RMCG

07 May 2018

# Greater Shepparton City Council - Review Panel: Solar Farm Permit Applications

## Planning Permit Application No: 2017-162, 2017-274, 2017-301 and 2017-344

EXPERT WITNESS REPORT BY DR DORIS BLAESING

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# Brief

1. My brief for preparing this report was provided by Holden Redlich via Joseph Monaghan via emailed letter dated 13 April 2018. Holden Redlich act for the Greater Shepparton City Council.
2. I was asked to act as an independent expert in relation to the Review Panel "Solar Farm Permit Applications, Planning Permit Application No: 2017-162, 2017-274, 2017-301 and 2017-344" before Planning Panels Victoria.
3. I was asked to provide advice as an independent expert witness in relation to issues associated with.
4. The brief seeks my opinion on four (4) matters. I was asked to consider Mr Ken Guthrie's preliminary opinion on a potential heat island effect of solar farm installations, which was provided to me. The four matters are:
    a) Describe any temperature change effects on neighbouring orchards and horticulture
    b) Describe any temperature change effects on farming for cattle and livestock
    c) Describe any insect effects from the solar farms
    d) Provide your opinion on any conditions insofar as they are relevant to your area of expertise, including the conditions in relation to setbacks.

The four matters are listed as headings in the relevant section of this report together with my responses.

# The Expert Witness

5. This report has been prepared by Dr Doris Blaesing of RM Consulting Group Pty Ltd (RMCG), office address: 9 Arnold Street (rear office), PO Box 316, Penguin TAS, 7316.
6. RMCG is a consulting business that operates nationally with offices in Melbourne, Bendigo, Torquay, Warragul, Hobart and Penguin. We have extensive experience in working with rural industries including research and development, economic analysis, stakeholder consultation, strategic reviews and investment planning, communication, technology transfer and program evaluation and planning.
7. Dr Doris Blaesing is an Associate and Director of RMCG. She holds the following degrees from Hannover University, Germany: Dipl. Ing. Ag. (equivalent to M. Agr. Sc) and a Dr. rer. hort (equivalent to PhD, Horticulture). She has majored in fruit

production and soil science; she conducted postdoc studies at the Macaulay Land Use Research Institute in Aberdeen, Scotland (via a British Royal Society Grant). This involved agroforestry systems for the production of high value timber and livestock. Doris understands horticultural and animal production, both from a scientific and practical perspective. Doris has worked in horticulture and agriculture in Australia since 1990 mainly in Victoria and Tasmania. She has extensive knowledge of integrated production systems, sustainable production and resource use efficiency. Her work includes emission reduction in agriculture and reuse of wastewater and organics. Prior to consulting Doris worked as lecturer, scientist (university, government and private organisations), horticulture manager in an export business and technical manager in an agribusiness company. Doris has extensive experience in managing agricultural, business development, RD&E and natural resource management projects. She has a good understanding of horticultural and agricultural production, supply chains, markets and related business and resource management issues.

8. I have read the Planning Panels Victoria Guide to Expert Evidence and agree to be bound by it.

9. In preparing this report, I have referred to a document prepared by Mr Ken Guthrie, emailed to me by Holden Redlich via Joseph Monaghan. I also had access to Planning Permit Application No: 2017-162, 2017-274, 2017-301 and 2017-344 via Holden Redlich (Tess Bowyer). I have reviewed the information provided and also sourced and analysed publically available information relevant to my brief. References are provided as footnotes in the report.

10. I investigated information I consider appropriate to respond to questions posed in the brief. No matters of significance, which I regard as relevant, have, to my knowledge, been withheld.

11. I have visited the proposed sites and surrounding areas on 27 April 2018. Visits were organised via Holden Redlich (Tess Bowyer).

12. Signature……………………………………………

Name Dr Doris Blaesing

Date 07 May 2018

# Background

13. Greater Shepparton City Council was the Responsible Authority for the following planning permit applications proposing solar farms in Greater Shepparton (Planning Permit Applications). The Minister for Planning is now the decision maker and has established a Review Panel which will make recommendations to the Minister as to whether a planning permit should issue for each application:

    (i) 2017-162

    (A) Subject Land: 610 Ferguson Road, Tatura East

    (B) Proponent: CleanGen (2017-162)

