

**SIMULATIONS**

**017 Holden Beach**  
**Starlit Night**





## SIMULATION

### **017 Holden Beach**

#### **Starlit Night**

Siemens SWT-3.6-107

10 nm

Simulation  
**017 Holden Beach**  
 Starlit Night  
 Siemens SWT-3.6-107  
 10 nm

**GENERAL INFORMATION**

**Base Photograph**

Photo Name: HBS\_0588  
 Date: April 14, 2012  
 Time: 9:08 PM  
 GPS Coordinates<sup>1</sup>: lat 33.910182°, long -78.304541°  
 Viewpoint Elevation: 3'

**Weather**

Moon is below horizon  
 Weather Conditions: Starlit with scattered clouds  
 Visibility<sup>2</sup>: 10 mi  
 Wave Height: 1 - 1.5'  
 Period: 9 sec.

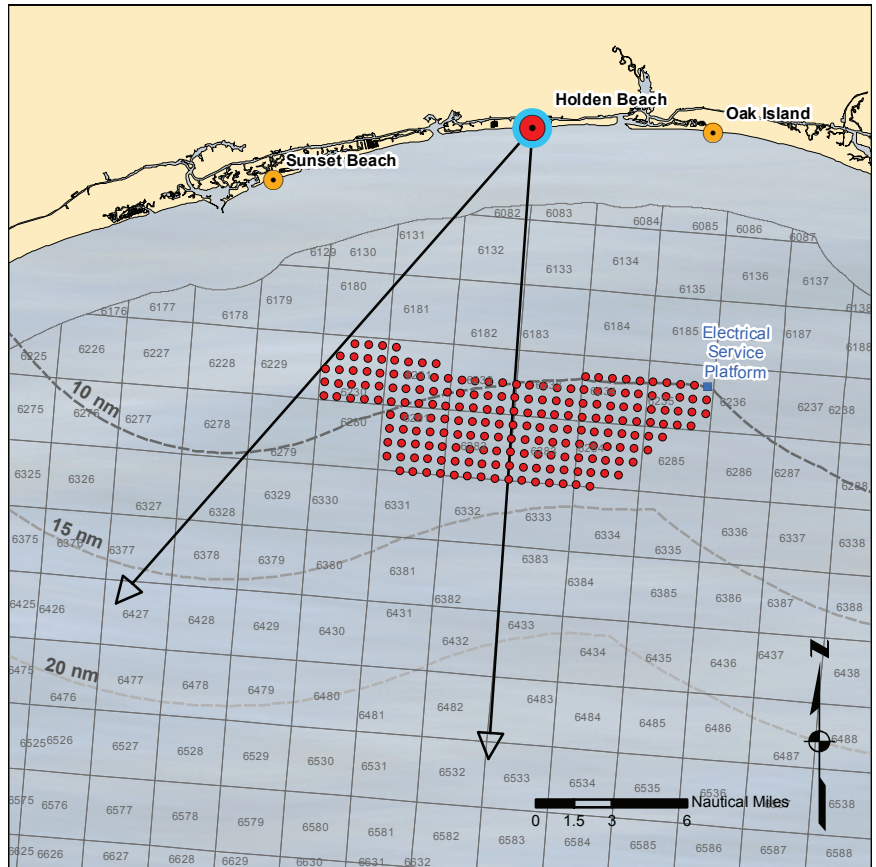
**Camera**

Camera Make/Model: Nikon D7000  
 Sensor Dimensions: 23.6 mm X 15.6 mm  
 Lens Make/Model: Nikkor DX AF-S 35 mm  
 Lens Focal Length: 35 mm  
 35 mm Equivalent Focal Length: 52.5 mm  
 Horizontal and Vertical Angles of View:  
 37.3° wide and 25.3° high  
 Camera Height: 1.5 m (5')  
 Camera Azimuth<sup>3</sup>: 199°

**Wind Turbine Information**

Number: 200  
 Make and Model: Siemens SWT-3.6-107  
 Height/Dimensions:  
 Support Structure/Monopile Ht.: 13 m (43')  
 Hub Ht. (above Monopile): 80 m (262')  
 Rotor Diameter: 107 m (351')  
 Total Height to Tip of Blade: 147 m (481')  
 Service Platform: A bldg. 50'H X 100'W X 200' L  
 elevated 50' above the water

**CONTEXT MAP**



**VIEWING INSTRUCTIONS**

The simulation is properly printed on an 11" X 17" sheet at actual size. If viewed on a computer monitor, use the highest screen resolution. The simulated image is at the proper perspective when viewed at 23.5" from the eye, or at a distance of approximately twice the image height.

