

20<sup>th</sup> July 2018

Mr. S. Taylor  
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Dear Mr Taylor

### RE-MODELLING OF NOISE IMPACT ASSESSMENT – KARREEBOSCH WIND ENERGY PROJECT

As per our recent correspondence, please find attached the re-modelling report for the Karreebosch Wind Energy Project near Laingsburg in the Western Cape and Northern Cape Provinces.

This report is to be viewed as an addendum to the main Noise Impact Report that was issued by Jongens Keet Associates (August 2015). The methodologies used to conduct the remodelling, identification of noise sensitive areas and the project description is described in the main report and is not repeated here.

The purpose of this report is to determine if the 65 turbine project layout with proposed amended turbine specifications will comply with the noise emission limits as contained in the Department of Environmental Affairs - Environmental Authorisation (14/12/16/3/3/2/807) issued on the 29<sup>th</sup> January 2016. The wind turbine specifications as authorised, are proposed to be amended, however. The proposed amendments include the following:

- Increase in output capacity per wind turbine from 2MW to 3.3MW, to 2MW up to 5.5MW;
- Increase in the rotor diameter from 140m to, up to 160m; and
- Increase in hub height from 100m to, up to 125m.

This has necessitated a remodelling of the layout. The results of the modelling are presented below.

Yours sincerely



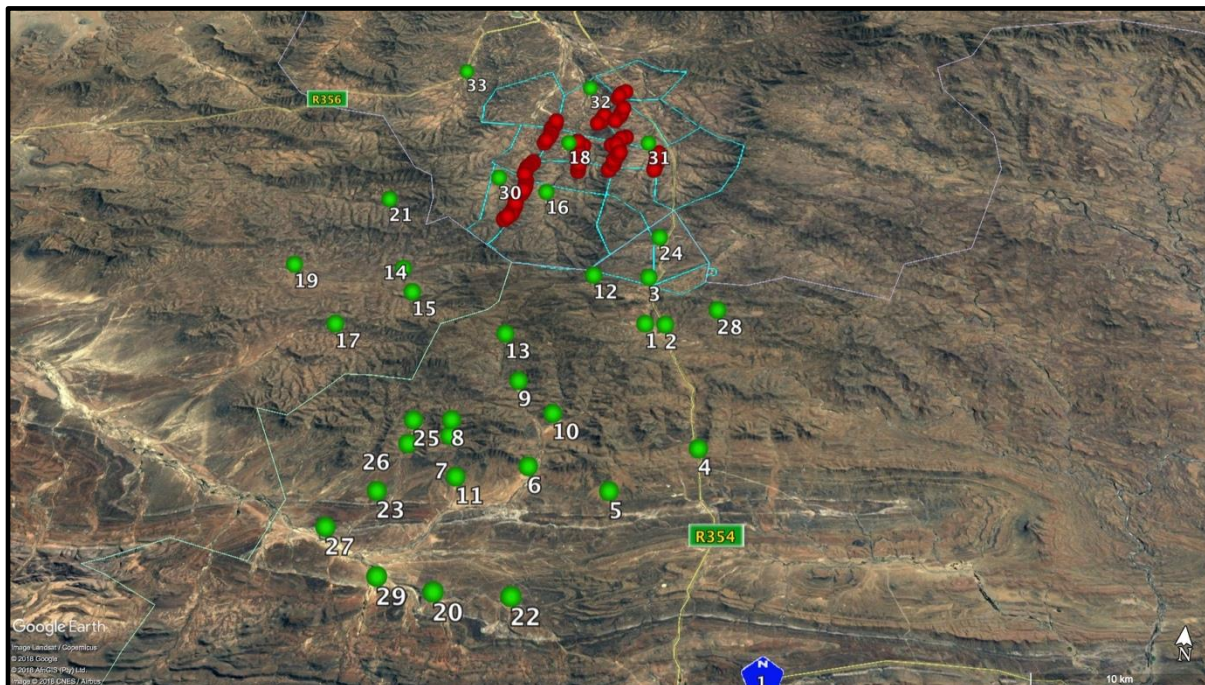
Dr Brett Williams

## 1. Noise Sensitive Areas (NSA)

The following noise sensitive areas have been used in the remodelling as identified in the Table 1 and Figure 1:

**Figure 1 – Noise Sensitive Areas**

WTG in Red, NSA in Green, Wind Farm Boundary in Blue



**Table 1 – Noise Sensitive Areas**

The text in blue indicates where a NSA is within the project boundary.

