SPEAKING NOTES TO ACCOMPANY PRESENTATION

BIRRIWA SOLAR PROJECT PUBLIC MEETING

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POTENTIAL LAND DEGRADATION OUTCOMES WITH RENEWABLE ENERGY PROJECTS

Alternative energy projects such as wind and solar cannot be considered renewable if there is a risk of extensive and serious land degradation issues developing.

Slide 1

Good afternoon Commissioners and participants to this public meeting.

Thank you for the opportunity to present my thoughts to you today in relation to the Birriwa Solar project.

I preface my remarks by advising you I have read Appendix L, the Land Use, Soils and Erosion Assessment (LUSEA) as part of the EIS.

As shown in Slide 1, I believe that renewable energy projects, be they wind or solar, cannot be considered renewable if there is a risk of land degradation issues developing as a result of the project.

It is very obvious that the LUSEA is essentially a "desk-top review" type of document rather than a detailed on site assessment Land and Soil Verification.

There are no details in the document describing the time spent on field work during the preparation of the report, other than a brief statement on page 23 referring to "the site inspection on 2 December 2021" at which time "opportunistic sampling of soils was undertaken at three sites".

This site in total is 1,535 hectares. To obtain a significant understanding of the environmental constraints with just three soil samples is an absolute nonsense – that is one soil sample for over 500 hectares, particularly when all the desktop data identifies it as Class 5 land with the main soiltype being Sodosols – by definition it is Environmentally Sensitive Land (ESL) and such requires a far more intensive Soil and Land Verification.

DRYLAND SALINITY

Class 5 with Sodosols tells me that the proposed project area is environmentally sensitive land that is highly susceptible to significant land degradation and the major manifestation of that degradation would be dryland salinity.

It is worthwhile spending a few minutes describing why I make this statement, and to do so we need to understand the changes that have occurred to the landscape since European settlement as shown in Slide 2.

The processes of dryland salinity:

Landscapes prior to clearing for early agriculture

Landscapes during early agricultural practices

Landscapes during modern agricultural practices

Landscapes following installation of wind and solar energy facilities

Slide 2

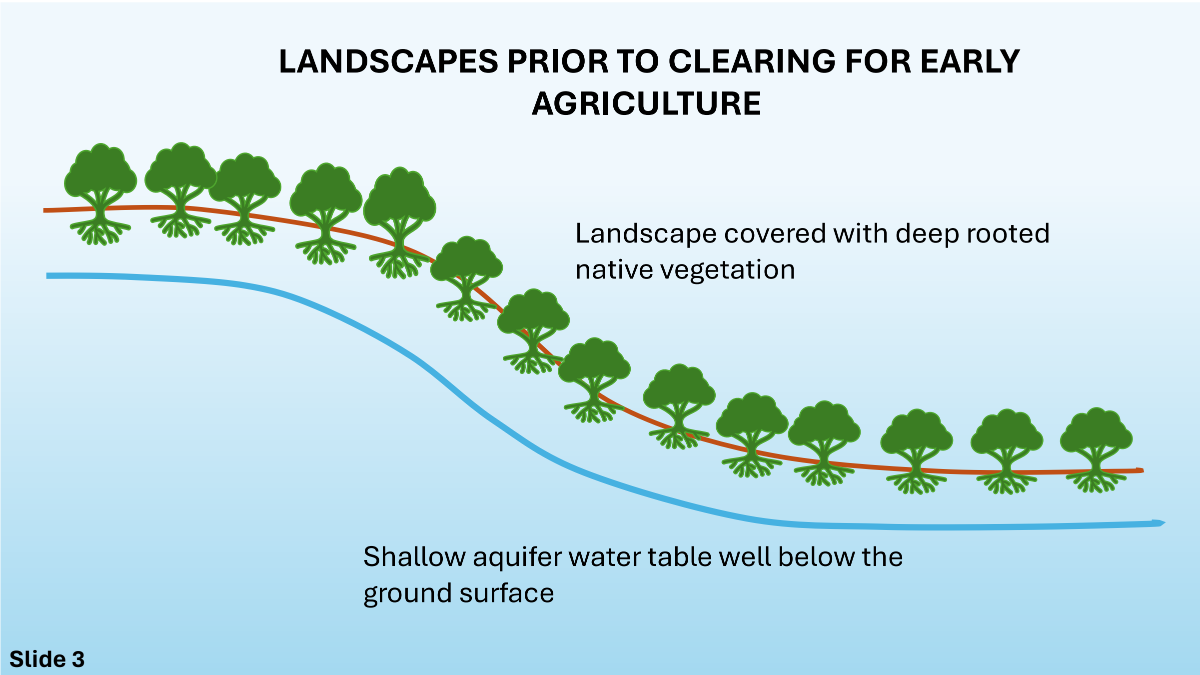
I will describe to you how these landscapes were prior to clearing for early agriculture, how they changed during that early agricultural period and what occurred to effectively rehabilitate these landscapes in the latter half of the twentieth century.

