SORELL COUNCIL

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Southern Tasmanian
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Climate Change Information for Decision Making

T.A. Remenyi, N. Earl, P.T. Love, D.A. Rollins, R.M.B. Harris
Climate Futures Programme, Discipline of Geography & Spatial Sciences, University of Tasmania

UNIVERSITY of TASMANIA

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THE PURPOSE OF THIS DOCUMENT

This document summarises key climate indices useful to operational council staff. The climate indices were selected in direct consultation with council personnel and reflect the operational, tactical and strategic climate information needs for decision makers within all of the local councils of southern Tasmania.

This document expands upon previously produced *local profiles* and has been developed to support decision making across Sorell's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Sorell has been developed using outputs from the *Climate Futures for Tasmania Project* and the *Climate Futures Australasian Projections 2019 data archive*, developed by the University of Tasmania's Climate Futures Programme.

All values are based on the projections generated by the Climate Futures Programme, using previously published results. Descriptive documentation and supporting reports can be found here: http://climatefutures.org.au. This document is to be reviewed and updated when more up-to-date information becomes available, or at 5-yearly intervals. It should be considered in conjunction with Sorell's policies and strategies, alongside technical and industry standards.

Values given are the multi-model mean from an ensemble of six downscaled global climate models based on the *business as usual* high emissions scenario RCP8.5 (the scenario human society is currenty most closely following). Averaging across the ensemble smooths out the inter-annual variability, revealing the forced climate response. For most variables, the range between climate models is not large relative to the percent change projected into the future.

In order to capture the regional variability, the data were separated into *cool* ($< 25^{th}$ percentile), *average* (between the 25^{th} and 75^{th} percentile) or *warm* ($> 75^{th}$ percentile) grid cells, based on average temperature during the baseline period, 1961–1990. These three groups of values were then analysed and presented separately. This provides councils with greater utility when mangaing a diverse landscape (NB: municiaplities with small spatial extents have limited differences captured across the municipality at 10km^2 resolution). It is the responsibility of the user to determine which values may be most appropriate for a given application. For example, if building a road over Vinces Saddle, it would be more useful to apply values from the cooler table, whereas for estimating future high-intensity rainfall within Kingston CBD, values from the warmer table would be more appropriate.

CURRENT CLIMATE AND RECENT TRENDS

All Tasmanian municipalities have a temperate, maritime climate with relatively mild winters at low elevations, transitioning towards warm alpine winters at higher elevations. Long-term average temperatures have risen in the decades since the 1950s at a rate of up to 0.1 °C per decade, with this rate expected to increase from 2020 onwards.

Despite covering small geographic areas all municipalities experience marked rainfall gradients, with average annual rainfall from about 600 mm per year at lower elevations and about 1500 mm per year at higher elevations. There has been a decline in average annual rainfall since the mid 1970s, and this decline has been strongest in autumn and enhanced over higher elevation regions.

EXTREME EVENTS

The changes in climate that are most likely to impact upon the each municipality's infrastructure, roads, the local community and the environment are an increase in intensity of extreme events. Potential impacts by 2100 are as follows (following the *business as usual* high emissions scenario RCP8.5):

- Increased evaporation and longer dry periods coupled with more extreme temperatures are likely to enhance the occurrence and intensity of bushfires.
- The frequency of extremely hot days (> 40°C) is projected to increase. Heat wave frequency is projected to remain stable, but will increase in intensity (warmer days and nights).
- The Annual Exceedance Probability (AEP) is a measure of the rarity of an event. Rainfall AEPs are expressed as the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. Heavier rainfall events are expected within a warmer climate. High daily runoff events are likely to increase, including those that may lead to erosion or flooding.
- Inundation along all coastal frontage will increase due to sea level rise. This means the coastal indunation AEP values for all probability events will increase in intensity. The current 100-year coastal inundation event may become a 50-year event by 2030, and a 5-year event by 2090.

