EIA REPORT

APPENDIX K:

Technical Report: Cumulative Topographical Analysis of Proposed PV Projects in AGA Area

Scoping and **Environmental Impact Assessment** for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 3) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

THE SCIENCE OF MEASUREMENT

Technical Report:

Cumulative Topographical Analysis of Proposed PV Projects in AGA Area

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Work done for: Scatec Solar SA 163 (Pty) Ltd.

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Executive Summary

MESA Solutions was asked by *Scatec Solar* to do a topographical analysis of the terrain profiles between various p hotovoltaic (PV) project locations in the Astronomy Geographic Advantage (AGA) area and the closest and core-site SKA telescopes. A total of three *Scatec Solar* sites (*Kenhardt PV1 to PV3*), as well as ten *Mulilo* sites (*Boven PV1 to PV4; Gemsbok PV1 to PV6*) in close proximity, are considered in this cumulative assessment.

EMI Characterisation of Representative Plant

Conducted Measurements

- TD conducted measurements on supply cables to the *Tracking Units* show large pulses when the plant is *ON*.
- Majority of the pulse energy extends up to at least 500 MHz.
- Equivalent FD measurements on the wireless antenna and pressure switch cables agree.
- Comparison with radiated results show higher frequencies radiate into the environment more efficiently.
- Better part of noise is likely to emanate from the inverter.
- *Tracking Unit* emissions are somewhat aggravated by the wireless communication.
- Switching noise associated with the tracking of the panels creates broadband interference.
- Biggest part of switching interference is generated by the pump contactor and relays.

Radiated Measurements

- Radiated results for the plant *ON* and in *STANDBY* mode show similar emissions levels.
- This confirms that interference producing systems are never completely *OFF*.
- Emissions associated with the *Inverter* units are dominant and occupy frequencies between 300 MHz and 2 GHz
- Peak levels identified range between 30 - 35 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz for both polarisations.
- For purposes of RFI mitigation, the fixed line communication would be the preferred implementation.
- The *String Cabinet* shows mostly broadband interference between 300 MHz and 800 MHz for both polarisations.
- Comparative measurements made with the doors to the *Inverters* and *Tracking Units* open show the limited levels of shielding provided by these enclosures.
- It is possible to improve the shielding by incorporating conductive gasketting.

Propagation Analysis

A preferred and alternative site location was included for the Mulilo developments in terms of the total path loss to the SKA receivers. This study attempts to define an E-field upper limit, as a function of frequency, at which the plants are allowed to radiate without exceeding emission limits (SARAS protection and receiver saturation limits) at the various SKA telescope locations. The conformance of the plant can be determined by comparing representative measured results, made at Scatec Solar's 75 MW Dreunberg plant, to the calculated levels provided.

From the results it is shown that:

- Radiated emissions at levels below that of CISPR 11/22 Class B are required (especially in the case of the closest telescope).
- Negligible terrain loss exists between majority of sites and closest SKA telescope.
- Predictions for the maximum allowed E-field level, as measured according to CISPR 11/22 Class B, are given in Figs. (a) to (c) below. A comparison with measured emission levels for each plant is shown.
- Based on plant emission and maximum allowed levels, the required (red) mitigation or surplus (green) attenuation for the closest, second closest and core-site telescopes are given in Tables 1 2 and 3 respectively.

The three proposed Kenhardt plants are shown in Table 1 to exceed the SARAS protection levels by up to 38 dB toward the closest SKA telescope. This includes the cumulative effect of a total of $N = 13$ PV plants developed. However, Boven PV1, PV3 and PV4 exceed this limit by approximately 50 dB in this scenario.

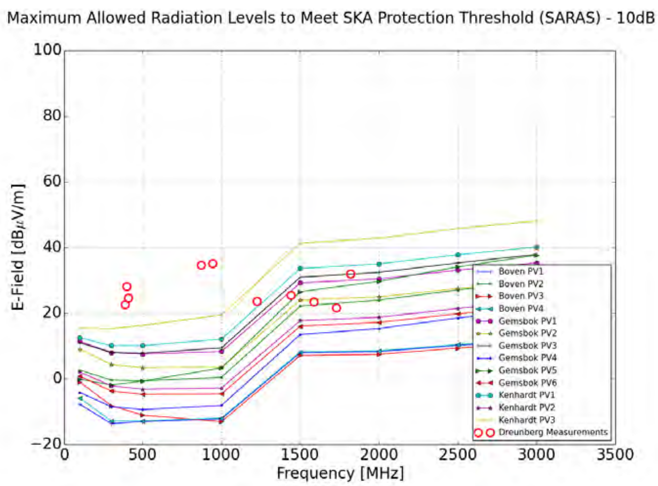
For the case where only the three Kenhardt plants are developed, the exceedance will reduce to 31.6 dB with a cumulative effect for $N = 3$ plants considered.

Mitigation Measures

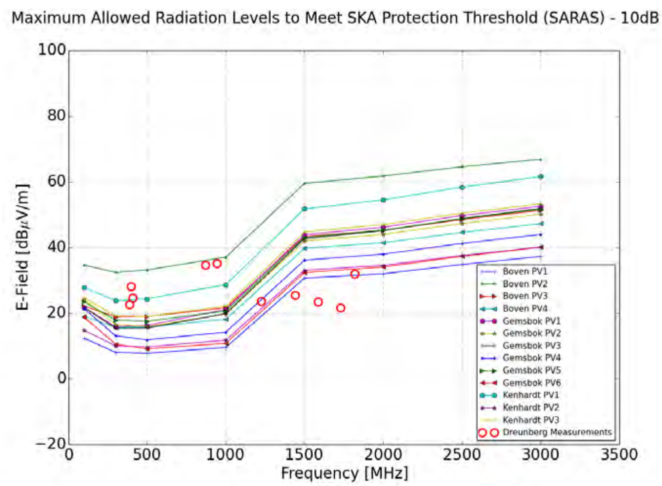
It is strongly recommended that the following **mitigation practises** be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment.
- For shielding of such an environment ensure:
  - RFI gasketting be placed on all seams and doors.
  - RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves).
- The use of bare copper directly in soil for earthing is recommended.
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps of the tracking units.
- All data communications to and from the plant to be via fibre optic.

It is MESA's expectations that, if the mitigation measures that are specified are implemented correctly, attenuation of between 20 dB and 40 dB can be achieved. The required maximum mitigation 50 dB for some plant especially towards the closest telescope would require significant attention to detail. *It is important to note that the success of the mitigation measures cannot be guaranteed or confirmed until measurements on a representative mock-up installation with mitigation measures implemented are performed. Furthermore, the findings from this assessment are for the client's own edification, and will be taken into account by SKA-SA during their own propagation analysis. This study is therefore not meant to supersede any investigation done by SKA-SA or relevant RFI working groups. It remains the responsibility of the developer to meet compliance to the SKA requirements, and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.*



(a)



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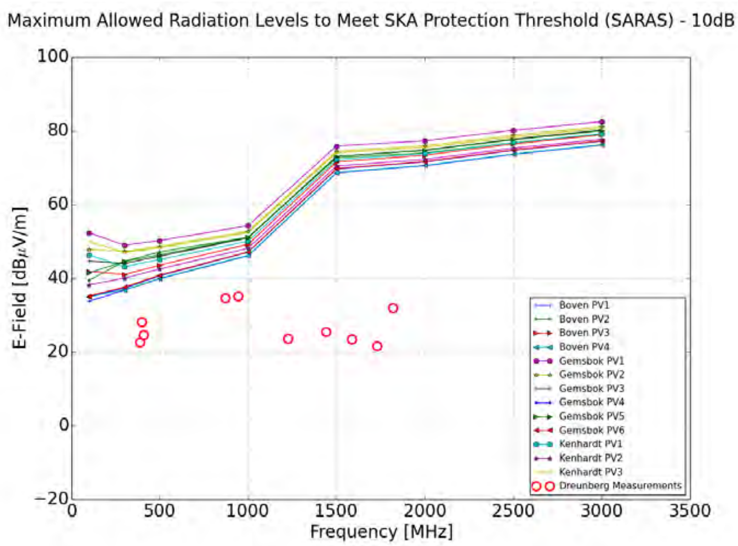

(c)

Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels toward: (a) Closest SKA telescope; (b) Second closest SKA telescope; and (c) SKA core-site telescopes compared to measured results at 75 MW Scatec Dreunberg PV plant.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	12.55	18.03	14.58	23.06	23.28	1.96	-5.57	-10.4	-12.54	-2.51
Kenhardt PV2	25.23	30.77	27.38	37.53	37.99	17.28	10.17	5.52	3.5	13.6
Kenhardt PV3	6.94	12.37	8.87	15.98	16.03	-5.57	-13.22	-18.11	-20.3	-10.3
Boven PV1	36.02	41.47	37.99	47.05	47.43	26.85	19.92	15.43	13.61	23.82
Boven PV2	23.16	28.66	25.23	34.35	34.79	13.48	5.88	0.97	-1.29	8.67
Boven PV3	32.07	37.73	34.44	47.17	47.95	27.69	20.76	16.27	14.45	24.66
Boven PV4	35.48	40.95	37.5	46.79	47.17	26.59	19.66	15.17	13.35	23.56
Gemsbok PV1	14.85	20.36	16.94	26.52	26.91	5.98	-1.29	-6.01	-8.08	1.99
Gemsbok PV2	18.72	24.26	20.87	31.2	31.68	11.01	3.92	-0.72	-2.73	7.38
Gemsbok PV3	14.75	20.25	16.81	25.63	25.9	4.6	-2.93	-7.77	-9.92	0.09
Gemsbok PV4	31.52	37.06	33.66	43.06	43.38	22.1	14.54	9.64	7.38	17.34
Gemsbok PV5	24.01	29.42	25.92	32.36	32.29	9.96	1.69	-3.63	-6.27	3.43
Gemsbok PV6	26.8	32.34	28.94	39.25	39.73	19.02	11.88	7.2	5.14	15.21

Table 1: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the closest SKA telescope.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	-1.38	4.07	0.59	7.05	6.94	-15.35	-23.55	-28.78	-31.31	-21.52
Kenhardt PV2	12.74	18.24	14.81	23.39	23.6	2.36	-5.07	-9.89	-12.05	-2.03
Kenhardt PV3	3.57	9.07	5.63	13.31	13.36	-8.6	-16.59	-21.69	-24.06	-14.19
Boven PV1	14.73	20.23	16.8	25.52	25.77	4.64	-2.72	-7.48	-9.58	0.46
Boven PV2	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV3	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV4	6.95	12.43	8.98	17.08	17.24	-4.17	-11.73	-16.61	-18.82	-8.84
Gemsbok PV1	6.64	12.1	8.64	14.75	14.56	-7.66	-15.72	-20.84	-23.23	-13.37
Gemsbok PV2	6.39	11.91	8.49	15.91	15.87	-6.01	-13.88	-18.9	-21.21	-11.29
Gemsbok PV3	7.22	12.7	9.25	15.89	15.77	-6.42	-14.51	-19.67	-22.11	-12.27
Gemsbok PV4	10.1	15.65	12.27	21.01	21.18	-0.36	-8.05	-13.0	-15.27	-5.33
Gemsbok PV5	4.92	10.42	6.99	14.78	14.84	-7.04	-14.98	-20.04	-22.4	-12.51
Gemsbok PV6	12.72	18.28	14.91	24.24	24.5	3.19	-4.35	-9.23	-11.45	-1.48

Table 2: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the second closest SKA telescope.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	-21.33	-15.96	-19.51	-14.15	-14.35	-36.27	-44.03	-48.97	-51.19	-41.21
Kenhardt PV2	-18.46	-13.12	-16.7	-12.06	-12.35	-34.46	-42.33	-47.32	-49.57	-39.61
Kenhardt PV3	-24.93	-19.53	-23.04	-16.73	-16.81	-38.43	-46.01	-50.85	-52.99	-42.97
Boven PV1	-15.48	-10.18	-13.79	-9.87	-10.25	-32.51	-40.46	-45.49	-47.77	-37.84
Boven PV2	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV3	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV4	-15.58	-10.28	-13.89	-10.0	-10.38	-32.64	-40.59	-45.62	-47.89	-37.95
Gemsbok PV1	-26.86	-21.45	-24.96	-18.6	-18.67	-40.28	-47.85	-52.69	-54.83	-44.81
Gemsbok PV2	-25.18	-19.78	-23.3	-17.06	-17.15	-38.81	-46.41	-51.27	-53.42	-43.41
Gemsbok PV3	-22.2	-16.84	-20.39	-15.06	-15.27	-37.2	-44.97	-49.91	-52.13	-42.16
Gemsbok PV4	-16.1	-10.82	-14.44	-10.79	-11.19	-33.51	-41.49	-46.53	-48.82	-38.89
Gemsbok PV5	-22.7	-17.32	-20.87	-15.26	-15.43	-37.26	-44.97	-49.88	-52.07	-42.09
Gemsbok PV6	-16.36	-11.07	-14.68	-10.91	-11.31	-33.62	-41.61	-46.65	-48.94	-39.0

Table 3: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the core-site SKA telescopes.

Contents

Nomenclature

AC	Alternating Current
AF	Antenna Factor
AGA	Astronomy Geographic Advantage
BW	Bandwidth
CISPR	Comitè International Spècial des Pertubations Radioèlectriques (French)
CISPR	International Committee on Radio Interference (English)
CM	Common Mode
CP	Current Probe
dB	Decibel
dBμA	Decibel Micro-Ampère
dBμV	Decibel Micro-Volt
dBμV/m	Decibel Micro-Volt per Metre
DC	Direct Current
DEM	Digital Elevation Model
DUT	Device Under Test
E-Field	Electric Field
EMI	Electromagnetic Interference
FD	Frequency Domain
FFT	Fast Fourier Transform
FSPL	Free Space Path Loss
GPS	Global Positioning System
ITM	Irregular Terrain Model
ITWOM	Irregular Terrain With Obstruction Model
KAT	Karoo Array Telescope
kV	Kilovolt
LOS	Line-of-Sight
mV	Millivolt
MW	Megawatt
NF	Noise Floor
PV	Photovoltaic
RBW	Resolution Bandwidth

RFI	Radio Frequency Interference
RFI-WG	Radio Frequency Interference Working Group
RTA	Real Time Analyser
SA	Spectrum Analyser
SARAS	South African Radio Astronomy Services
SKA	Square Kilometre Array
SKA-SA	Square Kilometre Array South Africa
SPLAT	Signal Propagation, Loss And Terrain - Analysis Tool
TD	Time Domain
TL	Terrain Loss
TPL	Total Path Loss
Z_T	Transfer Impedance

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1 Introduction

MESA Solutions was asked to investigate the cumulative effect and possible impact of a number of photovoltaic (PV) plants on the Square Kilometre Array (SKA) project. It is proposed that development of these plants take place in the Astronomy Geographic Advantage (AGA) area described in [1]. The proposed sites include three developments by *Scatec Solar*, as well as ten developments by *Mulilo Renewable Project Developments* in close proximity. From the terrain evaluation we are able to determine what influences, if any, natural topographical features will have on the total expected interference attenuation based on the location of the site. This determines the maximum allowable emission levels which the facility may generate in order to still comply with SKA threshold limits as specified in [2]. An initial study investigating the effect of three of the ten sites, namely *Boven PV1*, *Gemsbok PV1* and *Gemsbok PV2*, on the closest and core SKA telescopes were undertaken in [3].

The following additional sites considered in this cumulative study include:

Scatec Solar

- Kenhardt PV1
- Kenhardt PV2
- Kenhardt PV3

Mulilo Renewable Project Developments

- Boven PV2
- Boven PV3
- Boven PV4
- Gemsbok PV3
- Gemsbok PV4
- Gemsbok PV5
- Gemsbok PV6

For each of the additional Mulilo sites, a preferred and an alternative site location is considered in terms of the total path loss to the closest and core SKA telescopes. The purpose is to identify the recommended site location based on minimum potential impact.

The aim of this investigation is to define emission limits at relevant discrete frequencies to which *in situ* measurements, conducted once the project is built, have to adhere. Compliance to these limits, given the propagation analysis presented, will ensure that emissions will not exceed the SARAS protection or receiver saturation threshold levels. The report is not a prediction of what interference levels will be at each of the telescopes, but rather stipulates a requirement for the developer to ensure conformance. Assuming the same technology, the conformance of the plant can be determined by comparing representative measured results, from the 75 MW Scatec Dreunberg PV plant in Section 2, to the calculated levels provided in Section 6.

In the case where there are more than one PV plant (source of interference) emitting at a specific frequency, it is important that the cumulative effect be considered by taking into account:

$$P_{\text{Cumulative}} = 10\log_{10}(N) \tag{1}$$

where N=13 is the number of PV plants considered in this investigation. This could results in an accumulative effect of up to $P_{\text{Cumulative}}$=11.1 dB for power transmitted at a specific frequency.

It is important to note that the findings from this assessment are for the client's own edification, and will be taken into account by SKA-SA during their own propagation analysis. This study is therefore not meant to supersede any investigation done by SKA-SA or relevant RFI working groups. It remains the responsibility of the developer to meet compliance to the SKA requirements, and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.

2 EMI Characterisation of 75 MW Dreunberg PV Plant

The cumulative study firstly requires the characterisation of electromagnetic interference (EMI) generated by a representative plant using similar technology as what will be implemented on the proposed sites. Secondly, by making use of the identified interference from the facility in propagation analysis, the potential impact of the sites on both the closest and core-site SKA telescopes are determined. Finally, recommendations for the mitigation of interference based on the anticipated impact and plant layout are given.

2.1 Background & Scope

The AGA act specifies that the declared astronomy advantage areas are to be protected, preserved and properly maintained in terms of radio frequency interference (RFI). Therefore, the potential impact from new developments in terms of emissions, specifically on the SKA SA project, have to be determined. MESA Solutions will assist *Scatec Solar* in trying to establish the impact of interference from all the proposed projects on both the closest and core-site SKA stations. It is, however, important to take into account the fact that all measured results in this report include background interference which is dependent on the representative plant's location.

MESA's philosophy for identifying RFI generated by an electric/electronic system is to do both radiated and conducted measurements. Conducted interference, in the form of common mode (CM) current on the cables connected to the system, could radiate if a resonant galvanic path exists. CM current measurements made throughout a system using a current probe (CP), are therefore a diagnostic tool which helps to determine the likely source of interference. Radiated measurements, usually made using active antennas, provide information about how much of the conducted interference is being radiated into the environment. Differences in spectral content between the two methods mean that some interference radiates directly from parts of the system. Levels of radiated interference are, furthermore, subject to multi-path interference and as a consequence have to be made at various separation distances.

Another level of investigation is to repeat some the radiated and conducted measurements in the time domain using a *MESA Product Solutions'* Real Time Analyser (RTA-3). This allows the capture of transient signals usually associated with switching events which a conventional sweeping spectrum analyser (SA) is unlikely to capture. While they might only last for a short duration, the consequence could be a frequency spectrum filled with interference (fast rise time pulse results in broadband frequency content). The combination of these measurement techniques is relied upon to provide information about the total amount of interference produced by a device under test (DUT). Current measurements were made from 70 MHz to 1 GHz due to the operational frequencies of interest (lower limit) and CP (upper limit). Radiated measurements were made from 70 MHz to 3.6 GHz which covers the band of conducted interference and provides some additional information.

2.2 Measurement Locations

A diagram of the plant layout is shown in Fig. 1. The plant is divided into an eastern and western section. Measurement positions were chosen in the eastern section close to inverters 22 and 23 (Position 1) as well as inverters 1 and 2 (Position 2). The two positions were evaluated because of differences in communication methods between the tracking units at each location. The associated global positioning system (GPS) coordinates for the two position are:

- **Position 1:** 30° 50.167' S, 26° 12.930' E
- **Position 2:** 30° 49.944' S, 26° 13.204' E

Figure 1: Diagram of plant layout showing measurement location at inverters 22 and 23.

The Dreunberg plant makes use of a horizontal single-axis tracking facility operated hydraulically. Each inverter/transformer station is supplied by six arrays of panels each operated by two tracking units. The measurement location was chosen to provide characteristic emissions of a typical *Inverter* station, as well as nearby *String* and *Tracking* cabinets.

The *String* cabinets (Fig. 2) combines all the direct current (DC) supplies for a particular part of the plant onto positive and negative 1000 V DC cables. The *String* cabinet also contain a smart solar energy monitoring system that monitors the voltage, current and power output from the various PV panels (or strings) that feed DC into the *String* cabinet. The *Tracking* cabinets located on the *Tracking* unit contain all the control electronics for the array movement. The hydraulic system makes use of a master and slave hydraulic rams situated either side of a particular array. Depending on the direction the panels are moved in, only one will operate at any given time. Communication between the *Tracking* units are done via a local wireless network for most units in the plant, except at a few units close to Position 2. For the wireless system (Position 1), each pair of *Tracking* units has a unique operating frequency to ensure exclusive communication. For the wired implementation (Position 2), a fixed *RS-485* communication cable runs underground connecting each pair of *Tracking* units.

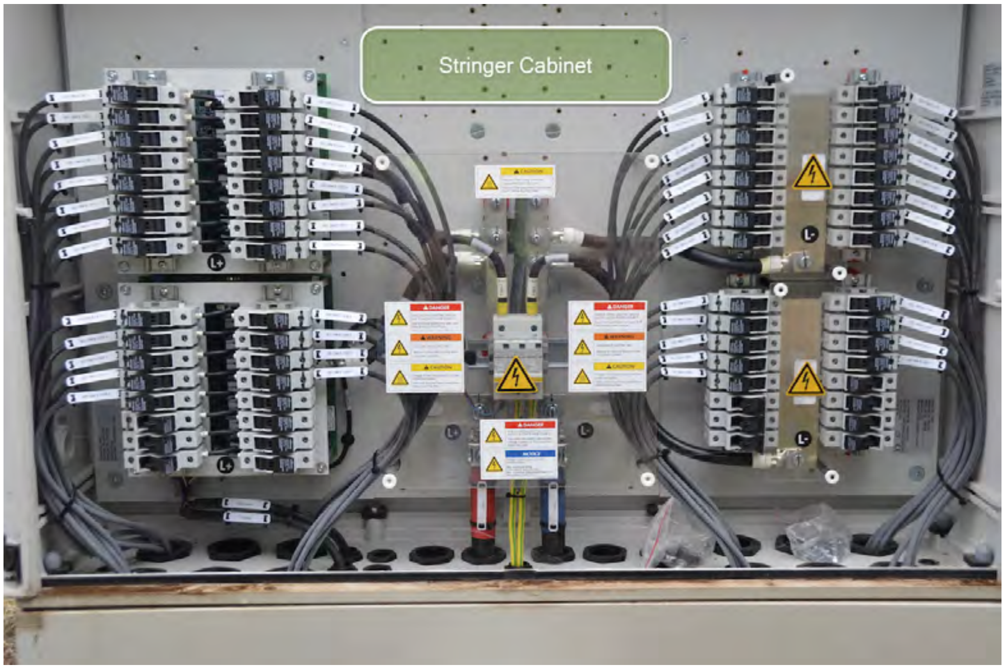


Figure 2: String Cabinet layout where supply from each panel is monitored.

2.3 Conducted Measurements

Conducted measurements were made using an *ETS-Lindgren EMCO* CM CP. Measurements in the time domain (TD) were made using a 800 MHz instantaneous bandwidth (BW) *MESA Product Solutions RTA-3* (Real Time Analyser) capable of measurements up to 2.6 GHz, while frequency domain (FD) measurements were made with a *Rohde & Schwarz ZVH-4* (70 MHz to 3.6 GHz) cable and antenna analyser (SA). In cases where strong low-frequency emissions compressed the receivers, a 100 MHz high pass filter was added.

The majority of measurements were made on cables close to the *Tracking Unit* and *String Cabinets* at Position 1 and 2. Measurements were also made on the cables connected to one of the weather stations located throughout the facility. A number of conducted interference measurement locations are shown in Figs. 3 to 5:

- Positive direct current (DC) panel cables
- Earth strap at the back of the PV panels
- DC cable bundle at the back of the PV panels
- Communication cable in String Cabinet
- Tracking Unit Position 1 wireless antenna cable
- Pressure switch cable (Tracking Unit)
- Tracking Unit communication cable Position 2
- Weather station cable

Measurements were made with the plant in full power generation mode, referred to as the *ON* state. After sunset the plant no longer produces power and enters an idle/standby mode. It is important to note, however, that most control and monitoring systems remain on during this period. This is referred to as the *STANDBY* state of operation and was also evaluated. With most systems remaining on, emissions levels will not necessarily change between *ON* and *STANDBY* modes of operation.

Figure 3: CP measurements on the panel earth strap.

Figure 4: CP measurements on cables connected to Tracking Cabinet.

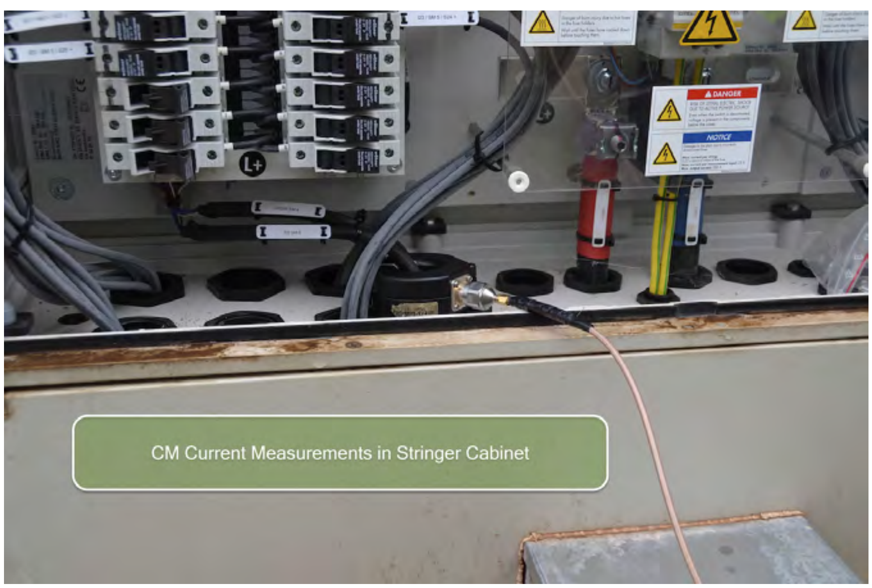


Figure 5: CP measurements on the communication cable inside the String Cabinet.

2.3.1 Frequency Domain Measurements

FD results obtained with the CM CP and SA are shown in Figs. 6 to 12. In these results the measured voltage levels [dBμV] are converted to current levels [dBμA] by removing the transfer impedance (Z_T [dBΩ]) of the probe. Each figure displays the frequency content measured from 70 MHz to 1 GHz. The dominating low-frequency content occasionally required the use of a low pass filter with a cut-in frequency of 100 MHz. The effect therefore on band of interest is negligible. In most cases the pre-amplifier was used with a 100 kHz resolution bandwidth (RBW) which is the closest option to CISPR equivalent RBW of 120 kHz for frequencies below 1 GHz.

Included in all results are the CISPR 11/22 Class B (more stringent standard for household applications) equivalent current limit. It is derived from antenna theory that any cable in free space carrying a CM current level of 5 μA (or 13.98 dBμA) above 230 MHz, will produce a worst-case E-field strength of 37 dBμV/m at a distance of 10 m from the DUT. This will only occur if the cable has resonant properties at a given frequency. The 37 dBμV/m limit is relaxed by 10 dB for CISPR 22 Class A (industrial applications). While the SKA, because of its sensitivity, enforces much more stringent limits than CISPR, it is purely included as a well-known reference.

Most of the results show a comparison between the *ON* and *STANDBY* modes of operation. Because the plant never fully switches off, evaluation of the *STANDBY* mode is relevant. In all cases where *STANDBY* measurements were made, the comparison with *ON* results confirms that there are no appreciable difference in terms of the interference generated. A prominent broadband interference signal seen on the DC cable bundle is visible at a lower level on the single panel DC cable. Also visible in the two DC results is a particularly strong narrowband emission at 872 MHz. It was also measured on the panel earth strap, the pressure switch and wireless antenna cables. Its narrowband feature and the fact that it was not measured on the cables connected to the *String* or fixed line *Tracking Cabinets* suggest it to be some local oscillator or clock frequency only visible at Position 1.

Other significant levels of conducted interference are seen on the pressure switch, wireless antenna and *Tracking Cabinet* communication cable. These levels are above the equivalent current limit between 100 MHz and 350 MHz and seem to be broadband in nature. The wireless antenna and pressure switch cables show narrowband higher frequency interference not measured anywhere else. The similarity in spectral content on these two cables can be attributed to their close proximity of the *Tracking Unit*, with the source likely to be the wireless communication system. Similar interference is not visible on the communication cable of the *Tracking Unit* at Position 2 where the wireless system is not used. A simple comparison of conducted and radiated interference will subsequently be presented to determine the contribution of CM current to the overall radiated emissions.

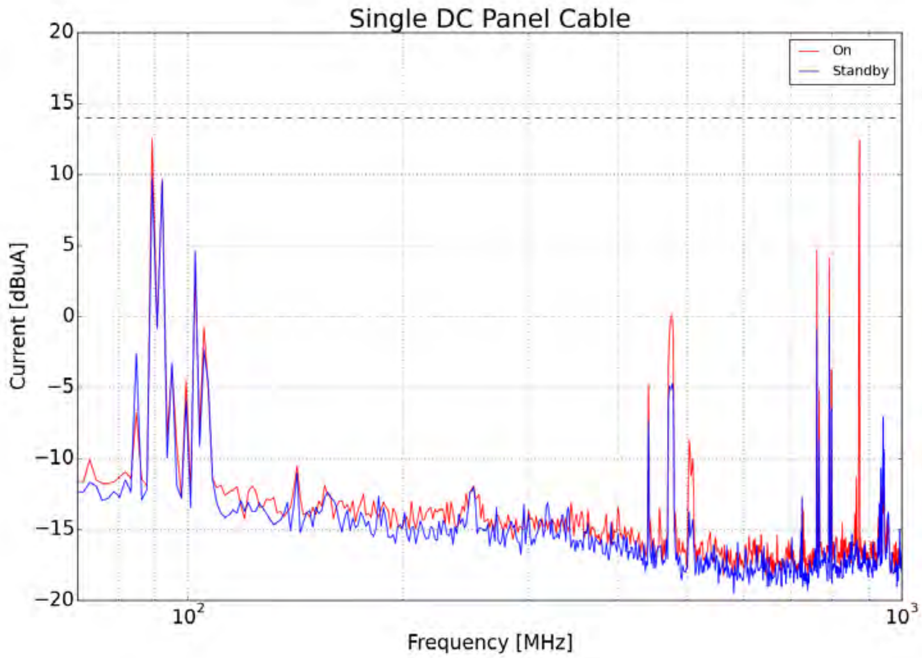


Figure 6: Frequency domain current probe measurements on the PV panel DC cables for the plant *ON* and in *STANBY* mode.

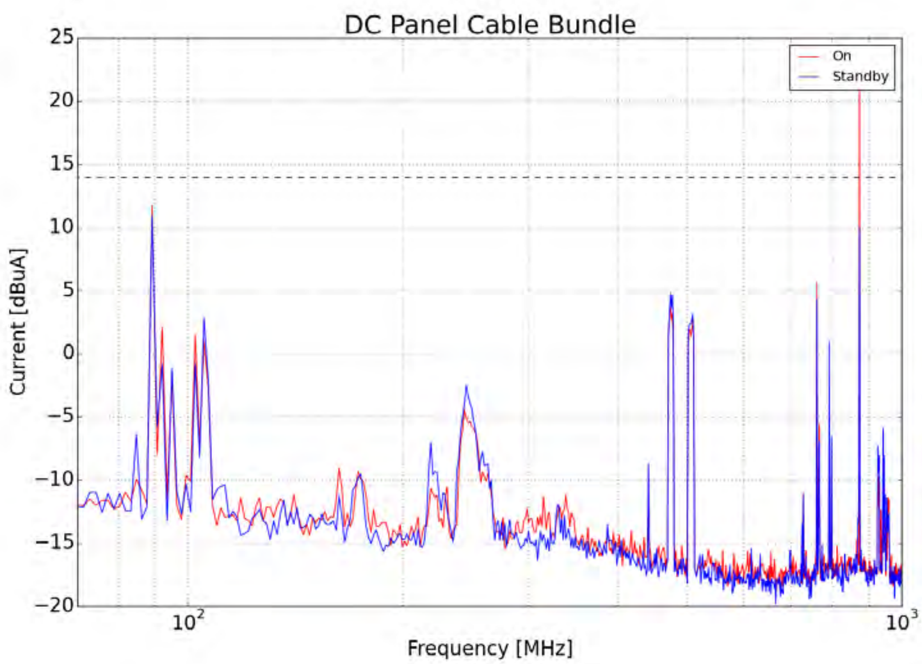


Figure 7: Frequency domain current probe measurements on DC cable bundle at the back of the PV pannels for the plant *ON* and in *STANDBY* mode.

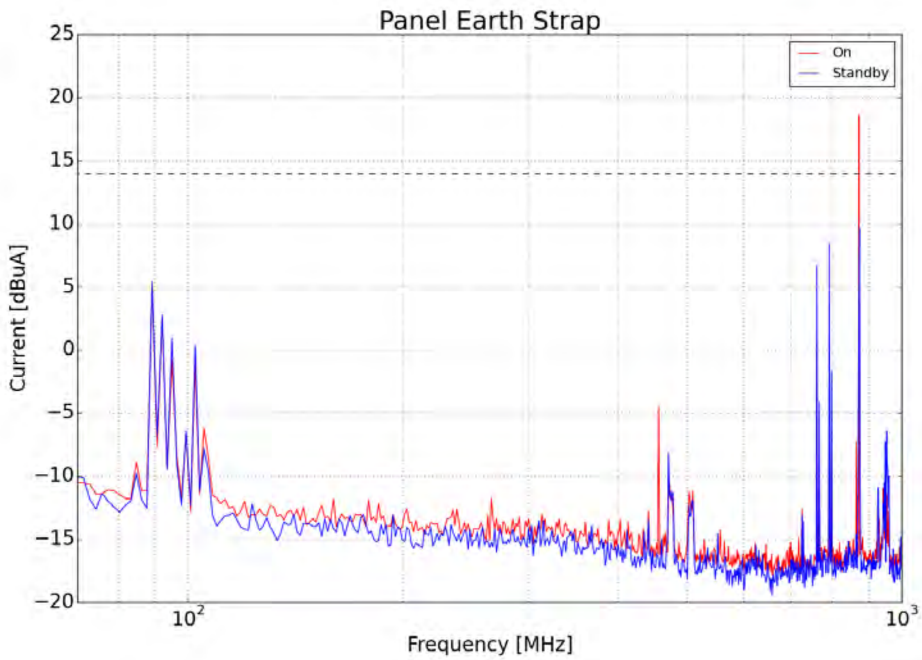


Figure 8: Frequency domain current probe measurements on PV earth strap for the plant *ON* and in *STANBY* mode.

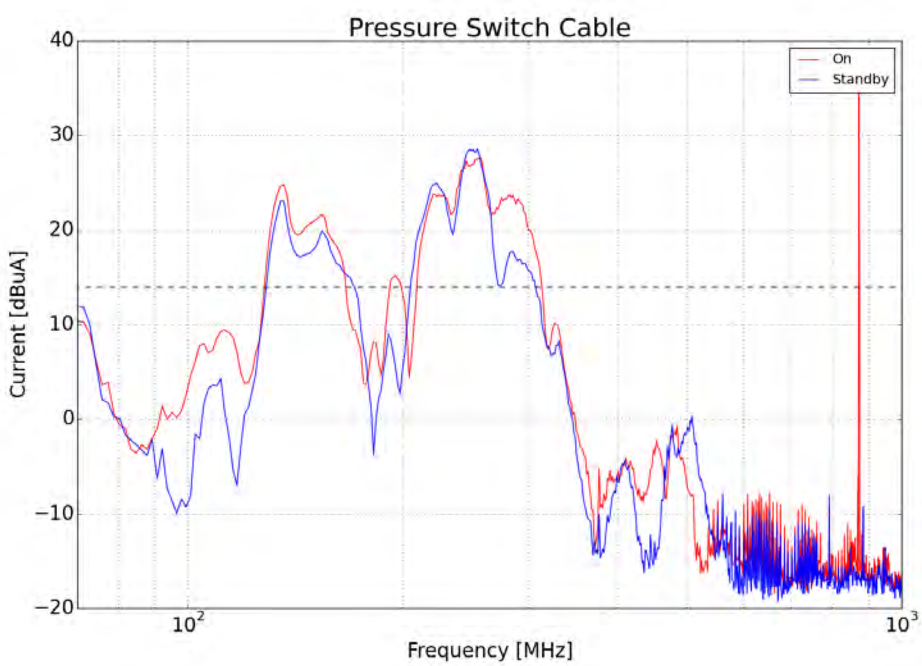


Figure 9: Frequency domain current probe measurements on the hydraulic pressure switch located at the Tracking Unit for the plant *ON* and in *STANDBY* mode.

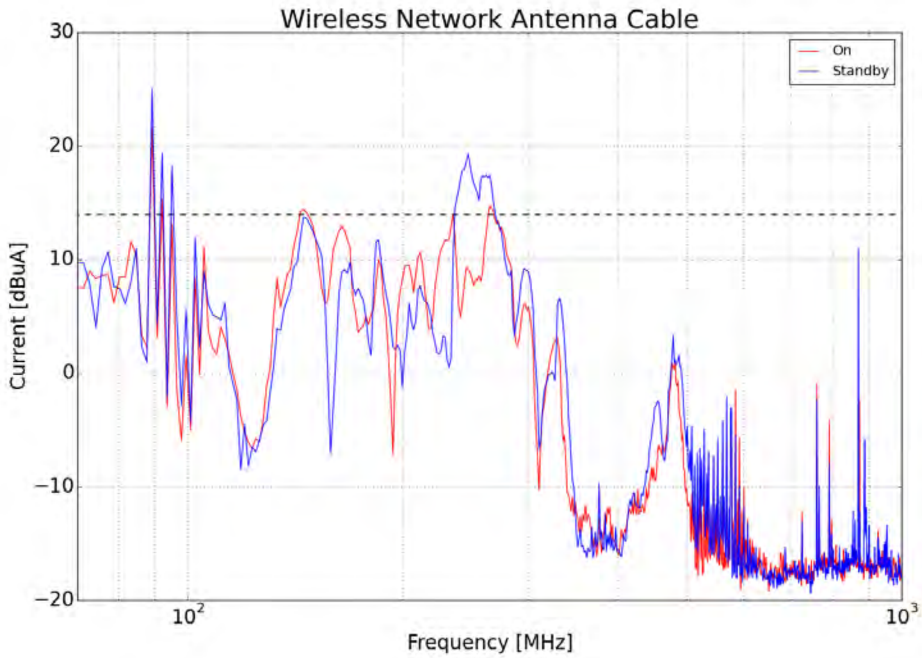


Figure 10: Frequency domain current probe measurements on wireless antenna cable located at the Tracking Unit at Position 1 for the plant *ON* and in *STANBY* mode.

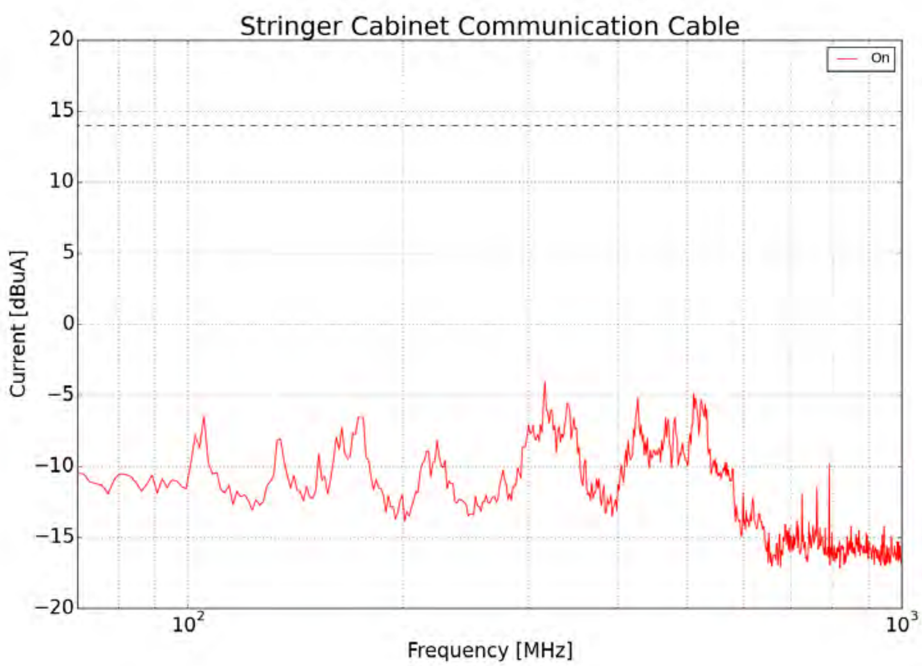


Figure 11: Frequency domain current probe measurements on String Cabinet communication cable for the plant *ON* and in *STANDBY* mode.

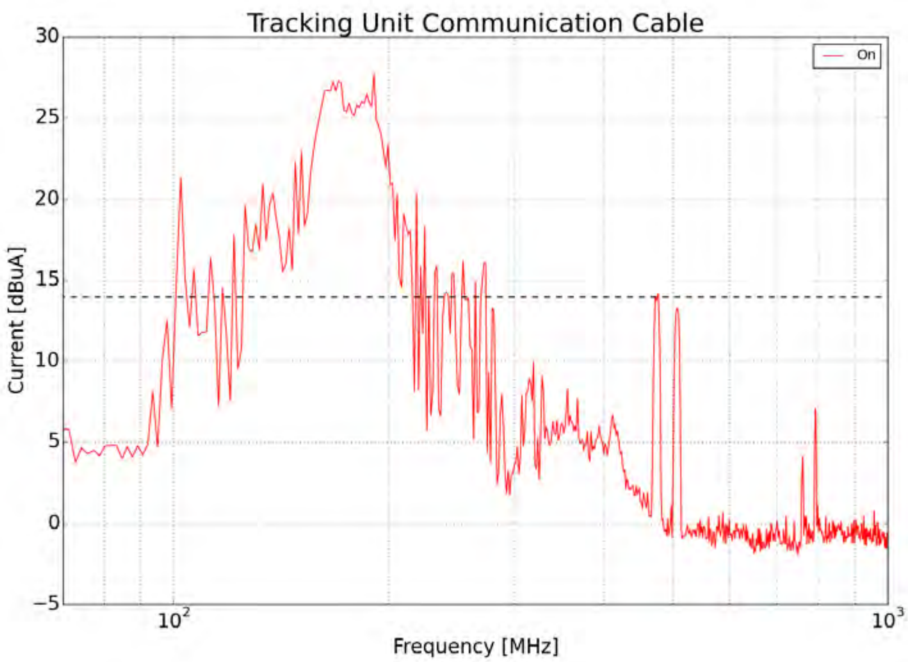


Figure 12: Frequency domain current probe measurements on Tracking Cabinet communication cable at Position 2 for the plant *ON* and in *STANBY* modes.

2.3.2 Time Domain Measurements

TD conducted measurements, focussing particularly on the *Tracking Unit* operation were made, as shown in Fig. 4. A typical TD transient pulse, as well as its corresponding Fast Fourier Transform (FFT) FD spectrum, captured on supply cables entering the cabinet of the unit at Position 1 with the RTA-3 and EMCO CM CP are shown in Fig. 13 and Fig. 14 respectively.

In both of the results shown above, the resultant spectrum gives the frequency content only associated with the particular pulse captured. The fast changing nature of the pulses cannot be captured using a conventional sweeping SA, so both TD and FD data have to both be considered. In the event of the supply cable that was measured, levels exceeding the CISPR equivalent current limit are seen from approximately 100 MHz across most of the frequency band. The pulse therefore suggests relatively strong transient events which will distribute to all cables closely spaced to this supply cable. A comparison with radiated results also measured in the TD in close proximity to the *Tracking Unit* are presented in Section 2.4.4.

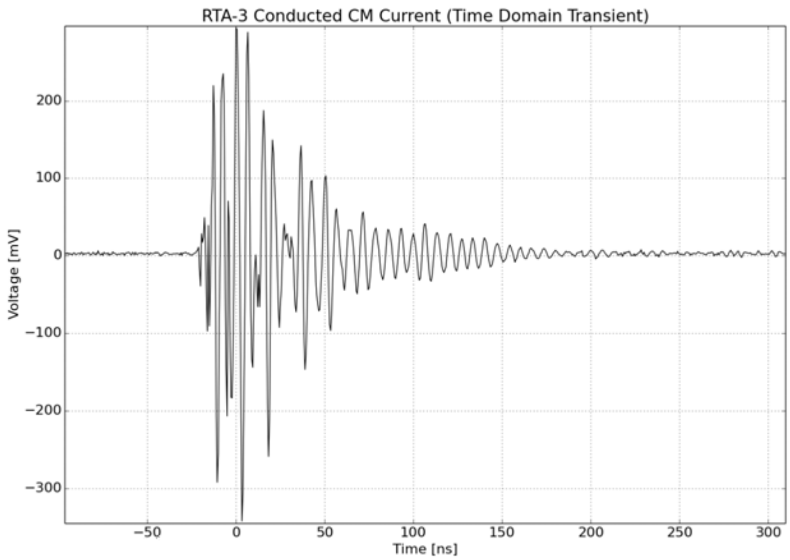


Figure 13: Typical CM current transient pulse captured with RTA-3 on supply cables to the Tracking Unit at Position 1.

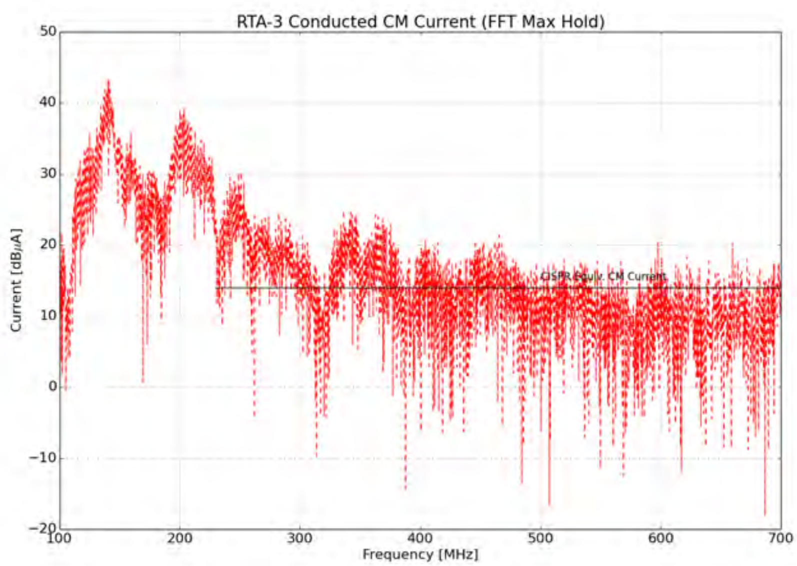


Figure 14: Equivalent Fast Fourier Transform spectrum for the conducted interference measured on supply cable to the Tracking Unit at Position 1.

2.4 Radiated Measurements

2.4.1 Frequency Domain Measurements

Inverters 22 and 23 Position 1
Radiated measurements were made in the TD and FD using the same conventional sweeping SA and RTA-3. A log periodic dipole array (LPDA) antenna in both active and passive modes were used as the receiver. Measurements were made between 70 MHz and 3.6 GHz, with measured voltage levels [dBμV] transformed into electric field (E-field) [dBμV/m] by incorporating the appropriate antenna factor (AF) values [dB/m].

Radiated measurements were made at Position 1 (Fig. 1) of Inverters 22 and 23 as well as the closest *Tracking* and *String Cabinets* at separation distances of 1, 3, 10 m as shown in Figs. 15 (a) and (b). Measurements were also made at Position 2 (Fig. 1) of the *Tracking Cabinet* at a location in the plant were fixed-line communication is used between the *Tracking Units*. A comparison of results for the two positions give an indication of the possible increased high frequency interference associated with the wireless communication network.

In addition to evaluating emissions as a function of distance, measurements were also made with the doors to the *Inverter* enclosures and *Tracking Cabinet* open. Both sets of results help to identify interference produced only by the plant. In all cases measurements were made during full power production (*ON*), and when no power was being generated (*STANDBY*) for both polarisations.

(a) (b)

Figure 15: Radiated measurements of (a) Inverter and Transformer units and (b) Tracking Cabinet.

Results as measured for *Inverters* 22 and 23 at Position 1 with the system *ON* and in *STANDBY* mode for both polarisations are given in Figs. 16 and 17. These results are with all doors to enclosures closed.

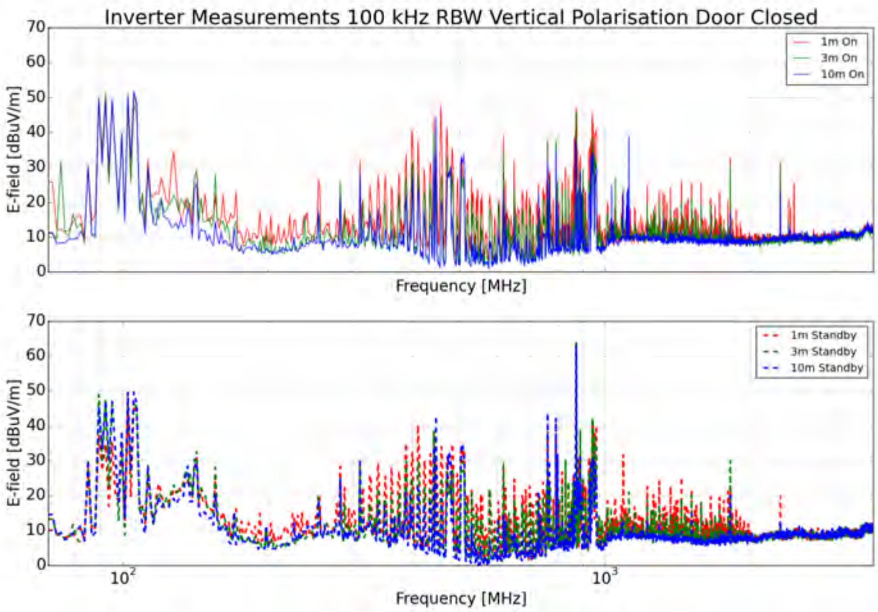


Figure 16: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with door **closed**.

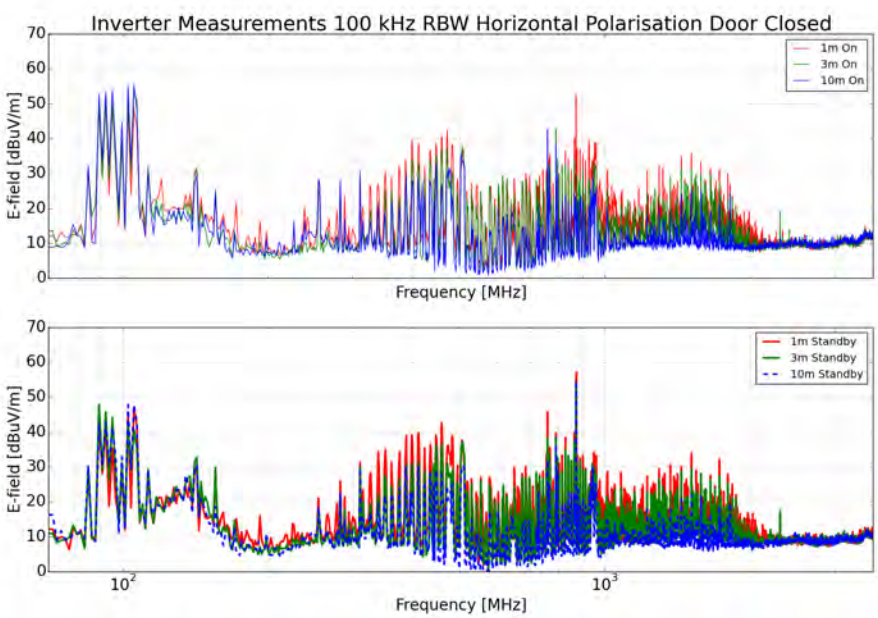


Figure 17: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with doors **closed**.

Similar levels of interference are measured for both polarisations, as well as for the plant *ON* and in *STANDBY* mode. Variation with distance can be seen from 300 MHz up to 2 GHz, and peak emission levels reach 48 dBμV/m at 1 m for vertical polarisation and 42 dBμv/m at 1 m for horizontal polarisation. A particularly strong emission at 872 MHz can be seen in all results shown.

Results for a repeat measurement as a function of distance, but with the doors to the *Inverter* enclosures open, are shown in Fig. 18 for vertical polarisation and in Fig. 19 for horizontal polarisation. In both cases results are shown for the plant *ON* and in *STANDBY* mode.

The comparison shows emission in the vertical polarisation to increase, especially between 1 and 2 GHz. Peak levels for vertical polarisations have increased to above 50 dBμV/m compared to 48 dBμV/m for the door closed. In the case of horizontal polarisation signal levels have increased by at least 10 dB for measurements with the inverter and transformer doors open. The variation with distance and level increase with the doors open, albeit less than expected at some frequencies, confirms the radiating source to be the *Inverters*.

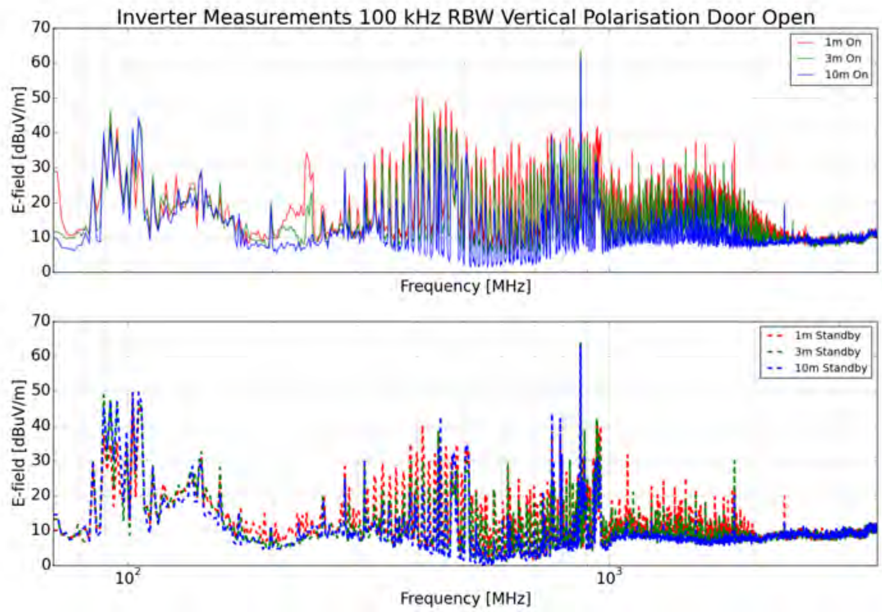


Figure 18: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverter at Position 1 for both *ON* and *STANDBY* modes of operation with doors **open**.

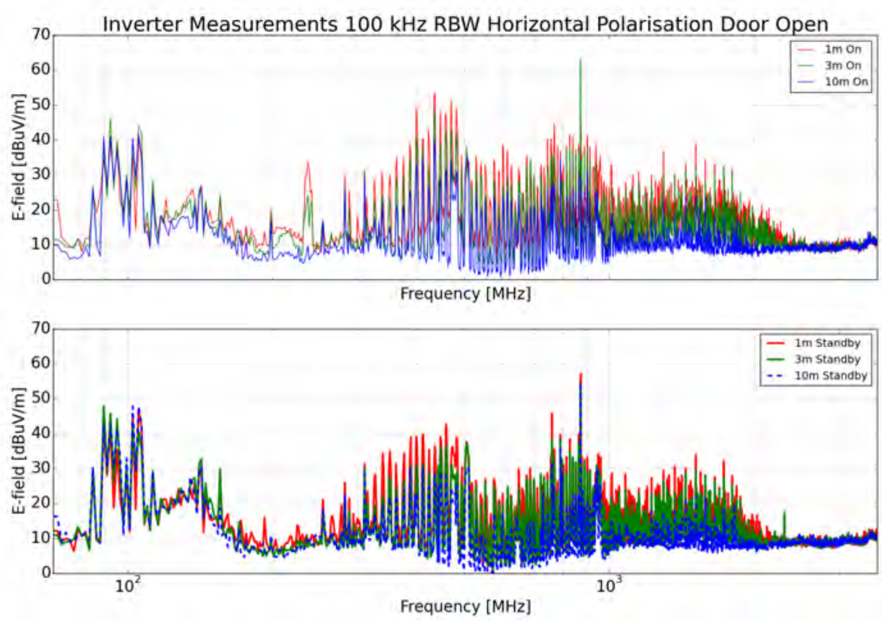


Figure 19: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with doors **open**.

Tracking Unit Position 1
Results measured for one of the *Tracking Units* at Position 1 with the plant *ON* and in *STANDBY* mode are given in Figs. 22 and 21. These results are for the door of the *Tracking Cabinet*, visible in Fig. 15(b), closed.

Peak interference levels for both polarisations can be seen around 250 MHz as well as between 500 MHz and 1 GHz. A decrease in amplitudes when moving away from the cabinet is also visible, but for some frequencies this is less than predicted free space loss. This can be attributed to the reflective nature of the surroundings and uncertainty about where the measurement point is in the far-field of the radiating source is. However, these measurements indicate specifically that the source has been correctly identified.

String Cabinet Position 1
Emissions from one of the *String Cabinets* at Position 1 with the plant *ON* and in *STANDBY* mode for both polarisations are given in Figs. 24 and 25. With the *String Cabinet* being made of fibre glass, measurements with the door open were not required, so only comparisons for 1, 3, and 10 m are given.

The spectrum shows predominantly wideband interference between 300 MHz and 800 MHz for both polarisations and with the plant *ON* and in *STANDBY* modes. Variation in amplitude when moving from 1 m to 10 m are between 14 dB and 16 dB for vertical polarisation, and between 7 dB and 15 dB for horizontal polarisation. This is less that the predicted 20 dB free space reduction, which again confirms the influence of the complex reflective environment between the panels. The precise source of radiating interference are therefore influential.

Tracking Cabinet Position 2
Below are results showing the difference in radiated emissions from the *Tracking Unit*'s cabinet as measured at Position 1 and 2 (Fig. 1). It shows the difference in radiated interference when comparing the wireless and fixed line communication systems that are implemented. Results are only shown for the plant *ON*. The measurements being compared were all made using a 100 kHz RBW with the cabinet door closed.

The comparison for both polarisations at all three separation distances clearly show more frequency content for the wireless implementation, especially between 500 - 700 MHz. Prominent wideband interference between 200 - 300 MHz are also not present for the fixed line implementation, suggesting that for purposes of radio interference mitigation, this would be a better implementation.

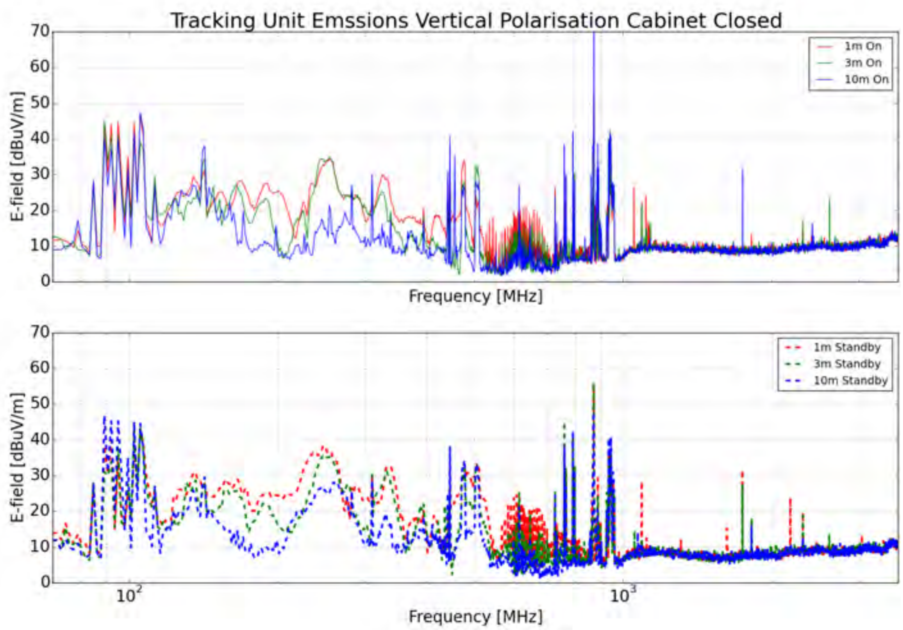


Figure 20: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **closed**.

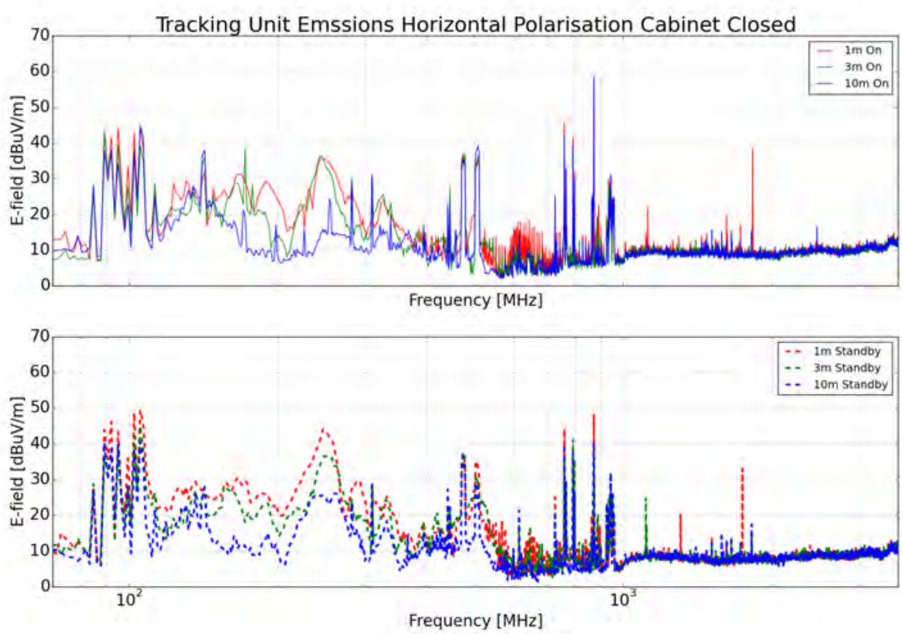


Figure 21: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **closed**.

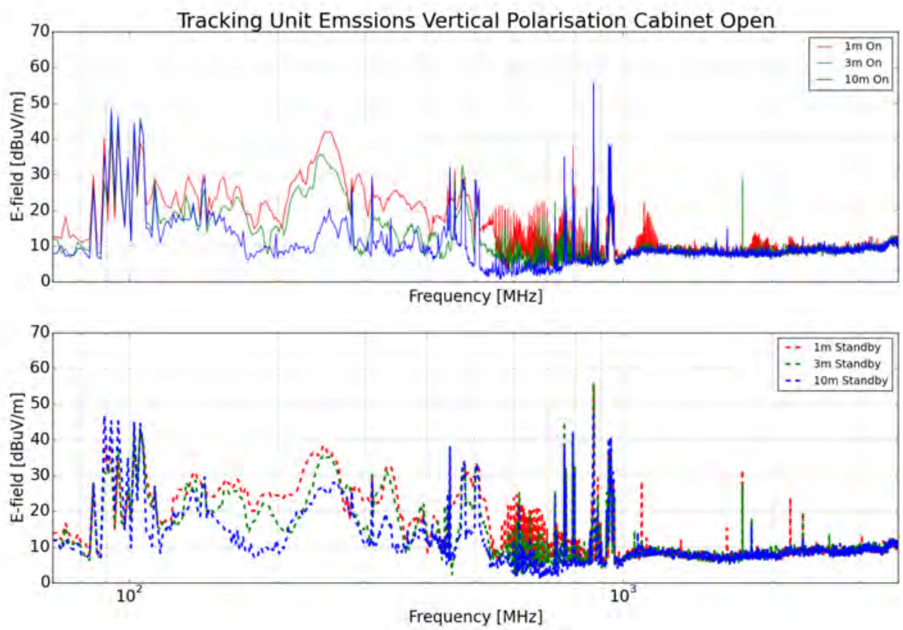


Figure 22: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **open**.

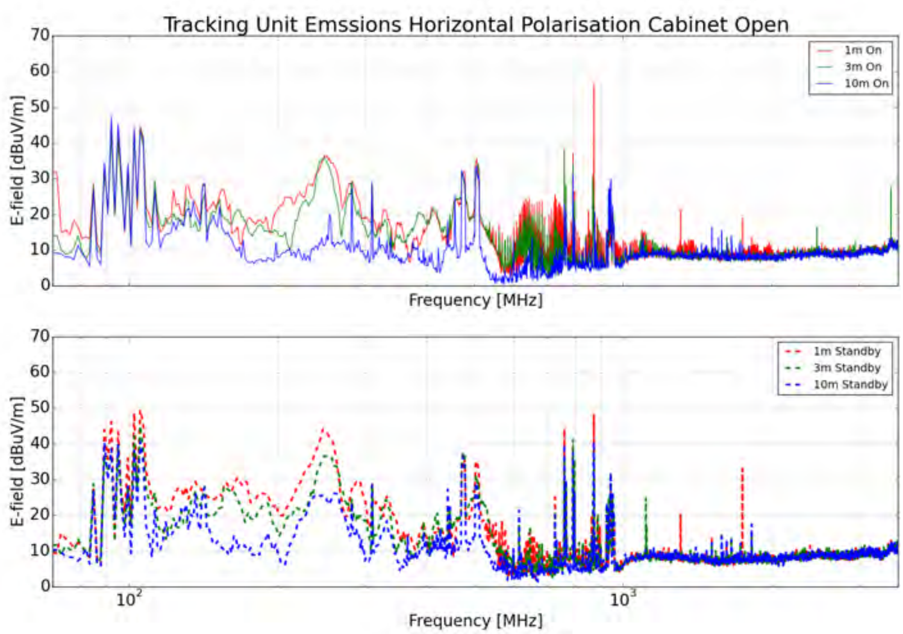


Figure 23: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **open**.

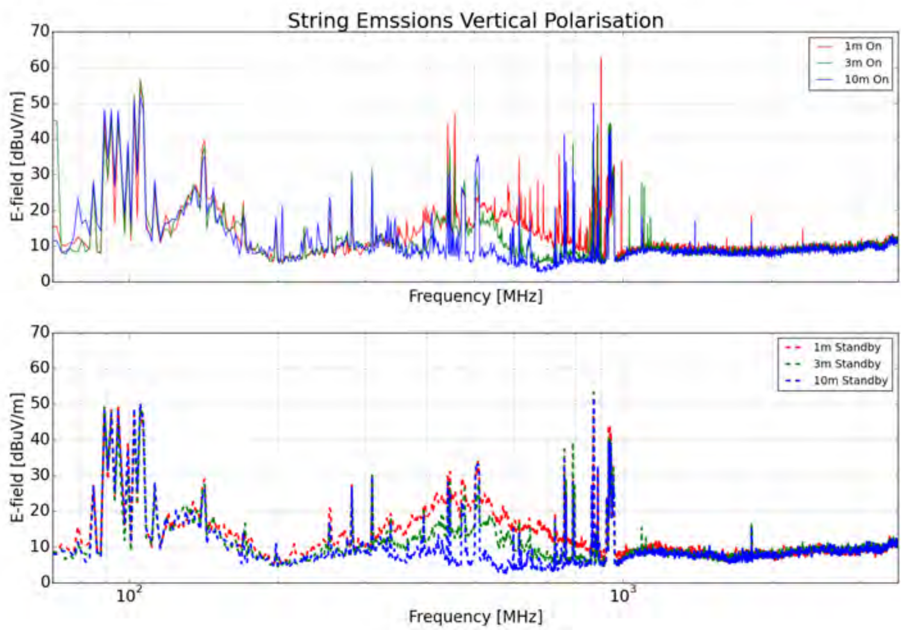


Figure 24: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the String Cabinet at Position 1 for both *ON* and *STANDBY* modes of operation.

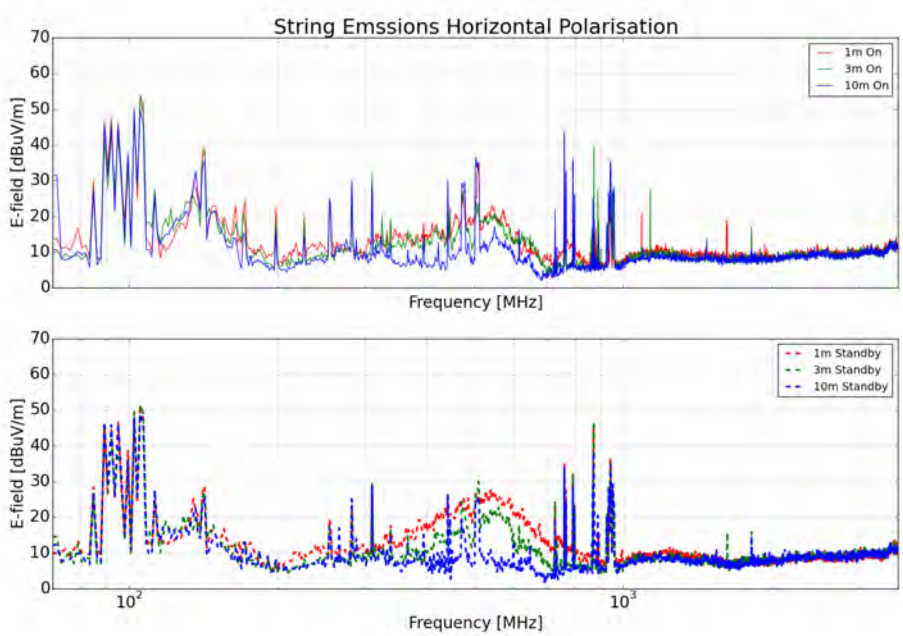
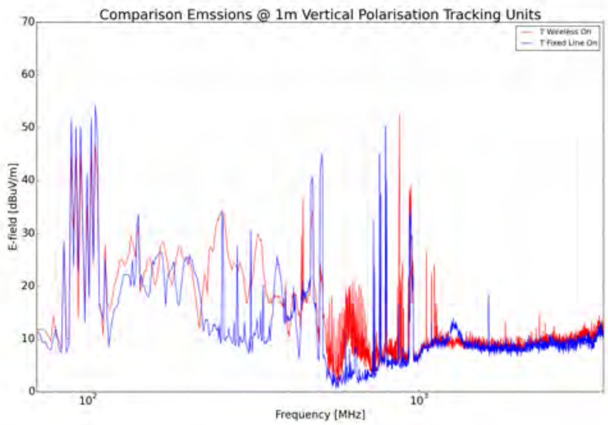
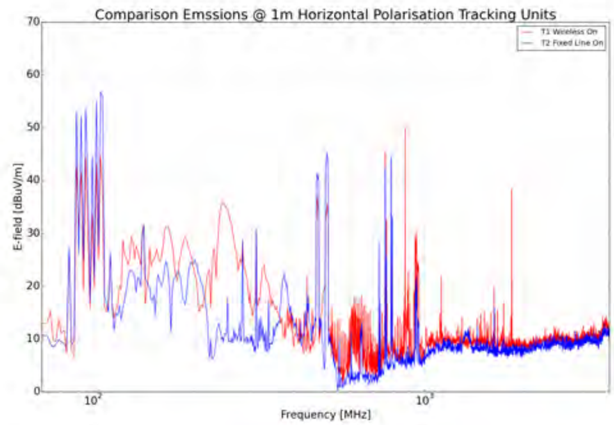


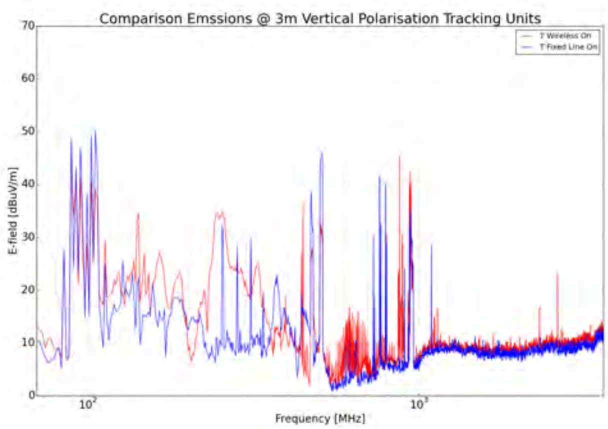
Figure 25: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the String cabinet at Position 1 for both *ON* and *STANDBY* modes of operation.



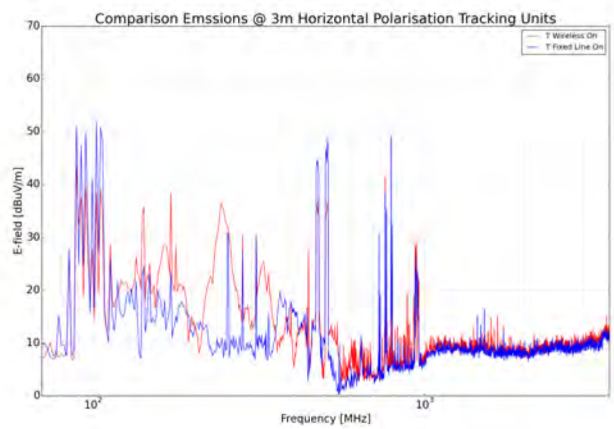
(a)



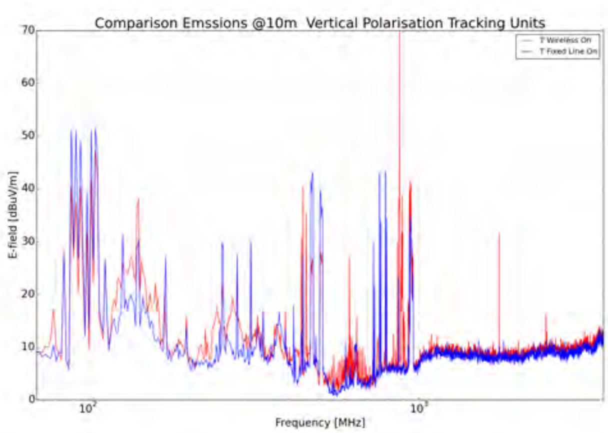
(b)



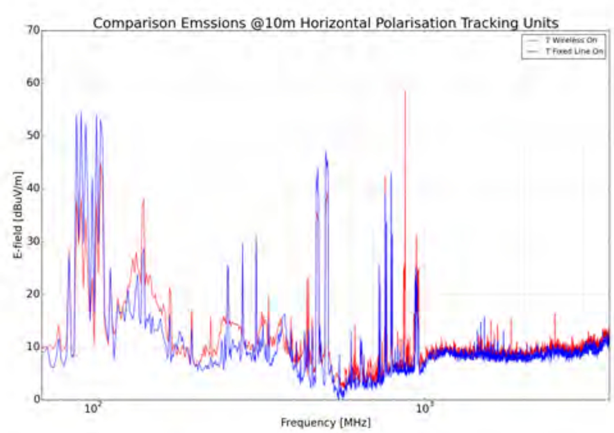
(c)



(d)



(e)



(f)

Figure 26: Comparison of radiated emissions measured for the Tracking Units at Position 1 and Position 2. Figures (a), (c) and (e) are for vertical polarisation at 1 m, 3 m, and 10 m and (b), (d) and (f) are for horizontal polarisation.

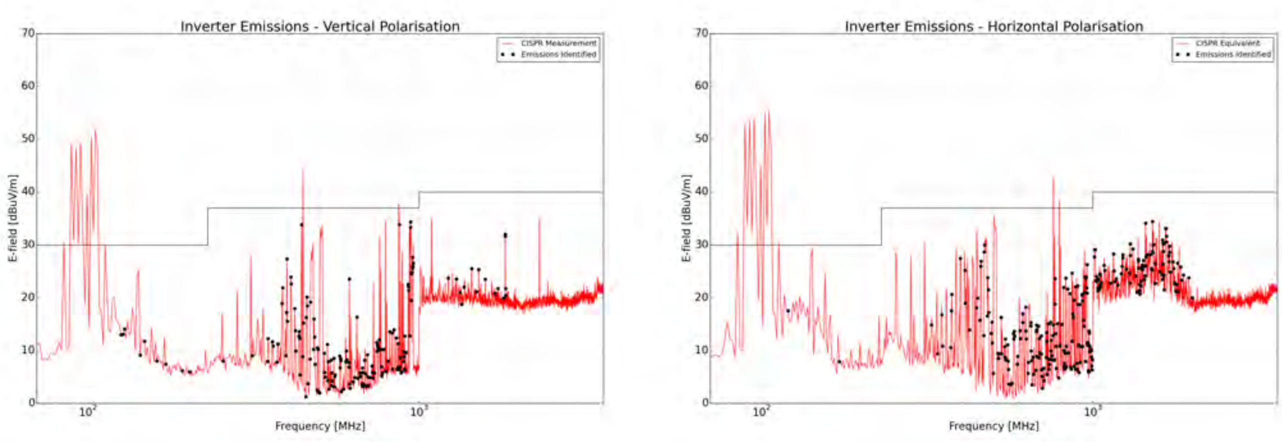
2.4.2 Interference Frequency Identification

Required for the subsequent propagation analysis are the maximum emission levels and associated frequencies identified to be generated by the plant. This is obtained by comparing emissions measured for the *Inverters*, *Tracking Units* and *String Cabinets* at 1, 3, and 10 m as discussed in Section 2.4. This is according to specifications in CISPR 11/22 Class B standard which is used as a well-known reference. It requires measurements at 3 m for frequencies above 1 GHz to use a 1 MHz RBW, and at 10 m below 1 GHz to use a 120 kHz RBW. The comparison to CISPR 11/22 Class B standard will subsequently be related to protection and saturation levels as specified by SKA-SA in [2].

To identify emissions generated by the plant, differences in measured levels at 1 m and 10 m are compared to the expected 20 dB free space path loss. However, from variations observed in the results in Section 2.4 due to the complex reflective environment, the 20 dB reduction was relaxed to 10 dB. The subsequent identified frequencies were then used in a second comparison of emissions measured at 3 m and 10 m, for which levels are expected to reduce by 10.46 dB. Again, considering the typical reduction seen in the radiated results, this criteria was relaxed to a 3 dB variation. All comparisons were were done using measurements made with a 100 kHz RBW, but the resulting frequency list in each case was used to identify the correct emission levels at 10 m for frequencies below 1 GHz (100 kHz RBW) and at 3 m for frequencies above 1 GHz (1 MHz RBW).

The results in Figs. 27 to 30 show both the total measured spectrum according to CISPR 11/22 Class B requirements as well as the plant-generated emissions using the search criteria just described for the *Inverters*, *Tracking Units* at both positions and *String Cabinet*. Included for reference purposes is the CISPR 11/22 Class B limit.

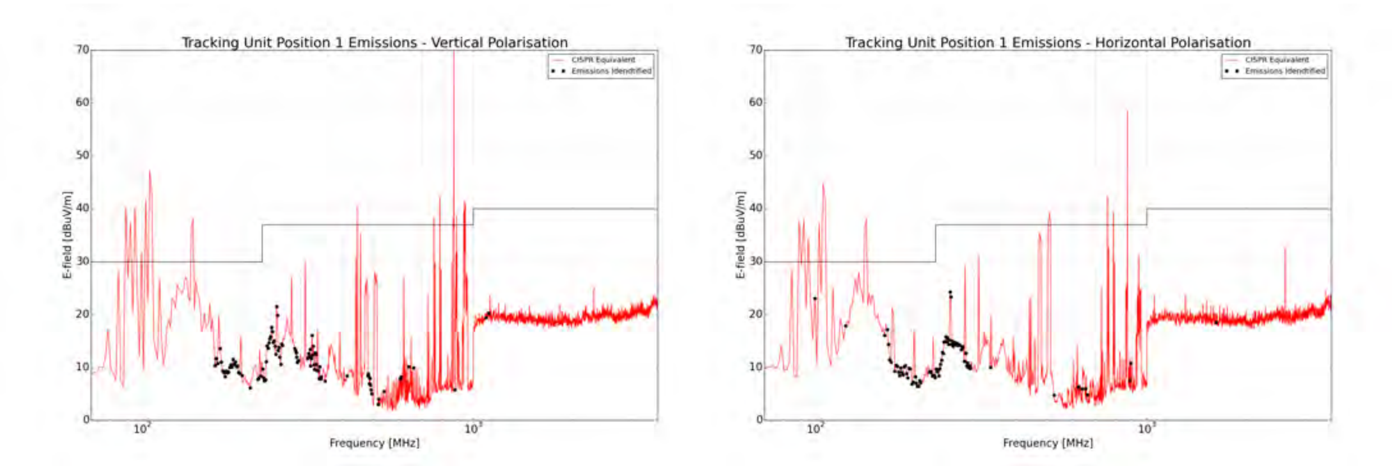
Inverters 22 and 23 Position 1



(a) (b)

Figure 27: Inverter radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

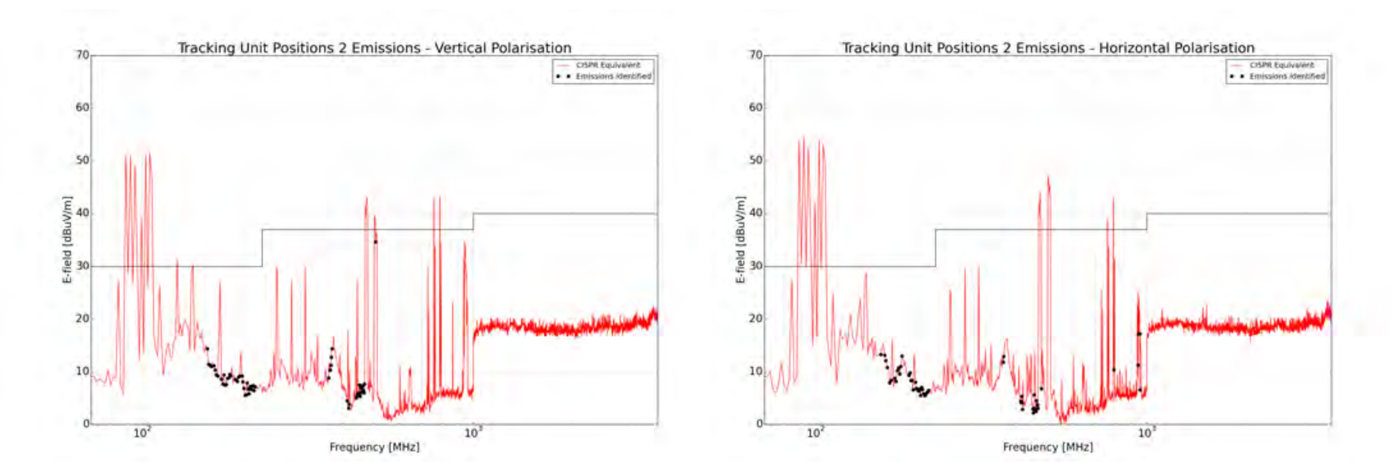
Tracking Unit Position 1



(a) (b)

Figure 28: Tracking Unit at Position 1 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

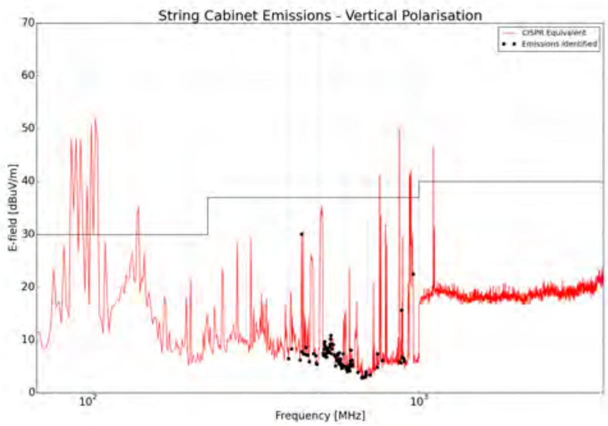
Tracking Unit Position 2



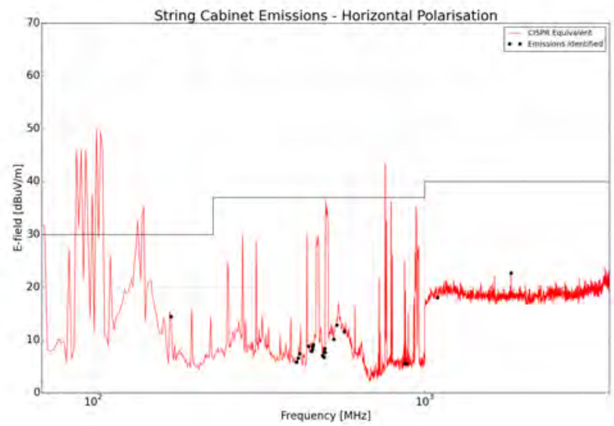
(a) (b)

Figure 29: Tracking Unit at Position 2 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisation.

String Cabinet



(a)



(b)

Figure 30: String Cabinet at Position 1 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

2.4.3 CM Current and Radiated Emission Comparison

When comparing radiated with conducted FD results we make use of the identified peaks for the Position 1 *Tracking Unit* emissions presented in Fig. 28, but only focus on frequencies between 230 MHz and 1 GHz. The radiated results will be compared to conducted interference measured on the pressure switch cable shown in Fig. 9. Similarities can be seen in the narrowband conducted interference between 500 MHz and 700 MHz. The broadband conducted interference measured on the cable between 100 MHz and 300 MHz can be seen to exceed the equivalent CM current limit and should therefore produce radiated interference also exceeding the limit if a resonant cable length exist. With the majority of cables running below ground, however, this seem to attenuate resonant effects at the longer wavelengths and therefore do not radiate efficiently. Table 4 gives a comparison of the five frequencies identified in Fig. 28 between 500 MHz and 700 MHz.

The results in brackets are the difference between the measured level and theoretical 13.98 dBμA for conducted CM current interference, and 37 dBμV/m for E-field levels		
Frequency [MHz]	**CM Current [dBμA]**	**E-field V-pol [dBμV/m]**
536	-11.74 (-25.72)	5.4 (-31.6)
599	-9.5 (-23.47)	7.7 (-29.3)
603	-7.92 (-21.89)	8.1 (-28.9)
636	-8.31 (-22.28)	10.16 (-26.84)
660	9.98 (-27.02)	-8.81 (-22.78)

Table 4: Comparison of conducted and radiated emission levels based on theoretically predicted levels for the Tracking Unit at Position 1.

