

# REPORT

On contract research for

**SAVANNAH ENVIRONMENTAL**



## **SOIL IMPACT ASSESSMENT FOR THE PROPOSED AGGENEYS 2 DEVELOPMENT NEAR AGGENEYS, NORTHERN CAPE**

By

**D.G. Paterson** (Pr. Sci. Nat. 400463/04)

**& A.B. Oosthuizen**

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ARC-Institute for Soil, Climate and Water,  
Private Bag X79, Pretoria 0001, South Africa

Tel (012) 310 2500

Fax (012) 323 1157

## **DECLARATION**

I have over 30 years' experience in soil surveying, classification and interpretation. I have compiled over 150 soil survey reports, including numerous EIA and related studies. I have a PhD in soil science and am a member of the Soil Classification Working Group of South Africa.

I hereby declare that I am qualified to compile this report as a registered Natural Scientist (SACNASP Registration No. 400463/04) and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

A handwritten signature in black ink, appearing to read 'D G Paterson', is centered within a light gray rectangular box.

**D G Paterson**

March 2019

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## 1. INTRODUCTION

ARC-Institute for Soil, Climate and water was contracted to provide soil and associated information for a proposed solar power development in the Northern Cape Province.

The project, known as Aggeneys 2, involves a 100 MW solar photovoltaic (PV) facility and associated infrastructure on a ~250 ha site southeast of Aggeneys, as shown in Figure 1.

The project will include:

- » Arrays of PV panels up to 3.5 m high (fixed-tilt PV, single-axis tracking PV or double-axis tracking PV) on up to 233 ha and with a contracted capacity of up to 100MW;
- » Mounting structures to support the PV panels;
- » Cabling between the project components (to be lain underground where applicable);
- » On-site substation (~0.625 ha);
- » On-site inverters to convert the power from a direct current (DC) to alternating current (AC);
- » On-site step-up transformers;
- » Site Offices and Maintenance Buildings (~1 ha), including workshop areas for maintenance and storage, canteen, visitor's centre;
- » Gatehouse and security office;
- » 1-2 laydown areas (total area ~5 ha);
- » 1-2 main site access roads (each ~200 m long and 6 m wide, tarred if necessary);
- » Internal access roads (~18-20 km total length and 4-5 m wide); and
- » Fencing.

The facility would be connected to the proposed on-site collector substation via an up to a 220kV power line. The collector substation will be connected via the proposed powerline to the nearby Eskom Aggeneys Main Transmission Substation (MTS) near Aggeneys. It must be noted that the proposed collector substation and powerline will form part of a separate environmental authorisation application, and is assessed in a separate report.

## 2. TERMS OF REFERENCE

The purpose of the investigation is to contribute to the Impact Assessment process for the proposed Aggeneys 2 project. The objectives of the study are;

- To obtain all existing soil and related information,
- To produce a soil map of the specified area, and
- To assess broad agricultural potential and impacts.

### 2.1 Legislative and Policy Framework

In terms of the Subdivision of Agricultural Land Act (Act 70 of 1970), any application for change of land use must be approved by the Minister of Agriculture, while under the Conservation of Agricultural Resources Act (Act 43 of 1983) no degradation of natural land is permitted.

The following section summarises South African Environmental Legislation with regard to soil and agricultural issues:

- The law on ***Conservation of Agricultural Resources*** (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal. The Act also requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.
- The ***Bill of Rights*** states that environmental rights exist primarily to ensure good health and well-being, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources.
- Environmental rights are furthered in the ***National Environmental Management Act*** (No. 107 of 1998), which prescribes three principals, namely the precautionary principle, the “polluter pays” principle and the preventive principle. It is stated in the above-mentioned act that the

