Environmental Benefits Analysis of Trees for Beavercreek, Ohio

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An Analysis of Tree Benefits for Beavercreek, Ohio

EXECUTIVE SUMMARY

An inventory of public trees on the streets and in the parks of the City of Beavercreek, Ohio was conducted by Ohio State Extension and its Greene County Master Gardeners. A total of 10,291 trees were inventoried during this period. A common bid price for this service is $4.00 per tree and thus the inventory represents a value of $41,200. Most importantly, however, is that the community now has a tree inventory in a form that can be used to better manage Beavercreek's tree resource. Benefits mentioned above do not include the value of the subsequent analysis and report by The Ohio State University's School of Environment and Natural Resources which would conservatively add another $12,000. Analysis of the inventory data was done using iTree, a software suite distributed by the USDA Forest Service. The specific program in the iTree suite used to identify benefits was iStreets. This program allows community leaders interested in making informed decisions about Beavercreek's green infrastructure or to explore many aspects including biodiversity and values of environmental services such that environmental benefits can be enhanced to reduce costs and the carbon footprint of Beavercreek.

A long standing rule of thumb for taxonomic biodiversity is the 10–20–30 guideline which suggests that no more than 10 percent of trees should be from the same species, no more than 20 percent should be from the same genera, and no more than 30 percent should be from the same family. In Beavercreek ash exceeds genus guidelines (Table 1). Ash plantings represent 1,749 individuals or 17 % of the public trees and 18.9% of the canopy (Table 3). This will represent a significant loss of canopy if emerald ash borer (EAB) should destroy all American ash as predicted. Ash removal and/or treatment costs will need to be addressed by informed community leaders. Ohio State Extension can assist in developing considered plans including costs and probabilities of treatment vs. no treatment. There is no single answer for communities facing this problem. Table 3A is presented to initiate discussion and to explore potential costs facing Beavercreek. Based on the inventory and an earlier study, removal costs would be expected to approach 1 million dollars with replacement costs adding another $500,000.

Larger growing deciduous trees constituting 2% or less of Beavercreek's canopy cover that could be used to replace the ash include the Kentucky coffeetree; Shumard, swamp white, and chinquapin oaks; American sycamore, buckeye, basswood, zelkova, and elms.

Under ideal conditions tree numbers among various size classes should be stable and then decline as trees reach their mature size and older trees die. Generally trees in Beavercreek tend toward smaller sizes (Tables 2 and 3). Environmental benefits will improve as trees become more mature with time.

Importance values (Table 4) show that smaller growing pears and crabapples are present in higher numbers than their respective importance values would indicate. This demonstrates the need for planting larger statured trees such as preferred in a Toledo, OH resident preference survey whenever possible. The importance value is a measure of the overall contribution of the species to the sum of environmental benefits delivered.

A major benefit of urban trees is their ability to intercept rainfall and reduce storm water runoff (Table 5). Storm water runoff is a major cost for Ohio communities. Columbus, OH is embarking on a multi-billion dollar sewer

and storm water upgrade for the community. Public trees, alone, in Beavercreek intercept more than 10 million gallons of storm water annually at a savings to the community of $277,000 dollars per year. This could be could be increased with strategic plantings of larger growing trees.

Carbon sequestration, as reported here, represents the carbon removed from the air and stored in trees (Table 6). Nearly 29 million pounds or 14,353 tons of carbon have been stored by the 10,291 trees over time. Beavercreek's trees currently sequester and avoided some 4,413,000 lbs of CO_2 yearly (Table 8) and would represent carbon credits worth $33,000 per year if a carbon trading system were in place and if a system for accounting for them were available for community trees. These are net gain figures and include deductions for tree losses and maintenance. Annual CO_2 benefits vary by species and size but average $3.22 per tree per year while larger cottonwoods average $8.18 per tree per year or more than twice as much. Strategic plantings could increase this substantially and be a significant tool in reducing Beavercreek's carbon footprint.

Energy savings by trees are particularly important in view of the citizenry's increasing concern over the nation's energy dependency. Energy is saved by shading structures, evaporating water (evapotranspiration) and reducing wind speed around structures (Table 7). Beavercreek trees save the community $104,300 in electricity and $90,300 in natural gas for a total savings of $294,600 or an average of $28.63 per tree per year. Recent interest in strategic plantings of large trees to enhance energy savings has real potential for savings.

