GLAMORGAN SPRING BAY COUNCIL

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 Glamorgan/Spring Bay's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Glamorgan/Spring Bay 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 Glamorgan/Spring Bay'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: **Glamorgan/Spring Bay 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)	10.1	10.5	0.5	4.7	11	1	9.7	11.7	1.6	16.1	12.4	2.4	23.4	13	3	29.5
Average daily maximum temperature (°C)	14.8	15.3	0.4	3	15.8	1	6.5	16.4	1.6	10.9	17.2	2.4	16	17.8	3	20
Average daily minimum temperature (°C)	5.3	5.8	0.5	9.4	6.3	1	18.6	6.9	1.6	30.9	7.7	2.4	44.3	8.3	3	55.9
Hottest daily temperature of the year (°C)	33.1	33.8	0.7	2.2	34.7	1.6	4.8	35.8	2.7	8.2	36.2	3.1	9.2	36.7	3.6	10.9
Temperature of warmest days [99^{th} percentile] (°C)	27.9	28.4	0.5	1.9	29	1.2	4.2	30	2.1	7.6	30.9	3	10.8	31.2	3.3	11.9
Temperature of warmest nights [99^{th} percentile] (°C)	14.5	14.9	0.4	3	15.3	0.8	5.7	15.8	1.3	9	16.4	1.9	13.3	16.7	2.2	15
Temperature of coldest nights [1^{st} percentile] (°C)	-3.3	-2.9	0.4	12.8	-2.4	0.9	26	-1.8	1.5	45	-1	2.3	70.2	-0.2	3.1	93.2
Average annual frost risk days (<2°C)	79	67	-13	-16.1	56	-23	-29.5	43	-37	-46.2	30	-50	-62.6	21	-59	-74.1
Average annual freeze risk days (<0°C)	36	28	-8	-21.3	22	-14	-38	15	-21	-58.4	9	-27	-75.5	5	-31	-85.5
Average annual summer days (>25°C)	9	10	1	9.8	12	3	31	15	5	58.7	18	9	94.8	21	12	127
Average annual hot days (>30°C)	2	2	0	22.6	3	1	66.3	4	2	130.5	5	4	209.8	6	5	276.5
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	64700	78700	14000	21.6	95500	30800	47.6	122100	57400	88.7	161500	96800	149.6	203900	139200	215.1
Average annual evaporation (mm)	908	917	9	1	951	43	4.7	998	91	10	1050	142	15.7	1129	221	24.4
Average annual rainfall (mm)	712	689	-23	-3.2	677	-35	-4.9	673	-39	-5.5	643	-70	-9.8	662	-50	-7
Seasonal rainfall - Winter (mm)	198	183	-15	-7.6	175	-23	-11.7	178	-20	-10.3	174	-24	-12	178	-20	-10
Seasonal rainfall - Spring (mm)	178	170	-7	-4.1	163	-15	-8.5	157	-20	-11.3	153	-25	-13.8	134	-44	-24.6
Seasonal rainfall - Summer (mm)	172	172	0	0.1	188	16	9.2	182	10	5.9	174	2	1.2	190	18	10.3
Seasonal rainfall - Autumn (mm)	176	179	3	1.9	168	-8	-4.5	172	-4	-2.4	156	-20	-11.5	169	-7	-4
Annual maximum daily rainfall (mm)	101	110	9	8.8	122	21	21.1	115	13	13.4	116	15	14.9	124	23	22.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	184	188	4	2.4	193	9	5	199	15	8.3	206	22	12.1	211	28	15.2
Rainfall Extreme - 24hr 5% AEP (mm)[a]	209	214	5	2.4	219	10	5	226	17	8.3	234	25	12.1	240	32	15.2
Rainfall Extreme - 24hr 1% AEP (mm)[a]	266	273	6	2.4	280	13	5	289	22	8.3	299	32	12.1	307	40	15.2
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	293	300	7	2.4	308	15	5	318	24	8.3	329	35	12.1	338	44	15.2
Rainfall Extreme - 48hr 10% AEP (mm)[a]	239	245	6	2.4	251	12	5	259	20	8.3	268	29	12.1	275	36	15.2
Rainfall Extreme - 48hr 5% AEP (mm)[a]	271	278	7	2.4	285	14	5	294	23	8.3	304	33	12.1	312	41	15.2
Rainfall Extreme - 48hr 1% AEP (mm)[a]	346	354	8	2.4	363	17	5	374	29	8.3	387	42	12.1	398	52	15.2
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	380	390	9	2.4	399	19	5	412	32	8.3	426	46	12.1	438	58	15.2
Average annual cummulative Forest Fire Danger Index	1228	1244	16	1.3	1337	108	8.8	1426	198	16.1	1602	374	30.4	1759	530	43.2
Sea level - 1% AEP with Freeboard (m)[b]	1.56	1.64	0.08	5.1	1.72	0.16	10.3	1.8	0.24	15.4	2.08	0.52	33.3	2.5	0.94	60.3

