Southern Tasmanian
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GLENORCHY
CITY COUNCIL

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

BACKGROUND

The Climate Change Information for Decision Making - Glenorchy 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 Glenorchy'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: **Glenorchy 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)	8.4	8.9	0.4	5.3	9.4	1	11.4	10	1.6	18.8	10.7	2.3	27.1	11.3	2.9	33.8
Average daily maximum temperature (°C)	12.7	13.2	0.5	3.6	13.7	1	8.1	14.4	1.7	13.3	15.2	2.4	19.2	15.7	3	23.6
Average daily minimum temperature (°C)	4.2	4.6	0.4	10.4	5.1	0.9	21.3	5.6	1.5	35.4	6.3	2.1	51	6.9	2.7	64.7
Hottest daily temperature of the year (°C)	30.4	31.2	0.8	2.5	31.9	1.5	4.9	32.7	2.3	7.6	33.3	2.9	9.6	33.7	3.3	10.9
Temperature of warmest days [99^{th} percentile] (°C)	27	27.5	0.6	2.2	28.1	1.2	4.4	29	2.1	7.7	30	3.1	11.4	30.2	3.2	11.9
Temperature of warmest nights [99^{th} percentile] (°C)	13.1	13.5	0.4	3.3	13.9	0.8	6.3	14.4	1.3	9.9	15.1	2	15.1	15.3	2.2	17.1
Temperature of coldest nights [1^{st} percentile] (°C)	-2.8	-2.4	0.3	12.5	-2.1	0.7	25.5	-1.5	1.2	44.2	-0.9	1.8	67	-0.3	2.4	88.4
Average annual frost risk days (<2°C)	104	90	-14	-13.7	77	-28	-26.4	60	-45	-42.8	44	-60	-57.9	31	-73	-70.2
Average annual freeze risk days (<0°C)	43	33	-10	-22.4	27	-16	-37.8	18	-25	-58.6	11	-32	-74.4	6	-36	-85
Average annual summer days (>25°C)	7	8	1	17.4	10	2	33.5	11	4	56.6	13	6	83.7	14	7	98.9
Average annual hot days (>30°C)	1	2	0	27.2	2	1	69.1	3	2	134.3	4	3	222.1	5	4	269.9
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	41900	49700	7800	18.6	59400	17500	41.8	74300	32400	77.3	95900	54000	128.9	119200	77300	184.5
Average annual evaporation (mm)	765	772	7	0.9	809	44	5.7	851	86	11.3	896	131	17.1	962	197	25.8
Average annual rainfall (mm)	1113	1080	-34	-3	1071	-42	-3.8	1073	-40	-3.6	1048	-66	-5.9	1109	-4	-0.4
Seasonal rainfall - Winter (mm)	317	299	-18	-5.7	287	-30	-9.5	307	-10	-3.3	303	-14	-4.5	328	11	3.3
Seasonal rainfall - Spring (mm)	277	269	-8	-2.8	260	-16	-5.9	252	-25	-9	251	-25	-9.2	227	-50	-18.1
Seasonal rainfall - Summer (mm)	260	252	-8	-3	284	24	9.3	265	5	1.7	260	0	0.1	279	19	7.2
Seasonal rainfall - Autumn (mm)	277	284	7	2.6	264	-13	-4.7	275	-2	-0.7	257	-20	-7.1	291	14	5.1
Annual maximum daily rainfall (mm)	79	79	0	0	90	11	13.9	84	5	6.2	83	4	4.9	102	23	28.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	162	166	4	2.3	170	8	4.9	175	13	8.1	181	19	11.7	186	24	14.6
Rainfall Extreme - 24hr 5% AEP (mm)[a]	186	190	4	2.3	195	9	4.9	201	15	8.1	208	22	11.7	213	27	14.6
Rainfall Extreme - 24hr 1% AEP (mm)[a]	241	246	6	2.3	252	12	4.9	260	19	8.1	269	28	11.7	276	35	14.6
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	267	273	6	2.3	280	13	4.9	288	22	8.1	298	31	11.7	306	39	14.6
Rainfall Extreme - 48hr 10% AEP (mm)[a]	213	218	5	2.3	223	10	4.9	230	17	8.1	238	25	11.7	244	31	14.6
Rainfall Extreme - 48hr 5% AEP (mm)[a]	243	248	6	2.3	255	12	4.9	262	20	8.1	271	28	11.7	278	35	14.6
Rainfall Extreme - 48hr 1% AEP (mm)[a]	316	323	7	2.3	331	15	4.9	341	26	8.1	353	37	11.7	362	46	14.6
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	349	357	8	2.3	366	17	4.9	377	28	8.1	390	41	11.7	400	51	14.6
Average annual cummulative Forest Fire Danger Index	625	641	16	2.6	683	58	9.3	715	90	14.4	775	150	24	818	193	30.9
Sea level - 1% AEP with Freeboard (m)[b]	1.77	1.85	0.08	4.5	1.92	0.15	8.5	2	0.23	13	2.24	0.47	26.6	2.6	0.83	46.9