A second comparison between conducted and radiated interference is shown Table 5 for the communication cable of the *Tracking Unit* at Position 2. For this comparison the identified radiated emissions, shown in Fig. 29 between 230 MHz and 1 GHz, were again used. In some cases the identified frequencies give measured levels close to or on the noise floor of the instrument. These were therefore not considered as they might not be accurate in amplitude.

The results in brackets are the difference between the measured level and theoretical 13.98 dBμA for conducted CM current interference, and 37 dBμV/m for E-field levels		
Frequency [MHz]	**CM Current [dBμA]**	**E-field V-pol [dBμV/m]**
373	5.05 (-8.93)	14.33 (-22.67)
451	1.59 (-12.39)	7.49 (-29.51)
459	2.02 (-11.96)	7.3 (-29.7)
506	13.20 (-0.78)	35.1 (-1.9)

Table 5: Comparison of conducted and radiated emission levels based on theoretically predicted levels for the Tracking Unit at Position 2.

It is clear that for measurements at both positions, significant levels of low frequency broadband interference visible between 100 MHz and 300 MHz do not radiate very efficiently. They exceed the equivalent current limit as indicated, but do not produce radiated interference that exceed the indicated CISPR 11/22 Class B limit by the same amount. For the *Tracking Unit* at Position 1 the results in Table 4 show better agreement between conducted and equivalent radiated levels (taking into account the reflective environment for frequencies between 500 MHz and 700 MHz). The difference in measured levels compared to the limits for both conducted and radiated interference are within an acceptable margin. This confirms that this interference originates at the *Tracking Unit* and associated systems.

The measurements of the *Tracking Unit* at Position 2, which incorporates the fixed line communication, again show significant levels of low-frequency conducted interference with reduced levels between 500 MHz and 700 MHz. In this case, however, none of the spectral content in the CM results seem to radiate efficiently when considering the levels in Table 5. Only at 506 MHz is there acceptable correlation with no frequencies identified beyond this point. The results therefore confirm that while high levels of conducted CM current are present at both positions, they are not efficiently converted to radiated interference. High frequency conducted noise is less for the fixed line communication and therefore are not being radiated.

2.4.4 Time Domain Measurements

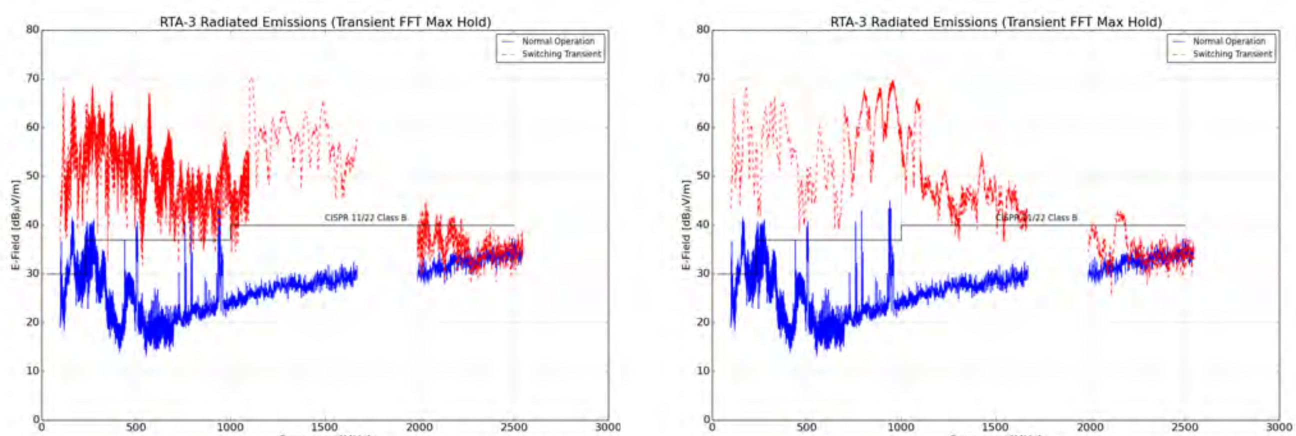
Tracking Units Position 1 and Position 2

A big concern is the switching noise generated every time the plant starts tracking. The system makes use of hydraulic rams which is operated by a small hydraulic pump located inside the hydraulic fluid reservoir located on top of each ram. The reservoir, a fully metallic enclosure, provides some level of attenuation of radiated interference generated by the pump. A cable still supplies the pump with power through a hole on top of the reservoir, but this can be mitigated.

A bigger contributor to transient interference is the switching contactor that operates the pump. An arcing effect can clearly be seen each time the pump switches on and off, and this produces wideband interference. Measurements were made at Position 1 and 2 as shown in Fig. 31. Typical spectrums when the plant is tracking compared to when it is stationary are shown in Fig. 32 (a) and (b) for vertical and horizontal polarisation respectively.

Peak level for measurements conducted at Position 1 are between 60 and 70 dBμV/m as measured at 1 m. This will however be influenced by likely near-field coupling. Transforming these levels to 10 m using the free space propagation loss, and accounting for a difference in RBW between the sweeping analyser and RTA-3 of approximately 7 dB, produce levels between 33 and 43 dBμV/m @ 10 m. A comparison with identified interference for the *Tracking Unit* at Position 1, given in Fig. 28, show higher levels in the TD. It should be considered that a sweeping analyser is inefficient at capturing transient events. The significance of these results should be the broadband nature of the interference.

Figure 31: Radiated time domain measurements of Tracking unit.



(a) (b)

Figure 32: Time domain radiated interference associated with the switching of the hydraulic pump to move the panels. The results can be seen for the system operating and stationary for (a) vertical polarisation and (b) horizontal polarisation as measured at Position 1.

A second measurement was done for the *Tracking Unit* at Position 2 making use of a fixed line communication. The radiated measurements were, however, made at a separation distances of 10 and 30 m to determine how efficiently the interference propagate with distance. This was again done with the system tracking and stationary, and the results are shown in Fig. 33. The absence of a trace for the system tracking below is because no reliable triggering of of interference from the plant could be established.

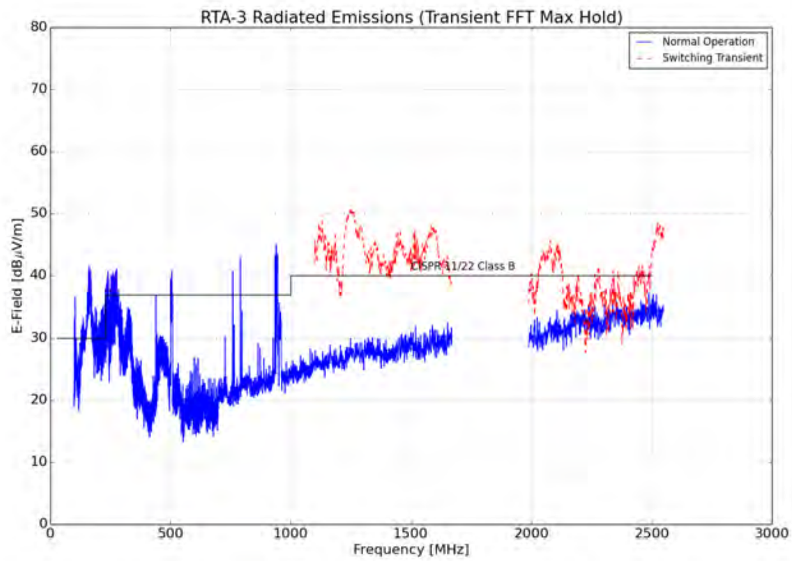


Figure 33: Time domain radiated interference associated with the switching of the hydraulic pump to move the panels. The results can be seen for the system operating and stationary for vertical polarisation as measured at Position 2.

2.5 Electric Fence Measurements

A radiate time domain pulse produced by a loose wire on the electric fence surrounding the PV plant (Fig. 36) are shown in Fig. 34. The equivalent FFT spectrum is given in Fig. 35.

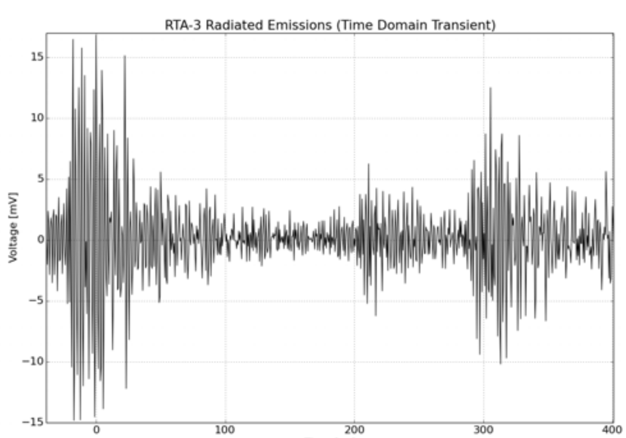


Figure 34: Radiated time domain pulse measured for a loose wire of the electric fence.

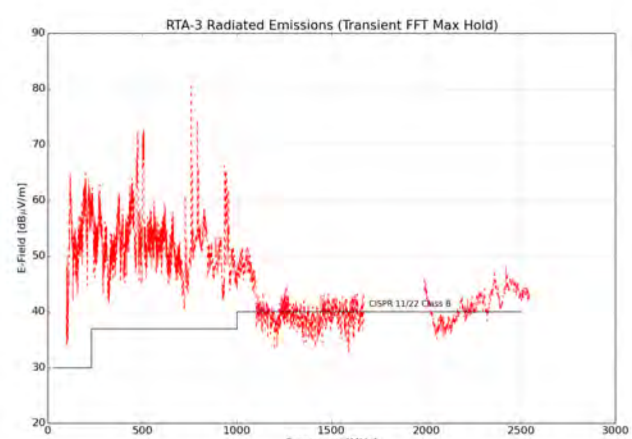


Figure 35: Equivalent Fast Fourier Transform spectrum for the radiated interference associated with a sparking electric fence.

Figure 36: Electric fence surrounding the perimeter of the Dreunberg PV plant.

Significant interference above the CISPR 11/22 Class B limit can be seen. While this is not directly associated with the operation of the plant, it will likely also be built on the proposed sites and could produce problematic levels of broadband interference.

2.6 Administration Building Emissions

An additional measurement of possible RFI culprits located at the Administration building (Fig. 37) were measured and the result is shown in Fig. 38. The results from this investigation are not meant to be comprehensive as it is unclear whether an Administration building will ultimately be built on the proposed site locations. This does, however, show some of the interference typically associated with such a building.

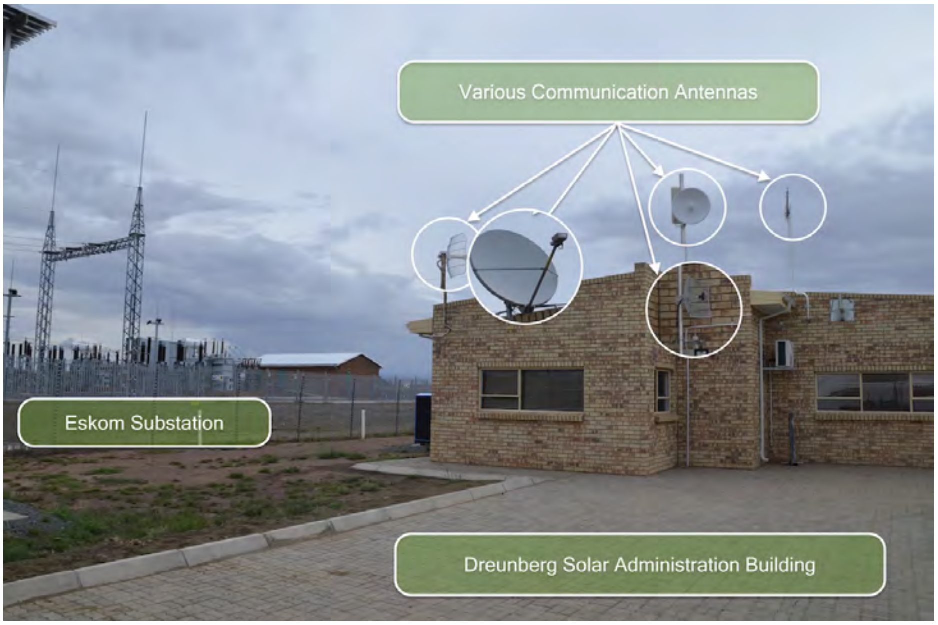


Figure 37: Administration building with potential RFI culprits

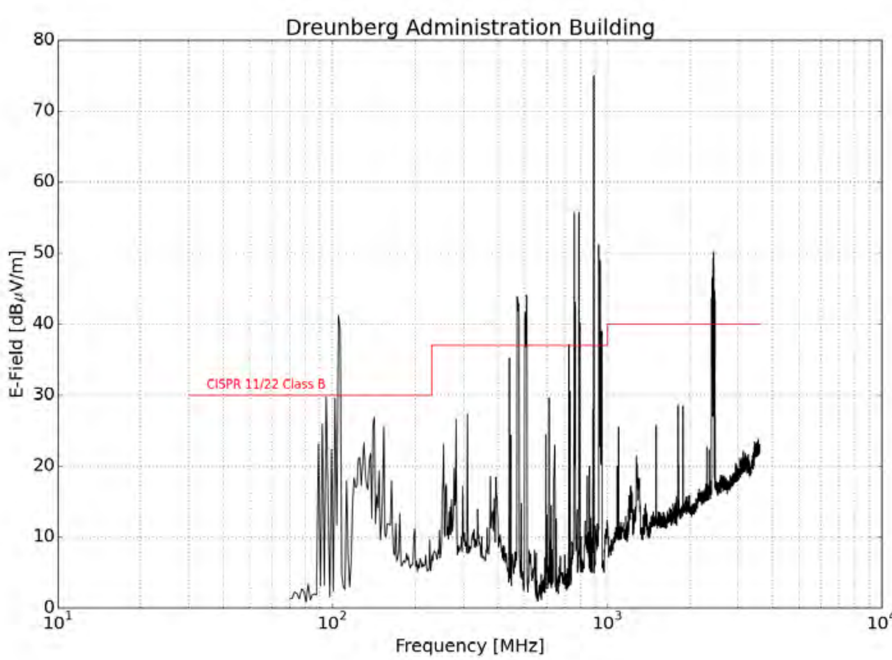


Figure 38: Radiated frequency domain emissions of the Administration building as measured at 10 m.

2.7 Discussion

2.7.1 Conducted Measurements

TD conducted measurements on supply cables to the *Tracking Unit* at Position 1 show large pulses when the plant is *ON*. When considering the FD content of these captured TD pulses (by applying the FFT), the majority of the energy extends up to at least 500 MHz. Equivalent FD measurements, particularly on the wireless antenna and pressure switch cables, agree with this, and additionally show trace peaks at frequencies around 150 MHz and 250 MHz. The higher frequencies seem to radiate into the environment more efficiently as confirmed by comparison with radiated results.

Conducted measurements, again made on the *Tracking Unit* at Position 2, still show significant levels of low frequency interference, but less higher frequency noise. This would indicate that the majority of the noise is likely to be in the vicinity of the inverter. The *Tracking Unit* emissions are somewhat aggravated by the wireless communication method. This is again confirmed with the radiated measurements.

Switching noise associated with the tracking of the panels, which were measured as conductive interference on cables connected to the *Tracking Unit* creates broadband interference. This happens both when the tracking pump switches *ON* and produces multiple pulses when it switches *OFF*. While some of the interference could be generated by the hydraulic pump, the majority is believed to be generated by the pump contactor.

2.7.2 Radiated Measurements

Radiated results for the plant *ON* and in *STANDBY* mode generally show similar emissions levels, confirming that interference producing systems are never completely *OFF*. Emissions associated with the *Inverter* units are dominant and occupy frequencies between 300 MHz and 2 GHz. Peak levels identified range between 30 - 35 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz for both polarisations.

Results for the *Tracking Unit* measured at Position 1 (wireless communication) show dominating frequencies around 250 MHz, with some additional components identified between 500 MHz and 1 GHz. Peak levels are again similar for both polarisations and are lower than *Inverter* emissions at 20 - 25 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz. In the case of emissions measured for the *Tracking Unit* at Position 2 (fixed line communication), broadband interference are present between 200 MHz and 300 MHz, and narrowband interference visible between 500 MHz and 700 MHz. Levels are lower by at least 10 dB, but this is only because of the limit in measurement sensitivity at 10 m. The results in Figs. 29 (a) and (b) show levels for many of the identified interference which are close to the measurement noise floor. Their exact levels can therefore be lower if sensitivity is improved. It shows that for purposes of RFI mitigation, the fixed line communication would be the preferred implementation.

The *String Cabinet* shows mostly broadband interference between 300 MHz and 800 MHz for both polarisations. Identified levels are again close to the measurement noise floor, with an exception at 440 MHz. The levels there are 30 dBμV/m.

Comparative measurements made with the doors to the *Inverters* and *Tracking Units* open not only helps to identify interference generated by the plant, but also show the limited levels of shielding provided by these enclosures. It is therefore possible to improve the shielding by incorporating conductive gasketting around the edges of the door and properly defining cable interfaces. This will help to reduce the level of radiated interference emitted by the devices. Radiated TD measurements of the *Tracking Units* at Position 1 and 2 show broadband interference across the 3.6 GHz frequency range. Levels of between 33 and 43 dBμV/m can be expected at 10 m. The main contributor is believed to be the switching relays and contactor inside the *Tracking Cabinet*. This, however, can be improved by proper shielding of the cabinet interfaces and apertures.

3 Site Location Data

The proximity of the proposed PV plant locations to the closest and core-site SKA telescopes are shown in Figs. 39 to 49, while separation distances, azimuth angles, transmitter and receiver heights for preferred and alternative site locations are given in Tables 6 to 24.

3.1 Scatec PV1, PV2 and PV3

Scatec PV1 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	20.92 km	56.60 km	169.79 km
Azimuth	86.21 ^{o}	163.45 ^{o}	173.55 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

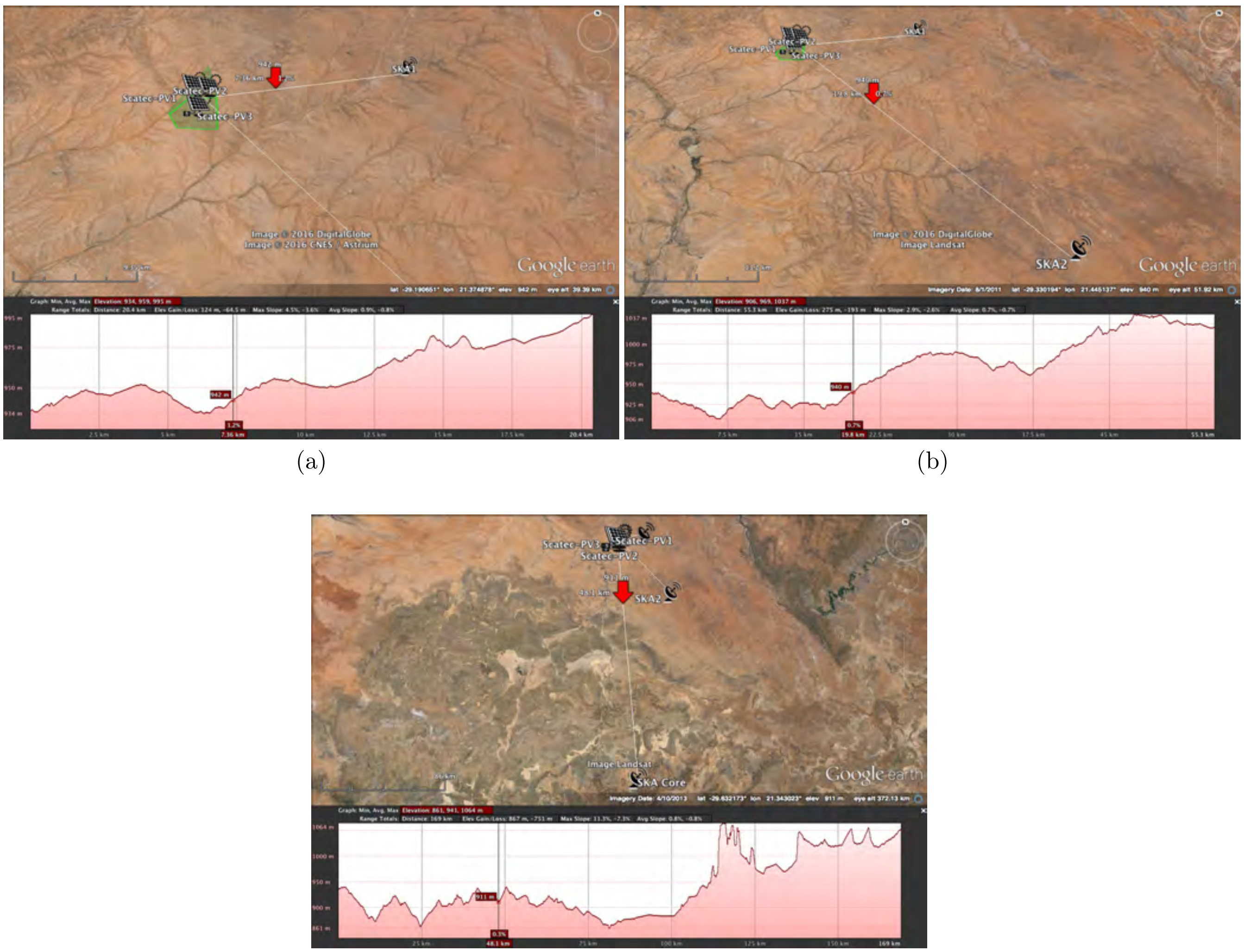
Table 6: Specifications of location Scatec PV1 solar farm relative to the SKA core and closest telescopes.

Scatec PV2 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.43 km	55.30 km	169.33 km
Azimuth	83.77 ^{o}	163.86 ^{o}	174.24 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 7: Specifications of location Scatec PV2 solar farm relative to the SKA core and closest telescopes.

Scatec PV3 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	20.57 km	54.09 km	167.02 km
Azimuth	75.12 ^{o}	162.75 ^{o}	173.91 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 8: Specifications of location Scatec PV3 solar farm relative to the SKA core and closest telescopes.

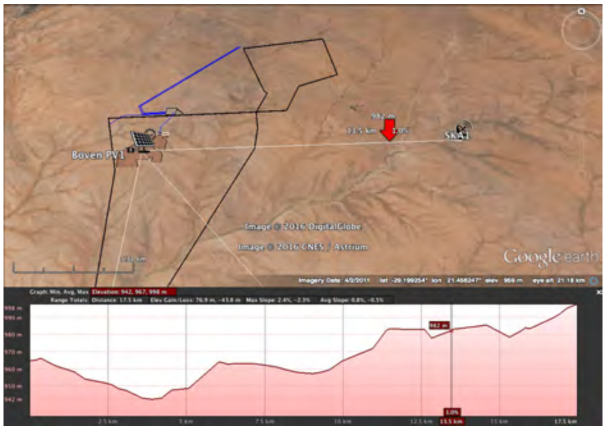


(a) (b)

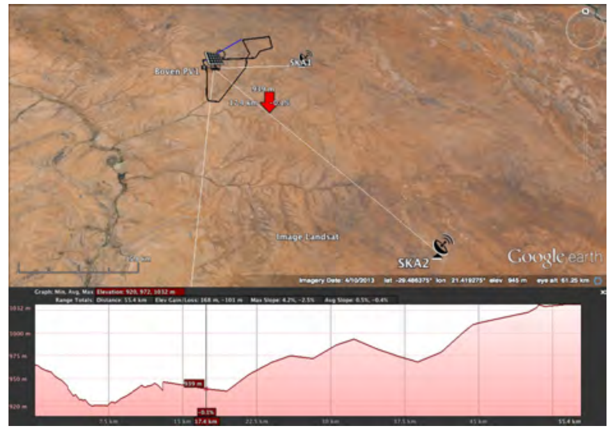
(c)

Figure 39: Google Earth terrain profile for Scatec PV1 to PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

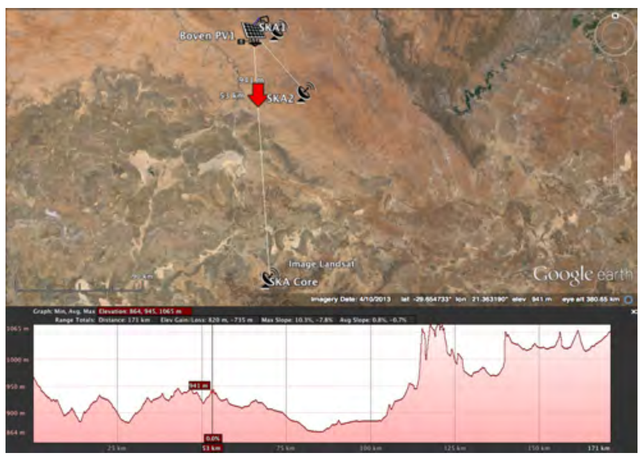
3.2 Boven PV1



(a)



(b)



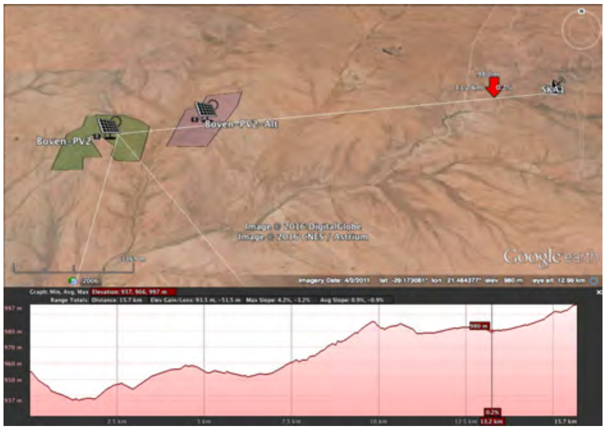
(c)

Figure 40: Google Earth terrain profile for Boven PV1 to (a) closest and (b) second closest and (c) core SKA telescopes.

Boven PV1	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	17.37 km	55.45 km	171.10 km
Azimuth	90.92 ^{o}	165.13 ^{o}	175.10 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 9: Specifications of location Boven PV1 solar farm relative to the SKA core and closest telescopes.

3.3 Boven PV2



(a)

(b)

(c)

Figure 41: Google Earth terrain profile for Boven PV2 to (a) closest and (b) second closest and (c) core SKA telescopes.

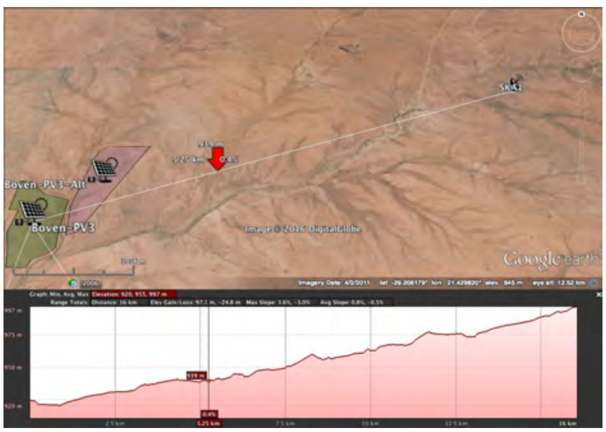
Boven PV2 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.00 km	52.46 km	169.08 km
Azimuth	80.68 ^{o}	140.60 ^{o}	177.13 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 10: Specifications of **preferred** location Boven PV2 solar farm relative to the SKA core and closest telescopes.

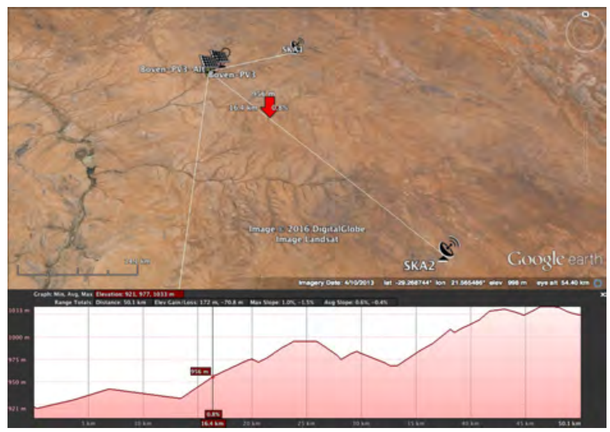
Boven PV2 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	12.52 km	52.07 km	170.30 km
Azimuth	84.93 ^{o}	143.50 ^{o}	177.93 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 11: Specifications of **alternative** location Boven PV2 solar farm relative to the SKA core and closest telescopes.

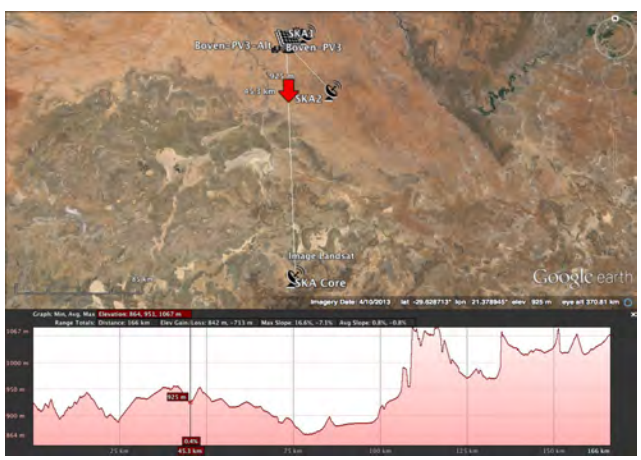
3.4 Boven PV3



(a)



(b)



(c)

Figure 42: Google Earth terrain profile for Boven PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

Boven PV3 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.69 km	50.06 km	166.01 km
Azimuth	69.50 ^{o}	138.46 ^{o}	177.11 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 12: Specifications of **preferred** location Boven PV3 solar farm relative to the SKA core and closest telescopes.

Boven PV3 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	13.79 km	50.41 km	167.63 km
Azimuth	73.94 ^{o}	140.96 ^{o}	177.63 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 13: Specifications of **alternative** location Boven PV3 solar farm relative to the SKA core and closest telescopes.

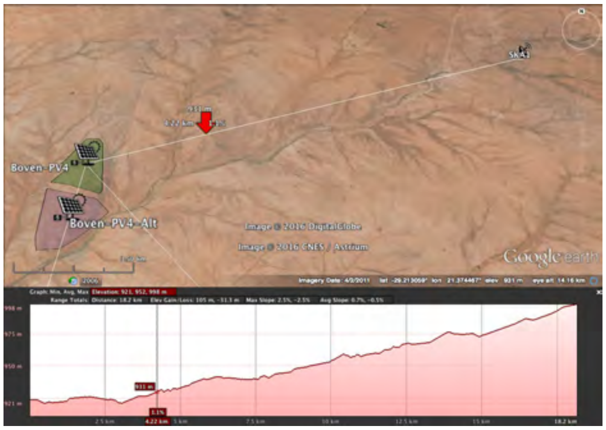
3.5 Boven PV4

Boven PV4 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	17.94 km	51.16 km	165.60 km
Azimuth	70.38 ^{o}	136.24 ^{o}	176.36 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

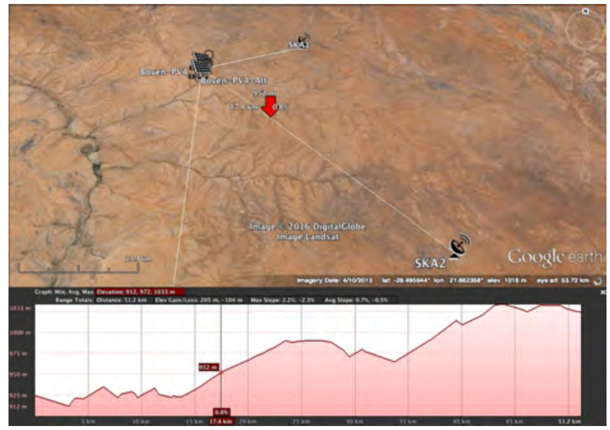
Table 14: Specifications of **preferred** location Boven PV4 solar farm relative to the SKA core and closest telescopes.

Boven PV4 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	18.72 km	49.62 km	163.48 km
Azimuth	64.21 ^{o}	134.58 ^{o}	176.32 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

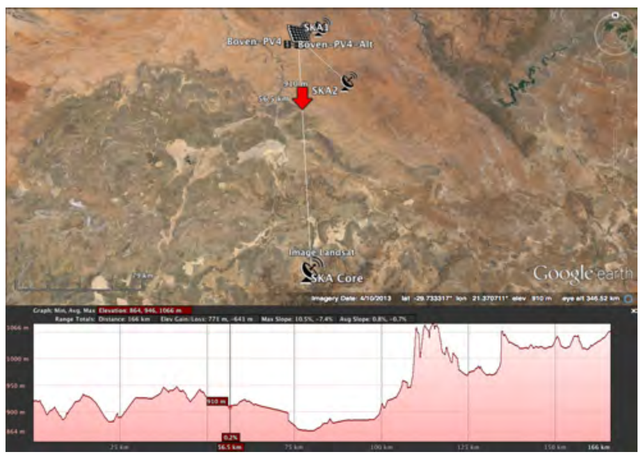
Table 15: Specifications of **alternative** location Boven PV4 solar farm relative to the SKA core and closest telescopes.



(a)



(b)



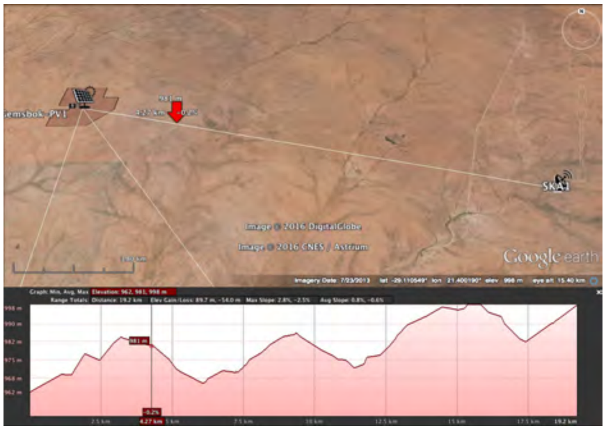
(c)

Figure 43: Google Earth terrain profile for Boven PV4 to (a) closest and (b) second closest and (c) core SKA telescopes.

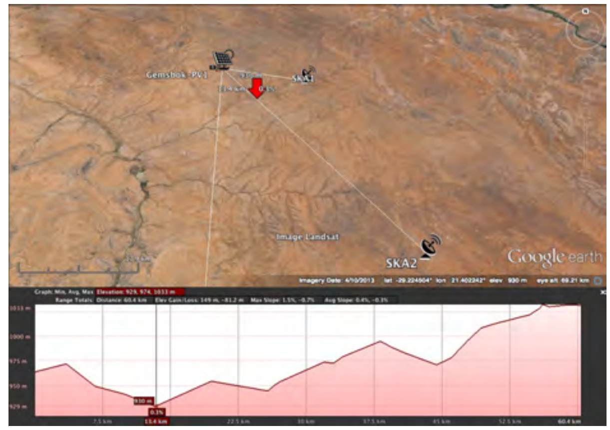
3.6 Gemsbok PV1

Gemsbok PV1	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.12 km	60.45 km	176.67 km
Azimuth	113.77 ^{o}	166.26 ^{o}	174.59 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 16: Specifications of location Gemsbok PV1 solar farm relative to the SKA core and closest telescopes.



(a)



(b)

(c)

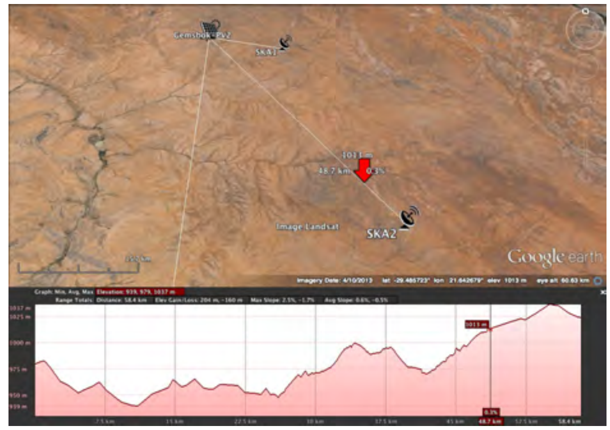
Figure 44: Google Earth terrain profile for Gemsbok PV1 to (a) closest and (b) second closest and (c) core SKA telescopes.

3.7 Gemsbok PV2

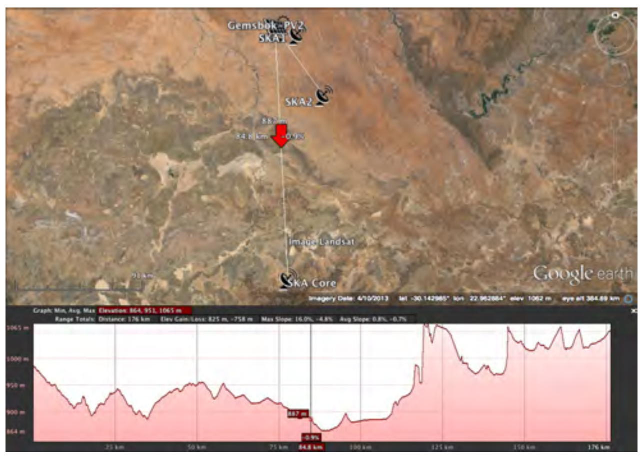
Gemsbok PV2	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	16.14 km	58.41 km	176.19 km
Azimuth	115.27 ^{o}	167.15 ^{o}	175.95 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 17: Specifications of location Gemsbok PV2 solar farm relative to the SKA core and closest telescopes.

(a)



(b)



(c)

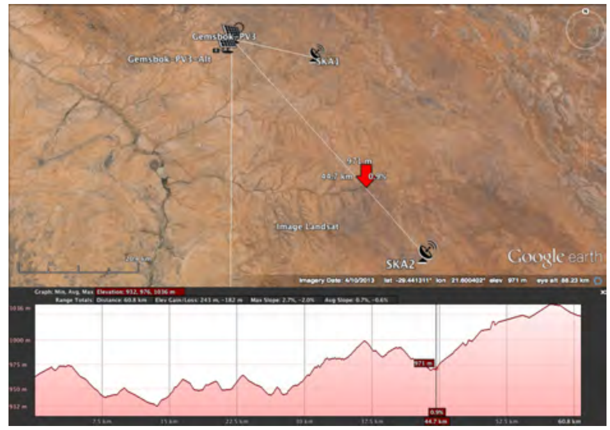
Figure 45: Google Earth terrain profile for Gemsbok PV2 to (a) closest and (b) second closest and (c) core SKA telescopes.

3.8 Gemsbok PV3

Gemsbok PV3 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.46 km	61.16 km	177.36 km
Azimuth	106.87 ^{o}	142.65 ^{o}	176.05 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 18: Specifications of **preferred** location Gemsbok PV3 solar farm relative to the SKA core and closest telescopes.

(a)



(b)

(c)

Figure 46: Google Earth terrain profile for Gemsbok PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

Gemsbok PV3 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.53 km	59.47 km	174.71 km
Azimuth	98.67 ^{o}	140.55 ^{o}	175.77 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 19: Specifications of **alternative** location Gemsbok PV3 solar farm relative to the SKA core and closest telescopes.

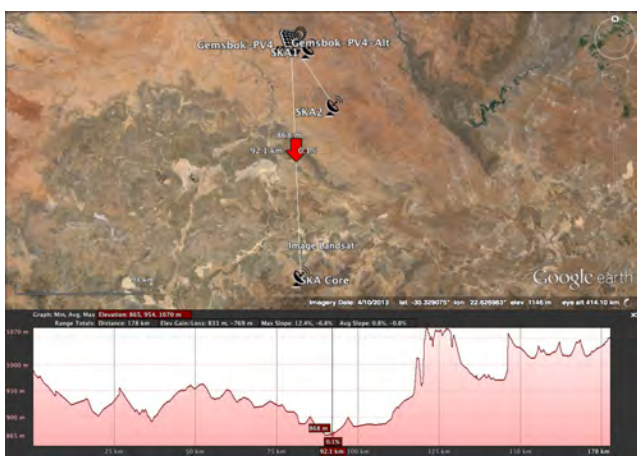
3.9 Gemsbok PV4

Gemsbok PV4 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.24 km	58.87 km	177.62 km
Azimuth	113.85 ^{o}	146.57 ^{o}	177.54 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 20: Specifications of **preferred** location Gemsbok PV4 solar farm relative to the SKA core and closest telescopes.

(a)

(b)



(c)

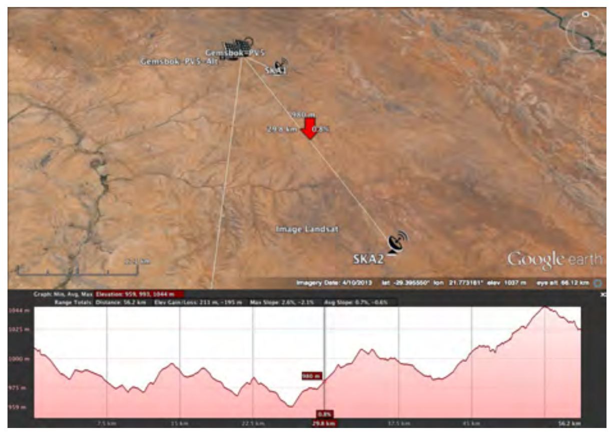
Figure 47: Google Earth terrain profile for Gemsbok PV4 to (a) closest and (b) second closest and (c) core SKA telescopes.

Gemsbok PV4 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.31 km	59.95 km	179.43 km
Azimuth	121.55 ^{o}	148.25 ^{o}	177.85 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 21: Specifications of **alternative** location Gemsbok PV4 solar farm relative to the SKA core and closest telescopes.

3.10 Gemsbok PV5

(a)



(b)

(c)

Figure 48: Google Earth terrain profile for Gemsbok PV5 to (a) closest and (b) second closest and (c) core SKA telescopes.

Gemsbok PV5 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	10.59 km	56.39 km	178.01 km
Azimuth	129.26 ^{o}	151.72 ^{o}	179.37 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 22: Specifications of **preferred** location Gemsbok PV5 solar farm relative to the SKA core and closest telescopes.

Gemsbok PV5 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	11.83 km	56.56 km	177.00 km
Azimuth	118.57 ^{o}	149.27 ^{o}	178.67 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 23: Specifications of **alternative** location Gemsbok PV5 solar farm relative to the SKA core and closest telescopes.

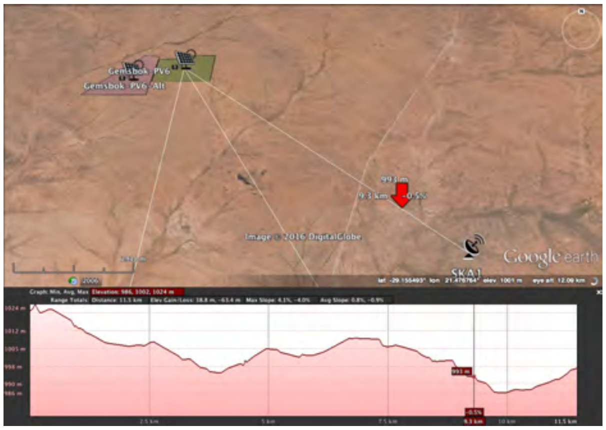
3.11 Gemsbok PV6

Gemsbok PV6 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	11.48 km	57.56 km	179.32 km
Azimuth	134.26 ^{o}	152.32 ^{o}	179.37 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 24: Specifications of **preferred** location Gemsbok PV6 solar farm relative to the SKA core and closest telescopes.

Gemsbok PV6 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	12.50 km	57.86 km	178.64 km
Azimuth	125.74 ^{o}	150.31 ^{o}	178.76 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 25: Specifications of **alternative** location Gemsbok PV6 solar farm relative to the SKA core and closest telescopes.



(a)

(b)

(c)

Figure 49: Google Earth terrain profile for Gemsbok PV6 to (a) closest and (b) second closest and (c) core SKA telescopes.

4 Signal Propagation Loss and Terrain Analysis

The default propagation analysis software used by MESA Solutions is called SPLAT!, which is a **S**ignal **P**ropagation, **L**oss **A**nd **T**errain analysis tool based on the *Longley-Rice Irregular Terrain Model (ITM)*, as well as the *Irregular Terrain With Obstructions Model (ITWOM 3.0)*. The software takes into account actual terrain elevation data, to ultimately predict the total path loss (TPL) between a transmitter and a receiver. As part of the analysis, certain assumptions are made regarding the source characteristics. For this investigation the various parameters defining the SPLAT! propagation model are listed in Table 26. The digital elevation model (DEM) makes use of 3-arc-second (90 m) elevation resolution data.

For this investigation, the frequency range of interest is defined from 100 MHz to 3 GHz. While the upper frequency limit of the standard in [2] is specified to at least 10 GHz, the span is limited to what is practically measurable and representative of the majority of expected interference. In the analysis the allowable SKA radiation limits defined by SARAS in citeAGA2007, including an additional 10 dB safety margin, are used as the reference level. This defines the maximum allowable levels of radiated interference than can be tolerated at the telescope.

This maximum level, which is given as a power spectral density (PSD) in dBm/Hz, is compensated for by the TPL as predicted by SPLAT!, to provide an equivalent PSD associated with the closest and core-site telescopes. This PSD for each case is then converted to an equivalent electric field (E-field) as measured at either 10 m (frequency $<$ 1 GHz) or 3 m (frequency $>$ 1 GHz) away from the plant. The 3 and 10 m separation distances is in accordance with measurement specifications defined in the latest international special committee on radio interference's (CISPR) 11/22 Class B standard. This standard is used for reference purposes as it is internationally know and used for industry qualification. This calculation is done for a number of representative frequencies within the band of interest and defines an E-field upper limit which the plant is allowed to radiate without exceeding emission limits at the various telescope locations. Ultimately, conformance of the plant can then be determined by comparing representative measured results to the calculated levels provided.

SPLAT! Analysis Parameters	
Frequency [MHz]	100 - 3000
Earth Dielectric Constant (Relative Permittivity [F/m])	4.000
Earth Conductivity [S/m]	0.001
Atmospheric Bending Constant	301
Radio Climate	4 (Desert)
Polarisation (Vertical=1; Horizontal=0)	1
Fraction of Time	0.05
Fraction of Situations	0.05

Table 26: SPLAT! parameters for predicted 100 MHz to 3 GHz emissions from proposed PV projects to SKA core and closest telescope.

5 Total Path Loss

Shown in Tables 27 to 45 are the values for the free space path loss (FSPL), terrain loss (TL), and total path loss (TPL) at each of the frequencies chosen for the investigation. The 0 dB TL at 100 MHz is a purely mathematical limitation of the software indicating a negligible contribution at that frequency over this particular terrain. The attenuation maps for 100, 1000, 2000 and 3000 MHz calculated at each of the site location are given in Figs. 50 to 69.

5.1 Scatec PV 1 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.85dB	25.85dB	**124.7dB**	107.5dB	32.55dB	**140.05dB**	117.04dB	41.49dB	**158.53dB**
300MHz	108.4dB	22.11dB	**130.51dB**	117.04dB	27.16dB	**144.2dB**	126.58dB	36.97dB	**163.55dB**
500MHz	112.83dB	21.54dB	**134.37dB**	121.48dB	27.13dB	**148.61dB**	131.02dB	38.31dB	**169.33dB**
1000MHz	118.85dB	22.67dB	**141.52dB**	127.5dB	30.64dB	**158.14dB**	137.04dB	42.46dB	**179.5dB**
1500MHz	122.37dB	24.04dB	**146.41dB**	131.02dB	33.55dB	**164.57dB**	140.56dB	44.38dB	**184.94dB**
2000MHz	124.87dB	25.12dB	**149.99dB**	133.52dB	35.96dB	**169.48dB**	143.06dB	45.72dB	**188.78dB**
2500MHz	126.81dB	25.97dB	**152.78dB**	135.46dB	37.92dB	**173.38dB**	145.0dB	46.77dB	**191.77dB**
3000MHz	128.4dB	26.75dB	**155.15dB**	137.04dB	39.58dB	**176.62dB**	146.58dB	47.63dB	**194.21dB**

Table 27: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV1 emissions.

5.2 Scatec PV 2 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.21dB	16.04dB	**114.25dB**	107.3dB	19.65dB	**126.95dB**	117.02dB	33.37dB	**150.39dB**
300MHz	107.75dB	10.55dB	**118.3dB**	116.84dB	13.63dB	**130.47dB**	126.56dB	33.87dB	**160.43dB**
500MHz	112.19dB	8.9dB	**121.09dB**	121.28dB	12.7dB	**133.98dB**	131.0dB	35.77dB	**166.77dB**
1000MHz	118.21dB	8.42dB	**126.63dB**	127.3dB	13.91dB	**141.21dB**	137.02dB	40.56dB	**177.58dB**
1500MHz	121.73dB	8.83dB	**130.56dB**	130.82dB	15.07dB	**145.89dB**	140.54dB	42.73dB	**183.27dB**
2000MHz	124.23dB	9.49dB	**133.72dB**	133.32dB	16.21dB	**149.53dB**	143.04dB	44.18dB	**187.22dB**
2500MHz	126.17dB	10.26dB	**136.43dB**	135.25dB	17.3dB	**152.55dB**	144.98dB	45.28dB	**190.26dB**
3000MHz	127.75dB	10.93dB	**138.68dB**	136.84dB	18.3dB	**155.14dB**	146.56dB	46.16dB	**192.72dB**

Table 28: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV2 emissions.

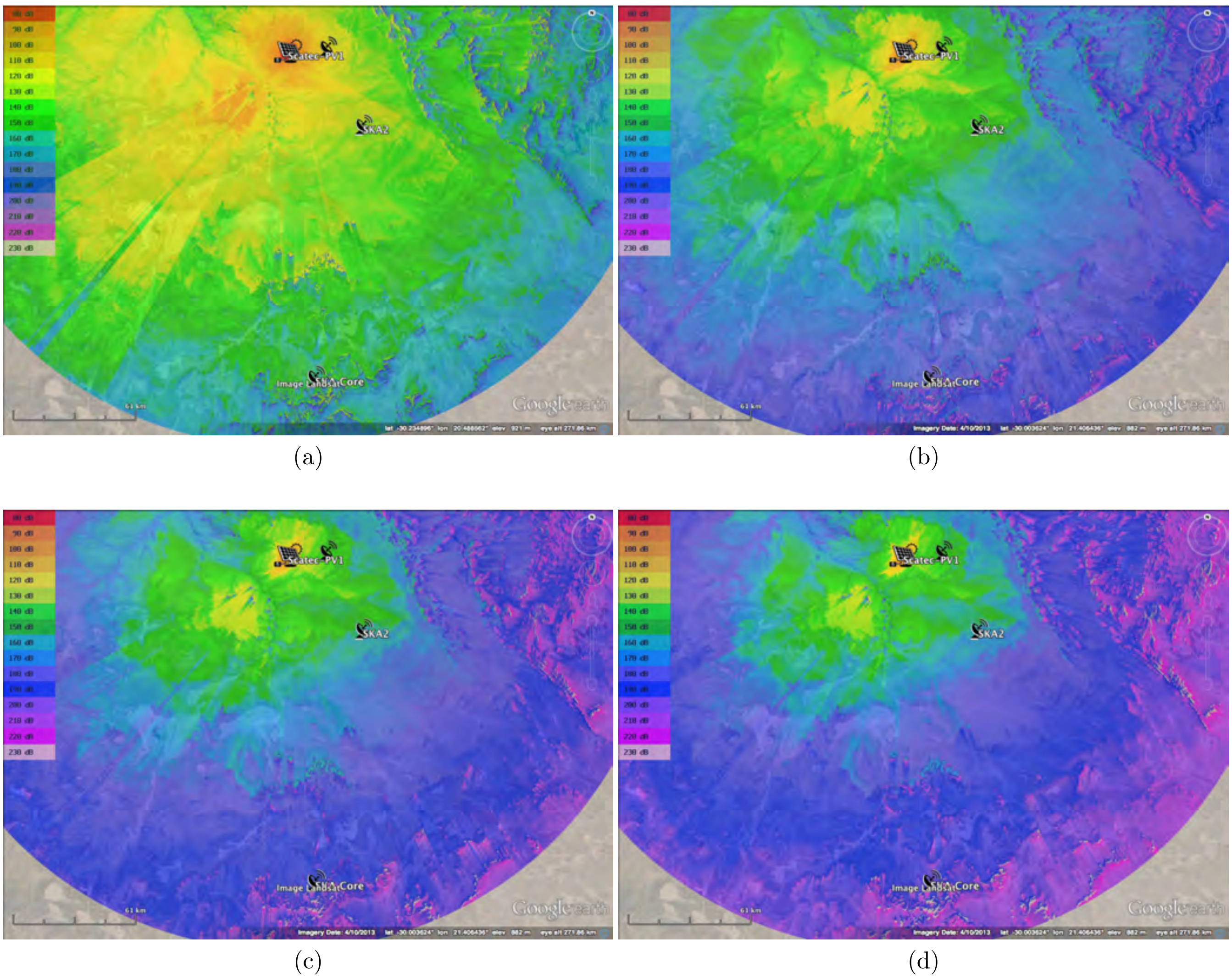
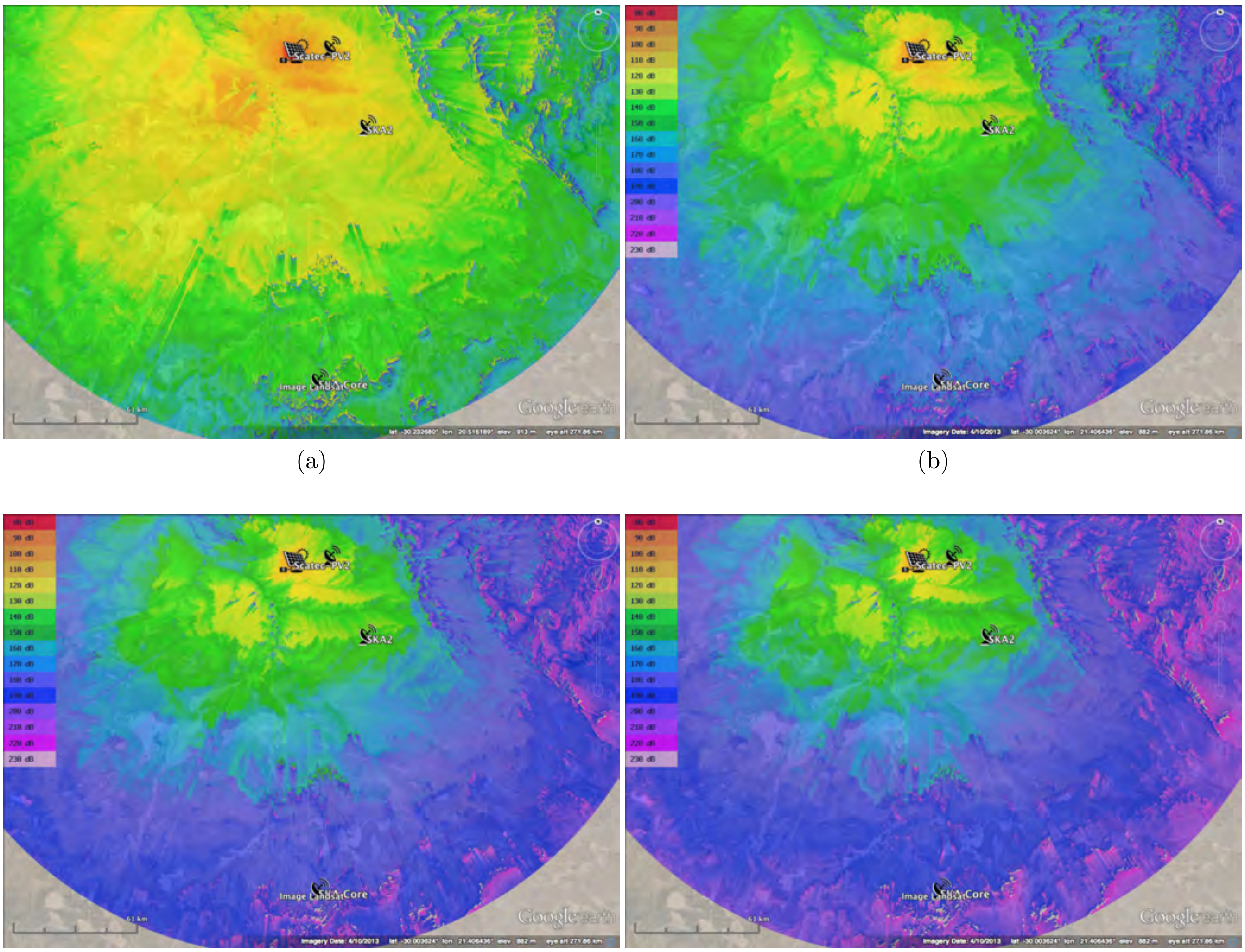


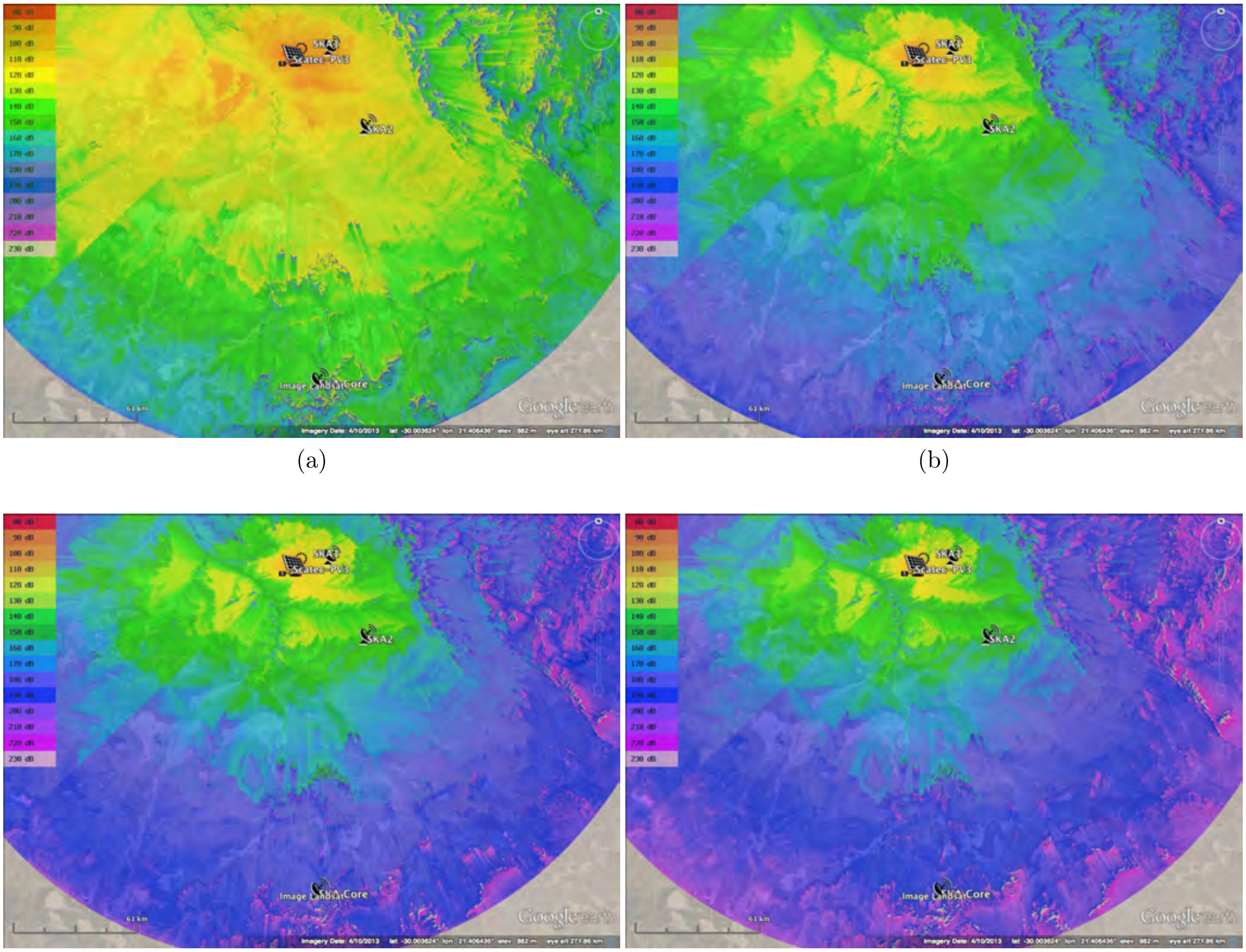
Figure 50: TPL attenuation maps for site location of Scatec PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 51: TPL attenuation maps for site location of Scatec PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.3 Scatec PV 3 Site Location



(a) (b) (c) (d)

Figure 52: TPL attenuation maps for site location of Scatec PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

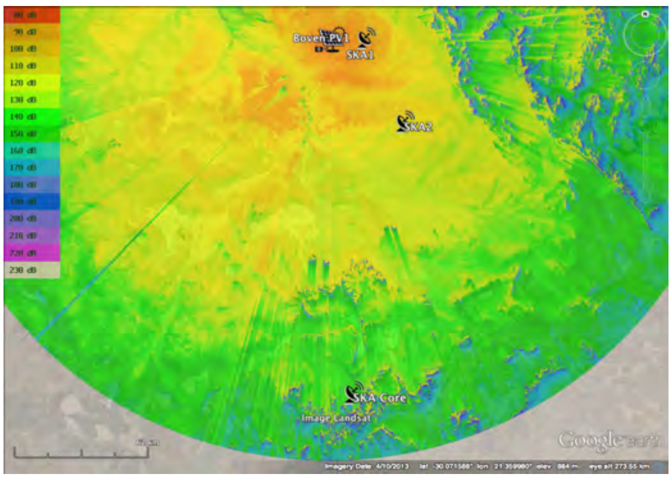
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.71dB	28.91dB	**127.62dB**	107.1dB	29.76dB	**136.86dB**	116.9dB	45.22dB	**162.12dB**
300MHz	108.25dB	27.45dB	**135.7dB**	116.65dB	22.96dB	**139.61dB**	126.44dB	41.0dB	**167.44dB**
500MHz	112.69dB	27.82dB	**140.51dB**	121.08dB	22.11dB	**143.19dB**	130.88dB	41.68dB	**172.56dB**
1000MHz	118.71dB	30.21dB	**148.92dB**	127.1dB	24.49dB	**151.59dB**	136.9dB	44.96dB	**181.86dB**
1500MHz	122.23dB	31.86dB	**154.09dB**	130.63dB	26.93dB	**157.56dB**	140.42dB	46.44dB	**186.86dB**
2000MHz	124.73dB	33.11dB	**157.84dB**	133.12dB	28.84dB	**161.96dB**	142.92dB	47.53dB	**190.45dB**
2500MHz	126.67dB	34.08dB	**160.75dB**	135.06dB	30.38dB	**165.44dB**	144.86dB	48.43dB	**193.29dB**
3000MHz	128.25dB	34.86dB	**163.11dB**	136.65dB	31.62dB	**168.27dB**	146.44dB	49.2dB	**195.64dB**

Table 29: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV3 emissions.

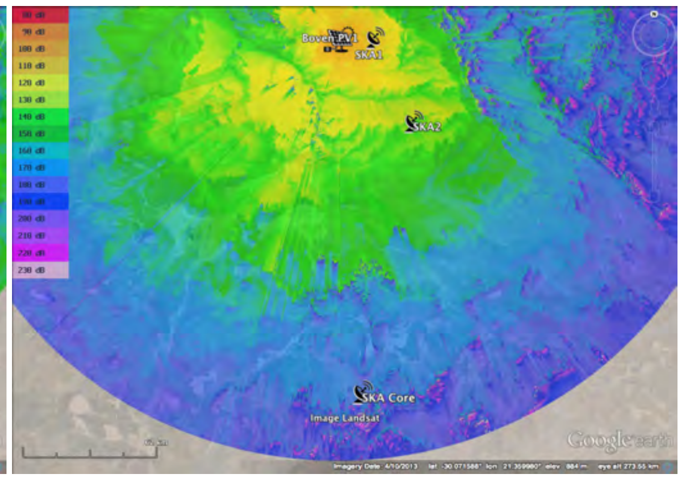
5.4 Boven PV1 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.24dB	7.21dB	**104.45dB**	107.32dB	17.22dB	**124.54dB**	117.11dB	28.82dB	**145.93dB**
300MHz	106.78dB	0.0dB	**106.78dB**	116.86dB	11.61dB	**128.47dB**	126.65dB	30.53dB	**157.18dB**
500MHz	111.22dB	0.0dB	**111.22dB**	121.3dB	10.71dB	**132.01dB**	131.09dB	33.05dB	**164.14dB**
1000MHz	117.24dB	0.0dB	**117.24dB**	127.32dB	11.7dB	**139.02dB**	137.11dB	38.43dB	**175.54dB**
1500MHz	120.76dB	0.0dB	**120.76dB**	130.84dB	12.67dB	**143.51dB**	140.63dB	40.79dB	**181.42dB**
2000MHz	123.26dB	0.0dB	**123.26dB**	133.34dB	13.63dB	**146.97dB**	143.13dB	42.36dB	**185.49dB**
2500MHz	125.19dB	0.0dB	**125.19dB**	135.28dB	14.53dB	**149.81dB**	145.07dB	43.52dB	**188.59dB**
3000MHz	126.78dB	0.0dB	**126.78dB**	136.86dB	15.39dB	**152.25dB**	146.65dB	44.46dB	**191.11dB**

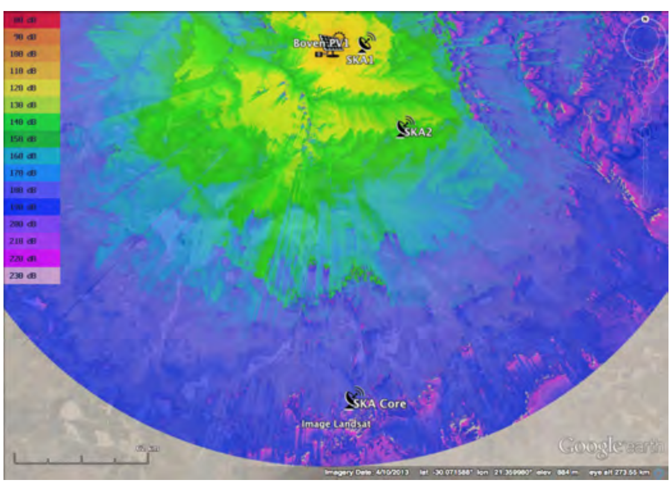
Table 30: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation site Boven PV1 emissions.



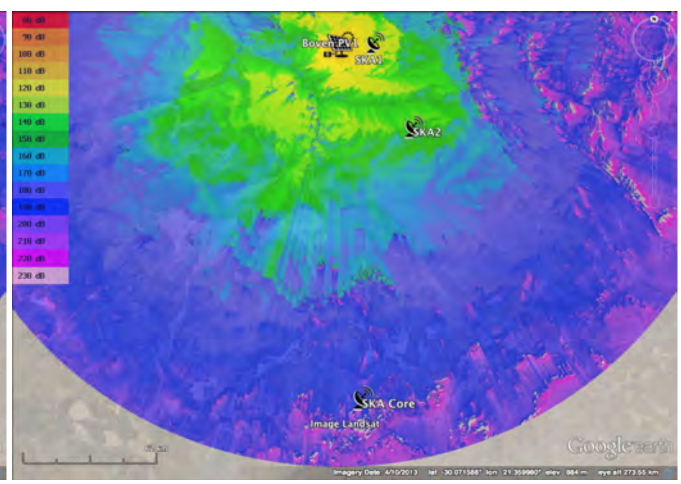
(a)



(b)



(c)



(d)

Figure 53: TPL attenuation maps for site location of Boven PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.5 Boven PV2 Site Location

5.5.1 Boven PV2 Preferred Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	96.35dB	9.89dB	**106.24dB**	106.96dB	19.16dB	**126.12dB**	117.03dB	28.24dB	**145.27dB**
300MHz	105.89dB	1.91dB	**107.8dB**	116.5dB	13.49dB	**129.99dB**	126.57dB	30.09dB	**156.66dB**
500MHz	110.33dB	0.0dB	**110.33dB**	120.94dB	12.54dB	**133.48dB**	131.01dB	32.71dB	**163.72dB**
1000MHz	116.35dB	0.0dB	**116.35dB**	126.96dB	13.45dB	**140.41dB**	137.03dB	38.18dB	**175.21dB**
1500MHz	119.87dB	0.0dB	**119.87dB**	130.48dB	14.41dB	**144.89dB**	140.55dB	40.57dB	**181.12dB**
2000MHz	122.37dB	0.0dB	**122.37dB**	132.98dB	15.38dB	**148.36dB**	143.05dB	42.15dB	**185.2dB**
2500MHz	124.31dB	0.0dB	**124.31dB**	134.92dB	16.31dB	**151.23dB**	144.99dB	43.32dB	**188.31dB**
3000MHz	125.89dB	0.0dB	**125.89dB**	136.5dB	17.18dB	**153.68dB**	146.57dB	44.26dB	**190.83dB**

Table 31: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV2 emissions.

5.5.2 Boven PV2 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	94.37dB	20.47dB	**114.84dB**	106.75dB	40.07dB	**146.82dB**	117.06dB	34.54dB	**151.6dB**
300MHz	103.91dB	16.13dB	**120.04dB**	116.29dB	36.53dB	**152.82dB**	126.61dB	38.39dB	**165.0dB**
500MHz	108.35dB	15.23dB	**123.58dB**	120.73dB	36.68dB	**157.41dB**	131.04dB	40.36dB	**171.4dB**
1000MHz	114.37dB	15.55dB	**129.92dB**	126.75dB	39.76dB	**166.51dB**	137.06dB	43.52dB	**180.58dB**
1500MHz	117.89dB	17.09dB	**134.98dB**	130.27dB	42.09dB	**172.36dB**	140.59dB	44.88dB	**185.47dB**
2000MHz	120.39dB	18.56dB	**138.95dB**	132.77dB	43.98dB	**176.75dB**	143.08dB	45.91dB	**188.99dB**
2500MHz	122.33dB	19.72dB	**142.05dB**	134.71dB	44.87dB	**179.58dB**	145.02dB	46.76dB	**191.78dB**
3000MHz	123.91dB	20.82dB	**144.73dB**	136.29dB	45.56dB	**181.85dB**	146.61dB	47.49dB	**194.1dB**

Table 32: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV2 emissions.

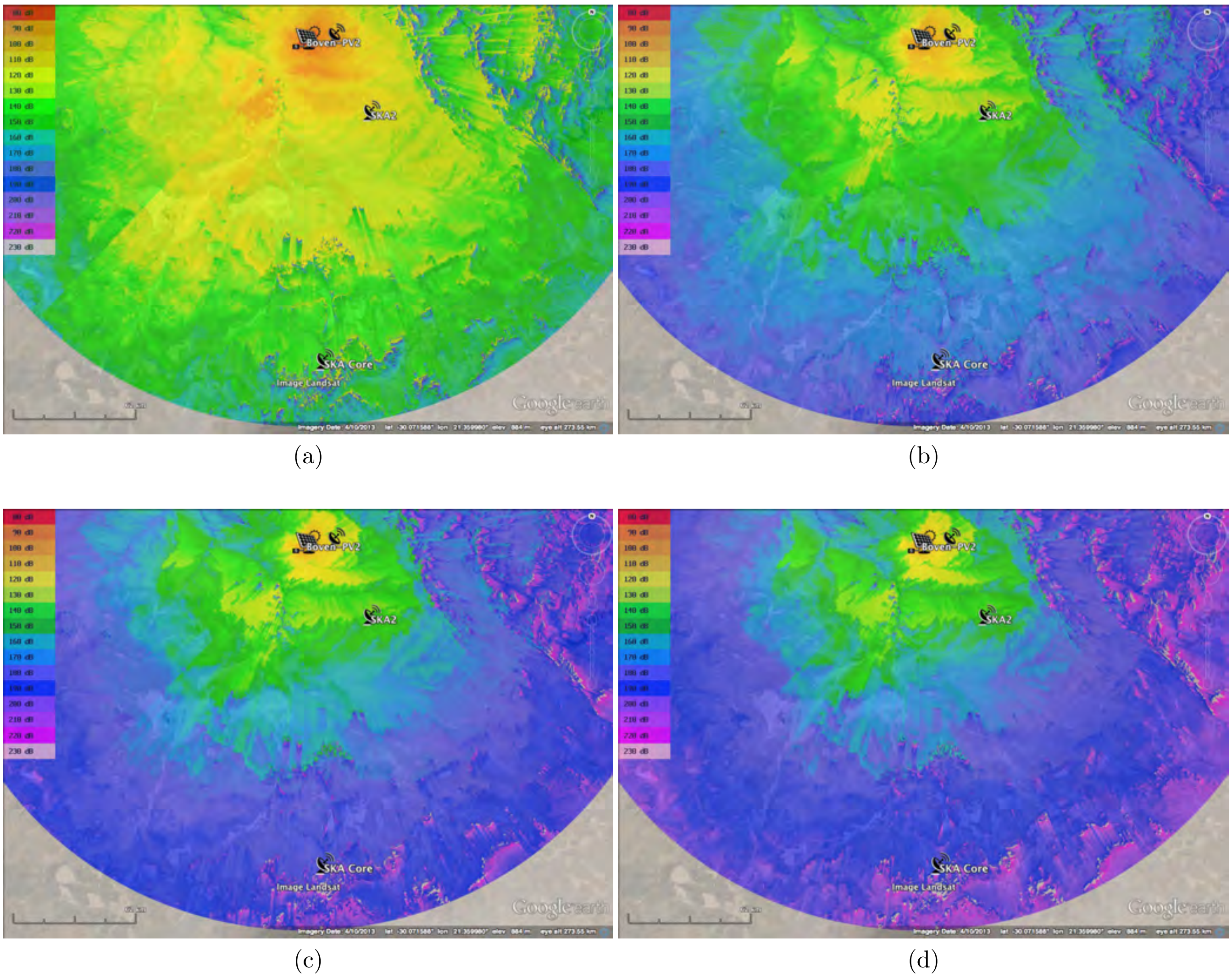
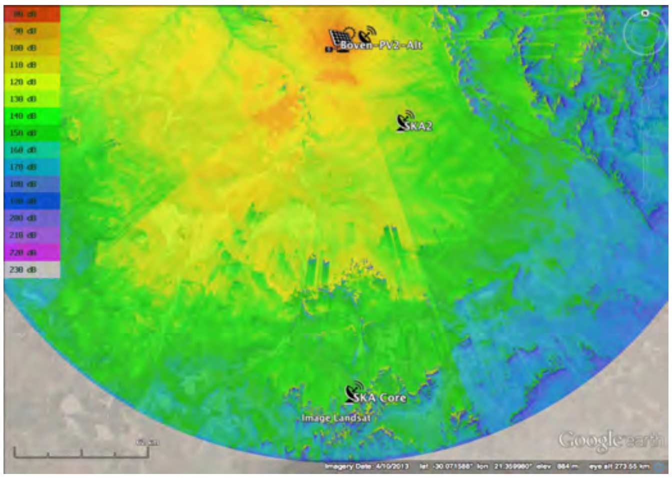
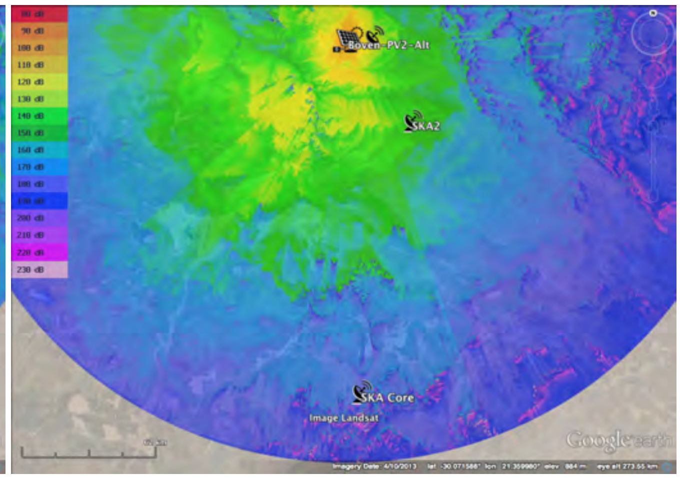


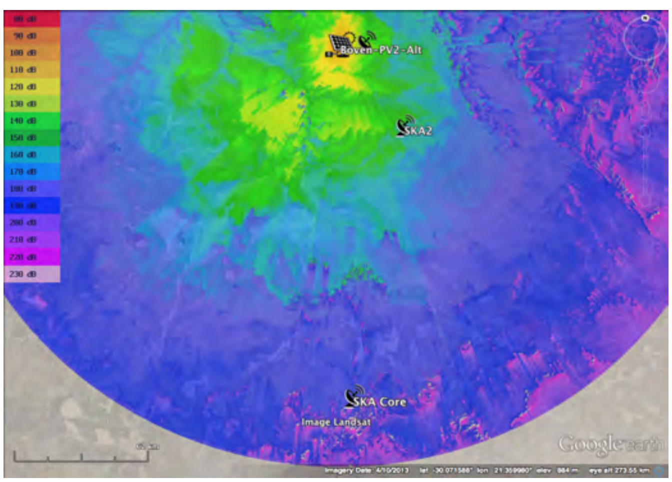
Figure 54: TPL attenuation maps for **preferred** site location of Boven PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



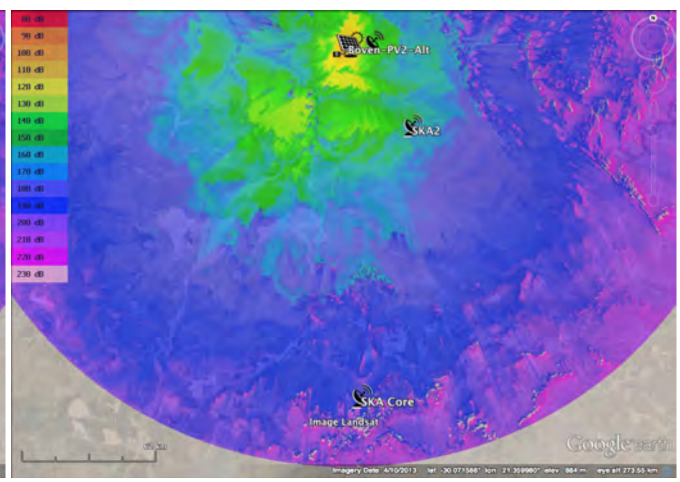
(a)



(b)



(c)



(d)

Figure 55: TPL attenuation maps for **alternative** site location of Boven PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.6 Boven PV3 Site Location

5.6.1 Boven PV3 Preferred Site Location

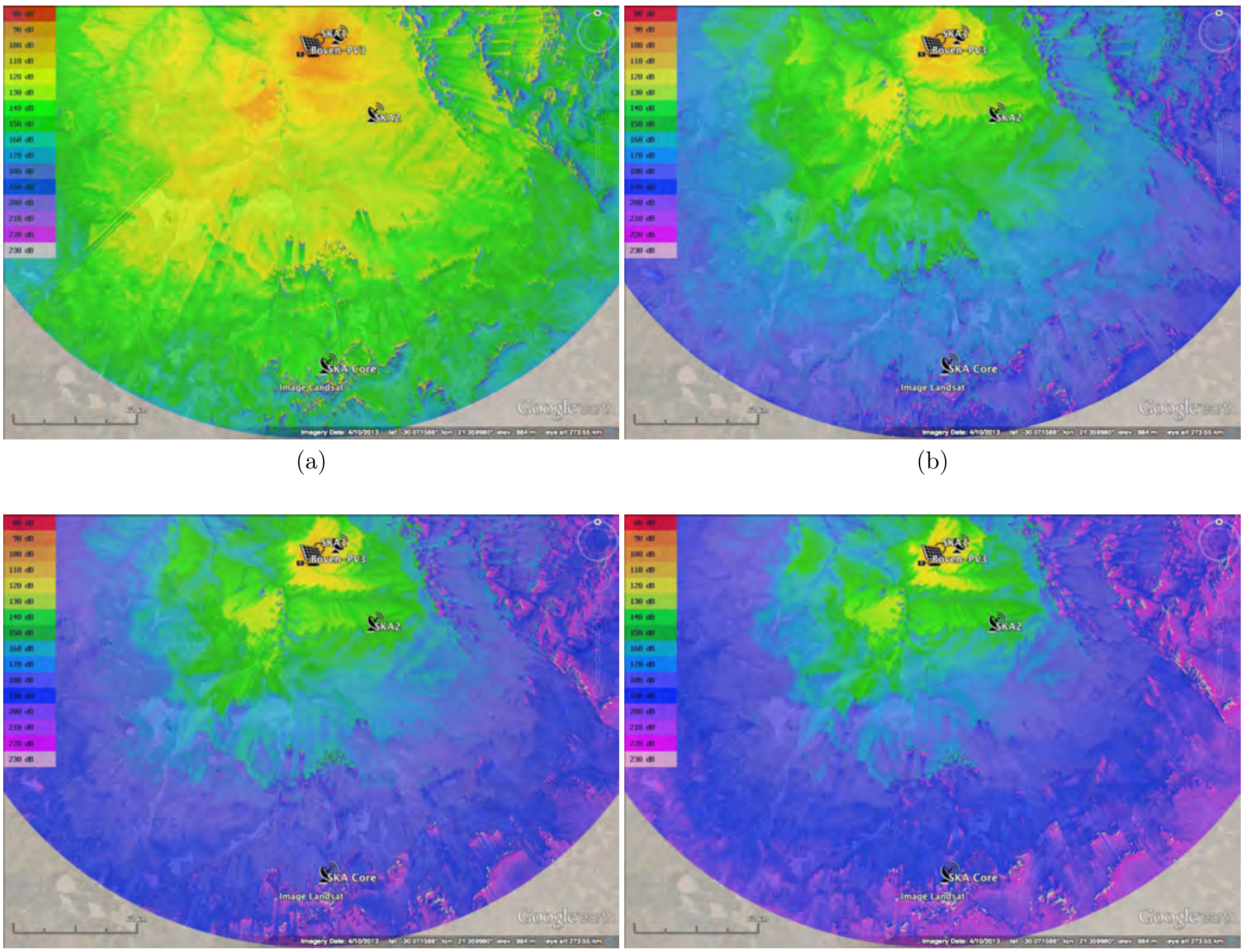
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	FSPL	TL	TPL	FSPL	TL	TPL	FSPL	TL	TPL
100MHz	96.4dB	14.84dB	**111.24dB**	106.43dB	27.93dB	**134.36dB**	116.85dB	37.22dB	**154.07dB**
300MHz	105.94dB	6.35dB	**112.29dB**	115.98dB	23.3dB	**139.28dB**	126.39dB	35.02dB	**161.41dB**
500MHz	110.38dB	2.78dB	**113.16dB**	120.41dB	22.83dB	**143.24dB**	130.83dB	36.95dB	**167.78dB**
1000MHz	116.4dB	0.0dB	**116.4dB**	126.43dB	24.64dB	**151.07dB**	136.85dB	41.82dB	**178.67dB**
1500MHz	119.92dB	0.0dB	**119.92dB**	129.96dB	26.23dB	**156.19dB**	140.37dB	44.02dB	**184.39dB**
2000MHz	122.42dB	0.0dB	**122.42dB**	132.46dB	27.74dB	**160.2dB**	142.87dB	45.49dB	**188.36dB**
2500MHz	124.36dB	0.0dB	**124.36dB**	134.39dB	29.1dB	**163.49dB**	144.81dB	46.61dB	**191.42dB**
3000MHz	125.94dB	0.0dB	**125.94dB**	135.98dB	30.29dB	**166.27dB**	146.39dB	47.51dB	**193.9dB**

Table 33: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV3 emissions.

5.6.2 Boven PV3 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	FSPL	TL	TPL	FSPL	TL	TPL	FSPL	TL	TPL
100MHz	95.25dB	19.28dB	**114.53dB**	106.47dB	29.2dB	**135.67dB**	116.93dB	35.52dB	**152.45dB**
300MHz	104.79dB	13.64dB	**118.43dB**	116.01dB	22.11dB	**138.12dB**	126.47dB	34.12dB	**160.59dB**
500MHz	109.23dB	11.02dB	**120.25dB**	120.45dB	20.61dB	**141.06dB**	130.9dB	36.33dB	**167.23dB**
1000MHz	115.25dB	8.35dB	**123.6dB**	126.47dB	21.35dB	**147.82dB**	136.93dB	41.43dB	**178.36dB**
1500MHz	118.77dB	7.28dB	**126.05dB**	129.99dB	22.42dB	**152.41dB**	140.45dB	43.71dB	**184.16dB**
2000MHz	121.27dB	6.94dB	**128.21dB**	132.49dB	23.61dB	**156.1dB**	142.95dB	45.19dB	**188.14dB**
2500MHz	123.21dB	7.07dB	**130.28dB**	134.42dB	24.82dB	**159.24dB**	144.88dB	46.32dB	**191.2dB**
3000MHz	124.79dB	7.19dB	**131.98dB**	136.01dB	26.06dB	**162.07dB**	146.47dB	47.21dB	**193.68dB**

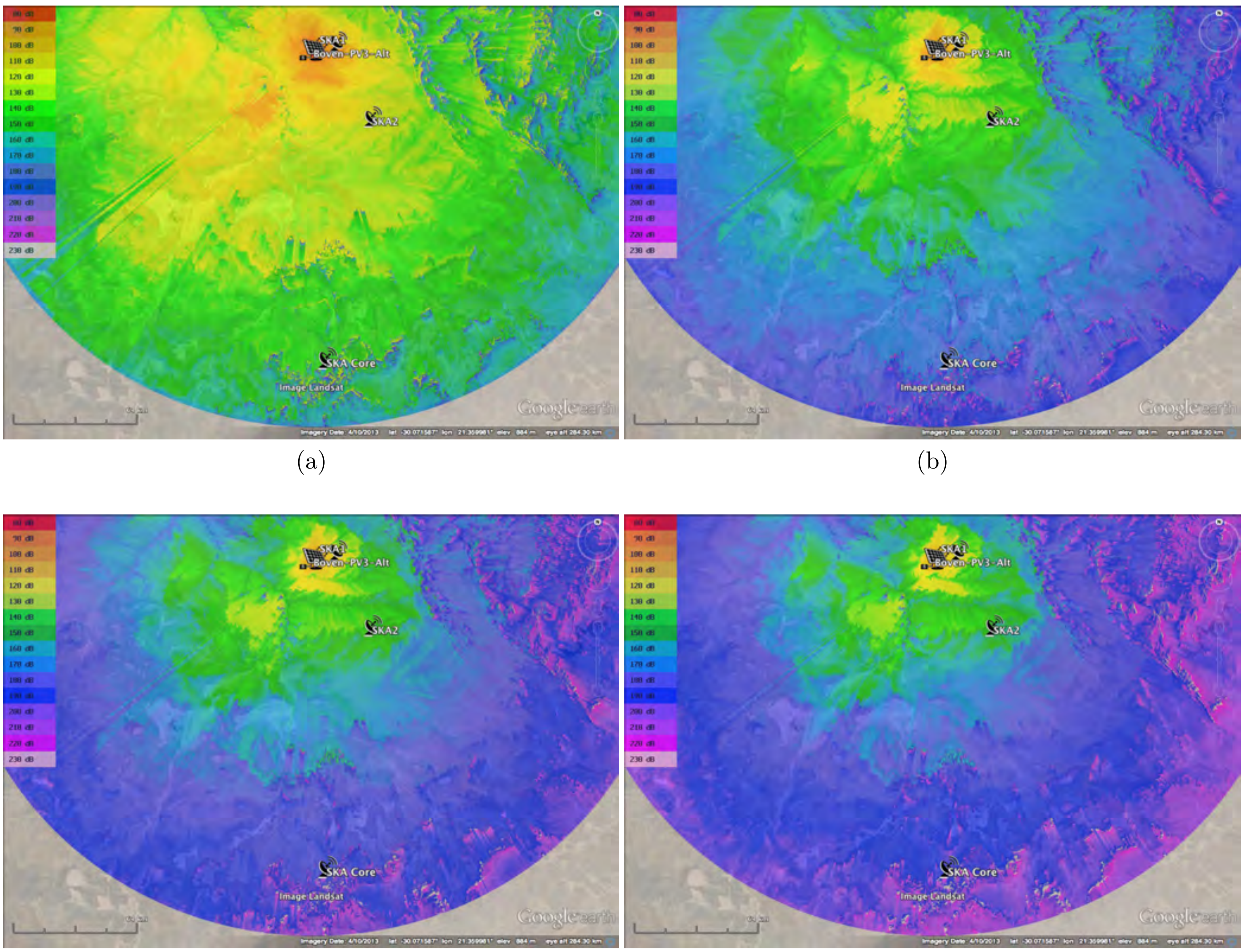
Table 34: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV3 emissions.



