BEFORE THE INDEPENDENT HEARING PANEL

ATSELWYN DISTRICT COUNCIL

Under	the Resource Management Act 1991
In the matter of	an application by KeaX Limited to construct and operate a 111ha solar array at 115 & 187 Buckleys Road, Leeston (RC235464).

BRIEF OF EVIDENCE OF HADEE THOMPSON-MORRISON

23 February 2024

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QUALIFICATIONS AND EXPERIENCE

1 My name is Hadee Thompson-Morrison. I hold a Masters degree in Environmental Management from Massey University and a PhD in Environmental Science from the University of Canterbury. I have been a member of the New Zealand Society of Soil Science since 2016. My current role is as a Land Scientist – Environmental Contaminants at Manaaki Whenua – Landcare Research and I have been employed in this role since May 2023. Prior to this I worked as a Land Resource Scientist at Environment Canterbury Regional Council for one year. My past and current research concerns soil quality with a particular focus on environmental contaminants, namely, heavy metals.

EXPERT WITNESS PRACTICE NOTE

2 While this is a Council hearing, I confirm that I have prepared this evidence in accordance with the Code of Conduct for Expert Witnesses Code of Conduct for Expert Witnesses contained in Part 7 of the Environment Court Practice Note 2023. The issues addressed in this statement of evidence are within my area of expertise except where I state that I am relying on the evidence or advice of another person. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence. I have not omitted to consider material facts known to me that might alter or detract from the opinions I have expressed.

SUMMARY STATEMENT

3 On 22 February 2024 I assessed the soil order and structural state of soils in the vicinity of solar panels at 56 Buckleys Road, Canterbury. I also assessed soils in surrounding dairy pasture as a measure of comparison. The findings of this assessment were inconclusive, as comparison was confounded by the fact that the soils in the vicinity of solar panels were non-irrigated and very dry while the soils under surrounding pasture were irrigated. The structure of the topsoils in the vicinity of the solar panels differed to the structure of the pasture topsoils. In some areas, the topsoils between the solar panel rows were cracked while in the irrigated pasture the topsoils were less hard and did not show obvious cracking. However, it currently cannot be concluded whether these differences were due to the presence of solar panels or other factors, notably irrigation.

PURPOSE AND SCOPE OF EVIDENCE

Objective

4 The objective of my assessment was to undertake a visual assessment of the soil profile to assess any potential effects of solar panels and classify soil type at 56 Buckleys Road, Leeston, Canterbury.

Assessment undertaken

5 On 22 February 2024 observations were taken from eight pits dug to ~70 deep and three small holes dug to ~20 cm deep in the vicinity of the panels. These included pits dug up to ~4.7 m outside the edge of the panels, underneath the dripline of the panels, and between the rows of panels. The smaller holes were dug underneath the dripline, underneath the panels and between the rows of panels.

6 A soil order assessment was undertaken on three pits, one in the vicinity of the existing solar panels, one in a pasture paddock adjacent to the existing solar panels, and one in the pasture adjacent to the proposed solar panel site.

7 A visual assessment of the state of the soil under solar panels was done using the other pits and smaller holes. In each of these other pits, the soil was visually assessed for similarities to the pit in the vicinity of the existing solar panels from which the soil order assessment was done.

8 This statement provides a summary of findings, with more detail available in the attached report.

Soils in the vicinity of solar panels

9 The soil in the vicinity of the solar panels was very dry as was all overlying vegetation. The soil was classified as a Mottled Argillic Pallic soil. The topsoil was 23 cm deep and a medium degree of structure. Some clumps/clods were present in the topsoil. The consistence was very hard, i.e. the soil had to be crushed underfoot to be broken apart.

10 The topsoil structure and depth was assessed in the other soil pits and small holes in the vicinity of the existing solar panels. Most soil pits and holes underneath the panels, under the dripline of the panels and outside the edges of the solar panelled area were concluded to have similar topsoil depth, horizon depth and other visual characteristics to the pit from which the full soil order description was done. In one of the pits located between solar panel rows near the centre of the area under solar panels, the topsoil showed wide cracking.

Soil in adjacent dairy pasture

11 One pit in an adjacent irrigated dairy pasture was assessed as a form of control. However, this soil was likely a different soil order to the soil in the vicinity of the solar panels. The soil here had recently been irrigated and was overlaid by green pasture. The topsoil in this pit was ~22 cm deep had medium, fine, polyhedral structure and was a hard consistence.