**NOTES**

- The simulated light is derived from a photograph of an LED L-864 FAA warning light taken at Lempster, NH on a clear night from a distance of 15 nm. The photograph of the light as displayed on a Lenovo W520 laptop computer at a screen resolution of 1600 X 900 was compared to the light as actually seen. The selected image most closely captured what was actually seen.
- Refraction Coefficient<sup>4</sup> (k) = .075

**PANORAMA**



Simulation location within the panorama view (190° X 60°) from the Holden Beach site





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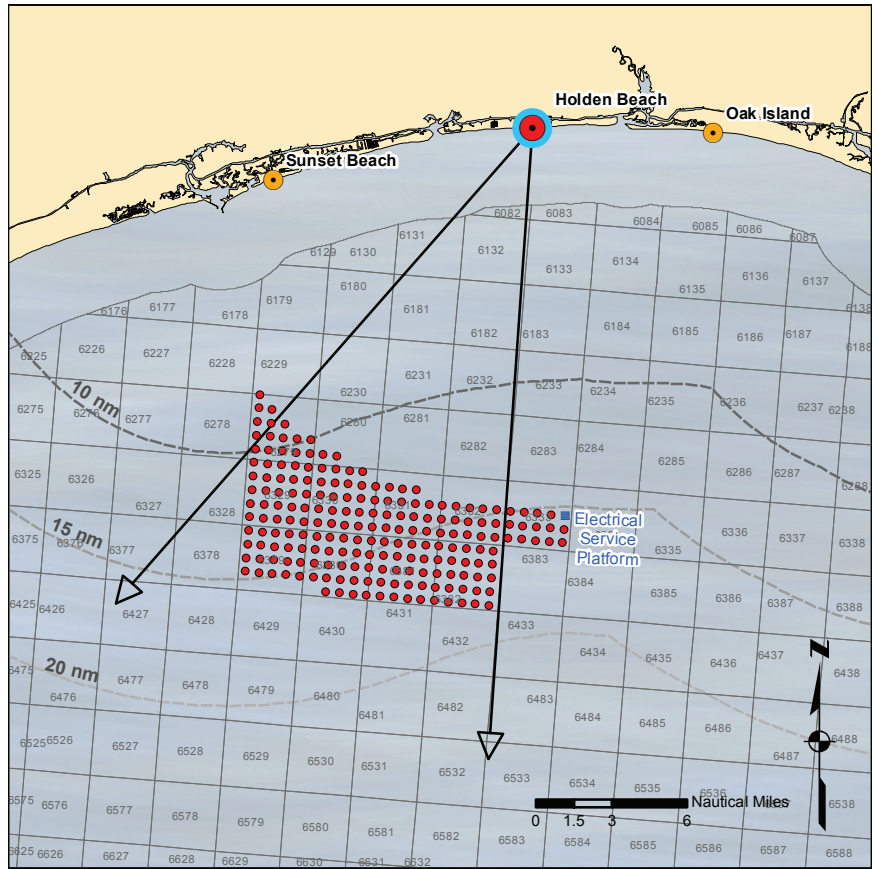