    (ii) 2017-274

    (A) Subject Land: 235 Victoria Road, Tallygaroopna

    (B) Proponent: X-Elio Australia Pty Ltd 2017- 274 and 2017-344

    (iii) 2017-301

    (A) Subject Land: 1190 and 1220 Cosgrove Lemnos Road, 260 Tank Corner East Road, 875 Boundary Road and 85 Crooked Lane, Lemnos

    (B) Proponent: Neoen Australia Pty Ltd 2017-301

    (iv) 2017-344

    (A) Subject Land: 1090 Lemnos North Road, Congupna

    (B) Proponent: X-Elio Australia Pty Ltd

14. Con Tsotsoros (Chair), Amanda Cornwall and Ken Joyner have been appointed as the Panel under sections 97E, 153 and 155 of the Planning and Environment Act 1987 to consider submissions about the Planning Permit Applications.

# Expert Opinion

15. This section of the report provides my opinion on the matters I have been asked to examine. The first two paragraphs describe relevant context:
    i. A potential heat island effect i.e. temperatures within, above and adjacent to solar farms.
    ii. Land use surrounding the proposed solar farms in Greater Shepparton.

16. The following four (4) paragraphs are my response to matters raised in the brief.

## CONTEXT

### HEAT ISLAND EFFECT

17. I have read Mr Ken Guthrie's preliminary opinion on a potential heat island effect. I have also read the original texts Mr Guthrie has reviewed to form his opinion.

### LAND USE SURROUNDING PROPOSED SOLAR FARM SITES

**2017-162 - Subject Land: 610 Ferguson Road, Tatura East**

18. Adjacent land is predominately used for cropping and grazing including some irrigated pasture. One orchard lies across Turnbull Rd. The subject land has access to irrigation water. Water is delivered via channels.

**2017-274 - Subject Land: 235 Victoria Road, Tallygaroopna**

19. Adjacent land is predominately used for grazing including irrigated pasture (e.g. for dairy heifers) and some cropping. One adjacent apple orchard is separated from the subject land by an easement and irrigation channel; and a windbreak has been established on most of the boundary between the orchard block and the easement. The subject land has access to irrigation water. It contains an environmental planting and planted windbreaks.

**2017-301 Subject Land: 1190 and 1220 Cosgrove Lemnos Road, 260 Tank Corner East Road, 875 Boundary Road and 85 Crooked Lane, Lemnos**

20. Adjacent land is predominately used for fruit production, irrigated pastures and some dryland grazing and cropping. Several easements with irrigation channels run along the boundary and through the subject land; it has access to irrigation water. Orchards of varying ages on surrounding land mainly produce apples, pears and nashi pears.

**2017-344 Subject Land: 1090 Lemnos North Road, Congupna**

21. Adjacent land is predominately used for dryland cropping and grazing. The subject land has no access to irrigation water.

# RESPONSE TO MATTERS RAISED IN THE BRIEF

## TEMPERATURE CHANGE EFFECTS ON NEIGHBOURING ORCHARDS AND HORTICULTURE

22. Horticultural production adjacent to land proposed for the development of solar farms is currently limited to tree fruit production: pome fruit (apples, pears, nashi pears) and potentially stone fruit (peaches, apricots, plums).
23. I investigated the possible effect on chilling of fruit trees due to a heat island effect, affecting temperatures by 0.5 -1.0 °C in the immediate vicinity of orchards for a proportion of the day (even though I expect this effect to be highly unlikely).
24. The Chill Hours model (Weinberger, 1950[1]) was the first to be developed and estimates winter chill based on hourly temperatures between 0 & 7.2°C. The newer Chill Units or Utah model (Richardson et al., 1974[2]) is slightly more complicated. It incorporates the understanding that temperatures vary in how much they contribute to winter chill and that high temperatures can have an adverse effect. In this model, temperatures below 1.4°C do not contribute to chill accumulation, temperatures between 2.4 and 9.1°C make the greatest contribution and temperatures above 15.9°C have a negative impact.
25. The Dynamic chill model (Erez et al. 1990[3]) is the current best practice model, especially in warmer climates. It calculates chill in Chill Portions, based on hourly temperatures. The Dynamic model has many features that capture known temperature-winter chill relationships that are lacking in other models including the Chill Hours model.
26. Chilling requirements are unknown for many cultivars of pome fruit and stone fruit. Cultivars are generally ranked in broad groups of 'high', 'medium' and 'low' chill, often based on observations of flowering time in the climate in which they have been grown. Gaps in understanding of the physiological processes involved in dormancy breaking and a lack of necessary research means that putting actual numbers on chilling requirements for cultivars remains difficult.
27. Fruit trees grown in the Shepparton region require the following average chill portions[4]:

| Fruit type | typical chill portion ranges |
|---|---|
| **Apple** | 34-50 |
| **Apricot** | 30-69 |
| **Nectarine** | 12-42 |
| **Peach** | 8-63 |

