

# NAMIBRAND NATURE RESERVE INTERNATIONAL DARK SKY RESERVE



## Annual report and light audit 2015



Photo: Felix Lipov (Visiting Photographer)

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## INTRODUCTION

### **International Dark Sky Association – NRNR Annual light audit report**

In 2012 the NamibRand Nature Reserve was inscribed as an International Dark-Sky Reserve at the Gold Tier level. For this reason an annual report and light audit is compiled to monitor any changes made to external light fixtures and gauge if these changes meets the criteria of the IDSA.

A Sky Quality Meter with a USB interface which was installed on the Reserve in July, 2012 still gives a regular interval live update of readings throughout the night. This SQM is situated on the roof of the Keerweder office. The graph on page 16 shows the readings taken by the SQM over one particular evening.

A second portable SQM (Unihedron Sky Quality Meter with Lens - Narrow Field of View SQM-L), purchased in October 2013 is used to take SQM readings at the sites where the quality of the night sky was originally measured when our submission was made. These readings are done annually and are shown in table 1 on page 17.

For the reporting year, September 2014 to 1 October 2015, the Reserve was visited by approximately 15 000 visitors. This is about 1 000 less visitors then the same period last year. This drop in visitor numbers is believe to be as a result of, amongst others, the economic hardship we are currently facing globally and cancellations in bookings due to the sensationalized Ebola virus threat.

All our concessionaires continually educate their guests about Dark Sky Reserves, and the importance of it. In 2014 at least 30% participated in stargazing and other astronomy related activities. This figure was increased as more guest coming to the Reserve are aware of our Dark Sky status. Concessionaires are continually reporting on the increase in interest shown by their guest on astronomy activities. The Sossusvlei Desert Lodge hosts a visiting astronomer throughout the year who guides their stargazing enthusiast guests at their observatory with a 12-inch Meade LX200 telescope every night. Wolwedans, one of our other concessionaires, have now started to become more involved in astronomy activities. Guides are educated to identify elementary star constellations and they now have a professional Astronomer, working on a consultant basis. They host frequent star gazing sessions and also continue to highlight the importance of having dark skies. Wolwedans hosted a desert guiding course in February. One of the modules handles during this course was Astronomy and the importance of a dark sky. Our environmental education Centre, NaDEET, hosts about a 1000 children and community members each year, and all of them participate in stargazing activities at the Centre. Tok Tokkie Trails and the NamibRand Family Hideout guests are also very enthusiastic about the dark sky and continue to eagerly participate in astronomy activities.

In early October 2015, NamibRand Nature Reserve and Sossusvlei Desert Lodge featured in an article in the CNN magazine, <http://edition.cnn.com/2015/10/11/travel/namibia-desert->

[sossusvlei-stargazing/index.html](https://www.sossusvlei-stargazing/index.html) . The Reserve is complimented on its beautiful dark skies and also mentioned as an inscribed International Dark Sky Reserve.

## Monitoring



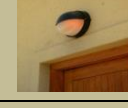

### Monitoring methods used

#### 1. External lighting audit








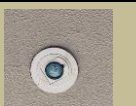
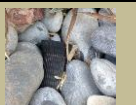


Pages 5 to 15 below show the external lighting fixtures at all the establishments and homesteads on the Reserve. In this report, only added, changed or removed light fixtures are indicated/demonstrated with a picture. All external light fixtures which remained unchanged since 2014 were indicated accordingly.



All external lighting fixtures which were changed, removed or added are indicated as such in the column 2015.


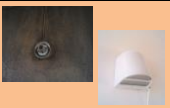
For all external light fixtures changes or additions, strict consideration was applied to make sure these light fixtures are dark-sky friendly.


Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Sossusvlei Desert Lodge Staff Village (on map shown as Vremdelingspoort)	Staff Quarters	22	Wall Light 7W CF 400 lumens	Yes						Building Egress		Remain Unchanged since 2014	Remain unchanged
	Walkways	11	Post Light (Bollard) 15W Red CF							Safety Lights on Walkways		Remain unchanged since 2014	90 lumen red bulbs - Remain unchanged
	Workshop	2	Wall Light 7W CF 400 lumens	Yes						Building Egress		Remained unchange since 2014	Remain unchanged
	Staff Quarters	1	Wall Light 7W CF 400 lumens	Yes						Building Egress		Remain unchanged since 2014	Remain unchanged
	Chef's Quarters	1	Wall Light 7W CF 400 lumens	Yes						Building Egress		Remain unchanged since 2014	Remain unchanged
	Chef's Quarters	2	Wall Light 7W CF 400 lumens	Yes						Building Egress		Remain unchanged since 2014	Remain unchanged
	Ranger's Quarters	2	Wall Light 12W Red CF	Yes						Building Egress		Remain unchanged since 2014	166 lumen red bulbs - Remain unchanged
	Ranger's Quarters	1	Wall Light 12W Red CF	Yes						Building Egress		Remain unchanged since 2014	166 lumen red bulbs - Remain unchanged

Sossusvlei Desert Lodge (on map shown as Mountain Lodge)

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Sossusvlei Desert Lodge (on map shown as Mountain Lodge)	Managers Residence	8	Wall Light 12W Red CF	Yes						Building Egress		Remained unchanged since 2014	166 lumen red bulbs Lights remain unchanged
	Assistant Managers Residence	8	Wall Light 12W Red CF	Yes						Building Egress		Remained unchanged since 2014	
	Guests Villas (10)	10	Front Wall Light 14W Red CF	Yes						Building Egress		Remained unchanged since 2014	Fully Shielded By Building - Remain Unchanged
	Guests Villas (10)	30	Wall Light 50W Halogen	Yes						Illumination of Outside Showers		Remained unchanged since 2014	Remain unchanged
	Guests Villas (10)	20	Recessed Ceiling Light 20W Halogen	Yes						Illumination of Walkway		Remained unchanged since 2014	Remain unchanged
	Kitchen	3	Wall Light 12W Red CF	Yes						Building Egress		Remained unchanged since 2014	166 lumen red bulbs Remain unchanged
	Main Lodge Building	2	Wall Light 12W Red CF	Yes						Building Egress		Remained unchanged since 2014	166 lumen red bulbs Remain unchanged
	Main Lodge Building	13	Recessed Ceiling Light 20W Halogen	Yes						Illumination of Walkways		Remained unchanged since 2014	Remain Unchanged
	Main Lodge Building	2	Flood Lamp 22W CF	Yes						Sign Illumination		Remained unchanged since 2014	Remain Unchanged
	Main Lodge Building	2	Wall Light 20W Incandescent	Yes						Building Egress		Remained unchanged since 2014	Fully Shielded By Building - Remain unchanged
	Walkways	40	Post Light 14W Red CF	Yes						Safety Lights on Walkways		Remained unchanged since 2014	Lights Are At 18 Inch Height - Remain unchanged


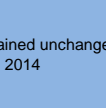

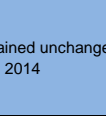

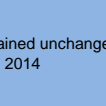
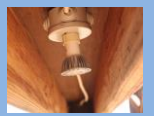
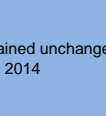
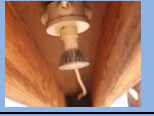



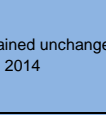

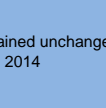
Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
<b>Kwessiegat</b>	Residence	2	Wall Light 7W Amber CF 300 lumens	Yes	2	0	0	0	0	Illuminate Porch		Remain Unchanged since 2014	Remain unchanged
	Residence	2	Overhead Light 7W Amber CF 300 lumens	Yes	2	0	0	0	0	Illuminate Porch		Remain Unchanged since 2014	Light Fixture was changed but is still shaded and at the same location





Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
<b>Toekoms</b>	Residence 1	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Residence 2	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Keerweder	Guest House	1	Wall Light 7W Amber CF 300 lumens	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Guest House	1	Wall Light 7W Amber CF 300 lumens	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Warden's Residence	3	Wall Light 7W Amber CF 300 lumens	Yes	3	0	0	0	0	Egress		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Warden's Residence	3	Bare Bulb 7W Amber CF 300 lumens	Yes	3	0	0	0	0	Egress		Remain Unchanged since 2014	Fully Shielded by Structure - Remain unchanged
	Workshop	0	No Light, Removed from Service	NA	0	0	0	0	0	NA		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Student Residence	1	Wall Light 7W Amber CF 300 lumens	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Workers' Quarters	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Workers' Quarters	1	Wall Light 7W Amber CF 300 lumens	Yes	1	0	0	0	0	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Butchery	1	Wall Light 7W Amber CF 300 lumens	Yes	1	0	0	0	0	Work area illumination		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Waterhole	0	No Light, Removed from Service	NA	0	0	0	0	0	NA	Light Removed	Remain Unchanged since 2014	Remain Unchanged and fully shielded



Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Wolwedans Base	Workshop	0	No Light, Removed from Service	NA	0	0	0	0	0	NA		Remain Unchanged since 2014	Remain unchanged
	Workshop	6	Wall Light 14W CF	Yes	6	6	0	6	0	Work area illumination		Remain Unchanged since 2014	Remain unchanged
	Workshop	1	Overhead Light 72W Fluorescent	Yes	1	1	0	1	0	Work area illumination		Remain Unchanged since 2014	Remain unchanged
	Reception	1	55 Watt Warm White	Yes	1	1	0	1	0	Varenda Reception		Remained unchange since 2014	Fully Shielded
	Reception Coffee Lounge	1	55 Watt Warm White	Yes	1	1	0	1	0	Coffee Lounge		Remained unchange since 2014	Fully Shielded - Newly fitted light fixture
	Kitchen	2	55 Watt Warm White	Yes	2	2	0	0	0	Kitchen Varenda/Dining Area		Remained unchange since 2014	Fully shielded
	Front of Kitchen	2	55 Watt Warm White	No	2	2	0	0	0	In front of the Kitchen		Remained unchange since 2014	Remain Unchanged
	Laundry Varenda	1	55 Watt Warm White	Yes	1	1	0	0	0	Laundry Varenda / Dining area		Remained unchange since 2014	Light were replaced by a fully shielded light
	Farm Shop	1	18 Watt Warm White	Yes	1	1				Farm Store Varenda		Remained unchange since 2014	Light was replaced with a new fully shielded light fixture
	Store Room	1	11 Watt Warm White	Yes	1	1				In Front of the Store		Remained unchange since 2014	Put in after first Audit
	Back of Guide Room	2	11 Watt Warm White	Yes	2	2				Varenda		Remained unchange since 2014	Put in after first Audit
	Welding Workshop			2 Int Bulb 1185 Watt						Used for occasional night welding		Remained unchange since 2014	Not used very often Half Shaded - Put in After first audit
	Car Park	1	85 Watt Cool White		1	1						Remained unchange since 2014	Not used very often Half Shaded
	Student (DA) House	6			Yes							Remained unchange since 2014	Shaded by the Building Roof - Put in After first audit
Walkways	8	Cool White LED	Yes	8	0	0	0	0	0	No light fixture at the time		Added in 2015	