Annual air quality savings (reduced ozone, nitrous and sulfur oxides as well as particulate matter) for the public trees is nearly $48,000 (Table 9). This includes both direct savings ($8,686) from Beavercreek's trees and avoided pollution which is much greater at $41,102. Avoided pollution is pollution not generated at power source because energy was not required (avoided) by the community. The total annual air quality benefits are discounted by $2,042 for the volatile emissions from the trees themselves.

Aesthetic and miscellaneous benefits from trees contribute $268,800 annually to Beavercreek in the form of increased property values and enhanced community identity among other things (Table 10). Research in public housing has shown that areas with trees facilitate interaction among residents and lead to reduced domestic violence and more sociable environments. Customer surveys suggest that customers prefer to spend their money and time in commercial streetscapes with trees and are willing to spend up to 11% more there.

When all benefits are included the 10,291 trees contribute an average of $26 per tree annually to the Beavercreek community (Table 11). Species vary in their annual benefits but mature size, longevity, and maintenance costs are but some of the factors determining annual benefits. This would be well in excess of their maintenance and planting costs for Beavercreek's trees.

The Beavercreek budget for trees maintenance was estimated to be $76,000 based on the budget of $2 per capita required for Tree City USA status by the National Arbor Day Foundation and Beavercreek's population of 37,984. Thus while the 10,291 trees on the grounds require relatively little care per year they deliver $921,428 in annual benefits from storm water abatement, carbon sequestration, energy savings, air quality, aesthetic benefits, and the like. This is an astounding 1200% return on investment. Returns here may seem high but Ohio communities studied routinely discover returns on their tree maintenance dollars of 2-300% and Toledo had a 436% annual return with one of the larger tree maintenance budgets in Ohio. Further, unlike most community infrastructure, annual tree benefits per tree continue to increase over a tree's lifetime.

Table 1. Species Distribution of the Most Common Trees in Beavercreek, Ohio Arranged from Most to Least Commonly Seen

Species	Percent
Ash	17.00
Maple	15.26
Hackberry	7.46
Pear	7.30
UNKNOWN	6.94
Spruce	5.82
Flowering crabapple	5.60
Black walnut	3.28
Oak	3.15
Honeylocust	3.01
OTHER SPECIES	25.19
Total	100.00

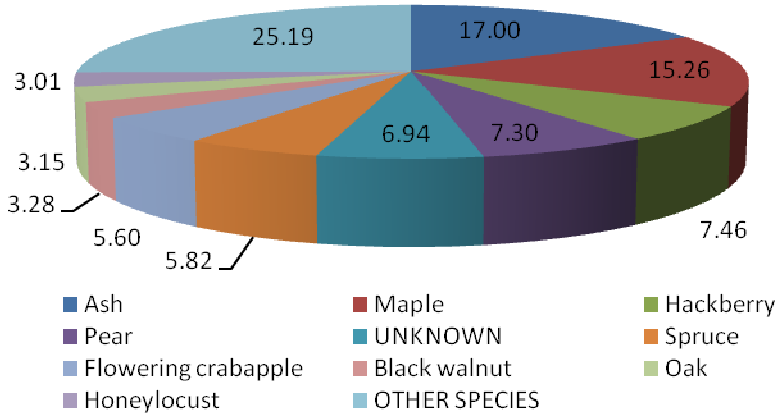
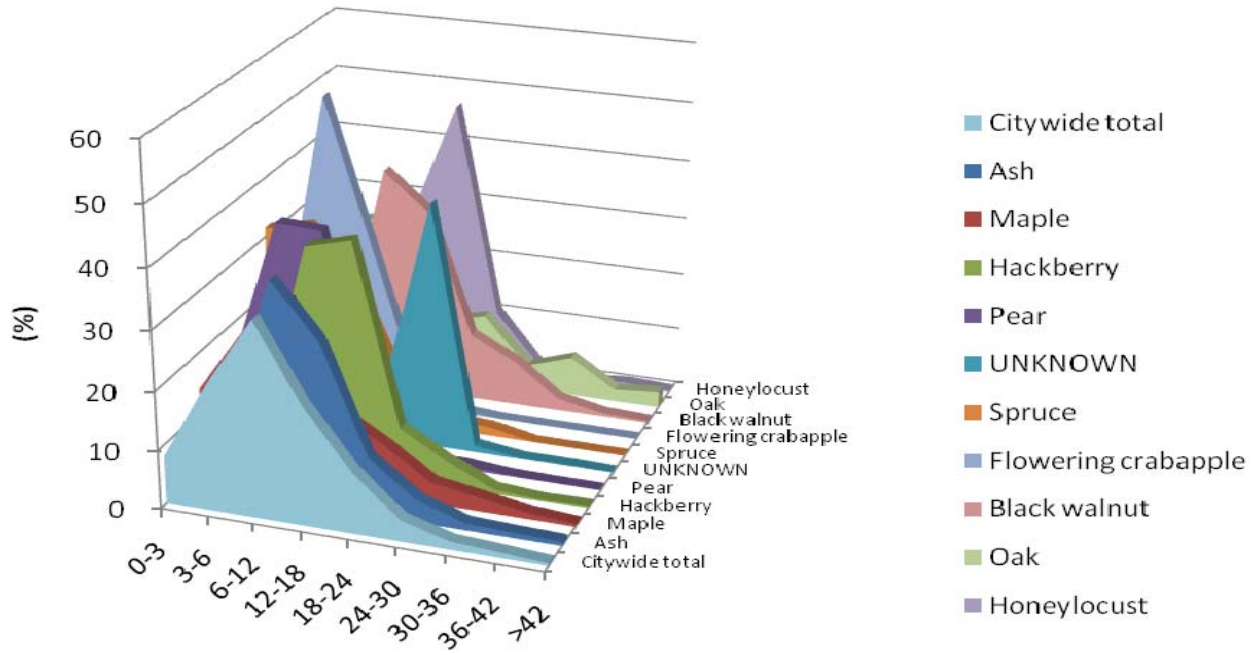


