Environmental Impact Assessment for the Establishment of the Langhoogte Wind Farm, Western Cape Province

Environmental Impact Report

AGRICULTURAL IMPACT ASSESSMENT

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Date: 04 December 2012
I, Francois H Knight, as duly authorised representative of Agri Informatics, hereby confirm my independence (as well as that of Agri Informatics) as the Agricultural specialist for the Langhoogte Wind Farm and declare that neither I nor Agri Informatics have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Arcus GIBB was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act) for the Langhoogte Wind Farm. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 and any other specific and relevant legislation (national and provincial), policies, guidelines and best practice.

Signature: ______________________________

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Date: 04 December 2012
Title / Position: Director
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EXECUTIVE SUMMARY

Agri informatics was contracted by Gibb Engineering and Science – the appointed Environmental Assessment Practitioner – on behalf of the applicant Sagit Energy Ventures to conduct an Agricultural Impact Assessment of the proposed Langhoogte Wind Farm, consisting of up to 45 turbines of maximum 3.6 MW each. The study area included 15 farm portions with a combined farm area of almost 3550 ha. Farming activities are limited to small irrigated pasture fields along the Bot River, extensive dryland winter cereal production and livestock (mainly sheep) on planted pastures, as part of the crop rotation system.

The study evaluated the possible impacts, using the guidelines of the Department of Agriculture Forestry and Fisheries on renewable energy structures on agricultural land. The study entailed an extension of the desktop assessment earlier conducted by Patterson (2012) followed by field observations of the natural resources and agricultural practices. The impacts of the proposed wind turbine layout were assessed, where after recommendations were made to minimise the anticipated impacts. Except for ten wind turbines, all recommendations could be integrated by the applicant into the final layout plan. Further mitigation measures to reduce the impact of these turbine where made, which should reduce the potential impact of the wind farm to the loss in small grain production of less than 2 ton/a and loss of grazing for about 3 ewes.

The additional farm income generated from the lease of the land to the wind farm operator is expected to contribute significantly to the general economic outlook of the farming ventures involved.
ENVIRONMENTAL IMPACT ASSESSMENT FOR THE ESTABLISHMENT OF THE PROPOSED LANGHOOGTE WIND FARM, WESTERN CAPE PROVINCE: AGRICULTURAL IMPACT REPORT

CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DETAILS OF SPECIALIST AND EXPERTISE</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>INTRODUCTION</td>
<td>8</td>
</tr>
<tr>
<td>2.1</td>
<td>Background</td>
<td>8</td>
</tr>
<tr>
<td>2.2</td>
<td>Legislative and Policy Context</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>Scope and limitations</td>
<td>11</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Scope of work</td>
<td>11</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Presentation of findings</td>
<td>12</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Limitations</td>
<td>12</td>
</tr>
<tr>
<td>2.4</td>
<td>Assessment Methodology</td>
<td>12</td>
</tr>
<tr>
<td>2.4.1</td>
<td>The study area</td>
<td>12</td>
</tr>
<tr>
<td>2.4.2</td>
<td>Information base</td>
<td>13</td>
</tr>
<tr>
<td>2.4.3</td>
<td>Literature surveys</td>
<td>13</td>
</tr>
<tr>
<td>2.4.4</td>
<td>Aerial photo interpretation</td>
<td>14</td>
</tr>
<tr>
<td>2.4.5</td>
<td>Ground truthing</td>
<td>14</td>
</tr>
<tr>
<td>2.5</td>
<td>Description of any assumptions made, uncertainties or gaps in knowledge</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>DESCRIPTION OF AFFECTED ENVIRONMENT</td>
<td>15</td>
</tr>
<tr>
<td>3.1</td>
<td>General overview of affected environment</td>
<td>15</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Geomorphology</td>
<td>15</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Surface hydrology</td>
<td>16</td>
</tr>
<tr>
<td>3.2</td>
<td>Present agricultural activity</td>
<td>17</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Regional agriculture</td>
<td>17</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Agriculture in the study area</td>
<td>18</td>
</tr>
<tr>
<td>3.3</td>
<td>Natural resources of the study area</td>
<td>29</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Climate</td>
<td>29</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Water</td>
<td>30</td>
</tr>
</tbody>
</table>
3.3.3 Geology and soils
3.4 Agricultural potential
3.4.1 Irrigated cultivation
3.4.2 Dry land cultivation
(a) Winter cereals
(b) Planted pastures
3.4.3 Livestock farming
3.4.4 External factors
3.4.5 Resulting agricultural potential
3.5 Study area sensitivity analysis

4 IMPACTS IDENTIFICATION AND ASSESSMENT
4.1 Introduction
4.2 Identification of Impacts
4.2.1 Degredation or occupation of agricultural resources
4.2.2 Interference with agricultural production
4.2.3 Impact on agri tourism
4.3 Impacts during Construction
4.3.1 Impact 1: Degredation of the natural resource: Soil Erosion
4.3.2 Impact 2: Disturbance to the soil profile and structure
4.3.3 Impact 3: Disturbance to surface drainage works
4.3.4 Impact 4: Disruption of farming activities
4.4 Impacts during Operation
4.4.1 Impact 1: Occupation of high potential arable or cultivated land
4.4.2 Impact 2: Interference with aerial crop spraying
4.4.3 Impact 3: Visual impact
4.4.4 Impact 4: Increased security
4.4.5 Impact 5: Additional farm income
4.4.6 Decommissioning phase
4.4.7 Cumulative Impacts
4.4.8 Impact of substation and transmission line
4.5 Potential Mitigation Measures
4.5.1 DAFF prescribed mitigation measures
4.5.2 Site specific mitigation measures
4.6 Impact Assessment Methodology
4.7 Impact Assessment – Langhoogte Wind Farm
4.7.1 Construction phase
4.7.2 Operational phase

5 MONITORING PROGRAMME

6 CONCLUSION
TABLES

Table 1: Cadastral units affected by the proposed wind energy facility
Table 2: Areas per land use category
Table 3: Soil properties of the land types
Table 4: Soil associations of the study area
Table 5: Theoretical irrigation requirements of key crops, grown at Langhoogte
Table 6: Calculation of ETcrop, soil water balance and crop water deficit
Table 7: Comparative profit margins in wheat production
Table 8: The sensitivity analysis map legend

FIGURES

Figure 1: Locality of the Langhoogte wind farm
Figure 2: The land portions of the study area
Figure 3: Cumulative distribution of slope gradients in the study area
Figure 4: Hydrology of the study area
Figure 5: Regional agricultural context of the site
Figure 6: Land use in the study area of the proposed Langhoogte wind farm
Figure 7: Rainfall and evaporation as recorded at the Boontjieskraal weather station
Figure 8: Spatial distribution of winter rainfall
Figure 9: Geology of the study area
Figure 10: Land types of the study area
Figure 11: Land capability of the study area
Figure 12: Water supply and demand of dry land wheat
Figure 13: Extract from the wheat potential map of the Western Cape
Figure 14: Sensitivity of the Langhoogte receiving agricultural environment
Figure 15: Sensitivity of the Langhoogte receiving agricultural environment – cultivated fields
Figure 16: Runoff from hard standing areas and contour banks
Figure 17: Importance of contour bank integrity
Figure 18: Special structures are required to collect and channel water flow
Figure 19: Proposed overhead power line route options
Figure 20: Preferred turbine foundation design

APPENDICES

Appendix 1: Climate summary of Boontjieskraal
ABBREVIATIONS

AIA  Agricultural Impact Assessment
amsl  Above Mean Sea Level
ARC  Agricultural Research Council
BGIS  Biodiversity GIS
CARA  Conservation of Agricultural Resources Act
DAFF  Department of Agriculture Fisheries and Forestry
DAWC  Department of Agriculture: Western Cape
DWA  Department of Water Affairs
ESRI  Environmental Systems Research Institute
GIS  Geographic Information Systems
GPS  Global Positioning System
ISCW  Institute for Soils Climate and Water
LSU  Large Stock Unit
LUPO  Land Use planning Ordinance
NDA  National Department of Agriculture
SALA  Subdivision of Agricultural Land Act
SRTM  Shuttle Radar Topographic Mission
SSU  Small Stock Unit
WRC  Water Research Commission

GLOSSARY

**Study area:**  Refers to the entire study area encompassing all the farm portions as indicated on the study area map.

**Turbine site:**  Refers to the specific location of one of the turbines

**Aeolian:**  Wind transported soil material

**Alluvial:**  Water transported soil material

**Colluvial:**  Soil material transported by the force of gravity

**Scree:**  Accumulation of broken rock fragments at the base of steep mountain slopes

**Horizon (Soil horizon):**  A diagnostic layer in the soil

**Solum:**  The upper part of the soil above the parent material, where geomorphologic processes occur actively.
1 DETAILS OF SPECIALIST AND EXPERTISE

This report was compiled by François H Knight, principal consultant at Agri Informatics. Mr Knight holds a B.Sc.Agric.Hons degree in Soil Science from the Free State University, a post graduate diploma in terrain evaluation from Potchefstroom University and a M.Sc.Agric. *cum laude* degree in Soil Science from the University of Stellenbosch. He has more than 25 years experience in natural agricultural resource assessments, which stems from his work as a senior researcher at the Department of Agriculture and, for the past 11 years, as an independent consultant.
INTRODUCTION

2.1 Background

Sagit Energy Ventures is planning to develop the ‘Langhoogte Wind Farm’ on a site approximately 2.5 km northeast of Botriver in the Western Cape (Figure 1). The project proposes the installation of up to 45 wind turbines, each with a nominal generation capacity of maximum 3.6 MW, for national distribution and would contribute to targets for renewable energy generation in South Africa and the Western Cape Province.

This study forms part of a full Environmental Impact Assessment (EIA). A brief desktop study on the soils and agricultural potential was conducted during the Scoping phase and a need for a more detailed Agricultural Impact Assessment (AIA) was identified and therefore commissioned by Gibb Engineering and Science – the appointed Environmental Assessment Practitioner – on behalf of the applicant Sagit Energy Ventures. This document reports on the findings of such an investigation and attempts to fulfil this requirement.

2.2 Legislative and Policy Context

The Department of Agriculture, Forestry and Fisheries (DAFF) has enacted a set of regulations pertaining to the development of renewable energy facilities on agricultural land in terms of Act 70 of 1970 (Subdivision of Agricultural Land Act) & Act 43 of 1983 (Conservation of Agricultural Resources Act). The following is an excerpt from the regulations, dated 8 September 2011:

*The following regulations aim to adhere to the requirements and specifications as stated in the mentioned Act. The regulations should be seen in context with another and not as separate entities and should be adhered to or taken into consideration when establishing a renewable energy operation with its associated structures:*

1. No renewable energy structure, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed on high potential or unique agricultural land as has been determined or identified by DAFF or the relevant provincial Department of Agriculture through its existing or future developed spatial information data sets and / or through a detail agricultural potential survey. Any area under any form of irrigation is also defined as high potential agricultural land.

2. No renewable energy structure, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed on areas currently being cultivated (cultivated fields/ production areas) or on land that have been cultivated in the last ten years. This is relevant to cultivated land utilized for dry land production as well as land under any form of irrigation.
3. No sub-division of agricultural land will be allowed to accommodate the establishment of any renewable energy structure, supporting infrastructure or access routes in any form or for any purpose unless the application adheres to the norms and standards for approval of the sub-division of agricultural land.

4. Change of land use on demarcated agricultural land for the establishment of any renewable energy structure, supporting infrastructure or access routes in any form or for any purpose will be reviewed on merit and informed or guided by the relevant planning legislation applicable to the area concerned. The recommended change of land use will be temporarily, dependent on the life span of the project where after the land should revert back to agriculture automatically. This exemption will be underwritten by specific conditions to ensure continued agricultural production and the protection of the natural agricultural resources, where applicable.

