VanNatta, A.R., N.M. Schuettpelz, and R.H. Hauer[1]. 2010. Cost Analysis of Removal and Replacement vs. Treatment of Ash Trees Susceptible to Emerald Ash Borer (*Agrilus planipennis*) on the UW-Stevens Point Campus. Proceedings of the International Society of Arboriculture 86th Annual Conference. Chicago, IL, July 23 – 28, 2010. [1]College of Natural Resources, University of Wisconsin–Stevens Point

Abstract

Emerald ash borer (EAB) plays a significant role in the health and extent of management of native ash species in Wisconsin's urban forests. Although there are no indications of the presence of EAB in Stevens Point, WI, it is necessary to develop a plan for the management of future infestations. From October 2009 to January 2010 data was collected on the size, condition, and distribution of all trees on the UW-Stevens Point campus. The campus tree population (excluding Schmeeckle Reserve) contains 155 ash trees of varying age, size, and condition. Using the USDA Forest Service's i-Tree Streets program and the Council of Tree and Landscape Appraisers (CTLA) methodology, a cost/benefit analysis was performed between a control scenario (no action, or do nothing approach) and three distinct management options: 1) preemptive removal of all ash trees, 2) preemptive removal of all ash trees and replacement with a different species, or 3) treating the entire population of ash with insecticides. This study provides an economic analysis of management options for the campus ash tree population. Being able to determine the total net cost of managing for EAB is an important component of making efficient management decisions. Through the course of this study, we found that retention of ash trees using insecticide treatments was economically better than doing nothing (control) which was better than preemptive removal or preemptive and replacement.

Introduction

Emerald ash borer (*Agrilus planipennis*) was first discovered near Detroit, MI in 2002 and has since spread to parts of IL, IN, IO, OH, WV, MO, PA, NY, MD, VA, MN, WI, and the Canadian provinces of Ontario and Quebec (Figure 1). It was most likely introduced from Asia (Kovacs et al. 2010). Emerald ash borer (EAB) was found in southeast Wisconsin in August 2008 and has since been identified in several other counties (Figure 2). The UW-Stevens Point campus currently has 155 ash (*Fraxinus pennsylvanica* and *Fraxinus americana*) trees, comprising nearly 8% of the entire campus tree population. There are currently no indications of EAB in Central Wisconsin, but the potential significance of an infestation cannot be ignored. The wood boring beetle larvae feed on the vascular tissues of ash trees, causing decline and eventually mortality (McCullough et. al. 2009). Management actions need to be implemented to handle the presence of EAB because of the threat the insect poses to established ash tree populations. Currently, Purdue University has an EAB Cost Calculator approach that looks at the costs associated with decision making for EAB management options for removal, replacement, and treatment (Sadof 2008). This model is an important step, however, it does not take the net value of trees into consideration.

Currently we know EAB will kill trees. Estimates vary depending on location (urban or all land areas), however, tens of millions of urban ash trees are likely impacted (Kovacs et al. 2010). It is also estimated that if EAB is left to take its course, by 2019 a discounted $10.7 billion cost could occur from EAB in 25 eastern states. Thus, developing the most cost-effective approaches is important for urban forest managers to decide how to respond to EAB (Baughman 1985, Herms et al. 2009). Doing nothing is an option with the estimated 10.7 billion cost (Kovacs et al. 2010). Knowing the economic impact of management options such as treating living ash trees or removing ash prior to infestation preemptively and comparing this to doing nothing is critical for sound urban forest management and, ideally, to reduce the economic impact (Herms et al. 2010). With this project we determined the value of the ash trees on the UWSP campus and the cost of removal, removal and replacement, and treatment with insecticides to control EAB infestations.

Methods

Field work: Tree data was collected using a hand-held PDA (HP iPAQ) loaded with Wachtel Tree Science inventory software. We used a diameter-tape to measure trunk diameters (dbh, 1.3 m) and the Council of Tree and Landscape Appraisers (CTLA 2000) methods to assess tree condition. Ocular evaluations were used to assess tree species, planting depth, percent deadwood in the canopy, and work priorities of spatially located trees (Figure 3). The existing 155 ash trees were a mean 8.1" (20.57 cm) in diameter (dbh), 75% condition rating, 70% species rating (Wisconsin Arborist Association rating), and 70% location rating.