Table 2. Relative Age Distribution of the 10 Most Commonly Planted Trees in Beavercreek, Ohio as a Percentage (%) of each Tree by Common Names



DBH Class

Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Ash	2.7	15.8	36.9	28.0	9.8	3.9	1.2	0.9	0.7
Maple	14.0	24.9	31.1	13.3	8.9	3.7	2.5	1.1	0.5
Hackberry	0.5	7.8	37.5	39.5	8.9	4.4	0.8	0.3	0.4
Pear	14.1	38.1	37.7	8.4	0.8	0.8	0.1	0.0	0.0
UNKNOWN	3.1	26.6	17.1	10.1	41.7	1.1	0.1	0.1	0.0
Spruce	31.6	33.1	24.4	7.7	1.8	1.5	0.0	0.0	0.0
Flowering crabapple	12.3	52.6	29.2	5.4	0.5	0.0	0.0	0.0	0.0
Black walnut	0.3	6.2	38.8	32.5	11.5	7.7	2.1	0.6	0.3
Oak	5.9	27.2	28.1	10.5	12.3	4.3	6.8	2.2	2.8
Honeylocust	4.8	8.7	27.1	46.5	10.3	1.6	0.0	0.6	0.3
Citywide total	**8.2**	**21.7**	**33.1**	**20.2**	**10.4**	**3.6**	**1.4**	**1.0**	**0.4**

Table 3. Population of Beavercreek Trees by Common Name, Tree Type and Size (DBH) Class.

Species	DBH Class (in)									
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
Broadleaf Deciduous Large (BDL)										
Maple	220	391	488	209	140	58	39	17	8	1,570
Hackberry	4	60	288	303	68	34	6	2	3	768
Black walnut	1	21	131	110	39	26	7	2	1	338
Oak	19	88	91	34	40	14	22	7	9	324
Cottonwood	0	6	18	64	76	69	15	44	4	296
American sycamore	2	85	45	39	5	5	5	1	2	189
Hickory	4	14	20	30	18	3	0	1	0	90
Linden	36	10	17	14	5	1	1	0	0	84
Catalpa	0	5	7	16	13	15	7	0	0	63
Tulip tree	0	4	7	5	17	0	0	0	0	33
Sweetgum	0	4	12	7	0	0	0	0	0	23
Poplar	2	3	3	4	3	2	2	0	1	20
Total	**288**	**691**	**1,127**	**835**	**424**	**227**	**104**	**74**	**28**	**3,798**
Broadleaf Deciduous Medium (BDM)										
Ash	47	276	646	490	172	69	21	16	12	1,749
UNKNOWN	22	190	122	72	298	8	1	1	0	714
Honeylocust	15	27	84	144	32	5	0	2	1	310
Black locust	4	5	160	52	24	6	2	0	1	254
Boxelder	1	19	171	35	8	1	3	2	2	242
Elm	31	68	78	26	20	9	3	2	0	237
Zelkova	33	78	1	2	9	2	0	0	0	125
Osage-Orange	0	0	9	3	1	1	0	0	0	14
Ginkgo	1	0	3	1	0	0	0	0	0	5
Total	**154**	**663**	**1,274**	**825**	**564**	**101**	**30**	**23**	**16**	**3,650**
Broadleaf Deciduous Small (BDS)										
Pear	106	286	283	63	6	6	1	0	0	751
Flowering crabapple	71	303	168	31	3	0	0	0	0	576
Cherry plum	9	17	80	139	42	15	5	1	1	309
Mulberry	9	22	163	45	9	6	2	0	0	256
Eastern redbud	7	16	39	11	1	1	0	0	0	75
Dogwood	9	6	6	0	0	0	0	0	0	21
Total	**211**	**650**	**739**	**289**	**61**	**28**	**8**	**1**	**1**	**1,988**