5. No renewable energy structure, its footprint, service area, supporting infrastructure or access routes in any form or for any purpose should impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads etc).

6. No renewable energy structure, its footprint, service area, supporting infrastructure or access routes in any form or for any purpose should result in a degradation of the natural resource base of the farm or surrounding areas. This includes, but are not limited to, the limit of soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition and condition of both natural or established vegetation). It also should not impact negatively on:

6.1. Wetlands (land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil). No renewable energy structure, supporting infrastructure or access routes will be allowed on a wetland, vlei, pan, drainage line or any other water body unless otherwise approved by DAFF.

6.2. Flow pattern of run-off water. No renewable energy structure, supporting infrastructure or access routes shall in any manner divert any run-off water from a water course to any other water course or obstruct the natural flow pattern of runoff water, except with the permission from DAFF.

6.3. Utilization and protection of vegetation. Every care should be taken before, during and after the construction and future maintenance of the renewable energy structure, supporting infrastructure or access routes to protect the vegetation and veld condition against deterioration and destruction.

7. No renewable energy structure, supporting infrastructure or access routes should result in soil loss as a result of erosion through the action of water or wind. It is the responsibility of the owner of the renewable energy project to ensure that suitable soil conservation works be established on the site to limited or restrict the loss of soil.

8. No renewable energy structure, its footprint, service area, supporting infrastructure or access routes in any form or for any purpose should result in a degradation of existing soil conservation work. This includes but is not limited to:
8.1. Established contour banks. Where possible every care should be taken not to erect a renewable energy structure, supporting infrastructure or access routes on an existing established contour bank. Should it however necessitate such an action (per approval from DAFF) all precautionary actions should be taken not to degrade the contour bank. The applicant has the responsibility to ensure that a contour bank should be re-established in a suited standard, as approved by a qualified soil conservation specialist.

8.2. Waterways (an artificial flow path constructed on land in order to carry away run-off water without causing excessive soil loss). Where possible every care should be taken not to erect a renewable energy structure, supporting infrastructure or access routes on an existing established waterway. Should it however necessitate such an action (per approval from DAFF) all precautionary actions should be taken not to degrade the waterway. The applicant has the responsibility to ensure that a waterway should be re-established in a suited standard, as approved by a qualified soil conservation specialist.

9. Renewable energy structures or supporting infrastructure should, where possible, not be established on slopes (the vertical difference in height between the highest and the lowest points of that portion of land, expressed as a percentage of the horizontal distance between those two points) of more than 20%. Should there however be no other suitable site, every care should be taken not to cause erosion in any form on the site concerned. This may necessitate the establishment of contours, terraces, gabion structures or any other soil conservation feature that may deem to be necessary.

10. All access routes, existing or newly constructed and utilized during the construction and/or maintenance of the renewable energy structures should be restore to its original state after completion of the establishment of the structures. Ever care should be taken not to damage or degrade the status of the natural resources base of the farm during the construction phase of the mentioned or to impact negatively on the farming or production practices on the farm.

11. All service routes that will be used to gain access to the renewable energy structures for maintenance purposes have to be covered in gravel, tarred or compressed in order to limit the possibility of degradation and erosion.

12. The installation of the underground power cables should not negatively impact on the resource base of the site. During the installation no soil conservation structure should be disturbed, the soil texture should be restored, the work area should not be wider than 5 m, should not be directed through existing or future cultivated land nor impact negatively on existing farming infrastructure or any farming activity.

13. A lease agreement under Act 70 of 1970 if granted and conceded to will be granted for a period of maximum 25 years or shorter period as may have been applied for by the Applicant.

14. The lease agreement should be transferred to the new land owner, should the farmer decide to sell the property during the time period of the current lease agreement. DAFF needs to be informed of the transfer of the lease agreement upon which a new approval number will be issued. Supporting documentation should be provided that the new land owner concurs with the specifications of the existing lease agreement.

15. DAFF will comment and raise its concerns pertaining to the EIA Regulations operational under the National Environmental Management Act through the registration of an “Affected
and interested party” and through formal interaction with the Department of Environmental Affairs.

16. The Department reserves the right to visit the renewable energy site at any time without prior arrangement to review the status of the natural resource base and the impact of the renewable energy structures. Should it be found that a degradation of the resource base has occurred as a result of the renewable energy structures or related activities, it will be the responsibility of the renewable energy structure lessee to restore the resource base at his / her own cost and within time frames as indicated by DAFF.

Both potential impacts and guidelines for mitigation are addressed in these regulations and will be drawn from, when evaluating the specific impact potential of the Langhoogte WEF, in the following chapters of this report.

An Agricultural Impact Assessment (AIA) is also required in terms of the Land Use Planning Ordinance 15 of 1985 (LUPO) in so far as the comment of the Department of Agriculture is needed in all applications for a long term lease agreement on agricultural land.

2.3 Scope and limitations

Agri Informatics was contracted to conduct an Agricultural Impact Assessment on the properties and sites identified for the wind energy facility at Langhoogte, as indicated in Figure 1.

2.3.1 Scope of work

The assessment had to include:

- Reconnaissance scale assessment of the soils and geology of the site
- Climate analysis, crop suitability assessment and water requirements
- Summary of available water sources (ground water, surface water and scheme water for irrigation and/or livestock)
- Topography/surface hydrology and impact on agricultural activities
- Current and historic agricultural activities
- Compilation of an agricultural land use map, including cultivated fields, natural veld, sensitive agricultural infrastructure such as contour banks and waterways
- Existing carrying capacity derived from general grazing capacity norms for the site
- Assessment of the agricultural potential of the properties, as determined by the availability and condition of the resources and relative access to markets
- Agricultural use during and after wind farm operation
- Description of potential impacts of the proposed WEF on agricultural resources, activities and potential farm income
- General description of mitigation measures and possible benefits
- Management and monitoring guidelines
- Report and Constraints Map
2.3.2 Presentation of findings

The findings of the assessment had to be presented in both digital and hardcopy formats. GIS data to be projected to WGS84, Transverse Mercator LO19.

2.3.3 Limitations

No specific limitations that could impact on the outcome of the findings of this study were indentified.

2.4 Assessment Methodology

2.4.1 The study area

The study area is situated in the Western Cape, between ±1 and ±12 km northeast of Botriver, to the north of the N2 and consists of 15 farm portions, spanning an area of almost 3700 ha as shown in Figure 2. The target properties are listed in Table 1.

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| Total as per GIS | 3546.8028 |
|                  | 3696.3033 |

No turbines are proposed for Remainder of Farm 356, Portion 1 of 362, Portion 2 of 362 or Portion 12 of 426. A new substation is proposed to be situated on Portion 1 of 362 (Figure 2).
2.4.2 Information base

The information used in this study was based on the following:

- A literature review; (see list provided in References)
- A collection of relevant spatial data
- A site visit
- Professional judgment based on experience gained with similar projects.

2.4.3 Literature surveys

A literature study was undertaken on the agricultural potential and activities of the study area. The literature search included formally published literature, documentation provided by the Provincial Department of Agriculture and other parastatal bodies and spatial (GIS) data from various sources, such as the Water Research Commission and the ARC Institute for Soils, Climate and Water.

Relevant documentation compiled by various specialists and Gibb Engineering and Science for the earlier Environmental Impact Assessment process, was also consulted, with specific reference to the Soils and Agricultural Potential Scoping Assessment of the ARC-Institute for Soils Climate and Water and also the relevant minutes/summaries of the public participation process. Also see the list of publications.
2.4.4 Aerial photo interpretation

Agricultural land use activities and trends were derived from aerial photo interpretation, observations made during the site visits and limited GPS recordings. Delineation (digitising) of clearly recognisable features and spatial patterns was used to derive surface areas per land use class, while features such as farm roads, dams, drainage lines and other farm infrastructure were also mapped from aerial imagery.

2.4.5 Ground truthing

Ground truthing mainly entailed the observation and GPS surveying of mapped features as well as observations on the soil properties visible in exposed soil profiles.

2.5 Description of any assumptions made, uncertainties or gaps in knowledge

No specific assumptions that could significantly alter the findings of the study, were made.
3 DESCRIPTION OF AFFECTED ENVIRONMENT

3.1 General overview of affected environment

3.1.1 Geomorphology

The study area is situated in the western part of the Rûens region of the Overberg.

The landscape of the study area varies from the steep mountain slopes of the Houwhoek mountains in the west to the typically undulating hills of the Rûens in the central and eastern parts. Although the farm portions involved, reaches to an altitude of 830 m amsl, the turbines will be on the footslopes and valley floor at altitudes between 200 m and 285 m amsl. While only 35% of the land has slopes below 10% slope gradient, 80% has slope gradients less than 20% (Map 2 in Appendix). These very steep slopes occur on the high elevations in the west, out of the proposed development area. The cross sections in Figure 2 shows the moderate slope gradients of the undulating hills, where the turbines are to be placed.

![Figure 2: The land portions of the study area. The profile above is along the cross section A-B, indicated by the dotted line. White circles represent the proposed turbine positions.](image-url)

**NOTE:** Different X and Y axis scales in Figure 2 result in a largely exaggerated presentation of slope gradients.
All proposed turbine sites are on slopes less steep than 20%, while 26 out of 45 are on slopes below 10%.

![Cumulative distribution of slope gradients in the study area. All turbines sites are within the green area (slopes <20%).](image)

**Figure 3**: Cumulative distribution of slope gradients in the study area. All turbines sites are within the green area (slopes <20%).

### 3.1.2 Surface hydrology

The study area is situated in quaternary catchments G40E and G40F, two sub-catchments of the catchment area of the Bot River. The western part of the study area (west of the R43) drains directly into the Bot River, while the portion east of the R43 drains into the Swart River, a tributary of the Bot River. Both the Swart and Bot Rivers are indicated as perennial rivers, but the Swart River is expected to be more intermittent, while the other streams and drainage lines in the study area are ephemeral. Numerous small dams and ponds are found scattered across the study area. They are exclusively used for livestock drinking purposes. A single larger dam – estimated at about 50 000 m³ – is found in one of the mountain streams west of the Bot River (Figure 4) and can be used for the supplementary irrigation of small fields on the floodplain of the Bot River with a combined area of 23 ha.
3.2 Present agricultural activity

3.2.1 Regional agriculture

The study area falls in the Overberg region of the Western Cape Province. Together with the Swartland it forms the main small grain producing area of the winter rainfall region of South Africa. It is also the main malt barley growing region of the country, a major supplier to the beer industry.

Three different homogeneous farming areas (HFA) have been demarcated by the Department of Agriculture: Western Cape, in the vicinity of the study area (Figure 5). These are Rüens, Bot River and Mountains, where the Mountains HFA are the steep mountain slopes of the Houwhoek mountains, without any significant agricultural potential, due to steep slopes and low grazing value of the predominantly fynbos natural vegetation. The Bot River HFA includes the valley floor and undulating hill slopes along the Bot River, where some irrigation water is available. Apart from wine grapes and limited deciduous fruit production, the water is mostly used for planted pastures.

The bulk of the study area is however in the western most part of the vast Rüens HFA. Here the main agricultural activity is small grain production in combination with sheep, cattle (mostly beef) and/or localised ostrich farming – the latter more towards the east (Heidelberg – Riversdale). A crop rotation system of barley, wheat, canola and oats as grain crops and lucerne for grazing is mostly followed, while smaller areas of fodder crops will also be planted. Crop surveys by Elsenburg indicate a ratio of 45:50:5 between cash crops, pastures and

Figure 4: Despite the watershed (solid blue line), approximately along the R43, the entire study area drains into the Bot River. The proposed positions of the turbines are indicated by white dots.
fallow land in any year. Figure 5, provides an overview of the regional agricultural context of the site.

