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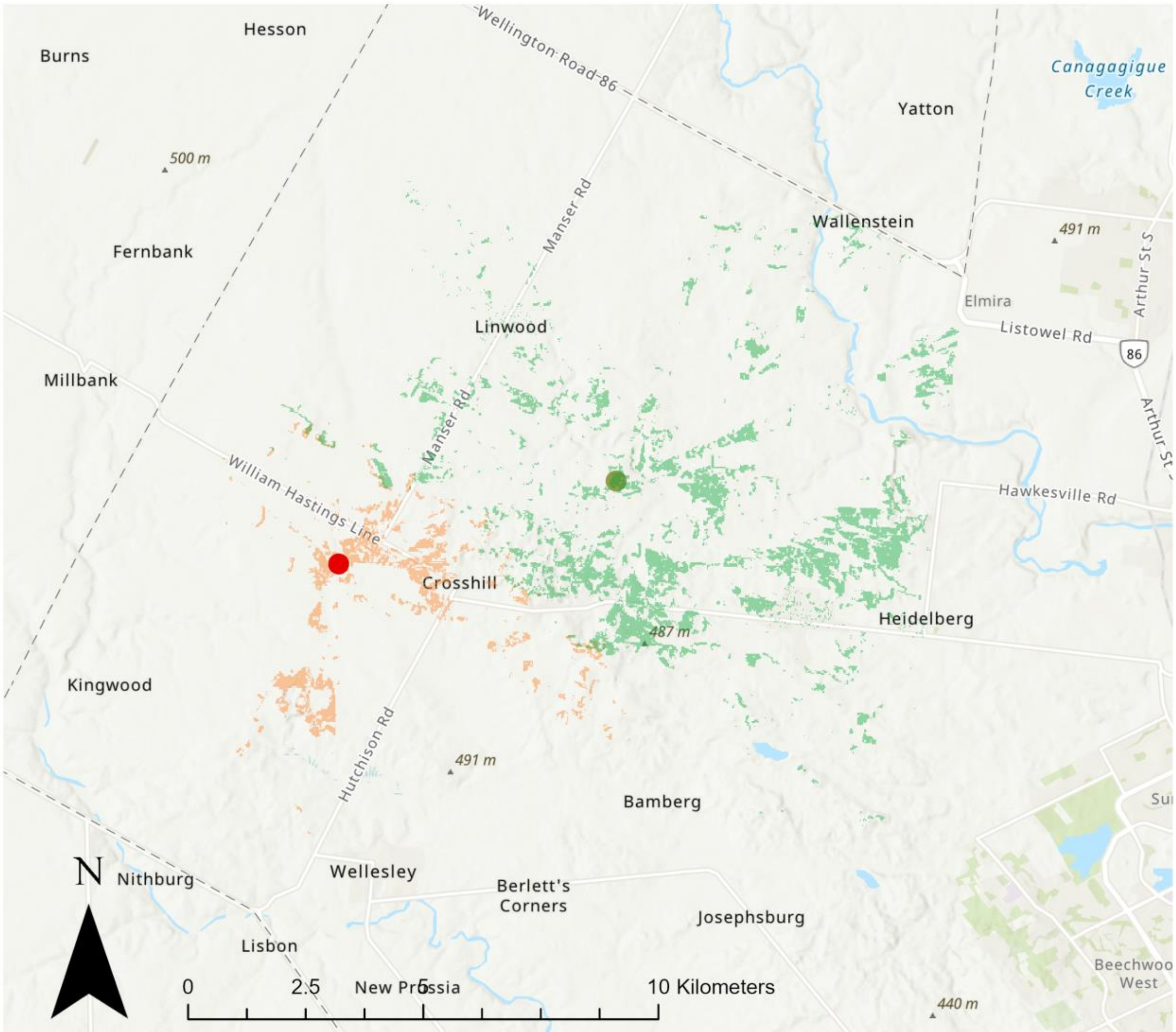
Part A:

