



Key Takeaways

- ❑ **Benefits of urban forests** such as the Knoxville Urban Wilderness include local economic activity, recreation, health, higher property values and ecosystem services.
- ❑ Using trail counter data and a survey of 1,166 K UW visitors, this study estimates **the K UW generates \$24.9 million annually for Knox County’s economy** through direct and indirect spending.
- ❑ At current visitation levels, **the K UW provides an additional \$7 million annually in recreational benefits** that are not captured by direct and indirect spending.
- ❑ The estimates of economic value in this report should be interpreted as a lower-bound since the **on-site survey underestimates the number of out-of-town visitors**.

ECONOMIC BENEFITS OF TRAIL USE AT THE KNOXVILLE URBAN WILDERNESS

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By 2050, it is expected that 68% of the world’s population will live in urban areas.³ As we become more urbanized, the benefits that urban forests provide are becoming more important. They provide economic benefits to the local economy through tourism and recreation as well as supporting physical and mental health and improve urban air and water quality.⁴ Quantifying these benefits is challenging but necessary to determine the impact of public and private activities that may enhance or diminish this asset. It is also important for local residents to recognize these benefits to instill pride in the local community.

The Knoxville Urban Wilderness (KUW), located in the heart of the city of Knoxville, Tennessee is one such urban forest. In the US, it is unique in its size, proximity to a city, and the extent of activities it offers. It is comprised of nine recreational areas connected by over 50 miles of trails and greenways, including five city parks, a nature center, a 600-acre wildlife management area, quarries, lakes, and playgrounds.

This extensive area facilitates numerous recreational activities including mountain biking, running, hiking, paddling, climbing, fishing, hunting, and ziplining. The urban wilderness is a collection of land parcels owned by the state, county and city government, private landowners, and non-profit foundations.

Using an onsite survey of KUW users, this report provides estimates of the economic value of two benefits provided by the KUW: 1) economic activity in Knox County, TN and 2) recreational access provided by the KUW. While useful, these estimates do not consider many other benefits of the multi-use trail system including employment impacts, job recruitment, trail proximity impacts on property values, and overall quality of life.



Credit: Room Fest

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³ <https://www.un.org/en/academic-impact/united-nations-projects-increase-worlds-urban-population>

⁴ Nesbitt, Lorien, Ngaio Hotte, Sara Barron, Judith Cowan, and Stephen R. J. Sheppard. 2017. "The Social and Economic Value of Cultural Ecosystem Services Provided by Urban Forests in North America: A Review and Suggestions for Future Research." *Urban Forestry & Urban Greening* 25 (July): 103–11. <https://doi.org/10.1016/j.ufug.2017.05.005>

Visitor Profile

Throughout 2021–2022, we surveyed 1,166 visitors to the KUW. **Table 1** provides an overview of the primary activities reported by surveyed visitors. A companion study provides additional details on how people are using the KUW trail system.⁵ For all surveyed visitors, the most popular recreational activities at the KUW were mountain biking, trail running and hiking. Visitors take 4.6 trips on average per month to engage in these and come from all over the US. **Figure 1** shows home zip codes of visitors from across the contiguous US. Over 75% of survey respondents were from Knox County. In contrast, mobile device data⁶ reveals that 65% of all visitors to KUW are local to Knox County (**Figure 2**). This comparison suggests that visitors from outside Knox County were less likely to take the online user survey. This discrepancy is a common finding in other studies since local residents are more invested in their local trail system and thus more likely to take the time to fill out the survey.

Visitors that are not local to Knox County (out-of-towners) are mostly males (55%), have an average age of 40, college graduates (82%), White (94%), and roughly 45% reported annual gross household income exceeding \$100,000. For 42%, the primary purpose of visiting the Knoxville area was visiting the KUW, while 25% were in the area to visit friends and family and 17% were on vacation. The average trip length for out-of-towners is 3 nights and the average distance travelled is 200 miles to Knoxville.

Table 1 shows that while most locals use the KUW for walking/running/hiking, out-of-towners equally used the park for biking and walking/running/hiking.

