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Assessment of the impact of sand mining on agricultural potential on Portion 2 of RE of Farm number 199, near Clanwilliam

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1 Introduction and brief

Johann Lanz was appointed to conduct a soil survey on Portion 2 of RE of Farm number 199, near Clanwilliam. This assessment report uses data from the soil survey to determine sand depths for suitability of mining and rehabilitation, to determine agricultural potential, to assess the impact of mining on that potential, and to provide recommended mitigation measures and rehabilitation guidelines for all the identified impacts caused by mining.

The soil investigation was conducted on 24 July 2019. A total of 3 test pits were investigated across the area. The location of the farm is shown in Figure 1 and the positions of test pits are shown in Figure 2.

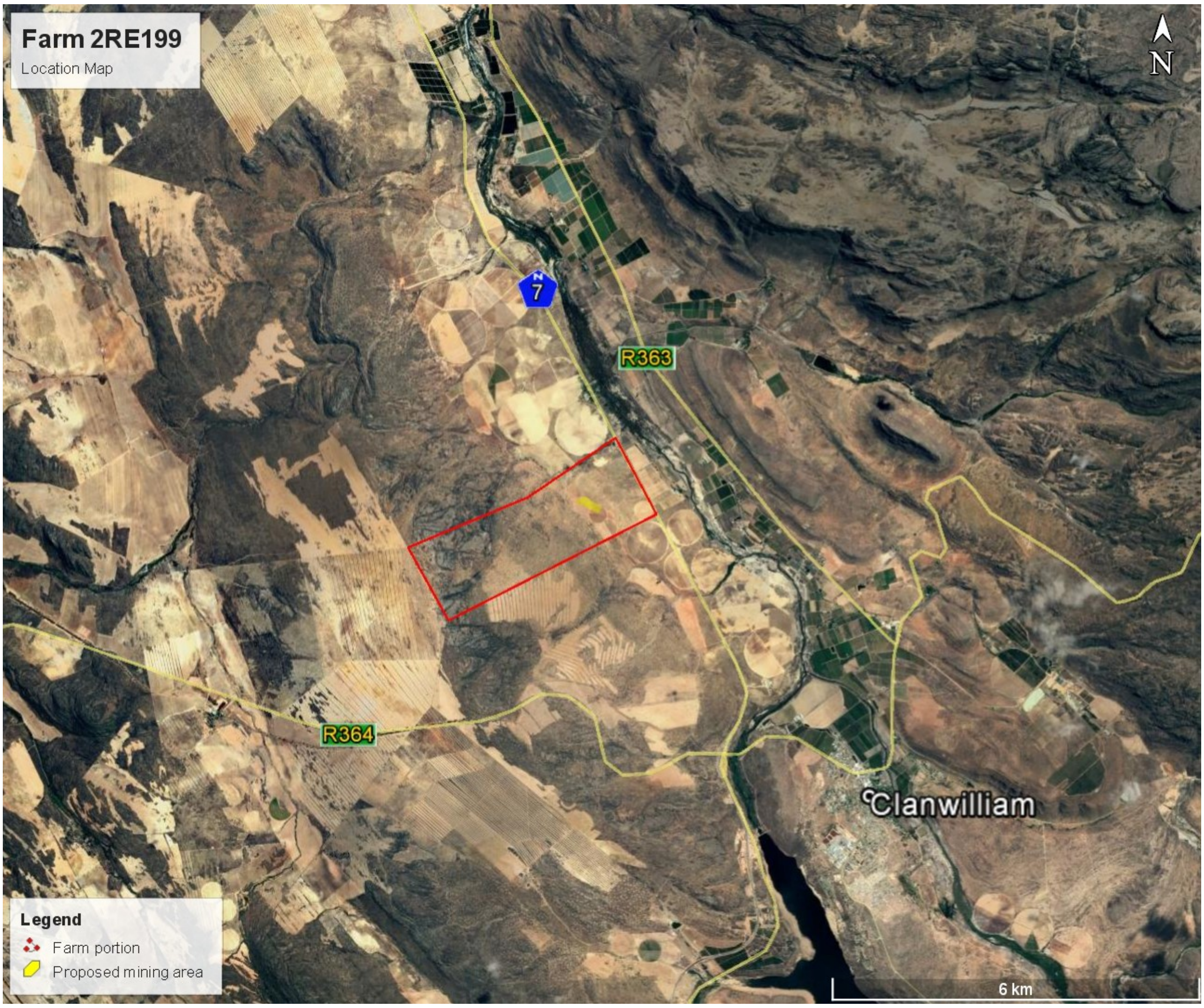

Figure 1. *Location of the investigated farm.*

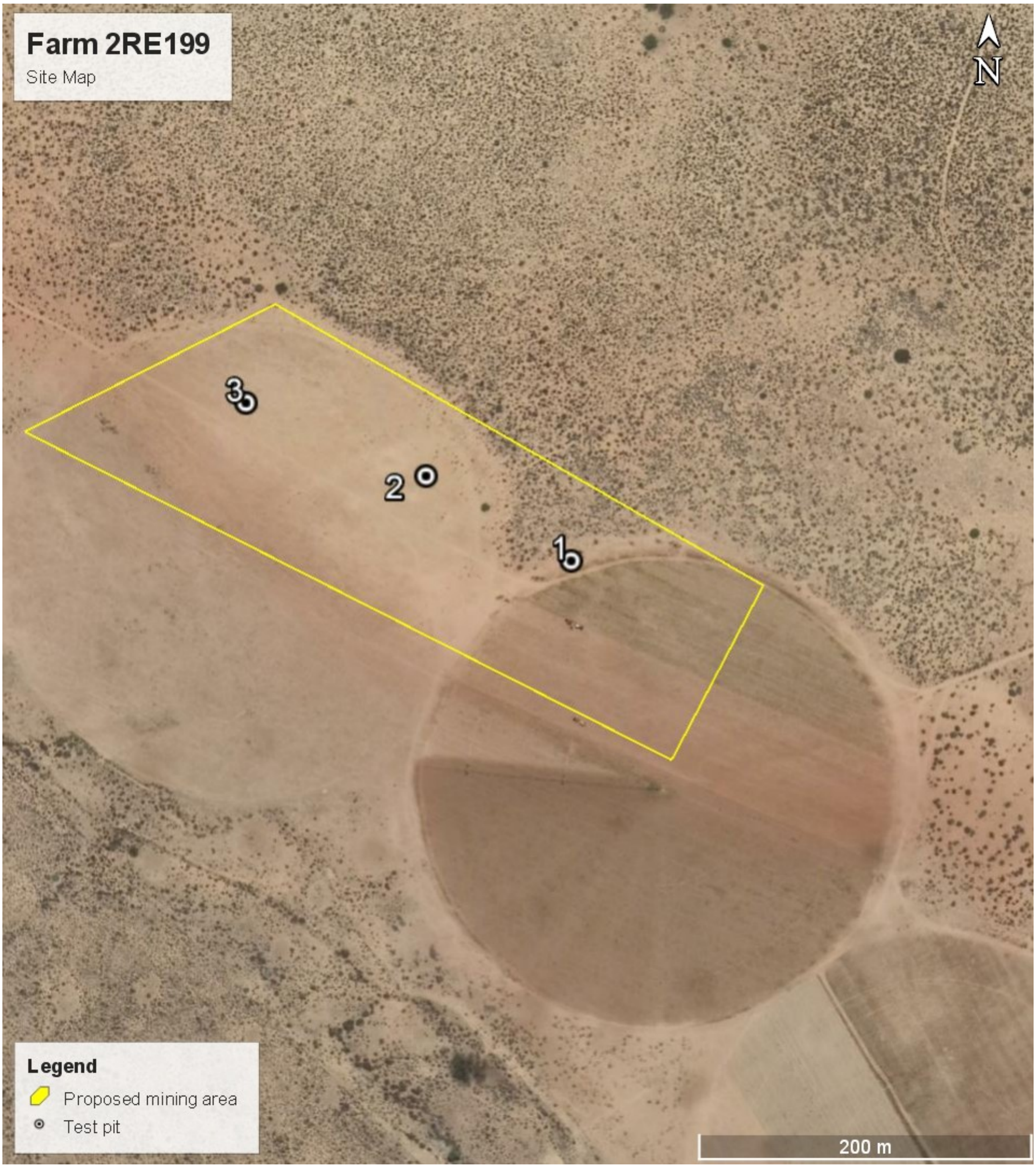

Figure 2. *Satellite image showing all investigated test pits. (image date: 09/11/2017).*

2 Soils and agricultural potential

The underlying geology of the area is quartzitic sandstone with minor grit, conglomerate and shale lenses of the Piekenierskloof Formation; Table Mountain Group, covered by aeolian sand. The soils are very deep, well-drained, orange-yellow coloured, very sandy soils. They are of the Clovelly 1100 soil family, as classified by the South African soil classification system. Soils are identical in all three of the investigated test pits and are likely to be uniform across the mining area. Based on an investigation of the excavation at the existing mine, the sands are very uniform to a depth of about 8 metres, below which there is a gradual increase in the clay content.