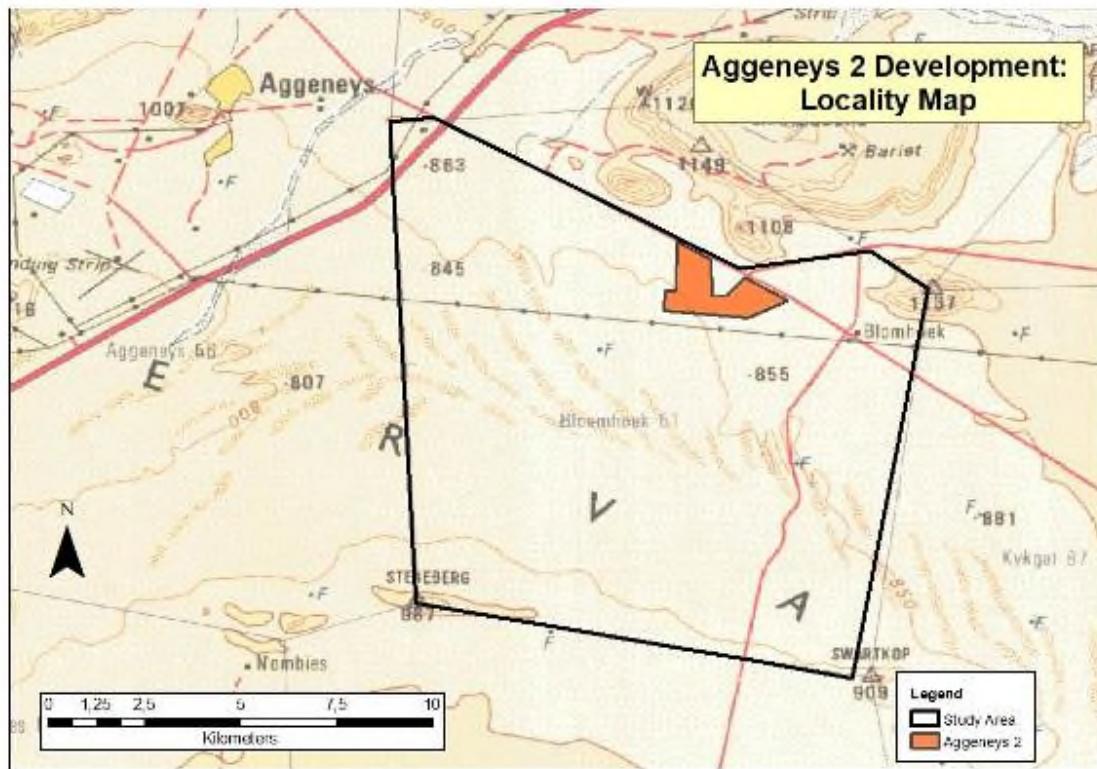
individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source.

- Soils and land capability are protected under the **National Environmental Management Act** (Act 107 of 1998), the **Environmental Conservation Act** (Act 73 of 1989) and the **Conservation of Agricultural Resources Act** (Act 43 of 1983).
- The **National Veld and Forest Fire Bill** of 10 July 1998 and the **Fertiliser, Farm Feeds, Agricultural Remedies and Stock Remedies Act** (Act 36 of 1947) can also be applicable in some cases.
- The **National Environmental Management Act** (Act 107 of 1998) requires that pollution and degradation of the environment be avoided, or, where they cannot be avoided, are minimised and remedied.

### **3. SITE CHARACTERISTICS**

#### **3.1 Location**

An area for the proposed Aggeneys 2 project site was investigated lying to the south-east of the town of Aggeneys on the Remaining Extent of the farm Bloemhoek 61. The broader study area (i.e. farm boundary/affected property) lies between 29° 14' and 29° 22' S and between 18° 52' and 19° 00' E, as is shown by the black line in Figure 1. The position of the proposed Aggeneys 2 project site is shown by the orange polygon on Figure 1.



**Figure 1** *Aggeneys 2 Locality map*

### 3.2 Terrain

The broader study area (including the project site) consists of gently undulating topography, with slopes of less than 5% over most of the area, and with an altitude above sea level of between 850 and 1 000 m.

The current natural vegetation of the project site is very sparse natural shrub vegetation (see Figure 2). The site also includes a significant proportion of sand dunes to the south of the proposed Aggeneys 2 site (see Figure 3).



**Figure 2** *Natural vegetation in study area*





**Figure 3** *Dune landscape in study area*

### **3.3 Climate**

The climate of the area has a mostly all year rainfall distribution, but the annual average is very low, at around 75 mm per year, although this might be slightly higher in the higher parts of the landscape (Koch *et al.*, 1987).

