Submission to Victorian Local Government Grants Commission
'Climate 'Cost Modifiers to Local Roads Grants
Prepared by: Strathbogie Shire Council

Executive Summary:

The Strathbogie Shire Council believes the 'Climate 'cost modifier to the Local Roads Grants is significantly disadvantaging our Shire in two respects:

1) The rainfall and evaporation data set used under the current methodology appears to be classifying Strathbogie as significantly drier than it is, and

2) in our view there exist additional criteria which should be incorporated into the methodology itself. We believe that by ignoring other key climate drivers to roads – these being altitude, gradients, soil compositions, underground aquifers, and unique challenges to unsealed roads – Strathbogie is greatly disadvantaged compared to most other shires.

Our submission request is that, based on existing criteria, Strathbogie would more properly fit at modifiers of 1.01 Urban / 1.00 Rural, and, based on the new criteria we are suggesting, Strathbogie would plausibly be near the top of the allowable modifier range at 1.10 Urban / 1.25 Rural.

1) Rainfall and Evaporation Data Under Current Methodology

Per the *VLGGC Annual Allocation Report 2024-25*, Strathbogie Shire's Climate Cost Modifier (CCM) applied was 0.96 Urban / 0.80 Rural.

This puts it exactly equal to its northern neighbour, Greater Shepparton City Council, which also had a CCM of 0.96 Urban / 0.80 Rural. However, Strathbogie Shire's southeastern half – where the majority of population, unsealed roads and sealed roads exist – is geographically very different from Shepparton, resulting in radically different annual rainfall totals[1].

The rainfall differences between these two shires are patently obvious to residents and visitors alike – the hills and mountains in Strathbogie's south resulting in more rain and a greener overall aspect than Shepparton, which resides solely in the dry northern plains.

Consulting Bureau of Meteorology (BOM) rainfall data for 2023 (the latest available) verifies this perception. Figure A shows BOM 2023 rainfall bandwidths overlaid on shire boundaries for central Victoria:

[1] Data for evaporation, which is also used by VLGGC for calculation, is not readily available to Strathbogie Shire; so for the purposes of this submission, we will be using solely rainfall as a proxy for both rainfall and evaporation, which we feel will produce a very similar outcome.

