristics of the rainfall; intensity and distribution, have far reaching consequences when agricultural and forestry working practices are considered in relation to the interests of the water supply. Hence the more than usual effort spent in analysing this feature of the climate in this particular catchment.

The tables and graphs of the Appendix give a full analysis of the rainfall for the periods for which records were available.

(iii) Temperature

There are no temperature recording stations within the catchment. The northern part of the catchment may be compared with Benalla; however, the higher elevations at the southern section would exert a considerable influence on the temperatures.

In the northern parts, at altitudes approximating to 1,000 feet, the normal maxima during the warmest month are estimated around 81°F while at 3,000 ft, around Archerton the normals would be in the vicinity of 73°F. With regard to winter period a lapse rate of 4° to 5°F per thousand feet would indicate for July, the coldest month of the year, at 1,000 ft elevation, maximum temperatures to 53°F whilst at 3,000 ft about 44°F.

The study of minimum temperatures in a much dissected area is complex. The Upper Goulburn Region Resources Survey is quoted in respect to the minimum temperatures: "In July, the normal minimum temperatures over the less elevation section of the Region are mainly between 37° and 40°F. Normal July minima of 32°F are experienced at an altitude approximately 10 3,000 ft.

In the Archerton area frosts are common in May, June and July, extending into August and September. Snow is most common between 4 to 6 inches.

(b) Geology and Topography

Geologically the main features are the Upper Devonian age porphyritic dacites. But for the head-water area around Archerton, which is on older basalt, the bulk of the catchment is on the acid igneous type rocks. The dacites, although similar in appearance to granite, produce significantly different soils.

Ryan's Creek is one of the major streams of the Broken River tributary system draining, with Holland Creek the north, north-west slopes of the Tolmie - Archerton plateau. The highlands gradually decrease in elevation to the north and the streams flow in a general northerly direction to joint the Broken River.

The Archerton area has several plateau levels up to 3,000 feet, forming the south-east corner of the catchment and containing most o the higher rainfall country. The lower plateau levels continue along the ridge tops to the north and gradually grade off into long south-north spurs separating the deeply incised streams.

Following the course of Ryan's Creek upstream from Loombah Weir, the catchment may be divided into three units.

The first one, which takes in the northern section of the catchment occupies the area between Loombah Weir and the proposed site of the second reservoir, about five miles upstream. In this section of its tract the creek is deeply entrenched in its narrow valley which is further dissected by the drainage lines at more or less right angles to the narrow floor of the valley. The result is a sharply defined system of secondary ridges and spurs.

The second unit extends roughly over the central section of the area where the valley widens. The topography consists of more gently dissected plateau areas with wider ridge tops and with slopes moderately steep.

Approaching Archerton the creek turns from its northerly course first west, then in a generally south-eastern course into its headwater area. This gently rolling to mildly hilly country, at altitudes between 2,500 and 3,000 feet forms the third unit.

(c) Soils and Vegetation

There is a close relationship between the soils and the vegetation of the catchment, an hence with the topography and climate.

Soils of the Broken River catchment have been grouped by A. Rundle. Using his classification the main soil groups recognised within the above established three units are as follows:

(i) NORTHERN UNIT Rainfall = 30 inches to 40 inches per year. Elevation up to 2,000 feet.

Skeletal soils occur on the steep ridges. Their small water holding capacity is reflected in the vegetation.

Yellow podsolic soils occur on the foothills and lower slopes. As they show a relatively sharp boundary between the A and B horizons in structure, texture and colour, they may be regarded as solodic soils. The profile normally consists of a few inches of brown loam over grey clay loam. This sharply overlies a brownish well structured clay which rapidly becomes mottled red and yellow. The clays have high water contents at wilting point materially reducing the effectiveness of the soil to store water useful to plants. The clays which are friable in summer swell and disperse when wetted so that the soils drain very slowly after thoroughly wetted. Having this limited ability to hold water once wet, run-off to the streams is almost instantaneous.

While there are some *Leptopodsols*, sandy-clay soils showing mild podsolisation only, with a reasonable ability to absorb water, provided there is no significant amount of rock present to reduce it, the soils in the Northern Unit are generally the yellow podsolic soils.