Description	East	South	Within Project Boundary	Type
NSA 1	20°30'17.97"	32°57'10.38"	No	Farmhouse
NSA 2	20°32'52.95"	32°59'17.08"	No	Farmhouse
NSA 3	20°33'46.34"	32°59'14.38"	No	Farmhouse
NSA 4	20°32'50.34"	32°57'02.30"	No	Farmhouse
NSA 5	20°35'33.01"	33°04'25.20"	No	Farmhouse
NSA 6	20°36'03.35"	32°58'22.40"	No	Farmhouse
NSA 7	20°32'05.40"	33°06'21.24"	No	Farmhouse
NSA 8	20°28'42.36"	33°05'39.20"	No	Farmhouse
NSA 9	20°23'38.49"	33°10'03.50"	No	Farmhouse
NSA 10	20°21'09.92"	33°08'30.25"	No	Farmhouse
NSA 11	20°23'36.36"	33°04'12.19"	No	Farmhouse
NSA 12	20°25'16.19"	33°04'42.76"	No	Farmhouse
NSA 13	20°25'12.35"	33°04'05.63"	No	Farmhouse

Description	East	South	Within Project Boundary	Type
NSA 14	20°27'42.38"	33°02'14.53"	No	Farmhouse
NSA 15	20°33'09.67"	32°54'52.62"	No	Farmhouse
NSA 16	20°22'49.18"	33°07'02.68"	Yes	Farmhouse
NSA 17	20°23'36.67"	33°05'09.53"	No	Farmhouse
NSA 18	20°29'22.71"	33°03'29.96"	Yes	Farmhouse
NSA 19	20°25'51.24"	33°06'16.52"	No	Farmhouse
NSA 20	20°28'51.51"	33°10'20.42"	No	Farmhouse
NSA 21	20°25'54.65"	33°10'25.14"	No	Farmhouse
NSA 22	20°21'25.27"	32°57'21.98"	No	Farmhouse
NSA 23	20°22'07.76"	32°58'30.41"	No	Farmhouse
NSA 24	20°16'15.80"	32°57'29.92"	Yes	Farmhouse
NSA 25	20°19'48.45"	32°53'44.68"	No	Farmhouse
NSA 26	20°27'23.34"	32°52'42.16"	No	Farmhouse
NSA 27	20°28'03.60"	32°49'35.62"	No	Farmhouse
NSA 28	20°26'46.16"	33°00'14.10"	No	Farmhouse
NSA 29	20°19'04.31"	33°00'15.87"	No	Farmhouse
NSA 30	20°24'54.14"	32°52'02.62"	Yes	Farmhouse
NSA 31	20°32'07.95"	32°49'19.83"	Yes	Farmhouse
NSA 32	20°28'41.48"	32°45'52.81"	Yes	Farmhouse
NSA 33	20°21'48.77"	32°45'14.37"	No	Farmhouse

## 2. Wind Turbine Generators (WTG)

The wind turbine generator that was modelled is described in Table 2 below. This turbine was chosen to represent the worst-case scenario of a wind turbine up to 5.5 MW and 125m hub height. This model of turbine was chosen as it has published noise data in the WindPro catalogue of wind turbines. Furthermore, the noise data has been tested according to the methods described in IEC 61400-11 and are thus traceable. The modelled hub height (125m) the same as the hub height amendment proposed by the developer.

If a lower final hub height is chosen, the noise impacts could be reduced. Furthermore, if the final turbine that is chosen has a maximum sound power level that is similar or lower than the turbine modelled in this report, it can be assumed that the noise impacts will be similar or lower, irrespective of the turbine manufacturer.

**Table 2 - Proposed Turbine Specifications**

Manufacturer	Nordex
Type / Version	N149/4.0-4.5
Rated Power	4.5 MW
Rotor Diameter	149m
Tower	Tubular
Grid Connection	50 Hz
Maximum Sound Power Level	108.1 dB
Hub Height	125m

Sound Power Level dB(A) reference to 1pW from WindPro 3.2 Catalogue

\*The specifications of this turbine model were used as the data is available in WindPro. This does not bind the applicant to this specific model, and any turbine model with similar turbine specifications. An equal or lower maximum sound power level would be acceptable for the site.

The sound power levels at lower and higher wind speeds as stated above were interpolated from the published data. **The actual sound power levels may thus be less than those stated when the final turbine is selected. The levels used in the re-modelling are thus a worst-case scenario.**

### 3. Cumulative Impacts

The proposed windfarm is located adjacent to several other windfarms. The details are as follows:

- Rietkloof – 60 wind turbines
- Witberg – 27 wind turbines
- Brandvalley – 58 wind turbines
- Esizayo – 55 wind turbines
- Roggeveld – 47 wind turbines
- Soetwater – 43 wind turbines
- Karusa – 43 wind turbines

The locations of these turbines are recorded in Annexure A. The turbine positions that are recorded in Annexure A, are purely as a record of what informed the cumulative noise modelling assessment. The same turbine data (as described in Table 2) was used to model the cumulative impacts from all the adjacent windfarms. This is thus a worst-case scenario, as it is unlikely that all 398 turbines will be operational simultaneously and if all the sites obtain the required regulatory approval.