[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: **Glenorchy 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)	10	10.5	0.5	4.8	11	1	10.1	11.7	1.7	16.7	12.4	2.4	23.9	13	3	29.9
Average daily maximum temperature (°C)	14.9	15.4	0.5	3.4	15.9	1.1	7.3	16.6	1.8	12	17.4	2.6	17.3	18	3.2	21.3
Average daily minimum temperature (°C)	5.2	5.7	0.5	8.8	6.1	0.9	17.9	6.7	1.5	29.8	7.4	2.2	42.8	8	2.8	54.5
Hottest daily temperature of the year (°C)	33.8	34.6	0.8	2.5	35.3	1.5	4.3	36.1	2.3	6.9	36.8	3	8.8	37.3	3.5	10.3
Temperature of warmest days [99^{th} percentile] (°C)	29.6	30.3	0.6	2.2	30.9	1.2	4.2	31.9	2.3	7.6	32.9	3.3	11.2	33.1	3.4	11.5
Temperature of warmest nights [99^{th} percentile] (°C)	14.3	14.8	0.6	3.9	15.2	0.9	6.5	15.6	1.4	9.7	16.4	2.1	14.9	16.6	2.4	16.8
Temperature of coldest nights [1^{st} percentile] (°C)	-2.4	-2.1	0.3	14.3	-1.7	0.7	29.1	-1.2	1.2	49.2	-0.6	1.8	75.5	0	2.4	101
Average annual frost risk days (<2°C)	78	65	-13	-16.7	55	-23	-29.5	41	-37	-47.2	30	-49	-62.2	20	-58	-74.5
Average annual freeze risk days (<0°C)	30	23	-7	-22.9	18	-12	-39.5	12	-18	-60.1	7	-23	-76.1	4	-26	-86.2
Average annual summer days (>25°C)	14	16	2	14.4	18	4	30.1	21	7	51.4	24	11	76.8	27	13	95.4
Average annual hot days (>30°C)	3	4	1	24.7	5	2	56.8	7	4	110.5	9	6	162.2	10	7	200.8
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	62000	74200	12200	19.7	89200	27200	43.9	112900	50900	82.1	147200	85200	137.4	185600	123600	199.4
Average annual evaporation (mm)	879	889	10	1.1	927	49	5.5	976	97	11.1	1024	146	16.6	1098	220	25
Average annual rainfall (mm)	778	753	-25	-3.3	748	-30	-3.9	750	-28	-3.6	739	-39	-5	786	7	1
Seasonal rainfall - Winter (mm)	228	217	-11	-4.9	210	-19	-8.2	222	-6	-2.8	223	-6	-2.5	240	12	5.1
Seasonal rainfall - Spring (mm)	193	189	-4	-1.9	179	-14	-7	175	-18	-9.2	176	-17	-8.6	161	-32	-16.5
Seasonal rainfall - Summer (mm)	179	172	-7	-4	194	15	8.4	182	3	1.5	179	0	0	192	13	7
Seasonal rainfall - Autumn (mm)	190	192	1	0.8	182	-8	-4.4	189	-2	-0.8	178	-12	-6.2	204	13	7
Annual maximum daily rainfall (mm)	79	79	0	0	90	11	13.9	84	5	6.2	83	4	4.9	102	23	28.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	162	166	4	2.5	170	8	5.2	176	14	8.6	182	20	12.3	187	25	15.4
Rainfall Extreme - 24hr 5% AEP (mm)[a]	186	190	5	2.5	195	10	5.2	202	16	8.6	209	23	12.3	214	29	15.4
Rainfall Extreme - 24hr 1% AEP (mm)[a]	240	246	6	2.5	253	12	5.2	261	21	8.6	270	29	12.3	277	37	15.4
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	266	273	7	2.5	280	14	5.2	289	23	8.6	299	33	12.3	307	41	15.4
Rainfall Extreme - 48hr 10% AEP (mm)[a]	212	218	5	2.5	223	11	5.2	230	18	8.6	238	26	12.3	245	33	15.4
Rainfall Extreme - 48hr 5% AEP (mm)[a]	242	248	6	2.5	255	13	5.2	263	21	8.6	272	30	12.3	279	37	15.4
Rainfall Extreme - 48hr 1% AEP (mm)[a]	315	323	8	2.5	332	16	5.2	342	27	8.6	354	39	12.3	364	48	15.4
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	348	357	9	2.5	366	18	5.2	378	30	8.6	391	43	12.3	402	53	15.4
Average annual cummulative Forest Fire Danger Index	949	980	31	3.3	1054	105	11	1127	178	18.7	1220	271	28.6	1294	345	36.4
Sea level - 1% AEP with Freeboard (m)[b]	1.77	1.85	0.08	4.5	1.92	0.15	8.5	2	0.23	13	2.24	0.47	26.6	2.6	0.83	46.9

