



## 2013 Radio/Cell Phone Coverage Maps

Created by the NPS Pacific Island Inventory & Monitoring Program (I&M). Field data were collected by the cooperative vegetation mapping team led by Meagan Selvig of the University of Hawaii at Hilo (UHH), including Kathy Akamine (UHH), Albert Espaniola (KALA), Colin Meston (HALE) and additional KALA staff. Data were spatially analyzed by I&M GIS Specialist Scott Kichman.

### Methodology Used to Create Coverage Maps for Radio and Cellular Telephone Reception

#### Radio Coverage

1. Data were collected at 243 accuracy assessment plots from March-July 2013 to test radio receptivity. Crews used the KALA-RPT-D channel and received a verbal confirmation with staff located at KALA headquarters. This was recorded on the datasheet and notated in database as a “yes” for reception or a “no” for no reception. In some cases no data were collected so it was assumed no reception. This assumption was verified by comments in the data sheets.
2. Point values of -1 for “yes” and 0 for “no” were attributed to a GIS point feature class.
3. The point data were then weighted by using the inverse distance weighted (IDW) interpolation which explicitly implements the assumption that things that are close to one another are more alike than those that are farther apart. This model is appropriate for radio data because these data can be reliably verified. The “yes” and “no” values were physically verified.
4. The weighted point data were then used to create a classified raster image that showed a range of values from good reception to no reception.
5. A visual line of sight analysis was also done within the Park boundary using a 5 meter Digital Elevation Model. The viewpoint location was the radio transmitter at the Kalapaupa lighthouse at 35 meters and the view shed was an extent of 15 kilometers. VHF radio waves are high wattage, travel a shorter distance and are propagated concentrically. The view shed can be modeled for these waves. These data depict whether any point on the ground at a height of 2 meters can actually see the lighthouse by line of sight. A polygon dataset was created with values of yes and no.
6. The classified raster and the view shed data were interpolated to filter out anomalies and to verify that good reception occurred in good line of sight and that no reception occurred in no line of sight. The interpolation takes into account the variable amplitude of radio transmissions over distance and terrain.

7. The final raster image was then clipped or cut to the Kalaupapa actual survey Park boundary and displayed in a map with terrain features and infrastructure.

### Cell Phone Coverage

1. Data were collected at 243 accuracy assessment plots from March-July 2013 to test cell phone reception throughout the park. Cell phones using a Verizon service provider were checked, “yes” was recorded if the cell phone received 1 or more bars. Crews notated on the datasheet and in the database as a “yes” for reception or a “no” for no reception. In some cases no data were collected so it was assumed no reception. This assumption was verified by comments in the data sheets.
2. Point values of -1 for “yes” and 0 for “no” were attributed to a GIS point feature class.
3. The point data were then weighted by using the ordinary kriging interpolation (hot spot) method which is the most general and widely used of the kriging methods. It assumes the constant mean is unknown. This is a reasonable assumption unless there is a scientific reason to reject it. Kriging assumes that there is an overriding trend in the data—for example, a prevailing wind—and it can be modeled by a deterministic function, a polynomial. This method was used for the cell data because the waves of cell transmissions are less powerful in wattage than radios and can easily be interfered with. This polynomial is subtracted from the original measured points, and the autocorrelation is modeled from the random errors. Once the model is fit to the random errors and before making a prediction, the polynomial is added back to the predictions to give meaningful results.
4. The weighted point data were then used to create a classified raster image that showed a range of values from good reception to no reception.
5. A visual line of sight analysis was also done within the park boundary using a 5 meter Digital Elevation Model. The viewpoint location was the cell tower located at the town of Kualapuu and the view shed was an extent of 25 kilometers. Cell transmissions as compared to radio waves are of a higher frequency, but less powerful, travel a longer distance and the wave is constant in amplitude. These data depict whether any point on the ground at a height of 2 meters can actually see the cell tower by line of sight. A polygon dataset was created with values of yes and no.
6. The classified raster and the view shed data were interpolated to filter out anomalies and to verify that good reception occurred in good line of sight and that no reception occurred in no line of sight.
7. The final raster image was then clipped or cut to the Kalaupapa actual survey park boundary and displayed in a map with terrain features and infrastructure.