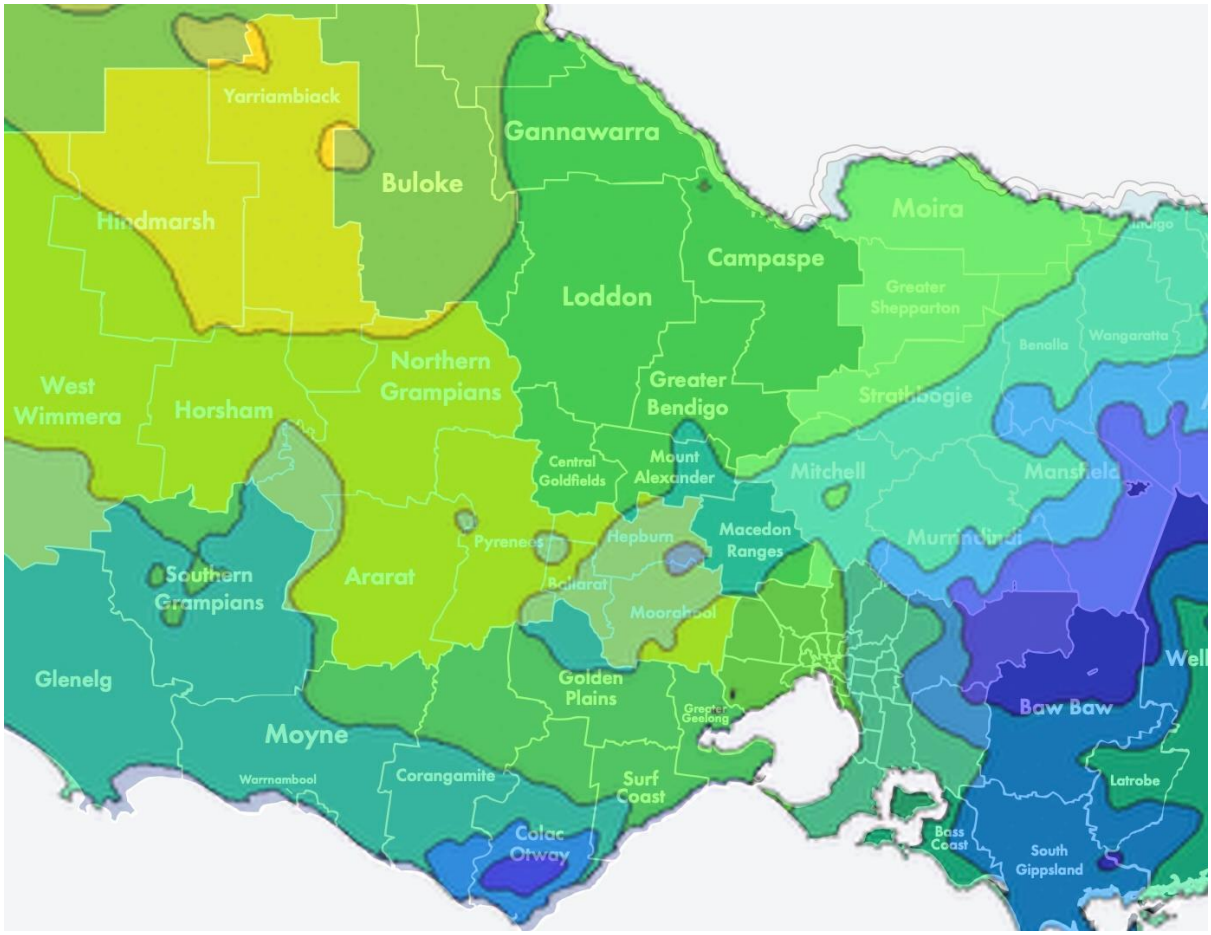

Figure A – BOM rainfall bandwidths for 2023 overlaid on Shire boundaries

The entirety of Shepparton resides within the 400-600mm annual rainfall, demonstrating both a low annual total and consistency across the region.

Strathbogie, on the other hand, spans three annual rainfall bandwidths:

- Slightly less than half of Strathbogie Shire in the northwest shares Shepparton's 400-600mm bandwidth
- About half of the Shire resides in the 600-900mm bandwidth
- A small portion of the shire in the southeast extends into the 900-1200mm bandwidth that runs through the alpine areas

So just a simple area-based average of these bandwidths would put Strathbogie at about 800mm, compared to Shepparton's 500mm[2].

Also, however, there is another good data point to compare: Weatherzone's long term rainfall totals. Figures B, C and D show charts for Strathbogie's northwest (Mangalore), Strathbogie's southeast (Strathbogie), and Shepparton (in aggregate), respectively:

[2] An average of this arithmetic simplicity would not meet any rigorous inspection; however, it is useful for casual comparison.

Mangalore Climate

Long Term Averages

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max (°C)	29.8	29.4	26.3	21.5	16.7	13.5	12.7	14.3	17.0	20.6	24.5	27.6	21.1
Mean Min (°C)	14.4	14.4	12.3	8.8	6.0	4.0	3.3	3.9	5.3	7.4	10.1	12.2	8.5
Mean Rain (mm)	44.2	33.4	34.3	40.7	52.6	54.4	55.6	59.8	53.5	49.5	48.8	40.6	566.2
Median Rain (mm)	29.5	18.5	27.3	36.3	45.2	44.3	52.6	53.4	37.7	37.0	35.2	28.6	543.0
Mean Rain Days	5.2	4.8	5.9	7.0	11.6	13.9	16.2	15.1	11.5	10.0	8.2	6.9	116.3

Figure B – Weatherzone long term averages for Mangalore

Strathbogie Climate

Long Term Averages

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max (°C)	27.5	27.3	24.0	19.0	14.5	11.3	10.3	11.6	14.4	17.9	21.7	24.8	18.6
Mean Min (°C)	11.6	11.4	9.2	5.8	3.7	2.0	1.7	2.3	3.7	5.3	7.6	9.5	6.1
Mean Rain (mm)	50.8	42.7	54.1	64.4	95.0	113.2	122.6	113.4	95.3	84.5	66.1	56.8	962.5
Median Rain (mm)	32.2	27.4	34.6	48.0	80.6	102.0	116.6	98.8	89.8	75.0	59.9	44.0	917.0
Mean Rain Days	5.4	4.6	5.7	7.5	11.7	14.0	16.1	15.0	12.4	10.6	8.4	6.7	118.2