Species	DBH Class (in)									
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
Conifer Evergreen Large (CEL)										
Spruce	189	198	146	46	11	9	0	0	0	599
Pine	2	8	110	72	11	3	1	0	0	207
Total	**191**	**206**	**256**	**118**	**22**	**12**	**1**	**0**	**0**	**806**
Conifer Evergreen Small (CES)										
Cedar of Lebanon	4	19	11	12	3	0	0	0	0	49
Total	**4**	**19**	**11**	**12**	**3**	**0**	**0**	**0**	**0**	**49**
Beavercreek Total	**848**	**2,229**	**3,407**	**2,079**	**1,074**	**368**	**143**	**98**	**45**	**10,291**

Table 3A Estimated Expenses for Ash Removal and/or Replacement for Beavercreek Street Trees

SIZE	NUMBER	REMOVAL COSTS PER TREE	REMOVAL TOTALS	REPLACEMENT COST	REMOVAL W/ REPLACEMENT
3	47	$375	$17,625	$290	$31,255
3-6	276	$375	$103,500	$290	$183,540
6-12	646	$375	$242,250	$290	$429,590
12-18	490	$675	$330,750	$290	$472,850
18-24	172	$675	$116,100	$290	$165,980
24-30	69	$1,290	$89,010	$290	$109,020
30-36	21	$1,625	$34,125	$290	$40,215
36-42	16	$2,150	$34,400	$290	$39,040
>42	12	$2,150	$25,800	$290	$29,280
		REMOVAL ONLY TOTALS	**$993,560**	**REMOVE + REPLACE TOTALS**	**$1,500,770**

Table 4. Beavercreek, Ohio Trees Listed by Common Name from Greatest to Least Importance Value.

Species	Number of Trees	% of Total Trees	Leaf Area (ft2)	% of Total Leaf Area	Canopy Cover (ft2)	% of Total Canopy Cover	Importance Value
Ash	1749	17.0	2672295	18.0	1099532	18.9	18.0
Maple	1570	15.3	2072854	13.9	867465	14.9	14.7
Hackberry	768	7.5	1304281	8.8	645937	11.1	9.1
UNKNOWN	714	6.9	1381141	9.3	512813	8.8	8.3
Cottonwood	296	2.9	1750943	11.8	432313	7.4	7.4
Black walnut	338	3.3	824141	5.5	272985	4.7	4.5
Oak	324	3.1	880194	5.9	238535	4.1	4.4
Honeylocust	310	3.0	636270	4.3	281086	4.8	4.0
Pear	751	7.3	142729	1.0	172836	3.0	3.7
Spruce	599	5.8	434850	2.9	89297	1.5	3.4
Flowering crabapple	576	5.6	76403	0.5	106343	1.8	2.6
Cherry plum	309	3.0	235534	1.6	183197	3.1	2.6
Black locust	254	2.5	335644	2.3	152101	2.6	2.4
Boxelder	242	2.4	347471	2.3	124090	2.1	2.3
Elm	237	2.3	262489	1.8	109786	1.9	2.0
Pine	207	2.0	351042	2.4	68184	1.2	1.8
Mulberry	256	2.5	100250	0.7	100637	1.7	1.6
American sycamore	189	1.8	224735	1.5	79920	1.4	1.6
Zelkova	125	1.2	56537	0.4	20511	0.4	0.6
OTHER TREES	477	4.6	774047	5.2	262429	4.5	4.8
Total	**10291**	**100.0**	**14863851**	**100.0**	**5819996**	**100.0**	**100.0**

Table 5. Annual Storm Water Benefits of Beavercreek, Ohio Trees by Species Ordered by Decreasing Benefits/Tree

