Johann Lanz
Soil Scientist (Pri.Sci.Nat)

Cell: 082 927 9018
e-mail: johann@johannlanz.co.za

1A Wolfe Street
Wynberg
7800
Cape Town
South Africa

Assessment of the impact of sand mining on agricultural potential on the farm Sandvlei number 1020, near Riebeek West

Table of Contents

1 Introduction and brief

Johann Lanz was appointed to conduct a soil survey on a part of the farm Sandvlei number 1020, near Riebeek West. 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 22 May 2019. A total of 18 test pits were investigated within the indicated part of the farm. The location of the farm is shown in Figure 1. Data from the test pits is provided in Appendix 1, and the positions of all test pits are shown in Figure 2.

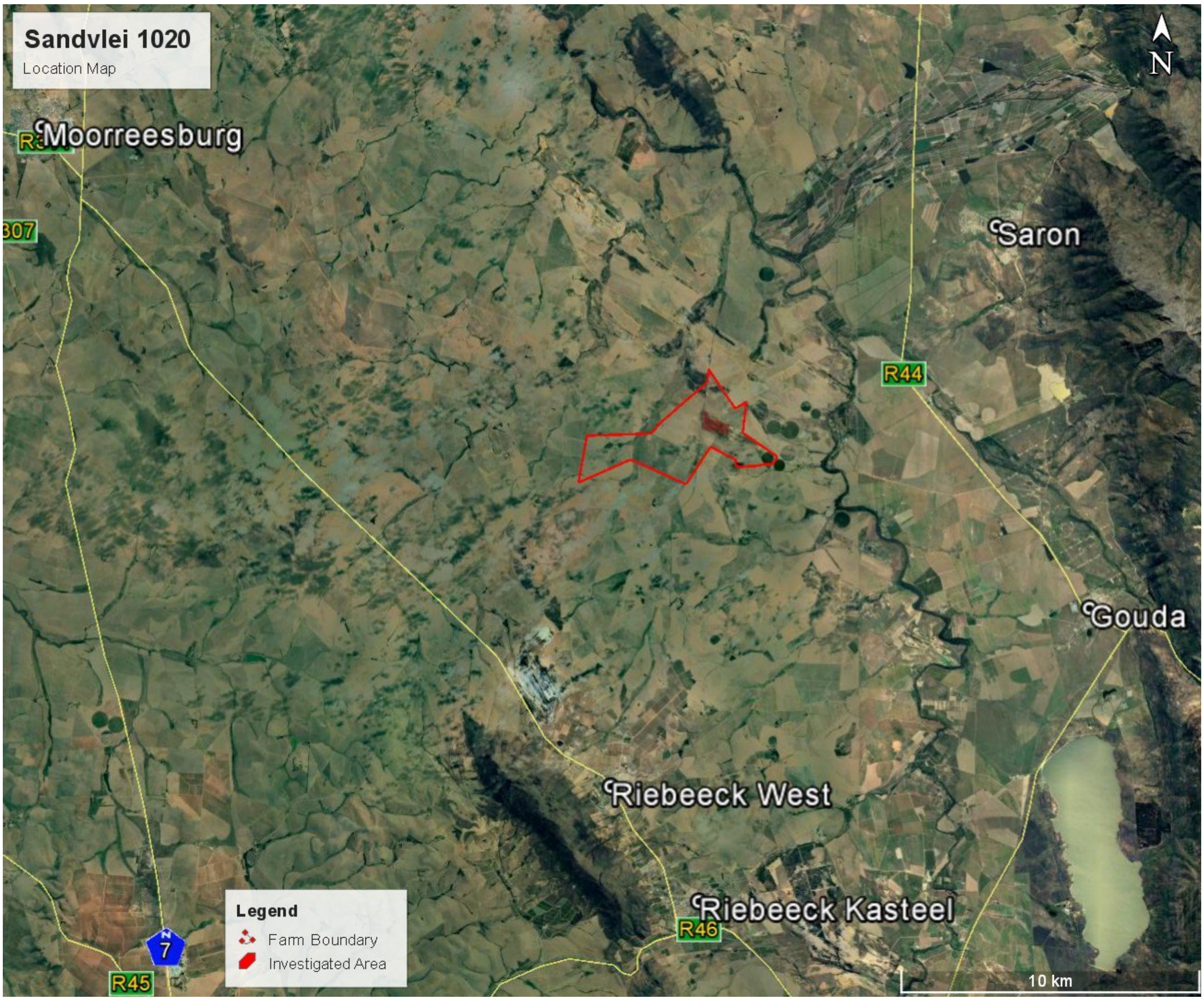

Figure 1. *Location of the soil investigation.*

2 Soils and agricultural potential

The geology of the area is mainly greywacke and phyllite of the Moorreesburg Formation, Malmesbury Group, mostly covered by Quaternary quartz sand of the Springfontein Formation. The soils are generally deep sands overlying clay. Soils generally have upper horizons of light yellow coloured sand, underlain by lighter coloured sand, overlying clay. The sands are up to about 2.2 metres deep. Soils are classified, according to the South African soil classification system, predominantly as Fernwood 1210 where soils are deeper, and Kroonstad 2000 where the clay is shallower.

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

The soils are limited by the very sandy texture 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 as >3 - ≤5 out of 10 according to the system used by Western Cape soil scientists. The uneven, dune topography of the site and the infestation of alien wattles further limit cultivation potential. The area is classified with a land capability value of 8. The low water holding capacity in combination with the fairly low and erratic rainfall of the area, limits the agricultural potential. The future agricultural potential of the zone, Swartland is rated on Cape Farm Mapper as remaining high for small grains but with increasing yield variability.

3 Agricultural land use

The investigated area is on land that, probably because of the dune topography and sandy soils, has never been under cultivation. The site is heavily infested by alien wattles. The surrounding lands are planted to small grains.