The dominant vegetation consist of d dry Sclerophyll forest of red stringybark and broad-lead peppermint with some blue gum in the gullies and long leaved box on the ridges and dry aspects.

The understorey is limited to wattles in the gullies and scattered Cherry Ballarat and grass tress on the hillsides. The floor is not fully closed with the sparse native tussock grasses and the wide range of ground flors such as the Snowy Bassiaea, Love Creeper, Slender Rice-flower, Tall Sundew, Scaly buttons, Grey bush-pea, Grevillea, Hop bitter-pea, Erect guinea flower, etc etc.

(ii) CENTRAL UNIT Rainfall: 40 in to 50 in per year. Elevation 2,200 to 2,700 ft

Acid Brown Earths are typical soils of the broad ridge tops and less steeply dissected areas of moderate altitude. The soils are leached, but not podsolised, the profile depth depends very much on the topographic position. From a dark brown loam of blocky structure the profile grades into lighter colours with increasing clay content remaining however, friable and well drained. The permeability of this soil, unless reduced by fire or compaction is such that surface runoff occurs only after prolonged wet periods.

Within this Unit, at lower elevation and rainfall, the mildly podsolised, more reddish than brown soils are referred to by Rundle as *Cryptopodsols*. He estimates the water holding capacity of these shallower soils about 20% below that of the brown earth.

The vegetation consists of a wet sclerophyll forest of Narrowleaf Peppermint with Candlebark and Messmate stands. In the southern areas, on the higher rainfall end of this unit Messmate is common, often in pure stands.

(iii) HEAD-WATER UNIT Rainfall: above 50 in per year. Elevation between 2,700 and 3,000 ft.

Krasnozems, the deep red loams developed on the older basalt and other rock types at this rainfall and around the 3,000 ft elevation. Krasnozems have much in common with the acid brown earth but are deeper, more friable and better structured.

A typical profile has a chocolate, reddish-brown organic rich surface layer of 6" - 10" deep, merging very gradually to a paler red-brown clay loam which becomes more red and heavier in texture with depth. The soils are acid, highly leached, having about the same capacity to hold water as the acid brown earth.

The vegetation in response to the climatic and topographic conditions of the area is of the wet sclerophyll forest type with Manna Gum, Messmate and Blackwood in the wetter areas, and Peppermint (narrow leaf) and Candlebark Gum on the drier sits. The understorey is daisy bush, blanket leaf and Tree-ferns in the wetter gullies, while wattles and hazel are to found on the drier sites. The floor layer is usually complete with tussock and creeping type grasses and herbs. Where the canopy has been opened-up the ground is covered by heavy stands of bracken-fern.

5. LAND TENURE

As had already been mentioned the total area of the catchment tapped for water supply is about 30.5 square miles, i.e. 19,500 acres.

Privately owned land	70 acres	0.4%
Benalla Waterworks Trust Land	3,157 acres	16.2%
Reserved Forest	15,845 acres	81.2%
Crown Land	433 acres	2.2%
	19,505 acres	100.0%

6. PRESENT LAND-USE

(a) Forestry

Most of the forests consist of un-even aged, partially cut-over mixed stands, remnants of apparently intermittent, selection utilisation with some pure stands of milling quality Messmate and Peppermint and patches of good re-growth pole stands.

In recent years, utilisation is being directed and controlled along silvicultural lines by the Forests Commission. This includes thinning, regeneration fellings and some clear felling in advance of pine planting.

(b) Agriculture and Pasture

The condition of the privately owned land is good. The management is mainly grazing use with some small areas cultivated for potato growing.

The land owned by the Benalla Waterworks Trust is unused and where formerly cleared has reverted to scrub and bracken. All these areas are within the Head-Water Unit.

7. EROSION HAZARD AND INCIDENCE

The erosion hazard of the steep slopes of the Northern Unit is high. Although actual erosion under forested conditions is low, the nature of the soils combined with the steepness of the slopes preclude safe clearing. Drainage lines where cleared suffered gully erosion, minor sheet erosion was also noted. Because these soils scour easily runoff water has and is causing damage along the tracks.