Photographs of soils and site conditions are shown in Figures 3 and 4.

The soils are limited by the very low clay content and leaching of the upper soil horizons and therefore have a low water and nutrient holding capacity. As a result they have a low to medium agricultural potential, and are rated between 4 and 5 out of 10 according to the system used by Western Cape soil scientists. However, because of their very low water holding capacity, they are highly dependent on effective irrigation for the cultivation of crops.

The land capability of the investigated area varies between land capability evaluation values of 3 and 6, but is predominantly 4 and 5, which is very low to low. The grazing capacity of the natural veld is very low at 66 hectares per large stock unit.

The future agricultural potential, in terms of warming predictions, of this zone, which is Olifants irrigation, is rated as remaining viable as long as river flows and dams fill up, but it will be constrained by heat.

3 Alternative site

A site alternative, adjacent to the existing mine, and on land that is not used for crop production, was proposed during the environmental authorisation process. This land is likely to have very similar soil conditions to the proposed site. However, it is not suitable for mining due to the sensitivity of the natural vegetation.

4 Agricultural land use

The proposed mining area is on two centre pivot irrigated lands that have been used for the production of potatoes, wheat and perennial pastures. The first centre pivot land was developed before 2012 and the second between 2012 and 2013. The surrounding area is natural vegetation.

Figure 3. *View of typical site conditions, looking in a south easterly direction down the mining area, with one centre pivot in the background.*

Figure 4. *Test pit showing the Clovelly 1100 soil that occurs across the site.*