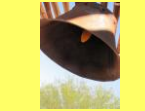



Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes	
Wolwedans Dune Lodge	Main Lodge	1	Wall Light 15W Incandescent	No	0	0	0	0	0	Porch Lighting			Remained unchanged since 2014	Remain Unchanged and fully shielded
	Walkways	13	Mounted Under Benches 15W Incandescent	Yes	13	0	0	0	0	Illumination of Walkways			Remained unchanged since 2014	Remain Unchanged and fully shielded
	Guest Chalets	10	Wall Light 7W Amber CF 300 lumens	No	0	0	0	0	0	Egress			Remained unchanged since 2014	Remain Unchanged and fully shielded
	Walkways	9	Flood Lamp 3W LED Mounted Under Benches	Yes	9	0	0	0	0	Illumination of Walkways			Remained unchanged since 2014	Remain Unchanged and fully shielded
	Guest Rooms	20	Flood Lamp 3W LED Mounted Under Benches	Yes	20	0	0	0	0	Egress			Remained unchanged since 2014	Remian unchanged and fully shielded
	Walkway Lights	15	Solar Jar Lamps	Yes		0	0	0	0	Illumination of Walkways	No light fixture at the time		Added in 2015	
Wolwedans Dune Camp	Old Dune Camp	9	Under Railing Mounted 5W Incandescent	Yes	9	0	0	0	0	Illumination of Walkways			Remained unchanged since 2014	Remain Unchanged and fully shielded
	Walkways	10	Unpressurized Oil Lantern	No	0	0	0	0	0	Illumination of Walkways			Remained unchanged since 2014	Remain Unchanged

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Wolwedans Private Camp	Walkways	9	Unpressurized Oil Lantern	No	0	0	0	0	0	Illumination of Walkways		Remained unchange since 2014	Remain Unchanged
	New Room	5	Wall Mount 3watt warm white LED 60 Lumens	Yes	0	1	0	1	0	Lights up the Deck		Remained unchange since 2014	New external light fixtures to new Private Camp Room
	Deck LED Strip	2	Wall Mount 3watt warm white LED 60 Lumens	Yes	0	1	0	1	0	Light up the deck		Remained unchange since 2014	New external light fixtures to new Private Camp Room
Wolwedans Boulders	Walkways	52	Unpressurized Oil Lantern	No	0	0	0	0	0	Illumination of Walkways		Remained unchange since 2014	Remain Unchanged

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
<b>NaDEET Centre</b>	Main Building	1	Wall Light 11W CF	Yes	1	1	0	0	0	Egress		Remained unchange since 2014	Unchanged since 2011
		1	Wall Light 11W CF	Yes	1	1	0	0	0	Dish Washing		Remained unchange since 2014	On motion detector/timer (foil around fixture) Unchanged since 2011
<b>NaDEET (Die Dune)</b>	Base	1	Overhead Bare Bulb 14W CF	Yes	1	1	0	0	0	Front Office		Remained unchange since 2014	Unchanged since 2011
	Director's Residence	1	Wall Light 5W CF	Yes	1	0	0	0	0	Veranda lighting		Remained unchange since 2014	Fully Shielded By Building Unchanged since 2011
	Director's Residence	1	Wall Light 5W CF	Yes	1	0	0	0	0	Veranda lighting		Remained unchange since 2014	Fully Shielded By Building Unchanged
	Base	1	18 Watt Warm White	Yes	1	1	0	0	0	Work Area		Remained unchange since 2014	Unchanged since 2011
	Little House	1	Wall Light 15 Watt CF	Yes	1	1				Veranda lighting		Remained unchange since 2014	Unchanged since 2013
	Back Rooms	1	Overhead Bare Bulb 11W CF	Yes	1	1	0	0	0	Residence Veranda Lightning		Remained unchange since 2014	Unchanged since 2011

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
Die Dunie Tok Tokkie Trails	Base	1	Wall Light 5W CF	Yes	1	1	0	0	0	Veranda lighting		Remain unchanged since 2014	Shield Added
	Base	1	Wall Light 14W CF	Yes	1	1	0	1	0	Egress		Remain unchanged since 2014	On motion detector/timer Unchanged since 2011
	Base	1	Overhead Bare Bulb 11W CF	Yes	1	1	0	0	0	Work Area		Remain unchanged since 2014	Shield was changed to cover the whole light
	Base	1	Wall Light 10 Watt CF	Yes	1	1				Veranda lighting		Remain unchanged since 2014	Foil removed and Shield painted black
	Horseshoe Camp	2		Yes	1	1	0	0	0	Campsite		Remain unchanged since 2014	Both lights shielded by the roof - Newly fitted fixtures
	Horseshoe Camp	1		Yes	1					Campsite		Remain unchanged since 2014	Fully Shielded - Newly fitted light fixture
	Horseshoe Camp	1								Campsite		Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture
	Horseshoe& Schafsberg Camp	4								Campsite		Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture
	Horseshoe& Schafsberg Camp	2								Camp site			Paraffin Lamps replaced with solar lamps
	Schafberg	1								Campsite		Remain unchanged since 2014	Fully Shielded - Newly fitted light fixture
Campsites	2										Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture	