In the Central Unit the hazard is fairly low, mainly due to the good permeability of the soils. Apart from local logging damage there is no discernible erosion except where tracks are left without drainage provision.

The Head-Water Unit is showing erosion in the areas where rabbits moved in and destroyed the former pasture. The bracken, which replaced the grass and has grown tall is not protecting the soil from the pounding of the rain which arrives in frequent and heavy storms.

Mention must be made here of fire, as a potential erosion hazard, threatening catchment values. There is, as yet, no sufficient knowledge available to assess the long term effects of repeated fuel reduction burns. In important and relatively small catchment broad scale fuel reduction burning is not considered acceptable.

Reducing slash following logging is necessary and should be carried out as part of the utilisation operation. The additional cost involved, weighed against the damage caused by wild fire cannot be regarded as prohibitive.

If fire is to be used as a means of reducing the wild fire hazard it should be restricted to specific areas.

On the whole the provision of the a good road network to give fast access to localise outbreaks in their initial stages seem, for the time being, to be essential requirement for these types of catchments.

8. POTENTIAL LAND-USE

(i) Northern Unit

This area should be managed primarily for catchment protection. The features of the topography, climate and soils are such that forest utilisation should be limited to certain slopes. The number and alignment of roads and the erosion prevention measures applied to these should be strictly controlled.

The time of operations should be restricted to periods with safe seasonal conditions.

(ii) Central Unit

This area should be managed for timber production and catchment protection. The development of softwood plantations in certain areas, subject to prescribed conditions is feasible, and should be compatible with the water supply interests.

(iii) Head-Water Unit

The development of these valuable lands for grazing purposes or some specialised form of agriculture, horticultural or forest plantation uses is not considered to constitute a threat to the water supply.

Following proclamation and land-use determination the area may be developed without damage to catchment values, in fact, there is no justification for withholding this lean from production in an attempt to protect the water supply.

(A. P. Fisher)
Catchment Investigation Officer

APPENDICES

Stream Flows (million galls) - Period 1952 - 1969

Year	Dec	Jan	Feb	Total	Jan	Feb	March	Total
52-52	697.2	308.1	163.9	1169.2	308.1	163.9	95.0	567.0
53-54	386.5	213.2	141.9	741.6	213.2	141.9	95.6	450.7
54-55	686.2	206.3	188.6	1081.1	206.3	188.6	234.5	629.4
55-56	604.0	565.0	277.0	1446.0	565.0	277.0	337.0	1179.0
56-57	1067.0	739.0	527.0	2333.0	739.0	527.0	310.0	1576.0
57-58	279.9	144.5	90.0	514.4	144.5	90.0	110.1	344.6
58-59	1143.1	522.6	181.1	1846.8	522.6	181.1	262.7	966.4
59-60	144.5	216.0	77.0	437.5	216.0	77.0	56.5	349.5
60-61	482.0	218.7	76.6	777.3	218.7	76.6	75.7	371.0
61-62	111.5	88.1	40.9	240.5	88.1	40.9	28.8	157.8
62-63	237.4	251.1	115.8	604.3	251.1	115.8	68.7	435.6
63-64	351.0	166.0	104.0	61.0	166.0	104.0	46.0	27.6
64-65	540.5	218.8	84.0	843.3	218.8	84.0	77.8	380.6
66-67	1337.0	51.0	212.0	2059.0	510.0	212.0	153.2	875.2
67-68	55.8	25.3	0.4	81.5	25.3	0.4	8.9	34.6
68-69	533.1	173.3	109.6	816.0	173.3	109.6	233.0	515.9
TOTALS	9082.0	4703.7	2517.7	16303.4	4703.7	2517.7	2308.2	9529.6
MEANS	532.0	277.0	148.0	957.0	277.0	148.0	135.9	560.9