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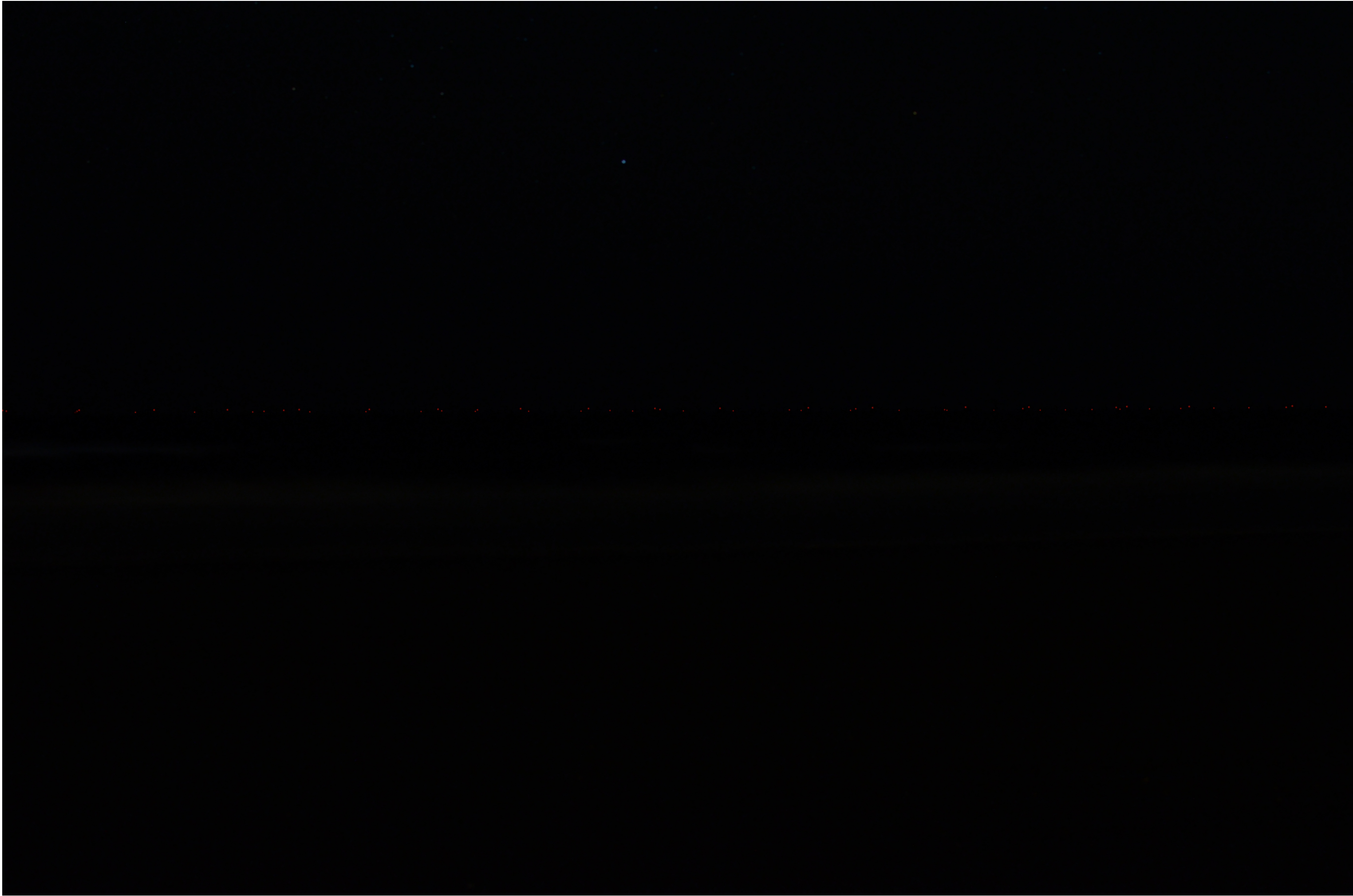
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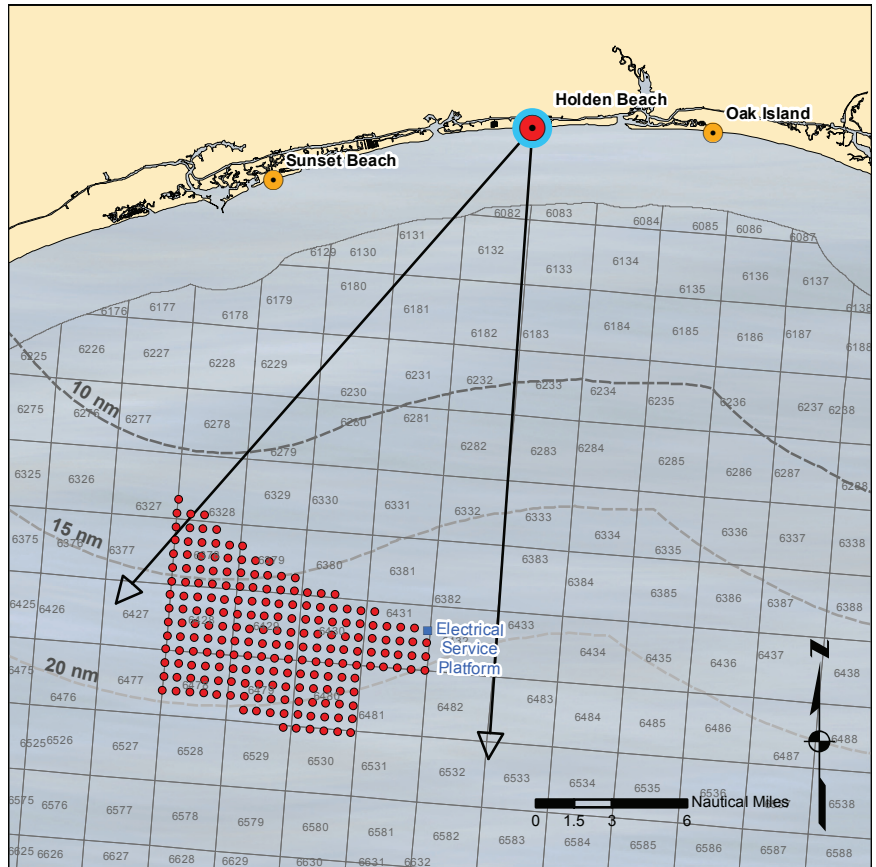
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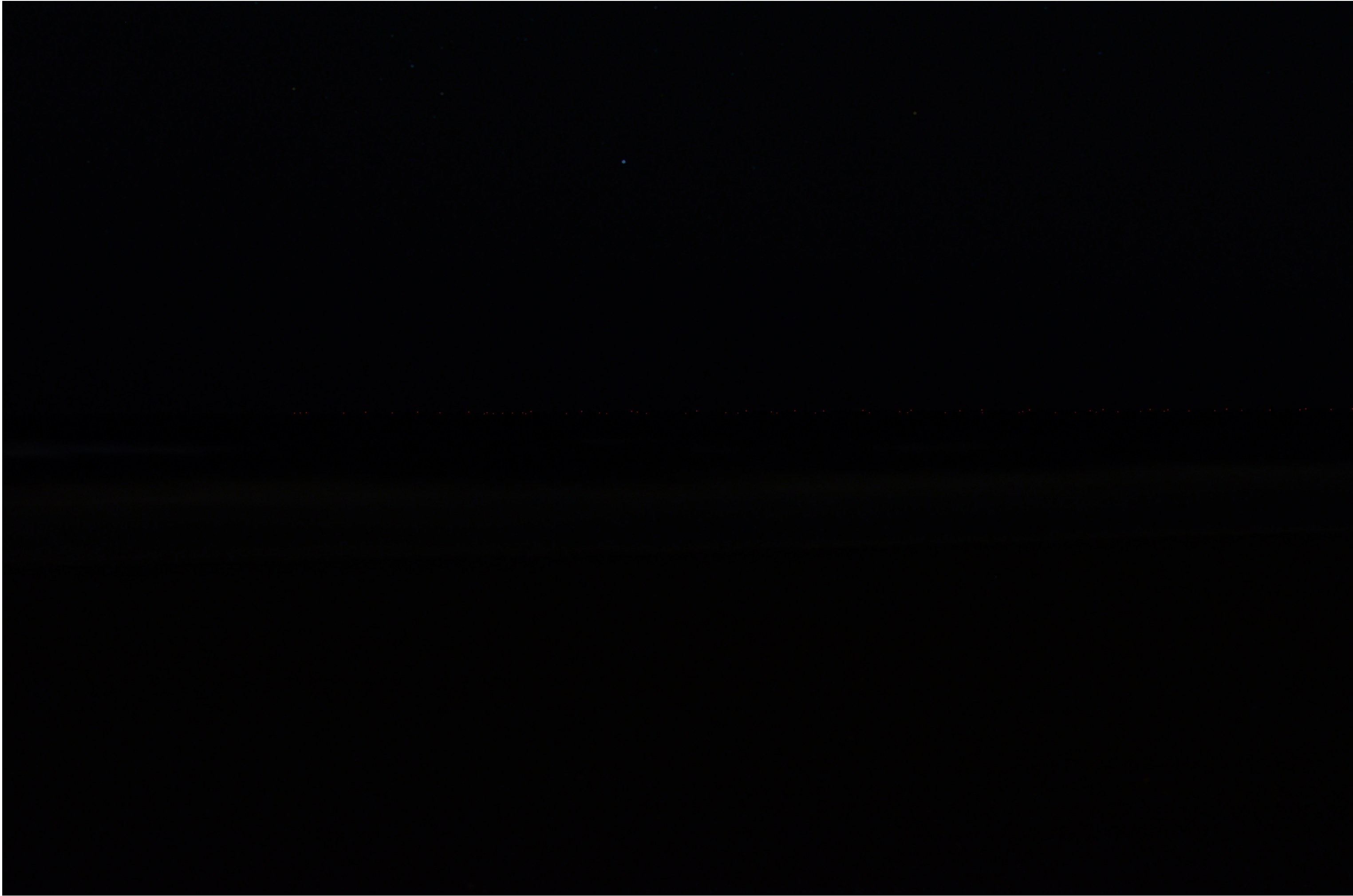
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Vestas V164-7.0 MW  