(a) (b)

(c) (d)

Figure 56: TPL attenuation maps for **preferred** site location of Boven PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 57: TPL attenuation maps for **alternative** site location of Boven PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.7 Boven PV4 Site Location

5.7.1 Boven PV4 Preferred Site Location

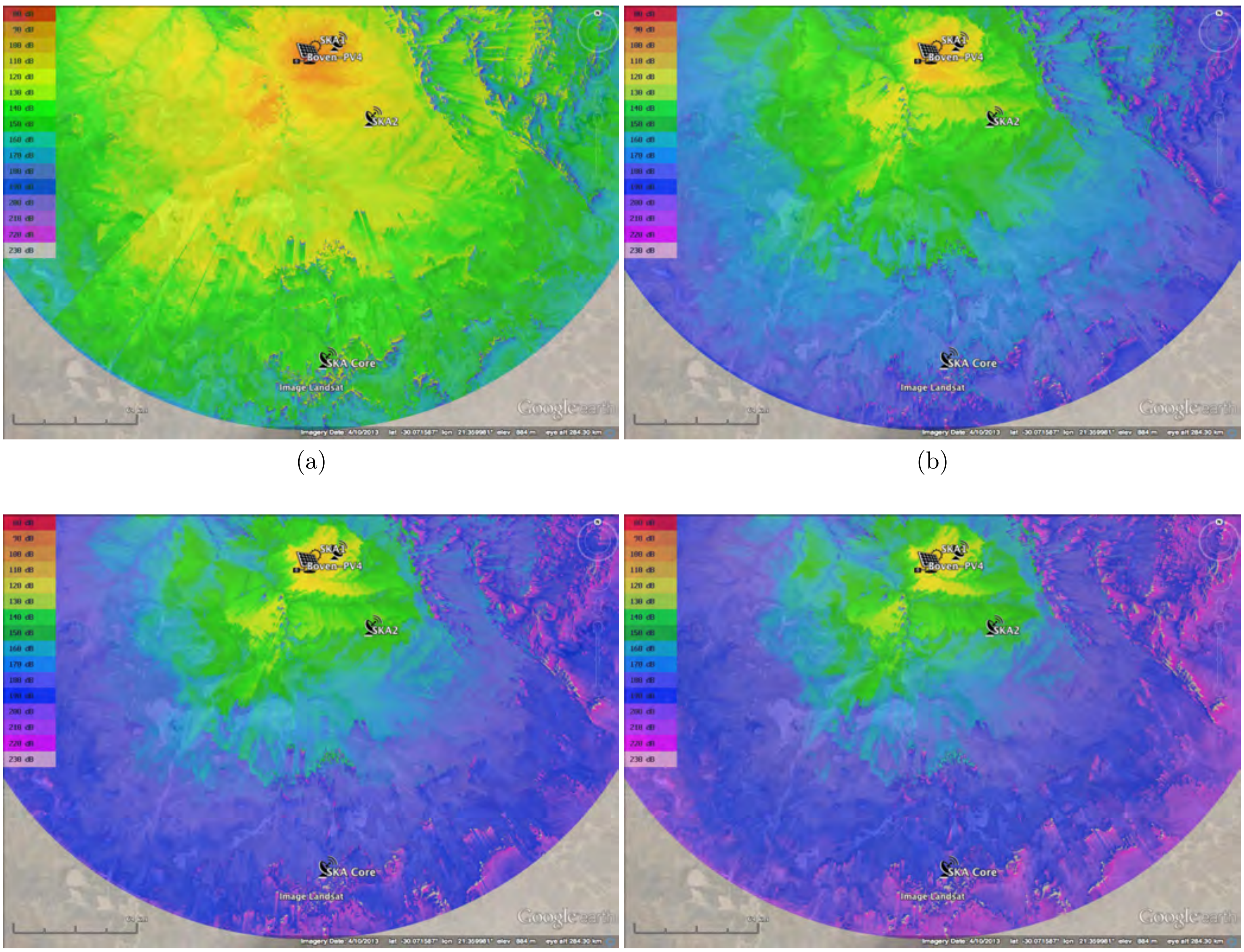
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.5dB	8.88dB	**106.38dB**	106.62dB	24.55dB	**131.17dB**	116.83dB	30.34dB	**147.17dB**
300MHz	107.04dB	0.51dB	**107.55dB**	116.16dB	19.93dB	**136.09dB**	126.37dB	30.91dB	**157.28dB**
500MHz	111.48dB	0.0dB	**111.48dB**	120.6dB	19.39dB	**139.99dB**	130.81dB	33.43dB	**164.24dB**
1000MHz	117.5dB	0.0dB	**117.5dB**	126.62dB	21.0dB	**147.62dB**	136.83dB	38.85dB	**175.68dB**
1500MHz	121.02dB	0.0dB	**121.02dB**	130.14dB	22.44dB	**152.58dB**	140.35dB	41.2dB	**181.55dB**
2000MHz	123.52dB	0.0dB	**123.52dB**	132.64dB	23.77dB	**156.41dB**	142.85dB	42.75dB	**185.6dB**
2500MHz	125.45dB	0.0dB	**125.45dB**	134.58dB	24.99dB	**159.57dB**	144.79dB	43.92dB	**188.71dB**
3000MHz	127.04dB	0.0dB	**127.04dB**	136.16dB	26.09dB	**162.25dB**	146.37dB	44.86dB	**191.23dB**

Table 35: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV4 emissions.

5.7.2 Boven PV4 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.85dB	14.26dB	**112.11dB**	106.31dB	28.21dB	**134.52dB**	116.71dB	33.63dB	**150.34dB**
300MHz	107.39dB	6.09dB	**113.48dB**	115.85dB	23.98dB	**139.83dB**	126.25dB	32.17dB	**158.42dB**
500MHz	111.83dB	2.74dB	**114.57dB**	120.29dB	23.59dB	**143.88dB**	130.69dB	34.53dB	**165.22dB**
1000MHz	117.85dB	0.0dB	**117.85dB**	126.31dB	25.52dB	**151.83dB**	136.71dB	39.82dB	**176.53dB**
1500MHz	121.37dB	0.0dB	**121.37dB**	129.83dB	27.17dB	**157.0dB**	140.23dB	42.14dB	**182.37dB**
2000MHz	123.87dB	0.0dB	**123.87dB**	132.33dB	28.64dB	**160.97dB**	142.73dB	43.67dB	**186.4dB**
2500MHz	125.81dB	0.0dB	**125.81dB**	134.27dB	29.94dB	**164.21dB**	144.66dB	44.83dB	**189.49dB**
3000MHz	127.39dB	0.0dB	**127.39dB**	135.85dB	31.1dB	**166.95dB**	146.25dB	45.75dB	**192.0dB**

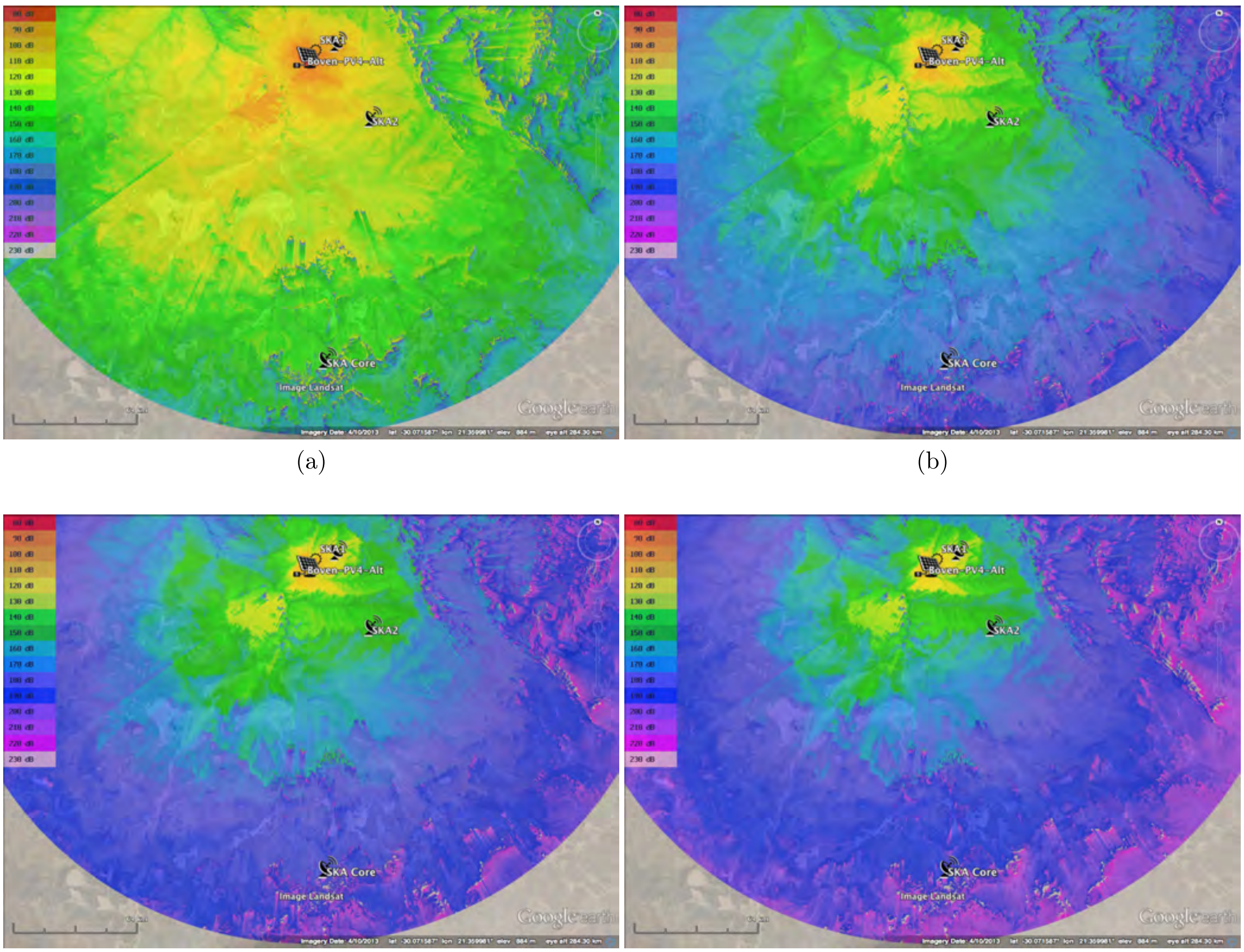
Table 36: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV4 emissions.



(a) (b)

(c) (d)

Figure 58: TPL attenuation maps for **preferred** site location of Boven PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 59: TPL attenuation maps for **alternative** site location of Boven PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.8 Gemsbok PV1 Site Location

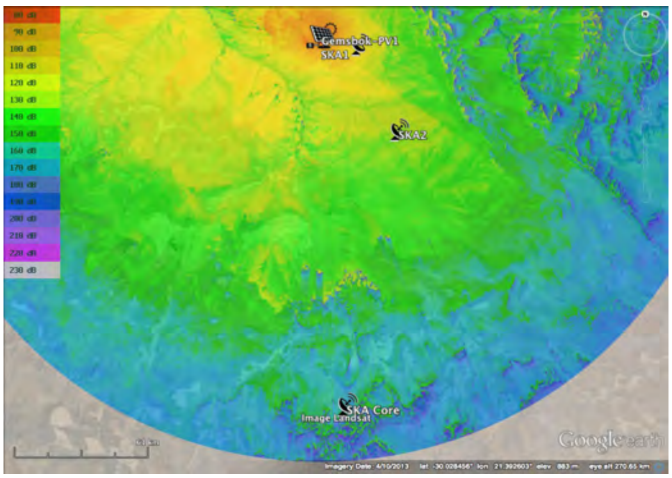
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.07dB	25.55dB	**123.62dB**	108.07dB	25.82dB	**133.89dB**	117.38dB	47.18dB	**164.56dB**
300MHz	107.62dB	20.83dB	**128.45dB**	117.61dB	18.67dB	**136.28dB**	126.93dB	42.44dB	**169.37dB**
500MHz	112.05dB	19.71dB	**131.76dB**	122.05dB	18.41dB	**140.46dB**	131.36dB	43.12dB	**174.48dB**
1000MHz	118.07dB	19.69dB	**137.76dB**	128.07dB	22.52dB	**150.59dB**	137.38dB	46.33dB	**183.71dB**
1500MHz	121.6dB	20.46dB	**142.06dB**	131.59dB	25.11dB	**156.7dB**	140.91dB	47.79dB	**188.7dB**
2000MHz	124.09dB	21.31dB	**145.4dB**	134.09dB	27.08dB	**161.17dB**	143.41dB	48.88dB	**192.29dB**
2500MHz	126.03dB	22.05dB	**148.08dB**	136.03dB	28.68dB	**164.71dB**	145.34dB	49.78dB	**195.12dB**
3000MHz	127.62dB	22.7dB	**150.32dB**	137.61dB	29.94dB	**167.55dB**	146.93dB	50.54dB	**197.47dB**

Table 37: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV1 emissions.

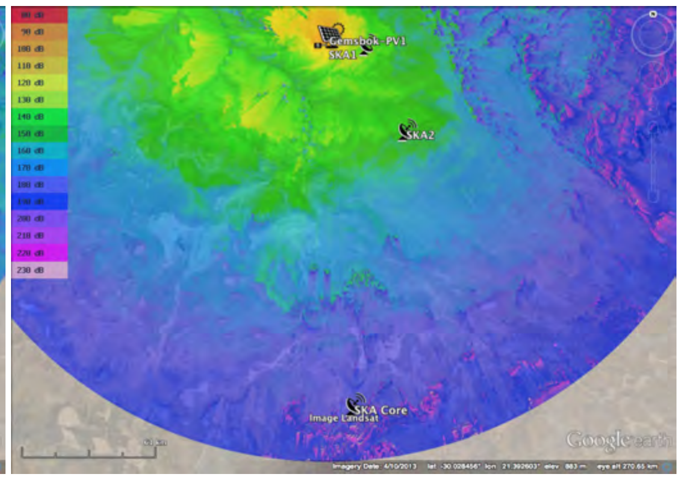
5.9 Gemsbok PV2 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	96.6dB	24.61dB	**121.21dB**	107.77dB	28.62dB	**136.39dB**	117.36dB	42.67dB	**160.03dB**
300MHz	106.14dB	18.66dB	**124.8dB**	117.31dB	19.64dB	**136.95dB**	126.9dB	40.76dB	**167.66dB**
500MHz	110.58dB	17.02dB	**127.6dB**	121.75dB	18.42dB	**140.17dB**	131.34dB	41.51dB	**172.85dB**
1000MHz	116.6dB	16.31dB	**132.91dB**	127.77dB	21.37dB	**149.14dB**	137.36dB	44.85dB	**182.21dB**
1500MHz	120.12dB	16.69dB	**136.81dB**	131.29dB	23.52dB	**154.81dB**	140.88dB	46.39dB	**187.27dB**
2000MHz	122.62dB	17.31dB	**139.93dB**	133.79dB	25.19dB	**158.98dB**	143.38dB	47.52dB	**190.9dB**
2500MHz	124.56dB	17.93dB	**142.49dB**	135.73dB	26.59dB	**162.32dB**	145.32dB	48.44dB	**193.76dB**
3000MHz	126.14dB	18.52dB	**144.66dB**	137.31dB	27.83dB	**165.14dB**	146.9dB	49.22dB	**196.12dB**

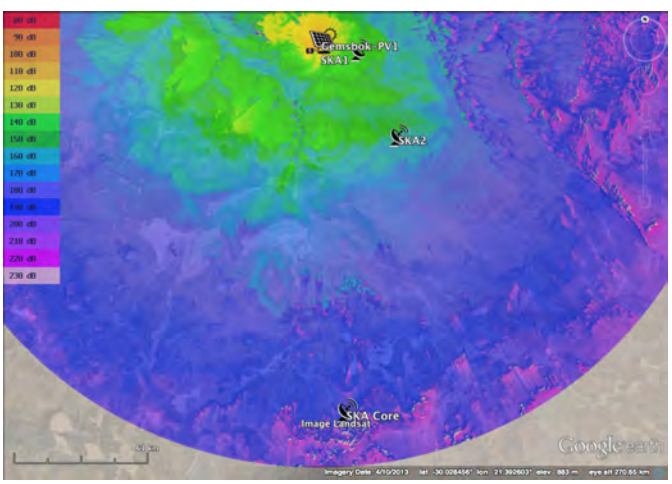
Table 38: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV2 emissions.



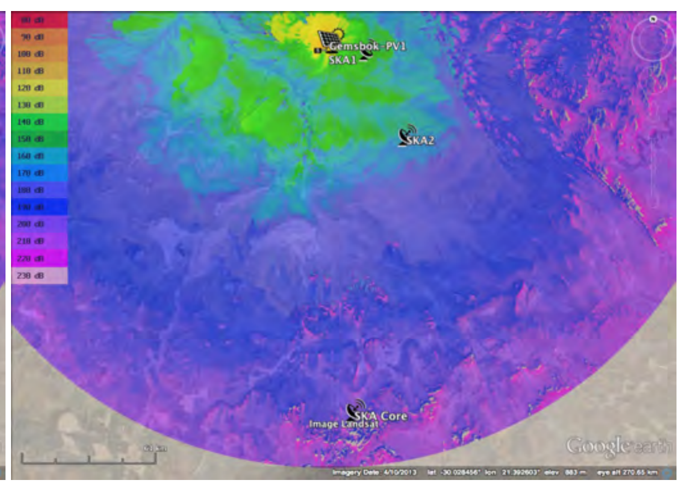
(a)



(b)

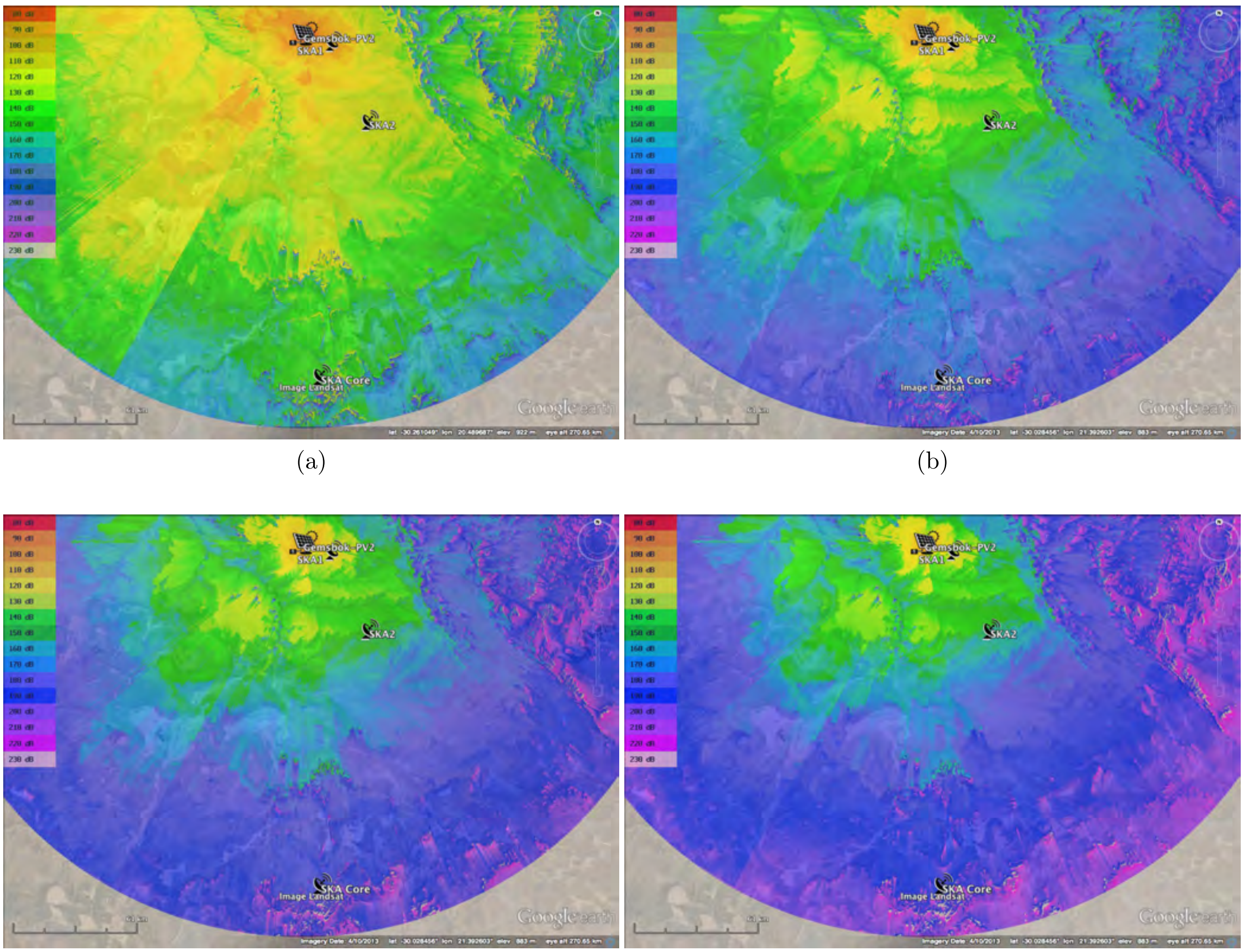


(c)



(d)

Figure 60: TPL attenuation maps for site location of Gemsbok PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 61: TPL attenuation maps for site location of Gemsbok PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.10 Gemsbok PV3 Site Location

5.10.1 Gemsbok PV3 Preferred Site Location

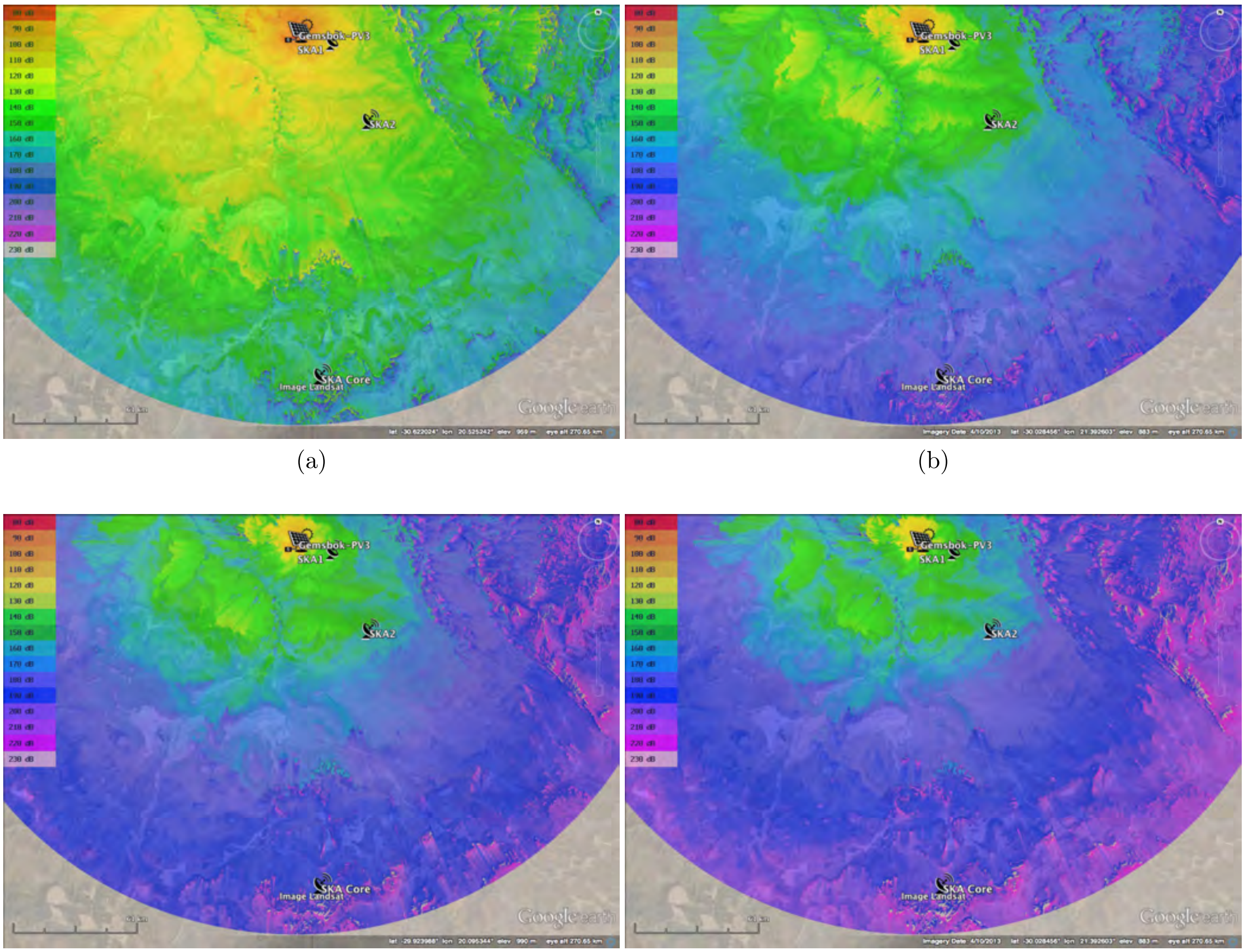
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.99dB	25.22dB	**123.21dB**	108.12dB	25.82dB	**133.94dB**	117.42dB	39.45dB	**156.87dB**
300MHz	107.53dB	20.88dB	**128.41dB**	117.66dB	18.16dB	**135.82dB**	126.96dB	37.44dB	**164.4dB**
500MHz	111.97dB	20.06dB	**132.03dB**	122.1dB	17.61dB	**139.71dB**	131.4dB	38.83dB	**170.23dB**
1000MHz	117.99dB	20.88dB	**138.87dB**	128.12dB	21.2dB	**149.32dB**	137.42dB	43.0dB	**180.42dB**
1500MHz	121.51dB	22.26dB	**143.77dB**	131.64dB	23.86dB	**155.5dB**	140.94dB	44.94dB	**185.88dB**
2000MHz	124.01dB	23.39dB	**147.4dB**	134.14dB	25.99dB	**160.13dB**	143.44dB	46.29dB	**189.73dB**
2500MHz	125.95dB	24.34dB	**150.29dB**	136.08dB	27.72dB	**163.8dB**	145.38dB	47.34dB	**192.72dB**
3000MHz	127.53dB	25.35dB	**152.88dB**	137.66dB	29.22dB	**166.88dB**	146.96dB	48.2dB	**195.16dB**

Table 39: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV3 emissions.

5.10.2 Gemsbok PV3 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.2dB	18.49dB	**116.69dB**	107.92dB	23.74dB	**131.66dB**	117.29dB	44.43dB	**161.72dB**
300MHz	107.75dB	12.49dB	**120.24dB**	117.46dB	15.51dB	**132.97dB**	126.84dB	42.4dB	**169.24dB**
500MHz	112.18dB	10.59dB	**122.77dB**	121.9dB	14.23dB	**136.13dB**	131.27dB	43.11dB	**174.38dB**
1000MHz	118.2dB	9.57dB	**127.77dB**	127.92dB	16.2dB	**144.12dB**	137.29dB	46.37dB	**183.66dB**
1500MHz	121.73dB	9.76dB	**131.49dB**	131.44dB	18.4dB	**149.84dB**	140.81dB	47.85dB	**188.66dB**
2000MHz	124.22dB	10.06dB	**134.28dB**	133.94dB	20.27dB	**154.21dB**	143.31dB	48.95dB	**192.26dB**
2500MHz	126.16dB	10.56dB	**136.72dB**	135.87dB	21.9dB	**157.77dB**	145.25dB	49.85dB	**195.1dB**
3000MHz	127.75dB	11.06dB	**138.81dB**	137.46dB	23.32dB	**160.78dB**	146.84dB	50.62dB	**197.46dB**

Table 40: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV3 emissions.



(a) (b) (c) (d)

Figure 62: TPL attenuation maps for **preferred** site location of Gemsbok PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

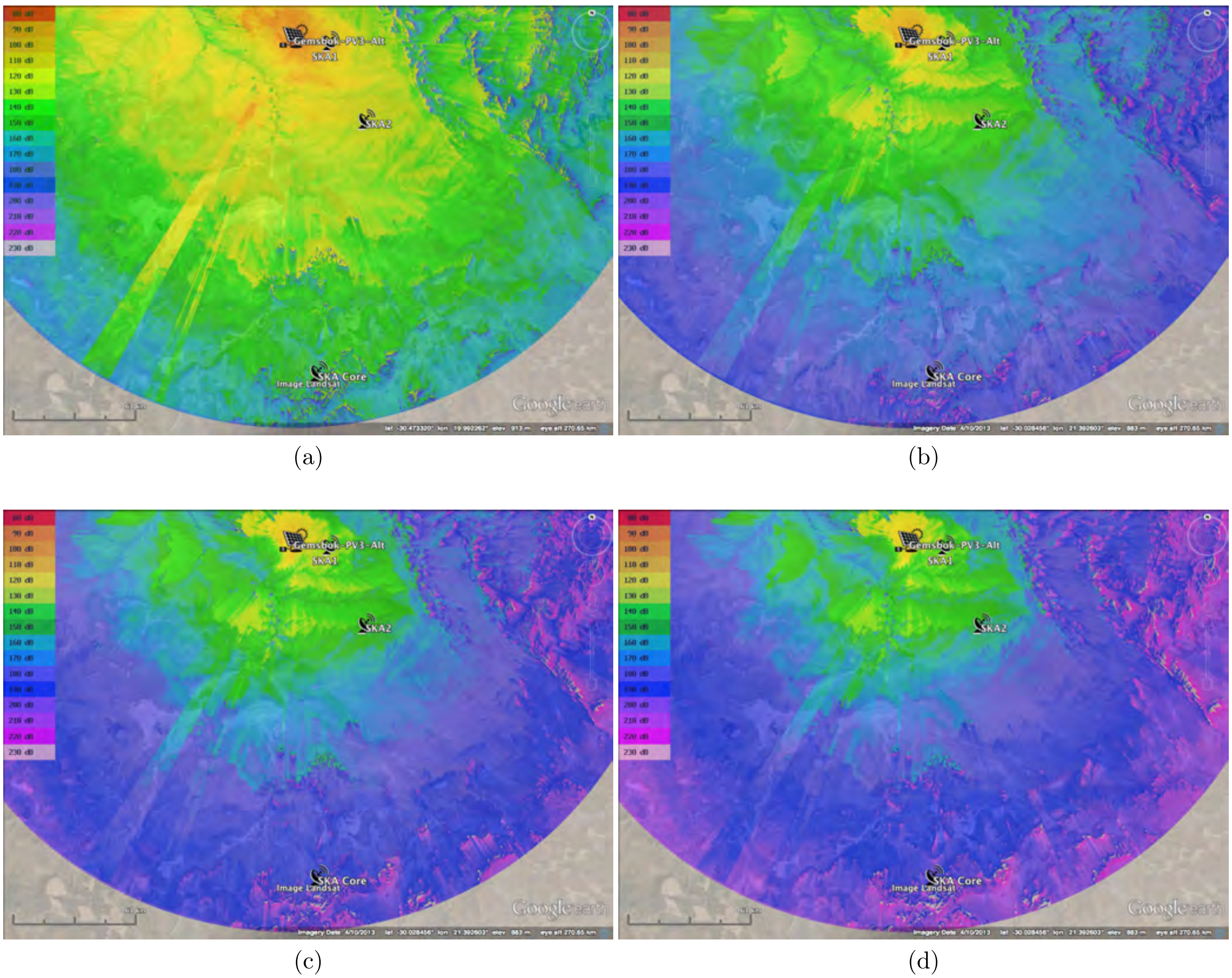


Figure 63: TPL attenuation maps for **alternative** site location of Gemsbok PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.11 Gemsbok PV4 Site Location

5.11.1 Gemsbok PV4 Preferred Site Location

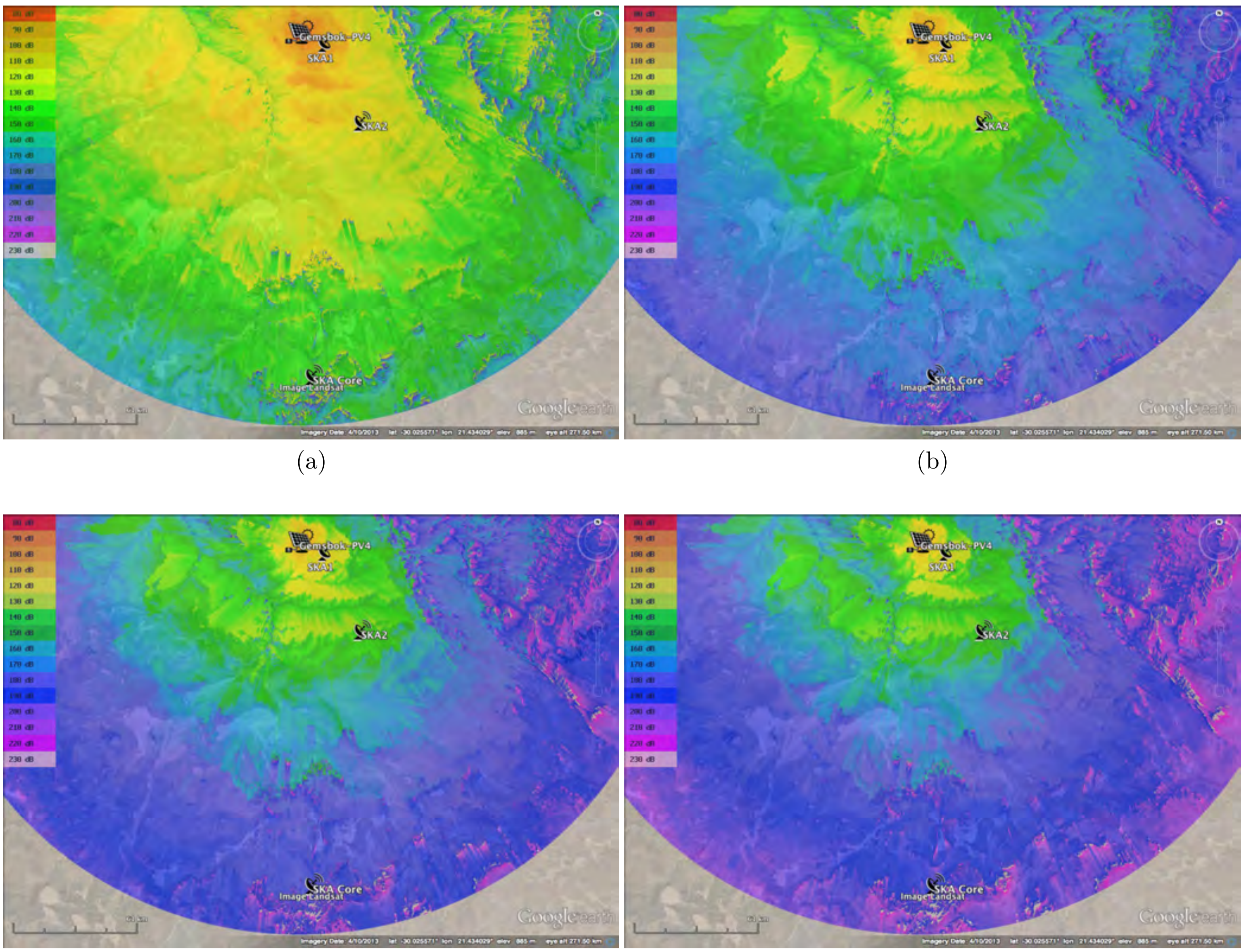
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	95.97dB	12.08dB	**108.05dB**	107.81dB	25.75dB	**133.56dB**	117.43dB	29.85dB	**147.28dB**
300MHz	105.51dB	6.43dB	**111.94dB**	117.35dB	16.16dB	**133.51dB**	126.97dB	30.72dB	**157.69dB**
500MHz	109.95dB	4.92dB	**114.87dB**	121.79dB	14.32dB	**136.11dB**	131.41dB	33.51dB	**164.92dB**
1000MHz	115.97dB	5.38dB	**121.35dB**	127.81dB	15.86dB	**143.67dB**	137.43dB	39.08dB	**176.51dB**
1500MHz	119.49dB	6.82dB	**126.31dB**	131.33dB	17.61dB	**148.94dB**	140.95dB	41.51dB	**182.46dB**
2000MHz	121.99dB	8.29dB	**130.28dB**	133.83dB	19.13dB	**152.96dB**	143.45dB	43.1dB	**186.55dB**
2500MHz	123.93dB	9.6dB	**133.53dB**	135.77dB	20.44dB	**156.21dB**	145.39dB	44.28dB	**189.67dB**
3000MHz	125.51dB	10.59dB	**136.1dB**	137.35dB	21.62dB	**158.97dB**	146.97dB	45.23dB	**192.2dB**

Table 41: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV4 emissions.

5.11.2 Gemsbok PV4 Alternative Site Location

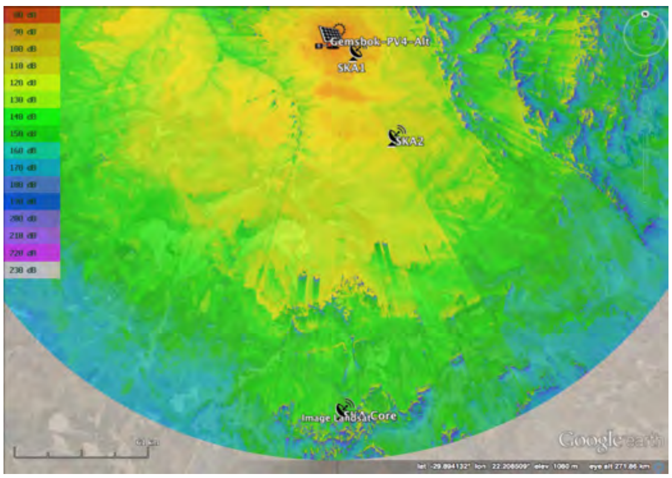
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	95.99dB	13.57dB	**109.56dB**	107.95dB	23.3dB	**131.25dB**	117.51dB	29.92dB	**147.43dB**
300MHz	105.54dB	8.15dB	**113.69dB**	117.49dB	13.5dB	**130.99dB**	127.05dB	30.93dB	**157.98dB**
500MHz	109.97dB	6.76dB	**116.73dB**	121.93dB	11.53dB	**133.46dB**	131.49dB	33.66dB	**165.15dB**
1000MHz	115.99dB	6.87dB	**122.86dB**	127.95dB	12.79dB	**140.74dB**	137.51dB	39.17dB	**176.68dB**
1500MHz	119.51dB	8.7dB	**128.21dB**	131.47dB	14.43dB	**145.9dB**	141.03dB	41.6dB	**182.63dB**
2000MHz	122.01dB	9.91dB	**131.92dB**	133.97dB	15.87dB	**149.84dB**	143.53dB	43.17dB	**186.7dB**
2500MHz	123.95dB	10.9dB	**134.85dB**	135.91dB	17.15dB	**153.06dB**	145.47dB	44.34dB	**189.81dB**
3000MHz	125.54dB	11.74dB	**137.28dB**	137.49dB	18.3dB	**155.79dB**	147.05dB	45.28dB	**192.33dB**

Table 42: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV4 emissions.

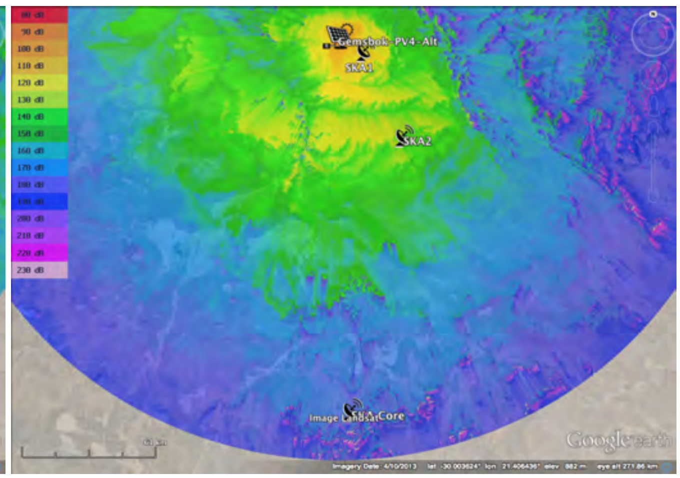


(a) (b) (c) (d)

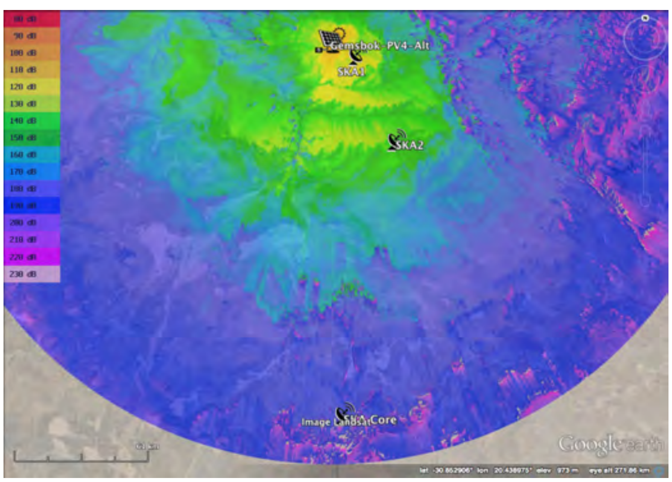
Figure 64: TPL attenuation maps for **preferred** site location of Gemsbok PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



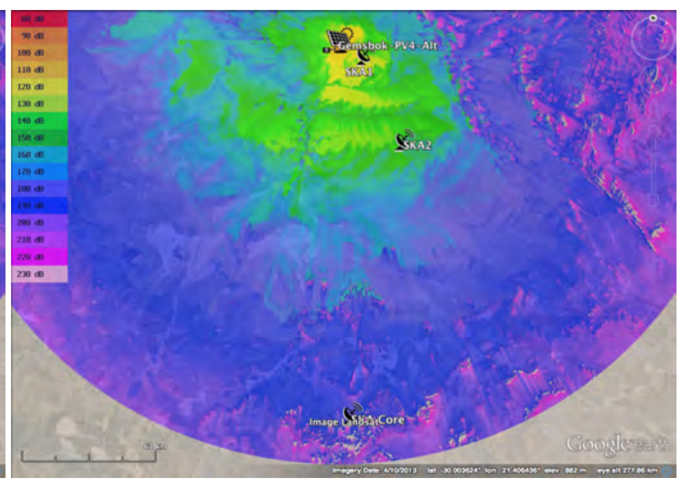
(a)



(b)



(c)



(d)

Figure 65: TPL attenuation maps for **alternative** site location of Gemsbok PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.12 Gemsbok PV5 Site Location

5.12.1 Gemsbok PV5 Preferred Site Location

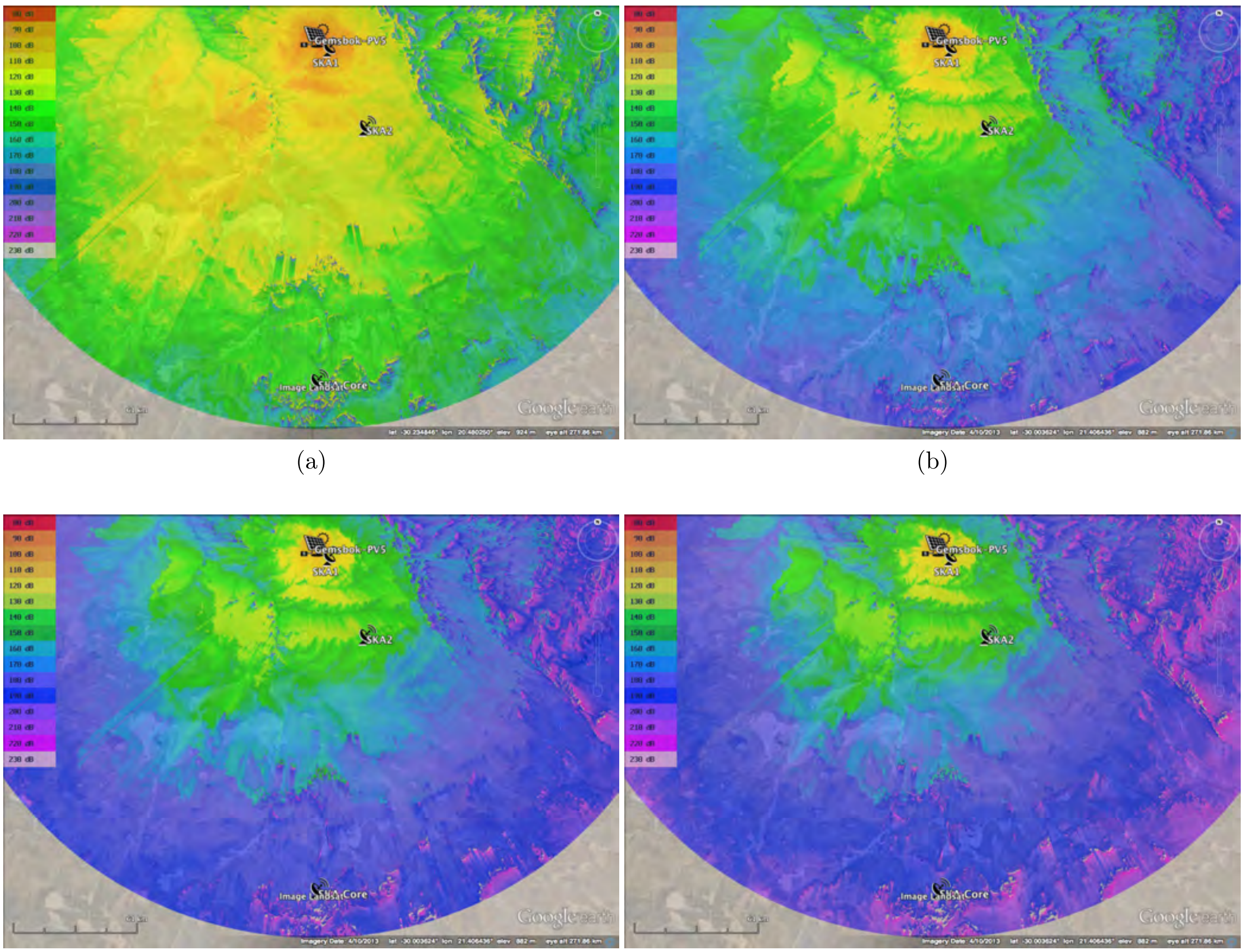
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	92.9dB	7.24dB	**100.14dB**	107.45dB	20.82dB	**128.27dB**	117.45dB	28.14dB	**145.59dB**
300MHz	102.44dB	0.0dB	**102.44dB**	116.99dB	13.65dB	**130.64dB**	126.99dB	30.17dB	**157.16dB**
500MHz	106.88dB	0.0dB	**106.88dB**	121.43dB	12.2dB	**133.63dB**	131.43dB	33.06dB	**164.49dB**
1000MHz	112.9dB	0.0dB	**112.9dB**	127.45dB	13.15dB	**140.6dB**	137.45dB	38.71dB	**176.16dB**
1500MHz	116.42dB	0.0dB	**116.42dB**	130.97dB	14.19dB	**145.16dB**	140.97dB	41.19dB	**182.16dB**
2000MHz	118.92dB	0.0dB	**118.92dB**	133.47dB	15.32dB	**148.79dB**	143.47dB	42.78dB	**186.25dB**
2500MHz	120.86dB	0.0dB	**120.86dB**	135.41dB	16.45dB	**151.86dB**	145.41dB	43.96dB	**189.37dB**
3000MHz	122.44dB	0.0dB	**122.44dB**	136.99dB	17.68dB	**154.67dB**	146.99dB	44.91dB	**191.9dB**

Table 43: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV5 emissions.

5.12.2 Gemsbok PV5 Alternative Site Location

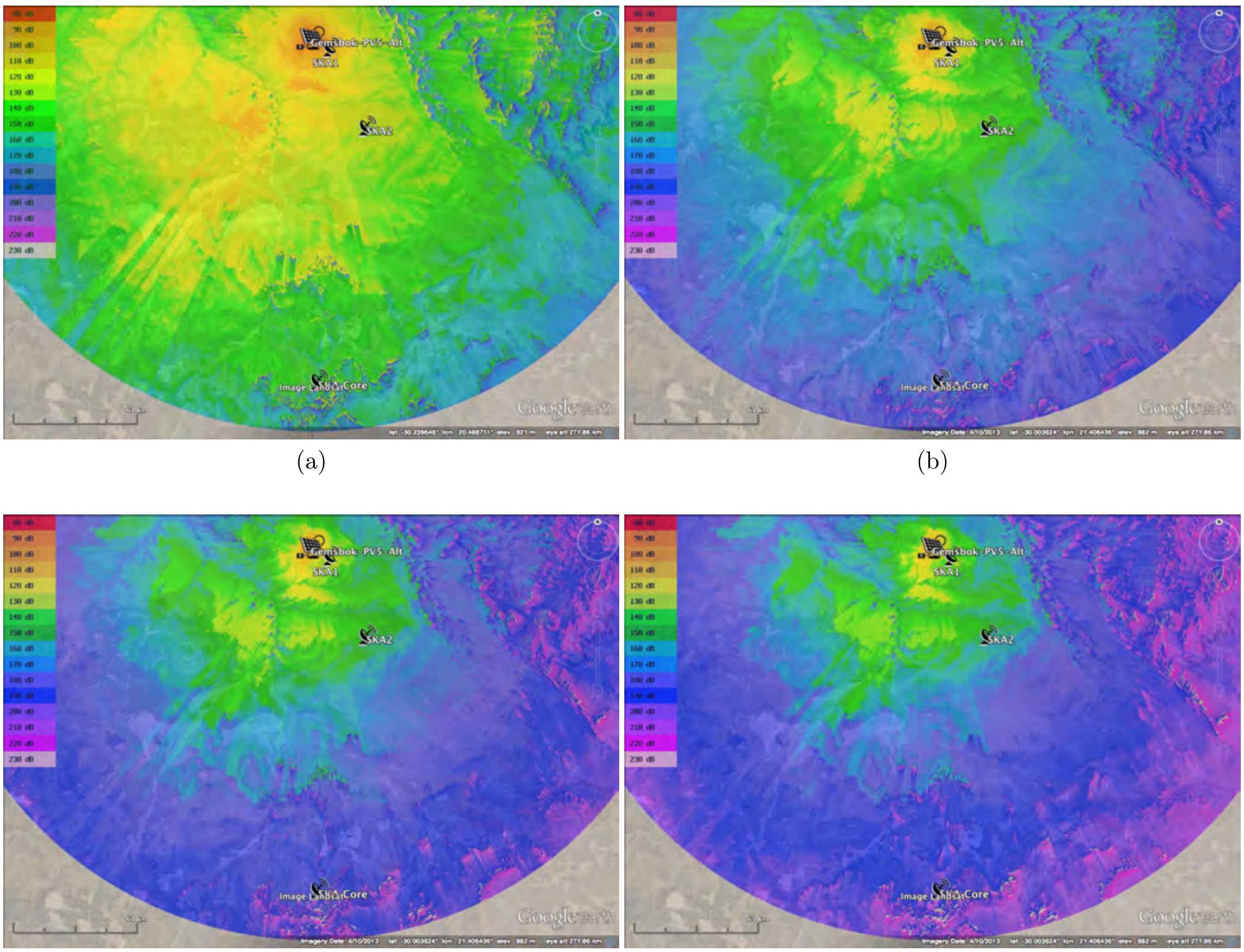
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	93.79dB	18.23dB	**112.02dB**	107.45dB	28.16dB	**135.61dB**	117.39dB	36.27dB	**153.66dB**
300MHz	103.33dB	15.23dB	**118.56dB**	116.99dB	21.32dB	**138.31dB**	126.94dB	38.02dB	**164.96dB**
500MHz	107.77dB	15.77dB	**123.54dB**	121.43dB	20.35dB	**141.78dB**	131.37dB	39.27dB	**170.64dB**
1000MHz	113.79dB	18.96dB	**132.75dB**	127.45dB	22.65dB	**150.1dB**	137.39dB	43.16dB	**180.55dB**
1500MHz	117.31dB	22.04dB	**139.35dB**	130.97dB	24.96dB	**155.93dB**	140.91dB	44.95dB	**185.86dB**
2000MHz	119.81dB	24.86dB	**144.67dB**	133.47dB	26.79dB	**160.26dB**	143.41dB	46.22dB	**189.63dB**
2500MHz	121.75dB	27.33dB	**149.08dB**	135.41dB	28.31dB	**163.72dB**	145.35dB	47.22dB	**192.57dB**
3000MHz	123.33dB	29.32dB	**152.65dB**	136.99dB	29.63dB	**166.62dB**	146.94dB	48.04dB	**194.98dB**

Table 44: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV5 emissions.



(a) (b) (c) (d)

Figure 66: TPL attenuation maps for **preferred** site location of Gemsbok PV5 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b)

(c) (d)

Figure 67: TPL attenuation maps for **alternative** site location of Gemsbok PV5 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.13 Gemsbok PV6 Site Location

5.13.1 Gemsbok PV6 Preferred Site Location

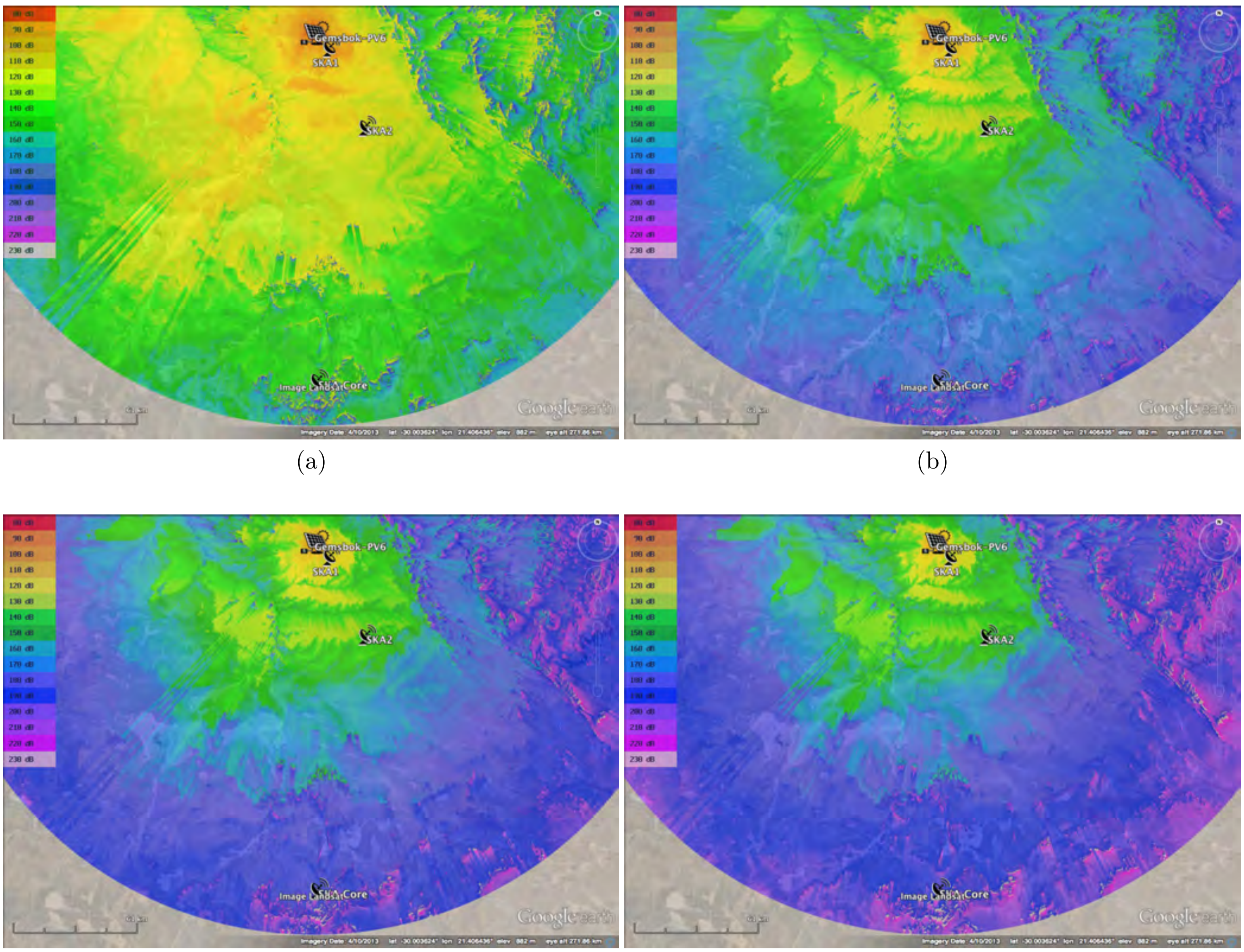
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	93.64dB	19.39dB	**113.03dB**	107.64dB	23.34dB	**130.98dB**	117.52dB	29.84dB	**147.36dB**
300MHz	103.18dB	13.52dB	**116.7dB**	117.18dB	13.78dB	**130.96dB**	127.06dB	30.93dB	**157.99dB**
500MHz	107.62dB	11.93dB	**119.55dB**	121.62dB	11.78dB	**133.4dB**	131.5dB	33.61dB	**165.11dB**
1000MHz	113.64dB	11.22dB	**124.86dB**	127.64dB	12.63dB	**140.27dB**	137.52dB	39.09dB	**176.61dB**
1500MHz	117.16dB	11.7dB	**128.86dB**	131.16dB	14.04dB	**145.2dB**	141.04dB	41.54dB	**182.58dB**
2000MHz	119.66dB	12.51dB	**132.17dB**	133.66dB	15.39dB	**149.05dB**	143.54dB	43.12dB	**186.66dB**
2500MHz	121.6dB	13.19dB	**134.79dB**	135.6dB	16.69dB	**152.29dB**	145.48dB	44.3dB	**189.78dB**
3000MHz	123.18dB	13.98dB	**137.16dB**	137.18dB	17.89dB	**155.07dB**	147.06dB	45.24dB	**192.3dB**

Table 45: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV6 emissions.

5.13.2 Gemsbok PV6 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	94.3dB	15.79dB	**110.09dB**	107.68dB	27.14dB	**134.82dB**	117.49dB	32.67dB	**150.16dB**
300MHz	103.84dB	11.16dB	**115.0dB**	117.23dB	17.25dB	**134.48dB**	127.03dB	32.01dB	**159.04dB**
500MHz	108.28dB	10.33dB	**118.61dB**	121.66dB	15.36dB	**137.02dB**	131.47dB	34.33dB	**165.8dB**
1000MHz	114.3dB	10.76dB	**125.06dB**	127.68dB	17.13dB	**144.81dB**	137.49dB	39.51dB	**177.0dB**
1500MHz	117.82dB	12.25dB	**130.07dB**	131.21dB	18.9dB	**150.11dB**	141.01dB	41.82dB	**182.83dB**
2000MHz	120.32dB	13.61dB	**133.93dB**	133.7dB	20.34dB	**154.04dB**	143.51dB	43.39dB	**186.9dB**
2500MHz	122.26dB	14.71dB	**136.97dB**	135.64dB	21.62dB	**157.26dB**	145.45dB	44.56dB	**190.01dB**
3000MHz	123.84dB	15.65dB	**139.49dB**	137.23dB	22.76dB	**159.99dB**	147.03dB	45.5dB	**192.53dB**

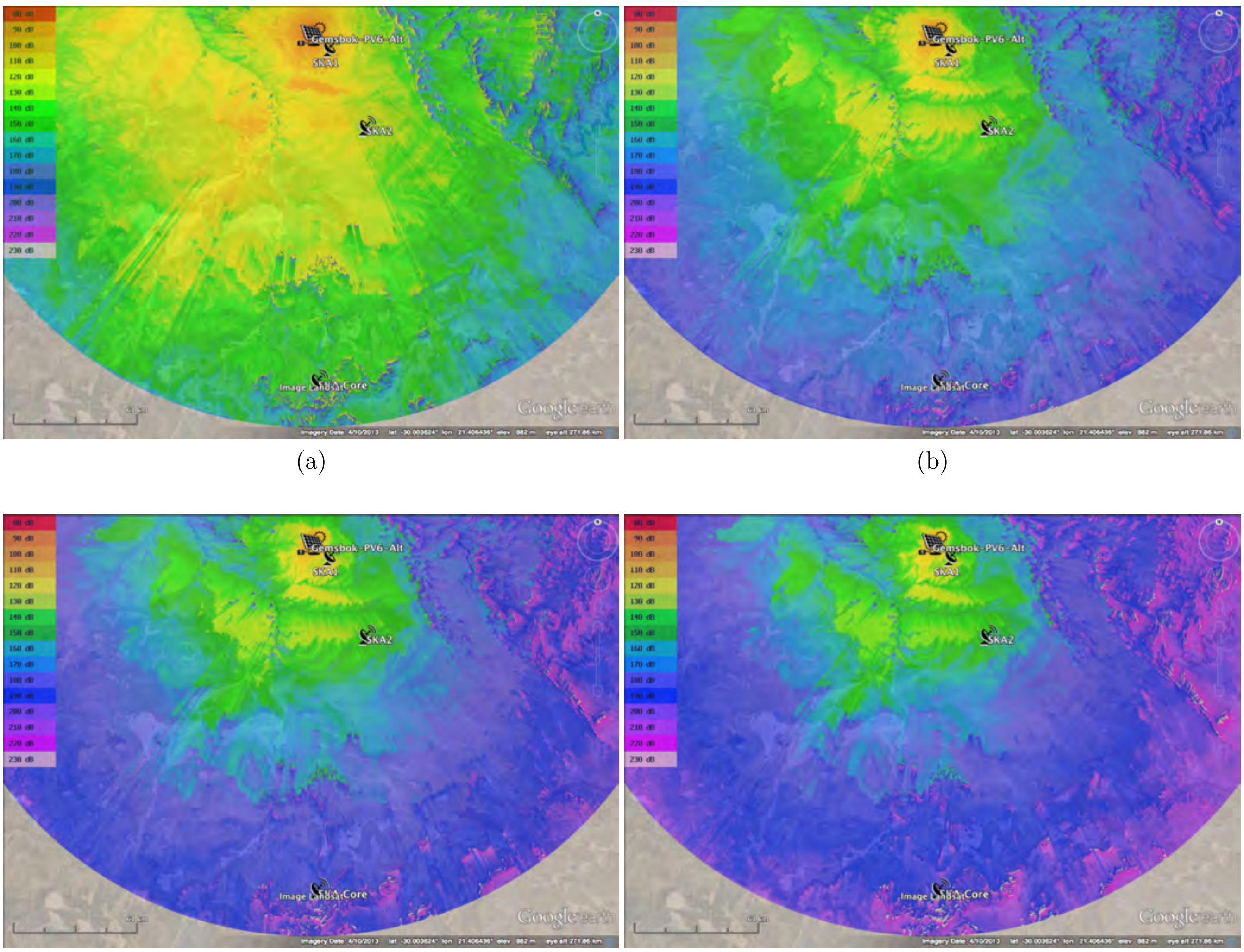
Table 46: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV6 emissions.



(a) (b)

(c) (d)

Figure 68: TPL attenuation maps for **preferred** site location of Gemsbok PV6 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 69: TPL attenuation maps for **alternative** site location of Gemsbok PV6 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

6 SKA Threshold Limits

SKA threshold limits are defined as *Protection Limits* (dBm/Hz as defined by SARAS) and *Receiver Saturation Limits* (-100 dBm). Using the attenuation maps and topographical profiles calculated in Section 5 , we next compare the acceptable levels as measured at 10 m from each plant (according to CISPR 11/22 class B) that will produce radiated emission levels 10 dB below the SKA threshold as defined by SARAS. The 10 dB theoretical value is a safety margin to ensure that each of the plants complies with the SKA threshold, and attempts to take into account any multi-path effects (6 dB variation) and any measurement uncertainties. The required level 10 dB below the threshold takes into account the TPL calculated by SPLAT! and are indicated as *Required Radiation Levels After Propagation Loss*. The required PSD of the radiated emission levels experienced at each telescope are given by Eq. 2 below. The required levels are represented by the *black squares* in Figs. 70 (b) to 72 (b) for projects to the closest and core SKA telescope sites respectively.

$$PSD_{\text{Required}}\,[dBm/Hz] = PSD_{\text{SARAS Continuum}}\,[dBm/Hz] - 10\,dB \tag{2}$$

Considering the TPL, the required PSD at the source of the interference, indicated as *Required Radiation Levels Before Propagation Loss at PV Plant* in Figs. 70 (b) to 72 (b), is given by:

$$PSD_{\text{Source}}\,[dBm/Hz] = PSD_{\text{Required}}\,[dBm/Hz] + TPL\,[dB] \tag{3}$$

The effective isotropic radiated power (EIRP) level at the source, that will result in an E-field E_0 as measured according to the CSIPR 11/22 Class B standard with a RBW and separation distance of 120 kHz and 10 m for f $<$ 1 GHz, and 1 MHz and 3 m for f $>$ 1 GHz respectively, is given by:

$$EIRP\,[dBm] = PSD_{\text{Source}}\,[dBm/Hz] + 10\log_{10}(RBW)\,[Hz] \tag{4}$$

The electric field (E_0) levels associated with the EIRP defined in Eq. 4, again as measured according to the CISPR 11/22 Class B standard, are shown in Figs. 70 (c) to 72 (c) and given by:

$$E_0\,[dB\mu V/m] = EIRP - 20\log_{10} D + 104.8 \tag{5}$$

The maximum EIRP levels of the source, to ensure the *Receiver Saturation Limit* of -100 dBm is met, are shown in Figs. 70 (a) to 72 (a) and given by:

$$EIRP_{\max}\,[dBm] = -100\,dBm + TPL\,[dB] \tag{6}$$

6.1 Cumulative Impact Assessment

In the case where there are more than one source of interference for a specific frequency, the cumulative effect should be considered by taking into account:

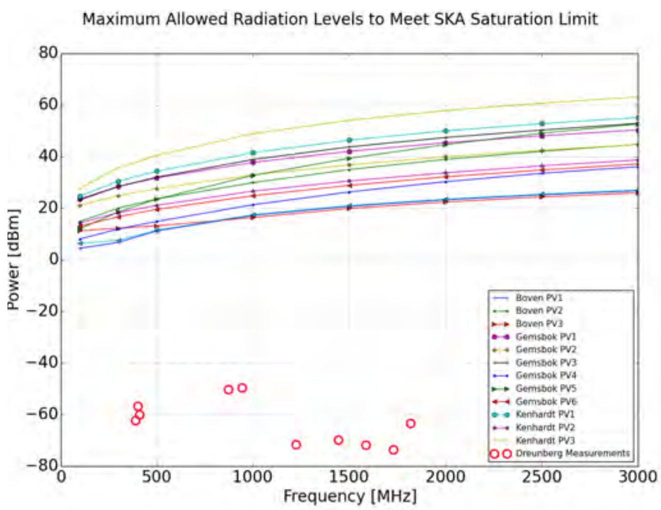
$$P_{\text{Cumulative}} = 10\log_{10}(N) \tag{7}$$

where $N = 13$ is the number of PV plants. This implies an increase in interference levels of up to 11.1 dB and is therefore subtracted from the maximum allowable radiated limits in Figs 70 to 72.

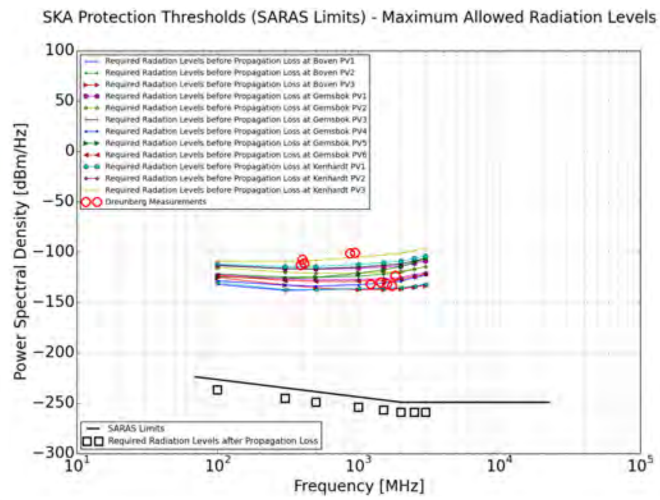
6.2 Maximum Allowed Radiation Levels

Below are given the maximum allowed radiation levels to meet both SKA *Saturation* and *Protection Threshold* (SARAS) limits for the two closest and core site telescopes for each of the proposed sites.

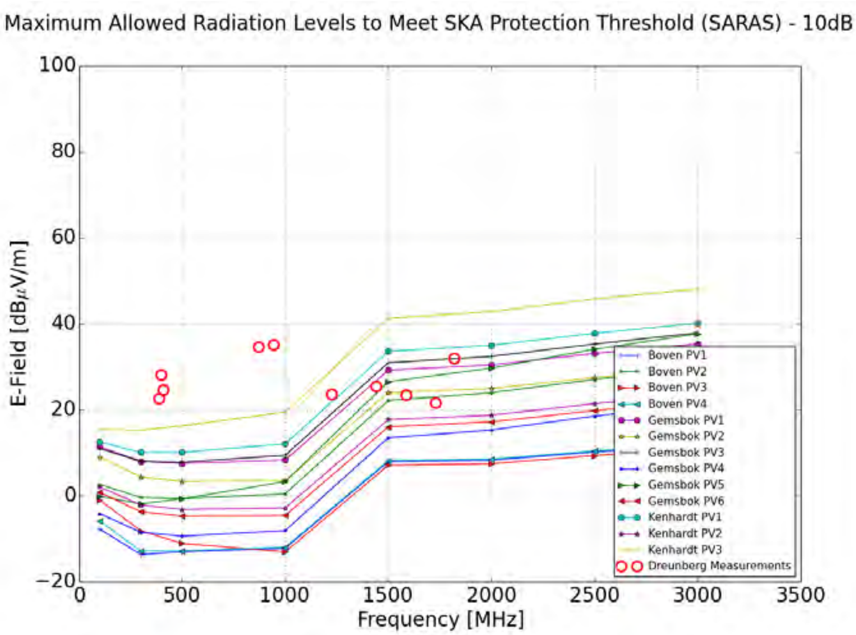
6.2.1 Closest SKA Telescope



(a)



(b)



(c)

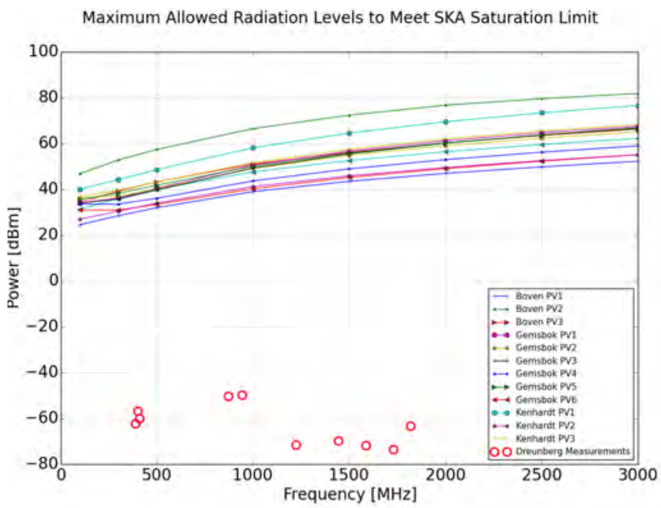
Figure 70: Closest SKA telescope receiver: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 47 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 70. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. The required 50 dB of shielding at Boven PV1 @ 942 MHz, for example, would require significant attention to detail to achieve.

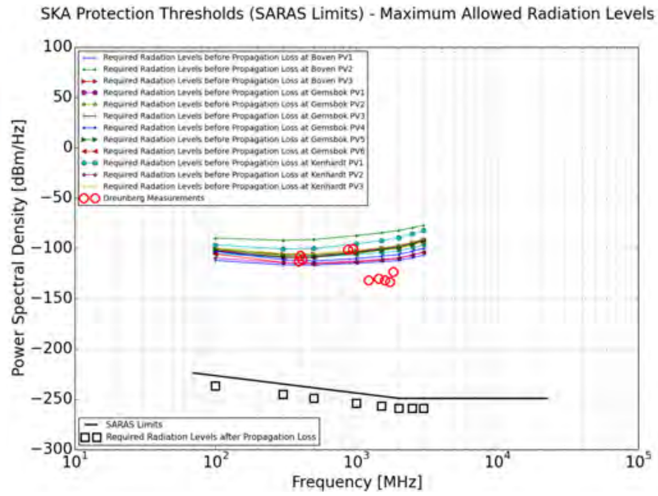
Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	12.55	18.03	14.58	23.06	23.28	1.96	-5.57	-10.4	-12.54	-2.51
Kenhardt PV2	25.23	30.77	27.38	37.53	37.99	17.28	10.17	5.52	3.5	13.6
Kenhardt PV3	6.94	12.37	8.87	15.98	16.03	-5.57	-13.22	-18.11	-20.3	-10.3
Boven PV1	36.02	41.47	37.99	47.05	47.43	26.85	19.92	15.43	13.61	23.82
Boven PV2	23.16	28.66	25.23	34.35	34.79	13.48	5.88	0.97	-1.29	8.67
Boven PV3	32.07	37.73	34.44	47.17	47.95	27.69	20.76	16.27	14.45	24.66
Boven PV4	35.48	40.95	37.5	46.79	47.17	26.59	19.66	15.17	13.35	23.56
Gemsbok PV1	14.85	20.36	16.94	26.52	26.91	5.98	-1.29	-6.01	-8.08	1.99
Gemsbok PV2	18.72	24.26	20.87	31.2	31.68	11.01	3.92	-0.72	-2.73	7.38
Gemsbok PV3	14.75	20.25	16.81	25.63	25.9	4.6	-2.93	-7.77	-9.92	0.09
Gemsbok PV4	31.52	37.06	33.66	43.06	43.38	22.1	14.54	9.64	7.38	17.34
Gemsbok PV5	24.01	29.42	25.92	32.36	32.29	9.96	1.69	-3.63	-6.27	3.43
Gemsbok PV6	26.8	32.34	28.94	39.25	39.73	19.02	11.88	7.2	5.14	15.21

Table 47: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the closest SKA telescope.

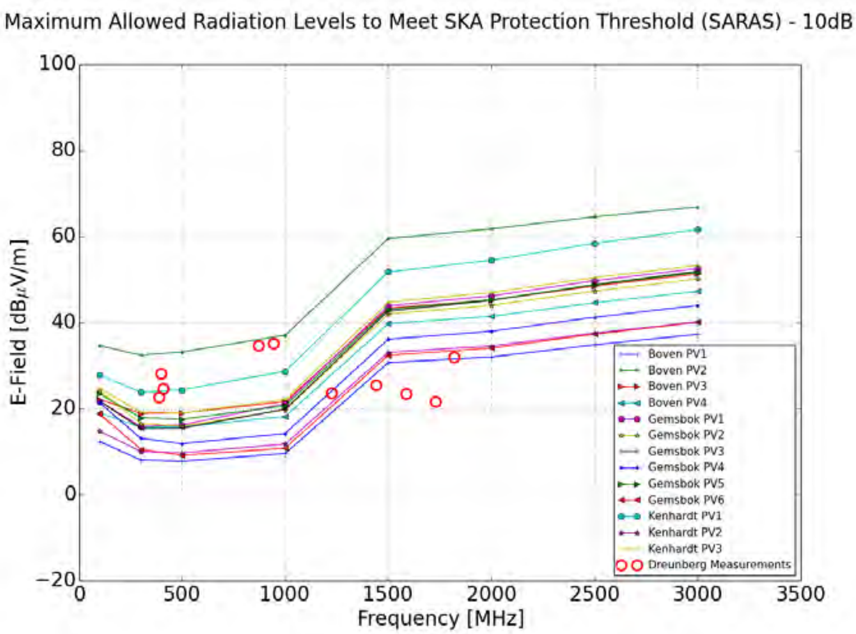
6.2.2 2nd Closest SKA Telescope



(a)



(b)



(c)

Figure 71: 2nd closest SKA telescope receiver: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 48 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 71. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the second closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. The required 50 dB of shielding at Boven PV1 @ 942 MHz, for example, would require significant attention to detail to achieve.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	-1.38	4.07	0.59	7.05	6.94	-15.35	-23.55	-28.78	-31.31	-21.52
Kenhardt PV2	12.74	18.24	14.81	23.39	23.6	2.36	-5.07	-9.89	-12.05	-2.03
Kenhardt PV3	3.57	9.07	5.63	13.31	13.36	-8.6	-16.59	-21.69	-24.06	-14.19
Boven PV1	14.73	20.23	16.8	25.52	25.77	4.64	-2.72	-7.48	-9.58	0.46
Boven PV2	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV3	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV4	6.95	12.43	8.98	17.08	17.24	-4.17	-11.73	-16.61	-18.82	-8.84
Gemsbok PV1	6.64	12.1	8.64	14.75	14.56	-7.66	-15.72	-20.84	-23.23	-13.37
Gemsbok PV2	6.39	11.91	8.49	15.91	15.87	-6.01	-13.88	-18.9	-21.21	-11.29
Gemsbok PV3	7.22	12.7	9.25	15.89	15.77	-6.42	-14.51	-19.67	-22.11	-12.27
Gemsbok PV4	10.1	15.65	12.27	21.01	21.18	-0.36	-8.05	-13.0	-15.27	-5.33
Gemsbok PV5	4.92	10.42	6.99	14.78	14.84	-7.04	-14.98	-20.04	-22.4	-12.51
Gemsbok PV6	12.72	18.28	14.91	24.24	24.5	3.19	-4.35	-9.23	-11.45	-1.48

Table 48: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the second closest SKA telescope.

6.2.3 Core SKA Telescopes

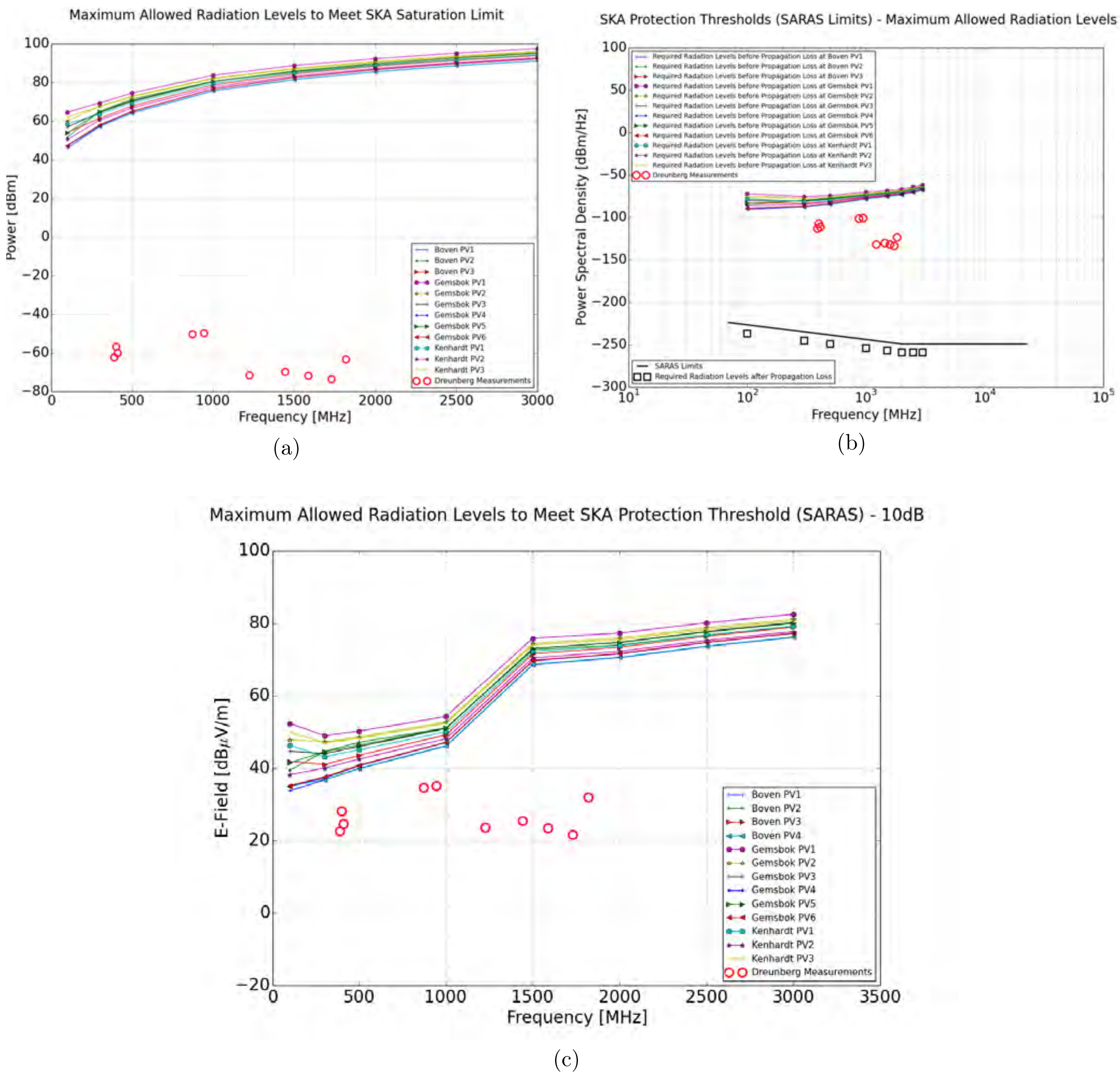


Figure 72: Core SKA telescope receivers: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 49 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 72. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. Towards the core site sufficient path attenuation exist to ensure emissions are below required limits.

Site Location	**387.38 MHz**	**399.19 MHz**	**409.52 MHz**	**871.57 MHz**	**942.42 MHz**	**1223.81 MHz**	**1441.27 MHz**	**1584.12 MHz**	**1728.57 MHz**	**1819.05 MHz**
Kenhardt PV1	-21.33	-15.96	-19.51	-14.15	-14.35	-36.27	-44.03	-48.97	-51.19	-41.21
Kenhardt PV2	-18.46	-13.12	-16.7	-12.06	-12.35	-34.46	-42.33	-47.32	-49.57	-39.61
Kenhardt PV3	-24.93	-19.53	-23.04	-16.73	-16.81	-38.43	-46.01	-50.85	-52.99	-42.97
Boven PV1	-15.48	-10.18	-13.79	-9.87	-10.25	-32.51	-40.46	-45.49	-47.77	-37.84
Boven PV2	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV3	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV4	-15.58	-10.28	-13.89	-10.0	-10.38	-32.64	-40.59	-45.62	-47.89	-37.95
Gemsbok PV1	-26.86	-21.45	-24.96	-18.6	-18.67	-40.28	-47.85	-52.69	-54.83	-44.81
Gemsbok PV2	-25.18	-19.78	-23.3	-17.06	-17.15	-38.81	-46.41	-51.27	-53.42	-43.41
Gemsbok PV3	-22.2	-16.84	-20.39	-15.06	-15.27	-37.2	-44.97	-49.91	-52.13	-42.16
Gemsbok PV4	-16.1	-10.82	-14.44	-10.79	-11.19	-33.51	-41.49	-46.53	-48.82	-38.89
Gemsbok PV5	-22.7	-17.32	-20.87	-15.26	-15.43	-37.26	-44.97	-49.88	-52.07	-42.09
Gemsbok PV6	-16.36	-11.07	-14.68	-10.91	-11.31	-33.62	-41.61	-46.65	-48.94	-39.0

Table 49: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the core-site SKA telescopes.

7 Plant Design Overview

RFI associated with the regular switching of relays and contactors to operate the single axis tracking systems has subsequently been found by MESA Solutions to be contributors of significant levels of broadband interference. Assuming a tracking PV plant design, significant care and effort will be required to shield the broadband interference generated during operation of the tracking units.

7.1 Expected Sources of Interference

The biggest RFI producing culprits for a plant layout incorporating a similar tracking philosophy were identified to be the inverter units and solar power tracker and monitoring controllers. Coupled to this is the way cabling is distributed throughout the plant. The combination of all three factors will influence the level of interference each plant is likely to produce.