Town Consumption (million gallons) - Period 1952 - 1969

Year	Dec	Jan	Feb	Total	Jan	Feb	March	Total
52-53	16.7	25.2	19.1	61.0	25.2	19.1	20.7	65.0
53-54	25.7	28.6	17.0	71.3	28.6	17.0	20.6	66.2
54-55	19.7	28.3	15.0	63.0	28.3	15.0	13.0	56.3
55-56	20.1	20.8	23.7	64.6	20.8	23.7	12.8	57.3
56-57	28.4	36.0	24.4	88.8	36.0	24.4	18.4	78.8
57-58	32.8	34.3	28.1	95.2	34.23	28.1	20.7	83.1
58-59	34.5	43.3	28.4	106.2	43.3	28.4	19.9	91.6
59-60	32.4	34.6	32.8	99.8	34.6	32.8	29.9	97.3
60-61	35.2	43.2	35.4	113.8	43.2	34.5	28.2	106.8
61-62	38.4	31.7	31.2	101.3	31.7	31.2	33.5	96.4
62-63	30.7	25.8	27.8	84.3	25.8	27.8	32.1	85.7
63-64	39.8	47.4	36.9	124.1	47.4	36.9	33.0	117.3
64-65	36.3	51.6	45.7	113.6	51.6	45.7	42.9	140.2
65-66	34.9	44.6	25.8	105.3	44.6	25.8	27.1	97.5
66-67	20.5	40.2	40.1	100.8	40.2	40.1	35.8	116.1
67-68	46.2	39.2	27.1	112.5	39.2	27.1	22.3	88.9
68-69	38.4	49.2	30.5	118.1	49.2	30.5	20.5	100.2
TOTALS	530.7	624.0	489.0	1643.7	624.0	489.0	431.4	1544.4
MEANS	31.3	36.7	28.8	96.8	36.7	28.8	25.4	90.9

TABLE 1 - Monthly and Yearly Rainfall Totals - Archerton, Period January 1940 to December 1968

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual	No of Wet Days
1940	92	23	133	298	331	142	512	209	338	103	343	287	28.1	73
1941	819	83	811	74	122	390	699	27	520	255	304	238	45.42	85
1942	299	216	222	404	1183	948	897	900	561	280	371	127	61.57	107
1943	125	133		682	149	453	450	408	472	218	263	51	34.04	91
1944	41	123	140	424	720	249	705	53	110	277	243	265	33.59	87
1945	488	112	25	38	258	936	398	759	431	466	580	62	45.53	77
1946	536	810	375	245	364	381	1165	442	173	416	325	305	55.37	89
1947	58	280	831	94	327	616	1224	633	484	762	332	579	62.20	92
1948	47	458	38	386	693	569	499	334	950	804	578	232	48.28	97
1949	124	212	655	183	272	246	435	283	548	1076	648	80	48.62	101
1950	57	541	918	135	558	95	579	321	754	622	548	286	54.06	88
1951	126	175	20	510	855	546	1048	611	171	603	227	256	52.38	118
1952	114	66	145	661	798	1030	414	561	759	830	849	358	65.82	149
1953	268	137	33	283	493	960	962	777	857	885	479	224	62.58	131
1954	379	28	37	618	291	705	320	739	340	409	795	845	55.06	101
1955	153	502	598	120	403	1145	908	1322	691	950	423	366	75.81	137

TABLE II - Maximum amounts of Rainfall recorded in 24 hours during each month - Archerton, Period January 1940 to December 1968.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1940	46	23	100	91	116	42	91	51	163	71	127	135	28.1
1941	250	40	192	46	89	117	125	56	186	108	164	100	45.4
1942	291	78		191	209	260	261	215	128	15	174	46	61.6
1943	39	74		153	48	98	79	119	80	64	190	25	34.0
1944	33	90	91	130	154	53	174	22	29	64	55	75	33.5
1945	250	56	21	21	75	351	158	111	163	165	129	50	45.5
1946	224	250	125	133	149	175	201	111	67	171	108	165	55.4
1947	56	78	520	70	113	144	185	181	212	172	154	148	62.2
1948	25	204	22	187	113	186	200	89	101	181	203	80	48.3
1949	41	101	168	116	62	80	176	101	402	294	230	23	48.6
1950	31	100	470	92	205	40	140	93	208	218	161	81	54.4
1951	75	76	20	92	214	326	315	151	33	170	76	88	52.4
1952	55	35	94	149	173	145	188	149	136	181	208	142	65.8
1953	90	120	17	118	169	165	279	116	245	384	108	35	62.6
1954	158	11	32	207	68	240	71	174	202	113	260	239	55.1
1955	85	13	1251	71	111	375	337	204	225	193	146	61	75.8
1956	225	60	350	281	267	207	298	164	188	138	142	57	93.4
1957	24	196	114	86	87	254	62	80	135	176	44	133	39.4