#### 4. Modelling Results

The masking effect of the wind noise will mitigate the noise impact. The results are based on NO wind noise masking, which in reality rarely occurs when the turbines are operational. The maximum noise rating limit as per the DEA Environmental Authorisation is 45 dB(A). The noise impacts were modelled in WindPro Version 3.2.669 using the above data. The results area as follows:

**Table 3 - Modelling Results**

Environmental Authorisation Limit = 45dB(A)

Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
NSA 1	2	0.0	20.9
	4	0.0	23.7
	6	0.0	33.1
	8	0.0	34.4
	10	0.0	34.4
	12	0.0	34.4
NSA 2	2	0.0	21.2
	4	0.0	24.0
	6	0.0	33.4
	8	0.0	34.7
	10	0.0	34.7
	12	0.0	34.7
NSA 3	2	0.0	23.5
	4	0.0	26.3
	6	3.9	35.7
	8	5.2	37.0
	10	5.2	37.0
	12	5.2	37.0
NSA 4	2	0.0	11.2
	4	0.0	14.0
	6	0.0	23.4
	8	0.0	24.6
	10	0.0	24.6
	12	0.0	24.6
NSA 5	2	0.0	14.5
	4	0.0	17.3
	6	0.0	26.7

Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	8	0.0	27.9
	10	0.0	27.9
	12	0.0	27.9
NSA 6	2	0.0	20.6
	4	0.0	23.4
	6	0.0	32.8
	8	0.0	34.0
	10	0.0	34.0
	12	0.0	34.0
NSA 7	2	0.0	20.1
	4	0.0	22.9
	6	0.0	32.3
	8	0.0	33.6
	10	0.0	33.6
	12	0.0	33.6
NSA 8	2	0.0	20.5
	4	0.0	23.3
	6	0.0	32.7
	8	0.0	33.9
	10	0.0	33.9
	12	0.0	33.9
NSA 9	2	0.0	21.8
	4	0.0	24.6
	6	0.0	34.0
	8	0.0	35.3
	10	0.0	35.3
	12	0.0	35.3
NSA 10	2	0.0	22.0
	4	0.0	24.8
	6	0.0	34.2
	8	0.0	35.5
	10	0.0	35.5
	12	0.0	35.5
NSA 11	2	0.0	15.2
	4	0.0	18.0
	6	0.0	27.4
	8	0.0	28.7
	10	0.0	28.7



Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	12	0.0	28.7
NSA 12	2	0.0	28.1
	4	0.0	30.9
	6	8.5	40.3
	8	9.8	41.6
	10	9.8	41.6
	12	9.8	41.6
NSA 13	2	0.0	22.9
	4	0.0	25.7
	6	0.0	35.1
	8	1.3	36.4
	10	1.3	36.4
	12	1.3	36.4
NSA 14	2	0.0	13.5
	4	0.0	16.3
	6	6.2	25.7
	8	7.5	26.7
	10	7.5	26.7
	12	7.5	26.7
NSA 15	2	0.0	16.5
	4	0.0	19.3
	6	3.8	28.7
	8	5.1	30.0
	10	5.1	30.0
	12	5.1	30.0
NSA 16	2	23.0	23.4
	4	25.8	26.2
	6	35.2	35.6
	8	36.5	36.9
	10	36.5	36.9
	12	36.5	36.9
NSA 17	2	0.0	2.4
	4	0.0	5.2
	6	0.0	14.6
	8	0.0	15.7
	10	0.0	15.7
	12	0.0	15.7
NSA 18	2	30.1	30.1



Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	4	32.9	32.9
	6	42.3	42.3
	8	43.6	43.6
	10	43.6	43.6
	12	43.6	43.6
NSA 19	2	0.0	10.2
	4	0.0	13.0
	6	0.0	22.3
	8	0.0	23.0
	10	0.0	23.0
	12	0.0	23.0
NSA 20	2	0.0	0.0
	4	0.0	0.0
	6	0.0	5.4
	8	0.0	6.5
	10	0.0	6.5
	12	0.0	6.5
NSA 21	2	0.0	20.9
	4	0.0	23.7
	6	7.3	33.1
	8	8.6	33.8
	10	8.6	33.8
	12	8.6	33.8
NSA 22	2	0.0	0.0
	4	0.0	0.0
	6	0.0	7.1
	8	0.0	8.3
	10	0.0	8.3
	12	0.0	8.3
NSA 23	2	0.0	0.2
	4	0.0	3.0
	6	0.0	12.4
	8	0.0	13.7
	10	0.0	13.7
	12	0.0	13.7
NSA 24	2	0.1	19.7
	4	2.9	22.5
	6	12.3	31.9

Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	8	13.6	33.1
	10	13.6	33.1
	12	13.6	33.1
NSA 25	2	0.0	10.4
	4	0.0	13.2
	6	0.0	22.6
	8	0.0	23.9
	10	0.0	23.9
	12	0.0	23.9
NSA 26	2	0.0	8.4
	4	0.0	11.2
	6	0.0	20.6
	8	0.0	21.9
	10	0.0	21.9
	12	0.0	21.9
NSA 27	2	0.0	0.0
	4	0.0	0.0
	6	0.0	2.0
	8	0.0	3.2
	10	0.0	3.2
	12	0.0	3.2
NSA 28	2	0.0	27.2
	4	0.0	30.0
	6	0.0	39.4
	8	0.0	40.7
	10	0.0	40.7
	12	0.0	40.7
NSA 29	2	0.0	0.0
	4	0.0	0.0
	6	0.0	3.7
	8	0.0	4.8
	10	0.0	4.8
	12	0.0	4.8
NSA 30	2	21.6	22.2
	4	24.4	25.0
	6	33.8	34.4
	8	35.1	35.6
	10	35.1	35.6

Receiver	Wind speed [m/s]	Only Karreebosch WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	12	35.1	35.6
NSA 31	2	24.3	24.5
	4	27.1	27.3
	6	36.5	36.7
	8	37.8	38.0
	10	37.8	38.0
	12	37.8	38.0
NSA 32	2	17.3	17.3
	4	20.1	20.1
	6	29.5	29.5
	8	30.8	30.8
	10	30.8	30.8
	12	30.8	30.8
NSA 33	2	0.0	0.0
	4	0.0	0.5
	6	4.5	9.9
	8	5.8	10.8
	10	5.8	10.8
	12	5.8	10.8

## 5. Discussion & Summary

### Karreebosch Wind Energy Farm

The modelling results indicate that the Environmental Authorisation Limit of 45 dB(A) limit will not be exceeded at any of the noise sensitive areas. This includes the cumulative impacts from the other windfarms. **Kareebosch Wind Farm along with any of the alternatives currently proposed by the applicant may therefore proceed.**

### Cumulative Impacts

The cumulative impact modelling results indicate that the Environmental Authorisation Limit of 45 dB(A) limit will not be exceeded at any of the noise sensitive areas. This includes the cumulative impacts from the other seven windfarms that were modelled.

### Summary

It is highly likely that the wind noise will provide a masking effect. Furthermore, the modelling assumes the receiver is outdoors at all times.

If the final number of turbines is reduced or the layout changed such that no turbine is moved closer to a noise sensitive area, then remodelling will not be required, provided the final turbine choice sound power level is not greater than that that was used in this report (108.1 dBA).

## 6. Impact Statement

The overall environmental impact of the changes made to the project scope is rated as low and has not changed from the original noise impact assessment. No additional mitigation measures are required. There are no additional advantages or disadvantages in relation to the project impacts. The entire site as proposed may be developed with no constraints.

## 7. Conclusion

The overall environmental noise impact significance remains low taking into account the changes to the turbine specifications. The amended project description does not exceed the current Environmental Authorisation limit of 45 dB(A) at any of the noise sensitive receptors using the data that was modelled. The specific conditions as set in the Environmental Authorisation are thus complied with. It is my recommendation that based on the results presented here, the granting of an Environmental Authorisation with respect to the noise impacts is recommended.

Please feel free to contact us should you have any further requirements. Assuring you of our best attention at all times.