5 Identification and assessment of the impacts of mining on agricultural resources and production

Mining can have both direct and indirect impacts on agricultural potential. Direct impacts are those that change the soil potential on site in terms of growing agricultural crops. Indirect impacts are those that do not directly affect on-site crop growth, but that might impact the success of agricultural enterprises in the general area of the proposed mine.

5.1 Indirect impacts

The following potential indirect impacts are identified

5.1.1 Alteration of the agricultural sense of place

Mining is an intrusive activity of an industrial nature that, during its operational phase, can alter the agricultural sense of place in a farming area and impact on agritourism potential and therefore on the agricultural economy However the surrounding area considered in this report does not seem to be an area with high agritourism potential. Furthermore the mine site has low visibility from surrounding roads and farms because of the topography. The significance of this impact is therefore not likely to be high. It is however very difficult to assess the significance of such impacts. An important indication of their significance would be provided by the response of neighbouring and surrounding land owners to the mining application.

The intrusive nature of mining may have some lifestyle impact on surrounding residents. However, the focus and defining question of an agricultural impact assessment is assessing the extent to which the development will cause a loss of future agricultural production. Such lifestyle impacts do not necessarily impact agricultural production and, if they do not, are a social issue that is beyond the relevance and scope of an agricultural impact assessment. Such issues should be addressed within a social impact assessment.