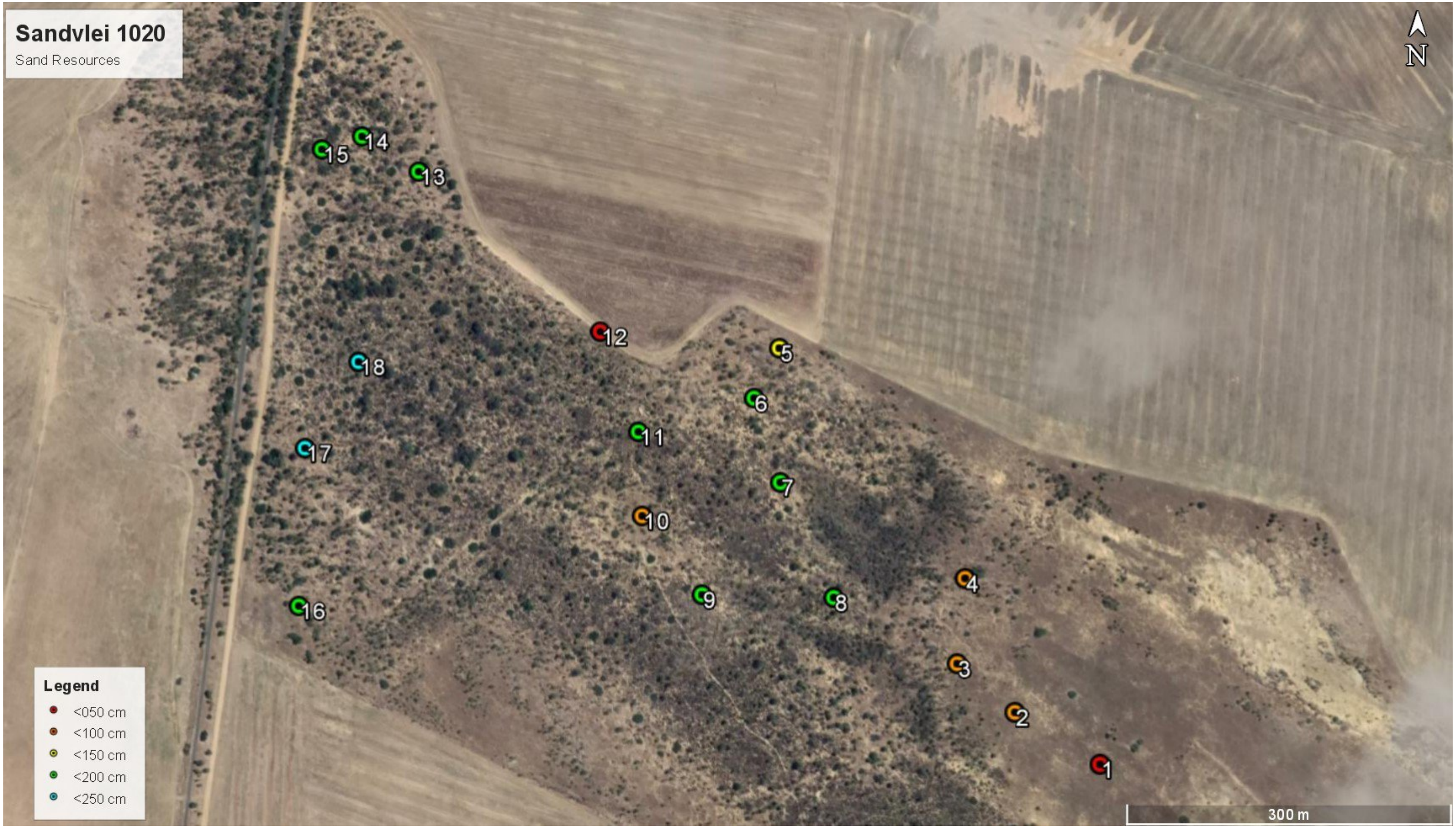

Figure 2. *Satellite image showing all investigated test pits colour coded for total sand depths (image date: 14/02/2019).*

Figure 3. *View of typical site conditions, showing the extent of wattle invasion.*

Figure 4. *Typical deep sand soil profile of the investigated area (Fernwood soil form).*

4 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.

4.1 Indirect impacts

The following potential indirect impacts are identified

4.1.1 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 proposed mine has low visibility from the surrounding area and is not close to agritourism features. 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 rather be addressed within a social impact assessment.

4.1.2 Dust deposition on surrounding crops

Sand mining can result in dust on surrounding crops, but there are no dust sensitive agricultural crops such as vineyards or orchards in the area.

4.2 Direct impacts

Direct impacts are viewed in the context of the agricultural potential of the site, which is limited by sandy soils with low water holding capacity, uneven topography and wattle infestation, which makes it unsuitable for cultivation.

Mining will change the existing soil profile through the removal of all sandy material below the upper 50 cm. 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 reduction 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 direct impacts are identified.

4.2.1 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. Given the low to medium agricultural potential of the land, the fact that there is no agriculture on it, and the fact that the duration of mining will be limited, the significance of this impact is low.

4.2.2 Reduction in soil depth