Yours sincerely



Dr Brett Williams

## Annexure A – WTG Positions

Rietkloof			Brandvalley			Karreebosch		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°26'24.18"	33°04'57.38"	1198	20°23'36.20"	33°01'11.11"	1322	20°30'33.18"	32°47'27.95"	938
20°26'47.81"	33°04'48.70"	1200	20°23'37.82"	33°00'58.26"	1321	20°30'30.35"	32°47'39.93"	970
20°26'44.27"	33°04'27.49"	1180	20°23'45.84"	33°00'47.17"	1289	20°30'25.50"	32°46'06.06"	970
20°27'13.28"	33°04'47.13"	1240	20°23'50.44"	32°58'20.63"	1190	20°30'37.28"	32°45'58.37"	940
20°27'23.56"	33°04'38.07"	1211	20°24'00.40"	32°59'35.37"	1280	20°30'37.67"	32°47'08.43"	930
20°27'42.27"	33°04'52.59"	1210	20°24'11.92"	33°01'09.07"	1309	20°30'16.42"	32°48'01.50"	1026
20°28'06.39"	33°04'55.28"	1182	20°24'25.27"	32°58'16.83"	1210	20°30'18.08"	32°46'16.71"	998
20°26'12.35"	33°03'50.84"	1203	20°24'24.81"	33°01'01.27"	1300	20°30'30.19"	32°49'30.59"	1120
20°26'23.02"	33°03'41.61"	1230	20°24'33.36"	32°57'59.95"	1308	20°29'33.58"	32°48'06.46"	1010
20°26'31.96"	33°03'31.15"	1216	20°24'33.87"	32°57'47.06"	1320	20°30'21.79"	32°47'49.92"	989
20°27'16.77"	33°03'36.50"	1180	20°24'35.10"	32°57'21.60"	1369	20°30'14.51"	32°46'29.04"	990
20°30'05.02"	33°05'08.34"	1205	20°24'37.58"	32°57'34.56"	1320	20°32'33.58"	32°50'59.29"	1058
20°30'29.33"	33°05'02.09"	1219	20°24'42.25"	32°57'10.20"	1345	20°30'42.55"	32°49'08.53"	1060
20°30'38.06"	33°04'37.14"	1211	20°24'57.51"	32°55'29.35"	1420	20°30'36.72"	32°49'19.68"	1110
20°30'43.65"	33°04'50.27"	1258	20°24'59.69"	32°55'51.45"	1378	20°29'34.59"	32°47'53.21"	1030
20°31'30.21"	33°04'31.37"	1228	20°25'19.74"	33°01'12.67"	1220	20°32'41.00"	32°50'08.37"	1076
20°31'27.45"	33°03'35.42"	1226	20°25'23.79"	32°55'32.32"	1400	20°30'39.56"	32°49'47.42"	1110
20°31'19.84"	33°03'19.55"	1250	20°25'33.17"	33°01'04.80"	1210	20°32'35.96"	32°50'46.60"	1062
20°31'30.90"	33°03'02.63"	1220	20°25'44.10"	32°59'03.38"	1280	20°30'44.22"	32°50'01.99"	1128
20°31'38.99"	33°02'51.75"	1240	20°26'03.36"	32°56'43.86"	1340	20°30'40.19"	32°50'14.05"	1110
20°31'50.02"	33°02'42.32"	1210	20°26'17.05"	32°56'23.90"	1390	20°29'21.94"	32°48'13.97"	983
20°31'45.25"	33°02'25.62"	1210	20°26'43.07"	32°55'44.03"	1405	20°30'28.72"	32°50'36.44"	1187
20°31'41.31"	33°02'13.06"	1238	20°26'46.09"	32°56'11.32"	1410	20°30'30.87"	32°50'50.87"	1147
20°31'53.12"	33°02'04.89"	1250	20°27'06.33"	32°55'54.69"	1416	20°30'18.28"	32°51'13.52"	1200
20°32'03.71"	33°01'55.61"	1260	20°27'24.88"	32°59'06.20"	1290	20°30'23.77"	32°51'02.14"	1176
20°32'17.02"	33°01'49.29"	1290	20°27'50.99"	32°58'55.95"	1363	20°32'38.21"	32°50'20.89"	1070
20°32'25.08"	33°01'38.36"	1320	20°28'03.52"	32°58'48.59"	1386	20°32'40.22"	32°50'34.94"	1091
20°32'20.27"	33°01'21.93"	1320	20°28'24.33"	32°59'27.91"	1308	20°28'35.49"	32°49'52.89"	1020
20°32'19.90"	33°01'09.03"	1330	20°28'24.15"	32°59'49.80"	1288	20°28'39.78"	32°50'17.15"	1113
20°32'31.75"	33°01'00.93"	1318	20°28'39.12"	32°58'36.92"	1427	20°28'40.92"	32°50'40.74"	1040
20°31'58.05"	33°00'40.83"	1328	20°28'54.42"	32°58'01.90"	1510	20°28'45.91"	32°50'53.34"	1040
20°32'08.84"	33°00'31.66"	1316	20°29'05.61"	32°58'50.45"	1409	20°28'45.03"	32°51'06.00"	1058
20°31'11.16"	32°59'46.78"	1351	20°29'06.72"	32°57'54.29"	1478	20°28'30.52"	32°49'28.62"	980
20°30'45.54"	32°59'46.97"	1380	20°29'11.42"	32°58'17.90"	1455	20°29'39.51"	32°47'39.85"	980
20°30'20.05"	32°59'45.72"	1369	20°29'32.94"	32°57'53.95"	1409	20°25'45.28"	32°54'17.49"	1160
20°29'46.43"	32°59'42.49"	1350	20°30'20.44"	32°57'48.80"	1380	20°25'54.12"	32°54'07.72"	1160
20°30'08.70"	33°00'14.48"	1288	20°30'41.46"	32°58'10.73"	1394	20°25'56.55"	32°53'55.13"	1204
20°30'01.91"	33°00'26.02"	1297	20°30'54.18"	32°58'03.59"	1369	20°26'00.52"	32°53'43.07"	1239
20°29'55.99"	33°00'38.00"	1260	20°31'44.49"	32°57'55.13"	1355	20°25'59.73"	32°53'29.83"	1230
20°29'50.86"	33°00'50.12"	1260	20°31'56.28"	32°57'46.89"	1400	20°26'15.92"	32°52'41.15"	1140
20°29'53.20"	33°01'02.82"	1246	20°32'08.84"	32°57'39.50"	1366	20°26'18.04"	32°52'28.99"	1135
20°29'57.14"	33°01'15.29"	1221	20°24'24.73"	32°59'41.10"	1270	20°26'08.04"	32°51'44.25"	1051
20°30'04.93"	33°01'37.92"	1200	20°24'29.38"	32°59'28.86"	1280	20°26'09.70"	32°51'31.34"	1077

