Attachment 1: Summary of submissions and submissions

Table describing the relief sought on the site

Submission Point	Theme	Comments	Relief sought
1.1	N/A	N/A	Decline the consent
2.1	Amenity/character	- The openness and expansiveness of the landscape makes the region an outstanding natural feature, therefore it should not be disturbed, altered, or modified. - Notable trees located on the site which add to the beauty of the landscape, along with historic and cultural values.	Decline the consent
2.2	Rural productivity	- The site is zoned as Rural Primary Production. There are lifestyle blocks located in the area. An intensive energy generation facility should not qualify as a farm. - The property could be converted to highly productive – it is flat, good irrigation, rainfall, and sunshine hours.	
2.3	Recreation/Tourism	- Lifestyle blocks on the edge of Greytown contribute to the character of the area and draw people to live, vacation, go on scenic drives, get back to nature, etc. - Provides people the opportunity to live in an open space, with a large garden, fresh food.	
2.4	Location/scale of proposal	- As the proposal is out of scale and out of character, it would introduce a new type of land use to the area, which would not be classed as Rural Primary Production.	
2.5	Stormwater	- Effects of stormwater and discharge. Regular flooding of the site is proposed, raising concerns of natural hazards.	
2.6	Construction effects	- Negative effects of construction include: noise, dust, volume of large vehicles, reduced revenue to local business with people staying away. - Ay benefits to the economy from additional labourers in the region would be overridden by negative impacts of construction.	
2.7	Operational effects	- Glare - Noise	

Submission Point	Theme	Comments	Relief sought
		- Substances for maintenance, cleaning, vegetation clearance, pesticides - End of life plan for panels - Electromagnetic radiation	
2.8	Environmental Impacts	- Concerns of the land being classed as HAIL due to soil and water contamination.	
3.1	Location/scale of proposal	- Unsuitable due to proximity to housing and industrial scale.	Decline the consent
3.2	Amenity/character	- Proposed mitigations will block views into the site, changing the existing character of the area. May also risk blocking views of distant ridgelines. - Industrial development covering hundreds of hectares is more than minor change to the landscape. - The District Plan specifically acknowledges natural character and seeks to protect it – open farmland is part of the natural character of the area.	
3.3	Stormwater	- Water run-off issues, with no provisions for drainage or soak pits currently proposed. - The area has surface water issues, which could present safety issues with electrical systems. - High water tables and flooding – the nature of materials increases the likelihood of contaminants entering waterways.	
3.4	Operational effects	- Increased vehicle movements on the unsealed, narrow, and poorly maintained Moroa Road will be disruptive and dangerous for residents, degrade it further, and increase dust. - Only 2 full time roles are created by the development, with locals impacted.	
3.5	Environmental Impacts	- Environmental impacts of the proposal include: people, water, wildlife, air, amenity, land values, and existing infrastructure. The application understates environmental impacts in favour of economic benefits.	

Submission Point	Theme	Comments	Relief sought
3.6	District Pan	- The proposed activity is not required for primary production, residential purposes, and site coverage exceeds 25m^2. - Proposed infrastructure does not meet setback requirements. - Dust is an issue, and no explanation has been provided by FNSF to a plan to mitigate impact.	
3.7	Economic	- Renewable electricity is not being produced to meet the demand of South Wairarapa. Little evidence of positive economic or social effects from the proposal.	
3.8	Planting/vegetation	- No detailed planting plans have been provided in the application. The site is challenging to plant on due to strong winds and low horizons resulting in high sunlight hours. The el-nino weather pattern predicated for the next few years will impact growing of plants. - Ongoing professional management, irrigation, and husbandry of plantings has not been addressed in the application.	
3.9	Recreation/Tourism	- Tourism is a fast growing economy in South Wairarapa. This proposal could impact that.	
4.1	Amenity/character	- The proposal is not keeping with the amenity and character of the area. - Density of the proposed structures will dominate the landscape.	Decline the consent
4.2	Location/scale of proposal	- The size and location near neighbouring residents presents many risks, including fire, threatening flora and fauna, structures having greater impact on surrounding environment during natural disasters, contamination of water and soil. - The application did not mention risk mitigation for any of the above.	
4.3	Policy/Environmental Standards	- There are not any New Zealand Standards established for the implementation, ongoing maintenance, and operation of solar.	

Submission Point	Theme	Comments	Relief sought
5.1	Location/scale of proposal	- Supports the establishment of a solar farm on this site as it would benefit local residents and the wider regional and national population. - The proposed site is flat, so won't be an issue for nearby residents.	Grant the consent
5.2	Operational effects	- Solar farms are quiet, unlike wind turbines or rural subdivisions with car traffic.	
5.3	Amenity/character	- Screen planting will reduce the visual change.	
5.4	Economic	- Consent this proposal on the grounds of contributing to the national need for renewable energy.	
5.5	Education	- Would like public access to the site, to educate young people about the importance of renewable energy.	
6.1	Location/scale of proposal	- Proximity to neighbouring properties incurs dangers for inhabitants and users (e.g. fire).	Decline the consent
6.2	Environmental Impacts	- Unspecified chemicals that will be used in maintenance procedures. These will be in proximity to water systems used by humans and livestock. - The solar system will be vulnerable to weather extremes (as a result of climate change) and earthquakes.	
7.1	Environmental Impacts	- Opposition to the proposal based on the environmental impact the activity would have on the surrounding rural area.	Decline the consent
7.2	Rural productivity	- The area is currently productive rural landscape and granting this consent would be to the detriment of the district without any benefits.	
8.1	District Plan	- The applicant has only consulted with Iwi and FENZ, which is inadequate. - The applicant's AEE is lacking details and is insufficient.	Decline the consent
8.2	Amenity/character	- The proposal will result in significant changes to the natural character of the site.	
8.3	Location/scale of proposal	- The proposal will have significant effect on the living environment of neighbours.	

Submission Point	Theme	Comments	Relief sought
8.4	Rural productivity	- The proposal will take up a significant amount of productive land and there are concerns regarding the disposal of panels at end of life.	
9.1	Rural productivity	- Concerns regarding degradation of the soil and agricultural land due to the proposal and the maintenance of the panels.	Decline the consent
9.2	Location/scale of proposal	- Moroa Road is already used extensively, resulting in concerns of potholes. Dust from use of the road would impact the panels and result in higher water and chemical use. Proposes that the applicant should seal and maintain this road for the duration of their lease.	
9.3	Operational effects	- The security lighting and expansion of the existing power station will impact the Dark Sky Status of South Wairarapa.	
9.4	Planting/vegetation	- Disappointing to see the use of Japanese Cedar rather than native trees. - Concerns about the length of time it takes for the trees to grow and the disruption of character during that time. - Planting will use additional water from the neighbouring farmers existing bore. A water meter would be required.	
9.5	Fire/natural hazards	- Currently there is a volunteer fire brigade. Questioned whether the application would better resource fire brigade to combat emergency situations as a result of the solar farm.	
9.6	District Plan	- The application has not met the objectives and policies of the DP or the RMA.	
10.1	District Plan	- Inadequacies regarding information and the consultation process, particularly with property owners neighbouring the site. - Concerns regarding the wording and the use of ‘farm’ for a commercial or industrial activity which is located in a rural environment.	Decline the consent
10.2	Location/scale of proposal	- Many properties located in close proximity to the proposal.	

Submission Point	Theme	Comments	Relief sought
		- Concerns about noise from the site – motorised panels and cooling the collection towers. Increased noise during the summer months and the detrimental impact on health.	
10.3	Environmental Impact	- The proposal will create a heat island leading to an increased ambient heat microclimate. - Risk of waste being deposited in the soil/environment if the panels were to break or leak. - Impact of cleaning products in water ways.	
10.4	Amenity/character	- The proposal will change the character of the area and block views of the rural environment and mountains. - Light pollution and risk to those who enjoy astronomy.	
10.5	Recreation/Tourism	- Impact on tourism – visual barrier to those travelling between Greytown and Martinborough.	
10.6	Fire/natural hazards	- Solar panels and collectors will require specialised fire-fighting resources, questioned whether ratepayers will have to carry this cost. - Fires in electrical equipment creates risks that current firefighters may not be equipped to deal with. - Firefighting agents will create further environmental risks with toxins.	
10.7	Economic	- Hidden costs may result in residents paying more for electricity to subsidise this scheme.	
11.1	Fire/natural hazards	- Concerns about photo voltaic cells containing toxic components being released into the air and waterways during a fire. - Impact a fire could have on Transpower assets, causing an outage. - No detailed fire mitigation and management plan. - Concerns regarding the chemical composition of fire fighting substances.	Decline the consent
11.2	District Plan	- The AEE was lacking fundamental information about the proposal.	

Submission Point	Theme	Comments	Relief sought
		- Requests that a 3D rendering of the proposal is provided to show the scale, and the specifics of the inverters and the panels including a list of materials.	
12.1	Location/scale of proposal	- The site is currently zoned rural, not industrial, but the primary purpose of the proposal will be power generation and not farming. - Proposal is a large scale, and in close proximity to housing. - The proposal is locking the land into this use for 30 years, it would be better use of land to rezone to residential as people want to live close to town.	Decline the consent
12.2	District Plan	- Proposal is inconsistent with the Objectives and Policies in the DP. - The proposed activity is not required for primary production, residential purposes, and site coverage exceeds 25m^2. - Proposed infrastructure does not meet setback requirements. - Dust is an issue, and no explanation has been provided by FNSF to a plan to mitigate impact.	
12.3	Environmental Impact	- Large section of the land will become a HAIL site. - The site has a high water table and experiences flooding, which increases the risk of contaminants entering the waterways and neighbouring properties. - Monitoring and remediation conditions should be imposed to ensure monitoring of soil and water. - Impacts from this development on people, water, wildlife, air, amenity, land values, and existing infrastructure. Understated in the application, and alternative locations in the area have not been documented. - Potential for heat generation and thermal convection from the panels, impacting neighbouring properties.	

Submission Point	Theme	Comments	Relief sought
12.4	Amenity/character	- Rows of hard infrastructure is not what you would expect to see in a rural setting – more than minor change. - The applicant hasn't provided realistic graphic representations of how the site will appear. - Proposed mitigations will block views into the site, changing the existing character of the area. May also risk blocking views of distant ridgelines. - A cultural assessment report has not been provided.	
12.5	Planting/vegetation	- Trees take 7 years to grow to screening size, meaning the visual impact is not less than minor. - Hedges on the boundary impacts views/openness/expansivity. - No detailed planting plans have been provided in the application. The site is challenging to plant on due to strong winds and low horizons resulting in high sunlight hours. The el-nino weather pattern predicated for the next few years will impact growing of plants. - Ongoing professional management, irrigation, and husbandry of plantings has not been addressed in the application.	
12.6	Rural productivity	- Large scale water use (for irrigation, planting, cleaning of panels) could dry up bore water which surrounding neighbours use for stock water. - Effect of herbicides on land and sheep grazing.	
12.7	Operational effects	- Impact on neighbouring properties from lighting during night and glint/glare during day. Noise of all the panels moving at the same time. - Increased vehicle movements on the unsealed, narrow, and poorly maintained Moroa Road will be disruptive and dangerous for residents, degrade it further, and increase dust. - Only 2 full time roles are created by the development, with locals impacted.	

Submission Point	Theme	Comments	Relief sought
		- Battery storage systems, substations, inverters, and other equipment should be located furthest from homes.	
12.8	Stormwater	- Run-off issues from the high surface area. No drainage plans or soak pits for this development. Surface water could impact access and safety due to water and electrical systems mixing.	
12.9	Economic	- Renewable electricity is not being produced to meet the demand of South Wairarapa. Little evidence of positive economic or social effects from the proposal. - SWDC should hold a bond to carry out on-going maintenance of the buffer planting and gravel road. - Submitters property directly adjacent to the proposed development, and home located ~100m away. Impact on the value of their property	
13.1	Location/scale of proposal	- SWDC should seek clarification on the number of substations, the height of the solar arrays, spacing between rows, total height of foundation piles, and setback from water races due to inconsistencies throughout the application. - The proposed site makes the development cheaper for the company at the expense of the community. - Concerns regarding the impact on neighbouring properties cell phone reception and internet.	Decline the consent
13.2	Operational effects	- Concerns regarding the use of insecticide, herbicides, grazing, cropping, the volume of water used to wash panels, increase of dust from traffic, disposal of damaged panels, and end of life disposal. - Removal of tall trees for the panels increases the risk of lightning strike and the application does not address whether a lightning rod will be erected. - Consistent low level noise annoyance will be an issue for neighbouring residents and tourists.	

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		- Glare from the panels can be an issue for aircraft and hot air balloons operating in the area. Anti-reflective coating can also erode and enter into the ground-water. - Risk of too much electrical load overloading the system, with other solar farms being consented. - Concerns about electromagnetic radiation.	
13.3	District Plan	- The proposal is not primary production, which the land zoning provides for. - Concerns regarding the gross floor area of the panels and non-compliance of unsealed road setbacks, which results in huge effects. - The proposal is not consistent with Part 2 of the RMA. - If batteries are added to the proposal after consent is granted this would create a HAIL site on the property. Not suitable for rural zoned land with neighbouring houses. - Does not meet the objectives and policies of the District Plan.	
13.4	Stormwater	- Concerns for the protection of groundwater and the aquifer which is used by all neighbours in the area from contaminants.	
13.5	Construction effects	- Concerns that the entrances from Moroa Road cannot provide for large trucks delivering loads frequently. - Concerns regarding construction noise and vibration disturbing residents. Vibrations could also disturb iron particles in the aquifer, raising levels in drinking water.	
13.6	Economic	- Renewable electricity is not being produced to meet the demand of South Wairarapa. Little evidence of positive economic or social effects from the proposal. - Impact on the land values of neighbouring properties. - Concerns that the land in surrounding areas will become unaffordable for local farmers.	
13.7	Amenity/character	- The feeling of openness and expansivity is what brings people to the area.	

Submission Point	Theme	Comments	Relief sought
		- The application is unclear as to what height the hedges will be kept, and trees can die so there is no assurance that it will screen the proposed development. - Screening blocks the views to the plains, mountains, and hillsides. - Japanese Cedar does not mitigate the visual impacts.	
13.8	Rural productivity	- Land will be impacted by the installation of solar panels, lack of sunlight, and increased heat, affecting productivity. Should aim to protect soils for future generations. - Site cannot be effectively used for cropping/grazing while panels are in place – cropping will shade the panels and sheep could damage them. - The proposed activity is not consistent with other activities taking place in the rural zone.	
13.9	Policy/Environmental Standards	- This application does not support the Government's 2050 vision for energy and industry.	
13.10	Fire/natural hazards	- Increased risk of fire due to heat radiated from the panels. - Currently there is a volunteer fire brigade. Questioned whether the application would better resource fire brigade to combat emergency situations as a result of the solar farm.	
13.11	Environmental Impacts	- Removal of wind breaks will increase speeds through the area, possibility of wind tunnels and turbulence. - Mature trees will be felled which birds use for nesting (Moreporks, pukeko, etc.). Should preserve this habitat. - Concerns for end of life, disposal of panels and how this will be sustainable. - Concerns regarding the impact of the solar farm during a natural disaster.	
13.12	Health	- Proposal is impacting negatively on the mental health of those who live in South Wairarapa (stress, insecurity).	

Submission Point	Theme	Comments	Relief sought
14.1	Construction effects	- Concerns that there are too many unknown risks with construction.	Decline the consent
14.2	Operational effects	- Placing local residents at risk with the operation of the solar farm.	
14.3	Environmental Impacts	- Negative effects on the environment due to the size and scale of the build, stormwater runoff, visual pollution, and noise pollution.	
15.1	Environmental Impacts	- The environment will become vulnerable to the effects of climate change. - Batteries will present risk to the regions water table and rivers, which is also used for consumption by people and stock.	Decline the consent
15.2	Location/scale of proposal	- New Zealand hasn't had a project of this scale is such close proximity to a settlement previously.	
16.1	District Plan	- The change of land use is of an industrial nature and is therefore not appropriate for the rural zone. - The application should be considered an Industrial Network Utility. - Proposed buildings will exceed the allowed gross floor area and not meet the required setbacks from an unsealed road. - Does not agree with the statement of the panels being similar to glasshouses. - The District Plan pre-dates the possibility of solar farms of this scale, so SWDC should look at their guidelines concerning Renewable Wind Energy Facilities to compare.	Decline the consent
16.2	Amenity/character	- The proposal will alter the open pastoral landscape which is currently present, and result in more than minor effects. - Concerns for the rural landscape, heritage town, and rural corridors being changed forever.	

Submission Point	Theme	Comments	Relief sought
16.3	Planting/vegetation	- Until the plantings grow tall enough, they will not disguise the visual effects on the landscape (potentially five years).	
16.4	Construction effects	- Construction activities will take place over a longer period of time than seasonal harvesting or cultivating, so this comparison is inaccurate.	
16.5	Operational effects	- Noise of batteries and mechanical components associated with the solar farm will produce noise which will stand out in this rural setting.	
16.6	Environmental Impact	- The proposal will create a HAIL site due to hazardous materials causing environmental contamination. - Potential risk of improper disposal of panels upon decommissioning, important factor of ensuring long-term sustainability.	
16.7	Location/scale of proposal	- Concerns regarding choice of location close to settlements and substations that are cheaper to connect to electricity network, when there are areas in Wairarapa that wouldn't negatively impact the landscape or communities.	
17.1	Location/scale of proposal	- Concerns that the proposal does not align with the communities needs and desires. Crucial for developers to actively engage residents and listen to feedback, which has been insufficient so far.	Decline the consent
18.1	Amenity/character	- Concerns for the loss of clean, green pastures.	Decline the consent
18.2	Environmental Impact	- Potential risk of improper disposal of panels upon decommissioning.	
18.3	Health	- Concerns for the health of current and future residents.	
19.1		- Fully supports submission 13.	Decline the consent
20.1	Economic	- Proposal has the potential to undermine property values in the surrounding rural area.	Decline the consent
20.2	Amenity/character	- The proposal will alter the visual nature of current farmland and will result in an industrial looking area.	

Submission Point	Theme	Comments	Relief sought
		- The historic nature of Greytown is protected, and surrounding farmland should have the same protections to protect visual and historical value.	
20.3	Operational effects	- Noise pollution resulting from the solar farm could have harmful impact on humans and animals in the area. This risk has not been sufficiently analysed.	
20.4	Rural productivity	- The site is currently used for productive food growing. This use should be protected. Solar panels can be installed on rooftops, which would protect agricultural use.	
21.1	District Plan	- The proposal does not align with the WCDP strategic direction or intent.	Decline the consent
21.2	Rural productivity	- RE-O2 Productive Capacity – affirms protecting primary production in the rural zone. Any continuation of agricultural activity on this site will be at significantly reduced capacity, both growing pasture and stock.	
21.3	Amenity/character	- Re-O3 Character of the Rural Environment – screening trees are unlikely to hide the impact of this proposal.	
21.4	Operational effects	- Traffic flows and audio and electromagnetic noise will increase as a result of the proposal. - Risk of glare, impacting on aviation in the area.	
21.5	Fire/natural hazards	- CCR-O3 Resilience to Natural Hazards – the proposal does not enhance regional resilience to natural disasters. - The installation will be sensitive to weather events, including hail, tropical storms, and earthquakes.	
21.6	Environmental Impacts	- Risk of contamination from the panels if they break impacting surrounding waterways. - Potential risk of improper disposal of panels upon decommissioning.	
21.7	Location/scale of proposal	- Hangar and associated runway located on the eastern boundary of the site, which presents risks to those who use it clearing the panels during take-off and landing. In	

Submission Point	Theme	Comments	Relief sought
		cases of engine failure during take-off, occupant survival chances would be reduced by the solar farm.	
22.1	Amenity/character	- Visual impact on the neighbouring residents, with tall solar panels and shipping containers in view from adjacent properties until the hedging grows.	Decline the consent
22.2	Planting/vegetation	- Proposed hedging is not a native species and will look unattractive.	
22.3	Rural productivity	- The proposed site is currently high-quality agricultural land and should be used for this purpose.	
22.4	Environmental Impact	- Existing shelterbelts provide habitat for Morepork. - Risk of birds mistaking the glare from solar panels as glare from water, causing them to collide and die/be injured from impact. - Wind speeds will increase with the removal of shelterbelts, creating wind tunnels.	
22.5	Recreation/Tourism	- The proposal will result in less tourists visiting the area, as the rural area is converted into an industrial zone.	
22.6	Economic	- Minimal advantages or employment opportunities for the local community as a result of the proposal, possibly a few jobs for local contractors during building.	
22.7	Construction effects	- Noise effects of pies being hammered into ground, the installation of panels, and construction of the substation.	
23.1	Fire/natural hazards	- The Wairarapa Fault Line runs under neighbouring properties, risk that the land is too unstable for commercial infrastructure of such scale. - Recent changes have been made regarding consent requirements for works on land subject to liquefaction. - Increased risk of fire due to the presence of electrical components, and high voltage means firefighters have to exercise caution and may require training.	Decline the consent
23.2	Location/scale of proposal	- Hangar and associated runway located on the eastern boundary of the site, which presents risks to those who use it clearing the panels during take-off and landing. In	

Submission Point	Theme	Comments	Relief sought
		cases of engine failure during take-off, occupant survival chances would be reduced by the solar farm. - Proposal will be at the expense of Ahurea Tuakiri. - Undertake a true assessment of alternative sites.	
23.3	Environmental Impact	- Concerns regarding contamination of surrounding environment and water ways by toxic chemicals present on the panels. - Potential risk of improper disposal of panels upon decommissioning. - Concerns regarding weeds under panels and use of chemicals to manage this.	
23.4	Economic	- Compensation for rural accommodation providers who could lose business due to the industrial nature of this proposal. - Compensation for neighbouring properties should they be subject to pollution traced back to the solar farm. - Compensation for neighbouring property owners if parts of the solar farm become detached during a natural disaster and damage other properties. - Concerns whether the developer will cover any increased cost of public liability insurance for all impacted properties.	
23.5	Rural productivity	- The site is prime agricultural land and should be preserved.	
23.6	Amenity/character	- Proposal is inconsistent with the local character, heritage, and features of Greytown.	
23.7	Health	- Overseas examples have documented health problems for people and animals living near solar farms.	
23.8	Construction effects	- Increased dust during construction with use of Moroa Road.	
24.1	Amenity/character	- Concerns for the character of the area and change to the existing rural landscape.	Decline the consent
24.2	Economic	- Expect compensation to neighbouring properties for loss of value to property, amenity, and on-going nuisance.	

Submission Point	Theme	Comments	Relief sought
24.3	Location/scale of proposal	- There are two residential properties soon to be built adjacent to the corner of Battersea and Moroa Roads – this has not been mentioned in the application.	
24.4	Planting/vegetation	- Request that trees be taller at the time of planting, and that shelterbelt and security fence are held as minimum requirements. - Concerns that Amended Sites Plans only show screening trees at 2m, not the 4m set out in the application.	
24.5	Fire/natural hazards	- Concerns regarding fire risks and the lack of information on the water tanks located on site. No information provided on where the water is sourced from, or consideration given to the developer paying for reticulated supply to each lot.	
25.1	Planting/vegetation	- It is unclear from the application whether the screening will be sufficient to block views of the substation switching area. - The landscape assessment (not reviewed by a second person) included in the application underestimates the visual screening of existing windbreaks. Cars on SH2 can be seen from the property, and the time it takes for trees to be planted will have impact. - Screening heights are inconsistent throughout the application (3m vs 4m tall).	Grant consent with conditions
25.2	Amenity/character	- Comparison to Kapuni solar farm is not useful as South Taranaki already has oil infrastructure, which South Wairarapa does not. - The application only offers for the loss of character (with planting to screen panels). The current environment has open fields and windbreaks, which will change under this proposal and has not been addressed.	
25.3	Operational effects	- Reference to glint and glare effects are inconsistent, unclear whether screening will be tall enough to block this out.	

Submission Point	Theme	Comments	Relief sought
25.4	Mapping	- The drawings included in the application are inconsistent with stated dimensions. - 220103-Plan-final-10012023 shows a depth of 1.3m, not 600mm. - A mix of units (imperial and metric) making it confusing and leading to uncertainty of actual dimensions proposed. - 1.5m is listed as the height when the panels are flat, but 2466m is shown in the drawings. - There are numbered items in the drawings which don't link to other drawings. - The scale on the maps seems incorrect, giving a false impression of what the outlook will be. Doesn't reflect the change in visual outlook.	
25.5	Location/scale of proposal	- Strongest winds are from the north-west and south-west directions. The west-east orientation of the panels provides the greatest profile to the wind, providing uncertainty that high wind loadings have been taken into account.	
25.6	Construction effects	- Comparing construction to harvesting is inaccurate, as harvesting is seasonal and construction is estimated to take 6-9 months. The constant noise of a pile driver can't be compared to other activities, and no mitigation has been proposed.	
25.7	District Plan	- The setback from Moroa Road is not consistent with the Plan. Currently there is a section of the road sheltered by trees which cannot dry out during winter, and as a result becomes slippery. Proposed screening is close to the road – should be setback to reduce this risk. - The only detail shown for iwi consultation is an email in July 2022, with no response. An agenda item was not proposed with the Māori Standing Committee. - Recommend that further consultation is undertaken with the Wairarapa Dark Skies Reserve. It is not obvious that	

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		there is no increase in light pollution, as the current substation is always lit at night.	
25.8	Fire/natural hazards	- Stated consultation with FENZ, but drawings do not appear to have taken this into account. Proposed water tanks appear to have been placed for irrigation and are not readily accessible in the case of fire.	
25.9	Economic	- Creation of a community group, including affected neighbours, with funding it crate an amenity for the wider neighbourhood and provide an avenue for future proposals.	
26.1	Rural productivity	- The farm has been providing people with organic nutrient dense food.	Decline the consent
26.2	Location/scale of the proposal	- Concerns regarding the scale of the proposal, and the known and unknown adverse effects this will have on people who live and work, or eat food produced, in the area. - A solar farm of this scale is an industrial operation and should be treated as such.	
26.3	Environmental Impacts	- Potential risk of improper disposal of panels upon decommissioning.	
26.4	Economic	- Hydro and geothermal has better financial, environmental, and social outcomes than solar.	
27.1	Health	- Potential health risks to the residents who will be living in close proximity to the proposal. Radiation, heavy metals, electrical current, or intense glare could cause unknown health issues.	Decline the consent
27.2	Amenity/character	- A solar farm will destroy the visual beauty of the area.	
27.3	Economic	- Negative effects on property values.	
27.4	District Plan	- There has not been proper consultation with the community, hard to access information, or know what stage of the process it is up to.	
28.1	Environmental Impacts	- Potential risk of improper disposal of panels upon decommissioning.	Decline the consent

Submission Point	Theme	Comments	Relief sought
28.2	Amenity/character	- Impact on rural character and amenity values of the environment.	
28.3	Operational effects	- Concerns regarding the impact of noise pollution from inverters and wind going over and around the panels.	
28.4	Health	- Concerns for adverse health impacts due to electromagnetic emissions.	
28.5	Recreation/Tourism	- Loss of personal enjoyment of the area.	
29.1	District Plan	- Proposed solar farm is inconsistent with other activities taking place in the rural zone. - Concerns that the structures for the switch yard are not compliant with the District Plan.	Decline the consent
29.2	Amenity/character	- Amenity values of the rural environment would be adversely impacted.	
29.3	Stormwater	- Concerns regarding the chemicals used in operation and construction and these entering the stormwater.	
294	Rural productivity	- Findings from Massey University on combined solar and pastoral farming are yet to be released, but could be relevant to the proposal.	
29.5	Mapping	- Existing site access is from Bidwills Cutting Road, which is not shown on the plan. - Plan final 10012023 – concerns that the panels are not oriented in the correct direction. Should face north and not west.	
30.1	District Plan	- The rural zone should be protected for rural activities. Submitter accepts that the size of a solar farms means it cannot be undertaken in the industrial zone, but should be located closer to an industrial zone or near a township so the built-up nature is more aligned with the environment. - This proposal could set a precedent that industrial businesses can locate in the rural zone. - Will not be meeting the setbacks of the rural zone, would be more fitting in the industrial zone where they can cover the whole site.	Decline the consent

Submission Point	Theme	Comments	Relief sought
30.2	Planting/vegetation	- Screening should be at full height before construction of the structures to hide the effects (year 5).	
30.3	Location/scale of proposal	- No alternative sites considered by the applicant. Should be located away from roads and built up rural residential lifestyle. - Locating away from the substation would reduce the visual impacts.	
31.1	Location/scale of proposal	- Concerns regarding site selection, when 85% of New Zealand is empty.	Decline the consent
32.1	Rural productivity	- Application has inconsistent information with many reports that state solar farms result in soil compaction, alteration of drainage channels, and increased erosion. Should be resolved by an agreed independent expert before consent is granted.	Grant consent with conditions a. Prior to consent being granted, the applicant must provide a report from an independent expert approved by SWDC to confirm its assertion that there will be no significant increase in impermeable cover and that there will be no adverse effect on the productive potential of the soils on the site. b. When the site reaches the end of its useful life the solar panels must be removed and disposed of in an environmentally safe manner and that an adequate fund be
32.2	Environmental Impact	- Concerns of potential improper disposal of panels upon decommissioning. Should be an express condition of the consent that they are disposed of in an environmentally safe manner.	
32.3	Economic	- No financial information available about the New Zealand entities involved in this application. - Applicant appears to be a special purpose company, so there is no guarantee it will have the financial capability to fulfil its obligations to dispose of panel properly. - Consent should include a condition requiring applicant to establish a fund to be held by an independent trustee to cover disposal of panels.	

Submission Point	Theme	Comments	Relief sought
			established, either in cash or through a bond provided by an approved bank or insurance company, to pay for the removal.
33.1	District Plan	- Lack of consultation with neighbours immediately adjacent to the site. Had to buy a copy of the proposal for an intensive industrial installation. - This proposal should be considered alongside the other proposed sites as they are immediately adjacent to each other. - District Plan is currently under review and this could set a precedent for the region.	Decline the consent
33.2	Operational effects	- Increased ambient noise which is higher than what is expected in a rural environment. - Comparison of noise to that of an idling tractor is inaccurate, as that is short-term and limited to a time and place. - No consideration as to how this will be mitigated at the boundary. - Proposal does not address how they will mitigate noise generated by wind hitting the panels. - Lighting impacting on the dark sky reserve. - Increased vehicle movements on the unsealed, narrow, and poorly maintained Moroa Road will be disruptive and dangerous for residents, degrade it further, and increase dust. Sealing it will add cost to ratepayers.	
33.3	Environmental Impact	- Risk of environmental damage. - Increased heat envelope around the panels and potential for ground contamination. - Concerns about water contamination and the impact on people, animals, and land. Aquifers under the property would also be at risk.	

Submission Point	Theme	Comments	Relief sought
33.4	Economic	- Risk of increased cost to ratepayers and electricity consumers. - Impact on property values. - Proposal does not include remediation (including a dedicated fund) for the land should it become uneconomical.	
33.5	Location/scale of proposal	- Many neighbouring properties will be impacted by the proposal. - Such a large scale solar installation is not appropriate in the Wairarapa.	
33.6	Construction effects	- No mitigation provided for construction noise.	
33.7	Amenity/character	- Surrounding properties would lose their view to the Tararua's.	
33.8	Planting/vegetation	- The proposed planting is not fast growing and will not mitigate the impact on neighbours.	
33.9	Fire/natural hazards	- Increased risk of fire and volunteer brigade does not have the experience or equipment to deal with electrical fires.	
34.1	Amenity/character	- Loss of landscape with introduction of hedges along Moroa Road. - Concerns regarding losing rural views. - Comparison to JR Orchards is inaccurate as no road runs directly alongside it.	Decline the consent
34.2	Location/scale of proposal	- The claim of Moroa Road having low usage in the application is incorrect, as the road has been used as a SH2 detour. - Concerns regarding the impact on neighbouring properties cell phone reception, radio, and internet.	
34.3	Environmental Impacts	- Many birds nest in the existing shelterbelts – many animals live in the area and will be impacted by change to the landscape. - No research has been presented on bird deaths on solar farms.	

Submission Point	Theme	Comments	Relief sought
		- Concerns regarding the impact of removing existing shelterbelts on wind speeds. The current landscape has a series on windbreaks. - Concerns that the solar farm will create a heat island, not considered in the impact assessment. - Concerns of potential improper disposal of panels, concrete, cables, inverters, fencing, and screening upon decommissioning. - Concerns regarding the management of pest species on the property, including rabbits and weeds.	
34.4	Planting/vegetation	- Recent screening plantings in the area have used native trees, not exotic which this application is proposing.	
34.5	Operational effects	- Concerns regarding noise, particularly at night. Not enough information has been provided on this, including source of noise, how much noise, and at what time of the day.	
34.6	Fire/natural hazards	- Concerns regarding the increased risk of fires due to dry grass not being removed. - Concerns regarding the solar farm during an earthquake and if this could cause a fire. - Flooding is more likely with climate change and extreme weather events, concerns that the solar farm will lead to more dangerous situations during these events.	
34.7	Rural productivity	- Excess spring growth is usually used to make silage/baleage/hay, as sheep will not eat the long stalks.	
34.8	Recreation/Tourism	- Impact of environmental change on tourism has not been assessed in the application.	
35.1	Environmental Impacts	- A great proposal to reduce emissions in the South Wairarapa and New Zealand. Could lead to the close of the Huntly coal power plant. - Taking action on climate change.	Grant the consent
35.2	Economic	- The proposal will create jobs during construction and ongoing during operation.	

Submission Point	Theme	Comments	Relief sought
36.1	Amenity/character	- Rural characteristics of the environment which attracts residents and visitors. - Loss of amenity for local residents, which is understated.	Decline the consent a. Only the area to the north of Moroa Road be developed, as the southern section are surrounded by affected people. b. Shelter belts should be planted and maintained before construction commences. c. Site is dark at night. d. Restrictions on noise to limit disturbance. e. Due to winter ground conditions, restrict construction to summer months and consider adequacy of proposed roading.
36.2	Recreation/Tourism	- Concerns regarding the loss of tourism due to the character of the district changing.	
36.3	Stormwater	- The application states there is no change required to drainage and that stormwater will infiltrate the ground as normal. Risk that the site will become unworkable and they arrays unstable in wet and waterlogged ground conditions.	
36.4	Fire/natural hazards	- Application does not consider the impact of climate change and other unlikely climatic weather events in enough detail, including large scale precipitation and cyclone levels of wind.	
36.5	Health	- Concerns for the health of people and livestock living within the area, with further development of the substation and associated transmission lines. Needs to be more fully explored in the application.	
37.1	Health	- Concerns for the health of the people who live in the vicinity of the proposal.	Decline the consent
37.2	Environmental Impact	- Concerns regarding contamination of drinking water. - Potential risk of improper disposal of panels upon decommissioning. - Concerned that there will be large environmental impacts of this proposal, but is being disguised as greenwashing. - Concerns for the organic farm neighbouring the site and the impact it will have on their produce.	
37.3	Recreation/Tourism	- Impacts on people who were thinking of coming to the Wairarapa, affecting the business in Greytown and Martinborough.	

Submission Point	Theme	Comments	Relief sought
37.4	District Plan	- SWDC should consider the precedent this proposal is setting, with future solar farms coming to the district. - Neighbours do not have enough information.	
37.5	Location/scale of proposal	- A project of this scale has not been done on land so close to a resident population. Request more information on the safety of this.	
38.1	Location/scale of proposal	- Site selection is unsuitable due to proximity to housing. - Proposal is of an industrial scale. - Alternative locations in the area have not been explored. Concerns that the site was selected as it is the easiest, low-cost option, rather than alternative, viable, and less impactful options.	Decline the consent
38.2	District Plan	- Proposal is inconsistent with the rural zone and district plan objectives. - The proposed activity is not required for primary production, residential purposes, and site coverage exceeds 25m^2. - Proposed infrastructure does not meet setback requirements. - Dust is an issue, and no explanation has been provided by FNSF to a plan to mitigate impact.	
38.3	Amenity/character	- Blocking views into the site with hedgerows will change the character of the area. - Significantly changes the existing natural character, more than minor.	
38.4	Environmental Impact	- Electric works, power generation, and transmission is likely to cause a large section of land to become a HAIL site. - Concerns of contaminants entering waterways due to high water table and flooding.	
38.5	Stormwater	- No provision for drainage or soak pits. - Surface water is an issue in the area and access and safety would be affected if water and electrical systems started mixing.	

Submission Point	Theme	Comments	Relief sought
38.6	Operational effects	- Increased vehicle movements on the unsealed, narrow, and poorly maintained Moroa Road will be disruptive and dangerous for residents, degrade it further, and increase dust.	
38.7	Economic	- Minimal advantages or employment opportunities for the local community as a result of the proposal. - Renewable electricity is not being produced to meet the demand of South Wairarapa. Little evidence of positive economic or social effects from the proposal.	
38.8	Planting/vegetation	- No detailed planting plans have been provided in the application. The site is challenging to plant on due to strong winds and low horizons resulting in high sunlight hours. The el-nino weather pattern predicated for the next few years will impact growing of plants. - Ongoing professional management, irrigation, and husbandry of plantings has not been addressed in the application.	
39.1	Economic	- Supports the principle of moving to a low carbon economy and considers that the development of solar generation of electricity as an important contributor to this goal.	Grant consent with conditions a. Plants considered as pests by GWRC (e.g. arrow bamboo, pampas grass, or hawthorn) will not be used for screening. b. Plant a polyculture of 12+ native species (e.g. mānuka, kohuhu, hebe, flax, toetoe, cabbage tree, ribbonwood, *Coprosma* spp, kowhai, lemonwood,
39.2	Environmental Impacts	- Concerns regarding the removal of large trees. - The current proposal is missing an opportunity to add meaningful biodiversity benefits. - The mature trees to be removed provide habitat to a range of native invertebrates and birds (potentially lizards), in a landscape which has limited habitats. - Existing tall trees provide take-off and landing perches for kereru and other birds. Large trees with cavities (pine/macrocarpa) are rich in insects and provide potential roosting sites for morepork and native bats.	
39.3	Planting/vegetation	- A diverse polyculture hedge of native trees and shrub species could achieve a higher biodiversity restoration	

Submission Point	Theme	Comments	Relief sought
		value than the proposed monoculture of Japanese Cedar. This would achieve the same screening function. - Virtually no native insect eats any part of Japanese Cedar and this species provides no nectar or fruit for native birds.	*Olearia virgatum*, *Olearia paniculate*, broadleaf, totara). c. Screening to be maintained at a height of 4.5m or higher. d. Where existing trees are present on the southern boundary, maintain these at their current size.
39.4	Location/scale of proposal	- Proposed location indicates that establishing corridors of native vegetation could enhance dispersal of birds, bats, lizards, and insects. Situated between Tauharenikau Bush fragments to the south-west, Morrisons Bush/Ruamahanga River Terraces to the south-east, and Elm Road Wetland to the north. - Location provides an opportunity to reconnect isolated remnants of bush as a response to global extinction and climate change crises.	
40.1	Environmental Impacts	- Concerns of displacement of the area's native wildlife and birds. Proposal could have a transformative effect on the land and have dire consequences on the local wildlife. - Existing shelterbelts provide habitat for Morepork. - Potential risk of improper disposal of panels upon decommissioning and the land not being returned to its previous condition.	Decline the consent
40.2	Rural productivity	- Concerns that prime farmland is being removed from agricultural use. Consider the long-term interest and use of the site for industrial development.	
40.3	Amenity/character	- Concerns regarding the degradation of rural, scenic views that are associated with the district. - Visual impact would change the character of the area. - Landscaping will not be immediate.	
40.4	Economic	- Potential for the surrounding properties to experience a decrease in value.	
40.5	Construction effects	- Risk that construction noise will disrupt the daily life of those that live in the area.	

Submission Point	Theme	Comments	Relief sought
		- Increased dust, mud, and debris on roads, driveways, and surrounding properties. - Safety concerns with truck traffic bringing in materials.	
41.1	Environmental Impacts	- Concerns about water contamination from the solar panels and electrochemical storage batteries being present on the property.	Decline the consent
41.2	Fire/natural hazards	- Concerns regarding extreme weather events and the numerous, low-lying rivers which run through the Wairarapa. - Concerns that the solar panel array will present an impediment to civil defence rescue operations during a natural event. - The solar farm presents a significant hazard to the local community during an extreme weather event.	
42.1	Location/scale of proposal	- Transpower's interest in the proposal relates to works proposed in the southern portion of the Site, which could adversely impact Transpower's ability to operate and maintain the MST-UHT A National Grid assets, is not appropriately managed.	Grant consent with conditions *General* a. The consent holder shall provide Transpower NZ Ltd 10 working days notice in writing prior to commencing the proposed works. Note: notification can be sent to transmission.corridor@transpower.co.nz *Building and Structures* a. No buildings or structures (except non-conductive fencing) shall be located within 12m of
42.2	Mapping	- The National Grid support structures located within the Site are not shown on the Plan, nor is the National Gird Yard. Transpower request that this detail is provided on the Plans to clearly show the location of the National Grid assets in relation to the proposed solar farm. - Section 3.6 of the Assessment of Environmental Effects ('AEE') confirms that three entrances to the solar farm will be provided on Moroa Road, while the 'Resource Consent Application 415 Moroa Road, Greytown (Planning Application No. 220103) – Response to Further Information Request' dated 1 March 2023' states "five accessways will be constructed on site" (two of which are existing). No detail is provided on the width of these entrance ways or the width of internal accessways through the solar farm, other than referring	

Submission Point	Theme	Comments	Relief sought
		to Appendix 5 of the Wairarapa Combined District Plan ('District Plan'). Transpower require internal accessways to be 6m in width to allow for large mobile plant access required for tower maintenance activities. Similarly, any fences or gates proposed at the site shall not impede Transpower's access to towers MST-UHT-A0192 to 0199. Where gates are installed to provide for access to the MST-UHT A National Grid assets, they shall be at least 6 metres wide to allow access for large mobile plant required for tower maintenance.	the centreline of the MST-UHT A National Grid transmission lines. b. No buildings or structures shall be located within 12m of any outer visible edge of the foundation of National Grid support structures MST-UHT-A0192 to 0199; except for non-conductive fencing, which can be located 6m from any outer visible edge of the support structure foundation. *NZECP Compliance* a. All land use activities, including the construction of new buildings/structures, earthworks, fences, any operation of mobile plant and /or persons working near exposed lines parts shall comply with the New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001) or
42.3	Policy/Environmental Standards	- Policy 2 of the NPSET requires decision-makers to recognise and provide for the effective operation, maintenance, upgrading and development of the electricity transmission network. Whilst Policy 10 requires that all decision-makers: "to the extent reasonably possible manage activities to avoid reverse sensitivity effects on the electricity transmission network and to ensure that operation, maintenance, upgrading, and development of the electricity transmission network is not compromised." - NZECP34: 2001 is a mandatory code of practice pursuant to the Electricity Act 1992 which sets minimum safe distances from overhead transmission lines to protect persons, property, vehicles and mobile plant from harm or damage from electrical hazards. The Code establishes safe clearance distances to buildings and structures, the ground (including stockpiles of earth and filling activities), and other lines, as well as how close buildings, structures and excavations can occur to poles and towers. All proposed works must comply with the NZECP requirements.	
42.4	National Grid Yard (NGY)	- Access to the MST-UHT A National Grid transmission lines and support structures shall be maintained to ensure maintenance can be undertaken at all	

Submission Point	Theme	Comments	Relief sought
		reasonable times and emergency works can be undertaken at all times, including pre and post construction. - Transpower requires suitable vehicle access is maintained as part of the solar farm to the MST-UHT A transmission lines and towers MST-UHT A0192 to 0199. When comparing the proposed location of the solar panels with Transpower's current access through the site to the MST-UHT A National Grid assets, access will potentially be impeded and a new access arrangement will need to be agreed. - The appropriate management of any land disturbance or construction related activities around Transpower's National Grid transmission lines, including support structures, is critical for security of supply to the National Grid and providing for the health and safety of those undertaking the works. Such activities undertaken in proximity to the National Grid must comply with the safe separation distances set out in NZECP34:2001. - Mobile plant and machinery, such as excavators, or cranes, along with the transport of oversized loads, have the potential to reach up to, or above, the height of the conductors. In Transpower's experience, mobile plant and other vehicles working in proximity to transmission lines pose a real and significant risk (safety of those operating the machinery and those in the vicinity, damage to the machinery or lines, impact on the operation of the line). It is essential that the use and location of this machinery is carefully considered to avoid contact with the conductors. - In order to maintain a 4 metres clearance from the transmission lines at all times, mobile plant operating within 12 m of the MST-UHT A National Grid transmission line is limited to a maximum height of 2.1	any subsequent revision of the code. Access a. All buildings, structures and vegetation must be located to ensure vehicle access is maintained to the MST-UHT A National Grid transmission lines, and support structures MST-UHT-A0192 to 0199, for maintenance at all reasonable times, and emergency works at all times. *Advice Note:* *Transpower NZ Ltd has a right to access its existing assets under s23 of the Electricity Act 1992. Any development on must not preclude or obstruct this right of access. It is an offence under s163D of the Electricity Act 1991 to intentionally obstruct any person in the performance of any duty or in doing any work that the person has the lawful authority*

Submission Point	Theme	Comments	Relief sought
		m, including plant operating at full extension and loads being lifted. - Earth Potential Rise (EPR) is the potential for towers or poles to transfer high voltage and dangerous currents into the ground during a lightning strike or fault on the transmission line. An EPR assessment of the proposed solar farm development will be required given it will be located within 50m of towers MST-UHT-A0192 to 0199. The assessment will identify the EPR risk and determine whether any mitigation measures will be required during the design and construction of the solar farm, which includes all buildings, structures and fences. Transpower will obtain an EPR assessment and liaise with the applicant in this regard.	*to so under s23 of the Electricity Act 1992.* *Mobile Plant* a. All machinery and mobile plant operated in association with the works shall maintain a minimum clearance distance of 4 metres from the live overhead conductors (wires) of the MST-UHT A National grid transmission lines at all times to avoid the potential of machinery striking the lines. b. To ensure safe separations distances to the conductors (wires) of the National Grid transmission lines are maintained, all machinery, mobile plant and vehicles operating within 12m of the transmission lines, and traversing beneath the lines, shall be limited to a maximum reach height of 2.1m. This includes any loads being lifted or
42.5	Planting/vegetation	- Given the discrepancies in the information provided, Transpower is unable to confirm the maximum height of shelter belt planting on Site at maturity, particularly in proximity to the National Grid. - Sufficient clearance is provided for planting of vegetation of 2.5 m in height along the western boundary of the Site. However, the proposed vegetation shall not be closer to the NGY than the existing rows of vegetation and no vegetation is permitted in the NGY. - Vegetation planted along the eastern boundary of the Site between span MST-UHT-A0198 and 0199 shall not impede access to Transpower's National Grid assets, noting that shelter belt planting is proposed continuously around the eastern site boundary through to Transpower's substation to the east of the Site, including within the NGY. Transpower request that the shelter belt in this area is located so as to maintain vehicle access between Transpower's substation and the National Grid assets.	

Submission Point	Theme	Comments	Relief sought
	Construction effects	- Transpower requests that a Construction Management Plan (CMP) be prepared for the proposed works. This is to ensure that the solar farm works will comply with NZECP34:2001 minimum approach distances (i.e., minimum required distance between wires / conductors and large construction plan), and land disturbance around National Grid support structure is appropriately managed. In addition, the CMP shall outline how any dust generated from land disturbance activities and any stockpiling in proximity to the National Grid is appropriately managed so as not to create any dust hazard or nuisance to the MST-UHT A National Grid transmission lines, including support structures.	transported underneath the line. *Vegetation* a. No trees or vegetation greater than 2m in height shall be proposed within 12 m of the centreline of the MST-UHT A National Grid transmission line, and along the eastern boundary of the Site between span MST-UHT-A0198 and 0199. Transpower recommend to low growing bushy plants such as tussock, flax, hebe and similar, within the NGY, which will not require ongoing maintenance. b. Any proposed new trees or vegetation planted outside of 12 metres either side of the centreline of the transmission line must be setback sufficiently to ensure that trees cannot fall within 4 metres of the transmission lines.

Submission Point	Theme	Comments	Relief sought
			c. All vegetation must comply with the Electricity (Hazards from Trees) Regulations 2003, or any subsequent revision of the regulations. *Construction Management Plan* a. Prior to the commencement of the solar farm works, the consent holder shall prepare and submit to the Council for approval a Construction Management Plan (CMP) to ensure the protection of the MST – UHT A National Grid transmission lines and support structures. The CMP must be given to Transpower NZ Ltd for its certification at least 20 working days prior to being submitted to the Council. Note: the CMP should be sent to Transpower via PATAI Form 5:

Submission Point	Theme	Comments	Relief sought
			https://transpower.patai.co.nz/new-enquiry b. The CMP must include the following (but is not limited to): 1. The name, experience and qualifications of the person/s nominated by the consent holder to supervise the implementation of, and adherence to, the CMP. 2. Construction drawings, plans, procedures, methods and measures to demonstrate that all construction activities undertaken on the site will meet the safe distances within the New Zealand Electrical Code of Practice for Electrical Safe Distances 2001 (NZECP 34: 2001) or any subsequent revision of the code; including (but not limited to) those relating to: i. Excavation and Construction near Towers (Section 2);

Submission Point	Theme	Comments	Relief sought
			ii. Building to conductor clearances (Section 3); iii. Ground to conductor clearances (Section 4); iv. Mobile Plant to conductor clearances (Section 5); and v. People to conductor clearances (Section 9). 3. Details of any areas that are “out of bounds” during construction and/or areas within which additional management measures are required, such as fencing off, entry and exit hurdles, maximum height limits, or where a safety observer may be required (a safety observer will be at the consent holder’s cost. 4. Demonstrate how the existing transmission lines and support structures will remain accessible during and

Submission Point	Theme	Comments	Relief sought
			after construction activities; 5. Demonstrate how the effects of dust (including any other material potentially resulting from construction activities able to cause material damage beyond normal wear and tear) on the transmission lines will be managed; 6. Demonstrate how changes to the drainage patterns, runoff characteristics and stormwater will avoid adverse effects on the foundations of any support structure; 7. Demonstrate how construction activities that could result in ground vibrations and/or ground instability will be managed to avoid causing damage to the transmission lines, including support structures. 8. Details of proposed contractor training for

Submission Point	Theme	Comments	Relief sought
			those working near the transmission lines. c. All activities are to be undertaken in accordance with the approved CMP.
43.1	Environmental Impacts	- Concerns regarding the impact of electromagnetic fields on insect and human life on surrounding properties. - Potential risk of improper disposal of panels upon decommissioning. - Concerned that there will be large environmental impacts of this proposal, but is being disguised as greenwashing. - Concerns that the site will be listed as HAIL. - Rare Earths used to make the panels, have an environmental impact on source country (China and Africa). - Contamination from washing panels and the source of water.	Decline the consent
43.2	Amenity/character	- Loss of sight of the ranges and sunsets on the western side. - Visual simulations and virtual views do not take into account the effect on surrounding properties and neighbours experience of the environment. - Neighbouring properties planted fast-growing shelterbelts to dampen the extremes of wind and rainfall and to encourage the establishment of production trees and plants. They are planned to be cut down in ~2 years. - Concerns that the views from One Tree Hill in Featherston and Mount Dick in Carterton will be ruined by solar panels.	
43.3	District Plan	- SWDC should consider the precedent this proposal is setting, with future solar farms coming to the district.	

Submission Point	Theme	Comments	Relief sought
		- The proposal has been expanded since the first application, resulting in more impact on surrounding properties. - Applicant should provide additional information on the size of substations and inverters and the other properties assessed for the site. - Concerns that batteries or additional access points will be added to the site post granting the proposed activity. - Permitted Baseline example of JR's orchard is not comparable to the proposed solar farm.	
43.4	Location/scale of proposal	- Neighbours will be working within 20 metres of the proposed panels. - Property owners are responsible for the upkeep of Pharazyns Road, and over the last 25 years have seen an increase in use by bigger machinery and number of cattle. This has already had an impact on the upkeep of the road, and are concerned that the proposal will put further demands on it. - Solar energy cannot be stored as well as other forms of energy and cannot be piped to other countries, so important to consider the most appropriate site for this development.	
43.5	Recreation/Tourism	- Visitors are attracted to stay at neighbouring properties due to the healthy vibes and nature.	
43.6	Operational effects	- Concerns regarding noise from the solar farm impacting surrounding properties. The north-east wind comes through the solar farm and creates an echo over neighbours. Questions whether the panels will be blown into surrounding properties. - Moroa Road is not sealed and will result in dust impacting neighbours. - Risk of glare impacting road safety.	

Submission Point	Theme	Comments	Relief sought
43.7	Mapping	- Inconsistencies with where the application describes the inverters being, and where the map shows them located (e.g. centrally/along the site boundary).	
43.8	Health	- Concerns for the health of the people who live in the vicinity of the proposal.	
43.9	Fire/natural hazards	- Fires in electrical equipment creates risks that current firefighters may not be equipped to deal with. - Concerns over who will be responsible for clearing up the solar farm and surrounding areas in the event of a fire or natural hazard.	
43.10	Policy/Environmental Standards	- The NPS-REG 2011 does not mention large scale solar farms, only PV systems for rooftops.	
43.11	Economic	- Concerns for the impact this proposal will have on the property values of neighbours.	
44.1	Amenity/character	- Concern that the "glimpse views" 500-700m from SH2 referenced in the applicant's landscaping assessment are not appropriately mitigated. Specifically, the landscaping plan prepared by Aquila Capital indicates the Shelter Belt planting along the periphery of the north and north-eastern boundaries of the site proposed to consist of 0.6m tall Cryptomeria Japonica planting.	Grant consent with conditions a. Ensure that any glint/glare effects on the state highway network are appropriately mitigated. b. Extension of the 2m high screening vegetation of the north and north-eastern boundary of 'PLOT 3' identified on the applicant's landscaping plan, replacing the proposed 0.6m high shelter belts. c. Include appropriate conditions for the appropriate
44.2	Operational effects	- With the height of the planting currently proposed, the proposed solar farm may give rise to glint and glare effects which could result in dazzling effects that may affect road-users capacity to focus on the road environment. This would potential be dangerous to both northbound and southbound traffic utilising SH2.	
44.3	Planting/vegetation	- The expertise of a lighting assessor was sought to comment on any potential adverse effects which may arise from the proposed solar farm, who noted in areas within 500-600m of SH2 "appropriate planting should be implemented to eliminate any possibility of glint/glare". In this case an extension of the 2m high planting along the north and north-eastern boundary of 'PLOT 3' would	

Submission Point	Theme	Comments	Relief sought
		adequately mitigate any glint/glare effects resulting from this proposal. - Supports the inclusion of conditions ensuring the proposed screening vegetation is appropriately maintained and monitored supporting the planting to reach and retain the height and depth proposed within the application.	maintenance and monitoring of the proposed screening vegetation to ensure the planting reaches and maintains the height and maturity required to address the potential risk of glint and glare effects.
45.1	District Plan	- SWDC should consider the precedent this proposal is setting, with future solar farms coming to the district.	Decline the consent
45.2	Environmental Impact	- Important to strike a balance between renewable energy production and preserving the natural ecosystem. - Potential loss of biodiversity.	
45.3	Amenity/character	- Concerns regarding loss of the character of the area with the development of a solar farm. - Power infrastructure, transmission lines, and substations could detract from the aesthetics of the community.	
45.4	Rural productivity	- Loss of large areas of valuable agricultural land. Preserve agricultural resources to maintain food security and support the local economy.	
45.5	Construction effects	- Impact on surrounding residents by construction activities, noise pollution, increased traffic, visual disruption.	
45.6	Operational effects	- Impact of glare on surrounding neighbours.	
45.7	Economic	- Concerns regarding the impact on property values.	
46.1	Location/scale of proposal	- SWDC should seek clarification on the number of substations, the height of the solar arrays, spacing between rows, total height of foundation piles, and setback from water races due to inconsistencies throughout the application.	Decline the consent

Submission Point	Theme	Comments	Relief sought
		- The proposed site makes the development cheaper for the company at the expense of the community. - Concerns regarding the impact on neighbouring properties cell phone reception and internet.	
46.2	Operational effects	- Concerns regarding the use of insecticide, herbicides, grazing, cropping, the volume of water used to wash panels, increase of dust from traffic, disposal of damaged panels, and end of life disposal. - Removal of tall trees for the panels increases the risk of lightning strike and the application does not address whether a lightning rod will be erected. - Consistent low level noise annoyance will be an issue for neighbouring residents and tourists. - Glare from the panels can be an issue for aircraft and hot air balloons operating in the area. Anti-reflective coating can also erode and enter into the ground-water. - Risk of too much electrical load overloading the system, with other solar farms being consented. - Concerns about electromagnetic radiation.	
46.3	District Plan	- The proposal is not primary production, which the land zoning provides for. - Concerns regarding the gross floor area of the panels and non-compliance of unsealed road setbacks, which results in huge effects. - The proposal is not consistent with Part 2 of the RMA. - If batteries are added to the proposal after consent is granted this would create a HAIL site on the property. Not suitable for rural zoned land with neighbouring houses. - Does not meet the objectives and policies of the District Plan.	
46.4	Stormwater	- Concerns for the protection of groundwater and the aquifer which is used by all neighbours in the area from contaminants.	

Submission Point	Theme	Comments	Relief sought
46.5	Construction effects	- Concerns that the entrances from Moroa Road cannot provide for large trucks delivering loads frequently. - Concerns regarding construction noise and vibration disturbing residents. Vibrations could also disturb iron particles in the aquifer, raising levels in drinking water.	
46.6	Economic	- Renewable electricity is not being produced to meet the demand of South Wairarapa. Little evidence of positive economic or social effects from the proposal. - Impact on the land values of neighbouring properties. - Concerns that the land in surrounding areas will become unaffordable for local farmers.	
46.7	Amenity/character	- The feeling of openness and expansivity is what brings people to the area. - The application is unclear as to what height the hedges will be kept, and trees can die so there is no assurance that it will screen the proposed development. - Screening blocks the views to the plains, mountains, and hillsides. - Japanese Cedar does not mitigate the visual impacts.	
46.8	Rural productivity	- Land will be impacted by the installation of solar panels, lack of sunlight, and increased heat, affecting productivity. Should aim to protect soils for future generations. - Site cannot be effectively used for cropping/grazing while panels are in place – cropping will shade the panels and sheep could damage them. - The proposed activity is not consistent with other activities taking place in the rural zone.	
46.9	Policy/Environmental Standards	- This application does not support the Government's 2050 vision for energy and industry.	
46.10	Fire/natural hazards	- Increased risk of fire due to heat radiated from the panels. - Currently there is a volunteer fire brigade. Questioned whether the application would better resource fire	

Submission Point	Theme	Comments	Relief sought
		brigade to combat emergency situations as a result of the solar farm.	
46.11	Environmental Impacts	- Removal of wind breaks will increase speeds through the area, possibility of wind tunnels and turbulence. - Mature trees will be felled which birds use for nesting (Moreporks, pukeko, etc.). Should preserve this habitat. - Concerns for end of life, disposal of panels and how this will be sustainable. - Concerns regarding the impact of the solar farm during a natural disaster.	
46.12	Health	- Proposal is impacting negatively on the mental health of those who live in South Wairarapa (stress, insecurity).	

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

1

Submitter

Name	Abe Southey
Contact Person (If different from above)	
Postal Address	125 Battersea Rd Greytown
Home Phone	[redacted]
Cell Phone	
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far north solar farms
Address of Proposal	415 Moroa rd, Greytown 312 Bidwills Cutting rd, Greytown
Application No.	
Description of Proposal (use additional pages if required)	175-megawatt solar farms.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name Abe Southey

Date 06/06/2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

2

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Adrienne nunns

Contact Person:

(if different from above)

Postal Address: 44 Bidwills Cutting Rd, RD 1, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solaar Farm Ltd

Address of Proposal: 415 Moroa Rd, Greytown

Application No. 220103

Description of Proposal: 235Ha Solar Power Plant

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

x	Yes		No

x	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

I am opposed to the Far North proposal for a solar 'energy generation facility' due to;

- the adverse impacts it will have on the region and it's people
- the contradictory nature of the Application and Environmental Impact Assessment
- the Planning Manager's use and interpretation of the Operative Combined District Plan.

The openness and expansiveness of the landscape makes this region an outstanding natural feature, therefore it should not be disturbed, altered, or modified. Many of the trees are notable and add to the beauty of the landscape, due to their age and size giving them historic and heritage value.

This proposal is for an intensive 'energy generation facility', and the use of the word 'farm' is disingenuous. The Oxford dictionary defines farm as - an area of land and the buildings on it, used for growing crops and/or keeping animals

The site in question is classified for Rural Primary Production and has Lifestyle blocks dispersed throughout situated on the southern edge of Greytown enhancing and drawing people to the region to live, holiday and visit, in their pursuit of getting back to nature, going on scenic drives, unwinding, wining and dining, living the dream, and the prospect of a better life with lots of fresh air and open spaces, where you can have large gardens, fresh fruit and veges, and meat grown locally or by oneself.

The nature and scale of this proposal is not relatively large, it is **huge** (321,160 panels, installed on over 10,000 tables, over the majority of the 235ha site, together with 33 (or up to 40) inverters). Using comparisons to wind turbines or glasshouses is irrelevant and misleading, and the suggestion that the impact would be less than a minor adverse effect on the landscape and visual amenity effects, and that there values and the natural character will be maintained is an absolute untruth.

The proposal would introduce a new type of land use to the Wairarapa and could no longer be classed as Rural Primary Production.

This proposal has already had a major impact on the mental and emotional wellbeing of the site's surrounding property owners. As a qualified social worker

who operates as a therapist, I have interviewed a number of the residents in regard to the proposed development/s, and noted that we all share a sense of foreboding, uncertainty about wanting to remain here – even though most of us thought we had found 'our whenua,' fear of our properties losing their desirability (resulting in property values decreasing) as none of us would intentionally purchase a 'rural' property next to a solar facility. Some of the residents feel tramped, and there is a reduction in our enjoyment of properties and the reconsideration of further investment and development as it maybe a case of spending good money after bad.

Unfortunately, the Operative Combined District Plan (Plan) is antiquated as far as solar generating facilities go as they were only a distant possibility of an unknown scale and nature when it was written. But we must be true to the spirit of the Plan and consider the intention and vision in which it was inscribed. To discount rule 21.1.24 in relation to Network Utilities and Energy Generation Activities because it only relates to existing facilities and not 'new' energy generation facilities – is not adhering to the intention of the Plan but a see-through loophole.

The Plan, in discussion of General Amenity Values is to maintain and enhance those general amenity values which make the Wairarapa a pleasant place in which to live and work or visit. It would be a 'failure' in the management of activities (in accordance with the qualities of this rural environmental zone) to grant consent as the visual effects will have unacceptable negative impacts on the amenity values. The activities, density of the structures and buildings are "out-of scale, and out-of-character" and would introduce a new type of land use.

The assessment by Landscape Architect Ms Emma McRae is contradictory (conflict of interest), Ms McRae states that the impacts will be low due to mitigation of long lines of hedges (Japanese cedars – not even natives! What height will the hedge be trimmed to?) but then states that they will take away the open pastoral vistas and the landscape would be dominated by hectares of structures, 4.5mtrs - Ms McRae also refers to these as low in height – but 4.5mtrs is the average height of a single level dwelling!

Though the land capability only has class 4 soil I argue that the land can easily be made highly productive – due to it being flat, with good natural irrigation, rainfall and sunshine hours so therefore the proposal would have significant limitation for arable use or cultivation.

Stormwater diversion and discharge effects – regular flooding of site proposed – how is this not considered a natural hazard?

Negative construction effects

- Noise
- Dust
- Volumes of large vehicles – impact on roads
- Reduced revenue to local business due to people staying away

During construction the benefits that may be derived to the economy by the labourers would be overridden by the negative impacts due to noise, dust and traffic – this will make Greytown less desirable for visitors, or to move here. Greytown is a tourist town and Wellington's weekender, this will adversely effect the viability and vitality of the area.

Negative operational effects

- Noise – what is it to be 45dBA, 55dBA or 75dBA?
- impact of glare
- What substances will be used for maintenance and cleaning
- What would be used to keep the panels clear from insects, pests and vegetation
- how will the structures be disposed of at the end of the lease
- negative impacts to the environment by electromagnetic radiation
- will it be classed as a HAIL activity due to soil and underground water contamination

Impacts of Electromagnetic radiation are a real concern and I believe very underestimated – the last three occupants of the house next to the substation have died from cancer. This proposal has a plan to increase the size of the substation plus there up to 40 inverters – how far reaching will this electromagnetic radiation be? The proposal has reverse sensitivity but to what level of impact on the neighbouring and surrounding properties, and rural primary production.

What is or would be, the market for any animal raised on the property, it is debatable if grazing (or cropping) is viable, preliminary findings do not suggest so!

Greytown would be less desirable for visitors, or to move here adversely effecting the viability and vitality of the area as it would lose it's 'country charm'. The local

economy would suffer as the rural landscape is one of the major reasons that Greytown is a tourist town and Wellington's weekender.

In summary it is very concerning that 'big Government' and 'big business' have such a strong influence over local council rather than the rate payers who have moved here for the rural lifestyle – the flavour that entertaining these proposals has brough is bitter and has caused unnecessary suffering. I have solar panels and support the use of them but not on this scale in a rural setting. What about investing in bioenergy from sewage water – this production has negative carbon emissions and the site is already in areas acceptable to their communities.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	x	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Adrienne Nunns

Date: 6/6/23

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

3

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: AINSLEY KELLY

Contact Person:

(if different from above)

Postal Address: 97 Settlement Road, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Ltd

Address of Proposal: 415 Moroa Road, Greytown

Application No. RC220103

Description of Proposal: Development of a large solar farm in Greytown, South Wairarapa

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	Yes		No

X	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

3

The specific parts of the Proposal that this submission relates to.

Site Location and Description

- Unsuitable site due to proximity to housing, its industrial scale and activity being incongruent with rural zone planning and district plan objectives and protections.
- Mitigations to block views into the site with hedgerows, significantly changes the existing character described in the application as 'a feeling of openness and expansivity'.
- The activity proposed of electrical and electronic works, power generation and transmission are likely to cause a large section of land to become a new HAIL site.
- The area at times experiences a high water table and flooding. This significant development and the nature of materials used greatly increases the likelihood of site contaminants from site activity entering waterways.

Storm Water

- Run off issues. The panels represent a very very large roof – or series of. Current building regulations require buildings to have drainage plans and soak pits for which there is not provision for this development. At times, surface water is a considerable issue in the area and would affect access and safety due to water and electrical systems mixing.

Vehicular Access

- Increased vehicle movements on the unsealed, narrow and poorly maintained Moroa road will be disruptive to residents using the road, degrade it further, increase dust (which can be significant for some homes nearby) and be hazardous for other road users including cyclists, runners, horse riders who frequently use it.

Operational Activities

- Only 2 full time roles are created. Offshore investors take earnings offshore, power generated goes to Auckland (via National Grid) and locals and council pay for and live with the impacts of the development. It's an unacceptable price to pay.

Consideration of Alternatives

- The environmental impacts of this development on people, water, wildlife, air, amenity, land values and existing infrastructure are grossly understated in the application and alternatives in the area do not appear to have been documented – except to say FNSL have looked at various options all around NZ. The economic value of this development for shareholders is what drives it to apply for the easiest low-cost option available rather than other viable and less impactful alternatives. The application deliberately understates the impacts.

Wairarapa Combined District Plan

- The activity is not required for primary production and residential purposes and solar panels combined exceed 25m2 in gross floor area.
- The solar panels do not meet the relevant setback requirements for unsealed roads under standard 4.5.2 (c) (ii).
- Dust is an issue along this road and no explanation has been explained as to how FNSL plan to mitigate or cannot comply with the existing rules. One can only assume they cannot meet this standard as they need the available land in order to meet their

generation targets / viability of the business. No compensation should be provided if this is the reason for not being able to comply.