Temperatures will be warm to very hot in summer, with daily maximums regularly exceeding 40°C, but cool to cold in winter, with almost no occurrence of frost.

### **3.4 Parent Material**

The area is underlain by Quaternary sediments, mostly sandy (Geological Survey, 1984). As previously stated, dunes occur in places in the landscape.

#### 4. METHODOLOGY (Land Type Survey)

Existing desk-top information was obtained from the map sheet 2918 Pofadder (Schloms & Ellis, 1987) from the national Land Type Survey, published at a 1:250 000 scale. A **land type** is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The broad study area under investigation is covered by four land types, as shown on the map in Figure 4, namely:

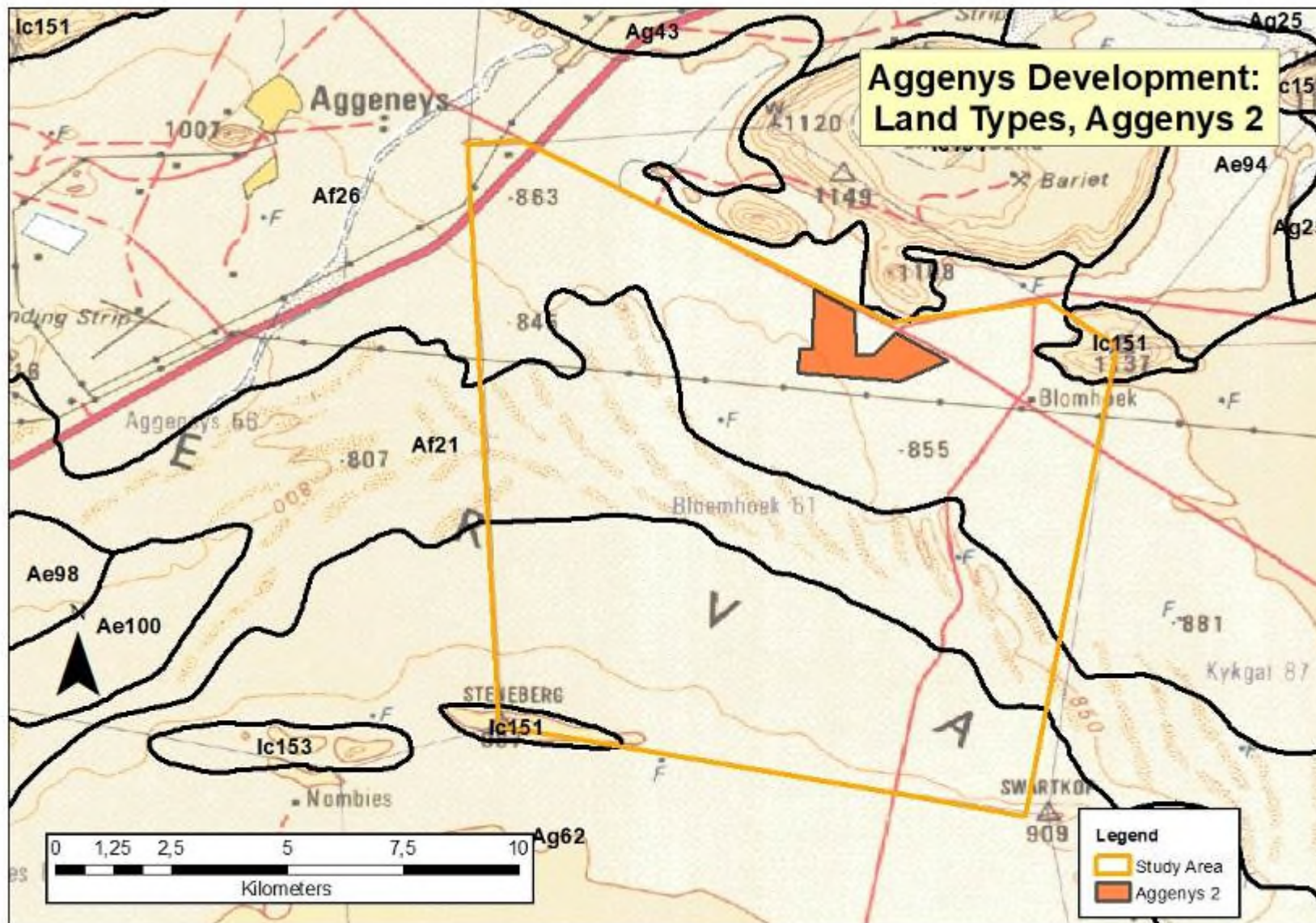
- **Af21, Af26** (High base status, red soils, with dunes)
- **Ag62** (High base status, red soils, mostly shallow)
- **Ic151\*** (Very rocky, shallow soils)