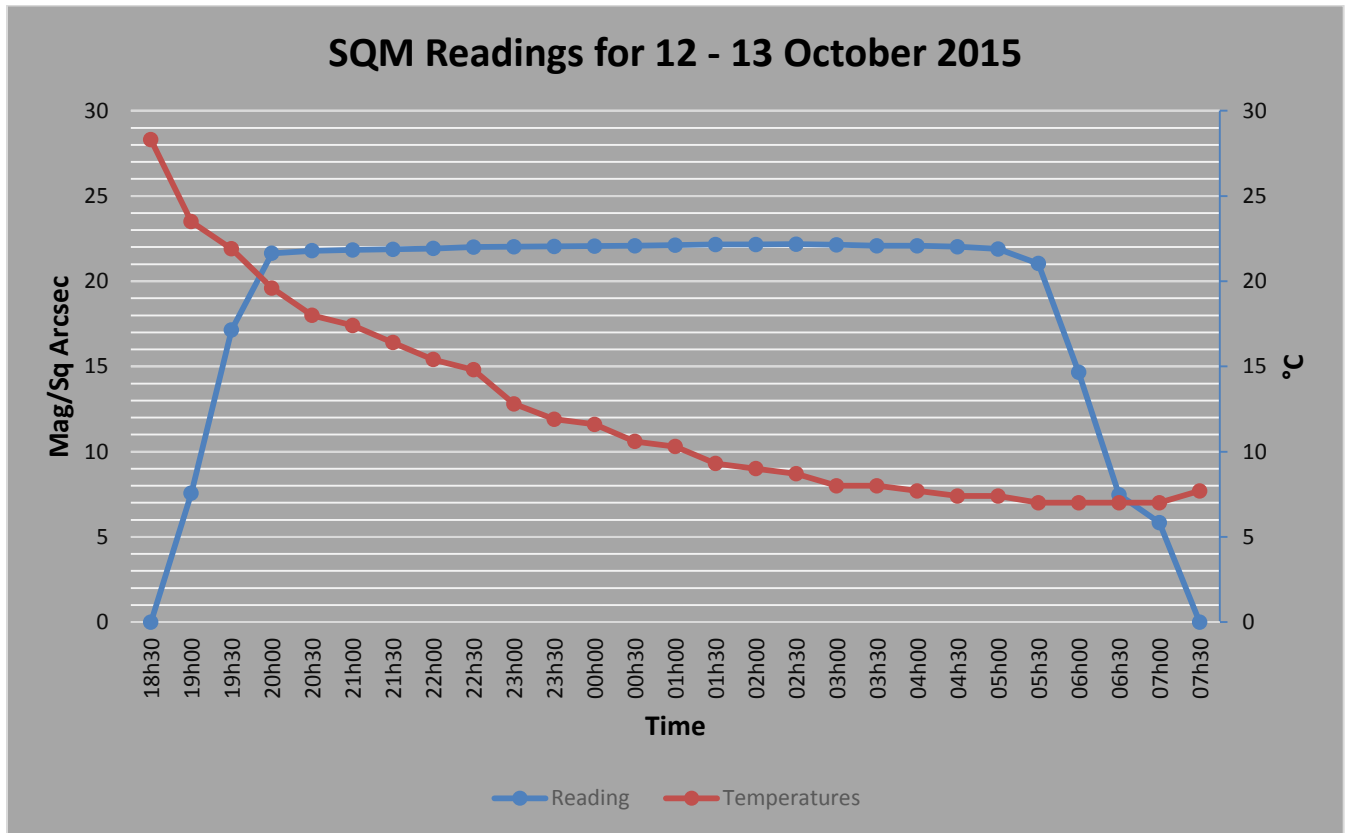
Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	image 2014	Image 2015	Notes	
<b>Family Hideout</b>	Residence	1	Wall Light 9W CF	Yes	1	1	0	0	0	Porch Lighting		Remained unchanged since 2014	Fully Shielded By Building unchanged since 2011	
	Campsite 1 (Orion)	1	Wall Light 5W CF	Yes	1	1	0	0	0	Dish Washing Station		Remained unchanged since 2014	Unchanged since 2011	
	Campsite 1(Orion)	4	Wall Light 5W CF	Yes	1	1	0	0	0	Dish Washing Station		Remained unchanged since 2014	Unchanged since 2014	
	Campsite 2 - New Campsite (Venus)	1	Wall Light 5W CF	Yes	1	1	0	0	0	0	No Ligh fixture at the time			New Light fixtures
	Campsite 2 - New Campsite (Venus)	1	Wall Light 5W CF	Yes	1	1	0	0	0	0	No Ligh fixture at the time			New Light fixtures
Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes	
<b>Aandster</b>	Residence	8	Recessed Ceiling Light 3W LED	Yes	8	0	0	0	0	Porch Lighting		Remain unchanged since 2014	Remain Unchanged	
	Annex	0	No Lights, Removed from Service	NA	0	0	0	0	0	Egress		Remain unchanged since 2014	Remain Unchanged	
	Annex	1	Wall Light 40W Incandescent	Yes	1	1	0	0	0	Egress		Remain unchanged since 2014	Fully Shielded By Building	
	Annex	0	No Light, Removed from Service	NA	0	0	0	0	0	Security		Remain unchanged since 2014	Remain Unchanged	
	Garage	1	Wall Light 40W Incandescent	Yes	1	1	0	0	0	Security	Remain Unchanged	Remain unchanged since 2014	Remain Unchanged	