Effects on the Environment

- The solar farm will not specifically provide renewable electricity to meet the demands of South Wairarapa district. I see little evidence that positive economic or social benefits will be derived from this development for South Wairarapa or Wellington. These claims need to be backed by an independent benefits analysis detailing the actual economic and social benefits to the region and compared against the benefits gained from the site remaining for use as farmland.

Landscape and Visual Effects

- The development significantly changes the existing natural character and the experience of this character for residents and visitors alike. Large scale industrial development covering hundreds of hectares of otherwise open land is a more than minor change to the landscape. As such, a development on this scale can only deplete the existing perceived value of this landscape.

Natural Character Effects

- Quote from application *"The site and its surroundings have been significantly modified in respect to its vegetation cover and therefore the proposed solar farm will result in limited changes to the natural character of the site".* Development of this site has remained open farming for over a century. Historically the area would have been wooded in lowland forest. To imply that it has been significantly modified since lowland forests where present (centuries ago) is correct, however our experience of the site for the last century has been open farmland and remained this way since. Open farmland is part of the natural character and part of our identity and history of this area. Our district plan specifically acknowledges this value and actively seeks to protect it. Supporting this application would be choosing to ignore the principles the Combined District Plan (developed in consultation by the residents of Wairarapa) seeks to protect.

- Planting hedgerows close to boundaries to screen out unsightly views of large scale industrial developments also blocks existing views and closes in the otherwise open and expansive feeling of the area. In some cases, distant views of ridgelines (of significant value) will also be lost from hedgerows close to boundaries.

- There are no detailed planting plans in the application or suggested provision to ensure these are maintained. The site is a challenging planting site due to strong winds and low horizons that facilitate a high a number of sun hours. Most plants take a lot of effort and care to get established. Under an el-nino pattern (predicted to arrive and last for the next few years) these negative growing environmental factors are heightened. Time for planting to be established and the ongoing professional management, irrigation and husbandry of these plantings to be successful is not adequately addressed in this application. If planting targets fail to reach anticipated levels what recourse do residents have for extra years of looking into an industrial power generation site or what penalties will be enforced on developers post approval.

- In my view calling this a Solar Farm is incorrect, as per the English dictionary 'an area of land and its buildings, used for growing crops and rearing animals.'

- South Wairarapa is a fast growing tourism area – praised for its open spaces, views, rural country aspect, Tourism in New Zealand is a bit part of our economy – this industrial site is detrimental to what SW is trying to achieve.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name: Ainsley Kelly

Date: 05/06/2023

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

4

Submitter

Name	Andrew Heaton
Contact Person (If different from above)	
Postal Address	62b Cross Line, RD1, Greytown
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Limited
Address of Proposal	415 Moroa Road, Greytown
Application No.	220103
Description of Proposal (use additional pages if required)	235Ja Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

SOUTH WAIRARAPA DISTRICT COUNCIL

4

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Andrew Heaton

Date 6/6/23

Important notes for the Submitter

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4

SUBMISSSION ON PUBLICLY NOTIFIED APPLICATION

FOR RESOURCE CONSENT BY FAR NORTH

TO:

South Wairarapa District Council

SUBMITTER:

Andrew Heaton, 62b Cross Line, RD1, Greytown

Ph: [redacted]

Email: [redacted]

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991

Date: 6 June 2023

DETAILS OF THE PROPOSAL TO WHICH THIS SUBMISSION RELATES:

Name of Applicant:	Far North Solar Farm Ltd.
Address of proposal:	415 Moroa Road, Greytown
Application Number:	220103
Description of proposal:	235Ja Solar Power Plant

Details of submission: This submission opposes the whole proposal

In the event this application is subject to a Resource Consent Hearing, I wish to be heard in respect of my submission if others make a similar submission I will consider presenting a joint case with them at the hearing.

Submission Statement:

Decision I want the council to make: decline the entire consent application:

Submission:

The proposal if accepted will see the installation of an industrial solar power plant over a vast area of prime rural land, approximately 235 hectares.

This proposal is not in keeping with the established rural amenity and character of the region and the density of the structures that will be erected will dominate the landscape.

The risks that an industrial power plant of this size present to the neighbouring residents and community are significant. These risks include (but are not limited to) the following:

- Risk of fire (in the event of a fire is the local Fire Service prepared and able to respond?)
- Risks and threats posed to flora and fauna of the region
- Risks posed to the environment from the erected structures as a result of earthquakes, flooding and other natural disasters
- Risks of contamination to water and soil

There are no New Zealand standards established for the implementation and ongoing maintenance and operation of an industrial solar power plant. Globally there are countries that have implemented standards which include minimal set-backs from bordering properties. For example in the United States an industrial solar power plant is defined as a plant that is larger than 20 megawatts, and for these plants, there is a minimum set back of 200 metres from adjacent properties.

The Far North application is silent on risk mitigation for any of the risks outlined above. In my view these risks should be assessed and appropriate mitigations and insurances should be provided to satisfy both the Council and the community. In the absence of the guarantees from the Far North to fully mitigate and/or insure against these risks I respectfully request that the current application is rejected.

Sincerely,

Andrew Heaton.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

5

Submitter

Name	Anna Whitehead
Contact Person (If different from above)	
Postal Address	169 Underhill Road, RD1 Greytown 5794.
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	415 Moroa Road, Greytown
Application No.	220103
Description of Proposal (use additional pages if required)	Solar farm in rural area

Details of Submission

My submission:

- [x] Supports the whole proposal
- [ ] Supports part of the proposal
- [ ] Opposes the whole proposal
- [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- [x] Yes
- [ ] No

- [ ] If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

5

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

I support the establishment of a solar farm in the Wairarapa for the benefit of Wairarapa residents and the wider regional and national population via desirable sustainability goals for renewable energy. Unlike wind energy farms, solar farms are quiet and once screening planting is done the visual change from green field to solar farm is not intrusive. I do not live close to the proposed site however, but as the site is flat I can't imagine it will be an issue for nearby residents. I would in fact welcome something like this on flat land near where I live. It is preferable to use the land in this way than to create rural subdivisions, which introduce cars and noise into the rural locality. I urge SWDC to consent this proposal on the grounds of contributing to the national need for renewable energy, clean and green, which the SWDC could be proud to boast about that our region has something like this.
I would like to see there be some kind of public access to the site for educational purposes to teach our young people about the importance of renewable energy, and to give their enquiring minds the scientific and environmental information about how it is of benefit to the country longterm.

Decision you want the Council to make:

☑ Grant the Consent ☐ Decline the Consent ☐ Grant the Consent with Conditions

This is a very worthwhile proposal and I hope it is given consent.

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name Anna Whitehead

Date 5/26/23

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

SOUTH WAIRARAPA DISTRICT COUNCIL

6

Submitter

Name	Anne McGee.
Contact Person (If different from above)	\
Postal Address	64 Cross line RD1 Greytown.
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far north Solar farms
Address of Proposal	Williamson Water. Land advisory 101 Putaki Dr, Kumeu 0841
Application No.	220103
Description of Proposal	proposal for a 235Ha Solar power plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☒ Opposes the whole proposal
- ☐ Supports part of the proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☒ Yes ☐ No
- ☒ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

SOUTH WAIRARAPA DISTRICT COUNCIL

6

Submission Statement

The specific parts of the Proposal that this submission relates to. as attached.

Decision you want the Council to make:

☐ Grant the Consent ☒ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name

Date 3.6.2023

Important notes for the Submitter

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Far North Solar Farm

The experimental status of this solar power station coincides with the paucity of ordnances determining the distance such generators must be from habitations, communities and major arterial routes.

The proposals of the generation site developer indicate a proximity to all these and it is this proximity that by definition incurs dangers for inhabitants and users.

This uncertainty means that on these grounds I must register my objection to this scheme.

At the same time I must register my objection on grounds of pollution.

This applies to the as-yet unspecified chemicals that compose the plant and to maintenance procedures.

These are scheduled to be in proximity to water systems for both humans and livestock.

I also object on grounds of this temporary generation project and its substantial acreage being vulnerable to the government's own forecast of weather extremes due to climate change.

The Wairarapa's vulnerability to earthquakes also requires deeper study in relation to this dispersed industrialisation.

The fire risk propensity also requires a more substantial analysis.

As a state registered nurse deployed into accident and emergency my observation is that any such rapid industrialisation of a hitherto pastoral environment brings with it uncharted hazards.

I want to put on record that the longer term guarantees concerning the proprietorship of these structures has yet to be explained and particularly so in regard to the responsibility for these structures should the original sponsors and proprietors no longer be in a situation in which they can maintain and or remove them.

Anne McGee

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

7

Submitter

Name	Avis Stanley
Contact Person (If different from above)	
Postal Address	38 Hollis Road, Paraparaumu
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Limited
Address of Proposal	415 Morra Road, Greytown
Application No.	RM220103
Description of Proposal	235Ha Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☒ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☒ No

☒ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

7

Submission Statement

The specific parts of the Proposal that this submission relates to.

As a frequent visitor to Greytown and staying in Bidwells Cutting my opposition to the proposal is based on the environmental impact that such an industrial activity would have on the surrounding rural area.

The area is currently a productive rural landscape and in granting this consent would be the detriment to the village and would not provide any benefit to the locals or visitors.

Decision you want the Council to make:

☐ Grant the Consent ☒ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Avis Stanley (Electronic Signature) 5th June 2023.

Name

Date

Important notes for the Submitter

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3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tatau

8

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Ben Burger LLM LLB BHRM DipHort

Contact Person:

(if different from above)

Postal Address: 84 Battersea Road

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm

Address of Proposal:

Application No.

Description of Proposal: Greytown Solar Farm

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing, Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

x	Yes	No

	If others make a similar submission I will consider presenting a joint case with them at the hearing

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

8

Submission Statement

The specific parts of the Proposal that this submission relates to.

1. The applicant has only consulted with the Iwi and Fire/Emergency NZ therefore - considering the impact of the proposed solar farm - the consultation process followed by the applicant has been inadequate. I invite the applicant to consult with me directly.

2. I refer to the Tauhei Solar Farm decision for the assessment of the effects of a solar farm. The applicant's assessment is lacking details and is insufficient.

3. Contrary to what the applicant tries to argue, the proposed solar farm will result in significant changes to the natural character of the site.

4. 321,160 solar panels with a height of 4.5 meter, Inventers, lines and the associated structures will also have a significant effect on our direct living environment.

5. Multiple previous different owners of the house close to the power substation died of cancer. In this context, what is the impact on our health if the capacity of the power station increases?

6. Solar farms take up a significant portion of productive land and next generations will face the problem of disposal of hundred and hundred thousand of panels.

7. We are going to regret the existence of solar farms. Across the whole world, there is a lot of research underway into methods of creating renewable energy and in the not too-distant future we will have long range wireless electricity infrastructures or "power beaming" methods in place. The Council should not be motivated by the policy idea that we need solar farms for our need for renewable electricity. There will be alternatives with less intrusive effects on our living environment.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	x	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

8

Name: RM Burger

Date: 5 June 2023

Important notes for the Submitter

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SUBMISSION ON PUBLICLY NOTIFIED APPLICATION FOR RESOURCE CONSENT BY FAR NORTH

TO

South Wairarapa District Council

SUBMITTER

Danielle Genty-Nott

273C Bidwills Cutting Road, Morison Bush, Greytown 5794

E: [redacted]

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991.

Date 04/06/2023

PROPOSAL TO WHICH THIS SUBMISSION RELATES

Name of applicant; Far North Solar Farm Ltd Address of proposal; 415 Moroa Road, Greytown

Application number; RM220103

Description of Proposal; 235Ha Solar Power Plant Details of submission;

This submission opposes the whole proposal.

In the event this application is subject to Resource Consent Hearing, I do not wish to be heard in person, in respect of my submission.

Decision I want the Council to make; decline the entire consent application.

Submission Statement:

- Soil degradation
- Moroa Road
- Dark Sky
- Plant screening
- Fire

2.

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION FOR RESOURCE CONSENT BY FAR NORTH

04 June 2023

The details of my submission statement are detailed below;

1. **Soil degradation** - I am not convinced that there won't be any degradation of this viable agricultural land due to the erection of the panels, their washing and the "washing" of Moroa Road. I would like to know more from the applicant regarding what they propose to use. I would also like to see the results from a current Massey University study "Massey exploring the potential for combined solar and pastoral farming' which has preliminary results available now/soon to learn of their findings. Dark Sky Status - I am concerned that the addition of security lighting and the expansion of the existing power station (corner Moroa Rd and Bidwills Cutting) alone will adversely affect our recently approved Dark Sky Status - one that will enhance the wider Wairarapa's reputation for visitors to enjoy and generate income for local businesses.

2. **Moroa Road.** This road is already extensively utilised and is constantly in need of repair. With the addition of the applicants' heavy vehicles utilising this road, I would have real concerns that it will be full of potholes on a constant basis. The dust that is thrown up by vehicles currently would also impact on the solar panels which will then require additional washing (no doubt with some chemical) which will further draw from the farmers bore. I propose the applicant pay for Moroa Road to be sealed and maintained for the duration of their lease if the application is successful.

3. **Dark Sky Status** - I am concerned that the potential addition of security lighting and the expansion of the existing power station (corner Moroa Rd and Bidwills Cutting which is already lit up like a Christmas tree) alone will adversely affect our recently approved Dark Sky status - one that will enhance the wider Wairarapa's reputation and draw visitors to enjoy further generating income for local businesses and which adds value to the community, unlike this proposal.

4. **Plant Screening**
   It is disheartening to see the use of Japanese Cedar (albeit in existence) rather than native trees. That said, my main concerns are:
   a) The length of time it will take for the trees to mature to full height and what they will be topped off at. 1m a year means many years of staring at these panels in what is currently a beautiful farm setting.
   b) Drawing water from the farmers existing bore. There are many trees proposed which will require considerable water (which many others draw from via the aquifer which is beneath the proposed farm) and should be considered commercial therefore a water meter would be required.

3.

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION FOR RESOURCE CONSENT BY FAR NORTH

04 June 2023

5. **Fire** – we already have an under resourced volunteer fire brigade. Would the applicant (if they are successful) be required to provide (pay) for additional and specific training in the event of a fire and ensure that all local fire brigades have extra equipment to combat any situation that may occur adversely affecting the solar farm and its surrounds – i.e. grass fire, cyclone/tornado, earthquake, vehicular crash through their boundaries in to panels etc.

I do not feel the applicant has met the objectives and policies of our District Plan, nor those of the RMA. I do not feel this proposal benefits the wider community in any way and don't see any evidence to suggest otherwise. I have no issue at all with the landowners looking at ways to earn money and my opposition is not to them, but to Far North Ltd and the very many outstanding aspects not met within their proposal in relation to our District Plan alone. I am aware of many submissions opposing this application that are far more detailed in their opposition (in particular, I refer to Elizabeth Creevy's submission which is very thorough) and look to our Council to oppose this application before it paves the way for a myriad of solar farms stretching throughout the Wairarapa. This is not what we bought in to when settling here and is not why visitors come to our region, and I worry the impact of these solar farms will have an adverse effect on our region and communities. As such, **I oppose this application.**

Yours sincerely

[redacted]

Danielle Genty-Nott

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

10

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Davida McDonald

Contact Person:

(if different from above)

Postal Address: 56 Settlement Road RD1 Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: 10/1 Putaki Drive Kumeu 0841

Application No. WWLA0589 (proposer reference)

Description of Proposal:

Installation of a solar installation on 350ha of land adjacent to SH2/Bidwells Cutting Road/Moroa Road

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	Yes		No

X	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

My objection relates to the complete proposal for a number of reasons.

Summary: The solar commercial installation in our rural environment will have a significant impact on the amenities of our property due to:

- Visual impact
- Noise pollution
- Light pollution
- Heat island effect
- Enjoyment of my environment and lifestyle
- Value of my property.

For this and the following reasons, I object to the proposal.

Consultation or the lack:

- The proposer has not provided adequate consultation with affected neighbours – indeed, not all neighbours were advised directly by the proposer (my own nearest neighbour learned indirectly).
- The 'consultation' was a single visit – unscheduled, without warning or opportunity for householder preparation – by a representative of the proposer. This appears to be nothing more than a 'tick-box' activity of consultation (it was more like being lectured by a rude and arrogant chauvinist). Doorstep intimidation does not mean community engagement was sought.
- Neighbours of the proposed site who did receive a direct advisory visit were not given any detailed information – a single leaflet with a poor quality picture is not adequate. When I asked, I was told to buy a copy of the proposal. A courtesy copy would not be provided by the proposer; there was not even an online site advised at that point (nor has there been to date).
  When the proposed installation is an intensive industrial site, set in a greenfield rural environment with significant numbers of lifestyle dwellings, this deliberate withholding of information appears to be a considered, tactical block to community engagement.
- Consultation in normal commercial situations by major companies is formalised, there are scheduled meetings, times for these meetings are agreed and information is provided – it is not a cowboy arrangement of 'tell the neighbours' without any information provision, as experienced by myself.
- The formal description of 'neighbours' by the proposer is farcical – by using road addresses rather than physical proximity the proposer appears to be trying to understate the potential impact on affected properties. With long rural driveways, paper roads and other such accessways, physical proximity and numbers of affected neighbours are far greater than a road address would imply.
- Disingenuous wording; This installation is not a "farm". It is being sited in a farming/ lifestyle environment on high grade flat, arable land (another 'summer' like the last two and cropping using rainfall alone as a water source is well within possibility). There are already concerns in some areas that NZ's cropping land is being built out by housing and, it would appear, by industrial activity.
- The proposer's representative did not have a single firm story to tell. Comparison of what was said with neighbours showed a variety of explanations – what I was told would be a 'deer fence' (very open mesh) was described as 'hurricane fencing' (like in a commercial security fence) to another neighbour. Suggested 'amenity' (read, view blocking) plantings ranged from cheap nasty pines or macrocarpa to slow growing natives that would only be a visual barrier in 50 or 60 years. Likewise, the immediacy of any noise pollution was a variable from one telling to the next.
- Again, please note. This is not a farm. It is a commercial, industrial use of farmland. Being on a farm does not make it farming, any more than parking my ute in front of the Aston Martin franchise make that ute into a supercar.

Impact on existing properties, including my own.

- Density of existing properties with family dwellings. There are at least twelve (12) immediate adjacent neighbours, sited on the boundary or directly across the road from this commercial installation. There are at least another ten (10) within close proximity, and soon there will be more as subdivisions at the Featherston end of Morora Road are ongoing.
  My bedroom is within 53m of the back boundary of the proposed site.
  Other properties still proposed for construction may end up even closer, although when those purchasers bought their sites, they had no way of knowing about this commercial development.
- Increased ambient noise experienced by neighbours.
  The noise will be far higher than what would be expected in a rural environment, and was poorly explained by the proposer's representative. 'The sound of an idling tractor' would be seen as acceptable only by a city boy who has never had to shout over the sound of such a vehicle. (And do you know what is great about idling tractors? They eventually go away or get turned off.)
  The panels will be motorised. The collection towers will be cooled. The representative could provide no details as to the total noise of the installation, but he did mention that it would be louder in summer. Oddly, summer is the season when most people keep their windows open for ventilation.
  The noise pollution of hundreds of unrelenting chugging motors (assuming that multiple stands will have multiple motors, in addition to the cooling motors for the collection towers – this information was not provided) has been shown to have a detrimental effect on health.
  Please note that I moved to the Wairarapa as somewhere rural, peaceful, with pleasant views and a nice lifestyle. I expected rural noises, such as weaning, harvesting (it's seasonal and intermittent, not a relentless 24/7 assault). Having multiple idling tractors running endlessly, right next door, is not an expected rural soundscape.
- Creation of a heat island leading to an increased ambient heat microclimate.
  Overseas, solar installations have been shown to create localised heat islands. In the Wairarapa, where summers are usually hot and people keep windows open for ventilation, a heat island created by an installation 53 metres from my bedroom will have an adverse effect on my enjoyment of my home.
  The creation of a heat island and microclimate is also of concern when fire risk is considered. Again, there was no mention of this by the representative.
- Visually, this installation is unattractive. It requires 4.5metre high stands carrying mirrors, and even taller collection units – these will effectively barricade me from the open rural and mountain view that I built my home to take advantage of.
  I, like many other lifestylers, moved to the Wairarapa to enjoy the views, the rural aspect, a quiet environment and a pleasant lifestyle. A solar installation 53 metres from my bedroom is not xxxx with this.
- Tourist impact – this same visual barrier will line Morora Road and Bidwell's Cutting Road. The tourist route to Martinborough from Greytown will no longer be attractive paddocks with pleasant plantings of trees.
  Plantings and fencing suggested by the proposer's representative sound more like barriers to a view than enhancements to it.
- Light pollution in a Darksky environment is a concern. I enjoy amateur astronomy; any light pollution from this site will be detrimental to my enjoyment of this hobby. Any lighting that detracts from the Darksky environment being advertised by Wairarapa agencies (or indeed, detracts from my enjoyment of my own back yard astronomy) is another degradation of the environment I moved here to enjoy.

Environment:

- Risk of environmental damage –
  - Should the solar panels be damaged and leak, or break up and waste be deposited in the soil/ environment

  - In case of fire (fires are a real and present danger in dry summers)
  - From any liquids used to wash the panels, in the case of dust degradation (Moroa Road is gravel and deposits dust on my windows from a considerable distance away)
- Fire risk. As noted under the concerns about a heat island, this installation will create a new fire environment. Solar panels and the collectors (electrical transformers?) will require specialised fire-fighting resources, the cost of which will be borne, I suspect, by ratepayers – thus leading to ratepayers subsidising a degradation of our environment.
  Our firefighters are, for the most part, volunteers.
  Fires in commercial electrical equipment such as transformers (they're filled with toxic, flammable oils) will create risks that our current firefighters may not be equipped to deal with in a way that's safe for them, and for the environment. Smoke from any such fire will be a risk to anyone downwind of a fire.
  New equipment using more polluting foams and other firefighting agents will create further environmental risks (eg, like airport firefighting foam being toxic).
- If the electrical equipment installed by the proposer contains high risk materials such as oils, then the risk of leakage to soil (or penetration of aquifers) will need to be allowed for and the proposer will have to provide protection for the environment.
- Risk to Moroa Water Race or to the various aquifers should any use of specialist cleaning products, etc, be needed to maintain or protect a commercial installation.

Other hidden issues:

- Greenwashing.
  This is being pushed as an 'eco' development, generating 'green' electricity – although the panels are useful for only about 20 years, and the manufacturing and decommissioning is never included in the 'eco' credentials.
- Greenwashing continues with the 'clean energy' story.
  From my understanding, anything within reasonable transmission range of the big hydroelectric systems in the Mainland (South Island) run on that nice renewable energy. New Zealand is already at 95% renewable energy, but coal is imported to run Huntly (for power and to do voltage support to help the clean South Island power get all the way to Auckland), and NZ natural gas is burned at Whiranaki, again, to support the Auckland power demand.
  Generating power in the Wairarapa will not decrease the need to burn fossil fuels to augment Auckland's power supply. To do that, the solar generation would need to be sited near to Auckland.
- Hidden costs may result in all of us paying more for electricity to subsidise this scheme. The infrastructure that the proposer seems to think will be provided has to be paid for by someone, and the representative that turned up at my farm was adamant that Transpower would be paying for any upgrades needed. Those costs would be recovered from consumers, aka, us.
  If it isn't Transpower, I hate to think what impact this could have on rates.
- This proposal will need to be considered in conjunction with the other proposed Wairarapa site. They are immediately adjacent to each other and effectively coat the Western side of Greytown with an endless glass reflective cover.
  Please note that I object to the second installation as well.
- The South Wairarapa District plan is under review. Allowing this industrial activity under a District plan could set a precedent for the region – not just the South Wairarapa, but across New Zealand.

Decision you want the Council to make:

(use X to indicate your choice)

10

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name: Davida McDonal

Date: 6 June 2023

Important notes for the Submitter

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4. A copy of your submission must be sent to both Council and to the applicant.

Dayandra Hettige

459 Bidwills Cutting Road

Morrisons Bush

Greytown 5794

2 June 2023

Subject Far North Solar Submission – Time Extension Etc

I am a member of the SWWAG group. I am a party directly affected by the Proposed Far North Solar Farm. I am very concerned that a massive utility scale power generating plant is being proposed closer to the Greytown city boundary. Most of the information about this venture has been promoted in the local media as benign in nature to the environment. As we now know from overseas experience, third generation photo voltaic cells contains toxic components. These toxic materials have been released into the environment during several major fires overseas. The problems are compounded when these toxic materials are released into aquifers where most of the local residents obtain their drinking water. These consequences become even more serious the closer the power plant is placed to the city boundary. The main reason for this appears to be purely commercial as there is a Grid substation closer to the plant.

I have closely examined the document lodged by Far North Consultants, Assessment of Environmental l Effects Document WWLA0589 Rev 1. This document in many ways is lacking fundamental information about this massive industrial scale power plant.

The landscape assessment visual documentation supplied Far North only denotes the plan view of this mega power plant which is not fit for the purpose what it is supposes to serve. For example, I refer to the 35 – 40 foot container-sized inverters referred in text descriptions relating to the project. Without a contextual 3D rendering of solar panels, inverter stations and other out buildings there is no indication of the shape or contour of this project in relation to the surrounding countryside.

Robert Schofield consultant planner report dated 18 April 2023, signed off by James Witham SWDC on 28 April 2023 has not considered major impact resulting from a catastrophic fire that could emanate from faulty componentry, lightning strikes, scrub fires etc. Such an event will lead to the closure of state highway 2 and Bidwills Cutting Rd, only one could imagine the impact. Attached article titled “Hidden Danger- Why Solar Farm Fire Risks Could Be Greater Than You Think” highlights these concerns.

Taking the fire scenario to another level, the toxic plumes of smoke will trip the Transpower 110 KV line causing power outages with significant restoration time.

Pupils of Kuranui College (800 students) and Greytown School (350 students) will have to be evacuated.

Far North Proposal has no detailed fire mitigation and management plan. At a recent meeting in Greytown, the question of fire management was posed to the Far North Executives. Their answer was they will keep the grass level down. This begs the question how a 15 ton fire truck could be maneuvered in boggy land let alone the specialized fire crews and resources required. This shows the tardiness of the Far North proposal. Therefore, I request a detailed fire mitigation and management plan for Photo Voltaic power generating plant of this magnitude. The proposal to cover skill levels of the resources required and the chemical composition of substances used to put out a major fire.

Due to inadequate levels of information supplied by Far North this effectively puts South Wairarapa District Council rate payers at a serious disadvantage when making an informed submission. In view of this, I request that the time frame for submissions on this project be extended until at least one month after the developer Far North has provided a 3D rendering of its scheme for examination by the South Wairarapa District Council and its ratepayers.

This will enable those in the district to have a true appreciation of the scale of this project.

I also request that the specifications of inverters and the photovoltaic panels to be made public, including specifying the materials that make up this equipment.

In future if storage systems are contemplated, such specifications should be declared, inclusive of substances used in these storage and the systems process.

Only then can any reasonable assessment be made of the impact of these systems on the farmland upon which they are scheduled to be installed.

Anything other than a 3D rendering of the profile of the project in relation to the farmland upon which it is installed is guesswork.

The impact of the systems upon the population and environment remains just a matter of conjecture until precise specifications, plans and renderings are forthcoming from the project company and its consultants.

Far North proposal has no noise emission modelling for the collective plant. This information should be made mandatory.

In New Zealand there is no precedent for a photo voltaic generating plant of this magnitude installed so close to human habitation and on valley floor farmland.

It therefore behooves both the developers and the regulating governmental authorities to ensure that there present a full inventory of the integral structures and processes in order that a true environmental impact can be evaluated by both specialists and lay people.

On a final note there is no plan provided for the end of life recycling of massive number toxic photo voltaic cells and associated electrical plant. **Far North** to provide a Remediation Escrow Agreement. This is mandatory to pay for costs and expenses incurred in connection with remediation of terms in accordance with a mutually agreed work plan.

Yours sincerely,

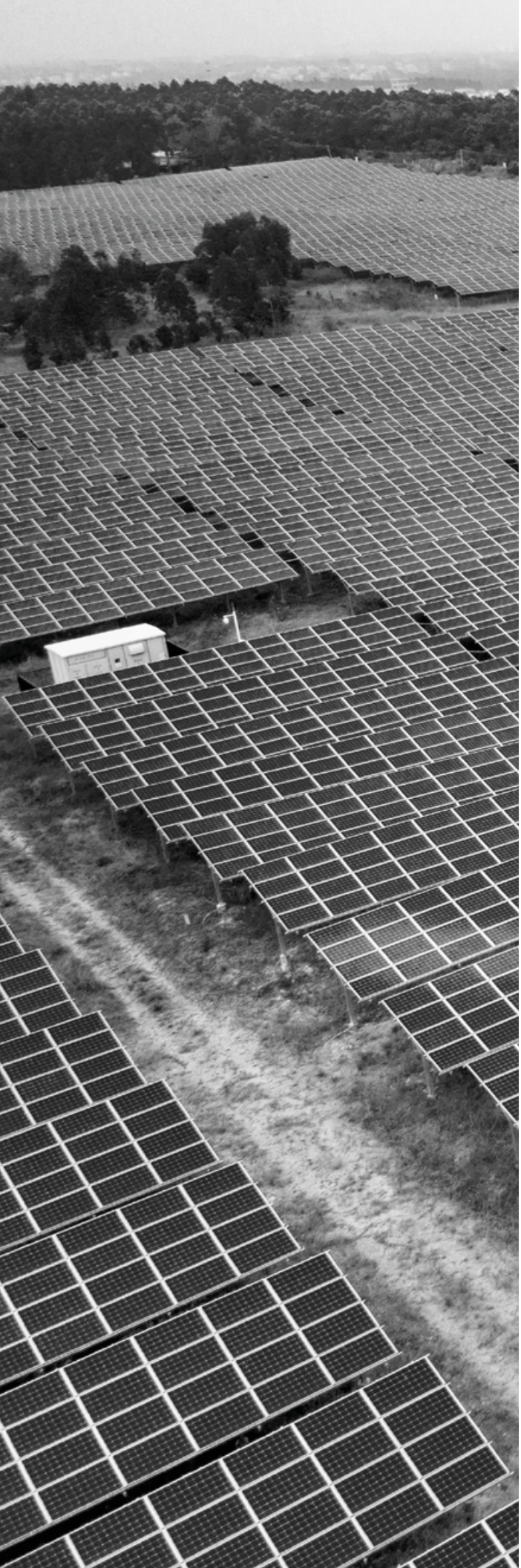
Dayandra HettigeBE, MBA, CMEngNZ (Ret)

FIRETRACE™ International

Halma

HIDDEN DANGER

Why solar farm fire risk could be greater than you think



Summary

The solar industry is potentially underestimating the risk of fire at solar farms.

Why? It's partly because there is a shortage of data on solar farm fires, and partly because research into the issue has given rise to suspicions that fires at solar farms have been under-reported.

This report will look at the solar fire data that is available and analyse what conclusions can be drawn from that data.

In addition, the report will look at:

- The factors that make a fire at a solar farm more likely
- The possible root causes of solar-related fires, and
- The PV components most likely to cause solar farm fires

Finally, the report will also explore what steps you can take to reduce the risk of solar farm fires.

What is certain is that solar farm fire risk is an issue that the solar industry needs to take more seriously. This is particularly the case when you consider how rapidly the global solar industry is expanding.

Data from the International Energy Agency (IEA) – which was published in the IEA Photovoltaic Power Systems Programme's 'Snapshot of Global PV Markets 2022' report – showed that the world's total cumulative installed PV capacity increased 23% in 2021 to 942GW.[1]

With the number of solar installations growing fast – amid concerns that instances of solar fires are being under-reported – now is the time for action to be taken to minimize solar farm fire risk.

1 https://iea-pvps.org/snapshot-reports/snapshot-2022/

How significant is solar fire risk?

There is a severe lack of data on the prevalence of solar farm fires.

Indeed, some studies have concluded that there is a high likelihood that instances of solar farm fires are under-reported.

A study by the UK's BRE National Solar Centre – which was entitled 'Fire and Solar PV Systems – Investigations and Evidence' and detailed an investigatigation into a total of 80 potential PV-related fire incidents – led to the finding that researchers "strongly suspect a degree of under-reporting, especially amongst solar farms and domestic thermal events that were resolved by a solar installer/ maintenance engineer."[2]

With regard to the data that is actually available, the US Department of Energy's Solar Energy Technologies Office has cited a study conducted by European testing and certification company TÜV Rheinland – entitled 'Assessing Fire Risks in Photovoltaic Systems and Developing Safety Concepts for Risk Minimization' – which found that, in approximately half of 430 cases of fire or heat damage in PV systems, the PV system itself was considered the "cause or probable cause."[3]

Meanwhile, the study carried out by the BRE National Solar Centre found that more than a quarter of fires involving solar systems were caused by the photovoltaics and those fires were all "serious fires", meaning fires that were "difficult to extinguish and spread beyond the area of origin."

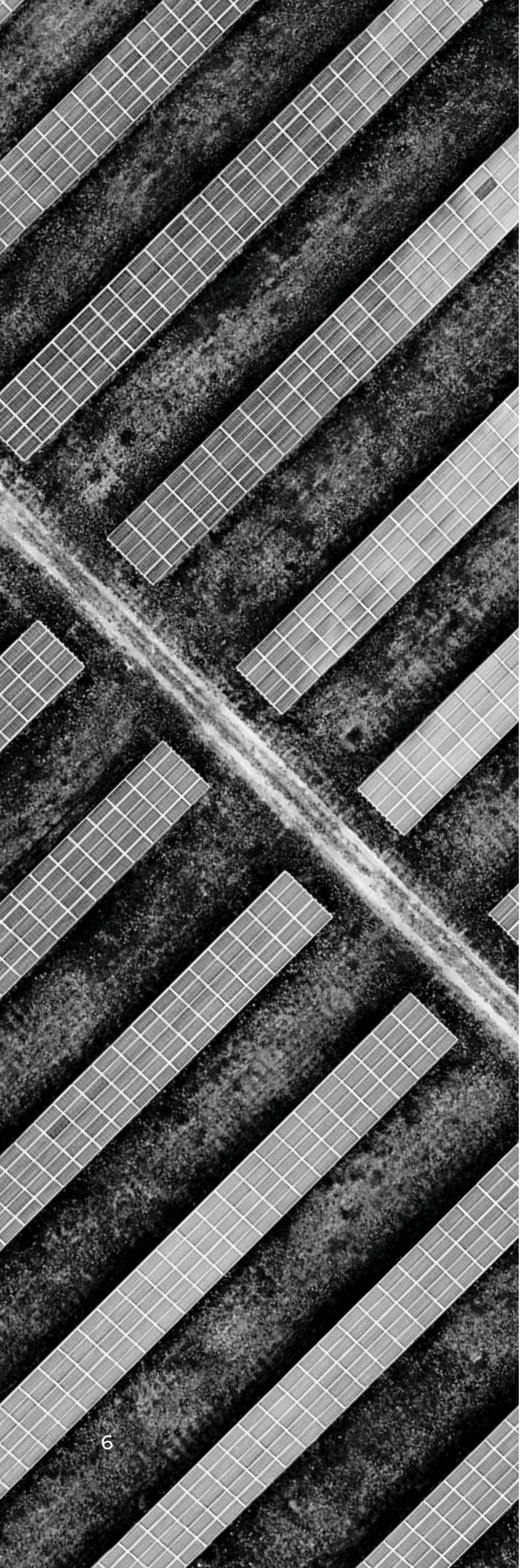
2 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786882/Fires_and_solar_PV_systems-Investigations_Evidence_Issue_2.9.pdf

3 https://www.energy.gov/sites/default/files/2018/10/f56/PV%20Fire%20Safety%20Fire%20Guideline_Translation_V04%2020180614_FINAL.pdf

However, as already indicated, the BRE National Solar Centre study did emphasize that the full extent of solar fire risk may have been concealed. Specifically, it highlighted how, in one instance during the course of the study, researchers were “denied access to one site by the insurance company’s loss adjuster.”

As a result, we cannot rule out the possibility that solar farm fire risk, and occurrences of solar farm fires, may be more prevalent than the available data suggests.

There is a high likelihood that instances of solar farm fires are under-reported.



What statistics are available?

Despite the challenges in obtaining data that provides a comprehensive picture of the extent of solar fires and the prevalence of solar fire risks, there are a number of studies that have attempted to gain an insight into the issue.

For example, one data set released by the US Fire Administration (USFA) found that instances of solar system fires more than doubled during the period 2015 to 2018.

The USFA reportedly does not track fires from solar installations, instead filing them under the 'other' category for causes. In the aforementioned instance, the USFA data was only made available following a specific request from an executive at a solar maintenance company.

The USFA data that was obtained showed that there were 56 solar system fires recorded in 2018, up from 25 in 2015.[4] A third of the fires that were recorded by USFA during the period 2015 to 2018 occurred in California, Arizona and Nevada.

However, while the number of fires recorded by the USFA more than doubled between 2015 and 2018, the number of solar installations in the US increased at a similar rate during the same period – from less than 30,000MWdc to more than 60,000MWdc, according to Solar Energy Industries Association research data – which suggests solar fire risk may not actually be increasing.[5]

Yet, in contrast, data from Australia indicates that the opposite is true – that is, solar fire risk is, in fact, increasing exponentially.

Statistics from the Australian PV Institute show that PV installations in the country increased from around 7.3GW in January 2018 to more than 20.7GW in December 2020.[6] However, while the increase in PV installations in Australia during the period was less than three-fold, data from Fire and Rescue New South Wales (NSW) showed that there was a six-fold increase in the number of solar fires attended by firefighters in the period 2018 to 2020, according to reports.[7] In 2020, Fire and Rescue (NSW) attended 139 solar fires, compared to 22 in 2018.

4 https://onedrive.live.com/?authkey=%21ADZAYZw3zBKJ%5F1k&id=C8BE25A716873030%216383&cid=C8BE25A716873030

5 https://www.seia.org/solar-industry-research-data

6 https://pv-map.apvi.org.au/analyses

7 https://www.smh.com.au/national/nsw/the-irony-s-not-lost-on-me-solar-panel-safety-device-led-to-500-per-cent-rise-in-rooftop-fires-20210129-p56xtp.html

What are the risk factors?

There are three possible root causes for solar farm fires, according to the BRE National Solar Study Report.

They are:

- an error in the system design
- a faulty product (a design or quality issue)
- poor installation practice

The report said DC isolators were found to present the greatest fire risk. Around 30 percent of the incidents recorded in the study were caused by DC isolator malfunctions.

A number of the incidents in question involved ingress of water into DC isolators, all with upward-facing cable glands, the BRE study said. The study also concluded that there was evidence of fires originating within DC isolators with "poor contact design" – that is, originally being designed for AC operation and being re-designated as DC-rated by the manufacturer – and with incorrect internal wiring.

The BRE report said there were three separate issues with DC isolators:

1. **Poorly designed or constructed products**
   Models originally designed for AC are "unlikely to be reliable over the life of a PV system."

2. **Incorrectly specified DC isolators**
   Isolators that are underrated for the current or voltage of the PV strings connected, for example.

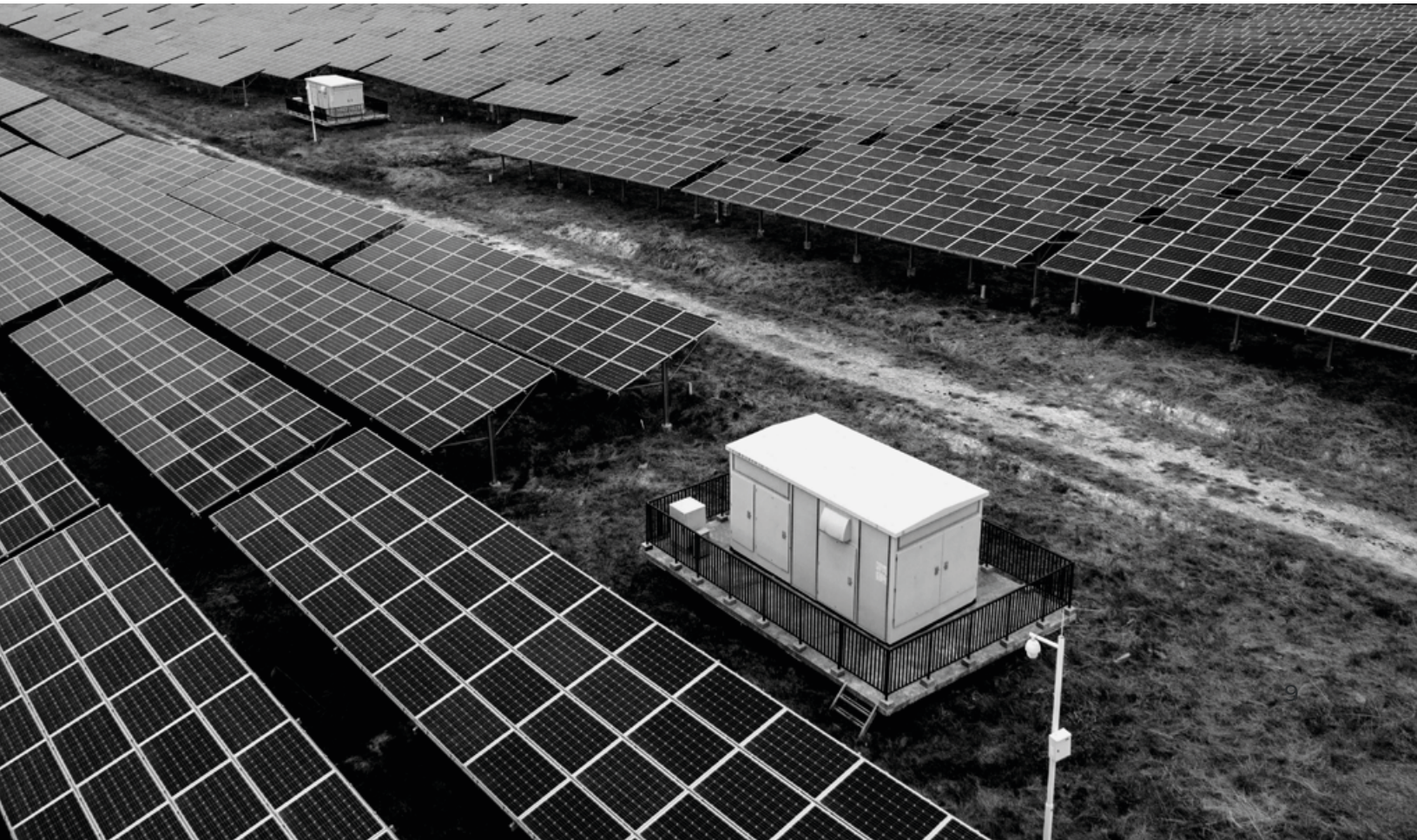
3. **Poor installation practice**
   The BRE report said this category accounted for the "majority of DC isolator failures leading to fires or thermal events." Poor installation frequently caused ingress of water into the isolator casing causing arcing.

Meanwhile, DC connectors are the second most likely PV component to cause a fire.

DC circuits connect the PV modules together, increasing the voltage in a similar way to connecting batteries in series. Parallel strings of PV modules increase the current. The DC circuits are fed back to the inverter, sometimes via a DC isolator.

The metal contacts of DC connectors tend to remain connected by frictional forces, even when the supporting plastic body has been burnt off, the BRE report said. Therefore, any DC connectors that have been subject to arcing should be suspected as a likely source of ignition.

DC isolators were found to present the greatest fire risk.



Inverters: How they cause fires

A number of fires start in inverters, which form the most complex part of a PV system and manage the power that flows through them. Though they have sensors and other safety features, there have been incidents of solar fires logged as initiating in an inverter, according to the BRE report.

The BRE has also highlighted how the use of "faulty inverters" has resulted in solar-related fires.[8] In 2020, there were reports of firefighters called to extinguish a fire in the central inverters of the Ullum photovolataic park – owned by energy company Genneia – in Argentina. In this incident, a number of inverters had caught fire, with firefighters taking an hour and a half to extinguish the blaze.[9]

Meanwhile, an article published by the Solar Power World website highlighted how "electrical abuse" was one of "three main abuse factors" that can send a battery into thermal runaway [meaning a situation where the heat generated within a battery exceeds the amount of heat that is dissipated to its surroundings]. The article added: "Electrical abuse happens during overcharging, undercharging or shorts from the inverter."[10]

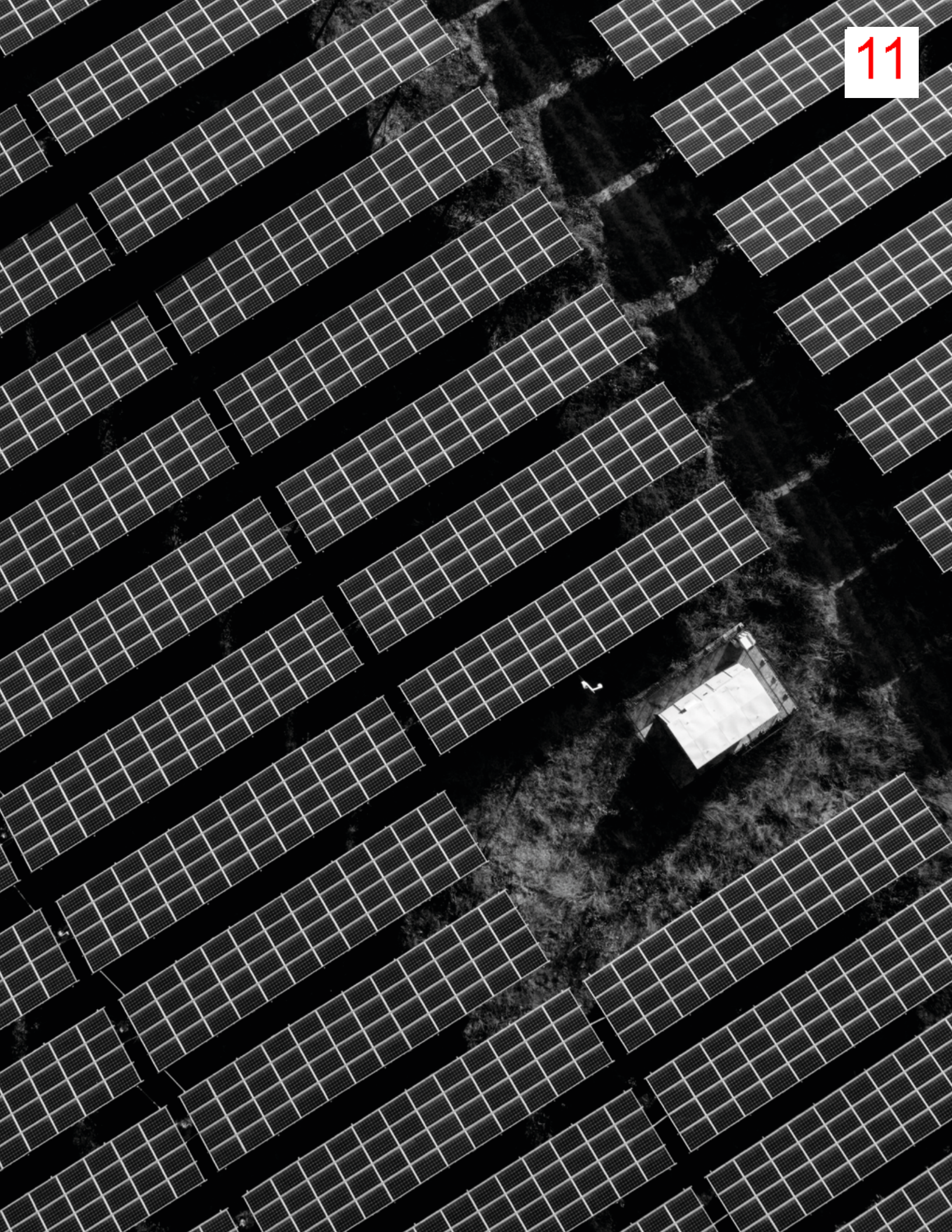
What causes fires in inverters? According to photovoltaic system distributor Solarity, inverters are combustible due to their polymer content.[11] Solarity has also highlighted how, during and after a solar fire, the PV system can potentially produce liquid, solid or smoke emissions and firefighters responding to the incident "could be exposed with dangerous levels of metals such as lead (c-Si) or cadmium and selenium."

8 https://www.bre.co.uk/page.jsp?id=3211

9 https://www.pv-magazine.com/2020/10/21/fire-accident-at-argentinian-solar-parks-central-inverters/

10 https://www.solarpowerworldonline.com/2020/02/just-how-concerned-should-the-solar-industry-be-about-battery-fires/

11 https://solarity.cz/blog/fire-hazards-and-mitigation-in-photovoltaic-systems/#



How can the risk of solar fires be reduced?

Even if quality assurance measures have been implemented for solar systems, it is difficult to completely eradicate the risk of fire.

The TÜV Rheinland study concluded that “despite quality assurance measures, overheating or electric arcs cannot be ruled out 100%.”

So what steps can be taken to minimise the risk of solar farm fires?

Recommendations made in the TÜV Rheinland study included:

1. **Ensure solar systems are regularly tested by independent third parties**
2. **Incorporate additional safety components everywhere possible**
3. **Create standardized quality assurance measures**
4. **Ensure defective or prematurely aged components are promptly replaced**

The report added that electric arc detectors can also reduce risks. However, it also said that it was vital that the electric arc detector remains fully functional over a very long period of time, if possible during the entire service life of the PV system, without itself causing any faults in the system. The report continued: “Protective measures such as an integrated self-test could be helpful here.”

In addition, an electric arc detector is “moreover useful only if it can be assumed to reliably detect electric arcs”, the TÜV Rheinland report concluded.

It added: “Electric arcs in modules produce different noise patterns than those in serial terminals. Different cable lengths greatly differ in their dampening of electric arc signatures. Interference from inverters, switching transients, or coupled radio signals can mask or overlay the noise coming from the electric arc. Only very robust detection algorithms tested on different systems can ensure real added utility here.”

Solar farm operators could also consider addressing the issue of fire risk by incorporating fire suppression systems, for example.

Conclusion

The risk of fires at solar farms is potentially being underestimated due to under-reporting and a lack of available data.

However, a number of studies have indicated that solar fires are on the increase. One US study found that solar system fires had tripled over a three-year period, while data from Australia showed that there had been a six-fold increase in the period 2018 to 2020.

Hence, there is an urgent need for the solar industry to address the issue of fire risk, particularly with data showing that global cumulative installed PV capacity increased by around a quarter in 2021.

Studies have shown that there are three root causes for photovoltaic fires – they are: an error in the system design; a faulty product (a design or quality issue); or poor installation practice.

The photovoltaic component that presents the greatest fire risk are DC isolators, which cause around a third of solar fire incidents.

However, DC connectors and inverters can also pose significant fire risks.

It's difficult to completely eradicate the risk of fire at solar farms, but there are a number of key steps you can take to minimize the risk.

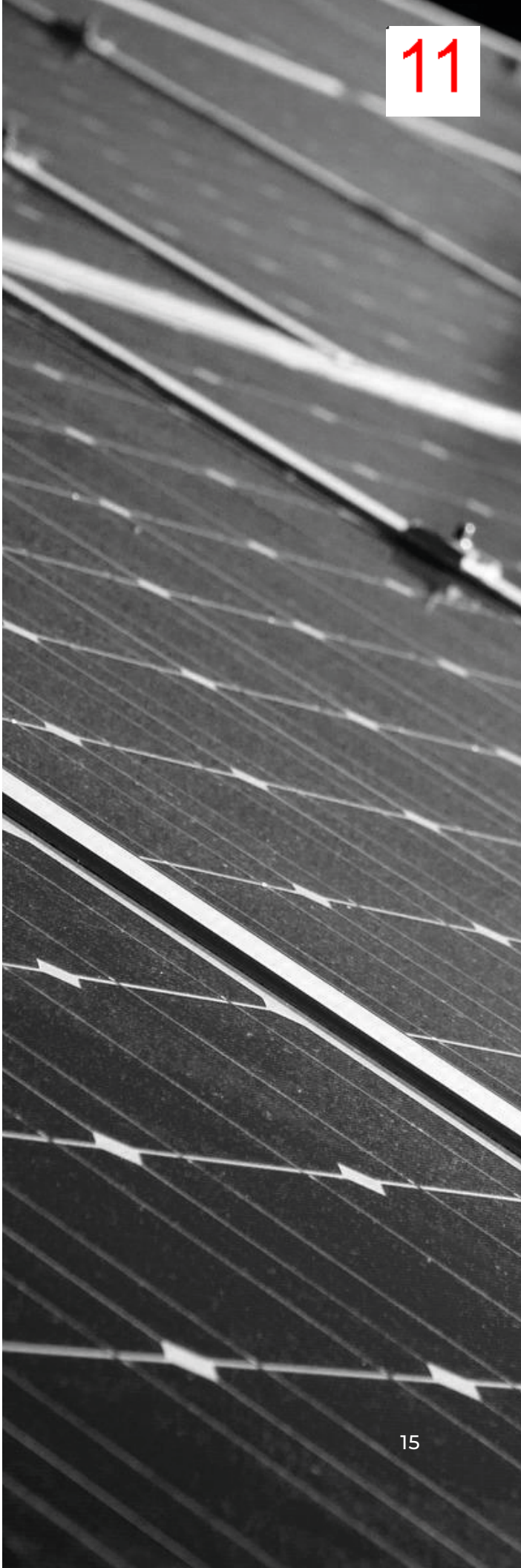
These steps include having solar systems regularly tested by independent third parties and incorporating additional safety components, such as fire suppression systems.

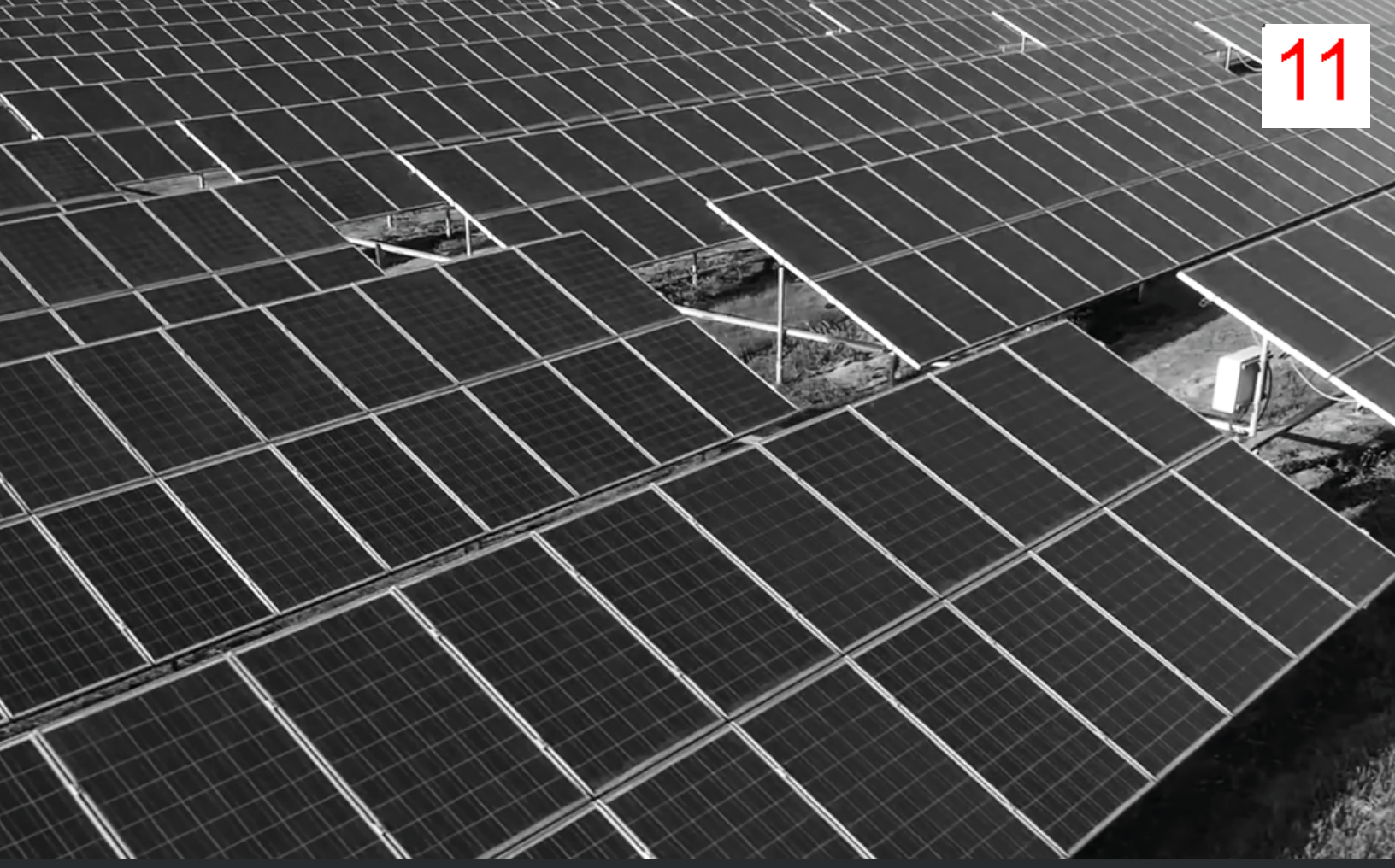
With the number of PV installations dramatically increasing around the world, taking these steps will be vital in order to reduce fire risk.

Would you like to talk about the risks in this report? How about your approach to fire risk in your portfolio?

Get in touch with the Firetrace team today.

www.firetrace.com/contact





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World Headquarters

Firetrace International
8435 N. 90th St. Suite 2
Scottsdale AZ 85258, USA
+1 480 535 4189

Middle East Office

Firetrace USA LLC (Middle East)
2117 Building 7WB,
Dubai Airport Free Zone,
Dubai, United Arab Emirates
+971 4 295 0167

India Office

Firetrace International
B-149, Ansal Pioneer
Industrial Area, Bilaspur
Guragon Haryana 122413,
India

China Office

Lane 1165 JinDu Road
Floor 3 Block 1 No. 123
Min Hang District,
Shanghai, 201108,
China

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

11

Submitter

Name	Dayandra Hettige
Contact Person (If different from above)	
Postal Address	459 Bidwills Cutting Road Morrison Bush, Greytown 5794
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803
Application No.	WWLA0589
Description of Proposal (use additional pages if required)	Construction and operation of a utility scale 175 megawatt peak (MWp) solar farm at 415 Moroa Road, Greytown.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

11

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

Please refer to attached documents:

Far North Solar Submission - Time Extension etc (2 June 2023)
FireTrace International - Hidden Danger - Why solar farm fire risk could be greater than you think.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Please refer to attached document

Far North Solar Submission - Time Extension etc (2 June 2023)

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name Dayandra Hettige

Date 6/6/23

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

Dayandra Hettige

459 Bidwills Cutting Road

Morrisons Bush

Greytown 5794

2 June 2023

Subject Far North Solar Submission – Time Extension Etc

I am a member of the SWWAG group. I am a party directly affected by the Proposed Far North Solar Farm. I am very concerned that a massive utility scale power generating plant is being proposed closer to the Greytown city boundary. Most of the information about this venture has been promoted in the local media as benign in nature to the environment. As we now know from overseas experience, third generation photo voltaic cells contains toxic components. These toxic materials have been released into the environment during several major fires overseas. The problems are compounded when these toxic materials are released into aquifers where most of the local residents obtain their drinking water. These consequences become even more serious the closer the power plant is placed to the city boundary. The main reason for this appears to be purely commercial as there is a Grid substation closer to the plant.

I have closely examined the document lodged by Far North Consultants, Assessment of Environmental l Effects Document WWLA0589 Rev 1. This document in many ways is lacking fundamental information about this massive industrial scale power plant.

The landscape assessment visual documentation supplied Far North only denotes the plan view of this mega power plant which is not fit for the purpose what it is supposes to serve. For example, I refer to the 35 – 40 foot container-sized inverters referred in text descriptions relating to the project. Without a contextual 3D rendering of solar panels, inverter stations and other out buildings there is no indication of the shape or contour of this project in relation to the surrounding countryside.

Robert Schofield consultant planner report dated 18 April 2023, signed off by James Witham SWDC on 28 April 2023 has not considered major impact resulting from a catastrophic fire that could emanate from faulty componentry, lightning strikes, scrub fires etc. Such an event will lead to the closure of state highway 2 and Bidwills Cutting Rd, only one could imagine the impact. Attached article titled “Hidden Danger- Why Solar Farm Fire Risks Could Be Greater Than You Think” highlights these concerns.

Taking the fire scenario to another level, the toxic plumes of smoke will trip the Transpower 110 KV line causing power outages with significant restoration time.

Pupils of Kuranui College (800 students) and Greytown School (350 students) will have to be evacuated.

Far North Proposal has no detailed fire mitigation and management plan. At a recent meeting in Greytown, the question of fire management was posed to the Far North Executives. Their answer was they will keep the grass level down. This begs the question how a 15 ton fire truck could be maneuvered in boggy land let alone the specialized fire crews and resources required. This shows the tardiness of the Far North proposal. Therefore, I request a detailed fire mitigation and management plan for Photo Voltaic power generating plant of this magnitude. The proposal to cover skill levels of the resources required and the chemical composition of substances used to put out a major fire.

Due to inadequate levels of information supplied by Far North this effectively puts South Wairarapa District Council rate payers at a serious disadvantage when making an informed submission. In view of this, I request that the time frame for submissions on this project be extended until at least one month after the developer Far North has provided a 3D rendering of its scheme for examination by the South Wairarapa District Council and its ratepayers.

This will enable those in the district to have a true appreciation of the scale of this project.

I also request that the specifications of inverters and the photovoltaic panels to be made public, including specifying the materials that make up this equipment.

In future if storage systems are contemplated, such specifications should be declared, inclusive of substances used in these storage and the systems process.

Only then can any reasonable assessment be made of the impact of these systems on the farmland upon which they are scheduled to be installed.

Anything other than a 3D rendering of the profile of the project in relation to the farmland upon which it is installed is guesswork.

The impact of the systems upon the population and environment remains just a matter of conjecture until precise specifications, plans and renderings are forthcoming from the project company and its consultants.

Far North proposal has no noise emission modelling for the collective plant. This information should be made mandatory.

In New Zealand there is no precedent for a photo voltaic generating plant of this magnitude installed so close to human habitation and on valley floor farmland.

It therefore behooves both the developers and the regulating governmental authorities to ensure that there present a full inventory of the integral structures and processes in order that a true environmental impact can be evaluated by both specialists and lay people.

On a final note there is no plan provided for the end of life recycling of massive number toxic photo voltaic cells and associated electrical plant. **Far North** to provide a Remediation Escrow Agreement. This is mandatory to pay for costs and expenses incurred in connection with remediation of terms in accordance with a mutually agreed work plan.

Yours sincerely,

Dayandra HettigeBE, MBA, CMEngNZ (Ret)

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Chapter

Toxic Materials Used in Thin Film Photovoltaics and Their Impacts on Environment

Hervé Joël Tchognia Nkuissi, Fransisco Kouadio Konan, Bouchaib Hartiti and Jean-Marie Ndjaka

Abstract

Photovoltaic industry has proved to be a growing and advantageous source of energy as it can be renewable, sustainable, reliable and clean. Significant improvements have been made in materials used and the production processes to reduce the costs, and to avoid possible issues induced by some hazardous materials. However, some health and environment challenges last, which must be overcome to make this technology a source of truly clean energy. This chapter provides an overview on the major environmental impacts of thin film technology associated with the use of toxic materials and the chemicals in the manufacturing processes. A summary of Environmental, Health and Safety issues associated with some thin film technologies like copper indium gallium diselenide (CIS/CIGS), cadmium telluride (CdTe) and amorphous silicon (a-Si) is done, in order to investigate potential infections induced by the environmental release of trace elements, usually coming from chemical vapor inhalation and eventually accidental spills during the manufacturing processes, on the health of humans and animals. Potential solutions will be provided to prevent some environmental issues.

Keywords: hazardous materials, toxic chemicals, manufacturing processes, environmental impacts, thin film technology, recycling, waste minimization

1. Introduction

The sun undoubtedly is known to be an incredible and inexhaustible source of energy, allowing the generation of electricity and showing distinct environmental advantages over conventional source. Once took out from the manufactory, photovoltaic (PV) systems do not produce any toxic gas emissions, any noise or greenhouse gases. However, as with any industrial product, there are health and environmental impacts associated with the manufacture of solar cells and solar panels. The PV industry uses harmful and flammable substances, although in small amounts, which can involve environmental and occupational risks. The main environmental impacts of solar panels are associated with the use of land, water, natural resources, hazardous materials, life-cycle global warming emissions etc.

The solar cell manufacturing process involves a number of harmful chemicals. These substances, similar to those used in the general semiconductor industry, include sulfuric acid, hydrogen fluoride, hydrochloric acid, nitric acid, 1,1,1-trichloroethane, and acetone. The amount and type of chemicals used depends on the

type of cell and the technology used [1]. Thin film PV (TFPV) technology contains a higher number of toxic materials than those used in traditional silicon PV technology, including indium, gallium, arsenic, selenium, cadmium, telluride [2]. These materials must be handled and disposed of properly, to avoid with time serious environmental and human health problems.

The current idea of the industry is to ensure that these highly valuable and often rare materials are recycled, to foresee the pollution hazards. This chapter deals with the possibility of chemicals used in PV cell manufacturing process to be released to air, water surface and the environment. An overview on the TFPV industry will be done to understand how TFPV cells and modules are designed and fabricated. Some hazardous materials and chemicals used in the manufacture of TFPV technology and their relative toxicity to human health and environment will be produced. Finally, some solutions to anticipate long term harmful impacts of these products will be proposed.

2. Overview of the thin film photovoltaic industry

2.1 Development of thin film solar cells

The ultimate goal in the manufacturing of a PV module is widely determined by the cost per unit power output. The development of new PV technologies based on thin film materials has been led by the need for cheaper and more efficient semiconductor materials. Thin film solar cells (TFSCs) have the potential for rapid growth and low cost production. They have several advantages in manufacturing processes compared to conventional silicon solar cells such as [3]:

- Cheaper to produce
- Lower consumption of materials
- Fewer processing steps
- Availability of materials
- Simplified materials handling
- Can be deposited on many different substrates
- A variety of deposition technique
- Process lends itself to automation
- Integrated, monolithic circuit design instead of assembly of individual solar cells into final products

TFSCs are typically made up of thin layers of semiconductor materials, for instance cadmium or zinc sulfide, glass, and a contact material. The materials used in the design of TFSCs include polycrystalline silicon, amorphous silicon (a-Si), and semiconductors compounds. Semiconductors compounds include cadmium sulfide (CdS), cadmium telluride (CdTe), copper sulfide (CuS_2), copper indium diselenide (CIS), copper indium gallium diselenide (CIGS), copper gallium diselenide (CGS), germanium (Ge), and gallium arsenide (GaAs) [4]. Other semiconductors compounds like copper zinc tin sulfide (CZTS), copper zinc tin selenide (CZTSe)

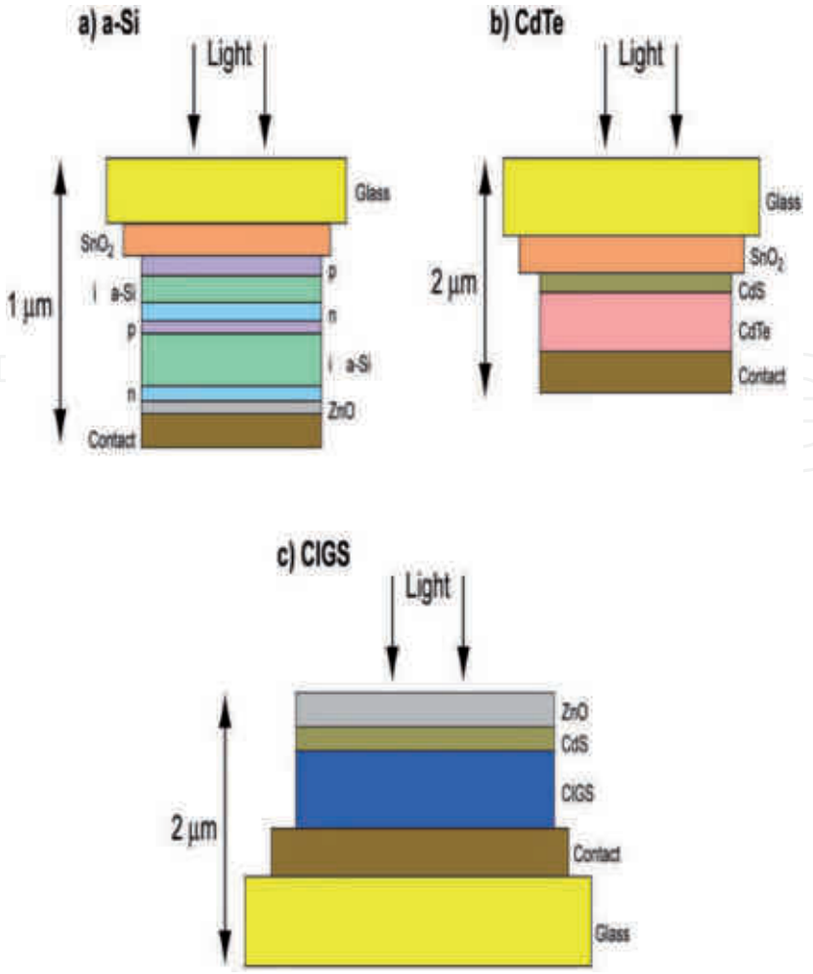

Figure 1.
Examples of thin-film solar cells structures: (a) amorphous silicon, (b) cadmium telluride, and (c) copper indium gallium diselenide [5].

and copper iron tin sulfide (CFTS) have proved over recent years their potential to convert the solar radiation into electricity and are being developing in laboratories. In these solar cells, the n material can be made of CdS or ZnS, while the p material can be made of $CuInSe_2$ (CIS) or Cu_2ZnSnS_4 (CZTS). Gallium arsenide (GaAs) solar cells can use aluminum, indium, or phosphorous as p or n-type materials. In **Figure 1**, are shown typical traditional structures of a-Si, CdTe and CIGS thin film solar cells.