*\*Only occurs as isolated koppies at the edge of the broader study area, not at the Aggeneys 2 site.*

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur.

A summary of the dominant soil characteristics of each land type is given in Table 1 below.

Column 6 shows the distribution of agricultural potential per soil class within each land type (see Section 5), with the dominant class shown in **bold**. These figures will always add up to 100%, so that the relative proportions of each potential class within every land type can be determined and easily compared with other land types.



**Figure 4** Land types occurring, Aggenys 2

**Table 1** Land types present within the broader study area (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Soil Potential* (%)
<b>Af21</b>	Hutton 31	>1200	75%	Red, sandy, structureless dune soils	High: 0.0 Mod: 0.0
	Hutton 32/35	300-700	16%	Red, sandy, structureless soils, on calcrete/dorbank	<b>Low: 100.0</b>
<b>Af26</b>	Hutton 30/31	>1200	63%	Red, sandy, structureless soils, occasional dunes	High: 0.0 Mod: 0.0
	Fernwood 21	>1200	17%	Grey, sandy, structureless soils	<b>Low: 100.0</b>
<b>Ag62</b>	Hutton 31/32	200-350	81%	Red, sandy, structureless soils on rock/dorbank	High: 0.0 Mod: 0.0
	Hutton 34/35/42/45	200-450	10%	Red, sandy, structureless soils on rock/dorbank	<b>Low: 100.0</b>
<b>Ic151</b>	Rock	-	86%	Surface rock outcrops	High: 0.0 Mod: 0.0
	Mispah 10	50-100	7%	Red to brown, sandy, structureless soils on rock	<b>Low: 100.0</b>

\***Note** – this describes the **soil characteristics only**, and does not take into account any other limiting factors, such as climate.



## 5 SOILS

### 5.1 Field observations

The site was visited on 6<sup>th</sup> and 7<sup>th</sup> November 2018. The purpose of the field visit was to confirm, by reconnaissance ground-truthing, the soils occurring in the area, as well as to carry out a visual evaluation of the landscape. The soils were investigated using a hand-held soil auger on a free style basis throughout the study area. No samples were collected, due mainly to the low prevailing agricultural potential.

As evident from Figure 4, Aggeneys 2 lies within land type Af26, which consists largely of deep, sandy soils. However, possibly due to the location at the foot of the rocky hills to the north, the field investigation confirmed the presence of much shallower soils on the site in question, with soils classified as belonging to the **Garies** (orthic topsoil on red apedal subsoil on cemented dorbank) and **Knersvlakte** (orthic topsoil on cemented dorbank) forms, with depths of less than 450 mm. Some outcrops of gravel and dorbank were also observed at the surface, as shown in Figure 5.



**Figure 5** Cemented dorbank layer exposed in soil profile

## **5.2 Erodibility**

The soils present in most of the Aggeneys 2 project site are not considered susceptible to erosion by water. However, if the vegetation cover is disturbed (for example by overgrazing or construction activities) and considering the sandy nature of the topsoils, as well as the dry climate, there is a significant possibility of removal of some or all of the topsoil by wind action.

This can be mitigated by ensuring that the minimum area is disturbed, and that rehabilitation of surface vegetation is carried out as soon as possible.

## **6. AGRICULTURAL POTENTIAL**

As can be seen from the information contained in Table 1, there are no high potential soils present within the project site and the soils are of generally low potential at best. This is due mainly to a combination of the shallow depth (observed during the field visit) and the sandy texture which will lead to rapid water infiltration and the soils drying out.