[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: **Glenorchy 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)	11.6	12.1	0.5	4	12.6	1	8.5	13.2	1.6	14.2	14	2.4	20.4	14.6	3	25.5
Average daily maximum temperature (°C)	16.3	16.8	0.5	2.8	17.4	1	6.2	18	1.7	10.3	18.8	2.4	14.9	19.4	3	18.4
Average daily minimum temperature (°C)	6.8	7.3	0.5	6.9	7.8	1	14	8.4	1.6	23.4	9.1	2.3	33.5	9.8	2.9	42.5
Hottest daily temperature of the year (°C)	35	35.8	0.8	2.3	36.4	1.4	4	37.5	2.5	7.2	38.1	3.1	9	38.7	3.7	10.6
Temperature of warmest days [99^{th} percentile] (°C)	30.6	31.2	0.6	2	31.8	1.3	4.2	32.9	2.3	7.7	34	3.5	11.4	34.2	3.7	12
Temperature of warmest nights [99^{th} percentile] (°C)	15.6	16	0.4	2.8	16.4	0.8	5	16.8	1.2	7.8	17.5	1.9	12	17.7	2.1	13.5
Temperature of coldest nights [1^{st} percentile] (°C)	-0.7	-0.3	0.4	53.8	0.1	0.7	109.2	0.6	1.3	186.1	1.3	2	290	2	2.7	395.8
Average annual frost risk days (<2°C)	37	28	-9	-24	22	-15	-40.7	14	-23	-62.3	8	-29	-78.3	4	-32	-87.9
Average annual freeze risk days (<0°C)	8	6	-3	-32.4	4	-4	-53.4	2	-6	-72.1	1	-7	-87.7	0	-8	-94.3
Average annual summer days (>25°C)	16	17	2	10.1	19	4	23.1	22	6	40.6	26	10	64	28	13	81.7
Average annual hot days (>30°C)	5	6	1	23.1	7	2	45.6	9	4	92.7	11	6	130.4	12	8	161.8
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	115900	139500	23600	20.4	168500	52600	45.4	215600	99700	86	282800	166900	144	358100	242200	209
Average annual evaporation (mm)	983	995	12	1.2	1035	52	5.3	1100	117	11.9	1160	177	18	1251	268	27.2
Average annual rainfall (mm)	650	636	-14	-2.1	630	-20	-3	627	-23	-3.6	611	-39	-6	643	-7	-1.1
Seasonal rainfall - Winter (mm)	175	164	-11	-6	156	-19	-10.7	165	-10	-5.5	164	-11	-6.4	177	2	1.1
Seasonal rainfall - Spring (mm)	163	160	-2	-1.5	156	-7	-4.3	148	-14	-8.7	148	-15	-9.1	130	-32	-19.8
Seasonal rainfall - Summer (mm)	159	157	-2	-1.4	177	17	10.8	164	5	2.9	161	1	0.8	173	13	8.5
Seasonal rainfall - Autumn (mm)	164	170	6	3.7	157	-7	-4.3	164	1	0.3	153	-11	-6.5	172	8	5.2
Annual maximum daily rainfall (mm)	79	79	0	0	90	11	13.9	84	5	6.2	83	4	4.9	102	23	28.7
Rainfall Extreme - 24hr 10% AEP (mm)[a]	162	166	4	2.4	170	8	5	176	14	8.4	182	20	12.1	187	25	15.2
Rainfall Extreme - 24hr 5% AEP (mm)[a]	186	190	4	2.4	195	9	5	202	16	8.4	209	23	12.1	214	28	15.2
Rainfall Extreme - 24hr 1% AEP (mm)[a]	240	246	6	2.4	252	12	5	261	20	8.4	270	29	12.1	277	36	15.2
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	267	273	6	2.4	280	13	5	289	22	8.4	299	32	12.1	307	40	15.2
Rainfall Extreme - 48hr 10% AEP (mm)[a]	212	218	5	2.4	223	11	5	230	18	8.4	238	26	12.1	245	32	15.2
Rainfall Extreme - 48hr 5% AEP (mm)[a]	242	248	6	2.4	255	12	5	263	20	8.4	272	29	12.1	279	37	15.2
Rainfall Extreme - 48hr 1% AEP (mm)[a]	316	323	8	2.4	331	16	5	342	27	8.4	354	38	12.1	363	48	15.2
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	349	357	8	2.4	366	18	5	378	29	8.4	391	42	12.1	402	53	15.2
Average annual cummulative Forest Fire Danger Index	1633	1651	19	1.1	1777	144	8.8	1893	260	15.9	2061	428	26.2	2182	549	33.6
Sea level - 1% AEP with Freeboard (m)[b]	1.77	1.85	0.08	4.5	1.92	0.15	8.5	2	0.23	13	2.24	0.47	26.6	2.6	0.83	46.9

[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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