To achieve better conversion efficiency, the active layer of the cell should have its band gap energy within the optimum range of 1.1–1.8 eV [5, 6]. Amorphous silicon is just at the rear end of the optimum band gap range at 1.8 eV [6]. Ge (0.66 eV) and CdS (2.45 eV) for example, have band gap energies outside of the optimum range, which means that those materials show limited conversion efficiencies. Ge is usually used to improve conversion efficiency of amorphous silicon cells [7], whereas, CdS is used to improve conversion efficiency in CIS and CdTe cells [8]. In general, on the basis of the band gap, materials used in TFSCs such as GaAs and CdTe have higher theoretical conversion efficiency than crystalline silicon, as they show band gap energies close to the optimum value of approximately 1.5 eV [8].

Thin film materials have higher light absorption capabilities than crystalline silicon as they have a direct absorption profile. Therefore, they can be shaped thinner than conventional silicon which must cut on wafers. For example, 1 µm of a GaAs direct semiconductor is sufficient to absorb the same quantity of the photons light than 100 µm of an indirect silicon semiconductor. CIS or CIGS are direct band gap polycrystalline materials with high absorption coefficients in the order of 10^5 cm^{-1}, allowing the active layer only to be about 2 µm [9]. Some CIGS-based solar cells

usually introduce a thin film of CdS on the top of the CIGS layer as a buffer layer, in order to ensure the electrical transition between the CIGS layer and the window layer (the front of the cell). Zinc, molybdenum, tin, and aluminum are used in these cells as front and back contacts or components of the layers.

The efficiency of the energy conversion process is determined by the materials parameters and technical design of the solar cell. Theoretical research on TFSCs indicates that, devices could achieve conversion efficiencies up to 25% under lab conditions [10]. In addition, efficiencies of cells can substantially increase by stacking interconnected cells, which could achieve up to 41.9% for tandem (two cells) and 50% for multi cells [11]. Concentrator systems and devices used to track the sun can be another way to improve efficiency of PV systems. For example, the use of terrestrial concentrator GaAs/Ge solar cells achieved conversion efficiency up to 36.9% [12]. The first TFSCs had conversion efficiencies of 8–12% [4]. **Table 1** presents the record lab efficiencies for cells and modules of different technology. Note that these are just record lab efficiencies, not commercially guaranteed efficiencies.

Crystalline silicon-based technologies continue to dominate the world market share with about 95% of the total production in 2017 [26]. The share of multi crystalline technology is now about 62% of total production [26]. In 2017, the market share of all thin film technologies counted for about 5% [26]. Amorphous silicon holds 4% of this part followed by cadmium telluride with 1%. The others, especially CIGS and thin film silicon, although already available at the commercial stage still represent a negligible part of the market.

Thin film materials such GaAs, $GaInP_2$, and CIGS have been investigated for the development of concentrator cells. Concentrator cells have been designed to increase the intensity of the solar radiation on PV cells through the use of optical lenses. They consist of optical lenses, a cell assembly, a housing element, a secondary concentrator to reflect off-center light rays onto the cell, a mechanism to dissipate excess heat produced by concentrated sunlight, and various adhesives and contacts [27]. The main advantages of concentrator cells are: they reduce the number or size of solar cells used, enhance the power output, and enhance the solar cell efficiency under concentrated sunlight [8]. A conversion efficiency of 32% has been reported for concentrator cells [28]. This other way to increase the cells efficiency nevertheless presents some drawbacks: they involve expensive tracking systems and

Technology	Cell efficiency (%)	Module efficiency (%)	Description cell/module
Crystalline silicon	26.7 ± 0.5	24.4 ± 0.5	Kaneka [14]/Kaneka (10^8 cells) [14]
Multi crystalline silicon	22.3 ± 0.4	19.9 ± 0.4	FhG-ISE [15]/Trina solar (120 cells) [16]
CIGS	21.7 ± 0.5	19.2 ± 0.5	Solar Frontier [17]/Solar Frontier (70 cells) [18]
CdTe	21.0 ± 0.4	18.6 ± 0.5	First Solar [19]/First Solar [20]
Thin film silicon	10.5 ± 0.3	–	CSG solar [21]/
Amorphous silicon	10.2 ± 0.3	9.1	AIST [22]
GaAs	28.8 ± 0.9	25.1 ± 0.8	Alta devices [23]/Alta devices [24]
CZTS	10.0 ± 0.2	–	UNSW [25]

Table 1.
Confirmed terrestrial record cell and module efficiencies measured under the global AM 1.5 spectrum (1000 W/m²) at a cell temperature of 25°C (IEC 60904-3: 2008, ASTM G-173-03 global) [13].

more precise controls than the traditional flat plate systems, they generate higher operating temperatures, which can decrease the long-term stability and lifetime of the PV cells. Concentrator cells were first designed for space applications, but modules for terrestrial applications are already commercially available [8].

2.2 The manufacturing processes

It is known that the complexity of solar cells and modules manufacturing strongly raises their costs. Conventional silicon is handled in different many ways, complicating therefore fabrication processes. First, silicon raw material is melted at very high temperatures and grown into a silicon ingot. Then, the ingot is molded and sawn into individual wafers for cell processing [3]. After testing, individual cells are connected together in a suitable electrical configuration. Finally, the connection circuit is hermetically packaged in a weatherproof flat container, typically with an aluminum frame. **Figure 2** shows the flowchart describing the complete process to manufacture a conventional crystalline silicon-based module. The process requires more than 20 separate steps before a module is complete.

In contrast to crystalline silicon, thin film manufacturing steps are very simple. For example, the connection of the circuit from individual cells is removed. Instead of processing and handling ingots, wafers and cells, the final circuit is directly fabricated on a single large substrate, usually glass [3]. Thin film circuits require

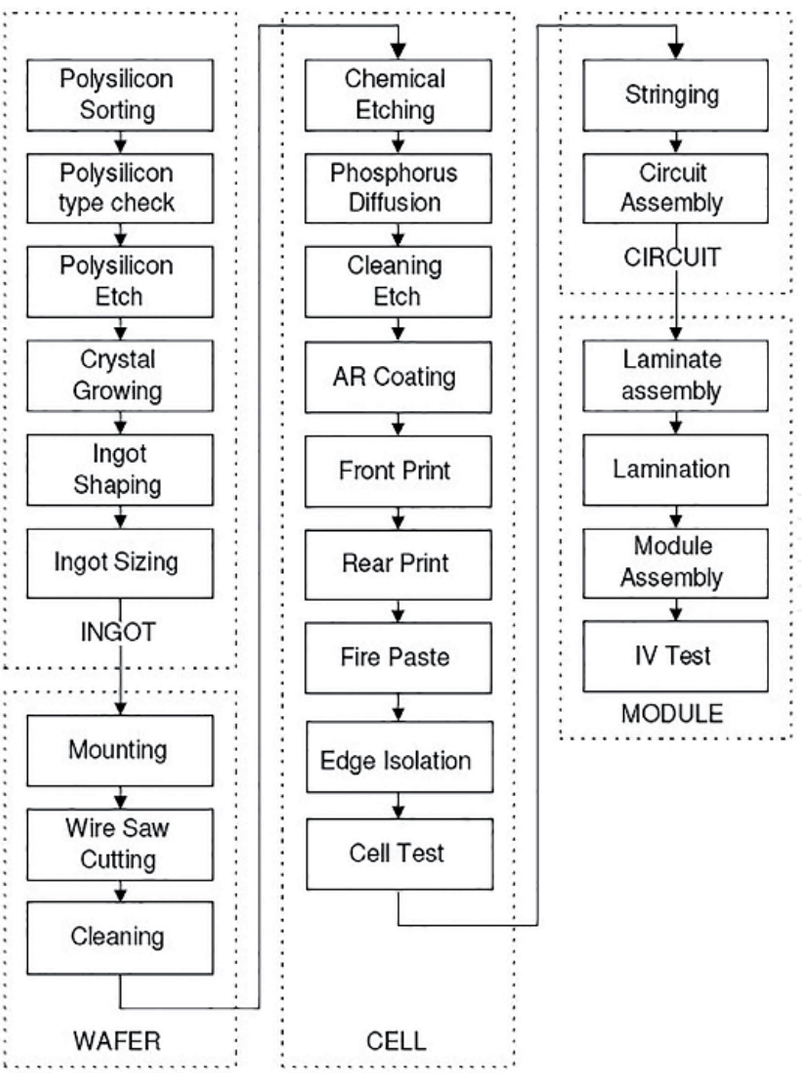

Figure 2.
Different process steps for fabrication of crystalline silicon modules [3].

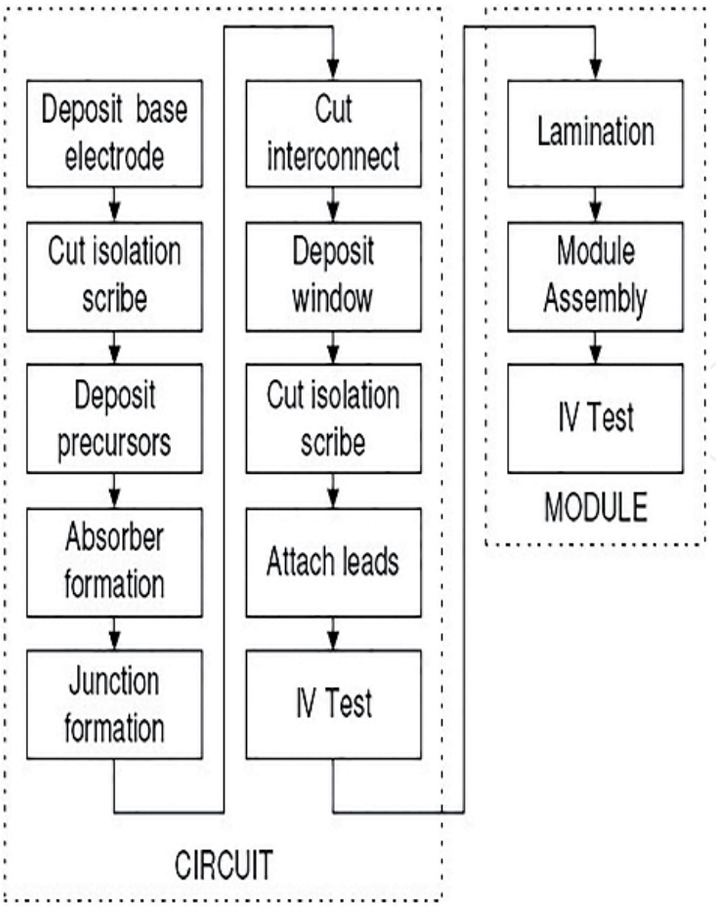

Figure 3.
Different process steps for fabrication of thin film modules [3].

the deposition of three main layers namely a back contact or a base electrode layer usually deposited on glass, a semiconductor layer and a transparent window layer also acting like a conductor front contact as it is typically seen in **Figure 1(c)**. The semiconductor layer is divided into the absorber and buffer layers. The stack of the absorber layer in one side and the buffer and window layers in another side creates an efficient n-p PV heterojunction. In TFSCs, the crucial phenomena of charge carriers generation and separation occur within the absorber; this layer therefore plays an important role in defining the electrical output parameters of the solar cell and usually confers its name to the technology. We have for instance CdTe for cadmium telluride based PV technology, CIGS for a range of chalcopyrite based PV technology and CZTS for a range of kesterite-based PV technology [3, 29].

An important advantage of thin film PV module manufacturing is found in the monolithic series interconnection of individual cells. Thin film cells are interconnected through simple patterning steps integrated into the processing line. The patterning steps achieve the integrated series interconnection from cell to cell on the circuit as shown in **Figure 3**. Three scribes between deposition steps complete the cell definition, separation and interconnection. A transparent conductive oxide (TCO) can also be integrated to the system for photon absorption optimization [29].

3. Chemicals and materials used in the fabrication of thin film cells and modules

To produce thin film PV devices, a variety of chemicals and materials is used. The types and quantities of chemicals used will depend on the type of the

Toxic Materials Used in Thin Film Photovoltaics and Their Impacts on Environment
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CIS	CIGS	CZTS	GaAs	CdTe	Cu_2S	a-Si
Cadmium	Cadmium	Cadmium	Arsenic	Cadmium chloride	Ammonium chloride	Acetone
Copper	Copper	Copper	Arsine	Cadmium	Ammonium fluoroborate	Aluminum
Hydride gas	Gallium	Hydrogen selenide	Gallium	Molybdenum	Cadmium sulfide	Chloro-silanes
Hydrogen sulfide	Indium	Hydrogen sulfide	Hydrochloric acid	Nickel	Chromate coating	Diborane
Hydrogen selenide	Molybdenum	Molybdenum	Methane	Sulfur	Copper	Hydrochloric acid
Indium	Selenium	Selenium	Phosphine	Tellurium	Cuprous chloride	Hydrofluoric acid
Molybdenum	Zinc	Thiourea	Trichloroethylene	Thiourea	Gold	Hydrogen
Selenium		Tin	Triethyl gallium	Tin	Hydrochloric acid	Isopropanol
Zinc		Zinc	Trimethyl gallium		Hydrogen sulfide	Nitrogen
					Methanol	Phosphine
					Nickel	Phosphoric acid
					Nitrogen	Silane
					Polyvinyl butyral	Silicon tetrafluoride
					Silicon monoxide	Silicon
					Sodium chloride	Sodium hydroxide
					Tantalum pentoxide	Tin
					Zinc	
					Zinc fluoroborate	

Table 2.
Chemicals and materials involved in the manufacturing process of different thin film PV technology [8].

technology and the type of cell being produced. One can found also some variability in the use of chemicals for producing the same type of PV solar cells by different PV manufacturers. This means that each manufacturer has its own recipe to produce a type of solar cell. **Table 2** gives a general list, but non-exhaustive of chemicals and materials used in the manufacturing of some TFSCs and modules.

In TFPV technology, only few amounts of semiconductor materials are necessary to produce thin or ultra-thin layers of a solar cell. The amounts of chemicals and materials used in the manufacturing of TFPV devices vary depending on the type of cell being produced. For example, the quantity of cadmium in a CIS PV module is evaluated at 0.04 g/m^2 and in a CdTe PV module at 5 g/m^2 [30]. Research allowed reducing significantly the amount of cadmium in PV devices by using light-trapping methods [8]. These methods have led to reduce the thickness of CdTe layers from 2 to o.5 μm, corresponding to 5.5 and 0.55 g/m^2 amount of cadmium, respectively [8]. A diversified number of acids and corrosive liquids are used sensibly in large quantities during the manufacturing processes. These chemicals, similar to those used in the general semiconductor industry, and including sulfuric acid, hydrochloric acid, hydrogen fluoride and nitric acid are primarily used for cleaning wafers in the case of crystalline silicon or for removing impurities from raw

Material	Source	DOT hazard classification	Critical effects
Arsenic	GaAs	Poison	Cancer, lung
Arsine	GaAs (CVD)	Highly toxic gas	Blood, kidney
Cadmium	CdTe, CdS, $CdCl_2$	Poison	Cancer, kidney, bone
Diborane	a-Si dopant	Flammable gas	Pulmonary
Diethyl silane	a-Si deposition	Flammable liquid	
Diethyl zinc		Pyrophoric liquid	
Dimethyl zinc		Spontaneously combustible	
Hydrochloric acid	a-Si, GaAs, Cu_2S/CdS	Corrosive material	
Hydrofluoric acid	a-Si	Corrosive material	
Hydrogen	a-Si	Flammable gas	Fire hazard
Hydrogen selenide	CIS	Highly toxic gas	Irritant
Hydrogen sulfide	CIS, Cu_2S/CdS	Flammable gas	Irritant, Fire hazard
Indium	CIS, CIGS	Not regulated	Pulmonary, bone
Methane	GaAs	Flammable gas	Fire hazard
Molybdenum hexafluoride		Toxic and corrosive gas	
Oxygen	x-Si	Gaseous oxidizer	
Phosphine	a-Si dopant	Highly toxic and pyrophoric gas	Irritant, fire hazard
Phosphorus oxychloride	x-Si	Corrosive material	Irritant, kidney
Selenium	CIS, CZTS	Poison	Irritant
Silane	a-Si deposition	Pyrophoric gas	Irritant, fire, explosion hazard
Silicon tetrafluoride	a-Si deposition	Toxic and corrosive gas	

Material	Source	DOT hazard classification	Critical effects
Tellurium	CdTe	Not regulated	Cyanosis, liver
Tertiarybutyl arsine		Pyrophoric and highly toxic liquid	
Tertiarybutyl phosphine		Pyrophoric liquid	
Trimethyl aluminum		Pyrophoric liquid	
Trimethyl gallium	GaAs	Pyrophoric liquid	
Tungsten hexafluoride		Toxic and corrosive gas	

Table 3.
Hazard classification of chemicals typically used in PV module manufacturing [31, 32].

semiconductor materials. Solvents like acetone, ethanol and 1,1,1-trichloroethane are also used for cleaning in different steps of the fabrication processes.

Many hazardous materials as well as explosive and toxic gases are involved in the manufacturing processes of thin film PV cells and modules. **Table 3** presents a general list of some materials and chemicals and their description, classified as hazardous by the Department of Transportation (DOT) in USA and used in the whole PV industry. But the amounts and recipes vary from one manufacturer to another. Moreover, it is possible that some of these chemicals may no longer be used for PV devices production as the fabrication processes are constantly changing and evolving [8].

The wastes generated by the semiconductors materials used in TFPV industry are in general non-negligible. Acids and solvents each represented about one-third of the total wastes by weight (about 7000 tons) [33]. About 35% of the semiconductor wastes were evacuated as diluted acid solutions to sewage treatment plants and 37% were sent to offsite treatment facilities. About 27% of the total wastes were released to the atmosphere. Only 0.8% of the total wastes were discharged directly to the surface water and 0.015% to the landfills [33].

4. Potential health and environmental hazards

The manufacturing of PV devices includes some chemicals which can be toxic or harmful to the humankind. The potential for health concerns is not only depend on the material harmful characteristics, but also on certain conditions which must be taken into account. For example, in addition to harmful characteristics of the chemicals, their concentration must be high enough to constitute a real problem in a given environment: a human or an animal must be in the surroundings of where the device or compound is used; there must be a total exposition process from the compound to the environment. Most often, the primary persons exposed to the PV manufacturing residues are the plant workers. The easiest exposure route for workers is inhalation of vapors or dusts and also via direct contact if spills occur [8]. Another route for workers to be infected by chemicals resulting from manufacturing processes could be accidental ingestion. The ones outside a manufacturing environment could be infected by chemicals via inhalation from stack emissions, elusive air emissions or from accidental release after fire or explosion [8]. But the exposure of nearby residents or other workers would be less than the plan workers because the chemicals would be dispersed in the ambient air after their emission. There are possibilities for lands containing spent PV modules to pollute the environment. For example, at the surroundings of spent PV modules, groundwater seepage could reach a drinking water source or river; but in both cases, there would be dilution

(not totally) of the waste before the water was used. In short, any vapor emissions or groundwater seepage would be diluted by the ambient air or by the water before reaching nearby residents.

It is well known that the fabrication of PV cells and modules needs the use of more or less large quantities of solvents and acids for synthesis and cleaning, gases for depositing ultra-thin film of semiconductors materials and metals according to the type of PV cell or module being fabricated. Most of these chemicals are highly toxic and harmful for humans and environment. Here are discussed some health and environment issues caused by chemicals hazards related to materials' toxicity, flammability, explosiveness, and carcinogen nature. Below is a summary of potential health and environmental issues concerning the manufacture and the use of some thin film technologies such as CdTe, a-Si and CI(G)S.

4.1 Cadmium telluride (CdTe)

The manufacturing of CdTe solar cells can cause occupational health risks associated with the toxicity of the main constitutive materials such as CdTe, CdS, and cadmium chloride ($CdCl_2$). Since cadmium compounds are usually used in powder and in liquid form, the primary route of exposure in manufactory settings is inhalation of cadmium-containing vapors or dust or ingestion of spills if this occurs. Processes in which cadmium compounds are used or produced in the form of fine fumes or particles present more risks to health, because they promote the absorption of these fine particles by the lung and thus can cause lung cancer. A long-term exposure can also have harmful effects on bone and kidney [32]. In addition, the inhalation of cadmium-containing vapors or dusts can result in metal vapor fever, pneumonitis, pulmonary edema, and finally death [32]. Since cadmium is produced primarily as a by-product of zinc mining, the levels of Cd production is fixed by the levels of zinc production. Because Zn is produced in large amounts, considerable amounts of Cd are also generated as by-product, without taking into account the amount used or required in PV technology. If the amount of Cd generated as a by-product of zinc is not totally absorbed by the whole market, it is discharged to the environment as hazardous waste. Thus, encapsulating Cd in CdTe for PV modules fabrication could be a trusty way to preserve the environment of hazards that can cause free elemental Cd. CdTe is more stable and insoluble to water; as such, it may be less toxic or harmful than free elemental Cd.

CdTe and CdS thin films are solid and are packaged into thick layers of glass or a waterproof container. At ambient conditions, the vapor pressure of CdTe is zero. Therefore, it is impossible for any vapors or dust to be released when using CdTe PV modules. The only or the more plausible way for cadmium to be released and absorbed by residents is via consumed modules in residential fires. Even in this way, flame temperatures in residential fires typically 800–1000°C, are not sufficient to vaporize CdTe [34]. The melting point of CdTe is 1041°C, and evaporation starts at 1050°C. The melting point of CdS is 1750°C [34]. Previous studies showed that CdTe releases are not probable to happen during residential fires or accidental breaks [35–37]. The potential for CdTe emissions could occur only in the case of industrial fires or from incinerating spent PV modules. In the first case, the fire itself probably would cause much greater risk than any potential Cd emissions [38]. The second case can happen only if CdTe modules end in waste-incineration streams [32].

4.2 Amorphous silicon (a-Si)

Amorphous silicon based solar cells are usually fabricated using the plasma enhanced chemical vapor deposition (PECVD) technique. Silane gas (SiH_4), mainly

used as precursor, is extremely pyrophoric and represents the main safety hazard of this technology. It can spontaneously ignite for lower concentrations ranging from 2 to 3%, depending on the carrier gas. Due to the high pyrophoric nature of silane and even for concentrations lower than 2% in the carrier gas, pyrophoric footprints can be found locally if mixtures are not complete. Mixtures could be metastable and ignited after a certain time, for silane concentrations greater than 4.5% [32].

Amorphous silicon solar cells contain a large concentration of hydrogen atoms about 10%, as they are crucial for the material electronic properties [3]. But, the technology usually refers to use the words "amorphous silicon" instead of "hydrogenated amorphous silicon (a-Si:H)," because "unhydrogenated amorphous silicon" is of no use in electronic devices [3]. Hydrogen used in amorphous silicon manufacturing is explosive and flammable [32]; therefore, it is necessary for PV manufacturers to use highly sophisticated gas handling systems to minimize and even avoid the risks of fire and explosions. One efficient way to overcome these hazards is to store silane and hydrogen gases in bulk from tube trailers to avoid changing gas cylinders. Others toxic gases such as arsine (AsH_3), phosphine (PH_3) and germane (GeH_4), used as doping-gases in the amorphous silicon manufacturing cannot pose any serious hazards to the public health or the environment if they are used in very small amounts. However, leakage of these gases should be avoided because it could cause significant occupational risks.

4.3 Copper indium (gallium) diselenide (CI(G)S)

CIGS thin films can either be deposited by the thermal co-evaporation of the constitutive elements, or by the fast deposition of metal precursor layers which then react in a subsequent processing step to form the final compound [3]. In CIGS TFSCs, a very thin film of cadmium sulfide (CdS) is deposited by chemical bath method and acting as a buffer layer. However, CIGS solar cells freed of toxic cadmium have already been successfully produced [39]. The toxicity of copper, indium, gallium, and selenium is considered benign. In addition, elemental selenium is capital in the human nutrition; daily absorptions of 500–860 μg of selenium are acceptable for long periods [40]. Although elemental selenium has only a moderated toxicity associated with it, hydrogen selenide (H_2Se) used in the manufacture of CIGS TFSCs is highly toxic and is dangerous to life and health [32]. Hydrogen selenide acts like arsine gas on human body even though its vapor pressure is lower than that of arsine. Moreover, it can oxidize to the less toxic selenium on the mucous membranes of the breathing system. The manufacturing system should be enclosed under negative pressure, and should be exhausted through an essential control scrubber to prevent hazards from highly toxic H_2Se gas. Associated hazardous chemicals can be minimized by using safer alternatives methods like flow restricting valves and other safety options presented in detail by Fthenakis [41]. Some studies have shown that CIS and CGS have mild systemic toxicity and have shown no effects on ovulation, reproduction, liver and kidney [8]. But CIS was found to be less toxic than CGS and CdTe [8].

5. Methods to prevent environmental concerns

The releases of chemicals in form of vapors or spills from the PV industry constitute the real hazards to the public health and to the environment. A variety of treatment methods or ways have been developed to manage or to minimize wastes produced by PV industries. These methods include waste minimization and recycling of PV modules at the end of their life.

5.1 Waste minimization

Waste minimization is usually employed in the semiconductor industry, and is also appropriate to the PV sector. It includes reuse of rinse water after treatment, shifting toward less toxic chemicals as possible, control of spills and leaks, reduction of vapor losses, and selection of process that use fewer hazardous chemicals [8]. Some of these methods are not broadly used in the semiconductor sector due to the requirement of highly purified materials. The main goal to reuse processed chemicals in the semiconductor sector is to limit amounts of some harmful solvents and acids. A lot of changes have been successfully made in the manufacturing processes such as using less toxic materials instead of hazardous and replacing acid bath processing by acid spray in cleanings [33]. Splitting of spent solvents by type like chlorinated and non-chlorinated solvents can help increasing the volume of solvents that can be easily recycled [8].

Another way to minimize wastes generated during the fabrication of thin film solar cells and modules is reducing the amounts of toxic elements. For example, the possibility of reducing the quantity of toxic cadmium in the synthesis of CdS thin films, which plays the role of the buffer layer in CdTe and CIS solar cells has been investigated. It was found that by varying the solution concentration and temperature in the chemical bath deposition process for instance, the typical concentration of cadmium can be reduced up to 10 times [42]. These different ways to operate can help reducing substantially the amount of wastes generated during the PV manufacturing processes.

5.2 Recycling

It will be many years before most PV panels come to the end of their life (about 30 years), so it is needed to put in place some recycling schemes to prevent in time the harmful effects of spent panels on the environment. Some major PV manufacturers have experienced a promising approach called "cradle to cradle" [8]. The concept of this approach is to recycle the toxic materials of the process into new products, which are less or not at all toxic. This approach has enabled reducing the potential for release wastes into the environment, and enhancing the amount of new resources that must be obtained.

There are different ways or models of recycling PV modules implemented by PV manufacturers. Deficient PV systems from manufacturing plants and spent PV modules are collected by manufacturers for being recycled. The first intent was to apply the electronics model of recycling, which involves an intermediate company that would gather the spent PV modules, dismount them, and deal the usable parts. Unfortunately, this model is less suitable to the PV sector, because usable materials are very thin, and therefore, the modules are difficult to dismantle. An efficient way for recycling PV modules is to use large metal smelters to melt scrap PV modules. For example, save cadmium from CIS modules would need the use of a copper and zinc smelter, whereas CdTe cannot be melted in a zinc smelter as cadmium is a by-product of zinc mining. A method of recycling CdTe modules and developed by Solar Cells Inc. involves dismantling of the module, followed by glass milling and separation of the metals following a combination of physical and chemical methods such as chemical dissolution, mechanical separation, precipitation, and electrodeposition [43]. By this way, about 80% of the original tellurium was saved. Another method for recycling CIS and CdTe modules, and developed by Drinkaard Metalox Inc. uses chemical stripping, electrodeposition, precipitation, and evaporation. About 95% of tellurium and 96% of the lead for cells connection were saved by combining these different methods. This method allows the potential reuse of

the substrate, because the metal conducting layer remains connected to the glass substrate after the separation of the elements [44]. A method of recycling CIS and CdTe modules based on electrochemical reactions in a closed loop system has been experienced at the early of years 2000 By Menezes et al. [45]. This approach could also lead to improve efficiency in the original CIS solar cells.

In addition to the environment safety, another major reason for developing relevant and cost-effective methods for recycling PV modules is the scarcity of some of the exotic elements used in PV industry. Reserves of some elements like germanium, indium and tellurium are low and continue to decrease with time [8]. Considering that the TFPV technology is still growing, it is needed to develop more feasible ways to recycle PV materials in order to preserve their reserves in the earth crust.

6. Conclusions

This chapter has shown the potential of some materials and chemicals used in the manufacture of thin film PV solar cells and modules to be hazardous. These hazardous chemicals can pose serious health and environment concerns, if proper cautions are not taken. Hazards could arise first from the toxicity and explosiveness of specific gases, then could affect occupational health and, in some cases, public health through accidents or elusive air emissions. Accidental releases of toxic gases and vapors can be prevented by minimizing wastes produced during the processes through choosing safer technologies, processes and less toxic materials. Recycling is expected to be the preferred disposal option for spent PV modules in the future, in order to minimize the potential environmental impacts and recover source of metals. Research is ongoing to build feasible methods of recycling spent modules for environmental safety.

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Conflict of interest

The authors declare that they have no conflict of interest.

Notes/thanks/other declarations

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Author details

Hervé Joël Tchognia Nkuissi[1,2*], Fransisco Kouadio Konan[2,3], Bouchaib Hartiti[2] and Jean-Marie Ndjaka[1]

1 Laboratory of Mechanics, Materials and Structure, Department of Physics, Faculty of Science, University of Yaoundé I, Yaoundé, Cameroon

2 ERDyS Laboratory, Materials, Energy, Water, Modeling and Sustainable Development Group, Faculty of Science and Technique, Hassan II University of Casablanca, Mohammedia, Morocco

3 Laboratory of Solar Energy and Nanotechnology, Research Institute on New Energies, Nangui Abrogoua University, Abidjan, Côte d'Ivoire

*Address all correspondence to: hervetchognia@gmail.com

References

[1] Bain R, Denholm P, Heath G, Mai T, Tegen S. Biopower technologies. In: Hand MM, Baldwin S, DeMeo E, Reilly JM, Mai T, Arent D, et al., editors. Renewable Electricity Futures Study. Vol. 2. Golden, Colorado, United States: National Renewable Energy Laboratory; 2012. pp. 6-1-6-58. NREL/TP-6A20-52409-2.Ch6

[2] National Renewable Energy Laboratory (NREL). Best Research-Cell Efficiencies [Internet]. 2018. Available from: https://www.nrel.gov/pv/cell-efficiency.html [Accessed: February 11, 2019]

[3] Minnaert, B. Thin Film Solar Cells: An Overview [Internet]. 2008. Available from: https://biblio.ugent.be/publication/4238935/file/4238983.pdf [Accessed: February 12, 2019]

[4] Partain LD. Solar Cells and Their Applications. 1st ed. New York, United States: John Wiley and Sons Ltd; 1995. p. 600. ISBN: 9780471574200

[5] Goetzberger A, Hebling C. Photovoltaic materials, past, present, future. Solar Energy Materials and Solar Cells. 2000;**62**:1-19

[6] Haug FJ, Zurich ETH. Solar Cells: Thin Film Solar Cells [Internet]. 2018. Available from: http://www.tfp.ethz.ch/Lectures/pv/thin-film.pdf [Accessed: February 15, 2019]

[7] Andersson BA, Jacobsson S. Monitoring and assessing technology choice: The case of solar cells. Energy Policy. 2000;**28**:1037-1049

[8] Summers K, Radde J. Potential Health and Environmental Impacts Associated with the Manufacture and Use of Photovoltaic Cells. Vol. 98. Sacramento, CA, United States: EPRI and California Energy Commission; 2003

[9] Neumann H. Optical properties and electronic band structure of CuInSe2. Solar Cells. 1986;**16**(1-4):317-333. DOI: 10.1016/0379-6787(86)90092-X

[10] Moller HJ. Semiconductors for Solar Cells. ARTECH House; 1993. p. 343. ISBN: 978-0890065747

[11] Goetzberger A, Hebling C, Schock HW. Photovoltaic materials, history, status, and outlook. Materials Science and Engineering. 2003;**40**:1-46

[12] Spectrolab. Triple-Junction Terrestrial Concentrator Solar Cells [Internet]. 2003. Available from: http://www.spacedaily.com/reports/Spectrolab_Terrestrial_Solar_Cell_Concentrator_Maxs_Energy_Conversion.html [Accessed: February 16, 2019]

[13] Green MA, Hishikawa Y, Dunlop ED, Levi DH, Hohl-Ebinger J, Ho-Baillie AWY. Solar cell efficiency tables (version 51). Progress in Photovoltaics: Research and Applications. 2018;**26**: 3-12. DOI: 10.1002/pip.2978

[14] Yoshikawa K, Kawasaki H, Yoshida W, Irie T, Konishi K, Nakano K, et al. Silicon heterojunction solar cell with interdigitated back contacts for a photoconversion efficiency over 26%. Nature Energy. 2017;**2**(17032):1-5

[15] Benick J, Richter A, Müller R, Hauser H, Feldman F, Krenckel P, et al. High-efficiency n-type HP mc silicon solar cells. IEEE Journal of Photovoltaics. 2017;**7**:1171-1175. DOI: 10.1109/JPHOTOV.2017.2714139

[16] Verlinden PJ. Will we have > 22% efficient multi-crystalline silicon solar cells? In: Presented at PVSEC 26; Singapore. 2016. pp. 24-28

[17] Kato T, Handa A, Yagioka T, Matsuura T, Yamamoto K, Higashi S, et al. Enhanced efficiency of Cd-free

Cu(In,Ga)(Se,S)2 minimodule via (Zn,Mg)O second buffer layer and alkali post treatment. In: Proceedings of the 44th IEEE Photovoltaic Specialists Conference; 25-30 June 2017. Washington DC, New York: IEEE; 2017

[18] Sugimoto H. High efficiency and large volume production of CIS-based modules. In: 40th IEEE Photovoltaic Specialists Conference, Denver, 8-13 June 2014. 2014. pp. 2767-2770. DOI: 10.1109/PVSC.2014.6925503

[19] First Solar Press Release. First Solar Builds the Highest Efficiency Thin Film PV Cell on Record [Internet]. 2014. Available from: https://investor.firstsolar.com/news/press-release-details/2014/First-Solar-Builds-the-Highest-Efficiency-Thin-Film-PV-Cell-on-Record/default.aspx [Accessed: April 13, 2019]

[20] First Solar Press Release. First Solar Achieves World Record 18.6% Thin Film Module Conversion Efficiency [Internet]. 2015. Available from: https://investor.firstsolar.com/news/press-release-details/2015/First-Solar-Achieves-World-Record-186--Thin-Film-Module-Conversion-Efficiency/default.aspx [Accessed: April 13, 2019]

[21] Keevers MJ, Young TL, Schubert U, Green MA. 10% efficient CSG minimodules. In: Proceedings of the 22nd European Photovoltaic Solar Energy Conference; 3-7 September 2007. Milan; 2007. pp. 1783-1790

[22] Matsui T, Sai H, Suezaki T, Matsumoto M, Saito K, Yoshida I, et al. Development of highly stable and efficient amorphous silicon based solar cells. In: Proceedings of the 28th European Photovoltaic Solar Energy Conference; September 30–October 4 2013. Paris; 2013. pp. 2213-2217. DOI: 10.4229/28thEUPVSEC2013-3DO.7.2

[23] Kayes BM, Nie H, Twist R, Spruytte SG, Reinhardt F, Kizilyalli IC, et al. 27.6% conversion efficiency, a new record for single-junction solar cells under 1 sun illumination. In: Proceedings of the 37th IEEE Photovoltaic Specialists Conference; 19-24 June 2011; Seattle. New York: IEEE; 2012. DOI: 10.1109/PVSC.2011.6185831

[24] Mattos LS, Scully SR, Syfu M, Olson E, Yang L, Ling C, et al. New module efficiency record: 23.5% under 1-sun illumination using thin-film single-junction GaAs solar cells. In: Proceedings of the 38th IEEE Photovoltaic Specialists Conference; 3-8 June 2012; Austin. New York: IEEE; 2012. DOI: 10.1109/PVSC.2012.6318255

[25] Sun K, Yan C, Liu F, Huang J, Zhou F, Stride JA, et al. Over 9% efficient kesterite Cu_2ZnSnS_4 solar cell fabricated by using Zn1-xCdxS buffer layer. Advanced Energy Materials. 2016;**6**(12):1600046. DOI: 10.1002/aenm.201600046

[26] Fraunhofer Institute for Solar Energy Systems ISE. Photovoltaics Report [Internet]. 2019. Available from: https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/Photovoltaics-Report.pdf [Accessed: April 13, 2019]

[27] Azom. Photovoltaic – Concentrator Systems [Internet]. 2003. Available from: http://www.azom.com/details.asp?ArticleID=1173 [Accessed: February 13, 2019]

[28] Surek T. Photovoltaics: Energy for the New Millenium [Internet]. 2003. Available from: http://www.aps.org/units/fps/meetings/april2000/surek.html [Accessed: February 13, 2019]

[29] Powalla M, Bonnet D. Thin-film solar cells based on the polycrystalline compound semiconductors CIS and CdTe. Advances in OptoElectronics. 2007;**2007**:6. DOI: 10.1155/2007/97545

[30] Hill R, Baumann AE. Environmental costs of photovoltaics. IEE Proceedings A Science, Measurement and Technology. 1993;**140**:76-80. DOI: 10.1049/ip-a-3.1993.0013

[31] Moskowitz PD. An overview of environmental, health and safety issues in the photovoltaic industry. In: Partain LD, editor. Solar Cells and Their Applications. 1st ed. New York, NY: John Wiley & Sons, Inc.; 1995. pp. 391-416. Chapter 18

[32] Fthenakis VM. Overview of potential hazards. In: Markvart T, Castaner L, editors. Practical Handbook of Photovoltaics: Fundamentals and Applications. Elsevier; 2003. pp. 1-14. ISBN 1-856-17390-9.chVII-2

[33] Gilles DG, Loehr RC. Waste generation and minimization in semiconductor industry. Journal of Environmental Engineering (ASCE). 1994;**120**:72-86

[34] Drysdale D. An Introduction to Fire Dynamics. 1st ed. Wiley; 1985. p. 424

[35] Patterson M, Turner A, Sadeghi M, Marshall R. Health, safety and environmental aspects of the production and use of CdTe thin film modules. In: Proceedings of the 12th European PV Solar Energy Conference; 11-15 April 1994; Amsterdam. 1994. pp. 951-953. ISBN: 0952145235

[36] Thumm W, Finke A, Nuemeier B, Beck B, Kettrup A, Steinberger H, et al. Environmental and health aspects of CIS-module production, use and disposal. In: Proceedings of 1994 IEEE First World Conference on Photovoltaic Energy Conversion; 5-9 December 1994; Hawaii. New York: IEEE; 1994. pp. 262-265

[37] Steinberger H. HSE for CdTe and CIS thin film module operation. In: Niewlaar E, Alsema E, editors. IEA Expert Workshop on Environmental Aspects of PV Power Systems; May 23, 1997, Report No. 97072. The Netherlands: Utrecht University; 1997

[38] Bohland J, Smigielski K. First solar's CdTe module manufacturing experience; environmental, health and safety results. In: Proceedings of the 28th IEEE Photovoltaic Specialists Conference; 17-22 September 2000; Anchorage, Alaska. New York: IEEE; 2000. pp. 575-578

[39] Miles RW, Hynes KM, Forbes I. Photovoltaic solar cells: An overview of state-of-the-art cell development and environmental issues. Progress in Crystal Growth and Characterization of Materials. 2005;**1**:1-42

[40] Piscator M. The essentiality and toxicity of selenium. In: Carapella SC, editor. In: Proceedings of the Fourth International Symposium on Uses of Selenium and Tellurium; 7-10 May 1989; Alberta, Canada

[41] Fthenakis V. Multi-layer protection analysis for photovoltaic manufacturing. Process Safety Progress. 2001;**20**(2):1-8

[42] Bayer A, Boyle DS, Heinrich MR, O'Brien P, Otway DJ, Robbe O. Developing environmentally benign routes for semiconductor synthesis: Improved approaches to the solution deposition of cadmium sulfide for solar cell applications. Green Chemistry. 2000;**2**:79-86. DOI: 10.1039/A909257I

[43] Bohland J, Dapkus T, Kamm K, Smigielski K. Photovoltaics as hazardous materials: The recycling solution. In: Fthenakis V, Zweibel K, Moskowitz P, editors. Presented at the BNL/NREL Workshop on Photovoltaics and the Environment 1998, Keystone, Colorado, July 23-24; 1998. pp. 33-40

[44] Goozner R, Byrd C, Long M, Drinkard WF. Recycling thin film photovoltaic materials. In: Fthenakis V, Zweibel K, Moskowitz P, editors. Presented at the BNL/NREL Workshop

on Photovoltaics and the Environment 1998, Keystone, Colorado, July 23-24. 1998. pp. 42-59

[45] Menezes S. Electrochemical solutions to some thin-film PV manufacturing issues. Thin Solid Films. 2000;**361-362**:278-282

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REVIEW

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Third-Generation Solar Cells: Toxicity and Risk of Exposure

Elina Buitrago,[a, b] Anna Maria Novello,[a, b] and Thierry Meyer*[a, b]

[a] Ecole Polytechnique Fédérale de Lausanne (EPFL), Safety Competence Center (DSPS-SCC), Station 6, CH-1015 Lausanne, Switzerland

[b] Ecole Polytechnique Fédérale de Lausanne (EPFL), Group of Chemical and Physical Safety (ISIC-GSCP), Station 6, CH-1015 Lausanne, Switzerland, e-mail: thierry.meyer@epfl.ch

Dedicated to our colleague and friend *Michael Grätzel*

Solar energy is considered clean energy, and its use is predicted to increase in the near future. Most installed units today are crystalline solar cells, but the field is in constant development, and when the first dye sensitized solar cell was published by *Grätzel* and *O'Reagan* a new, third-generation, solar power was born. Highly toxic metals are used to produce the photovoltaic units today, and with the predicted increase in solar cell installation, the human health hazards of these panels could become an issue. Additionally, many of these materials are used in their nanoform, which is associated with an additional risk. In this article, we discuss the technology behind the third-generation solar cells with its valuable use of nanotechnology as well as the possible health hazard when such nanomaterials are used in solar power units. We will show that the main exposure will occur either during the development and production phases or at the end-of-life stage of the solar cells, where toxic material can leach into landfills, and subsequently into the environment and impact the ecosystem directly, or humans indirectly through edible plants or drinking water.

Keywords: nanosafety, *Grätzel* cells, solar power, occupational and public safety, photovoltaics, nanotechnology, photochemistry.

1. Introduction

The first solar cell (SC) in Switzerland was installed in 1982, and since then, the use of solar power has increased steadily (*Figure 1*). At the end of 2018, 1945 GWh had been produced by solar panels, which corresponds to the energy needs of half a million households.[1] The European Union installed a total of 131.9 GW of solar panels in 2019 with the largest solar power producers being Germany, Spain, The Netherlands, France and Italy.[2] The global photovoltaic (PV) energy systems represented 513.2 GW in 2018, out of which 54% were installed in the last three years.[3] In 2017, Switzerland accepted the new energy strategy 2050 that has defined the first milestone as producing 7 TWh with solar power by 2025.[4]

Figure 1. Cumulative photovoltaic capacity connected in the EU[3,5] and Switzerland[4] per year.

Solar power is considered a clean source of energy, since it neither releases any CO_2 nor creates any waste in the energy production process, and with the urgent requirements for clean energy it is expected that the solar power development continues over the coming

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years. Solar cell production is, however, not a green process, an issue that will have to be mitigated before the technology would be ready to take over the energy market.

While solar power is a very promising prospect, there are still some weaknesses in the technology in terms of conversion rate and stability. Extensive research is ongoing to produce new generation SC (*Figure 2*) with improved properties, and in the last decade, the third generation SC has reached the fame of the previous technologies. The most promising prospect seems to be the combination of established strategies with nanotechnology, like for example the halide perovskite SC, that have been studied extensively in the last years.

Nanotechnology has shown its usefulness in almost all industries, and the use of nanomaterials (NM) in consumer products is growing steadily. NM differ significantly from their bulk counterparts, as they have a much larger active surface that gives them extraordinary characteristics in terms of strength, conductivity and chemical reactivity. NM are used in many consumer applications to increase material strength, transport of pharmaceuticals as drug carriers and also in the field of solar energy.

Using NM instead of the corresponding bulk materials to produce SC significantly reduces production costs and gives thinner and more flexible units that are easier to install. NM in photovoltaics range from titanium dioxide crystals in dye-sensitized solar cells (DSSC) to the use of lead halide perovskites.[5–9]

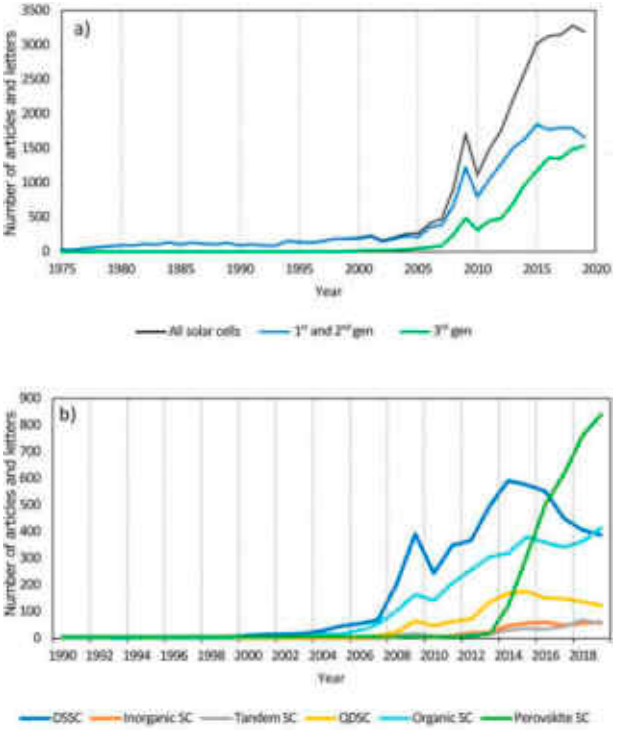

Figure 2. Number of publications (articles and letters) per year (Source Scopus, March 31st, 2020, see *Supporting Information*). a) Number of publications about solar cells in general between 1975 and 2019. b) Number of publications about the 3rd generation of solar cells between 1990 and 2019. SC = solar cell; DSSC = dye-sensitized solar cell; QDSC = quantum dot solar cell.

Elina Buitrago works as a chemical safety specialist at EPFL since 2016. She studied organometallic chemistry at Stockholm University where she also received her PhD, followed by postdoctoral research at Université Grenoble Alpes in the field of bioinorganic chemistry. Her focus today is on nanomaterial safety.

Anna Maria Novello works as a safety specialist at EPFL since 2016. She studied condensed matter physics at University of Trieste. Then she moved to University of Geneva where she received her PhD in Physics with a research work in the field of scanning probe microscopy. Her focus today is nanomaterial safety.

Thierry Meyer currently serves as both head of the Safety Competence Center and head of the research group on Chemical and Physical Safety at EPFL, Switzerland. His professional affiliations include industrial companies as Ciba Geigy Inc., Ciba Specialty Chemicals, etc. His research interest embraces risk and safety management, safety culture, decision making, nano- and lab-specific hazards.

While these new technologies have extraordinary potential in terms of environmental benefits and costs, health hazards involved with the technology must be evaluated. PV panels are partly made up of toxic materials and NM that could affect the health of humans through occupational or environmental exposure. The use of NM in research & development and production is one of the biggest challenges for health and safety specialists. The toxicity of these materials is not fully known or understood, and occupational exposure is difficult to estimate due to the high amount of ambient NM and lack of specificity of measurement methods. In this article, we have focused on the occupational and public health hazards that could arise from the use of NM in third generation SC, in particular what we can call the 'dye-family' of SC including dye-, quantum dot (QD) and perovskite-sensitized SC, and we will discuss some mitigation strategies to protect workers from these hazards.

2. Photovoltaic Energy

The operating principle of PV cells is based on the PV effect discovered by *Edmund Becquerel* in 1839, which consists in the generation of an electric voltage in certain types of materials when they are exposed to light.[10]

PV technology was born in 1954 in the *Bell* labs when *Daryl Chapin*, *Calvin Fuller* and *Gerald Pearson* developed the first silicon PV cell with an efficiency of 6%, in which the term efficiency corresponds to the ratio between the generated maximum power and the incident optical power.[11] Initially used in aerospace applications, the interest in photovoltaics increased in the 1990s when people started looking into alternatives to fossil fuels. As a consequence, PV production has expanded at a rate of 15–25% per year, and the cost of this new technology has decreased.[12]

The three basic elements to generate a photocurrent in a SC are:[13]

- a light-sensitive material, where the incident photons can generate charge carriers;
- separation of charge carriers;
- an external circuit to collect the photo-generated charge carriers.

PV technologies are classified into three generations according to their appearance on the market (*Figure 3*), and they can be made using a p-n junction (first and second generation), a photoelectrochemical system (third generation sensitized SC) or a heterojunction (third generation).

General requirements for the ideal SC material are:[14]

- bandgap in the visible near-infrared region;
- direct band structure;
- readily available, non-toxic materials;
- easy, reproducible deposition technique, suitable for large-scale production;
- good PV conversion efficiency;
- long-term stability.

The first generation of SC is based on mono- or polycrystalline silicon, which is so far the predominant technology on the market. The disadvantages are the cost, the complex process of manufacturing and assembly, and the large amount of highly purified silicon needed as raw material.[15] The second generation is based on thin film technologies. A thin layer of semiconductor material – from a few nanometers to tens of micrometers – is deposited on a substrate such as glass, stainless steel, or plastic. The small amount of semiconductor needed allows to reduce the cost and to build flexible devices. The most used materials in this case are amorphous silicon, cadmium telluride, copper indium gallium diselenide, copper indium diselenide and gallium arsenide. However, there are some concerns and drawbacks related to this technology too: amorphous silicon is easily degradable, cadmium is highly toxic, tellurium is a rare element, and the other type of thin films have higher manufacturing costs.[15,16] Moreover, they have on average a lower efficiency compared to the first generation.[16] The third generation includes all non-silicon based technologies such as organic/semi-organic PV panels, perovskite solar cell (PSC), dye sensitized solar cells (DSSC) and QD cells. These new technologies should allow a reduction in the costs and a higher efficiency thanks to alternative mechanisms of energy conversion, bringing together the advantages of both first and second generation.[16] Although they are today mainly at the laboratory stage, they are quite promising for future applications, and will soon gain their place in the market as shown in a recent study of the International Renewable Energy Agency (IRENA) and International Energy Agency (IEA).[17] Results from this study are reported in *Table 1* where the percentages represent the market share of PV panels by technology groups in the years 2014 (real data), 2020 (projection), and 2030 (projection).

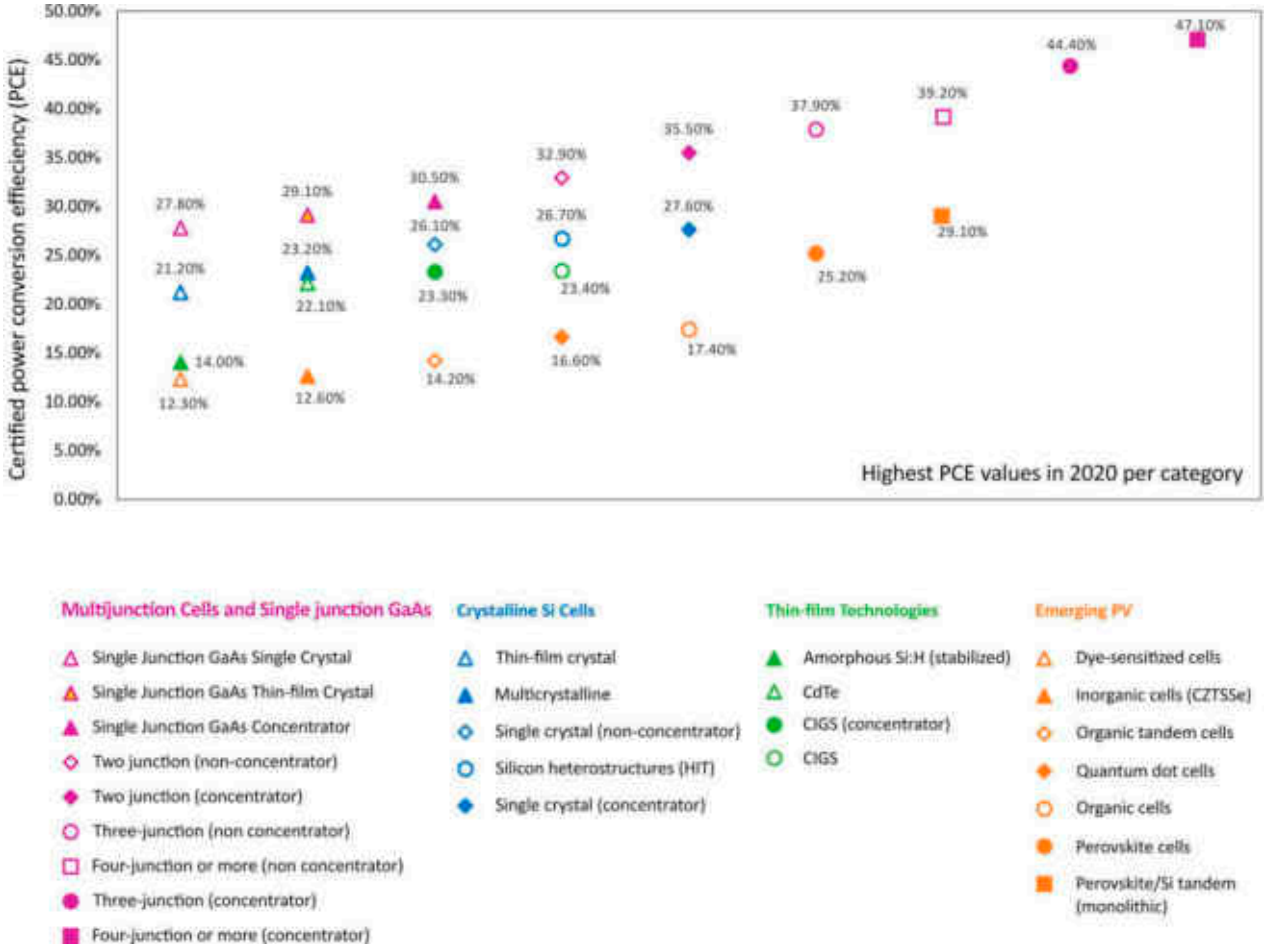

Figure 3. Best research cell efficiency in 2020 for the 3rd generation solar cells. Data from the 'Best research cell-efficiency chart' by the National Renewable Energy laboratory (NREL).[38]

3. *Grätzel* Cells and The Third-Generation Photovoltaic Cells

3.1. *History*

The relatively high cost and complicated manufacturing of first and second generation SC has stimulated the development of new PV technologies, the third-generation PV cells (*Figure 3*). Employment of new concepts using semiconductor nanoparticles has the potential to overcome the *Shockley–Queisser* limit of 30%[18] power efficiency for single-bandgap SC and thereby reach efficiencies of up to 95%.[19]

Notably, the first dye sensitized solar cell (DSSC) was published in 1991 by *Grätzel* and *O'Regan*.[20] They demonstrated a cell that uses nanoporous TiO_2 electrodes to increase the roughness of the surface, and thereby increasing the number of dye molecules attached to the surface. The cell reached conversion efficiency of 7.1–7.9% in artificial sunlight and 12% in diffuse sunlight. They showed that quantitative conversion using nanostructured titanium oxide and a charge transfer dye could theoretically reach quantitative conversions, and the article was the starting point of a new generation in photovoltaics.[20] Since then, there has been a rapid development of DSSC, with the last certified power conversion efficiency (PCE) for DSSC is 12.3% obtained with a zinc–porphyrin co-sensitized DSSC by the *Grätzel* group in 2011.[21] A comparable result was obtained in 2019 by *Zhang et al.* with a DSSC containing a triazatruxene-based sensitizer (ZL003) that showed a certified PCE of 12.4%. This was quite a promising result since the experimental PCE for their DSSC based on ZL001 and ZL003 reached even higher PCE of 12.8% and 13.6% respectively, already showing potential for future improvements.[22]

In order to improve the efficiency and stability of DSSC, there have been efforts in finding alternatives to

Table 1. Percentages in the table represent the market share of PV panels by technology groups in the years 2014 (real data), 2020 (projection), 2030 (projection). Reproduced from International Renewable Energy Agency (IRENA) and International Energy Agency (IEA), 2016. End-of-life management: solar PV panels.[17]

Technology		2014	2020	2030
Silicon-based (c-Si)	Monocrystalline Poly- or multicrystalline Ribbon a-Si (amorph/micro-morph)	92%	73.3%	44.8%
Thin-film based	Copper indium gallium (di)selenide (CIGS)	2%	5.2%	6.4%
	Cadmium telluride (CdTe)	5%	5.2%	4.7%
Other	Concentrating solar PV (CPV)	1%	1.2%	0.6%
	Organic PV/dye-sensitized cells (OPV)		5.8%	8.7%
	Crystalline silicon (advanced c-Si)		8.7%	25.6%
	CIGS alternatives, heavy metals (for example, perovskite), advanced III–V		0.6%	9.3%

liquid electrolytes and molecular dyes. Liquid electrolytes have some technological limitations such as dye desorption, solvent evaporation and degradation, or seal imperfections. A solution to these issues has been proposed by *Tennakone et al.* who built the first solid state SC, where the dye molecules were inserted between a n-type semiconductor layer and a p-type semiconductor layer.[23] Although the efficiency of this prototype was quite low (0.8%), this first attempt opened the path towards a new class of solid state DSSC with improved efficiency and stability.[24]

Another way to improve the DSSC efficiency is to find alternatives to the current molecular dyes. The most promising alternatives to them are QD, and perovskites. QD are semiconductor nanoparticles, and they are quite promising as sensitizers due to their tunable band gap properties and high absorption coefficient, and at the same time, they require low-temperature solution processing. The energy bandgap can easily be tuned by varying the size with smaller QDs showing a blue-shifted energy spectrum and larger QDs having a red-shifted energy spectrum.[8] This means that combining QDs of different sizes it is possible to capture a larger portion of the light spectrum of the sun. The first QD solar cell was developed by *Zaban et al.* in 1998, and It was based on InP QDs attached to mesoporous TiO_2.[25] An improvement was obtained in 2002 in the *Grätzel* group, where *Plass et al.* built the first solid-state quantum dot sensitized solar cell, which reached an efficiency of 0.49%.[26] There are also other types of QD SC[27] such as *Schottky* junction solar cell,[28,29] p-n junction solar cells (homojunction[30,31] or heterojunction[32,33]) and hybrid QD-polymer SC,[34–36] but at the moment, they are all less efficient than QD sensitized SC. The last maximum certified PCE was reached in 2019 is 16.6% for a mixed cesium and formamidinium lead triiodide perovskite system ($Cs_{1-x}FA_xPbI_3$),[37] which brings together the best of QDs and perovskite properties in a QD sensitized solar cell. Perovskites have been known since 1939, when the mineral calcium titanium oxide ($CaTiO_3$) was discovered in the Ural Mountains of Russia by *Gustav Rise*, but they were first applied for SC in 2009 by *Kojima* and coworkers.[38] They used an organometal halide perovskite as a visible-light sensitizer obtaining an efficiency of almost 4%. A big improvement was obtained in 2012, when *Kim et al.* fabricated the first solid state PSC reaching an efficiency of 9.7%.[39] The present records in efficiency are 25.2% obtained at the Korea Research Institute of Chemical Technology in 2019 for a PSC, and 29.15% obtained at the Helmholtz-Zentrum Berlin in 2020 for a SC made of perovskite in tandem architecture with Silicon.[40] PSC have recently outperformed other kinds of DSSC and are widely considered the most promising solution for future energy generation systems.[41]

Two other important families of SC worth to mention are organic and inorganic SC. Organic SC are made of thin film polymers and small molecules and they have the advantage of being flexible, low weight and low cost.[42] Since the first organic cell fabricated in 1958 by *Kearns* and *Calvin*,[43] much progress has been made in this field. Nowadays the highest certified PCE is 17.4%, reached in 2018.[44] Inorganic SC belonging to the third generation are the evolution of the thin film technology of the second generation. Due to the toxicity of cadmium and the rarity of indium and tellurium, a big effort has been spent in finding alternatives. The possible substituted materials are compounds containing copper, zinc, tin and selenium (Cu_2ZnSnS_4 (CZTS), $Cu_2ZnSnSe_4$ (CZTSe), and $Cu_2ZnSn(S,Se)_4$ (CZTSSe)). This family of compounds has a tunable bandgap, a high absorption coefficient, and is made of non-toxic and quite abundant elements. The first CZTS solar cell was built in 1997 and it reached an efficiency of 0.66%.[45] The current certified record is 12.6% in 2013 obtained in the IBM labs.[46]

So far, only DSSC and organic SC have found some commercial applications while all the other third generation SC are still in the laboratory/prototype phase.[8]

3.2. *Structure of a DSSC*

The difference between DSSC and conventional SC is the separation of the function of light absorption (the dye) from the function of charge carrier transport (a n-type material such as TiO_2).[20] A DSSC is a photo-electrochemical cell where the main components are a dye-sensitized photoanode, a liquid electrolyte and a counter electrode.[47] The photoanode is a mesoporous metal oxide layer usually made of TiO_2 nanoparticles where the sensitizer is anchored. The photoanode is deposited on top of a transport conducting oxide (TCO) such as fluorine-doped tin oxide or indium-doped tin oxide, but also graphene, aluminum-doped zinc oxide and doped TiO_2. The most common electrolyte is an iodide-triiodide electrolyte, while the counter electrode is usually made of TCO coated with platinum. When the light illuminates the SC, the electrons in the valence band of the sensitizer absorb photons and they acquire enough energy to jump to the conduction band. The excited electrons are then injected into the conduction band of the photoanode while holes are transferred to the electrolyte. The electrons reach the counter electrode through an external circuit, while the dye is regenerated by electron transfer from a redox species in solution, the oxidized redox mediator diffuses towards counter electrode.[8,20]

In the most recent DSSCs the liquid electrolyte solution has been substituted in order to obtain a solid state device, but the structure remains quite similar[48] with a metal-based cathode, a hole transport material (HTM), an absorber layer, an electron transport material (ETM) and a transparent conductive layer (TCO). The role of the HTM – such as 2,2′,7,7′-tetrakis[*N*,*N*-di(4-methoxyphenyl)amino]-9,9′-spirobifluorene (Spiro-OMeTAD), NiO, CuO, CuI, Cu_2O and poly(triarylamine) (PTAA) – is to collect holes from the absorber layer, transport them towards the cathode and block electrons. In a similar way the function of the ETM is to collect electrons from the absorber layer, transport them towards the anode and block holes. A good ETM will have high transmittance in the UV-Visible region so that photons can be easily absorbed by the absorber layer. Examples of ETM are TiO_2, SnO_2, SiO_2, ZnO. In general, transport layers need not only to have good thermal stability and a good resistance towards external degrading factors, but also to be non-toxic.

4. Toxicity of Materials in Third-Generation Solar Cells

With this generation of SC arising, a new range of materials is being introduced on the market and many of them are in nanoform. The toxicity of NM is not fully known, but they are believed to be biopersistent due to their high stability, and their small size makes it possible for them to access biological systems. The most commonly used materials in the third-generation SC are:

- ruthenium dyes,
- TiO_2,
- quantum dots (QD),
- lead halide perovskites.

