

Appendix

Appendix A. Assumptions of the Optimal Shelter Siting Model

- Origins (census block groups) are the geometric centroids of the census block groups. So, it is assumed that all the people in each block group travel from the centroid of that block group to the selected locations.
- Demand at each census block group is one of the population counts (i.e., the total population, the population 65 and older, the population under 5, and the non-white population) at that census block group. For each population distribution a different model is solved. Total population is referred as Model 1, the population 65 and older is referred as Model 2, the population under 5 is referred as Model 3, and the non-white population is referred as Model 4.
- There is no limit on the number of people who are served by the proposed locations (i.e., shelters have unlimited capacity). Thus, block groups are assigned to the closest location among the selected locations.
- Regular traffic conditions are considered for calculating the travel times between origins (census block groups) and destinations (possible shelter locations).
- Destinations (possible shelter locations) are the centroids of census blocks. To increase the precision of the location selection, census block centroids are used as possible shelter locations rather than census block group centroids. Accordingly, 815 possible destination locations were considered.
- The census block centroids within the Mayfield city limits are omitted and are not considered as possible locations.
- p is set to 6 due to budgetary constraints, meaning that for each demand setting (e.g., total population) 6 different shelter locations are searched.
- One of the locations is pre-selected (chosen prior to our analysis by community leaders based on our interview with Tracey Warner, emergency management director at Graves County, Kentucky) as Mayfield Fairgrounds (1001 Housman Street, Mayfield, KY) based on the expert feedback, and it is coded as “Location 238”. Based on this pre-selection, the models determine other locations in each setting.

Appendix B. Travel Times to Shelter Sites for Each Model

Scenario		Travel Time (in minutes)		
Model	p	Maximum	Minimum	Average
Model 1	1	26.8	3.9	12.6
	2	20.2	0.8	10.4
	3	19.9	0.8	8.9
	4	14.8	0.8	7.9
	5	14.8	0.1	7.0
	6	13.2	0.1	6.4
Model 2	1	26.8	3.9	12.6
	2	20.2	0.8	10.6
	3	19.9	0.8	8.8
	4	15.7	0.8	7.7
	5	15.7	0.1	6.8
	6	15.7	0.1	6.1
Model 3	1	26.8	3.9	12.5
	2	20.2	2.3	10.3
	3	20.2	2.2	8.9
	4	20.2	1.1	7.7
	5	18.0	1.1	6.6
	6	12.8	0.1	5.9
Model 4	1	26.8	3.9	11.2
	2	20.2	0.8	9.0
	3	19.9	0.8	7.6
	4	19.9	0.1	6.8
	5	15.7	0.1	6.0
	6	15.7	0.1	5.5

Appendix for Mathias, J., Skipalis, B., Valappanandi, S., Holmes, T., LaFontant, D., Ozguven, E., Alisan, O., Kaya, M., McCreary, T., Roxas, E., & Bush, A. 2023. "Sheltering Behavior During the December 2021 Tornado in Mayfield, Kentucky." *Natural Hazards Center Weather Ready Report Series, 10*. Boulder, CO: Natural Hazards Center, University of Colorado Boulder.