- **Inverters**
  - The inverters are considered to be the main source of interference due to their switching operation through which the direct current (DC) from the panels is converted to alternating current (AC) supplied to the transformers. This interference can be in the form of CM current present on the cables connected to the units, or through direct radiation.
- **Solar Power Tracker and Monitoring Controller**
  - RFI associated with the regular switching of relays and contactors to operate the single axis tracking systems has recently been found to be prominent sources of interference. These relays will switch the motors or hydraulic pumps on and off on a regular basis during the day, resulting in broadband interference with substantial frequency content. Furthermore, RFI generated by the tracking controller is typically due to the default system operation implementing a wireless mesh network for communication purposes between units. A number of other electrical components, which are also likely sources of interference, form part of the controller.
- **Cable Routing and Earthing**
  - The way noise-producing equipment in the plant are interconnected has a significant influence on the level of RFI emitted. Cabling is the means by which interference in the form of common mode current (CM) is distributed. When sections of cabling become resonant, the interference is radiated into the environment. Depending on a number of factors such as height of transmission, frequency, emission level at source and topography, the interference will have a certain severity at the nearest SKA telescope as well as the core-site.

7.2 Mitigating Measures

It is strongly recommended that the following **mitigation practises** be incorporated into the plants design. The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment. For shielding of such an environment ensure RFI gasketting be placed on all the seams and doors. Furthermore, RFI Honeycomb filtering should be placed on all ventilation openings. It is important to ensure that the cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves). The use of bare copper directly in soil for earthing is recommended to shunt CM interference currents to ground. In the case of a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps/motors of the tracking units. It is recommended that data communications to and from the plants to be via fibre optic.

7.3 Expected RFI Reductions due to Mitigation Measures

By simply following good practices such as implementing an adequate earthing philosophy, and paying attention to the cabling interconnections and layout below ground, a reduction of at least 20 dB in the typical plant emissions across the frequency range of interest can be achieved. With added attention to detail, particularly regarding the shielding of enclosures, defining cable interfaces by correctly terminating cable screens or armouring, and the use of galvanic earthed cable trays for short cable runs above ground, a total reduction of 40 dB is likely. A further 20 dB reduction would require detailed analysis of the required enclosure shielding and gasketting, more stringent filtering at all cable interfaces, and implementing additional cable screening that could include using fully enclosed metallic cable conduits. It is therefore MESA's expectations that if the mitigation measures specified are implemented correctly, an improvement of between 20 and 40 dB in emissions levels are likely. The required maximum mitigation of 50 dB towards the closest telescopes for some plant locations would therefore require significant care. **It is important to note that this is purely predicted values and cannot be guaranteed or confirmed until measurements on operating plants (or representative installations) with recommended mitigation measures have been performed.**

8 Conclusions

MESA Solutions was asked by *Scatec Solar* to do a cumulative topographical analysis of the terrain profile between three proposed *Scatec Solar* PV projects, as well as ten proposed *Mulilo* PV projects, towards the closest and core-site SKA Telescopes. The purpose of the investigation is to define a level that can be verified through measurements which will result in an equivalent emission level that is 10 dB below the SKA threshold limit. This measurement level is influenced by the TPL between both telescope locations. However, the TPL is a function of topography and frequency as well as characteristics such as the transmitter and receiver heights. The measurement level is related to the well-known CISPR 11/22 Class B standard that is defined at a measurement distance of 10 m for frequencies below 1 GHz and at 3 m for frequencies above 1 GHz.

From the results in Section 6 it is clear that radiated emissions at levels below that of CISPR 11/22 Class B are required (especially in the case of the closest telescope). This is mainly due to the absence of any TL over this short distance. This requirement relaxes slightly toward the second closest telescope, while allowable measured levels increase to slightly above the CISPR limit due to the additional TL toward the core. The possibility exists that, due to the large number of sites that are proposed in that area, the overall lower levels would have to be achieved to limit interference to the closest telescopes as much as possible. A comparison between measured plant RFI and required mitigation or surplus attenuation have been provided for the closest and core site telescopes

It is strongly recommended that the following **mitigation practises** be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment.
- For shielding of such an environment ensure:
  - RFI gasketting be placed on all seams and doors.
  - RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves).
- The use of bare copper directly in soil for earthing is recommended.
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps/motors of the tracking units.

The three proposed Kenhardt plants are shown in Table 47 to exceed the SARAS protection levels by up to 38 dB toward the closest SKA telescope. This includes the cumulative effect of a total of $N = 13$ PV plants developed.

However, Boven PV1, PV3 and PV4 exceed this limit by approximately 50 dB in this scenario. For the case where only the three Kenhardt plants are developed, the exceedance will reduce to 31.6 dB with a cumulative effect for $N = 3$ plants considered.

It is MESA's expectations that, if the mitigation measures that are specified are implemented correctly, an improvement of between 20 and 40 dB in emissions levels are likely. However the maximum required attenuation for some of the plants towards the closest telescope would require significant attention to detail to achieve shielding levels of 50 dB. If required attenuation for the closest telescope is achieved, the second closest and core site will comply. *It is important to note that this is purely predicted values and cannot be guaranteed or confirmed until measurements on a representative mock-up installation with mitigation measures implemented are performed. It remain the developers responsibility to ensure that compliance to SKA requirements is met and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.*

MESA Solutions
Drs A. J. Otto and P. S. van der Merwe
January 2016

References

[1] *Astronomy Geographic Advantage Act, 2007*, No. 21 of 2007, Government Gazette, Vol. 516, No. 31157, Cape Town, Republic of South Africa, 17 June 2008.

[2] P. Dewdney and G. Han Tan, *SKA EMI/EMC Standards and Procedures*, Technical Report SKA-TEL-SKO-0000202, Revision 1, Square Kilometre Array (SKA) Organisation, Jodrell Bank Observatory, UK, 10 January 2015.

[3] A. J. Otto and P. S. van der Merwe, *Topographical Analysis of Proposed Nieuwehoop PV Projects*, Technical Report, MUL/NH/15/07/28, MESA Solutions (Pty) Ltd., Stellenbosch, Western Cape, South Africa, 7600, 31 July 2015.

[4] A. J. Otto and P. S. van der Merwe, *Basic Site Assesment of Proposed Prieska Photovoltaic Plant*, Technical Report, SUN/14/08/22, Revision 0, MESA Solutions Pty (Ltd), Stellenbosch, South Africa, 22 August 2014.

Appendix

A Fresnel Zones and Line of Sight

The Fresnel zones and elevation profiles, including the earth curvature, are shown in Figs. 73 to 132. In all case the profiles are given towards the two closest and core-site SKA telescopes. A more detailed terrain profile shows features not visible in a normal Google Earth profile. This profile is then compensated for the earth curvature, clearly visible for the longer distance toward the core site. Important to note is the scale used in these figures. The elevation change is in meters but the separation distance varies in kilometres. The earth curvature representation is therefore somewhat enhanced.

A.1 Boven PV1 to Closest SKA

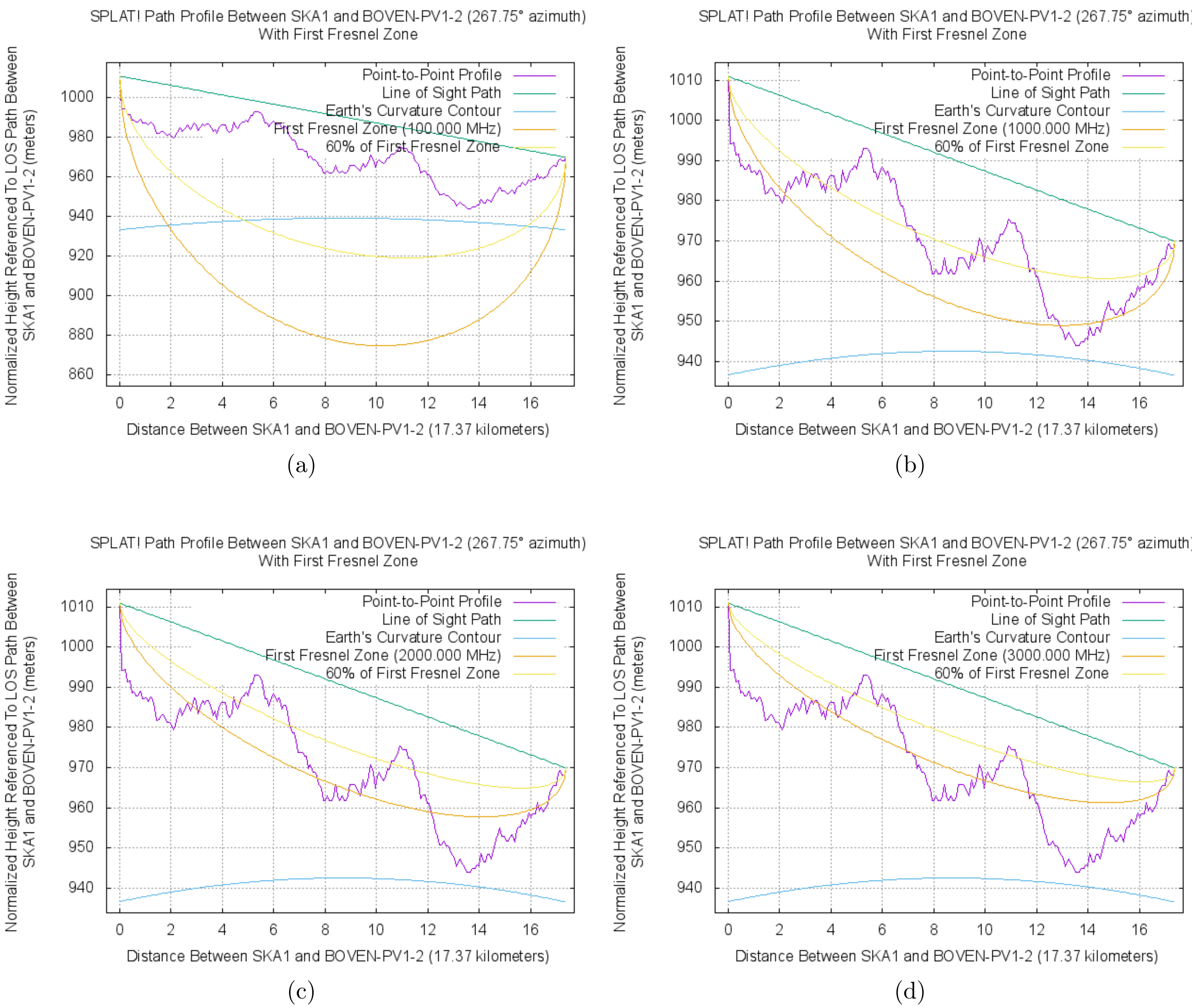
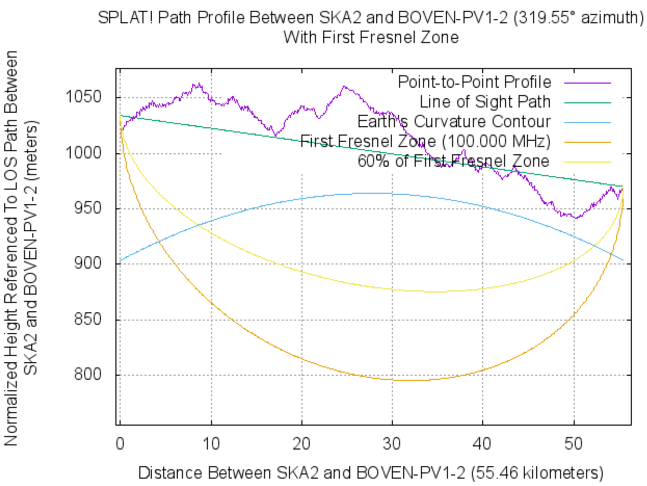
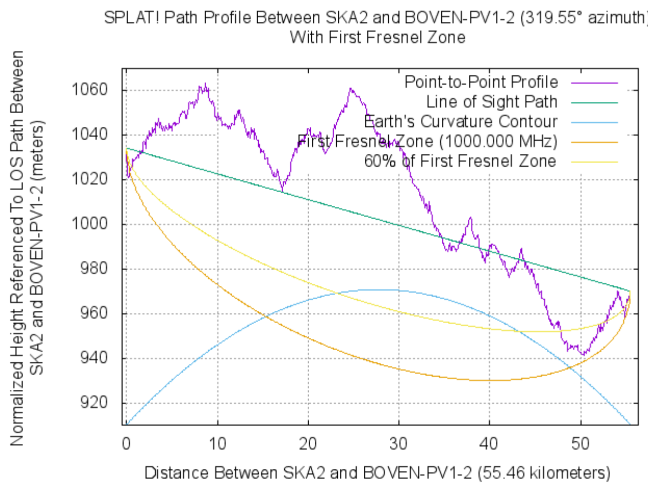


Figure 73: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.2 Boven PV1 to 2nd Closest SKA



(a)



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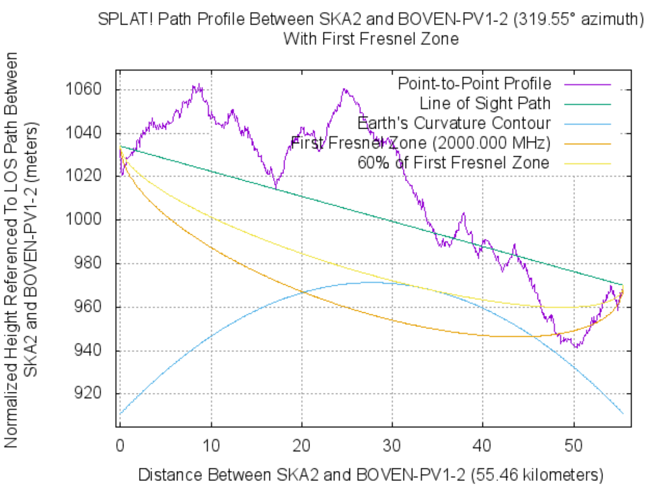
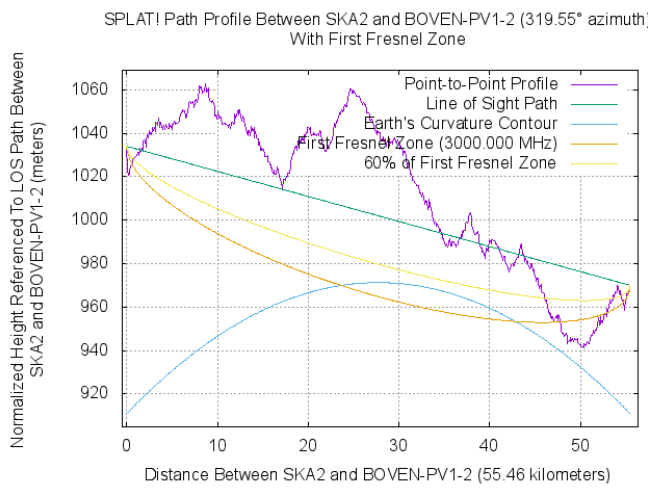


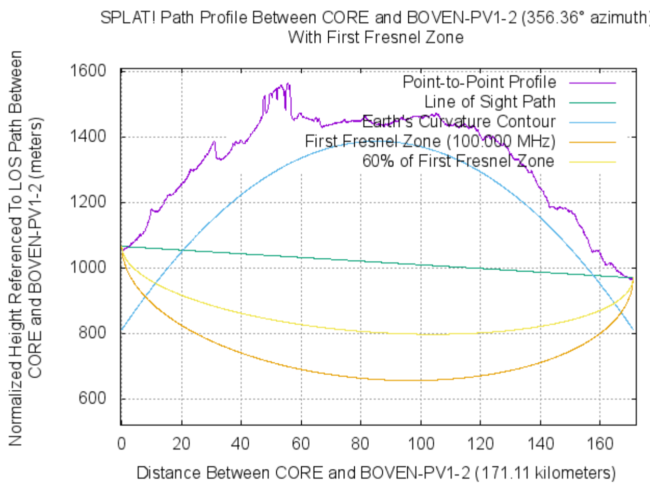
(c)



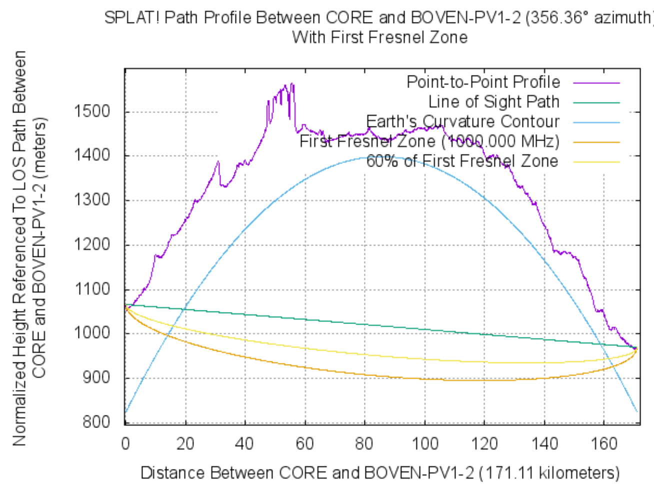
(d)

Figure 74: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

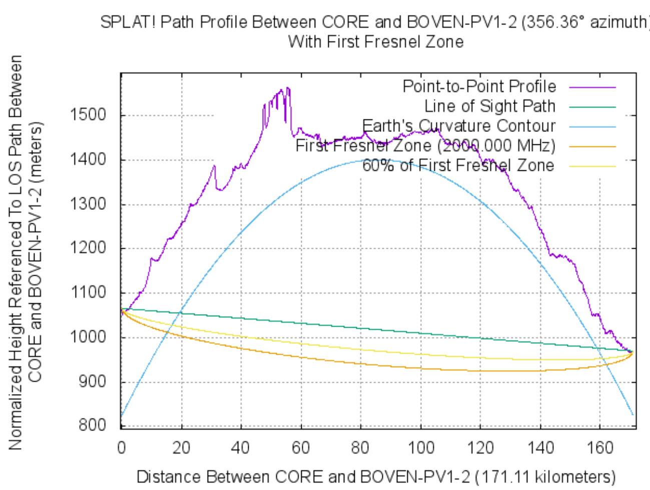
A.3 Boven PV1 to Core SKA



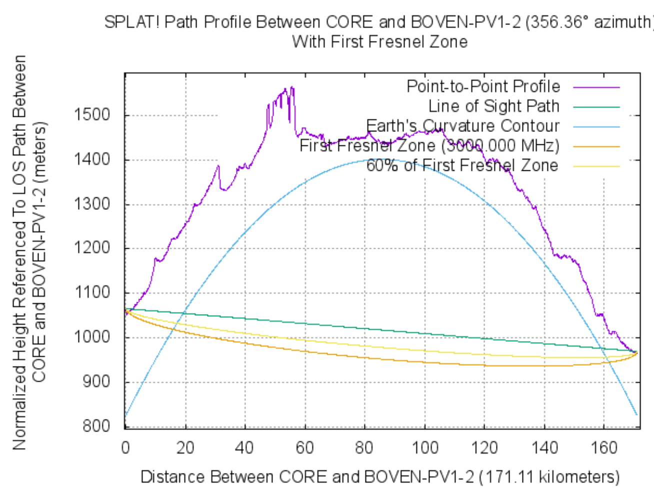
(a)



(b)



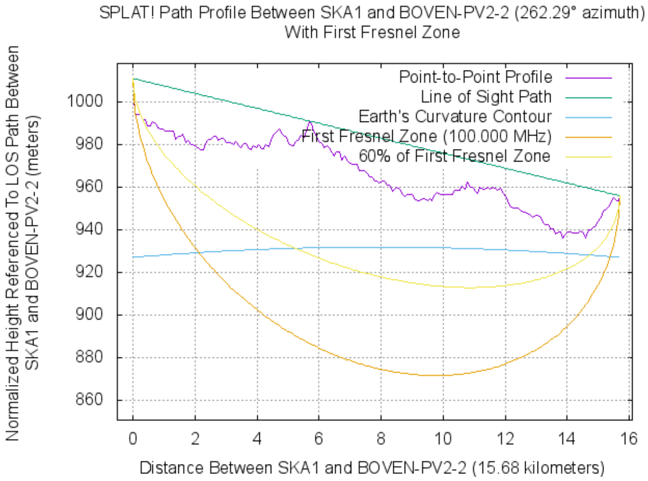
(c)



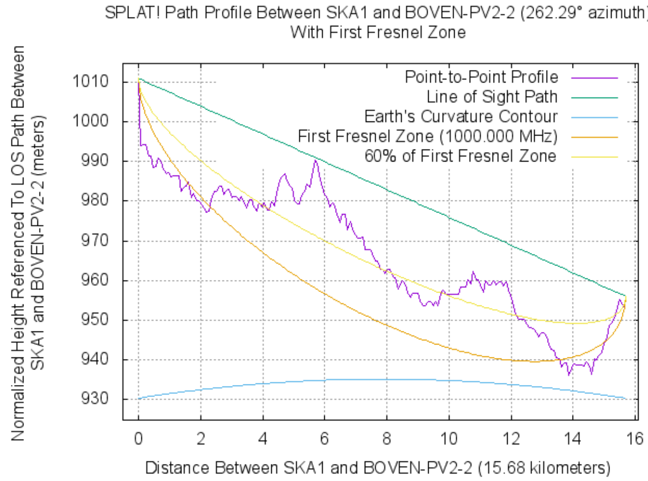
(d)

Figure 75: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

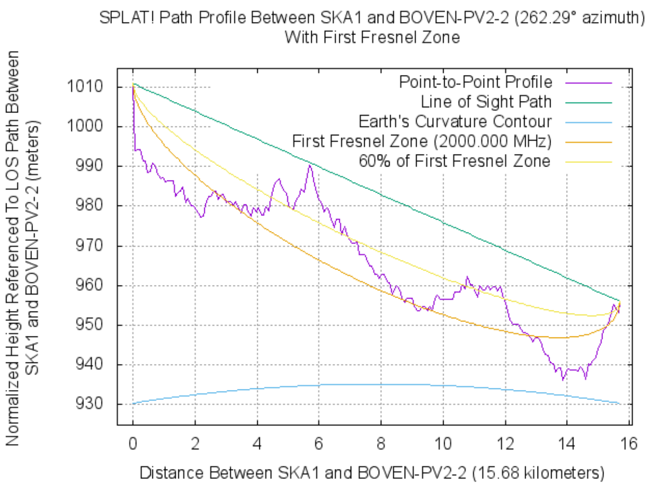
A.4 Boven PV2 to Closest SKA



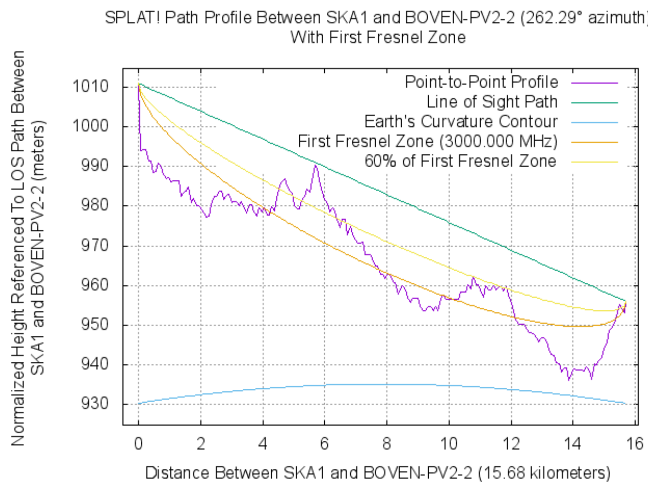
(a)



(b)



(c)



(d)

Figure 76: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.5 Boven PV2 to 2nd Closest SKA

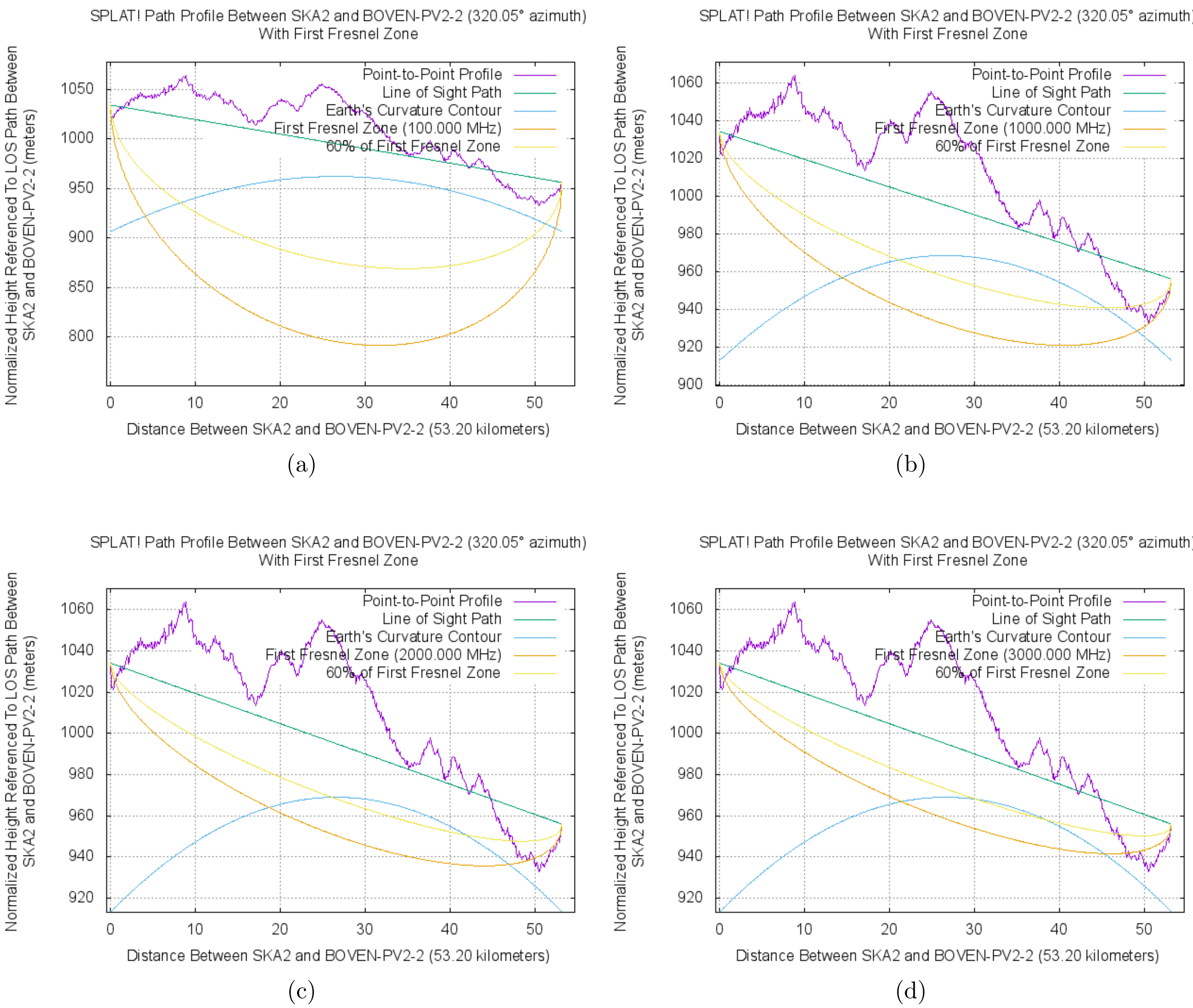


Figure 77: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.6 Boven PV2 to Core SKA

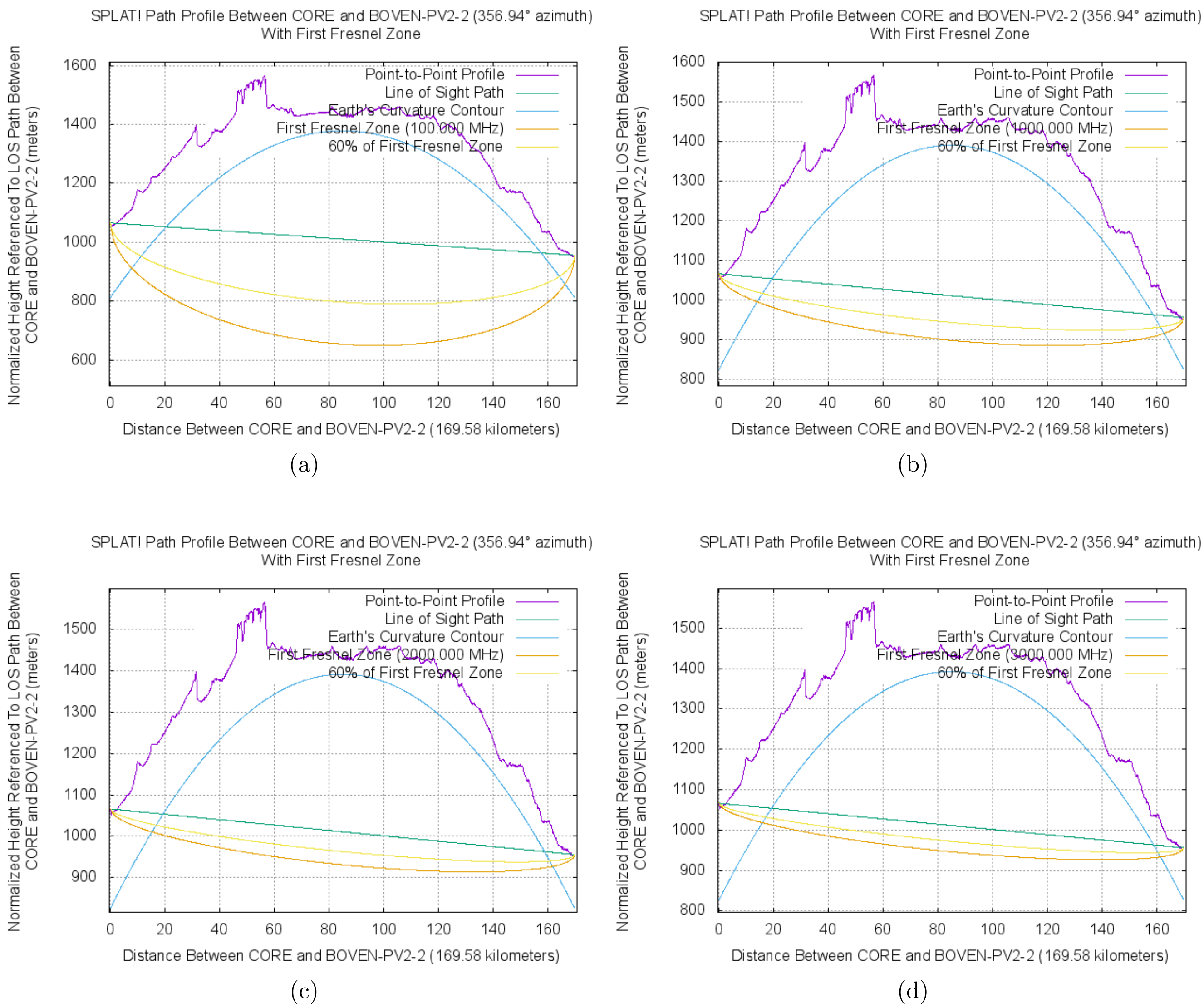


Figure 78: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.7 Boven PV2 Alternative to Closest SKA

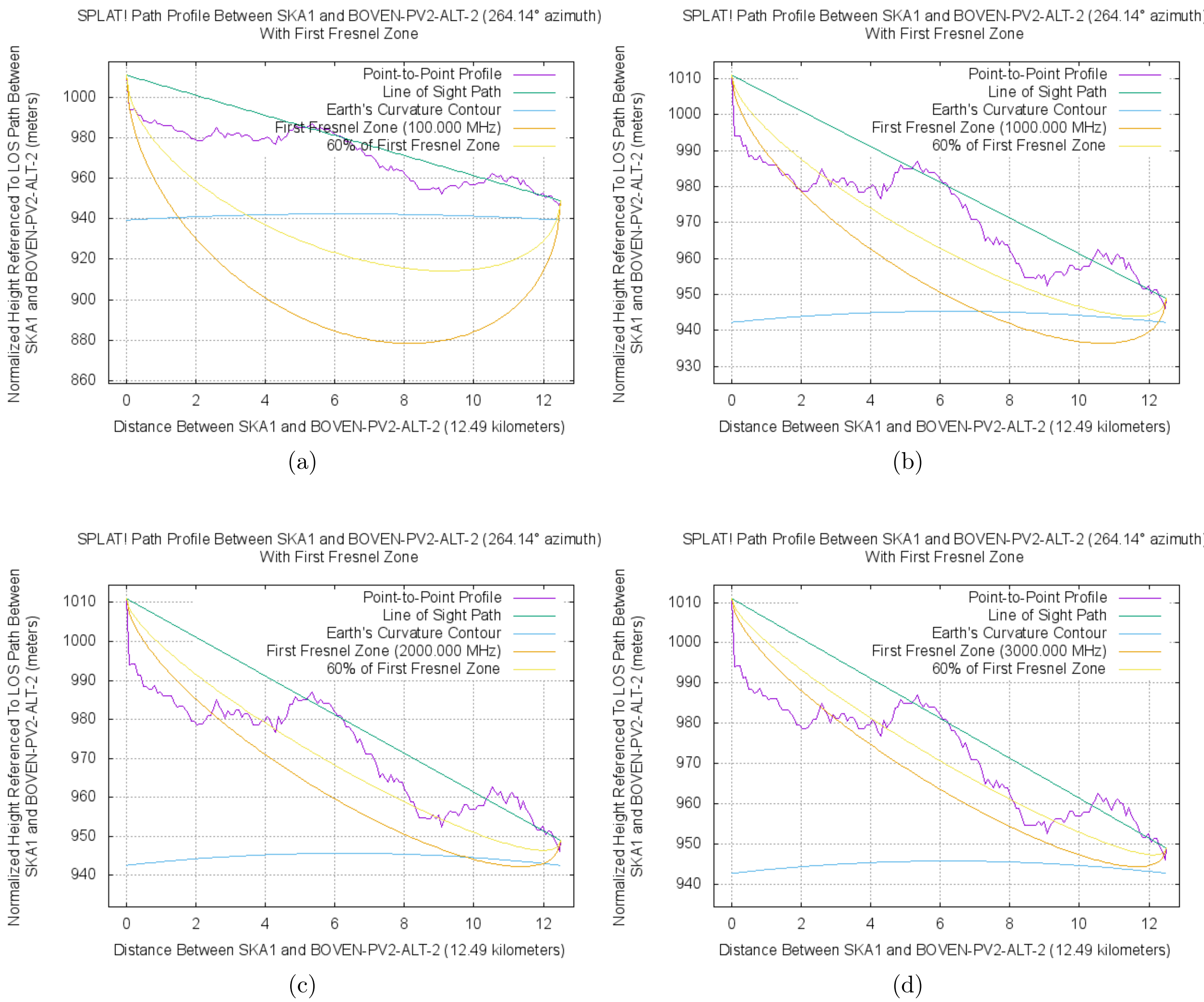


Figure 79: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.8 Boven PV2 Alternative to 2nd Closest SKA

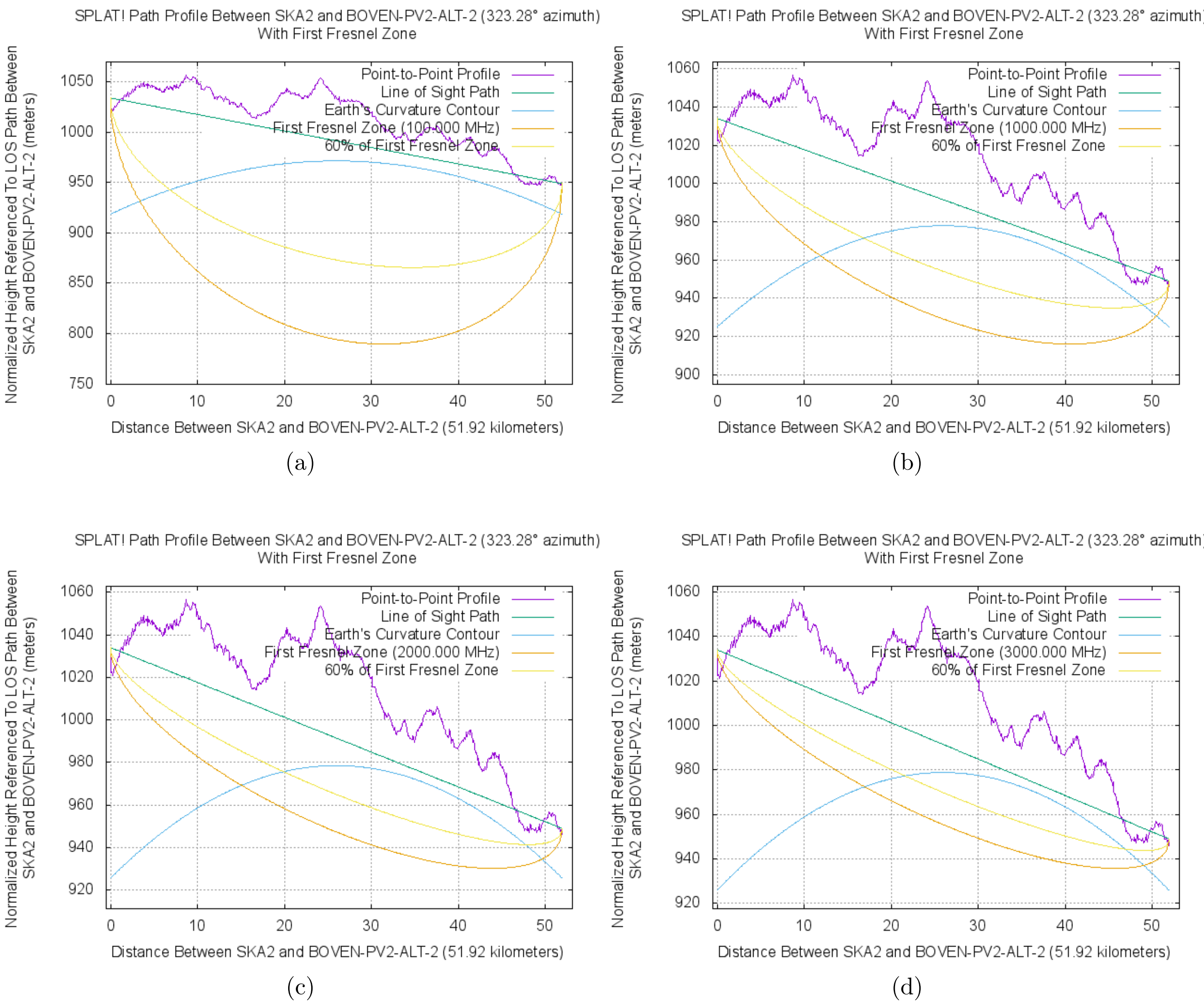


Figure 80: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.9 Boven PV2 Alternative to Core SKA

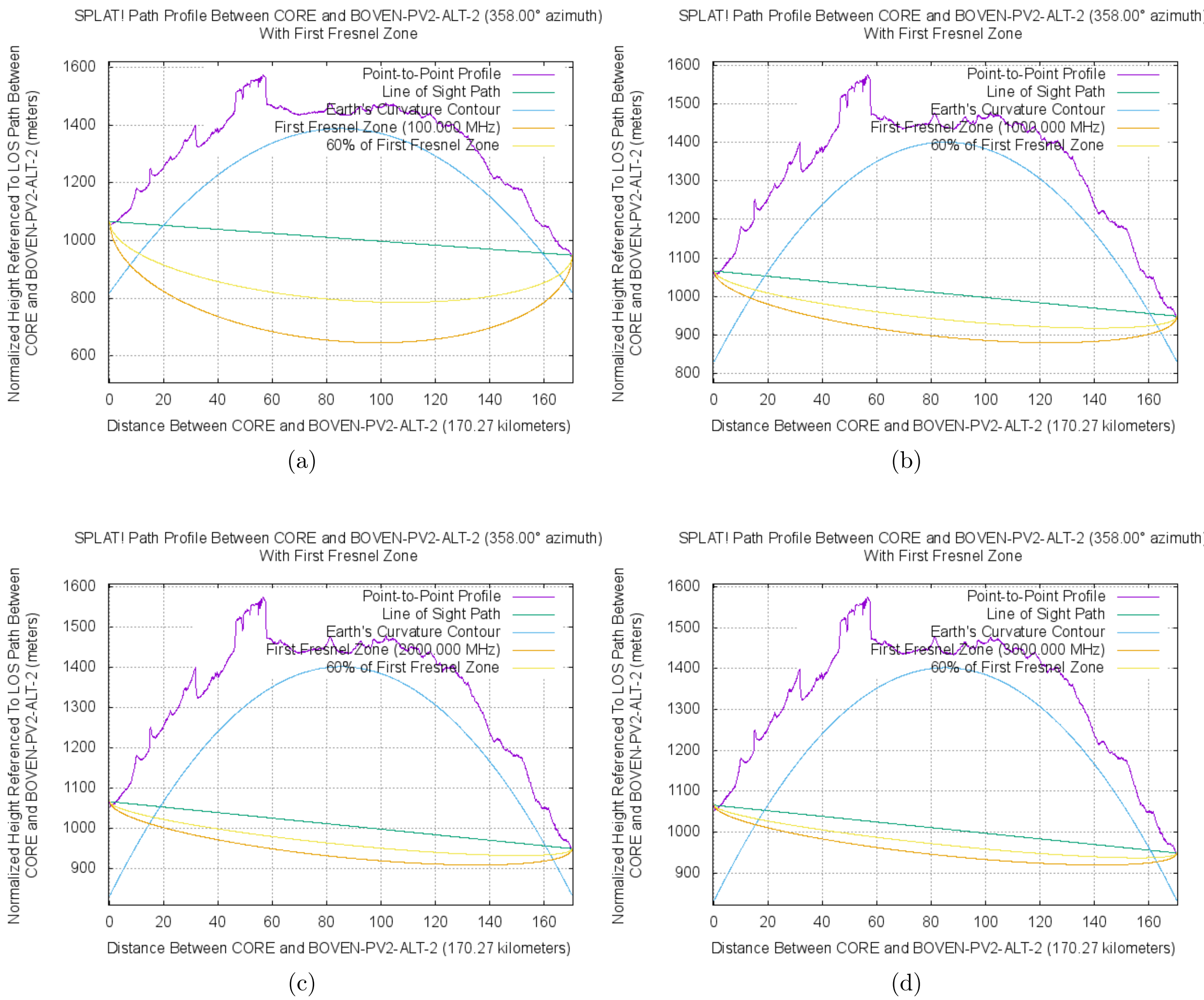


Figure 81: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.10 Boven PV3 to Closest SKA

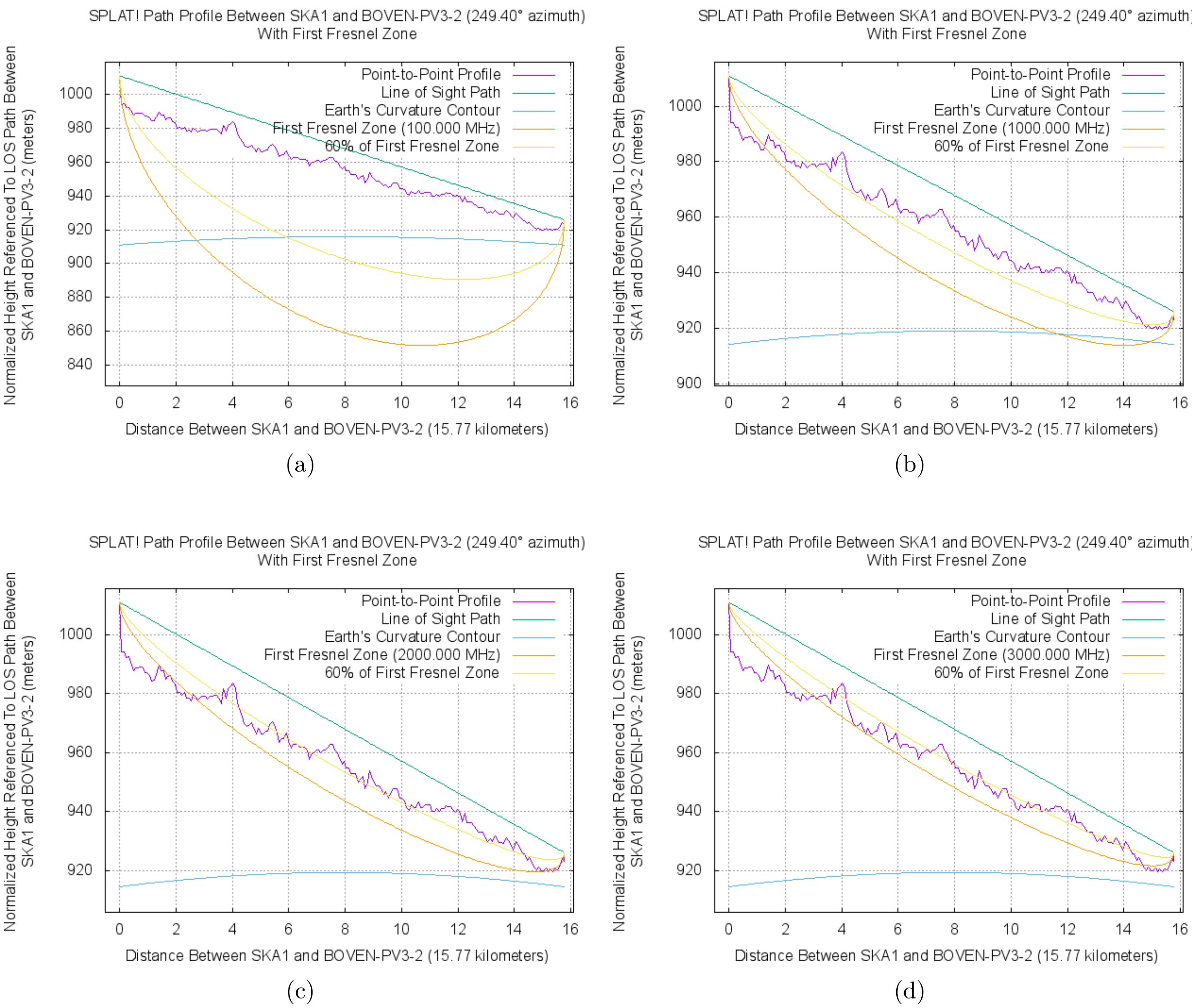


Figure 82: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.11 Boven PV3 to 2nd Closest SKA

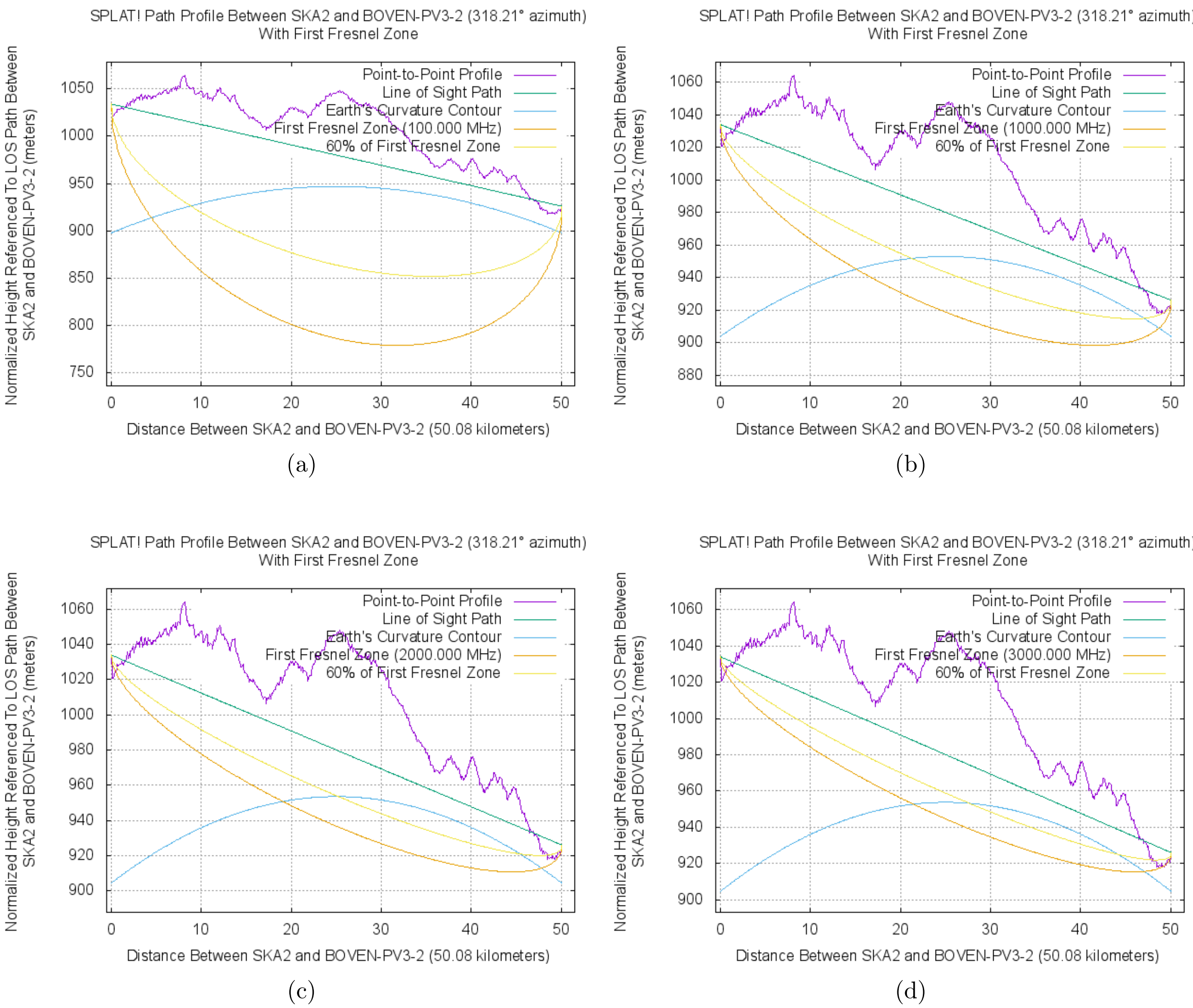
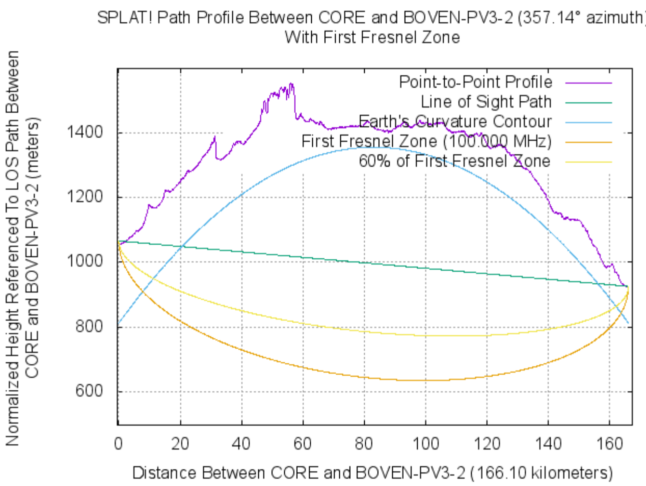
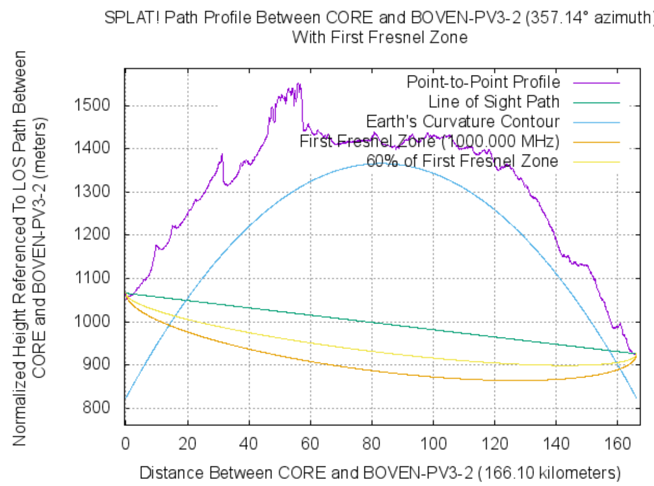


Figure 83: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

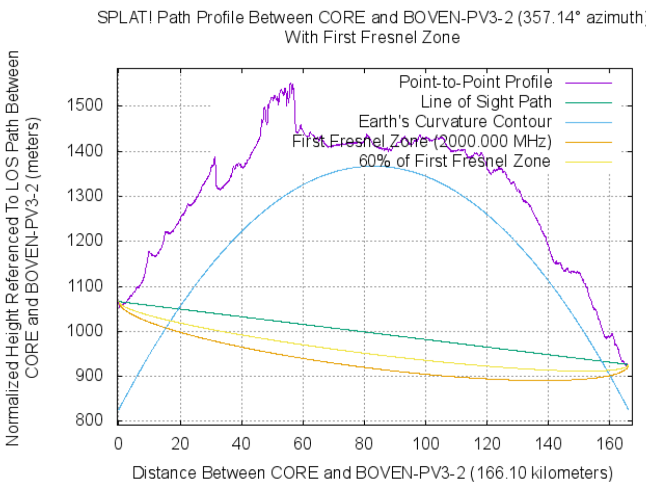
A.12 Boven PV3 to Core SKA



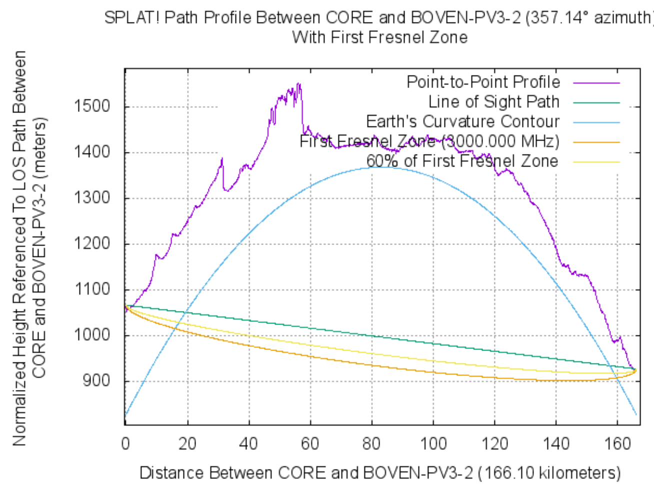
(a)



(b)



(c)



(d)

Figure 84: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.13 Boven PV3 Alternative to Closest SKA

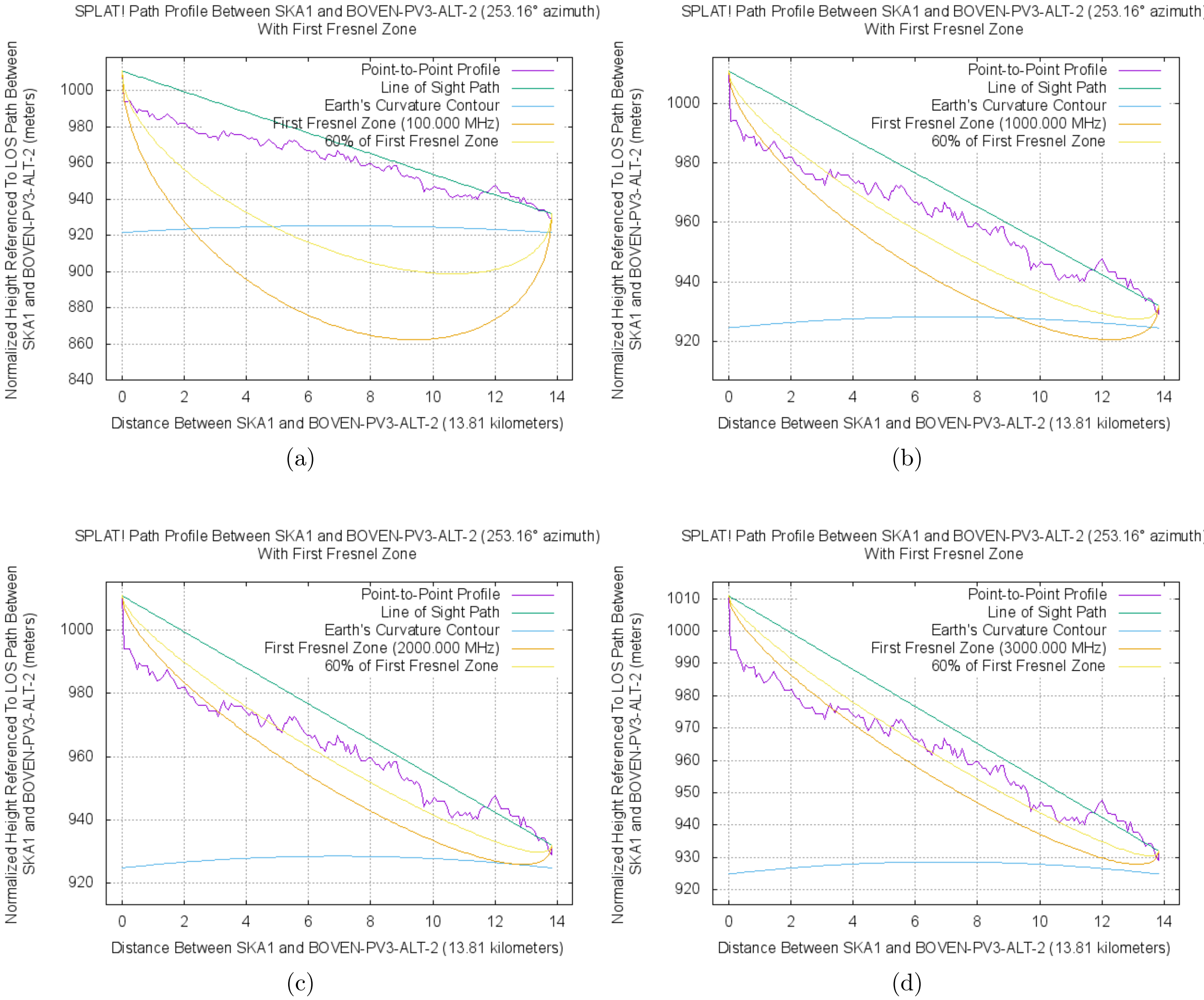
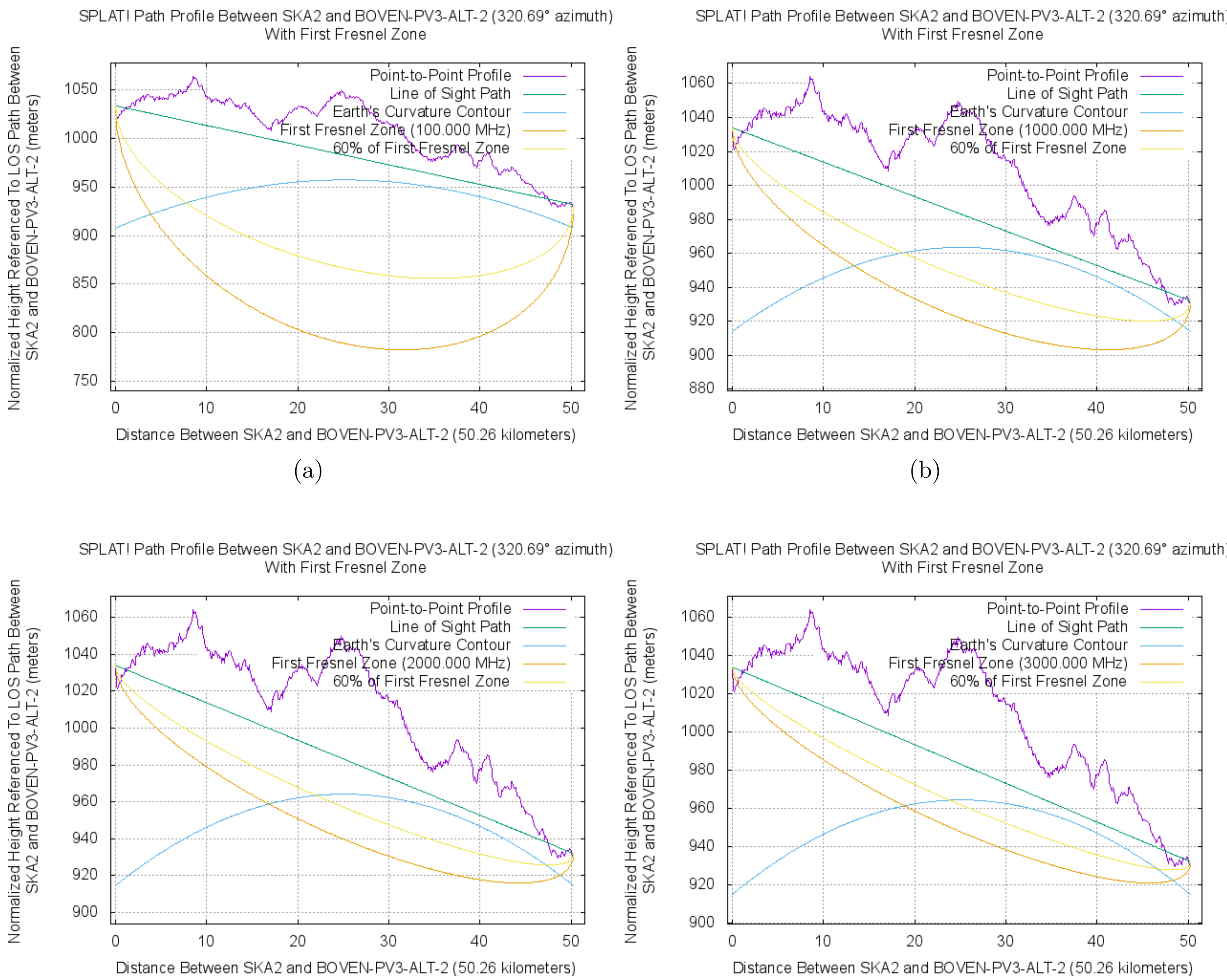


Figure 85: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.14 Boven PV3 Alternative to 2nd Closest SKA



(a) (b) (c) (d)

Figure 86: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.15 Boven PV3 Alternative to Core SKA

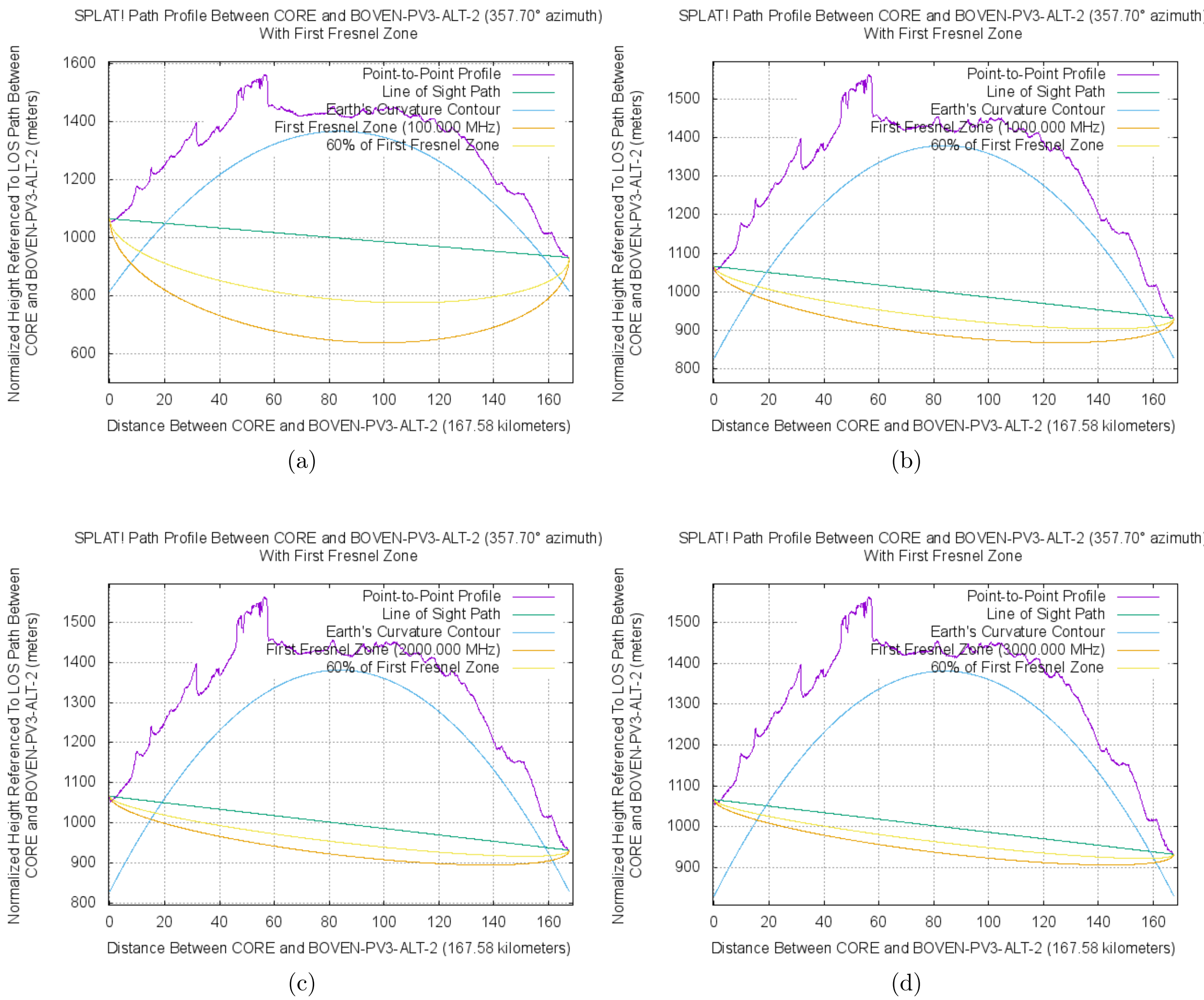


Figure 87: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.16 Boven PV4 to Closest SKA

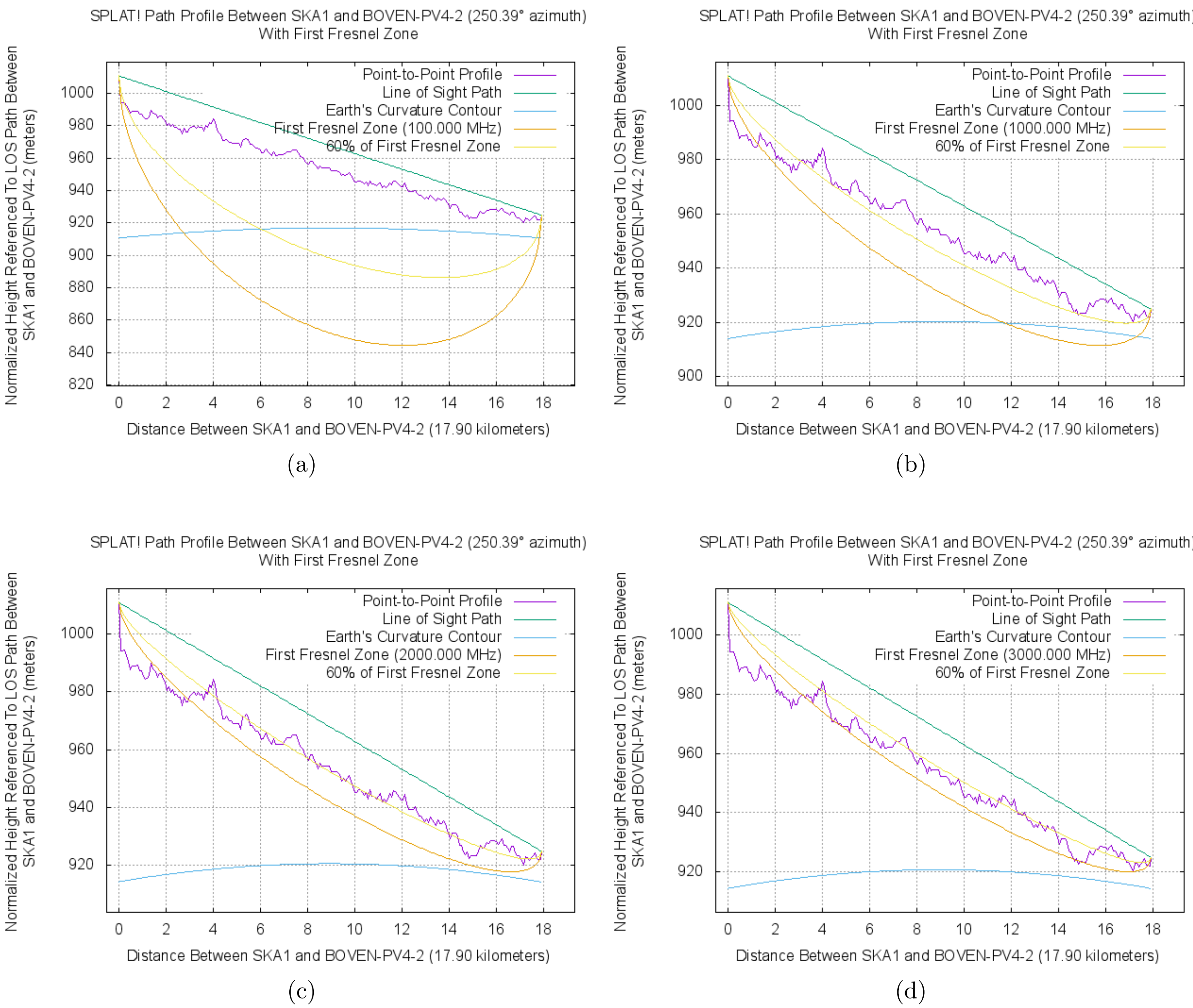
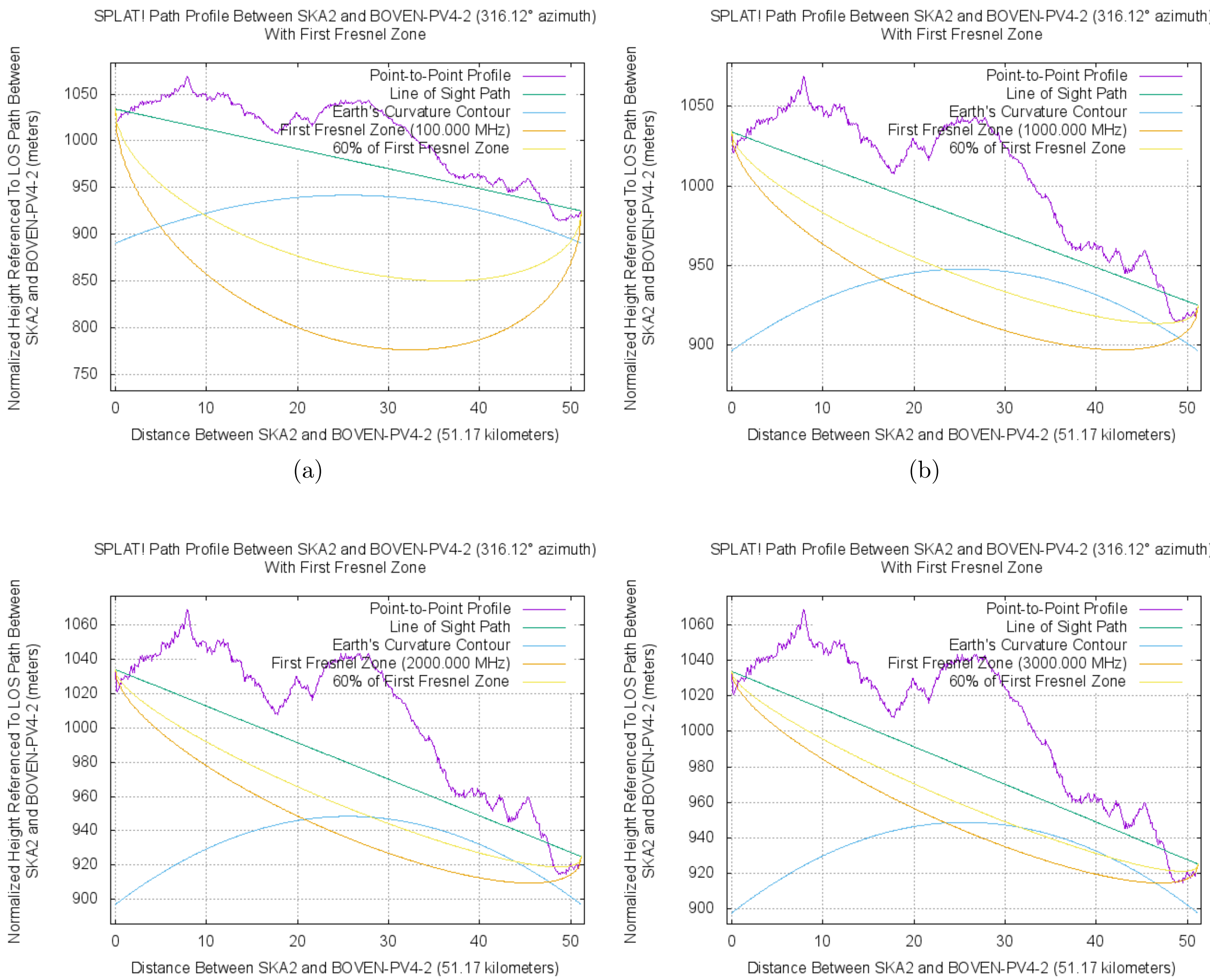


Figure 88: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.17 Boven PV4 to 2nd Closest SKA



(c) (d)

Figure 89: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.18 Boven PV4 to Core SKA

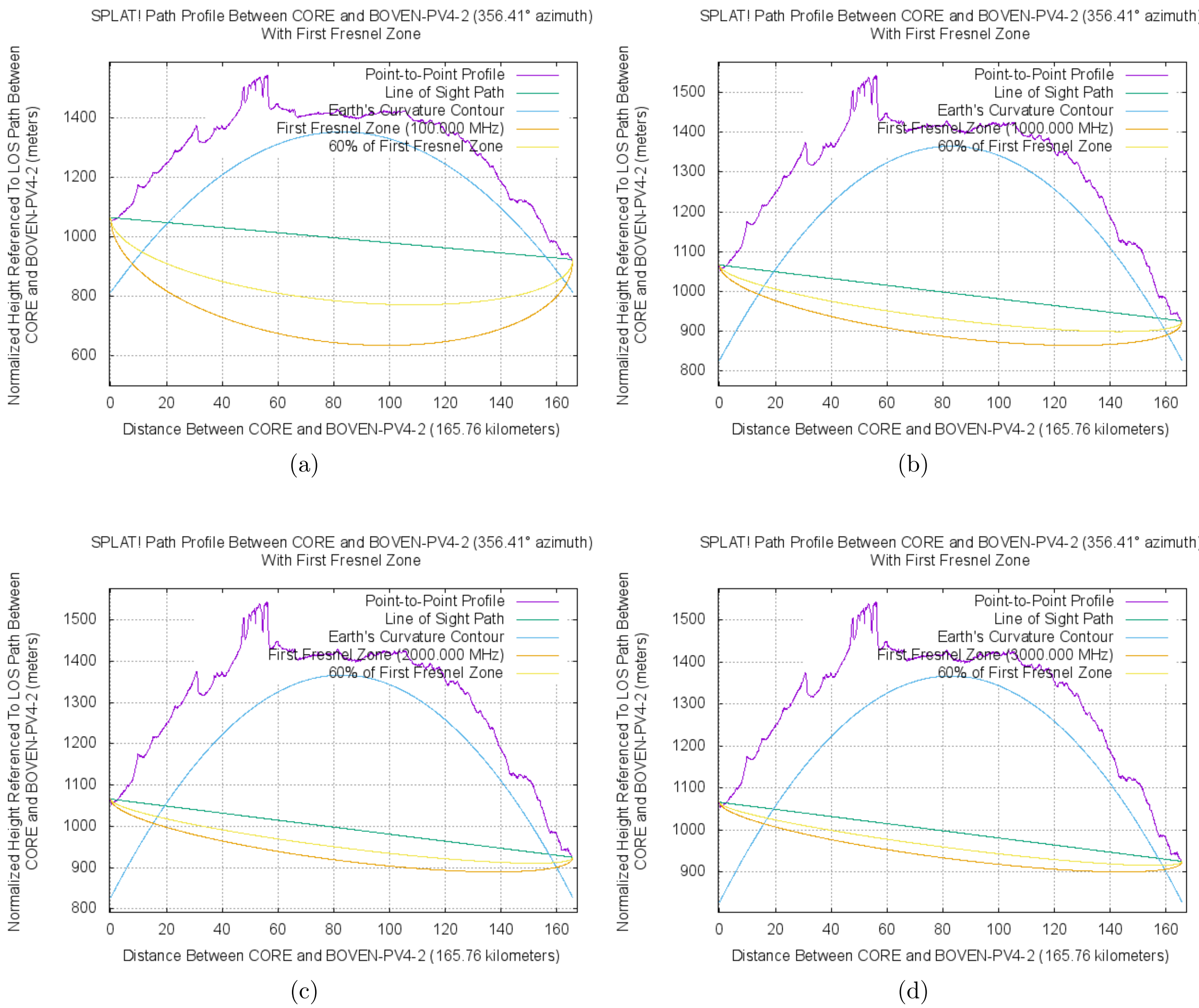


Figure 90: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.19 Boven PV4 Alternative to Closest SKA

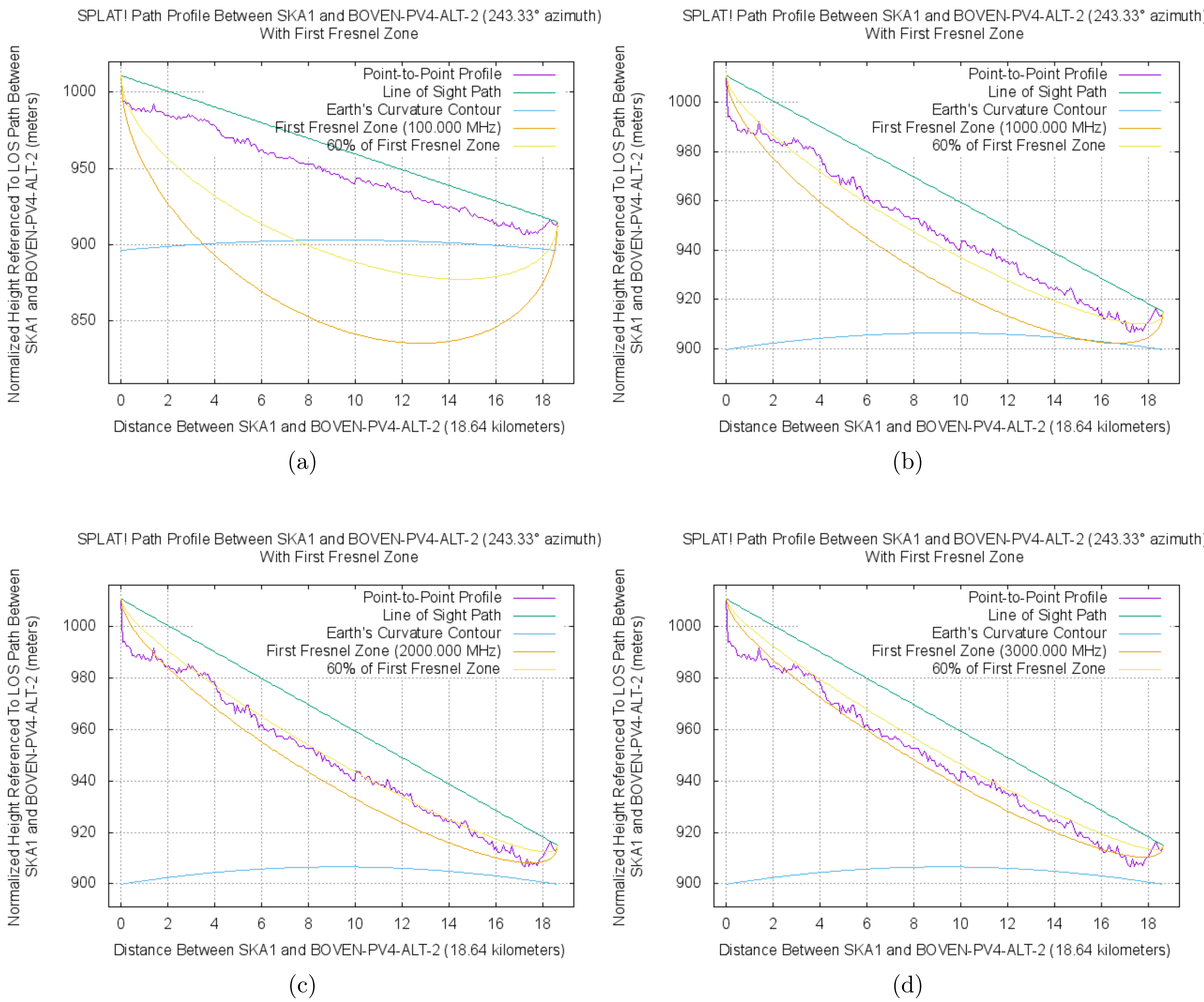
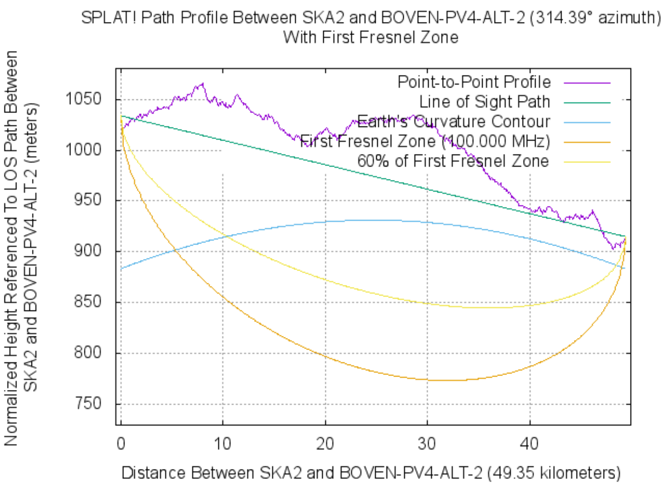
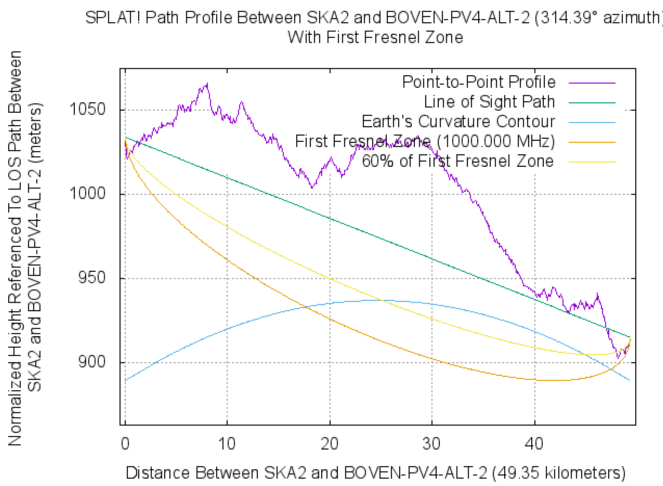


Figure 91: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

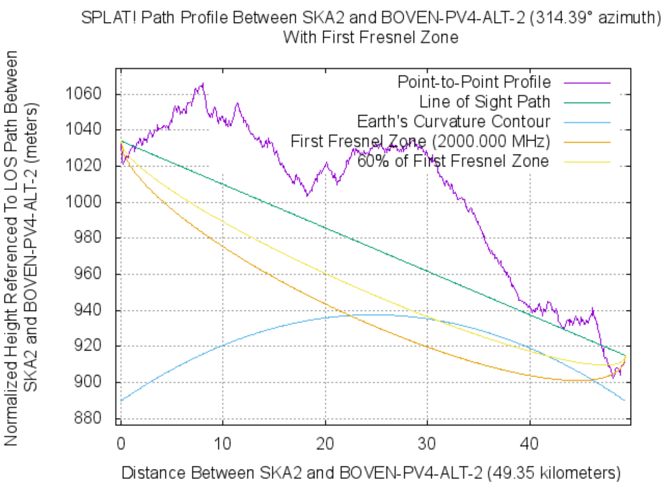
A.20 Boven PV4 Alternative to 2nd Closest SKA



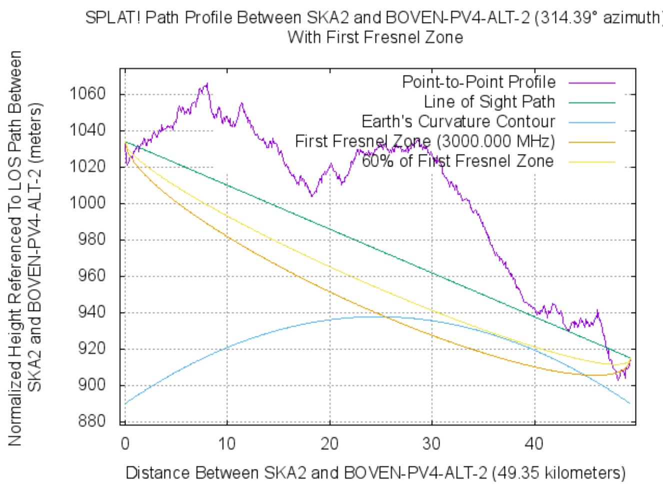
(a)



(b)



(c)



(d)

Figure 92: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.21 Boven PV4 Alternative to Core SKA