Ecotoxicology data related to SC components is still lacking,[49–52] in particular for the third generation, since this technology is not on the market yet, and the main effort is spent in improving their efficiency leaving aside the ecotoxicological studies.[48]

4.1. *Sensitizer Dyes*

Ruthenium is a rare transition metal that is not used in large quantities in any consumer products, and ruthenium compounds are rarely encountered by people. Industrially, it is used in small amounts as a hardener, and interest in the metal was sparked by its use as a sensitizer in the DSSC.[53] Ruthenium has a very rich redox chemistry, and it is also used in medicine as a less toxic alternative to platinum in chemotherapeutics.[54] Ruthenium compounds have been shown to be both moderately toxic and carcinogenic.[55]

4.2. *Titanium Dioxide Nanomaterials*

TiO_2 is a non-toxic metal oxide that is used in many consumer products, such as sunscreen and paint, and as a safe whitening agent in toothpaste and food products. It is not classified as hazardous to humans[56] and a 'no observed adverse effect limit' (NOAEL) of 2250 mg/kg bodyweight after oral exposure has been widely accepted.[57] IARC has categorized TiO_2 as possibly carcinogenic to humans (2B) based on results from lung exposure in rats,[58] but rats are particularly sensitive to lung overload, which could explain the increased tumor incidence.[59] Epidemiological studies

on workers exposed to TiO_2 show no evidence of increased risk of lung cancer from occupational exposure.[59]

TiO_2 NM were until recently considered to be equally harmless, but recent studies show that nano-sized TiO_2 has different biological effects than the bulk material.[60] Cellular damage caused by nanoparticles generally occurs through oxidative pathways, through reactive oxygen species (ROS) formation, upregulation of inflammatory pathways and DNA breakage.[61] Because of the uncertainty arising from NM content and hazard, the lack of sufficient information for a risk assessment and by applying the precautionary principle, the French government banned the use of TiO_2 (food additive E171) in food from 2020 on.[62]

There are two main forms of TiO_2, rutile and anatase, that have different physical and chemical properties. Out of the two, anatase has a larger band gap, is more chemically reactive and has a more active surface, properties that make it both more attractive to use and more toxic.[63,64]

The toxicity of TiO_2 NM depends on various aspects, but among the most important ones are size, aspect ratio and surface reactivity. TiO_2 NM can cross biological barriers and accumulate in tissues and organs. They are both cytotoxic and genotoxic, and since hepatocytes are the main metabolizers of NM, ingestion of TiO_2 NM can lead to liver injury.[65] Hepatic damage could already be detected in mice at doses of 10 mg/kg bodyweight when administered for 14 days.[66]

TiO_2 NM can affect the integrity of and cross the blood brain barrier, accumulate in the brain and cause oxidative damage to the neurons by disturbing the oxidant and antioxidant processes, as well as cause injury through inflammatory and apoptotic pathways.[67,68] Brain damage in the form of morphological changes and loss of spatial recognition memory was detected in mice exposed to 5 mg/kg bodyweight for 60 consecutive days.[69] Additionally, TiO_2 NM can interact with other hazardous chemicals and facilitate their access through biological membranes by functioning as a carrier, or cause synergistic toxicity.[70]

The large variations in hazard effect doses make it a challenge to assess the actual risk of TiO_2 NM exposure. Not all experiments are done with the NM size and with the same protocol, which makes direct comparison unreliable. The difference in hazard level between NM and bulk is, however, evident when comparing the adverse effect doses from toxicological studies: while bulk TiO_2 is completely inert and the no-effect dose is in the gram range, TiO_2 NM induce adverse effects already at mg doses.[58]

4.3. *Lead Halide Perovskites*

Using lead halide perovskites is considered among the state of the art in SC development,[71] they have certified conversion efficiency of more than 25% and it has been predicted that the methodology can be commercialized in the near future.[72]

While the high PCE shows promise for the future, public use of lead containing materials, in particular highly soluble materials such as perovskites, is cause for concern. WHO lists lead as one out the ten chemicals of major public health concern, and because of the known toxicological hazards the use of lead in gasoline and paint has been phased out, with many countries banning its use for these applications.[73]

Lead is a highly toxic metal that affects almost all organs, in particular the central and peripheral nervous systems,[74] the hematopoietic[75,76] and renal systems,[77] and it acts as an immunosuppressant.[78,79]

In addition, lead is strongly toxic to the reproductive system of both males and females. Of particular importance, it can cross the placental barrier affecting the developing fetus severely, and it can pass through the breast milk to the newborn child and affect the development of the brain.[80]

Divalent lead acts as a calcium analogue; it can replace Ca^{2+}, and consequently be stored in bones and teeth. This storage is sensitive to alterations in calcium homeostasis and lead can be released into the blood even years after exposure has occurred. Lead release can be triggered by pregnancy, lactation and menopause.[81] Lead initially binds to red blood cells after exposure and is transported to different organs and tissues through the systemic circulation.[82] The half-life of lead is approximately 30 days in blood, and 10–30 years in bone, which leads to significant bioaccumulation.[83]

The European chemicals agency (ECHA) has determined 'no observed adverse effect levels' (NOAELs) for the most common endpoints based on epidemiological studies (*Table 2*). Renal and hematological effects in adults can occur at blood lead levels (BLL) higher than 60 and 50 μg/dL respectively, while the same value for the CNS is 40 μg/dL. Reproductive effects can occur at BLL above 30 μg/dL. Children are particularly susceptible to lead toxicity because of their soft tissue that allows for much higher absorption, and their still developing nervous system. There are no known safe levels for lead in children, neurological damage in

Table 2. No observed adverse effect levels values for different endpoints reproduced from the European chemicals agency (ECHA) lead registration dossier[90]

Health effects endpoint	NOAEL	Exposed population
Renal system effects	60 µg/dL	Adults
	25 µg/dL	Child
Hematological effects	50 µg/dL	Adults
	40 µg/dL	Child
Reproductive effects (male)	45 µg/dL	Male adults
Nervous system effects (adult)	40 µg/dL	Adults
Reproductive effects (female)	30 µg/dL	Women of child-bearing capacity
Nervous system effects (fetal developmental effects) during pregnancy	10 µg/dL	Pregnant women/women of child-bearing capacity
Nervous system effects (child)	5 µg/dL	Individual child
Nervous system effects (child)	2 µg/dL	Population based child limit

children has been detected at BLL below 5 µg/dL (*Table 2*).[73] The center for disease control (CDC) in the US has set 5 µg/dL as a blood level reference value to identify children that are exposed to lead.[84]

At cellular level, the toxic mechanisms of lead can be divided into two groups, oxidative stress and ionic toxicity.

Oxidative stress is caused both by increased ROS production, and through depletion of the antioxidant response. Although lead is not a redox active metal, it has been shown to increase the generation of ROS.[85] Lead is capable of forming covalent bonds with the sulfur in glutathione (GSH), the main antioxidant response, thereby decreasing antioxidant activity and hindering neutralization of the released ROS.[86] A reduction in the activity of antioxidant enzymes has been identified in lead-exposed workers.[87,88]

In the blood, lead interferes with the heme synthesis, which leads both to decreased levels of hemoglobin that is, anemia, as well as build-up of the heme precursor delta-aminolaevulinic acid (ALA), which is itself harmful to neurons.[89]

The ionic toxicity is due to substitution of other divalent cations, in particular calcium, with lead and thereby interfering with biological processes. Calcium homeostasis is crucial for cell survival,[91] and lead binds to calcium-activated proteins with higher affinity than calcium itself. The neurotoxic effects of lead are connected to this ability to substitute calcium in biological functions and interfere with ion channels and pumps,[92] which is also the how lead passes through the blood brain barrier.[93]

Lead affects the CNS and gives lower IQ, behavioral changes and learning deficits. During its development the brain is very sensitive to the effects of lead, which is why children are more sensitive to lead exposure.[94] Adult exposure reversibly affects motor function through damage to the peripheral nervous system.[95,96]

Alternatives to Lead Halide Perovskites. Because of the high toxicity of lead, extensive research is dedicated to finding a less hazardous alternative. Some of the most commonly studied candidates include bismuth-, tin- and germanium-based perovskites, but out of these, tin has been identified as the most promising one because it shows similar electro-optical properties as lead.[97,98] While tin is advertised as a non-toxic alternative to lead, tin has also been identified as a harmful chemical. In particular, certain organo-tin compounds hold high acute toxicity.[99,100]

A comparison between the toxic effects of PbI_2 and SnI_2 on *Danio Rerio* embryos indicated significantly higher toxicity of tin iodide, with lower EC_{50} and LD_{50} values measured. However, the toxic effect was believed to be related to the much lower pH generated by SnI_2 in water. Additionally, Sn precipitates as a toxicologically inactive compound under acidic conditions.

Pb, on the other hand, exhibits heavy metal toxicity. While the mechanism of toxicity differs, and the chronic effects are lower for Sn, it is still important to consider the environmental impact of the highly acidic conditions created by tin.[101]

4.4. *Quantum Dot Solar Cells*

QDs vary a lot in structure and composition, which makes it impossible to generalize about their toxicity. The QD used in photovoltaics contain one or several toxic metals: CdS, CdTe, CdSe, PbS, PbSe, SnS or SnSe. Due to the high toxicity of some of the heavy metals that the QD are made up of, there is some concern

about the toxicity of the QDs, and their toxicology is not yet fully known.[102] Apart from Pb, Cd is also a known environmental and occupational pollutant classified as a type I carcinogen by the International Agency for Cancer Research (IARC), since it can cause tumors of the lung, prostate, injection site and other tissues.[103] For humans, an eight hour inhalation exposure to 5 mg Cd/m^3 is considered lethal and 1 mg Cd/m^3 is considered immediately dangerous for life.[104] Prolonged exposure to Cd can induce nephrotoxicity, osteotoxicity and immunotoxicity.[104] The main organ for long term accumulation is the kidney, where the half-life period for cadmium is approximately 10–20 years. Long-term exposure to Cd can therefore lead to kidney dysfunction.[103]

QD have been considered to be less toxic than their individual components and are used in biomedical research.

In vitro studies and studies in zebrafish embryos have identified two possible toxic mechanisms of QD; toxicity induced by heavy metal ions and generation of ROS. Which mechanism is predominant depends on the properties of the QD, the coating and their environment.[105] Comparing the form of cadmium with the resulting damage revealed surface oxidation in contact with oxygen, and the subsequent release of Cd^{2+} ions as probable causes of cytotoxicity.[106] Capping the QD with organic ligands or a polymer shell decreases toxicity significantly by reducing the leaching of metal ions. The challenge is to find the suitable capping strategy that doesn't impact the optoelectronic properties of the QD. Surface properties have a large impact on both toxicity and stability of the QD.[107]

In vivo studies indicate accumulation of QD in animals, but the long-term effects have not been studied, and it is not known if the incidence of cancer or similar pathologies increases when exposed to QD.[102] Tail vain injection (200 μL of PBS or buffered QD dispersion 2 nmol/kg) of CdSe/ZnS QD in mice showed that QD accumulates in the reticuloendothelial system (RES) organs. During the same experiment, it was also found that exposure to QD could suppress immune defense against foreign stimuli, which could lead to an increased susceptibility of hosts to diseases.[108] Rats injected with CdSe/ZnS QD (15.0 nmol/week) showed no toxic effects to any organs after four weeks.[109] A different set of rats was intratracheally instilled (with functionalized CdSe/ZnS) QD and showed inflammatory lung damage after 7 and 14 days of exposure to 12.5 μg and 5 μg respectively. No lung damage was observed for the lowest dose of 1.25 μg.[110] *Xu et al.* performed an experiment on mice suggesting that CdSe/ZnS QD can be toxic for the female reproductive system. QD were found in the ovaries starting from 5.0 pmol/day. No changes in the behavior and estrous cycle was observed. Starting from a dosage of 1.0 pmol/day, the mRNA down-regulations of FSHr and LHr were observed together with a decreasing in the number of matured oocytes. Moreover, the *in vitro* fertilization success rate was reduced.[111] Primates intravenously injected with phospholipid micelle-encapsulated CdSe/CdS/ZnS QD (25 mg/kg) showed neither acute nor chronic toxic effects, but they did observe significant accumulation in the liver, spleen and kidneys. A slow degradation of the QD and subsequent release and accumulation of Cd ions was observed in the liver and the spleen.

The large discrepancy between different studies is probably due to variations in exposure routes, type of QD and potentially coating, and more research in the field is called for.[112]

5. Exposure

Exposure to the materials in SC can occur at every stage during their life cycle: development, production, transport, use and end-of-life. To determine the exposure, it is crucial to determine the release of potentially hazardous NM in the different processes. In this article, we have focused on occupational exposure and potential exposure to the general public from the use of NM PV panels.

5.1. *Public Exposure*

While solar power is considered a green source of energy, there is some concern about the hazards related to the materials used. Third generation SC contain NM that are made up of both toxic and non-toxic materials, and there is potential for release of these materials into the environment during the production, operation and end of life of the PV panels that could have negative consequences for the general public.[113,114]

NM release into the environment cannot be measured, but there are models to estimate it.[115] The proportion of leached material in nanoform remains elusive, however, since there is the potential of aggregation or dissolution of the particles. NM might be very stable in the environment and aggregated NM could redistribute to their nanoform when entering a biological system.[116,117] This implies that public ex-

posure to NM remains a possibility for long periods after they have been released.

The main routes of exposure are ingestion, inhalation and dermal penetration, and because of their small size, NM can cross biological barriers and reach the systemic circulation, from where they can gain access to and accumulate in all tissues and organs.[118]

The aim of the European Union Waste Electrical and Electronic Equipment (WEEE) directive of the European Parliament and of the council of 4 July 2012 on WEEE[119] is to maximize the collection, recycling and recovery of valuable and hazardous materials from electronic waste in order to optimize the use of natural resources and to prevent the contamination of the environment.[120] A thin-film PV manufacturing facility with an annual production of 2000 tons of solar panels (= 10 MW) produces 0.1% semiconductor material, the rest is glass. Assuming 20% defects initially and 5% defects at steady state production, after 25–30 years, 2000 tons of modules per year have to be decommissioned. Approximately 90% of the module weight can be recovered and the estimated recovery of semiconductor materials (Te and Cd) is 95% for second SC,[121] but there is possible contamination of the soil if the PV panels are not treated properly. Cadmium and lead compounds have different solubilities, which does not affect compliance with RoHS criteria, but it may affect end-of-life disposal.[122] The semiconductor layer is usually encapsulated between layers of glass, therefore, under normal operation, PV modules do not represent a risk for health and for the environment.[123]

PV panels can be damaged by extreme weather or human factors, but the result will most of the time be cracked glass. Statistics on thin-film cadmium-telluride PV modules shows that module breakage is rare (0.04%/year) and usually this happens during shipping or installation, so they are immediately substituted.[123] Standard tests involve breaking the module in small pieces (order of centimeters), using solvents and treatment methods that are not comparable with real conditions during everyday use (different from the case of waste).

Several studies have attempted to determine if there is a possibility that the toxic heavy metals used in SC can contaminate the soil and water in the near surroundings of solar panel instalments. While one study showed that soil metal levels of toxic metals such as Pb and Cd did not increase around monocrystalline silicon PV installations, some other metals were found in higher amounts.[124] These results are in contrast with long-term simulated landfill studies on commercial c-Si, a-Si, CdTe, and CIGS modules that indicate that Cd (from CdTe cells) and Pb (from solder ribbons) are the most common ecological contaminants from PV waste and that the leaching increases substantially with time.[125] Studies on second generation PV units show that while some metals are found in the soil, the amounts are very low, in all cases below the recommended limits.[124] The leaching is pH dependent and occurs in higher rates at acidic pH.[120]

These results are based on second generation solar units since the third-generation SC have not yet been commercialized, but they are indicative of issues that could arise from large scale use of third generation solar units.

Ruthenium is a rare metal and exists in very low amounts in the earth crust. It is therefore highly unlikely that the public will be exposed to high amounts of ruthenium. Ruthenium compounds are largely insoluble in water and are as such absorbed very slowly if ingested or through the skin, but absorption after inhalation is potentially extensive. While metal ions can generally interact with the bone matrix and thereby bioaccumulate in the bones, it seems unlikely that this will be the case for ruthenium, since most of it is rapidly excreted after exposure.[126]

Alternatives to ruthenium dyes include Os(II) complexes, organic dyes, porphyrin dyes and other metal free dyes. Natural dyes have also been considered, but so far, they have shown efficiencies that are much lower than for the other dyes.[127]

Both cadmium and lead can accumulate in the root and the stem of edible plants and are thereby consumed by humans.[128,129] The accumulation in biosystems is higher for lead than for cadmium, which increases the risk of human exposure through food or drinking water.

Not much is known about the stability of QD in the environment. It is highly likely that heavy metals accumulate, but it is not clear in what form and in what organisms. The half-lives can be expected to be long, from months to years, and it is possible that the public will be exposed to the toxic metals from the QD.[130] CdTe QD can accumulate in microorganisms and carry up the food chain, and the subsequent biomagnification could possibly lead to an increased risk to human health. QD can dissolve in water to release toxic Cd^{2+} ions and the CdTe QD bioaccumulate over several trophic levels.[131]

Lead is a known environmental toxicant that, because of substantial human use, has had a strong negative impact on human health. Historically, lead has been used in various consumer products,[132] and

over time, corrosion forms water-soluble lead compounds that end up in the environment contaminating drinking water reserves or getting taken up by plants.[133] Due to the high toxicity of lead, and the identified effects on the world population, in particular children, its use has been heavily limited and a global phase out is undergoing.[134] Soil and water pollution can lead to serious long term effects on both ecosystems and on human health. Lead salts are water soluble and therefore have high bioavailability and lead is additionally highly bioaccumulative.[135] Children are particularly susceptible to lead exposure, and absorption of lead can reach levels as high as 70%, the same number in adults is 20%. This raises concern about the use of lead containing perovskites in SC, both because of the possible leaching from rain and UV exposure, and their end of life handling. The amount of lead in perovskites is above the limits of the lead free directives for electronics that are set to 0.1% in Europe.[136] The amount of Pb used in PSC is 0.4 g/m^2, which is much smaller than the amount used in soldering of commercial Si PV panels.[48]

In case of a damaged solar cell exposed to rain, the absorber layer will decompose to its starting materials. A theoretical model shows that up to 80% of the lead in a perovskite solar cell can be solubilized in the form of PbI_2 and end up in the soil.[137] Additionally, it is important to consider tests that are representative of field conditions. An example is a test done in Japan, where modules with a predetermined number of cracks were exposed to rainwater.[123] If the soil lead content is increased by perovskite compounds, even below the non-hazardous level, the lead content in edible plants increases significantly. It has been shown that perovskite lead is more readily taken up by plants than other lead in nature.[138]

TiO_2, both in its bulk form and as nanoparticles, is used extensively in many consumer products, and is already abundantly present in the environment. There are also natural sources of TiO_2, so finding a way to identify anthropogenic TiO_2 NM is necessary to allow for a complete impact analysis of the human activities.[139] The food additive TiO_2 has been shown to contain up to 36% of nanoparticles and is therefore banned in France as of 2020.[62]

Estimation of the release of TiO_2 NM into the environment has indicated that the likelihood of release into the air is low, while the risk quotients for water are very high both in the high emission estimation and the realistic emission estimation. Most of the environmental release was estimated to be from the recycling process.[140] The stability of TiO_2 in aqueous environment depends on the zeta potential, which in turn is affected by factors such as pH and the presence of dissolved organic matter. The particle size is inversely proportional with the zeta potential and smaller particles are more dispersed in water.[141] Titanium oxide nanoparticles can be taken up by plants and fish from sediment exposed to the particles, the particles accumulate in the plants and fish, and can undergo a biomagnification process before being available to humans through consumption.[142] Depending on the exposure route, the nanoparticles can accumulate in different organs, which also has an impact on biotransfer and biomagnification.[143]

5.2. *Occupational Exposure*

The PV industry can be divided into research and development, manufacturing, installation, and recycling. Solar power installations range from individual panels on roofs of summer houses to large scale solar farms that produce solar power on a utility level.

Installation of solar panels is considered to be safe, but occupational exposure could occur both during the development phase and the manufacturing of the cells. Additionally, PV waste is considered as hazardous waste, and must therefore be treated according to EU legislation.[119]

WHO considers health and safety to be an essential part of sustainable development.[144] Many severely hazardous chemicals are used during solar cell production or are produced in the process. This includes toxic materials, such as hydrofluoric acid, hazardous acids and bases, and flammable compounds such as silane and chlorosilanes.[121] In this article, we focus on the occupational hazards from NM used in PV development and manufacture.

The third generation PV systems contain engineered NM, whose toxic properties are not fully understood. Exposure to NM in the workplace occurs mainly through inhalation, with dermal exposure as a secondary route. Ingestion of NM in the workplace is considered unlikely and is therefore not usually included in occupational risk assessments. NM can be released during production and handling of the final products.[115]

The threshold limit value (TLV) for lead in Switzerland is 0.1 mg/m^3 in the inhalable portion and the biological exposure index (BEI) is 400 μg/kg for men and women above 45 years and 100 μg/kg for younger women in childbearing age.[145] No nano-specific TLVs exist for lead materials. Possible occupational exposure to lead can occur either during the development

phase of new solar cell materials or, during the manufacturing process. People exposed to high levels of lead at work risk bringing home dust on their clothes and exposing their families, in particular their children.[135]

Inhaled NM are deposited in the alveolar region of the lungs. For cadmium, the Swiss national insurance agency, SUVA, has determined a TLV for alveolar exposure, 0.004 mg/m^3, which is almost four times lower than the inhalable exposure value.[145] The National Institute for Occupational Safety and Health (NIOSH) in the US has recommended an exposure limit of 0.3 mg/m^3 for ultrafine TiO_2, which the SUVA has adopted.[146]

While these values are a good indication of the hazardousness of the materials, they are not useful in practice. Portable instruments used to measure particle concentration in the atmosphere are still not accurate enough to count these particles and to differentiate them from the background concentrations.[147,148] *Asbach et al.* have made a complete review of personal monitors and samplers to assess the exposure of workers to airborne NM.[149] Unfortunately, reducing the size of the measurement instrument often corresponds to a loss in accuracy compared to conventional aerosol measurement equipment.

Because of the many unknowns regarding the hazardousness of NM, and the difficulties with detecting NM in the respirable air in a workplace, it is widely accepted that a precautionary approach must be adopted to protect workers potentially exposed to them. In 1996, the American Public Health Association passed a resolution entitled, 'The Precautionary Principle and Chemical Exposure Standards for the Workplace'.[150]

Several risk assessment methods for work with NM based on a precautionary principle have been developed by different stakeholders. Many of these methods are based on a control banding strategy, to avoid performing separate risk assessments for each material and process. The Federal Office of Public Health (FOPH) in Switzerland has developed the Precautionary Matrix destined towards self-control of industry and trade dealing with synthetic NM.[151] *Stoffenmanager Nano* is a tool for risk prioritization that bases its hazard assessment on available information in for example safety data sheets and its user friendliness has been tested and reviewed by companies in the field.[152] The French agency for food, environmental and occupational health & safety (ANSES) in France describes a strategy for application of the control banding methodology on work with NM.[153] *NanoSafer* was developed by the National Research Centre for the Working Environment in Denmark and allows for risk management in specific work scenarios based on information from the technical data sheet of safety data sheet from the supplier.[154] Ecole Polytechnique Fédérale de Lausanne (EPFL) has developed a control banding method for estimation of risk arising from research activities involving work with NM. The method bases the risk assessment on both a hazard assessment of the used material, and on the predicted exposure. Based on a precautionary principle, a series of mitigation measures is proposed for each risk level. The EPFL method works well for small quantity work but is not suitable for large processes due to the relatively restrictive quantities that lead to an increased risk level.[155]

A comparison of the different methods concludes that they all determine a risk level for a task, but the results vary substantially in risk level between the methods and based on the understanding of the process. It is therefore crucial that occupational health and safety specialists work together with nanotechnology scientists for the most accurate understanding of material properties and processes.[156]

After the initial hazard and exposure assessments, the residual risks can be managed with a series of technical, organizational and personal mitigation measures. Moreover, for a successful risk management policy, the workers at risk must be involved in the process. Because of the limited number of TLV available for NM and the difficulties to obtain accurate exposure values, a zero exposure scenario is the most desirable. The technical measures are the most efficient to achieve this, and it is recommended to enclose processes where NM can be released to completely avoid the risk of exposure. In case this is not possible, extra ventilation, capture at source and HEPA filters should be installed. Organizational measures that should never be neglected are control access of the area where NM are handled and specific safety training for the workers. According to the risk of exposure of the activity workers must wear adapted PPE. The use of long gloves (eventually two pairs), safety goggles and overshoes should be considered; the choice between a standard cotton lab coat, a non-woven lab coat or *Tyvek*® hooded coverall, as well as the choice between a FFP3 mask or an assisted ventilation system should be evaluated according to the activity.

Research laboratories are very active in the quest of developing new PV systems, all with the goal of

increasing the PCE and reaching the maximum possible energy yield. The variety of materials is considerable, but batch sizes are often very small (in the order of mg or g). The vast amount of naturally and incidentally occurring NM in the atmosphere, and the low amounts used in research experiments makes it challenging to measure the release of ENM from the experiments. Relatively high exposure methods are used in research settings when preparing thin layers of dye sensitized or PSC. As an example, spin-coating is a commonly used technique where a drop of the perovskite material or dye in solution is placed on a plate and is spread into a very thin layer by rapid spinning of the plate. Spin-coating cannot be used for production of SC because of the very high material losses. Additionally, spin-coating releases a lot of aerosols that contain toxic material, that is, lead, which is a source of occupational exposure. New methods that reduce the material sacrifice and the use of an anti-solvent are being investigated.[48,157]

To fabricate perovskite solar panels on large scale, techniques compatible with roll to roll (R2R) equipment have to be preferred in order to guarantee a high production rate. Instead of spin coating or drop casting, the choice will be between inkjet printing, doctor blade coating, slot die coating and spray.[48,158] This means to move from small scale equipment that can easily fit into a fume hood to larger size machines that need proper ventilation and filters to avoid any possible contamination of the workers.

Occupational exposure measurements during the production of perovskite solar panels are missing due to their recent appearance in the market. The basic technology is the one used for printed electronics, but this technology is quite recent too, and facing the same new challenges such as possible exposure to NM.[159]

However, general considerations can still be made: while the amounts used in production far exceed those in the development phase of PV units, the exposure is generally more controlled.[158] The processes are standardized, and protective measures can be made part of the process. For example, CdTe solar panels are produced on an industrial scale since the '90s, therefore techniques and processes are well established and performed using fully automated machines.[160] CdTe SC are usually manufactured through a high-rate vapor transport (VTD) process, where the semiconducting layer is sublimated and deposited on the conductive contact.[161] The fraction of evaporated material that does not reach the surface forms a fine particulate, and several measures are applied in order to avoid any contamination of workers and environment. First of all, a HEPA filtration systems with a 99.7% capture efficiency (0.1 μm particles) are used to keep emissions below regulatory standards. As an additional control measure, systems for flow rate and pressure drop monitoring of the ventilation systems are also applied.[162,163] One of the main producers of CdTe is the US company *First Solar*, which has an extensive industrial hygiene management program in order to keep under control Cd exposure of workers and environment.[164] To guarantee worker safety, they decided to consider an exposure limit (8-hr-time-weighted average TWA) of 1 $\mu g/m^3$. At their manufacturing site, Cd concentration levels are continuously monitored, and measured TWA was only 0.11 $\mu g/m^3$. Higher values were measured only during maintenance where PPE were used in order to protect workers and to respect the TWA of 1 $\mu g/m^3$. *Sinha et al.* performed a biomonitoring study over 5 years (2009–2014) on 3000 workers showing that blood and urine concentrations were below occupational biological limits and background values, and show a statistically significant decreasing trend as a function for years worked for non-smokers.[165] This shows the validity of the control measures in place to avoid or reduce at minimum any possible Cd exposure for workers in this field. In a similar study, the exposure to arsenic and cadmium in a thin film solar cell production plant was measured with environmental and biological sampling over a period of five years. Also in this case, average exposure was well below the TLV, and no significant difference was found between exposed and non-exposed workers. Only the exposure levels for maintenance (7.66 $\mu g/m^3$) and laboratory (11.2 $\mu g/m^3$) workers were substantially higher than for low exposure workers, and the exposure was at some points higher than the TLV for Cd (7.66 $\mu g/m^3$ for maintenance and 11.2 $\mu g/m^3$ for laboratory simulations.[166]

Another example comes from printed electronics and an exposure assessment conducted by *Lee et al.* in two facilities: a roll-based printing and coating facility and a nano thin SC/supercapacitors continuous printing production system.[159] Their study focused on concentration measurements of nanomaterials in the air. They measured the TWA for suspended particulate concentration and Ag nanoparticles and found in both cases values lower than the occupational exposure limits given by the American Conference of Governmental industrial hygienists (3 mg/m^3 for suspended particulate concentrations and 0.1 mg/m^3 for Ag powder). The highest measured values were

0.0004 mg/m^3 for Ag nanoparticles and 0.00906 mg/m^3 for suspended particulate concentration, both measured close to a press. Although the exposure levels to nanomaterials was low, they were still able to measure high level of solvent concentration during cleaning or maintenance, two critical steps from the point of view of safety.

These examples show that, although workers are in general well protected, they can still be exposed to the hazardous materials that are being handled especially during cleaning and maintenance, which are the riskiest procedures. In these cases, the use of specific PPE should be mandatory to protect the workers. The initial loading of the reservoir containing the ink/suspension with nanomaterials should also be considered as a step at high risk if this is not done automatically.[167]

The fact that for PSC the scale-up process from lab-to-fab is still under development introduces an extra layer of risk. This is not an easy task, since several parameters need to be tweaked in order to optimized production. As a consequence, mistakes can be made, and this can lead to ink loss and sudden processing breakdowns.[158] This will increase the risk for human intervention in maintenance and cleaning processes compared to better established procedures.

6. Discussion and Conclusions

PV technology that uses nanotechnology has shown tremendous potential in breaching the limits set by the first generation SC. With the pioneering work of *Grätzel* and *O'Reagan* in 1991, a new era of solar power technology saw the light and gave rise to the third generation cells. As new energy conversion records are set with the new materials, the technology becomes cheaper and more available as one of the green energy solutions of the future.

The need of exchanging the use of fossil energy sources with clean sources and the decreasing price of solar systems has led to a huge predicted increase in PV energy in the coming years. The increase in production will at the same time lead to increased use of hazardous materials used in the technology. Additionally, these metals are used in nanoform in the SC, which could have a negative effect on safety. NM are used increasingly in consumer products and new technologies. They have been established as an emerging technology of large importance. The hazards involved with the use of NM are not fully known or understood, and toxic heavy metals such as lead and cadmium are used in the third-generation cells.

History has taught us that the use of toxic metals and materials in large scale leads to these materials ending up in the environment and that the general public is subsequently exposed to it through food, drinking water or air pollution. The most efficient measure to reduce this exposure is to reduce the use of these materials in large scale, as has been shown by the decrease in lead poisoning after the ban of using it in paint or gasoline. With the predicted increase in solar cell use, and the relatively high amounts of toxic materials used in this technology, it is fair to question if this green technology could have detrimental effects on human health. Tin is considered a promising alternative to lead in SC, if the energy conversion issues can be solved, but a complete risk assessment would be necessary to remove any doubts on the safety of that strategy.

Ruthenium compounds are used as sensitizer dyes in DSSCs, and although ruthenium is toxic, it is a rare metal and public exposure is unlikely. The DSSC technologies have been replaced as QDSSC and lead halide perovskite SC as the most promising, and therefore most likely to be commercialized.

The estimated use of TiO_2 NM in energy storage and production is approximately one sixth of the amount used in cosmetics, but it is expected to grow. The estimates cannot be considered very accurate, since it is not mandatory to specify that added TiO_2 is in nano form, and even if it were, the mixtures are never homogeneous in size. The concentration in air is considered to be low, since release into air is less likely than into water.[140]

Since there cannot be a safe amount of exposure to lead, the most reasonable solution is to replace the lead with other, less or non-toxic materials. Efforts are being put into trying to find lead free, non-hazardous alternatives to lead perovskites. Tin-based halide perovskites have shown some promise, but today lead-free alternatives still suffer from lower conversion and from low stability.[168] The highest efficiency for a tin-based Perovskite solar cell is 9%.[169]

The most commonly used QD for PV cells contain either lead or cadmium. Whether the toxicity from QD is due to the nano form of the materials or release of lead or cadmium ions from the surface of the particles, it cannot be concluded that no harm can come to human health and that the QD are safe to use. Alternatives to toxic quantum dot materials like lead and cadmium include Ag_2S QD[170] and $CuInS_2/ZnS$

core shell structures,[171] and the performances show promise for future competitiveness.

The use of NM in consumer products is growing in all fields, and it is also the case in the field of PV. NM show great promise in improving material properties and in lowering the costs, and their use can therefore be predicted to increase rapidly with time. Their stability, accumulation and ecotoxicological potential is not known, and while solar power is not yet one of the main nanopollutants, it will surely play a role in the future. Increased environmental exposure to NM will as a result end up with increased human exposure. NM taken up by microorganisms or algae might also finish on our plates after going through a biomagnification process.

Occupational hazards from using NM in research and in production of PV units is a challenging task for health and safety specialists, but with the existing risk assessment methodologies and an integrated risk prevention approach these hazards can be managed in a satisfactory manner.

While the use of these materials is certainly beneficial, it is important to ensure that we don't increase the potential risk to society. More research into the safety aspects of the new materials is called for, but research in this field is already ongoing and initial results show great promise. There is no purely clean or purely dirty energy, and the choice of strategy will always be a compromise, but overall, solar energy remains one of the cleanest sources of energy.

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Author Contribution Statement

Dr. *Elina Buitrago* and Dr. *Anna Maria Novello* contributed equally to the literature search, article design and writing of the manuscript. MER Dr. *Thierry Meyer* supervised and reviewed the paper.

References

[1] T. Hostettler, 'Recensement du marché de l'énergie solaire en 2017', Swisssolar, Office fédéral de l'énergie OFEN, Bundesamt für Energie BFE, 2018, pp. 1–25.
[2] 'Global Market Outlook 2019–2023', SolarPower Europe, 2020, https://www.solarpowereurope.org/global-market-outlook-2019-2023/.
[3] International Energy Agency – Photovoltaic Power Systems Program, 'Trends in PV Applications 2019', IEA-PVPS, 2019, https://iea-pvps.org/trends_reports/2019-edition/.
[4] Swiss Federal Office of Energy, 'Energy Strategy 2050', 2018, https://www.bfe.admin.ch/bfe/en/home/policy/energy-strategy-2050.html.
[5] C. Wu, K. Wang, M. Batmunkh, A. S. R. Bati, D. Yang, Y. Jiang, Y. Hou, J. G. Shapter, S. Priya, 'Multifunctional nanostructured materials for next generation photovoltaics', *Nano Energy* **2020**, *70*, 104480.
[6] G. Chen, J. Seo, C. Yang, P. N. Prasad, 'Nanochemistry and nanomaterials for photovoltaics', *Chem. Soc. Rev.* **2013**, *42*, 8304–8338.
[7] Y. Bai, I. Mora-Seró, F. De Angelis, J. Bisquert, P. Wang, 'Titanium Dioxide Nanomaterials for Photovoltaic Applications', *Chem. Rev.* **2014**, *114*, 10095–10130.
[8] S. Kumar, M. Nehra, A. Deep, D. Kedia, N. Dilbaghi, K.-H. Kim, 'Quantum-sized nanomaterials for solar cell applications', *Renewable Sustainable Energy Rev.* **2017**, *73*, 821–839.
[9] C. C. Raj, R. Prasanth, 'A critical review of recent developments in nanomaterials for photoelectrodes in dye sensitized solar cells', *J. Power Sources* **2016**, *317*, 120–132.
[10] R. Williams, 'Becquerel Photovoltaic Effect in Binary Compounds', *J. Chem. Phys.* **1960**, *32*, 1505–1514.
[11] D. M. Chapin, C. S. Fuller, G. L. Pearson, 'A New Silicon *p-n* Junction Photocell for Converting Solar Radiation into Electrical Power', *J. Appl. Phys.* **1954**, *25*, 676–677.
[12] Y. N. Sudhakar, M. Selvakumar, D. K. Bhat, 'Biopolymer Electrolytes for Solar Cells and Electrochemical Cells', Chapt. 4 in 'Biopolymer Electrolytes', Eds. Y. N. Sudhakar, M. Selvakumar, D. K. Bhat, Elsevier, Amsterdam, 2018, pp. 117–149.
[13] E. Fortunato, D. Gaspar, P. Duarte, L. Pereira, H. Águas, A. Vicente, F. Dourado, M. Gama, R. Martins, 'Optoelectronic Devices from Bacterial NanoCellulose', Chapt. 11 in 'Bacterial Nanocellulose', Eds. M. Gama, F. Dourado, S. Bielecki, Elsevier, Amsterdam, 2016, pp. 179–197.
[14] A. Goetzberger, C. Hebling, H.-W. Schock, 'Photovoltaic materials, history, status and outlook', *Mater. Sci. Eng. R* **2003**, *40*, 1–46.
[15] A. Paiano, 'Photovoltaic waste assessment in Italy', *Renewable Sustainable Energy Rev.* **2015**, *41*, 99–112.
[16] V. Muteri, M. Cellura, D. Curto, V. Franzitta, S. Longo, M. Mistretta, M. L. Parisi, 'Review on Life Cycle Assessment of Solar Photovoltaic Panels', *Energies* **2020**, *13*, 252.
[17] S. Weckend, A. Wade, G. A. Heath, 'End of Life Management: Solar Photovoltaic Panels', 2016, https://www.osti.gov/biblio/1561525/.
[18] W. Shockley, H. J. Queisser, 'Detailed Balance Limit of Efficiency of *p-n* Junction Solar Cells', *J. Appl. Phys.* **1961**, *32*, 510–519.

[19] M. A. Green, 'Third generation photovoltaics: solar cells for 2020 and beyond', *Physica E* **2002**, *14*, 65–70.
[20] B. O'Regan, M. Grätzel, 'A low-cost, high-efficiency solar cell based on dye-sensitized colloidal TiO_2 films', *Nature* **1991**, *353*, 737–740.
[21] A. Yella, H.-W. Lee, H. N. Tsao, C. Yi, A. K. Chandiran, M. K. Nazeeruddin, E. W.-G. Diau, C.-Y. Yeh, S. M. Zakeeruddin, M. Grätzel, 'Porphyrin-Sensitized Solar Cells with Cobalt (II/III)-Based Redox Electrolyte Exceed 12 Percent Efficiency', *Science* **2011**, *334*, 629–634.
[22] L. Zhang, X. Yang, W. Wang, G. G. Gurzadyan, J. Li, X. Li, J. An, Z. Yu, H. Wang, B. Cai, A. Hagfeldt, L. Sun, '13.6% Efficient Organic Dye-Sensitized Solar Cells by Minimizing Energy Losses of the Excited State', *ACS Energy Lett.* **2019**, *4*, 943–951.
[23] K. Tennakone, G. R. R. A. Kumara, A. R. Kumarasinghe, K. G. U. Wijayantha, P. M. Sirimanne, 'A dye-sensitized nano-porous solid-state photovoltaic cell', *Semicond. Sci. Technol.* **1995**, *10*, 1689–1693.
[24] M. Grätzel, 'The light and shade of perovskite solar cells', *Nat. Mater.* **2014**, *13*, 838–842.
[25] A. Zaban, O. I. Mićić, B. A. Gregg, A. J. Nozik, 'Photosensitization of Nanoporous TiO_2 Electrodes with InP Quantum Dots', *Langmuir* **1998**, *14*, 3153–3156.
[26] R. Plass, S. Pelet, J. Krueger, M. Grätzel, U. Bach, 'Quantum Dot Sensitization of Organic–Inorganic Hybrid Solar Cells', *J. Phys. Chem. B* **2002**, *106*, 7578–7580.
[27] M. R. Kim, D. Ma, 'Quantum-Dot-Based Solar Cells: Recent Advances, Strategies, and Challenges', *J. Phys. Chem. Lett.* **2015**, *6*, 85–99.
[28] J. M. Luther, M. Law, M. C. Beard, Q. Song, M. O. Reese, R. J. Ellingson, A. J. Nozik, 'Schottky Solar Cells Based on Colloidal Nanocrystal Films', *Nano Lett.* **2008**, *8*, 3488–3492.
[29] V.-T. Mai, N.-H. Duong, X.-D. Mai, 'Boosting the current density in inverted Schottky PbS quantum dot solar cells with conjugated electrolyte', *Mater. Lett.* **2019**, *249*, 37–40.
[30] M.-J. Choi, F. P. G. de Arquer, A. H. Proppe, A. Seifitokaldani, J. Choi, J. Kim, S.-W. Baek, M. Liu, B. Sun, M. Biondi, B. Scheffel, G. Walters, D.-H. Nam, J. W. Jo, O. Ouellette, O. Voznyy, S. Hoogland, S. O. Kelley, Y. S. Jung, E. H. Sargent, 'Cascade surface modification of colloidal quantum dot inks enables efficient bulk homojunction photovoltaics', *Nat. Commun.* **2020**, *11*, 103.
[31] J. Tang, H. Liu, D. Zhitomirsky, S. Hoogland, X. Wang, M. Furukawa, L. Levina, E. H. Sargent, 'Quantum Junction Solar Cells', *Nano Lett.* **2012**, *12*, 4889–4894.
[32] K. S. Leschkies, T. J. Beatty, M. S. Kang, D. J. Norris, E. S. Aydil, 'Solar Cells Based on Junctions between Colloidal PbSe Nanocrystals and Thin ZnO Films', *ACS Nano* **2009**, *3*, 3638–3648.
[33] Q. Zhao, A. Hazarika, X. Chen, S. P. Harvey, B. W. Larson, G. R. Teeter, J. Liu, T. Song, C. Xiao, L. Shaw, M. Zhang, G. Li, M. C. Beard, J. M. Luther, 'High efficiency perovskite quantum dot solar cells with charge separating heterostructure', *Nat. Commun.* **2019**, *10*, 2842.
[34] M. Nabil, S. A. Mohamed, K. Easawi, S. S. A. Obayya, S. Negm, H. Talaat, M. K. El-Mansy, 'Surface modification of CdSe nanocrystals: Application to polymer solar cell', *Curr. Appl. Phys.* **2020**, *20*, 470–476.
[35] S. Ren, L.-Y. Chang, S.-K. Lim, J. Zhao, M. Smith, N. Zhao, V. Bulović, M. Bawendi, S. Gradečak, 'Inorganic–Organic Hybrid Solar Cell: Bridging Quantum Dots to Conjugated Polymer Nanowires', *Nano Lett.* **2011**, *11*, 3998–4002.
[36] N. C. Greenham, X. Peng, A. P. Alivisatos, 'Charge separation and transport in conjugated-polymer/semiconductor-nanocrystal composites studied by photoluminescence quenching and photoconductivity', *Phys. Rev. B* **1996**, *54*, 17628–17637.
[37] M. Hao, Y. Bai, S. Zeiske, L. Ren, J. Liu, Y. Yuan, N. Zarrabi, N. Cheng, M. Ghasemi, P. Chen, M. Lyu, D. He, J.-H. Yun, Y. Du, Y. Wang, S. Ding, A. Armin, P. Meredith, G. Liu, H.-M. Cheng, L. Wang, 'Ligand-assisted cation-exchange engineering for high-efficiency colloidal $Cs_{1-x}FA_xPbI_3$ quantum dot solar cells with reduced phase segregation', *Nat. Energy* **2020**, *5*, 79–88.
[38] A. Kojima, K. Teshima, Y. Shirai, T. Miyasaka, 'Organometal Halide Perovskites as Visible-Light Sensitizers for Photovoltaic Cells', *J. Am. Chem. Soc.* **2009**, *131*, 6050–6051.
[39] H.-S. Kim, C.-R. Lee, J.-H. Im, K.-B. Lee, T. Moehl, A. Marchioro, S.-J. Moon, R. Humphry-Baker, J.-H. Yum, J. E. Moser, M. Grätzel, N.-G. Park, 'Lead Iodide Perovskite Sensitized All-Solid-State Submicron Thin Film Mesoscopic Solar Cell with Efficiency Exceeding 9%', *Sci. Rep.* **2012**, *2*, 591.
[40] 'Best Research-Cell Efficiency Chart', https://www.nrel.gov/pv/cell-efficiency.html.
[41] M. L. Parisi, S. Maranghi, R. Basosi, 'The evolution of the dye sensitized solar cells from Grätzel prototype to up-scaled solar applications: A life cycle assessment approach', *Renewable Sustainable Energy Rev.* **2014**, *39*, 124–138.
[42] O. A. Abdulrazzaq, V. Saini, S. Bourdo, E. Dervishi, A. S. Biris, 'Organic Solar Cells: A Review of Materials, Limitations, and Possibilities for Improvement', *Part. Sci. Technol.* **2013**, *31*, 427–442.
[43] D. Kearns, M. Calvin, 'Photovoltaic Effect and Photoconductivity in Laminated Organic Systems', *J. Chem. Phys.* **1958**, *29*, 950–951.
[44] L. Meng, Y. Zhang, X. Wan, C. Li, X. Zhang, Y. Wang, X. Ke, Z. Xiao, L. Ding, R. Xia, H.-L. Yip, Y. Cao, Y. Chen, 'Organic and solution-processed tandem solar cells with 17.3% efficiency', *Science* **2018**, *361*, 1094–1098.
[45] H. Katagiri, N. Sasaguchi, S. Hando, S. Hoshino, J. Ohashi, T. Yokota, 'Preparation and evaluation of Cu_2ZnSnS_4 thin films by sulfurization of E–B evaporated precursors', *Sol. Energy Mater. Sol. Cells* **1997**, *49*, 407–414.
[46] W. Wang, M. T. Winkler, O. Gunawan, T. Gokmen, T. K. Todorov, Y. Zhu, D. B. Mitzi, 'Device Characteristics of CZTSSe Thin-Film Solar Cells with 12.6% Efficiency', *Adv. Energy Mater.* **2014**, *4*, 1301465.
[47] S. Shalini, R. Balasundara prabhu, S. Prasanna, T. K. Mallick, S. Senthilarasu, 'Review on natural dye sensitized solar cells: Operation, materials and methods', *Renewable Sustainable Energy Rev.* **2015**, *51*, 1306–1325.
[48] P. Roy, N. Kumar Sinha, S. Tiwari, A. Khare, 'A review on perovskite solar cells: Evolution of architecture, fabrication techniques, commercialization issues and status', *Sol. Energy* **2020**, *198*, 665–688.
[49] N. R. Brun, B. Wehrli, K. Fent, 'Ecotoxicological assessment of solar cell leachates: Copper indium gallium selenide

(CIGS) cells show higher activity than organic photovoltaic (OPV) cells', *Sci. Total Environ.* **2016**, *543*, 703–714.
[50] N. Espinosa, L. Serrano-Luján, A. Urbina, F. C. Krebs, 'Solution and vapour deposited lead perovskite solar cells: Ecotoxicity from a life cycle assessment perspective', *Sol. Energy Mater. Sol. Cells* **2015**, *137*, 303–310.
[51] G. Wang, Y. Zhai, S. Zhang, L. Diomede, P. Bigini, M. Romeo, S. Cambier, S. Contal, N. H. A. Nguyen, P. Rosická, A. Ševců, C. Nickel, M. G. Vijver, W. J. G. M. Peijnenburg, 'An across-species comparison of the sensitivity of different organisms to Pb-based perovskites used in solar cells', *Sci. Total Environ.* **2020**, *708*, 135134.
[52] Y.-S. Zimmermann, A. Schäffer, C. Hugi, K. Fent, P. F.-X. Corvini, M. Lenz, 'Organic photovoltaics: Potential fate and effects in the environment', *Environ. Int.* **2012**, *49*, 128–140.
[53] Y. Qin, Q. Peng, 'Ruthenium Sensitizers and Their Applications in Dye-Sensitized Solar Cells', *Int. J. Photoenergy* **2012**, 291579.
[54] W. Han Ang, P. J. Dyson, 'Classical and Non-Classical Ruthenium-Based Anticancer Drugs: Towards Targeted Chemotherapy', *Eur. J. Inorg. Chem.* **2006**, 4003–4018.
[55] S. Higgins, 'Regarding ruthenium', *Nat. Chem.* **2010**, *2*, 1100–1100.
[56] 'Titanium dioxide - Registration Dossier - ECHA', 2020, https://echa.europa.eu/registration-dossier/-/registered-dossier/15560/2/1.
[57] EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS), 'Re-evaluation of titanium dioxide (E 171) as a food additive', *EFSA J.* **2016**, *14*, e04545.
[58] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 'Carbon Black, Titanium Dioxide, and Talc', 'IARC Monographs on the Evaluation of Carcinogenic Risks to Humans', Volume 93, WHO Press, Lyon, France, 2006.
[59] P. M. Hext, J. A. Tomenson, P. Thompson, 'Titanium Dioxide: Inhalation Toxicology and Epidemiology', *Ann. Occup. Hyg.* **2005**, *49*, 461–472.
[60] X. Jia, S. Wang, L. Zhou, L. Sun, 'The Potential Liver, Brain, and Embryo Toxicity of Titanium Dioxide Nanoparticles on Mice', *Nanoscale Res. Lett.* **2017**, *12*, 478.
[61] R. K. Shukla, A. Kumar, D. Gurbani, A. K. Pandey, S. Singh, A. Dhawan, 'TiO_2 nanoparticles induce oxidative DNA damage and apoptosis in human liver cells', *Nanotoxicology* **2013**, *7*, 48–60.
[62] French Agency for Food, Environmental and Occupational Health & Safety, 'ANSES Opinion on the Risks Associated with Ingestion of the Food Additive E171', ANSES, 2019, https://www.anses.fr/en/content/anses-opinion-risks-associated-ingestion-food-additive-e171.
[63] V. De Matteis, M. Cascione, V. Brunetti, C. C. Toma, R. Rinaldi, 'Toxicity assessment of anatase and rutile titanium dioxide nanoparticles: The role of degradation in different pH conditions and light exposure', *Toxicol. in Vitro* **2016**, *37*, 201–210.
[64] Q. Yu, H. Wang, Q. Peng, Y. Li, Z. Liu, M. Li, 'Different toxicity of anatase and rutile TiO_2 nanoparticles on macrophages: Involvement of difference in affinity to proteins and phospholipids', *J. Hazard. Mater.* **2017**, *335*, 125–134.
[65] A. Kermanizadeh, B. K. Gaiser, H. Johnston, D. M. Brown, V. Stone, 'Toxicological effect of engineered nanomaterials on the liver', *Br. J. Pharmacol.* **2014**, *171*, 3980–3987.
[66] R. K. Shukla, A. Kumar, N. V. S. Vallabani, A. K. Pandey, A. Dhawan, 'Titanium dioxide nanoparticle-induced oxidative stress triggers DNA damage and hepatic injury in mice', *Nanomedicine* **2013**, *9*, 1423–1434.
[67] J. Wu, J. Sun, Y. Xue, 'Involvement of JNK and P53 activation in G2/M cell cycle arrest and apoptosis induced by titanium dioxide nanoparticles in neuron cells', *Toxicol. Lett.* **2010**, *199*, 269–276.
[68] E. Brun, M. Carrière, A. Mabondzo, '*In Vitro* evidence of dysregulation of blood–brain barrier function after acute and repeated/long-term exposure to TiO_2 nanoparticles', *Biomaterials* **2012**, *33*, 886–896.
[69] R. Hu, X. Gong, Y. Duan, N. Li, Y. Che, Y. Cui, M. Zhou, C. Liu, H. Wang, F. Hong, 'Neurotoxicological effects and the impairment of spatial recognition memory in mice caused by exposure to TiO_2 nanoparticles', *Biomaterials* **2010**, *31*, 8043–8050.
[70] H. Sun, X. Zhang, Q. Niu, Y. Chen, J. C. Crittenden, 'Enhanced Accumulation of Arsenate in Carp in the Presence of Titanium Dioxide Nanoparticles', *Water Air Soil Pollut.* **2007**, *178*, 245–254.
[71] P. K. Nayak, S. Mahesh, H. J. Snaith, D. Cahen, 'Photovoltaic solar cell technologies: analysing the state of the art', *Nat. Rev. Mater.* **2019**, *4*, 269–285.
[72] C. Ma, N.-G. Park, 'A Realistic Methodology for 30% Efficient Perovskite Solar Cells', *Chem* **2020**, *6*, 1254–1264.
[73] World Health Organization, 'Lead poisoning and health', 2019, https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health.
[74] D. C. Bellinger, 'Lead', *Pediatrics* **2004**, *113*, 1016–1022.
[75] A. G. Vij, 'Hemopoietic, Hemostatic and Mutagenic Effects of Lead and Possible Prevention by Zinc and Vitamin C', *Al Ameen J. Med. Sci.* **2009**, *2*, 27–36.
[76] A. G. Vij, N. K. Satija, S. J. Flora, 'Lead induced disorders in hematopoietic and drug metabolizing enzyme system and their protection by ascorbic acid supplementation', *Biomed. Environ. Sci.* **1998**, *11*, 7–14.
[77] C. V. Nolan, Z. A. Shaikh, 'Lead nephrotoxicity and associated disorders: biochemical mechanisms', *Toxicology* **1992**, *73*, 127–146.
[78] L. D. Koller, 'The Immunotoxic Effects of Lead in Lead-Exposed Laboratory Animals', *Ann. N. Y. Acad. Sci.* **1990**, *587*, 160–167.
[79] R. W. Luebke, D. H. Chen, R. Dietert, Y. Yang, M. King, M. I. Luster, 'The Comparative Immunotoxicity of Five Selected Compounds Following Developmental or Adult Exposure', *J. Toxicol. Environ. Health Part B* **2006**, *9*, 1–26.
[80] H. L. Needleman, C. Gunnoe, A. Leviton, R. Reed, H. Peresie, C. Maher, P. Barrett, 'Deficits in Psychologic and Classroom Performance of Children with Elevated Dentine Lead Levels', *N. Engl. J. Med.* **1979**, *300*, 689–695.
[81] ATSDR, 'Toxicological Profile: Lead', 2020, https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=96&tid=22.
[82] P. E. deSilva, 'Determination of lead in plasma and studies on its relationship to lead in erythrocytes', *Br. J. Ind. Med.* **1981**, *38*, 209–217.

[83] EFSA Panel on Contaminants in the Food Chain (CONTAM), 'Scientific Opinion on Lead in Food', *EFSA J.* **2010**, *8*, 1570.
[84] CDC, Centers for Disease Control and Prevention, 'Blood Lead Levels in Children', 2020, https://www.cdc.gov/nceh/lead/prevention/blood-lead-levels.htm.
[85] H. Gurer, N. Ercal, 'Can antioxidants be beneficial in the treatment of lead poisoning?', *Free Radical Biol. Med.* **2000**, *29*, 927–945.
[86] B. Hultberg, A. Andersson, A. Isaksson, 'Interaction of metals and thiols in cell damage and glutathione distribution: potentiation of mercury toxicity by dithiothreitol', *Toxicology* **2001**, *156*, 93–100.
[87] H. Gurer-Orhan, H. U. Sabır, H. Özgüneş, 'Correlation between clinical indicators of lead poisoning and oxidative stress parameters in controls and lead-exposed workers', *Toxicology* **2004**, *195*, 147–154.
[88] F. Farmand, A. Ehdaie, C. K. Roberts, R. K. Sindhu, 'Lead-induced dysregulation of superoxide dismutases, catalase, glutathione peroxidase, and guanylate cyclase', *Environ. Res.* **2005**, *98*, 33–39.
[89] M. J. W. Brennan, R. C. Cantrill, 'δ-Aminolaevulinic acid is a potent agonist for GABA autoreceptors', *Nature* **1979**, *280*, 514–515.
[90] ECHA, 'Lead - Registration Dossier', https://echa.europa.eu/registration-dossier/-/registered-dossier/16063/7/11/1.
[91] D. E. Clapham, 'Calcium Signaling', *Cell* **2007**, *131*, 1047–1058.
[92] N. Singh, A. Kumar, V. K. Gupta, B. Sharma, 'Biochemical and Molecular Bases of Lead-Induced Toxicity in Mammalian Systems and Possible Mitigations', *Chem. Res. Toxicol.* **2018**, *31*, 1009–1021.
[93] G. Flora, D. Gupta, A. Tiwari, 'Toxicity of lead: a review with recent updates', *Interdiscip. Toxicol.* **2012**, *5*, 47–58.
[94] T. I. Lidsky, J. S. Schneider, 'Lead neurotoxicity in children: basic mechanisms and clinical correlates', *Brain* **2003**, *126*, 5–19.
[95] M. Hirata, H. Kosaka, 'Effects of Lead Exposure on Neurophysiological Parameters', *Environ. Res.* **1993**, *63*, 60–69.
[96] J. Bressler, K.-a. Kim, T. Chakraborti, G. Goldstein, 'Molecular Mechanisms of Lead Neurotoxicity', *Neurochem. Res.* **1999**, *24*, 595–600.
[97] B.-W. Park, B. Philippe, X. Zhang, H. Rensmo, G. Boschloo, E. M. J. Johansson, 'Bismuth Based Hybrid Perovskites $A_3Bi_2I_9$ (A: Methylammonium or Cesium) for Solar Cell Application', *Adv. Mater.* **2015**, *27*, 6806–6813.
[98] W. Ke, C. C. Stoumpos, M. G. Kanatzidis, '"Unleaded" Perovskites: Status Quo and Future Prospects of Tin-Based Perovskite Solar Cells', *Adv. Mater.* **2019**, *31*, 1803230.
[99] Agency for Toxic Substances & Disease Registry, ATSDR, 'Public Health Statement: Tin and Compounds', 2020, https://www.atsdr.cdc.gov/phs/phs.asp?id=541&tid=98.
[100] P. Howe, P. Watts, 'Tin and Inorganic Tin Compounds', World Health Organization, Geneva, 2005, https://apps.who.int/iris/handle/10665/43223.
[101] A. Babayigit, D. D. Thanh, A. Ethirajan, J. Manca, M. Muller, H.-G. Boyen, B. Conings, 'Assessing the toxicity of Pb- and Sn-based perovskite solar cells in model organism *Danio rerio*', *Sci. Rep.* **2016**, *6*, 18721.
[102] L. Ye, K.-T. Yong, L. Liu, I. Roy, R. Hu, J. Zhu, H. Cai, W.-C. Law, J. Liu, K. Wang, J. Liu, Y. Liu, Y. Hu, X. Zhang, M. T. Swihart, P. N. Prasad, 'A pilot study in non-human primates shows no adverse response to intravenous injection of quantum dots', *Nat. Nanotechnol.* **2012**, *7*, 453–458.
[103] IARC, 'Beryllium, Cadmium, Mercury, and Exposures in the Glass Manufacturing Industry', IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 58, Lion, France, 1993.
[104] ECHA, 'Cadmium - Registration Dossier', 2020, https://echa.europa.eu/registration-dossier/-/registered-dossier/15342/1.
[105] T. C. King-Heiden, P. N. Wiecinski, A. N. Mangham, K. M. Metz, D. Nesbit, J. A. Pedersen, R. J. Hamers, W. Heideman, R. E. Peterson, 'Quantum Dot Nanotoxicity Assessment Using the Zebrafish Embryo', *Environ. Sci. Technol.* **2009**, *43*, 1605–1611.
[106] A. M. Derfus, W. C. W. Chan, S. N. Bhatia, 'Probing the Cytotoxicity of Semiconductor Quantum Dots', *Nano Lett.* **2004**, *4*, 11–18.
[107] C. Kirchner, T. Liedl, S. Kudera, T. Pellegrino, A. Muñoz Javier, H. E. Gaub, S. Stölzle, N. Fertig, W. J. Parak, 'Cytotoxicity of Colloidal CdSe and CdSe/ZnS Nanoparticles', *Nano Lett.* **2005**, *5*, 331–338.
[108] X. Wang, J. Tian, K.-T. Yong, X. Zhu, M. C.-M. Lin, W. Jiang, J. Li, Q. Huang, G. Lin, 'Immunotoxicity assessment of CdSe/ZnS quantum dots in macrophages, lymphocytes and BALB/c mice', *J. Nanobiotechnol.* **2016**, *14*, 10.
[109] T. S. Hauck, R. E. Anderson, H. C. Fischer, S. Newbigging, W. C. W. Chan, 'In vivo Quantum-Dot Toxicity Assessment', *Small* **2010**, *6*, 138–144.
[110] J. R. Roberts, J. M. Antonini, D. W. Porter, R. S. Chapman, J. F. Scabilloni, S.-H. Young, D. Schwegler-Berry, V. Castranova, R. R. Mercer, 'Lung toxicity and biodistribution of Cd/Se-ZnS quantum dots with different surface functional groups after pulmonary exposure in rats', *Part. Fibre Toxicol.* **2013**, *10*, 5.
[111] G. Xu, G. Lin, S. Lin, N. Wu, Y. Deng, G. Feng, Q. Chen, J. Qu, D. Chen, S. Chen, H. Niu, S. Mei, K.-T. Yong, X. Wang, 'The Reproductive Toxicity of CdSe/ZnS Quantum Dots on the *In Vivo* Ovarian Function and *In Vitro* Fertilization', *Sci. Rep.* **2016**, *6*, 37677.
[112] K. M. Tsoi, Q. Dai, B. A. Alman, W. C. W. Chan, 'Are Quantum Dots Toxic? Exploring the Discrepancy Between Cell Culture and Animal Studies', *Acc. Chem. Res.* **2013**, *46*, 662–671.
[113] J. I. Kwak, S.-H. Nam, L. Kim, Y.-J. An, 'Potential environmental risk of solar cells: Current knowledge and future challenges', *J. Hazard. Mater.* **2020**, *392*, 122297.
[114] I. D'Adamo, M. Miliacca, P. Rosa, 'Economic Feasibility for Recycling of Waste Crystalline Silicon Photovoltaic Modules', *Int. J. Photoenergy* **2017**, e4184676.
[115] T. A. J. Kuhlbusch, S. W. P. Wijnhoven, A. Haase, 'Nanomaterial exposures for worker, consumer and the general public', *NanoImpact* **2018**, *10*, 11–25.
[116] W.-I. Li, M. Perzl, J. Heyder, R. Langer, J. D. Brain, K.-H. Englmeier, R. W. Niven, D. A. Edwards, 'Aerodynamics and aerosol particle deaggregation phenomena in model oral-pharyngeal cavities', *J. Aerosol Sci.* **1996**, *27*, 1269–1286.

[117] W.-I Li, D. A. Edwards, 'Aerosol particle transport and deaggregation phenomena in the mouth and throat', *Adv. Drug Delivery Rev.* **1997**, *26*, 41–49.
[118] S.-Y. Bae, S. Y. Lee, J. Kim, H. N. Umh, J. Jeong, S. Bae, J. Yi, Y. Kim, J. Choi, 'Hazard potential of perovskite solar cell technology for potential implementation of "safe-by-design" approach', *Sci. Rep.* **2019**, *9*, 4242.
[119] 'Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on Waste Electrical and Electronic Equipment (WEEE) Text with EEA Relevance', 2012, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3 A32012 L0019.
[120] A. Ramos-Ruiz, J. V. Wilkening, J. A. Field, R. Sierra-Alvarez, 'Leaching of cadmium and tellurium from cadmium telluride (CdTe) thin-film solar panels under simulated landfill conditions', *J. Hazard. Mater.* **2017**, *336*, 57–64.
[121] M. M. Aman, K. H. Solangi, M. S. Hossain, A. Badarudin, G. B. Jasmon, H. Mokhlis, A. H. A. Bakar, S. N. Kazi, 'A review of Safety, Health and Environmental (SHE) issues of solar energy system', *Renewable Sustainable Energy Rev.* **2015**, *41*, 1190–1204.
[122] M. A. Green, A. Ho-Baillie, H. J. Snaith, 'The emergence of perovskite solar cells', *Nat. Photonics* **2014**, *8*, 506–514.
[123] P. Sinha, A. Wade, 'Assessment of Leaching Tests for Evaluating Potential Environmental Impacts of PV Module Field Breakage', *IEEE J. Photovolt.* **2015**, *5*, 1710–1714.
[124] S. A. Robinson, G. A. Meindl, 'Potential for leaching of heavy metals and metalloids from crystalline silicon photovoltaic systems', *J. Nat. Resour. Dev.* **2019**, *9*, 19–24.
[125] J. Nover, R. Zapf-Gottwick, C. Feifel, M. Koch, J. W. Metzger, J. H. Werner, 'Long-term leaching of photovoltaic modules', *Jpn. J. Appl. Phys.* **2017**, *56*, 08MD02.
[126] European chemicals agency (ECHA), 'Ruthenium - Registration Dossier', https://echa.europa.eu/registration-dossier/-/registered-dossier/21165/7/2/1.
[127] S. Ananthakumar, J. R. Kumar, S. M. Babu, 'Third-Generation Solar Cells: Concept, Materials and Performance - An Overview', in 'Emerging Nanostructured Materials for Energy and Environmental Science', Eds. S. Rajendran, M. Naushad, K. Raju, R. Boukherroub, Springer International Publishing, Cham, 2019, pp. 305–339.
[128] N. T. Hung, I. I. Kosinova, 'Environmental Toxicology of Cadmium and Lead (in the Case of Long Khang, Vietnam)', *Russ. Agric. Sci.* **2019**, *45*, 271–275.
[129] Q. Zhang, F. Hao, J. Li, Y. Zhou, Y. Wei, H. Lin, 'Perovskite solar cells: must lead be replaced – and can it be done?', *Sci. Technol. Adv. Mater.* **2018**, *19*, 425–442.
[130] R. Hardman, 'A Toxicologic Review of Quantum Dots: Toxicity Depends on Physicochemical and Environmental Factors', *Environ. Health Perspect.* **2006**, *114*, 165–172.
[131] G. S. Gupta, A. Kumar, V. A. Senapati, A. K. Pandey, R. Shanker, A. Dhawan, 'Laboratory Scale Microbial Food Chain To Study Bioaccumulation, Biomagnification, and Ecotoxicity of Cadmium Telluride Quantum Dots', *Environ. Sci. Technol.* **2017**, *51*, 1695–1706.
[132] M. Payne, 'Lead in drinking water', *Can. Med. Assoc. J.* **2008**, *179*, 253–254.
[133] World Health Organization, 'Lead in drinking-water: background document for development of WHO guidelines for drinking-water quality', 2003, https://apps.who.int/iris/handle/10665/75370.
[134] P. L. Tsai, T. H. Hatfield, 'Global Benefits From the Phaseout of Leaded Fuel', *J. Environ. Health* **2011**, *74*, 8–15.
[135] A. L. Wani, A. Ara, J. A. Usmani, 'Lead toxicity: a review', *Interdiscip. Toxicol.* **2015**, *8*, 55–64.
[136] 'Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Text with EEA Relevance', 2011, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011 L0065.
[137] B. Hailegnaw, S. Kirmayer, E. Edri, G. Hodes, D. Cahen, 'Rain on Methylammonium Lead Iodide Based Perovskites: Possible Environmental Effects of Perovskite Solar Cells', *J. Phys. Chem. Lett.* **2015**, *6*, 1543–1547.
[138] J. Li, H.-L. Cao, W.-B. Jiao, Q. Wang, M. Wei, I. Cantone, J. Lü, A. Abate, 'Biological impact of lead from halide perovskites reveals the risk of introducing a safe threshold', *Nat. Commun.* **2020**, *11*, 310.
[139] A. E. P. del Real, H. Castillo-Michel, R. Kaegi, C. Larue, W. de Nolf, J. Reyes-Herrera, R. Tucoulou, N. Findling, E. Salas-Colera, G. Sarret, 'Searching for relevant criteria to distinguish natural *vs.* anthropogenic TiO_2 nanoparticles in soils', *Environ. Sci. Nano* **2018**, *5*, 2853–2863.
[140] N. C. Mueller, B. Nowack, 'Exposure Modeling of Engineered Nanoparticles in the Environment', *Environ. Sci. Technol.* **2008**, *42*, 4447–4453.
[141] X. N. Yang, F. Y. Cui, 'Stability of nano-sized titanium dioxide in an aqueous environment: effects of pH, dissolved organic matter and divalent cations', *Water Sci. Technol.* **2013**, *68*, 276–282.
[142] M. Asztemborska, M. Jakubiak, R. Stęborowski, E. Chajduk, G. Bystrzejewska-Piotrowska, 'Titanium Dioxide Nanoparticle Circulation in an Aquatic Ecosystem', *Water Air Soil Pollut.* **2018**, *229*, 208.
[143] X. Zhu, J. Wang, X. Zhang, Y. Chang, Y. Chen, 'Trophic transfer of TiO_2 nanoparticles from daphnia to zebrafish in a simplified freshwater food chain', *Chemosphere* **2010**, *79*, 928–933.
[144] World Health Organization, 'Targets of other Sustainable Development Goals directly linked to health', 2020, http://www.euro.who.int/en/health-topics/health-policy/sustainable-development-goals/sustainable-development-goals-sdgs/targets-of-other-sustainable-development-goals-directly-linked-to-health.
[145] SUVA, 'Valeurs limites d'exposition aux postes de travail; 1903. f)', 2020, https://www.suva.ch/fr-CH/materiel/directives-et-textes-de-lois/explications-sur-les-valeurs-limites.
[146] National Institute for Occupational Safety and Health, 'Current Intelligence Bulletin 63: Occupational Exposure to Titanium Dioxide' 2017, https://www.cdc.gov/niosh/docs/2011-160/default.html.
[147] M. Levin, A. Gudmundsson, J. H. Pagels, M. Fierz, K. Mølhave, J. Löndahl, K. A. Jensen, I. K. Koponen, 'Limitations in the Use of Unipolar Charging for Electrical Mobility Sizing Instruments: A Study of the Fast Mobility Particle Sizer', *Aerosol Sci. Technol.* **2015**, *49*, 556–565.
[148] A. M. Todea, S. Beckmann, H. Kaminski, D. Bard, S. Bau, S. Clavaguera, D. Dahmann, H. Dozol, N. Dziurowitz, K. Elihn, M. Fierz, G. Lidén, A. Meyer-Plath, C. Monz, V. Neumann, J. Pelzer, B. K. Simonow, P. Thali, I. Tuinman, A. van der V-

leuten, H. Vroomen, C. Asbach, 'Inter-comparison of personal monitors for nanoparticles exposure at workplaces and in the environment', *Sci. Total Environ.* **2017**, *605–606*, 929–945.
[149] C. Asbach, C. Alexander, S. Clavaguera, D. Dahmann, H. Dozol, B. Faure, M. Fierz, L. Fontana, I. Iavicoli, H. Kaminski, L. MacCalman, A. Meyer-Plath, B. Simonow, M. van Tongeren, A. M. Todea, 'Review of measurement techniques and methods for assessing personal exposure to airborne nanomaterials in workplaces', *Sci. Total Environ.* **2017**, *603–604*, 793–806.
[150] American Public Health Association, 'The Precautionary Principle and Chemical Exposure Standards for the Workplace', 2020, https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/07/10/18/the-precautionary-principle-and-chemical-exposure-standards-for-the-workplace.
[151] J. Höck, R. Behra, L. Bergamin, M. Bourqui-Pittet, C. Bosshard, T. Epprecht, V. Furrer, S. Frey, M. Gautschi, H. Hofmann, K. Höhener, K. Hungerbühler, K. Knauer, H. Krug, L. Limbach, P. Gehr, B. Nowack, M. Riediker, K. Schirmer, K. Schmid, C. Som, W. Stark, B. Suarez Merino, A. Ulrich, N. von Goetz, T. Walser, S. Wengert, P. Wick, C. Studer, 'Precautionary Matrix for Synthetic Nanomaterials', Federal Office of Public Health and Federal Office of Environment, Bern, 2018, https://www.bag.admin.ch/bag/en/home/gesund-leben/umwelt-und-gesundheit/chemikalien/nanotechnologie/sicherer-umgang-mit-nanomaterialien/vorsorgeraster-nanomaterialien-downloadversion.html.
[152] B. Van Duuren-Stuurman, S. R. Vink, K. J. M. Verbist, H. G. A. Heussen, D. H. Brouwer, D. E. D. Kroese, M. F. J. Van Niftrik, E. Tielemans, W. Fransman, 'Stoffenmanager Nano Version 1.0: A Web-Based Tool for Risk Prioritization of Airborne Manufactured Nano Objects', *Ann. Occup. Hyg.* **2012**, *56*, 525–541.
[153] French Agency for Food, Environmental and Occupational Health & Safety, 'Development of a Specific Control Banding Tool for Nanomaterials', 2010.
[154] 'NanoSafer', 2020, http://www.nanosafer.org/#about.
[155] A. Groso, A. Petri-Fink, B. Rothen-Rutishauser, H. Hofmann, T. Meyer, 'Engineered nanomaterials: toward effective safety management in research laboratories', *J. Nanobiotechnol.* **2016**, *14*, 21.
[156] F. Silva, S. P. B. Sousa, P. Arezes, P. Swuste, M. C. S. Ribeiro, J. S. Baptista, 'Qualitative risk assessment during polymer mortar test specimens preparation – methods comparison', *J. Phys. Conf. Ser.* **2015**, *617*, 012037.
[157] J. Zheng, M. Zhang, C. F. J. Lau, X. Deng, J. Kim, Q. Ma, C. Chen, M. A. Green, S. Huang, A. W. Y. Ho-Baillie, 'Spin-coating free fabrication for highly efficient perovskite solar cells', *Sol. Energy Mater. Sol. Cells* **2017**, *168*, 165–171.
[158] M. Hösel, H. F. Dam, F. C. Krebs, 'Development of Lab-to-Fab Production Equipment Across Several Length Scales for Printed Energy Technologies, Including Solar Cells', *Energy Technol.* **2015**, *3*, 293–304.
[159] J. H. Lee, E. K. Sohn, J. S. Ahn, K. Ahn, K. S. Kim, J. H. Lee, T. M. Lee, I. J. Yu, 'Exposure assessment of workers in printed electronics workplace', *Inhalation Toxicol.* **2013**, *25*, 426–434.
[160] A. Bosio, S. Pasini, N. Romeo, 'The History of Photovoltaics with Emphasis on CdTe Solar Cells and Modules', *Coating* **2020**, *10*, 344.
[161] V. M. Fthenakis, H. C. Kim, 'CdTe photovoltaics: Life cycle environmental profile and comparisons', *Thin Solid Films* **2007**, *515*, 5961–5963.
[162] V. Fthenakis, C. Athias, A. Blumenthal, A. Kulur, J. Magliozzo, D. Ng, 'Sustainability evaluation of CdTe PV: An update', *Renewable Sustainable Energy Rev.* **2020**, *123*, 109776.
[163] P. Sinha, A. Wade, 'Addressing Hotspots in the Product Environmental Footprint of CdTe Photovoltaics', *IEEE J. Photovolt.* **2018**, *8*, 793–797.
[164] J. R. Bohland, K. Smigielski, 'First solar's module manufacturing experience; environmental, health and safety results', in 'Proceedings of the 28th IEEE Photovoltaic Specialists Conference, Anchorage, 2000, pp. 575–578.
[165] P. Sinha, M. Fischman, J. Campbell, G. C. Lee, L. S. Lim, 'Biomonitoring of CDTE PC Manufacturing and Recycling Workers' in '2016 IEEE 43rd Photovoltaic Specialists Conference, PVSC', 2016, pp. 3587–3592.
[166] A. Spinazzè, A. Cattaneo, D. Monticelli, S. Recchia, S. Rovelli, S. Fustinoni, D. M. Cavallo, 'Occupational Exposure to Arsenic and Cadmium in Thin-Film Solar Cell Production', *Ann. Occup. Hyg.* **2015**, *59*, 572–585.
[167] F. C. Simeone, M. Blosi, S. Ortelli, A. L. Costa, 'Assessing occupational risk in designs of production processes of nano-materials', *NanoImpact* **2019**, *14*, 100149.
[168] W. Ke, M. G. Kanatzidis, 'Prospects for low-toxicity lead-free perovskite solar cells', *Nat. Commun.* **2019**, *10*, 965.
[169] S. Shao, J. Liu, G. Portale, H.-H. Fang, G. R. Blake, G. H. ten Brink, L. J. A. Koster, M. A. Loi, 'Highly Reproducible Sn-Based Hybrid Perovskite Solar Cells with 9% Efficiency', *Adv. Energy Mater.* **2018**, *8*, 1702019.
[170] X. Zhang, J. Liu, E. M. J. Johansson, 'Efficient charge-carrier extraction from Ag_2S quantum dots prepared by the SILAR method for utilization of multiple exciton generation', *Nanoscale* **2015**, *7*, 1454–1462.
[171] Z. Pan, I. Mora-Seró, Q. Shen, H. Zhang, Y. Li, K. Zhao, J. Wang, X. Zhong, J. Bisquert, 'High-Efficiency "Green" Quantum Dot Solar Cells', *J. Am. Chem. Soc.* **2014**, *136*, 9203–9210.