[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: **Glamorgan/Spring Bay 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)	11.6	12.2	0.6	4.9	12.8	1.1	9.7	13.6	2	16.9	14.5	2.8	24.4	15.2	3.6	31.1
Average daily maximum temperature (°C)	16.2	16.8	0.6	3.5	17.3	1.1	7	18.2	2	12.4	19.1	2.9	18.1	19.9	3.7	23.1
Average daily minimum temperature (°C)	7.1	7.6	0.6	8.2	8.2	1.1	15.8	9	1.9	27.2	9.8	2.8	39	10.6	3.5	49.4
Hottest daily temperature of the year (°C)	35.2	36.1	0.9	2.6	36.9	1.7	5	38.1	3	8.5	39	3.9	11	39.8	4.7	13.3
Temperature of warmest days [99^{th} percentile] (°C)	28.5	29.3	0.7	2.6	30	1.5	5.2	31.5	2.9	10.3	32.8	4.3	15	33.8	5.2	18.3
Temperature of warmest nights [99^{th} percentile] (°C)	15.7	16.3	0.6	3.9	16.8	1.1	7.2	17.8	2.1	13.3	19	3.3	21	20	4.4	27.7
Temperature of coldest nights [1^{st} percentile] (°C)	-1.2	-0.8	0.4	34.5	-0.4	0.8	67.7	0.3	1.5	121.7	1	2.2	187.7	1.8	3	251.6
Average annual frost risk days (<2°C)	37	28	-9	-24.2	22	-15	-40.9	14	-23	-61.5	8	-29	-77.8	5	-33	-86.8
Average annual freeze risk days (<0°C)	11	8	-3	-29.8	5	-5	-49.2	3	-8	-70.5	2	-9	-85.9	1	-10	-92.5
Average annual summer days (>25°C)	10	11	1	13.8	13	3	33.4	17	7	73.8	23	13	131	29	19	190.8
Average annual hot days (>30°C)	2	3	1	26.8	4	2	69	6	3	157.2	9	6	289.9	13	10	476.4
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	126800	159400	32600	25.7	197700	70900	55.9	268000	141200	111.4	372800	246000	194	494400	367600	289.9
Average annual evaporation (mm)	990	1018	28	2.8	1047	57	5.7	1137	148	14.9	1213	224	22.6	1331	341	34.4
Average annual rainfall (mm)	660	636	-24	-3.7	629	-31	-4.7	627	-33	-5	591	-69	-10.4	613	-48	-7.2
Seasonal rainfall - Winter (mm)	170	155	-15	-8.7	151	-19	-11.1	155	-15	-8.8	153	-17	-9.9	158	-11	-6.7
Seasonal rainfall - Spring (mm)	164	156	-7	-4.5	150	-14	-8.6	145	-19	-11.4	140	-24	-14.4	123	-40	-24.7
Seasonal rainfall - Summer (mm)	165	164	-1	-0.8	179	13	8.1	173	8	4.9	161	-4	-2.5	175	10	5.8
Seasonal rainfall - Autumn (mm)	173	176	3	2	165	-7	-4.3	169	-3	-2	151	-21	-12.4	165	-8	-4.5
Annual maximum daily rainfall (mm)	101	110	9	8.8	122	21	21.1	115	13	13.4	116	15	14.9	124	23	22.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	183	188	5	2.9	193	11	5.8	201	18	10.1	209	27	14.6	217	34	18.6
Rainfall Extreme - 24hr 5% AEP (mm)[a]	207	214	6	2.9	220	12	5.8	228	21	10.1	238	30	14.6	246	39	18.6
Rainfall Extreme - 24hr 1% AEP (mm)[a]	265	273	8	2.9	280	15	5.8	292	27	10.1	304	39	14.6	314	49	18.6
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	292	300	9	2.9	309	17	5.8	321	29	10.1	334	43	14.6	346	54	18.6
Rainfall Extreme - 48hr 10% AEP (mm)[a]	238	245	7	2.9	251	14	5.8	261	24	10.1	272	35	14.6	282	44	18.6
Rainfall Extreme - 48hr 5% AEP (mm)[a]	270	278	8	2.9	286	16	5.8	297	27	10.1	309	39	14.6	320	50	18.6
Rainfall Extreme - 48hr 1% AEP (mm)[a]	344	354	10	2.9	364	20	5.8	379	35	10.1	394	50	14.6	408	64	18.6
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	378	390	11	2.9	400	22	5.8	417	38	10.1	434	55	14.6	449	70	18.6
Average annual cummulative Forest Fire Danger Index	1619	1648	29	1.8	1759	139	8.6	1860	240	14.8	2073	453	28	2240	621	38.3
Sea level - 1% AEP with Freeboard (m)[b]	1.56	1.64	0.08	5.1	1.72	0.16	10.3	1.8	0.24	15.4	2.08	0.52	33.3	2.5	0.94	60.3