Species	Total Rainfall Interception (Gal)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Cottonwood	1004479	$27,223	2.9	9.8	$91.97
Oak	515995	$13,984	3.2	5.1	$43.16
Black walnut	483883	$13,114	3.3	4.7	$38.80
UNKNOWN	980526	$26,574	6.9	9.6	$37.22
Honeylocust	412466	$11,179	3.0	4.0	$36.06
Hackberry	971674	$26,334	7.5	9.5	$34.29
Ash	1984959	$53,796	17.0	19.4	$30.76
Pine	229152	$6,210	2.0	2.2	$30.00
Black locust	261253	$7,080	2.5	2.6	$27.88
Boxelder	233661	$6,333	2.4	2.3	$26.17
Maple	1447641	$39,234	15.3	14.2	$24.99
Elm	196057	$5,314	2.3	1.9	$22.42
American sycamore	147829	$4,006	1.8	1.5	$21.20
Cherry plum	190166	$5,154	3.0	1.9	$16.68
Spruce	283145	$7,674	5.8	2.8	$12.81
Mulberry	94635	$2,565	2.5	0.9	$10.02
Zelkova	39293	$1,065	1.2	0.4	$8.52
Pear	152520	$4,134	7.3	1.5	$5.50
Flowering crabapple	89945	$2,438	5.6	0.9	$4.23
OTHER STREET TREES	507971	$13,767	4.6	5.0	$28.86
CITYWIDE TOTAL	**10227250**	**$277,178**	**100.0**	**100.0**	**$26.93**

Table 6. Stored CO_2 Benefits in the Trees in Beavercreek, Ohio by Species Ordered by Decreasing Benefits per Tree

Species	Total stored CO2 (lbs)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Cottonwood	4293954	$32,205	2.9	15.0	$108.80
Oak	2071312	$15,535	3.2	7.2	$47.95
UNKNOWN	2947597	$22,107	6.9	10.3	$30.96
Black walnut	1270412	$9,528	3.3	4.4	$28.19
Ash	5599605	$41,997	17.0	19.5	$24.01
American sycamore	573469	$4,301	1.8	2.0	$22.76
Cherry plum	929478	$6,971	3.0	3.2	$22.56
Black locust	684931	$5,137	2.5	2.4	$20.22
Honeylocust	832348	$6,243	3.0	2.9	$20.14
Boxelder	613975	$4,605	2.4	2.1	$19.03
Elm	554286	$4,157	2.3	1.9	$17.54
Maple	3465365	$25,990	15.3	12.1	$16.55
Hackberry	1387548	$10,407	7.5	4.8	$13.55
Mulberry	403322	$3,025	2.5	1.4	$11.82
Zelkova	127622	$957	1.2	0.4	$7.66
Pine	179535	$1,347	2.0	0.6	$6.50
Pear	588243	$4,412	7.3	2.1	$5.87
Flowering crabapple	321758	$2,413	5.6	1.1	$4.19
Spruce	203517	$1,526	5.8	0.7	$2.55
OTHER STREET TREES	751901	$12,432	4.6	5.8	$26.06
CITYWIDE TOTAL	**28705931**	**$215,294**	**100.0**	**100.0**	**$20.92**

Table 7. Annual Energy Benefits of Beavercreek, Ohio Trees by Common Name and Decreasing Dollars/Tree

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Cottonwood	87	$6,566	11771	$11,536	$18,101	2.9	6.1	$61.15
Hackberry	156	$11,860	21620	$21,187	$33,047	7.5	11.2	$43.03
Honeylocust	65	$4,964	8462	$8,293	$13,256	3.0	4.5	$42.76
Black walnut	64	$4,878	8233	$8,068	$12,946	3.3	4.4	$38.30
UNKNOWN	119	$8,997	17638	$17,285	$26,282	6.9	8.9	$36.81
Ash	277	$21,020	39484	$38,694	$59,715	17.0	20.3	$34.14
Black locust	38	$2,916	5640	$5,528	$8,443	2.5	2.9	$33.24
Oak	50	$3,800	6825	$6,688	$10,488	3.2	3.6	$32.37
Cherry plum	45	$3,390	6549	$6,418	$9,808	3.0	3.3	$31.74
Maple	197	$14,963	26997	$26,457	$41,419	15.3	14.1	$26.38
Boxelder	30	$2,256	4087	$4,005	$6,261	2.4	2.1	$25.87
Elm	27	$2,033	3982	$3,902	$5,936	2.3	2.0	$25.04
American sycamore	21	$1,561	2863	$2,806	$4,367	1.8	1.5	$23.11
Mulberry	24	$1,841	3828	$3,752	$5,592	2.5	1.9	$21.85
Pine	18	$1,368	2447	$2,398	$3,766	2.0	1.3	$18.19
Pear	42	$3,174	6748	$6,613	$9,788	7.3	3.3	$13.03
Flowering crabapple	26	$1,950	4210	$4,126	$6,076	5.6	2.1	$10.55
Zelkova	5	$393	768	$753	$1,146	1.2	0.4	$9.17
Spruce	23	$1,714	3410	$3,342	$5,056	5.8	1.7	$8.44
OTHER STREET TREES	62	$4,691	8582	$8,410	$13,101	4.6	4.5	$27.47
CITYWIDE TOTAL	**1375**	**$104,334**	**194144**	**$190,261**	**$294,595**	**100.0**	**100.0**	**$28.63**