Post-field work: Data was uploaded from field units to a desktop computer. From there it was transferred into a Microsoft Access database, where it was formatted to be compatible with the USDA i-Tree Streets software (USDA-FS undated). The CTLA approach was conducted with a simulation model developed in Microsoft Excel.

Tree populations in future years were modeled using a standard mortality rate (2%) and an average growth rate of 0.4 inches DBH per year (Miller and Walsh undated, Hauer 2007). For the control option, mortality was set at 20% after seven years, an EAB population "tipping point" (Knight et. al. 2007). Prior to this seven year tipping point, we applied an increasing mortality rate, adding 1% in the second year of infestation to the 2% natural mortality, 1% in the third year of infestation to the 2% natural mortality, 2% in the fourth year to the 2% natural mortality, 2% in the fifth year to the 2% natural mortality, 4% in the sixth year, and 8% in the seventh year. For the remainder of the 20 year study time period, a 20% mortality rate was used. The mortality rate of replanted trees for the remove & replace option was fixed at 2%, an accepted natural rate for healthy tree populations (Miller and Walsh undated). We removed 20% of the ash each year for five years and assumed that after each year's removal (31 trees per year for a period of 5 years) an equal amount of new trees (non-ash) for the remove and replace option. For the insecticide treatment option, we applied a conservative mortality rate of 5% after the seven year tipping point (Bernick 2010, Herms et al. 2010). Two percent natural mortality was modeled for the preceding years. The management scenarios were then analyzed in yearly increments for a period of twenty years to determine their annual value and then compared to the control population using a benefit/cost analysis (B/C). Annual values were then summed over the 20-year simulation period.

To calculate our B/C, we first determined the net value of each management option by subtracting costs from benefits for each of 20 annual simulations. We determined a discounted net tree value for different management approaches for ash tree populations subjected to EAB. Net tree value was calculated from tree value using two approaches (CTLA and i-Tree Streets) minus tree costs from each management scenario (Miller and Schuman 1981, Miller 1997). Values were derived from the CTLA method for street tree appraisal and the USDA's i-Tree Streets program. Costs were determined using commercial prices for insecticide application ($7.00 per diameter inch annually based in Milwaukee, WI), tree removal ($10 per diameter inch based on Stevens Point WI, municipal removal contract), and tree planting costs ($100 for a two-inch caliper tree, assuming in-house installation). The present value of each increment was then calculated using a 6% annual rate of return. Finally, we divided the net benefit of our management action by the net value of our control scenario to calculate the B/C.

Results and Discussion

Over a 20 year period, the discounted value of the university's ash tree population associated with the treatment scenario was higher ($1,531,933) than the remove only ($265,698) and the remove & replace ($505,793) scenarios for the CTLA method for tree valuation (Table 1). The do nothing (control approach) had a $1,1018,514 value. The i-Tree method shows a similar trend. Both treatment options were greater value than the control after year 7, which coincides with the greater EAB induced mortality that year. The B/C approached 1 between years 11 and 14 for the CTLA and i-Tree valuation methods.

Money aside, after 20 years the remove only option leaves the campus with no ash or replacements, the do nothing approach has 6 (4% of original) ash remaining, the treatment scenario has 69 (47%) ash left, and the remove and replant had the most trees with 110 (73%) new trees. Net benefits provided by a treated population far outweigh the benefits provided by a much younger population of replacement trees, over the given time period. When comparing benefit cost ratios of the three options and the control population, in both valuation methods, the treatment B/C line was significantly higher than the remove & replace B/C line (Figure 4). In addition, cumulative B/C ratios were found for the entire 20 year period (Figure 5). Treatment again was found to provide a higher B/C ratio than the remove & replace and remove only options.

During our data analysis, we performed a sensitivity test on the variables associated with our algorithm (Table 2). We found that changing the cost of these values had no significant effect on our study findings (e.g., treatment > control > preemptive removal and replacement > preemptive removal). By example, if 2 inch (5 cm) caliper replacement trees cost $18, then treatment and doing nothing are comparable. It is highly unlikely you could purchase a 2 inch tree. Likewise if tree growth rates were 0.91 inches per year, interest rates were 33%, injection costs were $37.9 / diameter inch per year, or injection survival was 80.5%, treatment and doing nothing are comparable.