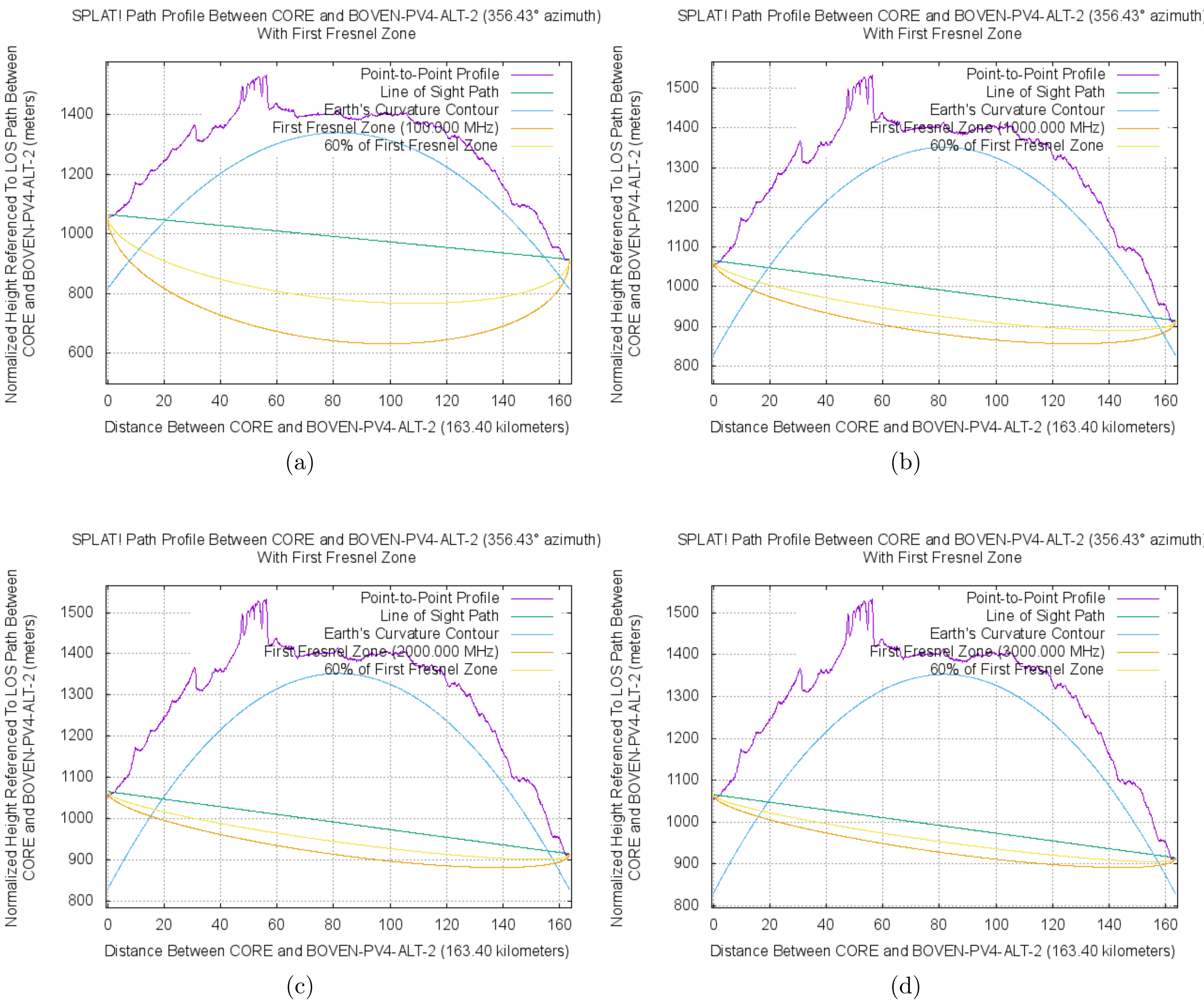


Figure 93: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.22 Gemsbok PV1 to Closest SKA

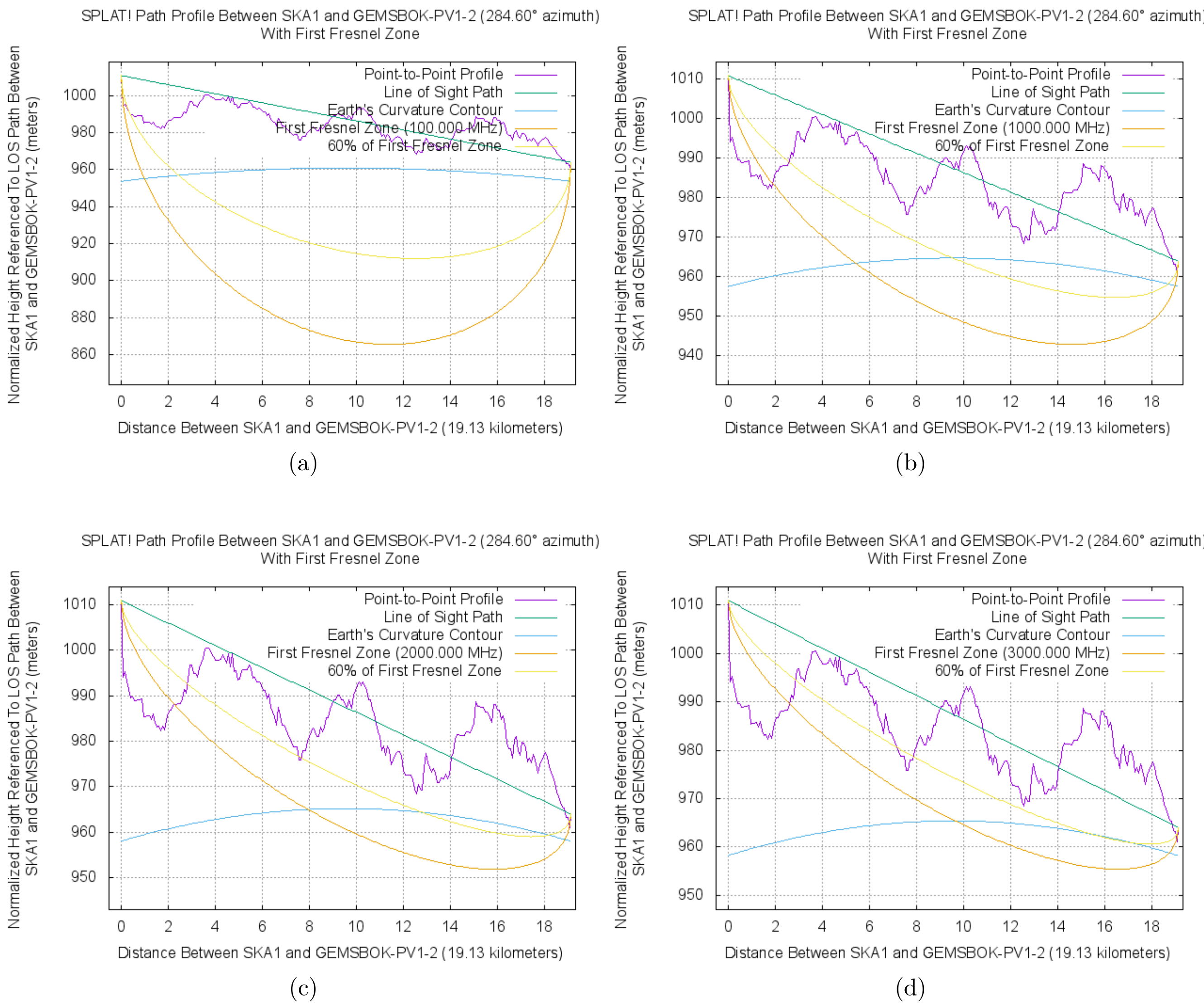
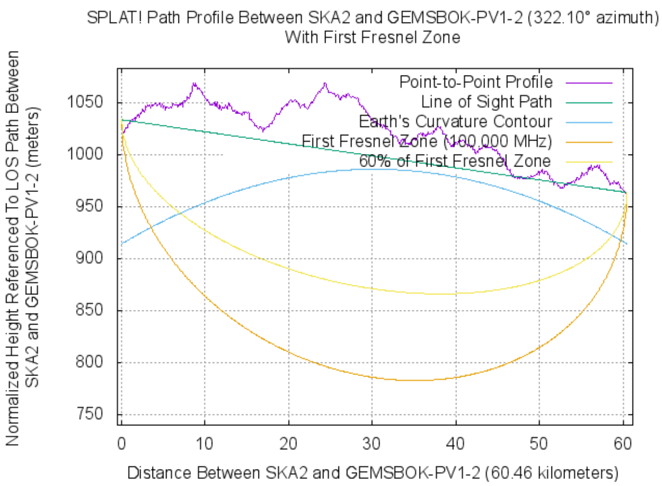
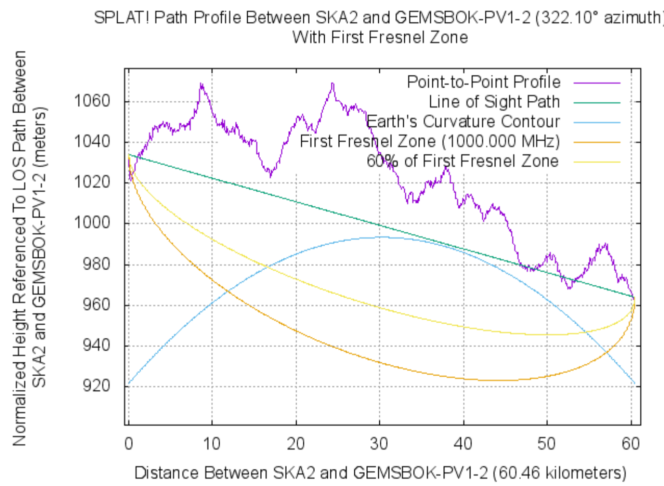


Figure 94: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

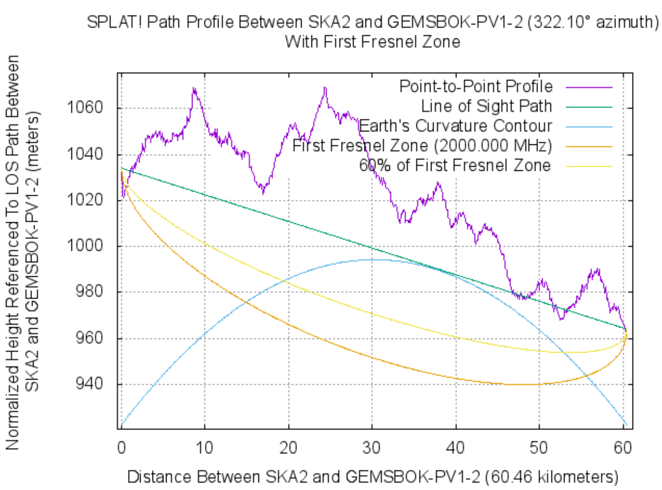
A.23 Gemsbok PV1 to 2nd Closest SKA



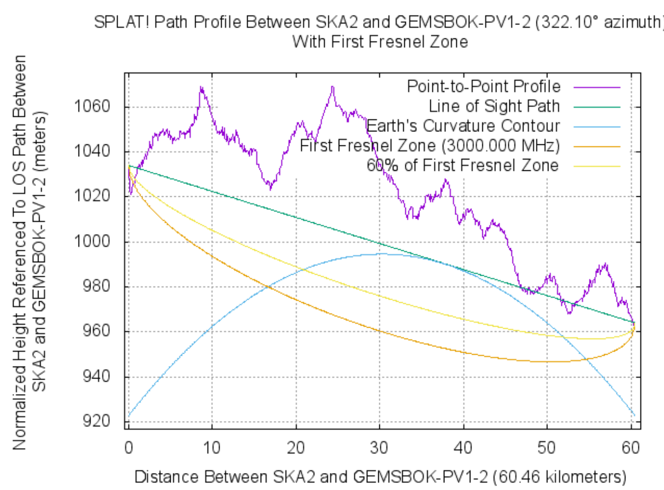
(a)



(b)



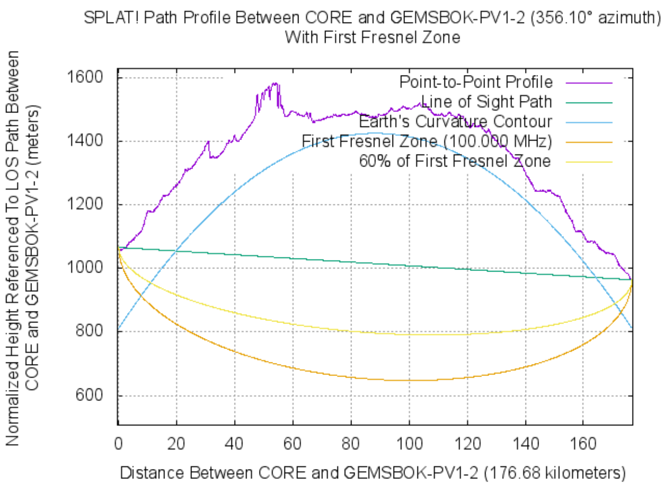
(c)



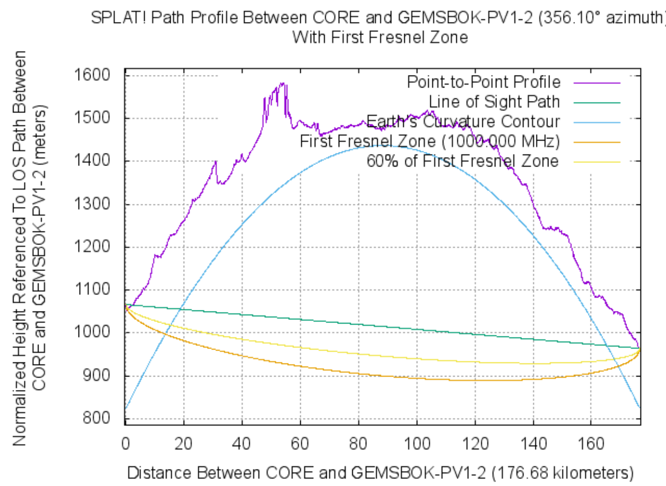
(d)

Figure 95: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

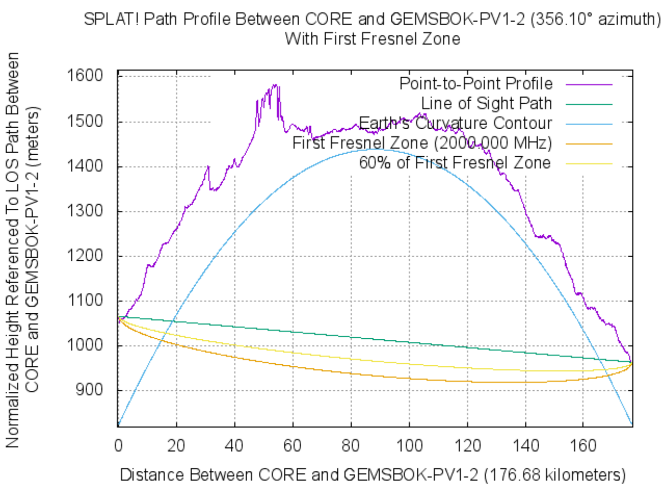
A.24 Gemsbok PV1 to Core SKA



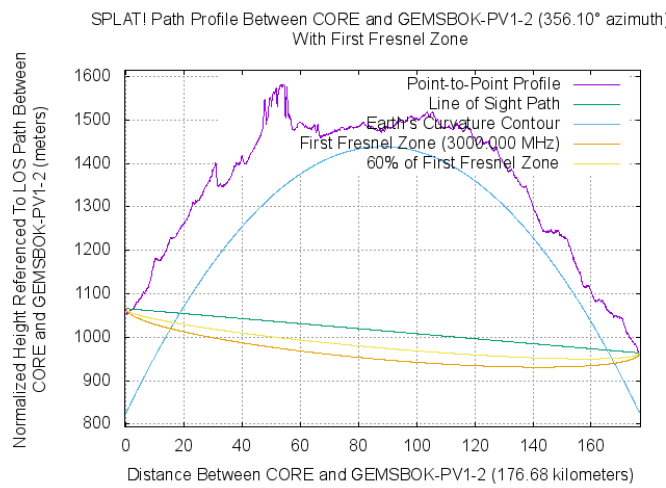
(a)



(b)



(c)



(d)

Figure 96: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.25 Gemsbok PV2 to Closest SKA

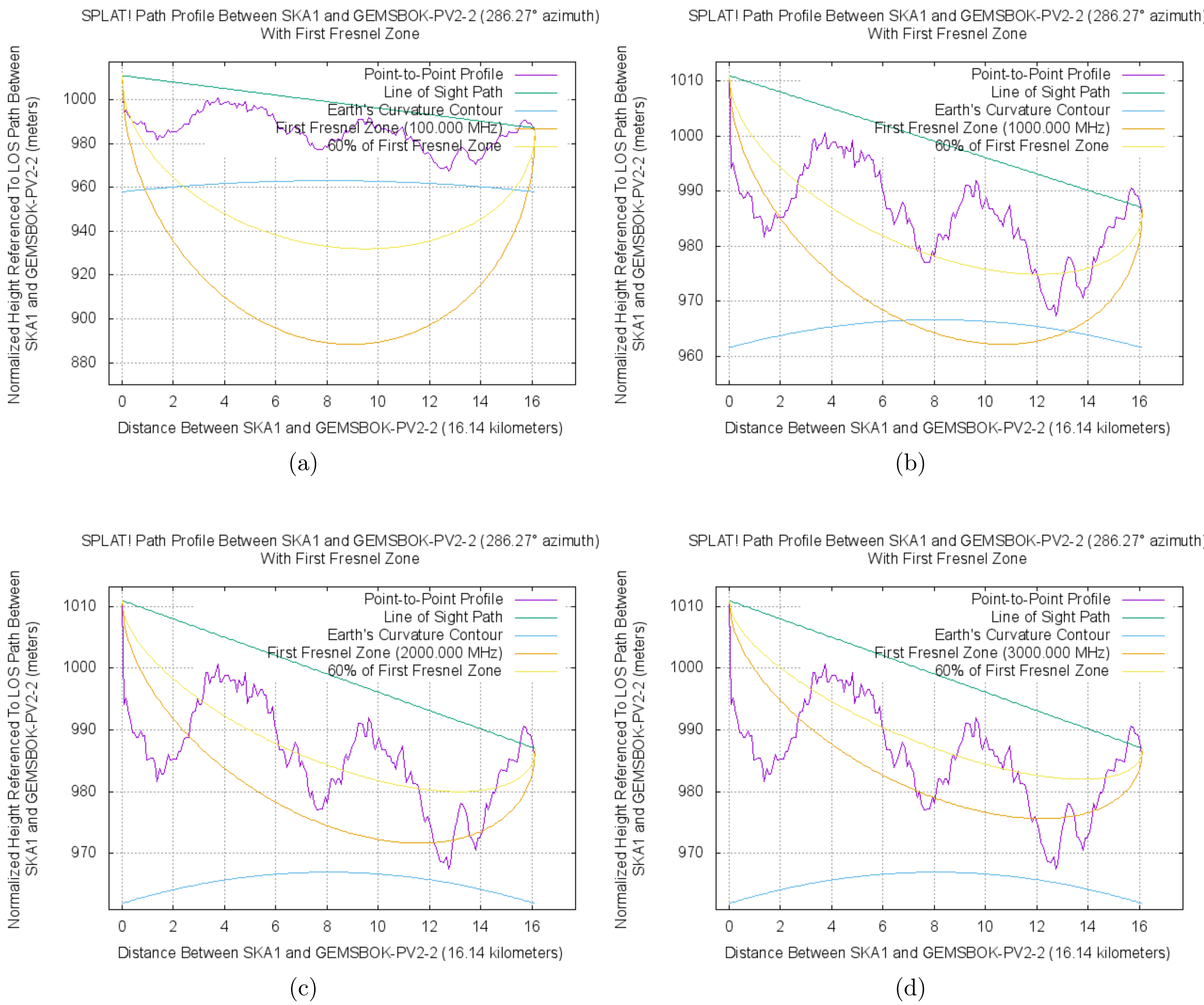
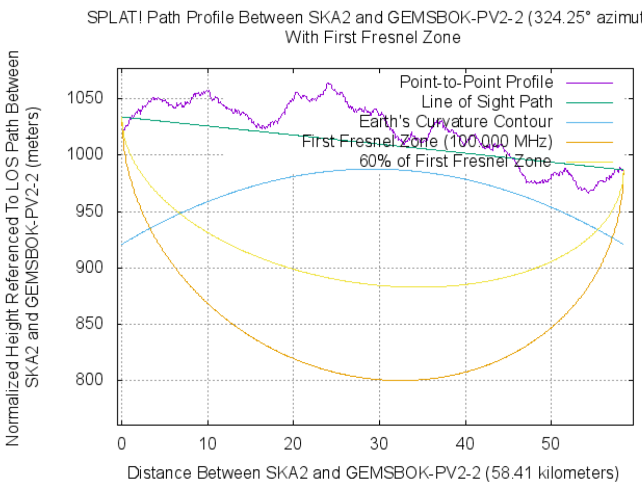
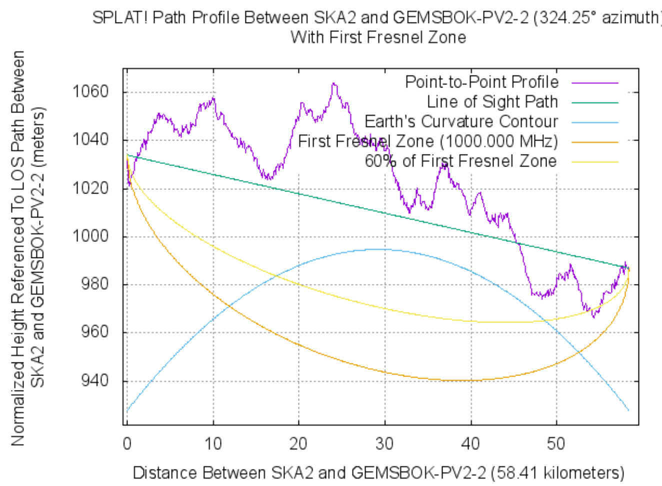


Figure 97: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

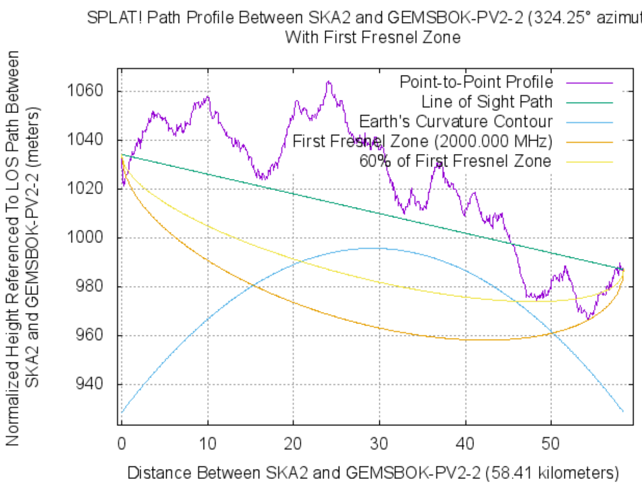
A.26 Gemsbok PV2 to 2nd Closest SKA



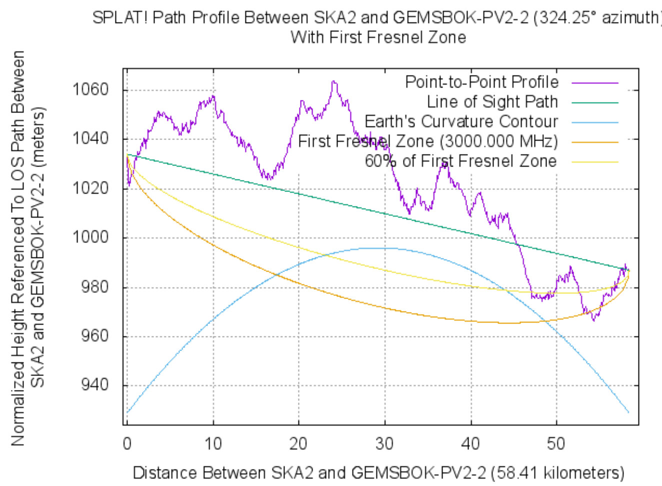
(a)



(b)



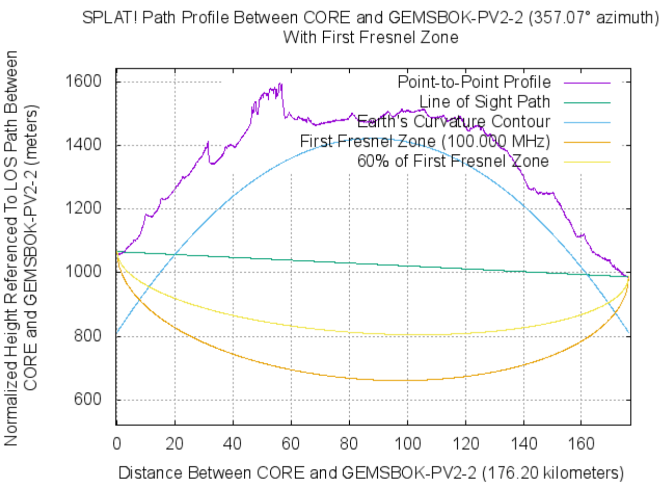
(c)



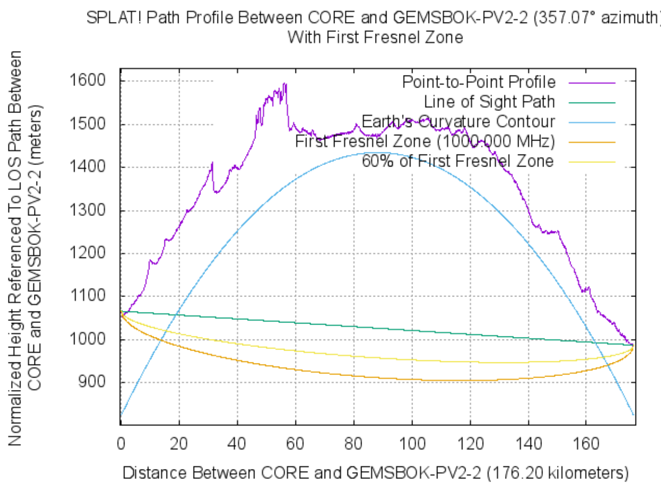
(d)

Figure 98: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

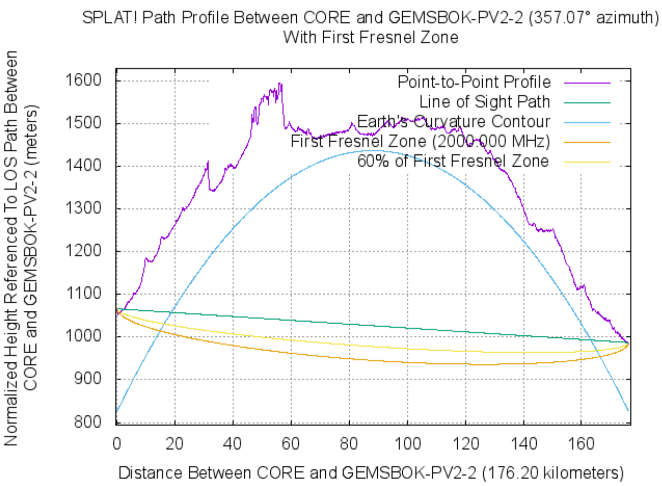
A.27 Gemsbok PV2 to Core SKA



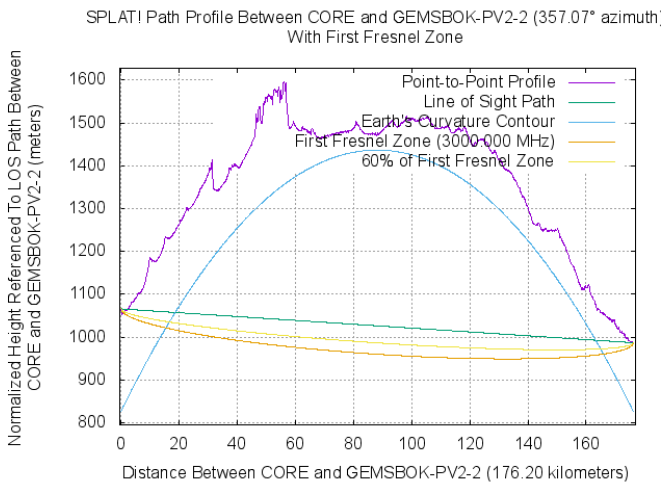
(a)



(b)



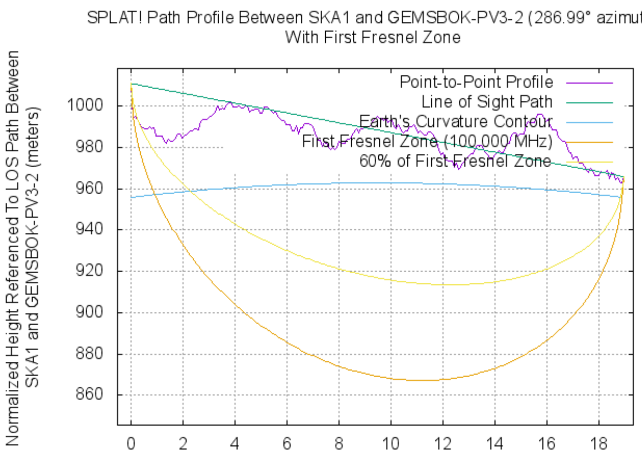
(c)



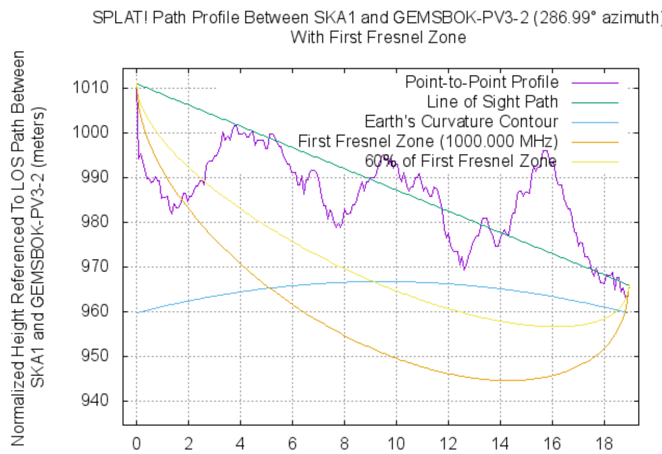
(d)

Figure 99: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

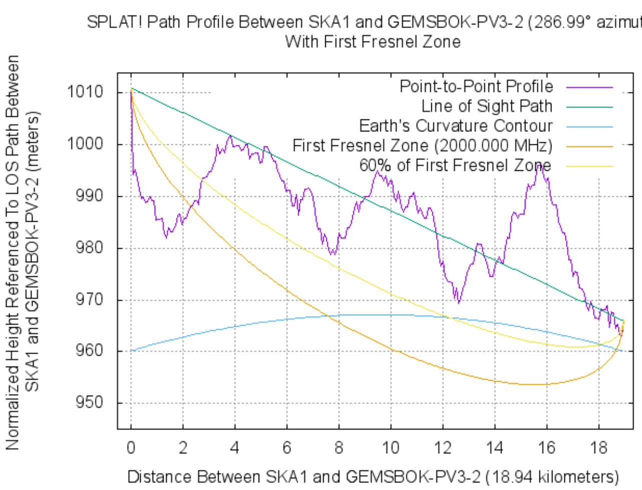
A.28 Gemsbok PV3 to Closest SKA



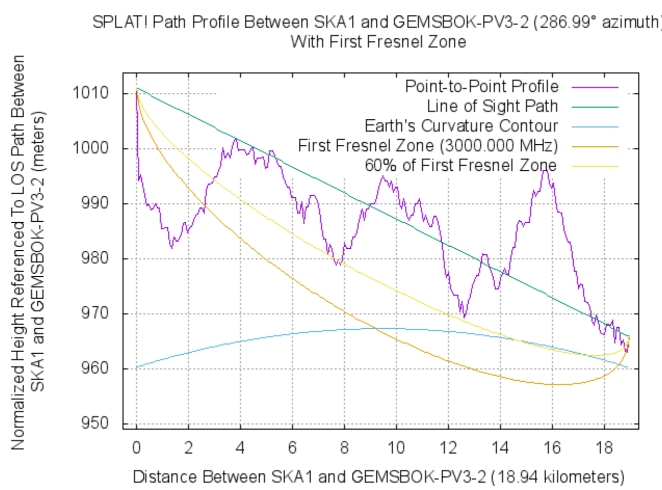
(a)



(b)



(c)



(d)

Figure 100: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.29 Gemsbok PV3 to 2nd Closest SKA

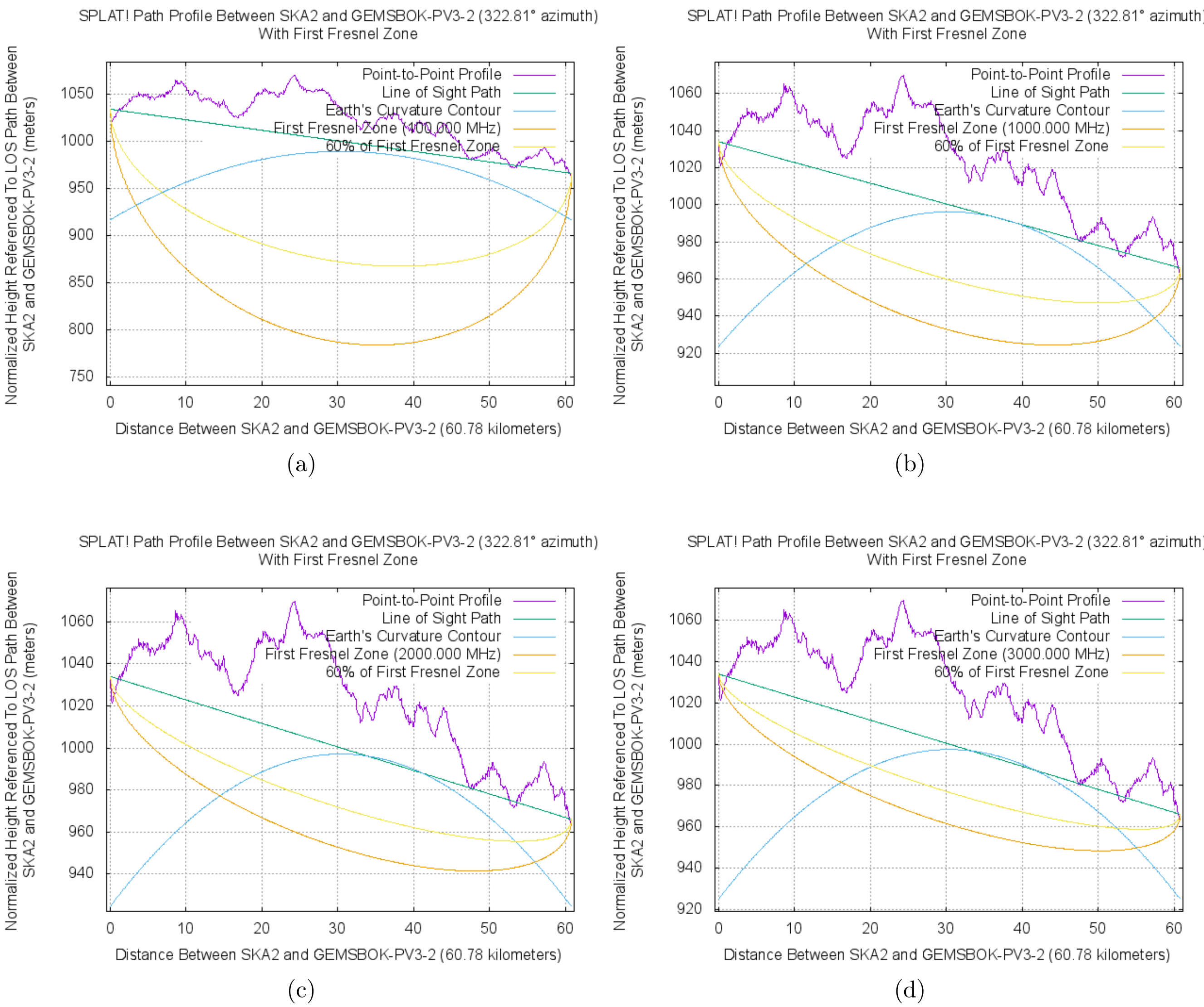


Figure 101: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.30 Gemsbok PV3 to Core SKA

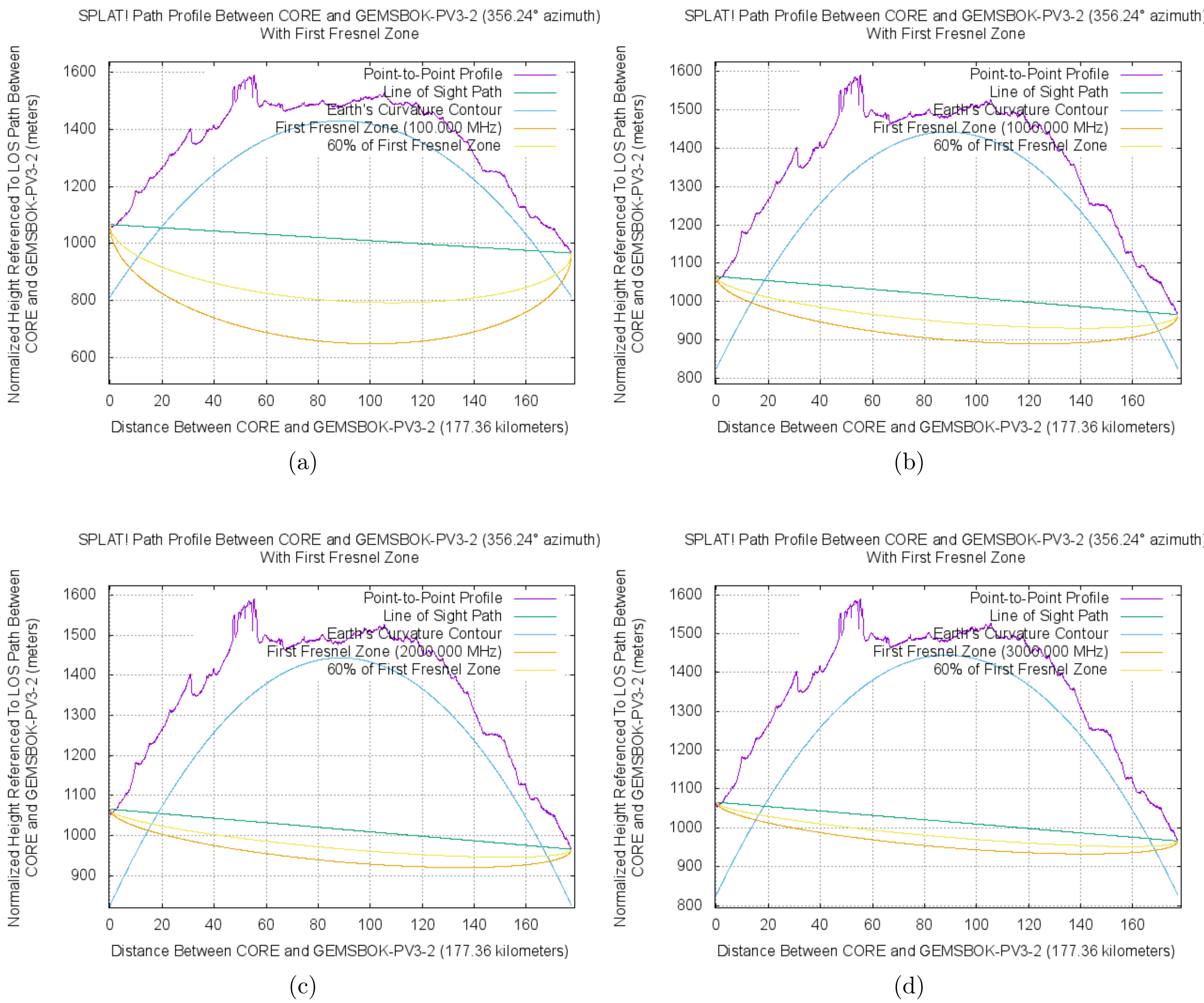
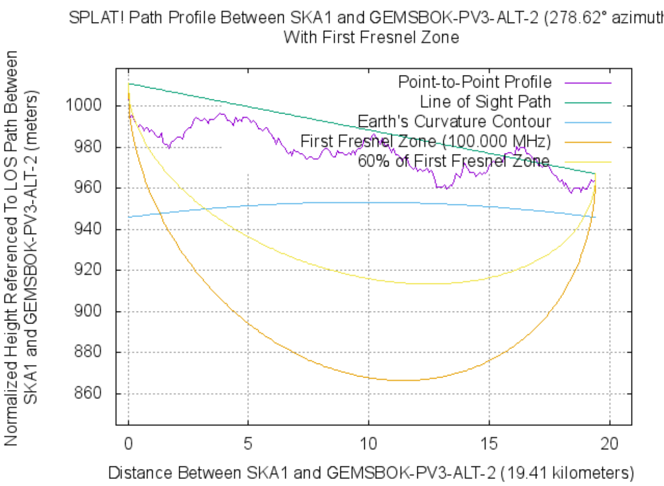
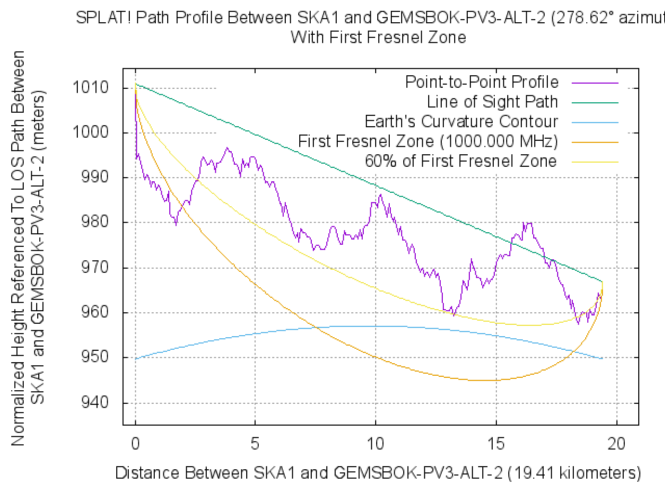


Figure 102: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

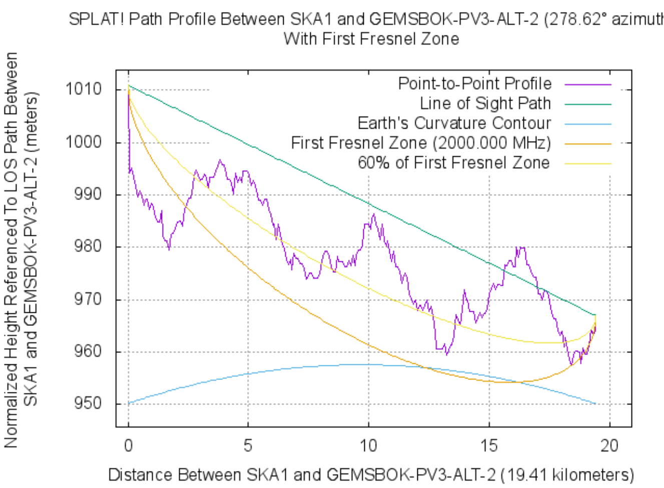
A.31 Gemsbok PV3 Alternative to Closest SKA



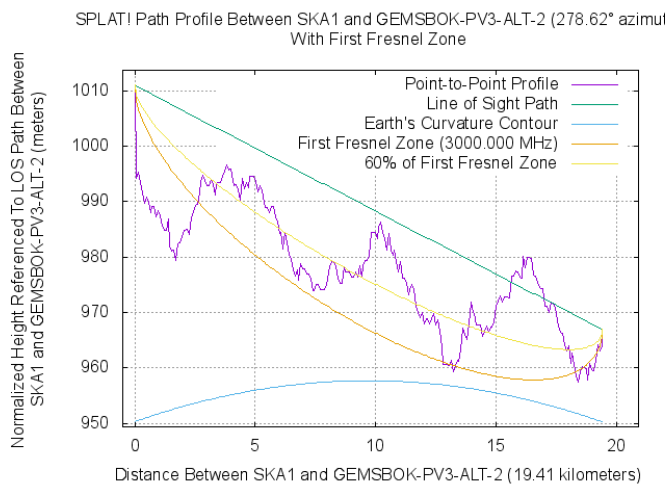
(a)



(b)



(c)



(d)

Figure 103: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.32 Gemsbok PV3 Alternative to 2nd Closest SKA

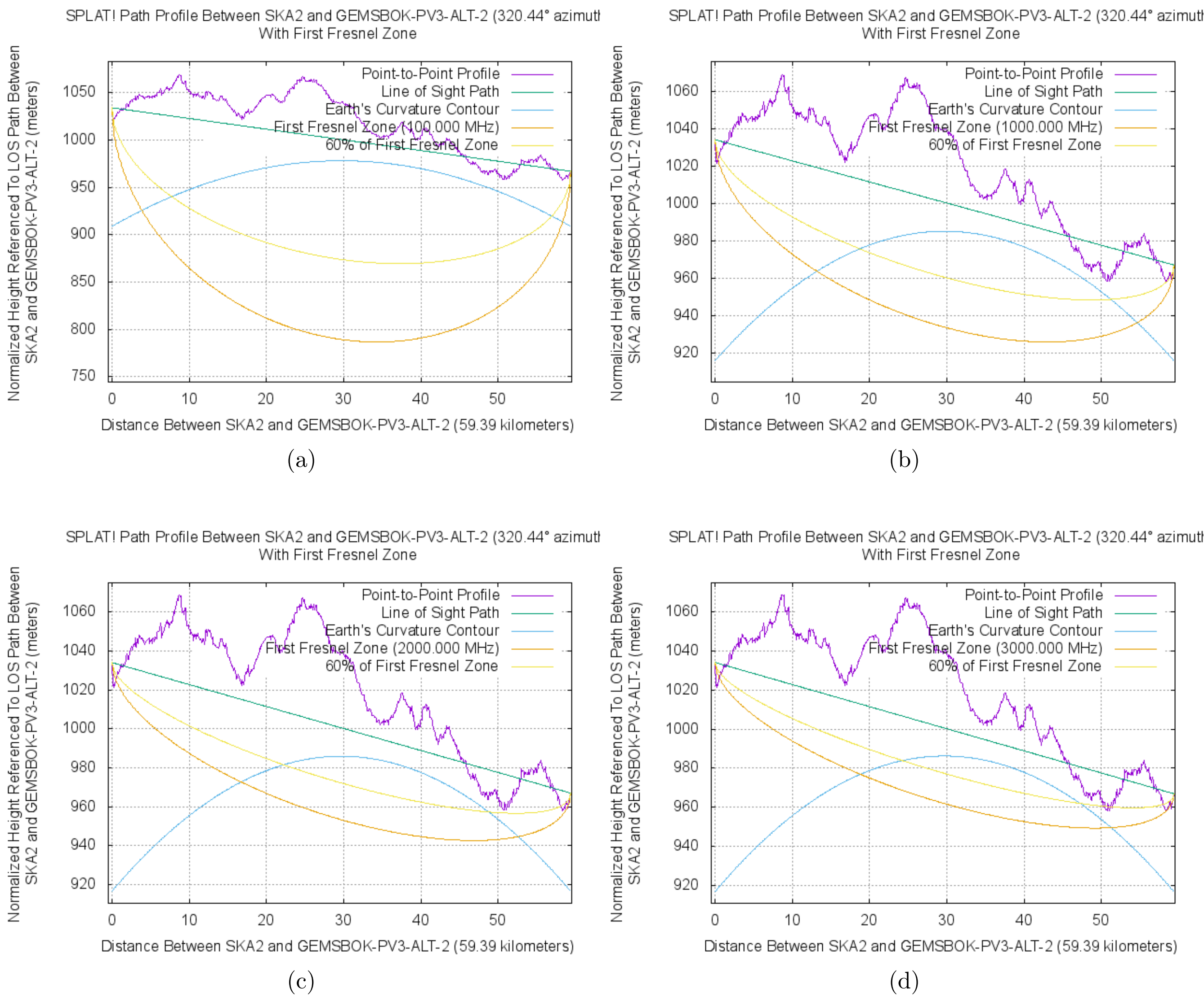
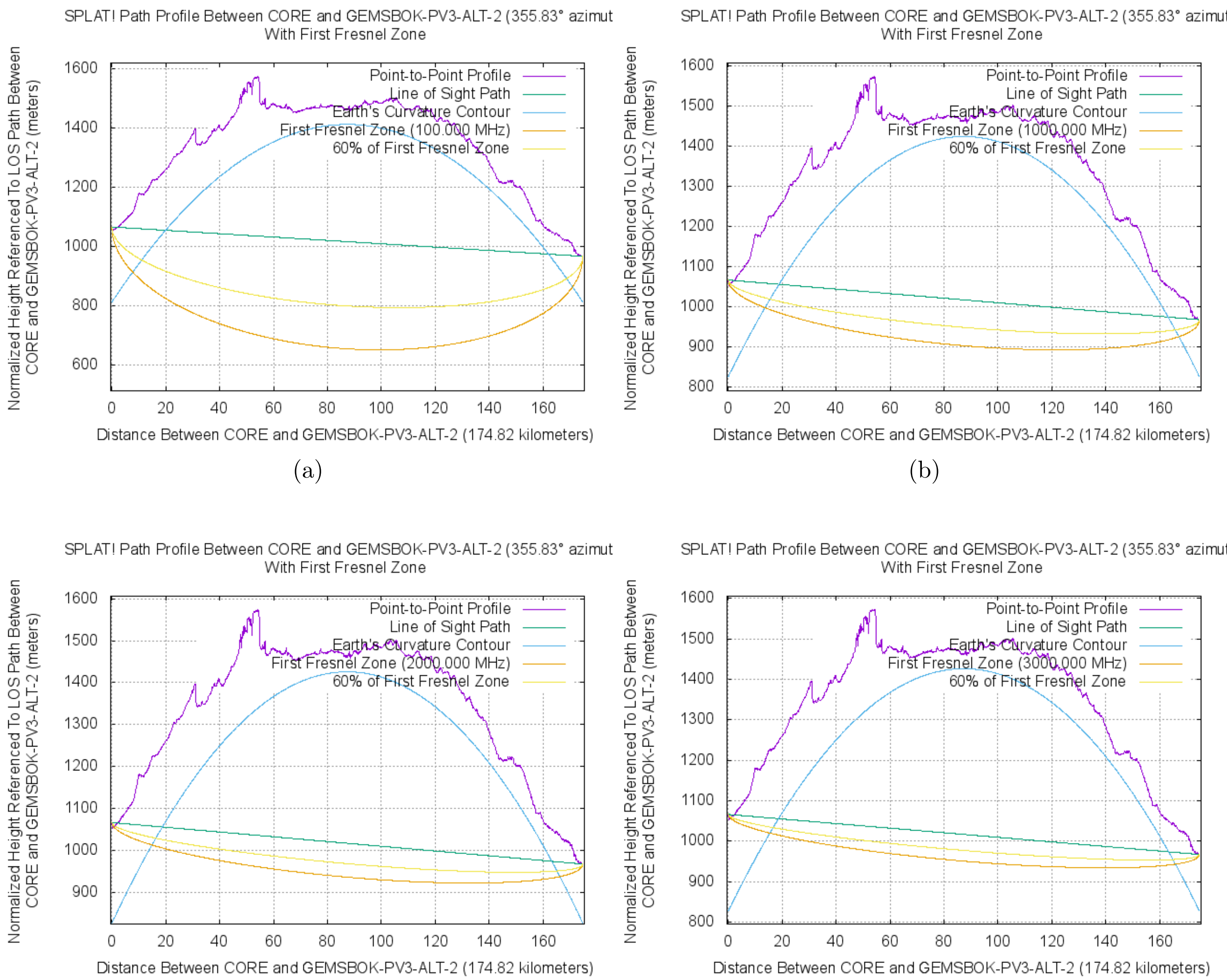


Figure 104: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

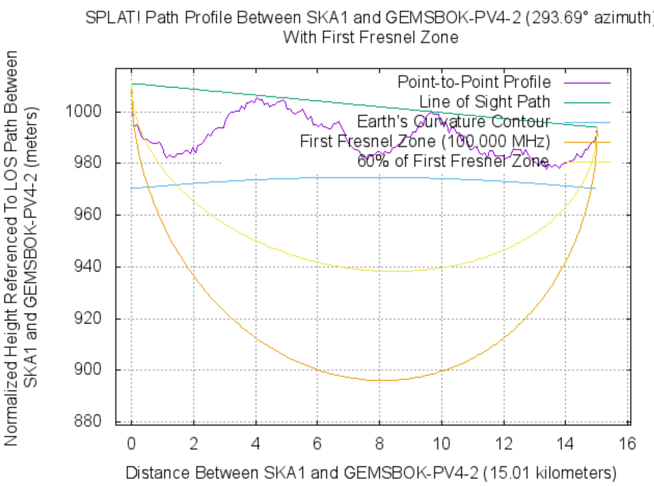
A.33 Gemsbok PV3 Alternative to Core SKA



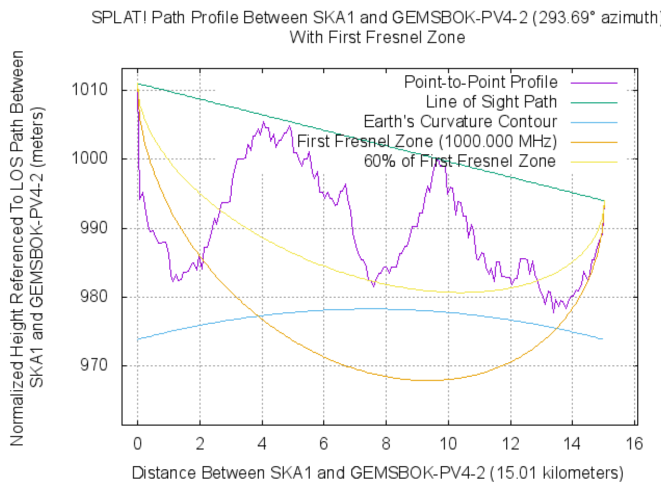
(c) (d)

Figure 105: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

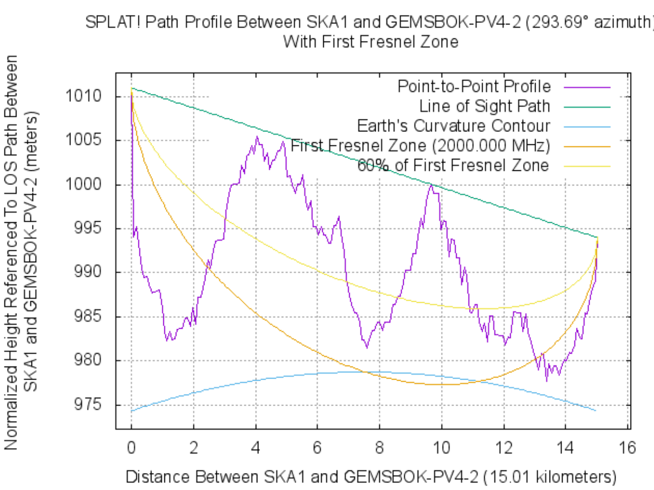
A.34 Gemsbok PV4 to Closest SKA



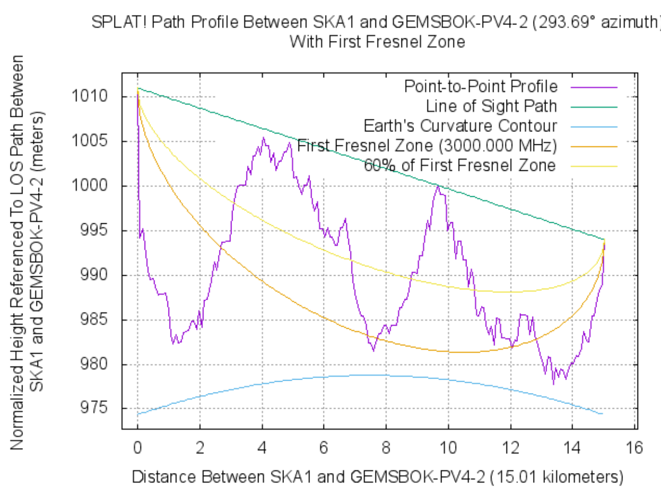
(a)



(b)



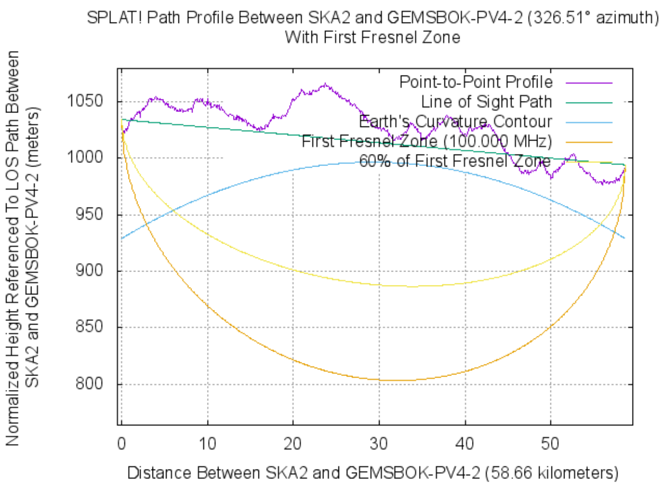
(c)



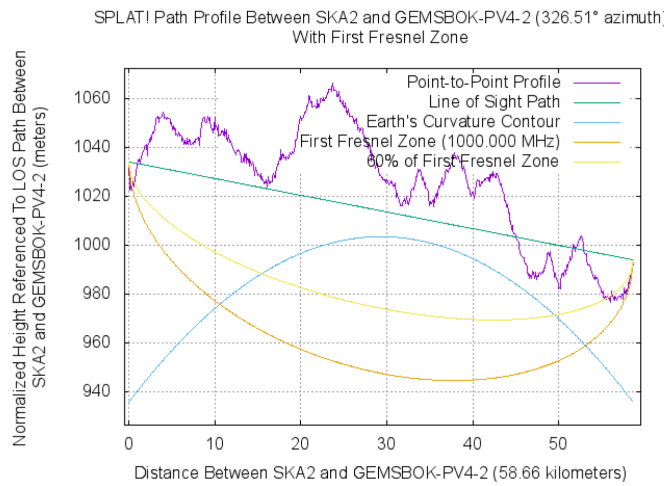
(d)

Figure 106: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

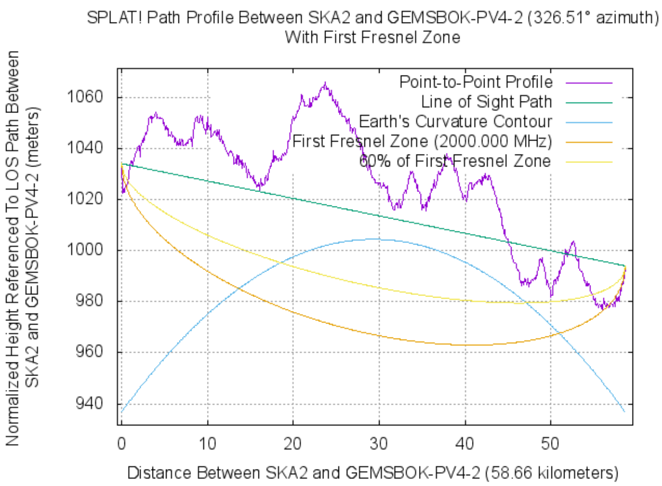
A.35 Gemsbok PV4 to 2nd Closest SKA



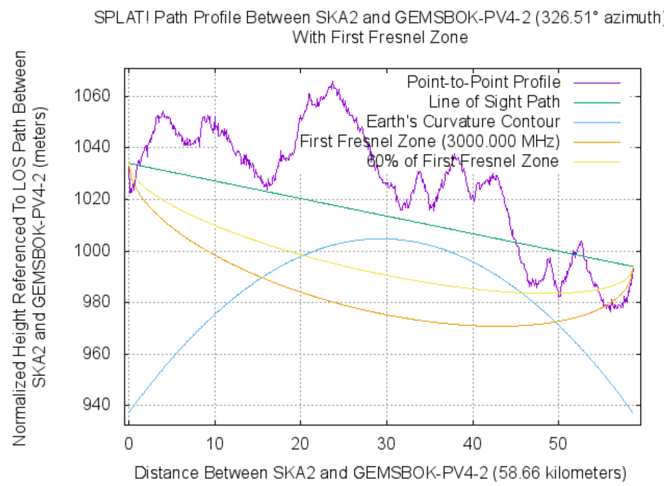
(a)



(b)



(c)



(d)

Figure 107: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.36 Gemsbok PV4 to Core SKA

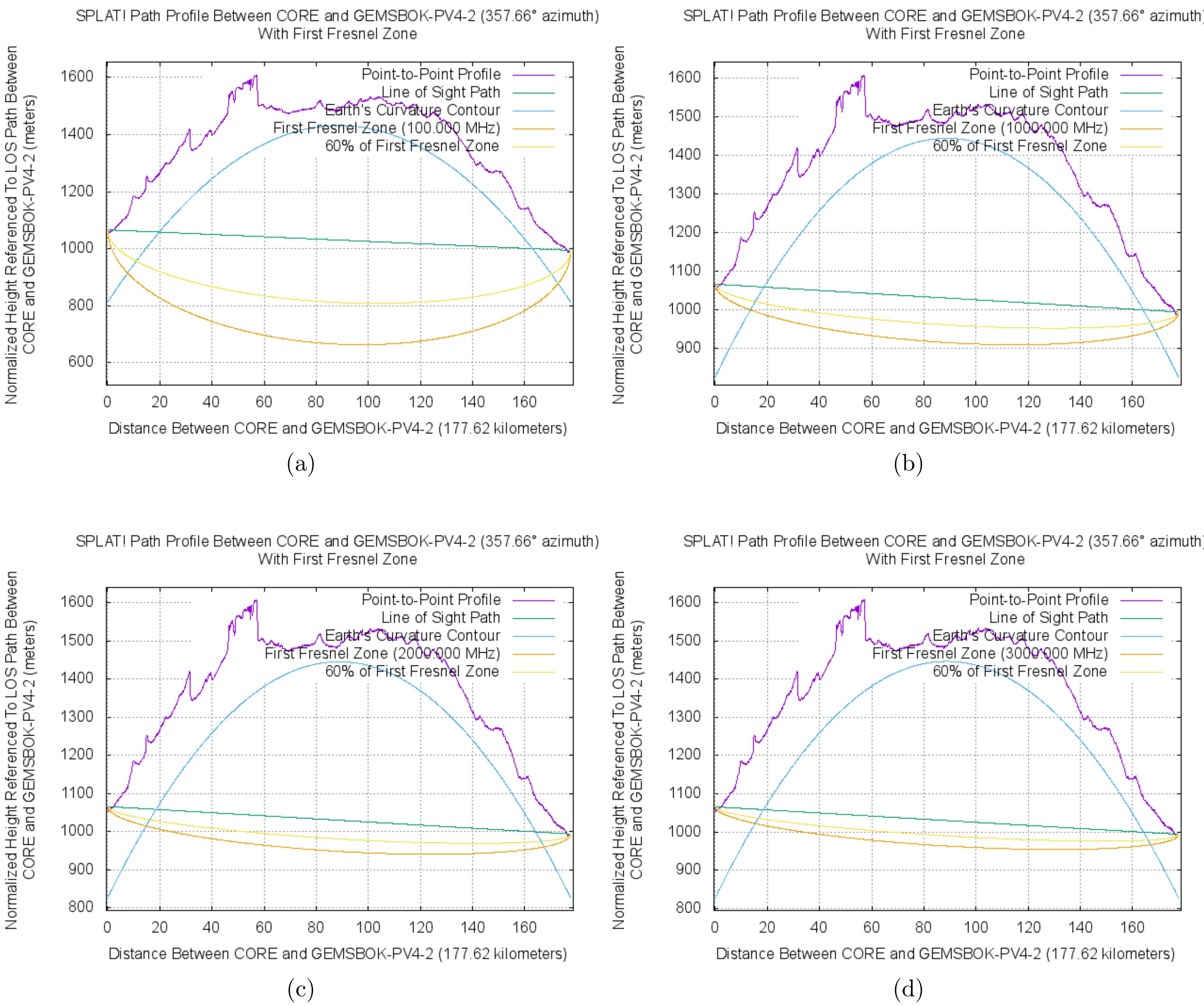


Figure 108: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.37 Gemsbok PV4 Alternative to Closest SKA

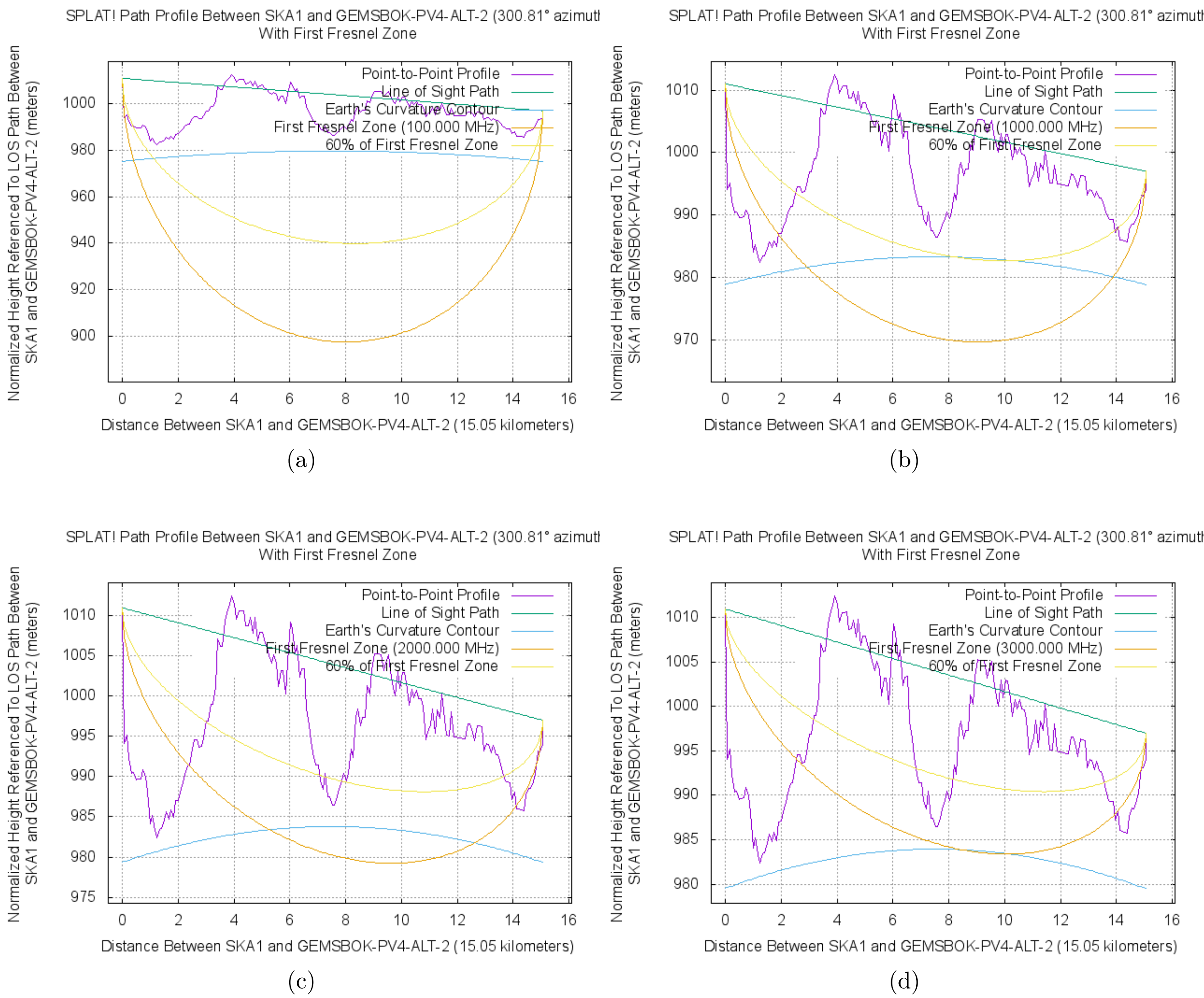


Figure 109: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.38 Gemsbok PV4 Alternative to 2nd Closest SKA

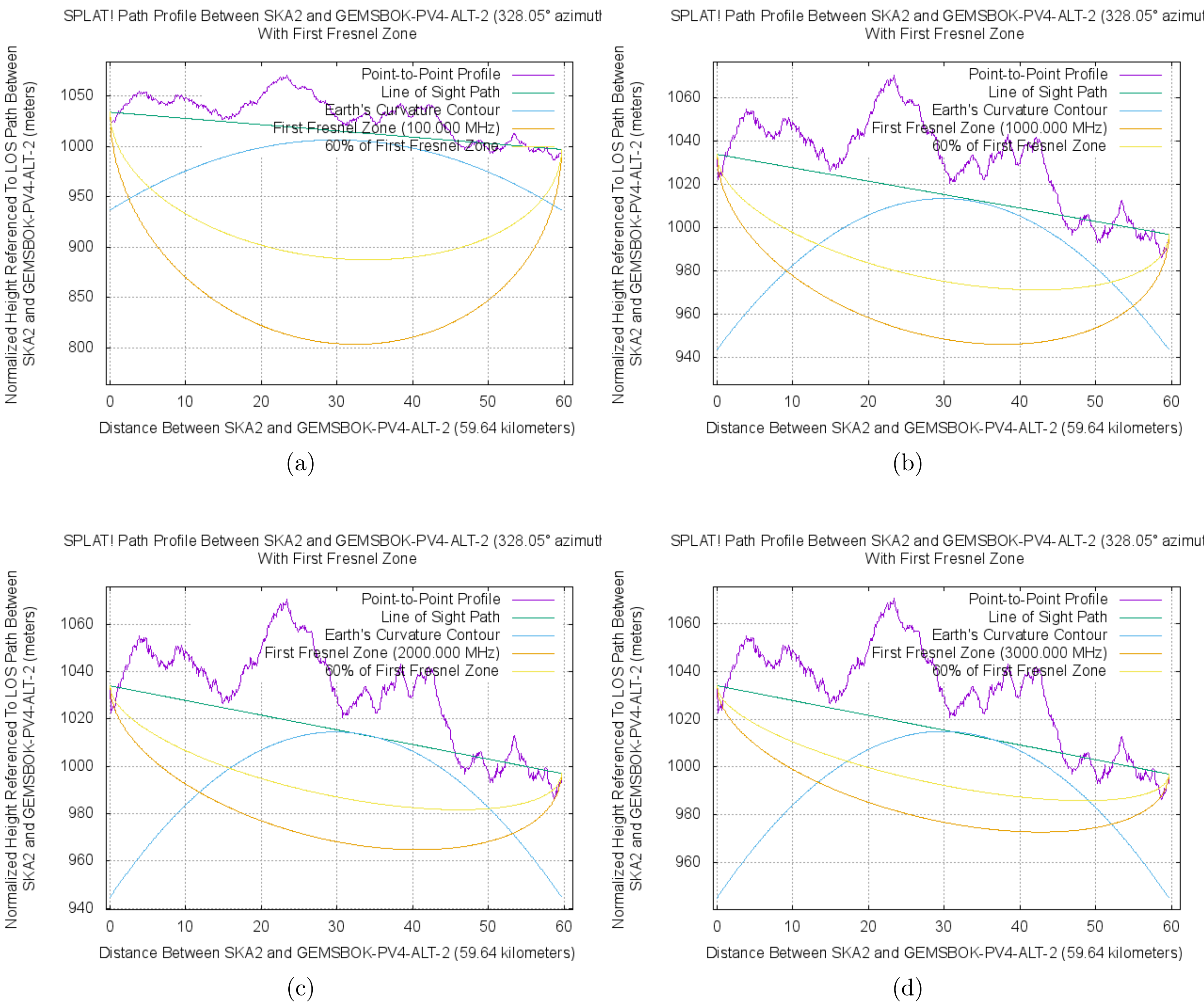


Figure 110: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.39 Gemsbok PV4 Alternative to Core SKA

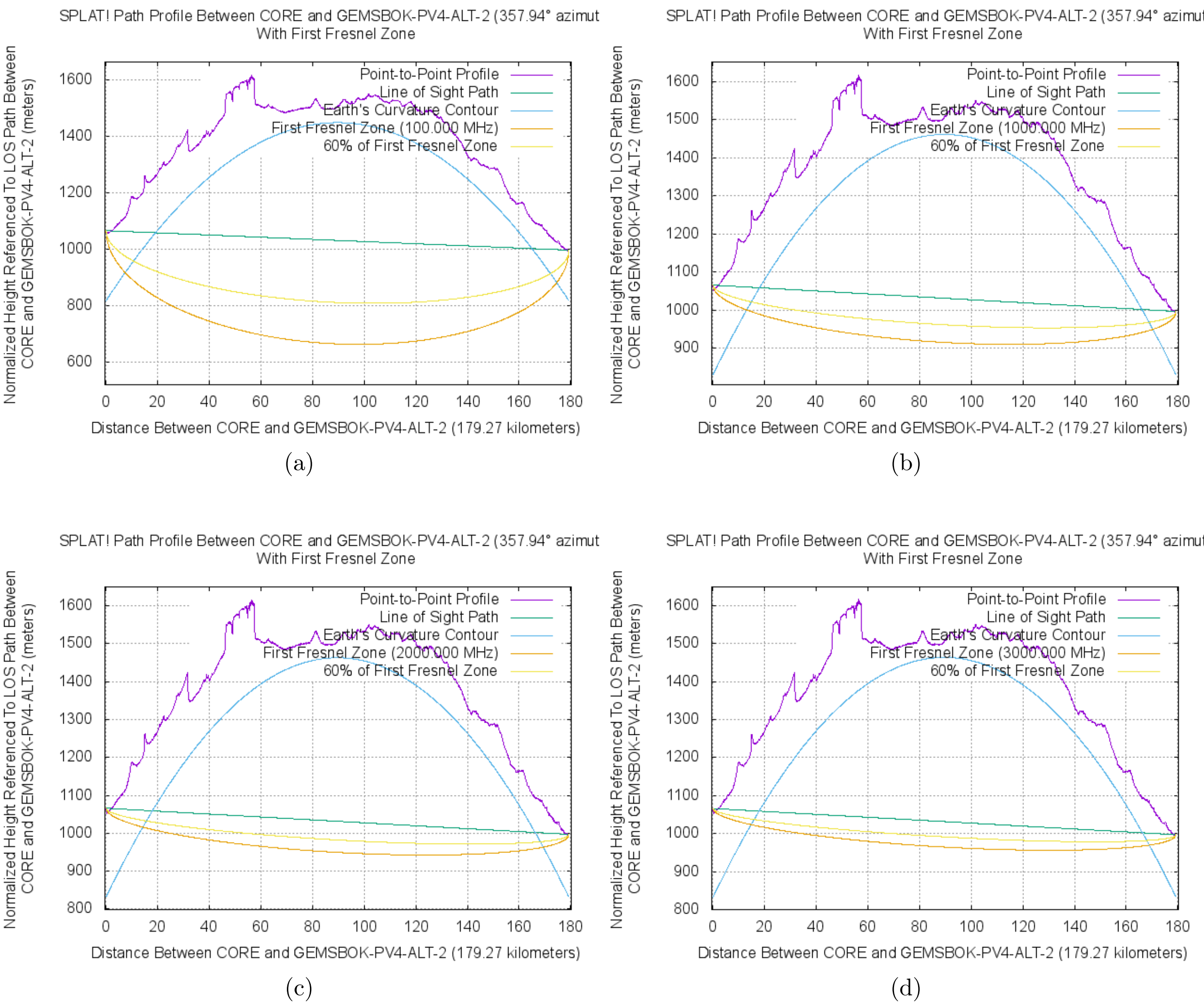


Figure 111: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.40 Gemsbok PV5 to Closest SKA

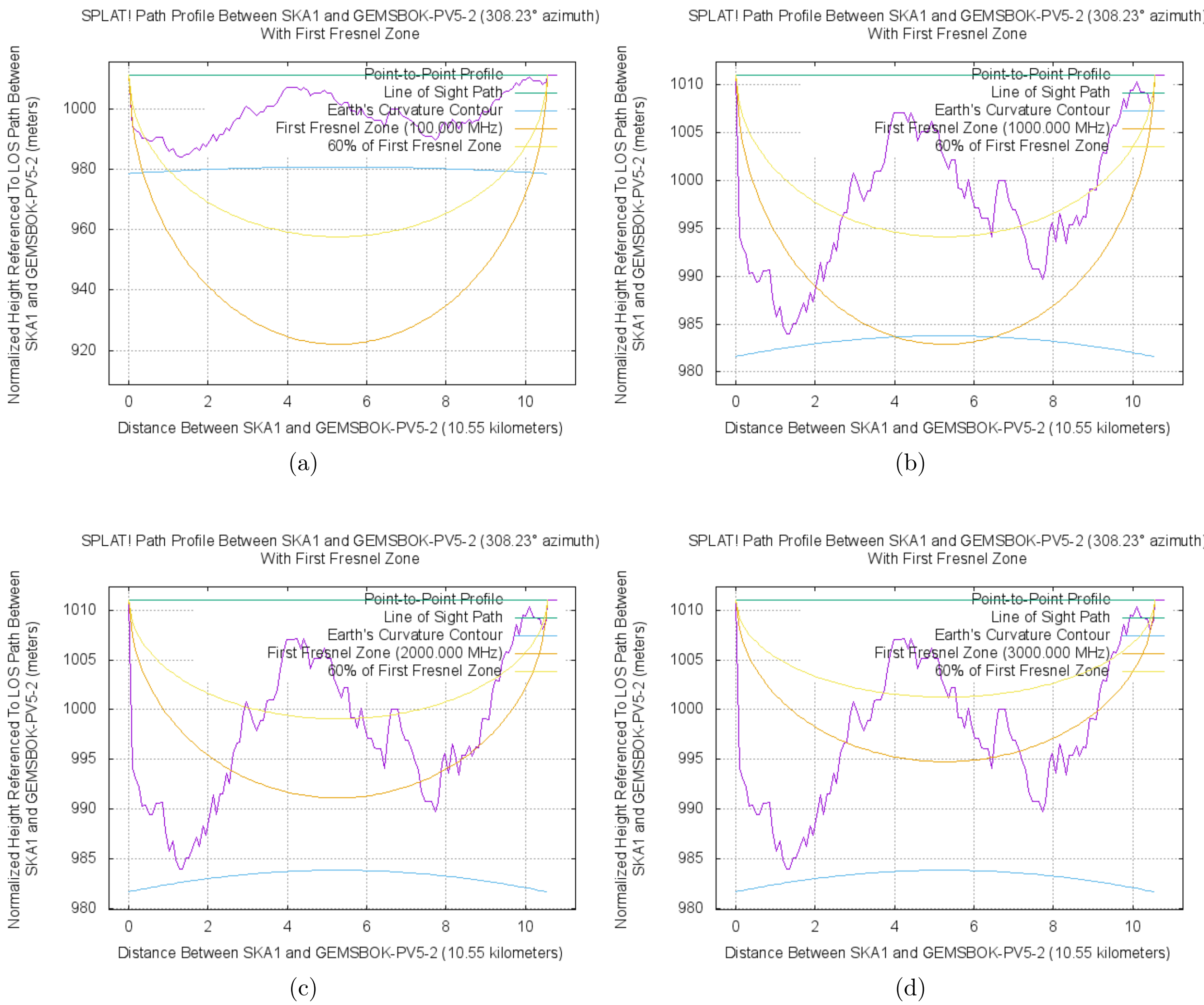


Figure 112: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.41 Gemsbok PV5 to 2nd Closest SKA

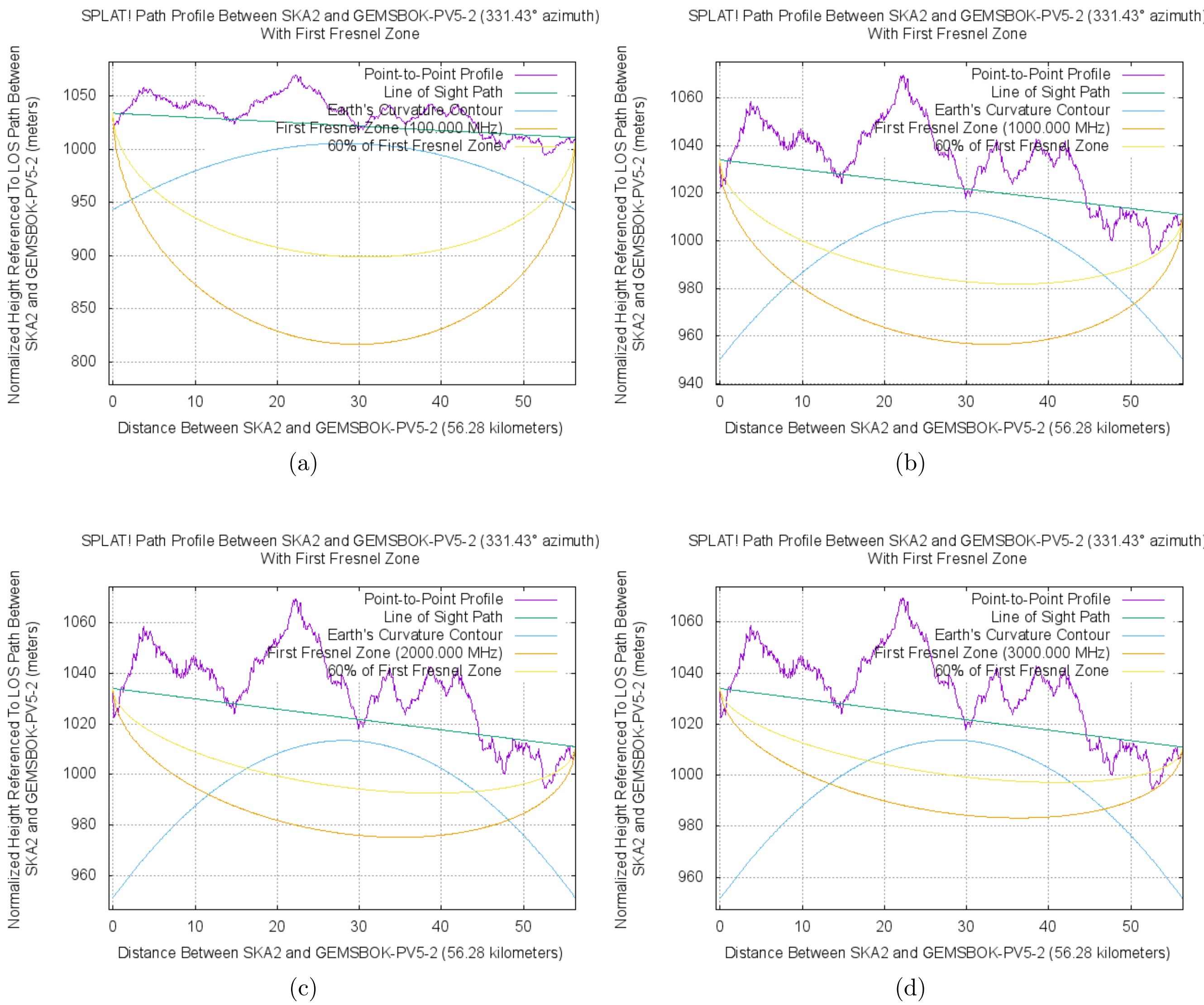


Figure 113: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.42 Gemsbok PV5 to Core SKA

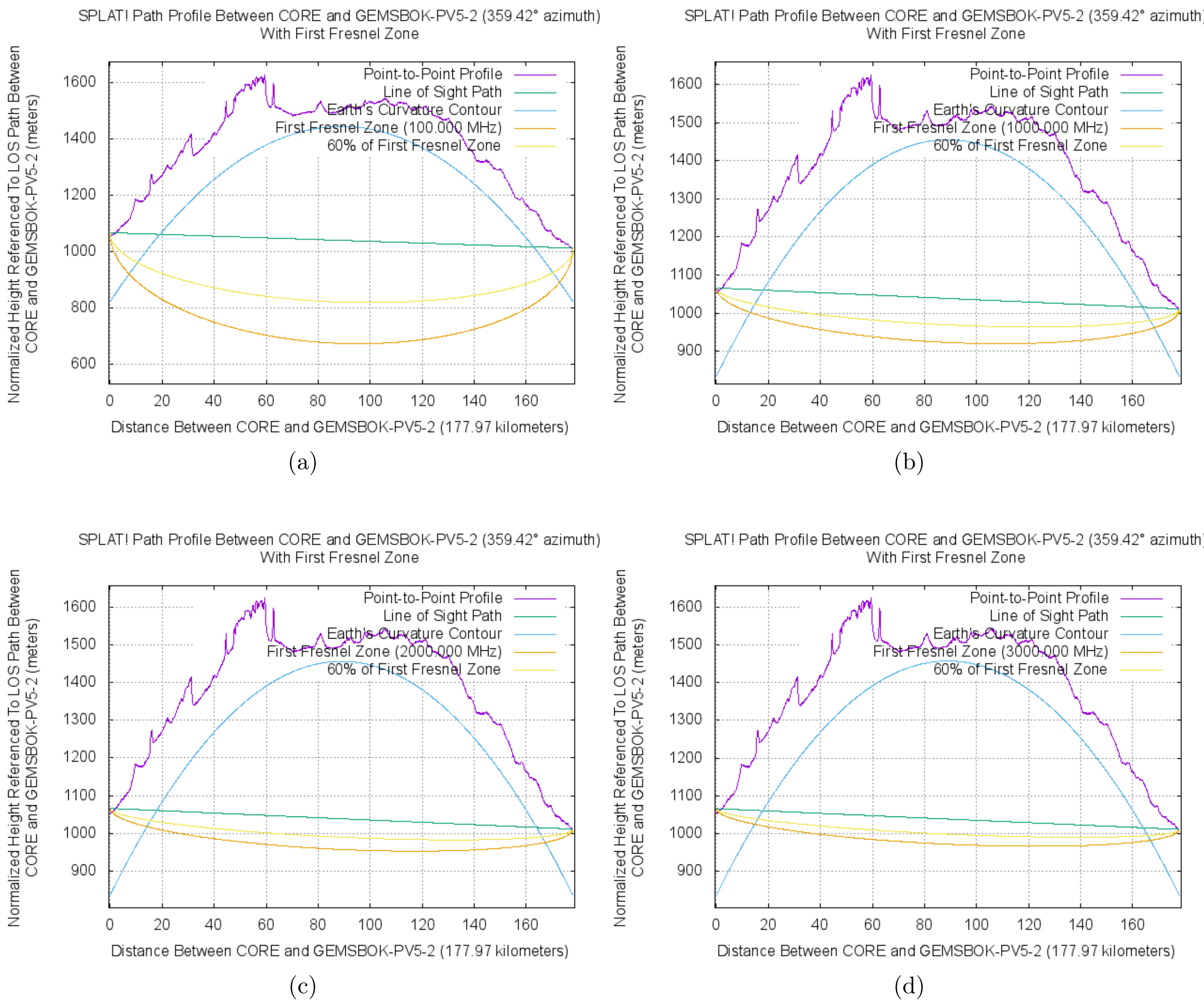
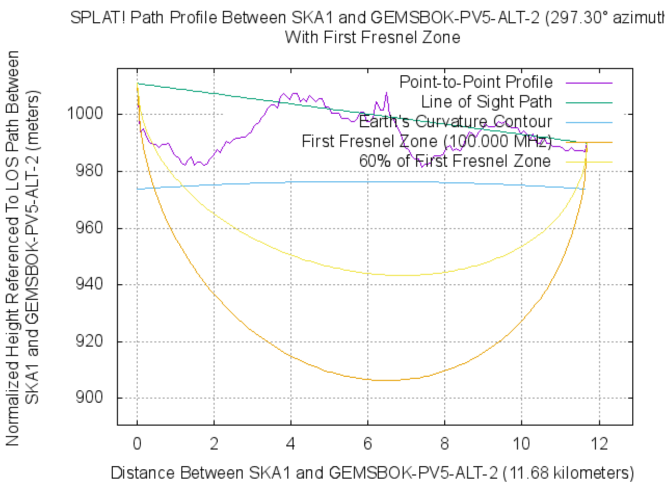
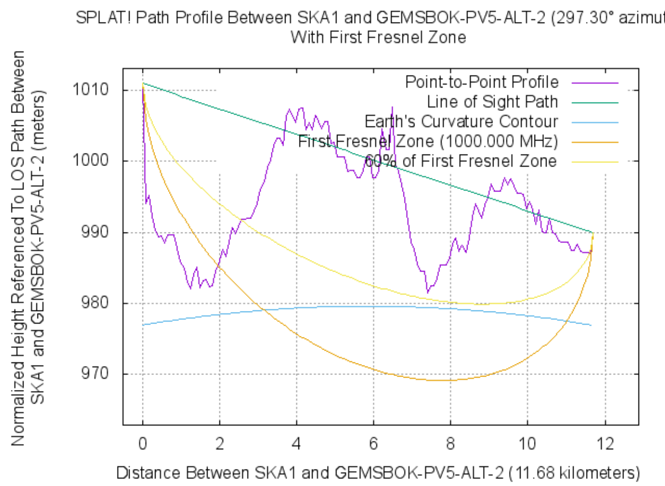


