Southern Tasmanian
COUNCILS AUTHORITY

Climate Change Information for Decision Making

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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 Central Highlands's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Central Highlands 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 Central Highlands'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: **Central Highlands 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)	6.2	6.8	0.6	9.4	7.4	1.2	19.2	8.1	1.9	30.9	9	2.7	44.2	9.6	3.4	55.2
Average daily maximum temperature (°C)	10.7	11.3	0.7	6.3	12	1.4	12.9	12.9	2.2	20.6	13.8	3.1	29.4	14.5	3.9	36.4
Average daily minimum temperature (°C)	1.8	2.3	0.5	28.2	2.8	1	57.4	3.4	1.6	93.2	4.1	2.4	133.6	4.7	3	168.9
Hottest daily temperature of the year (°C)	29.5	30.4	0.9	3.2	31.2	1.7	5.7	32.3	2.8	9.4	33.2	3.6	12.4	33.9	4.4	14.8
Temperature of warmest days [99^{th} percentile] (°C)	25.2	26.2	1	3.9	27	1.8	7.2	28	2.8	11.3	29.1	3.9	15.4	29.7	4.5	18
Temperature of warmest nights [99^{th} percentile] (°C)	11.7	12.4	0.7	6.1	13.2	1.4	12.4	14	2.3	19.8	15.1	3.4	28.8	15.5	3.8	32.4
Temperature of coldest nights [1^{st} percentile] (°C)	-5.9	-5.3	0.6	10.1	-4.9	1	16.6	-4.3	1.6	27.6	-3.5	2.4	40.3	-2.8	3.1	52.4
Average annual frost risk days (<2°C)	198	178	-20	-10.1	160	-38	-19.4	137	-61	-30.6	113	-85	-42.8	94	-104	-52.7
Average annual freeze risk days (<0°C)	123	107	-17	-13.5	92	-31	-25.5	74	-50	-40.3	56	-68	-54.9	43	-81	-65.5
Average annual summer days (>25°C)	4	6	2	40.6	9	4	99.5	13	8	190.1	18	13	306.2	23	19	427.5
Average annual hot days (>30°C)	0	1	0	103.4	1	1	204.6	2	1	515.5	3	2	986.9	4	4	1521.6
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	16900	20600	3700	21.9	25200	8300	49.1	31900	15000	88.8	42400	25500	150.9	53400	36500	216
Average annual evaporation (mm)	660	684	25	3.7	725	65	9.9	780	120	18.2	835	175	26.6	914	254	38.6
Average annual rainfall (mm)	1399	1321	-78	-5.6	1249	-150	-10.7	1216	-183	-13.1	1184	-215	-15.4	1214	-185	-13.2
Seasonal rainfall - Winter (mm)	563	538	-25	-4.4	514	-49	-8.6	505	-58	-10.3	502	-61	-10.9	514	-48	-8.6
Seasonal rainfall - Spring (mm)	339	317	-22	-6.5	283	-56	-16.4	277	-62	-18.2	280	-58	-17.3	255	-83	-24.6
Seasonal rainfall - Summer (mm)	203	191	-12	-6.1	196	-8	-3.8	186	-17	-8.3	169	-34	-16.8	183	-21	-10.2
Seasonal rainfall - Autumn (mm)	316	304	-12	-3.8	284	-32	-10.2	274	-42	-13.2	259	-56	-17.9	276	-39	-12.4
Annual maximum daily rainfall (mm)	102	105	2	2.2	114	12	11.4	111	8	8.3	111	9	8.3	127	25	24.1
Rainfall Extreme - 24hr 10% AEP (mm)[a]	125	129	4	3	133	8	6.1	137	12	9.9	143	18	14.1	147	22	17.7
Rainfall Extreme - 24hr 5% AEP (mm)[a]	145	149	4	3	153	9	6.1	159	14	9.9	165	20	14.1	170	26	17.7
Rainfall Extreme - 24hr 1% AEP (mm)[a]	189	194	6	3	200	12	6.1	207	19	9.9	215	27	14.1	222	33	17.7
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	210	217	6	3	223	13	6.1	231	21	9.9	240	30	14.1	248	37	17.7
Rainfall Extreme - 48hr 10% AEP (mm)[a]	167	172	5	3	177	10	6.1	184	17	9.9	191	24	14.1	197	30	17.7
Rainfall Extreme - 48hr 5% AEP (mm)[a]	191	197	6	3	203	12	6.1	210	19	9.9	218	27	14.1	225	34	17.7
Rainfall Extreme - 48hr 1% AEP (mm)[a]	251	258	8	3	266	15	6.1	276	25	9.9	286	35	14.1	295	44	17.7
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	280	288	8	3	297	17	6.1	308	28	9.9	320	40	14.1	329	49	17.7
