Making a Derivative Radon-Risk Map of Williamsburg, Virginia

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Introduction

What is Radon?
- Radioactive gas
- Colorless & odorless
- 2nd leading cause of lung cancer after smoking, can be deadly (Figure 1)
- EPA safe limit: 4 pCi/L

The Role of Geology
- Coastal Plain previously thought to be at low-risk for radon (Figure 2).
- 40% of radon tests in Williamsburg zip code 23188 exceed 4 pCi/L (Figure 3).
- Yorktown Formation, containing sandy sediments, previously suggested as a radon-producing geologic unit (Hipps, 2020).
  - Sediment cores contained elevated concentrations of 238U, 226Ra, and 210Pb in the >2mm sediment fraction of the lower Yorktown.
  - Sediments containing fossils and marine-mammal bones have up to 300 Bq 226Ra/kg (10-times the crustal average).
- Home radon test results show higher radon gas levels in homes built in and slightly above the Yorktown Formation than in other formations.

Purpose
- Identify regions in Williamsburg that are predicted to have higher radon levels
  - Create a map showing moderate and high-risk areas
  - Publish findings in interactive StoryMap for residents.

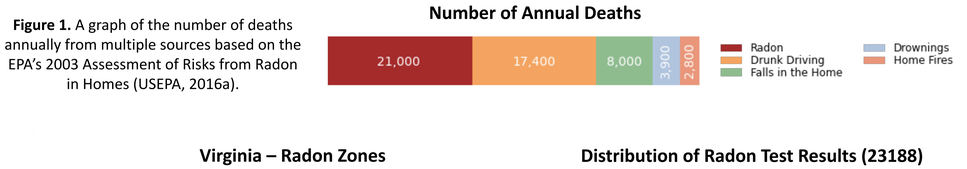

Figure 1. A graph of the number of deaths annually from multiple sources based on the EPA's 2003 Assessment of Risks from Radon in Homes (USEPA, 2016a).

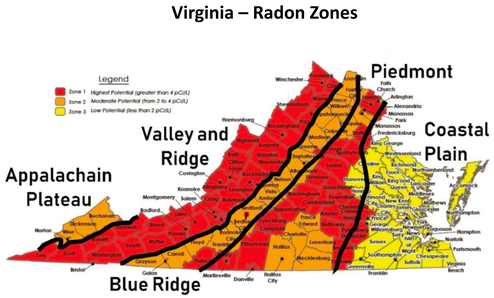

Figure 2. Map of radon risk in Virginia as previously assessed by the EPA. Areas in red have high potential for radon, orange moderate, and yellow low (Hipps, 2020).

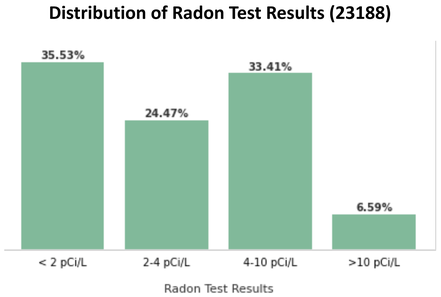

Figure 3. A graph showing the results from 425 radon tests conducted in Williamsburg (23188) between 2001 and 2021. Radon concentrations are measured in pCi/L (DrHomeAir, n.d.).

Methods

Datasets Used
- Topographic data (2-foot contour intervals)
- Building footprints
- Infrastructure GIS data from the City of Williamsburg

Method
- Determined the top of the Yorktown Formation to be 58ft above sea level using field observations, borehole data, and the 1:24,000-scale geologic map of Williamsburg (Bick and Coch, 1969).
- Areas below 58ft were mapped as high risk.
- Areas between 58ft and 64ft were mapped as moderate risk.
- Areas above 64ft were mapped as low-risk.
- Created polygons using the contour data that delineated each of these risk areas.
- Clipped polygons to the extent of the Williamsburg city limits.
- The final map (Figure 4) is embedded in an interactive ArcGIS StoryMap that allows residents to input their address and identify the associated risk. The StoryMap also contains background information about radon and its health effects.

Discussion

Results
- Creation of radon risk map derived from geology (Figure 4)
- Identified the number of homes within each risk area
- Help homeowners determine whether they could be at risk
- The overlap between development and predicted risk helps identify areas that have the highest health hazard (Figure 5).

Validation
- A William & Mary geology major is currently conducting tests to determine the validity of the map.

Next Steps
- Publish StoryMap for residents of Williamsburg to view and determine whether a radon test is recommended.
- Continue to monitor radon trends in the region

Predicted Radon-Prone Areas in Williamsburg, VA

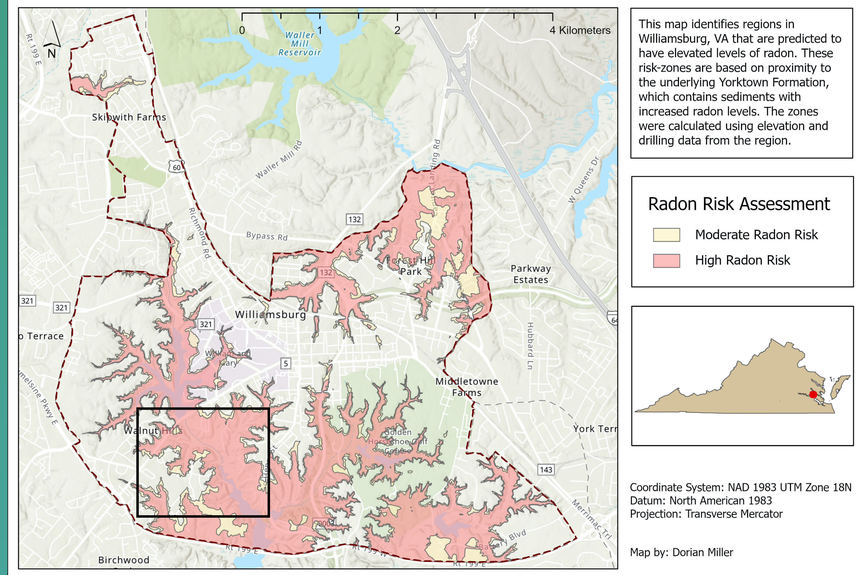

Figure 4.

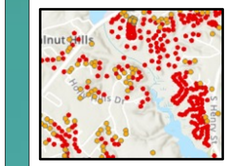

Figure 5. Point data of homes in the predicted high-risk area (red) and moderate risk area (orange) within the black rectangle in figure 4.

Interactive StoryMap
Scan this QR code to visit the interactive StoryMap that can used to explore radon risk levels in Williamsburg.

References

Bick, K.F., and Coch, N.K. Geology of the Williamsburg, Hog Island, and Bacons Castle Quadrangles, Virginia: Report of Investigations I8, Plate 1 p., https://www.dmme.virginia.gov/commercedocs/RI_18.pdf (accessed March 2021).

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USEPA, 2016a, A Citizen's Guide to Radon:, http://www.epa.gov/radon/pubs/citguide.html (accessed October 2019).