Rietkloof			Brandvalley			Karreebosch		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°30'11.58"	33°02'15.16"	1170	20°24'41.92"	32°59'21.55"	1270	20°26'11.71"	32°51'18.42"	1110
20°30'11.14"	33°02'33.92"	1147	20°24'53.56"	32°59'11.12"	1266	20°26'20.20"	32°51'08.49"	1114
20°29'01.92"	33°02'22.86"	1156	20°25'17.86"	32°59'04.74"	1286	20°26'26.39"	32°50'57.28"	1081
20°28'23.90"	33°01'15.40"	1280	20°28'30.60"	32°58'47.67"	1420	20°26'52.78"	32°49'30.37"	940
20°28'29.59"	33°01'03.43"	1231	20°28'46.68"	32°58'13.03"	1453	20°26'59.04"	32°49'19.29"	950
20°28'23.60"	33°00'44.44"	1280	20°28'51.75"	32°58'29.66"	1450	20°27'03.74"	32°49'04.99"	943
20°28'32.36"	33°00'33.88"	1260	20°24'36.81"	33°00'53.24"	1243	20°27'00.48"	32°48'50.66"	960
20°29'00.01"	33°02'42.77"	1120	20°23'48.07"	32°59'42.92"	1282	20°27'03.92"	32°48'38.36"	979
20°33'02.47"	33°03'28.28"	1205	20°24'06.86"	32°59'23.72"	1240	20°27'12.12"	32°48'28.27"	966
20°33'05.59"	33°03'15.57"	1199	20°25'19.90"	32°58'21.05"	1270	20°30'57.15"	32°49'02.99"	1028
20°33'01.45"	33°03'01.41"	1209	20°28'21.75"	32°58'17.34"	1394	20°30'15.51"	32°49'36.06"	1081
20°32'59.88"	33°02'48.54"	1204	20°29'27.48"	32°58'07.75"	1423	20°32'42.30"	32°49'55.32"	1010
20°33'03.34"	33°02'35.90"	1215	20°28'50.03"	32°59'24.72"	1336	20°25'37.40"	32°54'27.75"	1145
20°27'57.12"	33°00'36.62"	1242	20°28'36.43"	32°59'06.60"	1370	20°26'17.47"	32°52'09.33"	1080
20°32'19.70"	33°00'21.35"	1290	20°25'44.81"	33°00'55.98"	1184	20°26'48.20"	32°49'42.23"	937
20°31'28.69"	33°04'54.31"	1184				20°27'11.87"	32°48'13.14"	1000
20°28'27.72"	33°01'27.87"	1226				20°28'34.86"	32°50'05.16"	1086
						20°30'33.63"	32°50'24.87"	1147
						20°26'10.75"	32°52'54.62"	1150
						20°28'49.93"	32°49'43.05"	972
						20°28'45.93"	32°51'19.95"	1053
						20°26'00.02"	32°53'11.41"	1210

Witberg			Esizayo			Roggeveld		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°28'08.82"	33°16'59.07"	1442.7	20°33'40.64"	32°57'30.35"	1380	20°29'48.80"	32°56'31.84"	1392
20°28'09.84"	33°17'07.88"	1450	20°35'09.27"	32°57'22.54"	1335	20°29'59.40"	32°56'24.35"	1423
20°27'58.98"	33°17'09.71"	1450	20°33'59.92"	32°57'25.55"	1370	20°30'12.40"	32°56'18.53"	1410
20°27'48.42"	33°17'11.90"	1437.6	20°38'07.36"	33°01'29.88"	1200	20°30'19.68"	32°56'08.68"	1383
20°27'29.38"	33°17'22.74"	1412.8	20°37'22.97"	33°01'44.37"	1201	20°30'26.37"	32°55'58.45"	1370
20°27'16.41"	33°17'24.43"	1410	20°38'24.73"	33°01'23.44"	1180	20°30'20.28"	32°55'44.74"	1401
20°27'02.33"	33°17'21.48"	1400	20°34'50.00"	32°57'24.09"	1333	20°30'25.43"	32°55'34.16"	1420
20°26'49.53"	33°17'19.94"	1381.7	20°38'28.65"	33°01'07.22"	1140	20°30'30.49"	32°55'23.53"	1418
20°26'51.87"	33°17'30.93"	1400	20°38'47.93"	33°01'05.65"	1120	20°30'34.79"	32°55'12.02"	1387
20°26'39.57"	33°17'31.76"	1380.9	20°38'52.28"	32°59'00.64"	1218	20°30'49.65"	32°55'24.78"	1375
20°27'07.29"	33°17'36.05"	1380	20°35'28.53"	32°57'22.60"	1294	20°31'00.62"	32°55'17.37"	1350
20°26'28.02"	33°17'32.85"	1352.2	20°36'31.06"	33°01'13.36"	1222	20°31'08.87"	32°55'08.31"	1310
20°26'15.98"	33°17'45.06"	1346.2	20°37'48.06"	33°01'36.33"	1190	20°30'31.77"	32°54'58.90"	1328
20°26'31.76"	33°18'00.94"	1340	20°34'28.82"	32°57'22.40"	1328	20°30'33.25"	32°54'45.24"	1340
20°26'18.51"	33°17'58.18"	1353.5	20°38'34.92"	32°59'07.08"	1205	20°30'47.32"	32°54'40.94"	1340
20°26'05.34"	33°17'55.46"	1370	20°36'17.80"	33°00'21.36"	1170	20°30'59.89"	32°54'34.73"	1320
20°25'51.44"	33°17'57.28"	1343.1	20°35'08.37"	33°00'34.12"	1199	20°31'07.55"	32°54'25.18"	1320