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

12

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Denise Clements

Contact Person:

(if different from above)

Postal Address: 96 Settlement Road, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Ltd

Address of Proposal: 415 Moroa Road, Greytown

Application No. RC220103

Description of Proposal: Development of industrial scale solar farm in Greytown, South Wairarapa

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	Yes		No

X	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

I fully support Elisabeth Creevey's application and would like answers to her concerns raised.

Site Location and Description

- Zoned rural, not industrial – primary purpose will be power generation, not farming
- Unsuitable site due to proximity to housing, its industrial scale and activity being incongruent with rural zone planning and district plan objectives and protections.
- The activity proposed of electrical and electronic works, power generation and transmission are likely to cause a large section of land to become a new HAIL site.
- The area at times experiences a high-water table and flooding. This significant development and the nature of materials used greatly increases the likelihood of site contaminants from site activity entering waterways and neighbouring properties.
- Covers the land on an industrial scale with rows of hard infrastructure, not what you would expect in a rural expansive setting
- Trees take years to grow, screening size 7yrs - visual impact not less than minor
- Excessive large scale water use - irrigation planting, cleaning of panels may contribute to drying up of bore water which surrounding neighbours have/use for stock water (cumulative impact report)
- Herbicide sprays on panels effect report on land and sheep grazing.
- At a minimum, if consent were granted, monitoring and remediation conditions must be imposed to ensure that soil and water samples are routinely monitored for potential contaminants, and where detected beyond ambient levels, appropriate remediation of contaminants is ensured at the cost of the land owner and consent holder.
- Planting mitigation - hedge rows on the boundary in the outlook of existing properties severely impacts views/openness/expansivity (cumulative impact)
- Large scale lighting for security, details of where lights will be, wattage, hours of operation (cumulative impact on neighbouring properties)
- Please ask for detailed glare/glint reports for inside and outside of effected properties. Outdoor living space which is more frequently the case in fine weather when the degree of glint and glare will likely be greater and/or more prolonged.
- Provide acoustic assessment, there are thousands of panels all making noise at the same time (cumulative impact 24/7)

Storm Water

- Run off issues. The panels represent a very very large roof – or series of. Current building regulations require buildings to have drainage plans and soak pits for which there is no provision for in this development. At times, surface water is a considerable issue in the area and would affect access and safety due to water and electrical systems mixing.

Vehicular Access

- Increased vehicle movements on the unsealed, narrow and poorly maintained Moroa road will be disruptive to residents using the road, degrade it further, increase dust (which can be significant for some homes nearby) and be hazardous for other road users including cyclists, runners, horse riders who frequently use it.

Operational Activities

- Only 2 full time roles are created. Offshore investors take earnings offshore, power generated goes to Auckland (via National Grid) and locals and council pay for and live with the impacts of the development. It's an unacceptable price to pay.

- Battery storage systems, substations, inverters and other equipment should be required to be situated on portions of the industrial site furthest from homes - please clarify and supply detailed maps of all infrastructure.

Consideration of Alternatives

- The environmental impacts of this development on people, water, wildlife, air, amenity, land values and existing infrastructure are grossly understated in the application and alternatives in the area do not appear to have been documented – except to say FNSL have looked at various options all around NZ. The economic value of this development for shareholders is what drives it to apply for the easiest low-cost option available rather than other viable and less impactful alternatives. The application deliberately understates the impacts.

- There are other options which will have less impact on the people who live here, and on other land that is not as productive, it just costs the company who profits more.

- Establish on sites where solar panels are not visible from homes year-round or at least 200m from homes.

- The national grid can only take some much power, if the Council rejects this proposal they can always go elsewhere.

- Locking up land for min of 30yrs, if the district plan did change the zoning it would make more sense to change this land to residential, people want to live closer to town centres and schools not further away.

Wairarapa Combined District Plan

- The activity is not required for primary production and residential purposes and solar panels combined exceed 25m2 in gross floor area.

- The solar panels do not meet the relevant setback requirements for unsealed roads under standard 4.5.2 (c) (ii).

- Dust is an issue along this road and no explanation has been explained as to how FNSL plan to mitigate or cannot comply with the existing rules. One can only assume they cannot meet this standard as they need the available land in order to meet their generation targets / viability of the business. No compensation should be provided if this is the reason for not being able to comply.

Effects on the Environment

- The solar farm will not specifically provide renewable electricity to meet the demands of South Wairarapa district. I see little evidence that positive economic or social benefits will be derived from this development for South Wairarapa or Wellington. These claims need to be backed by an independent benefits analysis detailing the actual economic and social benefits to the region and compared against the benefits gained from the site remaining for use as farmland.

- Please provide an independent assessment on potential heat generation and thermal convection from the proposed solar panels for all neighbouring properties.

- Please prove an independent assessment on risk of fire based on heat generation.

Landscape and Visual Effects

- The development significantly changes the existing natural character and the experience of this character for residents and visitors alike. Large scale industrial development covering hundreds of hectares of otherwise open land is a more than minor change to the landscape. As such, a development on this scale can only deplete the existing perceived value of this landscape.

- No taking into consideration the negative aftermath of these industrial scale solar plants.

- Any measures need to be made binding on current and future property owners, guarantees must be in place to ensure impact reduction measures will be maintained throughout the life of the industrial solar site.

- At minimum maintenance of each measure should be made an enforceable condition, SWDC should hold a bond sufficient to carry out on-going maintenance of the vegetation buffer planting, gravel road, in the event a measure fails.

Natural Character Effects

- Quote from application *"The site and its surroundings have been significantly modified in respect to its vegetation cover and therefore the proposed solar farm will result in limited changes to the natural character of the site".* Development of this site has remained open farming for over a century. Historically the area would have been wooded in lowland forest. To imply that it has been significantly modified since lowland forests where present (centuries ago) is correct, however our experience of the site for the last century has been open farmland and remained this way since. Open farmland is part of the natural character and part of our identity and history of this area. Our district plan specifically acknowledges this value and actively seeks to protect it. Supporting this application would be choosing to ignore the principles the

Combined District Plan (developed in consultation by the residents of Wairarapa) seeks to protect.

- Applicant has failed to provide realistic graphic representations of how the proposed industrial solar site will visually appear, applicant should be asked to provide detailed 3d imaging/rendering of the solar arrays and flyover animations of what this development will look like for all neighbouring properties, state highway 2, surrounding hills/high points – looking down on it.

- Planting hedgerows close to boundaries to screen out unsightly views of large scale industrial developments also blocks existing views and closes in the otherwise open and expansive feeling of the area. In some cases, distant views of ridgelines (of significant value) will also be lost from hedgerows close to boundaries.

- There are no detailed planting plans in the application or suggested provision to ensure these are maintained. The site is a challenging planting site due to strong winds and low horizons that facilitate a high a number of sun hours. Most plants take a lot of effort and care to get established. Under an el-nino pattern (predicted to arrive and last for the next few years) these negative growing environmental factors are heightened. Time for planting to be established and the ongoing professional management, irrigation and husbandry of these plantings to be successful is not adequately addressed in this application. If planting targets fail to reach anticipated levels what recourse do residents have for extra years of looking into an industrial power generation site or what penalties will be enforced on developers post approval.

- The north-eastern boundary of our property is directly adjacent to the development and our home (living space) approximately 100m from the proposed boundary of this development. As such we are intimately close to the construction, operation and visual impact of this development. The value of our property will most certainly be negatively impacted. This development if approved would be very unsettling and unjust, especially when we located and settled on our specific location knowing that our district plan protected us from being located adjacent to industrial developments. In my view, for this development to go forward in this location there would need to be a district plan change that re-zoned this land from rural to industrial.

Mana Whenua
- Would like the Council to obtain a cultural assessment report.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

12

[redacted]

Name: Denise Clements

Date: 05/06/2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION

FOR RESOURCE CONSENT BY FAR NORTH

TO

South Wairarapa District Council

SUBMITTER

Elisabeth Creevey, 144 Bidwills Cutting Road, Greytown

[redacted]

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991

Date 30/05/2023

PROPOSAL TO WHICH THIS SUBMISSION RELATES

Name of applicant; Far North Solar Farm Ltd

Address of proposal; 415 Moroa Road, Greytown

Application number; RM220103

Description of Proposal; 235Ha Solar Power Plant

Details of submission; This submission opposes the whole proposal

In the event of this application is subject to Resource Consent Hearing I would like to be heard in respect of my submission.

Decision I want the Council to make; decline the entire consent application.

Submission Statement;

1) Extraordinary change to an entire district and community
2) Discrepancies in application
3) Issues not considered in application
4) The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

The details of my submission statement are detailed below;

1. **Extraordinary Change to an entire District.**

The vast acreage required for this industrial proposal is a result of solar power generation being the least efficient of all renewable power options. The siting of which amongst residences and adjacent to Greytown, negatively alters not only the visual effects (openness and expansivity), but the identity of what Greytown and its environs is and its attractiveness as a destination for both visitors and residents. The site is historic land, being part of the first planned inland farming town of New Zealand purchased by the Small Farms Association. The loss of appeal and history will negatively affect land values and visitor numbers, and will harm tourist reliant businesses of Greytown and its environs. It negatively impacts how nearby residents experience their own properties and beyond their boundaries. How the council manages this proposal will pave the way for more proposals of the same nature, that the council knows are waiting in the wings. This is an industrial site that will intensively cover the land by rows of infrastructure that are essentially buildings with tilting rooves, the height of a house. It is not suitable at the currently proposed site. Planting the borders is just hiding an industrial power plant, but because you can't see it, doesn't mean it isn't there. I urge SWDC to decline this application.

The proposal should be classified as an Industrial Network Utility as defined in the District Plan.

Industry – means premises used for manufacturing, fabricating or processing, substances or material into new products. (Sun into electricity)

Network Utility – means any utility which is part of a network and includes electrical lines ... and associated support structures. (The proposed facility would connect, thus becoming, a part of the NZ electrical network grid)

It is obvious this activity does not meet Councils for the rural zone.

2.2.1 The natural Environment - Protecting and enhancing the natural environment is an important issue locally, nationally and internationally. Through the plan, the councils seek to achieve enduring protection of natural values by minimizing further loss or degradation of the natural environment, while allowing sustainable change to occur.

2.2.3 Natural Features. Natural features are those features that are a result of natural processes, and comprise of landscapes, landforms and habitats. At a broad level the characteristic natural features include mountain ranges, undulating hill country, broad plains... These features are valued by the local community, as they provide a sense of identity and naturalness. The importance placed on these features requires that activities that might affect their values need management, to ensure they are protected for both current and future generations.

2. **The Far North Application has some discrepancies;**

(Numbered in accordance with application)

-**(3) Description of proposed work**-The first paragraph states "the solar array and associated structures; medium voltage substations and 33 inverters". What number of substations are there? Also, under Site Preparation there is mention of foundation blocks for substations, but no dimensions. What size? **Council should seek clarification.**

– the proposal states the height of solar arrays when lying horizontal will be 1.55m above ground, but the adjacent drawings say 2205mm, and in the plan final diagrams 2466mm high. Which is it? **Council should seek clarification.**

-the proposal states spacing between rows to be 6m apart, later in the Stormwater section 6.4m apart, then in Effects on Prime Soils 7-8m apart. Which is it? **Council should seek clarification.**

-The application states total height for the foundation piles to be 600mm deep but figure 3, the foundation pile diagram shows 1300. Also, around the post the diagram is indicating what looks to be concrete that extends to just above ground around the post. As is un labelled, is this concrete and will all posts be concreted? The Infrastructure Establishment and Construction section states the posts will be pile driven. Depth and ground securing will surely be essential for support structures in water sodden ground, with high wind loads, with substantial solar 'sails' attached. **Council should seek clarification.**

-Vehicular Access and Crossings – 5m setback from water races. Is this 5m from pile or outer reaches of solar arrays? **Council should seek clarification.**

-**(3.7) Operational Activities** - will there be insecticide spraying to keep panels clear of spider webs? Also, which will it be, sheep grazing or cropping? If this application is applying for a change of land use, then surely grazing and cropping are the very activities it no longer wants to use the land for. And in the event of neither happening (and advice from farmers neither is realistic) will there be herbicide spraying? What volume of water will be required to wash panels, will a bore be required, and should Far North also be seeking a water right consent? Far North will find this unsealed road has more dusty traffic than they forecast and washing occurs more frequently. Where will any damaged panels be disposed, which toxic dump site? Here it also states panels have "an expected lifespan in excess of the consent duration" but application is requesting an unlimited consent duration. My research shows panels will be lucky to reach 30 years during which time they become decreasingly effective. How long would this consent last? **Please clarify all of these points.**

- Operational Activities – End of life needs clarification. (Again, here a reference to end of consented period though this application requests unlimited consent duration). Recycling ability and facilities are rare worldwide even in countries that have had solar power plants for some time. There are none within country and no plans to build one. Worldwide evidence shows recycling to be expensive, highly toxic, and impractical for the sheer volume of panels. Alternatively, these panels would be required to be placed in toxic waste dump, of which there are not enough to cope. If all materials removed on decommissioning, are there guarantees all concrete and inground cables are included? And soil repair costs included? Are funds held in country to guarantee decommission plans possible even in the event of company collapse? Experience from USA shows decommissioned Solar power plants often incompletely cleared, money for decommission not sufficient and soil left severely depleted and possibly toxic. **Council should seek clarification and guarantees on all these issues.**

-(3.8) Consideration of Alternatives - Far North may feel this site is the best practicable option, but it is also the best practicable site for farming, residences and tourism as well. The flat terrain needs no grading and close access to power grid make it cheaper for the company at the expense of the community and residences. I**t is possible to site power plants away from communities, use undulating land and hillsides, and use marginal land.**

-(4) Resource Consent Requirements – Here the application rightly states this land is zoned rural primary production. A large-scale solar power plant is not primary production, nor conducive to it. The District Plan predating the reality of large industrial solar power plants puts Council at a disadvantage and so does the shocking fact that the NZ Government is allowing a new industry to develop totally unregulated. I do have sympathy for the council and hope the Council will do its utmost to safe guard South Wairarapa and people in these unchartered waters. **Not compatible to rural zone.**

Rural polices 4.3.3 explanation – Threats to the environmental quality and character of the Rural Zone include buildings and structures that due to their location, scale, or density, are not in keeping with the established rural amenity and character. This Character is where buildings are at a relatively low non-urban density with generous setbacks from external property boundaries and where the height, scale, density and number of buildings do not dominate the landscape. Activities can have external effects out of character and unacceptable within the rural environment, inappropriate levels of vehicle movements and parking, excessive out-of-character noise, and obtrusive or excessive signage. (My underlining)

-(4.2) Here in table 2 the applicant states buildings will exceed allowed gross floor area. These solar arrays are essentially buildings, and with each array being nearly 5 meters wide and 59612mm long, coupled with footprints of inverters, substations, switchyard, and possibly water tanks (depending on size). The applicant should state the overall % footprint on the land. It will be far in excess of anything permitted in a rural zone. 21.1.24 a) (iii) (1) The gross floor area of a network utility i.e., solar panel array (they are buildings) cannot exceed 10 square meters in area. On this basis alone the effects of the proposal are **huge and not minor.**

The applicant is also requesting the planned non-compliance of unsealed road setbacks. There is no reason nor explanation as to why this plan cannot adhere to the rules. **This application should address this.**

-(4.3)- Stormwater runoff – here the applicant claims this site would not be a Hazardous Activities and Industries List site, industrial or trade site. This is blatantly not true. The substations alone make this a HAIL site. This proposal is obviously an industrial site. (I further discuss this under 6.3.1, 6.6.2, 5.6.2) **Protect ground water.**

Construction and operation of an electrical generating facility. Here the applicant is claiming rule 21.1.24 does not apply to them. The rule clearly states *the construction, maintenance and upgrading of network utilities and energy generating facilities,* and to claim exception for being a new energy generating facility, is frankly questionable. **This proposal should have to meet all requirements of rule 21.1.24 and the application should reflect that.** For example, the removal of all tall trees in the area, because of shading, creates large open space, which increases possibility of lightning strike. Reports range from 26 – 32% of damages to solar power plants occurs from lightning. Will there be lightning rods erected and what height?

21.1.25 (b) access (i) all sites and activities shall have safe and practicable vehicle access from a public road. Surely this application should also be applying to create large hard shoulders around all entrances, particularly on Moroa Road which is narrow and unsealed? These are huge trucks that are delivering large loads over a substantial period

-**(5.2) Effects on the Environment. Positive Effects** – The application states there will be economic and social benefits by supporting the functioning of communities and businesses across the Wellington Region. This is a large stretch to claim. The electricity goes into the National Grid (not local), Wairarapa already has electricity for communities and businesses, money generated from the power plant will leave the country, as though registered in NZ, it is an international company (not local), there is significant reliance on tourism dollar locally and this proposal will negatively impact that, especially if the consent to this proposal creates a snowball effect of similar proposals (as experienced in the USA) There are no social benefits. Those working on the land currently will not be able to continue, replaced by two jobs. **Not a positive exchange by any calculation.**

-**(5.4) Natural Character Effects** –Here the application refers to the landscape as 'ordinary' (according to a non-Nèw Zealand scale). So ordinary, that until recently, SWDC used this landscape in its logo. It is a part of our identity. The landscape description in the General Setting section quoted the Wairarapa Character Study as saying "**the Central Plains landscape has a feeling of openness and expansivity**" and this is what brings people to settle, stay and visit the area. Here the application feels a wall of Japanese Conifers will disguise a 235Ha industrial power plant, and somehow be consistent with the landscape. (Not even a suggestion of native plantings). The application is unclear as to what height the hedges will be kept. References range from 3m to exceeding the height of the arrays (which would need to be at least 4.8m). Trees can die, and there is no assurance this screen can or will keep its screening abilities for the duration of the existence of this power plant. Screening destroys the access to view the broad plain, hillside to mountain features the Plan should protect. **Council should seek clarification. This is not a suitable site. The loss of openness and expansivity is not 'limited', it is total for 235Ha of countryside.**

-**(5.5) Construction Noise** - Here the application likens construction noise to harvesting or cultivating. Harvesting and cultivating are short term seasonal events and a pleasure to watch. Construction will be daily and consistent, not conducive to any business in the area and dusty and disturbing for residents. If posts are pile driven there is concern that vibrations caused would be of disturbance to surrounding residences and disturb iron particles within the aquafer, raising levels in drinking water. **Negative effects.**

-**(5.6.1) Operational Noise** – operational fan noise may not be considered loud in decibels, but consistent low level noise annoyance will be a serious issue for residents and tourists staying nearby. For example; currently the house near the corner of Moroa and Battersea Roads can hear the existing substation from their front yard (approx. 100m). To add low level noise behind them as well creates confronting living conditions. There are many studies into the damaging effects of living with consistent low-level noise. I believe it is used as a form of torture. Added to the inverter noise will be the sound of the rotating machinery as it tracks the sun, the noise of the infrastructure heating and cooling, possibly whistling of wind turbulence through infrastructure, and the noise hectares of glass will reflect during rain or hail. **Negative effects. This is not a suitable site as it is too close to residences.**

District plan, Network Utilities 22.1.20 Wind Energy Facilities (v) The actual or potential noise effects of the construction, development and operation of the wind energy facilities, including particular

consideration of the special audible characteristics and the proximity and effect on settlements. (My underlining).

This proposal is a Renewable Solar Energy facility, and it is reasonable to expect that, as the District Plan pre dates the possibility of large scale solar, council adhere to its own guide lines concerning Renewable Wind Energy facilities. This would adhere to the intent of the Plan. Solar Power Plants have their own particular insidious noise that is spread over a larger acreage, and in this location, closer proximity to settlements, and will have a negative effect on people and animals.

Noise (iii) Acoustics – the assessment and measurement of sound from Wind Turbine Generators A) the assessment of the activity shall not be made in isolation, The assessment shall be made with all other uses and activities in the area in normal operation and the cumulative effect taken into account. Added to this the power plant will be surrounded by C) *noise sensitive activities; habitation, residential, visitor accommodation.*

-(5.6.2) Glare Effects – The specific type of anti-reflective coating on the solar panels to be used on site should be sought by Council. The substances used slowly erode and filter into the ground water. Locals draw drinking water from the high-water table, so extreme caution needs to be taken. *(RMA part 2 – sustainable management)* The panels seen from above can appear dark, but generally when sited in a desert, and at certain angles. The new solar power plant in Taranaki clearly shows solar arrays as brighter than the surrounding NZ landscape on the google earth satellite picture. Glare can be a problem for aircraft, especially as this site runs adjacent to a private airstrip. It can also be a problem for Hot Air Ballons, which generally land in the vicinity in large numbers during the annual festival. But further to the glare issue, the very infrastructure of a solar power plant removes any safety margin for the existing airstrip during takeoff and landing, (and down drafting of Balloons), making possible survival of an incident very slim. The Balloon Festival may have to cut short prior to Greytown, robbing this district and its visitors the enjoyment of this event. **This is not a suitable site for a power plant.**

-(5.8) Effects on Prime Soils – Here Far North claim this site will not only be Solar 'farmed', in addition, sheep grazing or cropping will occur. Though in 3.7 admit sheep grazing would only be to maintain the grass). Farming will not be occurring on this proposed industrial site.

The application states "no adverse effect on the productivity potential of the soils". Experience in the USA has shown that solar power production leaves land compacted from installation, seriously degraded from years of lack of light, and extreme heat reflected from panels. Leaving soils expensive and possibly years to rejuvenate. Productivity potential will be adversely affected. **Sustainable management should protect soils for future generation, which this proposal will not do.**

Sciencedirect.com ecological restoration of solar park plant communities and the effect of solar panels

Craven.ces.ncsu.edu/2021/10/can-solar-energy-production-be-converted-to-farmland

-(5.9) Summary of Effects – The proposed Solar Farm will provide adverse effects not positive ones. There will be no stabilizing of electricity prices as the main driver for Far North is as an investment venture, owners will demand maximizing profits. There is a vested interest to keep prices rising. **There are adverse effects and risks which are not less than minor.**

-(6.2)- Part 2 of the RMA – *The purpose and principles of the Act promotes sustainable management of natural and physical resources, ... for their social, economic and cultural wellbeing, and for their health and safety while, b) safe-guarding the life supporting capacity of, air, water, soil and ecosystems.*

Social - there is no social wellbeing here. Economic – This can only negatively affect a tourist-based township's economics. Cultural – the desecrating of historic land of the earliest settlers of inland farming Small Farms Association. Ecosystems; This proposal removes bird habitation with the loss of mature trees and covering the soil. Air; the air itself will be transmitting endless low frequency noise, electromagnetic radiation and less trees and grass that convert CO2 to fresh oxygen. Soil; the soil is at risk of contamination and degradation. Water; the serious risk of contamination to drinking water for surrounding residences and others further downstream. Add increased wind and heat, this proposal will change local climate. **This proposal is not consistent with part 2 of the RMA.**

-(6.4.2) - Table 5. Objective 2.1 - This power plant will adversely impact the productive potential of the soils on the site. It will not protect those soils for future generations. The removal of light, the effects of heat, impaction from building and removal, and lack of care of the soils for 30 years plus, will damage the soil. **Negative Effect**

Objective 2.2 - The applicant's comment are incorrect. The soils will be damaged, a power plant is not easy to remove, adverse effects will not be less than minor. Save this resource, **save this land for farming into the future.**

Policy 2.2(8) -*Highly productive land is protected from inappropriate use and development.* The productive potential of this land will decline. More every year a power plant is sited upon it. Cropping and sheep grazing are not realistic propositions. Firstly, this site's soil does not lend itself to cropping and cropping activities could easily damage or shade panels. Sheep would create damage to infrastructure and jam turning mechanisms by leaning on or standing underneath the panels. The grass will not grow enough to sustain sheep in any economical quantity. **This is not appropriate use of the site.**

-(6.3.1) - National Environmental Standards Here the application states 'there are no HAIL activities associated with this site' which at present is true. My point is that building a solar power plant is creating just that. In the Ministry for the environment publication, *Hazardous Activities and Industries Guidance, category B is electrical and electronic works, power generation and transmission. An electrical power plant would apply to; 2. Electrical transformers, 4. power stations, substations or switchyards.* In addition, if batteries are added after consent, *1. batteries.* This would be an industrial site that would be included on the local government land-use register. It is not suitable to be established on rural zoned land neighboring residences. **Council should suggest Far North find more suitable land – marginal, away from residences and towns.**

-(6.3.2) - Resource Management (National Environmental Standard for Freshwater) - Water. The application repeatedly states there are no other water bodies present other than stock water races. This is not true. The whole site sits directly on top of a fresh water aquifer that is shared by all neighbors in the vicinity and miles downstream. *(RMA; re part 2 sustainable management; and definition - water body - fresh water or geothermal water in a river....or aquifer, or any part thereof)* With an extremely high-water table in this area, placing a HAIL qualifying facility directly on top of (and during flooding, in) drinking water, risks contamination from; eroding minerals off coatings, broken fragments of toxic

panel, leakages from use of substations, more should there be a fire in the infrastructure, and of course if batteries are subsequently added and damaged. This will create a public health risk. **Protect this valuable resource, water, for future generations.**

-6.6 National policy statements. The Government's 2050 vision for energy and industry is not supported by this application. By 2050 the electrical generating efficiency of these panels will have declined to the point of end-of-life. This application repeatedly suggests at that stage the proposed power plant could possibly be decommissioned and return to primary production. Thus, not only does it not support the 2050 vision but then creates instability of supply.

-(6.5) - Table 6. Objective (3), Policy (6), Policy (9), Comment, this proposal does not have less than minor adverse effects on the environment. Soil, water, air is at risk. The land would no longer be rural, but industrial in look and use. A row of Japanese Cedars does not mitigate the visual impacts, let alone, soil, noise, water issues. There are serious potential adverse effects on human health and well-being. **This is not a suitable site.**

-(6.6) - Table 7. Objective 4.3.1, comment. An industrial power plant is not consistent with other rural activities (as I have previously discussed) – and to liken an industrial power plant to glasshouses is astounding. Glasshouses are for primary production, a thoroughly suitable activity for a rural zone. Overall, the amenity values of the rural zone, including natural character, will not be maintained. This is obvious by the fact that there will be no countryside for 235 hectares. That land will be intensively covered by infrastructure, ringed by security fencing, filled with industrial generation, not primary production.

-(7.3) Fire and Emergency – Here it states water supplies available on site for firefighting. If there is a tank, what volume? Or again will be a bore be available? This needs clarification. Water will only be of use in a grass fire (which will be of enhanced possibility given the heat radiated from panels and arcing can occur anywhere along the infrastructure). What provision and training will be given to local volunteer fire fighters who will be required to enter an actively generating industrial power plant. During daylight these panels continue to generate electricity, fire or not, and being fully automated, nobody on site to turn them off. Also, possibly to deal with inverter or substation fire. Water will not extinguish a lithium battery fire (should these be included); they are left to burn themselves out. Water won't help in these instances, and is the volunteer fire brigade equipped to fight such a chemical fire within an actively generating power plant? Coupled with possibly only 6 meters between rows (as stated in 3. description of proposed work), and when the panels are at lowest angle, they would cover almost 5 meters of that space, it is dangerous to ask firefighters to squeeze along a 1m gap of panels actively generating power to fight a fire. **Dangerous effect**

3. Other issues not addressed

-Batteries – There is no mention of Batteries in the application. Given that two other applications for Industrial sized Solar power plants are lodged at Masterton Council and additional companies are proposing others in the Wairarapa, electrical loads could soon be a problem. What safe guard do local residences and Greytown have that once established, this site will not then include the addition of industrial sized batteries? Batteries pose an additional fire risk, which would then cause serious soil and

drinking water contamination issues, and will turn a daytime problem of low-level buzz noise into a 24/7 one. (Alongside the environmental and humanitarian issues of battery production and disposal). Will Council even have the authority to consent or deny such an addition. Or will, once established as an Energy Utility Entity, allow Far North the ability to add batteries as part of maintenance and upgrade of their facility without Council consent? Can locals be assured that, there are no plans by other Utility providers or companies to establish batteries within this site, and that is why the subject has not been addressed in this application? **Please clarify**

Network utilitiesE1 policies, method 16.3.7(a). (c) ensure the operation, establishment, maintenance or upgrading of network utilities does not compromise community health and safety.

-Heat Island Effect – Unlike outdated computer-generated studies, on ground study has shown this is a very real occurrence over solar power plants. Only 20% of light hitting panels is converted to electricity, 80% is reflected as heat. These panels will be 20 degrees hotter than the ambient temperature during daylight and heat the soil and surrounds enough to make the local area 3-4 degrees hotter during the evening. Not only will this have negative effect on the soil on this site, but on land nearby. It will make life very uncomfortable for residents and animals in the vicinity. **This site is unsuitable.**

Barron-Gafford G.A. et al The Photovoltaic Heat Island Effect; larger Solar Power Plants increase local temperatures (found on the national library of medicine website)

-Wind – Not only will the removal of wind breaks increase wind levels for the area, but there are real concerns for possible wind tunnels and turbulence, shown in the study by

Irtaza and Agarwal – CFD simulation of turbulent wind effect on an array of ground-mounted solar PV panels; It advises *"extensive damages of PV panels, arrays and mounting modules have been reported the world over due to high winds"* and *"PV panels are subject to significant lift and drag forces under wind loading, which needs to be quantified with sufficient factor of safety to avoid damages".* Coupled with this site being prone to water logging and possibly only pile driven posts 600mm deep, there could be serious issues. Not only that, the concern for wind effects on neighboring roads and properties. Council should require Far North to provide a study of wind loadings specific to this site, panels, planned layout and the range and strength of Wairarapa winds. **Negative effect**

-Biodiversity – Mature trees will be felled and these are what Moreporks require for nesting. Moreporks reside in the area, as do Pukekos and there are many other native birds. But the Wairarapa has a poor number generally and Council should preserve and enhance any habitat it can. All birds will avoid the glare angles, covered soil, and the heat island, causing numbers in the area to decrease. **Negative effect**

-Fire – With the increased heat and dryness of the site and surrounds, there will be a heightened grass fire risk. Power plants are at high risk of fire because of possible arcing that can occur throughout the infrastructure. Will this risk of fire in a power plant result in a permanent fire ban on neighboring farms and properties? That would prevent them from burning fallen branches, impacting on the maintenance of their properties and costing them in ever escalating dump fees. The heat island effect will also dry land outside the proposed site, also increasing fire risk on other properties. **Negative effect**

-Electromagnetic Radiation – There is no doubt that there is electromagnetic radiation produced from solar power plants. Residents that are either worried by it or sensitive to it should not be subjected to now live with it, especially as it is often a driving factor for seeking to live in open countryside in the first

place, to breathe deeply, clean, uncluttered oxygenated air. A discrete screen of conifers will not change that. Preserve the purity of the air. **Negative effect.**

-Land Values - Houses located in industrial use areas and under high voltage power lines have less value and appeal to buyers, similarly, properties anywhere near the solar power plant will be less desirable because a vast industrial power plant is on their back doorstep, alongside the fear of possible electromagnetic radiation effects, noise, higher winds, heat, greater fire risk, little bird life... The Council has a duty to protect the large collective capital investment local property owners and their businesses have sunk into Wairarapa land and community. This would give confidence to potential settlers when choosing South Wairarapa to live and purchase land in. **Protect the value of Wairarapa Land and confidence in its Council.**

-Protection of Farmland – The enormous increase in the lease value of the land by companies like Far North, makes the land unaffordable for local farmers to compete in the lease of that land, decreasing the amount of farmland available for primary production (which is what a rural zone is supposed to protect). Evidence in the USA shows the attractive lease deals make farming the land less desirable to other land owners, creating a snow ball effect of farmers seeking to get on the gravy train of solar power. These farmers risk losing control of their land, as I believe they will not be able to simply opt out of electricity generation at the end of the lease period once they become a part of the National power supply. If they did it would **cause an instability of supply.** Which is the exact opposite of what Far North are claiming they are creating. **Rural zone is for primary production, protect it.**

-Internet and Cell phone coverage – Living rurally can come with weak and disrupted internet and cell phone coverage and it would not take much to weaken and disrupt it further. Residents will have already paid for sometimes expensive solutions for their individual site. These connections are of vital importance to run one's life, business, community connectiveness and access to emergency services. This Solar Power Plant is an extensive tall array of metal and glass, both of which are known to disrupt or block internet and cell phone coverage. If this proposed power plant further disrupts this connectivity, it should not cost residents to find a solution. It has real possibility to leave them isolated, unable to run their business, and unable to call emergency services. Copper land lines are no longer an option. How is Council going to safe guard these rate payers? **This site is not suitable.**

-Sustainability – I noticed in the new draft district plan, that Council is wanting to steer toward renewable and sustainable energy sources. The prime source of the electricity (the sun) is indeed free and renewable, but everything else not only decreases in efficiency, it has a maximum lifespan of 30 years, when all panels at least must be replaced. Before Council grants consent to large overseas interests, large tracts of land that will be permanent industrial sites (Far North are asking for an unlimited consent duration), Far North should be required to show if this Power Plant can be considered sustainable and if so, explain how it is. The entire infrastructure is solely reliant on the petrochemical industry, from the mining, to the creating of materials, the multiple shipping of components... That's not even including the humanitarian costs of mining some of the ores, especially if batteries will in future be included. If the Council wants to be supporting less carbon emissions, this solar infrastructure has already emitted vast quantities out of sight prior to arrival and has a short use-by date (Not even a need to plant conifers to hide that). And to rub salt into the wound, mature CO_2 converters (trees) will be cut down to facilitate it. **Not sustainable.**

-Natural Disaster – We live on an island that is subject to earthquakes (1855 quake centered in Wairarapa) and tropical storms (Gabriel was expected to land further south into Wairarapa), high winds, floods, tornado (Wairarapa 2004). The very nature of the infrastructure required for solar power, hectares of very large glass panels secured on a single axis, in the event of a natural disaster, would result in shattered (possibly flying) glass and contamination of soil and water. **Unsuitable site for power plant.** The operative district plan explains how network utilities need to be carefully located;

Network Utilities 16.3.3

... Maintaining the valued environment characteristics of the Wairarapa is a fundamental premise of the Plan. Network Utilities can significantly affect the landscape and local amenity values and therefore should be located and managed in a manner that avoids, remedies or mitigates their impact on the character of the Wairarapa, its outstanding landscapes and important natural or heritage values. Such controls need to reflect the relative characteristics and amenity values of the different environmental zones in the development standards.

AVOID the impact please, this is not a suitable site.

Mental Health and Wellbeing – I feel this needs to be addressed. This proposal (and others that we know are coming) has already been creating stress and insecurity, particularly for those living within the current impact radius of southern Greytown. It already has daily impact on decisions residents in the area are making in regard to their life and their properties. Some already making plans to move out of the Wairarapa. The District Plan talks of things such as values and community - they are nothing without people. This is a mental health and wellbeing issue and I urge Council to not only protect the natural resources of this land, but protect its people.

4. The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

For the reasons given above this application must be declined as it clearly does not meet the objectives and policies of the District Plan and the provisions of the Resource Management Act. As I have demonstrated in this submission this proposal will generate major effects both on and off site. There are serious deficiencies in the information supplied with the application and a number of effects have not been addressed. The proposal fails to meet the objectives, policies and rules of the district plan and the provisions of the Resource Management Act for notified applications as it lacks information and fails to meet the principles and purposes of the RMA and the tests for notified activities. The proposal fails to comply with the District Plan objectives, policies and rules relating to the rural zone, public utilities and notified applications.

The people of South Wairarapa need the Council to consider all the above, protect the soil, water, people's incomes, heritage, quality of living, drinking water, enjoyment of their surrounds, investments in property, trees, wildlife... This site is not suitable. Land can be sought elsewhere, away from people, drinking water, using marginal land. Treat our natural resources, people and their lives gently and with care.

Yours respectfully,

[redacted]

Elisabeth Creevey

Date 30/06/2023

RECEIVED
30 MAY 2023
BY:

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tāwa

13

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Elisabeth Creevey

Contact Person:

(if different from above)

Postal Address: 144 Bidwills Cutting

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: 415 Morea Rd

Application No. RM 220103

Description of Proposal: 235 ha Solar Power Plant.

Details of Submission

My submission *(use X to indicate your choice)*:

- [ ] Supports the whole proposal
- [ ] Supports part of the proposal
- [x] Opposes the whole proposal
- [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

- [x] Yes
- [ ] No

- [ ] If others make a similar submission I will consider presenting a joint case with them at the hearing

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

13

Submission Statement

The specific parts of the Proposal that this submission relates to.

Please refer to attached Submission.

Decision you want the Council to make:

(use X to indicate your choice)

[ ] Grant the Consent [✓] Decline the Consent [ ] Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Elisabeth Greeve

Date: 30/05/2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

14

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Folkert Burger

Contact Person:

(if different from above)

Postal Address: 13Wilford Street, Wallaceville, Upper Hutt

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far north Solar Farms

Address of Proposal: 415 Moroa Road, Greytown; 312 Bidwills Cutting road, Greytown, 1942 State Highway 2, Greytown

Application No.

Description of Proposal:

They want to build the solar farm

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

x	Yes		No

x	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

I oppose the proposal to build a solar farm as there are too many unknown risks with such construction. These risks are on local resident's health and environmental. If the council was to accept issue consent, they will be placing local residents at undue risk which will not be able to be managed. There will also be further negative ramifications to the environment due to the size and scale of the build, storm water run of, visual pollution and noise pollution. By building the proposal the SWDC will contradict an image of having a 'clean environment'.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	x	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Folkert Burger

Name: Folkert Burger

Date: 06/06/2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

15

Submitter

Name	Marion GAIL Isaac
Contact Person (If different from above)	
Postal Address	47 Cross Line Morison's Bush Greytown 5794
Home Phone	[redacted]
Cell Phone	
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	Putaki Drive KUMEU 0841
Application No.	220103
Description of Proposal (use additional pages if required)	Solar "farm" on the land as described in the Public Notice of Application concering Resource Consent advertised in newspapers by the South Wairarapa District Council 8 May 2023.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

15

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

The construction over so much grazing land between the towns of Martinborough, Greytown and Featherston will render these communities and their environs vulnerable to the worst effects of the climate change that the government and its specialist agencies unanimously countenance for this geographic region.

The presence of substantial concentrations of industrial battery capacity presents an enhanced hazard in terms of this farming region's water table, rivers, and other sources of water for consumption by humans and beasts. It is understood that never before in New Zealand has such a big power project been positioned so close to settlements and the experimental nature of this project further leads me to place on record my objection to this project.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Marion GAIL Isaac

Date 24 May 2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

16

Submitter

Name	Gaylene O'Connor
Contact Person (if different from above)	
Postal Address	122 Cross Line, RD1, Greytown
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Ltd
Address of Proposal	415 Moroa Road, Greytown
Application No.	220103
Description of Proposal (use additional pages if required)	235Ja Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

As per Attached submission document

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Gaylene O'Connor

Date 6/6/23

Important notes for the Submitter

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16

SUBMISSSION ON PUBLICLY NOTIFIED APPLICATION

FOR RESOURCE CONSENT BY FAR NORTH

TO:

South Wairarapa District Council

SUBMITTER:

Gaylene O'Connor, 122 Cross Line, RD1, Greytown

Ph: [redacted]

Email: [redacted]

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991

Date:

DETAILS OF THE PROPOSAL TO WHICH THIS SUBMISSION RELATES:

Name of Applicant:	Far North Solar Farm Ltd.
Address of proposal:	415 Moroa Road, Greytown
Application Number:	220103
Description of proposal:	235Ja Solar Power Plant

Details of submission: This submission opposes the whole proposal

In the event this application is subject to a Resource Consent Hearing, I wish to be heard in respect of my submission if others make a similar submission I will consider presenting a joint case with them at the hearing.

Submission Statement:

Decision I want the council to make: decline the entire consent application:

Submission Introduction:

This industrial proposal is a result of solar power generation over a vast area of land 235 hectares (ha).

This proposal is an entire threat to the environmental quality and character of the Greytown Rural Zone as it includes building/structures that due to their location, scale and density are not in keeping with the established rural amenity and character, which is one of where buildings are at a relatively low non-urban density with generous setbacks from property boundaries and where the height, scale density and number of buildings do not dominate the landscape.

A solar power plant of this size will definitely dominate the landscape entirely opposite to that of the intent of the Wairarapa combined District Plan- Rural Character & Amenity.

Submission Points around Application 220103:

1.4 Consent Duration: The applicant Far North Solar Farm Ltd are seeking a land use consent change with an unlimited consent duration.

The intent of this is to change the land use from one of Primary Production to a "Solar Farm".

Solar farms are also known as 'solar parks,' 'solar plants' and 'solar power stations.' They operate as power plants, just like the fossil-fueled power plants that have generated electricity for consumers for the last century.

Surely the change of the land use is therefore one of an Industrial change which would tend to indicate that this is a Zone change rather than a land use change under Rural Zoning.

If not a Zone change then surely the application should be considered as an Industrial Network Utility as defined in the District Plan:

Industry – means premises used for manufacturing, fabricating or processing, substances or material into new products. (Processing the sun via solar panels into Electricity)

Network Utility – means any utility which is part of a network and includes electrical lines... and associated support structures. (The proposed facility would connect to an existing substation, thus becoming part of the NZ Electrical network grid)

4.2 Resource Consent Requirements:

In Table 2 the applicant states buildings will exceed allowed gross floor area. These solar arrays are essentially buildings, and with each array being nearly 5 meter's wide and 59,612mm long, coupled with footprints of inverters, substations, and possibly water tanks for cooling(depending on size) The council should be requesting the applicant to state the overall footprint % on the land. It would be far in excess of anything permitted in the rural zone. The gross floor area of a network utility i.e cannot exceed 10 square meters in area, and on this basis alone the effects of the proposal are huge not minor.

The applicant is also requesting the planned non-compliance of unsealed road setbacks (erection of solar panels within 25m of unsealed road), there does not appear to be an explanation for this in the application as to why this ruling cannot be adhered to. This should be addressed with further clarification requested by Council.

Rural Zone 4.3.1:

The applicant (Far North) claims *"the proposed solar panels are consistent with other rural activities and refer to glass houses, so therefore the amenity values of the rural zone including natural character will be maintained".*

In my belief there is a flaw to this statement in that glasshouses are usually concentrated on smaller sites, and do not take up a massive % of an area of land as a solar power plant will and on such a large scale.

5.4.1 Natural Character Effects:

In the application Far North Solar Farm Limited imply that the change to the existing pastoral and rural character of the site are **less than minor** due to the fact that they propose a 3m wide screen planting with Japanese Cedar along the entire site boundary.

There appears to be some discrepancy with this statement as the Councils advice from Landscape Architect at Boffa Miskell, Emma McRae states that the Landscape assessment terminology of "moderate" assessment to the RMA framework for assessing effects. The assessment indicates that the introduction of built electricity infrastructure into a currently open pastoral landscape will be a potentially moderate effect that is, more than minor.

To add to this observation it should also be noted that until recently SWDC used this landscape in its logo. It is part of the identity of the Wairarapa Region. The Central Plains landscape has a feeling of openness and expanse and this is what brings people to settle, stay and visit the area.

Potentially for five years until the plantings reach a certain height they will not disguise the visual effects on the landscape of an electricity infrastructure of such a scale therefore impacting the openness and expanse of the rural landscape potentially deterring people to stay and visit within the affected area.

5.6.1 Noise Effects:

Far North Solar Farm Limited state that both the construction noise and operational noise effects are minor/minimal

In the case **of construction noise** the applicant states *"The noise produced from the construction activities is likely to be indiscernible from normal rural activities, such as harvesting or cultivating"*

I disagree with this comment as the construction activities will take place over a daily, continuous 6-9 month period, which in itself a longer duration than seasonal harvesting or cultivating, most farmers want to gather in their harvest or cultivate their land in a short time frame and in most cases may only be for a period of a couple of weeks.

In the case **of Operational Noise** the applicant states "Operational noise effects are minimal and will not be noticeable from the boundary of the site" and overall the operation noise effects are considered to be negligible. Stating that the average maximum sound pressure at 1m distance was measured at 62dBA.

Inverters are essential in solar power production as they convert the direct current (DC) electrical power collected in the solar panels into alternating-current (AC) power. Solar power farms must convert the DC to AC power to distribute electricity to the local grid and it is this conversion process that generates noise pollution.

Also movements in other mechanical components in the Inverter and transformer, like coil vibrations and high-speed cooling fans, contribute to the body and level of noise.

There are other factors to consider when assessing the potential noise impact of a solar farm which I believe should include:

- nature of the area/setting;
- The existing noise climate in the area;
- The character of the noise generated; and,
- The level of noise generated.

In this application a proposed commercial scale solar farm is to be located on farmland in a tranquil rural setting, away from transport or industrial infrastructure. Rural soundscape will include noise from livestock, seasonal farming activities, bird song etc. In these instances, sensitive receptor locations are like to be exposed to relatively low background noise levels and a generally tranquil landscape.

Against this context, noise from unnatural sources such as noise pollution may stand out. Any hums or tones associated with the electrical plant while not subjectively loud are likely to be more readily identifiable giving rise to impacts virtually irrespective of the absolute level of the noise generated.

The proposal is definitely a Network Utility, and given that the introduction of large scale Solar is still in its infancy in NZ then it is reasonable to expect that as the District Plan pre dates the possibility of large scale solar, therefore perhaps the council should look to their own guidelines concerning Renewable Wind Energy Facilities as a comparative as outlined:-

District Plan, Network Utilities 22.1.20 Wind Energy Facilities(v). The actual or potential noise effects of the construction, development and operation of the wind energy facilities, including particular consideration of the special audible characteristics and the proximity and effect on settlements.

Noise(iii)Acoustics – the assessment and measurement of sound from Wind Turbine Generators

A) The assessment of the activity shall not be made in isolation, The assessment shall be made with all other uses and activities in the area in normal operation and the cumulative effect taken into account. And the power plant will be surrounded by C) noise sensitive activities, residential, visitor accommodation.

6.3.1 National Environmental Standards:-

The applicant states "there are no HAIL activities associated with this site" which in its present state is true. This statement is only around the current site, it does not take into consideration that the site should the proposal for solar is approved then it could in itself be creating a HAIL site with future ramifications on the rural zoned land due to, Photovoltaic panels may contain hazardous materials and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they are damaged or improperly disposed upon decommissioning.

There is no indication by the Applicant (Far North) on how they propose to mitigate this potential risk and as this is an important part of ensuring long term sustainability of rural land I would be strongly recommending that the Council seek further clarification and request a plan around mitigation.

Decommissioning of the Solar Farm and all Materials

The Applicant (Far North) state "that at the end of the consented period, the solar farm is decommissioned and all materials are removed for recycling"

There is no indication by the Applicant on how they propose recycling of the materials will occur. My thoughts on this are that currently worldwide there are limited capabilities on the recycling of solar panels and in fact is becoming an issue in other countries as already existing solar panels are starting to fill up landfills.

Council should be addressing this issue with the Applicant and seeking their plan on the mitigation of disposal of panels, not only at the end of their life, but also around how they will dispose of any damaged panels during the operational cycle of the solar power plant.

Conclusion:

In conclusion, applicants for Solar Energy Generation are choosing rural locations that are close to settlements and substations etc. to make it cheaper to connect to the electricity network.

I am sure that within the Wairarapa, there are areas large enough where Solar Plants could be built without negatively effecting landscape or communities, but solar farm promoters do not appear to be interested as the necessary network infrastructure is not in place, making sites too expensive to attract investment.

I am not against solar farms or renewable energy what I am resistant to is solar farms being put in inappropriate places where the land use and character is changed.

I am pushing for a rational and proactive council to facilitate renewable energy schemes that don't harm our landscape.

Given the Solar Power Generation is in its infancy in New Zealand, and that there are many variables to Solar Power Generation a prudent Council should be deferring applications and holding off for at least a year without making rushed decisions until there is more research and clarification around potential impacts:-

1. NZ has a general election coming up in only a few months and should there be any change in Government, then there may be a change around the environmental impacts of Solar Power Generation, and the pending changes with in legislation around the RMA etc.
2. There are a number of overseas countries, USA and Australia as an example where given that they have been in the solar power generation game much longer than NZ who are continuously reviewing the impact that Solar Power Generation has on the environment. An example of areas that are being investigated and reviewed are:-
   - Wind Impact
   - Impact on Soil
   - Impact on Water
   - Impact on natural species and habitats
   - Safe distancing of solar farms to both rural communities and rural environments.
   - The life cycle of solar panels from manufacturing through to disposal and the total emission generation from the full life cycle compared to the gains.

3. One of the biggest issue that countries whom have taken up the opportunity to use alternative sources of energy is the recycling conundrum, in that currently there does not seem to be a recycling plan in place as in most instances there is a huge cost in the recycling of panels etc. Experts claim that there will be potentially over a billion panels to be replaced and if we continue in this manner then it's going to be a waste mountain by 2050 according to Ute Collier, deputy director of the International Renewable Energy Agency.

How the Council manages this proposal will pave the way for more proposals of the same nature, that the Council are aware of that are waiting in the wings. These Companies are all waiting to utilize rural land close to electrical power generation infrastructure, once one application is approved it has the potential to set a precedent for the approval of other applications. This will change the rural landscape drastically, a heritage town and its rural corridors will be changed forever. Instead of a rural vista, and working productive rural land for primary production there will be a seascape of solar panels that will be an entire threat to the environmental quality of the Greytown Rural Zone.

NZ and its council's should be waiting to see the outcomes of the research and I don't believe it is unreasonable to delay applications for Solar Power Generation for a minimum of a year until we all have further information around the potential implications to our NZ heritage and environment.

I trust you will take on board my valid concerns, and at this time decline the application as it clearly does not meet District Plan Standards, around rural zone, neither the objectives nor policies of the Resource Management Act.

It does not show how it will mitigate any concerns around both the District Plan and Resource Management Act. Where these can't be addressed then one of the options for mitigation is to "avoid". I urge the Council to do this at this stage and decline the application.

Thank you for the opportunity to make this submission

Gaylene O'Connor

6 June 2023

Chris Gorman-Temp Planner

From: GCB-Warren Woodgyer
Sent: Sunday, 4 June 2023 7:01 pm
To: [redacted]
Cc: GCB-Louise brown; GCB-Warren Woodgyer; GCB-Jo Woodcock; Neil Morison; Councillor Aaron Woodcock; Councillor Martin Bosley
Subject: Far North Solar Farms Submission

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Greytown Community Board

Contact Person:

Louise Brown, Chairperson Greytown Community Board

Postal Address: c/- SWDC, P.O.Box 6, Martinborough, 5741

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Limited

Address of Proposal:415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Application No. 220103

Description of Proposal:

321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground

40 inverters, lines and associated structures

Buildings not required for primary industry or residential

purposes exceeding 25m2

Associated site works and new accessways

Screening planting.

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

x	Yes		No

	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

The Local Government Act 2002, Section 52 states that one of the roles of the Community Board is to represent, and act as an advocate for the interests of its community. Within this we feel that Community boards play a crucial role in land use planning and development processes, ensuring that they align with the community's needs and desires. Such as potential impacts of development on the district, environmental concerns, and social and economic implications, and strive to ensure that development is in line with the community's vision and interests.

While we recognize the importance of renewable energy and its potential benefits, we believe Community engagement and consultation are paramount in addressing concerns. It is crucial for developers to actively involve Greytown Ward residents, provide transparent information, and listen to their feedback. Meaningful engagement allows for a more inclusive decision-making process that takes into account the community's perspectives and concerns.

The Greytown Community Board feels the applicant has done insufficient consultation at this time and it is too soon for this consent to be approved and therefore declined at this time.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	x	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name: Louise Brown

Date: 4 June 2023

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

18

Submitter

Name	gerry and jenny van dalen
Contact Person (If different from above)	gerry and jenny van dalen
Postal Address	112 wards line RD 1 Greytown 5794
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	far north solar farm ltd
Address of Proposal	415 moroa road, greytown; 312 bidwills cutting road, greytown; 1942 SH 2, greytown; 18 pharazyns road, featherston
Application No.	220103
Description of Proposal (use additional pages if required)	175-megawatt peak solar power plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☐ No

- ☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

the whole proposal

we support the submission from frank van steensel and josje neerincx

the whole neighborhood will be negative influenced if this goes ahead, and also greytown itself

we came to new zealand for its green clean pastures, not for solar panels, from which you don't know the health effects, when they are running and afterwards, when they come to the end of their productive time, look at the electric cars and batteries, no one wants to touch

we are concerned for the health of ourselves and of the generations to come

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name gerry and jenny van dalen

Date 6/6/20

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 – Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Ingrid Ward
Contact Person: (If different from above)
46 Reading Street, Greytown
[redacted]

Details of the Proposal to which this Submission Relates

Far North
Address of Proposal: 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston
Application No.
To build a solar farm on farm 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

Yes	X	No

If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

I entirely endorse the submission of Elisabeth Creavey of Bidwills Cutting Road, Greytown submitted under the emai[redacted]

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Ingrid Ward

Name:
Date:6 June 2023

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

20

Submitter

Name	Jacqui Southey
Contact Person (If different from above)	
Postal Address	5 Colville Street, Masterton, 5810
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Submission
Address of Proposal	Williamson Water and Land Advisory 10/1 Putaki Drive
Application No.	WWLA0589
Description of Proposal (use additional pages if required)	The construction and operation of a 175 megawatt peak (MWp) solar farm at 415 Moroa Road, Greytown (the site).

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

20

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

This proposal has the potential to undermine the property values in the rural areas in the vicinity of the proposed solar farm. The solar of the proposed solar farm will completely change the visual nature of the current farmland and will potentially move from an area known for rural beauty to an industrial looking area that completely lacks in visual appeal and could be termed visual pollution.
There is a risk of noise pollution from the proposed solar farm, this could have a harmful impact on humans and animals residing in this area. It is my view this risk has not been sufficiently analysed and there is no guarantee in the proposal that there will no noise pollution.
Currently this land is reasonably open and flat with views stretching toward the Tararuas. This land has been farmed since the early 19th century is a vital part of the historical nature of the town of Greytown. Much of the historical character of Greytown is protected and this has enhanced the beauy and character of the town leading to high returns in terms of property value. The surrounding farmland should be accorded the same protections to protect the visual and historical value of the township and immediate rural surrounds.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

I request that the council declines this consent. In addition to reasons for objecting above I will provide an attached written document.

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Jacqui Southey

Date 6/6/23

Important notes for the Submitter

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Far North Solar Farm Submission

Submitter Jacqui Southey

Date 06 June 2023

Submission Objecting to the entire proposal by Far North Solar Farm Submission to establish a Solar Farm described as the construction and operation of a 175 megawatt peak (MWp) solar farm at 415 Moroa Road, Greytown (the site).

I am a landowner and rate payer in the Battersea Road area Greytown and completely oppose the proposed establishment of the 175 megawatt peak (MWp) solar farm at 415 Moroa Road, Greytown (the site).

Reasons for objecting

1. Undermining nearby property values.

This proposal has the potential to undermine the property values in the rural areas in the vicinity of the proposed solar farm. The solar of the proposed solar farm will completely change the visual nature of the current farmland and will potentially move from an area known for rural beauty to an industrial looking area that completely lacks in visual appeal and could be termed visual pollution.

2. Risks related to noise pollution.

There is a risk of noise pollution from the proposed solar farm, this could have a harmful impact on humans and animals residing in this area. It is my view this risk has not been sufficiently analysed and there is no guarantee in the proposal that there will no noise pollution.

3. Undermining the current visual beauty and historical character of this land.

Currently this land is reasonably open and flat with views stretching west toward the Tararua ranges or East toward the Jury Hills. This land has been farmed since the early 19th century (at least) and is a vital part of the historical nature of the town of Greytown. Much of the historical character of Greytown is protected and this has enhanced the beauty and character of the town leading to high returns in terms of property value. The surrounding farmland should be accorded the same protections to protect the visual and historical value of the township and immediate rural surrounds.

4. Undermining the use of productive farmland.

The farmland that is proposed to be used for this solar farm is currently productive food producing agricultural land. This land should be protected to support the production of food via agriculture. As the climate crisis impacts our future, it is essential that we have reliable food agriculture and that land being used for this is protected to ensure our future food supply.

Furthermore, the use of any agricultural land should be prohibited for solar supply as there are millions of rooftops across New Zealand that could hold solar panels and generate solar electricity supply. We can look to countries such as Australia, and increasingly the United States, utilising urban

rooftops to generate solar power. This would protect our farmland from being unnecessarily devalued to create industrial solar power installations.

I do not support this proposal and request that the South Wairarapa District Council does not give consent based on the objections listed in this submission.

Jacqui Southey

[redacted]

5 Colville Street
Masterton 5810

[redacted]

6 June 2023

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION FOR RESOURCE CONSENT BY FAR NORTH SOLAR FARM LTD TO

South Wairarapa District Council

SUBMITTER

James Field, 268 Bidwills Cutting Road, Greytown

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991

PROPOSAL TO WHICH THIS SUBMISSION RELATES
Name of applicant; Far North Solar Farm Ltd
Address of proposal; 415 Moroa Road, Greytown
Application number; RM220103
Description of Proposal; 235Ha Solar Power Plant

Details of submission; This submission opposes the whole proposal.

In the event this application is subject to Resource Consent Hearing I would like to be heard in respect of my submission. I would consider a joint case if others present similar objections.

Decision I want the Council to make; Decline the entire consent application.

Submission Statement;
a) The proposal contravenes of the Wairarapa Combined District Plan (WCDP) strategic principles and objectives (specifically RE-O2, RE-O3, and CCR-O3.)
2) The proposal significantly increases the risk to flight safety for operations from the adjacent runway.
3) The proposal does not adequately address end of useful life infrastructure recycling.

The details of my submission statement are detailed below.

Resource Consent RM220103 Opposition Statement Detail

1. I am a local farmer, and professional aviator. I operate farms immediately bounding the north and east borders of this proposal, and I operate a grass runway with a climb out lane directly across the site. Furthermore I have a house 600m downstream of the site.

2. The Far North Solar Farm Ltd (FNSF) proposal contravenes the strategic direction and intent of the WCDP.

a. Strategic Objective RE-O2 Productive Capacity. This objective affirms the councils intent to protect primary production within the rural zone. Continuing food production must be balanced against the needs of a growing community. The proposal, along with the armchair assessment of effects document, flippantly claims that pastoral production will continue largely unaffected by the installation of 235ha of solar panels. Any career farmer will confirm that baseline South Wairarapa finishing land will carry 8-15 stock units per hectare over autumn/spring, and produce 2 tonnes of barley per hectare or 80-120 conventional bales of hay in the summer. The obstruction and shading effect of 321,000 photovoltaic panels will completely preclude hay or barley production. The lamb stocking rate would be reduced by approximately 75%.

b. Strategic Objective RE-O3 Character of the Rural Environment. It is a far stretch of the imagination to believe that a row of screening trees is sufficient to hide the dramatic visual and functional change to the 235 hectare site. This is a huge proposal, on a very large scale. The manmade silicon and steel solar forest will affect the visual landscape significantly, and its impact will be permanent. It will also bring significant traffic flows, audio and electromagnetic noise which are well above the normal threshold for our small town.

c. Strategic Objective CCR-O3 Resilience to Natural Hazards. The installation of high tech solar panels will not enhance our regional resilience to disasters. If anything this type of installation is more sensitive to adverse climatic events, including hail, tropical storms and earthquakes. We know from recent experiences with Cyclone Gabrielle and the Christchurch Earthquake, that these events are becoming more frequent. Sealed photovoltaic panels present little threat to health and safety, however if ruptured or broken, the toxic ingredients of lead, cadmium and antimony can escape and poison the surrounding ground and groundwater – operating a bore water supplied home, with young family a mere 600m downstream is a real concern for me.

3. Flight Safety. I have a hangar and an associated grass runway near the site of the proposal solar farm. My westerly runway terminates just 10m from the eastern boundary of the site. The highest risk for any single engine aircraft operation is the relatively high power take-off and climb out. On most Wairarapa days, the westerly wind dictates a climb out on the westerly runway. With the addition of the proposed solar installation, an additional climb out obstruction is presented which must be cleared, but also in case of an engine failure after take-off, there would be almost zero chance of occupant survival.

4. Modern photovoltaic panels claim to minimise sun glare. However my 20 years of aviation, across dozens of countries and nearly 4000 flying hours, say otherwise. The risk posed by panel derived sun strike, poses a danger to aeronautical operations.

5. End of Life Maintenance and Recycling. I admire the underlying principle of increasing renewable power generation, whether it be altruistic, economic or big tech carbon offset motivated. However, any new endeavour especially of this industrial scale, must be closely examined from the cradle to grave. At the time of writing, the South Wairarapa does not have a large scale landfill. And indeed nowhere in NZ has access to photovoltaic panel recycling facilities. 321,000 panels will happily be

imported into our region, but I would imagine they will not be safety shipped out again when they reach the end of their productive life. Cadmium, lead and antimony sound exotic and exciting until we find them in our drinking water. Companies fail, or sell. Will the next owner, or FNSF Ltd in 25 years, have the resource or motivation to protect our environment by properly maintaining and disposing of this complex and sizeable problem?