[1] Weinberger J. H. (1950) Chilling requirements of peach varieties. Proceedings of the American Society for Horticultural Science, 56: 122-128.
[2] Richardson, E. A., Seeley, S. D., And Walker, D. R. (1974) A model for estimating the completion of rest for Redhaven and Elberta peach trees. HortScience 9: 331-332.
[3] Erez A, Fishman S, Linsley-Noakes GC, Allan P (1990) The dynamic model for rest completion in peach buds. Acta Hortic 276, 165-174
[4] http://fruitsandnuts.ucdavis.edu/Weather_Services/prune_chilling_prediction

28. Definitive data on the chill requirements of pear varieties in Australia are difficult to find. However, the common varieties grown commercially in Australia can be roughly divided into those requiring, high, medium or low chill. High chill – Williams, Beurre Bosc, Winter Nelis, Comice, Lemon Bergamot; Medium chill – Packham's, Josephine; Low chill – Corella[5]. Nashi pears have a low chilling requirement.[6]

| Chill Portions | |
|---|---|
| High | >70 |
| Medium | 30 – 70 |
| Low | <30 |

29. For the near future (2030), the annually averaged warming across all emission scenarios is projected by CSIRO to be around 0.6 to 1.3 °C above the climate of 1986–2005[7].
30. I used predicted chill portions under climate change scenarios (greenhouse gas scenarios using representative concentration pathways (RCPS)[8]) for the Shepparton area[9] to look at potential temperature effects on fruit trees:

(RCP4.5: moderate scenario; RCP8.5: worst case scenario modelling approach)

| Predicted chill portions median (range) | Present | 2030 | | 2050 | |
|---|---|---|---|---|---|
| | | RCP4.5 | RCP8.5 | RCP4.5 | RCP8.5 |
| | 84 (73-93) | 75 (63-85) | 74 (62-86) | 71 (57-81) | 67 (56-79) |

31. The climate change scenarios assume a consistent day and night temperature rise, not a rise over a proportion of the day (with temperature dissipation overnight) and over a very small area of land.

## TEMPERATURE CHANGE EFFECTS ON FARMING FOR CATTLE AND LIVESTOCK.

32. **Temperature requirements of pastures generally used for grazing livestock**: Cool season grasses grow best between 15.5-24°C while warm season grasses prefer temperatures in the 27-35°C range. When day temperatures are above optimum, cool season grasses become much less effective forage producers, especially if soil temperatures increase. If night temperatures increase this problem intensifies. If soil temperatures exceed 40°C for extended periods, many cool season grasses begin to die.[10]

[5] http://apal.org.au/industry-info/intensive-pear-production/climate-and-aspect/
[6] http://stfc.org.au/nashi-pears-for-south-east-queensland
[7] CSIRO https://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer
[8] www.climatechangeinaustralia.gov.au/en/climate-campus/modelling-and-projections/projecting-future-climate/greenhouse-gas-scenarios/
[9] hort-science.shinyapps.io/ChillCalculator/
[10] M. Harman (2915) onpasture.com/2015/08/17/managing-heat-stress-across-your-farm/