Figure 114: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

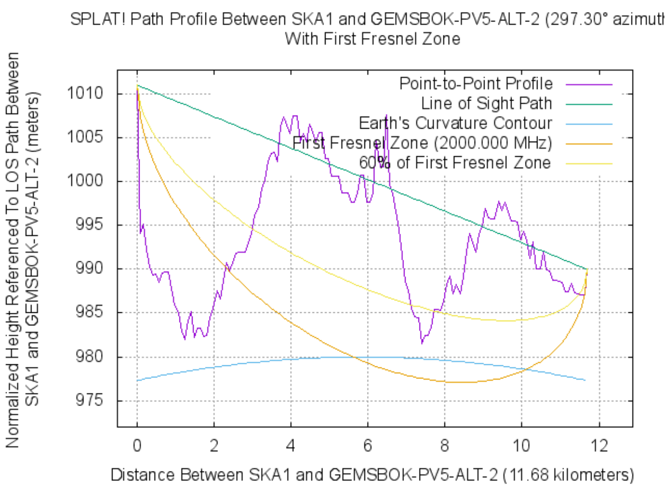
A.43 Gemsbok PV5 Alternative to Closest SKA



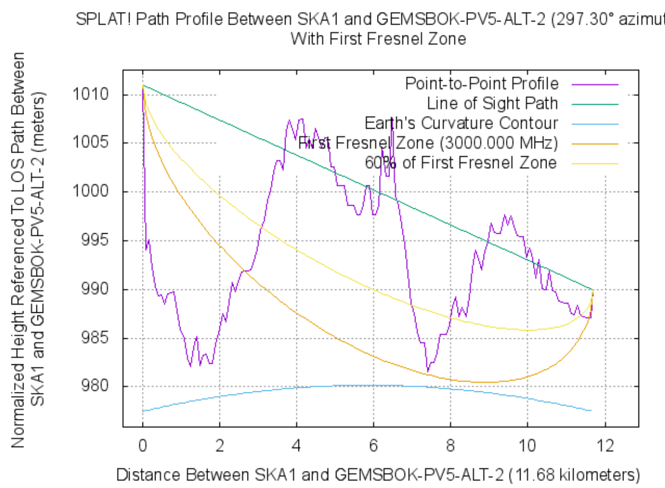
(a)



(b)



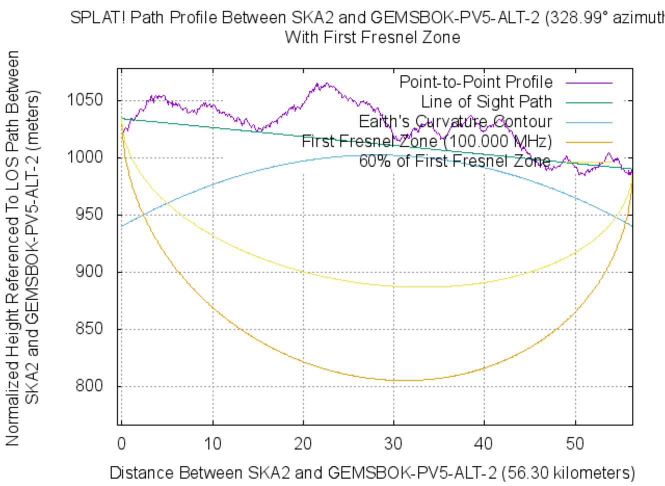
(c)



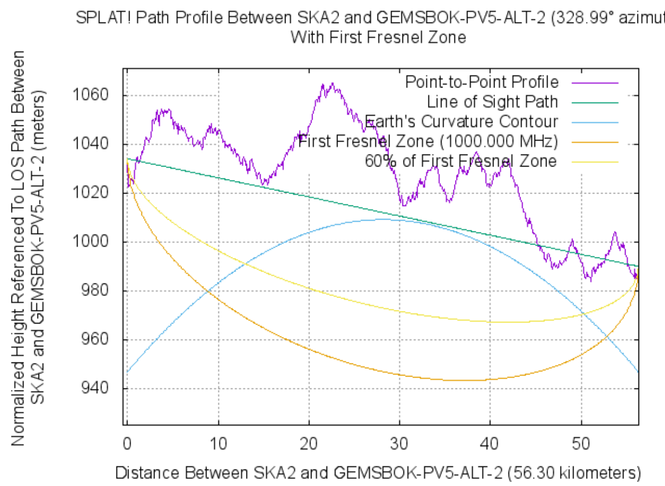
(d)

Figure 115: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

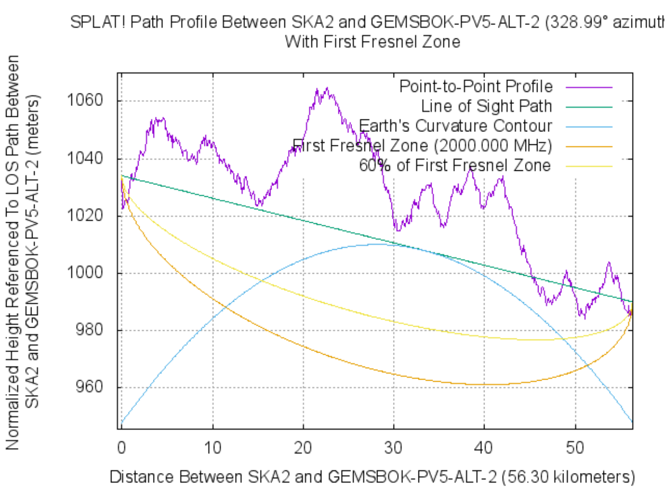
A.44 Gemsbok PV5 Alternative to 2nd Closest SKA



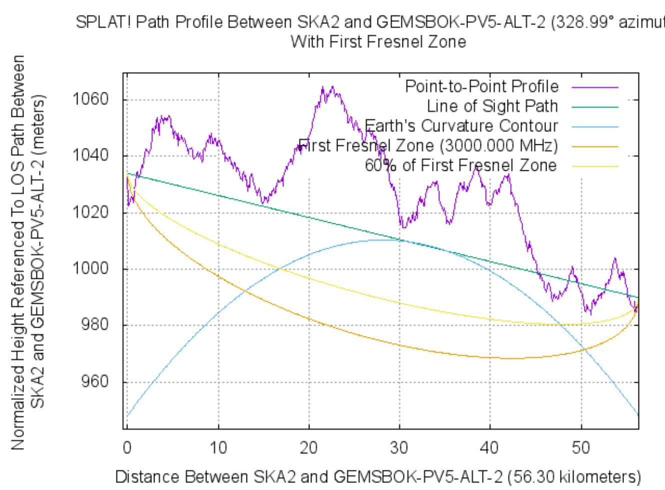
(a)



(b)



(c)



(d)

Figure 116: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.45 Gemsbok PV5 Alternative to Core SKA

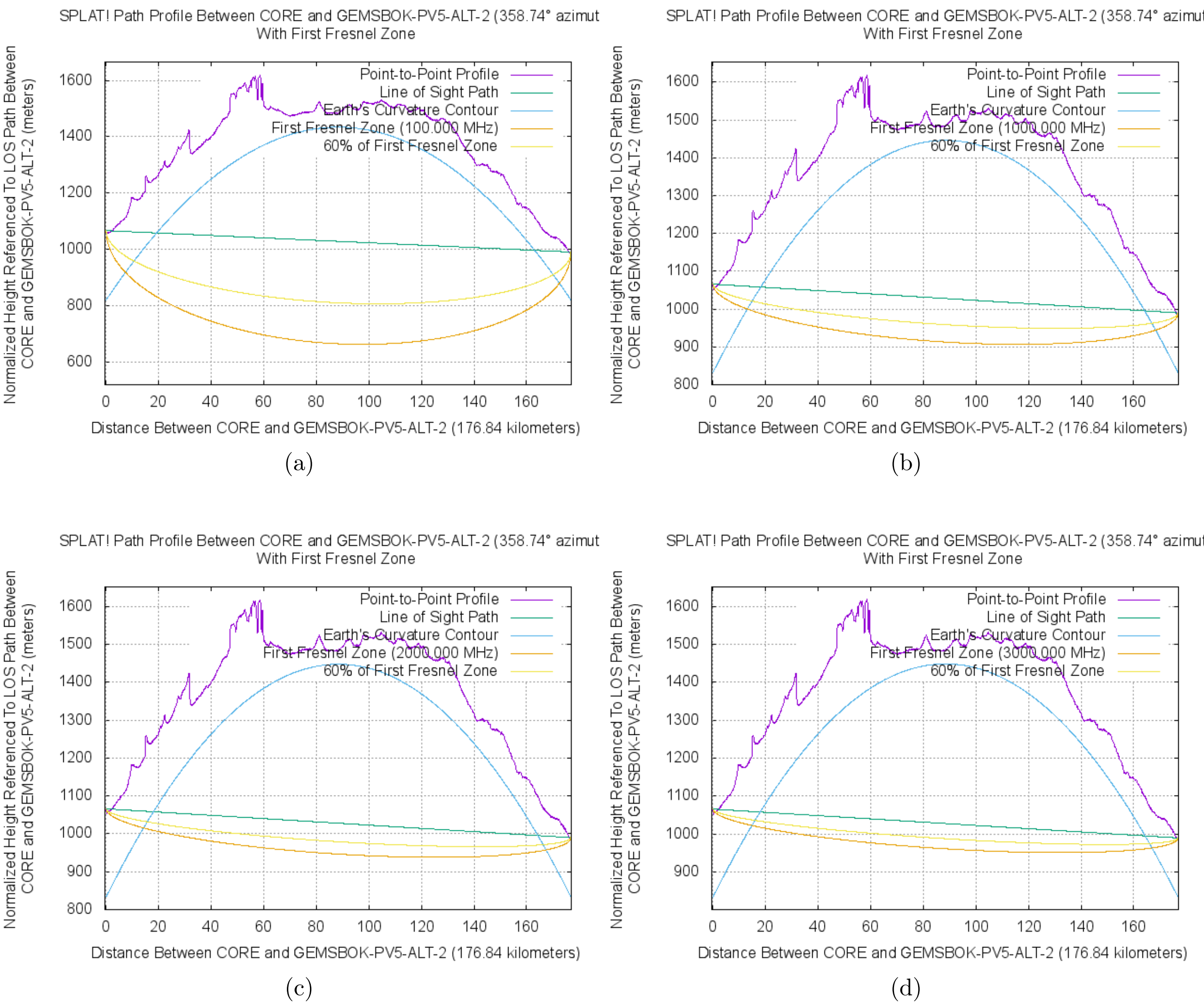


Figure 117: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.46 Gemsbok PV6 to Closest SKA

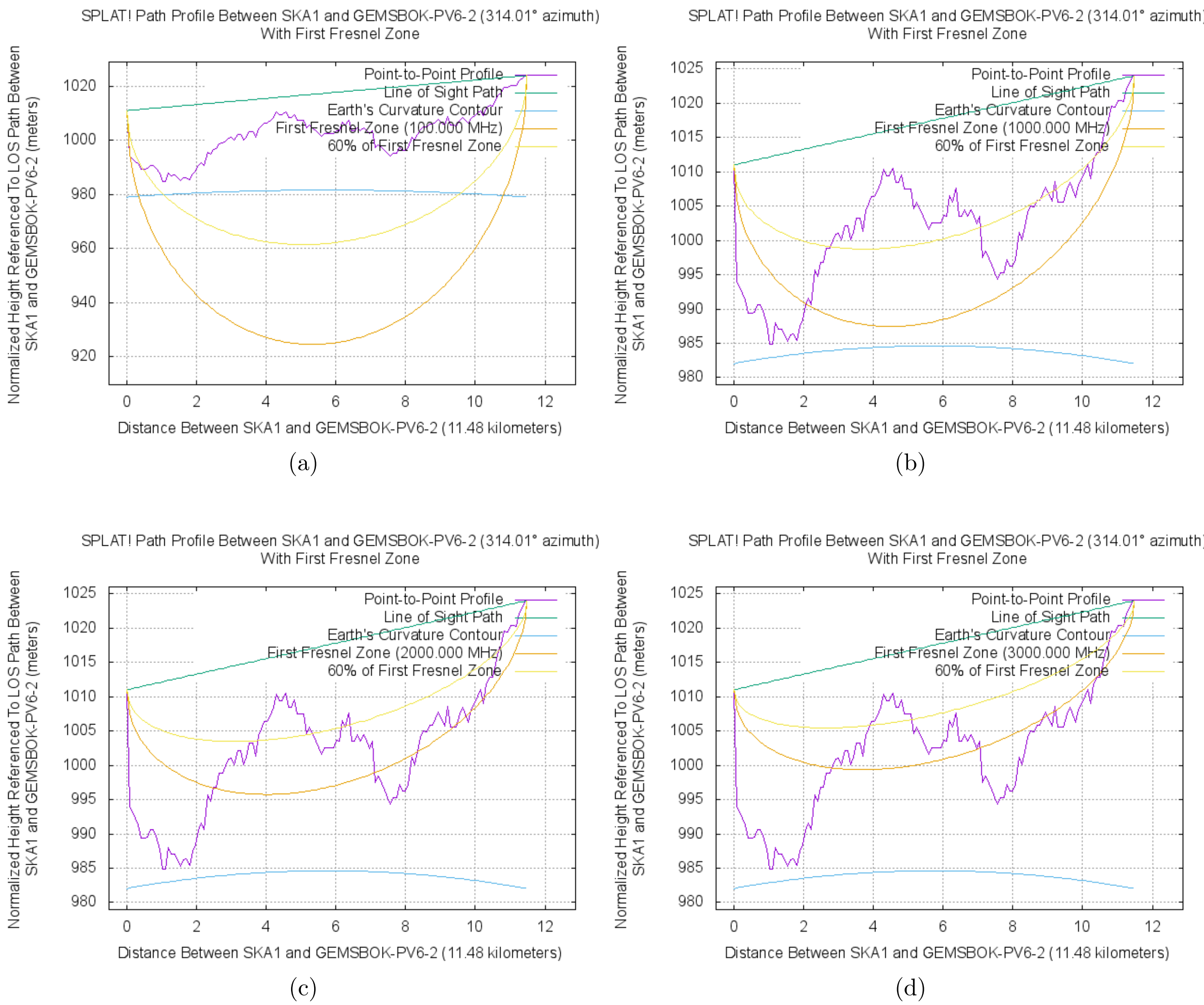


Figure 118: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.47 Gemsbok PV6 to 2nd Closest SKA

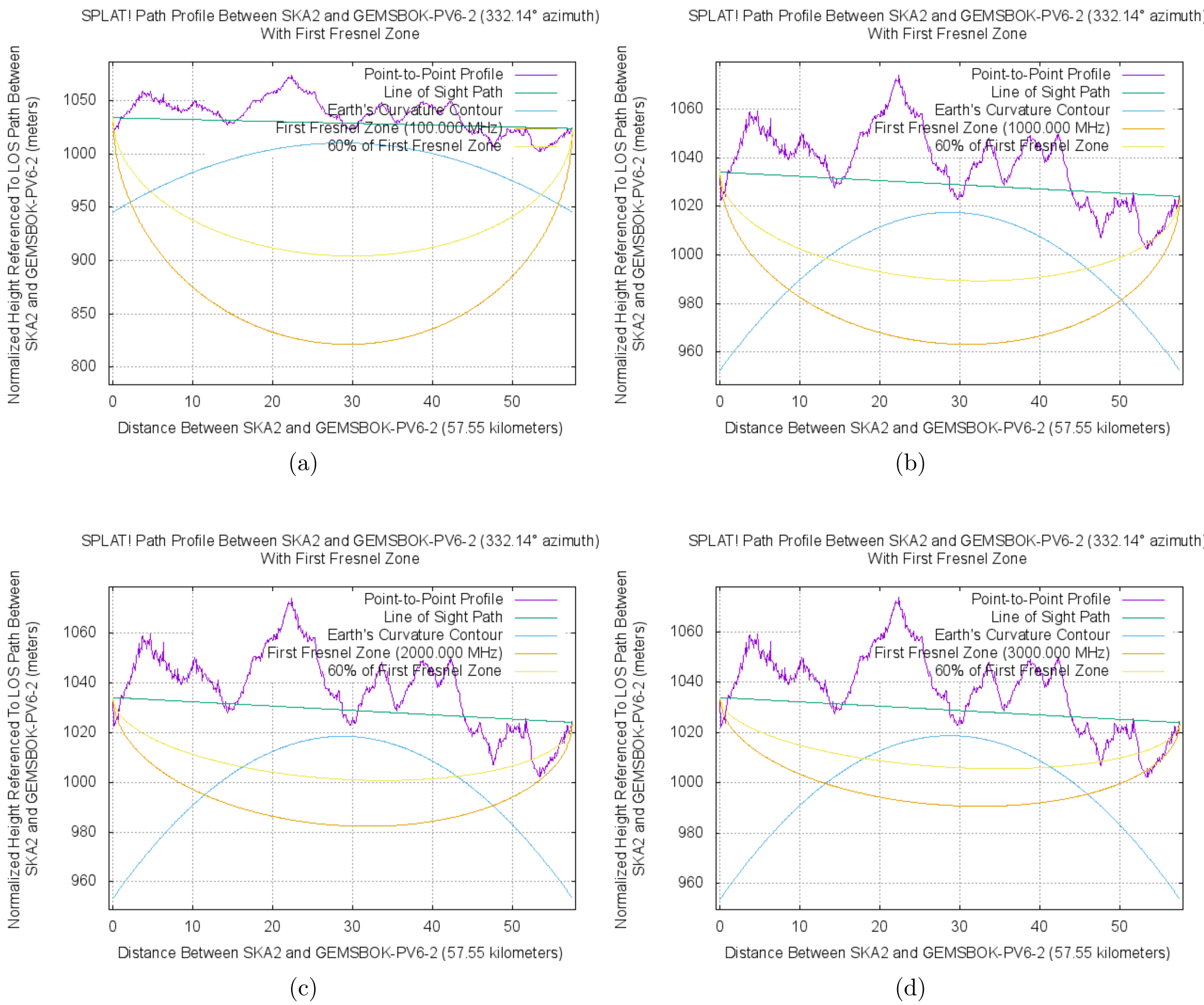


Figure 119: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.48 Gemsbok PV6 to Core SKA

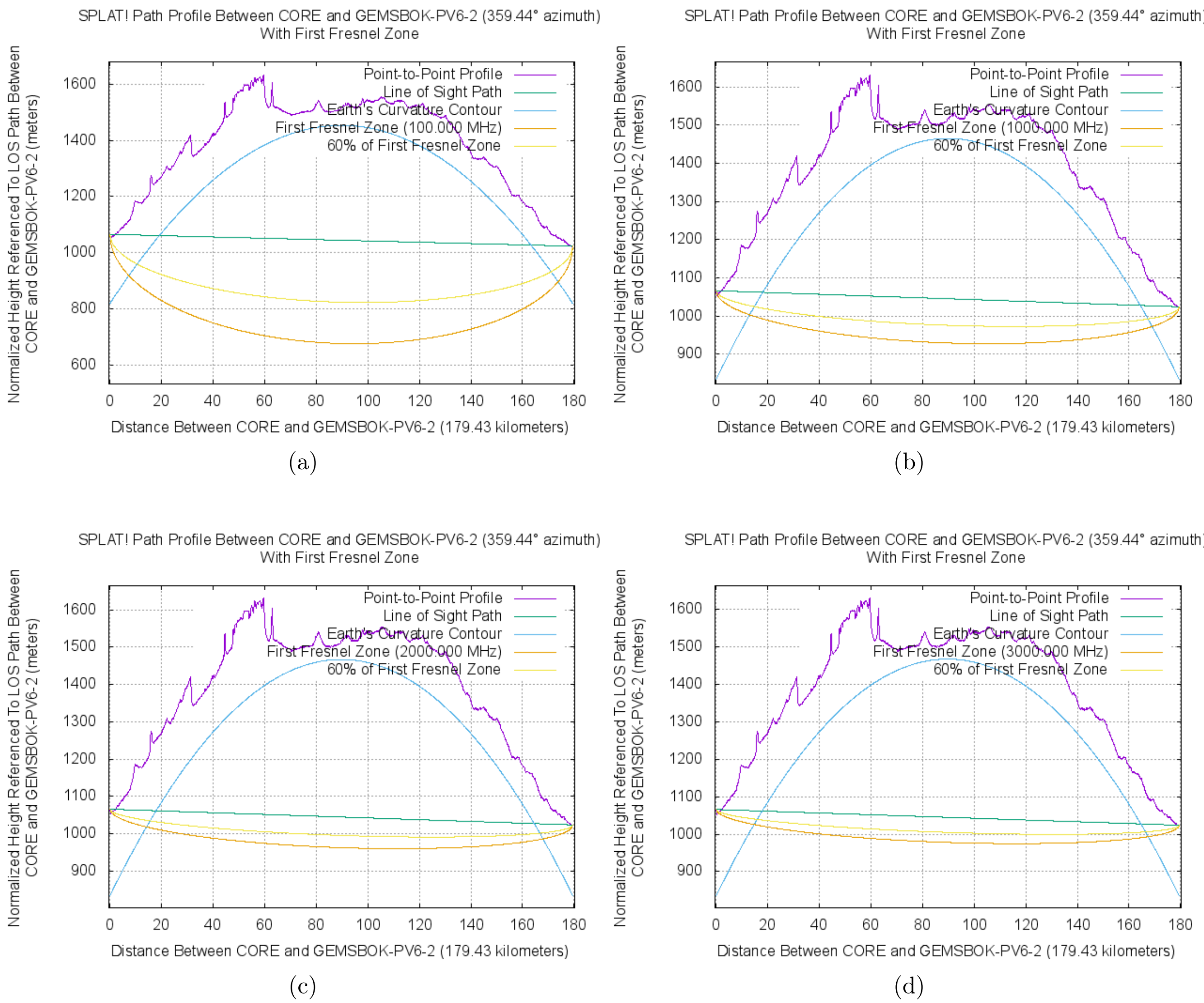
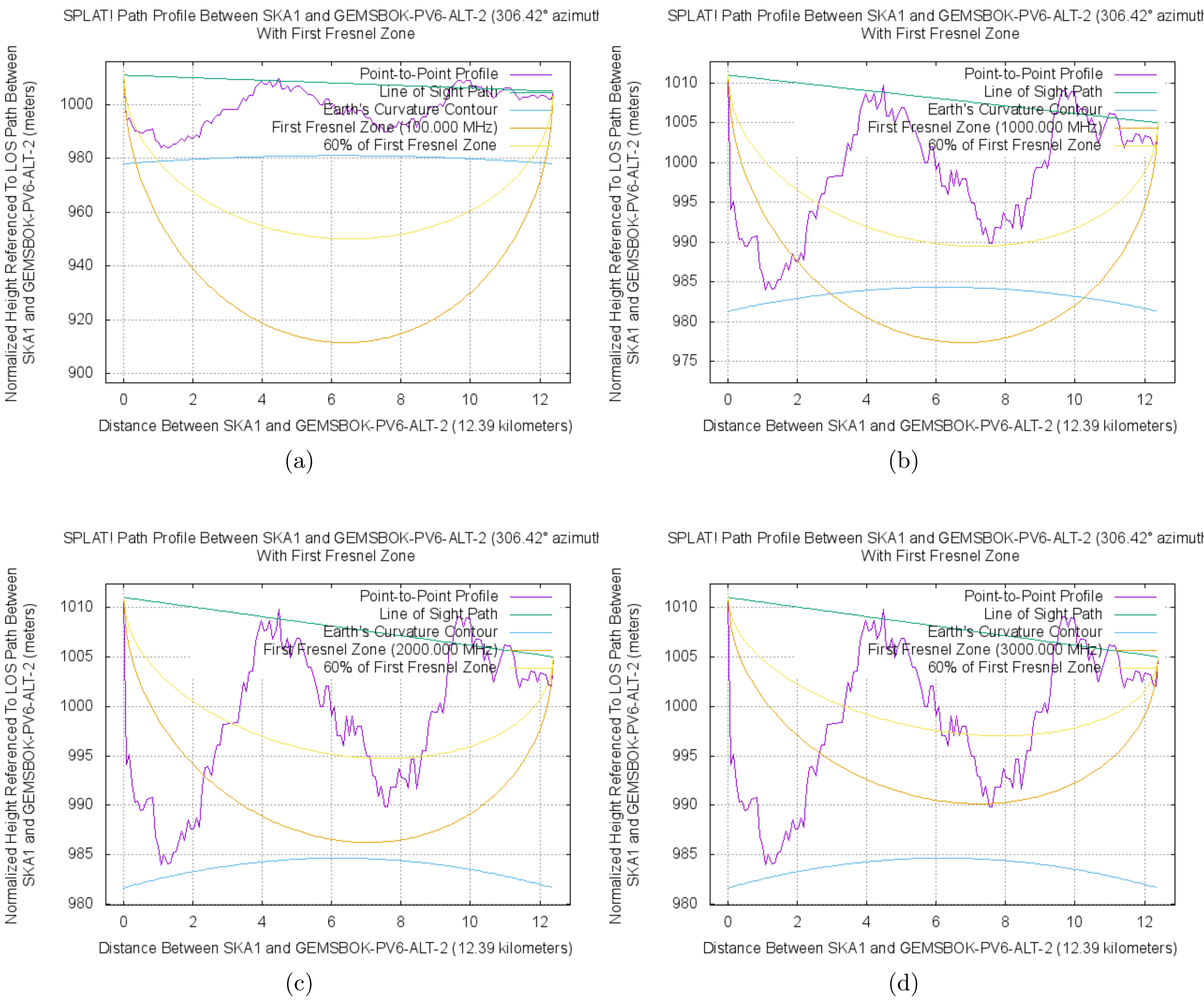


Figure 120: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.49 Gemsbok PV6 Alternative to Closest SKA



(a) (b) (c) (d)

Figure 121: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.50 Gemsbok PV6 Alternative to 2nd Closest SKA

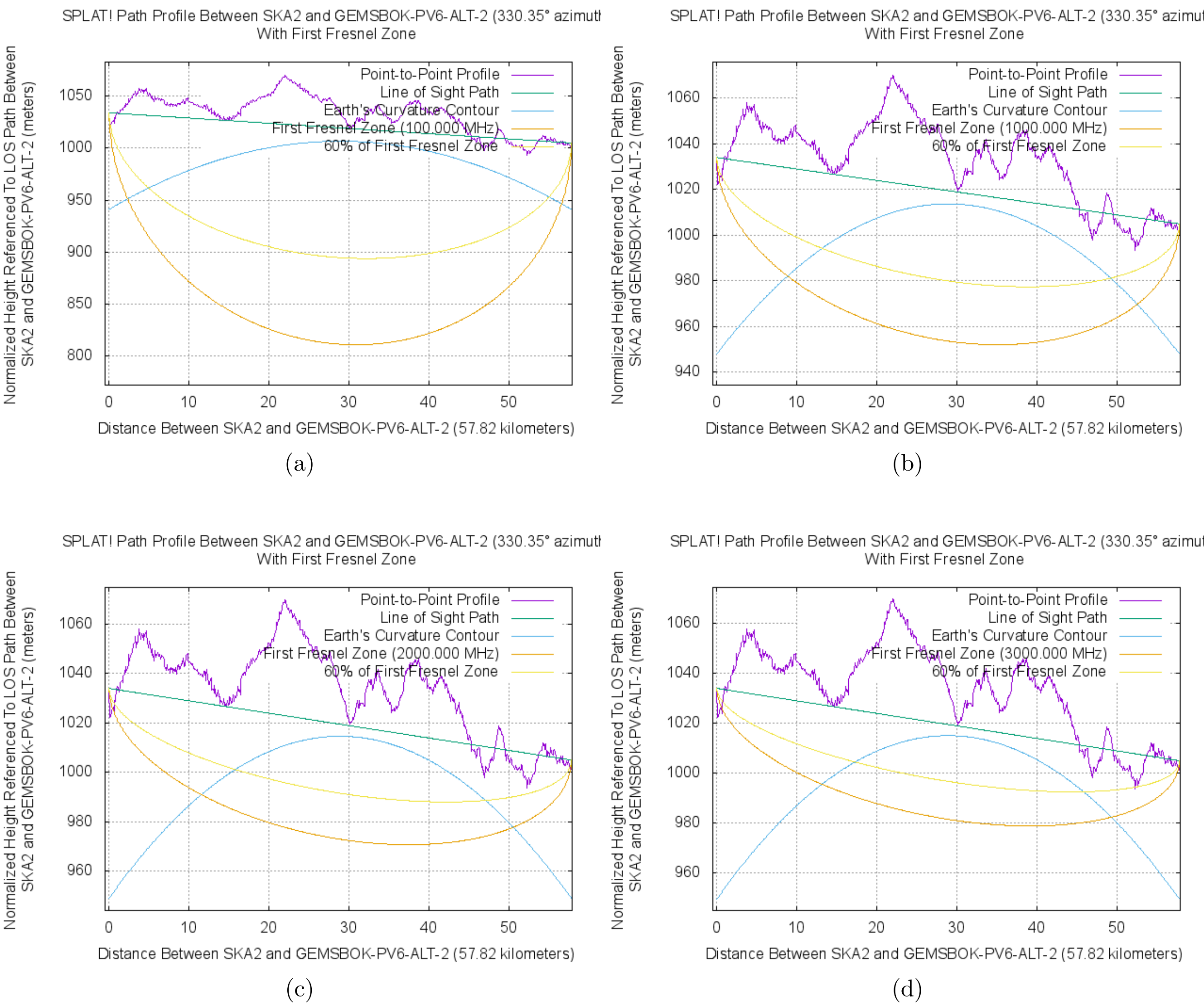


Figure 122: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.51 Gemsbok PV6 Alternative to Core SKA

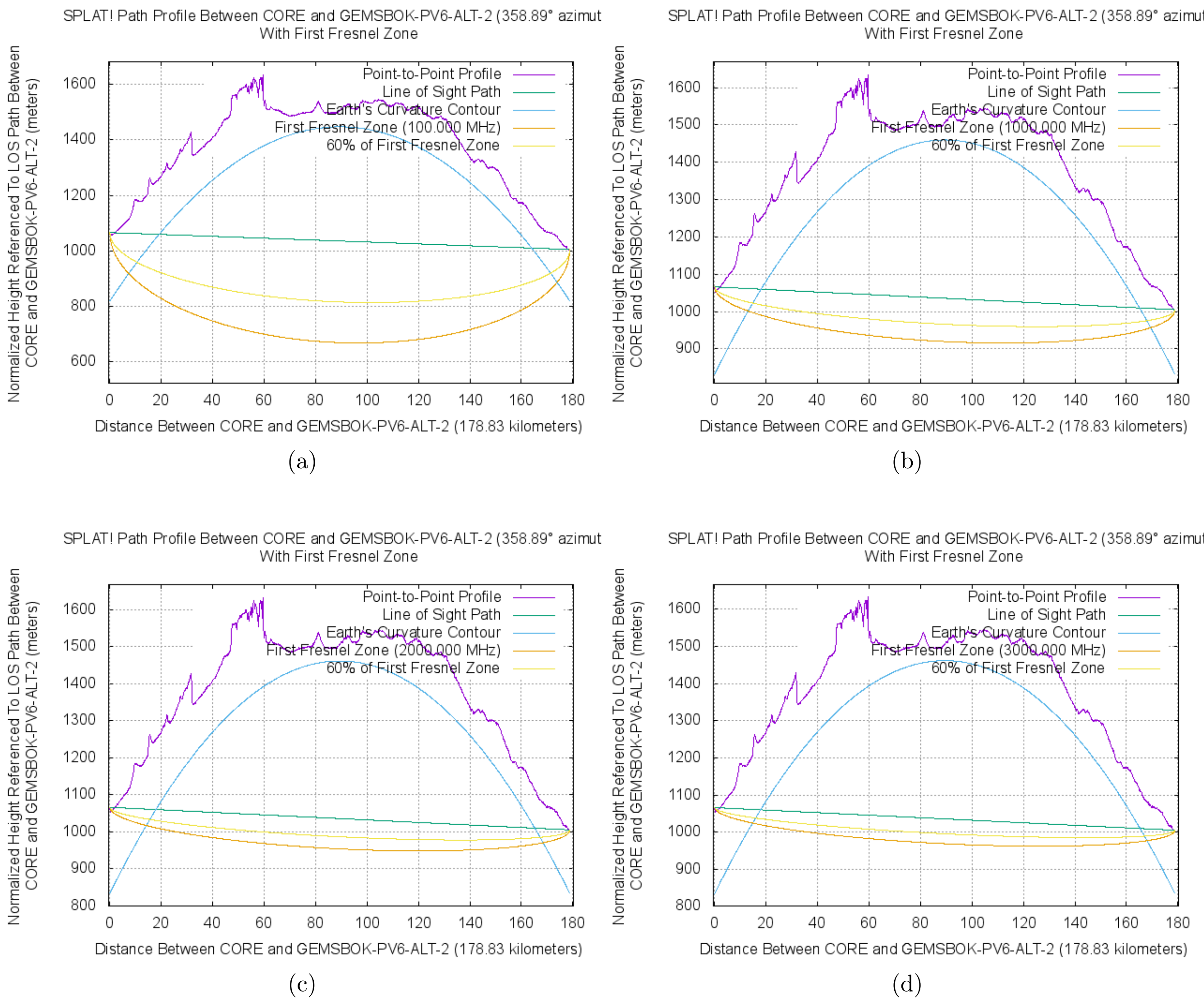


Figure 123: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.52 Scatec PV1 to Closest SKA

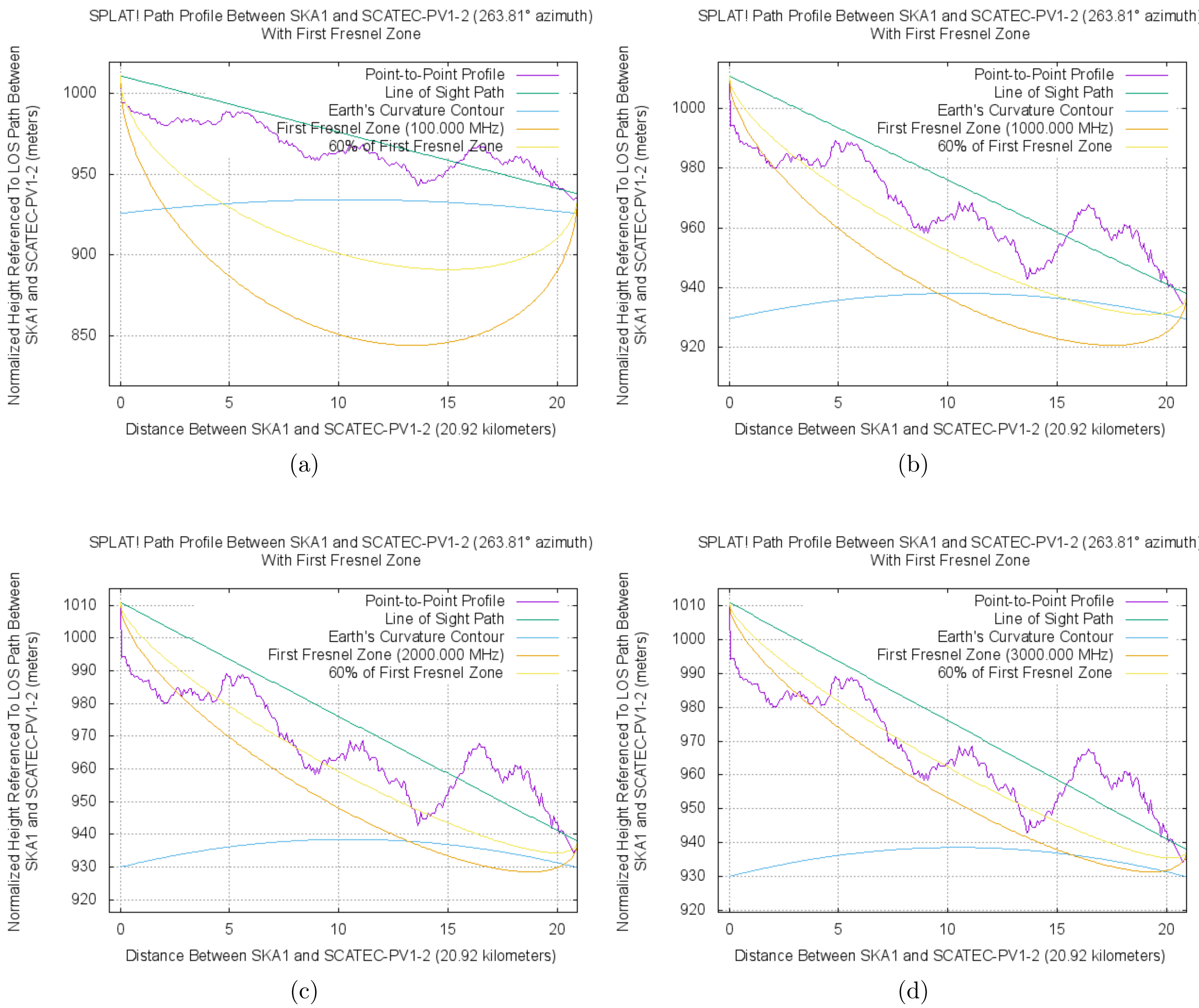
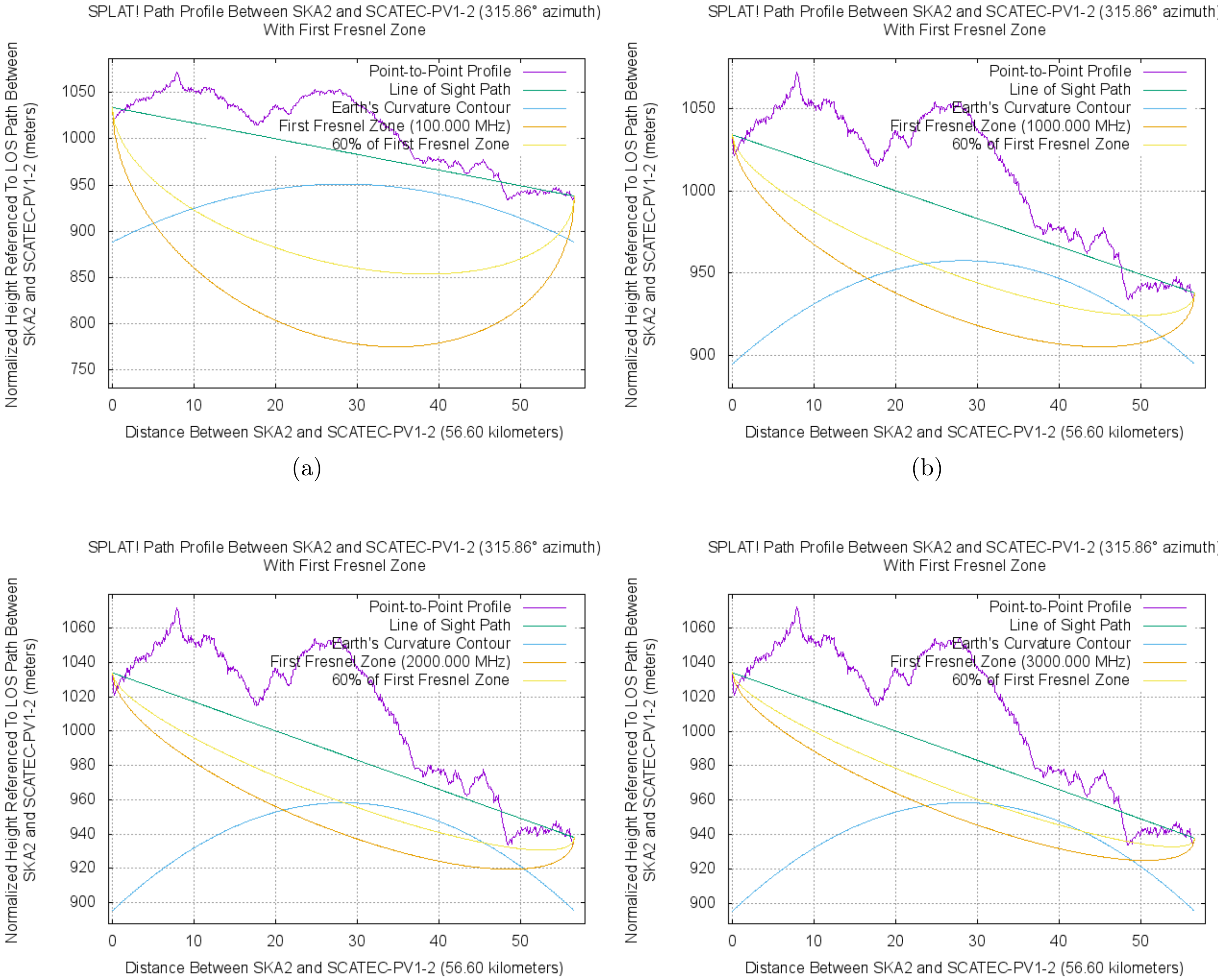


Figure 124: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.53 Scatec PV1 to 2nd Closest SKA



(a) (b) (c) (d)

Figure 125: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.54 Scatec PV1 to Core SKA

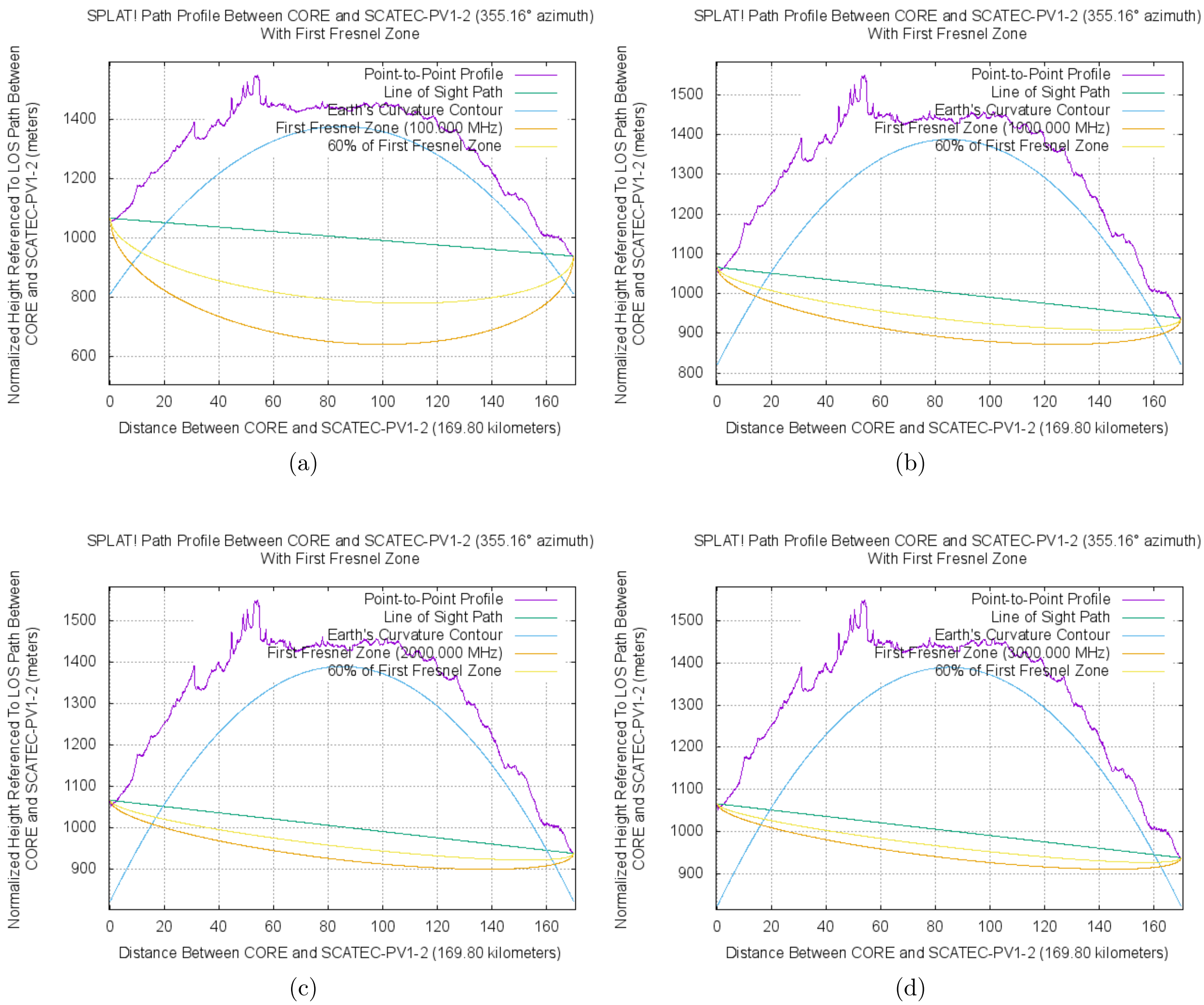
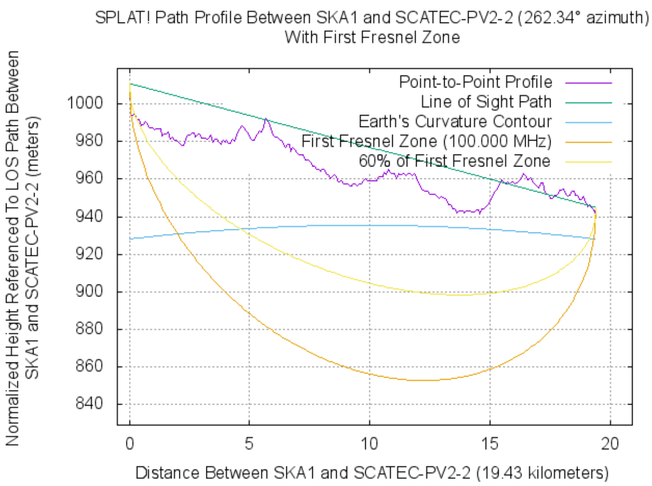
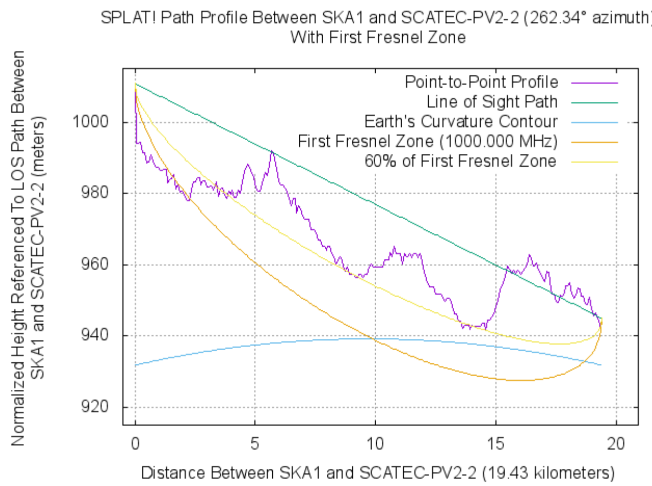


Figure 126: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

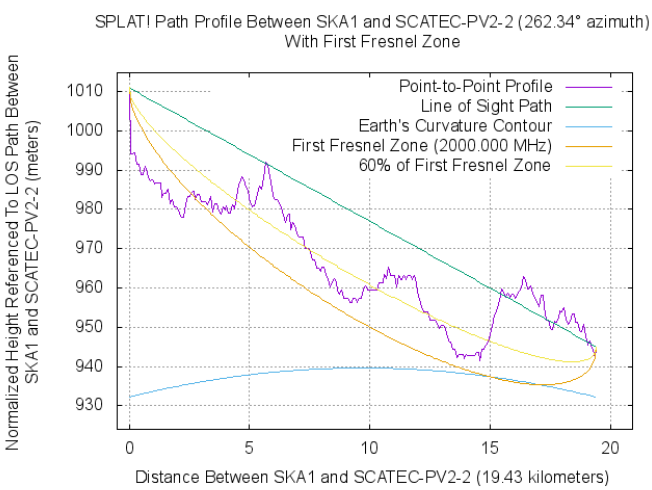
A.55 Scatec PV2 to Closest SKA



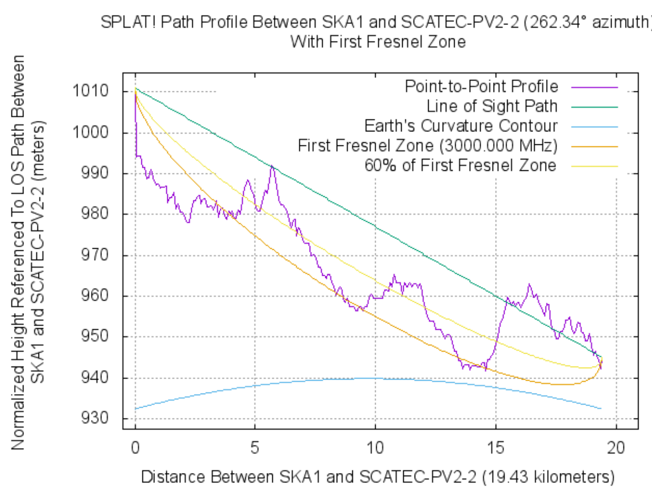
(a)



(b)



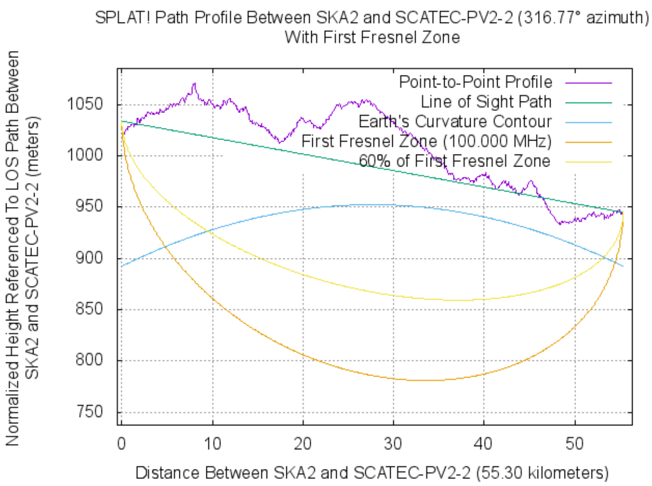
(c)



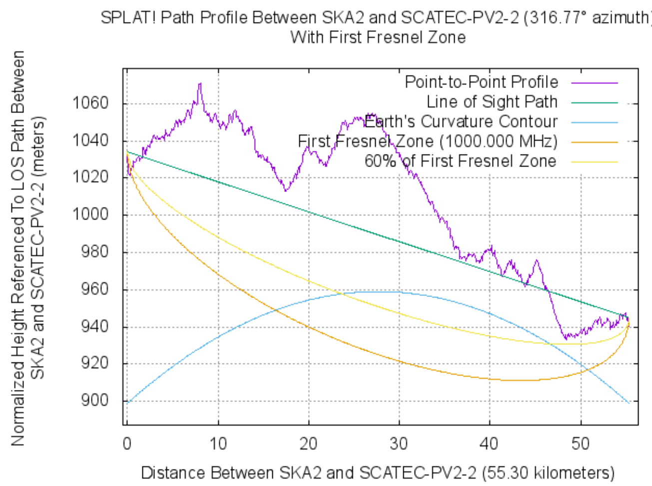
(d)

Figure 127: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

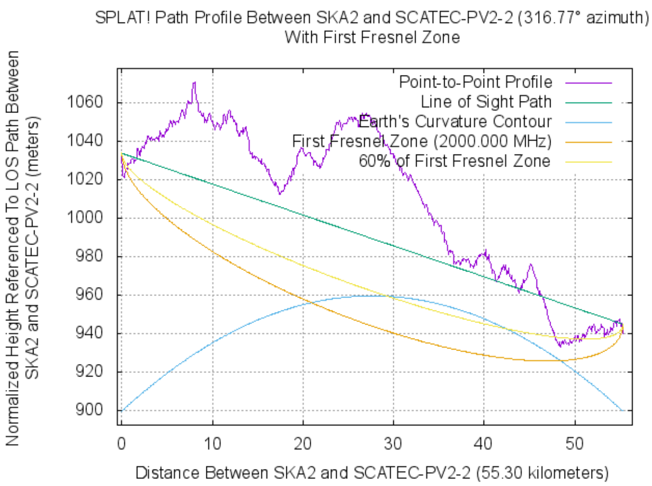
A.56 Scatec PV2 to 2nd Closest SKA



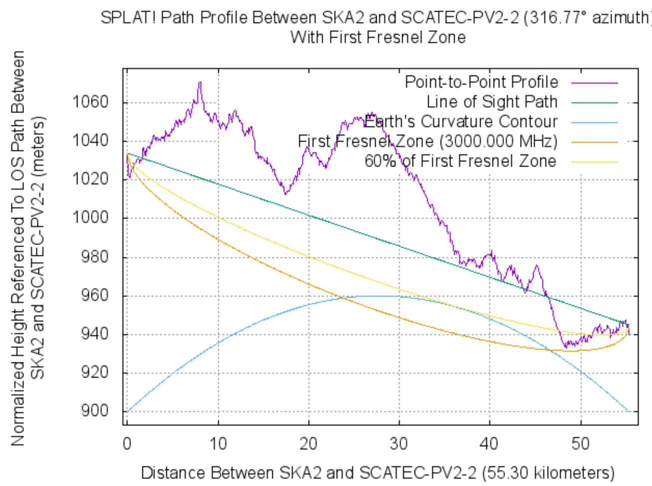
(a)



(b)



(c)



(d)

Figure 128: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.57 Scatec PV2 to Core SKA

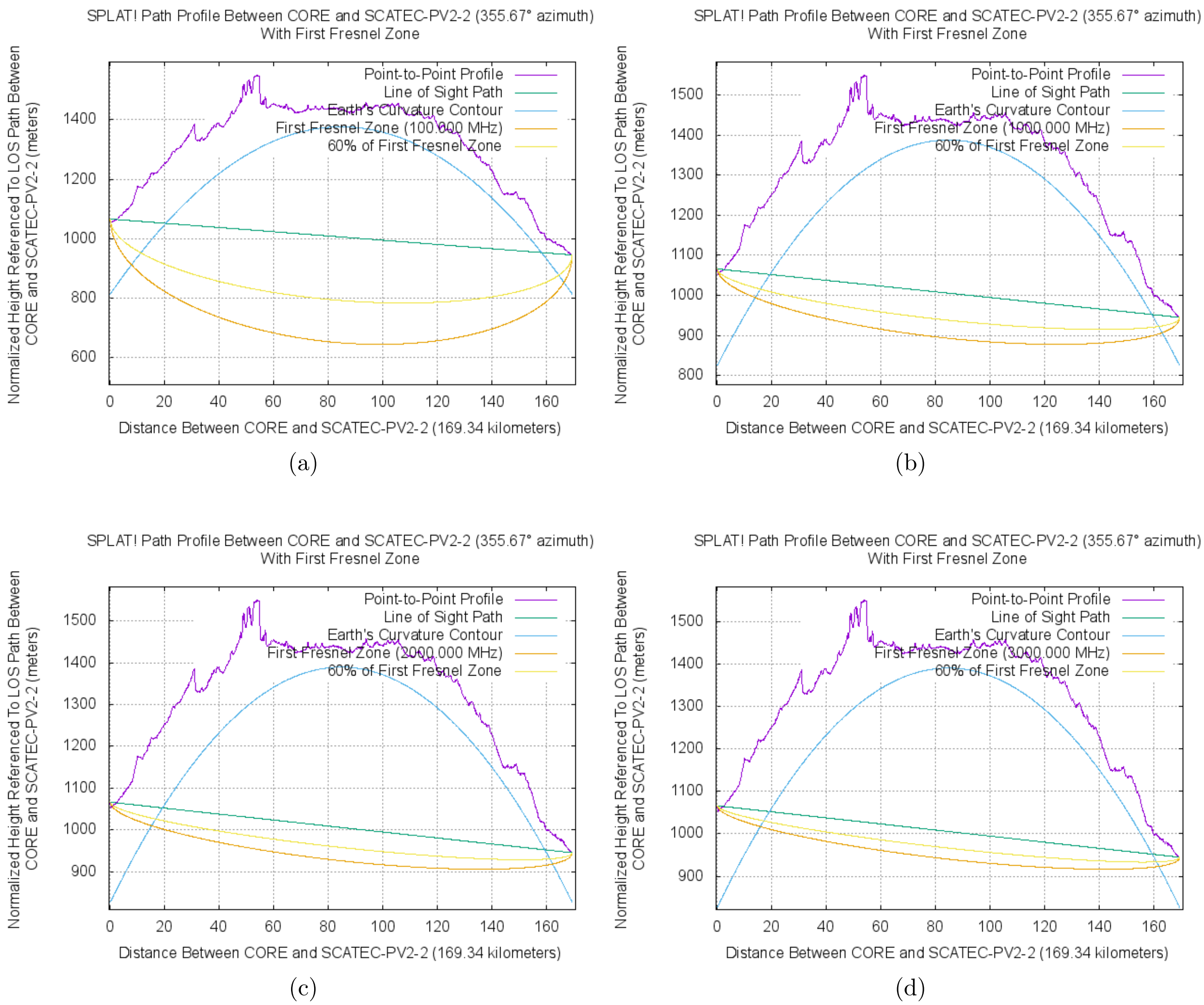


Figure 129: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.58 Scatec PV3 to Closest SKA

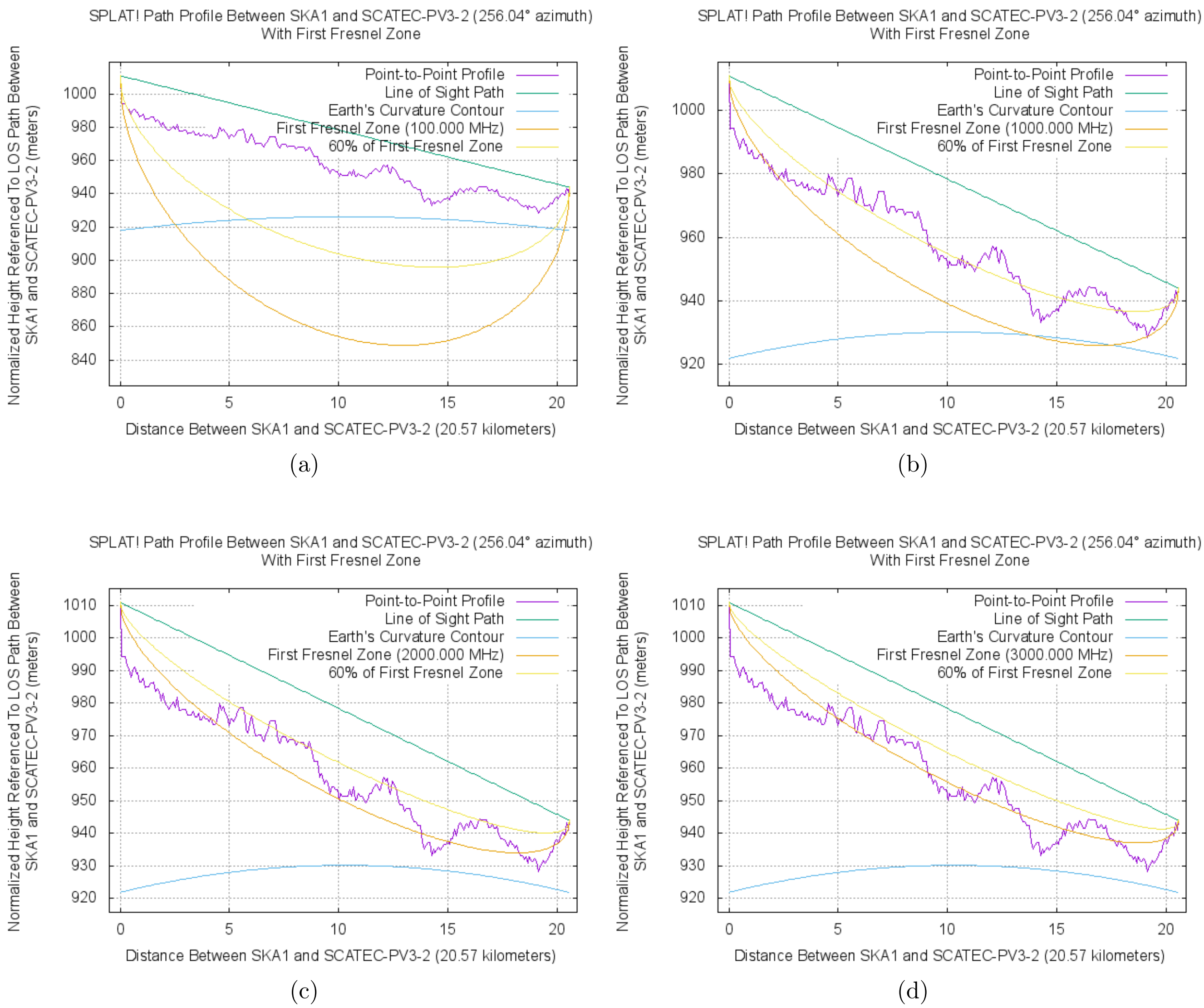


Figure 130: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.59 Scatec PV3 to 2nd Closest SKA

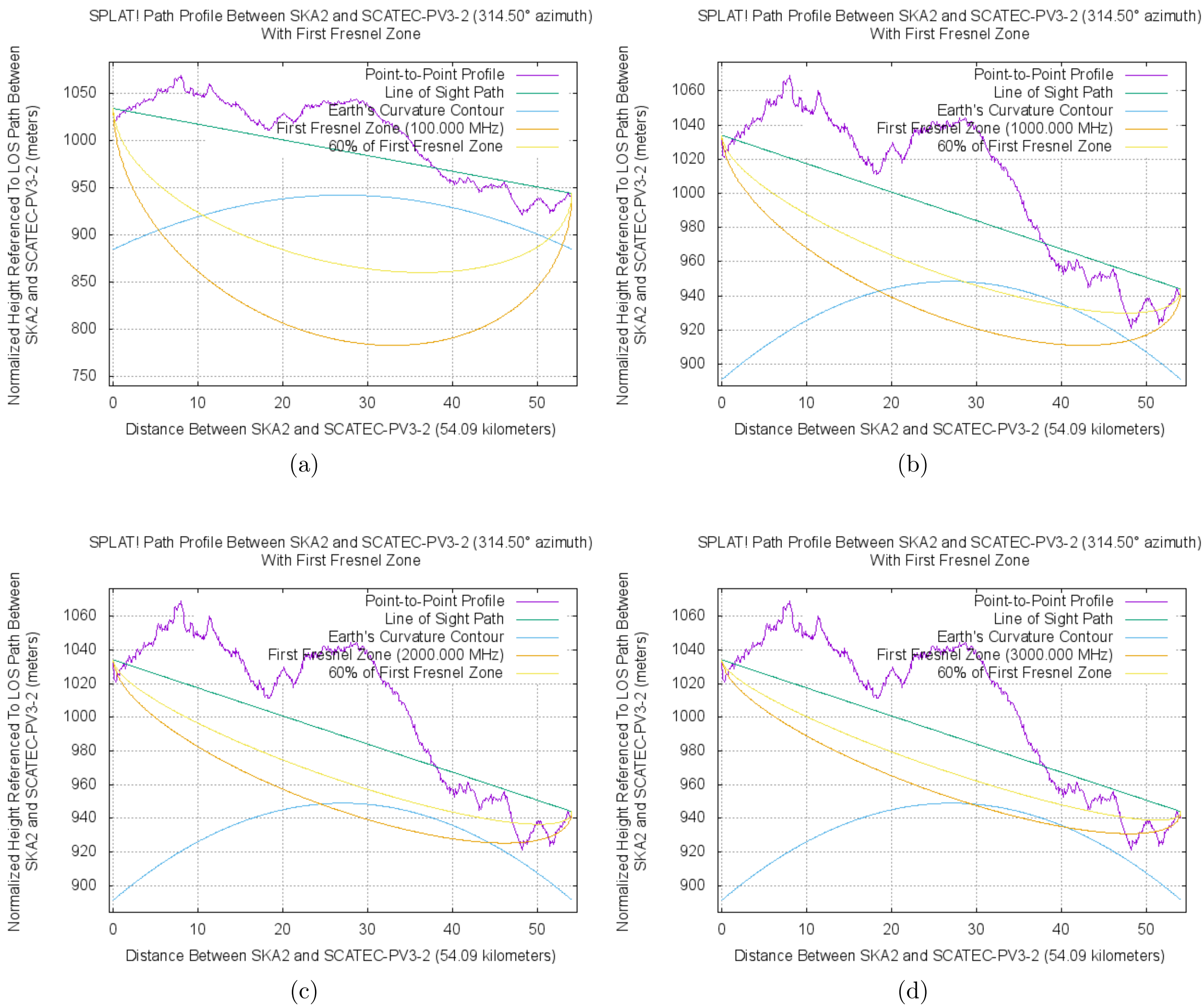
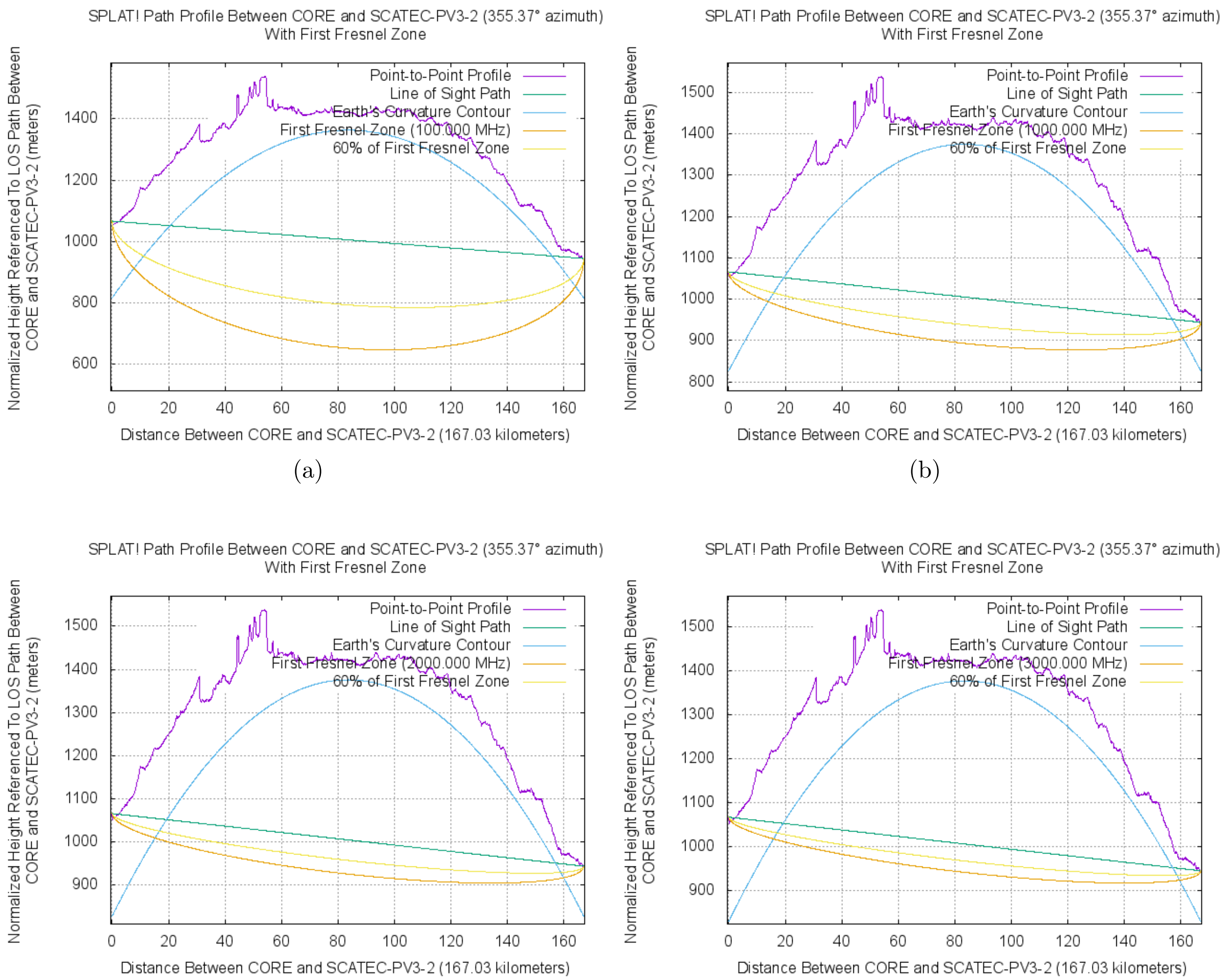


Figure 131: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.60 Scatec PV3 to Core SKA



(a) (b) (c) (d)

Figure 132: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

Scatec Solar
Improving our future™

EIA REPORT

PART B

EMP

Scoping and **Environmental Impact Assessment**
for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 3) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

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1 INTRODUCTION

This Environmental Management Programme (EMPr) is prepared as part of the requirements of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations promulgated in Government Gazette 38282 and Government Notice (GN) R982, R983, R984 and R985 on 8 December 2014. This EMPr is being submitted to the National Department of Environmental Affairs (DEA) as part of the Application for Environmental Authorisation (EA) for the proposed construction of a 75 Megawatt (MW) Solar Photovoltaic (PV) power generation facility and associated infrastructure on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 20-30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province (Figure 1). The proposed project is referred to as Kenhardt PV 3 and has been assigned the following DEA Reference Number: 14/12/16/3/3/2/836. The Project Applicant for this proposed 75 MW solar PV project is Scatec Solar SA 370 (PTY) Ltd (hereinafter referred to as Scatec Solar).

Scatec Solar intend to construct two other 75 MW Solar PV facilities adjacent to the Kenhardt PV 3 facility, on the remaining extent of Onder Rugzeer Farm 168. Separate full Scoping and EIA Processes have been undertaken for these proposed Solar PV facilities referred to as Kenhardt PV 1 (DEA Reference Number: 14/12/16/3/3/2/837) and Kenhardt PV 2 (DEA Reference Number: 14/12/16/3/3/2/838). A separate Basic Assessment Process has been undertaken for the development of the associated electrical infrastructure and transmission lines (to be constructed within an electrical corridor) that are required to connect the proposed PV facilities to the national grid via the Eskom Nieuwehoop Substation. Figure 1 shows the overall locality of the three proposed 75 MW Solar PV facility projects and the electrical infrastructure corridor (within which the proposed transmission lines and electrical infrastructure will be constructed to support each Solar PV project).

This EMPr was made available to Interested and Affected Parties (I&APs), stakeholders and Organs of State, as part of the EIA Report, for a 30-day review period, extending from 3 March 2016 to 5 April 2016. Comments received from stakeholders during this aforementioned review period have been incorporated into this EMPr, where applicable. Following the incorporation of comments from I&APs, stakeholders and Organs of State, this EMPr is intended as a “living” document and should continue to be updated regularly, as needed.

1.1 PROJECT DESCRIPTION

The proposed project will make use of PV solar technology to generate electricity from the sun’s energy. The Applicant is proposing to develop a facility with a possible maximum installed capacity of 100 MW Direct Current (DC) which produces 75 MW Alternating Current (AC) of electricity from PV solar energy. Once a Power Purchase Agreement (PPA) is awarded, the proposed facility will generate electricity for a minimum period of 20 years. The Eskom Nieuwehoop Substation (which is currently being constructed and is located approximately 3 km from the project site) will be used to connect the proposed PV facility to the national grid. An EA for the construction of the Eskom Nieuwehoop Substation was granted to Eskom Holdings SOC Limited on 21 February 2011 by the DEA (Reference Number: 12/12/20/1166). In addition, an EA (DEA Reference Number: 12/12/20/2606; NEAS Reference Number: DEA/EIA/0000785/2011), dated 14 February 2014, was also granted to Eskom Holdings SOC Limited to construct transformer feedback bays, transformers, busbars and 132 kV feeder bays and associated lines within the existing development footprint of the Nieuwehoop Substation.

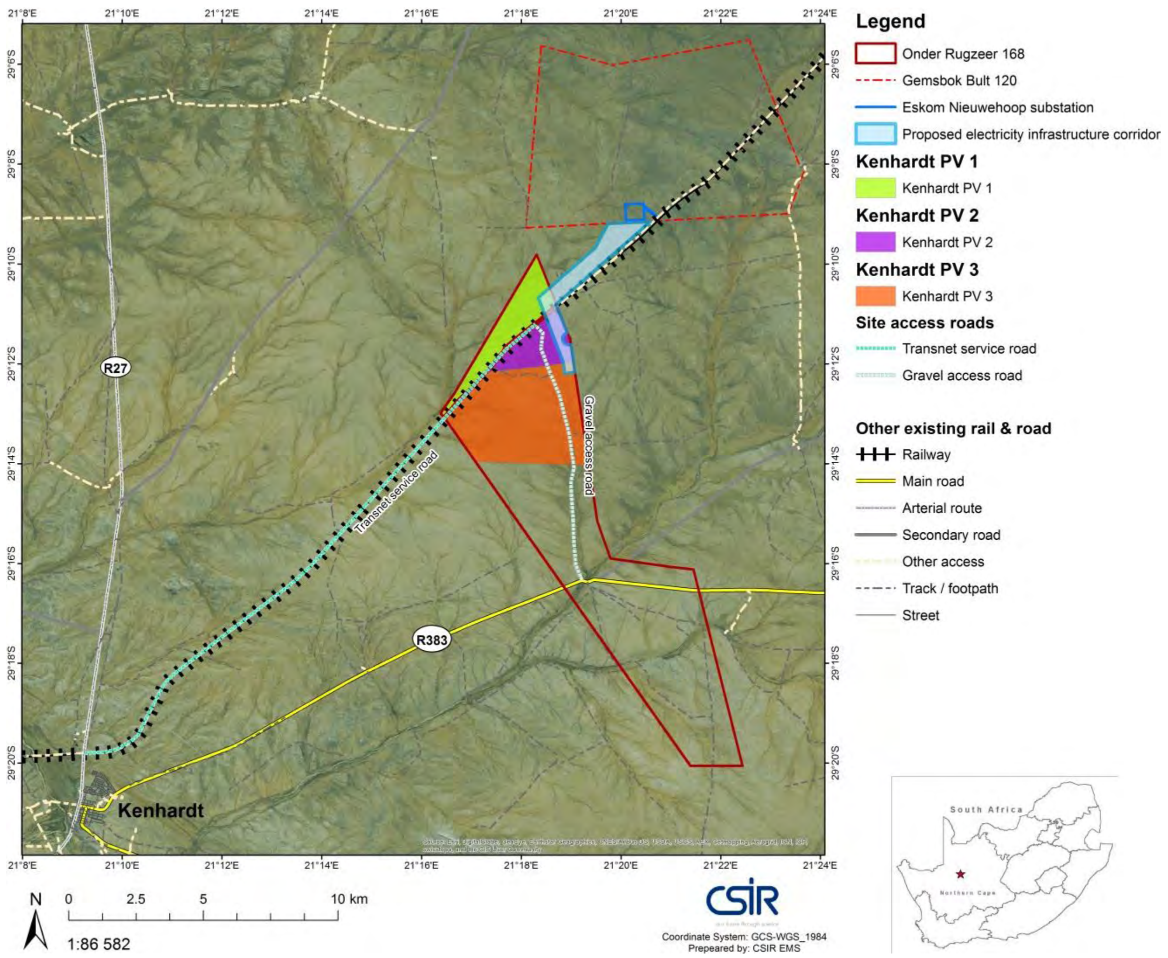


Figure 1: Locality of the three proposed 75 MW PV Facilities and Electrical Infrastructure Corridor

The preferred site for the proposed Kenhardt PV 3 project includes approximately 1341 ha of land (as shown in Figure 1), which was increased from 1000 ha since the release of the Scoping Report (based on design progression). Overall, a portion of area previously allocated to Kenhardt PV 2 was removed and allocated to that of Kenhardt PV 3 in order to ensure that the proposed projects are constructed close together (as explained in the finalised EIA Report). However, the proposed solar facility and associated infrastructure requires a development area of approximately 250 ha only. The larger 1341 ha area was considered and assessed by the specialists in order to ensure that any development constraints or environmental sensitivities can be avoided in the final siting and location of the proposed facility. Based on the findings of the specialist studies, an environmental sensitivity map has been produced (and included in Chapter 16 of the finalised EIA Report and Appendix B of this EMPr). This map shows the sensitivities on site (terrestrial, aquatic, and sensitive heritage features) within the larger 1341 ha buildable area that was identified. Specifically, two quartzite koppies and an association which includes *Aloe claviflora* and *A dichotoma* (which is associated with those areas proximal to the two quartzite kopjies), major and minor drainage lines, a single likely grave, large scatter of quartz artefacts, and a flaked quartz outcrop with a few artefacts around it towards the west of the Kenhardt PV 3 site (which forms part of a larger quartz hill/ridge) were identified. No other sites were deemed sensitive by the specialists. Based on this map, the preferred location for the 250 ha Kenhardt PV 3 facility, also known as the Development Envelope, avoids the sensitive features that were identified by the specialists within the original 1341 ha buildable area. Based on the boundaries of the Development Envelope and the constraints of the environmental sensitivities, a site layout has also been preliminarily determined for this project (Appendix A of this EMPr).

Therefore, the sensitive features highlighted above (i.e. Aloes, two quartzite kopjies, major drainage lines, two archaeological sites and possible grave site) have been excluded from the proposed development footprint with the required buffers proposed by the specialists as the features are located towards the western edge of the Development Envelope (i.e. 1341 ha site).

It is important to note that should the layout change subsequent to the issuing of an EA (should such authorisation be granted), any alternative layout or revisions to the layout occurring **within the boundaries of the Development Envelope** would not be regarded as a change to the scope of work or the findings of the impact assessments undertaken during the EIA Phase. This is based on the understanding that the specialists have assessed the larger area and have identified sensitivities, which have been avoided in the siting of the proposed infrastructure. The Development Envelope is considered to be a “box” in which the project components can be constructed at whichever location without requiring an additional assessment or change in impact significance. Any changes to the layout **within the boundaries of the Development Envelope** following the issuing of the EA (should it be granted) will therefore be considered to be non-substantive.

Appendix B of this EMPr includes an environmental sensitivity map which indicates the environmental sensitive areas and features identified during the EIA Process (as described above). Appendix C of this EMPr includes a map combining the site layout and the environmental sensitivity map.

The proposed **Kenhardt PV 3** project will consist of the following main components:

- **Solar Field**
  - Solar Arrays:
    - PV Modules;
    - Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south) or Fixed Tilt Mounting Structure;
    - Solar module mounting structures comprised of galvanised steel and aluminium; and
    - Foundations which will likely be drilled and concreted into the ground.

  - Building Infrastructure:
    - Offices;
    - Operational and maintenance control centre;
    - Warehouse/workshop;
    - Ablution facilities;
    - Converter stations;

- On-site substation building; and
- Guard Houses.

- **<u>Associated Infrastructure</u>**
  - 132 kV overhead transmission line (which has been subjected to a separate Basic Assessment Process, referred to as Kenhardt PV 3 – Transmission Line);
  - Associated electrical infrastructure at the Eskom Nieuwehoop Substation (including but not limited to an additional feeder bay(s), Busbar(s), transformer bay and extension to the platform at the substation (which has been subjected to a separate Basic Assessment Process, referred to as Kenhardt PV 3 – Transmission Line);
  - On-site substation;
  - 33 kV internal transmission lines/underground cables;
  - Underground low voltage cables or cable trays;
  - Access roads;
  - Internal gravel roads;
  - Fencing;
  - Panel maintenance and cleaning area;
  - Stormwater channels; and
  - Temporary work area during the construction phase (i.e. laydown area).

The proposed project can be divided into the following three main phases:

- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

Activities will be undertaken during each phase which may cause an environmental impact. These activities have therefore been considered by the appointed specialists, and considered during the EIA and management and mitigation measures required to address all the impacts included within this EMPr. The construction phase will take place subsequent to the issuing of an EA from the DEA and a successful BID in terms of the REIPPPP (i.e. the issuing of a PPA from the DOE). The construction phase is expected to extend 14 months (however the construction period is subject to the final requirements of Eskom and the REIPPPP Request for Proposal provisions at that point in time). The proposed Kenhardt PV 3 project is expected to become operational by 2018.

The main activities that will form part of the <u>construction phase</u> are:

- Transportation of personnel, construction material and equipment to the site, and personnel away from the site;
- Construction of the site camp and laydown areas, as well as dedicated access routes from the laydown areas to the working areas;
- Vegetation clearing in the areas required for building infrastructure and brush cutting in the solar field area where the panels will be installed;
- Excavations for infrastructure and associated infrastructure;
- Establishment of a laydown area for equipment;
- Construction of internal access roads, where required;
- Stockpiling of soil and cleared vegetation; and

- Construction of the solar field (consisting of the solar arrays and buildings) and additional infrastructure.

The following main activities will occur during the operational phase:

- Generation of 75 MW of electricity to add to the national grid; and
- Maintenance of the solar facility, including washing of panels.

The projected operations are expected to provide several services and added economic spin offs. The solar facility is expected to generate electricity for a minimum period of 20 years.

Should it be decided not to extend the operational lifespan of the project beyond 20 years, the project will be decommissioned. The main aim of decommissioning is to return the land to its original, pre-construction condition. Should the unlikely need for decommissioning arise (i.e. if the facility becomes outdated or the land needs to be used for other purposes), the decommissioning procedure will involve removing the solar panels and associated infrastructures, and covering the concrete footings with soil to a depth sufficient for the re-growth of natural vegetation. Whether all components of the solar facility will be removed still needs to be agreed upon with the landowner (some components may be useful for the landowner and therefore it could be decided that those remain on site). Any other supporting infrastructure no longer in use will be removed from the site and either disposed of at a registered disposal facility or recycled if possible.

It should be noted that a detailed project description (based on the conceptual design) is provided in Chapter 2 of the finalised EIA Report.

1.2 AUTHORS OF THE EMPr

This EMPr has been compiled by the Environmental Assessment Practitioners (Paul Lochner, Surina Laurie and Rohaida Abed) and the various specialists on the team (as indicated in Table 1). The details and expertise of the Environmental Assessment Practitioners and the specialists are provided in Appendix A of the finalised EIA Report.

Paul Lochner has more than 20 years of experience in environmental assessment and management studies, primarily in the leadership and integration functions. This has included Strategic Environmental Assessments (SEA), EIAs and Environmental Management Plans. In July 2003, he obtained certification as a registered EAP with the Interim Certification Board for EAPs of South Africa (EAPSA). Paul has extensive experience in conducting environmental assessment and management processes throughout South Africa.

Surina Laurie has a Masters degree in Environmental Management and more than 5 years of experience in environmental assessment and management. She has experience in undertaking Basic Assessments and Scoping and EIAs for various sectors, including renewable energy, industry and tourism. She is a registered Professional Natural Scientist (Registration Number: 400033/15) with the South African Council for Natural Scientific Professions (SACNASP). Rohaida Abed has a Masters degree in Environmental Science and is a registered Professional Natural Scientist (Registration Number: 400247/14) with the SACNASP. She has experience in conducting Basic Assessments and Scoping and EIAs for various sectors, including Port infrastructure and Bulk Liquid Storage facilities, and has been involved in various transport infrastructure related projects as an Environmental Control Officer.

Table 1: The EIA Management Team

NAME	ORGANISATION	ROLE/ SPECIALIST STUDY UNDERTAKEN
Environmental Assessment Practitioners		
Paul Lochner	CSIR	Technical Advisor and Quality Assurance (EAPSA) Certified
Surina Laurie	CSIR	Project Leader (*Pr. Sci. Nat.)*
Rohaida Abed	CSIR	Project Manager (*Pr. Sci. Nat.)*
Specialists		
Simon Bundy	Sustainable Development Projects cc	Ecological Impact Assessment (including Terrestrial Ecology, Aquatic Ecology and Avifauna)
Henry Holland	Private	Visual Impact Assessment
Dr. Jayson Orton	ASHA Consulting (Pty) Ltd	Heritage Impact Assessment (Archaeology and Cultural Landscape)
Dr. John Almond	Natura Viva cc	Desktop Palaeontological Impact Assessment
Julian Conrad	GEOSS	Geohydrological Assessment
Johann Lanz	Private	Soils and Agricultural Potential Assessment
Rudolph du Toit	CSIR	Social Impact Assessment
P. S. van der Merwe and A. J. Otto	MESA Solutions (PTY) Ltd	Electromagnetic Interference and Radio Frequency Interference Surveys

As noted above, an Electromagnetic Interference and Radio Frequency Interference Survey Technical Study was commissioned by the Project Applicant to determine the impact of the proposed project on the Square Kilometre Array (SKA), as requested by the SKA Project Office. This report is not a standard specialist study in terms of Appendix 6 of the EIA Regulations, as it is a detailed, technical report which provides a cumulative topographical analysis of the proposed PV projects in the Astronomy Geographic Advantage Area and was undertaken to determine appropriate mitigation and management measures to reduce the risk of a detrimental impact on the SKA project.

1.3 IMPACTS IDENTIFIED DURING THE EIA PROCESS

Based on the specialist studies (as shown in Table 1), the following main direct potential impacts, as indicated in Table 2, have been identified and appropriate management and mitigation measures included within the EMPr (where required) as per the recommendations made in the specialist studies to ensure the potential impacts are suitably addressed and managed during all phases of the project. Indirect and cumulative impacts are noted in Sections 4 to 12 of this EMPr.