Figure 5: The study area is spread over three homogeneous farming areas (orange lines). Perennial crops (mostly irrigated) are shown in darker green and annual crops in olive green.

### 3.2.2 Agriculture in the study area

A land use map (Figure 6) has been compiled from aerial imagery (NGI & Google Earth) and personal ground observations, to determine the extent of the cultivated areas. Table 2, provides a summary of the results. Based on an analysis of older imagery no significant land use changes during the past decade is evident.

**Table 2: Areas per land use category.**

<table>
<thead>
<tr>
<th>Land use category</th>
<th>Area (ha)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated fields (with contour banks)</td>
<td>2138</td>
<td>55%</td>
</tr>
<tr>
<td>Natural veld &amp; Drainage areas</td>
<td>949</td>
<td>24%</td>
</tr>
<tr>
<td>Cultivated fields (with contour banks)</td>
<td>668</td>
<td>17%</td>
</tr>
<tr>
<td>Old fields</td>
<td>34</td>
<td>0.9%</td>
</tr>
<tr>
<td>Roads &amp; roads reserves</td>
<td>33</td>
<td>0.8%</td>
</tr>
<tr>
<td>Farmsteads and un-cultivated land</td>
<td>26</td>
<td>0.7%</td>
</tr>
<tr>
<td>Irrigated fields</td>
<td>23</td>
<td>0.6%</td>
</tr>
<tr>
<td>Earth dams, dam areas &amp; ponds</td>
<td>21</td>
<td>0.5%</td>
</tr>
<tr>
<td>Fall out land</td>
<td>17</td>
<td>0.4%</td>
</tr>
<tr>
<td>Plantations (Eucalyptus)</td>
<td>10</td>
<td>0.2%</td>
</tr>
<tr>
<td>Perennial crops (Fruit orchards)</td>
<td>1</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3920</strong></td>
<td></td>
</tr>
</tbody>
</table>
Figure 6: Land use in the study area of the proposed Langhoogte wind farm.
**Photoset 1:** The following photographs provide a visual overview of the activities and character of the land and the farming activities.

Contoured dry land fields. Oats cut for silage in the foreground.

Lupin field with inspection point of rural livestock watering scheme

Typical pond used for livestock watering
Sheep on planted pastures

Lupins

Wheat

Blue cranes on fallow land
Typical drainage line with small dam with waterblommetjies

Another small dam

Further small dams/ponds
Typical fall out area between cultivated fields

Supplementary feeding of livestock becomes essential in late summer

Watering point in planted pasture field
Sheep is the dominant livestock farming activity.
Constructed contour banks to control runoff and reduce erosion

Natural drainage line
Severe donga erosion due to uncontrolled runoff
Donga erosion in water way

Typical small Eucalyptus plantation
Proposed Langhoogte Windfarm
Agricultural Impact Assessment

Date: 04 December 2012

Natural vegetation remnants on steep slopes in the western part of the study area

Rocky outcrop

Irrigated pastures, with powerlines

Irrigated pastures along Bot River
3.3 Natural resources of the study area

Agricultural activity and potential depends on the properties of the natural resources of the farm, namely the soil, climate, water and – for extensive grazing – the natural vegetation. The relative abundance and quality of these resources largely determines the natural agricultural potential of the property. Secondary factors like access to market, cost of production, producer prices, availability of labour and security related issues like stock/equipment theft and personal safety ultimately determines the viability of the farming enterprise.

3.3.1 Climate

The study area is ±20 km from the nearest coastline (Walker Bay) and situated at the “entrance” to an inland valley surrounded by mountain ranges. The resulting climate is marginally continental with orographic rain induced by the mountains.

The winter rainfall map in Figure 8 suggests a winter rainfall gradient between 275 mm and 350 mm in the study area. This correlates well with the rainfall record at the nearby Boontjieskraal weather station (±3km west) which indicates a rainfall of 276 mm between April and September. The area receives about 70% of its annual rainfall during the winter months, bringing the total annual rainfall to 389 mm at Boontjeskraal, while the A-pan evaporation amounts to 1664 mm per annum (Figure 7). The warmest months are January and February with an average maximum temperature of 28.6°C and 28.9°C respectively, when average highest maximum temperatures above 35°C can also be expected. Temperatures above 40°C are seldom encountered. The coldest months are July and August at average minimum temperatures of 5.5°C and 5.9°C, respectively. Lowest average minimums are -0.6°C and -0.9°C respectively. Light frost does occur infrequently, but is expected to be limited to the low laying areas. The highest wind incidence is during the summer months from October to March, when the average wind speed is moderately high at 7.5 km/h.

![Figure 7: Rainfall and evaporation as recorded at the Boontjieskraal weather station.](image-url)
Figure 8 clearly indicates the orographic effect on the spatial distribution of the annual winter rainfall\(^4\) in this part of the Western Cape, leading to winter rainfall figures above 500 mm closer to the mountain ranges, whilst the winter rainfall at the site varies between ±400 mm in the small mountain area in the far west to ±300 further east. A comprehensive monthly summary of the climate data of Boontjieskraal is attached in the appendix.

![Figure 8: Spatial distribution of winter rainfall. Note position of the Boontjieskraal weather station indicated by the blue triangle.](image)

### 3.3.2 Water

The National Water Act\(^5\) (NWA) (Act no 36 of 1998) regulates the lawful and permitted use of all water sources. In terms of the rulings of Government Notice No 399, certain water uses have been allowed for, under a General Authorisation (GA) as described under Section 39 of the NWA. The GA’s are allocated on a quaternary catchment basis and for the catchments of the study area (G40E & G40F) it allows for the abstraction of 400 m\(^3\)/ha/annum and 150 m\(^3\)/ha/annum, respectively from the groundwater source. Given the total study area of 1920 ha in catchment G40E and 1750 ha in catchment G40F, the theoretical volume of groundwater available under the GA amounts to 1 031 000 m\(^3\)/a. This figure is however totally irrelevant as the groundwater quality is very poor and unsuitable for irrigation. Also using the water for livestock drinking was severely problematic prior to the deployment of a number of rural livestock (and potable) water schemes, the one in the study area being supplied from Theewaterskloof dam\(^6\). In catchment G40E, the taking of surface water is also restricted by means of an exclusion from the general authorisations. The mean annual runoff (MAR) for the
two catchments is moderate to low at 135 mm and 51 mm, respectively. This implies that a Water Licence needs to be obtained from DWA for all irrigation dams (taking of surface water) prior to construction, apart from water harvested for livestock watering purposes. All water use also needs to be registered with DWA in their WARMS database, irrespective whether it is a licenced use or a use under the GA.

A total of 56 dams have been identified in the study area. Except for one irrigation dam west of the Bot River, all the other dams are small and only used for livestock drinking purposes.

The estimated storage capacity of the irrigation dam is ±50 000 m³ and is situated on Remainder of Farm 791, Caledon RD. As most of the irrigation water will be required during the dry summer season, when little inflow into the dam is expected, the total supply of irrigation water is assumed to be marginally more than the storage capacity of the dams. Thus an estimated 70 000 m³/a is available for irrigation. There is no irrigation scheme or other source of surface water available to the farms in the study area, apart from the rural livestock water scheme.

3.3.3 Geology and soils

Weathering of the landscape east of the Bot River has exposed a succession of geological sediments of the Bokkeveld Group, dating back to the late Silurian and early Devonian, consisting mainly of shale, siltstone and minor thin bedded sandstone. The older, thicker bedded sandstone of the Table Mountain Group is more resistant to weathering and comprises the higher mountains of the western part of the study area. Quaternary alluvium is found on the narrow valley floor of the Bot River.

Figure 9: Geology of the study area, with layout of the proposed turbine positions superimposed. (Recompiled from the 1:250 000 scale geological map series, GeoScience, 1997).
The soils of the study area have been described, by Patterson (2012)\(^7\) as part of the EIA process, based on a desktop study of the Land type dataset\(^8\) (ARC: ISCW), followed by a site visit during which a transect type survey of the soils has been conducted. The Land type data provides a 1:250 000-scale overview of the soil types and properties of South Africa and can be used as a first approximation of the soil potential of the study area, based on the descriptive information contained by the Land type memoirs. The following information was extracted from this data source and relates to the map units (Land types) as shown in Figure 10.

### Table 3: Area weighted mean depth, clay content and resulting water retention capacity of the Land types of the Langhoogte site.

<table>
<thead>
<tr>
<th>Land Type</th>
<th>Description</th>
<th>Ave Depth mm</th>
<th>Clay% A-hor(^1)</th>
<th>Clay% B-hor(^1)</th>
<th>WRC(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fa207</td>
<td>GLENROSA AND/OR MISPAH FORMS (Lime rare or absent in the entire landscape)</td>
<td>550</td>
<td>20-25</td>
<td>15</td>
<td>ML</td>
</tr>
<tr>
<td>Fb110</td>
<td>GLENROSA AND/OR MISPAH FORMS (Lime rare or absent in upland soils but generally present in low-lying soils)</td>
<td>530</td>
<td>20</td>
<td>5-10</td>
<td>ML – L</td>
</tr>
<tr>
<td>Ib113</td>
<td>ROCK AREAS WITH MISCELLANEOUS SOILS</td>
<td>100</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>L</td>
</tr>
</tbody>
</table>

\(^1\) Average clay content calculated from memoir data on an area weighted basis

\(^2\) Water Retention Capacity derived from average depth and clay content

In this study the Land type information was augmented by a few observations of exposed soil profiles in road cuttings, erosion dongas and trenches, during the site visit. These observations confirmed the absence of deep, high potential soils, except for a narrow band...
along the floodplain of the Bot River, not indicated by the Land type dataset. This valley is however not part of the proposed development area of the wind farm and may only be affected by a possible transmission line (see Chapter 4).

![Figure 10: Land types of the study area (ARC: ISCW). Wind turbine positions are indicated by white circles.](image)

The soils of the steep mountain slopes, west of the Bot River are shallow sandy gravel on rock, while the dominant soils on the remainder of the study area are thin bleached A-horizons on gravelley, litocutanic B-horizons (Glenrosa or Cartref soil forms) or sub-dominantly, structured shallow clayey soils (Swartland or Sterkspruit soil forms). The effective depth is rarely more than 500 – 550 mm and the resulting water retention capacity is moderate to low. The soils are susceptible to water erosion as evident in severe gully erosion on some of the steeper slopes and along roads where poor water runoff control measures are in place.
Photoset 2: The following photographs provide a visual overview of the soil character of the study area.
3.4 Agricultural potential

The term “land capability” is often used to refer to the suitability of land for agricultural activities. Various independent but similar Land Capability classification systems have been developed or used internationally to classify land. Most systems put strong emphasis on soil properties, but other factors such as climate and topography can also play a role. The National Department of Agriculture, Forestry and Fisheries (DAFF), provides an 8 class Land Capability classification of the RSA, with the following interpretation:

<table>
<thead>
<tr>
<th>Class</th>
<th>Group</th>
<th>Description</th>
<th>Increased intensity of land use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wildlife</td>
</tr>
<tr>
<td>I</td>
<td>Arable Land</td>
<td>Very high potential arable land</td>
<td>●</td>
</tr>
<tr>
<td>II</td>
<td></td>
<td>High potential arable land</td>
<td>●</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>Moderate potential arable land</td>
<td>●</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td>Marginal potential arable land</td>
<td>●</td>
</tr>
<tr>
<td>V</td>
<td>Grazing Land</td>
<td>Non-arable; moderate potential grazing land</td>
<td>●</td>
</tr>
<tr>
<td>VI</td>
<td></td>
<td>Non-arable; low to mod potential grazing land</td>
<td>●</td>
</tr>
<tr>
<td>VII</td>
<td></td>
<td>Non-arable; low potential grazing land</td>
<td>●</td>
</tr>
<tr>
<td>VIII</td>
<td>Wildlife</td>
<td>Wilderness</td>
<td>●</td>
</tr>
</tbody>
</table>

In terms of the DAFF classification, the mountain land in the study area has been mapped as Class VII – “Wilderness”. The parts of the study area targeted for the placement of the wind turbines are either Class IV – “marginal potential arable land” or Class VI – “non-arable, low to moderate potential grazing land”. It should be remembered that this DAFF classification is intended to be used at a scale of 1:250 000 and therefore is often too generalised to inform decisions regarding the potential impact of a proposed wind energy facility on the agricultural potential of a specific site.

