

From Perished Peaks to Sliding Slopes: Mapping Landslides and Environmental Justice on Select Mountaintop Removal Sites in Eastern Kentucky

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Backstage

MTR Mining?
Mountaintop removal mining is a form of coal mining characterized by methodically blasting the tops off mountains to get at thin coal seams underneath. The waste rock is then thrown overboard into terraced valley fills.

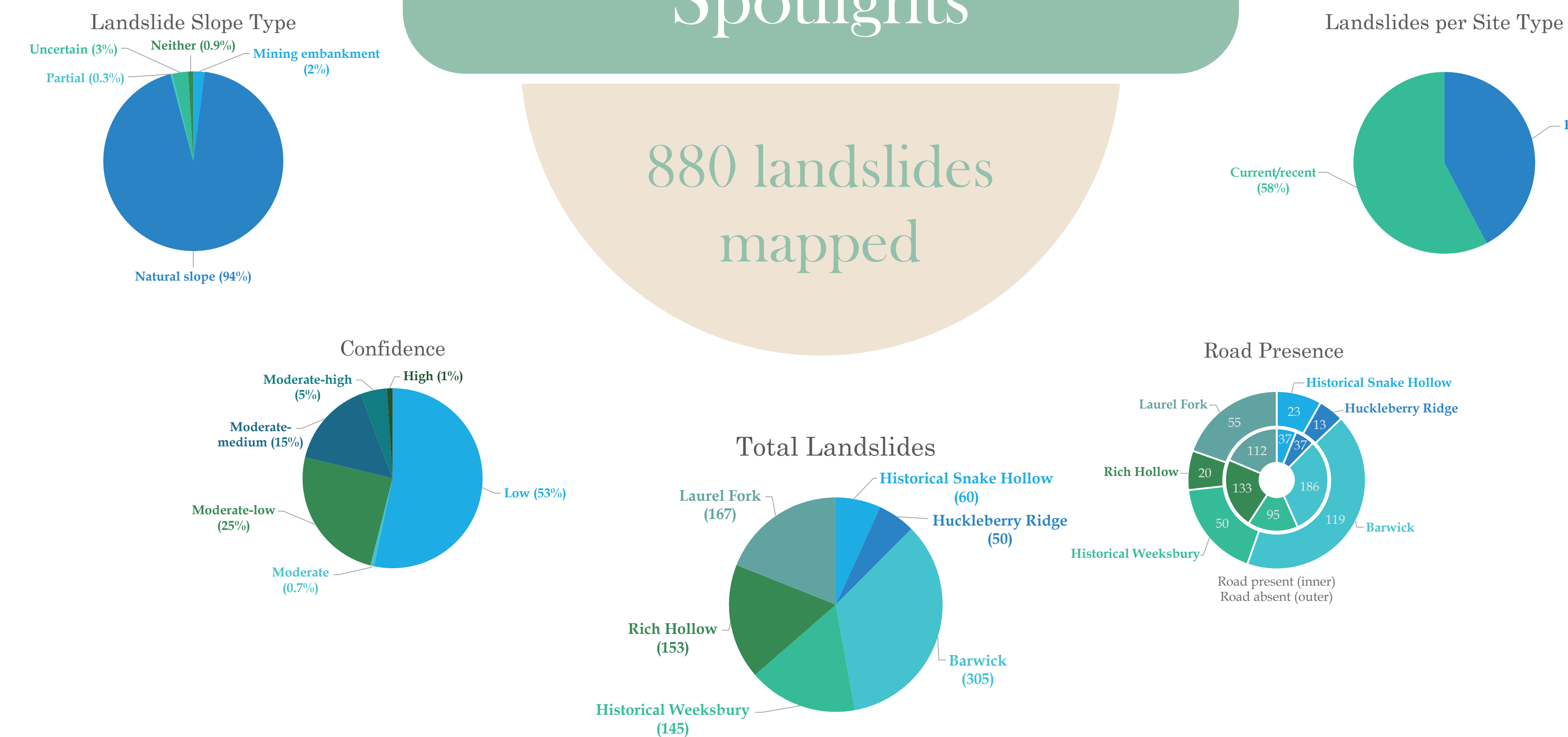
Landslides??
Reed and Kite (2020) have documented various erosional events occurring in MTR sites in eastern Kentucky. My project mapped landslides in both valley fills and natural/altered slopes in six MTR sites across eastern Kentucky.

Environmental Justice???
MTR mining presents a myriad of dangers to Appalachia’s communities, from the various hazards of landslides and debris flows to the loss of a shared social ecology and the deep symbolism of the mountains (Canu et al., 2017).

Lights, Camera, and...Mapping!