There is now another major change occurring to these landscapes as a result of the accelerated approval and installation of renewable energy projects.

As shown in Slide 3, the landscape prior to 1750 was covered by deep rooted native vegetation – essentially trees and deep rooted grasses.

In this diagram the upper slopes are where the tenosols (undifferentiated sandy soils on the Narrabeen sandstone geology - of marine origin) with high infiltration rates.

As we head towards the lower slopes the soil types change gradually to the sodosols – by their very name they are high in sodium.



The tree cover density is determined largely by the amount of water they available for tree growth. The average rainfall at Birriwa is around 600 mm/annum, allowing for a reasonably dense forest of large trees.

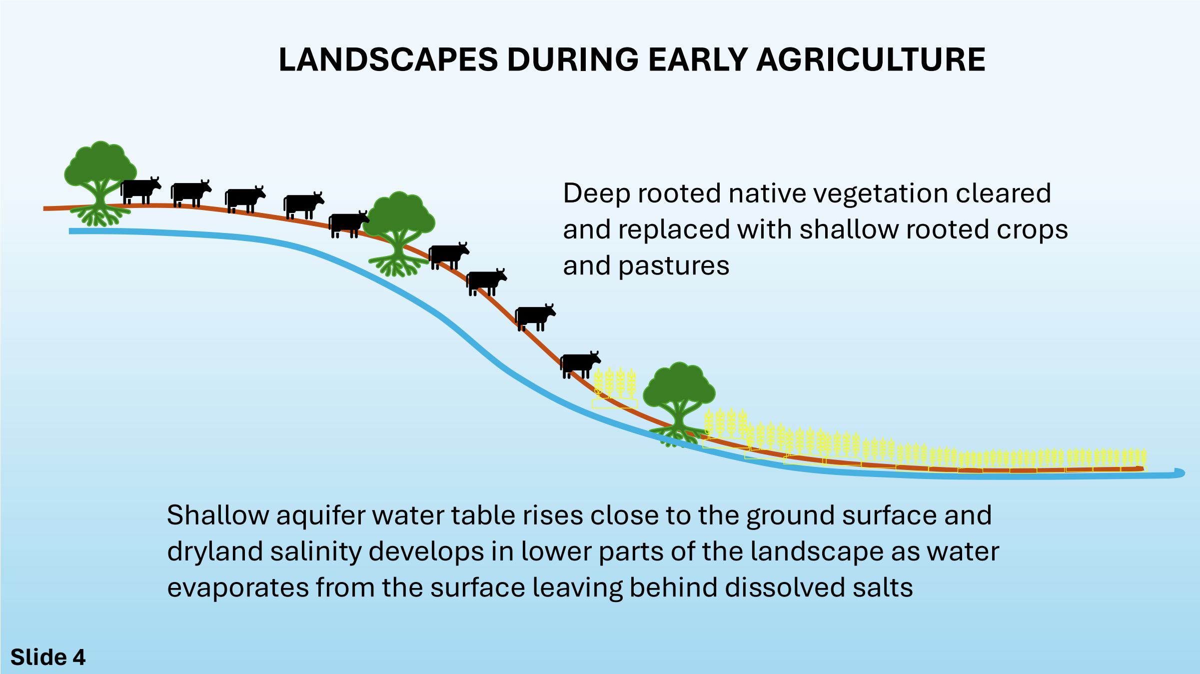
The type and density of tree cover changes as we travel towards west from the coast – rainforests on the coast to open woodlands on the slopes and tablelands with tree density declining with rainfall towards far western areas.

These trees act as water pumps preventing the shallow water tables from reaching the surface throughout the catchment.

Slide 4 shows how the landscapes changed once large scale clearing for agriculture commenced.

While there was obviously clearing of some native vegetation as soon as farmers started farming in the new colony, it probably was not until high horsepower tractors appeared in the early 20th century that large tracts of forested land could logistically be cleared and then farmed – much of it between 1945 and 1970.

