PROPOSED HEUNINGSPRUIT PV 1 AND PV 2 PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Farm Voorspoed Nr.1508 and Remainder of Farm Verdun Nr.1511, Koppies, Free State Province

VISUAL IMPACT ASSESSMENT

Prepared as part of an Basic Assessment Process undertaken in terms of the National Environmental Management Act, 107 of 1998

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Produced for:

Sun Mechanics (Pty) Ltd.

On behalf of:

Savannah Environmental (Pty) Ltd.

Produced by:

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1 INTRODUCTION

1.1 Background and Purpose of Report

Sun Mechanics (Pty) Ltd. proposes to establish two 5 MW photovoltaic (PV) solar energy facilities as well as associated infrastructure on a site approximately 30 km north-east of Kroonstad and 30 km south-west of Koppies in the Free State Province. The two facilities are referred to as Heuningspruit PV 1 Solar Energy Facility and Heuningspruit PV 2 Solar Energy Facility. The purpose of the projects is to generate electricity which will be fed into the national electricity grid (via the existing Heuningspruit Substation). The projects will participate in the National Department of Energy's Small Projects Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The REIPPP Programme has been designed to contribute towards the South African government's renewable energy target and to stimulate the renewable energy industry in the country.

As each project will be implemented through separate Special Purpose Vehicles, separate Environmental Authorisations will be required. Separate applications have therefore been prepared and submitted to the Department of Environmental Affairs (DEA), as the competent authority. During the completion of this Visual Impact Assessment (VIA) study it was found that there are very little difference between the visual impact of PV 1 and PV 2. This was mainly attributed to the scale of the proposed activity, relative to the property and it surroundings, the proximity of the two facilities to each other and the characteristics of the surrounding landscape. Therefore, the combined impact of PV 1 and PV 2 have been assessed in the VIA. This VIA is undertaken as part of the Basic Assessment process being facilitated by Savannah Environmental (Pty) Ltd. in terms of the National Environmental Management Act 107 of 1998 (NEMA). As such, the purpose of this report is to assess the proposed activity for the site(s) in terms of the *Guidelines for Involving Visual and Aesthetic Specialists in the EIA Process* and the *NEMA EIA Regulations of 2010*.

1.2 Components of the Report

The aspects addressed in this report are as follows:

a) Description of the methodology adopted in preparing the report.
b) Description of the receiving environment.
c) Description of the view catchment area, view corridors, viewpoints and receptors.
d) Identification and evaluation of potential visual impacts associated with the proposed activity by using the established criteria, including potential lighting impacts at night.
e) Addressing of additional issues such as:
    - Impact on skyline.
    - Negative visual impact.
    - Impact on aesthetic quality and character of place.
f) Assumptions made and uncertainties or gaps in knowledge.

g) Recommendations in respect of mitigation measures that should be considered by the applicant and competent authority.

1.3 Study Methodology

As stated previously, this VIA was undertaken in accordance with the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* as issued by the Western Cape Government's Department of Environmental Affairs and Development Planning during 2005[1]. The VIA was undertaken in distinct steps, each of which informed the subsequent steps. The figure below summarises the methodology adopted for undertaking the assessment.

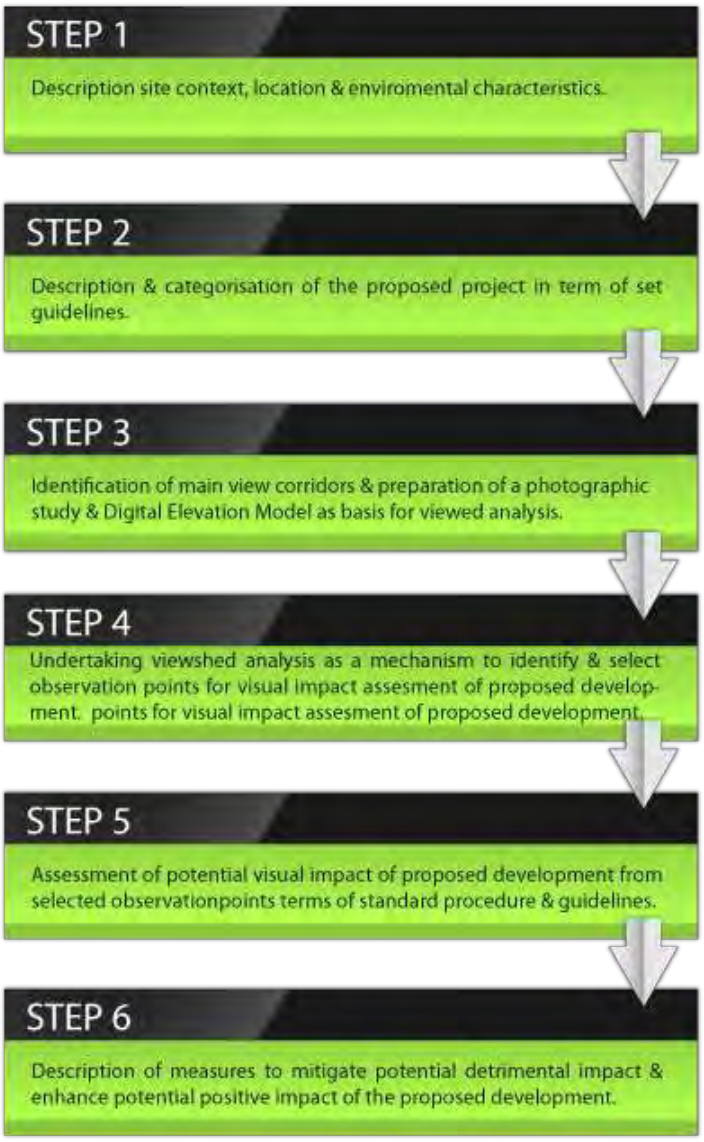

Figure 1: Methodology adopted for the VIA.

[1] No similar policy exists for the Free State Province. The guidelines are based upon universally accepted principles and is therefore applicable to the said project.

1.4 Supplementary Documentation

This report is to be read together with Annexure 2 (Selected observation point viewsheds and assessments), which provides an identification of selected observation points and visual assessment of the proposed activity from each of these points.

1.5 Gaps in Knowledge, Assumptions and Limitations

This assessment was undertaken during the planning stage of the project and is based on the information and Terms of Reference provided by Savannah Environmental (Pty) Ltd.

Assessments of this nature generally suffer from a number of defects that must be acknowledged:

- **Limited time:** A comprehensive assessment requires a systematic assessment of the environment at different times of the day. Such luxury is not always possible and therefore most assessments are based on observations made at a specific time of day. Educated estimates are made, where applicable, based on the knowledge of the area.
- **Availability of literature:** A thorough assessment requires that all relevant literature on the subject matter is studied, acknowledged and incorporated in the report. Due to a range of factors, forward planning documents are not always available for all spheres of government.

Notwithstanding the above, it is believed that this assessment identified all issues of likely importance from a visual point of view.

2 THE AFFECTED ENVIRONMENT

2.1 Locality

The project site is located in the Ngwathe Local Municipality (FS202), part of the Fezile Dabi District Municipality in the Free State Province, at Heuningspruit some 30 km north-east of Kroonstad (defined in the Free State Provincial Spatial Development Framework [2013] as a Regional Town) via the R82 and about equally as far south-west from Koppies.

There are no active intensive cropping on the project site itself and is being used for livestock grazing with sheep and cattle. The area surrounding the project site is rural, mainly characterised by grasslands and maize fields. The main infrastructure developments in close proximity of the project site is the R82 road passing ± 350 m east of the site and the N1, ± 4 km to the west. The S156 minor (gravel) road runs north of the site connecting the N1 with the R82. The project site will have access from this road. Also, just east of the site runs a railway line that runs all the way from the Western Cape

to Johannesburg. Heuningspruit train station just about borders the site. South of Heuningspruit train station one finds the SENWES silo's and accompanying agriculture related infrastructure for the storing and transportation of regional product.

There are no formally protected or conservation area in close proximity to the project site. Also, no heritage sites are evident in the area.

Figure 2: Regional context of the subject property.

The Free State Provincial Spatial Development Framework (PSDF, 2013) described the economic base of Kroonstad and its immediate surrounding area as mainly depending on agriculture, transport and tourism as the traditional anchor activities. In terms of the PSDF (2013), Kroonstad is identified as having Development Potential, situated on a Development Corridor (i.e. the N1 Corridor).

2.1.1 Intrinsic Values of the Highveld

It is a common principle of planning that each place has a specific intrinsic, instrumental and systemic value and that such values need to be carefully considered when contemplating the current and future use of any particular place.

Broadly -speaking, two different philosophical perspectives are possible when considering the value of any place or object, namely **what is it good for?** and **what is**

its own good? The first question relates to its instrumental value, while the second deals with intrinsic value. Instrumental value uses something as a '*means to an end'* while intrinsic value refers to being '*worthwhile in itself'* (Rolston, 1994).

Systemic value relates to the fact that '*things do not have their separate natures merely in, and for themselves, but they face outward and co-fit into broader natures. Value seeps out into the system and the individual lose its status as sole locus of value'* (Rolston, 1994:174). Systemic value refers to the relations that things have with other things, and to the role they play in larger wholes.

The value system of region was determined in the various collaborative, participative processes undertaken during the drafting of forward planning documentation, policy and guidelines. As such, the intrinsic value of the region is found in the agrarian landscape with strong linkages to the rural, natural landscape.

As described above, even though the intrinsic value of the area is based on the agrarian characteristics, the values of the project site and its surroundings have to a large degree been lost.

2.2 Project Site Description

As illustrated by the figure below, the project site consists of two properties, namely the Farm Voorspoed No. 1508 (PV1) and Remainder of Farm Verdun 1511 (PV2). Combined, this portion of land is approximately 320 ha in extent (±180 ha and ±140 ha respectively), while the development footprint of the proposed activity will cover an area of approximately 26 ha, ± 13 ha for each solar energy facility. The provisional location of the projects is indicated on Figure 3. There is an existing substation, the Heuningspruit Substation along with an 88 kV Eskom overhead power line, next to the S156 road to the north of the site. This substation is essentially part of the project site which means that routing corridors will be at a minimum. The electricity generated on site will be evacuated into the electrical grid at the Heuningspruit Substation.

2.2.1 Landscape Character

As mentioned above, the project site's surrounding landscape is characterized by grasslands and fields of various grain crops.

The area is very much flat with no real topographical features standing protruding from the landscape. The whole area surrounding the project site slightly varies at an elevation of about 1400 m above sea level. Several large trees and bushes are in the area.

The region normally receives about 468mm of rain per year, with most rainfall occurring during mid-summer. It receives the lowest rainfall (± 2 mm) in June and the highest (± 76 mm) in January. Midday temperatures range from 17°C in June to 28.7°C in January.

The region is the coldest during June when the mercury drops to 0°C on average during the night.

Figure 3: Extent of subject property and location of proposed developments.

The project site falls within the Grassland Biome (DEDTEA, 2009). Prominent grass species in this biome include *Eragrostis chloremelas* (Curly leaf), *Hyparrhenia hirta* (common thatch grass), *Eragrostis gummiflua* (Gum grass), *Heteropogon contortus* (Spear grass), *Phragmites australis* (Common reed), *Merxmuellera drakensbergensis* (Broom grass), etc. The Grassland Biome is the mainstay of the dairy, beef and wool production in South Africa. Furthermore, this biome is the cornerstone of the maize crop, and many grassland habitats have been converted into maize fields. Sorghum, wheat and sunflowers are also cultivated on transformed Grassland habitat[2].

[2] http://www.plantzafrica.com/vegetation/grassland.htm

2.2.2 Solar Radiation

Portions of South Africa have the highest solar radiation intensity in the world (Northern Cape State of the Environment Report, 2005). This translates to an excellent comparative economic advantage for these regions and an opportunity to harness the natural sun power and to generate electricity. The project site falls within an area with such potential and can be considered as being well located for the development of concentrated solar power (CSP) and photovoltaic solar power generation technologies[3].

Figure 4 below illustrates the measured annual direct and diffuse solar radiation of the country as a whole.

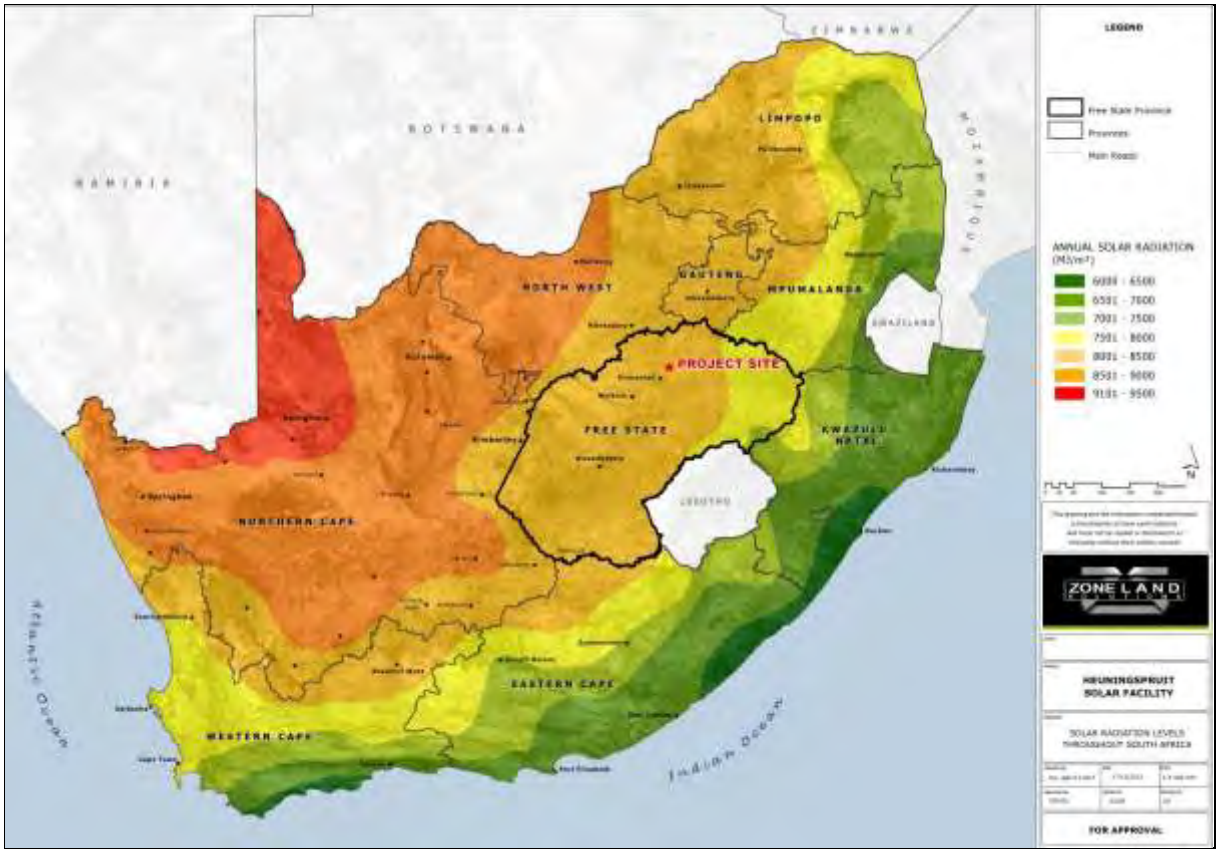

Figure 4: Solar radiation levels for South Africa.

3 PROJECT DESCRIPTION AND INSTALLATIONS

The proposed solar power plants will make use of PV solar panels and associated infrastructure with a generation capacity of approximately 5 MW each.

[3] It has however been confirmed that a photovoltaic solar power plant will be considered for development on the project site.

The overall aim of the design and layout of the facilities is to maximise electricity production through exposure to the solar radiation, while minimising infrastructure, operation and maintenance costs, as well as possible social and environmental impacts. The use of solar energy for power generation can be described as a non-consumptive use of natural resources which emits zero greenhouse gas emissions.

3.1 Project Components

Each facility would comprise of the following infrastructure:

- An array of photovoltaic panels up to 5 m high (fixed or tracking) with a capacity of up to 5 MW.
- Mounting structures to be either rammed steel piles or piles with pre-manufactured concrete footing to support the PV panels.
- Cabling between the project components, to be lain underground.
- Inverters / Transformer enclosures.
- An on-site switching station up to 88kV in capacity.
- An overhead power line of approximately 250 m in length to tie into the existing Heuningspruit Rural-Syferfontien Traction 88 kV Eskom power line on site.
- Internal access roads.
- Fencing.
- Workshop area for maintenance, storage, offices and small modular water filtration or di-ionisation unit.
- Parking and water storage tanks.

3.2 Renewable Energy Technology Proposed

Various renewable energy technologies are available for electricity generation. Renewable energy technologies offer an alternative to fossil fuels, thereby reducing the amount of CO^2 emissions into the atmosphere.

3.2.1 Photovoltaic Technology

A solar energy facility uses the energy from the sun to generate electricity through a process known as the Photovoltaic Effect. This effect refers to photons of light colliding with electrons, and therefore placing the electrons into a higher state of energy to create electricity.

The proposed solar energy facilities will comprise of the following components:

The Photovoltaic Cell:

A photovoltaic (PV) cell can consist of a thin film technology or polycrystalline silicone cell which acts as a semiconductor used to produce the photovoltaic effect. Individual PV cells are linked and placed behind a protective glass sheet to form a photovoltaic panel.

The Inverter:

The photovoltaic effect produces electricity in direct current. Therefore an inverter must be used to change it to alternating current.

The Support Structure:

The PV panels will be attached to a steel support structure set at an angle so to receive the maximum amount of solar radiation. The angle of the panel is dependent on the latitude of the proposed facility and the angles may be adjusted to optimise for summer or winter solar radiation characteristics.

The PV panels are designed to operate continuously for more than 20 years, unattended and with low maintenance.

Figure 5: Illustration of typical photovoltaic panels (Source: YB Mashalaba and Associates Consultants CC).

Fixed Mounted PV System

In a fixed mounted PV system, PV panels are installed at a pre-determined angle from which they will not move during the lifetime of the plant's operation. The limitations imposed on this system due to its static placement are offset by the fact that the PV panels are able to absorb incident radiation reflected from surrounding objects. In addition, the misalignment of the angle of PV panels has been shown to only marginally affect the efficiency of energy collection. There are further advantages which are gained from fixed mounted systems, including:

- The maintenance and installation costs of a fixed mounted PV system are lower than that of a tracking system, which is mechanically more complex given that these PV mountings include moving parts.

- Fixed mounted PV systems are an established technology with a proven track record in terms of reliable functioning. In addition, replacement parts are able to be sourced more economically and with greater ease than with alternative systems.
- Fixed mounted systems are robustly designed and able to withstand greater exposure to winds than tracking systems.

Single Axis Tracking System

A 'single axis tracker' will track the sun from east to west, while a dual axis tracker will in addition be equipped to account for the seasonal waning of the sun. These systems utilise moving parts and complex technology, including solar irradiation sensors to optimise the exposure of PV panels to sunlight. Tracking systems are a new technology and, as such, are less suitable to operations in South Africa. This is because:

- A high degree of maintenance is required due to the nature of the machinery used in the system, which consists of numerous components and moving parts. A qualified technician is required to carry out regular servicing of these parts, which places a question on the feasibility of this system given the remote location of the proposed project site.
- The costs of the system are necessarily higher than a fixed mounted system due to the maintenance required for its upkeep and its complex design.
- A larger project site is required for this system given that the separate mountings need to be placed a distance apart to allow for their tracking movement.
- A power source is needed to mechanically drive the tracking system and this would offset a certain portion of the net energy produced by the plant.

Fixed or tracking panels are being considered for the proposed solar energy facilities.

3.3 Potential 'triggers' or Key Issues

A 'trigger' is a characteristic of either the receiving environment or the proposed project which indicates that visibility and aesthetics are likely to be key issues and may require further specialist involvement (DEA&DP, 2005).

The 'triggers', as it relates to the proposed project refer to the following:

Table 1: Potential triggers.

KEY ISSUE	FOCAL POINTS	DESCRIPTION
a) Nature of the receiving environment:	*Areas lying outside a defined urban edge line.*	The proposed activity is situated outside the demarcated urban edge of the nearest town and will be assessed accordingly.

	Areas of important tourism or recreational value.	The N1 is regarded as a tourism and development corridor and stretches from Cape Town to Johannesburg and beyond.
	Areas with visually prominent ridgelines or skylines.	The subject property is not characterised by several prominent hills and mountains.
b) Nature of the project:	*A change in land use from the prevailing use.*	The prevailing use will change on approximately 26 ha. Should the proposed mitigation measures be implemented, the prevailing use could be retained to a degree.
	Possible visual intrusion in the landscape.	The proposed activity is visually prominent from defined observation points, the impact of which will be assessed through this VIA.
	A significant change to the fabric and character to the area.	The proposed activity will form an integral part of the future landscape character. The extent and significance of a possible visual impact is to be determined through this VIA.

3.4 Development Category

Based upon the 'triggers' and key issues and the environmental context summarised above, the proposed activity is categorised as a **Category 4 Development**.

This categorisation is based upon the *Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes*, which lists the following categories of development:

Box 3: KEY TO CATEGORIES OF DEVELOPMENT

Category 1 Development: e.g. nature reserves, nature-related recreation, camping, picnicking, trails and minimal visitor facilities.

Category 2 Development: e.g. low-key recreation/resort/residential type development, small-scale agriculture/nurseries/narrow roads and small-scale infrastructure.

Category 3 Development: e.g. low density residential/resort type development, golf or polo estates, low to medium-scale infrastructure.

Category 4 Development: e.g. medium density residential development, sport facilities, small-scale commercial faculties/office parks, one-stop petrol stations, light industry, medium-scale infrastructure.

Category 5 Development: e.g. high density township/residential development, retail and office

complexes, industrial facilities, refineries, treatment plants, power stations, wind energy farms, power lines, freeways, toll roads, large-scale infrastructure generally. Large-scale development of agriculture land and commercial tree plantations. Quarrying and mining activities with related processing plants.

Based upon the above categorization and the assessment criteria provided in the *Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes* it is expected that the visual impact of the proposed activity would be classified as **'moderate'** (refer to the table below).

The objectives of the VIA described in this report is to:

a) determine whether such broad impact categorisation is appropriate and if not, to determine an appropriate category of impact;

b) formulate and implement measures or interventions that would mitigate any detrimental impacts to the extent that the activity will be acceptable.

Table 2: Categorization of expected visual impact (DEA&DP, 2005).