Figure C – Weatherzone long term averages for Strathbogie

Shepparton Climate

Long Term Averages

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max (°C)	32.0	31.0	27.5	22.5	17.6	14.1	13.4	15.0	18.3	22.2	26.3	29.3	22.4
Mean Min (°C)	15.5	15.1	12.6	8.7	5.6	3.8	3.4	3.8	5.5	7.7	11.0	13.0	8.8
Mean Rain (mm)	34.4	32.8	33.1	37.1	35.3	42.6	40.2	44.4	36.4	36.5	46.3	30.0	451.7
Median Rain (mm)	13.6	17.0	15.2	26.8	34.8	36.2	34.1	44.4	36.2	20.6	58.2	10.8	426.2
Mean Rain Days	5.3	4.5	5.3	5.8	9.8	12.9	14.9	12.8	9.7	8.6	7.0	6.0	102.4

Figure D – Weatherzone long term averages for Shepparton

Mangalore, representing Strathbogie's northwest portion, is at 566mm annual mean rainfall, compared with Shepparton's 451mm annual mean. Strathbogie's southeast – at 962mm annual mean – is more than double Shepparton's totals. This illustrates four points:

- While Strathbogie's northwest shares the 400mm-600mm BOM bandwidth with Shepparton, the former is at the upper end of the bandwidth and the latter is at the lower end

- Strathbogie's southeast half – at a whopping 962mm median – is more properly largely all within the alpine 900mm-1200mm bandwidth, rather than just the small southeastern corner. This goes to support a local beliefe that the BOM alpine 900mm-1200mm bandwidth should probably extend much further westward than it does, to link similar geographies (specifically a large 400 – 1,000 metre elevation plateau encompassing Strathbogie and Ruffy towns and surrounds) under the same rainfall totals.

- Rainfall totals are gradually increasing the more south and east one travels, in keeping with leaving the northern plains on which Shepparton resides and entering first foothills, then mountainous and plateau terrain.

- It is likely that, in aggregate, nearly all (or possibly absolutely all) of Strathbogie shire receives significantly more rainfall than does Shepparton

Having established that Strathbogie is unlike Shepparton in rainfall, what then is it like? Residents may say that it will be similar to Murrindindi Shire on Strathbogie's southern border, both geographically and in terms of rainfall. For the data on that, we consult Lake Eildon weather station in Figure E:

Lake Eildon Climate

Long Term Averages

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max (°C)	29.2	29.1	25.8	20.9	16.1	12.6	12.1	13.8	16.7	20.1	23.7	26.6	20.5
Mean Min (°C)	12.9	12.8	10.7	7.9	5.9	4.1	3.7	4.3	5.7	7.4	9.5	11.1	8.0
Mean Rain (mm)	49.1	42.0	51.9	60.3	78.1	92.3	92.7	98.7	81.1	79.2	67.3	58.8	847.0
Median Rain (mm)	39.7	31.2	41.9	48.7	75.0	86.3	90.7	97.2	80.6	76.6	60.8	46.3	840.7
Mean Rain Days	5.8	5.1	6.5	8.9	13.9	16.6	17.8	17.1	13.6	11.8	9.2	7.6	134.0

Figure E – Weatherzone long term averages for Lake Eildon

At 847mm annual mean rainfall, Murrindindi is higher than Mangalore but less than Strathbogie. So, it might serve as an average very similar to Strathbogie overall (for roads), particularly since Strathbogie's road network is weighted toward the high-rainfall southeast. We will assume it is effectively similar.

VLGGC's *2024 Annual Allocation Report 2024-25*, however, puts Murrindindi's CCM at 1.01 Urban / 1.00 Rural. Remembering that Strathbogie's CCM is at 0.96 Urban / 0.80 Rural – identical to low-rainfall and geographically-different Shepparton – this results in lumping Strathbogie in with an 'unlike' Shire that is causing a perverse outcome in the Climate Cost Modifier ranking to the *extreme detriment* of Strathbogie.

Therefore, given Strathbogie's overall rainfall, geography and level of urbanisation is much more like Murrindindi than it is to Shepparton, we formally request that Strathbogie's CCM be normalised to 1.01 Urban / 1.00 Rural under current methodology in line with Murrindindi (and other like Shires).

2) Potential Shortfalls to the Methodology Which Are Acting to the Detriment of Strathbogie Shire

Having met with the VLGGC panel on 5 February 2025, it was confirmed to councillors that the two criteria for the Climate Cost Modifier to local roads grants are rainfall and evaporation. While these certainly do affect roads longevity, we feel there are other factors that negatively affect roads longevity, and unfortunately our Shire has an abundant assortment of all of them.