The result of this clearing was that the shallow groundwater was no longer being extracted – either in the upper catchment or down on the lower slopes.



Water accumulated in the lower catchment areas, and once it rose to within two metres of the soil surface, it began to rise to the soil surface by capillary action and evaporated at the surface depositing the salts dissolved in the groundwater on the soil surface.

Once the salts accumulate to a level where green plants can no longer survive, dryland salinity is present.

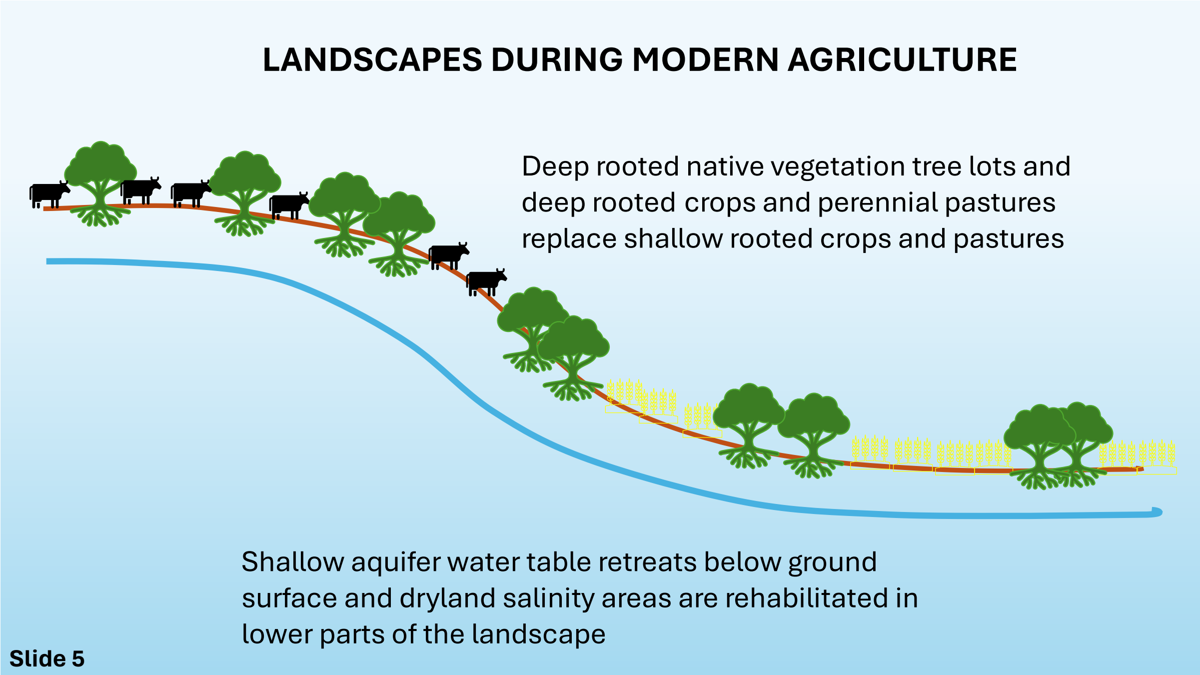
A key message with respect to this problem is:

DRYLAND SALINITY IS NOT A SALT PROBLEM – IT IS A WATER PROBLEM!

Numerous areas of dryland salinity began to appear on the western slopes and plains, and although they were individually small in area some areas they were extremely saline with high soil electrical conductivity (eC) readings and some with extremely high water salinity up to almost twice the salinity of seawater.

Many piezometer tubes (plastic tubes inserted 3-4 metres into the soil to monitor water levels) were installed on these sites. The groundwater pressure is able to be assessed, and in some cases the water in the piezometer tubes rose to above ground level so there was positive pressure forcing the water to the soil surface.

Once this developing problem was identified and recognisable, owners of affected land were advised to alter their management practice to do whatever was required to lower the shallow water tables in the lower parts of the catchments.