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Number Fully Shielded	Number >500 Lumens	Number >500 Lumens and Not Fully Shielded	Number >1000 Lumens	Number >1000 Lumens and Not Fully Shielded	Application	Image 2014	Image 2015	Notes
<b>Springbokvlakte</b>	Bunk House	2	11A Under roof	Yes	2	2						Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	2	7 A Exposed	Yes	2	2						Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	3	65mA Oranngge Light	Yes	3	3						Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	12	Under Roof	Yes	12	12						Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Staff Quarters	2	Under Roof	Yes	2	2						Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Pool Area	4	75Ms Under roof	Yes	4	4						Remain unchanged since 2014	Shielded By Building - Remain unchanged

## 2. Sky Quality Meter with a USB interface was installed at Keerweder - Reserve headquarters.

The graph in figure 1 below shows the sky quality readings taken by the SQM reader at Keerweder on the night of the 12-13<sup>th</sup> of October 2015 and the corresponding temperatures.

Figure 1





### 3. Dark-Sky reading throughout the Reserve

The darkness of the sky measured on the nights of 22, 23 and 24 September 2015, were done at strategic locations spread throughout the Reserve. The time during which these readings were done it was almost full moon. The readings were thus done after moon set. The moon on the night of the 22<sup>nd</sup> set around 01h54, on the 23<sup>rd</sup> around 02h46, and the 24<sup>th</sup> around 03h36. The readings are done using a portable Unihedron Sky Quality Meter. Three readings are done with the SQM at each location in order to get an average reading. The reading is done at least 10m away from any building, trees and/or vehicle. The SQM is pointed directing up into the sky (but not facing the Milky Way) and the reading is taken and recorded.

Table 1 below shows the Dark-Sky reading taking on the nights of the 22<sup>nd</sup> to the 24<sup>th</sup> of September 2015. This year we added a new location, the intersection of the C19 and D845 roads to the north of the Reserve.