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1958	6	137	107	55	262	114	272	350	101	101	145	37	61.3
1959	116	265	225	166	106	94	69	97	168	144	88	48	39.1
1961	54	35	89	196	63	244	179	218	103	92	115	64	409.
1962	159	35	146	102	183	114	107	134	83	101	165	79	55.3
1963	229	43	56	46	249	138	112	106	102	132	119	41	55.1
1964	50	54	38	93	74	196	178	119	181	136	52	142	61.2
1965	12	10	69	76	114	31	215	196	248	172	262	157	45.8
1966	57	239	247	51	312	81	127	128	188	157	98	535	66.6
1967	56	56	37	44	64	108	91	134	78	127	23	46	29.4
1968	130	12	101	334	238	252	95	159	51	244	197	193	71.0

TABLE III - Monthly and Yearly Rainfall Totals (Points) at Ryan's Creek for period January 1915 to December 1928

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual (Inches)	Number of Wet Days
1915	105	80	7	162	543	554	416	386	364	297	47	133	30.9	101
1916	132	79	25	393	145	515	479	496	604	452	347	333	40.0	134
1918	286	127	308	304	959	357	269	389	119	80	24	139	33.6	109
1919	0	183	317	214	245	228	126	117	261	51	81	468	22.9	89
1920	1	0	106	72	166	542	402	468	476	545	220	103	31.0	97
1921	284	106	162	111	369	407	389	291	583	273	116	207	33.0	90
1923	30	0	0	9	421	683	503	221	216	265	88	305	27.4	112
1924	184	246	388	357	156	326	94	544	250	339	438	228	35.5	110
1925	631	232	176	26	182	285	291	229	275	45	129	3	25.0	89
1926	141	0	325	487	692	328	237	481	156	273	68	69	32.3	99
1927	41	62	14	2	213	99	327	414	115	275	99	47	17.1	78
1928	227	574	415	244	299	451	249	59	164	465	12	42	32.0	104
MEAN	172	141	204	198	366	398	314	333	299	280	137	173	30.1	101

TABLE IV - Maximum Rainfall at Ryan's Creek recorded in 24 hours during each month January 1915 to December 1928

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual (Inches)
1915	35	76	7	41	243	107	116	77	108	110	19	86	30.9
1916	69	30	18	183	77	91	145	130	305	130	52	138	40.0
1918	117	83	164	92	370	96	51	90	63	13	24	95	33.6
1919	0	160	230	67	59	48	40	27	72	14	36	213	22.9
1920	1	0	84	28	63	130	125	121	105	151	89	33	31.0
1921	126	36	48	45	105	182	97	98	212	141	49	155	33.0
1923	16	0	0	9	90	113	110	73	40	57	29	96	27.4
1924	50	127	110	160	62	75	28	157	60	76	117	122	35.5
1925	306	85	113	15	71	45	93	66	81	13	60	3	25.0
1926	130	0	230	85	150	170	50	87	50	89	25	59	32.3
1927	26	34	12	2	57	30	68	67	56	84	62	31	17.1
1928	55	187	98	128	92	150	90	21	46	88	6	30	32.0
MEAN	55	187	98	128	92	150	90	21	46	88	6	30	32.0

TABLE V - Mean Seasonal Rainfall at Archerton for Period 1940 - 1968

Autumn	March April May	12.3"
Winter	June July August	19.0
Spring	September October November	14.3
Summer	December January February	7.5

TABLE VI - Amounts of Rainfall at Archerton in excess of 100 points recorded in 24 hours during each month from January 1940 to December 1968