Type of environment	Type of development				
	Category 1	**Category 2**	**Category 3**	**Category 4**	**Category 5**
Protected/wild areas of international or regional significance	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected	Very high visual impact expected
Areas or routes of high scenic, cultural, historical significance	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected
Areas or routes of medium scenic, cultural or historical significance	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected
Areas or routes of low scenic, cultural or historical significance/disturbed	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	**Moderate visual impact expected**	High visual impact expected
Disturbed or degraded sites / run-down urban areas / wasteland	Little or no visual impact expected. Possible benefits	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected

4 VIEWSHED ANALYSIS

4.1 Dominant View Corridors

As a first step of this VIA, a survey was undertaken to determine the existence of significant view corridors associated with the project site. A view corridor is defined as *'a linear geographic area, usually along movement routes, that is visible to users of the route'* (DEA&DP, 2005). Accordingly, three dominant *view corridors* were identified in the region, namely:

a) **N1-** The main movement corridor between Cape Town and Johannesburg.
b) **R82-** Connects the R34, between Edenville and the N1 north of Kroonstad, with the R720 south of Koppies.
c) **S156-** Connects the R82 and the N1 passing along the northern boundary of the project site.

When determining dominant view corridors, one has to take into consideration the class of the road and dominance and nature of the town/settlement in which direction it travels.

The R82 and S156 are located within 1 km form the project site and are located in the Foreground of the project site. They have therefor been regarded as being either high or moderately sensitive receptors to visual impact related to the proposed activity. As the N1 is located in the Background of the project site (refer to Chapter 8.1), it has not been regarded as dominant view corridor of relevance to the proposed activity.

4.2 Relevant Topographic and Physical Characteristics

A further key aspect affecting the potential visual impact of any proposed activity is the topography of the project site and the surrounding environment and the existence of prominent biophysical features from where the project site is visible. The topography and the major ridgelines of the area were subsequently determined and mapped by using a *Digital Elevation Model*[4].

As illustrated by the DEM below, the project site is located at a mean elevation of approximately 1400 m above sea level. The DEM shows that there are no prominent topographical manifestations on the project site and in close proximity to the project site from which the proposed activity is particularly visually exposed.

[4] A Digital Elevation Model (DEM) is a geographic information system-based outcome generated from contours for a specific area. In this instance, 20m contour intervals were used to calculate the DEM for the region.

Figure 6: Digital Elevation Model illustrating major ridgelines and dominant view corridors in the sub-region.

4.3 Photographic Study as Supplementary Component

In order to quantify and assess the visibility and potential impact of the proposed activity and to provide a basis for selecting appropriate observation points outside of the project site, a photographic study and analysis was undertaken in the vicinity of the project site. The analysis and ground-truthing identified several observation points with similar characteristics and assessments outcomes. A selection of Key Observation Points is therefore included under Annexure 2.

5 DIGITAL VIEWSHED ANALYSIS

The photographic study summarised above was supplemented with a digital viewshed analysis based upon the Digital Elevation Model. As stated previously, the purpose of these two steps was to provide a basis for the identification and selection of appropriate observation points outside the project site for the VIA.

The viewshed[5] analysis was undertaken in accordance with the *Guideline Document for involving Visual Specialists in EIA Processes*. Geographic Information Systems (GIS) technology was used to analyse and map information in order to understand the relationships that exist between the observer and the observed view. Key aspects of the viewshed are as follows:

- It is based on a *single viewpoint* from the highest point of the project site.
- It is calculated at an assumed 3.4m above the natural ground level to reflect the highest point of the PV panels.
- It represents a '*broad-brush' designation*, which implies that the zone of visual influence may include portions that are located in a view of shadow and it is therefore not visible from the project site and *vice versa*. This may be as a result of landscape features such as vegetation, buildings and infrastructure not taken into consideration by the DEM.
- The viewshed generated from each of the selected observation points referred to in Annexure 2 is calculated at 1.7m above the natural ground level to reflect the average height of person either walking or sitting in a vehicle.

As illustrated by the generated viewshed (calculated from the highest point on the relevant site) (refer to Figure 7), the project site has quite a large *zone of visual influence*[6]. It must, however, be emphasized that the viewsheds generated are done taking into account no other feature other than the contours of the area. Thus, no man-made structure's or vegetation's influence on the visibility of the proposed activity is reflected in the viewsheds.

The viewshed indicates primary visual impact to the immediate vicinity (Foreground and Middle ground) of the project site to the north, east and south of the project site and small pockets beyond. To the west and south-west the impact is mainly located in the Background, 3 km and beyond.

The GIS-generated viewshed illustrates a theoretical *zone of visual influence*. This does not mean that the proposed activity would be visible from all observation points in this area.

The distance radii indicating the various viewing distances from the combined development sites are illustrated by Figure 7. Also illustrated by the figure are the view corridors of the N1, R82 and the S156.

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[5] A viewshed is defined as *'the outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed'*. A Viewshed Analysis is therefore the study into the extent to which a defined area is visible to its surroundings.

[6] Zone of visual influence is defined as 'An area subject to the direct visual influence of a particular project'.

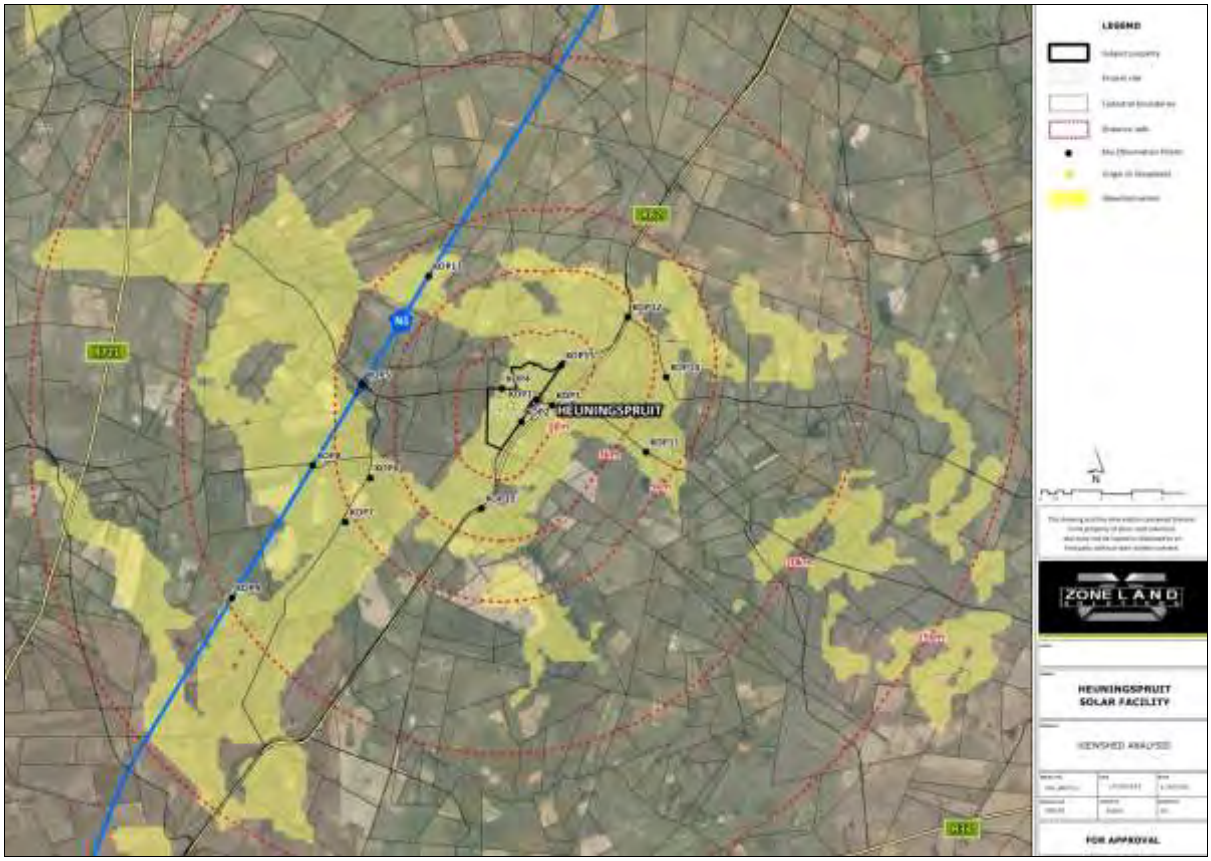

Figure 7: Viewshed generated from the highest point of the project site.

5.1 Key Aspects of the Viewshed

The distance between the observer and the observed activity is an important determinant of the magnitude of the visual impact. This is due to the visual impact of an activity diminishing as the distance between the viewer and the activity increases. Viewsheds are categorised into three broad categories of significance, namely:

a) Foreground: The foreground is defined as the area within 1km from the observer within which details such as colour, texture, styles, forms and structure can be recognised. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.

b) Middle ground: The middle ground is the area between 1km and 3km from the observer where the type of detail which is clearly visible in the foreground becomes indistinguishable. Objects in the middle ground can be classified as visible to moderately visible, unless obscured by other elements within the landscape.

c) Background: the background stretches from approximately 3km onwards. Background views are only distinguishable by colour and lines, while structures, textures, styles and forms are often not visible (SRK Consulting, 2007).

6 VISUAL IMPACT ASSESSMENT

6.1 Selection of Observation Points

A total of 14 Key Observation Points (KOPs) were identified and selected within the defined viewshed for the visual assessment in accordance with the selection criteria stipulated in the Visual Guidelines. These KOPs correspond with movement routes, major farmsteads, residential areas and general populated areas in the region. The assessment results of the KOPs are included in Annexure 2.

KOPs selected for the assessment are generally located at the intersection between the zone of visual influence and the defined view corridors (refer to Sections 4.1 and 5 above). The view corridors are those areas that are accessible to the general observer.

6.2 Assessment Process

The identified *observation points* were categorised and assessed as summarised in the table below.

Table 3: VIA methodology and process.

KEY	DESCRIPTION
NUMBER	Each observation point was allocated a reference number.
CO-ORDINATES	The co-ordinates of each of the observation points are provided.
ALTITUDE	The altitude of the observation point was provided in meters above sea level.
DESCRIPTION	A brief description where the observation point is located is provided.
TYPE	Each observation point is categorised according to its location and significance rating. These criteria include the following: • Tourist-related corridors, including linear geographical areas visible to users of a route or vantage points. • Residential areas (including farmsteads).
PHOTOGRAPH	A photograph was taken from each observation point in the direction of the project site to verify the digitally-generated viewshed.

PROPERTY LOCATION	The location of the property was described a *foreground*, *middle ground* or *background*.
PROXIMITY	The distance between the observation point and the project site was provided in kilometres.
VISUAL SENSITIVITY OF RECEPTORS	The visual impact considered acceptable is dependent on the type of receptors. A *high* (i.e. residential areas, nature reserves and scenic routes or trails), *moderate* (e.g. sporting or recreational areas, or places or work), or *low* sensitivity (e.g. industrial, mining or degraded areas) was awarded to each observation point.
VISUAL EXPOSURE	Exposure or visual impact tends to diminish exponentially with distance. A *high* (dominant or clearly visible), *moderate* (recognisable to the viewer) or *low* exposure (not particularly visible to the viewer) rating was allocated to each observation point.
VISUAL ABSORPTION CAPACITY (VAC)	The potential of the landscape to conceal the proposed activity was assessed. A rating of *high* (effective screening by topography and vegetation), *moderate* (partial screening) and *low* (little screening) was allocated to each observation point.
VISUAL INTRUSION	The potential of the activity to fit into the surrounding environment was determined. The visual intrusion relates to the context of the proposed activity while maintaining the integrity of the landscape. A rating of *high* (noticeable change), *moderate* (partially fits into the surroundings) or *low* (blends in well with the surroundings) was allocated.
DURATION	With regard to roads, the distance (in kilometres) and duration (in seconds) for which the property will be visible to the road user, were calculated for each observation point.

6.3 Summary of Assessment

Based on the viewshed analysis and the preceding sections, the envisaged visual impact of the proposed activity was assessed in accordance with the criteria for visual impact assessments (DEA&DP, 2005). The findings of the assessment from selected observation points are included under Annexure 2.

6.3.1 Assessment Criteria

It is stated in the DEA&DP's Visual Guidelines that to aid decision-making, the assessment and reporting of possible impacts requires consistency in the interpretation of impact assessment criteria. The criteria that specifically relate to VIAs were therefore described in Table 3 and Annexure 2.

The potential visual impact of the proposed activity was assessed against these criteria, with reference to the summary of criteria in Box 12 of the Visual Guidelines. Table 4 provides a description of the summary criteria used to determine the impact significance.

Table 4: Summary of criteria used to assess the potential impacts of the proposed activity.

CRITERIA	DESCRIPTION
NATURE OF THE IMPACT	The nature of the impact refers to the visual effect the proposed activity would have on the receiving environment. The nature of the development proposals are described in the preceding sections.
EXTENT	This category deals with the spatial or geographic area of influence and refers to the following levels: • *Site-related* (extending only as far as the activity), • *Local* (limited to the immediate surroundings), • *Regional* (affecting a larger metropolitan or regional area), • *National* (affecting large parts of the country), • *International* (affecting areas across international boundaries). A value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high).
DURATION	Duration refers to the expected life-span of the visual impact. A rating of short term (during the construction phase) (assigned score of 1 or 2), *medium term* (duration for screening vegetation to mature) (assigned score of 3), *long term* (the lifespan of the project) (assigned score of 4), or *permanent* (where time will not mitigate the visual impact) (assigned score of 5) were applied.
MAGNITUDE	Magnitude refers to the magnitude of the impact on views, scenic or cultural resources. The following ratings were allocated to determine the intensity of the impact: • *No effect* (assigned score of 0), • *Low* (visual and scenic resources not affected) (score of 2), • *Minor* (will not result in impact on processes) (score of 4), • *Medium* (affected to a limited scale) (assigned score of 6), • *High* (scenic and cultural resources are significantly affected) (assigned score of 8), • *Very high* (result in complete destruction of patterns) (score of 10).
PROBABILITY	This category refers to the degree of possibility of the visual impact occurring. A rating of *very improbable* (probably will not happen) (assigned score of 1), *improbable* (very low possibility of the impact occurring) (assigned score of 2), *probable* (distinct possibility that the impact will occur) (assigned score of 3), *highly probable* (most likely) (assigned score of 4), or *definite* (impact will occur regardless of any preventative measures) (assigned score of 5) were applied.
STATUS	Status will be described as positive, *negative* or *neutral*.

REVERSIBILITY	Degree to which the activity can be reversed. The following rating were allocated: • Reversible (assigned score of 1), • Recoverable (assigned score of 3), or • Irreversible (assigned score of 5).
SIGNIFICANCE	The significance is calculated by combining the criteria in the following formula: S = (E+D+M)P S = Significance E = Extent D = Duration M = Magnitude P = Probability The significance ratings for each potential impact are as follows: • *Low* (where it will not have an influence on the decision) (<30 points), • *Medium* (where it should have an influence on the decision unless it is mitigated) (30-60 points), or • *High* (where it would influence the decision regardless of any possible mitigation) (>60 points).

6.4 Assessment of Impacts

6.4.1 Assessment of Impact on Sensitive Receptors in the *Foreground* and *Middle ground*

Several receptors are located in the *foreground* and *middle ground* of the project site. The sensitive receptors in the *foreground* and *middle ground* of the generated viewshed represent mostly users of the road networks. The settlement of Heuningspruit, its train station and the silos south of Heuningspruit are all situated in very close proximity to the proposed development.

The proposed activity will represent a change in land use and land form to what is currently the status quo. The introduction of foreign structures and forms in the agrarian landscape will have an impact on these sensitive receptors as described in the table below.

Table 5: Impact table summarising the significance of visual impact on sensitive receptors in the *foreground* and *middle ground*.

NATURE:	Potential visual impact on the sensitive receptors in the foreground and middle ground.	
	Without Mitigation	**With Mitigation**
Extent	Regional (**3)**	Local (**2)**
Duration	Medium term (**3)**	Medium term (**3)**
Magnitude	Medium (**6)**	Minor (**4)**
Probability	Highly probable (**4)**	Probable (**3)**
Significance	Medium (**48)**	Low (**27)**
Status	Negative	Neutral
Reversibility	Recoverable (**3)**	Recoverable (**3)**
Irriplaceable Loss Of Resource?	No	No
Can Impacts Be Mitigated?	Yes	

Mitigation:

- Keep disturbed areas to a minimum.
- No clearing of land to take place outside the demarcated footprint.
- Institute a rigorous planting regime around the proposed activity to limit direct views onto the project site.
- Only indigenous plant species to be introduced and planted in an organic manner and location which would not cast shadows on the PV 'strings'.
- Buildings and similar structures must be in keeping with regional planning policy documents, especially the principles of critical regionalism, namely sense of place, sense of history, sense of nature, sense of craft and sense of limits.
- Utilise existing roads and tracks to the extent possible. Where new roads are required, they should be two-track gravel roads, maintained to prevent dust plumes and erosion.

Cumulative Impacts:

The project site is not pristine in terms of its location, land use or vegetation cover. There is an existing substation on the project site. Several other infrastructural improvements have also been introduced in the area, which further adds to the complexity of the landscape.

It is therefore expected that the cumulative impact of the proposed activity would be **direct** and **additive** where the proposed activity is proposed on previously undeveloped land.

Residual Impacts:

The proposed infrastructure is of such a nature that the status quo could be regained after decommissioning of the plant. Providing that the site is rehabilitated to its current state, the visual impact will also be removed.

6.4.2 Assessment of Impact on Sense of Place

Sense of place and intrinsic values are closely related to one another. Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically visual character of an area (informed by a combination of aspects, such as topography, level of development, vegetation, noteworthy features, cultural/historical features, etc.) play a significant role (MetroGIS, 2012).

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light (MetroGIS, 2012).

As described above, the sense of place of the project site is mixed as a result of the mentioned infrastructural improvements on the agriculturally-dominated landscape.

Table 6: Impact table summarising the significance of visual impact on the sense of place.

NATURE:	Potential visual impact on the intrinsic value and sense of place of the region.	
	Without Mitigation	**With Mitigation**
Extent	Local (**2)**	Local(**2)**
Duration	Long term (**4)**	Medium term(**3)**
Magnitude	Medium(**6)**	Minor(**4)**
Probability	Probable(**3)**	Probable(**3)**
Significance	Medium (**36)**	Low(**27)**
Status	Negative	Negative
Reversibility	Recoverable(**3)**	Recoverable(**3)**
Irriplaceable Loss Of Resource?	No	No
Can Impacts Be Mitigated?	Yes	
Mitigation: • Keep disturbed areas to a minimum. • No clearing of land to take place outside the demarcated footprint. • Institute a rigorous planting regime around the proposed activity to limit direct views onto the project site. • Only indigenous plant species to be introduced and planted in an organic manner and location which would not cast shadows on the PV 'strings'. • Buildings and similar structures must be in keeping with regional planning policy documents, especially the principles of critical regionalism, namely sense of place, sense of history, sense of nature, sense of craft and sense of limits. • Utilise existing roads and tracks to the extent possible. Where new roads are required, they should be two-track gravel roads, maintained to prevent dust plumes and erosion.		
Cumulative Impacts: The project site is not pristine in terms of its location, land use or vegetation cover. Several		

infrastructural improvements have also been introduced in the area, which further adds to the complexity of the landscape. It is therefore expected that the cumulative impact of the proposed activity would be **direct** and **additive**, where the proposed activity is proposed on previously undeveloped land.
Residual Impacts: The proposed infrastructure is of such a nature that the status quo could be regained after decommissioning of the plant. Providing that the site is rehabilitated to its current state, the visual impact will also be removed.

6.4.3 Assessment of Impact of Artificial Lighting

The project site has a low illumination factor. The occurrence of light sources in the vicinity of the project site is confined to individual farmsteads and the by-passing road traffic. A slight sky glow[7] effect is however associated with the surrounding town of Kroonstad.

The proposed PV 'string' will not include lights of any kind, however, the associated ancillary buildings and infrastructure may include some degree of lighting.

It is not expected that the proposed activity will contribute to the effects of sky glow or artificial lighting of the area. In order to ensure this, the proposed mitigation measures will have to be complied with.

Table 7: Impact table summarising the significance of visual impact of artificial lighting.

NATURE:	Potential visual impact of artificial lighting as a result of the activity.	
	Without Mitigation	**With Mitigation**
Extent	Local(**2**)	Site-related (**1**)
Duration	Long term (**4**)	Medium term(**3**)
Magnitude	Low (**2**)	Low (**2**)
Probability	Probable(**3**)	Probable(**3**)
Significance	Low(**24**)	Low (**18**)
Status	Negative	Negative
Reversibility	Recoverable(**3**)	Recoverable (**3**)
Irreplaceable Loss Of Resource?	No	No
Can Impacts Be Mitigated?	Yes	

Mitigation:

- Outdoor lighting must be strictly controlled so as to prevent light pollution.
- All lighting must be installed at downward angles.
- Sources of light must as far as possible be shielded by physical barriers such as a planted trees and shrubs or built structures.
- Consider the application of motion detectors to allow the application of lighting only where and

[7] Sky glow refers to the illumination of the night sky or parts thereof. The most common cause of sky glow is artificial light that emits light pollution, which accumulates into a fast glow that can be seen from miles away.

when it is required. • Only minimum wattage light fixtures must be used.
Cumulative Impacts: As mentioned above, the area within which the proposed activity is to be undertaken is relatively low lit. The occurrence of ancillary structures of the PV Plant will contribute to the cumulative lighting effect of the area but it is expected to be negligible in a local context. It is expected that the cumulative impact of artificial lighting caused by the proposed activity would be **direct** and **additive**.
Residual Impacts: The proposed infrastructure is of such a nature that the status quo could be regained after decommissioning of the plant. Providing that the site is rehabilitated to its current state, the visual impact will also be removed.

6.4.4 Assessment of Impact of Reflection and Glare of PV Panels

Photovoltaic solar panels are designed to absorb sunlight in order to convert it into electricity. The more sunlight that is absorbed, the more energy can be produced.

The polycrystalline silicone cell absorbs two-thirds of the sunlight reaching the panel's surface. This effectively means that only one-third of the sunlight reaching the surface of a solar panel has a chance to be reflected.

In addition, the PV panels have a reflectivity of around 30%, while surface materials such as dry sand has a reflectivity of around 45% and grass-type vegetation at 25%. Moreover, PV panels are installed at a fixed angle of around 30°. The solar panels will therefore not noticeably alter the site's current amount of reflected, indirect sunlight.

Table 8: Impact table summarising the significance of visual impact of reflection and glare of the PV panels and infrastructure.