33. **Temperature effects on beef cattle:** Temperatures above the optimum lead to reduced animal performance. The upper critical temperature can vary for beef cattle. For younger cattle it is about 27 °C whereas for feedlot cattle and mature cows their upper comfort zone is about 24 °C. Animals can start experiencing heat stress when their body temperature is above this temperature. Heat stress occurs when an animal cannot dissipate heat from its body. Some of the main factors causing heat stress are: high air temperature, high air humidity, low air movement and thermal radiation load[11].
34. **Temperature effects on dairy cows:** Dairy cow breeds may have reduced milk production and or milk quality in a temperature range of 24-35°C[12]. Heat stress on cows becomes evident (rectal temperature, disturbance in respiratory and cardiac function) at temperatures above 30°C. Distress is evident above 35°C (restlessness, panting, tongue protrusion, frequent visits to water, salivation, sliming of nostrils and change in faecal texture). The duration of heat stress, especially when night temperatures remain high, determines the overall effect.[13]
35. According to CSIRO research, "by 2025 small changes in the number of days of heat stress are likely across the entire Murray Dairy region for low, mid and high emission futures. An additional 5 days of heat stress are simulated for both the modest heat stress range and the moderate heat stress range. An additional 5–15 days were simulated severe heat stress days. By 2050 larger changes in the number of days of heat stress are likely across the entire Murray Dairy region for the low, mid and high emission futures. An additional 5–37 days of heat stress are simulated across each heat stress range. Largest increases are simulated for severe heat stress with up to 37 additional days of heat stress if the high greenhouse gas (GHG) emission scenario is realised. Modest and moderate heat stress was simulated to increase by 5–25 days, with greatest change occurring in the south-east of the Murray Dairy region under a high emission scenario."[14]
36. A temperature humidity index (THI) is commonly used to assess/predict heat stress for cattle. THI is calculated from air temperature and relative humidity using the following equation: THI = [(Dry bulb temperature $^{o}$C) + (0.36 x dew point temperature $^{o}$C) + 41.2][15]. In the CSIRO research and predictions, heat stress is indicated by consecutive days of THI >75. For heat stress to occur, temperatures have to be above optimum for long enough to increase animal body temperature.
37. Given the prevailing summer weather conditions in the Shepparton areas and abundance of information on the topic, including from CSIRO, Dairy Australia, Meat

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[11] Lunn D. (not dated) managing heat managing heat stress in beef cattle. Shur-Gain, Nutreco Canada Inc. Publication

[12] Pragna. et al (2017). Heat Stress and Dairy Cow: Impact on Both Milk Yield and Composition. International Journal of Dairy Science, 12: 1-11.

[13] Rees H.V. (1964) Heat Stress in Dairy Cattle; Physiological Responses and Variations in Milk Composition and Equilibrium. Master of Agricultural Science Thesis, University of Tasmania

[14] Nidumolu, U., Crimp, S., Gobbett, D., Laing, A., Howden, M. and Little, S. (2010). Heat stress in dairy cattle in northern Victoria: responses to a changing climate. CSIRO Climate Adaptation Flagship Working Paper No. 10. http://www.csiro.au/resources/CAF-working- papers.html

[15] Dairy Australia http://www.coolcows.com.au/go-on-alert/thi.htm

and Livestock Australia (MLA)[16] advisers and Agriculture Victoria[17] livestock producers will be aware of measures to reduce the impact of heat stress in livestock, i.e. providing abundant water, and shade for livestock. Extra cooling with sprinklers are beneficial when the THI is greater than 82. [18] Cows will do up to 70% of their daily grazing at night in hot weather [18].

38. As mentioned above, climate change scenarios are looking at sustained temperature increases of an entire region, not intermittent, minor increases over a small paddock area.

39. Even if the proposed solar farm installations increased daytime air temperatures by 0.5 to 1.0°C in a small proportion of a paddock during the middle part of the day, good grazing and herd management means that animals never spend extended time in the same paddock. Also, cattle instinctively move to sheltered and cooler areas of a paddock during adverse conditions.

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[16] Meat and Livestock Australia https://www.mla.com.au/news-and-events/industry-news/mla-rd-examines-heat-load-impacts/

[17] Agriculture Victoria: Code of Accepted Farming Practice for the Welfare of Cattle, Bureau of animal welfare, Attwood. http://agriculture.vic.gov.au/agriculture/animal-health-and-welfare/animal-welfare/animal-welfare-legislation/victorian-codes-of-practice-for-animal-welfare/code-of-accepted-farming-practice-for-the-welfare-of-cattle

[18] https://www.daf.qld.gov.au/business-priorities/animal-industries/dairy/feed-and-nutrition/nutrition-for-lactating-dairy-cows/heat-stress

