Rear axle and GVM to GTM % research

There have been a number of discussions on this forum regarding Rear Axle Weights and ratio of GVM to GTM so I thought I would do some research myself. What I found, quite surprised me. When we load our vehicle and caravan at home before we go on our trip, we may or may not try to ensure we do not overload the rear axle and may or may not try to ensure we have the GVM at least 10% heavier than the GTM. What I found and what surprised me was that if we load the rear axle to its maximum and load the combination so that we have 10% GVM to GTM, we are not necessarily safe at our next fuel stop. Now the more experienced on this forum will say, "Yes, that's obvious and yes, I knew that", but the less experienced like me may say "That make sense but, I had not even thought about that". It's all to do with fuel burn. I created three examples, each showing two versions so six combinations in all. All examples use a fuel burn of 15 litres per one hundred kilometres travelled. I have tried to get the TBD % as close to 10% while juggling all the other parameters in the spreadsheet. Each example shows the actual rear axle load and GVM to GTM % after each 100 kilometres travelled except the last entry which stops when there is 10 litres of fuel left in the tank. Examples 1 and 2 are an Isuzu MUX with a 65 litre fuel tank. Examples 3 and 4 are a Toyota Landcruiser Series 2 with a 138 litre fuel tank. Examples 5 and 6 are a Toyota Landcruiser Series 2 with a 180 litre fuel tank. In all examples, the rear axle load reduces as we drive which is a good thing so we can ignore that. In examples 1, 3 and 5, we start out with maximum axle load and 10% GVM to GTM. By the time we get to our next fuel stop having 10 litres left in our tank, the GVM to GTM % is 8.2%, 6.5% and 5.1% respectively. In examples 2, 4 and 6, we reduce the caravan payload before we leave home which increases the GVM to GTM % sufficiently so that when we get to the next fuel stop it is sitting on 10%. To keep this 10% margin, we had to offload 40 kg, 91 kg and 129 kg respectively. Interestingly, in Examples 3 and 4, I could only get 158 kg of payload in the vehicle before it exceeded the rear axle weight. Similarly, in Examples 5 and 6, I could only get 145 kg of payload in the vehicle before it exceeded the rear axle weight. Both 145 kg and 158 kg is roughly the weight of two people with or without a small amount of luggage.

The takeaway points for me on this are that firstly, the bigger the fuel tank, the bigger the reduction in GVM to GTM % during the trip and the more payload we need to sacrifice at the outset. The second point is that you really can't load the caravan at home as much as you would like as the safety margin reduces as you travel. For me, understanding the physics allows me to manage the journey and relax in the process.

I'd welcome the more experienced on this forum to comment on whether my findings are on the mark or I have missed it completely and should wear a white jacket with the arms around the back.

Example 1										
Fuel tank	Fuel used	Distance travelled	Vehicle payload	Act TBD	TBD %	Act GVM	Act GCM	Caravan payload	Act Rear Axle	GVM to GTM %
65	0	0	232	275	9.92	2746	5242	431	1600	10.00
65	15	100	232	275	9.92	2734	5230	431	1591	9.50
65	30	200	232	275	9.92	2721	5217	431	1582	9.00
65	45	300	232	275	9.92	2709	5205	431	1572	8.50
65	55	366	232	275	9.92	2701	5197	431	1566	8.20

Example 2										
Fuel tank	Fuel used	Distance travelled	Vehicle payload	Act TBD	TBD %	Act GVM	Act GCM	Caravan payload	Act Rear Axle	GVM to GTM %
65	0	0	232	275	10.07	2746	5202	391	1600	11.80
65	15	100	232	275	10.07	2734	5190	391	1591	11.30
65	30	200	232	275	10.07	2721	5177	391	1582	10.80
65	45	300	232	275	10.07	2709	5165	391	1572	10.30
65	55	366	232	275	10.07	2701	5157	391	1566	10.00