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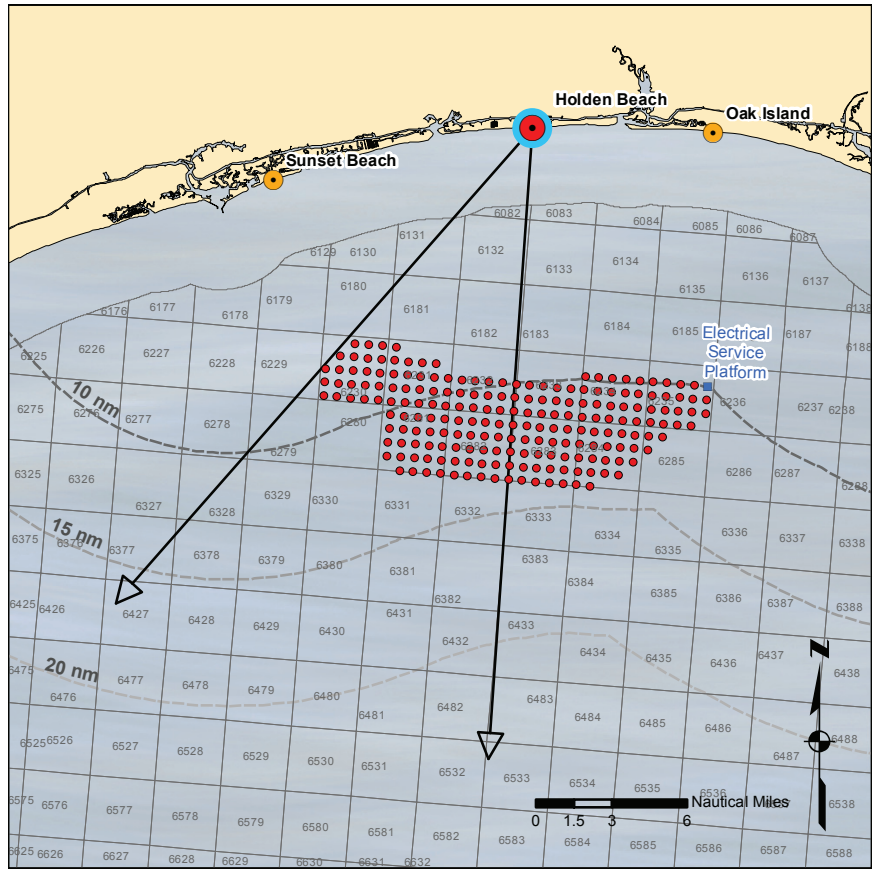
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Number: 200  
 Make and Model: Vestas V164-7.0 MW  
 Height/Dimensions:  
 Support Structure/Monopile Ht.: 13 m (43')  
 Hub Ht. (above Monopile): 105 m (345')  
 Rotor Diameter: 164 m (538')  