[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: **Glamorgan/Spring Bay 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)	12.5	13.1	0.6	4.7	13.7	1.1	9.2	14.5	2	16.1	15.5	2.9	23.4	16.3	3.7	29.9
Average daily maximum temperature (°C)	17.3	17.9	0.6	3.2	18.4	1.1	6.5	19.3	2	11.6	20.3	2.9	17	21.1	3.8	22
Average daily minimum temperature (°C)	7.7	8.4	0.6	7.9	8.9	1.2	15.1	9.8	2	26.2	10.7	2.9	37.6	11.4	3.7	47.6
Hottest daily temperature of the year (°C)	35.9	36.7	0.8	2.3	37.6	1.8	4.9	39	3.1	8.6	39.9	4	11.2	40.8	4.9	13.8
Temperature of warmest days [99^{th} percentile] (°C)	29.4	30.1	0.7	2.5	30.9	1.5	5.1	32.4	3	10.4	33.8	4.5	15.2	34.8	5.4	18.5
Temperature of warmest nights [99^{th} percentile] (°C)	16.3	16.8	0.6	3.5	17.3	1	6.4	18.2	1.9	11.9	19.1	2.9	17.7	20	3.7	22.6
Temperature of coldest nights [1^{st} percentile] (°C)	-0.6	-0.1	0.5	85.6	0.3	0.9	158.8	1.1	1.7	294.9	2.1	2.6	460.8	2.9	3.5	608.4
Average annual frost risk days (<2°C)	29	21	-8	-28.8	15	-14	-48.3	8	-21	-71.5	4	-25	-86.5	2	-27	-93
Average annual freeze risk days (<0°C)	7	4	-3	-38.5	3	-4	-58.5	1	-6	-79.9	1	-6	-91.8	0	-7	-95.9
Average annual summer days (>25°C)	12	14	2	14.2	16	4	31.5	21	9	71.4	28	16	126.4	36	24	189.7
Average annual hot days (>30°C)	3	4	1	24.5	5	2	61.6	7	4	140.1	11	8	258.7	15	12	419
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	164400	209400	45000	27.4	261900	97500	59.3	363300	198900	121	513600	349200	212.4	691400	527000	320.6
Average annual evaporation (mm)	1039	1074	35	3.4	1099	60	5.7	1213	174	16.7	1305	266	25.6	1453	414	39.9
Average annual rainfall (mm)	609	598	-11	-1.9	588	-21	-3.5	590	-20	-3.2	557	-52	-8.6	563	-46	-7.5
Seasonal rainfall - Winter (mm)	144	131	-13	-8.8	125	-19	-12.9	129	-15	-10.2	127	-17	-11.5	130	-14	-9.8
Seasonal rainfall - Spring (mm)	153	148	-6	-3.6	141	-12	-8	136	-18	-11.4	132	-21	-13.8	113	-40	-26.3
Seasonal rainfall - Summer (mm)	161	164	3	2.1	177	16	10.2	174	13	7.8	164	3	2.1	174	13	8
Seasonal rainfall - Autumn (mm)	161	169	8	4.7	159	-3	-1.6	166	4	2.7	147	-15	-9.1	155	-6	-3.9
Annual maximum daily rainfall (mm)	101	110	9	8.8	122	21	21.1	115	13	13.4	116	15	14.9	124	23	22.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	182	188	6	3	193	11	5.9	201	19	10.4	210	28	15.1	218	35	19.3
Rainfall Extreme - 24hr 5% AEP (mm)[a]	207	214	6	3	220	12	5.9	229	22	10.4	239	31	15.1	247	40	19.3
Rainfall Extreme - 24hr 1% AEP (mm)[a]	265	273	8	3	280	16	5.9	292	28	10.4	305	40	15.1	316	51	19.3
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	291	300	9	3	309	17	5.9	322	30	10.4	335	44	15.1	348	56	19.3
Rainfall Extreme - 48hr 10% AEP (mm)[a]	237	245	7	3	251	14	5.9	262	25	10.4	273	36	15.1	283	46	19.3
Rainfall Extreme - 48hr 5% AEP (mm)[a]	270	278	8	3	286	16	5.9	298	28	10.4	310	41	15.1	322	52	19.3
Rainfall Extreme - 48hr 1% AEP (mm)[a]	344	354	10	3	364	20	5.9	379	36	10.4	395	52	15.1	410	66	19.3
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	378	390	11	3	400	22	5.9	417	39	10.4	435	57	15.1	451	73	19.3
Average annual cummulative Forest Fire Danger Index	1880	1876	-4	-0.2	1976	97	5.1	2077	197	10.5	2291	411	21.9	2523	643	34.2
Sea level - 1% AEP with Freeboard (m)[b]	1.56	1.64	0.08	5.1	1.72	0.16	10.3	1.8	0.24	15.4	2.08	0.52	33.3	2.5	0.94	60.3

[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 - Glamorgan/Spring Bay

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