6. In summary, I respect progress. However when we look beyond the renewables romance and look at the practical challenges associated with this proposal, we can see that this is not the correct location for this endeavour. The WCDP forms a logical ruleset which helps us to protect our lifestyle, community and environment. Under this proposal, primary production will be reduced to a fraction, the rural character change will be significant and permanent, environmental resilience reduced, the hazard to local aeronautical operations increased and heavy metal trash and leaching a huge problem the next generation of Wairarapa residents aren't equipped or prepared for. The WDCP plan must be followed and this proposal should be rejected.

Yours sincerely

[redacted]

James Field, 268 Bidwills Cutting Road, Greytown

[redacted]

6 June 2023

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

22

Submitter

Name	Jeannie Hancock
Contact Person (If different from above)	
Postal Address	255 Bidwells Cutting, Morrisons Bush Greytown, 5794.
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Limited
Address of Proposal	415 Moroa Road, Greytown
Application No.	RM220103
Description of Proposal	235Ha Solar Power Plant

Details of Submission

My submission:

- [ ] Supports the whole proposal
- [ ] Supports part of the proposal
- [x] Opposes the whole proposal
- [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- [x] Yes
- [ ] No

- [x] If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

1. In my opinion the development is not temporary.
2. Significant negative visual impact for residents and visitors adjacent to the site.
3. Loss of productive land and the impact on the character of the landscape.
4. Effects on wildlife.
5. Likely negative impact on local tourism.
6. No tangible benefit to the local community.
7. Disruption during construction and ongoing noise of operating plant.

Decision you want the Council to make:

☐ Grant the Consent ☒ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Jeannie Hancock 5th June 2023.

(Electronic Signature).

Name

Date

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

Submitter

Name	Jeannie Hancock
Contact Person (If different from above)	
Postal Address	255 Bidwells Cutting, Morrisons Bush Greytown, 5794
Home Phone	
Cell Phone	[redacted]
Email	

Submission Statement

The specific parts of the Proposal that this submission relates to.

1. In my opinion the development is not temporary.
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5. Likely negative impact on local tourism.
6. No tangible benefit to the local community.
7. Disruption during construction and ongoing noise of operating plant.

- In my opinion the development is not temporary.

The proposed 35-year lease is for a considerable amount of time. The construction and the size of the proposed solar farm will cost millions of dollars so I believe it will never be returned to its current agricultural use, therefore to me there is no weight that the development is temporary and can be reversed. Alternatively, I am unaware of any recycling of these panels and it is becoming a worldwide problem of what to do with them once there use is over.

- Significant negative visual impact for residents and visitors adjacent to the site.

There are many residential properties located close to the boundary of the development and this will have a significant visual and environmental impact on their lives. The high dark solar panels will be in sight from most of the adjacent properties for many years until the hedging grows, this hedging is not native and itself will look unattractive. The currently attractive landscape will go from green paddocks with far reaching views to the ranges to an industrial power complex of fields of high dark solar panels, shipping containers containing electrical equipment and security fencing.

- Loss of productive land and the impact on the character of the landscape.

Currently the paddocks where the proposed solar farm is be located is mainly used for growing grass and the grazing of cows and sheep. It is good high quality agricultural, and this is why it is currently zoned rural not industrial and should be used for its main purpose.

- Effects on wildlife

The removal of any of the current shelter belts will have a huge effect on the birdlife, the Ruru (Morepork) nests in these trees and once gone so will they. Also removing the shelter belts will

have on impact on the wind, as they were planted many years ago to slow down the volume of wind it would be a huge mistake to remove any of them.

Large solar panel farms such as this one has dire consequences for the local birdlife, studies have suggested that birds mistake the mirror like glare from a solar panel as water and collide into the panels when trying to land with deadly consequences or worse leaving birds injured and in pain to die slowly.

- Likely impact on Tourism.

Greytown hailed New Zealand's most beautiful village a few years ago because of the Fields of green, big open spaces, friendly locals, fantastic shops and handsome shops and houses. If this solar farm goes ahead that award will never come our way again it will turn the currently rural green area (gateway to Greytown) into an industrial area filled with dark panels of glass surrounded by a high fence with a ugly line of trees trying to hide it, I have no doubt there will be warning signs everywhere and CCTV To me this is far from welcoming to any visitors.

Visitors will also not want to stay anywhere near the solar farm as it's an ugly outlook and people are unsure as to the consequences' of being near one let alone staying for a few days. Another thing is locals are divided and will talk and visitors will pick up on the bitterness in conversations heard in shops and by simply talking to the locals and this will result in less visitors to the area, resulting in less money spent in the homestays, restaurants and local shops.

- No tangible benefit to the local community.

Apart from a few jobs that may or may not be available for local contractors for the year of building I cannot see any advantages or employment opportunities. I imagine the power will either be put straight into the national grid or stored in batteries. I cannot see any evidence that power will be distributed at a discount to South Wairarapa residents who must `drive past and or live by this solar farm.

- Disruption during construction and ongoing noise once completed.

I can only imagine the noise that will be all day every working day for months on end there will be piles that need to be hammered into the ground and the installation of the panels themselves. Let alone the construction of the substation and with all the trucks coming and going, they are all going to drive up Bidwells Cutting. Bidwells cutting is a skinny fast rural road with no room for error also many cyclists go up and down this road. Surely this is a safety concern.

Based on the above I implore the South Wairarapa district council to decline this application.

[redacted] Jeannie Hancock 5th June 2023

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

23

Submitter

Name	Jo Woodcock & Aaron Woodcock
Contact Person (If different from above)	
Postal Address	2128 State Highway 2 Greytown
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	Putaki Drive KUMEU 0841
Application No.	220103
Description of Proposal	Solar "farm" on the land as described in the public notice of application concerning Resource consent advertised in newspapers by the South Wairarapa District Council 8 May 2023.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☑ Opposes the whole proposal
- ☐ Supports part of the proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes
- ☐ No

☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

23

Submission Statement

The specific parts of the Proposal that this submission relates to.

See document attached.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Jo Woodcock
Aaron Woodcock

Date 6/6/2023

Important notes for the Submitter

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3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION FOR RESOURCE CONSENT BY FAR NORTH

TO

South Wairarapa District Council

SUBMITTER

Jo and Aaron Woodcock

[redacted]

We are not a trade competitor for the purposes of section 308B of the Resource Management Act 1991 Date 6/6/2023

PROPOSAL TO WHICH THIS SUBMISSION RELATES
Name of applicant; Far North Solar Farm Ltd

Address of proposal; 415 Moroa Road, Greytown Application number; RM220103
Description of Proposal; 235Ha Solar Power Plant

Details of submission; This submission opposes the whole proposal
In the event of this application being subject to Resource Consent Hearing we would like to be heard in respect of our submission.

Decision I want the Council to make; decline the entire consent application.

NB: When referring to the proposed "solar farm" that is the developer Far Norths wording, not ours. The correct term/classification is a solar power plant. It is not farming, it is an industrial power plant on a huge commercial scale. Sunshine is not farmed, you harness the energy from the sun. The term solar farming is being used for marketing purposes to represent this project as environmentally friendly.

We support Elisabeth Creevy's submission and have added our objections and issues not considered in the application.

1.Earthquakes

In 1855 the most powerful earthquake recorded in New Zealand occurred and its epicenter was Greytown, 8.5.

- The Wairarapa fault line runs directly under properties near the proposed site and the proposed power plant is trying to gain consent. Given the incredible geological change of the topography after the 1855 earthquake it is a risk that the land is unstable to place commercial infrastructure on such a large scale.
- Recent changes regarding consent requirements for work on land subject to liquefaction.

- The need to obtain a report from a suitably qualified person (geotechnical engineer for example) showing that the land is or is not subject to liquefaction.

2.Flight Safety

A local farmer has a grass runway and hangar, near the proposed Solar power plant. Any structures that encroach on the climb-out or decent flightpath at the west end of the runway, will reduce the useable length of the runway, essentially creating an inset threshold and reducing safety margins. But even more concerning than this, is the possibility of engine failure on take-off. Statistically, the most dangerous phase of the flight is the take-off. In case of an engine failure immediately after or during take-off, the probability of surviving an overrun or forced landing into the Solar power plant, which will essentially be a forest of steel pillars and formwork, is very limited.

The claim that the proposed solar panels have an albedo similar to grass, does appear incredulous to me. Quoted from Jimmy Field, 415 Moroa Road "My 25 years of professional aviation have taught me that sun reflections from smooth surfaces will always present a hazard. In my opinion, the threat of sunstrike during the critical phases of take-off and landing will be major".

Therefore the proposal poses a risk to aviation and road safety with glare and glint from solar panels (both the metal frames and the glazed surfaces). The proposal height of the panels are 4.5 metres high.

1. The application should have included a reflectivity assessment. NZTA must be consulted and a report outlining safety concerns.

3.Toxicity

The danger presented by the photovoltaic panel's rare earth metal components, namely lead and carcinogenic cadmium, is a cause for concern. Recent storms in California have highlighted the ease with which damaged panels can result in these pollutants entering the water table. The groundwater for several houses flows under the proposed Solar power plant. The historic Moroa Water Race runs along the boundary of several properties which is a source of water for stock. From the information Far north has given us, there are currently ground water bores on the proposed property.

4.Fire risk

Fire risks are a concern in solar farms due to the presence of electrical components and the potential for flammable materials. Faulty wiring, over heating of electrical components , or equipment failure can lead to electrical fires with the solar array. These fires can spread quickly, especially if the solar panels are close to one another.

Firefighters efforts can be challenging in "solar farms" due to high voltage present in the systems. Firefighters must exercise caution when approaching the area and may require specialized training to safety handle incidents involving solar panels. Additionally, the

location of "solar farms" in remote areas can delay response times allowing to intensify and cause more damage.

Once ignited, fires in "solar farms" can be difficult to extinguish completely. The material used in solar panels , such as glass, metal and plastic, can generate toxic smoke and hazardous by-products when burned. Fire suppression systems, early detection mechanisms, and proper maintenance practise are critical for minizming fire risk and migrating potential damage in "solar farms". Regular inspections and adherence to fire safety codes and guidelines are essential for ensuring the safe operation of solar.

A study carried out by the BRE National Solar Centre found that more than a quarter of fires involving solar systems were caused by the photovoltaics and those fires were all "serious fires", meaning fires that were "difficult to extinguish and spread beyond the area of origin."

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786882/Fires_and_solar_PV_systems-Investigations_Evidence_Issue_2.9.pdf

We understand that FENZ was consulted but have seen no fire management plan for the proposed Solar power plant. A fire management plan must be submitted for viewing.

5.Indemnity

The council requires information re compensation and restitution for loss of business defined as having been incurred by rural accommodation providers due to the industrial nature of this power generation scheme and over such a substantial expanse of the countryside.

If batteries are planned to be used now or in the future, information is similarly required in the event of pollution damage in neighbouring properties being traced to or identified with this project.

The above also applies to contamination being identified as having been sourced in any other commercial applications on the project site such as light receptor panel cleansing systems.

Also requested due to the only semi permanence of this extensive project in this catchment is information on compensation and restitution to property owners in the event of the component parts becoming detached with damaging or injurious effect in the event of climate extremes.

6. International standards

At the meeting with SWDC council meeting, it was confirmed that central government has not been given any directions/scope of best practices to install solar power plants in NZ. Local councils must follow the RMA Act and combined district plan.

Looking at Australia and countries beyond. Solar power stipulates not 500m near a state highway, 200 meters near a road, and 10 km from a town.

Only NZ standards located Solar standards update 07 March 2014 click link below
https://www.standards.govt.nz/news-and-updates/solar-standards-update/

7. Historic Heritage/Ahurea Tuakiri

The Wairarapa's rich cultural and spiritual heritage is found in:

- *Buildings, features, and trees of historic heritage value;*
- *Sites of archaeological importance;*
- *Sites of significance to Wairarapa Maori, including waahi tapu; and sites of significance to European settlers.*
- *Precincts – areas of buildings or other features that, collectively, have significant historic heritage value.*

These historic resources are important as they represent links to the past and provide insights into the way the Wairarapa's communities and settlements have developed. They also contribute to the character and amenity values of localities, particularly where there are neighbourhoods containing relatively numerous historic heritage buildings and features.

Some areas of the Wairarapa have a significant historic heritage as a consequence of the combined character and values associated with a number of buildings and structures within a locality, many of which individually may not be regarded as significant. Such 'precincts' include the town centres of the South Wairarapa ... Most of the Wairarapa's historic heritage requires active management in a way to ensure its continued existence and enhancement.

Greytown is the oldest permanent inland settlement in New Zealand, dating from 1854. In 1853, the first Small Farms Associational purchased 100 acres for urban settlement in Greytown and an adjoining 4000 acres on the Taurherenikau and Moroa Plains. From this time onwards pastural farming has been the lifeblood of provincial New Zealand. The plains have provided a home, sustenance, a career, a lifestyle and an Ahurea Tuakiri (cultural identity) to generations of rural New Zealanders. The Moroa Plains are taonga (a treasure) and together with Greytown itself, they are our living heritage. The foundation of the Solar Farm project will be built at the expense of our Ahurea Tuakiri.

8. Site suitability

1. Prime agricultural land located on moroa plains and should be preserved - it is not industrial land.
2. This sets a precedent for other solar power plants to be built near residential homes.
3. It is inconsistent with the local character of Greytown, its heritage, and the destination features of Arbour town as all existing trees will need to be chopped down to allow the sun to reach the panels.
4. Undertake a true assessment of alternative site consideration.
5. Studies undertaken overseas document health problems for people and animals that live close to solar power plants.

9.Decommissioning and rehabilitation

1. The plan does not lay out a decommissioning plan.

2. The condition of the soil during and after solar power plant is decommissioned. A rehabilitation and decommissioning plan should be submitted.

10.Environmental impacts

1. Environmental degradation and habitat loss are burnt by the heat from the solar mirrors and beam of concentrated sunlight.
2. Leaks of toxic materials and chemicals could be harmful to the environment.
3. Solar power plants give off carbon.
4. Increase weeds and use of chemicals under the panels- a weed management plan needs to be provided.
5. We would like to draw you to a study commissioned by Massey University on Thursday October 2022. Massey is exploring the potential for combined solar and pastoral farming, and we understand that preliminary results maybe out shortly regarding this study.

https://www.massey.ac.nz/about/news/massey-exploring-the-potential-for-combined-solar-and-pastoral-farming/

In the context of this project's potential to inflict detrimental longer-term environmental impacts on the district we object on the grounds of insufficient data on-

- Ultimate ownership and thus responsibility for the project.
- Provision for restitution should action be taken by those adversely affected and which would otherwise fall upon the local authority to meet.
- Provision of guarantees that there be total remediation of the environment at the end of the project's stated timeline and should this be curtailed for any reason prior to this.
- The actual provenance, the true origin, of the equipment and all elements to be installed on the site.
- Specific details of equipment and components on this site which should they be adversely impacted by breakdown or by fire or flood will cause to enter the environment substances detrimental to livestock and humans.

11.Social and economic impacts

The impact on properties public liability insurance as a result of the development -the application should include a clause that the developer covers any increased cost of public liability insurance for all
impacted properties.

12. Roading impacts

Excess dust due to traffic on Moroa road whilst building the solar farm, over the projected five year period of construction.

13. Reverse sensitivity

We would like to highlight a paper in the NZ journal of environmental law regarding reverse sensitivity- The common law giveth and the RMA taketh away.

"Reverse sensitivity exists where an established use produces adverse effects and a new use is proposed for nearby land. It is the legal vulnerability of the established activity to objection from the new use. Under the Resource Management Act 1991 ("RMA "), new uses may be prohibited or limited on the ground of reverse sensitivity in order to protect established uses from having to modify their operations".

The term "reverse sensitivity" does not appear in the RMA. It is not a term of art, but has become the label for a particular kind of effect. It was defined in Auckland Regional Council v Auckland City Council: 4 [The term refers] to the effects of the existence of sensitive activities on other activities in their vicinity, particularly by leading to restraints in the carrying on of those activities.

Link to NZ journal of environmental law regarding reverse sensitivity- The common law giveth and the RMA taketh away.

http://www.nzlii.org/nz/journals/NZJlEnvLaw/1999/6.html

We would like the commissioner to consider this proposal and any future planned solar power plants for the Greytown ward would fall into this catergory. The existing substation is a favourable location for a developer however it is on highly productive land, not marginal and so close to residential housing.

To conclude the Far North application must be declined as it clearly does not meet the objectives and policies of the District plan and Resource Management Act. The people of the Greytown ward need the council to consider that consenting to having solar power plants in close proximity to town, schools and exporting orchards and eco farms is risking the town's heritage, economic viability and future tourism with the dark skies status. The council needs to recognise that marginal land away from residential properties is to be considered the better option. We are aware that the combined district council plan has been out for consultation and is being drafted to consider these impacts to our region in the future, in the meantime can you consider a solar power plant near Greytown as an economic risk.

Yours Respectfully,

Jo and Aaron Woodcock

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

24

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: John Walsh & Anne Clark

Contact Person:

(if different from above)

Postal Address: 38A Abbott Street, Ngaio, Wellington

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Greytown Solar Farm – Far North Solar Farms Ltd

Address of Proposal: 415 Moroa Road, Greytown

Application No. (this is not clear on your website or on the application)

Description of Proposal:

The **South Wairarapa District Council** has received an application from **Far North Solar Farms** for a land use consent to establish and operate a 175-megawatt (peak) solar farm including:

- 321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground
- 40 inverters, lines and associated structures
- Buildings not required for primary industry or residential purposes exceeding 25m2
- Associated site works and new accessways
- Screening planting.

Situated at the following locations:
415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

	Yes	X	No

X	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

We oppose the entire proposal.

We purchased a property (LOT 2 DP 570788) near the corner of Moroa Road and Battersea Road approximately two years ago. We were drawn to the site because of the quiet rural setting. The solar farm will be directly opposite our house when completed. We did not purchase the property to live in a semi-industrial landscape or to experience the nuisance likely to accrue during the construction of the solar farm and its on-going operation.

The landscape is classified as "ordinary" by the applicant. Indeed it is. It is an ordinary, quiet, peaceful rural location with (other than the Battersea sub-station) no industrial activity on it. A solar farm of the size proposed will change this indelibly.

If the consent is granted and the development proceeds we would expect to be financially compensated for loss of value of our property, loss of amenity, loss of enjoyment and for on-going nuisance.

We are concerned that the developer appears to have little knowledge of the two residential properties (one belonging to us) soon to be built adjacent to the corner of Battersea and Moroa Roads. We note a neighbour informed representatives of the developer about our property and our neighbours and advised they get in touch with us. They advised the neighbour they would. We are still waiting. This gives us concern that the company does not live up to its commitments. We are concerned that mitigation plans have been developed without knowledge of this

forthcoming developments, and certainly with no consultation prior to the application being lodged.

We understand the developer intends to plant double rows of Japanese cedar along Moroa Road opposite our property and that these will be at 1.5m centres and will be at least 2-2.5 m when planted and 2.5 - 3m at the date of commissioning. We also understand a security fence will be built inside the shelter belt. We request that, should the proposal go ahead, the council holds this as minimum requirements. Our preference would be for the trees to be taller at the time of planting.

We are concerned that the Amended Site Plans accompanying the application only show screening tress at 2m height not 4m as set out in other documents. If the application proceeds we request the height of screening is mandated to a minimum of 4m, particularly opposite our property.

We are also concerned with inconsistent information in relation to maximum height of the solar panels. Page 4 of the Assessment of Landscape Effects says max. height at full tilt is 4 metres (4,000 millimetres). However, a diagram in the Siter Plan suggests the max. height is 4532 millimetres. (i.e. more than 4.5m). If the later height is correct, the minimum height of the screening plant should at least match this and should not be permitted to be approximately half a metre too short to provide adequate screening, or the panels should not be permitted to be raised above 4m.

We are concerned about fire risk. The area is noted for becoming very dry in summer months. Not a happy combination with a power plant. We note FENZ have been consulted and they seem to require provision for firefighting water on the site. However there is not further information in the associated documents as to how this will occur. There seems to be only two small water tanks on the amended site plan drawings and these do not appear in the Final plan drawings. We submit the applicant be required to specify how sufficient water will be provided to the site, with consideration given to the developer paying for the reticulation of town supply to each of the site lots.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: John Walsh

Date: 5 June 2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

25

Submitter

Name	Lawrence Stephenson and Laura Pilgrim
Contact Person (If different from above)	
Postal Address	273 A Bidwills Cutting Road, RD1 Greytown 5794
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Ltd
Address of Proposal	415 Moroa Road, Greytown
Application No.	220103
Description of Proposal (use additional pages if required)	Land use consent to establish and operate a 175-megawatt (peak) solar farm.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☑ Supports part of the proposal
- ☐ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

I am generally in favour of the solar farm application, however I don't think the proposal addresses the visual environment effects sufficiently in the short term and the change in character of the area.

There is a general inconsistency throughout the application, with differences in dimensions between drawings, reports and the application, missing details around how the effects and change from Primary Production will be avoided, remediated or mitigated.

A major oversight is that the AEE relies on the Assessment of Landscape affects, which is written and reviewed by a single person. This lack of quality assurance is not encouraging, when one of the main effects will be the visual effects on neighbours such as ourselves.

Decision you want the Council to make:

☐ Grant the Consent ☐ Decline the Consent ☑ Grant the Consent with Conditions

Suggestions:
Further mitigation for visual effects, including a detailed plant screening management and maintenance plan. The plan will include native plants 3m in front of the intial screening 2m of the exotic trees suggested.
Further ammenity for the local community, such as a cycleway to provide continued ammenity after the initial construction.

25m setback from the road reserve and 10m back from a 5m screening

No lights as security measure; infared cameras as per Tauhei consent, or as a minimum a Lighting management plan approved by the Wairarapa Dark Sky Reserve Committee within 3 months of commencement.

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name Lawrence Stephenson and Laura Pilgrir

Date 6/6/23

Important notes for the Submitter

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Additional pages in Submission

TO

South Wairarapa District Council

SUBMITTER

Lawrence Stephenson and Laura Pilgrim, 273A Bidwills Cutting Road, Greytown

We have resided at 273A Bidwills Cutting Road since January 2022, and our property Lot 1 DP846232 is listed, however our house on the property is not identified as an affected dwelling. My partner was visited by a representative of FNRP and had a good discussion. However reviewing the details of the application these appear to have not been addressed.

State Highway 20 is referenced all the way through AEE, showing a lack of quality assurance in the documents.

Landscape assessments

As mentioned above, our house is not indicated, presumably due to old aerial photography used, we are approximately 520m direct visual range from the dwelling and 220m looking past the southern neighbour's house to the substation switching area (SSA). It is unclear from the application what height this equipment in the SSA will be and if the screening will be sufficient. Looking at the current substation, this appears higher and the Tauhei consent referenced by the applicant has a transformer up to 6.5m in height.

The landscape assessment as outlined by Simon Cocker, Landscape Architect I think underestimates the visual screening of the existing windbreaks. Cars on State Highway 2 can be seen from our property, and the time for the trees to be planted will have an impact. The report was also written and reviewed by Simon Cocker, which I can't believe is in accordance with the Guidelines stated in 2.0, NZILA (New Zealand Institute of Landscape Architects) Code of Conduct. Seeing as a large part of the evaluation the effects are less than minor is based on the evidence of this Landscape assessment it is flawed to not have it reviewed by someone else.

The comparison to other sites is useful, but comparison to Kapuni solar farm is flawed in my view as that is a landscrape that already has industrial installations with the frequent oil infrastructure in the South Taranaki area, something that is not present in the Wairarapa.

The Glint & glare effects & mitigation report and the Landscape mitigation report are also inconsistent – with references to 'screenings will be greater than the height of the panels', 4m in the mitigation plan compared to the 3m in the AEE.

Design details on the installation

As an engineer, I feel there is insufficient details and too much inconsistency to give me confidence that aspects are considered, for instance:

The drawings (220103-Plan-final-10012023), are inconsistent with the stated dimensions in the application. It is obvious that different drawings have been snipped to create the profile drawings;

1. The drawing which I assume is the depth (220103-Plan-final-10012023, Figure 3) appear to have a depth of 1.3m, not 600mm,
2. There are a mixture of units, imperial and metric, making it confusing and leading to uncertainty of the actual dimensions proposed,
3. 1.5m is listed as the height when the panels are flat, yet the 2466m is shown in the drawings and
4. There are numbered items in the drawings which don't appear to link to any of the other drawings.

I am familiar with the area and know that the strongest winds are from the north west and south west directions. The direction of the winds mean that the west-east orientation of the panels provides the greatest profile to the wind and the inconsistencies mean I am not confident that the high wind loadings have been taken into account. The wind zone mapping provided by the SWDC show the area is High Wind zone.

Construction

Section 5 states an opinion the effects of the construction will be minor and compares to harvesting. Harvesting is seasonal, so the construction estimated to take 6-9 months will go on considerably longer, causing considerable disruption. Based on the drawings, information provided I estimate there are 23,000 piles to be installed, so the concussive noise of the pile driver over that period can't be compared to any other activities in the rural area. There hasn't been any mitigation for these effects that I can see.

I have suggested a condition for the increased site traffic, at least to the Bidwill Cutting Road residents.

Moroa Road

The setback from Moroa Road is not consistent with District Plan. There is a a section of existing trees which shelter the road, causing it be become slippery during winter when I is not able to dry out. The screening proposed and close proximity to the road increases this risk over a longer period. I suggest setting it back further and have the planting set-back as well.

This also creates the opportunity of a cycle path strip which could be created to remediate after the change in land character.

Consultation

The only detail shown for Iwi consultation is an email in Jul 2022, nothing attached in response, or note. Yet there was 5 months to follow-up, or propose an agenda item with the Maori Standing Committee.

It is stated that there has been consultation with FENZ, however the general drawings do not appear to have take this into account. The water tanks appear to have been placed for irrigation and not readily accessible in the event of a fire.

I recommend that further consultation is undertaken, particularly with Wairarapa Dark Skies Reserve. Details on the security arrangements mean it is not obvious that there is no increase in light pollution, to preserve the Wairarapa Dark Skies Reserve Status. The current substation is always lit-up overnight.

Loss of amenity and character

The documents only offer for the loss of character, is the mitigation of the screening of the panels, and until these are grown there will be a major change to the environment, unless it is proposed for the plantings to be completed first.

The current character is one of open fields and windbreaks, so this will change, for which there has been no remediation. While there maybe sheep grazing under the panels, and a sense of connectiveness with nature, a significant area will be hidden from view.

The assessment also has not been updated from the proposal in July last year, with the distance to Bidwills Cutting Road retained at 650m, not taking into account the increased area, and the decreased distance to properties in our neighbourhood. While the visual representation are useful, I feel scale seems wrong, giving a false impression of what the outlook will be and I feel doesn't correctly reflect the change in visual outlook. Also some of the trees in the photos will be internal to the solar farm, and proposed to be removed.

The creation of a community group, including affected neighbours with funding to create an amenity for the wider neighbourhood and also provide an avenue for the other solar farm proposals that are being considered. Maybe to work with the Wairarapa five towns trial group. Then a genuine mitigation for the loss of character could be provided.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

26

Submitter

Name	Liat Gush
Contact Person (If different from above)	
Postal Address	21 Hupenui Road, RD1, Greytown
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Ltd
Address of Proposal	415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 SH 2, Greytown;18 Pharazyns Road, Featherston
Application No.	220103
Description of Proposal (use additional pages if required)	175-megawatt peak Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☑ No

☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

This submission is in support of the full and detailed submission put forward by Frank van Steensel & Josje Neerincx of Wairarapa Eco Farm at 260 Moroa Road.
I have been a volumteer on the farm for many years, and the farm has supported my family by provding us with organic nutrient dense food. I share all of their concerns regarding the solar farm proposal, not only as a person directly involved with the farm, but also as a long-time resident of Greytown.
I am particularly concerned about the scale of this project, known and unknown adverse effects on the health of those living and working in the proximity of this project (or indeed consunming any food produced in the visinity), and the lack of regulation.
An electricity generating plant of the proposed size covering 235 hectares (which is 30 hectares larger than Resolution Island in Fiordland and the 7th largest island of New Zealand), is nothing else than an industrial operation and should be treated as such. If not, it will open the floodgates for more unregulated solar plants and expansions near towns and places of interest. We know the Helios proposal is on the way, increasing the acreage even more and FNSF actively wants to expand its

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Solar as a 'renewable' energy is poorly defined at the moment as there is no significant information yet on cradle-to-grave lifecycle assessment. An educated guess will clearly point out that compared to hydro and geothermal, the latter two will beat solar hands down for financial, environmental and social reasons. Refer to radio interview with Bryan Leyland. See also Stuff article with Transition Engineer Susan Krumdieck. This is clearly experimenting with the public and the environment.
The trend in these development is the privatisation of profits and the socialisation of costs and debts. In a true democracy this would not be an option and I certainly do not consent to this.
I urge the Council not be hurried by investors who have mainly financial returns on their agenda, or by doomsday fear, and to decline the Consent.

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Liat Gush

Name Liat Gush

Date 5/6/20

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

27

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Lucyarna Fowles

Contact Person: N/A

(if different from above)

Postal Address: 13 Wilford Street, Wallaceville, Upper Hutt (Land owner of 51 Settlement rd, Morrisons Bush)

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: Situated at the following locations:
415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Application No. Unsure of the exact application number as I couldn't see it on the application doc

Description of Proposal:

Far North Solar Farms – notice of application concerning resource consent. The intention to develop a large solar farm.

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

x	Yes		No

x	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

The proposed construction of the Far North Solar Farm comes with a range of serious concerns, which is why I oppose the proposal completely.

Firsty, the proposal does a poor job at considering the potential negative impacts/effects to the surrounding environment and community. A simple glance at the short list of negative risks outlined in the proposal vs the positive ones will show you that 'Far North' have applied a bias lens on emphasising the positive effects of the assessment, and have not done enough to consider the wide range of negative effects.

I do not feel like the company has taken their responsibility of conducting a thorough risk assessment seriously, and as such risks exposing the surrounding community to adverse impacts of the project. Specifically, there is absolutely no mention or consideration of the potential health risks to those residents who will be living within close proximity to the farm. Solar farms are a relatively new technology, even more so at the scale that 'Far North' are proposing. There is not enough research or evidence into the long term health effects on those living close to large farms to know if it is safe for communities of people to be living so close to them. Exposure to radiation, heavy metals, intense glare from the sun etc are all factors that *could* cause unknown health issues that no one in this proposal has taken into consideration or done research on. As someone who plans to raise children in the area, how am I to know we will be safe and healthy? Easy answer; we don't.

There are however studies and various cases of people developing terminal cancer and other serious health issues as a result of living within close proximity to large power transformers and sub-stations. These produce things like high levels of electrical current and radiation that has proven to cause long term health effects in humans and animals. How do we know that solar farms won't have similar affects long term?

In addition to the lack of consideration or research into the potential long term health affects that large solar farms could pose to surrounding communities, I also feel not enough weight has been put on the visual and audible population of the farm. Greytown / Morrisons Bush is a beautiful area and I feel the presence of a large solar farm will destroy the visual beauty of the area. Even more so if the farm expands. This will have negative flow on effects to property values and quality of life for surrounding residents.

Finally, I think this proposal has been submitted and considered without proper community consultation or information. As a property owner on Settlement Rd in Morrisons Bush, it has been a struggle to keep up with developments of this proposal and gain information on its progress. This proposal feels sneaky and that there has been an attempt to get consent from the council behind the community's back in fear of what the feedback will be.

Ultimately, I feel there are too many unknown adverse impacts of the proposed Far North Solar Farm on the surrounding environment and community to ignore. I strongly oppose the project and stand with my community in encouraging the council to do the right thing and reject the proposal.

Decision you want the Council to make:

(use X to indicate your choice)

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

27

	Grant the Consent	x	Decline the Consent		Grant the Consent with Conditions		

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Lucyarna Fowles

Date: 06/06/2023

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

28

Submitter

Name	Maria Berry
Contact Person (If different from above)	
Postal Address	PO BOX 122 FEATHERSTON
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms Limited
Address of Proposal	415 moroa Road greytown, 312 bidwells cutting road greytown, 1942 sh 2 greytown, 18 pharazyns road featherston
Application No.	Not known, was not included in public notice of application
Description of Proposal (use additional pages if required)	321,160 solar panels4.5m above ground 40 inverters, lines and associated structures Site works Screening planting

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

28

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

Impact on environment after 30 year lifespan of panels - consequences of disposal of panels
Significant impact on rural character of environment
Significant impact on amenity values of our environment
Concerns for impact of noise pollution eg, inverters, wind over and around panels
Adverse health effects of electromagnetic emmissions
Impact on personal enjoyment of our home due to loss of rural character and Remutaka Range vistas

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Maria Berry

Date 6/6/23

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

SOUTH WAIRARAPA DISTRICT COUNCIL

29

Submitter

Name	Mark Crawford
Contact Person (If different from above)	
Postal Address	273b Bidwills Cutting Road
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Ltd
Address of Proposal	415 Moroa Road, Greytown
Application No.	RM220103
Description of Proposal (use additional pages if required)	235Ha Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☐ Yes
- ☑ No

☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

SOUTH WAIRARAPA DISTRICT COUNCIL

29

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

Submission attached.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Mark Crawford

Date 6/5/23

Important notes for the Submitter

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Submission continued.

The proposed solar farm is inconsistent with the other activities taking place in the Rural zone, and as such the amenity values of the rural environment would be adversely impacted.

What Chemicals may be required during construction & operation, and what is the consequences of this getting into the water table?

Findings from Massey University exploring the potential for combined solar and pastoral farming are not released yet and may be relevant to this proposal.

In the application 3.3 existing site access is from Bidwills Cutting Road and this is not shown on the Plan

No viewpoint of the proposed switch yard on Bidwills Cutting Road and are the structures for the switch yard compliant with district plan?

Are the solar panels in Plan final 10012023 orientated the correct direction? Shouldn't they face north and not west?

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Matthew Bell

Contact Person:

(if different from above)

Postal Address: 57 Cross Line, RD1, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: Maroa Road/Bidwells Cutting Road, Greytown

Application No.

Description of Proposal: Solar panel farm

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

	Yes	X	No

	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

See attached.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Matthew Bell

Date: 6 June 2023

Important notes for the Submitter

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Submission

I oppose the application in full because of the following;

- ***Non rural activity in a rural zone***

The Rural Zone within Wairarapa should be protected for rural activities; with farmhouses and associated farming buildings, plus the rural residential houses and associated buildings being all that should be permitted within this zone.
I accept the size of a site for a solar farm means they are unable to undertake this industrial activity in an industrial zone, however maybe this activity should be right beside that industrial zone or on the border of a township. Then the proposed industrial scale of structures and site coverage are all more aligned with a built-up township, than out in a rural area as is proposed.

- ***Setting a precedent of industrial activity on a rural zone***

As soon as councils allow industrial activities and structures, such as the applicants 4.5m steel structures (with over say 75% coverage of the site), being erected within the rural zone then you are essentially setting a precedent. That precedent is that industrial businesses will then know the cheaper rural zoned land is there for their activities to spread out beyond the townships dedicated zones; bringing with it all the traffic, visual effects and noise and non-rural activities we all move away from the townships for.

- ***Visual effects of the 4.5m high industrial structures***

I note the applicant has sought approval to build closer to the boundaries than permitted in a rural zone. This is against the open and low-density rules of the rural zone, again this is more suited to an activity within the industrial zone where they want to cover the whole site. Within the rural zone farmhouses, farm structures and landscaping are spread out and low in density.
Of concern, is that the applicant proposes to have trees planed around the site to lessen the visual impact, however we will need to wait for several years for the landscaping to screen the full height of their industrial structures. The applicant states visual effects will be 'less than minor', however if they are accepting screening is required in their application, then this should be at full height before construction of the structures starts.
To wait for the landscaping to actually screen these structures, the applicant should not be permitted to erect the structures until year 5. The visual effects will be there as soon as the structures are erected, so therefore they should not be permitted to build until the screening is in place. If they erect them sooner, then the visual effects will indeed be **more** than minor.
It should be no different for any other resource consent holder, for example, council would never put a condition for say road widening entrance for a subdivision but then allow that subdivision to operate before the entrance was widened. So having conditions on visual effects should mean they have to 100% screen the activity before that activity is constructed.

- ***Alternative rural zoned location maybe better suited has not been considered***

Due to the visual effects and essentially an industrial activity proposed there appears to be no alternative sites considered by the applicant. An area better suited for a solar farm is where it is located well away from roads or built up rural residential lifestyle properties. There are remote areas within the Wairarapa where only the farm owner where a solar farm was to be located are the only potentially affected party, and this is where this sort of activity should be located.

I would suggest the applicant will state the location of the sub-station to receive this electricity is why it is located where it is proposed on Maroa Road, however sub-stations are always near to areas where there is a higher electrical use. So why should this be the only reason they propose to locate it there. I see no evidence in the application to state they could be located many kilometres from a substation, which will take away a lot of the visual and industrial appearance of the solar farm if located in a remote rural zone location.

Therefore, I request council decline the application in full.

If, however the council chooses to approve this application; the conditions need to be for full 4m screening in place before the 4.5m high structures are erected, and set-back of the boundary to be as per the rural zone rules.

****

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

31

Submitter

Name	nicole kolvenbag
Contact Person (if different from above)	
Postal Address	84 battersea road
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far north solar farm
Address of Proposal	
Application No	
Description of Proposal (use additional pages if required)	321.160 of 4.6 m solar panels On Moroa rad / bidwelss cutting road/ stahc high way Greytown

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☐ Supports part of the proposal
- ☑ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

31

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

85 % of New Zealand is Empty
Just bare land

Greytown is a small rural village , attractive to many tourists and flourishing well
Is the council permitting to surround this beautiful village with thousands of solar panels while the rest of New Zealanc is empty ?

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name nicole kovenbag

Date 5/6/23

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

32

Submitter

Name	Peter Ratner & Carol Walters
Contact Person (if different from above)	
Postal Address	15 Udy Street Greytown 5712
Home Phone	
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Limited
Address of Proposal	415 Moroa Road Greytown; 1942 State Highway 2, Greytown; and18 Pharazyns Road, Featherston
Application No.	220103
Description of Proposal (use additional pages if required)	A land use consent to establish and operate a 175-megawatt (peak) solar farm including: 321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground;40 inverters, lines and associated structures; buildings not required for primary industry or residential purposes exceeding 25m2; associated site works and new accessways and screening planting

Details of Submission

My submission:

- ☑ Supports the whole proposal
- ☐ Supports part of the proposal
- ☐ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

32

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

See attached Submission Statement

Decision you want the Council to make:

☐ Grant the Consent ☐ Decline the Consent ☑ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Peter Ratner & Carol Walters

Date 24.5.2023.

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SUBMISSION STATEMENT

(Application Number 220103)

This submission is made by Peter Ratner and Carol Walters, both residents of Greytown, in qualified support of the application from Far North Solar Farm Limited for a land use consent to establish and operate a 175-megawatt (peak) solar farm including:

- 321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground
- 40 inverters, lines and associated structures
- Buildings not required for primary industry or residential purposes exceeding 25m2
- Associated site works and new accessways
- Screening planting.

Situated at the following locations: 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston

The submitters have owned and occupied their home on Udy Street for 13 years and have been full time residents of the town since January 2019

1. **Conditions**

1.1. The Submitters support the proposal but believe the following conditions should be imposed:

(a) That before consent is granted the Applicant must provide a report from an independent expert approved by the Council to confirm its assertion that there will be no significant increase in impermeable cover and that there will be no adverse effect on the productive potential of the soils on the site.

(b) That when the site reaches the end of its useful life the solar panels must be removed and disposed of in an environmentally safe manner and that an adequate fund be established, either in cash or through a bond provided by an approved bank or insurance company, to pay for the removal; and

2. Independent Soil Report

2.1. In the Assessment of Environmental Effects dated 21 December 2022 ("the Application") at section 5.7, page 18, the Applicant states:

> "the solar arrays will be elevated above the ground, thereby enabling the existing groundcover below to remain. On that basis, there is no significant increase in impermeable surface cover across the site, and existing site drainage channels will remain."

2.2. In section 5.8 on page 19 the Applicant also states:

> "The proposed solar farm will have no adverse effect on the productively potential of the soils on the site. There is adequate space in-between the solar panels (approximately 7-8 m) to enable the grazing of sheep or seasonal crop

farming. Furthermore, the carbon status of the soil will be maintained, and the solar panels can be easily removed and the site reinstated to fully grazing upon completion of solar use. Overall, adverse effects on prime soils are considered less than minor."

2.3. These assertions seem at odds with many comments appearing in reports about solar energy that: "The construction of solar facilities on vast areas of land imposes clearing and grading, *resulting in soil compaction, alteration of drainage channels and increased erosion."* Impact of Solar Energy on the Environment, https://www.greenmatch.co.uk/blog/2015/01/impact-of-solar-energy-on-the-environment

2.4. It may well be that the nature of these panels will avoid destruction of the underlying grass and not cause soil compaction.

2.5. However, this is a significant concern and it should be resolved by an agreed independent expert before the project goes ahead.

3. Safe Removal of Works

3.1. Solar panels have an estimated life of 30 years.

3.2. Given the rapid development of technology in this area it is likely that new technology will be developed in a shorted time frame that. will render this project obsolete before then.

3.3. It is our understanding that solar panels contain hazardous chemicals. According to the U. S. Energy Information Administration:

> "Some types of PV cell technologies use heavy metals, and these types of cells and PV panels may require special handling when they reach the end of their useful life. Some solar thermal systems use potentially hazardous fluids to transfer heat, and leaks of these materials could be harmful to the environment". (https://www.eia.gov/energyexplained/solar/solar-energy-and-the environment.php#:~:text=Some%20types%20of%20PV%20cell,be%20harmful%20to%20the%20environment)

3.4. In section 3.7 at page 10 of the Application the Applicant states that, "At the end of the consented period the solar farm is decommissioned and all materials are removed for recycling."

3.5. It should be an express condition of consent that the Applicant enter into a legally binding undertaking that at the end of the sites' useful life the Applicant will remove the panels and other site works and dispose of the panels in an environmentally safe manner.

3.6. According to the Companies Office Register, the Applicant is a wholly owned subsidiary of Co-Generation Limited. 30% of the shares in that company are jointly owned by Richard Homehood and Tompkins Wake Trustees 2021 Limited which, it is reasonable to assume, holds the shares as the trustees of a trust. The remaining 70% of the shares are owned by Country Connect Solar Pty Limited, a company incorporated in Victoria, Australia.

3.7. No financial information is readily available about the New Zealand entities.

3.8. As the Applicant appears to be a special purpose company there is nothing to suggest that it either has, or will have in the future, the financial capability to fulfill its obligations to remove the solar panels or to dispose of them safely.

3.9. New Zealand is covered with sites which are contaminated or covered with environmentally dangerous materials which have not been removed because the site owner does not have the financial ability to fulfill its obligations.

3.10. The sensible time to deal with the essential issue is before the project is undertaken and not, as is far too often the case, at the end when it is too late.

3.11. Accordingly, as a condition of granting the Application the Applicant should be required to establish a fund to be held by an independent trustee such as a law firm or to provide a bond from a bank or insurance company that is sufficient to remove the site works and dispose of hem in a responsible manner.

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

33

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Rachael Hughes

Contact Person:

(if different from above)

Postal Address: 56 Settlement Road RD1 Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: 10/1 Putaki Drive Kumeu 0841

Application No. WWLA0589 (proposer reference)

Description of Proposal:

Installation of a solar installation on 350ha of land adjacent to SH2/Bidwells Cutting Road/Moroa Road

Details of Submission

My submission *(use X to indicate your choice):*

[ ]	Supports the whole proposal	[ ]	Supports part of the proposal
[X]	Opposes the whole proposal	[ ]	Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

[X]	Yes	[ ]	No

[X] If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

My objection relates to the complete proposal for a number of reasons. These are detailed in the Appendix to this document but are summarised below.

- Immediate neighbours had to buy a copy of the proposal rather than being delivered a copy of the application for such an intensive industrial installation and not a "farm" that is proposed for what is a rural environment. This has a significant impact on the amenities of our property.
- A lack of consultation with the immediate adjacent neighbours by the proposer– one visit with no information other than a little leaflet. There are at least twelve (12) immediate adjacent neighbours – as in on the boundary. There are at least another ten (10) within close proximity. My house is within 53m of the back boundary of the proposed site.
- Increased ambient noise – far higher than what is expected in a rural environment
- Risk of environmental damage
- Increased cost to the ratepayers and electricity consumers
- This proposal should be considered in conjunction with the other proposed site as they are immediately adjacent to each other – and I object to that one as well.
- District plan under review and this could set a precedent for the region – not just the South Wairarapa

APPENDIX ON THIS SUBMISSION "FAR NORTH SOLAR FARM OBJECTION – RACHAEL HUGHES, DAVIDA MCDONALD"

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name: Rachael Hughes

Date: 6 June 2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.

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4. A copy of your submission must be sent to both Council and to the applicant.

APPENDIX: "FAR NORTH SOLAR FARM OBJECTION – RACHAEL HUGHES, DAVIDA MCDONALD"

Location details
My location is: 53 Settlement Road
We back onto the Far North Solar installation that is proposed for Moroa Road.

Our property starts 3 metres from the boundary with our house located a further 50 metres back from this boundary.

Objections

1. Nature of installation
Although the applicant calls this a "solar farm", it is really an intensive industrial installation that is being proposed to be created within a rural environment. It is in this light that this application should be considered and not with the rural connotations of a "farm".

Further, given the other known (but not yet requested) proposal for a further industrial solar installation, the intensification will be extreme along major roads in the South Wairarapa.

2. Adjacent land-owners and consultation
The Moroa Road/Bidwells Cutting Road/State Highway 2 is a rural area with a number of lifestyle blocks of varying size around other more conventional farm land.

The proposal notes distances from the houses to the various roads which is ingenuous. This does not reflect the actuality of the impact of this proposal on our properties.

For example: We live at the south end of the Moroa Road part of this industrial installation. This proposed industrial installation is 3m from our nearest property boundary. It is 53 meters from our house – with a clear view all the way to the Tararuas that will be destroyed.

Around just this south end of the Far North proposal, there are approximately twenty (20) liefestyle blocks on the immediate boundary. There are far more that will be directly impacted by this industrial installation given the extent.

The consultation for this proposal has been almost non-existent. This is on both Far North's part and the Council's.

- We have had but one fleeting visit from Far North's representatives.
    - No literature was available to be left except a small photo-copied pamphlet with a single solar panel on it. This was certainly not representative.
    - The representative could/would not clarify anything about any considerations around planting, noise management or potential light pollution.
      The only comment was that it would not be louder than "an idling tractor". I

did wonder whether this representative has ever listened to an idling tractor – or whether this was for each panel or for all the panels.
    - There was an impression – perhaps unintentional – of "we know better than you" which certainly did not provide any confidence that they would be "good neighbours".
    - Discussion with neighbours down our road would indicate that (1) not all neighbours were visited and (2) the story changed down the road.
    - Nothing has been sent to the residents outlining the proposal and it's expected impact on us.
- The Council has not formally notified us that this proposal was up. The Council has multiple channels to provide that notification – especially as this type of proposal will impact on the lives of many people.
    - Council should have emailed or sent documents to the immediately affected neighbours. This would have provided these immediately impacted people with the full details of the proposal – instead of having to pay for it. This is not democracy in action.
    - This has been an issue with the Council in the past and the Council should look at it's effective communications with ratepayers and residents.

3. District Plan changes

The Council is presently reviewing, with Carterton and Masterton District Councils, the Combined District Plan.

These types of industrial solar installations are new to New Zealand and there are no plan rules around how to measure their impact on neighbours or set in place requirements for mitigation of impacts on the environment and . If this proposal is accepted as is, then this sets a precedent for both the Wairarapa as well as for New Zealand.

In our opinion, it would be more appropriate to have these rules set in place first – agreed with the area – and then review this proposal.

Such rules should include:

- Full details of proposal outlining mitigation of impact.
- Formal and real consultation with immediately impacted neighbours and others as required.
- Clarification of financial impact on the region and it's ratepayers – roading, land-use, remediation and electricity infrastructure.
- Public notification

4. Impact on neighbours

There are a number of impacts that we do not consider to have been addressed – either adequately or at all – from this proposal.

4.1 Noise

The one brief consultation with Far North said that the noise will be equivalent to the "sound of an idling tractor". An idling tractor is noisy – very noisy. It was also unclear as to whether or not this was for the entire site or just one of the moving panels.

Sustained noise does have a considerable impact on the enjoyment of a space as well as mental well-being. Part of the rural environment is certainly agricultural noise such as tractors and other harvesting or farm equipment. But these are short-term and limited as to time and place – we all know when harvesting will be taking place. At other times, the quiet environment is beneficial – and is one of the main reasons we moved here from Wellington city – to get away from persistent consistent noise.

However, this proposal will be generating noise at a higher level the majority of the day. During summer, when people are outside more and have windows open, this noise will be on-going for even longer – as well as being unavoidable.

There is no consideration to how this noise will be mitigated to ensure that it doesn't breach the maximum level at the boundaries. The proposal is light on this aspect.

This additional noise would have a considerable impact to our lifestyle. Our environment is overall quiet enough to hear traffic on State Highway 2 – further if the wind is blowing in the right direction.

4.2 Wind

That the south Wairarapa is windy is a well known fact. It is also a (reasonably) flat plain with which wind interacts quite differently that would be expected from the more hilly terrain in Wellington, for example. We were quite surprised when we first moved to the Wairarapa with that difference – after living in Wellington for 20+ years we thought we knew wind.

The proposal does not take into account how the panels will interact with the wind. From an engineering perspective, we would expect that they will be built strong enough to withstand wind – but the proposal does not address how they will mitigate against the noise generated by the wind hitting the panels. From experience, wind can create a lot of noise when it hits an obstacle.

There is also no information provided on mitigation of construction noise.

This would be a considerable impact to our lifestyle. Our environment is overall quiet enough to hear traffic on State Highway 2 – further if the wind is blowing in the right direction.

4.3 Heat

Again, the Wairarapa is usually know for it's long dry summers. In these summers, the heat is not just from the sun beating down but is also radiated back from the ground storage. (Overseas, this effect is used to provide heating for houses.)

Overseas, solar farms have impacted on the heat envelope around them. Although this is probably not a large issue in regions of the Earth with lower average temperatures, it will be a significant issue for the Wairarapa.

The proposal has no information provided on how this will be managed – especially around the enhanced fire risk and potential ground contamination.

4.4 Visual degradation

The quiet and peaceful enjoyment of our land does include, in part, the outlook through to the Tararuas. It provides a quiet restful view for our house and land.

We sited our house to face that view – as would be expected. There is not one part of our house where we would not see this proposed industrial installation across the entire window or door space. Our house has a lot of window/door space.

4.5 Dark sky reserve

This region is part of the dark sky reserve in the Wairarapa. It is a magical sky when the sky is clear.

Although there is no information in relation to the future lighting that will be installed if there are issues on the site. If they install security lighting, this will impact on the dark sky reserve as well as potentially spilling into our property and causing a further disturbance.

4.6 Fencing and planting

The proposed fencing is not of a rural standard.
The proposed planting is not fast growing to reduce the impact on the local residents.

5. Other concerns

We have a number of other concerns in relation to this proposed intensive industrial solar installation and where it is located. These should not be considered as "NIMBY"isms but concerns for our local environment and people – especially on our rates or electricity bills.

5.1 Moroa Road

Moroa Road – a local mainly gravel road - separates the two parts of this proposed industrial installation.

As would be expected, a lot of dust is generated from Moroa Road that is carried on the wind across farm land. That dust can land on our windows approximately 1km back from Moroa Road – and that is under a wide verandah.

There is one of two "fixes" – regular washing of the solar panels OR Moroa Road is tar-sealed. Tar-sealing Moroa Road would add additional maintenance costs on to the ratepayers of the Council even if Far North pay for the initial paving.

The length of Moroa Road that this proposal is adjacent to is not well-formed and is subject to wash-outs and rutting – especially after heavy rain falls. If this was just tar-sealed on top of the existing road structure, then it would need increased maintenance at the ratepayers expense.

5.2 Moroa water-race and aquifers

Solar panels are made of hazardous materials and these can be passed into the local environment when burnt or damaged. This has happened overseas.

The proposed industrial site is near/adjacent to the Moroa water-race and is upstream of much of it's length. If these hazardous materials get into the water-race, then they will be carried a considerable distance and putting a large number of people, animals and land at risk of contamination. Further, the aquifers that many people in the Wairarapa rely on for water run under this proposed land and would be subject to contamination.

5.3 Fire-fighting

The south Wairarapa has a dedicated volunteer force for fire-fighting. But they are that – volunteer. They are trained on building fires and road accidents – not on the types of electrical equipment that is contained within solar panels and the associated battery banks.

We do not have the specialist equipment required in the south Wairarapa – and deploying it here from elsewhere would be too late. If the grass was already on fire, the fire would have already ripped through our property before specialist equipment arrived.

5.4 Impact on property values

Our property value – and thus the rates that we pay – is based on the environment within which our property already exists.

Building a noisy industrial solar installation adjacent to our property would impact on the value of that property. The real estate agents and valuers that we have talked to cannot put a figure on the reduction except to say that it will be considerable and would depend on a purchaser being okay with the industrial installation being there.

Granting this proposal would seriously impact on our future options for living in the Wairarapa.

5.5 Why an industrial solar installation? Why in the Wairarapa?

New Zealand has a significant investment already in renewable technologies. On any one day, NZ already generates electricity on 90-95% renewables with the large water dams, wind farms and distributed solar generation on people's roofs. There have been days when generation was close to 100% renewable already.

Such a large intensive industrial solar installation would not be sited correctly if in the Wairarapa. We do not have heavy load concentrations here and the electricity generated would need to be transmitted into the main grid – we are on a spur – to be utilised fully.

The proposal is light on information relating to how the generation would be connected into the national grid and transmitted to where it is required. Some will be used in the Wairarapa but the not the majority. Especially as many houses in this region already have solar panels generating into the local grid.

As it stands now, we would assume that the transmission grid may need upgrading to accommodate generation from this industrial solar installation. This may extend beyond just connecting it into the local substation but involve upgrading the

transmission lines back to the Haywards substation across the Remutakas. (Please note that this is speculation based on the interpretation of readily available information from the Electricity Authority, Transpower and PowerCo.)

Transpower upgrade costs, if not paid directly by the generator, are passed onto all electricity consumers in New Zealand. This is through two ways on your electricity bill - the Transpower part of the line charges and also as part of the rolled up "unit price" from your retailer through the constraints on the national grid.

The largest non-renewable (and polluting) generation in New Zealand is the Huntly power station in the Waikato. This is needed to ensure that the lights stay on in Auckland (mainly) and further north. If additional renewable generation was to be installed, this is where it should be to maximise it's usage and effectiveness.

However, land is expensive in the Waikato/Auckland.

5.6 Remediation

The proposal for this intensive industrial solar installation does not include remediation of the land – including what happens if it becomes uneconomical in the future and is moth-balled.

This remediation – including a dedicated fund – should be included in any consent that is given. Remediation should not be at the cost of the rate-payer.

Rachael Hughes
56 Settlement Road
Greytown

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Richard Schofield

Contact Person: as above

Postal Address: 149 Bidwills Cutting Road, RD1 Greytown 5794

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Limited

Address of Proposal: 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Application No. 220103

Description of Proposal: The proposed solar farm will consist of approximately 175 MW photovoltaic panels . This will include the solar array and associated structures (medium voltage substations and 33 inverters).

In total for the site, arrays will be placed along with 33 inverter stations and approximately 321,160 solar panels.

The panels will be on a single-axis fixed East-to-West mounting structure. At maximum 'tilt' (this being the maximum height of the structures) the panels will be 4.5 m above the ground and the ground clearance height will be approximately 300 mm above ground . When tilted down, the height will be approximately 1.55 m above ground. The total height for the foundation piles will be 600 mm.

The panels will be mounted on tracking tables, with the panels mounted in portrait format and 32 panels placed per table. The spacing (pitch) between the rows of tables will be 6 m.

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	Yes		No

	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

Incorrect assumptions in various Landscape assessment documents.

Large number of missing areas in the assessment of environmental effects.

See submission below.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name: Richard Schofield

Date: 5 June 2023

Summary

Manatū Mō Te Taiao, the Ministry for the Environment, says every application for a resource consent must include "an assessment of environmental effects – this identifies all the environmental effects, positive and negative, of a proposed activity, and ways to avoid, remedy, and mitigate adverse effects".

In my submission I demonstrate that the application by Far North Solar Farm Limited (FNSF) focuses tightly on visual impacts, misrepresents comparisons, and uses objectively incorrect and unsubstantiated data.

More importantly, I then show a number of important areas that at best are barely mentioned; most are completely missing.

This is a big project, with a big budget, and big impacts. It warrants a thorough environmental impact assessment but the applicant has not provided one.

In the absence of an adequate assessment of environmental effects this application should be declined.

1. Wrong assumptions in Landscape assessment

1.1 Impact on Moroa Road

There are two very wrong suppositions made without any supporting data about the users of and impact on Moroa Road.

"220103-Landscape-assessment-final-10012023" 6.5 Perceptual Attributes Table 2 says "Travelling from the west, views to the main (northern) portion of the Farm, and western portion over a distance of some 1.4km and 900m respectively.

The road corridor is, for the most part open and ***affords long views across the landscape to the north and south*** (my italics)."

Impact is assessed as ***Low to moderate*** (my italics).

This despite the fact that that long views across the landscape will become a 2km long view of an exotic hedge on Moroa Road. Clearly the impact is moderate to high. As a user of the road, it is in my opinion, a high impact.

It then goes on to claim the number of users of Moroa Road is low, again with with no supporting data, and the users are insensitive to change. To quote the "220103-Landscape-assessment-final-10012023" 4.3 Visual Catchment "This gravel road experiences a ***low volume of traffic*** (my italics), and provides access to a limited number of properties", and again in 6.5 Perceptual Attributes "Road users on Bidwills Cutting, Battersea and Moroa Road: Low to moderate number of individuals with a ***low to moderate sensitivity to change*** (my italics)".

There is a significant catchment of residents in the Bidwills Cutting, Battersea and Moroa Roads who use Moroa Road as the direct access route to SH2. Moroa Road has also on occasion been used as a detour route for SH2 closures. It appears the claim of low usage is incorrect, and it is not supported by any data.

Where does the "low to moderate sensitivity to change" claim come from? Everyone I've spoken to is **very** sensitive to losing the rural views. People chose to live here because of the views.

The applicant's own "220103-Landscape-assessment-methodology-final-10012023" says "This should also recognise that people more susceptible to change generally include: residents at home, people engaged in outdoor recreation whose attention or interest is likely to be focused on the landscape and on particular views; visitors to heritage assets or other important visitor attractions; and communities where views contribute to the landscape setting." This contradicts their above quoted low to moderate assessment.

1.2 Affect on animal and plant life

The only reference I found to this is "220103-Landscape-assessment-final-10012023" 6.2 Physical - biophysical biotic attributes, where the implausible claim is of little impact, quote "The proposal will only necessitate the clearance of predominantly exotic shelter belt vegetation within the Site, and the anticipated change to the biotic attributes resulting from the proposal will be very small."

On open farmland the shelter belts are where many animals live. On the ground the possible inhabitants presumably include the undesirables (mice, rats, stoats, feral cats, rabbits etc.) but may also include New Zealand birds and lizards. The trees, in a landscape where the shelter belts are almost the only trees, are where many birds nest. Are there any bats?

To suggest that removing the only shelter, over such a great area, will have a very small impact is an argument that cannot be sustained. What the applicant should have done is surveyed the animal life present and assessed how badly impacted they will be. Are any native birds, lizards or bats impacted?

A significant impact is to hunting birds (e.g. hawks, falcons, ruru) whose landscape will **massively** change from open farmland to a game of dodge-the-solar-panels.

This may be a contributor to bird deaths on solar farms. This is a significant but not yet well understood issue overseas, but not mentioned by the applicant, e.g. see:

https://www.wired.com/story/why-do-solar-farms-kill-birds-call-in-the-ai-bird-watcher/

https://www.scientificamerican.com/article/solar-farms-threaten-birds/

https://natsci.source.colostate.edu/death-by-solar-2-million-doe-grant-supports-scientists-studying-bird-deaths-at-solar-facilities/

The applicant has presented no research to show they assessed what and how many birds may be killed even though they already have functioning solar farms in New Zealand for research.

1.3 Visual Impact Baseline

The purpose of establishing a baseline is to show what impacts would be reasonable. Instead the applicant has gone looking for the worst example and tried to make it seem comparable, refer "220103-Landscape-assessment-final-10012023" 4.2 Statutory Matters.

The Baseline cites JR Orchards which uses white netting over the orchard. Included is Plate 4 that is the worst road view of the orchard. If you check a topographical map, or drive Fabians Road yourself, you will find the orchard is only visible for a short section towards the north end, and at no closer distance than that shown in Plate 4 (approximately 420m according to Google Earth). **No roads run directly alongside the orchard**.

Despite this major disparity, the "20103-Landscape-assessment-final-10012023" document somehow concludes "... it is reasonable to conclude that the permitted baseline for the site includes greenhouses or shelter structures which may extend across the entire, or a significant portion of the site..." This is not a reasonable conclusion. The applicant wants to put a 2km exotic hedge next to a well used road.

In "20103-Landscape-assessment-final-10012023" 3.0 The Proposal we are told, in reference to the exotic hedge plantings "The use of shelter belt plantings has been adopted in deference to the existing landscape character of the area – which is structured by shelter belts." In reality there is no comparison between a low dense exotic hedge and open shelter belts.

As a more reasonable baseline, it is worth noting that a number of recent screening plantings in the area (e.g. SH2 at the southern end of Greytown, private land along Cross Line, planting on SH2 next to new Carterton treatment ponds (includes some exotics)) all use a mixed **native** tree planting. Would anyone prefer an exotic hedge to native plantings?

1.4 Noise

Noise gets hardly any assessment. "220103-Application-form-final-10012023" 5.6.1 Noise Effects provides little information.

"Operational noise effects are minimal and will not be noticeable from the boundary of the site. The substation units are the vented and will emit a low hum in operation. Average maximum sound pressure at 1m distance was measured at 62dBA."

62dBA would be really annoying at night. Why would there be any noise at night? No daylight, no power, no noise would seem likely but this is not stated.

What is needed here is a simple breakdown of what and when:

- how much noise do the inverters make, over what period of the day and how does that compare to current noise levels;
- how much noise do the panel angle adjustment motors make (one for every panel!) and what times do they operate; and
- what other sources of noise are there, and at what times?

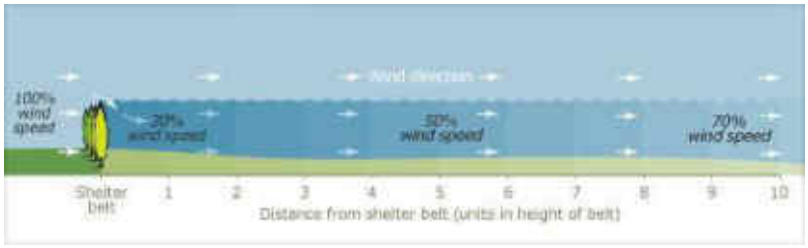
2. Environmental Impacts Not Covered

2.1 Wind Impacts of Shelter belt Removal

The proposal includes complete removal of shelter belts across the large area of the proposed solar farm.

This is treated in the application as being of only visual impact, there being no assessment on wind speed across the entire solar farm and its impact on neighbouring properties.

The following diagram is from https://teara.govt.nz/en/diagram/15600/shelter-belts-effect-on-wind



If all shelter belts across an area the size of the solar farm proposed are removed, the wind speed hitting properties on the lee side will effectively be 100%. The current landscape is a series of windbreaks, how does it compare?

The situation is made worse by the increasing number and severity of extreme weather events.

What liability does the applicant have for damage done and potential injury to those on neighbouring properties?

Why has the applicant done no assessment of this impact?

2.2 "Heat Island" Impacts

The term "Heat Island" refers to the observation that solar farms can raise the temperature above a farm by 3 to 4C even through the night.

In simple terms, solar panels typically convert less than 20% of incident light to electricity, much of the remaining light energy dissipates from the panels as heat. Where this heat goes is still being studied overseas, e.g:

https://www.nature.com/articles/srep35070

http://www.clca.columbia.edu/13_39th%20IEEE%20PVSC_%20VMF_YY_Heat%20Island%20Effect.pdf (PDF)

https://apvi.org.au/solar-research-conference/wp-content/uploads/2019/12/123_Guthrie-Ken_DI_2019.pdf (PDF)

The impact this will be worsened by climate change and rising summer temperatures.

Again the applicant has chosen not to provide any impact assessment, despite already having functioning solar farms in New Zealand for reference.

Will neighbouring downwind properties have several degrees added to already potentially record high summer temperatures?

Will sheep under the panels be subject at times to inhumane temperatures?

2.3 Radio Frequency Interference (RFI) impact on AM radio and xDSL broadband

While solar panels in themselves are low voltage DC devices, their output must be fed to Inverters, which chop the DC into an AC current and transform it to voltages suitable to feed back into the substation.

This process inherently generates a large amount of radio frequency interference e.g. refer to https://www.solar-electric.com/learning-center/reducing-electromagnetic-interference-pv-systems.html/. There are 33 large inverters in the proposed farm.

Inverter design seeks to minimise RFI, but even so careful installation is required to further reduce it. Look at the two "EMC Installation guides" on Power Electronics (a New Zealand supplier of large inverters) web site at "https://www.power-electronics.co.nz/resources/application-notes/" to see the lengths they have to go to during installation to try manage RFI.

The RFI generated is skewed towards lower frequencies, as used in AM radio and ADSL/VDSL.

The problem of RFI is compounded in the area of the proposed solar farm. AM reception is weak, National radio is from Titahi Bay, Wellington, or a much smaller transmitter near Masterton. ADSL speeds are low, residents are too far away from the Chorus DSLAMs (Nokia ISAMs), and many of the house connections are aerial, where they can pick up RF interference.

Mobile phones are less likely to be impacted despite the very poor reception in the area, as mobile phone transmission is at much higher frequencies. But mobile phone reception here is already poor.

In the recent Hawkes Bay flooding, it was noted by commentators how important AM radio was when all other communications were down, because of its ability to transmit across long distances to remote areas.

For ADSL, the rural residents in the area lack other broadband choices:

- 4G fixed wireless broadband is kneecapped by poor mobile coverage.
- WIZWireless offer a point-to-point radio broadband that relies on clear line of sight, so often isn't viable, like at my home on Bidwills Cutting Rd.
- Star Net is effective, but expensive.
- ADSL is a little slow, but reliable. **It is also vulnerable to RFI**.

Again the applicant offers no assessment of impact, let alone any possible mitigation. There should be an assessment, and a locked in commitment to keep RFI at levels that do not merely meet a legal limit, but which will not cause issues for neighbouring properties.

At the very least they should be required to do pre- and post-installation benchmarking of the levels of RFI to demonstrate if they are or not causing issues, with a commitment to fix any issues.

2.4 Fire Hazard

During summer it is essential to keep the grass low to reduce fire hazard. The only method to do this on the proposed solar farm appears to be sheep grazing. This is a big fail as:

- On a conventional pasture farm the excess spring growth is used to make silage/baleage/hay. Is this even possible on a solar farm? If so how effective could it be under the panels? As the grass dries the rows of panels could become a rapid path for spreading fire.
- There is a mistaken belief among non-farmers that any stock will clear all pasture growth. While mixed grazing can be effective, and cows do a better job than sheep, sheep alone do not like the tall dead stalks produced by the spring growth and dried in summer. Over our time of living on a lifestyle block with only sheep grazing I have been surprised how even hungry sheep won't remove long stalks. If needed in an open pasture a topping mow can be used but again how effective could this be on a solar farm?

I could find only two references to fire in the available documents:

- "220103-Application-final-10012023" 7.3 Fire and Emergency New Zealand refers to consultation with Fire and Emergency New Zealand focusing on access and water supply and says risk management plans to be developed
- In the Response to Further Information Request question about structures is another reference to water tanks.

Neither of these actually addresses what the risks are, fire-spread mechanisms and containment methods.