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1940			100		102				101		127	135	7
					106				163				
1941	109		102			117	106		186	100	164	100	18
	250		102				125		120	108			
	130		128										
	176		125										
			192										
1942	291			191	210	260	114	130	128		108		20
					130	240	157	134			174		
					115	152	261	215					
					143			101					
					209								
1943				153				119			190		4
				133									
1944				130	154		137						6
					145		174						
					104								

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1945	187					173	104	111	163	162	129		13
	250					351	158	99		165			
						157							
1946	224	155	125	133	116	175	109	100		138	108	165	21
	209	225			146		201	111		171			
		250					174						
							114						
							105						
1947			104		113	144	130	181	212	130	154	134	22
			109			113	115	146		172		148	
			520			135	153	117					
						111	173						
							185						
1948		204		187	113	186	200		101	146	116		11
					111					181	213		
1949		101	151	116			176	101	402	109	230		
			168							110	175		14
										294			
										113			

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
										110			
1950		100	470		148		140		135	218	106		17
			255		148		136		208	101	161		
					205				109		120		
											104		
1951					125	326	125	136		170			14
					214		315	151		132			
					120		102	135		121			
							303						
1952				130	122	145	188	149	126	181	107	142	22
				149	173	121	114	116	136	117	121		
						127			126	125	208		
						132							
1953		120		118	118	143	122	106	245	384	108		16
					169	165	279	116	103				
						103			181				
1954	158			166		240		148	202	113	128	115	19
	149			207		166		174			260	113	
				118							108	146	

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
												210	
												239	
1955		102	156		111	375	337	202	117	171	146		23
	100	251			188	163	104	144	193	121			
	131				138		204	225	121				
							135						
1956	207		239	275	124	107	298	101	188	132	142		27
	225		154	281	267	207	122	164	117	138			
			350	142	217	166	102	111					
				122									
				171									
1957		196	114			145			135	176		133	8
						242							
						254							
1958		137	107		108	114	272	220	101	101	145		18
					106		100	218					
					262		118	350					
							102	113					
								113					

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1959	116	265	225	166	106				110	144			9
				156					168				
1961				121		244	161	218	103		115		12
				125			179	152					
				196									
1962	101		146	102	163	114	107	134		101	165		13
	159				111								
					183								
					168								
1963	128				249	112	112	106	102	110	119		13
	229					108				132			
						138				101			
1964						186	119	119	181	136		109	18
						196	106		106	121		142	
						107	178		112				
							152						
							144						
							142						
							136						

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1965					114		199	196	248	172	262	157	9
							215	168					
1966		239	247		312		118	128	134	112		154	22
			161		109		127	117	152	121		102	
							107		115	157		535	
									120			135	
									188				
1967					108			109		127			4
								134					
1968	130		101	121	112	184		102		244	197	106	24
	125			334	114	252		159		117		193	
				122	237			111					
					103								
					132								
					108								
					117								
Total Points	3552	2325	4902	4534	8421	7568	8891	6875	6124	6798	4832	3423	
Mean	178	168	189	162	168	176	159	143	153	148	151	163	1958

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
Average Fall >1" = $\frac{1958}{12} = 163$ Points													
Monthly Total Number of Storms	20	14	26	28	50	43	56	48	40	46	32	21	424
% of Total	4.7	3.4	6.1	6.6	11.8	10.2	13.2	11.3	9.5	10.8	7.5	5.0	100.0

Average No. of Days when Rainfall > 1" = 15 days

TABLE VII - Amounts of Rainfall at Ryan's Creek in excess of 100 points recorded in 24 hours during each month. January 1915 to December 1928

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1915					243	107	116		108	110			5
1916				183			145	130	305	130		138	8
									106			110	
1918	117		164		153								5
					370	173							
1919		160	230									213	4
												107	
1920						130	125	121	105	123			7
						110				151			
1921	102				105	182			212	141		155	7
	126												
1923						113	110						3
						100							
1924		127	110	160				157			117	122	8
				113							99		
1925	306		113										3
	154												