NATURE:	Potential visual impact of reflection of the PV Panels and infrastructure.	
	Without Mitigation	**With Mitigation**
Extent	Regional(**3**)	Local (**2**)
Duration	Long term(**4**)	Medium term (**3**)
Magnitude	Low(**2**)	Low (**2**)
Probability	Improbable(**2**)	Improbable (**2**)
Significance	Low(**18**)	Low (**14**)
Status	Neutral	Neutral
Reversibility	Recoverable (**3**)	Recoverable (**3**)
Irriplaceable Loss Of Resource?	No	No
Can Impacts Be Mitigated?	Yes	
Mitigation: • Consider installing anti-reflective coating or glass to reduce the sunlight that is reflected and increase the amount of sunlight that is absorbed.		

• Consider installing all electrical cables underground en-route to the substation. • Where cables cannot be laid underground and electricity towers (pylons) need to be erected, install H-frame wooden poles to transmit electrical lines instead or steel towers. • Strictly orientate PV panels in a northerly direction to prevent possible reflection on sensitive receptors in the vicinity of the project site.
Cumulative Impacts: The introduction of the PV plant, coupled with the transmission lines will contribute to an increased cumulative visual impact and possible overall increased reflection in the area. It is however expected that the cumulative impact of reflection and glare would be **direct** and **additive**.
Residual Impacts: The proposed infrastructure is of such a nature that the status quo could be regained after decommissioning of the plant. Providing that the site is rehabilitated to its current state, the visual impact will also be removed.

7 POLICY CONTEXT

The development of sustainable energy sources holds huge benefits for the country as a whole, and would have significant multipliers in the local economy. Not only do renewable energy projects contribute to clean development mechanism, but it would also establish an empowering environment in the region within which the facility is established. Sustainable energy projects should therefore be undertaken to provide the necessary infrastructure and associated amenities to accommodate the industry in an efficient manner and which does not negatively impact on the comparative economic advantages of a region.

Several policy documents have been drafted which promote the expansion of the green economy and especially environmentally friendly practice with regard to electricity generation in the country. Of particular reference to the Heuningspruit Facility is the recent Free State Provincial Spatial Development Framework (FSPSDF, 2013), which also deals with these issues. The FSPSDF, under Chapter C8.3.3, provides policy with regard to regulating the development of industrial areas. As such, the document states that *renewable energy sources are to comprise 25% of the province's energy generation capacity by 2020*. Several other references to renewable energy sources are found throughout the document. Some of these are found in Chapters C8.1, C8.2.3, etc.

Of particular important, however, to any potential developer of a renewable energy facility is Policy No. C9.1.2 (d), which states; *Where tracts of agricultural land are to be used for non-agricultural uses such as mining, construction of renewable energy installations, etc., such activities must create sustainable multipliers in the local economy and synergies that would unlock meaningful benefit through implementation programmes (refer to Toolkit D10 [The Sustainable Development Initiative Approach]).*

8 IMPACT STATEMENT

The viewshed indicates primary visual impact to the immediate vicinity (Foreground and Middle ground) of the project site to the north, east and south of the project site and small pockets beyond. To the west and south-west the impact is mainly located in the Background, 3 km and beyond.

To this end, the results of the viewshed analysis from defined Key Observation Points, together with a photograph indicating the actual view has been included under Annexure 2.

The results of the Visual Impact Assessment for the proposed Heuningspruit Facility therefore found that the proposed activity will have a **medium to high** impact from KOPs identified in the *foreground* (<1km) and a **low** impact from KOPs identified in the *middle-* and *background* (>1km).

As described earlier, the project site has quite a large zone of visual influence, judging from the viewsheds generated. As explained, however, the viewsheds generated are done taking into account the contours of the area. The project site and the surrounding area are relatively flat. As a result, the initial viewshed created from the highest point on the project site does give the impression that the site is highly visible from its immediate surroundings. The on-site verification from the selected Key Observation Points and the viewsheds generated from the latter points, however, indicated that the project site is not very distinguishable from most observation points. This is perhaps with the exception of the observation points in the foreground to the project site. This is mainly due to the flatness of the surrounding area. Trees, buildings or any other obstacle in the landscape has maximum effect in obscuring views from any point. The proposed mitigation measures will likewise reduce any significant impact to be a localised impact.

8.1 Recommendations

Based on the above and the documentation attached under Annexure 2, it is herewith recommended that the proposed activity be approved subject to the mitigation measures described in section 6.4 above and the Environmental Management Programme described in section 9 below.

In addition, the following recommendations are put forward:

a) That the proposed project does not sterilize the entire landholding upon which it is to be developed. Once the exact position of the activity has been determined, consideration should be given to erect PV 'strings' in such a manner so that sheep can roam underneath the panels. Alternatively, the project site should be demarcated and the existing extensive agricultural practices be allowed to continue unabated.

b) In order to restrict viewing from the S156 road and from areas to the east rigorous tree planting is to take place on-site in the vicinity of the latter receptor.

c) The use of steel transmission towers to convey electrical lines are discouraged. Instead it is proposed that the developer make use of H-frame wooden poles. These are regarded to be more organic and better suited to the rural landscape. Should steel towers be unavoidable, these should be of steel lattice work and not of the single cylindrical variety.

9 ENVIRONMENTAL MANAGEMENT PROGRAMME

The management plan tables aim to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts.

Table 9: Environmental Management Programme – Planning Phase

OBJECTIVE: To establish a facility that would fit in with the landscape and not create a detrimental visual impact.		
Project component/s	Photovoltaic 'string' of panels including ancillary infrastructure such as a maintenance workshop, storage building and offices.	
Potential Impact	Potential visual intrusion in the area and damage to the natural environment.	
Activity/risk source	Potential impact on sensitive receptors within the *foreground*.	
Mitigation: Target/Objective	Diligent planning of the proposed facility to minimise the expected visual impact.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Prepare an environmental constraints plan to establish the environmental sensitive areas and those areas upon which the development may occur.	Sun Mechanics (Pty) Ltd./ planners	In the planning phase
Plan vegetated and landscaped berms around the perimeter of the project site to minimise visual impacts onto the site.	Sun Mechanics (Pty) Ltd./ planners / landscape architect	In the planning phase
Design buildings to reflect the local architecture and sense of place of the region.	Sun Mechanics (Pty) Ltd./ contractor	Pre-construction
Consider raising the PV platforms so that cattle and sheep and goats can roam underneath the PV 'string'.	Sun Mechanics (Pty) Ltd./ planners	In the planning phase
Continue farming practices elsewhere on the property to ensure that the property is not completely denude of agricultural activities.	Sun Mechanics (Pty) Ltd./ planners	In the planning phase
Performance	Well maintained facility that has a small footprint on the environment.	

Indicator	Natural processes continuing to occur unhindered. All actions to be measured against the Operational Phase Environmental Management Plan.
Monitoring	N/A

Table 10: Environmental Management Programme – Construction Phase

OBJECTIVE: Mitigate the possible visual impact associated with the construction phase.		
Project component/s	Construction site	
Potential Impact	Visual impact of general construction activities and associated impacts.	
Activity/risk source	Potential impact on sensitive receptors within the *foreground*.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and general acceptance and compliance with Environmental Specifications.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
An Environmental Control Officer (ECO) must be appointed to oversee the construction process and ensure compliance with conditions of approval.	Sun Mechanics (Pty) Ltd.	Pre-construction
Contractor to sign and undertake to comply with Environmental Specifications.	Contractor	Pre-construction
Demarcate sensitive areas and no-go areas with danger tape to prevent disturbance during construction.	Sun Mechanics (Pty) Ltd./ contractor	Pre-construction
Keep disturbed areas to a minimum.	Sun Mechanics (Pty) Ltd./ contractor	Throughout construction
Identify suitable areas within the construction site for fuel storage, temporary workshops, eating areas, ablution facilities and washing areas.	Sun Mechanics (Pty) Ltd./ contractor	Throughout construction
Institute a solid waste management programme to minimise waste generated on the construction site, and recycle where possible.	Sun Mechanics (Pty) Ltd./ contractor	Throughout construction
Reduce and control dust through the use of approved dust suspension techniques as and when required.	Sun Mechanics (Pty) Ltd./ contractor	Throughout construction
Construction to occur only during daytime. Should the ECO authorize night work, low flux and frequency lighting shall be used.	Sun Mechanics (Pty) Ltd./ contractor	Throughout construction
Rehabilitate all disturbed areas in accordance with the development plan.	Sun Mechanics (Pty) Ltd./ contractor	Construction
Institute a rigorous planting regime in collaboration with the appointed botanical	Sun Mechanics (Pty) Ltd./ contractor	Construction

specialist.		
Performance Indicator	Construction site is confined to the demarcated areas identified on a Development Plan. No transgression of the Environmental Specifications visible and natural processes occurring freely outside boundaries of the construction site.	
Monitoring	Monitoring to be undertaken by an appointed Environmental Control Officer who will enforce compliance with the Environmental Specifications.	

Table 11: Environmental Management Programme – Operational Phase

OBJECTIVE: Mitigate the possible visual impact associated with the operational phase.		
Project component/s	Photovoltaic 'string' of panels including ancillary infrastructure such as a maintenance workshop, storage building and offices.	
Potential Impact	Potential visual intrusion in the area and damage to the natural environment.	
Activity/risk source	Potential impact on sensitive receptors within the *foreground*.	
Mitigation: Target/Objective	A facility that fits in with the landscape, that is well maintained and managed.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Maintain the general appearance of the facility as a whole (i.e. the PV panels, buildings and associated infrastructure, roads and natural environment).	Sun Mechanics (Pty) Ltd./ contractor	Throughout operational phase
Monitor land surface below PV 'strings' to prevent loss of vegetation and first signs of desertification.	Sun Mechanics (Pty) Ltd./ contractor	Throughout operational phase
Maintain access roads to prevent scouring and erosion, especially after rains.	Sun Mechanics (Pty) Ltd./ contractor	Throughout operational phase
Performance Indicator	Well maintained facility that has a small footprint on the environment. Natural processes continuing to occur unhindered. All actions to be measured against the Operational Phase Environmental Management Plan.	
Monitoring	ECO to undertake monitoring functions for a year after construction has been completed to ensure compliance with mitigation measures. Management thereafter to be undertaken by operator.	

Table 12: Environmental Management Programme – Decommissioning Phase

OBJECTIVE: To restore the property to is former natural state.	
Project component/s	Photovoltaic 'string' of panels including ancillary infrastructure such as a maintenance workshop, storage building and offices.
Potential Impact	Potential residual visual impacts left by buildings and infrastructure after decommissioning.
Activity/risk source	Potential impact on sensitive receptors within the *foreground*.

Mitigation: Target/Objective	To leave a property that is rehabilitated to the extent that natural processes will be able to continue unhindered.		
Mitigation: Action/control		**Responsibility**	**Timeframe**
Prepare a decommissioning plan to establish a timeframe and order of decommissioning of the plant.		Sun Mechanics (Pty) Ltd.	Pre-decommissioning phase
Removal of all infrastructure introduced into the landscape (i.e. PV panels, ancillary infrastructure such as a maintenance workshop, storage building and offices)		Sun Mechanics (Pty) Ltd./ operator	During decommissioning phase
Rehabilitate all new access roads created during the construction period.		Sun Mechanics (Pty) Ltd./ operator	During decommissioning phase
Institute monitoring of all decommissioned and rehabilitated sections of the project site at regular intervals.		Sun Mechanics (Pty) Ltd./ operator	During decommissioning phase
Performance Indicator	Intact vegetation cover with no signs of former foreign infrastructure in the landscape. No signs of erosion.		
Monitoring	Operator, in consultation with botanical specialist, to undertake monitoring functions at regular intervals to ensure rehabilitation in accordance with the decommissioning plan.		

10 REFERENCES

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ZONE LAND SOLUTIONS
30 OCTOBER 2013

PROPOSED HEUNINGSPRUIT PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Farm Voorspoed Nr.1508 and Remainder of Farm Verdun Nr.1511, Koppies, Free State Province

ANNEXURE 1

DECLARATION OF INDEPENDENCE

30 OCTOBER 2013

Produced for:

Sun Mechanics (Pty) Ltd.

On behalf of:

Savannah Environmental (Pty) Ltd.

Produced by:

PROPOSED HEUNINGSPRUIT PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Farm Voorspoed Nr.1508 and Remainder of Farm Verdun Nr.1511, Koppies, Free State Province

ANNEXURE 2

SELECTED OBSERVATION POINT VIEWSHEDS AND ASSESSMENTS

30 OCTOBER 2013

Produced for:

Sun Mechanics (Pty) Ltd.

On behalf of:

Savannah Environmental (Pty) Ltd.

Produced by:

1 SELECTED OBSERVATION POINT ASSESSMENTS

The *observation points* were categorized and assessed in terms of the following assessment criteria.

KEY	DESCRIPTION
NUMBER	Each observation point was allocated a reference number.
CO-ORDINATES	The co-ordinates of each of the observation points are provided.
ALTITUDE	The altitude of the observation point was provided in meters above sea level.
DESCRIPTION	A brief description where the observation point is located is provided.
TYPE	Each observation point is categorized according to its location and significance rating. These criteria include the following: a) Tourist-related areas. b) Corridors, including linear geographical areas visible to users of a route or vantage points. c) Residential Areas/Farmstead. d) Areas of cultural significance.
PHOTOGRAPH	A photograph was taken from each observation point in the direction of the project site to verify the digitally generated view-shed.
PROPERTY LOCATION	The location of the property was described as *foreground*, *middle ground* or *background*.
PROXIMITY	The distance between the observation point and the project site was provided in kilometres.
VISUAL SENSITIVITY OF RECEPTORS	The visual impact considered acceptable is dependent on the type of receptors. A high (e.g. residential areas, nature reserves and scenic routes or trails), moderate (e.g. sporting or recreational areas, or places of work), or low sensitivity (e.g. industrial, mining or degraded areas) was awarded to each observation point.
VISUAL EXPOSURE	Exposure or visual impact tends to diminish exponentially with distance. A high (dominant or clearly visible), moderate (recognizable to the viewer) or low exposure (not particularly visible to the viewer) rating was allocated to each observation point.
VISUAL ABSORPTION CAPACITY (VAC)	The potential of the landscape to conceal the proposed development was assessed. A rating of high (effective screening by topography and vegetation), moderate (partial screening) and low (little screening) was allocated to each observation point.
VISUAL INTRUSION	The potential of the development to fit in with the surrounding environment was determined. The visual intrusion relates to the context of the proposed development while maintaining the integrity of the landscape. A rating of high (noticeable change), moderate (partially fits into the surroundings) or low (blends in well with the surroundings) was allocated.
DURATION	With regard to roads, the distance (in kilometres) and duration (in seconds) for which the property will be visible to the road user, were calculated for each observation point.

2 KEY OBSERVATION POINT 1

KOP1 is situated at the Heuningspruit Train Station. In terms of theviewshed generated from this KOP, most of the project site is visible from this observation point. This is mainly due to the proximity of the project site to the station.Special attention should be paid to mitigation measures to soften the visual impact on this area.

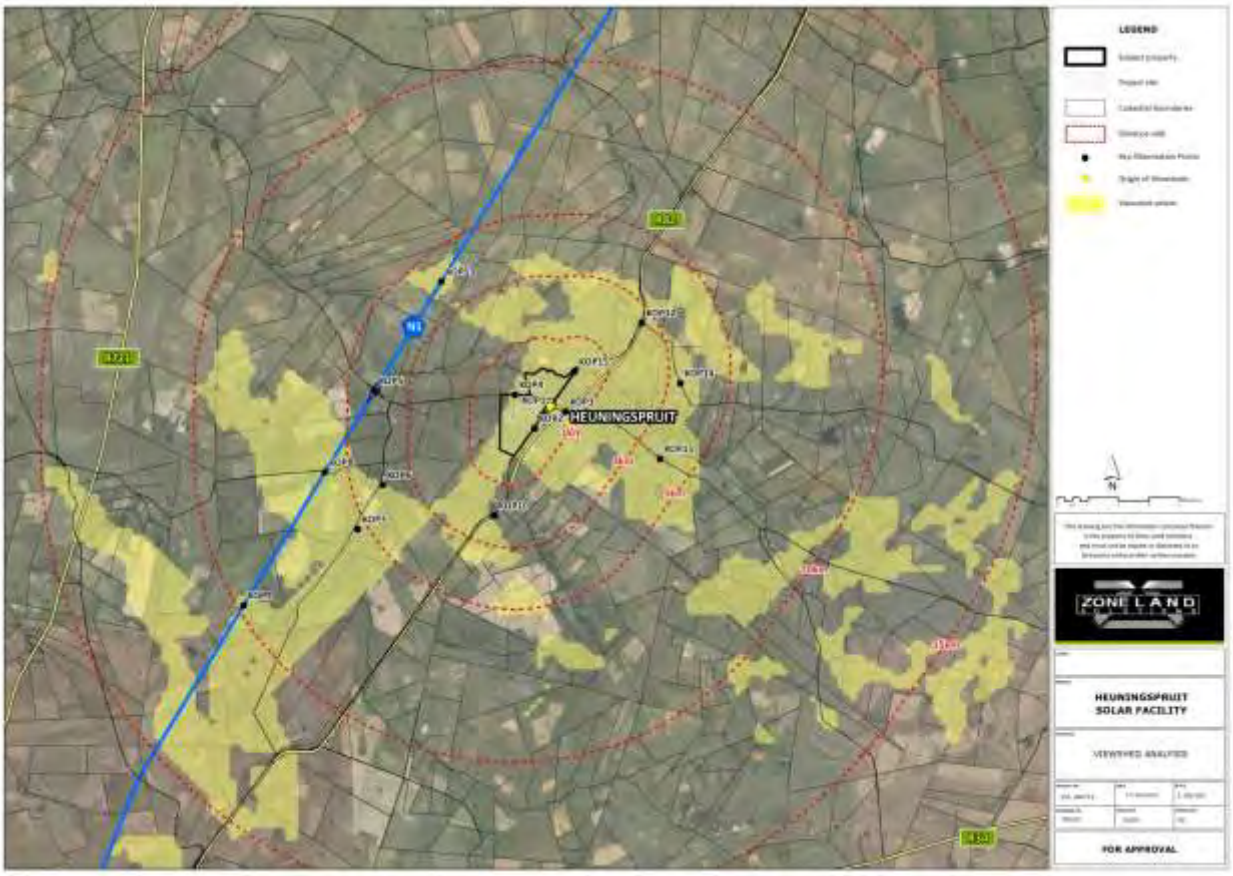


Figure 1: KOP1Viewshed. Areas shaded yellow is theoretically visible from KOP1.

NUMBER:	KOP1	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1400m		27°26'55.10"	27°25'12.81"
DESCRIPTION:	KOP1 is located at the Heuningspruit Train Station.			
TYPE:	Station/gathering point	**PHOTO:**		
PROP. LOCATION:	Foreground	**PROXIMITY:**	85 m	
VISUAL SENSITIVITY:	Moderate/High			
VISUAL EXPOSURE:	Dominant	**VAC:**	Moderate	
VISUAL INTRUSION:	High	**DURATION:**	N/A	

3 KEY OBSERVATION POINT 2

KOP2 is situated approximately 800 m south-west of KOP1, directly adjacent to the railway line, at the silos south of Heuningspruit.As illustrated by the figure below, most of the project site is visible from this point. This is mainly due to the nature of the surrounding topography and the proximity of the KOP to the project site.Special attention should be paid to mitigation measures to soften the visual impact on this area.

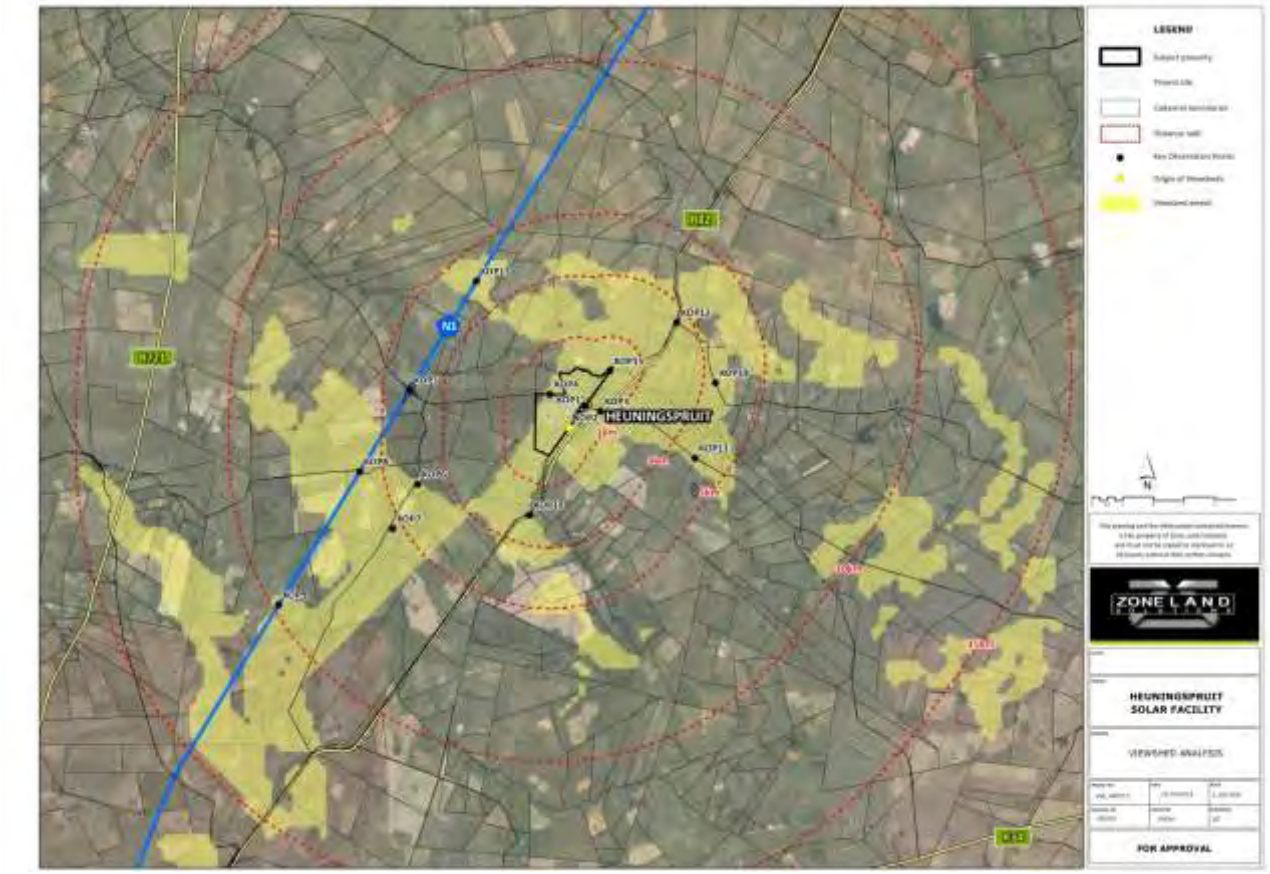


Figure 2: KOP2Viewshed. Areas shaded yellow istheoretically visible from KOP2.