Removal of sand from the soil profile will decrease the depth of suitable rooting material and the total soil moisture reservoir, above a depth limiting clay layer in the sub soil. The retention of at least 50cm depth of rooting material (as recommended under mitigation) will mean that the loss of rooting depth is not significant to agricultural use, under the soil and agricultural potential that exists on site (shallow rooted crops).

4.2.3 Impaired soil drainage resulting in water logging in potential root zone

The investigated soils are reasonably well-drained because of their depth and permeability and the dune topography elevates the site above the surrounding area. However, some lateral water movement down-slope above the clay layer will occur periodically after significant rain. Reduction in the soil depth above the clay layer will mean that the lateral water movement will occur closer to the soil surface and therefore potentially impact more on the root zone.

Furthermore, the creation of surface and/or subsurface depressions that are not free draining, will also incur some risk of water logging in the potential root zone. Although the site is slightly elevated, the slope of the area is minimal (approximately 2%). Depth of mining and the slope of the mining floor will need to be carefully controlled to ensure that mining does not create a depression.

The retention of at least 50cm depth of sandy rooting material above the clay and ensuring that depressions are free-draining (as recommended under mitigation) will keep this impact of low significance for shallow rooted crops.

4.2.4 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.

4.2.5 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 accelerated run-off is not anticipated, but erosion risk still exists. Mitigation of significant impact is highly dependent on effective erosion management during mining and during the rehabilitation phase.