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Number
1926	130		230		118	170							5
					150								
1927													
1928		187		128		150							4
						130							
Total Points	935	474	847	584	1312	1192	496	408	836	655	216	845	
Mean	156	158	169	146	187	132	124	136	167	131	108	141	1755
Average Fall ? 1" = $\frac{1755}{12} = 146$ Points													
Monthly Total Number of Storms	6	3	5	4	7	9	4	3	5	5	2	6	59
% of Total	10.2	5.1	8.5	6.8	11.8	15.2	6.8	5.1	8.5	8.5	3.3	10.2	100.1

Average No. of Days when Rainfall > 1" = $\frac{59}{12}$ = 5 days

TABLE VIII - Summary of Rainfall distribution and intensity - Archerton and Ryan's Creek

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
ARCHERTON (for the period January, 1940 to December, 1968)												
Average daily rainfall on wet days	48.4	41.3	56.4	50.9	47.4	48.2	52.2	46.6	47.2	45.6	46.9	40.8
Average number of wet days per month	4.9	4.9	5.9	7.0	11.6	12.0	13.3	13.4	10.6	11.9	8.4	7.6
Average rainfall on days when rainfall >1"	178	168	189	162	168	176	159	143	153	148	151	161
Number of days per month when rain >1"	20	14	26	28	50	43	56	48	40	46	32	21
RYAN'S CREEK (for the period January, 1915 to December, 1928)												
Average daily rainfall on wet days	34.4	26.1	44.4	31.9	33.6	27.7	25.8	24.2	26.9	25.7	22.8	37.6
Average number of wet days per month	5.0	5.4	4.6	6.2	10.7	13.9	12.2	13.8	11.1	10.9	6.0	4.6
Average rainfall on days when rainfall >1"	156	158	169	146	216	131	124	136	167	131	108	141
Number of days per month when rain >1"	6	3	5	4	7	9	4	3	5	5	2	6

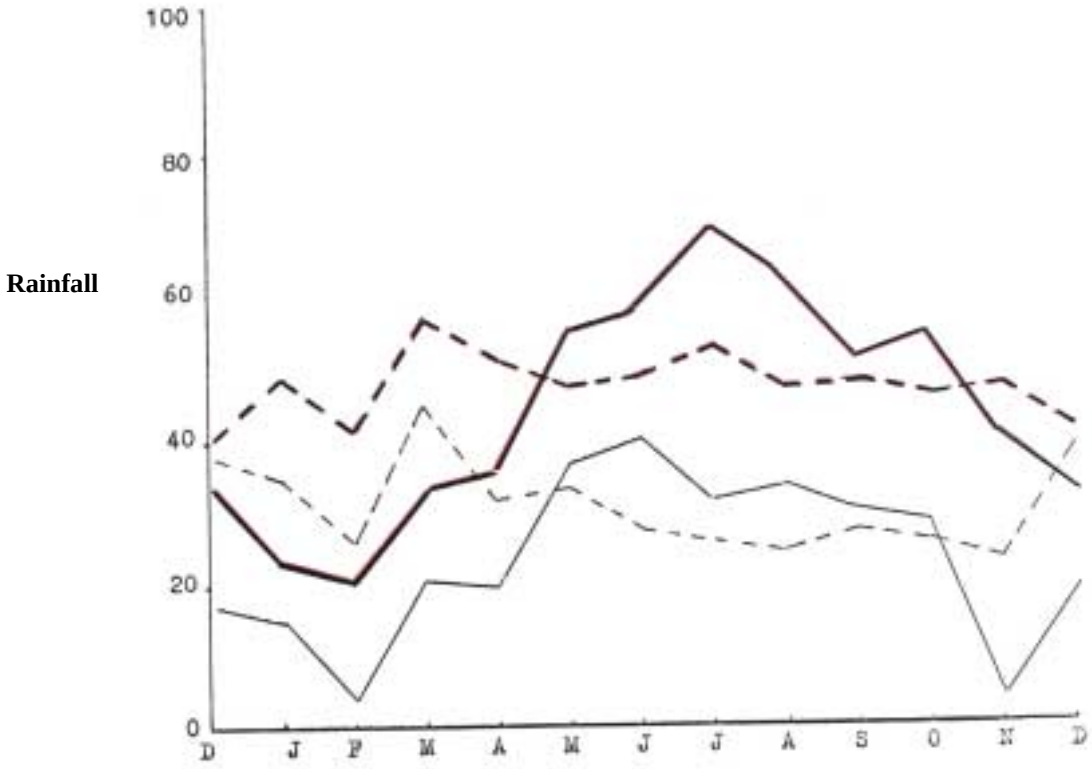
GRAPH 1 - Rainfall Distribution for Archerton and Ryan's Creek

