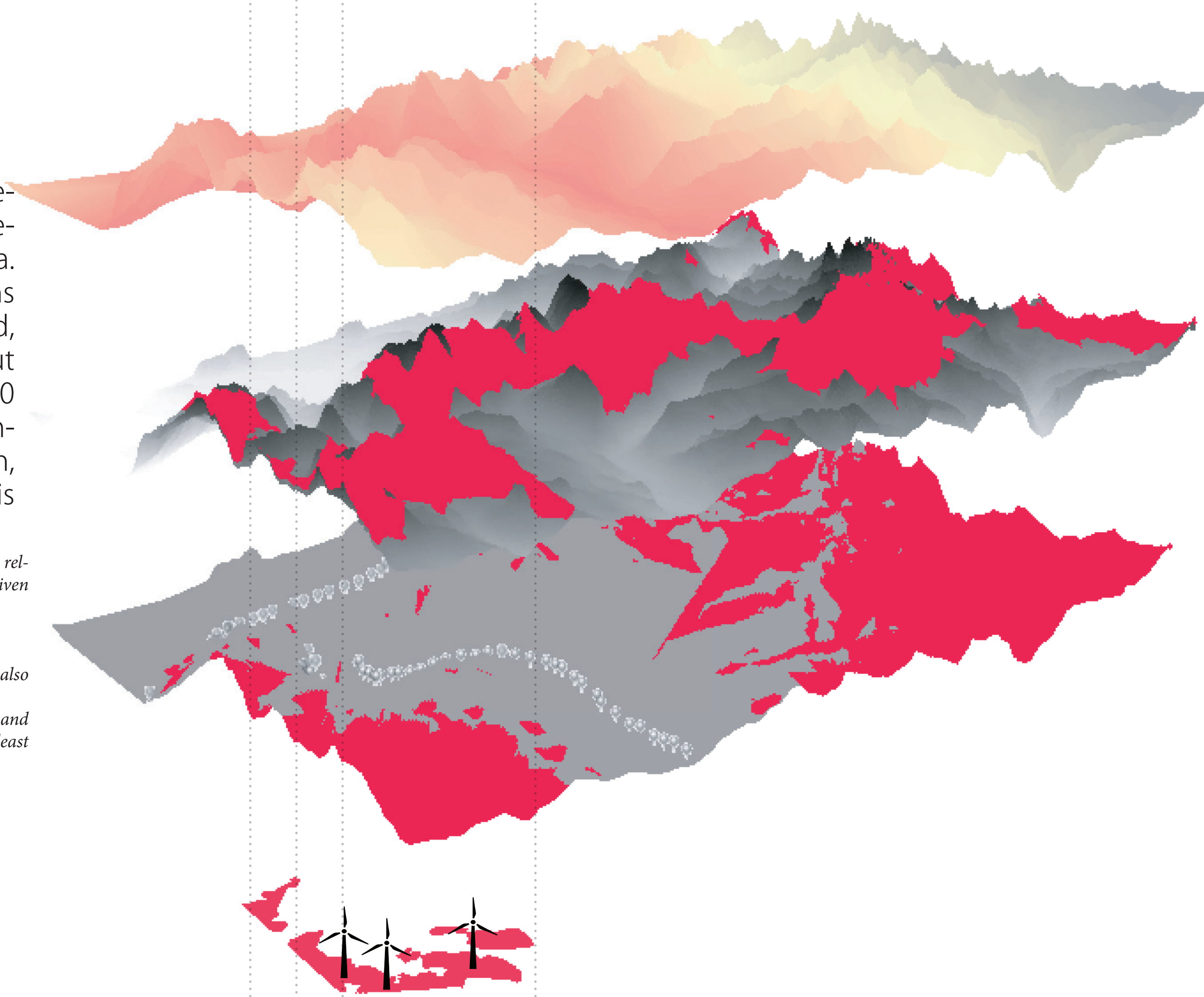
TUTORIAL: SITING A WIND TURBINE

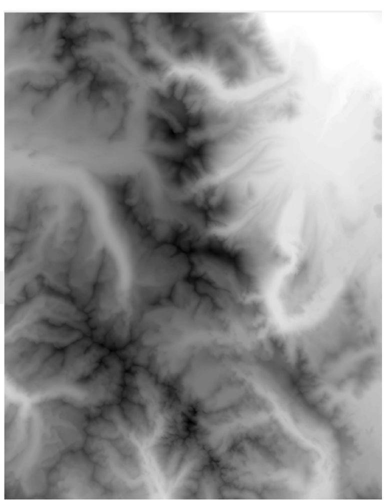
MATT STEELE



This tutorial demonstrates the process for developing a suitability analysis for the placement of wind turbines in Mono Lake California. The critical considerations were obstructions of west to east wind, distance from the road, and visibility from the road. The ideal output indicated by the following analysis is a 300 hectare conterminous space in the north-west portion of the area under consideration, shown on the right in red. Directions for this tutorial are below:

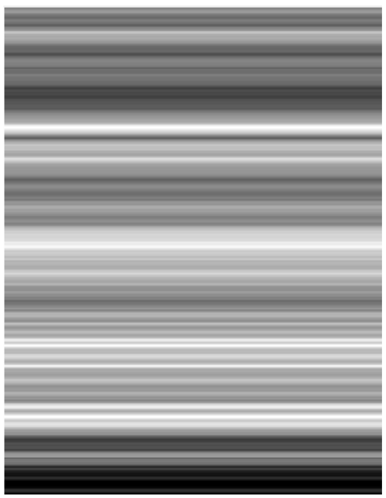
Generate a grid on which each pixel is set to a value indicating its relative suitability for the siting of a 100-meter high wind turbine, given that …