Witberg			Esizayo			Roggeveld		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°27'28.41"	33°16'59.33"	1378.8	20°36'54.18"	33°01'16.68"	1199	20°31'20.88"	32°54'19.25"	1301
20°27'14.18"	33°17'00.46"	1387.1	20°38'07.45"	33°01'08.78"	1139	20°31'29.89"	32°54'10.58"	1291
20°26'59.96"	33°17'00.88"	1369.3	20°39'15.22"	32°59'47.79"	1120	20°31'30.66"	32°53'56.88"	1260
20°22'22.34"	33°17'49.96"	1230	20°35'41.12"	33°00'37.48"	1180	20°31'35.77"	32°53'45.18"	1230
20°21'59.66"	33°17'54.29"	1220	20°38'32.57"	33°00'50.99"	1077	20°31'41.21"	32°53'34.61"	1194
20°21'45.50"	33°17'54.78"	1220	20°35'58.51"	33°00'26.17"	1160	20°31'47.35"	32°53'24.44"	1200
20°21'31.88"	33°17'54.92"	1220	20°37'46.52"	33°00'03.77"	1100	20°31'55.36"	32°53'15.25"	1230
20°28'23.16"	33°17'04.97"	1424.4	20°37'03.75"	33°01'31.32"	1190	20°32'04.80"	32°53'06.84"	1218
20°25'38.42"	33°17'59.93"	1320.1	20°38'09.70"	32°59'49.23"	1120	20°32'14.43"	32°52'57.72"	1173
20°26'44.72"	33°17'59.29"	1340	20°39'11.54"	32°59'02.32"	1200	20°32'23.56"	32°52'49.13"	1180
			20°38'21.34"	32°59'29.78"	1128	20°32'29.26"	32°52'38.65"	1188
			20°37'05.80"	33°01'03.72"	1145	20°32'48.91"	32°52'22.79"	1230
			20°38'32.85"	32°59'42.80"	1119	20°32'57.06"	32°52'13.58"	1205
			20°39'48.11"	32°59'12.16"	1180	20°32'36.70"	32°52'27.87"	1240
			20°36'45.10"	32°59'08.38"	1165	20°30'05.26"	32°54'21.85"	1304
			20°40'51.63"	32°59'26.94"	1174	20°29'51.83"	32°54'06.01"	1298
			20°35'08.94"	32°58'32.35"	1196	20°30'03.85"	32°54'00.56"	1313
			20°38'15.65"	32°59'07.03"	1179	20°30'10.80"	32°53'50.33"	1286
			20°37'19.56"	32°59'58.82"	1105	20°30'13.89"	32°53'38.86"	1270
			20°35'05.32"	32°57'42.00"	1251	20°30'21.01"	32°53'26.18"	1270
			20°37'21.71"	32°59'06.87"	1158	20°30'25.68"	32°53'15.42"	1261
			20°36'35.18"	33°00'14.92"	1120	20°30'24.66"	32°53'04.04"	1236
			20°35'40.16"	32°57'06.40"	1197	20°30'18.27"	32°52'44.60"	1270
			20°35'24.40"	32°58'22.66"	1210	20°32'25.36"	32°51'34.69"	1100
			20°36'56.46"	32°59'53.88"	1111	20°32'28.27"	32°51'23.15"	1089
			20°35'07.17"	32°57'58.25"	1221	20°32'33.48"	32°51'12.61"	1087
			20°35'21.92"	33°00'22.80"	1161	20°30'34.11"	32°52'41.54"	1240
			20°36'40.63"	33°01'28.00"	1160	20°30'05.02"	32°52'46.81"	1230
			20°39'40.12"	33°00'25.20"	1060	20°29'29.70"	32°56'43.50"	1410
			20°39'28.85"	32°59'08.86"	1182	20°29'30.70"	32°56'58.59"	1419
			20°37'21.56"	32°59'42.59"	1118			
			20°36'58.31"	33°00'11.74"	1104			
			20°34'53.49"	32°58'42.04"	1171			
			20°38'11.37"	33°00'52.55"	1083			
			20°36'27.28"	33°00'57.11"	1142			
			20°35'34.50"	32°56'40.40"	1141			
			20°34'46.05"	32°57'45.19"	1246			
			20°35'31.94"	32°58'58.40"	1160			