Figure 1. Zip code of surveyed visitors to the KUW

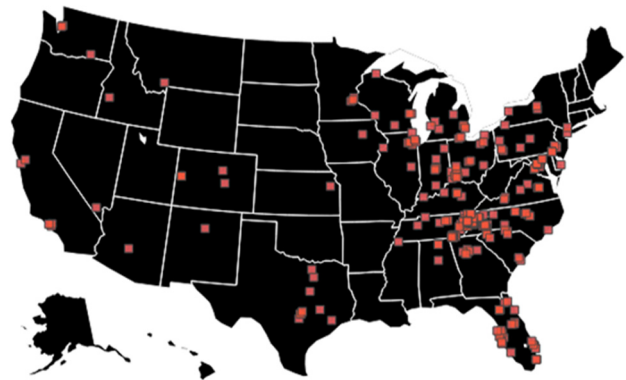


Figure 2. Visitors to the KUW using mobile device data

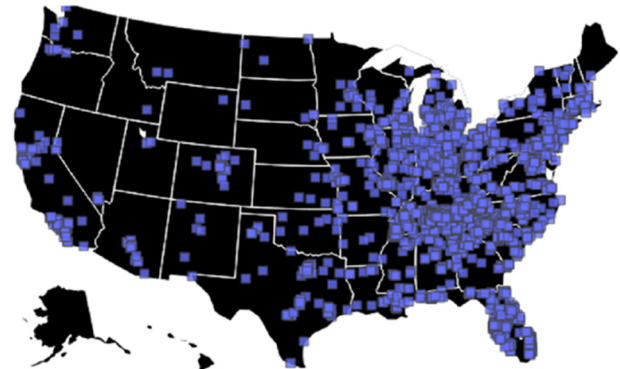


Table 1. Primary activity of KUW visitors (%)

Visitor Type	Biking [♦]	Hiking / Running / Walking	Other [*]	Total
Out-of-towner	45	44.2	10.8	23.1
Local to Knox	30.7	60.1	9.3	76.9
All visitors	34	56.4	9.6	100

* Other is an aggregation of all other activities, including birding, swimming, rock climbing, paddleboarding etc.

♦ The biking category comprises mountain biking, pump track (cycling), and biking on the greenway.

⁵ Fitzhugh, Eugene C, Douglas Gregory, and Charles Sims. 2023. "The Knoxville Urban Wilderness Trail System and Baker Creek Preserve Bike Park: A Profile of Users and Physical Activity." <https://krss.utk.edu/wp-content/uploads/sites/30/2023/01/KUW-Trail-and-Bike-Park-User-Report-Jan-2023.pdf>

⁶ Mobile device visitation data is collected from Avan. This is anonymized, aggregated data that is collected from devices that enable location services. It gives an estimate for the number of visitors whose devices were registered within the park boundary.

Benefits Versus Values

This report documents the economic value of the benefits provided by the KUW. It is important to distinguish between a benefit or service provided by the KUW and the value of that benefit. [Table 2](#) illustrates the different benefits provided by the KUW and the way these benefits generate economic value. KUW benefits fall into one of five categories: 1) economic activity, 2) recreation, 3) health, 4) property values, and 5) ecosystem services. Each of these KUW benefits can create economic value in four ways:

1. **Wealth generation** such as higher property values and earnings generated by industries dependent on the KUW (i.e., restaurants, hotels, and outfitters)
2. **Tax revenues** such as increased property-tax revenues due to higher property values or sales-tax revenues from hotel, restaurant, and equipment purchases.
3. **Avoided costs** such as the dollars that would be spent to improve water quality or mitigate floods in the absence of the KUW.
4. **Willingness to pay**, which captures what individuals would be willing to pay for recreational activities or wildlife habitat if these services were not provided by the KUW.

The first two categories are values generated by the presence of the KUW, while the last two are economic costs avoided by the presence of the KUW. For example, residents are generally willing to pay to run and bike in the KUW even though they do not have to pay any access fee to enjoy these recreational pursuits. While all four categories are viewed as the economic value created by the KUW, the last two—avoided costs and willingness to pay—are not based on actual monetary transactions. Unlike wealth generation and tax revenues, avoided costs and willingness to pay should be viewed not as actual income generated but as the value that local residents, visitors, businesses, and local governments gain from the KUW benefits above what they must already pay for these benefits (which is often zero).

The KUW is beneficial for many important industries in Knoxville. For example, restaurants, breweries, hotels, and outfitters benefit from the visitors attracted to the KUW’s scenic beauty and recreational opportunities. A previous study by the Baker School for Public Policy and Public Affairs estimated the potential spending and tax revenues associated with these economic activities on three counties surrounding the KUW.⁷ The current study focuses on Knox County and clarifies this previous study based on a careful estimate of the number and type of visitors to the KUW. These estimates represent the economic impact in Knox County generated from the KUW (the top row in Table 2).

