Appendix G – Greenhouse Gas Estimate for Greenbushes Expansion Project (Greenbase 2018)

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By email: Tom.Mitchell@talisonlithium.com

Dear Tom,

GREENHOUSE GAS ESTIMATES FOR GREENBUSHES EXPANSION PROJECT

Greenbase Pty Ltd was engaged by Talison Lithium in September 2018 to prepare a greenhouse gas estimate out to 2030 for the Greenbushes expansion project as part of their application for environmental approvals for the project.

The Greenbushes Expansion Project consists of an expansion of the existing Greenbushes mine and processing infrastructure to increase production of lithium mineral concentrate from 700 kilo tonnes per year to 2,400 kilo tonnes per year.

Greenhouse gas emissions from the existing Greenbushes mine and processing infrastructure have been reported under the *National Greenhouse and Energy Reporting Act 2007* since the commencement of the program in 2007. The key inputs for estimating the historical emissions from the facility are diesel combustion from the mining fleet; diesel combustion from clearing and construction; LPG combustion in the processing of the lithium ore; soda ash consumption for the processing of lithium ore and grid electricity consumption for processing. From a greenhouse gas perspective the expansion project will only expand the existing sources of emissions and not add any new significant sources.

Estimates

The estimates have been prepared using methods from the *NGER (Measurement) Determination 2008*. The emissions sources and methods used are consistent with the historical reporting of the Greenbushes facility.

The key inputs provided by Talison Lithium staff for estimating CO_2-e over the estimate period can be seen in Table 1 attached to this letter. Using these inputs the estimated CO_2-e and emissions intensity can be seen in Table 2 attached to this letter.

The estimates for Scope 2 emissions from the consumption of grid electricity from the SWIS grid use the most recent Scope 2 emission factor on a flat basis going forward. Based on historical experience this factor may be conservatively high given the trend toward this grid using less greenhouse intensive technology over time. No attempt has been made to model the likely reduction in this factor over the estimate period.

Results

The results show that the expansion project is predicted to result in Greenbushes greenhouse gas emissions increasing from the existing FY2018 of 73,161 t CO_2-e / year to an estimated 436,481 t CO_2-e/year in 2029 during the assessment period. The emissions intensity of the project is expected to increase from the existing 105 kg CO_2-e/t concentrate to 183 kg CO_2-e/t concentrate in the 2029 year.

Benchmarking

The most recent benchmarking information available is the December 2017 greenhouse gas inventory for Australia, the 2016 National Inventory by Economic Sector and 2016 State and Territory Greenhouse Gas Inventories. These documents are all published by the Australian Department of the Environment and Energy. The relevant information from these documents can

be seen in Table 3 including the comparison against the Greenbushes expansion project predicted emissions.

Based on these inventories, the highest predicted emission from the project is equivalent to 0.08% of Australia's 2017 greenhouse gas footprint, 0.53% of Western Australia's 2016 greenhouse footprint and 0.41% of the mining industry's 2016 greenhouse gas footprint.

Yours sincerely,

Alistair Marks
Environmental Accountant
Greenbase Pty Ltd

Table 1 - Significant inputs for greenhouse gas estimates

Input	Actuals[1]		Estimates											
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel consumption – kilolitres														
- clearing and construction – CGP2 and supporting infrastructure	-	827	623	-	-	-	-	-	-	-	-	-	-	-
- clearing and construction – CGP3 and supporting infrastructure	-	-	-	751	623	-	-	-	-	-	-	-	-	-
- clearing and construction – CGP4 and supporting infrastructure	-	-	-	-	645	605	124	-	-	-	-	-	-	-
- clearing and construction – TRP	-	-	-	315	-	-	-	-	-	-	-	-	-	-
- clearing and construction – TSF4	-	-	-	75	-	-	-	-	-	-	-	-	-	-
- mining and operations[2]	4,645	7,700	8,717	16,434	22,170	21,841	21,571	21,758	28,387	39,535	39,813	38,596	40,801	23,225
Grid electricity – gigawatt hours[3]	61	66	212	272	355	443	483	483	458	458	458	458	458	458
LPG consumption – kilolitres[4]	2,295	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359	2,359
Soda ash consumption – tonnes	536	567	789	1,403	1,710	2,076	2,408	2,408	2,408	2,408	2,408	2,408	2,408	2,408
Lithium mineral concentrate production – kilo tonnes	698	698	1,108	1,578	1,934	2,276	2,668	2,668	2,455	2,383	2,383	2,383	2,383	2,383
Incidental sources - % of all CO_2-e	0.2%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%