In addition, the low rainfall in the area (Section 3.3) means that there is little potential for rain-fed arable agriculture in the area in any case. Arable production would therefore be possible only by irrigation, and no indications of any irrigated areas, within and surrounding the project site, can be identified through Google Earth.

In general, the soils that do occur within the project site are suited for extensive grazing at best and furthermore the grazing capacity of the area is very low, at around 26-40 ha/large stock unit (ARC-ISCW, 2004).

### **6.1 Recommendations**

The prevailing potential of the soils for rain-fed cultivation throughout most of the area, as well as the use of irrigation activities for cultivation, is low. Considering the land types and soils located within the Aggeneys 2 project site and the current land-use activities, it is recommended that no further detailed soil investigation is required for the Aggeneys 2 project.

## 7. IMPACTS

### ***Assessment of Impacts***

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase are assessed in terms of the following criteria:

- » The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
- » The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- » The **duration**, wherein it is indicated whether:
  - \* the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - \* the lifetime of the impact will be of a short duration (2–5 years) - assigned a score of 2;
  - \* medium-term (5–15 years) – assigned a score of 3;
  - \* long term (> 15 years) - assigned a score of 4; or
  - \* permanent - assigned a score of 5;
- » The **consequences (magnitude)**, quantified on a scale from 0–10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, which is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- » the **status**, which is described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated*.

The **significance** is calculated by combining the criteria in the following formula:

$$S = (E+D+M) \times P$$

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- » < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- » 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- » > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Two impacts have been identified to be associated with the development of Aggeneys 2 from a soils perspective; these impacts include:

**Impact 1 (Table 2)**: In most environmental investigations, the major impact on the natural resources of the site would be the loss of potential agricultural land due to the installation of the solar arrays and construction of the associated infrastructure. However, in this instance, there is no evidence of any cultivation in the vicinity, so this impact would be of extremely limited significance and would be local in extent, if at all.

**Impact 2 (Table 3)**: In this area, the sandy soils, coupled with the dry climate, means that a possible impact would be the increased risk of wind erosion of the topsoil when vegetation cover is removed or disturbed. This would be especially relevant for the construction of access roads and other associated infrastructure.

The significance of the impacts can be summarised as follows:



**Table 2** Loss of agricultural land

<b>Nature: Loss of potentially productive agricultural land (both construction and operation phase)</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (4)	Minor (2)
<b>Probability</b>	Improbable (2)	Improbable (2)
<b>Significance (E+D+M) x P</b>	<b>Low (18)</b>	<b>Low (14)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Low	High
<b>Irreplaceable loss of resources?</b>	No	No
<b>Can impacts be mitigated?</b>	Yes	
<b>Mitigation:</b> The main mitigation measures would be: <ul style="list-style-type: none"> <li>To minimise the footprint of construction as much as possible.</li> </ul>		
<b>Cumulative impacts:</b> likely to be low, as all soil-related aspects will be confined to the site, and the prevailing agricultural potential in the area is low.		
<b>Residual Risks:</b> likely to be low, since the implementation of the appropriate mitigation measures will enable more or less complete rehabilitation during and after the life of the project.		

**Table 3:** Soil erosion

<b>Nature: Increased soil erosion hazard by wind (construction and operation phase)</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local to regional (3)	Local (1)
<b>Duration</b>	Permanent (5)	Short-term (2)
<b>Magnitude</b>	High (8)	Minor (2)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance (E+D+M) x P</b>	<b>High (64)</b>	<b>Low (10)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Low	High
<b>Irreplaceable loss of resources?</b>	Very possible	No
<b>Can impacts be mitigated?</b>	Yes	
<b>Mitigation:</b> The main mitigation measures would be: <ul style="list-style-type: none"> <li>To minimise the footprint of construction as much as possible.</li> <li>Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible.</li> <li>Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure).</li> </ul>		
<b>Cumulative impacts:</b> likely to be high, as wind erosion can carry soil particles for a considerable distance, depending on wind strength and direction, as well as soil texture.		
<b>Residual Risks:</b> if mitigation is not carried out, long-term wind erosion, with results such as loss of valuable topsoil, may occur.		