- the prevailing wind in this area is from west to east;
- nearby mountains block wind, which is not a good thing;
- being visible from a major road upsets people here, which is also not a good thing;
- being close to a major road reduces cost, which is a good thing; and
- every candidate site must occupy a conterminous area of at least 300 hectares.



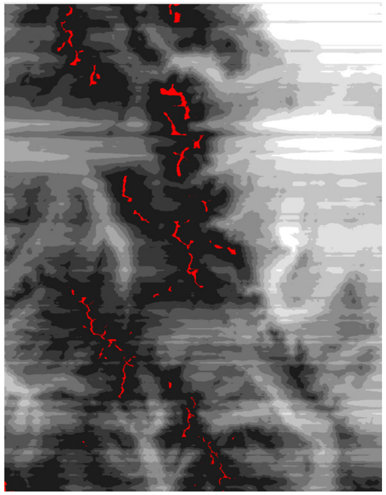
1.

focal statistics - rectangle



2.

raster calculator



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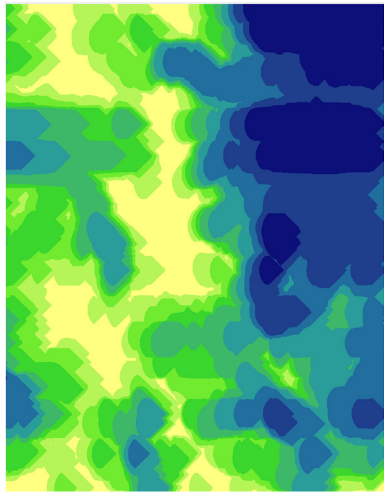
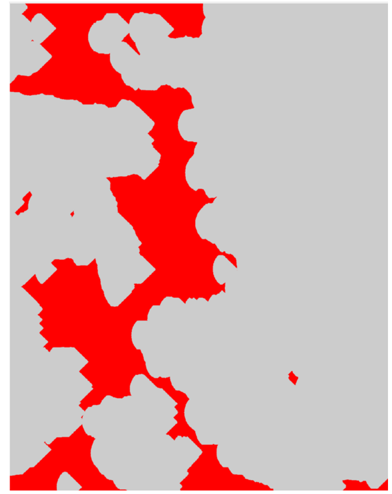


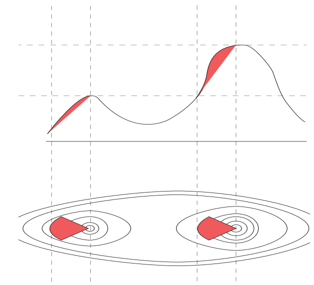
focal statistics - wedge (-45, 45, 80)

4.



reclassify (0/1)

5.