NUMBER:	KOP2	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1399m		27°27'18.46"	27°24'53.91"
DESCRIPTION:	KOP2 is located at the silos south of Heuningspruit.			
TYPE:	Agricultural infrastructure	**PHOTO:**	Photograph 1	
PROP. LOCATION:	Foreground	**PROXIMITY:**	60 m	
VISUAL SENSITIVITY:	Moderate/High			
VISUAL EXPOSURE:	Dominant	**VAC:**	Moderate	
VISUAL INTRUSION:	High	**DURATION:**	N/A	

Photograph 1: View from KOP6 towards the project site.

4 KEY OBSERVATION POINT 3

KOP3is located at the point where the R82 crosses the S156 east of Heuningspruit. In terms of the viewshed generated from this KOP, most of the project site is visible from this observation point. As is evident from the photographs included existing structures and vegetation obscures most of the project site from this KOP. Mitigation measures implemented, to soften the visual impact on KOP 1 and 2 will, will negate the visual impact associated with the proposed project on this KOP.

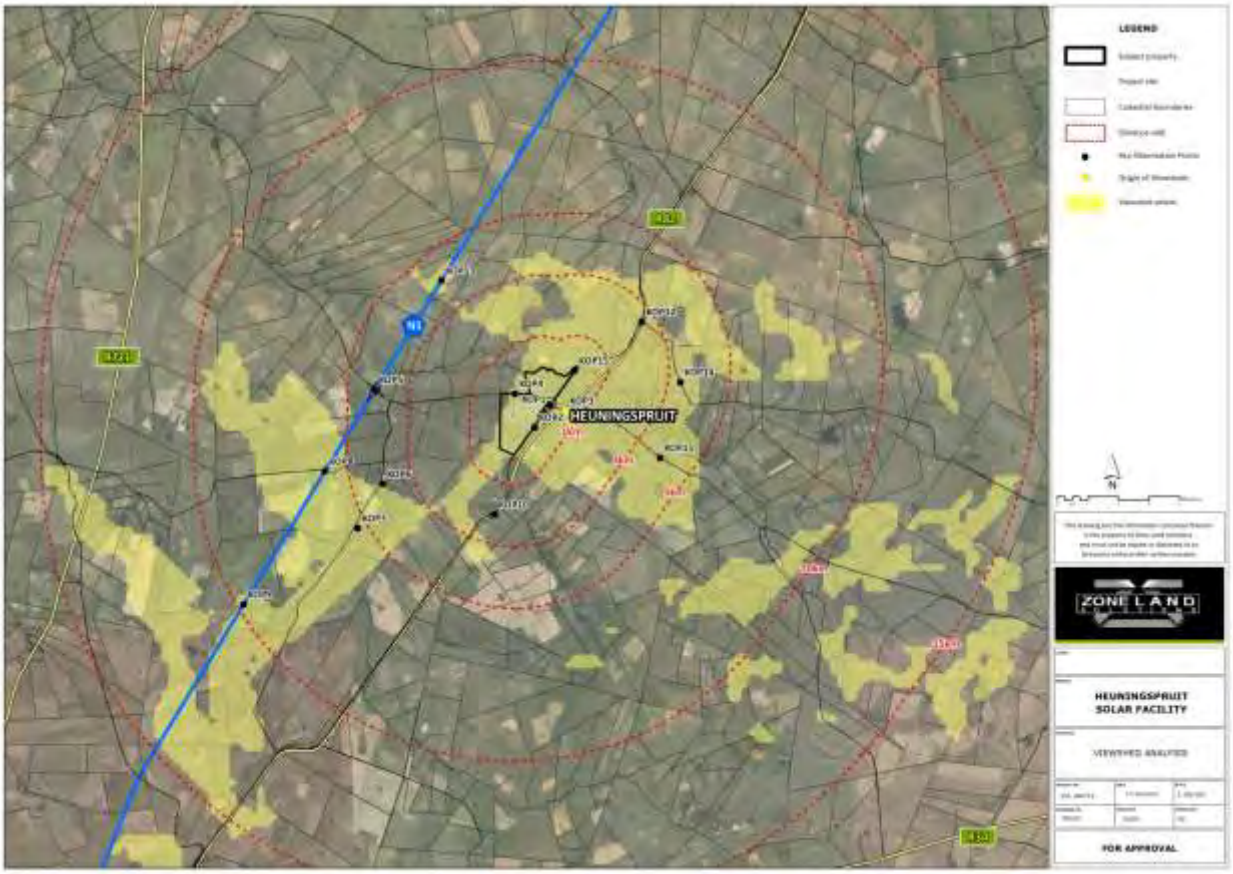


Figure 3: KOP3Viewshed. Areas shaded yellow is theoretically visible from KOP3.

NUMBER:	KOP3	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1400m		27°27′01.09″	27°25′30.79″
DESCRIPTION:	KOP3 is located at the point where the R82 crosses the S156 east of Heuningspruit.			
TYPE:	Regional road	**PHOTO:**	Photographs 2, 3&4	
PROP. LOCATION:	Foreground	**PROXIMITY:**	600 m	
VISUAL SENSITIVITY:	High			
VISUAL EXPOSURE:	Moderate	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	6.5 km 4.8min @ 80km/h	

Photograph 2: View from KOP3 towards the project site.

Photograph 3: View from KOP3 towards the project site.

Photograph 4: View from KOP3 towards the project site.

5 KEY OBSERVATION POINT 4

KOP4 is situated on the S156 minor road next to the project site, north of the proposed project. As illustrated by the figure below, the whole of the project site is visible from this point. This is mainly due to the nature of the surrounding topography and the proximity of the KOP to the project site. Special attention should be paid to mitigation measures to soften the impact on this area.

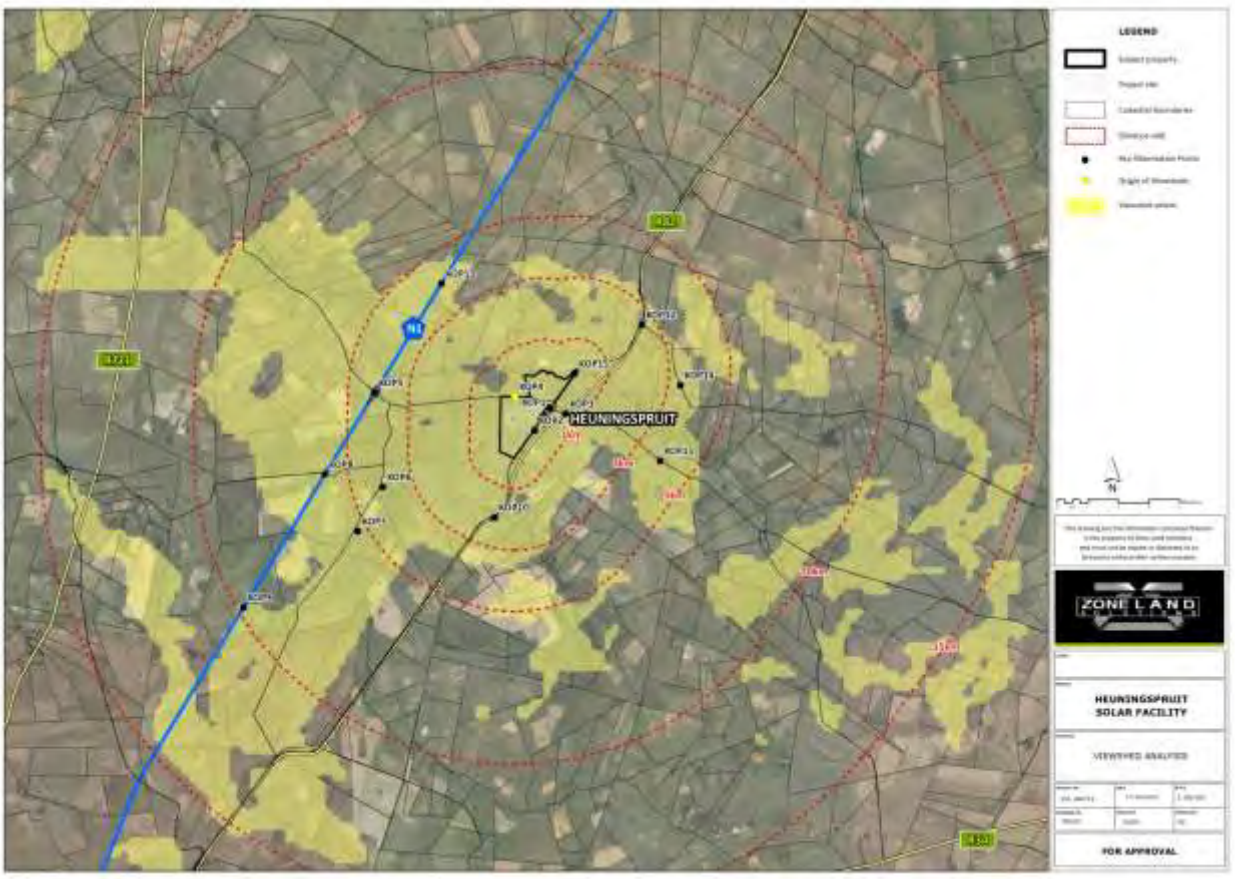


Figure 4: KOP4Viewshed. Areas shaded yellow is theoretically visible from KOP4.

NUMBER:	KOP4	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1392m		27°26'42.71"	27°24'30.71"
DESCRIPTION:	KOP4 is situated on the S156 minor road next to the project site.			
TYPE:	Minor road	**PHOTO:**	Photograph 5&6	
PROP. LOCATION:	Foreground	**PROXIMITY:**	10 m	
VISUAL SENSITIVITY:	High			
VISUAL EXPOSURE:	High	**VAC:**	Moderate	
VISUAL INTRUSION:	Moderate	**DURATION:**	6.7 km 5.0min @ 80km/h	

Photograph 5: View from KOP4 towards the project site.

Photograph 6: View from KOP4 towards the project site.

6 KEY OBSERVATION POINT 5

KOP5 is located at the point where the S156 minor road crosses the N1, west of the project site. From this point, very little of the project site would be visible.

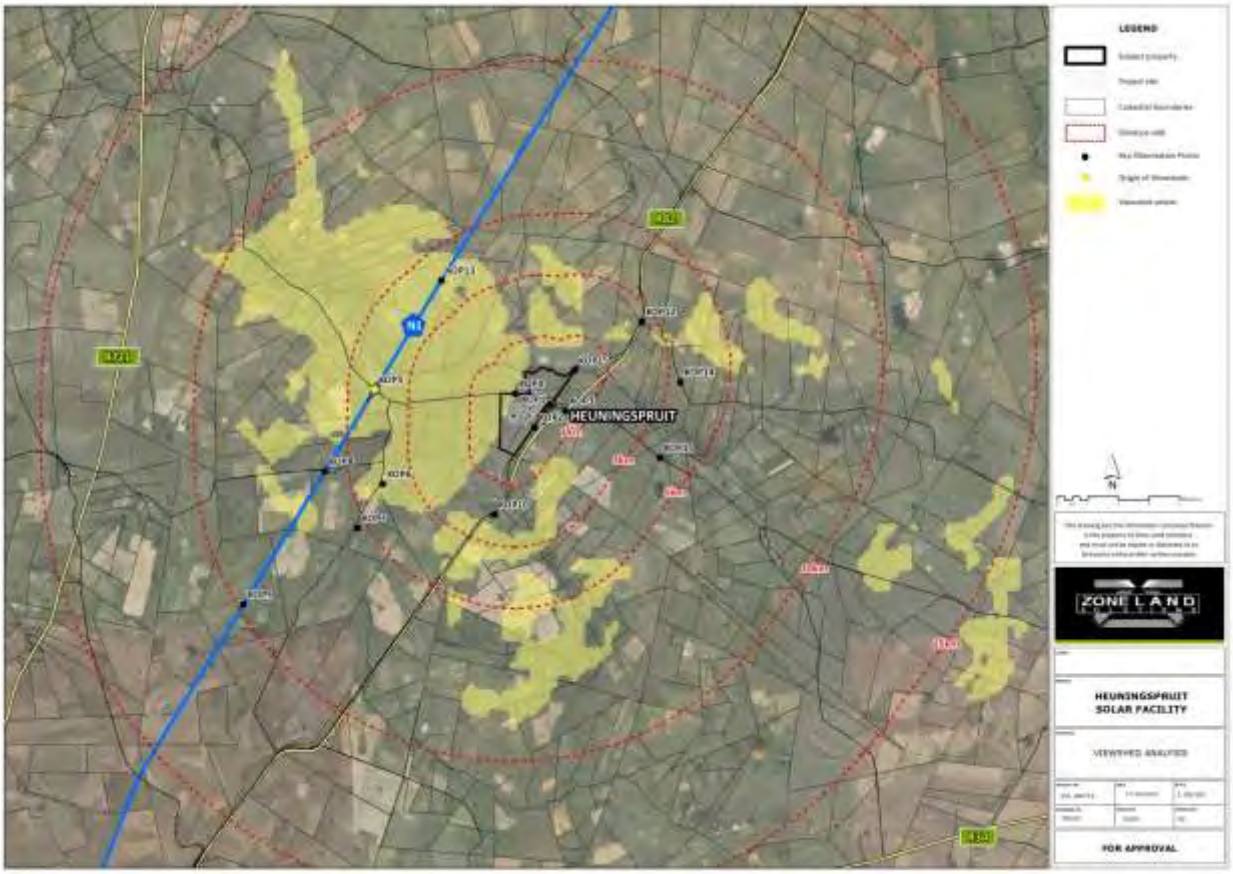


Figure 5: KOP5Viewshed. Areas shaded yellow is theoretically visible from KOP5.

NUMBER:	KOP5	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1388m		27°26'37.30"	27°21'44.01"
DESCRIPTION:	KOP5 is located at the point where the S156 minor road crosses the N1.			
TYPE:	National road	**PHOTO:**	Photograph 7 & 8	
PROP. LOCATION:	Background	**PROXIMITY:**	4.15km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	N/A	

Photograph 7: Panoramicview from KOP5 towards the project site.

Photograph 8: View from KOP5 towards the project site.

7 KEY OBSERVATION POINT 6

KOP6 is located at an on-farm settlement to the south-west of the project site. As illustrated by the veiwshed below, a very limited portion of the project site will be visible form this KOP.

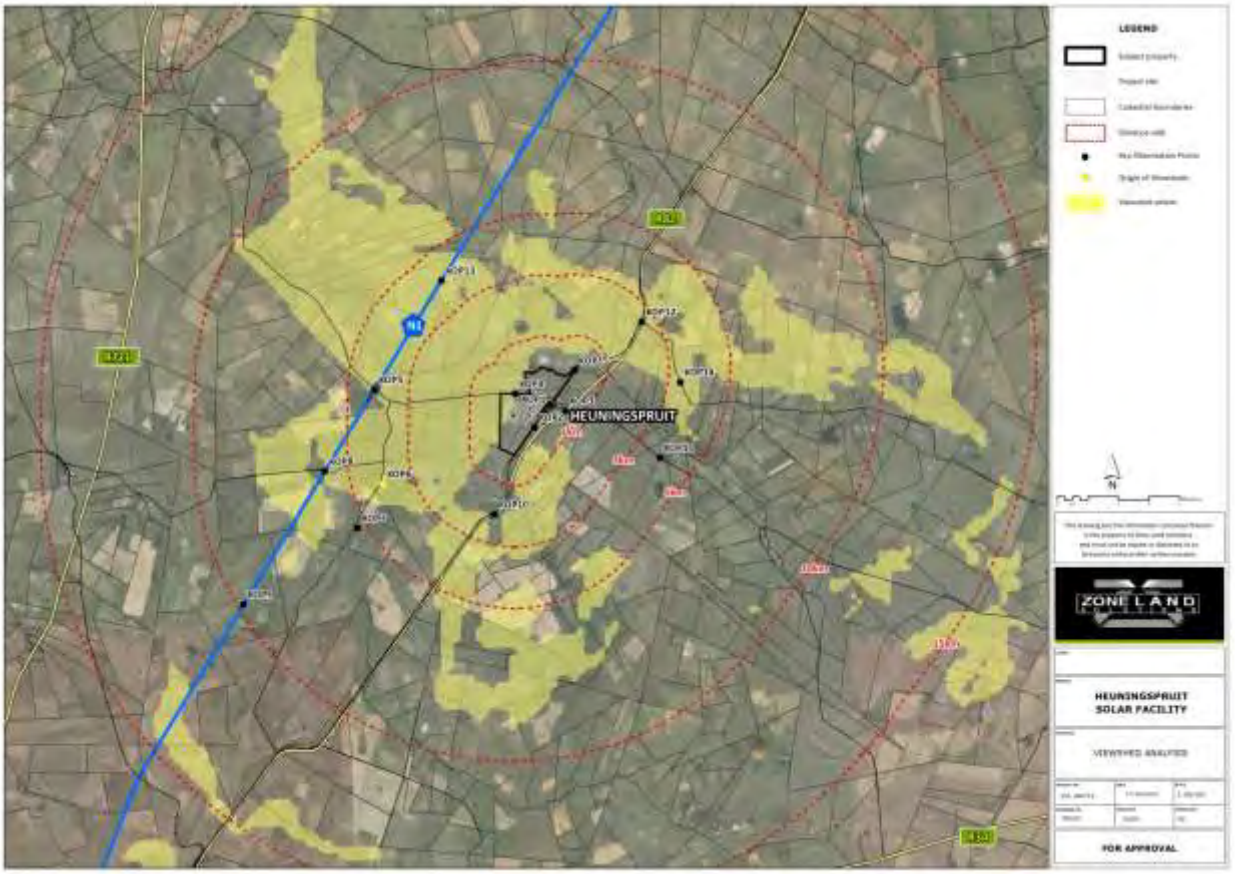


Figure 6: KOP6Viewshed. Areas shaded yellow is theoretically visible from KOP6.

NUMBER:	KOP6	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1392m		27°28'17.48"	27°21'52.79"
DESCRIPTION:	KOP6 is located at an on-farm settlement to the south-west of the project site.			
TYPE:	On-farm settlement	**PHOTO:**	Photograph 9&10	
PROP. LOCATION:	Background	**PROXIMITY:**	4.01km	
VISUAL SENSITIVITY:	Moderate			
VISUAL EXPOSURE:	Low	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	N/A	

Photograph 9: Panoramic view from KOP6 towards the project site.

Photograph 10: View from KOP6 towards the project site.

8 KEY OBSERVATION POINT 7

KOP7 is located at an on-farm settlement to the south-west of the project site. As illustrated by the veiwshed below, the project site will be visible form this KOP.This is mainly due to the nature of the surrounding topography to the project site.

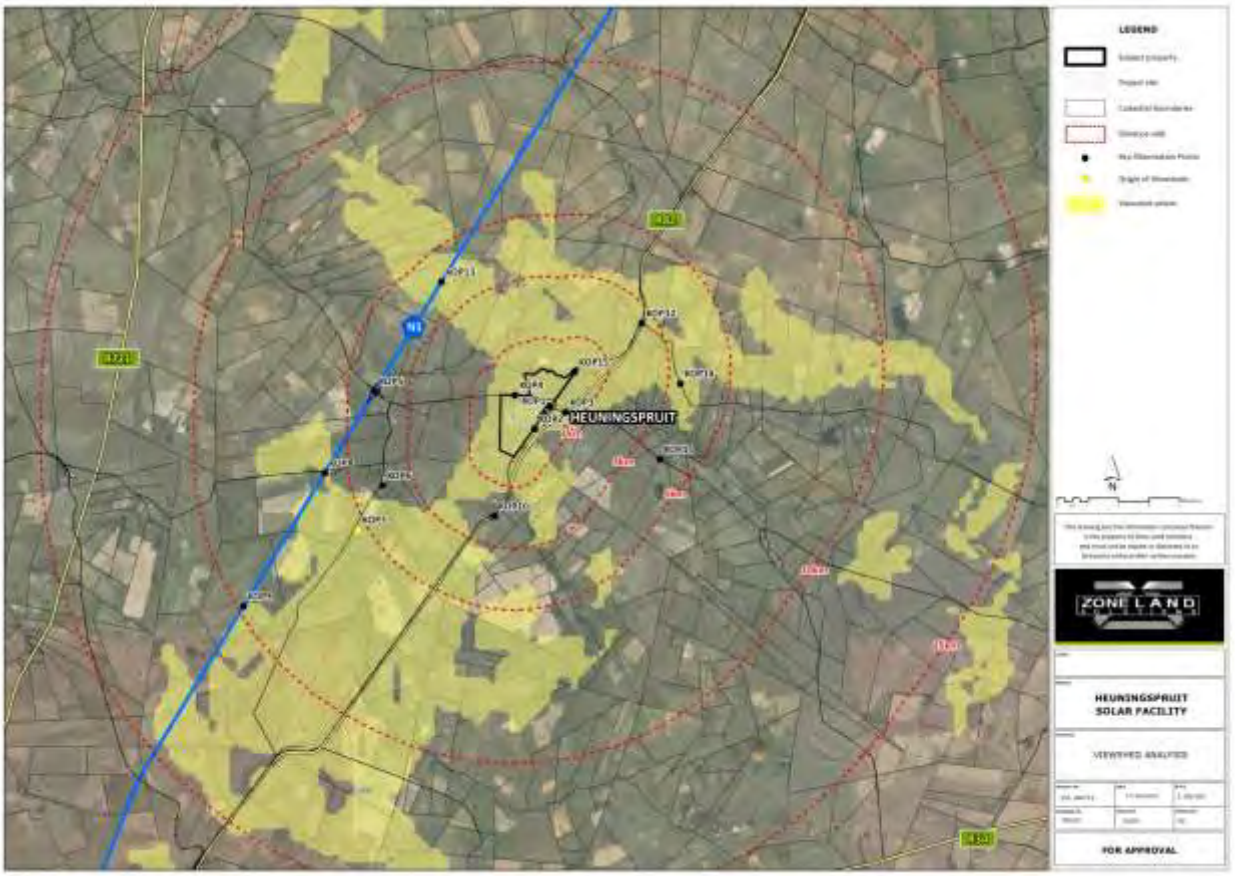


Figure 7: KOP7Viewshed. Areas shaded yellow is theoretically visible from KOP7.