Soil in dairy pasture adjacent to the proposed solar farm site

12 One 60 cm deep pit was assessed in an area of irrigated dairy pasture ~300 m south of the existing solar panels, adjacent to the proposed solar farm site. This pit was approximately 20 m from the fence line, across a hedge, fence and track from the neighbouring property where the solar farm is proposed. The pasture overlying the soil was green and the soil was less dry than the soil under the solar panels. The soil here, like the soil around the solar panels, was classified as a Mottled Argillic Pallic soil. The topsoil was 18 cm deep, had a medium degree of structure.

Conclusions of assessment

13 While the soil in the vicinity of the solar panels appeared to differ in structure from the soil in the surrounding pasture, this comparison is confounded by the fact that the soil around the solar panels was not irrigated while the dairy pastures were irrigated.

14 There were stark differences in pasture condition in these different locations, with soils in the area around the solar panels being substantially harder and dryer. It is likely that the cracking and consistence of soils under the solar panels were due to the dryness in this area. Specifically, it cannot be concluded whether is the apparent difference in soil structure is due to the presence of the solar panels or to the differences in management of the two areas (i.e. irrigated and grazed vs. non-irrigated).

23 February 2024

Hadee Thompson-Morrison

ATTACHMENT 1 – Report

Assessment of soils in the vicinity of solar panels in Brookside, Canterbury

Hadee Thompson-Morrison, Land Scientist – Environmental Contaminants, Manaaki Whenua – Landcare Research

23 February 2024

Background

A 111 ha solar farm is proposed for an area of land currently under dairy land use in Brookside, Canterbury. On 21 February 2024 Brookside Ratepayers Opposed to a Solar Farm contracted Manaaki Whenua – Landcare Research to provide advice on the soil type and condition of soil in the vicinity of existing solar panels at an adjacent property to the proposed site of the solar farm. This was assessed by visual assessment of soil pits and holes that were both underneath and outside of the solar panels.

Soil assessment

On 22 February 2024 observations were made of eight pits dug to ~70 deep and three small holes dug to ~20 cm deep in the vicinity of the panels. The deeper pits were located up to ~4.7 m outside the edge of the panels, underneath the dripline of the panels, and between the rows of panels. The smaller holes were dug underneath the dripline, underneath the panels and between the rows of panels. A soil order assessment using the New Zealand Soil Classification[1] was undertaken on three pits; one close to the existing solar panels, one in a pasture paddock adjacent to the existing solar panels, and one in the pasture adjacent to the proposed solar panel site. The two pits in pasture were intended as controls, to determine any differences in the visual properties of the soils between the areas near to solar panels and the surrounding soils. The pit dug adjacent to the proposed site of the solar farm was also intended to determine whether the soil type under the existing panels was likely the same as that of the proposed solar farm site. A visual assessment of the state of the soil near to the solar panels was undertaken on the other pits and smaller holes. In each of these other pits, the soil was visually assessed for similarities to the pit in the vicinity of the existing solar panels from which the soil order assessment was done.

Soils in the vicinity of solar panels

All soil in the vicinity of the solar panels was non-irrigated and overlain by pasture vegetation. It was grazed at the time of assessment by sheep. The soil here was very dry as was all overlying vegetation (Fig 1). A full soil order assessment was done in a pit dug to ~80 cm deep, situated ~4.7 m east of the edge of the existing panels (Fig 2 and 3). The soil was classified as a Mottled Argillic Pallic soil. The topsoil was ~23 cm deep comprised of silt loam. The topsoil had very fine, medium structure with polyhedral peds. Some clumps/clods were present in the topsoil. The consistence of the topsoil was very hard, i.e. the soil had to be crushed underfoot to be broken apart. Beyond this depth, the soil transitioned into a heavily mottled silty clay, with no discernible structure and very firm consistence. Mottles are areas of soil with reddish colouring, indicating oxidised iron, usually from periods of wetness followed by periods of dryness. The colour of the soil around the mottles had low chroma (i.e., pale/grey), which together with the heavy mottling in this soil indicates that the water table at this site likely rises and falls, reaching up to ~20 cm below the soil surface. The drainage class of the soil was poorly drained. There were no rooting barriers observed in the soil profile, with few roots (defined as between 1-10 microfine roots <1 mm in diameter per 100 mm^2) extending down to the lower horizons.