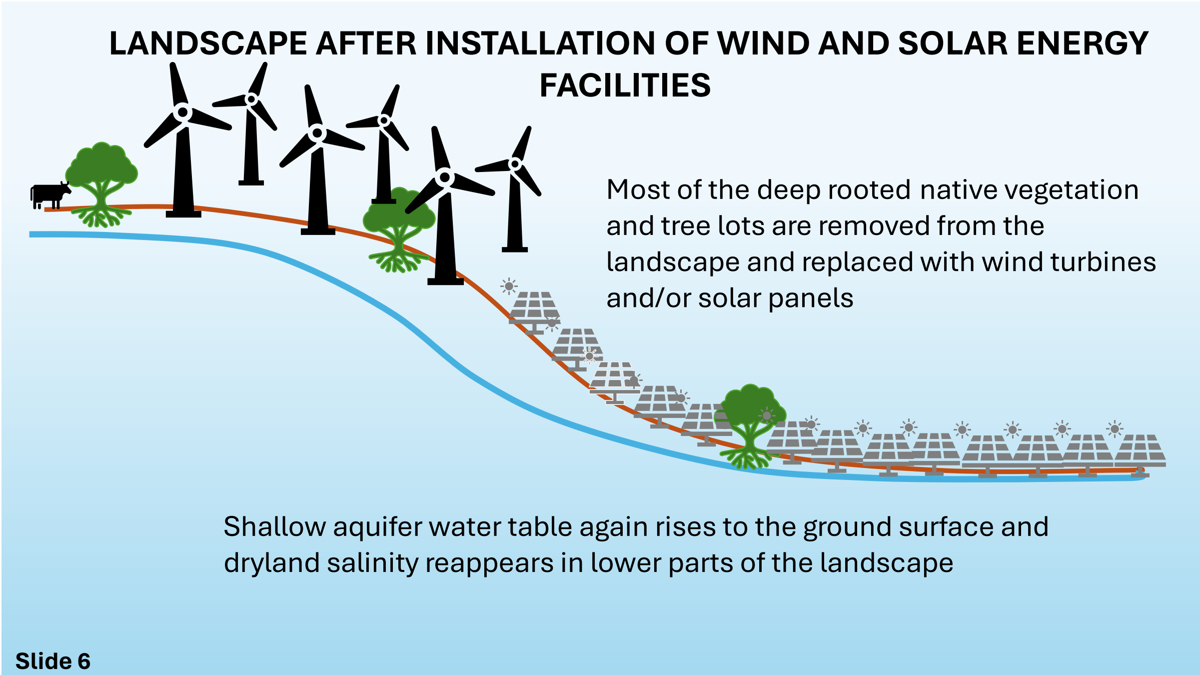


As shown in Slide 5, there are basically a number components to these altered practices which landowners were advised to adopt:

- Identify the recharge areas for the water. Installation of a network of piezometers are required to identify water table levels throughout the site;
- Plant belts of trees across the slopes above the saline area to intercept the subsurface flow of water;
- Utilise deep rooted crops and pastures to access the water 2-3 metres below the soil surface and maintain surface cover to minimise evaporation;
- In areas devoid of vegetation due to the soil and water saline conditions planting of salt tolerant species such as tall wheat grass (Thinopyrum spp) and puccinellia (Puccinellia ciliata) to assist with water extraction and ground cover;
- Monitor ground water levels in the piezometer network over time.

These practices resulted in the retreat of the saline conditions and the rehabilitation of saline areas. Although not suited to intensive cropping, such areas again became productive grazing with perennial deep rooted pastures preventing further saline conditions.

This situation will change dramatically should a solar project be proposed on land where dryland salinity has been identified and rehabilitation works been undertaken, or on land where dryland salinity has not yet been identified but may be predisposed to the problems occurring should inappropriate land management commence.



Solar energy projects prefer to maximise full access to sunlight, so individual trees or tree lots are not compatible with solar projects. Any remnant trees or planted tree lots will likely be removed to maximise solar interception.

As shown in Slide 6, most deep rooted plants of all species will be removed, allowing the water table to again rise close to the surface and evaporation will recommence, allowing dissolved salts to accumulate at the surface.

There is already desk-top evidence that the underlying soil is high in sodium and susceptible to dispersion and tunnel erosion on the Birriwa site.

No investigation has been undertaken to evaluate the shallow groundwater levels which may predispose this site to the development of dryland salinity according to the LUSEA.

The likelihood of the land on the site of the proposed Birriwa Solar project being susceptible to dryland salinity has to be high for the following reasons:

- The upper catchment areas with steep slopes, tenosols soil on Narrabeen sandstone will have high infiltration rates, providing a recharge area for the shallow groundwater aquifers further down the slope;
- The very low slopes in the project area itself (less than 1.5%) would suggest that water may well accumulate in shallow aquifers within two metres of the soil surface on these slopes;

- The chemical nature of the sodosols provide the chemistry to allow a various combination of salts to accumulate on the surface once the shallow aquifer rises to two metres of the soil surface and evaporation commences.