Table 2. KUW benefits and the subsequent values generated
(items in red text are addressed in this study)

Ways KUW creates economic value

	Wealth generation	Tax revenue	Avoided costs	Willingness to pay
Economic activity	✓	✓		
Recreation	✓			✓
Health			✓	
Property values	✓	✓		
Ecosystem services			✓	✓

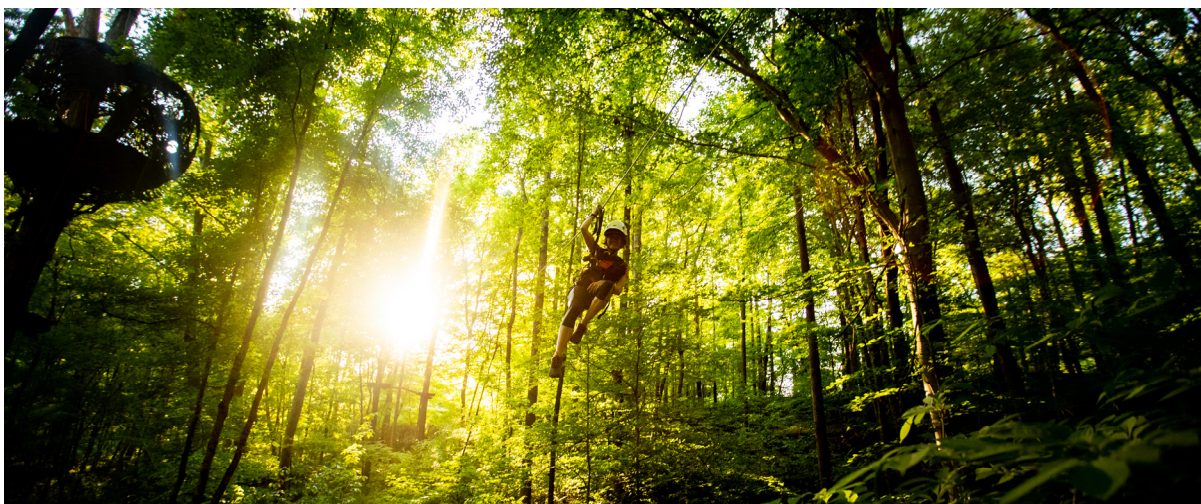
⁷ Sims, Charles, Becky Davis, and Bongkyun Kim. 2015. "Economic Potential of South Knoxville’s Urban Wilderness." 2:15. White Paper. The Howard H. Baker Jr. Center for Public Policy. <https://baker.utk.edu/publication-cetep-economics/economic-potential-of-south-knoxvilles-urban-wilderness>

Residents use the K UW for recreation and leisure-time physical activity (LTPA). In a private market setting, residents would register their value for these experiences in a gym membership or an entrance fee to a bike park. However, for public amenities like the K UW where users are not forced to pay, there is no mechanism for trail users to register the value they receive from recreation or LTPA. This study estimates this value (i.e., residents' willingness to pay) for recreational access provided by the K UW. People who are physically active at the K UW are almost always getting health-enhancing physical activity at the moderate- (e.g., walking) or vigorous-intensity (e.g., bicycling). This health-enhancing physical activity helps residents avoid costly health ailments (e.g., coronary heart disease) and benefits the region's businesses through increases in worker productivity and decreases in absenteeism. Living near green space such as the K UW has also been associated with increased life expectancy⁸ and slower aging⁹. This current study *does not* estimate the health benefits of the K UW.

Homeowners may be willing to pay a premium to live in close proximity to the K UW. This preference among homeowners suggests that the K UW adds to the overall value of the housing stock. Residents

capture this increase in wealth through higher sales values for homes near the K UW. State and local governments capture this increase in wealth via larger property tax collections. A previous study by the Baker School for Public Policy and Public Affairs, using 2017 home sales data, could not document that the K UW was responsible for an increase in housing values.¹⁰ This current study *does not* provide an update of this previous work on the property-value benefits of the K UW.

Finally, open space also provides value in the form of ecosystem services such as clean-water provision, flood control, and air-pollution mitigation. If the K UW were developed, the area would be forced to spend money to replicate these ecosystem services. Knoxville and Knox County enjoy significant cost savings from the natural landscapes found in the K UW. A previous study by the Baker School provides estimates of the cost savings associated with several ecosystem services provided by the K UW including water supply, water quality, flood mitigation, wildlife habitat, pollination, air pollution removal, and carbon sequestration and storage.¹¹ This current study *does not* provide an update of this previous work on the value of ecosystem services provided by the K UW.