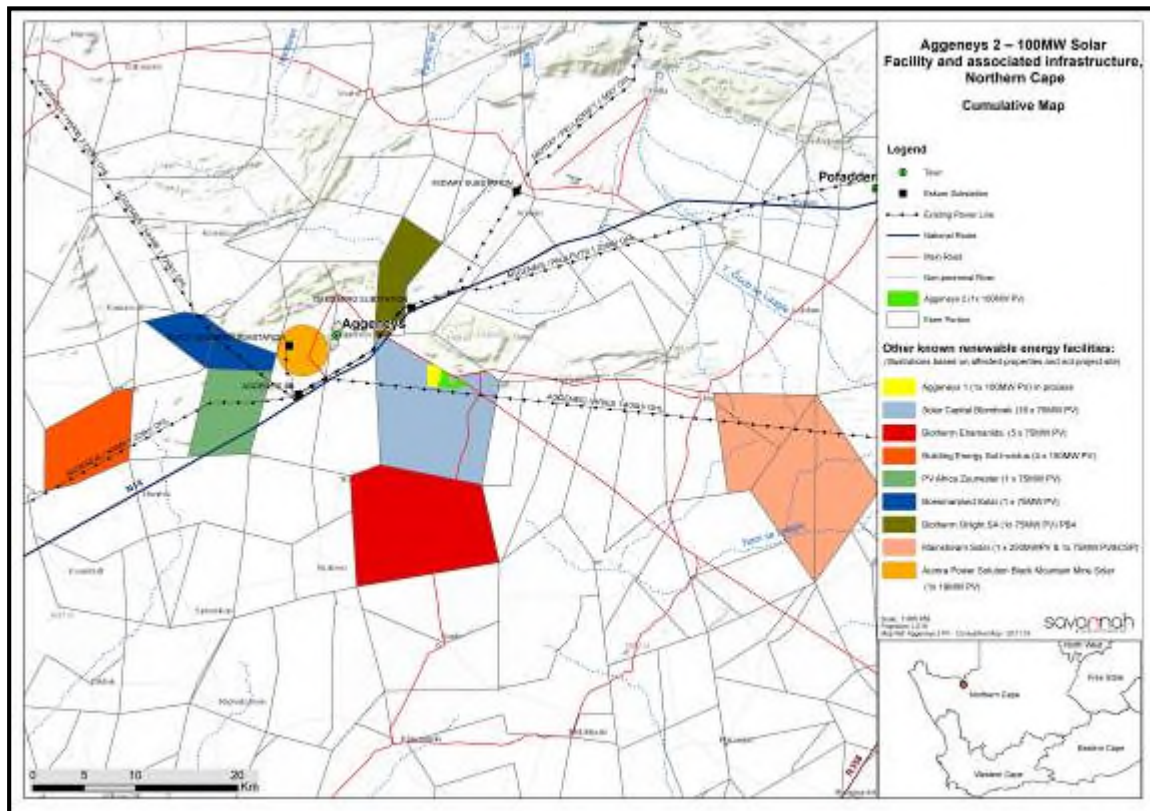
The main impact would be due to the construction activities for the solar arrays and connecting infrastructure (roads, buildings, cables etc).

### **7.1 Cumulative Impacts**

The likelihood of cumulative impacts for wind erosion may be significant, if not mitigated. This is because concurrent developments are proposed close to the Aggeneys 2 project site investigated in this report; this is summarised in Table 4 below.

When considering the other renewable energy developments within the surrounding area, it is assumed that the impact of erosion and appropriate mitigation measures at a site-specific level for each of the facilities has been considered and the mitigation measures recommended are sufficient for the management and mitigation of erosion. Therefore, considering that the impact of erosion at each facility will be low in extent, subject to the implementation of the recommended mitigation measures, and managed for each facility separately, the cumulative impact for erosion is considered to be low. Under these circumstances, the loss associated with erosion is therefore considered to be acceptable loss, without detrimental consequences.

If there is large scale development of renewable energy facilities in the area, any failure to prevent wind erosion of topsoil on one project could lead to that material being deposited on any or all neighbouring properties.



**Figure 6** Map showing Renewable Energy projects in the vicinity of Aggeneys 2

## 7.2 Assumptions and Limitations

The main limitation regarding soil information has been addressed with the field visit, which has confirmed soil conditions prevalent in the area, as well as carrying out a visual inspection.