N.

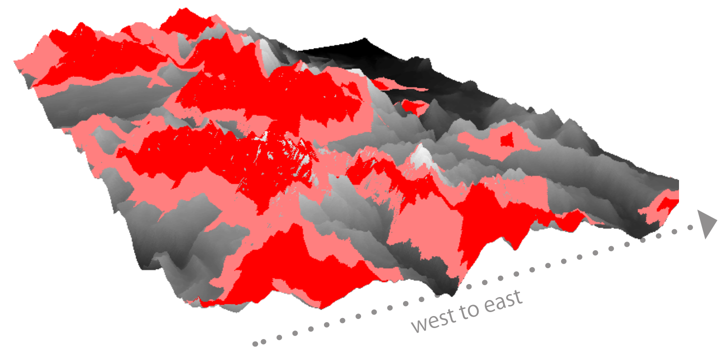
High : 4004

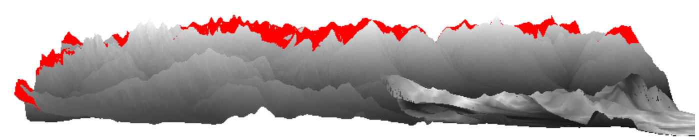
Low : 1942

FIND AREAS IDEAL FOR WESTERN WIND

Because air moves west to east across the extent of the areas considered for this analysis, the ideal area was located west of the highest points, and avoided the valleys.

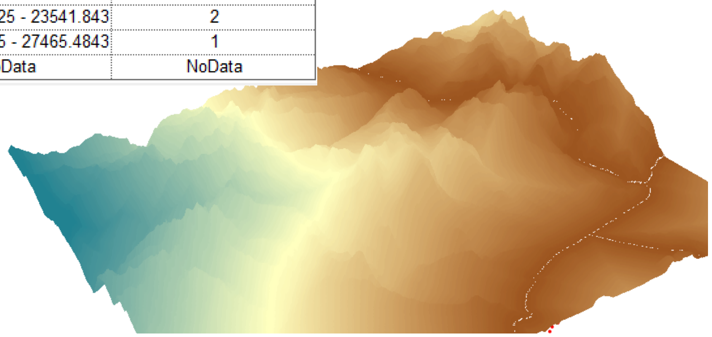
1. Such an area is found by first taking the elevation file and identifying the highest point looking west to east. This was done through the **focal statistics tool** using a thin **rectangle** (30px deep) that spans the width of the extent. Each point in the raster along each parallel held the value of the highest point.
2. Using **raster calculator**, take the difference between these values and the original elevation to output a raster. This gives elevation in relation to the highest peaks running the length of the extent. Areas to the east of these areas would have mountains obstructing their wind path.
3. Because mountainous areas could exist at various heights running east to west, the **wedge tool of focal statistics** should be used to find the local highest point, looking west to east. The wedges used had an angle starting at -45 to 45, with a radius of 80.
4. **Relcassify** using 0/1 for areas under 700 meters from the hightest local point on the western side of each mountain creates a ideal area, based on wind and areas that avoided valleys under-which western air would not significantly reach.