Soetwater			Karusa		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°42'02.34"	32°44'33.40"	1420	20°37'51.20"	32°46'50.73"	1310
20°41'15.97"	32°44'03.45"	1395	20°37'43.61"	32°46'58.09"	1310
20°40'51.47"	32°43'54.06"	1408	20°38'45.89"	32°47'29.63"	1315
20°40'28.05"	32°43'46.64"	1410	20°38'38.17"	32°47'36.42"	1340
20°40'25.19"	32°43'55.65"	1394	20°38'30.19"	32°47'42.67"	1333
20°40'10.60"	32°43'58.52"	1390	20°38'13.19"	32°47'44.41"	1309
20°40'05.60"	32°44'06.40"	1390	20°37'58.00"	32°47'49.47"	1231
20°39'54.17"	32°44'10.83"	1384	20°37'43.41"	32°47'52.40"	1241
20°39'38.74"	32°44'12.97"	1370	20°37'29.87"	32°47'55.90"	1260
20°39'23.12"	32°44'14.92"	1347	20°37'18.09"	32°48'00.65"	1256
20°39'05.72"	32°44'15.58"	1360	20°37'09.37"	32°48'17.43"	1250
20°38'58.76"	32°44'30.92"	1316	20°37'05.78"	32°48'29.30"	1250
20°38'53.65"	32°44'38.90"	1310	20°37'03.39"	32°48'38.68"	1263
20°38'44.38"	32°44'44.99"	1320	20°37'01.31"	32°48'48.00"	1286
20°38'34.41"	32°44'50.65"	1320	20°37'05.58"	32°49'00.08"	1280
20°38'24.65"	32°44'56.35"	1310	20°37'08.81"	32°49'11.83"	1238
20°38'13.37"	32°45'12.42"	1293	20°37'05.55"	32°49'39.38"	1212
20°37'59.92"	32°45'15.87"	1290	20°37'01.28"	32°49'47.88"	1244
20°37'43.52"	32°45'17.59"	1320	20°36'57.13"	32°49'56.41"	1270
20°37'32.83"	32°45'22.59"	1314	20°36'54.97"	32°50'05.91"	1260
20°37'36.62"	32°45'34.30"	1308	20°36'49.90"	32°50'14.04"	1260
20°37'40.40"	32°45'46.10"	1330	20°36'46.66"	32°50'23.60"	1264
20°44'16.41"	32°46'12.27"	1364	20°36'30.49"	32°50'48.94"	1240
20°43'52.03"	32°46'28.21"	1308	20°36'18.84"	32°50'53.80"	1206
20°42'34.39"	32°47'23.36"	1150	20°36'03.62"	32°51'32.40"	1226
20°41'47.31"	32°47'53.19"	1189	20°35'52.88"	32°51'37.49"	1246
20°41'50.47"	32°48'08.06"	1213	20°35'42.80"	32°51'43.27"	1227
20°41'40.83"	32°48'13.55"	1237	20°37'48.68"	32°52'51.08"	1230
20°41'54.15"	32°44'39.15"	1379	20°38'12.30"	32°52'52.82"	1211
20°38'48.16"	32°44'16.36"	1360	20°38'31.47"	32°52'50.99"	1210
20°38'21.03"	32°45'05.39"	1300	20°38'38.54"	32°52'43.53"	1213
20°37'50.74"	32°46'02.55"	1275	20°38'41.70"	32°52'33.65"	1180
20°43'50.02"	32°45'45.80"	1370	20°38'45.44"	32°52'24.46"	1160
20°43'37.55"	32°45'51.04"	1370	20°38'47.29"	32°52'14.22"	1150
20°44'18.42"	32°46'02.09"	1390	20°37'32.90"	32°46'24.23"	1301
20°43'56.76"	32°46'06.28"	1366	20°37'34.92"	32°46'36.21"	1304
20°42'26.69"	32°47'33.01"	1212	20°38'00.19"	32°47'11.17"	1339
20°42'19.71"	32°47'39.68"	1243	20°37'58.80"	32°47'21.36"	1347
20°42'11.23"	32°47'45.05"	1248	20°39'43.02"	32°47'33.21"	1285
20°41'58.19"	32°47'48.04"	1208	20°39'36.53"	32°47'40.47"	1326

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Soetwater			Karusa		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°41'33.74"	32°48'20.42"	1250	20°39'29.70"	32°47'47.63"	1333
20°41'21.77"	32°48'22.99"	1267	20°39'12.94"	32°47'45.63"	1321
20°41'15.33"	32°48'30.06"	1270	20°37'09.81"	32°48'06.67"	1240

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