 Total Height to Tip of Blade: 200 m (656')  
 Service Platform: A bldg. 50'H X 100'W X 200' L  
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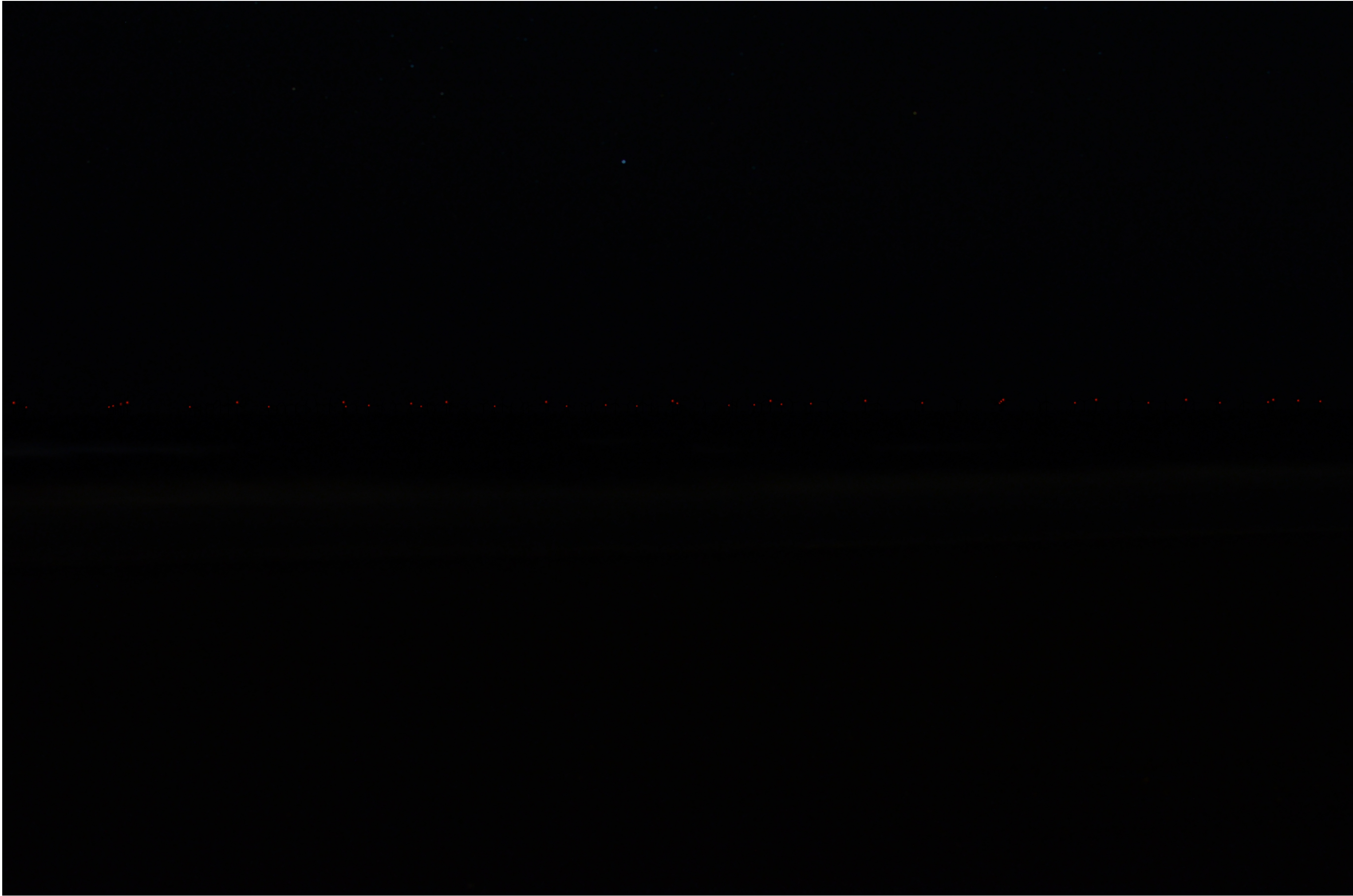
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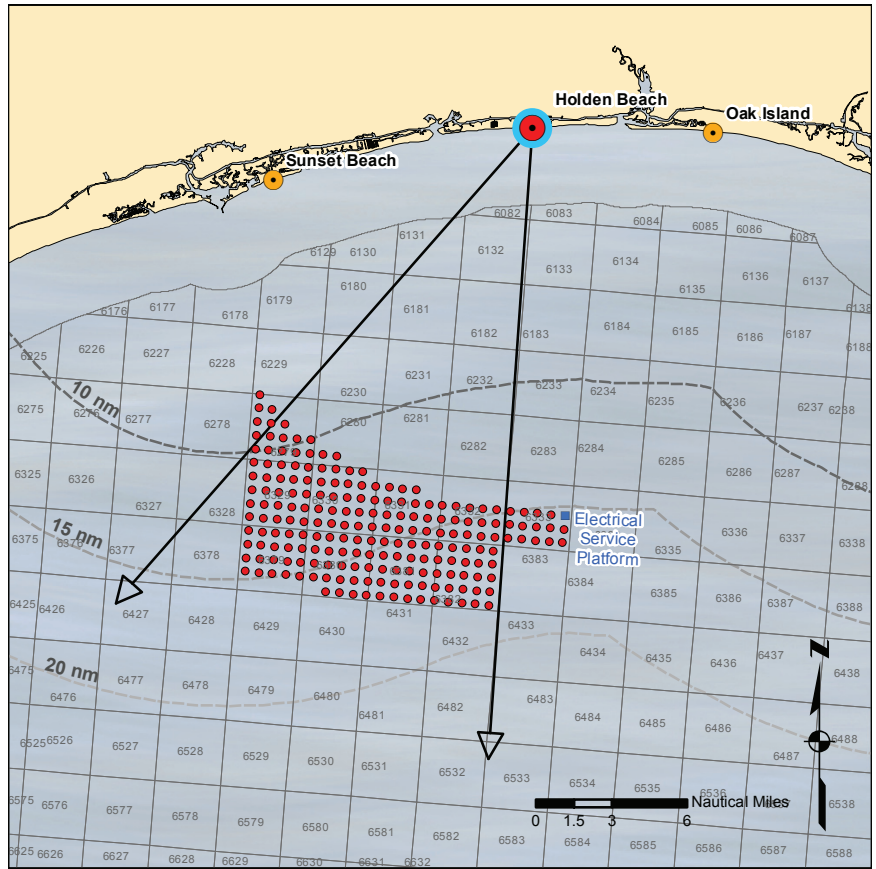