Average annual cummulative Forest Fire Danger Index	491	541	50	10.2	613	122	24.9	690	200	40.7	801	310	63.3	906	416	84.7
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[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: **Central Highlands 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)	8	8.5	0.5	6.7	9.1	1.1	13.9	9.8	1.8	22.4	10.6	2.6	32.2	11.2	3.2	40.3
Average daily maximum temperature (°C)	12.9	13.5	0.6	4.6	14.2	1.3	9.7	14.9	2	15.6	15.8	2.9	22.3	16.5	3.6	27.7
Average daily minimum temperature (°C)	3.1	3.6	0.5	15.2	4.1	1	31.1	4.7	1.6	50.8	5.4	2.3	73	6	2.9	92.7
Hottest daily temperature of the year (°C)	33	33.8	0.8	2.5	34.8	1.8	5.3	35.7	2.7	8.1	36.3	3.3	10	36.9	3.9	11.9
Temperature of warmest days [99^{th} percentile] (°C)	27.8	28.7	0.9	3.1	29.5	1.6	5.9	30.4	2.6	9.3	31.4	3.6	12.8	31.8	4	14.4
Temperature of warmest nights [99^{th} percentile] (°C)	12.8	13.3	0.5	4.2	13.9	1.1	8.3	14.5	1.7	13.2	15.3	2.5	19.7	15.6	2.8	21.8
Temperature of coldest nights [1^{st} percentile] (°C)	-4.9	-4.4	0.4	9.2	-4	0.8	17.3	-3.5	1.4	28.5	-2.8	2.1	43	-2.1	2.8	57.4
Average annual frost risk days (<2°C)	145	127	-18	-12.4	111	-34	-23.3	92	-53	-36.5	72	-73	-50.3	57	-88	-60.7
Average annual freeze risk days (<0°C)	78	66	-13	-16.1	55	-23	-29.7	42	-36	-46.2	30	-48	-61.6	21	-57	-73
Average annual summer days (>25°C)	10	13	2	23.8	16	6	54.4	20	10	94.9	25	14	142.8	29	19	184.6
Average annual hot days (>30°C)	1	2	1	46.3	3	2	119	5	3	240.9	7	6	407.5	10	8	576
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	28200	34000	5800	20.6	41400	13200	46.8	52100	23900	84.8	68600	40400	143.3	86300	58100	206
Average annual evaporation (mm)	775	793	17	2.2	831	56	7.2	874	99	12.8	921	146	18.8	991	216	27.8
Average annual rainfall (mm)	1239	1175	-63	-5.1	1129	-110	-8.9	1111	-127	-10.3	1092	-147	-11.9	1136	-102	-8.3
Seasonal rainfall - Winter (mm)	458	442	-16	-3.5	428	-30	-6.6	431	-27	-5.9	430	-28	-6	452	-6	-1.3
Seasonal rainfall - Spring (mm)	308	292	-15	-4.9	267	-41	-13.3	261	-47	-15.2	265	-42	-13.8	247	-61	-19.8
Seasonal rainfall - Summer (mm)	204	190	-14	-7	197	-7	-3.5	187	-17	-8.3	172	-32	-15.5	187	-17	-8.3
Seasonal rainfall - Autumn (mm)	288	277	-11	-3.9	263	-26	-8.9	257	-31	-10.7	248	-40	-13.8	265	-24	-8.2
Annual maximum daily rainfall (mm)	102	105	2	2.2	114	12	11.4	111	8	8.3	111	9	8.3	127	25	24.1
Rainfall Extreme - 24hr 10% AEP (mm)[a]	125	129	3	2.8	132	7	5.7	137	12	9.2	142	17	13.2	146	21	16.6
Rainfall Extreme - 24hr 5% AEP (mm)[a]	145	149	4	2.8	153	8	5.7	158	13	9.2	164	19	13.2	169	24	16.6
Rainfall Extreme - 24hr 1% AEP (mm)[a]	189	194	5	2.8	200	11	5.7	207	17	9.2	214	25	13.2	221	31	16.6
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	211	217	6	2.8	223	12	5.7	230	19	9.2	239	28	13.2	246	35	16.6
Rainfall Extreme - 48hr 10% AEP (mm)[a]	167	172	5	2.8	177	10	5.7	183	15	9.2	190	22	13.2	195	28	16.6
Rainfall Extreme - 48hr 5% AEP (mm)[a]	192	197	5	2.8	202	11	5.7	209	18	9.2	217	25	13.2	223	32	16.6
Rainfall Extreme - 48hr 1% AEP (mm)[a]	251	258	7	2.8	266	14	5.7	275	23	9.2	285	33	13.2	293	42	16.6
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	281	288	8	2.8	297	16	5.7	307	26	9.2	318	37	13.2	327	47	16.6
Average annual cummulative Forest Fire Danger Index	746	799	53	7.2	887	142	19	971	226	30.3	1083	338	45.3	1188	443	59.4