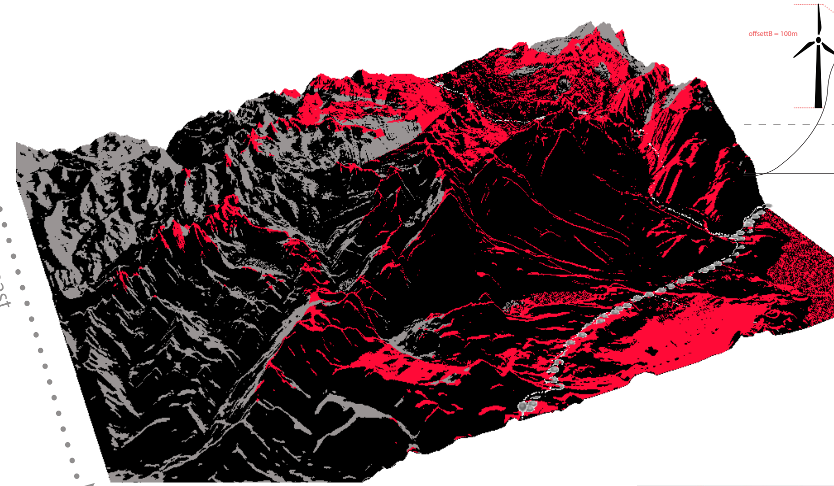


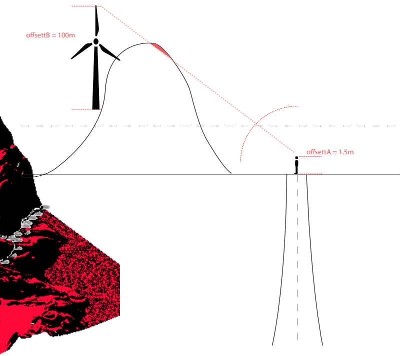
view from the east

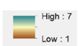
Old values	New values
0 - 3923.640625	7
3923.640625 - 7847.28125	6
7847.28125 - 11770.92187	5
11770.921875 - 15694.562	4
15694.5625 - 19618.20312	3
19618.203125 - 23541.843	2
23541.84375 - 27465.4843	1
NoData	NoData



west to east



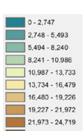




raster calculator

reclassify, 1 -7

2.



euclidean distance to roads

1.

DISTANCE AND VIEW FROM ROAD

A. Euclidean distance to identify distance to road

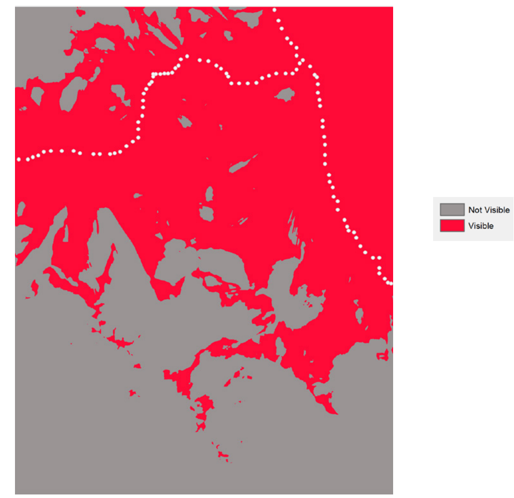
It was important that areas close to the road were prioritized. Take the distance from each using the **Euclidean Distance t**ool, and then reclass its output into a score scaling from 1 to 7, with the highest number indicating close proximity.

B. Viewable from the road

To understand the viewshed from the road, create points that cover the road lines. Input these points using the **view-shed** tool, making use of the elevation file. To account for the heights of the viewer and the height of the wind turbine, set the heights in the attribute table for both. Label these offset points as OFFSETA and OFFSETB, with the former being the viewer, set at 1.5m (5ft), and the later being the viewed, set at 100m. Default settings for the vertices of the viewshed should be set to between 90 to -90. To increase accuracy, accounted for the curvature in the Earth by integrating (.13) discount into the calculation.