Conclusion

Our analysis found that treatment provided the best value when compared to the control scenario which was better than the remove only or remove & replace options. The results of this study show that the preemptive removal and preemptive remove & replace approach, although seemingly logical, provides less value to the urban forest over the 20-year model time period. By prolonging the life of large mature ash trees, you receive exponentially greater benefits through aesthetics, energy savings and ecological improvement than you will from small newly planted trees. Were this analysis to be extended over a longer time period, replanted trees would likely narrow the gap between benefit-cost ratios of treatment and replace & remove management actions.

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Figure 1. Locations of emerald ash borer (*Agrilus planipennis*) in North America as of May 10, 2010.

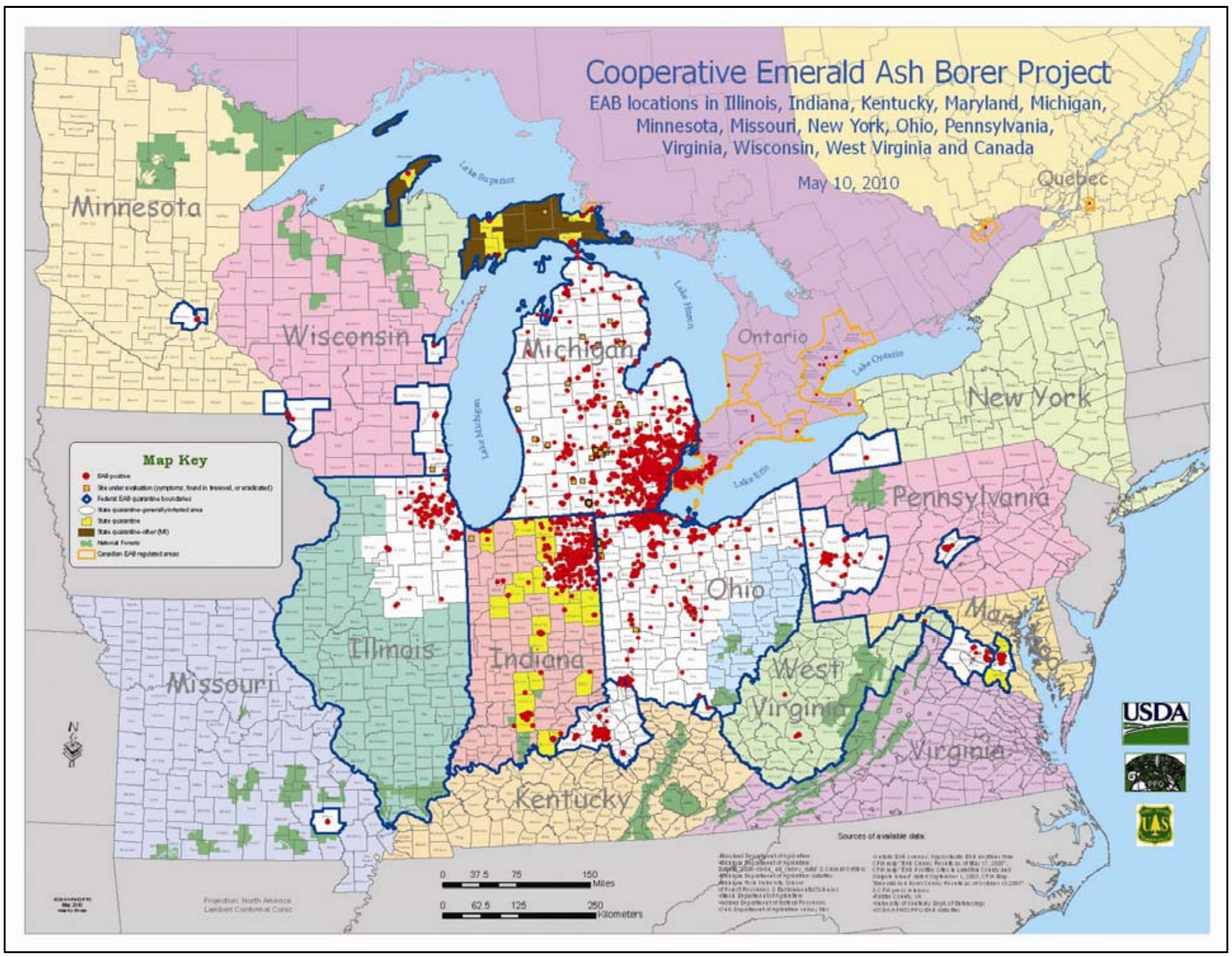

Figure 2. Locations of emerald ash borer (*Agrilus planipennis*) in Wisconsin as of September 2009.

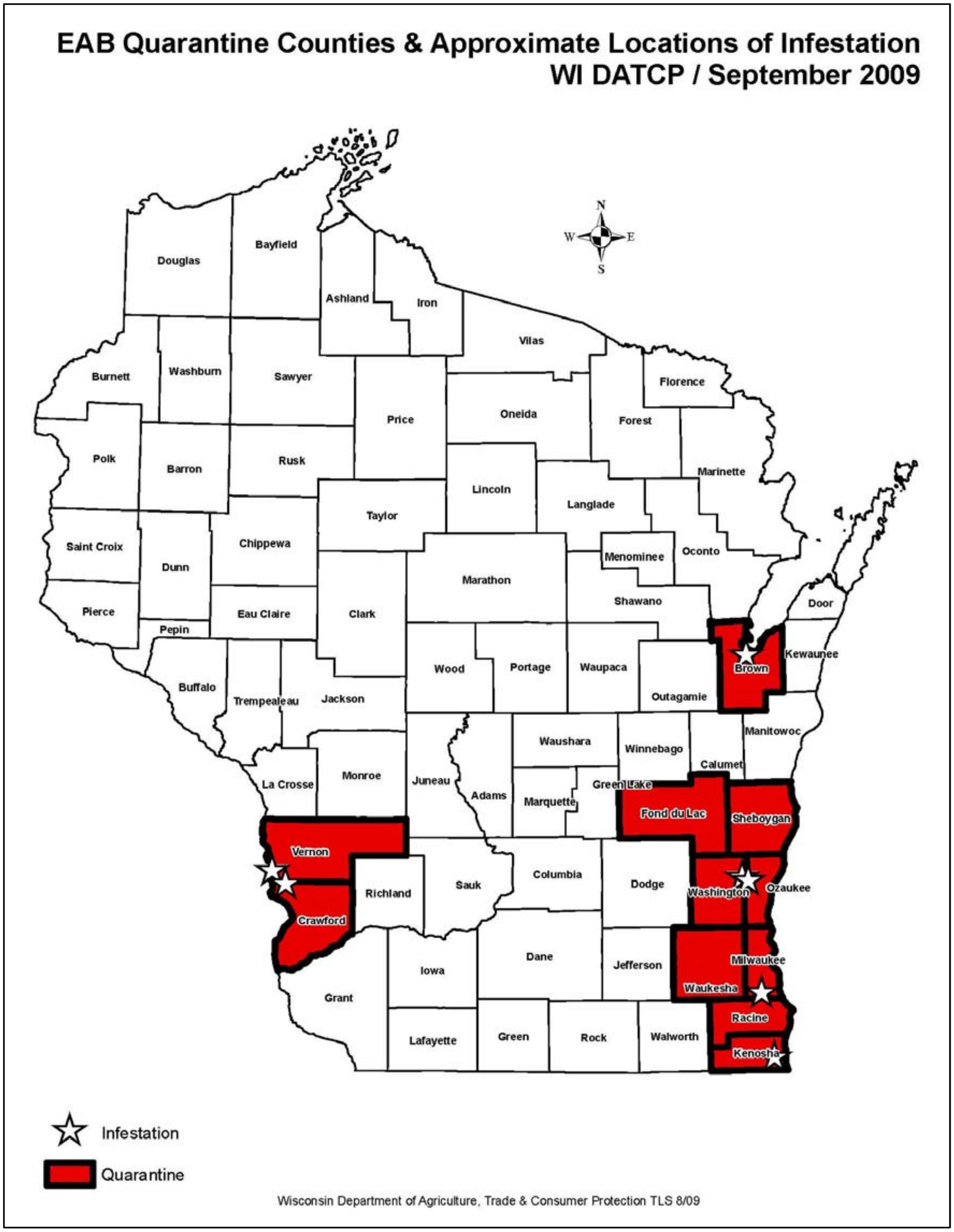

Figure 3. Aerial photo of project area and campus tree population at the University of Wisconsin – Stevens Point.