Average monthly rainfall at Archerton _____

Average monthly rainfall at Ryan's Creek _____ (verticle scale 0-10")

Average rainfall intensity at Archerton ----------

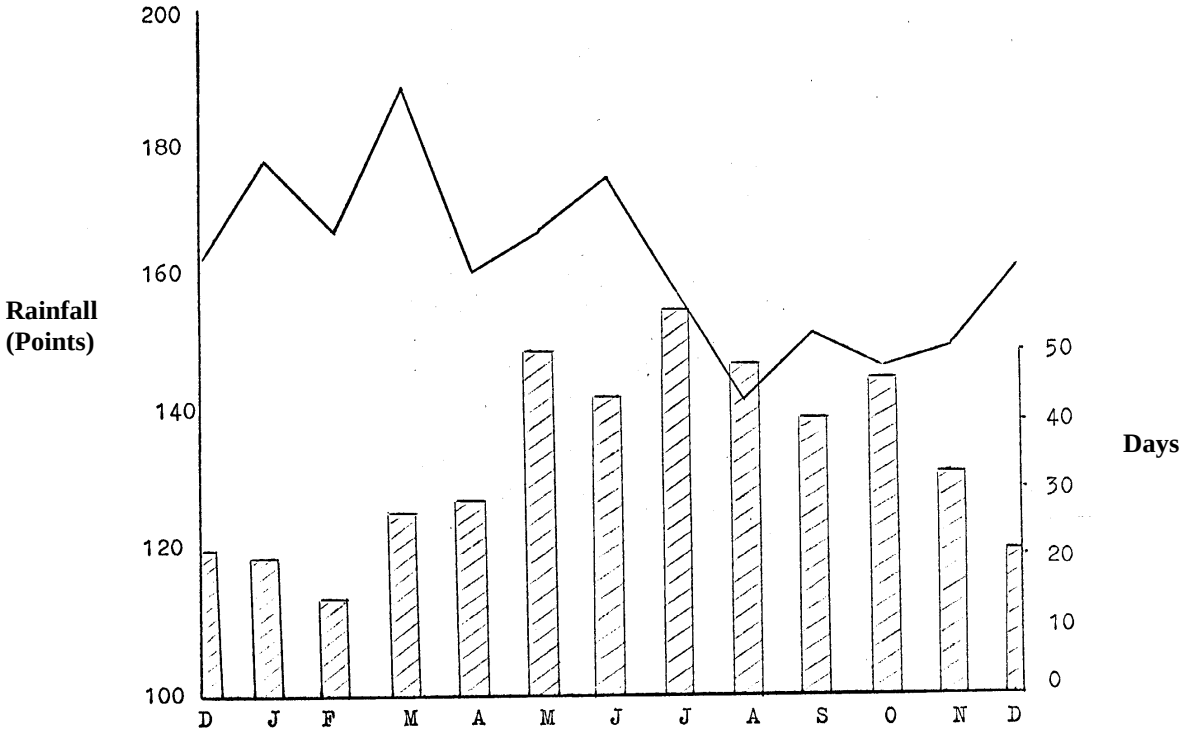
Average rain intensity at Ryan's Creek ---------- (verticle scale 0-100 points)



GRAPH II - Rainfall intensities, Archerton - period 1940 - 1969

Graph: Average rainfall intensity on days when rainfall exceeds 100 points

Histogram: Number of days in the period when rainfall exceeds 100 points.



GRAPH III - Rainfall intensities, Ryan's Creek period 1915 to 1929

Graph: Average rainfall intensity on days when rainfall exceeds 100 points.

Histogram: Number of days in the period when rainfall exceeds 100 points