NUMBER:	KOP7	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1398m		27°29'04.30"	27°21'22.85"
DESCRIPTION:	KOP7 is located at an on-farm settlement to the south-west of the project site.			
TYPE:	On-farm settlement	**PHOTO:**	Photograph 11&12	
PROP. LOCATION:	Background	**PROXIMITY:**	5.41km	
VISUAL SENSITIVITY:	Moderate			
VISUAL EXPOSURE:	Moderate	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	N/A	

Photograph 11: Panoramic view from KOP7 towards the project site.

Photograph 12: View from KOP7 towards the project site.

9 KEY OBSERVATION POINT 8

KOP8 is located 3km south of KOP5 on the N1 south-west of the project site. As illustrated by the viewshed below, the entire project site is visible from this KOP.

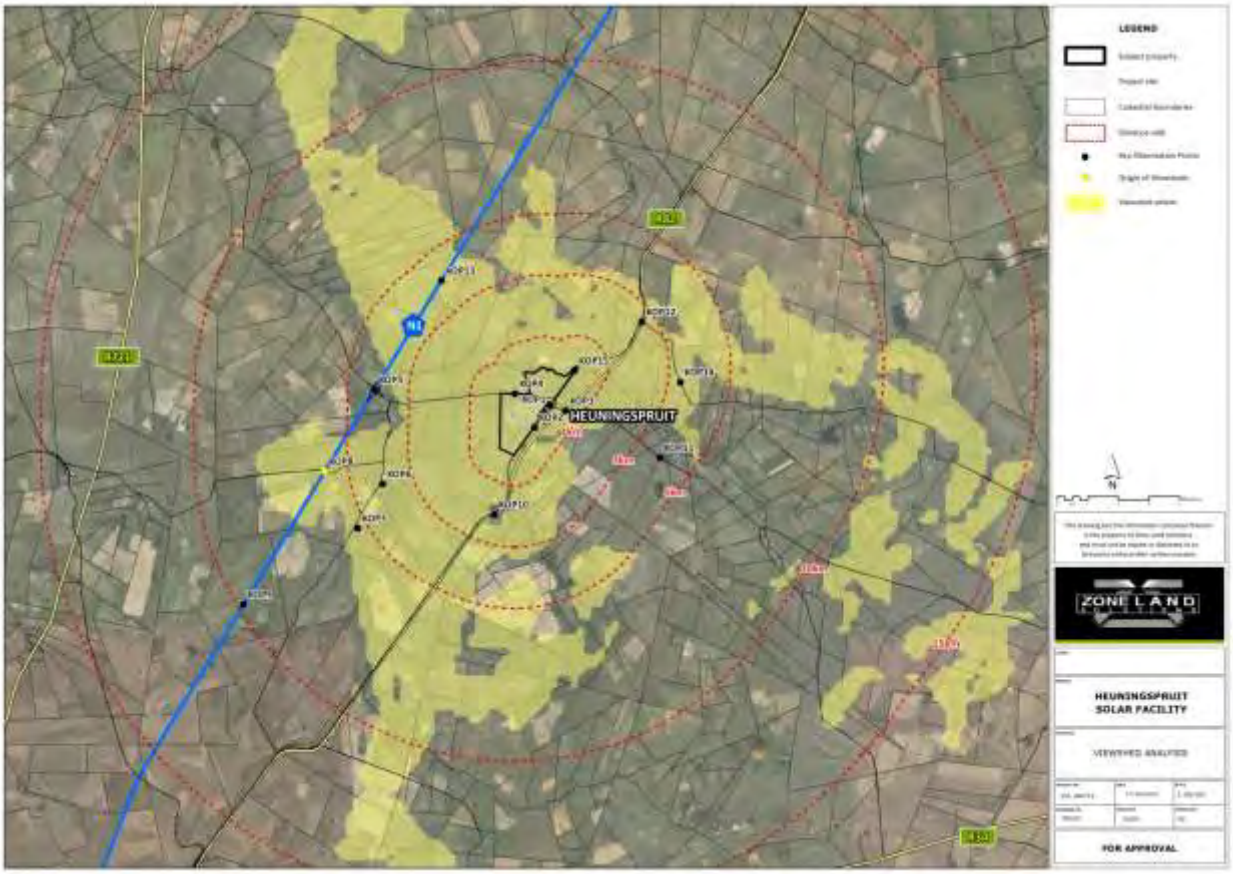


Figure 8: KOP8Viewshed. Areas shaded yellow is theoretically visible from KOP8.

NUMBER:	KOP8	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1404m		27°28'03.75"	27°20'43.89"
DESCRIPTION:	KOP8 is located on the N1 south-west of the project site.			
TYPE:	National road	**PHOTO:**	Photograph 13	
PROP. LOCATION:	Background	**PROXIMITY:**	5.82km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Moderate	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	3.6 km 2.7min @ 80km/h	

Photograph 13: View from KOP8 towards the project site.

10 KEY OBSERVATION POINT 9

KOP9 is located 5km south of KOP8 on the N1 south-west of the project site. As illustrated by the viewshed below, the entire project site is visible from this KOP.

Figure 9: KOP9Viewshed. Areas shaded yellow is theoretically visible from KOP9.

NUMBER:	KOP9	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1425m		27°30'24.91"	27°19'06.31"
DESCRIPTION:	KOP9 is located on the N1 south-west of the project site.			
TYPE:	National road	**PHOTO:**	Photograph 14	
PROP. LOCATION:	Background	**PROXIMITY:**	9.87km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	8.3 km intermittent 6.2min @ 80km/h	

Photograph 14: View from KOP9 towards the project site.

11 KEY OBSERVATION POINT 10

KOP10 is located on the R82 south of the project site. From this point, most of the project site will be visible.Special attention should be paid to mitigation measures to soften the impact on this area.

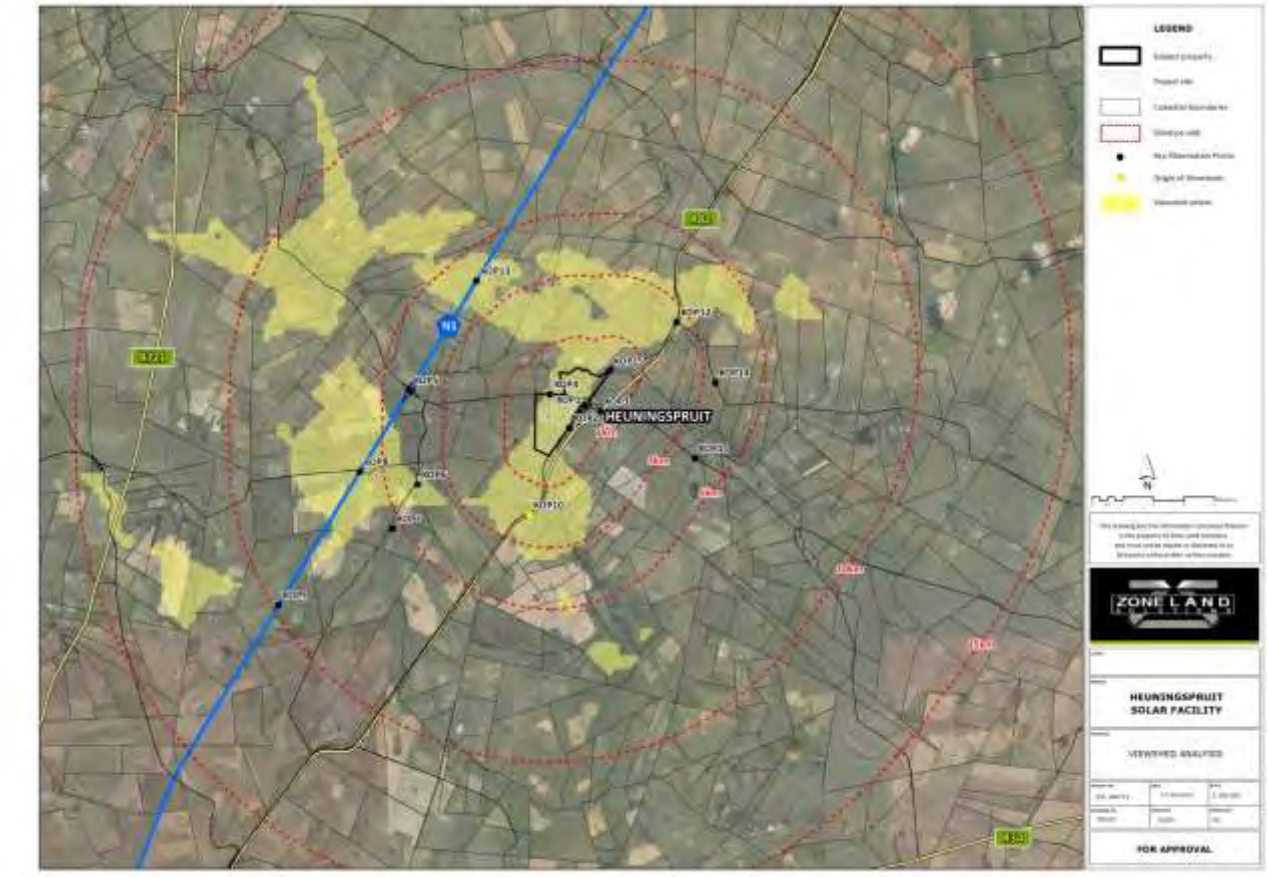


Figure 10: KOP10Viewshed. Areas shaded yellow is theoretically visible from KOP10.

NUMBER:	KOP10	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1407m		27°28'50.51"	27°24'05.84"
DESCRIPTION:	KOP10 is located on the R82 south of the project site.			
TYPE:	Regional road	**PHOTO:**	Photograph 15&16	
PROP. LOCATION:	Middle ground	**PROXIMITY:**	2.12km	
VISUAL SENSITIVITY:	Moderate			
VISUAL EXPOSURE:	High	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	2.7 km intermittent 2.0min @ 80km/h	

Photograph 15: Panoramic view from KOP10 towards the project site.

Photograph 16: View from KOP10 towards the project site.

12 KEY OBSERVATION POINT 11

KOP11 is located on the S156 east of the project site. From this point, the northern most section of the project site will be visible.

Figure 11: KOP11 Viewshed. Areas shaded yellow is theoretically visible from KOP11.

NUMBER:	KOP11	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1408m		27°27'51.17"	27°27'23.10"
DESCRIPTION:	KOP11 is located on the S156 east of the project site.			
TYPE:	Minor road	**PHOTO:**		
PROP. LOCATION:	Background	**PROXIMITY:**	2.53km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	**VAC:**	High	
VISUAL INTRUSION:	Moderate	**DURATION:**	4.4 km intermittent 3.3min @ 80km/h	

13 KEY OBSERVATION POINT 12

KOP12 is located on the R82 north-east of the project site. From this point, most of the project site will be visible.

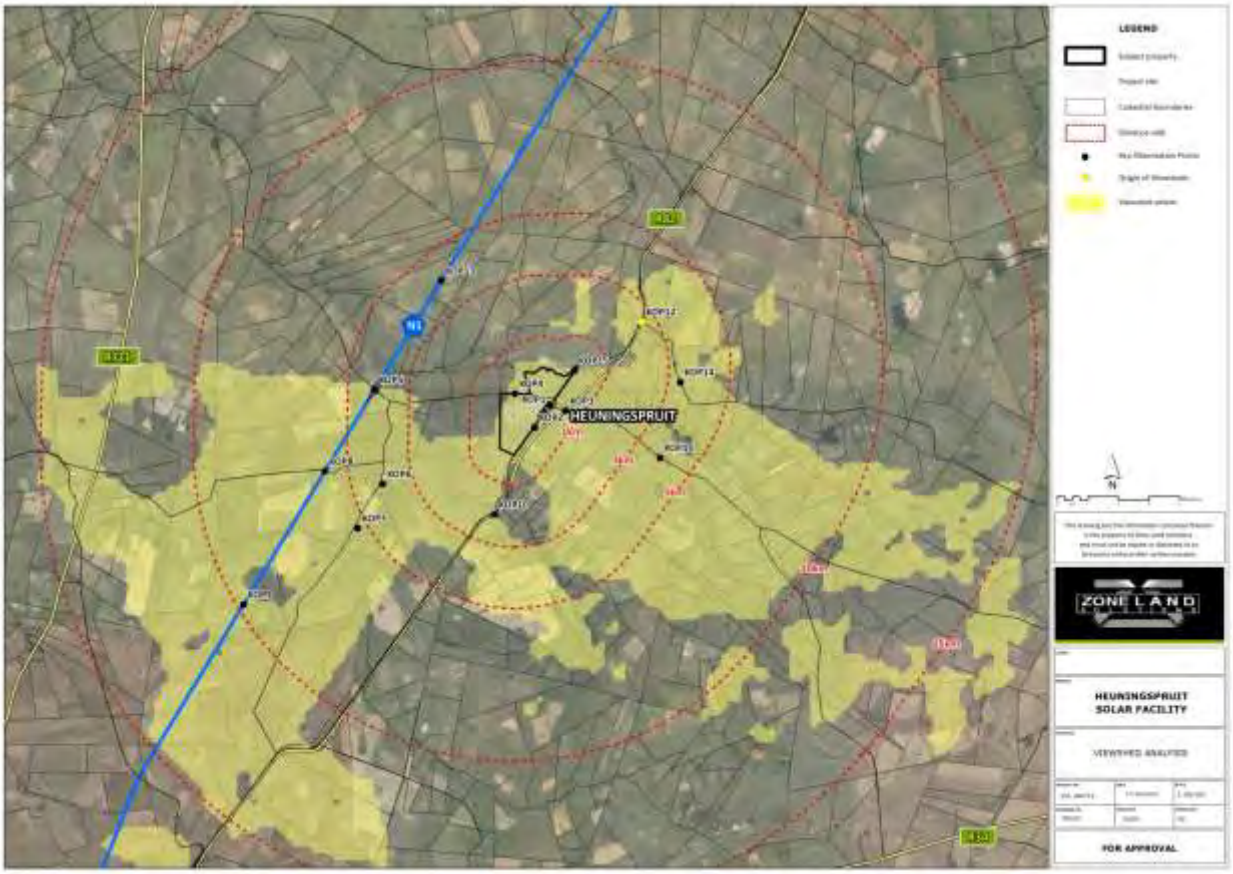


Figure 12: KOP12Viewshed. Areas shaded yellow is theoretically visible from KOP12.

NUMBER:	KOP12	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1427m		27°25'26.98"	27°27'01.80"
DESCRIPTION:	KOP12 is located on the R82 north-east of the project site.			
TYPE:	Regional road	**PHOTO:**		
PROP. LOCATION:	Middle ground	**PROXIMITY:**	3.48km	
VISUAL SENSITIVITY:	Moderate			
VISUAL EXPOSURE:	High	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	2.2 km intermittent 1.7min @ 80km/h	

14 KEY OBSERVATION POINT 13

KOP13 is located approximately 4 km north of KOP5 on the N1,north-west of the project site. From this point, most of the project site will be visible.

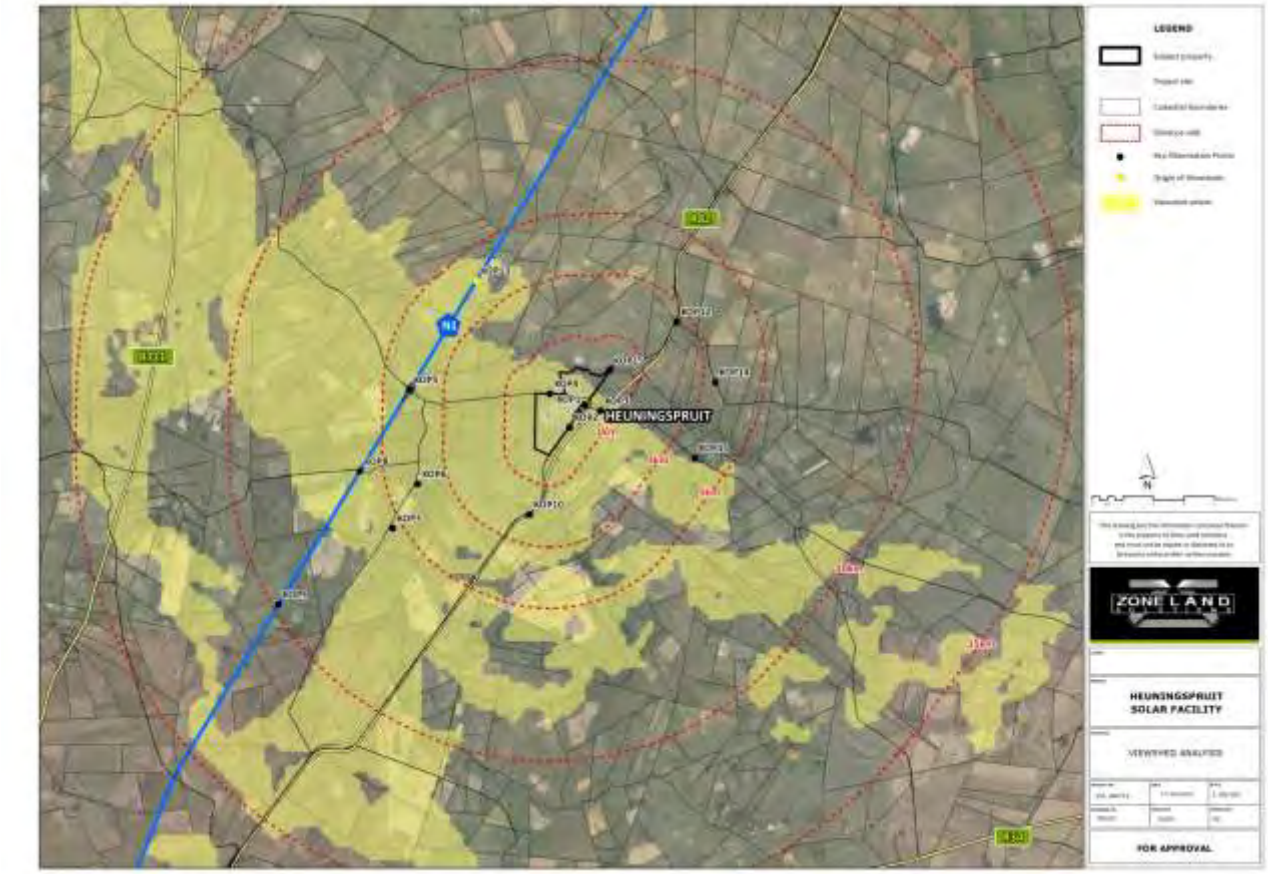


Figure 13: KOP13Viewshed. Areas shaded yellow is theoretically visible from KOP13.

NUMBER:	KOP13	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1412m		27°24'42.28"	27°23'03.79"
DESCRIPTION:	KOP13 is located north-west of the project site on the N1.			
TYPE:	National road	**PHOTO:**	Photograph 17 & 18	
PROP. LOCATION:	Background	**PROXIMITY:**	4.68km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	8.3 km intermittent 6.2min @ 80km/h	

Photograph 17: Panoramic view from KOP13 towards the project site.

Photograph 18: View from KOP13 towards the project site.

15 KEY OBSERVATION POINT 14

KOP14 is located on the farm entrance-road north-east of the project site. From this point, most of the project site will be visible.

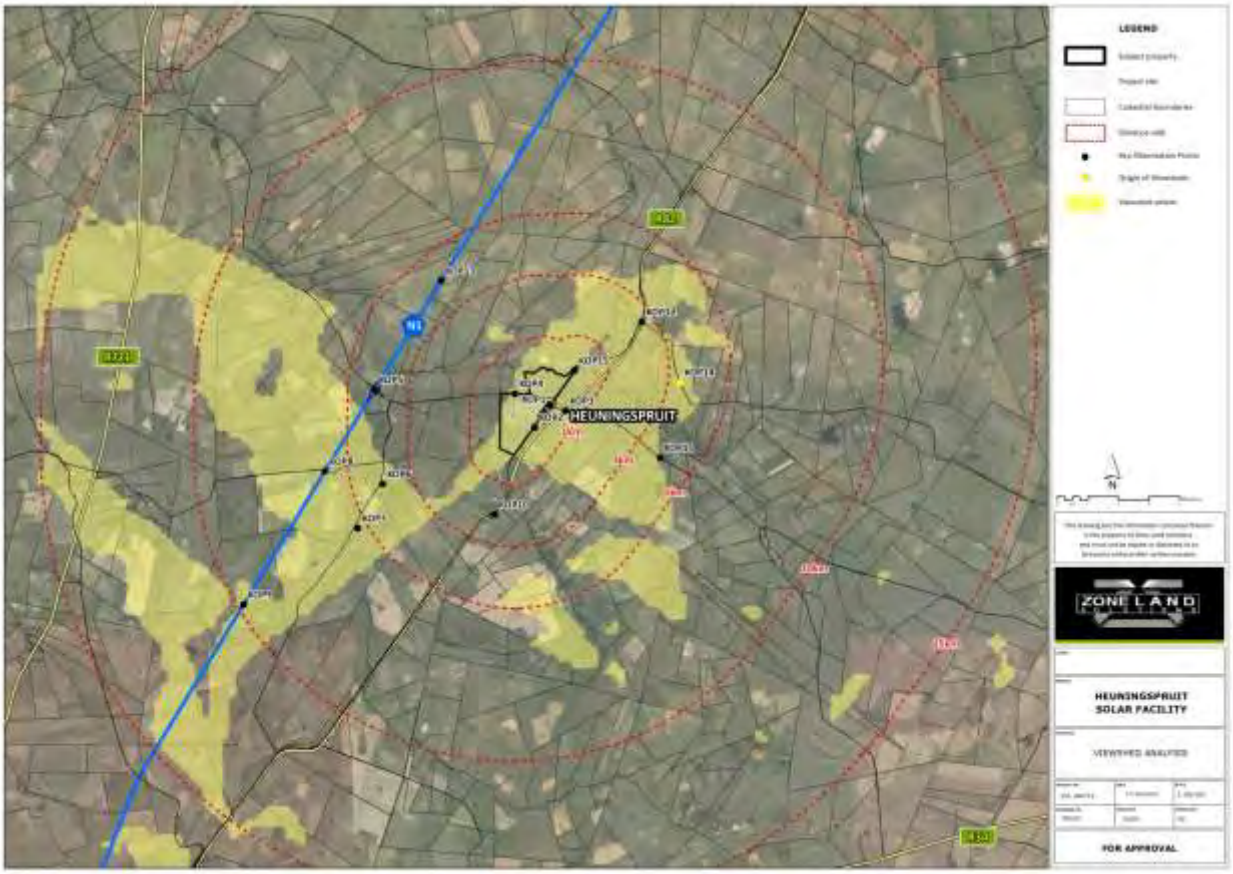


Figure 14: KOP14Viewshed. Areas shaded yellow is theoretically visible from KOP14.