Credit: VML

⁸ Connolly, R., Lipsitt, J., Aboelata, M., Yañez, E., Bains, J. and Jerrett, M., 2023. The association of green space, tree canopy and parks with life expectancy in neighborhoods of Los Angeles. *Environment International*, 173, p.107785. <https://www.sciencedirect.com/science/article/pii/S0160412023000582>

⁹ Kim, K., Joyce, B.T., Nannini, D.R., Zheng, Y., Gordon-Larsen, P., Shikany, J.M., Lloyd-Jones, D.M., Hu, M., Nieuwenhuijsen, M.J., Vaughan, D.E. and Zhang, K., 2023. Inequalities in urban greenness and epigenetic aging: Different associations by race and neighborhood socioeconomic status. *Science Advances*, 9(26), p.eadf8140. <https://www.science.org/doi/10.1126/sciadv.adf8140>

¹⁰ Welch, J. G., Sims, C. B., & McKinney, M. L. 2022. Does an urban wilderness promote gentrification? A case study from Knoxville, Tennessee, USA. *Sustainability*, 14(2), 973. <https://baker.utk.edu/wp-content/uploads/2022/08/sustainability-14-00973.pdf>

¹¹ Sims, Charles, Cassidy Quistorff. 2022. "Valuing the Ecosystem Services Provided by Knoxville's Urban Wilderness." The Howard H. Baker Jr. Center for Public Policy. <https://baker.utk.edu/wp-content/uploads/2022/10/KUW-Report.pdf>

Economic Activity

We estimate the economic impact on Knox County, through economic activity, using Regional Input-Output Modeling System (RIMS II) multipliers. Visitors to the urban wilderness spend money locally. However, this direct spending has a multiplier effect on the local economy and generates further output in an indirect way. That is, visitors will spend money at local businesses including hotels, restaurants, gas stations etc. The income that is generated by these businesses creates further income and employment because they make purchases from other businesses and employ workers who use their income to buy goods and services from other businesses. In essence, a ripple effect of purchases takes place in the local economy through which the initial direct spending of visitors generates further indirect spending as well.



Credit: Visit Knoxville

A summary of the KUW's economic impact on Knox County is provided in [Table 3](#). It is estimated that there were 303,782 individual trips to the KUW trail systems in 2021.¹² From our survey, we estimated the spending per trip to KUW as \$47.08. This includes spending on items such as transportation, food, and accommodations. Therefore, the total annual expenditure (the direct impact) attributed to KUW, in Knox County is roughly \$14.3 million. Using the RIMS II output multiplier for Knox County, this generates an additional \$10.4 million in annual spending, resulting in a total of \$24.7 million. Direct spending also generates \$199,614 in annual state and local sales tax revenue in Knox County.

Recreation

The previous section captures the direct and indirect spending generated by the KUW. However, the value that individuals receive from the KUW exceeds the amount of direct spending generated by the KUW. Otherwise, these individuals would have never chosen to visit the KUW because the value they received from the visit was smaller than what it cost to take the trip. This section captures what individuals would be willing to pay for recreational activities if these services were not provided by the KUW.

We use a hybrid individual-zonal travel cost method to estimate the net economic benefit of an average trip to the KUW. The travel cost method uses data on the amount spent traveling to the KUW (the travel cost) as a proxy for the price paid for the recreational services provided by the KUW. The travel cost estimates, along with other variables such as gender and perception of trail quality, are important predictors of the number of trips taken to

Table 3. Summary of the KUW's economic impact on Knox County

Impact	Direct	Indirect & Multiplier	Total
Output (GDP)	\$14,302,057	\$10,440,501	\$24,742,558
State & Local Sales Tax Revenue			\$199,614

¹² Fitzhugh, Eugene C, Douglas Gregory, and Charles Sims. 2023. "The Knoxville Urban Wilderness Trail System and Baker Creek Preserve Bike Park: A Profile of Users and Physical Activity." <https://krss.utk.edu/wp-content/uploads/sites/30/2023/01/KUW-Trail-and-Bike-Park-User-Report-Jan-2023.pdf>

the KUW. Males tend to have a higher visitation rate than females. The visitation rate is also higher amongst individuals who have a higher perception of the quality of trails at KUW. Younger individuals take more trips than older individuals.