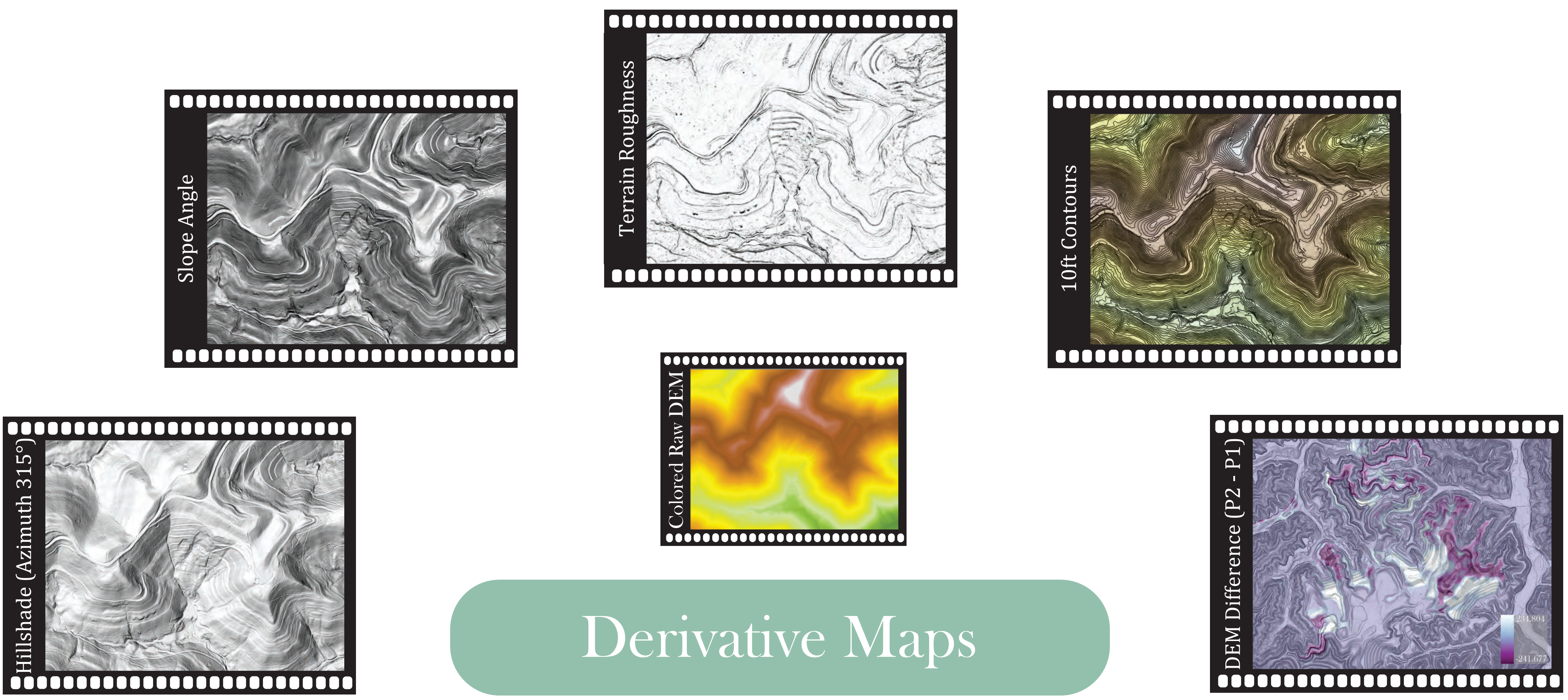
- Data**
 - KY LiDAR data (Phase 1 & 2)
 - DEM-derived derivative datasets
 - National Risk Index (NRI) environmental justice data (from FEMA)
- Process**
 - Visual analysis aided by primary + derivative DEMs (predominantly used colored raw DEM + 30% transparent slope angle map)
 - 1st Passover** = visual examination + point markers to note suspicious spots
 - 2nd Passover** = visual examination + 10ft contours + terrain roughness map to draw polygons around landslides
 - 3rd Passover** = 10ft contours + terrain roughness map to ensure validity and add, edit, and delete landslides
 - 4th Passover** = final double-check of all landslides and their point markers
 - Attributes noted: site, feature, unique ID, landslide components (head scarp, flanks, toe, additional features), confidence measures (numerical value and text description), and type of slope
- Confidence**
 - Modified system taken from Burns & Madin (2009); recorded in a custom attribute table for each landslide
 - High: 30–40
 - Moderate-high: 24–29
 - Moderate-medium: 17–23
 - Moderate-low: 11–16
 - Low: 0–10
 - Visual assessments of visibility of landslide features from 0 (not visible) to 10 (clearly visible)

Spotlights



And Presenting...the Final Act!

- Conclusions**
 - Most landslides seemed to dot the slopes surrounding the MTR sites (97.955%) instead of their valley fills (2.045%).
 - MTR sites, even if reclaimed, have very little avenue for dedicated use after mining due to land instability and unevenness. The numerous landslides on these sites further irritates the issue of desirability and use.
 - Most reclamation methods on these sites make use of non-native species of grasses that can grow in the absence of topsoil. This combined with the multitude of landslides may disrupt the establishment of both old and new ecologies, leaving MTR sites in a perpetual half-done state of abandon.
 - MTR mining shears off mountaintops and reclamation efforts change ecologies. Add the landslides, and one can imagine a deep wound slashed across the cultural and symbolic importance that mountains and their native ecologies bring to Appalachia’s many communities.
- Limitations**
 - Landslide ages unknown: it is possible that some landslides were present before mining operations
 - Difficult to tell whether some areas were landslides, mine waste dumped overboard, or strangely contoured land
 - No way to be certain that a given landslide was caused specifically by mining operations...coincidences are possible + there are too many variables to consider
 - No ground truthing/field data to check against the current mapped data



References & Acknowledgements

Burns, W. J. & Madin, I. P. (2009). Protocol for inventory mapping of landslide deposits from light detection and ranging (LiDAR) imagery. *Oregon Department of Geology and Mineral Industries*, 1-30.

Canu, W.H., Jameson, J. P., Steele, E. H., & Denslow, M. (2017). Mountaintop removal coal mining and emergent cases of psychological disorder in Kentucky. *Community Mental Health Journal*, 53(7), 802–810. <https://doi.org/10.1007/s10597-017-0122-y>

Reed, M. & Kite, S. (2020). Peripheral gully and landslide erosion on an extreme anthropogenic landscape produced by mountain top removal coal mining. *Earth Surface Processes and Landforms*, 45(9), 2078-2090. <https://doi.org/10.1002/esp.4867>

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