NUMBER:	KOP14	**CO-ORDINATES:**	**S**	**E**
ALTITUDE:	1418m		27°26'31.42"	27°27'47.30"
DESCRIPTION:	KOP14 is located on the farm entrance road north-east of the project site.			
TYPE:	Farm road	**PHOTO:**		
PROP. LOCATION:	Background	**PROXIMITY:**	4.43km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Moderate	**VAC:**	High	
VISUAL INTRUSION:	High	**DURATION:**	3.4 km intermittent 2.6min @ 80km/h	

PROPOSED HEUNINGSPRUIT PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Farm Voorspoed Nr.1508 and Remainder of Farm Verdun Nr.1511, Koppies, Free State Province

ANNEXURE 3

LIST OF PLANS

30 OCTOBER 2013

Produced for:

Sun Mechanics (Pty) Ltd.

On behalf of:

Savannah Environmental (Pty) Ltd.

Produced by:

LEGEND

- District municipalities
- Local municipalities
- Project site
- Conservation Areas
- Urban Areas
- National Roads
- Main Roads
- Railway Lines
- Rivers

N

0 1.25 2.5 5 7.5 10 Kilometers

ZONE LAND SOLUTIONS

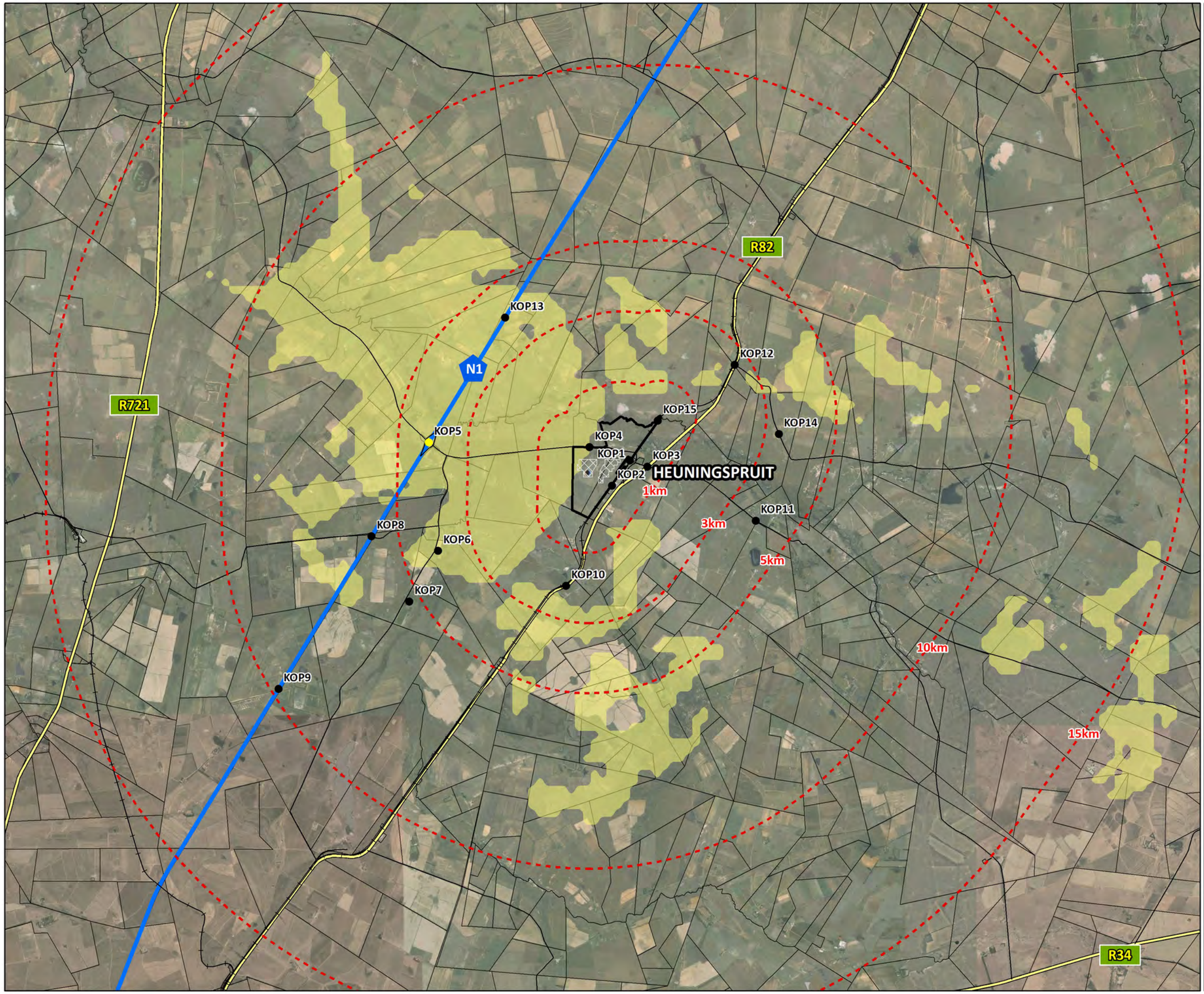
CLIENT

HEUNINGSPRUIT SOLAR FACILITY

REGIONAL CONTEXT

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:300 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/01	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

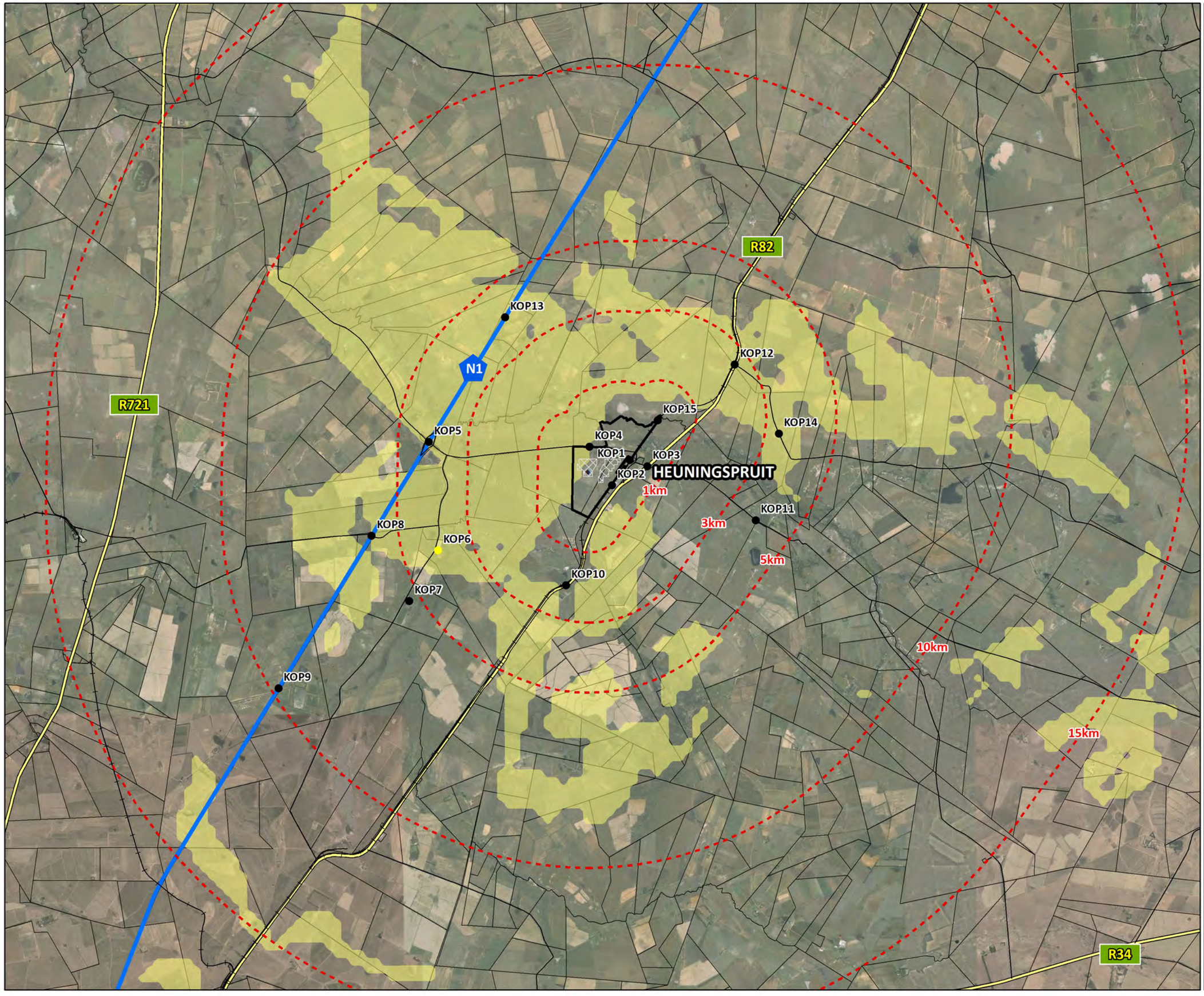
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

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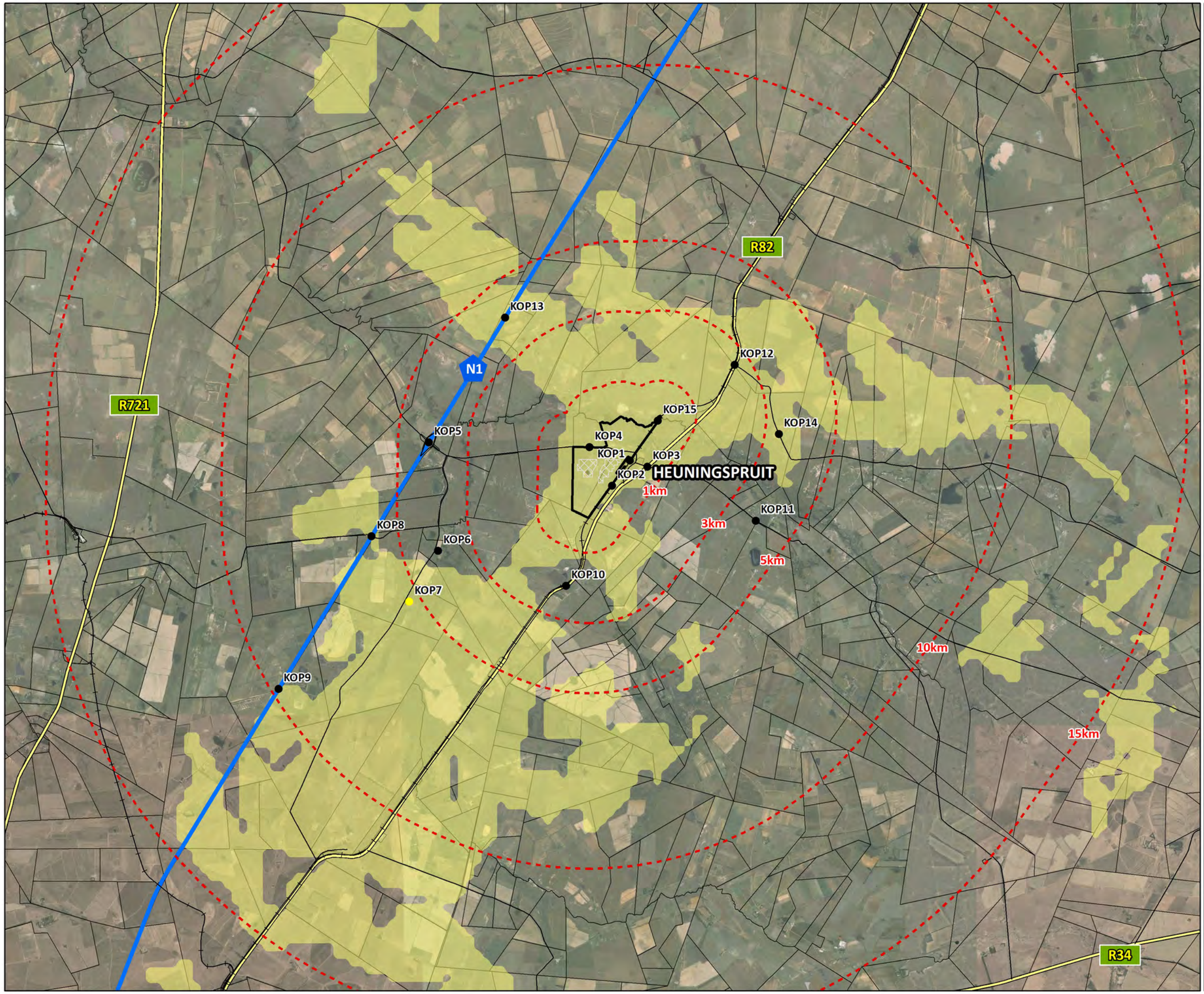
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

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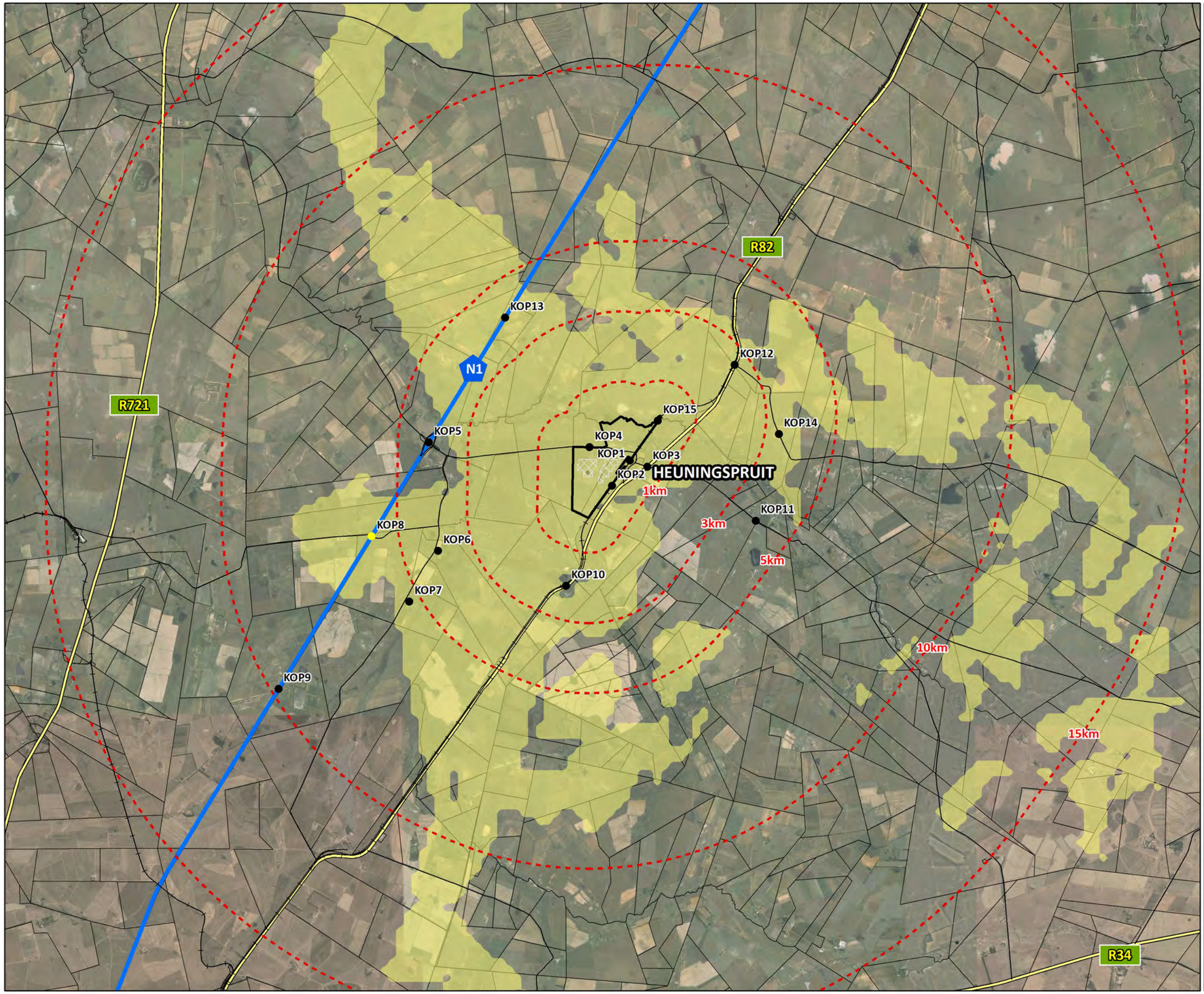
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

DRAWING

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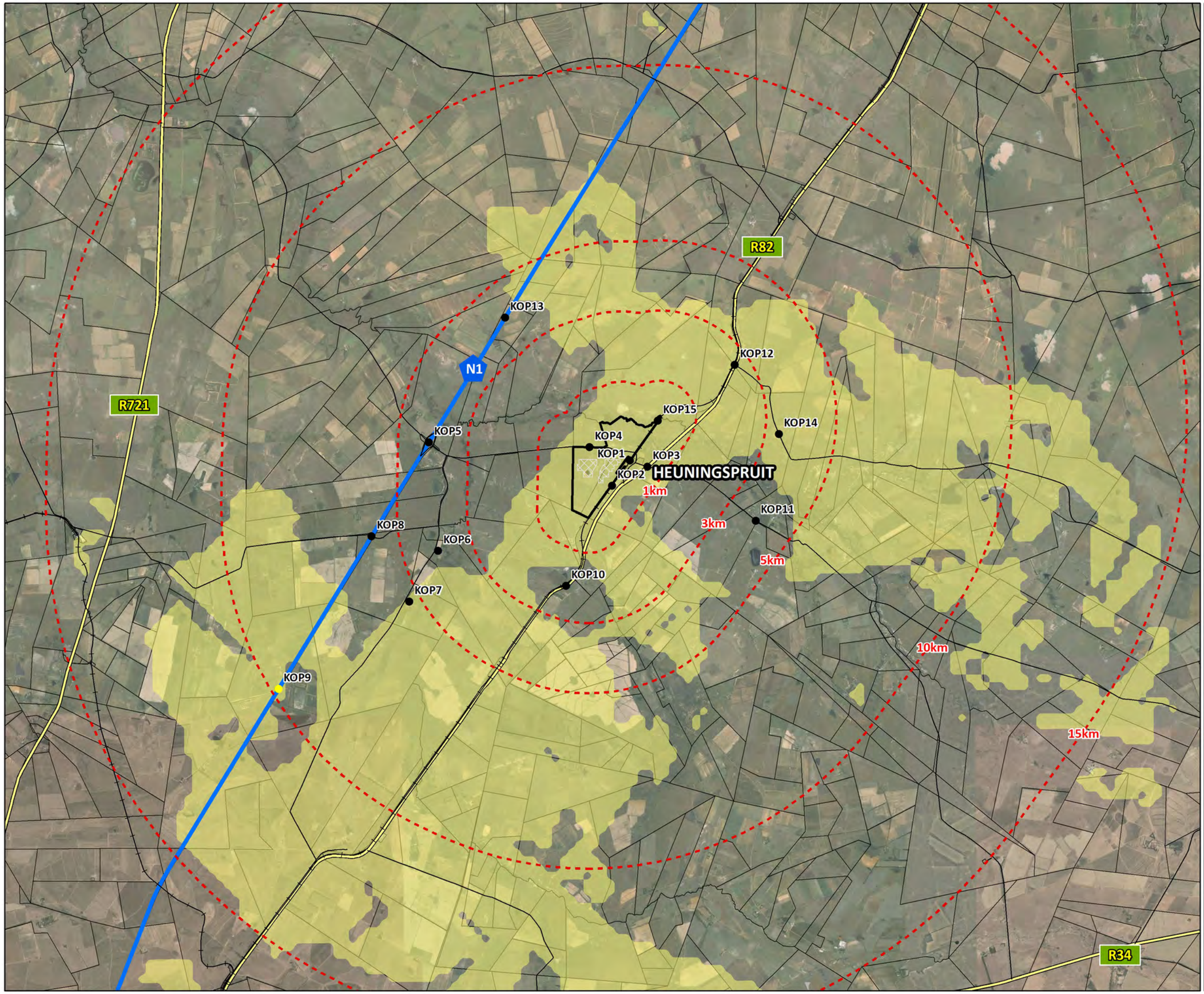
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

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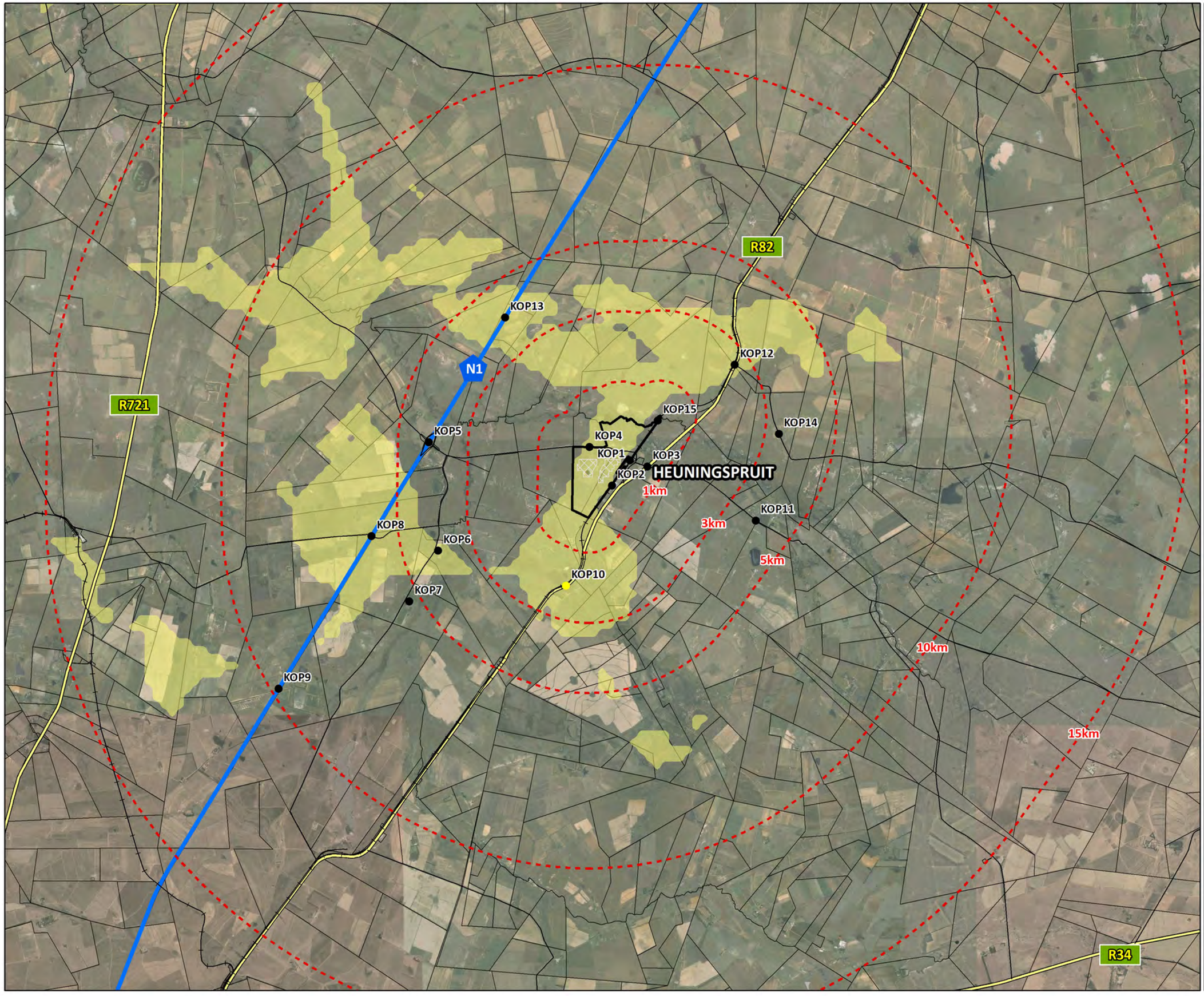
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