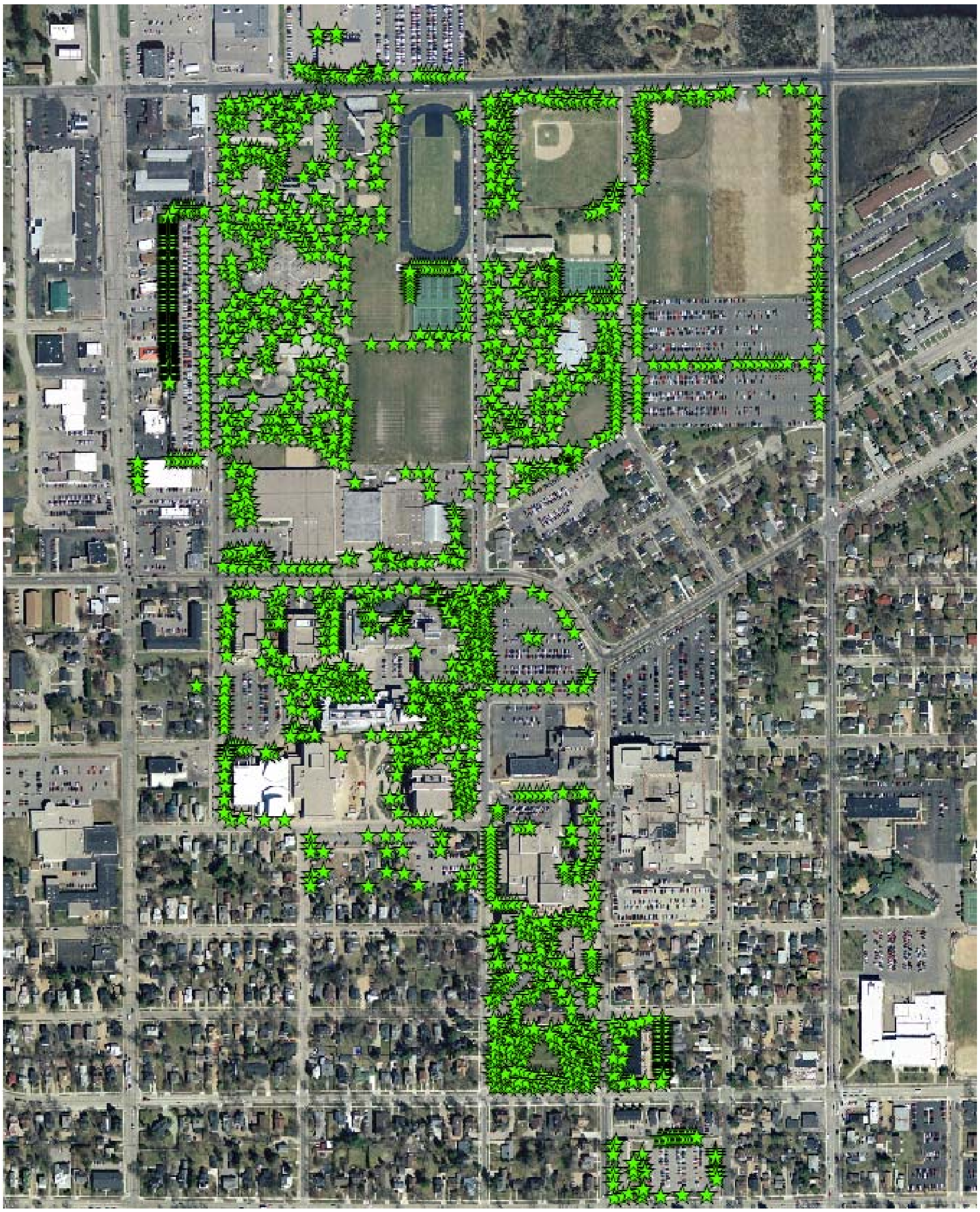

Figure 4. Results of benefit/cost comparison of CTLA and i-Tree Streets valuation approaches over a 20-year time period for both preemptive removal and replacement option and treatment option compared to doing nothing.