Table 1: **Sorell local government area: *Cool subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	11.2	11.7	0.5	4.4	12.2	1	8.9	12.9	1.7	15	13.6	2.4	21.7	14.3	3	27.1
Average daily maximum temperature (°C)	15.6	16	0.5	3.1	16.6	1	6.4	17.3	1.7	10.9	18	2.5	16	18.6	3.1	19.8
Average daily minimum temperature (°C)	6.9	7.4	0.5	7.4	7.9	1	14.4	8.5	1.7	24.2	9.2	2.4	34.8	9.9	3	43.8
Hottest daily temperature of the year (°C)	32.9	33.8	1	2.9	34.4	1.5	4.6	35.4	2.5	7.7	36	3.2	9.6	36.4	3.5	10.6
Temperature of warmest days [99^{th} percentile] (°C)	28.1	28.8	0.7	2.4	29.3	1.2	4.3	30.5	2.4	8.6	31.5	3.4	12.1	31.8	3.7	13.3
Temperature of warmest nights [99^{th} percentile] (°C)	15.4	15.9	0.5	3	16.2	0.8	5.2	16.8	1.4	9.2	17.5	2.1	13.6	17.9	2.5	16.3
Temperature of coldest nights [1^{st} percentile] (°C)	-0.4	-0.1	0.4	86.6	0.3	0.7	164.5	0.9	1.3	300.6	1.5	1.9	443.6	2.2	2.6	613.9
Average annual frost risk days (<2°C)	35	26	-9	-25	20	-14	-41.5	13	-22	-63.5	7	-28	-80	4	-31	-89.2
Average annual freeze risk days (<0°C)	7	4	-2	-35.4	3	-4	-55.6	2	-5	-75	1	-6	-91.4	0	-6	-95.7
Average annual summer days (>25°C)	9	10	1	10.6	11	2	24.5	14	5	49.8	17	8	82.3	19	10	109.3
Average annual hot days (>30°C)	2	2	0	20.9	3	1	53.7	4	2	122.9	6	4	188.6	6	4	231.4
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	116900	142600	25700	22	172600	55700	47.6	222600	105700	90.4	295600	178700	152.9	375000	258100	220.8
Average annual evaporation (mm)	969	995	26	2.6	1032	63	6.5	1117	148	15.3	1192	223	23	1295	326	33.6
Average annual rainfall (mm)	743	702	-41	-5.5	694	-49	-6.6	688	-55	-7.4	643	-100	-13.4	684	-59	-7.9
Seasonal rainfall - Winter (mm)	209	193	-17	-7.9	189	-21	-9.8	194	-15	-7.2	191	-19	-8.9	198	-12	-5.7
Seasonal rainfall - Spring (mm)	183	172	-11	-5.8	167	-16	-8.6	162	-21	-11.5	153	-30	-16.6	142	-41	-22.6
Seasonal rainfall - Summer (mm)	169	162	-7	-4.4	176	7	4.1	169	1	0.3	154	-14	-8.5	173	4	2.5
Seasonal rainfall - Autumn (mm)	194	192	-2	-1	178	-16	-8	179	-15	-7.7	160	-34	-17.3	182	-12	-6.3
Annual maximum daily rainfall (mm)	71	71	0	0.4	82	11	16	76	5	7.1	72	1	1.5	79	9	12.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	161	165	4	2.5	169	8	5.1	175	14	8.6	181	20	12.5	186	25	15.6
Rainfall Extreme - 24hr 5% AEP (mm)[a]	185	190	5	2.5	195	9	5.1	201	16	8.6	208	23	12.5	214	29	15.6
Rainfall Extreme - 24hr 1% AEP (mm)[a]	236	242	6	2.5	249	12	5.1	257	20	8.6	266	30	12.5	273	37	15.6
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	260	267	7	2.5	274	13	5.1	283	22	8.6	293	33	12.5	301	41	15.6
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	215	5	2.5	220	11	5.1	227	18	8.6	235	26	12.5	242	33	15.6
Rainfall Extreme - 48hr 5% AEP (mm)[a]	238	244	6	2.5	250	12	5.1	258	20	8.6	268	30	12.5	275	37	15.6
Rainfall Extreme - 48hr 1% AEP (mm)[a]	304	312	8	2.5	319	16	5.1	330	26	8.6	342	38	12.5	351	47	15.6
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	334	343	8	2.5	351	17	5.1	363	29	8.6	376	42	12.5	387	52	15.6
Average annual cummulative Forest Fire Danger Index	1202	1263	61	5.1	1341	139	11.5	1437	235	19.5	1624	422	35.1	1707	505	42
Sea level - 1% AEP with Freeboard (m)[b]	1.97	2.05	0.08	4.1	2.12	0.15	7.6	2.2	0.23	11.7	2.44	0.47	23.9	2.8	0.83	42.1