So there are some important matters to consider in relation to the risk of dryland salinity developing on the Birriwa site, as shown in Slide 7.

Some things to consider:

according to the Central Resource for Sharing and Enabling Environmental Data in NSW:

1. Land Classification

   This project area is all classified as Class 5 due to risk of acid soil, water & wind erosion, soil structural decline and dryland salinity.

2. Soil Types

   The soils within this project are all mapped as "sodosols" – they are inherently high in sodium. If shallow aquifer watertables are within 2 metres of the soil surface dryland salinity may be present.

   The soils in the upper catchment above the project area are mapped as "tenosols" – shallow sandy soils on sandstone geology.

Slide 7

As has been highlighted in the Assessment document, the project area is classified as Class 5. This is a result of the risks due to acid soil, water and wind erosion, soil structural decline and dryland salinity, according to the Central Resource for Sharing and Enabling Environmental Data in NSW (SEED). Hardly an overwhelming endorsement to install a one billion dollar investment on this land, given it is susceptible to this type of land degradation.

When the original mapping was completed (under the Statewide Land Capability Mapping Program during the 1980's and 1990's) the land shown as Class 5 within this site would been tagged as Environmentally Sensitive Land (ESL) because of the Sodosols soil types present. If the soil types were vertosols, chromosols or kandosols, the majority of the project area would likely have been Class 2 or 3 as a result of the low slopes present.

As correctly identified in the LUSEA, the Solar Guidelines only require a soil survey if the subject land is mapped as LSC Class 1-4, BSAL or a CIC. The fact that this land, mapped as Class 5 and is environmentally sensitive land subject to land degradation, does not require full investigation through a soil survey is an anomaly and a major shortcoming of the Solar Guidelines.

The soil type is all mapped as sodosols – as the name implies, they are inherently high in sodium in the B horizon. Sodosols are widespread in NSW and in many areas they are the dominant soil type. They are extensively used for agriculture, particularly in the central and south west parts of the state.

Should the topsoil layer be removed or interrupted, these soil types are highly susceptible to gully and tunnel erosion, which once commenced, can be difficult and expensive to rehabilitate.

The LUSEA briefly mentions the issue of trenching to install the cabling required for the electrical connections. There is no mention of the total length of these trenches, but it is assumed that each row of panels will have a companion trench to carry the cables. If the panel rows are 10 metres apart, there will be 1,000 metres of trench per hectare. The EIS states that 1,159 ha will be the maximum extent of ground disturbing work, equivalent to 1,159 kilometres of trenches that will in all likelihood be susceptible to tunnel erosion should the Sodosols be the dominant soil type.

The predominant soil type on the sandstone ridges south of the project area is described as tenosols – typically soils on sandstone geology that do not have well defined soil horizons and low clay levels below the surface layers.

These ridges are likely high recharge areas for shallow groundwater aquifers lower in the catchment, predisposing the Birriwa Solar project area to dryland salinity.

OTHER MATTERS

There are a couple of other potential land degradation matters I wish to refer to, as summarised in Slide 8.

OTHER POTENTIAL LAND DEGRADATION ISSUES TO CONSIDER:

- **Grazing management**
  - Maximum dry matter for fire control expressed as pasture height and tonnes/ha dry matter
  - Root depth in relation to pasture height
- **Soil zinc levels from galvanized support posts**
  - Desirable soil zinc level is 5 – 15 kg of Zn/ha
  - Zinc in galvanized posts as high as 1,200 – 2,000 kg of Zn/ha
  - Potential Zn toxicity for pasture growth at 150 – 200+ kg of Zn/ha
  - Zinc toxicity prevents leaves from maturing properly by:
    - blocking uptake of iron and other minerals
    - restricting water movement through the plant
    - yellow leaves appear at the bottom of the plant as it dies from the bottom up

Slide 8

There are two issues that arise in relation to grazing management and soil zinc levels.

Grazing Management

I understand it is proposed to graze sheep under the panels to assist with fire control.

Fire control is a major issue for this type of development due to the difficulty of accessing the site in a major fire emergency.

I find it extraordinary that there is no mention in the LUSEA or no guidelines for the maximum amount of dry matter permissible under the panels. Dry matter, or matured and dry vegetative growth less than 6 mm in diameter is the major source of fuel that determines the ferocity of bush fires. Fire flame height, speed of advance and perimeter spread are exacerbated by air temperature, relative humidity, wind speed, days since rain and ground fuel levels all need to be taken into consideration.