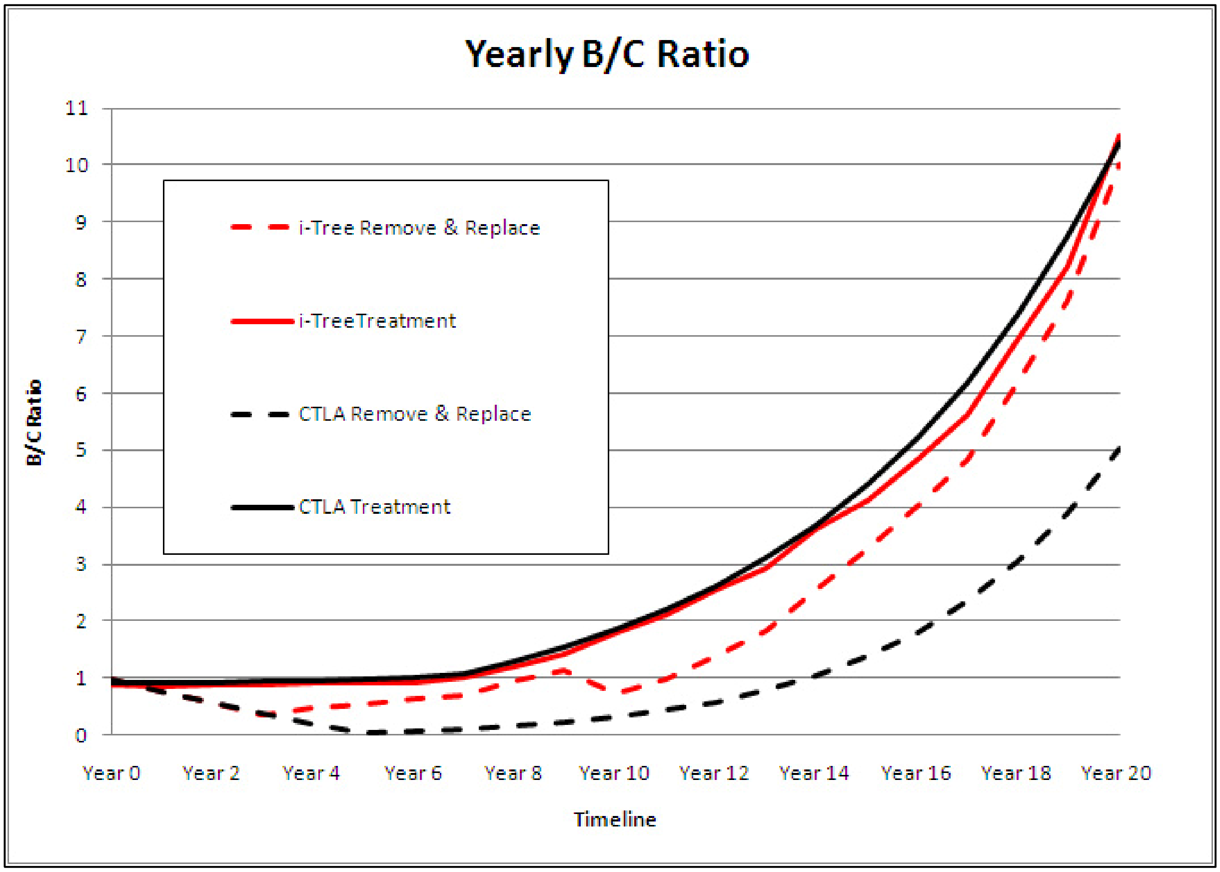

Figure 5. Cumulative results over 20 years of cost/benefit comparison of CTLA and i-Tree Streets valuation approaches over a 20 year time period for preemptive removal, preemptive removal and replacement, and treatment compared to doing nothing.