In order to produce the viewshed for the two proposed wind turbines in the region of Wellesley, the raster data of vegetation, buildings, and elevation of the region is geo-processed. For this report, the DEM and Landcover data were obtained from the Grand River Conservation Authority, whereas the Roads, Buildings, and Regional Boundary layers were obtained from the Region of Waterloo, all data is projected to NAD83 UTM Zone 17N, and cell size is 25X25 m for raster data. First of all, to produce elevation raster data for the vegetations of the region, the landcover raster “landcover_Wellesley” is reclassified, where tall vegetation is aggregated to 15 and the rest of the landcover being 0, corresponding to the height of these landcover. Afterwards, the elevation raster is produced by clipping the the building shapefiles “Building_Footprints” to the Wellesley region with the shapefile “Wellesley_Boundary” and converted to the raster “Bldgsraster”, which is similarly reclassified into the elevation raster “bldgs10”, where the raster has only cell values of 10 for the elevation of the buildings. Last but not least, sea-level raster, tall vegetation raster and building raster are combined to produce an elevation mapping of the area. The viewshed for each turbine is produced with their location marked as a shapefile and processed by the function “Geodesic Viewshed”. In conclusion, the raster viewshed for turbine A possesses 6102 cells, or the equivalent to 3,813,750 meters squared and approximately 1.37% of the region of Wellesley by area. On the other hand, the raster viewshed for turbine B possesses 180005 cells, or the equivalent of 11,253,125 meters squared and approximately 4.04% of the region of Wellesley by area. Since turbine B with its larger viewshed and effect on the surrounding landscape aesthetics is not optimal in comparison to turbine A.

Overall, the main advantage of this approach is that combining the DEM, landcover, and building data allows me to create a realistic elevation model in raster form. This allows the Geodesic Viewshed tool to produce simple and easy to understand raster. However, in order to produce the viewshed, the original data required multiple steps of processing, such as clipping, reclassifying, and converting data types. These multiples steps open room to error, which did cost me time going back and forth. In addition, given that the spatial resolution of this raster is 25X25M, the viewshed can be improved with a smaller cell size for a better resolution.



The viewshed of two different turbine locations in the region of Wellesley.

Turbine B

Turbine A

Turbine B Viewshed

Turbine A Viewshed

Esri, NASA, NGA, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Part B:

In order to produce the path of least cost from Wellesley to Linwood, multiple rasters were overlayed to produce a cost raster, taking account of path length, the terrain's slope, landcover features and roads, each raster has the cell size of 25 x 25 m. First of all, in order to taking in account of path length for the path least cost, a base cost layer ”CostBase" is produced, covering the entirety of the region of Wellesley, with each of its cell having a cost of 1. Afterwards, to account of the terrain's slope when calculating for the path, the sea-level-elevation raster ”DEM25M_Wellesley" is converted to a slope raster and reclassified to ”CostSlope" from least to highest into 4 quantiles, with cell values from 1 to 4. In addition, to account for different landcover types along the path, the landcover raster ”Landcover_Wellesley" is reclassified into ”CostLandCov", where easy terrain has the cost of 1, farmer's field with the cost of 3, water features and residentials area with the cost of 5. Last but not least, to avoid roads in the calculation, the roads shapefile ”Roads" is converted to a raster by the field ”CartoClass" and reclassified to ”CostRoads", where all road features have the cost of 5, and the non-roads features have the cost of 1. Finally, the above cost raster is summed up in the function ”Raster Calculator" to produce a singular cost map taking into account the above-mentioned factors. With the starting point and the end point marked on the map as shapefiles, the functions "Distance Accumulation" and "Optimal Path as Line" were used to produce the path of least cost shapefiles from the Wellesley to Linwood. Overall, the approach of combining multiple cost rasters allows the model to consider multiple real-life factors, and the cost addition systems allow them to be considered equally. However, given that some landcover can't be crossed, such as water or residential area, I proposed that the landcover raster is multiplied to the sum of the rest of the raster, where easy terrain has the multiplier of 1, farmer field has the multiplier of 1.5, and water and residential area has the multiplier of 5. This allows the weight of the easy terrain and the farmer field to be maintained while heavily disregarded in the water body and residentials areas. However, it would be better if waterbody and residential aeras to be excluded from the raster entirely.

The path of least cost from Wellesley to Linwood, taking account in different landcovers, terrain's slope and roads.

—— Path of Least Cost

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