At approximately 70 cm deep, the soil transitioned into an earthy, sandy loam horizon containing coarse gravels.

Figure 1. Vegetation underneath and between rows of solar panels

Figure 2. Soil pits dug both outside the solar panelled area (left pit) and underneath the dripline of solar panels (right pit). The soil description was determined from the left pit.

Figure 3. Soil profile of the pit used for soil description

The topsoil structure and depth was assessed in the other soil pits and small holes underneath the panels, under the dripline of the panels and outside the edges of the solar panelled area (Fig 4 and 5). Pasture outside the edges of the solar panelled area appeared to be taller than pasture underneath the panels and between the rows of panels (Fig 6), it was observed that sheep graze in this area, which may contribute to observed differences. Most soil pits and holes underneath the panels, under the dripline of the panels and outside the edges of the solar panelled area were concluded to have similar topsoil depth, horizon depth and mottling to the pit from which the full soil order description was done. In several of these pits, the topsoil was divided into two layers, with the top layer between 6-10 cm thick and the underlying layer extending to between 20-23 cm from the soil surface (Fig 7). The upper layer was silt loam texture and was firm to very hard with medium structure, while the lower layer had a different consistence than the overlying layer and was less structured. The soil texture varied between the two layers in some of the pits/holes, with the underlying layer a loamy clay. In one of the pits located between solar panel rows near the centre of the area under solar panels, the topsoil showed wide cracking (Fig 8). The separation of the topsoil into two layers in areas may be the result of historic management of the soil, e.g. ploughing or pugging by livestock.

Figure 4. Soil pit dug under the dripline of solar panels, with a shallow hole extending to underneath the panels

Figure 5. Soil pit dug underneath the dripline, extending out to the area around the solar panels

Figure 6. Differences in vegetation height visible between the area outside of the solar panels (foreground) and areas underneath panels and between the rows of panels

Figure 7. Two topsoil layers present, with a silt loam layer between 0-10 cm and a loamy clay layer between 10-22 cm

Figure 8. Wide cracks present in topsoil of a soil pit between solar panel rows

Soil in dairy pasture adjacent to existing solar panels

One pit in an adjacent irrigated dairy pasture was assessed as a form of control, to determine any differences between soils near to the solar panels and soils under surrounding pasture (Fig 9 and 10). However, this soil was assessed as being of a different soil order - likely an Argillic Orthic Gley – to the soil under the solar panels. It should be noted that the soil order classification here is indicative only, as this pit was only dug to ~40 cm, rather than the specified 90 cm for this soil classification, so assessment of the lower horizons was not possible. The soil here had recently been irrigated and was overlaid by green pasture. This soil displayed less mottling in the visible soil horizons than the soil around the solar panels, and was more heavily reduced with a higher proportion of pale colours. The topsoil in this pit was ~22 cm deep and was not obviously divided into two layers. The topsoil had medium, fine, polyhedral structure and was a hard consistence. Mottles were present in all horizons however there were substantially more in the subsoil horizons below 22 cm than in the topsoil. The subsoil horizons were a loamy clay texture with no discernible structure.

A second pit was dug in this pasture however a visual inspection indicated the soil was likely substantially different in terms of stoniness and texture to the soil under the solar panels. As such, no observations were made from this second pit.

Figure 9. Soil pit in pasture adjacent to the solar panel area

Figure 10. Soil profile of pit in the pasture adjacent to the solar panel area

Soil in dairy pasture adjacent to the proposed solar farm site

One 60 cm deep pit was assessed in an area of irrigated dairy pasture ~300 m south of the existing solar panels, adjacent to the proposed solar farm site (Fig 11 and 12). This pit was approximately 20 m from the fence line, across a hedge, fence and track from the neighbouring property where the solar farm is proposed (Fig 13). The pasture overlying the soil was green and the soil was less dry than the soil under the solar panels. The soil here, like the soil around the solar panels, was classified as a Mottled Argillic Pallic soil. The topsoil extended to 18 cm below the soil surface with a transitional horizon from 18-32 cm. The topsoil was divided into two layers, similar to some of the topsoils under the solar panels. There was an abrupt boundary (between 0.5-2 cm thick) between these layers. Here, both layers had silt loam texture. The topmost layer was more strongly structured than the underlying layer and was of semi-firm consistence, while the underlying layer was of very firm consistence (i.e. was harder than the underlying layer). Both had very fine polyhedral structure. The transitional horizon also had silt loam texture however contained more clay than the topsoil horizons. It had medium structure and very fine polyhedral peds. This horizon had semi-firm consistence and approximately 15% fine mottles. The subsoil horizon from 32-50 cm was a loamy clay texture and was earthy and apedal, with ~70% mottles. Below this, the soil became a sandy skeletal layer consisting of loamy sand and ~50% coarse gravels, with ~20% mottling.