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 2: **Sorell local government area: *Average subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	11.9	12.4	0.6	4.7	13	1.1	9.2	13.8	1.9	15.9	14.6	2.7	23	15.3	3.4	29
Average daily maximum temperature (°C)	16.2	16.7	0.6	3.5	17.3	1.1	7	18.1	2	12.1	19	2.8	17.6	19.7	3.6	22.2
Average daily minimum temperature (°C)	7.6	8.1	0.6	7.3	8.7	1.1	14	9.4	1.8	24	10.2	2.6	34.4	10.9	3.3	43.6
Hottest daily temperature of the year (°C)	34.4	35.3	0.9	2.6	35.8	1.5	4.3	36.7	2.4	6.9	37.7	3.3	9.7	38.2	3.8	11.1
Temperature of warmest days [99^{th} percentile] (°C)	28.8	29.6	0.8	2.9	30.2	1.4	4.8	31.4	2.6	9	32.6	3.8	13.2	33.1	4.3	14.9
Temperature of warmest nights [99^{th} percentile] (°C)	15.9	16.5	0.5	3.4	17	1	6.4	17.7	1.8	11.2	18.6	2.7	16.6	19.2	3.3	20.7
Temperature of coldest nights [1^{st} percentile] (°C)	0.2	0.6	0.4	213	0.9	0.8	416.5	1.5	1.3	747.1	2.2	2	1130.4	2.9	2.8	1530.6
Average annual frost risk days (<2°C)	20	14	-6	-29.4	11	-9	-46.2	6	-14	-69	3	-17	-84	2	-19	-91.9
Average annual freeze risk days (<0°C)	3	2	-1	-33.8	1	-2	-58.1	1	-2	-77.3	0	-3	-91.5	0	-3	-96.1
Average annual summer days (>25°C)	11	12	2	14.4	14	3	30.5	17	7	62.7	22	11	107.1	26	16	150.4
Average annual hot days (>30°C)	2	3	1	27.9	4	1	57.7	6	3	126.5	8	5	212	10	7	294.5
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	154800	192300	37500	24.2	235400	80600	52.1	314800	160000	103.4	429400	274600	177.4	560700	405900	262.2
Average annual evaporation (mm)	1007	1044	37	3.7	1081	73	7.3	1189	182	18.1	1279	272	27	1408	401	39.8
Average annual rainfall (mm)	672	648	-24	-3.5	642	-29	-4.4	639	-33	-4.9	606	-66	-9.8	649	-23	-3.4
Seasonal rainfall - Winter (mm)	193	183	-10	-5.1	180	-13	-6.9	187	-5	-2.8	186	-7	-3.6	194	1	0.6
Seasonal rainfall - Spring (mm)	164	158	-6	-3.8	154	-10	-6.1	148	-16	-10	145	-19	-11.8	133	-31	-18.6
Seasonal rainfall - Summer (mm)	151	145	-6	-4.1	157	6	4.1	152	1	0.6	137	-14	-9.4	159	7	4.9
Seasonal rainfall - Autumn (mm)	175	178	3	1.8	167	-8	-4.6	167	-8	-4.7	153	-22	-12.8	172	-2	-1.4
Annual maximum daily rainfall (mm)	71	71	0	0.4	82	11	16	76	5	7.1	72	1	1.5	79	9	12.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	160	165	5	2.9	169	9	5.6	176	16	9.7	183	23	14	189	28	17.7
Rainfall Extreme - 24hr 5% AEP (mm)[a]	184	190	5	2.9	195	10	5.6	202	18	9.7	210	26	14	217	33	17.7
Rainfall Extreme - 24hr 1% AEP (mm)[a]	236	242	7	2.9	249	13	5.6	259	23	9.7	269	33	14	277	42	17.7
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	259	267	7	2.9	274	15	5.6	285	25	9.7	296	36	14	305	46	17.7
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	215	6	2.9	220	12	5.6	229	20	9.7	238	29	14	246	37	17.7
Rainfall Extreme - 48hr 5% AEP (mm)[a]	237	244	7	2.9	250	13	5.6	260	23	9.7	270	33	14	279	42	17.7
Rainfall Extreme - 48hr 1% AEP (mm)[a]	303	312	9	2.9	320	17	5.6	332	29	9.7	345	42	14	357	54	17.7
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	333	343	10	2.9	352	19	5.6	366	32	9.7	380	47	14	392	59	17.7
Average annual cummulative Forest Fire Danger Index	1356	1402	46	3.4	1473	117	8.6	1590	234	17.2	1762	405	29.9	1861	505	37.2
Sea level - 1% AEP with Freeboard (m)[b]	1.97	2.05	0.08	4.1	2.12	0.15	7.6	2.2	0.23	11.7	2.44	0.47	23.9	2.8	0.83	42.1