5.1.2 Dust deposition on surrounding crops

Mining can result in dust on surrounding crops. There are however no dust sensitive agricultural crops in close proximity. Dust can also be effectively mitigated by means of damping down surfaces when required. This impact is considered to be of low significance.

5.2 Direct impacts

Direct impacts are viewed in the context of the agricultural potential of the site, which is limited by the low water holding capacity of the sandy soils.

Mining can have both positive and negative effects on the agricultural potential of the site. The impact of mining occurs by way of different identified mechanisms, listed below. All these mechanisms impact on the agricultural potential. For the purposes of this report, the overall impact, namely change in agricultural potential, as a result of the interaction of these different mechanisms, is assessed. Each mechanism is discussed below. Details of mitigation measures are provided in the following section.

The following positive effects are identified.

5.2.1 Increase in clay content and resultant water holding capacity of the soil

Because there is a gradual increase in the clay content with depth, removal of the upper sand will leave a soil that has higher clay and resultant higher water holding capacity. This will alleviate, to some extent, the low water holding capacity limitation of the existing soil.

5.2.2 Decreased slope

Excavation of the mining area has the potential to level the centre pivot lands, which will have advantages for preventing irrigation run-off and improving ease of agricultural management.

The following negative effects are identified.

5.2.3 Loss of agricultural land for duration of mining

All mining areas will be lost to agricultural production for the duration of mining activity on them.

5.2.4 Loss of topsoil and of topsoil fertility during mining and stockpiling

Poor topsoil management during mining may result in the loss of topsoil for rehabilitation through burial or erosion from stockpiles. Also, disturbance and dilution of topsoil can cause loss of fertility as a result of reduced organic carbon and biological activity. The significance of this impact is highly dependent on the effectiveness of topsoil management during mining and during the rehabilitation phase.

5.2.5 Erosion

Downslope erosion during the operational phase can be caused by run-off accumulation from the mining excavations. When topsoil is re-spread, on completion of mining, the newly rehabilitated land will also be prone to erosion. Slopes are not steep and will be reduced by mining, but erosion risk still exists. Mitigation of significant impact is highly dependent on effective erosion management during mining and during the rehabilitation phase.

5.2.6 The creation of uneven surfaces or steep slopes

Mining excavations can create an uneven surface or steep slopes (usually on the edge of the mining excavation) that would prevent or hinder future agricultural land use. This can be completely mitigated by effective levelling during rehabilitation.

5.2.7 Alien vegetation encroachment

Soil disturbance can result in alien vegetation encroachment after rehabilitation. This can be controlled with effective environmental management of alien removal.

5.2.8 Soil contamination due to fuel spills

The presence of heavy machinery in the mining area may result in contamination from fuel spills. This can be prevented or ameliorated with effective environmental spill management.

6 Recommended mitigation and rehabilitation plan

A very important factor affecting the success of rehabilitation, and consequently the significance of all direct impacts, is the level of care that is taken to rehabilitate effectively. This is dependent on the level of environmental management of all mining activities that can impact on rehabilitation, both during the mining process and during the rehabilitation phase.

The following is the sequence of recommended rehabilitation steps:

1. The upper 30 cm of the soil across the entire mining area must be stripped and stockpiled before mining.
2. Topsoil is a valuable and essential resource for rehabilitation and it should therefore be managed carefully to conserve and maintain it throughout the stockpiling and rehabilitation processes.
3. Topsoil stockpiles should be protected against losses by water and wind erosion. Stockpiles should be positioned so as not to be vulnerable to erosion by wind and water. The establishment of plants (weeds or a cover crop) on the stockpiles will help to prevent erosion. Stockpiles should be no more than 2 metres high.
4. During mining, the outflow of run-off water from the mining excavation must be controlled to prevent any down-slope erosion. This must be done by way of the construction of temporary banks and ditches that will direct run-off water. These should be in place at any points where overflow out of the excavation might occur.
5. To ensure minimum impact on drainage, it is essential that no depressions are left in the mining floor. A surface slope (even if minimal) must be maintained across the mining floor in the drainage direction, so that all excavations are free draining. This means that mining depths will need to be controlled on the down-slope side of the

mine, so that the mining floor remains free-draining and above the low point for drainage out of the mining area.