## INSECT EFFECTS FROM THE SOLAR FARMS

40. Solar panels, due to polarised light, may be confused with a water surface by birds and insects. However, both can recognise the gaps between panels from a greater distance than humans would[19]. Solar panels also do not act like windows as they are not transmitting light. Water birds observed flying over solar farms did not change the direction of flight. The above cited review reports that solar panels that follow the sun would not reflect/mirror vegetation and therefore not confuse birds.
41. The above-cited study reviewed research on the effect of solar farms on insects. It reports that, compared with agricultural land, solar farm installations with well managed vegetation covers (meadows) provide valuable habitats for insects. This habitat would not include orchard pests (e.g. light brown apple moth, Qld or Med. fruit fly) as they are attracted by fruit only. Shade under panels and the proportion of area shaded would influence the insect population.
42. The vegetation buffer around a solar farm cold be used to attract certain beneficial insects and birds. It then would have the potential to enhance area wide integrated pest management (IPM) programs and would certainly benefit neighbouring orchards[20] [21].
43. German studies found that solar farm structures provided nesting sites for birds, especially compared to farmland; even smaller birds of prey were observed hunting amongst structures.[23]. Arrangements such as stone cairns, sand/dirt heaps, or woodpiles together with a conservation-sound vegetation and mowing/grazing under and between the panels would further improve the situation for breeding birds in large solar power stations[22].
44. Predictions for climate change related impacts on pest insects such as Qld and Med. fruit fly on orchards[23] [24]do not apply to potential effects of solar farms on insect life. Solar farms will not attract pest insects, they are attracted by fruit. Climate change predictions are for area wide, sustained increases in day and night temperatures which would allow insects that are currently limited by periods of low temperatures to survive. A time limited temperature increases above solar panels, or even in the immediate vicinity (0.5-1.0$^{o}$C extending over 30-100 m) during part of the day cannot have an effect on orchard pests as predicted with climate change scenarios.
45. In my view, insect effects of solar farms on surrounding farm land will be neutral or most likely positive if vegetation buffers were planted.

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[19] Heussler S. (2010) Großflächige Photovoltaikanlagen im Außenbereich - ein Vergleich zwischen den Bundesländern Baden-Württemberg und Bayern. Bachelorarbeit zur Erlangung des Grades einer Bachelor of Arts (B.A.) im Studiengang gehobener Verwaltungsdienst – Public Management
[20] NSW DPI (not dated) Integrated pest management for Australian apples & pears. http://www.dpi.nsw.gov.au/agriculture/horticulture/pomes/health/ipm-apples-pears
[21] Schellhorn, N. (2007) Native vegetation to enhance biodiversity, beneficial insects and pest control in horticulture systems, Horticulture Innovation Project VG05014, CSIRO Entomology
[22] Tröltzsch P. and E. Neuling (2013) Die Brutvögel großlfächiger Photovoltaik-Anlagen in Brandenburg. Vogelwelt 134: 155 – 179 (2013*)*
[23] Apple and Pear Australia Limited (2008) Submission to Climate Change and the Australian Agriculture Sector Inquiry.
[24] Santhanam-Martin M. and Stevens L. (2017) Understanding Apple and Pear Growers' Climate Change Adaptation Decision-making. Report by Rural Innovation Research Group Faculty of Veterinary & Agricultural Sciences The University of Melbourne

**ANY CONDITIONS INSOFAR AS THEY ARE RELEVANT TO MY AREA OF EXPERTISE, INCLUDING THE CONDITIONS IN RELATION TO SETBACKS.**

46. I expect that the setback area, partly planted with indigenous trees and shrubs, will have a positive effect on surrounding farmland which currently contains few environmental plantings or remnant bush.
47. In reviewing scientific literature relating to my area of expertise i.e. assessing environmental/agricultural impacts from non-agricultural activities I found that Turney D. and Fthenakis V. (2011)[25] identified and appraised 32 impacts related to the installation and operation phases of large-scale solar power plants in the U.S. They investigated the themes of land use intensity, human health and well-being, plant and animal life, geohydrological resources, and climate change. Their appraisals assumed that electricity generated by new solar power facilities would displace electricity from traditional U.S. generation technologies. Altogether they found 22 of the considered 32 impacts to be beneficial. Of the remaining 10 impacts, 4 were neutral, and 6 required further research before they could be appraised. None of the impacts were negative relative to traditional power generation. The authors ranked the impacts in terms of priority and found all the high-priority impacts to be beneficial.

[25] Turney D. and Fthenakis V. (2011) Environmental impacts from the installation and operation of large-scale solar power plants. Renewable and Sustainable Energy Reviews 15 (2011) 3261–3270

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**Document review and authorisation**

**RMCG Job Number: 55-J-01**

| Doc Version | Final/Draft | Date | Author | Reviewed by | Quality checked | Release approved by | Issued to |
|---|---|---|---|---|---|---|---|
| 1.0 | Draft | 07-05-2018 | D. Blaesing | | | | Holding Redlich for review |
| | | | | | | | |
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