In this report therefore, agricultural potential would rather be viewed as the combined result of the quality of the natural resources, soil, climate and water – as discussed above – with full incorporation of the concept of sustainability with respect to both environmental and financial sustainability.

Medium or high agricultural potential therefore implies an above average possibility to conduct agricultural activities that will be sustainable and financially viable under normal market conditions. The discussions below attempt to analyse each of the main possible agricultural activities against this definition of agricultural potential.
3.4.1 Irrigated cultivation

Irrigation allows the farmer to supply water to the plant when needed and therefore adds significant flexibility to the production system. With irrigation it becomes possible to grow crops with a higher water demand than supplied by the natural rainfall, while it also compensates for other limitations, such as poor soil properties (i.e. low water retention capacity) and rectification of low fertility through technologies such as fertigation. It does however add a significant cost factor in the production chain and therefore irrigation farming tends to elevate the entire production process in terms of technology, skills and management requirements. This inevitably leads to the production of high value crops, often with high quality and food safety standards and challenging marketing (export) conditions.

Against this background, the irrigation potential of the Langhoogte study area is very limited, due to the limited availability of irrigation water. It is only the small fields on the alluvial flood plain of the Bot River that can be irrigated from the irrigation dam or from the Bot River, while it is still flowing (winter and spring). The magnitude of irrigation in this area depends on crop type and its water requirement.

The water requirement of a plant has two components: (i) evaporation from the soil or other wetted surfaces and (ii) transpiration of water through the plant – taken up by the roots and transpired (evaporated) through the leaves. Therefore the amount of water needed by all crops is correlated with the evaporation at the site, which in turn is driven by humidity, temperature and wind. This correlation or ratio (also known as a crop coefficient or crop factor - $K_c$) varies between crop types and growth stage, but when known, can be used to estimate the water (irrigation) requirement of a crop in a specific climate where the evaporation has been measured. When using the Boontjeskraal rainfall and evaporation data, the following water requirements are calculated for a number of dominant crop types.

**Figure 11:** All areas where turbines are to be erected have been mapped as Class 4 (marginal potential arable land) or Class 6 (Non-arable, low to moderate potential grazing land (DAFF: Land Capability)).
Table 5: Theoretical irrigation requirements\(^9\) of key crops, grown at Langhoogte.

<table>
<thead>
<tr>
<th>Crop</th>
<th>mm/a(^a)</th>
<th>m(^3)/ha(^b)</th>
<th>m(^3)/ha/wk</th>
<th>Drip</th>
<th>Micro</th>
<th>Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planted pastures</td>
<td>830</td>
<td>11071</td>
<td>330</td>
<td>367</td>
<td>412</td>
<td>440</td>
</tr>
<tr>
<td>Wine Grapes</td>
<td>314</td>
<td>3484</td>
<td>150</td>
<td>167</td>
<td>187</td>
<td>200</td>
</tr>
<tr>
<td>Table Grapes</td>
<td>639</td>
<td>7103</td>
<td>300</td>
<td>333</td>
<td>375</td>
<td>400</td>
</tr>
<tr>
<td>Olives</td>
<td>500</td>
<td>5556</td>
<td>210</td>
<td>233</td>
<td>262</td>
<td>280</td>
</tr>
<tr>
<td>Stone Fruit</td>
<td>602</td>
<td>7523</td>
<td>330</td>
<td>367</td>
<td>412</td>
<td>440</td>
</tr>
<tr>
<td>Pome Fruit</td>
<td>602</td>
<td>7523</td>
<td>330</td>
<td>367</td>
<td>412</td>
<td>440</td>
</tr>
<tr>
<td>Citrus</td>
<td>600</td>
<td>7499</td>
<td>240</td>
<td>267</td>
<td>300</td>
<td>320</td>
</tr>
<tr>
<td>Tomato/Peppers</td>
<td>669</td>
<td>8916</td>
<td>420</td>
<td>466</td>
<td>525</td>
<td>560</td>
</tr>
<tr>
<td>Vegetable Seed</td>
<td>400</td>
<td>5328</td>
<td>397</td>
<td>441</td>
<td>496</td>
<td>529</td>
</tr>
<tr>
<td>Potatoes</td>
<td>314</td>
<td>3484</td>
<td>150</td>
<td>167</td>
<td>187</td>
<td>200</td>
</tr>
<tr>
<td>Maize</td>
<td>341</td>
<td>4551</td>
<td>351</td>
<td>390</td>
<td>438</td>
<td>467</td>
</tr>
<tr>
<td>Wheat</td>
<td>325</td>
<td>4332</td>
<td>284</td>
<td>316</td>
<td>355</td>
<td>379</td>
</tr>
<tr>
<td>Figs</td>
<td>484</td>
<td>6458</td>
<td>330</td>
<td>367</td>
<td>412</td>
<td>440</td>
</tr>
<tr>
<td>Pecan Nuts</td>
<td>91</td>
<td>1208</td>
<td>69</td>
<td>76</td>
<td>86</td>
<td>92</td>
</tr>
<tr>
<td>Pomegranates</td>
<td>598</td>
<td>7968</td>
<td>540</td>
<td>600</td>
<td>675</td>
<td>720</td>
</tr>
</tbody>
</table>

\(A\) Crop water requirement, without allowance for irrigation system inefficiency
\(B\) Total irrigation requirement under most suited irrigation system for crop type

From this data, it is obvious that all crops would require supplementary irrigation to meet their water requirement. Given the fact that all the irrigated fields along the Bot River are used for planted pastures, the area that can be irrigated with ±70 000 m\(^3\) (paragraph 3.3.2) is only ±6 ha. This area is however far removed from the proposed wind farm development zone and is therefore only of theoretical significance.

3.4.2 Dry land cultivation

Dryland or rain fed cultivation refers to the practice of growing a crop without irrigation, thus fully depending on the rainfall to supply in the water requirement of the crop. During the warm summer months, when the water requirement of a summer crop would be at its highest, the rainfall is only ±113 mm. This volume is not sufficient to grow any cash crop and also constrains the provision of good summer grazing for livestock. The production of a cash crop is therefore limited to the cool winter rainy season when a rainfall of 276 mm (Boontjieskraal station) can be expected. A semi quantitative assessment of the suitability of the area for the production of a rainfed cash crop can be done by comparing the water requirement of the crop with the supply from rainfall when evaporation data is also available. Wheat is the dominant cash crop in the Western Cape and will be evaluated here, using the evaporation data of the Boontjieskraal weather station.

(a) Winter cereals

The following example provides an indication of the degree to which rainfall at the study area (Boontjieskraal) can supply in the water requirement of wheat grown on medium deep (60 cm) gravelley, loamy soils, with a plant available water retention capacity (PAW) of 48 mm in the root zone, based on an effective rooting depth for cereals of only 60 cm and a soil water
Proposed Langhoogte Windfarm
Agricultural Impact Assessment

retention capacity of 80 mm/m between -10 and -100 kPa. Figure 12 gives a graphical representation of the water supply, demand and deficit for this scenario (based on the data presented in Table 7) in comparison with Malmesbury as an example of a high potential small grain area.

Table 6: Calculation of ETcrop, soil water balance and crop water deficit.

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain (mm)</td>
<td>11</td>
<td>16</td>
<td>17</td>
<td>35</td>
<td>46</td>
<td>57</td>
<td>51</td>
<td>54</td>
<td>33</td>
<td>31</td>
<td>23</td>
<td>15</td>
<td>389</td>
</tr>
<tr>
<td>Effective Rain (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>13</td>
<td>18</td>
<td>16</td>
<td>17</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>85</td>
</tr>
<tr>
<td>Reference ET₀ (mm)</td>
<td>266</td>
<td>208</td>
<td>173</td>
<td>110</td>
<td>68</td>
<td>45</td>
<td>47</td>
<td>63</td>
<td>93</td>
<td>151</td>
<td>192</td>
<td>251</td>
<td>1664</td>
</tr>
<tr>
<td>Crop Factor</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.35</td>
<td>0.5</td>
<td>0.65</td>
<td>0.4</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Crop PET (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>16</td>
<td>23</td>
<td>41</td>
<td>37</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>164</td>
</tr>
<tr>
<td>Surplus Rainfall (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Soil PAW (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Crop water deficit (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>24</td>
<td>30</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 12: Water supply and demand of dry land wheat grown at Langhoogte (top) vs Malmesbury (bottom).
At Langhoogte, during March and April the effective rainfall will contribute towards raising the water content in the soil. During May (the planting month), June, July, August and the first part of September, the crop requirement is supplied from stored soil moisture and effective rainfall, but from then until harvest the plant will experience moderate to significant water stress, as its demand exceeds the supply from rainfall and the stored soil moisture has already been depleted. The total shortfall in water supply is 63 mm, implying that approximately 70% of the theoretical water requirement of wheat to achieve optimum yield is supplied by the natural rainfall. This scenario has a long term expected average wheat yield of 2.7 t/ha, whilst yields up to 3.5 t/ha can be expected in good rainfall years.

The above analysis also illustrates the limited contribution of the soil’s ability to store water in the root zone, towards higher yields. In other words the amount of rainfall and its distribution during the growing season is of much higher significance, under these moderately low rainfall conditions, than soil potential. Any soil with a plant available water retention capacity of ±10 mm or more will theoretically produce similar wheat yields. Shallow, stony soils as well as poorly drained duplex soils may however result in lower yields.

The result of this modelling procedure is in partial agreement with the wheat potential analysis of the Western Cape, conducted by the provincial Department of Agriculture (Wallace, 2011) of, making use of averaged Modis NDVI data, for the month of August over a 10 year period. This data (Figure 13) reflects the vegetation index of dry land cultivated areas and correlates well with typical yield levels and indicates that, especially the eastern part of the study area, can be regarded as a moderately-high to high wheat (winter cereal) area.

![Figure 13: Extract from the wheat potential map of the Western Cape, as derived from 10-year averaged Modis NDVI data (M Wallace, Department of Agriculture).](image_url)
This finding is in contrast to the initial conclusion of the Soils and Agricultural Scoping Report (Paterson, 2012) which indicated that “Almost the whole study area is dominated by low potential soils and/or rock, with little potential for arable agriculture”. This finding was however rectified, after the author conducted a site visit, and then indicated that the soils properties are “sufficient in this winter rainfall area for grain or fodder production for livestock”.

(b) Planted pastures

The crop rotation system of the central and eastern parts of the Rûens and often includes dry land lucerne, as the portion of summer rainfall increases towards the east. Although the water requirement of lucerne far exceeds the water supplied through rainfall, the crop tolerates dry periods well and will respond rapidly after good rains. This provides good summer grazing and in some years can even produce a lucerne crop that can be cut and baled. Due to the lower portion of summer rainfall in the western part of the Rûens, fewer plantings of lucerne are found, but other legume crops for fodder or direct grazing such as lupins or clover/medic mixtures are an important component of the crop rotation system.