**Table 1**

Location	Latitude	Longitude	Date	Time	Average SQM reading for 2014	Average SQM reading for 2015
C19 to D845 Intersection (New Location)	24°41'55.95"S	16° 1'13.42"E	22/09/2015	01h37	-	21.37
C27 Road Intersection	24° 42' 25.40"S	15° 52' 56.24"E	22/09/2015	01h51	21.74	21.62
C27 Road at Northern Reserve Boundary	24° 45' 14.16"S	15° 53' 46.68"E	22/09/2015	01h59	21.69	21.75
C27 Road at Entrance to Sossusvlei Desert Lodge	24° 46' 51.84"S	15° 54' 13.02"E	22/09/2015	02h03	21.70	21.79
7C27 Road at Entrance to Kwessiegat	24° 50' 11.52"S	15° 54' 35.58"E	22/09/2015	02h09	21.72	21.80
C27 Road at Entrance to Camp Musho	24° 52' 59.88"S	15° 57' 16.19"E	22/09/2015	02h17	21.73	21.79
C27 Road at Entrance to Keerweder	24° 57' 32.74"S	16° 1' 26.33"E	22/09/2015	02h27	21.75	21.79
C27 Road at Entrance to Wolwedans	24° 59' 46.19"S	16° 3' 27.45"E	22/09/2015	02h32	21.73	21.79
C27 Road at Entrance to Toekoms	25° 2' 7.39"S	16° 5' 41.08"E	22/09/2015	02h38	21.68	21.81
C27 Road at NRRR Motor Gate	25° 6' 19.69"S	16° 6' 7.66"E	22/09/2015	02h45	21.64	21.74
C27 Road at Entrance to NaDEET	25° 12' 11.81"S	16° 9' 31.60"E	24/09/2015	03h45	21.62	21.54
NaDEET Centre (within Core)	25° 13' 42.49"S	16° 3' 37.35"E	24/09/2015	04h21	21.31	21.60
NaDEET / Tok Tokkie Trails Base (New Location)	25° 13' 42.49"S	16° 3' 37.35"E	24/09/2015	04h12	-	21.65
C27 Road at Entrance to Aandstêr (New Location)	25° 19' 0.50"S	16° 10' 13.92"E	23/09/2015	02h35	-	21.65
Aandstêr	25° 21' 40.44"S	16° 5' 59.74"E	23/09/2015	02h45	22.51	21.77
Springbokvlakte – Two Pumps	25° 26' 15.94"S	16° 1' 36.10"E	23/09/2015	02h08	20.93	21.67

Notes on the NamibRand Nature Reserve (NRNR) SQM measurements:

- Readings tabled in order of north to south.
- Namibian local time at this time of the year is UTC +1.
- Readings were done by NamibRand and NaDEET staff members.
- A Unihedron Sky Quality Meter with Lens - Narrow Field of View was used to take the readings.
- Measurements were made on three consecutive nights in 2015, the night of September 22-23, the night of September 23-24 and the night of September the 24-25.
- Conditions for all measurements were clear and cloudless. The Milky Way close to the horizon.
- Readings were taken after moonset.

## Summary

In the beginning of the year, 2015, a new campsite was built in the south of the Reserve (25°17'21.95"S, 16° 3'10.86"E) as part of the NamibRand Family Hideout concession. Two fully shaded new external light fixtures were installed at the campsite. Pictures indicated in the light audit spreadsheet on page 14. Eight walkway lights were installed at Wolwedans base. These lights shine down to the ground and are shaded. A new walkway has also been built at Wolwedans Dunes Lodge. Solar Jar lights are used for the walkway. At the Wolwedans Boulders Camp, the old staff quarters two new external light fixtures were fitted and are mounted under the porch roof and shines downwards. Pictures indicated in the audit sheet on pages 9 & 10. Tok Tokkie Trails replaced all their paraffin lamps with solar lamps at their respective camps. These are indicated on page 13.

The sky quality readings on page 17 show almost no change in the darkness of the sky, compared to last year. Although some lights were changed and added, this was strictly done under the requirements of the IDSA. This verifies to our commitment to preserve our dark skies, and to the ever increasing mindset to minimize light pollution in and around the Reserve.