Example 3										
Fuel tank	Fuel used	Distance travelled	Vehicle payload	Act TBD	TBD %	Act GVM	Act GCM	Caravan payload	Act Rear Axle	GVM to GTM %
138	0	0	158	300	9.35	3197	6104	867	1950	10.00
138	15	100	158	300	9.35	3185	6092	867	1942	9.60
138	30	200	158	300	9.35	3172	6079	867	1933	9.10
138	45	300	158	300	9.35	3160	6067	867	1923	8.70
138	60	400	158	300	9.35	3147	6054	867	1914	8.30
138	75	500	158	300	9.35	3135	6042	867	1905	7.80
138	90	600	158	300	9.35	3122	6029	867	1896	7.40
138	105	700	158	300	9.35	3110	6017	867	1887	7.00
138	120	733	158	300	9.35	3097	6004	867	1878	6.50

Example 4										
Fuel tank	Fuel used	Distance travelled	Vehicle payload	Act TBD	TBD %	Act GVM	Act GCM	Caravan payload	Act Rear Axle	GVM to GTM %
138	0	0	158	300	9.63	3197	6013	776	1950	13.50
138	15	100	158	300	9.63	3185	6001	776	1942	13.10
138	30	200	158	300	9.63	3172	5988	776	1933	12.60
138	45	300	158	300	9.63	3160	5976	776	1923	12.20
138	60	400	158	300	9.63	3147	5963	776	1914	11.80
138	75	500	158	300	9.63	3135	5951	776	1905	11.30
138	90	600	158	300	9.63	3122	5938	776	1896	10.90
138	105	700	158	300	9.63	3110	5926	776	1887	10.40
138	120	733	158	300	9.63	3097	5913	776	1878	10.00

Example 5										
Fuel tank	Fuel used	Distance travelled	Vehicle payload	Act TBD	TBD %	Act GVM	Act GCM	Caravan payload	Act Rear Axle	GVM to GTM %
180	0	0	145	289	9.01	3208	6125	866	1950	10.00
180	15	100	145	289	9.01	3195	6112	866	1941	9.50
180	30	200	145	289	9.01	3183	6100	866	1932	9.10
180	45	300	145	289	9.01	3171	6088	866	1923	8.70
180	60	400	145	289	9.01	3158	6075	866	1914	8.30
180	75	500	145	289	9.01	3146	6063	866	1905	7.90
180	90	600	145	289	9.01	3133	6050	866	1896	7.40
180	105	700	145	289	9.01	3121	6038	866	1886	7.00
180	120	800	145	289	9.01	3108	6025	866	1877	6.50
180	135	900	145	289	9.01	3096	6013	866	1868	6.10
180	150	1000	145	289	9.01	3083	6000	866	1859	5.70
180	165	1100	145	289	9.01	3071	5988	866	1850	5.30
180	170	1133	145	289	9.01	3067	5984	866	1847	5.10

Example 6										
Fuel tank	**Fuel used**	**Distance travelled**	**Vehicle payload**	**Act TBD**	**TBD %**	**Act GVM**	**Act GCM**	**Caravan payload**	**Act Rear Axle**	**GVM to GTM %**
180	0	0	145	289	9.39	3208	5996	737	1950	15.10
180	15	100	145	289	9.39	3195	5983	737	1941	14.60
180	30	200	145	289	9.39	3183	5971	737	1932	14.20
180	45	300	145	289	9.39	3171	5959	737	1923	13.70
180	60	400	145	289	9.39	3158	5946	737	1914	13.30
180	75	500	145	289	9.39	3146	5934	737	1905	12.80
180	90	600	145	289	9.39	3133	5921	737	1896	12.40
180	105	700	145	289	9.39	3121	5909	737	1886	11.90
180	120	800	145	289	9.39	3108	5896	737	1877	11.50
180	135	900	145	289	9.39	3096	5884	737	1868	11.00
180	150	1000	145	289	9.39	3083	5871	737	1859	10.60
180	165	1100	145	289	9.39	3071	5859	737	1850	10.20
180	170	1133	145	289	9.39	3067	5855	737	1847	10.00