3.4.3 Livestock farming

Livestock, both cattle (beef/dairy) and sheep farming, is an important agricultural activity in the traditional small grain regions of the Western Cape, whilst sheep predominates at Langhoogte. It is accommodated in the crop rotation system with barley, wheat or oats as cash crops and oats or triticale used for silage and fodder. Lucerne, medics or lupins – are often also incorporated in the crop rotation. A general ratio of 45:50:5 between cash crops, pastures and fallow land is mostly used in the Rûens (Thousand point surveys – Department of Agriculture, Elsenburg11). The grain stubble, plant rests and volunteer growth also provide important grazing for livestock in this system. A grazing capacity of 0.85 to 1.72 ewes/ha without supplementary feeding and 2.0 to 2.5 ewes/ha with supplementary feeding on the stubble lands is proposed by Van Heerden & Ferreira (2008)12, while a grazing capacity between 4 – 6 ewes per hectare on the lucerne pastures is proposed (Elsenburg). Due to the low summer rainfall the availability of fodder during late summer and autumn is very low and supplementary feeding is normally provided and often limits the feasible stock numbers on a farm during this period.

At a conversion of 4 small stock units (SSU) per large stock unit (LSU) the grazing capacity of a medics/grain stubble system with supplementary feeding would imply 1.6 to 2 ha per cow (LSU). At these grazing an capacities estimated ±5600 small stock units or about 1400 large stock units can theoretically be accommodated within the entire study area.

3.4.4 External factors

The economic viability of a farm with sufficient resources is largely determined by the difference between input cost and producer prices – driven by supply and demand. A recent study by Hoffman and Kleynhans (2011) indicates a net farm profit of R590.61/ha for wheat production at yield levels of 2.9 t/ha in the high potential parts of the Rûens (Goue Rûens). Low profit margins on wheat is however the general trend in South Africa, compared to world markets, as indicated by a study on the competitiveness of Western Cape wheat production, by Vink, Kleynhans and Street (1998), as shown by the table below.
Table 7: Comparative profit margins in wheat production (Vink et al., 1998).

<table>
<thead>
<tr>
<th>Country</th>
<th>Gross Income</th>
<th>Subsidies</th>
<th>Variable Cost</th>
<th>Gross Margin</th>
<th>Fixed Cost</th>
<th>Net Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>3666,40</td>
<td>0</td>
<td>1449,19</td>
<td>2217,21</td>
<td>504,00</td>
<td>1713,21</td>
</tr>
<tr>
<td>Australia</td>
<td>1368,79</td>
<td>0</td>
<td>416,71</td>
<td>952,07</td>
<td>107,64</td>
<td>844,43</td>
</tr>
<tr>
<td>Canada</td>
<td>2250,57</td>
<td>54,43</td>
<td>388,08</td>
<td>1862,49</td>
<td>342,93</td>
<td>1519,57</td>
</tr>
<tr>
<td>Britain</td>
<td>8286,56</td>
<td>1931,47</td>
<td>2679,02</td>
<td>5607,54</td>
<td>2396,46</td>
<td>3211,08</td>
</tr>
<tr>
<td>Germany</td>
<td>9862,87</td>
<td>2138,99</td>
<td>3678,71</td>
<td>6184,16</td>
<td>1507,08</td>
<td>4677,08</td>
</tr>
<tr>
<td>USA</td>
<td>2647,57</td>
<td>0</td>
<td>582,10</td>
<td>2065,47</td>
<td>358,93</td>
<td>1706,55</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>5377,38</td>
<td>0</td>
<td>2123,98</td>
<td>3253,40</td>
<td>1677,08</td>
<td>1576,32</td>
</tr>
<tr>
<td>Suid-Westelike</td>
<td>1093,13</td>
<td>0</td>
<td>640,64</td>
<td>452,49</td>
<td>210,58</td>
<td>241,91</td>
</tr>
<tr>
<td>Riversdal-Albertinia</td>
<td>972,44</td>
<td>0</td>
<td>824,10</td>
<td>148,34</td>
<td>214,75</td>
<td>(66,41)</td>
</tr>
<tr>
<td>Sentraal-Suid</td>
<td>1171,99</td>
<td>0</td>
<td>745,78</td>
<td>426,21</td>
<td>312,18</td>
<td>114,03</td>
</tr>
<tr>
<td>Bredasdorp-Napier</td>
<td>1702,79</td>
<td>0</td>
<td>770,14</td>
<td>932,65</td>
<td>318,29</td>
<td>614,36</td>
</tr>
<tr>
<td>Caledon-Riversonderend</td>
<td>1502,63</td>
<td>0</td>
<td>868,21</td>
<td>634,42</td>
<td>382,98</td>
<td>251,44</td>
</tr>
<tr>
<td>Moorreesburg</td>
<td>1812,91</td>
<td>0</td>
<td>1170,53</td>
<td>642,38</td>
<td>450,00</td>
<td>192,38</td>
</tr>
<tr>
<td>Porterville</td>
<td>1728,33</td>
<td>0</td>
<td>1078,57</td>
<td>649,75</td>
<td>440,93</td>
<td>208,82</td>
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<tr>
<td>WPK</td>
<td>1432,66</td>
<td>0</td>
<td>908,57</td>
<td>524,09</td>
<td>412,15</td>
<td>121,94</td>
</tr>
<tr>
<td>Bethlehem</td>
<td>1554,36</td>
<td>0</td>
<td>709,51</td>
<td>844,85</td>
<td>307,00</td>
<td>537,85</td>
</tr>
<tr>
<td>Senekal</td>
<td>1165,77</td>
<td>0</td>
<td>564,00</td>
<td>601,77</td>
<td>307,00</td>
<td>294,77</td>
</tr>
<tr>
<td>Bloemfontein</td>
<td>802,58</td>
<td>0</td>
<td>357,31</td>
<td>445,27</td>
<td>206,21</td>
<td>239,06</td>
</tr>
</tbody>
</table>

Other factors that can have a significant impact on viability can include distance to market – in which case the study area is moderately far from the Cape Metropole but well serviced by the N2 normal logistical infrastructure. Security issues, such as stock theft has forced many farmers near urban settlements to abandon small stock farming. This is expected to also be prevalent in the study area, but was not confirmed in this study. Stock losses to predation are not expected to be a significant factor.

3.4.5 Resulting agricultural potential

The limited availability of irrigation water along the Bot River does not significantly contribute to the overall agricultural potential of the study area, but do offer some opportunity for perennial crops or planted pastures (±6 ha). The winter rainfall is however sufficient for above average yields of winter cereal crops. In rotation with fodder crops and planted pastures the study area also offers good livestock farming opportunity and therefore the general agricultural potential of the site is regarded as medium to medium-high in terms of dryland winter cereal production in combination with livestock.
3.5 Study area sensitivity analysis

The sensitivity of the receiving environment depends largely on the following:

- Erodibility of the soils – which in turn, is the result of slope gradients, soil properties and exposure of the soil surface
- The agricultural potential of the site
- Present and potential future agricultural activities
- Design specifications, installation and operational procedures of the wind turbines and appurtenant structures

Table 8: The sensitivity analysis entailed a GIS procedure based on the following parameters, to compile a sensitivity map.

<table>
<thead>
<tr>
<th>Features</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Slope gradient</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Cultivated areas*</td>
<td>None</td>
</tr>
<tr>
<td>Perennial crop orchards;</td>
<td></td>
</tr>
<tr>
<td>Cultivated fields</td>
<td></td>
</tr>
<tr>
<td>Non-cultivated areas</td>
<td>Natural vegetation;</td>
</tr>
<tr>
<td>Fall out areas; Eucalyptus stands;</td>
<td>Streams (30 m buffer);</td>
</tr>
<tr>
<td>Road reserves</td>
<td></td>
</tr>
</tbody>
</table>

\* In terms of the guidelines of DAFF, all cultivated areas should be treated as no-go areas for renewable energy structures.

Figure 14: Sensitivity of the Langhoogte receiving agricultural environment with respect to the placement of renewable energy structures.
Figure 14 suggests a highly sensitive environment for the development of a wind farm, which is a rather skewed perspective, induced by the fact that all cultivated areas have been demarcated as no-go (red) areas. When the cultivated fields are shown in orange (Figure 15), it becomes evident that most of the sensitivity of the site is seated in the cultivated fields and a more focussed assessment of the placement of each turbine relative to cultivated land becomes necessary.

Figure 15: Sensitivity of the Langhoogte receiving agricultural environment with respect to the placement of renewable energy structures, with cultivated fields indicated in orange.

Although this map provides a first approximation of the sensitivity of the study area, the possible impacts of each of the wind turbines and their associated infrastructure, as described in Chapter 4, was based more on the source data used to produce the map, rather than the map itself. This information was also used to guide the developer in the final placement of the turbines, to ensure the lowest possible impacts.
4 IMPACTS IDENTIFICATION AND ASSESSMENT

4.1 Introduction

Worldwide, the generation of more electricity from renewable sources is imperative, to meet the reduction in CO$_2$-emission targets. In South Africa coal fired power stations not only produce vast amounts of CO$_2$, but also threaten to convert thousands of hectares of productive farmland into coal mines.

Furthermore, the electricity supply of the Western Cape is highly dependent upon the generation capacity at the Koeberg nuclear power plant, as the national grid is unable to supply the local (Western Cape) demand from the northern provinces. Additional generation capacity is therefore essential to:

- Contribute to green energy targets
- Ensure adequate power supply for the present demand
- Provide for growth in future demand

Local wind conditions provide an ideal opportunity to generate part of this additional capacity through wind farms.

Globally there are many examples of wind farms on agricultural land with minimal, if any, impact on the agricultural production of the land. In most cases it can be assumed that the revenue earned through lease agreements are used in support of the farming enterprise and therefore contributing to the viability of the farm.

The construction of a wind energy facility on farm land also provides an opportunity for the upgrading of farm roads and water runoff infrastructure. Examples of poorly maintained water runoff infrastructure are common on farm land in the Western Cape. This can perhaps be partly addressed through strict requirements attached to the approval of a renewable energy facility on agricultural land.

Photo set 3 (following page)
Examples of wind turbines in productive farm land.
4.2 Identification of Impacts

Poor planning, design and installation of wind turbines and appurtenant structures can induce unacceptable impacts on the natural resources, agricultural production and ultimately on food security. The following photos are examples of undesired impacts which can mostly be prevented or adequately mitigated when considered properly during the design and construction stages (NOTE: Photos were not taken in the study area):

The area demarcated by the red line was previously cultivated, but cultivation was abandoned due to impracticality of working “over” the access road to the turbines. The impact could have been reduced by placing the road to the left of the turbines, but ideally the turbines should have been placed in the non-cultivated land left of the drainage line.

Turbines should preferably be placed at the edges of fields. The impact of a turbine in the middle of a field is much higher than merely the land lost due to the access road, as it interferes with tractor and implement movement, often resulting in shorter rows and downtime due to more turns required to cultivate the field.
During construction, the site office and lay down area can occupy large tracts of land. The old mining area, used in the photo is ideal, but on farms the site needs to be carefully selected, not to interfere with farming activities.

Steep slopes require large cut-and-fill and should be avoided on productive farm land. Steep slopes are also more prone to water erosion.