The factors we would like to propose being added to the Climate Cost Modifier are: a) altitude, b) gradients, c) soil compositions, d) underground aquifers, and e) unique issues with unsealed roads. Each will be discussed in turn.

a) Altitude

The entirety of Strathbogie Shire's southern boundary comprises the foothills and mountains of the Strathbogie Ranges. Two towns within the Shire – Ruffy and Strathbogie – are at altitudes of above 500m and have a significant road network around them of both sealed and unsealed roads. The sealed road networks on the tablelands[3] are generally all between 400m and 600m above sea level.

Roads within these altitudes are of course exposed to cooler weather, and are more susceptible to frosts, both passing and occasionally multi-day. As anyone who has lived in colder climates will know, the freezing and thawing of roads works in conjunction with subsurface water to damage roads from the inside out, increasing maintenance requirements, increasing potholing, and sometimes (though not always) resulting in pavement failures often referred to as 'heaves'. Refer to Figure F below.

[3] Ruffy and Strathbogie each have their own 'tableland' – essentially mesas of rolling hills and valleys, all of which are above 400m (even in their local valleys). The maximum altitude of the Strathbogie Ranges is Mt Strathbogie with an altitude of 1030m.

Figure F – Two pavement failures with 'heaves' to their left (Tames Road)

It is hard to make out, but the fault here (almost certainly associated with an underground aquifer, discussed below) is raising the bitumen in two places as 'heaves', in addition to it causing potholing that is being ablated due to traffic. This would almost certainly be exacerbated by the altitude of about 600m at this spot which makes it prone to frosts.

Figure F also illustrates that repeated patching (three year-on-year patches are evident) has little effect and the fault causes a new pothole and heave within a matter of months after correction.

b) Gradients

High gradients present exceptional challenges both to the design and maintenance of the road itself, design and maintenance of shoulders and other affecting natural features, and greater risks of damage that cannot be effectively mitigated.

This should be fairly self-evident – if a huge deluge of rain occurs to a road on a hillside, this road is more likely to be damaged or washed away (or the hillside washed into the road) than if the same deluge occurred to a road on a flat plain.

Strathbogie Shire has a huge number of roads, both sealed and unsealed, that ascend/descend slopes or cling to the side of a slope. This comes from having two communities (Strathbogie and Ruffy) that exist on tablelands, plus numerous farms and hamlets in the hilly southern half of the shire. Many of Strathbogie's roads are affected by slope due to this fairly unique geographic and human topography[4]. While this is an excellent attribute from an agriculture, liveability and scenery perspective, it adds significant challenges to road maintenance.

These challenges include having to build additional drainage infrastructure and support structures (retaining walls, etc.) to support the road, which have a reduced lifespan and additional maintenance requirements due to the gradients on which they are constructed.

[4] While hills and mountains are very common throughout Victoria, settlements on top of hilly tablelands are not.

Mostly these factors just add to overall costs on a fairly predictable basis, but unfortunately Strathbogie has an example of a near-catastrophic failure of a road, directly attributable to the slope it was ascending, and resulting in a road in crisis that unfortunately has no funding yet to properly address it. This exemplar is Harrys Creek Road, as it ascends the slope from Violet Town to the Strathbogie tableland. Figures G(i)-(iii) illustrate it:

Figure G(i) – Erosion damage due to water sheeting from steep gradient at Harrys Creek Road

Figure G(ii) – Uphill side drainage measures present at Harrys Creek Road

Figure G(iii) – Overall aspect of Harrys Creek Road, showing drainage exit into uphill side canyon (other side of road far centre)

Heavy rains made water sheet across the road where Harrys Creek Road executed a hairpin turn while ascending steeply. As seen in Figure G(i), the sheeting has eroded and undermined the downhill side of the road and created an exceedingly dangerous situation; one in need of proper repair but for which funding does not currently exist.[5]

Without travelling fully into a climate-change tangent, it does appear that storms in the Strathbogie area are becoming more severe in recent years, and roads such as Harrys Creek that had for decades accommodated stormwater are no longer always doing so. Larger and more frequent storms will necessarily challenge roads on steeper gradients far more than roads on the flats. Both the maintenance and repair burdens will increase much more for roads near a steep gradient than other roads, and we feel that this in particular should merit a hefty upward Climate Cost Modifier.