Table 8. Annual Carbon Dioxide Benefits of Bevercreek, Ohio Trees by Common Name and Ordered by Decreasing Benefits per Tree

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Cottonwood	199246	$1,494	-20611	-908	-$161	145105	$1,088	322831	$2,421	2.9	7.3	$8.18
Honeylocust	123972	$930	-4011	-507	-$34	109693	$823	229146	$1,719	3.0	5.2	$5.54
Oak	112793	$846	-9943	-565	-$79	83970	$630	186255	$1,397	3.2	4.2	$4.31
UNKNOWN	216390	$1,623	-14282	-1249	-$116	198825	$1,491	399684	$2,998	6.9	9.1	$4.20
Ash	466788	$3,501	-27074	-2804	-$224	464540	$3,484	901450	$6,761	17.0	20.4	$3.87
Black locust	69899	$524	-3291	-392	-$28	64437	$483	130652	$980	2.5	3.0	$3.86
Black walnut	70950	$532	-6110	-624	-$51	107795	$808	172012	$1,290	3.3	3.9	$3.82
Hackberry	132948	$997	-6674	-1321	-$60	262093	$1,966	387046	$2,903	7.5	8.8	$3.78
Boxelder	65571	$492	-2960	-339	-$25	49853	$374	112124	$841	2.4	2.5	$3.47
Cherry plum	67130	$503	-4462	-568	-$38	74921	$562	137021	$1,028	3.0	3.1	$3.33
Maple	326670	$2,450	-16646	-1965	-$140	330671	$2,480	638730	$4,790	15.3	14.5	$3.05
American sycamore	41504	$311	-2753	-247	-$23	34495	$259	72999	$547	1.8	1.7	$2.90
Elm	46901	$352	-2710	-295	-$23	44938	$337	88834	$666	2.3	2.0	$2.81
Mulberry	35824	$269	-1936	-346	-$17	40679	$305	74221	$557	2.5	1.7	$2.17
Pine	17088	$128	-862	-319	-$9	30241	$227	46149	$346	2.0	1.1	$1.67
Zelkova	15840	$119	-660	-89	-$6	8693	$65	23784	$178	1.2	0.5	$1.43
Pear	63729	$478	-2828	-683	-$26	70154	$526	130372	$978	7.3	3.0	$1.30
Flowering crabapple	40975	$307	-1548	-456	-$15	43093	$323	82064	$615	5.6	1.9	$1.07
Spruce	21595	$162	-978	-475	-$11	37885	$284	58027	$435	5.8	1.3	$0.73
OTHER STREET TREES	124448	$933	-7959	-716	-$65	103671	$778	219445	$1,646	4.6	5.0	$3.45
CITYWIDE TOTAL	**2260262**	**$16,952**	**-138299**	**-14869**	**-$1,149**	**2305751**	**$17,293**	**4412846**	**$33,096**	**100.0**	**100.0**	**$3.22**

Table 9. Annual Air Quality Benefits of Beavercreek, Ohio Trees by Species' Common Names and Ordered by Decreasing Total Air Pollution Benefits per Tree

Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	% of Total Tree Numbers	Avg. $/tree
Cottonwood	130	21	61	6	$691	412	60	57	392	$2,571	0	$0	1140	$3,261	2.9	$11.02
Honeylocust	68	11	34	3	$366	308	45	43	296	$1,927	-44	-$163	764	$2,129	3.0	$6.87
Hackberry	102	18	62	5	$586	749	109	104	709	$4,661	0	$0	1857	$5,247	7.5	$6.83
Black walnut	45	8	27	2	$256	302	44	42	291	$1,893	0	$0	761	$2,148	3.3	$6.36
UNKNOWN	179	31	91	8	$974	580	83	79	538	$3,578	-44	-$164	1545	$4,389	6.9	$6.15
Oak	62	10	30	3	$330	239	35	33	227	$1,487	0	$0	638	$1,818	3.1	$5.61
Ash	332	57	174	15	$1,823	1339	194	185	1257	$8,304	-85	-$317	3467	$9,810	17.0	$5.61
Cherry plum	60	10	28	3	$320	217	31	30	202	$1,343	0	-$1	582	$1,662	3.0	$5.38
Black locust	40	7	22	2	$222	187	27	26	174	$1,157	-11	-$40	474	$1,339	2.5	$5.27
Maple	305	52	148	14	$1,640	940	137	131	893	$5,856	-107	-$401	2512	$7,096	15.3	$4.52
Elm	32	6	17	1	$179	131	19	18	122	$809	-8	-$31	338	$956	2.3	$4.03
Boxelder	22	3	12	1	$120	142	21	20	135	$883	-10	-$38	344	$965	2.4	$3.99
American sycamore	15	3	8	1	$84	99	14	14	93	$614	-14	-$54	232	$644	1.8	$3.41
Mulberry	24	4	12	1	$131	120	17	16	110	$738	0	-$1	305	$868	2.5	$3.39
Pear	33	5	17	1	$180	209	30	28	190	$1,277	0	-$1	513	$1,456	7.3	$1.94
Pine	24	5	21	3	$163	86	13	12	82	$535	-85	-$318	160	$380	2.0	$1.83
Flowering crabapple	17	3	9	1	$93	129	18	17	116	$786	0	$0	310	$879	5.6	$1.53
Zelkova	6	1	3	0	$31	25	4	3	24	$156	-3	-$10	63	$177	1.2	$1.41
Spruce	26	5	25	3	$179	110	16	15	102	$682	-105	-$393	197	$467	5.8	$0.78
OTHER STREET TREES	57	10	32	3	$320	296	43	41	280	$1,843	-29	-$109	733	$2,054	4.6	$4.31
CITYWIDE TOTAL	**1577**	**268**	**834**	**75**	**$8,686**	**6619**	**960**	**914**	**6233**	**$41,102**	**-544**	**-$2,042**	**16936**	**$47,746**	**100.0**	**$4.64**

Table 10. Annual Aesthetic or Other Benefits of Trees by Species in Beavercreek, Ohio

Species	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Honeylocust	$25,818	3.0	9.6	$83.28
Cottonwood	$16,185	2.9	6.0	$54.68
Hackberry	$26,195	7.5	9.7	$34.11
Oak	$11,040	3.2	4.1	$34.07
Black walnut	$11,200	3.3	4.2	$33.14
Boxelder	$7,502	2.4	2.8	$31.00
UNKNOWN	$21,608	6.9	8.0	$30.26
Black locust	$7,529	2.5	2.8	$29.64
Maple	$46,457	15.3	17.3	$29.59
Ash	$49,388	17.0	18.4	$28.24
Pine	$4,686	2.0	1.7	$22.64
Elm	$5,169	2.3	1.9	$21.81
American sycamore	$3,528	1.8	1.3	$18.67
Zelkova	$1,998	1.2	0.7	$15.98
Cherry plum	$3,909	3.0	1.5	$12.65
Spruce	$6,934	5.8	2.6	$11.58
Mulberry	$2,045	2.5	0.8	$7.99
Pear	$3,552	7.3	1.3	$4.73
Flowering crabapple	$2,268	5.6	0.8	$3.94
OTHER STREET TREES	$11,801	4.6	4.4	$24.74
BEAVERCREEK TOTAL	**$268,813**	**100.0**	**100.0**	**$26.12**

Table 11. Annual Benefits and Total Annual Benefits per Tree by Common Name for Beavercreek Street Trees