Excessive working areas around turbine positions should be avoided.
Contour banks and waterways are a special case relative to potential impact of turbine placement and deserve particular attention at micrositing time. Contour banks have been constructed in most cultivated fields with moderate to steep slopes in the Western Cape, mostly under guidance of a soil conservation technologist of the Department of Agriculture and often partly funded through government subsidies. The contour banks and waterways have been designed to control surface runoff and dissipate the energy of the flowing water to minimise soil erosion. The maintenance and integrity of the system is essential to ensure proper functioning. A broken contour bank will spill into the next, mostly with catastrophic consequences (see photo), as each contour is designed to contain only the runoff in its own “catchment”. Any disturbance of contour banks is therefore not ideal and should be limited as far as possible during micrositing. Where it is inevitable, careful mitigation is essential (Figure 16).

Figure 16: In this example of another wind farm the integrity of contours 2 and 3 has been compromised by the hard standing area of the wind turbine (red lines), spilling the runoff water along the access road into contour 4. Without proper mitigation, contour 4 may not be able to accommodate all the water during a flash flood.
An integral part of a contour bank system is the waterway into which the contour banks spill their water. Waterways need to be protected by a permanent vegetation cover or concrete lining to prevent excessive erosion, as shown in Figure 17, below.

Figure 17: Contour banks on the left spill into a concrete waterway [1], without any erosion. Contours bank on the right spill into an unprotected waterway [2], resulting in severe donga erosion. (NOTE: Photo not taken in the study area.)

Figure 18: Special structures are required to collect and channel water flow, where roads are constructed over contour banks.

Thus, the two main potential impacts associated with wind farms on agricultural land, are:
- Degradation or occupation of agricultural resources
- Interference with or prevention of agricultural activities

Secondary impacts include:
- Impact on Agri-tourism
- Contribution to farm income (positive impact)
4.2.1 Degradation or occupation of agricultural resources

The infrastructure of a wind energy facility, namely the wind turbines, hard set areas, access roads, cable trenches, overhead power lines for grid connection, the control room, site construction office, lay down areas and/or spoil stock piling areas may have a temporary (during construction), long term (during operation) or permanent (concrete structures remaining after decommissioning) impact on the natural resource base to the disposal of agricultural production, through:

- occupation of land that has a high potential for future production
- interference with natural or artificial drainage lines or structures (contour banks & waterways)
- inducing additional runoff from hard set areas or access roads
- erosion (wind and water) due to increased runoff and/or removal of vegetation cover
- disturbance to the soil (i.e. for temporary roads or cable trenches) with inappropriate reclamation afterwards
- deterioration of grazing capacity

4.2.2 Interference with agricultural production

Agricultural production and eventually food security can potentially be compromised, especially through the cumulative effect of renewable energy structures on productive farm land, through:

- occupation of productive agricultural land by the turbine, hard standing area, access roads, other infrastructure and storage area for spoil/top soil
- complicating workability of or access to some cultivated fields
- disrupting farming activities during the construction phase
- complicating or preventing the use of aircraft for crop spraying

The specific design, construction procedure and operation of the wind farm, can have a very significant effect on the anticipated impacts on the agricultural resources and farming activities. Sagit Energy Ventures has opted for a design which entails:

- All laydown and construction areas, to be fully rehabilitated after construction.
- No permanent hard standing area for cranes, post construction.
- Where existing farm roads do not provide access to turbines, the access road will be rehabilitated to a farm type track after construction, wherever possible.
- All cable trenches will follow access roads and will be sufficiently deep to allow for normal farming activities at the surface.
- Turbine foundations to be well below the surface, effectively limiting the above ground footprint of the turbine base to less than 30 m²

This design and operational procedure practically limits the potential impact of a turbine on agricultural activities and the natural resources to the construction phase.
4.2.3 Impact on agri tourism

Agri tourism can contribute significantly to farm income and, in some cases, form an integral part of the marketing strategy of agricultural enterprises, such as wine estates. Although some agri tourism activities do occur in the Bot River area, it is of lower intensity compared to the Cape Winelands, but not necessarily of lower importance. This aspect is however, more of socio-economic nature and falls beyond the scope of this study which has the pure agricultural production and protection of natural agricultural resources as focus. It should however receive proper consideration in the full impact assessment of the proposed wind facility, as a number of large investments in agri tourism have recently been made in the area.

4.3 Impacts during Construction

During the construction phase a site office will be set up, farm roads will be upgraded, some additional temporary access roads will be constructed, temporary laydown areas and storage areas for topsoil/spoil will be prepared, trenches and turbine foundations will be made and construction and assembly will take place. Thereafter all temporary access roads, laydown areas and crane standing areas will be rehabilitated to a better or equal condition prior to construction.

The potential impacts associated with these activities, specific to the Langhoogte Wind Farm, are:

- Degradation of the natural resource: soil erosion
- Disturbance to the soil profile and structure
- Disturbance to surface drainage works
- Disruption of farming activities
- Occupation of cultivated land

4.3.1 Impact 1: Degradation of the natural resource: Soil Erosion

Removal of vegetation cover on moderate to steep slopes during the rainy season may induce higher runoff and soil erosion. This will be aggravated by increased runoff from road surfaces and hard standing or lay down areas. Full mitigation is possible by limiting construction during winter to “safe” sites only, by controlling the movement of traffic in sensitive areas and construction of appropriate runoff control structures.

Wind erosion is not considered a potential threat during construction or thereafter, due to the soil properties.

4.3.2 Impact 2: Disturbance to the soil profile and structure

The movement of heavy vehicles and excavations for trenching and foundations could induce compaction, break down of soil structure and will disturb the natural soil profile. Dry soil is less sensitive to compaction and disturbance and wet or waterlogged soil conditions should therefore be avoided during construction. During excavation the top soil (A-horizon) should be kept apart to allow for proper rehabilitation post construction. The gravelley or stony nature of the sub-soil is however less problematic than clayey sub soils, in terms of rehabilitation.
4.3.3 Impact 3: Disturbance to surface drainage works
In uncultivated areas, the natural surface flow of water should be left undisturbed. Access roads, stock pile and laydown areas and turbine construction sites should be designed not to disturb water flow or should incorporate structures to accommodate the flow. In cultivated areas, water runoff is often channelled by contour banks or drainage trenches. The integrity of these structures should be protected throughout the construction phase and beyond.

4.3.4 Impact 4: Disruption of farming activities
Construction will bring many large and slow moving trucks and equipment into the farming area. Some seasons in the growth cycle of crops are more critical than others, like harvest time. Careful planning of access roads, traffic flow and timing of construction at each site can largely mitigate the potential disruptions.

Possible damage to farm infrastructure, such as electricity supply should be avoided or limited to the minimum and repaired without delay.

4.4 Impacts during Operation

Based on the design, construction and operation procedure chosen by Sagit Energy the potential impacts, normally associated with wind turbines on farm land are almost fully mitigated. During the operational phase the small footprint of the wind turbine will become a fixed feature around which normal farming activities can continue unhindered, similar to a boulder, tree or pylon of a power line.

The access roads will either follow existing farm roads or will be rehabilitated to a farm track post construction, wherever possible. Similarly, all laydown and hard standing areas will be rehabilitated. The potential for increased runoff from road or other surfaces due to the wind farm operation is therefore very small. It should be noted that rehabilitation after construction may not be the preferred scenario in some cases – especially on steeper slopes, where cut-and-fill may be required for road construction. In such instances the road design should allow for runoff control structures that will be effective for the lifespan of the windfarm and thereafter. Road alignment along existing farm roads or field edges should also be used as far as possible.

Traffic to the turbines during operation, will also be very limited and should not impact on farming activities.

The only anticipated impacts during operation of the wind farm are:
- Occupation of high potential arable land
- Interference with aerial crop spraying
- Visual impact
- Increased security
- Additional farm income
4.4.1 Impact 1: Occupation of high potential arable or cultivated land

This impact assessment included consultation with the developer to refine the turbine layout in an effort to minimise any anticipated impacts. During this process an alternative wind turbine layout was proposed so as to mitigate the potential impact of the turbines, access roads and associated infrastructure to the smallest possible level.

Most of the proposed amendments in the alternative layout could be accommodated by Sagit Energy, with the exception of the following turbines: 1; 2; 5; 10; 12; 16; 22; 30; 43. Due to other environmental and/or wind energy constraints, these turbines could not be moved completely out of cultivated fields. They are however all on or near crest positions, which will effectively mitigate any erosion risk and, with the exception of turbine 43, they are all less than 100 m from the edge of a field. It should also be kept in mind that the fields are extensive dry land winter cereal fields that will not be cultivated in some years, as part of the crop rotation system. Also, the footprint of the turbine – due to the design chosen by the developer – is very small, without any permanent hard standing area, thereby reducing the potential loss of total productive area, caused by the turbine positions to less than $\frac{1}{5}$ of a hectare. Given the crop rotation system, where only 45% of the fields will be used for cash crop production in any year, the theoretical total annual loss in grain production will be less than 300 kg (or 0.3 ton).

None of the other turbine positions will occupy high potential arable land.

The access road network will however occupy 2.7 ha of cultivated fields plus a further 4.1 ha where the roads have been aligned with existing contour banks. In these cases it will not be possible to align the road with existing farm roads or along field edges (Figure 19). The loss of potential production associated herewith amounts to ±9 ton of cereal and 14 small stock units.

Figure 19: Proposed road alignments. Red lines indicate roads through cultivated fields, orange is on existing contour banks and green along field edges or exisitng roads.
4.4.2 Impact 2: Interference with aerial crop spraying
Aerial crop spraying is often used by farmers in the Overberg. The presence of a number of wind turbines in the landscape is expected to complicate or even terminate crop spraying on fields in the near vicinity. Ground based spraying then becomes the only alternative, which can impact on timeliness of application of agrochemicals as fields may be too wet for tractor movement at certain times or take too long when applied by spray cart and tractor.

4.4.3 Impact 3: Visual impact
The visual impact associated with 45 turbines in a picturesque farm landscape is probably significant and may negatively impact on especially agri tourism activities. This impact is well covered in two parallel studies, namely the visual impact assessment and the socio-economic assessment.

4.4.4 Impact 4: Increased security
It is expected that additional security will be put in place for the duration of the operational phase, which should also be to the benefit of the general farm security, specifically in terms of stock theft losses.

4.4.5 Impact 5: Additional farm income
In terms of the lease agreement, each land owner will receive compensation in the form of a substantial rental amount for each turbine. Although this arrangement cannot replace the loss of natural resources or production (where such impacts do occur), it will enable all affected land owners to either reduce possible debt or invest in measures to enhance the productivity of the land.

In all well designed and properly constructed wind farms, this impact – from an agricultural viewpoint – is anticipated to be the most significant of all.

4.4.6 Decommissioning phase
No specific impacts relative to agriculture is expected after decommissioning, provided that the guidelines pertaining to the construction and operation phases are followed.

4.4.7 Cumulative Impacts
Three more wind farms are being proposed in the Langhoogte area, namely Caledon Wind to the north, with 31 turbines, Dassiesfontein with 6 turbines to the south and Klipheuwel with 10 turbines, some 6 km southeast of the study area. At a micro scale, each turbine or access road may induce small impacts that may escalate when repeated at more turbines. The more significant impact of a number of wind farms in one area, is however related to the restriction on aerial spraying induced by many turbines.

4.4.8 Impact of substation and transmission line
A new substation for the wind farm is proposed for a site approximately 1.5 km northwest of the intersection of the R43 and the N2 (Figure 20). This structure will occupy approximately 1 ha of cultivated field on a relatively flat crest area. Potential runoff can easily be mitigated, but future production from this area will be lost. This loss should not amount to more than 1.5 ton of winter cereal per annum, due to the fact that the land is part of a rotation system where only 45% of the surface area is used for cash crop production in any single year. The loss in grazing should however also be factored in, which amounts to grazing for ±2 ewes.
Connection to the national grid will be via an overhead power line from the new substation to the existing Eskom substation south of the N2 at Bot River. Two alternative routes – a northern route and a southern route – have been proposed, of which the southern route again has 3 possible routes. The southern route is favoured by the developer as Eskom has indicated that they also favour this route.