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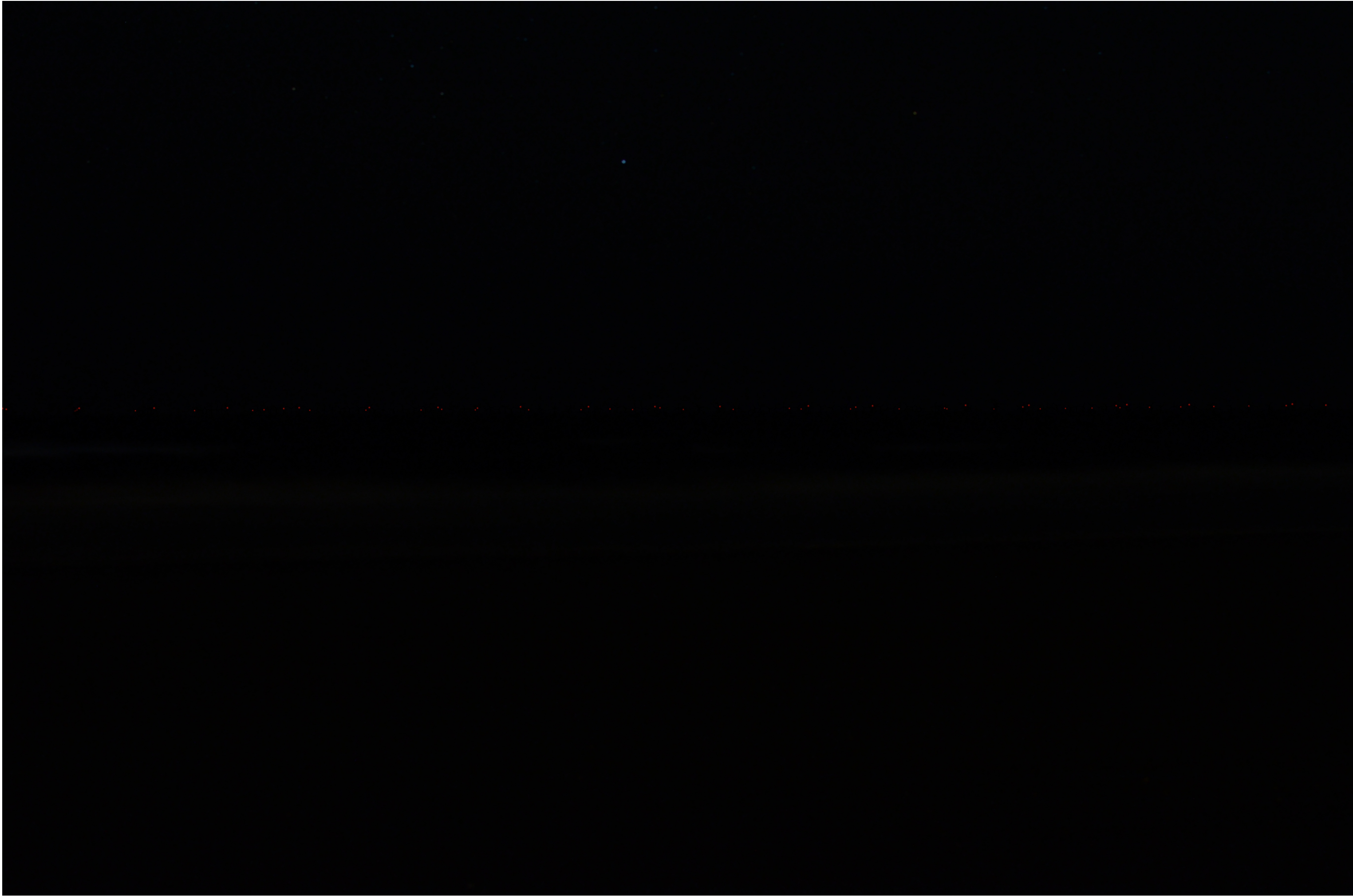
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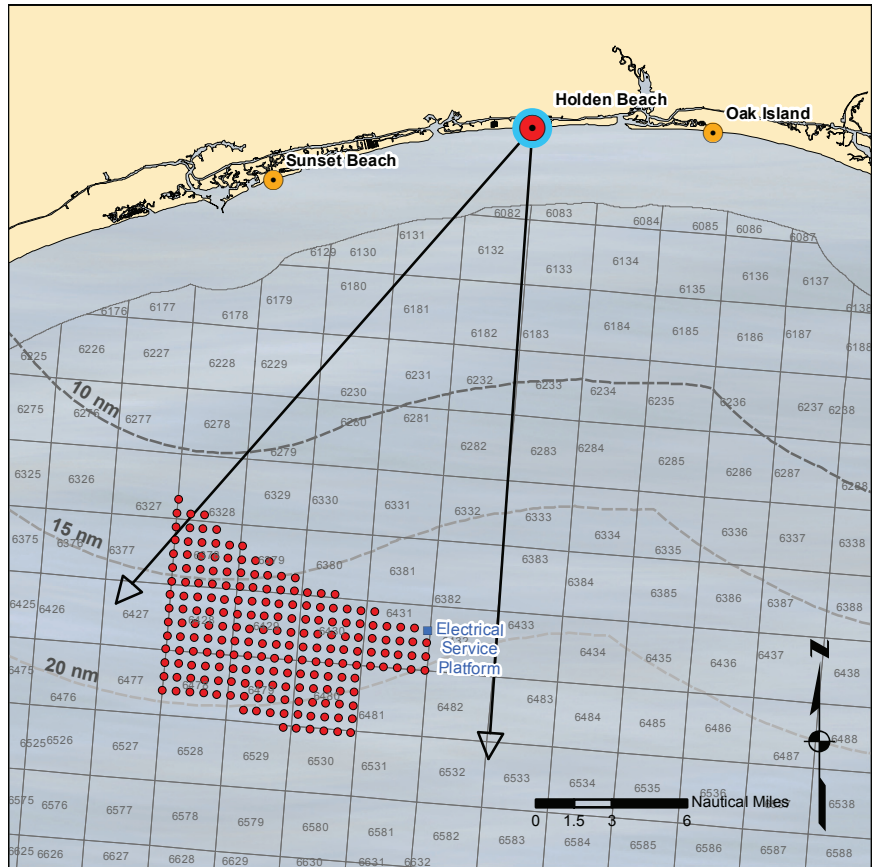
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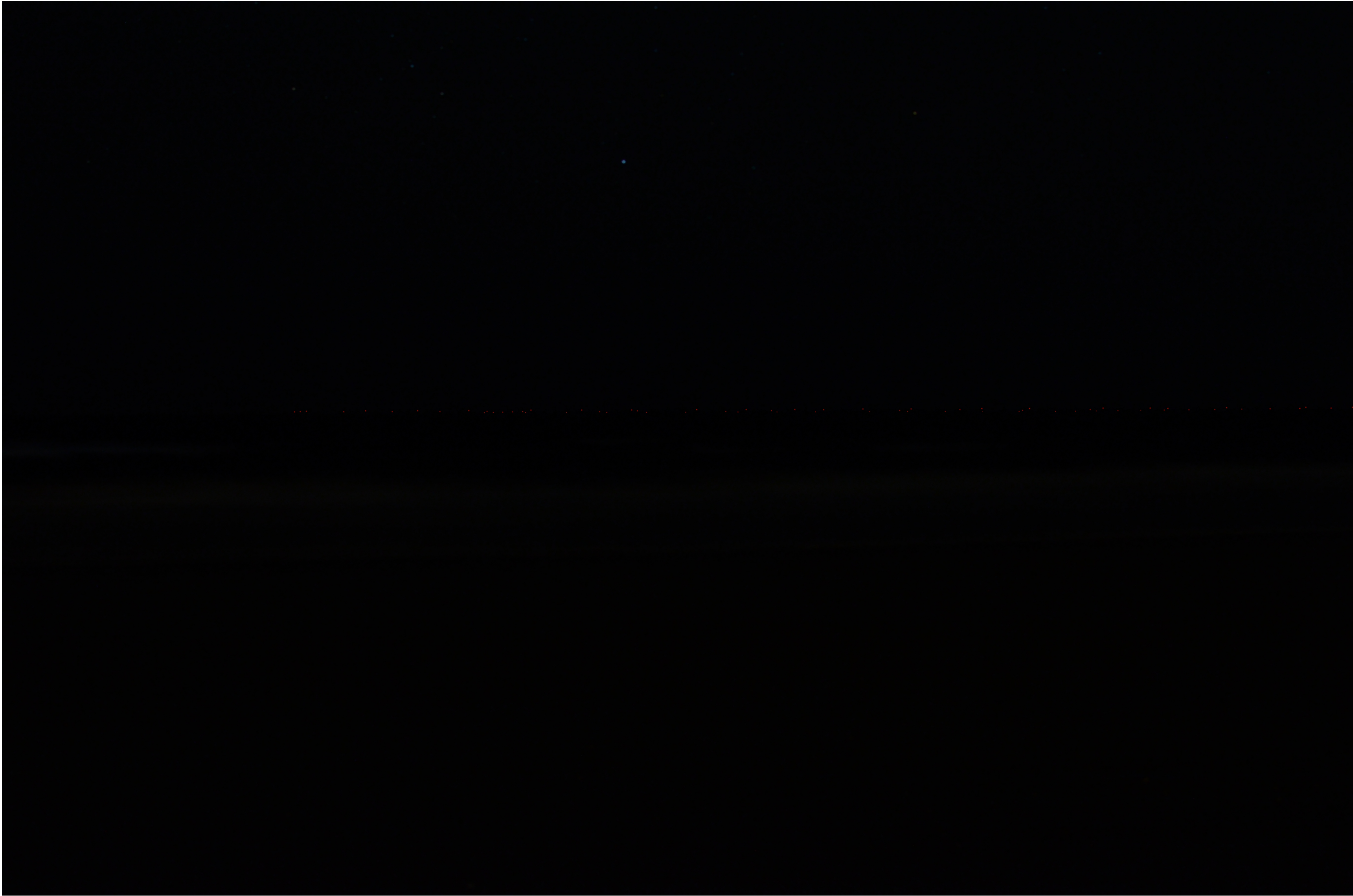
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## INFORMATION PAGE FOOTNOTES