It is assumed that, for accurate determination of any cumulative impacts, there will be an optimal level of co-operation between representatives of all projects planned in the vicinity in the future. This will ensure that important environmental information is not withheld, that could lead to increased impact levels, such as wind erosion.

The cumulative impacts are summarised in Table 4 below.

**Table 4** Cumulative Impacts

<b>Nature:</b> Cumulative impact of the Proposed Development in terms of wind erosion		
	<b>Overall impact of the proposed project considered in isolation<sup>1</sup></b>	<b>Cumulative impact of the project and other projects in the area<sup>2</sup></b>
<b>Extent</b>	Local (1)	Local (2)
<b>Duration</b>	Short-term (2)	Short-term (2)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Probability</b>	Improbable (2)	Improbable (2)
<b>Significance (E+D+M)x P</b>	<b>Low (10)</b>	<b>Low (12)</b>
<b>Status (positive/negative)</b>	Negative	Negative
<b>Reversibility</b>	High	High
<b>Loss of resources?</b>	No	No
<b>Can impacts be mitigated?</b>	Yes	
<b>Confidence in findings:</b> High.		
<b>Mitigation:</b> The main mitigation measures would be: <ul style="list-style-type: none"> <li>• To minimise the footprint of construction for each facility as much as possible.</li> <li>• Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible.</li> <li>• Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure).</li> <li>• Ensure that equal responsibility and co-operation is accepted if more than one facility will be using the same access road, or if the possibility exists of sediment transfer (by wind or water) from one site to another</li> </ul>		
<b>Residual Risks:</b> Significant risk of accelerated soil erosion by wind if mitigation measures of each facility are not applied correctly.		

<sup>1</sup> It is assumed that the appropriate mitigation measures have been implemented.

<sup>2</sup> It is assumed that the appropriate mitigation measures have been implemented.

## 8 CONCLUSION AND RECOMMENDATIONS

The main recommendation is that care should be taken within all aspects of the construction phase to ensure that erosion is managed and mitigated appropriately. The Aggenneys 2 project site is a dry area, with fragile vegetation and sandy topsoils and will be susceptible to uncontrolled topsoil removal by wind. The long-term effects of ignoring this aspect could be severe, both for the project and for the surrounding environment.

### 8.1 Measures for inclusion in the draft Environmental Management Programme

<b>OBJECTIVE:</b> Conservation, as far as possible, of the existing soil resource, both on site and in adjoining areas.	
<b>Project component/s</b>	Construction of all infrastructure where topsoil will be disturbed
<b>Potential Impact</b>	Loss of topsoil leading to wind erosion
<b>Activity/risk source</b>	Construction activities
<b>Mitigation: Target/Objective</b>	To retain all topsoil with a stable soil surface

Mitigation: Action/control	Responsibility	Timeframe
<ul style="list-style-type: none"> <li>Storage of all topsoil that is disturbed (maximum height 2 m; maximum length of time before re-use 18 months)</li> <li>Immediate replacement of topsoil after the undertaking of construction activities within an area</li> <li>Soil conservation measures must be put in place to ensure soil stabilisation</li> </ul>	Construction Engineer	Construction
	Construction Engineer	Construction
	Construction Engineer	Post-Construction

<b>Performance Indicator</b>	No indications of visible topsoil loss
<b>Monitoring</b>	Visual inspection every 6 months (minimum) of all areas where disturbance has taken place (for both the construction phase and the duration of the project). Responsibility: Project site manager If soil loss is suspected, acceleration of soil conservation and rehabilitation measures must be implemented (as specified above).

No high potential soils or productive cultivated areas occur within the development footprint, or within the two on-site substation location alternatives. Therefore, the placement of the on-site substations within either of the preferred locations will be acceptable from a soils and agricultural potential perspective.

Considering the findings of the report and the current soils environment within which the Aggeneys 2 project is proposed, it is the opinion of the specialist that the proposed activities should be authorised, subject to the implementation of the recommended mitigation measures. The activities proposed are considered to be acceptable from a soils perspectives considering the characteristics and potential of the soils present within the project site.

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