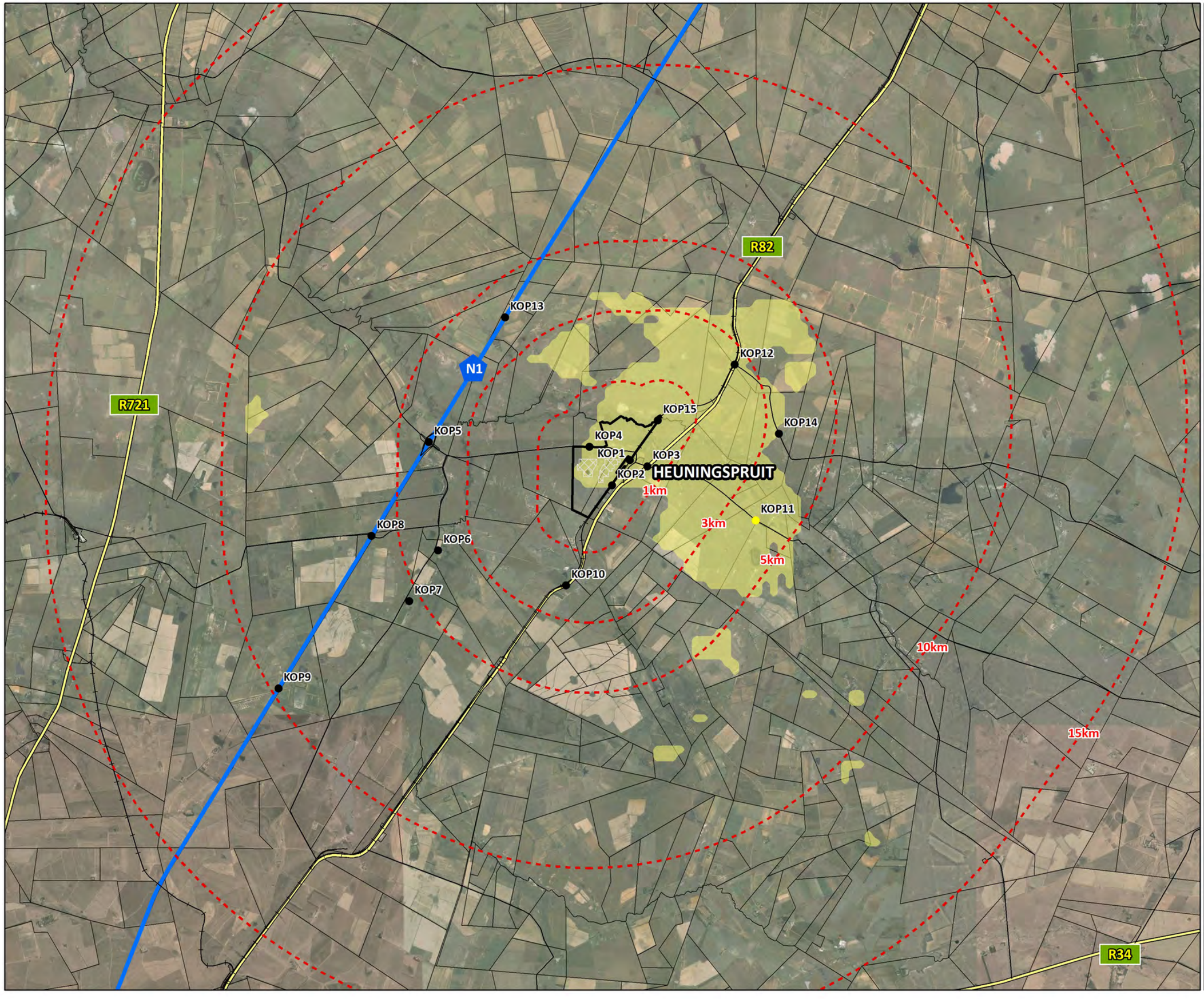
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

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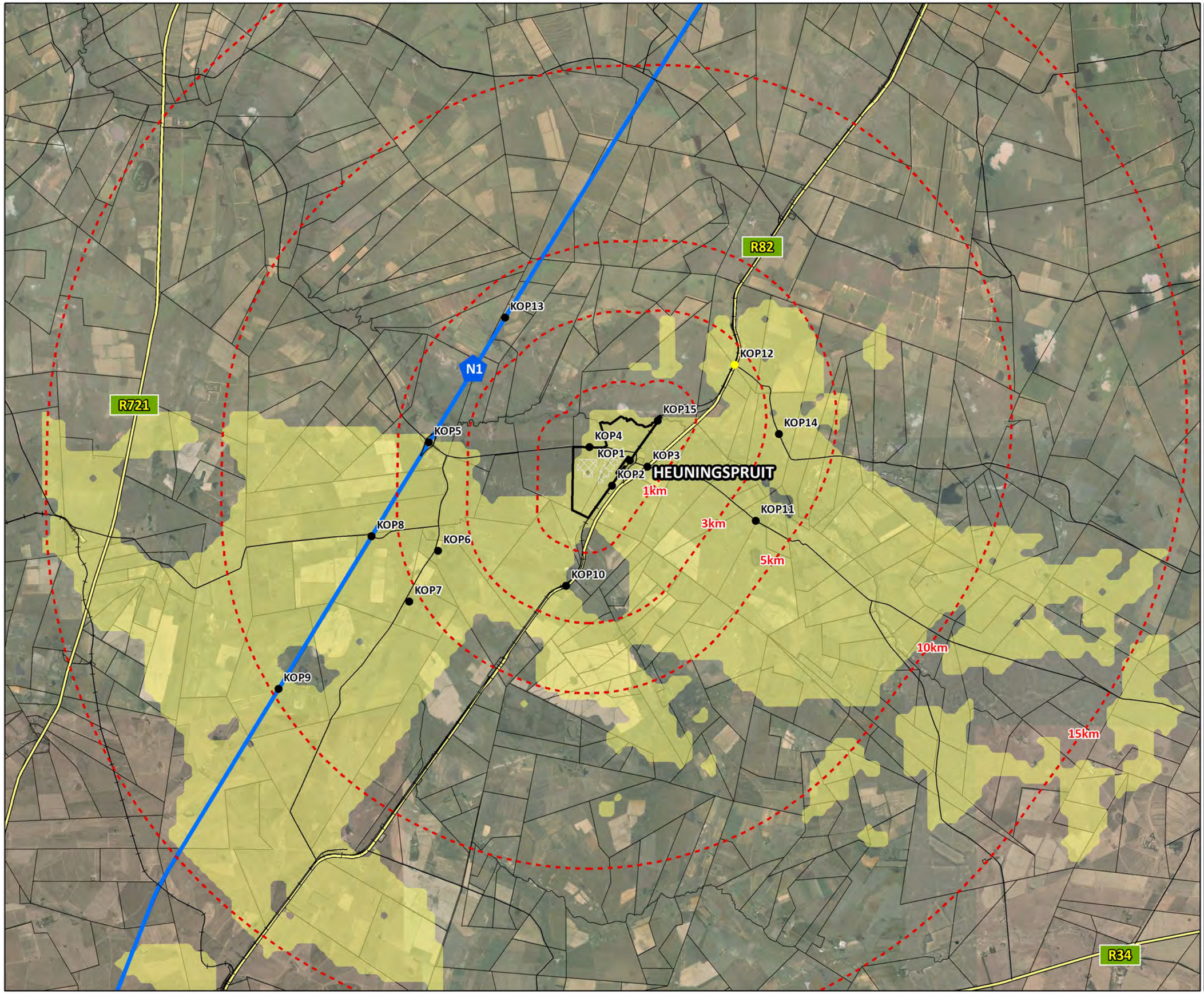
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

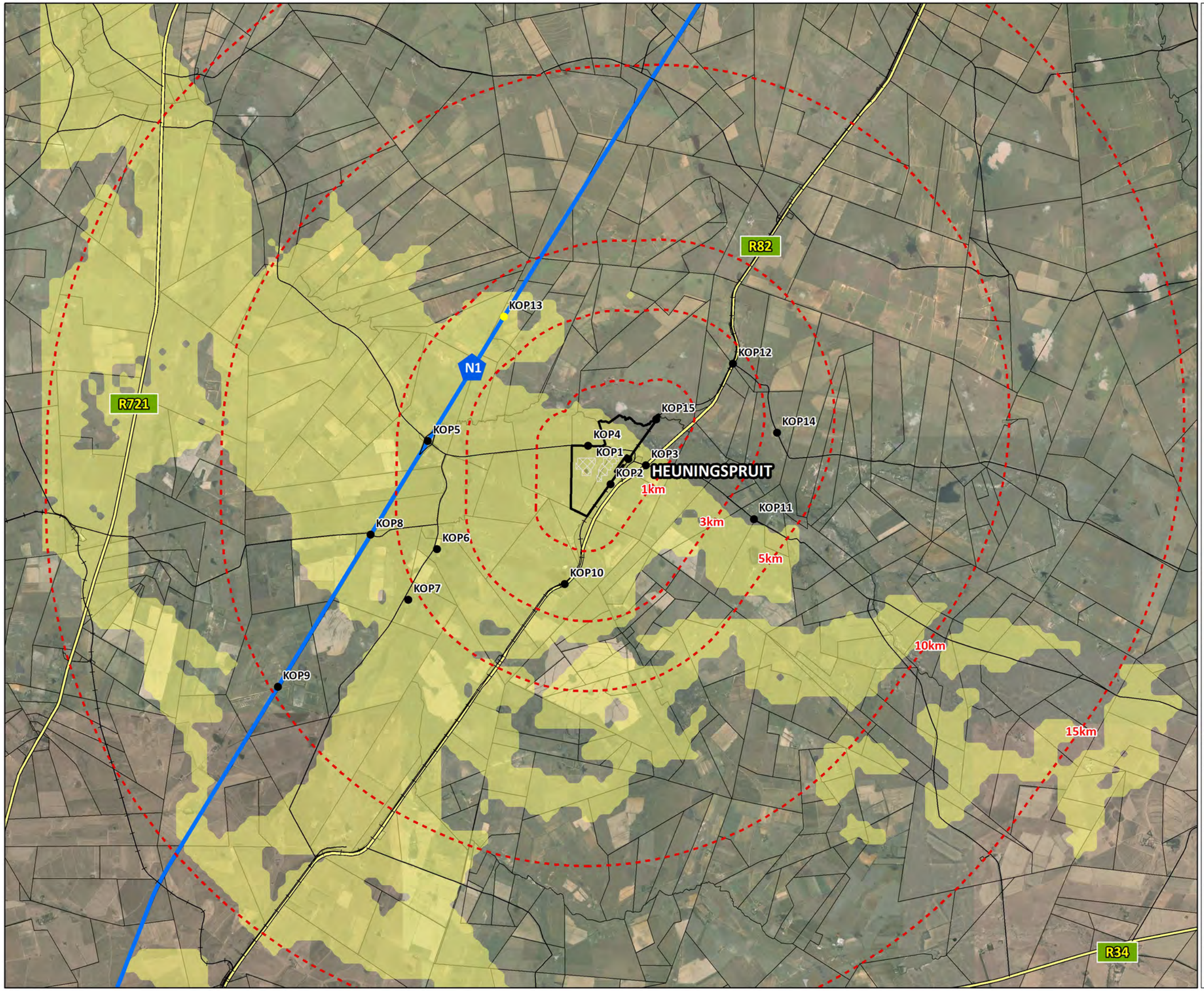
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

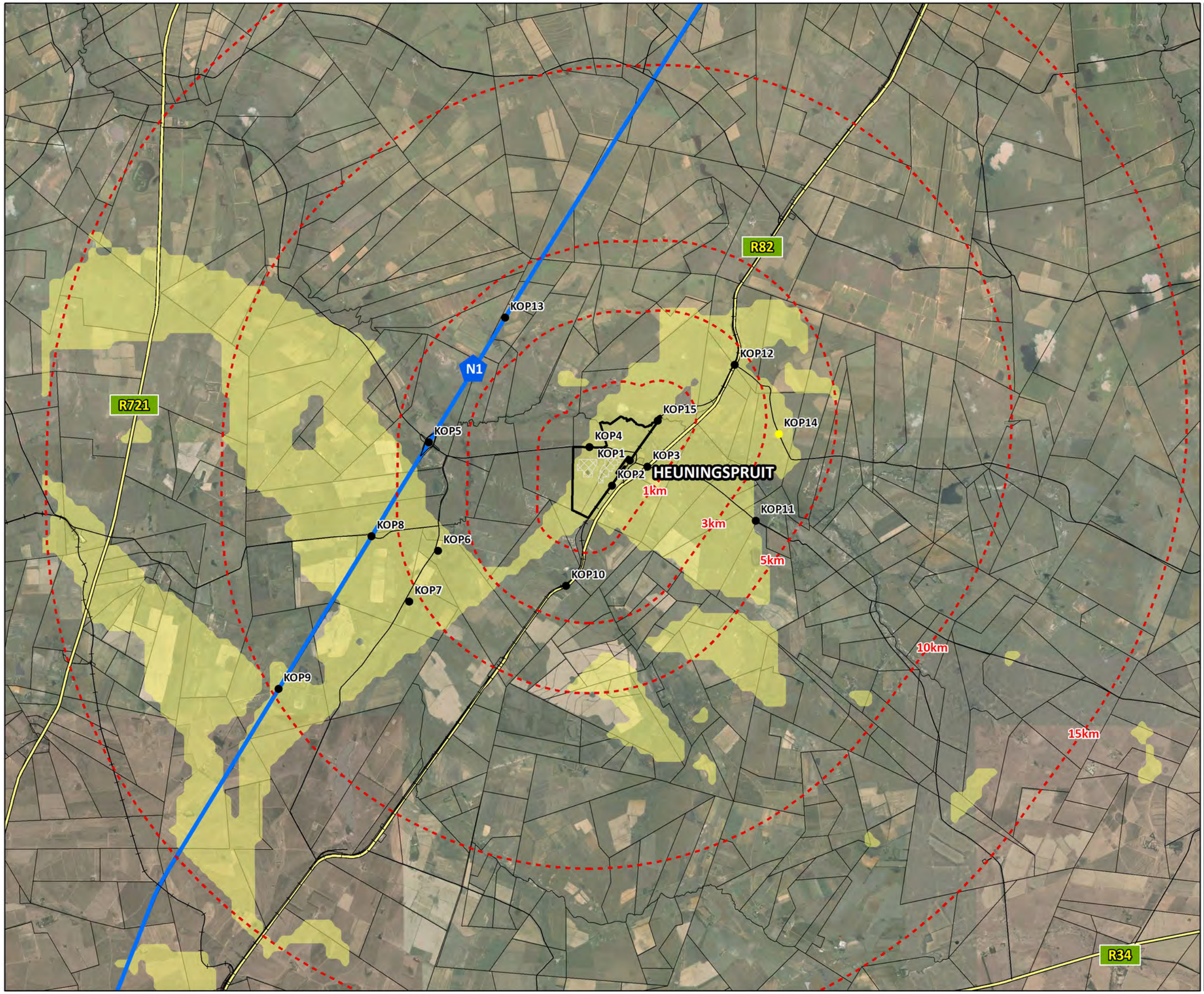
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL

LEGEND

- Subject property
- Project site
- Cadastral boundaries

N

0 0.05 0.1 0.2 0.3 0.4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

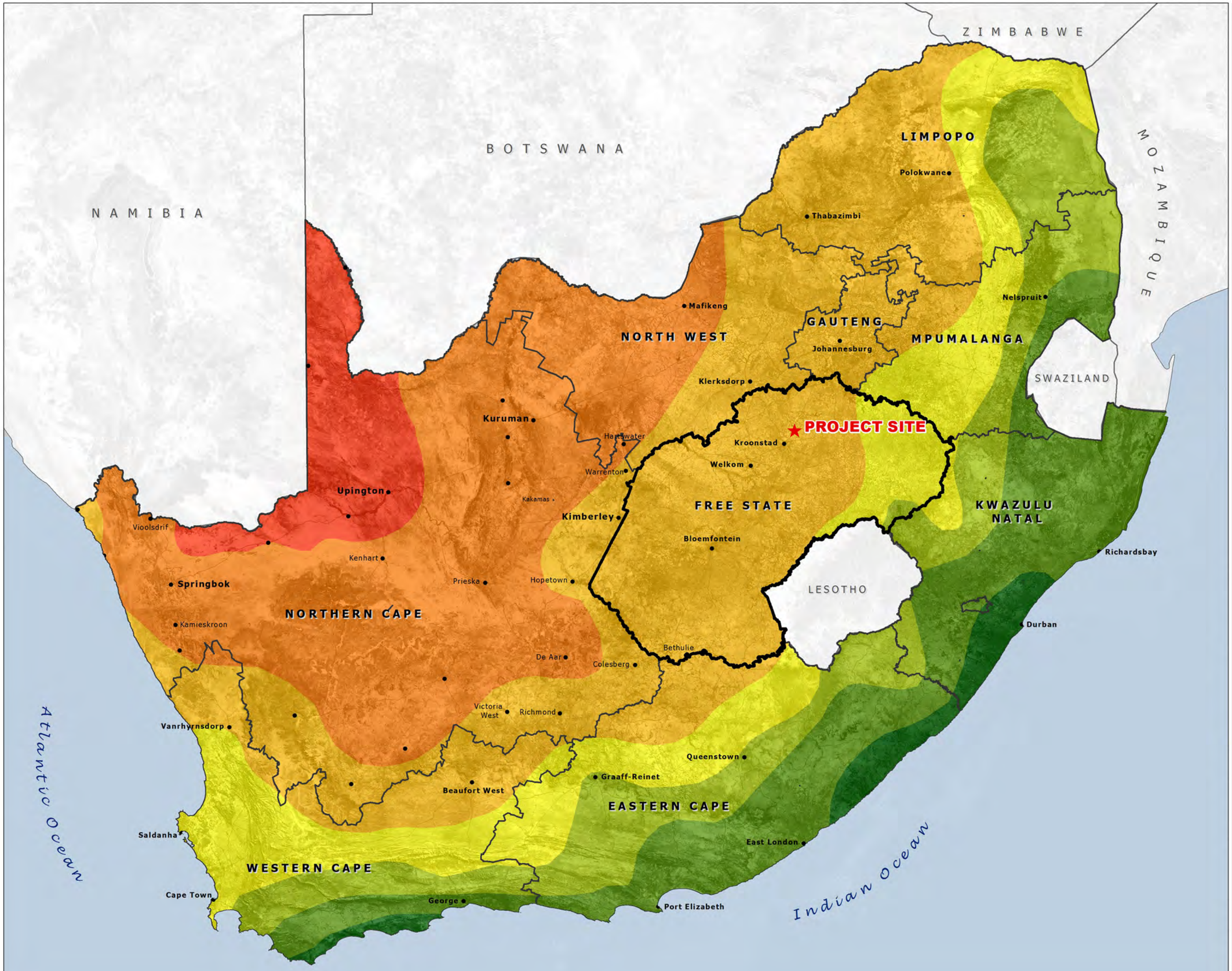
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:15 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Free State Province
- Provinces
- Main Roads

ANNUAL SOLAR RADIATION (MJ/m²)

- 6000 - 6500
- 6501 - 7000
- 7001 - 7500
- 7501 - 8000
- 8001 - 8500
- 8501 - 9000
- 9101 - 9500