The travel cost method uses this statistical prediction of the number of trips taken to estimate the net economic benefit for an average individual in our survey sample. The net economic benefit to an individual for an average trip to KUW, shown in [Table 4](#), is approximately \$23. By comparison, the Taylor Mountain Regional Park, an urban open space in California, is estimated to have an average per trip economic benefit of \$17.64 (\$13.70 in 2015 dollars).¹³

The 303,782 individual trips to the KUW trail system implies an annual net economic benefit of $\$23 \times 303,782 = \$6,986,986$ for all users. Note that this net economic benefit is not directly comparable to estimates of economic activity in the previous section.¹² Estimates of economic activity focus on KUW-related direct and indirect spending, and sales tax revenues. However, the net economic benefit in this section is not actual spending generated, but rather benefits to visitors, beyond the expenses (e.g., paying for gas, vehicular upkeep, lodging, and food) that they would have paid to visit the KUW. Knox County residents have a lower per trip net economic benefit (\$7) than our full sample of all



Credit: Visit Knoxville

users. This is expected since local users tend to spend less to visit the KUW than those from outside Knox County. Since 77% of visitors to KUW are local to Knox County, the annual net economic benefit for local users is $\$7 \times 0.77 \times 303,782 = \$1,637,384$ ([Table 4](#)). Those that indicated their primary activity was hiking/walking/running also have a lower per trip net economic benefit (\$15) than our full sample of all users. This may be explained by the relatively large number of alternative sites that are conducive to walking and hiking. Since 56% of all surveyed visitors indicated that the primary activity that they were involved in was hiking/walking/running, the annual net economic benefit of the hiking/walking/running user group is $\$15 \times 0.56 \times 303,782 = \$1,979,940$ ([Table 4](#)).

Table 4. Net economic value of recreation benefits to KUW visitors

Sample	Individual economic benefit	Average number of trips*	Individual economic benefit per trip†	Number of visitors	Total net economic benefit ♠
All users	\$107.81	4.62	\$23	303,782	\$6,986,986
Locals only	\$38.79	5.46	\$7	233,912	\$1,637,384
Hiking/walking/running	\$76.58	4.84	\$15	131,996	\$1,979,940

* Average number of trips taken by visitors in a month to engage in their preferred physical activity.

† Individual economic benefit per trip = Individual economic benefit ÷ Average number of trips.

♠ Net economic benefit to all users = Number of visitors × Individual economic benefit per trip

¹³ Hanauer, Merlin M., and John Reid. 2017. "Valuing Urban Open Space Using the Travel-Cost Method and the Implications of Measurement Error." *Journal of Environmental Management* 198 (August): 50–65. <https://doi.org/10.1016/j.jenvman.2017.05.005>



Important Considerations

This study estimates the economic value of two benefits generated by the KUW: 1) economic activity and 2) recreation. While both are measures of the value the KUW provides, they are used in different contexts and cannot be added together. The economic activity measures provide a snapshot of how the KUW impacts the local and regional economy including GDP increases in Knox County and state and local sales tax revenues. The value of recreation captures what individuals would be willing to pay for recreational activities if these services were not provided for free by the KUW. Unlike the economic activity measure, these willingness to pay measures are values held by individuals and are not expressed as purchasing decisions in a market.

This study does not value several additional services provided by the KUW. First it does not consider impacts to personal income and employment. Second, it does not consider potential impacts to property values generated from proximity to Urban Wilderness trails and corresponding impacts to property tax revenues. An update of previous work on this topic performed by the Baker School is needed. Third, it does not consider how the presence of such natural amenities may help attract and retain workers to the region. Fourth, it does not consider several costs that are avoided by the presence of the KUW such as the costs associated with health ailments that are avoided with exercise at the KUW or the cost of flood control or water filtration infrastructure that is avoided by the ecosystem services provided by the KUW.



About the Author

Alecia Evans is a postdoctoral research fellow at the Center for Energy, Transportation and Environmental Policy, housed within the Baker School of Public Policy and Public Affairs. Her research interests include behavioral/experimental economics, environmental and natural resource economics, energy economics, and industrial organization. She holds a PhD in agricultural economics from Purdue University and earned master's and bachelor's degrees in economics from the University of the West Indies, Mona.

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¹³ Hanauer, Merlin M., and John Reid. 2017. "Valuing Urban Open Space Using the Travel-Cost Method and the Implications of Measurement Error." *Journal of Environmental Management* 198 (August): 50–65. <https://doi.org/10.1016/j.jenvman.2017.05.005>