A field assessment of the amount of dry matter can be estimated by the height and density of pasture. A 50 cm high dense, dry pasture may have a fuel load as high as 30 tonnes of dry matter per hectare.

To estimate the fire risk we can consider the 30-30 principle.

A 30°C day, 30% humidity, 30 km/hr wind speed, 30 days since rain and 30 tonnes/ha of dry matter.

CSIRO produces a series of fire danger ready reckoners allowing a quick and easy assessment of potential fire danger by inputting these parameters, and the 30-30 conditions described above would indicate a very high fire danger.

If a fire started under these conditions, the flame height would be 12-14 metres high according to the ready reckoners.

If the fuel level is reduced to 5 tonnes/ha of dry matter, the flame height would be reduced to 2-2.5 metres.

As it is planned to graze sheep what is the desired or planned fuel level as a result of the grazing?

5 t/ha of dry matter on pasture growth would essentially be an eaten out paddock – probably only 4-5 cm high. Heavy grazing with sheep can reduce the dry matter to a much lower level than 5 t/ha.

Plant root systems roughly grow in proportion to the above ground height, so the root systems would only reach 4-5 cm into the soil in this example. Keep in mind that the major dryland salinity control measure is to utilise deep rooted vegetation to extract that groundwater – in this case there is minimal root depth to allow that extraction to occur.

Dryland salinity may well develop or re-manifest itself in the case of a rehabilitated area.

Soil Zinc Levels

The final point I wish to make is in relation to the amount of zinc on the galvanised steel support posts.

Assuming there will be 10 rows of panels per hectare with posts every 7 metres, that equates to 140 C-section posts per hectare. If the C-section dimensions are 150mm * 60mm * 20 mm and they are inserted 2.5 metres into the ground, there will be 217 m^2 of galvanised C-Section per hectare in contact with the soil.

Typically the galvanising process applies one mm of zinc to the raw steel, equivalent to 0.217 m^3 of zinc per hectare.

Zinc has a specific gravity of 7.14 (it is a heavy metal), so the total amount of zinc being added to the soil is 1,549 kg/ha.

Galvanised steel has a life of about 50 years under good conditions, but in contact with acid soils and saline groundwater, this could be reduced to 15-25 years. Over that time the 1,549 kg/ha of elemental zinc will be released into the soil as the galvanising corrodes off the steel C-section posts.

Zinc is an essential trace element for plants and animals which is deficient in most Australian soils. The desirable level of zinc in the soil is between 5 and 15 kg/ha, depending on soil type.

Although zinc has a very low toxicity (roughly the same as table salt or coffee), when it is present at levels above 150 – 200+ kg/ha in the soil, it impedes the uptake of other plant nutrients, mainly phosphorus and iron, with plants showing signs of chlorosis from the older leaves to younger leaves, until the plant finally dies as a result.

The LUSEA should address the amount of zinc that will be applied on the galvanised posts.

CONCLUSION and RECOMMENDATIONS

The only conclusion that can be drawn as a result of the above discussion is that the Birriwa Solar Project assessment is not yet in a position to be approved.

The unverified land and soil classification has not been properly addressed with an adequate level of field assessment.

No shallow groundwater studies have been completed.

A full impact of the effect of the grazing strategy in relation plant rooting depth and water extraction, ground cover and fuel levels has not been considered.

No assessment has been made of the potential toxic effects of highly elevated zinc levels as a result of inserting hundreds of galvanised steel posts per hectare some 2.5 metres into the soil.

It is for these reasons I believe a far more investigative analysis needs to be completed on this site before it can be granted approval to proceed.

Recommendations

Investigations should be undertaken on the following basis:

- A thorough and comprehensive land and soil verification should be completed, at least on the basis of one soil sample per 20-25 hectares, with a full chemical and physical analysis in the top 150 mm and a second analysis in the B horizon including an Emmerson Aggregate Test.
- A network of piezometer tubes needs to be installed to determine and monitor groundwater levels to assess if there is a risk of dryland salinity destroying the landscape. These tubes should be installed along the upper slope boundary of the site and at regular intervals in downslope locations.
- An assessment of the impact of the proposed grazing strategy on groundwater extraction (quantity and depth), dry matter volumes throughout the year and groundcover percentages as a result.
- A full estimation of the amount of elemental zinc that will be applied to the soil profile as a result of installation of galvanised support posts.