4.2.6 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.

4.2.7 Alien vegetation encroachment

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

4.2.8 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.

5 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. 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.
2. The upper 50 cm of the soil must be stripped and stockpiled before mining. Mining can then be done down to the clay layer (or other depth limiting layer).

3. 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.
4. Topsoil stripping, stockpiling and re-spreading must be done in a systematic way. The mining plan should be such that topsoil is stockpiled for the minimum possible time by rehabilitating different mining blocks progressively as the mining process continues.
5. Topsoil stockpiles should be protected against losses by water and wind erosion. Stockpiles should be positioned so as not to be vulnerable to erosion. 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.
6. To ensure minimum impact on drainage, it is important 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.
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.
8. Thereafter, the stockpiled topsoil must be evenly spread over the entire mining area, so that there is a depth of at least 50cm of sandy topsoil above the underlying clay. The depth should be monitored during spreading to ensure that coverage is adequate and even.
9. Topsoil spreading should only be done at a time of year when moisture is available for vegetation growth so that vegetation cover can be established as quickly as possible after spreading. This is to minimize erosion of returned topsoil by both rain and wind, before vegetation is established.
10. A cover crop must be planted and established immediately after spreading of topsoil, to stabilise the soil and protect it from erosion. The cover crop should be fertilized for optimum 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.
11. The rehabilitated area must be monitored for erosion, and appropriately stabilised if any erosion occurs.
12. On-going alien vegetation control must keep the area free of alien vegetation after mining.

6 Conclusions

This assessment has found that there are adequate reserves of sand on site for mining and rehabilitation. Soils are sandy with low water holding capacity, which in combination with the uneven dune topography and alien vegetation encroachment makes the site unsuitable for cultivation.

The direct potential impact of mining on the land is to reduce its agricultural potential by way of different identified mechanisms:

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

Of the above the most important impacts are impaired soil drainage on the lower parts of the landscape; and loss of topsoil.

Mitigation measures and a rehabilitation plan are provided in this report. Successful mitigation and rehabilitation of impacts is highly dependent on maintaining a sufficient level of environmental management. All the recommended steps must be well managed and effectively implemented in order for rehabilitation to be successful.

If rehabilitation is successful, the agricultural potential will not be reduced. With effective mitigation, the reduction in agricultural potential is therefore assessed as having low significance. Without mitigation or with ineffective mitigation it can result in impacts that prevent any potential future agricultural production on the site.

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 has been sufficiently smoothed to allow cultivation;
2. that the slope has not been steepened anywhere by mining excavations to the extent that it is problematically steep for cultivation;
3. that topsoil has been spread on the surface;

4. that there is a potential rooting depth of at least 50 cm above the clay of non-compacted soil material, which is suitable for root growth, across the entire mining area;
5. 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;
6. 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;
7. that a successful cover crop has been established across the entire area.

Johann Lanz (Pri. Sci. Nat.)
31 May 2019

Appendix 1: Measured depths in all investigated test pits.

Test pit no.	GPS Position Lat/Lon hddd.ddddd° WGS84		Total sand thickness (cm)	Mine-able sand thickness (cm)
	latitude	longitude		
1	-33.2436081581	18.9111669548	30	0
2	-33.2431787532	18.9103228133	60	10
3	-33.2427723147	18.9097473118	80	30
4	-33.2420583442	18.9098317176	50	0
5	-33.2401104737	18.9079842623	100	50
6	-33.2405384537	18.9077233337	180	130
7	-33.2412543520	18.9079848491	150	100
8	-33.2422248088	18.9085186925	160	110
9	-33.2422062848	18.9071912505	160	110
10	-33.2415407617	18.9065838978	60	10
11	-33.2408237737	18.9065451734	160	110
12	-33.2399621140	18.9061528165	50	0
13	-33.2385728974	18.9042723365	180	130
14	-33.2382686343	18.9036871120	180	130
15	-33.2383835502	18.9032756444	180	130
16	-33.2423211168	18.9030450583	180	130
17	-33.2409625780	18.9031093474	200	150
18	-33.2402188517	18.9036583621	220	170