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic /Other	Total
Cottonwood	$61.15	$8.18	$11.02	$91.97	$54.68	$227.00
Honeylocust	$42.76	$5.54	$6.87	$36.06	$83.28	$174.52
Hackberry	$43.03	$3.78	$6.83	$34.29	$34.11	$122.04
Black walnut	$38.30	$3.82	$6.36	$38.80	$33.14	$120.41
Oak	$32.37	$4.31	$5.61	$43.16	$34.07	$119.53
UNKNOWN	$36.81	$4.20	$6.15	$37.22	$30.26	$114.64
Ash	$34.14	$3.87	$5.61	$30.76	$28.24	$102.61
Black locust	$33.24	$3.86	$5.27	$27.88	$29.64	$99.89
Boxelder	$25.87	$3.47	$3.99	$26.17	$31.00	$90.50
Maple	$26.38	$3.05	$4.52	$24.99	$29.59	$88.53
Elm	$25.04	$2.81	$4.03	$22.42	$21.81	$76.12
Pine	$18.19	$1.67	$1.83	$30.00	$22.64	$74.34
Cherry plum	$31.74	$3.33	$5.38	$16.68	$12.65	$69.78
American sycamore	$23.11	$2.90	$3.41	$21.20	$18.67	$69.28
Mulberry	$21.85	$2.17	$3.39	$10.02	$7.99	$45.42
Zelkova	$9.17	$1.43	$1.41	$8.52	$15.98	$36.52
Spruce	$8.44	$0.73	$0.78	$12.81	$11.58	$34.33
Pear	$13.03	$1.30	$1.94	$5.50	$4.73	$26.51
Flowering crabapple	$10.55	$1.07	$1.53	$4.23	$3.94	$21.31
OTHER STREET TREES	**$27.47**	**$3.45**	**$4.31**	**$28.86**	**$24.74**	**$88.82**

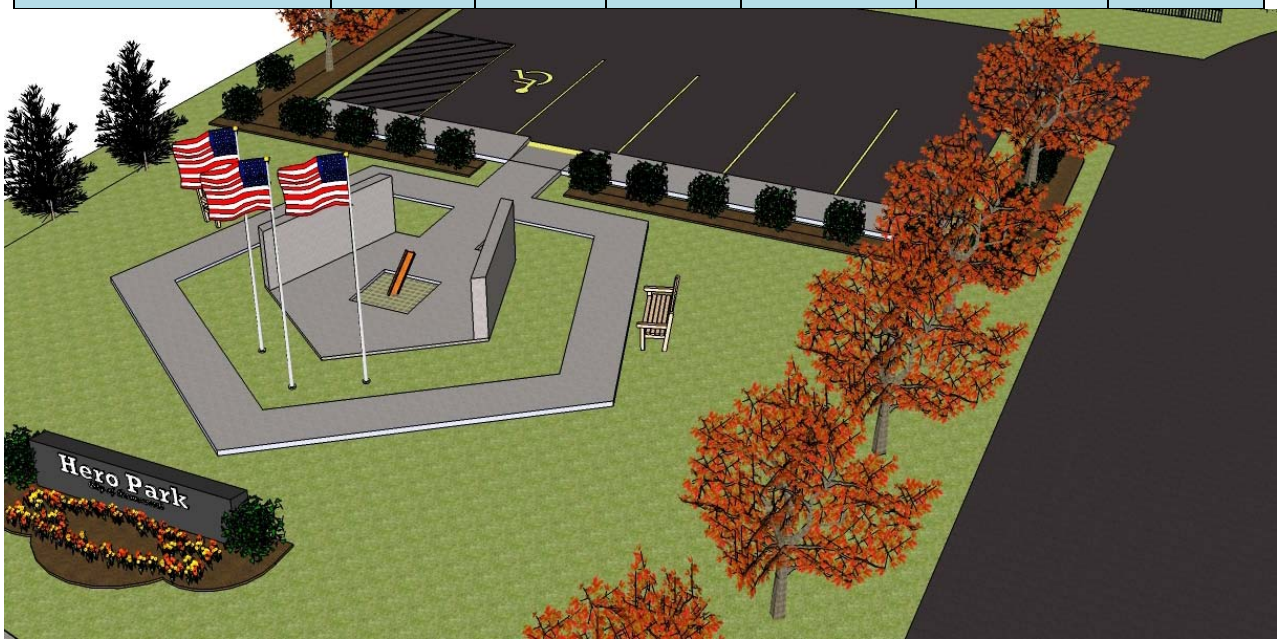


Table 12 Environmental Benefits from Five Benefit Categories for Beavercreek Street Trees

Benefits	Total ($)	$/tree
Energy	$294,595	$28.63
Stormwater	$277,178	$26.93
Aesthetic/Other	$268,813	$26.12
Air Quality	$47,746	$4.64
CO2	$33,096	$3.22
Total Benefits	**$921,428**	**$89.54**