It should be noted that other impacts for which specialist studies were not undertaken but where mitigation or management actions may be required, are also included in the EMPr.

Table 2: Impacts Identified in the EIA

KEY IMPACT	IMPACTS IDENTIFIED
Terrestrial Ecology, Aquatic Ecology and Avifauna	**Construction Phase:** ▪ The ousting of fauna through anthropogenic activities, disturbance of refugia and general change in habitat. ▪ Alteration of surface drainage patterns on account of construction activities leading to change in plant communities and general habitat structure. ▪ Impact on plant water relations as a result of abstraction from subsurface aquifers. ▪ Alteration of the availability of water to plants within the site due to the introduction of water to site by import, which may lead to changes in habitat form and structure around areas that receive such import. ▪ Alteration of surface water quality that lead to change in water chemistry. ▪ Changes in edaphics (soils) on account of excavation and import of soils, leading to the alteration of plant communities and fossorial species in and around these points. ▪ Increased Electrical Light Pollution (ELP), leading to changes in nocturnal behavioural patterns amongst fauna. ▪ Exclusion or entrapment of in particular large fauna, on account of the fencing of the site. **Operational Phase:** ▪ Alteration of ecological processes on account of the exclusion of certain fauna, inherent to the functional state of the land within the PV facility. ▪ Changes in plant water relations and possible changes in plant community structures within the site as a result of increased shading, as a consequence of the PV arrays. ▪ Changes in meteorological factors at a local scale, on account of the PV arrays. ▪ Alteration to the state of subsurface water resources as a result of abstraction of groundwater for the cleaning of the PV panels, as well as for operational use. ▪ Alteration of avian behaviour as a result of overhead transmission lines, as well as subtle changes in habitat. ▪ Impact on faunal behaviour, leading to the exclusion of certain species and possible mortalities, due to the fencing of the site, possibly electric fencing. **Decommissioning Phase:** ▪ A reversion to the present seral stage, where continued grazing by livestock and herbivory by game will arise. ▪ A reversion of present faunal population states within the study area. ▪ Changes in the geomorphological state of drainage lines as hydraulic changes arise within the catchment. ▪ Exotic weed invasion as a consequence of abandonment of site and cessation of weed control measures.
Visual	**Construction Phase:** ▪ Potential visual intrusion of construction activities on existing views of sensitive visual receptors. **Operational Phase:** ▪ Potential landscape impact of a large solar energy facility on a rural agricultural landscape. ▪ Potential visual intrusion of the proposed solar energy facility on the views of sensitive visual receptors. ▪ Potential impact of night lighting of a large solar energy facility on the nightscape of the region. **Decommissioning Phase:** ▪ Potential visual intrusion of decommissioning activities on views of sensitive visual receptors.
Heritage (Archaeology and Cultural	**Construction Phase:** ▪ Destruction of archaeological resources ▪ Destruction of graves

KEY IMPACT	IMPACTS IDENTIFIED
Landscape)	▪ Impacts to the natural and cultural landscape **<u>Operational Phase:</u>** ▪ Impacts to the natural and cultural landscape **<u>Decommissioning Phase:</u>** ▪ Impacts to the natural and cultural landscape
Palaeontology	**<u>Construction Phase:</u>** ▪ Loss of fossil heritage at or beneath ground surface
Geohydrology	**<u>Construction Phase:</u>** ▪ Potential impact on the groundwater as a result of the construction of storage yards and temporary labour accommodation; ▪ Potential impact of increased storm water outflows; and ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. **<u>Operational Phase:</u>** ▪ Potential impact of increased storm water outflows; and ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. **<u>Decommissioning Phase:</u>** ▪ Potential impact on groundwater quality as a result of accidental oil spillages and fuel leakages.
Soils and Agricultural Potential	**<u>Construction Phase:</u>** ▪ Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to constructional disturbance and potential trampling by vehicles ▪ Loss of topsoil due to poor topsoil management ▪ Loss of agricultural land use ▪ Soil erosion due to alteration of the land surface characteristics ▪ Additional land use income generation **<u>Operational Phase:</u>** ▪ Loss of agricultural land use ▪ Soil erosion due to alteration of the land surface characteristics ▪ Additional land use income generation **<u>Decommissioning Phase:</u>** ▪ Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to constructional disturbance and potential trampling by vehicles ▪ Loss of topsoil due to poor topsoil management ▪ Loss of agricultural land use ▪ Soil erosion due to alteration of the land surface characteristics ▪ Additional land use income generation
Socio-Economic	**<u>Construction Phase:</u>** ▪ Influx of jobseekers ▪ Increases in social deviance and increases in incidence of HIV/AIDS infections ▪ Expectations regarding jobs ▪ Local spending ▪ Local employment ▪ Human development resulting from the proposed Economic Development Plan **<u>Operational Phase:</u>** ▪ Influx of jobseekers ▪ Increases in social deviance and increases in incidence of HIV/AIDS infections ▪ Expectations regarding jobs ▪ Local spending ▪ Local employment ▪ Human development resulting from the proposed Economic Development Plan

KEY IMPACT	IMPACTS IDENTIFIED
	<u>Decommissioning Phase:</u> ▪ Job losses at the end of the project life-cycle.
Traffic *Note: A Traffic Impact Statement was compiled by the CSIR. It is not a specialist study in terms of Appendix 6 of the EIA Regulations; however it provides a general description of the potential traffic impacts.*	▪ Increase in traffic generation. ▪ Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads. ▪ Impact on air quality due to noise and release of air pollutants from vehicles and construction equipment. ▪ Decrease in quality of surface condition of the roads.

2 APPROACH TO PREPARING THE EMPr

2.1 COMPLIANCE WITH RELEVANT LEGISLATION

In terms of legal requirements, a crucial objective of the EMPr is to satisfy the requirements of Appendix 4 of the NEMA EIA Regulations promulgated in Government Gazette 38282 and GN R982 on 8 December 2014, and Section 24N of the NEMA. These regulations regulate and prescribe the content of the EMPr and specify the type of supporting information that must accompany the submission of the report to the authorities. An overview of where the requirements are addressed in this EMPr is presented in Tables 3 and 4.

Table 3: Compliance with Section 24N of NEMA

Requirements of Section 24N of NEMA	Where it is included in this EMPr?
2) The environmental management programme must contain- a) information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts or objectives in respect of: (i) planning and design; (ii) pre-construction and construction activities; (iii) the operation or undertaking of the activity in question; (iv) the rehabilitation of the environment; and (v) (v) closure, if applicable;	Section 1.3 and the columns detailing the impact description, mitigation and management objectives, and mitigation and management actions in Sections 4 to 12 of this EMPr.
b) details of- (i) the person who prepared the environmental management programme; and (ii) the expertise of that person to prepare an environmental management programme;	Section 1.2 and Appendix A of the EIA Report
c) a detailed description of the aspects of the activity that are covered by the environmental management programme;	Section 1 and Section 1.1
d) information identifying the persons who will be responsible for the implementation of the measures contemplated in paragraph (a);	Columns in Section 4 to 12 of the EMPr regarding the monitoring responsibility, including the requirements for monitoring and reporting on compliance and the responsible parties noted in Section 3.
e) information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance;	The columns detailing the mitigation and management actions, and the monitoring methodology, frequency and responsibility in Sections 4 to 12 of this EMPr.

Requirements of Section 24N of NEMA	Where it is included in this EMPr?
f) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and	Sections 4 to 12 of this EMPr, as applicable to the post-construction, rehabilitation phase and the decommissioning phase.
g) a description of the manner in which it intends to- (i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) remedy the cause of pollution or degradation and migration of pollutants; and (iii) comply with any prescribed environmental management standards or practices.	The columns detailing the mitigation and management objectives, mitigation and management actions, and the monitoring methodology, frequency and responsibility in Sections 4 to 12 of this EMPr.
3) The environmental management programme must, where appropriate- a) set out time periods within which the measures contemplated in the environmental management programme must be implemented; b) contain measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of polluted or extraneous water or ecological degradation which may occur inside and outside the boundaries of the operations in question; and c) develop an environmental awareness plan describing the manner in which- (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment.	The columns detailing the mitigation and management actions, and the monitoring methodology, frequency and responsibility in Sections 4 to 12 of this EMPr. Section 11 of this EMPr includes an Environmental Awareness Plan.
5) The Minister, the Minister responsible for mineral resources or an MEC may call for additional information and may direct that the environmental management programme in question must be adjusted in such a way as the Minister, the Minister responsible for mineral resources or the MEC may require.	Not applicable at this stage.
6) The Minister, the Minister responsible for mineral resources or an MEC may at any time after he or she has approved an application for an environmental authorisation approve an amended environmental management programme.	Not applicable at this stage.
7) The holder and any person issued with an environmental authorisation- a) must at all times give effect to the general objectives of integrated environmental management laid down in section 23; b) must consider, investigate, assess and communicate the impact of his or her prospecting or mining on the environment; c) must manage all environmental impacts (i) in accordance with his or her approved environmental management programme, where appropriate; and (ii) as an integral part of the prospecting or mining, exploration or production operation, unless the Minister responsible for mineral resources directs otherwise; d) must monitor and audit compliance with the requirements of the environmental management programme; e) must, as far as is reasonably practicable, rehabilitate the environment affected by the prospecting or mining operations to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and f) is responsible for any environmental damage, pollution, pumping and treatment of polluted or extraneous water or ecological degradation as a result of his or her operations to which such right, permit or environmental authorisation relates.	Throughout the EMPr
8) Notwithstanding the Companies Act, 2008 (Act No. 71 of 2008), or the Close Corporations Act, 1984 (Act No. 69 of 1984), the directors of a company or members of a close corporation are jointly and severally liable for any negative impact on the environment, whether advertently or inadvertently caused by the company or close corporation which they represent, including damage, degradation or pollution.	Section 3 details the responsibility of the Project Applicant.

Table 4: Compliance with Appendix 4 of the 2014 NEMA EIA Regulations

Requirements of Appendix 4 of the 2014 NEMA EIA Regulations (Government Gazette Government Gazette 38282 and GN R982 on 8 December 2014)	Where it is included in this EMPr?
1. (1) An EMPr must comply with section 24N of the Act and include: a) details of: (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	Section 1.2 and Appendix A of the EIA Report
b) a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	Section 1 and Section 1.1
c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers;	Appendix A, Appendix B and Appendix C of this EMPr.
d) a description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including: (i) planning and design; (ii) pre-construction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where applicable post (v) closure; and (vi) where relevant, operation activities;	Section 1.3 and the columns detailing the impact description, mitigation and management objectives, and mitigation and management actions in Sections 4 to 12 of this EMPr.
e) a description and identification of impact management outcomes required for the aspects contemplated in paragraph (d);	The columns detailing the mitigation and management objectives in Sections 4 to 12 of this EMPr.
f) a description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable, include actions to: (i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;	The columns detailing the mitigation and management actions in Sections 4 to 12 of this EMPr.
g) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	The columns detailing the monitoring methodology in Sections 4 to 12 of this EMPr.
h) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	The columns detailing the monitoring frequency in Sections 4 to 12 of this EMPr.
i) an indication of the persons who will be responsible for the implementation of the impact management actions;	The columns detailing the monitoring responsibility in Sections 4 to 12 of this EMPr.
j) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	The columns detailing the mitigation and management actions, and the monitoring methodology and frequency in Sections 4 to 12 of this EMPr.
k) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	The columns detailing the mitigation and management actions, and the monitoring methodology, frequency and responsibility in Sections 4 to 12 of this EMPr.
l) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 4 to 12 of the EMPr, including the requirements for monitoring and reporting on compliance and the responsible parties noted in Section 3.

Requirements of Appendix 4 of the 2014 NEMA EIA Regulations (Government Gazette Government Gazette 38282 and GN R982 on 8 December 2014)	Where it is included in this EMPr?
m) an environmental awareness plan describing the manner in which: (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 11 of this EMPr.
n) any specific information that may be required by the competent authority.	Section 2.2 and the management objectives and management actions in Sections 4 to 11.

2.2 COMPLIANCE WITH DEA REQUIREMENTS

The Scoping Report was submitted to the DEA in November 2015, in accordance with Regulation 21 (1) of the 2014 NEMA EIA Regulations, for decision-making in terms of Regulation 22 of the 2014 NEMA EIA Regulations. The DEA accepted the Scoping Report and Plan of Study for EIA on 8 December 2015, which marked the end of the Scoping Phase. The acceptance letter is included in Appendix I.4 of the EIA finalised Report.

The requirements listed in the acceptance letter from the DEA (dated 8 December 2015), stipulated certain plans that must be included in the EMPr. The EMPr is therefore structured in such a way to comply with the requirements of the DEA and to ensure that the mitigation and management measures that have been identified during the EIA Process are included in the respective plans. The requirements listed within the acceptance letter are detailed in Table 5.

It is important to note that other project specific aspects (such as the findings and recommendations of the specialist studies), in addition to those covered by the plans required by the DEA, have been included in Section 12 of the EMPr.

Table 5: DEA Requirements for the EMPr

DEA Requirements	Relevant Section in the EMPr
All recommendations and mitigation measures recorded in the EIA Report and the specialist studies conducted.	Recommended mitigation measures and monitoring actions as noted in the EIA Report and specialist studies have been included in this EMPr, where relevant.
The final site layout map	Refer to Appendix A of this EMPr for the site layout map. Refer to Section 1.1 of this EMPr for a description of the approach followed to determine the site layout.
Measures as dictated by the final site layout map and micro-siting.	Refer to Appendix A of this EMPr for the site layout map. Refer to Section 1.1 of this EMPr for a description of the approach followed to determine the site layout.
An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA Process.	Refer to Appendix B of this EMPr for an environmental sensitivity map. Refer to Section 1.1 of this EMPr for a description of the approach followed to identify the environmental sensitivities.
A map combining the final layout map superimposed (overlain) on the environmental sensitivity map.	Refer to Appendix C of this EMPr for a combined environmental sensitivity and layout map. Refer to Section 1.1 of this EMPr for a description of the approach followed to identify the environmental sensitivities and to determine the site layout.

DEA Requirements	Relevant Section in the EMPr
An alien invasive management plan to be implemented during the construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.	Refer to Section 4 of this EMPr.
A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase.	Refer to Section 5 of this EMPr. It should be noted that faunal protection and habitat rehabilitation has also been included in this section.
A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.	Refer to Section 5 of this EMPr. It should be noted that faunal protection and habitat rehabilitation has also been included in this section.
An open space management plan to be implemented during the construction and operation of the facility.	Refer to Section 6 of this EMPr.
A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimise impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.	Refer to Section 7 of this EMPr.
A transportation plan for the transport of components, main assembly cranes and other large pieces of equipment.	Refer to Section 7 of this EMPr.
A storm water management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water run-off.	Refer to Section 8 of this EMPr.
A fire management plan to be implemented during the construction and operation of the facility.	Refer to Section 11 of this EMPr. It should be noted that this has been combined with an Environmental Awareness Plan.
An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.	Refer to Section 9 of this EMPr.
An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems	Refer to Section 10 of this EMPr.
Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants.	Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments have been included throughout the EMPr, such as Sections 8, 9 and 10.

2.3 CONTENTS OF THE EMPr

Where applicable, each section of the EMPr is divided into the following four phases of the project cycle:

- Design Phase;
- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

The EMPr includes the findings and recommendations of the EIA Process and specialists studies. However, the EMPr is considered a "living" document and must be updated with additional information or actions during the design, construction, operational and decommissioning phases if applicable.

The EMPr follows an approach of identifying an over-arching goal and objectives, accompanied by management actions that are aimed at achieving these objectives. The management actions are presented in a table format in order to show the links between the goal and associated objectives, actions, responsibilities, and monitoring requirements and targets.

The management plans for the design, construction, operational and decommissioning phases consist of the following components:

- **Impact:** The potential positive or negative impact of the development that needs to be enhanced, mitigated or eliminated.
- **Objectives:** The objectives necessary in order to meet the goal; these take into account the findings of the specialist studies.
- **Mitigation/Management Actions**: The actions needed to achieve the objectives of enhancing, mitigating or eliminating impacts; taking into consideration factors such as responsibility, methods, frequency, resources required and prioritisation.
- **Monitoring**: The key monitoring actions required to check whether the objectives are being achieved, taking into consideration methodology, frequency and responsibility.

2.4 GOAL FOR ENVIRONMENTAL MANAGEMENT

The overall goal for environmental management for the Kenhardt PV 3 project is to construct and operate the project in a manner that:

- Minimises the ecological footprint of the project on the local environment;
- Minimises impacts on fauna, flora and freshwater ecosystems;
- Facilitates harmonious co-existence between the project and other land uses in the area; and
- Contributes to the environmental baseline and understanding of environmental impacts of solar energy facility in a South African context.

3 ROLES AND RESPONSIBILITIES

For the purposes of the EMPr, the generic roles that need to be defined are those of the:

- Project Developer;
- Environmental Control Officer;
- Construction Manager (Lead Contractor); and
- Facility Manager.

It is acknowledged that the specific titles for these functions will vary from project to project. The intent of this section is to give a generic outline of what these roles typically require. It is expected that this will be appropriately defined at a later stage.

3.1 PROJECT DEVELOPER

The Project Developer (i.e. Scatec Solar) is the 'owner' of the project and, as such, is responsible for ensuring that the conditions of the EA issued in terms of NEMA (should the project receive such authorisation) are fully adhered to, as well as ensuring that any other necessary permits or licenses are obtained and complied with. It is expected that the Project Developer will appoint the Environmental Control Officer and the Lead Contractor, and possibly an Environmental Manager (or Health, Safety and Environmental Manager).

3.2 ENVIRONMENTAL CONTROL OFFICER

An independent Environmental Control Officer (ECO) must be appointed to monitor the compliance of the proposed project with the conditions of EA (should such authorisation be granted by the DEA) during the construction and decommissioning phases (and possibly the operational phase, depending on the requirements of the DEA). The ECO must also monitor compliance of the proposed project with environmental legislation and recommendations of the EMPr, as well as oversee the implementation of the EMPr during the phases of the project, monitor environmental impacts, undertake record-keeping.

The ECO will be responsible for updating the EMPr as and when necessary, and compiling a monitoring checklist based on the EMPr. The roles and responsibilities of the ECO should include the following:

- The ECO must undertake periodic environmental audits during the relevant phases of the proposed project in order to monitor and record environmental impacts and non-conformances, and to monitor site activities to ensure adherence to the specifications contained in the EMPr, using a monitoring checklist. The timeframes for environmental audits will be indicated in the EA (should such authorisation be granted by the DEA).
- Environmental compliance/audit reports must be compiled and submitted by the ECO to the Competent Authority (i.e. DEA and/or Provincial Department of Environment and Nature Conservation) on a regular basis (i.e. at intervals as indicated in the EA (should such authorisation be granted by the DEA)).
- The ECO must maintain a diary of site visits and audits, a copy of the Environmental Authorisation (should such authorisation be granted by the DEA) and relevant permits for reference purposes, a non-conformance

register, a public complaint register, and a copy of previous environmental audits undertaken.

- Prior to the commencement of construction, the ECO must meet on site with the Contractor to confirm the construction procedure and designated construction areas and work activity zones.
- Reporting of any non-conformances within 48 hours of identification of such non-conformance to the relevant agents.
- Conducting an environmental inspection on completion of the construction period and 'signing off' the construction process with the Contractor.
- Ensure that records are kept of all monitoring activities and results.
- Conducting an environmental inspection on completion of decommissioning and 'signing off' the site rehabilitation process.

The Lead Contractor and sub-contractors may have their own Environmental Officers, or designate Environmental Officer functions to certain personnel.

3.3 LEAD CONTRACTOR

The Lead Contractor will be responsible for the following:

- Ensure that all appointed contractors and sub-contractors are aware of the EMPr and their respective responsibilities;
- Prior to the commencement of construction, the Lead Contractor must meet on site with the ECO in order to confirm the construction procedure and designated construction areas and work activity zones.
- Ensure that each sub-contractor employs an Environmental Officer (or employs a designated suitably qualified individual to fulfil the role of an Environmental Officer) to monitor and report on the daily activities on-site during the construction period;
- Implementation of the overall construction programme, project delivery and quality control for the construction for the solar project;
- Overseeing compliance with the Health, Safety and Environmental Responsibilities specific to the project management related to project construction;
- Promoting total job safety and environmental awareness by employees, contractors and sub-contractors and stress to all employees and contractors and sub-contractors the importance that the project proponent attaches to safety and the environment;
- Ensuring that safe, environmentally acceptable working methods and practices are implemented and that sufficient plant and equipment is made available properly operated and maintained, to facilitate proper access and enable any operational to be carried out safely;
- Ensuring that all appointed contractors and sub-contractors repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained in the EMPr, to the satisfaction of the Project Developer's ECO;
- Implement the Traffic Management Plan (Section 7), Transportation Plan (Section 7) and Storm Water Management Plan (Section 8).

3.4 FACILITY MANAGER

The Facility Manager will be responsible for the following:

- Operation of the 75 MW Solar PV facility;
- Required maintenance of the facility; and
- Overall compliance with the EMPr and EA.

4 ALIEN INVASIVE VEGETATION MANAGEMENT PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
4.1. Impacts due to establishment of alien invasive plants	Ensure the appropriate removal of alien invasive vegetation from the proposed project area and prevent the establishment and spread of alien invasive plants due to the project activities.	4.1.1. Ensure compliance with relevant Environmental Specifications for the control and removal of alien invasive plant species. 4.1.2. Appoint a specialist or contact relevant authorities to seek guidance on the removal of the alien vegetation on site. 4.1.3. Compile and finalise an alien weed eradication programme.	▪ Appoint a suitable specialist/ Contractor or contact the relevant authorities to seek guidance on the removal of the planted alien invasive species. ▪ Appoint a suitable specialist to compile an alien invasive vegetation eradication plan. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the design phase. ▪ Once-off during the design phase. ▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar) ▪ ECO
B. CONSTRUCTION PHASE					
4.2. Impacts due to the establishment of and increased spread of alien invasive plants	Avoid establishment and reduce the spread of alien invasive plants due to the project activities.	4.2.1. Appoint a specialist or contractor to undertake a sweep and survey of the final development footprint site, with an alien invasive eradication team to remove exotic vegetation prior to the commencement of construction. 4.2.2. Establish an ongoing monitoring programme for the construction phase to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) and National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM: BA)).	▪ Appoint a suitable vegetation contractor to inspect the site and remove any exotic weeds prior to the commencement of construction. ECO to ensure that this is taken into consideration and implemented. ▪ Prepare monitoring programme which will monitor the presence of alien invasive species on the site. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of concentrations of plants). The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area.	▪ Prior to the commencement of construction ▪ Once-off	▪ Project Developer (Scatec Solar), ECO and Specialist Contractor ▪ ECO and Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions		Monitoring		
				Methodology	Frequency	Responsibility
		4.2.3.	Ensure proper management of soil stockpiles. Do not import soil stockpiles from areas with alien plants to ensure proper management of stockpiles.	▪ Monitor the presence of alien invasive plants during the construction phase via visual inspections and take action to remove and control these species.	▪ On-going	▪ ECO and Contractor
		4.2.4.	Undertake rehabilitation of disturbed areas as soon as possible after construction. Stockpile the shallow topsoil layer separately from the subsoil layers. Reinstate the topsoil layers (containing seed and vegetative material) when construction is complete to allow the plants to rapidly re-colonise the bare soil areas.	▪ Rehabilitate disturbed areas and monitor the presence of alien invasive species on site.	▪ On-going	▪ ECO and Contractor
		4.2.5.	Keep clearance and disturbance of indigenous vegetation to a minimum.	▪ Monitor and manage vegetation clearing by undertaking visual inspections to ensure minimal disturbance and to restrict activities to within demarcated areas.	▪ On-going	▪ ECO and Contractor
		4.2.6.	Ensure that the footprint required for the proposed project activities (such as temporary stockpiling, earthworks, storage areas, site establishment etc.) is kept at a minimum.	▪ Verify that the proposed project area is determined and outlined prior to the commencement of the construction phase by undertaking visual inspections.	▪ Once-off prior to construction and as required during the construction process.	▪ ECO and Contractor
		4.2.7.	Ensure that alien invasive vegetation found on site, within the proposed project footprint, is immediately controlled and removed promptly, in a scheduled manner throughout the construction phase. The removal of alien vegetation on site during the construction phase should use registered control methods and take into consideration the Alien and Invasive Species Regulations published in terms of Section 97(1) of the NEM: BA, if applicable.	▪ Monitor the presence of alien invasive plants during the construction phase via visual inspections and take action to remove and control these species. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of concentrations of plants). The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. Any alien invasive should be cleared from site.	▪ On-going	▪ ECO and Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions		Monitoring		
				Methodology	Frequency	Responsibility
		4.2.8.	The removed alien invasive vegetation should be immediately disposed at a suitable waste disposal facility and should not be kept on site for prolonged periods of time, as this will enhance the spread of these species.	▪ Monitor the removal of the alien vegetation found on site via visual inspections.	▪ As necessary during the construction phase.	▪ ECO
		4.2.9.	All construction machinery and plant equipment delivered to site for use during the construction phase should be cleaned in order to limit the introduction of alien species.	▪ Clean machinery and equipment prior to the construction phase. ▪ ECO to conduct visual inspections to verify that machinery and equipment are cleaned, and report any non-compliance.	▪ Prior to the commencement of construction. ▪ As necessary during the construction phase.	▪ ECO and Contractor
C. OPERATIONAL PHASE						
4.3. Impacts due to establishment of alien invasive plants. Exotic weed invasion may result in the ousting of natural vegetation and alteration of ecological processes on site, with incremental impacts on the adjacent veld types.	Reduce the establishment and spread of alien invasive plants. To remove exotic weeds as and when they may arise and thereby prevent alteration of local and adjacent habitat forms.	4.3.1.	Continue with on-going monitoring programme to detect and quantify any alien species that may become established and identify the highly invasive species during the operation phase.	▪ Annual audit of project area and immediate surroundings. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of concentrations of plants). The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area.	▪ Annual	▪ Operations and Maintenance Contractor
		4.3.2.	Immediately control any alien plants that become established using registered control methods. Use of herbicides and undertake manual removal of alien vegetation on site where this may arise. Regular address and redress of weeds identified on site by a suitable contractor. The clearance of exotic weed to be undertaken bi-annually at a minimum and on a needs basis at an intermittent level.	▪ Monitor the use of herbicide sprays and manual removal of alien vegetation by undertaking visual inspections and reporting any non-compliance. ▪ Maintain register of weed spraying activities and ensure that herbicide use is recorded.	▪ Bi-annually	▪ Project Developer (Scatec Solar) and Environmental Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
D. DECOMMISSIONING PHASE					
4.4. Exotic weed invasion of the decommissioned site resulting in ecological change	To prevent the excessive growth and propagation of exotic weeds on disturbed lands that formed a portion of the PV facility.	4.4.1. All natural areas must be rehabilitated with species indigenous to the area. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction.	▪ Final external audit of area to confirm that area is rehabilitated to an acceptable level.	▪ Once off	▪ Lead Contractor with advice from specialist
		4.4.2. Exotic weed control measures to be instituted through weed control programme. Regular redress of exotic weed through the use of herbicide and manual removal.	▪ Compile weed eradication programme for a period of 12 months after the decommissioning exercise. ▪ Appoint contractor to undertake the weed eradication programme. ▪ Monitor newly disturbed areas where infrastructure has been removed to detect and quantify any aliens that may become established after decommissioning and rehabilitation. ▪ Final external audit of area to confirm that area is free of alien invasive plants after 5 years.	▪ Weed eradication exercise to be undertaken every 6 months for a period of 12 months following decommissioning. ▪ Prior to the commencement of the decommissioning phase. ▪ Once-off ▪ Once-off	▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar) ▪ Facility Manager and Specialist/ Contractor ▪ Facility Manager and Specialist/ Contractor

5 PLANT RESCUE AND PROTECTION PLAN INCLUDING RE-VEGETATION AND HABITAT REHABILITATION PLAN (INCLUDING FAUNA AND AVIFAUNA)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	**Frequency**	**Responsibility**
A. DESIGN PHASE					
5.1. The ousting of fauna through anthropogenic activities, disturbance of refugia and general change in habitat, with impacts on terrestrial and aquatic ecology as a result of the final site layout and routes of the access roads.	Avoidance of unnecessary disturbance to the site and surrounds, and to establish buffers where required.	5.1.1. Avoid of major drainage lines during the design and layout of the proposed PV facility. An Ecologist should be appointed to review the layout plan in relation to existing drainage lines and comment accordingly. Ensure that sensitive habitat and features (as defined in the Ecological Impact Assessment, Chapter 7 of the EIA Report) are considered in the design. 5.1.2. Incorporate minor drainage lines into design and avoid unnecessary disturbance, where applicable. Refer to Appendix 7.A of Ecological Impact Assessment, Chapter 7 of the EIA Report and Appendix B and C of this EMPr). 5.1.3. Consider the most applicable access road to site (i.e. the unnamed farm road or the Transnet Service Road (subject to the discussions between the Applicant and Transnet Freight Rail)). 5.1.4. Appoint a specialist or suitable contractor to identify any plant species on site that may require "rescue" as well as any exotic weeds/vegetation that require removal. Appoint a specialist team flush game from the construction area. 5.1.5. Consideration of the siting and layout of the temporary construction site and worker camp.	▪ Review the site plan with the ECO and possibly an ecologist (if required). ▪ Appoint a specialist to oversee the final development footprint area and undertake search and rescue, game sweep and alien removal. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off, prior to the commencement of construction. ▪ Appoint specialist once-off, prior to the commencement of construction. ▪ Once-off during the planning and design phase.	▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar)
5.2. Destruction of indigenous vegetation.	Ensure compliance with relevant Provincial and National legislation in respect of habitat and vegetation forms.	5.2.1. Ensure the necessary permits or licences are identified and applied for as applicable for removal of protected, indigenous vegetation. 5.2.2. Await response and provision of permit (as required) from the relevant Authorities prior to the removal of the indigenous species (if	▪ Review the findings of the Ecological Impact Assessment and consider legislative requirements in respect of loss of indigenous vegetation etc. ▪ Contact the Provincial Department of Environment and Nature Conservation,	▪ Once-off, prior to the commencement of construction ▪ Once-off, prior to the	▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar), Specialist/

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		required). Once these permits are obtained, search and rescue must be undertaken for the indigenous species.	and the Provincial Department of Agriculture, Forestry and Fisheries to discuss if any protected species need to be relocated or rescued. ▪ Appoint a suitable Search and Rescue Specialist/Contractor to undertake Search and Rescue. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	commencement of construction ▪ Once-off during the planning and design phase.	Contractor and ECO ▪ Project Developer (Scatec Solar)
5.3. Impact on sensitive habitat and vegetation.	To ensure that the quartzite kopjies remain excluded from construction and operational activities of the proposed PV facility.	5.3.1. The presence of the two quartzite kopjies identified in the Ecological Impact Assessment must be noted and considered in the design as they are distinct topographic anomalies within the site and, in line with their geological divergence; they offer some variability to the prevailing habitat form. A 250 m buffer from the highest point of these quartzite kopjies is recommended. Confirm the outer extent of the 250 m buffer around quartzite kopjies (especially if the kopjies fall within or proximal to the proposed development footprint). 5.3.2. The association including *Aloe claviflora* and *A dichotoma*, which is associated with those areas proximal to the two quartzite kopjies should be noted and considered in the design as applicable. The aloes found on and around the two quartzite kopjies in the Kenhardt PV 3 area should be excluded from the development footprint, as the kopjies themselves require exclusion on the grounds of habitat preservation. The laydown area should be located to the east of these quartzite areas and the kopjies must remain outside of the proposed PV facility.	▪ Undertake survey and pegging and report non-compliance. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Prior to construction ▪ Once-off during the planning and design phase	▪ Contractor and ECO ▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions		Monitoring		
				Methodology	Frequency	Responsibility
5.4. Loss of Species of Special Concern (SSC) and protected species and their habitats.	Minimise fragmentation and loss of SSC and protected species and their habitats through the careful siting and layout planning for the project.	5.4.1.	Avoid the removal of listed SSC and protected species as far as possible.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase	▪ Project Developer (Scatec Solar)
		5.4.2.	A buffer zone of 32 m must be implemented from the edge of the major drainage lines on site (as shown in Appendix B and C of this EMPr), in which no development or activities should take place.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase	▪ Project Developer (Scatec Solar)
5.5. Impact on avian behaviour and avian species as a result of collision with infrastructure of the proposed PV facility	Allocation of Bird Flight Diverters (BFDs) to powerlines.	5.5.1.	Establish BFDs across powerlines at appropriate points.	▪ Identify appropriate points within infrastructure for the establishment of BFDs. ▪ Verify that this is undertaken by reviewing the signed approved designs.	▪ Once-off ▪ Once-off	▪ Project Developer (Scatec Solar) and ECO ▪ ECO
B. CONSTRUCTION PHASE						
5.6. Excessive loss of natural vegetation in and outside the development footprint area and veld degradation	Minimise loss of natural vegetation. Prevent impacts on natural vegetation in sensitive habitats and SSC.	5.6.1.	Sensitive habitats and areas outside of the project development area should be clearly demarcated as no go areas during the construction phase to avoid accidental impacts. No development or activities should take place in the high sensitivity ecosystems (shown in Appendix B and Appendix C of this EMPr).	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. ▪ ECO must monitor activities and record and report non-compliance ▪ Strict control and proper education of staff to prevent misconduct. If ECO is absent, there should be a designated EO present to deal with any urgent issues.	▪ Daily	▪ ECO and Contractor
		5.6.2.	Ensure that the footprint required for the proposed project activities is kept at a minimum.	▪ Verify that the proposed project area is determined and outlined prior to the commencement of the construction phase by undertaking visual inspections.	▪ Once-off prior to construction and as required during the construction process.	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		5.6.3. The proposed project footprint must be demarcated to reduce unnecessary disturbance beyond the proposed project area.	▪ Carry out visual inspections to ensure strict control over the behaviour of staff in order to restrict activities to within demarcated areas.	▪ Weekly	▪ ECO
		5.6.4. The Contractors and construction personnel must be made aware that indigenous vegetation must be not be removed or damaged (this includes succulents (e.g. *Hoodia gordonii*, *Euphorbia spp*.) and the protected quiver tree, *Aloe dichotoma*.	▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Contractor/ ECO ▪ ECO
		5.6.5. Ensure that the temporary site camp is established at least 32 m away from the banks of the major drainage lines.	▪ Monitor the placement of the site camp via visual inspections, and record and report any non-compliance.	▪ Once-off prior to construction and as required during the construction phase.	▪ ECO
		5.6.6. Unnecessary impacts on surrounding natural vegetation must be avoided during construction. All construction vehicles should remain on properly and clearly demarcated roads.	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. ▪ Include periodical site inspection in environmental performance reporting that specifically records occurrence of off-road vehicle tracks in specific areas.	▪ Daily	▪ ECO and Contractor
		5.6.7. Undertake rehabilitation of disturbed areas as soon as possible after construction. Stockpile the shallow topsoil layer separately from the subsoil layers. Reinstate the topsoil layers (containing seed and vegetative material) when construction is complete to allow the plants to rapidly re-colonise the bare soil areas. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site during the pre-construction phase.	▪ Undertake following the construction phase and report any non-compliance.	▪ Daily	▪ ECO and Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring – Methodology	Monitoring – Frequency	Monitoring – Responsibility
		5.6.8. The collection, hunting or harvesting of any plants, fuel wood or animals at the site during construction should be strictly forbidden and the staff educated to prevent this from happening.	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Daily ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ Contractor/ ECO ▪ ECO
		5.6.9. Fires should only be allowed within fire-safe demarcated areas. Open fires must be prohibited. Appropriate fire safety training should also be provided to staff that are to be on site for the duration of the construction phase.	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas. ▪ Ensure fire safety requirements are well understood and respected by workers (by providing basic fire safety training).	▪ Daily	▪ ECO and Contractor
		5.6.10. Existing access roads/servitudes must be used and should be located along the boundaries of existing disturbed areas, if possible.	▪ Compile plan pre-construction.	▪ Prior to construction commencing	▪ Project Developer (Scatec Solar) and ECO
5.7. Impact on indigenous vegetation, and on SSC and their habitats	To reduce negative impacts on and loss of indigenous vegetation and protected trees. Minimise impacts on SSC and protected trees. Placement of barrier at the outer extent of the buffer zones around the kopjies for exclusion purposes and maintenance of ecological status quo.	5.7.1. Appoint a specialist to undertake a second review and site visit of the final layout of the development footprint, possibly during the late summer period, in order to identify any plant species on site that may require "rescue" as well as any exotic weeds/vegetation that require removal.	▪ Appoint an Ecologist to oversee the final development footprint area through a reconnaissance survey.	▪ Prior to the commencement of construction	▪ Project Developer (Scatec Solar), Specialist and ECO
		5.7.2. Identify and cordon of the recommended 250 m buffer around the quartzite kopjies found within the PV 3 site. The kopjie must be considered as a no-go area. In this regard, a 1.8 m wire fence with an access point should be established around the buffer extents of the two quartzite kopjies, if the kopjies fall proximal to final laydown area.	▪ Establishment of fence with access gate (if the kopjies fall proximal to the final laydown area). Undertake survey and pegging and report non-compliance.	▪ Once off. To be maintained if required	▪ ECO and Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		5.7.3. Identification of roadways and areas where extensive vegetation loss will result is required. Upon consideration, the avoidance of unnecessary clearance of vegetation on site should be undertaken through minor deviations to the design. 5.7.4. Ensure that the footprint required for the proposed project activities is kept at a minimum.	▪ Review how larger vegetation will be dealt with by contractors. ▪ Vegetation should be subject to redress when given a height that aligns with the lower limit of the PV array or when adjudged to affect construction.	▪ Ongoing	▪ ECO and Project Developer (Scatec Solar)
		5.7.5. A plant rescue operation must be initiated to confirm that no other species are located within the development site.	▪ ECO must undertake a final walkthrough of the site prior to commencement of construction to ensure no SCC will be impacted on	▪ Once-off	▪ ECO and Contractor
		5.7.6. Clearing of vegetation should be kept to a minimum, keeping the width and length of the earthworks to a minimum.	▪ Monitor activities and record and report non-compliance.	▪ Daily	▪ ECO and Contractor
		5.7.7. Avoid the removal of listed SSC or protected species as far as possible. Should any of the listed/protected species need to be removed, the requisite permits must be obtained prior to the removal of the species.	▪ Monitor activities and record and report non-compliance.	▪ Daily	▪ ECO and Contractor
5.8. Disturbance of terrestrial fauna and flora on site due to construction workers and activities.	To advise construction staff of the requirements in respect of management of flora and fauna on site during the construction phase.	5.8.1. Conduct an Environmental Awareness Training and induction for all construction staff and personnel.	▪ Carry out Environmental Awareness Training with a discussion on the management of terrestrial fauna and flora on site. ▪ Conduct audits of the signed attendance registers.	▪ Prior to construction and as required by the ECO. Ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ ECO
5.9. Impact on fauna as a result of construction activities.	To identify any faunal mortalities and record the details (such as the reason, spatial extent etc.) in order to avoid repetition of fatality.	5.9.1. Establish a recording method in order to monitor the construction activities, including species presence within site, mortalities and sitings.	▪ Establish database of species, sitings etc. ▪ Construction personnel should advise on the findings and presence of fauna on site.	▪ Daily to monthly	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
	To remove species that may be found present in the construction footprint and laydown area.	5.9.2. Appoint a specialist to conduct an inspection of the final project area and sweep or inspect the site for any fauna, once the fencing is complete (i.e. the established site should be flushed to ensure any large wildlife is not contained within the fenced area). Appoint a small team to flush game during the early evening. Game should be flushed by driving a team through the gated facility towards the exit.	▪ Team to flush game as required. ▪ ECO to monitor flushing process and record any incidents or non-compliance.	▪ Once off prior to commencement and thereafter if required.	▪ ECO and Project Developer (Scatec Solar)
		5.9.3. The Contractor or Contractors Environmental Officer should monitor trenches at the start and end of each working day to check if any small animals are trapped.	▪ Monitor activities and record and report non-compliance.	▪ As required during construction	▪ ECO and Contractor
		5.9.4. No animals (including snakes) shall be killed on site. An expert or a suitable specialist should be appointed to remove and relocate any poisonous snakes during the construction phase.	▪ Monitor activities and record and report non-compliance.	▪ As required during construction	▪ ECO and Contractor
5.10. Faunal and avifaunal road mortality as a result of increased vehicles travelling to and within the site.	Minimise loss of fauna as a result of road mortalities.	5.10.1. The construction personnel and staff should be made aware of the presence of fauna within the proposed project area. The construction personnel and staff must also be made aware of the general speed limits on site and must be alert at all times for potential crossings.	▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ ECO
		5.10.2. To ensure that animals are not attracted to the site (and potentially resulting in increased road mortality), the waste collection bins and skips should be covered with suitable material, where appropriate, and the site camp must be kept clean on a daily basis.	▪ Monitor the activities via visual inspections, and record and report any non-compliance.	▪ Daily	▪ ECO and Contractor
5.11. Impact and loss of fauna as a result of the fence line and exclusion of fauna from site resulting in ecological	To reduce incidental mortality and injury of fauna within the construction area.	5.11.1. Ensure that the live electrical fence wire is not placed at ground level. 5.11.2. Conduct inspections of the fence line to address any animals that may be affected by the fence.	▪ Conduct regular (daily) inspections of the fence line to address any animals that may be affected by the fence.	▪ Daily to monthly record keeping. A register of all faunal sitings indicating date of siting; species	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
change within the site.				affected; position of species (specific or indicative) and other observations should be established	
5.12. Increased ELP, leading to changes in nocturnal behavioural patterns amongst fauna	The avoidance of electrical light pollution through prudent positioning of external lighting.	5.12.1. Placement of lighting, particularly security lighting, to avoid excessive influence on surrounding areas. Placement of lighting to be judiciously considered at time of implementation.	▪ Review lighting plans and identify important habitat zones to be avoided.	▪ Prior to the installation of lighting.	▪ Project Developer (Scatec Solar), Contractor and ECO
C. OPERATIONAL PHASE					
5.13. Vegetation management on site	Manage vegetation throughout the site to avoid conflict with operations of the proposed PV facility. Excessive growth of vegetation on site may affect operations of the PV facility, while excessive clearance of vegetation on site has concomitant impacts on the land in question. Management of vegetation at an optimum level of growth and height is required.	5.13.1. Identify protocol for pruning of vegetation and clearance where required. 5.13.2. Identify level of pruning and vegetation management required.	▪ Identify means of pruning and clearance of vegetation. For example, brushcutter, grazing etc.	▪ Ongoing and as required	▪ Environmental Manager
5.14. Loss of SSC and their habitats	Control loss of natural vegetation during the operational phase. Prevent impacts on natural vegetation in sensitive habitats and SSC.	5.14.1. Unnecessary impacts on surrounding natural vegetation must be avoided. All operational and maintenance vehicles to remain on the roads and no driving off road allowed. No unauthorized persons should be allowed onto the site.	▪ Strict control over the behaviour of operation workers, restricting activities to within demarcated areas for operation. Strict control and proper education of staff to prevent misconduct.	▪ Monthly	▪ Environmental Manager
		5.14.2. The collection, hunting or harvesting of any plants, any protected trees, fuel wood or animals at the site should be strictly forbidden and the staff educated to prevent this from happening.	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. ▪ Carry out Environmental Awareness	▪ Daily ▪ Once-off training and ensure all new staff are inducted. ▪ As required	▪ Facility Manager and Environmental Manager ▪ Facility Manager ▪ Environmental

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	**Frequency**	**Responsibility**
			Training. ▪ Conduct audits of the signed attendance registers.		Manager
		5.14.3. All hazardous materials should be stored in the appropriate manner to prevent impacts on vegetation. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.	▪ Monitor the activities via visual inspections, and record and report any non-compliance.	▪ Daily	▪ Environmental Manager
		5.14.4. Fires should only be allowed within fire-safe demarcated areas. Open fires must be prohibited. Appropriate fire safety training should also be provided to staff that are to be on site for the duration of the operational phase.	▪ Strict control over the behaviour of construction workers, restricting activities to within demarcated areas. ▪ Ensure fire safety requirements are well understood and respected by workers (by providing basic fire safety training).	▪ Daily	▪ Facility Manager and Environmental Manager
		5.14.5. A storm-water management plan must be implemented during the operational phase. Regular inspections of stormwater infrastructure should be undertaken to ensure that it is kept clear of all debris and weeds.	▪ Verify that the stormwater management plan is being implemented and signed off prior the commencement of operations. ▪ Undertake regular inspections of the stormwater infrastructure (i.e. by implementing walk through inspections).	▪ Prior to commencement of operations. ▪ Weekly/Monthly	▪ Environmental Manager ▪ Facility Manager
		5.14.6. Undertake maintenance of rehabilitated areas in accordance with the rehabilitation and landscaping plan.	▪ Monitor topsoil removal and rehabilitation activities, and record and report non-compliance.	▪ Weekly or Monthly	▪ Facility Manager and Environmental Manager
		5.14.7. Continue with on-going monitoring programme to detect and quantify any alien species that may become established and identify the highly invasive species during the operation phase.	▪ Monitor the presence of alien invasive species on the development site.	▪ Reporting frequency depends on legal compliance framework	▪ Facility Manager and Environmental Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
5.15. Maintenance of the cordon of 250 m buffer around the quartzite kopjies.	Restriction of access and incursion into buffer zones around quartzite kopjies and proximal areas to maintain area as habitat under prevailing land use/ conservation value	5.15.1. Exclude the quartzite kopjies from the facility and ensure that intrusion by the operational staff and contractors is limited and undertaken for land management purposes.	▪ Ensure exclusion of kopjies and buffer area from site. ▪ Monitor area for incursions by staff and contractors.	▪ Ongoing	▪ Project Developer (Scatec Solar)
5.16. Impact and loss of fauna as a result of operational activities.	To reduce the loss of and impact on fauna.	5.16.1. Prior to the commencement of the operational phase, the plant manager and the landowner need to reach a decision in terms of the allowance of faunal activities or redress of faunal activities within site. 5.16.2. Identify points of excessive faunal activity and impact on operations. Undertake monitoring of faunal activities within the fenced area of the site and the immediate proximity of the site. 5.16.3. Reduction in speed limits in and around site.	▪ Establish reporting procedure. ▪ Monitor the presence of fauna during the operational phase via visual inspections and site visits. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Daily ▪ Daily ▪ Once-off training and ensure all new staff are inducted. ▪ As required	▪ Facility Manager and Environmental Manager ▪ Facility Manager and Environmental Manager ▪ Facility Manager ▪ Environmental Manager
5.17. Impact and loss of fauna as a result of the fence line and exclusion of fauna from site resulting in ecological change within the site.	To reduce the impact and loss of fauna from site as a result of their exclusion from the area.	5.17.1. Avoidance of damage to infrastructure by faunal activity as well as impact on fauna as a result of the site infrastructure. 5.17.2. Identify impact of burrowing and other faunal activities on the fence line and operations activities. 5.17.3. Undertake the management of faunal intrusion through the fence, including possible mortalities. 5.17.4. Provide critter paths through the fence line to allow species access to site. 5.17.5. Ensure that the live electrical fence wire is not placed at ground level. 5.17.6. Conduct inspections of the fence line to address any animals that may be affected by the fence. 5.17.7. Promote and support faunal presence and	▪ Identify where fauna may be affecting operations of site (burrows etc.) Consider redress if necessary. ▪ Conduct regular (daily) inspections of the fence line to address any animals that may be affected by the fence. ▪ Monitor the activities via visual inspections, and record and report any non-compliance.	▪ Daily to monthly record keeping. ▪ A register of all faunal sitings indicating date of siting; species affected; position of species (specific or indicative) and other observations should be established. ▪ Daily	▪ Environmental Manager and Project Developer (Scatec Solar) ▪ Environmental Manager and Project Developer (Scatec Solar) ▪ Environmental Manager and Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		activities within the proposed PV facility.			
5.18. Impact of ELP around the site.	The avoidance of electrical light pollution through prudent positioning of external lighting.	5.18.1. Placement of lighting, particularly security lighting to avoid excessive influence on surrounding areas.	▪ Review lighting plans and identify important habitat zones to be avoided.	▪ Prior to the installation of lighting.	▪ Project Developer (Scatec Solar) and Environmental Manager
5.19. Faunal and avifaunal road mortality as a result of increased vehicles travelling to and within the site.	Minimise loss of fauna as a result of road mortalities.	5.19.1. The operational personnel and staff should be made aware of the presence of fauna within the proposed project area. The operational personnel and staff must also be made aware of the general speed limits on site and must be alert at all times for potential crossings.	▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Facility Manager ▪ Environmental Manager
		5.19.2. To ensure that animals are not attracted to the site (and potentially resulting in increased road mortality), the waste collection bins and skips should be covered with suitable material, where appropriate, and the offices must be kept clean on a daily basis.	▪ Monitor the activities via visual inspections, and record and report any non-compliance.	▪ Daily	▪ ECO and Contractor
D. DECOMMISSIONING PHASE					
5.20. Rehabilitation of flora on site	Re-vegetation of the disturbed site is aimed at approximating as near as possible the natural vegetative conditions prevailing prior to operation.	5.20.1. All damaged areas shall be rehabilitated upon completion of the contract. 5.20.2. All natural areas must be rehabilitated with species indigenous to the area. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction. 5.20.3. Rehabilitation must be executed in such a manner that surface run-off will not cause erosion of disturbed areas.	▪ Conduct a final external audit to confirm that area is rehabilitated to an acceptable level.	▪ Once off	▪ Project Developer (Scatec Solar) with feedback and input from an appropriate specialist. with advice from specialist

6 OPEN SPACE MANAGEMENT PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
6.1. Loss of vegetation and habitat fragmentation	Keeping the area cleared of vegetation to a minimum	6.1.1. Clearing of vegetation should be kept to a minimum and take into consideration the sensitivities on site shown in Appendices A and B of this EMPr.	▪ Ensure that solar panel/array design and layout is uniform and well-adapted to the surrounding environment and that no unnecessary areas are cleared of vegetation.	▪ Once-off during design	▪ Project Developer (Scatec Solar)
6.2. Impacts due to establishment of alien invasive plants	Ensure the appropriate removal of alien invasive vegetation from the proposed project area and prevent the establishment and spread of alien invasive plants due to the project activities.	6.2.1. Ensure compliance with relevant Environmental Specifications for the control and removal of alien invasive plant species. 6.2.2. Appoint a specialist or contact relevant authorities to seek guidance on the removal of the alien vegetation on site. 6.2.3. Compile and finalise an alien weed eradication programme.	▪ Appoint a suitable specialist/ Contractor or contact the relevant authorities to seek guidance on the removal of the planted alien invasive species. ▪ Appoint a suitable specialist to compile an alien invasive vegetation eradication plan. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the design phase. ▪ Once-off during the design phase. ▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar) ▪ ECO
6.3. Permanent barriers to animal movement and habitat fragmentation	The reduction in the impact that barrier will have on animal movement within the area	6.3.1. Fencing should allow for the passage of small and medium sized mammals and all forms of mesh fencing should be avoided.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase	▪ Project Developer (Scatec Solar)
		6.3.2. All remaining areas that are not impacted upon by the proposed development footprint should remain unfenced to allow for movement corridors between the remainder of the farm.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase	▪ Project Developer (Scatec Solar)
		6.3.3. BFDs should be installed on the overhead cables where known flight paths of birds occur.	▪ Identify appropriate points within infrastructure for the establishment of BFDs. ▪ Verify that this is undertaken by reviewing the signed approved designs.	▪ Once-off ▪ Once-off	▪ Project Developer (Scatec Solar) and ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
B. CONSTRUCTION PHASE					
6.4. Permanent barriers to animal movement and habitat fragmentation	The reduction in the impact that barrier will have on animal movement within the area	6.4.1. BFDs should be installed on the overhead cables where known flight paths of birds occur.	▪ The flight paths and birds observed in the area should be monitored by the ECO during the construction phase to determine where these measures should be installed. ▪ Verify whether these have been installed by inspecting the site prior to commencement of the operational phase.	▪ Daily ▪ Once-off	▪ ECO and Contractor ▪ ECO
		6.4.2. Fencing should allow for the passage of small and medium sized mammals and all forms of mesh fencing should be avoided.	▪ This should be monitored by the ECO to determine whether this is effective.	▪ Daily	▪ ECO and Contractor
6.5. Loss of vegetation and habitat fragmentation	Keeping the area cleared of vegetation to a minimum	6.5.1. Clearing of vegetation should be kept to a minimum, keeping the width and length of the earthworks to a minimum.	▪ Monitor activities and record and report non-compliance.	▪ Daily	▪ ECO and Contractor
C. OPERATIONAL PHASE					
6.6. Increased risk of alien plant invasion	Ensure that the site is kept free from alien invasive species.	6.6.1. Continuously monitor the site and remove alien invasive species that are found.	▪ Monitor the presence of alien invasive species on the development site.	▪ Reporting frequency depends on legal compliance framework	▪ Facility Manager and Environmental Manager
6.7. Increased animal road mortality	Minimise loss of fauna as a result of road mortalities.	6.7.1. Create awareness during staff induction programmes. Staff must be made aware of the general speed limits as well as the potential animals that may cross and how to react in these situations.	▪ Conduct staff awareness training programmes.	▪ Once-off training and ensure all new staff are inducted.	▪ Facility Manager and Environmental Manager
6.8. Permanent barriers to animal movement and habitat fragmentation	Avoid or reduce bird collisions with or due to infrastructure related to the project	6.8.1. The impact on birds must be monitored by environmental staff member during the first six months of the operational phase.	▪ Record any evidence of bird collisions, injury or other bird-related incidents (with GPS coordinates). ▪ Where necessary, a bird specialist should oversee the recording and reporting of incidents, help with species identification, assess the significance of any impacts, and if required, suggest mitigation.	▪ Weekly for the first month, thereafter, monthly	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		6.8.2. Annual monitoring by an avifaunal specialist. This should be based on a minimum of 3-5 days observations.	▪ Monitor the flight paths of birds occurring on site, noting which birds are seen.	▪ Annually	▪ Project Developer (Scatec Solar)
		6.8.3. Any avian mortality or injury at the facility should be duly recorded and reported.	▪ Record any bird fatalities and undertake the necessary reporting to relevant authority.	▪ When required	▪ Project Developer (Scatec Solar)
D. DECOMMISSIONING PHASE					
6.9. No specific impacts are associated with the decommissioning phase other than those from the operational phase that will still be relevant for the duration of the decommissioning phase due to on-going occupation of the area.	To manage impacts on the surrounding environment during the operational phase.	6.9.1. Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes	▪ Final external audit of area to confirm that area is rehabilitated to an acceptable level	▪ Once off	▪ Project Developer (Scatec Solar)
		6.9.2. Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a mix of native species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape.	▪ Final external audit of area to confirm that area is rehabilitated to an acceptable level	▪ Once off	▪ Project Developer (Scatec Solar)
		6.9.3. Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape.	▪ Final external audit of area to confirm that area is rehabilitated to an acceptable level	▪ Once off	▪ Project Developer (Scatec Solar)

7 TRAFFIC MANAGEMENT PLAN INCLUDING TRANSPORTATION PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
7.1. Increased traffic generation	Manage impact that additional traffic generation will have on road network	7.1.1. If abnormal loads need to be transported by road to the site, a permit needs to be obtained from the Provincial Government Northern Cape (PGNC) Department of Public Works, Roads and Transport.	▪ Ensure that the permits are applied for and obtained prior to commencement. ▪ Verify that this has been undertaken by reviewing approved permits.	▪ Once-off during the design phase ▪ Once-off during the design phase.	▪ Contractor ▪ ECO
		7.1.2. If the Transnet Service Road will be used as the designated access road to site, discussions must be held with Transnet Freight Rail prior to commencement to confirm requirements and details of the agreement.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar) and ECO
		7.1.3. Ensure that the requirements for use of the Transnet Service Road are addressed and considered in the design, as and where applicable.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar) and ECO
		7.1.4. If the Transnet Service Road will be used as the designated access road, the registration details of all vehicles that will make use of the road during the construction and operational phases must be provided to Transnet Freight Rail, in order to obtain official permits.	▪ Ensure that the permits are applied for and obtained prior to commencement. ▪ Verify that this has been undertaken by reviewing approved permits.	▪ Once-off during the design phase ▪ Once-off during the design phase.	▪ Contractor ▪ ECO
		7.1.5. Provide a Transport Traffic Plan to SANRAL (if required).	▪ Ensure that the plan is compiled and submitted prior to commencement. ▪ Verify that this has been undertaken by reviewing approved plans.	▪ Once-off during the design phase ▪ Once-off during the design phase.	▪ Contractor ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
7.2. Accelerated degradation of road structure due to construction and operational traffic.	Limit the deterioration of the road condition due to construction and operational traffic.	7.2.1. A Road Maintenance Plan should be developed for the section of the Transnet Service Road that will be used. The plan should address the requirements of Transnet Freight Rail, including but not limited to, grading, dust suppressant mechanisms, drainage, signage, and speed limits.	▪ Ensure that the plan is compiled and submitted prior to commencement. ▪ Verify that this has been undertaken by reviewing approved plans.	▪ Once-off during the design phase ▪ Once-off during the design phase.	▪ Contractor ▪ ECO
B. CONSTRUCTION PHASE					
7.3. Increased traffic generation during the construction phase resulting in a reduction of road based level of service	Reduce the amount of road based traffic during the construction phase.	7.3.1. Well maintained vehicles should be used together with well-trained drivers during the construction phase. Vehicle maintenance and driver competency should be monitored. Proof of driver competency as well as the vehicle checks should be verified and undertaken to ensure that vehicles are roadworthy and hence, do not pose a safety risk. The Contractors must ensure that construction vehicles are roadworthy, properly serviced and maintained, and respect the vehicle safety standards implemented by the Project Developer.	▪ Carry out random checks of driver licenses and conduct random visual inspections of construction vehicles for roadworthiness.	▪ Random visual inspection of vehicles weekly.	▪ Contractor
		7.3.2. Plan trips so that it occurs during the day but avoid construction vehicle movement on the regional road during peak time (06:00-10:00 and 16:00-20:00).	▪ Monitor and management of traffic generated and when trips are made.	▪ During construction	▪ Contractor and ECO
		7.3.3. During the construction phase, suitable parking areas should be designated for trucks and vehicles.	▪ Monitor the placement of the designated parking area for trucks and vehicles via visual inspections and record and report any non-compliance.	▪ Once-off prior to construction and as required during the construction phase.	▪ Project Developer (Scatec Solar) and ECO
		7.3.4. The use of public transport (buses and/or minibus taxis) to convey construction personnel to the site should be encouraged.	▪ Contractor may record arrival and departure times as well as number of workers using minibuses.	▪ Once a month on a randomly selected day.	▪ Appointed Contractor
		7.3.5. It is recommended that vehicles are not overloaded during the construction phase in order to reduce impacts on the road	▪ Perform visual inspection of vehicles during the construction	▪ Random visual inspection of	▪ Appointed Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		structures, particularly the access roads leading to the site. Random visual inspection of vehicles should be undertaken in order to monitor for overloading. The inspections should also verify if the trucks are covered with appropriate material (such as tarpaulin) if and where possible.	phase.	vehicles weekly.	
7.4. Increased level of road accidents (involving pedestrians, animals, other motorists on the surrounding tarred/ gravel road network) due to increased traffic during construction.	Minimise the impact of the construction activities on the local traffic and avoid accidents with pedestrians, animals and other drivers on the surrounding tarred/ gravel roads. Reduce number of road accidents due to increased traffic during construction.	7.4.1. Well maintained vehicles should be used together with well-trained drivers during the construction phase. Vehicle maintenance and driver competency should be monitored. Proof of driver competency as well as the vehicle checks should be verified and undertaken to ensure that vehicles are roadworthy and hence, do not pose a safety risk. The Contractors must ensure that construction vehicles are roadworthy, properly serviced and maintained, and respect the vehicle safety standards implemented by the Project Developer.	▪ Carry out random checks of driver licenses and conduct random visual inspections of construction vehicles for roadworthiness.	▪ Random visual inspection of vehicles weekly.	▪ Contractor
		7.4.2. Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established fences should be installed, if needed, to direct animals to safe road crossings.	▪ Appropriate monitoring should be undertaken and fences installed, if needed to direct animals to safe road crossings.	▪ Weekly	▪ Contractor and ECO
		7.4.3. Adhere to all speed limits applicable to all roads used. All heavy load vehicles should maintain a speed limit of 40 km/hour in the proposed section of the Transnet Service Road.	▪ Ensure that speed limits are adhered to. ▪ Carry out random visual inspections to verify speed limits and general awareness of vehicle drivers.	▪ Daily ▪ Random during the construction phase	▪ Contractor and ECO ▪ ECO
		7.4.4. Implement clear and visible signage and signals indicating movement of vehicles at the intersection with the Transnet Service Road to ensure safe entry and exit.	▪ Implement clear signalisation. ▪ Carry out random inspections to verify whether proper construction signage is being implemented.	▪ On-going ▪ Random during the construction phase	▪ Contractor and ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
7.5. Accelerated degradation of road structure due to construction traffic.	Limit the deterioration of the road condition due to construction traffic.	7.5.1. Construction activities will have a higher impact than the normal road activity and therefore the main access roads to site should be inspected on a weekly basis for structural damage.	▪ Ensure that the main access road to site maintains current condition through photographic surveys and monitoring.	▪ Weekly	▪ Contractor and ECO
		7.5.2. Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles.	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Contractor and ECO
		7.5.3. It is recommended that vehicles are not overloaded during the construction phase in order to reduce impacts on the road structures, particularly the access roads leading to the site. Random visual inspection of vehicles should be undertaken in order to monitor for overloading. The inspections should also verify if the trucks are covered with appropriate material (such as tarpaulin) if and where possible.	▪ Perform visual inspection of vehicles during the construction phase.	▪ Random visual inspection of vehicles weekly.	▪ Appointed Contractor
		7.5.4. Make provision for the repairing of subgrade deterioration (i.e. pot holes, dust holes) that could possibly result due to loading of heavy construction vehicles on the Transnet Service Road.	▪ Make provision for repairs required to road	▪ Agree to with Transnet	▪ Contractor and ECO
7.6. Impact on air quality due to dust generation, noise and exhaust emissions from construction vehicles and equipment.	Limit the release of noise, pollutants and dust emissions	7.6.1. Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles.	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Contractor and ECO
		7.6.2. Construction vehicles must have their lights on at all times. Lights to be properly set to not blind train drivers, who may then miss an important signal, e.g. stop signal (Signal Passed at Danger (SPAD).	▪ Ensure lights are on and properly set.	▪ On-going	▪ Contractor and ECO
		7.6.3. Postpone or reduce dust-generating activities during periods with strong wind. Earthworks may need to be rescheduled or the frequency of application of dust	▪ Ensure dust management measures are in place to decrease the dust generated	▪ On-going	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		control/suppressant increased.			
		7.6.4. Avoid using old and unmaintained construction equipment (which generate high sound levels) and ensure equipment is well maintained.	▪ Manage the air pollutants form construction vehicles through checking the condition of vehicles	▪ On-going	▪ Contractor and ECO
C. OPERATIONAL PHASE					
7.7. Increased level of road accidents (involving pedestrians, animals, other motorists on the surrounding tarred/ gravel road network) due to increased traffic during the operational phase.	Minimise the impact of the operational activities on the local traffic and avoid accidents with pedestrians, animals and other drivers on the surrounding tarred/ gravel roads. Reduce number of road accidents due to increased traffic during the operational phase.	7.7.1. Well maintained vehicles should be used together with well-trained drivers during the operational phase, as required. Vehicle maintenance and driver competency should be monitored. Proof of driver competency as well as the vehicle checks should be verified and undertaken to ensure that vehicles are roadworthy and hence, do not pose a safety risk. Vehicles must be roadworthy, properly serviced and maintained.	▪ Carry out random checks of driver licenses and conduct random visual inspections of vehicles for roadworthiness.	▪ Random visual inspection of vehicles weekly.	▪ Facility Manager
		7.7.2. Adhere to all speed limits applicable to all roads used. All heavy load vehicles should maintain a speed limit of 40 km/hour in the proposed section of the Transnet Service Road.	▪ Ensure that speed limits are adhered to. ▪ Carry out random visual inspections to verify speed limits and general awareness of vehicle drivers.	▪ Daily ▪ Random during the operational phase	▪ Facility Manager ▪ Facility Manager
		7.7.3. Implement clear and visible signage and signals indicating movement of vehicles at the intersection with the Transnet Service Road to ensure safe entry and exit.	▪ Implement clear signalisation. ▪ Carry out random inspections to verify whether proper construction signage is being implemented.	▪ Ongoing ▪ Random during the operational phase	▪ Facility Manager ▪ Facility Manager
		7.7.4. The use of public transport (buses and/or minibus taxis) or carpooling to convey operational personnel to the site should be encouraged.	▪ Monitor the requirements	▪ On-going	▪ Facility Manager
		7.7.5. Adhere to requirements made within Transport Traffic Plan.	▪ Monitor the requirements as set out in the Plan as ensure that it is adhered to	▪ On-going	▪ Facility Manager
		7.7.6. Limit access to the site to personnel.	▪ Maintain a register of visitors and staff that enter site and restrict	▪ On-going	▪ Facility Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			access to personnel.		
7.8. Accelerated degradation of road structure due to operational traffic.	Limit the deterioration of the road condition due to operational phase traffic.	7.8.1. The main access roads to site should be inspected on a weekly basis for structural damage.	▪ Ensure that the main access road to site maintains current condition through photographic surveys and monitoring.	▪ Weekly	▪ Facility Manager
		7.8.2. Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles.	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Facility Manager
		7.8.3. It is recommended that vehicles are not overloaded during the operational phase (where applicable) in order to reduce impacts on the road structures, particularly the access roads leading to the site. Random visual inspection of vehicles should be undertaken in order to monitor for overloading (where applicable).	▪ Perform visual inspection of vehicles during the construction phase.	▪ Random visual inspection of vehicles weekly.	▪ Facility Manager
		7.8.4. Make provision for the repairing of subgrade deterioration (i.e. pot holes, dust holes) that could possibly result due to overloading of vehicles (where applicable) on the Transnet Service Road.	▪ Make provision for repairs required to road.	▪ Agree to with Transnet	▪ Project Developer (Scatec Solar)
		7.8.5. Implement requirements of the Road Maintenance Plan.	▪ Adhere to requirements of the Road Maintenance Plan.	▪ On-going	▪ Facility Manager
D. DECOMMISSIONING PHASE					
7.9. Ensure that the construction mitigation and management measures are adhered to during the decommissioning phase.					

8 STORM WATER MANAGEMENT PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
8.1. Impact of the project if a detailed storm water management plan is not correctly prepared.	To limit the effect of uncontrolled storm water run-off from developed areas onto natural areas	8.1.1. Prepare a detailed stormwater management plan outlining appropriate treatment measures to address runoff from disturbed portions of the site, such that they do not: ▪ result in concentrated flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural water courses; ▪ result in any necessity for concrete or other lining of natural water courses to protect them from concentrated flows of the development; ▪ divert flows out of their natural flow pathways, thus depriving downstream watercourses of water.	▪ Check compliance with specified conditions. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during design followed by regular control ▪ During the design phase	▪ Contractor ▪ ECO
B. CONSTRUCTION PHASE					
8.2. Diversion and impedance surface water flows - Changes to the hydrological regime and increased potential for erosion.	Prevent interference with natural run-off patterns, diverting flows and increasing the velocity of surface water flows.	8.2.1. The appointed Contractor should compile a Method Statement for Stormwater Management during the construction phase.	▪ Compile a Method Statement for Stormwater Management during the construction phase. ▪ Inspect and verify if a Method Statement for Stormwater Management has been compiled by the Contractor via audits prior to the commencement of the construction phase.	▪ Prior to the construction phase. ▪ Once-off prior to the commencement of the construction phase.	▪ Contractor ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Diversion and increased velocity of surface water flows – reduction in permeable surfaces		8.2.2. Stormwater and any run-off generated by the hard surfaces should be discharged into retention swales or areas with rock rip-rap (or similar). These could be used to enhance the sense of place, if they are planted with indigenous vegetation.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or bi-weekly	▪ ECO
		8.2.3. Erosion and sedimentation into water bodies must be minimised through the effective stabilisation (gabions and Reno mattresses or similar) and the re-vegetation of any disturbed riverbanks.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or Bi-weekly	▪ ECO
		8.2.4. Place energy dissipation structures in a manner that allows the management of flows prior to being discharged into the natural environment, thus not only preventing erosion, but supporting the maintenance of natural base flows within these systems i.e. hydrological regime (water quantity and quality) is maintained.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or bi-weekly	▪ ECO
		8.2.5. Reinforce soil slopes to minimise erosion during rehabilitation (as needed, and once construction in a specific area has ceased).	▪ Monitor activities and record and report non-compliance.	▪ As needed during the construction phase	▪ ECO
		8.2.6. Any irrigation of the development area for landscaping or dust control purposes should be controlled, such that it does not result in any measurable increase in moisture being passed into natural drainage lines.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or bi-weekly	▪ ECO
		8.2.7. Drainage along the sides of the roads should be designed so that it does not result in concentrated flows into watercourses.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or bi-weekly	▪ ECO
		8.2.8. Perform periodic inspections and maintenance of soil erosion measures and stormwater control structures.	▪ Monitor activities and record and report non-compliance.	▪ As needed during the construction phase	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
8.3. Pollution of the surrounding environment as a result of the contamination of stormwater. Contamination could result from the spillage of chemicals, oils, fuels, sewage, solid waste, litter etc.	To prevent contaminated stormwater from entering into and adversely impacting on freshwater ecosystems and reducing the water quality. To reduce sedimentation of nearby water systems. To apply best practice principles in managing risks to storm water pollution.	8.3.1. The appointed Contractor should compile a Method Statement for Stormwater Management during the construction phase.	▪ Compile a Method Statement for Stormwater Management during the construction phase. ▪ Inspect and verify if a Method Statement for Stormwater Management has been compiled by the Contractor via audits prior to the commencement of the construction phase.	▪ Prior to the construction phase. ▪ Once-off prior to the commencement of the construction phase.	▪ Contractor ▪ ECO
		8.3.2. Provide secure storage for fuel, oil, chemicals and other waste materials to prevent contamination of stormwater runoff. Fuels and chemicals (i.e. any hazardous materials and dangerous goods) used during the construction phase must be stored safely on site and in bunded areas. Fuel and chemical storage containers must be inspected to ensure that any leaks are detected early.	▪ Monitor the storage and handling of dangerous goods and hazardous materials on site via site audits and record non-compliance and incidents. Monitor if spillages have taken place and if they are removed correctly.	▪ Weekly	▪ ECO
		8.3.3. All stockpiles must be protected from erosion and stored on flat areas where run-off will be minimised. Erosion and sedimentation into water bodies must be minimised through effective stabilisation. No stockpiling should take place within a watercourse. 8.3.4. Stockpiles must be located away from river channels i.e. greater than 32 m.	▪ Monitor the excavations and stockpiling process throughout the construction phase via visual site inspections. Record non-compliance and incidents.	▪ Daily	▪ ECO
		8.3.5. Littering and contamination of water resources during construction must be prevented by effective construction camp management.	▪ Monitor via site audits and record non-compliance and incidents (i.e. by implementing walk through inspections).	▪ Weekly	▪ Contractor and ECO
		8.3.6. Emergency plans must be in place to deal with potential spillages (especially those leading to any watercourses).	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or Bi-weekly	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		8.3.7. Erosion and sedimentation into water bodies must be minimised through the effective stabilisation (gabions and Reno mattresses or similar) and the re-vegetation of any disturbed riverbanks.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or Bi-weekly	▪ ECO
		8.3.8. Ensure that the temporary site camp and ablution facilities are established at least 32 m away from the banks of the major drainage lines.	▪ Monitor the placement of the site camp via visual inspections, and record and report any non-compliance.	▪ Once-off prior to construction and as required during the construction phase.	▪ ECO
		8.3.9. Ensure that there is no ad-hoc crossing of channels by vehicles during the construction phase. Access routes across the site should be strictly demarcated and selected with a view to minimise impacts on drainage lines.	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or Bi-weekly	▪ ECO
		8.3.10. Ensure that no waste materials or sediments are left in the surrounding drainage lines (as a result of the construction).	▪ Check compliance with specified conditions of the Stormwater Management Plan and Method Statement.	▪ Weekly or Bi-weekly	▪ ECO
		8.3.11. Regular inspections of stormwater infrastructure should be undertaken to ensure that it is kept clear of all debris and weeds.	▪ Monitor via site audits and record non-compliance and incidents (i.e. by implementing walk through inspections).	▪ Weekly	▪ Contractor and ECO
C. OPERATIONAL PHASE					
8.4. Stormwater discharge into the surrounding environment during operations	To minimise the contamination of stormwater by uncontrolled release of contaminated or grey water. To protect soil resources and prevent soil erosion.	8.4.1. An operational phase Stormwater Management Plan should be designed and implemented, with a view to prevent the passage of concentrated flows from hardened surfaces and onto natural areas.	▪ Compile a Stormwater Management Plan for the operational phase. ▪ Inspect and verify if a Stormwater Management Plan has been compiled prior to the commencement of the operational phase.	▪ Continuously during operational phase. ▪ Once-off prior to the commencement of the operational phase.	▪ Project Developer (Scatec Solar)
		8.4.2. All release points into the natural environment must have appropriate energy dissipaters to minimise scouring/erosion.	▪ Monitor activities and record and report non-compliance. ▪ Monitor the placement of energy dissipaters via visual inspections, and record and report any non-	▪ On-going	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			compliance.		
		8.4.3. As far as reasonably possible, separate "clean" and "dirty" storm water. As far as reasonably possible, capture and contain "dirty" stormwater for appropriate disposal/discharge.	▪ Monitor via site audits and record non-compliance and incidents (i.e. by implementing inspections).	▪ Weekly or as required during operations.	▪ Project Developer (Scatec Solar)
		8.4.4. Regular inspections of stormwater infrastructure should be undertaken to ensure that it is kept clear of all debris and weeds.	▪ Undertake regular inspections of the stormwater infrastructure (i.e. by implementing walk through inspections).	▪ Weekly/Monthly	▪ Project Developer (Scatec Solar)
D. DECOMMISSIONING PHASE					
8.5. The proposed solar facility would be expected to run for a minimum period of 20 years, after which it would either be decommissioned, alternatively upgraded or an application submitted to obtain a new license. Should the plant be decommissioned, the solar field would be rehabilitated to its original (pre-development) state. In the (unlikely) event that none of the mitigation measures outlined for the construction and operational phases of the proposed project had been implemented, the period of time for recovery to take place would be extended. In the event that decommissioning occurs, and assuming implementation of mitigation measures, the hydrological regime should fully recover over time to present day conditions.					

9 EROSION MANAGEMENT PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. CONSTRUCTION PHASE					
9.1. Increased wind erosion and resultant deposition of dust	Prevent wind erosion and resultant deposition of dust on surrounding indigenous vegetation.	9.1.1. Sand, stone and cement should be stored in demarcated areas, and covered or sealed to prevent wind erosion and resultant deposition of dust on the surrounding indigenous vegetation.	▪ Undertake regular inspections of the via site audits to verify that sand, stone and cement are stored and handled as instructed.	▪ Daily	▪ ECO and Contractor
		9.1.2. During construction, efforts should be made to retain as much natural vegetation as possible on the site, to reduce disturbed areas and maintain plant cover, thus reducing erosion risks.	▪ Monitor activities via site inspections and record and report non-compliance.	▪ Daily	▪ ECO and Contractor
		9.1.3. All stockpiles must be protected from erosion and stored on flat areas where run-off will be minimised. Erosion and sedimentation into water bodies must be minimised through effective stabilisation.	▪ Monitor the stockpiling process throughout the construction phase via visual site inspections. Record non-compliance and incidents.	▪ Daily	▪ ECO
9.2. Excessive loss of natural vegetation within the development footprint area	Prevent loss of natural vegetation through erosion.	9.2.1. Vegetation clearing during construction must be restricted to the footprint of the proposed project components and planned infrastructure only. It should be phased to ensure that the minimum area of soil is exposed to potential erosion at any one time.	▪ Monitor vegetation clearing throughout the construction phase via visual site inspections. Record non-compliance and incidents. ▪ Undertake regular monitoring for erosion to ensure is reduced and rectified as soon as possible.	▪ Daily ▪ Daily	▪ ECO and Contractor ▪ ECO
		9.2.2. Stockpile the shallow topsoil layer separately from the subsoil layers (especially if the excavation exceeds 0.5 m). Reinstate the topsoil layers (containing seed and vegetative material) when construction is complete to allow the plants to rapidly re-colonise the bare soil areas.	▪ Rehabilitate disturbed areas and monitor the presence of alien invasive species on site.	▪ Daily (stockpiling) and once-off for the reinstatement of the top soil layer	▪ ECO and Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		9.2.3. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction.	▪ Re-seed with seeds of indigenous grass species.	▪ Once off	▪ ECO with advice from specialist (if required)
		9.2.4. Topsoil stockpiles not used in three months after stripping must be seeded to prevent dust and erosion.	▪ Regular monitoring for erosion to ensure that no erosion problems are occurring at the site. All erosion problems observed should be rectified as soon as possible.	▪ Weekly initially and thereafter monthly	▪ ECO and Contractor
9.3. Erosion of surface soils, rilling and gulleys.	Measures to be implemented that address or avoid the loss of surface soils and exacerbates gulley formation.	9.3.1. Identify cause of erosion and possible means of redress (i.e. implement erosion control measures, where applicable), such as the use of geofabric, stone gabions and re-vegetation or similar measures. 9.3.2. Erosion control measures should seek to reduce surface flow velocity and allow for settlement on site of silt laden surface waters. Washaways, excessive loss of soils and gulleys can be considered to be indicative of excessive erosion.	▪ Monitor the erosion on site during construction, as well as the implementation and effectiveness of erosion control on site (such as the use of geofabric, stone gabions and re-vegetation or similar measures).	▪ Ongoing and as required during erosion events.	▪ ECO and Project Developer (Scatec Solar)
B. OPERATIONAL PHASE					
9.4. Excessive loss of natural vegetation in the development footprint area and resulting impacts on SSC, faunal habitat and habitat fragmentation.	Prevent loss of natural vegetation and minimise habitat fragmentation and the loss of connectivity as a result of erosion.	9.4.1. To prevent erosion, indigenous grasses that seed themselves below the solar arrays should (where possible) be left to form a ground cover and kept short.	▪ ECO to advise on seed to be used.	▪ Prior to re-vegetation.	▪ Project Developer (Scatec Solar)
		9.4.2. The use of silt fences, sand bags or other suitable methods must be implemented in areas that are susceptible to erosion. Other erosion control measures that can be implemented are as follows: 1) Brush packing with cleared vegetation, 2) Planting of vegetation, 3) Hydro seeding/hand sowing. All erosion control mechanisms need to be regularly maintained.	▪ Monitor efficiency of erosion control measures.	▪ Weekly or monthly	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		9.4.3. Conduct regular monitoring for erosion to ensure that no erosion problems are occurring at the site as a result of the roads and other infrastructure. Ensure that all erosion problems are rectified as soon as possible.	▪ Undertake regular monitoring for erosion to ensure is reduced and rectified as soon as possible.	▪ Monthly	▪ Project Developer (Scatec Solar)
9.5. Increased wind erosion and resultant deposition of dust.	Prevent wind erosion and resultant deposition of dust on surrounding indigenous vegetation.	9.5.1. Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.	▪ Include periodic site inspections in environmental performance reporting that inspects the effectiveness and integrity of the run-off control system and specifically records occurrence or non-occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	▪ Monthly	▪ Project Developer (Scatec Solar)
C. DECOMMISSIONING PHASE					
9.6. No specific impacts are associated with the decommissioning phase other than those from the operational phase that will still be relevant for the duration of the decommissioning phase due to on-going occupation of the area. Rehabilitation must be executed in such a manner that surface run-off will not cause erosion of disturbed areas. Monitoring: Final external audit of area to confirm that area is rehabilitated to an acceptable level (once off event to be conducted by ECO).					

10 HAZARDOUS SUBSTANCES LEAKAGE OR SPILLAGE MONITORING SYSTEM

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. CONSTRUCTION PHASE					
10.1. Contamination of soil and risk of damage to vegetation and/or fauna through spillage of concrete and cement.	To control concrete and cement batching activities in order to reduce spillages and resulting contamination of soil, groundwater and the vegetation and/or fauna.	10.1.1. If any concrete mixing takes placed on site, this must be carried out in a clearly marked, designated area at the site camp on an impermeable surface (such as on boards or plastic sheeting and/or within a bunded area with an impermeable surface).	▪ Monitor the handling and storage of sand, stone and cement as instructed.	▪ Daily	▪ Project Developer (Scatec Solar), Contractor and ECO
		10.1.2. Bagged cement must be stored in an appropriate facility and at least 10 m away from any water courses, gullies and drains.	▪ Monitor the handling and storage of sand, stone and cement as instructed.	▪ Daily	▪ Project Developer (Scatec Solar), Contractor and ECO
		10.1.3. A washout facility must be provided for washing of concrete associated equipment. Water used for washing must be restricted.	▪ Monitor the handling and storage of sand, stone and cement as instructed.	▪ Daily	▪ Project Developer (Scatec Solar), Contractor and ECO
		10.1.4. Hardened concrete from the washout facility or concrete mixer can either be reused or disposed of at an appropriate licenced disposal facility. Proof of disposal (i.e. waste disposal slips or waybills) should be retained on file for auditing purposes.	▪ Monitor the handling and storage of sand, stone and cement as instructed. ▪ Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ Daily ▪ Monthly	▪ Project Developer (Scatec Solar), Contractor and ECO ▪ ECO
		10.1.5. Empty cement bags must be secured with adequate binding material if these will be temporarily stored on site. Empty cement bags must be collected from the construction area at the end of every day. Sand and aggregates containing cement must be kept damp to prevent the generation of dust.	▪ Monitor the handling and storage of sand, stone and cement as instructed.	▪ Daily	▪ Project Developer (Scatec Solar), Contractor and ECO
		10.1.6. Any excess sand, stone and cement must be removed from site at the completion of the construction period and disposed at a licenced waste disposal facility. Proof of disposal (i.e. waste	▪ Monitor the handling and storage of sand, stone and cement as instructed.	▪ Daily ▪ Monthly	▪ Project Developer (Scatec Solar), Contractor and

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		disposal slips or waybills) should be retained on file for auditing purposes.	▪ Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.		ECO ▪ ECO
10.2. Contamination of soil and risk of damage to vegetation and/or fauna through spillage of fuels and oils.	To control and eliminate fuel and oil spillages which may result in soil contamination and damage to vegetation and/or fauna.	10.2.1. Ensure that adequate containment structures are provided for the temporary storage of liquid dangerous goods and hazardous materials on site (such as chemicals, oil, fuel, hydraulic fluids, lubricating oils etc.). Appropriate bund areas must be provided for the storage of these materials at the site camp. Bund areas should contain an impervious surface in order to prevent spillages from entering the ground. Bund areas should have a capacity of 110 % of the volume of the largest tank in the bund (tanks include storage of fuel/diesel).	▪ Monitor the storage and handling of dangerous goods and hazardous materials on site via site audits and record non-compliance and incidents.	▪ Weekly	▪ Contractor and ECO
		10.2.2. Monitor and inspect construction equipment and vehicles to ensure that no fuel spillage takes place. Ensure that drip trays are provided for construction equipment and vehicles as required.	▪ Monitor the construction equipment and vehicles and monitor the occurrence of spills and the management process thereof. ▪ Record all spills and lessons learnt.	▪ Daily ▪ During spill events	▪ Contractor and ECO ▪ ECO
		10.2.3. Contractor to compile a Method Statement for refuelling activities under normal and emergency situations. If on-site servicing and refuelling is required in emergency situations, a designated area must be created at the construction site camp for this purpose. Drip trays or similar impervious materials must be used during these procedures.	▪ Verify if a Method Statement is compiled by reviewing approved and signed off reports. ▪ Monitor the refuelling/ servicing process and record the occurrence of any spillages.	▪ Once-off prior to commencement of construction. ▪ During emergency refuelling and servicing activities.	▪ ECO ▪ ECO
		10.2.4. Spilled fuel, oil or grease must be retrieved and contaminated soil removed, cleaned and replaced.	▪ Monitor the handling and storage of fuels and oils via site audits and monitor if spillages have taken place and if so, are removed correctly. Monitor waste disposal slips and waybills	▪ Daily (or during spills)	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			via site audits and record non-compliance and incidents.		
		10.2.5. Contaminated soil to be collected by the Contractor (under observation of the ECO) and disposed of at a registered waste facility designated for this purpose. Proof of disposal (i.e. waste disposal slips or waybills) should be retained on file for auditing purposes.	▪ Monitor the correct removal of contaminated soil. Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ Daily (or during spills)	▪ Contractor and ECO
		10.2.6. A Spill Response Method Statement must be compiled by the Contractor for the construction phase in order to manage potential spill events.	▪ Compile a Spill Response Method Statement. ▪ Audit signed and approved Spill Response Method Statement.	▪ Once-off (and thereafter updated as required during the construction phase). ▪ Once-off (and thereafter as required during the construction phase).	▪ Contractor and Project Developer (Scatec Solar) ▪ ECO
		10.2.7. The Contractor must ensure that adequate spill containment and clean-up equipment are provided on site for use during spill events.	▪ Monitor via site audits and record incidents and non-compliance.	▪ Daily/Weekly	▪ ECO and Contractor
		10.2.8. Portable bioremediation kit (to remedy chemical spills) is to be held on site and used as required.	▪ Ensure that a well-maintained portable bioremediation kit is available on site and that construction personnel and contractors are aware of its location and instructions	▪ Daily	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		10.2.9. In case of a spillage of hazardous chemicals where contamination of soil occurs, depending on the degree and level of contamination, excavation and removal to a hazardous waste disposal facility could be necessary. If the spillage is widespread and the soil is considered to be significantly contaminated, a specialist will need to be immediately appointed to address the spillage. This will usually entail the collection of samples of the contaminated soil followed by analysis in terms of the 2014 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (i.e. GN 331). If the soil is determined to be significantly contaminated, then compliance with Part 8 of the NEMWA should be achieved by the Applicant, including notifying the Minister of Environmental Affairs of the significant contamination.	▪ Ensure that a suitably qualified specialist is appointed to collect and analyse the contaminated soil samples in terms of the 2014 Norms and Standards (i.e. GN 331) in order to determine if the soil is significantly contaminated or not. ▪ If the contaminated soil is considered to be significantly contaminated, then compliance with Part 8 of the NEMWA should be achieved by the Applicant.	▪ During spill events	▪ Project Developer (Scatec Solar)
		10.2.10. The Contractor must record and document all significant spill events.	▪ Monitor documentation and records of significant spill events via audits and record non-compliance and incidents.	▪ During spill events	▪ ECO
B. OPERATIONAL PHASE					
10.3. Contamination of soil and risk of damage to vegetation and/or fauna through spillage of fuels and oils	To control and eliminate fuel and oil spillages which may result in soil contamination and damage to vegetation and/or fauna.	10.3.1. Monitor and inspect maintenance equipment and vehicles to ensure that no fuel spillage takes place.	▪ Implement specifications for maintenance equipment use as specified by the maintenance Contractor.	▪ Monthly	▪ Project Developer (Scatec Solar)
		10.3.2. Spilled fuel, oil or grease is retrieved during operations where possible and contaminated soil removed, cleaned and replaced.	▪ Monitor the handling and storage of fuels and oils via site audits and monitor if spillages have taken place and if so, are removed correctly. Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ During spills	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		10.3.3. Contaminated soil to be collected by the Contractor and disposed of at a registered waste facility designated for this purpose. Proof of disposal (i.e. waste disposal slips or waybills) should be retained on file for auditing purposes.	▪ Monitor the correct removal of contaminated soil. Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ During spills	▪ Project Developer (Scatec Solar)
		10.3.4. A Spill Response Plan must be compiled for the operational phase in order to manage potential spill events.	▪ Compile a Spill Response Plan. ▪ Audit signed and approved Spill Response Method Statement.	▪ Once-off (and thereafter updated as required). ▪ Once-off (and thereafter as required).	▪ Project Developer (Scatec Solar) ▪ Facility Manager
		10.3.5. Ensure that adequate spill containment and clean-up equipment are provided on site for use during spill events. Portable bioremediation kit (to remedy chemical spills) is to be held on site and used as required.	▪ Ensure that a well-maintained portable bioremediation kit is available on site and that operational personnel are aware of its location and instructions.	▪ Weekly	▪ Facility Manager
		10.3.6. In case of a spillage of hazardous chemicals where contamination of soil occurs, depending on the degree and level of contamination, excavation and removal to a hazardous waste disposal facility could be necessary. If the spillage is widespread and the soil is considered to be significantly contaminated, a specialist will need to be immediately appointed to address the spillage. This will usually entail the collection of samples of the contaminated soil followed by analysis in terms of the 2014 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (i.e. GN 331). If the soil is determined to be significantly contaminated, then compliance with Part 8 of the NEMWA should be achieved by the Applicant, including notifying the Minister of Environmental Affairs of the significant contamination.	▪ Ensure that a suitably qualified specialist is appointed to collect and analyse the contaminated soil samples in terms of the 2014 Norms and Standards (i.e. GN 331) in order to determine if the soil is significantly contaminated or not. ▪ If the contaminated soil is considered to be significantly contaminated, then compliance with Part 8 of the NEMWA should be achieved by the Applicant.	▪ During spill events	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		10.3.7. Ensure that adequate containment structures are provided for the temporary storage of liquid dangerous goods and hazardous materials on site (such as chemicals, oil, fuel, hydraulic fluids, lubricating oils etc.). Appropriate bund areas must be provided for the storage of these materials at the PV facility. Bund areas should contain an impervious surface in order to prevent spillages from entering the ground. Bund areas should have a capacity of 110 % of the volume of the largest tank in the bund (tanks include storage of fuel/diesel).	▪ Monitor the storage and handling of dangerous goods and hazardous materials on site via site audits and record non-compliance and incidents.	▪ Weekly	▪ Facility Manager
10.4. Impacts due to management solid and liquid wastes disposed of on the site during operational phase.	Prevent environmental impacts as a result of the operational phase such as pollution.	10.4.1. All operation waste to be removed from the site by an appointed service provider.	▪ Waste removal and disposal to be monitored throughout operation.	▪ Monthly	▪ Facility Manager
		10.4.2. All liquid waste or spills (used oil, paints, lubricating compounds and grease from vehicles passing through the entrance facility) to be packaged and disposed appropriately at a registered landfill site.	▪ Monitor the correct removal of liquid waste or spills. Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ During spills	▪ Project Developer (Scatec Solar)
		10.4.3. Adequate containers for the cleaning of equipment and materials (paint, solvent) must be provided in order to avoid spillages.	▪ Monitor the storage and handling of dangerous goods and hazardous materials on site via site audits and record non-compliance and incidents.	▪ Weekly	▪ Facility Manager
C. DECOMMISSIONING PHASE					
10.5. No specific impacts are associated with the decommissioning phase other than those from the operational phase that will still be relevant for the duration of the decommissioning phase due to on-going occupation of the area.					