2.5 End-of-life Clean-up

There is no assessment of the end-of-life strategy for the solar farm.

As written, when FNSF or the then owners determine the solar farm is no longer viable they can just walk away.

That would leave a huge environmental mess.

There needs to be a locked-in obligation for removal and safe disposal of not just the solar panels, but the mounts including concrete slabs, cables, inverters, large security fencing and at least a major portion of the screening plantings.

2.6 Pest Control

Is the solar farm likely to provide a rabbit haven?

Given that shooting is a non-starter on a solar farm how do FNSF propose to manage rabbits or any other pest animals?

We don't know, this hasn't been assessed.

How do they propose to handle weed management? No one wants hectares and hectares of e.g. thistles next door.

Again, there is no assessment.

2.7 Earthquakes

How well will the solar farm handle a major earthquake?

This is a serious possibility in the Wairarapa. Will the farm, especially the inverters and high voltage cabling, become a fire hazard? Will they endanger the sub-station?

We don't know, this hasn't been assessed.

2.7 Floods

How well will the solar farm handle a flood?

In my 20 plus years here there has already been a small flood (less than 20cm at 179 Bidwills Cutting Road). During this event there was significant flow of water from the farmland from the other side of the road (i.e. bordering north of the proposed site).

The likelihood of another, more serious, flood is made much more likely by climate change and extreme weather events.

How will the solar farm cope? Will the panels and inverters become an electrical fire hazard? Will they endanger the sub-station?

There is no assessment provided beyond an unsubstantiated claim that storm-water run-off "...will be very small and will not cause or exacerbate flooding of any other property". This is not our experience!

2.8 Tourism

Greytown and the environs is a major tourist destination. Yet impact of the environmental change on tourism does not appear to be assessed at all. Has the applicant consulted with any tourist businesses? With Destination Wairarapa?

3. Conclusion

FNSF have not provided anything resembling "an assessment of environmental effects – this identifies all the environmental effects, positive and negative, of a proposed activity, and ways to avoid, remedy, and mitigate adverse effects".

They have tried to tick a few legal boxes and ignored the rest.

They cannot be granted a consent based on the inadequate information they have provided.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

35

Submitter

Name	Robyn Ramsden
Contact Person (If different from above)	
Postal Address	3 Farrier GRove Featherston
Home Phone	-
Cell Phone	[redacted]
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	
Application No.	
Description of Proposal (use additional pages if required)	Building a Solar panel array between Greytown and Featherston.

Details of Submission

My submission:

- [x] Supports the whole proposal
- [ ] Supports part of the proposal
- [ ] Opposes the whole proposal
- [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- [x] Yes
- [ ] No

- [ ] If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

35

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

This proposal is awesome. It is one of the most important decisions that can be made to reduce emissions for the South Wairarapa and for the Country. This one array will produce enough electricity that the Huntly coal power plant can be shut down.

Decision you want the Council to make:

☑ Grant the Consent ☐ Decline the Consent ☐ Grant the Consent with Conditions

I urge the Council to be bold. See past the 'Not in my backyard' people and see the benefit for the Community and the Country as a whole. This array will generate enough electricity to make the Huntly power coal station unnecessary. It will create jobs while been built and ongoing jobs once complete. Take this decisive action to help reduce emissions and take action on Climate Change.

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name Robyn Ramsden

Date 6/5/23

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

36

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Rodney and Judith Jay

Contact Person:

(if different from above)

Postal Address: 80 Battersea Road, Greytown, 5790

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms Ltd

Address of Proposal: 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Application No. WWLA0589

Description of Proposal: The construction of a 175 Megawatt solar farm including: 321,160 solar panels, 40 inverters, buildings, associated site works and accessways and screening planting.

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

	Yes		No

X If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

Section Five - Environmental Impacts

Amenity Value

The area of land proposed for this development has to date been utilised for agricultural and life-style purposes and this is the overwhelming characteristic of the South Wairarapa District which attracts residents and visitors alike. The application will fundamentally change the land purpose from agricultural to industrial with minimal consideration of the loss of amenity value to the local residents (all of whom have invested in their properties on the basis of good faith and the assumption that the environmental amenity value would be considered a priority by planners and council), the wider South Wairarapa community and the district at large.

The South Wairarapa and its three main communities of Featherston, Martinborough and Greytown have developed a regional identify and character that attracts many thousands of visitors to the area every year, the economic growth of the region bought about by capitalising on the broader environmental value has been significant. This proposal if approved will undermine this environmental value and character by changing the regions signature away from its current value set to a more industrial posture. The application does not appear to have had a counter factual argument commissioned to provide a balanced view. In short, the application understates the impact and loss of amenity value on local residents, the region and district and should be declined on that basis.

Environmental Impacts & Safety.

The proposed site was for much of the winter of 2022 waterlogged with surface water sitting in paddocks for protracted periods of time with runoff flowing freely across Moroa Road (North to South). These types of weather conditions are forecast to become more normal than abnormal and could have major implications for the site's horizontal, vertical and inground infrastructure. The application suggests that there is no change required to drainage (Section 3.4) and that stormwater will infiltrate the ground as normal, based on the experience of 2022 there is risk that the site will become unworkable and that the arrays will become unstable in wet and waterlogged ground conditions.

The applicants should be required to more fully assess the impact cognisant of climate change and likely other climatic weather events (such as the cyclone that hit the Hawkes Bay recently) including large scale precipitation and cyclone levels of wind (which is often significant as a norm as this is a highly exposed area).

The impact on health of people and livestock as a result of positioning 321,000+ solar panels into a concentrated area, with further development of the sub-station and associated transmission lines (electromagnetic fields) needs to be more fully explored in the application.

In the event that the Council do consider the application worthy of progression it is requested that:

1. Consideration is given too constraining the proposal to the area to the North of Moroa Road. The smaller area to the south of Moroa road is surrounded by residents all of whom will be impacted to varying degrees; whereas the area to the North is not bounded by as many residential properties and therefore the impacts are reduced.
2. The shelter belts are required to be planted and maintained before construction commences.
3. The council ensures that the site is dark at night.
4. The council places conditions on noise so that local residents are not disturbed by the facility once constructed.
5. Given the winter ground conditions the council considers not issuing consent to build during the winter and assures itself of the adequacy of the proposed roading within the site to withstand waterlogged ground conditions.
6.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: R. E. JAY

Date: 6/6/23

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

37

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Sanne van Steensel

Contact Person:

(if different from above)

Postal Address: 168 Main St Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: far North Solar Farms Ltd

Address of Proposal: 415 Moroa Road, Greytown.

Application No. 220103

Description of Proposal: The **South Wairarapa District Council** has received an application from **Far North Solar Farms** for a land use consent to establish and operate a 175-megawatt (peak) solar farm including:

- 321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground
- 40 inverters, lines and associated structures
- Buildings not required for primary industry or residential purposes exceeding 25m2
- Associated site works and new accessways
- Screening planting.

Situated at the following locations:

415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
x	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

	Yes		No

x	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

I stand alongside a number of people in this, and I believe the council should decline consent.

My family moved to the Wairarapa when I was just 3. We built a home on 260 Moroa Road and grew a small Farm based on organic, environmental principles. Our ethos is respect for life. The Wairarapa Eco farm. My childhood and my future are tied to that block of land. 25 years ago my family was frowned upon for their environmental beliefs, now we will be frowned upon for not believing that a monoculture of solar panels are not the answer to our environmental issues.

Firstly, I would like to note that my family's block of land The Wairarapa Eco Farm is next to block number 13. We have multiple people living and staying with us there for various time periods. We rely heavily on our woofers, interns and guests who are attracted to our farm because of our environmental values.This block is very much becoming the livelihood of my siblings and I, as much as it has been for my parents. I am in the process of setting up herb gardens. I am distilling the lavender I am growing along with other herbs and crafting many other herbal remedies. I have been studying herbalism for the last 4 years whilst working in the CSA very gardens, both hold to organic, environmental principles. Because of these values, our health and the health of the people living and working with us are very important to us all. Can the council guarantee without a reasonable doubt that it is safe and healthy to live and work so close to such a large quantity of solar panels and batteries? to live next to a power plant? because it is a power plant. Can the counsel guarantee our continued safety?Can the council guarantee that the batteries will not

contaminate our drinking water from the groundwater well? and our long-term health? I think not, I think the council does not have enough information to do so.

Secondly, this Solar scheme is being pushed with the idea that it will make NZ more environmentally secure. An electric car is only as environmentally friendly as the source of its electricity. In NZ we are lucky we already have hydro and thermal setups. Individuals can install solar panels on their roofs(where they don't use up valuable land). Just as my family had for the first 15 years till we outgrew our system and our windmill caught fire due to the racing Wairarapa winds. We are not against a handful of solar panels when properly planned into a system that supports the individual creating independence from the grid. We see power prices going up everywhere. We should not be reliant on big business. This monoculture of solar panels is just big business greenwashed. Elisabeth Creevey points out plenty of environmental flaws in her submission, one such being the issue of end-of-life cleanup. How will these panels hold up against the Wairarapa winds coming off the ranges? Will we be forced to clean up broken glass after they fly into our tree lines like our trampoline did one year before we tied it down to a tree? In my understanding of environmental care(I was brought up on the concept) never has a monoculture been beneficial for the land. Nature grows diversity because that is where the most opportunity is for growth and self-regulation. Plants are the only efficient use of sunlight if we wish to farm sunlight. This is not farming Sunlight, this is a power plant.

My family is not the only people next to the power plant the Solar Farms are proposing, not to mention the rest of Greytown. This has not been done before. The whole town is some 3-5kms away. That sure is a lot of people living near a power plant with how many unknown hazards? again what guarantees does the council have that this won't affect the long-term health of Greytown?

What about the long-term effect on the growing population? Currently, the Wairarapa is enticing many families looking to escape the city, many are even looking for lifestyle opportunities. What is it they are escaping by coming here? Will they still come when the valley is full of solar panels and big industries? will they change their minds about moving here when they realise they will be living next to a power plant? will this affect the business in Grewtown and Martinborough, when they drive past fields of panels between the two currently popular towns?

This will be the first solar farm of its kind in the region, the Wairarapa and its council should consider the precedent it is setting with this proposal. We are already aware that the companies have been asking around for further interest in leasing land, and that there is more than one proposal in the planning. The other solar farm is planned to be even closer to town. So I ask the council, how close to town is too close to have a power plant? how close to a family home, lifestyle block or business is too close to the power plant? How many solar farms in the region are too many? how many solar panels and how close together? what are our limits here? do we even have any limits? what do we wish to see when we look into the valley from one tree hill? Will anyone still wish to live here when the Vally is full of solar panels? where will all those panels go after their 30 yr life expectancy runs out? if one of these plans goes ahead how will the council regulate them to maintain our landscapes, our little town country vibe? what will be the unforeseen circumstances of this proposal going ahead? What effect will this have on the wind in our region? How many Solar farms are too many?

Many of us believe that we do not have enough information and even some that suggest living and working next to so much electricity is not at all good for the long-term health of people, animals, insects and land. So it stands that my family will likely be forced to sell our long-term dream if this proposal gets accepted. We have dedicated everything on the farm for the sake of our health, the

health of the animals, insects and land. The farm has faced many challenges and it will be with great sadness that we will have to leave it all behind to find a safer healthier environment to live in.

This solar project is an experiment, it has not been done before, on land like this so close to a living population. As such the council should be asking for more information and better planning. I can see it is not really the council, but our government that is not thinking through its environmental plans. As the government's environmental response is all about the image without thought, it comes to you our council to step up, ask lots of questions, think things through, and if there is not enough information to make an informed decision about a proposal then a proposal simply falls short.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent		Decline the Consent		Grant the Consent with Conditions
		x			

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Sanne

Name:Sanne van Steensel

Date: 31-5-23

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

38

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Shane Wratt

Contact Person:

(if different from above)

Postal Address: 96 Settlement Road, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Ltd

Address of Proposal: 415 Moroa Road, Greytown

Application No. RC220103

Description of Proposal: Development of a large solar farm in Greytown, South Wairarapa

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	Opposes the whole proposal		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	Yes		No

X	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

Site Location and Description

- Unsuitable site due to proximity to housing, its industrial scale and activity being incongruent with rural zone planning and district plan objectives and protections.
- Mitigations to block views into the site with hedgerows, significantly changes the existing character described in the application as 'a feeling of openness and expansivity'.
- The activity proposed of electrical and electronic works, power generation and transmission are likely to cause a large section of land to become a new HAIL site.
- The area at times experiences a high water table and flooding. This significant development and the nature of materials used greatly increases the likelihood of site contaminants from site activity entering waterways.

Storm Water

- Run off issues. The panels represent a very very large roof – or series of. Current building regulations require buildings to have drainage plans and soak pits for which there is not provision for this development. At times, surface water is a considerable issue in the area and would affect access and safety due to water and electrical systems mixing.

Vehicular Access

- Increased vehicle movements on the unsealed, narrow and poorly maintained Moroa road will be disruptive to residents using the road, degrade it further, increase dust (which can be significant for some homes nearby) and be hazardous for other road users including cyclists, runners, horse riders who frequently use it.

Operational Activities

- Only 2 full time roles are created. Offshore investors take earnings offshore, power generated goes to Auckland (via National Grid) and locals and council pay for and live with the impacts of the development. It's an unacceptable price to pay.

Consideration of Alternatives

- The environmental impacts of this development on people, water, wildlife, air, amenity, land values and existing infrastructure are grossly understated in the application and alternatives in the area do not appear to have been documented – except to say FNSL have looked at various options all around NZ. The economic value of this development for shareholders is what drives it to apply for the easiest low-cost option available rather than other viable and less impactful alternatives. The application deliberately understates the impacts.

Wairarapa Combined District Plan

- The activity is not required for primary production and residential purposes and solar panels combined exceed 25m2 in gross floor area.
- The solar panels do not meet the relevant setback requirements for unsealed roads under standard 4.5.2 (c) (ii).
- Dust is an issue along this road and no explanation has been explained as to how FNSL plan to mitigate or cannot comply with the existing rules. One can only assume they cannot meet this standard as they need the available land in order to meet their

generation targets / viability of the business. No compensation should be provided if this is the reason for not being able to comply.

Effects on the Environment

- The solar farm will not specifically provide renewable electricity to meet the demands of South Wairarapa district. I see little evidence that positive economic or social benefits will be derived from this development for South Wairarapa or Wellington. These claims need to be backed by an independent benefits analysis detailing the actual economic and social benefits to the region and compared against the benefits gained from the site remaining for use as farmland.

Landscape and Visual Effects

- The development significantly changes the existing natural character and the experience of this character for residents and visitors alike. Large scale industrial development covering hundreds of hectares of otherwise open land is a more than minor change to the landscape. As such, a development on this scale can only deplete the existing perceived value of this landscape.

Natural Character Effects

- Quote from application *"The site and its surroundings have been significantly modified in respect to its vegetation cover and therefore the proposed solar farm will result in limited changes to the natural character of the site".* Development of this site has remained open farming for over a century. Historically the area would have been wooded in lowland forest. To imply that it has been significantly modified since lowland forests where present (centuries ago) is correct, however our experience of the site for the last century has been open farmland and remained this way since. Open farmland is part of the natural character and part of our identity and history of this area. Our district plan specifically acknowledges this value and actively seeks to protect it. Supporting this application would be choosing to ignore the principles the Combined District Plan (developed in consultation by the residents of Wairarapa) seeks to protect.

- Planting hedgerows close to boundaries to screen out unsightly views of large scale industrial developments also blocks existing views and closes in the otherwise open and expansive feeling of the area. In some cases, distant views of ridgelines (of significant value) will also be lost from hedgerows close to boundaries.

- There are no detailed planting plans in the application or suggested provision to ensure these are maintained. The site is a challenging planting site due to strong winds and low horizons that facilitate a high a number of sun hours. Most plants take a lot of effort and care to get established. Under an el-nino pattern (predicted to arrive and last for the next few years) these negative growing environmental factors are heightened. Time for planting to be established and the ongoing professional management, irrigation and husbandry of these plantings to be successful is not adequately addressed in this application. If planting targets fail to reach anticipated levels what recourse do residents have for extra years of looking into an industrial power generation site or what penalties will be enforced on developers post approval.

- The north eastern boundary of our property is directly adjacent to the development and our home (living space) approximately 100m from the proposed boundary of this development. As such we are intimately close to the construction, operation and

visual impact of this development. The value of our property will most certainly be negatively impacted. This development if approved would be very unsettling and unjust, especially when we located and settled on our specific location knowing that our district plan protected us from being located adjacent to industrial developments. In my view, for this development to go forward in this location there would need to be a district plan change that re-zoned this land from rural to industrial.

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	Decline the Consent		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Shane Wratt

Date: 05/06/2023

Important notes for the Submitter

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SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

39

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Dr Stephen Hartley

Contact Person:

(if different from above)

Postal Address: 6 Matai Grove, Greytown, 5712

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farms

Address of Proposal: Williamson Water and Land Advisory
10/1 Putaki Drive, Kumeu 0841

Application No.

Description of Proposal:

for a land use consent to establish and operate a 175-megawatt (peak) solar farm including:

- 321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground
- 40 inverters, lines and associated structures
- Buildings not required for primary industry or residential purposes exceeding 25m^2
- Associated site works and new accessways
- Screening planting.

Details of Submission

My submission ***(use X to indicate your choice):***

	Supports the whole proposal	X	**Supports part of the proposal**

[ ] Opposes the whole proposal [X] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

[ ] Yes [ ] No

[X] If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

Summary of Request: That the screening planting be used as a biodiversity offset to compensate loss of large trees, via the greater use of native species.

I support the principle of moving to a low carbon economy and the development of solar generation of electricity as an important contributor to this goal.

My concern with the project is that the removal of large trees is not being adequately offset, and that the project is missing the opportunity to add meaningful biodiversity co-benefits when planting a hedge for screening purposes.

The mature trees to be removed (mostly pine, macrocarpa and eucalyptus) are admittedly limited in quantity and of relatively low habitat quality, but nonetheless they will be providing habitat for a range of native invertebrates and birds (and potentially lizards) in a landscape that has precious little other habitat for native biodiversity. Hence, loss of mature shelter belts represents a tangible loss of habitat in this landscape context.

Biodiversity offsetting guidelines indicate that where a negative impact on biodiversity cannot be avoided or minimised then on-site remediation is the next best step, followed by off-site offsetting [1].

A diverse polyculture hedge of native tree and shrub species could achieve ten times the biodiversity restoration value of the proposed monoculture of exotic Japanese cedar, with the same visual screening function. Virtually no native insect eats any part of Japanese cedar and the species provides no nectar or fruit for native birds.

The location of the proposed solar farm indicates that establishing corridors of native vegetation could enhance dispersal of birds, bats, lizards and insects between two Key Native Ecosystems and a wetland: Tauharenikau Bush fragments (23 ha), 2.5km to the south-west; Morrisons Bush / Ruamahanga River Terraces (38ha) 5.5 km south-east, and Elm Road Wetland, 2km north [2,3].

The proposal sits in a landscape that has lost 98% of its native forest cover [3], hence the need to reconnect isolated remnants of bush as a practical and local response to the current global extinction and climate change crises. An excellent example of such an initiative, with high buy-in by local landowners, is the Tonganui Biodiversity Corridors Project in South Wairarapa [4, 5].

References:

[1] DOC (2014) Guidance on Biodiversity Offsetting in New Zealand https://www.doc.govt.nz/about-us/our-policies-and-plans/guidance-on-biodiversity-offsetting/
[2] GW GIS viewer. GWRC Key Native Ecosystem and Wetland programme locations. https://gwrc.maps.arcgis.com/apps/webappviewer/index.html?id=2844233a5d9745bab939df9355f541a9
[3] Sarah Beadel, Alison Perfect, Aalbert Rebergen & John Sawyer (2000) Wairarapa Plains Ecological District: Survey Report for the Protected Natural Areas Programme. Department of Conservation. https://www.doc.govt.nz/globalassets/documents/getting-involved/landowners/wairarapa-plains-pna.pdf. See Table 4.
[4] Wai2PK Tonganui Corridors: https://waip2k.org.nz/tonganui-corridors/
[5] Trees That Count, Tonganui Corridors Showcase Project on YouTube https://www.youtube.com/watch?v=YZii_0iKrXA

Modifications/assurances I would welcome in the proposal:

1. Plants considered as pest plants by GWRC (such as arrow bamboo, pampas grass or hawthorn) will not be used for screening. For list of pest plants see: https://www.gw.govt.nz/environment/pest-management/pest-plants/

2. For screening purposes and as a biodiversity offset, consider planting a polyculture of 12+ native species as illustrated in *Figure 1. View of Kapunui Solar Farm* of the *Proposed Screening* document. These species might include mānuka, kohuhu, hebe, flax, toetoe, cabbage tree, ribbonwood, *Coprosma* spp., kowhai, lemonwood, *Olearia virgatum*, *Olearia paniculata*, broadleaf, totara and many more. A mix of native shrubs and trees will provide an extended season of nectar, fruit, seed and foliage to support a diverse assemblage of native birds, invertebrates and potentially lizards.

3. For purposes of visual amenity, the screening to be maintained at a height of 4.5m or higher. Statements in the documents provided by the applicant frequently cite a target of 3m or 4m in height for screening, while in other places it is suggested that screening will be at least as high as the solar panel structures (=4.53m).

4. Where existing large trees are present on southern boundaries these be maintained at their current size. Tall trees provide take-off and landing perches for kereru and many other birds. Large trees with cavities (including pine and macrocarpa) are rich in insects and provide potential roosting sites for morepork and native bats.

Selected quotes from the supplied documentation, relating to screening plans and guidelines

Glint and Glare effects mitigation document. https://swdc.govt.nz/wp-content/uploads/220103-Glint-glare-effects-mitigation-01032023.pdf

Screening –
page 2. “In all the studies we have reviewed, the mitigation for glint and glare was to propose screening to a height equal to the panel height. ... With screening in place, the low angles of reflection will be stopped by the trees.

In all FNSF's solar farms, trees are proposed for screening on all sides, planted early in the project and maintained at either 3m or 4m height."

Summary

page 3 . "All FNSF's solar farms are designed and consented with high levels of tree screening, covering as many boundaries as possible, and maintained to a height that exceeds the height of the panels."

Comment: The maximum height of the proposed panels at full tilt is 4.5m, therefore, why is it not proposed that the height of the screening be at least 4.5m height?

Landscape Assessment /Assessment of Landscape Effects https://swdc.govt.nz/wp-content/uploads/220103-Landscape-assessment-final-10012023.pdf

Page 5 "The hedges will be maintained to a minimum height of 4.0m, so that screening is afforded to the proposed structures from external locations,.."

Page 7. "Indigenous vegetation is very limited and insignificant, limited to some distinctive stands of kanuka, and small isolated lowland forest remnants such as the 13 hectare Trenair (Lowes Bush) broadleaf remnant, and occasional groups or single trees."

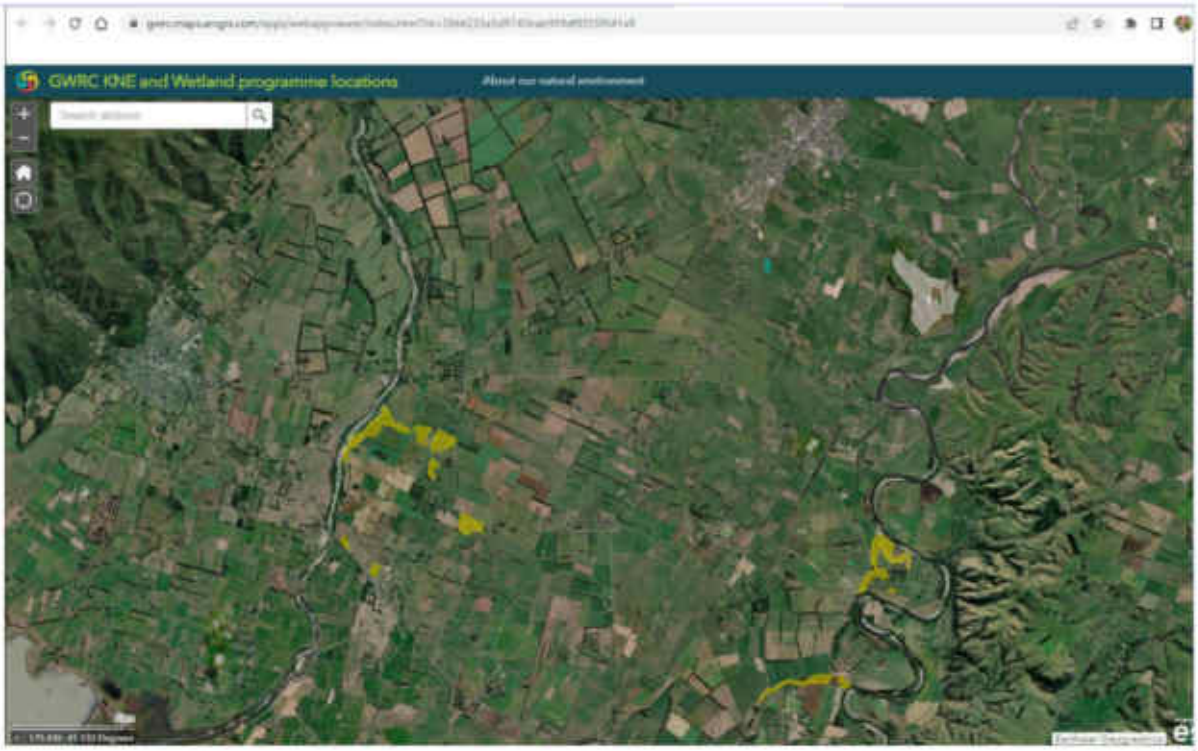
Page 15. "The proposed advanced grade mitigation planting will, as is evidenced by visual simulations 1 – 5, contained in Appendix 4, predominantly screen such views immediately with the exception of those periods when the panels are at 'full tilt'.

Proposed screening document https://swdc.govt.nz/wp-content/uploads/220103-Proposed-screening-01032023.pdf

Page 2. "All of FNSF's consented projects require a mix of native species planted in an arrangement to provide depth as well as height."

GWRC GIS Viewer

Fig 1. Screenshot from the GWRC GIS viewer of Key Native Ecosystems (yellow) and wetland sites (blue) in the vicinity of the proposed solar farm site.



Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent		Decline the Consent	X	Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name: Stephen Hartley

Date: 5 June, 2023

Important notes for the Submitter

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SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

40

Submitter

Name	Steve Hancock
Contact Person (If different from above)	
Postal Address	2603 State Highway 2, Ahikouka, Greytown, 5719.
Home Phone	
Cell Phone	[redacted]
Email	[redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Limited
Address of Proposal	415 Morra Road, Greytown
Application No.	RM220103
Description of Proposal	235Ha Solar Power Plant

Details of Submission

My submission:

- [ ] Supports the whole proposal
- [ ] Supports part of the proposal
- [x] Opposes the whole proposal
- [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- [x] Yes
- [ ] No

- [x] If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

a) Extraordinary change to an entire district and community

b) The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

Refer to the attached submission continued.

Decision you want the Council to make:

☐ Grant the Consent ☒ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Steve Hancock 5th June 2023.
(Electonic Signature).

Name

Date

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Submitter

Name	Steve Hancock
Contact Person (If different from above)	
Postal Address	2603 State Highway 2, Ahikouka, Greytown, 5719
Home Phone	
Cell Phone	[redacted]
Email	

Submission Statement Continued.

a) Extraordinary change to an entire district and community

b) The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

Adverse, long-term consequences to natural resources on and within the surrounding proposed site.

Displacement of the area's thriving native wildlife and birds. Large solar farms such as the one being proposed has the potential to have a transformative effect on the land which can lead to dire consequences to local wildlife. The removal of current shelter belts will remove the habitat of our native Morepork which we know are prevalent in the area.

Removal of hundreds of acres of prime farmland from agricultural use. It is in New Zealand best long-term interest to prevent good quality land being lost to industrial development.

Degradation of rural, scenic views the residents of this community chose to build and invest, and those further afield who visit the area. Greytown has become a rural tourist destination known for its natural beauty and in 2017 was voted New Zealand's most beautiful town. The visual impact of this industrial solar farm would fundamentally change the character of the area.

A decrease in surrounding property values caused by the wrongful siting of this utility-scale operation in a South Wairarapa District Council zoned rural area.

Concerns and costs related to the proper disposal of solar panels and storage batteries and the land being returned to its previous natural conditions at the end of the project.

As to the construction of the project, I have the following additional concerns which include.....

Unbearable noise that will disrupt the daily life of those in the surrounding area during the construction period. Dust, mud and debris on the roadways, driveways and property.

Landscaping promised will not be instant and there is no mention of continuous maintenance.

Excess truck traffic during the construction stage bringing in the solar panels, containers containing electrical equipment and other infrastructure along Bidwell Cutting which is popular with cyclists and is already unsuitable for large vehicles manoeuvring on this narrow rural arterial road.

[redacted] Steve Hancock 5th May 2023.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

41

Submitter

Name	South Wairarapa Whenua Advisory Gro
Contact Person (If different from above)	Peter Isaac
Postal Address	47 Cross line Greytown
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms
Address of Proposal	101 Putaki Drive Kumeu 0841
Application No.	
Description of Proposal	land use consent to establish & operate a 175 -megawatt solar farm

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☑ Opposes the whole proposal
- ☐ Supports part of the proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

41

Submission Statement

The specific parts of the Proposal that this submission relates to.

As attached, SWWAG for North Solar farm Submission.

Decision you want the Council to make:

☐ Grant the Consent ☑ Decline the Consent ☐ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

[redacted]

Name

May 15 2023.

Date

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Far North Solar Farm Submission

The presence of extensive demountable heavy electrical equipment in the proximity to so much water by definition poses an environmental threat to human safety for those in the neighbourhood. This is compounded by the number of electrochemical storage batteries of container dimension that are part of this project.

The construction of such a large scale generating project and over such a substantial area is contrary to the officially predicted onset of extreme weather events demonstrated by the arrival of Cyclone Gabrielle the effects of which on Hawkes Bay for example will be with us for many years to come.

It is acknowledged by territorial authorities that there is "little time to warn people" of the onset of such calamities.

The southern Wairarapa is bisected by numerous rivers, is categorised low lying, and is dependent on the presence of bridges which experience has so recently demonstrated are vulnerable to the extreme manifestations of climate change.

We also note that the existence of such an array of generating equipment over so many hectares because in the event of an emergency these dispersed and conjoined structures will present an immediate additional impediment to civil defence rescue operations.

We note that more than 350,000 pieces of heavy equipment are intended for the site.

Recent experience of the onset of extreme manifestations of climate change calls into question the capability of even the most advanced flood control management installations.

The lesson is that even the most advanced flood control systems such as the Heretaunga one can be overwhelmed by the extreme weather conditions now predicted by the constituted authorities for these regions.

This industrial installation in this era of climate extremes presents a significant hazard to the wider community and recent events demonstrate that these are now of a threatening imminence.

An industrial electrical generation installation on a low lying area of the valley floor with its corresponding near-surface water table and proximity to rivers, lakes, wetlands and potable water bores in addition to those residing in the immediate proximity also presents in the light of recent maritime warming outcomes a permanent existential threat to nearby communities.

These include the South Wairarapa county boroughs of Martinborough, Featherston, and Greytown.

Peter Isaac – President South Wairarapa Whenua Advisory Group Incorporated.

To: South Wairarapa District Council

Submission by Transpower New Zealand Limited on the Publicly Notified Resource Consent Application (Ref: RM220103) – Far North Solar Farm

6 June 2023

Keeping the energy flowing




TRANSPOWER

Address for Service:

Transpower New Zealand Ltd
PO Box 21154, Edgeware
Christchurch 8143
Attention: Andy Eccleshall
Senior Environmental Planner
Ph: (04) 590 8687
Email: Andy.Eccleshall@transpower.co.nz

1. INTRODUCTION

1.1 This document and appendices form part of Transpower New Zealand Limited's (Transpower) submission to South Wairarapa District Council on the land use consent application by Far North Solar Farm Ltd for the construction and operation of a 175-megawatt peak solar farm located at 415 Moroa Road, Greytown ('the Site'). The proposal involves 321,160 175 MWp photovoltaic solar panels mounted on tracking tables, with a maximum height of 4.5m above the ground, for utility-scale renewable energy generation which will be connected to the local substation for supply into the local and wider area electricity network. The proposed works are set out in the "Assessment of Environmental Effects – Greytown Solar Farm – Far North Solar Farm Ltd, WWLA0589, Rev. 1" dated 21 December 2022 and prepared by William Water and Land Advisory and supporting documents ('the resource consent application'). Transpower understand that work associated with trenching and connection of the solar farm to the National Grid does not form part of the resource consent application.

1.2 Transpower is the State-Owned Enterprise that plans, builds, maintains, and operates New Zealand's high voltage transmission network - The National Grid. The National Grid comprises around 12,000 km of transmission lines and cables, and some 164 substations. It links generators to distribution companies and major industrial users from Kaikohe in the North Island to Tiwai Point in the South Island. Transpower's principal role is to ensure the reliable supply of electricity throughout the country and, therefore, has a significant interest in ensuring that development does not adversely affect the operation, maintenance, upgrading and development of the existing transmission network.

1.3 Transpower's Masterton – Upper Hutt A (MST-UHT A) 110kV National Grid transmission line traverses the southern portion of the Site, through the proposed solar farm. This line is supported by several double circuit steel towers MST-UHT-A0192 to 0199, located within the Site. Transpower's Greytown Substation is located adjacent to the eastern boundary of the Site. Please refer to the Transpower asset map provided in **Appendix A** for further detail. The National Grid Yard (NGY) is a 12-metre setback either side of the transmission line and support structures (it should be noted that the 12m setback from the closest visible edge of the tower foundation will need to be physically measured on-site), shown as the blue corridor on the appended map.

1.4 Transpower's interest in the proposal relates to works proposed in the southern portion of the Site, which could adversely impact Transpower's ability to operate and maintain the MST-UHT A National Grid assets, if not appropriately managed. The Site Layout Plan titled 'Greytown 175 MWp New Zealand - Module General Arrangement Layout' Rev H dated 13-02-2023 provided in Appendix C of the resource consent application refers to Transpower's MST-UHT A National Grid transmission line in relation to the Site and Transpower's Greytown Substation. However, the National Grid support structures located within the Site are not shown on the Plan, nor is the NGY. Transpower request that this detail is provided on the Plans to clearly show the location of the National Grid assets in relation to the proposed solar farm. Transpower notes there are discrepancies in the information provided as part of the application regarding the proposed planting to screen the solar farm – refer to Section 3.11 of this Submission. Transpower is also concerned around access to the National Grid assets as a result of the solar panels potentially impeding Transpower's current access.

1.5 Prior to lodgment of the resource consent application, the applicant's agent (Wiliamson Water and Land Advisory) undertook limited consultation with Transpower in April 2022 (Reference

PATAI000542) seeking to understand electrical clearance requirements under the New Zealand Electrical Code of Practice for Electrical Safe Distances - NZECP 34:2001. From the information provided to Transpower, Transpower's engineers were unable to provide a fulsome response and requested further detail on the proposed solar panels (locations, sizes and maximum heights) to allow Transpower to assess the clearance between the solar panels and the MST-UHT A National Grid transmission line in accordance with the requirements NZECP 2001:34. No further correspondence was undertaken with Transpower via the PATAI portal nor was further information provided to Transpower's engineers.

1.6 Transpower does not oppose this proposal in principle. However, Transpower opposes the application on the basis of ensuring that the proposed solar farm and associated works are appropriately managed and do not adversely impact the operation, maintenance, upgrading and development of the MST-UHT A National Grid transmission assets. Transpower requests that appropriate conditions are imposed on any resource consents granted in this regard.

2. STATUTORY CONTEXT

National Policy Statement on Electricity Transmission 2008 (NPSET)

2.1 Under the Resource Management Act 1991 (RMA), the National Grid is recognised as a significant physical resource that must be sustainably managed, and any adverse effects on that infrastructure must be avoided, remedied or mitigated. The NPSET confirms the national significance of the National Grid and the need to appropriately manage activities and development under, and close to it.

2.2 The Objective of the NPSET is as follows:

To recognise the national significance of the electricity transmission network by facilitating the operation, maintenance and upgrade of the existing transmission network and the establishment of new transmission resources to meet the needs of present and future generations, while:

- *Managing the adverse environmental effects of the network; and*
- *Managing the adverse effects of other activities on the network.*

2.3 The NPSET contains 14 Policies. In particular, Policy 2 of the NPSET requires decision-makers to recognise and provide for the effective operation, maintenance, upgrading and development of the electricity transmission network. Whilst Policy 10 requires that all decision-makers: *"to the extent reasonably possible manage activities to avoid reverse sensitivity effects on the electricity transmission network and to ensure that operation, maintenance, upgrading, and development of the electricity transmission network is not compromised."*

2.4 In 2017, the High Court[1] emphasised the strength of Policy 10, stating:

"[85] Policy 10, though subject to the "reasonably possible" proviso, is, in my judgment, relatively prescriptive. It requires that decision-makers "must" manage activities to avoid reverse sensitivity effects on the electricity transmission network, and "must" ensure that the operation, maintenance, upgrading and development of the electricity transmission network is not compromised. What is sought to be protected is the national electricity transmission grid – an asset which the NPSET recognises is of national

[1] Paragraph 85, High court interim judgement of Justice Wyllie in TRANSPOWER NEW ZEALAND LTD v AUCKLAND COUNCIL [2017] NZHC 281 [28 February 2017]

significance. A mandatory requirement to ensure that an asset of national significance is not compromised is, in my judgment, a relatively strong directive."

The New Zealand Electrical Code of Practice for Electrical Safe Distances - NZECP 34:2001

2.5 The National Grid is subject to various operational and engineering requirements that dictate how other activities are undertaken in relation to the National Grid, including the requirements of NZECP34: 2001.

2.6 NZECP34: 2001 is a mandatory code of practice pursuant to the Electricity Act 1992 which sets minimum safe distances from overhead transmission lines to protect persons, property, vehicles and mobile plant from harm or damage from electrical hazards. The Code establishes safe clearance distances to buildings and structures, the ground (including stockpiles of earth and filling activities), and other lines, as well as how close buildings, structures and excavations can occur to poles and towers. All proposed works must comply with the NZECP requirements.

3. MATTERS OF INTEREST TO TRANSPOWER

3.1 In accordance with Policies 2 and 10 of the NPSET, Transpower's interest in the proposal is to ensure that the operation, maintenance, upgrading and development of the existing National Grid is not compromised by the proposed solar farm and that any works undertaken in proximity to the MST-UHT A National Grid transmission line and towers MST-UHT-A0192 to 0199 are carried out safely.

National Grid Yard Access

3.2 Transpower seeks to keep the NGY free of most buildings in order to provide for the operation and maintenance of the National Grid. In particular, Transpower requires that all sensitive activities (such as residential dwellings) shall be located outside the NGY. No activities sensitive to the National Grid are proposed as part of the resource consent application.

3.3 In addition to the NGY building restrictions, access to the MST-UHT A National Grid transmission lines and support structures shall be maintained to ensure maintenance can be undertaken at all reasonable times and emergency works can be undertaken at all times, including pre and post construction.

3.4 Transpower has a legal right to access the transmission lines and support structures on site (e.g., for maintenance, inspections and upgrading) under the Electricity Act 1992. However, this does not guarantee that physical access is available. Transpower requires suitable vehicle access is maintained as part of the solar farm to the MST-UHT A transmission lines and towers MST-UHT-A0192 to 0199. When comparing the proposed location of the solar panels with Transpower's current access through the site to the MST-UHT A National Grid assets, access will potentially be impeded and a new access arrangement will need to be agreed.

3.5 Section 3.6 of the Assessment of Environmental Effects ('AEE') confirms that three entrances to the solar farm will be provided on Moroa Road, while the 'Resource Consent Application 415 Moroa Road, Greytown (Planning Application No. 220103) – Response to Further Information Request' dated 1 March 2023' states "five accessways will be constructed on site" (two of which are existing). No detail is provided on the width of these entrance ways or the width of internal accessways through the solar farm, other than referring to Appendix 5 of the Wairarapa Combined District Plan

('District Plan'). Transpower require internal accessways to be 6m in width to allow for large mobile plant access required for tower maintenance activities. Similarly, any fences or gates proposed at the site shall not impede Transpower's access to towers MST-UHT-A0192 to 0199. Where gates are installed to provide for access to the MST-UHT A National Grid assets, they shall be at least 6 metres wide to allow access for large mobile plant required for tower maintenance.

NZECP34:2001 Safe Separation Distances – building to conductor clearance, land disturbance and mobile plant operation

3.6 The appropriate management of any land disturbance or construction related activities around Transpower's National Grid transmission lines, including support structures, is critical for security of supply to the National Grid and providing for the health and safety of those undertaking the works. Such activities undertaken in proximity to the National Grid must comply with the safe separation distances set out in NZECP34:2001.

3.7 The proposed solar panels are located approximately 20 m away from the centreline of the MST-UHT A transmission lines. As such, there are no clearance concerns with respect to the NZECP34: 2001 building / structure to conductor setback requirements.

3.8 Mobile plant and machinery, such as excavators, or cranes, along with the transport of oversized loads, have the potential to reach up to, or above, the height of the conductors. In Transpower's experience, mobile plant and other vehicles working in proximity to transmission lines pose a real and significant risk. It is essential that the use and location of this machinery is carefully considered to avoid contact with the conductors. Coming into close proximity to a live conductor and causing a flashover (i.e., the flashover will occur prior to contact) can:

- Compromise the safety of the machinery operators, workers, or members of the public in or near the machinery and result in electric shock;
- Damage the machinery or the line itself; and
- Affect the operation of the National Grid and the security of supply.

3.9 Mobile plant operation in proximity to the National Grid must comply with the minimum safe clearance distances set out in Section 5 of NZECP34: 2001 relating to works in proximity to conductors and towers. All machinery and mobile plant operated in association with construction works or during operation of the solar farm shall maintain a minimum clearance distance of 4 metres from the live overhead conductors (wires) of the MST-UHT A National Grid transmission lines at all times to avoid the potential of machinery striking the lines. In order to maintain a 4 metres clearance from the transmission lines at all times, mobile plant operating within 12 m of the MST-UHT A National Grid transmission line is limited to a maximum height of 2.1 m, including plant operating at full extension and loads being lifted.

Planting of vegetation in proximity to the National Grid Transmission Lines

3.10 Planting vegetation underneath and in proximity to the National Grid transmission lines has the potential to cause a fault subsequently affecting the operation of the line, injury or death to someone near the tree and damage to land and property. Furthermore, should vegetation touch high voltage conductors or a flashover[2] occur, dangerous voltages may arise in the area around the

[2] Arcs of electric current that can pass from the wires / conductors to the steel towers into the earth.

tree or on the tree itself. High voltage electricity flowing into trees can cause trees to ignite. Therefore, it is critical that the safe clearances within the Electricity (Hazards from Trees) Regulations 2003, including the setbacks to cover tree fall hazard, are met.

3.11 The Landscape Mitigation Plan provided as Appendix D to the resource consent application proposes screen planting along the boundary of the Site. The Landscape Mitigation Plan identified screening will comprise existing shelter belts up to 3m in height, along with proposed shelter belt planting at 2.5m in height. The AEE does not align with the heights specified in the Landscape Mitigation Plan, stating in Section 5.4.2 – *"Japanese Cedar trees will be planted early in the construction process, to ensure they are 2.5-3m high by the time the solar farm is commissioned for use. Trees will generally be topped to 3m*". Further information on the proposed screen planting is also provided by way of a memo titled 'Tree planting for screening of FNSF's solar farm' 'the memo' provided as Appendix C of the 'Resource Consent Application 415 Moroa Road, Greytown (Planning Application No. 220103) – Response to Further Information Request' dated 1 March 2023[3]. The memo also does not align with the Landscape Mitigation Plan or AEE, stating on Page 5, in relation to the existing shelter belt planting *"White dashed with yellow or red - existing shelter belt trees, 5-6m to be trimmed to 4m".* A further reference to existing trees being over 8m in height is made on Page 6 of the memo. Given the discrepancies in the information provided, Transpower is unable to confirm the maximum height of shelter belt planting on Site at maturity, particularly in proximity to the National Grid.

3.12 Transpower makes the following comments with respect to the proposed planting:

a) Sufficient clearance is provided for planting of vegetation of 2.5 m in height along the western boundary of the Site. However, the proposed vegetation shall not be closer to the NGY than the existing rows of vegetation and no vegetation is permitted in the NGY.

b) Vegetation planted along the eastern boundary of the Site between span MST-UHT-A0198 and 0199 shall not impede access to Transpower's National Grid assets, noting that shelter belt planting is proposed continuously around the eastern site boundary through to Transpower's substation to the east of the Site, including within the NGY. Transpower request that the shelter belt in this area is located so as to maintain vehicle access between Transpower's substation and the National Grid assets.

3.13 Any landscaping / planting proposed in proximity to the NGY must comply with the following:

a) No trees or vegetation greater than 2m in height shall be proposed within 12 m of the centreline of the MST-UHT A National Grid transmission line, and along the eastern boundary of the Site between span MST-UHT-A0198 and 0199. Transpower recommend to low growing bushy plants such as tussock, flax, hebe and similar, within the NGY, which will not require ongoing maintenance.

[3] The fulsome 'Resource Consent Application 415 Moroa Road, Greytown (Planning Application No. 220103) – Response to Further Information Request' dated 1 March 2023 is not provided with the publicly notified application documents on Council's website - https://swdc.govt.nz/far-north-solar-farms-notice-of-application/. Therefore the memo titled 'Tree planting for screening of FNSF's solar farm' is assumed to constitute 'Appendix C' referred to in the Response to the Further Information Request

b) Any proposed new trees or vegetation planted outside of 12 metres either side of the centreline of the transmission line must be setback sufficiently to ensure that trees cannot fall within 4 metres of the transmission lines.

c) All vegetation must comply with the Electricity (Hazards from Trees) Regulations 2003, or any subsequent revision of the regulations.

Construction Management Plan (CMP)

3.14 Given the solar farm will be located in close proximity to the MST-UHT A National Grid transmission line and support structures, construction works will need to be carefully managed to avoid any impacts on the National Grid and minimise risk to people and plant. Transpower requests that a Construction Management Plan (CMP) be prepared for the proposed works. This is to ensure that the solar farm works will comply with NZECP34:2001 minimum approach distances (i.e., minimum required distance between wires / conductors and large construction plan), and land disturbance around National Grid support structure is appropriately managed. In addition, the CMP shall outline how any dust generated from land disturbance activities and any stockpiling in proximity to the National Grid is appropriately managed so as not to create any dust hazard or nuisance to the MST-UHT A National Grid transmission lines, including support structures.

Earth Potential Rise (EPR)

3.15 Earth Potential Rise (EPR) is the potential for towers or poles to transfer high voltage and dangerous currents into the ground during a lightning strike or fault on the transmission line. This can affect, among other things, all new installed services such as pipelines, communication cables, fences, streetlights and buildings located in close proximity to transmission towers. Any new buildings or structures within 50 m of the MST-UHT-A0192 to 0199 support structures may be subject to EPR.

3.16 An EPR assessment of the proposed solar farm development will be required given it will be located within 50m of towers MST-UHT-A0192 to 0199. The assessment will identify the EPR risk and determine whether any mitigation measures will be required during the design and construction of the solar farm, which includes all buildings, structures and fences. Transpower will obtain an EPR assessment and liaise with the applicant in this regard.

4. CONSENT CONDITIONS

4.1 Transpower considers that the aspects of the proposed solar farm development outlined above, which have the potential to result in adverse effects on the MST-UHT A National Grid assets, can be addressed through conditions imposed on the land use resource consents. Transpower requests the conditions set out in **Appendix B** of this submission form part of the consent conditions, should the land use resource consents be granted for the proposal, to ensure the protection of the National Grid assets.

5. DECISION / RELIEF SOUGHT

5.1 Transpower seeks a decision that ensures that the operation, maintenance, upgrading and future development of National Grid infrastructure is protected from the potential adverse effects of the proposed solar farm.

5.2 Transpower requests that the conditions set out in Appendix B of this submission form part of the consent conditions, should the land use resource consent be granted for the proposal. Transpower

would be happy to work with Far North Solar Farm Ltd with a view to reaching an agreed position on this as required.

5.3 Transpower would be happy to work with Far North Solar Farm Ltd, during the implementation of any resource consents granted for the proposal to ensure the proposed activities comply with the requirements of NZECP and that Transpower's National Grid assets are appropriately protected.

5.4 Transpower wishes to be heard in support of its submission.

Dated at Christchurch on 6 June 2023

Rachel Purdy
Principal Planner
Tonkin + Taylor Ltd

[redacted]

Approved for Release by Transpower NZ Ltd:

[redacted]

p.p. Daniel Hamilton, Environmental Regulatory Team Leader, Transpower New Zealand Limited

Andy Eccleshall
Senior Environmental Planner
Transpower New Zealand Limited
(Authorised to sign on behalf of Transpower NZ Ltd)

[redacted]

Appendices:

Appendix A: Map of Transpower assets
Appendix B: Recommended condition set

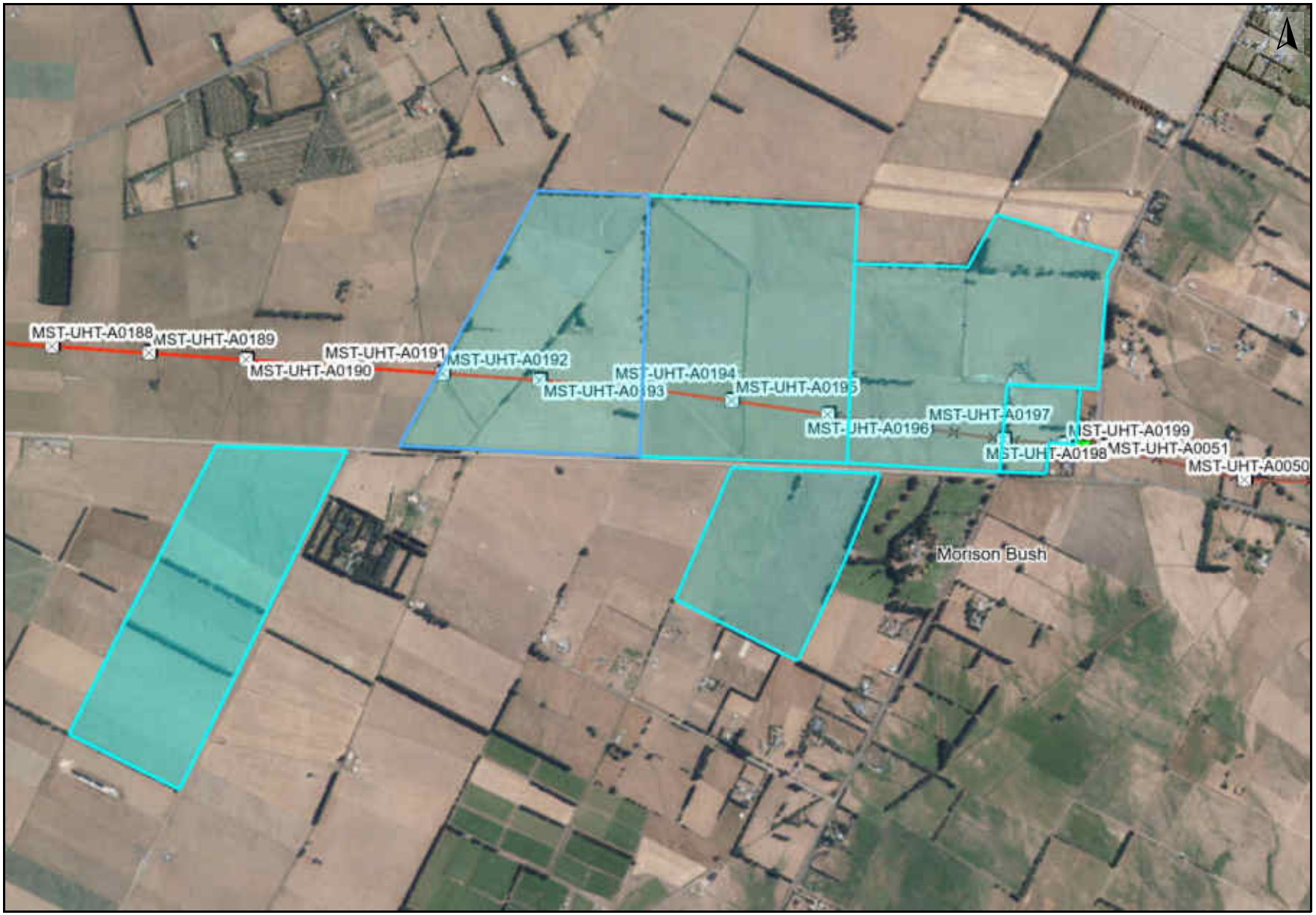
Copy Served to:
Far North Solar Farms
C/- William Water and Land Advisory
10/1 Putaki Drive
Kumeu 0841
Attn: Laila Alkamil
[redacted]

Appendix A:

Map of Transpower Assets

TRANSPOWER | Greytown Solar Farm on Moroa Road

42



Legend

Maximo Assets

Site

- AC Substation

Structure

- Double Circuit Steel Tower
- Termination

Earthwire

Span

- 110 kV

Transpower Data

Asbestos at Substation

0 0.5 1 km

2-Jun-2023 Scale 1: 18056 Plan size: A4L

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Appendix B:

Requested Consent Conditions

General

1. The consent holder shall provide Transpower NZ Ltd 10 working days notice in writing prior to commencing the proposed works. Note: notification can be sent to transmission.corridor@transpower.co.nz

Building and Structures

2. No buildings or structures (except non-conductive fencing) shall be located within 12m of the centreline of the MST-UHT A National Grid transmission lines.

3. No buildings or structures shall be located within 12m of any outer visible edge of the foundation of National Grid support structures MST-UHT-A0192 to 0199; except for non-conductive fencing, which can be located 6m from any outer visible edge of the support structure foundation.

NZECP Compliance

4. All land use activities, including the construction of new buildings/structures, earthworks, fences, any operation of mobile plant and/or persons working near exposed line parts shall comply with the New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001) or any subsequent revision of the code.

Access

5. All buildings, structures and vegetation must be located to ensure vehicle access is maintained to the MST-UHT A National Grid transmission lines, and support structures MST-UHT-A0192 to 0199, for maintenance at all reasonable times, and emergency works at all times.

   Advice note: Transpower NZ Ltd has a right to access its existing assets under s23 of the Electricity Act 1992. Any development on must not preclude or obstruct this right of access. It is an offence under s163D of the Electricity Act 1992 to intentionally obstruct any person in the performance of any duty or in doing any work that the person has the lawful authority to do under s23 of the Electricity Act 1992.

Mobile Plant

6. All machinery and mobile plant operated in association with the works shall maintain a minimum clearance distance of 4 metres from the live overhead conductors (wires) of the MST-UHT A National Grid transmission lines at all times to avoid the potential of machinery striking the lines.

7. To ensure safe separation distances to the conductors (wires) of the National Grid transmission lines are maintained, all machinery, mobile plant and vehicles operating within 12m of the

transmission lines, and traversing beneath the lines, shall be limited to a maximum reach height of 2.1 metres. This includes any loads being lifted or transported underneath the line.

Vegetation

8. Any proposed new trees or vegetation within 12 metres either side of the centreline of the MST-UHT A National Grid transmission line must not exceed 2 metres in height at full maturity and must comply with the Electricity (Hazards from Trees) Regulations 2003, or any subsequent revision of the regulations.

9. Any proposed new trees or vegetation outside of 12 metres either side of the centreline of the MST-UHT A National Grid transmission lines must be setback sufficiently to ensure the tree cannot fall within 4 metres of the National Grid transmission lines and must comply with the Electricity (Hazards from Trees) Regulations 2003, or any subsequent revision of the regulations.

Construction Management Plan

10. Prior to the commencement of the solar farm works, the consent holder shall prepare and submit to the Council for approval a Construction Management Plan (CMP) to ensure the protection of the MST – UHT A National Grid transmission lines and support structures. The CMP must be given to Transpower NZ Ltd for its certification at least 20 working days prior to being submitted to the Council.

    Note: The CMP should be sent to Transpower via PATAI Form 5: https://transpower.patai.co.nz/new-enquiry

11. The CMP must include the following (but is not limited to):

a) The name, experience and qualifications of the person/s nominated by the consent holder to supervise the implementation of, and adherence to, the CMP.
b) Construction drawings, plans, procedures, methods and measures to demonstrate that all construction activities undertaken on the site will meet the safe distances within the New Zealand Electrical Code of Practice for Electrical Safe Distances 2001 (NZECP 34: 2001) or any subsequent revision of the code; including (but not limited to) those relating to:
    i. Excavation and Construction near Towers (Section 2);
    ii. Building to conductor clearances (Section 3);
    iii. Ground to conductor clearances (Section 4);
    iv. Mobile Plant to conductor clearances (Section 5); and
    v. People to conductor clearances (Section 9).
c) Details of any areas that are “out of bounds” during construction and/or areas within which additional management measures are required, such as fencing off, entry and exit hurdles, maximum height limits, or where a safety observer may be required (a safety observer will be at the consent holder’s cost.
d) Demonstrate how the existing transmission lines and support structures will remain accessible during and after construction activities;

e) Demonstrate how the effects of dust (including any other material potentially resulting from construction activities able to cause material damage beyond normal wear and tear) on the transmission lines will be managed;
f) Demonstrate how changes to the drainage patterns, runoff characteristics and stormwater will avoid adverse effects on the foundations of any support structure;
g) Demonstrate how construction activities that could result in ground vibrations and/or ground instability will be managed to avoid causing damage to the transmission lines, including support structures.
h) Details of proposed contractor training for those working near the transmission lines.

12. All activities are to be undertaken in accordance with the approved CMP.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Wairarapa Eco Farm

Contact Person:

(if different from above) Frank van Steensel and Josje Neerincx

Postal Address: 260 Moroa Road, Po Box 19, Greytown

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Ltd

Address of Proposal: 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 SH 2, Greytown;18 Pharazyns Road, Featherston

Application No. 220103

Description of Proposal: 175-megawatt peak Solar Power Plant

Details of Submission

My submission *(use X to indicate your choice):*

	Supports the whole proposal		Supports part of the proposal
X	**Opposes the whole proposal X**		Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

X	**Yes**		No

	If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

The whole proposal

Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent	X	**Decline the Consent**		Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Frank van Steensel
Josje Neerincx

Name: Frank van Steensel & Josje Neerincx

Date: 5 June 2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

There are several reasons why we are **strongly against** this proposal and they are listed below (not necessarily in order of importance). We urge the Council to fully decline.

Background

We are the owners of LOT 2 DP 28980 BLK IV WAIRARAPA SD BLK I as described Table 1: Potentially affected properties / individuals on page 13 of Document "Assessment of landscape effects" 8 December 2022, 22042_01 Rev 2 FINAL that is part of the Far North Solar Farm application to the SWDC. We are also known "on Google maps as CSA Wairarapa Eco Farm".

The Wairarapa Eco Farm is a 7 hectare property owned by Frank van Steensel and Josje Neerincx, directly neighbouring the 40+ hectare parcel of land at 18 Pharazyns Road, Featherston and close neighbours to the Moroa Road part of the proposed solar plant. This added block directly* adjoins our property on our whole west side (*only a small strip of land sits in between; being the paper road of which we have the usage).

Our block of land was bought in 1996 after careful considerations of soil, climate and distance from main roads, intensive farming practices, and high voltage power lines. Over the past 26 years we have transformed the grass monoculture into a diverse and sustainable piece of Eden with the intention to show and educate New Zealanders that Wairarapa stony soils can be used for much more than just sheep and beef farming; free draining alluvial rocky soils are highly valuable for Mediterranean type tree crops and herbs. But also, to show how to live and work in harmony with Nature, developing a throughput system, instead of an high input, high output, and high waste system. For that, we rely on a resilient ecosystem that includes healthy bee and insect populations.

We attract much wildlife to our abundant farm. What will be the unknown effects of such a big change in electromagnetic fields around us on the insect life, but also on ourselves on our farm? It is well known that bees are affected by electromagnetic fields.

Over the past 26 years, we have built up a resilient property with its own micro climate where we grow a large variety of crops and animals for ourselves, the local community and members in the wider Wellington Region who trust our ecologically and healthy grown produce. Trust we have built up over a long period of time. Our Wairarapa Eco farm CSA brand is now well known nationally and even internationally (a 2018 Facebook clip was viewed over 9 million times). In 2018 we were chosen as NZ Organic Grower of the Year, and in 2014 we won 2 Gold and 1 Silver Green Agriculture Innovation Awards for our work. Members buy our produce because they want to know their farmer and the produce they eat. Many of our members have sensitive health issues and take things like pesticides, but also electromagnetic smog seriously. A vegetable is not just healthy because it's a vegetable, but because of where and how it has been grown.

Last year we hosted the Mount Bruce Pukaha Garden Tour and welcomed over 1200 visitors in one weekend, we have been on several NZ tv shows and are part of a feature film documentary called "Living the Change: Inspiring Stories for a Sustainable Future" that explores solutions to the crises we face today through the inspiring stories of people living in a more sustainable way.

For the past 30 years we have been taking our own responsibility to look after the environment and our health. We take electrical smog very seriously and stay away from things like microwaves and use copper for our phone and internet. Our little A-frame cabin and yurt tents are popular with our members, who use the opportunity to volunteer and relax on the farm while staying in a healthy natural environment away from Wi-Fi and other modern technology.

Our 4 children, ranging from 30-17 either live and/or work with us on the farm, all developing their own niches for future ecological businesses. They are also saving up to build their (tiny) home somewhere on the farm. One preferred spot for a house site is located in the south-west corner of the property overlooking the ranges and the gorgeous sunsets on the western side. This will become obsolete if the solar plant is going ahead. Together we have been creating a little paradise; it is not just a 'dwelling', our home, our business, our farm, it is our life!

Our issues with the proposal are:

- The scale of the project
- Distance to our property and business
- Known and unknown Adverse Effects
- Lack of regulation

Having an industrial solar plant directly next to the Wairarapa Eco Farm (or maybe even around us at some time), will negatively impact our lives work, our image, and our business. But it's green, you might say… no, it's not; this proposal is what is called 'virtue signalling'/'green washing'.

The Wairarapa Eco Farm prides itself on being ahead of the game with respect to looking after our environment. We have been off grid for the first 15 years of our life here. Our philosophy is to tread the earth lightly and leave the place more fertile, more in balance than how we found it. A few solar panels and a small wind mill did fit that bill.

The reason why we started the farm is to show that small scale, local based, independent through-put farms are the cornerstones of society. They build soil, water, air, landscape and food quality. We can validate this through Frank's 30 years + experience on soil quality, including Sustainability

Advisor Wellington, Organic National Research Manager OANZ, and research manager for the project: "A review of New Zealand and International Organic Land Management Research" published in 2002 and researcher/writer of Chapter 2 on Soil Systems in NZ, funded by the Ministry of Environment.

Shelterbelts were planted at the start of our journey to reduce the impact of water, wind and road dust and to favour plant, animal and soil life conditions. With the guidance of its owners and extended family, the permaculture property is now home to a diverse type of (subtropical) tree crops, annual and perennials as well as animals (from soil life to bumble bees, bees and larger animals such as sheep, horses and pigs).

A 6-minute short film "The Future of Food" went viral on Facebook in 2017 and was viewed by over 9 million people worldwide. This has catapulted us with yearly visitors, wwoofers (Willing Workers on Organic Farms) and an internship program that we ow run on a yearly basis in spring/summer/autumn.

The property has starred in Peta Matthias's Taste new Zealand, Topp Country Season 2, episode 8, "for the love of organics" and in 2018 in the New Zealand feature film documentary "Living the Change: Inspiring Stories for a Sustainable Future" by Happen Films which also featured ecological scientist Dr. Mike Joy en Professor Transition Engineering Susan Krumdieck. Krumdieck is co-leader and trustee of the Global Association for Transition Engineering, which she co-founded. According to Krumdieck our New Zealand's best long term options for renewable energy are hydro, geothermal and biomass. While the use of solar panels is 'green' during the time of operation, there is a dark side to the construction phase and they become toxic waste at the end of their life. Solar panels and batteries have a short lifespan in comparison to the hydro and geothermal, they require the mining of rare earth materials which next to being rare also have negative social and environmental external costs as they are found in places such as Africa, and they become toxic waste materials that will be highly difficult to recycle. This being a large-scale industrial site means a high concentration of rare earths in a small area. This means that rare earth will enter the environment in higher quantities than normal causing soil contamination and toxicity. **This is not a 'potential', it is a given that accidents and/or time will validate this to happen.**

1. Existing Environment

We are smack bam in the middle. For the planners of FRSF and SWDC to assume that because we have "internalised our views by structure shelterbelts and vegetation" and thus are not impacted by the proposed activity, is very short sighted and utter outrageous. **It is an attack on our way of life and an attack on healthy rural living and we will defend ourselves.**

An electricity generating plant of the proposed size covering 235 hectares (which is 30 hectares larger than Resolution Island in Fiordland and the 7th largest island of New Zealand), is nothing else than **an industrial operation** and should be treated as such. If not, it will open the floodgates for more unregulated solar plants and expansions near towns and places of interest. We know the Helios proposal is on the way, increasing the acreage even more and FNSF actively wants to expand its operation onto new sites but also to existing sites. No clear regulation means opportunity for cancerous growth. With the leases offered and the international push on consumers to eat less meat and the drive on farmers to stop farming altogether (eg Netherlands), it is not unlikely that NZ farmers will eagerly sign up for a solar 'farm'.

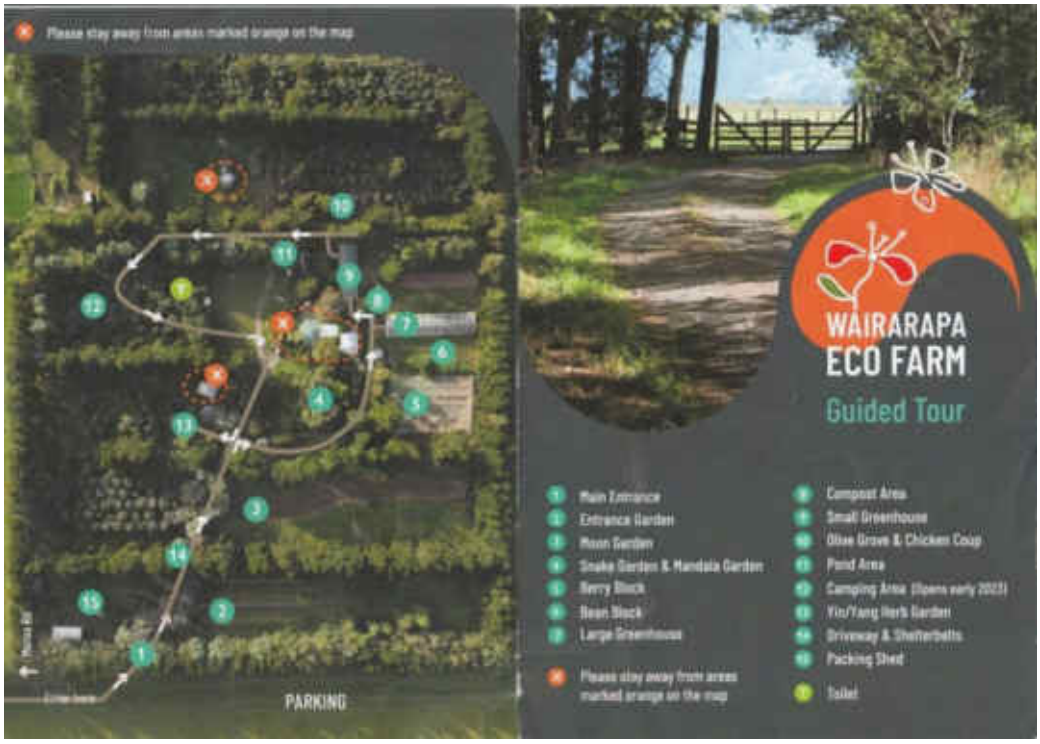
If this proposal goes ahead without any regulations, there is a big chance more farmers around us will want to join and we become completely encircled. This will be unacceptable for us and our farm.

