

FALL 2018



UNIVERSITY OF HOUSTON
TREE INVENTORY
TREE VALUATION SUMMARY

UH OFFICE OF SUSTAINABILITY

University of Houston – Campus Trees Value

Background

Fig. 1. Original site of the University of Houston



The University of Houston moved to its current site in June 1939 (Fig. 1). At that time, trees dominated the landscape as much of the original land surrounding the campus remained undeveloped. Over the years, much of this natural landscape was replaced by buildings and other impermeable surfacing.

In 2015 the UH Tree Campus USA Committee developed a [UH Campus Tree Care Plan](#) which includes tree management, treatment, and goals. A comprehensive campus tree survey and inventory, including risk assessment, was one of the goals that was completed in the summer of 2018. This

tree inventory is vital to determine the health, economic prosperity, and continuation of sustainable environmental stewardship efforts for all students, faculty, staff, visitors, and surrounding Houston community.

Survey and Data Analysis

The tree inventory included health status, species, size and location on campus. This information was then analyzed to determine annual benefits of UH's public trees by valuing their aesthetics, building energy reduction contribution, storm water management, air quality improvement, and carbon sequestration. The tree value summaries were generated using *i-Tree*, a peer-reviewed software suite from the USDA Forest Service that provides urban and community forestry analysis and benefits assessment tools.

Limitations

The current tree survey only captures 85% of the campus boundary and did not include the Technology Bridge (formerly Energy Research Park), nor any campus property south of Wheeler Ave. (Fig. 2). Additionally, Crape Myrtles and any tree under four caliper inches were excluded in the inventory. There are plans to complete the entire campus by 2020 as well as utilize the tree survey information to develop tree maintenance and irrigation plans, which include updates to the tree inventory.

Fig. 2. Survey boundary (outlined in red).



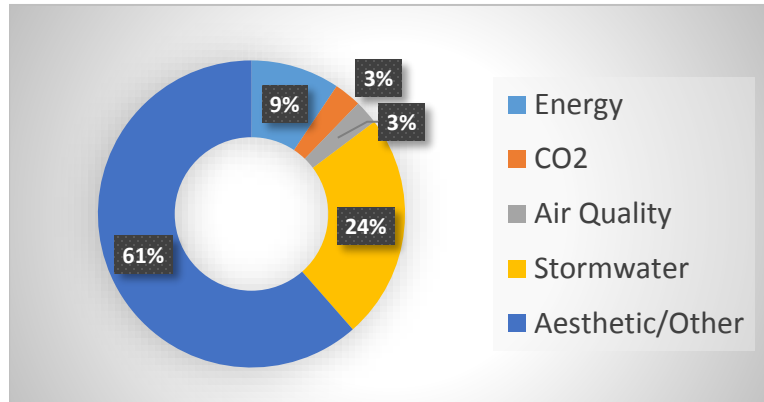
Trees Value

The tree inventory has enabled our campus to quantify the environmental and economic impacts and benefits from trees on campus. Given our current data we have estimated the total replacement value of trees surveyed, which equals \$16,251,880 at the time of the survey completion.

Campus trees provide added benefits beyond aesthetic or property value including:

- Air quality improvement and associated public health impacts
- Carbon dioxide reduction
- Storm water control
- Tree-building related energy effects

Fig. 3. Distribution of Tree Benefits



Air Quality

Air pollution is a significant problem in the United States that affects human health and well-being, ecosystem health, crops, climate, visibility, and man-made materials. The Clean Air Act requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards for six “criteria pollutants” that are both common throughout the United States and detrimental to human welfare (US EPA, 2013a). These pollutants are:

- carbon monoxide (CO)
- nitrogen dioxide (NO₂)
- ozone (O₃)
- lead (Pb)
- sulfur dioxide (SO₂)
- particulate matter (PM)

The trees in the UH inventory remove over 8,700 pounds of combined particulate matter annually. This contributes to the overall health of campus users.

Air Quality Improvement									
Species	Deposition O ₃ (lb)	Deposition NO ₂ (lb)	Deposition PM ₁₀ (lb)	Deposition SO ₂ (lb)	Avoided NO ₂ (lb)	Avoided PM ₁₀ (lb)	Avoided VOC (lb)	Avoided SO ₂ (lb)	Total (lb)
Oak	1,563.86	161.16	543.29	79.96	1,157.69	281.13	279.36	3,447.98	7,259.93
Pine	134.32	23.79	62.47	15.90	87.63	21.29	21.16	261.13	93.29
Elm	83.47	8.60	29.00	4.27	65.80	15.92	15.81	194.98	406.15
Pear	34.65	3.64	12.31	1.95	28.72	6.94	6.89	84.89	179.99
Baldcypress	27.95	4.95	13.00	3.31	18.29	4.46	4.43	54.72	29.53
All Others	202.11	24.28	75.52	13.97	149.79	36.32	36.09	445.20	731.47
Total	2,046.36	226.41	735.59	119.36	1,507.91	366.06	363.74	4,488.90	8,700.35

Carbon Dioxide Reduction

The increase in greenhouse gases, particularly carbon dioxide, into the atmosphere is considered to be one of the main causes of global warming. Trees play an important role in the removal of carbon dioxide from the atmosphere.