In the case of Harrys Creek Road, we are currently seeking grant money to properly redesign and rebuild it to be more storm resilient, with possibly deeper drainage channels and a larger cutting into the hillside6. Merely repairing it to be as it was we feel to not be a prudent fix, as we expect climate-change challenges to increase in coming years especially for our steeper-gradient roads.

[5] Funding has been secured to correct the downhill erosion only. It is the considered unanimous opinion of decision makers within Strathbogie Shire's Council and Staff that a downhill fix will not ameliorate the root cause of the problem – the uphill drainage challenges that caused the downhill erosion.

[6] An engineer's report on remediation has not yet been received.

c) Soil Compositions

While the Shire's northern half is generally a fairly-stable loam type of soil, Strathbogie's southern half is geologically interesting, which can and does make road maintenance far more challenging. To start with, the Violet Town area is the remains of what was once a super volcano, meaning soils there are geologically young and unstable. The towns of Strathbogie and Ruffy sit astride the remains of magma domes which cooled a relatively short time ago (geologically speaking) to form decomposing basalt along the northern flank and decomposing granite along the southern flank. Both the basalt and the granite are young, very porous, very crumbly, and not terribly stable. This presents constant challenges with our roads in these areas.

One good example of a unique challenge is represented in Figure G, evident along the Euroa-Strathbogie Road:

Figure H – Sinkhole along Euroa-Strathbogie Road.

Some kind passer-by helpfully spray painted the outline, which makes it easier to see what is going on here: a circular part of the road recently and suddenly sunk in a bowl shape. It dipped to about 100mm at its centre, making a feature badly in need of repair, as it is very jarring to go over in a car, and exceedingly dangerous to traverse on a motorcycle or bicycle.

The seal has held up very well, considering, but this section of road needs to be reconstructed and sealed. We can rule out that this road was laid and/or compacted improperly, because of the defined outline of the new fault – a construction error would show rather long, linear faults that result in longitudinal pavement failures. This fault was most definitely caused by a subsoil issue of something under the road base settling, shifting, or being eroded due to ground water.

d) Underground Aquifers

In the Shire's southeast, the country is predominantly made up of the Strathbogie granite batholith (visible as boulders or sheets), with areas of siltstone and sandstone. Perched groundwater, springs, and elevated bogs are found throughout, and have developed through the horizontal nature of the granite sheets along with predominantly horizontal and vertical cracking.

The result is, in many areas of the Strathbogie and Ruffy tablelands, excess groundwater that either manifests itself as a spring, or remains below the surface causing perpetual instability in the road base, usually resulting in pavement failures including potholing.

Figure I – Underground aquifer as evidenced by repeated potholing and lush vegetation (Boundary Hill Road, Boho South)

While Figures F and H above show road damage almost certainly associated with excess ground water, Figure I illustrates road damage almost certainly solely caused by excess groundwater. It is a unique attribute of the granite sheets in the tablelands that areas of excess groundwater are not always – or even usually – associated with dips or valleys.

The area of Figure I is a fairly low gradient, absolutely straight, stretch of road that is slowly rising from about 500m to 600m over several kilometres. This is one of two areas on the road affected by excess groundwater, as evidenced by the repeated potholing (four years of annual patches are visible), and exceedingly lush vegetation in the background, even though this photograph was taken at the height of summer in near-drought conditions.

In many areas of the Shire – particularly in the southeast – potholes return six-monthly or yearly due to this climatic anomaly of underground aquifers[7]. If the road is completely reconstructed and sealed, these potholes will still return on schedule, even on a brand-new road. It is a climatic phenomenon that appears almost unique and adds significantly to Strathbogie's road maintenance expense.

Figure J – Repeated patching requirements on brand new road (Euroa-Strathbogie Road, Strathbogie)

[7] 'Aquifer' as used here denotes either a spring or an area of excess subsurface water that does not penetrate the surface, as discussed above.

Figure J illustrates potholes associated with aquifers that will return no matter what is done. The stretch of road in photo was completely reconstructed and sealed less than a year before this photo was taken. This was the third time in less than ten years that this road has been completely reconstructed. Since the most recent reconstruction, the large stretch on the right one third of the road required patching. Recently, two long areas just to the right of the centre line required patching, and since that, two potholes appeared and required filling. To be clear, the photo itself shows 4 separate maintenance events within the span of 12 months, and this section of road has always required multiple patches per year, every year, despite good road design and good surface drainage. Such are the challenges of subsurface water retention.