Incomplete Assessments of Effects

The proposed area of the solar plant ('the site') has been expanded subsequent to the first assessment on by the contracted landscape architect. The main result is that the Wairarapa Eco Farm is further negatively impacted. Assessment of these expanded areas is incomplete for several reasons.

"No assessment was provided from Pharazyns Road" (page 23, 2201030e95 220418). The Wairarapa Eco Farm is located at 0 Pharazyns Road and will be more then minor impacted for several reasons.

The visual simulations and virtual views do not take into account the effect of the solar plant on our direct experience of the environment. Why? There is **no one picture provided** with the viewpoints we see daily.



The Visual Assessment also falsely assumes that because we 'internalised the views with shelterbelts' some 27 years ago, the impact is going to be 'nil'. This is incorrect and inconsiderate of work that we have done in the past and for what is in the pipelines over the next two years. The fast growing species of trees that were planted in 1996 as a quick shelterbelt to dampen the extremes of the environment (winds and rainfall) and to encourage the establishment of production trees and plants have done their duty well. However, they are now past their due by date; they are planned to be cut down within the next two years.

We have production gardens and work areas directly behind these shelterbelts. We work here on a daily basis; we will be within 20 meters of the solar plant and ancillaries every day.

Our 'dwelling' is our garden and our garden is our 'dwelling'. We (and our children) live in tiny houses on the property. We have a positive carbon footprint (sequestering carbon in soil plants and animals) by immersing ourselves in nature, i.e. our gardens. There is little difference between our 'dwelling' and (especially the Pharazyns end of) our property. To assume the visual effect is 'nil' is 100% false.

The shelterbelts comprising of quick growing specimens such as Pinus radiatus, Eucalypt species and naturally nitrogen fixing Acacia's were planted in 1996-1997 as we wanted quick shelter. The plan was to replace them in year 15-20 with slower growing natives. These are now all way past their use by dates and need replacing in the next couple of years.

We have 4 children ranging from 30-17. The oldest ones live in tiny homes/sleep outs on our property and they have big dreams to build their future homes in between all the plants and trees we have planted together, and for their children and our grandchildren to live and grow up in our little paradise. They have their eyes set of parts of the property and one is just at the start of the entrance of the farm, directly bordering Pharazyns Road where the evening sun is at its best.

Since the lockdown of 2020 we realise that future generations need to be able to go back to nature to stay sane and de-stress. At the moment we are building tiny structures plotted over our property to rent out as Air B and B, and as accommodation for our (inter)national visitors. Visitors are attracted to visit and stay here, because of the healthy vibes that are felt all over the property. A property in natural balance.

Pharazyns Road/ Moroa Road:

Although our property is accessed via Moroa Road and we have a Moroa Road fire number, officially we live on Pharazyns Road; our Rating Unit Address with the SWDC is "0 Pharazyns Road". We use the unsealed part of Pharazyns Road to access our property. When we bought our block of land in 1996, we were told by Council and real estate agents that the paper road was minimally used by extensive livestock farmers. Only in summer to bring in hay and on New Year's Day by horse carriages for a fun racecourse event. Before the sale could go ahead, we had to sign a paper with SWDC (9 July 1996) to acknowledge that we (and only we) were responsible for the upkeep of the paper road between our block and Moroa Road.

Over the years, blocks of land around us have changed hands and different types of farmers with different farming practices have taken over. The effect has been that larger and heavier farming vehicles use this part of Pharazyns Road and more often (daily), with heavier and bigger machinery, and with larger number of cattle. This has had a huge effect on our small footprint of this part of Pharazyns Road and we feel that the new proposal for the solar plant will put further demands on an already undoable ask to be responsible for the upkeep.

If the solar plant next to Pharazyns Road goes ahead, who is to say that the new FNSF user will not at some stage make use of this part of Pharazyns Road? Thirty years (or 60 years – according to information on the Overseas Investment Office website for similar Aquila Holdings) is a very long time to assume that no changes will take place, for example another access point onto Pharazyns Road. There are gates onto Pharazyns Road, so… Even if this access point was to be constructed further along the road, the chance that quick trips back and forth to Moroa Road would take place is very likely, as we see farmers do that now, and this would then already double the use of 'our' part of Pharazyns Road. As this is not a private road, we will be unable to stop anyone from using this road or ask for help in maintenance. The responsibility to do the upkeep of this road can no longer be ours in this case. As per letter dated 9 July 1996 (letstd1.doc/55), we request that SWDC will have to take over the formation and maintenance of Pharazyns Road as a public road.

Gunclub / Noise – The proposed solar plant sits directly in between the Moroa Road gun club and our farm. <u>What will be the effect of the solar plant with noise onto our property?</u> <u>Can the Council guarantee us that the noise pollution already experienced by us and visitors of our farm will not further increase?</u> The predominate nor'easter wind comes exactly from that direction and creates an

echo on our property. A sea of panels, when flat during part of the day, might just make that echo worse?

2.1 Site Location and Description

According to FNSF there are "no HAIL activities associated with this site". This is true at this point in time, however,

Substations - We note according to the drawings, 4 inverters (33 & 34 and 35 &36) are to be placed along the boundary of Pharazyns Road. Our property sits just in the middle of these. We would like further clarification what the container size substations/inverters entail? In the description of proposed works, it says that "this will include the solar array and associated structures (medium voltage substations and 33 inverters)". Substations are included on the HAIL activity list and can possible cause pollution and harm to environment and humans.

Batteries - At the moment no batteries are mentioned in the FNSF proposal, however, the FNSF website which is written to promote the solar plant as a great investment opportunity, states that the future opportunities include introducing battery storage facilities to existing and new sites. Batteries are another source of possible future pollution to the environment and humans. We need to have a guarantee that batteries (if not already included as part of the substations/inverters set-up) is disallowed. Batteries use/storage necessary at this scale is creating a new HAIL site.

The possible future inclusion of batteries needs to be better understood before this proposal can be taken serious. How many? Where? What type?

3.3 Infrastructure Establishment and Construction

Inverters - FNSF says that "inverters will be placed as centrally as possible within the site to minimise any potential disruption to neighbours". However the site plan for the Pharazyns block shows a number of inverters/substations along the boundary. This is not in the middle at all? Please clarify?

Vehicular Access – FNSF says that "no changes are proposed to public roads". To propose something is a very loose word and does not mean much in the end. 30 years or 60 years is long period in time to change something you have proposed earlier. This also means that number of access points could easily be changed in the (near) future. If the solar plant goes ahead, we demand clarification about the future of Pharazyns Road, including commitment for Council to put the paper road in gravel.

3.8 Consideration of alternatives

The Pharazyns Road plot is likely to result in significant adverse effects onto the receiving environment (the neighbours - us). See above.

FNSF says that the particular 'site' possesses the 'best practicable option for a solar farm" and says it has assessed sites all over NZ. Could we please have an insight in this assessment? Why?

In 2020, the NZ Ministry of Business, Innovation and E commissioned a research report "Economics of Utility-Scale Solar in Aotearoa New Zealand, Forecasting Transmission and Distribution Network Connected 1 MW to 200 MW Utility-Scale Photovoltaic Solar to 2060" on exactly this and the writer of document has come up with many forecasted sites that are economically the most viable from a return of investment basis. Is concludes:

"In general, the first forecast transmission connected utility-scale solar systems are forecast to locate (i.e. become economic) in the Mackenzie District and Tasman District, followed by Marlborough, Waikato, Hawke's Bay, Bay of Plenty and Central Otago as shown below. The first forecast distribution

connected utility-scale solar systems locate (i.e. become economic) in the Far North District, Tasman and Marlborough, followed by the Bay of Plenty, Hawke's Bay, Waikato and Canterbury, as shown below." (*https://www.mbie.govt.nz/assets/Uploads/utility-scale-solar-forecast-in-aotearoa-new-zealand-v3.pdf)*

The Wairarapa does not even come close!

Also, according to Transpower, one megawatt of capacity (1 MW) is roughly enough capacity to power the average demand of 1,000 houses. 175 MW capacity solar plant can therefor thus power up 1000 time 175 = 175.000 houses. Right! That's great!

Transpower's received over 100 applications for 2022.

"Transpower receiving a significant increase in the number of enquiries to connect new generation (with 107 generation enquiries, more than the combined total of the 6 years before that);[1]"

As a result of all the enquiries Transpower set up a dashboard. According to this dashboard over 35.000 potential new megawatts are in the pipeline for assessment. This is the sum of the capacities of all enquiries for generation, energy storage, load and network upgrades.

According to a report from Transpower in 2020 *"Achieving an accelerated electrification future will require 40 new grid connected generation projects by 2035, 30 connections to accommodate increased electricity demand, 10-15 new transmission interconnections and other network investments needed to enable energy to reach consumers."*

35.000 MW times 1000 households equals 35.000.000 households. Does this mean 35 million households? How many are there in NZ? If this is correct, why the hurry if we have till 2050 and we only just started? (Did anybody vote on this in this democracy, we did not consent).

Transpower itself acknowledges this in their 2023 report *"New grid connection enquiries and renewable energy continue to increase – The total potential capacity of generation in the pipeline has increased by 3 GW to 30 GW over the last six months. This suggests ample renewable production to meet our Accelerated Electrification scenario of 22 GW total installed capacity by 2050."*

Considering that solar cannot be stored as well as other types of electricity (coal, fuel, water) and considering we are an island and are unable to pipe our electricity to Europe, Australia or the Pacific, shouldn't we take the cautionary approach here and make sure we put the environment and communities in high regard, above financial gain for a few? Let's take our time and together find the best sites for all of us, not just for the few overseas investors. Again do we the people really want this or need this!!

For example, would it not be better to stagger the development of solar plants (if we think they are the best solution)?

By 2050, the year that New Zealand pledges to be carbon zero with regard to electricity, all these panels (which have a life of around 25-30 years max) will be coming to their end of the life cycle, and will either be recycled (still mainly wishful thinking as this is too expensive and difficult) or dumped somewhere. Where do we go with them? Imagine,

175-megawatt comprises 300.000 solar panels. (300.000/175 = ca 1700)

20.000 megawatt (20 GW) would then be more or less, 20.000 times 1700 panels, which are 34 million panels that will need to be recycled/dumped in New Zealand in 30 years from now. How

much carbon dioxide will that cost? Renewable energy or green washing by bureaucrats and technocrats? There is no proof of concept at all!!

Another point, 34 million panels were made from natural resources in the first place. Rare earths (as the name suggests, they are very rare) are dug up in countries such as China and Africa where slave and child labour is used to mine these materials. Does New Zealand want to take part in this? At what cost?

We (NZ, the world) have started to run, while we are not even walking! Let's do some real research first please!

According to Russel McVeagh in his publication Investing in utility scale solar in New Zealand: top 4 legal considerations (2022), "The political climate is (now) favourable for large scale solar projects – NZ's first Emissions Reduction Plan released in June 2022" did just that. The new green industry needs this political goodwill as they have no proof of concept for large scale solar projects. Solar as a '**renewable'** energy is poorly defined at the moment as there is no significant information yet on cradle-to-grave lifecycle assessment. An educated guess will clearly point out that compared to hydro and geothermal, the latter two will beat solar hands down for financial, environmental and social reasons. Refer to radio interview with Bryan Leyland. See also Stuff article with Transition Engineer Susan Krumdieck. This is clearly experimenting with the public and the environment. Validation for us is something different than validating is for investors. The trend in these development is the privatisation of profits and the socialisation of cost' and debts. In a true democracy this would not be an option and we certainly do not consent to this.

4. Resource Consent Requirements

4.2 Wairarapa Combined District Plan

The proposal is of such a grand scale that it completely changes the natural character and visual amenity. With shelterbelts and trees cut down in **an area the size of the 7 largest island of NZ**, the site will become even more of a monoculture in the middle of the golden triangle of the South Wairarapa. Imagine walking up One Tree Hill in Featherston, or Mount Dick in Carterton, and seeing this large island of 300.000 solar panels dominating the typical polka-dot Wairarapa Plains landscape.

Permitted baseline

The example of the 'fairly permissive baseline' is JR's pip fruit orchard at the far end of the dead end street called, Papawai Road. While the shelter structure is large, it finds itself in a completely different landscape with a river and hills behind it and far away from major traffic. This is ridiculous to use a comparative baseline for the proposed solar plant.

Traffic/Roading Issues

Moroa Road is a 5km long straight unsealed road. It was one of the first main roads built in the South Wairarapa and was a straight main road starting in Featherston to Morrison's Bush. Although it seems unimportant these days due to the gravel status, it is still very widely used by heavy trucks and cars as a shortcut between SH2 and Morrison's Bush/Martinborough.

Two days of dry weather ensure that cars and trucks bring up dust. This then travels according to the wind direction of the day onto neighbouring land and properties. The first 15 years, when we lived off-grid, we needed to clean our solar panels on a regular basis in order for them to be as efficient as possible. Our windows in the house have within a week of washing dust back on them. From our 25 year + personal experience living behind large shelterbelts, washing the panels only a few times a

year will not be enough to be an efficient solar plant. Dust will have a guaranteed effect on the solar panels and decrease efficiency if not washed regularly. Our questions:

Has FNSF researched, analysed effect of the dust created on Moroa Road onto the panels? On which research is the proposal based to wash the panels 2 times per year? Where will the water come from with which the panels are to be washed? What will be added to wash the panels and where will the dirty water go? Panels will need washing more in summer than in winter. Summer sees ground water levels drop quickly on the plains. Will possible resource consent be needed to pump up water for washing? The effect will be contaminated soil, water and aquifer in perpetuity. This will effect on neighbouring home wells and result in prosecution?

Wind

We choose our block of land in order to be able to harness the wind. However, the winds were so unpredictable that our windmill (as well as our greenhouse) broke several times in the early days before we had shelterbelts up. Boxing Day 2002 the windmill caused a fire due to falling hot parts onto the dry grass beneath. Today we have a large windbreak and small opening with a gate; on windy days it is almost impossible to open the gates.

We will be to the west of the proposed block, the Nor Wester is known to race over the plains. We will be directly in harm's way if anything goes wrong. Will the arrays be secure enough in the ground to not be blown onto our property? Have the arrays been tested in windy places?

Glare

Moroa Road has seen a number of car crashes over the years. Our daughter and our neighbour have both rolled their car in the past, but there have been more. Our wonderful neighbour is often straight on the scene helping people out and towing cars away with the tractor before officials are notified. The last crash was last November. This time, fire brigade, police and ambulance were involved. Back in February 2022, my daughter and I picked up a young man who rolled his car at the southern end of Moroa Road hitting the edge, he said. The high edges of the road make it easy to roll if you come in contact with them. We would like to know what the fire brigade and police's opinion is of the effects of possible glare on Moroa Road traffic users?

Fire hazard

On the day of the Blenheim Boxing Day fire in 2000, we also had a fire, started by falling parts of our windmill onto the dry grass. Summer 2000 was dry and very windy. Luckily we noticed it on time and when the fire brigade arrived at breakfast time, we had most under control.

Insurance Business Magazine reported in 2022 that "fire is a major hidden danger for solar farms". It seems that because the industry is still very young there is lack of data and often it is under reported. According to the same paper, "there have been numerous solar farm fires ranging from Argentina to the USA and in Europe".

Our soils are well known to be vulnerable to droughts in warm summers; the plains totally dry up. With trees and shrubs being taken down over a large part of the site according to the proposal, will this make it more vulnerable to large fires if an electrical fault occurs somewhere on the site? How realistic is a fire? Just last week, two fires were started by electrical faults with installed solar panels in the Netherlands; in the first case a piggery with 3000 pigs burned out (all animals died) and a few days later a greenhouse complex burned down, also due to electrical faults with panels. Our questions:

Does the NZ fire brigade have enough New Zealand experience and know-how with this type of emerging industry to analyse the potential fire risk of solar plants, especially on sites like these that are known to receive the hot nor westers winds in summer AND are also vulnerable to droughts?

Secondly, at the Dutch greenhouse site, tiny pieces of glass were found in a 1 km radius of the fire. People living near the piggery were advised to stay inside, due to possible risks of the deposition of small parts. According to the Dutch Institute for Physical Safety who has been researching sola panel safety, the main issue with fire hazards of solar panels seems to be to grazing animals and people who might end up eating little sharp shards dropped into their fields.

"In large-scale fires involving solar panels, combustion products and unburned residues from solar panels can be spread into the surrounding area, sometimes up to kilometres away. This leads to questions from farmers, local residents, emergency services and other parties involved about the possible risks of this deposition and about the tasks and responsibilities of the various parties involved."

The recent fires with solar panels has started a discussion in the Netherlands for the need of a proper protocol on how to deal with the small particles(including rare earth and/or other contaminants/pollution) in the event of a fire, and both industry and government realise the need for more 'Solar Panel Incident Experts'. The Dutch government has not yet put solar panels on the Dutch HAIL site but there are now new initiatives to train salvage experts. Training is being executed by the same people dealing with cleaning up asbestos. A Dutch mayor called solar panels "the new asbestos", not because they can cause cancer, but because the incidents will produce so many small parts that have dangerous aspects; small pieces of glass that can be hazardous to animals eating the grass on which they fell or to people who have to clean up the sites. The industry and the government have just jointly started a major and urgent research to deal with future incidents (in our view too late). Do solar panels need to be on the HAIL list? We believe it does?

Who will be responsible to the clean-up, in case a fire or tornado goes through the site? Who would do the clean-up? Is there enough expertise in NewZealand to clean up all the waste, including all the small sharp particles from our gardens? What about compensation?

Noise

Next to the noise from the gun club which we did not ask for, nor ever having been consulted upon, we are now being confronted with the noise and vibrations of the solar plant, which are going to be more than minor, at least during the time of construction. During the week drilling noise and in the weekend gun shots! Who is not going mad from that? During shooting days, we either have to start making big noise ourselves, move indoors, or leave the property. Our American visitor, the US Ambassador to New Zealand, got a big scare last January as he thought there was a shooting assault taking place against him. We had to reassure him several times, that it was 'just' the gun club! We already have been tested to the core… The drilling will be even closer, every day for months on time…..and when the construction is finished we will have thousands of panels turning with the sun and substations humming in the background. The rural character of our living environment is under attack.

National Policy Statement Renewable Energy Generation 2011

The utility scale solar industry is still in very much its infancy, in the world, but especially in New Zealand. Any international science paper on PV systems acknowledges that. The New Zealand National Policy Statement Renewable Energy Generation 2011 (on which the RMA relies) does not

mention large scale solar farms/parks etc. **once**. It only mentions PV systems as options for stand-alone private rooftop projects.

With all new technology we need to walk before we start running. New Zealand is on top of the world ranking with regards to renewable energy generation. Professor Susan Krumdieck, who is an expert on transition technology (see also doco "Living the Change") warns that solar and wind technology are NOT the answers for the future in New Zealand.

Electro Magnetic Radiation (EMF)

The impact of electromagnetic radiation is not touched upon or analysed by the proposer. Electromagnetic radiation is associated with some utility services and electromagnetic generation and transmission. We do know that bee and ant colonies are affected by EMF's. A 2018 study in Nature found that Extremely Low Frequency Electromagnetic Fields impair the Cognitive and Motor Abilities of Honey Bees. For the past 27 years we have kept ourselves as much as possible free from EMF's. No microwave in our house!

SWDC does mention it and notes in its report that "**It is anticipated** the solar farm **can** comply with these levels **given the technology of solar panels and setback of equipment from property boundaries.**"

First of all, the terminology used in this sentence by SWDC confirms that SWDC, nor the proposer, are 100% unable to say with certainty that EMF's will not have a negative effect at some time in the short term on insects and other creatures or long term on humans living in a constant electro-magnetic field.

Secondly, there is **no** setback at all from inverters and panels from our property boundary (except Pharazyns Road, over which we have use). We request a 200m setback from our boundary to minimise EMF's from the solar panels, inverters and other electronic equipment.

Property value

Neighbouring activities do affect property prices. The gun club has had a negative impact on the value of our property and so will this solar plant. A recent large-scale "six-state study area encompassed 53% of the total MW nameplate capacity of PV generators in the U.S., and the analysis included evidence from over 1,500 Large Scale PV Projects (LSPVP)s and over 1.8 million home transactions". They found "adverse property value impacts of LSPVP construction for homes very close to a LSPVP and those predominantly in rural agricultural settings around larger projects." They conclude by saying that this research points out "the importance of carefully considering siting strategies for rural, large, or agricultural installations" and that the research will further the "emerging literature on the economic impacts of LSPVPs and point to important avenues for future policy discussions and research".

Discussion/Conclusion

We were attracted to New Zealand in the late eighties, as we were experiencing first hand as agricultural aid workers in Central America, the many environmental, economic and social disadvantages of the "Green Revolution", also known as the Third Agricultural Revolution onto the Developing World. During the Green Revolution agricultural productivity skyrocketed due to new technologies being introduced. This was rolled out on a grand scale, in a quick effort to abolish hunger in the world.

In "Lessons From the Aftermaths of Green Revolution on Food System and Health", the authors explain that:

"Food production has seen various advancements globally in developing countries, such as India. One such advancement was the green revolution. Notably, the World Bank applauds the introduction of the green revolution as it reduced the rural poverty in India for a certain time. Despite the success of the green revolution, the World Bank reported that health outcomes have not been improved. During the post-green revolution period, several notable negative impacts arose. Exclusive studies were not conducted on the benefits and harms before the introduction of the green revolution. Some of such interventions deviate from the natural laws of balance and functioning and are unsustainable practices. To avoid the adverse effects of some of these developments, a review of these interventions is necessary".

Our experience overseas 35 years ago, made us into the deep green environmentalists and resulted in the creation of our own little heaven on earth, the Wairarapa Eco Farm and the upcoming Tauherenikau Food Forest Garden. Certified organic, off grid etc. Parts of our house can be composted back to nature! **Not** in the name of climate change, but in our effort to truly care for the earth (water, soil, air and all living creatures on/in it).

Now 30 years on, after researching the possible impacts of large scale solar plants, it has become clear to us, that we are on the verge of making the exact same mistakes again; in doing our best to quickly combat climate change, we are possibly creating new issues/problems for our future generations. Fear and hurry, are the bad advisors!

If this project goes ahead as it is proposed, there is the real possibility of cancerous growth around us for more farmers joining up to the scheme. We will then be completely surrounded and living, growing and working in an unhealthy electromagnetic field. **These are incompatible activities and we will have to move.**

Let us all take a deep breath, not be hurried by investors who have mainly financial returns on their agenda, or by doomsday fear, and first learn from mistakes made in the past.

Thank you,

Frank van Steensel, BSc Soil Science & Water Management, MSc Soil Science

Josje Neerincx, BSc Rural development, Dip Development Studies

And family

PS. This submission covers some important issues that affect us personally, but not all. Next to this submission, we endorse Elisabeth Creevey's submission.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

44

Submitter

Name	New Zealand Transport Agency/ Waka Kotahi
Contact Person (If different from above)	Joshua Kenneally
Postal Address	See attached submission
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farms Limited
Address of Proposal	415 Moroa Road, Greytown
Application No.	RM220103
Description of Proposal (use additional pages if required)	235 Hectare. 175-megawatt solar farm.

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☑ Supports part of the proposal
- ☐ Opposes the whole proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes
- ☐ No

☐ If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to (use additional pages if required):

See attached document.

Decision you want the Council to make:

☐ Grant the Consent ☐ Decline the Consent ☑ Grant the Consent with Conditions

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.

Name New Zealand Transport Agency/ Waka

Date 6/6/20

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

Waka Kotahi NZ Transport Agency
Level 7, Majestic Centre
PO Box 5084, Lambton Quay
Wellington 6145

Waka Kotahi NZ Transport Agency Reference: 2023-0643

6th June 2023

South Wairarapa District Council
C/- Duty Planner
19 Kitchener Street
Martinborough 5741

Via email: planningteam@swdc.govt.nz

Dear South Wairarapa District Council,

Submission on Resource Consent Application RM220103 for land use consent to establish and operate a 235 hectare, 175-megawatt peak solar farm – Greytown

Attached is the Waka Kotahi NZ Transport Agency submission on the publicly notified application for land use consent to establish and operate a 235-hectare solar, 175-megawatt solar farm comprising three blocks (415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston) south-west of Greytown.

We welcome the opportunity to discuss the contents of our submission with South Wairarapa District Council and/or the applicant as required.

If you have any questions, please contact me.

Yours sincerely

[redacted]

Joshua Kenneally
Planner – Poutiaki Taiao / Environmental Planning
System Design, Transport Services
[redacted]

WAKA KOTAHI
NZ TRANSPORT AGENCY

FORM 13, SECTION 9, RESOURCE MANAGEMENT ACT 1991

Submission on subdivision and land use to establish and operate a 235-hectare, 175-megawatt solar farm at 415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston – Far North Solar Farm Limited, RM220103.

To:
South Wairarapa District Council
C/- Duty Planner
19 Kitchener Street
Greytown, 5741

Via email: planningteam@swdc.govt.nz

From:
Waka Kotahi NZ Transport Agency
Level 7, Majestic Centre
PO Box 5084, Lambton Quay
Wellington 6145

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1. This is a submission on an application by Far North Solar Farms Limited for the construction and operation of a 235-hectare, 175-megawatt solar farm comprising of three block to the south-west of the Greytown settlement area. The proposal requires consent for a discretionary (unrestricted) activity in accordance with the Rule 21.6(a) of the Operative Combined Wairarapa District Plan.

2. Waka Kotahi NZ Transport Agency (Waka Kotahi) could not gain an advantage in trade competition through this submission.

3. Role of Waka Kotahi

3.1 Waka Kotahi is a Crown entity with its functions, powers and responsibilities set out in the Land Transport Management Act 2003 (LTMA) and the Government Roading Powers Act 1989. The primary objective of Waka Kotahi under Section 94 of the LTMA is to contribute to an effective, efficient, and safe land transport system in the public interest.

3.2 Waka Kotahi has a mandate under the Land Transport management Act 2003, the Government Roading Powers Act 1989, and the Government Policy Statement on Land Transport to carry out its functions in a way that delivers the transport outcomes set by Government.

3.3 An integrated approach to transport planning, funding and delivery is taken by Waka Kotahi. This includes investment in public transport, walking and cycling, local roads and the construction and safe operation of state highways.

3.4 Waka Kotahi is also a Requiring Authority under section 167 of the RMA. As such it is financially responsible for designation 076 (State Highway 2) within the Combined Wairarapa District Plan (CWDP).

4. State Highway 2 - Greytown to Featherston

4.1 State Highway 2 (SH2) between Greytown to Featherston is a strategically important road, serving as the primary thoroughfare route through the Wairarapa Region. The road in this location is categorised under the One Network Road Classification as a road of regional importance, and carries approximately 6,464

vehicles per day, of which 8% are heavy vehicles[1]. The Nguranga to Woodville section of SH2 is listed as a 'Regionally Strategic' road under Waka Kotahi's One Network Framework[2], providing a vital connection from Hawke's Bay to the north, and provides an alternative route north from Wellington.

4.2 SH2 Greytown to Featherston in this location is characterised by stretches of relatively straight road as it turns northbound from the SH2/ Moroa Road intersection, approaching the Greytown urban settlement. The speed limit on this section of SH2 is 100km/h with a single lane heading both northbound toward Greytown and southbound toward Featherston.

4.3 The SH2/ Moroa Road intersection following Tauherenikau River Bridge is located approximately 3km to the west of the proposed site and characterised by a relatively sharp bend with a number of rural residential and commercial activities adjoining and directly accessing the SH2 corridor in the vicinity of the intersection.

4.4 In order to serve its function as a regionally significant route, SH2 requires protection from inappropriate land use and development. Land use and development adjacent to or in the vicinity of the state highway needs to be carefully managed to ensure that it does not affect the function of the state highway including its ability to operate safely, serve the community, and support ongoing economic growth.

5. The following matters relevant to Waka Kotahi are raised in the resource consent application:

5.2 The proposal seeks to install up to 33 inverter stations and approximately 321,160 solar panels across three blocks of land. The panels will be mounted on tracking tables in a single axis fixed to an east-to-west mounting structure. When tilted down the height will be approximately 1.55m above ground level while at maximum title the panels will reach a height of 4.523m above ground level.

5.3 The application includes a landscape assessment and glint glare assessment which detail the use of screening vegetation implemented to mitigate visual, glint and glare effects. The following shelter belts are proposed around the periphery of the proposed site:

- Normal trees from nursery (0.6m) around 1-year 1m high; and
- Trees purchased one-year earlier and now 2-2.5m high; and
- Existing shelter belt 5-6m to be trimmed 4m

5.4 Once operational the solar farm will involve 2 full-time roles. General maintenance of the tracking tables, solar panels and inverter connections will require some intervention during the operational life of the plant. Annual cleaning of the panels (with water only) will also be carried out. The panels themselves are warranted for 30 years with an expected lifespan in excess of the consent duration.

5.5 Construction will consist of earthworks and the installation of solar arrays. Construction traffic is estimated to be 3 truck deliveries per day during the initial construction period, with construction plant and equipment unloaded and all turning and manoeuvring of vehicles to be undertaken within the proposed site. Once completed site maintenance is limited and will be carried out by staff arriving in small vans. Construction will take place over a 6–9-month period.

[1] NZ's national road classification system, recognising how busy the road is, it's connections and the availability of other routes - https://www.nzta.govt.nz/roads-and-rail/road-efficiency-group/projects/onrc

[2] The ONRC is a new framework that categorises roads throughout the country considers the needs of all road users, be they motorists, cyclists or pedestrians - https://www.nzta.govt.nz/planning-and-investment/planning/transport-excellence-partnership/

5.6 The applicant has provided a landscaping assessment, partially assessing the effects on the safety and functionality SH2 located 500m to the northeast concluding the following on the effects SH2: "*To the north of the main portion of the Site (between the Site and the State Highway), the 'grain' of the landscape has a northwest – southeast patterning, with the shelterbelts assuming this alignment. This precludes views to the Site until the receptor is at a point to the northwest (as represented by VP19). From this point east to #1822 State Highway 2, glimpse views are possible across the flat landscape over a minimum distance of between 500 – 700m. These views tend to be fragmented by shelterbelt vegetation and are not easily gained when travelling along the road at speed*" [3].

5.7 The existing accessways from Bidwillis Cutting Road (local road) and Moroa Road (local road) will be used to access the site. No new accessways form part of this application.

6. The submission of Waka Kotahi is:

6.1 Waka Kotahi **supports the application in part**. Waka Kotahi supports and recognises the benefits of renewable energy as it contributes to reducing greenhouse gas emissions and combating climate change.

6.2 Waka Kotahi has concern that the "glimpse views" 500-700m from SH2 referenced in the applicant's landscaping assessment are not appropriately mitigated. Specifically, the landscaping plan prepared by Aquila Capital indicates the Shelter Belt planting along the periphery of the north and north-eastern boundaries of the site proposed to consist of 0.6m tall Cryptomeria Japonica planting,

6.3 With the height of the planting currently proposed, the proposed solar farm may give rise to glint and glare effects which could result in dazzling effects that may affect road-users capacity to focus on the road environment. This would potential be dangerous to both northbound and southbound traffic utilising SH2.

6.4 Waka Kotahi has sought the expertise of a lighting assessor to comment on any potential adverse effects which may arise from the proposed solar farm, who noted in areas within 500-600m of SH2 "*appropriate planting should be implemented to eliminate any possibility of glint/glare*". In this case an extension of the 2m high planting along the north and north-eastern boundary of 'PLOT 3' would adequately mitigate any glint/glare effects resulting from this proposal.

6.5 Waka Kotahi additionally supports the inclusion of conditions ensuring the proposed screening vegetation is appropriately maintained and monitored supporting the planting to reach and retain the height and depth proposed within the application.

Waka Kotahi seeks the following decision from the consent authority:

7.1 Waka Kotahi seeks that the application of the resource consent to establish and operate a 235-hectare solar farm 5km to the southwest of the Greytown Settlement Area to only be granted in the event that conditions of consent are imposed ensuring that any glint/glare effects on the state highway network are appropriately mitigated.

7.2 Specifically Waka Kotahi are seeking an extension of 2m high screening vegetation of the north and north-eastern boundary of 'PLOT 3' identified on the applicant's landscaping plan, replacing the proposed 0.6m high shelter belts.

[3] Quote taken from page 13 of the Applicant's landscape assessment prepared by Simon Cocker, Landscape Architecture, dated 8th December 2022.

7.3 Additionally Waka Kotahi are seeking for Council to include appropriate conditions for the appropriate maintenance and monitoring of the proposed screening vegetation to ensure the planting reaches and maintains the height and maturity required to address the potential risk of glint and glare effects.

7. **Waka Kotahi does wish to be heard in support of this submission.**

8. **If others make a similar submission, Waka Kotahi will consider presenting a joint case with them at the hearing.**

9. **Waka Kotahi is willing to work with the applicant in advance of a hearing.**

Signature:

[redacted]

Principal Planner / Senior Planner – Poutiaki Taiao / Environmental Planning
System Design, Transport Services
Pursuant to an authority delegated by Waka Kotahi NZ Transport Agency

Date 6th June 2023

Address for service: Waka Kotahi NZ Transport Agency
Level 7, Majestic Centre
PO Box 5084, Lambton Quay
Wellington 6145

Contact Person: Josh Kenneally
Telephone Number: [redacted]
E-mail:
Alternate Email:

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

45

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96,

127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

Submitter

Name: Warren Woodgyer

Contact Person:

Warren Woodgyer

Postal Address: 20A Cotter Street Greytown, 5712

Home Phone: [redacted]

Email: [redacted]

Details of the Proposal to which this Submission Relates

Name of Applicant: Far North Solar Farm Limited

Address of Proposal:415 Moroa Road, Greytown; 312 Bidwills Cutting Road, Greytown; 1942 State Highway 2, Greytown; 18 Pharazyns Road, Featherston legally described as Pt LOT 6 DP 8803 (WN391/56) Pt LOT 7 DP 8803 (WN391/56) Pt LOT 10 DP 3106 (WN583/131, WN583/132) SECTION 27 MOROA SETT (WNE1/330) LOT 1 DP 52574 BLKS IV WAIRARAPA SD BLK (WN22A/575) PT SEC 122 MOROA DISTRICT (WN36B/542) LOT 1 DP 76478 (WN43B/286)

Application No. 220103

Description of Proposal:

321,160 photovoltaic solar panels on arrays mounted on tracking tables, with a maximum height of 4.5m above the ground

40 inverters, lines and associated structures

Buildings not required for primary industry or residential

purposes exceeding 25m2

Associated site works and new accessways

Screening planting.

Details of Submission

My submission *(use X to indicate your choice):*

☐ Supports the whole proposal

☐ Supports part of the proposal

[x] Opposes the whole proposal [ ] Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission? *(use X to indicate your choice)*

[x] Yes [ ] No

[ ] If others make a similar submission I will consider presenting a joint case with them at the hearing

Submission Statement

The specific parts of the Proposal that this submission relates to.

My submission regarding the Far North Solar Farm is contingent on their proposal proceeding. I believe that a green light could see an increase of solar farms being constructed around the existing substation. In that light I would ask the commissioner to consider placing restrictions on possible future applications of a similar proposal.

While I appreciate the efforts to transition towards renewable energy sources, I firmly believe that the construction of more than one solar farm in our area would have detrimental effects on our environment, social fabric, and overall quality of life. I also feel that multiple solar farms move away from Agri voltaic farming concept to one of an industrial power plant,

First and foremost, the environmental impact of a close grouping of solar farms should not be overlooked. While solar energy is undoubtedly a cleaner alternative to conventional power generation, it is essential to strike a balance between renewable energy production and preserving the natural ecosystem. Constructing numerous solar farms in close proximity can result in a loss of biodiversity,

Furthermore, the establishment of multiple solar farms lead to the loss of large tracts of valuable agricultural land. I feel the classification of the land proposed in the Far North Solar Farm proposal as Grade 4 is incorrect and misleading. In my opinion the land is either class 1 or 2. This is based on my 25 years' as Director of the Drainage Extension Service with the Department of Soil Science, Massey University. We must ensure that we strike a balance between energy generation and the preservation of agricultural resources to maintain food security and support our local economy.

In addition to environmental concerns, the social fabric of our community could be negatively impacted by the construction of more solar farms. These projects often entail significant construction activities, noise pollution, increased traffic, and visual disruption, causing considerable inconvenience to nearby residents. Moreover, the presence of many solar farms in a concentrated area may result in a proliferation of power infrastructure, transmission lines, and substations, which can detract from the aesthetics of our community. Preserving the natural beauty and tranquillity of our area is crucial for residents' well-being and maintaining our appeal to visitors.

Lastly, the cumulative effect of a large grouping of solar farms on our quality of life cannot be ignored. Excessive glare from the reflection of sunlight off solar panels, can have adverse impacts

on nearby residences, affecting the residents' visual comfort and potentially decreasing property values. We must prioritise the well-being and safety of our community members and ensure that any proposed developments are compatible with a high standard of living.

In light of the aforementioned concerns, I kindly request that you carefully consider the impact of establishing further solar farms in this area. While renewable energy is undoubtedly important for our future, we must also account for the preservation of our environment, the viability of local agriculture, the social well-being of our residents, and the overall quality of life in our community

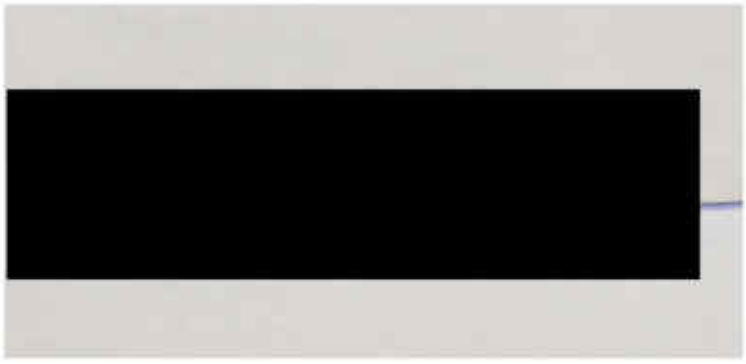
Decision you want the Council to make:

(use X to indicate your choice)

	Grant the Consent		Decline the Consent		Grant the Consent with Conditions
		x			

Signature

To be signed by the submitter or person authorised to sign on behalf of the submitter.



Name: Warren Woodgyer

Date: 4 June 2023

Important notes for the Submitter

1. In accordance with the Privacy Act 1993, submissions will be made available for viewing by Council and members of the public.
2. This form is for your convenience only. You may make a submission that addresses the points above in a letter or other suitable format.
3. Submissions will not be returned, so please keep a copy.
4. A copy of your submission must be sent to both Council and to the applicant.

SUBMISSION ON A NOTIFIED RESOURCE CONSENT APPLICATION

FORM 13 - Pursuant to Sections 95A, 95B, 95C, 96, 127(3), 137(5)(c) and 234(4) of the Resource Management Act 1991

46

Submitter

Name	Chris + Roz Geany
Contact Person (if different from above)	" "
Postal Address	247 Bidwills Cutting Road
Home Phone	[redacted]
Cell Phone	
Email	

Details of the Proposal to which this Submission Relates

Name of Applicant	Far North Solar Farm Ltd
Address of Proposal	415 Moroa Road Greytown
Application No.	RM 220103
Description of Proposal	235 Ha Solar Power Plant

Details of Submission

My submission:

- ☐ Supports the whole proposal
- ☑ Opposes the whole proposal
- ☐ Supports part of the proposal
- ☐ Opposes part of the proposal

In the event this application is subject to a Resource Consent Hearing. Do you wish to be heard in respect of your submission?

- ☑ Yes ☐ No
- ☑ If others make a similar submission I will consider presenting a joint case with them at the hearing

SUBMISSION ON PUBLICLY NOTIFIED APPLICATION

FOR RESOURCE CONSENT BY FAR NORTH

TO

South Wairarapa District Council

SUBMITTER

Chris and Roz Geany, 247 Bidwills Cutting Road, Greytown

[redacted]

I am not a trade competitor for the purposes of section 308B of the Resource Management Act 1991

Date 30/05/2023

PROPOSAL TO WHICH THIS SUBMISSION RELATES

Name of applicant; Far North Solar Farm Ltd

Address of proposal; 415 Moroa Road, Greytown

Application number; RM220103

Description of Proposal; 235Ha Solar Power Plant

Details of submission; This submission opposes the whole proposal

In the event of this application is subject to Resource Consent Hearing I would like to be heard in respect of my submission.

Decision I want the Council to make; decline the entire consent application.

Submission Statement;

1) Extraordinary change to an entire district and community
2) Discrepancies in application
3) Issues not considered in application
4) The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

The details of my submission statement are detailed below;

1. **Extraordinary Change to an entire District.**

The vast acreage required for this industrial proposal is a result of solar power generation being the least efficient of all renewable power options. The siting of which amongst residences and adjacent to Greytown, negatively alters not only the visual effects (openness and expansivity), but the identity of what Greytown and its environs is and its attractiveness as a destination for both visitors and residents. The site is historic land, being part of the first planned inland farming town of New Zealand purchased by the Small Farms Association. The loss of appeal and history will negatively affect land values and visitor numbers, and will harm tourist reliant businesses of Greytown and its environs. It negatively impacts how nearby residents experience their own properties and beyond their boundaries. How the council manages this proposal will pave the way for more proposals of the same nature, that the council knows are waiting in the wings. This is an industrial site that will intensively cover the land by rows of infrastructure that are essentially buildings with tilting rooves, the height of a house. It is not suitable at the currently proposed site. Planting the borders is just hiding an industrial power plant, but because you can't see it, doesn't mean it isn't there. I urge SWDC to decline this application.

The proposal should be classified as an Industrial Network Utility as defined in the District Plan.

Industry – means premises used for manufacturing, fabricating or processing, substances or material into new products. (Sun into electricity)

Network Utility – means any utility which is part of a network and includes electrical lines ... and associated support structures. (The proposed facility would connect, thus becoming, a part of the NZ electrical network grid)

It is obvious this activity does not meet Councils for the rural zone.

2.2.1 The natural Environment - Protecting and enhancing the natural environment is an important issue locally, nationally and internationally. Through the plan, the councils seek to achieve enduring protection of natural values by minimizing further loss or degradation of the natural environment, while allowing sustainable change to occur.

2.2.3 Natural Features. Natural features are those features that are a result of natural processes, and comprise of landscapes, landforms and habitats. At a broad level the characteristic natural features include mountain ranges, undulating hill country, broad plains... These features are valued by the local community, as they provide a sense of identity and naturalness. The importance placed on these features requires that activities that might affect their values need management, to ensure they are protected for both current and future generations.

2. **The Far North Application has some discrepancies;**

(Numbered in accordance with application)

-**(3) Description of proposed work**-The first paragraph states "the solar array and associated structures; medium voltage substations and 33 inverters". What number of substations are there? Also, under Site Preparation there is mention of foundation blocks for substations, but no dimensions. What size? **Council should seek clarification.**

– the proposal states the height of solar arrays when lying horizontal will be 1.55m above ground, but the adjacent drawings say 2205mm, and in the plan final diagrams 2466mm high. Which is it? **Council should seek clarification.**

-the proposal states spacing between rows to be 6m apart, later in the Stormwater section 6.4m apart, then in Effects on Prime Soils 7-8m apart. Which is it? **Council should seek clarification.**

-The application states total height for the foundation piles to be 600mm deep but figure 3, the foundation pile diagram shows 1300. Also, around the post the diagram is indicating what looks to be concrete that extends to just above ground around the post. As is un labelled, is this concrete and will all posts be concreted? The Infrastructure Establishment and Construction section states the posts will be pile driven. Depth and ground securing will surely be essential for support structures in water sodden ground, with high wind loads, with substantial solar 'sails' attached. **Council should seek clarification.**

-Vehicular Access and Crossings – 5m setback from water races. Is this 5m from pile or outer reaches of solar arrays? **Council should seek clarification.**

-**(3.7) Operational Activities** - will there be insecticide spraying to keep panels clear of spider webs? Also, which will it be, sheep grazing or cropping? If this application is applying for a change of land use, then surely grazing and cropping are the very activities it no longer wants to use the land for. And in the event of neither happening (and advice from farmers neither is realistic) will there be herbicide spraying? What volume of water will be required to wash panels, will a bore be required, and should Far North also be seeking a water right consent? Far North will find this unsealed road has more dusty traffic than they forecast and washing occurs more frequently. Where will any damaged panels be disposed, which toxic dump site? Here it also states panels have "an expected lifespan in excess of the consent duration" but application is requesting an unlimited consent duration. My research shows panels will be lucky to reach 30 years during which time they become decreasingly effective. How long would this consent last? **Please clarify all of these points.**

- Operational Activities – End of life needs clarification. (Again, here a reference to end of consented period though this application requests unlimited consent duration). Recycling ability and facilities are rare worldwide even in countries that have had solar power plants for some time. There are none within country and no plans to build one. Worldwide evidence shows recycling to be expensive, highly toxic, and impractical for the sheer volume of panels. Alternatively, these panels would be required to be placed in toxic waste dump, of which there are not enough to cope. If all materials removed on decommissioning, are there guarantees all concrete and inground cables are included? And soil repair costs included? Are funds held in country to guarantee decommission plans possible even in the event of company collapse? Experience from USA shows decommissioned Solar power plants often incompletely cleared, money for decommission not sufficient and soil left severely depleted and possibly toxic. **Council should seek clarification and guarantees on all these issues.**

-(3.8) Consideration of Alternatives - Far North may feel this site is the best practicable option, but it is also the best practicable site for farming, residences and tourism as well. The flat terrain needs no grading and close access to power grid make it cheaper for the company at the expense of the community and residences. **It is possible to site power plants away from communities, use undulating land and hillsides, and use marginal land.**

-(4) Resource Consent Requirements – Here the application rightly states this land is zoned rural primary production. A large-scale solar power plant is not primary production, nor conducive to it. The District Plan predating the reality of large industrial solar power plants puts Council at a disadvantage and so does the shocking fact that the NZ Government is allowing a new industry to develop totally unregulated. I do have sympathy for the council and hope the Council will do its utmost to safe guard South Wairarapa and people in these unchartered waters. **Not compatible to rural zone.**

Rural polices 4.3.3 explanation – Threats to the environmental quality and character of the Rural Zone include buildings and structures that due to their location, scale, or density, are not in keeping with the established rural amenity and character. This Character is where buildings are at a relatively low non-urban density with generous setbacks from external property boundaries and where the height, scale, density and number of buildings do not dominate the landscape. Activities can have external effects out of character and unacceptable within the rural environment, inappropriate levels of vehicle movements and parking, excessive out-of-character noise, and obtrusive or excessive signage. (My underlining)

-(4.2) Here in table 2 the applicant states buildings will exceed allowed gross floor area. These solar arrays are essentially buildings, and with each array being nearly 5 meters wide and 59612mm long, coupled with footprints of inverters, substations, switchyard, and possibly water tanks (depending on size). The applicant should state the overall % footprint on the land. It will be far in excess of anything permitted in a rural zone. 21.1.24 a) (iii) (1) The gross floor area of a network utility i.e., solar panel array (they are buildings) cannot exceed 10 square meters in area. On this basis alone the effects of the proposal are **huge and not minor.**

The applicant is also requesting the planned non-compliance of unsealed road setbacks. There is no reason nor explanation as to why this plan cannot adhere to the rules. **This application should address this.**

-(4.3)- Stormwater runoff – here the applicant claims this site would not be a Hazardous Activities and Industries List site, industrial or trade site. This is blatantly not true. The substations alone make this a HAIL site. This proposal is obviously an industrial site. (I further discuss this under 6.3.1, 6.6.2, 5.6.2) **Protect ground water.**

Construction and operation of an electrical generating facility. Here the applicant is claiming rule 21.1.24 does not apply to them. The rule clearly states *the construction, maintenance and upgrading of network utilities and energy generating facilities,* and to claim exception for being a new energy generating facility, is frankly questionable. **This proposal should have to meet all requirements of rule 21.1.24 and the application should reflect that**. For example, the removal of all tall trees in the area, because of shading, creates large open space, which increases possibility of lightning strike. Reports range from 26 – 32% of damages to solar power plants occurs from lightning. Will there be lightning rods erected and what height?

21.1.25 (b) access (i) all sites and activities shall have safe and practicable vehicle access from a public road. Surely this application should also be applying to create large hard shoulders around all entrances, particularly on Moroa Road which is narrow and unsealed? These are huge trucks that are delivering large loads over a substantial period

-(5.2) Effects on the Environment. Positive Effects – The application states there will be economic and social benefits by supporting the functioning of communities and businesses across the Wellington Region. This is a large stretch to claim. The electricity goes into the National Grid (not local), Wairarapa already has electricity for communities and businesses, money generated from the power plant will leave the country, as though registered in NZ, it is an international company (not local), there is significant reliance on tourism dollar locally and this proposal will negatively impact that, especially if the consent to this proposal creates a snowball effect of similar proposals (as experienced in the USA) There are no social benefits. Those working on the land currently will not be able to continue, replaced by two jobs. **Not a positive exchange by any calculation.**

-(5.4) Natural Character Effects –Here the application refers to the landscape as 'ordinary' (according to a non-New Zealand scale). So ordinary, that until recently, SWDC used this landscape in its logo. It is a part of our identity. The landscape description in the General Setting section quoted the Wairarapa Character Study as saying **"the Central Plains landscape has a feeling of openness and expansivity"** and this is what brings people to settle, stay and visit the area. Here the application feels a wall of Japanese Conifers will disguise a 235Ha industrial power plant, and somehow be consistent with the landscape. (Not even a suggestion of native plantings). The application is unclear as to what height the hedges will be kept. References range from 3m to exceeding the height of the arrays (which would need to be at least 4.8m). Trees can die, and there is no assurance this screen can or will keep its screening abilities for the duration of the existence of this power plant. Screening destroys the access to view the broad plain, hillside to mountain features the Plan should protect. **Council should seek clarification. This is not a suitable site. The loss of openness and expansivity is not 'limited', it is total for 235Ha of countryside.**

-(5.5) Construction Noise - Here the application likens construction noise to harvesting or cultivating. Harvesting and cultivating are short term seasonal events and a pleasure to watch. Construction will be daily and consistent, not conducive to any business in the area and dusty and disturbing for residents. If posts are pile driven there is concern that vibrations caused would be of disturbance to surrounding residences and disturb iron particles within the aquafer, raising levels in drinking water. **Negative effects.**

-(5.6.1) Operational Noise – operational fan noise may not be considered loud in decibels, but consistent low level noise annoyance will be a serious issue for residents and tourists staying nearby. For example; currently the house near the corner of Moroa and Battersea Roads can hear the existing substation from their front yard (approx. 100m). To add low level noise behind them as well creates confronting living conditions. There are many studies into the damaging effects of living with consistent low-level noise. I believe it is used as a form of torture. Added to the inverter noise will be the sound of the rotating machinery as it tracks the sun, the noise of the infrastructure heating and cooling, possibly whistling of wind turbulence through infrastructure, and the noise hectares of glass will reflect during rain or hail. **Negative effects. This is not a suitable site as it is too close to residences.**

District plan, Network Utilities 22.1.20 Wind Energy Facilities (v) The actual or potential noise effects of the construction, development and operation of the wind energy facilities, including particular

consideration of the special audible characteristics and the proximity and effect on settlements. (My underlining).

This proposal is a Renewable Solar Energy facility, and it is reasonable to expect that, as the District Plan pre dates the possibility of large scale solar, council adhere to its own guide lines concerning Renewable Wind Energy facilities. This would adhere to the intent of the Plan. Solar Power Plants have their own particular insidious noise that is spread over a larger acreage, and in this location, closer proximity to settlements, and will have a negative effect on people and animals.

Noise (iii) Acoustics – the assessment and measurement of sound from Wind Turbine Generators A) the assessment of the activity shall not be made in isolation, The assessment shall be made with all other uses and activities in the area in normal operation and the cumulative effect taken into account. Added to this the power plant will be surrounded by C) *noise sensitive activities; habitation, residential, visitor accommodation.*

-(5.6.2) Glare Effects – The specific type of anti-reflective coating on the solar panels to be used on site should be sought by Council. The substances used slowly erode and filter into the ground water. Locals draw drinking water from the high-water table, so extreme caution needs to be taken. *(RMA part 2 – sustainable management)* The panels seen from above can appear dark, but generally when sited in a desert, and at certain angles. The new solar power plant in Taranaki clearly shows solar arrays as brighter than the surrounding NZ landscape on the google earth satellite picture. Glare can be a problem for aircraft, especially as this site runs adjacent to a private airstrip. It can also be a problem for Hot Air Ballons, which generally land in the vicinity in large numbers during the annual festival. But further to the glare issue, the very infrastructure of a solar power plant removes any safety margin for the existing airstrip during takeoff and landing, (and down drafting of Balloons), making possible survival of an incident very slim. The Balloon Festival may have to cut short prior to Greytown, robbing this district and its visitors the enjoyment of this event. **This is not a suitable site for a power plant.**

-(5.8) Effects on Prime Soils – Here Far North claim this site will not only be Solar 'farmed', in addition, sheep grazing or cropping will occur. Though in 3.7 admit sheep grazing would only be to maintain the grass). Farming will not be occurring on this proposed industrial site.

The application states "no adverse effect on the productivity potential of the soils". Experience in the USA has shown that solar power production leaves land compacted from installation, seriously degraded from years of lack of light, and extreme heat reflected from panels. Leaving soils expensive and possibly years to rejuvenate. Productivity potential will be adversely affected. **Sustainable management should protect soils for future generation, which this proposal will not do.**

Sciencedirect.com ecological restoration of solar park plant communities and the effect of solar panels

Craven.ces.ncsu.edu/2021/10/can-solar-energy-production-be-converted-to-farmland

-(5.9) Summary of Effects – The proposed Solar Farm will provide adverse effects not positive ones. There will be no stabilizing of electricity prices as the main driver for Far North is as an investment venture, owners will demand maximizing profits. There is a vested interest to keep prices rising. **There are adverse effects and risks which are not less than minor.**

-(6.2)- Part 2 of the RMA – *The purpose and principles of the Act promotes sustainable management of natural and physical resources, ... for their social, economic and cultural wellbeing, and for their health and safety while, b) safe-guarding the life supporting capacity of, air, water, soil and ecosystems.*

Social - there is no social wellbeing here. Economic – This can only negatively affect a tourist-based township's economics. Cultural – the desecrating of historic land of the earliest settlers of inland farming Small Farms Association. Ecosystems; This proposal removes bird habitation with the loss of mature trees and covering the soil. Air; the air itself will be transmitting endless low frequency noise, electromagnetic radiation and less trees and grass that convert CO2 to fresh oxygen. Soil; the soil is at risk of contamination and degradation. Water; the serious risk of contamination to drinking water for surrounding residences and others further downstream. Add increased wind and heat, this proposal will change local climate. **This proposal is not consistent with part 2 of the RMA.**

-(6.4.2) - Table 5. Objective 2.1 - This power plant will adversely impact the productive potential of the soils on the site. It will not protect those soils for future generations. The removal of light, the effects of heat, impaction from building and removal, and lack of care of the soils for 30 years plus, will damage the soil. **Negative Effect**

Objective 2.2 - The applicant's comment are incorrect. The soils will be damaged, a power plant is not easy to remove, adverse effects will not be less than minor. Save this resource, **save this land for farming into the future.**

Policy 2.2(8) -*Highly productive land is protected from inappropriate use and development.* The productive potential of this land will decline. More every year a power plant is sited upon it. Cropping and sheep grazing are not realistic propositions. Firstly, this site's soil does not lend itself to cropping and cropping activities could easily damage or shade panels. Sheep would create damage to infrastructure and jam turning mechanisms by leaning on or standing underneath the panels. The grass will not grow enough to sustain sheep in any economical quantity. **This is not appropriate use of the site.**

-(6.3.1) - National Environmental Standards Here the application states 'there are no HAIL activities associated with this site' which at present is true. My point is that building a solar power plant is creating just that. In the Ministry for the environment publication, *Hazardous Activities and Industries Guidance, category B is electrical and electronic works, power generation and transmission. An electrical power plant would apply to; 2. Electrical transformers, 4. power stations, substations or switchyards.* In addition, if batteries are added after consent, *1. batteries.* This would be an industrial site that would be included on the local government land-use register. It is not suitable to be established on rural zoned land neighboring residences. **Council should suggest Far North find more suitable land – marginal, away from residences and towns.**

-(6.3.2) - Resource Management (National Environmental Standard for Freshwater) - Water. The application repeatedly states there are no other water bodies present other than stock water races. This is not true. The whole site sits directly on top of a fresh water aquifer that is shared by all neighbors in the vicinity and miles downstream. *(RMA; re part 2 sustainable management; and definition - water body - fresh water or geothermal water in a river....or aquifer, or any part thereof)* With an extremely high-water table in this area, placing a HAIL qualifying facility directly on top of (and during flooding, in) drinking water, risks contamination from; eroding minerals off coatings, broken fragments of toxic

panel, leakages from use of substations, more should there be a fire in the infrastructure, and of course if batteries are subsequently added and damaged. This will create a public health risk. **Protect this valuable resource, water, for future generations.**

-6.6 National policy statements. The Government's 2050 vision for energy and industry is not supported by this application. By 2050 the electrical generating efficiency of these panels will have declined to the point of end-of-life. This application repeatedly suggests at that stage the proposed power plant could possibly be decommissioned and return to primary production. Thus, not only does it not support the 2050 vision but then creates instability of supply.

-(6.5) - Table 6. Objective (3), Policy (6), Policy (9), Comment, this proposal does not have less than minor adverse effects on the environment. Soil, water, air is at risk. The land would no longer be rural, but industrial in look and use. A row of Japanese Cedars does not mitigate the visual impacts, let alone, soil, noise, water issues. There are serious potential adverse effects on human health and well-being. **This is not a suitable site.**

-(6.6) - Table 7. Objective 4.3.1, comment. An industrial power plant is not consistent with other rural activities (as I have previously discussed) – and to liken an industrial power plant to glasshouses is astounding. Glasshouses are for primary production, a thoroughly suitable activity for a rural zone. Overall, the amenity values of the rural zone, including natural character, will not be maintained. This is obvious by the fact that there will be no countryside for 235 hectares. That land will be intensively covered by infrastructure, ringed by security fencing, filled with industrial generation, not primary production.

-(7.3) Fire and Emergency – Here it states water supplies available on site for firefighting. If there is a tank, what volume? Or again will be a bore be available? This needs clarification. Water will only be of use in a grass fire (which will be of enhanced possibility given the heat radiated from panels and arcing can occur anywhere along the infrastructure). What provision and training will be given to local volunteer fire fighters who will be required to enter an actively generating industrial power plant. During daylight these panels continue to generate electricity, fire or not, and being fully automated, nobody on site to turn them off. Also, possibly to deal with inverter or substation fire. Water will not extinguish a lithium battery fire (should these be included); they are left to burn themselves out. Water won't help in these instances, and is the volunteer fire brigade equipped to fight such a chemical fire within an actively generating power plant? Coupled with possibly only 6 meters between rows (as stated in 3. description of proposed work), and when the panels are at lowest angle, they would cover almost 5 meters of that space, it is dangerous to ask firefighters to squeeze along a 1m gap of panels actively generating power to fight a fire. **Dangerous effect**

3. Other issues not addressed

-Batteries – There is no mention of Batteries in the application. Given that two other applications for Industrial sized Solar power plants are lodged at Masterton Council and additional companies are proposing others in the Wairarapa, electrical loads could soon be a problem. What safe guard do local residences and Greytown have that once established, this site will not then include the addition of industrial sized batteries? Batteries pose an additional fire risk, which would then cause serious soil and

drinking water contamination issues, and will turn a daytime problem of low-level buzz noise into a 24/7 one. (Alongside the environmental and humanitarian issues of battery production and disposal). Will Council even have the authority to consent or deny such an addition. Or will, once established as an Energy Utility Entity, allow Far North the ability to add batteries as part of maintenance and upgrade of their facility without Council consent? Can locals be assured that, there are no plans by other Utility providers or companies to establish batteries within this site, and that is why the subject has not been addressed in this application? **Please clarify**

Network utilitiesE1 policies, method 16.3.7(a). (c) ensure the operation, establishment, maintenance or upgrading of network utilities does not compromise community health and safety.

-Heat Island Effect – Unlike outdated computer-generated studies, on ground study has shown this is a very real occurrence over solar power plants. Only 20% of light hitting panels is converted to electricity, 80% is reflected as heat. These panels will be 20 degrees hotter than the ambient temperature during daylight and heat the soil and surrounds enough to make the local area 3-4 degrees hotter during the evening. Not only will this have negative effect on the soil on this site, but on land nearby. It will make life very uncomfortable for residents and animals in the vicinity. **This site is unsuitable.**

Barron-Gafford G.A. et al The Photovoltaic Heat Island Effect; larger Solar Power Plants increase local temperatures (found on the national library of medicine website)

-Wind – Not only will the removal of wind breaks increase wind levels for the area, but there are real concerns for possible wind tunnels and turbulence, shown in the study by

Irtaza and Agarwal – CFD simulation of turbulent wind effect on an array of ground-mounted solar PV panels; It advises *"extensive damages of PV panels, arrays and mounting modules have been reported the world over due to high winds"* and *"PV panels are subject to significant lift and drag forces under wind loading, which needs to be quantified with sufficient factor of safety to avoid damages".* Coupled with this site being prone to water logging and possibly only pile driven posts 600mm deep, there could be serious issues. Not only that, the concern for wind effects on neighboring roads and properties. Council should require Far North to provide a study of wind loadings specific to this site, panels, planned layout and the range and strength of Wairarapa winds. **Negative effect**

-Biodiversity – Mature trees will be felled and these are what Moreporks require for nesting. Moreporks reside in the area, as do Pukekos and there are many other native birds. But the Wairarapa has a poor number generally and Council should preserve and enhance any habitat it can. All birds will avoid the glare angles, covered soil, and the heat island, causing numbers in the area to decrease. **Negative effect**

-Fire – With the increased heat and dryness of the site and surrounds, there will be a heightened grass fire risk. Power plants are at high risk of fire because of possible arcing that can occur throughout the infrastructure. Will this risk of fire in a power plant result in a permanent fire ban on neighboring farms and properties? That would prevent them from burning fallen branches, impacting on the maintenance of their properties and costing them in ever escalating dump fees. The heat island effect will also dry land outside the proposed site, also increasing fire risk on other properties. **Negative effect**

-Electromagnetic Radiation – There is no doubt that there is electromagnetic radiation produced from solar power plants. Residents that are either worried by it or sensitive to it should not be subjected to now live with it, especially as it is often a driving factor for seeking to live in open countryside in the first

place, to breathe deeply, clean, uncluttered oxygenated air. A discrete screen of conifers will not change that. Preserve the purity of the air. **Negative effect.**

-Land Values - Houses located in industrial use areas and under high voltage power lines have less value and appeal to buyers, similarly, properties anywhere near the solar power plant will be less desirable because a vast industrial power plant is on their back doorstep, alongside the fear of possible electromagnetic radiation effects, noise, higher winds, heat, greater fire risk, little bird life... The Council has a duty to protect the large collective capital investment local property owners and their businesses have sunk into Wairarapa land and community. This would give confidence to potential settlers when choosing South Wairarapa to live and purchase land in. **Protect the value of Wairarapa Land and confidence in its Council.**

-Protection of Farmland – The enormous increase in the lease value of the land by companies like Far North, makes the land unaffordable for local farmers to compete in the lease of that land, decreasing the amount of farmland available for primary production (which is what a rural zone is supposed to protect). Evidence in the USA shows the attractive lease deals make farming the land less desirable to other land owners, creating a snow ball effect of farmers seeking to get on the gravy train of solar power. These farmers risk losing control of their land, as I believe they will not be able to simply opt out of electricity generation at the end of the lease period once they become a part of the National power supply. If they did it would **cause an instability of supply.** Which is the exact opposite of what Far North are claiming they are creating. **Rural zone is for primary production, protect it.**

-Internet and Cell phone coverage – Living rurally can come with weak and disrupted internet and cell phone coverage and it would not take much to weaken and disrupt it further. Residents will have already paid for sometimes expensive solutions for their individual site. These connections are of vital importance to run one's life, business, community connectiveness and access to emergency services. This Solar Power Plant is an extensive tall array of metal and glass, both of which are known to disrupt or block internet and cell phone coverage. If this proposed power plant further disrupts this connectivity, it should not cost residents to find a solution. It has real possibility to leave them isolated, unable to run their business, and unable to call emergency services. Copper land lines are no longer an option. How is Council going to safe guard these rate payers? **This site is not suitable.**

-Sustainability – I noticed in the new draft district plan, that Council is wanting to steer toward renewable and sustainable energy sources. The prime source of the electricity (the sun) is indeed free and renewable, but everything else not only decreases in efficiency, it has a maximum lifespan of 30 years, when all panels at least must be replaced. Before Council grants consent to large overseas interests, large tracts of land that will be permanent industrial sites (Far North are asking for an unlimited consent duration), Far North should be required to show if this Power Plant can be considered sustainable and if so, explain how it is. The entire infrastructure is solely reliant on the petrochemical industry, from the mining, to the creating of materials, the multiple shipping of components... That's not even including the humanitarian costs of mining some of the ores, especially if batteries will in future be included. If the Council wants to be supporting less carbon emissions, this solar infrastructure has already emitted vast quantities out of sight prior to arrival and has a short use-by date (Not even a need to plant conifers to hide that). And to rub salt into the wound, mature CO2 converters (trees) will be cut down to facilitate it. **Not sustainable.**

-Natural Disaster – We live on an island that is subject to earthquakes (1855 quake centered in Wairarapa) and tropical storms (Gabriel was expected to land further south into Wairarapa), high winds, floods, tornado (Wairarapa 2004). The very nature of the infrastructure required for solar power, hectares of very large glass panels secured on a single axis, in the event of a natural disaster, would result in shattered (possibly flying) glass and contamination of soil and water. **Unsuitable site for power plant.** The operative district plan explains how network utilities need to be carefully located;

Network Utilities 16.3.3

... Maintaining the valued environment characteristics of the Wairarapa is a fundamental premise of the Plan. Network Utilities can significantly affect the landscape and local amenity values and therefore should be located and managed in a manner that avoids, remedies or mitigates their impact on the character of the Wairarapa, its outstanding landscapes and important natural or heritage values. Such controls need to reflect the relative characteristics and amenity values of the different environmental zones in the development standards.

AVOID the impact please, this is not a suitable site.

Mental Health and Wellbeing – I feel this needs to be addressed. This proposal (and others that we know are coming) has already been creating stress and insecurity, particularly for those living within the current impact radius of southern Greytown. It already has daily impact on decisions residents in the area are making in regard to their life and their properties. Some already making plans to move out of the Wairarapa. The District Plan talks of things such as values and community - they are nothing without people. This is a mental health and wellbeing issue and I urge Council to not only protect the natural resources of this land, but protect its people.

4. The proposal fails to meet the objectives and policies of the District Plan and the provisions of the Resource Management Act.

For the reasons given above this application must be declined as it clearly does not meet the objectives and policies of the District Plan and the provisions of the Resource Management Act. As I have demonstrated in this submission this proposal will generate major effects both on and off site. There are serious deficiencies in the information supplied with the application and a number of effects have not been addressed. The proposal fails to meet the objectives, policies and rules of the district plan and the provisions of the Resource Management Act for notified applications as it lacks information and fails to meet the principles and purposes of the RMA and the tests for notified activities. The proposal fails to comply with the District Plan objectives, policies and rules relating to the rural zone, public utilities and notified applications.

The people of South Wairarapa need the Council to consider all the above, protect the soil, water, people's incomes, heritage, quality of living, drinking water, enjoyment of their surrounds, investments in property, trees, wildlife... This site is not suitable. Land can be sought elsewhere, away from people, drinking water, using marginal land. Treat our natural resources, people and their lives gently and with care.

Yours respectfully,

[redacted]

Chris and Roz Geany

Date 30/05/2023