### <sup>1</sup>GPS Coordinates

Location coordinates as used in WindPRO to register the wireframe diagram to the photograph. Due to slight errors and lens distortion, these values may differ at the fourth significant digit as obtained from a handheld GPS device at the time the photographs were taken and as shown on the Project Location Map.

### <sup>2</sup>Visibility

Visibility is obtained from the closest airport weather station (see chart at right). The chart shows which weather station was used for each site. Visibility is measured up to ten statute miles.

### <sup>3</sup>Camera Azimuth

Camera azimuth was obtained using a magnetic compass at the time of photography. However magnetic anomalies in the study area make some of these measurements unreliable. The camera azimuth reported here is for true north and reflects the bearing used to register the wind turbines to the photograph in WindPRO.

### <sup>4</sup>Refraction Coefficient

The correction for refraction comes from Technical Appendix F Earth Curvature and Refraction of Light, in the report *Visual Representation of Windfarms Good Practice Guidance*, prepared for Scottish Natural Heritage (h+m 2006). The coefficient of refraction  $k$  is commonly defined as the ratio between the radius of the earth and the radius of the light in the line of sight between an object and the observer (Hirt 2010). The value reported here is half this value, but it is multiplied by two in the Technical Appendix's equation.

### ABBREVIATIONS

|      |                |
|------|----------------|
| nm   | nautical miles |
| mi   | statute miles  |
| mm   | millimeters    |
| m    | meters         |
| sec. | seconds        |
| '    | feet           |
| "    | inches         |
| °    | degrees        |
| lat  | latitude       |
| long | longitude      |

### REFERENCES

h+m and envision. 2006. Visual Representation of Windfarms Good Practice Guidance. Scottish Natural Heritage.

Hirt C., Guillaume S., Wisbar A., Bürki B. and Sternberg, H. 2010. Monitoring of the refraction coefficient of the lower atmosphere using a controlled set-up of simultaneous reciprocal vertical angle measurements. *Journal of Geophysical Research*, 115, D21102, doi:10.1029/2010JD014067

### Closest Airport Weather Station to Sites

| Site                                     | Weather Station Location NC |
|--|-----------------------------|
| 001 Corolla Lighthouse                   | Kill Devil Hills            |
| 002 Beach at Duck                        | Kill Devil Hills            |
| 003 Kitty Hawk                           | Kill Devil Hills            |
| 004 Coquina Beach                        | Kill Devil Hills            |
| 005 Bodie Island Lighthouse              | Hatteras                    |
| 006 Cape Hatteras Lighthouse             | Hatteras                    |
| 007 Lighthouse Beach                     | Hatteras                    |
| 008 Ocracoke Beach                       | Hatteras                    |
| 009 Portsmouth Life Saving Station Tower | Hatteras                    |
| 010 Long Point Camps                     | Hatteras                    |
| 011 Great Island Camps                   | Beaufort                    |
| 012 Cape Lookout Lighthouse              | Beaufort                    |
| 013 Cape Point                           | Beaufort                    |
| 014 Atlantic Beach                       | Beaufort                    |
| 015 Bald Head Island                     | Southport                   |
| 016 Oak Island                           | Southport                   |
| 017 Holden Beach                         | Southport                   |
| 018 Sunset Beach                         | Southport                   |