11 ENVIRONMENTAL AWARENESS AND FIRE MANAGEMENT PLAN

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
11.1. Potential impacts resulting from the lack of overall compliance with the conditions of the EA (issued by the DEA)	Ensure compliance with all environmental conditions of approval (issued by DEA as part of the EA).	11.1.1. Audit the implementation of the EMPr requirements.	▪ Audit report on compliance with actions and monitoring requirements.	▪ Weekly	▪ Project Developer (Scatec Solar)
		11.1.2. Establish clear and transparent reporting of the activities undertaken with regard to all recommendations included in the EMPr.	▪ Audit report on compliance with actions and monitoring requirements.	▪ Weekly	▪ Project Developer (Scatec Solar)
B. CONSTRUCTION PHASE					
11.2. Potential risk of fire due to construction activities or behaviour of staff on site during the construction phase	Prevent fire on site resulting of workers smoking or starting fires (i.e. cooking, heating purposes).	11.2.1. Designate smoking areas, as well as areas for cooking, where the fire hazard could be regarded as insignificant.	▪ Ad-hoc checks to ensure workers are smoking or cooking in designated areas only.	▪ Daily	▪ ECO and Contractor
		11.2.2. Educate workers on the dangers of open and/or unattended fires.	▪ Ensure fire safety requirements are well understood and respected by construction personnel. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Ongoing. ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ Contractor/ ECO ▪ ECO
		11.2.3. Open fires must be prohibited. Appropriate fire safety training should also be provided to staff that are to be on the site for the duration of the construction phase.	▪ Ensure fire safety requirements are well understood and respected by construction personnel. Provide basic fire safety training.	▪ On-going	▪ ECO and Contractor
		11.2.4. Ensure that cooking takes place in a designated area shown on the site map. Ensure that no firewood or kindling may be gathered from the site or surrounds.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		11.2.5. Fire-fighting equipment must be made available at various appropriate locations on the construction site.	▪ Ensure fire safety requirements are well understood and respected by workers. ▪ Assurance of functionality of fire extinguishers via inspections and certification by an accredited fire service company.	▪ On-going ▪ Bi-annually	▪ ECO and Contractor ▪ Contractor
11.3. Inappropriate behaviour of civil contractors and sub-contractors during the construction phase	Prevent unnecessary impacts on the surrounding environment by ensuring that contractors are aware of the requirements of the EMPr. Ensure that contractors and sub-contractors do not induce impacts on the surrounding environment as a result of unplanned pollution on site. Ensure that actions by on-site contractors and sub-contractors and workers are properly managed in order to minimise impacts to surrounding environment.	11.3.1. Ensure that the EMPr and the EA (should it be granted by the DEA), are included in all tender documentation and contractors and sub-contractors contracts.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors
		11.3.2. Contractors and sub-contractors must use the ablution facilities situated in a designated area within the site; and no bathing/washing should be permitted outside the designated area.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors
		11.3.3. All litter will be deposited in a clearly labelled, closed, animal-proof disposal bin in the construction area; particular attention needs to be paid to food waste.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors
		11.3.4. No person other than a qualified specialist or personnel authorised by the Project Developer, will disturb or remove plants outside the demarcated construction area.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors
		11.3.5. No person other than a qualified specialist or personnel authorised by the Project Developer, will disturb animals on the site.	▪ Check compliance with specified conditions using a report card, and allocate fines when necessary.	▪ On-going	▪ ECO and Contractors
		11.3.6. Educate workers on site about suitable behaviour on site and initiate environmental awareness. Staff must be informed that no trapping, snaring or feeding of any animal will be allowed.	▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Contractor/ ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
11.4. Inappropriate planning and of site camp establishment.	Ensure that environmental issues are taken into consideration in the planning for site establishment.	11.4.1. All construction activities, materials, equipment and personnel must be restricted to the actual construction area specified (as required to undertake the construction work). The construction area must be demarcated by the Contractor.	▪ Monitor compliance and record non-compliance and incidents.	▪ Before construction	▪ ECO
		11.4.2. The Contractor should install and maintain Construction Site Information Boards in the position, quantity, design and dimensions specified by the Project Developer.	▪ Monitor compliance and record non-compliance and incidents.	▪ Before construction	▪ ECO
		11.4.3. General building materials should be stored in appropriate designated areas on site such that there will be no runoff from these areas towards sensitive systems. The site camp must be removed after construction.	▪ Monitor compliance and record non-compliance and incidents.	▪ Before construction	▪ ECO
11.5. Increased animal road mortality	Reduction in animal mortality	11.5.1. The construction staff should be made aware of the presence of fauna and within the proposed project area. The construction personnel and staff must also be made aware of the general speed limits on site and must be alert at all times for potential crossings, and should be trained on how to react in these situations.	▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Contractor/ ECO ▪ ECO
		11.5.2. To ensure that animals are not attracted to the site (and potentially resulting in increased road mortality), the waste collection bins and skips should be covered with suitable material, where appropriate, and the site camp must be kept clean on a daily basis.	▪ Monitor the activities via visual inspections, and record and report any non-compliance.	▪ Daily	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		11.5.3. Establish a monitoring programme to record the number of faunal road mortalities and collisions. If it is established that the number of collisions and faunal fatalities increase within an area, particularly with regards to smaller species (reptiles), then measures such as exclusion fences within these areas only should be installed.	▪ Appropriate monitoring and recording should be undertaken. ▪ Exclusion fences should be installed, if needed to direct animals to safe road crossings.	▪ Weekly ▪ As required	▪ ECO ▪ ECO and Contractor
11.6. Increased energy consumption during the construction phase.	Reduce energy consumption where possible.	11.6.1. Encourage the use of energy saving equipment at the site camp site (such as low voltage lights and low pressure taps) and promote recycling. Construction personnel must be made aware of energy conservation practices as part of the Environmental Awareness Training programme.	▪ Contractor to monitor energy usage via audits. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Monthly ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Contractor ▪ Contractor/ ECO ▪ ECO
11.7. Impact on the regional water balance as a result of increased water usage.	Reduce water usage during the construction phase.	11.7.1. Water conservation should be practiced as follows: ▪ Cleaning methods utilised for cleaning vehicles, floors, etc. should aim to minimise water use (e.g. sweep before wash-down). ▪ Ensure that regular audits of water systems are conducted to identify possible water leakages. 11.7.2. Avoid the use of potable water for dust suppression during the construction phase and consider the use of alternative approved sources, where possible.	▪ Monitor via site audits and record non-compliance and incidents.	▪ Monthly	▪ ECO
		11.7.3. Make construction personnel aware of the importance of limiting water wastage, as well as reducing water use.	▪ Carry out Environmental Awareness Training with a discussion on water usage and conservation. ▪ Conduct audits of the signed attendance registers.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Contractor/ ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
C. OPERATIONAL PHASE					
11.8. Potential risk of fire due to behaviour of staff on site during the operational phase	Ensure appropriate and efficient fire prevention during the operational phase.	11.8.1. Designate smoking areas as well as areas for cooking, where the fire hazard could be regarded as insignificant.	▪ Random inspections during a month to ensure workers are smoking or starting fires in designated areas only.	▪ Monthly	▪ Facility Manager
		11.8.2. Educate workers on the dangers of open and/or unattended fires.	▪ Ensure fire safety requirements are well understood and respected by operational personnel. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Ongoing ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ Facility Manager ▪ Facility Manager ▪ Facility Manager
		11.8.3. Open fires must be prohibited. Appropriate fire safety training should also be provided to staff that are to be on the site for the duration of the operational phase.	▪ Ensure fire safety requirements are well understood and respected by operational personnel. Provide basic fire safety training.	▪ On-going	▪ Project Developer (Scatec Solar)
		11.8.4. Ensure that adequate fire-fighting equipment is available and easily accessible on site.	▪ Ensure fire safety requirements are well understood and respected by workers. ▪ Assurance of functionality of fire extinguishers via inspections and certification by an accredited fire service company.	▪ On-going ▪ Bi-annually	▪ Facility Manager ▪ Project Developer (Scatec Solar)
11.9. Increased energy consumption during the operational phase.	Reduce energy consumption where possible.	11.9.1. Encourage the use of energy saving equipment at the PV facility (such as low voltage lights and low pressure taps) and promote recycling. Operational personnel must be made aware of energy conservation practices as part of the environmental awareness training programme.	▪ Monitor energy usage via site investigations. ▪ Conduct training for all operational personnel.	▪ Monthly ▪ As and when required and ensure that all new staff are inducted.	▪ Facility Manager ▪ Project Developer (Scatec Solar)
11.10. Impact on the regional water balance as a result of increased water usage.	Reduce water usage during operations.	11.10.1. Water conservation to be practiced in line with Energy Saving Policies as follows: ▪ Cleaning methods utilised for cleaning vehicles, floors, the offices etc. should	▪ Record water usage during the operational phase, conduct audits and record non-compliance and incidents.	▪ Monthly	▪ Facility Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		aim to minimise water use (e.g. sweep before wash-down). ▪ Where possible, encourage the re-use of water. ▪ Ensure that regular audits of water systems are conducted to identify possible water leakages. 11.10.2. Consider installing water saving devices (e.g. dual flush toilets, automatic shut-off taps, etc.).			
		11.10.3. Carry out environmental awareness training with a discussion on water usage and conservation, and make operational personnel aware of the importance of limiting water wastage.	▪ Conduct training for all operational personnel.	▪ As and when required during operations and ensure that all new staff are inducted.	▪ Facility Manager
11.11. Non respect of waste management practices	Minimise the production of general waste. Ensure compliance with relevant waste management legislation. Minimise pollution of the environment.	11.11.1. Control and implement waste management plans. Ensure that relevant legislative requirements are respected. 11.11.2. Determine specific areas on site for temporary management of waste.	▪ Control of waste management practices throughout operation phase.	▪ Monthly	▪ Facility Manager
		11.11.3. Promote waste reduction, re-use, and recycling opportunities on site during the operation phase. 11.11.4. Ensure an adequate and sustainable use of resources.	▪ Monitor waste generation and collection throughout operation.	▪ Monthly	▪ Facility Manager
11.12. Excessive generation of waste water on site during the operation phase	Maintain reasonable levels of waste water generation	11.12.1. Waste water must be collected and disposed of at a suitable licenced disposal facility. Proof of disposal (i.e. waste disposal slips or waybills) should be retained on file for auditing purposes.	▪ Waste water generation to be monitored throughout the operational phase. ▪ Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ Quarterly	▪ Facility Manager
D. DECOMMISSIONING PHASE					
11.13. Ensure that the construction mitigation and management measures are adhered to during the decommissioning phase.					

12 SPECIFIC PROJECT RELATED ENVIRONMENTAL IMPACTS

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. DESIGN PHASE					
A.1. VISUAL IMPACTS					
12.1. Potential visual intrusion of construction activities on existing views of sensitive visual receptors	Reduce visual intrusion of construction activities project wide.	12.1.1. Ensure plans are in place to minimise fire hazards and dust generation. 12.1.2. Ensure plans are in place to rehabilitate temporary cleared areas as soon as possible.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ During design cycle and before construction commences.	▪ Project Developer (Scatec Solar) ▪ ECO
		12.1.3. Clearance of the area for the solar field should be phased in such a way that the exposed area is always at a minimum.	▪ Ensure that this is taken into consideration prior to the commencement of construction by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar)
	Reduce visual intrusion of the solar energy facility	12.1.4. A maintenance plan for buildings and structures should be in place. 12.1.5. Colours of buildings and structures should blend in with the landscape background where this is technically feasible and where it will not affect the functionality of the structures. 12.1.6. Materials, coatings and paints should be chosen based on minimal reflectivity. 12.1.7. Grouped structures should be painted in the same colour where this will not affect the functionality of the structures, to reduce visual complexity and contrast. 12.1.8. Appropriate coloured materials should be used for structures to blend in with the backdrop of the project. 12.1.9. Appropriate colours for smooth surfaces often need to be two to three shades darker than the background colour to compensate for shadows that darken most textured natural surfaces.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ During design cycle and before construction commences.	▪ Project Developer (Scatec Solar) and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
12.2. Potential impact of night lighting of the Solar PV Facility on the nightscape of the region.	Reduce the impact of night lighting of structures and buildings associated with the solar energy facility on the surrounding nightscape and visual receptors.	12.2.1. A lighting plan for the proposed Solar PV plant that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised and that also demonstrates that project lighting is effectively shielded from surrounding and adjacent properties must be prepared with the design plans of the plant. The plan should minimize light spill onto neighbouring properties and glare which can affect visual receptors in the surrounding landscape. 12.2.2. The lighting plan should also minimize contribution to light pollution (night glow) of the regional nightscape. 12.2.3. The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts. 12.2.4. Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security. 12.2.5. Uplighting and glare (bright light) should be minimised using appropriate screening. 12.2.6. Low-pressure sodium light sources should be used to reduce light pollution. 12.2.7. Light fixtures should not spill light beyond the project boundary. 12.2.8. Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously.	▪ A lighting specialist should be contracted to design the lighting plan for the project. The plan should provide for temporary lighting during the construction and decommissioning phases of all components of the project. ▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ During design cycle and before construction commences. ▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar) ▪ ECO
A.2. HERITAGE IMPACTS (ARCHAEOLOGY AND CULTURAL LANDSCAPE)					
12.3. Impacts to archaeology and graves (note that none are expected).	Achieve a layout that minimizes the potential later impacts to archaeological resources and/or graves.	12.3.1. Ensure that project layout avoids as many known archaeological resources and/or graves as possible.	▪ Take cognizance of the archaeological sites and graves reported in the HIA when designing facility layout.	▪ Once-off	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
12.4. Impacts to the natural and cultural landscape (note that none are expected).	Reduce the degree of visual contrast in the landscape.	12.4.1. Plan to use an earth-coloured paint on the built elements of the facility.	▪ Include earth-coloured paint in the design specifications for the facility.	▪ Once-off	▪ Project Developer (Scatec Solar)
A.3. SOCIAL IMPACTS					
12.5. In-migration of potential job seekers into the Kenhardt area	Proactively manage the in-migration of potential employment seekers and in so doing mitigate impacts on existing social structures.	12.5.1. Develop and implement a Workforce Recruitment Plan 12.5.2. Reserve employment, where practical, for local residents 12.5.3. Clearly define and agree upon the Project Affected People (PAP) 12.5.4. Develop a database of PAP and their relevant skills and experience 12.5.5. Develop and implement a Stakeholder Engagement Plan	▪ Mitigation measures (12.5.1); (12.5.4) and (12.5.5) requires the drafting of a document which would in each instance serve as the method through which the mitigation actions are monitored. ▪ Mitigation measures (12.5.2) and (12.5.3) requires clear statements regarding for whom work would be reserved (i.e. mitigation measure (12.5.2)) and who the PAP is (i.e. mitigation measure (12.5.3)).	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar)
12.6. Economic Development Plan	Draft an Economic Development Plan to align local investment with bona fide local needs.	12.6.1. The proponent should engage with local NGOs, CBOs and local government structures to identify and agree upon relevant skills and competencies required in the Kenhardt community. 12.6.2. Such skills and competencies should then be included in the Economic Development Plan. 12.6.3. Where possible, align Economic development Plan with Local Municipality's IDP. 12.6.4. Delivery on the Economic development Plan must be contractually binding on the proponent.	▪ Mitigation measures 12.6.1; 12.6.4; 12.6.3 and 12.6.5 require the drafting of a document (i.e. the Economic development Plan) which would in each instance serve as the method through which the mitigation actions are monitored.	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar)
A.4. ELECTROMAGNETIC AND RADIO FREQUENCY INTERFERENCE					
12.7. Impact on the nearest and surrounding Square Kilometer Array (SKA) telescopes and the overall SKA	To reduce the impact of the proposed PV project on the SKA. To implement the mitigation	12.7.1. The inverter units, transformers, communication and control units for an array of panels should all be housed in a single shielded environment. For shielding of such an environment it must be ensured that: ▪ Radio Frequency Interference (RFI)	▪ Ensure that the requirements and mitigation practices are incorporated into the design of the proposed PV plant during the planning and design phase by reviewing signed minutes of	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
project	measures correctly and achieve an improvement of between 20 and 40 dB in emissions levels.	gasketting is placed on all the seams and doors. ▪ RFI Honeycomb filtering should be placed on all ventilation openings. 12.7.2. It is important to ensure that the cables are laid directly in the soil or properly grounded cable trays (not plastic sleeves). 12.7.3. The use of bare copper directly in the soil for earthing is recommended to shunt Common Mode (CM) interference currents to ground. 12.7.4. In the case of a tracking PV plant design, care will need to be taken to shield the noise associated with the relays, contactors and hydraulic pumps/motors of the tracking units. 12.7.5. Data communications to and from the plants should be via fibre optic.	meetings or signed reports.		
		12.7.6. An appropriate Electromagnetic Control (EMC) Plan should be developed to identify specific mitigation measures that will be implemented for Kenhardt PV 3. 12.7.7. Ensure that the EMC Plan will be provided to the SKA for comment and approval during the design phase (i.e. approval from the SKA prior to the commencement of construction).	▪ Ensure that this is taken into consideration and a suitable specialist is appointed to compile the EMC Plan during the planning and design phase. Review signed minutes of meetings or signed reports to ensure compliance. ▪ Ensure that the EMC Plan is submitted to the SKA for review and approval prior to construction. Review the comments and approval correspondence from the SKA and report any non-compliance.	▪ During design cycle and before construction commences. ▪ During design cycle and before construction commences.	▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar) and ECO
A.5. IMPACT ON SURFACE WATER RESOURCES					
12.8. Impact on surface water resources.	To reduce the impact of the proposed PV project on the surrounding drainage lines	12.8.1. Ensure that the Department of Water and Sanitation are consulted with to confirm the need and requirements of a Water Use Licence, as noted in the Ecological Impact Assessment.	▪ Ensure that the requirements of the Department of Water and Sanitation are considered during the planning and design phase. ▪ Ensure that the Water Use Licence submitted and approved prior to the commencement of construction,	▪ Once-off during the design phase.	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			based on the requirements of the Department of Water and Sanitation.		
B. CONSTRUCTION PHASE					
B.1. ECOLOGICAL IMPACTS (TERRESTRIAL, AQUATIC AND AVIFAUNA)					
12.9. Changes in edaphics (soils) on account of excavation and import of soils, resulting in changes in soil state, compaction, and alteration of plant communities and fossorial species in and around these points etc.	Avoidance of undue disturbance to soils	12.9.1. Ripping of compact soils to be considered according to site specifics and impact.	▪ If deemed applicable, monitor the manual or machine driven ripping of compact soils.	▪ Intermittent and upon identification of excess compaction or option of ripping is considered necessary (i.e. when and where extensive compaction arises)	▪ Contractor and Project Developer (Scatec Solar) ▪
12.10. Abstraction from sub surface aquifers may have a significant impact on plant water relations.	To reduce excessive abstraction of sub surface waters and impacts on groundwater.	12.10.1. Identify yield and water quality levels in borehole prior to establishment (if borehole water will be used, which is unlikely based on the findings of the Geohydrology Assessment). 12.10.2. Identify limitations on rate and level of abstraction (if required and if (in the unlikely event that) borehole water will be used). 12.10.3. Identify alternative water sources (such as municipal supply) based on the recommendations made in the Geohydrology Assessment).	▪ Ensure borehole is registered with imposed limits on abstraction ▪ Undertake blow test on boreholes (if required) ▪ Undertake water quality analysis. ▪ Install flow meter during construction period and beyond (if borehole water will be used, which is unlikely based on the findings of the Geohydrology Assessment). ▪ Ensure that Municipal or alternate Supply is arranged prior to the commencement of the construction phase	▪ Prior to construction	▪ Project Developer (Scatec Solar) and ECO
12.11. Alteration of surface water quality leading to changes in water chemistry.	To manage construction activities that may impact on surface and subsurface water quality	12.11.1. Avoidance of significant earthworks with concomitant risk of increasing silt mobility. 12.11.2. Conduct judicious excavation and clearance.	▪ Undertake site and visual inspections and reporting any non-compliance. ▪ Containment of hazardous waste	▪ Ongoing	▪ Contractors, Project Developer (Scatec Solar) and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.11.3. Undertake stabilisation of disturbed soils. 12.11.4. Implement the use of surface flow attenuators or energy dissipaters (if required). 12.11.5. Management of potential liquid material that may be classified as hazardous. 12.11.6. Management of hazardous waste. 12.11.7. Avoid significant sculpting of land and maintenance of the general topography of site.	and hazardous materials.		
12.12. Alteration of surface drainage patterns on account of construction activities leading to change in plant communities and general habitat structure	Limit alteration of surface drainage, leading to changes in plant communities and general habitat structure, patters due to construction activities.	12.12.1. Avoidance of major drainage features during construction. The proposed project footprint must be demarcated to reduce unnecessary disturbance beyond the proposed project area. Demarcate as no-go areas. 12.12.2. Undertaking and completion of earthworks and road construction outside of the high rainfall period (if possible). 12.12.3. Avoidance of significant sculpting of land and maintenance of the general topography of the site. 12.12.4. Maintenance of a high level of housekeeping on site during the construction phase. 12.12.5. Inspection of drainage features immediately outside of the footprint of the proposed PV facility and undertake removal of solid waste and litter on a regular basis.	▪ Carry out visual inspections to ensure strict control over the behaviour of staff in order to restrict activities to within demarcated areas. ▪ Monitor the construction period to verify if this is being undertaken (where possible). ▪ Carry out visual inspections to ensure minimal impact on soils and erosion. ▪ Monitor the condition of the site camp throughout the construction phase via visual site inspections. Record non-compliance and incidents. ▪ Monitor the condition of drainage features immediately outside of the footprint of the PV plant and the condition of the construction area throughout the construction phase via visual site inspections. Record non-compliance and incidents.	▪ Ongoing ▪ Ongoing ▪ Ongoing ▪ Ongoing ▪ Ongoing	▪ ECO ▪ Contractor, Project Developer (Scatec Solar) and ECO ▪ Contractor, Project Developer (Scatec Solar) and ECO ▪ ECO ▪ Contractor, Project Developer (Scatec Solar) and ECO
B.2. VISUAL IMPACTS					
12.13. Potential visual intrusion of construction activities on	Prevent unnecessary visual clutter and focusing attention of surrounding visual receptors on the proposed	12.13.1. Preparation of the solar field area (i.e. clearance of vegetation, grading, contouring and compacting) and solar field construction should be phased in a way that makes practical sense in	▪ Ensure that this is taken into consideration prior to the commencement of construction. ▪ Conduct site inspections to monitor	▪ Once-off during the construction phase. ▪ Weekly	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
existing views of sensitive visual receptors	development.	order to minimise the area of soil exposed and the shortest duration of exposure.	the phasing of construction to verify unnecessary soil disturbance and clearing and report any non-compliance.		▪ ECO
		12.13.2. Parking areas should be demarcated and strictly controlled so that vehicles are limited to specific areas only.	▪ Carry out visual inspections to ensure the construction area and parking area is demarcated clearly, and record and report any non-compliance. ▪ Carry out visual inspections to ensure strict control over the parking of construction vehicles and access routes in order to restrict activities to within demarcated areas.	▪ Weekly ▪ Weekly	▪ ECO ▪ ECO
		12.13.3. Night time construction should be avoided where possible.	▪ Construction operation times to be monitored and managed (as well as included in the tender contract).	▪ Weekly	▪ ECO
		12.13.4. Night lighting of the construction sites should be minimised within requirements of safety and efficiency.	▪ Complaints about night lights should be investigated and documented in a register.	▪ Weekly or bi-weekly	▪ Contractor and ECO
	Reduce the visual impact of construction activities project wide	12.13.5. Maintain good housekeeping on site to avoid litter and minimize waste. 12.13.6. Monitor construction sites for strict adherence to demarcated boundaries. 12.13.7. Monitor adherence to lighting plan. 12.13.8. Monitor adherence to rehabilitation plan. 12.13.9. Monitor adherence to erosion control plan. 12.13.10. Monitor adherence to dust and fire control plans.	▪ Carry out site visits and inspections of the construction sites and ensure good housekeeping is maintained. Record and report any non-compliance. ▪ Carry out site visits and record and report any non-compliance. ▪ Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register. ▪ Visit sites requiring rehabilitation. ▪ Carry out site visits and record and report any non-compliance.	▪ Daily ▪ Daily ▪ Daily and as complaints arise. ▪ Daily ▪ Daily ▪ Daily	▪ Construction Manager and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			▪ Carry out site visits and record and report any non-compliance.		
B.3. HERITAGE IMPACTS (ARCHAEOLOGY AND CULTURAL LANDSCAPE)					
12.14. Construction vehicles and activities could result in damage to or destruction of archaeological sites and/or graves.	Minimise the chances of significant archaeological sites and/or graves being disturbed.	12.14.1. Ensure that all heritage resources requiring mitigation are mitigated prior to the start of construction. 12.14.2. Ensure that no activity takes place outside of the authorized construction footprint.	▪ Carry out visual inspections to ensure strict control over the behaviour of construction staff in order to restrict activities to within demarcated areas.	▪ Weekly	▪ ECO
		12.14.3. The Contractor and ECO must be informed of the possibility of archaeological resources and graves (i.e. ensure that all personnel are aware of the potential of encountering graves and what to do if this occurs (i.e. to report any suspicious stone features prior to disturbance)). 12.14.4. Alternatively commission an archaeologist to examine the final development footprint at least six months prior to the commencement of construction.	▪ Carry out Environmental Awareness Training to ensure that the Contractors are informed of the possible type of heritage features that may be encountered during the construction phase. ▪ Conduct audits of the signed attendance registers. ▪ Appoint a professional archaeologist to examine the construction footprint. ▪ Conduct an audit to verify that the necessary permits are obtained by the archaeologist, if required.	▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly ▪ Once-off six months prior to construction. ▪ As required/ necessary during the construction phase.	▪ Contractor/ ECO ▪ ECO
		12.14.5. If archaeological sites and potential graves cannot be avoided, the buffers as stipulated in the HIA should be implemented during the construction phase.	▪ Carry out visual inspections to ensure strict control over the behaviour of construction staff in order to restrict activities to within demarcated areas and outside of the buffer area.	▪ Weekly	▪ ECO
		12.14.6. If any of the graves or potential graves found on site cannot be avoided then an archaeologist should be contracted to conduct a test excavation to determine the status of the feature. A Ground Penetrating Radar (GPR) investigation and, if necessary, test excavations will need to be conducted to verify the presence of human remains for any potential graves found	▪ Appoint a professional archaeologist to conduct a test excavation to determine if the sites are graves. ▪ Conduct an audit to verify that the necessary permits are obtained by the archaeologist for the test excavation, if required.	▪ As potential graves are encountered	▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		during construction. Apply a 30 m buffer around the potential grave until the testing is conducted (i.e. prior to construction). If it is determined to be a grave, then exhumation would need to occur (if necessary) with the permission of SAHRA (and in accordance with any requirements that SAHRA might impose at the time). A report detailing the testing must be submitted to SAHRA, following which the appropriate permits should be applied for if necessary.	▪ Submit a report to SAHRA detailing the testing and GPR if required.		
		12.14.7. If any concentrations of archaeological material, graves or stone features are uncovered during the proposed construction, work in the immediate area should be halted. The find would need to be reported to the heritage authorities (i.e. the SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402 must be altered)) and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution. Sufficient time should be allowed to remove/collect such material. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Itumeleng Masiteng/Mimi Seetelo 012 320 8490), must be alerted immediately. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contracted as soon as possible to inspect the findings.	▪ Monitor excavations and construction activities for archaeological materials via visual inspections and report the finds accordingly. ▪ Contact the heritage authorities and the identified archaeologist if any heritage features are uncovered.	▪ Daily or during excavations. ▪ As required/ necessary during the construction phase.	▪ Contractor and ECO ▪ Project Developer (Scatec Solar)
12.15. Alteration of the landscape from rural to industrial in nature.	Reduce visual contrast of the development in the landscape.	12.15.1. Use earthy-coloured paint on built elements	▪ Monitor the paint colour via visual inspections and report non-compliance	▪ Once-off, at an appropriate time during construction period.	▪ ECO
B.4. PALAEONTOLOGICAL HERITAGE IMPACTS					
12.16. Loss of legally-protected palaeontological heritage resources at or beneath	Reporting, conservation, recording and judicious sampling of scientifically important fossil material exposed during the	12.16.1. Reporting chance fossil finds to SAHRA for possible professional mitigation.	▪ Monitoring of all substantial excavations into sedimentary bedrocks for fossil material (e.g. vertebrate bones & teeth, fossilized wood, shells)	▪ Throughout the construction phase ▪ Throughout the construction phase	▪ ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
ground surface within development footprint (fossils, fossil sites and contextual geological data).	construction phase of development.		▪ Safeguarding of chance fossil finds, preferably *in situ*.		
		12.16.2. Recording and sampling of fossil material and associated geological data (only necessary for chance fossil finds made during the proposed development).	▪ Application by a qualified palaeontologist for fossil collection permit from SAHRA. ▪ Palaeontologist to undertake field study of fossil finds in situ on site. Photography and sampling of important finds. ▪ Curation of fossils collected in an approved repository (museum/ university collection).	▪ Following alert of chance fossil finds on site (It is important to note that there is no need for on-site palaeontological monitoring unless new fossil finds are made during development).	▪ Qualified palaeontologist appointed and commissioned by the Project Developer. ▪ Qualified palaeontologist appointed and commissioned by the Project Developer ▪ Qualified palaeontologist appointed and commissioned by the Project Developer
B.5. SOILS AND AGRICULTURAL POTENTIAL IMPACTS					
12.17. Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to constructional disturbance and potential trampling by vehicles	To conserve the surrounding natural veld vegetation.	12.17.1. Minimize footprint of disturbance during the construction phase and ensure that construction work is undertaken within the demarcated area only. 12.17.2. Confine vehicle access on roads only. 12.17.3. Control dust generation during construction activities by implementing standard construction site dust control measures (dampening with water) where required. Because of water scarcity, this should only be done where and when dust generation is a significant problem.	▪ Monitor the construction activities via site audits to ensure that they are undertaken within the demarcated construction area, and record non-compliance and incidents. ▪ Include periodic site inspection in environmental performance reporting that specifically records occurrence or not of off-road vehicle tracks surrounding the site. Monitor via site audits and record non-compliance and incidents. ▪ Monitor dust suppression mechanisms via visual inspections and record non-compliances. Maintain an incidents/ complaints	▪ Daily ▪ Monthly during the construction phase ▪ Monthly and during complaints/incidents	▪ Contractor and ECO ▪ ECO ▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			register. The date, time, nature of complaint, name of complainant and corrective actions must be logged for all complaints. Complaints must be investigated and, if appropriate, acted upon.		
12.18. Loss of topsoil due to poor topsoil management	Ensure effective topsoil covering to conserve soil fertility on all disturbed areas, after they have been rehabilitated.	12.18.1. Strip and stockpile topsoil from all areas where soil (below surface) will be disturbed. 12.18.2. After cessation of disturbance, re-spread topsoil over the surface. 12.18.3. Dispose of any sub-surface spoils from excavations where they will not impact on land that supports vegetation, or where they can be effectively covered with topsoil.	▪ Establish an effective record keeping system for each area where soil is disturbed for construction purposes. These records should be included in environmental performance reports, and should include all the records below: ○ Record the GPS coordinates of each area. ○ Record the date of topsoil stripping. ○ Record the GPS coordinates of where the topsoil is stockpiled. ○ Record the date of cessation of construction activities at the particular site. ○ Photograph the area on cessation of construction activities. ○ Record date and depth of re-spreading of topsoil. ○ Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.	▪ As needed, dependent on the specifics of construction activities.	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
12.19. Soil erosion due to alteration of the land surface characteristics	To reduce erosion on site and downstream of the site as a result of run-off from the site, or due to wind erosion.	12.19.1. Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.	▪ Include periodic site inspection in environmental performance reporting that inspects the effectiveness and integrity of the run-off control system and specifically records the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	▪ Monthly during the construction phase.	▪ ECO
B.6. SOCIAL IMPACTS					
12.20. Influx of job seekers into the Kenhardt area.	Control influx of job seekers into the Kenhardt area with the aim of protecting local social structures.	12.20.1. Implement the Workforce Recruitment Plan. 12.20.2. Ensure employment is reserved, where practical, for local residents. 12.20.3. Actively use the database of PAP and their relevant skills and experience to guide local employment. 12.20.4. Implement the Stakeholder Engagement Plan.	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current recruitment practices, as well as cross-referencing employed personnel with PAP database; ▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO
12.21. Outsiders moves into the Kenhardt area	Limit incidences of in social deviance in the Kenhardt area.	12.21.1. Implement the Workforce Recruitment Plan 12.21.2. Ensure employment is reserved, where practical, for local residents 12.21.3. Actively use the database of PAP and their relevant skills and experience to guide local employment 12.21.4. Implement the Stakeholder Engagement Plan	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current recruitment practices, as well as cross-referencing employed personnel with PAP database; ▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
12.22. Expectations created regarding possible employment	Prevent frustration resulting from miscommunication of employment opportunities and project-related benefits in the local community.	12.22.1. Implement the Stakeholder Engagement Plan	▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO
12.23. Local spending	Ensure the generation of socio-economic benefits as a result of the multiplier effect.	12.23.1. Procure goods and services, where practical, within the study area 12.23.2. Obtain regularly required goods and services from as large a selection of local service providers as possible	▪ Verify purchase of local goods and services through proof of purchase.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO
12.24. Local employment	Ensure optimum employment creation while taking cognizance of the local levels of experience and education.	12.24.1. Implement the Workforce Recruitment Plan	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current recruitment practices, as well as cross-referencing employed personnel with PAP database.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO
12.25. Economic Development Plan	Ensure contribution to local employment, local spending and human capacity development is being made.	12.25.1. Implement the Economic Development Plan	▪ Verify that the Economic development Plan is being implemented.	▪ Three times during the estimated 14 month construction period (i.e. at 3 months, 6 months, and 9 months).	▪ Construction Manager and ECO
B.7. GEOHYDROLOGY IMPACTS					
12.26. Potential impact on groundwater as a result of the construction of storage yards and temporary labour accommodation camps (i.e. wastewater from construction activities disposed	To prevent unnecessary infiltration of polluted surface water	12.26.1. Waste water from labour accommodation site camps or yards must be collected in a designated container and disposed of at a suitable disposal point off site (i.e. a licenced waste disposal facility). A suitable waste contractor must be appointed to collect waste from site on a regular basis for correct disposal. Proof of disposal (waybills or waste disposal slips) must be retained and kept on file for auditing purposes. 12.26.2. Other non-hazardous solid waste (e.g. refuse) to be disposed of at a licensed landfill. A suitable	▪ Monitor the placement of structures, storage yards, accommodation camps and infrastructure during the construction phase to ensure existing wind pumps / boreholes are not damaged. ▪ Waste removal and disposal to be monitored. Monitor via site audits and record non-compliance and incidents. Monitor waste disposal	▪ Once off prior to the commencement of construction. ▪ Weekly ▪ Four times per annum for the construction period, i.e. at 3 months, 6 months, 9 months and 12 months.	▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
of on the site leading to environmental impacts (e.g. groundwater pollution))		waste contractor must be appointed to collect waste from site on a regular basis for correct disposal. Proof of disposal (waybills or waste disposal slips) must be retained and kept on file for auditing purposes. 12.26.3. Avoid using old or damaged construction equipment and vehicles and ensure that they are well maintained and regularly serviced in order to ensure no leakages. 12.26.4. Any engines that stand in one place must have drip trays, fuel storage tanks should be above ground on an impermeable surface (within a bunded area) and construction vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for refuelling activities and drip trays or similar impervious materials must be used during these procedures. Vehicle and washing areas must also be on paved surfaces and the by-products correctly managed.	slips and waybills via site audits and record non-compliance and incidents. ▪ Construction vehicles need to be monitored throughout the construction phase. Monitor via site audits and record non-compliance and incidents. ▪ Monitor the placement and designation of the area for refuelling at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance.	▪ Weekly	and ECO ▪ Project Developer (Scatec Solar) and ECO
12.27. Potential impact on groundwater as a result of stormwater outflows	To prevent unnecessary infiltration of polluted storm water	12.27.1. Ensure the storm water runoff is not contaminated. All reasonable measures must be taken to prevent the contamination of storm water outflows.	▪ Monitor the quality of the storm water ▪ ECO to verify that measures are in place to reduce the contamination of storm water and to monitor the quality of storm water by undertaking site visits and visual inspections.	▪ If possible do this during or shortly after a storm event, at the start of the rain season. ▪ Weekly	▪ Project Developer (Scatec Solar) and ECO. ▪ ECO
12.28. Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.	To reduce the potential of groundwater pollution.	12.28.1. Avoid using old or damaged construction equipment and vehicles and ensure that they are well maintained and regularly serviced in order to ensure no leakages. 12.28.2. Any engines that stand in one place for an excessive length of time, must have drip trays, fuel storage tanks should be above ground on an impermeable surface (within a bunded area) and construction vehicles and equipment should also be refuelled on an impermeable surface. A	▪ Construction vehicles need to be monitored throughout the construction phase. Monitor via site audits and record non-compliance and incidents. ▪ Monitor the placement and designation of the area for refuelling at the site camp via visual inspections. Monitor the usage of spill containment measures and	▪ Four times per annum for the construction period, i.e. at 3 months, 6 months, 9 months and 12 months. ▪ Weekly ▪ Weekly	▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		designated area should be established at the construction site camp for refuelling activities and drip trays or similar impervious materials must be used during these procedures. If liquid product is being transported it must be ensured this does not spill during transit. 12.28.3. If spillages occur during refuelling, they should be contained and removed as rapidly as possible, with correct disposal of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes. During the operational phase, the same principles should be adhered to. Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.	record and report non-compliance. ▪ Monitor the refuelling/ servicing process and record the occurrence of any spillages.		(Scatec Solar) and ECO
B.8. WASTE MANAGEMENT					
12.29. Pollution of the surrounding environment (including drainage lines) as a result of the handling, temporary stockpiling and disposal of general waste.	Reduce environmental impacts such as soil, surface water and groundwater contamination as a result of incorrect storage, handling and disposal of general waste. Minimise the production of waste. Prevent environmental problems (e.g. pollution / change in soil pH) due to solid and liquid wastes disposed of on the site. Ensure compliance with waste management legislation.	12.29.1. General waste (i.e. construction waste, building rubble, discarded concrete, bricks, tiles, wood, glass, window panes, air conditioners, plastic, metal, excavated material, packaging material, paper and domestic waste etc.) generated during the construction phase should be stockpiled temporarily (i.e. once-off) on site in a designated area within suitable waste collection bins and skips (or similar). Waste collection bins and skips should be covered with suitable material, where appropriate.	▪ Monitor the strategic placement of the temporary, designated waste stockpiling area at the site camp via visual inspections, and record and report any non-compliance. ▪ Monitor the temporary storage and handling of general waste on site via site audits and record non-compliance and incidents (i.e. conduct visual inspections of the temporary waste storage area).	▪ Once-off prior to the commencement of the construction phase and as required as the construction phase process evolves. ▪ Daily	▪ ECO and Contractor ▪ ECO
		12.29.2. Should the on-site stockpiling of general waste exceed 100 m^3 and a period of 90 days, then the National Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) must be adhered to.	▪ Record the amount of general waste that is temporarily stockpiled at the designated area on site, as well as the duration and record non-compliance and incidents. ▪ Monitor the duration and amounts of general waste that is temporarily stockpiled at the designated area on site via site audits and record non-compliance and incidents (i.e. conduct visual inspections of the	▪ Daily ▪ Weekly ▪ Monthly	▪ Contractor ▪ ECO ▪ Project Developer (Scatec Solar).

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			temporary waste storage area). ▪ Audit compliance with the Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) if the storage amounts are exceeded (i.e. only if required).		
		12.29.3. Ensure that the designated stockpiling area for general waste (i.e. skips and waste collection bins) is inspected on a daily basis to verify its condition and integrity, particularly after rainfall events.	▪ Monitor the temporary, designated waste stockpiling area at the site camp, as well as the handling of general waste on site via site audits and record non-compliance and incidents.	▪ Daily	▪ ECO
		12.29.4. Ensure that general waste generated during the construction phase is removed from the site on a regular basis, and safely disposed of at an appropriate, licenced waste disposal facility by an approved waste management Contractor. Waste disposal slips or waybills should be kept on file as proof of disposal. As a general principle, waste manifests must be obtained to prove legal disposal of waste.	▪ Ensure that a suitable Waste Management Contractor is appointed to remove and dispose the general waste at an appropriate, licenced waste disposal facility. ▪ Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ Once-off prior to the construction phase. ▪ Weekly	▪ Project Developer (Scatec Solar)/ Contractor ▪ ECO
		12.29.5. Ensure that the construction site is kept clean at all times and that construction personnel are made aware of correct waste disposal methods. Littering must be prevented through effective site camp management.	▪ Monitor the condition of the site camp throughout the construction phase via visual site inspections. Record non-compliance and incidents. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Daily ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ ECO and Contractor ▪ ECO
		12.29.6. Sufficient general waste disposal bins must also be provided for use by construction personnel throughout the site. These bins must be emptied on a regular basis.	▪ Monitor general waste generation by construction staff and collection via audits throughout the construction phase.	▪ Daily or Weekly	▪ ECO and Contractor.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.29.7. Ensure that all general waste emanating from the construction phase is removed from site prior to the commencement of the rehabilitation and operational phases.	▪ Undertake a final inspection at the end of the construction phase in order to verify and ensure that all general waste is removed from site and correctly disposed, prior to the commencement of the rehabilitation and operational phases.	▪ At the end of the construction phase.	▪ ECO and Contractor.
		12.29.8. Promote waste reduction, re-use, and recycling opportunities on site during the construction phase.	▪ Monitor waste generation and collection throughout construction. ▪ Investigate if any complaints have been expressed by the surrounding community regarding waste handling.	▪ Weekly or bi-weekly	▪ ECO and Contractor
		12.29.9. Ensure an adequate and sustainable use of resources.	▪ Monitor waste generation and collection throughout construction.	▪ Weekly or bi-weekly	▪ ECO and Contractor
		12.29.10. Control and implement waste management plans provided by contractors. Ensure that relevant legislative requirements are respected.	▪ Control of waste management practices throughout construction phase	▪ Weekly or bi-weekly	▪ ECO and Contractor
12.30. Pollution of the surrounding environment as a result of the handling, temporary stockpiling and disposal of hazardous waste.	Reduce environmental impacts such as soil, surface water and groundwater contamination as a result of incorrect storage, handling and disposal of hazardous waste.	12.30.1. Hazardous waste (i.e. empty tins, oils, fuel spillages, spilled materials and chemicals etc.) generated during the construction phase should be stockpiled temporarily (i.e. once-off) on site in a designated area in suitable waste collection bins and leak-proof storage skips (or similar). Waste collection bins and skips should be covered with suitable material, where appropriate. Hazardous waste must be stored separately from all other general waste. The designated stockpiling area must be labelled correctly.	▪ Monitor the strategic placement of the temporary, designated waste stockpiling area at the site camp via visual inspections, and record and report any non-compliance. ▪ Monitor the temporary storage and handling of hazardous waste on site via site audits and record non-compliance and incidents (i.e. conduct visual inspections of the temporary waste storage area).	▪ Once-off prior to the commencement of the construction phase and as required as the construction process evolves. ▪ Daily	▪ ECO and Contractor ▪ ECO
		12.30.2. Should the on-site stockpiling of hazardous waste exceed 80 m^3, then the National Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) must be adhered to.	▪ Record the amount of hazardous waste that is temporarily stockpiled at the designated area on site, as well as the duration and record non-compliance and incidents.	▪ Daily ▪ Weekly ▪ Monthly	▪ Contractor ▪ ECO ▪ Project Developer (Scatec Solar).

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			▪ Monitor the duration and amounts of hazardous waste that is temporarily stockpiled at the designated area on site via site audits and record non-compliance and incidents (i.e. conduct visual inspections of the temporary waste storage area). ▪ Audit compliance with the Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) if the storage amounts are exceeded (i.e. only if required).		
		12.30.3. Ensure that the designated stockpiling area for hazardous waste (i.e. leak proof skips and waste collection bins) is inspected on a daily basis to verify its condition and integrity, particularly after rainfall events.	▪ Monitor the temporary, designated waste stockpiling area at the site camp, as well as the handling of hazardous waste on site via site audits and record non-compliance and incidents.	▪ Daily	▪ ECO
		12.30.4. Ensure that all hazardous waste is removed from the site on a regular basis, and safely disposed at an appropriate, licenced hazardous waste disposal facility by an approved waste management Contractor.	▪ Ensure that a suitable Waste Management Contractor is appointed to remove and dispose the hazardous waste at an appropriate, licenced hazardous waste disposal facility. ▪ Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	▪ Once-off prior to the construction phase. ▪ Weekly	▪ Project Developer (Scatec Solar)/ Contractor ▪ ECO
		12.30.5. Ensure that the construction site is kept clean at all times and that construction personnel are made aware of correct waste disposal methods. Littering must be prevented through effective site camp management.	▪ Monitor the condition of the site camp throughout the construction phase via visual site inspections. Record non-compliance and incidents. ▪ Carry out Environmental Awareness Training. ▪ Conduct audits of the signed attendance registers.	▪ Daily ▪ Once-off training and ensure that all new staff are inducted. ▪ Monthly	▪ ECO and Contractor ▪ ECO and Contractor ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.30.6. Ensure that all hazardous waste emanating from the construction phase is removed from site prior to the commencement of the rehabilitation and operational phases.	▪ Undertake a final inspection at the end of the construction phase in order to verify and ensure that all general waste is removed from site and correctly disposed, prior to the commencement of the rehabilitation and operational phases.	▪ At the end of the construction phase.	▪ ECO and Contractor.
		12.30.7. All liquid waste (used oil, paints, lubricating compounds and grease) to be packaged and disposed of by appropriate means.	▪ Waste removal and disposal to be monitored throughout construction	▪ Weekly or bi-weekly	▪ ECO and Contractor
		12.30.8. Adequate containers for the cleaning of equipment and materials (paint, solvent) must be provided as to avoid spillages.	▪ Waste removal and disposal to be monitored throughout construction	▪ Weekly or bi-weekly	▪ ECO and Contractor
		12.30.9. Waste water from construction and painting activities must be collected in a designated container and disposed of at a suitable disposal point off site.	▪ Waste removal and disposal to be monitored throughout construction	▪ Weekly or bi-weekly	▪ ECO and Contractor
		12.30.10. Control and implement waste management plans provided by contractors. Ensure that relevant legislative requirements are respected.	▪ Control of waste management practices throughout construction phase	▪ Weekly or bi-weekly	▪ ECO and Contractor
C. OPERATIONAL PHASE					
C.1. ECOLOGICAL IMPACTS (TERRESTRIAL, AQUATIC AND AVIFAUNA)					
12.31. Erosion control measures. The impact of wind and water erosion results in loss of surface soils and degradation of land.	To mitigate and manage the site to prevent any soil loss arising from wind and water.	12.31.1. Where appropriate and within the general drainage of the site, attenuators (or similar) should serve to reduce flow energy, while the maintenance of general vegetation cover to avoid excessive aeolian impacts should be implemented.	▪ Monitor the erosion on site during operations, as well as the implementation and effectiveness of erosion control on site (such as the use of gabions and geofabric materials or similar) at appropriate points.	▪ Ongoing and as required	▪ Project Developer (Scatec Solar) and Environmental Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
12.32. Alteration of the state of subsurface water resources due to excessive abstraction of groundwater for the cleaning of the PV panels, as well as for operational use.	To reduce excessive abstraction of sub surface waters and impacts on groundwater.	12.32.1. Identify alternative water sources (such as municipal supply) based on the recommendations made in the Geohydrology Assessment). 12.32.2. Preferential use of recycled water sources for operational phase requirements (instead of groundwater). 12.32.3. Ensure the prudent use of surface water resources. 12.32.4. Adopt "dry" cleaning methods, such as dusting and sweeping the site before washing down. 12.32.5. Increased monitoring of the impact of dust generation and implement a more judicious cleaning protocol. 12.32.6. Low level and ongoing cleaning of PV panels over time to reduce demand on aquifers.	▪ Ensure that Municipal Supply or alternate supply is arranged prior to the commencement of the operational phase. ▪ Monitor via site audits and record non-compliance and incidents.	▪ During the operational phase.	▪ Project Developer (Scatec Solar) and ECO
C.2. VISUAL IMPACTS					
12.33. Potential visual intrusion of the proposed Solar Energy Facility on the views of sensitive visual receptors.	Reduce visual intrusion of the solar energy facility on the views of sensitive visual receptors as well as its impact on the surrounding landscape	12.33.1. Monitor effectiveness of the rehabilitation plan for temporarily cleared areas and erosion scarring. 12.33.2. Monitor building and façade maintenance. Painted features should be maintained and repainted when colour fades or paint flakes.	▪ Carry out visual inspections during site audits to verify the effectiveness of the rehabilitation, and record and report any non-compliance. ▪ Carry out an inspection of solar energy facility to ensure that it is being maintained in a good condition.	▪ Monthly ▪ Annually	▪ Project Developer (Scatec Solar) and Environmental Manager ▪ Project Developer (Scatec Solar) and Environmental Manager
		12.33.3. Maintain re-vegetated surfaces until a self-sustaining stand of vegetation is established and visually adapted to the undisturbed surrounding vegetation. No new disturbance should be created during operations without approval from the Environmental Manager. 12.33.4. Restoration of disturbed land should commence as soon after disturbance as possible.	▪ Carry out visual inspections during site audits to verify the effectiveness of the rehabilitation and the progress of rehabilitation, and record and report any non-compliance. ▪ Ensure that all vegetation removal outside of the project footprint is	▪ Weekly during the rehabilitation phase ▪ Throughout the operational phase ▪ During road maintenance activities.	▪ Environmental Manager ▪ Project Developer (Scatec Solar) and Environmental Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.33.5. Road maintenance activities should avoid damaging or disturbing vegetation. 12.33.6. Dust and noxious weed control should be part of maintenance activities.	approved by the Environmental Manager. ▪ Monitor the road maintenance process to ensure limited damage to vegetation. Record and report any non-compliance. ▪ Monitor the presence of alien vegetation on site. ▪ Monitor dust suppression mechanisms and record non-compliances. Maintain an incidents/ complaints register, in which any complaints from the public must be logged. The date, time, nature of complaint, name of complainant and corrective actions must be logged for all complaints. Complaints must be investigated and, if appropriate, acted upon.	▪ Throughout the operational phase ▪ During complaints/ incidents	▪ Project Developer (Scatec Solar) and Environmental Manager ▪ Project Developer (Scatec Solar) and Environmental Manager ▪ Project Developer (Scatec Solar) and Environmental Manager
12.34. Potential impact of night lighting of the proposed Solar Energy Facility on the nightscape of the region.	Reduce the impact of night lighting of the proposed PV facility on the surrounding nightscape and sensitive visual receptors.	12.34.1. Monitor the effectiveness of the lighting plan to minimize light spill and glare.	▪ Visit surrounding neighbouring farmsteads and ensure that residents in the surrounding landscape are not affected by glaring lights from the plant. ▪ Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register.	▪ Once off at the end of the construction phase or the start of the operational Phase. ▪ As complaints arise.	▪ Project Developer (Scatec Solar) and Environmental Manager ▪ Project Developer (Scatec Solar) and Environmental Manager
		12.34.2. Lights should be switched off when not in use whenever it is in line with safety and security.	▪ Carry out visual inspections during site audits to monitor lighting, and record and report any non-compliance.	▪ Weekly	▪ Project Developer (Scatec Solar) and Environmental Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
C.3. HERITAGE IMPACTS (ARCHAEOLOGY AND CULTURAL LANDSCAPE)					
12.35. Maintenance vehicles and activities could result in damage to or destruction of archaeological sites and/or graves.	Minimise the chances of significant archaeological sites and/or graves being disturbed.	12.35.1. Ensure that no activity takes place outside of the authorized operational footprint.	▪ Carry out visual inspections to ensure strict control over the behaviour of operational staff in order to restrict activities to within demarcated areas.	▪ Weekly	▪ Environmental Manager
C.4. SOILS AND AGRICULTURAL POTENTIAL IMPACTS					
12.36. Soil erosion due to alteration of the land surface characteristics	To reduce erosion on site and downstream of the site as a result of run-off from the site, or due to wind erosion.	12.36.1. Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.	▪ Include periodic site inspection in environmental performance reporting that inspects the effectiveness and integrity of the run-off control system and specifically records the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	▪ Quarterly during the Operational Phase.	▪ Environmental Manager
C.5. SOCIAL IMPACTS					
12.37. Influx of job seekers into the Kenhardt area.	Control influx of job seekers into the Kenhardt area with the aim of protecting local social structures.	12.37.1. Implement the Workforce Recruitment Plan 12.37.2. Ensure employment is reserved, where practical, for local residents 12.37.3. Actively use the database of PAP and their relevant skills and experience to guide local employment 12.37.4. Implement the Stakeholder Engagement Plan	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current recruitment practices, as well as cross-referencing employed personnel with PAP database; ▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer
12.38. Outsiders moves into the Kenhardt area	Limit incidences of in social deviance in the Kenhardt area.	12.38.1. Implement the Workforce Recruitment Plan 12.38.2. Ensure employment is reserved, where practical, for local residents	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.38.3. Actively use the database of PAP and their relevant skills and experience to guide local employment 12.38.4. Implement the Stakeholder Engagement Plan	recruitment practices, as well as cross-referencing employed personnel with PAP database; ▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.		
12.39. Expectations created regarding possible employment	Prevent frustration resulting from miscommunication of employment opportunities and project-related benefits in the local community.	12.39.1. Implement the Stakeholder Engagement Plan	▪ Verify that Stakeholder Engagement Plan is being implemented with written proof of such engagement with the PAP.	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer
12.40. Local spending	Ensure the generation of socio-economic benefits as a result of the multiplier effect.	12.40.1. Procure goods and services, where practical, within the study area 12.40.2. Obtain regularly required goods and services from as large a selection of local service providers as possible	▪ Verify purchase of local goods and services through proof of purchase.	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer
12.41. Local employment	Ensure optimum employment creation while taking cognizance of the local levels of experience and education.	12.41.1. Implement the Workforce Recruitment Plan	▪ Verify that local labour is, as far as practically possible, being used, by cross-referencing the Workforce Recruitment Plan with current recruitment practices, as well as cross-referencing employed personnel with PAP database.	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer
12.42. Economic Development Plan	Ensure contribution to local employment, local spending and human capacity development is being made.	12.42.1. Implement the Economic Development Plan	▪ Verify that the Economic development Plan is being implemented.	▪ Once a year during the operational phase.	▪ Environmental Manager/ Officer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
C.6. GEOHYDROLOGY IMPACTS					
12.43. Potential impact on groundwater as a result of stormwater outflows	To prevent unnecessary infiltration of polluted storm water	12.43.1. Ensure the storm water runoff is not contaminated. All reasonable measures must be taken to prevent the contamination of storm water outflows	▪ Monitor the quality of the storm water. Facility Manager to verify that measures are in place to reduce the contamination of storm water and to monitor the quality of storm water by undertaking site visits and visual inspections.	▪ If possible do this during or shortly after a storm event, at the start of the rain season.	▪ Project Developer (Scatec Solar)
12.44. Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.	To reduce the potential of groundwater pollution.	12.44.1. Avoid using old or damaged equipment and vehicles and ensure that they are well maintained and regularly serviced in order to ensure no leakages. 12.44.2. Any engines that stand in one place for an excessive length of time, must have drip trays, fuel storage tanks should be above ground on an impermeable surface (within a bunded area) and vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the PV facility for refuelling activities and drip trays or similar impervious materials must be used during these procedures. If liquid product is being transported it must be ensured this does not spill during transit. 12.44.3. If spillages occur during refuelling, they should be contained and removed as rapidly as possible, with correct disposal of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes. During the operational phase, the same principles should be adhered to. Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.	▪ Vehicles need to be monitored throughout the operational phase. Monitor via site audits and record non-compliance and incidents. ▪ Monitor the placement and designation of the area for refuelling at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance. ▪ Monitor the refuelling/ servicing process and record the occurrence of any spillages.	▪ Monthly during operations. ▪ Weekly ▪ Weekly	▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar) ▪ Project Developer (Scatec Solar)

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
C.7. WASTE MANAGEMENT					
12.45. Pollution of the surrounding environment as a result of the handling, temporary storage and disposal of solid waste (general and hazardous).	Reduce soil and groundwater contamination as a result of incorrect storage, handling and disposal of general and hazardous waste.	12.45.1. Sufficient waste collection bins and skips (or similar) should be provided at the PV facility. Waste collection bins and skips should be covered with suitable material and correctly labelled, and should be kept in a designated, demarcated area, where access control is monitored and managed.	▪ Monitor waste generation and collection throughout the operational phase.	▪ Weekly	▪ Facility Manager
		12.45.2. Segregation of hazardous waste from general waste to be in place. Waste separation is encouraged and therefore receptacles should be labelled to reflect the different waste types.	▪ On-site inspection of waste segregation. ▪ Control of waste management practices throughout operational phase.	▪ Weekly ▪ Weekly	▪ Facility Manager ▪ Facility Manager
		12.45.3. General waste and hazardous waste should be removed from the site on a regular basis and disposed of at an appropriate, licenced waste disposal facility. Hazardous waste should be removed by an approved waste management Contractor. General solid waste could be removed from the site by municipal services. Waste disposal slips or waybills should be kept on file for auditing purposes as proof of disposal, as applicable	▪ Inspection of the waste storage area. ▪ Monitor via site audits and record non-compliance and incidents. Facility Manager to monitor and audit disposal slips.	▪ Daily ▪ Monthly	▪ Facility Manager
		12.45.4. Ensure that the PV facility is kept clean at all times and that operational personnel are made aware of correct waste disposal methods.	▪ Conduct training for all operational personnel. ▪ Monitor the state of PV facility via site audits and record non-compliance and incidents.	▪ Once-off during operations and ensure that all new staff are inducted. ▪ Daily	▪ Facility Manager
		12.45.5. No solid waste may be burned or buried on site.	▪ Monitor via site audits and record non-compliance and incidents.	▪ Daily	▪ Facility Manager
		12.45.6. Waste amounts shall be recorded on a monthly basis.	▪ Waste amounts to be documented.	▪ Monthly	▪ Facility Manager
		12.45.7. All operational waste (concrete, steel, rubbles etc.) to be removed from the site and waste hierarchy of prevention, as the preferred option,	▪ Waste removal and disposal to be monitored	▪ Monthly	▪ Facility Manager

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		followed by reuse, recycling, recovery must be implemented, where possible.			
		12.45.8. Other non-hazardous solid waste (e.g. packaging material) to be disposed of at a licensed landfill.	▪ Waste removal and disposal to be monitored	▪ Monthly	▪ Facility Manager
		12.45.9. All liquid waste (used oil, paints, lubricating compounds and grease) to be packaged and disposed of by appropriate means.	▪ Waste removal and disposal to be monitored	▪ Monthly	▪ Facility Manager
		12.45.10. Adequate containers for the cleaning of equipment and materials (paint, solvent) must be provided as to avoid spillages.	▪ Waste removal and disposal to be monitored	▪ Monthly	▪ Facility Manager
		12.45.11. Waste water from operations and painting activities must be collected in a designated container and disposed of at a suitable disposal point off site.	▪ Waste removal and disposal to be monitored	▪ Monthly	▪ Facility Manager
D. DECOMMISSIONING PHASE					
D.1. ECOLOGICAL IMPACTS (TERRESTRIAL, AQUATIC AND AVIFAUNA)					
12.46. Exotic weed invasion of abandoned site resulting in ecological change	To prevent the excessive growth and propagation of exotic weeds on disturbed lands that formed portion of the PV facility	12.46.1. Exotic weed control measures to be instituted through weed control programme. 12.46.2. Regular redress of exotic weed through use of herbicide and manual removal.	▪ Compile weed eradication programme for period of 12 months post the decommissioning exercise. ▪ Appoint contractor to undertake weed eradication programme.	▪ Weed eradication exercise to be undertaken every 6 months for a period of 12 months following decommissioning	▪ Project Developer (Scatec Solar)
D.2. VISUAL IMPACTS					
12.47. Potential visual intrusion of decommissioning activities on existing views of sensitive visual receptors.	Prevent unnecessary visual clutter and focusing attention of surrounding visual receptors on the proposed development.	12.47.1. Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes. 12.47.2. Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape.	▪ Conduct visual inspections to ensure that landscaping is following the rehabilitation plan.	▪ Weekly	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		12.47.3. Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a mix of indigenous species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape.	▪ Site visits to ensure that stockpiled topsoil (or appropriate soil for vegetation when stockpiled topsoil is exhausted) is used.	▪ Weekly	▪ ECO
		12.47.4. Night lighting of decommissioning sites should be minimised within requirements of safety and efficiency.	▪ Complaints about night lights should be investigated and documented in a register.	▪ Weekly or bi-weekly	▪ Contractor and ECO
		12.47.5. Working at night should be avoided where possible.	▪ Operation times for decommissioning activities to be monitored and managed (as well as included in the tender contract).	▪ Weekly	▪ ECO
	Reduce the visual impact of decommissioning activities project wide.	12.47.6. Maintain good housekeeping on site to avoid litter and minimize waste. 12.47.7. Monitor sites for strict adherence to demarcated boundaries. 12.47.8. Monitor adherence to lighting plan. 12.47.9. Monitor adherence to rehabilitation plan. 12.47.10. Monitor adherence to erosion control plan. 12.47.11. Monitor adherence to dust and fire control plans.	▪ Carry out site visits and inspections of the sites and ensure good housekeeping is maintained. Record and report any non-compliance. ▪ Carry out site visits and record and report any non-compliance. ▪ Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register. ▪ Visit sites requiring rehabilitation. ▪ Carry out site visits and record and report any non-compliance. ▪ Carry out site visits and record and report any non-compliance.	▪ Daily ▪ Daily ▪ Daily and as complaints arise. ▪ Daily ▪ Daily ▪ Daily	▪ Construction Manager and ECO
D.3. HERITAGE IMPACTS (ARCHAEOLOGY AND CULTURAL LANDSCAPE)					
12.48. Construction vehicles and activities could result in damage to or destruction of	Minimise the chances of significant archaeological sites and/or graves being disturbed.	12.48.1. Ensure that no activity takes place outside of the authorized construction footprint.	▪ Carry out visual inspections to ensure strict control over the behaviour of construction staff in order to restrict activities to within	▪ Weekly	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
archaeological sites and/or graves.			demarcated areas.		
12.49. Scarring of the landscape once infrastructure has been removed.	Ensure that the landscape within the development footprint has a similar appearance to that around it.	12.49.1. Ensure removal of all foundations, construction materials and foreign matter. 12.49.2. Ensure rehabilitation of the site in accordance with environmental guidelines.	▪ Follow the relevant environmental guidelines.	▪ Throughout the decommissioning phase.	▪ ECO
D.4. SOILS AND AGRICULTURAL POTENTIAL IMPACTS					
12.50. Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to decommissioning disturbance and potential trampling by vehicles	To conserve the surrounding natural veld vegetation.	12.50.1. Minimize footprint of disturbance during the decommissioning phase and ensure that work is undertaken within the demarcated area only. 12.50.2. Confine vehicle access on roads only 12.50.3. Control dust generation during decommissioning activities by implementing standard construction site dust control measures (dampening with water) where required. Because of water scarcity, this should only be done where and when dust generation is a significant problem.	▪ Monitor the decommissioning activities via site audits to ensure that they are undertaken within the demarcated decommissioning area, and record non-compliance and incidents. ▪ Include periodic site inspection in environmental performance reporting that specifically records occurrence or not of off-road vehicle tracks surrounding the site. Monitor via site audits and record non-compliance and incidents. ▪ Monitor dust suppression mechanisms via visual inspections and record non-compliances. Maintain an incidents/ complaints register. The date, time, nature of complaint, name of complainant and corrective actions must be logged for all complaints. Complaints must be investigated and, if appropriate, acted upon.	▪ Daily ▪ Monthly during the decommissioning phase ▪ Monthly and during complaints/incidents	▪ Contractor and ECO ▪ ECO ▪ Contractor and ECO
12.51. Loss of topsoil due to poor topsoil management	Ensure effective topsoil covering to conserve soil fertility on all disturbed areas, after they have been rehabilitated.	12.51.1. Strip and stockpile topsoil from all areas where soil (below surface) will be disturbed. 12.51.2. After cessation of disturbance, re-spread topsoil over the surface. 12.51.3. Dispose of any sub-surface spoils from excavations where they will not impact on land that supports vegetation, or where they can be	▪ Establish an effective record keeping system for each area where soil is disturbed for decommissioning purposes. These records should be included in environmental performance reports, and should include all the records	▪ As needed, dependent on the specifics of decommissioning activities.	▪ ECO

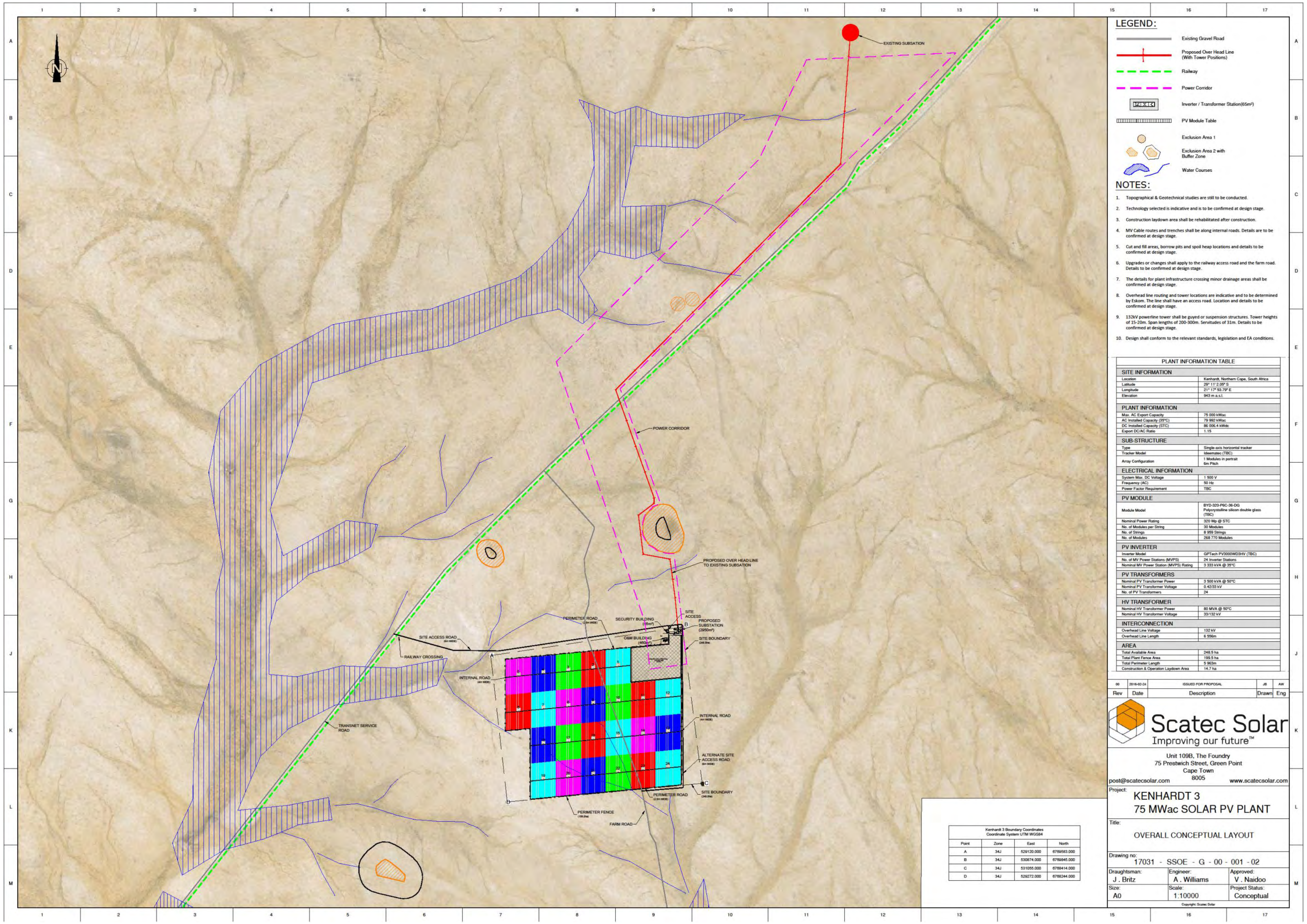
Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		effectively covered with topsoil.	below: ○ Record the GPS coordinates of each area. ○ Record the date of topsoil stripping. ○ Record the GPS coordinates of where the topsoil is stockpiled. ○ Record the date of cessation of decommissioning activities at the particular site. ○ Photograph the area on cessation of decommissioning activities. ○ Record date and depth of re-spreading of topsoil. ○ Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.		
12.52. Soil erosion due to alteration of the land surface characteristics	To reduce erosion on site and downstream of the site as a result of run-off from the site, or due to wind erosion.	12.52.1. Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.	▪ Include periodic site inspection in environmental performance reporting that inspects the effectiveness and integrity of the run-off control system and specifically records the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	▪ Monthly during the decommissioning phase.	▪ ECO
D.5. SOCIAL IMPACTS					
12.53. Decommissioning of the proposed development	Minimize job losses	12.53.1. The proponent should comply with relevant South African labour legislation when retrenching employees. 12.53.2. Scatec Solar must implement appropriate succession training of locally employed staff earmarked for retrenchment during	▪ Verify that retrenchment practices are compliant with south African labour legislation ▪ Verify that Scatec implemented succession training of locally employed staff before the plant is	▪ Once-off during the decommissioning phase (for mitigation measures (12.53.1) and (12.53.2) and once-off after decommissioning is	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		decommissioning. 12.53.3. All project infrastructures should be decommissioned appropriately and thoroughly to avoid misuse.	decommissioned ▪ Verify that decommissioned infrastructure does not pose any significant risk to the environment or the people living in the environment.	completed (for mitigation measure (12.53.3)).	
D.6. GEOHYDROLOGY IMPACTS					
12.54. Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.	To reduce the potential of groundwater pollution.	12.54.1. Avoid using old or damaged equipment and vehicles and ensure that they are well maintained and regularly serviced in order to ensure no leakages. 12.54.2. Any engines that stand in one place for an excessive length of time, must have drip trays, fuel storage tanks should be above ground on an impermeable surface (within a bunded area) and vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the site camp for refuelling activities and drip trays or similar impervious materials must be used during these procedures. If liquid product is being transported it must be ensured this does not spill during transit. 12.54.3. If spillages occur during refuelling, they should be contained and removed as rapidly as possible, with correct disposal of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes. During the operational phase, the same principles should be adhered to. Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.	▪ Vehicles need to be monitored throughout the decommissioning phase. Monitor via site audits and record non-compliance and incidents. ▪ Monitor the placement and designation of the area for refuelling at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance. ▪ Monitor the refuelling/ servicing process and record the occurrence of any spillages.	▪ Four times per annum for the decommissioning period, i.e. at 3 months, 6 months, 9 months and 12 months. ▪ Weekly ▪ Weekly	▪ Project Developer and ECO. ▪ Project Developer (Scatec Solar) and ECO ▪ Project Developer (Scatec Solar) and ECO
D.7. WASTE MANAGEMENT					
12.55. Generation of waste due to disassembly of the	Avoid substantial negative impacts at the decommissioning phase due to	12.55.1. Suitable receptacles must be provided for the temporary storage of various waste types such as scrap metal and concrete, until it is removed to	▪ Audit the implementation of mitigation measures recommended for the decommissioning phase.	▪ During the decommissioning phase	▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
solar facility.	insufficient planning.	the nearest licensed landfill.			
		12.55.2. Waste separation is encouraged and therefore receptacles should be labelled to reflect the different waste types.	▪ Audit the implementation of mitigation measures recommended for the decommissioning phase.	▪ During the decommissioning phase	▪ ECO

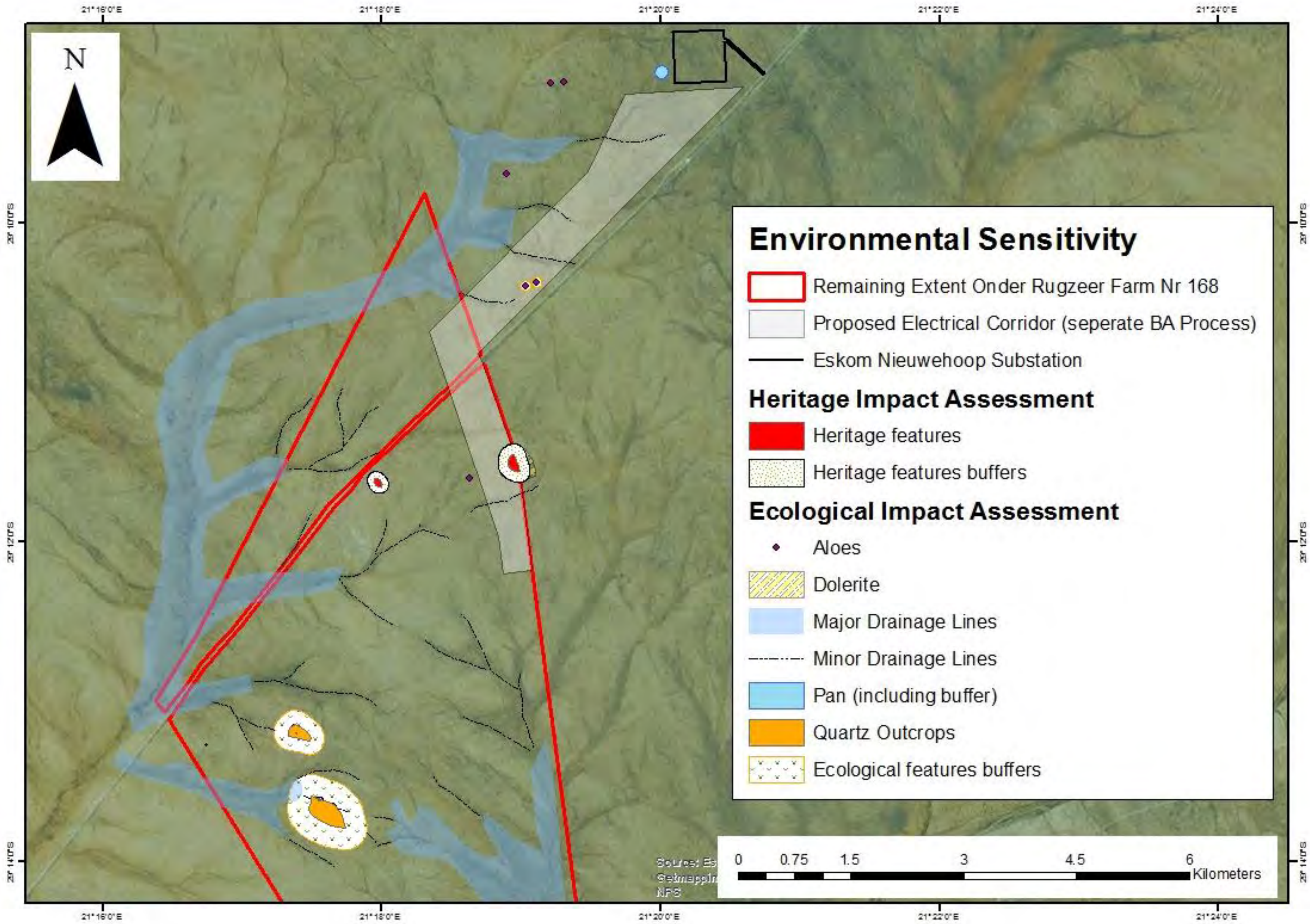
13 APPENDIX A – SITE LAYOUT MAP

Fine Scale Layout Map for Kenhardt PV 3

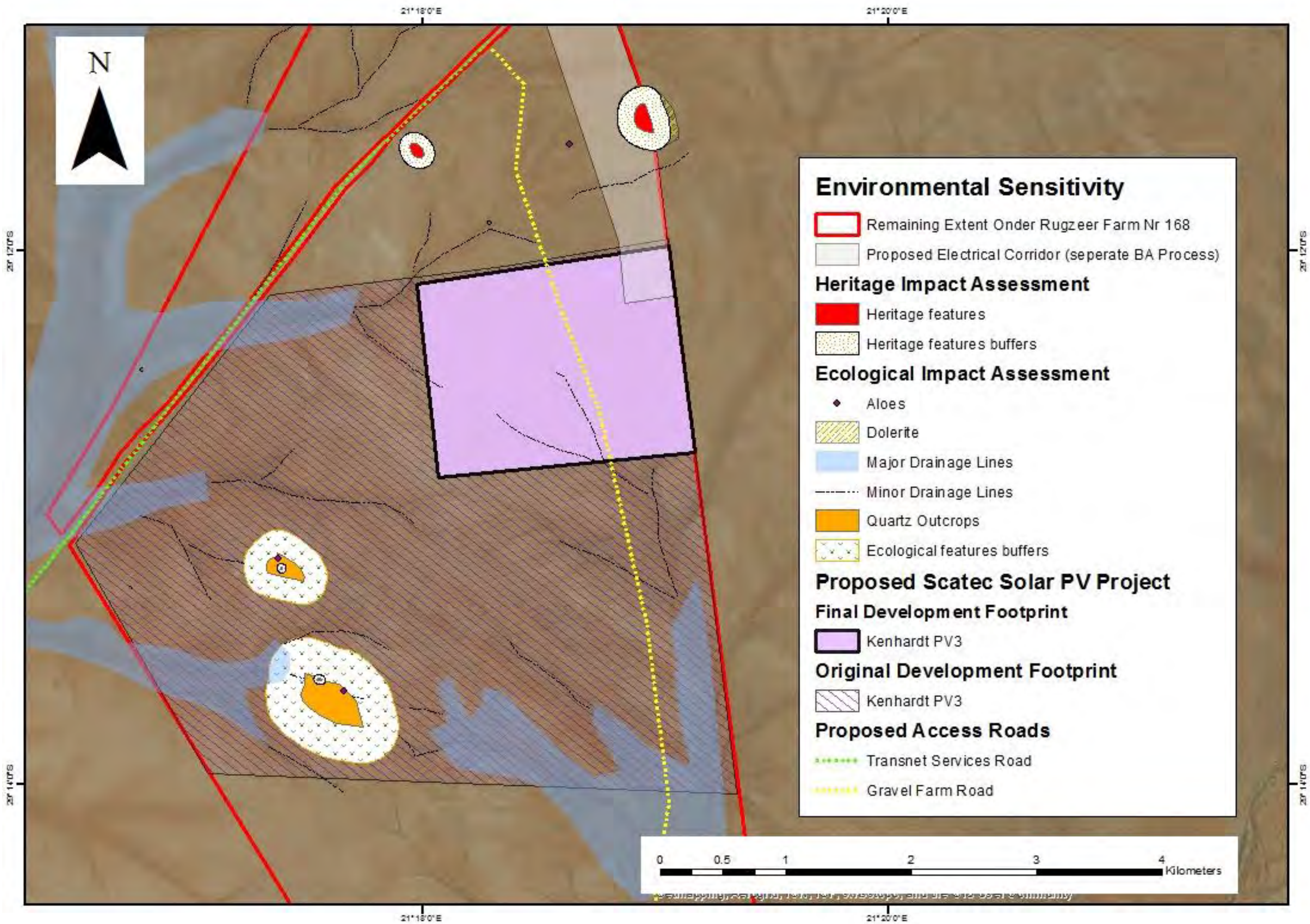


Coarse Scale Layout Map for Kenhardt PV 3 (and the associated Transmission Line and Electrical Infrastructure Corridor)

14 APPENDIX B – ENVIRONMENTAL SENSITIVITY MAP



Combined Sensitivity Map for Kenhardt PV 1, 2 and 3



Sensitivity Map for Kenhardt PV 3

15 APPENDIX C – COMBINED LAYOUT AND SENSITIVITY MAP

SINGLE AXIS PV TRACKER (Not to Scale)
6m
LEGEND:
Site Access Road
Construction Road
Railway
Proposed Over Head Line (With Tower Positions)
Power Corridor
Fence
Water Courses
Exclusion Area 2 with Buffer Zone
PV Module Table
NOTES:
1. Topographical & Geotechnical studies are still to be conducted.
2. Technology selected is indicative and is to be confirmed at design stage.
3. Construction laydown area shall be rehabilitated after construction.
4. MV Cable routes and trenches shall be along internal roads. Details are to be confirmed at design stage.
5. Cut and fill areas, borrow pits and spoil heap locations and details to be confirmed at design stage.
6. Upgrades or changes shall apply to the railway access road and the farm road. Details to be confirmed at design stage.
7. The details for plant infrastructure crossing minor drainage areas shall be confirmed at design stage.
8. Overhead line routing and tower locations are indicative and to be determined by Eskom. The line shall have an access road. Location and details to be confirmed at design stage.
9. 132kV powerline tower shall be guyed or suspension structures. Tower heights of 15-20m. Span lengths of 200-300m. Servitudes of 31m. Details to be confirmed at design stage.
10. Design shall conform to the relevant standards, legislation and EA conditions.
PLANT INFORMATION TABLE
SITE INFORMATION
Location: Kenhardt, Northern Cape, South Africa
PLANT INFORMATION
SUB STRUCTURE
ELECTRICAL INFORMATION
PV MODULE
PV INVERTER
PV TRANSFORMERS
HV TRANSFORMER
INTERCONNECTION
AREA
Rev
Date
Description
Drawn
Eng
Scatec Solar
Improving our future™
Unit 109B, The Foundry
75 Prestwich Street, Green Point
Cape Town
8005
post@scatecsolar.com
www.scatecsolar.com
Project:
KENHARDT 3
75 MWac SOLAR PV PLANT
Title:
CONCEPTUAL LAYOUT
Drawing no:
17031 - SSOE - G - 00 - 001 - 01
Draughtsman: J . Britz
Engineer: A . Williams
Approved: V . Naidoo
Size: A0
Scale: 1:3000
Project Status: Conceptual