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 3: **Sorell local government area: *Warm subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	12.3	12.8	0.5	4.2	13.3	1.1	8.6	14.1	1.8	14.7	14.9	2.6	21.1	15.6	3.3	26.6
Average daily maximum temperature (°C)	16.9	17.5	0.5	3	18	1.1	6.4	18.8	1.9	11	19.6	2.7	16	20.3	3.4	19.9
Average daily minimum temperature (°C)	7.6	8.2	0.5	6.8	8.7	1	13.3	9.4	1.7	22.8	10.1	2.5	32.6	10.8	3.2	41.3
Hottest daily temperature of the year (°C)	35.6	36.5	1	2.7	37.2	1.6	4.5	38.1	2.5	7	39	3.4	9.6	39.6	4	11.4
Temperature of warmest days [99^{th} percentile] (°C)	30.4	31.2	0.8	2.7	31.8	1.4	4.7	33	2.6	8.4	34.2	3.8	12.4	34.6	4.2	13.8
Temperature of warmest nights [99^{th} percentile] (°C)	16.3	16.8	0.5	3.1	17.2	0.9	5.7	17.9	1.6	9.9	18.8	2.4	15	19.3	3	18.2
Temperature of coldest nights [1^{st} percentile] (°C)	0.1	0.4	0.3	576	0.7	0.7	1206.1	1.3	1.2	2142.3	2	1.9	3309.6	2.7	2.6	4557.6
Average annual frost risk days (<2°C)	23	17	-6	-27	13	-10	-42.9	8	-15	-66.4	4	-19	-81.4	2	-21	-89.8
Average annual freeze risk days (<0°C)	4	2	-1	-31.4	2	-2	-53.5	1	-3	-72.1	0	-3	-89.2	0	-3	-94.1
Average annual summer days (>25°C)	16	18	2	11.5	20	4	27.8	24	8	51.4	29	14	85.7	34	18	114.1
Average annual hot days (>30°C)	5	6	1	24.2	7	2	49.5	9	5	105.1	11	7	154.2	14	9	204.5
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	157200	192700	35500	22.6	234900	77700	49.4	309100	151900	96.6	415300	258100	164.2	536500	379300	241.3
Average annual evaporation (mm)	1055	1078	23	2.2	1116	61	5.8	1203	149	14.1	1278	223	21.2	1388	333	31.6
Average annual rainfall (mm)	527	515	-12	-2.3	519	-9	-1.6	510	-17	-3.2	489	-38	-7.2	524	-3	-0.6
Seasonal rainfall - Winter (mm)	143	135	-8	-5.5	133	-10	-7	138	-5	-3.8	138	-5	-3.7	145	1	0.9
Seasonal rainfall - Spring (mm)	131	128	-3	-2.1	127	-4	-3	119	-11	-8.6	119	-12	-9.1	106	-24	-18.7
Seasonal rainfall - Summer (mm)	125	123	-3	-2	137	11	9.1	129	3	2.7	120	-5	-4.3	140	14	11.4
Seasonal rainfall - Autumn (mm)	137	141	5	3.4	135	-2	-1.6	137	0	-0.1	124	-13	-9.3	141	4	3.1
Annual maximum daily rainfall (mm)	71	71	0	0.4	82	11	16	76	5	7.1	72	1	1.5	79	9	12.5
Rainfall Extreme - 24hr 10% AEP (mm)[a]	161	165	4	2.7	169	9	5.4	176	15	9.3	182	21	13.3	188	27	16.8
Rainfall Extreme - 24hr 5% AEP (mm)[a]	185	190	5	2.7	195	10	5.4	202	17	9.3	209	25	13.3	216	31	16.8
Rainfall Extreme - 24hr 1% AEP (mm)[a]	236	242	6	2.7	249	13	5.4	258	22	9.3	268	31	13.3	276	40	16.8
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	260	267	7	2.7	274	14	5.4	284	24	9.3	295	35	13.3	304	44	16.8
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	215	6	2.7	220	11	5.4	228	19	9.3	237	28	13.3	244	35	16.8
Rainfall Extreme - 48hr 5% AEP (mm)[a]	238	244	6	2.7	250	13	5.4	260	22	9.3	269	32	13.3	277	40	16.8
Rainfall Extreme - 48hr 1% AEP (mm)[a]	304	312	8	2.7	320	16	5.4	332	28	9.3	344	40	13.3	354	51	16.8
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	334	343	9	2.7	352	18	5.4	365	31	9.3	378	45	13.3	390	56	16.8
Average annual cummulative Forest Fire Danger Index	1756	1778	22	1.3	1894	138	7.9	2022	266	15.1	2209	453	25.8	2303	547	31.1
Sea level - 1% AEP with Freeboard (m)[b]	1.97	2.05	0.08	4.1	2.12	0.15	7.6	2.2	0.23	11.7	2.44	0.47	23.9	2.8	0.83	42.1

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

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Private Bag 78
Hobart Tasmania 7001
Tel: +61 3 6226 1511
Email: ted-admin@utas.edu.au

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