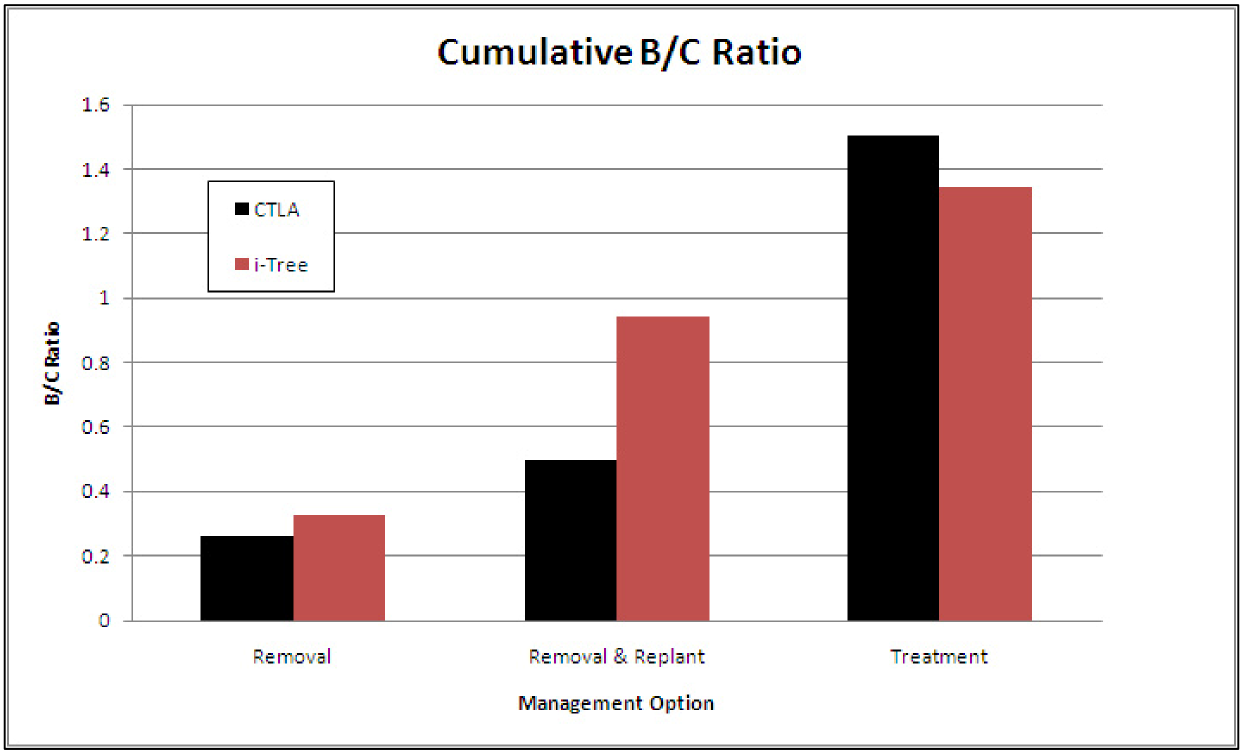

Table 1. Number of trees remaining (starting population of 151 green and white ash trees) and discounted present value over 20 years of CTLA and i-Tree Streets valuation approaches over a 20 year time period for preemptive removal, preemptive removal and replacement, and control (doing nothing).

Management Approach	Trees (#)	CTLA ($)	i-Tree ($)
Remove	0	265,698	204,591
Remove/Replace	110	505,793	594,614
Treatment	69	1,531,933	847,196
Control	6	1,018,514	630,938

Table 2. Model input variables, default study input values, and value that the B/C of treatment compared to control (do nothing) = 1.

Model Input	Unit	Default Value	B/C = 1 Value
Injection cost	$ / year / diameter inch	7.0	37.9
Removal cost	$ / year / diameter inch	10.0	-1150.0
Replacement cost	$ / 2" caliper tree	100.0	18.0
Injection survival	percent	95.0	80.5
Species rating	percent	70.0	12.5
Condition rating	percent	75.0	13.5
Location rating	percent	70.0	12.6
Interest rate	percent	6.0	33.0
Survival rate	percent	80.0	95.5
Growth rate	inches / year	0.40	0.91