The trees in the UH inventory store over 9635 tons of carbon annually. Additionally, the trees remove over 721 tons of CO₂ from their immediate surroundings.

This carbon reduction is the equivalent of over 2000 passenger vehicles removed from the road each year.

Carbon Storage	
Species	Total stored CO ₂ (lbs)
Oak	16,107,978.13
Pine	741,976.17
Elm	647,326.18
Pear	248,531.08
Baldcypress	145,937.73
All Others	1,378,903.78
Total	19,270,653.07

CO ₂ Reduction					
Species	Sequestered (lb)	Decomposition Release (lb)	Maintenance Release (lb)	Avoided (lb)	Net Total (lb)
Oak	536,877.89	- 73,452.38	- 4,772.28	604,535.10	1,063,188.33
Pine	60,717.66	- 3,383.41	- 565.31	45,722.91	102,491.85
Elm	35,934.90	- 2,951.81	- 313.76	34,158.50	66,827.83
Pear	20,956.16	- 1,133.30	- 155.22	14,875.19	34,542.83
Baldcypress	12,462.43	- 665.48	- 129.48	9,584.60	21,252.07
All Others	83,165.83	- 6,295.32	- 811.40	77,994.50	154,053.61
Total	750,114.86	- 87,881.69	- 6,747.45	786,870.80	1,442,356.52

Stormwater Control

The presence of trees on campus can decrease the amount of stormwater runoff and pollutants that reach local waters.

- Trees reduce stormwater runoff by capturing and storing rainfall in their canopy and releasing water into the atmosphere.
- Tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil.
- Trees help slow down and temporarily store runoff and reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots.
- Trees transform pollutants into less harmful substances.

The trees in the UH inventory mitigate 14,883,376.47 gallons annually. This contributes to the overall resilience of campus and the surrounding watershed.

Stormwater Control	
Species	Total Rainfall Interception (Gal)
Oak	11,808,016.20
Pine	787,306.61
Elm	589,811.25
Pear	209,285.89
Baldcypress	155,785.74
All Others	1,333,170.77
Total	14,883,376.47

Tree-Building Energy Effects

Trees improve the spaces surrounding buildings aesthetically and contribute to control the ambient temperature. A tree's shade affects the micro climate surrounding buildings and explains why consideration toward green spaces is growing as an important aspect of campus planning. Trees improve comfort conditions outdoors within the campus by blocking hot and dust-laden winds. Trees can affect the building's cooling-energy use by lowering the urban heat

island effect and reducing ambient temperature around buildings.

The trees in the UH inventory help to conserve 572.12 MWh of electricity annually by providing shade and reducing ambient temperature around campus buildings. That is the equivalent annual energy use of about 40 average Texas homes.

The energy conservation translates into costs savings for building operations. In total, the conservations saves UH \$32,462.15 in avoided energy costs.

Energy Usage Reduction		
Species	Electricity (MWh)	Natural Gas (Therms)
Oak	441.85	8,406.46
Pine	33.42	643.83
Elm	24.97	516.06
Pear	10.87	233.71
Baldcypress	7.01	128.21
All Others	57.01	1,133.35
Total	575.12	11,061.62

Replacement Costs

Trees in the inventory range from 4 caliper inches to 48 caliper inches in diameter with the average 27 inches. Trees age range from 5 years to over 100 with an average of 30 years. Most trees surveyed are in fair to good condition. The replacement costs were determined using a trunk formula method provided through the *i-Tree* software and designed by the U.S. Forestry Service to consider the trunk diameter, tree species, tree condition, and rating for location. See Fig. 4 for a full table of the tree replacement value for each species and categorized by trunk diameter.

Benefits to the University

The UH Office of Sustainability routinely submits campus wide sustainability efforts ranging from energy usage to research and engagement to the national Association for the Advancement of Sustainability in Higher Education (AASHE). AASHE utilizes their Sustainability Tracking Assessment and Rating System (STARS) tool which is a transparent, framework for colleges and universities to measure their sustainability performance.

UH is also recognized by Tree Campus USA, a program from the Arbor Day Foundation, and submits for recertification annually. Tree Campus is a designation reserved for universities and colleges that prioritize healthy community forests. The tree survey factors into STARS and Tree Campus USA. Both elevate UH's national ranking as a green campus, making UH and Houston a destination for higher education.