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[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: **Central Highlands 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)	10.1	10.7	0.5	5.1	11.2	1.1	10.6	11.9	1.8	17.4	12.7	2.5	24.9	13.3	3.2	31.2
Average daily maximum temperature (°C)	15.6	16.2	0.5	3.5	16.8	1.2	7.5	17.5	1.9	12.1	18.4	2.7	17.4	19	3.4	21.6
Average daily minimum temperature (°C)	4.6	5.1	0.5	10.6	5.6	1	21.1	6.2	1.6	35	6.9	2.3	50.1	7.6	3	64
Hottest daily temperature of the year (°C)	35.6	36.3	0.7	1.8	37.3	1.7	4.7	38.2	2.6	7.4	38.7	3.1	8.7	39.4	3.8	10.7
Temperature of warmest days [99^{th} percentile] (°C)	30.7	31.4	0.7	2.2	32.1	1.4	4.4	33	2.3	7.3	33.9	3.2	10.4	34.2	3.5	11.4
Temperature of warmest nights [99^{th} percentile] (°C)	14.3	14.7	0.5	3.2	15.1	0.9	6	15.6	1.4	9.6	16.3	2.1	14.4	16.7	2.4	16.8
Temperature of coldest nights [1^{st} percentile] (°C)	-4	-3.6	0.4	9.3	-3.2	0.8	19	-2.7	1.3	32.9	-2	2	50.2	-1.3	2.7	68.3
Average annual frost risk days (<2°C)	99	84	-14	-14.5	73	-26	-25.9	58	-41	-41.3	43	-55	-55.9	32	-66	-67.4
Average annual freeze risk days (<0°C)	49	39	-9	-19.2	33	-16	-33	24	-25	-51.4	16	-33	-67.1	10	-38	-78.5
Average annual summer days (>25°C)	20	23	3	13.1	26	6	29.3	30	10	50.8	36	15	76.3	40	19	95.5
Average annual hot days (>30°C)	5	7	1	25.7	8	3	57.7	11	6	112.7	14	9	167.6	17	12	225
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	49900	60500	10600	21.2	73200	23300	46.7	93300	43400	87	123100	73200	146.7	156700	106800	214
Average annual evaporation (mm)	934	948	14	1.5	985	51	5.4	1031	97	10.4	1082	148	15.8	1159	225	24.1
Average annual rainfall (mm)	597	577	-20	-3.3	563	-34	-5.7	560	-37	-6.2	549	-48	-8	580	-17	-2.9
Seasonal rainfall - Winter (mm)	187	180	-7	-3.9	172	-15	-8	176	-11	-5.9	177	-10	-5.2	191	4	2.3
Seasonal rainfall - Spring (mm)	144	141	-3	-2.1	132	-13	-8.9	128	-17	-11.6	130	-14	-9.9	118	-26	-18.3
Seasonal rainfall - Summer (mm)	129	123	-6	-4.6	136	8	5.8	130	1	1	122	-7	-5.3	133	4	3.4
Seasonal rainfall - Autumn (mm)	147	147	0	0	136	-10	-7	140	-7	-4.7	133	-14	-9.5	146	-1	-0.7
Annual maximum daily rainfall (mm)	102	105	2	2.2	114	12	11.4	111	8	8.3	111	9	8.3	127	25	24.1
Rainfall Extreme - 24hr 10% AEP (mm)[a]	125	129	3	2.7	132	7	5.5	137	11	9	142	16	12.9	146	20	16.3
Rainfall Extreme - 24hr 5% AEP (mm)[a]	145	149	4	2.7	153	8	5.5	158	13	9	164	19	12.9	169	24	16.3
Rainfall Extreme - 24hr 1% AEP (mm)[a]	189	194	5	2.7	200	10	5.5	206	17	9	214	25	12.9	220	31	16.3
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	211	217	6	2.7	223	12	5.5	230	19	9	238	27	12.9	245	34	16.3
Rainfall Extreme - 48hr 10% AEP (mm)[a]	168	172	4	2.7	177	9	5.5	183	15	9	189	22	12.9	195	27	16.3
Rainfall Extreme - 48hr 5% AEP (mm)[a]	192	197	5	2.7	202	11	5.5	209	17	9	216	25	12.9	223	31	16.3
Rainfall Extreme - 48hr 1% AEP (mm)[a]	252	258	7	2.7	265	14	5.5	274	23	9	284	33	12.9	292	41	16.3
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	281	288	7	2.7	296	15	5.5	306	25	9	317	36	12.9	327	46	16.3
Average annual cummulative Forest Fire Danger Index	1655	1722	67	4.1	1869	214	12.9	1995	340	20.5	2166	511	30.9	2300	645	39
Sea level - 1% AEP with Freeboard (m)[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[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.

Climate Change Information for Decision Making - Central Highlands

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