We consider the road in Figure J the 'poster child 'of the excess road maintenance burdens our Shire faces due to Strathbogie's unique climatic conditions. No matter what steps are taken, in some places our roads will never enjoy the same longevity as elsewhere.

e) Unique Issues with Unsealed Roads

Heretofore, our submission has utilised examples and photographs from sealed roads. This is perhaps unfair, as the vast majority of our network outside of town zones – 95% in fact – is indeed unsealed roads. To be clear, all of the climatic issues discussed above which affect sealed roads affect unsealed roads as much or more so. Altitude, gradients, soil compositions, and the presence of underground aquifers do not distinguish between whether there is a bitumen seal on it or not.

However, there are obviously increased maintenance burdens unique to unsealed roads. Some of these are non-climatic, such as the cost of trucking gravel over long distances from the nearest quarries. The reader will note that we always use the term 'unsealed road ' rather than 'gravel road', because the extremely high expense to import gravel means that most roads in our Shire that lack seal, also lack gravel. They are quite literally graded by the grader with the materials that exist at the site, and left as is. Strathbogie's enormous lengths of unsealed roads – approximately 1,464km – means that any effort to apply gravel to the vast majority of these roads would result in an expense that exceeds the Shire's total budget by an order of magnitude. It is simply never going to be economic to gravel more than a small portion of the Shire's road network.

While the inability to gravel is not itself a climatic factor, it most certainly exacerbates the climatic factors that exist. Obviously, gravel improves permeability and drainage, and without it the climate is dictating the road's properties more than it otherwise would were gravel (or bitumen seal) is available.

Moving then to the climate, in the northwestern portion of the Shire, the topography is generally flat, with the surface geology generally consisting of sandy loam materials, deposited over millions of years of erosion by tributaries of, and of the Goulburn River. Unfortunately, the flat aspect and high-clay loam composition contribute to extremely poor drainage, meaning that in high rainfall events many of these roads are severely damaged from standing water.

In the southeast, the surface materials are generally decomposed granite and granite sand, that are extremely prone to erosion, causing wash-aways, corrugation, and blocking of culverts. "Washboarding" (extreme corrugation) is extremely common where the geography forces the road to have a higher than normal camber. In many roads on the tablelands, a double whammy is delivered because the grader must create steep cambers and deep shoulder table drains to accommodate water runoffs from the high rainfall, but the poor native materials wash away extremely easily, causing ruts in the roads and blocking the drainage infrastructure. Unsealed roads on the tablelands quite commonly become ruined/4wd only/dry weather only between gradings and maintenance due to the combination of high rainfall and poor pavement materials. Please refer to Appendix for photographs of environmental challenges regarding unsealed roads in Strathbogie Shire.

Conclusion

In part 1) we submitted that Strathbogie Shire should be baselined against Murrindindi Shire with a climate modifier of 1.01 Urban / 1.00 Rural based on rainfall and evaporation alone, rather than being baselined against Shepparton. We feel this is a reasonable and data-supported submission request.

The additional climatic considerations we are asking VLGGC to consider for the climate cost modifiers in part 2) are criteria for which we do not have anything but anecdotal data to support. However, we do feel that our anecdotal data is extremely compelling, and shows that Strathbogie Shire has a very challenging road network to maintain, based on a holistic view of climatic effects.

We do not wish to make any claims without data and so would not be suggesting specific numeric climatic modifiers for the specific unique climatic challenges that we have noted above in part 2). However, perusing the *VLGGC Annual Allocation Report 2024-25*, we note that the allowable modifiers to be applied to any shire due to Climate are 0.95-1.10 Urban and 0.75-1.25 Rural.

We would put forward for your consideration that the additional unique climatic challenges outlined in section 2) above would quite plausibly put Strathbogie at or near the top of this range, most certainly in the Rural category, so our request is that Strathbogie be assessed at or near a Climate Cost Modifier of 1.10 Urban / 1.25 Rural.

We thank you for your consideration of this submission and would be more than happy to answer any questions you may have and/or partner with yourselves to acquire more substantive comprehensive data to bolster the anecdotal data we have submitted.

Appendix – Challenges to Strathbogie Unsealed Roads

Landslide at Tarcombe Road, Avenel

Erosion at Falcon Vale Road, Tarcombe

Flood Damage at Hughes Creek Bridge, Ponkeen Creek Road, Tarcombe