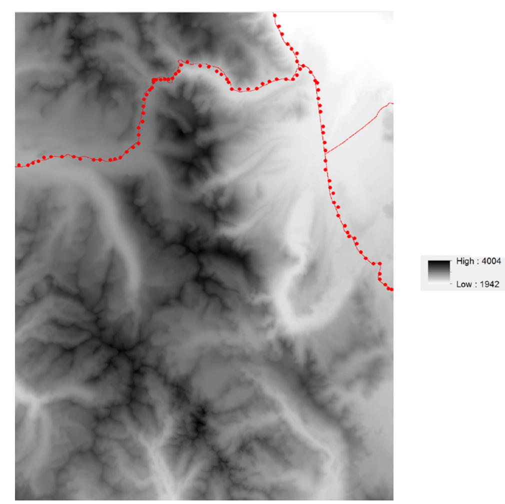
use viewshed tool with off-

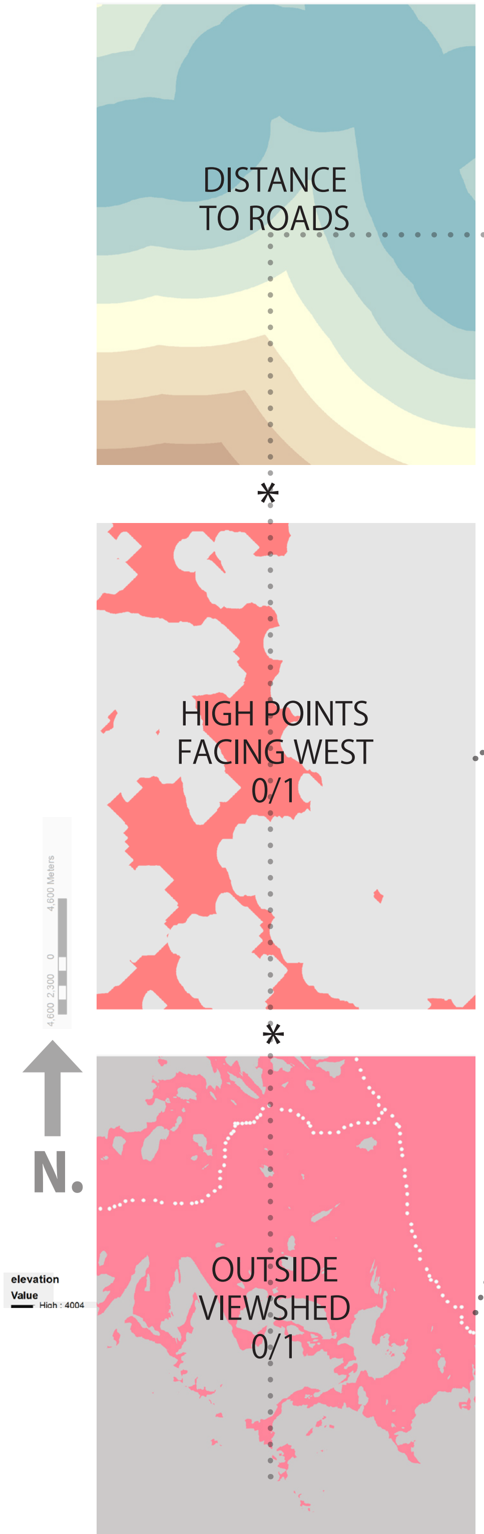
2.