[1] 2017, 2018 are actuals sourced from the Talison NGER reports for the Greenbushes facility
[2] Mining and operations includes Floyds construction and construction of miscellaneous infrastructure such as the mine services area, infrastructure, roads and pipelines
[3] The electricity is expected to be sourced from the SWIS grid
[4] No increase in LPG is expected as the expansion will only involve an increase in chemical grade lithium mineral concentrate whereas LPG is used to make technical grade lithium mineral concentrate.

Table 2 - Scope 1 and 2 greenhouse gas estimates (t CO_2-e)

Source	Actuals- t CO_2-e		Estimates - t CO_2-e											
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel consumption[5]														
- clearing and construction – CGP2 and supporting infrastructure	-	2,240	1,689	-	-	-	-	-	-	-	-	-	-	-
- clearing and construction – CGP3 and supporting infrastructure	-	-	-	2,036	1,689	-	-	-	-	-	-	-	-	-
- clearing and construction – CGP4 and supporting infrastructure	-	-	-	-	1,749	1,640	336	-	-	-	-	-	-	-
- clearing and construction – TRP	-	-	-	854	-	-	-	-	-	-	-	-	-	-
- clearing and construction – TSF4	-	-	-	204	-	-	-	-	-	-	-	-	-	-
- mining and operations	12,589	20,872	23,620	44,532	60,075	59,182	58,450	58,958	76,921	107,129	107,883	104,583	110,558	62,933
LPG consumption[6]	3,574	3,673	3,674	3,674	3,674	3,674	3,674	3,674	3,674	3,674	3,674	3,674	3,674	3,674
Soda ash consumption	222	235	327	582	710	862	999	999	999	999	999	999	999	999
Incidental emissions[7]	124	109	262	356	466	557	598	599	599	644	645	640	649	578
Total Scope 1 CO_2-e	16,510	27,129	29,575	52,244	68,368	65,917	64,058	64,230	82,194	112,447	113,202	109,897	115,881	68,184
Grid electricity - Scope 2[8]	43,996	46,032	148,400	190,400	248,500	310,100	338,100	338,100	320,600	320,600	320,600	320,600	320,600	320,600
Total Scope 1 + 2 CO_2-e	60,506	73,161	177,975	242,644	316,868	376,017	402,158	402,330	402,794	433,047	433,802	430,497	436,481	388,784
Intensity kg CO_2-e/t	87	105	161	154	164	165	151	151	164	182	182	181	183	163

[5] The non-transport diesel factor has been used for estimating CO_2-e emissions from diesel.
[6] The non-transport LPG factor for has been used for estimating CO_2-e emissions from LPG.
[7] Incidental emission sources are estimated from the proportion of incidental sources in the FY2018 NGER report relative to the total emissions from material sources. These incidental sources have historically included partial combustion of lubricating oils, partial combustion of greases, combustion of unleaded petrol, leakage of sulphur hexafluoride from switchgear and emissions from onsite sewerage treatment.
[8] Scope 2 estimates have been estimated using the SWIS grid factor for the 18-19 financial year. In the past 10 years this factor has declined by approximately 15% as the SWIS grid has moved toward lower emission intensity technology. It is possible that this trend will continue in the future.

Table 3 - Greenhouse gas benchmarking results

Footprint	Direct Emissions (Scope 1) (MT CO_2-e)	Indirect Emissions (Scope 2) (MT CO_2-e)	Direct + Indirect Emissions (MT CO_2-e)	Predicted peak footprint of Greenbushes Expansion Project as a % of this footprint
Australia – December 2017[9]	N/A[10]	N/A	533.7	0.08%
Western Australia – 2016[11]	N/A	N/A	82.2	0.53%
Mining industry – 2016[12]	82.3	23.6	105.9	0.41%

[9] Sourced from the Australia Government Department of Environment and Energy - *Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2017.*
[10] The split between direct and indirect emissions is not appropriate at the country or state level
[11] Sourced from the Australia Government Department of Environment and Energy – *State and Territory Greenhouse Gas Inventories 2016.*
[12] Sourced from the Australia Government Department of Environment and Energy – *National Inventory by Economic Sector 2016.*