![Proposed overhead power line route options](image)

**Figure 20:** Proposed overhead power line route options.

The three southern routes will all three traverse the Wildekrans Wine Estate and pass near the Gabrielskloof Wine Estate, with a minimum route length of 6 km over cultivated fields. The northern route will have a route length of ±4.3 km over cultivated fields and are therefore favoured from and agricultural impact perspective. However, as the southern route is preferred by the developer and Eskom, the alignments along proposed Routes 1 and 3 are deemed to have the lowest potential impact on agriculture, as it mostly follows the farm boundaries of the Wildekrans Wine Estate, where potential interference with farming activities is expected to be the lowest. The visual impact is however not taken into consideration here, as it is addressed by a parallel study.

All three southern routes will traverse high potential agricultural land – existing irrigated perennial crops or areas planned for future irrigated fruit and wine grapes and mitigation should therefore include careful placement of the pylons to prevent interference with intensive agricultural activities.
4.5 Potential Mitigation Measures

4.5.1 DAFF prescribed mitigation measures

The following mitigation measures, applicable to the Langhoogte WEF are prescribed by the DAFF regulations for renewable energy facilities on agricultural land:

- Every care should be taken before, during and after the construction and future maintenance of the renewable energy structure, supporting infrastructure or access routes to protect the vegetation and veld condition against deterioration and destruction.
- It is the responsibility of the owner of the renewable energy project to ensure that suitable soil conservation works be established on the site to limit or restrict the loss of soil.
- No renewable energy structure, supporting infrastructure or access routes shall in any manner divert any run-off water from a water course to any other water course or obstruct the natural flow pattern of runoff water, except with the permission from DAFF.
- All access routes, existing or newly constructed and utilized during the construction and / or maintenance of the renewable energy structures should be restored to its original state after completion of the establishment of the structures. Every care should be taken not to damage or degrade the status of the natural resources base of the farm during the construction phase of the mentioned or to impact negatively on the farming or production practices on the farm.
- All service routes that will be used to gain access to the renewable energy structures for maintenance purposes have to be covered in gravel, tarred or compressed in order to limit the possibility of degradation and erosion.
- The installation of the underground power cables should not negatively impact on the resource base of the site. During the installation no soil conservation structure should be disturbed, the soil texture should be restored, the work area should not be wider than 5 m, should not be directed through existing or future cultivated land nor impact negatively on existing farming infrastructure or any farming activity.
- The lease agreement should be transferred to the new land owner, should the farmer decide to sell the property during the time period of the current lease agreement. DAFF needs to be informed of the transfer of the lease agreement upon which a new approval number will be issued. Supporting documentation should be provided that the new land owner concurs with the specifications of the existing lease agreement.

4.5.2 Site specific mitigation measures

The following general siting considerations can drastically reduce the impact of wind turbines on agricultural land, when adhered to:

- Locate wind turbines and support structures along field edges so as to minimise negative impacts on agricultural land and farming operations.
- Limit permanent road widths to 5 m or less, and where possible, follow field edges to minimise loss of productive agricultural land.
- Where it is unavoidable to have roads that cross agricultural fields, remain on ridge tops and high ground. The advantages of this are:
  - it allows farming along the contours,
- It requires no cut and fill or ditching that would take additional land out of production and
- It avoids potential drainage and erosion problems.

- Avoid cutting existing fields into smaller irregularly shaped fields which are more difficult to farm, by locating access roads along the edges of agricultural fields where possible.
- Locate parking areas, construction lay down areas, and other temporary and permanent support facilities outside of active agricultural fields as far as possible.
- Overhead electrical connecting lines should have as wide a span as possible to minimise the number of poles that are used in agricultural areas.
- Avoid disturbance of surface and subsurface drainage features (contour banks, water ways, ditches, diversions, drainage lines, etc.).
- Consult with landowners during the siting of access roads that cross/intersect active agricultural lands.
- All construction activities (i.e. vehicle movement) in cultivated fields should be minimised and contained within clearly demarcated areas (see photo).
- No vehicular access to the tower sites should be permitted until permanent access roads have been constructed.
- Top soil (±300 mm) should be stored at an appropriate site on each farm for future rehabilitation after decommissioning.
- Subsoil can be used – if suitable – for road construction and fills.

- When constructing roads through productive agricultural land, the final road surface should be level with the adjacent field surface. If drainage or other issues preclude a level surface, the road should not be elevated more than 150 mm above the surrounding field. Topsoil should be used after construction to create a smooth transition between the road surface and surrounding agricultural land, so as not to impede crossing by farm equipment.
- Where necessary, culverts or gutters should be installed to assure uninterrupted natural surface water drainage patterns. Such culverts or gutters should be installed in a manner that prevents concentration of water runoff and soil erosion.
- To prevent damage to adjacent agricultural land, all vehicle traffic and parking should be confined to the access roads, designated work areas at the tower sites, and/or designated parking and lay down areas. Any necessary pull-offs and parking areas should be developed outside of active agricultural fields. If this is not possible, all topsoil should be stripped from agricultural areas used for vehicle and equipment traffic and parking. Such areas should then be restored at the end of construction, under supervision of a competent soil scientist.
- Excavated subsoil and rock should not be stockpiled or spoiled on active agricultural land.
- Excess excavated subsoil and rock, or that which is not suitable as backfill should be removed from the site. On-site disposal should only occur with permission from the environmental manager and the landowner. Such disposal should not impact active agricultural land.
- Open excavation areas in active pasture land should be temporarily fenced to protect livestock.
- Buried electric lines in active agricultural fields should be at least 1200 mm deep, unless bedrock is encountered prior to reaching this depth. If bedrock is encountered, the buried lines must be placed completely below the bedrock surface.
- No rock backfill is allowed in the top 400 mm in active agricultural fields.
- The establishment of a ground cover (vegetation) on disturbed land soon after construction is essential to reduce the risk of water erosion. Sowing of oats at the onset of the winter rainfall is suggested.
- The impact of groundwater abstraction for dust control and/or concrete mixing during the construction period, may significantly impact on the availability of water for livestock watering. It is therefore recommended that alternative (off-site) sources of water be used.
- The implementation of a sloped turbine foundation rather than a flat surface is preferred, to assist soil water drainage after decommissioning (see Figure 20).

![Figure 20: A sloped and buried turbine foundation (right) will allow cultivation closer to the base and also assist external drainage of water in the soil.](image)

Possible benefits to agriculture from the wind energy facility, apart from the projected revenue stream to the lessor of the land, include:
- Increased farm security
- Upgrading of certain farm roads (access roads) and drainage infrastructure
- Clearing of aliens

## 4.6 Impact Assessment Methodology

Impacts are to be described and then evaluated in terms of the criteria given below.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rating Scales</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature</td>
<td>Positive</td>
<td>This is an evaluation of the type of effect the construction,</td>
</tr>
<tr>
<td>Criteria</td>
<td>Rating Scales</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Extent</td>
<td>Low</td>
<td>Site-specific, affects only the development footprint</td>
</tr>
<tr>
<td>Extent</td>
<td>Medium</td>
<td>Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);</td>
</tr>
<tr>
<td>Extent</td>
<td>High</td>
<td>Regional (beyond a 10 km radius) to national</td>
</tr>
<tr>
<td>Duration</td>
<td>Low</td>
<td>Short-term: 0-5 years, typically impacts that are quickly reversible within the construction phase of the project</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium</td>
<td>Medium-term, 6-10 years, reversible over time</td>
</tr>
<tr>
<td>Duration</td>
<td>High</td>
<td>Long-term, 10-60 years, and continue for the operational life span of the development</td>
</tr>
<tr>
<td>Intensity</td>
<td>Low</td>
<td>Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected</td>
</tr>
<tr>
<td>Intensity</td>
<td>Medium</td>
<td>Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected</td>
</tr>
<tr>
<td>Intensity</td>
<td>High</td>
<td>Where natural, cultural or social functions and processes are altered to the extent that the impact will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.</td>
</tr>
<tr>
<td>Degree of Reversibility</td>
<td>Low</td>
<td>Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the short-term.</td>
</tr>
<tr>
<td>Degree of Reversibility</td>
<td>Medium</td>
<td>Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the medium to long term.</td>
</tr>
<tr>
<td>Degree of Reversibility</td>
<td>High</td>
<td>Impacted natural, cultural or social functions and processes will never return to their pre-impacted state.</td>
</tr>
<tr>
<td>Potential for impact on irreplaceable resources</td>
<td>Low</td>
<td>No irreplaceable resources will be impacted.</td>
</tr>
<tr>
<td>Potential for impact on irreplaceable resources</td>
<td>Medium</td>
<td>Resources that will be impacted can be replaced, with effort.</td>
</tr>
<tr>
<td>Potential for impact on irreplaceable resources</td>
<td>High</td>
<td>There is no potential for replacing a particular vulnerable resource that will be impacted.</td>
</tr>
<tr>
<td>Consequence</td>
<td>Low</td>
<td>A combination of any of the following</td>
</tr>
<tr>
<td>Criteria</td>
<td>Rating Scales</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.</td>
<td>• Intensity, duration, extent and impact on irreplaceable resources are all rated low • Intensity, duration and extent are rated low but impact on irreplaceable resources is rated medium to high • Intensity is low and up to two of the other criteria are rated medium • Intensity is medium and all three other criteria are rated low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Intensity is medium and one other criteria is rated high, with the remainder being rated low • Intensity is low and at least two other criteria are rated medium or higher • Intensity is rated medium and at least two of the other criteria are rated medium or higher • Intensity is high and at least two other criteria are medium or higher • Intensity is rated low, but irreplaceability and duration are rated high</td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td>Low</td>
<td>Improbable. It is highly unlikely or less than 50 % likely that an impact will occur.</td>
</tr>
<tr>
<td>Probability</td>
<td>Medium</td>
<td>Distinct possibility. It is between 50 and 70 % certain that the impact will occur.</td>
</tr>
<tr>
<td>Probability</td>
<td>High</td>
<td>Most likely. It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.</td>
</tr>
<tr>
<td>Significance</td>
<td>Low</td>
<td>• Low consequence and low probability • Low consequence and medium probability • Low consequence and high probability</td>
</tr>
<tr>
<td>Significance</td>
<td>Low to medium</td>
<td>• Low consequence and high probability • Medium consequence and low probability</td>
</tr>
</tbody>
</table>
4.7 Impact Assessment – Langhoogte Wind Farm

The single most critical impact associated with all proposed wind farm developments in the Western Cape is the potential loss of arable land. In most areas the landscape has almost entirely been converted to cultivated fields or orchards, thereby placing a high conservation value on all remaining natural vegetation, often demarcated as critical biodiversity areas (CBA’s). The placement of turbines and access roads in these areas is mostly not compatible with the conservation priorities attached to these areas, and therefore wind energy developers often turn to cultivated land as the only alternative sites to place wind turbines.
This was also the case with the earlier iterations for the turbine layout of the Langhoogte WEF. A process of refining the turbine layout, under guidance of the agricultural specialist was however followed to ensure a turbine layout plan that minimises the potential negative impacts. The impact assessment below, therefore already reflects significant mitigation incorporated in the siting of the turbines.