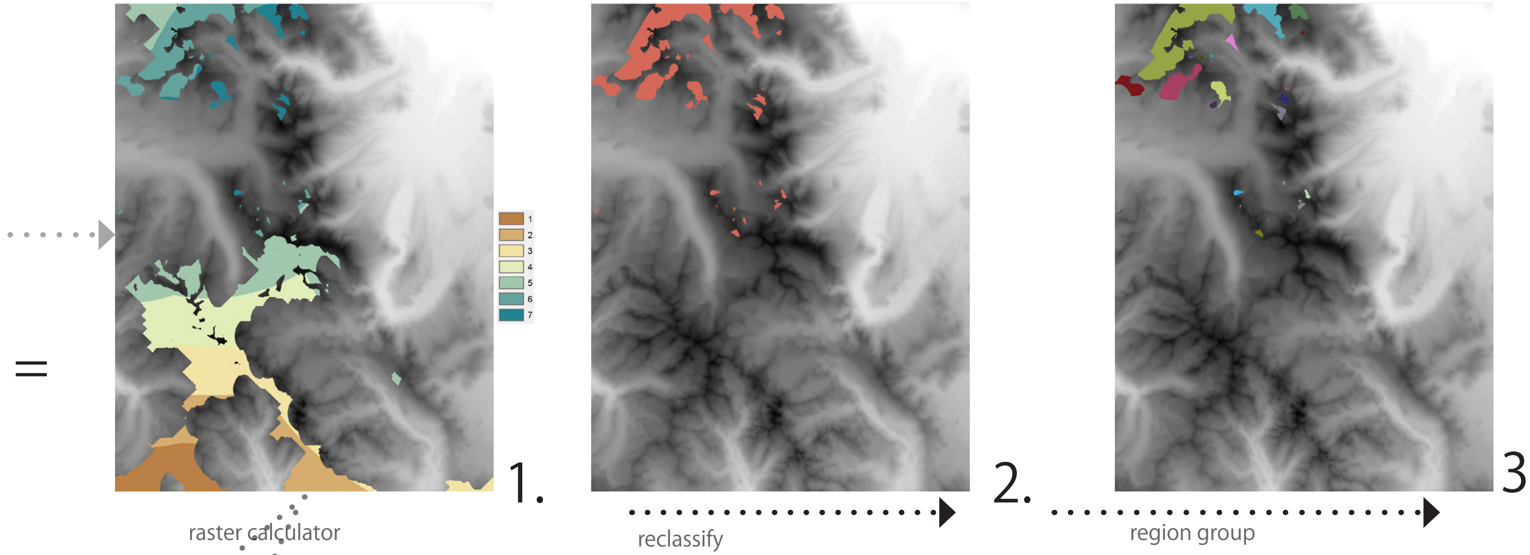


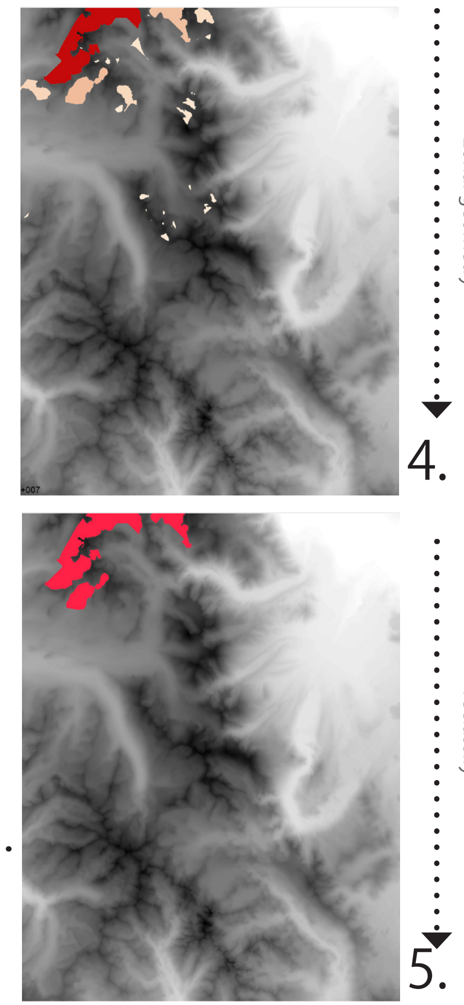
input view points via the editor

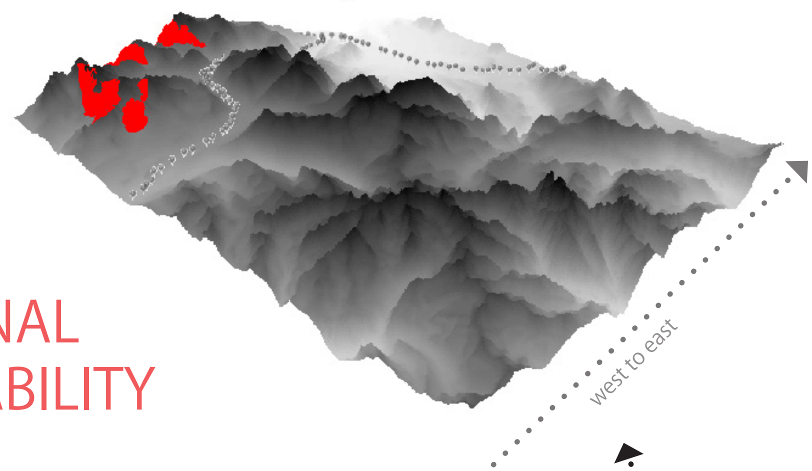
1.











FINAL SUITABILITY

The final suitability map should consist of the distance to roads, high points facing west and areas outside the viewshed. All should be set to scores of 0 to 7, with 0 indicating areas that were unsuitable. This final output should display suitable areas on a scale of 1 to 7, relating to their distance from the roads. Areas receiving the highest two scores should be reclassified into one separate group. To identify the area, region group the zones identifyied and use the **zonal geometry tool** to identify the size of these areas. Reclassify the areas into two categories, with areas above 300 hectares, or 3 million square meters, being isolated into one category and smaller areas being categorized as NoData. This will result in the final suggested areas for siting the wind turbines.