6. It is also important that mining depths are controlled across the entire mine so that excavation results in a levelling of the centre pivot lands rather than a hole with steep edges.
7. After mining, any steep slopes at the edges of excavations, must be reduced to a minimum and profiled to blend with the surrounding topography, and allow the travel of the centre pivot. The entire surface must also be sufficiently smoothed and profiled to allow cultivation and the travel of the centre pivot.
8. The stockpiled topsoil must then be evenly spread, to a depth of 30cm, and smoothed over the entire mining area.
9. A cover crop must be planted, irrigated and established, immediately after spreading of topsoil, to stabilise the soil and protect it from erosion. The cover crop should be fertilized for optimum biomass production, and any soil chemical deficiencies must be corrected, based on a chemical analysis of the re-spread soil. A chemical analysis from an agricultural laboratory will include a recommendation of the appropriate quantities of chemical ameliorants (for example lime, phosphate etc) that should be applied to optimize the soil chemistry for the relevant crop. It is important that rehabilitation is taken up to the point of cover crop stabilisation. Rehabilitation cannot be considered to be complete until the first cover crop is well established.
10. The rehabilitated area must be monitored for erosion, and appropriately stabilised if any erosion occurs.
11. If any alien vegetation is introduced by mining activity it must be removed and on-going alien vegetation control must keep the area free of alien vegetation.

7 Conclusions

This assessment has found that there are adequate reserves of sand on site for mining and rehabilitation. Soils are very sandy with low water holding capacity which results in low to medium agricultural potential. The site is used for and is suitable for irrigated crop cultivation, but the low water holding capacity is a limitation.

The direct potential impact of mining on the land is to change its agricultural potential by way of different identified mechanisms. There are both positive and negative effects of sand mining. The potential positive effects are:

1. Increase in clay content and resultant water holding capacity of the soil, due to the removal of the upper, more sandy soil.
2. Decreased slope due to the levelling effect of excavation.

The potential negative effects are:

1. Loss of agricultural land for duration of mining
2. Loss of topsoil and fertility during mining and stockpiling
3. Erosion
4. The creation of steep slopes and uneven surfaces
5. Alien vegetation encroachment
6. Soil contamination from fuel spills

Of the above the most important effects are the two positive effects as well as the creation of steep slopes and uneven surfaces. Realising the positive effects and minimising the negative ones is highly dependent on effectively implementing the mitigation measures and rehabilitation plan that are provided in this report. All the recommended steps must be well managed and effectively implemented in order for rehabilitation to be successful, especially controlling the mining depths to ensure a flat and level surface after rehabilitation.

If rehabilitation is successful, the land is likely to have a slightly higher agricultural potential than what it was pre-mining. With effective mitigation, the impact on agricultural potential is therefore assessed as having low significance. Without mitigation or with ineffective mitigation it can result in negative impacts of higher significance, that destroy all agricultural potential.

Mine management must be held accountable for well managed and effectively implemented rehabilitation. The specific, measurable rehabilitation outcomes against which the effectiveness of completed rehabilitation must be measured are:

1. that the topography and surface has been sufficiently smoothed, without steep excavation edges, to allow for cultivation and the passage of the centre pivots;
2. that topsoil has been spread across the entire surface;
3. that there is a potential rooting depth of at least 50 cm of non-compacted soil material, which is suitable for root growth, across the entire mining area;
4. that there are no non free-draining depressions across the surface and that the depth of mining has not created an effective sub-surface dam, that is lower than the low point for drainage out of the mining area;
5. that there is no visible erosion across the area, or down-slope of it as a result of mining, and that no part of the area has been left unacceptably vulnerable to erosion;
6. that a successful cover crop has been established across the entire area.

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