N

0 25 50 100 150 200 Kilometers

ZONE LAND SOLUTIONS

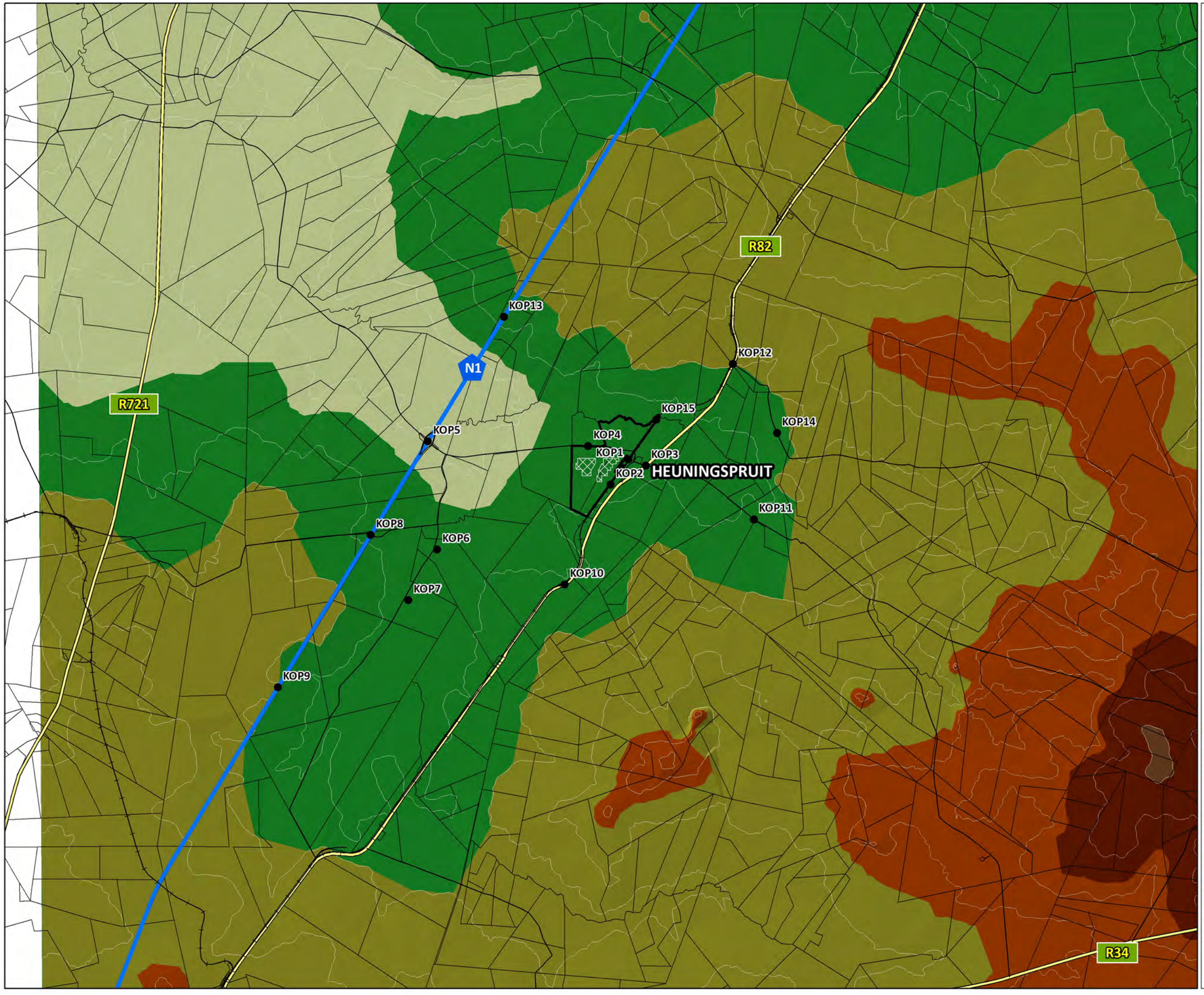
CLIENT

PROJECT
HEUNINGSPRUIT SOLAR FACILITY

DRAWING
SOLAR RADIATION LEVELS THROUGHOUT SOUTH AFRICA

PROJECT NR.	DATE	SCALE
VIA_400713.SWT	17/10/2013	1:5 000 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Key Observation Points
- Main Roads
- Railway Lines

Digital Elevation Model

Elevation

- 1586.667 - 1620
- 1553.333 - 1586.667
- 1520 - 1553.333
- 1486.667 - 1520
- 1453.333 - 1486.667
- 1420 - 1453.333
- 1386.667 - 1420
- 1353.333 - 1386.667
- 1320 - 1353.333

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

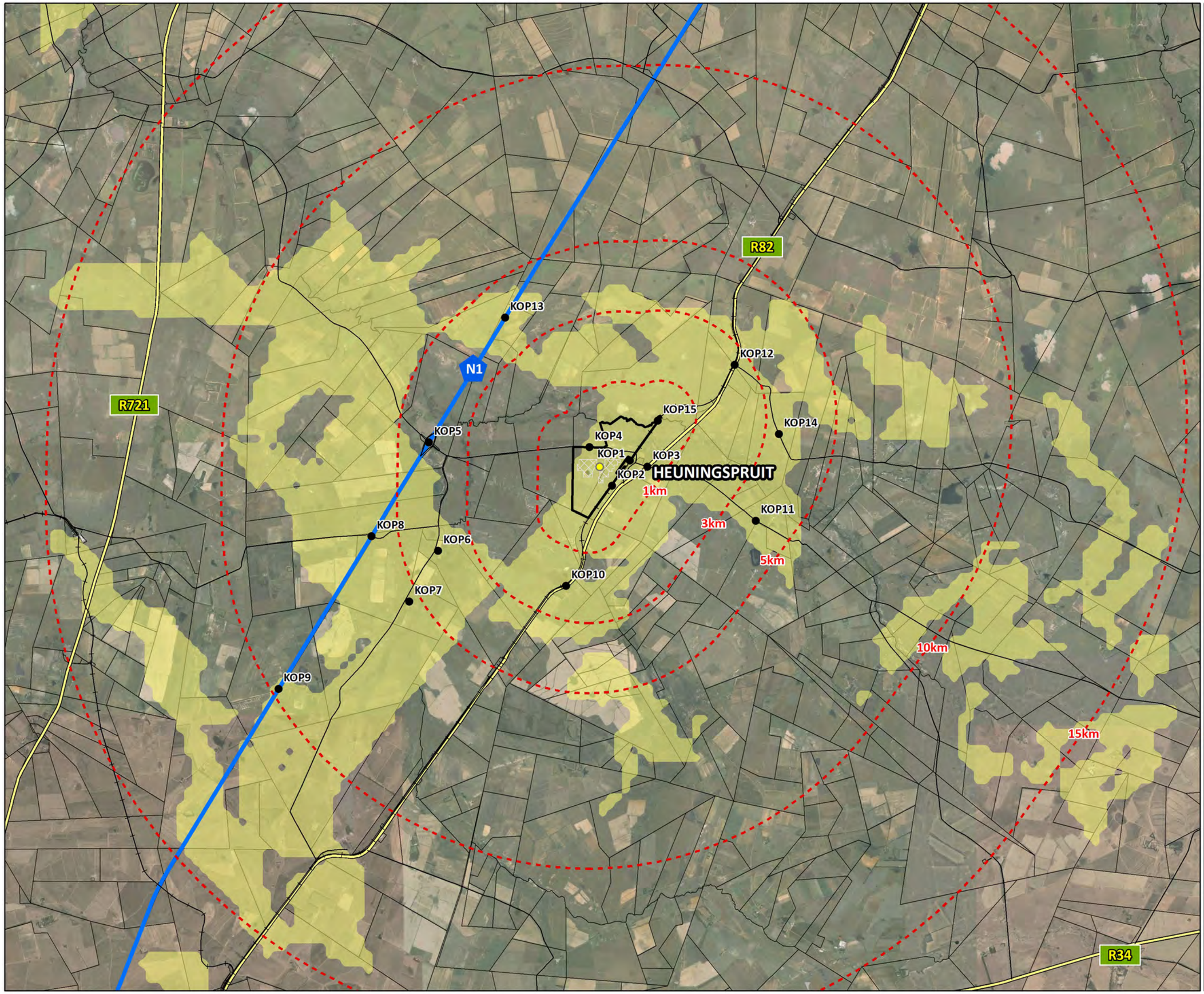
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

DIGITAL ELEVATION MODEL

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

CLIENT

PROJECT

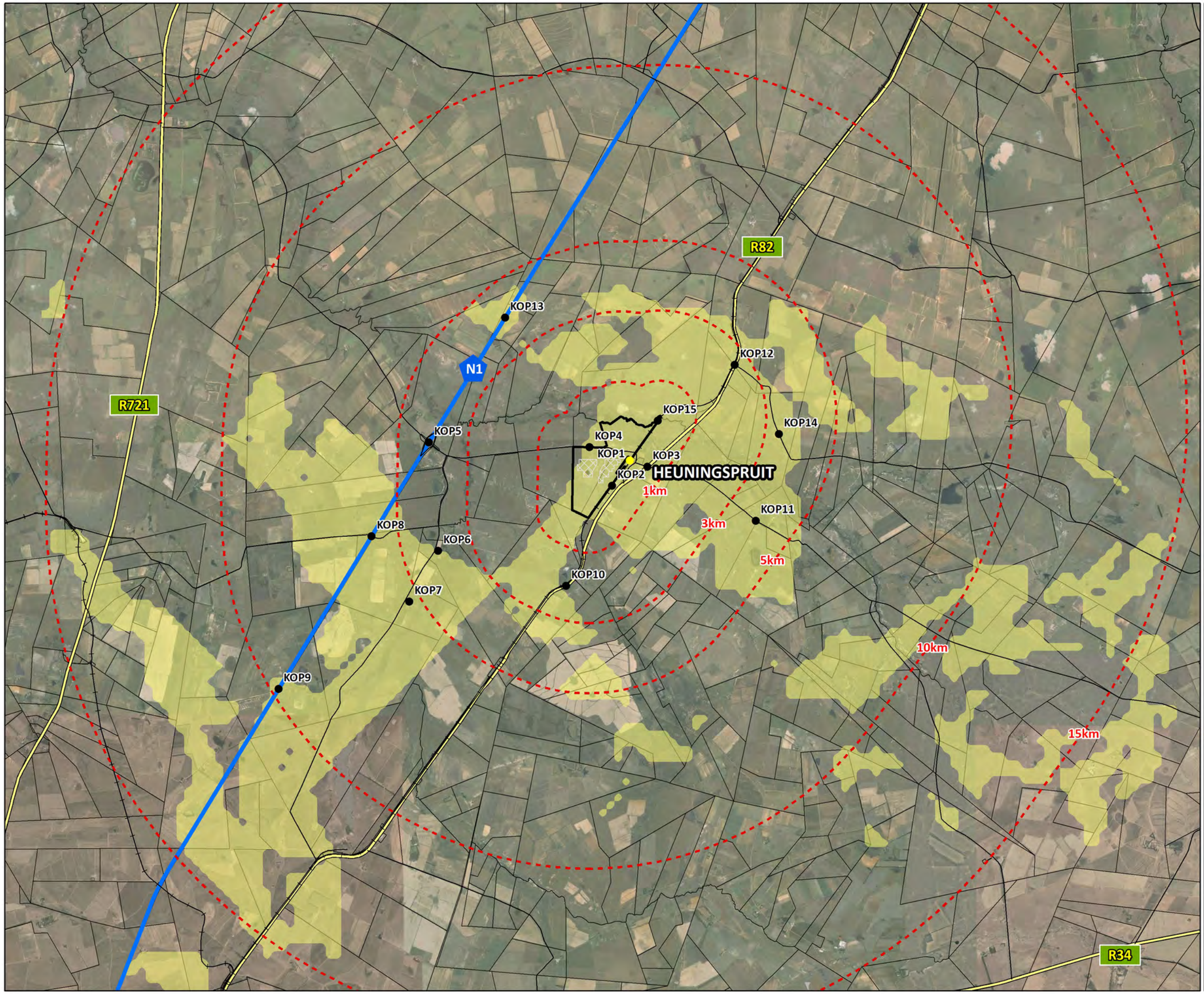
HEUNINGSPRUIT SOLAR FACILITY

DRAWING

VIEWSHED ANALYSIS

PROJECT NR.	DATE	SCALE
VIA_400713	17/10/2013	1:100 000
DRAWING NR.	DRAWN BY	CHECKED BY
GIS/03	SVDM	JJC

FOR APPROVAL



LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

0 0.5 1 2 3 4 Kilometers

ZONE LAND SOLUTIONS

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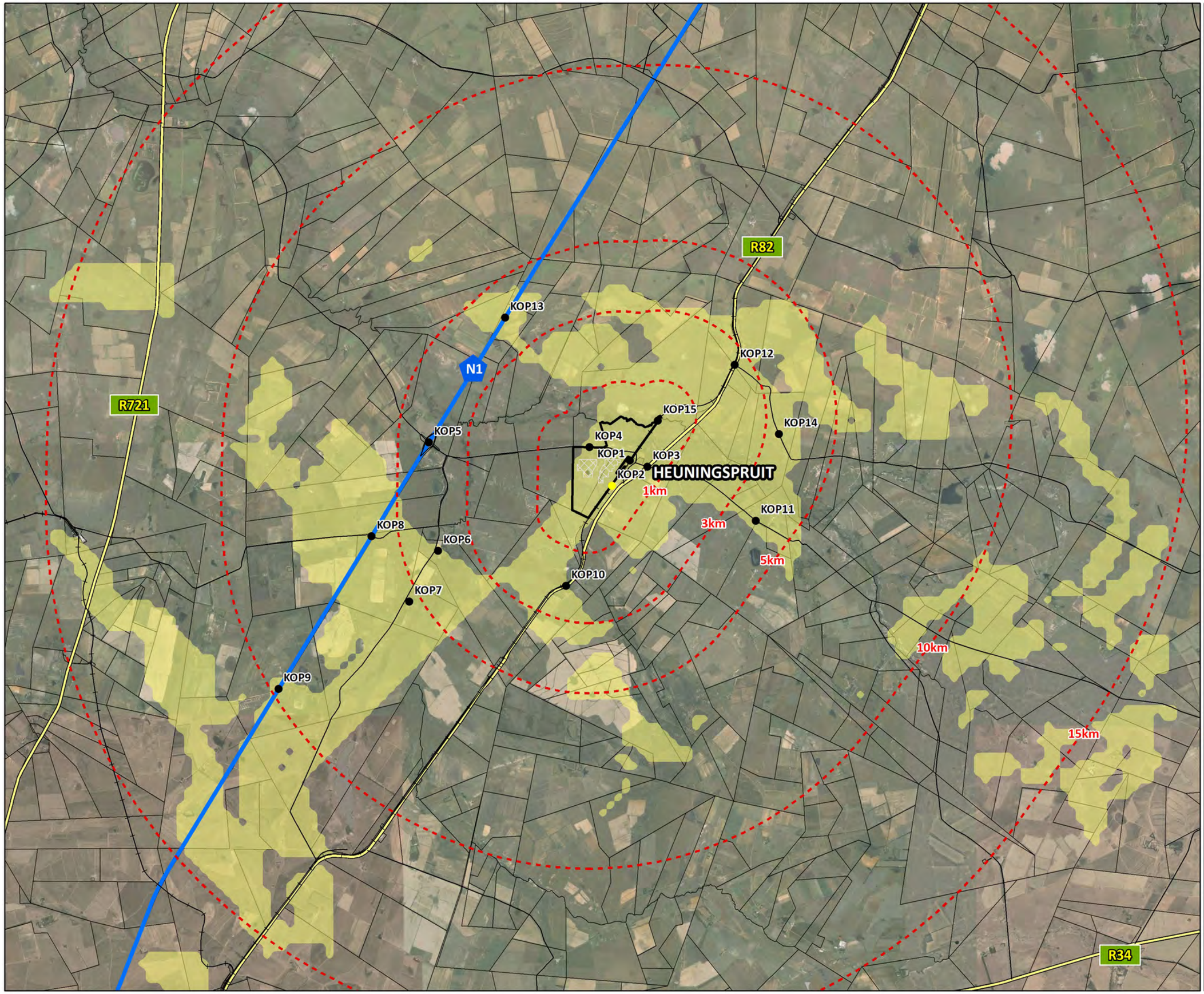

LEGEND

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- Project site
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- Viewshed extent

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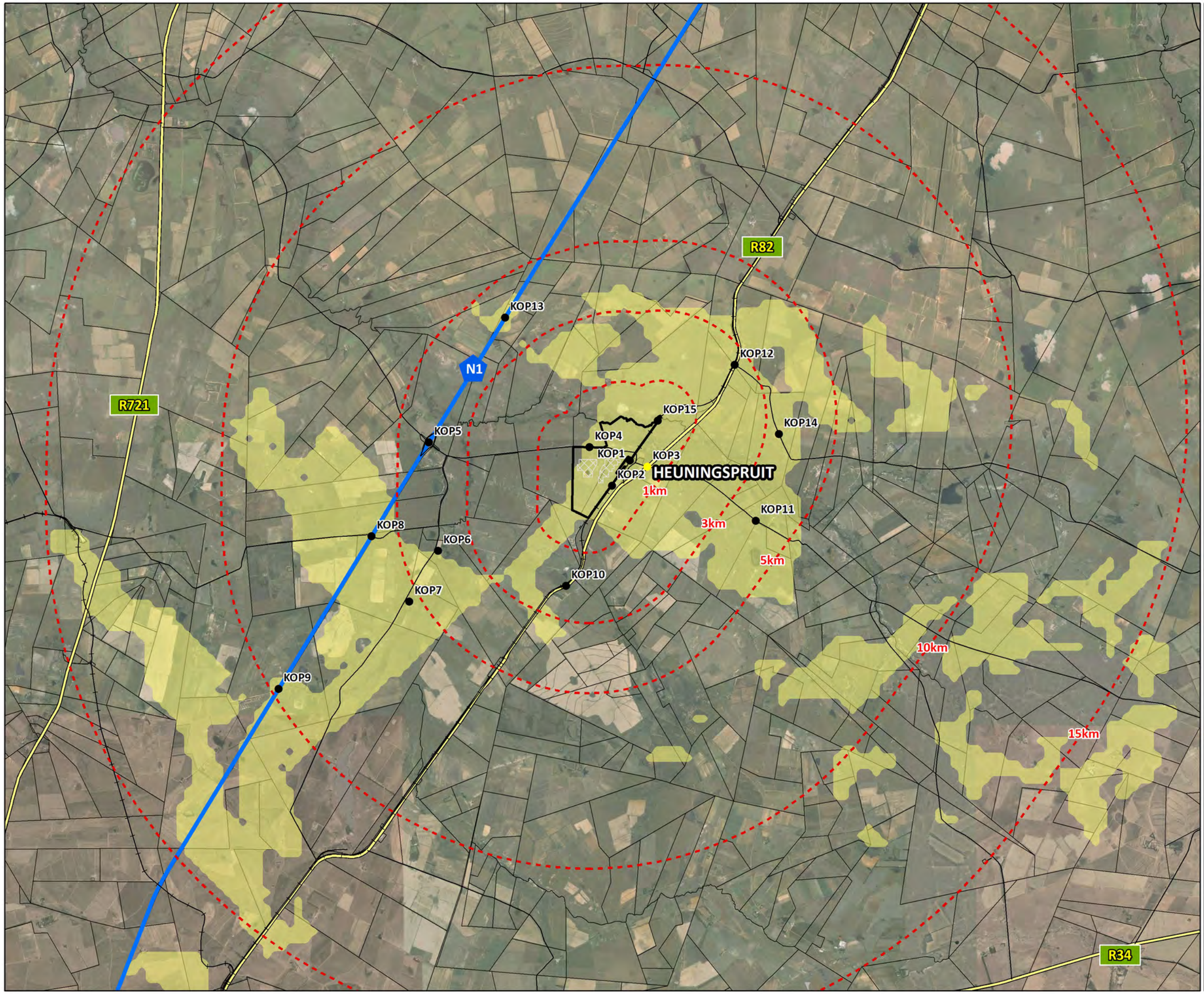

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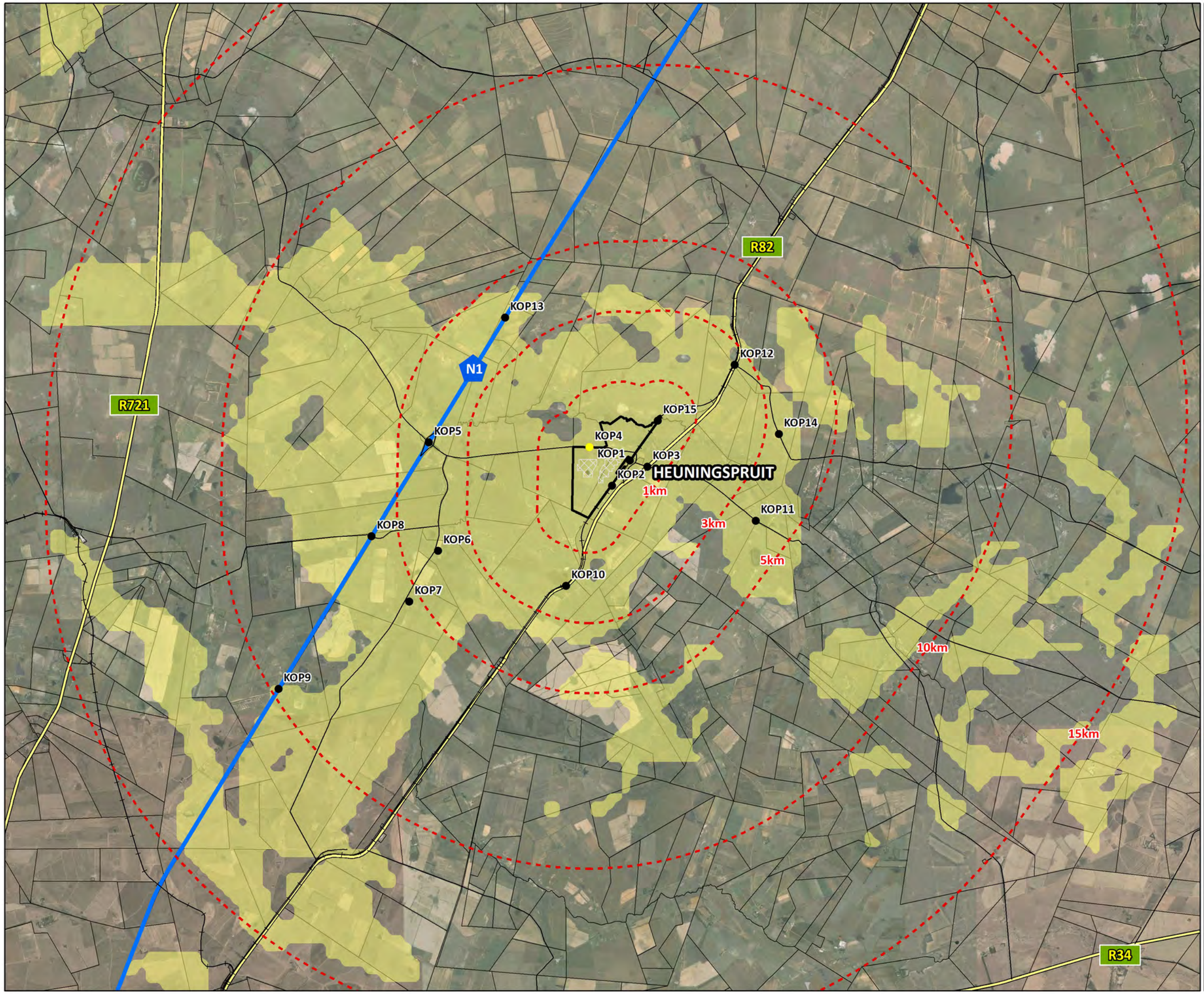

LEGEND

- Subject property
- Project site
- Cadastral boundaries
- Distance radii
- Key Observation Points
- Origin of Viewsheds
- Viewshed extent

N

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FOR APPROVAL