UH students benefit from tress on campus directly. Trees provide public health benefits to campus users including stress reduction, social connectedness, and support for campus walkability. Providing a campus landscape that creates a supportive environment for students and bolsters their mental and physical wellbeing ultimately contributes to student success.

Finally, the trees add value to the aesthetic of the campus and lend to campus beautification, which can be a factor in a student's decision to attend the university. This inventory will allow the university to move forward with other campus goals such as increasing canopy coverage, and updating standards for future tree maintenance and treatment plans. This inventory will continue as a living document for the trees on campus and the inventory will serve as a learning tool for students as they participate in applied learning projects that update the inventory annually.

Aggregate Replacement Costs for Total Trees in the Inventory										
	Caliper Diameter (in)									
Species	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42	Total	% of Total
Oak	\$66,838.79	\$739,586.74	\$1,690,552.36	\$3,832,299.31	\$3,920,133.09	\$767,350.20	\$582,839.18	\$96,483.79	\$11,696,083.46	71.97%
Pine	\$5,372.30	\$113,706.11	\$567,162.64	\$569,391.20	\$268,021.15	\$43,364.47	\$0.00	\$0.00	\$1,567,017.87	9.64%
Elm	\$12,505.32	\$118,062.47	\$156,269.55	\$212,145.14	\$78,627.31	\$0.00	\$0.00	\$0.00	\$577,609.79	3.55%
Baldcypress	\$6,203.72	\$93,379.78	\$67,567.77	\$50,676.19	\$83,594.30	\$48,720.10	\$0.00	\$0.00	\$350,141.86	2.15%
Pear	\$891.02	\$42,006.06	\$172,165.68	\$66,528.29	\$12,146.87	\$0.00	\$0.00	\$26,109.38	\$319,847.31	1.97%
All Others	\$31,055.59	\$316,800.33	\$486,592.11	\$393,747.74	\$355,702.88	\$59,950.77	\$50,282.25	\$47,048.83	\$1,741,180.50	10.71%
Total	\$122,866.75	\$1,423,541.49	\$3,140,310.10	\$5,124,787.87	\$4,718,225.60	\$919,385.54	\$633,121.43	\$169,642.01	\$16,251,880.79	100.00%

Replacement Cost Reference Chart for Individual Trees										
	Caliper Diameter (in)									
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42	
Oak	\$156.90	\$431.22	\$1,357.04	\$3,551.58	\$6,843.39	\$11,232.47	\$16,326.60	\$21,586.64	\$24,120.95	
Pine	\$122.63	\$488.39	\$1,722.82	\$4,648.87	\$9,037.96	\$14,890.06	\$21,682.23	\$28,695.62	\$32,074.70	
Elm	\$156.90	\$431.22	\$1,357.04	\$3,551.58	\$6,843.39	\$11,232.47	\$16,326.60	\$21,586.64	\$24,120.95	
Baldcypress	\$105.50	\$516.98	\$1,905.71	\$5,197.52	\$10,135.24	\$16,718.86	\$24,360.05	\$32,250.10	\$36,051.57	
Pear	\$148.33	\$445.51	\$1,448.48	\$3,825.90	\$7,392.03	\$12,146.87	\$17,665.51	\$23,363.88	\$26,109.38	
Palm	\$1,891.23	\$2,975.25	\$5,855.03	\$5,855.03	\$5,855.03	\$5,855.03	\$5,855.03	\$5,855.03	\$5,855.03	
Sycamore	\$156.90	\$431.22	\$1,357.04	\$3,551.58	\$6,843.39	\$11,232.47	\$16,326.60	\$21,586.64	\$24,120.95	
Pistache	\$122.63	\$488.39	\$1,722.82	\$4,648.87	\$9,037.96	\$14,890.06	\$21,682.23	\$28,695.62	\$32,074.70	
Ash	\$139.77	\$459.80	\$1,539.93	\$4,100.23	\$7,940.67	\$13,061.27	\$19,004.42	\$25,141.13	\$28,097.82	
Maple	\$111.00	\$508.00	\$1,851.00	\$5,033.00	\$9,806.00	\$16,170.00	\$23,557.00	\$31,184.00	\$34,859.00	
Live Oak	\$96.93	\$531.27	\$1,997.15	\$5,471.84	\$10,683.88	\$17,633.26	\$25,698.96	\$34,027.35	\$38,040.01	
Magnolia	\$105.50	\$516.98	\$1,905.71	\$5,197.52	\$10,135.24	\$16,718.86	\$24,360.05	\$32,250.10	\$36,051.57	
Pecan	\$122.63	\$488.39	\$1,722.82	\$4,648.87	\$9,037.96	\$14,890.06	\$21,682.23	\$28,695.62	\$32,074.70	
Average	\$183.03	\$510.86	\$1,566.20	\$3,943.61	\$7,509.74	\$12,264.58	\$17,783.22	\$23,481.59	\$26,227.10	

Fig. 4. Replacement Value of Trees

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