4.7.1 Construction phase

| Impact 1: Degradation of the natural resource: Soil Erosion: |
|---|---|---|---|---|---|---|---|---|---|---|
| Impact Description: |
| Loss of soil due to water or wind erosion |
| Without Mitigation |
| Mitigation Description: |
| Full mitigation is possible by limiting construction during winter to “safe” sites only, by controlling the movement of traffic in sensitive areas and construction of appropriate runoff control structures. |
| With Mitigation |
| - | Local | Short-term | Negligible | Low | Low | Low | Low | Low | High |
| Cumulative Impact: |
| If significant erosion occurs (without mitigation) at various turbines and/or access roads the cumulative impact would be high. |

| Impact 2: Disturbance to the soil profile and structure |
|---|---|---|---|---|---|---|---|---|---|
| Impact Description: |
| Vehicle traffic on wet soils or improper backfill of trenches will induce compaction, loss of soil structure and poor internal and external drainage |
| Without Mitigation |
| Mitigation Description: |
| Wet or waterlogged soil conditions should therefore be avoided during construction. During excavation the top soil (A-horizon) should be kept apart to allow for proper rehabilitation post construction. |
| With Mitigation |
| - | Local | Short-term | Low | Low | Low | Low | Low | Low | High |
| Cumulative Impact: |
| Indiscriminate treatment of the soil at all trenches and turbine sites could result in significant degradation of the resource. |

| Impact 3: Disturbance to surface drainage works |
|---|---|---|---|---|---|---|---|---|---|
| Impact Description: |
| Damage to runoff control structures such as contour banks or structures designed to drain excess soil water like cut-off drains. |
| Without Mitigation |
| Mitigation Description: |
| Keep integrity of structures intact during construction and operation |
| With Mitigation |
| - | Local | Short-term | Low | Low | Low | Low | Low | Low | High |
| Cumulative Impact: |
| Cumulative occurrence will escalate the impact. |

| Impact 4: Disruption of farming activities |
|---|---|---|---|---|---|---|---|---|---|

Proposed Langhoogte Windfarm
Agricultural Impact Assessment

Date: 04 December 2012
Proposed Langhoogte Windfarm
Agricultural Impact Assessment

4.7.2 Operational phase

<table>
<thead>
<tr>
<th>Impact</th>
<th>Nature</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Reversability</th>
<th>Impact on Irreplaceable Resources</th>
<th>Consequence</th>
<th>Probability</th>
<th>Significance</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact 1: Occupation of high potential arable or cultivated land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact Description:</td>
<td>Loss of production due to the positioning of 9 wind turbines and 6.8 ha of road surface area in cultivated fields.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without Mitigation</td>
<td>Neg</td>
<td>Local</td>
<td>Medium-term</td>
<td>Medium</td>
<td>Med</td>
<td>Med</td>
<td>Med</td>
<td>High</td>
<td>Med</td>
<td>High</td>
</tr>
<tr>
<td>Mitigation Description:</td>
<td>Rehabilitation of access roads and hard standing areas to allow further production. Minimising the footprint of the turbine.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Mitigation</td>
<td>-</td>
<td>Local</td>
<td>Short-term</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Cumulative Impact:</td>
<td>No cumulative impact is anticipated.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact 2: Interference with aerial crop spraying

Impact Description:
Loss of production due to sub-optimal timing of application of agro-chemicals

Without Mitigation | Neg | Local | Medium-term | Medium | Low | Low | Med | High | Med | Med |
Mitigation Description:
Making use of ground based crop spraying.

With Mitigation | - | Local | Short-term | Low | Low | Low | Low | Medium | Low | Medium |
Cumulative Impact:
A number of wind farms in the same vicinity will escalate the potential impact.

Impact 3: Visual impact on Agri tourism (Covered by separate study – only listed here)

Impact 4: Increased farm security

Impact Description:
Security measures of wind farm may positively impact on farm security in general.

Without Mitigation | Pos | Local | Medium-term | Low | N/A | N/A | Med | Probable | Med | Low |
### Mitigation Description:
Not applicable

### Impact 5: Additional farm income

**Impact Description:**
Additional farm income generated through lease agreement with wind operator

<table>
<thead>
<tr>
<th>Without Mitigation</th>
<th>Pos Local</th>
<th>Medium- term</th>
<th>Medium</th>
<th>Med</th>
<th>Med</th>
<th>Med</th>
<th>High</th>
<th>Med</th>
<th>High</th>
</tr>
</thead>
</table>

### Mitigation Description:
Not applicable

### Impact: New substation and transmission line

**Impact Description:**
Loss of productive land to new substation and souther (route 1 or 3) transmission line

<table>
<thead>
<tr>
<th>Without Mitigation</th>
<th>Neg Local</th>
<th>Long term</th>
<th>Low</th>
<th>Low</th>
<th>Low</th>
<th>Med</th>
<th>High</th>
<th>Med</th>
<th>High</th>
</tr>
</thead>
</table>

**Mitigation Description:**
Use least productive land for transmission line and substation

<table>
<thead>
<tr>
<th>With Mitigation</th>
<th>- Local</th>
<th>Long term</th>
<th>Low</th>
<th>Low</th>
<th>Low</th>
<th>Low</th>
<th>High</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
</table>
5 MONITORING PROGRAMME

In order to ensure that the mitigation measures and good agricultural practice guidelines are followed and appropriately applied, it is strongly recommended that an agricultural specialist in natural resources be part of the installation team and periodically visit the site to recommend specific measures as may be required during the construction phase. No specific monitoring guidelines are required during the operational phase, other than monitoring adherence to the guidelines.

In their guidelines, the Department of Agriculture, Forestry and Fisheries also reserves the right to visit the renewable energy site at any time without prior arrangement to review the status of the natural resource base and the impact of the renewable energy structures. During restoration, after decommissioning, an agricultural specialist in natural resources should once again be contracted as part of the rehabilitation team.
6 CONCLUSION

The agricultural potential of the land of the Langhoogte wind farm is generally only medium to medium-high, due to the following constraints:

- Low water retention capacity due to high stone/gravel content and/or shallow soils
- Low summer rainfall
- Sub-optimal winter rainfall for maximum winter cereal yields
- High evaporation in summer leading to high water requirement of crops
- Very limited availability of irrigation water
- Low grazing capacity of natural veld

A limited but reliable supply of irrigation water allows for small areas of irrigated cultivation along the Bot River. This area is however far removed from the proposed development area of the wind farm and may only be impacted upon, should the northern route be used for the overhead power line connection to the Bot River Eskom substation, in which case the impact is expected to be low, due to the narrow width of the irrigated fields making a clear span of this area possible – thus no power line pylon within the cultivated fields. The preferred southern routes (1 or 3) of the overhead powerline will also cross irrigated fields on the Wildekrans Wine Estate. Proper planning of the placement of the pylons should fully mitigate the potential impact of the powerline on farming activities.

The remainder of the study area is an extensive small grain production area, where a crop rotation system allows for a significant livestock (sheep) component. The rainfall is sufficient for medium to medium-high yields, but the soils are only of medium to medium-low potential.

The construction and operational design proposed by the wind farm developer has no permanent hard standing or laydown areas while all new access roads will be rehabilitated to minor farm tracks after construction. The proposed turbine layout has also been modified with the input of the agricultural specialist to ensure minimum impact during construction almost full agricultural production during the operational phase. The total long term loss of grain production is estimated at approximately 10 ton/a and grazing for 16 small stock units.

The significance of the anticipated negative impacts after mitigation is low and far outweighed by the potential positive impacts, directly on farm income and the entrenched benefits for the local communities and indirectly on national green energy targets.
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3 Agromet. ARC: ISCW database of weather data.
6 Elsenburg, 2000. Regional development programme: South Coast Region. Department of Agriculture: Western Cape.
8 Institute for Soils, Climate and Water. Land Type Data. Agricultural Research Council.
11 Department of Agriculture: Western Cape. Agricultural land use statistics based on thousand point surveys.
LANGHOOGTE WIND FARM: ROAD AND OVERHEAD POWERLINE LAYOUT AMENDMENTS

Background

Towards the end of 2012, all specialists appointed for the Langhoogte WEF EIA concluded their assessment of anticipated impacts based on the finalised turbine layout, internal road layout, and proposed alignment of the proposed overhead powerline options. All specialists presented their findings in their specialist reports which were presented in the draft EIR in Dec 2012.

Subsequently, Dean Ollis of the Freshwater Consulting Group recommended that some small alterations were to be made to the road and southern powerline route layouts which would reduce the impact on wetlands.

The purpose of this addendum is to confirm whether or not these recommended changes would influence the findings of other specialists in any way.

Changes to the Internal Road Layout

The proposed changes to the road layout are described below and presented in Figure 1.

- The connection road to the east of turbine 41 should not be built. Instead, turbines 3, 35 and 41 should connect with the road leading to turbines 17 and 19 via the loop between turbines 3 and 24. This would eliminate the need for a road crossing of the drainage channel of moderate conservation importance immediately south of turbine 41.
- The road to the north of turbine 10 should be moved at least 30 m (although preferably > 100 m) away from the edge of the wetland of high conservation importance to the north.
- The loop road north of turbine 20 should be moved at least 30 m away from the edge of the drainage channel of moderate conservation importance.
- The road to the east of turbine 29 should be moved at least 30 m away from the edge of the section of drainage channel marked as being of moderate conservation importance.
- The road immediately to the east of turbine 32 should be moved at least 30 m away from the edge of the wetland of moderate conservation importance.
- The road to the west of turbine 26 should not cross the wetland of moderate conservation importance twice. Instead, a single crossing at the northern end of the wetland (against the railway line) should suffice. From this crossing the road could link with turbine 26, making sure that the road does not encroach within 30 m of the eastern edge of this wetland.

The changes described above are presented in the Figure 1, where red indicates those roads which are no longer being proposed, and green indicates new additions to the road layout.

Changes to the Proposed Overhead Powerline Route

The draft EIR concluded that Southern Option Route 1 is the most preferable of the southern route options, however from a freshwater ecology perspective, there is an area of concern where the three southern route options share a common pathway (before they split into three) towards the northern section of the southern route. It is therefore recommended that, after crossing the wetland of high importance (to the north of the N2 freeway), that the power line should run along the northern edge of this wetland at a distance of at least 30 m from the wetland edge rather than crossing it twice before reaching the split for Option 1, as is the current scenario.
Figure 1: Updated road layout.

Figure 2 (A) shows the powerline route as assessed previously,
Figure 2 (B) shows the recommended diversion. The route has been altered so the line does not cross the wetland and valley. The red section in (B) indicates the section that has been abandoned.

Specialist Review

I, Francois Knight (for Agri Informatics), the appointed Agricultural specialist for the Langhoogte WEF EIA, have considered and assessed the above internal road and powerline amendments and conclude that this alters the findings of our report, dated 4 December 2012, as follows:

General comment on impacts and mitigation:

- Generally, the road layout has been aligned to make use of existing road alignments or field boundaries, as far as possible. This in itself minimises the potential impact on agricultural activities. The ±6 recent amendments to the proposed road layout implies either no difference in the anticipated impact compared to the earlier layout or in a few cases will have a marginally lower impact.
- The few new roads into cultivated fields remain a non-ideal scenario from an agricultural perspective. It is especially the access road southeast of turbine 3, which will cross a number of contour banks that will require special care and mitigation during construction and may require some form of rehabilitation post construction.
- The adjustment of the proposed powerline route does not impose any new significant impact on agriculture.

Assessment of impact significance:

- The significance of the anticipated impacts after appropriate mitigation, remains low.

Recommendations:

- As most of the identified impacts on agriculture, relative to the initial layout and the final amendments shown here, can be mitigated to a level of low or very small impact, it is strongly recommended that the appointment of an agricultural resource specialist during the pre-
construction and construction phases, be made a condition of approval to ensure knowledgeable insight and guidance with regard to agricultural and natural resource sensitivities.

Yours Sincerely

Signed

Date: 7 February 2013

Francois Knight
for AGRI INFORMATICS