Figure 11. Soil pit dug in irrigated dairy pasture adjacent to the site of the proposed solar farm

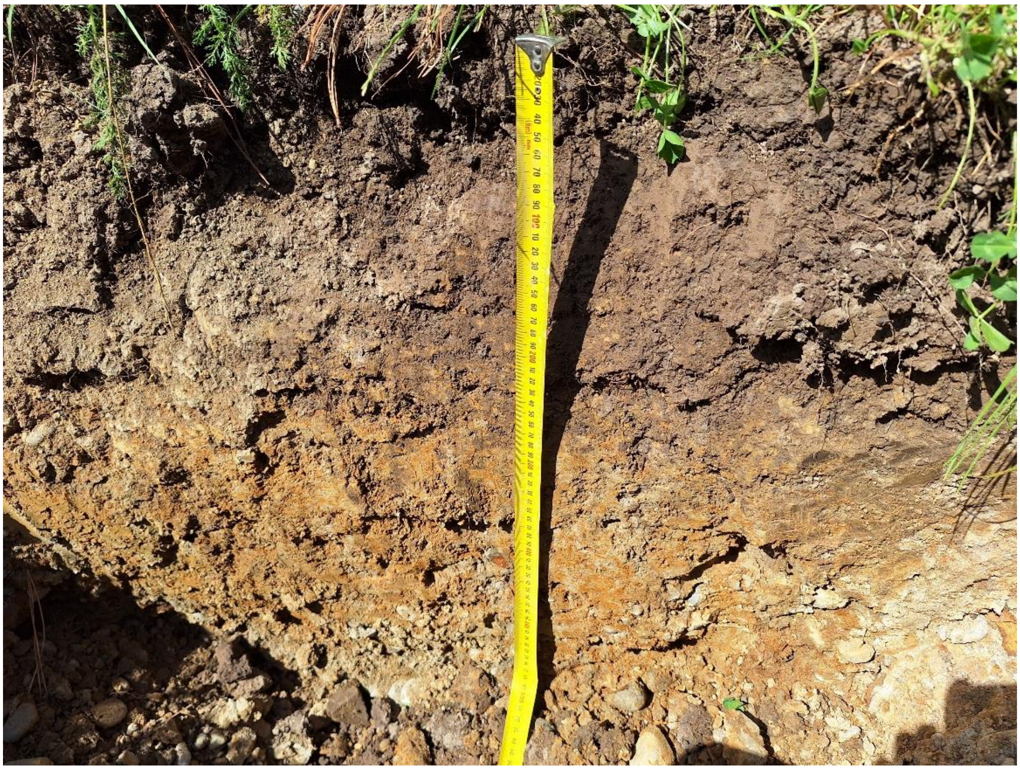

Figure 12. Soil profile of pit in irrigated pasture adjacent to the site of the proposed solar farm

Figure 13. Proximity of the pit shown in Fig 11 and 12 to the neighbouring property where the solar farm is proposed

Discussion and conclusions

While the soil in the vicinity of the solar panels appeared to differ in structure from the soil in the surrounding pasture, this comparison is confounded by the fact that the soil around the solar panels was non-irrigated while the dairy pastures were irrigated. There were stark differences in pasture condition in these different locations, with soils in the area around the solar panels being substantially harder and dryer. It is possible that the cracking and consistence of soils under the solar panels were due to the dryness in this area. Specifically, it cannot be concluded whether is the apparent difference in soil structure is due to the presence of the solar panels or to the differences in management of the two areas (i.e. irrigated and grazed vs. non-irrigated).

It would be useful to assess the structure of soils near to solar panels when they are moist, to allow a robust comparison between these soils and soils under surrounding irrigated pasture in order to determine whether there are any notable differences that may be due solely to the presence of panels.

References

1. Hewitt AE 2010. New Zealand Soil Classification. New Zealand: Manaaki Whenua Press.